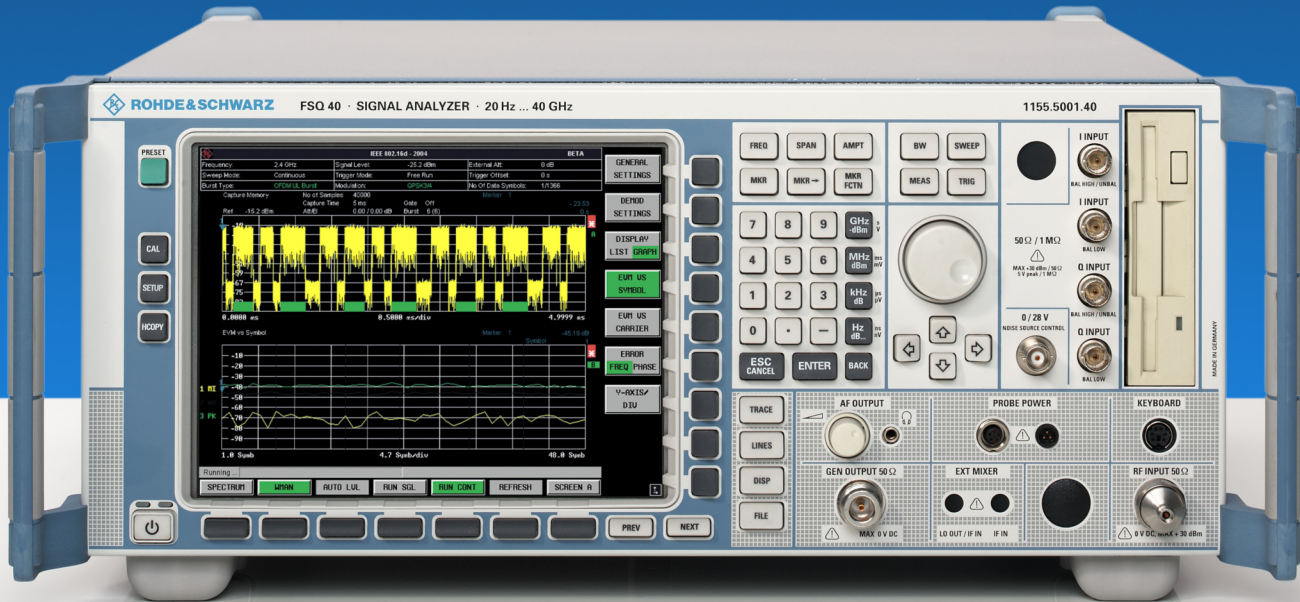# Software Manual

WiMAX IEEE 802.16-2004, IEEE 802.16e-2005 TX Tests

Applications Firmware
R&S® FSQ-K92/K93/K94
1300.7410.02

Printed in the Federal
Republic of Germany

Test and Measurement

This Software Manual describes the following models:

R&S®FMU

R&S®FSG

R&S®FSQ

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.

⚠ **DANGER**	indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠ **WARNING**	indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ **CAUTION**	indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	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**	PELIGRO identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.
⚠ **ADVERTENCIA**	ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.
⚠ **ATENCIÓN**	ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.
AVISO	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.

Qualitätszertifikat
Certificate of quality
Certificat de qualité

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.

Environmental commitment
- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Cher client,

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
- Produits à efficience énergétique
- Amélioration continue de la durabilité environnementale
- Système de gestion de l'environnement certifié selon ISO 14001

1171.0200.11 V 04.01

ROHDE & SCHWARZ

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

ROHDE & SCHWARZ

Contents

1 General Information

The Rohde & Schwarz FSQ-K92/K93/K94 application extends the functionality of the R&S FSQ spectrum analyzer to enable WiMAX and WiBro TX-measurements according to the standards

1. IEEE 802.16-2004/Cor 1-2005 SISO-OFDM physical layer mode (R&S FSQ-K92/K93/K94).
    The short form 'SISO-OFDM' is used in this document, to reference this operation mode.

2. IEEE 802.16-2004/Cor 1-2005, IEEE 802.16e-2005,
    P802.16Rev2/D3 (February 2008)
    SISO-OFDMA physical layer mode (R&S FSQ-K93/K94 only). The short form 'SISO-OFDMA'
       is used in this document, to reference this operation mode.
    MIMO-OFDMA physical layer mode (R&S FSQ-K94 only). The short form 'MIMO-OFDMA'
       is used in this document, to reference this operation mode.

3. IEEE 802.16-2004/Cor 1-2005, IEEE 802.16e-2005 based WiBro,
    P802.16Rev2/D3 (February 2008) based WiBro
    SISO-WiBro physical layer mode (R&S FSQ-K93/K94 only). The short form 'SISO-WiBro'
       is used in this document, to reference this operation mode.
    MIMO-WiBro physical layer mode (R&S FSQ-K94 only). The short form 'MIMO-WiBro'
       is used in this document, to reference this operation mode.

The standard is selected in the *General Settings Panel, Standard* field.

This manual supports the user in working with R&S FSQ-K92/K93/K94. It aids the preparation, execution and evaluation of a measurement and gives many helpful hints and examples.

For the user wanting to make a quick start to using R&S FSQ-K92/K93/K94, the Quick Start Guide section below works step-by-step through an ordinary measurement. The remainder of this section describes all of the basic information about how the R&S FSQ-K92/K93/K94 application works, without covering measurements in detail. A detailed description of all measurement modes, settings and results can be found in section 2. Section 4 covers remote control operation of R&S FSQ-K92/K93/K94.

This section covers the following subjects:

Introduction to R&S FSQ-K92/K93/K94 measurements

*   Installation

*   Starting the application

*   Exiting the application

*   Quick start guide – allows the user to get up-and-running in minimum time

*   Navigation

*   Save/recall – saving & recalling user settings & measurement results

*   Printing

Introduction to R&S FSQ-K92/K93/K94 WiMAX Measurements

The use of an R&S FSQ spectrum analyzer with its high sensitivity enables the accurate and reproducible TX-measurement of a WiMAX Device Under Test (DUT) according to the standards specified for the device:

- Modulation formats:
    - IEEE 802.16-2004
      - BPSK (SISO-OFDM)
      - QPSK
      - 16QAM
      - 64QAM

- Modulation measurements:
    - Constellation diagram
    - Constellation diagram per OFDM carrier
    - I/Q offset and I/Q imbalance
    - Quadrature error
    - Carrier and symbol frequency errors
    - Modulation error (EVM) per OFDM carrier or symbol
    - Amplitude response and group-delay distortion (spectral flatness)

- Amplitude statistics (CCDF) and crest factor

- Transmit spectrum mask

- Adjacent Channel Power (Absolute and Relative)

- FFT, also over a selected part of the signal, e.g. preamble

- Payload bit information

- Burst Summary provides information about the analyzed bursts

- Capture time selectable up to 50 ms, multiple sweeps possible for large number of bursts

Installation

From the analyzer select firmware update.

➢ Press the SETUP hardkey followed by NEXT, FIRMWARE UPDATE and finally the FIRMWARE UPDATE softkey. Following the instructions displayed.

Once the installation has completed the analyzer will reboot.

Once the option has been installed it needs to be activated:

➢ Start up the analyzer.

➢ Press the *SETUP* hardkey, followed by the *GENERAL SETUP* softkey and then the *OPTIONS* softkey. A list of the options currently activated is displayed.

➢ Press the *INSTALL OPTION* softkey. A Dialog is displayed allowing the option key to be entered.
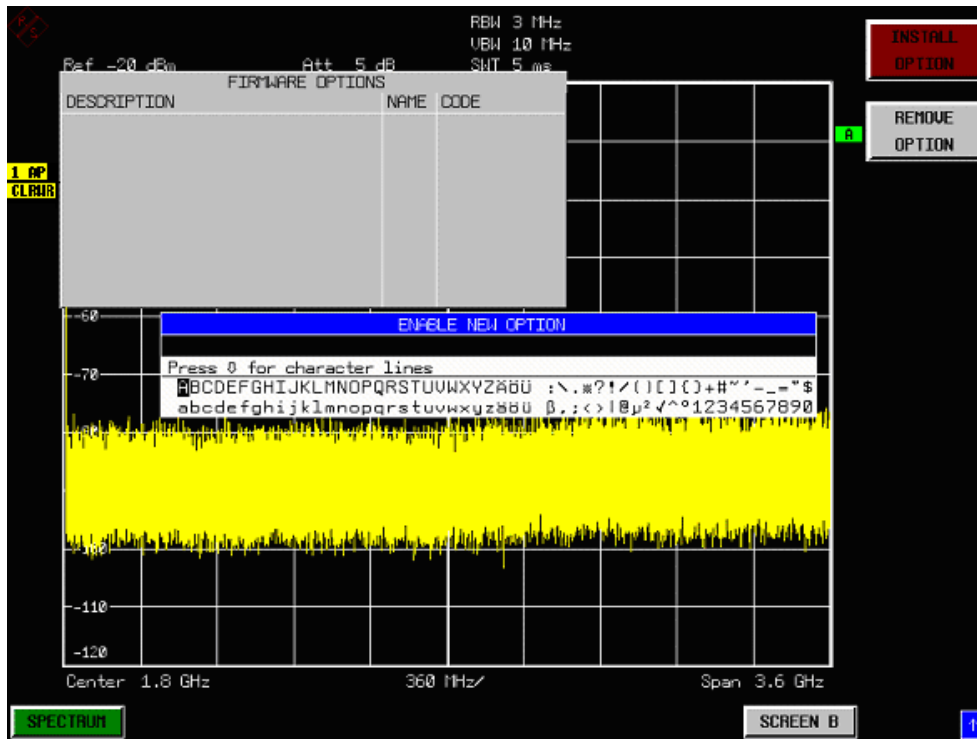
➢ Enter the option key supplied with the R&S FSQ-K92/K93/K94 software. If upgrading from R&S FSQ-K92 to R&S FSQ-K93, the upgrade key needs to be entered in addition to the original R&S FSQ-K92 option key.

➢ When a valid option key has been supplied a dialog will be displayed explaining that a reboot is required to complete this operation. Select OK in this dialog and the instrument will be rebooted.

➢ When the analyzer starts after the reboot a new hotkey will be displayed at the bottom of the display labelled *WIMAX.* In addition an entry for the R&S FSQ-K92/K93/K94 option will be displayed in the *FIRMWARE OPTIONS* dialog.
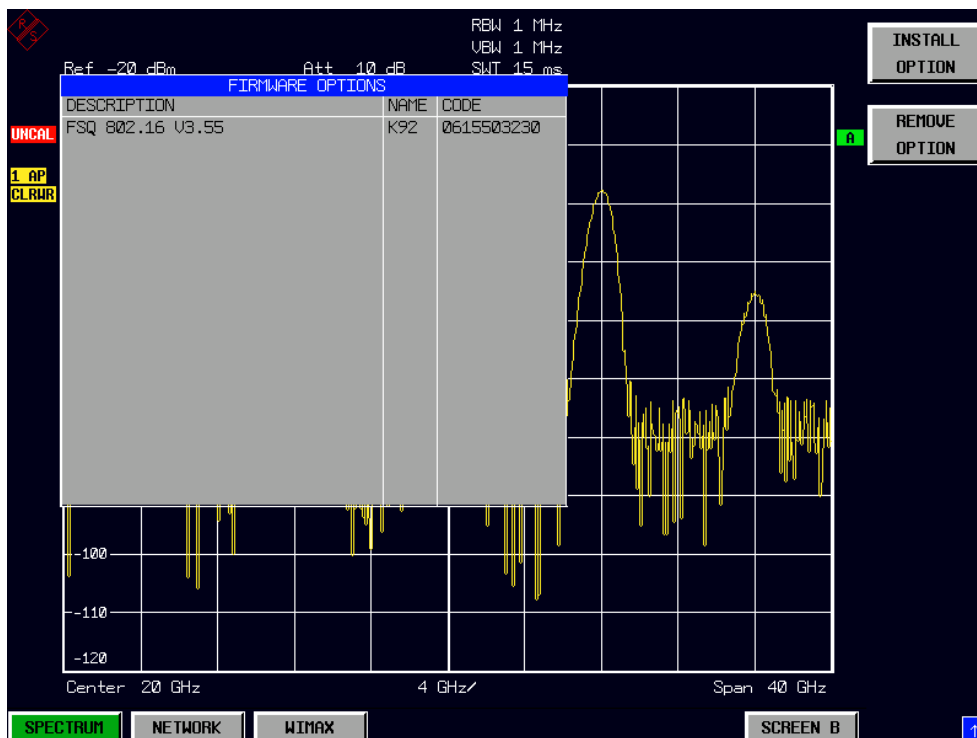
Starting the Application

Power up the R&S FSQ spectrum analyzer. When R&S FSQ-K92/K93/K94 is correctly installed there will be a hotkey labelled *WIMAX* at the bottom of the screen. Press the *WIMAX* hotkey to start R&S FSQ-K92/K93/K94.

Note that if the spectrum analyzer is powered down whilst R&S FSQ-K92/K93/K94 is active, then when the spectrum analyzer is powered up again it will start up in the R&S FSQ-K92/K93/K94 application.

Exiting the Application

To exit the R&S FSQ-K92/K93/K94 option, press the *SPECTRUM* hotkey at the bottom of the screen. This will cause the option to exit and the spectrum analyzer to be activated.

Quick Start Guide

This section helps the user to quickly become familiar with R&S FSQ-K92/K93/K94 by working step-by-step through an ordinary measurement. (Refer to section 2 for a detailed reference guide.)

For this example a DUT using IEEE 802.16-2004 will be used. The DUT will be connected to the analyzer using the RF input of the analyzer. The DUT will generate a signal modulated using 64QAM 2/3.

Setting up the Measurement

➢ Start the R&S FSQ-K92/K93/K94 application.

➢ Press the *GENERAL SETTINGS* softkey to open the General Settings view.
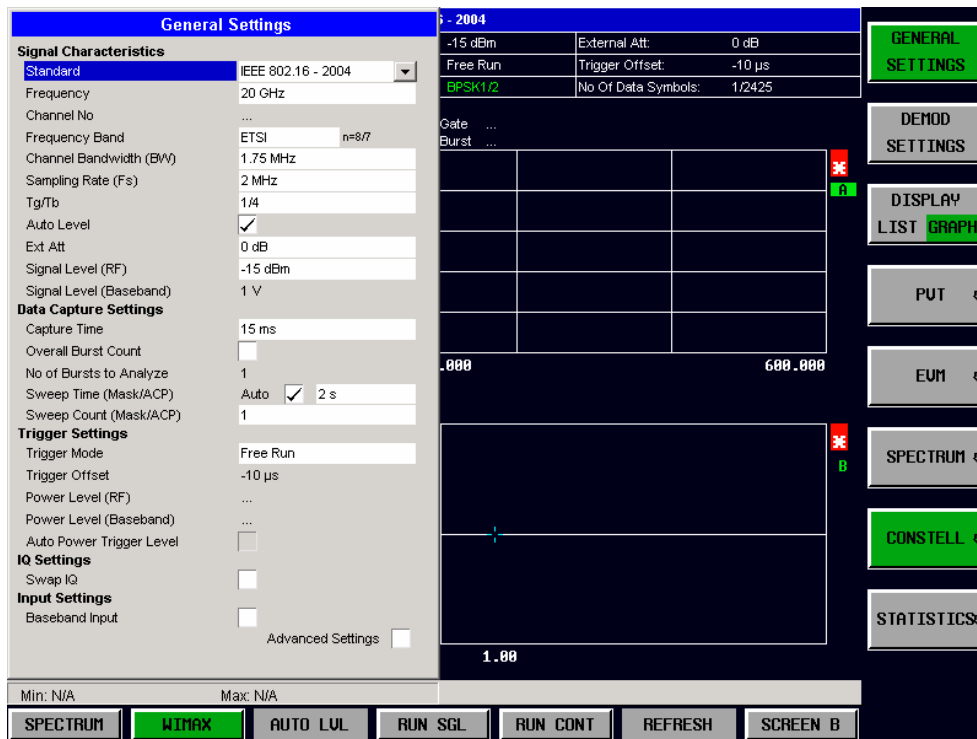
➢ Select the *Frequency* field and enter the desired frequency to measure. Note that when a valid frequency is entered the *Channel No* field updates.

➢ Select the *Frequency Band* in which the Signal to be analyzed is located. The target band is either one of the bands given as example in the 802.16-2004 standard[1] or an unspecified band.

➢ Select either the *Channel Bandwidth (BW)* or *Sampling Rate (Fs)* according to the characteristics of the signal to be analyzed. The second parameter is derived from the first according to the standard[2].

➢ Select the $G = T_g / T_b$ CP [Cyclic Prefix] to useful time ratio according to the characteristics of the signal to be analyzed.

➢ Switch Off the *Auto Level* Field. In this example the level detection measurement will be executed manually.

All other settings in this view are sufficient for this example.

---

[1] B.3.2 Wireless MAN-OFDM/OFDMA PHY symbol and performance parameters.

[2] 8.3.2.2 Derived Parameter definitions

➢ Press the *DEMOD SETTINGS* softkey to open the Demod Settings view
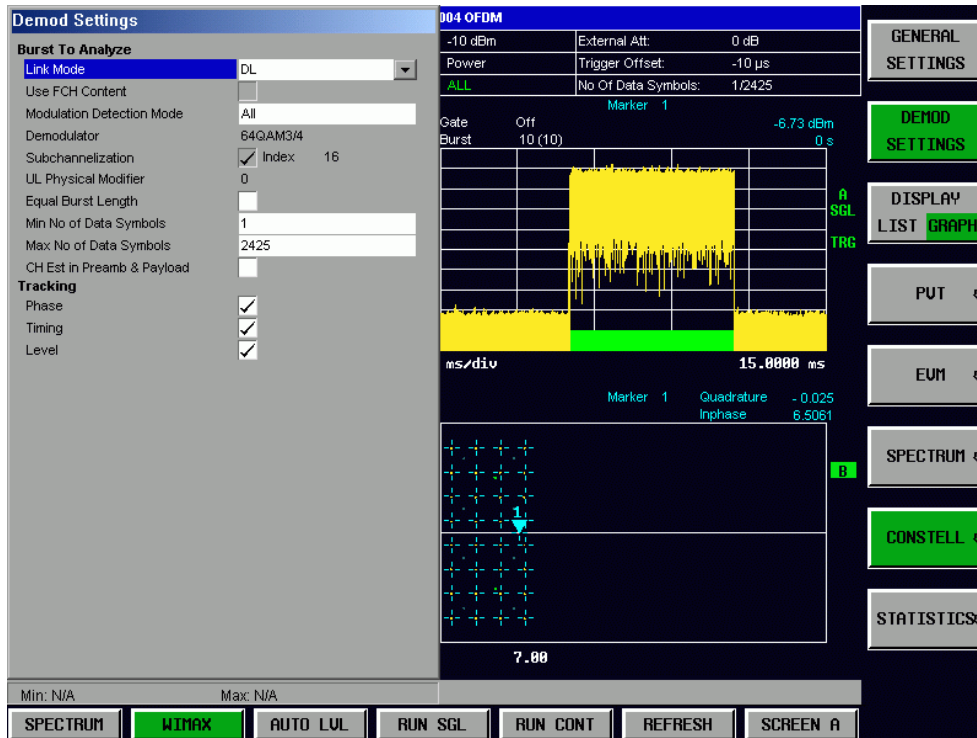
➢ Select the *Link Mode* of the Bursts to be analyzed.

➢ In case *Modulation Detection Mode* is set to *All* , All modulation formats of the bursts will be analyzed.
   This is useful, to get an overview of the signal content.
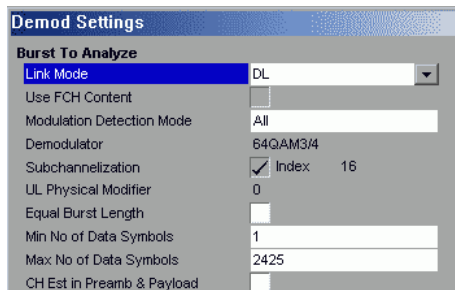
➢ Close the Demod Settings by pressing the *WIMAX* hotkey.

Performing Level Detection

➢ Connect the DUT to the RF input of the spectrum analyzer. (see Fig. 1)
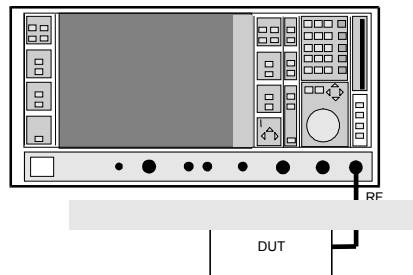
Fig. 1   Preparation for level detection

➢ Start the Level Detection measurement by pressing the *AUTO LVL* hotkey.

➢ During the level detection measurement the text "*Running ...*" is displayed in the Status Bar at the bottom of the screen.

➢ After successful level detection, the Status Bar will display "*Measurement Complete*", the signal level field for the selected input will be updated to show the detected signal level and the Magnitude Capture Buffer (Screen A) will be updated to show the zero span trace obtained during the measurement sequence.

Performing the main measurement

After level detection has been successfully completed the main measurement can be started. The set-up for the main measurement is the same as that for the level detection measurement.

➢ Start the measurement by pressing the *RUN SGL* hotkey.

➢ During the measurement, the text "*Running...*" is displayed in the Status Bar at the bottom of the screen.

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

Setting up a MIMO-OFDMA/WiBro Measurement

For this example a 2 Tx MIMO DUT[3] according to IEEE 802.16e-2005 is used.

➢ The MIMO DUT is connected to the analyzers according to the following setup:

---

[3] a two channel SMU in this example
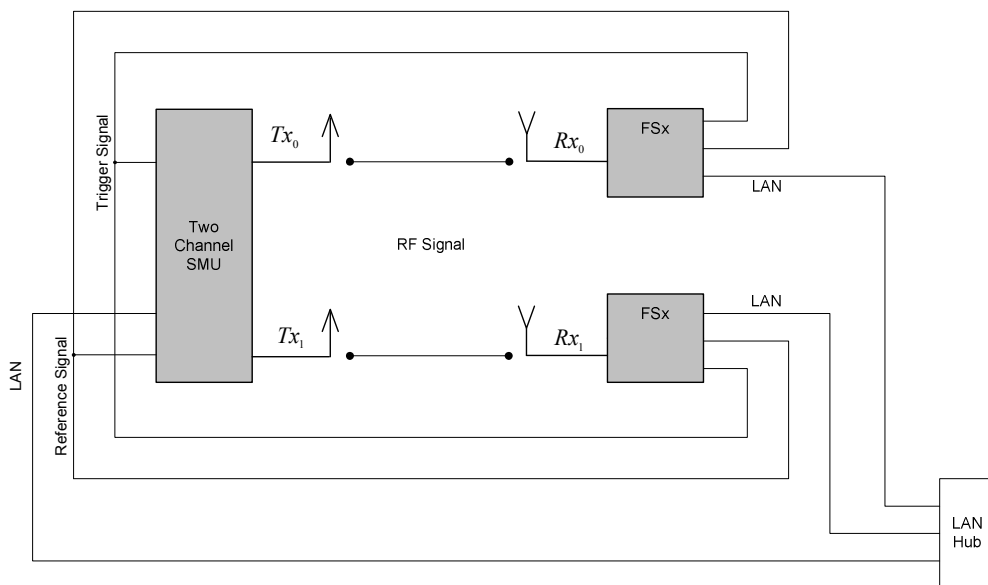
➢ Connect the external reference REF OUT of the SMU with the external reference REF IN of the analyzers. Switch on the external reference for both analyzers in the spectrum analyzer base system.

➢ Connect the marker output of the SMU with the Ext Trigger input of the analyzers.

➢ Either connect Path A RF connector with one analyzer and Path B RF connector with the other analyzer, or use the air interface with appropriate antennas.

➢ Connect the SMU and the analyzers via LAN according to the figure above. Make sure, that all instruments can be accessed by their IP-address. It is sufficient to connect the master and the slave with a cross LAN cable. But for convenience in this example, the SMU is also connected via LAN.

Setup the SMU to transmit in example a WiMAX MIMO Matrix B signal.

SMU Frame Configuration Dialog.

SMU Configure Zone #1 Dialog.
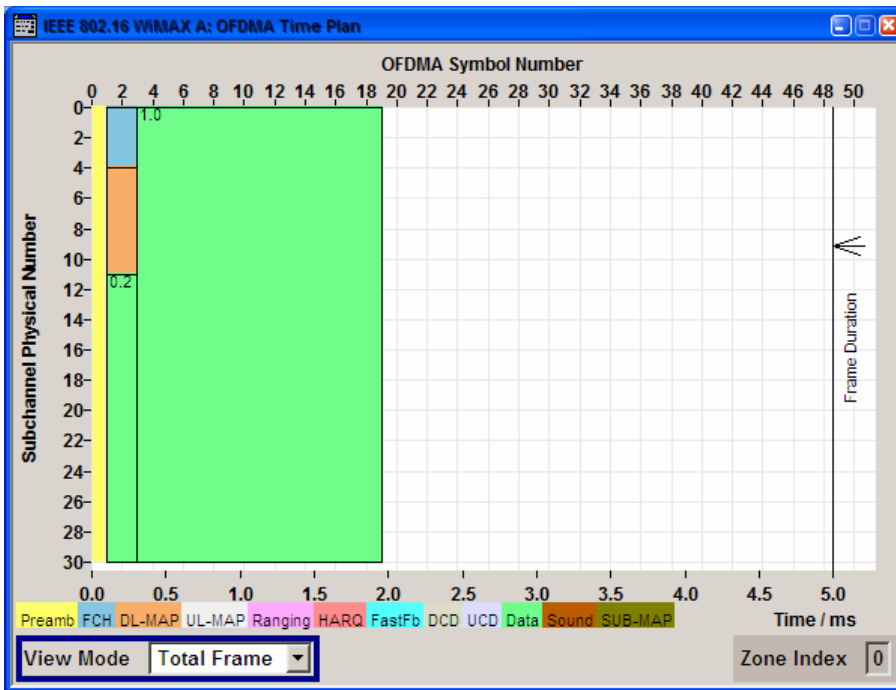
SMU Time Plan Dialog
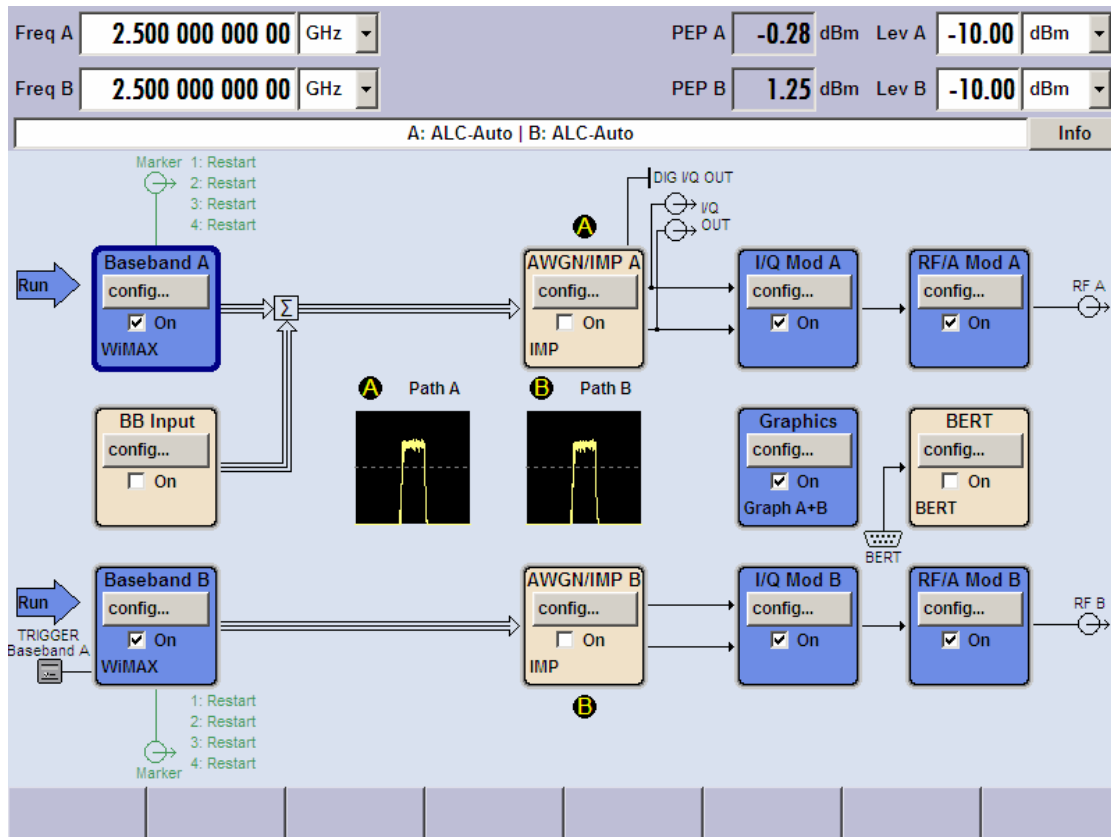
SMU transmitting the WiMAX Matrix B signal.

➢ The analyzer with the FSQ-K94 MIMO option is called the master. The other analyzer doesn't require the FSQ-K94 option and is called the slave.
In the subsequent steps – if not mentioned otherwise – the master is referred.

➢ For the master in General Settings select the IEEE 802.16e-2005 MIMO Standard.

➢ In General Settings Advanced enter the SMU IP address.
Use the File Manager to download the WiMAX MIMO settings from the SMU.
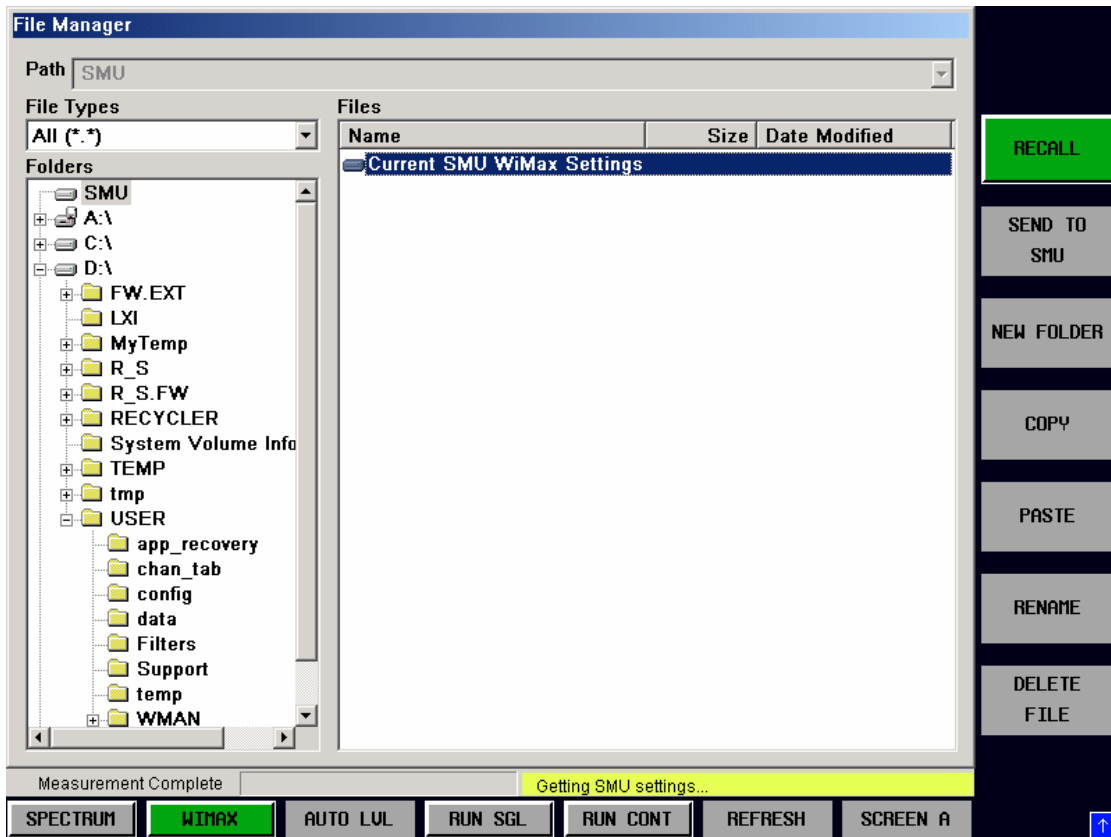
➢ In General Settings select External Trigger and set the Capture Time appropriate to capture at least one sub frame.

➢ In General Settings section STC/MIMO Config:
  a. The DUT MIMO Configuration specifies the number of Tx antennas of the DUT. This value defines the maximal number of Tx antennas per MIMO zone. See Frame Config | More Zone/Segment Settings, STC/MIMO Config. In case the setup was loaded from a SMU setting, this parameter will be set automatically.
  b. Enter the IP address of the slave and switch the state of the slave On. Additionaly check Auto Assignment in case the antenna assignment is delegated to the application.
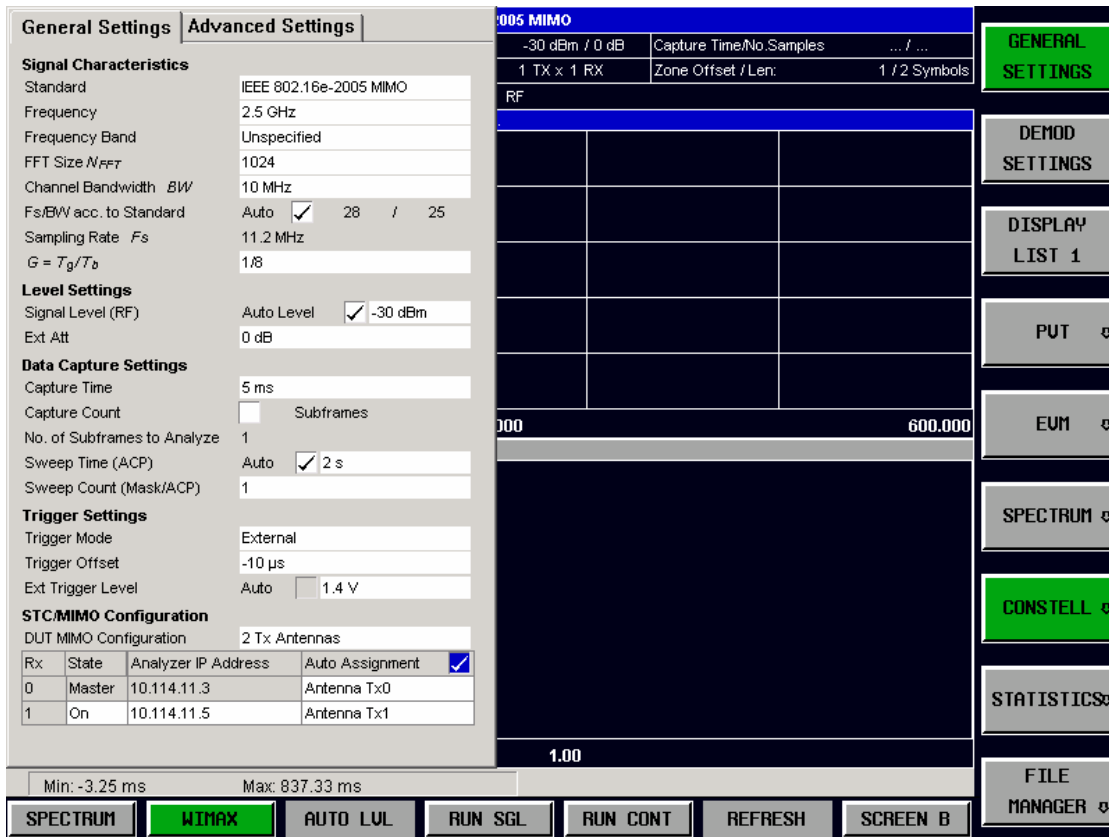
➤ In Demod Settings choose Channel Estimation Payload Only because the MIMO zone is not preceeded by a preamble. Note for DL, the MIMO zone is the second or higher zone in the DL subframe.

➤ In case the air interface was chosen to transmit the WiMAX signal, check Compensate Crosstalk in Demod Settings. In case of a wired connection this parameter might be cleared or checked.

➤ In Demod Settings Frame Config select the MIMO zone for analysis.

➢ Now start the measurement with RUN SGL or RUN CONT to get the various WiMAX MIMO measurement results.

Navigation

This section deals with navigation within the option. Navigation here is taken to mean all forms of interaction with the option except for remote control. The different methods of interacting with the option are:

- Hotkeys

- Softkeys

- Hardkeys

- Numeric Keypad

- Roll-key

- Cursor Keys

- External Keyboard

- Mouse

Hotkeys

Hotkeys are allocated to the seven keys at the bottom edge of the screen. On initial start-up of the R&S FSQ-K92/K93/K94 option, the hotkeys provided are shown in Fig. 2. These hotkeys are present at all times once the option has been started.

SPECTRUM	WIMAX	AUTO LVL	RUN SGL	RUN CONT	REFRESH	SCREEN B
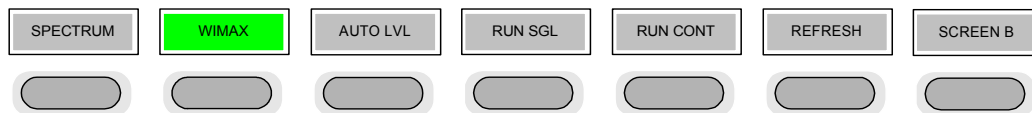
Fig. 2   Initial Hotkey menu

A keystroke activates the associated hotkey. An activated hotkey changes colour to green, as shown.
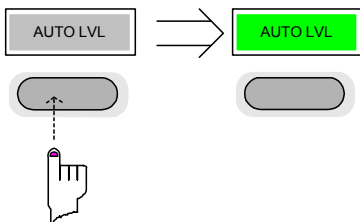
These hotkeys perform the following operations:

SPECTRUM

The *SPECTRUM* hotkey exits the R&S FSQ-K92/K93/K94 option & returns to the spectrum analyzer with all previous settings restored.
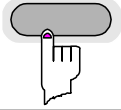
WIMAX

The *WIMAX* hotkey returns the user to the main measurement menu of R&S FSQ-K92/K93/K94, where measurement results can be seen. All settings views and dialogs are removed from the display, and the default softkey menu is displayed
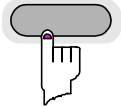
The *WIMAX* hotkey remains green whenever R&S FSQ-K92/K93/K94 is active
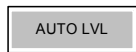
AUTO LVL

The *AUTO LVL* hotkey starts an automatic level detection measurement.
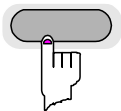
If another measurement is running then the running measurement will be aborted before the automatic level detection measurement is started. If a continuous measurement is running when the *AUTO LVL* hot-key is pressed then the continuous measurement shall resume after the automatic level detection has completed

Pressing the *AUTO LVL* hotkey whilst an automatic level detection measurement is running causes the measurement to be stopped (aborted).

RUN SGL

The *RUN SGL* hotkey starts the selected measurement in single sweep mode.
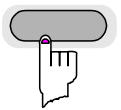
If another measurement is running, such as a continuous sweep measurement, the running measurement will be aborted before the single sweep measurement is started.

Pressing the *RUN SGL* hotkey whilst a single frequency range measurement is running causes the measurement to be stopped (aborted).
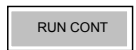
RUN CONT

The *RUN CONT* hotkey starts the selected measurement in continuous sweep mode
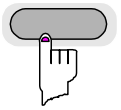
If another measurement is running then the running measurement will be aborted before the continuous sweep measurement is started.

Pressing the *RUN CONT* hotkey whilst a continuous sweep measurement is running causes the measurement to be stopped (aborted).

REFRESH

The *REFRESH* hotkey updates the current measurement results with respect to the current gate settings.
The *REFRESH* hotkey is only available for measurement results which are affected by the gate settings (Spectrum FFT, PVT and CCDF). The *REFRESH* hotkey only becomes available when the gate settings are modified after a measurement result has been obtained.
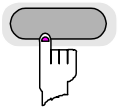
SCREEN [A|B]

The *SCREEN [A|B]* hotkey selects the specified screen as the active screen.
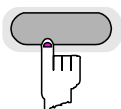
In full screen mode pressing the *SCREEN [A|B]* hotkey will display the specified screen.

After Pressing the *SCREEN [A|B]* hotkey the label displayed in the hotkey is changed e.g. after pressing the *SCREEN A* hotkey the label of the hotkey is changed to *SCREEN B.* The label indicates which screen will become the active screen after the hotkey is pressed.

Softkeys

Settings Softkeys

The softkeys are assigned to the nine keys on the right-hand side of the display. These enable quick access to all of the parameter settings and measurement screens of the R&S FSQ-K92/K93/K94 option. Each of the top two softkeys, when pressed, brings up a settings view for a group of parameters. These softkeys are always available (except when using Save/Recall and Print manager or controlling markers) and are as follows:

GENERAL SETTINGS	**General settings** - Signal characteristics, Data Capture Trigger and IQ settings
DEMOD SETTINGS	**Demod settings** - specifies details about the type of burst to measure
DISPLAY LIST GRAPH	
PUT	
EVM	
SPECTRUM	
CONSTELL	
STATISTICS	
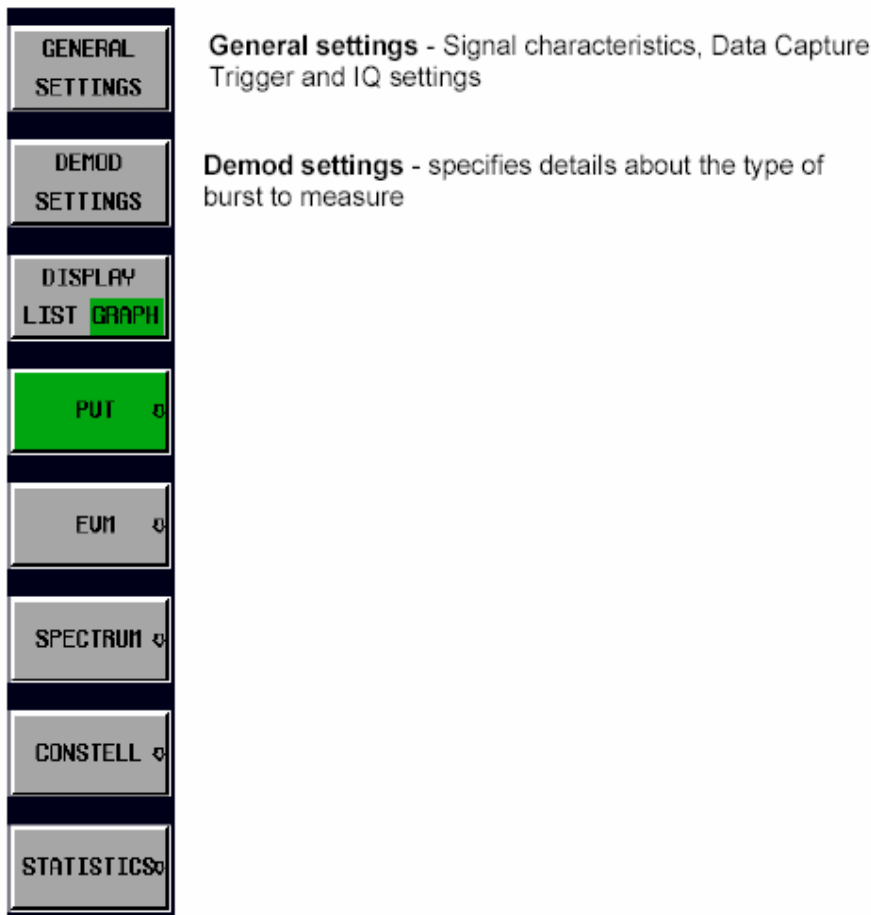
Fig. 3   Main Softkeys

Each of these groups of settings is described in detail in the Measurements & Settings section of this manual.

Other Softkeys

All other softkeys have different functions depending on the instrument state. Therefore, the labels (text) on the softkeys will vary to reflect their current function. The state of the softkeys is indicated by different appearances and colours, as follows:
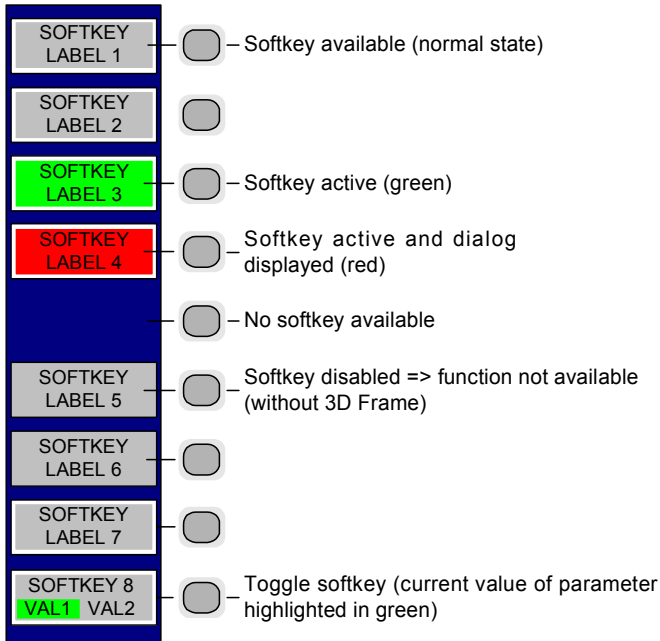
Fig. 4   Setup of the softkey area

A softkey in its normal state, where its function is available, is coloured grey with a 3D border.

A softkey that is disabled, because its function is <u>not</u> available, is coloured grey <u>without</u> a 3D border. Softkeys may become disabled because of the state of the instrument or because other settings disable the function associated with the softkey.

An active softkey (highlighted in green) is used when the softkey selects an item or view. For example, the *GATE SETTINGS* softkey will be highlighted green when the Gate Settings pop-up dialog is displayed.

A toggle softkey is used to change the value of a parameter that has only two states. Each press of the softkey toggles the value of the parameter. The current parameter value is highlighted in green in the lower half of the softkey label. For example, in the measurement results view, the *DISPLAY* softkey will have either *LIST* or *GRAPH* highlighted in green depending on whether the results are currently displayed as a list of measurement points or graphical trace(s).

When no function is assigned to a softkey then no softkey label will be shown.

Hardkeys

Hardkeys allow quick access to the desired parameter and various functions. The hardkeys supported by the R&S-FSQ-K92/K93/K94 option are as follows (other hardkeys do nothing):

FREQ Hardkey | When the *FREQ* hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the *Frequency* parameter is selected.

AMPT Hardkey | When the AMPT hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the relevant *Signal Level* parameter for the selected signal input is selected.

MKR Hardkey | When the MKR hardkey is pressed the main Marker softkey menu is displayed (if it is not already being displayed).

MKR-> Hardkey | When the MKR-> hardkey is pressed the Marker extension softkey menu is displayed (if it is not already being displayed).

SWEEP Hardkey | When the SWEEP hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the *Capture Time* parameter is selected.

MEAS Hardkey | When the *MEAS* hardkey is pressed the Main softkey menu is displayed (if it is not already being displayed).

TRACE Hardkey | When the *TRACE* hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the *Burst Count* parameter is selected.

LINES Hardkey | When the *LINES* hardkey is pressed the Limit Lines softkey menu is displayed (if it is not already being displayed) and the first limit in the results summary is selected. Note this hard-key only functions when the results summary is displayed

DISP Hardkey | When the *DISP* hardkey is pressed the Display softkey menu is displayed (if it is not already being displayed).

FILE Hardkey | When the *FILE* hardkey is pressed, the Save & Recall softkey menu is displayed, allowing the save & recall of settings and/or measurement results of the R&S FSQ-K92/K93/K94 option.

PRESET Hardkey | When the *PRESET* hardkey is pressed the R&S FSQ-option is exited and a preset will be performed. Note that all options (including R&S FSQ-K92/K93/K94) shall also be preset.

HCOPY Hardkey | When the *HCOPY* hardkey is pressed the print manager softkey menu is displayed, allowing selection of the items to be printed.

External Keyboard

The external keyboard is optional. The keys on the external keyboard that can be used to interact with the R&S FSQ- option are as follows:

Number keys 0 to 9

Decimal point (".")	Inserts a decimal point "." at the cursor position.
Minus key	Changes the sign of the mantissa or exponent of a numeric parameter. A "-" is inserted at the cursor position in the case of an alphanumeric parameter.
ESC key	Aborts the entry before it has been terminated. The previous value is restored. Closes the entry field after termination of input. Closes pop-up dialogs.
ENTER key	Terminates the input of dimension quantities. The new value is set. Invokes the input of parameters or immediately sets the new value. Selects the highlighted item in drop-down menus.
Left and Right Cursor Keys are used to:	Navigate between individual parameters within the setting views and some of the pop-up dialogs. Navigate between the individual items within drop-down menus. Move the cursor left & right inside the entry window to reach a particular position in the string during alphanumeric entry.
Up and Down Cursor keys are used to:	Navigate between individual parameters within the setting views and some of the pop-up dialogs. Navigate between the individual items within drop-down menus. Increment or decrement the value of a parameter during numeric entry.
CTRL keys	Used to activate hotkeys. Each of the seven hotkeys is allocated a different function (F) key. To access these hotkeys press CTRL and the corresponding F key together (see Fig. 5):

CTRL + F1   CTRL + F2   CTRL + F3   CTRL + F4   CTRL + F5   CTRL + F7

| SPECTRUM | NOISE | AUTO LVL | RUN SGL | RUN CONT | | SCREEN B |
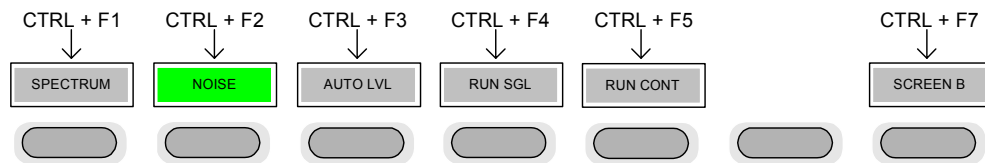
Fig. 5   Quick Access to Hotkeys

Function Keys   Used to activate softkeys. Each of the nine softkeys is allocated a different function (F) key. To access these softkeys the corresponding F key, as shown below:

F1 → SOFTKEY 1
F2 → SOFTKEY 2
F3 → SOFTKEY 3
F4 → SOFTKEY 4
F5 → SOFTKEY 5
F6 → SOFTKEY 6
F7 → SOFTKEY 7
F8 → SOFTKEY 8
F9 → SOFTKEY 9
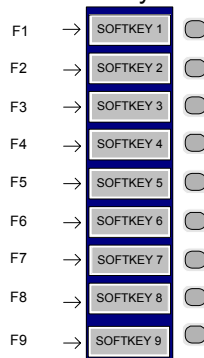
Fig. 6   Quick access to softkeys

Mouse

The mouse can be used to select individual parameters within the settings views or data entry dialogs and to activate hotkeys and softkeys. It can also be used to select values from a drop-down list.

Selecting & Editing Parameters

Parameters are set either by numeric or alphanumeric entry or by simple selection from a list of possible values (a drop-down list is used to select an "enumerated" value) or by using checkboxes to turn a parameter setting on and off.

In all cases, the parameter has to be selected by placing focus on it and then editing has to be enabled before its value can be changed.

The rollkey and cursor keys on the front panel are provided for navigation and selection of parameters.

The numeric keypad, rollkey and cursor keys on the front panel and an external keyboard (optional) are provided for the entry of parameter values.

Numeric Keypad

The numeric keypad is provided for entry of numeric parameters. It contains the following keys:

- Number keys 0 to 9

  Starts editing of the selected parameter. This enables a new value to be entered for a parameter directly without having to press *ENTER* first. The digit will be displayed as the first digit of the newly entered value. Inserts a digit at the cursor position when editing an alphanumeric parameter.

- Decimal point

  Inserts a decimal point "." at the cursor position.

- Sign key ("-")

  Changes the sign of the mantissa or exponent of a numeric parameter. A "-" is inserted at the cursor position when editing an alphanumeric parameter.

- Unit keys (GHz/-dBm, MHz/dBm, kHz/dB and Hz/dB)

- Provides the numeric value entered with the selected unit and sets the parameter to that value.

  The unit keys are all assigned the value "1" for dimensionless quantities or for level entries (e.g. in dB). The unit keys thus assume the function of an *ENTER* key.

- *BACK* key

  Deletes the character to the left of the cursor with alphanumeric entry.

- *ESC/CANCEL* key

  Aborts the entry of a new parameter value. The previous value is restored.

Closes pop-up dialogs.

- *ENTER* key

  Enables editing of the selected parameter (using numeric keys or rollkey). Finishes the editing of a parameter value. The new value is set. For an alphanumeric value, the new value is set to that displayed (using the current unit if applicable).

  In a drop-down menu, the parameter is set to the currently selected value in the list.

Rollkey
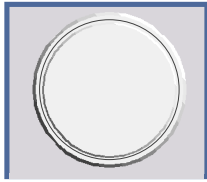
The rollkey has various functions:

- In a settings view, the rollkey can be used to navigate between individual parameters (the parameter selected being highlighted).

- In drop-down menus, the rollkey can be used to navigate between the individual values for the parameter.

- During numeric entry, the parameter is incremented (by turning clockwise) or decremented (by turning counter-clockwise) at a defined step size (depending on the parameter).

- In setting views and data entry dialogs pressing the rollkey invokes the input of parameters or immediately sets the new value, i.e. pressing the rollkey is like pressing the *ENTER* key.

- In drop-down menus, pressing the rollkey selects the relevant item.

Cursor Keys
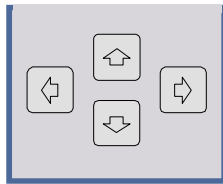
The keys ⬅ and ➡ are used to:

- Navigate between individual parameters within the setting views and some of the pop-up dialogs.

- Navigate between the individual values within drop-down menus.

- Move the cursor left & right inside the entry window to reach a particular position in the string during alphanumeric entry.

The keys ⬆ and ⬇ are used to:

- Navigate between individual parameters within the setting views and some of the pop-up dialogs.

- Navigate between the individual items within drop-down menus.

- Increment or decrement the value of a parameter during numeric entry.

Selection of a parameter within a settings view

Selection using rollkey ➢ Press GENERAL SETTINGS softkey for example (General settings view is displayed).

➢ Rotate the rollkey until reaching the required parameter.
Turning the rollkey clockwise selects parameters in the upward direction, turning it counter-clockwise selects parameters in the downward direction.

Example: Selecting *Signal Level* (General settings)

Signal Level (RF)	0 dBm
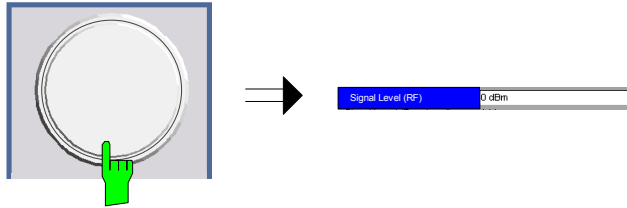
Note: *When the Signal Level parameter is selected its label is highlighted blue.*

When the desired parameter is reached press the rollkey to edit the parameter.

Selection using cursor keys   Cursor ⬆ , ⬇ , ⬅ or ➡ until obtaining the required parameter.
Within a list of parameters, the *Down* and *Right* both move to the next item (down) in the list and the *Up* and *Left* keys both move to the previous item (up) in the list.
Within a table of parameters, the cursor keys move the cursor in the direction indicated.

To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey.

For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Example: Selecting PDSU Modulation

PDSU Modulation	BPSK

PDSU Modulation	BPSK
	BPSK
	QPSK
	16 QAM
	64 QAM
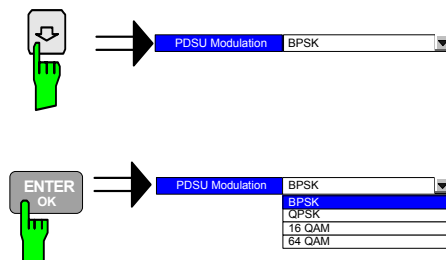
Note: *When ENTER is pressed, a drop-down menu is displayed, which contains all the available settings to which the Demodulator parameter can be set.*

Selection using mouse

➢ Use the mouse to move thursor to the parameter and press the left mouse button to select the parameter.

➢ To start editing the parameter, either press the ENTER key on the numeric keypad, or press the rollkey.

For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Selection using external keyboard

➢ Select parameter using the cursor keys (in the same way as using the cursor keys on the front panel).

➢ To start editing the parameter, either press the ENTER key on the numeric keypad, or press the rollkey.

For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Entry of a numeric value

Once a parameter has been selected (see above), a new value for a numeric parameter can be entered in a number of ways. With the exception of entry via the number keys, to start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey before following the instructions below.

If an error occurs, for example, the entered value is out of range, then the new value will not be accepted for the parameter setting.

Entry using number keys (numeric keypad)

➢ Enter required value using the number keys.

Example: To enter 200 MHz

| Frequency | 200 MHz |
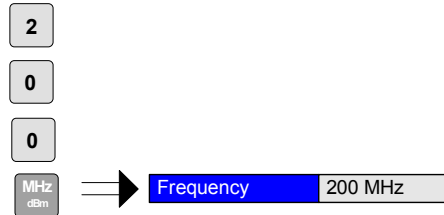
Note: *The parameter is not set to the new value until either one of the unit keys on the numeric keypad, the ENTER or the rollkey is pressed.*

If the new value is not valid, then a message box is displayed and the entered value will be replaced with a valid value. For example, when a value above the maximum allowed is entered, then the maximum value allowed will be shown in the entry box. The parameter will still be ready for editing so that another value can be entered if desired.

Entry using cursor keys

➢ Cursor ⬆ or ⬇ until obtaining the required value.

The application prevents the minimum and maximum values of the parameter from being exceeded and displays an "Out of range" message box if attempted.

N.B The cursor keys increment/decrement a parameter value in large steps.

Example: Cursor down to 100MHz
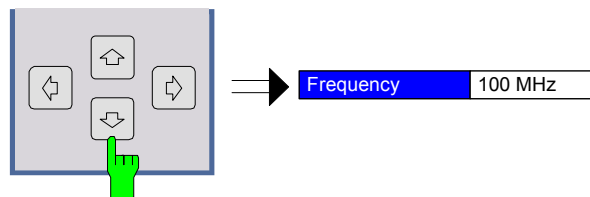
| Frequency | 100 MHz |

Note: *Each change of the parameter value takes place immediately. No other keys need to be pressed.*

Entry using rollkey
➢ Rotate the rollkey until reaching the required value.

Turning the rollkey clockwise increases the value, turning it counter-clockwise decreases the value.

The application prevents the minimum and maximum values of the parameter from being exceeded and displays an "Out of range" message box if attempted.
N.B. The rollkey increment/decrement a parameter value in small steps
Example: Rotate to 200 MHz
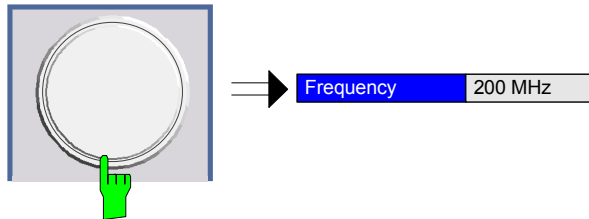
Note: *Each change of the parameter value takes place immediately. No other keys need to be pressed.*

Entry using external keyboard
➢ Enter value using number keys 0 – 9 in the same way as for using the number keys on the numeric keypad (see above).

Terminating the entry
➢ Press one of the unit keys on the numeric keypad.

The unit is entered in the parameter's edit box and the new parameter value is set immediately.

➢ Press the *ENTER* key (on numeric keypad or external keyboard) or press the rollkey.

The new parameter value is set immediately.

Note: *Pop-up dialogs, where used, do not close automatically. They can be closed by pressing the ESC key.*

In both cases, if the new value is not valid, then a message box is displayed and the entered value will be replaced with a valid value. For example, when a value above the maximum allowed is entered, then the maximum value allowed will be shown in the entry box. The parameter will still be ready for editing so that another value can be entered if desired.

Correcting the entry   ➢ Position the cursor to the right of the digit which is to be deleted using the cursor keys ⬅ or ➡.

➢ Press the BACK key. The digit to the left of the cursor is deleted.

➢ Enter new digits. Each digit is inserted to the left of the cursor, the other digits are shifted right.

Aborting the entry   ➢ Press the *ESC* key during parameter editing.

The original parameter value is restored. The new entry is deleted.

➢ If a pop-up dialog is displayed, press the *ESC* key again.

The entry window is closed, the original value remains active.

Entry of an enumerated value

Once a parameter has been selected (see above), a new value for an enumerated parameter can be entered in a number of ways. To start editing the parameter, either press the *ENTER* key on the numeric keypad, press the rollkey or left click with the mouse on the drop down button before following the instructions below.

Note: *When the rollkey or ENTER is pressed, a drop-down menu is displayed, which contains all the available settings that may be selected for the parameter.*

Selection of setting using cursor keys	➢ Cursor ⬆ or ⬇ until obtaining the required setting.
	➢ Press *ENTER* on external keyboard or numeric keypad, or press rollkey to select the desired setting of parameter.

Note: *Currently selected setting of the parameter is highlighted blue.*

Pressing ENTER sets the new setting of the parameter immediately.

Selection of setting using rollkey	➢ Rotate the rollkey until reaching the required setting.
	➢ Press rollkey to select setting.

Example: Select *Mode* parameter.

Note: *Currently selected setting of the parameter is highlighted blue.*
Pressing the rollkey sets the new setting of the parameter immediately.

Selection of setting using mouse	➢ When the parameter is selected and ready for editing, select a new setting using the mouse by left-clicking on the new setting from the drop-down list. The new setting of the parameter is set immediately.
Selection of setting using external keyboard	➢ Select setting using cursor keys.
	➢ Press *ENTER* to set the parameter to the new value.

Entry of a checkbox

A checkbox is used for parameter settings that are either On or Off (Boolean settings). A checkmark (✓) appears in the box when the setting is On; the checkbox is empty when the setting is Off.

Once a parameter has been selected (see above), a new value for a Boolean parameter can be entered in a number of ways. Because Boolean parameters are very simple, it is not necessary to press the *ENTER* key on the numeric keypad or to press the rollkey in order to edit them.

Toggle between the two states of a checkbox using rollkey	➢ Press the rollkey to toggle between the two states. **Example**: Turn *Auto Level* setting to Off
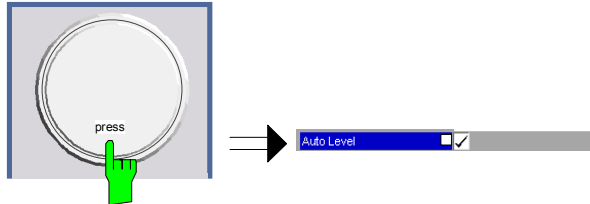
Note: *The checkbox is empty when the settings is Off*

Toggle between the two states of a checkbox using numeric keypad	➢ Press the *ENTER* key to toggle between the two states. **Example**: Turn *Auto Level* setting to On

Toggle between the two states of a checkbox using a mouse	➢ Left-click on the checkbox to toggle between the two states.
Toggle between the two states of a checkbox using external keyboard	➢ Press *ENTER* to toggle between the two states.

Status Bar & Title Bar

Title Bar

The title bar is visible at the very top of the display when R&S FSQ-K92/K93/K94 is active and no settings views are displayed.

Fig. 7   Title Bar

The centre of the title bar shows the WiMAX standard applicable to the current measurement.

Status Bar

The main status bar is displayed at the bottom of the display, just above the hotkeys.

When a parameter in a settings view is selected, the status bar will display the minimum and maximum, settings for the selected parameter (see Fig. 8).

MIN:<XX.XX>   MAX:<XX.XX>
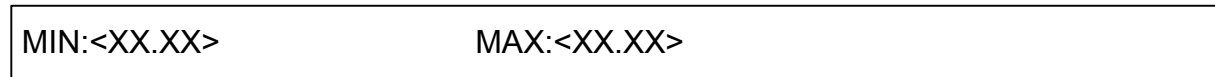
Fig. 8   Status Bar

When a parameter whose value is enumerated or Boolean in type is selected in any dialog, the status bar will show "N/A" displayed for the minimum and maximum, since the minimum and maximum values are "Not Applicable."

At other times, the status bar shows the current measurement status along with detailed information about the progress through any running measurement.

The status bar is also used to display warning and error messages to the user. In order to highlight these messages, warning messages are displayed with a blue background and error messages with a red background. Refer to Section 6 for a list of warning and error messages.

Save/Recall

This section of the user manual describes the Save/Recall facility of the option.
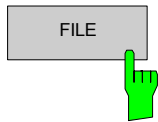
FILE

The *FILE* hardkey brings up the Save/Recall softkey menu. Any settings views on display when the save/recall softkey menu is displayed shall be closed.
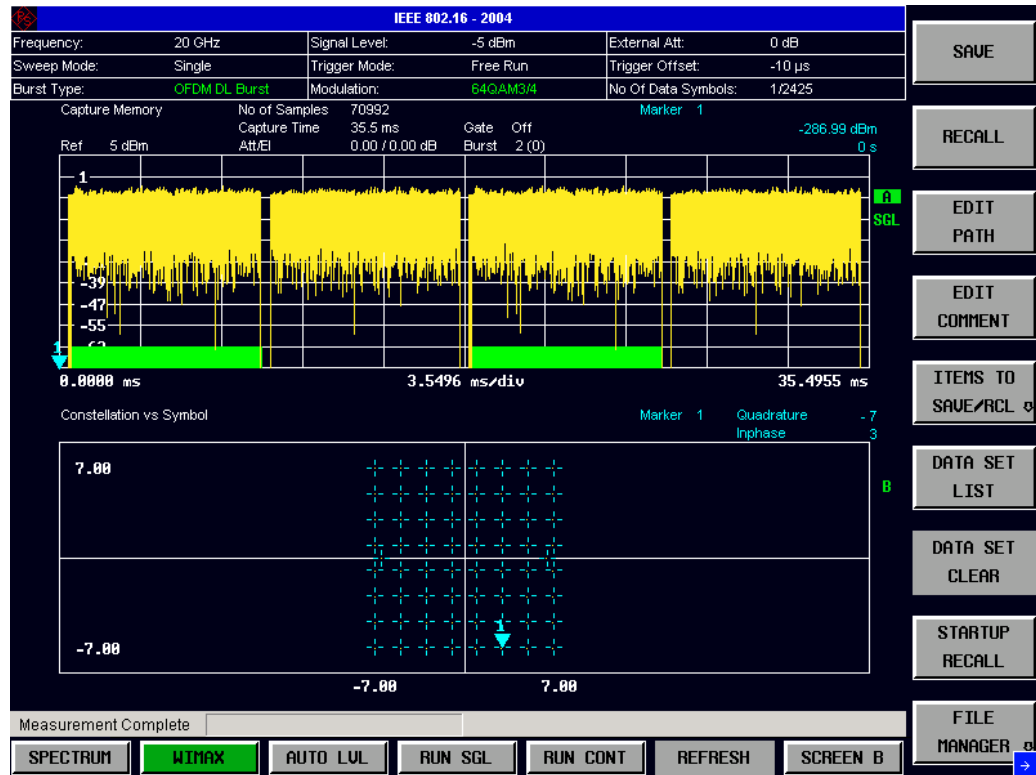
Fig. 9   Save/Recall softkey menu

The save/recall facility provided by R&S FSQ-K92/K93/K94 is exactly the same as that provided by the host analyzer. Refer to the user manual for the spectrum analyzer for details of the save/recall facility operation.

The save/recall facility in R&S FSQ-K92/K93/K94 provides the following items that can be saved and/or recalled:

- Current Settings   All user settings provided by R&S FSQ-K92/K93/K94
- WIMAX Results   All current trace and table results
- User Limits   All limit lines and table limit values.
- IQ Data   Allows the raw IQ trace results to be stored. When recalled the data is reprocessed to generate results

To close the save/recall softkey menu and return to the main R&S FSQ-K92/K93/K94 softkey menu, press the *WIMAX* hotkey.

Printing

This section of the user manual describes print facility of the option

<table>
<tr><td>HCOPY</td></tr>
</table>
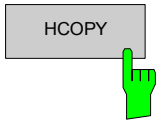
The *HCOPY* hardkey brings up the print softkey menu. Any settings views on display when the print softkey menu is displayed shall be closed.
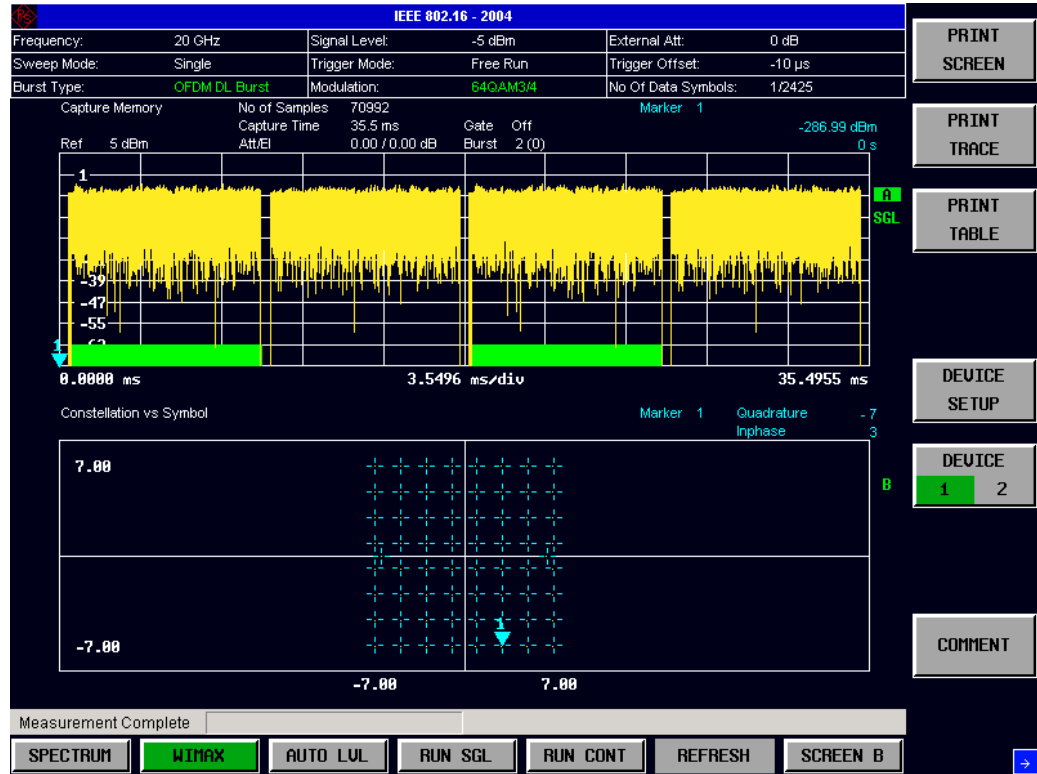
Fig. 10   Print softkey menu

<table>
<tr><td>PRINT
SCREEN</td></tr>
</table>
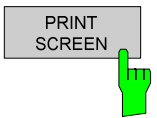
The *PRINT SCREEN* softkey prints the top header and displayed measurement traces. If the table size exceeds the screen size (e.g. the Spectrum Mask and Spectrum ACP), only the visible part of the table is printed.
Printing the entire table is done via the *PRINT TABLE* softkey.

Remote: `HCOP:ITEM:ALL`

<table>
<tr><td>PRINT
TRACE</td></tr>
</table>
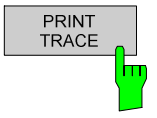
The *PRINT TRACE* softkey prints the displayed measurement traces only.

Remote: `HCOP:ITEM:WIND:TRAC:STAT ON`

<table>
<tr><td>PRINT
TABLE</td></tr>
</table>
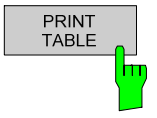
The *PRINT TABLE* softkey prints the Results Display Table only unless the displayed trace has its own results table (e.g. Spectrum ACP and Spectrum Mask). In this case the entire results table is printed.

Remote: `HCOP:ITEM:WIND:TABLe:STAT ON`

The print facility provided by R&S FSQ-K92/K93/K94 is exactly the same as that provided by the host analyzer. Refer to the user manual for the spectrum analyzer for details of the print facility operation.

To close the print softkey menu and return to the main R&S FSQ-K92/K93/K94 softkey menu, press the *WIMAX* hotkey.

2 Measurements & Settings

This section contains a detailed description of all measurement modes, settings & results. It covers the following subjects:

- Measurement modes
- Running measurements
- Measurement results
- General settings
- Demodulation settings
- Gate settings
- Marker settings
- General hints about measurements

Measurements

This section contains a detailed description of all measurement modes, settings & results. It covers the following subjects:

- Measurement modes
- Running measurements
- Measurement results
- General settings
- Demodulation settings
- Gate settings
- Marker settings
- General hints about measurements

Measurements

R&S FSQ-K92/K93/K94 provides two main measurement types:

- IQ Measurements
- Frequency Sweep Measurements

IEEE 802.16e-2005 SISO- and MIMO-OFDMA/WiBro Measurements

Important Note: For the current restrictions to the application and the measurements provided with a firmware release check the corresponding firmware release notes!

Current restrictions to the IEEE802.16e-2005 OFDMA, WiBro Signal to be analyzed[4]

1. Standard
   IEEE 16-2004, 1. Oct. 2004;
   IEEE 16e-2005 and IEEE 16-2004/Cor1-2005, 28. Feb. 2006.
   IEEE 16e-2005 and IEEE 16-2004/Cor1-2005, 28. Feb. 2006 based WiBro.
   IEEE 16-2004/Cor1-2005, IEEE 16e-2005 based WiBro.
   P802.16Rev2/D3 (February 2008)
2. FFT sizes
   The FFT sizes 128, 512, 1024 and 2048 are supported.
3. Subframes
   a. Either a DL-Subframe or a UL-Subframe can be analyzed at one point in time by ticking the corresponding Zone/Segment in '*Frame Config|Zone/Segment List|Analyze*' column. The application assumes the Zone/Segment to be analyzed being available in the signal! Otherwise the measurement results will be bad or the application won't synchronize. In Frame Config the complete frame DL and UL can be defined.
   b. The first UL-PUSC zone of the UL-Subframe is supported. In case each UL-zone defined in Frame Config contains power, each defined UL-zone can be analyzed.
4. Currently supported frame structure and specific allocations.
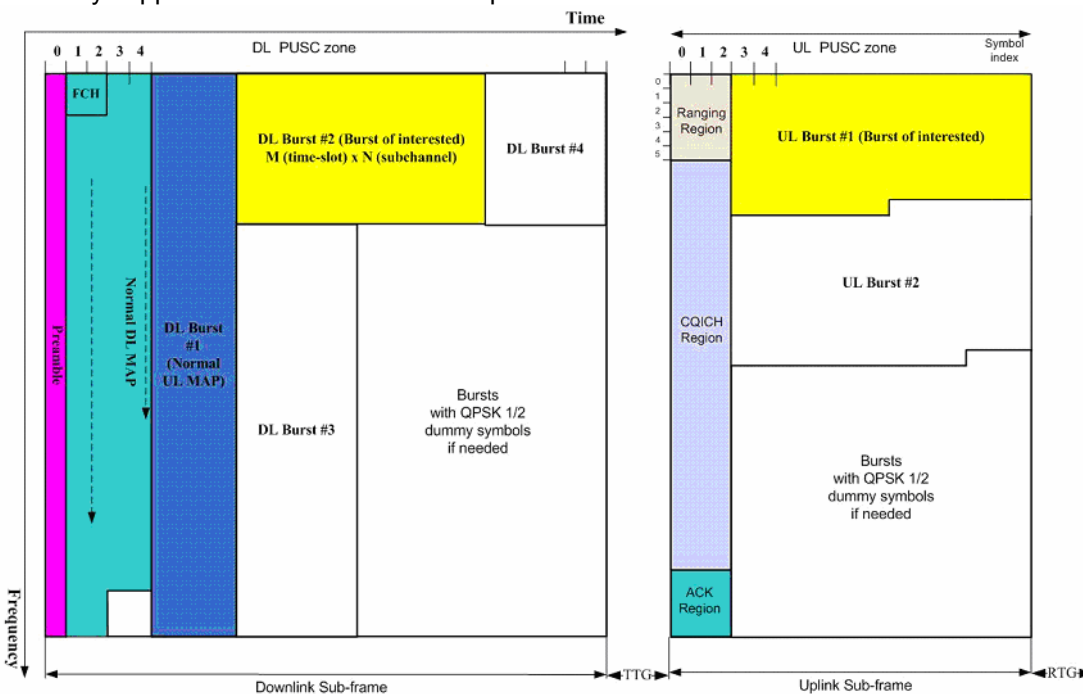
The UL-control region[5] is adjustable from 0,3,6,…,30 OFDMA Symbols.
The analysis of a rectangular **DL-subframe HARQ allocation** is supported. The HARQ allocation must completely be occupied by a single modulation format.
The analysis of **CQICH allocations** according to the figure above is supported, in case the UL-CQICH bursts and UL-data bursts use the same boosting value.
5. Auto demod for signals using normal DL-MAP and compressed DL-MAP is supported. Exclusively the DL zones being available in the Frame Config | Zone field are supported by auto demod.

---

[4] For the current restrictions to the MIMO-OFDMA and MIMO-WiBro analysis see the corresponding release notes.

[5] The UL-control region is defined by the first n OFDMA Symbols of the first UL-zone using all subchannels.

Assuming a valid DL-MAP according to the WiMAX standard.
6. DL Subframes length:
    The signal to be analyzed must contain at least two OFDMA data symbols. More OFDMA data symbols will improve the accuracy of the measurement results.
7. UL Subframe length:
    The signal to be analyzed must contain at least three OFDMA data symbols [1 slot]. More OFDMA data symbols will improve the accuracy of the measurement results.

IEEE802.16e-2005 SISO-OFDM, SISO- and MIMO-OFDMA/WiBro Scalar Measurement Results

For these measurement results, the minimum, mean and maximum is taken over the analyzed zones of the current capture buffer content.

- BER Pilots (SISO- and MIMO-OFDMA/WiBro)
  Deviation of the measured pilots from the expected pilots according to the standard in percent. Not available in UL with Demod Settings | Pilots for Tracking = According to Standard.

Accuracy measurements

- Center Frequency Error
  Difference between measured and reference center frequency

- Symbol Clock Error
  Difference between measured and reference symbol clock relative to the system sampling rate.

EVM measurements

- EVM Data and Pilots
  EVM over Data and Pilot Symbols for the analyzed zone or the analyzed segment.

- EVM Data
  EVM over Data Symbols for the analyzed zone or the analyzed segment.

- EVM Pilots
  EVM over Pilot Symbols of the analyzed zone or the analyzed segment.

- EVM Preamble (SISO- and MIMO-OFDMA/WiBro).

- Unmodulated Subcarrier Error (SISO-OFDMA/WiBro)
  Accumulated power of the unmodulated subcarriers relative to the accumulated power of the modulated subcarriers.
  See IEEE Std 802.16e-2005 section "8.4.12.3.4 Unmodulated subcarrier errors for SS".

IQ constellation measurements

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

- Gain Imbalance
  Logarithm or percentage figure of the Q-Channel to I-Channel gain ratio.

- Quadrature Error
  Measure of the phase angle between Q-Channel and I-Channel deviating from the ideal 90 degree.

Power measurements (SISO-OFDM)

- Burst Power
  Statistic over the burst power of the analyzed bursts.

- Crest Factor
  Statistic over the peak to average power ratio of the analyzed bursts.

Power measurements for *Result Summary of Analyzed Subframes* (SISO- and MIMO-OFDMA/WiBro)

- TD Power DL Preamble
  Time domain power of the DL Preamble. I.e. a zero span measurement over the DL preamble will give the corresponding measurement result.

- TD Power Subframe
  Time domain power of the subframe [excluding the DL Preamble in case of DL]. I.e. a zero span measurement over the subframe will give the corresponding measurement result.

- TD Power Zone
  Time domain power of the zone to be analyzed. I.e. a zero span measurement over the zone will give the corresponding measurement result.

- Crest Factor
  Peak to average power ratio of the analyzed zone.

Power measurements for *Result Summary of Analyzed Zone/Segment* (SISO- and MIMO-OFDMA/WiBro)

- Power DL Preamble
  Power of the Preamble corresponding to the Zones/Segments to be analyzed.
  Relation between the TD Power DL Preamble and the FD Power DL Preamble measurement results:

  $$P_{\text{TD,Preamble}} = P_{\text{FD,Preamble}} + 10\log 10\left(\frac{N_{used}}{N_{FFT}}\right) = P_{\text{FD,Preamble}} + 10\log 10\left(\frac{852/3}{1024}\right)$$

  in case N_{FFT} =1024 and on segment being used.

- Power Data and Pilots
  Weighted average – according to the used number of subcarriers – between the 'Power Data' and 'Power Pilots' results.

- Power Data
  Average power of the subcarriers belonging to the data parts of the zone weighted with N_{FFT}.

- Power Pilots
  Average power of the pilots belonging to the zone weighted with N_{FFT}.

- Power Null Pilots (MIMO-OFDMA/WiBro)
  For a MIMO Tx antenna signal specific pilot positions are unused, because they are used by the complementary Tx antennas. Power Null Pilots is the power of the unused pilot positions.

RSSI and CINR measurements

- RSSI
  The Received Signal Strength Indicator is an estimate of the total received power of the DL preamble.
  Note the TD Preamble Power from the Result Summary deviates from the RSSI because the RSSI uses the mean over absolute amplitudes. The preamble power in contrary uses the mean over squared absolute amplitudes.

- RSSI Standard Deviation
  Standard deviation of the RSSI result.

- CINR
  Carrier Interference Noise Ratio is the ratio of the signal power and the noise power for the DL Preamble Symbol. See also section "Measurements in Detail".

- CINR Standard Deviation
  Standard deviation of the CINR result.

IEEE802.16e-2005 SISO-OFDM, SISO- and MIMO-OFDMA/WiBro Graphical Measurement Results

Power vs Time measurements

- Capture Buffer
  Power profile of the capture buffer data being analyzed

- Full Subframe
  min mean max power profile of the subframe containing the zone to be analyzed.

- Rising / Falling
  min mean max profile of the rising respective falling edge of the subframe containing the zone to be analyzed.

EVM measurements

- EVM vs Symbol ALL
  EVM versus the symbols of the analyzed zone. In case the capture buffer contains more than one analyzed zones, the corresponding result graphs will be appended. The min mean max statistics is performed over carriers.

- EVM vs Carrier ALL
  EVM versus physical carriers. The min mean and max statistics is performed over the symbols of all analyzed zones in the capture buffer.

- Error Freq / Phase (SISO-OFDM and SISO-OFDMA/WiBro)
  Relative Frequency Error vs Sample, and Phase Error vs Sample. The Frequency Error vs Sample measurement is relative to the Center Frequency Error.

Spectrum Measurements

- Spectrum Flatness
  Average energy of the constellations for the physical carriers. The limit lines are displayed according to the requirements of the standard. The min mean and max statistic is performed over the analyzed zones in the capture buffer.

- Spectrum Flatness Difference
  Absolute difference of adjacent carriers. The limit lines are displayed according to the requirements of the standard. The min mean and max statistic is performed over the analyzed zones in the capture buffer.

- Preamble Channel Frequency Response: Phase

- Group Delay

- Spectrum Mask
  Spectrum Emission Mask measurement according to the IEEE / ETSI standard, or user defined configuration.
  IEEE 802.16-2004 section "8.5.2 Transmit spectral Mask".
  ETSI EN 301 021 V1.6.1 (2003-07). Fixed radio systems; point-to-multipoint equipment; time division multiple access (TDMA); Point-to-multipoint digital radio systems in frequency bands in the range 3 GHz to 11 GHz

- Spectrum ACP ABS/REL

- Spectrum FFT

Constellation Measurements

- Constellation Diagram
  Complex Constellation Diagram of the modulation symbols. The modulation symbols belong to the Bursts of the analyzed zone. The different modulation formats are assigned unique colors. These colors are also used for the Bitstream measurement. With the [CONSTELL SELECTION] Softkey it is possible to suppress unwanted information.

Statistic Measurements

- CCDF Complementary Cumulative Distribution Function
  Complementary Probability Distribution for the capture buffer sample exceeding the average power.

- Bit Stream
  The modulation symbols define bit sequences. The mapping is defined in the standard. The modulation symbols of the bursts from the analyzed zone are displayed. The different modulation formats are assigned unique colors. These colors are also used for the Constellation Diagram Measurement. The selection panel allows select highlight the data the user is interested in.

- Burst Summary
  Provides information about the bursts from the analyzed zone. I.e. Modulation of the burst, Power Boosting information, EVM of the burst. Each analyzed zone will produce a set of burst results.

MEAS

WIMAX

GENERAL SETTINGS
DEMOD SETTINGS
DISPLAY LIST ⟷ DISPLAY GRAPH
PVT
EVM
SPECTRUM
CONSTELL
STATISTIC
FILE MANAGER

GENERAL SETTINGS
DEMOD SETTINGS
DISPLAY LIST
FLATNESS FLAT GRDEL
FLATNESS DIFFERENCE
SPECTRUM MASK
SPECTRUM FFT
ACP ABS REL
FILE MANAGER

GATING ON OFF
GATE SETTINGS
SEM SETTINGS
ACP SETTINGS
IMPORT
EXPORT

SUPPORT

GENERAL SETTINGS
DEMOD SETTINGS
DISPLAY LIST
FULL BURST
START END

BURST SELECTION

GATING ON OFF
GATE SETTINGS

IMPORT
EXPORT

SUPPORT

GENERAL SETTINGS
DEMOD SETTINGS
DISPLAY LIST
EMV VS SYMBOL
EMV VS CARRIER
ERROR FREQ PHASE
Y-AXIS/ DIV

GENERAL SETTINGS
DEMOD SETTINGS
DISPLAY LIST
CONSTELL
CONSTELL VS CARRIER
CARRIER SELECTION

GENERAL SETTINGS
DEMOD SETTINGS
DISPLAY LIST
CCDF
BIT STREAM
BURST SUMMARY

RECALL
SEND TO SMU
NEW FOLDER
COPY
PASTE
RENAME
DELETE FILE

Fig. 11   SISO-OFDM menu

Fig. 12   SISO-OFDMA/WiBro menu
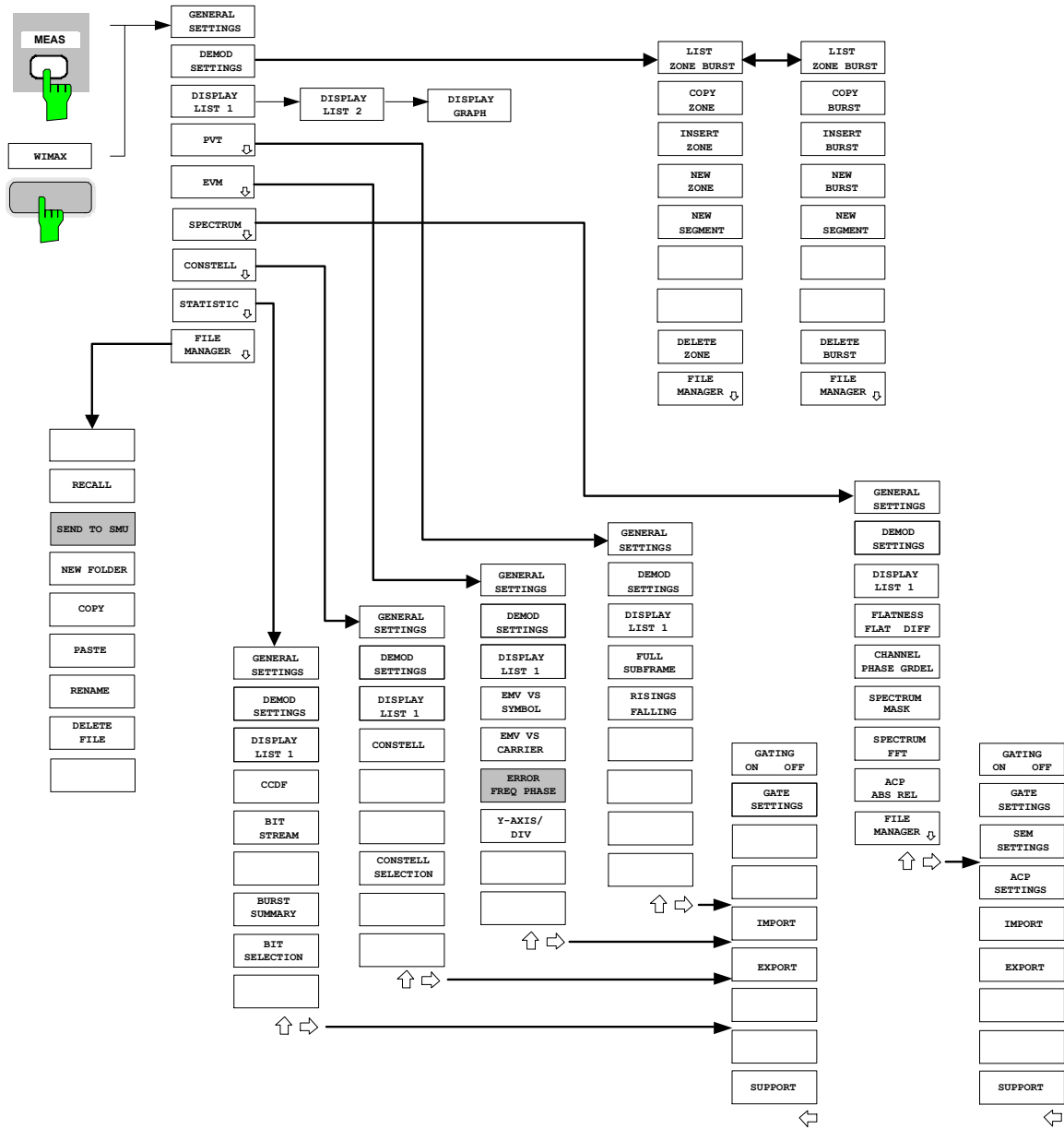
Fig. 13   MIMO-OFDMA/WiBro menu

IQ measurements

The following measurements results are obtained in IQ measurement mode:

- Power vs Time (PVT)
- EVM vs Symbol
- EVM vs Carrier
- Phase vs Preamble
- Frequency vs Preamble
- Spectrum Flatness
- Spectrum Group Delay
- Spectrum Flatness Adjacent Carrier Power Difference
- Spectrum FFT
- Constellation vs Symbol
- Constellation vs Carrier (IEEE 802.16-2004 SISO-OFDM)
- Complementary Cumulative Distribution Function (CCDF)
- Bit Stream

For each of the above results the Magnitude Capture Buffer display is available.
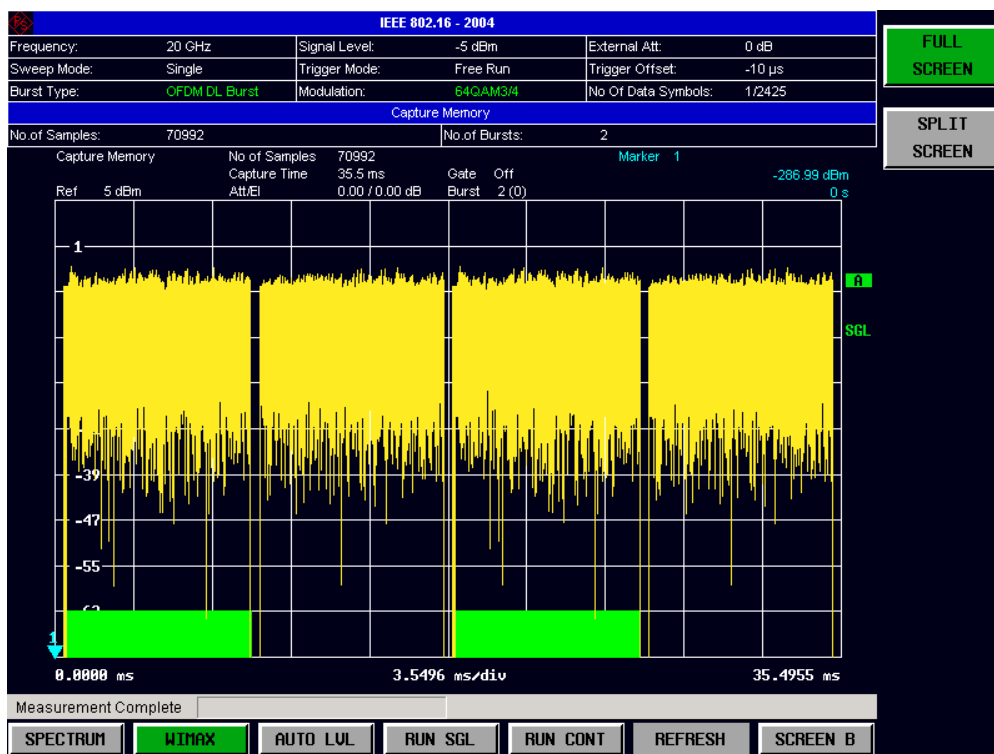
Fig. 14   Magnitude Capture Buffer Results (SISO-OFDM)

The Magnitude Capture buffer shows the complete range of captured data for the last sweep. All analyzed bursts are identified with a green bar at the bottom of the Magnitude Capture buffer. Only those bursts which matched the required criteria are marked with a green bar.

All IQ measurements process the same signal data and as such all IQ measurement results are available after a single IQ measurement execution.

IQ measurements can be run in split screen mode (allowing both the Magnitude Capture Buffer Display and the selected IQ measurement results to be displayed simultaneously) or in full screen mode (with either the Magnitude Capture Buffer Display or the selected IQ measurement results displayed).

IQ measurements may be performed for RF or Baseband input.

Power vs Time (PVT)

PVT
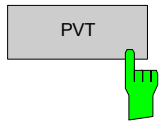
The PVT measurement results are selected by pressing the *PVT* softkey in the main measurement softkey menu.
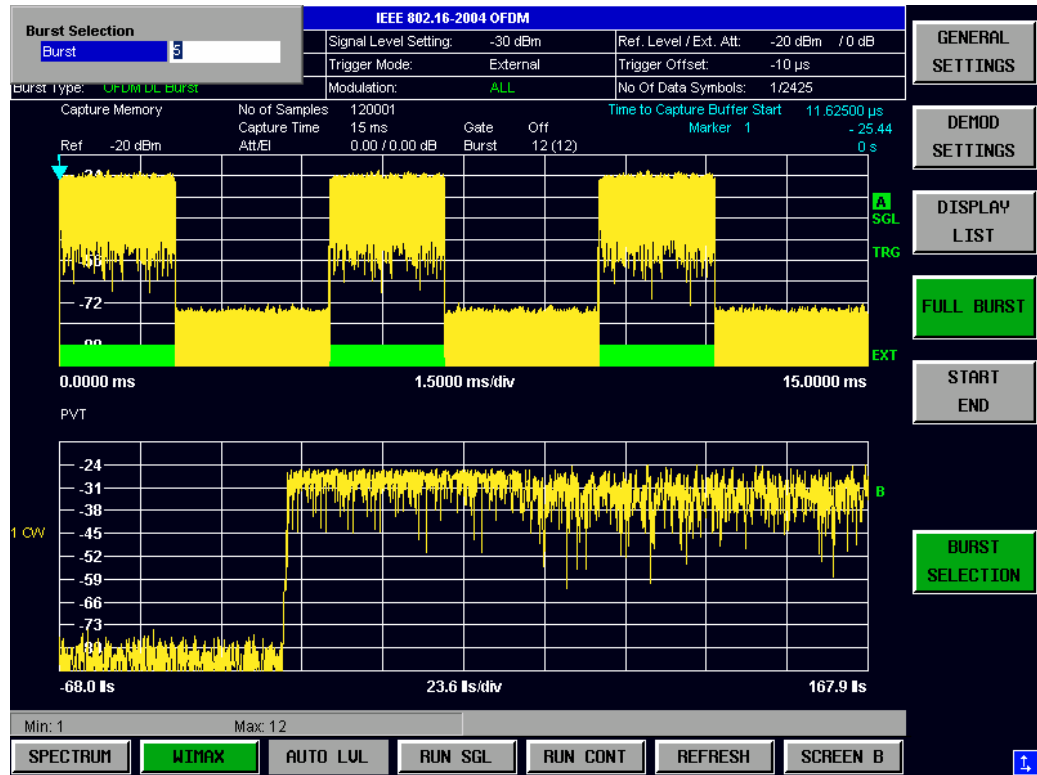
Fig. 15   PVT Results – Full Burst (SISO-OFDM)

The PVT results display shows measured input data, or over complete bursts displayed within the gating lines if gating is switched on. The results are displayed as a single burst.

Remote: `CONF:BURS PVT:BUR`

SISO-OFDM
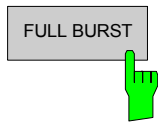
FULL BURST

Pressing the *FULL BURST* softkey displays the results in a single graph with all burst data being displayed.

Remote: `CONF:BURS:PVT:SEL FULL`
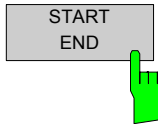
START END

Pressing the *START END* softkey displays the results in two separate graphs, the left hand side showing the start and the right hand side showing the end of a burst.
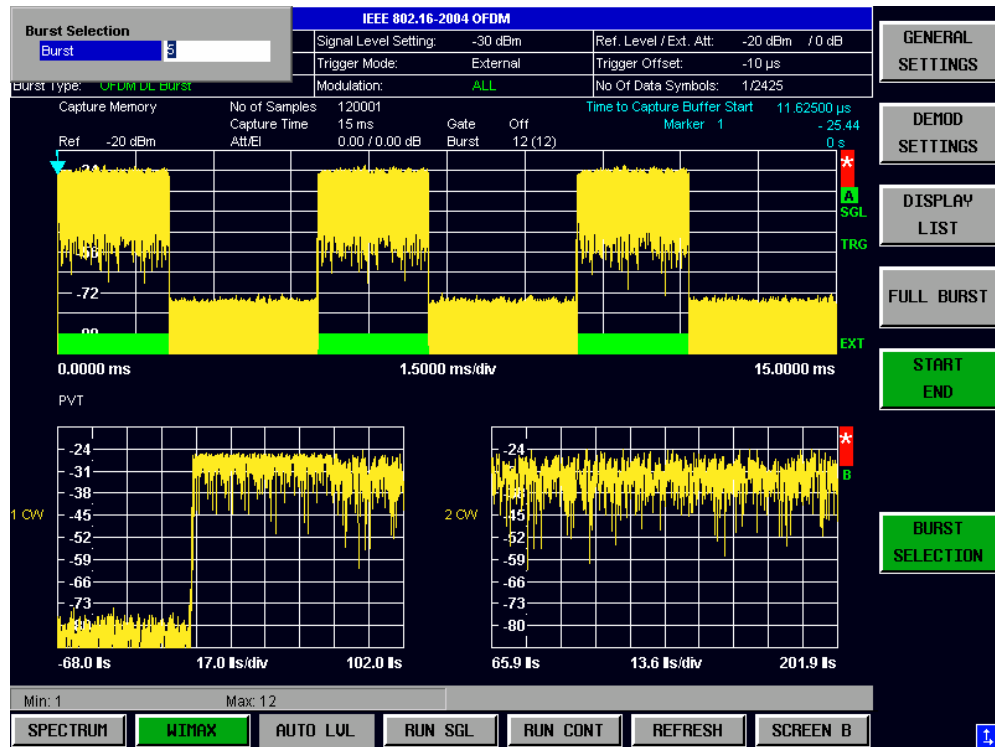
Fig. 16   PVT Results – Start and End (SISO-OFDM)
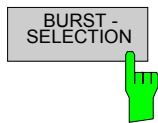
BURST - SELECTION

Pressing the *BURST SELECTION* softkey displays a pop-up dialog which allows the burst for data display to be selected.

Remote: `CONF:BURS:PVT:SEL EDGE`

SISO-OFDMA/WiBro
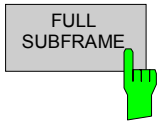
| FULL SUBFRAME | Pressing the *FULL SUBFRAME* softkey displays the results in a single graph with all subframe data being displayed. |

Fig. 17   PVT Results – Full Subframe (SISO-OFDMA/WiBro)

Remote: `CONF:BURS:PVT:SEL FULL`

MIMO-OFDMA/WiBro
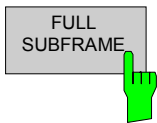
| FULL SUBFRAME | Pressing the *FULL SUBFRAME* softkey displays the results in a single graph with all subframe data being displayed. |

Fig. 18   PVT Results – Full Subframe (MIMO-OFDMA/WiBro)

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' two RX path results are available. Therefore two Full Subframe result traces are displayed one for each Rx Path. The Rx path information for the trace is given in the corresponding measurement window title bar.

Note: The Rx 1 signal is shorter by the Preamble and the first SISO DL-PUSC zone, not transmitted from antenna 1.

Remote: `CONF:BURS:PVT:SEL FULL`

SISO-OFDMA/WiBro
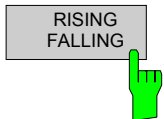
Pressing the *RSINING FALLING* softkey displays the results in two separate graphs, the left hand side showing the start and the right hand side showing the end of a subframe.
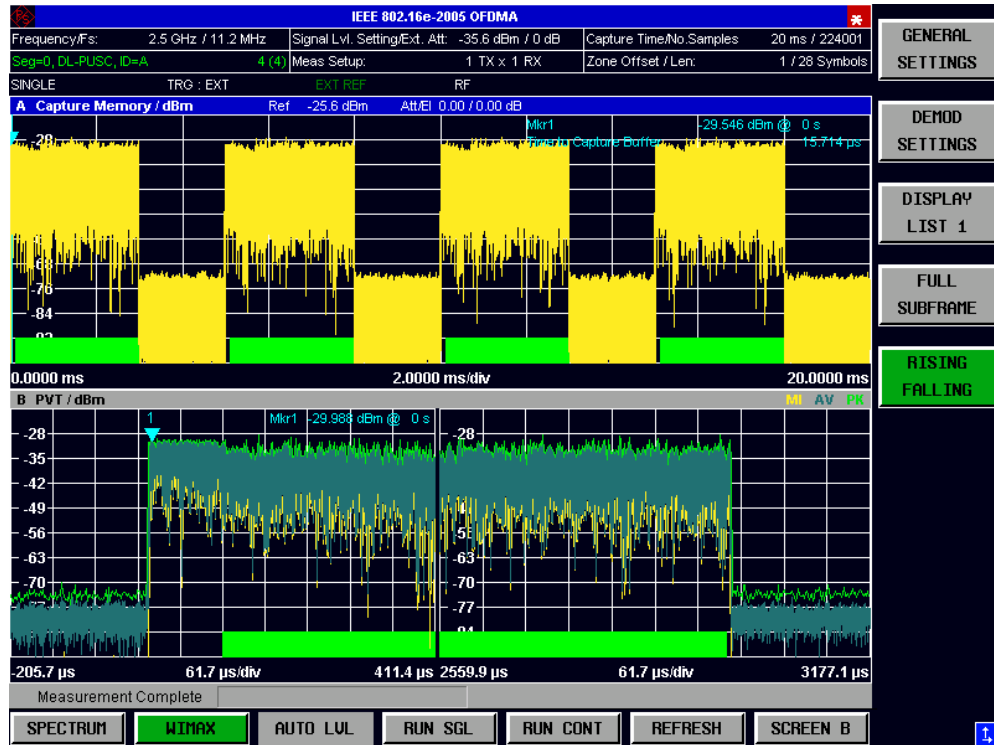
Fig. 19   PVT Results – Rising/Falling (SISO-OFDMA/WiBro)

Remote: `CONF:BURS:PVT:SEL EDGE`

MIMO-OFDMA/WiBro
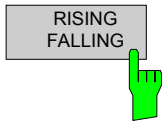
RISING
FALLING

Pressing the *RSINING FALLING* softkey displays the results in two separate graphs, the left hand side showing the start and the right hand side showing the end of a subframe.
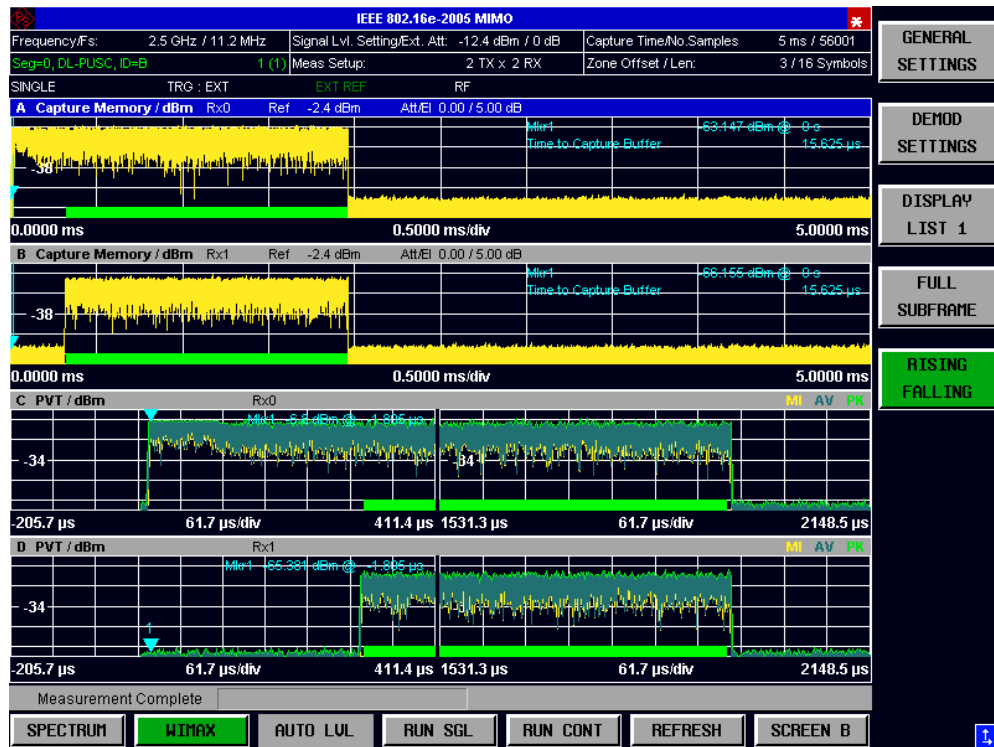
Fig. 20   PVT Results – Rising/Falling (MIMO-OFDMA/WiBro)

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' two Rx path results are available. Therefore two Rising/Falling Subframe result traces are displayed one for each Rx Path. The Rx path information for the trace is given in the corresponding measurement window title bar.

Note: The RX 1 signal is shorter by the Preamble and the first SISO DL-PUSC zone, not transmitted from antenna 1.

Remote: `CONF:BURS:PVT:SEL EDGE`

EVM vs Symbol

SISO-OFDM and SISO-OFDMA/WiBro
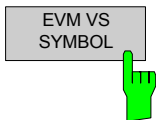
EVM VS SYMBOL

The EVM vs Symbol measurement results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *EVM VS SYMBOL* Softkey:
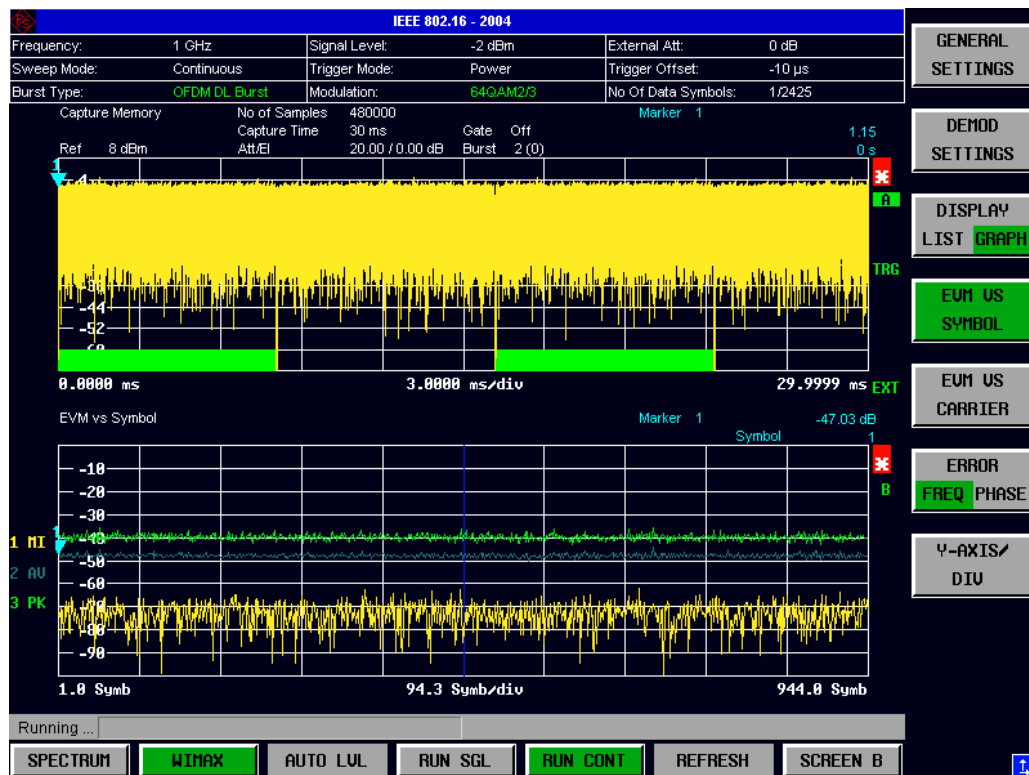
Fig. 21   EVM vs Symbol (SISO-OFDM)

The EVM vs Symbol results display shows the EVM measured over the full range of the measured input data. The results are displayed on a per-symbol basis, with blue vertical lines marking the boundaries of each burst. Note that burst boundary lines are only displayed if the number of analyzed bursts is less than 250. The minimum, average and maximum traces are displayed.

For the trace labelled with EVM a commonly used EVM definition is applied, which is the square root of the momentary error power normalized by the averaged reference power. For details of this measurements please refer to chapter 3.

Remote: `CONF:BURS:EVM:ESYM:IMM`

MIMO-OFDMA/WiBro
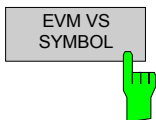
EVM VS SYMBOL

The EVM vs Symbol measurement results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *EVM VS SYMBOL* Softkey:

Fig. 22   EVM vs Symbol (MIMO-OFDMA/WiBro)

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' two Rx path results are available. Therefore two EVM vs Symbol result traces are displayed one for each RX Path. The RX path information for the trace is given in the corresponding measurement window title bar.

The EVM vs Symbol results display shows the EVM measured over the full range of the measured input data. The results are displayed on a per-symbol basis, with blue vertical lines marking the boundaries of each analyzed zone. The minimum, average and maximum traces are displayed.

For the trace labelled with EVM a commonly used EVM definition is applied, which is the square root of the momentary error power normalized by the averaged reference power. For details of this measurements please refer to chapter 3.

Remote: `CONF:BURS:EVM:ESYM:IMM`

EVM vs Symbol Y Axis
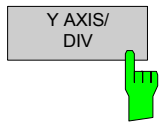
Y AXIS/ DIV

Pressing *Y AXIS/ DIV* softkey displays a pop-up dialog which allows the settings of the Y-Axis to be controlled.
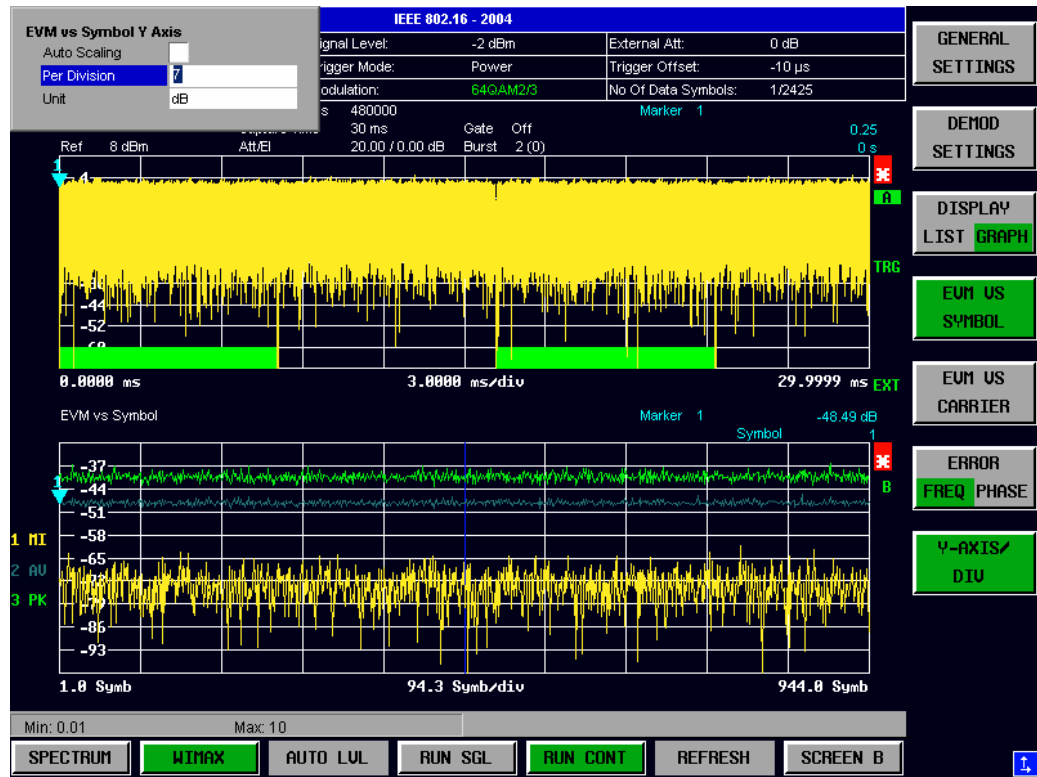
Fig. 23   EVM vs Symbol - Y-Axis Scaling

Auto Scaling

Auto Scaling specifies whether the Y-Axis scale should be calculated manually or automatically.

When the *Auto Scaling* parameter is switched OFF then the setting of the *Per Division* setting is used to calculate the Y-Axis scale.

Remote: `DISP2:TAC1:Y:SCAL:AUTO`

Per Division

Per Division specifies the scaling is to be used when *Auto Scaling* is switched OFF.

Remote: `DISP2:TRAC1:Y:SCAL:PDIV`

Unit

Unit allows Y-Axis unit to be specified.

Remote: `DISP:TABL:UNIT PCT`

EVM vs Carrier

SISO-OFDM and SISO-OFDMA/WiBro
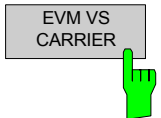
EVM VS
CARRIER

The EVM vs Carrier measurement results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *EVM vs CARRIER* softkey.

Fig. 24　　　EVM vs Carrier Results (SISO-OFDM)

The EVM vs Carrier results display shows the all EVM values recorded on a per-carrier basis over the full set of measured data. The minimum, average and maximum traces are displayed.

The scaling of the Y-Axis can be modified to allow the results to be scaled to an optimum level.

Remote: `CONF:BURSt:EVM:ECAR:IMM`

MIMO-OFDMA/WiBro
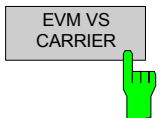
EVM VS
CARRIER

The EVM vs Carrier measurement results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *EVM vs CARRIER* softkey.

Fig. 25   EVM vs Carrier Results (MIMO-OFDMA/WiBro)

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' two Rx path results are available. Therefore two EVM vs Carrier result traces are displayed one for each Rx Path. The Rx path information for the trace is given in the corresponding measurement window title bar.

The EVM vs Carrier results display shows the all EVM values recorded on a per-carrier basis over the full set of measured data. The minimum, average and maximum traces are displayed.

The scaling of the Y-Axis can be modified to allow the results to be scaled to an optimum level.

Remote: `CONF:BURSt:EVM:ECAR:IMM`

EVM vs Symbol Y Axis
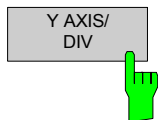
Pressing *Y AXIS/ DIV* softkey displays a pop-up dialog which allows the settings of the Y-Axis to be controlled. The settings provided are the same as for the EVM vs Symbol measurement screen.

Remote: `DISP:WIND2:TRAC:Y:SCAL:AUTO ON`
`DISP:WIND2:TRAC1:Y:SCAL:PDIV 2`

Error vs Preamble (SISO-OFDM) / Error vs Sample (SISO-OFDMA/WiBro)
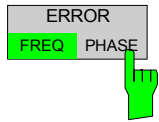
ERROR
FREQ PHASE

The Error vs Preamble results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *ERROR FREQ/PHASE* softkey. Subsequent presses of the *ERROR FREQ/PHASE* softkey toggle the Error measurement between Frequency Error vs Preamble and Phase Error vs Preamble.

For SISO-OFDMA/WiBro, the measurement results provided are Frequency Error vs Sample and Phase Error vs Sample.

Fig. 26   Rel. Frequency Error vs Preamble Results (SISO-OFDM)
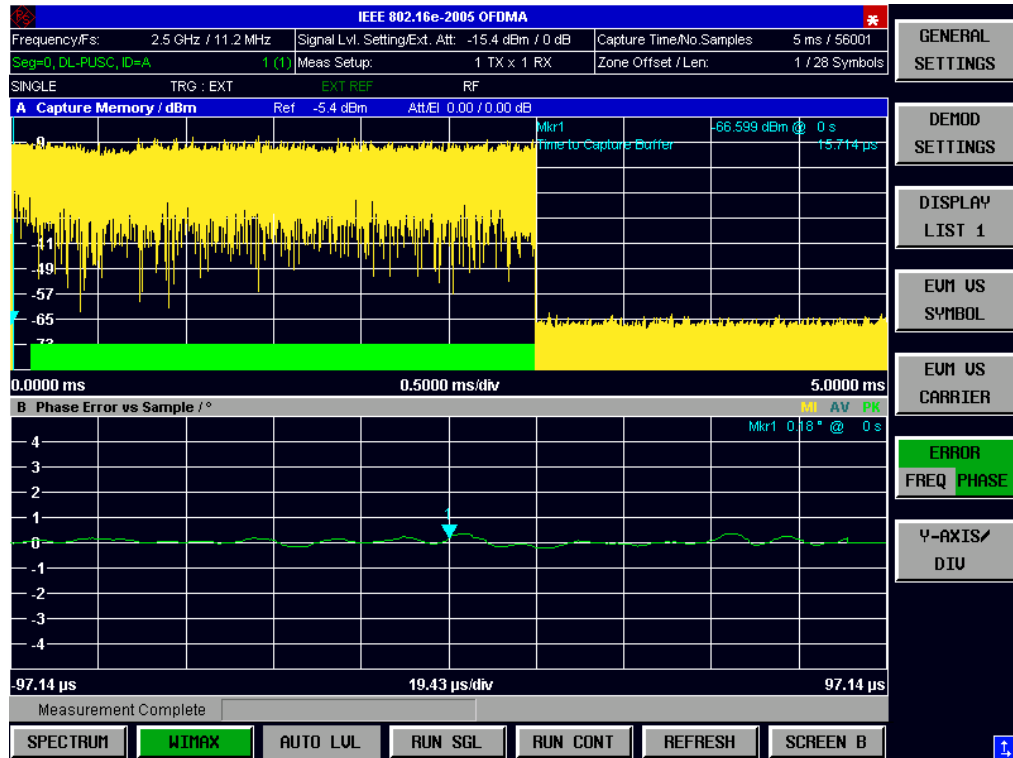
Fig. 27   Phase Error vs Sample Result (SISO-OFDMA/WiBro).

The Error vs Preamble results display shows the error values recorded over the preamble part of the burst. A minimum, average and maximum trace are displayed. The results display either relative frequency error or phase error.

The scaling of the Y-Axis can be modified to allow the results to be scaled to an optimum level.

Remote: CONF:BURS:PRE:SEL FREQ
          CONF:BURS:PRE:IMM
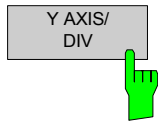
Y AXIS/
DIV

Pressing *Y AXIS/ DIV* softkey displays a pop-up dialog which allows the settings of the Y-Axis to be controlled. The settings provided are the same as for the EVM vs Symbol measurement screen.

Remote: DISP:WIND1:TAC1:Y:AUTO
          DISP:WIND1:TRAC1:Y:PDIV

Spectrum Flatness

SISO-OFDM
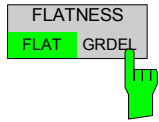
FLATNESS
FLAT | GRDEL

The Spectrum Flatness measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *FLATNESS FLAT/GRDEL* softkey. Subsequent presses of the *FLATNESS FLAT/GRDEL* softkey toggle between the Spectrum Flatness and the Group Delay measurement.

Fig. 28   Spectrum Flatness Results (SISO-OFDM).

The Spectrum Faltness measurement uses the Channel Estimation based on the '*Demod Settings | CH Est in Preamb & Payload*' selection. A minimum, average and maximum trace is displayed generated by averaging in time dimension. The upper and lower limit line, according to the standard, is displayed. Finally the overall pass/fail status, for the statistic results against these limit lines, is shown.

Remote: `CONF:BURS:SPEC:FLAT:SEL FLAT`
         `CONF:BURS:SPEC:FLAT:IMM`

SISO-OFDM and SISO-OFDMA/WiBro

FLATNESS
FLAT | DIFF

The Spectrum Flatness measurement result is selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *FLATNESS FLAT/DIFF* softkey. Subsequent presses of the *FLATNESS FLAT/DIFF* softkey toggle between the Spectrum Flatness and the Spectrum Flatness Difference measurement.

Fig. 29   Spectrum Flatness Results (SISO-OFDMA/WiBro).

The Spectrum Faltness measurement uses the Channel Estimation based on the '*Demod Settings | Channel Estimation Range*' selection. A minimum, average and maximum trace is displayed generated by averaging in time dimension. The upper and lower limit line, according to the standard, is displayed. Finally the overall pass/fail status, for the statistic results against these limit lines, is shown.

Remote: CONF:BURS:SPEC:FLAT:SEL FLAT
           CONF:BURS:SPEC:FLAT:IMM

MIMO-OFDMA/WiBro

The Spectrum Flatness measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *FLATNESS FLAT/GRDEL* softkey. Subsequent presses of the *FLATNESS FLAT/GRDEL* softkey toggle between the Spectrum Flatness and the Group Delay measurement.

Fig. 30   Spectrum Flatness Results (MIMO-OFDMA/WiBro).

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' 2*2 results are available. Therefore four Spectrum Flatness result traces are displayed one for each Tx->Rx path. The Tx->Rx path information for the result trace is given in the corresponding measurement window title bar.

The Spectrum Faltness measurement uses the Channel Estimation based on the '*Demod Settings | Channel Estimation Range Payload*' selection [a MIMO zone isn't prefixed by a preamble]. The traces are normalized by the total power of all transmission paths. A minimum, average and maximum trace is displayed generated by averaging in time dimension. The upper and lower limit line, according to the standard, is displayed. Finally the overall pass/fail status, for the statistic results against these limit lines, is shown.

In case 'Demod Settings | Compensate Crosstalk' is cleared, the secondary diagonal elements are assumed being zero. Therefore the Tx1->Rx0 and Tx0->Rx1 Spectrum Flatness traces won't be available.

Remote: `CONF:BURS:SPEC:FLAT:SEL FLAT`
         `CONF:BURS:SPEC:FLAT:IMM`

Flatness Difference

SISO-OFDM
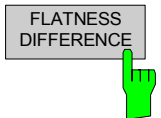
FLATNESS
DIFFERENCE

The Spectrum Flatness Difference result is selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *FLATNESS DIFFERENCE* softkey.
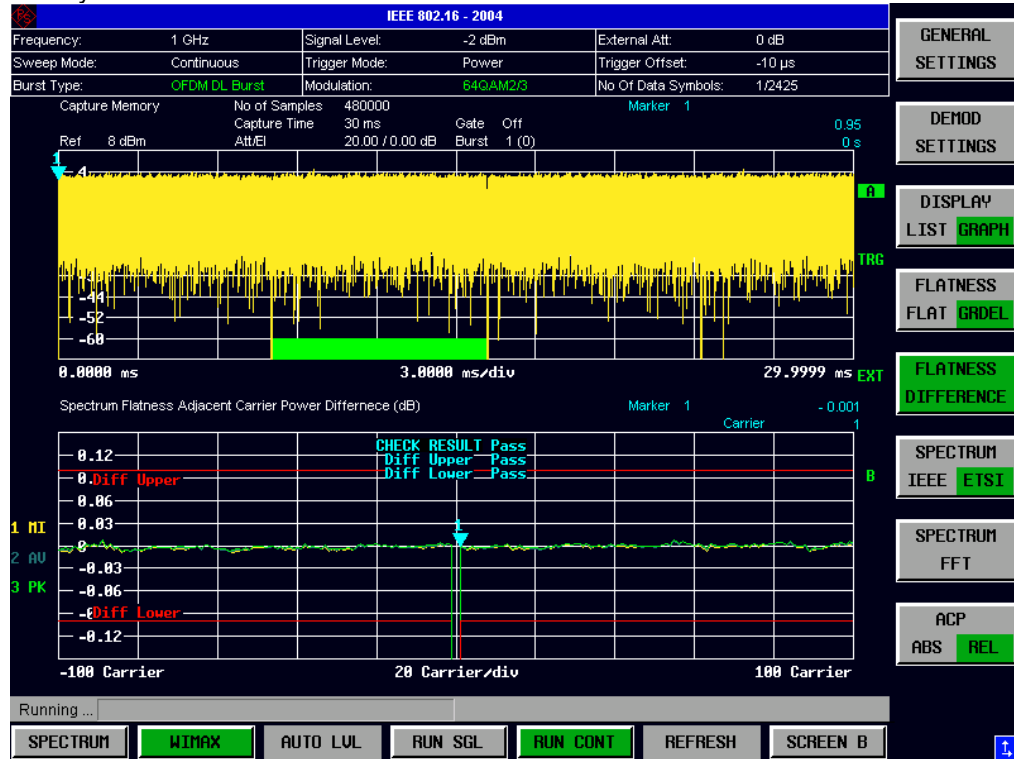
Fig. 31   Flatness Difference Results (SISO-OFDM).

The Spectrum Flatness Difference result display shows the adjacent carrier power difference. The Spectrum Faltness Difference measurement uses the Channel Estimation based on the '*Demod Settings | CH Est in Preamb & Payload*' selection. A minimum, average and maximum trace is displayed generated by averaging in time dimension. The upper and lower limit line, according to the standard, is displayed. Finally the overall pass/fail status, for the statistic results against these limit lines, is shown.

Remote: `CONF:BURS:SPEC:FLAT:SEL DIFF`
         `CONF:BURS:SPEC:FLAT:IMM`

SISO-OFDM and SISO-OFDMA/WiBro
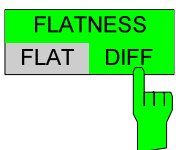
FLATNESS
FLAT   DIFF

The Flatness Difference results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *FLATNESS FLAT / DIFF* softkey. . Subsequent presses of the *FLATNESS FLAT / DIFF* softkey toggle between the Spectrum Flatness and the Spectrum Flatness Difference measurement.

Fig. 32   Flatness Difference Results (SISO-OFDMA/WiBro).

The Spectrum Flatness Difference result display shows the adjacent carrier power difference. The Spectrum Faltness Difference measurement uses the Channel Estimation based on the '*Demod Settings | Channel Estimation Range*' selection. A minimum, average and maximum trace is displayed generated by averaging in time dimension. The upper and lower limit line, according to the standard, is displayed. Finally the overall pass/fail status, for the statistic results against these limit lines, is shown.

Remote: CONF:BURS:SPEC:FLAT:SEL DIFF
              CONF:BURS:SPEC:FLAT:IMM

MIMO-OFDMA/WiBro

FLATNESS DIFFERENCE

The Spectrum Flatness Difference result is selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *FLATNESS DIFFERENCE* softkey.

Fig. 33   Flatness Difference Results (MIMO-OFDMA/WiBro).

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' 2*2 results are available. Therefore four Spectrum Flatness Difference result traces are displayed one for each Tx->Rx path. The Tx->Rx path information for the result trace is given in the corresponding measurement window title bar.

The Spectrum Flatness Difference results display shows the adjacent carrier power difference. The Spectrum Faltness Difference measurement uses the Channel Estimation based on the '*Demod Settings | Channel Estimation Range Payload*' selection [a MIMO zone isn't prefixed by a preamble]. A minimum, average and maximum trace is displayed generated by averaging in time dimension. The upper and lower limit line, according to the standard, is displayed. Finally the overall pass/fail status, for the statistic results against these limit lines, is shown.

In case 'Demod Settings | Compensate Crosstalk' is cleared, the secondary diagonal elements are assumed being zero. Therefore the Tx1->Rx0 and Tx0->Rx1 Spectrum Flatness Difference traces won't be available.

Remote: `CONF:BURS:SPEC:FLAT:SEL DIFF`
          `CONF:BURS:SPEC:FLAT:IMM`

Preamble Channel Frequency Response

SISO-OFDMA/WiBro and MIMO-OFDMA/WiBro
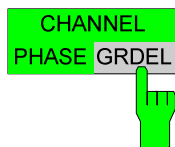
The Preamble Channel Frequency Response result is selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *CHANNEL PHASE / GRDEL* softkey. . Because the measurement is based on the DL-Preamble, its only available in case of downlink analysis.
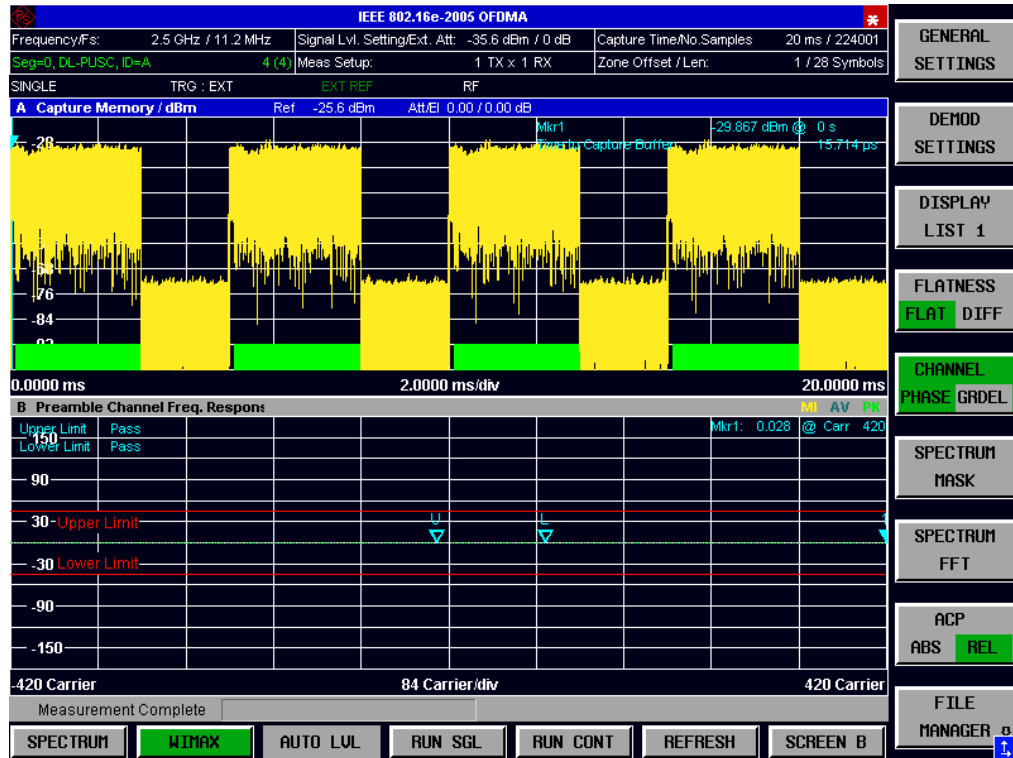
Fig. 34   Preamble Channel Frequency Response: Phase Results (SISO-OFDMA/WiBro).

This displays the Preamble Channel Frequency Response results. A minimum, average and maximum trace are displayed. The L/U markers indicate the points of the trace that are closest to the lower respective upper limit lines.

Remote: `CONF:BURS:SPEC:PHAS:PRE`
          `CONF:BURS:SPEC:PHAS:PRE:IMM`

Group Delay

SISO-OFDM
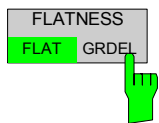
The Group Delay measurement result is selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *FLATNESS FLAT / GRDEL* softkey. Subsequent presses of the *FLATNESS FLAT / GRDEL* softkey toggle between the Spectrum Flatness and the Group Delay measurement.
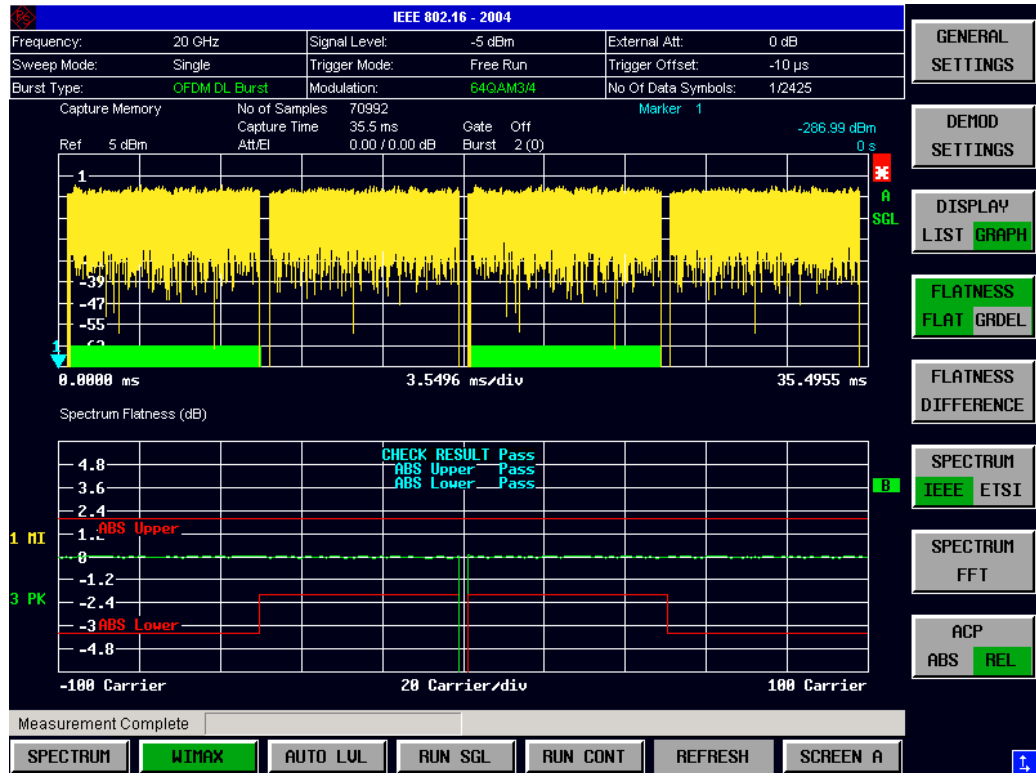
Fig. 35   Group Delay Result (SISO-OFDM).

The Group Delay measurement uses the Channel Estimation based on the '*Demod Settings | CH Est in Preamb & Payload*' selection.

Remote: `CONF:BURS:SPEC:FLAT:SEL GRD`
              `CONF:BURS:SPEC:FLAT:IMM`

SISO-OFDMA/WiBro
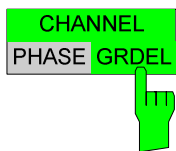
The Group Delay measurement result is selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *CHANNEL PHASE / GRDEL* softkey. Subsequent presses of the *CHANNEL PHASE / GRDEL* softkey toggle between the Group Delay and the Preamble Channel Frequency Response Phase.
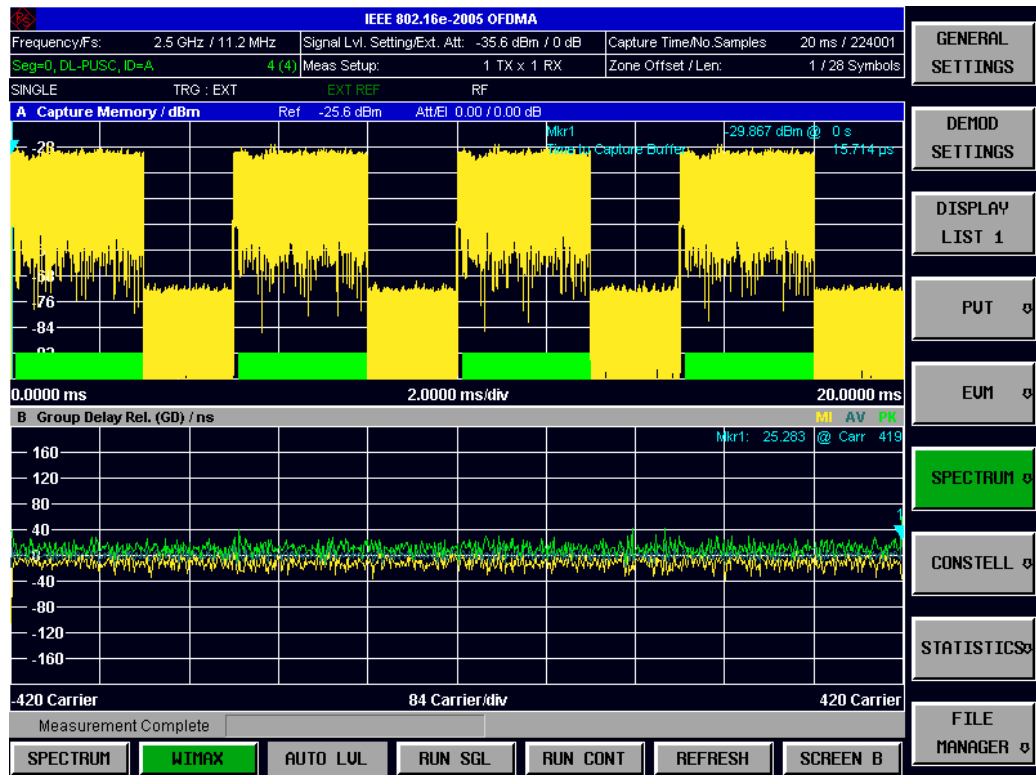
Fig. 36   Group Delay Result (SISO-OFDMA/WiBro).

The Group Delay measurement uses the Channel Estimation based on the '*Demod Settings | Channel Estimation Range*' selection.

The measurement requires all useful carriers to be active (for example for a 1024 FFT size, 840 positions are required).
This requirement is affected by the **Channel Estimation Range** parameters in the Demod Settings dialog:

- If Downlink (DL) = Preamble Only, then the requirement is automatically met.

- If Downlink (DL) = Preamble and Payload / Payload Only, then all bitgroups must be switched on and all channels must be covered by data bursts.

Remote: CONF:BURS:SPEC:FLAT:SEL GRD
          CONF:BURS:SPEC:FLAT:IMM
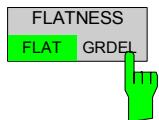
MIMO-OFDMA/WiBro

The Group Delay measurement result is selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *FLATNESS FLAT / GRDEL* softkey. Subsequent presses of the *FLATNESS FLAT / GRDEL* softkey toggle between the Spectrum Flatness and the Group Delay measurement.
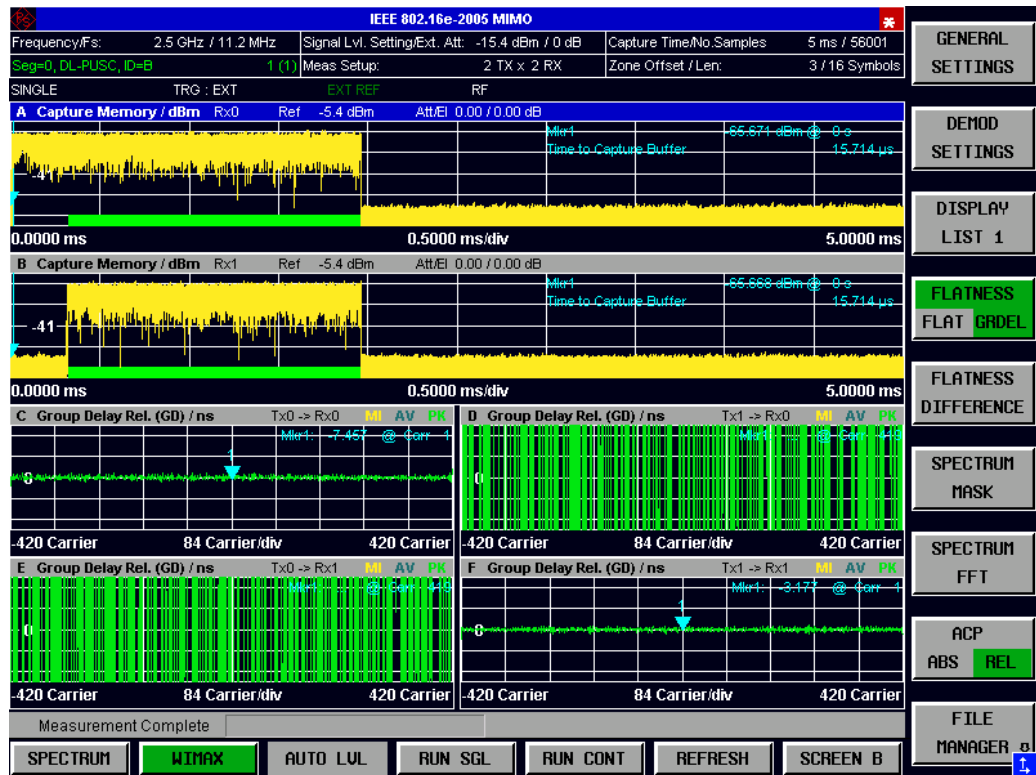
Fig. 37   Group Delay Result (MIMO-OFDMA/WiBro).

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' 2*2 results are available. Therefore four Group Delay result traces are displayed one for each Tx->Rx path. The Tx->Rx path information for the result trace is given in the corresponding measurement window title bar.

The Group Delay measurement uses the Channel Estimation based on the '*Demod Settings | Channel Estimation Range*' selection.

The measurement requires all useful carriers to be active (for example for a 1024 FFT size, 840 positions are required).
This requirement is affected by the **Channel Estimation Range** parameters in the Demod Settings dialog:

- If Downlink (DL) = Preamble Only, then the requirement is automatically met.

- If Downlink (DL) = Preamble and Payload / Payload Only, then all bitgroups must be switched on and all channels must be covered by data bursts.

In case 'Demod Settings | Compensate Crosstalk' is cleared, the secondary diagonal elements are assumed being zero. Therefore the Tx1->Rx0 and Tx0->Rx1 Spectrum Flatness Difference traces won't be available.

Remote: `CONF:BURS:SPEC:FLAT:SEL GRD`
         `CONF:BURS:SPEC:FLAT:IMM`

Spectrum FFT

SISO-OFDM and SISO-OFDMA/WiBro
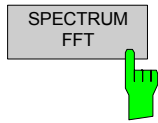
SPECTRUM
FFT

The Spectrum FFT measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *SPECTRUM FFT* softkey.
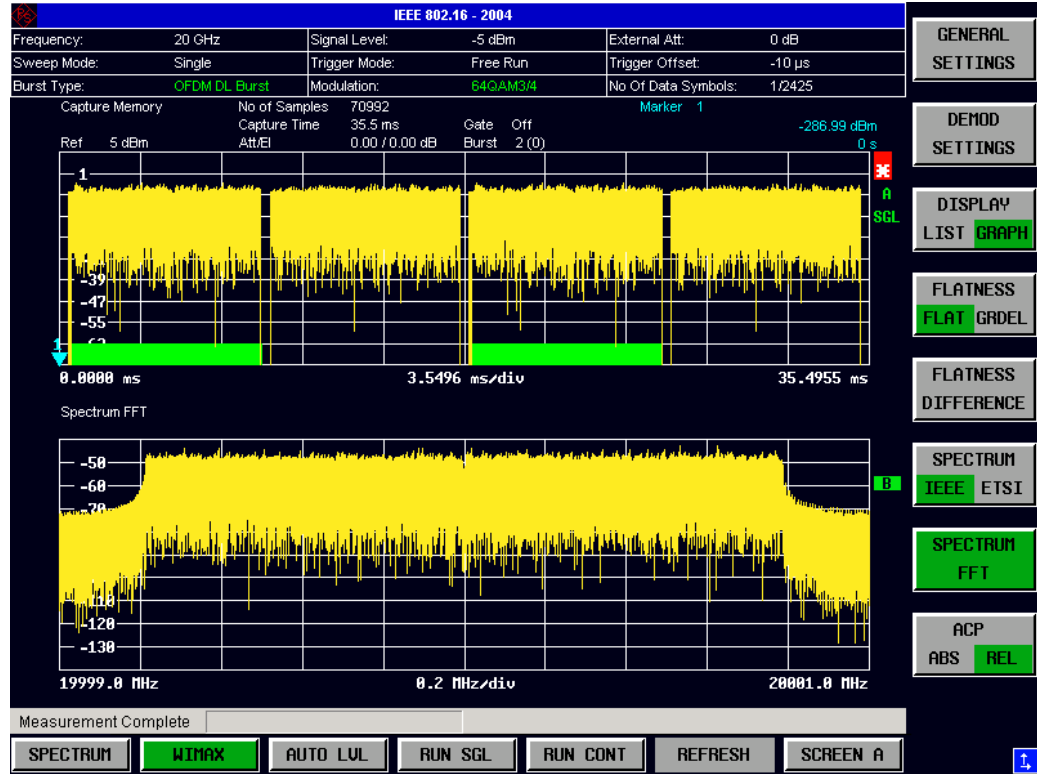

Fig. 38   Spectrum FFT Result (SISO-OFDM).

The Spectrum FFT results display shows the Power vs Frequency results obtained from a FFT performed over the range of data in the Magnitude Capture buffer which lies within the gate lines. If the gate start or gate length are altered then the results can be updated to reflect these changes by pressing the *REFRESH* hotkey.

Remote: `CONF:BURS:SPEC:FFT:IMM`

MIMO-OFDMA/WiBro
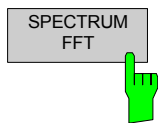
SPECTRUM
FFT

The Spectrum FFT measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *SPECTRUM FFT* softkey.
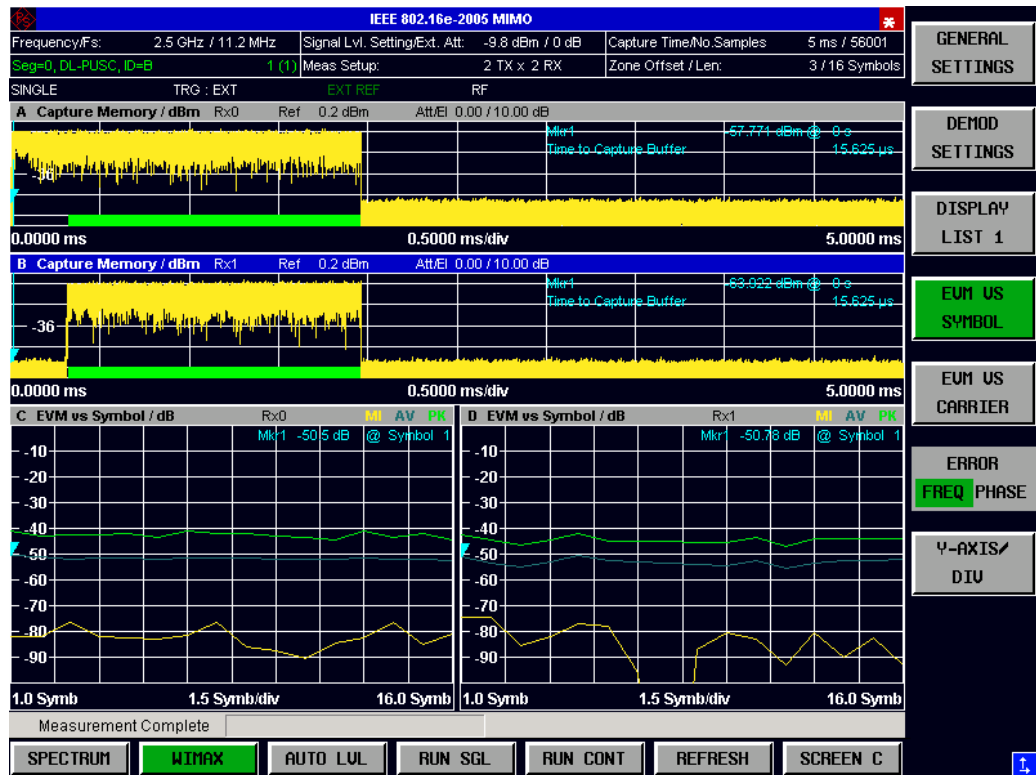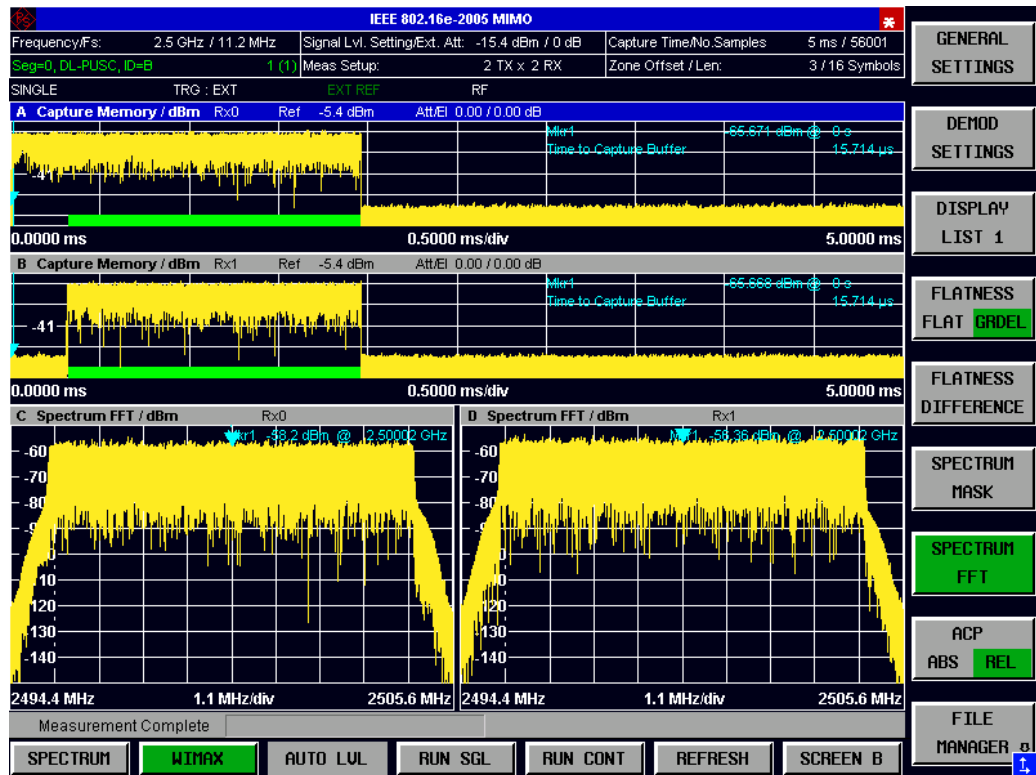
Fig. 39　　　　Spectrum FFT Results (MIMO-OFDMA/WiBro).

According to the overall measurement settings field 'Meas Setup 2 RX' results are available. Therefore two Spectrum FFT result traces are displayed one for each Rx path. The Rx path information for the result trace is given in the corresponding measurement window title bar.

The Spectrum FFT results display shows the Power vs Frequency results obtained from a FFT performed over the range of data in the Magnitude Capture buffer which lies within the gate lines. If the gate start or gate length are altered then the results can be updated to reflect these changes by pressing the *REFRESH* hotkey.

Remote:　`CONF:BURS:SPEC:FFT:IMM`

Constellation vs Symbol

SISO-OFDM
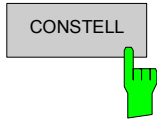
CONSTELL

The Constellation diagram is selected by pressing the *CONSTELL* softkey in the main measurement softkey menu.
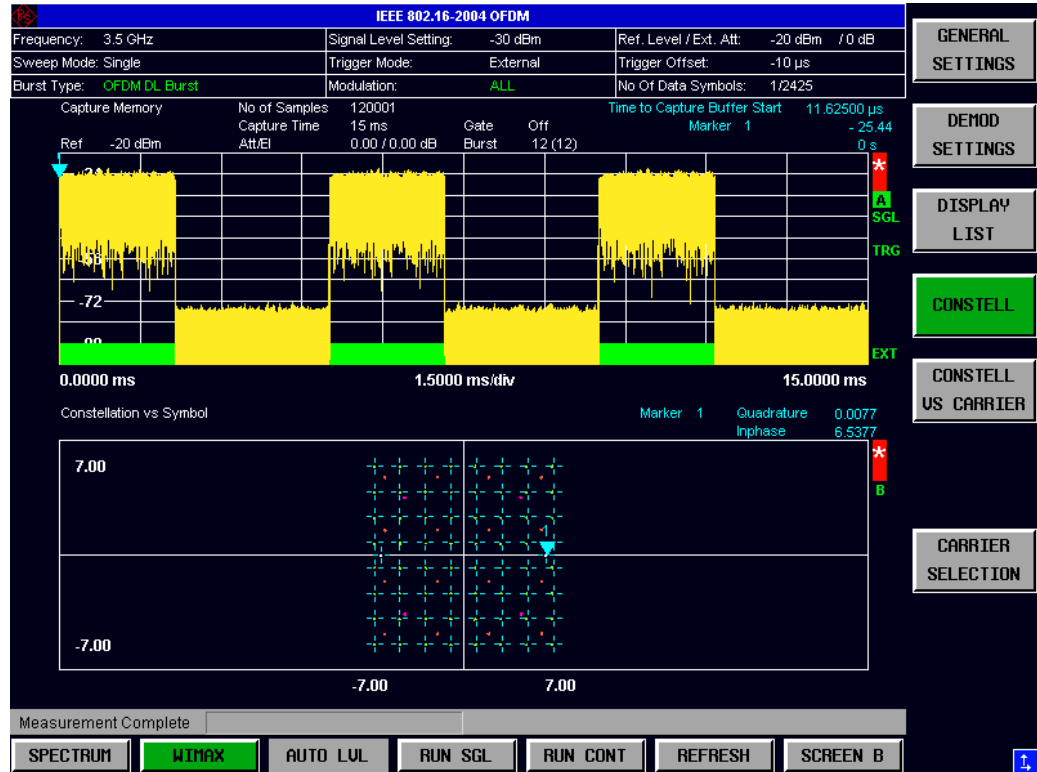
Fig. 40   Constellation vs Symbol Results (SISO-OFDM).

The Constellation display shows the Inphase and Quadrature phase results over the full range of the measured input data. The ideal points for the selected modulations scheme are displayed for reference purposes.

The amount of data displayed in the Constellation results display can be reduced by selecting the carrier or carriers for which data is to be displayed.

Remote: `CONF:BURS:CONS:CSYM:IMM`
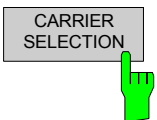
CARRIER SELECTION

Pressing *CARRIER SELECTION* softkey displays a pop-up dialog which allows the carrier for data display to be selected. Either a specific carrier number or pilots only can be selected. Selecting All Carriers allows all the results to be displayed.

Remote: `CONF:BURSt:CONS:CARR:SEL`

SISO-OFDMA/WiBro
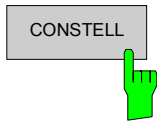
CONSTELL

The Constellation diagram is selected by pressing the *CONSTELL* softkey in the main measurement softkey menu.
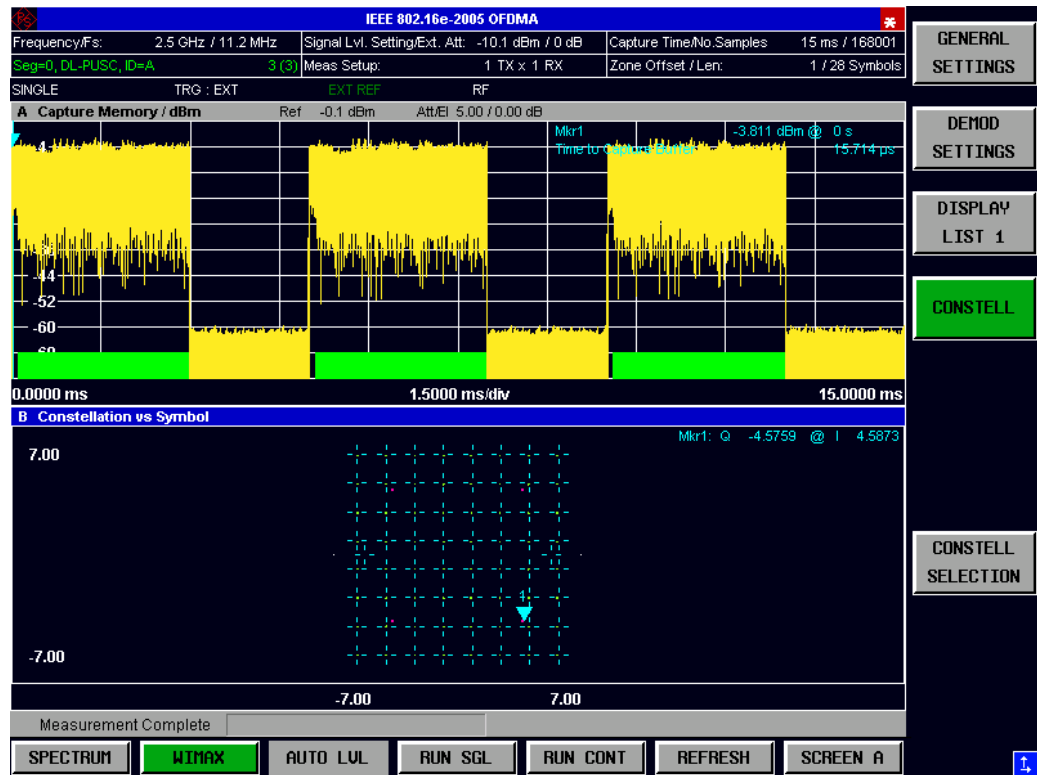
Fig. 41   Constellation vs Symbol Results (SISO-OFDMA/WiBro).

The Constellation display shows the Inphase and Quadrature phase results over the full range of the measured input data. The ideal points for the selected modulations scheme are displayed for reference purposes.

The amount of data displayed in the Constellation results display can be reduced by selecting the carrier or carriers for which data is to be displayed.

Remote: `CONF:BURS:CONS:CSYM:IMM`

CONSTELL SELECTION

Pressing *CONSTELL SELECTION* softkey displays a pop-up dialog which allows the displayed results to be filtered. The results may be filtered by any combination of modulation, burst, symbol or carrier. The results will be updated as soon as any change to the constellation selection parameters are made.

Fig. 42   Constellation vs Symbol - Constell Section (SISO-OFDMA/WiBro)

Remote: `CONF:BURS:CONS:FORM:SEL ALL|QPSK|QAM16|QAM64`
          `CONF:BURS:CONS:BURS:SEL ALL|<value>`
          `CONF:BURS:CONS:SYMB:SEL ALL|<value>`
          `CONF:BURS:CONS:CARR:SEL ALL|<value>`

MIMO-OFDMA/WiBro
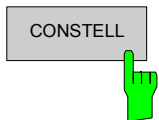
The Constellation diagram is selected by pressing the *CONSTELL* softkey in the main measurement softkey menu.
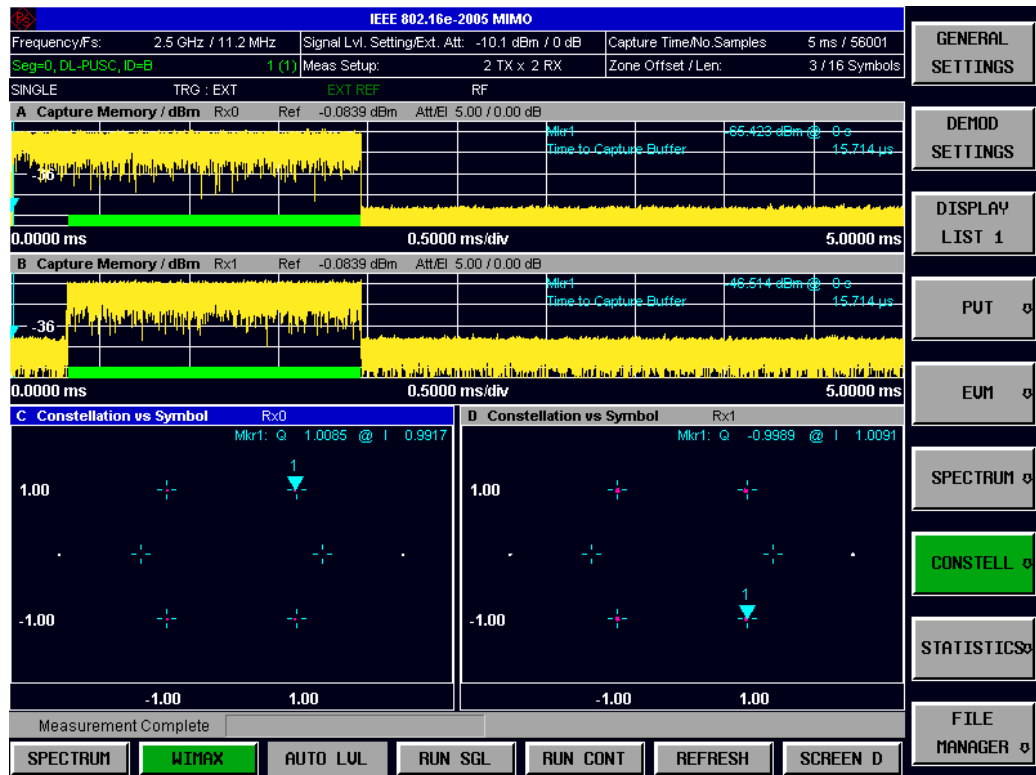
Fig. 43　　　　Constellation vs Symbol Results (MIMO-OFDMA/WiBro).
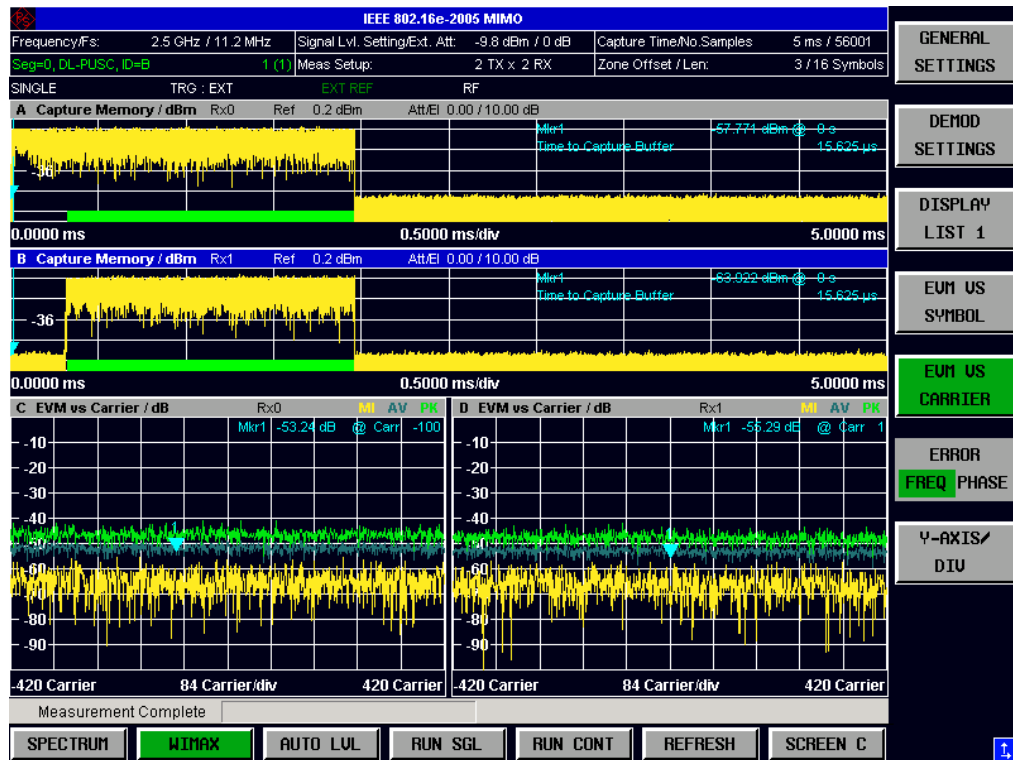
According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' two Rx path results are available. Therefore two Constellation vs Symbol result traces are displayed one for each Rx Path. The Rx path information for the trace is given in the corresponding measurement window title bar.

The Constellation display shows the Inphase and Quadrature phase results over the full range of the measured input data. The ideal points for the selected modulations scheme are displayed for reference purposes.

The amount of data displayed in the Constellation results display can be reduced by selecting the carrier or carriers for which data is to be displayed.

Remote: `CONF:BURS:CONS:CSYM:IMM`

CONSTELL
SELECTION

Pressing *CONSTELL SELECTION* softkey displays a pop-up dialog which allows the displayed results to be filtered. The results may be filtered by any combination of modulation, burst, symbol or carrier. The results will be updated as soon as any change to the constellation selection parameters are made. Currently the selection applies to both constellation diagrams.
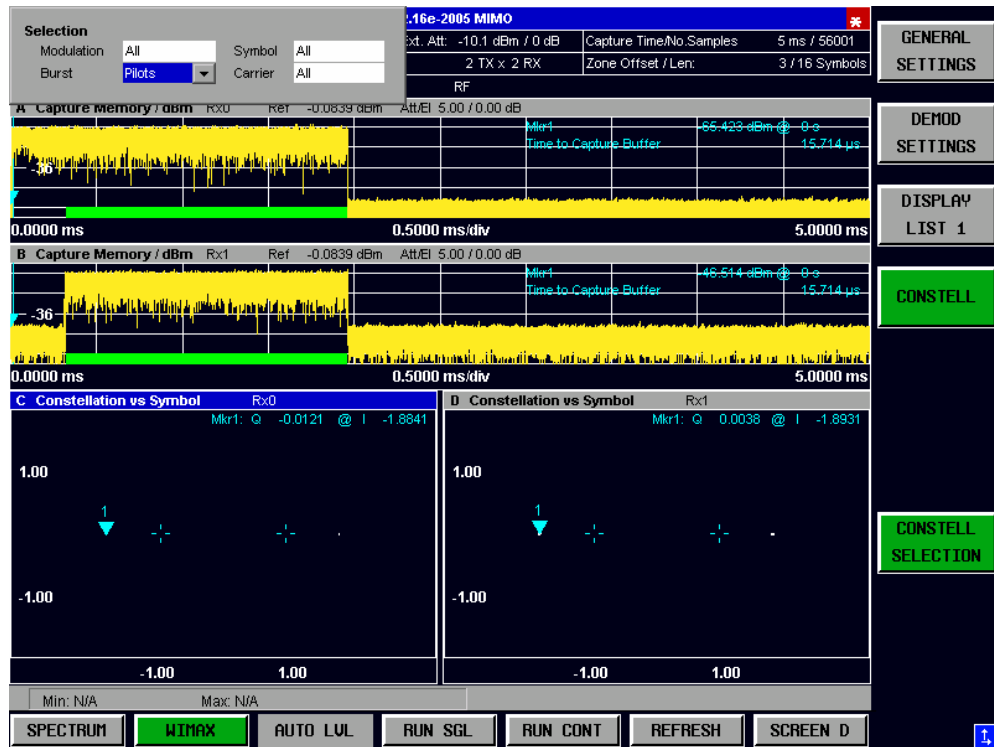
Fig. 44   Constellation vs Symbol - Constell Section (MIMO-OFDMA/WiBro).

Remote: `CONF:BURS:CONS:FORM:SEL ALL|QPSK|QAM16|QAM64`
          `CONF:BURS:CONS:BURS:SEL ALL|<value>`
          `CONF:BURS:CONS:SYMB:SEL ALL|<value>`
          `CONF:BURS:CONS:CARR:SEL ALL|<value>`

Constellation vs Carrier

SISO-OFDM
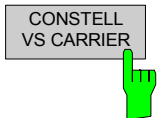
CONSTELL
VS CARRIER

The Constellation vs Carrier measurement results are selected by pressing the *CONSTELL* softkey in the main measurement softkey menu followed by the *CONSTELL VS CARRIER* softkey,
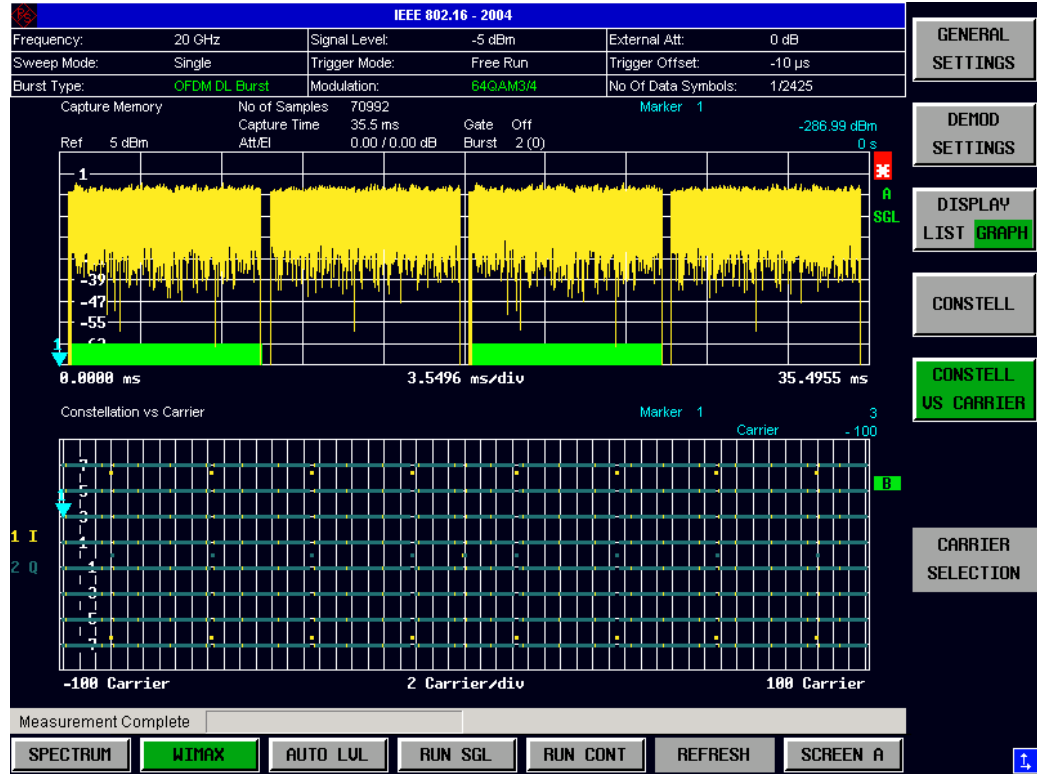
Fig. 45   Constellation vs Carrier Results (SISO-OFDM).

The Constellation vs Carrier results display shows the Inphase and Quadrature phase results over the full range of the measured input data plotted on a per-carrier basis. The magnitude of the Inphase and Quadrature part is shown on the Y-axis, both are displayed as separate traces (I-> trace 1, Q-> trace 2).

This measurement is not available when the IEEE 802.16e-2005 OFDMA or WiBro standards are selected.

Remote: `CONF:BURSt:CONS:CCAR:IMM`

Complementary Cumulative Distribution Function (CCDF)

SISO-OFDM and SISO-OFDMA/WiBro
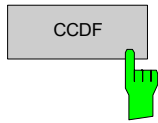
CCDF

The CCDF measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *CCDF* softkey.
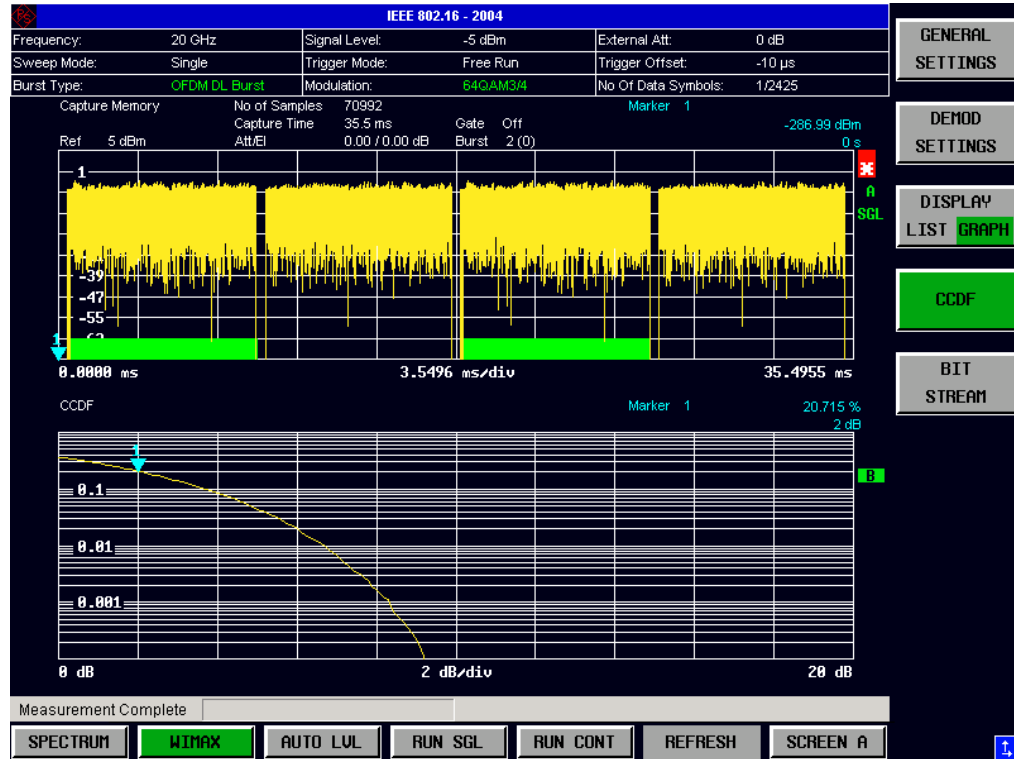
Fig. 46   CCDF Results (SISO-OFDM).

The CCDF results display shows the probability of an amplitude within the gating lines exceeding the mean power measured between the gating lines. The X-axis displays power relative to the measured mean power. If the gate start or gate length are altered then the results can be updated to reflect these changes by pressing the *REFRESH* hotkey.

Remote: `CONF:BURS:STAT:CCDF:IMM`

MIMO-OFDMA/WiBro
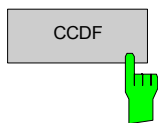
CCDF

The CCDF measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *CCDF* softkey.
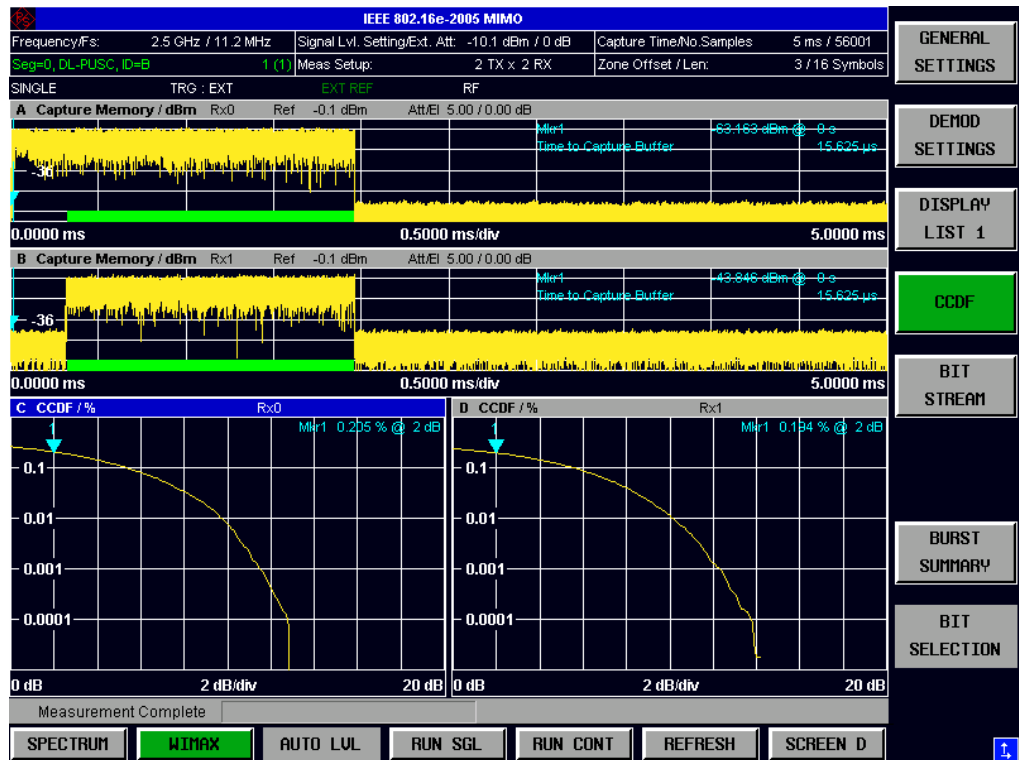
Fig. 47   CCDF Results (MIMO-OFDMA/WiBro).

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' two results are available. Therefore two CCDF result traces are displayed one for each RX path. The RX path information for the result trace is given in the corresponding measurement window title bar.

The CCDF results display shows the probability of an amplitude within the gating lines exceeding the mean power measured between the gating lines. The X-axis displays power relative to the measured mean power. If the gate start or gate length are altered then the results can be updated to reflect these changes by pressing the *REFRESH* hotkey.

Remote: `CONF:BURS:STAT:CCDF:IMM`

Bit Stream

SISO-OFDM and SISO-OFDMA/WiBro
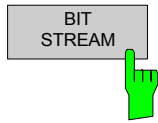
The Bit Stream measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *BIT STREAM* softkey.
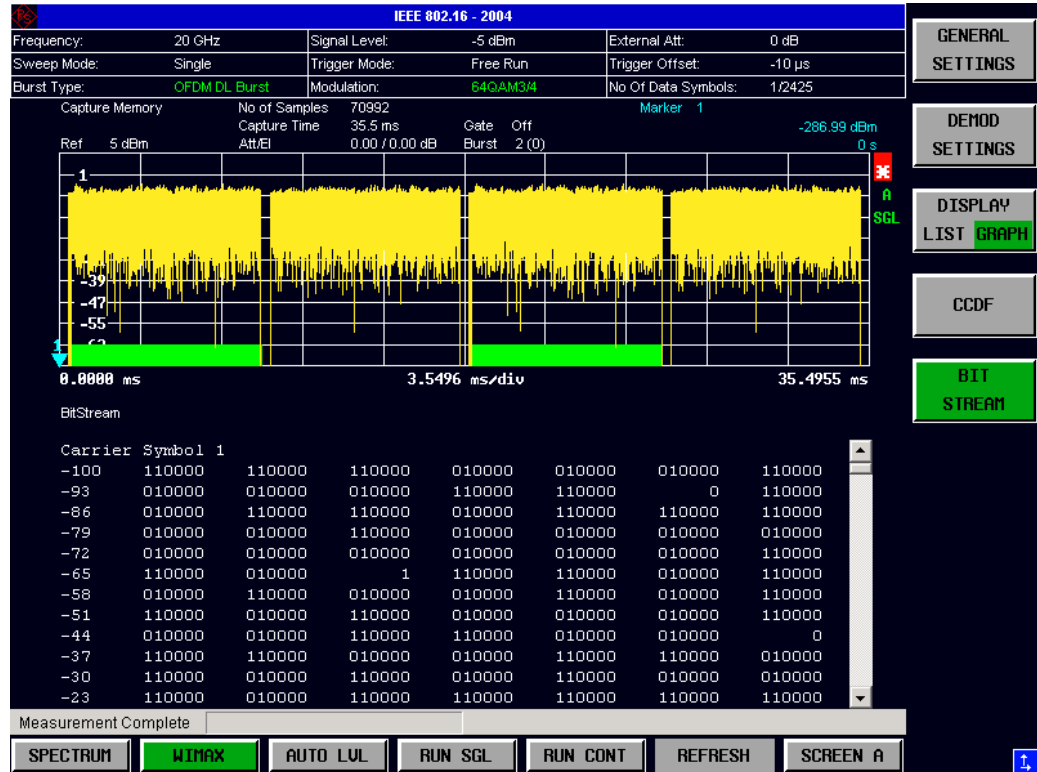
Fig. 48   Bit-Stream Results (SISO-OFDM).

According to the overall measurement settings field 'Meas Setup 2 RX' results are available. Therefore two CCDF result traces are displayed one for each RX path. The RX path information for the result trace is given in the corresponding measurement window title bar.

The bit stream results display shows the demodulated data stream. These results are grouped by burst and symbol. When no other dialogs are on display the results can be scrolled through using the cursor keys or scroll wheel.

Pilot Errors (SISO-OFDMA/WiBro)

If pilots errors are detected in the analysed signal, then they will be displayed with a red background in the Bit Stream (See Fig. 50).

Note that this behaviour is affected by the Pilots for Tracking setting in the DEMOD SETTINGS.

Remote: `CONF:BURS:STAT:BSTR:IMM`

MIMO-OFDMA/WiBro
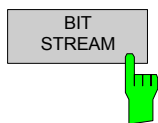
BIT
STREAM

The Bit Stream measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *BIT STREAM* softkey.
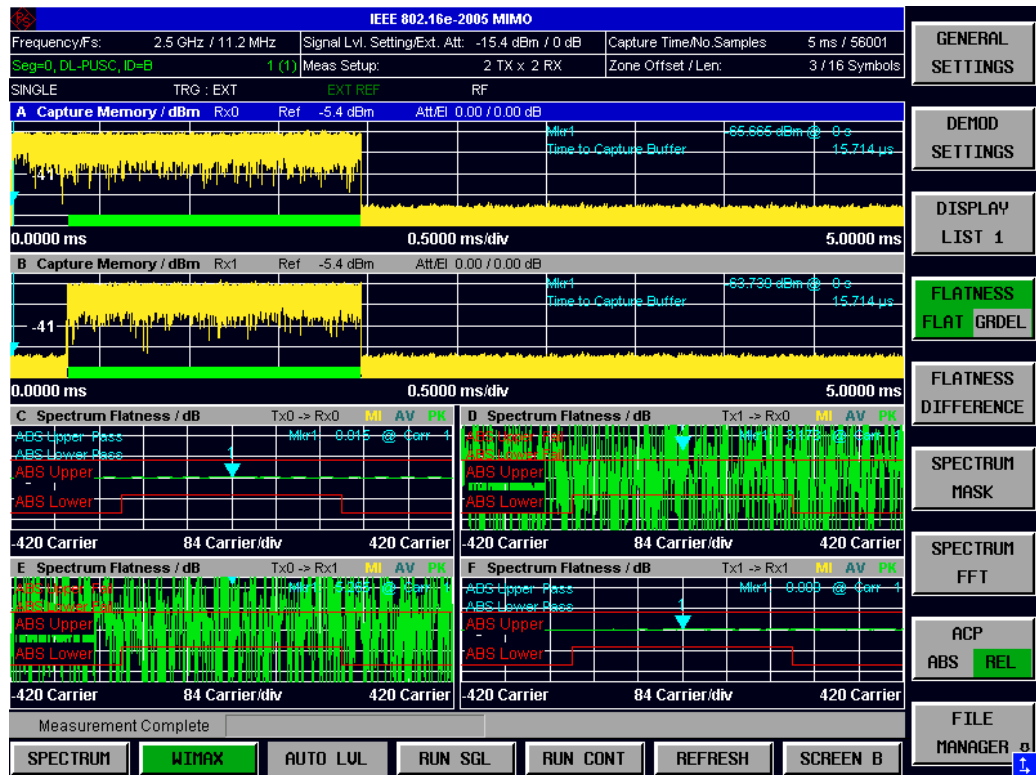

Fig. 49   Bit-Stream Results (MIMO-OFDMA/WiBro).

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' two Rx results are available. Therefore two Bit Stream result traces are displayed one for each Rx path. The Rx path information for the result trace is given in the corresponding measurement window title bar.

The bit stream results display shows the demodulated data stream. These results are grouped by burst and symbol. When no other dialogs are on display the results can be scrolled through using the cursor keys or scroll wheel.

If pilots errors are detected in the analysed signal, then they will be displayed with a red background in the Bit Stream (see figure 'Bit-Stream for OFDMA, showing the Bit Selection dialog and highlighted erroneous pilots').

Note that this behaviour is affected by the Pilots for Tracking setting in the DEMOD SETTINGS.

Remote: `CONF:BURS:STAT:BSTR:IMM`

Bit Selection (SISO-OFDMA/WiBro and MIMO-OFDMA/WiBro)
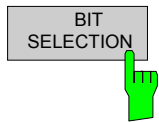
BIT SELECTION	Pressing *BIT SELECTION* softkey displays a pop-up dialog which allows the displayed results to be filtered. The results may be filtered by any combination of modulation, symbol or burst. The results will be updated as soon as any change to the bit selection parameters are made.

Fig. 50   Bit-Stream for OFDMA, showing the Bit Selection dialog and highlighted erroneous pilots.

Remote:

```
CONF:BURS:CONS:SYMB:SEL ALL | <numeric value>      (Symbol)
CONF:BURS:CONS:FORM:SEL QPSK
                       ALL|QPSK|QAM16|QAM64      (Modulation)
CONF:BURS:CONS:BURS:SEL ALL|PILOTS|<numeric value> (Burst)
```

Burst Summary

SISO-OFDM
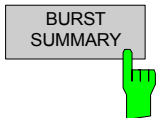
BURST
SUMMARY

The Burst Summary measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *BURST SUMMARY* softkey.

Fig. 51   Burst-Summary Results (SISO-OFDM).

The burst summary results display shows the summary data for the analyzed bursts. The colour in the Modulation and Burst column indicates the modulation format used by the corresponding burst. When no other dialogs are on display the results can be scrolled through using the cursor keys or scroll wheel.

Remote: `CONF:BURS:STAT:BSUM:IMM`

SISO-OFDMA/WiBro
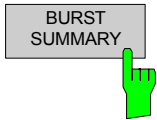
BURST SUMMARY

The Burst Summary measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *BURST SUMMARY* softkey.

Fig. 52   Burst-Summary Results (SISO-OFDMA/WiBro).

The burst summary results display shows the summary data for the analyzed bursts. The colour in the Modulation and Burst column indicates the modulation format used by the corresponding burst. When no other dialogs are on display the results can be scrolled through using the cursor keys or scroll wheel.

Remote: `CONF:BURS:STAT:BSUM:IMM`

MIMO-OFDMA/WiBro
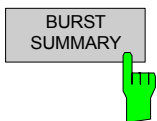
BURST SUMMARY

The Burst Summary measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *BURST SUMMARY* softkey.
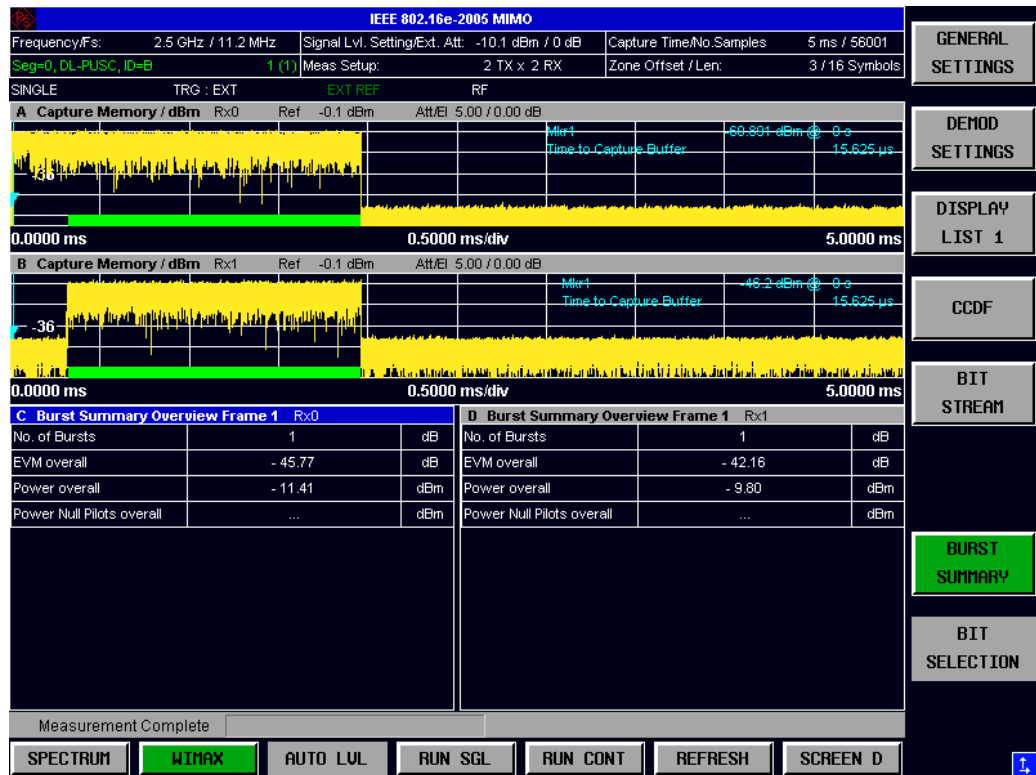
Fig. 53   Burst-Summary Results (MIMO-OFDMA/WiBro).

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' two Rx results are available. Therefore two burst summary overview result tables are displayed one for each RX path. The RX path information for the result table is given in the corresponding measurement window title bar.

The burst summary overview result tables show the averaged overall results for the corresponding RX path.

The burst summary 'detailed' results are displayed after using the following sequence: Bring the measurement windows focus to the burst summary overview window of interest by toggling the [SCREEN …] hotkey. Now press the [DISP][FULL SCREEN] key sequence. This brings up the burst summary 'detailed' results for the measurement window of intrest. Pressing [DISP][SPLIT SCREEN] will restore the split screen mode as shown inn the figure above.

This measurement shows the summary data for the analyzed bursts. For each analyzed subframe the corresponding set of analyzed bursts is added to the burst summary list. The colour in the modulation and burst column indicates the modulation format used by the corresponding burst. Power, null pilot power (UL) and EVM results for each analyzed bursts are shown. The overall results at the end of each subframe section gives the mean of this values.
In case no dialog is displayed, the results can be scrolled using the cursor keys or scroll wheel.

Remote: CONF:BURS:STAT:BSUM:IMM

Frequency sweep measurements

The following measurements results are obtained in frequency sweep mode:

- Spectrum Mask

- Spectrum ACP/ACPR

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.

All frequency sweep measurements are run in full screen mode. Frequency sweep measurements are only available when RF input is selected.

Spectrum Emission Mask
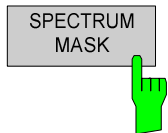
SPECTRUM MASK

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.
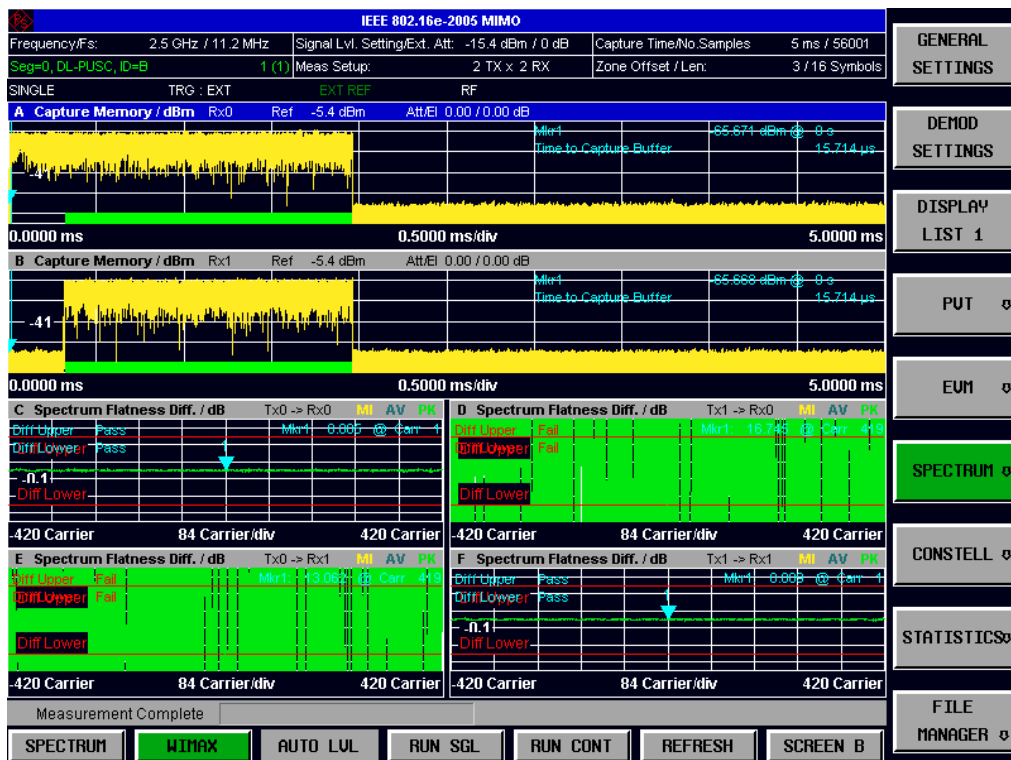

Fig. 54   Spectrum Emission Mask Results

The Spectrum Mask results display shows power against frequency. The span of the results is related to the specified sample rate respective channel bandwidth. A limit line representing the spectrum mask specified for the selected standard is displayed and an overall pass/fail status is displayed for the obtained results against this limit line. If the *Sweep Count (Mask/ACP)* parameter in the General Settings view is set to any value other than 1 then the measurement is performed over the specified number of sweeps. When the measurement is performed over multiple sweeps a max hold trace is displayed as well as an average trace.

Spectrum Emission Mask Table Results

Spectrum Emission Mask							
Tx Channel:	Bandwidth	9.54 MHz	Power	22.75 dBm			
Start Freq. Rel.	Stop Freq. Rel.	RBW	Freq. at Δ to Limit	Pwr Abs	Pwr Rel	Δ to Limit	
-22.500 MHz	-9.270 MHz	1 MHz	3.489543269 GHz	-43.02 dBm	-65.77 dB	-14.02 dB	
-9.270 MHz	-4.770 MHz	1 MHz	3.495168269 GHz	-19.37 dBm	-42.12 dB	-4.87 dB	
4.770 MHz	9.270 MHz	1 MHz	3.504831731 GHz	-18.08 dBm	-40.82 dB	-3.58 dB	
9.270 MHz	22.500 MHz	1 MHz	3.511250000 GHz	-42.56 dBm	-65.31 dB	-13.56 dB	
...	...	...	...	...	...	...	
...	...	...	...	...	...	...	
...	...	...	...	...	...	...	
...	...	...	...	...	...	...	

Fig. 55   Spectrum Emission Mask Table Results

The Tx Channel Bandwidth is the difference between the right and left border of the innermost [closest to the center frequency] frequency segments. According to the table above 9.54MHz = 4.77MHz + 4.77MHz.

The Power in the head line of the table is the reference power according to the '*SEM Settings | Reference Power*' setting:

TX Channel Power: The integrated power of the Tx Channel is used as reference power for the spectrum emission mask limits.

TX Channel Peak Power: The Peak of the sweep trace in the TX Channel is used as reference power for the spectrum emission mask limits.

The *Start Freq. Rel.* and *Stop Freq. Rel.* columns specify the frequency segments of the SEM mask definition to be measured. The values are relative to the center frequency.

Freq. at Δ to Limit states the absolute frequency whose power measurement being closest to the limit line; for the corresponding frequency segment.

Pwr Abs states the absolute power at the frequency whose power measurement being closest to the limit line; for the corresponding frequency segment.

Pwr Rel states the power relative to the Reference Power at the frequency closest to the limit line; for the corresponding frequency segment.

Δ to Limit states the minimal distance of the tolerance limit to the SEM trace for the corresponding frequency segment. Negative distances indicate the trace is below the tolerance limit, positive distances indicate the trace is above the tolerance limit.

The Spectrum Emission Mask (SEM) measurement can be configured from the SEM settings view. The SEM Settings softkey is located in the right side menu - [NEXT] hotkey - of the spectrum measurement :

SEM
SETTINGS
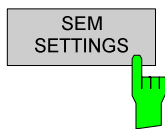
The *SEM SETTINGS* softkey brings up the SEM Settings view.
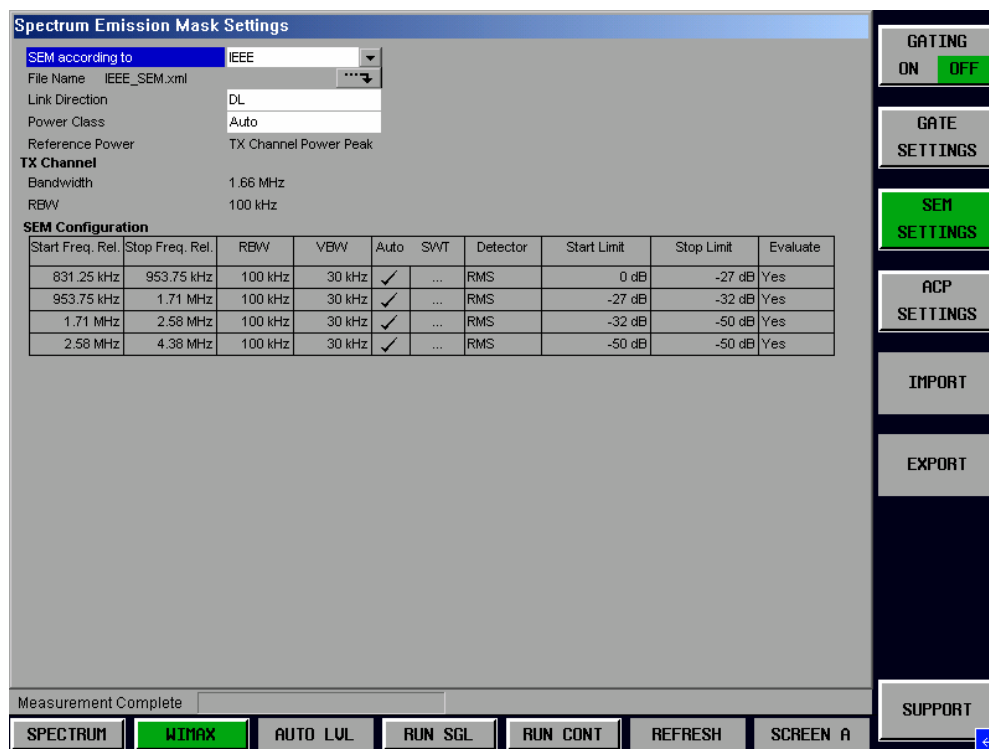
Fig. 56   Spectrum Emission Mask Settings view

SEM according to
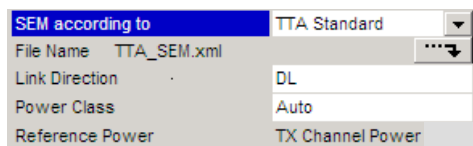
SEM according to specifies how the Spectrum Emission Mask settings and limits are applied. This parameter provides the following settings:

TTA Standard – Settings and limits are as specified in the standard (SISO- and MIMO-WiBro)

ETSI – Settings and limits are as specified in the standard (SISO- and MIMO-OFDM/OFDMA)

IEEE – Settings and limits are as specified in the standard (SISO- and MIMO-OFDM/OFDMA)

User – Settings and limits are configured via an XML file (SISO- and MIMO-OFDM/OFDMA/WiBro)

Remote: `SENS:POW:SEM USER|STANdard|IEEE|ETSI`

File Name
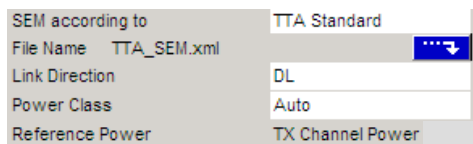
When **User** settings are specified, *File Name* shows the name of the loaded XML file. Clicking the arrow switches to the File Manager to locate an XML file, and automatically selects *SEM According To:* **User.**

When using TTA/ETSI/IEEE standards, *File Name* reflects the name of the built-in configuration.

Remote: `SENS:POW:SEM USER`
`MMEM:LOAD:SEM:STAT 1,`
`'D:\USER\WMAN\SEM\SEM_example2.xml'`

Link Direction

Link Direction allows the settings and limits for the relevant link direction (Uplink or Downlink) to be displayed.

Remote: `SENS:POW:SEM:MODE UL|DL`

Power Class

The SEM settings allow different set of limits depending on the signal level. By default the *Power Class* is set to Auto, which selects the limits automatically based on the measured signal level. If required, the Power Class can be set by hand, to force a set of limits to be used.

Remote: `SENS:POW:SEM:CLAS`

Reference Power

In case of a user selected Spectrum Emission Mask, the Reference Power can be set in the corresponding xml file. Value Range:
Tx Channel Power: The integrated power of the Tx Channel is used as reference power for the spectrum emission mask limits.
Tx Channel Peak Power: The Peak of the sweep trace in the TX Channel is used as reference power for the spectrum emission mask limits.

Remote: `N.A.`

SEM Configuration

The SEM configuration shows the settings and limits applied over specified frequency ranges around the TX channel. The settings displayed are dependent on the selected *Link Direction* and *Power Class*

Start Freq. Rel.	Stop Freq. Rel.	RBW	VBW	Auto	SWT	Detector	Start Limit	Stop Limit	Evaluate
831.25 kHz	953.75 kHz	100 kHz	30 kHz	✓	...	RMS	0 dB	-27 dB	Yes
953.75 kHz	1.71 MHz	100 kHz	30 kHz	✓	...	RMS	-27 dB	-32 dB	Yes
1.71 MHz	2.58 MHz	100 kHz	30 kHz	✓	...	RMS	-32 dB	-50 dB	Yes
2.58 MHz	4.38 MHz	100 kHz	30 kHz	✓	...	RMS	-50 dB	-50 dB	Yes

Fig. 57   SEM Configuration

- The *Start Freq. Rel.* and *Stop Freq. Rel.* columns specify the frequency segments of the SEM mask definition to be measured. The values are relative to the center frequency.

- Resolution Bandwidth RBW used for the frequency segment.

- Video Bandwidth used for the frequency segment.

- In case Auto is ticked, the sweep time for the frequency segment will be determined automatically.

- Detector

- Start Limit defines the tolerance limit at the beginning of the frequency segment.
  The unit **dB** indicates the tolerance limit value is relative to the measured 'Reference Power'.
  The unit **dBm** indicates the tolerance limit is absolute. Ie. the measured 'Reference Power' has no effect on the tolerance limit.

- Stop Limit defines the tolerance limit at the end of the frequency segment.
  The unit **dB** indicates the tolerance limit value is relative to the measured 'Reference Power'.
  The unit **dBm** indicates the tolerance limit value is absolute. Ie. the measured 'Reference Power'
  has no effect on the tolerance limit.

User SEM Configuration

The FSQ contains in
D:\USER\WMAN\SEM\SEM_example1.xml
D:\USER\WMAN\SEM\SEM_example2.xml
two example User SEM xml setting files.
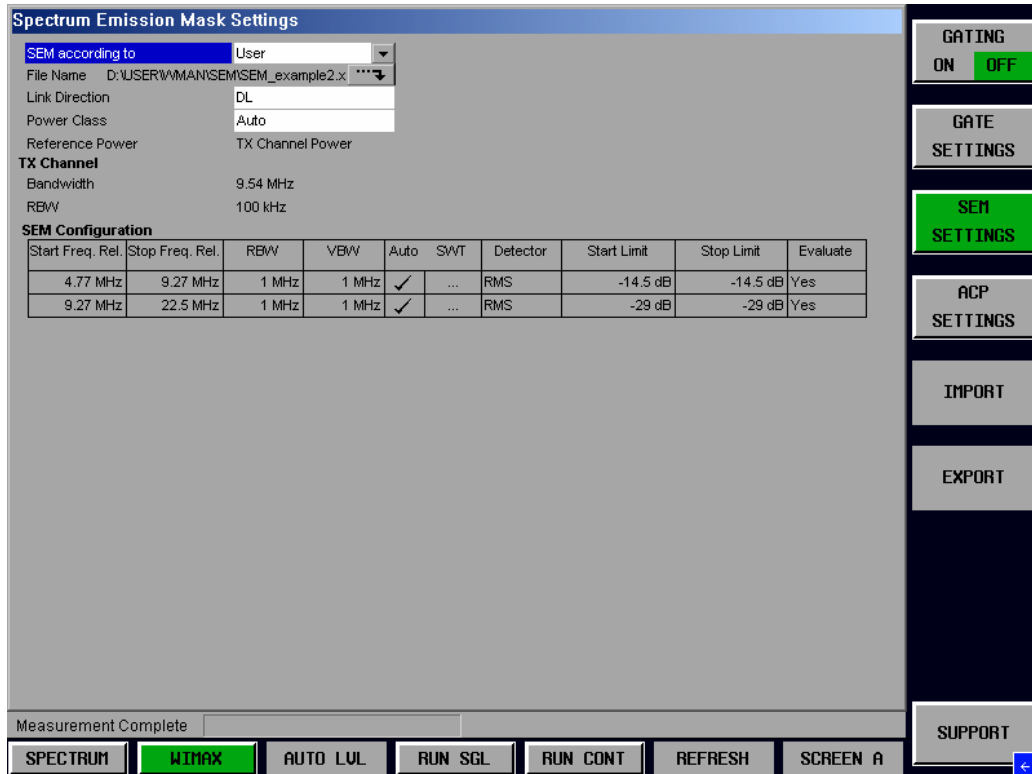
Fig. 58   D:\USER\WMAN\SEM\SEM_example2.xml Example SEM xml setting file.

Description of the User SEM xml file setting parameters

Link Direction ∈ {*DL*, *UL*}.
For the usage of *Power Class* see SEM_example2.xml.
    In case SEM Settings Panel | Power Class = Auto,
    the power measured according to the *Reference Power* setting
    determines the power class to be used.
    In case SEM Settings Panel | Power Class = [29, 40)dBm, the corresponding power class will be
    used regardless of the power measured according to the *Reference Power* setting.
Reference Power ∈{*TX Channel Power*, *TX Channel Peak Power*}.
Start Frequency of the frequency segment [relative to center frequency] *StartF* in Hz.
Stop Frequency of the frequency segment [relative to center frequency] *StopF* in Hz.
RBW in Hz can be selected according to the values supported by the used instrument.
VBW in Hz can be selected according to the values supported by the used instrument.
Det ∈{RMS, POS}
FilterType ∈{NORMal [=default], CFILter , RRC, FFT, P5}[6]

---

[6] Supported from FSQ V4.20; FSL V1.80

$SWT\_Mode \in \{Auto, Manual\}$
    In case of *Auto*, the *SWT_Value* is treated as dummy and has no effect.
    In case of *Manual*, the *SWT_Value* defines the sweep time for the corresponding frequency segment.

Tolerance Limit *StartL* at the Start Frequency *StartF* of the frequency segment
    StartL="float_value unit" with unit $\in \{dB, dBm\}$
    unit = *dB*: the tolerance limit is relative to the power measured according to the *Reference Power* setting
    unit = *dBm*: the tolerance limit is an absolute dBm value. The *Reference Power* setting has no effect onto this tolerance limit.

Tolerance Limit *StopL* at the Stop Frequency *StopF* of the frequency segment
    StopL="float_value unit" with unit $\in \{dB, dBm\}$
    unit = *dB*: the tolerance limit is relative to the power measured according to the *Reference Power* setting
    unit = *dBm*: the tolerance limit is an absolute dBm value. The *Reference Power* setting has no effect onto this tolerance limit.

Scaling the frequency segments with the Bandwidth (BW)

In this section the functionality of the
    AUTOFreqFromBW
    MASKChannelSpacing (MCS)
parameters are described.

Relations between absolute and relative Start- StopFrequencies
$$[\text{AbsStartFreq}_k, \text{AbsStopFreq}_k] := f_c + [\text{RelStartFreq}_k, \text{RelStopFreq}_k]$$

    k indexes the different frequency segments

    $\text{RelStartFreq}_k, \text{RelStopFreq}_k$ is the Start- StopFrequency relative to

    f_c the center frequency.

    $\text{StartFreq}_k, \text{StopFreq}_k$ are the Start- StopFrequencies, from the ranges list in the

    *.xml file. See document further down.

1. AutoFreqFromBW = true, MASKChannelSpacing (MCS) is defined
$$[\text{RelStartFreq}_k, \text{RelStopFreq}_k] := [\text{StartFreq}_k, \text{StopFreq}_k] * \frac{BW}{MCS} ,$$

2. AutoFreqFromBW = true, MASKChannelSpacing (MCS) is NOT defined
$$[\text{RelStartFreq}_k, \text{RelStopFreq}_k] := [\text{StartFreq}_k, \text{StopFreq}_k]$$

3. AutoFreqFromBW = false, MASKChannelSpacing (MCS) is defined or NOT defined.
$$[\text{RelStartFreq}_k, \text{RelStopFreq}_k] := [\text{StartFreq}_k, \text{StopFreq}_k]$$

Current restrictions to the definition of SEM xml files:

1. The sweeps must have no gaps. Otherwise the message
   'The file cannot be loaded: incorrect or corrupt content'
   is displayed.
2. There must be at least one DL power class and one UL power class per xml file!
   Otherwise the message 'The file cannot be loaded: incorrect or corrupt content'
   is displayed.

Spectrum ACP
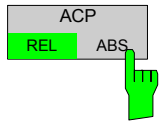
The Spectrum ACP measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *ACP REL/ABS* softkey. Subsequent presses of the *ACP REL/ABS* softkey toggle the measurement between relative and absolute results display.

Fig. 59　　　　Spectrum ACPR Results (example)

The Spectrum ACPR (Adjacent Channel Power (Relative)) is similar to the Spectrum Mask measurement, and provides information about leakage into adjacent channels. The results show the relative power measured in the three nearest channels either side of the measured channel. This measurement is the same as the Adjacent Channel Power measurement provided by the Spectrum Analyzer. . If the *Sweep Count (Mask/ACP)* parameter in the General Settings view is set to any value other than 1 then the measurement is performed over the specified number of sweeps. When the measurement is performed over multiple sweeps a max hold trace is displayed as well as an average trace.

By default the ACP Settings are derived from the Channel Bandwidth setting of the General Settings Panel.

Remote:　SENS:POW:ACH:MODE REL | ABS
　　　　　CONF:BURS:SPEC:ACPR:IMM

The Spectrum ACP measurement can be configured from the ACP settings view:

ACP
SETTINGS

The *ACP SETTINGS* softkey brings up the ACP Settings view.
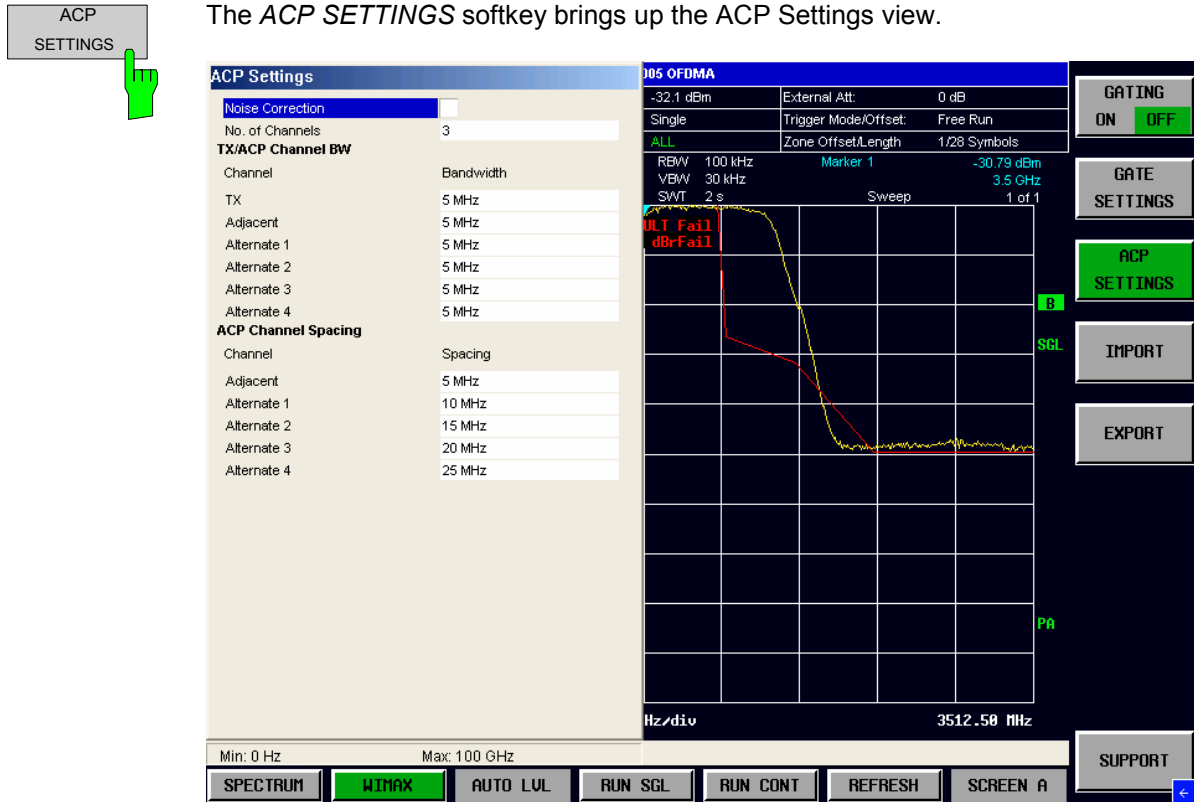
Fig. 60   ACP Settings view

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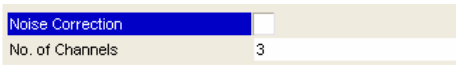
Noise Correction - when selected enables noise reduction to be performed on the signal.

Remote: `SENS:POWer:NCOR`

No of Channels

No of Channels specifies then number of channels adjacent to the transmit channel to be measured.

If *No of Channels* is set to 0 then only the transmit channel is measured.

Remote: `SENS:POW:ACH:ACP`

TX/ACP Channel BW

The TX/ACP Channel BW settings specify the bandwidth of specific channels.

TX Channel Bandwidth

TX/ACP Channel BW	
Channel	**Bandwidth**
TX	5 MHz
Adjacent	5 MHz
Alternate 1	5 MHz
Alternate 2	5 MHz
Alternate 3	5 MHz
Alternate 4	5 MHz

TX Channel Bandwidth specifies the bandwidth of the transmit channel to be measured by the ACP measurement.

Remote: `SENS:POW:ACH:BAND:CHAN`

Adjacent Channel Bandwidth

Channel	**Bandwidth**
TX	5 MHz
Adjacent	5 MHz
Alternate 1	5 MHz
Alternate 2	5 MHz
Alternate 3	5 MHz
Alternate 4	5 MHz

Adjacent Channel Bandwidth specifies the bandwidth of the first channel before and after the transmit channel to be measured.

Remote: `SENS:POW:ACH:BAND:ACH`

Alternate 1,2,3 & 4 Channel Bandwidth

TX/ACP Channel BW	
Channel	**Bandwidth**
TX	5 MHz
Adjacent	5 MHz
Alternate 1	5 MHz
Alternate 2	5 MHz
Alternate 3	5 MHz
Alternate 4	5 MHz

Adjacent Channel Bandwidth specifies the bandwidth of the specified channel before and after the transmit channel to be measured.

Remot   `SENS:POW:ACH:BAND:ALT<1..11>`

ACP Channel Spacing

The ACP Channel Spacing settings specify the spacing of specific channels.

Adjacent Channel Spacing

ACP Channel Spacing	
Channel	**Spacing**
Adjacent	5 MHz
Alternate 1	10 MHz
Alternate 2	15 MHz
Alternate 3	20 MHz
Alternate 4	25 MHz

Adjacent Channel Bandwidth specifies the spacing of the first channel before and after the transmit channel to be measured.

Remote: `SENS:POW:ACH:SPAC:ACH`

Alternate 1,2,3 & 4 Channel Spacing

ACP Channel Spacing	
Channel	**Spacing**
Adjacent	5 MHz
Alternate 1	10 MHz
Alternate 2	15 MHz
Alternate 3	20 MHz
Alternate 4	25 MHz

Adjacent Channel Bandwidth specifies the spacing of the specified channel before and after the transmit channel to be measured.

Remote: `SENS:POW:ACH:SPAC:ALT<1..11>`

Automatic Level Detection

Automatic level detection allows the Signal Level and Reference Level settings to be calculated from the input signal.

Automatic level detection can be performed in one of two ways:

Pressing the *AUTO LVL* hot-key
Setting *Auto Level* in the General Settings view to ON.

Running the Automatic Level Detection by pressing the *AUTO LVL* hot-key allows the level detection to be run at any time. Once the Automatic Level Detection has completed the trace is displayed in the Magnitude Capture Buffer display.

Running the Automatic Level Detection by Setting *Auto Level* in the General Settings view to ON means that an Automatic Level Detection measurement is executed before each main measurement sweep. When running the Automatic Level Detection this way no trace for the Automatic Level Detection measurement is displayed. This way of running the Automatic Level Detection will cause measurements to run more slowly and as such it is recommended that Automatic Level Detection is only run in this way when the speed of measurement is not important or when running continuous measurements are being run with a signal which varies in level from one sweep to the next.

Running measurements

To start a measurement, press the *RUN SGL* hotkey (single) or *RUN CONT* hotkey (continuous).

A single measurement will complete once the requested number of bursts have been obtained or a single sweep has been completed, depending on the measurement settings. When a measurement is completed in continuous mode then a new measurement will be started.

Note that if one measurement is started whilst another measurement is in progress, for example, a single measurement is started whilst a continuous measurement is in progress, then the first measurement will be aborted and the new measurement started immediately.

During a measurement, the text "*Running...*" is displayed in the Status Bar at the bottom of the screen. After successful completion of a single measurement, the Status Bar will display "*Measurement Complete*".

Measurement results

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

SISO-OFDM

IEEE 802.16-2004 OFDM					
Frequency:	20 GHz	Signal Level Setting:	-33.1 dBm	Ref. Level / Att:	-23.1 dBm / 0 dB
Sweep Mode:	Single	Trigger Mode:	Free Run	Trigger Offset:	-10 µs
Burst Type:	OFDM DL Burst	Modulation:	ALL	No Of Data Symbols:	1/2425

Fig. 61   Overall measurement settings summary for IEEE 802.16 – 2004 OFDM

The settings summary includes the following information:

- Frequency   The frequency of the measured input signal according to the General Settings value.

- Sweep Mode   Shows "Single" for a single measurement and "Continuous" for a continuous measurement.

- Burst Type   The type of burst being analyzed. SISO-OFDM

- Signal Level Setting   The expected mean signal level of the input signal according to the General Settings value.

- Trigger Mode   The trigger source used to start the measurement sweep. SISO-OFDM.

- Modulation   The *Demodulator* setting from the Demod Settings panel is shown. In case the *Modulation Analysis Scope* is set to *ALL*, *ALL* is displayed.

- Ref Level   The internal instrument reference level used for the measurement.

- Att   The attenuation (positive values) or gain (negative values) applied to the signal **externally** (i.e. before the RF- or IQ- connector of the spectrum analyzer). e.g.

                     External Att = 10 dB means that before the RF-connector of the R&S a 10 dB attenuator is used

                     External Att = -20 dB means that before the RF-connector of the R&S FSQ a amplifier with 20 dB gain is used

- Trigger Offset   The trigger delay (positive value) or pre-trigger time (negative value) applied to the trigger according to the General Settings value. SISO-OFDM

- Trigger Mode/Offset   A combined display of the trigger source and any associated offset applied according to the General Settings values. SISO-OFDMA/WiBro.

- No Of Data Symbols   Shows the minimum and maximum number of data symbols that a burst may have if it is to be considered in results analysis. SISO-OFDM.

SISO-OFDMA/WiBro and MIMO-OFDMA/WiBro

IEEE 802.16e-2005 OFDMA					
Frequency/Fs:	2.5 GHz / 11.2 MHz	Signal Lvl. Setting/Ext. Att:	-10.1 dBm / 0 dB	Capture Time/No.Samples	15 ms / 168001
Seg=0, DL-PUSC, ID=A	9/30 (3)	Meas Setup:	1 TX x 1 RX	Zone Offset / Len:	1 / 28 Symbols
SINGLE	TRG : EXT	EXT REF		RF	

Fig. 62   Overall measurement settings summary for IEEE 802.16e – 2005 OFDMA and WiBro

IEEE 802.16e-2005 MIMO		
Frequency/Fs: 2.5 GHz / 11.2 MHz	Signal Lvl. Setting/Ext. Att: -10.1 dBm / 0 dB	Capture Time/No.Samples 15 ms / 168001
Seg=0, DL-PUSC, ID=B 21/30 (3)	Meas Setup: 2 TX x 2 RX	Zone Offset / Len: 3 / 16 Symbols
CONTINUOUS TRG : EXT	EXT REF RF	

Fig. 63   Overall measurement settings summary for IEEE 802.16e – 2005 MIMO-OFDMA/WiBro

The settings summary includes the following information:

- Frequency   The frequency of the measured input signal according to the General Settings value.

- Fs   Sampling Rate Fs or Sampling Frequency according to the General Settings value.

- Signal Level Setting The expected mean signal level of the input signal according to the General Settings value.

- Ext. Att   The attenuation (positive values) or gain (negative values) applied to the signal externally (i.e. before the RF- or IQ- connector of the spectrum analyzer). e.g.

                     External Att = 10 dB means that before the RF-connector of the R&S a 10 dB attenuator is used.

                     External Att = -20 dB means that before the RF-connector of the R&S FSQ a amplifier with 20 dB gain is used.

- Capture Time   Data is recorded for this amount of time at the Sampling Rate Fs. The corresponding General Settings value is displayed.

- No. Samples   equals Sampling Rate Fs * Capture Time.

- Zone/Seg   The zone and segment being analyzed according to the '*Frame Config | Zone/Segment List | Analyze*' setting.

                     In case the subframe/zone statistic is switched on [Capture Count in General Settings is checked], the following information is available: The number of subframes/zones that contributed to the statistic so far. The Number of Subframes to Analyze [according to the General Settings value].

- MIMO Meas Setup   The number of Tx Antennas is defined by the '*Frame Config|STC/MIMO Config*' setting for the Zone/Segment to be analyzed. The number of Rx Antennas is defined by the corresponding General Settings value. The contribution to the statistic by the current capture buffer content.

- Zone Offset/Length A combined display of the offset and length of the analyzed zone according to the '*Frame Config | Zone/Segment List*' settings.

- Sweep Mode   Shows "Single" for a single measurement and "Continuous" for a continuous measurement.

- Trigger Mode   The trigger setting according to the general settings is displayed in this field. In case the user performs gated measurements, the label will change in example for an external trigger to GAT:EXT.

- External Reference In case the external reference is switched on in the base spectrum analyzer, the label EXT REF is displayed. In case the external reference signal is available, the label is displayed in green color. In case the external reference signal is missing, the label is displayed in red color.

- Signal Input   The General Advanced Settings | Input selection is displayed in this field. The possible input modes depend on the hardware configuration of the analyzer.

Results Summary

The results summary table is displayed for IQ measurements when the display mode is set to List. This table shows the overall measurement results and provides limit checking for result values in accordance with the selected standard. Result values which are within the limit as specified by the standard are displayed in green. Result values which are outside of the limits specified by the standard are displayed in red with a '*' to the left. Results which have no limits specified by the standard are displayed in white. Limit values are displayed in white (not bold). See also figures further down.

For a brief description of the scalar measurement results see 'IEEE802.16e-2005 SISO- and MIMO-OFDMA/WiBro Scalar Measurement Results' further up. For more details regarding how the results are calculated see section 3.

The results displayed in this table are for the entire measurement. If a specific number of bursts/subframes/zones has been requested which requires more than one sweep then the results summary update at the end of each sweep shows the results so far. The number of bursts/subframes/zones measured and the number of bursts/subframes/zones requested are displayed over the *Capture Memory* measurement to show the progress through the measurement. If more than one burst/subframe/zone is evaluated (several analyzed bursts in the capture buffer or with the help of Overall Burst Count/Capture Count), the Min / Mean / Max columns show the minimum, mean or maximum values of the burst/subframe/zone results.

SISO-OFDM
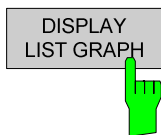
DISPLAY LIST GRAPH

The *DISPLAY LIST GRAPH* softkey shows the scalar measurement results, based on the bursts to be analyzed, for the measured signal.

Fig. 64 Result Summary Table (SISO-OFDM).

Remote `:DISP:TABL ON`

SISO-OFDMA/WiBro

The results for SISO-OFDMA/WiBro standards are displayed on two tables. The first table '*Result Summary of Analyzed Subframes*' is displayed by pressing the DISPLAY LIST 1 softkey. The second table '*Result Summary of Analyzed Zone/Segment*' is displayed by pressing the DISPLAY LIST 2 softkey. Pressing DISPLAY GRAPH will switch from the scalar table results to the selected graphical measurement.
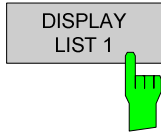
DISPLAY LIST 1

The *DISPLAY LIST 1* softkey shows the scalar measurement results, based on the Subframe containing the Zone/Segment to be analyzed, for the measured signal.

Fig. 65   Subframe Result Summary Table (SISO-OFDMA/WiBro).

Remote: `:DISP:TABL ON`
               `:DISP:TABL:LIST 1`

DISPLAY LIST 2

The *DISPLAY LIST 2* softkey shows the scalar measurement results, based on the Zone/Segment to be analyzed, for the measured signal.

Fig. 66   Zone/Segment Result Summary Table (SISO-OFDMA/WiBro).

Remote: `:DISP:TABL ON`
                  `:DISP:TABL:LIST 2`

MIMO-OFDMA/WiBro

The number of Tx Antennas is defined by the '*Frame Config|STC/MIMO Config*' setting for the Zone/Segment to be analyzed. The number of Rx Antennas is defined in General Settings STC MIMO Config by the number of Rx entries in the corresponding table being switched on. The scalar measurement results are grouped to reflect their occurrence in the system model.
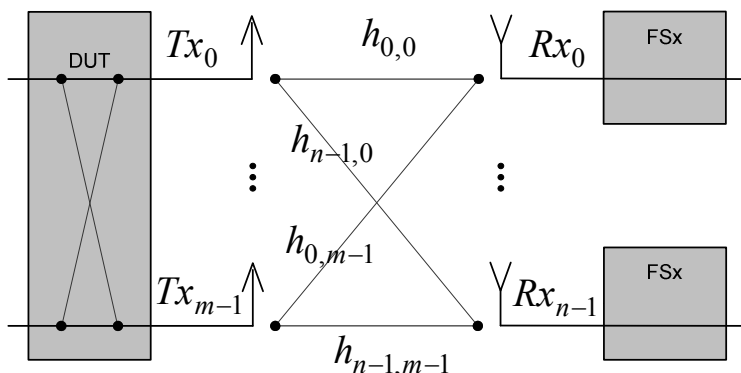
Fig. 67   mxn MIMO System Model.

The following four examples demonstrate how the MIMO measurement setup and the parameterisation affect the result summary measurement results!

Example 1: Diagonal mode setup. The expected antenna assignment matches the MIMO DUT FSx setup

Demod Settings | Compensate Crosstalk is cleared

Fig. 68   2x2 MIMO System Model describing the MIMO DUT FSx setup.

In General Settings STC/MIMO Configuration, the expected antenna assignment matches the MIMO DUT FSx setup. Therefore in Result Overview of Analyzed Zone/Segment EVM Data and Pilots is good, Power Pilots shows power and Power Null Pilots doesn't show power.

Example 2: Diagonal mode setup. The expected antenna assignment doesn't match the MIMO DUT FSx setup

Demod Settings | Compensate Crosstalk is cleared
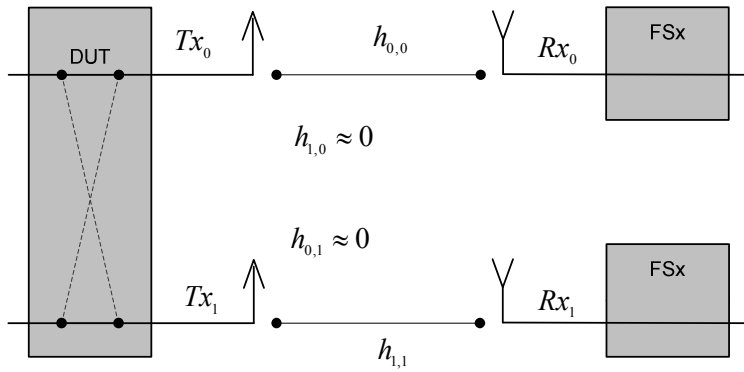
Fig. 69   2x2 MIMO System Model describing the MIMO DUT FSx setup.

In General Settings STC/MIMO Configuration, the expected antenna assignment doesn't match the MIMO DUT FSx setup. Therefore in Result Overview of Analyzed Zone/Segment EVM Data and Pilots is bad, Power Pilots doesn't show power and Power Null Pilots shows power.

Example 3: Secondary diagonal mode setup. The expected antenna assignment matches the MIMO DUT FSx setup
Demod Settings | Compensate Crosstalk is cleared

Fig. 70   2x2 MIMO System Model describing the MIMO DUT FSx setup.

In General Settings STC/MIMO Configuration, the expected antenna assignment matches the MIMO DUT FSx setup. Therefore in Result Overview of Analyzed Zone/Segment EVM Data and Pilots is good, Power Pilots shows power and Power Null Pilots doesn't show power.

Example 4: Secondary diagonal mode setup. The expected antenna assignment doesn't match the MIMO DUT FSx setup
Demod Settings | Compensate Crosstalk is cleared

Fig. 71   2x2 MIMO System Model describing the MIMO DUT FSx setup.

In General Settings STC/MIMO Configuration, the expected antenna assignment doesn't match the MIMO DUT FSx setup. Therefore in Result Overview of Analyzed Zone/Segment EVM Data and Pilots is bad, Power Pilots doesn't show power and Power Null Pilots shows power.

Comment to Example 1 to 4.
In case Demod Settings | Compensate Crosstalk is cleared and Auto Assignment is checked, the application will determine according to the MIMO DUT FSx setup the correct expected antenna assignment.

The results forMIMO-OFDMA/WiBro standards are displayed using two tables. The first table '*Result Overview of Analyzed Subframes*' is displayed by pressing the DISPLAY LIST 1 softkey. The second table '*Result Overview of Analyzed Zone/Segments*' is displayed by pressing the DISPLAY LIST 2 softkey. Pressing DISPLAY GRAPH will switch from the scalar table results to the selected graphical measurement.

The '*Result Overview of Analyzed Subframes*' and '*Result Overview of Analyzed Zone/Segments*' list results provide the overview results for the corresponding measurement groups. They contain the most important measurement results for the various groups. In case all the measurement results for a specific group are required simply make the required overview measurement the active measurement and press the [DISP] [FULL SCREEN] key sequence.
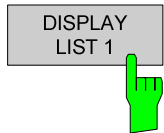
DISPLAY LIST 1

The *DISPLAY LIST 1* softkey shows the scalar measurement results overview, based on the Subframe containing the Zone/Segment to be analyzed, for the measured signal. The overview measurement provides all the important scalar subframe measurement results at a glance.

Fig. 72   Overview Subframe Result Summary Table (MIMO-OFDMA/WiBro).

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' two Rx results are available. Therefore two Result Overview of Analyzed Subframe tables are displayed. One for each Rx path. The Rx path information for the result table is given in the corresponding measurement window title bar.

In order to see all the measurement results for a specific group, select the required measurement window and press the [DISP] [FULL SCREEN] hardkey, softkey sequence. See also next figure.

Remote: :DISP:TABL ON
            :DISP:TABL:LIST 1

DISP

FULL
SCREEN

Fig. 73   Full Screen Subframe Result Summary Table (MIMO-OFDMA/WiBro).

Remote: `DISP:FORM SING`

DISPLAY
LIST 2

The *DISPLAY LIST 2* softkey shows the scalar measurement results overview based on the Zone/Segment to be analyzed, for the measured signal. The overview measurement provides all the important scalar zone/segment measurement results at a glance.

Fig. 74   Overview Zone/Segment Result Summary Table (MIMO-OFDMA/WiBro).

According to the overall measurement settings field 'Meas Setup 2 TX x 2 RX' two Tx and 2 Rx results are available. Therefore four Result Overview of Analyzed Subframe tables are displayed. One for each Tx path and one for each Rx path. The Tx respectively Rx path information for the result table is given in the corresponding measurement window title bar.

In order to see all the measurement results for a specific group, select the required measurement window and press the [DISP] [FULL SCREEN] hardkey, softkey sequence. See also next figure.

Remote: `DISP:TABL:LIST 2`

Fig. 75   Full Screen Zone/Segment Result Summary Table (MIMO-OFDMA/WiBro).

MIMO measurement results
- Power Null Pilots
  According to 'General Settings/SRC/MIMO Configuration' and the Figure 'mxn MIMO System Model.' above, a DUT Antenna data stream Tx_k will be assigned to a FSx spectrum analyzer serving as receiver Rx_l. The Power Null Pilots is the power at the pilot positions for the DUT Antenna data streams Tx_j with $j \neq k$ received at Rx_l for the zone/segment to be analyzed.

Remote: `DISP:FORM SING`

The limit values in the table of results can be modified.
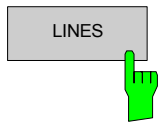
LINES

Pressing the *LINES* hardkey allows limits to be selected and modified

Fig. 76   Editing Limit Values

Limits are modified for the currently selected modulation scheme. Each modulation scheme may have its own set of user defined limits.
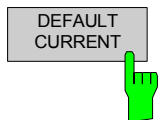
DEFAULT CURRENT

Pressing the *DEFAULT CURRENT* softey resets all limits for the current modulation scheme to those values specified in the selected standard.

Remote: CALC1:LIM1:BURS:ALL
         CALC1:LIM1:BURS:ALL:RESULT?
         CALC1:LIM1:BURS:FERR:AVER
         CALC1:LIM1:BURS:FERR:AVER:RES?
         CALC1:LIM1:BURS:FERR:MAX
         CALC1:LIM1:BURS:FERR:MAX:RES
         CALC1:LIM1:BURS:IQOF:AVER
         CALC1:LIM1:BURS:IQOF:AVER:RES
         CALC1:LIM1:BURS:IQOF:MAX
         CALC1:LIM1:BURS:IQOF:MAX:RES
         CALC1:LIM1:BURS:EVM:ALL[:AVER
         CALC1:LIM1:BURS:EVM:ALL[:AVER:RES
         CALC1:LIM1:BURS:EVM:ALL:MAX
         CALC1:LIM1:BURS:EVM:ALL:MAX:RES
         CALC1:LIM1:BURS:EVM:DATA:AVER
         CALC1:LIM1:BURS:EVM:DATA:AVER:RES
         CALC1:LIM1:BURS:EVM:DATA:MAX
         CALC1:LIM1:BURS:EVM:DATA:MAX:RES
         CALC1:LIM1:BURS:EVM:PIL:AVER
         CALC1:LIM1:BURS:EVM:PIL:AVER:RES
         CALC1:LIM1:BURS:EVM:PIL:MAX
         CALC1:LIM1:BURS:EVM:PIL:MAX:RES

DEFAULT
ALL

Pressing the *DEFAULT ALL* softkey resets all limits for all modulation schemes to those values specified in the selected standard.

Remote:
```
CALC1:LIM:BURS:ALL DEF
CALC1:LIM:BURS:BERP:AVER DEF
CALC1:LIM:BURS:BERB:MAX DEF
CALC1:LIM:BURS:EVM:ALL:AVER  DEF
CALC1:LIM:BURS:EVM:ALL:MAX DEF
CALC1:LIM:BURS:FERR:AVER DEF
CALC1:LIM:BURS:FERR:MAX DEF
CALC1:LIM:BURS:IQOF:AVER DEF
CALC1:LIM:BURS:IQOF:MAX DEF
CALC1:LIM:BURS:SYMB:AVER DEF
CALC1:LIM:BURS:SYMB:MAX DEF
```

General Settings

This section of the user manual describes the General Settings view where all settings related to the overall measurement can be modified, that is the Signal Characteristics, Data Capture, Trigger IQ, Input and Advanced settings.
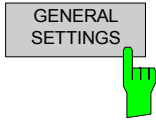
GENERAL
SETTINGS

The *GENERAL SETTINGS* softkey brings up the General Settings view.

Fig. 77   General Settings view for OFDM standard selection.
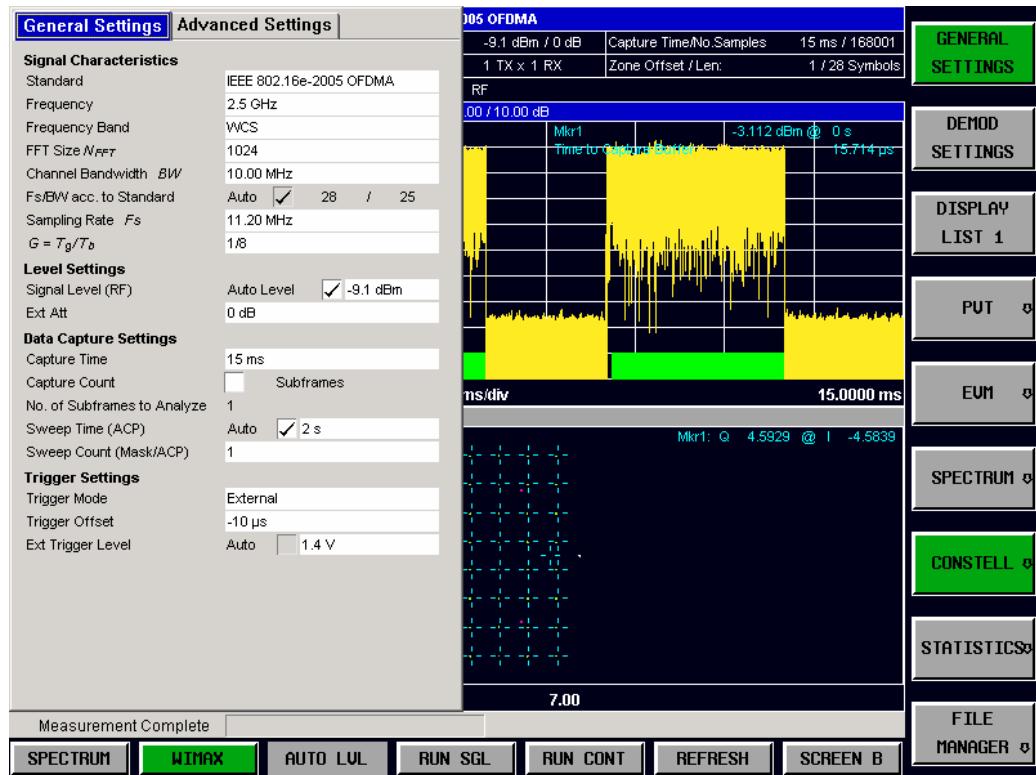
Fig. 78   General Settings view for SISO-OFDMA/WiBro standard selection.
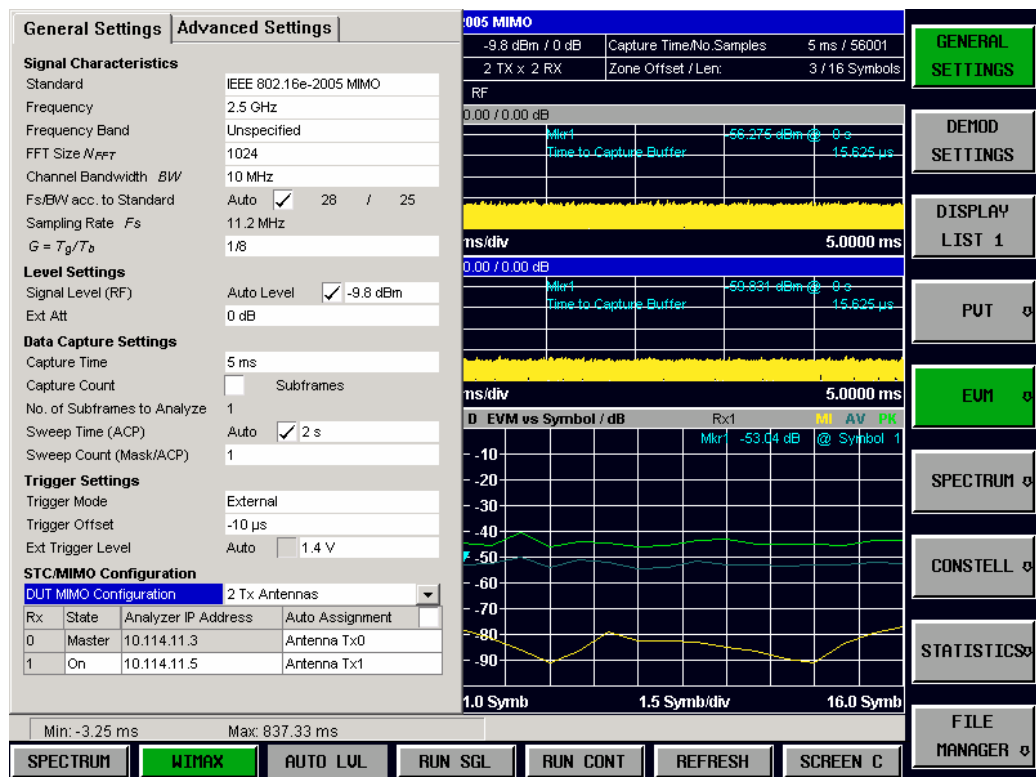
Fig. 79   General Settings view for MIMO-OFDMA/WiBro standard selection.

The parameters within the General settings view are logically grouped together into:

- Signal Characteristics

- Level Settings

- Data Capture Settings

- Trigger Settings

- STC/MIMO Configuration (MIMO-OFDMA/WiBro)

- IQ Settings

- Input Settings

- Advanced Settings

Any parameters that are not available for editing will have a grey background. This usually occurs when one parameter setting makes another parameter invalid, for example if the *Trigger Mode* is Free Run then none of the parameters below this (*Trigger Offset, Power Level* and *Auto Power Trigger Level*) have any meaning, so these parameters are greyed out.
When a particular parameter is selected within the General Settings view the status bar changes to display information about the valid settings for the selected parameter.

Signal Characteristics

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

Standard

Signal Characteristics	
Standard	IEEE 802.16-2004 OFDM
Frequency	20 GHz
Channel No	...
Frequency Band	ETSI 3.410-4.200 GHz
Channel Bandwidth BW	1.75 MHz
Fs/BW acc. to Standard	Auto ✓ 8 / 7
Sampling Rate Fs	2 MHz
$G = T_g/T_b$	1/4

Standard is used to select the WiMAX standard to be measured against. This is necessary to ensure that the measurements are performed according to the specified standard with the correct limit values and limit lines.

This parameter provides a list of settings. The list provided depends on the standards which have been installed:

IEEE 802.16e-2004 OFDM (R&S FSQ-K92/K93/K94)
IEEE 802.16e-2005 OFDMA (R&S FSQ-K93/K94)
IEEE 802.16e-2005 WiBro (R&S FSQ-K93/K94)
IEEE 802.16e-2005 MIMO (R&S FSQ-K94)
Remote: `CONF:STAN`

Frequency

Signal Characteristics	
Standard	IEEE 802.16-2004 OFDM
Frequency	20 GHz
Channel No	...
Frequency Band	ETSI 3.410-4.200 GHz
Channel Bandwidth BW	1.75 MHz
Fs/BW acc. to Standard	Auto ✓ 8 / 7
Sampling Rate Fs	2 MHz
$G = T_g/T_b$	1/4

Frequency specifies the Center Frequency of the signal to be measured.

When the *Frequency* is modified and the Baseband input is not selected, the *Channel No* parameter is updated accordingly.

The *Frequency* parameter is editable when Baseband input is selected however the frequency range is limited according to the setting of the IQ Path paramerter as follows:

IQ Path = I or Q.   Range = 0 to 35 MHz
IQ Path = I + j*Q   Range = -35 to 35 MHz

Remote: `SENS:FREQ:CENT`

Channel No (SISO-OFDM)

Signal Characteristics	
Standard	IEEE 802.16-2004 OFDM
Frequency	3.412125 GHz
Channel No	5
Frequency Band	ETSI 3.410-4.200 GHz
Channel Bandwidth *BW*	1.75 MHz
Fs/BW acc. to Standard	Auto ✓ 8 / 7
Sampling Rate *Fs*	2 MHz
G = T_g/T_b	1/4

Channel No specifies the channel to be measured.

When the *Channel No* is modified the *Frequency* parameter is updated accordingly.

For the Licensed Bands {ETSI, MMDS, WCS} Channel Numbers are supported according to [IEEE Std 802.16-2004] "8.3.10.2 Transmitter channel bandwidth and RF carrier frequencies". For the target frequency bands see [IEEE Std 802.16-2004] "B.1 Targeted frequency bands". I.e. entering a Channel Number will derive the corresponding Center Frequency according to the section in the standard mentioned above.

For the License Exempt Bands {U-NII, CEPT} Channel Numbers are supported according to [IEEE Std 802.16-2004] "8.5.1 Channelization". I.e. entering a Channel Number will derive the corresponding Center Frequency according to the section in the standard mentioned above.

The *Channel No* parameter is not editable when Base band input is selected because *Channel No* only make sense for a RF signal.

Remote: `CONF:CHAN`

Frequency Band

Signal Characteristics	
Standard	IEEE 802.16-2004 OFDM
Frequency	20 GHz
Channel No	...
Frequency Band	ETSI 3.410-4.200 GHz ▼
Channel Bandwidth *BW*	1.75 MHz
Fs/BW acc. to Standard	Auto ✓ 8 / 7
Sampling Rate *Fs*	2 MHz
G = T_g/T_b	1/4

Frequency Band specifies the relationship between the *Channel Bandwidth* and the *Sample Rate* parameters.

The ratio of sample rate to channel bandwidth is shown to the side of the *Frequency Band* settings in the following format:
The Sampling Factor n is defined in the IEEE Std. 802.16-2004, section "8.3.2.1 Derived Parameter Definitions."

Remote:
`CONF:WIM:FBAN UNSP|ETSI|ETSI1|ETSI2|MMDS`
`|MMDS1|MMDS2|WCS|WCS1|WCS2|CEPT|CEPT1|CEPT2|`
`UNII|UNII1|UNII2`

FFT Size N_{FFT} (SISO- and MIMO-OFDMA/WiBro)

Signal Characteristics	
Standard	IEEE 802.16e-2005 OFDMA
Frequency	20 GHz
Frequency Band	ETSI
FFT Size N_{FFT}	1024 ▼
Channel Bandwidth *BW*	14 MHz
Fs/BW acc. to Standard	Auto ✓ 8 / 7
Sampling Rate *Fs*	16 MHz
G = T_g/T_b	1/16

FFT Size specifies the maximum number of carriers supported by the signal to be measured.

Remote: `CONF:WIM:NFFT`
`        FFT128|FFT512|FFT1024|FFT2048`

Channel Bandwidth

Channel Bandwidth specifies the bandwidth of the channel to be measured.

Remote: `SENS:BAND:CHAN 1.75MHZ`

Fs/BW acc. to Standard

The *FS/BW* setting allows a user-defined Channel Bandwidth to Sampling Rate relationship. It is only available when the Frequency Band is "Unspecified".

When the setting is ticked, the relationship used is defined by the standard.

When the setting is unticked, the Fs and BW values can be modified with increased flexibility.

Initially the ratio takes the current Fs and BW values.

Changing the ratio updates Fs and vice versa. BW remains unchanged.

Remote: `CONF:WIM:FSBW:AUTO ON`
`CONF:WIM:FSBW:FS 2.5`
`CONF:WIM:FSBW:BW 1.5`

Sample Rate

Sample Rate specifies the sample rate used for IQ measurements.

Remote: `TRAC:IQ:SRAT 20000HZ`

G = Tg/Tb

G = Tg/Tb specifies the guard time ratio

Remote: `CONF:WIM:IGR 4`

Level Settings

The level settings are the general settings concerning the level and attenuation of the signal to be measured.

Auto Level

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, R&S FSQ-K92/K93/K94 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 result in slightly increased measurement times.

Remote: `CONF:POW:AUTO ON`

Signal Level (RF)

Signal Level (RF) specifies the expected level of the RF input signal.

The *Signal Level (RF)* is updated after an automatic level detection measurement has been executed when RF input is selected.

The *Signal Level (RF)* parameter is not editable when Base band input is selected because *Signal Level (RF)* only make sense for an RF signal.

Remote: `CONF:POW:EXP:RF -331`

Signal Level (Baseband)

Signal Level (Baseband) specifies the expected level of the Baseband input signal.

The *Signal Level (Baseband)* is updated after an automatic level detection measurement has been executed when Baseband input is selected.

The *Signal Level (Baseband)* parameter is not editable when RF input is selected because *Signal Level (Baseband)* only make sense for a Baseband signal.

Remote: `DISP:WIND:TRAC:Y:RLEV:IQ 1`

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 0`

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 IQ measurement sweep.

A maximum of 1 MSamples can be captured for an IQ measurement, allowing up to 500ms capture time for a 2MHz Sample Rate (Fs).

Remote: `SENS:SWE:TIME`

Overall Burst Count (SISO-OFDM)

Overall Burst Count specifies whether a specified number of bursts are to be captured and analyzed.

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

Remote: `SENS:BURS:COUN:STAT ON`

No of Burst to Analyze (SISO-OFDM)

No of Burst to Analyze specifies the number of bursts to be measured.

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

The *No of Burst to Analyze* parameter is not editable when *Overall Burst Count* is set to OFF.

Remote: `SENS:BURS:COUN?`

Capture Count (SISO- and MIMO-OFDMA/WiBro)

Capture Count specifies whether a specified number of subframes are to be captured and analyzed.

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

Remote: `SENS:ZONE:COUN:STAT ON`

No of Subframes to Analyze (SISO- and MIMO-OFDMA/WiBro)

No of Subframes to Analyze specifies the number of subframes to be measured.

If the number of subframes specified are not contained in a single measurement sweep then measurement sweeps will continue to be performed until the requested number of subframes have been captured.

The *No of Subframes to Analyze* parameter is not editable when *Capture Count* is set to OFF.

Remote: `SENS:ZONE:COUN?`

Sweep Time (Mask/ACPR)

Sweep Time (ACP/Mask) specifies whether the sweep time for the spectrum ACP & Mask measurements should be calculated automatically or specified manually.

If the sweep time auto check box is switched off the sweep time to be used can be specified.

Remote: `SENS:SWE:ACPR:TIME 2s`

Sweep Count (Mask/ACPR)

Sweep Count (ACP/Mask) specifies the number of sweeps which should be performed for Spectrum ACP/ACPR and Spectrum Mask measurements.

Remote: `SENS:SWE:COUNt 1`

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.

Power - the measurement sweep starts when the signal power meets or exceeds the specified power trigger level.

Remote: `TRIG:SEQ: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:SEQ:HOLD –10us`

External Trigger Level

External Trigger Level specifies the trigger level when a external trigger is selected.

The *External Trigger Level* parameter is editable only when *Trigger Mode* is set to External.

Remote: `TRIG:SEQ:LEV 1.4V`

Auto Power Trigger Level

Auto Power Trigger Level selects whether the level for the power trigger is measured automatically (ON) or entered manually by the user (OFF).

When *Auto Power Trigger Level* is set to ON, R&S FSQ-K92/K93/K94 will measure and determine the power trigger level automatically at the start of each measurement sweep. This ensures that the power trigger level is always set at the optimal level for obtaining accurate results but will result in a slightly increased measurement times.

The *Auto Power Trigger Level* parameter is editable only when *Trigger Mode* is set to Power.

Remote: `TRIG:SEQ:LEV:POW:AUTO ON`

Trigger Level (RF)

Trigger Level (RF) Specifies the trigger level when a power trigger is selected and Baseband input is not selected.

The *Trigger Level* parameter is editable only when *Trigger Mode* is set to Power.

The *Trigger Level (RF)* parameter is not editable when Baseband input is selected because *Trigger Level (RF)* only makes sense for an RF signal.

Remote: `TRIG:SEQ:LEV:IFP 0DBM`

Trigger Level (Baseband)

Trigger Level (Baseband) Specifies the trigger level when a power trigger is selected and Baseband input is selected.

The *Trigger Level* parameter is editable only when *Trigger Mode* is set to Power.

The *Trigger Level (Baseband)* parameter is not editable when RF input is selected because *Trigger Level (Baseband)* only makes sense for a Baseband signal.

Remote: `TRIG:SEQ:LEV:IFP 500mV`

Ext.Trigger Lvl

Ext. Trigger Lvl specifies the trigger level when an external trigger is selected.

The *Ext. Trigger Level* parameter is editable only when *Trigger Mode* is set to External.

Remote: `TRIG:SEQ:MODE EXT 1.4V`

STC/MIMO Configuration (MIMO-OFDMA/WiBro)

The STC/MIMO Configuration specifies the STC/MIMO measurement setup [DUT, Spectrum Analyzers].

DUT MIMO Configuration (MIMO-OFDMA/WiBro)

DUT MIMO Configuration specifies the number of DUT Tx Antennas according to the MIMO system, the DUT is designed for operation. The maximal number of Tx Antennas per zone will be less or equal to this setting.
Value range:
1 Tx Antenna
2 Tx Antennas

Remote: `CONF:WIM:DUT TX2`

Auto Assignment (MIMO-OFDMA/WiBro)

Auto Assignment checked: The subsequent assignment of expected Tx antennas to analyzers is ignored. The application will determine the assignment and update the assignment in the column appropriate.

Remote: `CONF:WIM:ANTM:AUTO ON`

Auto Assignment cleared: The subsequent assignment of expected Tx antennas to analyzers is assumed. In example for the left hand side figure:
Analyzer Rx0 expects the antenna Tx0 signal.
Analyzer Rx1 expects the antenna Tx1 signal.
In case the assignment matches with the DUT MIMO analyzer setup: In 'Result Overview of Analyzed Zone/Segment' the EVM Data and Pilots will be good, the Pilots will show power and the Null Pilots won't show power.
In case the assignment doesn't match with the DUT MIMO analyzer setup: In 'Result Overview of Analyzed Zone/Segment' the EVM Data and Pilots will be bad, the Pilots will show no power and the Null Pilots will show power.
See also the Result Summary description in case of MIMO-OFDMA/WiBro.

Remote: `CONF:WIM:ANTM:AUTO OFF`
`CONFigure:WIMax:ANTM:ANT <1...4>`

State (MIMO-OFDMA/WiBro)

State defines if the specified analyzer captures data or remains inactive.

Remote: `CONF:WIM:ANTM:STATe <1...4>`

Analyzer IP Address (MIMO-OFDMA/WiBro)

Analyzer IP Address assignes the analyzer to a Rx label – first column. The various measurement results will be indicated by this lable, where it is appropriate. In example the Capture Memory result Rx_k will show the data captured by the analyzer assigned to the IP address in row Rx k.

Remote:
`CONF:WIM:ANTM:ADDR<1..4> '10.114.11.5'`

IQ Settings

The IQ settings contains settings related the Inphase and Quadrature phase of the input signal.

Swap IQ

Swap IQ allows selection between normal and inverted I/Q modulation. The settings for this parameter are:
OFF   Normal I/Q modulation.
ON   I and Q signals are interchanged.

The *Swap IQ* parameter is editable only when *IQ Path* is set to I + j*Q.

Remote: SWAP ON

Input Settings

The Input settings group contains settings related to the input source of the signal to be measured. Note that this group is only available when the B71 option is installed.

Baseband Input

Baseband Input allows the selection between RF and Baseband inputs. The settings for this parameter are:
OFF   RF Input.
ON   Baseband Input.

Remote: INPut:SEL AIQ | RF

Advanced Settings

The Advanced Settings contains settings which control details of how the instrument operates and how measurements are performed.

The advanced settings are displayed on the right hand side of the general settings view, and are only displayed when the Advanced Settings checkbox is checked.
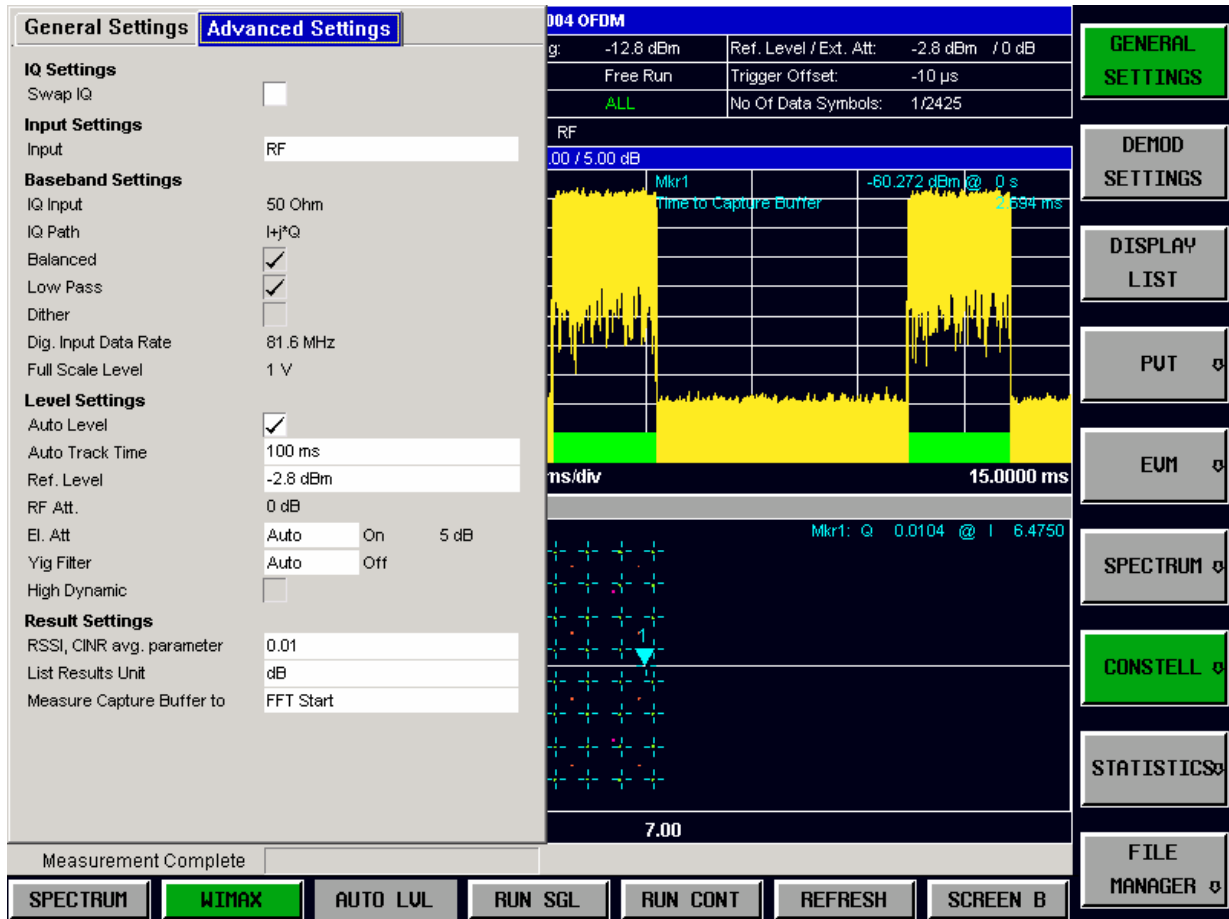
Fig. 80　　　Advanced Settings for SISO-OFDM.
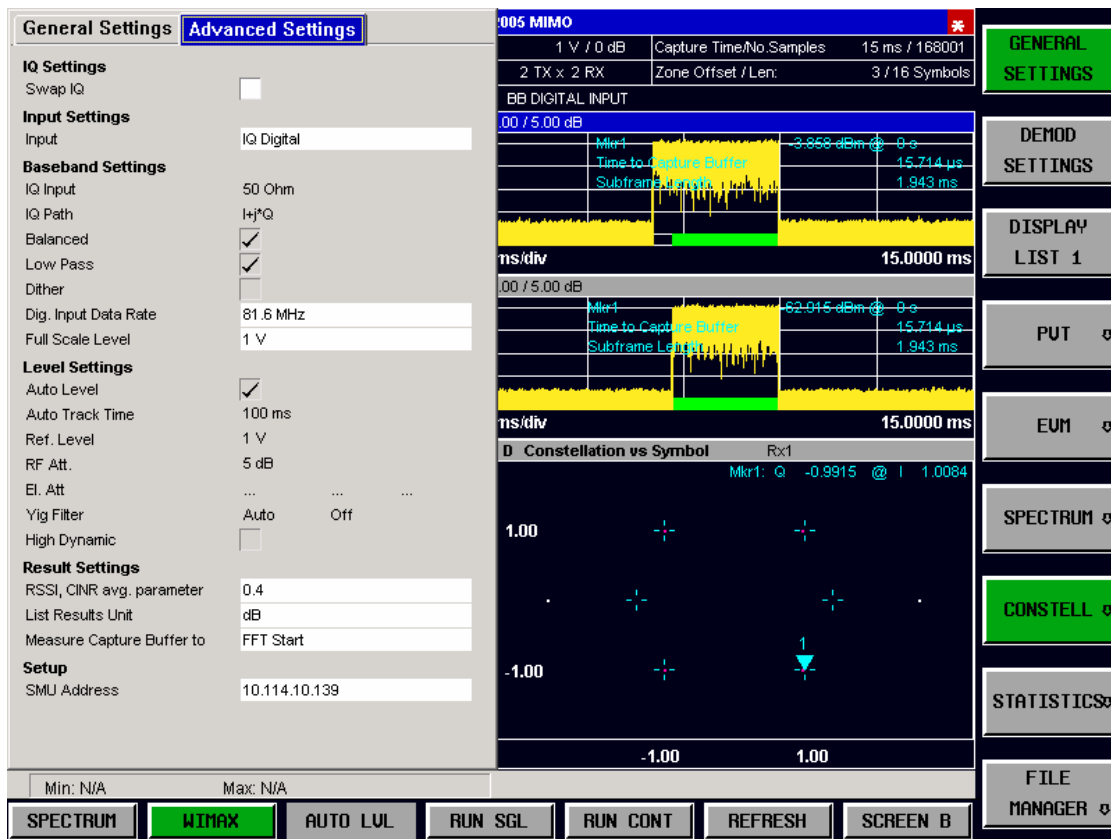
Fig. 81   Advanced Settings for SISO- and MIMO-OFDMA / WiBro.

Swap IQ

Swap IQ allows selection between normal and inverted I/Q modulation. The settings for this parameter are:

OFF   Normal I/Q modulation.

ON   I and Q signals are interchanged.

The *Swap IQ* parameter is editable only when *IQ Path* is set to I + j*Q.

Remote: `SWAP ON`

Input Settings

The input settings group specifies the input path of the signal to be measured. Note this group is only available if the R&S FSQ-B71 I/Q baseband inputs or R&S FSQ-B17 digital baseband interface option is installed.

Input
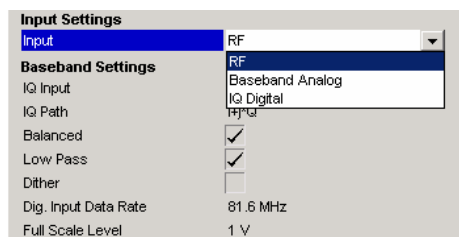
Input allows the selection between RF, Baseband and Digital IQ inputs. The settings for this parameter are RF,Baseband Analog, IQ Digital.

Remote: `INPut:SEL AIQ | RF | DIQ`

Baseband Settings

The baseband settings group contains settings related to the input path of the signal to be measured. Note the appearance of this group depends on the Hw options R&S FSQ-B71 I/Q baseband inputs, R&S FSQ-B17 digital baseband interface being installed.

IQ Input

IQ Input allows the selection of the impedance of the Baseband inputs. The values that can be selected are 50 Ω and 1 kΩ/1 MΩ (depending on the instrument configuration).

The *IQ Input* parameter is editable only when Baseband input is selected.

Remote: `INP:IQ:IMP LOW`

IQ Path

IQ Path allows the selection of the input path for Baseband inputs. Either a single input (either I or Q) may be used or both may be used. If only a single input is selected then the *Swap IQ* parameter is not used and becomes disabled.

The *IQ Path* parameter is editable only when baseband input is selected.

Remote: `INP:IQ:TYPE IQ`

Balanced

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

The *Balanced* parameter is editable only when Baseband input is selected.

Remote: `INP:IQ:BAL ON`

Low Pass

When switched on the *Low Pass* parameter specifies that a filter is applied from 36 MHz for the IQ inputs.

The *Low Pass* parameter is editable only when Baseband input is selected.

Remote: `SENS:IQ:LPAS ON`

Dither

Input Settings	
Input	Baseband Analog
Baseband Settings	
IQ Input	50 Ohm
IQ Path	I+j*Q
Balanced	✓
Low Pass	✓
Dither	
Dig. Input Data Rate	81.6 MHz
Full Scale Level	1 V

When switched on 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.

Remote: `SENS:IQ:DITH 1`

Digital Input Data Rate

Input Settings	
Input	IQ Digital
Baseband Settings	
IQ Input	50 Ohm
IQ Path	I+j*Q
Balanced	✓
Low Pass	✓
Dither	
Dig. Input Data Rate	81.6 MHz
Full Scale Level	1 V

This command defines the input date sample rate read by the digital baseband input. This command is only available with Digital IQ input (B17 option).

Remote: `INP:DIQ:SRAT 81.6 MHZ`

Full Scale Level

Input Settings	
Input	IQ Digital
Baseband Settings	
IQ Input	50 Ohm
IQ Path	I+j*Q
Balanced	✓
Low Pass	✓
Dither	
Dig. Input Data Rate	81.6 MHz
Full Scale Level	1 V

This sets the voltage corresponding to the maximum input value of the digital baseband input. This command is only available with Digital IQ input (B17 option).

Remote: `INP:DIQ:RANG 1 V`

Auto Level

Input Settings Advanced		
Auto Level		
Auto Track Time	100 ms	
Ref. Level	-5 dBm	
RF Att.	5 dB	
El. Att	Auto	On	0 dB
Yig Filter	Auto	Off
High Dynamic		

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

The *Auto Level* advanced settings is the same as the *Auto Level* in the Signal Characteristics. It is repeated in the Advanced Settings for convenience.

Remote: `SENS:SWE:ACPR:TIME:AUTO OFF`

Auto Track Time

Input Settings Advanced		
Auto Level		
Auto Track Time	100 ms	
Ref. Level	-5 dBm	
RF Att.	5 dB	
El. Att	Auto	On	0 dB
Yig Filter	Auto	Off
High Dynamic		

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

Remote: `CONF:POW:AUTO:SWE:TIME 100MS`

Ref Level

Ref Level specifies the reference level to use when running measurements.

When the *Ref Level* is modified the *Signal Level* parameter is updated accordingly (depending on the currently selected standard and measurement type).

The *Ref Level* is editable only when *Auto Level* is switched off.

Remote: `DISP:WIND:TRAC:Y:SCAL:RLEV?`

RF Att

Rf Att specifies the mechanical attenuation to be applied to the input RF signal.

Remote: `INP:ATT 5DB`

El Att

The *El Att* parameters specify the settings for the electronic attenuator.

The *El Att* parameters are:

Mode   Specifies whether the electronic attenuator should be controlled manually (Manual) or by the option (Auto)

State   Specifies whether the electronic attenuator should be switched ON or OFF.

Settings   Specifies the attenuation value the electronic attenuator should be switched to.

When the mode is set to Auto then the state and settings fields will be automatically calculated by the option and so these fields will not be editable.

When the state is switched off the setting field is non-editable.

When the frequency is set such that the electronics attenuator cannot be used then all the Electronic Attenuator fields are read-only.

Remote: `INP:EATT:AUTO ON`

YIG Filter

The *YIG Filter* parameter specifies how the YIG filter is used during measurements.

The *YIG Filter* parameters are:

Mode   Specifies whether the YIG filter should be controlled manually (Manual) or by the option (Auto).

State   Specifies whether the YIG filter should be switched ON or OFF.

When the mode is set to Auto then the state field will be automatically calculated by the option and so this field will not be editable.

Remote: `INP:FILT:YIG:AUTO ON`
          `INP:FILT:YIG:STAT OFF`

High Dynamic

The *High Dynamic* parameter is only available when the B72 option is installed, and the sample rate is set between 20.4 MHz and 40.8 MHz.

When the *High Dynamic* parameter is set to ON then measurements are performed using a wide filter in the normal signal path rather than using the B72 option.

The advantage of setting the *High Dynamic* parameter ON is a higher resolution (because the "normal" signal path uses a 14 bit ADC). The disadvantage is that all signals left or right the spectrum of interest are folded into the spectrum itself.

Remote: `TRAC:IQ:FILT:FLAT`

RSSI, CINR avg parameter

RSSI, CINR avg parameter specifies the mean and standard deviation for the RSSI and CINR results

See [IEEE Std 802.16-2004] "8.3.9.2 RSSI mean and standard deviation", "8.3.9.3 CINR mean and standard deviation".

Remote: `CONF:WIMAX:AVER`

List Results Unit (SISO-OFDM)

List Results Unit specifies the units for the results in the results summary table.

Remote: `UNIT:TABL DB | PCT`

Measure Capture Buffer to …

The Capture Memory display provides the 'Time to Capture Buffer Start' measurement.

In case 'Measure Capture Buffer to FFT Start' the 'Time to Capture Buffer Start' measurement shows the time between the capture buffer start and the FFT start of the first ofdm symbol from the analyzed subframe. For an ideal channel, the FFT start sample is the sample in the center of the cyclic prefix.

In case 'Measure Capture Buffer to Frame Start' the 'Time to Capture Buffer Start' measurement shows the time between the capture buffer start and the first sample of the first ofdm symbol from the analyzed subframe. This is hold for an ideal channel.

IEC/IEEE-bus command:
    `CALC:MARK:FUNC:TTC:STAR FFT | FRAM`

SMU Address (SISO- and MIMO-OFDMA/WiBro)

SMU Address specifies the IP address of an R&S SMU Signal generator. This can be used to load SMU-wimax settings into the FSQ-K93/K94.

Remote: `SYST:COMM:TCP:ADDR '10.114.11.26'`

Demod Settings (SISO-OFDM)

This section of the user manual describes the Demod (Short for Demodulation) Settings view for the SISO-OFDM standard where the settings associated with the signal modulation can be modified.
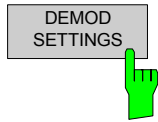
The *DEMOD SETTINGS* softkey brings up the Demod Settings view.
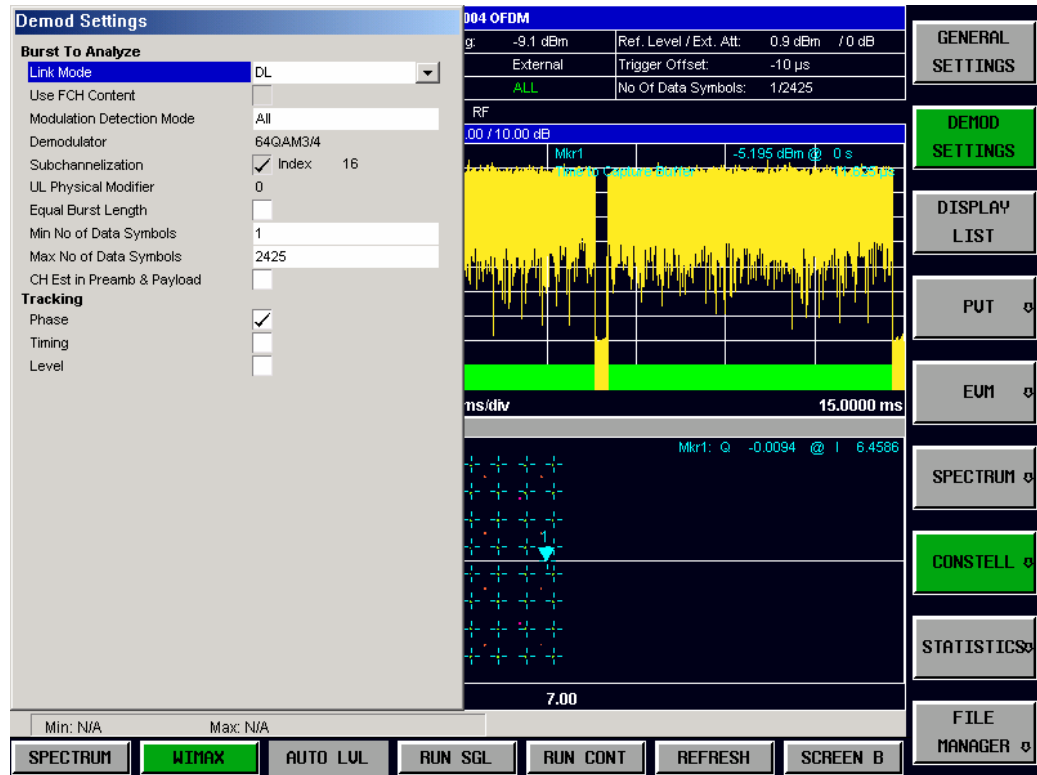
Fig. 82   Demod Settings view (SISO-OFDM standard).

The Demod settings are logically grouped together into:

- Burst to analyze settings
- Tracking settings

When a particular parameter is selected within the Demod Settings view the status bar changes to display information about the valid settings for the selected parameter. The parameters available in the Demod setting view are dependent on the currently selected standard.

Burst To Analyze Settings

The burst to analyze settings specify the characteristics of the bursts to be considered in the measurement results. Only those burst which meet the criteria specified in this group will be included in measurement analysis

Link Mode

Link Mode specifies the Link Mode of burst which should be included in measurement analysis. The following Link Mode types are supported:

UL –   Up Link
DL –   Down Link

Remote: `CONF:WIM:LMOD UL`

Use FCH Content

Use FCH Content specifies whether the FCH field of the captured burst data should be decoded.

When *Use FCH Content* is set to ON then only those bursts whose modulation format matches the modulation format specified in the *PDU Mod to Analyze* parameter are included in the results analysis.

Currently this parameter is always switched off and cannot be modified.

Remote: n.a.

Modulation Detection Mode

Modulation detection mode specifies how the signal should be demodulated. The following values are supported:

None	No modulation detection is performed. The signal will beanalyzed according to the *Demodulator* setting. Therefore the *Demodulator* setting must match with the modulation format of the subframe. This setting excludes the analysis of multiple modulation formats in a subframe.
First Symbol	The first data symbol specifies the modulation format. I.e. the signal will be anaylzed according to the modulation format of the first data symbol. This setting supports multiple modulation formats in a subframe.
User	Only bursts matching the setting in the *Demodulator* setting are analyzed. This setting supports multiple modulation formats in a subframe.
ALL	All bursts individual payload modulations are analyzed accordingly.

When *Modulation detection mode* is set to First Symbol then the *Demodulator* setting is disabled and will automatically update with the modulation scheme detected in the first symbol.

Remote: `SENS:DEM:FORM:BCON:AUTO`
`NON|FIRST|USER|ALL`

Demodulator

Demod Settings	
Burst To Analyze	
Link Mode	DL
Use FCH Content	☐
Modulation Detection Mode	All
Demodulator	BPSK1/2
Subchannelization	✓ Index 16
UL Physical Modifier	0
Equal Burst Length	☐
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	☐

In case *Modulation detection mode* ∈ {*None, User*} *Demodulator* defines the modulation format according to which the signal will be analyzed.

Modulation detection mode = None: The measurement application will apply this modulation format onto the subframe to be analyzed. Therefore, the modulation format defined by this parameter must match with the modulation format of the subframe to be analyzed.

Modulation detection mode = User: The areas of the subframe with the modulation format defined by this parameter will be analyzed.

Important Note: At the moment the R&S FSQ-K92/K93/K94 measurement application can't distinguish between different coding rates for the same modulation format. I.e. if the signal to be analyzed contains the profiles (modulation format A, coding rate B) and (modulation format C, coding rate D). The signal to be analyzed must hold the following condition: $[A == C \Rightarrow B == D]$ in order to produce correct measurement results.

Remote: `SENS:DEM:FORM:BAN <String>`

Subchannelization

Demod Settings	
Burst To Analyze	
Link Mode	UL
Use FCH Content	☐
Modulation Detection Mode	All
Demodulator	BPSK1/2
Subchannelization	✓ Index 16
UL Physical Modifier	0
Equal Burst Length	☐
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	☐

With link mode uplink Subchannelization can be enabled (ticked) this allows the subchannel index of uplink bursts to be analyzed.

Remote: `SENS:SUB:STAT`

Subchannelization Index

Demod Settings	
Burst To Analyze	
Link Mode	UL
Use FCH Content	☐
Modulation Detection Mode	All
Demodulator	BPSK1/2
Subchannelization	✓ Index 16
UL Physical Modifier	0
Equal Burst Length	☐
Min No of Data Symbols	1
Max No of Data Symbols	2425
CH Est in Preamb & Payload	☐

The *Subchannelization index* of uplink bursts to be anlysed. Subchannel Index 16 is the default subchannel with full occupation.

Remote: `SENS:SUB`

UL Physical Modifier

A common *UL Physical Modifier* for all uplink bursts must be chosen by the user.

Remote: `SENS:SUB:ULPH`

Equal Burst Length

Equal Burst Length allows burst with a range of data symbols/bytes or bursts with a specific number of data symbols/bytes to be selected for measurement analysis.

When *Equal Burst Length* is set to ON then the next parameter in the group becomes *No of Data Symbols* and only burst with exactly the number of symbols specified in *No of Data Symbols* are considered for measurement analysis.

When *Equal Burst Length* is set to OFF then the next parameter in the group becomes *Min No of Data Symbols* and bursts with a number of data symbols within the range specified by the *Min No of Data Symbols* and *Max No of Data Symbols* parameters take part in measurement analysis.

Remote: `SENS:DEM:FORM:BAN:SYM:EQU ON`

Min No of Data

Min No of Data Symbols specifies the minimum number of data symbols a burst must have for it to be considered in measurement analysis.

Min No of Data Symbols is only available when *Equal Burst Length* is set to OFF.

Remote: `SENS:DEM:FORM:BAN:SYM:MIN 1`

Max No of Data Symbols

Max No of Data Symbols specifies the maximum number of data symbols a burst must have for it to be considered in measurement analysis.

Max No of Data Symbols is only available when *Equal Burst Length* is set to OFF.

Remote: `SENS:DEM:FORM:BAN:SYM:MAX 2425`

Chan Est in Preamb and Payload
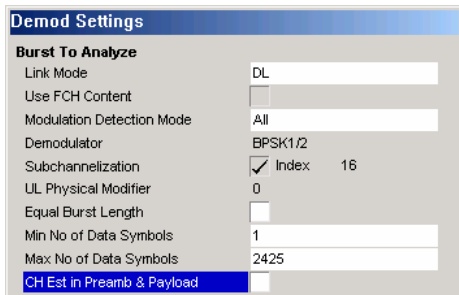
Chan Est in Preamb and Payload specifies how accurately the EVM results should be calculated.

When *Chan Est in Preamb and Payload* is set to OFF then the EVM results are calculated in accordance with the selected standard. In this case channel estimation is done in the preamble only.

When *Chan Est in Preamb and Payload* is set to ON then the EVM results are calculated more accurately. In this case channel estimation is done in both preamble and payload.

Remote: `SENS:DEM:FORM:BAN:SYM:MIN 1`

Tracking Settings

The tracking settings allow various errors in measurement results to be compensated for.

Phase

Phase is used to specify whether or not the measurement results should be compensated for phase error.

When *Phase* is set to ON then the measurement results will be compensated for phase error on a per-symbol basis.

Remote: `SENS:TRACk:PHAS ON`

Timing

Timing is used to specify whether or not the measurement results should be compensated for timing error.

When *Timi*

ng is set to ON then the measurement results will be compensated for timing error on a per-symbol basis.

Remote: `SENS:TRAC:TIME ON`

Level

Level is used to specify whether or not the measurement results should be compensated for level error.

When *Level* is set to ON then the measurement results will be compensated for level error on a per-symbol basis.

Remote: `SENS:TRAC:LEV ON`

Demod Settings(SISO- and MIMO-OFDMA/WiBro)

This section of the user manual describes the Demod (Short for Demodulation) Settings view for the SISO- and MIMO-OFDMA/WiBro standard where the settings associated with the signal modulation can be modified.
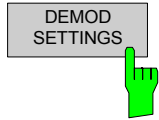
DEMOD
SETTINGS

The *DEMOD SETTINGS* softkey brings up the Demod Settings view.
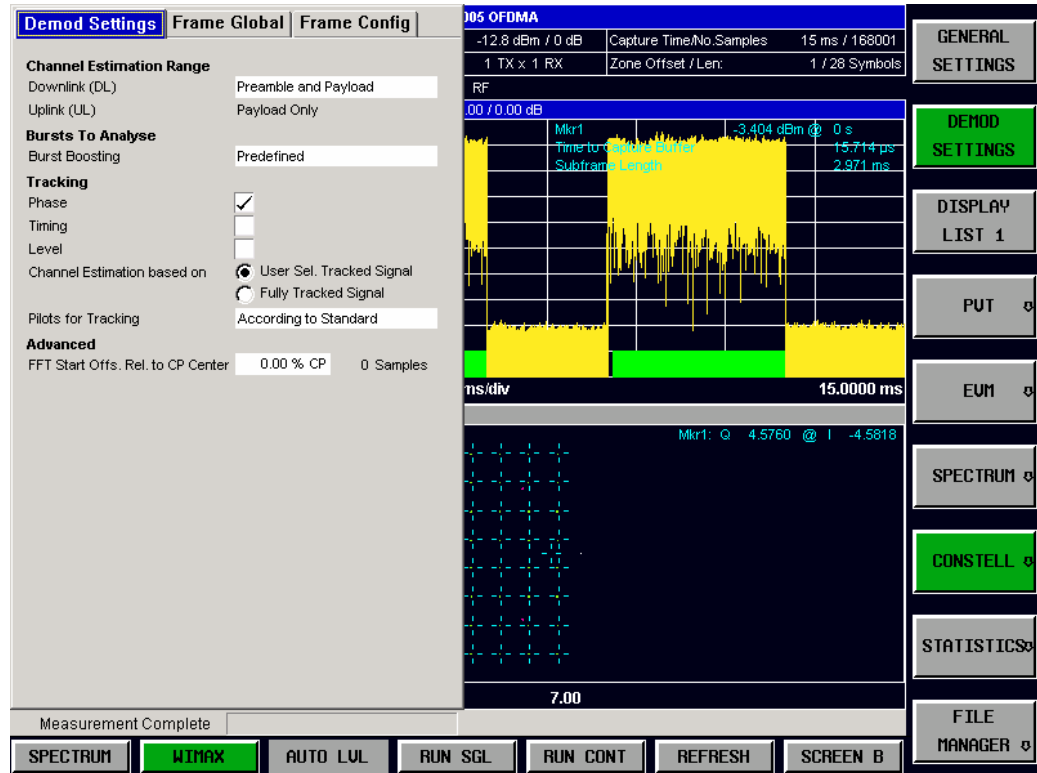
Fig. 83   Demod Settings view SISO-OFDMA/WiBro.
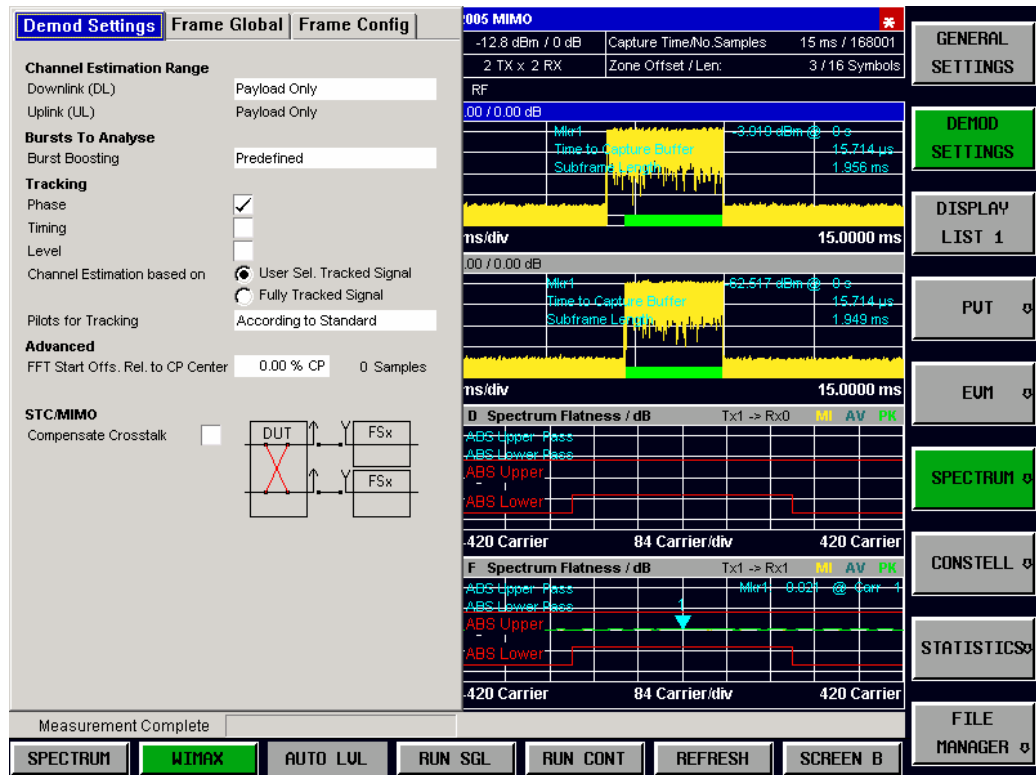
Fig. 84   Demod Settings view MIMO-OFDMA/WiBro.

The Demod settings are logically grouped together into:

- Demod Settings – contains the demodulation settings which are used to analyse the signal.

- Frame Global – contains the general frame settings used in configuring and analysing the signal.

- Frame Config – contains the Zone and Burst setting that specifies a Frame.

When a particular parameter is selected within the Demod Settings view the status bar changes to display information about the valid settings for the selected parameter. The parameters available in the Demod setting view are dependent on the currently selected standard.

Channel Estimation Range

Allows that user to specify the Channel Estimation settings used in measuring a signal.

Downlink (DL)

Downlink (DL) specifies how channel estimation is performed for downlink signals.
Note: only the second or higher DL-zone can be a MIMO zone. Therefore the preamble is never followed by a MIMO zone. For MIMO zone analysis, the Channel Estimation must be *Payload Only*!

Value Range:
Preamble Only
Preamble and Payload [Payload comprises Pilots and Data]
Payload Only

Remote: `SENS:DEM:CEST`

Uplink (DL)

Uplink (DL) specifies how channel estimation is performed for uplink signals. This parameter is read only and is for information purposes only as it indicates that channel estimation for uplink signals is always performed in payload [payload comprises pilots and data] only.

Remote: N.A.

Bursts To Analyze

In this section application settings on burst level are made.

Burst Boosting

Burst Boosting specifies how the information about the burst boosting factors is derived.
Predefined: The burst boosting factors are taken from the Frame Config dialog.
Estimated: The measurement application estimates the burst boosting factors from the signal to be analyzed.

Remote: `CONF:BURS:BOOS    PRED|EST`

Demodulator

Demodulator is read only and is for information purposes only as it indicates the modulation scheme detected in the analyzed signal. For signals using multiple modulation schemes then the modulation scheme with the highest data rate is displayed. This parameter also indicates which limits are applied to the EVM results in the table or results.

Remote: `SENS:DEM:FORM:BAN 'QPSK1/2'`

Tracking Settings

The tracking settings allow various errors in measurement results to be compensated for.

Phase

Phase is used to specify whether or not the measurement results should be compensated for phase error.
When *Phase* is set to ON then the measurement results will be compensated for phase error on a per-symbol basis.

Remote: `SENS:TRAC:PHAS ON`

Timing

Timing is used to specify whether or not the measurement results should be compensated for timing error.
When Timing is set to ON then the measurement results will be compensated for timing error on a per-symbol basis.

Remote: `SENS:TRAC:TIME ON`

Level

Level is used to specify whether or not the measurement results should be compensated for changes in DUT gain over time.
When Timing is set to ON then the measurement results will be compensated for gain on a per-symbol basis.

Remote: `SENS:TRAC:LEV ON`

Channel Estimation Based On

Channel Estimation based on is used to specify if the processing of the Channel Estimation uses the user selected Phase, Timing and Level settings or whether these settings are determined by the DSP, in which case all tracking options are used.

Remote: `SENS:TRAC:CEST USER|FULL`

Pilots for Tracking

Pilots for Tracking is used to specify how the pilot sequence, for is determined for frame synchronisation. The following values are supported:

According to Standard　　　The pilot sequence is computed according to the standard.

Detected　　　　　　　　　The pilot sequence detected in the signal is used.

Remote: `SENS:TRAC:PIL DET`

STC/MIMO Settings

This section contains dedicated STC/MIMO Demod Settings.

Compensate Crosstalk
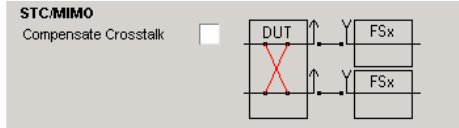
Compensate Crosstalk cleared. A wired MIMO DUT analyzer setup is assumed. Ie the the only crosstalk comes from the DUT itself and contributes as distortion to the measurement results.

Remote: CONFigure:WIMax:STC:CROSstalk OFF
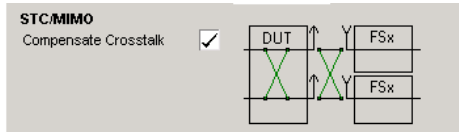
Compensate Crosstalk checked. Any crosstalk either generated by the DUT or the MIMO DUT analyzer setup – in example using the air interface – will be compensated.

Note: *In case of a Matrix A Antenna 0 + Antenna 1 signal Compensate Crosstalk has to be checked in order to demodulate the composite signal.*

Remote: CONF:WIM:STC:CROS ON

Advanced

This section contains the more advanced setting used in analysing the signal.

FFT Start offset rel to CP center

FFT start offset rel to CP center: The application determines the optimal FFT starting point. However this parameter allows you to add an offset to the optimal FFT starting point determined by the Application. The parameter ranges from -100 %, …, 100 % of the Cyclic Prefix [CP] length. The default setting is 0 %. In this case the optimal FFT starting point, determined by the application, is used.

Remote: SENS:FFT:OFFS

Frame Global (SISO- and MIMO-OFDMA/WiBro)

This section of the user manual describes the Frame Global Settings view where the common settings associated with the frame to be analyzed can be modified.
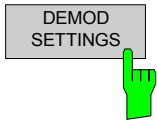
The *DEMOD SETTINGS* softkey brings up the Demod Settings view. Selecting the Frame Global tab displays the Frame Global settings view. Use the left/right arrow to navigate between the tabs.
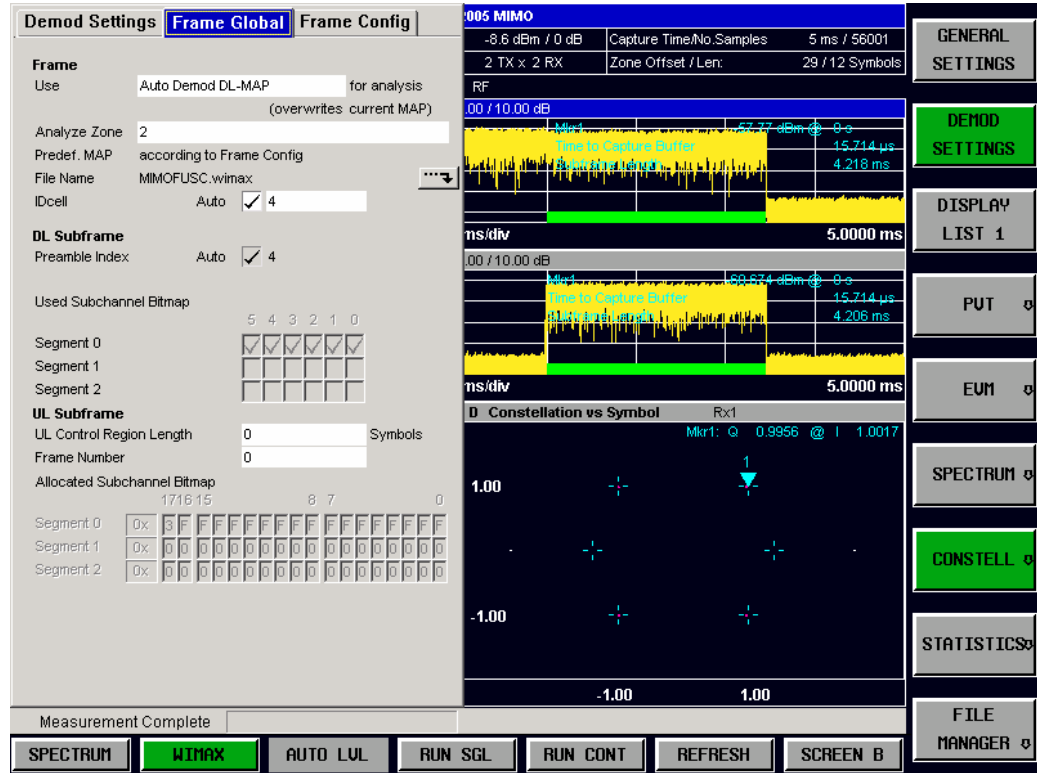
Fig. 85   Frame Global Settings view

Frame

Use … for analysis
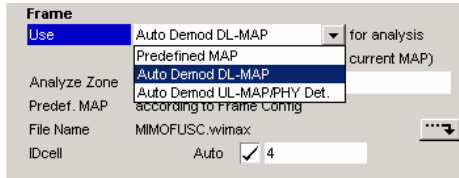
This setting specifies whether the analysis should be performed using the current user-defined frame configuration, or whether automatic determination of the frame configuration according to the signal should be performed.

In case of *Predefined MAP*, the signal is analysed according to the frame definition in Frame Config.

In case of *Auto Demod DL-MAP*, the DL-MAP from the signal is read into the Frame Config dialog. Afterwards the signal is analysed according to the DL-MAP.

In case of *Auto Demod UL PHY Det.* UL signals can be analysed without knowledge about the UL-MAP. The following signals can be measured with *Auto Demod UL PHY Det.*:
- A single UL-PUSC data burst.
- In case the *UL Control Region Length* is specified [>0], a single data burst righthand side to the control region. The content of the control region will be ignored. Currently the user has to specify the *UL Control Region Length* in the Frame Global settings panel.
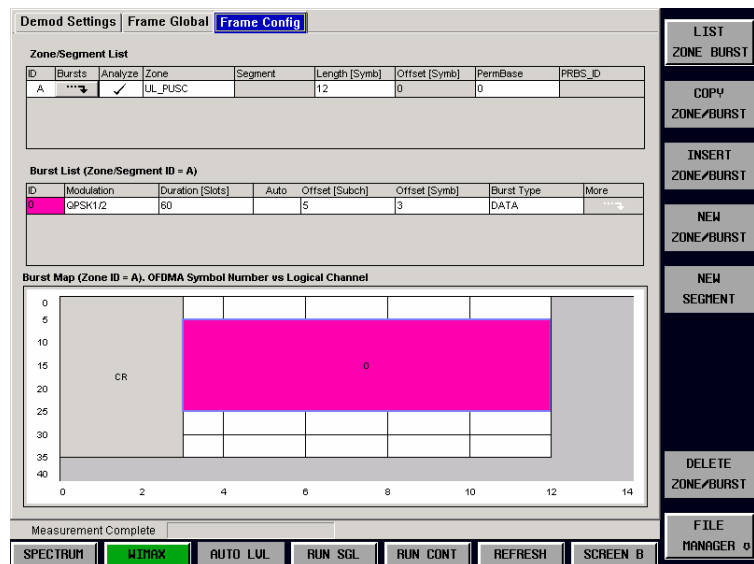
Note:

1. *Automatic detection of the frame configuration requires several measurement parameters to be configured correctly :*
   Frequency, Sample Rate / Channel Bandwidth, FFT size, Guard Time.

2. *In case of UL Auto Demod. PHY Det. the following steps are required:*
   - Pilots for Tracking must be set to Detected. Selecting UL Auto Demod PHY Det. will set Pilots for Tracking to Detected automatically.
   - For the MIMO mode: Selecting UL Auto Demod PHY Det. will generate a dummy UL-PUSC zone in Frame Config. The user must specify the following two settings

*Zone/Segment List|More|STC MIMO Config and
Zone/Segment List|More|STC Mode
in order to perform an UL auto demod measurement. All
the other settings will be rerplaced by the application
after a successful measurement according to the UL
frame configuration of the signal.*

3. *After a successful auto demod measurement the Frame
   Config dialog will contain the frame configuration
   according to the parameters detected in the signal!*

Remote: `DEM:FORM:AUTO PRED | DLMap | ULPH`

Analyze Zone

In Frame Global *Analyze Zone* is enabled exclusively for auto
demod. It allows any zone to be analyzed, which is available in
the signal, in connection with auto demod. In case the
specified zone is not available in the signal, the zone to be
analyzed will be adjusted to the last available zone in the
signal.

Remote: `CONF:WIM:FRAM:ZONE LAST|Z1|Z2|Z3|Z4|Z5|`
`Z6|Z7|Z8|Z9|Z10|Z11|Z12|Z13|Z14|Z15|Z16`
`|Z18|Z19|Z20|Z21|Z22|Z23|Z24|Z25|Z26`

File Name

File Name indicates the name of the loaded R&S SMx[7]
*.wimax settings file. If no file is loaded then '….' is displayed.
To load a R&S SMx setting file, select the parameter and press
the icon displayed. The File Manager dialog is opened.

Note: *Loading a R&S SMx *.wimax file, selects
               automatically "Predefined MAP" analysis mode.*

Remote: `MMEM:LOAD:FRAM:STAT`

IDCell

IDCell affects the definition of the preamble sequence (in
conjunction with the used segments according to the *Used
Subchannel Bitmap* selection), the pilot sequence of the
first zone and the subchannel definition of the first zone. For
the availability of these controls see section 'Dependencies
between the Use … for analysis, IDcell and Preamble Index
settings' further down.

Auto checked: The IDcell is determined from the signal by
the application.
Auto cleared: The IDcell from the text edit control is used
by the application.

Remote:
`CONF:WIM:FRAM:IDC:AUTO OFF|ON`
`CONF:WIM:FRAM:IDC 0…31`

---

[7] SMU, SMATE, SMJ, SMBV, SMU simulation.

Dependencies between the *Use … for analysis*, *IDcell* and *Preamble Index* settings

Use Predefined MAP for analysis:

Analyze Zone control: disabled.	

IDcell controls:
    Auto check box: disabled and cleared.
    Text edit control: enabled.	

Preamble Index controls: Auto check box: enabled.	

Auto check box cleared
    Text edit control enabled.
	Auto check box checked
	    Text edit control disabled.

Used Subchannel Bitmap controls: Check boxes enabled.	

Use Auto Demod DL-MAP for analysis:

Analyze Zone control: enabled.	
IDcell controls: Auto check box: enabled.	

Auto check box cleared
    Text edit control enabled.
	Auto check box checked
	    Text edit control disabled.

Preamble Index controls:
    Auto check box:
        IDcell Auto checked => disabled.
        IDcell Auto cleared => enabled.	

Auto check box cleared
    Text edit control enabled.
	Auto check box checked
	    Text edit control disabled.

Used Subchannel Bitmap controls: Check boxes disabled.	

DL Subframe

Preamble Index
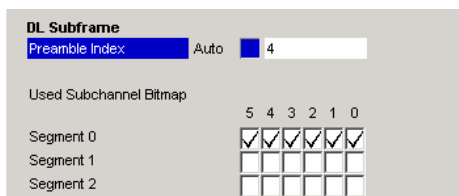
The *Preamble Index* defines the preamble pattern – according to the standard – to be used by the application. For the availability of these controls see section 'Dependencies between the Use … for analysis, IDcell and Preamble Index settings' further down.

Auto checked: The *Preamble Index* is derived from the *IDcell* and *Used Subchannel Bitmap* settings.

Auto cleared: The *Preamble Index* from the text edit control is used by the application.

Remote:
```
CONF:WIM:DLSF:PRE:MODE AUTO|USER
CONF:WIM:DLSF:PRE:IND 0…113
```

Used Subchannel Bitmap

Used Subchannel Bitmap assigns subchannel groups to segments. See [802.16e-2005].360 Table 268a Subchannel index of the six subchannel groups. This table defines how many subchannels will be available for the Burst List belonging to the corresponding segment of a DL-PUSC zone [with Use All Subchannels being false]. In the Burst List - corresponding to the segment – this selection controls the height of the white area in the burst map.

Remote: `CONF:WIM:DLSF:SEGM3 1`

UL Subframe

UL Control Region Length

UL Control Region Length specifies the length, in symbols, of a control region to be found at the start of the first UL zone.

The control region will not be analysed, but the length must be specified to allow synchronisation.

Remote: `CONF:WIM:ULSF:CRL`

Frame Number

Frame Number specifies the number of the frame to be analyzed.
In case '*Demod Settings | Pilots for Tracking = According to Standard*' only the UL-subframes with the specified *Frame Number* will be analyzed.
In case '*Demod Settings | Pilots for Tracking = Detected*' the *Frame Number* setting is ignored and all UL-Subframes will be analyzed.

Remote: `CONF:WIMAX:ULSF:FRAM`

Frame Config (SISO- and MIMO-OFDMA/WiBro)

This section of the user manual describes the Frame Config Settings view where the settings associated with the frame configuration can be modified.
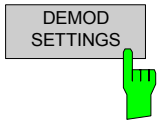
The *DEMOD SETTINGS* softkey brings up the Demod Settings view. Selecting the Frame Config tab displays the Frame Config settings view. Use the left/right arrow to navigate between the tabs.

Fig. 86   SISO-OFDMA/WiBro Frame Configuration Settings view.

| Demod Settings | Frame Global | **Frame Config** | | | | | | | | LIST ZONE BURST |

Zone/Segment List

ID	Bursts	Analyze	Zone	Segment	Length [Symb]	Offset [Symb]	PermBase	PRBS_ID	More
A	⋯↴		DL_PUSC	0	2	1	4	1	⋯↴
B	⋯↴	✓	DL_PUSC	0	16	3	4	1	⋯↴

Burst List (Zone/Segment ID = A)

ID	Modulation	No.of Subch	No.of Symb	Offset Subch	Offset Symb	Power [dB]	Burst Type	More
C0	QPSK1/2	4	2	0	0	0	FCH	⋯↴
C1	QPSK1/2		7 Slots	4	0	0	DL_MAP	⋯↴
2	16QAM3/4	19	2	11	0	0	DATA	⋯↴

Zone/Segment Map. 2 DL-Zones[18 Symbols]. 0 UL-Zones [0 Symbols]

1	2 Symbols	16 Symbols
D L - P r e a m b l e	DL_PUSC, Seg = 0 Zone/Seg ID = A	DL_PUSC, Seg = 0 Zone/Seg ID = B

Measurement Complete

| SPECTRUM | WIMAX | AUTO LVL | RUN SGL | RUN CONT | REFRESH | SCREEN B |

Buttons on right panel: COPY ZONE/BURST, INSERT ZONE/BURST, NEW ZONE/BURST, NEW SEGMENT, DELETE ZONE/BURST, FILE MANAGER ⇩

Fig. 87   MIMO-OFDMA/WiBro Frame Configuration Settings view

The Frame Configuration Settings view comprises three parts:

- the Zone/Segment List

- the Burst List

- a graphical panel which shows, depending on the current selection, either the Zone/Segments of the configuration, or the bursts of the current zone.

Zone/Segment List (SISO- and MIMO-OFDMA/WiBro)

Fig. 88   Definition of the Zone Offset [red arrows] and the Zone Length [green arrows] parameters from the Zone/Segment List

Zone/Segment List parameters:

1. **ID**
   Provides a unique ID for the zone. This parameter is read only. If there are any errors in the zone/segment configuration then the background of this item will be red.

2. **Bursts**
   Pressing the roll-key or ENTER on tyhis field causes the Burst List to become selected and the Burst Map to be displayed.

3. **Analyze**
   Defines the Zone/Segment to be analyzed. Note that only one sone/segment can be marked for analysis at any given time.

4. **Zone**
   Defines the zone type. The following types are supported:
   DL-PUSC
   DL-FUSC
   DL-AMC 2x3 (SISO only)
   UL-PUSC
   UL-AMC 2x3 (SISO only)

5. **Segment**
   Defines the segment for a DL-PUSC zone.
   Note: in case of DL-FUSC, this parameter has no effect.

6. ***Length [Symb]***
   Defines the length in OFDMA Symbols of the zone.
   The zone *Length* must be a multiple of the number of symbols per slot. In case this condition is not hold a '*Zone/Burst configuration Error*' is displayed in the status bar and the measurement won't start.

7. ***Offset [Symb]***
   Defines the offset in OFDMA Symbols from the start of the subframe.
   Note I: The first DL-PUSC zone starts with 1.
   Note II: The first UL-PUSC zone starts with 0.

8. ***PermBase***
   This parameter is required for the computation of the subchannel – physical carrier assignment permutation.

9. ***PRBS_ID***
   Is required for the computation of the pilot sequence.

Remote: `CONF:WIM:ZONE1:CONT`

Zone/Segment List Down Link (MIMO-OFDMA/WiBro)

Fig. 89   Pressing the [⋯↴] button in the Zone/Segment List | More column invokes the More Zone/Segment Settings dialog.

Zone/Segment List | More parameters:

1. **STC/MIMO Config**
   Sets the number of Tx Antennas the DUT is operating with for the specified zone/segment. This value can be set for each zone/segment and is limited by the maximal value specified in '*General Settings | DUT MIMO Configuration*'. In case this '*General Settings | DUT MIMO Configuration*' value is set to '*1 Tx Antenna*' SISO operation, only SISO operation for all zone/segments is possible. Ie. no MIMO operation for any zone/segment.
   No STC specifies SISO operation for this zone/segment.

2. **Matrix Indicator**

Matrix A:	Each burst assigned to this zone/segment will be MIMO matrix A encoded.
Matrix B:	Each burst assigned to this zone/segment will be MIMO matrix B encoded.
Burst Defined:	The MIMO Matrix encoding is defined for each burst individually in the burst list assigned to this zone/segment.

Remote: `CONF:WIM:ZONE1:CONT`

Zone/Segment List Up Link (MIMO-OFDMA/WiBro)
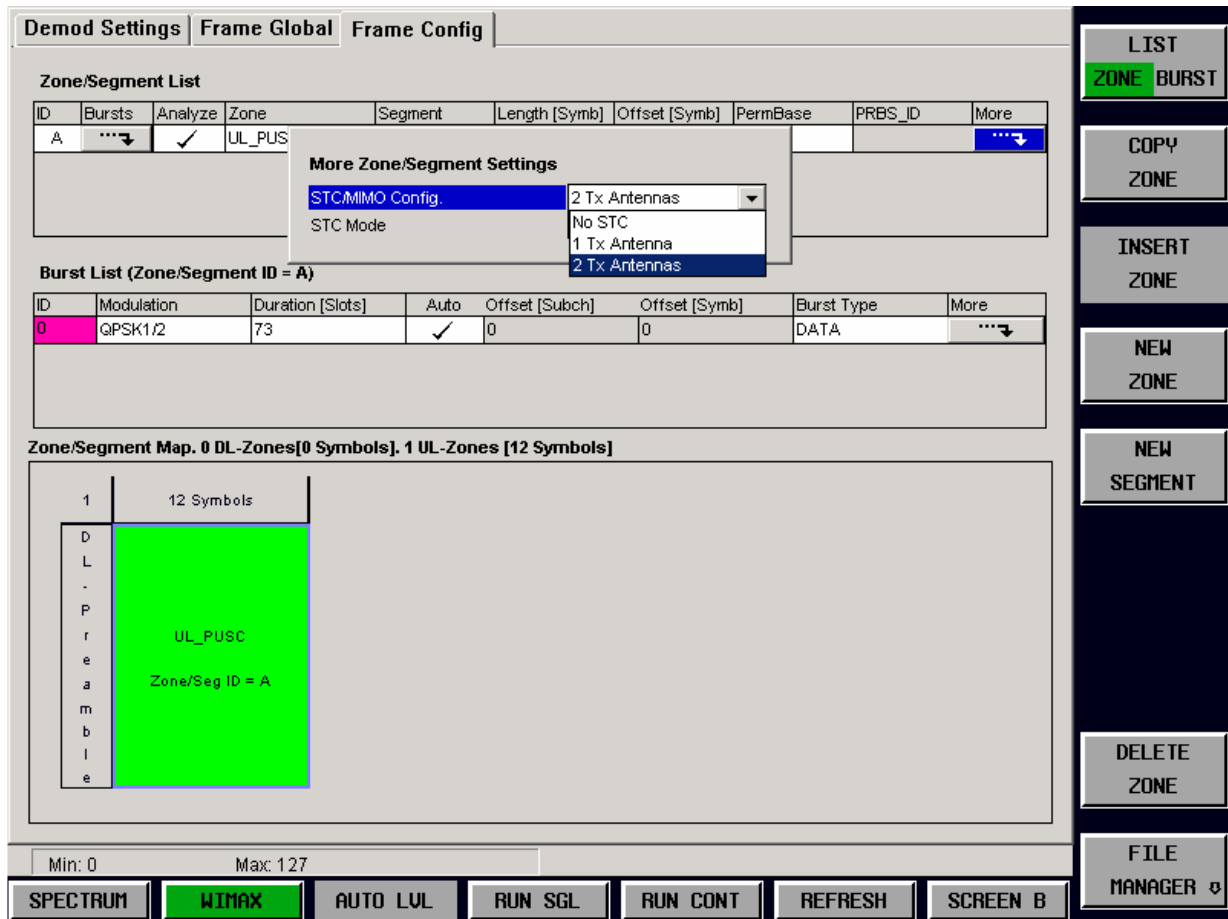
Fig. 90   Pressing the ⬛ button in the Zone/Segment List | More column invokes the More Zone/Segment Settings dialog.

Zone/Segment List | More parameters:

1. **STC/MIMO Config**
   Sets the number of Tx Antennas the DUT is operating with for the specified zone/segment. This

value can be set for each zone/segment and is limited by the maximal value specified in '*General Settings | DUT MIMO Configuration*'. In case this '*General Settings | DUT MIMO Configuration*' value is set to '*1 Tx Antenna*' SISO operation, only SISO operation for all zone/segments is possible. Ie. no MIMO operation for any zone/segment.

No STC specifies SISO operation for this zone/segment.

2. **STC Mode**

STTD[8]:	Each burst assigned to this zone/segment will be Alamouti encoded. This corresponds to matrix A encoding in DL.
Spatial Multiplexing:	Bursts assigned to this zone/segment will be transmitted simultenously over the two antennas of the mobile. Ie. collaborative multiplexing. This corresponds to matrix B encoding in DL.
Burst Defined:	The MIMO encoding is defined for each burst individually in the burst list assigned to this zone/segment.

Remote: `CONF:WIM:ZONE1:CONT`

Burst List (SISO- and MIMO-OFDMA/WiBro)

Burst List DL (Down Link)
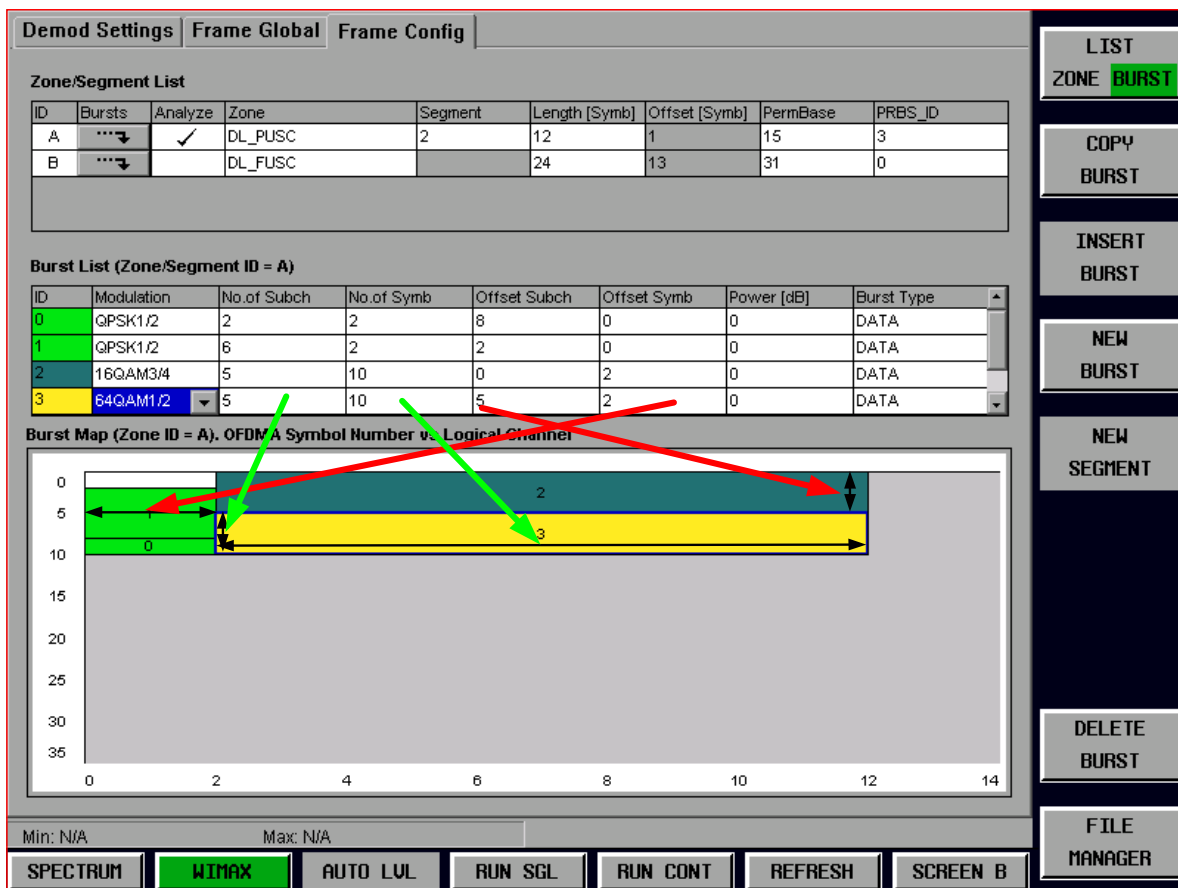
Fig. 91   DL-Burst List demonstrating the Burst Offset [red arrows] and the Burst Length [green arrows] parameters.

---

[8] Space Time Transmit Diversity (STTD).

DL-Burst List parameter:

1. *ID*
Provides a unique ID for the burst. This parameter is read only. The background colour of this parameter reflects the modulation of the burst. If there are any errors in the burst configuration then the background of this item will be red.

2. *Modulation*
Defines the modulation format of the burst. Identical modulation formats use the same colour in the Burst Map.

3. *No. of Subch.*
Defines the number of logical Subchannels occupied by the burst.

4. *No. of Symb.*
Defines the number of OFDMA symbols occupied by the burst.
The *No. of Symb.* must be a multiple of the number of symbols per slot. If this condition is not met a '*Zone/Burst configuration Error*' is displayed in the status bar and the measurement won't start.

5. *Offset Subch*
Defines the offset in logical subchannels from subchannel 0.

6. *Offset Symb*
Defines the offset in OFDMA symbols. The start of the zone defines symbol 0.
The *Offset Symb.* must be a multiple of the number of symbols per slot. If this condition is not met a '*Zone/Burst configuration Error*' is displayed in the status bar and the measurement won't start.

7. *Power[dB]*
Defines the boosting factor of the burst.

8. *Burst Type*
Defines the burst type from the protocol layer perspective.
FCH,
DL-MAP,
UL-MAP,
DATA,
HARQ

Remote: `CONF:WIM:ZONE1:BURS1:CONT`

Burst List DL (MIMO-OFDMA/WiBro)

Fig. 92　　　Pressing the [image] button in the Burst List | More column invokes the More Burst Settings dialog.

Burst List | More parameters[9]:

Matrix Indicator
This control is available if and only if *Matrix Indicator = Burst Defined* for the corresponding zone/segment from the Zone/Segment List.

Matrix A:　　　　Each burst assigned to this zone/segment will be MIMO matrix A encoded.
Matrix B:　　　　Each burst assigned to this zone/segment will be MIMO matrix B encoded.

Remote: `CONF:WIM:ZONE1:BURS1:CONT`

---

[9] Currently the Burst List buttons from the More column are enabled if and only if the *Matrix Indicator = Burst Defined* for the corresponding zone/segment from the Zone/Segment List.

Burst List Up Link (UL)
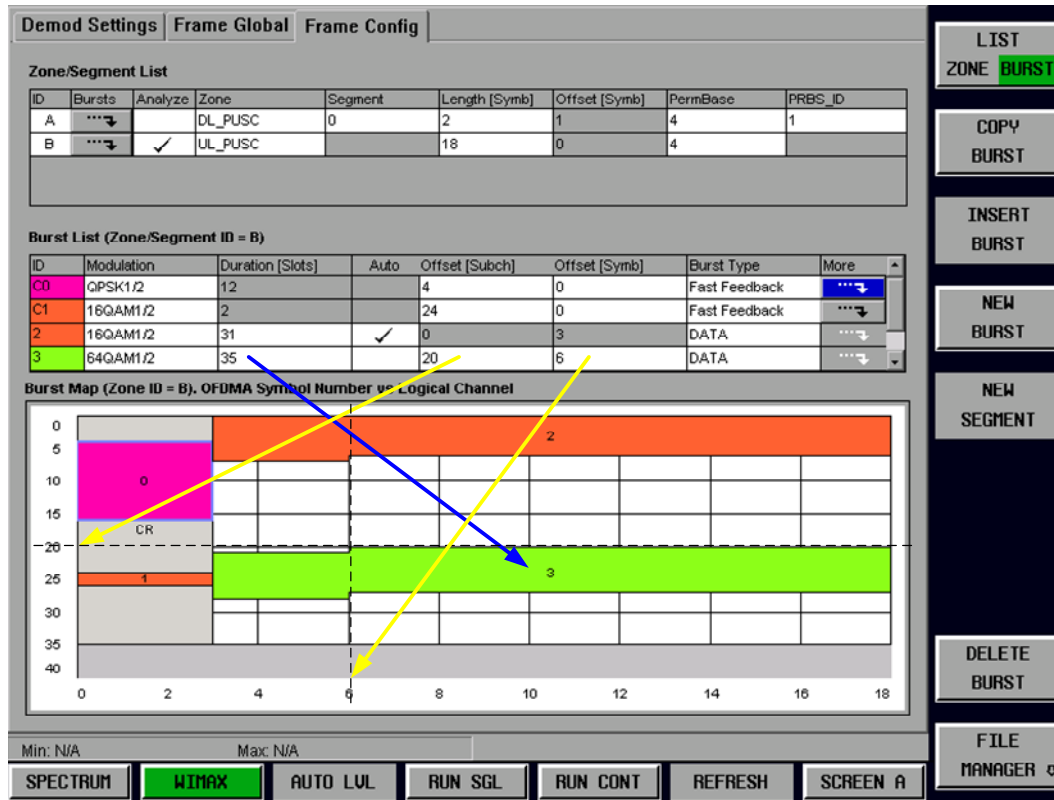
Fig. 93   UL-Burst List defining UL-Data Bursts and UL-Fast Feedback Bursts. Also the Duration [blue arrow] and the Offset [yellow arrow] parameters are demonstrated. The Control Region CR at the beginning of the zone is defined in '*Frame Global | UL Control Region Length = 3*'.

UL-Burst List parameter:

1. *ID*
   Provides a unique ID for the burst. This parameter is read only. The background colour of this parameter reflects the modulation of the burst. If there are any errors in the burst configuration then the background of this item will be red.

2. *Modulation*
   Defines the modulation format of the burst. Identical modulation formats use the same colour in the Burst Map.

3. *Duration [Slots]*
   Specifies the area in slots occupied by the burst.

4. *Auto*
   Ticked**:** The burst starts with the first available slot after the previos burst – in case there is any. Offset Subch and Offset

5. *Offset Subch*
   Defines the offset in logical subchannels from subchannel 0.

6. *Offset Symb*
   Defines the offset in OFDMA symbols. The start of the zone defines symbol 0.
   The *Offset Symb.* must be a multiple of the number of symbols per slot. If this condition is not met a '*Zone/Burst configuration Error*' is displayed in the status bar and the measurement won't start.

7. *Burst Type*
   Defines the burst type from the protocol layer perspective.
   Data,
   Fast Feedback

Remote: `CONF:WIM:ZONE1:BURS1:CONT`

Fig. 94   Pressing the [button] button in the Burst List | More column invokes the More Burst Settings dialog. This button is only for specific *Burst Types* enabled.

Burst List UL (MIMO-OFDMA/WiBro)

Fig. 95   Pressing the [button] button in the Burst List | More column invokes the More Burst
            Settings dialog.

Burst List | More parameters[10]:

STC Mode
This control is available if and only if *STC Mode = Burst Defined* for the corresponding zone/segment
from the Zone/Segment List.

2 Tx STTD: Each burst assigned to this zone/segment will be Alamouti encoded.
                            This corresponds to matrix A encoding in DL.
1 Tx Spatial Multiplexing: Two mobiles transmit simultaneously at the same time, frequency allocation
                            [collaborative multiplexing].
2 Tx Spatial Multiplexing: Bursts assigned to this zone/segment will be transmitted simulatenously
                            over the two antennas of the mobile. Ie collaborative multiplexing.
                            This corresponds to matrix B encoding in DL.

Remote: CONF:WIM:ZONE1:BURS1:CONT

---

[10] Currently the Burst List buttons from the More column are enabled if and only if the *Matrix Indicator = Burst Defined* for the corresponding zone/segment from the
Zone/Segment List.

Zone/Segment Map
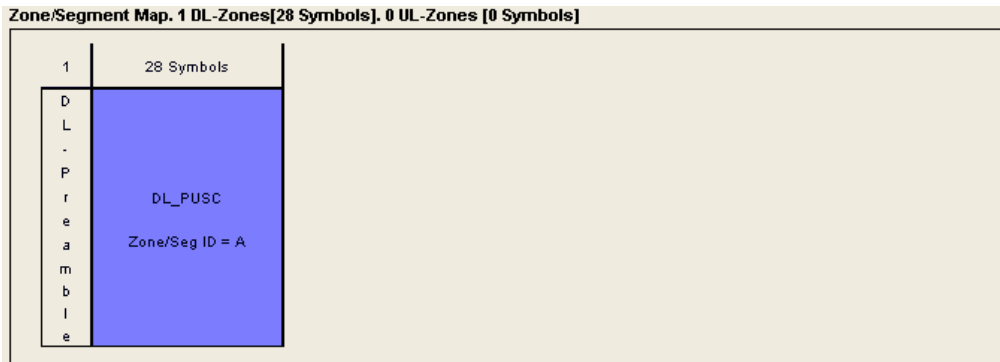
Fig. 96   Zone/Segment Map

The Zone/Segment map is displayed at the bottom of the Frame Config dialog when the zone/segment list has focus. The Zone/Segment map displays a graphical view of the Zone/Segment list. The currently selected zone/segement in the Zone/Segment list is highlighted in the Zone/Segment map.

Burst Map
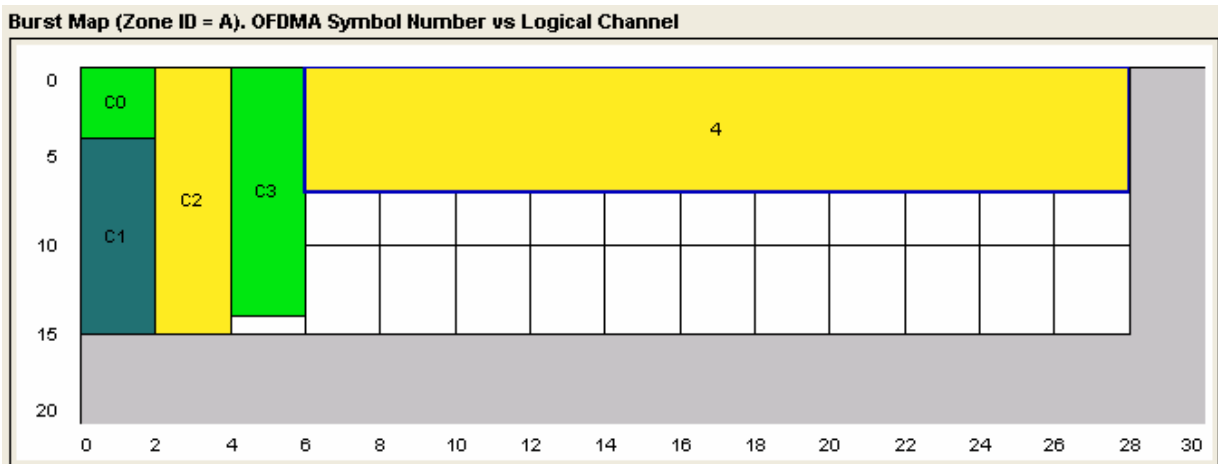
Fig. 97   Burst Map

The Burst map is displayed at the bottom of the Frame Config dialog when the burst list has focus. The Burst map displays a graphical view of the Burst list. The currently selected burst in the Zone/Segment list is highlighted in the Burst map. The background color of each burst in the diagram corresponds to the modulation format of the burst. Any burst that is incorrectly configured will be displayed with a red background. In example if the burst definition exceeds the available time x subchannel area [indicated white in the graphic above].
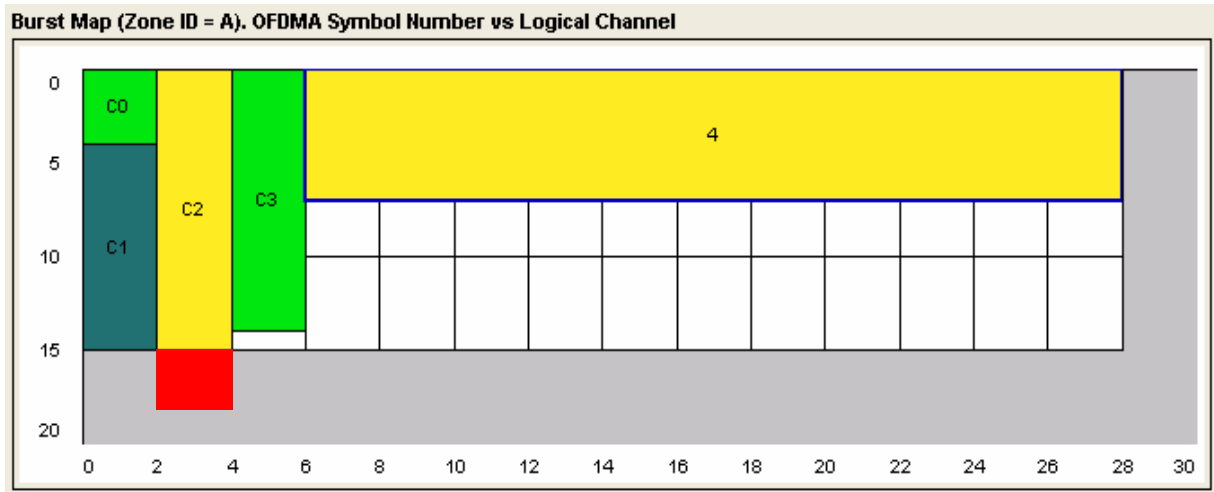
Fig. 98　　Burst Map with Burst C2 exceeding the available amount of logical subchannels. The area causing the problem is highlighted red.

In this case the measurement won't start unless the frame definition is correct. In the example above this might be achived by.
a. reducing the number of subchannels for burst C2 in the Burst List or
b. assigning more subchannels to the zone/segment to which burst C2 belongs or
c. increase N_{FFT} .

The burst editing changes slightly when a burst is specified as DL_MAP. Instead of specifying the number of subchannels and symbols for the burst, the number of slots is specified.
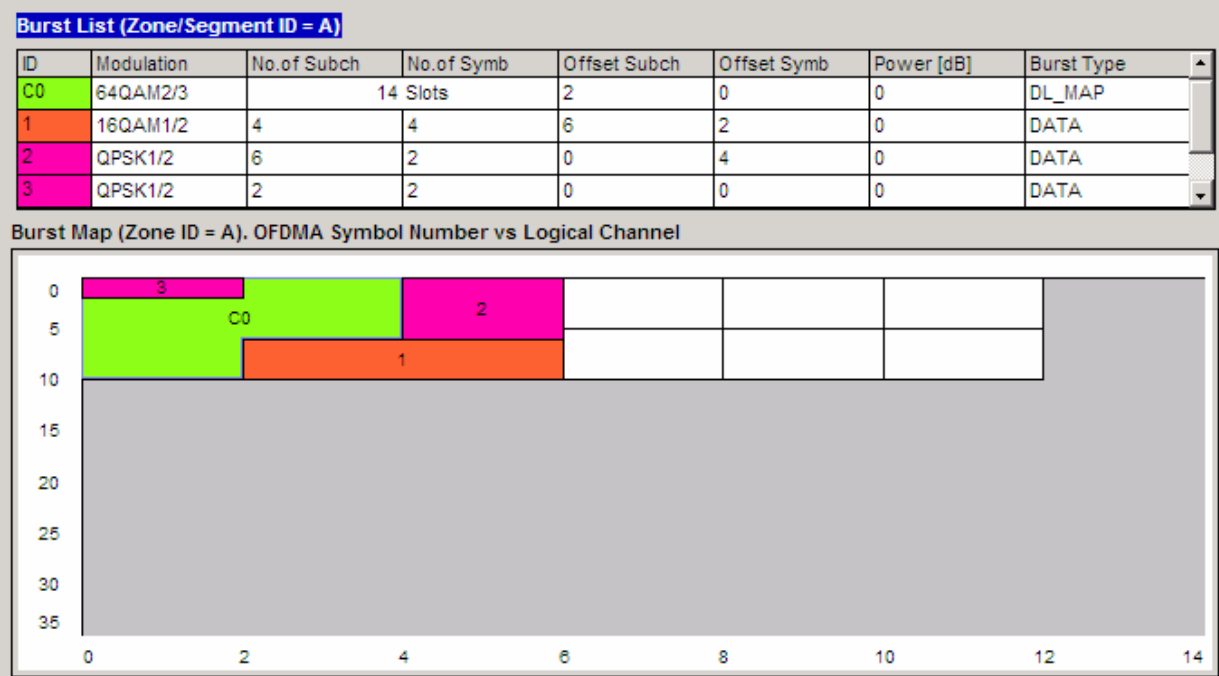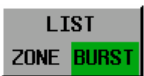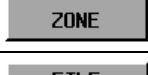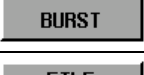
Fig. 99　　Zone containing a wrapping DL_MAP burst (C0). Note the shape of the burst, which fills the available symbols in the first column (of two symbols), and then uses the second column.

Frame Config Softkeys

Zone Softkeys	Burst Softkeys	Description
LIST ZONE BURST	LIST ZONE BURST	Toggles between the Zone and Burst lists. The green highlight indicates which list is currently selected.
COPY ZONE	COPY BURST	Copies the currently selected Zone/Burst into the copy buffer.
INSERT ZONE	INSERT BURST	Inserts a Zone/Burst which has been copied into the copy buffer after the currently selected Zone/Burst. This softkey is disabled until a Zone/Burst has been copied.
NEW ZONE	NEW BURST	Creates a new Zone/Burst after the currently selected Zone/Burst.
NEW SEGMENT	NEW SEGMENT	If a DL_PUSC burst is selected then a new segment will be created for this Zone. The segment ID will be the next available ID after the last DL_PUSC segment in the Zone. If there are no free IDs available for the Zone a new DL_PUSC Zone is created and the segment ID is set to 0. If the selected Zone is not a DL_PUSC then a new Zone is created. Disabled when the Burst list is selected.
DELETE ZONE	DELETE BURST	Deletes the currently selected Zone/Burst. If a Zone is deleted then all of the Zones bursts are also deleted.
FILE MANAGER ⇩	FILE MANAGER ⇩	Navigates to the File Manager dialog. This dialog allows *.WiMax file to be loaded. These files are generated using the SMU.

File Manager

This section of the user manual describes the File Managerview, which provides the possibility to load WIMAX settings files saved from a R&S SMU signal generator, as well as providing some general file management support.

The File Manager is enabled for all standards, however .WIMAX files can only be loaded when in the IEEE 802.16e-2005 OFDMA or the WiBro standard.

Note: *The File Manager will write only*
            a. to the directory D:\USER\WMAN and its subdirectories or
            b. to a USB memory stick.
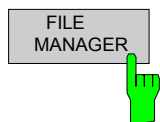
FILE MANAGER   The *FILE MANAGER* softkey brings up the File Manager view.
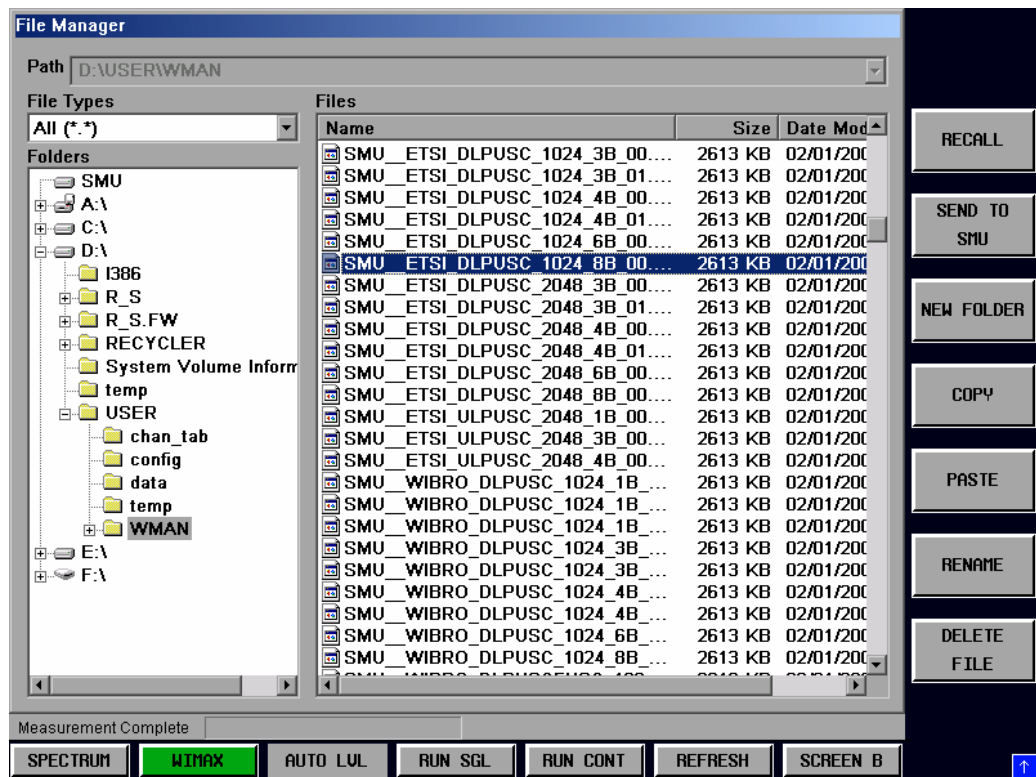
Fig. 100   File Manager view

The roll-key is used to navigate between the different sections of the file manager dialog. Pressing the roll key (or pressing the ENTER key) enters the selected section. To return back to navigating through the different sections of the File Manager dialog press the ESC key.

File Type

The *File Type* parameter applies filtering to the files view. The following selections are available:

- All (*.*)   – This selection allows all file types to be displayed. Use this selection when performing general file management tasks.

- SMU WiMax – This selection allows only files with the extension .wimax to be displayed. Use this selection when using the file manager to locate and load SMU signal files.

Loading settings from a file on the local instrument
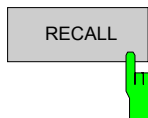
RECALL

Select a .WIMAX file and clicking the RECALL softkey. WiMax files can only be loaded in OFDMA or WiBro modes.
Remote: `MMEM:LOAD:FRAM:STAT 1,'D:\USER\DATA.WiMax'"`

Transfer settings between R&S FSQ and R&S SMU

If an R&S SMU signal generator is connected via LAN then settings can be transferred between the R&S SMU and R&S FSQ. In order for settings to be transferred the R&S SMU and R&S FSQ must be networked and the TCP-IP address of the SMU must be specified in the General Settings – Advanced Settings panel. See description *SMU Address* above.

In order to access the SMU via LAN the SMU Windows Firewall has to be switched Off. See figure below.
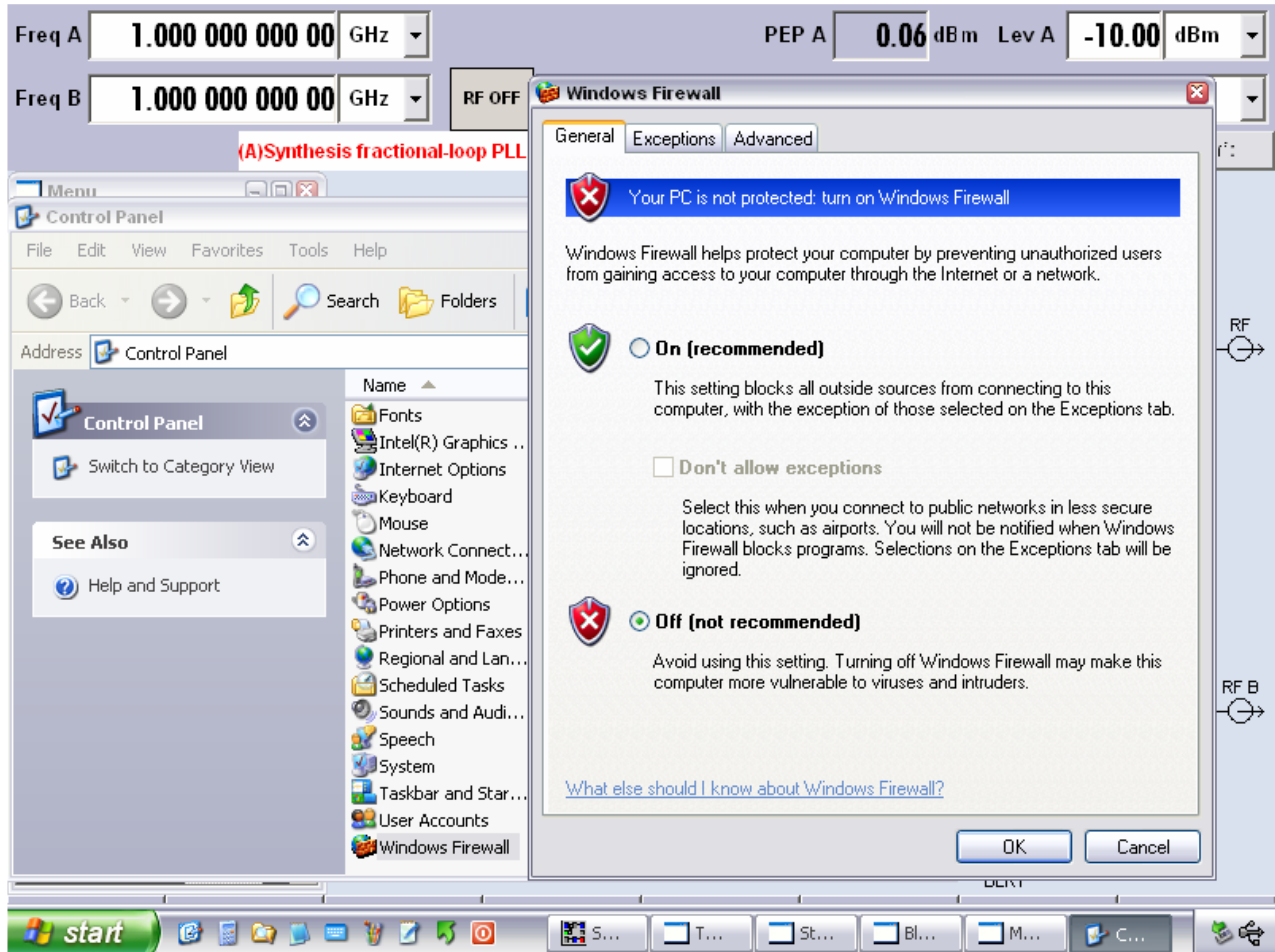
Fig. 101   SMU Windows Firewall setting, in order to access the SMU via LAN from the R&S FSQ.

Download from R&S FSQ to R&S SMU
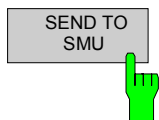
SEND TO SMU

An SMU WIMAX settings file (.WIMAX) file can be downloaded from the FSQ to the SMU using the filemanager. Download is achieved by selecting the file to be downloaded then pressing the SEND TO SMU soft-key.

Remote: `MMEM:STORE:FRAM:STAT 1,'D:\USER\DATA.WiMax'"`

Upload from R&S SMU to R&S FSQ
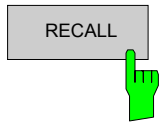
RECALL

The WIMAX settings active on the SMU can be uploaded to the FSQ using the filemanager. Upload is achieved by selecting the SMU entry in the *Folders* list then selecting *Current SMU WiMax Settings* in the *Files* list and the pressing the *RECALL* soft-key.
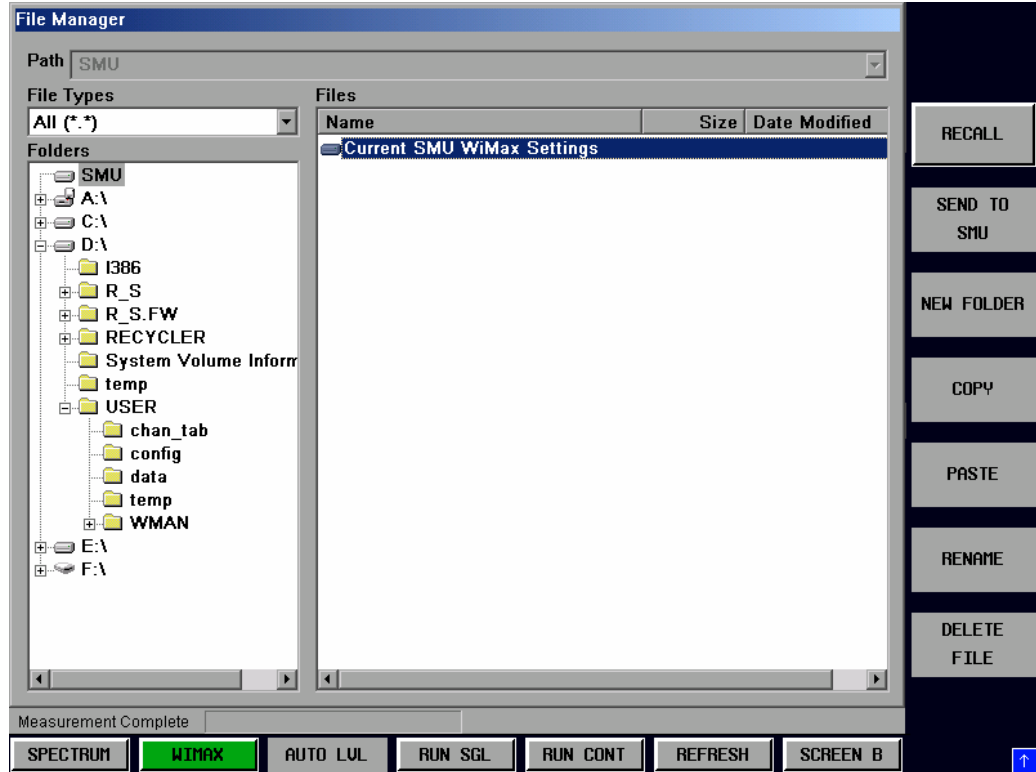
Fig. 102   File Manager view

Remote: `MMEM:LOAD:FRAM:STAT 1,'SMU'`

Gate Settings

This section of the user manual describes the Gate Settings. The gate settings allow the range of captured data used in results calculation to be specified.

When gating is switched on vertical lines are displayed in the Magnitude Capture trace. The two lines mark the area of data to be used in the calculation of results.
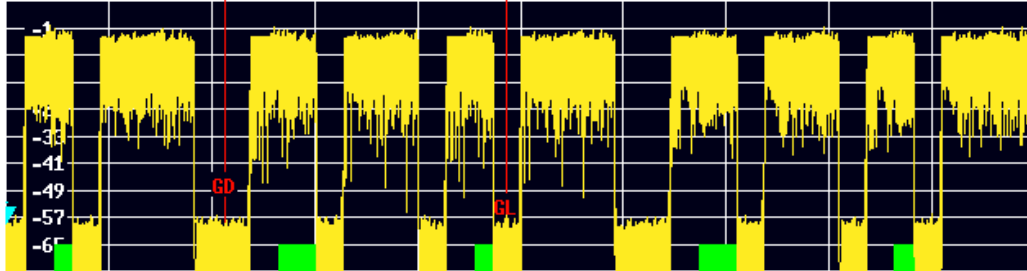
Fig. 103   Gate lines displayed in Magnitude Capture Buffer

The gate settings can be used to specify the region of input data to analyze for the following measurements:

- Spectrum FFT
- CCDF
- Spectrum Mask
- Spectrum ACP

The softkeys to access the gate settings are located from each of the measurement softkey menus. Press the NEXT hard-key to access the gate setting menu.
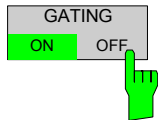
The *GATING* softkey allows gating to be switched on or off.
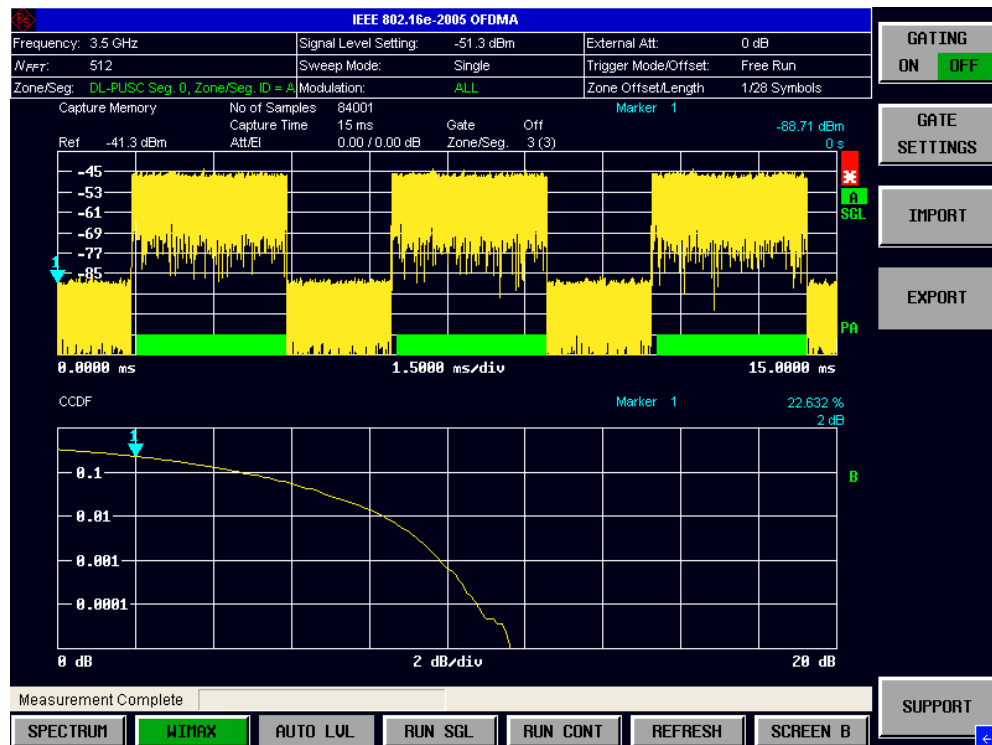
Fig. 104   Gate Settings menu view

When gating is switched off all the captured data is used in results calculation.

Remote: `SENS:SWE:EGAT ON|OFF`

GATE
SETTINGS

The *GATE SETTINGS* softkey displays the Gate Settings pop-up dialog.
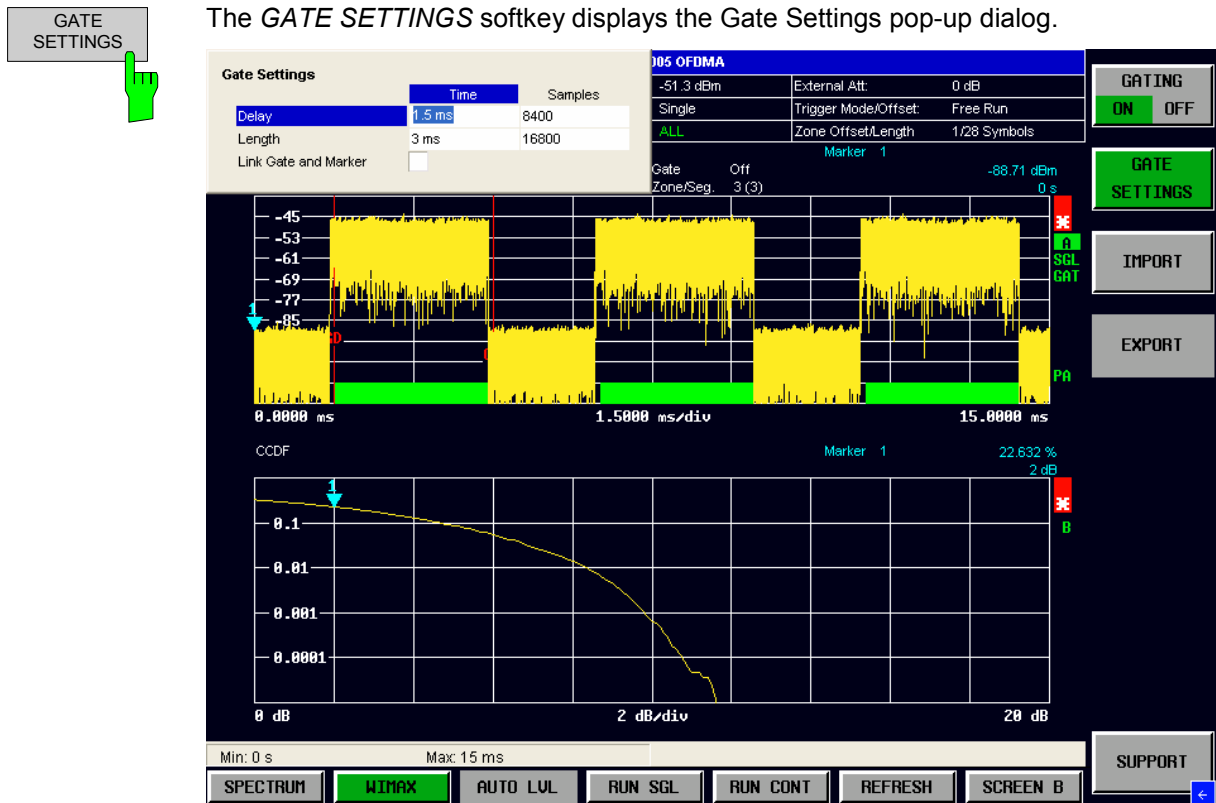
Fig. 105   Gate Settings Pop-up Dialog

Gate Settings

The gate settings specify the characteristics of the gate to be applied to the measurement. Note that when the gate settings dialog is displayed when a frequency sweep measurement is active (Spectrum Mask and Spectrum ACP) the measurement view automatically swaps to the Magnitude Capture buffer display in order to allow the gate to be set the correct part of the sweep.

Delay

Delay specifies the start point of captured data to be used in results calculation, i.e. the delay from the start of the captured data.

Delay can be specified in the following ways:

- Time
- Samples

When the delay is specified in one unit, the other unit field is updated accordingly.

When a value is supplied for the gate delay (in any unit) the gate delay line in the Magnitude Capture Buffer (marker with GD) is displayed in the new position.

Remote: `SENS:SWE:EGAT:HOLD:TIME 129us`
                     `SENS:SWE:EGAT:HOLD:SAMP 2579`

Length

Length specifies the amount of captured data to be used in results calculation.

Length can be specified in the following ways:

- Time
- Sample

When the length is specified in one unit, the other unit field is updated accordingly.

When a value is supplied for the gate length (in any unit) the gate length line in the Magnitude Capture Buffer (marker with GL) is displayed in the new position.

Remote: `SENS:SWE:EGAT:LENG:TIME 196us`
        `SENS:SWE:EGAT:LENG:SAMP 3920`

Link Gate and Marker

Link Gate and Marker allows the position of the marker and the gate lines to be linked.

When *Link Gate and Marker* is switched ON the marker is positioned half way between the gate start and the gate end. The marker position alters when the gate is modified, and the gate lines move with the marker when the marker position is altered.

Remote: `SENS:SWE:EGAT:LINK ON|OFF`

Import/Export of IQ Data

This section of the user manual describes the IQ Data Import/Export function, which allows the captured IQ data to be saved and recalled to and from an external file.

The softkeys for accessing the import/export IQ data settings are located in each of the measurement softkey menus. Press the NEXT hardkey to access the import/export softkeys.
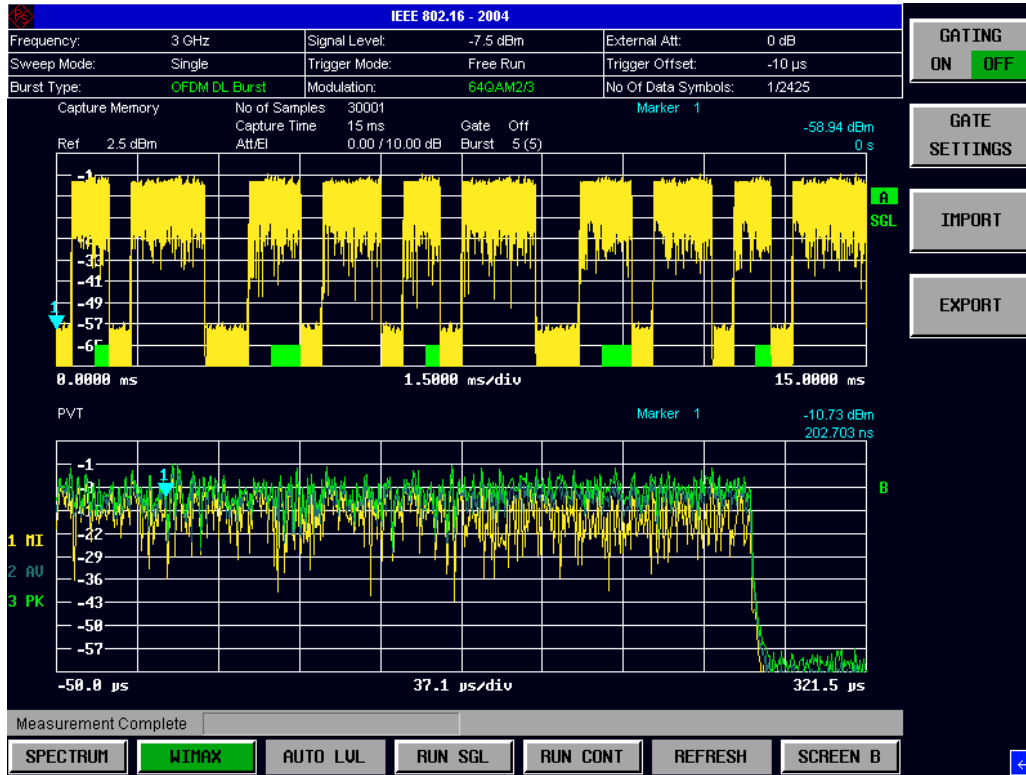
Fig. 106   Gate Settings pop-up dialog
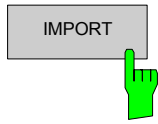
IMPORT

The *IMPORT* softkey displays the Import pop-up dialog.
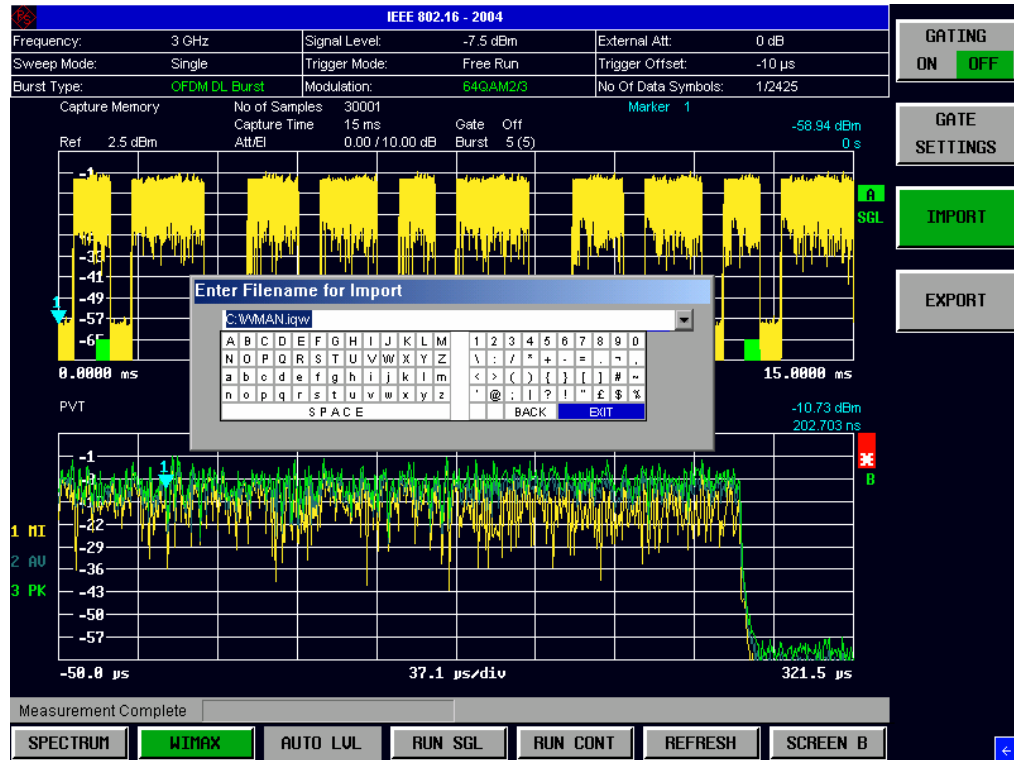
Fig. 107   Import pop-up dialog

The import pop-up dialog allows the full name and path of the IQ data file to be imported to be specified. Pressing ENTER causes the specified IQ data file to be loaded and the results displayed.

If the specified file cannot be found or is not a valid IQ data file, an error messge will be displayed indicating that the IQ data could not be imported.

Remote: `MMEM:LOAD:IQ:STAT 1,'D:\USER\DATA.iqw'`

EXPORT

👆
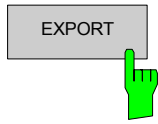
The EXPORT softkey displays the Export pop-up dialog.
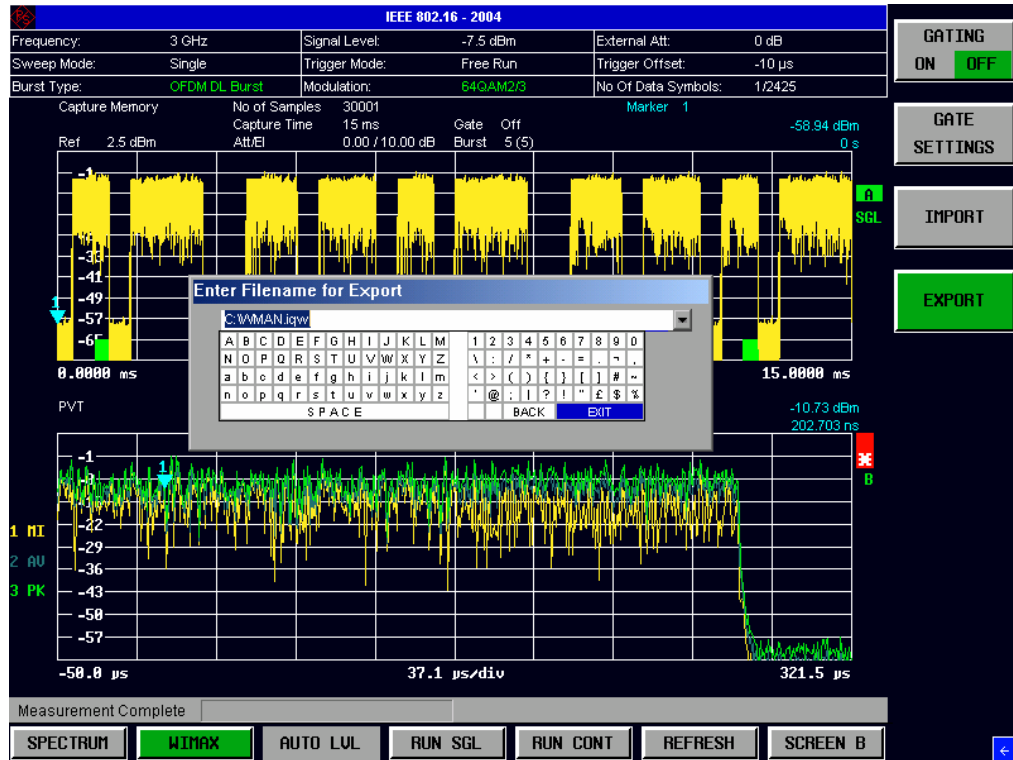
Fig. 108   Export pop-up dialog

The export pop-up dialog allows the full name and path of the IQ data file to be exported to be specified. Pressing ENTER causes the IQ data to be written to the specified file.

If the specified file cannot be created or if there is no valid IQ data to export (i.e. IQ measurement has not been executed), an error messge will be displayed indicating that the IQ data could not be exported.

Remote: `MMEM:STOR:IQ:STAT 1,'D:\USER\DATA.iqw'`

Markers

This section of the user manual describes the Marker facility of the option.

MKR
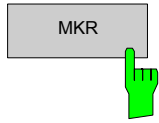
The *MKR* hardkey brings up the marker softkey menu. Any settings views on display when the marker softkey menu is displayed shall be closed.
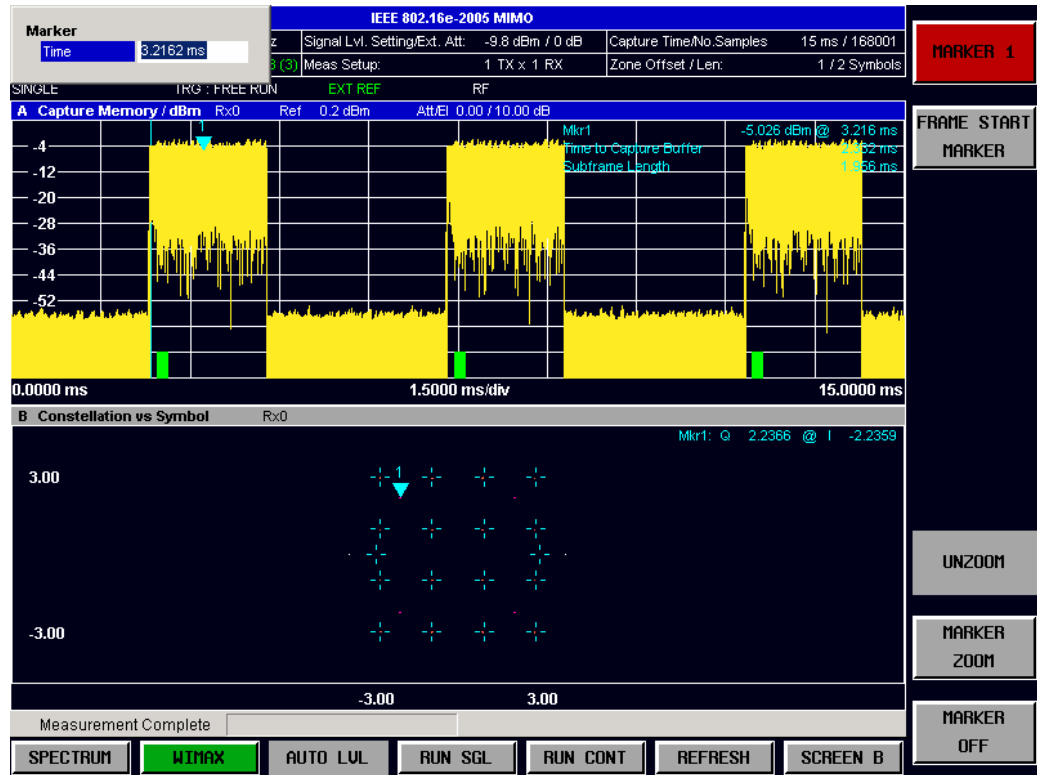
Fig. 109   Marker Menu

From the marker menu it is possible to adjust the marker position, use the marker to zoom in & out and switch the marker display off.

Adjusting Markers

The marker can be adjusted by pressing the marker softkey in the marker softkey menu
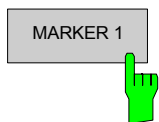
MARKER 1

The *MARKER 1* softkey displays the Marker pop-up dialog. The contents of the marker pop-up depend on the type of graph to which the marker being adjusted belongs.

As soon as a field in the marker pop-up dialog is adjusted then the marker position in the trace will update, along with the results displayed for the marker.

Remote: `CALC<1|2>:MARK<1>:X`

Marker Zoom

A zoom facility is available for markers belonging to the following result traces:

- Magnitude Capture
- PVT
- Constellation vs Symbol
- Constellation vs Carrier

MARKER ZOOM	The *MARKER ZOOM* softkey displays the Marker Zoom pop-up dialog which contains the magnification factor for the zoom. The maximum magnification depends on the type of results trace. Remote: N.A.
UNZOOM	The *UNZOOM* softkey cancels the marker zoom. Remote: N.A.

Toggle Marker Display

Markers can be toggled by pressing the Marker softkey as follows:

MARKER 1	Pressing the *MARKER* softkey when the marker is not displayed (softkey has grey background) causes the Marker pop-up to be displayed and the marker to be switched on. Remote: `CALC1:MARK:STAT ON` *Note: Does not display popup.*
MARKER 1	Pressing the *MARKER* softkey when the Marker pop-up is displayed (softkey has red background) causes the marker to be switched off. Remote: `CALC1:MARK:STAT OFF` *Note: Does not display popup.*
MARKER 1	Pressing the *MARKER* softkey when the Marker is displayed but the Marker pop-up is not displayed (softkey has green background) causes the Marker pop-up to be displayed. Remote: `CALC1:MARK:STAT ON` *Note: Does not display popup.*

All markers in the active screen can be switched off by pressing the *MARKER OFF* softkey.

Assigning Marker to Traces

In result graphs which have more than one trace (e.g. PVT) the marker can be assigned to any of the displayed traces.

MKR->
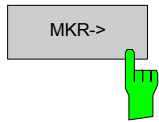
Pressing the *MKR->* hardkey displays the Marker Extension softkey menu.

Fig. 110   Marker Extension Softkey Menu
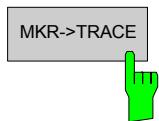
MKR->TRACE

Pressing the *MKR->TRACE* displays the Select Trace pop-up dialog. This allows the ID of the trace to which the marker is to be attached to be supplied.

Remote: `CALC2:MARK:TRAC 2`

Frame Start Marker

The Frame Start Marker dialog configures the Time to Capture Buffer and Subframe Length measurement results displayed in the top right corner of the Capture Memory display.
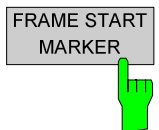
FRAME START MARKER

Pressing the *FRAME START MARKER* softkey displays the Frame Start Marker Dialog.
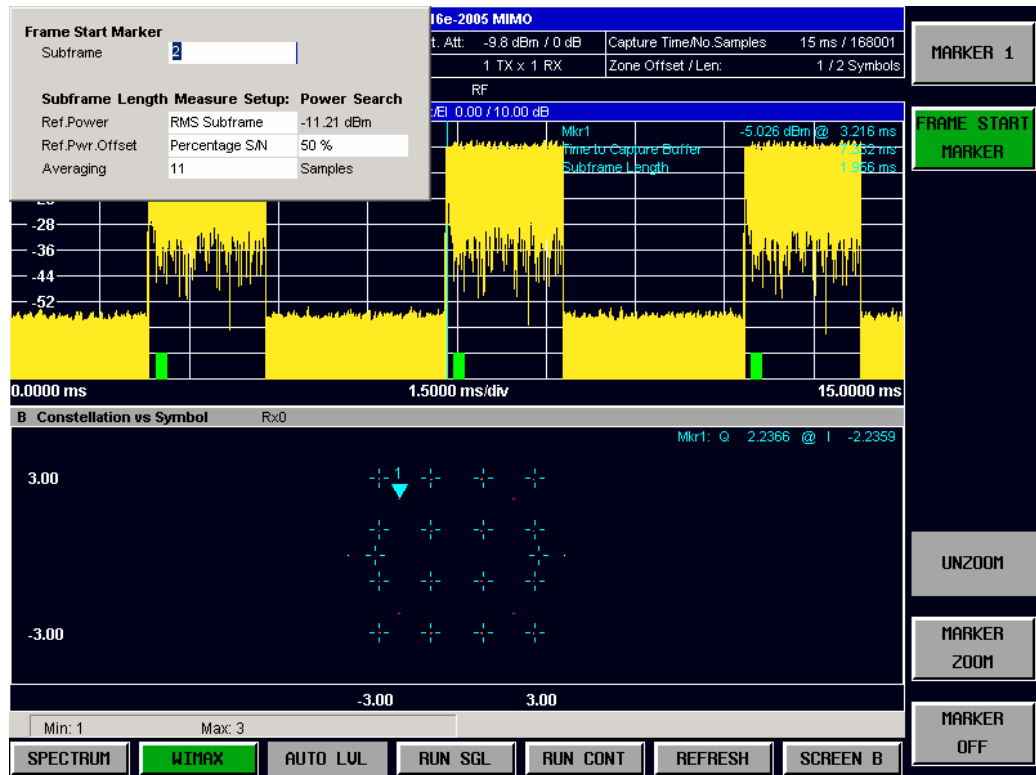
Fig. 111   Frame Start Marker Dialog. SISO- and MIMO-OFDMA/WiBro.

Subframe
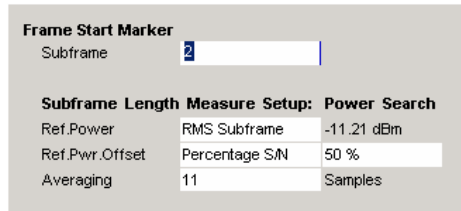
The Time to Capture Buffer and Subframe Length measurement results refer to the selected *Subframe.*

Remote: `CALC1:MARK1:FUNC:TTC:FRAM`

Ref. Power SISO- and MIMO-OFDMA/WiBro only!
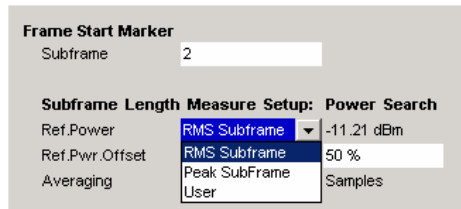
The frame length is computed for the smoothed trace, of the selected subframe, where it crosses the threshold
Ref. Power + Ref. Pwr. Offset
In case of a successful demodulation, the *RMS Subframe* respective *Peak Subframe* power is derived from the corresponding result summary power.
Alternatively the user can specify his own Ref. Power.

Remote:
`CALC1:MARK1:FUNC:TTC:RPTY RMS|PEAK|USER`
`CALC1:MARK1:FUNC:TTC:RPOW`

Ref. Pwr. Offset SISO- and MIMO-OFDMA/WiBro only!

According to the Ref. Power description above, the frame length is computed for the smoothed trace, of the selected subframe, where it crosses the threshold
Ref. Power + Ref. Pwr. Offset
The selection *Ref. Pwr. Offset = Percentage S/N* uses the specified percentage of the signal to noise ratio S/N, in dB, as *Ref. Pwr. Offset.* Note the S/N is identical with the EVM measurement result and therefore negative or positive.
Alternatively the user can specify his own *Ref. Pwr. Offset.*

Note: *The Ref. Pwr. Offset might be positive or negative.*
In case the Ref. Pwr. Offset is positive, the offset is added to the Ref. Power.
In case the Ref. Pwr. Offset is negative, the offset is subtracted from the Ref. Power.

Remote:
```
CALC1:MARK1:FUNC:TTC:RPOT PSN|USER
CALC1:MARK1:FUNC:TTC:RPOF
```

Averaging SISO- and MIMO-OFDMA/WiBro only!

According to the Ref. Power description above, the frame length is computed for the smoothed trace, of the selected subframe, where it crosses the threshold
Ref. Power + Ref. Pwr. Offset
The odd averaging value defines the number of samples to average, from the orginal trace, in order to compute the smoothed trace.

Remote: `CALC1:MARK1:FUNC:TTC:AVER`

Display Settings

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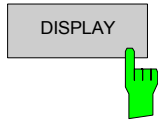
DISPLAY

The *DISPLAY* hardkey brings up the display softkey menu. Any settings views on display when the display softkey menu is displayed shall be closed.
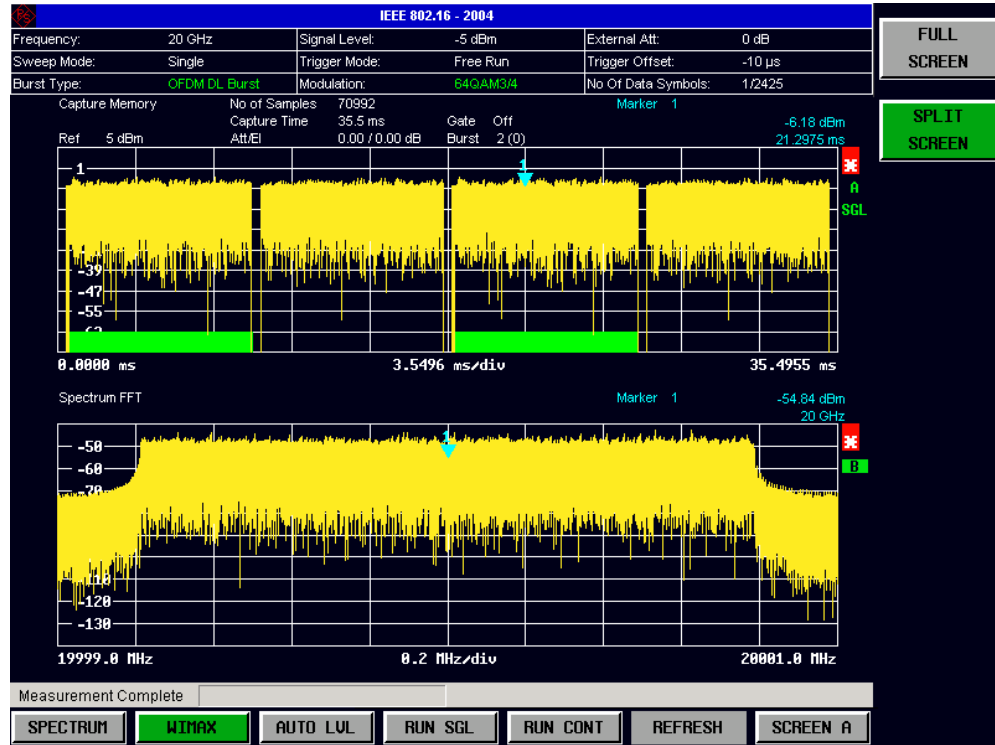
Fig. 112   Display Menu

The display menu allows the display to be changed between split and full screen display for IQ measurement results. Note that for frequency sweep measurement results (Spectrum Mask and Spectrum ACPR) the display is always full screen.

The active screen can be selected by pressing the *SCREEN A/SCREEN B* hotkey. A screen needs to be made active in order to control the markers it displays.

In full screen mode the *SCREEN A/SCREEN B* hotkey also toggles which screen is displayed.

Remote: `DISP:FORM SING|SPL`

3 Measurements in Detail

This section provides a more detailed explanation of the measurements provided by R&S FSQ-K92/K93/K94 and provides help for using R&S FSQ-K92/K93/K94 to measure the characteristics of specific types of DUT.

Signal Processing of the IEEE802.16-2004 OFDM Measurement Application

Abbreviations

$N_{FFT} = 256$	FFT length.
$a_{l,k}$	symbol from the alphabet at symbol-index l of subcarrier k
EVM_k	error vector magnitude of subcarrier k
EVM	error vector magnitude of current packet
g	signal gain
Δf	frequency deviation between Tx and Rx
l	symbol index $l = [1, nof\_Symbols]$
$nof\_symbols$	number of symbols of payload
H_k	channel transfer function of subcarrier k
k	channel index $k = [-128, 127]$
K_{mod}	modulation dependent normalization factor
ξ	relative clock error of reference oscillator
$r_{l,k}$	received symbol at symbol-index l of subcarrier k .

Pilots = {-88, -63, -38, -13, 13, 38, 63, 88}

This description gives a rough view of the IEEE802.16-2004 OFDM measurement application signal processing. Details are disregarded in order to get a concept overview.

A diagram of the interesting blocks is shown in Fig. 113. First the RF signal is downconverted to the IF frequency $f_{IF} = $ 20.4 MHz. The resulting IF signal $r_{IF}(t)$ is shown on the left-hand side of the figure. After bandpass filtering, the signal is sampled by an Analog to Digital Converter (ADC) at a sampling rate of $f_{s1} = 81.6$ MHz. This digital sequence is resampled to the new sampling frequency of $f_{s2} = 80$ MHz which is a multiple of the Nyquist rate (20 MHz). The subsequent digital downconverter shifts the IF signal to the complex base band. In the next step the base band signal is filtered by a FIR filter. To get an idea, the rough transfer function is plotted in the figure. This filter fulfils two tasks: first it suppresses the IF image frequency, secondly it attenuates the aliasing frequency bands caused by the subsequent downsampling. After filtering, the sequence is sampled down by the factor of 4. Thus the sampling rate of the downsampled sequence $r(i)$ is the Nyquist rate of $f_{s3} = 20$ MHz. Up to this point the digital part is implemented in an ASIC.
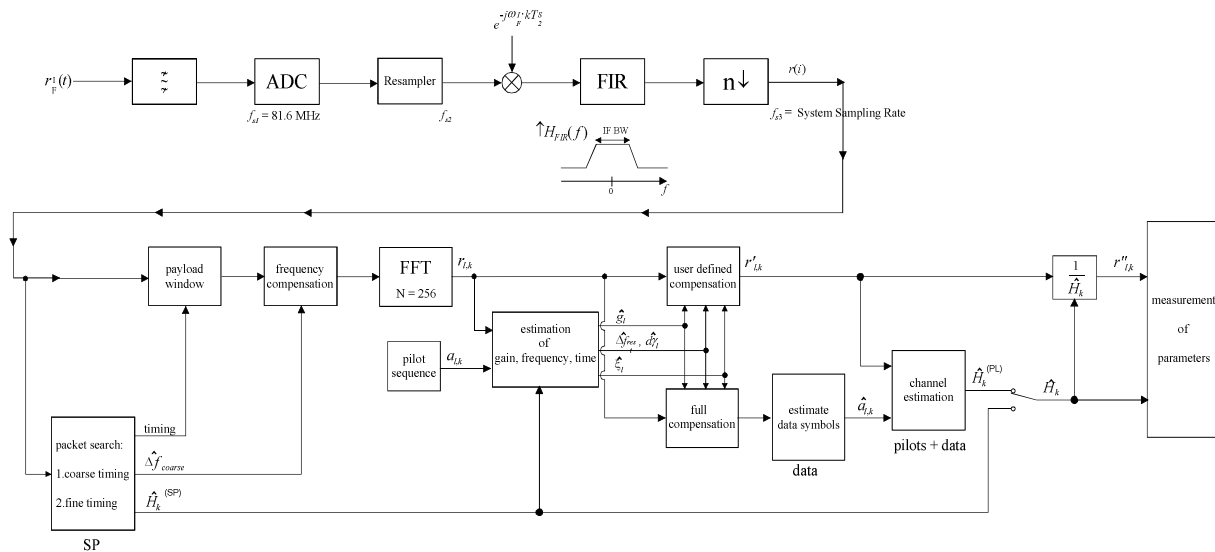
Fig. 113   Signal processing of the IEEE802.16 OFDM measurement application

In the lower part of the figure the subsequent digital signal processing is shown. In the first block the packet search is performed. This block detects the Short Preamble (SP) and recovers the timing. The coarse timing is detected first. This search is implemented in the time domain. The algorithm is based on cyclic repetition within the SP after $N = N_{FFT}/2 = 128$ samples. Note this cyclic repetition occurs also in the Long Preamble (LP). Numerous treatises exist on this subject, e.g. [1]-[3]. Furthermore a coarse estimate $\Delta\hat{f}_{coarse}$ [11] of the Rx-Tx frequency offset Δf is derived from the metric in [6]. This can easily be understood because the phase of $r(i) \cdot r^*(i+N)$ is determined by the mod 2π frequency offset. As the frequency deviation Δf can exceed several bins (distance between neighbour sub-carriers) the SP is further used to solve this n2π [offset over several bins] ambiguities.

After the coarse timing calculation the time estimate is improved by the fine timing calculation. This is achieved by first estimating the coarse frequency response $\hat{H}_k^{(SP)}$, with $k = [-100, 100]$ denoting the channel index of the occupied sub-carriers. First the FFT of the SP is calculated. After the FFT calculation the known symbol information of the SP sub-carriers is removed by dividing by the symbols. The result is a coarse estimate $\hat{H}_k$ of the channel transfer function. In the next step the complex channel impulse response is computed by an IFFT. Next the energy of the windowed impulse response (the window size is equal to the guard period) is calculated for every trial time. Afterwards the trail time of the maximum energy is detected. This trial time is used to adjust the timing.

Now the position of the SP is known and the starting point of the useful part of the first payload symbol can be derived. In the next block this calculated time instant is used to position the payload window. Only the payload part is windowed. This is sufficient because the payload is the only subject of the subsequent measurements.

In the next block the windowed sequence is compensated by the coarse frequency estimate $\Delta\hat{f}_{coarse}$. This is necessary because otherwise inter channel interference (ICI) would occur in the frequency domain.

The transition to the frequency domain is achieved by an FFT of length 256. The FFT is performed symbol-wise for every of the *nof_symbols* symbols of the payload. The calculated FFTs are described by $r_{l,k}$ with

- the symbol index $l = [1, nof\_symbols]$ and
- the channel index $k = [-128, 127]$.

In case of an additive white Gaussian noise (AWGN) channel the FFT is described by [4], [5]

---

[11] In this paper the hat generally describes an estimate. Example: $\hat{x}$ is the estimate of x.

$$r_{l,k} = K_{\text{mod}} \cdot a_{l,k} \cdot g_l \cdot H_k \cdot e^{j\left(phase_l^{(\text{commom})} + phase_{l,k}^{(\text{timing})}\right)} + n_{l,k} \tag{1}$$

with

- the modulation-dependent normalization factor K_{mod},

- the alphabet symbol $a_{l,k}$ at symbol-index l of sub-carrier k,

- the gain g_l at the symbol l in relation to the reference gain $g = 1$ at the Short Preamble (SP),

- the channel frequency response H_k at the Short Preamble (SP),

- the common phase drift $phase_l^{(\text{common})}$ of all sub-carriers at symbol l (see below),

- the phase $phase_{l,k}^{(\text{timing})}$ of sub-carrier k at symbol l caused by the timing drift (see below),

- the independent Gaussian distributed noise samples $n_{l,k}$.

The common phase drift in equation (1) is given by

$$phase_l^{(\text{common})} = 2\pi \cdot N_s / N \cdot \Delta f_{rest} T \cdot l + d\gamma_l \tag{2}$$

with

- $N_s = N_g + N_b$ being the number of Nyquist samples of the symbol period,

- $N = N_b = 256$ being the number of Nyquist samples of the useful part of the symbol,

- Δf_{rest} being the (not yet compensated) frequency deviation,

- $d\gamma_l$ being the phase jitter at the symbol l.

In general, the coarse frequency estimate $\Delta \hat{f}_{coarse}$ (see Fig. 113) is not error-free. Therefore the remaining frequency error Δf_{rest} represents the not yet compensated frequency deviation in $r_{l,k}$. Consequently the overall frequency deviation of the device under test (DUT) is calculated by $\Delta f = \Delta \hat{f}_{coarse} + \Delta f_{rest}$. Remark: The only motivation for dividing the common phase drift in equation (2) into two parts is to be able to calculate the overall frequency deviation of the DUT.

The reason for the phase jitter $d\gamma_l$ in equation (2) may be different. The nonlinear part of the phase jitter may be caused by the phase noise of the DUT oscillator. Another reason for nonlinear phase jitter may be the increase of the DUT amplifier temperature at the beginning of the burst. Please note that besides the nonlinear part the phase jitter $d\gamma_l$ also contains a constant part. This constant part is caused by the not yet compensated frequency deviation Δf_{rest}. To understand this, please keep in mind that the measurement of the phase starts at the first symbol $l = 1$ of the payload. In contrast the channel frequency response H_k in equation (1) represents the channel at the Short Preamble of the preamble. Consequently the not yet compensated frequency deviation Δf_{rest} produces a phase drift between the Short Preamble and the first symbol of the payload. Therefore this phase drift appears as a constant value ("DC value") in $d\gamma_l$.

Referring to the IEEE802.16-2004 measurement standard *Chapter 8.3.10.1.2 "Transmitter constellation error and test method"* [6], the common phase drift $phase_l^{(\text{common})}$ must be estimated and compensated from the pilots. Therefore this "symbol wise phase tracking" (Tracking Phase) is activated as the default setting of the R&S FSQ-K92/K93/K94.

Furthermore the timing drift in equation (1) is given by

$$phase_{l,k}^{(\text{timing})} = 2\pi \cdot N_s / N \cdot \xi \cdot k \cdot l \tag{3}$$

with ξ being the relative clock deviation of the reference oscillator. Normally a symbol-wise timing jitter is negligible and thus not modelled in equation (3). There may be situations where the timing drift has to be taken into account. This is illustrated by an example: In accordance to [6] the allowed clock deviation

of the DUT is up to $\xi_{\max} = \pm\, 8$ ppm. Furthermore the maximal length of a frame $nof\_symbols = 2420$ symbols[12] is assumed. From equations (1) and (3), it results that the phase drift of the highest sub-carrier $k = 100$ in the last symbol $l = nof\_symbols$ is degrees. Even in the noise-free case, this would lead to symbol errors. The example shows that it is actually necessary to estimate and compensate the clock deviation, which is accomplished in the next block.

Referring to the IEEE802.16-2004 measurement standard [6], the timing drift $phase_{l,k}^{(\mathrm{timing})}$ is not part of the requirements. Therefore the "time tracking" (Tracking Time) is not activated as the default setting of the R&S FSQ-K92/K93/K94.

The time tracking option should rather be seen as a powerful analysing option.

In addition the tracking of the gain g_l in equation (1) is supported for each symbol in relation to the reference gain $g = 1$ at the time instant of the Short Preamble (SP). At this time the coarse channel transfer function $\hat{H}_k^{(SP)}$ is calculated. This makes sense since the sequence $r'_{l,k}$ is compensated by the coarse channel transfer function $\hat{H}_k^{(SP)}$ before estimating the symbols. Consequently a potential change of the gain at the symbol l (caused, for example, by the increase of the DUT amplifier temperature) may lead to symbol errors especially for a large symbol alphabet M of the MQAM transmission. In this case the estimation and the subsequent compensation of the gain are useful.

Referring to the IEEE802.16-2004 measurement standard [6], the compensation of the gain g_l is not part of the requirements. Therefore the "gain tracking" (Tracking Gain) is not activated as the default setting of the R&S FSQ-K92/K93/K94.

The unknown deviations of gain, frequency and time are calculated by an optimum maximum likelihood procedure, which works well even at low signal to noise ratios with the Cramer Rao Bound being reached. After estimation of these parameters, the received signal is fully compensated for the decision of the ideal reference signal $\hat{a}_{l,k}$ and compensated according to the user settings to get the measurement signal $r'_{l,k}$. Then the measurement signal is equalized by the inverse channel transfer function. According to the choosen setting, either the preamble estimation of the channel transfer function or a data aided estimation using the ideal reference signal is used. According to the IEEE802.16-2004 measurement standard [6], the coarse channel estimation $\hat{H}_k^{(SP)}$ (from the Short Preamble) has to be used for equalization. Therefore the default setting of the R&S FSQ-K92/K93/K94 is equalization from the coarse channel estimate derived from the Short Preamble.

In the last block the <u>measurement variables</u> are calculated. The most important variable is the error vector magnitude

$$EVM_k \;=\; \sqrt{ \frac{1}{nof\_Symbols} \cdot \sum_{l=1}^{nof\_Symbols} \left| r''_{l,k} - K_{\mathrm{mod}} \cdot a_{l,k} \right|^2 } \tag{4}$$

of the sub-carrier k of the current packet. Furthermore the packet error vector magnitude

$$EVM \;=\; \sqrt{ \frac{1}{200} \cdot \sum_{\substack{k=-100 \\ (k \neq 0)}}^{100} EVM_k^2 } \tag{5}$$

is derived by averaging the squared EVM_k versus k. Finally the average error vector magnitude

$$\overline{EVM} \;=\; \sqrt{ \frac{1}{nof\_packets} \sum_{counter=1}^{nof\_packets} EVM^2(counter) } \tag{6}$$

is calculated by averaging the packet EVM of all $nof\_packets$ detected packets. This parameter is equivalent to the so-called "RMS average of all errors $Error_{RMS}$" of the IEEE802.16-2004 measurement commandment (see [6], *Chapter 8.3.10.1.2*).

---

[12] Assuming the maximal System Sampling Rate Fs = 32MHz.

Analysis Steps

Preamble related result	Remark
Rough frequency estimation	In case of subchannelization, a rough frequency estimation is obtained by exploiting the cyclic prefix of the OFDM symbols.
Preamble power	
Preamble EVM	Uses payload channel estimation for equalization.
Frequency error vs. preamble	
Phase error vs. preamble	
Channel estimation	Used for equalizing if 'CH Est in Preamb & Payload' is not selected in 'Demod' settings.

Payload related result	Remark
Fine frequency estimation	Estimation on pilots used for phase correction if 'Phase Tracking' is selected. Phase tracking needs at least one pilot. In case of subchannelization, the value shown in the result summary table is estimated on pilots and data.
Clock offset estimation	Estimation on pilots used for timing correction if 'Timing Tracking' is selected. Timing tracking needs at least two pilots. In case of subchannelization, the value shown in the result summary table is estimated on pilots and data.
IQ Offset	Power at spectral line 0 normalized to the total transmitted power.
Gain Imbalance	Estimation not available in case of subchannelization.
Quadrature Error	Estimation not available in case of subchannelization.
Payload channel estimation	Combined with the preamble channel estimation and used for equalization if 'CH Est in Preamb & Payload' is selected in 'Demod' settings.

Burst related result	Remark
EVM All carriers EVM Data carriers EVM Pilot carriers	According to standard normalized to the average power of all 200 used carriers.
Burst Power	
Crest Factor	

Subchannelization

Subchannelization can be used in uplink bursts to allocate only a subset of the available OFDM subcarriers. The measurement software can distinguish between downlink bursts, uplink bursts without subchannelization and uplink bursts with a selectable subchannel index. Thus it is possible to analyze the complete WirelessMAN traffic with one capture buffer shot.

Synchronization

The synchronization of uplink bursts using subchannelization is performed after the synchronization on standard downlink and uplink preambles:

1. Synchronization of downlink and uplink bursts without subchannelization.
2. Preanalysis of the bursts without subchannelization to determine their length.
3. Extraction of TX power areas without already detected bursts.
4. Synchronization of uplink bursts with the selected subchannel index.

Results influenced by Subchannelization

Channel Results

The standard requires an interpolation of order 0 for the channel estimation on unallocated subcarriers, i.e the estimated channel coefficient of the nearest allocated subcarrier shall be used for those subcarriers not part of the allocated subchannels.
For the derived channel results like group delay or flatness difference, the unallocated carriers are not taken into account.

Fig. 114   Spectrum flatness using subchannel index 4

Frequency and Clock Offset

The measurement software allows selectable compensation of phase, timing and gain errors based on pilot estimations. However, in case of subchannelization the number of pilots is decreased. Bursts with odd subchannel indices don't provide pilots at all. The following table lists the restrictions on the tracking ability for subchannelization:

Tracking	Subchannel Index		
	16 (8 Pilots) 8, 24 (4 Pilots) 4, 12, 20, 28 (2 Pilots)	2, 6, 10, 14, 18, 22, 26, 30 (1 Pilot)	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31 (No Pilot)
Phase	Available	Available	Available, but uses rough frequency offset estimation from the synchronization step only
Timing	Available	Not available	Not available
Gain	Available	Available	Not available

While the tracking functionality has to use pilot based estimates, the actual results for frequency and clock offset in the result summary can be data aided. In case of subchannelization the final estimation of frequency and clock offset is done using the already decided data sequence, which gives stable results even without pilots.

EVM

The error vector magnitude of a single constellation point is defined by

$$\text{EVM}(l,k) = \sqrt{\frac{\left|r(l,k) - a(l,k)\right|^2}{\frac{1}{N_{\text{used}}} \sum_{\substack{k=-N_{\text{used}}/2 \\ k \neq 0}}^{k=N_{\text{used}}/2} \left|a(l,k)\right|^2}} \ . \tag{7}$$

where $r(l,k)$ is the received constellation point and $a(l,k)$ is the transmitted constellation point at the l th symbol and carrier number k .

In case of subchannelization, it is required by the standard to include the unallocated carriers k_{unalloc} by assuming $a(l,k_{\text{unalloc}}) = 0$ in the denominator of the EVM calculation.
Thus the 'EVM All Carriers' result for one burst in the result summary equals

$$\text{EVM\_All\_Carr} = \sqrt{\frac{\frac{1}{L}\sum_{l=1}^{L}\frac{1}{N_{\text{used}}} \sum_{\substack{k=-N_{\text{used}}/2 \\ k \neq 0}}^{k=N_{\text{used}}/2} \left|r(l,k) - a(l,k)\right|^2}{\frac{1}{L}\sum_{l=1}^{L}\frac{1}{N_{\text{used}}} \sum_{\substack{k=-N_{\text{used}}/2 \\ k \neq 0}}^{k=N_{\text{used}}/2} \left|a(l,k)\right|^2}} \ , \tag{8}$$

where L is the number of symbols in the burst.

This definition is according to the relative constellation error defined in the IEEE Std 802.16-2004.

Using the equations above, the error power is normalized by the average transmitted power in all 200 carriers. Please notify, that by this definition the same absolute error power leads to different EVM results depending on the number of allocated carriers in case of subchannelization.

IQ Impairments

IQ imbalance in an OFDM transmitter or receiver leads to an interference of the symbols $a_{l,-k}$ with the symbols $a_{l,k}$. In case of subchannelization, the used subcarriers are always situated in such a way, that $a_{l,-k} = 0$, if $a_{l,k} \neq 0$. There is no impact of IQ imbalance on the actually allocated carriers of a subchannelization transmission. The effect can only be seen on the unallocated carriers and yields a pattern around the origin of the constellation diagram.

Fig. 115   IQ imbalance influence on the unallocated carriers using subchannel index 4

The unsymmetrical allocation of the subcarriers prevents a measurement of gain imbalance and quadrature error in case of subchannelization. The influence of the occupied carriers $a_{l,k}$ on the unoccupied carriers $a_{l,-k}$ could be measured, but there is no possibility to distinguish them from an unknown channel coefficient.

RSSI Measurements

See [6] section "8.3.9.2 RSSI mean and standard deviation". The Received Signal Strength Indication [RSSI] is basically the Preamble Power. The Result Summary provides the RSSI statistics according to the standard. A possible method to compute RSSI[k] at the antenna connector is given in [6] equation (87). RSSI[k] is the RSSI measurement based on the k-th signal/preamble.

The RSSI statistics of the *Result Summary* is calculated as follows:

1. RSSI row:
   Statistic {min, mean, max} of the R[k]=RSSI[k].
   The mean value is $\hat{\mu}_{RSSI\ dBm}[k]$ according to [6] formula (89).

2. RSSI Standard Deviation row:
   $\hat{\sigma}_{RSSI\ dB}$ according to [6] formula (91).

CINR Measurements

See [6] section "8.3.9.3 CINR mean and standard deviation". The Result Summary provides the Carrier Interference Noise Ratio [CINR] statistics according to the standard. One possible method to estimate the CINR of a single message is to compute the ratio of the sum of signal power and the sum of residual error for each data sample, using equation [6] (92).

$$CINR[k] = \frac{\sum_{n=0}^{N-1}|s[k,n]|^2}{\sum_{n=0}^{N-1}|r[k,n]-s[k,n]|^2}$$

  r[k,n]   received/measured sample n within message k
  s[k,n]   corresponding detected/reference sample (with channel state weighting)
          corresponding to received symbol n.

The CINR statistics of the *Result Summary* is calculated as follows:

1. CINR row:
   Statistic {min, mean, max} of the CINR[k].
   The mean value is $\hat{\mu}_{CINR\ dB}[k]$ according to [6] formula (94).

2. CINR Standard Deviation row
   $\hat{\sigma}_{CINR\ dB}$ according to [6] formula (96).

Literature

[1]   Speth, Classen, Meyr: „Frame synchronisation of OFDM systems in frequency selective fading channels", VTC '97, pp. 1807-1811

[2]   Schmidl, Cox: „Robust Frequency and Timing Synchronization of OFDM", IEEE Trans. on Comm., Dez. 1997, pp. 1613-621

[3]   Minn, Zeng, Bhargava: „On Timing Offset Estimation for OFDM", IEEE Communication Letters, July 2000, pp. 242-244

[4]   Speth, Fechtel, Fock, Meyr: „Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM - Part I", IEEE Trans. On Comm. VOL. 47, NO 11, Nov. 1999

[5]   Speth, Fechtel, Fock, Meyr: „Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM - Part II", IEEE Trans. On Comm. VOL. 49, NO 4, April. 2001

[6]   IEEE802.16-2004, Part 16: Air Interface for Fixed Broadband Wireless Access Systems; 1 October 2004; Medium Access Control (MAC) and Physical Layer (PHY) specifications

Signal Processing of the IEEE802.16-2005 SISO- and MIMO-OFDMA / WiBro Measurement Application

Symbols and Abbreviations

$a_{l,k}, \hat{a}_{l,k}$	data symbol (actual, decided)
$\Delta f, \Delta f_{\mathrm{coarse}}$	carrier frequency offset between transmitter and receiver (actual, coarse estimate)
Δf_{res}	residual carrier frequency offset
ζ	relative sampling frequency offset
g_l	gain
$H_{l,k}, \hat{H}_{l,k}$	channel transfer function (actual, estimate)
$\hat{\mathbf{H}}_{l,k}, \hat{\mathbf{H}}_{l,k}^{-1}$	channel matrix (estimate, inverse of estimate)
i	time index
$\hat{i}_{\mathrm{coarse}}, \hat{i}_{\mathrm{fine}}$	timing estimate (coarse, fine)
$k, k_{\mathrm{p}}, k_{\mathrm{d}}, k_{\mathrm{ch}\,n}$	subcarrier index (general, pilot, data, subchannel n)
l	OFDM symbol index
N_{FFT}	length of FFT
N_{g}	number of samples in cyclic prefix (guard interval)
N_{s}	number of Nyquist samples
N_{sc}	number of subcarriers
n	subchannel index, subframe index
$n_{l,k}$	noise sample
Φ_l	common phase error
$\Delta Q, \Delta \hat{Q}$	I/Q-imbalance (actual, estimate)
$r(i)$	received sample in the time domain
$r_{l,k}, r'_{l,k}, r''_{l,k}, r'''_{l,k}$	received sample (uncompensated, fully compensated, partially compensated, equalized) in the frequency domain
T	useful symbol time
T_{g}	guard time
T_{s}	symbol time
AWGN	**A**dditive **W**hite **G**aussian **N**oise
BER	**B**it **E**rror **R**ate
CFO	**C**arrier **F**requency **O**ffset
CINR	**C**arrier to **I**nterference and **N**oise **R**atio
CIR	**C**hannel **I**mpuls **R**esponse
CP	**C**yclic **P**refix (Guard Interval)
CPE	**C**ommon **P**hase **E**rror
CTF	**C**hannel **T**ransfer **F**unction
DL	**D**own**l**ink
DUT	**D**evice **U**nder **T**est
EVM	**E**rror **V**ector **M**agnitude
FFT	**F**ast **F**ourier **T**ransform
MIMO	**M**ultiple **I**nput **M**ultiple **O**utput
R&S FSQ	Rohde & Schwarz Signal Analyzer
IF	**I**ntermediate **F**requency
ISI	**I**nter**s**ymbol **I**nterference
OFDM	**O**rthogonal **F**requency **D**ivision **M**ultiplexing
OFDMA	**O**rthogonal **F**requency **D**ivision **M**ultiple **A**ccess
PAPR	**P**eak to **A**verage **P**ower **R**atio
RSSI	**R**eceived **S**ignal **S**trength **I**ndicator
SFO	**S**ampling **F**requency **O**ffset
SISO	**S**ingle **I**nput **S**ingle **O**utput
STC	**S**pace-**T**ime **C**oding
UL	**U**p**l**ink

Introduction

The following description provides a brief overview of the digital signal processing used in the R&S FSQ's IEEE 802.16 OFDMA measurement application.

From the received IF signal as the point of origin to the actual analysis results like EVM or CINR, the digital signal processing can be divided into four major groups:

- Data capturing
- Synchronization
- Channel estimation / equalization } OFDMA measurement application
- Analysis

The remainder of this description is structured accordingly.

Data Capturing

The block diagram in Fig. 116 shows the R&S FSQ hardware from the IF section to the processor running the OFDMA 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 IF image frequencies as well as 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 so-called capture buffer.
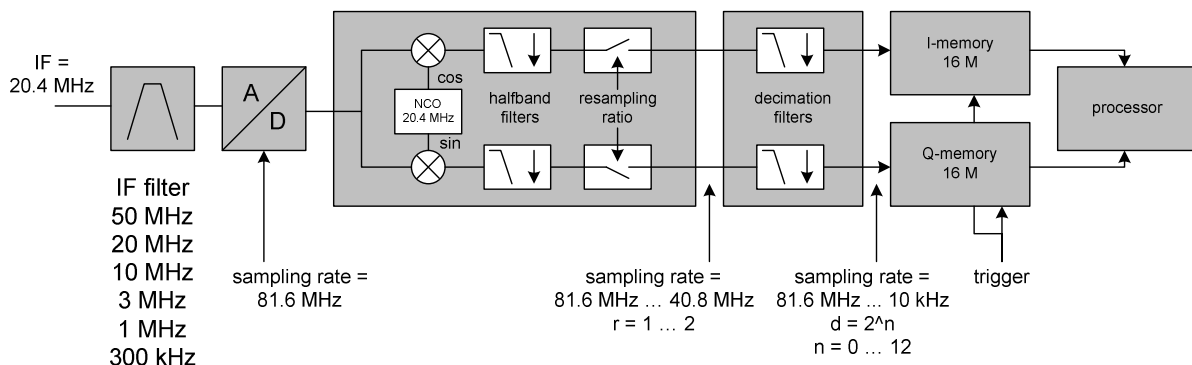
Fig. 116   Data capturing mechanism of the R&S FSQ.
The maximum allowable bandwidth of the measurement signal depends on the target sampling rate according to Table 1.

Table 1   Maximum bandwidth depending on the target sampling rate.

Sampling Rate	max. Bandwidth
10 kHz – 20.4 MHz	0.8 x sampling rate
20.4 MHz – 40.8 MHz	0.68 x sampling rate
40.8 MHz – 81.6 MHz	30 MHz

A lot of MIMO measurements can be performed with only one R&S FSQ simply by connecting to the DUT's Tx antennas one after the other. For each partial measurement the DUT needs to retransmit the same signal. Full-fledged MIMO measurements require one capture buffer for each Tx antenna.

OFDMA Measurement Application

The block diagram in Fig. 117 shows the OFDMA measurement application from the capture buffer containing the I/Q-data to the actual analysis block. Outcome of the fully compensated reference path (green) are the estimates $\hat{a}_{l,k}$ of the transmitted data symbols $a_{l,k}$. Depending on the user defined compensation, the received samples $r'''_{l,k}$ of the measurement path (orange) still contain the transmitted signal impairments of interest. The analysis block reveals these impairments by comparing the reference and the measurement path. Prior to the analysis, diverse synchronization and channel estimation tasks have to be accomplished.

Synchronization

The first of the synchronization tasks is to detect relevant signal areas within the captured I/Q-data stream. The subframe detection block determines the beginning and end of each subframe and coarsely estimates both timing and carrier frequency offset. The fine timing block prior to the FFT allows a timing improvement using a level-based search for the beginning and end of the coarsely estimated channel impulse response. In case of DL-SISO the coarse estimate of the CIR can be directly obtained from the preamble. For DL-MIMO and for the UL only payload information with scattered pilots in the subcarrier-symbol plane is available, thus several OFDM symbols have to be observed to get a reliable estimate of the CIR. Since the OFDM symbols need to be phase synchronized prior to the channel estimation, the blue blocks in Fig. 117 have to be carried out twice. In the first iteration the timing estimate $\hat{i}_{coarse}$ is used to position the window of the FFT. Having found the pilot-based estimate of the CIR, the fine timing estimate $\hat{i}_{fine}$ is used in the second iteration.

As a by-product of the pilot processing in case of MIMO signals, the subframe detection can identify the test setup between the Tx and Rx antennas.
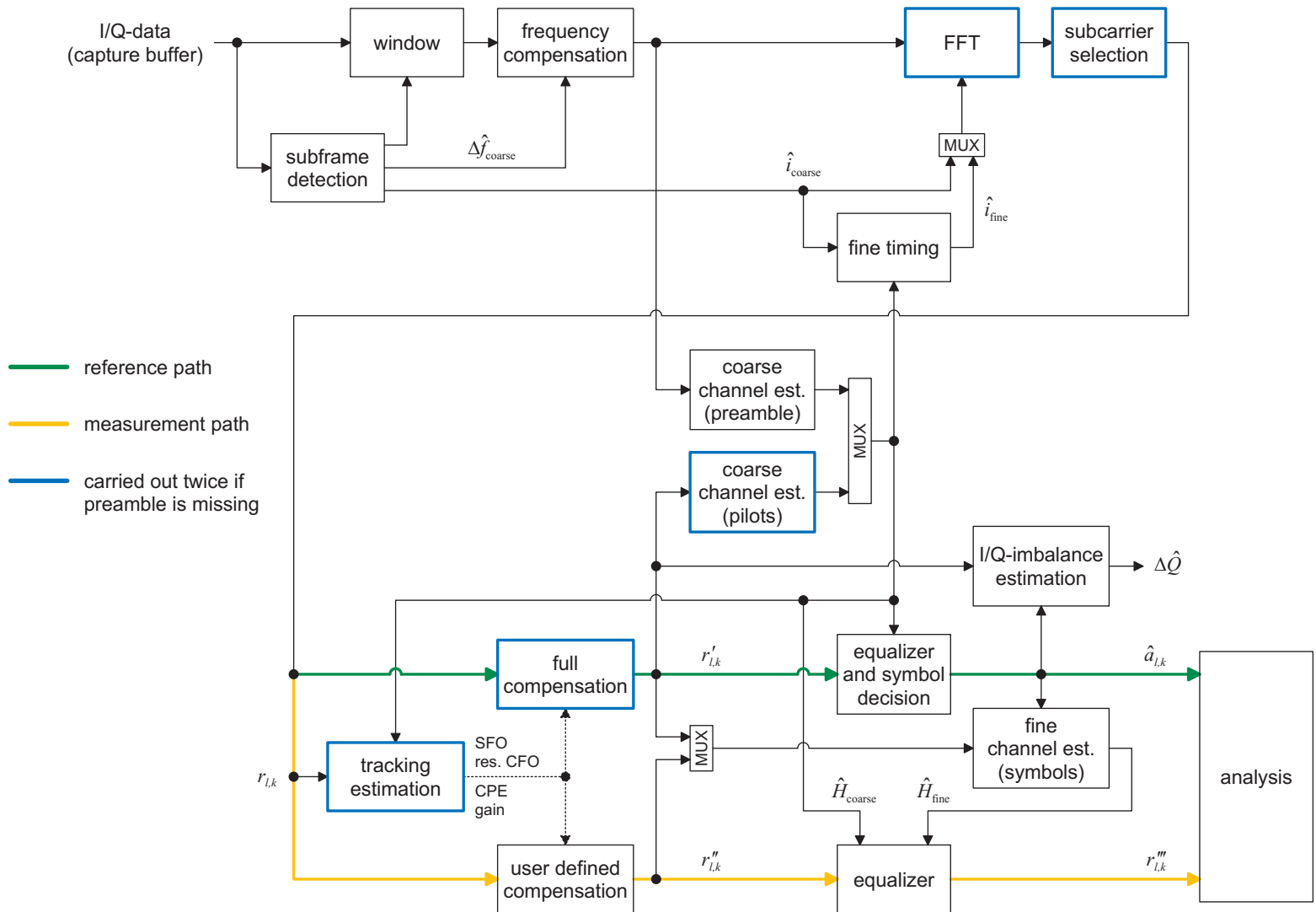
Fig. 117   SISO- and MIMO-OFDMA measurement application Block Diagram

After the time to frequency transformation by an FFT of length N_{FFT}, the tracking estimation block is used to estimate

- the relative sampling frequency offset ζ,

- the residual carrier frequency offset Δf_{res},

- the common phase error Φ_l,

- and the gain g_l.

Corresponding to [3] and [4], the uncompensated samples $r_{l,k}$ can be expressed as

$$r_{l,k} = g_l \cdot a_{l,k} \cdot H_{l,k} \cdot \underbrace{e^{j\,\Phi_l}}_{\text{CPE}} \cdot \underbrace{e^{j\,2\pi \cdot N_{\text{s}}/N_{\text{FFT}} \cdot \zeta \cdot k \cdot l}}_{\text{SFO}} \cdot \underbrace{e^{j\,2\pi \cdot N_{\text{s}}/N_{\text{FFT}} \cdot \Delta f_{\text{res}} \cdot T \cdot l}}_{\text{res. CFO}} + n_{l,k} \tag{9}$$

with

- the data symbol $a_{l,k}$ on subcarrier k at OFDM symbol l,

- the channel transfer function $H_{l,k}$,

- the number of Nyquist samples N_{s} within the symbol time T_{s},

- the useful symbol time $T = T_{\text{s}} - T_{\text{g}}$,

- as well as the independent and Gaussian distributed noise sample $n_{l,k}$.

Within one OFDM symbol both the CPE and the residual CFO respectively cause the same phase rotation for each subcarrier, while the rotation due to the SFO linearly depends on the subcarrier index. A linear phase increase in symbol direction can be observed for the residual CFO as well as the SFO.

The results of the tracking estimation block are used to compensate the samples $r_{l,k}$. While a full compensation is performed in the reference path, the signal impairments that are of interest to the user are left uncompensated in the measurement path.

In case of MIMO settings each Tx antenna can cause an individual gain impairment. The SFO, the residual CFO, and the CPE are considered to be impairments of a single oscillator.

Channel Estimation / Equalization

According to Fig. 117, there are two coarse and one fine channel estimation blocks. Which of the two coarse estimation blocks is used depends on the link direction and the SISO/MIMO configuration. For DL-SISO subframes the coarse channel estimation is based on the preamble and directly follows the coarse frequency compensation block. The pilot-based estimation for DL-MIMO and UL subframes is tapped behind the full compensation block of the reference path. Both of the coarse estimation blocks use available training symbols to determine initial estimates $H_{l,k}$ of the channel transfer function at fixed positions in the subcarrier-symbol plane. Based on these nodes, the missing CTF values are obtained by interpolation in both time and frequency direction. The coarse estimation results are used for the above mentioned fine timing and to equalize the samples $r'_{l,k}$ of the reference path prior to symbol decision. Based on the decided data symbols and the received samples $r'_{l,k}$ or $r''_{l,k}$, a fine channel estimation is performed and then used to equalize the partially compensated samples of the measurement path.

MIMO channel estimation determines a matrix $\hat{\mathbf{H}}_{l,k}$ containing the estimates of the individual path components. The usage of $\hat{\mathbf{H}}_{l,k}$ for equalization depends on the STC mode at hand:

- Matrix A: The elements of $\hat{\mathbf{H}}_{l,k}$ are used within the Alamouti decoder.

- Matrix B: The inverse matrix $\hat{\mathbf{H}}_{l,k}^{-1}$ is used to equalize the channel.

If the DUT is connected via cables, the user can force the nondiagonal elements of the matrix $\hat{\mathbf{H}}_{l,k}$ to zero. Thus potential crosstalk of the DUT is not compensated for in the EVM results.

Analysis

The analysis block of the OFDMA measurement application allows to compute a variety of measurement variables.

EVM

The most important variable is the error vector magnitude

$$EVM_{l,k} = \left| \frac{r_{l,k}''' - \hat{a}_{l,k}}{\hat{a}_{l,k}} \right| \tag{10}$$

on subcarrier k at OFDM symbol l. The subsequent average values can be derived from (10).

1. EVM of subchannel n at OFDM symbol l:

$$EVM_{l,\text{subchannel } n} = \sqrt{\frac{1}{N_{\text{sc}}} \sum_{k_{\text{ch} n}} EVM_{l,k_{\text{ch} n}}^2} \tag{11}$$

2. EVM of all pilot subcarriers:

$$EVM_{\text{pilots}} = \sqrt{\frac{1}{N_{\text{sc}}} \sum_{l} \sum_{k_{\text{p}}} EVM_{l,k_{\text{p}}}^2} \tag{12}$$

3. EVM of all data subcarriers:

$$EVM_{\text{data}} = \sqrt{\frac{1}{N_{\text{sc}}} \sum_{l} \sum_{k_{\text{d}}} EVM_{l,k_{\text{d}}}^2} \tag{13}$$

4. EVM of all used subcarriers:

$$EVM_{\text{all}} = \sqrt{\frac{1}{N_{\text{sc}}} \sum_{l} \left[\sum_{k_{\text{p}}} EVM_{l,k_{\text{p}}}^2 + \sum_{k_{\text{d}}} EVM_{l,k_{\text{d}}}^2 \right]} \tag{14}$$

The number of subcarriers respectively taken into account is denoted by N_{sc}.

CINR

The carrier to interference and noise ratio is determined for each subframe n. The computation is based on the partially compensated samples $r_{l,k}''$, the decided symbols $\hat{a}_{l,k}$, and the channel estimates $\hat{H}_k$ (DL: preamble and fine; UL: fine).

$$CINR(n) = \frac{\sum_{l} \sum_{k} | \hat{a}_{l,k} \cdot \hat{H}_k |^2}{\sum_{l} \sum_{k} | r_{l,k}'' - \hat{a}_{l,k} \cdot \hat{H}_k |^2} \tag{15}$$

Further CINR statistics are defined in the standard [5]

$$\hat{\mu}_{\text{CINR}}(n) = \begin{cases} CINR(0) & n = 0 \\ (1 - \alpha_{\text{avg}}) \cdot \hat{\mu}_{\text{CINR}}(n-1) + \alpha_{\text{avg}} \cdot CINR(n) & n > 0 \end{cases}$$

$$\hat{\mu}_{\text{CINR}}^{(\text{dB})}(n) = 10 \cdot \log \hat{\mu}_{\text{CINR}}(n) \, \text{dB}$$

(16)

$$\hat{x}_{\text{CINR}}^2(n) = \begin{cases} CINR^2(0) & n = 0 \\ (1 - \alpha_{\text{avg}}) \cdot \hat{x}_{\text{CINR}}^2(n-1) + \alpha_{\text{avg}} \cdot CINR^2(n) & n > 0 \end{cases}$$

$$\hat{\sigma}_{\text{CINR}}^{(\text{dB})}(n) = 5 \cdot \log (\hat{x}_{\text{CINR}}^2(n) - \hat{\mu}_{\text{CINR}}^2(n)) \, \text{dB}$$

RSSI

The received signal strength indicator is determined for each subframe n. The computation is based on the time domain samples $r(i)$ extracted by the subframe detection block.

$$RSSI(n) \sim \overline{|r(i)|^2}$$

(17)

Further RSSI statistics are defined in the standard [5]

$$\hat{\mu}_{\text{RSSI}}(n) = \begin{cases} RSSI(0) & n = 0 \\ (1 - \alpha_{\text{avg}}) \cdot \hat{\mu}_{\text{RSSI}}(n-1) + \alpha_{\text{avg}} \cdot RSSI(n) & n > 0 \end{cases}$$

$$\hat{\mu}_{\text{RSSI}}^{(\text{dB})}(n) = 10 \cdot \log \hat{\mu}_{\text{RSSI}}(n) \, \text{dB}$$

(18)

$$\hat{x}_{\text{RSSI}}^2(n) = \begin{cases} RSSI^2(0) & n = 0 \\ (1 - \alpha_{\text{avg}}) \cdot \hat{x}_{\text{RSSI}}^2(n-1) + \alpha_{\text{avg}} \cdot RSSI^2(n) & n > 0 \end{cases}$$

$$\hat{\sigma}_{\text{RSSI}}^{(\text{dB})}(n) = 5 \cdot \log (\hat{x}_{\text{RSSI}}^2(n) - \hat{\mu}_{\text{RSSI}}^2(n)) \, \text{dB}$$

I/Q-Imbalance

The I/Q-imbalance estimation block allows to evaluate the

$$modulator\ gain\ balance = |1 + \Delta Q|$$

(19)

and the

$$quadrature\ mismatch = \arg\{1 + \Delta Q\}$$

(20)

respectively based on the block's estimate $\Delta \hat{Q}$. In case of MIMO settings each Tx antenna can cause an individual I/Q-imbalance.

Other Measurement Variables

Without going into detail, the OFDMA measurement application additionally provides the following results:

- Burst power
- Constellation diagram
- Group delay
- I/Q-offset
- PAPR
- Pilot BER
- Spectral flatness

References

[1] Speth, M., Classen, F., and Meyr, H.: Frame Synchronization of OFDM Systems in Frequency Selective Fading Channels. IEEE VTC'97, May 1997, pp. 1807-1811.

[2] Schmidl, T. M. and Cox, D. C.: Robust Frequency and Timing Synchronization of OFDM. IEEE Trans. on Commun. Vol. 45 (1997) No. 12, pp. 1613-1621.

[3] Speth, M., Fechtel, S., Fock, G., and Meyr, H.: Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM – Part I. IEEE Trans. on Commun. Vol. 47 (1999) No. 11, pp. 1668-1677.

[4] Speth, M., Fechtel, S., Fock, G., and Meyr, H.: Optimum Receiver Design for OFDM-Based Broadband Transmission – Part II: A Case Study. IEEE Trans. on Commun. Vol. 49 (2001) No. 4, pp. 571-578.

[5] IEEE 802.16-2004: Air Interface for Fixed Broadband Wireless Access Systems (2004).

[6] Neumann, S.: DSP in the IEEE 802.16 OFDMA Measurement Application. Rohde & Schwarz GmbH & Co. KG 2008.

4 Remote Control

Description of commands

This section specifies all the remote control commands specific to the R&S FSQ-K92/K93/K94 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.

Notation

In the following sections, all commands implemented in the instrument 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.

Table of Comm

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 (see Section 3.5.2). The instrument itself does not distinguish between upper and lower case letters.
Special characters	A selection of key words with an identical effect exists for several commands. These 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 1kHz:

`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 (cf. Section 3.5.2, Optional Keywords). The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards. Parameters in square brackets can 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 (see also Section 3.5.5, "Parameters").

<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.

SCPI Command Examples

Setup 1TX/1RX SISO measurement

```
// Load Zone/Burst configuration from .wimax file
:MMEMory:LOAD:FRAMe:STATe 1,'D:\User\test.wimax';*OPC?

// Select 2 TX channels
:CONFigure:WIMax:DUTConfig TX1

// Master setup
:CONFigure:WIMax:ANTMatrix:ANTenna1 ANTenna0"

// Slave setup – turn slave off
:CONFigure:WIMax:ANTMatrix:STATe2 OFF"

// select SISO zone to be analysed
:CONFigure:WIMax:ZONE1:ANALyze:STATe ON

// do sweep
:INIT:IMM;*OPC

// Select EVM v Symbol measurement
:CONFigure:BURSt:EVM:ESYMbol

:DISP:WIND1:SSEL      // select TX0 MagCap graph
:TRACE:DATA? TRACE1   // get MagCap trace data
…
:DISP:WIND2:SSEL      // select RX0 EVM graph
:TRACE:DATA? TRACE2   // get EVM mean trace data
…
```

Setup 2TX/2RX MIMO measurement

```
// Load Zone/Burst configuration from .wimax file
:MMEMory:LOAD:FRAMe:STATe 1,'D:\User\test.wimax';*OPC?

// Select 2 TX channels
:CONFigure:WIMax:DUTConfig TX2

// Master setup
:CONFigure:WIMax:ANTMatrix:ANTenna1 ANTenna0"

// Slave setup
:CONFigure:WIMax:ANTMatrix:ANTenna2 ANTenna1"
:CONF:WIM:ANTM:ADDR2 '192.168.123.212'
:CONFigure:WIMax:ANTMatrix:STATe2 ON"

// select external trigger (master + slave signal must be synchronized)
:TRIG:SEQ:MODE EXT

// MIMO signal so select analysis of PAYLOAD only
:SENSe:DEMod:CESTimation PAYLonly

// select MIMO zone to be analysed
:CONFigure:WIMax:ZONE2:ANALyze:STATe ON
```

```
// do sweep
:INIT:IMM;*OPC

// Select EVM v Symbol measurement
:CONFigure:BURSt:EVM:ESYMbol

:DISP:WIND1:SSEL       // select TX0 MagCap graph
:TRACE:DATA? TRACE1    // get MagCap trace data
…
:DISP:WIND2:SSEL       // select TX1 MagCap graph
:TRACE:DATA? TRACE1    // get MagCap trace data
…
:DISP:WIND3:SSEL       // select RX0 EVM graph
:TRACE:DATA? TRACE2    // get EVM mean trace data
…
:DISP:WIND4:SSEL       // select RX1 EVM graph
:TRACE:DATA? TRACE2    // get EVM mean trace data
…
```

ABORt Subsystem

The ABORt subsystem provides a mechanism by which running measurements can be aborted.

COMMAND	PARAMETERS	UNIT	COMMENT
ABORt			

ABORt

This causes the current measurement, which is being performed, to be aborted.

Example: `"ABOR"` **-**   The R&S FSQ-K92/K93/K94 option will attempt to abort the
                                   current active measurement.

Characteristics: *RST value: --
                     SCPI: conforming

Mode: OFDM, OFDMA

CALCulate Subsystem

CALCulate:BURSt Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:BURSt	-	-	
[:IMMediate]			

CALCulate<1|2>:BURSt[:IMMediate]

This command forces the IQ measurement results to be recalculated according to the current settings.

Example: `"CALC:BURS"`   Forces an update of the IQ results.

Characteristics: *RST value: –
                   SCPI: device-specific

Mode: OFDM, OFDMA

CALCulate:LIMit Subsystem

The CALCulate subsystem contains commands to manipulate limits associated with measurement traces. The commands are of the form CALCulate<1|n>:LIMit<1to8> where n refers to the active screen when used graphically i.e. SCREEN A is 1 and SCREEN B is 2 etc. in OFDM and OFDMA this will be CALCulate1 for magnitude capture display and list results and CALCulate2 for the selected measurement trace.. With MIMO operation it is possible to have a maximum of six traces available at any one time i.e. dual magnitude capture and list results available as SCREEN A and SCREEN B and a maximum of four result traces available as SCREEN C to SCREEN F. Analysing a SISO zone in the MIMO standard will affect the available active screens with the active screens being the same as those available for OFDM,OFDMA.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:LIMit<1 to 8>			
:BURSt			
:ALL	<numeric_value>		
:RESult?	...		query only
:BERPilot			
[:AVERage]	<numeric_value>	PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	PCT	
:RESult?	--		query only
:EVM			
:ALL			
[:AVERage]	<numeric_value>	DB	PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	DB	PCT	
:RESult?	--		query only
:DATA			
[:AVERage]	<numeric_value>	DB	PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	DB	PCT	
:RESult?	--		query only
:IQOFfset			
[:AVERage]	<numeric_value>	DB	PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	DB	PCT	
:RESult?	--		query only
:FERRor			
[:AVERage]	<numeric_value>	HZ	PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	HZ	PCT	
:RESult?	--		query only
:SSTiming			
[:AVERage]	<numeric_value>	PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	PCT	
:RESult?	--		query only
:SYMBolerror			
[:AVERage]	<numeric_value>	PPM	PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	PPM	PCT	
:RESult?	--		query only
:USERror	--		
[:AVERage]	<numeric_value>	DB	
:RESult?	--		query only
:MAXimum	--		
:RESult?	<numeric_value>	DB	query only
:SPECtrum	--		
:MASK			
:CHECk			
:X?	--	HZ	query only
:Y?	--	DBM	query only
FAIL?	--		query only

CALCulate<1|2>:LIMit<1>:BURSt:ALL <numeric value>, …

This command sets or returns all the limit values. The limits are set or returned as a list of values separated by ',' in the following (ASCII) format:

Query/Set OFDM:

<average EVM All Carriers>, <max EVM All Carriers>,
<average EVM Data>, <max EVM Data>,   -- Not used [1]
<average Frequency Error>, <max Frequency Error>,
<average Symbol Error>, <max Symbol Error>,
<average SS Timing>, <max SS Timing>,   -- Not used, uplink only [2]
<average IQ Offset>, <max IQ Offset>

[1] EVM Data values are no longer used for OFDM, but are kept to maintain positions for backward compatibility.

[2] SS Timing values are no longer used for OFDM, but are kept to maintain positions for backward compatibility. The SS Timing values are only used in UL (i.e. they are not returned, and should not be set, in DL).

Query/Set OFDMA:

<average EVM Data and Pilots >, <max EVM Data and Pilots >,
<average EVM Data>, <max EVM Data>,
<average Frequency Error>, <max Frequency Error>,
<average Symbol Error>, <max Symbol Error>,
<average IQ Offset>, <max IQ Offset>,
<average BER Pilots>, <max BER Pilots>   -- Optional when setting [3]
<average Unmod Subcarrier Error>, <max Unmod Subcarrier Error> -- Optional when setting,
                                                                       Returned in

Uplink only [4]

[3] BER Pilots values do not have to be provided when setting OFDMA limits, unless the Unmod. Subcarrier Error values are following (in which case they are required to maintain the correct positions).

[4] Unmod Subcarrier Error values do not have to be provided when setting OFDMA limits. If provided, the values will be ignored unless an uplink zone is marked for analysis. When querying OFDMA limits, the Unmod. Subcarrier Error values are only returned when an uplink zone is marked for analysis.

Note: Additional limits may be returned in future releases. However, the order and position of limits will be maintained for backward compatibility (e.g. SS Timing) and setting additional limits will be optional (e.g. BER Pilots). Remote command scripts that expect a fixed number of limits to be returned will fail. It may be preferable for scripts to expect the current number of limits, or more, to be returned.

Value	Description
EVM All Carriers / EVM Data and Pilots / EVM Data	Returned in either dB or % depending on selected table display units (UNIT:TABLe).
Frequency Error	Returned in Hz.
Symbol Error	Returned in ppm.
IQ Offset	Returned in either dB or % depending on selected table display units (UNIT:TABLe).
BER Pilots	Returned in %.
Unmod Subcarrier Error	Returned in dB.

Example: `"CALC:LIM:BURS:ALL?"`   All limit values are returned

Characteristics: *RST value: –
                 SCPI: device-specific

Mode: OFDM, OFDMA

CALCulate<1|2>:LIMit<1>:BURSt:ALL:RESULT

This command returns all the limit results (PASSED | FAILED). The results are output as a list of result strings separated by ',' in the following (ASCII) format:

OFDM:
<average EVM All Carriers>, <max EVM All Carriers>,
<average EVM Data>, <max EVM Data>,
<average Frequency Error>, <max Frequency Error>,
<average Symbol Error>, <max Symbol Error>,
<average SS Timing>, <max SS Timing>,
<average IQ Offset>, <max IQ Offset>,

Note: *SS Timing and EVM Data maintained for backward compatibility.*

OFDMA:
<average EVM Data and Pilots>,<max EVM Data and Pilots>,
<average EVM Data>,<max EVM data>,
<average Frequency Error>,<max Frequency Error>,
<average Symbol Error>,<max Symbol Error>,
<average IQ Offset>,<max IQ Offset>,
<average BER Pilots>,<max BER Pilots>
<average Unmod Subcarrier Error>,<max Unmod Subcarrier Error> -- only returned for uplink zones

Note: *Unmodulated Subcarrier Error values are only returned for an analyzed Uplink zones.*

Example:	`"CALC:LIM:BURS:ALL:RES?"`	All limit values are returned
Characteristics:	*RST value: – SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

CALCulate<1|2>:LIMit<1>:BURSt:BERPilot[:AVERage]   <numeric value>, …

This command sets the average Bit Error Rate for pilot carriers Limit in %.

Example:	`"CALC:LIM:BURS:BERP –25.0"`	Average BER for pilot carriers limit is set to –25.0 dB
Characteristics:	*RST value: – SCPI: device-specific	
Mode:	OFDMA, MIMO	

CALCulate<1|2>:LIMit<1>:BURSt:BERPilot[:AVERage]:RESult

This command returns the average Bit Error Rate for pilot carriers Limit result (PASSED | FAILED).

Example:	`"CALC:LIM:BURS:BERP:RES?"`	Average BER for pilot carriers limit result is returned
Characteristics:	*RST value: – SCPI: device-specific	
Mode:	OFDMA, MIMO	

CALCulate<1|2>:LIMit<1>:BURSt:BERPilot:MAXimum <numeric value>

This command sets the maximum Bit Error Rate for pilot carriers Limit in %.

Example:	`"CALC:LIM:BURS:BERP:MAX?"`	Maximum BER for pilot carriers limit is returned

Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:BERPilot:MAXimum:RESult

This command returns the maximum Bit Error Rate for pilot carriers Limit result (PASSED | FAILED).

Example:	`"CALC:LIM:BURS:BERP:MAX:RES?"`	Maximum BER for pilot carriers limit result is returned

Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERage] <numeric value>

This command sets the average Error Vector Magnitude Limit in dB or %. If no units are specified then the value will be set using the currently selected units specified by `UNIT:TABLe`. This is a combined figure that represents the pilot, data and the free carrier.

Example:	`"CALC:LIM:BURS:EVM:ALL –25.0"`	Average EVM for all carrier limit is set to –25.0 dB

Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERage]:RESult

This command returns the average Error Vector Magnitude Limit result (PASSED | FAILED). This is a combined figure that represents the pilot, data and the free carrier.

Example:	`"CALC:LIM:BURS:EVM:ALL:RES?"`	Average EVM for all carrier limit result is returned

Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum <numeric value>

This command sets the maximum Error Vector Magnitude Limit in dB or %. If no units are specified then the value will be set using the currently selected units specified by `UNIT:TABLe`. This is a combined figure that represents the pilot, data and the free carrier.

Example:	`"CALC:LIM:BURS:EVM:ALL:MAX?"`	Maximum EVM for all carrier limit is returned

Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum:RESult

This command returns the maximum Error Vector Magnitude Limit result (PASSED | FAILED). This is a combined figure that represents the pilot, data and the free carrier.

Example: `"CALC:LIM:BURS:EVM:ALL:MAX:RES?"`   Maximum EVM for all carrier limit
                                                                            result is returned

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA

This command suite is obsolete for K92 but retained for backward-compatibility with old scripts.

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERage] <numeric value>

This command sets the average Error Vector Magnitude Limit in dB or % for the data carriers only. If no units are specified then the value will be set using the currently selected units specified by `UNIT:TABLe`.

Example: `"CALC:LIM:BURS:EVM:DATA –25.0"` Average EVM limit for data carriers is
                                                                            set to –25.0 dB

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERage]:RESult

This command returns the average Error Vector Magnitude Limit result (PASSED | FAILED) for the data carriers only.

Example: `"CALC:LIM:BURS:EVM:DATA:RES?"`   Average EVM limit for data carriers
                                                                            result is returned

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum <numeric value>

This command sets the maximum Error Vector Magnitude Limit in dB or % for the data carriers only. If no units are specified then the value will be set using the currently selected units specified by `UNIT:TABLe`.

Example: `"CALC:LIM:BURS:EVM:DATA:MAX?"`   Maximum EVM limit for DATA carrier is
                                                                            returned

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum:RESult

This command returns the maximum Error Vector Magnitude Limit result (PASSED | FAILED) for the data carriers only.

Example:	`"CALC:LIM:BURS:EVM:DATA:MAX:RES?"`	Maximum EVM limit for data carrier result is returned

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage] <numeric value>

This command sets the average frequency error limit in Hertz or %. If no unit is specified then the value will be set using the units depending on the current Up/Down Link mode. If in Down Link mode the units will be Hz and if in Up Link mode the units will be %.

Note: there is no relationship between the Down Link and Up Link values so setting a Down Link value in Up Link mode will not cause the displayed limit value to change.

Example:	`"CALC:LIM:BURS:FERR 10000"`	The average frequency error limit is set to 10 kHz

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]:RESult

This command returns the average frequency error limit result (PASSED | FAILED)

Example:	`"CALC:LIM:BURS:FERR:RES?"`	Average frequency error limit result is returned

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum <numeric value>

This command sets the maximum frequency error limit in Hertz or %. If no unit is specified then the value will be set using the units depending on the current Up/Down Link mode. If in Down Link mode the units will be Hz and if in Up Link mode the units will be %.

Note: there is no relationship between the Down Link and Up Link values so setting a Down Link value in Up Link mode will not cause the displayed limit value to change.

Example:	`"CALC:LIM:BURS:FERR:MAX?"`	Maximum frequency error limit is returned

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum:RESult

This command returns the maximum frequency error limit result (PASSED | FAILED)

Example: `"CALC:LIM:BURS:FERR:MAX:RES?"`   Maximum frequency error limit result is returned

Characteristics: *RST value: –
                       SCPI: device-specific
Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset[:AVERage] <numeric value>

This command sets the average IQ offset limit in dB or %. If no unit is specified then the value will be set in dB.

Example: `"CALC:LIM:BURS:IQOF –15"`   The average IQ offset limit is set to -15 dB

Characteristics: *RST value: –
                       SCPI: device-specific
Mode: OFDM

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset[:AVERage]:RESult

This command returns the average IQ offset limit result (PASSED | FAILED)

Example: `"CALC:LIM:BURS:IQOF:RES?"`   Average IQ offset error limit result is returned

Characteristics: *RST value: –
                       SCPI: device-specific
Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset:MAXimum <numeric value>

This command sets the maximum IQ offset limit in dB or %. If no unit is specified then the value will be set in dB.

Example: `"CALC:LIM:BURS:IQOF:MAX?"` Maximum IQ offset limit is returned

Characteristics: *RST value: –
                       SCPI: device-specific
Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset:MAXimum:RESult

This command returns the maximum IQ offset limit result (PASSED | FAILED)

Example: `"CALC:LIM:BURS:IQOF:MAX:RES?"`   Maximum IQ offset limit result is returned

Characteristics: *RST value: –
                       SCPI: device-specific
Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:SSTiming

This command is obsolete but retained for backward-compatibility with old scripts.

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERage] <numeric value>

This command sets the average symbol error limit in ppm or %. If no unit is specified then the value will be set using the units depending on the current Up/Down Link mode. If in Down Link mode the units will be ppm and if in Up Link mode the units will be %.

Note: there is no relationship between the Down Link and Up Link values so setting a Down Link value in Up Link mode will not cause the displayed limit value to change.

Example:	`"CALC:LIM:BURS:SYMB 10000"`	The average symbol error limit is set to 10000 Hz

Characteristics:	*RST value: –
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERage]:RESult

This command returns the average symbol error limit result (PASSED | FAILED)

Example:	`"CALC:LIM:BURS:SYMB:RES?"`	Average symbol error limit result is returned

Characteristics:	*RST value: –
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum <numeric value>

This command sets the maximum symbol error limit in ppm or %. If no unit is specified then the value will be set using the units depending on the current Up/Down Link mode. If in Down Link mode the units will be ppm and if in Up Link mode the units will be %.

Note: there is no relationship between the Down Link and Up Link values so setting a Down Link value in Up Link mode will not cause the displayed limit value to change.

Example:	`"CALC:LIM:BURS:SYMB:MAX?"`	Maximum symbol error limit is returned

Characteristics:	*RST value: –
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum:RESult

This command returns the maximum symbol error limit result (PASSED | FAILED)

Example:	`"CALC:LIM:BURS:SYMB:MAX:RES?"`	Maximum symbol error limit result is returned

Characteristics:	*RST value: –
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:BURSt:USERror[:AVERage] <numeric value>

This command gets/sets the average Unmodulated Subcarrier Error limit in dB. This limit value is only valid for an Up Link zone.

Note: An Up Link zone must be selected as the zone to be analysed before the limit can be set.

| **Example**: | "CALC:LIM:BURS:USER?" | Unmodulated Subcarrier Error limit is returned |

| **Characteristics**: | *RST value: – |
| | SCPI: device-specific |

| **Mode**: | OFDMA, MIMO |

CALCulate<1|2>:LIMit<1>:BURSt:USERror[:AVERage]:RESult

This command returns the average Unmodulated Subcarrier Error limit result (PASSED | FAILED) for an analysed Up Link zone.

| **Example**: | "CALC:LIM:BURS:SYMB:USER:RES?" | Unmodulated Subcarrier Error limit result is returned |

| **Characteristics**: | *RST value: – |
| | SCPI: device-specific |

| **Mode**: | OFDMA, MIMO |

CALCulate<1|2>:LIMit<1>:BURSt:USERror:MAXimum <numeric value>

This command gets/sets the maximum Unmodulated Subcarrier Error limit in dB. This limit value is only valid for an Up Link zone.

Note: An Up Link zone must be selected as the zone to be analysed before the limit can be set.

| **Example**: | "CALC:LIM:BURS:USER:MAX?" Unmodulated Subcarrier Error limit is returned |

| **Characteristics**: | *RST value: – |
| | SCPI: device-specific |

| **Mode**: | OFDMA, MIMO |

CALCulate<1|2>:LIMit<1>:BURSt:USERror:MAXimum:RESult

This command returns the Unmodulated Subcarrier Error limit result (PASSED | FAILED) for an analysed Up Link zone.

| **Example**: | "CALC:LIM:BURS:SYMB:USER:MAX:RES?" | Unmodulated Subcarrier Error limit result is returned |

| **Characteristics**: | *RST value: – |
| | SCPI: device-specific |

| **Mode**: | OFDMA, MIMO |

CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECk:X

This command returns the X-value at the maximum overstepping of the spectrum mask limits

Example: `"CALC:LIM:SPEC:MASK:CHEC:X?"`   Returns the frequency at the maximum overstepping.

Characteristics: *RST value: –
                    SCPI: device-specific

Mode: OFDM

CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECk:Y

This command returns the Y-value at the maximum overstepping of the spectrum mask limits

Example: `"CALC:LIM:SPEC:MASK:CHEC:Y?"`   Returns the power at the maximum overstepping.

Characteristics: *RST value: –
                    SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:LIMit<1>:FAIL?

This command queries the result of the limit check of the limit line indicated in the selected measurement window. It should be noted that a complete sweep must have been performed for obtaining a valid result. A synchronization with *OPC, *OPC? or *WAI should therefore be provided.

The result of the limit check responds with 0 for PASS and 1 for FAIL.

Note that no limit lines are displayed in screen A and as such all CALCulate1:LIMit:FAIL? commands will return 0.

The index for LIMit for specific limit lines is as follows:

Index	Limit
1 to 2	These indices are not used
3	ETSI Spectrum Mask limit line
4	IEEE Spectrum Mask limit line
5	Spectrum Flatness (Upper) limit line
6	Spectrum Flatness (Lower) limit line
7	Spectrum Flatness Difference (Upper) limit line
8	Spectrum Flatness Difference (Lower) limit line
9	Channel Frequency Response Phase (Upper) limit line
10	Channel Frequency Response Phase (Lower) limit line

Example: `"INIT;*WAI"`   Starts a new sweep and waits for its end.
                    `"CALC2:LIM1:FAIL?"`   Queries the result of the check for limit line 1 in screen B.

Characteristics: *RST value: –
                    SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate:MARKer Subsystem

The CALCulate:MARKer subsystem checks the marker functions within the option.The commands are of the form CALCulate<1|n>:MARKer<1> where n refers to the active screen when used graphically i.e. SCREEN A is 1 and SCREEN B is 2 etc. in OFDM and OFDMA this will be CALCulate1 for magnitude capture display results and CALCulate2 for the selected measurement trace.. With MIMO operation it is possible to have a maximum of six traces available at any one time i.e. dual magnitude capture and list results available as SCREEN A and SCREEN B and a maximum of four result traces available as SCREEN C to SCREEN F. Analysing a SISO zone in the MIMO standard will affect the available active screens with the active screens being the same as those available for OFDM,OFDMA.

Note: There is only one marker available per screen.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer<1>			
:MAXimum			
[:PEAK]			no query
:MINimum			
[:PEAK]			no query
:TRACe	<numeric_value>		
:X	<numeric_value>	HZ	S	DB	
:Y	<numeric_value>	PCT	DB	query only
:BURSt	<numeric_value>		
:SYMBol	<numeric_value>		
:CARRier	<numeric_value>		
:AOFF			no query
[:STATe]	<Boolean>		

CALCulate<1|2>:MARKer<1>:MAXimum[:PEAK]

This command sets the selected marker to the maximum peak value in the current trace. This command is only available for the following result displays:

Spectrum Flatness

Example: "CALC2:MARK:MAX"   Set marker 1 in screen B to maximum value in trace

Characteristics: *RST value: –
                                   SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:MINimum[:PEAK]

This command sets the selected marker to the minimum peak value in the current trace.
This command is only available for the following result displays:

Spectrum Flatness

Example: "CALC2:MARK:MIN" Set marker 1 in screen B to minimum value in trace

Characteristics: *RST value: –
                                   SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:TRACe <numeric value>

This command assigns the selected marker to the indicated measurement curve in the selected measurement window.Note, for the PVT Start / End result display, selecting the trace switches the marker between the Start / End traces. This command is only available for the following result displays:

Constellation versus Carrier
EVM versus Symbol
EVM versus Carrier
Frequency Error vs Preamble
Phase Error vs Preamble
PVT Rising / Falling
Spectrum Flatness
Spectrum Flatness Difference
Spectrum Mask - When Max Hold trace is displayed
Spectrum ACP/ACPR - When Max Hold trace is displayed

Example:	`"CALC2:MARK:TRAC 2"`	Assigns the marker in screen B to trace 2.
Characteristics:	*RST value: 1	
	SCPI:	device-specific
Mode:	OFDM, OFDMA, MIMO	

CALCulate<1|2>:MARKer<1>:X <numeric value>

This command positions the selected marker to the indicated inphase (Constellation vs Symbol), frequency (Spectrum FFT, Spectrum Mask), time (Magnitude Capture Buffer, Auto Level, PVT Full Burst, PVT Start / End), power (CCDF), sub-carrier (Constellation vs Carrier, EVM vs Carrier, Spectrum Flatness) or symbol (EVM vs Symbol) in the selected measurement window. This command is query only for the following result displays:

Constellation vs Symbol
Constellation vs Carrier
Bitstream (802.16e/D11 standard only)

Example:	`"CALC:MARK:X 2ms"`	Positions marker 1 in screen A to time 2ms.
Characteristics:	*RST value: –	
	SCPI:	device-specific
Mode:	OFDM, OFDMA, MIMO	

CALCulate<1|2>:MARKer<1>:Y <numeric value>

This command returns the position of the selected marker at the quadrature (Constellation vs Symbol), magnitude of I or Q (Constellation vs Carrier), EVM (EVM vs Carrier) or abs (Spectrum Flatness) in the selected measurement window.
This command is query only for all result displays.
Constellation vs Symbol
Constellation vs Carrier
Bitstream (802.16e/D11 standard only)
For the bitstream measurement in 802.16e/D11, the modulation scheme in use is returned via this SCPI command in the following format.
BPSK Pilots   0
QPSK   2
16QAM   3
64QAM   4

Example:	`"CALC:MARK:Y?"` Outputs the measured value of marker 1 in screen A.	
Characteristics:	*RST value: –	
	SCPI:	device-specific
Mode:	OFDM, OFDMA, MIMO	

CALCulate<1|2>:MARKer<1>:BURSt <numeric value>

This command positions the selected marker to the indicated burst for Constellation vs Symbol.
This command is valid only for the following result displays:
Constellation vs Symbol

Example:	`"CALC2:MARK:BURS 2"`	Positions marker 1 in screen B to burst 2.
	`"CALC2:MARK:BURS?"`	Outputs the symbol value of marker 1 in screen B.
Characteristics:	*RST value: –	
	SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

CALCulate<1|2>:MARKer<1>:SYMBol <numeric value>

This command positions the selected marker to the indicated symbol (Constellation vs Symbol and Constellation vs Carrier).
This command is valid only for the following result displays:

Constellation vs Symbol
Constellation vs Carrier
Bitstream (802.16e/D11 standard only)

For the bitstream measurement in 802.16e/D11, the bitstream value can be returned by querying the marker X value. The modulation scheme in use for the selected symbol/carrier combination can be returned by querying the marker Y value.

Example:	`"CALC2:MARK:SYMB 2"`	Positions marker 1 in screen B to symbol 2.
	`"CALC2:MARK:SYMB?"`	Outputs the symbol value of marker 1 in screen B.
Characteristics:	*RST value: –	
	SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

CALCulate<1|2>:MARKer<1>:CARRier <numeric value>

This command positions the selected marker to the indicated carrier (Constellation vs Symbol and Constellation vs Carrier).
This command is valid only for the following result displays:

Constellation vs Symbol
Constellation vs Carrier
Bitstream (802.16e/D11 standard only)

For the bitstream measurement in 802.16e/D11, the bitstream value can be returned by querying the marker X value. The modulation scheme in use for the selected symbol/carrier combination can be returned by querying the marker Y value.

Example:	`"CALC2:MARK:CARR -7"`	Positions marker 1 in screen B to carrier -7
	`"CALC2:MARK:CARR?"`	Outputs the carrier value of marker 1 in screen B.
Characteristics:	*RST value: –	
	SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

CALCulate<1|2>:MARKer<1>:AOFF

This command switches off all active markers in the specified measurement window. The window will either be "screen a" or "screen b" and will be determined by the numeric value that follows the "CALCulate" keyword.

Example:	`"CALC1:MARK:AOFF"` Switches off all markers in the screen A window.
	`"CALC2:MARK:AOFF"` Switches off all markers in the screen B window.
Characteristics:	*RST value: –
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>[:STATe] <Boolean>

This command switches the marker in the specified measurement window on or off.

Example:	`"CALC1:MARK1:STATE ON"` Switches the screen A marker ON.
	`"CALC2:MARK1:STATE OFF"` Switches the screen B marker OFF.
Characteristics:	*RST value: 1
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CALCulate:MARKer:FUNCtion Subsystem

The measurement window is selected by CALCulate 1 (screen A) or 2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer<1>			
:FUNCtion			
:ZOOM	<numeric_value>		
:POWer			
:RESult			
[:CURRent]		DB	Query only
:MAXHold		DB	Query only
:RPOFfset			
:TTCapture			
:AVERaging			
:FRAMe	<numeric_value>		
:LENGth?			Query only
:RPOFfset	<numeric_value>		
:RPOWer:			
:RPType	RMS | PEAK | USER		
:STARt	FFT | FRAMe		
[:TIMe]	<numeric_value>	S	Query only

CALCulate<1|2>:MARKer<1>:FUNCtion:ZOOM <numeric value>

This command defines the ratio to be zoomed around the marker 1 in the selected measurement window. The default value is 1, where the full trace is shown.
This command is only available for the following result displays:
Constellation vs Carrier
Constellation vs Symbol
PVT Full Burst
PVT Start / End
Magnitude Capture Buffer

Example:	"CALC:MARK:FUNC:ZOOM 2"	Zooms 50% in screen A.
	"CALC:MARK:FUNC:ZOOM 4"	Zooms 25% in screen A.
	"CALC:MARK:FUNC:ZOOM 1"	Deactivates zooming in screen A.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

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
2. Power of lower adjacent channel
3. Power of upper adjacent channel
4. Power of lower alternate adjacent channel 1
5. Power of upper alternate adjacent channel 1
6. Power of lower alternate adjacent channel 2
7. Power of upper alternate adjacent channel 2
8. Power of lower alternate adjacent channel 3
9. Power of upper alternate adjacent channel 3
10. Power of lower alternate adjacent channel 4
11. Power of upper alternate adjacent channel 4

Adjacent channel power values are output in dB. The returned list is variable length depending on the number of channels specified to be measured, i.e. if the number of channels is set to 3 then the list will contain 7 results (main channel plus two results each for each adjacent channel specified).

Example: `"CALC2:MARK:FUNC:POW:RES?"`

Characteristics: *RST value: –
                   SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult:MAXHold?

This command queries the maximum result values of the adjacent channel power measurement. An ACPR (Adjacent channel power relative) measurement must have previously been run with more than one sweep for there to be maximum summary data available.
Results are output separated by commas in the following order:

1. Power of main channel
2. Power of lower adjacent channel
3. Power of upper adjacent channel
4. Power of lower alternate adjacent channel 1
5. Power of upper alternate adjacent channel 1
6. Power of lower alternate adjacent channel 2
7. Power of upper alternate adjacent channel 2
8. Power of lower alternate adjacent channel 3
9. Power of upper alternate adjacent channel 3
10. Power of lower alternate adjacent channel 4
11. Power of upper alternate adjacent channel 4

Adjacent channel power values are output in dB. The returned list is variable length depending on the number of channels specified to be measured, i.e. if the number of channels is set to 3 then the list will contain 7 results (main channel plus two results each for each adjacent channel specified).

Example: `"CALC2:MARK:FUNC:POW:RES:MAXH?"`

Characteristics: *RST value: –
                   SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:FUNCtion:TTCapture:AVERaging <numeric value>

This command sets the smoothing factor of the 'subframe length' calculation. It may only be odd.

Example: "CALC:MARK:FUNC:TTC:AVER 129"

Characteristics: *RST value: 11
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:FUNCtion:TTCapture:FRAMe <numeric value>

This command sets or returns the frame that the Time to Capture Buffer marker is to be set to.

Example: "CALC:MARK:FUNC:TTC:FRAM 2"

Characteristics: *RST value: 1
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:FUNCtion:TTCapture:LENGth?

This command returns the result of the 'subframe length' calculation.

Example: "CALC:MARK:FUNC:TTC:LENG?"

Characteristics: *RST value: 0
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:FUNCtion:TTCapture:RPOType PSN | USER

This command sets the type of the reference power offset of the 'subframe length' calculation. The following types are available:

PSN   The offset is calculated as a percentage of the "EVM Data and Pilots" result.
USER   The offset is user-defined.

Example: "CALC:MARK:FUNC:TTC:RPOT PSN"
                     "CALC:MARK:FUNC:TTC:RPOT USER"

Characteristics: *RST value: PSN
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:FUNCtion:TTCapture:RPOFfset <numeric value>

This command sets the reference power offset of the 'subframe length' calculation.

Example: "CALC:MARK:FUNC:TTC:RPOF 5"

Characteristics: *RST value: 5
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:FUNCtion:TTCapture:RPOWer <numeric value>

This command sets the reference power of the 'subframe length' calculation in the case that the reference power type is USER.

Example: `"CALC:MARK:FUNC:TTC:RPOW -20"`

Characteristics: *RST value: 0
                    SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:FUNCtion:TTCapture:RPTYpe RMS | PEAK | USER

This command sets the type of the reference power for the 'subframe length' calculation. The following types are available:

RMS The reference power is relative to the RMS power of the subframe.
PEAK The reference power is relative to the peak power of the subframe.
USER The reference power is user-defined.

Example: `"CALC:MARK:FUNC:TTC:RPTY RMS"`
                       `"CALC:MARK:FUNC:TTC:RPTY PEAK"`
                       `"CALC:MARK:FUNC:TTC:RPTY USER"`

Characteristics: *RST value: RMS
                       SCPI: device-specific

Mode: K92, K93, K94

CALCulate<1|2>:MARKer<1>:FUNCtion:TTCapture:STARt FFT | FRAMe

This command sets the 'time to capture buffer' calculation to be with respect to either FFT or frame.

Example: `"CALC:MARK:FUNC:TTC:STAR FFT"`

Characteristics: *RST value: FFT
                       SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CALCulate<1|2>:MARKer<1>:FUNCtion:TTCapture[:TIMe]?

This command returns the time to the start of the frame of the capture buffer. The frame that is returned is set by CALC<1|2>:MARK<1>:FUNC:TTC:FRAM

Example: `"CALC:MARK:FUNC:TTC?"`

Characteristics: *RST value: 1
                       SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

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.

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			
:ADDRess			
:SMU	<String>		
:POWer			
:EXPected			
:RF	<numeric_value>	DBM	
:IQ	<numeric_value>	V	
:AUTO	<Boolean> | ONCE		
:SWEep			
:TIME	<numeric_value>	S	
:CHANnel	<numeric_value>		
:STANdard	<numeric_value>		
:BURSt			
:PVT			
:SELect	EDGE | FULL		
[:IMMediate]			
:BURSt	<numeric_value>		
:EVM			
:ECARrier			
[:IMMediate]			
:ESYMbol			
[:IMMediate]			
:SPECtrum			
:MASK			
:SELect	IEEE | ETS | ETSI | ETSI301021 | ETSI30254401 | ETSI30254401,BW5M | ETSI30254401,BW10M		
[:IMMediate]			
:FLATness			
:SELect	FLATness | GRDelay | DIFFerence		
[:IMMediate]			
:FFT			
[:IMMediate]			
:ACPR			
SELect	ABS | REL		
[:IMMediate]			
:PHASE			
:PREamble			
[:IMMediate]			
:CONSt			
:CCARrier			
[:IMMediate]			
:CSYMbol			
[:IMMediate]			
:SYMBol			
:SELect	ALL | <numeric_value>		
:CARRier			
:SELect	-2048 to 2048 | ALL | PILOTS		
:BURst			
:SELect	ALL | PILOTS | <numeric_value>		
:FORMat			
:SELect	ALL | QPSK | QAM16 | QAM64		

COMMAND	PARAMETERS	UNIT	COMMENT
:BURSt			
:STATistics			
:CCDF			
[:IMMediate]			
:BSTReam			
[:IMMediate]			
:BURSt			
:SELect	ALL | <numeric_value>		
:FORMat			
:SELect	ALL | BPSK | QPSK | QAM16 | QAM64		
:SYMBol			
:SELect	<numeric_value>		
:BSUMmary			
[:IMMediate]			
:PREamble			
:SELect	FREQuency | PHASe		
[:IMMediate]			
:WIMAX			
:AVERaging	<numeric_value>		
:FBANd	UNSPecified | ETSI | ETSI1 | ETSI2 | MMDS | MMDS1 | MMDS2 | WCS | WCS1 | WCS2 | CEPT | CEPT1 | CEPT2 | UNII | UNII1 | UNII2		
:FSBWratio			
:AUTO	<boolean>		
:FS	<numeric_value>		
:BW	<numeric_value>		
:IGRatio	<numeric_value>		
:LMODe	DL | UL		
:NFFT	FFT128 | FFT512 | FFT1024 | FFT2048|		
:TDDFrame	<numeric_value>		
:TTG		S	
:DLSFrame	<numeric_value>		
:IDCell			
:PREamble	<numeric_value>		
:INDex			
:MODe	<numeric_value>		
:SEGMent<1 to 3>	AUTO | USER		
:ULSFrame	<numeric_value>		
:FRAMe			
:CRLength	<numeric_value>		
:SEGMent<1 to 3>	<numeric_value>		
:BITMap<1 to 18>			
:DUTConfig	<numeric_value>		
:STC	TX1 | TX2		
:CROSstalk			
:ZONE<1 to 26>	<boolean>		
:COUNt?			
:CONTrol			
[:DATA]	<boolean>,DLFUSC | DLPUSC | DLPUSCALL | DLOFUSC | DLAMC2X3 | ULPUSC | ULPUSCALL | ULOPUSC | ULAMC2X3, <numeric_value>,<numeric_value>,<numeric_value>, <numeric_value>,<numeric_value>		
:STCConfig	NOSTc | TX2		
:MXINdicator	BURStdefined | A | B		
[:ANALyze]			
:STATe			
	<boolean>		
:TYPE	DLFUSC | DLPUSC | DLPUSCALL | DLOFUSC | DLAMC2X3 | ULPUSC | ULPUSCALL | ULOPUSC |		
:Frame			
PREDefmap	CONFig |IQDL | IQUL		
:IDCell	<numeric_value>		
:AUTO	<numeric_value>		
:ZONEtouse	LAST|Z1|Z2|Z3|Z4|Z5|Z6|Z7|Z8|Z9|Z10|Z11|Z12|Z13|Z14|Z15|Z16|Z18|Z19|Z20|Z21|Z22|Z23|Z24|Z25|Z26		

COMMAND	PARAMETERS	UNIT	COMMENT
:WIMAX			
:DLSFrame			
:IDCell			
:ZONE<1 to 26>			
BURSt<1 to 32>			
:CONTrol			
[:DATA]			
STCConfig	NOSTC | TX1 | TX2		
STCMode			
:FORMat			
:CONTrol			
:STCConfig	NOSTC | TX1 | TX2		
:STCMode	STTD | MULTiplexing | BURStdefined		
:IDSegment	ULAMC2X3		
:PERMbase	<numeric_value>		
:PRBS	<numeric_value>		
:DELete	<numeric_value>		
:SYMBol			
:COUNt	<numeric_value>		
:OFFSet	<numeric_value>		
:RESet			
:BURSt<1 to 32>			
:COUNt?			
:CONTrol			
[:DATA]	QPSK_1_2 | QPSK_3_4 | QAM16_1_2 | QAM16_3_4 | QAM64_1_2 | QAM64_2_3 | QAM64_3_4 | QAM64_5_6,<numeric_value>,<numeric_value>, <numeric_value>,<numeric_value>,<numeric_value>,< numeric_value>, FCH | DLMAP | ULMAP | DATA | HARQ | FASTfeedback		
:MXINdicator	A | B		
:STCMode	STTD | 1TX | 2TX		
:FORMat	AUTO | QPSK | QPSK_1_2 | QPSK_3_4 | QAM16_1_2 | QAM16_3_4 | QAM64_1_2 | QAM64_2_3 | QAM64_3_4 | QAM64_5_6		
:OFFSet	<boolean>		
:AUTO			
:SLOT	<numeric_value>		
:DURation			
:SUBChannel	<numeric_value>		
:COUNt	<numeric_value>		
:OFFSet			
:SYMBol	<numeric_value>		
:COUNt	<numeric_value>		
:OFFSet	<numeric_value>	DBM	
:POWer	FCH | DLMAP | ULMAP | DATA | HARQ | FASTfeedback		
:TYPE			
:DELete			
:RESet			
:ANTMatrix			
:AUTO	<boolean>		
:STATe<1 to 4>	<boolean>		
:ADDRess<1 to 4>	<String>		
:ANTenna<1 to 4>	ANTENNA0 | ANTENNA1 | ANTENNA2 | ANTENNA3		

CONFigure:ADDRess:SMU <String>

This remote control command is used to specify the IP address of the SMU to which WiMax settings can be uploaded or downloaded.

Example: `"CONF:ADDR:SMU '192.168.1.68'"`

Characteristics: *RST value: –
                 SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:POWer:EXPected:RF <numeric_value>

This remote control command is used to specify the mean power level of the source signal as supplied to the Analyzer RF input. This value will be overwritten if Auto Level is turned on.

Example:	`"CONF:POW:EXP:RF 9"`	The R&S FSQ-K92 option assumes an input signal strength of 9 dBm
Characteristics:	*RST value: – SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

CONFigure:POWer:EXPected:IQ <numeric_value>

This remote control command is used to specify the mean power level of the source signal as supplied to the Analyzer IQ inputs. This value will be overwritten if Auto Level is turned on.

Example:	`"CONF:POW:EXP:IQ 1"`	The R&S FSQ-K92 option assumes an input signal strength of 1 Volt
Characteristics:	*RST value: – SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

CONFigure:POWer:AUTO <Boolean> | ONCE

This remote control command is used to switch on or off automatic power level detection. When switched on, power level detection is performed at the start of each measurement sweep. If this command is issued with the ONCE parameter then the auto level routine is performed immediately one time, regardless of the current state of this parameter (ON or OFF).

Example:	`"CONF:POW:AUTO 1"`	The R&S FSQ-K92 option will automatically detect the input power level
Characteristics:	*RST value: – SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

CONFigure:POWer:AUTO:SWEep:TIME <numeric_value>

This remote control command is used to specify the seep time for the automatic power level detection.

Example:	`"CONF:POW:AUTO:SWE:TIME 200MS"`	
	The auto detect measurement will use a sweep time of 200 ms	
Characteristics:	*RST value: 100ms SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

CONFigure:CHANnel <numeric_value>

This remote control command is used to specify the input channel for which measurements are to be performed. This command will automatically cause the internal measurement frequency to be re-calculated.

Example:	`"CONF:CHAN 9"`	The R&S FSQ-K92 option will perform measurements at the frequency represented by channel 9.
Characteristics:	*RST value: 0 SCPI: device-specific	
Mode:	OFDM	

CONFigure:STANdard <numeric_value>

Note: This command is maintained in R&S FSQ-K92 for compatibility reasons. The only valid value is 0.

Example:	`"CONF:STAN 0"`	The R&S FSQ-K92 option will perform measurements according to IEEE 802.16 - 2004.

Characteristics: *RST value: 0
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:PVT:SELect EDGE | FULL

This remote control configures how R&S FSQ-K92 will interpret the Power vs Time measurement results. The supplied string can be one of the following:

EDGE - configures the measurement to be Start / End.

FULL - configures the measurement to be Full Burst.

Example:	`"CONF:BURS:PVT:SEL FULL"`	R&S FSQ-K92 option is will interpret the measurement results as full burst

Characteristics: *RST value: –
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:PVT[:IMMediate]

This remote control command configures R&S FSQ-K92 measurement type to be Power vs Time. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example:	`"CONF:BURS:PVT"`	R&S FSQ-K92 option is configured to run a Power vs Time measurement.

Characteristics: *RST value: –
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:PVT:BURSt <numeric_value>

This remote control configures the PVT to use the specified burst for its measurement results.

Example:	`"CONF:BURS:PVT:BURS 1"`	The option will select burst 1 for the PVT measurement results.

Characteristics: *RST value: –
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:EVM:ECARrier[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be EVM vs Carrier. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example:	`"CONF:BURS:EVM:ECAR"`	R&S FSQ-K92 option is configured to run an EVM vs Carrier measurement.

Characteristics: *RST value: –
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:EVM:ESYMbol[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be EVM vs Symbol. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example: `"CONF:BURS:EVM:ESYM"`   R&S FSQ-K92 option is configured to run an EVM vs Symbol measurement.

Characteristics: *RST value: –
                          SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:SPECtrum:MASK[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be Spectrum mask. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example: `"CONF:BURS:SPEC:MASK"`   R&S FSQ-K92 option is configured to run a Spectrum Mask measurement.

Characteristics: *RST value: –
                          SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:SPECtrum:MASK:SELect   IEEE | ETS | ETSI | ETSI301021 | ETSI30254401 | ETSI30254401,BW5M | ETSI30254401,BW10M

This remote control configures how R&S FSQ-K92/K93 will interpret the Spectrum MASK measurement results. This is either performed using the IEEE or ETSI standard.

The ETSI standards are selected as follows:
ETSI or ETSI301021   ETSI EN 301021 SEM standard (this is the default standard)
ETSI30254401   or   ETSI EN 30254401 SEM standard for 5MHz BW
ETSI30254401,BW5M
ETSI30254401,BW10M   ETSI EN 30254401 SEM standard for 10MHz BW

Note: *This command is maintained for backward compatibility only. It has been replaced by SENSe:]POWer:SEM.*

Example: `"CONF:BURS:SPECT:MASK:SEL ETS"`
                          R&S FSQ-K92/93 option is will interpret the measurement results using the ETSI standard

Characteristics: *RST value: –
                          SCPI: device-specific

Mode: OFDM, OFDMA

CONFigure:BURSt:SPECtrum:FLATness[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be Spectrum Flatness. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example: `"CONF:BURS:SPEC:FLAT:SEL FLAT"`
                           R&S FSQ-K92 option is configured to run a Spectrum Flatness measurement

Characteristics: *RST value: –
                          SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:SPECtrum:FLATness:SELect FLATness | GRDelay | DIFFerence

This remote control command configures the R&S FSQ-K92 Spectrum Flatness measurement type. The supplied string can be one of the following:

FLATness   - Spectrum Flatness results
GRDelay   - Spectrum Flatness Group Delay results
DIFFerence   - Spectrum Flatness Difference results specified.

Example: `"CONF:BURS:SPEC:FLAT:SEL DIFF"`

R&S FSQ-K92 flatness measurement type is configured as Spectrum Flatness Difference

Characteristics: *RST value: –
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:SPECtrum:PHASe:PREamble[:IMMediate]

This remote control command configures the R&S FSQ-K93 measurement type to be Preamble Channel Frequency Response. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example: `"CONF:BURS:SPEC:PHAS:PRE"`

R&S FSQ-K93 option is configured to run a Preamble Channel Frequency Response measurement.

Characteristics: *RST value: –
                         SCPI: device-specific

Mode: OFDMA

CONFigure:BURSt:SPECtrum:FFT[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be FFT (Fast Fourier Transform). After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example: `"CONF:BURS:SPEC:FFT"`   R&S FSQ-K92 option is configured to run a FFT measurement.

Characteristics: *RST value: –
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:SPECtrum:ACPR[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be ACPR (adjacent channel power relative). After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example: `"CONF:BURS:SPEC:ACPR"`   R&S FSQ-K92 option is configured to run a ACPR measurement.

Characteristics: *RST value: –
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:SPECtrum:ACPR:SELect ABS | REL

This command sets the ACPR measurement mode to either absolute or relative. The mode can be specified as follows:

ABS - Absolute measurement

REL - Relative measurement

Example:	`"CONF:BURS:SPEC:ACPR:SEL ABS"`	R&S FSQ-K92 option is configured to run an ACPR Absolute measurement

Characteristics:	*RST value: REL
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CONFigure:BURSt:CONSt:CCARrier[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be Constellation vs Carrier. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example:	`"CONF:BURS:CONS:CCAR"`	R&S FSQ-K92 option is configured to run a Constellation vs Carrier measurement.

Characteristics:	*RST value: –
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CONFigure:BURSt:CONSt:CSYMbol[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be Constellation vs Symbol. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example:	`"CONF:BURS:CONS:CSYM"`	R&S FSQ-K92 option is configured to run a Constellation vs Symbol measurement.

Characteristics:	*RST value: –
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CONFigure:BURSt:CONSt:SYMBol:SELect ALL | <numeric_value>

This remote control command is only available when Constellation vs Symbol measurement is selected. When the Constellation vs Symbol measurement is initiated, it will calculate the results of the selected symbol.

Example:	`"CONF:BURS:CONS:SYMB:SEL 1"`	Symbol 1 is selected.
	`"CONF:BURS:CONS:SYMB:SEL ALL"`	All symbols are selected.

Characteristics:	*RST value: ALL
	SCPI: device-specific
Mode:	OFDMA, MIMO

CONFigure:BURSt:CONSt:FORMat:SELect ALL | QPSK | QAM16 | QAM64

This remote control command is only available when Constellation vs Symbol measurement is selected. When the Constellation vs Symbol measurement is initiated, it will calculate the results of the selected modulation format.

| **Example**: | `"CONF:BURS:CONS:FORM:SEL QPSK"` | QPSK modulation formats. |
| | `"CONF:BURS:CONS:FORM:SEL ALL"` | All modulation formats. |

Characteristics: *RST value: ALL
SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:BURSt:CONSt:BURSt:SELect ALL | PILOTS | <numeric_value>

This remote control command is only available when Constellation vs Symbol measurement is selected. When the Constellation vs Symbol measurement is initiated, it will calculate the results of the selected burst.

Example:	`"CONF:BURS:CONS:BURS:SEL 1"`	Burst 1 is selected.
	`"CONF:BURS:CONS:BURS:SEL ALL"`	All bursts are selected.
	`"CONF:BURS:CONS:BURS:SEL PILOTS"`	Pilots only selected.

Characteristics: *RST value: ALL
SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:BURSt:CONSt:CARRier:SELect

This remote control command is only available when Constellation vs Symbol measurement is selected. When the Constellation vs Symbol measurement is initiated, it will calculate the results of the selected carrier.

Example:	`"CONF:BURS:CONS:CARR:SEL –26"`	Carrier –26 is selected.
	`"CONF:BURS:CONS:CARR:SEL 10"`	Carrier 10 is selected.
	`"CONF:BURS:CONS:CARR:SEL ALL"`	All carriers are selected.
	`"CONF:BURS:CONS:CARR:SEL PIL"`	Pilots only.

Characteristics: *RST value: ALL
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:STATistics:CCDF[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be CCDF (conditional cumulative distribution functions.). After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

| **Example**: | `"CONF:BURS:STAT:CCDF"` | R&S FSQ-K92 option is configured to run a CCDF measurement. |

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:STATistics:BSTReam[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be bit stream. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example:	`"CONF:BURS:STAT:BSTR"` R&S FSQ-K92 option is configured to run a bit stream measurement.
Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CONFigure:BURSt: STATistics:BSTReam:SYMBol:SELect <numeric_value>

This remote control command is only available when Bit Stream measurement is selected. When the Bit Stream measurement is initiated, it will calculate the results of the selected symbol.

Example:	`"CONF:BURS:STAT:BST:SYMB:SEL 1"` Symbol 1 is selected.
Characteristics:	*RST value: 1 SCPI: device-specific
Mode:	OFDMA, MIMO

CONFigure:BURSt: STATistics:BSTReam:FORMat:SELect ALL | BPSK | QPSK | QAM16 | QAM64

This remote control command is only available when Bit Stream measurement is selected. When the Bit Stream measurement is initiated, it will calculate the results of the selected modulation format.

Example:	`"CONF:BURS:STAT:BST:FORM:SEL QPSK"` QPSK modulation formats. `"CONF:BURS:STAT:BST:FORM:SEL ALL"` All modulation formats.
Characteristics:	*RST value: ALL SCPI: device-specific
Mode:	OFDMA, MIMO

CONFigure:BURSt: STATistics:BSTReam:BURSt:SELect ALL | <numeric_value>

This remote control command is only available when Bit Stream measurement is selected. When the Bit Stream measurement is initiated, it will calculate the results of the selected burst.

Example:	`"CONF:BURS:STAT:BST:BURS:SEL 1"` Burst 1 is selected. `"CONF:BURS:STAT:BST:BURS:SEL ALL"` All bursts are selected.
Characteristics:	*RST value: ALL SCPI: device-specific
Mode:	OFDMA, MIMO

CONFigure:BURSt:STATistics:BSUMmary[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be Burst Summary. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example:	`"CONF:BURS:STAT:BSUM"` R&S FSQ-K92 option is configured to run a Burst Summary measurement.
Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

CONFigure:BURSt:PREamble:SELect FREQuency | PHASe

This remote control command configures the R&S FSQ-K92 measurement type to be Phase or Frequency Vs Preamble. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example: `"CONF:BURS:PRE:SEL FREQ"` R&S FSQ-K92 option is configured to run a Frequency Error vs Preamble measurement.

Characteristics: *RST value: –
 SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:BURSt:PREamble[:IMMediate]

This remote control command configures the R&S FSQ-K92 measurement type to be Phase or Frequency Vs Preamble. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command.

Example: `"CONF:BURS:PRE"` R&S FSQ-K92 option is configured to run a Preamble measurement.

Characteristics: *RST value: –
 SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:WIMax:AVERaging

This remote control command is used to specify the RSSI, CINR averaging parameter.

Example: `"CONF:WIM:AVER 0.1"` Sets the value to 0.1

Characteristics: *RST value: –
 SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:WIMax:FBANd UNSPecified | ETSI | ETSI1 | ETSI2 | MMDS | MMDS1 | MMDS2 | WCS |
 WCS1 | WCS2 | CEPT | CEPT1 | CEPT2 | UNII | UNII1 | UNII2

This remote control command configures the R&S FSQ-K92 measurement type to be Phase or Frequency Vs Preamble. After this command has been executed, the specified measurement will only be started when the user issues the INITiate command. The options with the suffix '1' are equivalent to the option without the suffix i.e. "ETSI" the same as ETSI1. When querying a selected option that was set using the option with a suffix of '1' the returned value will be without the suffix (see examples below).

Example: `"CONF:WIM:FBAN ETSI"` Configures the Frequency Band to be ETSI 3.41GHz – 4.2GHz

 `"CONF:WIM:FBAN?"` After Frequency Band is set to ETSI this will return "ETSI" as the current Frequency Band

 `"CONF:WIM:FBAN ETSI1"` Configures the Frequency Band to be ETSI 3.41GHz – 4.2GHz

 `"CONF:WIM:FBAN?"` After Frequency Band is set to ETSI1 this will return "ETSI" as the current Frequency Band

 `"CONF:WIM:FBAN ETSI2"` Configures the Frequency Band to be ETSI 10.0GHz –10.68GHz

 `"CONF:WIM:FBAN?"` After Frequency Band is set to ETSI2 this will return "ETSI2" as the current Frequency Band

The following table shows the relationship between the selection and the Frequency Band.

Selection	Value	Range in GHz	
UNSPECIFIED	Unspecified		
ETSI or ETSI1	ETSI	3.410-4.200	Licensed Band
ETSI2	ETSI	10.000-10.680	Licensed Band
MMDS or MMDS1	MMDS	2.150-2.162	Licensed Band
MMDS2	MMDS	2.500-2.690	Licensed Band
WCS or WCS1	WCS	2.305-2.320	Licensed Band
WCS2	WCS	2.345-2.360	Licensed Band
CEPT or CEPT1	CEPT	5.470-5.725	License Exempt Band
CEPT2	CEPT	5.725-5.875	License Exempt Band
UNII or UNII1	U-NII	5.250-5.350	License Exempt Band
UNII2	U-NII	5.725-5.825	License Exempt Band

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:WIMax: FSBWratio:AUTO <boolean>

This remote control command only switches the Fs/BS ratio to automatic (as per standard) or to user defined values. User mode is only available when the Frequency Band is set to UNSPECIFIED.

Example: `"CONF:WIM:FSBW:AUTO ON" – set to auto`

Characteristics: *RST value: ON
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:WIMax: FSBWratio:FS

This remote control command sets the Sample Rate (Fs) part of the ratio used to calculate the relationship between the Channel Bandwidth (BW) and the Sample Rate (FS). Ratio = Fs/BW.

Example: `"CONF:WIM:FSBW:FS 2.5"`

Characteristics: *RST value: 8
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:WIMax: FSBWratio:BW <numeric_value>

This remote control command sets the Channel Bandwidth (BW) part of the ratio used to calculate the relationship between the Channel Bandwidth (BW) and the Sample Rate (Fs). Ratio = Fs/BW.

Example: `"CONF:WIM:FSBW:BW 1.5"`

Characteristics: *RST value: 7
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:WIMax:IGRatio <numeric_value>

This remote control command is used to specify the number of Guard Samples. The valid range for the Guard Samples are:

$$\frac{T_g}{T_b} \in \{1/32,\ 1/16,\ 1/8,\ 1/4\}$$

The ration can be set to one of four values – 4, 8, 16 or 32. The table below shows the relationship between these values and the number of Guard Samples.

Value	Guard Samples (T_g/T_b)
4	¼
8	1/8
16	1/16
32	1/32

Example: `"CONF:WIM:IGR 16"`   Sets the Guard Samples to 1/16

Characteristics: *RST value: –
                              SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

CONFigure:WIMax:NFFT FFT128 | FFT512 | FFT1024 | FFT2048|<numeric_value>

This remote control command allows the current FFT size to be specified.

This is supplied either by a numeric value or by using the predefined set of symbols:

FFT128   FFT size of 128 carriers

FFT512   FFT size of 512 carriers

FFT1024   FFT size of 1024 carriers

FFT2048 FFT size of 2048 carriers

Example: `"CONF:WIM:NFFT FFT2048"`

Characteristics: *RST value: FFT1024
                              SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:LMODe DL | UL

This remote control command configures the R&S FSQ-K92 option to only analyze the Down Link or Up Link bursts during a measurement.

The supplied string can be one of the following:

DL - Down Link

UL - Up Link

Example: `"CONF:WIM:LMOD UL"` Sets the option to analyze only the Up Link bursts

Characteristics: *RST value: –
                              SCPI: device-specific

Mode: OFDM

CONFigure:WIMax:TDDFrame:TTG <numeric_value>

This remote control command can be used to specify the TDD frame Tx Transition Gap TTG

Example: `"CONF:WIM:TDDF:TTG 5uS"`

Characteristics: *RST value: 5uS
                         SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:DLSFrame:IDCell <numeric_value>

This remote control command can be used to specify the downlink.IDCell number, which in turn is used as DL_PermBase parameter for the permutation equations to partly set the sub carrier randomizer initialisation vector.

Example: `"CONF:WIM:DLSF:IDC 0"`

Characteristics: *RST value: 0
                         SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:DLSFrame:PREamble:INDex <numeric_value>

This remote control command can be used to specify the Preamble Index, which is used in finding the subframe.

Example: `"CONF:WIM:DLSF:PRE:IND 0"`

Characteristics: *RST value: 0
                         SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:DLSFrame:PREamble:MODe AUTO | USER

This remote control command can be used to specify whether the Preamble Index will be automatically calculated 'AUTO' or the 'USER' specified value will be used. The Preamble Index value is used in finding the subframe.

Example: `"CONF:WIM:DLSF:PRE:MOD AUTO"`

Characteristics: *RST value: AUTO
                         SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:DLSFrame:SEGMent<1..3>

This remote control command is used to specify the allowable logical sub channel usage of the transmission spectrum for one of the three downlink PUSC segments.

Example: `"CONF:WIM:DLSF:SEGM1 63"`

Characteristics: *RST value: 0
                         SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ULSFrame:FRAMe <numeric_value>

This remote control command is used to select the frame number of the uplink frame in which the UL map that specifies the uplink burst was transmitted.

Example:	`"CONF:WIM:ULSF:FRAM 0"`
Characteristics:	*RST value: 0
	SCPI: device-specific
Mode:	OFDMA, MIMO

CONFigure:WIMax:ULSFrame:CRLength <numeric_value>

This remote control command is used to specify the Control Region length for the uplink frame.

Example:	`"CONF:WIM:ULSF:CRL 0"`
Characteristics:	*RST value: 0
	SCPI: device-specific
Mode:	OFDMA, MIMO

CONFigure:WIMax:ULSFrame:SEGMent<1..3>:BITMap<1..18> <numeric_value>

This remote control command is used to specify the allowable logical sub channel bitmap usage of the transmission spectrum for one of the three uplink segments.

Example:	`"CONF:WIM:ULSF:SEGM1:BITM1 15"`
Characteristics:	*RST value: 0
	SCPI: device-specific
Mode:	OFDMA, MIMO

CONFigure:WIMax:DUTConfig TX1 | TX2

This remote control specifies the number of antennas

TX1   One antenna

TX2   Two antennas

Example:	`"CONF:WIM:DUTc TX1"`
Characteristics:	*RST value: 0
	SCPI: device-specific
Mode:	MIMO

CONFigure:WIMax:STC:CROSstalk <boolean>

This remote control command enables/disables compensate crosstalk for MIMO.

Example:	`"CONF:WIM:STC:CROS ON"` – set crosstalk ON
Characteristics:	*RST value: OFF
	SCPI: device-specific
Mode:	MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:CONTrol[:DATA]

This remote control command can be used to enter a burst definition that is to be associated with a specific zone. It accepts eight arguments which make up all the input settings to create a new burst. A zone may have up to 32 bursts defined within it.

New bursts can only be appended to the end of the existing burst list. For example if 4 bursts are already defined, then the suffix required to enter a new burst is 5.

The argument list must be defined as follows:

Modulation	Modulation scheme - AUTO | QPSK | QPSK_1_2 | QPSK_3_4 | QAM16 | QAM16_1_2 | QAM16_3_4 | QAM64 | QAM64_1_2 | QAM64_2_3 | QAM64_3_4 | QAM64_5_6 (see *CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:FORMat* for modulation details)
Subchannels	Number of sub channels used by the burst (does not apply to downlink DL_MAP burst and uplink bursts)
Symbols	Number of symbols used by the burst (does not apply to downlink DL_MAP burst and uplink bursts)

Slot Duration	Slot duration (only applies to downlink DL_MAP burst and uplink bursts)
SubChannel Offset	Sub channel offset of the burst
Symbol Offset	Symbol offset of the burst
Burst Power	Defines the boosting power of the burst
Burst Type	Burst type - FCH | DLMAP | ULMAP | DATA | HARQ | FASTfeedback

Example: `"CONF:WIM:ZONE1:BURS1:CONT QAM16_1_2,5,10,20,0,0,0,DATA"`
To define a 16 QAM 1/2 burst using 5 sub channels and 10 symbols.

`"CONF:WIM:ZONE1:BURS1:CONT QAM16_1_2,0,0,6,0,0,0,DLMAP"`
To define a 16 QAM 1/2 DL Map burst of 6 slots in length.

Characteristics: *RST value:
SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:CONTrol:STCMode

This remote control specifies the STC mode for the burst (uplink MIMO only).

STTD 2TX STTD

1TX   1 TX Spatial Multiplexing

2TX   2 TX Spatial Multiplexing

Example: `"CONF:WIM:ZONE1:CONT:STCM STTD"`

Characteristics: *RST value: 0
SCPI: device-specific

Mode: MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:FORMat

This remote control command can be used to specify the burst modulation format. The following formats are available:

AUTO	Auto Detect – modulation is detected when the signal is analysed
QPSK	QPSK_1_2
QPSK_1_2	QPSK code rate 1/2
QPSK_3_4	QPSK code rate 3/4
QAM16	QAM16_1_2
QAM16_1_2	16 QAM code rate 1/2
QAM16_3_4	16 QAM code rate 3/4
QAM64	QAM64_1_2
QAM64_1_2	64 QAM code rate 1/2
QAM64_2_3	64 QAM code rate 2/3
QAM64_3_4	64 QAM code rate 3/4
QAM64_5_6	64 QAM code rate 5/6

Example: `"CONF:WIM:ZONE1:BURS1:FORM QAM64_3_4`

Characteristics: *RST value:

                    SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:CONTrol[:DATA]   <boolean>,DLFUSC | DLPUSC | DLPUSCALL | DLOFUSC | DLAMC2X3 | ULPUSC | ULPUSCALL | ULOPUSC | ULAMC2X3, <numeric_value>, <numeric_value>,<numeric_value>,<numeric_value>, <numeric_value>

This remote control command can be used to enter a new zone. It accepts only seven arguments which make up all the input settings to create a new zone. Up to 26 user zones can be defined. New zones can only be appended to the end of the existing defined zones. For example if 4 zones are already defined, then the suffix required to enter a new zone is 5. The argument list must be defined as follows:

Analyze	Boolean to specify whether the zone is too be marked for analysis.
Type	DLFUSC	DLPUSC	DLAMC2X3	ULPUSC	ULAMC2X3 are the only supported zone types
Segment	downlink PUSC zone segment – 0|1|2
Length	Zone symbol length
Offset	This argument is ignored and reserved for future use. The zone offset is automatically calculated to follow the previous zone in the list.
Permbase	Permbase to be used for channel decoding
PRBS_ID	PRBS to be used for channel decoding

Example: `"CONF:WIM:ZONE1:CONT ON,DLFUSC,0,10,0,0,0`

                 To enter a DL_PUSC zone, length of 10 symbols.

Characteristics: *RST value:
                    SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:CONTrol:STCConfig   NOSTc | TX2

This remote control specifies the space time coding.

NOSTC	No space time coding
TX2	two antennas

Example: `"CONF:WIM:ZONE1:CONT:STCC TX2"`

Characteristics: *RST value: 0
                    SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:CONTrol:MXINdicator BURStdefined | A | B

This remote control specifies the matrix configuration for the zone.
BURStdefined   defined by the burst
A   Matrix A
B   Matrix B

Example: "CONF:WIM:ZONE1:CONT:MXIN A"

Characteristics: *RST value: 0
                    SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:COUNt?

This remote control command returns the current count of user defined zones..

Example: "CONF:WIM:ZONE1:COUNT?

Characteristics: *RST value: 0
                    SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>[:ANAlyze]:STATe   <boolean>

This remote control command can be used to set a zone for analysis. This will be actioned when the next measurement is executed.

Example: "CONF:WIM:ZONE1:ANAL ON

Characteristics: *RST value:
                    SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:TYPE DLFUSC | DLPUSC | DLPUSCALL | DLOFUSC | DLAMC2X3 | ULPUSC | ULPUSCALL | ULOPUSC | ULAMC2X3

This remote control command can be used to specify the zone type. The following zone types are currently available:
DLFUSC   Downlink FUSC zone
DLPUSC   Downlink PUSC zone
DLPUSCALL   Reserved for future use
DLOFUSC   Reserved for future use
DLAMC2X3   Downlink AMC 2x3 zone
ULPUSC   Uplink PUSC
ULPUSCALL   Reserved for future use
ULOPUSC   Reserved for future use
ULAMC2X3   Uplink AMC 2x3 zone

Example: "CONF:WIM:ZONE1:TYPE DLPUSC

Characteristics: *RST value:
                    SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:Frame:IDCell

This remote control command can be used to specify the downlink.IDCell number, which in turn is used as DL_PermBase parameter for the permutation equations to partly set the sub carrier randomizer initialisation vector.

Example: `"CONF:WIM:DLSFFRAMe:IDC 0"`
Characteristics: *RST value: 0
                     SCPI: device-specific
Mode: OFDMA, MIMO

CONFigure:WIMax:Frame:IDCell:AUTO

This remote control command can be used to specify that IDCell number will be determined by analysis

Example: `"CONF:WIM:FRAMe:IDC:AUTO 0"`
Characteristics: *RST value: 0
                     SCPI: device-specific
Mode: OFDMA, MIMO

CONFigure:WIMax:FRAMe:ZONEtouse LAST|Z1|Z2|Z3|Z4|Z5|Z6|Z7|Z8|Z9|Z10|Z11|Z12|Z13|Z14| Z15|Z16|Z18|Z19|Z20|Z21|Z22|Z23|Z24|Z25|Z26

This remote control command can be used to configure the zone that will be used for auto demodulation.

Example: `"CONF:WIM:FRAMe:ZONe LAST"`Last zone is used
                     `"CONF:WIM:FRAMe:ZONe Z2`   Zone 2 is used"

Characteristics: *RST value: 0
                     SCPI: device-specific
Mode: OFDMA, MIMO

CONFigure:WIMax:DLSFrame:IDCell

Backward compatible, see CONFigure:WIMax:FRAMe:IDCell

CONFigure:WIMax:ZONE<1…26>:CONTrol:STCConfig

This remote control specifies the space time coding.

NOSTC   No space time coding
TX1   One antenna (uplink MIMO only).
TX2   Two antennas

Example: `"CONF:WIM:ZONE1:CONT:STCC TX2"`

Characteristics: *RST value: 0
                     SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:CONTrol:STCMode STTD | MULTiplexing | BURStdefined

This remote control specifies the STC Mode for any uplink zone (uplink MIMO only).

STTD[13]:   Each burst assigned to this zone/segment will be Alamouti encoded.
                               This corresponds to matrix A encoding in DL.
Spatial Multiplexing: Bursts assigned to this zone/segment will be transmitted simultenously over
                               the two antennas of the mobile. Ie. collaborative multiplexing. This
                               corresponds to matrix B encoding in DL.
Burst Defined: The MIMO encoding is defined for each burst individually in the burst list
                               assigned to this zone/segment.

Example: `"CONF:WIM:ZONE1:CONT: STCMode STTD"`

Mode: MIMO

CONFigure:WIMax:ZONE<1…26>:IDSegment <numeric_value>

This remote control command is used to specify the segment number associated with the zone. This is only valid for PUSC zones and will have no effect on other zone types. Segments can be defined as either 0, 1 or 2.

Example: `" CONF:WIM:ZONE1:IDS 0`

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:SYMB:COUNt <numeric_value>

This remote control command is used to specify the number of symbols defined to the zone.

Example: `" CONF:WIM:ZONE1:SYMB:COUNT 10`

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:SYMB:OFFSet <numeric_value>

This remote control command is used to specify the symbol offset associated with this zone. This is used to analyze signals which contain multiple zones and allows any zone in a sub frame to be set up for analysis.
The command is reserved for future use and can currently only be queried. The zone offset is automatically calculated when a new zone is entered.

Example: `" CONF:WIM:ZONE1:SYMB:OFFS 0`

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:PERMbase <numeric_value>

This remote control command is used to specify the perm base which is used in the permutation equations.

Example: `" CONF:WIM:ZONE1:PERM 0`

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

---

[13] Space Time Transmit Diversity (STTD).

CONFigure:WIMax:ZONE<1…26>:PRBS

This remote control command is used to specify a known PRBS modulated data sequence (PRBS = pseudo random binary sequence) that is in use by the DUT.

Example: " CONF:WIM:ZONE1:PRBS 0

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:RESet?

This remote control command removes all zone and burst data. The zone index is ignored.

Example: "CONF:WIM:ZONE1:RES

Characteristics: *RST value: 0
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:DELete

This remote control command is used to delete a specific zone. If the specified zone is within a larger list of zones, then all following zones will be shuffled down to take up the space occupied by the deleted zone.

Example: " CONF:WIM:ZONE1:DEL

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:CONTrol[:DATA] QPSK_1_2 | QPSK_3_4 |
    QAM16_1_2 | QAM16_3_4 | QAM64_1_2 | QAM64_2_3 | QAM64_3_4 | QAM64_5_6,
    <numeric_value>,<numeric_value>,<numeric_value>,<numeric_value>, <numeric_value>,
    <numeric_value>, FCH | DLMAP | ULMAP | DATA | HARQ | FASTfeedback

This remote control command can be used to enter a burst definition that is to be associated with a specific zone. It accepts eight arguments which make up all the input settings to create a new burst. A zone may have up to 32 bursts defined within it.
New bursts can only be appended to the end of the existing burst list. For example if 4 bursts are already defined, then the suffix required to enter a new burst is 5.
The argument list must be defined as follows:

Modulation	Modulation scheme - QPSK_1_2	QPSK_3_4	QAM16_1_2	QAM16_3_4	QAM64_1_2	QAM64_2_3	QAM64_3_4	QAM64_5_6
Subchannels	Number of sub channels used by the burst (does not apply to downlink DL_MAP burst and uplink bursts)
Symbols	Number of symbols used by the burst (does not apply to downlink DL_MAP burst and uplink bursts)
Slot Duration	Slot duration (only applies to downlink DL_MAP burst and uplink bursts)
SubChannel Offset	Sub channel offset of the burst
Symbol Offset	Symbol offset of the burst
Burst Power	Defines the boosting power of the burst
Burst Type	Burst type - FCH	DLMAP	ULMAP	DATA	HARQ	FASTfeedback

Example: "CONF:WIM:ZONE1:BURS1:CONT QAM16_1_2,5,10,20,0,0,0,DATA"
                      To define a 16 QAM 1/2 burst using 5 sub channels and 10 symbols.

> `"CONF:WIM:ZONE1:BURS1:CONT QAM16_1_2,0,0,6,0,0,0,DLMAP"`
> To define a 16 QAM 1/2 DL Map burst of 6 slots in length.

Characteristics:	*RST value:
	SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:CONTrol:MXINdicator A | B

This remote control specifies the matrix configuration for the zone

BURStdefined defined by the burst

A Matrix A
B Matrix B

Example: `"CONF:WIM:ZONE1:CONT:MXIN A"`

Characteristics: *RST value: 0
SCPI: device-specific

Mode: OFDMA

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:COUNt?

This remote control command returns the current count of user defined bursts within the specified zone.

Example: `"CONF:WIM:ZONE1:BURS1:COUN?"`

Characteristics: *RST value:
SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:FORMat QPSK_1_2 | QPSK_3_4 | QAM16_1_2 | QAM16_3_4 | QAM64_1_2 | QAM64_2_3 | QAM64_3_4 | QAM64_5_6

This remote control command can be used to specify the burst modulation format. The following formats are available:

QPSK_1_2 QPSK code rate 1/2
QPSK_3_4 QPSK code rate 3/4
QAM16_1_2 16 QAM code rate 1/2
QAM16_3_4 16 QAM code rate 3/4
QAM64_1_2 64 QAM code rate 1/2
QAM64_2_3 64 QAM code rate 2/3
QAM64_3_4 64 QAM code rate ¾
QAM64_5_6 64 QAM code rate 5/6

Example: `"CONF:WIM:ZONE1:BURS1:FORM QAM64_3_4`

Characteristics: *RST value:
SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:OFFSet:AUTO <boolean>

This remote control command only applies to Uplink bursts. It allows the logical sub channel and symbol offsets to be automatically calculated so that they are contiguous.

Example: `"CONF:WIM:ZONE1:BURS1:OFFS:AUTO ON`

Characteristics: *RST value:
SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:SLOT:DURation <numeric_value>

This remote control command defines the duration of an uplink burst in slots. The command has no effect on downlink bursts.

Example: "CONF:WIM:ZONE1:BURS1:SLOT:DUR 10

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:SUBChannel:COUNt <numeric_value>

This remote control command defines the number of logical sub channels used by the burst.

Example: "CONF:WIM:ZONE1:BURS1:SUBC:COUN 5

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:SYMBol:COUNt <numeric_value>

This remote control command defines the number of symbols used by the burst.

Example: "CONF:WIM:ZONE1:BURS1:SYMB:COUN 5

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:SUBChannel:OFFSet <numeric_value>

This remote control command defines the logical sub channels offset for the burst. This, together with the symbol offset, can be used to help specify the frequency bandwidth in use by specific bursts

Example: "CONF:WIM:ZONE1:BURS1:SUBC:OFFS 5

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:SYMBol:OFFSet <numeric_value>

This remote control command defines the symbol offset for the burst. This, together with the logical sub channel offset, can be used to help specify the frequency bandwidth in use by specific bursts

Example: "CONF:WIM:ZONE1:BURS1:SYMB:OFFS 5

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:POWer <numeric_value>

This remote control command specifies the boosting power associated with the burst.

Example: "CONF:WIM:ZONE1:BURS1:POW 0

Characteristics: *RST value:
                      SCPI: device-specific

Mode: OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:TYPE FCH | DLMAP | ULMAP | DATA | HARQ | FASTfeedback

This remote control command specifies the type of burst from a higher layer point of view. Ie if the burst contains signalling information or if it is just a data burst.
The following burst types are currently available.

FCH | DLMAP | ULMAP | DATA | HARQ | FASTfeedback

Example:	"CONF:WIM:ZONE1:BURS1:TYPE DATA
Characteristics:	*RST value:
	SCPI: device-specific
Mode:	OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:DELete

This remote control command is used to delete a specific burst from within the specified zone.

Example:	"CONF:WIM:ZONE1:BURS1:DEL
Characteristics:	*RST value:
	SCPI: device-specific
Mode:	OFDMA, MIMO

CONFigure:WIMax:ZONE<1…26>:BURSt<1...32>:RESet?

This remote control command removes all burst data associated with a specific zone. The burst index is ignored.

Example:	"CONF:WIM:ZONE1:BURS1:RES
Characteristics:	*RST value: 0
	SCPI: device-specific
Mode:	OFDMA

CONFigure:WIMax:ANTMatrix:AUTO <boolean>

This remote control specifies automatic detection of antenna configuration.

Example:	"CONF:WIM:ANTM:AUTO"
Characteristics:	*RST value: 0
	SCPI: device-specific
Mode:	MIMO

CONFigure:WIMax:ANTMatrix:ADDRess<1..4> <String>

This remote control specifies the TCP/IP address in IPV4 format.
Note, it is not possible to set the IP address of ANTMatrix1 (Master)

Example:	"CONF:WIM:ANTM:ADDR2 '192.168.114.157'"
Characteristics:	*RST value: 0
	SCPI: device-specific
Mode:	MIMO

CONFigure:WIMax:ANTMatrix:STATe<1..4> <boolean>

This remote control specifies the ON/OFF state of the receive path.

Note, it is not possible to set the state of ANTMatrix1 (Master)

Example: "CONF:WIM:ANTM:STAT2 ON"

Characteristics: *RST value: 0
                                SCPI: device-specific

Mode: MIMO

CONFigure:WIMax:ANTMatrix: ANTenna<1..4> ANTENNA0 | ANTENNA1 | ANTENNA2 |
                                                                                      ANTENNA3

This remote control specifies the antenna configuration of the receive path.

Note, it is not possible to set the antenna of ANTMatrix1 (Master)

Example: "CONF:WIM:ANTM:ANT2 ANTENNA1"

Characteristics: *RST value: 0
                                SCPI: device-specific

Mode: MIMO

DIAGnostic Subsystem

For internal use by R&S 1UK MTC.

COMMAND	PARAMETERS	UNIT	COMMENT
DIAGnostic			
:SERV			
:INFormation	--		query only

DISPlay Subsystem

The DISPlay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

The commands are of the form DISPlay:WINDow<1|n> where n refers to the active screen when used graphically i.e. SCREEN A is 1 and SCREEN B is 2 etc. in OFDM and OFDMA this will be WINDow1 for magnitude capture display and list results and WINDow2 for the selected measurement trace.. With MIMO operation it is possible to have a maximum of six traces available at any one time i.e. dual magnitude capture and list results available as SCREEN A and SCREEN B and a maximum of four result traces available as SCREEN C to SCREEN F. Analysing a SISO zone in the MIMO standard will affect the available active screens with the active screens being the same as those available for OFDM,OFDMA.

COMMAND	PARAMETERS	UNIT	COMMENT
DISPlay			
:FORmat	SPLit | SINGle		
[:WINDow<1…3>]			
:SELect			
:SSELect			
:TABLe	<Boolean>		
:LIST	<numeric_value>		
:UNIT	DB | PCT		
:TRACe<1…3>			
:Y			
[:SCALe]			
:AUTO	<Boolean>		
:PDIVision	<numeric_value>		
:RLEVel			
[:RF]	<numeric_value>	DBM	
:IQ	<numeric_value>	V	
:OFFSet	<numeric_value>	DB	

DISPlay:FORMat SPLit | SINGle

    This command sets the visible screen display type to full or split screen.

    Example: `"DISP:FORM SINGle"` Sets the R&S FSQ-K92 display to full screen.
                        `"DISP:FORM SPLit"`   Sets the R&S FSQ-K92 display to split screen.

    Characteristics: *RST value: SPL
                      SCPI: device-specific

    Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:SELect

    This command selects whether screen A, B or C is active

    Example: `"DISP:WIND1:SEL 0"`   Sets the R&S FSQ-K92 screen A active.

    Characteristics: *RST value: –
                      SCPI: device-specific

    Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:SSELect

This is an alias for DISPlay[:WINDow<1…3>]:SELect. SSELect means Screen SELect.

Example: `"DISP:WIND1:SSEL"`   Sets the R&S FSQ-K92 screen A active.

Characteristics: *RST value: –
                    SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:TABLe <Boolean>

This command selects whether the results table is displayed

Example: `"DISP:TABL 0"` Hides the results table
                    `"DISP:TABL OFF"` Alternate form to hide the results table

Characteristics: *RST value: 0
                    SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:TABLe:LIST <numeric_value>

This command displays the requested page for the results table. The number of available pages depends on the selected standard (e.g. OFDM has 1 page, OFDMA has 2 pages).

Example: `"DISP:TABL:LIST 2"` Displays the second page of the results table

Characteristics: *RST value: 0
                    SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:TABLe:UNIT DB | PCT

This command specifies the units for the Table of Results parameters that can be displayed as dB or percent.

Parameter: DBresults returned in dB
                    PCT   results returned in percent

Example: `"DISP:TABL:UNIT DB"`   results to be returned in dB.

Characteristics: *RST value: DB
                    SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:TRACe1:Y[:SCALe]:AUTO <Boolean>

This command switches on or off automatic scaling of the Y-axis for the specified trace display.
Automatic scaling sets the Y-axis to automatically scale to best fit the measurement results.
This command is only available for the following result displays:

EVM Vs Carrier
EVM Vs Symbol.
Frequency error Vs Preamble
Phase error Vs Preamble

The numeric suffix at WINDow<1 to 3> must be 2 or 3 as the relevant results are always displayed in screen B or C. The numeric suffix at TRACe<1 to 3> must be 1.

Example: "DISP:WIND2:TRAC:Y:SCAL:AUTO ON"   switches on automatic scaling of the Y-axis for the active trace

Characteristics: *RST value: 1
                       SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:TRACe1:Y[:SCALe]:PDIVision <numeric_value>

This command sets the size of each Y scale division for the specified trace display. Note that this command has no affect if automatic scaling of the Y-axis is enabled.
This command is only available for the following result displays:

EVM Vs Carrier
EVM Vs Symbol.
Frequency error Vs Preamble
Phase error Vs Preamble

The numeric suffix at WINDow<1 to 3> must be 2 or 3 as the relevant results are always displayed in screen B or C. The numeric suffix at TRACe<1 to 3> must be 1.

Example: "DISP:WIND2:TRAC:Y:SCAL:PDIV 2"   Sets the Y scale division to 2.

Characteristics: *RST value: 3

Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:TRACe<1…3>:Y[:SCALe]:RLEVel[:RF] <numeric_value>

This remote control command specifies the reference level applied to a RF measurements. The value is in DB.
The numeric suffix at WINDow<1 to 3> and TRACe<1 to 3> are irrelevant.

Example: "DISP:TRAC:Y:RLEV 10"   reference level of the analyzer is 10dB
              "DISP:TRAC:Y:RLEV:RF –10" reference level of the analyzer is -10dB

Characteristics: *RST value: 0 dB
                       SCPI: conforming

Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:TRACe<1…3>:Y[:SCALe]:RLEVel:IQ   <numeric_value>

This remote control command specifies the reference level applied to a IQ measurements. The value is in volts.
The numeric suffix at WINDow<1 to 3> and TRACe<1 to 3> are irrelevant.

Example: `"DISP:TRAC:Y:RLEV:IQ 1"` reference level of the analyzer is 1V

Characteristics: *RST value: 0 dB
               SCPI: conforming

Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet   <numeric_value>

This remote control command specifies the external attenuation/gain applied to measurements. The value corresponds to the reference level offset in spectrum analyzer mode.

The numeric suffix at WINDow<1 to 3> and TRACe<1 to 3> are irrelevant.

Example: `"DISP:TRAC:Y:RLEV:OFFS 10"`   external attenuation (level offset) of the analyzer is 10dB

                            `"DISP:TRAC:Y:RLEV:OFFS -10"`   external attenuation of the analyzer is -10dB. i.e. a gain of 10dB

Characteristics: *RST value: 0 dB
               SCPI: conforming

Mode: OFDM, OFDMA, MIMO

DISPlay[:WINDow<1…3>]:TRACe<1…3>:Y[:SCALe]:RLEVel

This remote control command can be used to retrieve the current internal instrument reference level used when performing measurements. This command is for query only.

The numeric suffix at WINDow<1 to 3> and TRACe<1 to 3> are irrelevant.

Example: `"DISP:TRAC:Y:RLEV?"`   returns the current reference level in use

Characteristics: *RST value: –
               SCPI: conforming

Mode: OFDM, OFDMA, MIMO

FETCh Subsystem

The FETCh subsystem contains commands for reading out results of complex measurement tasks. This subsystem is closely linked to the CONFigure and SENSe subsystems.

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			
:BURSt			
:ALL?		--	
:BERPilot			query only
:AVERage?		PCT	query only
:MINimum?		PCT	query only
:MAXimum?		PCT	query only
:CINR?			query only
:AVERage?			query only
:MINimum?			query only
:MAXimum?			query only
:SDEViation?			query only
:CRESt			
:AVERage?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:COUNt?			query only
ALL?			query only
:EVM			
:ALL			
:AVERage?		PCT	DB	query only
:MINimum?		PCT	DB	query only
:MAXimum?		PCT	DB	query only
:DATA			
:AVERage?		PCT	DB	query only
:MINimum?		PCT	DB	query only
:MAXimum?		PCT	DB	query only
:PILot			
:AVERage?		PCT	DB	query only
:MINimum?		PCT	DB	query only
:MAXimum?		PCT	DB	query only
:Preamble			
:AVERage?		PCT	DB	query only
:MINimum?		PCT	DB	query only
:MAXimum?		PCT	DB	query only
:FERRor			
:AVERage?		HZ	query only
:MINimum?		HZ	query only
:MAXimum?		HZ	query only
:GIMBalance			
:AVERage?		PCT	DB	query only
:MINimum?		PCT	DB	query only
:MAXimum?		PCT	DB	query only
:IQOFfset			
:AVERage?		PCT	DB	query only
:MINimum?		PCT	DB	query only
:MAXimum?		PCT	DB	query only
:QUADoffset			
:AVERage?		DEG	query only
:MINimum?		DEG	query only
:MAXimum?		DEG	query only
:RMS			
:AVERage?		DBM	query only

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			
:RMS			
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:ALL			
:AVERage?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:DATA			
:AVERage?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:DLPReamble			
:AVERage?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:NPILot			
:AVERage?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:PILot			
:AVERage?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:RSSi?			query only
:AVERage?			query only
:MINimum?			query only
:MAXimum?			query only
:SDEViation?			query only
:SSTiming			
:AVERage?		PCT	query only
:MINimum?		PCT	query only
:MAXimum?		PCT	query only
:SYMBolerror			
:AVERage?		PPM	query only
:MINimum?		PPM	query only
:MAXimum?		PPM	query only
:TDOMain			
:PREamble			
:AVERage?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:SUBFrame			
:AVERage?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:ZONE			
:AVERage?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:USERror			
:AVERage?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:SYMBol			
:COUNt?			query only
:ZONE			
:COUNt?			query only
:STATISTIC			
:COUNt?			query only

FETCh:BURSt:ALL?

This command returns all the results. The results are output as a list of comma separated strings. Different sets of results are obtained depending on whether in OFDM standard, or OFDMA uplink, or OFDMA downlink. The format of the results are as defined below:-

OFDM results:

<min EVM all bursts>, <average EVM all bursts>, <max EVM all bursts>,
<min EVM data carriers>, <average EVM data carriers>, <max EVM data carriers>,
<min EVM pilots>, <average EVM pilots>, <max EVM pilots>,
<min IQ offset>, <average IQ offset>, <maximum IQ offset>,
<min gain imbalance>, <average gain imbalance>, <max gain imbalance>,
<min quadrature offset>, <average quadrature offset>, <max quadrature offset>,
<min frequency error>, <average frequency error>, <max frequency error>,
<min symbol error>, <average symbol error>, <max symbol error>,
<min burst power>, <average burst power>, <max burst power>,
<min crest factor>, <average crest factor>, <max crest factor>,
<min SS timing>, <average SS timing>, <max SS timing>,
<min RSSI>, <average RSSI>, <max RSSI>,
<min RSSI SD>, <average RSSI SD>, <max RSSI SD>,
<min CINR>, <average CINR>, <max CINR>,
<min CINR SD>, <average CINR SD>, <max CINR SD>,

OFMDA Uplink results:

<min BER pilots>, <average BER pilots>, <max BER pilots>,
<min EVM all bursts>, <average EVM all bursts>, <max EVM all bursts>,
<min EVM data carriers>, <average EVM data carriers>, <max EVM data carriers>,
<min EVM pilots>, <average EVM pilots>, <max EVM pilots>,
<min IQ offset>, <average IQ offset>, <maximum IQ offset>,
<min gain imbalance>, <average gain imbalance>, <max gain imbalance>,
<min quadrature offset>, <average quadrature offset>, <max quadrature offset>,
<min frequency error>, <average frequency error>, <max frequency error>,
<min symbol error>, <average symbol error>, <max symbol error>,
<min power all>, <average power all>, <max power all>,
<min power data>, <average power data>, <max power data>,
<min power pilots>, <average power pilots>, <max power pilots>,
<min crest factor>, <average crest factor>, <max crest factor>,
<min unmod. subcarrier error>, <average unmod. subcarrier error >, <max unmod. subcarrier error >

MIMO Uplink results:

<min BER pilots>, <average BER pilots>, <max BER pilots>,
<min EVM all bursts>, <average EVM all bursts>, <max EVM all bursts>,
<min EVM data carriers>, <average EVM data carriers>, <max EVM data carriers>,
<min EVM pilots>, <average EVM pilots>, <max EVM pilots>,
<min IQ offset>, <average IQ offset>, <maximum IQ offset>,
<min gain imbalance>, <average gain imbalance>, <max gain imbalance>,
<min quadrature offset>, <average quadrature offset>, <max quadrature offset>,
<min frequency error>, <average frequency error>, <max frequency error>,
<min symbol error>, <average symbol error>, <max symbol error>,
<min power all>, <average power all>, <max power all>,
<min power data>, <average power data>, <max power data>,
<min power pilots>, <average power pilots>, <max power pilots>,
<min power null pilots>, <average power null pilots>, <max power null pilots>
<min crest factor>, <average crest factor>, <max crest factor>,
<min unmod. subcarrier error>, <average unmod. subcarrier error >, <max unmod. subcarrier error >,

OFDMA Downlink results:
<min BER pilots>, <average BER pilots>, <max BER pilots>,
<min EVM all bursts>, <average EVM all bursts>, <max EVM all bursts>,
<min EVM data carriers>, <average EVM data carriers>, <max EVM data carriers>,
<min EVM pilots>, <average EVM pilots>, <max EVM pilots>,
<min IQ offset>, <average IQ offset>, <maximum IQ offset>,
<min gain imbalance>, <average gain imbalance>, <max gain imbalance>,
<min quadrature offset>, <average quadrature offset>, <max quadrature offset>,
<min frequency error>, <average frequency error>, <max frequency error>,
<min symbol error>, <average symbol error>, <max symbol error>,
<min power DL preamble>, <average power DL preamble>, <max power DL preamble>,
<min power all>, <average power all>, <max power all>,
<min power data>, <average power data>, <max power data>,
<min power pilots>, <average power pilots>, <max power pilots>,
<min crest factor>, <average crest factor>, <max crest factor>,
<min RSSI>, <average RSSI>, <max RSSI>,
<RSSI SD>,
<min CINR>, <average CINR>, <max CINR>,
<CINR SD>,
<min unmod. subcarrier error>, <average unmod. subcarrier error >, <max unmod. subcarrier error >
<min EVM preamble>, <average EVM preamble >, <max EVM preamble >,

MIMO Downlink results:
<min BER pilots>, <average BER pilots>, <max BER pilots>,
<min EVM all bursts>, <average EVM all bursts>, <max EVM all bursts>,
<min EVM data carriers>, <average EVM data carriers>, <max EVM data carriers>,
<min EVM pilots>, <average EVM pilots>, <max EVM pilots>,
<min IQ offset>, <average IQ offset>, <maximum IQ offset>,
<min gain imbalance>, <average gain imbalance>, <max gain imbalance>,
<min quadrature offset>, <average quadrature offset>, <max quadrature offset>,
<min frequency error>, <average frequency error>, <max frequency error>,
<min symbol error>, <average symbol error>, <max symbol error>,
<min power DL preamble>, <average power DL preamble>, <max power DL preamble>,
<min power all>, <average power all>, <max power all>,
<min power data>, <average power data>, <max power data>,
<min power pilots>, <average power pilots>, <max power pilots>,
<min power null pilots>, <average power null pilots>, <max power null pilots>
<min crest factor>, <average crest factor>, <max crest factor>,
<min RSSI>, <average RSSI>, <max RSSI>,
<RSSI SD>,
<min CINR>, <average CINR>, <max CINR>,
<CINR SD>,
<min unmod. subcarrier error>, <average unmod. subcarrier error >, <max unmod. subcarrier error >,
<min EVM preamble>, <average EVM preamble >, <max EVM preamble >,
Note that the units for the EVM results are specified with the UNITS:EVM command

Example: `"FETC:BURS:ALL?"`   All calculated results are returned

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

FETCh:BURSt:BERPilot?

This command returns the minimum, average and maximum BER values for pilots. The result is returned in (ASCII) format:

Example:　　　`"FETC:BURS:BERP:MIN?"`

Characteristics:　*RST value: –
　　　　　　　　　SCPI:　　　device-specific

Mode:　　　　　OFDM, OFDMA, MIMO

FETCh:BURSt:CINR?

This command returns the minimum, average and maximum CINR values as well as the CINR standard deviation. The results are returned in the following (ASCII) format:

<minimum CINR>, <average CINR>, <maximum CINR>, <CINR Standard Deviation>

Example:　　　`"FETC:BURS:CINR?"`　　　The calculated CINR results from the most recent measurement are returned.

Characteristics:　*RST value: –
　　　　　　　　　SCPI:　　　device-specific

Mode:　　　　　OFDM

FETCh:BURSt:CINR:MINimum?

This command returns the minimum CINR (carrier to interference and noise ratio) standard deviation value. The result is returned in (ASCII) format:

Example:　　　`"FETC:BURS:RSS:MIN?"`

Characteristics:　*RST value: –
　　　　　　　　　SCPI:　　　device-specific

Mode:　　　　　OFDMA, MIMO

FETCh:BURSt:CINR:AVERage?

This command returns the average CINR (carrier to interference and noise ratio) standard deviation value. The result is returned in (ASCII) format:

Example:　　　`"FETC:BURS:RSS:AVER?"`

Characteristics:　*RST value: –
　　　　　　　　　SCPI:　　　device-specific

Mode:　　　　　OFDMA, MIMO

FETCh:BURSt:CINR:MAXimum?

This command returns the maximum CINR (carrier to interference and noise ratio) standard deviation value. The result is returned in (ASCII) format:

Example:　　　`"FETC:BURS:RSS:MAX?"`

Characteristics:　*RST value: –
　　　　　　　　　SCPI:　　　device-specific

Mode:　　　　　OFDMA, MIMO

FETCh:BURSt:CRESt

This command returns the average, minimum or maximum determined CREST factor (= ratio of peak power to average power) in dB.

Example: `"FETC:BURS:CRES:MAX?"`   The maximum calculated crest factor from the most recent measurement is returned.

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM

FETCh:BURSt:COUNt?

This command returns the number of bursts analyzed in the last sweep.

Example: `"FETC:BURS:COUN?"`   The number of analyzed bursts in the most recent measurement is returned.

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

FETCh:BURSt:COUNt:ALL?

This command returns the number of bursts analyzed in all sweeps.

Example: `"FETC:BURS:COUN:ALL?"`   The number of analyzed bursts analyzed in all sweeps.

Characteristics: *RST value: –

SCPI: device-specific

FETCh:BURSt:EVM:ALL

This command returns the Error Vector Magnitude measurement results summary (average, minimum or maximum value). This is a combined figure that represents the pilot, data and the free carrier.

Note that the units for the results are specified with the DISPlay[:WINDow1]:TABLe:UNIT command.

Example: `"FETC:BURS:EVM:ALL:MAX?"`   The maximum EVM recorded for all measurement carriers is returned.

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

FETCh:BURSt:EVM:DATA

This command returns the Error Vector Magnitude measurement results summary for the data carrier (average, minimum or maximum value).

Note that the units for the results are specified with the DISPlay[:WINDow1]:TABLe:UNIT command.

Example: `"FETC:BURS:EVM:DATA:MAX?"`   The maximum EVM recorded for the data carrier is returned.

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

FETCh:BURSt:EVM:PILot

This command returns the Error Vector Magnitude measurement results summary for the EVM pilot carrier (average, minimum or maximum value).

Note that the units for the results are specified with the DISPlay[:WINDow1]:TABLe:UNIT command.

Example:	`"FETC:BURS:EVM:PIL:MAX?"`	The maximum EVM recorded for the EVM pilot carrier is returned.

Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

FETCh:BURSt:EVM:PREamble

This command returns the Error Vector Magnitude measurement results summary for the EVM preamble carrier (average, minimum or maximum value).

Note that the units for the results are specified with the DISPlay[:WINDow1]:TABLe:UNIT command.

Example:	`"FETC:BURS:EVM:PRE:MAX?"`	The maximum EVM recorded for the EVM preamble carrier is returned.

Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDMA, MIMO

FETCh:BURSt:FERRor

This command returns the measured average, minimum or maximum frequency errors in Hertz

Example:	`"FETC:BURS:FERR:MAX?"`	The maximum frequency error from the most recent measurement is returned.

Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

FETCh:BURSt:GIMBalance

This command returns the measured average, minimum or maximum IQ Imbalance errors.

Note that the units for the results are specified with the DISPlay[:WINDow1]:TABLe:UNIT command.

Example:	`"FETC:BURS:GIMB:MAX?"`	The maximum IQ Imbalance error from the most recent measurement is returned.

Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

FETCh:BURSt:IQOFfset

This command returns the measured average, minimum or maximum IQ Offset errors.

Note that the units for the results are specified with the DISPlay[:WINDow1]:TABLe:UNIT command.

Example:	`"FETC:BURS:IQOF:MAX?"`	The maximum IQ Offset error from the most recent measurement is returned.

Characteristics:	*RST value: – SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

FETCh:BURSt:QUADoffset

This command returns the accuracy in terms of the phase error of symbols within a burst.

Example: `"FETC:BURS:QUAD:MAX?"`   The maximum angle error recorded for a symbol during the measurement.

Characteristics: *RST value: –
                   SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

FETCh:BURSt:RMS:ALL:MINimum?

This command returns the minimum RMS burst power in dBm for all carriers measured during the measurement.

Example: `"FETC:BURS:RMS:ALL:MIN?"`

Characteristics: *RST value: –
                   SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:RMS:ALL:AVERage?

This command returns the average RMS burst power in dBm for all carriers measured during the measurement.

Example: `"FETC:BURS:RMS:ALL:AVER?"`

Characteristics: *RST value: –
                   SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:RMS:ALL:MAXimum?

This command returns the maximum RMS burst power in dBm for all carriers measured during the measurement.

Example: `"FETC:BURS:RMS:ALL:MAX?"`

Characteristics: *RST value: –
                   SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:RMS:DATA:MINimum?

This command returns the minimum RMS burst data power in dBm for data carriers measured during the measurement.

Example: `"FETC:BURS:RMS:DATA:MIN?"`

Characteristics: *RST value: –
                   SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:RMS: DATA:AVERage?

This command returns the average RMS burst data power in dBm for data carriers measured during the measurement.

Example: `"FETC:BURS:RMS:DATA:AVER?"`

Characteristics: *RST value: –
                   SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:RMS: DATA:MAXimum?

This command returns the maximum RMS data burst power in dBm for data carriers measured during the measurement.

Example: `"FETC:BURS:RMS:DATA:MAX?"`

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDMA, K94

FETCh:BURSt:RMS:DLPReamble:MINimum?
This command returns the minimum RMS burst power in dBm for the downlink preamble measured during the measurement.

Example: `"FETC:BURS:RMS:DLPR:MIN?"`

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDMA, K94

FETCh:BURSt:RMS:DLPReamble:AVERage?
This command returns the average RMS burst power in dBm for the downlink preamble measured during the measurement.

Example: `"FETC:BURS:RMS:DLPR:AVER?"`

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:RMS:DLPReamble:MAXimum?

This command returns the maximum RMS burst power in dBm for the downlink preamble measured during the measurement.

Example: `"FETC:BURS:RMS:DLPR:MAX?"`

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:RMS:NPILot:MINimum?

This command returns the minimum RMS burst power in dBm for null pilot carriers measured during the measurement.

Example: `"FETC:BURS:RMS:NPIL:MIN?"`

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: MIMO

FETCh:BURSt:RMS:NPILot:AVERage?

This command returns the average RMS burst power in dBm for null pilot carriers measured during the measurement.

Example: `"FETC:BURS:RMS:NPIL:AVER?"`

Characteristics: *RST value: –
                    SCPI: device-specific

Mode: MIMO

FETCh:BURSt:RMS:NPILot:MAXimum?
This command returns the maximum RMS burst power in dBm for null pilot carriers measured during the measurement.

Example: `"FETC:BURS:RMS:NPIL:MAX?"`

Characteristics: *RST value: –
                    SCPI: device-specific

Mode: (MIMO

FETCh:BURSt:RMS:PILot:MINimum?
This command returns the minimum RMS burst power in dBm for pilot carriers measured during the measurement.

Example: `"FETC:BURS:RMS:PIL:MIN?"`

Characteristics: *RST value: –
                    SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:RMS:PILot:AVERage?
This command returns the average RMS burst power in dBm for pilot carriers measured during the measurement.

Example: `"FETC:BURS:RMS:PIL:AVER?"`

Characteristics: *RST value: –
                    SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:RMS:PILot:MAXimum?
This command returns the maximum RMS burst power in dBm for pilot carriers measured during the measurement.

Example: `"FETC:BURS:RMS:PIL:MAX?"`

Characteristics: *RST value: –
                    SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:RMS

For OFDM, this command returns the average, minimum or maximum RMS burst power in dBm measured during the measurement.
For OFDMA, this command is an alias for FETch:BURST:RMS:DATA.

Example:	`"FETC:BURS:RMS:MAX?"`	The maximum burst power recorded for the most recent measurement.

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

FETCh:BURSt:RSSi?

This command returns the minimum, average and maximum RSSI values as well as the RSSI standard deviation. The results are returned in the following (ASCII) format:
<min RSSI>, <average RSSI>, <max RSSI>, <RSSI Standard Deviation>

Example:	`"FETC:BURS:RSS?"`	The calculated RSSI results from the most recent measurement are returned.

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

FETCh:BURSt: RSSi:MINimum?

This command returns the minimum RSSI (received signal strength indicator) standard deviation value. This is an estimate of the total received power of the frame preamble of the segment of the connected BS. The result is returned in (ASCII) format:

Example:	`"FETC:BURS:RSS:MIN?"`

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt: RSSi:AVERage?

This command returns the average RSSI (received signal strength indicator) standard deviation value. This is an estimate of the total received power of the frame preamble of the segment of the connected BS.The result is returned in (ASCII) format:

Example:	`"FETC:BURS:RSS:AVER?"`

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt: RSSi:MAXimum?

This command returns the maximum RSSI (received signal strength indicator) standard deviation value. This is an estimate of the total received power of the frame preamble of the segment of the connected BS.The result is returned in (ASCII) format:

Example:	`"FETC:BURS:RSS:MAX?"`

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:SSTiming

This command is obsolete but retained for backward-compatibility with old scripts.

FETCh:BURSt:SYMBolerror:MINimum?

This command returns the percentage of symbols that were outside permissible de-modulation range within a burst.

Example:	`"FETC:BURS:SYMB:MIN?"`	The minimum number of symbols that were out of range per burst.

Characteristics: *RST value: –
                         SCPI: device-specific

Mode: OFDM

FETCh:BURSt:SYMBolerror:AVERage?

This command returns the percentage of symbols that were outside permissible de-modulation range within a burst.

Example:	`"FETC:BURS:SYMB:AVER?"`	The average number of symbols that were out of range per burst.

Characteristics: *RST value: –
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

FETCh:BURSt:SYMBolerror:MAXimum?

This command returns the percentage of symbols that were outside permissible de-modulation range within a burst.

Example:	`"FETC:BURS:SYMB:MAX?"`	The maximum number of symbols that were out of range per burst.

Characteristics: *RST value: –
                         SCPI: device-specific

Mode: OFDM

FETCh:BURSt:USERror:MINimum?

This command returns the minimum Unmodulate Subcarrier Error for the analysed zone.

Example:	`"FETC:BURS:USER:MIN?"`	The minimum unmodulated subcarrier error.

Characteristics: *RST value: –
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

FETCh:BURSt:USERror:AVERage?

This command returns the average Unmodulate Subcarrier Error for the analysed zone.

Example:	`"FETC:BURS:USER:AVER?"`	The average unmodulated subcarrier error.

Characteristics: *RST value: –
                         SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:USERror:MAXimum?

This command returns the maximum Unmodulate Subcarrier Error for the analysed zone.

Example:	`"FETC:BURS:USER:MAX?"`	The maximum unmodulated subcarrier error.

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:BURSt:TDOMain:PREamble?

This command returns the minimum, average and maximum preamble time domain values. The result is returned in (ASCII) format:

Example:	`"FETC:BURS:TDOM:PRE:MIN?"`

Characteristics: *RST value: –
                      SCPI: device-specific

FETCh:BURSt:TDOMain:SUBFrame?

This command returns the minimum, average and maximum subframe time domain values. The result is returned in (ASCII) format:

Example:	`"FETC:BURS:TDOM:SUBF:MIN?"`

Characteristics: *RST value: –
                      SCPI: device-specific

FETCh:BURSt:TDOMain:ZONE?

This command returns the minimum, average and maximum zone time domain values. The result is returned in (ASCII) format:

Example:	`"FETC:BURS:TDOM:ZONE:MIN?"`

Characteristics: *RST value: –
                      SCPI: device-specific

FETCh:SYMBol:COUNt?

For the 802.16 2004 standard, this command returns the number of symbol in each analyzed burst found in the last measurement sweep The results are output as a list of result strings separated by ',' in the following (ASCII) format:

<Symbols in 1st burst>, <Symbols in 2nd burst>,…, <Symbols in last burst>

For the 802.16e/D11 standard, the command returns the number of symbols contained in each analyzed zone.

Example:	`"FETC:SYMB:COUN?"`	The calculated symbols in the analyzed bursts for the most recent measurement are returned.

Characteristics: *RST value: –
                      SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

FETCh:ZONE:COUNt?

This remote control command returns the current number of zones found during measurement analysis.

Example:	`"FETC:ZONE:COUN?"`	Returns the current number of zone found during analysis.

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDMA, MIMO

FETCh:ZONE:STATISTIC:COUNt?

This remote control command returns the number of zones captured so far for the current statistical measurement analysis.

Example:	`"FETC:ZONE:STAT:COUN?"`	Returns the number of zone captured so far for the current statistical analysis.

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDMA, MIMO

FORMat Subsystem

The FORMat subsystem provide specifies the data format of the data transmitted from and to the instrument.

COMMAND	PARAMETERS	UNIT	COMMENT
FORMat 　[:DATA]	ASCii|REAL|UINT[,<numeric value>]	-	

FORMat[:DATA]   ASCii | REAL| UINT [8 | 32]

This command specifies the data format for the data transmitted to from the instrument to the control PC. It controls whether the bitstream data is sent as ASCII or UINT8 binary format.

Example:　　　　　　"FORM UINT,8"　　　The R&S FSQ-K92/K93/K94 option will send bitstream data
　　　　　　　　　　　　　　　　　　　　　　　equested by the TRACE:DATA? command as
　　　　　　　　　　　　　　　　　　　　　　　unsigned integers in binary format.

Characteristics:　　*RST value: ASCii
　　　　　　　　　　　　SCPI:　　　　　conforming

Mode:　　　　　　　OFDM, OFDMA

INITiate Subsystem

The INITiate subsystem configures the instrument prior to a measurement being carried out. It is basically used to tell the instrument which measurement is to be performed and takes any necessary step to set up the instrument for the measurement.

COMMAND	PARAMETERS	UNIT	COMMENT
INITiate			
:CONTinuous	<Boolean>		
[:IMMediate]			no query
:REFResh			no query

INITiate:CONTinuous   <Boolean>

This command determines whether the trigger system is continuously initiated (continuous) or performs single measurements (single).

Example: "INIT:CONT OFF" The R&S FSQ-K92/K93/K94 option will attempt a non continuous measurement when initiated.

Characteristics: *RST value: -
                     SCPI: conforming

Mode: OFDM, OFDMA

INITiate[:IMMediate]

This remote control command requests the R&S FSQ- OFDM option to start a new measurement sequence. If a measurement sequence is already in progress, then the command will be ignored.

Example: "INIT"   The R&S-OFDM option will attempt to start a new measurement.

Characteristics: *RST value: -
                     SCPI: conforming

Mode: OFDM, OFDMA

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-K92/K93/K94 will update the IQ measurement results according to the current settings.

Characteristics: *RST value: -
                     SCPI: conforming

Mode: OFDM, OFDMA

INPut Subsystem

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

COMMAND	PARAMETERS	UNIT	COMMENT
INPut<1|2>			
:ATTenuation	<numeric_value>	DB	
:DIQ		DB	
:RANGe			
[:UPPer]	<numeric_value >	V	B17 Option Only
:SRATe	<numeric_value>	HZ	B17 Option Only
:EATT	<numeric_value>	DB	
:AUTO	<Boolean>		
:STATe	<Boolean>		
:FILTer			
:YIG			
[:STATe]	<Boolean>		
:AUTO	<Boolean>		
:GAIN			FSL only
:STATe	OFF | ON | AUTO		
:IQ			
:BALanced			
[:STATe]	<Boolean>		B71 Option Only
:IMPedance	LOW | HIGH		B71 Option Only
:TYPE	IQ | I | Q		B71 Option Only
:SELect	RF | AIQ | DIQ		

INPut<1|2>:ATTenuation <numeric_value>

This command programs the input attenuator. To protect the input mixer against damage from overloads, the setting 0 dB can be obtained by entering numerals, not by using the command DEC. The step width is 10 dB without the option electronic attenuator, the range 0 dB to 70 dB. The input attenuation can be set in 5 dB steps between 0 dB and 75 dB with the option electronic attenuator.

Example: "INP:ATT?"   Returns the current mechanical attenuator setting in use

Characteristics: *RST value: 10 dB
                    SCPI: conforming

Mode: OFDM, OFDMA, MIMO

INPut<1|2>:DIQ:RANGe[:UPPer] <numeric_value>

This command defines the voltage corresponding to the maximum input value of the digital baseband input (value 7FFF hex) This command is only available with option FSQ B17.

Example: "INP:DIQ:RANG?"   'Returns the upper range of the digital baseband input

Characteristics: *RST value: 1 V
                    SCPI: conforming

Mode: ALL

INPut<1|2>:DIQ:SRATe <numeric_value>

This command defines the input data sample rate read by the digital baseband input. This command is only available with option FSQ B17

Note: *Current firmware version only supports 81.6 MHz input sample rate The same sample rate has to be configured with the TRAC:IQ:SET command.*

Example:	`"INP:DIQ:SRAT 80E6"`	'Returns the upper range of the digital baseband input
Characteristics:	*RST value: 81.6 MHZ	
	SCPI: conforming	
Mode:	ALL	

INPut<1|2>:EATT <numeric_value>

This command programs the attenuation of the electronic input attenuator. The attenuation can be varied in 5 dB steps from 0 to 30 dB. Other entries are rounded to the next lower integer value.

The electronic attenuator is switched off in the default state.

Example:	`"INP:EATT?"`	Returns the current electronic attenuator setting in use
Characteristics:	*RST value: 0 dB	
	SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

The command is only available with the electronic attenuator option B25.

INPut<1|2>:EATT:AUTO <Boolean>

This command automatically couples the electronic input attenuation to the reference level and the attenuation of the mechanical attenuator (state ON) or switches the input attenuation to manual entry (state OFF).

Example:	`"INP:EATT:AUTO ON"`	Couples the attenuation of the electronic attenuator to the reference level.
Characteristics:	*RST value: ON	
	SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

The command is only available with the electronic attenuator option B25.

INPut<1|2>:EATT:STATe <Boolean>

This command switches the electronic input attenuation into the signal path (state ON) or removes it from the signal path (state OFF).

Example:	`"INP:EATT:STAT ON"`	Switches the electronic attenuator into the signal path.
Characteristics:	*RST value: 0	
	SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

The command is only available with the electronic attenuator option B25.

INPut<1|2>:FILTer:YIG[:STATe]   <Boolean>

This command switches the YIG filter for image frequency suppression into the signal path (condition ON) and/or removes it from the signal path (condition OFF).

Example: `"INP:FILT:YIG OFF"` Switches the YIG filter off

Characteristics: *RST value: 0
                    SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

INPut<1|2>:FILTer:YIG:AUTO   <Boolean>

This command switches the YIG filter between Auto and Manual mode.

Example: `"INP:FILT:YIG:AUTO ON"`   Switches automatic YIG filter setting ON.

Characteristics: *RST value: ON
                    SCPI: conforming

Mode: OFDM, OFDMA, MIMO

INPut:GAIN:STATe

This remote control command is used to select whether the Pre-Amplifier is ON, OFF, or AUTO (Pre-Amplifier is automatically selected as required). The values which can be specified are as follows:

:GAIN:STATe ON   Pre-Amplifier is always ON

:GAIN:STATe OFF   Pre-Amplifier is always OFF

:GAIN:STATe AUTO Pre-Amplifier is automatically selected when required

Note this command only available on FSL.

Example: `"INPut:GAIN:STATe ON"`   Specifies that Pre-Amplifier is always ON.

Characteristics: *RST value: AUTO
                    SCPI: conforming

Mode: OFDM, OFDMA

INPut:IQ:BALanced[:STATe]   <Boolean>

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

Example: `"INPut:IQ:BAL 1"`   Specifies symmetrical (balanced) IQ inputs.

Characteristics: *RST value: 1
                    SCPI: conforming

Mode: OFDM, OFDMA, MIMO

INPut:IQ:IMPedance   LOW | HIGH

This remote control command specifies the input impedance for the IQ inputs. Note that this command requires option B71.

Example: `"INPut:IQ:IMP LOW"` Specifies low input impedance for IQ inputs.

Characteristics: *RST value: LOW
                    SCPI: conforming

Mode: OFDM, OFDMA, MIMO

INPut:IQ:TYPE IQ | I | Q

This remote control command specifies the input path for the Baseband input. The values which can be specified are as follows:

:INPut:IQ:TYPE IQ   I + j*Q (=default)
:INPut:IQ:TYPE I   I Only
:INPut:IQ:TYPE Q   Q Only

Note that this command requires option B71.

Example:	`"INPut:IQ:TYPE I"`	Specifies only the I input is used for the Baseband path.
Characteristics:	*RST value: IQ	
	SCPI: conforming	
Mode:	OFDM, OFDMA, MIMO	

INPut:SELect RF | AIQ | DIQ

This remote control command specifies whether the RF, Baseband or Digital IQ inputs are the currently selected signal input.
Note that Baseband input requires option B71 and Digital IQ input requires option B17.

Example:	`"INPut:SEL AIQ"`	Select Baseband input
Characteristics:	*RST value: RF	
	SCPI: conforming	
Mode:	ALL	

INSTrument Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
: INSTrument			
:NSElect	\<numeric value\>		
:SELect	WIMAX		

INSTrument:NSELect \<numeric value\>

his remote control command selects active operation of the R&S FSQ-K92/K93/K94 option by specifying its associated option number.

Example: "INST:NSEL 6"   The R&S FSQ-K92/K93/K94 option will be selected as the active option.

Characteristics: *RST value: 1
                      SCPI: device-specific

Mode: FSQ Base System

INSTrument:SELect WIMAX

This remote control command selects active operation of the R&S FSQ-K92/K93/K94 option by specifying its name.

Example: "INST:SEL WIMAX" The R&S FSQ-K92/K93/K94 option will be selected as the active option.

Characteristics: *RST value: SAN
                      SCPI: device-specific

Mode: FSQ Base System

MMEMory Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
MMEMory			
:LOAD			
:FRAMe			
:STATe	1,<file_name>		
:IQ			
:STATe	1,<file_name>		
:SEM			
:STATe	1,<file_name>		
:STORe			
:IQ			
:STATe	1,<file_name>		
: FRAMe			
:STATe	1,<file_name>		

MMEMory:LOAD:IQ:STATe 1,<file_name>

The remote control command is used to load IQ data from the specified .iqw file.

Example: `"MMEM:LOAD:IQ:STAT 1,'D:\USER\DATA.iqw'"`
                                 loads IQ data from the specified file

Characteristics: *RST value: –
                 SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

MMEMory:STORe:IQ:STATe 1,<file_name>

The remote control command is used to save IQ data to the specified .iqw file.

Example: `"MMEM:STOR:IQ:STAT 1,'D:\USER\DATA.iqw'"`
                                 stores IQ data to the specified file

Characteristics: *RST value: –
                 SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

MMEMory:LOAD:FRAMe:STATe 1,<file_name>

The remote control command is used to load a K93 zone frame setup from an xml file created from a SMU signal generator, with support for the IEEE 80216e/D11 standard.
Using the special filename "SMU" will attempt to receive the current settings from a networked SMU.
The IP address used is configured by `CONF:ADDR:SMU`.

Example: `"MMEM:LOAD:FRAM:STAT 1,'D:\USER\DATA.xml'"`

Characteristics: *RST value: –
                 SCPI: device-specific

Mode: OFDMA, MIMO

MMEMory:STORe:FRAMe:STATe   1,<file_name>

The remote control command is used to send a locally created and stored K93 zone frame file name, with support for the IEEE 80216e/D11 standard, to the SMU signal generator. If the command succeeds, the SMU will generate the waveform associated with the file sent.

Example: `"MMEM:STOR:FRAM:STAT 1,'D:\USER\WMAN\DATA.wimax'"`

Characteristics: *RST value: –
                          SCPI: device-specific

Mode: OFDMA, MIMO

MMEMory:LOAD:SEM:STATe   1,<file_name>

The remote control command is used to load a K93 spectrum emission mask setup from an xml file

Example: `"MMEM:LOAD:SEM:STAT 1,'D:\USER\TTA_SEM.xml'"`

Characteristics: *RST value: –
                          SCPI: device-specific

Mode: OFDMA, MIMO

SENSe Subsystem

The SENSe command is used to set and get the values of parameters in the remote instrument. The get variant of the SENSe command differs from set in that it takes no parameter values (unless otherwise stated) but is followed by the character '?' and will return the parameter's value in the same format as it is set.

e.g.   SENS:FREQ 10GHZ – sets the frequency to 10 GHz
      SENS:FREQ?   -   response 10GHZ   - returns the current frequency

COMMAND	PARAMETERS	UNIT	COMMENT
[:SENSe]			
:FFT			
:OFFSet	<numeric_value>		
:BANDwidth			
:CHANnel	<numeric_value>	Hz	
:FREQuency			
:CENTer	<numeric_value>	Hz	
:IQ			
:DITHer			
[:STATe]	<Boolean>		
:LPASs			
[:STATe]	<Boolean>		
:SWEep			
:ACPR			
:TIME	<numeric_value>	S	
:AUTO	<Boolean>		
:TIME	<numeric_value>	S	
:COUNt	<numeric_value>		
:EGATE	<Boolean>		
:HOLDoff			
[:TIMe]	<numeric_value>	S	
:SAMPle	<numeric_value>		
:LENgth			
[:TIMe]	<numeric_value>	S	
:SAMPle	<numeric_value>		
:LINK	<Boolean>		
:DEMod			
:CESTimation	PREAMONLY|PREAMPAYL|PAYLONLY| <Boolean>		query only
:FORMat			
[:BCONtent]			
:AUTo	NONE	FIRSt	USER	ALL	SIGNal	PREDefined	ULPHY	ULMAP	DLMAP		
:BANalyze	<String>		
:BTYPe	OFDM		
:SYMBols			
:EQUal	<Boolean>		
:MIN	<numeric_value>		
:MAX	<numeric_value>		
:BURSt			
:COUNt	<numeric_value>		
:STATe	<Boolean>		
:SWAPiq	<Boolean>		
:TRACking			
:LEVel	<Boolean>		
:PHASe	<Boolean>		

COMMAND	PARAMETERS	UNIT	COMMENT
[:SENSe]			
:TRACking			
:TIME	\<Boolean>		
:PILot	PRED|DET		
:CESTimation			
[:BASE]	USERtracked|FULLytracked		
:POWer			
:ACHannel			
:ACPairs	\<numeric_value>		
:BANDwidth			
[:CHANnel]	\<numeric_value>	Hz	
:ACHannel	\<numeric_value>	Hz	
:ALTernate\<1…4>	\<numeric_value>	Hz	
:BWIDth			
[:CHANnel]	\<numeric_value>	Hz	
:ACHannel	\<numeric_value>	Hz	
:ALTernate\<1…4>	\<numeric_value>	Hz	
:MODe	ABS | REL		
:SPACing			
[:ACHannel]	\<numeric_value>	Hz	
:ALTernate\<1…4>	\<numeric_value>	Hz	
:SEM	USER|STANDARD|IEEE|ETSI		
:MODe	UL | DL		
:TTA	USER|STANDARD		
:CLASs	\<numeric_value>		
:NCORrection	\<Boolean>		
:SUBChannel	\<numeric_value>		
:STATe	\<Boolean>		
:ULPHysmod	\<numeric_value>		
:SUBFrame			
:COUNt	\<numeric_value>		
:STATe	\<Boolean>		
:ZONE			
:COUNt	\<numeric_value>		
:STATe	\<Boolean>		

[SENSe:]FFT:OFFSet \<numeric_value>

The remote control command is used to specify the FFT start offset relative to the GP centre.

Example: "SENS:FFT:OFF 0"

Characteristics: *RST value: 0
                   SCPI: conforming

Mode: OFDMA, MIMO

[SENSe:]BANDwidth:CHANnel \<numeric_value>

The remote control command is used to specify the channel bandwidth of the signal to be measured.

Example: "SENS:BAND:CHAN 7MHZ"   The R&S FSQ-K92 option uses a channel
                                                   bandwidth value of 7 MHZ

Characteristics: *RST value: 1.75 MHz
                   SCPI: conforming

Mode: OFDM, OFDMA, MIMO

[SENSe:]FREQuency:CENTer <numeric_value>

The remote control command is used to specify the frequency that the Analyzer will use to make measurements against the input signal.

Example:	`"SENS:FREQ:CENT 5GHZ"`	The R&S FSQ-K92 option uses the specified frequency value to set the analyzer detection frequency.

Characteristics: *RST value: fmax / 2
                                SCPI: conforming

Mode: OFDM, OFDMA, MIMO

[SENSe:]IQ:DITHer[:STATe] <Boolean>

This instruction links a 2 MHz broad intoxication signal with 42.67 MHz into the signal path of the Baseband inputs. Note that this command requires option B71

Example: `"SENS:IQ:DITH 1"`   switches on the 2 MHz broad intoxication signal

Characteristics: *RST value: 0
                                SCPI: conforming

Mode: OFDM

[SENSe:]IQ:LPASs[:STATe] <Boolean>

This instruction switches a 36 MHz filter into the I and Q branch of the Baseband inputs. Note that this command requires option B71

Example: `"SENS:IQ:LPASs 1"`   Switches on the low pass filter for the IQ inputs.

Characteristics: *RST value: 1
                                SCPI: conforming

Mode: OFDM

[SENSe:]SWEep:ACPR:TIME <numeric_value>

The remote control command is used to specify the sweep time for Spectrum ACP and .MASK measurements If this SCPI command is successfully entered, then the automatic setting is disabled.

Example: `"SENS:SWE:ACPR:TIME 100mS"`

Characteristics: *RST value: 2
                                SCPI: conforming

Mode: OFDMA

[SENSe:]SWEep:ACPR:TIME:AUTO <Boolean>

The remote control command is used to specify automatic sweep time calculation for Spectrum ACPR and .MASK measurements

Example: `"SENS:SWE:ACPR:TIME:AUTO OFF"`

Characteristics: *RST value: ON
                                SCPI: conforming

Mode: OFDMA, MIMO

[SENSe:]SWEep:TIME <numeric_value>

The remote control command is used to specify the sweep acquisition period (capture time) for which the input signal is to be measured.

Example:	`"SENS:SWE:TIME 20ms"`	The R&S FSQ-K92 option uses the specified sweep acquisition period.

Characteristics: *RST value: 0.015 (15 ms)
                         SCPI: conforming

Mode: OFDM, MIMO

[SENSe:]SWEep:COUNt <numeric_value>

The remote control command is used to specify the number of sweeps for Spectrum Mask and Spectrum ACPR measurements.

Example:	`"SENS:SWE:COUN 64"`	Sets the number of sweeps to 64.

Characteristics: *RST value: 1
                         SCPI: conforming

Mode: OFDM, OFDMA, MIMO

[SENSe:]SWEep:EGATe <Boolean>

This command switches on/off the gating.

Example:	`"SENS:SWE:EGAT ON"`	Switches on gating.

Characteristics: *RST value: 0
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]SWEep:EGATe:HOLDoff[:TIMe] <numeric_value>

This command defines the gate delay in the capture buffer in time units. The range of this value is dependent on the last run measurement.

Example:	`"SENS:SWE:EGAT:HOLD 125us"`	The R&S FSQ-K92 option will enforce a delay of 125µs in the Capture buffer

Characteristics: *RST value: 0.0001   (100µs)
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]SWEep:EGATe:HOLDoff:SAMPle <numeric_value>

This command defines the gate delay in the capture buffer as a number of samples. The range of this value is dependent on the last run measurement.

Example:	`"SENS:SWE:EGAT:HOLD:SAMP 2500"`	The R&S FSQ-K92 option will enforce a delay of 2500 samples in the Capture buffer.

Characteristics: *RST value: 200
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]SWEep:EGATe:LENGth[:TIMe] <numeric_value>

This command defines the gate time in the capture buffer in time units. The range of this value is dependent on the last run measurement.

Example:	`"SENS:SWE:EGAT:LENG 100ms"`	The R&S FSQ-K92 option will enforce a gate length of 100 milliseconds between sweeps.

Characteristics: *RST value: 0.0004 (400µs)
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]SWEep:EGATe:LENGth:SAMPle <numeric_value>

This command defines the gate time in the capture buffer as a number of samples. The range of this value is dependent on the last run measurement.

Example:	`"SENS:SWE:EGAT:LENG:SAMP 200000"`	The R&S FSQ-K92 option will enforce a gate length of 200000 samples in the Capture buffer.

Characteristics: *RST value: 800
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]SWEep:EGATe:LINK <Boolean>

This command links together the movement of the gating lines and the capture buffer marker

When linked, the R&S FSQ-K92 option will move the capture buffer marker to the centre of the gating lines, update the gating delay as the capture buffer marker is updated, and update the capture buffer marker so that it remains in the centre of the gating lines as the gating line delay and length are changed.

Example: `"SENS:SWE:EGAT:LINK ON"`

Characteristics: *RST value: 0
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]DEMod:CESTimation PREAMONLY|PREAMPAYL|PAYLONLY|<Boolean**>**

This command defines whether channel estimation will be done in preamble and payload (if set to 1) or only in preamble (if set to 0) for OFDM. The effect of this is most noticeable for the EVM measurement results, where the results will be improved when this feature is enabled
Alternatively for OFDMA the arguments PREamonly, PREampayl and PAYLonly can be specified, where the payload also becomes available for channel estimation, by using the argument PAYLONLY.
However, this functionality is not supported by the IEEE 802.16 standard and must be disabled if the results are to be strictly measured against the standard.

Example:	`"SENS:DEMod:CEST 1"`	Specifies that the IQ measurement results will use improved channel estimation.

Characteristics: *RST value: 0
SCPI: device-specific

Mode: OFDM, OFDMA

[SENSe:]DEMod:FORMat[:BCONtent]:AUTo NONE | FIRSt | USER | ALL | ALL64 | ALL256 | SIGNal | PREDefined | ULPHY | DLMAP

This remote command defines how the WiMAX signal is demodulated. For OFDMA and MIMO the DL-MAP is read out in a first step. In a second step the zone to be analyzed, according to the user selection, is measured.

NONE	'OFDM' demodulation off (Brute force mode) the specified modulation is used for all bursts.
FIRSt	'OFDM' retrieve the first valid payload modulation and analyze all bursts with same modulation.
USER	'OFDM' analyze all bursts carrying the modulation specified.
ALL	'OFDM' analyze each burst with the first valid payload modulation found for that burst.
ALL64	'OFDM' analyze each burst with the first valid payload modulation found for that burst up to 64QAM. Ie BPSK, QPSK, 16QAM and 64QAM. This parameter is identical to the ALL parameter.
ALL256	'OFDM' analyze each burst with the first valid payload modulation found for that burst up to 64QAM. Ie BPSK, QPSK, 16QAM, 64QAM and 256QAM.
SIGNal	'OFDMA' read out the DL-MAP from the WiMAX signal for the first internal step. For the second internal step analyze the zone specified with the remote command CONFig:WIMax:FRAMe:ZONEtouse.
PREDefined	'OFDMA' and MIMO configure the DL-MAP, UL-MAP in Frame Config using the commands CONFigure:WIMax:ZONE<1…26>:… . Select the zone to be analyzed with the command CONFigure:WIMax:ZONE<1…26>[:ANAlyze]:STATe.
ULPHY	'OFDMA' and 'MIMO' analyze a **single** UL-data burst.
DLMAP	'OFDMA' and 'MIMO' read out the DL-MAP from the WiMAX signal for the first internal step. For the second internal step analyze the zone specified with the remote command CONFig:WIMax:FRAMe:ZONEtouse.

Example: `"SENSe:DEM:FORM:AUT FIRSt"`
Specifies for OFDM mode, that all bursts are demodulated according to the modulation format of the first burst.

Characteristics: *RST value: ALL
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]DEMod:FORMat:BANalyze <string>

The remote control command sets the analysis modulation format that will be assumed when the measurement is performed.
The supplied string can be one of the following:

'BPSK1/2' -   BI-Phase shift keying
'QPSK1/2' -   Quadrature phase shift keying
'QPSK3/4' -   Quadrature phase shift keying
'16QAM1/2' -   Quadrature Amplitude Modulation
'16QAM3/4' -   Quadrature Amplitude Modulation
'64QAM2/3' -   Quadrature Amplitude Modulation
'64QAM3/4' -   Quadrature Amplitude Modulation
'256QAM' -   Quadrature Amplitude Modulation

Example: `"SENS:DEM:FORM:BAN '16QAM1/2'"`
The R&S FSQ-K92 option will only analyze bursts that are of the 16 QAM modulation format

Characteristics: *RST value: 'BPSK1/2'
SCPI: device-specific

Mode: OFDM

[SENSe:]DEMod:FORMat:BANalyze:BTYPe OFDM

This command is maintained in R&S FSQ-K92/K93 for backward compatibility. The command may be issued in all standards with the argument OFDM. If queried, it always returns OFDM. Any other usage results in an error.

Example: `"SENS:DEM:FORM:BAN:BTYPe?"`

Characteristics: *RST value: 'OFDM'
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]DEMod:FORMat:BANalyze:SYMbols:EQUal <Boolean>

When this command is set to ON then only bursts of equal length will take part in the PVT analysis. When this command is set to ON the value specified by the [SENSe:]DEMod:FORMat:BANalyze:SYMbols:MIN command specifies the number of symbols that a burst must have in order to take part in PVT analysis.

Example: `"SENS:DEM:FORM:BAN:SYM:EQU ON"`
Only bursts of equal length will take part in the PVT analysis.

Characteristics: *RST value: 0
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]DEMod:FORMat:BANalyze:SYMbols:MIN <numeric_value>

This command specifies the number of data symbols required for bursts to qualify for measurement analysis. Only bursts with the specified number of symbols will be used in the measurement analysis. The number of data symbols is defined as the uncoded bits including service and tail bits.
When the [SENSe:]DEMod:FORMat:BANalyze:SYMbols:EQUal command has been set to ON then this command specifies the exact number of symbols required for a burst to take part in measurement analysis. When the [SENSe:]DEMod:FORMat:BANalyze:SYMbols:EQUal command is set to OFF this command specifies the minimum number of symbols required for a burst to take part in measurement analysis.

Example: `"SENS:DEM:FORM:BAN:SYM:MIN 16"`
The R&S FSQ-K92 option will only analyze bursts which contain a symbol count of 16.

Characteristics: *RST value: 1
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]DEMod:FORMat:BANalyze:SYMbols:MAX <numeric_value>

This command specifies the maximum number of data symbols required for bursts to qualify for measurement analysis. Only bursts with the specified number of symbols will be used in the measurement analysis. The number of data symbols is defined as the uncoded bits including service and tail bits. This value will not have any immediate effect if the [SENSe:]DEMod:FORMat:BANalyze:SYMbols:EQUal command has been set to ON as in this case no range of symbols is allowed and only bursts with exactly the number of symbols specified by the [SENSe:]DEMod:FORMat:BANalyze:SYMbols:MIN command shall take place in measurement analysis.

Example:	`"SENS:DEM:FORM:BAN:SYM:MAX 1300"`
	The R&S FSQ-K92 option will only analyze bursts which contain a maximum symbol count of 1300.
Characteristics:	*RST value: 64
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

[SENSe:]BURSt:COUNt <Boolean>

This command defines the number of bursts that will be analyzed by the measurement.

Example:	`"SENS:BURS:COUN 16"`	Sets the number of bursts to 16.
Characteristics:	*RST value: 1	
	SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

[SENSe:]BURSt:COUNt:STATe <Boolean>

When this command is set to on, the burst count parameter will be used by the measurement, otherwise the burst count parameter will be ignored.

Example:	`"SENS:BURS:COUN:STAT 1"`	Sets the burst count state to ON
Characteristics:	*RST value: 0	
	SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

[SENSe:]SWAPiq <Boolean>

This command defines whether or not the recorded IQ pairs should be swapped (I<->Q) before being processed.

Example:	`"SWAP 1"`	Specifies that IQ values should be swapped.
Characteristics:	*RST value: 0	
	SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

[SENSe:]TRACking:LEVel <Boolean>

This command defines whether or not the measurement results should be compensated for level.
Note: [SENSe] is not optional for this command when using the short form: "TRAC" as it conflicts with the "TRACe" command.

Example:	`"SENS:TRAC:LEV 1"`	Specifies that the measurement results should be compensated for level.
Characteristics:	*RST value: 0	
	SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

[SENSe:]TRACking:PHASe <Boolean>

This command defines whether or not the measurement results should be compensated for phase.

Note: [SENSe] is not optional for this command when using the short form: "TRAC" as it conflicts with the "TRACe" command.

Example: `"SENS:TRAC:PHAS 1"` Specifies that the measurement results should be compensated for phase.

Characteristics: *RST value: 1
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]TRACking:TIME <Boolean>

This command defines whether or not the measurement results should be compensated for time.

Note: [SENSe] is not optional for this command when using the short form: "TRAC" as it conflicts with the "TRACe" command.

Example: `"SENS:TRAC:TIME 1"`   Specifies that the measurement results should be compensated for time.

Characteristics: *RST value: 0
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]TRACking:PILot PRED|DET

This command defines whether or not the measurement results should have predefined pilot tracking (PRED) or whether the tracking should be determined when the measurement is run (DET).

Example: `"SENS:TRAC:PIL DET"`

Characteristics: *RST value: PRED
                         SCPI: conforming

Mode: OFDMA, MIMO

[SENSe:]TRACking:CESTimation[:BASE] USERtracked|FULLytracked

This command defines whether or not the measurement is analyzed with all tracking options used. If USERtracked is specified then the tracking options specified by the user are used to analyze the signal (Level, Phase and Time). If FULLytracked is specified then the signal is automatically analyzed using all tracking options. This option is not available if the Channel Estimation Range for downlink is set to "Preamble Only". In this case the user defined tracking options are used.

Example: `"SENS:TRAC:CEST USER"`

Characteristics: *RST value: USER
                         SCPI: conforming

Mode: OFDMA, MIMO

[SENSe:]POWer:ACHannel:ACPairs <numeric_value>

This command sets the number of adjacent channels pairs (upper and lower channel pairs). The figure 0 stands for pure channel power measurement.

Example: `"POW:ACH:ACP 3"` Sets the number of adjacent channels to 3, i.e. the adjacent channel and alternate adjacent channels 1 and 2 are switched on.

Characteristics: *RST value: –
                         SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]POWer:ACHannel:SPACing[:ACHannel] <numeric_value>

This command defines the channel spacing of the adjacent channel to the TX channel.

Example: `"SENS:POW:ACH:SPAC 33KHZ"` Sets the spacing between the carrier signal
                                                 and the adjacent channel to 33 kHz

Characteristics: *RST value: 1750000 (1.75 MHz)
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]POWer:ACHannel:SPACing:ALTernate<1…4> <numeric_value>

This command defines the channel spacing of the alternate adjacent channels to the TX channel.

Example: `"SENS:POW:ACH:SPAC:ALT1 100KHZ"` Sets the spacing between TX channel and
                                                        alternate adjacent channel 1 to 100 kHz.

Characteristics: *RST value: 3.5MHz for alternate adjacent channel 1
                                   5.25MHz for alternate adjacent channel 2
                                   7MHz for alternate adjacent channel 3
                                   8.75MHz for alternate adjacent channel 4
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel] <numeric_value>

This command sets the channel bandwidth of the system. The bandwidths of adjacent channels are not influenced by this modification.

Example: `"SENS:POW:ACH:BAND 30KHZ"`
                          Sets the bandwidth of the TX channel to 30 kHz.

Characteristics: *RST value: 1750000 (1.75 MHz)
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel <numeric_value>

This command defines the channel bandwidth of the adjacent channel of the system.

Example: `"SENS:POW:ACH:BAND:ACH 30KHZ"`
                          Sets the bandwidth of the adjacent channel to 30 kHz.

Characteristics: *RST value: 1750000   (1.75 MHz)
                                    SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1…4> <numeric_value>

This command defines the channel bandwidth of the alternate adjacent channels of the system.

Example: `"SENS:POW:ACH:BAND:ALT2 30KHZ"`
                              Sets the bandwidth of the second alternate channel to 30 kHz.

Characteristics: *RST value: 1750000 (1.75 MHz)
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]POWer:ACHannel:MODe ABS | REL

This command selects the ACP measurement to be measured as Absolute or Relative.

Example: `"POW:ACH:MOD ABS"`   Switched to ACP measurement to Absolute.

Characteristics: *RST value: REL
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]POWer:SEM   USER|STANDARD|IEEE|ETSI

This command sets the behaviour of the Spectrum Emission Mask (SEM) analysis to use a specific
configuration:
USER   - Analysis according to a user-defined configuration
STANDARD   - Analysis according to the TTA standard (WiBro only)
IEEE   - Analysis according to the ETSI standard (OFDM/OFDMA only)
ETSI   - Analysis according to the IEEE standard (OFDM/OFDMA only)

Example: `"POW:SEM USER"`   set SEM analysis according to a user defined
                                         configuration.

Characteristics: *RST value: IEEE (OFDM/OFDMA), STANDARD (WiBro)
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

[SENSe:]POWer:SEM:MODe   UL | DL

This command sets the Spectrum Emission Mask (SEM) analysis to be UL or DL (uplink or
downlink).

Example: `"POW:SEM:MOD UL"` set SEM analysis to uplink

Characteristics: *RST value: –DL
                     SCPI: device-specific

Mode: OFDMA, MIMO

[SENSe:]POWer:SEM:TTA   USER | STANDARD

This command sets the Spectrum Emission Mask (SEM) analysis for WiBro mode according to TTA
standard or a user defined mask.

*Note: This command is maintained for backward compatibility only. It has been replaced by
SENSe:]POWer:SEM.*

Example: `"POW:SEM:TTA STANDARD"`   set SEM analysis according to TTA

Characteristics: *RST value: STANDARD
                     SCPI: device-specific

Mode: OFDMA, MIMO

[SENSe:]POWer:SEM:CLASs <numeric_value>

This command sets the Spectrum Emission Mask (SEM) power class index. The index represents
the power classes to be applied. The index is directly related to the entries displayed in the power
class drop down combo box, within the SEM settings configuration page.

Example: `"POW:SEM:CLASs 0"`   set SEM power class to automatic

Characteristics: *RST value: 0
                     SCPI: device-specific

Mode: OFDMA, MIMO

[SENSe:]POWer:NCORrection <Boolean>

This command sets the noise correction on/off for future spectrum ACP measurements.

Example:	`"POW:NCOR ON"` turn ON noise correction

Characteristics:	*RST value: – SCPI: device-specific

Mode:	OFDM, OFDMA, MIMO

[SENSe:]SUBChannel <numeric_value>

This command sets the sub-channel to be used in the measurement. This has a range of 1 to 31. This is only available in up link mode.

Example:	`"SUBC 12"` Sets the sub-channel to 12.

Characteristics:	*RST value: – SCPI: device-specific

Mode:	OFDM, OFDMA, MIMO

[SENSe:]SUBChannel:STATe <Boolean>

This command enables or disables the subchannelization used in the measurement. This is only available in up link mode.

Example:	`"SUBC:STAT 1"` Specifies that the measurement will be analyzed using the specified sub-channel.

Characteristics:	*RST value: 1 SCPI: conforming

Mode:	OFDM, OFDMA, MIMO

[SENSe:]SUBChannel:ULPHysmod <numeric_value>

This command sets the Up Link Physical Modifier to be used in the measurement. This has a range of 0 to 255. This is only available in up link mode.

Example:	`"SUBC:ULPH 1"` Sets the UL Physical Modifier to 1.

Characteristics:	*RST value: – SCPI: device-specific

Mode:	OFDM, OFDMA, MIMO

[SENSe:]SUBFrame:COUNt <numeric_value>

This command defines the number of subframes/zones that will be analyzed by the measurement. This command is the same as [SENSe:]ZONE:COUNt.

Example:	`"ZONE:COUN 16"` Sets the number of subframes/zones to 16.

Characteristics:	*RST value: 1 SCPI: device-specific

Mode:	OFDMA, MIMO

[SENSe:]SUBFrame:COUNt:STATe <Boolean>

When this command is set to on, the subframes/zone count parameter will be used by the measurement, otherwise the subframes/zone count parameter will be ignored. This command is the same as [SENSe:]ZONE:COUNt:STATe.

Example:	`"ZONE:COUN:STAT 1"` Sets the subframes/zone count state to ON

Characteristics:	*RST value: 0 SCPI: device-specific

Mode:	OFDMA, MIMO

[SENSe:]ZONE:COUNt <numeric_value>

This command defines the number of subframes/zones that will be analyzed by the measurement. This command is a the same as [SENSe:]SUBFrame:COUNt.

Example: "ZONE:COUN 16"   Sets the number of subframes/zones to 16.

Characteristics: *RST value: 1
                    SCPI: device-specific

Mode: OFDMA, MIMO

[SENSe:]ZONE:COUNt:STATe <Boolean>

When this command is set to on, the subframes/zone count parameter will be used by the measurement, otherwise the subframes/zone count parameter will be ignored. This command is the same as [SENSe:]SUBFrame:COUNt:STATe.

Example: "ZONE:COUN:STAT 1" Sets the subframes/zone count state to ON

Characteristics: *RST value: 0
                    SCPI: device-specific

Mode: OFDMA, MIMO

STATus Subsystem

The STATus subsystem contains the commands for the status reporting system. *RST does not influence the status registers.

COMMAND	PARAMETERS	UNIT	COMMENT
:STATus			
:QUEStionable			
:LIMit<1|2>			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:POWer			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:SYNC			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	

STATus:QUEStionable:LIMit<1|2>[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LIMit Register for screen A and B. Readout deletes the contents of the EVENt section.

Example: `"STAT:QUES:LIM?"`

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

STATus:QUEStionable:LIMit<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LIMit register for screen A and B. Readout does not delete the contents of the CONDition section.

Example: `"STAT:QUES:LIM:COND?"`

Characteristics: *RST value: –
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

STATus:QUEStionable:LIMit<1|2>:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:LIMit register for screen A and B. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example:	`"STAT:QUES:LIM:ENAB 65535"`	All events bits will be represented in the LIMit summary bit.

Characteristics: *RST value: –
                                  SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

STATus:QUEStionable:LIMit<1|2>:PTRansition   0 to 65535

This command determines what bits in the STATus:QUEStionable:LIMit Condition register of screen A or B will set the corresponding bit in the STATus:QUEStionable:LIMit Event register when that bit has a positive transition (0 to 1).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example:	`"STAT:QUES:LIMit:PTR 65535"`	All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: –
                                  SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

STATus:QUEStionable:LIMit<1|2>:NTRansition   0 to 65535

This command determines what bits in the STATus:QUEStionable:LIMit Condition register of screen A or B will set the corresponding bit in the STATus:QUEStionable:LIMit Event register when that bit has a negative transition (1 to 0).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example:	`"STAT:QUES:LIM:NTR 65535"`	All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: –
                                  SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

STATus:QUEStionable:POWer[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:POWer Register. Readout deletes the contents of the EVENt section.

Example:	`"STAT:QUES:POW?"`

Characteristics: *RST value: –
                                  SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

STATus:QUEStionable:POWer:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:POWer register. Readout does not delete the contents of the CONDition section.

Example: `"STAT:QUES:POW:COND?"`

Characteristics: *RST value: –
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

STATus:QUEStionable:POWer:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:POWer register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: `"STAT:QUES:POW:ENAB 65535"`   All events bits will be represented in the POWer summary bit.

Characteristics: *RST value: –
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

STATus:QUEStionable:POWer:PTRansition   0 to 65535

This command determines what bits in the STATus:QUEStionable:POWer Condition register will set the corresponding bit in the STATus:QUEStionable:POWer Event register when that bit has a positive transition (0 to 1).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example: `"STAT:QUES:POWer:PTR 65535"`   All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: –
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

STATus:QUEStionable:POWer:NTRansition   0 to 65535

This command determines what bits in the STATus:QUEStionable:POWer Condition will set the corresponding bit in the STATus:QUEStionable:POWer Event register when that bit has a negative transition (1 to 0).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example: `"STAT:QUES:POW:NTR 65535"`   All condition bits will be summarised in the Event register when a positive transition occurs.

Characteristics: *RST value: –
                     SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

STATus:QUEStionable:SYNC:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:SYNC register. Readout does not delete the contents of the CONDition section.

Example:	`"STAT:QUES:SYNC:COND?"`
Characteristics:	*RST value: – SCPI: conforming
Mode:	OFDM, OFDMA, MIMO

STATus:QUEStionable:SYNC:ENABle   0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:SYNC register. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example:	`"STAT:QUES:SYNC:ENAB 65535"`	All events bits will be represented in the SYNC summary bit.
Characteristics:	*RST value: – SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

STATus:QUEStionable:SYNC:PTRansition   0 to 65535

This command determines what bits in the STATus:QUEStionable:SYNC Condition register will set the corresponding bit in the STATus:QUEStionable:SYNC Event register when that bit has a positive transition (0 to 1).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example:	`"STAT:QUES:SYNC:PTR 65535"`	All condition bits will be summarised in the Event register when a positive transition occurs.
Characteristics:	*RST value: – SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

STATus:QUEStionable:SYNC:NTRansition   0 to 65535

This command determines what bits in the STATus:QUEStionable:SYNC Condition will set the corresponding bit in the STATus:QUEStionable:SYNC Event register when that bit has a negative transition (1 to 0).The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example:	`"STAT:QUES:SYNC:NTR 65535"`	All condition bits will be summarised in the Event register when a positive transition occurs.
Characteristics:	*RST value: – SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

SYSTEM Subsystem

The SYSTEM specifies parameters

COMMAND	PARAMETERS	UNIT	COMMENT
SYSTem			
:COMMunicate			
:TCPip			
:ADDRess	<String>		

SYSTem:COMMunicate:TCPip:ADDRess <String>

This command allows an external SMU signal generator to be connected via TCPIP to OFDMA, so that frame zone setup can be downloaded directly to K93.

Example:　　　　"SYST:COMM:TCP:ADDR 192.168.1.1"　　Sets the lookup TCPIP address
　　　　　　　　　　　　　　　　　　　　　　　　　　　of the SMU to 192.168.1.1

Characteristics:　*RST value: –
　　　　　　　　　SCPI:　　device-specific

Mode:　　　　OFDMA, MIMO

TRACe Subsystem

The TRACe subsystem controls access to the instrument's internal trace memory.

COMMAND	PARAMETERS	UNIT	COMMENT
TRACe			
[:DATA]	TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | LIST		Query only
:IQ			
:DATA			
:MEMory?	\<numeric_value\>,\<numeric_value\>		Query only
:SRATe	\<numeric_value\>	Hz	
:FILTer			
:FLATness	NORMal | WIDE		

TRACE[:DATA] TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | LIST

This command 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.

IQ Measurements

There are a number of measurements that can be performed in IQ mode. No data will be returned for any of the following measurements, should it be requested, until such time as a measurement belonging to the IQ group has been previously run.

Running a frequency sweep measurement, for example Spectrum Mask, will not generate results for this measurement group.

Constellation vs Symbol

This measurement represents I and Q data. Data will be returned as a repeating array of interleaved I and Q data in groups of selected carriers, until all the data is exhausted.

Each I and Q point will be returned in floating point format. TRACE1 is used for this measurement results.

The results are dependant on whether an 802.16e/D11 ODFMA or 802.16 2004 OFDM measurement has been run.

For 802.16 2004 OFDM the following rules apply:

If "All Carriers" is selected, it will return 200 IQ values per symbol.
If "Pilots Only" is selected, it will return 8 pilot IQ values per symbol in the following carrier order: -88, -63, -38, -13, 13, 38, 63, 88.
If a single carrier is selected, it will return 1 IQ value per symbol.
For 802.16e/D11 OFDMA the following rules apply:
The results are retuned in repeating groups of the FFT size, for all symbols.

For example if the FFT size was 1024 and 12 symbols were found then 12288 I/Q pairs worth of data would be returned. Carriers that do not exist or are filtered out by the current filter settings, are denoted by the text "NAN".

Filtering can be performed by burst, symbol, sub carrier and modulation.

Note: All sub carriers for each symbol are always returned regardless of the user filter settings.

Supported data formats (FORMat:DATA):ASCii|REAL

Constellation vs Carrier

This measurement represents I and Q data. Data will be returned as a repeating array of interleaved I and Q data in groups of 200 channels excluding channel 0, until all the data is exhausted. Each I and Q point will be returned in floating point format. TRACE1 is used for this measurement results.

Supported data formats (FORMat:DATA):ASCii|REAL

Power vs Time – Full Burst and Start / End data

This description applies to measurement results from the 802.16 2004 OFDM standard.

Both measurement results are once again simply slightly different views of the same results data.

All fully complete bursts within the capture time are analyzed into three master bursts. The three master bursts relate to the minimum, maximum and average values across all complete bursts. This data is returned in dBm values to the user on a per sample basis. Each sample will in some way relate to an analysis of each corresponding sample within each processed burst. The type of PVT data returned will be determined by the TRACE number passed as an argument to the SCPI command, in addition to the graphic type that is selected.

If the graphic type selected is full burst, then the return data is as follows.

  TRACE1 – full burst, burst data values.

If the graphic type selected is start/end, then the return data is as follows.

  TRACE1 – start, burst data values.

  TRACE2 – end, burst data values.

The number of samples returned during full burst analysis will depend on the modulation type and will typically be 5000.

The number of samples returned when the start / end graphic type is selected will be less than what is returned for full burst and will be approximately 400 samples.

The samples will be returned in floating point format as a single sequence of comma delimited values.

Supported data formats (FORMat:DATA):ASCii|REAL

Power vs Time – Full Sub Frame and Rising/Falling Sub Frame

This description applies to measurement results from the 802.16e/D11 standard.

Both measurement results are once again simply slightly different views of the same results data.

All fully complete frames within the capture time are analyzed into three master frames. The three master frames relate to the minimum, maximum and average values across all complete frames. This data is returned in dBm values to the user on a per sample basis. Each sample will in some way relate to an analysis of each corresponding sample within each processed frame. The type of PVT data returned will be determined by the TRACE number passed as an argument to the SCPI command, in addition to the graphic type that is selected.

If the graphic type selected is full burst, then the return data is as follows.

TRACE1 – full sub frame, minimum frame data values.

TRACE2 – full sub frame, mean frame data values.

TRACE3 – full sub frame, maximum frame data values.

If the graphic type selected is rising/falling, then the return data is as follows.

TRACE1 – rising edge, minimum frame data values.

TRACE2 – rising edge, mean frame data values.

TRACE3 – rising edge, maximum frame data values.

TRACE4 – falling edge, minimum frame data values.

TRACE5 – falling edge, mean frame data values.

TRACE6 – falling edge, maximum frame data values.

The number of samples returned during full frame analysis will depend on the modulation type and will typically be 5000.

The number of samples returned when the start / end graphic type is selected will be less than what is returned for full burst and will be approximately 400 samples.

The samples will be returned in floating point format as a single sequence of comma delimited values.

Supported data formats (FORMat:DATA):ASCii|REAL

Spectrum Flatness

There are six separate traces that are available with this measurement. Trace data for a particular trace will only be returnable by querying the appropriate trace

Spectrum flatness provides three basic graph types. These are an absolute power value graph (ABS), an adjacent carrier power difference graph and a relative group delay graph, which are all plotted on a per carrier basis. All carriers are drawn, in addition to the unused 0 carrier.
The number of carriers depends on the measured standard. For 802.16 2004 ODFM, the number of carriers is 200 but for the 802.16e/D11 ODFMA standard the number of carriers is dependent on the FFT size. Carriers that are not used are denoted by the keyword "NAN".
For example, the return data will be a repeating group of 201 carriers for the 802.16 2004 ODFM standard.

TRACE1 – ABS/adjacent carrier power difference/Group delay   (minimum trace)
TRACE2 – ABS/adjacent carrier power difference/Group delay   (average trace)
TRACE3 – ABS/adjacent carrier power difference/Group delay   (maximum trace)

Absolute power results are returned in dB or dB difference and group delay results are returned in ns.
Supported data formats (FORMat:DATA):ASCii|REAL

Spectrum FFT

All FFT points will be returned if the data for this measurement is requested. This will be an exhaustive call, due to the fact that there are nearly always more FFT points than IQ samples. The number of FFT points is the number presented by a power of 2 that is higher than the total number of samples.
For example, if there were 20000 samples, then 32768 FFT points would be returned.
Data will be returned in floating point format in dBm. TRACE1 is used for this measurement results.
Supported data formats (FORMat:DATA):ASCii|REAL

Statistics Bitstream data

Data will be returned depends on the selected standard from which the measurement was executed.
For the 802.16 2004 OFDM standard, data is returned in repeating groups of 200 data channels where each symbol value will be represented by an integer value within one byte. Channel 0 is unused and will therefore not have any data associated with it, with no return data being provided.
For the 802e16e/D11 OFDMA standard, the data is returned in groups of the selected FFT size, where each symbol value will be represented by an integer value within one byte. The FFT size is either, 128, 512, 1024, 2048 sub carriers. Unused carriers, including the zero carrier, are also retuned and these are denoted by the string value NAN.
The number of repeating groups that are returned will be equal to the number of measured symbols.
64QAM has the highest data rate and it contains symbol values up to 63, making one byte sufficient in size to represent all symbol data values, regardless of the modulation type in use.
Data will be returned in ASCII printable hexadecimal character format. TRACE1 is used for this measurement results.
Supported data formats (FORMat:DATA):ASCii|UINT

Statistics Burst Summary data

The return data depends on the current standard and measurement results.
For the IEEE 802.16 2004 OFDM standard, the data will be returned in repeating groups of 6 comma separated values as follows:

1st value – Burst number. If this value is 0 then it is an FCH burst.

2nd value – Area where:
   0 = Preamble
   1 = Data.

3rd value – Modulation where:
   0 = BPSK
   1 = QPSK
   2 = 16QAM

   3 = 64QAM

4th value – Symbol length. This is an integer value giving the number of symbols in the current area.

5th value – Power in dBm for the current area. This is returned as a float.

6th value – EVM in dB for the current area. This is returned as a float.

Example:

```
Burst       Area       Modulation    Length    Power      EVM
FCH         Preamble   QPSK               1     -1.96     -43.75
            Data       BPSK               1     -2.96     -33.75
Burst 2     Preamble   QPSK               1     -3.96     -23.75
            Data       64QAM             26     -4.96     -13.75
```

SCPI would return the following:

```
B|A|M|L |P    |E
u|r|o|e |o    |V
r|e|d|n |w    |M
s|a| | |e     |
t| | | |r     |

0,0,1, 1,-1.96,-43.75,
0,1,0, 1,-2.96,-33.75,
2,0,1, 1,-3.96,-23.75,
2,1,3,26,-4.96,-13.75
```

The number of repeating groups that are returned will be equal to the number of rows in the Burst Summary results.

For the IEEE 802.16e/D11 OFDMA standard, the data will be returned in repeating groups of 7 comma separated values as follows:

1st value – Sub Frame number.

2nd value – Burst number.

3rd value – Burst Type:

    1 = FCH.

    2 = DL Map.

    3 = UL Map.

    4 = Data.

4th value – Modulation where:

    1 = QPSK

    2 = 16QAM

    3 = 64QAM

5th value – Number of slots. This is an integer value giving the number of slots associated with the burst.

6th value – Power in dBm for the current area. This is returned as a float.

7th value – EVM in dB for the current area. This is returned as a float.

Data will be returned in ASCII printable hexadecimal character format. TRACE1 is used for this measurement results.

Supported data formats (FORMat:DATA):ASCii|UINT

Statistics CCDF - Complementary cumulative distribution function

Up to a maximum of 201 data points will be returned in addition to a data count value. The first value in the return data will represent the quantity of probability values that follow. Each of the potential 201 data points will be returned as probability value and will represent the total number of samples that are equal to or exceed the corresponding power level. Probability data will be returned up to the power level that contains at least one sample. It is highly unlikely that the full 201 data values will ever be returned.

Each probability value will be returned as a floating point number, with a value less than 1.

Supported data formats (FORMat:DATA):ASCii|REAL

EVM vs Carrier

Three traces types are available with this measurement. The basic trace types show either the minimum, mean or maximum EVM value, as measured over the complete capture period.
The number of points returned will be equal to the number of used sub carriers. This varies according to the measured standard and is 201 carriers for the 802.16 OFDM 2004, which includes the zero sub carrier.
For the 802.16e/D11 standard, the number of sub carriers returned varies according to the FFT size.
Each EVM value will be returned as a floating point number, expressed in units of dBm or percentage.

> TRACE1 – Minimum EVM values

> TRACE2 – Mean EVM values

> TRACE3 – Maximum EVM values

Supported data formats (FORMat:DATA):ASCii|REAL

EVM vs Symbol

Three traces types are available with this measurement. The basic trace types show either the minimum, mean or maximum EVM value, as measured over the complete capture period.
The number of repeating groups that are returned will be equal to the number of measured symbols.
Each EVM value will be returned as a floating point number, expressed in units of dBm.

> TRACE1 – Minimum EVM values

> TRACE2 – Mean EVM values

> TRACE3 – Maximum EVM values

Supported data formats (FORMat:DATA):ASCii|REAL

Error vs Preamble

Three traces types are available with this measurement. The basic trace types show either the minimum, mean or maximum frequency or phase value as measured over the preamble part of the burst.

Frequency Sweep Measurements

No data will be returned for these measurements, should it be requested, until such time as a measurement has been previously run.
Running an IQ measurement will not generate results for these measurements.
Supported data formats (FORMat:DATA):ASCii|REAL

Spectrum Mask

Result data will be returned as a fixed number of 625 trace points in floating point format. Only an array of Y data will be returned.

> TRACE1 – Clear write values

> TRACE2 – Max hold values

> LIST – Spectrum Emission Mask (SEM) summary results.

> SEM summary results format:
> 1st Value -Index into 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)

> The returned values repeat for each row of the results table.

> Supported data formats (FORMat:DATA):ASCii|REAL

Spectrum ACPR

Result data will be returned as a fixed number of 625 trace points in floating point format. Only an array of Y data will be returned.

TRACE1 – Clear write values

TRACE2 – Max hold values

Supported data formats (FORMat:DATA):ASCii|REAL

Example: `"TRAC? TRACE2"`   The measurement data for the selected graph is returned.

Characteristics: *RST value: –
      SCPI: conforming

Mode: OFDM, OFDMA, MIMO

TRACE:IQ:DATA:MEMory?   <numeric value>,<numeric value>

Returns all the IQ data associated with the measurement acquisition time.

The result values are scaled linear in unit *Volt* and correspond to the voltage at the RF input of the instrument. The command returns a comma separated list of the measured voltage values in floating point format (Comma Separated Values = CSV). The number of values returned is 2 * number of samples, the first half being the I-values, the second half the Q-values.

Parameter:	<offset samples>	Offset of the values to be read related to the start of the acquired data.
	Value range:	0 to <# of samples> - 1
	<# of samples>	Number of measurement values to be read.
	Value range:	1 to <# of samples> - <offset samples>

Example: `"TRAC:IQ:DATA:MEM? 0,2000"`Requests first 2000 samples.

Characteristics: *RST value: –
      SCPI: device-specific.

Mode: OFDM, OFDMA, MIMO

TRACE:IQ:SRATe   <numeric value>

This command allows the sample rate for IQ measurements to be specified

Example: `"TRACE:IQ:SRAT 20000"`   Specifies a sample rate of 20 MHz.

Characteristics: *RST value: –
      SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

TRACE:IQ:FILTer:FLATness   NORMal | WIDE

This command determines whether the wideband detector filters are too be used in preference to the wideband detector board, (B72 option), for a specified sample rate. The use of the wideband filters is restricted to the 20.4MHz to 40.8MHz range. These filters are only switchable if the B72 option is available in the test instrument. An FSQ which does not have the B72 option will automatically use the wideband filters where the sample rate is in the 20.4MHz to 40.8MHz range. This command only applies to the FSQ instrument.

Example: `"TRACE:IQ:FILT:FLAT WIDE"`   Specifies the use of wideband detector filters.

Characteristics: *RST value: NORMal
      SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

TRIGger Subsystem

The TRIGger subsystem is used to synchronize device action(s) with events.

COMMAND	PARAMETERS	UNIT	COMMENT
TRIGger			
[:SEQUence]			
:MODE	IMMediate | EXTernal | POWer		
:LEVel			
[:EXTernal]	<numeric_value>	V	
:POWer	<numeric_value>	DBM | V	
:AUTO	<Boolean>		
:HOLDoff	<numeric_value>	S	

TRIGger[:SEQuence]:MODE   IMMediate | EXTernal | POWer

This command configures how triggering is to be performed.

Parameter:	IMMediate	automatically triggers the next measurement at the end of the previous measurement. This is the FREE RUN setting.
	EXTernal	the next measurement is triggered by the signal at the external trigger input e.g. a Gated trigger.
	POWer	triggering of the measurement via signals which are outside the measurement channel.

Example:	`"TRIG:MODE IMM"`	AUTO triggering will occur for the next measurement at the specified video percentage value.

Characteristics: *RST value: IMMediate
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

TRIGger[:SEQuence]:LEVel[:EXTernal]   <numeric value>

This command accepts the level of the external trigger input for which triggering will occur. Only valid when an external trigger has been selected.

Example: `"TRIG:LEV 1 V"`

Characteristics: *RST value: 1.4 V
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

TRIGger[:SEQuence]:LEVel:POWer   <numeric value>

This command accepts the level of the input signal in dBm for which triggering will occur. Only valid when a power trigger has been selected.
The value is specified in dBm for RF input and Volts for baseband inputs.

Example:	`"TRIG:LEV:POW 10 DBM"`	Set to 10 dBm for RF measurement.
	`"TRIG:LEV:POW 1 V"`	Set to 1 Volt for baseband measurement.

Characteristics: *RST value: 0 DBM
SCPI: device-specific

Mode: OFDM, OFDMA, MIMO

TRIGger[:SEQuence]:LEVel:POWer:AUTO   <Boolean>

This command specifies whether or not an automatic power trigger level calculation is performed before each main measurement. The setting of this command is ignored if the setting for TRIGger[:SEQuence]:MODE is not POWer.

Note that the value is reset to OFF (0), however the value is set to ON (1) every time a POWer trigger is configured.

Example:	`"TRIG:LEV:POW:AUTO 1"`	Specifies that an automatic power trigger level calculation should be performed before the start of each main measurement.
Characteristics:	*RST value: 0 SCPI: device-specific	
Mode:	OFDM, OFDMA, MIMO	

TRIGger[:SEQuence]:HOLDoff

This command defines the length of the trigger delay. A negative delay time (pretrigger) can be set.

Example:	`"TRIG:HOLD 500us"`	The R&S FSQ-K92 option uses a holdoff period of 500µs after the trigger condition has been met.
Characteristics:	*RST value: -10µs SCPI: conforming	
Mode:	OFDM, OFDMA, MIMO	

UNIT Subsystem

The UNIT subsystem specifies the units for specific result types.

COMMAND	PARAMETERS	UNIT	COMMENT
:UNIT			
:EVM	DB | PCT		
:PREamble	HZ | PTC		
:TABLe	DB | PCT		

UNIT:EVM DB | PCT

This command specifies the units for EVM results.

Parameter:	DBEVM results returned in dB
	PCT EVM results returned in %
Example:	"UNIT:EVM PCT" EVM results to be returned in %.
Characteristics:	*RST value: DB
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

UNIT:PREamble HZ | PTC

This command specifies the units for Preamble error results.

Parameter:	HZPreamble error results returned in Hz
	PTC Preamble error results returned in %
Example:	"UNIT:PRE PCT" Preamble error results to be returned in %.
Characteristics:	*RST value: DB
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

UNIT:TABLe DB | PCT

This command specifies the Table of Results parameters that can be displayed as dB or percentage.

Parameter:	DBresults returned in dB
	PCT results returned in %
Example:	"UNIT:TABL DB" results to be returned in dB.
Characteristics:	*RST value: DB
	SCPI: device-specific
Mode:	OFDM, OFDMA, MIMO

Status Reporting Registers

The status reporting system (see Fig. 118) stores all information on the present operating state of the instrument, e.g. that the instrument presently carries out a calibration and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

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

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

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in Fig. 118.
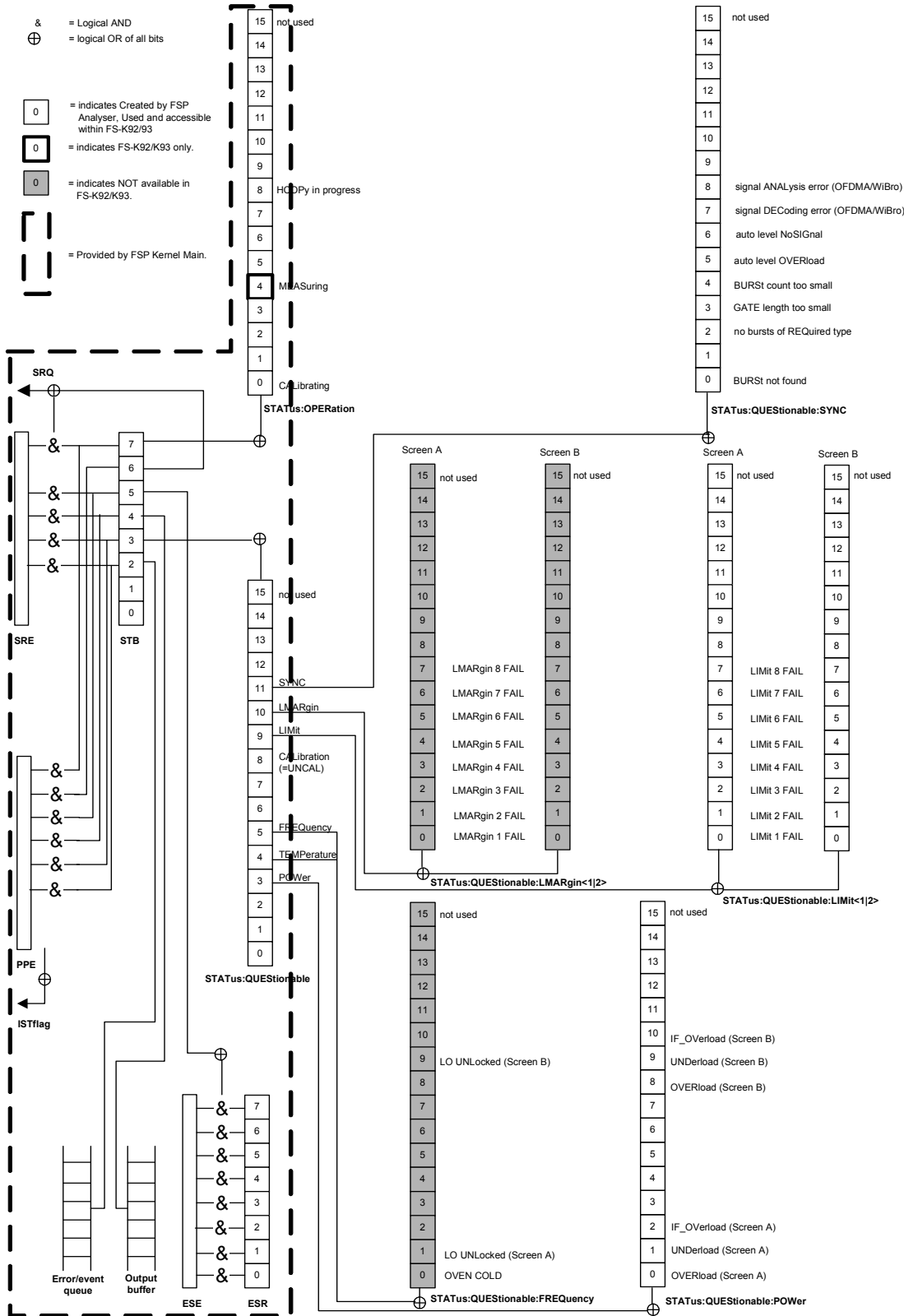
& = Logical AND
⊕ = logical OR of all bits

| 0 | = indicates Created by FSP Analyser, Used and accessible within FS-K92/93 |

| **0** | = indicates FS-K92/K93 only. |

| 0 | = indicates NOT available in FS-K92/K93. |

⌐ ¬
⌐ ¬   = Provided by FSP Kernel Main.
∟ ⌐

STATus:OPERation

15	not used
14	
13	
12	
11	
10	
9	
8	HCOPy in progress
7	
6	
5	
4	MEASuring
3	
2	
1	
0	CALibrating

STATus:QUEStionable:SYNC

15	not used
14	
13	
12	
11	
10	
9	
8	signal ANALysis error (OFDMA/WiBro)
7	signal DECoding error (OFDMA/WiBro)
6	auto level NoSIGnal
5	auto level OVERload
4	BURSt count too small
3	GATE length too small
2	no bursts of REQuired type
1	
0	BURSt not found

SRQ

SRE **STB**

&	7
	6
&	5
&	4
&	3
&	2
	1
	0

STATus:QUEStionable

15	not used
14	
13	
12	
11	SYNC
10	LMARgin
9	LIMit
8	CALibration (=UNCAL)
7	
6	
5	FREQuency
4	TEMPerature
3	POWer
2	
1	
0	

STATus:QUEStionable:LMARgin<1|2>

Screen A
15	not used
14	
13	
12	
11	
10	
9	
8	
7	LMARgin 8 FAIL
6	LMARgin 7 FAIL
5	LMARgin 6 FAIL
4	LMARgin 5 FAIL
3	LMARgin 4 FAIL
2	LMARgin 3 FAIL
1	LMARgin 2 FAIL
0	LMARgin 1 FAIL

Screen B
15	not used
14	
13	
12	
11	
10	
9	
8	
7	
6	
5	
4	
3	
2	
1	
0	

STATus:QUEStionable:LIMit<1|2>

Screen A
15	not used
14	
13	
12	
11	
10	
9	
8	
7	LIMit 8 FAIL
6	LIMit 7 FAIL
5	LIMit 6 FAIL
4	LIMit 5 FAIL
3	LIMit 4 FAIL
2	LIMit 3 FAIL
1	LIMit 2 FAIL
0	LIMit 1 FAIL

Screen B
15	not used
14	
13	
12	
11	
10	
9	
8	
7	
6	
5	
4	
3	
2	
1	
0	

PPE

ISTflag

STATus:QUEStionable:FREQuency

15	not used
14	
13	
12	
11	
10	
9	LO UNLocked (Screen B)
8	
7	
6	
5	
4	
3	
2	
1	LO UNLocked (Screen A)
0	OVEN COLD

STATus:QUEStionable:POWer

15	not used
14	
13	
12	
11	
10	IF_OVerload (Screen B)
9	UNDerload (Screen B)
8	OVERload (Screen B)
7	
6	
5	
4	
3	
2	IF_OVerload (Screen A)
1	UNDerload (Screen A)
0	OVERload (Screen A)

Error/event queue **Output buffer** **ESE** **ESR**

&	7
&	6
&	5
&	4
&	3
&	2
&	1
&	0

Fig. 118   Overview of the status registers

Description of the Status Registers

All the status registers shown in Fig. 118 are the same as those provided by the base system, with the exception of the following:

STATus:OPERation	Although this register is provided by R&S FSP Kernel main, R&S FSQ-K92/K93/K94 makes use of bits 4 & 7 in this register which are not used within R&S FSP Kernel main
STATus:QUESTionable:ACPLimit	This register is provided by the analyzer and is not available from the R&S FSQ-K92/K93/K94 command tree.
STATus:QUESTionable:LIMit2	This register is provided by the analyzer and is not available from the R&S FSQ-K92/K93/K94 command tree.
STATus:QUESTionable:LMARgin<1|2>	These registers are provided by the analyzer and are not available from the R&S FSQ-K92/K93/K94 command tree.

The deviations from the status register structure of the base system are detailed below.

STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVENt part, information on which actions the instrument has executed since the last reading. It can be read using commands `"STATus:OPERation:CONDition?"` or `"STATus:OPERation[:EVENt]?"`.

Bit No	Meaning
0	CALibrating This bit is set as long as the instrument is performing a calibration.
1 to 3	These bits are not used
4	MEASuring A '1' in this bit position indicates that a measurement is in progress. R&S FSQ-K92/K93/K94 only
5 to 7	These bits are not used
8	HardCOPy in progress This bit is set while the instrument is printing a hardcopy.
9 to 14	These bits are not used
15	This bit is always 0

STATus:QUEStionable Register

This register comprises information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be queried by commands "STATus:QUEStionable:CONDition?" and "STATus:QUEStionable[:EVENt]?".

Bit No	Meaning
0 to 2	These bits are not used
3	POWer This bit is set if a questionable power occurs (cf. also section "STATus:QUEStionable:POWer Register").
4	TEMPerature This bit is set if a questionable temperature occurs.
5	FREQuency The bit is set if a frequency is questionable (cf. section "STATus:QUEStionable:FREQuency Register").
6 to 7	These bits are not used
8	CALibration The bit is set if a measurement is performed uncalibrated (status information "UNCAL")
9	**LIMit** (device-specific) This bit is set if a limit value is violated (see also section STATus:QUEStionable:LIMit Register). Note: Limit register is associated with limit lines for the Spectrum Mask measurement only.
10	**LMARgin** (device-specific) This bit is set if a margin is violated (see also section STATus:QUEStionable:LMARgin Register)
11	**SYNC** (device-dependent) This bit is set if, in measurements or pre-measurements in WIMAX mode, synchronization fails, no signal is detected or no burst is found. This bit is also set if input settings conflict with the measurement setup (see also "STATus:QUEStionable:SYNC Register").
13 to 14	These bits are not used
15	This bit is always 0

STATus:QUEStionable:LIMit Register

This register comprises information about the observance of limit lines in the corresponding measurement window (LIMit 1 corresponds to Screen A, LIMit 2 to Screen B). It can be queried with command "`STATus:QUEStionable:LIMit<1|2>:CONDition?`" and "`STATus:QUEStionable:LIMit<1|2>[:EVENt]?`".
Note that no limit lines are displayed in screen A and as such all bits in the LIMit1 register will always be set to 0.

Bit No	Meaning
0 to 1	These bits are not used
2	LIMit FAIL This bit is set if the ETSI Spectrum Mask limit line is violated
3	LIMit FAIL This bit is set if the IEEE Spectrum Mask limit line is violated.
4	LIMit FAIL This bit is set if the Spectrum Flatness (Upper) limit line is violated
5	LIMit FAIL This bit is set if the Spectrum Flatness (Lower) limit line is violated
6	LIMit FAIL This bit is set if the Spectrum Flatness Difference (Upper) limit line is violated
7	LIMit FAIL This bit is set if the Spectrum Flatness Difference (Lower) limit line is violated
8 to 14	These bits are not used
15	This bit is always 0

STATus:QUEStionable:SYNC Register

This contains information about sync and bursts not found, and about pre-measurement results exceeding or falling short of expected values.
The bits can be queried with commands "`STATus:QUEStionable:SYNC:CONDition?`" and "`STATus:QUEStionable:SYNC[:EVENt]?`".

Bit No	Meaning
0	BURSt not found This bit is set if an IQ measurement is performed and no bursts are detected
1	This bit is not used
2	No bursts of REQuired type This bit is set if an IQ measurement is performed and no bursts of the specified type are detected
3	GATE length too small This bit is set if gating is used in a measurement and the gate length is not set sufficiently large enough
4	BURSt count too small This bit is set if a PVT measurement is performed with gating active and there is not at least 1 burst within the gate lines
5	Auto level OVERload This bit is set if a signal overload is detected when an auto-level measurement is performed
6	Auto level NoSIGnal This bit is set if no signal is detected by the auto-level measurement
7	Signal DECoding error (SISO-OFDMA/WiBro) This bit is set if the signal cannot be decoded. This corresponds to incorrect configuration of primary measurement settings, an incorrect zone/burst configuration, or a failed auto-demodulation.
8	Signal ANALysis error (SISO-OFDMA/WiBro) This bit is set if the signal cannot be decoded due to an unexpected error within the DSP component.
9 to 14	These bits are not used
15	This bit is always 0

Error Reporting

Error reporting for the R&S FSQ-K92/K93/K94 option is carried out using the Service Request (SRQ) interrupt in the GPIB interface. When an error occurs a Service Request interrupt will be generated. The master can then query the slave instrument for the error that triggered the interrupt Errors are queried through the "SYSTem:ERRor" command.

Table of softkeys with assignment of IEC/IEEE bus commands

Key MEAS or Hotkey WIMAX

<table>
<tr>
<td>GENERAL SETTINGS</td>
<td>

```
[SENSe:]BURSt:COUNt
[SENSe:]BURSt:COUNt:STATe
[SENSe:]FREQuency:CENTer
[SENSe:]IQ:DITHer[:STATe]
[SENSe:]IQ:LPASs[:STATe]
[SENSe:]SWAPiq
[SENSe:]SWEep:COUNt
[SENSe:]SWEep:TIME
CONFigure:CHANnel
CONFigure:POWer:AUTO
CONFigure:POWer:AUTO
CONFigure:POWer:EXPected:IQ
CONFigure:POWer:EXPected:RF
CONFigure:STANdard
CONFigure:WIMax:FBANd
CONFigure:WIMax:IGRatio
DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel
DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet
INPut:IQ:BALanced[:STATe]
INPut:IQ:IMPedance
INPut:SELect
INPut1:ATTenuation
INPut1:EATT
INPut1:EATT:AUTO
INPut1:EATT:STATe
INPut1:FILTer:YIG:AUTO
INPut1:FILTer:YIG:STATe
SENSe:BANDwidth:CHANnel
TRACe:IQ:SRATe
TRIGger[:SEQuence]:HOLDoff
TRIGger[:SEQuence]:LEVel:POWer
TRIGger[:SEQuence]:LEVel:POWer:AUTO
TRIGger[:SEQuence]:MODE
UNIT:TABLe
```

</td>
</tr>
<tr>
<td>DEMOD SETTINGS</td>
<td>

```
[SENSe:]DEMod:FORMat:BANalyze:BTYPe
CONFigure:WIMax:LMODE
[SENSe:]DEMod:FORMat:AUTO
[SENSe:]DEMod:FORMat:BANalyze
[SENSe:]DEMod:BANalyze:SYMbols:EQUal
[SENSe:]DEMod:BANalyze:SYMbols:MIN
[SENSe:]DEMod:BANalyze:SYMbols:MAX
[SENSe:]DEMod:CESTimation
SENSe:TRACking:PHASe
SENSe:TRACking:TIME
SENSe:TRACking:LEVel
```

</td>
</tr>
</table>

DISPLAY LIST GRAPH	DISPlay[:WINDow<1|2>]:TABLe Result query: FETCh:BURSt:ALL? FETCh:BURSt:PREamble? FETCh:BURSt:PAYLoad? FETCh:BURSt:RMS? FETCh:BURSt:PEAK? FETCh:BURSt:CRESt? FETCh:BURSt:FERRor? FETCh:BURSt:SYMBolerror? FETCh:BURSt:IQOFfset? FETCh:BURSt:GIMBalance? FETCh:BURSt:QUADoffset? FETCh:BURSt:EVM:ALL? FETCh:BURSt:EVM:DATA? FETCh:BURSt:EVM:PILot?
PVT	CONFigure:BURSt:PVT[:IMMediate]
GENERAL SETTINGS	CONFigure:STANdard [SENSe:]FREQuency:CENTer CONFigure:CHANnel CONFigure:WIMax:FBANd SENSe:BANDwidth:CHANnel TRACe:IQ:SRATe CONFigure:WIMax:IGRatio CONFigure:POWer:AUTO DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet CONFigure:POWer:EXPected:RF CONFigure:POWer:EXPected:IQ [SENSe:]SWEep:TIME [SENSe:]BURSt:COUNt:STATe [SENSe:]BURSt:COUNt [SENSe:]SWEep:COUNt TRIGger[:SEQuence]:MODE TRIGger[:SEQuence]:HOLDoff TRIGger[:SEQuence]:LEVel:POWer TRIGger[:SEQuence]:LEVel:POWer:AUTO [SENSe:]SWAPiq INPut:SELect INPut:IQ:IMPedance INPut:IQ:BALanced[:STATe] [SENSe:]IQ:LPASs[:STATe] [SENSe:]IQ:DITHer[:STATe] CONFigure:POWer:AUTO DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel INPut1:ATTenuation INPut1:EATT:STATe INPut1:EATT:AUTO INPut1:EATT INPut1:FILTer:YIG:AUTO INPut1:FILTer:YIG:STATe UNIT:TABLe
DEMOD SETTINGS	[SENSe:]DEMod:FORMat:BANalyze:BTYPe CONFigure:WIMax:LMODE [SENSe:]DEMod:FORMat:AUTO [SENSe:]DEMod:FORMat:BANalyze [SENSe:]DEMod:BANalyze:SYMbols:EQUal [SENSe:]DEMod:BANalyze:SYMbols:MIN [SENSe:]DEMod:BANalyze:SYMbols:MAX [SENSe:]DEMod:CESTimation SENSe:TRACking:PHASe SENSe:TRACking:TIME SENSe:TRACking:LEVel
DISPLAY LIST GRAPH	DISPlay[:WINDow<1|2>]:TABLe

FULL SUBFRAME	`CONFigure:BURSt:PVT:SELect FULL`
RISING FALLING	`CONFigure:BURSt:PVT:SELect EDGE`
FULL BURST	`CONFigure:BURSt:PVT:SELect FULL`
START END	`CONFigure:BURSt:PVT:SELect EDGE`
GATING ON OFF	`[SENSe:]SWEep:EGATe`

GATE SETTINGS	`[SENSe:]SWEep:EGATe:HOLDoff[:TIME]`
	`[SENSe:]SWEep:EGATe:HOLDoff:SAMPle`
	`[SENSe:]SWEep:EGATe:LENGth[:TIME]`
	`[SENSe:]SWEep:EGATe:LENGth:SAMPle`
	`[SENSe:]SWEep:EGATe:LINK`

ACP SETTINGS	`[SENSe:]POWer:NCOR`
	`[SENSe:]POWer:ACHennel:ACP`
	`[SENSe:]POWer:ACHennel:BANDwith:CHANnel`
	`[SENSe:]POWer:ACHennel:BANDwith:ALernateT<1..4>`
	`[SENSe:]POWer:ACHennel:SPACing:ACHennel`
	`[SENSe:]POWer:ACHennel:SPACing:ALTernate<1..4>`

IMPORT	`MMEMory:LOAD:IQ:STATe`
EXPORT	`MMEMory:STORe:IQ:STATe`
SUPORT	`---`
EVM	`---`

GENERAL SETTINGS	`CONFigure:STANdard`
	`[SENSe:]FREQuency:CENTer`
	`CONFigure:CHANnel`
	`CONFigure:WIMax:FBANd`
	`SENSe:BANDwidth:CHANnel`
	`TRACe:IQ:SRATe`
	`CONFigure:WIMax:IGRatio`
	`CONFigure:POWer:AUTO`
	`DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet`
	`CONFigure:POWer:EXPected:RF`
	`CONFigure:POWer:EXPected:IQ`
	`[SENSe:]SWEep:TIME`
	`[SENSe:]BURSt:COUNt:STATe`
	`[SENSe:]BURSt:COUNt`
	`[SENSe:]SWEep:COUNt`
	`TRIGger[:SEQuence]:MODE`
	`TRIGger[:SEQuence]:HOLDoff`
	`TRIGger[:SEQuence]:LEVel:POWer`
	`TRIGger[:SEQuence]:LEVel:POWer:AUTO`
	`[SENSe:]SWAPiq`
	`INPut:SELect`
	`INPut:IQ:IMPedance`
	`INPut:IQ:BALanced[:STATe]`
	`[SENSe:]IQ:LPASs[:STATe]`
	`[SENSe:]IQ:DITHer[:STATe]`
	`CONFigure:POWer:AUTO`
	`DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel`
	`INPut1:ATTenuation`
	`INPut1:EATT:STATe`
	`INPut1:EATT:AUTO`
	`INPut1:EATT`
	`INPut1:FILTer:YIG:AUTO`
	`INPut1:FILTer:YIG:STATe`
	`UNIT:TABLe`

DEMOD SETTINGS	`[SENSe:]DEMod:FORMat:BANalyze:BTYPe`
	`CONFigure:WIMax:LMODE`
	`[SENSe:]DEMod:FORMat:AUTO`
	`[SENSe:]DEMod:FORMat:BANalyze`
	`[SENSe:]DEMod:BANalyze:SYMbols:EQUal`
	`[SENSe:]DEMod:BANalyze:SYMbols:MIN`
	`[SENSe:]DEMod:BANalyze:SYMbols:MAX`
	`[SENSe:]DEMod:CESTimation`
	`[SENSe:]TRACking:PHASe`
	`SENSe:TRACking:TIME`
	`SENSe:TRACking:LEVel`

DISPLAY LIST GRAPH	`DISPlay[:WINDow<1|2>]:TABLe`
EVM VS SYMBOL	`CONFigure:BURSt:EVM:ESYMbol[:IMMediate]`
EVM VS CARRIER	`CONFigure:BURSt:EVM:ECARrier[:IMMediate]`
ERROR FREQ PHASE	`CONFigure:BURSt:PREamble:SELect FREQ	PHASe` `CONFigure:BURSt:PREamble [:IMMediate]`
Y AXIS/ DIV	`DISPlay[:WINDow<1|2>]:TACe1:Y[:SCALe]:AUTO` `DISPlay[:WINDow<1|2>]:TRACe1:Y[:SCALe]:PDIVision`
GATING ON OFF	`[SENSe:]SWEep:EGATe`

GATE SETTINGS	`[SENSe:]SWEep:EGATe:HOLDoff[:TIME]`
	`[SENSe:]SWEep:EGATe:HOLDoff:SAMPle`
	`[SENSe:]SWEep:EGATe:LENGth[:TIME]`
	`[SENSe:]SWEep:EGATe:LENGth:SAMPle`
	`[SENSe:]SWEep:EGATe:LINK`

IMPORT	`MMEMory:LOAD:IQ:STATe`
EXPORT	`MMEMory:STORe:IQ:STATe`
SUPORT	`---`
SPECTRUM	`---`

GENERAL SETTINGS	`CONFigure:STANdard`
	`[SENSe:]FREQuency:CENTer`
	`CONFigure:CHANnel`
	`CONFigure:WIMax:FBANd`
	`SENSe:BANDwidth:CHANnel`
	`TRACe:IQ:SRATe`
	`CONFigure:WIMax:IGRatio`
	`CONFigure:POWer:AUTO`
	`DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet`
	`CONFigure:POWer:EXPected:RF`
	`CONFigure:POWer:EXPected:IQ`
	`[SENSe:]SWEep:TIME`
	`[SENSe:]BURSt:COUNt:STATe`
	`[SENSe:]BURSt:COUNt`
	`[SENSe:]SWEep:COUNt`
	`TRIGger[:SEQuence]:MODE`
	`TRIGger[:SEQuence]:HOLDoff`
	`TRIGger[:SEQuence]:LEVel:POWer`
	`TRIGger[:SEQuence]:LEVel:POWer:AUTO`
	`[SENSe:]SWAPiq`
	`INPut:SELect`
	`INPut:IQ:IMPedance`
	`INPut:IQ:BALanced[:STATe]`
	`[SENSe:]IQ:LPASs[:STATe]`
	`[SENSe:]IQ:DITHer[:STATe]`
	`CONFigure:POWer:AUTO`
	`DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel`
	`INPut1:ATTenuation`
	`INPut1:EATT:STATe`
	`INPut1:EATT:AUTO`
	`INPut1:EATT`
	`INPut1:FILTer:YIG:AUTO`
	`INPut1:FILTer:YIG:STATe`
	`UNIT:TABLe`

DEMOD SETTINGS	`[SENSe:]DEMod:FORMat:BANalyze:BTYPe`
	`:CONFigure:WIMax:LMODE`
	`[SENSe:]DEMod:FORMat:AUTO`
	`[SENSe:]DEMod:FORMat:BANalyze`
	`[SENSe:]DEMod:BANalyze:SYMbols:EQUal`
	`[SENSe:]DEMod:BANalyze:SYMbols:MIN`
	`[SENSe:]DEMod:BANalyze:SYMbols:MAX`
	`[SENSe:]DEMod:CESTimation`
	`SENSe:TRACking:PHASe`
	`SENSe:TRACking:TIME`
	`SENSe:TRACking:LEVel`

DISPLAY LIST GRAPH	`DISPlay[:WINDow<1|2>]:TABLe`
FLATNESS FLAT GRDEL	`CONFigure:BURSt:SPECtrum:FLATness:SELect FLATness	GRDelay` `CONFigure:BURSt:SPECtrum:FLATness[:IMMediate]`
FLATNESS DIFFERENCE	`CONFigure:BURSt:SPECtrum:FLATness:SELect DIFFerence` `CONFigure:BURSt:SPECtrum:FLATness[:IMMediate]`

SPECTRUM IEEE ESTI	`CONFigure:BURSt:SPECtrum:MASK:SELect IEEE	ETSI` `CONFigure:BURSt:SPECtrum:MASK[:IMMediate]`
SPECTRUM FTT	`CONFigure:BURSt:SPECtrum:FFT[:IMMediate]`
ACP ABS REL	`[SENSe:]POWer:ACHannel:MODE REL	ABS` `CONFigure:BURSt:SPECtrum:ACPR[:IMMediate] ..`
GATING ON OFF	`[SENSe:]SWEep:EGATe`

GATE
SETTINGS
	`[SENSe:]SWEep:EGATe:HOLDoff[:TIME]`
	`[SENSe:]SWEep:EGATe:HOLDoff:SAMPle`
	`[SENSe:]SWEep:EGATe:LENGth[:TIME]`
	`[SENSe:]SWEep:EGATe:LENGth:SAMPle`
	`[SENSe:]SWEep:EGATe:LINK`

ACP SETTINGS	
IMPORT	`MMEMory:LOAD:IQ:STATe`
EXPORT	`MMEMory:STORe:IQ:STATe`
SUPORT	`---`
CONSTELL	`---`

GENERAL
SETTINGS
	`CONFigure:STANdard`
	`[SENSe:]FREQuency:CENTer`
	`CONFigure:CHANnel`
	`CONFigure:WIMax:FBANd`
	`SENSe:BANDwidth:CHANnel`
	`TRACe:IQ:SRATe`
	`CONFigure:WIMax:IGRatio`
	`CONFigure:POWer:AUTO`
	`DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet`
	`CONFigure:POWer:EXPected:RF`
	`CONFigure:POWer:EXPected:IQ`
	`[SENSe:]SWEep:TIME`
	`[SENSe:]BURSt:COUNt:STATe`
	`[SENSe:]BURSt:COUNt`
	`[SENSe:]SWEep:COUNt`
	`TRIGger[:SEQuence]:MODE`
	`TRIGger[:SEQuence]:HOLDoff`
	`TRIGger[:SEQuence]:LEVel:POWer`
	`TRIGger[:SEQuence]:LEVel:POWer:AUTO`
	`[SENSe:]SWAPiq`
	`INPut:SELect`
	`INPut:IQ:IMPedance`
	`INPut:IQ:BALanced[:STATe]`
	`[SENSe:]IQ:LPASs[:STATe]`
	`[SENSe:]IQ:DITHer[:STATe]`
	`CONFigure:POWer:AUTO`
	`DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel`
	`INPut1:ATTenuation`
	`INPut1:EATT:STATe`
	`INPut1:EATT:AUTO`
	`INPut1:EATT`
	`INPut1:FILTer:YIG:AUTO`
	`INPut1:FILTer:YIG:STATe`
	`UNIT:TABLe`

DEMOD SETTINGS	`[SENSe:]DEMod:FORMat:BANalyze:BTYPe`
	`CONFigure:WIMax:LMODE`
	`[SENSe:]DEMod:FORMat:AUTO`
	`[SENSe:]DEMod:FORMat:BANalyze`
	`[SENSe:]DEMod:BANalyze:SYMbols:EQUal`
	`[SENSe:]DEMod:BANalyze:SYMbols:MIN`
	`[SENSe:]DEMod:BANalyze:SYMbols:MAX`
	`[SENSe:]DEMod:CESTimation`
	`SENSe:TRACking:PHASe`
	`SENSe:TRACking:TIME`
	`SENSe:TRACking:LEVel`

DISPLAY LIST GRAPH	`DISPlay[:WINDow<1|2>]:TABLe`

CONSTELL	`CONFigure:BURSt:CONStellation:CSYMbol[:IMMediate]`

CONSTELL VS CARRIER	`CONFigure:BURSt:CONStellation:CCARrier[:IMMediate]`

CARRIER SELECTION	`CONFigure:BURSt:CONStellation:CARRier:SELect`

CONSTELL SELECTION	

GATING ON OFF	`[SENSe:]SWEep:EGATe`

GATE SETTINGS	`[SENSe:]SWEep:EGATe:HOLDoff[:TIME]`
	`[SENSe:]SWEep:EGATe:HOLDoff:SAMPle`
	`[SENSe:]SWEep:EGATe:LENGth[:TIME]`
	`[SENSe:]SWEep:EGATe:LENGth:SAMPle`
	`[SENSe:]SWEep:EGATe:LINK`

IMPORT	`MMEMory:LOAD:IQ:STATe`

EXPORT	`MMEMory:STORe:IQ:STATe`

SUPORT	---

STATISTICS	---

GENERAL SETTINGS	`CONFigure:STANdard`
	`[SENSe:]FREQuency:CENTer`
	`CONFigure:CHANnel`
	`CONFigure:WIMax:FBANd`
	`SENSe:BANDwidth:CHANnel`
	`TRACe:IQ:SRATe`
	`CONFigure:WIMax:IGRatio`
	`CONFigure:POWer:AUTO`
	`DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet`
	`CONFigure:POWer:EXPected:RF`
	`CONFigure:POWer:EXPected:IQ`
	`[SENSe:]SWEep:TIME`
	`[SENSe:]BURSt:COUNt:STATe`
	`[SENSe:]BURSt:COUNt`
	`[SENSe:]SWEep:COUNt`
	`TRIGger[:SEQuence]:MODE`
	`TRIGger[:SEQuence]:HOLDoff`
	`TRIGger[:SEQuence]:LEVel:POWer`
	`TRIGger[:SEQuence]:LEVel:POWer:AUTO`
	`[SENSe:]SWAPiq`
	`INPut:SELect`
	`INPut:IQ:IMPedance`
	`INPut:IQ:BALanced[:STATe]`
	`[SENSe:]IQ:LPASs[:STATe]`
	`[SENSe:]IQ:DITHer[:STATe]`
	`CONFigure:POWer:AUTO`
	`DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel`
	`INPut1:ATTenuation`
	`INPut1:EATT:STATe`
	`INPut1:EATT:AUTO`
	`INPut1:EATT`
	`INPut1:FILTer:YIG:AUTO`
	`INPut1:FILTer:YIG:STATe`
	`UNIT:TABLe`

DEMOD SETTINGS	`[SENSe:]DEMod:FORMat:BANalyze:BTYPe`
	`CONFigure:WIMax:LMODE`
	`[SENSe:]DEMod:FORMat:AUTO`
	`[SENSe:]DEMod:FORMat:BANalyze`
	`[SENSe:]DEMod:BANalyze:SYMbols:EQUal`
	`[SENSe:]DEMod:BANalyze:SYMbols:MIN`
	`[SENSe:]DEMod:BANalyze:SYMbols:MAX`
	`[SENSe:]DEMod:CESTimation`
	`SENSe:TRACking:PHASe`
	`SENSe:TRACking:TIME`
	`SENSe:TRACking:LEVel`

DISPLAY LIST GRAPH	`DISPlay[:WINDow<1|2>]:TABLe`
CCDF	`CONFigure:BURSt:STATistics:CCDF[:IMMediate]`
BIT STREAM	`CONFigure:BURSt:STATistics:BSTReam[:IMMediate]`
BURST SUMMARY	`CONFigure:BURSt:STATistics:BSUMmary[:IMMediate]`
GATING ON OFF	`[SENSe:]SWEep:EGATe`

GATE SETTINGS	`[SENSe:]SWEep:EGATe:HOLDoff[:TIME]`
	`[SENSe:]SWEep:EGATe:HOLDoff:SAMPle`
	`[SENSe:]SWEep:EGATe:LENGth[:TIME]`
	`[SENSe:]SWEep:EGATe:LENGth:SAMPle`
	`[SENSe:]SWEep:EGATe:LINK`

IMPORT	`MMEMory:LOAD:IQ:STATe`

| EXPORT | `MMEMory:STORe:IQ:STATe` |

| SUPORT | `---` |

| FILE MANAGER | `---` |

| RECAL | `MMEMory:LOAD:FRAMe:STATe` |

| NEW FOLDER | `---` |

| COPY | `---` |

| PASTE | `------` |

| RENAME | `---` |

| DELETE FILE | `---` |

Key DISP

| FULL SCREEN | `DISPlay:FORMat SINGle` |

| SPLIT SCREEN | `DISPlay:FORMat SPLit` |

Key LINES

| DEFAULT CURRENT | `CALCulate<1|2>:LIMit<1>:BURSt:ALL`
`CALCulate<1|2>:LIMit<1>:BURSt:ALL:RESULT`
`CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]`
`CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]:RESult`
`CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum`
`CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum:RESult`
`CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset[:AVERage]`
`CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset[:AVERage]:RESult`
`CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset:MAXimum`
`CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset:MAXimum:RESult`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERage]`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERage]:RESult`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum:RESult`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERage]`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERage]:RESult`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum:RESult`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot[:AVERage]`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot[:AVERage]:RESult`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot:MAXimum`
`CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot:MAXimum:RESult` |

| DEFAULT ALL | |

Key MKR

MARKR 1	`CALCulate<1|2>:MARKer<1>:STATe`
	`CALCulate<1|2>:MARKer<1>:X`
	`CALCulate<1|2>:MARKer<1>:Y`
	`CALCulate<1|2>:MARKer<1>:SYMBol`
	`CALCulate<1|2>:MARKer<1>:CARRier`
	`CALCulate<1|2>:MARKer<1>:FUNCtion:ZOOM 1`

UNZOOM	
MARKER ZOOM	`CALCulate<1|2>:MARKer<1>:FUNCtion:ZOOM <numeric value>`
MARKER OFF	`CALCulate<1|2>:MARKer<1>:AOFF`

Key MKR->

SELECT MARKER	---
MKR->TRACE	`CALCulate<1|2>:MARKer<1>:TRACe`

Hotkeys

SPECTRUM	`INSTrument:SELect SANalyzer` `INSTrument:NSELect 1`
WIMAX	---
AUTO LVL	`CONFigure:POWer:AUTO <boolean>	ONCE`
RUN SGL	`INITiate:CONTinuous OFF; INITiate[:IMMediate]`
RUN CONT	`INITiate:CONTinuous ON; INITiate[:IMMediate]`
REFRESH	---
SCREEN A/B	`DISPlay[:WINDow<1|2>]:SELect` `DISPlay[:WINDow<1|2>]:SSELect`

5 Remote Control - Programming Examples

The following section provides some examples of commonly performed operations when using R&S FSQ-K92/K93/K94. For more general remote control examples please refer to the programming examples chapter in the instrument user manual.

Synchronization Entry of Option

The following example shows how to synchronize entering the R&S FSQ-K92/K93/K94 option.

```
analyzer% = 20,Instrument address
CALL IBWRT(analyzer%, "INST:SEL WIMAX;*OPC?") ,waits for 1 from *OPC?
```

Selecting Measurements

Measurements are selected using the command CONFigure:BURSt:<Meas Type> where <Meas Type> is as follows.

<Meas Type>	Measurement Type
PVT	Power vs Time (PVT)
PVT:SELect:EDGE	PVT Start and End
PVT:SELect:FULL	PVT full burst
EVM:ECARrier	EVM vs Carrier
EVM:ESYMbol	EVM vs Symbol
SPECtrum:MASK	Spectrum Mask
SPECtrum:MASK:SELect:IEEE	Spectrum Mask IEEE
SPECtrum:MASK:SELect:ETSI	Spectrum Mask ETSI
SPECtrum:FLATness	Spectrum Flatness
SPECtrum:FLATness:SELect FLATNESS	Spectrum Flatness
SPECtrum:FLATness:SELect GRDELAY	Spectrum Flatness – Group Delay
SPECtrum:FLATness:SELect DIFFERENCE	Spectrum Flatness – Difference
SPECtrum:FFT	Spectrum FFT
SPECtrum:ACPR	Spectrum ACPR
SPECtrum:ACPR:SELect ABS	Spectrum ACPR (Absolute)
SPECtrum:ACPR:SELect REL	Spectrum ACPR (Relative)
CONSt:CCARrier	Constellation vs Carrier
CONSt:CSYMbol	Constellation vs Symbol
STATistics:CCDF	CCDF
STATistics:BSTREam	Bit Steam
STATistics:BSUMmary	Burst Summary
PREamble	Preamble Error
PREamble:SELect FREQ	Frequency Error vs Preamble
PREamble:SELect PHASE	Phase Error vs Preamble

The following example shows how to select a Spectrum Mark ETSI measurement:

```
REM select Spectrum Mask Select ETSI
CALL IBWRT(analyzer%, "SPECtrum:MASK:SELect:ETSI")
```

Running Synchronized Measurements

The following examples show how measurements can be synchronized. Synchronization is necessary to ensure that the measurement has completed before the measurement results and markers are requested.

```
PUBLIC SUB SweepSync()

REM The command INITiate[:IMMediate] starts a single sweep if the
REM command INIT:CONT OFF was previously sent. It should be ensured that
REM the next command is only then executed when the entire sweep is
REM complete.
CALL IBWRT(analyzer%, "INIT:CONT OFF")

REM ------ First possibility: Use of *WAI -----------------------------
CALL IBWRT(analyzer%, "INIT:IMM; *WAI")

REM ------ Second possibility: Use of *OPC? ---------------------------
OpcOk$ = SPACE$(2) 'Space for *OPC? - Provide response
CALL IBWRT(analyzer%, "INIT:IMM; *OPC?")

REM ------ here the controller can service other instrument------------
CALL IBRD(analyzer%, OpcOk$) 'Wait for "1" from *OPC?

REM ------- Third possibility: Use of *OPC ---------------------------
REM In order to be able to use the service request function in
REM conjugation with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM IBCONF!
CALL IBWRT(analyzer%, "*SRE 32")  'Permit service request for ESR
CALL IBWRT(analyzer%, "*ESE 1")   'Set event-enable bit for
                                  'operation-complete bit

CALL IBWRT(analyzer%, "INIT:IMM; *OPC")'Start sweep and
                                  'synchronize with OPC

CALL WaitSRQ(boardID%,result%)    'Wait for service request

REM ------- Fourth possibility: Use of INIT:IMM ----------------------
REM In order to be able to use the service request function in
REM conjugation with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM IBCONF!
CALL IBWRT(analyzer%, "*SRE 128") 'Permit service request for ESR
CALL IBWRT(analyzer%, "*ESE 0")   'Set event-enable bit for
                                  'operation-complete bit

CALL IBWRT(analyzer%, "STATus:OPERation:ENABle 16")  'Enable bit 4 of status
                                                'operation register'
CALL IBWRT(analyzer%, "STAT:OPERation:NTRansition 16") 'Set Negative
                                                'transition to 1
CAL IBWRT(analyzer%, "STATus:OPERation:PTRansition 0") 'Set Positive
                                                'transition to 0
CALL IBWRT(analyzer%, "INIT:IMM") 'Start sweep and synchronize with OPC

CALL WaitSRQ(boardID%,result%)  'Wait for service request

REM Continue main program here.

END SUB
REM ****************************************************************************
```

6 List of Warnings & Error Messages

The list of possible warning & error messages are shown below:

Status Bar Message	Description
Gate length too small - must be greater than 1	This message is only displayed for the FFT measurement. This message indicates that there are no samples contained within the gating lines. Increase the Gate length and then press the *REFRESH* hotkey to remove this error.
No valid analyzed bursts within gating lines	This message is only displayed for the PVT measurement. This message indicates that there are no complete & valid bursts contained within the gating lines. Increase the Gate length and then press the *REFRESH* hotkey to remove this error.
No bursts found	This message is displayed if no valid burst was detected in the input data. To correct this problem check the following: The connections between the DUT and analyzer are correct The input signal is of a sufficient level The capture time is long enough to capture at least one complete burst. If running with a Free Run trigger then the capture time must be greater than the burst length (ideally at least twice the burst length) to ensure that a complete burst is recorded. Check that the demod settings are correct
No bursts of desired type to analyze	This message is displayed if bursts are found, but none of desired type to analyze. Check that the setting for Burst Type is correct.
No signal found	This message is displayed when an automatic level detection measurement is executed and the measured signal level is lower the permitted minimum value.
Signal overload detected	This message is displayed when the OVLD enhancement label is displayed and indicates that the input mixer is overloaded. If this message is displayed then try increasing the setting for the Signal Level parameter (or settings Auto Level). If this does not clear the problem then an external attenuation may need to be applied.
Zone/Burst configuration error	This message is displayed when there are configuration errors in the frame setup. Check the zone/segment map and burst map for any highlighted errors
No TX Area found	There is insufficient power over specified subframe length. Resolution is as per "No Bursts Found".
No subframe found	The DSP cannot synchronize with the received signal.
No maximum found	Not currently in use.
Signal Map analysis failed	The auto-demodulation failed to determine the frame configuration (zone/segment map and burst map). There are several critical parameters that must be provided by the user for auto-demodulation to succeed: Frequency, Sample Rate / Channel Bandwidth, FFT size, Guard Time, IDCell and Preamble Index (if not in range 0 - 96)
First Zone must be PUSC with all Subchannels used	The Err Freq vs Phase measurement for SISO-OFDMA/WiBro has the listed restriction.
DSP error returned: 0xnnnnnnnn	One of these three error messages is displayed when an unexpected DSP error occurs while analyzing a signal. Contact your R&S support representative for assistance.
Analysis error	
Error processing DSP results	

7 Index