R&S®FS-K130PC
Distortion Analysis Software
User Manual

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ROHDE&SCHWARZ

This manual covers the following products:
- R&S®FS-K130PC (1310.0090.02)

The following abbreviations are used throughout this manual: R&S®FS-K130PC is abbreviated as R&S FS-K130PC.

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.

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

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

75 Years of Driving Innovation

ROHDE & SCHWARZ

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Contents

1 Documentation Overview

The documentation of the R&S FS-K130PC consists of the following parts:

User Manual

The user manual provides a detailed description of the R&S FS-K130PC functions.

It covers the following topics:

- installing and launching the R&S FS-K130PC
- setting up the R&S FS-K130PC in general
- setting up the R&S FS-K130PC for measurements
- performing measurements with the R&S FS-K130PC

Online Help

The online help provides quick access directly through the software interface to all information necessary to work with the R&S FS-K130PC.

It covers the same topics as the user manual.

Note that you need Microsoft Internet Explorer 4.0 or higher to properly view chm files.

Internet

The R&S FS-K130PC website provides the latest versions of the software and the documentation and information for the R&S FS-K130PC.

If you have any questions about the software or suggestions, send an email to FS-K130@rohde-schwarz.com

Release Notes

The release notes provide information about new and modified functions and eliminated problems.

2 Welcome to R&S FS-K130PC

2.1 Using the Help System

You can get information about using the R&S FS-K130PC in four different ways:

- **Manual**
  The manual is the most substantial part of the documentation. In addition to a detailed description of all elements of the software, it also contains information on how to set up and perform various measurements and background information on the software. The manual is available in pdf format. You'll find it on the CD that comes with the software and can download it off the internet.

- **Online Help**
  Hit the F1 key to start the online help. The online help contains detailed information about the operation of the software.

- **Tooltips**
  Some elements of the user interface show tooltips. You can view tooltips by hovering the mouse cursor over the corresponding element. Tooltips show only a short description of the functionality.

- **Parameter Description**
  The dialog boxes contain a field that shows a short description of the property you have currently selected. This field is always active and colored the way of the selected hardware component.

2.2 System Requirements

You need the following minimum system configuration to use R&S FS-K130PC:

Operating System: Microsoft Windows XP Professional (+ SP2)

Free Hard Disk Space: 1 GB

Free RAM: ≥1 GB

Graphics Resolution: ≥XGA (1024x768 pixel)

USB: one free USB port to connect the smartcard reader

Measuring instrument connection:

- Hardware: IEC/IEEE bus or LAN connection
- Software: VISA driver, National Instruments VISA version ≥4.2, Agilent IO Libraries Suite 15.1 or higher

2.3 Installing R&S FS-K130PC

For successful installation of the R&S FS-K130PC you need to

- prepare your PC
- install the R&S FS-K130PC software

2.3.1 Preparing the PC

The R&S FS-K130PC needs some additional components to run properly. All necessary components are delivered with the software itself. You can install them from the CD-ROM prior to installing the R&S FS-K130PC.

Prepare the PC as follows:

1. Check if Microsoft .NET Framework 2.0 is installed on your computer and start the installation if it is not already installed.

2. Install all required components using the Application Framework Installer.

3. Install VISA for remote operation of the used instruments.

Installing Microsoft .NET Framework Version 2.0

You need to install Microsoft .NET Framework 2.0 or a later version in order to use R&S FS-K130PC.

Check whether the .NET Framework is already installed.

1. Navigate to the installation location (usually the CD-ROM drive).

2. Start \Install\Framework\Microsoft .NET Framework 2.0\Check for .NET Installed.exe

   A message box tells you if the .NET Framework is installed or not. If not,

3. start \Install\Framework\Microsoft .NET Framework 2.0\dotnetfx.exe and follow the instructions.

Install the required components

A number of software components are required to use the R&S FS-K130PC. You can use the installer available on the CD-ROM to install all required components. You can start the installation routine directly from your computer and do not have to copy it to your hard drive.

Start the installation.

1. Navigate to the installation location (usually the CD-ROM drive).

2. Start \Install\Framework\DistortionAnalysisSoftwareFrameworkInstaller.exe

   The installer opens the following dialog box:

The first column shows the required components. Check if all components are already on your computer in the "Installed?" column.

Install all components that are not installed. The "Source Found?" column indicates if the Framework Installer could find the installation file on a local hard drive. If not, it shows you where you can download the installation files in the "Download Path" column.

3. Start the installation by pressing the "Start Framework Installation" button.

   All missing components will be installed.

   Note: Note that some installation routines may not confirm the installation by a message like 'Installation Finished'. Therefore it might be necessary to restart the framework installer and check again, if all components are installed.

You can also install all components manually. All files necessary are on the CD-ROM in the corresponding directories in the \Install folder.

It is recommended to install the components in the order the Framwork installer lists them.

Note that the Matlab .NET Interfacing is installed with the Matlab Component Runtime. There is no separate installation routine for it.

Install VISA

It is also necessary to install VISA (Virtual Instrument Software Architecture) to access instruments connected to the PC via IEEE or LAN bus. It is then possible to remote control the measurement instrument.

You can use both National Instruments and Agilent VISA.

- The National Instrument VISA driver CD is supplied together with the R&S FS-K130PC software package. You can also visit http://www.ni.com/visa to get the latest version for your operating system.
- If you are using an Agilent hardware or need to use the Agilent VISA, visit http://www.agilent.com to get the latest version for your operating system.

2.3.2 Installing R&S FS-K130PC

After installing all required components, you can install the R&S FS-K130PC. The installer will do the following:

- Install the R&S FS-K130PC software including an uninstall tool
- Create a Windows Start Menu entry (Programs ⇨ R&S Distortion Analysis Software)
- Create a shortcut on the desktop (optional)

Start the software via the Start menu entry or the shortcut on the desktop.

2.3.3 Deinstalling R&S FS-K130PC

You can uninstall the software itself via the uninstall tool available in the Windows Start Menu folder or via "Add or Remove Software" in the Windows Control Panel.

The Framework components have to be uninstalled manually via "Add or Remove Software" in the Windows Control Panel.

Before uninstalling the components, make sure that no other software uses one of the components.

The following programs have been installed:

- Intel Integrated Performance Primitives RTI4.1 for Windows on Intel Pentium processors
- Matlab Component Runtime 7.11
- Microsoft .NET Framework 2.0
- Microsoft Visual C++ 2005 Redistributable
- Rohde & Schwarz Distortion Analysis Software (FS-K130)

2.4 Using the Smart Card Reader

The R&S FS-K130PC is licensed via a smart card licensing system. When starting and running the software, the connection of the smart card to the PC is required.

You can use the smart card together with the USB smart card reader (for SIM format) supplied with the software or insert the smart card (Full format) in a reader already connected to your PC or built in your PC. Instructions on how to insert the card into the reader is also supplied together with the CD package.

Note that support for problems with the smart card licensing can only be guarantied if the supplied USB smart card reader (for SIM format) is used.

1. With the delivery of the R&S FS-K130PC you got a smart card and a smart card reader.

2. Remove the smart card.

3. Insert the smart card into the reader.
   If the OMNIKEY label faces upward, the smart card has to be inserted with the chip facedown and the angled corner facing away from the reader.
   With the USB stick such that the LED or "OMNIKEY" label is facing upward, insert the smart card with the chip facing downward and the angled corner facing away from the USB stick.

4. After pushing the smart card completely inside the USB smart card reader, you can use it together with the software.

If you insert the USB Smartcard reader into the PC, the drivers will be loaded. If your PC does not already have drivers installed for this reader, the hardware will not be detected and the R&S FS-K130PC software will not work.

In this case, please install the required driver manually. You will find it in the folder `\Install\USB SmartCard Reader Driver Files`, named according to the pro-

cessor architecture (OMNIKEY3x21_x86... or OMNIKEY3x21_x64). Detailed information on the file content and the download location for updated drivers can be found in the `ReadMe.txt` file in the same folder.

You may have problems locking your PC while the card is inserted, as Windows will try to get log-in information from the card immediate after you lock your PC.

You can overcome this problem by editing one registry entry. Either execute the registry file DisableCAD.reg in the same folder the USM Smartcard reader installation files are located. Or manually change the entry:

● Open the Windows Start Menu and select the "Run" item.

● Enter "regedit" in the dialog to open the system reigstry.

● Navigate to `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\policies\system`.

● Set the value of DisableCAD to 0.

Note that security policies may prevent you from editing the value. Contact your IT administration if you have problems with editing the value or installing the drivers.

2.5 Starting R&S FS-K130PC

► In the Windows Start menu, select Programs ⇨ R&S Distortion Analysis Software. R&S FS-K130PC checks if all components needed are installed on your computer. After that, the actual GUI opens.

The GUI of R&S FS-K130PC in its default state looks like this:
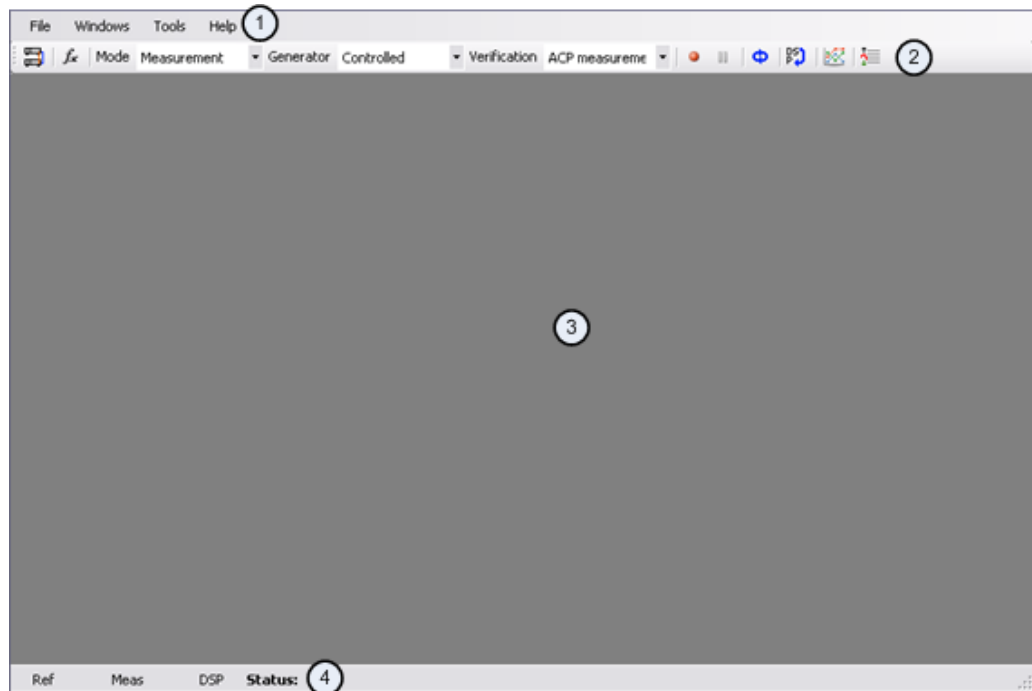
1 = Menu Bar: contains general functions of the software
2 = Toolbar: contains general measurement functions
3 = Workspace: contains all elements for user interaction
4 = Status Bar: contains the various message types about the status of the software

In the workspace of the interface, only the Message Log element is active after the initial startup of R&S FS-K130PC. All other elements you can add and remove as you like.

2.6 Adding GUI Elements to the Working Area

After you have started R&S FS-K130PC, you can add or remove the GUI elements you need.

2.6.1 Adding the HW Configuration Element

In the HW Configuration element, you can configure the components you need for performing the measurement.

► In the Menu Bar, open the Window menu and select the Hardware Configuration item. The Hardware Configuration element opens in the Working Area. In its default state, the Hardware Configuration window looks like this:
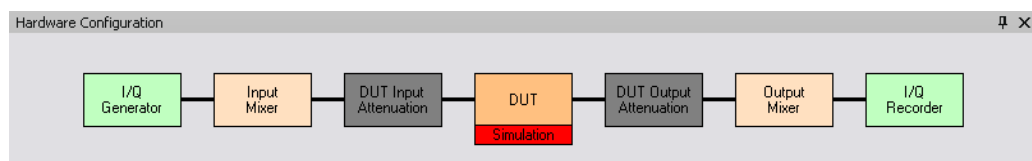
The following components may be part of the Hardware Configuration:

- I/Q Generator
- Input Mixer
- DUT Input Attenuation
- DUT
- Simulation
- DUT Output Attenuation
- Output Mixer
- I/Q Recorder
- RC

Depending on the measurement setup, the Hardware Configuration element may show different components and a different setup. Refer to the description of each component for more information on the various configurations.

2.6.2 Setting Properties

Each Hardware Component has its own Properties element. You can configure one hardware component at a time.

► Double-click on the hardware component you want to configure to open the corresponding Properties element.
Here's how a Properties element usually looks like (in this case the I/Q Generator Properties):
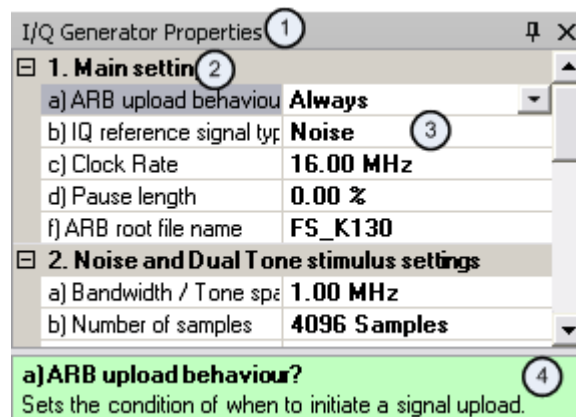
1 = Title Bar: shows the name of the hardware component.
2 = Parameter Group: group of similar parameters.
3 = Parameter: individual parameters that you can configure
4 = Parameter Description: short description of the selected parameter.

You can always expand or collapse parameter groups for a better overview of the settings.

1. To expand or collapse a parameter group, click on the ⊟ or the ⊞ symbol.

2. To change a property, click on the right column of the parameter you want to change to activate input.
    There are three ways to change a parameter:

    ● Select an item from a dropdown list (⏷ shows after selecting the parameter)
    ● Select a file from a standard Windows dialog box or open an extended dialog box that contains complex software properties (⏷ shows after selecting the parameter)
    ● Enter a value or name as you require including or excluding the unit (field stays empty, no icon shows)
        For every input field, there is a default unit that R&S FS-K130PC uses in case you don't enter a unit.

The Parameter Description shows a short description of the selected parameter. You can find a detailed description of each parameter in the Settings chapter. Pressing the F1 key while the parameter is active opens a more detailed help.

2.6.3 Starting a Measurement

After you have configured the measurement setup and have adjusted the properties, it is now time to start the measurement.

1. Click on the 🖼 button to open the Graphic Results element.
    The graphical results element is the graphic representation of the measurement results. There are several result displays available to choose from in order for you to view the results from different perspectives. The default result display is the Power aspect combined with the Standard evaluation method. To compare the results from different perspectives at one glance, you can open as many result displays at the same time as you like.
    Here's how a result display usually looks like (in this case the Power Spectrum of the signal):
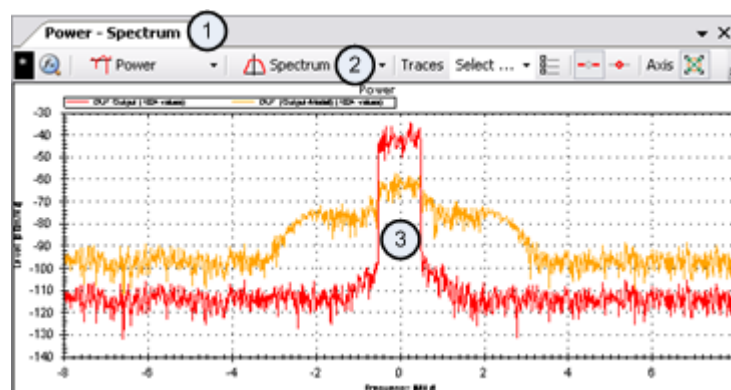
    1 = Title Bar: shows the currently selected combination of result display and evaluation method.
    2 = Toolbar: configures the result display.
    3 = Result Display: shows the measurement results in graphic form, including a legend for the traces.
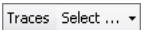
2. Click on the ● button in the toolbar of the main window to start the measurement.

The R&S FS-K130PC starts the measurement and plots the results in the result display.

3. You can always stop the measurement by clicking on the ⏸ button in the toolbar of the main window or freeze the measurement in one of the result displays by clicking on the ⏸ button in the result display you want to freeze.
Freezing one result display makes it possible to directly compare results from different measurements.
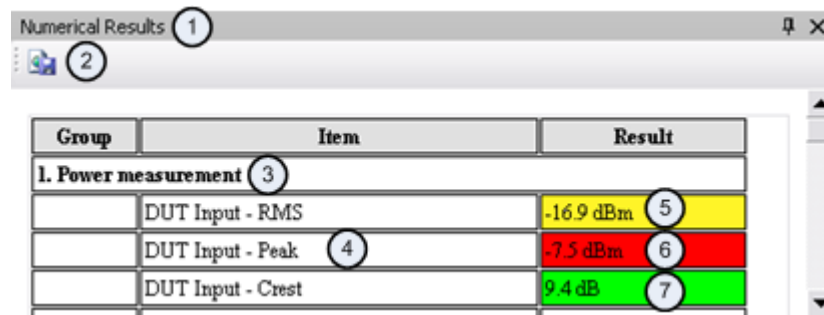
You can configure the result display via the toolbar. The toolbar contains the following elements:

- The flag (red or black) indicates whether the displayed measurement results are valid or not.
- ⊛ to open the configuration dialog.
- ⟨Power ▾⟩ to select the aspect of the result display.
- ⟨Spectrum ▾⟩ to select the evaluation method.
- ⟨Traces Select ... ▾⟩ to select the traces you want to see.
- ▤ to deselects all traces.
- ◦ to show the results in a line trace
- ◆ to show the results as dots
- ✕ to automatically scale the diagram to the results after each measurement.
- ✕ to zooms or unzooms the result display in order to fit in the screen.
- ↻ to updates the trace.
- ⏸ to freeze the result display in focus. All other result displays update the results as defined. To stop the measurement in general use the ⏸ button in the toolbar of the main window.
- ✂ ▾ to save the trace either in bitmap format or in vector format.
- ▦ to export the trace data to the clipboard.

2.6.4 Showing the Numerical Results Table

Now that you've seen the measurement results in a diagram, you can also view the results in numerical form.

► To open the Numerical Results element, open the Windows menu in the Menu Bar and select the Numerical Results item.
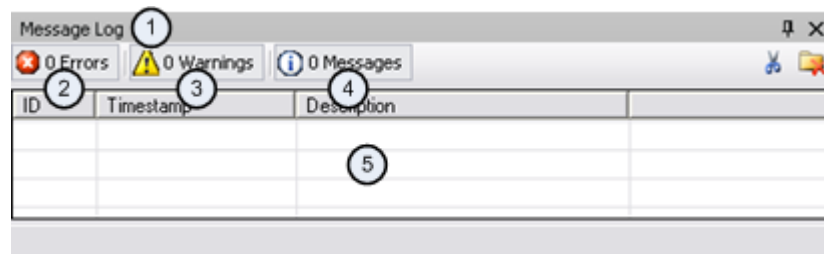The Numerical Results table look like this:

1 = Title Bar
2 = Save HTML report button
3 = Result group: group of similar results
4 = Result: individual measurement result
5 = Yellow Result: approximate result
6 = Red Result: invalid result
7 = Green Result: valid result

2.6.5 Adding the Message Log

The message log provides information about the measurement process or errors during the measurement. By default, the Message Log element is always open after starting R&S FS-K130PC.

► In the Menu Bar, open the Window menu and select the Message Log item. Here's how the Message Log looks like:

1 = Title Bar
2 = Error Tab: toggles a list of encountered errors
3 = Warnings Tab: toggles a list of warnings
4 = Messages Tab: toggles a list of messages from the software
5 = Log: shows details of the errors, warnings or messages in chronological order

The message log contains the following elements:

- Errors
- Warnings
- Messages

2.7 Customizing the User Interface

In addition to adding and removing elements to and from the working area, you can also customize the layout of the user interface by docking elements to a particular position of the working area, by adding a tab to an existing element or by altogether removing an element from the user interface.

2.7.1 Docking Elements

1. Select an element with the mouse and move it around until a docking spot appears. Docking spots look like this:

2. Move the mouse cursor over one of the possible docking spots.
    The border of the docking spot turns blue. The screen area in which the element will be positioned also turns blue.

3. Release the element.
    The element docks itself to the corresponding area of the GUI.

2.7.2 Adding an Element as a Tab

1. Select an element with the mouse and move it over another element.

2. Release the element.
    The released element is added as a tab to the element.
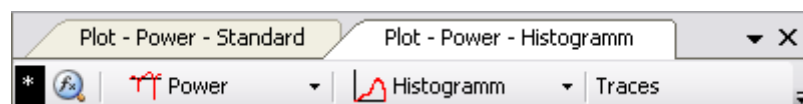
    The active tab always is in a lighter color than the others.

3. Select the tab you need by either clicking on the tab itself or by clicking on the ▾ symbol and selecting the tab you need from the list.

2.7.3   Removing an Element from the GUI

► Select an element with the mouse, move it around and release it.
If you haven't docked the element or added is a tab, it is floating around as an individual window. You can also move the element completely out of the GUI and work with it in an independent window.
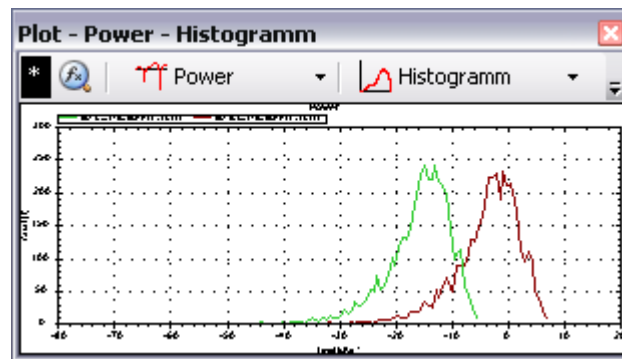
3 Using the Software

3.1 Menu Bar

3.1.1 'File' Menu

The File menu allows you to save and load the settings of the R&S FS-K130PC and to export measurement results.

Preset

Presets the software to its original settings.

Loading and Saving Settings

You can save the current R&S FS-K130PC settings for quick access at a later time.

Use File - Save - Settings to store the current software settings in a file on your computer. Save the file in the *.FS_K130_Config format in order to be able to import the settings at a later time.

To load specific settings, use File - Load - Settings and choose the file that contains the settings you want to use.

The *.FS_K130_Config format is in effect a *.xml file. Therefore you can open and edit the file with any editor capable of viewing xml files. However, if you want to change settings externally, make sure to keep the structure consistent.

Exporting data

You can also export various measurement data and results via the "Export" menu item.

Exiting the application

Use File - Exit to quit working with R&S FS-K130PC.

3.1.2 'Windows' Menu

In the Windows menu you can customize and reset the layout of the working area.

3.1.2.1 Adding Elements to the Working Area

► Open the Windows menu and

- select the Hardware Configuration item to add the Hardware Configuration element to the working area
  For more information see chapter 3.3, "Configuring the Measurement", on page 31
- select the Numerical Results item to add the Numerical Results table to the working area
  For more information see chapter 3.5, "Reading the Numerical Results", on page 61
- select the Message Log item to add the Message Log element to the working area

All open result displays are listed as items at the end of the menu. The currently active element is labeled with a check mark.

3.1.3 'Tools' Menu

3.1.3.1 Options

If you encounter any problems while using the software, you can use the functionality of the "Options" dialog box to solve them.

Note that the debug mode is intended for internal use. Activate the debug only when absolutely necessary. Consult the Rohde&Schwarz customer support before doing so.

⊟ 1. Debug properties	
a) Debug mode active?	No
b) Log debug outputs?	**No**
c) Log start-stop messages?	**No**
d) Debug file root	**C:\Program Files\Rohde**
e) Store kernel input?	**No**
f) Store kernel output?	**No**
g) VISA call logging depth?	**Off**

Debug Mode Active
Activates and deactivates the debug mode.

The debug mode is intended for internal use. Activate the debug only when absolutely necessary. Consult the Rohde&Schwarz customer support before doing so.

Log Debug Outputs
Defines whether or not to add debugging results to the message list.

The debug mode is intended for internal use. Activate the debug only when absolutely necessary. Consult the Rohde&Schwarz customer support before doing so.

Log Start Stop Message
If active, adds the start and stop time of the different software phases to the report.

The debug mode is intended for internal use. Activate the debug only when absolutely necessary. Consult the Rohde&Schwarz customer support before doing so.

Debug File Root

Shows the folder (including path) that contains the file that contains the debugging results (LOG output).

The folder also contains the executable.

Store DSP Input

If active, the R&S FS-K130PC saves the DSP input files in case unexpected signal processing events happen.

Problem solution for R&S customer support may be easier if you include these files in the error report to reproduce the entire DSP flow with all data going in and out of the DSP. The DSP input files are stored in the "Debug File Root" folder.

Store Kernel Output

If active, the R&S FS-K130PC saves the DSP output files in case unexpected signal processing events happen.

Problem solution for R&S customer support may be easier if you include these files in the error report to reproduce the entire DSP flow with all data going in and out of the DSP. The DSP input files are stored in the "Debug File Root" folder.

VISA Call Logging Depth

Defines the extent of logging of SCPI communication between PC and instrument.

Activate and use this feature to solve problems relating to remote control.

3.1.3.2 Show Verbose Measurement Report

Opens an external window that shows a summary of what has happened during the measurement. You can use the report to confirm whether or not the measurement was really according to your settings or for documentation.

```
Signal type: Noise
Best seed: 217468053 (Crest factor: 9.4 dB
4096 noise samples calculated
Signal source: Internal simulation
Measurement path: Internal simulation
DUT leveled after 3 loop(s).
```

3.1.4 'Help' Menu

The Help menu contains the online help and information about the software.

3.1.4.1 Opening the Online Help

To open the R&S FS-K130PC online help, proceed as follows:

1. Open the Help menu and select the Help item.
   The R&S FS-K130PC online help opens in a separate window.

2. Alternatively, hit the F1 key to open the online help.

3.1.4.2 About the Software and License Information

The "About" and "License Information" menu items show information about the software and the licenses currently in use.

► From the Help menu, select the "About" item.
The About R&S FS-K130PC message box opens.
Here's what the About R&S FS-K130PC message box looks like.
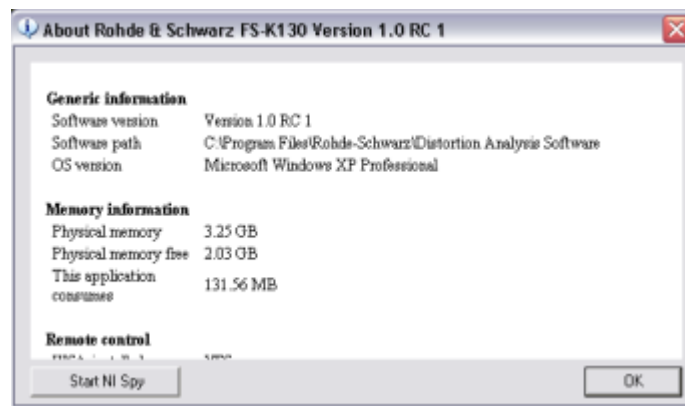
The Start NISpy button opens the NISpy software by National Instruments. NISpy is a debug tool that you can use if you encounter bugs or problems with the software. NISpy will compile an error report for your problem after pressing the "Record" button. Save the report adn send the file to Rohde & customer support.
For more information on its functionality refer to the NISpy manual available at http:// www.ni.com or the online help of the software.
Note that you have to install NISpy before you can use this function. NISpy is one component of the National Instruments VISA software package.

► From the Help menu, select the "License Information" item.
The License Information dialog box opens.
This dialog box contains miscellaneous functions to manage the licenses of the R&S FS-K130PC.
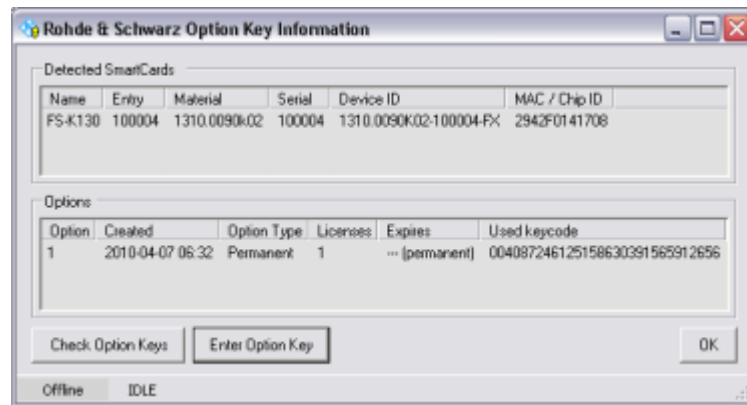
- **Check Option Keys**
  The "Check Option Keys" button checks for licenses that you have already installed and shows information like serial number or used keycode for each license.
- **Enter Option Key**
  The "Enter Option Key" button opens a new dialog box to enter the keycode for a new license.

3.2 Using the Toolbar

3.2.1 Configuring Instruments

If you use hardware like an signal generator or analyzer in the test setup, you can configure the instrument remote connection in this dialog.

► Click on the ▦ button.
  The Instrument Configuration opens.
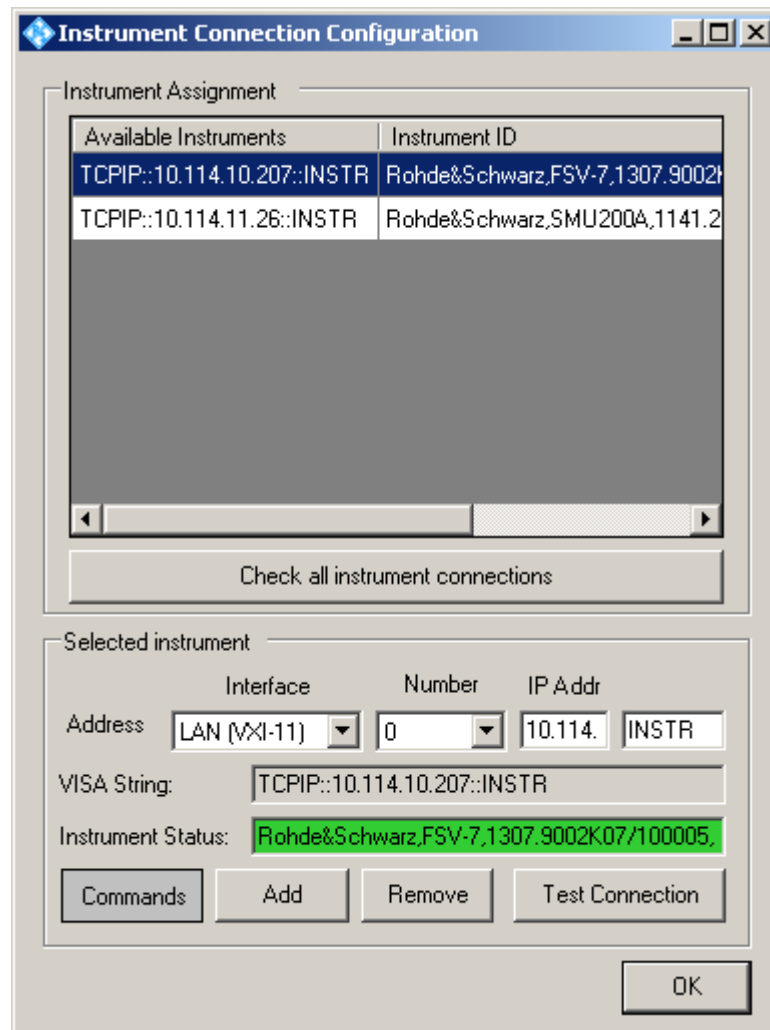
Instrument Assignment
The table shows all available instruments including their IDs, if you have queried them.
You can always check if the instrument is connected by clicking on the "Check all Instrument Connections" button.

Selected Instrument
You can configure one of the instruments in the list by selecting it. The details of the
instrument connections are then shown in the "Selected Instrument" area of the dialog
box.

You now can:

- define the address of the instrument.
- see the resulting VISA String
- check the instrument status and test the selected instrument connection.

3.2.2 Defining the DSP Properties

In order to configure the signal processing, you can adjust various parameters in the DSP properties dialog box.

► Click on the *fx* button.
The kernel properties dialog box opens.

□ 1. Signal synchronization	
a) Sync mode	**Timing, Phase and Gain ▼**
b) Search tolerance	**0.05**
c) Compensate IQ Imbala	**Yes**
d) Compensate IQ Offset	**Yes**
e) Compensate frequenc	**Yes**
f) Compensate timing offs	**Yes**
g) Compensate amplitude	**Yes**
□ 2. Generic parameter calculation	
a) Nonlinear estimation o	**7**
□ 3. Channel estimation	
a) Active	**Yes**
b) Impulse response taps	**1024**
c) Impulse response over	**0.75**
□ 3.) System identification	
a) Modelling	**Polynomial**
□ 4.1) System identification - Polynomial	
a) Full-fit maximum order	**-1**
b) Odd-fit maximum order	**9**
c) Calculate AM/PM	**Yes**
□ 4.2) System identification - Volterra	
⊞ a) Volterra structure	**Int32[] Array**
b) Number of pre-iteration	**50**
□ 5.1) DPD - Polynomial	
a) Active	**Yes**
□ 5.2) DPD - Volterra	
a) Active	**No**
b) DPD mode	**Pseudo-inverse**

3.2.2.1 Signal Flow

The signal flow settings control the main calculation steps that are performed by the software.

Sync Mode
Controls if and how both reference and measurement signal are synchronized. The exact synchronization is required to calculate a correct DUT model.

● **Off**
Performs no synchronization. Use this if you, e.g. create both signals with an EDA tool like Matlab and provide them in a file.
● **Timing, Phase and Gain**
Estimates a reduced set of parameters
● **Frequency, Timing, Phase, Gain, IQ Parameter**

Estimates the full set of parameters

In general, it is recommended to select the last configuration, e.g. if the instruments do not have reference frequencies coupled and a full set of parameters is to be estimated.

If the reference frequencies are coupled, you can use "Timing, Phase and Gain". If both signals are already aligned correctly, switch the sync mode off. This also speeds up the signal processing.

Note that only "Frequency, Timing, Phase, Gain, IQ Parameter" supports I/Q averaging.

Channel Estimation

Activates and deactivates the calculation of amplitude and phase response for the synchronized data.

If you are not interested in the channel impulse response, switch channel estimation off. This also speeds up the signal processing.

Modelling

Sets the method of DUT model calculation.

The following models are available:

● **Off**
  Performs no modeling; useful e.g. if you are interested in the raw EVM only.
● **Polynomial**
  Calculates a memoryless polynomial model
● **Volterra**
  Calculates a polynomial model with memory

DPD

Activates the DPD (Digital Pre-Distortion) calculation based on the model that you have selected.

The R&S FS-K130PC uses the DPD to predistort the existing I/Q data that you have to measure the DUT behavior. After applying the DPD to the reference signal and to the DUT, the output signal of the DUT should have a better performance with regards to ACP and/or EVM.

3.2.2.2 Signal Synchronization

With the signal synchronization parameters you can optimize the matching of both reference and measurement signal by adjusting the mode parameters.

Periods to analyze

Limits the number of analyzed reference signal periods within the measurement signal.

When analyzing data from a file, the file content may change over time, e.g. when the file starts with the reference signal but then continues with a different signal content. A case like that would lead to correlation and synchronization errors.

To avoid such erros, you can use this parameter to limit the analysis to a particular number of reference signal periods. For example, setting the periods to analyze to 1, analyzes only one period of the reference signal within the measurement signal.

Search Tolerance

Defines the percentage of reference signal periods to try to sync besides one reference signal period within the measurement signal.

For the typical applications, you should not change the search tolerance.

Compensate [DSP Parameter]

Compensates one of the DSP parameters' part from the measurement signal.

You can compensate the following DSP parameters:

- I/Q Imbalance
- I/Q Offset
- Frequency Error
- Timing Offset
- Amplitude Droop

All parameters are estimated during the signal synchronization. You can switch off the compensation for each parameter individually, so this error in the measurement signal will no be corrected.

3.2.2.3 Generic Parameter Calculation

Generic parameters include signal power, compression, gain, IP3 etc..

Nonlinear Estimation Order

Defines the supposed nonlinear order of the DUT used to estimate the nonlinear parameters.

The IP3 or IP5, for example, are derived from parameters of a nonlinear equation. The equation that is used to this end has a specific order that can not be estimated.

The nonlinear estimation order sets the order you need to calculate the equation.

If the order is set too high, too much energy may be spread to high-order terms, leading to wrong measurement results in lower orders and thus errors in the calculation of genereic parameters like the IP3.

3.2.2.4 Channel Estimation

The channel estimation process calculates the amplitude and phase response of the DUT. It also controls that spectral components that do not have enough power do not contribute on the impulse response calculation.

Impulse Response Taps

Defines the number of taps R&S FS-K130PC uses to calculate the impulse response.

The number is the sampling point count for calculating the impulse response from the reference and measurement data.

Impulse Response Overlap

Defines the overlap ratio for the impulse response calculation.

The R&S FS-K130PC calculates the impulse response via time-domain to frequency-domain conversion using FFT. The FFT width is defined in with the impulse response taps. If the signal is longer than the number of taps (typical measurement case), the signal processing steps over the signal in a step size defined by the impulse response overlap.

Example:

The number of impulse response taps is 1024, the impulse response overlap is 0.5 and the number of reference and measurement samples is 4096. The FFTs are calculated with a length of 1024, and the start points of the individual FFTs are 0, 512, 1024, 1536, 2048, 2560, 3072 and 3584, relative to the 1st measurement sample.

3.2.2.5 System Identification (Polynomial)

Full-fit Maximum Order

Defines the maximum order of the model to be calculated, using all polynomial coefficients.

The number defines the maximum order N in the polynomial representation of the model

$y = a_0 + a_1x + a_2x_2 + \ldots + a_Nx_N$

Note: The nonlinear effects consume an additional bandwidth proportional to 2 times the number of odd factors in the polynom, excluding the linear one. So, if the signal bandwidth is 1 MHz and the highest order N is 5, the bandwidth of the resulting signal is increased by 2 times 2 (because there are the factors x_3 and x_5) times 1 MHz which are 4 MHz and leading to a total signal bandwidth of 5 MHz. The configured recording bandwidth must be at least 5 MHz to record all nonlinear effects generated by the DUT.

Odd-fit Maximum Order

Defines the maximum order of the model to be calculated, using only odd factors.

If the physical model of nonlinearities is analyzed more closely, it can be seen that even factors in the polynom (x^2, x^4, …) generate spectral components which fall to integer multipliers of the center frequency the signal is generated at. So, if the signal is generated at 1 GHz, the factor x^2 generates intermodulation at 2 GHz, x^4 generates intermodulation at 3 GHz and so on. As these signals can not be analyzed due to the limited analysis bandwidth if the signal analyzer, calculating these factors is not required (and leaving them out also leads to a more accurate modeling).

Calculate AM/PM

Defines if the R&S FS-K130PC calculates the AM/AM curves for the model and DPD estimation (No) only, or also the AM/PM curves (Yes).

3.2.2.6 System Identification (Volterra)

Volterra Structure

Opens a dialog box to define the order and memory depth of the model.

You can configure the volterra model according to the needs required by the DUT characteristics. The dialog box shows the basic layout of the Volterra kernel. For each polynomial order (or power), you can set the memory depth can be set. Polynomial orders are represented by the position of the number within the configured number sequence. The memory depth is represented by the number at this position. You can select 0 (meaning "do not take this order into account) or any even number (as the model is symmetric in time delay).

3.2.3   Mode Selection

From the "Mode" dropdown menu you can select whether to run the software in "Measurement" mode or in "Reference Signal Recording" mode.

If you want to record the reference signal directly from a generator, e.g. to take generator effects into account, select "Reference Signal Recording". In this mode, the R&S FS-K130PC only measures the reference signal and skips the measurement on the DUT. In the "Hardware Configuration" element, the corresponding components are grayed out.

If the reference signal is defined by the software or provided numerically, or if you have already recorded the reference signal, select Measurement and set up and perform measurements as usual.

3.2.4   Defining the Generator Mode

From the Generator dropdown menu, you can define whether you want to control the generator or use it as a stand alone instrument.

If you select "Stand Alone", the R&S FS-K130PC assumes that all settings concerning the generator are okay and have been set manually.

The "Controlled" item checks if generator settings are okay or not.

3.2.5   Verificating the Measurement

Use "ACP ..." to upload a pre-distorted waveform file to the generator hardware and run an ACP measurement for both the original and the predistorted waveform file. The bandwidth of the ACP measurement is the same as set in the "Noise Bandwidth", even if e.g. a file-based reference signal is used. The ACP verification can only take place if hardware is connected and a DPD calculation is performed (which is configured in the DSP configuration).

For more information, see

● chapter 3.3.1.2, "Noise and Dual Tone Stimulus", on page 34
● "DPD" on page 26

3.2.6   Controlling the Measurement

You can perform a measurement and control the course of the measurement.

- ● starts the measurement. A measurement consists of capturing the data and displaying the results.
  By default, the R&S FS-K130PC performs one measurement after you press the button; that means the R&S FS-K130PC fills its capture buffer once and shows the results to the data in the capture buffer.

- ● pauses the measurement by interrupting the measurement without updating the result display. If you are measuring continuously, it interrupts the measurement loop. The result display shows the results to the last successfully finished measurement.

- ● starts a continuous measurement. After each update of the result display, a new measurement begins.

- ● reruns the measurement. Compared to a single measurement (●), the software does not capture new data before updating the result display. Instead it uses the same data and calculates the results again (e.g. based on a change in the DSP settings).

3.2.7 Opening Results Displays

opens a window containing the result display. Each click on the icon opens an additional result display. You can open as many of these as you need. As soon as one result display is open, new result displays may open in a background tab of an existing result display.

3.2.8 Using the Marker

The R&S FS-K130PC features a marker. Activate the marker and the corresponding information by pressing the button. The R&S FS-K130PC opens the marker information message box. You can get information to any measurement point by moving the mouse cursor over any pixel in the result display. The R&S FS-K130PC shows the corresponding information to that measurement point.

Markers are available in "Standard" mode.

The marker information message box contains the following information.

Timing	Index	3986
	Absolute	249.13 µs
Power	Input	-20.6 dBm
	Output	-3.7 dBm
	Gain	16.9 dB
Phase	Error	4.58 °
EVM		5.23 %
I/Q	Input	306.40 µV - 20.92 mV i
	Output	13.82 mV - 145.63 mV i

Timing Index

Shows the marker position on the time axis. It is an index with no unit. The timing index length depends on the length of the capture buffer. 0 correposnds to the start of the capture buffer.

Timing Absolute

Shows the absolute marker position in time in seconds. The range depends on the length of the capture buffer. 0 seconds correponds to the start of the capture buffer.

Power Input

Shows the absolute power at the DUT input at the marker position.

Power Output

Shows the absolute power at the DUT output at the marker position.

Power Gain

Shows the gain between DUT input and output at the marker position.

Phase Error

Shows the phase error at the marker position.

EVM

Shows the EVM at the marker position.

I/Q Input

Shows the voltage at the I/Q input at the moment of the marker position.

I/Q Output

Shows the voltage at the I/Q input at the moment of the marker position.

3.3 Configuring the Measurement

The Hardware Configuration window serves several purposes. For one, it visualizes the data flow in a block diagram. The block diagram consists of all hardware components you're using in the measurement. In addition, you define settings via the hardware configuration. To open the settings to one of the hardware components, simply double-click on the hardware component you want to set up.

3.3.1 Configuring the I/Q Generation

The I/Q Data Source component generates the I/Q reference signal or input data for the DUT to work with. The dialog box contains all parameters related to the baseband signal like signal type or signal parameters.

The I/Q Generator component corresponds to the ARB of a signal generator or a stand-alone ARB (like the R&S AMU).

► Click on the I/Q Generator component in the Hardware Configuration.
The I/Q Generator Properties dialog box opens.

⊟ 1. Main settings	
a) ARB upload behaviour?	**Always**
b) IQ reference signal type	**Noise**
c) Clock Rate	**16.00 MHz**
d) Pause length	**0.00 %**
f) ARB root file name	**FS_K130**
⊟ 2. Noise and Dual Tone stimulus settings	
a) Bandwidth / Tone spacing	**1.00 MHz**
b) Number of samples	**4096 Samples**
c) Random seed	**1**
d) Crest factor	**10.0 dB**
e) Crest factor tries	**10**
⊟ 3. File stimulus settings	
a) File type	**Binary, 1 file ; 32-bit flo**
b) Stimulus file name	
c) Stimulus file name - second	--- (single-file mode)
⊟ 4. Marker control	
a) Restart marker	**Marker 1**
b) Marker 1 offset	**0 Samples**
c) Marker 2 offset	**0 Samples**
d) Marker 3 offset	**0 Samples**
e) Marker 4 offset	**0 Samples**
⊟ 5. Hardware Information	
a) Instrument address	
b) Instrument IDN	
c) Instrument OPT	

In the dialog box that belongs to the I/Q Generator properties you can change and set up parameters as follows.

3.3.1.1 Main Settings

ARB Upload Behavior
Sets the condition of when to initiate a signal upload.

The upload may take a while, depending on the number of I/Q samples. The number of samples can reach 1.000.000.

An upload is only necessary if the signal has been changed. Therefore you can set up the R&S FS-K130PC to check the signal and upload the waveform only if it has been changed.

● **Always**
Uploads the signal even if the content is identical to the old one.
● **On Changed Data**
Uploads the signal only if it has been changed.
● **Never (Offline)**
Never uploads the signal.

I/Q Reference Signal Type

Selects the type and origin of the reference signal you want to use for the measurement.

R&S FS-K130PC is able to run measurements with nearly every type of signal. Two signal types are already provided. In addition, you can use and define customized types of reference signals.

- **Noise**
  Generate a noise signal using multi-carrier technique with constant carrier level and random carrier phases, trimming the phase to match the selected crest factor.
- **Dual Tone**
  Generate a two-tone signal with random phase and defined spacing.
- **File**
  Get the signal from a file that contains the signal characteristics. You can choose from various file formats.
- **Pre-recorder Reference Signal**
  Use a signal that has been previously measured and aquired from the analyzer while performing a reference measurement.

For more information see
- chapter 3.3.1.3, "File Stimulus", on page 34
- chapter 3.3.8, "Specifying the File Type", on page 45

Clock Rate

Sets the clock rate the I/Q source generates the signal with.

The clock rate is coupled directly to the signal analyzer sampling clock rate.

The purpose of R&S FS-K130PC is to measure nonlinear effects. These generate spectral regrowth (amplitude components in addition to the signal). Therefore you need to select a sampling rate (or recording bandwidth) in order to be able to record the signal and nonlinear effects.

Note: If you generate the signal with a file that already contains clock rate information, R&S FS-K130PC uses the clock rate specified here instead of that specified in the file.

For more information see
- chapter 3.3.1.3, "File Stimulus", on page 34
- chapter 3.3.8, "Specifying the File Type", on page 45

Pause Length

Adds a pause to the signal in order to generate a bursted signal instead of a continuous signal.

The percentage you enter here inserts a pause after the reference signal. During the pause the I and Q compenents equal 0. The length of the pause is relative to the length of the signal (number of samples).

Example: A signal contains 1000 samples. A pause length of 50% therefore adds 500 (or 50%) samples with I=Q=0 to the reference signal. The total signal length is then 1500 samples.

Random Seed

Sets the value for the random seed that initializes any random generator you are using during the internal signal generation process.

You can use the random seed, for example, to initialize the multi carrier phases of a noise signal.

Any number you enter here generates a different phase distribution and, therefore, a different signal. Values ≥ 0 result in a generation of the same distribution in every measurement. A value of -1 results in the generation of a different distribution in every measurement.

Note: The random seed works only with "Noise" and "Dual Tone" signals.

ARB Root File Name
Defines a file name prefix for any files that are transferred from the ARB generator.

You can specify different file name prefixes for each measurement. The file name is completed depending on its contents, e.g. _ORIG in case of the reference signal.

3.3.1.2 Noise and Dual Tone Stimulus

Bandwidth / Tone Spacing
Sets the bandwidth of an internally generated reference signal.

The value you enter here depends on the type of reference signal.

- if you have selected a "Noise" reference signal, enter the RF bandwidth of the signal.
- if you have selected a "Dual Tone" reference signal, enter the spacing of the two tones. If you enter, e.g., 1 MHz, R&S FS-K130PC generates two tones, one at +500 kHz and one at -500 kHz.

For more information see

- "I/Q Reference Signal Type" on page 33

Number of Samples
Sets the number of samples that the test signal consists of.

A power of 2 will speed up the internal signal processing and should be specified if no other requirements limit the choice of the sample count.

Note that the sample number is relevant only if the reference signal type is "Noise" or "Dual Tone". The sample number is also relevant for the reference signal measurement mode. The parameter does not include the pause length.

For more information see

- chapter 3.2.3, "Mode Selection", on page 29
- "Pause Length" on page 33

3.3.1.3 File Stimulus

Define the characteristics if you use data from a file as a signal source.

For more information see chapter 3.3.8, "Specifying the File Type", on page 45.

File Type
Selects a file format you need in case the reference signal information comes from a file.

You can import different standard signal types as well as generic I and Q data files.

Stimulus File Name

Selects the file that contains the reference or measurement signal information.

Stimulus File Name (Secondary File)

Select a secondary file that contains the reference or measurement signal information.

Selecting a secondary file is necessary only if you use a file type that requires two files.

3.3.1.4 Marker Control

Restart Marker

Specifies the marker you want to use as the restart marker.

The restart marker is generated by the ARB generator as TTL level signal at the marker output port. The restart marker is positioned on HIGH at the waveform start (sample index 0) and on LOW after half of the waveform length.

Marker 1/2/3/4 Offset

Specifies the marker offset relative to the start of the waveform (sample index 0).

R&S FS-K130PC ignores a marker offset if the marker ia also the restart marker.

Note: You can define a negative marker offset. A negative offset results in a pre-trigger that positions the marker on HIGH prior to the waveform start.
The length of the HIGH period is 1/100 of the waveform length if there are more then 1000 samples and ½ of the waveform length if there are less then 1000 samples.

3.3.1.5 Hardware Information

VISA Instrument Address

Shows the VISA address of the instrument currently in use.

For more information see.

● chapter 3.2.1, "Configuring Instruments", on page 23

Instrument Type

Shows name, serial number and firmware version of the instrument currently in use.

Instrument Options

Shows the options that are installed on the instrument currently in use.

3.3.2 Converting the Baseband Signal

A pure RF DUT needs a baseband signal converted into an RF signal. The corresponding component is the RF section of a vector signal generator or a separate I/Q to RF converter. All settings necessary for the up-conversion are available through the Up Converter dialog box.

► Click on the Up Converter component in the Hardware Configuration.

The Up Converter properties dialog box opens.

In the dialog box that belongs to the Up Converter properties you can change and set up parameters as follows.

3.3.2.1 Main Settings

RF Frequency
Shows the frequency at the DUT input.

Note that this field is read only. R&S FS-K130PC calculates the frequency from the DUT properties.

RF Output Path
Selects the RF path if more than one is available on the signal generator you use.

Currently, only path A is supported.

Settling Delay
Sets the time the DUT needs to settle after changing input parameters and before starting a measurement.

Due to a DUT's settling phenomena, it may be necessary to wait until you can perform further DUT output measurements after you have changed a DUT's input parameters. This period is the settling delay.

3.3.2.2 Hardware Information

Note that all parameters is the hardware information group are read only.

VISA Instrument Address
Shows the VISA address of the instrument currently in use.

For more information see.

● chapter 3.2.1, "Configuring Instruments", on page 23

Instrument Type
Shows name, serial number and firmware version of the instrument currently in use.

Instrument Options
Shows the options that are installed on the instrument currently in use.

3.3.3   Attenuating at the DUT Input

It may be necessary to attenuate the signal at the DUT input because of DUT restrictions and to avoid damage to the DUT.

Specifying the input attenuation also helps to display correct values in the measurement report and to run the model calculation on real measurement values.

► Click on the Input Attenuation component in the Hardware Configuration.
The DUT Attenuation properties element opens.

⊟ 1. Main settings	
a) Attenuation description	**Fixed attenuation** ▼
b) Fixed attenuation	**0.0 dB**
⊟ 2. Reference signal measurement	
a) Generator RMS power	**0.0 dBm**
b) Signal peak power mode	**As measured during I/Q**
c) Generator RMS power	**0.0 dBm**
d) Analyzer configuration	**Auto-level to supplied s**
e) Generator configuration	**Identical to measuremer**
f) Signal measurement plane	**At generator output**

In the dialog box that belongs to the Input Attenuation properties you can change and set up parameters as follows.

3.3.3.1   Main Settings

Attenuation Description
Specifies the method R&S FS-K130PC calculates the input and output attenuation.

Currently, R&S FS-K130PC supports only fixed attenuation.

Fixed Attenuation
Sets the attenuation at the DUT input or output in dB.

3.3.4   Configuring the DUT

In order to get valid measurement results you need to tell the software the characteristics of the DUT you are going to test.

► Click on the DUT component in the Hardware Configuration.
The DUT Attenuation properties element opens.

⊟ **1. Main settings**		
a) Input port type	**RF**	▼
b) Output port type	**RF**	
⊟ **2. Test settings**		
a) DUT output RMS level	**0.0 dBm**	
b) DUT output frequency	**1.00 GHz**	
c) Input frequency	1.00 GHz	
d) Post-measurement generat	**Leave in last level conf**	
e) Generator stand-by level	**-100.0 dBm**	
⊟ **3. Maximum DUT Input Ratings**		
a) Maximum peak level	**30.0 dBm**	
b) Maximum RMS level	**30.0 dBm**	
⊟ **4. Frequency conversion configuration**		
a) Multiplier	**1**	
b) Divider	**1**	
c) Frequency Offset	**0.00 Hz**	
⊟ **5. Auto leveling**		
a) Maximum gain	**20.0 dB**	
b) Initial power reduction	**20.0 dB**	
c) Maximum level error	**0.1 dB**	
d) Maximum level loops	**10**	
e) Auto leveling domain	**Time-domain power mea**	
g) Maximum number of sample	**10000**	

In the DUT Properties dialog box you can configure all DUT parameters necessary for successful testing.

3.3.4.1   Main Settings

Input Port Type
Select the port type at the DUT input.

You can choose from various port types like RF, baseband or digital inputs with different standards of interconnection (impedance, …).

Currently only the RF input port is supported.

Output Port Type
Select the port type at the DUT output.

You can choose from various port types like RF, baseband or digital inputs with different standards of interconnection (impedance, …).

Currently only the RF input port is supported.

3.3.4.2   Test Settings

DUT Output RMS Level
Defines the RMS level at the DUT output.

The RMS level is the output power level the R&S FS-K130PC performs the measurement with.

DUT Output Frequency
Sets the frequency at the DUT output.

The measurement frequency is the frequency the R&S FS-K130PC performs the measurement on.

Input Frequency
Calculates and shows the input frequency of the DUT.

The input frequency depends on the output frequency and the frequency conversion parameters. It is calculated with the following formula:

$f_{out} = (f_{in} * (^{multiplier}/_{divider})) + FrequencyOffset$

For more information see chapter 3.3.4.4, "Frequency Conversion Configuration", on page 40

Post-Measurement Generator Level
Sets the method of level configuration at the end of the measurement.

In some test setups (e.g. due to thermal restrictions), it may be necessary to reduce the DUT input power after the measurement. The available generator behaviors are as follows:

- **Leave In Last level Config**
  Maintains the level of the last measurement.
- **Power to Stand-by**
  Adjusts the level after the measurement according to the generator stand-by level).
- **Generator Stand-by Level**
  Deactivates the generator output after the measurement.

Generator Stand-by level
Defines the maximum power level of the signal generator after the measurement is done.

Note that the generator stand-by level is relevant only if you have set the "Post-Measurement Generator Level" on page 39 accordingly.

3.3.4.3 Maximum DUT Input Ratings

Maximum Peak Level
Defines the maximum peak power level allowed at the DUT input.

In order to avoid damage to the DUT, you can define the maximum peak power level that is allowed at the DUT input. The value you enter here is also considered during the auto level procedure.

Maximum RMS Level
Defines the maximum RMS power level allowed at the DUT input.

In order to avoid damage to the DUT, you can define the maximum RMS power level that is allowed at the DUT input. The value you enter here is also considered during the auto level procedure.

3.3.4.4 Frequency Conversion Configuration

If you perform measurements on frequency converting DUTs, you can set the corresponding parameters in the following parameter group.

R&S FS-K130PC calculates the DUT output frequency as follows:

$f_{out} = (f_{in} * (^{multiplier}/_{divider})) + FrequencyOffset$

Multiplier
Sets the frequency multiplication factor for a frequency conversion DUT.

Divider
Sets the frequency division factor for a frequency conversion DUT.

Frequency Offset
Sets the frequency offset for a frequency conversion DUT.

3.3.4.5 Auto Leveling

The R&S FS-K130PC automatically sets the level at the DUT output by performing an auto level routine.

Usually you do not have to modify any auto leveling settings to get correct results. Some DUTs however have special characteristics and the software needs to be set up accordingly.

The auto level routine works as follows:

- **Raw leveling**
  The process begins with an initial power level. This initial level is the
  DUT Level - Max Gain - Initial Power Reduction
  The software then increases the power level in even steps until it is close to the requested output level.

- **Fine leveling**
  When the level comes close to the requested level, the steps are adjusted according to the difference in requested and configured level until the level comes even closer to the requested level.
  If the maximum number of leveling steps is reached without coming close enough to the requested level, the process is terminated with an error.

Maximum Gain
Defines the maximum gain of the DUT.

The maximum gain is part of the calculation of the initial power of the auto level process.

Initial Power Reduction
Defines the power reduction of the DUT.

The power reduction is part of the calculation of the initial power of the auto level process.

If you don't know the exact reduction of the DUT you have to enter an approximate value or the reduction that you expect.

Maximum Level Error

Defines the maximum tolerable level difference between measured and requested output power of the DUT.

R&S FS-K130PC uses the level error to check if the leveling process can be completed successfully.

Maximum Level Loops

Set the maximum number of auto-leveling loops that are performed until the auto-level routine stops.

The leveling process may – due to special DUT effects like a negative gradient gain curve or heavy nonlinear effects – end up in an endless loop. The number you enter here defines the maximum number of auto-leveling attempts until R&S FS-K130PC aborts the levelling process.

By setting the maximum number of level loops, you can avoid dead-lock loops on amplifiers with a massive non-linear characteristic.

The number of level loops is the counter during both stages (raw and fine leveling) of the auto level process.

Auto Leveling Domain

Set the measurement type R&S FS-K130PC uses during auto-leveling.

- **Time Domain Power Measurement**
  Performs the auto level procedure in the time domain (zero span) of the analyzer.
- **Based on I/Q Data**
  Performs the auto level procedure on I/Q data.

By default, R&S FS-K130PC performs the auto-level procedure in the time domain as it is much faster compared to measurements on I/Q data, especially if you have long I/Q data sets.

Maximum Number of Samples

Set the maximum number of I/Q samples to capture during the auto-level process.

If you have a very large I/Q data set as reference signal, capturing I/Q data for auto-leveling purpose can take a long time.

If you perform the auto level procedure based on I/Q data, you can set a maximum sample count that is used if the complete sample exceeds the value you have entered here.

For more information see

- "Auto Leveling Domain" on page 41

3.3.5 Attenuating the DUT Output

It may be necessary to attenuate the signal at the DUT output if the power level is very high or due to analyzer restrictions. Attenuation of the signal can avoid damage to the hardware.

In order to display correct power readings, the output attenuation value can be specified.

► Click on the Output Attenuation component in the Hardware Configuration.
The DUT Attenuation properties element opens.

⊟ 1. Main settings	
a) Attenuation description	**Fixed attenuation** ▾
b) Fixed attenuation	**0.0 dB**

In the dialog box that belongs to the Output Attenuation properties you can change and set up parameters as follows.

3.3.5.1 Main Settings

Attenuation Description
Specifies the method R&S FS-K130PC calculates the input and output attenuation.

Currently, R&S FS-K130PC supports only fixed attenuation.

Fixed Attenuation
Sets the attenuation at the DUT input or output in dB.

3.3.6 Converting the RF Signal

When testing a DUT with an RF output you need to convert the RF signal back into a baseband signal. The corresponding component is the RF section of a vector signal analyzer. All settings necessary for the down-conversion are available through the Down Converter dialog box.

► Click on the Down Converter component in the Hardware Configuration.
The Down Converter properties dialog box opens.

⊟ 1. Main settings	
a) RF frequency	1.00 GHz
b) RF output path	A
c) Settling delay	**100.00 ms**
⊟ 2. Hardware Information	
a) Instrument address	
b) Instrument IDN	
c) Instrument OPT	

In the dialog box that belongs to the Down Converter properties you can change and set up parameters as follows.

3.3.6.1 Main Settings

RF Frequency
Shows the frequency at the DUT output.

This is a read only field. R&S FS-K130PC automatically calculates the frequency from the DUT properties.

For more information see

- chapter 3.3.4.4, "Frequency Conversion Configuration", on page 40

Reference Frequency Source
Defines the source of the reference frequency.

You can couple the reference frequencies of the instrument to get a better frequency accuracy. The full synchronization can compensate the frequency error, but if possible, coupling the reference frequencies is recommended.

You can also supply an external frequency generator to be used as reference frequency (e.g. if the DUT generates its own reference frequency).

3.3.6.2 Hardware Information

VISA Instrument Address
Shows the VISA address of the instrument currently in use.

For more information see.

- chapter 3.2.1, "Configuring Instruments", on page 23

Instrument Type
Shows name, serial number and firmware version of the instrument currently in use.

Instrument Options
Shows the options that are installed on the instrument currently in use.

3.3.7 Configuring the I/Q Recorder

The last hardware component to configure is the I/Q recorder or I/Q data sink. Like the I/Q generator, it is part of every measurement configuration. The I/Q recorder measures the signal, records the data at the DUT output and shows the results. Usually you will have a signal or spectrum analyzer as a data sink. The I/Q recording section of the analyzer is the part that correponds to the I/Q Data Sink component.

► Double-click on the I/Q Data Sink component in the Hardware Configuration.
The I/Q Data Sink properties element opens.

□ 1. Main settings	
a) Measurement data source	**Internal simulation** ▾
b) Averaging factor	**1**
c) Trigger mode	**Immediate trigger**
d) Measurement bandwidth	**Auto**
d) Sampling clock rate	16.00 MHz
□ 2. Response file settings	
a) File type	**Binary, 1 file ; 32-bit flo**
b) Response file name	
c) Response file name - secon	**--- (single-file mode)**

In the dialog box that belongs to the I/Q Data Sink properties you can change and set up parameters as follows.

3.3.7.1 Main Settings

Measurement Data Source
Selects the source of the I/Q data.

You can get the measurement data at the DUT output in three ways:

- **Hardware**
  Data recording by measuring the data with an analyzer
- **File**
  Import the data you want to measure via a file
- **Internal simulation**
  Simulate a DUT according to specification.

Averaging Factor
Sets the number of I/Q reference signal data blocks R&S FS-K130PC uses for averaging purposes.

R&S FS-K130PC can average I/Q data in both amplitude and phase. When averaging data, R&S FS-K130PC increases the recording length in order to capture the number of signal periods that you have defined here within one I/Q recording within the capture buffer.

Trigger Mode
Selects the trigger that initiates the measurement.

Typically, the marker output of the generator is connected to the trigger input of the analyzer to indicate the start of a signal. This trigger may not be available if, for example, you generate the reference signal with an external generator. In that case, you have to increase the recording length to three reference signal periods in order to capture the requested amount of data under all circumstances.

- **Immediate trigger**
  The data capture starts as soon as the analyzer is ready.
- **External trigger**
  The data capture starts as soon as the analyzer recognizes a trigger event at its input.

Note: The immediate trigger is not available in case of signals that are not periodic. The immediate trigger also slightly slows down the measurement because snychronization takes more time.

Measurement Bandwidth
Sets the resolution bandwidth for I/Q and auto-level measurements.

If you set the resolution bandwidth automatically, R&S FS-K130PC sets the smallest available bandwidth that is greater than 1.5 times the sampling rate.

Note: If you use an R&S FSV in the test setup, the bandwidth set here is ignored. This is because the R&S FSV calculates the bandwidth inernally.

Sampling Clock Rate
Displays the clock rate for recording I/Q data.

The clock rate of both signal generation and signal analysis are coupled one-by-one.

Resampling is not supported at the moment.

3.3.7.2   Response File Settings

File Type
Selects a file format you need in case the reference signal information comes from a file.

You can import different standard signal types as well as generic I and Q data files.

Stimulus File Name
Selects the file that contains the reference or measurement signal information.

Stimulus File Name (Secondary File)
Select a secondary file that contains the reference or measurement signal information.

Selecting a secondary file is necessary only if you use a file type that requires two files.

3.3.8   Specifying the File Type

The R&S FS-K130PC allows you to use several file formats for both import and export, e.g. files that contain the reference signal characteristics or files that contain the characteristics of the measurement signal. In the File Type dialog you can specify several characteristics of the file you want to use for import or export.

☐ **1. Basic settings**	
a) File type	**Binary, 1 file**
b) Data file name	
c) Secondary data file nar	--- (single-file mode)
☐ **2. Binary format specification**	
a) Data format	**32-bit floating point**
b) Data order	**IQIQ...IQ**
c) Intel order	**LSB first (Intel/Little-Endian**
d) Fixed-point scaling	**1**
e) Fixed-point offset	**0**
f) Resulting value range	--- (floating point format)
☐ **3. ASCII format specification**	
a) Main data direction	**Sample index in row directi**
b) IQ data order	**Block, Q beside I**
c) 1st value is	**I**
d) Sample separator	**;**
e) Row separator	**<CR-LF>**
f) Decimal separator	**.**
☐ **4. Matlab format specification**	
a) Signal name	**Signal**
b) Matlab format	**Default format**
c) Main data direction (M	**Sample index in row directi**
☐ **5. Specific values**	
a) Ignore first	**0 Samples**
b) Read only	**-1 Samples**
c) Remove DC	**No**
d) Signal name	**Measurement signal (ME ▼**

For more information see

- "I/Q Reference Signal Type" on page 33
- "Measurement Data Source" on page 44

3.3.8.1 Basic Settings

File Type

Basic format that is used to read or save data from or to a file.

R&S FS-K130PC supports the following file types:

- **Binary**
  One file or two files for I and Q or a separate file for I and Q.
- **ASCII**
  One file or two files for I and Q or separate file for I and Q.
- **Matlab**
  all Matlab versions. You can specify the signal name you want to load.
- **IQW file**
  Format of various analyzer applications, e.g. WLAN or WiMAX analysis software.
- **IBN file**
  Format of WinIQSIM software. Only the uncrypted version is supported.
- **WV file**
  Format for signal generators. Only the uncrypted format is supported.

- **Data exported with R&S FSx**
  Data that you get, e.g. with the R&SR&S FS-K130PCFS-K70 VSA application.
- **Data exported with R&S FSx in SIM format**
  The SIM format is a special format. Use it only on special advice from Rohde & Schwarz.

For more information see

- chapter 3.3.8.2, "Binary Format Specification", on page 47
- chapter 3.3.8.3, "ASCII Format Specification", on page 48
- chapter 3.3.8.3, "ASCII Format Specification", on page 48

Data File Name
Defines the file you want to use.

Secondary Data File Name
Defines the second file you want to use.

Defining a second file is necessary only if the selected file format is defined in two files.

3.3.8.2 Binary Format Specification

Data Format
Sets the precision or value range of the binary data in the file.

The R&S FS-K130PC supports:

- Fixed point, 8 Bit unsigned (0...255)
- Fixed point, 16 Bit signed (-32768...32767)
- Fixed point, 32 Bit signed (-2147483648 … 2147483647)
- Fixed point, 64 Bit signed (-9223372036854775808 … 9223372036854775807)
- Fixed point, 16 Bit unsigned (0 … 65535)
- Fixed point, 32 Bit unsigned (0 … 4294967295)
- Fixed point, 64 Bit unsigned (0 … 18446744073709551615)
- Floating point, 32 Bit (± 3.4028235E+38 … ± 1.401298E-45)
- Floating point, 64 Bit (± 1.79769313486231570E+308 … ± 4.94065645841246544E-324)

Data Order
Defines the order of the data in the file.

The data order is relevant only if you have selected the binary file format that includes both I and Q data in one file.

The R&S FS-K130PC supports:

- **IQIQ...IQ**
  Alternating I and Q samples, beginning with an I sample.
- **QIQI...QI**
  Alternating I and Q samples, beginning with a Q sample.
- **II...IQ...QQ**
  Combined I and Q samples. First all I samples in a block then all Q samples.
- **QQ..QII..I**
  Combined I and Q samples. First all Q samples in a block then all I samples.

Intel Order

Defines whether MSB or LSB comes first within the bytes of a single value.

The R&S FS-K130PC supports:

- **LSB first (Intel/Little-Endian)**
  MSB is the most left value.
- **MSB first (Motorola/Big-Endian)**
  LSB is the most right value.

The resulting floating-point value is (Fixed Point - Offset) / Scaling

The resulting fixed-point value is (Floating Point * Scaling) + Offset

Fixed Point Scaling

Sets a multiplier for fixed-point values in order to convert them to, e.g., Volt values with a fixed resolution.

The value is multiplied to all fixed-point values read in order to generate floating-point values.

The resulting floating-point value is (Fixed Point - Offset) / Scaling

The resulting fixed-point value is (Floating Point * Scaling) + Offset

Fixed Point Offset

Sets an offset for fixed-point values in order to convert them to e.g. Volt values with a fixed resolution.

The value is added to all fixed-point values read in order to generate floating-point values.

3.3.8.3 ASCII Format Specification

Click on the "Show Example" button to preview an example of the orientation and used separator characters of the data.

Main Data Direction

Defines the orientation of the data (row or column).

The R&S FS-K130PC supports:

- **Sample index in row direction (left - right)**
  Inserts row(s) when adding additional I/Q samples.
- **Sample index in column direction (top - bottom)**
  Inserts column(s) when adding additional I/Q samples.

I/Q Data Order

Defines the order of the data within the rows or columns.

The R&S FS-K130PC supports:

- **Interleaved**
  Alternating I and Q; only one row present.
- **Block, Q after I**
  Combined I and Q samples; only one row present.
- **Block, Q beside I**

Combined I and Q samples; I samples are in a different row or column than Q samples, depending on the data orientation.

For more information see

-

1st Value Is

Defines whether the file begins with an I or a Q sample.

Sample Separator

Defines the character or character combination that separates samples.

Row Separator

Defines the character or character combination that separates rows.

Separated rows are the equvalent to lines in a text file.

Decimal Separator

Defines the character that separates the integral and fractional part of each I and Q sample.

3.3.8.4 Matlab Format Specification

Signal Name

Sets the name of the variable to store or read from if you use a Matlab file.

If you save a file, the variable within this file gets the specified signal name. This feature can be useful if you want to load reference and measurement files and already want to distinguish both files while loading them, for example.

If you load a file, the loading function queries the variable with this name. It is possible to store multiple I/Q vectors (e.g. reference and measurement signal) in one file and specify the name of the signal to load here.

If the name was not found within the file and there is only one vector, this vector will be loaded. If there is more than one value, an error will be generated.

Matlab Format

Sets the version for *.mat files when saving a signal in Matlab format.

As the Matlab format has changed in the past, special user-defined functions for reading Matlab files may require older versions of the file format. If this is the case, you can specify the version here. The parameter is analoguous to the parameter of the save function of Matlab.

3.3.8.5 Specific Values

Ignore First

Ignores the first N samples when reading data from a file.

Read Only

Read only N samples when reading data from a file.

To read all samples, enter -1.

Remove DC

Remove the DC component from the read I/Q data by calculating the mean I and Q value and removing the complex offset.

Signal Name

Name of the signal when reading data exported from R&S FSV-K70.

3.4 Measuring the DUT and Evaluating the Results

After you have configured the measurement, you are ready to perform the measurement.

Without making any changes to the properties after starting the software the first time, or after a preset, the R&S FS-K130PC measures a signal that is simulated internally.

In its default state, this noise-like signal has a 1 MHz bandwidth and a clock rate of 16 MHz. A noise level of 60 dBc, a timing offset of 50 samples and a frequency offset of 100 Hz is applied to the signal. R&S FS-K130PC records 4096 samples for the evaluation.

The signal is then applied to a simulated DUT that generates AM/AM and AM/PM distortion.

To perform the measurement, proceed as follows:

1. Press the ▨ button in the toolbar to open one or more graphical result display window(s).
    In its default state, the result display shows the Power aspect in combination with the Standard evaluation method.
    There is no limit to the number of result display you can open simultaneously.

2. Press the ● button in the toolbar to run the measurement.
    R&S FS-K130PC performs a single measurement. It shows the results in the form of a trace in the diagram of the result display.

3. Press the ▨ button in the toolbar again to open a second result display window.
    Depending on the screen layout, R&S FS-K130PC either opens the result display in a second window or adds a tab to the result display you have already open. If in a tab, drag the result display out of the tab and dock it somewhere else to view both result displays at the same time.

4. Configure the result display(s) as you wish.
    After running the measurement, you can configure the result display. The following chapters describe all elements of the GUI you need for the configuration. They also give a description of the characteristics of each aspect and evaluation method.

You can also run a measurement without opening the result display element first.

3.4.1   Using the Toolbar

This chapter describes all elements that are available in the toolbar of the result display.

The toolbar provides several functions that configure the active graphical result(s). You can have as many active result displays as you like and can configure each as you need. You can recognize the active result display by either the blue line that is around the window or, if there are more than one results displays in one window, the tab that is at the front of the window.

The toolbar itself provides the following functions:

3.4.1.1   Configuring the Result Display

All you need for working with the result displays is either in the toolbar of the result display or in the context menu.

In the configuration dialog box, you can customize the diagram and the trace.

Level Unit
Select the unit of all axis related to an absolute level.

Changing the unit affects result displays with absolute scaling.

Relative Unit
Select the unit of all axis related to a relative level.

Changing the unit affects result displays with relative scaling.

Gain Normalization
Switches the correction of a linear gain factor between measurement and reference dependent signals on and off.

Typically, the measurement signal (and derived ones like the model) have a higher amplitude compared to the reference signal. Thus, comparing both signals optical is not easy. To enable a better comparison, you can switch on the gain normalization to remove this gain before displaying the curves.

AM/PM Reference Axis
Selects whether the x-axis of the AM/PM curve is the level of the reference or the level of the measurement signal.

Show Wrap Around Only
Set this parameter to Yes, if you want to analyze the wrap-around section of the signal in detail. R&S FS-K130PC then shows only the small part at the beginning and the end of the signal. You can define the length with the "Wrap Around Size" parameter.

This is useful if you want to observe non-cyclic signals in the "Capture Buffer" result display.

This parameter is available for the standard evaluation method.

Wrap Around Size
Defines the number of samples to the left and to the right of the wrap-around that R&S FS-K130PC shows.

This parameter is available for the standard evaluation method.

Window Function
Select the type of FFT window to reduce leakage.

This parameter is available for the spectrum evaluation method.

Use A Detector
Choose whether or not to use a detector for the measurement.

Applying a detector is possible for the Spectrum evaluation method. The detector combines several samples and evaluates the data depending on the detector type.

This parameter is available for the spectrum evaluation method.

Detector Type
Choose the type of detector to use. You can apply a maximum (peak of N samples), minimum (minimum of N samples), average (SUM(x)), RMS (SUM(x*x), sample (1st value of the sample) or median detector (middle value of a sorted list).

Note that the selection of a detector only takes effect, if the "Use A Detector" field is set to Yes.

This parameter is available for the spectrum evaluation method.

Detector Final Points

Determines how many spectrum samples the R&S FS-K130PC generates while using the detector.

This parameter is available for the spectrum evaluation method.

Bins

Defines the number of bins that are used for the histogram.

For more information see "Histogram" on page 59.

For a high number of y-axis values, it may be better to increase the number of bins to get a higher-resolution display. Reducing the bin count results in a better 'averaging' of the curve.

This parameter is available for the histogram evaluation method.

3.4.1.2 Selecting the Result Display and Corresponding Traces

R&S FS-K130PC offers various types of result display. The result display changes the aspect or the way you look at signal of the measurement results.

By default, R&S FS-K130PC shows the typical traces of interest. You can change the number and type of trace in the Trace Selection menu in the toolbar of the result display.

Use the ⟦ Power ⟧ dropdown menu to select the result display data to be displayed.

This chapter lists all result displays that R&S FS-K130PC offers.

For every result display there is a customized set of traces available. The evaluation method has no effect on the number and kind of trace that are available. In the result diagram, each trace is displayed in a different color. Above the diagram, R&S FS-K130PC shows a legend with the name and color of every active trace currently in the diagram. The labels of the axis are the same as that of the current evaluation method. The scaling can be different for each trace and is adjusted accordingly. This chapter gives a short overview of the characteristics of all available traces.

1. From the ⟦ Traces Select ... ⟧ dopdown menu, select the trace you'd like to see.
   Each currently active trace has a check mark in front of it (✓).
   Instead of using the mouse to activate and deactivate a trace, you can also use shortcuts. The shortcuts are Ctrl-'number' with 'number' being the number of the trace as it appears in the dropdown menu. So, for example, to display the DUT Model trace (the 5th in the dropdown menu) in the Power result display, the shortcut would be Ctrl-5.
   You can use the same procedure to deselect single traces.

2. Next to the trace selection dropdown menu is a deselect all traces function. Pressing the ⟦≣⟧ button clears the diagram from all traces.

The figure below shows the signal flow and the stage the corresponding traces result from. The colors in the diagram result to the colors of the traces in the R&S FS-K130PC.
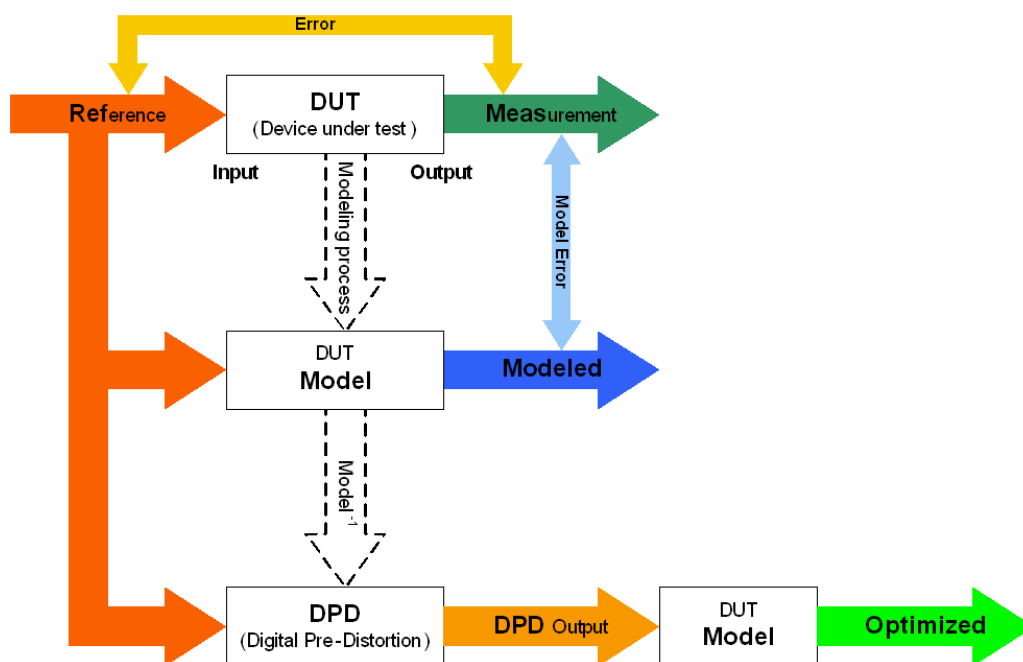
Fig. 3-1: Signal flow. The colors correspond to the traces you can view with the R&S FS-K130PC.

Capture Buffer

The capture buffer contains the raw data that has been recored during the first stage of signal processing (usually the synchronization algorithm). The raw data contains the reference signal as well as the measurement signal. It is the source data for the synchronization and all further evaluations.

Both the reference signal and the measurement signal are shifted in time by the measured trigger delay oof the synchronization algorithm. As both signals are matched in the time domain in that case, you can compare them visually.

You can use the capture buffer result display to identify the causes for possible unexpected or invalid results.

The available trace types are as follows:

- **Ref Captured**
  Shows the reference signal as defined for the I/Q generation.
  For more information, see chapter 3.3.1, "Configuring the I/Q Generation", on page 31

- **Meas Captured**
  Shows the measurement signal as recorded by the I/Q recorder.
  For more information, see chapter 3.3.7, "Configuring the I/Q Recorder", on page 43

Power

The power result display shows the power of the signal against time after the synchronization. You can view the signal from various angles within signal definition, measurement and processing flow.

The time period R&S FS-K130PC measures depends on the number of samples you have set.

The available trace types are as follows:

- **Ref**
  Shows the power of the reference signal that is used for the model estimation process.

- **Meas**
  Shows the power of the synchronized measurement signal that is used for the model estimation process.
  To match both signals visually, the nominal gain of the measurement signal can be eliminated.
  For more information see "Gain Normalization" on page 52.

- **Modeled**
  Shows the power of the signal that was created by the model extraction and calculation.
  If the model matches the behavior of the DUT, the modeled signal should look like the measurement signal.

- **Ref - Meas**
  Shows the error between reference signal and measurement signal.
  Depending on the DUT, noise and nonlinear effects may be added to the measurement signal. These are visualized by this trace.
  In addition, if you are using the Spectrum evaluation, the trace shows the in-band distortion.

- **Modelling Error**
  Shows the error between measurement signal and modeled signal.
  The modelling error indicates the quality of the DUT modelling. If the model matches the DUT behavior, the modelling error is zero (or merely influenced by noise).

- **DPD**
  Shows the output signal of the DPD as applied to the DUT input in the verification step of the measurement.
  The DPD (Digital Predistortion) output signal is the 'inverted' model behavior.
  In the spectrum evaluation, the DPD shows an increased ACP power as it must compensate the ACP power of the nonlinear behavior of the DUT.

- **Optimized**
  Shows the expected output signal of the DUT when the DPD signal is applied to the input.
  If both model and DPD are calculated correctly, the optimized signal should be a linear amplified version of the reference signal.

Gain

The gain result display shows the amplification and error effects of the DUT as a function of the DUT input or output power.

The gain is the ratio of input and output power of the DUT.

The available trace types are as follows:

- **Gain vs Ref**
  Shows the gain as a function of the reference signal power.

The power is shown on the horizontal axis.
In case of nonlinear amplifiers or DUTs, the gain decreases if the input power
becomes too high to follow the linear part of the DUT characteristics. For very low
levels, the trace widens vertically due to noise influence.

- **Gain vs Meas**
  Shows the gain as a function of the measurement signal power.
  The power is shown on the horizontal axis.
  In case of nonlinear amplifiers or DUTs, the gain decreases if the input power
  becomes too high to follow the linear part of the DUT characteristics. For very low
  levels, the trace widens vertically due to noise influence.

- **EVM vs Ref**
  Shows the error vector magnitude (EVM) as a function of the reference signal power.
  The power is shown on the horizontal axis.
  In case of nonlinear DUTs, the EVM increases if the is getting higher to follow the
  linear part of the DUT characteristics. Linear DUTs have wider and higher EVM only
  in case of low powers because of the increasing influence of noise.

- **Gain vs Ref - Modeled**
  Shows the output of the DUT that was modeled during system identification.
  If the DUT was modeled correctly, the trace should resemble the "Gain vs Ref" trace
  minus noise.

Constellation Diagram

The constellation diagram shows the complex values in an I vs Q diagram and plots the
constellation for modulated signals (e.g. 16QAM).

The available trace types are as follows:

- **Ref**
  Shows the constellation of the reference signal that is used for the model estimation
  process.

- **Meas**
  Shows the constellation for the synchronized measurement signal that is used for the
  model estimation process.
  To match both signals visually, the nominal gain of the measurement signal can be
  eliminated.
  For more information see "Gain Normalization" on page 52.

- **Modeled**
  Shows the constellation for the signal that was created by the model extraction and
  calculation.
  If the model matches the behavior of the DUT, the modeled signal should look like
  the measurement signal.

- **Ref - Meas**
  Shows the error between reference signal and measurement signal.
  The trace is suited, for example, to see whether the noise is uniform or has a special
  shape.

- **DPS**
  Shows the output signal of the DPD as applied to the DUT input in the verification
  step of the measurement.
  The DPD (Digital Predistortion) output signal is the 'inverted' model behavior.

- **Optimized**
  Shows the constellation of the expected output signal of the DUT
  If both model and DPD are calculated correctly, the optimized signal should be a
  linear amplified version of the reference signal.

AM/AM

The AM/AM result display is the display used to observe nonlinear effects with and without
memory. It shows the amplitude at the DUT output (or the signal processing block if one
is used for DPD) versus the amplitude at the DUT input.

Nonlinear effects typically result in a trace that flattens near high power levels.

Memory effects typically show as slopes within the curve, especially near high output
powers.

The available trace types are as follows:

- **Meas**
  Shows the AM/AM compression of the synchronized measurement signal that is used
  for the model estimation process.
- **Modeled**
  Shows the AM/AM compression of the signal that was created by the model extraction
  and calculation.
  If the model matches the nahvior of the DUT,
- **DPD**
  Shows the AM/AM compression of the DPD as applied to the DUT input in the veri-
  fication step of the measurement.
  The DPD (Digital Predistortion) output signal is the inverted model behavior. It should
  look like a mirrored version of the modeled signal where the mirror axis is of the form
  y = Gain * x
- **Optimized**
  Shows the AM/AM compression of the expected output signal of the DUT.
  If both model and DPD are calculated correctly, the optimized signal should be a
  linear amplified version of the reference signal and should look like
  y = Gain * x

AM/PM

The AM/PM result display is the display used to observe nonlinear effects with and without
memory. It shows the difference in phase between the DUT output and the DUT input
versus the input of the DUT.

Nonlinear effects typically result in a trace that not equal to zero near high power levels.

Memory effects typically show as slopes within the curve, especially near high output
powers.

The available trace types are as follows:

- **Meas**
  Shows the AM/PM compression of the synchronized measurement signal that is used
  for the model estimation process.
- **Modeled**

Shows the AM/PM compression of the signal that was created by the model extraction and calculation.

If the model matches the behavior of the DUT, the trace should look like the measurement signal minus the noise.

- **DPD**

  Shows the phase difference signal of the DPD as applied to the DUT input in the verification step of the measurement.

  The DPD (Digital Predistortion) output signal is the inverted model behavior. It should look like a mirrored version of the modeled signal where the mirror axis is of the form $y = 0$

- **Optimized**

  Shows the expected phase difference signal of the DUT then the DPD signal is applied to the input of the DUT.

  If both model and DPD are calculated correctly, the optimized signal should look like $y = 0$

I and Q

The I and Q signals are separate representations of the complex measurement (input) and reference (output) signal. They can be used, e.g. to judge the difference influence of nonlinear effect in both I and Q chain of the DUT.

- **Ref -I**

  Shows the I part of the reference signal that is used for the model estimation process.

- **Ref -Q**

  Shows the Q part of the reference signal that is used for the model estimation process.

- **Meas -I**

  Shows the I part of the synchronized measurement signal that is used for the model estimation process.

  To match both signals visually, the nominal gain of the measurement signal can be eliminated.

  For more information see "Gain Normalization" on page 52.

- **Meas -Q**

  Shows the Q part of the synchronized measurement signal that is used for the model estimation process.

  To match both signals visually, the nominal gain of the measurement signal can be eliminated.

  For more information see "Gain Normalization" on page 52

3.4.1.3 Selecting the Evaluation Method

After selecting the type of result display, you can view the results in different ways, depending on the evaluation method you have selected. The type or aspect of the results stay the same. Only the way R&S FS-K130PC presents the results changes.

Use the [⚠ Spectrum ▾] dropdown menu to select the evaluation method.

This chapter lists all evaluation methods that R&S FS-K130PC offers.

Standard

The standard or most typical evaluation method for every result display.

This evaluation method is available for every result display.

● For the Power result display it shows the power level (y-axis) over time (x-axis). By default, the unit for the power is dBm.
● For the Gain result display it shows the gain in % (y-axis) for every measured power level (x-axis).
● For the Constellation result display, it shows the constellation of the I and Q branches of the signal in a diagram. The unit is Volt by default.
● For the AM/AM result display, the standard evaluation method shows the signal's power level at the input of the DUT against the power level at the output of the DUT. The default unit for both axis is dBm.
● For the AM/PM result display, it shows the phase difference in degrees (y-axis) for every measured power level (x-axis).
● For the I and Q result display, it shows the power over time for either the I branch of the signal or the Q branch of the signal. The branch currently shown depends on the selected trace. The unit is Volt by default.
● For the EVM result, it shows the Error Vector Magnitude (y-axis) over time (x-axis). The default unit of the EVM is %.

The number of data R&S FS-K130PC returns depends on the number of samples. The number of samples you have currently set is displayed in the diagram header.

You can change the unit for all result displays in the Configuration Dialog.

Spectrum

This evaluation method shows the frequency spectrum of the signal. The type of display of the spectrum is adapted to the characteristics of the result display.

Histogram

The histogram is a tool that shows the statistical frequencies of the measured values, e.g. the statistical frequency of measured power levels.

The complete range of measured values is split into a certain number of bins, with each bin representing a particular interval of the whole value range. Each value that has been measured is put into the corresponding interval or bin and then plotted in a diagram. The R&S FS-K130PC then connects the coordinates that the histogram defines. The result is a line chart.

The histogram itself is the basis for the CCDF.

To evaluate the histogram, the Y axis values are taken (without taking the X axis values into account). Then, the range between the minimum and maximum Y axis value is separated in a certain amount of divisions (the so called "bins"), and each Y axis value is put into the corresponding bin. The CCDF is then the number of values within one bin, relative to the total amount ov Y axis values.

For more information

CCDF

The Complentary Cumulative Distribution Function (CCDF) is a tool to describe the probability distribution of a specific variable, in case of the R&S FS-K130PC the y-axis values. The result is a measure on the propability of the variable being greater than a certain value.

The CCDF (Complementary Cumulative Distribution Function) can be seen as:

1-integrate(Histogram)

The CCDF curve starts at (min(Y),1) (as all y-axis values are greater compared to the minimum one), falls monotonic (as the y-axis values appear sorted) and ends in (max(Y), 1/number of y-axis values), as there can only be one maximum value.

3.4.1.4 Configuring the Result Display

You can customize each of the result displays to make them look like you want.

By default, the R&S FS-K130PC shows a line trace. The software however does not receive a line, but one point for each pixel on the horizontal axis. It then interpolates those points to get a line trace. If you are more comfortable with the original results, i.e. a dotted trace, you can switch between line trace and dotted trace with the "Show Line" ( ) and "Show Dots" ( ) buttons. The R&S FS-K130PC adjusts the result display accordingly.

You can also automatically adjust the vertical axis with the   button. If active, the R&S FS-K130PC automatically adjusts the vertical after each measurement in order for an optimal fit of the trace.

If you are displaying the measurement results in more than one result display, all result displays are updated after each measurement. To compare two results visually, you can freeze one result display with the   button. The R&S FS-K130PC freezes the result display in which the button is active, but still updates all other result display. With the   button, you can update the result display any time, but have to unfreeze it first.

Most of the result displays cover a large span. If you need to see a small area of the trace in more detail, you can zoom in to that area. To do so, mark the area by keeping the mouse button pressed and moving the cursor over the area you need to see in more detail. You can zoom in as far as you want. The R&S FS-K130PC adjusts the horizontal and vertical axis accordingly.

To zoom out again, you have two options:

- Press the   button in order to fit the screen size to the size of the trace.
- Press the right mouse button and select "Unzoom" or "Undo all Zoom/Pan" from the context menu.

3.4.1.5 Handling Trace Data

You have several options of what to do with the measurement results for further evaluation.

Saving the Graph

For documentation you can save the graph itself in various forms.

► Click on the 🔧 button.
A submenu that offers you several alternatives. You can either

● Save the trace as a bitmap with the same scaling as in the software.
● Save the trace as a bitmap two time the size of the original trace.
● Save the trace as a bitmap three times the size of the original trace.
● Save the trace as a vector graphic (*.emf format).

Exporting Trace Data

In addition to the graphical export you can copy the trace data in numerical form to the clipboard.

► Click on the 📊 button.
A submenu that offers you several alternatives. You can either

● Save the first trace with the x-axis.
● Save the first trace without the x-axis.
● Save the x-axis only.

3.5 Reading the Numerical Results

The numerical results table contains the measurement results in numerical form. The table always shows the same results, no matter what hardware configuration, aspect of the result and evaluation method you are using.

After starting R&S FS-K130PC, the table is empty. Start a measurement to view the numerical results.

► Push the 🔴 icon to perform the measurement.
After the measurement is finished, the numerical results are diplayed in the Numerical Results table.
The numerical results are split into several result groups:

The numerical results table contains the following results:

Some results are colored to indicate the validity of that result.

3.5.1 Results of the Power Measurements

DUT Input RMS
RMS power at the DUT input.

R&S FS-K130PC sets the input RMS power during the auto-level process. It is the numerical (not measured) final output RMS power of the signal generator. The value is corrected by the DUT input attenuation that you have set in the signal flow.

Note: If you have set a pause length, the RMS power is corrected by the pause length duty cycle to add to the RMS power during the ON time of the signal.

-

DUT Input (Peak)

Peak power at the DUT input.

R&S FS-K130PC calculates the input peak power from the input RMS power and the crest factor of the signal. It is a numerical calculation, not the measured power.

DUT Input (Crest)

Crest factor of the signal at the DUT input.

R&S FS-K130PC calculates this value from the relation of the input RMS power and the input peak power.

Typically, the result is in the range from 4 to 8 dB for digitally modulated signals and from 8 to 12 dB for OFDM signals. These results may vary.

The Crest factor at the DUT input is always 3 dB in case of dual tone signals and 0 dB for CW signals.

DUT Output RMS

RMS power at the DUT output.

It is the power that the R&S FS-K130PC measures the output RMS power during the auto-level process. It is the configured final output RMS power of the DUT after a successful auto-level procedure.

Note: If you have set a pause length, the RMS power is corrected by the pause length duty cycle to add to the RMS power during the ON time of the signal.

For more information see

-

DUT Ouput (Peak)

Peak power at the DUT output.

It is the power the R&S FS-K130PC measures at the DUT output.

DUT Output (Crest)

Crest factor of the signal at the DUT output.

R&S FS-K130PC calculates this value from the relation of the output RMS power and the output peak power.

Because of nonlinear effects of the DUT, the crest factor at the DUT output is reduced compared to the crest factor at the DUT input if the DUT enters the compression area.

DUT Output (Levelling Error)

Level error between configured and measured RMS power at the DUT output.

During the auto-level process, R&S FS-K130PC adjusts the output RMS power to meet the RMS output power you have specified. After a correct auto-level procedure this result should be 0. However, a residual error can occur if, for example, the measurement bandwidth is not correct or if there are heavy nonlinear effects inside the DUT (e.g. negative gain around the target RMS value). You can solve that problem by adjusting the "Maximum Level Loops" or the "Maximum Level Error".

For more information see

- "Maximum Level Error" on page 41
- "Maximum Level Loops" on page 41

3.5.2 Results of Signal Synchronization

Shows how well the signals are synchronized.

All errors are compensated by the synchronization algorithm.

Averages Executed
Number of I/Q reference signal data blocks used for averaging purposes.

Usually, the result should be the same as the average count you have set. Depnding on the alignment of the reference signal relative to the measurement signal, however, the number of averages can be one lower or one higher compared to the set value.

For more information see

- "Averaging Factor" on page 44

Confidence
Quality of the synchronization of reference signal and measured signal.

Typically, the confidence should be above 97%. Heavy nonlinear effects can cause lower values.

If the confidence is below 50%, it is likely that the reference and measurement signal are completely different. Probable causes are that the generator output is not connected to the DUT input, that I and Q are swapped or a damaged DUT.

Frequency Offset
Frequency difference of reference signal and measurement signal.

If the reference oscillators of signal generator and analyzer are not coupled, the two internal 10 MHz OCXOs generate slightly different reference frequencies.

If the reference frequencies are coupled, the frequency offset should be about 0 Hz.

If the offset is very high, it is likely that

- the reference frequency sources are not coupled correctly, e.g. if the analyzer is configured for external reference frequency, but the cable is not connected.
- the OCXO offsets are too high, especially if you are using custom signal generators instead of measurement signal generator like the R&S SMU.

Within the simulation mode, the frequency offset can be set as a simulation parameter.

Phase Offset
Phase offset between reference signal and measurement signal.

If you are using the RF path for measurements, the phase between reference and measurement signal is random because the RF phases between signal generator and analyzer are not locked, even if the reference frequencies are locked. This is a typical behavior of two RF measurement instruments.

Trigger Offset
Offset between the trigger event and the start of the reference signal waveform.

I/Q Offset

Shift of the ideal I/Q constellation in the I/Q plane.

The I/Q offset value can be seen as a complex linear shift of the ideal I/Q constellation points in the I/Q plane.

Gain Imbalance

Gain difference between the real (I) and imaginary (Q) part of the signal.

This effect is typically generated by two separate amplifiers in the I and Q path of the analog baseband signal generation which have different gains.

Quadrature Error

Phase deviation of the 90° phase difference between I and Q.

Within a typical transmitter, the I and Q signal parts are mixed with an angle of 90° by the IQ output mixer. Due to hardware imperfections, the signal delay of I and Q may be different and thus lead to an angle non-equal to 90°.

I/Q Imbalance

Combination of Quadrature error and Gain imbalance.

The I/Q imbalance parameter is another representation of the combination of Quadrature error and gain imbalance.

Index