

R&S®FS-K40

Application Firmware for Phase Noise Tests for R&S®Analyzers Software Manual



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The Software Manual describes the following R&S®FS-K40 option and models:

- R&S®FSG
- R&S®FSMR (only for ser. no. >200 000)
- R&S®FSP
- R&S®FSQ
- R&S®FSU
- R&S®FSUP

The firmware of the instrument makes use of several valuable open source software packages. The most important of them are listed below, together with their corresponding open source license. The verbatim license texts are provided on the user documentation CD-ROM (included in delivery).

Package	Link	License
Xitami	http://www.xitami.com	2.5b6

Rohde&Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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The following abbreviations are used throughout this manual:

R&S®FS-K40 is abbreviated as R&S FS-K40.

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 $\pm 10\%$ shall apply to the nominal voltage and $\pm 5\%$ 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 $V_{\text{rms}} > 30 \text{ V}$, 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.

Basic Safety Instructions

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.

Informaciones elementales de seguridad

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	Advertencia: superficie caliente	Conexión a conductor de protección	Conexión a tierra	Conexión a masa	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)

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

Palabras de señal y su significado

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



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



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



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



AVISO indica la posibilidad de utilizar mal el producto y, como consecuencia, dañarlo.

En la documentación del producto se emplea de forma sinónima el término CUIDADO.

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

Estados operativos y posiciones de funcionamiento

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

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de $\pm 10\%$ sobre el voltaje nominal y de $\pm 5\%$ 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 $U_{\text{eff}} > 30 \text{ V}$ 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.

Informaciones elementales de seguridad

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 señalar 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.

Informaciones elementales de seguridad

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

Qualitätszertifikat

Certificate of quality

Certificat de qualité

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde&Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde&Schwarz-Qualitätsmanagementsystem ist u.a. nach ISO9001 und ISO14001 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 ISO9001 and ISO14001.

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 ISO9001 et ISO14001.

Engagement écologique

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

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 (except US public holidays)
8:00 AM – 8:00 PM Eastern Standard Time (EST)

Tel. from USA 888-test-rsa (888-837-8772) (opt 2)
From outside USA +1 410 910 7800 (opt 2)
Fax +1 410 910 7801

E-mail CustomerSupport@rohde-schwarz.com

East Asia

Monday to Friday (except Singaporean public holidays)
8:30 AM – 6:00 PM Singapore Time (SGT)

Tel. +65 6 513 0488
Fax +65 6 846 1090

E-mail CustomerSupport@rohde-schwarz.com

Rest of the World

Monday to Friday (except German public holidays)
08:00 – 17:00 Central European Time (CET)

Tel. +49 89 4129 13774
Fax +49 (0) 89 41 29 637 78

E-mail CustomerSupport@rohde-schwarz.com



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Documentation Overview

The user documentation for the R&S FS-K40 is divided as follows:

- R&S® FSG
- R&S® FSMR
- R&S® FSP
- R&S® FSQ
- R&S® FSU

Conventions Used in the Documentation

The following conventions are used throughout the R&S FS-K40 Software Manual:

Typographical conventions

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

Other conventions

- **Remote commands:** Remote commands may include abbreviations to simplify input. In the description of such commands, all parts that have to be entered are written in capital letters. Additional text in lower-case characters is for information only.
- **Procedure descriptions:** When describing how to operate the device, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described, where available. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the device or the on-screen keyboard is only described if it deviates from the standard operating procedures as described in the Quick Start Guide under "Basic Operations".

The terms "**select**" and "**press**" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the device or on a keyboard.

1 General Information

The Rohde & Schwarz FS-K40 application extends the functionality of the R&S FSP, R&S FSU and R&S FSQ spectrum analyzers to enable phase noise measurements.

This manual supports the user in working with R&S FS-K40. It aids the preparation, execution and evaluation of a measurement and gives many helpful hints and examples.

For the user wanting to make a quick start to using R&S FS-K40, the Quick Start Guide section below works step-by-step through an ordinary phase noise measurement. The remainder of this section describes all of the basic information about how the R&S FS-K40 application works, without covering phase noise measurements in detail. A detailed description of all measurement modes, settings and results can be found in section 2. Section 3 covers remote control operation of R&S FS-K40.

This section covers the following subjects:

- Introduction to R&S FS-K40 & Phase Noisemeasurements
- Installation
- Starting the application
- Exiting the application
- Quick start guide – allows the user to get up-and-running in minimum time
- Navigation
- Save/recall – saving & recalling user settings & measurement results
- Printing
- Limit Lines

1.1 Introduction to R&S FS-K40 & Phase Noise Measurements

Phase Noise Measurement Software R&S FS-K40 extends the measurement capabilities of Rohde&Schwarz spectrum analyzers to give a phase noise tester. The R&S FSP, R&S FSU & R&S FSQ are ideal for this purpose because of their low inherent phase noise and noise figure. The high phase noise measurement speed is achieved through the high sweep rates of all analyzers. It is possible to trade off speed against accuracy at small resolution bandwidths (≤ 1 kHz) by using either FFT or digital filters. The software allows different settings within a phase noise diagram, e.g. FFT close to the carrier and analog/digital filters far off the carrier.

1.2 Installation

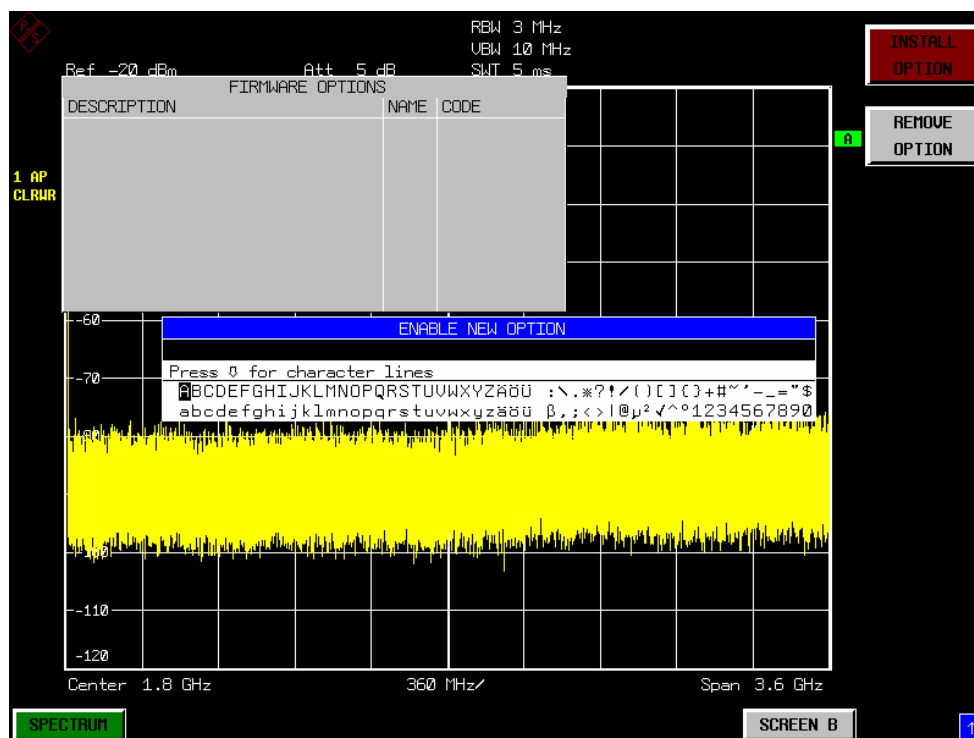
From the analyzer select firmware update.

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

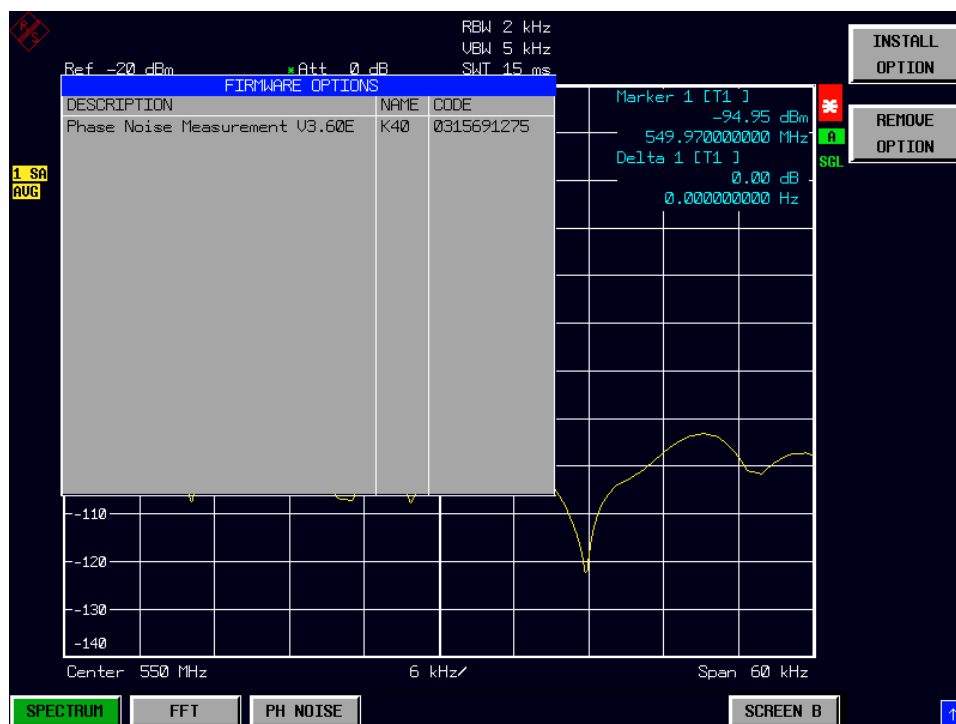
Once the installation has completed the analyzer will reboot.

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

2. Start up the analyzer
3. Press the *SETUP* hardkey, followed by the *GENERAL SETUP* softkey and then the *OPTIONS* softkey. A list of the options currently activated is displayed.
4. Press the *INSTALL OPTION* softkey. A Dialog is displayed allowing the option key to be entered.



5. Enter the option key supplied with the R&S FS-K40 software.
6. When a valid option key has been supplied a dialog will be displayed explaining that a reboot is required to complete this operation. Select OK in this dialog and the instrument will be rebooted
7. When the analyzer starts after the reboot a new hotkey will be displayed at the bottom of the display labelled *PH NOISE*. In addition an entry for the R&S FS-K40 option will be displayed in the *FIRMWARE OPTIONS* dialog.



1.3 Starting the application

Power up the R&S spectrum analyzer. When R&S FS-K40 is correctly installed there will be a hotkey labelled *PH NOISE* at the bottom of the screen. Press the *PH NOISE* hotkey to start R&S FS-K40.

Note that if the spectrum analyzer is powered down whilst R&S FS-K40 is active, then when the spectrum analyzer is powered up again it will start up in the R&S FS-K40 application.

1.4 Exiting the application

To exit the R&S FS-K40 option, press the *SPECTRUM* hotkey at the bottom of the screen. This will cause the option to exit and the spectrum analyzer to be activated.

1.5 Quick Start Guide

This section helps the user to quickly become familiar with R&S FS-K40 by working step-by-step through an ordinary measurement. (Refer to section 2 for a detailed reference guide.)

1.5.1 Setting up the measurement

1. Start the R&S FS-K40 application.

2. Press the *GENERAL SETTINGS* softkey to open the General Settings view.

General Settings

Signal Settings

Frequency	20.000000 GHz
Level	-20 dBm
Sweep Forward	<input type="checkbox"/>
Verify Frequency & Level	<input checked="" type="checkbox"/>
Frequency Tolerance	= max(Rel Tol, Abs Tol)
Relative	10 %
Absolute	1 kHz
Level Tolerance (+/-)	10 dB

AFC Settings

Track Frequency	<input type="checkbox"/>
Track Level	<input type="checkbox"/>

Display Settings

X Axis Start	1 kHz
X Axis Stop	1 MHz
Autoscale Once	<input checked="" type="checkbox"/>
Y Axis Top	-20 dBc/Hz
Y Axis Range	100 dB

Trace Settings

Trace Offset	0 dB
Smoothing	1 %
Smoothing Type	Linear

Residual Calculations

Use Meas Settings	<input checked="" type="checkbox"/>
Eval From	1 kHz
To	1 MHz

Spot Noise Settings

Enable	<input checked="" type="checkbox"/>
Offset Freq1	1 kHz
Offset Freq2	10 kHz
Offset Freq3	100 kHz
Offset Freq4	1 MHz

Analyzer Settings

PreSelector	<input type="checkbox"/>
Preamplifier (Preselect)	<input type="checkbox"/>
Preamplifier	<input type="checkbox"/>

Min: 0 Hz Max: 40 GHz

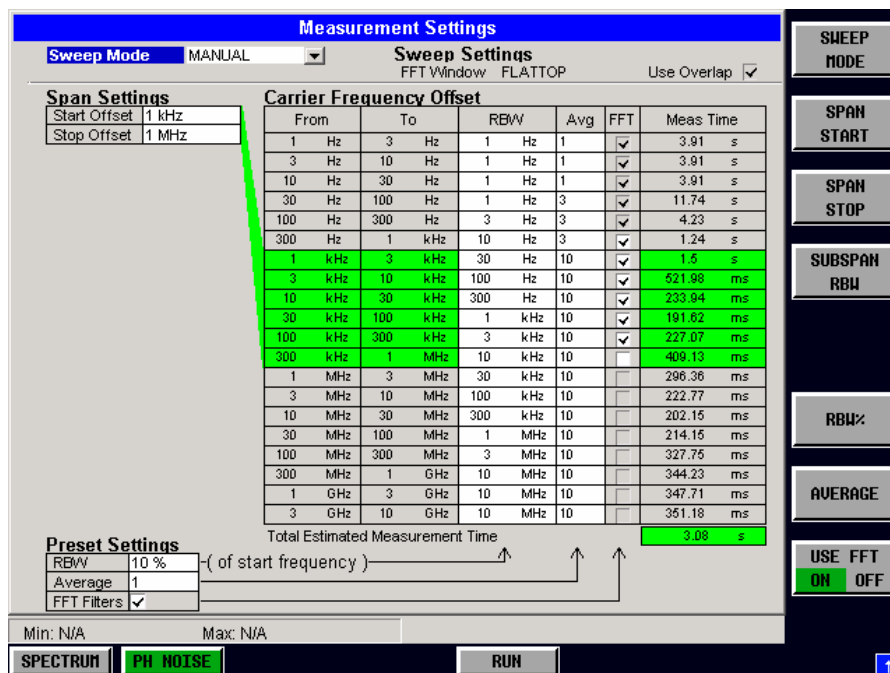
SPECTRUM PH NOISE RUN

SIGNAL SETTINGS
DISPLAY SETTINGS
TRACE SETTINGS
RESIDUAL CALC
SPOT NOISE
SMOOTHING%

3. Select the *Frequency* field and enter the desired frequency to measure.
4. Select the *Level* field and enter the level of the input signal.
5. Select the *Verify Frequency & Level* field and ensure the check box is switched off. The setting of this field can be changed by pressing the *ENTER* key or pressing the roll-key.

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

6. Press the *MEAS SETTINGS* softkey to open the Measurement Settings view



7. Enter the start and stop frequency offsets to measure. Note that the selected range is highlighted in the *Carrier Frequency Offset* table. Note also that the overall expected measurement time is displayed at the bottom of the *Carrier Frequency Offset* table.
8. Close the Measurement Settings by pressing the *PH NOISE* hotkey or by pressing *ESC*.

1.5.2 Performing the main measurement

Before performing a Phase Noise measurement connect the DUT to the RF Input of the spectrum analyzer.

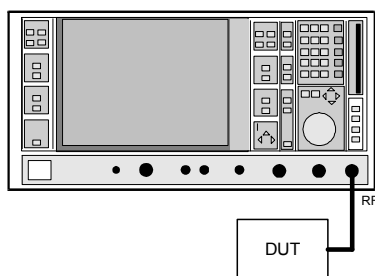
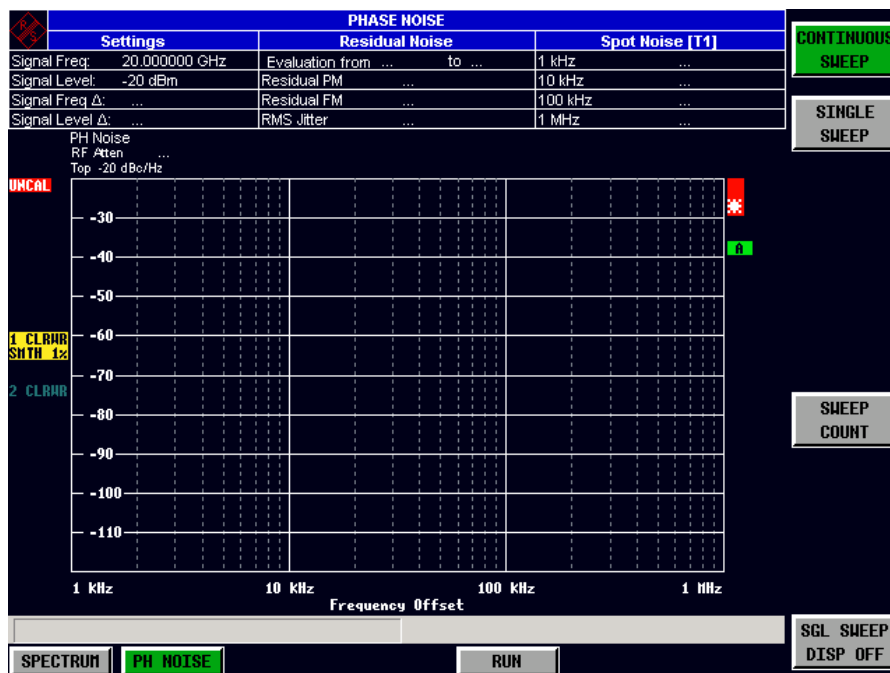


Fig. 1 Test Setup

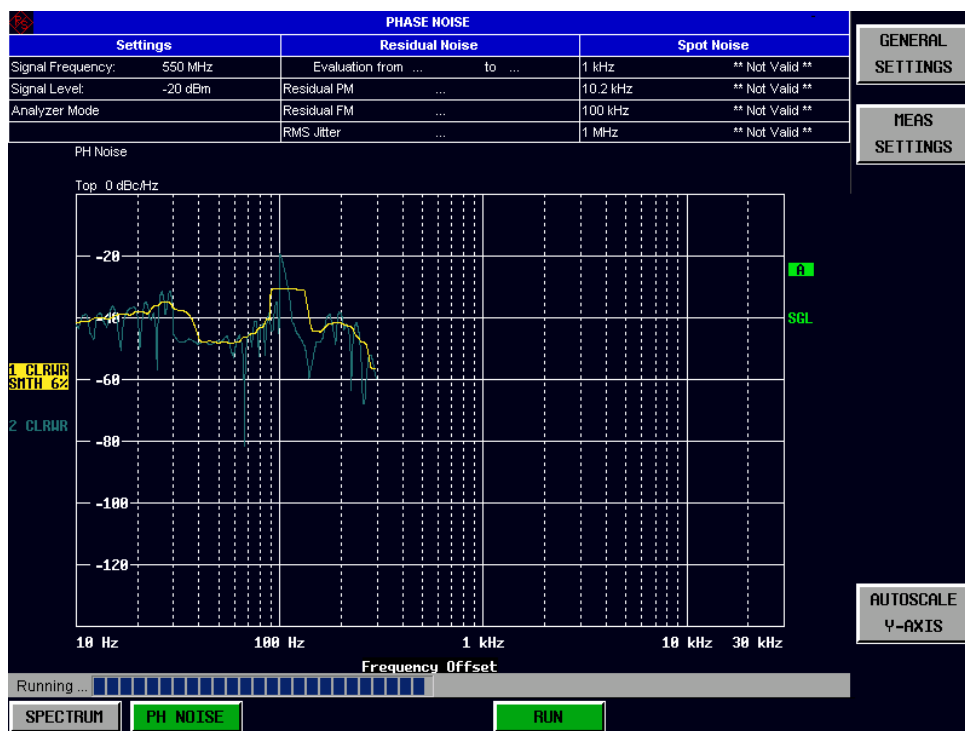
1. Press the *SWEEP* hard-key



2. Select a single sweep measurement by pressing the *SINGLE SWEEP* softkey
3. Start the measurement by pressing the *RUN* hotkey.

During the measurement, the text "*Running...*" is displayed in the Status Bar at the bottom of the screen. The progress bar will update to show progress through the measurement sub-sweeps.

Measurement results are updated whilst the measurement is running. The results are displayed in graphical form. Note that the trace may not be visible during a first measurement if the trace is below the display range. Once the full measurement sweep has completed the trace will rescale to show the trace results.



1.6 Navigation

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

- Hotkeys
- Softkeys
- Hardkeys
- Numeric Keypad
- Roll-key
- Cursor Keys
- External Keyboard
- Mouse

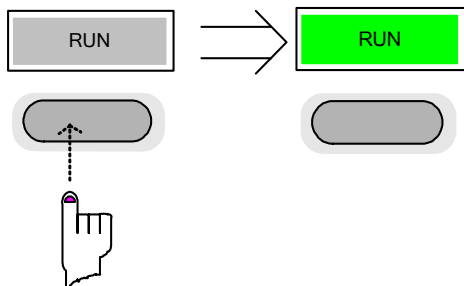
1.6.1 Hotkeys

Hotkeys are allocated to the seven keys at the bottom edge of the screen. On initial start-up of the R&S FS-K40 option, the hotkeys provided are shown in Fig. 2. These hotkeys are present at all times once the option has been started.



Fig. 2 Initial Hotkey menu

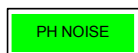
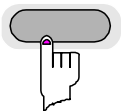
A keystroke activates the associated hotkey. An activated hotkey changes colour to green, as shown.



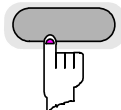
These hotkeys perform the following operations:



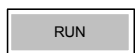
The *SPECTRUM* hotkey exits the R&S FS-K\$0 option & returns to the spectrum analyzer with all previous settings restored.



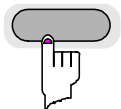
The *PH NOISE* hotkey returns the user to the main measurement menu of R&S FS-K40, where measurement results can be seen. All settings views and dialogs are removed from the display, and the default softkey menu is displayed



The *PH NOISE* hotkey remains green whenever R&S FS-K40 is active



The *RUN* hotkey starts the selected measurement.



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

1.6.2 Softkeys

1.6.2.1 Settings Softkeys

The softkeys are assigned to the nine keys on the right-hand side of the display. These enable quick access to all of the parameter settings and measurement screens of the K40 option. Each of the top two softkeys, when pressed, brings up a settings view for a group of parameters. These softkeys are always available (except when using Save/Recall and Print manager or controlling markers) and are as follows:

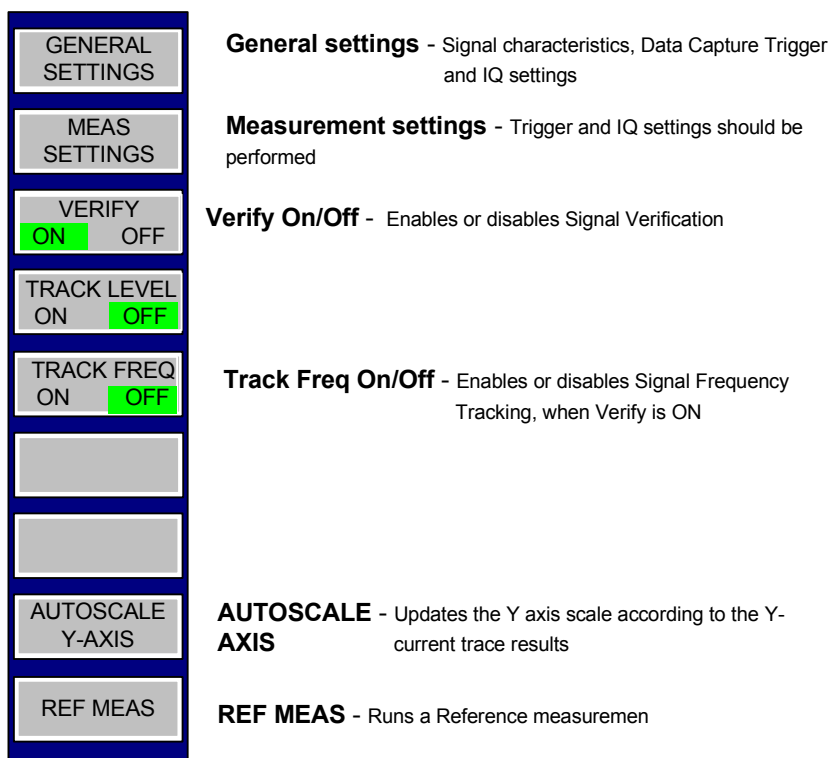


Fig. 3 Main softkeys

1.6.2.2 Other Softkeys

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

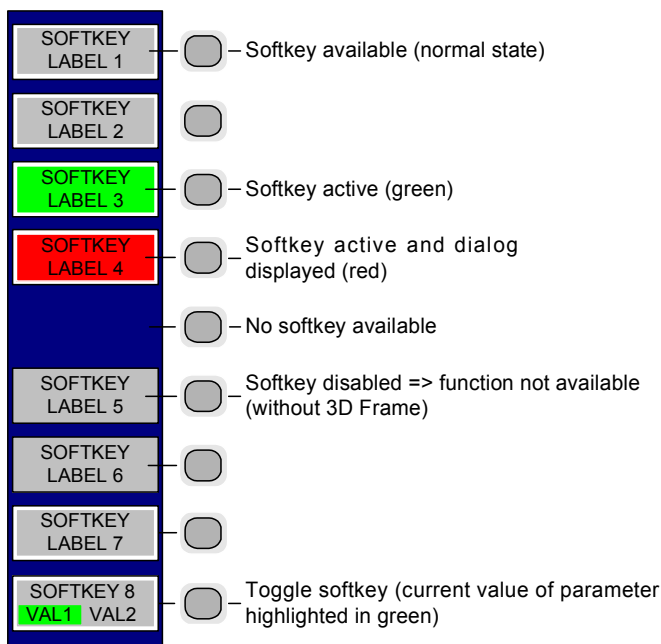


Fig. 4 Setup of the softkey area

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

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

An active softkey (highlighted in green) is used when the softkey selects an item or view. For example, the *GENERAL SETTINGS* softkey will be highlighted green when the General Settings view is displayed.

A toggle softkey is used to change the value of a parameter that has only two states. Each press of the softkey toggles the value of the parameter. The current parameter value is highlighted in green in the lower half of the softkey label. For example, in the marker menu, the *MARKER* softkey will have either *NORM* or *DELTA* highlighted in green depending on whether the marker is a normal or delta marker.

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

1.6.3 Hardkeys

FREQ Hardkey	When the <i>FREQ</i> hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the <i>Frequency</i> parameter is selected.
AMPT Hardkey	When the <i>AMPT</i> hardkey is pressed the General Settings view is displayed (if it is not already being displayed) and the <i>Level</i> parameter for the selected signal input is selected.
BW Hardkey	When the <i>BW</i> hardkey is pressed the Measurement Settings view is displayed (if it is not already being displayed) and the <i>RBW</i> parameter for the first active sub-sweep is selected.
MKR Hardkey	When the <i>MKR</i> hardkey is pressed the main Marker softkey menu is displayed (if it is not already being displayed).
MKR-> Hardkey	When the <i>MKR-></i> hardkey is pressed the Marker extension softkey menu is displayed (if it is not already being displayed).
SPAN Hardkey	When the <i>SPAN</i> hardkey is pressed the Measurement Settings view is displayed (if it is not already being displayed) and the <i>RBW</i> parameter for the first active sub-sweep is selected.
SWEEP Hardkey	When the <i>SWEEP</i> hardkey is pressed the Sweep softkey menu is displayed (if it is not already being displayed).
MEAS Hardkey	When the <i>MEAS</i> hardkey is pressed the Main softkey menu is displayed (if it is not already being displayed).
TRACE Hardkey	When the <i>TRACE</i> hardkey is pressed the Trace softkey menu is displayed (if it is not already being displayed).
LINES Hardkey	When the <i>LINES</i> hardkey is pressed the Limit Lines Editor is displayed, containing the list of limit lines relevant to the current measurement.
DISP Hardkey	When the <i>DISP</i> hardkey is pressed the Display softkey menu is displayed (if it is not already being displayed).
FILE Hardkey	When the <i>FILE</i> hardkey is pressed, the Save & Recall softkey menu is displayed, allowing the save & recall of settings and/or measurement results of the R&S FS-

	K40option.
PRESET Hardkey	When the <i>PRESET</i> hardkey is pressed the R&S FS-K40option is exited and a preset will be performed. Note that all options shall also be preset.
HCOPY Hardkey	When the <i>HCOPY</i> hardkey is pressed the print manager softkey menu is displayed, allowing selection of the items to be printed.

1.6.4 External Keyboard

The external keyboard is optional. The keys on the external keyboard that can be used to interact with the R&S FS-K40 option are as follows:

Number keys 0 to 9	
Decimal point (".")	Inserts a decimal point "." at the cursor position.
Minus key ("-")	Changes the sign of the mantissa or exponent of a numeric parameter. A "-" is inserted at the cursor position in the case of an alphanumeric parameter.
ESC key	Aborts the entry before it has been terminated. The previous value is restored. Closes the entry field after termination of input. Closes pop-up dialogs.
ENTER key	Terminates the input of dimension quantities. The new value is set. Invokes the input of parameters or immediately sets the new value. Selects the highlighted item in drop-down menus.
Left and Right Cursor Keys are used to:	Navigate between individual parameters within the setting views and some of the pop-up dialogs. Navigate between the individual items within drop-down menus. Move the cursor left & right inside the entry window to reach a particular position in the string during alphanumeric entry.
Up and Down Cursor keys are used to:	Navigate between individual parameters within the setting views and some of the pop-up dialogs. Navigate between the individual items within drop-down menus. Increment or decrement the value of a parameter during numeric entry.
CTRL keys	Used to activate hotkeys. Each of the seven hotkeys is allocated a different function (F) key. To access these hotkeys press CTRL and the corresponding F key together (see Fig. 1):

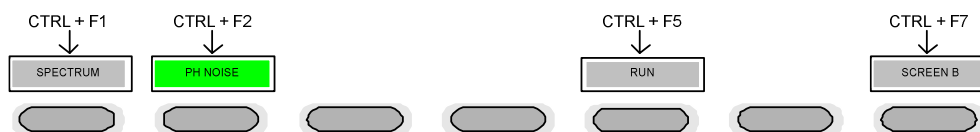


Fig. 1 Quick Access to Hotkeys

Function Keys

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

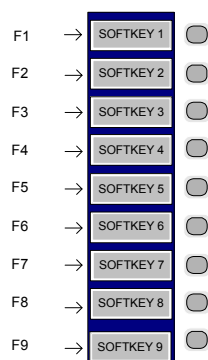


Fig. 2 Quick access to softkeys

1.6.5 Mouse

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

1.6.6 Selecting & Editing Parameters

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

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

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

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

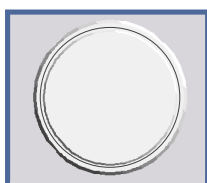
1.6.6.1 Numeric Keypad



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

- Number keys 0 to 9
Starts editing of the selected parameter. This enables a new value to be entered for a parameter directly without having to press *ENTER* first. The digit will be displayed as the first digit of the newly entered value.
- Inserts a digit at the cursor position when editing an alphanumeric parameter.
- Decimal point
Inserts a decimal point “.” at the cursor position.
- Sign key (“-“)
Changes the sign of the mantissa or exponent of a numeric parameter. A “-“ is inserted at the cursor position when editing an alphanumeric parameter.
- Unit keys (GHz/dBm, MHz/dBm, kHz/dB and Hz/dB)
- Provides the numeric value entered with the selected unit and sets the parameter to that value.
The unit keys are all assigned the value “1” for dimensionless quantities or for level entries (e.g. in dB). The unit keys thus assume the function of an *ENTER* key.
- *BACK* key
Deletes the character to the left of the cursor with alphanumeric entry.
- *ESC/CANCEL* key
Aborts the entry of a new parameter value. The previous value is restored.
- Closes pop-up dialogs.
- *ENTER* key
Enables editing of the selected parameter (using numeric keys or rollkey).
Finishes the editing of a parameter value. The new value is set.
For an alphanumeric value, the new value is set to that displayed (using the current unit if applicable).
- In a drop-down menu, the parameter is set to the currently selected value in the list.

1.6.6.2 Rollkey



The rollkey has various functions:

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

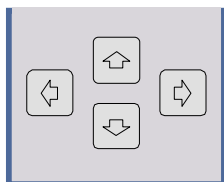
In drop-down menus, the rollkey can be used to navigate between the individual values for the parameter.

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

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

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

1.6.6.3 Cursor Keys



The keys  and  are used to:

- Navigate between individual parameters within the setting views and some of the pop-up dialogs.
- Navigate between the individual values within drop-down menus.
- Move the cursor left & right inside the entry window to reach a particular position in the string during alphanumeric entry.

The keys  and  are used to:

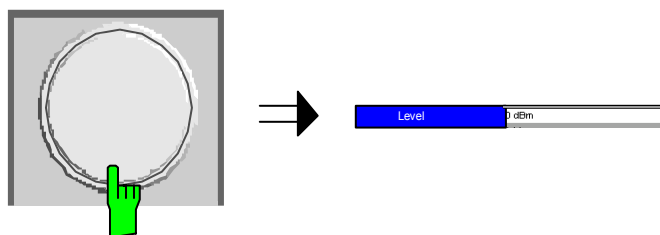
- Navigate between individual parameters within the setting views and some of the pop-up dialogs.
- Navigate between the individual items within drop-down menus.
- Increment or decrement the value of a parameter during numeric entry.

1.6.6.4 Selection of a parameter within a settings view

Selection using rollkey

4. Press *SET FREQ* softkey for example (Frequency settings view is displayed).
5. Rotate the rollkey until reaching the required parameter.
Turning the rollkey clockwise selects parameters in the upward direction, turning it counter-clockwise selects parameters in the downward direction.

Example: Selecting *Image Rejection* (Frequency settings)



When the Level parameter is selected its label is highlighted blue.

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

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

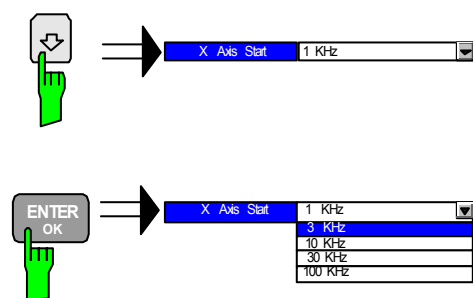
Selection using cursor keys

1. Cursor  ,  ,  or  until obtaining the required parameter.

Within a list of parameters, the *Down* and *Right* both move to the next item (down) in the list and the *Up* and *Left* keys both move to the previous item (up) in the list. Within a table of parameters, the cursor keys move the cursor in the direction indicated.

2. To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey.
3. For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Example: Selecting X-Axis Start



.When *ENTER* is pressed, a drop-down menu is displayed, which contains all the available settings to which the Demodulator parameter can be set.

Selection using mouse

1. Use the mouse to move the cursor to the parameter and press the left mouse button to select the parameter.
2. To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey.

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

Selection using external keyboard

1. Select parameter using the cursor keys (in the same way as using the cursor keys on the front panel).
2. To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey.

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

1.6.6.5 Entry of a numeric value

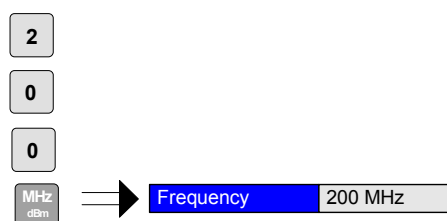
Once a parameter has been selected (see above), a new value for a numeric parameter can be entered in a number of ways. With the exception of entry via the number keys, to start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rollkey before following the instructions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

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

Entry using number keys (numeric keypad)

- ▶ Enter required value using the number keys.



Example: To enter 200 MHz



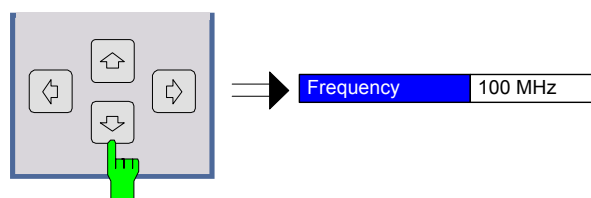
The parameter is not set to the new value until either one of the unit keys on the numeric keypad, the ENTER or the rollkey is pressed.

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

Entry using cursor keys

- ▶ Cursor  or  until obtaining the required value.
The application prevents the minimum and maximum values of the parameter from being exceeded and displays an “Out of range” message box if attempted.
N.B The cursor keys increment/decrement a parameter value in large steps.

Example: Cursor down to 100MHz



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

Entry using rollkey

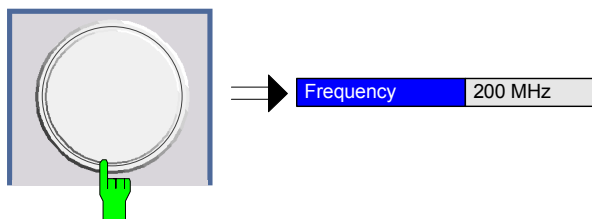
- ▶ Rotate the rollkey until reaching the required value.

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

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

N.B The rollkeys increment/decrement a parameter value in small steps

Example: Rotate to 200MHz



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

Entry using external keyboard

- ▶ Enter value using number keys 0 – 9 in the same way as for using the number keys on the numeric keypad (see above).

Terminating the entry

1. Press one of the unit keys on the numeric keypad.

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

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



The new parameter value is set immediately.



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

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

Correcting the entry

1. Position the cursor to the right of the digit which is to be deleted using the cursor keys  or .
2. Press the BACK key. The digit to the left of the cursor is deleted.
3. Enter new digits. Each digit is inserted to the left of the cursor, the other digits are shifted right.

Aborting the entry

1. Press the *ESC* key during parameter editing.
The original parameter value is restored. The new entry is deleted.
2. If a pop-up dialog is displayed, press the *ESC* key again.
The entry window is closed, the original value remains active.



1.6.6.6 Entry of an enumerated value

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



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

Selection of setting using cursor keys

1. Cursor  or  until obtaining the required setting.
2. Press *ENTER* on external keyboard or numeric keypad, or press rollkey to select the desired setting of parameter.



Currently selected setting of the parameter is highlighted blue.
Pressing ENTER sets the new setting of the parameter immediately.

Selection of setting using rollkey

1. Rotate the rollkey until reaching the required setting.
2. Press rollkey to select setting.

Example: Select *Mode* parameter.



Currently selected setting of the parameter is highlighted blue.
Pressing ENTER sets the new setting of the parameter immediately.

Selection of setting using mouse

- When the parameter is selected and ready for editing, select a new setting using the mouse by left-clicking on the new setting from the drop-down list. The new setting of the parameter is set immediately.

Selection of setting using external keyboard

1. Select setting using cursor keys.
2. Press *ENTER* to set the parameter to the new value.

1.6.6.7 Entry of a checkbox

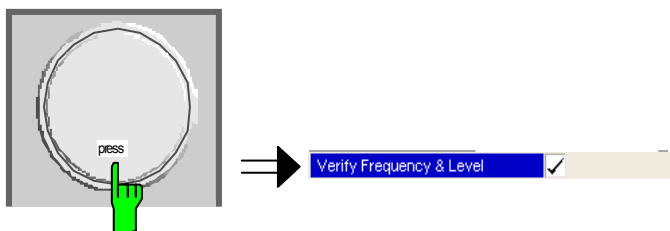
A checkbox is used for parameter settings that are either On or Off (Boolean settings). A checkmark (✓) appears in the box when the setting is On; the checkbox is empty when the setting is Off.

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

Toggle between the two states of a checkbox using rollkey

- ▶ Press the rollkey to toggle between the two states.

Example: Turn *Verify Frequency & Level* setting to Off

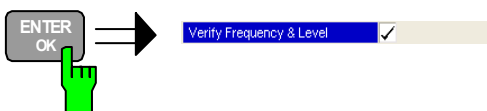


The checkbox is empty when the settings is Off

Toggle between the two states of a checkbox using numeric keypad

- ▶ Press the *ENTER* key to toggle between the two states.

Example: Turn *Auto Level* setting to On



Toggle between the two states of a checkbox using a mouse

- ▶ Left-click on the checkbox to toggle between the two states.

Toggle between the two states of a checkbox using external keyboard

- ▶ Press *ENTER* to toggle between the two states.

1.6.7 Status Bar & Title Bar

1.6.7.1 Title Bar

The title bar is visible at the very top of the display when R&S FS-K40 is active and no settings views are displayed.



Fig. 5 Title Bar

The centre of the title bar shows the name of the active application. For R&S FS-K40, this is “PHASE NOISE”.

1.6.7.2 Status Bar

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

When a parameter in a settings view is selected, the status bar will display the minimum and maximum, settings for the selected parameter (see Fig. 6).

MIN:<XX.XX>

MAX:<XX.XX>

Fig. 6 Status Bar

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

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

The status bar is also used to display warning and error messages to the user. In order to highlight these messages, warning messages are displayed with a blue background and error messages with a red background. Refer to Section 4 for a list of warning and error messages.

1.7 Save/Recall

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

FILE

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

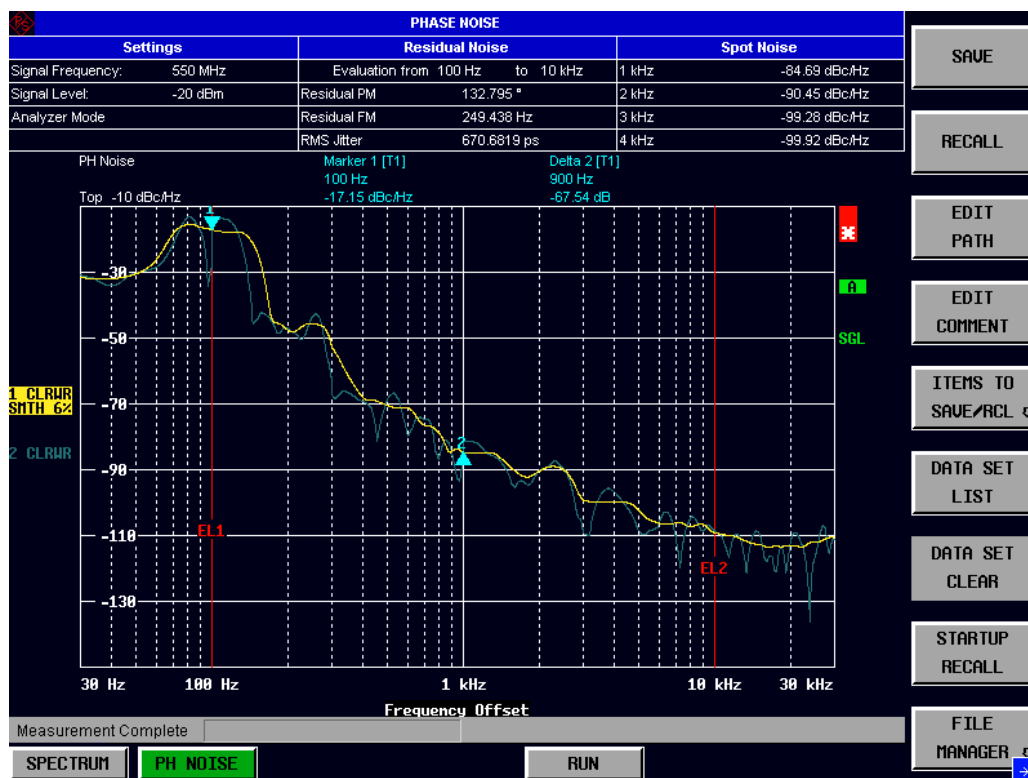


Fig. 7 Save/Recall softkey menu

The save/recall facility provided by R&S FS-K40 is exactly the same as that provided by the host analyser. Refer to the user manual for the spectrum analyzer for details of the save/recall facility operation.

The save/recall facility in R&S FS-K40 provides the following items that can be saved and/or recalled:

- Current Settings All user settings provided by R&S FS-K40
- K40 Results All current trace results
- All Limit Lines All limit lines.

To close the save/recall softkey menu and return to the main R&S FS-K40 softkey menu, press the *PH NOISE* hotkey.

1.8 Printing

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

HCOPY

The *HCOPY* hardkey brings up the print softkey menu. Any settings views on display when the print softkey menu is displayed shall be closed.



Fig. 8 Print softkey menu

The print facility provided by R&S FS-K40 is exactly the same as that provided by the host analyser. Refer to the user manual for the spectrum analyzer for details of the print facility operation.

To close the print softkey menu and return to the main R&S FS-K40 softkey menu, press the *PH NOISE* hotkey.

1.9 Limit Line

This section of the user manual describes limit line facility of the option.

LINES

The *LINES* hardkey brings up Limit Line selection view and softkey menu. Any settings views on display when the limit lines selection view is displayed shall be closed.

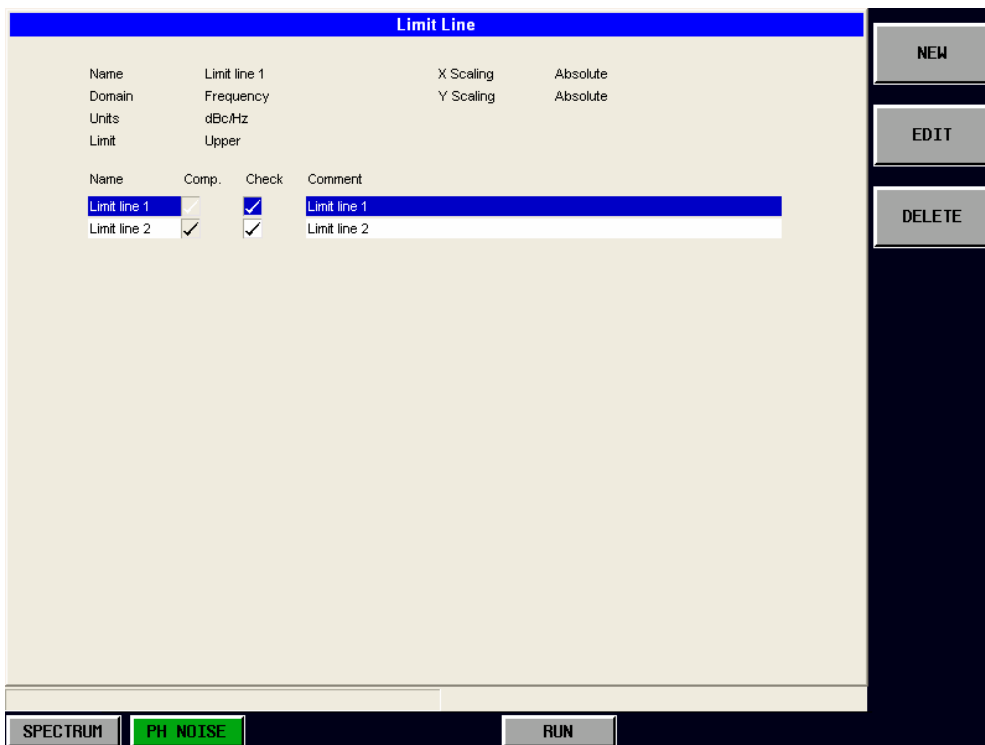


Fig. 9 Limit Line selection view

From the Limit Line selection view it is possible to add new limit lines, edit existing limit lines, delete limit lines and enable/disable the display of limit lines.

1.9.2 Adding Limit Lines

New limit lines can be defined by pressing the *NEW* softkey from the limit line selection softkey menu.

NEW

The *NEW* softkey allows a new limit line to be defined. After pressing the *NEW* softkey the limit line selection view will be replaced with the limit line data view.

Fig. 10 Limit Line data view (for a new limit line)

Once the limit line data has been entered as required, press the *SAVE* softkey to save the changes. Pressing the *ESC* hardkey will display a prompt requesting whether the limit line data should be stored or not. Select the appropriate response with the cursor keys or rollkey and hit *ENTER* or press the rollkey to perform the selected action.

1.9.2.2 Name

The *Name* field allows each limit line to be uniquely identified. The name can contain any combination of number, letters and characters.

Each limit line must have a unique name. An error message will be displayed if a new limit line is added with the same name as an existing limit line.

Pressing the *NAME* softkey will cause the *Name* field to be selected.

1.9.2.3 Comment

Comment

The *Comment* field allows the user to attach a textual description to a limit line. The comment can contain any combination of number, letters and characters.

1.9.2.4 Trace No.

Trace No.

The *Trace No.* field allows the user to specify the id of the trace to which the limit line is to be applied. Each limit may only be applied to one trace at a time. Each trace may have multiple limit line applied to it at any given time.

1.9.2.5 Frequency / Limit Table

The *Frequency/Limit Table* lists the Limit values for specific Frequency values.

When focus is moved to the Frequency/Limit Table at the bottom left of the view, the current parameter in the table is highlighted. Navigation through the table is possible in all four directions using the cursor keys.

It is possible to add individual values directly into the Frequency/Limit Table, including insertion and deletion of *Frequency/Limit* value pairs (rows in the list). The list can contain up to 100 *Frequency/Limit* value pairs. Note that the order of *Frequency* values must be in ascending sequence.

The screenshot shows the 'Limit Line' configuration window. It contains several input fields and a table. On the right side, there is a vertical column of buttons: NAME, VALUE, INSERT, DELETE, and SAVE. At the bottom, there are buttons for SPECTRUM, PH NOISE, and RUN.

Name	<input type="text" value="Name?"/>	X Scaling	Absolute
Domain	Frequency	Y Scaling	Absolute
Units	dBc/Hz	Trace No.	<input type="text" value="1"/>
Limit	Upper		
Comment	<input type="text" value="Comment?"/>		
Frequency	Limits/dBc/Hz		
55 MHz	-10 dBc/Hz		
60 MHz	-11 dBc/Hz		
70 MHz	-11.5 dBc/Hz		
...	...		

Fig. 11 Frequency/Limit table

INSERT

The *INSERT* softkey inserts a new row in the Limit Table directly above the row currently selected. The cursor will be moved to the corresponding column in the new row ready for detailed entry. The *INSERT* softkey shall be disabled when the maximum number of entries in the Limit Table has been reached

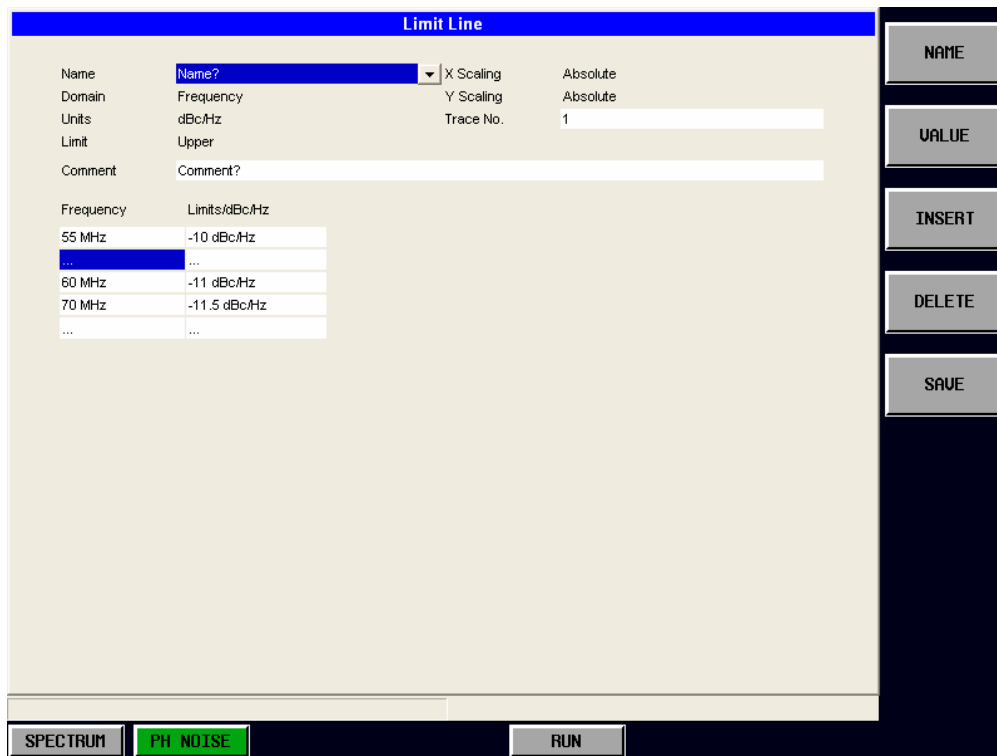


Fig. 12 Inserting limit line data

DELETE

The *DELETE* softkey deletes the currently selected row in the Limit Table. Note that no confirmation is required for this action. The cursor will be moved to the corresponding column in the next row.

1.9.3 Modifying Limit Lines

Existing limit lines can be modified by pressing the *EDIT* softkey from the limit line selection softkey menu

EDIT

The *EDIT* softkey allows the limit line selected in the limit line selection view to be modified. After pressing the *EDIT* softkey the limit line selection view will be replaced with the limit line data view containing the limit line data for the selected limit line.

Frequency	Limits/dBc/Hz
55 MHz	-10 dBc/Hz
60 MHz	-11 dBc/Hz
70 MHz	-11.5 dBc/Hz
...	...

Fig. 13 Limit Line data view (for an existing limit line)

Once the limit line data has been modified as required, press the *SAVE* softkey to save the changes. Pressing the *ESC* hardkey will display a prompt requesting whether the changes to the limit line data should be stored or not. Select the appropriate response with the cursor keys or scroll key and hit *ENTER* or press the rollkey to perform the selected action.

1.9.4 Deleting Limit Lines

Existing limit lines can be deleted by pressing the *DELETE* softkey from the limit line selection softkey menu

DELETE

The *DELETE* softkey allows the limit line selected in the limit line selection view to be deleted.

1.9.5 Enabling / disabling Limit Lines

Limit lines can be enabled and disabled. When a limit line is enabled it will be displayed in the relevant results graph, and limit checking will be performed. When a limit line is disabled it will not be displayed and no limit checking for this line will be performed.

To enable/disable a limit line select the required limit line in the limit line selection view. When the required limit line is highlighted press the ENTER key or press the rollkey to toggle the state of the limit line between enabled and disabled. When a limit line is enabled a ✓ symbol is shown in the *Enabled* field. Note that only one limit line of each type can be active at a given time.

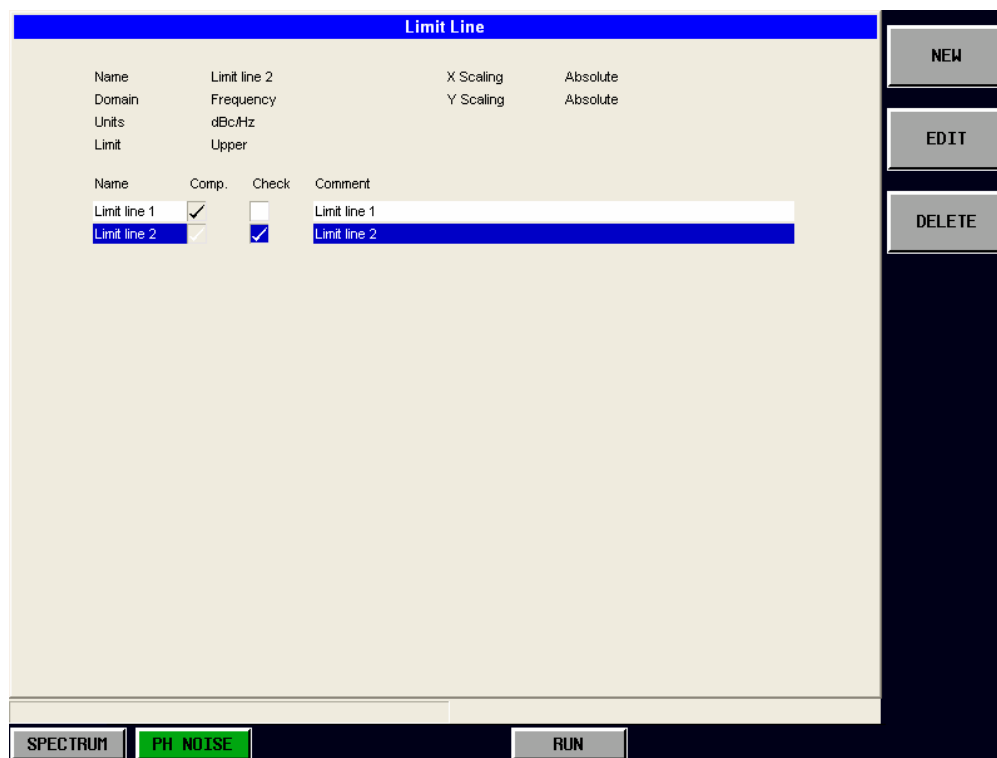


Fig. 14 Enabling/Disabling limit lines using the Limit line selection view

2 Measurements & Settings

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

- Running measurements
- Measurement results
- General settings
- Measurement settings
- Marker settings
- Trace Settings
- Sweep Settings

2.1 Running measurements

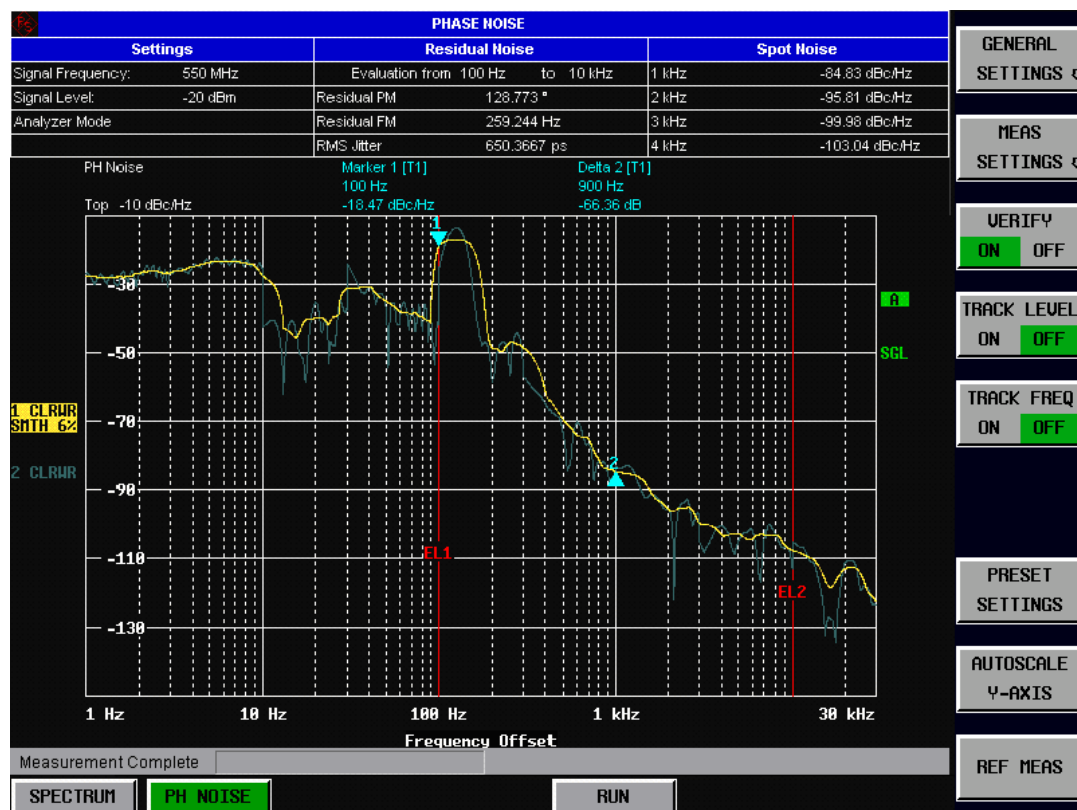


Fig. 15 Phase Noise Measurement Results

To start a measurement, press the *RUN* hotkey. Pressing the *RUN* hotkey whilst a measurement is running causes the measurement to be aborted.

During a measurement, the text "*Running...*" is displayed in the Status Bar at the bottom of the screen. A progress bar is also displayed to show progress through the current measurement sweep. After successful completion of a single measurement, the Status Bar will display "*Measurement Complete*"

If the Verify Frequency and Level parameter is selected in the General Settings view then FS-K40 will

then check to see if there is a Signal within the specified Frequency and Level Tolerance ranges relative to the specified Signal Frequency and Level. If no Signal is found, or a Signal is found, which is outside the tolerance range then a message will be displayed in the status bar ("No signals found within tolerance range") and the measurement will be aborted.

Whilst a measurement sweep is running, changing any of the setting in the General Settings or Meas Settings views will cause the measurement to be aborted, apart from the following settings:

VERIFY ON/OFF

The softkey *VERIFY ON/OFF* toggles Frequency and level verification on and off

```
Remote SENS:FREQ:VER 1
```

TRACK LEVEL ON/OFF

The softkey *TRACK LEVEL ON/OFF* toggles level tracking on and off

```
Remote SENS:POW:TRACk ON |OFF
```

TRACK FREQ ON/OFF

The softkey *TRACK FREQ ON/OFF* toggles Frequency tracking on and off

```
Remote SENS:FREQ:TRACk ON | OFF
```

PRESET SETTINGS

The softkey *PRESET SETTINGS* presets the option back to the default settings

```
Remote --
```

AUTOSCALE Y AXIS

The softkey *AUTOSCALE Y AXIS* scales the Y axis according to the trace results

```
Remote DISP:WIND:TRAC:Y:SCAL:AUTO ONCE
```

REF MEAS

The softkey *REF MEAS* performs a measurement and stores the trace as a reference trace in trace 3

```
Remote CONF:REFM ONCE
```

Once a measurement sweep has been performed all active limit lines will be displayed, with the limit result displayed.

2.2 Measurement results

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

	PHASE NOISE			
	Settings	Residual Noise		Spot Noise [T1]
Signal Freq:	2.000007 GHz	Evaluation from 1 kHz to 1 MHz		1 kHz -106.93 dBc/Hz
Signal Level:	-0.57 dBm	Residual PM	55.128 m°	10 kHz -115.72 dBc/Hz
Signal Freq Δ:	169.46 mHz	Residual FM	222.233 Hz	100 kHz -119.51 dBc/Hz
Signal Level Δ:	-0.12 dBm	RMS Jitter	0.0766 ps	1 MHz -136.39 dBc/Hz

Fig. 16 Overall measurement settings summary

The settings summary includes the following information:

3. Signal Frequency	The frequency of the measured input signal.
Signal Level	The level of the input signal
Signal Freq Δ	Shows the measured frequency difference (During verification & tracking)
Signal Level Δ	Shows the measured level difference (During verification & tracking)
Evaluation	Shows frequency the range over which Residual Noise results are calculated
Residual PM	Shows the Residual PM result over the selected evaluation range
Residual FM	Shows the Residual FM result over the selected evaluation range
RMS Jitter	Shows the RMS Jitter result over the selected evaluation range
Spot Noise	Shows the spot noise results for the requested frequencies and trace

Note that the Residual Noise results are displayed at the end of a measurement sweep. Once a measurement sweep has been run changing the range for the Residual Noise results in the General Setting view automatically updates the Residual noise results. The range of the Residual Noise calculations is displayed in the results trace with two lines, marker EL1 and EL2.

2.3 General Settings

This section of the user manual describes the General Settings view where all settings related to the overall measurement can be modified, that is the Signal Characteristics, Display settings, Trace settings, Residual calculation settings and spot noise settings.

GENERAL SETTINGS

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

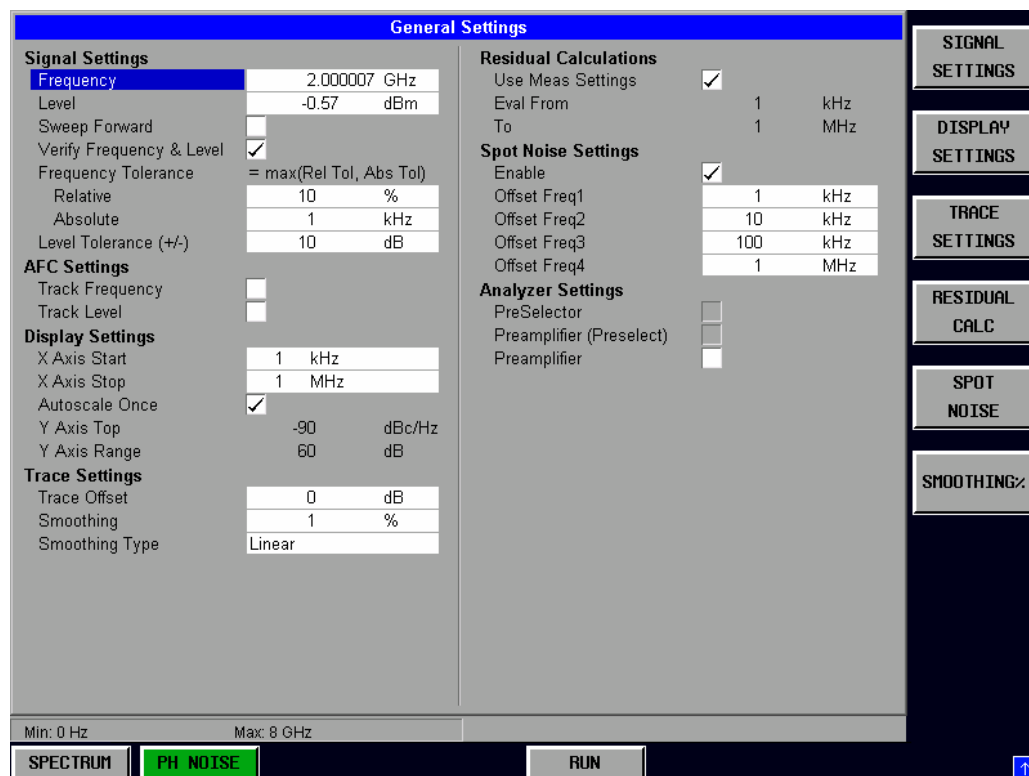


Fig. 17 General Settings view

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

- Signal Settings
- AFC Settings
- Display Settings
- Trace Settings
- Residual Calculations
- Spot Noise Settings
- Analyser Settings

Any parameters that are not available for editing will have a grey background. This usually occurs when one parameter setting makes another parameter invalid, for example if the *Verify Frequency and Level* is switched off then none of the parameters below this (*Frequency Tolerance* and *Level Tolerance*) have any meaning, so these parameters are greyed out.

When a particular parameter is selected within the General Settings view the status bar changes to display information about the valid settings for the selected parameter.

2.3.2 Signal Settings

The Signal Settings are the general settings concerning the level and frequency of the signal to be measured.

2.3.2.1 Frequency

Signal Settings	
Frequency	2.000007 GHz
Level	-0.57 dBm
Sweep Forward	<input type="checkbox"/>
Verify Frequency & Level	<input checked="" type="checkbox"/>
Frequency Tolerance	= max(Rel Tol, Abs Tol)
Relative	10 %
Absolute	1 kHz
Level Tolerance (+/-)	10 dB

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

Remote SENS:FREQ:CENT 20 GHz

2.3.2.2 Level

Signal Settings	
Frequency	2.000007 GHz
Level	-0.57 dBm
Sweep Forward	<input type="checkbox"/>
Verify Frequency & Level	<input checked="" type="checkbox"/>
Frequency Tolerance	= max(Rel Tol, Abs Tol)
Relative	10 %
Absolute	1 kHz
Level Tolerance (+/-)	10 dB

Level specifies the expected level of the RF input signal.

Remote POW:RLEV 1

2.3.2.3 Sweep Forward

Signal Settings	
Frequency	2.000007 GHz
Level	-0.57 dBm
Sweep Forward	<input type="checkbox"/>
Verify Frequency & Level	<input checked="" type="checkbox"/>
Frequency Tolerance	= max(Rel Tol, Abs Tol)
Relative	10 %
Absolute	1 kHz
Level Tolerance (+/-)	10 dB

Sweep Forward is used to determine the sweep direction for the current measurement.

If *Sweep Forward* is on the measurement will be done from the start offset frequency to the stop offset frequency.

If *Sweep Forward* is off the measurement will be done from the stop offset frequency to the start offset frequency.

Remote SENS:SWEEP:FORW

2.3.2.4 Verify Freq and Level

Signal Settings	
Frequency	2.000007 GHz
Level	-0.57 dBm
Sweep Forward	<input type="checkbox"/>
Verify Frequency & Level	<input checked="" type="checkbox"/>
Frequency Tolerance	= max(Rel Tol, Abs Tol)
Relative	10 %
Absolute	1 kHz
Level Tolerance (+/-)	10 dB

Verify Freq enables a search across a frequency tolerance range, for the carrier of greatest magnitude. Carrier frequency and level are measured. If the level is within a level tolerance range, the measured level overrides the specified *Level*. Otherwise the measurement is aborted.

This should be used when the carrier frequency is not known precisely.

When *Verify Freq* is ON, *Frequency Tolerance* and *Level Tolerance* parameters become enabled.

```
Remote SENS:FREQ:VER:STAT
```

2.3.2.5 Frequency Tolerance

Frequency Tolerance is used to verify the input signal frequency and the value used is the higher value of the specified *Relative* or *Absolute* Tolerance values.

Signal Settings	
Frequency	2.000007 GHz
Level	-0.57 dBm
Sweep Forward	<input type="checkbox"/>
Verify Frequency & Level	<input checked="" type="checkbox"/>
Frequency Tolerance	= max(Rel Tol, Abs Tol)
Relative	10 %
Absolute	1 kHz
Level Tolerance (+/-)	10 dB

The *Relative Frequency Tolerance* parameter is the ratio of the subspan's start frequency. There will be a frequency and level check before each subsweep.

```
Remote SENS:FREQ:VER:TOL
```

```
SENS:FREQ:VER:TOL:REL
```

Signal Settings	
Frequency	2.000007 GHz
Level	-0.57 dBm
Sweep Forward	<input type="checkbox"/>
Verify Frequency & Level	<input checked="" type="checkbox"/>
Frequency Tolerance	= max(Rel Tol, Abs Tol)
Relative	10 %
Absolute	1 kHz
Level Tolerance (+/-)	10 dB

The *Absolute Frequency Tolerance* is the range, either side of the *Signal Frequency*, within which the carrier is known to be. There will be a frequency and level check before each subsweep.

```
Remote SENS:FREQ:VER:TOL:ABS
```

2.3.2.6 Level Tolerance

Signal Settings		
Frequency	2.000007 GHz	
Level	-0.57 dBm	
Sweep Forward	<input type="checkbox"/>	
Verify Frequency & Level	<input checked="" type="checkbox"/>	
Frequency Tolerance	= max(Rel Tol, Abs Tol)	
Relative	10	%
Absolute	1	kHz
Level Tolerance (+/-)	10	dB

Level Tolerance parameter is an offset relative to the *Level*. It is used to verify the *Level* of the input signal.

Level Tolerance specifies the maximum and minimum deviation from the specified *Level* setting that the input signal may vary by and still pass the verification i.e. measured level between $(Level + Level_Tolerance)$ and $(Level - Level_Tolerance)$ is accepted.

Remote SENS:RLEV:VER:TOL

2.3.3 AFC Settings

2.3.3.1 Track Frequency

AFC Settings	
Track Frequency	<input type="checkbox"/>
Track Level	<input type="checkbox"/>

Track Frequency parameter enables or disables the Signal Frequency tracking mechanism during the measurement.

This parameter is only available when the *Verify Frequency & Level* parameter is enabled

Remote SENS:FREQ:TRAC

2.3.3.2 Track Level

AFC Settings	
Track Frequency	<input type="checkbox"/>
Track Level	<input type="checkbox"/>

Track Level parameter enables or disables the Signal Level tracking mechanism during the measurement.

This parameter is only available when the *Verify Frequency & Level* parameter is enabled.

Remote SENS:POW:TRAC

2.3.4 Display Settings

2.3.4.1 X Axis Start

Display Settings		
X Axis Start	1	kHz
X Axis Stop	1	MHz
Autoscale Once	<input checked="" type="checkbox"/>	
Y Axis Top	-20	dBc/Hz
Y Axis Range	140	dB

X Axis Start parameter specifies the min frequency for the X axis. When *X Axis Start* changes the *Start* parameter in Measurement Settings view gets updated accordingly.

Remote SENS:FREQ:STAR

2.3.4.2 X Axis Stop

Display Settings		
X Axis Start	1	kHz
X Axis Stop	1	MHz
Autoscale Once	<input checked="" type="checkbox"/>	
Y Axis Top	-20	dBc/Hz
Y Axis Range	140	dB

X Axis Stop parameter specifies the max frequency for the X axis. When *X Axis Stop* changes the *Stop* parameter in Measurement Settings view gets updated accordingly.

Remote SENS:FREQ:STOP

2.3.4.3 Autoscale Once

Display Settings		
X Axis Start	1	kHz
X Axis Stop	1	MHz
Autoscale Once	<input checked="" type="checkbox"/>	
Y Axis Top	-20	dBc/Hz
Y Axis Range	140	dB

If the *Autoscale Once* is ON, the y-axis scaling is calculated from results. The autoscaling will only be done once in the first sweep. The subsequent sweeps will not auto scale the y-axis. When *Autoscale Once* is ON, *Y Axis Top* and *Range* parameters will be greyed out. When it is OFF, *Y Axis Top* and *Range* parameters will be editable.

Remote DISP:WIND1:TRAC1:Y:SCAL:AUTO

2.3.4.4 Y Axis Top

Display Settings		
X Axis Start	1	kHz
X Axis Stop	1	MHz
Autoscale Once	<input type="checkbox"/>	
Y Axis Top	-20	dBc/Hz
Y Axis Range	140	dB

Y Axis Top parameter specifies the max Phase Noise level in y-axis for the trace results.

Remote DISP:WIND1:TRAC1:Y:SCAL:RLEV

2.3.4.5 Y Axis Range

Display Settings		
X Axis Start	1	kHz
X Axis Stop	1	MHz
Autoscale Once	<input type="checkbox"/>	
Y Axis Top	-20	dBc/Hz
Y Axis Range	140	dB

Y Axis Range parameter specifies the distance from the top to the origin in y-axis.

Remote SENS:RLEV:VER:TOL

2.3.5 Trace Settings

2.3.5.1 Trace Offset

Trace Settings		
Trace Offset	0	dB
Smoothing	1	%
Smoothing Type	Linear	

Trace Offset is an arithmetical reference level offset which is added to the y axis labelling.

Remote DISP:WIND1:TRAC1:Y:SCAL:RLEV:OFFS

2.3.5.2 Smoothing

Trace Settings		
Trace Offset	0	dB
Smoothing	1	%
Smoothing Type	Linear	

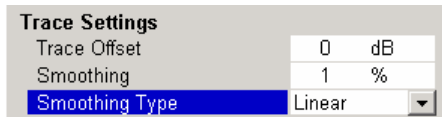
Smoothing specifies the % of the display width to be used as a window when a trace is smoothed.

The larger the setting of the *Smoothing* parameter the greater the effect of smoothing.

For more details regarding smoothing and the algorithm used see section *Trace Menu*

Remote DISP:WIND1:TRAC1:SMO:APER

2.3.5.3 Smoothing Type



Smoothing Type whether linear or logarithmic smoothing is to be used when trace smoothing is performed.

For more details regarding smoothing and the algorithm used see section *Trace Menu*

Remote DISP:WIND1:TRAC1:SMO:TYPE 1

2.3.6 Residual Calculations

2.3.6.1 Use Meas Settings



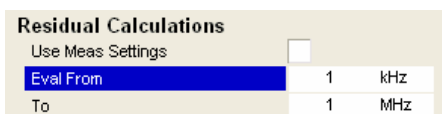
Use Meas Settings specifies whether to use the whole measurement range or the user defined evaluation range for the residual calculations.

If the *Use Meas Settings* is switched on then the *Eval From* and *To* become disabled and residual calculations are performed across the complete range of the measurement results

If the *Use Meas Settings* is switched off then the *Eval From* and *To* become enabled and allow the range over which residual calculations are performed to be specified.

Remote CALC1:EVAL:STAT

2.3.6.2 Eval From



Eval From specifies the start of the measurement range for which residual calculations are to be performed

The minimum value that can be specified for the *Eval From* setting is the value of the *X Axis Start* setting

The maximum value that can be specified for the *Eval From* setting is the value of the *X Axis Stop* setting

When the *X Axis Start* or *X Axis Stop* settings are modified the *Eval From* will be automatically adjusted to ensure that it is not outside the measurement range

The *Eval From* setting cannot be set higher than the *To* settings

Remote `CALC1:EVAL:STAR`

2.3.6.3 To

Residual Calculations		
Use Meas Settings	<input type="checkbox"/>	
Eval From	1	kHz
To	1	MHz

To specifies the end of the measurement range for which residual calculations are to be performed

The minimum value that can be specified for the *To* setting is the value of the *X Axis Start* setting

The maximum value that can be specified for the *To* setting is the value of the *X Axis Stop* setting

When the *X Axis Start* or *X Axis Stop* settings are modified the *Eval From* will be automatically adjusted to ensure that it is not outside the measurement range

The *To* setting cannot be set lower than the *Eval from* settings

Remote `CALC1:EVAL:STOP`

2.3.7 Spot Noise Settings

The Spot Noise settings allows up to 4 discrete frequency points to be specified where the Phase Noise result from a measurement sweep can be obtained and displayed.

Spot Noise results are updated whilst a sweep is running.

2.3.7.1 Enable

Spot Noise Settings		
Enable	<input checked="" type="checkbox"/>	
Offset Freq1	1	kHz
Offset Freq2	10	kHz
Offset Freq3	100	kHz
Offset Freq4	1	MHz

The *Enable* settings allows spot noise calculations to be switched on and off

Remote `CALC1:SN01:STATE ON`
`CALC1:SNO:AOFF`

2.3.7.2 Offset Freq1,2,3,4

Spot Noise Settings		
Enable	<input checked="" type="checkbox"/>	
Offset Freq1	1	kHz
Offset Freq2	10	kHz
Offset Freq3	100	kHz
Offset Freq4	1	MHz

The *Offset Freq* parameters allow up to four frequency points to be specified at which spot noise calculations will be performed.

If an offset frequency is specified which is outside the measurement frequency range then no results will be displayed for that offset frequency.

Remote `CALC1:SNO2:X 1 kHz`

2.3.8 Analyzer Settings

2.3.8.1 PreSelector

Analyzer Settings	
PreSelector	<input type="checkbox"/>
Preamplifier (Preselect)	<input type="checkbox"/>
Preamplifier	<input type="checkbox"/>

The *PreSelector* parameter allows the preselector (if installed) to be enabled or disabled.

Remote `INP:PRES ON`

2.3.8.2 Preamplifier (Preselect)

Analyzer Settings	
PreSelector	<input type="checkbox"/>
Preamplifier (Preselect)	<input type="checkbox"/>
Preamplifier	<input type="checkbox"/>

The *Preamplifier (Preselect)* parameter allows the Preamplifier on the preselector (if installed) to be enabled or disabled.

Remote `INP:GAIN:STAT ON`

2.3.8.3 Preamplifier

Analyzer Settings	
PreSelector	<input type="checkbox"/>
Preamplifier (Preselect)	<input type="checkbox"/>
Preamplifier	<input type="checkbox"/>

The *Preamplifier* parameter allows the Preamplifier to be enabled or disabled.

Remote `INP:GAIN:STAT ON`

2.4 Meas Settings

This section of the user manual describes the Meas (Short for Measurement) Settings view where the settings associated with measurement sweep are specified.

The *MEAS SETTINGS* softkey brings up the Meas Settings view.

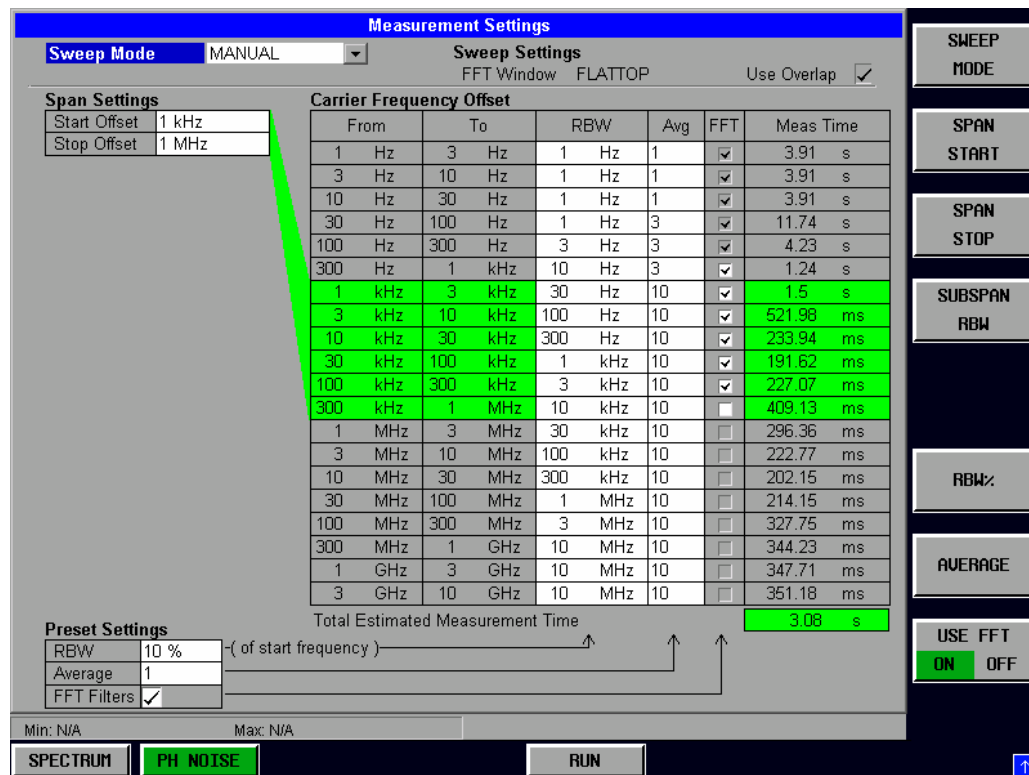


Fig. 18 Meas Settings view

The Meas settings are logically grouped together into:

- Sweep mode
- Span Settings
- Carrier Frequency Offset
- Preset Settings

When a particular parameter is selected within the Meas Settings view the status bar changes to display information about the valid settings for the selected parameter.

```
Remote SENS:SWE:MOD
SENS:BANDwidth|BWIDTH[:RESolution]:TYPE
SENS:FREQuency:START
SENS:FREQuency:STOP
SENS:BANDwidth:RES:RAT
SENS:SWEep:COUN
SENS:BANDwidth:RES:TYPE
SENS:LIST:RANG1:BAND[:RES
SENS:LIST:RANG1:FILT:TYPE
SENS:LIST:RANG1:SWE:COUN
```

2.4.1 Sweep Mode Settings

2.4.1.1 Sweep Mode



When the *Sweep Mode* parameter is set the Carrier Frequency Offset Table gets updated from the instruments default settings .

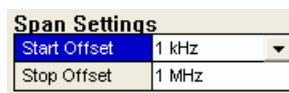
The possible values of the *Sweep Mode* parameter are:

- Fast Not averaged. The measurement runs very fast. As the average column is set to 1 for all sub-bands.
- Normal Normal averaged. The measurement runs slower then the *fast* mode, but the sub-bands are averaged more.
- Averaged Highly averaged. The measurement runs very slow with high average in each sub-band for more accurate results.
- Manual The *RBW*, *Average* and *FFT* columns can be set by the user.

In fast, normal and averaged modes, the table is not editable, it is information only.

2.4.2 Span Settings

2.4.2.1 Start Offset

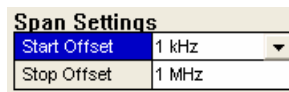


Start Offset Defines the start frequency of the measurement.

When this parameter changes the X-axis *Start* parameter in General Settings (Noise) view gets updated accordingly.

The Carrier Frequency Offset Table is highlighted to show the selected span for the noise measurement.

2.4.2.2 Stop Offset



Stop Offset – Defines the stop frequency of the measurement.

When this parameter changes the X-axis *Stop* parameter in General Settings (Noise) view gets updated accordingly.

The Carrier Frequency Offset Table is highlighted to show the selected span for the noise measurement.

2.4.3 Carrier Frequency Offset Table

Carrier Frequency Offset					
From	To	RBW	Avg	FFT	Meas Time
1 Hz	3 Hz	1 Hz	1	<input checked="" type="checkbox"/>	3.91 s
3 Hz	10 Hz	1 Hz	1	<input checked="" type="checkbox"/>	3.91 s
10 Hz	30 Hz	1 Hz	1	<input checked="" type="checkbox"/>	3.91 s
30 Hz	100 Hz	1 Hz	3	<input checked="" type="checkbox"/>	11.74 s
100 Hz	300 Hz	3 Hz	3	<input checked="" type="checkbox"/>	4.23 s
300 Hz	1 kHz	10 Hz	3	<input checked="" type="checkbox"/>	1.24 s
1 kHz	3 kHz	30 Hz	10	<input checked="" type="checkbox"/>	1.5 s
3 kHz	10 kHz	100 Hz	10	<input checked="" type="checkbox"/>	521.96 ms
10 kHz	30 kHz	300 Hz	10	<input checked="" type="checkbox"/>	233.94 ms
30 kHz	100 kHz	1 kHz	10	<input checked="" type="checkbox"/>	191.62 ms
100 kHz	300 kHz	3 kHz	10	<input checked="" type="checkbox"/>	227.07 ms
300 kHz	1 MHz	10 kHz	10	<input type="checkbox"/>	409.13 ms
1 MHz	3 MHz	30 kHz	10	<input type="checkbox"/>	296.36 ms
3 MHz	10 MHz	100 kHz	10	<input type="checkbox"/>	222.77 ms
10 MHz	30 MHz	300 kHz	10	<input type="checkbox"/>	202.15 ms
30 MHz	100 MHz	1 MHz	10	<input type="checkbox"/>	214.15 ms
100 MHz	300 MHz	3 MHz	10	<input type="checkbox"/>	327.75 ms
300 MHz	1 GHz	10 MHz	10	<input type="checkbox"/>	344.23 ms
1 GHz	3 GHz	10 MHz	10	<input type="checkbox"/>	347.71 ms
3 GHz	10 GHz	10 MHz	10	<input type="checkbox"/>	351.18 ms
Total Estimated Measurement Time					3.08 s

From: This column lists the start frequency of each sub-band.

To: This column lists the stop frequency of each sub-band.

RBW: This column lists the resolution filter bandwidth used for each sub-band. Enter values in steps of 1/3/10.

Range: 0.1 % .. 30 % of the start frequency in that row.

Average: This column lists the number of sweeps to average over for each sub-band.

Range: 1 .. 10000

FFT: It allows the user to choose whether to use the FFT Resolution Filter or the conventional filter for each decade.

FFT is only available for RBW values between 1 Hz and 30 kHz.

Meas Time: Shows the estimated measurement time for each sub-band. Note this time is for the measurement only and does not include processing time.

An overall measurement time is displayed at the bottom of the table showing the overall measurement time for the selected sub-bands.

2.4.4 Preset Settings

The Preset Settings group provides a short-cut method quickly configuring the settings in the Carrier Frequency Offset table.

Settings any of the settings in the Preset Settings group sets all the appropriate settings in the carrier offset table.

Note that when the *Sweep Mode* parameter is set to any value other than Manual then the Preset Settings group is disabled

2.4.4.1 RBW

Preset Settings	
RBW	10 %
Average	1
FFT Filters	<input type="checkbox"/>

The *RBW* parameter sets all the RBW settings in the Carrier Frequency Offset table to a proportion of the start frequency for each sub-band. The resulting RBW is rounded to the nearest 1/3/10 steps.

2.4.4.2 Average

Preset Settings	
RBW	10 %
Average	1
FFT Filters	<input type="checkbox"/>

The *Average* parameter sets all the Average settings in the Carrier Frequency Offset table to the specified value.

2.4.4.3 FFT

Preset Settings	
RBW	10 %
Average	1
FFT Filters	<input type="checkbox"/>

The *FFT* parameter sets all the FFT settings in the Carrier Frequency Offset table to the specified value.

Note that only those sub-bands where FFT filters are available will have FFT filters enabled if this parameter is switched on.

2.5 Markers

This section of the user manual describes the Marker facility of the option. The markers are used for marking points on traces, reading out measurement results and for quickly selecting a display section. R&S FS-K40 provides four markers. All markers can be used either as markers or delta markers.

The marker that can be moved by the user is defined in the following as the **active marker**.

The *MKR* hardkey brings up the marker softkey menu. Any settings views on display when the marker softkey menu is displayed shall be closed.



Fig. 19 Marker Menu

From the marker menu it is possible to adjust the marker position, change marker mode between normal and delta and switch the marker display on and off.

2.5.1 Adjusting Markers

The marker can be adjusted by pressing the marker softkey in the marker softkey menu.

MARKER

The MARKER softkeys displays the Marker pop-up dialog for the appropriate marker (1 to 4). As soon as an field in the marker pop-up dialog is adjusted then the marker position in the trace will update, along with the results displayed for the marker.

```
Remote CALC1:DELT1:STAT
        CALC1:DELT1:X
        CALC1:DELT1:Y
        CALC1:MARK1:STAT
        CALC1:MARK1:X
        CALC1:MARK1:Y
```

2.5.2 Marker Mode

The marker mode facility allows markers to be configured either as normal or delta markers. Normal markers show an absolute marker position, delta markers show a marker position result relative to the normal marker 1.

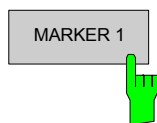
MARKER NORM DELTA

The *MARKER NORM DELTA* softkey toggles the currently active marker between normal and delta marker mode.

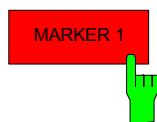
```
Remote CALC1:MARK1 ...
      CALC1:DELT1 ...
```

2.5.3 Toggle Marker Display

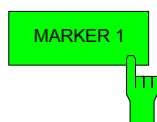
Markers can be toggled by pressing the Marker soft-key as follows:



Pressing the *MARKER* softkey when the marker is not displayed (softkey has grey background) causes the Marker pop-up to be displayed and the marker to be switched on. The associated marker then become the currently active marker. Pressing the *MARKER NORM DELTA* softkey then toggles the state of this marker.



Pressing the *MARKER* softkey when the Marker pop-up is displayed (softkey has red background) causes the marker to be switched off.



Pressing the *MARKER* softkey when the Marker is displayed but the Marker pop-up is not displayed (softkey has green background) causes the Marker pop-up to be displayed.

Because delta marker results are relative to marker 1, switching off marker 1 also causes all delta markers to be switched off

All markers in the active screen can be switched off by pressing the *ALL MARKER OFF* softkey

2.5.4 Assigning Markers to Traces

Marker can be assigned to any of the displayed traces.

MKR->

Pressing the *MKR->* hardkey displays the Marker Extension softkey menu.



Fig. 20 Marker Extension Softkey Menu

SELECT MARKER

Pressing the *SELECT MARKER* displays the Select Marker pop-up dialog. This allows a marker (1 to 4) to be selected. Selecting 0 selects delta marker 1. As soon as a marker has been selected the appropriate Marker pop-up dialog is displayed. This allows the position of the selected marker to be adjusted:

```
Remote CALC1:MARK1:TRAC
```

MKR->TRACE

Pressing the *MKR->TRACE* displays the Select Trace pop-up dialog. This allows the ID of the trace to which the currently active marker is to be attached to be supplied. The currently active marker can be selected using the *SELECT MARKER* softkey:

```
Remote CALC1:DELT1:TRAC
```

2.6 Trace Menu

TRACE

The *TRACE* hardkey brings up the Trace softkey menu. Any settings views on display when the display softkey menu is displayed shall be closed.



Fig. 21 Trace Menu

SELECT TRACE

When the *SELECT TRACE* softkey is pressed, the *Select Trace* pop-up dialog is displayed. Up to 3 traces can be selected. The selected trace will be the active trace for selecting the trace mode (Clear / Write, Average, View, Blank).

Remote --

CLEAR/WRITE

The *CLEAR/WRITE* softkey activates the overwrite mode for the collected measured values for the active trace, ie the trace is overwritten by each sweep.

Remote DISP:WIND1:TRAC1:MODE

MAX HOLD

The *MAX HOLD* softkey activates the maxhold mode for the collected measured values for the active trace, ie the maximum value of each point in the trace is determined over the requested number of sweeps.

Remote DISP:WIND1:TRAC1:MODE

AVERAGE

The *AVERAGE* softkey activates the trace averaging function for the active trace. The averaging is performed over the requested number of sweeps for single sweep mode.

For a sweep count = 0 , a running average is calculated according to the following formula:

$$\text{TRACE} = \frac{9 * \text{TRACE} + \text{meas. value}}{10}$$

Due to the weighting between the new measured value and the trace average, past values have practically no influence on the displayed trace after about ten sweeps. With this setting, signal noise is effectively reduced without need for restarting the averaging process after a change of the signal. If the sweep count is >1, averaging takes place over the selected number of sweeps. In this case the displayed trace is determined during averaging according to the following formula:

$$\text{TRACE}_n = 1/n \left[\sum_{i=1}^{n-1} (T_i) + \text{meas. value}_n \right]$$

where n is the number of the current sweep (n = 2 ... SWEEP COUNT). No averaging is carried out for the first sweep but the measured value is stored in the trace memory. With increasing n, the displayed trace is increasingly smoothed since there are more single sweeps for averaging.

After the selected number of sweeps the average trace is saved in the trace memory. Until this number of sweeps is reached, a preliminary average is displayed.

After completion of averaging, ie when the averaging length defined by *SWEEP COUNT* is attained, a running averaging is continued with *CONTINUOUS SWEEP* according to the following formula:

$$\text{TRACE} = \frac{(N - 1) * \text{TRACE}_{\text{old}} + \text{meas.Value}}{N}$$

Where Trace = new trace
 Trace_{old} = old trace
 N = SWEEP COUNT

The display "N of N" does not change any more until a new start is triggered.

In the *SINGLE SWEEP* mode, the sweeps are stopped when the selected number of sweeps is attained. The number of the current sweep and the total number of sweeps are shown on the display: "3 of 200".

Remote DISP:WIND1:TRAC1:MODE

VIEW

The *VIEW* softkey freezes the current contents of the active trace memory and displays it. If a trace is frozen by *VIEW*, the instrument settings can be changed without the displayed trace being modified.

The display settings such as Y axis and Trace Offset settings can be still changed, R&SFS-K40 automatically adapts the measured data to the changed display range.

Remote DISP:WIND1:TRAC1:MODE

BLANK

The *BLANK* softkey activates the blanking of the active trace.

Remote DISP:WIND1:TRAC1:STAT

SWEEP COUNT

The *SWEEP COUNT* softkey activates the entry of the number of sweeps used for averaging. The allowed range of values is 0 to 32767.

The default setting is 0. The number of sweeps used for averaging is the same for all active traces in the selected diagram.



The setting of the sweep count in the trace menu is equivalent to the setting in the sweep menu.

Remote SENS:SWE:COUN 64

SMOOTHING

The *SMOOTHING* softkey is ON (the softkey is green), the trace on the screen will be smoothed by the smoothing percentage (see general settings for noise). Toggling this softkey will have an immediate effect on the active trace on display. Each trace (trace1, trace2 and trace3) can be smoothed/unsmoothed individually.

The smoothing algorithm used is as follows:

$$y'(s) = 10 * \text{Log}_{10} \left(\left(\sum_{x=s-\frac{n-1}{2}}^{x=s+\frac{n-1}{2}} 10^{\left(\frac{y(x)}{10}\right)} \right) \div n \right)$$

Where: s = the trace sample number, $y(s)$ = the phase noise at sample s , x = the sample offset from s , and n = the width of the sliding window. When x exceeds the boundary samples, the boundary sample is used, i.e. if the trace has samples numbering 0 to 500 then with $n = 5$ and $s = 0$ the average is calculated as:

$$y'(0) = 10 * \text{Log}_{10} \left(\left(3 * 10^{\left(\frac{y(0)}{10}\right)} + 10^{\left(\frac{y(1)}{10}\right)} + 10^{\left(\frac{y(2)}{10}\right)} \right) \div 5 \right)$$

If both trace averaging and smoothing are specified then trace smoothing is applied first, and averaging is performed on the smoothed trace.

When smoothing is applied to a trace, the original (unsmoothed) trace is still held in memory. This makes it possible to toggle between a smoothed and unsmoothed trace without the need to run a new measurement sweep.

Remote DISP:WIND:TRAC:SMO:APER 10

TRACE MATH

The *TRACE MATH* softkey opens the Trace maths softkey sub menu, where the Trace Math operations can be specified.

2.6.2 Trace Maths Menu

T1-T3->T1

The *T1-T3->T1* softkey enables the trace maths expression to subtract Trace3 from Trace1 and copies the results into Trace1.

```
Remote CALC:MATH:EXPR:DEF (TRACE1-TRACE3)
```

T2-T3->T2

The *T2-T3->T2* softkey enables the trace maths expression to subtract Trace3 from Trace2 and copies the results into Trace2.

```
Remote CALC:MATH:EXPR:DEF (TRACE2-TRACE3)
```

TRACE MATH OFF

The *TRACE MATH OFF* softkey switches off the Trace Maths mode

```
Remote CALC:MATH:STAT ON
```

2.6.3 Trace Side Menu

MIN HOLD

The *MIN HOLD* softkey activates the minhold mode for the collected measured values for the active trace, ie the minimum value of each point in the trace is determined over the requested number of sweeps.

```
Remote DISP:WIND1:TRAC1:MODE
```

ASCII FILE EXPORT

The *ASCII FILE EXPORT* softkey stores the active trace in ASCII format on a floppy disk.

The file consists of the header containing important scaling parameters and a data section containing the trace data.

The data of the file header consist of three columns, each separated by a semicolon:

parameter name; numeric value; basic unit

The data section starts with the keyword " Trace;<n>," (<n> = number of stored trace), followed by the measured data in two columns which are also separated by a semicolon. The first column contains the frequency value, the second contains the corresponding Phase noise value.

This format can be read in from spreadsheet calculation programs, eg MSExcel.

It is necessary to define ';' as a separator.



Different language versions of evaluation programs may require a different handling of the decimal point. It is therefore possible to select between separators '.' (decimal point) and ',' (comma) using softkey DECIM SEP.

```
Remote FORM[:DATA] ASCii
      MMEM:STOR1:TRAC1,'TRACE.DAT'
```

DECIM SEP

The *DECIM SEP* softkey selects the decimal separator between '.' (decimal point) and ',' (comma) with floating-point numerals for the function ASCII FILE

EXPORT.

With the selection of the decimal separator different language versions of evaluation programs (eg MS-Excel) can be supported.

```
Remote FORM DEX:DSEP POIN
```

2.7 Sweep Menu

SWEEP

The *SWEEP* hardkey brings up the Sweep softkey menu. Any settings views on display when the display softkey menu is displayed shall be closed.

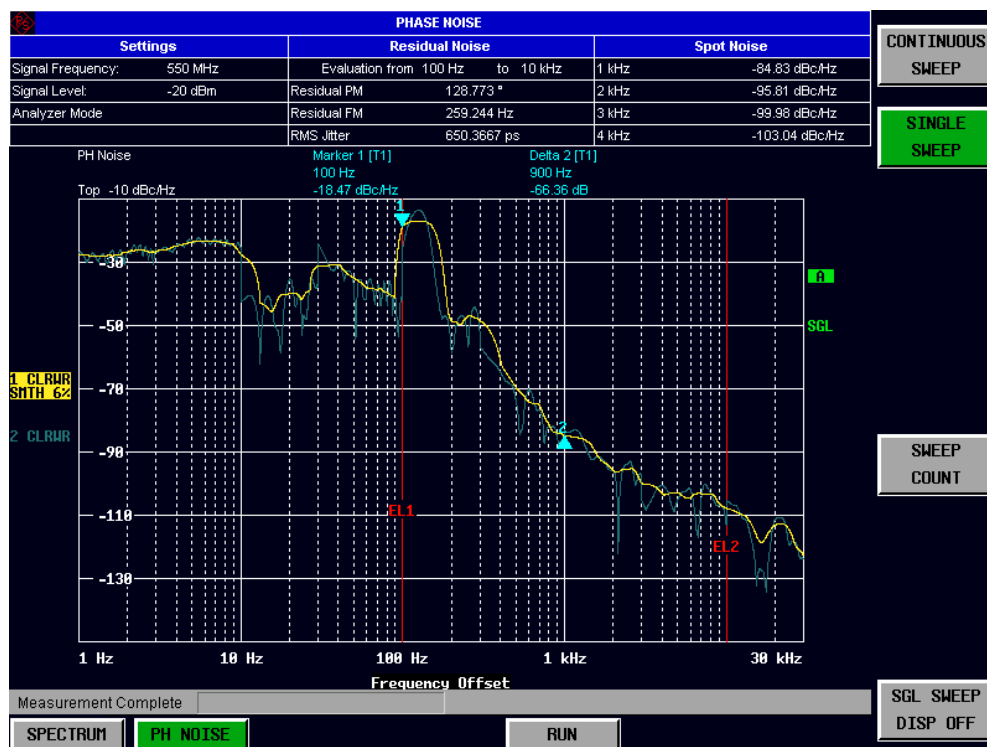


Fig. 22 Sweep Menu

CONTINUOUS SWEEP

The *CONTINUOUS SWEEP* softkey activates the continuous sweep mode. The next measurement sweep activated (using the *RUN* hotkey) will run in continuous mode

```
Remote INIT:CONT ON
```

SINGLE SWEEP

The *SINGLE SWEEP* softkey activates the single sweep mode. The next measurement sweep activated (using the *RUN* hotkey) will run in single sweep mode.

If the *SINGLE SWEEP* softkey is pressed whilst a continuous measurement is running then the measurement will abort at the end of the current sweep.

```
Remote INIT:CONT OFF
```

SWEEP COUNT

The *SWEEP COUNT* softkey activates the entry of the number of sweeps used for averaging. The allowed range of values is 0 to 32767.

In the continuous sweep mode averaging is performed until the set number of sweeps is attained and is then continued as running averaging.

The default setting is 0. The number of sweeps used for averaging is applied to all active traces.

```
Remote SENS:SWE:COUN
```

GENERAL SETTINGS

The *c* softkey deactivates the display while a single sweep is being performed. Once the sweep has been completed the display is reactivated.

```
Remote INIT:DISP OFF
```

3 Remote Control

3.1 Description of commands

This section specifies all the remote control commands specific to the R&S FS-K40 option. Only those commands provided for this option are specified. For details of remote control commands provided by the host analyzer please refer to the analyzer user manual.

3.1.1 Notation

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

Table of Commands

Command:	In the command column, the table provides an overview of the commands and their hierarchical arrangement (see indentations).
Parameter:	The parameter column indicates the requested parameters together with their specified range.
Unit:	The unit column indicates the basic unit of the physical parameters.
Comment:	In the comment column an indication is made on: <ul style="list-style-type: none"> – whether the command does not have a query form, – whether the command has only one query form – whether the command is implemented only with a certain option of the instrument

Indentations

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

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

<code>SENSe</code>	first level
<code> :FREQuency</code>	second level
<code> :CENTer</code>	third level

Individual description

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

Upper/lower case notation

Upper/lower case letters are used to mark the long or short form of the key words of a command in the description

	(see Section 3.5.2). The instrument itself does not distinguish between upper and lower case letters.
Special characters	<p>A selection of key words with an identical effect exists for several commands. These keywords are indicated in the same line; they are separated by a vertical stroke. Only one of these keywords needs to be included in the header of the command. The effect of the command is independent of which of the keywords is used.</p> <p>Example: <code>SENSe:FREQUency:CW :FIXed</code></p> <p>The two following commands with identical meaning can be created. They set the frequency of the fixed frequency signal to 1kHz:</p> <pre>SENSe:FREQUency:CW 1E3 = SENSe:FREQUency:FIXed 1E3</pre> <p>A vertical stroke in parameter indications marks alternative possibilities in the sense of "or". The effect of the command is different, depending on which parameter is used.</p> <p>Example: Selection of the parameters for the command <code>DISPlay:FORMat FULL SPLit</code></p> <p>If parameter FULL is selected, full screen is displayed, in the case of SPLit, split screen is displayed.</p>
	<p>[] Key words in square brackets can be omitted when composing the header (cf. Section 3.5.2, Optional Keywords). The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards. Parameters in square brackets can be incorporated optionally in the command or omitted as well.</p>
	<p>{ } Parameters in braces can be incorporated optionally in the command, either not at all, once or several times.</p>
Description of parameters	<p>Due to the standardisation, the parameter section of SCPI commands consists always of the same syntactical elements. SCPI has therefore specified a series of definitions, which are used in the tables of commands. In the tables, these established definitions are indicated in angled brackets (<...>) and will be briefly explained in the following (see also Section 3.5.5, "Parameters").</p>
	<p><Boolean> This keyword refers to parameters which can adopt two states, "on" and "off". The "off" state may either be indicated by the keyword OFF or by the numeric value 0, the "on" state is indicated by ON or any numeric value other than zero. Parameter queries are always returned the numeric value 0 or 1.</p>
	<p><numeric_value></p>
	<p><num> These keywords mark parameters which may be entered as numeric values or be set using specific keywords (character data). The following keywords given below are permitted:</p>

MINimum	This keyword sets the parameter to the smallest possible value.
MAXimum	This keyword sets the parameter to the largest possible value.
DEFault	This keyword is used to reset the parameter to its default value.
UP	This keyword increments the parameter value.
DOWN	This keyword decrements the parameter value. The numeric values associated to MAXimum/ MINimum/DEFault can be queried by adding the corresponding keywords to the command. They must be entered following the quotation mark. Example: <code>SENSE:FREQUENCY:CENTER? MAXimum</code> returns the maximum possible numeric value of the center frequency as result.
<arbitrary block program data>	This keyword is provided for commands the parameters of which consist of a binary data block.

3.2 ABORt Subsystem

The ABORt subsystem provide a mechanism by which running measurements can be aborted

ABORt

Causes the current measurement being performed to be aborted.

Example

```
ABOR
'The FS-K40 option will attempt to abort the current active measurement.
```

Characteristics

```
*RST value: -
SCPI: conforming
```

3.3 CALCulate Subsystem

Note for all CALCulate commands only CALCulate1 is valid in K40 as K40 has only a single measurement screen.

3.3.1 CALCulate:DELTamarker Subsystem

The CALCulate:DELTamarker subsystem checks the delta marker functions in the K40 option. Note that for all delta marker commands the suffix for the CALCulate must be 1.

```
CALCulate<1|2>:DELTamarker<1 to 4>:AOFF
CALCulate<1|2>:DELTamarker<1 to 4>:STATE <Boolean>
CALCulate<1|2>:DELTamarker<1 to 4>:TRACe
CALCulate<1|2>:DELTamarker<1 to 4>:X <numeric_value>
CALCulate<1|2>:DELTamarker<1 to 4>:Y <numeric_value>
```

CALCulate<1|2>:DELTamarker<1 to 4>:AOFF

This command switches off all active delta markers in the specified measurement window.

Example

```
CALC1:DELT:AOFF
'Switches off all delta markers in the screen A window.
```

Characteristic

```
*RST value: -
SCPI:      device-specific
```

CALCulate<1|2>:DELTamarker<1 to 4>:STATE <Boolean>

This command switches on or off the currently selected delta marker in the selected measurement window. If no indication is made, marker 1 is selected automatically. If marker 2, 3 or 4 is selected and used as a marker, it is switched to delta marker mode.

Example

```
CALC1:DELT:STATE ON
'Switches the screen A marker ON.
```

Characteristics

```
*RST value: 1
SCPI: device-specific
```

CALCulate<1|2>:DELTamarker<1 to 4>:TRACe

This command assigns the selected delta marker to the indicated measurement curve in the selected measurement window.

Example

```
CALC1:DELT:TRAC 2
'Assigns marker 1 in screen A to trace 2.
CALC2:MARK:TRAC 5
'Assigns marker 1 in screen B to trace 5.
```

Characteristics

*RST value: 1
 SCPI: device-specific

CALCulate<1|2>:DELTamarker<1 to 4>:X <numeric_value>

This command positions the selected delta marker to the indicated frequency or time in the selected measurement window.

Example

```
CALC1:DELT:X 2MHZ"
Positions marker 1 in screen A to time 2 MHz.
```

Characteristics

*RST value: -
 SCPI: device-specific

CALCulate<1|2>:DELTamarker<1 to 4>:Y <numeric_value>

This command positions the selected delta marker to the indicated Y position in the selected measurement window. The units for this command are dBc/Hz.

Example

```
CALC1:DELT:Y?
'Outputs the measured value of marker 1 in screen A.
```

Characteristics

*RST value: -
 SCPI: device-specific

3.3.2 CALCulate:EVALuation Subsystem

```
CALCulate<1|2>:EVALuation
CALCulate<1|2>:EVALuation:START
CALCulate<1|2>:EVALuation:STOP
```

CALCulate<1|2>:EVALuation

This command specifies whether Residual noise values are calculated over the entire trace or within a specified frequency range. When switched ON the residual noise values are calculated over the range specified by CALCulate<1|2>:EVALuation:START and CALCulate<1|2>:EVALuation:STOP. When switched OFF the results are calculated over the entire trace.

Example

```
CALC:EVAL 0
'Specifies that residual noise is calculated over the entire
trace
```

Characteristics

*RST value: 0
SCPI: device-specific

CALCulate<1|2>:EVALuation:START

This command specifies the start frequency for residual noise calculation when CALCulate<1|2>:EVALuation[:STATe] is switched ON. This command has no effect if CALCulate<1|2>:EVALuation[:STATe] is switched OFF

Example

```
CALC:EVAL:START 1MHZ
'Specifies that residual noise is calculated starting from 1
MHz
```

Characteristics

*RST value: 1 KHz
SCPI: device-specific

CALCulate<1|2>:EVALuation:STOP

This command specifies the stop frequency for residual noise calculation when CALCulate<1|2>:EVALuation[:STATe] is switched ON. This command has no effect if CALCulate<1|2>:EVALuation[:STATe] is switched OFF

Example

```
CALC:EVAL:STOP 1 MHz
Specifies that residual noise is calculated up to 1 MHz
```

Characteristics

*RST value: 1 MHz
SCPI: device-specific

3.3.3 CALCulate:LIMit Subsystem

The CALCulate:LIMit subsystem consists of the limit lines and the corresponding limit checks. The limit lines can be defined as upper or lower limit lines. The individual Y values of the limit lines correspond to the values of the X-axis (CONTrol). The number of X- and Y-values must be identical.

Up to 8 limit lines can be defined at the same time (marked by LIMIT1 to LIMIT8) in the screen

Each limit line can be assigned a name. An explanatory comment can also be given for Example.

Definition and use of a new limit line 5 for trace in the Noise Figure trace screen with the following features:

- upper limit line
- 5 ref. values: 126 MHz/-40 dB, 127 MHz/-40 dB, 128 MHz/-20 dB, 129 MHz/-40 dB, 130 MHz/-40 dB

Definition of the line:

Defining the name: `CALC:LIM5:NAME 'TEST1'`
 Entering the comment: `CALC:LIM5:COMM 'Upper limit line'`
 Associated trace in screen A: `CALC:LIM5:TRAC 2`
 Defining the X-axis values: `CALC:LIM5:CONT 126MHZ, 127MHZ, 128MHZ, 129MHZ, 130MHZ`
 Defining the y values: `CALC:LIM5:UPP -40, -40, -30, -40, -40`

The definition of the safety margin and shifting in X- and/or Y-direction can take place as from here (see commands below).

Switching on and evaluating the line

Switching on the line `CALC:LIM5:UPP:STAT ON`
 Switching on the limit `CALC:LIM5:STAT ON`
 Starting a new measurement with synchronization: `INIT; *WAI`
 Querying the limit check result: `CALC:LIM5:FAIL?`
`CALCulate:LIMit<1 to 8>:CLEar: [:IMMediate] <Boolean>`
`CALCulate:LIMit<1 to 8>:COMMeNT <string>`
`CALCulate:LIMit<1 to 8>:COpy 1 to 8 | <name>`
`CALCulate:LIMit<1 to 8>:DELeTE`
`CALCulate:LIMit<1 to 8>:FAIL?`
`CALCulate:LIMit<1 to 8>:NAME <name>`
`CALCulate:LIMit<1 to 8>:STATe ON | OFF`
`CALCulate:LIMit<1 to 8>:TRACe < numeric_value >`

CALCulate:LIMit<1 to 8>:CLEar: [:IMMediate] <Boolean>

This command clears the STATus:QUESTionable:LIMit event register for the selected limit line.

Example

```
CALC:LIM:CLE
'Clears the event register.
```

Characteristics

*RST value: -
 SCPI: conforming

This command is an event and is therefore not assigned an *RST value.

CALCulate:LIMit<1 to 8>:COMMeNt <string>

This command defines a comment for the limit line selected.

Example

```
CALC:LIM5:COMM 'Upper limit for Gain'  
'Defines the comment for limit line 5.'
```

Characteristic

*RST: value -
SCP: device-specific

CALCulate:LIMit<1 to 8>:COpy 1 to 8 | <name>

This command copies one limit line onto another one.
1 to 8 = number of the new limit line

name = name of the new limit line given as a string

Example

```
CALC:LIM1:COpy 2  
'Copies limit line 1 to line 2.'  
CALC:LIM1:COpy 'NFIG2'  
'Copies limit line 1 to a new line named 'NFIG2'.'
```

Characteristics

*RST value: -
SCPI: device-specific

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate:LIMit<1 to 8>:DELeTe

This command deletes the selected limit line.

Example

```
CALC:LIM1:DEL  
'Deletes limit line 1.'
```

Characteristics

*RST value: -
SCPI: device-specific

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate:LIMit<1 to 8>:FAIL?

This command queries the result of the limit check of the indicated limit line. It should be noted that a complete sweep must have been performed for obtaining a valid result. A synchronization with *OPC, *OPC? or *WAI should therefore be provided. The result of the limit check responds with 0 for PASS and 1 for FAIL.

Example

```
INIT;*WAI
'Starts a new measurement and waits for its end.

CALC:LIM3:FAIL?
'Queries the result of the check for limit line 3.
```

Characteristics

RST value: -
SCPI: conforming

CALCulate:LIMit<1 to 8>:NAME <name>

This command assigns a name to a limit line numbered 1 to 8. If it does not exist already, a limit line with this name is created.

name = name of the new limit line given as a string

Example:

```
CALC:LIM1:NAME 'NFIG1'
'Assigns the name 'NFIG1' to limit line 1.
```

Characteristics

*RST value: 'REM1' to 'REM8' for lines 1 to 8
SCPI: device-specific

CALCulate:LIMit<1 to 8>:STATe ON | OFF

This command switches on or off the limit check for the selected limit. The result of the limit check can be queried with CALCulate:LIMit<1 to 8>:FAIL?.

Example

```
CALC:LIM:STAT ON
'Switches on the limit check for limit line 1
CALC:LIM:STAT OFF
'Switches off the limit check for limit line 1
```

Characteristics

*RST value: OFF
SCPI: conforming

CALCulate:LIMit<1 to 8>:TRACe < numeric_value >

This command assigns a limit line to a particular trace..

Examples:

```

`CALC:LIM2:TRAC
'Assigns limit line 2 to the trace 1.

```

Characteristics

```

*RST value: 1
SCPI: device-specific

```

3.3.3.2 CALCulate:LIMit:CONTrol Subsystem

The CALCulate:LIMit:CONTrol subsystem defines the x-axis (CONTrol-axis).

```

CALCulate:LIMit<1 to 8>:CONTrol[:DATA] <numeric_value>,<numeric_value>
CALCulate:LIMit<1 to 8>:CONTrol:SHIFt <numeric_value>

```

CALCulate:LIMit<1 to 8>:CONTrol[:DATA] <numeric_value>,<numeric_value>

This command defines the X-axis values (frequencies) of the upper or lower limit lines. The number of values for the CONTrol axis and for the corresponding UPPER and/or LOWER limit lines have to be identical. Otherwise default values are entered for missing values or unnecessary values are deleted.

Example

```

CALC:LIM2:CONT 1MHz,30MHz,100MHz, 300MHz,1GHz
'Defines 5 reference values for the X-axis of limit line 2
CALC:LIM2:CONT?
'Outputs the reference values for the X-axis of limit line 2
separated by a comma.

```

Characteristics

```

*RST value: -
SCPI: conforming

```

CALCulate:LIMit<1 to 8>:CONTrol:SHIFt <numeric_value>

This command moves a limit line by the indicated value in x direction. The line is shifted by modifying the individual x values.

Example

```

CALC:LIM2:CONT:SHIF 50KHZ
'Shifts all reference values of limit line 2 by 50 kHz.

```

Characteristics

```

*RST value: -
SCPI: device-specific

```

This command is an event and is therefore not assigned an *RST value and has no query.

3.3.3.3 CALCulate:LIMit:LOWer Subsystem

The CALCulate:LIMit:LOWer subsystem defines the lower limit line. Note that if a set command is issued in this subsystem the limit line effected is automatically converted to a lower limit line.

CALCulate:LIMit<1 to 8>:LOWer[:DATA] <numeric_value>,<numeric_value>...

CALCulate:LIMit<1 to 8>:LOWer:STATe ON | OFF

CALCulate:LIMit<1 to 8>:LOWer:SHIFt <numeric_value>

CALCulate:LIMit<1 to 8>:LOWer[:DATA] <numeric_value>,<numeric_value>...

This command defines the values for the selected lower limit line.

The number of values for the CONTROL axis and for the corresponding LOWER limit line has to be identical. Otherwise default values are entered for missing values or unnecessary values are deleted.

If the measured values are smaller than the LOWER limit line, the limit check signals errors.

Example

```
CALC:LIM2:LOW -30,-40,-10,-40,-30
```

'Defines 5 lower limit values for limit line 2 in the preset unit.

```
CALC:LIM2:LOW?
```

'Outputs the lower limit values of limit line 2 separated by a comma.

Characteristics

*RST value: -

SCPI: conforming

CALCulate:LIMit<1 to 8>:LOWer:STATe ON | OFF

This command switches on or off the indicated limit line in the selected measurement window. The limit check is activated separately with

```
CALC:LIM:STAT ON.
```

Example

```
CALC:LIM4:LOW:STAT ON
```

'Switches on limit line 4 (lower limit)

```
CALC:LIM4:LOW:STAT OFF
```

'Switches off limit line 4 (lower limit)

Characteristics

*RST value: -

SCPI: conforming

CALCulate:LIMit<1 to 8>:LOWer:SHIFt <numeric_value>

This command shifts a limit line by the indicated value in Y-direction. The line is shifted by modifying the individual y values

Example

```
CALC:LIM3:LOW:SHIF 20DB
'Shifts all Y values of limit line 3 by 20 dB.
```

Characteristics

*RST value: -
SCPI: device-specific

This command is an event and is therefore not assigned an *RST value and has no query.

3.3.3.4 CALCulate:LIMit:UPPer Subsystem

The CALCulate:LIMit:UPPer subsystem defines the upper limit line. Note that if a set command is issued in this subsystem the limit line effected is automatically converted to an upper limit line.

```
CALCulate:LIMit<1 to 8>:UPPer[:DATA <numeric_value>,<numeric_value>...
```

```
CALCulate:LIMit<1 to 8>:UPPer:SHIFt <numeric_value>
```

```
CALCulate:LIMit<1 to 8>:UPPer:STATe ON | OFF
```

```
CALCulate:LIMit<1 to 8>:UPPer[:DATA <numeric_value>,<numeric_value>...
```

This command defines the values for the upper limit lines independently of the measurement window.

The number of values for the CONTROL axis and for the corresponding UPPER and/or LOWER limit line have to be identical. Otherwise default values are entered for missing values or unnecessary values are deleted.

The unit must be identical with the unit selected by CALC:LIM:UNIT. If no unit is indicated, the unit defined with CALC:LIM:UNIT is automatically used.

Example

```
CALC:LIM2:UPP -10,0,0,-10,-5
'Defines 5 upper limit values
for limit line 2 in the preset unit.
```

```
CALC:LIM2:UPP?
'Outputs the upper limit values for limit line 2 separated by
a comma.
```

Characteristics

*RST value: -
SCPI: conforming

CALCulate:LIMit<1 to 8>:UPPer:SHIFt <numeric_value>

This command moves a limit line by the indicated value in Y-direction. The line is shifted by modifying the individual y values.

Example

```
CALC:LIM3:UPP:SHIF 20DB
'Shifts all Y values of limit line 3 by 20 dB.
```

Characteristics

*RST value: -
SCPI: device-specific

This command is an event and is therefore not assigned an *RST value and has no query.

CALCulate:LIMit<1 to 8>:UPPer:STATe ON | OFF

This command switches on or off the indicated limit line. The limit check is activated separately with `CALC:LIM:STAT ON`.

Example

```
CALC:LIM4:UPP:STAT ON
'Switches on limit line 4 (upper limit)
```

Characteristics

*RST value: -
SCPI: conforming

3.3.4 CALCulate:MATH Subsystem

`CALCulate<1|2>:MATH[:EXPrESSion][:DEFine] <expr>`

`CALCulate:MATH:STATe <Boolean>`

`CALCulate<1|2>:MATH[:EXPrESSion][:DEFine] <expr>`

This command defines the mathematical expression for relating traces.

Parameter

`<expr> ::= 'OP1 - OP2'`
`OP1 ::= TRACE1 | TRACE2`
`OP2 ::= TRACE3`

Example

```
CALC1:MATH (TRACE1 - TRACE3
'Selects the subtraction of trace 1 from 'trace 3 in screen A
and puts the results 'in trace 1.
CALC2:MATH (TRACE2 - TRACE3)
'Selects the subtraction of trace 2 from trace 3 in screen B
and puts the results in trace 2.
```

Characteristics

*RST value: -
SCPI: conforming

CALCulate:MATH:STATe <Boolean>

This command switches the mathematical relation of traces on or off.

Example

```
CALC:MATH:STAT ON
```

Characteristics

*RST value: -
SCPI: conforming

3.3.5 CALCulate:MARKer Subsystem

The CALCulate:MARKer subsystem checks the marker functions in the R&S FS-K40 option. Note that for all marker commands the suffix for the CALCulate must be 1.

```
CALCulate<1|2>:MARKer<1 to 4>:AOFF
CALCulate<1|2>:MARKer1:FUNCTION ZOOM <Boolean>
CALCulate<1|2>:MARKer<1 to 4>:STATe <Boolean>
CALCulate<1|2>:MARKer<1 to 4>:TRACe <numeric_value>
CALCulate<1|2>:MARKer<1>:X <numeric_value>
CALCulate<1|2>:MARKer<1 to 4>:Y <numeric_value>
```

CALCulate<1|2>:MARKer<1 to 4>:AOFF

This command switches off all active markers in the specified measurement window. The window will either be “screen a” or “screen b” and will be determined by the numeric value that follows the “CALCulate” keyword.

Example

```
CALC1:MARK:AOFF
'Switches off all markers in the screen A window.
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer1:FUNCtion ZOOM <Boolean>

This command zooms the trace by the specified numeric level around marker 1.

Example

```
CALC1:MARK1:FUNC:ZOOM 10
'Zooms in around marker 1 by a factor of 10.
```

Characteristics

*RST value: 1
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:STATe <Boolean>

This command switches on or off the currently selected marker in the selected measurement window. If no indication is made, marker 1 is selected automatically. If marker 2, 3 or 4 is selected and used as a delta marker, it is switched to marker mode.

Example

```
CALC1:MARK1:STATE ON
'Switches the screen A marker ON.
```

Characteristics

*RST value: 1
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:TRACe <numeric_value>

This command assigns the selected marker to the indicated measurement curve in the selected measurement window.

Example

```
CALC1:MARK:TRAC 2
'Assigns marker 1 in screen A to trace 2.
```

Characteristics

*RST value: 1
SCPI: device-specific

CALCulate<1|2>:MARKer<1>:X <numeric_value>

This command positions the selected marker to the indicated frequency in the selected measurement window.

Example

```
CALC:MARK:X 2MHZ
'Positions marker 1 in screen A to time 2MHz.
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:Y <numeric_value>

This command positions the selected marker to the indicated Y position in the selected measurement window. The units for this command are dBc/Hz.

Example

```
CALC:MARK:Y?
'Outputs the measured value of marker 1 in screen A.
```

Characteristics

*RST value: -
SCPI: device-specific

3.3.6 CALCulate:SNOise Subsystem

The CALCulate:SNOise subsystem allows spot noise measurement points to be set, and results returned.

Note that for all spot noise commands the suffix for the CALCulate must be 1.

```
CALCulate<1|2>:SNOise<1 to 4>:AOFF
CALCulate<1|2>:SNOise<1 to 4>:STATe <Boolean>
CALCulate<1|2>:SNOise<1 to 4>:X <numeric_value>
CALCulate<1|2>:SNOise<1 to 4>:Y <numeric_value>
```

CALCulate<1|2>:SNOise<1 to 4>:AOFF

This command switches off all active spot noise markers in the specified measurement window.

Example:

```
CALC1:SNO:AOFF
'Switches off all spot noise markers in the screen A window.
```

Characteristic

*RST value: -
SCPI: device-specific

CALCulate<1|2>:SNOise<1 to 4>:STATe <Boolean>

This command switches on or off the currently selected spot noise marker in the selected measurement window. If no indication is made, marker 1 is selected automatically.

Example

```
CALC1:SNO1:STATE ON
'Switches the screen A marker ON.
```

Characteristics

*RST value: 1
SCPI: device-specific

CALCulate<1|2>:SNOise<1 to 4>:X <numeric_value>

This command positions the selected spot noise marker to the indicated frequency

Example

```
CALC1:SNO:X 2MHz
'Positions spot noise marker 1 in screen A to time 2 MHz.
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:SNOise<1 to 4>:Y <numeric_value>

This command returns the measured spot noise marker result in the selected measurement window. The units for this command are dBc/Hz.

Example

```
CALC1:SNO:Y?
'Outputs the measured value of spot noise marker 1 in screen A.
```

Characteristics

*RST value: -
SCPI: device-specific

3.4 CONFigure Subsystem

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

```
CONFigure:POWer:AUTO <Boolean>
CONFigure:POWer:EXPected:RF <numeric_value>
CONFigure:REFMeas ONCE
```

CONFigure:POWer:AUTO <Boolean>

This remote control command is used to switch on or off automatic power level detection. When switched on, power level detection is performed at the start of each measurement sweep.

Example

```
CONF:POW:AUTO 1
'The FS-K40 option will automatically detect the input power level
```

Characteristics

*RST value: 1
SCPI: device-specific

CONFigure:POWer:EXPeCted:RF <numeric_value>

This remote control command is used to specify the input power level of the source signal as supplied to the Analyzer RF input.

Example

```
CONF:POW:EXP:RF 9
'The FS-K40 option assumes an input signal strength of 9 dBm
```

Characteristics

*RST value: 0
SCPI: device-specific

CONFigure:REFMeas ONCE

This remote control command is used to configure and initiate a reference measurement.

Example

```
CONF:REFM ONCE
'The FSUP/FS-K40 option will start a reference measurement.
```

Characteristics

*RST value: -
SCPI: device-specific

3.5 DISPlay Subsystem

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

```
DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE WRITe |MAXHold |MINHold |AVERAge
|VIEW
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel <numeric_value>
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet <numeric_value>
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:AUTO
DISPlay[:WINDow<1|2>]:TRACe<1...3>:SMOothing:APERture <numeric_value>
DISPlay[:WINDow<1|2>]:TRACe<1...3>[:STATe] <Boolean>
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe] <numeric_value>
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:AUTO
```

**DISPlay[:WINDow<1|2>]:TRACe<1...3>:MODE WRITe |MAXHold |MINHold
|AVERAge |VIEW**

This command defines the type of display and the evaluation of the traces in the selected measurement window. WRITE corresponds to the Clr/Write mode of manual operation. The trace is switched off (= BLANK in manual operation) with DISP:WIND:TRAC:STAT OFF.

The number of measurements for AVERage is defined with the command `SENSe:SWEep:COUNT`. It should be noted that synchronization to the end of the indicated number of measurements is only possible in single sweep mode.

Example

```
DISP:TRAC1:MODE WRIT
'Sets trace 1 to clear/write mode
```

Characteristics

*RST value: WRITe for trace 1, STATe OFF for trace 2 & 3
 SCPI: conforming

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel <numeric_value>

This command specifies the current internal instrument reference level used when performing measurements.

The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example

```
DISP:TRAC:Y:RLEV?
'Returns the current reference level in use
```

Characteristics

*RST value: -
 SCPI: device-specific

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet <numeric_value>

This remote control command specifies the external attenuation/gain applied to measurements. The value corresponds to the reference level offset in spectrum analyzer mode.

The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example

```
DISP:TRAC:Y:RLEV:OFFS 10
'External attenuation (level offset) of the analyzer is 10dB
```

Characteristics

*RST value: 0 dB
 SCPI: conforming

DISPlay[:WINDow<1|2>]:TRACe<1...3>:SMOothing:APERture <numeric_value>

This remote control command specifies the aperture of the window to be used when trace smoothing is performed.

A single aperture applies to all traces which require smoothing and as such the numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant:

Example

```
DISP:TRAC1:SMO:APER 1
'Sets that smoothing window for trace 1 to 1 %
```

Characteristics

*RST value: OFF
SCPI: conforming

DISPlay[:WINDow<1|2>]:TRACe<1...3>:SMOothing[:STATe] <Boolean>

This remote control command specifies whether smoothing of a particular trace is carried out. The numeric suffix at WINDow<1|2> is irrelevant:

Example

```
DISP:TRAC1:SMO 1
'Specifies that smoothing of trace 1 is to be performed
```

Characteristics

*RST value: OFF
SCPI: conforming

DISPlay[:WINDow<1|2>]:TRACe<1...3>:SMOothing:TYPE LINear|LOGarithmic

This remote control command specifies whether linear or logarithmic smoothing is to be used when trace smoothing is performed.

Example

```
DISP:TRAC1:SMO:TYPE LIN
'Sets the smoothing type for trace 1
```

Characteristics

*RST value: LIN
SCPI: conforming

DISPlay[:WINDow<1|2>]:TRACe<1...3>[:STATe] <Boolean>

This command switches on or off the display of the corresponding trace in the selected measurement window.

Example

```
DISP:TRAC1 0
'Switches OFF trace 1
```

Characteristics

*RST value: ON for trace 1, OFF for trace 2 & 3
SCPI: conforming

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe] <numeric_value>

This command defines the display range of the Y-axis (level axis) in the selected measurement window. The numeric suffix in TRACe<1 to 3> is irrelevant.

Example

```
DISP:WIND:TRAC:Y?
'Returns the current Y Axis range in use
```

Characteristics

```
*RST value: 100 dB
SCPI: device-specific
```

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:AUTO

This command switches automatic scaling for the Y axis on and off. Using the ONCE setting with this command causes automatic scaling to be performed immediately, regardless of whether automatic scaling is switched on. The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example

```
DISP:WIND:TRAC:Y:SCAL:AUTO 1
'Switches on automatic Y axis scaling
```

Characteristics

```
*RST value: 1
SCPI: device-specific
```

3.6 FETCh Subsystem

The FETCh subsystem contains commands for reading out results of complex measurement tasks. This subsystem is closely linked to the CONFIgure and SENSE subsystems.

```
FETCh:PNOise:RFM?
FETCh:PNOise:RPM?
FETCh:PNOise:RMS?
```

FETCh:PNOise:RFM?

This command returns the measured Residual FM result for the specified trace.

Example

```
FETC:PNO1:RFM?
'Returns the Residual FM result for Trace1
```

Characteristics

```
*RST value: -
SCPI: device-specific
```

FETCh:PNOise:RPM?

This command returns the measured Residual PM result for the specified trace.

Example

```
FETC:PNO2:RPM?
'Returns the Residual PM result for Trace2
```

Characteristics

*RST value: -
SCPI: device-specific

FETCh:PNOise:RMS?

This command returns the measured Residual RMS result for the specified trace.

Example

```
FETC:PNO3:RMS?
'Returns the Residual RMS result for Trace3
```

Characteristics

*RST value: -
SCPI: device-specific

3.7 FORMat Subsystem

The FORMat subsystem provide specifies the data format of the data transmitted from and to the instrument.

```
FORMat[:DATA] ASCii | REAL
FORMat[:DATA]:DEXPort:DSEParator POINT | COMMa
```

FORMat[:DATA] ASCii | REAL

This command specifies the data format for the data transmitted to from the instrument to the control PC.

Example

```
FORM REAL
'The data requested by the TRACE:DATA? command as floats in
binary format.
```

Characteristics

*RST value: ASCii
SCPI: Conforming

FORMat[:DATA]:DEXPort:DSEParator POINt | COMMa

This command defines which decimal separator (decimal point or comma) is to be used for outputting measurement data to the file in ASCII format. Different languages of evaluation programs (eg MS-Excel) can thus be supported.

Example

```
FORM:DEXP:DSEP POIN
'Sets the decimal point as separator.
```

Characteristics

*RST value: POINt
SCPI: device-specific

3.8 INITiate Subsystem

The INITiate subsystem configures the instrument prior to a measurement being carried out. It is basically used to tell the instrument which measurement is to be performed and takes any necessary step to set up the instrument for the measurement.

```
INITiate[:IMMediate]
INITiate:CONTInuous <Boolean>
```

INITiate[:IMMediate]

This remote control command requests the R&S FS-K40 option to start a new measurement sequence. If a measurement sequence is already in progress, then the command will be ignored.

Example

```
INIT
'The R&S FS-K40 option will attempt to start a new measurement.
```

Characteristics

*RST value: -
SCPI: conforming

INITiate:CONTInuous <Boolean>

This command determines whether the trigger system is continuously initiated (continuous) or performs single measurements (single).

Example

```
INIT:CONT OFF
'The R&S FS-K40 option will attempt a non continuous
measurement when initiated.
```

Characteristics

*RST value: -
SCPI: conforming

INITiate:DISPlay <Boolean>

This command configures the behaviour of the display during a single sweep. `INITiate:DISPlay OFF` means that the display is switched off during the measurement, `INITiate:DISPlay ON` means that the display is switched on during the measurement. The numeric suffix of `INITiate` is irrelevant with this command.

Example

```
INIT:DISP OFF
'The display is switched off during single measurements
```

Characteristics

*RST value: -
 SCPI: device-specific

3.9 INPut Subsystem

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

`INPut:GAIN:STATe <Boolean>`
`INPut:PRESelection[:STATe] <Boolean>`

INPut:GAIN:STATe <Boolean>

This remote control command switches the electronic 20 dB RF preamplifier into the signal path (state ON) or removes it from the signal path (state OFF).

Example

```
INP:GAIN:STAT ON
'Switches the preamplifier into the signal path
```

Characteristics

*RST value: OFF
 SCPI: device-specific

The command is only available with option B2 or B25.

INPut:PRESelection[:STATe] <Boolean>

This remote control command switches the preselection on or off.

Example

```
INP:PRE:STAT ON
'Preselection is switched on.
```

Characteristics

*RST value: OFF
 SCPI: device-specific

The command is only available with the preselector option B2.

3.10 INSTRument Subsystem

INSTRument:NSElect <numeric_value>
 INSTRument:SElect PNOise

INSTRument:NSElect <numeric_value>

This remote control command selects active operation of the R&S FS-K40 option by specifying its associated option number.

Example

```
INST:NSEL 20
'The R&S FS-K40 option will be selected as the active option.'
```

Characteristics

*RST value: 1
 SCPI: device-specific

INSTRument:SElect PNOise

This remote control command selects active operation of the R&S FS-K40 option by specifying its name.

Example

```
INST:SEL PNO
The R&S FS-K40 option will be selected as the active option.'
```

Characteristics

*RST value: SAN
 SCPI: device-specific

3.11 MMEMory Subsystem

MMEMory:STORe<1|2>:TRACe 1 to 3, <file_name>

This command stores the selected trace (1 to 3) in a file with ASCII format. The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the command FORMat:DEXPort:DSEParator. The file name includes indication of the path and the drive name. Indication of the path complies with DOS conventions.

Example

```
MMEM:STOR:TRAC 3,'A:\TEST.DAT'
'Stores trace 3 in the file 'TEST.DAT' on a disk.'
```

Characteristic

*RST value: -
 SCPI: device-specific

This command is an event and therefore has no *RST value and no query.

3.12 SENSE Subsystem

The SENSE command is used to set and get the values of parameters in the remote instrument. The get variant of the SENSE command differs from set in that it takes no parameter values (unless otherwise stated) but is followed by the character '?' and will return the parameter's value in the same format as it is set.

e.g SENS:FREQ 10GHZ - sets the frequency to 10 GHz
 SENS:FREQ? - response 10GHZ - returns the current frequency

```
[SENSe]:BWiDth[:RESolution]:RATio <numeric_value>
[SENSe]BWiDth[:RESolution]:TYPE NORMal | FFT
[SENSe]:FREQuency:CENTer <numeric_value>
[SENSe]:FREQuency:STARt <numeric_value>
[SENSe]:FREQuency:STOp <numeric_value>
[SENSe]:FREQuency:TRACk <Boolean>
[SENSe]:FREQuency:VERify[:STATe] <Boolean>
[SENSe]:POWer:RLEVel:VERify:TOLerance <numeric_value>
[SENSe]:LIST:RANGe<1..20>:BWiDth[:RESolution] <numeric_value>
[SENSe]:LIST:RANGe<1..20>:FILTer:TYPE NORMal | FFT
[SENSe]:LIST:RANGe<1..20>:SWEep:COUNT <numeric_value>
[SENSe]:POWer:RLEVel:VERify[:STATe] <Boolean>
[SENSe]:POWer:RLEVel:VERify:TOLerance <numeric_value>
[SENSe]: POWer:TRACk <Boolean>
[SENSe]:SWEep:COUNT <numeric_value>
[SENSe]:SWEep:FORWard <Boolean>
[SENSe]:SWEep:MODE FAST | NORMal | AVERaged | MANual
[SENSe]:SWEep:POINts
[SENSe]:SWEep:TIME <numeric_value>
```

[SENSe]:BWiDth[:RESolution]:RATio <numeric_value>

The remote control command is used to specify the RBW value to be used for each sub span as a ratio of the start frequency of the sub span. A value of 10% specifies that the RBW should be set to 10% of the start frequency value. If the required RBW value is no valid then the nearest RBW value will be set.

Example

```
SENS:BWID:RAT 1PCT
'Sets the RBW ratio to 1% of the start frequency
```

Characteristics

*RST value: 10 PCT
 SCPI: conforming

[SENSe]BWiDth[:RESolution]:TYPE NORMal | FFT

The remote control command is used to specify whether to use the FFT Resolution Filter or the conventional filter for each decade

Example

```
SENS:BWID:TYPE FFT
'Sets the RBW to use FFT filtering
```

Characteristics

*RST value: FFT
SCPI: conforming

[SENSe]:FREQuency:CENTer <numeric_value>

The remote control command is used to specify the frequency that the Analyzer will use to make measurements against the input signal.

Example

```
SENS:FREQ:CENT 50MHZ
'The FS-K40 option uses the specified frequency value to set
the analyzer detection frequency.
```

Characteristic

*RST value: from Spectrum Analyzer
SCPI: conforming

[SENSe]:FREQuency:STARt <numeric_value>

The remote control command is used to specify the start frequency for a phase noise measurement.

Example

```
SENS:FREQ:STARt 3KHZ
'Sets the start frequency for a phase noise
measurement to 3 KHz
```

Characteristics

*RST value: 1 kHz
SCPI: conforming

[SENSe]:FREQuency:STOp <numeric_value>

The remote control command is used to specify the stop frequency for a phase noise measurement.

Example

```
SENS:FREQ:STOp 3MHZ
'Sets the start frequency for a phase noise measurement to
3 MHz
```

Characteristics

*RST value: 1 MHz
SCPI: conforming

[SENSe]:FREQuency:TRACk <Boolean>

The remote control command switches the automatic frequency control on and off.

Example

```
SENS:FREQ:TRACk ON
'Sets the automatic frequency control to ON.
```

Characteristics

*RST value: ON
SCPI: conforming

[SENSe]:FREQuency:VERify[:STATe] <Boolean>

The remote control command is used to specify whether frequency and level verification are to be performed before a phase noise measurement.

This command is synonymous with [SENSe]:POWer:RLEVel:VERify[:STATe]

Example

```
SENS:FREQ:VER 1
'Specifies that frequency and level verification is to be performed
```

Characteristics

*RST value: 1
SCPI: conforming

[SENSe]:FREQuency:VERify:TOLerance: <numeric_value>

The remote control command is used to specify the absolute frequency tolerance for the verification of the signal. If the signal frequency varies from the specified centre frequency by a value greater than the tolerance then the verification will fail. The setting for this parameter only has an effect if the [SENSe]:FREQuency:VERify:STATe or [SENSe]:POWer:RLEVel:VERify:STATe command is set to ON.

The tolerance used during the measurement is the highest of the Absolute & the relative tolerance values.

Example

```
SENS:FREQ:VERify:TOL 1KHZ
'Sets the absolute frequency tolerance for the verification measurement to 1 kHz
```

Characteristics

*RST value: 1 PCT
SCPI: conforming

[SENSe]:LIST:RANGe<1..20>:BWIDTH[:RESolution] <numeric_value>

This command selects the resolution bandwidth (RBW) for the specified sub-band

Example

```
SENS:LIST:RANG2:BAND 10KHZ
'Sets the RBW to 10 KHz
```

Characteristics

*RST value: sub-band dependent
SCPI: conforming

[SENSe]:LIST:RANGe<1..20>:FILTer:TYPE NORMAl | FFT

This command selects filter type for the specified sub-band

Example

```
SENS:LIST:RANG2:FILT:TYPE FFT
'Sets the filter to FFT mode
```

Characteristics

*RST value: sub-band dependent
SCPI: conforming

[SENSe]:LIST:RANGe<1..20>:SWEep:COUNt <numeric_value>

This command selects sweep count for the specified sub-band:

Example

```
SENS:LIST:RANG2:SWE:COUN 1
'Sets the sweep count to 1
```

Characteristics

*RST value: sub-band dependent
SCPI: conforming

[SENSe]:POWer:RLEVel:VERify[:STATe] <Boolean>

The remote control command is used to specify whether frequency and level verification are to be performed before a phase noise measurement.

This command is synonymous with [SENSe]:FREQUency:VERify[:STATe]

Example

```
SENS:POW:RLEV:VER 1
'Specifies that frequency and level verification is to be performed
```

Characteristics

*RST value: 1
SCPI: conforming

[SENSe]:POWer:RLEVel:VERify:TOLerance <numeric_value>

The remote control command is used to specify the power tolerance for the verification of the signal. If the signal level varies from the specified level by a value greater than the tolerance then the verification will fail.

The setting for this parameter only has an effect if the [SENSe]:FREQUency:VERify:STATe or [SENSe]:POWer:RLEVel:VERify:STATe command is set to ON.

Example

```
SENS:POW:RLEV:TOLerance 5DB
'Sets the level tolerance for the verification measurement to
1 dB
```

Characteristics

*RST value: 10 dB
SCPI: conforming

[SENSe]: POWer:TRACk <Boolean>

The remote control command switches the automatic level control on and off.

Example

```
SENS:POW:TRACk ON
'Sets the automatic level control to ON.
```

Characteristics

*RST value: ON
SCPI: conforming

[SENSe]:SWEep:COUNT <numeric_value>

The remote control command is used to specify the number of sweeps.

Example

```
SENS:SWEep:COUNT 64
'Sets the number of sweeps to 64.
```

Characteristics

*RST value: 1
SCPI: conforming

[SENSe]:SWEep:FORWard <Boolean>

The remote control command specifies the sweep direction. When switched on the sweep direction is from the start frequency to the stop frequency. When switched off the sweep direction is reversed

Example

```
SENS:SWEep:FORWARD 1
'The sweep direction is set to sweep from start to stop frequency
```

Characteristics

*RST value: 0
SCPI: conforming

[SENSe]:SWEep:MODE FAST | NORMAl | AVERaged | MANual

The remote control command specifies the general sweep mode for the measurement. The sweep mode is used to set the RBW, Average and FFT settings for each sub-sweep to specific values. When the sweep mode is set to MANual then the sub-sweep settings may be specified.

Example

```
SENS:SWEep:MODE FAST
'Sets the sweep mode such that each sub-sweep is executed as fast as possible.
```

Characteristics

*RST value: MANual
SCPI: conforming

[SENSe]:SWEep:POINTS

The remote control command is used for query only. It returns the number of sweep points currently held in trace 1.

Example

```
SENS:SWEep:POIN?
```

Characteristics

*RST value: ???
SCPI: conforming

[SENSe]:SWEep:TIME <numeric_value>

The remote control command is used to obtain the estimated measurement time.

Example

```
``SENS:SWEep:TIME?
'Obtains the estimated measurement time.
```

Characteristics

*RST value: -
SCPI: conforming

3.13 STATus Subsystem

The STATus subsystem contains the commands for the status reporting system (See Section Status reporting registers). *RST does not influence the status registers.

STATus:QUEStionable:LIMit<1|2>[:EVENT]?
 STATus:QUEStionable:LIMit<1|2>:CONDition?
 STATus:QUEStionable:LIMit<1|2>:ENABle 0 to 65535
 STATus:QUEStionable:LIMit<1|2>:PTRansition 0 to 65535
 STATus:QUEStionable:LIMit<1|2>:NTRansition 0 to 65535
 STATus:QUEStionable:PNOise:CONDition?
 STATus:QUEStionable:PNOise:ENABle 0 to 65535
 STATus:QUEStionable:PNOise:PTRansition 0 to 65535
 STATus:QUEStionable:PNOise:NTRansition 0 to 65535
 STATus:QUEStionable:POWer[:EVENT]?
 STATus:QUEStionable:POWer:CONDition?
 STATus:QUEStionable:POWer:ENABle 0 to 65535
 STATus:QUEStionable:POWer:PTRansition 0 to 65535
 STATus:QUEStionable:POWer:NTRansition 0 to 65535
 STATus:QUEStionable:POWer[:EVENT]?

STATus:QUEStionable:LIMit<1|2>[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUEStionable:LIMit. Register for screen A and B. Readout deletes the contents of the EVENT section.

Example

```
STAT:QUES:LIM?
```

Characteristics

*RST value: 0
SCPI: device-specific

STATus:QUEStionable:LIMit<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LIMit register for screen A and B. Readout does not delete the contents of the CONDition section.

Example

```
STAT:QUES:LIM:COND?
```

Characteristics

*RST value: 0
SCPI: conforming

STATus:QUEStionable:LIMit<1|2>:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:LIMit register for screen A and B. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example

```
STAT:QUES:LIM:ENAB 65535
'All events bits will be represented in the LIMit summary
bit.
```

Characteristics

*RST value: 65535
SCPI: device-specific

STATus:QUEStionable:LIMit<1|2>:PTRansition 0 to 65535

This command determines what bits in the STATus:QUEStionable:LIMit Condition register of screen A or B will set the corresponding bit in the STATus:QUEStionable:LIMit Event register when that bit has a positive transition (0 to 1). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example

```
STAT:QUES:LIM:PTR 65535
'All condition bits will be summarised in the Event register
when a positive transition occurs.
```

Characteristics

*RST value: 65535
SCPI: device-specific

STATus:QUEStionable:LIMit<1|2>:NTRansition 0 to 65535

This command determines what bits in the STATus:QUEStionable:LIMit Condition register of screen A or B will set the corresponding bit in the STATus:QUEStionable:LIMit Event register when that bit has a negative transition (1 to 0). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example

```
STAT:QUES:LIM:NTR 65535
'All condition bits will be summarised in the Event register
when a positive transition occurs.
```

Characteristics

*RST value: 0
SCPI: device-specific

STATus:QUESTIONable:PNOise:CONDition?

This command queries the contents of the CONDition section of the STATus:QUESTIONable:PNOise register. Readout does not delete the contents of the CONDition section.

Example

```
STAT:QUES:PNOI:COND?
```

Characteristics

*RST value: 0
SCPI: conforming

STATus:QUESTIONable:PNOise:ENABLE 0 to 65535

This command sets the bits of the ENABLE section of the STATus:QUESTIONable:PNOise register. The ENABLE register selectively enables the individual events of the associated EVENT section for the summary bit.

Example

```
STAT:QUES:PNOI:ENAB 65535
'All events bits will be represented in the PNOise summary bit.
```

Characteristics

*RST value: 65535
SCPI: device-specific

STATus:QUESTIONable:PNOise:PTRansition 0 to 65535

This command determines what bits in the STATus:QUESTIONable:PNOise Condition register will set the corresponding bit in the STATus:QUESTIONable:PNOise Event register when that bit has a positive transition (0 to 1). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example

```
STAT:QUES:PNOi:PTR 65535
'All condition bits will be summarised in the Event register when a positive transition occurs.
```

Characteristics

*RST value: 65535
SCPI: device-specific

STATus:QUESTIONable:PNOise:NTRansition 0 to 65535

This command determines what bits in the STATus:QUESTIONable:PNOise Condition will set the corresponding bit in the STATus:QUESTIONable:PNOise Event register when that bit has a negative transition (1 to 0). The variable

<number> is the sum of the decimal values of the bits that are to be enabled.

Example

```
STAT:QUES:PNOi:NTR 65535
'All condition bits will be summarised in the Event register
when a positive transition occurs.
```

Characteristics

*RST value: 0
SCPI: device-specific

STATus:QUESTionable:POWer[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUESTionable:POWer Register. Readout deletes the contents of the EVENT section.

Example

```
STAT:QUES:POW?
```

Characteristics

*RST value: 0
SCPI: device-specific

STATus:QUESTionable:POWer:CONDition?

This command queries the contents of the CONDition section of the STATus:QUESTionable:POWer register. Readout does not delete the contents of the CONDition section.

Example

```
STAT:QUES:POW:COND?
```

Characteristics

*RST value: 0
SCPI: conforming

STATus:QUESTionable:POWer:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus:QUESTionable:POWer register. The ENABle register selectively enables the individual events of the associated EVENT section for the summary bit.

Example

```
STAT:QUES:POW:ENAB 65535
'All events bits will be represented in the Power summary bit.
```

Characteristics

*RST value: 65535
SCPI: device-specific

STATus:QUEStionable:POWer:PTRansition 0 to 65535

This command determines what bits in the STATus:QUEStionable:POWer Condition register will set the corresponding bit in the STATus:QUEStionable:POWer Event register when that bit has a positive transition (0 to 1). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example

```
STAT:QUES:POW:PTR 65535
'All condition bits will be summarised in the Event register
when a positive transition occurs.
```

Characteristics

*RST value: 65535
SCPI: device-specific

STATus:QUEStionable:POWer:NTRansition 0 to 65535

This command determines what bits in the STATus:QUEStionable:POWer Condition will set the corresponding bit in the STATus:QUEStionable:POWer Event register when that bit has a negative transition (1 to 0). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Example

```
STAT:QUES:POW:NTR 65535
'All condition bits will be summarised in the Event register
when a positive transition occurs.
```

Characteristic

*RST value: 0
SCPI: device-specific

STATus:QUEStionable:POWer[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUEStionable:POWer Register. Readout deletes the contents of the EVENT section.

Example

```
STAT:QUES:POW?
```

Characteristics

*RST value: 0
SCPI: device-specific

3.14 TRACe Subsystem

The TRACe subsystem controls access to the instrument's internal trace memory.

TRACE[:DATA] TRACE1 | TRACE2 | TRACE3

This command returns all the measured data that relates to the currently selected measurement type. The data is returned as a comma separated list of sequential Poise Noise trace results.

Example

```
TRAC:DATA? TRACE1
'The measurement data for the selected graph is returned.
```

Characteristics

*RST value: -
SCPI: conforming

3.15 Status reporting registers

The status reporting system (see Fig. 23) stores all information on the present operating state of the instrument, e.g. that the instrument presently carries out a calibration and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

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

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

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

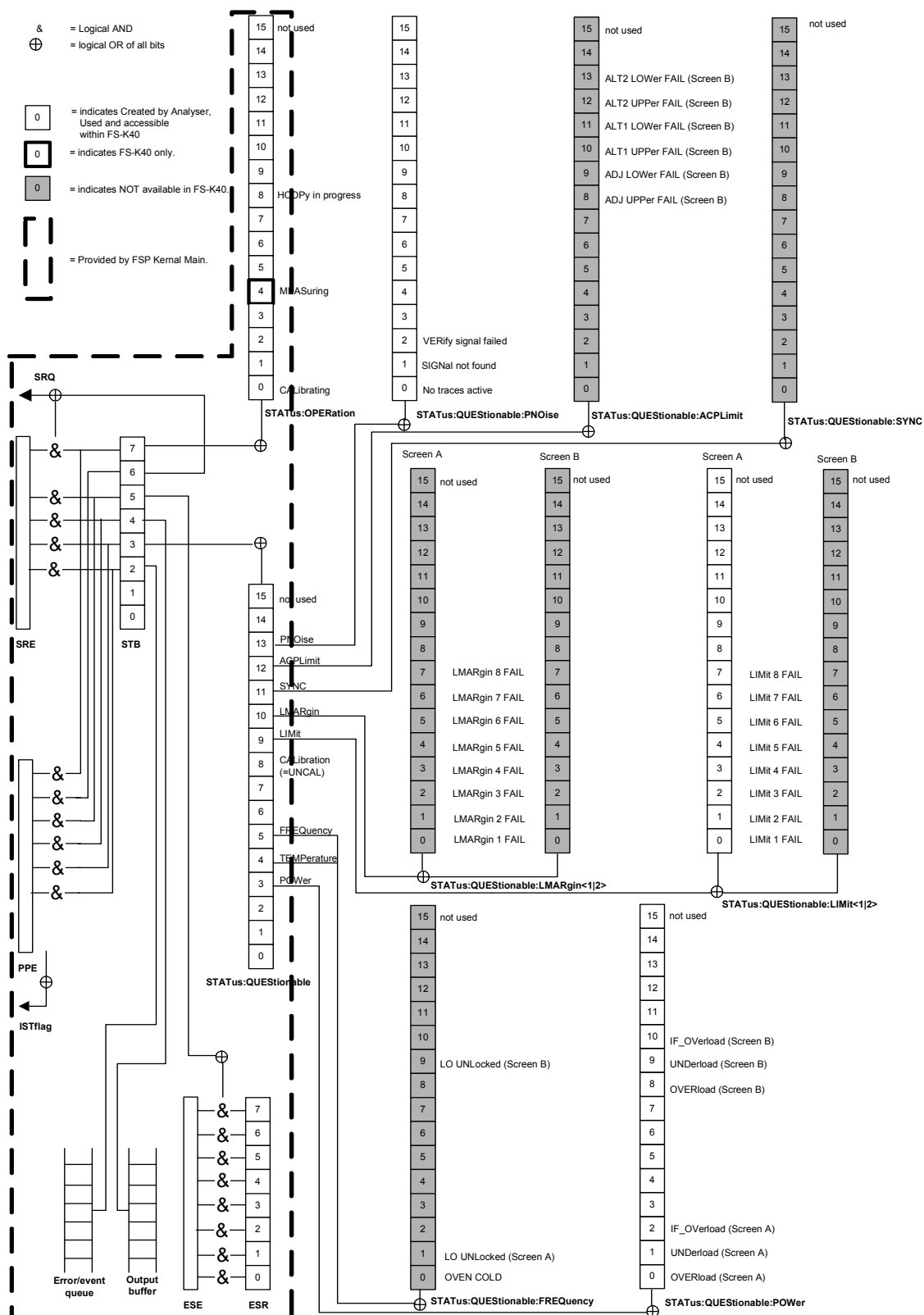


Fig. 23 Overview of the status registers

3.15.1 Description of the Status Registers

All the status registers shown in Fig. 23 are the same as those provided by the base system, with the exception of the following:

STATus:OPERation – Although this register is provided by R&S FSP Kernel main, R&S FS-K40 makes use of bit 4 in this register which are not used within R&S FSP Kernel main

STATus:QUESTionable:ACPLimit – This register is provided by the analyser and is not available from the R&S FS-K40 command tree

STATus:QUESTionable:LIMit2 – This register is provided by the analyser and is not available from the R&S FSQ-K40 command tree

STATus:QUESTionable:LMARgin<1|2> – These registers are provided by the analyser and are not available from the R&S FSQ-K40 command tree

STATus:QUESTionable:SYNC – This registers is provided by the analyser and is not available from the R&S FSQ-K40 command tree

The deviations from the status register structure of the base system are detailed below.

3.15.1.1 STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVENT part, information on which actions the instrument has executed since the last reading. It can be read using commands

"STATus:OPERation:CONDition?" or "STATus:OPERation[:EVENT]?".

Bit No	Meaning
0 to 3	These bits are not used
4	MEASuring A '1' in this bit position indicates that a measurement is in progress. R&S FS-K40 only
5 to 7	These bits are not used
8	HardCOPy in progress This bit is set while the instrument is printing a hardcopy.
9 to 14	These bits are not used
15	This bit is always 0

3.15.1.2 STATus:QUEStionable Register

This register comprises information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be queried by commands

STATus:QUEStionable:

CONDition? and STATus:QUEStionable[:EVENT]?

Bit No	Meaning
0 to 2	These bits are not used
3	POWER This bit is set if a questionable power occurs
4	TEMPERature This bit is set if a questionable temperature occurs.
5	FREQuency The bit is set if a frequency is questionable
6 to 7	These bits are not used
8	CALibration The bit is set if a measurement is performed uncalibrated (= ^ label "UNCAL")
9	LIMit (device-specific) This bit is set if a limit value is violated (see also section STATus:QUEStionable:LIMit Register). Note: Limit register is associated with limit lines for the Spectrum Mask measurement only.
10	LMARgin (device-specific) This bits are not used within R&S FS-K40
11	SYNC (device-dependent) This bits are not used within R&S FS-K40
12	ACPLimit This bits are not used within R&S FS-K40
13 to 14	These bits are not used
15	This bit is always 0

3.15.1.3 STATus:QUEStionable:LIMit Register

This register comprises information about the observance of limit lines in the corresponding

measurement window (LIMit 1 corresponds to Screen A, LIMit 2 to Screen B). It can be queried with

commands STATus:QUEStionable:LIMit<1|2>:CONDition? and STATus:QUEStionable:

LIMit<1|2>[:EVENT]?

Note that no limit lines are displayed in screen B and as such all bits in the LIMit2 register will always be set to 0.

Bit No	Meaning
0	LIMit 1 FAIL This bit is set limit line 1 is violated
1	LIMit 2 FAIL This bit is set limit line 2 is violated
2	LIMit 3 FAIL This bit is set limit line 3 is violated
3	LIMit 4 FAIL This bit is set limit line 4 is violated.
4	LIMit 5 FAIL This bit is set limit line 5 is violated.
5	LIMit 6 FAIL This bit is set limit line 6 is violated.
6	LIMit 7 FAIL This bit is set limit line 7 is violated.
7	LIMit 8 FAIL This bit is set limit line 8 is violated.
8-14	These bits are not used
15	This bit is always 0

3.15.1.4 STATus:QUEStionable:PNOise Register

This contains information about phase noise measurements.

The bits can be queried with commands

"STATus:QUEStionable:PNOise:CONDition?" and

"STATus:QUEStionable:PNOise[:EVENT]?".

Bit No	Meaning
0	No traces are active This bit is set when all the traces are switch off.
1	SIGNal not found This bit is set if no valid signal is detected
2	VERify signal failed This bit is set if verification failed to detect a signal within the supplied tolerances.
3 to 14	These bits are not used
15	This bit is always 0

3.16 Error Reporting

Error reporting for the K40 option is carried out using the Service Request (SRQ) interrupt in the GPIB interface. When an error occurs a Service Request interrupt will be generated. The master can then query the slave instrument for the error that triggered the interrupt Errors are queried through the "SYSTem:ERRor" command.

3.17 Table of softkeys with assignment of IEC/IEEE bus commands

3.17.1 Key MEAS or Hotkey PH NOISE

GENERAL SETTINGS	<pre>[SENSe]:FREQuency:CENTer [SENSe]:POWer:RLEVel [SENSe]:SWEEP:FORWard [SENSe]:FREQuency:VERify[:STATe] [SENSe]:POWer:RLEVel:VERify[:STATe] [SENSe]:FREQuency:VERify:TOLerance:ABSolute [SENSe]:FREQuency:VERify:TOLerance:RELative [SENSe]:POWer:RLEVel:VERify:TOLerance [SENSe]:POWer:TRACk [SENSe]:FREQuency:STARt [SENSe]:FREQuency:STOP [SENSe]:FREQuency:TRACk DISPlay[:WINDow<1 2>]:TRACe<1 to 3>:Y:SCALE:AUTO DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALE]:RLEVel DISPlay[:WINDow<1 2>]:TRACe<1 to 3>:Y[:SCALE] DISPlay[:WINDow<1 2>]:TRACe<1...3>:Y[:SCALE]:RLEVel:OFFset DISPlay[:WINDow<1 2>]:TRACe<1 to 3>:SMOothing:APERture CALCulate<1 2>:EVALuation[:STATe] CALCulate<1 2>:EVALuation:STARt CALCulate<1 2>:EVALuation:STOP</pre>
MEAS SETTINGS	<pre>[SENSe:]SWEep:MODE [SENSe]:BANDwidth BWIDth[:RESolution]:TYPE [SENSe]:FREQuency:STARt [SENSe]:FREQuency:STOP [SENSe]:BANDwidth:RESolution:RATio [SENSe]:SWEep:COUNT [SENSe]:BANDwidth:RESolution:TYPE [SENSe]:LIST:RANGe<1..20>:BANDwidth[:RESolution] [SENSe]:LIST:RANGe<1..20>:FILTer:TYPE [SENSe]:LIST:RANGe<1..20>:SWEep:COUNT</pre>
VERIFY ON OFF	<pre>SENSe]:FREQuency:VERify[:STATe]</pre>
TRACKLEVEL ON OFF	<pre>[SENSe]:POWer:TRACk</pre>
PRESET SETTINGS	---
AUTOSCALE Y-AXIS	<pre>DISPLAY[:WINDow]{1 2}:TRACe{1...3}:Y[:SCALE]:AUTO ONCE</pre>
REF MEAS	<pre>CONFigure:REFMeas ONCE</pre>

3.17.2 Key TRACE

SELECT TRACE	---
CLEAR WRITE	DISPlay[:WINDow<1 2>]:TRACe<1...3>:MODE
MAX HOLD	DISPlay[:WINDow<1 2>]:TRACe<1...3>:MODE
AVERAGE	DISPlay[:WINDow<1 2>]:TRACe<1...3>:MODE
VIEW	DISPlay[:WINDow<1 2>]:TRACe<1...3>:MODE
BLANK	DISPlay[:WINDow<1 2>]:TRACe<1...3>[:STATe]
SWEEP COUNT	[SENSe]:SWEep:COUNT
SMOOTHING	DISPlay[:WINDow<1 2>]:TRACe<1...3>:SMOothing[:STATe]
TRACE MATH	---
T1-T3->T1	CALCulate:MATH[:EXPRession][:DEFine] (TRACE1-TRACE3)
T2-T3->T2	CALCulate:MATH[:EXPRession][:DEFine] (TRACE2-TRACE3)
TRACE MATH OFF	CALCulate:MATH:STATe OFF
MIN HOLD	DISPlay[:WINDow<1 2>]:TRACe<1...3>:MODE
ASCII FILE EXPORT	FORMat[:DATA] ASCii MMEMory:STORe<1 2>:TRACe 1,'TRACE.DAT'
DECIM SEP . ,	FORMat:DEXPort:DSEParator POINT COMMa

3.17.3 Key SWEEP

CONTINUOUS SWEEP	INITiate:CONTinuous ON
SINGLE SWEEP	INITiate:CONTinuous OFF
SWEEP COUNT	[SENSe:]SWEep:COUNT
SGL SWEEP DISP OFF	:INITiate:DISPlay OFF

3.17.4 Key LINES

:CALCulate:LIMit<1 to 8>...

3.17.5 Key MKR

MARKER 1	:CALCulate<1 2>:DELTamarker<1 to 4>[:STATe]
MARKER 2	:CALCulate<1 2>:DELTamarker<1 to 4>:X
MARKER 3	:CALCulate<1 2>:DELTamarker<1 to 4>:Y
MARKER 4	:CALCulate<1 2>:MARKer<1 to 4>[:STATe]
MARKER NORM DELTA	:CALCulate<1 2>:MARKer<1 to 4>:X
ALL MARKER OFF	:CALCulate<1 2>:MARKer<1 to 4>:Y
	:CALCulate<1 2>:MARKer<1 to 4> ...
	:CALCulate<1 2>:DELTamarker<1 to 4> ...
	:CALCulate<1 2>:MARKer<1 to 4>:AOFF
	:CALCulate<1 2>:DELTamarker<1 to 4>:AOFF

3.17.6 Key MKR->

SELECT MARKER	:CALCulate<1 2>:MARKer<1 to 4>...
	:CALCulate<1 2>:DELTamarker<1 to 4>...
MKR->TRACE	:CALCulate<1 2>:MARKer<1 to 4>:TRACe
	:CALCulate<1 2>:DELTamarker<1 to 4>:TRACe

3.17.7 Hotkeys

SPECTRUM	:INSTRument:SElect SANalyzer :INSTRument:NSElect 1
PH NOISE	---
RUN	:INITiate[:IMMediate]

4 List of Warnings & Error Messages

The list of possible warning & error messages are shown below :

Status Bar Message	Description
Cannot run measurement - no traces are active	This message is displayed when all the traces are switched off or in VIEW mode. Set the trace mode of atleast one trace to be CLRWRT/AVG/MAXHOLD/MINHOLD
No signals found within tolerance range	This message is only displayed when the <i>Verify Frequency & Level</i> parameter is set in the General Settings view. This indicates that no input signal could be identified within the supplied tolerances of the specified frequency and level. Check that the <i>Frequency</i> and <i>Level</i> parametes are set correctly. If further measurement executions give this message then try increasing the frequency and/or level tolerance ranges.
Frequency offset out of range: Level out of range:	This message is similar to the above, but is displayed after the initial verification has been successfully performed and indicates that the current subsweep is outside tolerance.

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