

Software Manual



VOR/ILS Avionics Measurements Applications Firmware R&S® FS-K15

1302.0936.02



This Software Manual describes the following models:

R&S®FSMR

R&S®FSU

R&S®FSQ

Dear Customer,

throughout this manual, the Application Firmware R&S® FS-K15 is abbreviated as R&S FS-K15.
The Analyzers R&S® FSxx abbreviated as R&S FSxx.

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Trade names are trademarks of the owners.

Grouped Safety Messages









Make sure to read through and observe the following safety instructions!







All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standard of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, 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 an intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its 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.

Symbols and safety labels

| | | | | | | | |
|---|---|---|---|---|--|---|---|
|  |  |  |  |  |  |  |  |
| Observe product documentation | Weight indication for units >18 kg | Danger of electric shock | Warning! Hot surface | PE terminal | Ground | Ground terminal | Attention! Electrostatic sensitive devices |

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

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before putting the product into operation. It is also absolutely essential to observe the additional safety instructions on personal safety that appear in 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.

Tags and their meaning

| | |
|---------|---|
| DANGER | DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury. |
| WARNING | WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury. |
| CAUTION | CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. |
| NOTICE | NOTICE indicates a property damage message. |

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 thus contribute to personal injury or material damage.

Basic safety instructions

1. The product may be operated only under the operating conditions and in the positions specified by the manufacturer. Its ventilation must not be obstructed during operation. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products:
prescribed operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude 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 of $\pm 5\%$ to the nominal frequency.
2. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed. The product may be opened only by authorized, specially trained personnel. Prior to performing any work on the product or opening the product, the product must be disconnected from the supply network. Any adjustments, replacements of parts, maintenance or repair must be carried out only by technical personnel authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test).
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens, e.g. nickel) such as aluminum cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties), consult a physician immediately to determine the cause.
4. If products/components are mechanically and/or 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, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.

5. If handling the product yields hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation.
6. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered by electromagnetic radiation. The employer/operator is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.
7. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.
8. Prior to switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
9. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with earthing contact and protective earth connection.
10. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
11. If the product has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply. If products without power switches are integrated in racks or systems, a disconnecting device must be provided at the system level.
12. Never use the product if the power cable is damaged. 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, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.
13. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
14. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, this can result in sparks, fire and/or injuries.
15. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
16. For measurements in circuits with voltages $V_{\text{rms}} > 30 \text{ V}$, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
17. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.
18. 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.
19. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a license electrician.

Grouped Safety Messages

20. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that suitable protection is provided for users and products.
21. Do not insert any objects into the openings in the housing that are not designed for this purpose. Never pour any liquids onto or into the housing. This can cause short circuits inside the product and/or electric shocks, fire or injuries.
22. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a thunderstorm) can reach the product. Otherwise the operating personnel will be endangered by electric shocks.
23. Rohde & Schwarz products are not protected against penetration of liquids, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock for the user or damage to the product, which can also lead to personal injury.
24. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product was moved from a cold to a warm environment.
25. Do not close any slots or openings on the product, since they are necessary for ventilation and prevent the product from overheating. Do not place the product on soft surfaces such as sofas or rugs or inside a closed housing, unless this is well ventilated.
26. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.
27. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. Do not short-circuit batteries and storage batteries.
If batteries or storage batteries are improperly replaced, this can cause an explosion (warning: lithium cells). Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries must be recycled and kept separate from residual waste. Batteries and storage batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.
28. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.
29. The product can be very heavy. Be careful when moving it to avoid back or other physical injuries.
30. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves).
31. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.
32. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. The driver is always responsible for the safety of the vehicle. The manufacturer assumes no responsibility for accidents or collisions.
33. If a laser product (e.g. a CD/DVD drive) is integrated in a Rohde & Schwarz product, do not use any other settings or functions than those described in the product documentation. Otherwise this may be hazardous to your health, since the laser beam can cause irreversible damage to your eyes. Never try to take such products apart, and never look into the laser beam.
34. Prior to cleaning, disconnect the product from the AC supply. Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluent for cellulose lacquers.

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. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el comprobante de conformidad adjunto según las normas de la CE y ha salido de nuestra planta en estado impecable según los 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 despreciando las informaciones de seguridad del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones de la correspondiente documentación de 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 profundos y conocimientos básicas del idioma inglés. Por eso se debe tener en cuenta que el producto sólo pueda ser operado por personal especializado o personas minuciosamente instruidas con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de R&S, encontrará la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto y entréguela a usuarios posteriores.

Símbolos y definiciones de seguridad

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|---|---|---|---|---|--|---|---|
|  |  |  |  |  |  |  |  |
| Ver documentación de producto | Informaciones para maquinaria con un peso de > 18kg | Peligro de golpe de corriente | ¡Advertencia! Superficie caliente | Conexión a conductor protector | Conexión a tierra | Conexión a masa conductora | ¡Cuidado! Elementos de construcción con peligro de carga electrostática |

| | | | | | |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
| Potencia EN MARCHA/PARADA | Indicación Stand-by | Corriente continua DC | Corriente alterna AC | Corriente continua/- alterna DC/AC | El aparato está protegido en su totalidad por un aislamiento de doble refuerzo |

Tener en cuenta las informaciones de seguridad sirve para tratar de evitar daños y peligros de toda clase. Es necesario de que se lean las siguientes informaciones de seguridad concienzudamente y se tengan en cuenta debidamente antes de la puesta en funcionamiento del producto. También deberán ser tenidas en cuenta las informaciones para la protección de personas que encontrarán en el capítulo correspondiente de la documentación de producto y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por el grupo de empresas Rohde & Schwarz bajo la denominación de „producto“, entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Palabras de señal y su significado

| | |
|-------------|--|
| PELIGRO | Identifica un peligro directo con riesgo elevado de provocar muerte o lesiones de gravedad si no se toman las medidas oportunas. |
| ADVERTENCIA | Identifica un posible peligro con riesgo medio de provocar muerte o lesiones (de gravedad) si no se toman las medidas oportunas. |
| ATENCIÓN | Identifica un peligro con riesgo reducido de provocar lesiones de gravedad media o leve si no se toman las medidas oportunas. |
| AVISO | Indica la posibilidad de utilizar mal el producto y a 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 de 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 malinterpretaciones y tener por consecuencia daños en personas u objetos.

Informaciones de seguridad elementales

1. El producto solamente debe ser utilizado según lo indicado por el fabricante referente a la situación y posición de funcionamiento sin que se obstruya la ventilación. Si no se convino de otra manera, es para los productos R&S válido lo que sigue:
como posición de funcionamiento se define 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, utilizar solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4.500 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. En todos los trabajos deberán ser tenidas en cuenta las normas locales de seguridad de trabajo y de prevención de accidentes. El producto solamente debe de ser abierto por personal especializado autorizado. Antes de efectuar trabajos en el producto o abrirlo deberá este ser desconectado de la corriente. El ajuste, el cambio de partes, la manutención y la reparación deberán ser solamente efectuadas por electricistas autorizados por R&S. Si se reponen partes con importancia para los aspectos de seguridad (por ejemplo el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de la corriente conductora, control de funcionamiento).

3. Como en todo producto de fabricación industrial no puede ser excluido en general de que se produzcan al usarlo elementos que puedan generar alergias, los llamados elementos alergénicos (por ejemplo el níquel). Si se produjeran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averiguar los motivos de estas reacciones.
 4. Si productos / elementos de construcción son tratados fuera del funcionamiento definido de forma mecánica o térmica, pueden generarse elementos peligrosos (polvos de sustancia de metales pesados como por ejemplo plomo, berilio, níquel). La partición elemental del producto, como por ejemplo sucede en el tratamiento de materias residuales, debe de ser efectuada solamente por personal especializado para estos tratamientos. La partición elemental efectuada inadecuadamente puede generar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes al tratamiento de materias residuales.
 5. En el caso de que se produjeran agentes de peligro o combustibles en la aplicación del producto que debieran de ser transferidos a un tratamiento de materias residuales, como por ejemplo agentes refrigerantes que deben ser repuestos en periodos definidos, o aceites para motores, deberán ser tenidas en cuenta las prescripciones de seguridad del fabricante de estos agentes de peligro o combustibles y las regulaciones regionales para el tratamiento de materias residuales. Cuiden también de tener en cuenta en caso dado las prescripciones de seguridad especiales en la descripción del producto.
 6. Ciertos productos, como por ejemplo las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. En vista a la protección de la vida en desarrollo deberían ser protegidas personas embarazadas debidamente. También las personas con un bypass pueden correr peligro a causa de la radiación electromagnética.
- El empresario/usuario está comprometido a valorar y señalar áreas de trabajo en las que se corra un riesgo aumentado de exposición a radiaciones para evitar riesgos.
7. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.
 8. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la del la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso dabo cambiar los fusibles correspondientes del producto.
 9. Productos de la clase de seguridad I con alimentación móvil y enchufe individual de producto solamente deberán ser conectados para el funcionamiento a tomas de corriente de contacto de seguridad y con conductor protector conectado.
 10. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto. Puede tener como consecuencia el peligro de golpe de corriente por el producto. Si se utilizaran cables o enchufes de extensión se deberá poner al seguro que es controlado su estado técnico de seguridad.
 11. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurar de que el enchufe sea de fácil acceso y nabejo (según la medida del cable de distribución, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en bastidores o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

12. No utilice nunca el producto si está dañado el cable eléctrico. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.
13. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A (utilización de fusibles de mayor amperaje sólo previa consulta con el grupo de empresas Rohde & Schwarz).
14. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.
15. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.
16. En las mediciones en circuitos de corriente con una tensión de entrada de $U_{eff} > 30$ V se deberá tomar las precauciones debidas para impedir cualquier peligro (por ejemplo medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
17. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos del estándar IEC950/EN60950.
18. 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 heridas, fuego o daños en el producto.
19. Si un producto es instalado fijamente en un lugar, se deberá primero conectar el conductor protector fijo con el conductor protector del aparato antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
20. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, el circuito de suministro de corriente deberá estar protegido de manera que usuarios y productos estén suficientemente protegidos.
21. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir cortocircuitos en el producto y/o puede causar golpes de corriente, fuego o heridas.
22. Asegúrese con la protección adecuada de que no pueda originarse en el producto una sobrecarga por ejemplo a causa de una tormenta. Si no se verá el personal que lo utilice expuesto al peligro de un golpe de corriente.
23. Los productos R&S no están protegidos contra líquidos si no es que exista otra indicación, ver también punto 1. Si no se tiene en cuenta esto se arriesga el peligro de golpe de corriente para el usuario o de daños en el producto lo cual también puede llevar al peligro de personas.
24. No utilice el producto bajo condiciones en las que pueda producirse y se hayan producido líquidos de condensación en o dentro del producto como por ejemplo cuando se desplaza el producto de un lugar frío a un lugar caliente.
25. Por favor no cierre ninguna ranura u orificio del producto, ya que estas son necesarias para la ventilación e impiden que el producto se caliente demasiado. No pongan el producto encima de materiales blandos como por ejemplo sofás o alfombras o dentro de una caja cerrada, si esta no está suficientemente ventilada.
26. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.

27. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. No cortocircuitar baterías ni acumuladores. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención células de litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Las baterías y acumuladores deben reutilizarse y no deben acceder a los vertederos. Las baterías y acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de evacuación y reciclaje.
28. Por favor tengan en cuenta que en caso de un incendio pueden desprenderse del producto agentes venenosos (gases, líquidos etc.) que pueden generar daños a la salud.
29. El producto puede poseer un peso elevado. Muévelo con cuidado para evitar lesiones en la espalda u otras partes corporales.
30. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptas para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (por ejemplo paredes y estantes).
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Contents of the Software Manual for Application Firmware R&S FS-K15

This software manual provides information on how to operate Application Firmware R&S FS-K15. It describes the menus and remote control commands for avionics demodulation measurements. All other details about operation can be found in the relevant operating manual.

This software manual consists of the following chapters:

- Chapter 1** Describes the installation of the application firmware and how to enable the application firmware.
- Chapter 2** Describes the first operating steps for measurements.
- Chapter 3** Describes the test setup for measurements.
- Chapter 4** Contains a detailed description of all functions as a reference for manual operation. The chapter also lists the corresponding IEC/IEEE bus command for each function.
- Chapter 5** Describes all remote control commands defined for the application firmware. An alphabetic list of all remote control commands and a table containing the IEC/IEEE bus commands assigned to the softkeys are included at the end of the chapter.
- Chapter 6** Contains the index for this software manual.
- Chapter 7** Describes the Performance Test of the application firmware.

Installation and Enabling

Installation

Application Firmware R&S FS-K15 is part of the basic firmware of the base unit. The application is available starting with the following firmware version of the instruments:

| Instrument type | Firmware version |
|-----------------|------------------|
| R&S FSMR | 4.26 |
| R&S FSU | 4.31 |
| R&S FSQ | 4.35 |

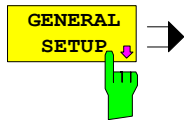
If the firmware has to be updated, start the update with the floppy disks containing the firmware by *SETUP* → *NEXT* → *FIRMWARE UPDATE*.

Enabling

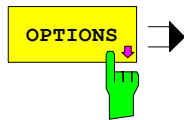
Application Firmware R&S FS-K15 is enabled in the *SETUP* → *GENERAL SETUP* menu by entering a keyword. The keyword is supplied together with the application firmware. After enabling the application firmware a performance verification test is required to check the measurement accuracy.

If the application firmware is installed at the factory, it will already be enabled and tested against the specifications.

SETUP menu:



The *GENERAL SETUP* softkey opens a submenu in which the general instrument parameters can be set up. In addition to the configuration of the digital interfaces (*IECBUS*, *COM*), the date and time may be entered.



The *OPTIONS* softkey opens a submenu in which you can enter the keywords for the application firmware. The existing applications are displayed in a table that opens when you enter the submenu.



The *INSTALL OPTION* softkey enables entry of the keyword for application firmware.

If the keyword is valid, the message *OPTION KEY OK* is displayed and the application firmware is entered in the *FIRMWARE OPTIONS* table.

If an invalid keyword is entered, *OPTION KEY INVALID* is displayed.

General information about ILS and VOR/DVOR

ILS (Instrument Landing System)

Through the globally standardized ILS an aircraft on a defined glidepath receives highly accurate position information in reference to the glidepath during landing. This landing path is described by the intersection of a vertical glideslope level and a horizontal localizer plane.

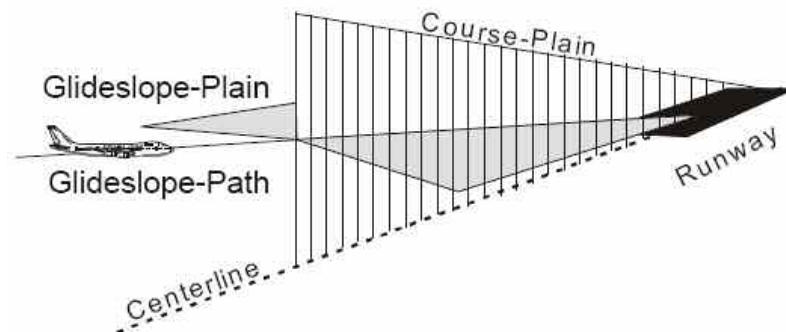


Fig. 1 Basics of the ILS landing

The ILS frequency range covers 108 to 118 MHz for the LLZ (localizer) and 320 to 340 MHz for the GS (Glideslope). The ILS is based on the interpretation of two amplitude modulated coherent carrier signals, each of which is emitted through an antenna array. If the aircraft is on the landing line both signals are received with the same modulation depth. If the aircraft deviates from the landing line, either the 90 Hz- or the 150 Hz- components predominate after the AM demodulation. The ILS-interpretation is done by measuring the modulation depth of both emitted signals, the difference allows the calculation of the DDM (Difference in Depth of Modulation).

$$DDM = m(x_{90}) - m(x_{150})$$

The ICAO (International Civil Aviation Organization) prescribes the way in which the DDM values must be generated for different distances from the runway threshold. According to this the corresponding antenna diagrams of the landing course transmitter LLZ (Localizer) and the glide path transmitter GS (Glideslope) are calibrated.

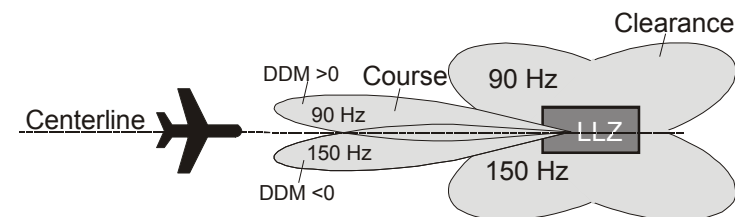


Fig. 2 Basic antenna diagrams of the ILS localizer

VOR (VHF Omni directional Radio Range)

VOR is a radio navigation system for short and medium distance navigation. VOR transmitter systems work in the VHF range from 108 to 118 MHz. The VOR radio navigation aid supplies the aircraft with directional information, angle information relative to the magnetic north from the site of the beacon. The range covered by a VOR station is ideally a circle around the VOR station with a radius depending on the flight altitude.

The VOR receiver obtains the directional information by measuring the phase difference of two 30 Hz signals transmitted by the beacon. A conventional VOR station transmits with a rotating antenna. From the rotation a sinewave AM modulated signal arises in the receiver, whose phase position depends on the present angle of rotation. The rotation frequency of the antenna sets the modulation frequency at 30 Hz. In order to determine the radial the phase difference to a reference phase must be measured. Because this reference phase must be independent of the rotation of the antenna it is modulated with a frequency deviation of 480 Hz in FM onto a secondary carrier with 9,96 kHz and emitted over a separate antenna with round characteristic.

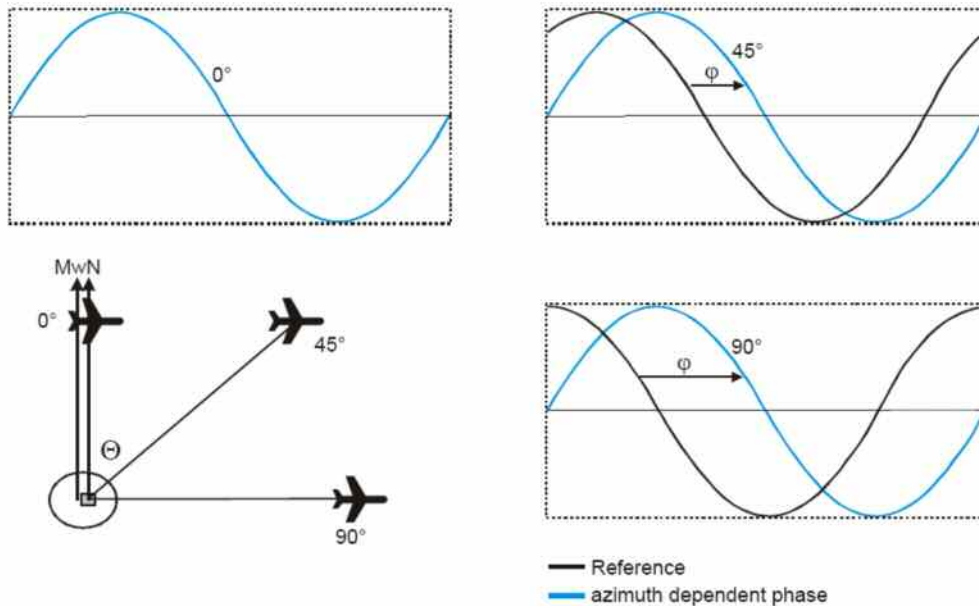


Fig. 3 Basics of the VOR phase angles (ϕ) depending on the azimuth angle (Θ)

The frequency modulated secondary carrier for the reference phase is itself again modulated in AM on the RF carrier of the VOR station. In addition to the signals necessary for navigation a morse code with 1020 Hz or speech in the usual AF from 300 Hz to 3.3 kHz can be transmitted on the VOR carrier. Often the voice channel of a VOR station is used for the transmission of ATIS (Automatic Terminal Information Service) messages. The spectrum of a VOR signal is therefore composed of the carrier and three modulated components.

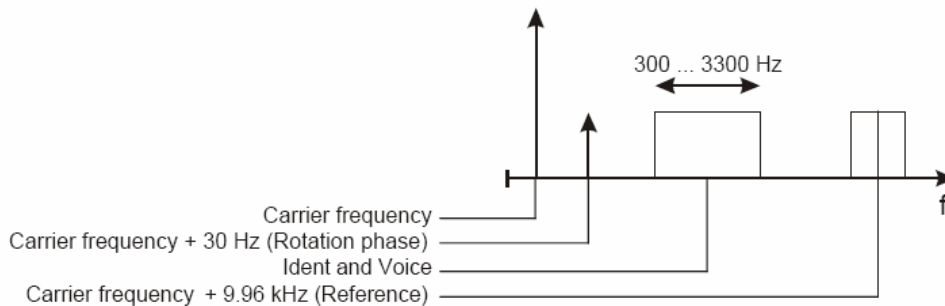


Fig. 4 Example of the VOR Spectrum

The identical modulation degree $m = 0.3$ for all three components was selected in ICAO annex-10 [63] such that the total signal still contains 10% modulation reserve. The carrier is therefore not suppressed at any time. The 9960 Hz reference carrier is FM modulated with 480 Hz deviation. The VOR signal generation as under ICAO is shown below.

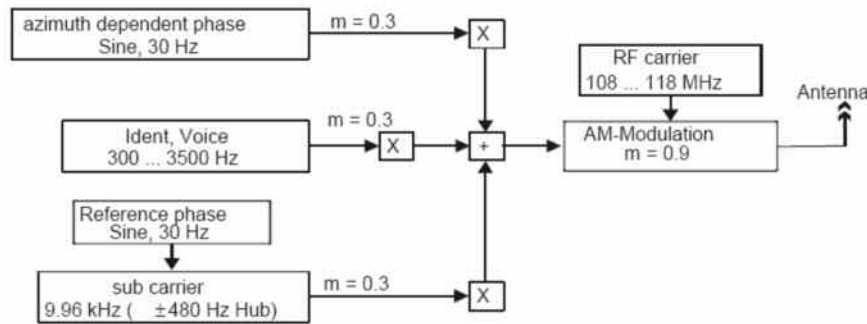


Fig. 5 Basics of the VOR signal generation

DVOR (Doppler VHF Omni directional Range)

A DVOR beacon transmits like a VOR a RF signal in which the two phase angles are coded from whose difference the receiver can calculate it's position in reference to the DVOR. In contrast to the VOR the meaning of the reference and azimuth depending phase is interchanged. This means that the reference phase is no longer emitted in FM through the secondary carrier, but rather the 30 Hz reference signal is emitted in AM from a fixed antenna.

In DVOR the azimuth dependent phase is generated using the Doppler effect. The Doppler effect is such that the receiving frequency f_{rx} increases when there is radial relative movement of a receiver with a speed v_x towards the transmitter, and correspondingly decreases when there is movement away from the transmitter.

The following figure shows the 50 circularly arranged single antennas of a DVOR station. The secondary carrier to be transmitted on (carrier + 9,96 kHz) is distributed using an electronic multiplexer on the circularly arranged antenna, such that the transmission signal seems to revolve at 30 Hz in the circle.

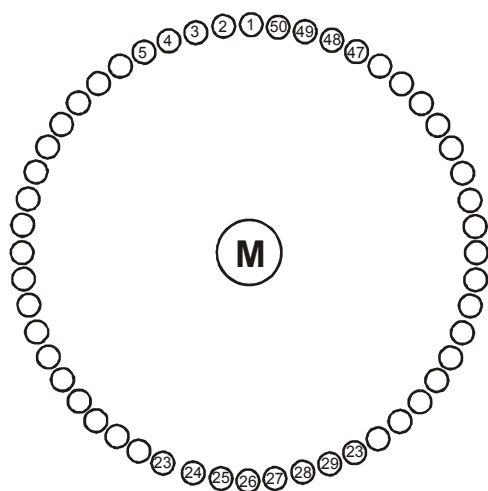


Fig. 6 Basics of a DVOR system

The circles shown in the above figure symbolize radial transmitters. The transmission antenna in the center of the circle (M) transmits the reference phase in the form of the 30 Hz AM modulated carrier and the identifier of the station. The Doppler shift corresponds to the FM deviation.

In practice both sidebands of the secondary carrier (carrier + 9,96 kHz and carrier - 9,96 kHz) are created separately and fed into the antenna array spatially displaced by 180°. Therefore two superimposed individual antennas are emitting at one period in time, each being one sideband of the total signal. In the far field there is the effect of a FM on the receiver, because one sideband component always increases in frequency because of the Doppler effect, while the other component decreases in frequency. The reason for this complex method of signal generation lies in the high accuracy which can be obtained for the azimuth dependent phase.

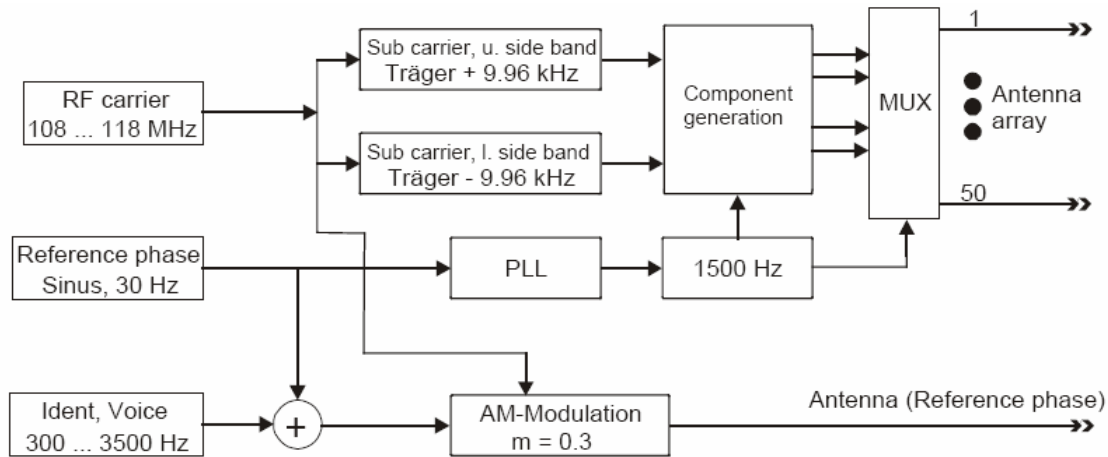


Fig. 7 Basics of the DVOR signal generation

Description of the Avionics Measurement Demodulator

The following chapter describe the functions of the Avionics measurement demodulator. In the case of functions identical to those of the base unit, reference is made to the relevant chapter in the base unit manual.

The digital signal processing used in the analyzer mode for digital IF filters are also ideally suited for demodulating VOR and ILS navigation aid signals.

By sampling (digitization) already at the IF and digital downconversion to the baseband (I/Q), the demodulator achieves maximum accuracy and temperature stability. There is no evidence of typical errors of an analog downconversion and demodulation like $AM \Leftrightarrow FM$ conversion, deviation error, frequency response or frequency drift at DC coupling. Only the characteristics of the analog IF filter ahead of the A/D converter needs to be taken into consideration.

Circuit Description - Block Diagrams

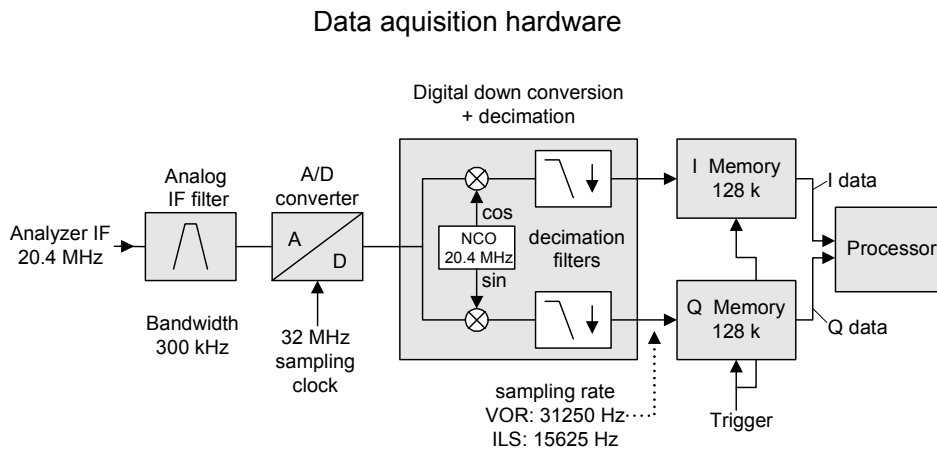


Fig. 8 Block diagram of analyzer signal processing

Fig. 8 shows the analyzer's hardware from the IF to the processor. The IF filter is the resolution filter of the spectrum analyzer, with a bandwidth range from 300 kHz to 10 MHz for ILS and VOR measurement. The A/D converter samples the IF (20.4 MHz) at 32 MHz.

Lowpass filtering and reduction of the sampling rate follow the downconversion to the complex baseband. The decimation depends on the selected demodulation bandwidth. The output sampling rate is set in powers of 2 between 800 Hz and 31.250 kHz. Useless oversampling at narrow bandwidths is avoided, saving computing time and increasing the maximum recording time.

The I/Q data is stored in memories each comprising 512 k words in case of FSU, FSQ and FSMR. The hardware triggering (external, IF power) controls the memory.

ILS demodulator

The software demodulator runs on the main processor of the analyzer. The demodulation process is shown below. All calculations are performed simultaneously with the same I/Q data set.

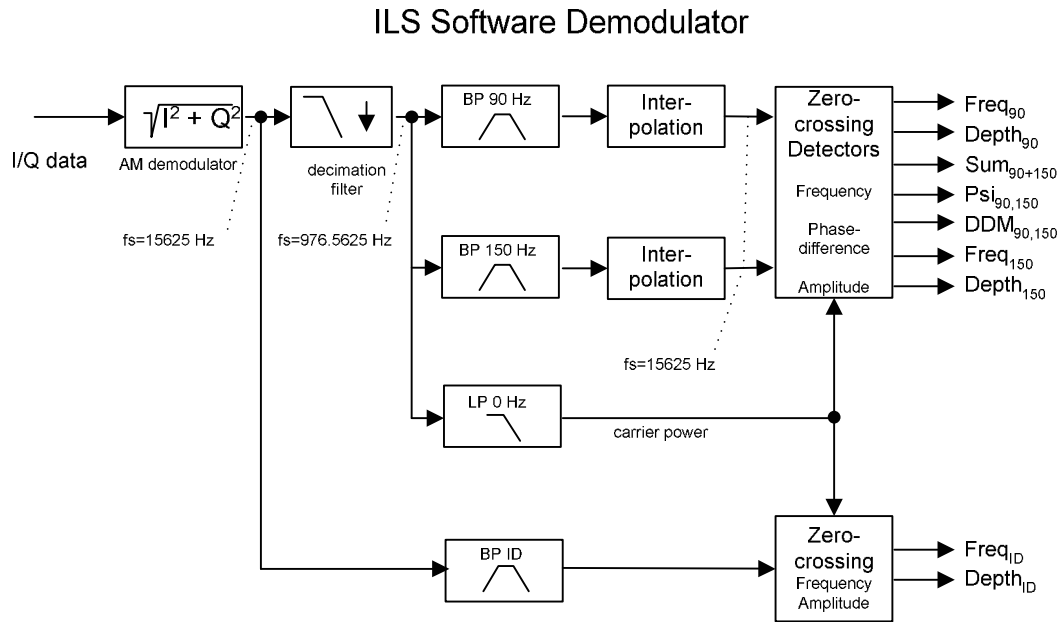


Fig. 9 Block diagram of ILS software demodulator

The ILS demodulation basically comprises of two bandpass filters with center frequencies of 90 and 150 Hz. In order to meet the required selectivity with a reasonable filter order the AM signal must be decimated in frequency before filtering and interpolated thereafter.

The optional ID signal is separated by a bandpass filter with a frequency range from 300 to 4000 Hz.

AM Modulation Depth

To obtain the AM depth the mean carrier power must be calculated by an lowpass filter. Since modulation depths are computed by using the RMS method, the averaging length is crucial and must be multiples of the period length. Thus zero crossing detector results are used to derive the appropriate averaging lengths. In this way the following AM depths and their derivates are computed

- 90 Hz
- 150 Hz
- 300 Hz – 4KHz (Identification/Voice)
- DDM **D**ifference in **D**epts of **M**odulation (90 Hz and 150 Hz)
- SDM **S**um of **D**epts of **M**odulation (90 Hz and 150 Hz)
- Sum90/150 Hz (vectorial) sum amplitude of the 90 and 150 Hz signals (peak-to-peak method, no RMS)

AF frequencies

Interpolated results of the zero crossing detectors are used to determine the frequencies of the AM signal components:

- 90 Hz
- 150 Hz
- 1020 Hz (Identification)

Phase angle 90/150 Hz

The phase angle is computed by the differences of the interpolated results of the 90/150 Hz zero crossing detectors. Since the frequencies having a ratio of 3 to 5, phase angles exceeding $\pm 60^\circ$ will lead to ambiguous results.

VOR demodulator

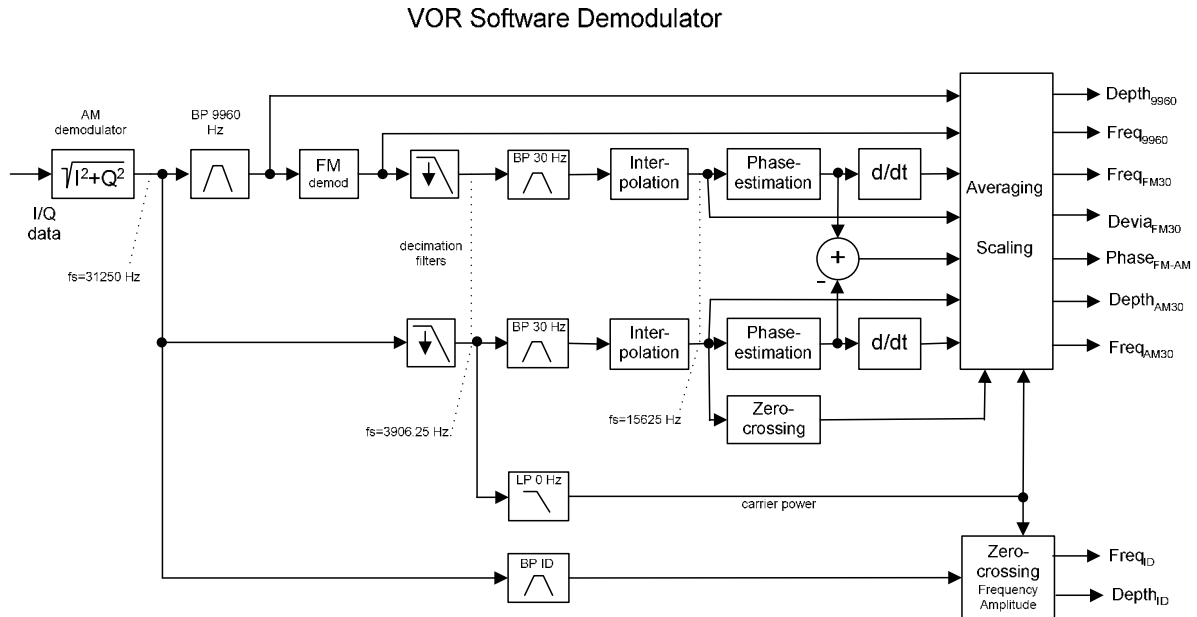


Fig. 10 Block diagram of VOR software demodulator

The VOR signal contains three AM modulated components that must be separated in a first step:

- Rotational signal (30 Hz)
- Identification /Voice part (300 Hz – 4 kHz)
- FM component (9960 ± 700 Hz)

This is done by means of bandpass filters covering the given frequency ranges. However, like in the case of the ILS demodulator, the low frequency component of 30 Hz must be computed on an downsampled version of the AM demodulated signal in order to obtain the required selectivity with a reasonable filter order.

The separated FM component is passed through a FM demodulator. To obtain the 30 Hz reference-signal the FM demodulator output is processed with the same procedure as the AM 30 Hz rotational-component (downsampling, 30 Hz bandpass filter and interpolation). FM deviation is computed using the RMS value of the 30 Hz reference signal.

Both signals, the 30 Hz reference and the rotational signal are fed to a phase estimation procedure for the azimuth processing.

AM Modulation Depth

To obtain the AM depth the mean carrier power must be calculated by an lowpass filter. Since modulation depths are computed by using the RMS method, the averaging length is crucial and must be multiple of the period length. Thus zero crossing detector result of the AM 30 Hz rotational component is used to derive the appropriate averaging length. Note that the precision as specified in the FS-K15 data sheet will be guaranteed only if the AM 30 Hz rotational component can be identified properly.

The following AM depths are computed:

- 30 Hz (Rotational-signal)
- 300 Hz – 4KHz (Identification/Voice)
- 9960 Hz (FM)

Azimuth (Phase difference at 30 Hz)

In order to meet the resolution requirements the phase of the 30 Hz rotational- (AM) and reference- (FM) components are computed by means of an Hilbert transform based phase estimation algorithm. The azimuth is obtained by the difference of both estimator results and the frequency results are obtained from the differential phase.

AF frequencies

In the VOR demodulator the AF frequencies are computed using different methods:

- 30 Hz Rotational-signal (AM), differential of the phase estimator result
- 30 Hz Reference-signal (FM), differential of the phase estimator result
- 1020 Hz (Identification), interpolated results of the zero crossing detector
- 9960 Hz (FM carrier frequency), mean value for the FM demodulator output

Further Characteristics

IF Bandwidth

The **analog IF filter** improves the selectivity, but also may cause signal distortion. The filter is negligible if the IF bandwidth is wider than the highest modulation frequency.

In general, the IF bandwidth should be set to auto coupling.

Demodulation Bandwidth

Digital filters determine the demodulation bandwidth. This is not the 3 dB bandwidth but the useful bandwidth which is distortion-free with regard to phase and amplitude.

Therefore the following automated settings are applied:

- ILS: demodulation bandwidth set to 12.5 kHz, in order to capture the full identifier signal
- VOR: demodulation bandwidth set to 25 kHz, in order to capture the 9.96 kHz signal
- DIST demodulation bandwidth set to same value as selected demodulator (ILS or VOR)

Note: *If the demodulation bandwidth setting is changed, some demodulation results may not be available due to bandwidth limitations. In case of harmonic distortion measurement the highest measured harmonic signal may be limited due to the demodulation bandwidth.*

In general, the demodulation bandwidth should be set to auto coupling.

Stability of Measurement Results

Stability of the mean-squares method involved for of computation of the modulation depths and Azimuth estimation rely on a sufficient length for the averaging.

This is achieved if at least five periods of the 30 Hz basic modulation frequency are recorded. To this time the summed filter settling times must, be added, thus a minimum recording time of 400 ms is needed to meet the required precision.

Note, that the precision as specified in FS-K15 data sheet will be guaranteed only if the AM 30 Hz rotational component can be identified properly in the VOR analysis case.

Due to rounding effects of the phase estimation algorithm, the systematic error is limited to 10E-8 for the Azimuth- and frequency results.

Configuration of the Avionics Demodulator

Getting Started

Before you can start measurements, you must adjust the instrument settings to the properties of the device under test. The following procedure is recommended:

1. Set the spectrum analyzer to its default state.

- Press the *PRESET* button.
The device is now in its default state. If the instrument is not in the spectrum analyzer mode, the mode has to be changed to the spectrum analyzer mode: Press the *SPECTRUM* hotkey.

2. Activate measurements with avionics demodulator.

- Press the *AVIONICS* hotkey.
Measurements with the avionics demodulator will be activated and the menu with the settings for the avionics demodulator will be opened.

3. Set the frequency

- In the default setting, the frequency of the avionics demodulator is coupled with the center frequency of the analyzer, i.e. when the center frequency of the analyzer is set (*FREQ* button), the avionics demodulator is automatically set to the frequency to be measured.

4. Set the measurement mode.

- In the avionics demodulator main menu, press the *VOR* softkey for measurements in the VOR standard (VHF Omnidirectional Radio Range), or press the *ILS* softkey for measurements in the ILS standard (Instrument Landing System)

5. Set the unit

- Press the *SETTINGS* softkey to select the harmonic distortion readings in % or dB values.

Additional setting options are described in the following reference section of the manual.

Test Setup for Measurements

NOTICE Instrument damage caused by disregarding the following precautions!

Before the instrument is put into operation, make sure the following are done:

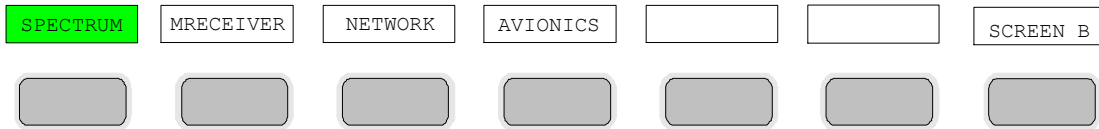
- The ventilation openings are unobstructed.
- No signal voltage levels exceed permitted limits.
- The instrument outputs are not overloaded or improperly connected.

This chapter describes the basic settings for the analyzer for measurements. Before measurements can be started, the analyzer must be correctly configured and powered as described in Chapter 1 of the operating manual for the base unit. Furthermore, Application Firmware R&S FS-K15 must be enabled. Chapter 1 of this manual describes how to install and enable the application firmware.

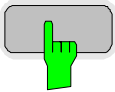
Selecting the Operating Mode – HOTKEY Bar

The base instrument has seven hotkeys below the display for fast mode selection. These hotkeys can be differently assigned depending on the available instrument options and instrument modes.

The keys after instrument preset: (in spectrum analysis mode, further keys may be available)



The *SPECTRUM* hotkey sets the instrument to spectrum analysis mode.



IEC/IEEE bus command: `INST:SEL SAN`



The *AVIONICS* hotkey sets the instrument to avionics demodulation mode.

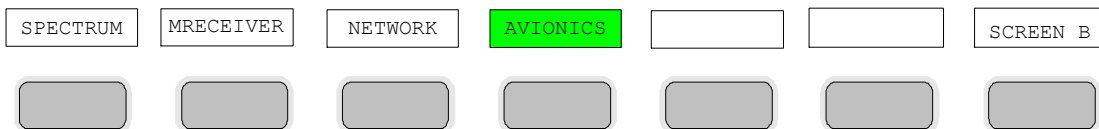


IEC/IEEE bus command: `INST:SEL AVI`

The operating manual of the base instrument or of the other options describes the meaning of the other keys.

Avionics Demodulator Mode

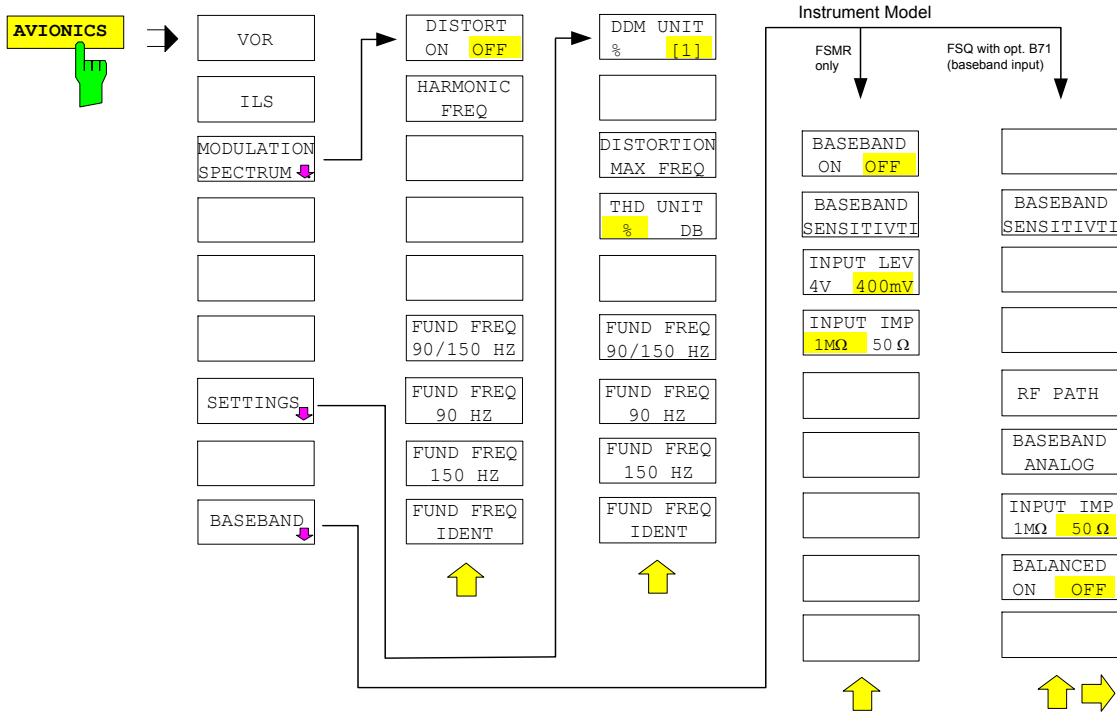
The application firmware R&S FS-K15 (avionics demodulation measurements) is activated with the *AVIONICS* hotkey.



The AVIONICS hotkey allows the access to the avionics measurement capabilities (VOR/ILS) of the instrument.

A softkey menu suitable for the currently selected operating mode is simultaneously displayed and allows the setting of the measurement parameters.

Simultaneously, the VOR demodulator is activated (default after Preset).



Note: The softkeys visible in the BASEBAND submenu depend on the instrument type. The BASEBAND submenu is only available in the R&S FSMR and R&S FSQ equipped with baseband inputs (option R&S FSQ-B71).

The individual settings are explained in the following menus.
The main measurement functions of the avionics demodulator are:

- VOR VOR Measurements
- ILS ILS Measurements
- MODULATION SPECTRUM Modulation Distortion measurements

In the avionics demodulator mode the base instrument is equipped with a high performance avionics demodulator. In order to display the measurement results the screen is divided in two halves.

The frequency setting, the frequency counter result and the RF or baseband input level is displayed in the upper half of the screen. The measurement results of the avionics demodulator are displayed in a table in the lower half of the screen. The modulation spectrum can be displayed in the lower half as a trace.

Signal parameters such as modulation depth and frequency deviation can be determined.

Result Display – RF level and frequency counter result

The upper screen shows the level readings and the frequency settings and frequency counter result.

Example for upper screen:



Fig. 11 RF Level measurement display

Screen description:

| | |
|-----------------|---|
| RF frequency | Result from the frequency counter |
| Carrier Offset | Frequency offset between measured frequency and tuned frequency |
| Tuned Frequency | RF Frequency setting |
| RF level | RF level reading (Baseband input level in case of baseband operation) |
| Bargraph | for visual information about the input level |

Status information flags for Power Splitter, Auto Tune, Average, AutoLevel etc.:

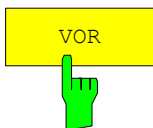
| | |
|----------|---|
| ATT | Setting of the RF attenuator. Manual or Coupled to Reference level |
| AQT | This is the measurement time or capture time. |
| RBW | Display of actual resolution bandwidth for distortion measurement |
| AUTO | Enhancement label for Autotune = ON. |
| TUNE | |
| AUTOL | Enhancement label for level Autorange. |
| EVEL | |
| SPLITTER | Enhancement label for Power Splitter Sensor head. The insertion loss of the splitter will be taken into account in the RF level reading |

The individual measured values are read out with the following commands:

| | |
|----------------|--------------------|
| RF frequency | CALC:AVI:RFFR:RES? |
| Carrier Offset | CALC:AVI:FERR:RES? |
| RF level | CALC:AVI:CARR:RES? |

Avionics Demodulator Main Menu

The AVIONICS hotkey opens the menu for setting the VOR/ILS demodulator functions.



The VOR softkey switches the VOR demodulator on. The VOR demodulator default setting is OFF. When the AVIONICS mode is selected after preset, the demodulator is switched on automatically.

IEC/IEEE bus command: CALC:AVI:STAN VOR

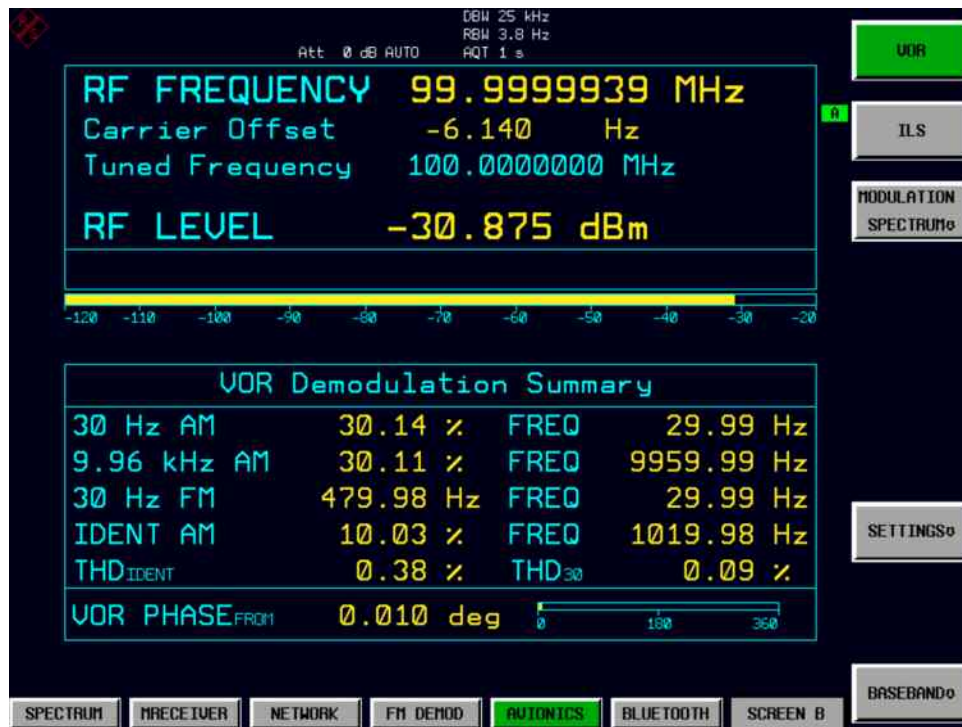


Fig. 12 VOR measurement display

Notes: The settings of the spectrum analyzer active before the demodulator is switched on will be restored when the demodulator is switched off. The center frequency setting is coupled between the operating modes. The trace operating mode and detector are restored (the VOR/ILS demodulator has separate trace settings).

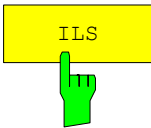
Screen description:

| | |
|----------------------|---|
| 30 Hz AM | Selective modulation depth and AF frequency measurement of VOR 30 Hz signal component. |
| 9.96 kHz AM | Selective modulation depth and AF frequency measurement of frequency modulated VOR 9960 Hz signal component. |
| IDENT AM | Modulation depth and frequency measurement of Identifier signal and speech band 300 Hz to 4 kHz without influence by the actual VOR signal component. |
| 30 Hz FM | Frequency deviation and AF frequency measurement at the frequency modulated VOR 9960 Hz signal component. |
| THD _{Ident} | Distortion measurement at the identifier signal component. |
| THD ₃₀ | Distortion measurement at the 30 Hz AM signal component. |
| VOR Phase | Phase measurement between 30 Hz AM signal and 30 Hz FM demodulated signal (= reference signal), measurement range 0 to 360 degree. |

The individual measured values are read out with the following commands:

```

30 Hz AM Depth      CALC:AVI:AM:DEPT? `30'
30 Hz AM Frequency  CALC:AVI:AM:FREQ? `30'
9.96 kHz AM Depth   CALC:AVI:AM:DEPT? `9960'
9.96 kHz AM Freq.   CALC:AVI:AM:FREQ? `9960'
IDENT AM depth      CALC:AVI:AM:DEPT? `ID'
IDENT AM Frequency  CALC:AVI:AM:FREQ? `ID'
30 Hz FM deviation  CALC:AVI:FM:DEV?
30 Hz FM Frequency  CALC:AVI:FM:FREQ?
THDident           CALC:AVI:THD:RES? `ID'
THD30             CALC:AVI:THD:RES? `30'
VOR Phase           CALC:AVI:PHAS?
    
```



The ILS softkey switches the ILS demodulator on.

IEC/IEEE-bus command: CALC:AVI:STAN ILS

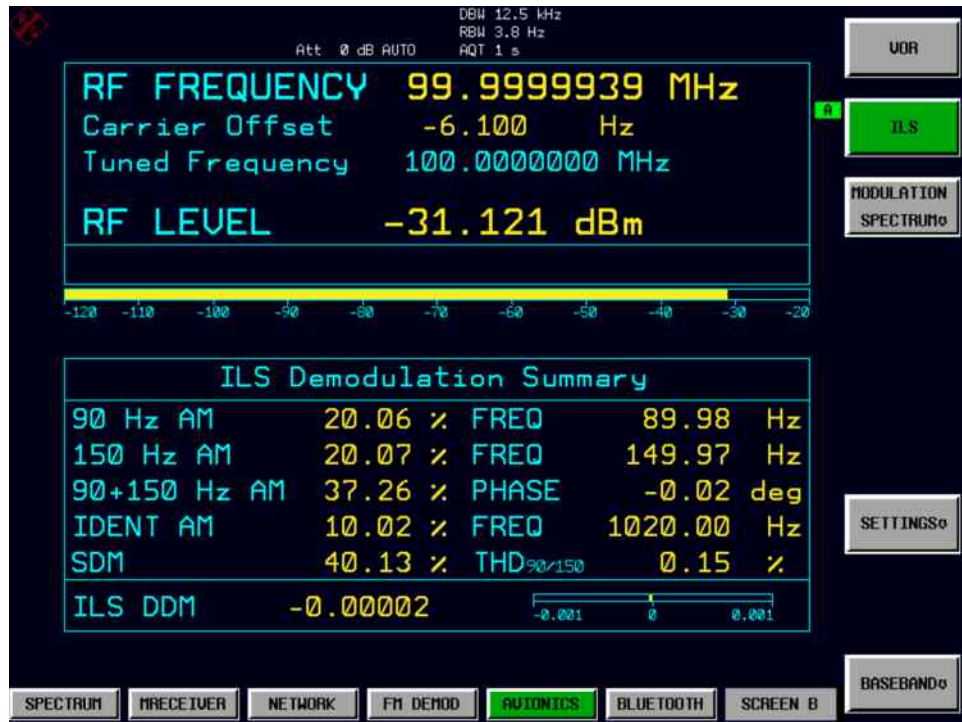


Fig. 13 ILS measurement display

Notes: The settings of the spectrum analyzer active before the demodulator is switched on will be restored when the demodulator is switched off. The center frequency setting is transferred between the operating modes. Similarly, the trace operating mode and detector are restored (the VOR/ILS demodulator has separate trace settings).

Screen description:

| | |
|----------------------|--|
| 90 Hz AM | Selective modulation depth and AF frequency measurement of 90 Hz ILS signal component. |
| 150 Hz AM | Selective modulation depth and AF frequency measurement of 150 Hz ILS signal component. |
| ILS Phase | Phase angle measurement between 90 Hz and 150 Hz AM signal (90 Hz = reference signal), measurement range ± 60 degree. |
| 90+150 Hz AM | Total modulation depth of the 90 Hz and the 150 Hz components taking the phase between the components into account. |
| IDENT AM | Modulation depth and frequency measurement of Identifier signal and speech band 300 Hz to 4 kHz without influence by the actual ILS signal components. |
| SDM | Selective measurement of the sum-modulation depth (SDM = Sum in Depth of Modulation); arithmetic sum of the modulation depth of the 90 Hz and the 150 Hz components without any influence of the phase between the components. |
| THD _{Ident} | Distortion measurement at the identifier signal component. |
| DDM | DDM (= difference in depth of modulation) between 90 Hz and 150 Hz AM signal ($m_{90\text{ Hz}} - m_{150\text{ Hz}}$). |

The individual measured values are read out with the following commands:

| | |
|---------------------|----------------------------|
| 90 Hz AM depth | CALC:AVI:AM:DEPT? `90' |
| 90 Hz AM Frequency | CALC:AVI:AM:FREQ? `90' |
| 150 Hz AM depth | CALC:AVI:AM:DEPT? `150' |
| 150 Hz AM Frequency | CALC:AVI:AM:FREQ? `150' |
| 90+150 Hz AM depth | CALC:AVI:AM:DEPT? `90+150' |
| ILS Phase | CALC:AVI:PHAS? |
| IDENT AM depth | CALC:AVI:AM:DEPT? `ID' |
| IDENT AM Frequency | CALC:AVI:AM:FREQ? `ID' |
| SDM | CALC:AVI:SDM? |
| THD | CALC:AVI:THD:RES? `` |
| DDM | CALC:AVI:DDM? |



The *DISTORTION MOD SPECT* softkey opens the submenu for the distortion meter operation and selects the display of the AF spectrum. The AF spectrum is calculated from the ILS signal or the VOR signal depending on the mode which was active before selecting the distortion/spectrum measurement.

IEC/IEEE-bus command: `CALC:FEED 'XTIM:SPEC'`

To switch back to the demodulation summary screen:

IEC/IEEE-bus command: `CALC:FEED 'XTIM:AMS'`

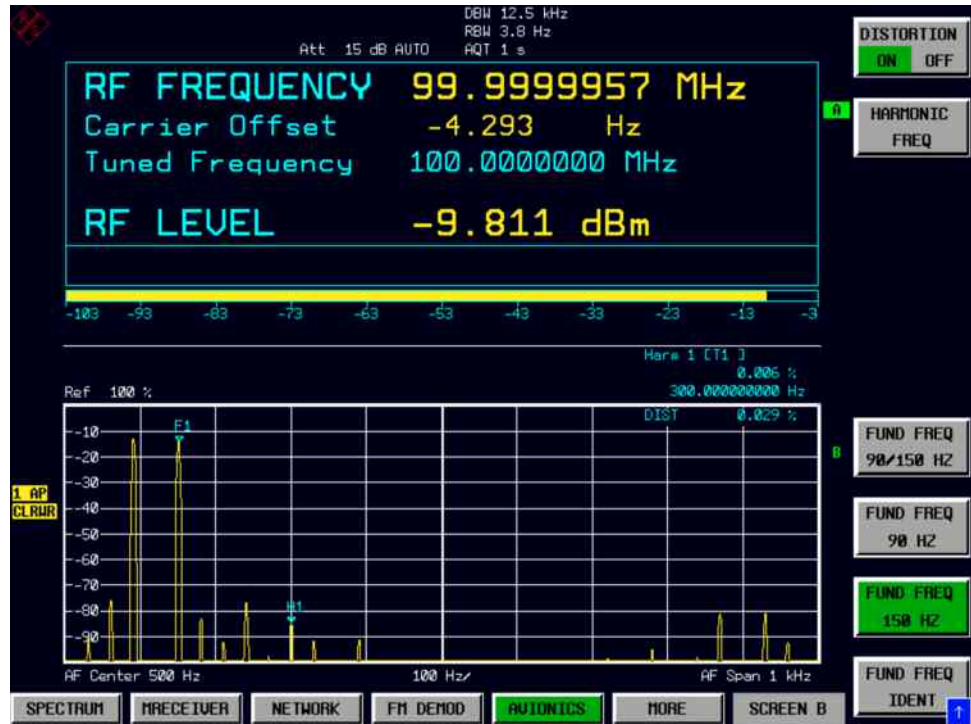


Fig. 14 Distortion measurement display

Notes: Similarly to the spectrum analyzer operation, the markers can be used for selective harmonic measurements on any arbitrary frequencies within the audio spectrum range. The spectrum is limited to the half of the demodulation bandwidth setting (default: 12.5 kHz in ILS mode and 25 kHz in VOR mode).

Screen description:

DIST Distortion measurement at the selected signal component.

The measured value are read out with the following command:

IEC/IEEE bus command: `CALC:AVI:SHD:RES?`



The *DISTORTION ON OFF* softkey activates the harmonic distortion measurement.

IEC/IEEE bus command: `CALC:AVI:SHD:STAT ON | OFF`



The *HARMONIC FREQUENCY* softkey sets the measurement frequency of the harmonic distortion measurement. This setting is only taken into account for the distortion reading in the distortion screen.

IEC/IEEE bus command: `CALC:AVI:SHD:FREQ 300HZ`

The result of the manual distortion measurement is available with the following command:

IEC/IEEE bus command: `CALC:AVI:SHD:RES?`



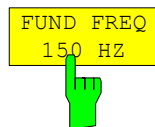
The *FUND FREQ 90/150HZ* softkey sets the reference frequency for the harmonic distortion reading to the 90 Hz and 150 Hz signal. Both modulation tones will be measured and the average level will be used as reference. This allows THD measurements at signals with non-equal tone modulation (DDM not zero). All harmonics at $N * 30$ Hz will be measured and the distortion result is calculated in % or dB to the average of the 90 Hz and 150 Hz signal level.

IEC/IEEE bus command:
`CALC:AVI:THD:FREQ:FUND '90_150'`



The *FUND FREQ 90* softkey sets the reference frequency for the harmonic distortion reading to the 90 Hz signal. All harmonics at $N * 90$ Hz will be measured and the distortion result is calculated in % or dB to the 90 Hz signal level.

IEC/IEEE bus command:
`CALC:AVI:THD:FREQ:FUND '90'`



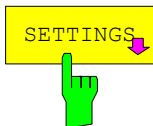
The *FUND FREQ 150* softkey sets the reference frequency for the harmonic distortion reading to the 150 Hz signal. All harmonics at $N * 150$ Hz will be measured and the distortion result is calculated in % or dB to the 150 Hz signal level.

IEC/IEEE bus command:
`CALC:AVI:THD:FREQ:FUND '150'`

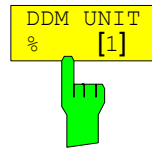


The *FUND FREQ IDENT* softkey sets the fundamental frequency for the harmonic distortion reading to the Identifier signal. The THD measurement will use the highest signal in the frequency range from 300 Hz to 4 kHz as the fundamental signal reference.

IEC/IEEE bus command:
`CALC:AVI:THD:FREQ:FUND 'ID'`



The *SETTINS* softkey opens the submenu for setting the measurement parameters of the selected measurement function.



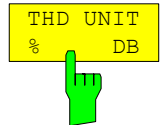
The *DDM UNIT %/1* softkey selects between % and unitfree for displaying the DDM measurement results of the ILS demodulator.

IEC/IEEE bus command: `UNIT:DDM PCT | UNIT`



The *DISTORTION MAX_FREQ* softkey sets the upper frequency limit of the total harmonic distortion measurement.

IEC/IEEE bus command: `CALC:AVI:THD:FREQ:UPP`



The *THD UNIT %/DB* softkey selects between % and dB for displaying the THD measurement results.

IEC/IEEE bus command: `UNIT:THD PCT`



The *FUND_FREQ 90/150HZ* softkey sets the reference frequency for the harmonic distortion reading to the 90 Hz and 150 Hz signal. Both modulation tones will be measured and the average level will be used as reference. This allows THD measurements at signals with non-equal tone modulation (DDM not zero). All harmonics at $N * 30$ Hz will be measured and the distortion result is calculated in % or dB to the average of the 90 Hz and 150 Hz signal level.

IEC/IEEE bus command:

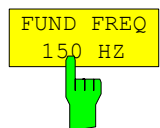
`CALC:AVI:THD:FREQ:FUND '90_150'`



The *FUND_FREQ 90* softkey sets the reference frequency for the harmonic distortion reading to the 90 Hz signal. All harmonics at $N * 90$ Hz will be measured and the distortion result is calculated in % or dB to the 90 Hz signal level.

IEC/IEEE bus command:

`CALC:AVI:THD:FREQ:FUND '90'`



The *FUND_FREQ 150* softkey sets the reference frequency for the harmonic distortion reading to the 150 Hz signal. All harmonics at $N * 150$ Hz will be measured and the distortion result is calculated in % or dB to the 150 Hz signal level.

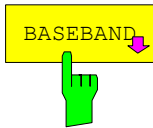
IEC/IEEE bus command:

`CALC:AVI:THD:FREQ:FUND '150'`



The *FUND_FREQ IDENT* softkey sets the fundamental frequency for the harmonic distortion reading to the Identifier signal. The THD measurement will use the highest signal in the frequency range from 300 Hz to 4 kHz as the fundamental signal reference.

IEC/IEEE bus command: `CALC:AVI:THD:FREQ:FUND 'ID'`



Instead of the RF signal (present at the RF input of the instrument) the modulation signal at the audio input or the baseband input is analyzed. The input level range is fixed (no autorange). In all VOR/ILS modulation depth measurements the selectively measured voltages are converted into modulation depth and read out in %AM, the sensitivity entered under Baseband Sensitivity in Volöts/100% being used as a reference. This applies also to the ILS measurements DDM, SDM and m(90+150)Hz derived from the 90 and 150 Hz tones modulation depth measurements. When baseband measurements are selected, the RF input is switched off.

Note: The baseband menu is only available when the instrument is equipped with an audio input (R&S FSMR) or with the option baseband inputs (R&S FSQ-B71).

Note: The baseband signal shall be connected to the “I” baseband input on the R&S FSQ.

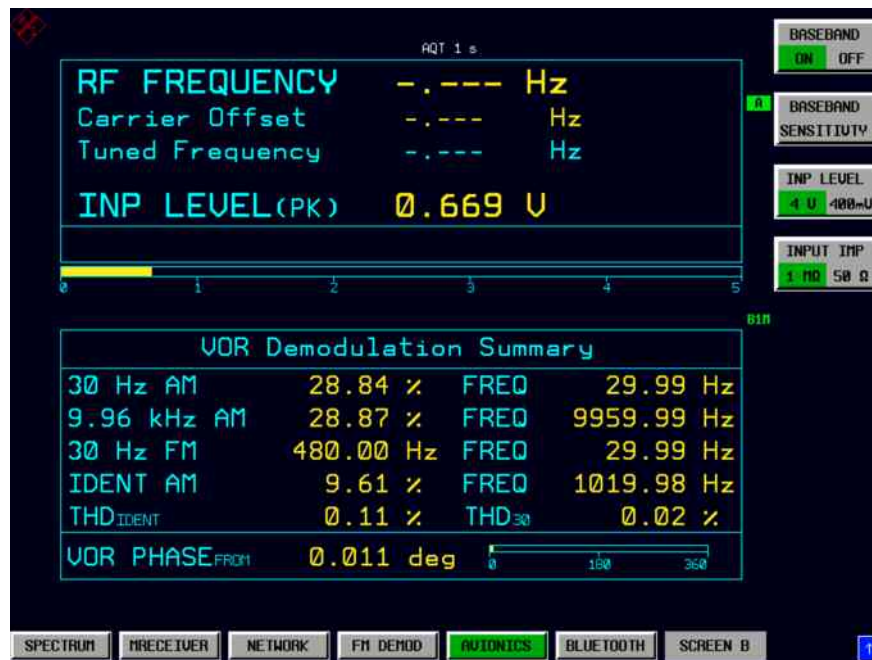


Fig. 15 Screen display of measurements on the audio input

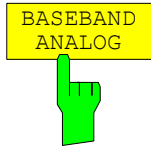
Screen description:

| | |
|-----------------|---|
| RF frequency | Not available in Baseband mode |
| Carrier Offset | Not available in Baseband mode |
| Tuned Frequency | Not available in Baseband mode |
| Input level | Peak input level of the modulation signal |
| Bargraph | for visual information about input level |

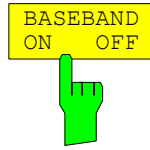
The following commands are used for reading out the individual measured value:

Input Level(Pk) CALC:AVI:POW:AC:RES?

R&S FSQ with
R&S FSQ-B71



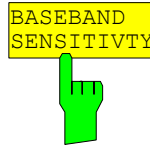
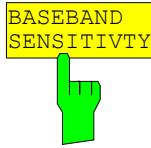
R&S FSMR



The *BASEBAND ON/OFF* or *BASEBAND ANALOG* softkey in the avionics mode switches the audio or baseband input to active.

IEC/IEEE bus command ON: `INP1:SEL AIQ| AUD`

IEC/IEEE bus command OFF: `INP1:SEL RF`

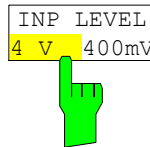


The *BASEBAND SENSITIVITY* softkey enables the entry of the sensitivity of an (external) AM modulator that could be or is driven by the applied baseband signal. The entered sensitivity [V_{peak}/100%AM] is used to convert the measured voltages into modulation depth.

Default value: 1 V peak voltage corresponds to 100 % AM.

IEC/IEEE bus command: `SENS1:VOLT:AC:SENS 2V`

Use reference level setting in amplitude menu.

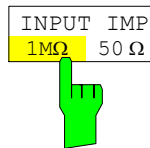
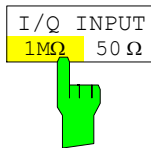


The *INP LEVEL 4V/400mV* softkey switches the input voltage range of the audio input between 4 V and 400 mV.

In the default setting, the 4 V range is switched on.

IEC/IEEE bus command:

`SENS1:VOLT:AC:RANG:UPP 0.4V`

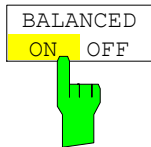


The *INPUT IMP 50Ω/1MΩ* or *I/Q INPUT 50Ω/1MΩ* softkey switches the input impedance of the audio input between 50 Ω and 1 MΩ.

Note: The baseband input impedance on the R&S FSQ depends on the model. Older models offer 50Ω/1kΩ impedance settings.

In the default setting, the input impedance is set to 1 MΩ.

IEC/IEEE bus command: `INP1:IMP 50OHM`



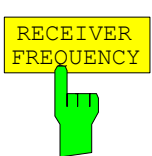
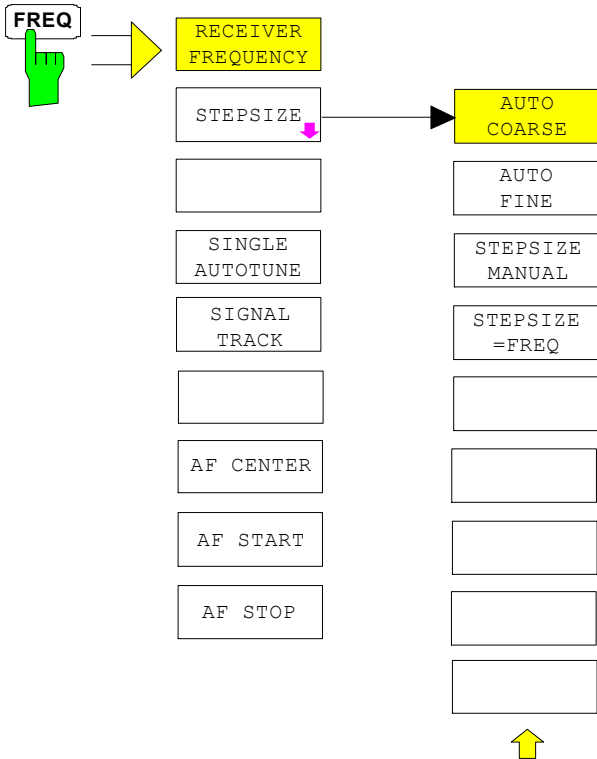
The *BALANCED ON/OFF* softkey switches the baseband input between balanced and unbalanced mode. (only R&S FSQ-B71)

In the default setting, the balanced mode is switched on.

IEC/IEEE bus command: `INP1:IQ:BAL ON`

FREQ Key

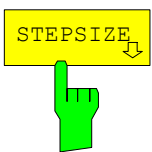
The FREQ key opens the RF frequency menu. The menu allows to set the RF frequency tuning mode on the instrument. In the default status the analyzer is set to manual tuning mode and 100 MHz receiver frequency. The keys for the RF frequency variation are not available in the baseband mode.



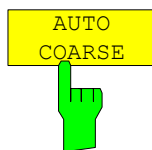
The *RECEIVER FREQUENCY* softkey activates the window for entering the receiver frequency .

The receiver frequency resolution is 0.1 Hz.
 Setting range: $20 \text{ Hz} \leq f_{\text{REC}} \leq f_{\text{max}}$

IEC/IEEE bus command: `SENS:FREQ:CENT 300MHz`

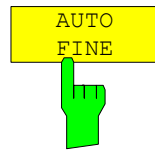


The *STEPSIZE* softkey opens a submenu for setting the step size of the receive frequency. The step size can either be coupled to the set frequency or be manually set to a fixed value. The menu softkeys are selection switches, and only one of them at a time can be active.



The *AUTO COARSE* softkey sets the step size of the receive frequency to coarse. In this setting, the fourth position of the set frequency is varied.

IEC/IEEE bus command: `--`



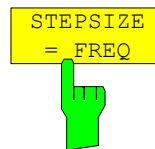
The *AUTO FINE* softkey sets the step size of the receive frequency to fine. The seventh position of the set frequency is varied in this setting.

IEC/IEEE bus command: --



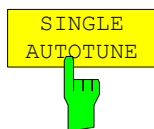
The *STEPSIZE MANUAL* softkey activates the window for entering a fixed value for the step size.

IEC/IEEE bus command: `FREQ:CENT:STEP 50 kHz`



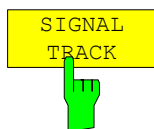
The *STEPSIZE = FREQ* softkey sets the step size to the receive frequency value. This function is particularly useful for measuring the harmonics of a signal. If the receiver is first tuned to the fundamental, the frequency of another harmonic is set with each frequency variation by using the rotary knob or the *STEP* keys.

IEC/IEEE bus command: --



This softkey activates a single automatic signal search.Q

IEC/IEEE-bus command: `SENS:FREQ:CW:AFC ONCE`



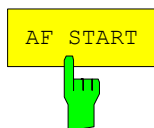
This softkey activates a function to track a drifting signal. If the measured signal frequency is too far away from the tuned center frequency and the level is above the threshold, the center frequency of the receiver will be changed to the new signal frequency.

IEC/IEEE-bus command: `SENS:FREQ:CW:AFC ON`



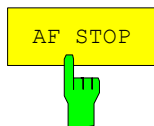
The *AF CENTER* softkey allows the user to select the center frequency within the AF spectrum.

IEC/IEEE-bus command `SENS:ADEM:AF:CENT 1KHZ`



The *AF START* softkey allows the user to select the start frequency within the AF spectrum.

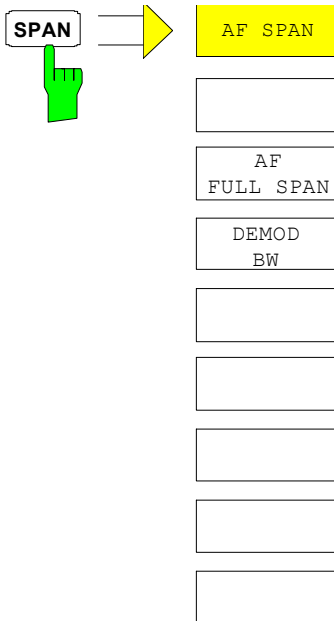
IEC/IEEE-bus command `SENS:ADEM:AF:STAR 0HZ`



The *AF STOP* softkey allows the user to select the stop frequency within the AF spectrum. The maximum AF stop frequency corresponds to half the demodulation bandwidth.

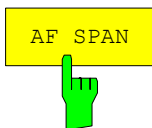
IEC/IEEE-bus command `SENS:ADEM:AF:STOP 2KHZ`

SPAN Key



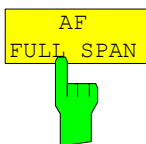
The *SPAN* menu allows the user to select the frequency range to be displayed.

Note: *The Span softkey is only available when the modulation spectrum is active.*



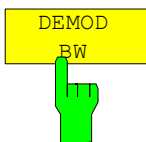
The *AF SPAN* softkey allows the user to select the frequency range if the modulation spectrum display is active. Values between the sampling rate/200 and the demodulation bandwidth/2 can be selected.

IEC/IEEE-bus command `SENS:ADEM:AF:SPAN 2.5 kHz`



The *AF FULL SPAN* softkey sets the maximum frequency range if the AF spectrum displays are active. The maximum frequency range corresponds to half the demodulation bandwidth.

IEC/IEEE-bus command `SENS:ADEM:AF:SPAN:FULL`



The demodulation bandwidth of the avionics demodulator is selected using the *DEMOD BW* softkey. The demodulation bandwidth determines the sampling rate for recording the signal to be analyzed. The *DEMOD BW MANUAL* softkey is only available in ILS demodulation mode. The bandwidth can be set to 12.5 kHz, 3.2 kHz and 800 Hz. This function can be used to suppress adjacent transmitters.

IEC/IEEE bus command: `SENS:BAND:DEM 3.2KHZ`

AMPT Key

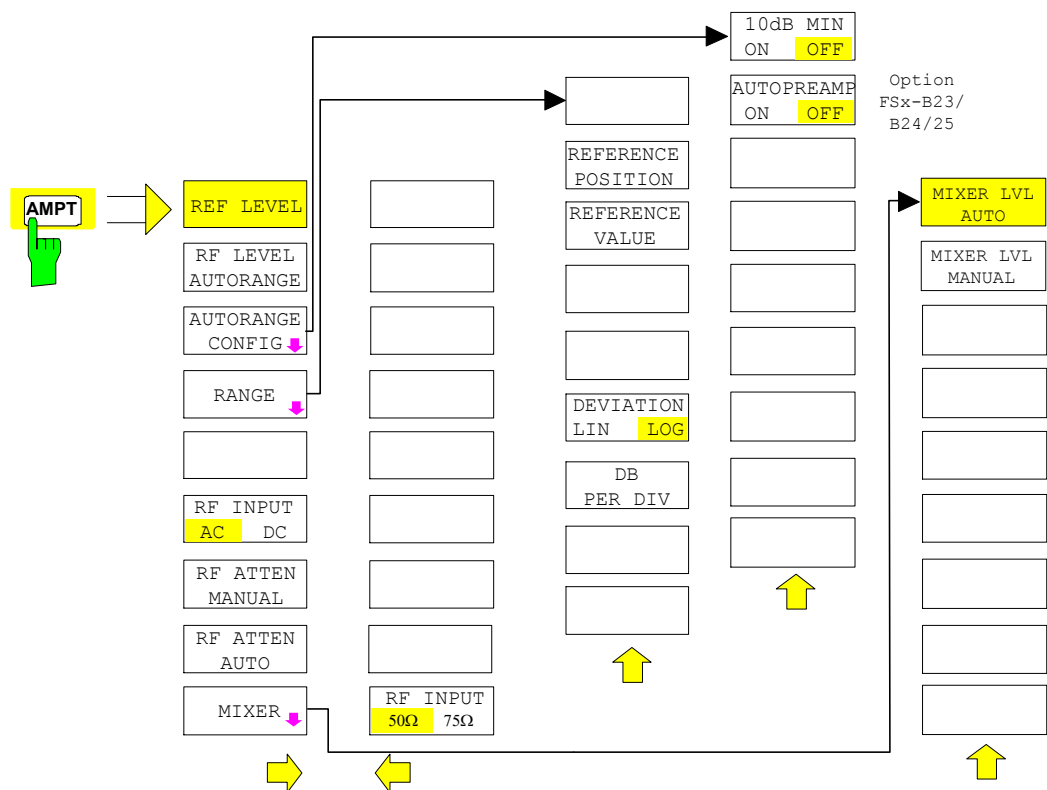
Setting the Level Display and Configuring the RF Input – AMPT Key

The AMPT key is used to set the reference level, the maximum level and the display range as well as the input impedance and the input attenuation of the RF input.

Further settings regarding the level display RF attenuation, the preamplifier and the autorange function can be made in this menu.

When the instrument is in default status, it is in autorange mode, i.e. the input level is automatically set depending on the measured peak level. In the default setting the measurement time is set to 1s, this allows the auto level routine to find the peak level for modulation frequencies down to 10 Hz.

For special cases, e.g. if a input signal is only temporarily applied, the RF level can also be manually set to a fixed value using the reference level function. This leads to improved measurement speed and saves unwanted switching of the mechanical attenuator. When manual level setting is activated, the current valid setting of the auto level function will be maintained when autorange was active before.



REF LEVEL



The REF LEVEL softkey activates the window for entering the reference level.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RLEV -60dBm`

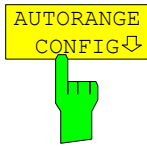
Note: The REF LEVEL value defines the clipping level of the A/D converter and must therefore be set greater than or equal to the maximum power of the signal to be analyzed.

RF LEVEL
AUTORANGE

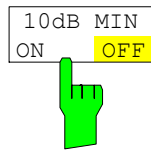


The RF LEVEL AUTORANGE softkey activates the autorange function; attenuation, IF gain and, if necessary, preamplification, are automatically matched to the applied RF signal.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RLEV:AUTO ON`



The *AUTORANGE CONFIG* softkey opens a submenu for configuring the automatic setting of attenuation and IF gain and, if necessary, preamplification.



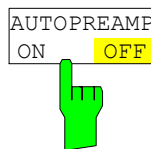
The 10 dB MIN ON/OFF softkey determines whether or not the 0 dB position of the attenuator is used when setting the insertion manually or automatically.

The default setting is 10 dB MIN OFF.

With 10 dB MIN ON an RF attenuation of at least 10 dB is always switched on in the instrument to ensure specific adjustment.

Even manually, the 0 dB position cannot be switched on.

IEC/IEEE bus command: `INP:ATT:PROT ON`



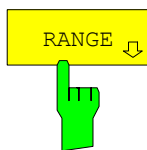
The *AUTO PREAMP ON/OFF* softkey activates the preamplifier for the autorange function.

ON The autorange function takes the preamplifier into account. The preamplifier is activated only when the attenuation of the attenuator has been reduced to the minimum settable value.

OFF The auto range does not take into account the preamplifier.

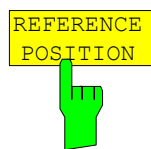
The softkey is only available with the R&S FSx-B23/B24/B25 preamplifier option.

IEC/IEEE bus command: `INP:GAIN:AUTO ON`



The *RANGE* softkey opens a submenu for determining the diagram scaling for the selected measurement.

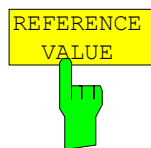
The softkeys visibility depends on the selected measurement function (only for modulation spectrum).



The *REFERENCE POSITION* softkey defines the position of the reference line.

The entry is in percentage of the diagram height, where 100% corresponds to the top edge of the diagram. The default setting is 100 % (top edge of diagram) for displaying the AF spectrum of the signal.

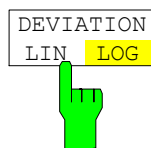
IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RPOS 50PCT`



The *REFERENCE VALUE* softkey defines the modulation depth at the at the reference line of the y axis.

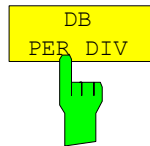
The settable value range is 0% to 10000%.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RVAL 100PCT`



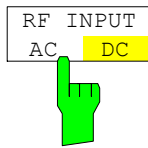
The *DEVIATION LIN/LOG* softkey switches between logarithmic and linear modulation spectrum display.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:SPAC LOG`



The *DB PER DIV* softkey allows to scale the modulation depth in the range from 0.1 dB/div to 20 dB/div. The softkey is not available with linear display.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:PDIV 5DB`



The *RF INPUT AC/DC* softkey switches the analyzer input between AC and DC coupling.

Note: The softkey is not available in all models.

IEC/IEEE bus command: `INP:COUP AC`



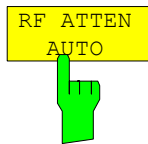
The *RF ATTEN MANUAL* softkey activates the window for entering attenuation independently of the reference level.

The attenuation can be altered in 5 dB steps between 0 dB and 75 dB. Other entries are rounded down to the next lowest integral value.

If the specified reference level can no longer be set with the specified RF attenuation, the level is adjusted and the "Limit reached" message is displayed.

Note: *The 0 dB value cannot be switched on unless the 10 dB MIN function is off. This protects the input mixer from overloading by mistake.*

IEC/IEEE bus command: `INP:ATT 40 DB`

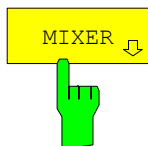


The *RF ATTEN AUTO* softkey automatically sets the RF attenuation depending on the set reference level.

This ensures that the optimum RF attenuation is always used.

RF ATTEN AUTO is the default setting.

IEC/IEEE bus command: `INP:ATT:AUTO ON`



The *MIXER* softkey opens a submenu for changing the mixer level on the input mixer.



The *MIXER LVL AUTO* softkey activates the automatic coupling of the maximum mixer level to the reference level and the RF attenuation.

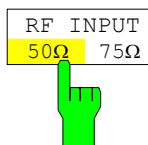
IEC/IEEE bus command: `INP:MIX:AUTO ON`



The *MIXER LVL MANUAL* softkey activates the window for entering the maximum mixer level that can be achieved with reference levels.

The setting range is 0 dB to -100 dBm with a step size of 1 dB.

IEC/IEEE bus command: `INP:MIX -25DBM`



The *RF INPUT 50 Ω / 75 Ω* softkey switches the reference impedance for the measured level values between 50 Ω (= default setting) and 75 Ω.

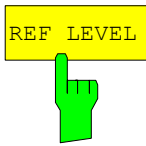
Select the 75 Ω setting if the 50 Ω input impedance is transformed to the next higher impedance by using a 75 Ω matching pad of the RAZ type (= 25 Ω in series with the input impedance of the analyzer). The correction value used is 1.76 dB = 10 log (75 Ω/50 Ω).

All level specifications in this manual refer to the default setting (50 Ω) of the device.

IEC/IEEE bus command: `INP:IMP 50 OHM`

Setting the Level Display at the Baseband Input – AMPT Key

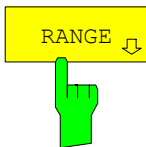
In Baseband mode the AMPT key allows to set the display range in the modulation spectrum display.



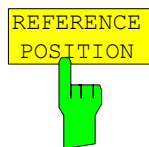
The *REF LEVEL* softkey activates the window for entering the peak reference level.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RLEV 1V`

Note: The *REF LEVEL* value defines the clipping level of the A/D converter and must therefore be set greater than or equal to the maximum peak voltage of the signal to be analyzed.



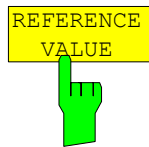
The *RANGE* softkey opens a submenu for configuring the Y-axis in the graphical display of the modulation spectrum measurement results.



The *REFERENCE POSITION* softkey defines the position of the reference line.

The entry is in percentage of the diagram height, where 100% corresponds to the top edge of the diagram. The default setting is 100% (top edge of diagram) for displaying the AF spectrum of the signal.

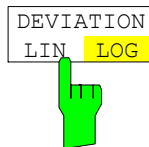
IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RPOS 50PCT`



The *REFERENCE VALUE* softkey defines the modulation depth at the top edge of the diagram.

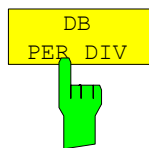
The settable value range is 0% to 10000%.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:RVAL 100PCT`



The *DEVIATION LIN/LOG* softkey switches between logarithmic and linear modulation spectrum display.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:SPAC LOG`



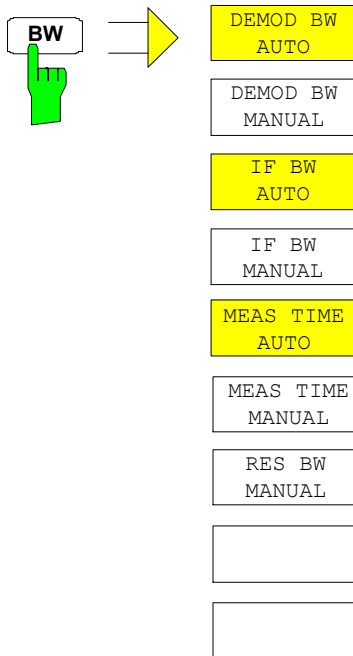
The *DB PER DIV* softkey allows you to select the modulation depth in the range from 0.1 dB/div to 20 dB/div.

The softkey is not available with linear display.

IEC/IEEE bus command: `DISP:WIND:TRAC:Y:PDIV 5DB`

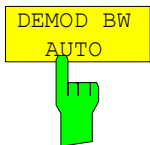
BW Key

Setting the Bandwidths and the Measurement Time – BW Key



The *BW* menu comprises all functions relating to the band limiting of the analyzed signal.

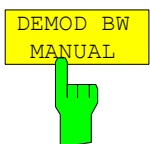
Note: *In the default setting, demodulation bandwidth, IF bandwidth and measurement time are automatically selected depending on the selected operating mode. To obtain optimum measurement results these settings shall not be changed.*



The *DEMOM BW AUTO* softkey activates the automatic setting of the demodulation bandwidth. Depending on the operating mode (VOR, ILS), the demodulation bandwidth is set in such a way that only the smallest possible measurement error occurs within the specified measurement range.

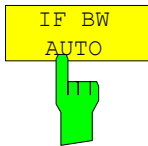
| Mode | Demodulation bandwidth |
|------|------------------------|
| VOR | 25 kHz |
| ILS | 12.5 kHz |

IEC/IEEE bus command: SENS:BAND:DEM:AUTO ON



The demodulation bandwidth of the avionics demodulator is selected using the *DEMOM BW* softkey. The demodulation bandwidth determines the sampling rate for recording the signal to be analyzed. The *DEMOM BW MANUAL* softkey is only available in ILS demodulation mode. The bandwidth can be set to 12.5 kHz, 3.2 kHz and 800 Hz. This function can be used to suppress adjacent transmitters.

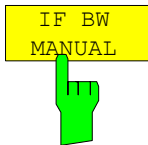
IEC/IEEE bus command: SENS:BAND:DEM 12.5 KHZ



The *IF BW AUTO* softkey couples the IF bandwidth of the analyzer (i.e. the bandwidth of the analog LC filters) to the selected receive frequency.

| Receive frequency | IF bandwidth |
|-------------------|--------------|
| ≥10 MHz | 10 MHz |
| <10 MHz | 500 kHz |

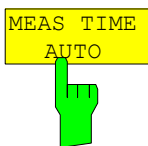
IEC/IEEE bus command: BAND:RES:AUTO ON



The *IF BW MANUAL* softkey activates the entry of the IF bandwidth (i.e. the bandwidth of the analog filters). Bandwidths from 300 kHz to 10 MHz can be selected.

Notes: *Manual setting of the IF bandwidth is usually not required. In case of strong signals close to the test signal the IF bandwidth may be reduced to suppress these signals.*

IEC/IEEE bus command: SENS:BAND:RES 10 MHZ

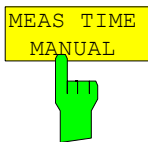


The *MEAS TIME AUTO* softkey activates automatic coupling of the measurement time.

| Mode | Measurement time |
|------------|------------------|
| VOR | 1000 ms |
| ILS | 1000 ms |
| Distortion | 1000 ms |

Note: *To obtain a correct result display, at least five periods of the demodulated signal should be monitored. If the modulation frequencies are low, it may be useful to manually prolong the measurement time (= signal monitoring time).*

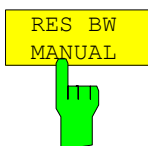
IEC/IEEE bus command: SENS:SWE:TIME:AUTO ON



The *MEAS TIME MANUAL* softkey opens the entry field for determining the data acquisition time. The permissible value range depends on the selected demodulation bandwidth:

Note: *To obtain a correct result display, at least five periods of the demodulated signal should be monitored.*

IEC/IEEE bus command: SENS:SWE:TIME 800 MS



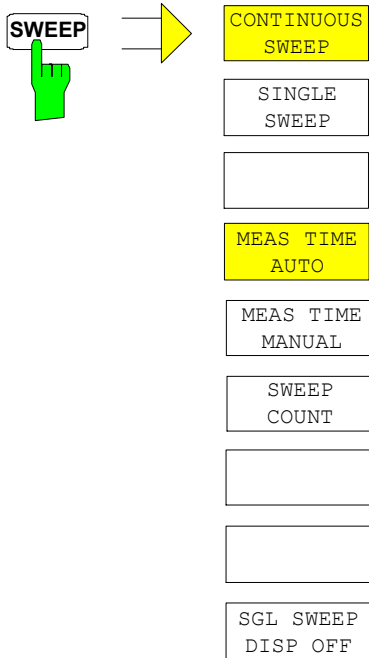
If the spectrum display is active, the *RES BW MANUAL* softkey selects the resolution bandwidth for the displayed signal. Note that these resolution bandwidths are implemented as FFT filters.

Notes: *The softkey is only available if the modulation spectrum result displays is active.*

IEC/IEEE-bus command SENS:ADEM:SPEC:BAND:RES 10 Hz

SWEEP Key

Setting the Sweep – SWEEP/MEAS Keys



The *SWEEP* key calls a menu in which the sweep mode is defined.

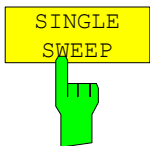
The *CONTINUOUS SWEEP*, *SINGLE SWEEP* and *SGL SWEEP DISP OFF* softkeys are mutually exclusive selection keys.



The *CONTINUOUS SWEEP* softkey sets the continuous sweep, i.e. the sweep occurs continuously in accordance with the trigger setting.

CONTINUOUS SWEEP is the default setting of the instrument.

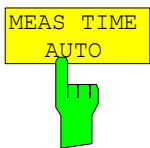
IEC/IEEE bus command: `INIT:CONT ON`



The *SINGLE SWEEP* softkey starts an n-times sweep after the trigger event has occurred. The *SWEEP COUNT* softkey defines the number of sweeps.

If a trace is sampled with *TRACE AVERAGE* or *MAXHOLD*, the value set with the *SWEEP COUNT* softkey defines the number of measurements. If the value is 0, a sweep is performed.

IEC/IEEE bus command: `INIT:CONT OFF;:INIT`

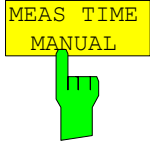


The *MEAS TIME AUTO* softkey activates the automatic coupling of measurement time.

| Mode | Measurement time |
|------------|------------------|
| VOR | 1000 ms |
| ILS | 1000 ms |
| Distortion | 1000 ms |

Note: To obtain a correct result display, at least five periods of the demodulated signal should be monitored. If the modulation frequencies are low, it may be useful to manually prolong the measurement time (= signal monitoring time).

IEC/IEEE bus command: `SWE:TIME:AUTO ON`

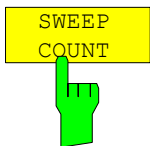


The *MEAS TIME MANUAL* softkey opens the entry field for determining the data acquisition time. The permissible value range depends on the selected demodulation bandwidth:

| Demodulation bandwidth | min. measurement time | max. measurement time |
|------------------------|-----------------------|-----------------------|
| 25 kHz | 400 ms | 12.8 s |
| 12.5 kHz | 400 ms | 25.6 s |
| 3.2 kHz | 400 ms | 102.4 s |
| 800 Hz | 400 ms | 410 s |

Note: *To obtain a correct result display, at least five periods of the demodulated signal should be monitored.*

IEC/IEEE bus command: SENS:SWE:TIME 800 MS



The *SWEEP COUNT* softkey activates the window for entering the number of sweeps that the instrument performs after a single sweep has been started. If Trace Average, Max Hold or Min Hold has been activated, the number of averages or maximum value findings is specified as well.

Example:
 [TRACE1: MAX HOLD]
 [SWEEP: SWEEP COUNT: {10} ENTER]
 [SINGLE SWEEP]

The instrument performs the Max Hold function across ten sweeps.

The value range permissible for the sweep count is 0 to 32767. If the sweep count is 0 or 1, a sweep is performed. With trace averaging and if the sweep count is 0, the instrument performs sliding averaging across ten sweeps in continuous sweep mode; if the sweep count is 1, no averaging occurs.

The sweep count is valid for all traces in a diagram.

Note: *Setting the number of sweeps in the TRACE menu is identical with setting them in the SWEEP menu.
 In the SINGLE SWEEP setting, the measurement is stopped once the selected number of sweeps has been reached.*

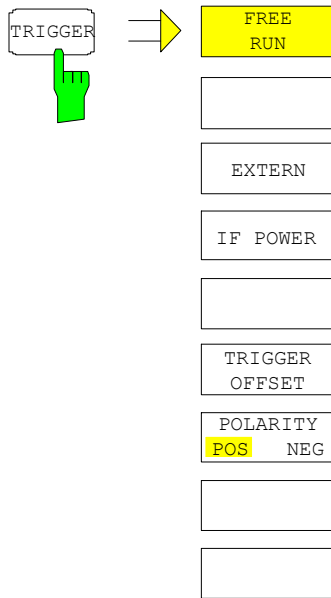
IEC/IEEE bus command: SENS:SWE:COUN 64



The *SGL SWEEP DISP OFF* softkey starts a sweep and switches off the display during a single sweep. Once the sweep is completed, the display is reactivated and the trace displayed.

IEC/IEEE bus command: INIT:DISP OFF;:INIT

TRIG Key



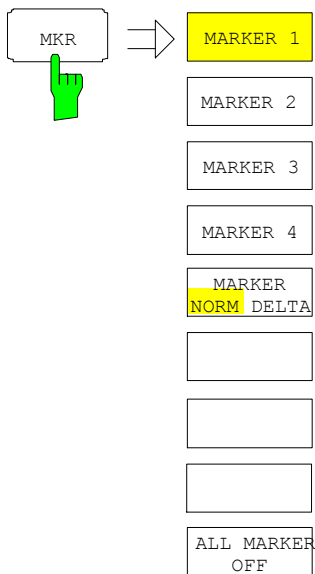
The *TRIG* key opens a menu for setting the different trigger sources and for selecting the trigger polarity. The active trigger mode is indicated by highlighting the associated softkeys.

To indicate that a trigger mode other than FREE RUN has been set, the **TRG** enhancement label is displayed on the screen. If two measurement windows are displayed, TRG is indicated next to the window in question.

The available *TRIGGER* menu functions are identical to those of the base unit.

Note: *Video Trigger and Gated Trigger are not available in the avionics mode.*

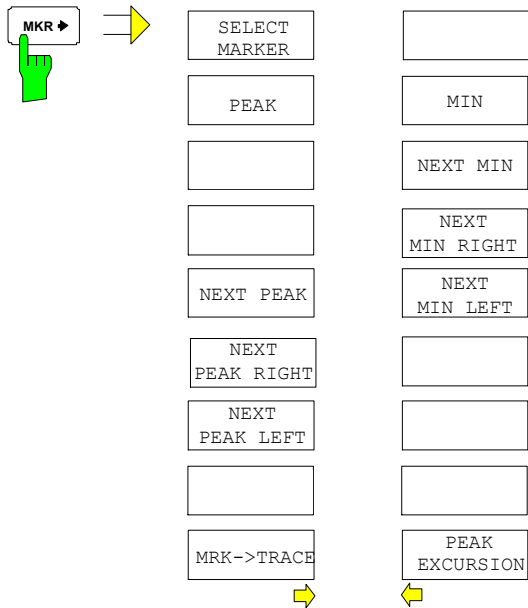
MKR Key



The available *MKR* menu functions are identical to those of the base unit.

The *MKR* menu is only available when the modulation spectrum is active.

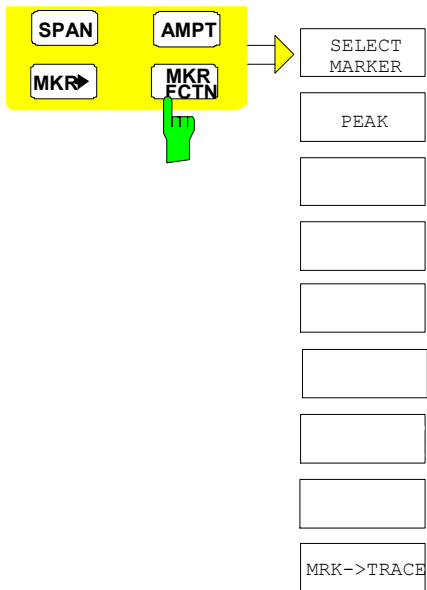
MKR -> Key



The available *MKR* ⇒ menu functions are identical to those of the base unit.

The *MKR* ⇒ menu is only available when the modulation spectrum is active.

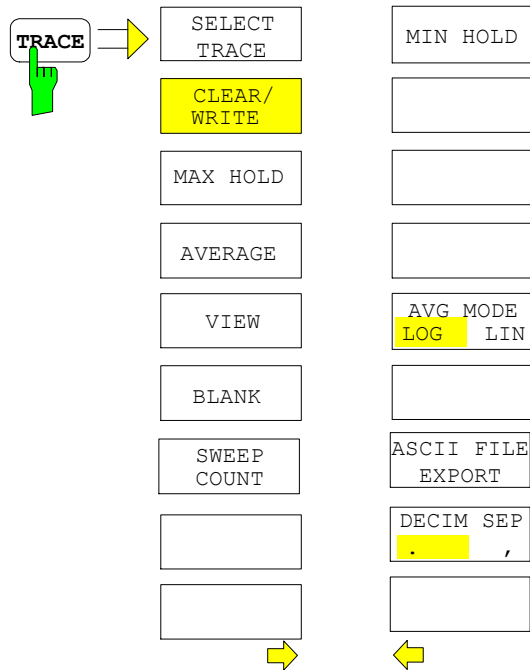
MKR FCTN Key



The available *MKR FCTN* menu functions are identical to those of the base unit.

The *MKR FCTN* menu is only available when the modulation spectrum is active.

TRACE Key

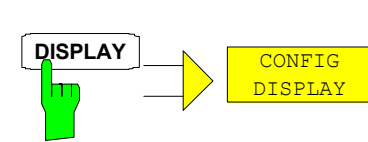


The available *TRACE* menu functions are identical to those of the base unit.

The function Trace Math and Trace Detector is not available in the avionics demodulator.

The *TRACE* menu is only available when the modulation spectrum is active.

DISP Key



The available *CONFIG DISPLAY* menu functions are identical to those of the base unit.

Other Keys

The functions of the other keys are identical to those of the base unit. Please refer to the relevant chapters in the operating manual of the base unit.

Remote Control

This chapter describes the remote control commands for the application firmware. An alphabetic list following the text of the manual provides a quick overview of the commands

The commands that also apply to the base unit in the *SPECTRUM* mode and the system settings are described in the operating manual for the analyzer.

Remote Control Commands

Common Commands

| Command | Parameters | Comment |
|---------|------------|--|
| *OPT? | | Option Identification Query; query only |

*OPT?

OPTION IDENTIFICATION QUERY polls the options contained in the device and returns a list of installed options. The options are separated by commas. The identifier for option R&S FS-K15 is contained in the response string at position 57.

Example: 0,0, /...../ ,0,0,0,0,0,0,0,K15,0,0,0,0,0,0,0

CALCulate:AVIonics Subsystem

The CALCulate:AVIonics subsystem controls the settings of the instrument for avionics measurements.

CALCulate:AVIonics:AM:FREQUENCY? <string>

This command queries the results of the audio frequency counter measurement.

Parameter:

<string>::= '90' ILS 90 Hz.
 '150' ILS 150 Hz
 'ID' identifier signal (300 to 4000 Hz)

Example: "CALC:AVI:AM:FREQ? '150'" queries the 150 Hz ILS tone frequency

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

CALCulate:AVIonics:CARRIER[:RESULT]?

This command queries the result of the RF level measurement.

Example: "CALC:AVI:CARR?" queries the RF level reading.

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

CALCulate:AVIonics:DDM?

This command queries the result of the ILS DDM measurement.

Example: "CALC:AVI:DDM?" queries the DDM reading.

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

CALCulate:AVIonics:FERROR[:RESULT]?

This command queries the result of the RF frequency offset measurement.

Example: "CALC:AVI:FERR?" queries the RF frequency offset reading.

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

CALCulate:AVIonics:FM[:DEVIATION]?

This command queries the results of the FM deviation measurement.

Example: "CALC:AVI:FM?" queries the FM deviation

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

CALCulate:AVIonics:FM:FREQUENCY?

This command queries the audio frequency of the FM deviation measurement.

Example: "CALC:AVI:FM:FREQ?" queries the audio frequency.

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

CALCulate:AVIonics:PHASe?

This command queries the results of the ILS or VOR phase measurement.

Example: "CALC:AVI:PHAS?" queries the VOR phase (bearing).

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

CALCulate:AVIonics:POWer:AC[:RESult]?

This command queries the result of the audio or baseband input level measurement.

Example: "CALC:AVI:POW:AC?" queries the input level reading.

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

CALCulate:AVIonics:RFFRequency[:RESult]?

This command queries the result of the RF frequency counter measurement.

Example: "CALC:AVI:RFFR?" queries the RF frequency reading.

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

CALCulate:AVIonics:SDM?

This command queries the result of the ILS SDM measurement.

Example: "CALC:AVI:SDM?" queries the SDM reading.

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

CALCulate:AVIonics:SHD[:STATe] ON | OFF

This command switches the distortion measurement on.

Example: ":CALC:AVI:SHD ON" activates the distortion reading of the result

Characteristics: *RST value: OFF
SCPI: device-specific

CALCulate:AVIonics:SHD:FREQuency f_{\min} to f_{\max}

This command sets the measurement frequency of the harmonic distortion measurement to a single signal within the audio frequency range.

The limit value f_{\max} is half of the demodulation bandwidth.

Example: "CALC:AVI:SHD:FREQ 1KHZ" sets the frequency of the distortion measurement to 1 kHz

Characteristics: *RST value: 750 Hz
SCPI: device-specific

CALCulate:AVIonics:SHD:RESult?

This command queries the result of the selective distortion measurement.

Example: "CALC:AVI:SHD:RES?" queries the SHD reading.

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

CALCulate:AVIonics:THD:FREQUENCY:FUNDament <string>

This command selects the fundamental frequency of the harmonic distortion measurement.0

Parameter:

<string>::= '90' fundamental frequency ILS 90 Hz.
'150' fundamental frequency ILS 150 Hz
'90_150' fundamental frequency Average of ILS 90 and 150 Hz
'ID' fundamental frequency identifier signal (300 to 4000 Hz)

Example: "CALC:AVI:THD:FREQ:FUND '90'" sets the fundamental frequency of the distortion measurement to the ILS 90 Hz signal

Characteristics: *RST value: '90_150' Hz
SCPI: device-specific

CALCulate:AVIonics:THD:FREQUENCY:UPPer f_{\min} to f_{\max}

This command sets the maximum frequency of the harmonic distortion measurement.
The limit value f_{\max} is half of the demodulation bandwidth.

Example: "CALC:AVI:THD:FREQ:UPP 1KHZ" sets the max. frequency of the distortion measurement to 1 kHz

Characteristics: *RST value: 750 Hz
SCPI: device-specific

CALCulate:AVIonics:THD[:RESult]? <string>

This command queries the results of the total harmonic distortion measurement.

Parameter:

<string>::= ILS '30' 'ID' VOR Identifier signal (300 to 4000 Hz)

Example: "CALC:AVI:THD:RES" queries the identifier THD measurement

Characteristics: *RST value: 30 Hz
SCPI: device-specific

CALCulate:FEED - Subsystem

The CALCulate:FEED - Subsystem selects the type of evaluation of the measured data. In the avionics demodulator the evaluation is independent of the selected measurement window. The numeric Suffix <1|2> is meaningless and will be ignored.

| COMMAND | PARAMETERS | UNIT | COMMENT |
|---------------------|------------|------|----------|
| CALCulate<1 2>:FEED | <string> | | No query |

CALCulate<1|2>:FEED <string>

This command selects the type of evaluation of the measured data.

Parameter:

<string>::= 'XTIM:SPECtrum' FFT display of the modulation spectrum.
 'XTIM:AMSummary' AM-demodulation results in tables.

Example: "CALC:FEED `XTIM: SPEC` " selects the modulation spectrum display

Characteristics: *RST value: 'XTIM:AMSummary'
 SCPI: compliant

DISPlay Subsystem

The DISPLay subsystem controls the selection and presentation of text and graphics information as well as measurement data on the screen.

| COMMAND | PARAMETERS | UNIT | COMMENT |
|--|--|-----------------------------------|---------|
| DISPlay [:WINDow<1 2>] :TRACe<1...3> :Y [:SCALe] :RLEVel :AUTO :RVALue :RPOSition :PDIVision SPACing | <numeric_value> <ON OFF> <numeric_value> <numeric_value> <numeric_value> <LINear LOGarithmic> | DBM, Volt PCT PCT DB | |

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

This command defines the reference level in the selected measurement window. The numeric suffix under TRACe <1...3> is irrelevant.

Example: "DISP:WIND:TRAC:Y:RLEV 10 DBM" sets the reference level to 10 dBm

Characteristics: *RST value: -- (AUTO is set to ON)
SCPI: compliant

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

This command enables the referenc level autorange. The numeric suffix under TRACe <1...3> is irrelevant.

Example: "DISP:WIND:TRAC:Y:RLEV:AUTO ON" enables autorange for the reference level.

Characteristics: *RST value: ON
SCPI: compliant

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

This command defines the modulation depth value assigned to the reference position. The numeric suffix under TRACe <1...3> is irrelevant.

Example: "DISP:WIND:TRAC:Y:RVAL 50 PCT" sets the modulation depth value at the reference position to 50 %

Characteristics: *RST value: 100 %
SCPI: compliant

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

This command defines the position of the reference value in the selected measurement window. The numeric suffix in TRACe<1 to 3> is irrelevant.. *N*
The numeric suffix under TRACe <1...3> is irrelevant.

Example: "DISP:WIND:TRAC:Y:RPOS 50 PCT" sets the reference position to the middle of the grid scale.

Characteristics: *RST value: 100 %
SCPI: compliant

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

This command defines the scaling of the Y axis .

Example: "DISP:WIND:TRAC:Y:PDIV 1DB" sets the grid scale to 1 dB per division.

Characteristics: *RST value: 10 DB
SCPI: compliant

The numeric suffix under TRACe <1...3> is irrelevant.

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing <LINear | LOGarithmic>

This command toggles between linear and logarithmic display in the selected measurement window
The numeric suffix under TRACe <1...3> is irrelevant.

Example: "DISP:WIND:TRAC:Y:SPAC LIN" sets the grid scale to linear.

Characteristics: *RST value: LOG
SCPI: compliant

INITiate Subsystem

The INITiate subsystem is used to control the measurement sequence in the selected measurement window.

| COMMAND | PARAMETERS | UNIT | COMMENT |
|--------------|------------|------|----------|
| INITiate | | | |
| :CONTinuous | <Boolean> | -- | |
| [:IMMEDIATE] | -- | -- | no query |
| DISPlay | <Boolean> | -- | |

INITiate:CONTinuous ON | OFF

This command determines whether the device performs measurements continuously ("Continuous") or only individual measurements ("Single").

In the spectrum analysis mode, this setting refers to the sweep operation (switchover between Continuous and Single Sweep).

Example:

```
"INIT:CONT OFF"           'switches operation to Single Sweep
"INIT:CONT ON"            'switches operation to Continuous Sweep
```

Characteristics: *RST value: ON
SCPI: compliant

INITiate[:IMMEDIATE]

This command starts a new measurement sequence in the specified measurement window.

This command starts a new measurement sequence (sweep) in the specified measurement window. A sweep count > 0 or average count > 0 means the number of specified measurements will be restarted. In the case of the trace functions MAXHold, MINHold and AVERage, the previous results are reset when the measurement is restarted.

In the Single Sweep mode, the commands *OPC, *OPC? or *WAI can be used to perform synchronization with the end of the specified number of measurements. In the Continuous Sweep mode, synchronization with the end of the sweep is not possible because the entire measurement "never" actually ends.

Example:

```
"INIT:CONT OFF"           'switches to Single Sweep mode
"DISP:WIND:TRAC:MODE AVER 'activates Trace Averaging
"SWE:COUN 20"             'sets the sweep counter to 20 sweeps
"INIT;*WAI"               'starts the measurement by waiting for the
                           end of 20 measurements
```

Characteristics: *RST value: -
SCPI: compliant

This command is an "event" and thus has neither a *RST value nor a query.

INITiate:DISPlay ON | OFF

This command configures the behavior 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:CONT OFF"           'switches operation to Single Sweep
"INIT:DISP OFF"           'Sets the display behavior to OFF
"INIT;*WAI"               'Starts the measurement with display OFF
```

Characteristics: *RST value: ON
SCPI: compliant

INPut Subsystem

The INPut subsystem controls the input characteristics of the RF inputs of the instrument. The measurement windows are assigned to INPut1 (screen A) and INPut2 (screen B).

| COMMAND | PARAMETERS | UNIT | COMMENT |
|-------------------------|------------------|------|----------------------|
| INPut<1 2> | | | |
| :ATTenuation | <numeric_value> | DB | No query |
| :AUTO | <Boolean> | -- | |
| :PROTection [:STATe] | <Boolean> | -- | |
| :IMPedance | 50 75 | OHM | |
| :MIXer [:POWeR] | <numeric_value> | DBM | Only with option B25 |
| :AUTO | ON OFF | | |
| :COUPling | AC DC | | |
| :GAIN | <numeric value> | dB | |
| :AUTO | ON OFF | | |
| SElect | AIQ AUDio RF | | |

INPut<1|2>:ATTenuation 0 to 75 dB

This command programs the input attenuator. To protect the input mixer against damage from overloads, the setting 0 dB can be obtained by entering numerals, not by using the command DEC. The input attenuation can be set in 5 dB steps between 0 dB and 75 dB. In the default state, the attenuation set on the step attenuator is coupled to the reference level of the instrument. If the attenuation is programmed directly, the coupling to the reference level is switched off.

Example: "INP:ATT 40dB" Sets the attenuation on the attenuator to 40 dB and switches off the coupling to the reference level.

Characteristics: *RST value: 10 dB (AUTO is set to ON)
SCPI: conforming

INPut<1|2>:ATTenuation:AUTO ON | OFF

This command automatically couples the input attenuation to the reference level (state ON) or switches the input attenuation to manual entry (state OFF). The minimum input attenuation set with the coupling switched on is 10 dB.

Example: "INP:ATT:AUTO ON" Couples the attenuation set on the attenuator to the reference level.

Characteristics: *RST value: ON
SCPI: conforming

INPut<1|2>:ATTenuation:PROTection ON | OFF

This command defines whether the 0 dB position of the attenuator is to be used in manual or automatic adjustment.

Example: "INP:ATT:PROT ON"

Characteristics: *RST value: OFF
SCPI: device-specific

INPut:COUPling AC | DC

This command switches the input coupling of the RF input between AC and DC.C

Example: "INP:COUP DC"

Characteristics: *RST value: AC
SCPI: conforming

INPut<1|2>:IMPedance 50 | 75 | 1M

This command sets the nominal input impedance of the instrument. The set impedance is taken into account in all level indications of results..

The setting 75 Ω should be selected, if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type (= 25 Ω in series to the input impedance of the analyzer). The correction value in this case is 1.76 dB = 10 log (75 Ω / 50 Ω).

Example: "INP:IMP 75"

Characteristics: *RST value: 50 Ω
SCPI: conforming

INPut<1|2>:GAIN:AUTO ON | OFF

This command automatically switches on the preamplifier for low levels. The switchable gain is fixed to 20 dB.

Example: "INP:GAIN ON"

Characteristics: *RST value: OFF
SCPI: conforming

The command is only available with the option electronic attenuator B25, preamplifier B23 and B24.

INPut<1|2>:MIXer[:POWer] <numeric value>

This command defines the desired power at the input mixer of the analyzer. On any change to the reference level the RF attenuation will be adjusted in a way that makes the difference between reference level and RF attenuation come as close to the desired mixer level as possible.

Example: "INP:MIX -30"

Characteristics: *RST value: - 25 dBm
SCPI: device-specific

INPut<1|2>:MIXer:AUTO ON | OFF

This command enables/disables the automatic setup of the mixer level.

Example: "INP:MIX:AUTO ON"

Characteristics: *RST value: ON
SCPI: device-specific

INPut<1|2>:SELEct AIQ | AUDio | RF

This command switches the audio input – and thus the BASEBAND mode – on (AUDio) or off (RF).

Example: "INP:SEL:AUD"

Characteristics: *RST value: RF
SCPI: conforming

INSTrument Subsystem

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

| COMMAND | PARAMETERS | UNIT | COMMENT |
|-------------------------------------|---------------------------------------|------|---------|
| INSTrument [:SElect] :NSElect | SANalyzer AVIonics <numeric_value> | | |

INSTrument[:SElect] SANalyzer | AVIonics

This command switches between the operating modes by means of text parameters.

Parameter: SANalyzer: Spectrum analysis
AVIonics: Avionics demodulator

Example: "INST SAN" Switches the instrument to *SPECTRUM*.

Characteristics: *RST value: SANalyzer
SCPI: conforming

Changeover to AVIonics is only possible with option avionics demodulator FS-K15 installed.

INSTrument:NSElect 1 | 25

This command switches between the operating modes by means of numbers.

Parameter: 1: Spectrum analysis
25: Avionics analyzer

Example: "INST:NSEL 1" Switches the instrument to *SPECTRUM*.

Characteristics: *RST value: 1
SCPI: conforming

Changeover to 25 is only possible with Avionics Analyzer FS-K15 option installed.

[SENSe:]ADEMod Subsystem

The purpose of the commands defined below is to set up the spectrum analyzer for the measurement of AM and FM modulated avionics signals in a way that allows to obtain as many measurement results as possible with a single shot measurement.

For that purpose the option K15 is been equipped with a demodulator that is capable of performing both FM and AM demodulation at a time.

Note: Demodulation will be performed offline, that means, on signals previously stored into memory. The I/Q memory available for that purpose is 2 x 128 k samples. The sample rate can be selected in the range of 800 Hz to 25 kHz.

The signal schematic is described in the manual operation mode section of this manual.

| COMMAND | PARAMETERS | UNIT | COMMENT |
|--|---|--|---------|
| [SENSe<1 2>] :ADEMod :AF :CENTer :SPAN :FULL :STARt :STOP :SPECtrum :BANDwidth [:RESolution] | <numeric_value> <numeric_value> <numeric_value> <numeric_value> <numeric_value> | HZ HZ HZ HZ HZ | |

[SENSe:]ADEMod:AF:CENTer <numeric_value>

This command sets the center frequency for result display AF spectrum..

Example: "SENS:ADEM:AF:CENT 2kHz" 'Sets the AF center frequency to 2 kHz

Characteristics: *RST value: 6.25 kHz
SCPI: compliant

[SENSe:]ADEMod:AF:STARt <numeric_value>

This command sets the start frequency for result display AF spectrum..

Example: " ADEM:AF:STAR 1kHz" 'Sets the AF start frequency to 1 kHz

Characteristics: *RST value: 0 Hz
SCPI: compliant

[SENSe:]ADEMod:AF:STOP <numeric_value>

This command sets the stop frequency for result display AF spectrum..The stop frequency is limited to half the demodulation bandwidth.

Example: " ADEM:AF:STOP 1kHz" 'Sets the AF stop frequency to 1 kHz

Characteristics: *RST value: 12.5 kHz
SCPI: compliant

[SENSe:]ADEMod:AF:SPAN <numeric_value>

This command sets the maximum span for result display AF spectrum. . The span is limited to half the measurement bandwidth of demodulation bandwidth.

Example: "SENS:ADEM:AF:SPAN 2kHz" 'Sets the AF span to 2 kHz

Characteristics: *RST value: 12.5 kHz
SCPI: compliant

[SENSe:]ADEMod:AF: SPAN:FULL

This command sets the span for result display AF spectrum N . The maximum span corresponds to half the demodulation bandwidth.

Example: "SENS:ADEM:AF:SPAN:FULL" 'Sets the AF span to 12.5 kHz (in case of VOR)

Characteristics: *RST value: FULL
SCPI: compliant

[SENSe:]ADEMod:SPECTrum:BANDwidth|BWIDth[:RESolution]: <numeric_value>

This command sets the resolution bandwidth for spectrum representation that was determined from the analog demodulation data. The recording time required is calculated from bandwidth. If the available recording time is not sufficient for the given bandwidth, the recording time is set to its maximum and the resolution bandwidth is enlarged to the resulting bandwidth..

Example: "SENS:ADEM:SPEC:BAND 20Hz" 'Sets the RBW to 20 Hz.

Characteristics: *RST value: 3.8 Hz
SCPI: compliant

SENSe:BANDwidth Subsystem

This subsystem controls the setting of the instrument's filter bandwidths. Both groups of commands (BANDwidth and BWIDth) perform the same functions. The measurement windows are selected by SENSE1 (screen A) and SENSE2 (screen B).

| COMMAND | PARAMETERS | UNIT | COMMENT |
|---|--|----------------------|---------|
| [SENSe<1 2>] :BANDwidth [:RESolution] :AUTO :DEMod :AUTO | <numeric_value> <Boolean> <numeric_value> <Boolean> | HZ -- HZ -- | |

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution] <numeric_value>

This command defines the receiver IF bandwidth or, in *SPECTRUM* mode, the analyzer's resolution bandwidth.

Analog resolution filters from 300 kHz to 10 MHz in 1, 3, 10 steps are available. These filters are implemented as 5-circuit LC filters in the range from 300 kHz to 10 MHz.

Example: "SENS:BAND 1MHz" Sets the resolution bandwidth to 1 MHz

Characteristics: *RST value: - (AUTO is set to ON)
SCPI: conforming

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:AUTO ON | OFF

This command either automatically couples the resolution bandwidth of the instrument to the span or cancels the coupling. The automatic coupling adapts the resolution bandwidth to the currently set frequency according to the relationship between frequency and resolution bandwidth.

Example: "SENS:BAND:AUTO OFF" Switches off the coupling of the resolution bandwidth to the span.

Characteristics: *RST value: ON
SCPI: conforming

[SENSe<1|2>:]BANDwidth|BWIDth:DEMod <numerical value>

This command defines the demodulation bandwidth of the instrument for analog demodulation. The required sampling rate is automatically set depending on the selected demodulation bandwidth. The available demodulation bandwidths are determined by the selected standard (ILS, VOR).

Example: "SENS:BAND:DEM 12.6kHz"

Characteristics: *RST value: - (AUTO is set to ON)
SCPI: conforming

[SENSe<1|2>:]BANDwidth|BWIDth:DEMod:AUTO ON | OFF

This command activates automatic setting of the demodulation bandwidth. The demodulation bandwidth is set as a function of the operating mode (ILS, VOR) in order to minimize the measurement error in the specified measurement range.

Example: "SENS:BAND:DEM:AUTO OFF"

Characteristics: *RST value: ON
SCPI: conforming

SENSe:FREQuency Subsystem

The SENSe:FREQuency subsystem defines the frequency-axis of the active display. The frequency-axis can either be defined via the start/stop frequency or via the center frequency and span. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

| COMMAND | PARAMETERS | UNIT | COMMENT |
|---|--|----------|---------|
| [SENSe<1 2>] :FREQuency :CENTer :STEP :CW :AFC | <numeric_value> <numeric_value> <numeric_value> <ONCE ON> | HZ HZ | |

[SENSe<1|2>]:FREQuency:CENTer 0 to f_{max}

This command defines the center frequency of the analyzer or the measuring frequency for span = 0.

Example: "SENS:FREQ:CENT 100MHz"

Characteristics: *RST value: $f_{max} / 2$ with f_{max} = maximum frequency of the analyzer
 SCPI: conforming

[SENSe<1|2>]:FREQuency:CENTer:STEP 0 to f_{max}

This command defines the step width of the center frequency.

Example: "SENS:FREQ:CENT:STEP 100MHz"

Characteristics: *RST value: - (AUTO 0.1 × SPAN is switched on)
 SCPI: conforming

[SENSe<1|2>]:FREQuency:CW:AFC <ONCE | ON>

This command defines the center frequency tracking and the single signal search.

Example: "SENS:FREQ:CENT:AFC ONCE" starts a single signal search.

Characteristics: *RST value: -
 SCPI: conforming

SENSe:SWEep Subsystem

This subsystem controls the sweep parameters. The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

| COMMAND | PARAMETERS | UNIT | COMMENT |
|------------------------|-----------------|------|---------|
| [SENSe<1 2>] :SWEep | | | |
| :TIME | <numeric_value> | S | |
| :AUTO | <Boolean> | -- | |
| :COUNT | <numeric_value> | -- | |

[SENSe<1|2>:]SWEep:TIME 400ms... 800s

This command defines the measurement time. The available time values are different in the operating modes and depend on the selected demodulation bandwidth (400ms to 800s with DemodBW = 800 Hz).

Example: "SENS:SWE:TIME 10s"

Characteristics: *RST value - (AUTO is set to ON)
SCPI: conforming

[SENSe<1|2>:]SWEep:TIME:AUTO ON | OFF

This command controls the automatic coupling of the sweep time to the bandwidth settings.

Example: "SENS:SWE:TIME:AUTO ON" Switches on the coupling to bandwidths.

Characteristics: *RST value: ON
SCPI: conforming

[SENSe<1|2>:]SWEep:COUNT 0 to 32767

This command defines the number of sweeps started with single sweep, which are used for calculating the average or maximum value. In average mode, the value 0 defines a continuous averaging of measurement data over 10 sweeps.

Example: "SENS:SWE:COUN 64" Sets the number of sweeps to 64.
"SENS:INIT:CONT OFF" Switches to single-sweep mode.
"SENS:INIT;*WAI" Starts a sweep and waits for its end.

Characteristics: *RST value: 0
SCPI: conforming

SENSe:VOLTage Subsystem

The Unit subsystem is used to switch the basic measurement unit of setting parameters. In split-screen display, a distinction is made between UNIT1 (SCREEN A) and UNIT2 (SCREEN B).

| COMMAND | PARAMETERS | UNIT | COMMENT |
|---|------------------------------------|--------------|---------------|
| SENSe<1 2> :VOLTage :AC RANGe SENSitivity | <numeric value> <numeric value> | Volt Volt | Option FS-K15 |

[SENSe:]VOLTage:AC:RANGe[:UPPer] <numeric_value>

This command selects 4 V or 400 mV as the input voltage range for the audio input.

Example: "SENS:VOLT:AC:RANG 0.4 V" 'Selects 400 mV as the input voltage range.

Characteristics: *RST value: 4V
 SCPI: compliant

[SENSe:]VOLTage:AC:SENSitivity <numeric_value>

This command selects the input voltage for 100% modulation depth at the audio input.

Example: "SENS:VOLT:AC:SENS 0.1 V" 'Selects 100 mV as 100% AM depth.

Characteristics: *RST value: 1V
 SCPI: compliant

UNIT Subsystem

The Unit subsystem is used to switch the basic measurement unit of setting parameters. In split-screen display, a distinction is made between UNIT1 (SCREEN A) and UNIT2 (SCREEN B).

| COMMAND | PARAMETERS | UNIT | COMMENT |
|----------------------------|----------------------------|------|---------------|
| UNIT<1 2> :THD: :DDM | DB PCT UNITless PCT | | Option FS-K15 |

UNIT<1|2>:THD DB | PCT

This command selects the unit for distortion measurements.

Example: "UNIT:THD DB"

Characteristics: *RST value: %
 SCPI: compliant

UNIT<1|2>:DDM UNITless | PCT

This command selects the unit for ILS DDM reading.

Example: "UNIT:DDM PCT"

Characteristics: *RST value: UNITless
 SCPI: compliant

Softkeys Assignment to IEC/IEEE Bus Commands

AVIONICS Hotkey

| | |
|---------------------|---|
| AVIONICS | SENSe<1 2>:]INSTRument:SElect AVIonics |
| VOR | CALCulate:AVIonics[:STANdard] VOR |
| ILS | CALCulate:AVIonics[:STANdard] ILS |
| DISTORTION SPECTRUM | :CALCulate:FEED 'XTIME:SPECTrum' |
| DISTORTION ON OFF | CALCulate:AVIonics:SHD[:STATe] ON OFF |
| DISTORTION MAX FREQ | CALCulate:AVIonics:THD:FREQuency:UPPer |
| DISTORTION MAN FREQ | CALCulate:AVIonics:SHD:FREQuency |
| THD UNIT % DB | UNIT:THD PCT |
| FUND FREQ 90/150 HZ | CALCulate:AVIonics:THD:FREQuency:FUNDament '90_150' |
| FUND FREQ 90 HZ | CALCulate:AVIonics:THD:FREQuency:FUNDament '90' |
| FUND FREQ 150 HZ | CALCulate:AVIonics:THD:FREQuency:FUNDament '150' |
| FUND FREQ IDENT | CALCulate:AVIonics:THD:FREQuency:FUNDament 'ID' |
| SETTINGS | --- |
| DDM UNIT % [1] | UNIT:DDM PCT UNITless |
| DISTORTION MAX FREQ | CALCulate:AVIonics:THD:FREQuency:UPPer |
| THD UNIT % DB | UNIT:THD PCT |
| FUND FREQ 90/150 HZ | CALCulate:AVIonics:THD:FREQuency:FUNDament '90_150' |
| FUND FREQ 90 HZ | CALCulate:AVIonics:THD:FREQuency:FUNDament '90' |
| FUND FREQ 150 HZ | CALCulate:AVIonics:THD:FREQuency:FUNDament '150' |
| FUND FREQ IDENT | CALCulate:AVIonics:THD:FREQuency:FUNDament 'ID' |

| | |
|-------------------------|--|
| BASEBAND | --- |
| BASEBAND ON OFF | INPut1:SElect AIQ AUDIo INPut1:SElect RF |
| BASEBAND SENSITIVITY | SENSel:VOLTage:AC:SENSitivity |
| INP LEVEL 4V 400mV | SENSel:VOLTage:AC:RANGE[:UPPer] , 4, 0.4 |
| INPUT IMP 1MΩ 50Ω | INPut1:IMPedance 1MOHM |

FREQ Key

| | |
|--------------------|--------------------------------------|
| FREQ | |
| CENTER | [SENSe:]FREQuency:CENTer <num_value> |
| CF-STEPSIZE | |
| MANUAL | [SENSe:]FREQuency:CENTer:STEP 50 kHz |
| SINGLE AUTOTUNE | SENS:FREQ:CW:AFC ONCE |
| SIGNAL TRACK | SENS:FREQ:CW:AFC ON |
| AF CENTER | SENS:ADEM:AF:CENT 1KHZ |
| AF START | SENS:ADEM:AF:STAR 0HZ |
| AF STOP | SENS:ADEM:AF:STOP 2KHZ |

SPAN Key

| | |
|----------------|----------------------|
| SPAN | |
| FULL SPAN | ADEM:AF:SPAN:FULL |
| SPAN MANUAL | ADEM:AF:SPAN 2.5 kHz |
| | |

AMPL Key

| | |
|-----------------------|---|
| AMPT | |
| REF LEVEL | DISPlay[:WIND:TRAC:Y[:SCALE]:RLEVel <num_value> |
| RF LEVEL AUTORANGE | DISP:WIND:TRAC:Y:RLEV:AUTO ON |
| AUTORANGE CONFIG | --- |
| 10 DB MIN ON OFF | INP:ATT:PROT ON |
| AUTOPREAMP ON OFF | INP:GAIN:AUTO ON |
| RANGE | |
| REFERENCE POSITION | DISP:WIND:TRAC:Y:RPOS 50PCT |
| REFERENCE VALUE | DISP:WIND:TRAC:Y:RVAL 100PCT |
| DEVIATION LIN LOG | DISP:WIND:TRAC:Y:SPAC LOG |
| dB PER DIV | DISP:WIND:TRAC:Y:PDIV 5DB |
| RF INPUT AC DC | INP:COUP AC |
| RF ATTEN MANUAL | INPut:ATTenuation <num_value> |
| RF ATTEN AUTO | INPut:ATTenuation:AUTO ON |
| MIXER | |
| MIXER LVL AUTO | INPut<1 2>:MIXer:AUTO ON |
| MIXER LVL MANUAL | INPut<1 2>[:POWer]:MIXer <num_value> |
| RF INPUT 50Ω 75Ω | INPut:IMPedance 50 75 |

BW Key

| |
|-----------|
| BW |
|-----------|

| |
|------------------|
| DEMOM BW AUTO |
|------------------|

[SENSe:]BANDwidth|BWIDth:DEMod:AUTO ON

| |
|--------------------|
| DEMOM BW MANUAL |
|--------------------|

[SENSe:]BANDwidth|BWIDth:DEMod:AUTO OFF
[SENSe:]BANDwidth|BWIDth:DEMod <num_value>

| |
|---------------|
| IF BW AUTO |
|---------------|

[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO ON

| |
|-----------------|
| IF BW MANUAL |
|-----------------|

[SENSe:]BANDwidth|BWIDth:AUTO OFF
[SENSe:]BANDwidth|BWIDth[:RESolution] <num_value>

| |
|-------------------|
| MEAS TIME AUTO |
|-------------------|

[SENSe:]SWEep:TIME:AUTO ON

| |
|---------------------|
| MEAS TIME MANUAL |
|---------------------|

[SENSe:]SWEep:TIME:AUTO OFF
[SENSe:]SWEep:TIME <num_value>

| |
|------------------|
| RES BW MANUAL |
|------------------|

[SENSe:]ADEM:SPEC:BAND:RES 10 Hz]

SWEEP Key

| |
|---------------------|
| CONTINUOUS SWEEP |
|---------------------|

INITiate<1|2>:CONTInuous ON

| |
|-----------------|
| SINGLE SWEEP |
|-----------------|

INITiate<1|2>:CONTInuous OFF
INITiate<1|2>[:IMMediate]

| |
|-------------------|
| MEAS TIME AUTO |
|-------------------|

[SENSe:]SWEep:TIME:AUTO ON | OFF

| |
|---------------------|
| MEAS TIME MANUAL |
|---------------------|

[SENSe:]SWEep:TIME <num_value>

| |
|-----------------------|
| SGL SWEEP DISP OFF |
|-----------------------|

INITiate:DISPlay OFF
INITiate:IMMediate

Performance Test

Test Instructions

The rated specifications of the analyzer are tested after a warm-up time of at least 30 minutes and complete internal calibration.

Starting of internal calibration: [**CAL** : CAL TOTAL]

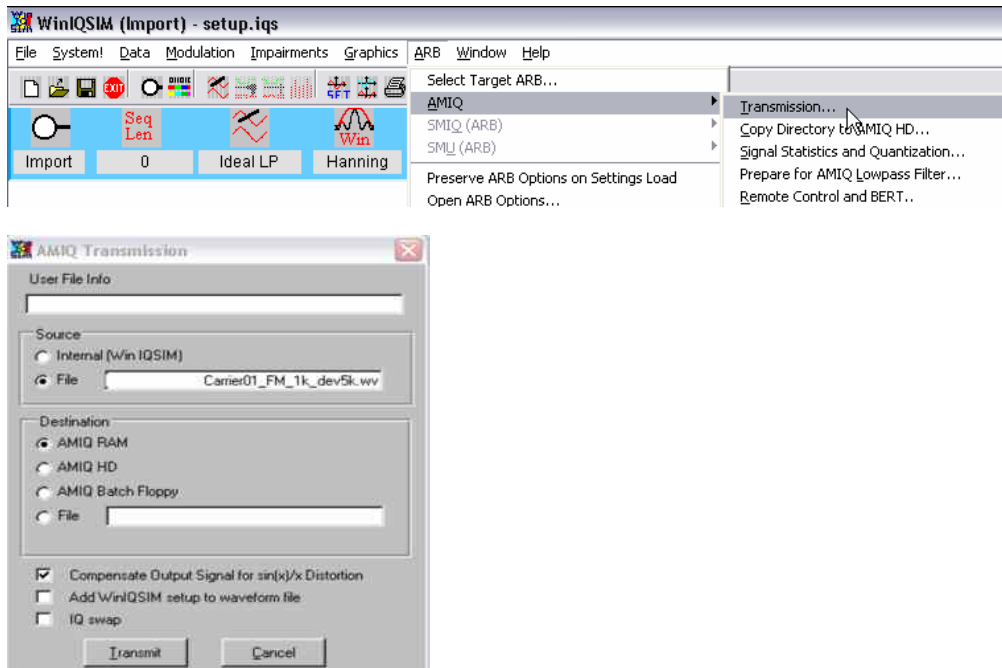
- If nothing else is specified, all measurements will be done with **external reference frequency**.
- Values given in the following sections are not guaranteed. Only the technical specifications of the data sheet are binding.
- The values given in the datasheet are the guaranteed limits. Due to measurement uncertainties these limits must be extended by the tolerance of the measuring equipment used in this performance test.
- Inputs for settings during measurements are shown as follows:
 - [<KEY>] Press a key on the front panel, e.g. [**SPAN**]
 - [<SOFTKEY>] Press a softkey, e.g. [MARKER -> PEAK]
 - [<nn unit>] Enter a value and terminate by entering the unit, e.g. [**12 kHz**]
 Successive entries are separated by [:], e.g. [**BW** : RES BW MANUAL : **3 kHz**]

Test Files for Arbitrary Waveform Generator R&S AMIQ

Most of the modulation test signals must be generated using an Arbitrary Waveform Generator in order to attain the requisite accuracy and other characteristics.

Suitable files for the R&S AMIQ can be downloaded from GLORIS (<https://gloris.rohde-schwarz.com/>):
Firmware/Software → Software → R&S FSMR → **Modulation Test Files K15**

A convenient method to transfer the files into the AMIQ is to use WinIQSIM, also available from GLORIS:
Firmware/Software → Software → **WinIQSIM**



Measuring Equipment and Accessories

| Item | Type of equipment | Specifications recommended | Equipment recommended | R&S Order No. | Use |
|------|------------------------------|--|-----------------------|---------------|--|
| 1 | Arbitrary Waveform Generator | Flat Bandwidth >13MHz Programmable Sampling Rate up to 60 MHz Memory depth ≥ 1.2 M Samples 14 Bit Resolution SFDR > 70 dB @ 0dBm into 50Ω External Reference Freq. Input 2 sinusoidal signals with 90 deg phase difference | AMIQ | 1110.2003.04 | Audio Input Frequency Counter Uncertainty AM: Modulation Depth Uncertainty FM Deviation Uncertainty |
| 2 | WinIQSIM | PC test program for AMIQ | | | . |

Measuring hints

Note:

The phase readings on the screen of the VOR/ILS demodulator are limited to a unique range. In VOR mode the default measurement range is 0 to 360 degree, in ILS mode the range is -60 to +60 degree. Due to this discontinuous phase range a reading of 359.98 degree is equal to - 0.02 degree.

In the performance test of this demodulator unique phase ranges are used as limits.

Example: In the VOR test a measurement at 0 degree VOR phase is performed. The test limit in this case is defined from -0.03 degree to + 0.03 degree.

Due to the discontinuous phase range a negative reading of -0.03 degree will not be displayed. The displayed reading of 359.97 degree is equal to -0.03 degree.

The phase readings outside of the continuous range have to be adjusted before the value is checked against the limit.

Performance Test FS-K15

Checking the ILS Demodulation (AM)

The test of the ILS demodulator is performed on several test signals with variation of the following parameters: Modulation depth = 18% to 48 % (covering Localizer and Glideslope ranges), Freq(ID) = 300 Hz to 3990 Hz (to test the full bandwidth of the identifier channel), DDM = 0 to ±0,4 (center to maximum deviation from center), Phase 0 to 59° (to test nonlinearities of the demodulator), Modulation frequency +1% (to test the selectivity).

Test 1 Standard ILS Glideslope Signal, DDM = 0, no distortion

Signal 1 ILS Glideslope, m = 48%
 File ILS_AM_ph0_m48_DDM0.WV

| | AM | Frequency | |
|------------|------|-----------|-----|
| 90 Hz | 48 % | 90 Hz | |
| 150 Hz | 48 % | 150 Hz | |
| Identifier | 10 % | 1020 Hz | |
| | DDM | Phase | THD |
| 90/150 Hz | 0 | 0° | 0 % |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [PRESET]
 [AVIONICS MODE]
 [AMPT : REF LEVEL : 5 dBm]
 [FREQ : RECEIVER FREQUENCY : 12 MHz]
 [AVIONICS : ILS]

Signal Generator Settings: Generate a ILS amplitude modulated carrier. Set carrier frequency, modulation frequency and depth as listed in the table. 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:
 File ILS_AM_ph0_m48_DDM0.WV

Measurement: Read the indications from the FS-K15:
 90 Hz AM depth and frequency, 150 Hz AM depth and frequency
 ID AM depth and frequency, DDM, 90/150 Hz phase and THD

| ILS Demodulation Summary | | | | | |
|--------------------------|---------|-------|--------|-----|--|
| 90 Hz AM | 48.00 % | FREQ | 90.000 | Hz | |
| 150 Hz AM | 48.00 % | FREQ | 150.00 | Hz | |
| 90+150 Hz AM | 89.14 % | PHASE | 0.00 | deg | |
| IDENT AM | 10.00 % | FREQ | 1.0200 | kHz | |
| SDM | 96.00 % | THD | 0.02 | % | |
| ILS DDM | 0.0000 | | | | |

Test 2 ILS Localizer Signal, DDM = 0, distortion meter and ID low frequency test

Signal 2 Localizer m = 18%, fid = 300 Hz
 File ILS_AM_ph0_m18_DDM0_fid03.WV

| | AM | Frequency | | THD |
|------------|------------|------------------|---------|------------|
| 90 Hz | 18 % | 90 Hz | | |
| 150 Hz | 18 % | 150 Hz | | |
| Identifier | 10 % | 300 Hz | | |
| | DDM | Phase | | |
| 90/150 Hz | 0 | 0° | 55.56 % | |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [**PRESET**]
 [AVIONICS MODE]
 [**AMPT** : REF LEVEL : **5 dBm**]
 [**FREQ** : RECEIVER FREQUENCY : **12 MHz**]
 [AVIONICS : ILS]

Signal Generator Settings: Generate a ILS amplitude modulated carrier with a peak level of 0 dBm. Set carrier frequency, modulation frequency and depth as listed in the table. 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File ILS_AM_ph0_m18_DDM0_fid03.WV

Measurement: Read the indications from the FS-K15:
 90 Hz AM depth and frequency
 150 Hz AM depth and frequency
 ID AM depth and frequency
 DDM, 90/150 Hz phase and THD

| ILS Demodulation Summary | | | | |
|--------------------------|---------|-------|--------|-----|
| 90 Hz AM | 18.00 % | FREQ | 90.000 | Hz |
| 150 Hz AM | 18.00 % | FREQ | 150.00 | Hz |
| 90+150 Hz AM | 33.43 % | PHASE | -0.01 | deg |
| IDENT AM | 10.00 % | FREQ | 300.00 | Hz |
| SDM | 36.00 % | THD | 55.57 | % |
| ILS DDM | 0.0001 | | | |

Test 3 ILS Localizer Signal, DDM = 0, Phase =45°, ID high frequency test

Signal 3 Localizer, phase 45°, fid = 3990 Hz
File ILS_AM_ph45_m20_DDM0_fid40.WV

| | AM | Frequenz | |
|------------|------------|-----------------|------------|
| 90 Hz | 20 % | 90 Hz | |
| 150 Hz | 20 % | 150 Hz | |
| Identifier | 10 % | 3990 Hz | |
| | DDM | Phase | THD |
| 90/150 Hz | 0 | 45° | 0 % |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [**PRESET**]
 [**AVIONICS MODE**]
 [**AMPT** : REF LEVEL : **5 dBm**]
 [**FREQ** : RECEIVER FREQUENCY : **12 MHz**]
 [**AVIONICS** : ILS]

Signal Generator Settings: Generate a ILS amplitude modulated carrier with a peak level of 0 dBm. Set carrier frequency, modulation frequency and depth as listed in the table. 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File ILS_AM_ph45_m20_DDM0_fid40.WV

Measurement: Read the indications from the FS-K15:
 90 Hz AM depth and frequency
 150 Hz AM depth and frequency
 ID AM depth and frequency
 DDM, 90/150 Hz phase and THD

| ILS Demodulation Summary | | | |
|--------------------------|---------|-------|------------|
| 90 Hz AM | 20.00 % | FREQ | 90.000 Hz |
| 150 Hz AM | 20.00 % | FREQ | 150.00 Hz |
| 90+150 Hz AM | 39.83 % | PHASE | 45.00 deg |
| IDENT AM | 10.00 % | FREQ | 3.9900 kHz |
| SDM | 40.01 % | THD | 0.03 % |
| ILS DDM | -0.0000 | | |

Test 4 Standard ILS Localizer Signal, DDM = 0.2 , (DDM test)

Signal 4 Localizer, DDM = 0.2
File ILS_AM_ph0_m20_DDM02.WV

| | AM | Frequency | |
|------------|------------|------------------|------------|
| 90 Hz | 30 % | 90 Hz | |
| 150 Hz | 10 % | 150 Hz | |
| Identifier | 10 % | 1020 Hz | |
| | DDM | Phase | THD |
| 90/150 Hz | 0.2 | 0° | 0 % |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [**PRESET**]
 [**AVIONICS MODE**]
 [**AMPT** : REF LEVEL : **5 dBm**]
 [**FREQ** : RECEIVER FREQUENCY : **12 MHz**]
 [**AVIONICS** : ILS]

Signal Generator Settings: Generate a ILS amplitude modulated carrier with a peak level of 0 dBm. Set carrier frequency, modulation frequency and depth as listed in the table. 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File ILS_AM_ph0_m20_DDM02.WV

Measurement: Read the indications from the FS-K15:
 90 Hz AM depth and frequency
 150 Hz AM depth and frequency
 ID AM depth and frequency
 DDM, 90/150 Hz phase and THD

| ILS Demodulation Summary | | | |
|--------------------------|---------|-------|------------|
| 90 Hz AM | 30.00 % | FREQ | 90.000 Hz |
| 150 Hz AM | 10.00 % | FREQ | 150.00 Hz |
| 90+150 Hz AM | 37.21 % | PHASE | 0.01 deg |
| IDENT AM | 10.00 % | FREQ | 1.0200 kHz |
| SDM | 40.01 % | THD | 0.03 % |
| ILS DDM | 0.2000 | | |

Test 5 ILS Localizer Signal, DDM = -0.2 , Phase = -30° (DDM test at different phase)

Signal 5 Localizer, DDM = -0.2, phase = -30°
 File ILS_AM_ph-30_m20_DDM-02.WV

| | AM | Frequency | |
|------------|------------|------------------|------------|
| 90 Hz | 10 % | 90 Hz | |
| 150 Hz | 30 % | 150 Hz | |
| Identifier | 10 % | 1020 Hz | |
| | DDM | Phase | THD |
| 90/150 Hz | -0.2 | -30° | 0 % |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [PRESET]
 [AVIONICS MODE]
 [AMPT : REF LEVEL : 5 dBm]
 [FREQ : RECEIVER FREQUENCY : 12 MHz]
 [AVIONICS : ILS]

Signal Generator Settings: Generate a ILS amplitude modulated carrier with a peak level of 0 dBm. Set carrier frequency, modulation frequency and depth as listed in the table. 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File ILS_AM_ph-30_m20_DDM-02.WV

Measurement: Read the indications from the FS-K15:
 90 Hz AM depth and frequency
 150 Hz AM depth and frequency
 ID AM depth and frequency
 DDM, 90/150 Hz phase and THD

| | | | |
|--------------|---------|-------|------------|
| 90 Hz AM | 10.00 % | FREQ | 90.000 Hz |
| 150 Hz AM | 30.00 % | FREQ | 150.00 Hz |
| 90+150 Hz AM | 39.57 % | PHASE | -30.00 deg |
| IDENT AM | 10.00 % | FREQ | 1.0200 kHz |
| SDM | 40.01 % | THD | 0.04 % |
| ILS DDM | -0.2000 | | |

Test 6 Standard ILS Glideslope Signal, DDM = 0.4 (Glideslope DDM test)

Signal 6 Glideslope, DDM = 0.4
File ILS_AM_ph0_m40_DDM04.WV

| | AM | Frequency | |
|------------|------------|------------------|------------|
| 90 Hz | 60 % | 90 Hz | |
| 150 Hz | 20 % | 150 Hz | |
| Identifier | 10 % | 1020 Hz | |
| | DDM | Phase | THD |
| 90/150 Hz | 0.4 | 0° | 0 % |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [PRESET]
 [AVIONICS MODE]
 [AMPT : REF LEVEL : 5 dBm]
 [FREQ : RECEIVER FREQUENCY : 12 MHz]
 [AVIONICS : ILS]

Signal Generator Settings: Generate a ILS amplitude modulated carrier with a peak level of 0 dBm. Set carrier frequency, modulation frequency and depth as listed in the table. 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File ILS_AM_ph0_m40_DDM04.WV

Measurement: Read the indications from the FS-K15:
 90 Hz AM depth and frequency
 150 Hz AM depth and frequency
 ID AM depth and frequency
 DDM, 90/150 Hz phase and THD

| ILS Demodulation Summary | | | |
|--------------------------|---------|-------|------------|
| 90 Hz AM | 60.00 % | FREQ | 90.000 Hz |
| 150 Hz AM | 20.00 % | FREQ | 150.00 Hz |
| 90+150 Hz AM | 74.40 % | PHASE | 0.01 deg |
| IDENT AM | 10.00 % | FREQ | 1.0200 kHz |
| SDM | 80.00 % | THD | 0.02 % |
| ILS DDM | 0.4001 | | |

Test 7 ILS Glideslope Signal, DDM = -0.4 , Phase = 59° , Frequency offset 1%

Signal 7 Glideslope, DDM = -0.4, Frequency offset +1%, Phase 59°
 Receiver Frequency = 12.12 MHz !
 File ILS_AM_ph59_m40_DDM-04_offset01.WV

| | AM | Frequency | |
|------------|------------|------------------|------------|
| 90 Hz | 20 % | 90.9 Hz | |
| 150 Hz | 60 % | 151.5 Hz | |
| Identifier | 10 % | 1030.2 Hz | |
| | DDM | Phase | THD |
| 90/150 Hz | -0.4 | 59° | 0 % |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

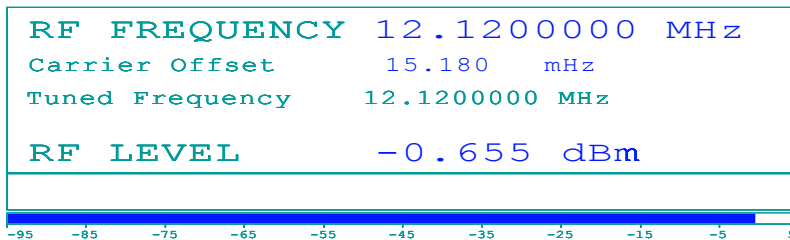
Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [**PRESET**]
 [**AVIONICS MODE**]
 [**AMPT : REF LEVEL : 5 dBm**]
 [**FREQ : RECEIVER FREQUENCY : 12.12 MHz**]
 [**AVIONICS : ILS**]

Signal Generator Settings: Generate a ILS amplitude modulated carrier with a peak level of 0 dBm. Set carrier frequency, modulation frequency and depth as listed in the table. 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File ILS_AM_ph59_m40_DDM-04_offset01.WV

Measurement: Read the indications from the FS-K15:
 90 Hz AM depth and frequency, 150 Hz AM depth and frequency
 ID AM depth and frequency, DDM, 90/150 Hz phase and THD



| ILS Demodulation Summary | | | | | |
|--------------------------|---------|-------|------------|--------|-------|
| 90 Hz AM | 19.99 % | FREQ | 90.900 Hz | | |
| 150 Hz AM | 59.97 % | FREQ | 151.50 Hz | | |
| 90+150 Hz AM | 79.95 % | PHASE | 58.98 deg | | |
| IDENT AM | 10.00 % | FREQ | 1.0302 kHz | | |
| SDM | 79.96 % | THD | 0.02 % | | |
| ILS DDM | -0.3998 | | | -0.001 | 0.001 |

Checking the VOR Demodulation (AM, FM)

The test of the VOR demodulator is performed on several test signals with variation of the following parameters:

Modulation depth = 10% to 40 % (30 Hz, 9.96 kHz), Freq(ID) = 300 Hz to 3990 Hz (to test the full bandwidth of the identifier channel), 9.96 kHz carrier with frequency deviation = 200 to 700 Hz, VOR phase 0 to 360°, modulation frequency +1% (to test the selectivity).

Test 1 Standard VOR Signal, VOR phase = 0°, no distortion

Signal 1 Standard VOR
 File VOR_AM_ph0_m30_dev480.WV

| | AM (depth) | Frequency |
|------------|-----------------------|-----------|
| 30 Hz | 30 % | 30 Hz |
| 9960 Hz | 30 % | 9960 Hz |
| Identifier | 10 % | 1020 Hz |
| 9960 Hz | FM (deviation) | 480 Hz |
| 30/30 Hz | Azimuth | 0° |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [**PRESET**]
 [AVIONICS MODE]
 [**AMPT** : REF LEVEL : **5 dBm**]
 [**FREQ** : RECEIVER FREQUENCY : **12 MHz**]
 [AVIONICS : VOR]

Signal Generator Settings: Generate a VOR amplitude modulated carrier with a peak level of 0 dBm. Set carrier frequency, modulation frequency and depth as listed in the table.

4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File VOR_AM_ph0_m30_dev480.WV

Measurement: Read the indications from the FS-K15:
 30 Hz AM depth and frequency, 9.96 kHz AM depth and frequency
 30 Hz FM deviation and frequency, ID AM depth and frequency
 VOR Phase

| VOR Demodulation Summary EXT | | | | |
|---|-----------|------|------------|--|
| 30 Hz AM | 30.00 % | FREQ | 30.000 Hz | |
| 9.96 kHz AM | 30.01 % | FREQ | 9.9600 kHz | |
| 30 Hz FM | 480.01 Hz | FREQ | 30.000 Hz | |
| IDENT AM | 10.00 % | FREQ | 1.0200 kHz | |
| VOR PHASE | 0.02 deg | | | |

Test 2 VOR Signal, low AM depth, Freq(ID) 300 Hz, ID low frequency test

Signal 2 m = 10%, frequency(Id) = 300 Hz
File VOR_AM_ph0_m10_dev480_fid03.WV

| | AM (depth) | Frequency |
|------------|-----------------------|------------------|
| 30 Hz | 10 % | 30 Hz |
| 9960 Hz | 10 % | 9960 Hz |
| Identifier | 10 % | 300 Hz |
| 9960 Hz | FM (deviation) | 480 Hz |
| 30/30 Hz | Azimuth | 0° |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)


Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [PRESET]
 [AVIONICS MODE]
 [AMPT : REF LEVEL : 5 dBm]
 [FREQ : RECEIVER FREQUENCY : 12 MHz]
 [AVIONICS : VOR]

Signal Generator Settings: Generate a VOR amplitude modulated carrier with a peak level of 0 dBm.
 Set carrier frequency, modulation frequency and depth as listed in the table.
 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File VOR_AM_ph0_m10_dev480_fid03.WV

Measurement: Read the indications from the FS-K15:
 30 Hz AM depth and frequency
 9.96 kHz AM depth and frequency
 30 Hz FM deviation and frequency
 ID AM depth and frequency
 VOR Phase, THD (30)

| VOR Demodulation Summary | | | | |
|--------------------------|-----------|--|------------|--|
| 30 Hz AM | 10.00 % | FREQ | 30.000 Hz | |
| 9.96 kHz AM | 10.00 % | FREQ | 9.9600 kHz | |
| 30 Hz FM | 479.99 Hz | FREQ | 30.000 Hz | |
| IDENT AM | 10.00 % | FREQ | 299.99 Hz | |
| VOR PHASE | 0.02 deg |  | | |

Test 3 VOR, high AM depth, high deviation, ID high freq. test, Phase 350°

Signal 3 m = 40%, fid = 3990 Hz, dev = 700 Hz, Azimuth =350°
 File VOR_AM_ph350_m40_dev700_fid40.WV

| | AM (depth) | Frequency |
|-----------------------|-------------------|------------------|
| 30 Hz | 40 % | 30 Hz |
| 9960 Hz | 40 % | 9960 Hz |
| Identifier | 10 % | 3990 Hz |
| FM (deviation) | | |
| 9960 Hz | | 700 Hz |
| 30/30 Hz | Azimuth | 350° |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

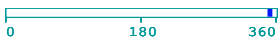
Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [PRESET]
 [AVIONICS MODE]
 [AMPT : REF LEVEL : 5 dBm]
 [FREQ : RECEIVER FREQUENCY : 12 MHz]
 [AVIONICS : VOR]

Signal Generator Settings: Generate a VOR amplitude modulated carrier with a peak level of 0 dBm.
 Set carrier frequency, modulation frequency and depth as listed in the table.
 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File VOR_AM_ph350_m40_dev700_fid40.WV

Measurement: Read the indications from the FS-K15:
 30 Hz AM depth and frequency
 9.96 kHz AM depth and frequency
 30 Hz FM deviation and frequency,
 ID AM depth and frequency
 VOR Phase

| VOR Demodulation Summary | | | | |
|--------------------------|------------|--|------------|--|
| 30 Hz AM | 39.99 % | FREQ | 30.000 Hz | |
| 9.96 kHz AM | 39.47 % | FREQ | 9.9600 kHz | |
| 30 Hz FM | 699.61 Hz | FREQ | 30.000 Hz | |
| IDENT AM | 10.01 % | FREQ | 3.9900 kHz | |
| VOR PHASE | 350.02 deg |  | | |

Test 4 Standard VOR Signal, VOR phase = 45°, no distortion

Signal 4 Azimuth = 45°
 File VOR_AM_ph45_m30_dev480.WV

| | AM (depth) | Frequency |
|-----------------------|-------------------|------------------|
| 30 Hz | 30 % | 30 Hz |
| 9960 Hz | 30 % | 9960 Hz |
| Identifier | 10 % | 1020 Hz |
| FM (deviation) | | |
| 9960 Hz | | 480 Hz |
| 30/30 Hz | Azimuth | 45° |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)


Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [**PRESET**]
 [AVIONICS MODE]
 [**AMPT** : REF LEVEL : **5 dBm**]
 [**FREQ** : RECEIVER FREQUENCY : **12 MHz**]
 [AVIONICS : VOR]

Signal Generator Settings: Generate a VOR amplitude modulated carrier with a peak level of 0 dBm.
 Set carrier frequency, modulation frequency and depth as listed in the table.
 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File VOR_AM_ph45_m30_dev480.WV

Measurement: Read the indications from the FS-K15:
 30 Hz AM depth and frequency
 9.96 kHz AM depth and frequency
 30 Hz FM deviation and frequency
 ID AM depth and frequency
 VOR Phase

| VOR Demodulation Summary | | | | |
|--------------------------|-----------|--|------------|--|
| 30 Hz AM | 30.00 % | FREQ | 30.000 Hz | |
| 9.96 kHz AM | 30.01 % | FREQ | 9.9600 kHz | |
| 30 Hz FM | 479.98 Hz | FREQ | 30.002 Hz | |
| IDENT AM | 10.00 % | FREQ | 1.0200 kHz | |
| VOR PHASE | 45.01 deg |  | | |

Test 5 VOR Signal, VOR phase = 271°, low deviation (200 Hz)

Signal 5 Azimuth = 271°, Deviation 200 Hz
 File VOR_AM_ph271_m30_dev200.WV

| | | |
|------------|-----------------------|------------------|
| | AM (depth) | Frequency |
| 30 Hz | 30 % | 30 Hz |
| 9960 Hz | 30 % | 9960 Hz |
| Identifier | 10 % | 1020 Hz |
| | | |
| 9960 Hz | FM (deviation) | 200 Hz |
| 30/30 Hz | Azimuth | 271° |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)


Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [PRESET]
 [AVIONICS MODE]
 [AMPT : REF LEVEL : 5 dBm]
 [FREQ : RECEIVER FREQUENCY : 12 MHz]
 [AVIONICS : VOR]

Signal Generator Settings: Generate a VOR amplitude modulated carrier with a peak level of 0 dBm.
 Set carrier frequency, modulation frequency and depth as listed in the table.
 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File VOR_AM_ph271_m30_dev200.WV

Measurement: Read the indications from the FS-K15:
 30 Hz AM depth and frequency
 9.96 kHz AM depth and frequency
 30 Hz FM deviation and frequency
 ID AM depth and frequency
 VOR Phase

| VOR Demodulation Summary | | | | | |
|--------------------------|------------|---|--------|-----|--|
| 30 Hz AM | 30.00 % | FREQ | 30.000 | Hz | |
| 9.96 kHz AM | 30.01 % | FREQ | 9.9600 | kHz | |
| 30 Hz FM | 199.98 Hz | FREQ | 30.004 | Hz | |
| IDENT AM | 10.00 % | FREQ | 1.0200 | kHz | |
| | | | | | |
| VOR PHASE | 271.01 deg |  | | | |

Test 6 VOR Signal, VOR phase = 180.1°, frequency offset 1%

Signal 6 Azimuth = 180.1°, Frequency offset +1%
 Receiver Frequency = 12.12 MHz
 File VOR_AM_ph180_m30_dev480_offset01.WV

| | | |
|------------|-----------------------|------------------|
| | AM (depth) | Frequency |
| 30 Hz | 30 % | 30.3 Hz |
| 9960 Hz | 30 % | 10059.6 Hz |
| Identifier | 10 % | 1030.2 Hz |
| | | |
| 9960 Hz | FM (deviation) | 480 Hz |
| 30/30 Hz | Azimuth | 180.1° |

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

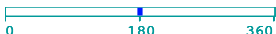
Test Setup: Connect the Signal Generator to the RF Input of the instrument.
 When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [**PRESET**]
 [AVIONICS MODE]
 [**AMPT** : REF LEVEL : **5 dBm**]
 [**FREQ** : RECEIVER FREQUENCY : **12 MHz**]
 [AVIONICS : VOR]

Signal Generator Settings: Generate a VOR amplitude modulated carrier with a peak level of 0 dBm.
 Set carrier frequency, modulation frequency and depth as listed in the table.
 4x oversampling (4x carrier frequency) is recommended.
 When using the R&S AMIQ download the listed files into the AMIQ:

File VOR_AM_ph180_m30_dev480_offset01.WV

Measurement: Read the indications from the FS-K15:
 30 Hz AM depth and frequency
 9.96 kHz AM depth and frequency
 30 Hz FM deviation and frequency
 ID AM depth and frequency
 VOR Phase

| VOR Demodulation Summary | | | | | |
|--------------------------|------------|--|--------|-----|--|
| 30 Hz AM | 29.98 % | FREQ | 30.300 | Hz | |
| 9.96 kHz AM | 29.99 % | FREQ | 10.060 | kHz | |
| 30 Hz FM | 480.01 Hz | FREQ | 30.300 | Hz | |
| IDENT AM | 10.00 % | FREQ | 1.0302 | kHz | |
| | | | | | |
| VOR PHASE | 180.11 deg |  | | | |

Checking the Audio Input Characteristics (only in case of FSMR and FSQ-B71)

Note: The Baseband input absolute level readings are not calibrated in this section. In the ILS test the absolute level has an influence on the DDM readings. Therefore the baseband sensitivity setting must be corrected in case of any attenuation between the ARB generator and the instruments input connector.

Example: Adjust the baseband sensitivity for ILS test case 1 accordingly that the 90Hz and 150 Hz AM reading is 20.00 % and use this value in all subsequent tests.

Test 1 VOR Phase and FM Deviation

The test is performed with VOR baseband signals from the AMIQ.

Nominal deviation of 480 Hz and Phase: 0°, 50°, 180°, 300°

Filename: VOR_baseband_ph.wv, where ph is the phase in degree

Test are performed on phase and deviation readings only.

AM modulation depth is depending on the absolute level accuracy and baseband sensitivity entry.

The test of the absolute level accuracy of the baseband input is part of the instrument calibration.

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

Test Setup: Connect the Signal Generator to the RF Input of the instrument.
When using the R&S AMIQ the "I" output must be used.

Instrument Settings: [**PRESET**]
[AVIONICS MODE]
[AVIONICS : VOR]
FSMR:
[AVIONICS : BASEBAND ON]
[AVIONICS : BASEBAND : MAX LEVEL : 4 Volt]
[AVIONICS : BASEBAND : INP IMP : 50 Ohm]
[AVIONICS : BASEBAND : SENSITIVITY : 0.833 V]
FSQ with FSQ-B71:
[AVIONICS : BASEBAND : BASEBAND ANALOG]
[AVIONICS : BASEBAND : I/Q INPUT : 50 Ohm]
[AVIONICS : BASEBAND : BALANCED OFF]
[AVIONICS : BASEBAND : SENSITIVITY : 0.833 V]

Signal Generator Settings: Generate a VOR carrier with the described parameters.
When using the R&S AMIQ download the listed files into the AMIQ:

| | |
|--------|---------------------|
| File 1 | VOR_baseband_0.wv |
| File 2 | VOR_baseband_50.wv |
| File 3 | VOR_baseband_180.wv |
| File 4 | VOR_baseband_300.wv |

Measurement: Read the indications from the FS-K15:
30 Hz FM deviation and frequency
VOR Phase

Specification:
Deviation: 480 Hz \pm 0.5 % (= \pm 2.4 Hz)
Phase: 0.03 °

Test 2 ILS DDM and Phase

The test of the ILS demodulator is performed on several test signals from the AMIQ with variation of the following parameters:

Modulation depth = 20% / 40 % (Localizer/Glideslope), DDM = 0, ± 0.2 and ± 0.4, Phase 0/-45°/30°.

Test are performed on phase and DDM readings only.

AM modulation depth is depending on the absolute level accuracy and baseband sensitivity entry.

The test of the absolute level accuracy of the baseband input is part of the instrument calibration.

| | | | | | | |
|------------------|-----|-----|------|------|------|-----|
| Modulation depth | 20% | 20% | 20% | | | |
| DDM | 0 | 0.2 | -0.2 | | | |
| Phase | 0° | 0° | 0° | | | |
| Modulation depth | 40% | 40% | 40% | 40% | 40% | 40% |
| DDM | 0 | 0.4 | -0.4 | 0 | 0.4 | 0 |
| Phase | 0° | 0° | 0° | -45° | -45° | 30° |

Filename example: ILS_baseband_ph0_m40_DDM-04.WV (equals to Phase 0°, m=40%, DDM = -0,4)

Test Equipment: Arbitrary Waveform Generator (Section "Measuring Equipment", item 1)

Test Setup: Connect the Signal Generator to the RF Input of the instrument.
When using the R&S AMIQ the "I" output must be used.

Instrument Settings: **[PRESET]**
[AVIONICS MODE]
[AVIONICS : ILS]
 FSMR:[AVIONICS : BASEBAND ON]
 [AVIONICS : BASEBAND : INP LEVEL : 4 Volt]
 [AVIONICS : BASEBAND : INP IMP : 50 Ohm]
 [AVIONICS : BASEBAND : SENSITIVITY : 0.5 V]
 FSQ with FSQ-B71:
 [AVIONICS : BASEBAND : BASEBAND ANALOG]
 [AVIONICS : BASEBAND : I/Q INPUT : 50 Ohm]
 [AVIONICS : BASEBAND : BALANCED OFF]
[AVIONICS : BASEBAND : SENSITIVITY : 0.5 V]

Signal Generator Settings: Generate a ILS carrier with the described parameters.
When using the R&S AMIQ download the listed files into the AMIQ:

Tests for ILS DDM and Phase:

| | |
|--------|---------------------------------|
| Test 1 | ILS_baseband_ph0_m20_DDM0.WV |
| Test 2 | ILS_baseband_ph0_m20_DDM02.WV |
| Test 3 | ILS_baseband_ph0_m20_DDM-02.WV |
| Test 4 | ILS_baseband_ph0_m40_DDM0.WV |
| Test 5 | ILS_baseband_ph0_m40_DDM04.WV |
| Test 6 | ILS_baseband_ph0_m40_DDM-04.WV |
| Test 7 | ILS_baseband_ph-45_m40_DDM0.WV |
| Test 8 | ILS_baseband_ph-45_m40_DDM04.WV |
| Test 9 | ILS_baseband_ph30_m40_DDM0.WV |

Measurement: Read the indications from the FS-K15:
 ILS DDM, ILS Phase
 Specification:
 Glide Slope 32-48 %: 0.0004 DDM ± 1% of rdg. (FSQ-B71: 3.5%)
 Localizer 18-22 %: 0.0002 DDM ± 1% of rdg. (FSQ-B71: 3.5%)

Performance Test Report FS-K15

Table 1 Performance Test report

| | | | |
|-----------------|-------------------------|-----------------------------|-----------------------|
| ROHDE & SCHWARZ | Performance Test Report | Avionics Demodulator FS-K15 | Version: 07. Oct 2008 |
| Order number: | 1302.0936.02: | | |
| Serial number: | | | |
| Test person: | | | |
| Date: | | | |
| Signature: | | | |

| Characteristic | Target value | Min. value | Actual value | Max. value | Unit | Tolerance |
|---------------------|--------------|------------|--------------|------------|--------|-----------|
| ILS Demodulation | | | | | | |
| Test 1 | | | | | | |
| 90 Hz AM Depth | 48 | 47,808 | _____ | 48,192 | % | |
| 90 Hz Frequency | 90 | 89,9955 | _____ | 90,0045 | Hz | |
| 150 Hz AM Depth | 48 | 47,808 | _____ | 48,192 | % | |
| 150 Hz Frequency | 150 | 149,9925 | _____ | 150,0075 | Hz | |
| ID Modulation Depth | 10 | 9,9 | _____ | 10,1 | % | |
| ID Frequency | 1020 | 1019,949 | _____ | 1020,051 | Hz | |
| DDM reading | 0 | -0,0004 | _____ | 0,0004 | [1] | |
| ILS Phase 90/150 Hz | 0 | -0,03 | _____ | 0,03 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |
| Test 2 | | | | | | |
| 90 Hz AM Depth | 18 | 17,928 | _____ | 18,072 | % | |
| 90 Hz Frequency | 90 | 89,9955 | _____ | 90,0045 | Hz | |
| 150 Hz AM Depth | 18 | 17,928 | _____ | 18,072 | % | |
| 150 Hz Frequency | 150 | 149,9925 | _____ | 150,0075 | Hz | |
| ID Modulation Depth | 10 | 9,96 | _____ | 10,04 | % | |
| ID Frequency | 300 | 299,985 | _____ | 300,015 | Hz | |
| DDM reading | 0 | -0,0002 | _____ | 0,0002 | [1] | |
| ILS Phase 90/150 Hz | 0 | -0,03 | _____ | 0,03 | degree | |
| Harmonic Distortion | 55,56 | 55,2 | _____ | 56 | % | |
| Test 3 | | | | | | |
| 90 Hz AM Depth | 20 | 19,92 | _____ | 20,08 | % | |
| 90 Hz Frequency | 90 | 89,9955 | _____ | 90,0045 | Hz | |
| 150 Hz AM Depth | 20 | 19,92 | _____ | 20,08 | % | |
| 150 Hz Frequency | 150 | 149,9925 | _____ | 150,0075 | Hz | |
| ID Modulation Depth | 10 | 9,96 | _____ | 10,04 | % | |
| ID Frequency | 3990 | 3989,8005 | _____ | 3990,1995 | Hz | |
| DDM reading | 0 | -0,0002 | _____ | 0,0002 | [1] | |
| ILS Phase 90/150 Hz | 45 | 44,97 | _____ | 45,03 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |

| Characteristic | Target value | Min. value | Actual value | Max. value | Unit | Tolerance |
|---------------------|--------------|------------|--------------|------------|--------|-----------|
| Test 4 | | | | | | |
| 90 Hz AM Depth | 30 | 29,88 | _____ | 30,12 | % | |
| 90 Hz Frequency | 90 | 89,9955 | _____ | 90,0045 | Hz | |
| 150 Hz AM Depth | 10 | 9,96 | _____ | 10,04 | % | |
| 150 Hz Frequency | 150 | 149,9925 | _____ | 150,0075 | Hz | |
| ID Modulation Depth | 10 | 9,96 | _____ | 10,04 | % | |
| ID Frequency | 1020 | 1019,949 | _____ | 1020,051 | Hz | |
| DDM reading | 0,2 | 0,1994 | _____ | 0,2006 | [1] | |
| ILS Phase 90/150 Hz | 0 | -0,03 | _____ | 0,03 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |
| Test 5 | | | | | | |
| 90 Hz AM Depth | 10 | 9,96 | _____ | 10,04 | % | |
| 90 Hz Frequency | 90 | 89,9955 | _____ | 90,0045 | Hz | |
| 150 Hz AM Depth | 30 | 29,88 | _____ | 30,12 | % | |
| 150 Hz Frequency | 150 | 149,9925 | _____ | 150,0075 | Hz | |
| ID Modulation Depth | 10 | 9,96 | _____ | 10,04 | % | |
| ID Frequency | 1020 | 1019,949 | _____ | 1020,051 | Hz | |
| DDM reading | -0,2 | -0,2006 | _____ | -0,1994 | [1] | |
| ILS Phase 90/150 Hz | -30 | -30,03 | _____ | -29,97 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |
| Test 6 | | | | | | |
| 90 Hz AM Depth | 60 | 59,76 | _____ | 60,24 | % | |
| 90 Hz Frequency | 90 | 89,9955 | _____ | 90,0045 | Hz | |
| 150 Hz AM Depth | 20 | 19,92 | _____ | 20,08 | % | |
| 150 Hz Frequency | 150 | 149,9925 | _____ | 150,0075 | Hz | |
| ID Modulation Depth | 10 | 9,96 | _____ | 10,04 | % | |
| ID Frequency | 1020 | 1019,949 | _____ | 1020,051 | Hz | |
| DDM reading | 0,4 | 0,3988 | _____ | 0,4012 | [1] | |
| ILS Phase 90/150 Hz | 0 | -0,03 | _____ | 0,03 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |
| Test 7 | | | | | | |
| 90 Hz AM Depth | 20 | 19,92 | _____ | 20,08 | % | |
| 90 Hz Frequency | 90,9 | 90,895455 | _____ | 90,904545 | Hz | |
| 150 Hz AM Depth | 60 | 59,76 | _____ | 60,24 | % | |
| 150 Hz Frequency | 151,5 | 151,492425 | _____ | 151,507575 | Hz | |
| ID Modulation Depth | 10 | 9,96 | _____ | 10,04 | % | |
| ID Frequency | 1030,2 | 1030,14849 | _____ | 1030,25151 | Hz | |
| DDM reading | -0,4 | -0,4012 | _____ | -0,3988 | [1] | |
| ILS Phase 90/150 Hz | 59 | 58,97 | _____ | 59,03 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |

| Characteristic | Target value | Min. value | Actual value | Max. value | Unit | Tolerance |
|---------------------|--------------|------------|--------------|------------|--------|-----------|
| VOR Demodulation | | | | | | |
| Test 1 | | | | | | |
| 30 Hz AM Depth | 30 | 29,85 | _____ | 30,15 | % | |
| 30 Hz Frequency | 30 | 29,9985 | _____ | 30,0015 | Hz | |
| 9960 Hz AM Depth | 30 | 29,85 | _____ | 30,15 | % | |
| 9960 Hz Frequency | 9960 | 9959,502 | _____ | 9960,498 | Hz | |
| ID Modulation Depth | 10 | 9,9 | _____ | 10,1 | % | |
| ID Frequency | 1020 | 1019,949 | _____ | 1020,051 | Hz | |
| 30 Hz FM Deviation | 480 | 477,6 | _____ | 482,4 | [1] | |
| VOR Phase 30/30 Hz | 0 | -0,03 | _____ | 0,03 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |
| Test 2 | | | | | | |
| 30 Hz AM Depth | 10 | 9,95 | _____ | 10,05 | % | |
| 30 Hz Frequency | 30 | 29,9985 | _____ | 30,0015 | Hz | |
| 9960 Hz AM Depth | 10 | 9,95 | _____ | 10,05 | % | |
| 9960 Hz Frequency | 9960 | 9959,502 | _____ | 9960,498 | Hz | |
| ID Modulation Depth | 10 | 9,9 | _____ | 10,1 | % | |
| ID Frequency | 300 | 299,985 | _____ | 300,015 | Hz | |
| 30 Hz FM Deviation | 480 | 477,6 | _____ | 482,4 | [1] | |
| VOR Phase 30/30 Hz | 0 | -0,03 | _____ | 0,03 | degree | |
| Harmonic Distortion | 100 | 90 | _____ | 110 | % | |
| Test 3 | | | | | | |
| 30 Hz AM Depth | 40 | 39,8 | _____ | 40,2 | % | |
| 30 Hz Frequency | 30 | 29,9985 | _____ | 30,0015 | Hz | |
| 9960 Hz AM Depth | 40 | 39,8 | _____ | 40,2 | % | |
| 9960 Hz Frequency | 9960 | 9959,502 | _____ | 9960,498 | Hz | |
| ID Modulation Depth | 10 | 9,9 | _____ | 10,1 | % | |
| ID Frequency | 3990 | 3989,8005 | _____ | 3990,1995 | Hz | |
| 30 Hz FM Deviation | 700 | 696,5 | _____ | 703,5 | [1] | |
| VOR Phase 30/30 Hz | 350 | 349,97 | _____ | 350,03 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |

| Characteristic | Target value | Min. value | Actual value | Max. value | Unit | Tolerance |
|---------------------|--------------|-------------|--------------|-------------|--------|-----------|
| Test 4 | Page 1.3 | | | | | |
| 30 Hz AM Depth | 30 | 29,85 | _____ | 30,15 | % | |
| 30 Hz Frequency | 30 | 29,9985 | _____ | 30,0015 | Hz | |
| 9960 Hz AM Depth | 30 | 29,85 | _____ | 30,15 | % | |
| 9960 Hz Frequency | 9960 | 9959,502 | _____ | 9960,498 | Hz | |
| ID Modulation Depth | 10 | 9,9 | _____ | 10,1 | % | |
| ID Frequency | 1020 | 1019,949 | _____ | 1020,051 | Hz | |
| 30 Hz FM Deviation | 480 | 477,6 | _____ | 482,4 | [1] | |
| VOR Phase 30/30 Hz | 45 | 44,97 | _____ | 45,03 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |
| Test 5 | Page 1.3 | | | | | |
| 30 Hz AM Depth | 30 | 29,85 | _____ | 30,15 | % | |
| 30 Hz Frequency | 30 | 29,9985 | _____ | 30,0015 | Hz | |
| 9960 Hz AM Depth | 30 | 29,85 | _____ | 30,15 | % | |
| 9960 Hz Frequency | 9960 | 9959,502 | _____ | 9960,498 | Hz | |
| ID Modulation Depth | 10 | 9,9 | _____ | 10,1 | % | |
| ID Frequency | 1020 | 1019,949 | _____ | 1020,051 | Hz | |
| 30 Hz FM Deviation | 200 | 199 | _____ | 201 | [1] | |
| VOR Phase 30/30 Hz | 271 | 270,97 | _____ | 271,03 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |
| Test 6 | Page 1.3 | | | | | |
| 30 Hz AM Depth | 30 | 29,85 | _____ | 30,15 | % | |
| 30 Hz Frequency | 30,3 | 30,298485 | _____ | 30,301515 | Hz | |
| 9960 Hz AM Depth | 30 | 29,85 | _____ | 30,15 | % | |
| 9960 Hz Frequency | 10059,6 | 10059,09702 | _____ | 10060,10298 | Hz | |
| ID Modulation Depth | 10 | 9,9 | _____ | 10,1 | % | |
| ID Frequency | 1030,2 | 1030,14849 | _____ | 1030,25151 | Hz | |
| 30 Hz FM Deviation | 480 | 477,6 | _____ | 482,4 | [1] | |
| VOR Phase 30/30 Hz | 180,1 | 180,07 | _____ | 180,13 | degree | |
| Harmonic Distortion | | | _____ | 0,1 | % | |

Table 2 Checking FSMR Audio Input (only with FSMR)

| Characteristic | Target value | Min. value | Actual value | Max. value | Unit | Tolerance |
|------------------------------------|--------------|------------|--------------|------------|--------|-----------|
| Test 1: VOR Phase and FM Deviation | Page 82 | | | | | |
| 30 Hz AM Frequency | | 29.9985 | _____ | 30.0015 | Hz | |
| 9960 Hz Frequency | | 9959.5 | _____ | 9960.5 | Hz | |
| 30 Hz FM Deviation | | 477.6 | _____ | 482.4 | Hz | |
| 30 Hz FM Frequency | | 29.9985 | _____ | 30.0015 | Hz | |
| Phase 0 degree | | -0.03 | _____ | +0.03 | degree | |
| Phase 50 degree | | 48.97° | _____ | 50.03° | degree | |
| Phase 180 degree | | 179.97 | _____ | 180.03 | degree | |
| Phase 300 degree | | 299.97 | _____ | 300.03 | degree | |
| ILS Demodulation | Page 83 | | | | | |
| Test 1: LOC/ 0.0 / 0° | | | | | | |
| DDM reading | | -0.0002 | _____ | 0.0002 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2 | degree | |
| Test 2: LOC/ 0.2 / 0° | | | | | | |
| DDM reading | | 0.1978 | _____ | 0.2022 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2 | degree | |
| Test 3: LOC/ -0.2 / 0° | | | | | | |
| DDM reading | | -0.2022 | _____ | -0.1978 | | |
| ILS Phase 90/150 Hz | | -0.05 | _____ | 0.05° | degree | |
| Test 4: GS/ 0.0 / 0° | | | | | | |
| DDM reading | | -0.0004 | _____ | 0.0004 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2 | degree | |
| Test 5: GS/ 0.4 / 0° | | | | | | |
| DDM reading | | 0.3956 | _____ | 0.4044 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2 | degree | |
| Test 6: GS/ -0.4 / 0° | | | | | | |
| DDM reading | | -0.4044 | _____ | -0.3956 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2 | degree | |
| Test 7: GS/ 0.0 / -45° | | | | | | |
| DDM reading | | -0.0004 | _____ | 0.0004 | | |
| ILS Phase 90/150 Hz | | -45.2 | _____ | -44.8 | degree | |
| Test 8: GS/ 0.4 / -45° | | | | | | |
| DDM reading | | 0.3956 | _____ | 0.4044 | | |
| ILS Phase 90/150 Hz | | -45.2 | _____ | -44.8 | degree | |
| Test 9: GS/ 0.0 / 30° | | | | | | |
| DDM reading | | -0.0004 | _____ | 0.0004 | | |
| ILS Phase 90/150 Hz | | 29.8 | _____ | 30.2 | degree | |

Table 3 Checking FSQ-B71 Baseband Input (only with FSQ and FSQ-B71)

| Characteristic | Target value | Min. value | Actual value | Max. value | Unit | Tolerance |
|------------------------------------|--------------|------------|--------------|------------|--------|-----------|
| Test 1: VOR Phase and FM Deviation | Page 82 | | | | | |
| 30 Hz AM Frequency | | 29.9985 | _____ | 30.0015 | Hz | |
| 9960 Hz Frequency | | 9959.5 | _____ | 9960.5 | Hz | |
| 30 Hz FM Deviation | | 477.6 | _____ | 482.4 | Hz | |
| 30 Hz FM Frequency | | 29.9985 | _____ | 30.0015 | Hz | |
| Phase 0 degree | | -0.03 | _____ | +0.03 | degree | |
| Phase 50 degree | | 48.97° | _____ | 50.03° | degree | |
| Phase 180 degree | | 179.97 | _____ | 180.03 | degree | |
| Phase 300 degree | | 299.97 | _____ | 300.03 | degree | |
| ILS Demodulation | Page 83 | | | | | |
| Test 1: LOC/ 0.0 / 0° | | | | | | |
| DDM reading | | -0.0002 | _____ | 0.0002 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2 | degree | |
| Test 2: LOC/ 0.2 / 0° | | | | | | |
| DDM reading | | 0.1928 | _____ | 0.2072 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2 | degree | |
| Test 3: LOC/ -0.2 / 0° | | | | | | |
| DDM reading | | -0.2072 | _____ | -0.1928 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2° | degree | |
| Test 4: GS/ 0.0 / 0° | | | | | | |
| DDM reading | | -0.0004 | _____ | 0.0004 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2 | degree | |
| Test 5: GS/ 0.4 / 0° | | | | | | |
| DDM reading | | 0.3856 | _____ | 0.4144 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2 | degree | |
| Test 6: GS/ -0.4 / 0° | | | | | | |
| DDM reading | | -0.4144 | _____ | -0.3856 | | |
| ILS Phase 90/150 Hz | | -0.2 | _____ | 0.2 | degree | |
| Test 7: GS/ 0.0 / -45° | | | | | | |
| DDM reading | | -0.0004 | _____ | 0.0004 | | |
| ILS Phase 90/150 Hz | | -45.2 | _____ | -44.8 | degree | |
| Test 8: GS/ 0.4 / -45° | | | | | | |
| DDM reading | | 0.3856 | _____ | 0.4144 | | |
| ILS Phase 90/150 Hz | | -45.2 | _____ | -44.8 | degree | |
| Test 9: GS/ 0.0 / 30° | | | | | | |
| DDM reading | | -0.0004 | _____ | 0.0004 | | |
| ILS Phase 90/150 Hz | | 29.8 | _____ | 30.2 | degree | |

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