



ROHDE & SCHWARZ

Test and
Measurement Division

Service Manual Instrument

SPECTRUM ANALYZER

FSEA20/30

1065.6000.20/.25/35

FSEB20/30

1066.3010.20/.25/35

FSEM20/30

1080.1505.20/.21/.25

1079.8500.30/.31/.35

FSEK20/30

1088.1491.20/.21/.25

1088.3494.30/.31/.35

Printed in the Federal
Republic of Germany

Tabbed Divider Overview

Index

Safety Instructions

Certificate of Quality

Spare Parts Express Service

List of R&S Representatives

Contents of Manuals for Signal Analyzer
Service and Repair

Tabbed Divider

1	Chapter 1:	Performance Test
2	Chapter 2:	Adjustment
3	Chapter 3:	Functional Description/Selftest
4	Chapter 4:	Firmware Update/Options
5	Chapter 5:	Documents

Index

1

1 st IF Image Frequency Rejection	1.7
1 st IF Rejection	1.8

2

2 nd IF Image Frequency Rejection	1.8
--	-----

3

3-dB Bandwidths	1.13
-----------------------	------

A

Adjustment	2.1
Attenuator	1.19
Option FSE-B22	1.46

C

Cable list	5.3
Calibration Source at 120 MHz	1.3
Option FSE-B22	1.41
Checking the Rated Specifications	1.1
Circuit diagram	5.5

D

Display Linearity	1.18
Option FSE-B22	1.45
Documents	5.1

F

Firmware update	4.1
Frequency Accuracy of the Reference Oscillator	1.4
Frequency Response	1.16
Option FSE-B22	1.43
Tracking Generator	1.24

I

I/Q Modulator	
Tracking Generator	1.25
IF Filters	1.12
Option FSE-B22	1.42
IF Gain Switching	1.20
Immunity to Interference	1.7

L

Level Error	1.12
Option FSE-B22	1.42
LO Feedthrough	1.15

M

Measuring Equipment	1.1
---------------------------	-----

N

Noise Display	1.15
Non-linearities	1.9

O

Option	
1-dB Attenuator - FSE-B13	4.2
2 nd IEC/IEEE Bus Interface - FSE-B17	4.2
Ethernet Interface - FSE-B16	4.2
External Mixer Output - FSE-B21	4.2
Installation	4.2
List	4.2
Tracking Generator - FSE-B10/B11	4.2
Ordering of spare parts	5.1
Output Level	
Tracking Generator	1.24

P

Performance Test Report	1.26
Option FSE-B22	1.47
Phase Noise	1.22
Power cables	5.3

R

Rated Specifications	1.1
Replacement parts	
ordering	5.2
Return Loss at the RF Input	1.5

S

Second-Order Harmonic Distortion	1.10
Self test	3.6
Shape Factor	1.14
Shipping	
instrument	5.1
module	5.1
Softkey	
FIRMWARE UPDATE	4.1
RESTORE FIRMWARE	4.1
Software	
installation	4.1
update	4.1
Spare parts	
ordering	5.1

T

Test Instructions	1.3
Option FSE-B22	1.41
Third-Order Intercept	1.9
Tracking Generator	1.24



Before putting the product into operation for the first time, make sure to read the following



Safety Instructions

Rohde & Schwarz makes every effort to keep the safety standard of its products up to date and to offer its 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. This product 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, Rohde & Schwarz 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 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 operating manual and within its performance limits (see data sheet, documentation, the following safety instructions). Using the products requires technical skills and knowledge of English. It is therefore essential that the products be used exclusively by skilled and specialized staff or thoroughly trained personnel with the required skills. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation.

Symbols and safety labels

Observe operating instructions	Weight indication for units >18 kg	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Attention! Electrostatic sensitive devices

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

Safety Instructions

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 other parts of the documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by Rohde & Schwarz, including instruments, systems and all accessories.

Tags and their meaning

DANGER	This tag indicates a safety hazard with a high potential of risk for the user that can result in death or serious injuries.
WARNING	This tag indicates a safety hazard with a medium potential of risk for the user that can result in death or serious injuries.
CAUTION	This tag indicates a safety hazard with a low potential of risk for the user that can result in slight or minor injuries.
ATTENTION	This tag indicates the possibility of incorrect use that can cause damage to the product.
NOTE	This tag indicates a situation where the user should pay special attention to operating the product but which does not lead to damage.

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. It is therefore essential to make sure that the tags described here are always used only in connection with the associated documentation and the associated product. The use of tags in connection with unassociated products or unassociated documentation can result in misinterpretations 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 max. 2000 m. Unless specified otherwise in the data sheet, 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.

Safety Instructions

4. If products/components are mechanically and/or thermically 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 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 (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. 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.
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 $V_{rms} > 30 \text{ V}$, 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. Never remove the cover or part of the housing while you are operating the product. This will expose circuits and components and can lead to injuries, fire or damage to the product.

Safety Instructions

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 skilled electrician.
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 water, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock 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. 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 are hazardous waste. Dispose of them only in specially marked containers. Observe local regulations regarding waste disposal. Do not short-circuit batteries or storage batteries.
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. Please be aware of the weight of the product. Be careful when moving it; otherwise you may injure your back or other parts of your body.
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 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.



Por favor lea imprescindiblemente antes de la primera puesta en funcionamiento las siguientes informaciones de seguridad



Informaciones de seguridad

Es el principio de Rohde & Schwarz de tener a sus productos siempre al día con los standards de seguridad y de ofrecer a sus 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. Este 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 standards técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, deberá el usuario atenerse a todas las informaciones, informaciones de seguridad y notas de alerta. 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 solamente fue elaborado para ser utilizado en la industria y el laboratorio o para fines de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda ser dañada. 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 maluso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones del correspondiente manual del uso y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso de los productos hace necesarios conocimientos profundos y el conocimiento del idioma inglés. Por eso se deberá tener en cuenta de exclusivamente autorizar para el uso de los productos a personas péritas o debidamente minuciosamente instruidas con los conocimientos citados. 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.

Símbolos y definiciones de seguridad

Ver manual de instrucciones del uso	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

Informaciones de seguridad

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 otro capítulo de esta documentación y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por 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	Indica un punto de peligro con gran potencial de riesgo para el usuario. Punto de peligro que puede llevar hasta la muerte o graves heridas.
ADVERTENCIA	Indica un punto de peligro con un potencial de riesgo mediano para el usuario. Punto de peligro que puede llevar hasta la muerte o graves heridas .
ATENCIÓN	Indica un punto de peligro con un potencial de riesgo pequeño para el usuario. Punto de peligro que puede llevar hasta heridas leves o pequeñas
CUIDADO	Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo.
INFORMACIÓN	Indica una situación en la que deberían seguirse las instrucciones en el uso del producto, pero que no consecuentemente deben de llevar a un daño del mismo.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el ámbito de la comunidad económica europea. Pueden existir definiciones diferentes a esta definición. Por eso se debiera tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación 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 principalmente 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.
A menos que se especifique otra cosa en la hoja de datos, 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 périto 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. Despues 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 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 radiación HF, 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 está comprometido a valorar y señalar áreas de trabajo en las que se corra un riesgo de exposición a radiaciones aumentadas de riesgo aumentado 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 prodcuto.
 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 ya que 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 (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 construcciones o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

12. No utilice nunca el producto si está dañado el cable eléctrico. 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.
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 $U_{eff} > 30 \text{ V}$ 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 de la EC950/EN60950.
18. Nunca abra la tapa o parte de ella si el producto está en funcionamiento. 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, deberá la toma de corriente estar protegida de manera que los productos o los usuarios 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 corto circuitos 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 el agua 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 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. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención celulas de Litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Baterías y acumuladores son deshechos problemáticos. Por favor tirenlos en los recipientes especiales para este fin. Por favor tengan en cuenta las prescripciones nacionales de cada país referente al tratamiento de deshechos. Nunca sometan las baterías o acumuladores a un corto circuito.
28. Tengan en consideración de que en caso de un incendio pueden escaparse gases tóxicos del producto, que pueden causar daños a la salud.
29. 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.
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).
31. Las asas instaladas en los productos sirven solamente de ayuda para el manejo que solamente está previsto para personas. Por eso no está permitido utilizar las asas para la sujecion en o sobre medios de transporte como por ejemplo grúas, carretillas elevadoras de horquilla, carros etc. El usuario es responsable de que los productos sean sujetados de forma segura a los medios de transporte y de que las prescripciones de seguridad del fabricante de los medios de transporte sean tenidas en cuenta. En caso de que no se tengan en cuenta pueden causarse daños en personas y objetos.
32. Si llega a utilizar el producto dentro de un vehículo, queda en la responsabilidad absoluta del conductor que conducir el vehículo de manera segura. Asegure el producto dentro del vehículo debidamente para evitar en caso de un accidente las lesiones u otra clase de daños. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Siempre queda en la responsabilidad absoluta del conductor la seguridad del vehículo y el fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.
33. Dado el caso de que esté integrado un producto de laser en un producto R&S (por ejemplo CD/DVD-ROM) no utilice otras instalaciones o funciones que las descritas en la documentación. De otra manera pondrá en peligro su salud, ya que el rayo laser puede dañar irreversiblemente sus ojos. Nunca trate de descomponer estos productos. Nunca mire dentro del rayo laser.

Safety Instructions

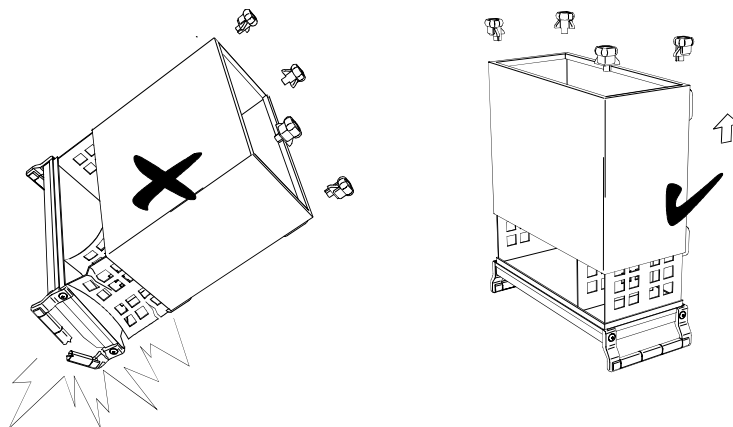
WARNING



Danger of injuries

When removing the rear feet, the unit can slip out of the cabinet.

Put the unit onto the front handles, before removing the rear feet and taking off the cabinet. Thus the risk of personal injuries and damages to the unit is avoided.

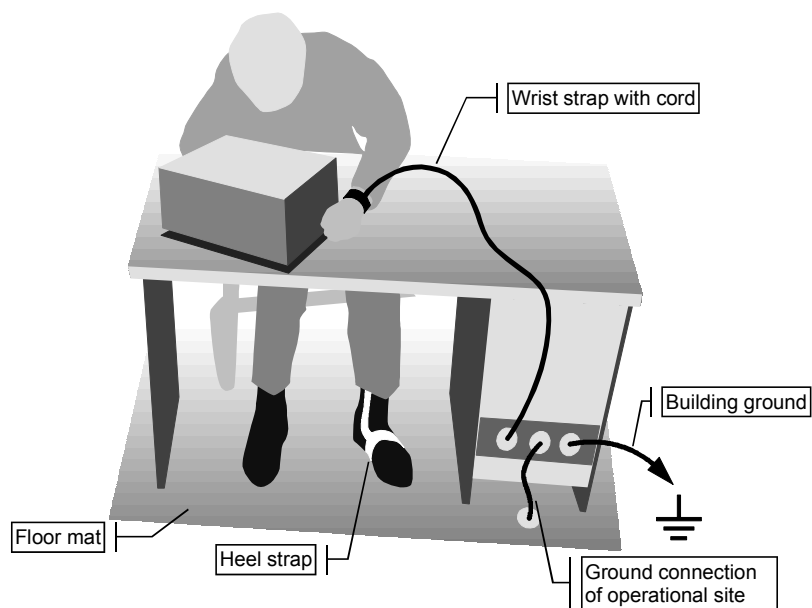


When mounting the cabinet take care not to pen in the fingers. Also pay attention not to damage or pull off cables. Screw the rear feet back on immediately after mounting the cabinet. Do not move the unit with the rear feet missing.

ATTENTION



To avoid damage of electronic components, the operational site must be protected against electrostatic discharge (ESD).



The following two methods of ESD protection may be used together or separately:

- *Wrist strap with cord to ground connection*
- *Conductive floor mat and heel strap combination*

Spare Parts Express Service

Phone: +49 89 4129 - 12465

Fax: +49 89 4129 - 13306

E-mail: werner.breidling@rsd.rohde-schwarz.com

In case of urgent spare parts requirements for this Rohde & Schwarz unit, please contact our spare parts express service.

Outside business hours, please leave us a message or send a fax or e-mail. We shall contact you promptly.

Contents of Manuals for Signal Analyzer FSE

Service Manual - Instrument

The service manual - instrument informs on how to check compliance with rated specifications (performance test), on instrument function, and on selftest of FSE.

The service manual comprises the following chapters:

- | | |
|------------------|---|
| Chapter 1 | provides all the information necessary to check FSE for compliance with rated specifications. The required test equipment is included, too. |
| Chapter 2 | describes the adjustment. |
| Chapter 3 | describes the function of the instruments and the selftest. |
| Chapter 4 | contains information on the extension and modification of FSE by installing instrument software and retrofitting options. |
| Chapter 5 | describes the shipping of the instrument and ordering of spare parts. It contains the documents for the basic instrument. |

Service Manual

The service manual modules is not delivered with the instrument but may be obtained from your R&S service department.

The service manual informs on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the FSE by the replacement of modules.

The service manual contains information about the individual modules of FSE. This comprises the test and adjustment of the modules, fault detection within the modules and the interface description.

Operating Manual

In the operating manual for FSE you will find information about the technical specifications of FSE, the controls and connectors on the front and rear panel, necessary steps for putting the instrument into operation, the basic operating concept, manual and remote control.

For introduction typical measurement tasks are explained in detail using the functions of the user interface and program examples.

The operating manual further provides hints on preventive maintenance and fault diagnosis by means of warnings and error messages output by the unit.

Service and Repair

Please contact your Rohde & Schwarz support center or our spare parts express service if you need service or repair of your equipment or to order spare parts and modules.

The list of the Rohde & Schwarz representatives and the address of our spare parts express service are provided at the beginning of this service manual.

We require the following information in order to answer your inquiry fast and correctly and to decide whether the warranty still applies for your instrument:

- Instrument model
- Serial number
- Firmware version
- Detailed error description in case of repair
- Contact partner for checkbacks

Rohde & Schwarz offers the following calibrations:

- Calibration on R&S-type test systems. The calibration documentation meets the requirements of the quality management system ISO 9000.
- Calibration at an R&S calibration center approved by the German Calibration Service (DKD). The calibration documentation consists of the DKD calibration certificate.

Refer to Chapter 5 for a detailed description on shipping of the instrument and ordering of spare parts.

Contents - Chapter 1 "Checking the Rated Specifications"

1 Checking the Rated Specifications.....	1.1
Measuring Equipment and Accessories.....	1.1
Test Instructions	1.3
Checking the Calibration Source at 120 MHz.....	1.3
Checking the Frequency Accuracy of the Reference Oscillator	1.4
Checking the Return Loss at the RF Input	1.5
Checking Immunity to Interference	1.7
Checking Non-linearities.....	1.9
Checking IF Filters.....	1.12
Checking LO Feedthrough, Noise Display.....	1.15
Checking the Frequency Response	1.16
Checking the Display Linearity.....	1.18
Checking the Attenuator	1.19
Checking the IF Gain Switching.....	1.20
Checking the Phase Noise	1.22
Checking the Tracking Generator – Option FS-B8/B9/B10/B11	1.24
Performance Test Report	1.26
Test Instructions (option FSE-B22 included).....	1.41
Checking the Calibration Source at 120 MHz.....	1.41
Checking IF Filters.....	1.42
Checking the Frequency Response	1.43
Checking the Display Linearity.....	1.45
Checking the Attenuator	1.46
Performance Test Report (option FSE-B22 included).....	1.47

1 Checking the Rated Specifications

Measuring Equipment and Accessories

Table 1-1 Measuring Equipment and Accessories

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Page
1	Frequency counter	error $< 1 \times 10^{-9}$, frequency range up to 10 MHz	Advantest R5361B with option 23		1.4
2	Signal generator	FSEA: 10 MHz to 3.5 GHz FSEB: 10 MHz to 7 GHz FSEM: 10 MHz to 26.5 GHz FSEK: 10 MHz to 40 GHz	SMHU SMP02 SMP03 SMP04	0835.8011.52 1035.5005.02 1035.5005.03 1035.5005.04	1.5 1.7 1.9
3	Signal generator	phase noise at 498 MHz: < -100 dBc/Hz @ 100 Hz < -115 dBc/Hz @ 1 kHz < -127 dBc/Hz @ 10 kHz < -130 dBc/Hz @ 100 kHz < -142 dBc/Hz @ 1MHz	SMHU	0835.8011.52	1.4 1.9 1.10 1.12 1.16
4	Signal generator (FSEB / FSEM / FSEK)	FSEB: 10 MHz to 7 GHz FSEM: 10 MHz to 26.5 GHz FSEK: 10 MHz to 40 GHz	SMP02 SMP03 SMP04	1035.5005.02 1035.5005.03 1035.5005.04	1.9 1.16
5	3-dB coupler (power combiner)	decoupling > 12 dB FSEA: 10 MHz to 3.5 GHz FSEB: 10 MHz to 7 GHz FSEM: 10 MHz to 26.5 GHz FSEK: 10 MHz to 40 GHz			1.9
6	6-dB divider (power splitter)	level imbalance 1MHz to 1GHz ≤ 0.15 dB 1GHz to 7GHz ≤ 0.2 dB 7GHz to 18GHz ≤ 0.3 dB 18GHz to 26.5GHz ≤ 0.4 dB 26.5GHz to 40GHz ≤ 0.4 dB FSEA: 10 MHz to 3.5 GHz FSEB: 10 MHz to 7 GHz FSEM: 10 MHz to 26.5 GHz FSEK: 10 MHz to 40 GHz			1.16
7	50- Ω termination	Return loss > 20 dB FSEA: up to 3.5 GHz FSEB: up to 7 GHz FSEM: up to 26.5 GHz FSEK: up to 40 GHz	RNA RNA Wiltron 28S50 Wiltron 28K50	0272.4510.50 0272.4510.50	1.15
8	Power meter		NRVD	0857.8008.02	1.3 1.5 1.16

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Page
9	Power sensor	1 MHz to 3.5 GHz RSS $\leq$ 0.8% Meter noise $\leq$ 20 pW	NRV-Z4	0828.3618.02	1.3 1.5 1.16
10	Power sensor (FSEB / FSEM / FSEK)	RSS referred to indicated Power: 1 MHz to 1 GHz $\leq$ 1.5 % 1 GHz to 7 GHz $\leq$ 2 % 7 GHz to 26.5 GHz $\leq$ 3.5 % 26.5 GHz to 40 GHz $\leq$ 4 % FSEB: 10 MHz to 7 GHz FSEM: 50 MHz to 26.5 GHz FSEK: 1 MHz to 40 GHz	NRV-Z2 NRV-Z6 NRV-Z55	0828.3218.02 0828.5010.02 1081.2005.02	1.5 1.16
11	Reflection coefficient VSWR bridge (FSEA / FSEB)	directivity > 30 dB FSEA / FSEB: 10 MHz to 3.5 GHz FSEB: 3.5 GHz to 7 GHz	ZRC Wiltron 87A50 (also required: adapter 34AN50, open/short 22NF50)	1039.9492.55	1.5
12	Network analyzer (FSEM / FSEK)	FSEM: 10 MHz to 26,5 GHz FSEK: 10 MHz to 40 GHz			1.5
13	Step attenuator	variable attenuation 0 dB to 100 dB, 1-dB steps attenuation error < 0.05 dB (f = 5 MHz)	RSP	0831.3515.02	1.18 1.19 1.20
14	Attenuator (2 x)	fixed attenuation 10 dB FSEA: 10 MHz to 3.5 GHz FSEB: 10 MHz to 7 GHz FSEM: 10 MHz to 26.5 GHz FSEK: 10 MHz to 40 GHz	DNF DNF Wiltron 43KB-10 Wiltron 43KC-10	0272.4210.50 0272.4210.50	1.9
15	Lowpass ¹⁾	cut-off frequency: 10 kHz, 40 kHz, 100 kHz, 20 MHz, 29 MHz, 108 MHz, 263 MHz, 454 MHz, 641 MHz, 1.1 GHz, 1.3 GHz, 1.8 GHz			1.10
16	N-connecting cables Tracking RF input	Attenuation up to 7 GHz < 0.1dB			1.24
17	2 DC sources for I and Q	can be set between $\pm 0.5V$	NGT35	0191.2019.02	1.24
18	2 DC voltmeters		URE	0350.5315.02	1.25

1) The lowpass filters improve the harmonics suppression of the test signal. If the harmonics suppression at the signal generator output is already large enough, no filters are required for the frequency ranges concerned (see section "Second-Order Harmonic Distortion" for harmonics suppression required)

Test Instructions

The rated specifications of the analyzer are tested after a warm-up time of at least 30 minutes and overall calibration. Only in this case can the compliance with the guaranteed data be ensured.

Values given in the following sections are not guaranteed. Only the technical specifications of the data sheet are binding.

Conventions for setting the FSE during measurements:

- [<KEY>] Press a key on the front panel, eg [SPAN]
 - [<SOFTKEY>] Press a softkey, eg [MARKER -> PEAK]
 - [<nn unit>] Enter a value and terminate by entering the unit, eg [12 kHz]
- Successive entries are separated by [:], eg [SPAN: 15 kHz]

Checking the Calibration Source at 120 MHz

Note: If option FSE-B22 is installed see chapter "Test Instructions (option FSE-B22 included)" for test instructions.

Test equipment:

- signal generator (table 1-1, item 3):
 - frequency 120 MHz
 - level -40 dBm
- power meter (table 1-1, item 8)
- power sensor (table 1-1, item 9)
 - frequency 120 MHz
 - maximum power $P_{\max} \geq 1 \mu\text{W}$
 - meter noise $\leq 20 \text{ pW}$
 - RSS $\leq 0.8\%$ referred to indicated power
 - impedance $Z = 50 \Omega$

Power meter settings:

- connect power sensor to power meter and carry out function 'ZERO' when no signal is applied to the power sensor.
- connect power sensor to RF output of signal generator.

Signal generator settings:

- frequency 120 MHz
 - level -40 dBm $\pm 0.1 \text{ dB}$
- Use power meter for exact level adjustment.

Test setup:

- connect RF output of the signal generator to RF input of the FSE

FSE settings:

- [**SYSTEM PRESET**]
- [**FREQUENCY CENTER : 120 MHz**]
- [**FREQUENCY SPAN : 15 kHz**]
- [**SWEEP COUPLING : RES BW MANUAL : 5 kHz**]
- [**LEVEL REF : REF LEVEL : -10 dBm**]
- [**INPUT : RF ATTEN MANUAL : 20 dB**]
- set marker to peak of signal
[**MARKER SEARCH : PEAK**]
- set reference to peak of signal
[**MARKER DELTA : REFERENCE FIXED**]
- switch internal reference generator to RF input
[**CONFIGURATION SETUP : SERVICE : INPUT CAL**]

Evaluation: ➤ set marker to peak of signal
[**MARKER SEARCH** : PEAK]
The reading 'Delta 1 [T1 FXD]' displays the difference between the output level of the signal generator and the level of the calibration source < 0.3 dB

Note: *The level of the calibration source can be adjusted with R22 on FracSyn module.*

Checking the Frequency Accuracy of the Reference Oscillator

Test equipment: frequency counter (table 1-1, item 1):
error < 1×10^{-9}
frequency range up to 10 MHz

Test setup: - connect frequency counter to 10-MHz reference output of the FSE (rear panel)

FSE settings: - [**CONFIGURATION SETUP** : REFERENCE INT / EXT]
toggle to internal reference (INT)

Measurement: measure frequency with frequency counter
nominal frequency:
Model 20 without OCXO (option B4)10 MHz ± 10 Hz
Model 30 or 20 with OCXO (option B4)10 MHz ± 1 Hz

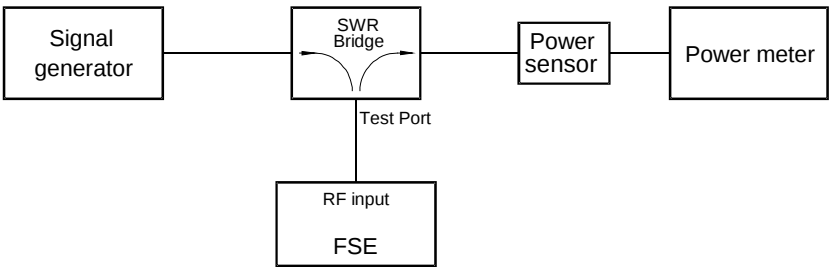
Checking the Return Loss at the RF Input

Test equipment:

- FSEA / FSEB:
- signal generator (table 1-1, item 2)
 - frequency range FSEA: 10 MHz to 3.5 GHz
 - FSEB: 10 MHz to 7 GHz
 - maximum level ≥ 0 dBm
 - power meter (table 1-1, item 8)
 - power sensor (table 1-1; FSEA: item 9; FSEB: item 10)
 - frequency range FSEA: 10 MHz to 3.5 GHz
 - FSEB: 10 MHz to 7 GHz
 - reflection coefficient bridge (table 1-1, item 11)
 - frequency range FSEA: 10 MHz to 3.5 GHz
 - FSEB: 10 MHz to 7 GHz
 - directivity ≥ 30 dB
- FSEM / FSEK:
- network analyzer (table 1-1, item 12)
 - frequency range FSEM: 10 MHz to 26.5 GHz
 - FSEK: 10 MHz to 40 GHz

Test setup:

FSEA / FSEB:



FSEM / FSEK:

Connect port 1 of network analyzer to RF input of the FSE.

Signal generator settings:
(FSEA / FSEB)

- level 0 dBm
 - frequency { f_{in} }
- See table 1-2 (item 3) of performance test report for values of f_{in} .

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT : RF ATTEN MANUAL : 10 dB**]

Calibration:

FSEA / FSEB:

Use total reflection (OPEN or SHORT) at the test port of the SWR bridge as a reference:

Remove cable from RF input of the FSE and connect precision short or open to the cable. Determine reflected power with the power meter and store measured level L_{Ref} as reference. Repeat this procedure for every measurement over the whole frequency range.

FSEM / FSEK:

See operating manual of the network analyzer for detailed information about calibration for S_{11} measurement.

Measurement

FSEA / FSEB:

Connect the RF input of the FSE to the test port of the SWR bridge. Measure reflected power L_r with the power meter. The return loss a_r of the RF input of the FSE can be calculated as

$$a_r = L_{Ref} - L_r .$$

The SWR can be calculated as

$$S = \frac{10^{0.05a_r} + 1}{10^{0.05a_r} - 1} .$$

FSEM / FSEK:

Determine S_{11} of the FSE at the frequencies shown in table 1-2 (item 3) of performance test report. See operating manual of the network analyzer for detailed information about S_{11} measurement.

a_r / dB	s
6	3.0
7.4	2.5
8	2.3
9.5	2.0
10	1.9
12	1.7
14	1.5
16	1.4
18	1.3
20	1.2

Checking Immunity to Interference

- Test equipment: signal generator (table 1-1, item 2):
- | | | |
|-----------------|----------------|-------------------|
| frequency range | FSEA: | 10 MHz to 3.5 GHz |
| | FSEB: | 10 MHz to 7 GHz |
| | FSEM / FSEK: | 10 MHz to 8 GHz |
| maximum level | ≥ -10 dBm | |
- Test setup: connect RF output of the signal generator to RF input of the FSE.
- Signal generator settings: level -10 dBm ± 0.5 dB
- FSE settings:
- [**SYSTEM PRESET**]
 - [**INPUT : RF ATTEN MANUAL : 0 dB**]
 - [**LEVEL REF : REF LEVEL : -30 dBm**]
 - [**FREQUENCY SPAN : 100 kHz**]
 - [**SWEEP COUPLING : RES BW MANUAL : 2 kHz**]

1st IF Image Frequency Rejection

- Additional signal generator settings:
- | | |
|-------------|--|
| - frequency | $f_{in} + 2 \times 1\text{st IF}$ |
| FSEA | $f_{in} + 8682.8$ MHz |
| FSEB | $f_{in} + 15.8828$ GHz |
| FSEM / FSEK | $f_{in} + 15.8828$ GHz ($f_{in} < 7$ GHz) |

See table 1-2 (item 4) of performance test report for values of f_{in}

- Additional FSE settings:
- [**FREQUENCY CENTER : { f_{in} }**]
- See table 1-2 (item 4) of performance test report for values of f_{in}
- set marker to peak of signal
 - [**MARKER SEARCH : PEAK**]

Evaluation: The image frequency rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):

$$\text{Image frequency rejection} = -10\text{dBm} - L_{dis}$$

Unit	1st IF image frequency rejection
FSEA20	> 75 dB
FSEA30	> 80 dB
FSEB / FSEM / FSEK	> 80 dB

2nd IF Image Frequency Rejection

Additional signal generator - frequency $f_{in} + 2 \times 2\text{nd IF}$
 settings: $f_{in} + 1482.8 \text{ MHz}$

See table 1-2 (item 5) of performance test report for values of f_{in} .

Additional FSE settings: - [**FREQUENCY CENTER** : { f_{in} }]

See table 1-2 (item 5) of performance test report for values of f_{in} .

- set marker to peak of signal
 [**MARKER SEARCH** : PEAK]

Evaluation: The image frequency rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):

$$\text{Image frequency rejection} = -10\text{dBm} - L_{dis}$$

Unit	2nd IF image frequency rejection
FSEA20	> 75 dB
FSEA30	> 80 dB
FSEB / FSEM / FSEK	> 80 dB

1st IF Rejection

Additional signal generator - frequency = 1st IF
 settings: FSEA 4341.4 MHz
 FSEB 7941.4 GHz
 FSEM / FSEK 7941.4 GHz ($f_{in} < 7 \text{ GHz}$)
 741.4 MHz ($f_{in} \geq 7 \text{ GHz}$)

Additional FSE settings: - [**FREQUENCY CENTER** : { f_{in} }]

See table 1-2 (item 6) of performance test report for values of f_{in} .

- set marker to peak of signal
 [**MARKER SEARCH** : PEAK]

Evaluation: The IF rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):

$$\text{IF rejection} = -10\text{dBm} - L_{dis}$$

Unit	1st IF rejection
FSEA20	> 80 dB
FSEA30	> 100 dB
FSEB / FSEM	> 75 dB
FSEK	> 80 dB

Checking Non-linearities

Third-Order Intercept

- Test equipment:
- 2 signal generators (FSEA: table 1-1, item 2 and 3;
FSEB / M / K: table 1-1, item 2 and 4)
frequency range
FSEA: 10 MHz to 3.5 GHz
FSEB: 10 MHz to 7 GHz
FSEM: 10 MHz to 26.5 GHz
FSEK: 10 MHz to 40 GHz
maximum level ≥ 0 dBm
 - 2 attenuators (table 1-1, item 14)
attenuation $a_{ATT} = 10$ dB
frequency range
FSEA: 10 MHz to 3.5 GHz
FSEB: 10 MHz to 7 GHz
FSEM: 10 MHz to 26.5 GHz
FSEK: 10 MHz to 40 GHz
 - 3-dB coupler (table 1-1, item 5)
frequency range
FSEA: 10 MHz to 3.5 GHz
FSEB: 10 MHz to 7 GHz
FSEM: 10 MHz to 26.5 GHz
FSEK: 10 MHz to 40 GHz
decoupling > 12 dB
- Test setup:
- connect RF outputs of the signal generators via 10-dB attenuators to the inputs of the 3-dB coupler
 - connect output of the 3-dB coupler to RF input of the FSE.
- Signal generator settings:
(both generators)
- frequency: generator 1 $f_{g1} = f_{in}$
generator 2 $f_{g2} = f_{in} + 100$ kHz
See table 1-2 (item 7) of performance test report for values of f_{in}
 - level: 0 dBm
- FSE settings:
- [**SYSTEM PRESET**]
 - [**INPUT : RF ATTEN MANUAL : 0 dB**]
 - [**LEVEL REF : -10 dBm**]
 - [**FREQUENCY SPAN : 50 kHz**]
 - [**SWEEP COUPLING : RES BW MANUAL : 2 kHz**]
 - [**FREQUENCY CENTER : $\{f_{in}\}$**]
See table 1-2 (item 7) of performance test report for values of f_{in}
 - [**MARKER SEARCH : PEAK**]
Adjust the output level of signal generator 1 until the level reading of marker 1 is -10 dBm ± 0.1 dB.

- [**FREQUENCY CENTER** : { $f_{in} + 100 \text{ kHz}$ }]

See table 1-2 (item 7) of performance test report for values of f_{in}

- [**MARKER SEARCH** : PEAK]

Adjust the output level of signal generator 2 until the level reading of marker 1 is $-10 \text{ dBm} \pm 0.1 \text{ dB}$.

- set reference to peak of signal
[**MARKER DELTA** : REFERENCE FIXED]
- set center frequency to intermodulation product ($2 \times f_{g2} - f_{g1}$)
[**FREQUENCY CENTER** : { $f_{in} - 100 \text{ kHz}$ }]

- [**MARKER SEARCH** : PEAK]

The intermodulation ratio IMR_1 is displayed by the reading
‘Delta 1 [T1 FXD]’

- set center frequency to intermodulation product ($2 \times f_{g1} - f_{g2}$)
[**FREQUENCY CENTER** : { $f_{in} + 200 \text{ kHz}$ }]

- [**MARKER SEARCH** : PEAK]

The intermodulation ratio IMR_2 is displayed by the reading
‘Delta 1 [T1 FXD]’

Evaluation:

The third order intercept point (T.O.I) referred to the input signal can be calculated as

$$T.O.I. = \frac{IMR}{2} - 10\text{dBm} ,$$

where IMR is the lower of IMR_1 and IMR_2

Unit	Frequency range	T.O.I.
FSEA	$f \leq 50 \text{ MHz}$	$\geq 7 \text{ dBm}$
	$f > 50 \text{ MHz}$	$\geq 12 \text{ dBm}$
FSEB / FSEM / FSEK	$f \leq 150 \text{ MHz}$	$\geq 7 \text{ dBm}$
	$f > 150 \text{ MHz}$	$\geq 12 \text{ dBm}$
FSEK	$f > 7 \text{ GHz}$	$\geq 10 \text{ dBm}$

Second-Order Harmonic Distortion

Test equipment:

- signal generator (table 1-1, item 3)
frequency range
FSEA: 9 kHz to 1.7 GHz
FSEB / FSEM / FSEK: 9 kHz to 3.4 GHz

- to improve the harmonic suppression of the generator it is recommended to insert a lowpass filter with a suitable cut-off frequency (table 1-1, item 15) after the generator.

The required suppression of the second harmonics is listed in the table at the end of this section. As a result, the error for the entire frequency range is $< 1\text{dB}$.

- Test setup:
- connect RF output of the signal generator to the input of the lowpass
 - connect the output of the lowpass to the RF input of the FSE
- Note:** *If the harmonic suppression of the signal generator is sufficient, the lowpass can be left out.
The RF output of the generator can be connected directly to the RF input of the FSE in this case.*
- Signal generator settings:
- frequency: f_{in}
see table 1-2 (item 8) of performance test report for values of f_{in}
 - level: -10 dBm
- FSE settings:
- [**SYSTEM PRESET**]
 - [**INPUT : RF ATTEN MANUAL : 0 dB**]
 - [**LEVEL REF : -10 dBm**]
 - [**FREQUENCY SPAN : 3 kHz**]
 - [**SWEEP COUPLING : RES BW MANUAL : 1 kHz**]
 - [**FREQUENCY CENTER : $\{f_{in}\}$**]
- See table 1-2 (item 8) of performance test report for values of f_{in}
- set marker to peak of signal
[**MARKER SEARCH : PEAK**]
 - set reference to peak of signal
[**MARKER DELTA : REFERENCE FIXED**]
 - set center frequency of the FSE to the frequency of the 2nd harmonic
[**FREQUENCY CENTER : $\{2 \times f_{in}\}$**]
- See table 1-2 (item 8) of performance test report for values of f_{in}
- set marker to peak of the 2nd harmonic
[**MARKER SEARCH : PEAK**]
- Evaluation:
- The reading 'Delta 1 [T1 FXD]' displays the second harmonic suppression (a_{k2}). The exact input level L_{in} is displayed by the reading 'FXD {level} dBm'.
- The second order harmonic distortion can be calculated as
- $$IP_{k2} / \text{dBm} = a_{k2} + L_{in}$$

Unit	Frequency range	IP_{k2}	Required suppression of the second harmonics
FSEA	$f \leq 50 \text{ MHz}$	> 25 dBm	45 dBc
	$f > 50 \text{ MHz}$	> 45 dBm	65 dBc
FSEB / FSEM / FSEK	$f \leq 150 \text{ MHz}$	> 25 dBm	45 dBc
	$f > 150 \text{ MHz}$	> 40 dBm	60 dBc

Checking IF Filters

Test equipment: signal generator (table 1-1, item 3):
 frequency 120 MHz
 level ≥ -10 dBm

Test setup: connect RF output of the signal generator to the RF input of the FSE.

Checking the Level Error

Note: If option FSE-B22 is installed see chapter "Test Instructions (option FSE-B22 included)" for test instructions.

Reference Measurement (RBW 5 kHz)

Signal generator settings: - frequency: 120 MHz
 - level: -20 dBm

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT : RF ATTEN MANUAL : 10 dB**]
- [**LEVEL REF : 0 dBm**]
- [**FREQUENCY CENTER : 120 MHz**]
- [**SWEEP COUPLING : COUPLING RATIO : RBW/VBW SINE [1]**]
- [**SWEEP COUPLING : COUPLING RATIO : SPAN/RBW MANUAL : 5 : ENTER**]
- resolution bandwidth 5 kHz
 [**FREQUENCY SPAN : 25 kHz**]
- set marker to peak of signal
 [**MARKER SEARCH : PEAK**]
- set reference to peak of signal
 [**MARKER DELTA : REFERENCE FIXED**]

Checking the Level Error

FSE settings:

- [**FREQUENCY SPAN : {5 x RBW}**]

See table 1-2 (item 9) of performance test report for values of RBW.

- [**SWEEP COUPLING : RES BW MANUAL : {RBW}**]¹

¹ **Note:** To check the level error of the 5-MHz and the 10-MHz filter, the resolution bandwidth has to be set manually to 5 MHz or 10 MHz. All other bandwidths will be set automatically by changing the frequency span.

- set marker to peak of signal
 [**MARKER SEARCH : PEAK**]

The level error is displayed by the reading
 'Delta 1 [T1 FXD] {level error} dB'.

Evaluation: See table 1-2 (item 9) of performance test report for upper and lower limits of level error.

Checking 3-dB Bandwidths

Signal generator settings:

- frequency: 120 MHz
- level: -20 dBm

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **0 dBm**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**SWEEP COUPLING** : COUPLING RATIO : RBW/VBW SINE [1]]
- [**SWEEP COUPLING** : COUPLING RATIO : SPAN/RBW MANUAL : **5** : **ENTER**]

- determine 3-dB bandwidth
[**MARKER SEARCH** : **MENU** ⇒ : N DB DOWN : **3 dB**]
- [**FREQUENCY SPAN** : {5 × RBW}]
See table 1-2 (item 10) of performance test report for values of RBW.
- [**SWEEP COUPLING** : RES BW MANUAL : {RBW}]¹

¹ **Note:** To check the bandwidth of the 5-MHz and the 10-MHz filter, the resolution bandwidth has to be set manually to 5 MHz or 10 MHz. All other bandwidths will be set automatically by changing the frequency span.

- [**MARKER SEARCH** : **PEAK**]

The 3-dB bandwidth is displayed by the reading
'BW {bandwidth}'.

Evaluation: See table 1-2 (item 10) of performance test report for upper and lower limits of 3dB-bandwidths.

Note: Due to the phase noise, measurements on models 20 can only be carried with IF filters of a bandwidth ≥ 5 kHz.

Checking the Shape Factor

Signal generator settings:

- frequency: 120 MHz
- level: -10 dBm

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **0 dBm**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**SWEEP COUPLING** : VBW MANUAL : **100 Hz**]
- [**SWEEP COUPLING** : COUPLING RATIO : SPAN/RBW MANUAL : **30** : **ENTER**]
- determine shape factor
- [**MARKER SEARCH** : **MENU** ⇒ : SHAPE FACT 60/3 DB]
- [**FREQUENCY SPAN** : {30 x RBW}]

See table 1-2 (item 11) of performance test report for values of RBW.

- [**SWEEP COUPLING** : RES BW MANUAL : {RBW}]¹

¹ **Note:** To check the shape factor of the 5-MHz and the 10-MHz filter the resolution bandwidth has to be set manually to 5 MHz or 10 MHz. All other bandwidths will be set automatically by changing the frequency span.

- [**MARKER SEARCH** : **PEAK**]

The shape factor is displayed by the reading 'SH3 {shape factor}'.

Evaluation: See table 1-2 (item 11) of performance test report for upper and lower limits of shape factor.

Checking LO Feedthrough, Noise Display

Test equipment: 50-Ω termination (table 1-1, item 7)
 frequency range FSEA up to 3.5 GHz
 FSEB up to 7 GHz
 FSEM up to 26.5 GHz
 FSEK up to 40 GHz
 return loss > 20 dB

Test setup: terminate the RF input of the FSE with 50 Ω

FSE settings:
 - [**SYSTEM PRESET**]
 - [**INPUT : RF ATTEN MANUAL : 0 dB**]
 - [**FREQUENCY SPAN : 0 Hz**]

LO Feedthrough

Note: This measurement is only possible with model 30. The LO feedthrough of model 20 can be checked by measuring the noise display near $f = 0$ Hz (see "Noise Display").

Additional FSE settings:
 - [**LEVEL REF : -10 dBm**]
 - [**FREQUENCY CENTER : 0 Hz**]
 - start calibration of LO compensation
 [**SYSTEM CAL : CAL LO SUP**]
 - set marker to peak
 [**MARKER SEARCH : PEAK**]

Evaluation: The LO feedthrough is displayed by the level reading of marker 1.

Noise Display

Additional FSE settings:
 - [**SWEEP COUPLING : RES BW MANUAL : 10 Hz**]
 - [**SWEEP COUPLING : VIDEO BW MANUAL : 1 Hz**]
 - [**SWEEP COUPLING : SWEEP TIME MANUAL : 0.1 s**]
 - [**TRACE 1 : AVERAGE**]
 - [**TRACE 1 : SWEEP COUNT : 30 ENTER**]
 - [**LEVEL REF : -60 dBm**]
 - [**FREQUENCY CENTER : $\{f_n\}$**]

See table 1-2 (item 13) of the performance test report for values of f_n . On models 20 set the reference level to 30 dBm for receive frequencies less than 100 kHz since the instrument can be overdriven by the LO (message IFOVL).

- set marker to peak
 [**MARKER SEARCH : PEAK**]

f_n	20 Hz	1 kHz	9,9 kHz	≥ 95 kHz
Model 20	-		-30 dBm	-60 dBm
Model 30	-30 dBm	-30 dBm	-60 dBm	-60 dBm

Evaluation: The noise level is displayed by the level reading of marker 1.

Checking the Frequency Response

Test equipment:

- signal generator (FSEA: table 1-1, item 3;
FSEB / M / K: table 1-1, item 3 and item 4)
frequency range FSEA: 1 MHz to 3.5 GHz
FSEB: 1 MHz to 7 GHz
FSEM: 1 MHz to 26.5 GHz
FSEK: 1 MHz to 40 GHz
maximum level ≥ -10 dBm
 - power meter (table 1-1, item 8)
 - power sensor (FSEA: table 1-1, item 9;
FSEB / M: table 1-1, item 9 and 10;
FSEK: table 1-1, item 10)
frequency range FSEA: 1 MHz to 3.5 GHz
FSEB: 1 MHz to 7 GHz
FSEM: 1 MHz to 26.5 GHz
FSEK: 1 MHz to 40 GHz
maximum power $P_{\max} \geq 100 \mu\text{W}$
RSS referred to indicated power 1 MHz to 1 GHz $\leq 1.5 \%$
1 GHz to 7 GHz..... $\leq 2 \%$
7 GHz to 26.5 GHz..... $\leq 3.5 \%$
26.5 GHz to 40 GHz..... $\leq 4 \%$
impedance $Z = 50 \Omega$
 - 6-dB divider (table 1-1, item 6)
frequency range FSEA: 1 MHz to 3.5 GHz
FSEB: 1 MHz to 7 GHz
FSEM: 1 MHz to 26.5 GHz
FSEK: 1 MHz to 40 GHz
level imbalance¹ 1 MHz to 1 GHz ≤ 0.15 dB
1 GHz to 7 GHz ≤ 0.2 dB
7 GHz to 18 GHz ≤ 0.3 dB
18 GHz to 26.5 GHz ≤ 0.4 dB
26.5 GHz to 40 GHz ≤ 0.4 dB
- ¹If a power splitter with higher level imbalance is used correction of the measured frequency response is recommended.

Determining the absolute error at 120 MHz

Test setup:

- connect power sensor (table 1-1, item 9) to the power meter and execute function 'ZERO' when there is no signal applied to the power sensor
- connect power sensor to RF output of signal generator

Signal generator settings:

- frequency 120 MHz
- level -10 dBm

Measurement:

- determine output power of the signal generator with the power meter
- connect RF output of the signal generator to RF input of the FSE

- FSE settings:
- [**SYSTEM PRESET**]
 - [**INPUT : RF ATTEN MANUAL : 10 dB**]
 - [**LEVEL REF : -7 dBm**]
 - [**FREQUENCY SPAN : 15 kHz**]
 - [**SWEEP COUPLING : RES BW MANUAL : 5 kHz**]
 - [**FREQUENCY CENTER : 120 MHz**]
 - set marker to peak of signal
 - [**MARKER SEARCH : PEAK**]

Evaluation: The deviation between the signal levels measured with the power meter and the FSE (level reading of marker 1) reflects the absolute level error of the FSE. It can be calculated as

$$\text{absolute error}_{120\text{MHz}} = L_{\text{FSE}} - L_{\text{powermeter}}$$

Checking the frequency response

- Test setup:
- connect RF output of the signal generator to input of the divider
 - connect output 1 of the divider to the power sensor of the power meter
 - connect output 2 of the divider to RF input of the FSE

- Signal generator settings:
- level -10 dBm
 - frequency f_{fresp}
- see table 1-2 (item 14) of performance test report for values of f_{fresp}

- FSE settings:
- [**SYSTEM PRESET**]
 - [**INPUT : RF ATTEN MANUAL : 10 dB**]
 - [**LEVEL REF : -7 dBm**]
 - [**FREQUENCY SPAN : 30 kHz**]
 - [**SWEEP COUPLING : RES BW MANUAL : 5 kHz**]
 - [**FREQUENCY CENTER : $\{f_{\text{fresp}}\}$**]
- see table 1-2 (item 14) of performance test report for values of f_{fresp}
- activate 'preselector peak' if center frequency is higher than 7 GHz (only available for FSEM and FSEK)
 - [**SYSTEM CAL : PRESEL PEAK**]
 - set marker to peak of signal
 - [**MARKER SEARCH : PEAK**]
- The signal level L_{FSE} is displayed by the level reading of marker 1.

Power meter settings: Determine signal level $L_{\text{powermeter}}$. To achieve higher accuracy it is recommended to compensate the frequency response of the power sensor.

Evaluation: The frequency response can be calculated as

$$\text{Frequency response} = L_{\text{FSE}} - L_{\text{powermeter}} - \text{absolute error}_{120\text{ MHz}}$$

Note: If option FSE-B22 is installed see also chapter "Test Instructions (option FSE-B22 included)" for additional test instructions.

Checking the Display Linearity

Note: If option FSE-B22 is installed see chapter "Test Instructions (option FSE-B22 included)" for test instructions.

Test equipment:

- signal generator (table 1-1, item 3)
 - frequency 5 MHz
 - maximum level ≥ 6 dBm
- step attenuator (table 1-1, item 13)
 - frequency 5 MHz
 - attenuation 0 to 95 dB
 - steps 1 dB
 - maximum attenuation error < 0.05 dB

Test setup:

- connect RF output of the signal generator to RF input of the step attenuator
- connect RF output of the step attenuator to RF input of the FSE

Signal generator settings:

- frequency 5 MHz
- level +6 dBm

Step attenuator settings:

- attenuation 16 dB

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT : RF ATTEN MANUAL : 10 dB**]
- [**LEVEL REF : 0 dBm**]
- [**FREQUENCY CENTER : 5 MHz**]
- [**FREQUENCY SPAN : 500 Hz**]
- [**SWEEP COUPLING : RES BW MANUAL : 3 kHz**]
- [**SWEEP COUPLING : VIDEO BW MANUAL : 100 Hz**]
- [**LEVEL RANGE : LOG 100 dB**]
- set marker to peak of signal
[**MARKER SEARCH : PEAK**]
- set reference to peak of signal
[**MARKER DELTA : REFERENCE FIXED**]

Measurement

Step attenuator settings:

- attenuation { a_{ATT} }

see table 1-2 (item 15) of performance test report for values of a_{ATT} .

Evaluation:

The difference between the level of the input signal of the FSE and the reference (about 10 dB below the reference level) is displayed by the reading 'Delta 1 [T1 FXD]'. Compare the measured values with the limits given in table 1-2 (item 15) of performance test report.

Checking the Attenuator

Note: If option FSE-B22 is installed see chapter "Test Instructions (option FSE-B22 included)" for test instructions.

Test equipment:

- signal generator (table 1-1, item 3)
 - frequency 5 MHz
 - maximum level ≥ 6 dBm
- step attenuator (table 1-1, item 13)
 - frequency 5 MHz
 - attenuation 0 to 70 dB
 - steps 10 dB
 - maximum attenuation error < 0.05 dB

Test setup:

- connect RF output of the signal generator to RF input of the step attenuator
- connect RF output of the step attenuator to RF input of the FSE

Signal generator settings:

- frequency 5 MHz
- level 0 dBm

Step attenuator settings:

- attenuation 60 dB

FSE settings:

- [**SYSTEM PRESET**]
- [**FREQUENCY CENTER : 5 MHz**]
- [**FREQUENCY SPAN : 500 Hz**]
- [**SWEEP COUPLING : RES BW MANUAL : 3 kHz**]
- [**SWEEP COUPLING : VIDEO BW MANUAL : 100 Hz**]
- [**INPUT : RF ATTEN MANUAL : 10 dB**]
- [**LEVEL REF : -30 dBm**]
- [**MARKER SEARCH : PEAK**]

adjust output level of the signal generator until the level reading of marker 1 is exactly -60.0 dBm.

Measurement

Step attenuator settings:

- attenuation $\{a_{ATT}\}$
- see table below for values of a_{ATT} .

FSE settings:

- [**INPUT : RF ATTEN MANUAL : $\{a_{FSE}\}$**]
- [**LEVEL REF : {reference level} dBm**]
- [**MARKER SEARCH : PEAK**]

see table below for values of a_{FSE} and reference level.

Evaluation:

Compare level reading of marker 1 with the limits given in table 1-2 (item 16) of performance test report.

a_{ATT}	70 dB	60 dB	50 dB	40 dB	30 dB	20 dB	10 dB	0 dB
a_{FSE}	0 dB	10 dB	20 dB	30 dB	40 dB	50 dB	60 dB	70 dB
reference level	-40 dBm	-30 dBm	-20 dBm	-10 dBm	0 dBm	+10 dBm	+20 dBm	+30 dBm

Checking the IF Gain Switching

Test principle: The IF gain of the FSE can be switched from 0 to 50 dB by changing the reference level at fixed RF attenuation. To prevent the IF gain errors to be mixed up with the log amplifier error it is determined by comparison using an external precision attenuator.

Test equipment:

- signal generator (table 1-1, item 3)
 - frequency 5 MHz
 - maximum level ≥ -10 dBm
- step attenuator (table 1-1, item 11)
 - frequency 5 MHz
 - attenuation 0 to 50 dB
 - steps 1 dB
 - maximum attenuation error < 0.05 dB

Test setup:

- connect RF output of the signal generator to RF input of the step attenuator
- connect RF output of the step attenuator to RF input of the FSE

Signal generator settings:

- frequency 5 MHz
- level -10 dBm

Step attenuator settings: attenuation 30 dB

FSE settings:

- [**SYSTEM PRESET**]
- [**FREQUENCY CENTER : 5 MHz**]
- [**FREQUENCY SPAN : 2 kHz**]
- [**SWEEP COUPLING : RES BW MANUAL : 1 kHz**]
- [**SWEEP COUPLING : VIDEO BW MANUAL : 100 Hz**]
- [**INPUT : RF ATTEN MANUAL : 10 dB**]
- [**LEVEL REF : -30 dBm**]
- [**MARKER SEARCH : PEAK**]

adjust output level of the signal generator until the level reading of marker 1 is exactly -40.0 dBm.

Measurement

Step attenuator settings: attenuation $\{a_{ATT}\}$
 see table below for values of a_{ATT} .

FSE settings:

- [**LEVEL REF : {reference level} dBm**]
 see table below for values of reference level.
- [**MARKER SEARCH : PEAK**]

Evaluation: Compare level reading of marker 1 with the limits given in table 1-2 (item 17) of performance test report.

10-dB gain steps:

a_{ATT}	reference level	Marker level
0 dB	0 dBm	-10 ± 0.2 dBm
10 dB	-10 dBm	-20 ± 0.2 dBm
20 dB	-20 dBm	-30 ± 0.2 dBm
30 dB	-30 dBm	-40 ± 0.2 dBm
40 dB	-40 dBm	-50 ± 0.2 dBm
50 dB	-50 dBm	-60 ± 0.2 dBm

1-dB gain steps:

a_{ATT}	reference level	Marker level
30 dB	-30 dBm	-40.0 ± 0.2 dBm
31 dB	-31 dBm	-41 ± 0.2 dBm
32 dB	-32 dBm	-42 ± 0.2 dBm
33 dB	-33 dBm	-43 ± 0.2 dBm
34 dB	-34 dBm	-44 ± 0.2 dBm
35 dB	-35 dBm	-45 ± 0.2 dBm
36 dB	-36 dBm	-46 ± 0.2 dBm
37 dB	-37 dBm	-47 ± 0.2 dBm
38 dB	-38 dBm	-48 ± 0.2 dBm
39 dB	-39 dBm	-49 ± 0.2 dBm

Checking the Phase Noise

- Test equipment:
- signal generator (table 1-1, item 3)
 - frequency 498 MHz
 - level ≥ 0 dBm
 - phase noise at 498 Mhz:
 - < -100 dBc/Hz @ 100 Hz
 - < -115 dBc/Hz @ 1 kHz
 - < -127 dBc/Hz @ 10 kHz
 - < -130 dBc/Hz @ 100 kHz
 - < -142 dBc/Hz @ 1MHz
- Test setup:
- connect RF output of the signal generator to RF input of the FSE
 - connect signal generator EXT REF input to the EXT REF output of the FSE and set the generator to external reference
- Signal generator settings:
- frequency 498 MHz
 - level 0 dBm
- FSE settings:
- [**SYSTEM PRESET**]
 - [**CONFIGURATION SETUP** : REFERENCE INT / EXT]
toggle to internal reference (INT)
 - [**FREQUENCY CENTER** : 498 MHz]
 - [**REF LEVEL** : 0 dBm]
 - [**INPUT** : RF ATTEN MANUAL : 10 dB]
 - [**FREQUENCY SPAN** : {span}]
depending on offset, see table below for values of span.
 - [**SWEEP COUPLING** : COUPLING RATIO : RBW/VBW NOISE]
 - [**SWEEP COUPLING** : RBW MANUAL : {RBW}]
depending on offset, see table below for values of RBW.
 - [**TRACE 1** : AVERAGE]
 - [**SWEEP** : SWEEP COUNT : 20 : ENTER]
 - [**MARKER NORMAL**]
 - set marker to peak of signal
[**MARKER SEARCH**: PEAK]
 - activate phase noise marker
[**MARKER DELTA**: PHASE NOISE]
 - [**FREQUENCY CENTER** : {498 MHz + offset}]
see table below for values of offset.
 - [**REF LEVEL** : {reference level}]
depending on offset, see table below for values of reference level.
 - [**INPUT** : RF ATTEN MANUAL : {a_{FSE}}]
depending on offset, see table below for values of a_{FSE} .

- set phase noise marker
[**MARKER DELTA** : {offset}]
- see table below for values of offset.

Note: Make sure not to measure on a spurious signal. The switching frequency may cause interference especially at an offset of 100 kHz. In this case measure at an offset of 95 kHz.

Evaluation:

The phase noise is displayed by the reading 'Delta 1 [T1 NOI]'. Compare the measured values with the limits given in table 1-2 (item 18) of performance test report

Phase noise measurement settings				
Offset	Span	RBW	Reference Level	a _{FSE}
100 Hz	20 Hz	10 Hz	0 dBm	10 dB
1 kHz	200 Hz	100 Hz	0 dBm	10 dB
10 kHz	2 kHz	500 Hz	-10 dBm	10 dB
100 kHz	10 kHz	3 kHz	-20 dBm	0 dB
1 MHz	100 kHz	30 kHz	-20 dBm	0 dB

Notes: To obtain a precise measurement of the phase noise at high offsets the level used at the FSE input is 20 dB higher than the reference level. To reduce the measurement time the phase noise is measured with a small span around the frequency offset. This prevents the FSE from being overloaded.

Checking the Tracking Generator – Option FS-B8/B9/B10/B11

Checking the Output Level

- Test equipment: N-connecting cable (Table 1-1, item no. 16)
- Test setup: ➤ Connect output of tracking generator to RF-input of FSE.
- FSE settings:
- [**MODE TRACKING**]
 - [**FREQUENCY CENTER : 120 MHz**]
 - [**FREQUENCY SPAN : 0 MHz**]
 - [**SWEEP COUPLING : RBW MANUAL : 20 kHz**]
 - [**SWEEP COUPLING : VBW MANUAL : 20 kHz**]
 - [**LEVEL RANGE : LOG 50 dB**]
 - [**MODE TRACKING : SOURCE ON**]
 - [**MODE TRACKING : SOURCE POWER {level}**]
- Values for {level} : 0 dBm; -3 dBm; -6 dBm; -10 dBm; -20 dBm
- Test setup: ➤ Compare measured values with values from Table 1-2, item no. 19.

Checking the Frequency Response

- Test equipment: N-connecting cable (Table 1-1, item no. 16)
- Test setup: ➤ Connect output of tracking generator to RF-input of FSE.
- FSE settings:
- [**MODE TRACKING**]
 - [**FREQUENCY START : 1 MHz**]
 - [**FREQUENCY STOP : 3.5(7) MHz**]
 - [**SWEEP COUPLING : RBW MANUAL : 20 kHz**]
 - [**SWEEP COUPLING : VBW MANUAL : 20 kHz**]
 - [**SWEEP COUPLING : SWEEP TIME MANUAL : 100 ms**]
 - [**LEVEL RANGE : LOG 50 dB**]
 - [**MODE TRACKING : SOURCE ON**]
 - [**MODE TRACKING : SOURCE POWER 0 dBm**]
- Evaluation: ➤ Compare measured values with limits from Table 1-2, item no. 20.

Checking the I/Q Modulator

- Test equipment:
- 2 DC power sources (Table 1-1, item no. 17)
 - 2 DC-voltmeters (Table 1-1, item no. 18)
- Test setup:
- Connect DC power sources to the I and Q input of the analyzer.
 - Use DC-voltmeter to measure voltage at the I and Q inputs.
- Power source settings
- Set voltage to $250 \text{ mV} \pm 3 \text{ mV}$.
- FSE settings:
- [**MODE TRACKING**]
 - [**FREQUENCY CENTER : 120 MHz**]
 - [**FREQUENCY SPAN : 0 MHz**]
 - [**SWEEP COUPLING : RBW MANUAL : 20 kHz**]
 - [**SWEEP COUPLING : VBW MANUAL : 20 kHz**]
 - [**REF : REF LEVEL : 0 dBm**]
 - [**MODE TRACKING : SOURCE POWER 0 dBm**]
 - [**MARKER NORMAL**]
 - Rated value: $-6 \text{ dBm} \pm 0.5 \text{ dB}$
This value serves as a reference for the following measurements.
- Measurements
- Measurement of the residual carrier
- [**LEVEL RANGE : 100 dB**]
 - Short-circuit I and Q voltages (do not remove!)
The voltmeter must indicate a value $< 0.1 \text{ mV}$.
 - Rated value: $< -50 \text{ dBm}$
- Imbalance measurement (imbalance between the I and Q paths)
- [**LEVEL RANGE : 10 dBm**]
 - Apply $\pm 250 \text{ mV}$ at the Q input, short-circuit at the I input.
 - Rated value: (reference value – 3 dB) $\pm 0.5 \text{ dB}$.
 - Apply $\pm 250 \text{ mV}$ at the I input, short-circuit at the Q input.
 - Rated value: (reference value - 3dB) $\pm 0.5 \text{ dB}$.
- Measurement of the quadrature offset
- Apply $+250 \text{ mV}$ at the I input, -250 mV at the Q input.
 - Rated value: (reference value $\pm 0.5 \text{ dB}$).
 - Apply $+250 \text{ mV}$ at the Q input, -250 mV at the I input.
 - Rated value: (reference value $\pm 0.5 \text{ dB}$).

Note: The values given in the datasheet are the guaranteed limits. Due to measurement errors these limits must be extended by the tolerance of the measuring equipment used in this performance test.

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
1	Calibration source at 120 MHz	1.3	-0.3	_____	+0.3	dB
2	Frequency accuracy Reference oscillator	1.4				
	Model 20		9.99999	_____	10.00001	MHz
	Model 30 or Model 20 with B4		9.999999	_____	10.000001	MHz
3	Return loss RF input f_{in}	1.5				
	FSEA / FSEB / FSEM / FSEK:					
	10 MHz		14	_____	-	dB
	250 MHz		14	_____	-	dB
	500 MHz		14	_____	-	dB
	750 MHz		14	_____	-	dB
	1000 MHz		14	_____	-	dB
	1250 MHz		14	_____	-	dB
	1500 MHz		14	_____	-	dB
	1750 MHz		14	_____	-	dB
	2000 MHz		14	_____	-	dB
	2250 MHz		14	_____	-	dB
	2500 MHz		14	_____	-	dB
	2750 MHz		14	_____	-	dB
	3000 MHz		14	_____	-	dB
	3250 MHz		14	_____	-	dB
	3500 MHz		14	_____	-	dB
	3250 MHz		14	_____	-	dB
	3500 MHz		14	_____	-	dB
	FSEB / FSEM / FSEK:					
	3750 MHz		9.5	_____	-	dB
	4000 MHz		9.5	_____	-	dB
	4250 MHz		9.5	_____	-	dB
	4500 MHz		9.5	_____	-	dB
	4750 MHz		9.5	_____	-	dB
	5000 MHz		9.5	_____	-	dB
	5250 MHz		9.5	_____	-	dB
	5500 MHz		9.5	_____	-	dB
	5750 MHz		9.5	_____	-	dB
	6000 MHz		9.5	_____	-	dB
	6250 MHz		9.5	_____	-	dB
	6500 MHz		9.5	_____	-	dB
	6750 MHz		9.5	_____	-	dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
3	Return loss RF input RF ATT: 10 dB	1.5				
	FSEM / FSEK:		FSEM / K:			
	7000 MHz		6 / 7.4	_____	-	dB
	8000 MHz		6 / 7.4	_____	-	dB
	9000 MHz		6 / 7.4	_____	-	dB
	10 GHz		6 / 7.4	_____	-	dB
	11 GHz		6 / 7.4	_____	-	dB
	12 GHz		6 / 7.4	_____	-	dB
	13 GHz		6 / 7.4	_____	-	dB
	14 GHz		6 / 7.4	_____	-	dB
	15 GHz		6 / 7.4	_____	-	dB
	16 GHz		6 / 7.4	_____	-	dB
	17 GHz		6 / 7.4	_____	-	dB
	18 GHz		6 / 7.4	_____	-	dB
	19 GHz		6 / 7.4	_____	-	dB
	20 GHz		6 / 7.4	_____	-	dB
	21 GHz		6 / 7.4	_____	-	dB
	22 GHz		6 / 7.4	_____	-	dB
	23 GHz		6 / 7.4	_____	-	dB
	24 GHz		6 / 7.4	_____	-	dB
	25 GHz		6 / 7.4	_____	-	dB
	26 GHz		6 / 7.4	_____	-	dB
	26.5 GHz		6 / 7.4	_____	-	dB
	FSEK:					
	27 GHz		7.4	_____	-	dB
	28 GHz		7.4	_____	-	dB
	29 GHz		7.4	_____	-	dB
	30 GHz		7.4	_____	-	dB
	31 GHz		7.4	_____	-	dB
	32 GHz		7.4	_____	-	dB
	33 GHz		7.4	_____	-	dB
	34 GHz		7.4	_____	-	dB
	35 GHz		7.4	_____	-	dB
	36 GHz		7.4	_____	-	dB
	37 GHz		7.4	_____	-	dB
	38 GHz		7.4	_____	-	dB
	39 GHz		7.4	_____	-	dB
	39.9 GHz		7.4	_____	-	dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
4	1st IF image frequency rejection f_{in} FSEA: 11 MHz 100 MHz 1701 MHz 3499 MHz FSEB / FSEM / FSEK: 11 MHz 100 MHz 1701 MHz 3499 MHz 6999 MHz	1.7	Mod. 20 / 30 75 / 80 75 / 80 75 / 80 75 / 80 80 80 80 80 80	_____	-	dB dB dB dB dB dB dB dB dB
5	2nd IF image frequency rejection f_{in} FSEA: 999 MHz FSEB / FSEM / FSEK: 999 MHz 7999 MHz	1.8	Mod. 20 / 30 75 / 80 80 80	_____	-	dB dB dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
6	1st IF rejection f_{in} FSEA: 100 MHz 1701 MHz 3500 MHz FSEB / FSEM / FSEK: 100 MHz 1701 MHz 3500 MHz FSEM / FSEK: 7001 MHz	1.8	Mod. 20 / 30 80 / 100 80 / 100 80 / 100 FSEB,M / K 75 / 80 75 / 80 75 / 80 FSEM / K 75 / 80	 _____ _____ _____ _____ _____ _____ _____	 - - - - - - -	 dB dB dB dB dB dB dB
7	3 rd order intercept, f_{in} FSEA / FSEB / FSEM / FSEK: 10 MHz 28 MHz 106 MHz 261 MHz 640 MHz 1 GHz 1.7 GHz 2.5 GHz 3.48 GHz FSEB / FSEM / FSEK: 6.98 GHz FSEM / FSEK: 7.5 GHz 15 GHz 25 GHz FSEK: 30 GHz 35 GHz 39 GHz	1.9	FSEA / B,M,K 7 / 7 7 / 7 12 / 7 12 / 12 *) 12 / 12 *) 12 / 12 *) 12 / 12 *) 12 / 12 *) 12 / 12 *) 12 FSEM / K 12 / 10 12 / 10 12 / 10 10 10 10	 _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	 - - - - - - - - - - - - - - - - - -	 dBm dBm dBm dBm dBm dBm dBm dBm dBm dBm dBm dBm dBm dBm dBm dBm
*) 15 dBm for FSEB models 25 / 35 . 17 dBm for FSEM / FSEK models 25 / 35						

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
	2 nd order harmonic distortion f_{in} FSEA / FSEB / FSEM / FSEK:	1.10	FSEA / B,M,K			
	9 kHz		25 / 25	_____	-	dBm
	35 kHz		25 / 25	_____	-	dBm
	99 kHz		25 / 25	_____	-	dBm
	19 MHz		25 / 25	_____	-	dBm
	28 MHz		25 / 25	_____	-	dBm
	107 MHz		45 / 25	_____	-	dBm
	262 MHz		45 / 40	_____	-	dBm
	453 MHz		45 / 40	_____	-	dBm
	640 MHz		45 / 40	_____	-	dBm
	1 GHz		45 / 40	_____	-	dBm
	1,25 GHz		45 / 40	_____	-	dBm
	1,7 GHz		45 / 40	_____	-	dBm
	FSEB / FSEM / FSEK:					
	3,4 GHz		40	_____	-	dBm

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
9	IF bandwidths	1.12				
	Level error					
	reference (Ref):					
	5 kHz		-	_____	-	dBm
	100 Hz		-0.2	_____	+0.2	dB
	1 kHz		-0.2	_____	+0.2	dB
	2 kHz		-0.2	_____	+0.2	dB
	3 kHz		-0.2	_____	+0.2	dB
	10 kHz		-0.2	_____	+0.2	dB
	20 kHz		-0.2	_____	+0.2	dB
	30 kHz		-0.2	_____	+0.2	dB
	50 kHz		-1.0	_____	+1.0	dB
	100 kHz		-0.2	_____	+0.2	dB
	200 kHz		-0.2	_____	+0.2	dB
	300 kHz		-0.2	_____	+0.2	dB
	500 kHz		-0.2	_____	+0.2	dB
	1 MHz		-0.3	_____	+0.3	dB
	2 MHz		-0.3	_____	+0.3	dB
	3 MHz		-0.3	_____	+0.3	dB
	5 MHz		-0.3	_____	+0.3	dB
	10 MHz		-0.3	_____	+0.3	dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
10	IF bandwidths 3-dB bandwidth	1.13				
	100 Hz		-10 %-	_____	+10 %	-
	1 kHz		-10 %-	_____	+10 %	-
	2 kHz		-10 %-	_____	+10 %	-
	3 kHz		-10 %-	_____	+10 %	-
	5 kHz		-10 %-	_____	+10 %	-
	10 kHz		-10 %-	_____	+10 %	-
	20 kHz		-10 %-	_____	+10 %	-
	30 kHz		-10 %-	_____	+10 %	-
	50 kHz		-10 %-	_____	+10 %	-
	100 kHz		-10 %-	_____	+10 %	-
	200 kHz		-10 %-	_____	+10 %	-
	300 kHz		-10 %-	_____	+10 %	-
	500 kHz		-10 %-	_____	+10 %	-
	1 MHz		-10 %-	_____	+10 %	-
	2 MHz		-10 %-	_____	+10 %	-
	3 MHz		-10 %-	_____	+10 %	-
	5 MHz		-15 %-	_____	+15 %	-
	10 MHz		-10 %-	_____	+25 %	-
11	IF bandwidths Shape factor	1.13			Mod. 20 / 30	
	100 Hz		-	_____	- / 6	-
	1 kHz		-	_____	- / 12	-
	2 kHz		-	_____	- / 12	-
	3 kHz		-	_____	- / 12	-
	5 kHz		-	_____	15 / 12	-
	10 kHz		-	_____	15 / 12	-
	20 kHz		-	_____	15 / 12	-
	30 kHz		-	_____	15 / 12	-
	50 kHz		-	_____	15 / 12	-
	100 kHz		-	_____	15 / 12	-
	200 kHz		-	_____	15 / 12	-
	300 kHz		-	_____	15 / 12	-
	500 kHz		-	_____	15 / 12	-
	1 MHz		-	_____	15 / 12	-
	2 MHz		-	_____	15 / 12	-
	3 MHz		-	_____	7 / 7	-
	5 MHz		-	_____	7 / 7	-
	10 MHz		-	_____	7 / 7	-

1065.6016.82	1.33	E-14
--------------	------	------

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
13	FSEM:	1.15			Mod. 20 / 30	
	20 Hz		-	_____	- / -74	dBm
	1 kHz		-	_____	- / -104	dBm
	9.9 kHz		-	_____	-84 / -119	dBm
	95 kHz		-	_____	-104 / -129	dBm
	999 kHz		-	_____	-124 / -142	dBm
	9.99 MHz		-	_____	-138 / -138	dBm
	19.99 MHz		-	_____	-138 / -138	dBm
	49.99 MHz		-	_____	-138 / -138	dBm
	99.99 MHz		-	_____	-138 / -138	dBm
	199.99 MHz		-	_____	-138 / -138	dBm
	499.99 MHz		-	_____	-138 / -138	dBm
	999.9 MHz		-	_____	-138 / -138	dBm
	1999.9 MHz		-	_____	-138 / -138	dBm
	3499.9 MHz		-	_____	-138 / -138	dBm
	5999.9 MHz		-	_____	-138 / -138	dBm
	6999.9 MHz		-	_____	-135 / -135	dBm
	7199.9 MHz		-	_____	-138 / -138	dBm
	11999.9 MHz		-	_____	-138 / -138	dBm
	17999.9 MHz		-	_____	-138 / -138	dBm
	21999.9 MHz		-	_____	-135 / -135	dBm
	26399.9 MHz		-	_____	-135 / -135	dBm
	FSEK:				Mod. 20 / 30	
	20 Hz		-	_____	- / -74	dBm
	1 kHz		-	_____	- / -104	dBm
	9.9 kHz		-	_____	-84 / -119	dBm
	95 kHz		-	_____	-104 / -129	dBm
	999 kHz		-	_____	-124 / -142	dBm
	9.99 MHz		-	_____	-138 / -138	dBm
	19.99 MHz		-	_____	-138 / -138	dBm
	49.99 MHz		-	_____	-138 / -138	dBm
	99.99 MHz		-	_____	-138 / -138	dBm
	199.99 MHz		-	_____	-138 / -138	dBm
	499.99 MHz		-	_____	-138 / -138	dBm
	999.9 MHz		-	_____	-138 / -138	dBm
	1999.9 MHz		-	_____	-138 / -138	dBm
	3499.9 MHz		-	_____	-138 / -138	dBm
	5999.9 MHz		-	_____	-138 / -138	dBm
	6999.9 MHz		-	_____	-135 / -135	dBm
	7199.9 MHz		-	_____	-134 / -134	dBm
	11999.9 MHz		-	_____	-134 / -134	dBm
	17999.9 MHz		-	_____	-134 / -134	dBm
	21999.9 MHz		-	_____	-131 / -131	dBm
	26499.9 MHz		-	_____	-131 / -131	dBm
	27000 MHz		-	_____	-120 / -120	dBm
	29999 MHz		-	_____	-120 / -120	dBm
	30000 MHz		-	_____	-116 / -116	dBm
	35000 MHz		-	_____	-116 / -116	dBm
	40000 MHz		-	_____	-116 / -116	dBm

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
14	Frequency response	1.16				
	FSEA / FSEB / FSEM / FSEK:					
	120 MHz (absolute error)		-0.3	_____	+0.3	dB
	f_{resp}					
	1 MHz		-0.5	_____	+0.5	dB
	10 MHz		-0.5	_____	+0.5	dB
	50 MHz		-0.5	_____	+0.5	dB
	100 MHz		-0.5	_____	+0.5	dB
	200 MHz		-0.5	_____	+0.5	dB
	300 MHz		-0.5	_____	+0.5	dB
	400 MHz		-0.5	_____	+0.5	dB
	500 MHz		-0.5	_____	+0.5	dB
	600 MHz		-0.5	_____	+0.5	dB
	700 MHz		-0.5	_____	+0.5	dB
	800 MHz		-0.5	_____	+0.5	dB
	900 MHz		-0.5	_____	+0.5	dB
	1000 MHz		-0.5	_____	+0.5	dB
	1500 MHz		-1	_____	+1	dB
	2000 MHz		-1	_____	+1	dB
	2500 MHz		-1	_____	+1	dB
	3000 MHz		-1	_____	+1	dB
	3499 MHz		-1	_____	+1	dB
	FSEB / FSEM / FSEK:					
	4000 MHz		-1	_____	+1	dB
	4500 MHz		-1	_____	+1	dB
	5000 MHz		-1	_____	+1	dB
	5500 MHz		-1	_____	+1	dB
	6000 MHz		-1	_____	+1	dB
	6500 MHz		-1	_____	+1	dB
	6999 MHz		-1	_____	+1	dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
14	FSEM / FSEK:	1.16				
	8000 MHz		-2	_____	+2	dB
	9000 MHz		-2	_____	+2	dB
	10000 MHz		-2	_____	+2	dB
	11000 MHz		-2	_____	+2	dB
	12000 MHz		-2	_____	+2	dB
	13000 MHz		-2	_____	+2	dB
	14000 MHz		-2	_____	+2	dB
	15000 MHz		-2	_____	+2	dB
	16000 MHz		-2	_____	+2	dB
	17000 MHz		-2	_____	+2	dB
	18000 MHz		-2	_____	+2	dB
	19000 MHz		-2.5	_____	+2.5	dB
	20000 MHz		-2.5	_____	+2.5	dB
	21000 MHz		-2.5	_____	+2.5	dB
	22000 MHz		-2.5	_____	+2.5	dB
	23000 MHz		-2.5	_____	+2.5	dB
	24000 MHz		-2.5	_____	+2.5	dB
	25000 MHz		-2.5	_____	+2.5	dB
	26000 MHz		-2.5	_____	+2.5	dB
	26499 MHz		-2.5	_____	+2.5	dB
	FSEK:					
	27000 MHz		-3	_____	+3	dB
	28000 MHz		-3	_____	+3	dB
	29000 MHz		-3	_____	+3	dB
	30000 MHz		-3	_____	+3	dB
	31000 MHz		-3	_____	+3	dB
	32000 MHz		-3	_____	+3	dB
	33000 MHz		-3	_____	+3	dB
	34000 MHz		-3	_____	+3	dB
	35000 MHz		-3	_____	+3	dB
	36000 MHz		-3	_____	+3	dB
	37000 MHz		-3	_____	+3	dB
	38000 MHz		-3	_____	+3	dB
	39000 MHz		-3	_____	+3	dB
	40000 MHz		-3	_____	+3	dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
15	Display linearity	1.18				
	a_{ATT}					
	6 dB		9.7	_____	10.3	dB
	8 dB		7.7	_____	8.3	dB
	10 dB		5.7	_____	6.3	dB
	12 dB		3.7	_____	4.3	dB
	14 dB		1.7	_____	2.3	dB
	16 dB		-	Reference	-	-
	18 dB		-2.3	_____	-1.7	dB
	20 dB		-4.3	_____	-3.7	dB
	22 dB		-6.3	_____	-5.7	dB
	24 dB		-8.3	_____	-7.7	dB
	26 dB		-10.3	_____	-9.7	dB
	28 dB		-12.3	_____	-11.7	dB
	30 dB		-14.3	_____	-13.7	dB
	32 dB		-16.3	_____	-15.7	dB
	34 dB		-18.3	_____	-17.7	dB
	36 dB		-20.3	_____	-19.7	dB
	38 dB		-22.3	_____	-21.7	dB
	40 dB		-24.3	_____	-23.7	dB
	42 dB		-26.3	_____	-25.7	dB
	44 dB		-28.3	_____	-27.7	dB
	46 dB		-30.3	_____	-29.7	dB
	48 dB		-32.3	_____	-31.7	dB
	50 dB		-34.3	_____	-33.7	dB
	52 dB		-36.3	_____	-35.7	dB
	54 dB		-38.3	_____	-37.7	dB
	56 dB		-40.3	_____	-39.7	dB
	61 dB		-45.5	_____	-44.5	dB
	66 dB		-50.5	_____	-49.5	dB
	71 dB		-55.5	_____	-54.5	dB
	76 dB		-60.5	_____	-59.5	dB
	81 dB		-66.0	_____	-64.0	dB
	86 dB		-71.0	_____	-69.0	dB
	only models 30					
	91 dB		-76.0	_____	-74.0	dB
	96 dB		-81.0	_____	-79.0	dB
	101 dB		-86.0	_____	-84.0	dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
16	Attenuator	1.19				
	a_{ATT}					
	70		-70.3	_____	-69.7	dBm
	60		-60.3	_____	-59.7	dBm
	50		-50.3	_____	-49.7	dBm
	40		-40.3	_____	-39.7	dBm
	30		-30.3	_____	-29.7	dBm
	20		-20.3	_____	-19.7	dBm
	10		-10.3	_____	-9.7	dBm
	0		-0.3	_____	+0.3	dBm
17	IF gain switching	1.20				
	Reference level					
	0 dBm		-10.2	_____	-9.8	dBm
	-10 dBm		-20.2	_____	-19.8	dBm
	-20 dBm		-30.2	_____	-29.8	dBm
	-30 dBm		-40.2	_____	-39.8	dBm
	-40 dBm		-50.2	_____	-49.8	dBm
	-50 dBm		-60.2	_____	-59.8	dBm
	-31 dBm		-41.2	_____	-40.8	dBm
	-32 dBm		-42.2	_____	-41.8	dBm
	-33 dBm		-43.2	_____	-42.8	dBm
	-34 dBm		-44.2	_____	-43.8	dBm
	-35 dBm		-45.2	_____	-44.8	dBm
	-36 dBm		-46.2	_____	-45.8	dBm
	-37 dBm		-47.2	_____	-46.8	dBm
	-38 dBm		-48.2	_____	-47.8	dBm
	-39 dBm		-49.2	_____	-48.8	dBm

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
18	Phase noise offset:	1.20				
	FSEA20 without B4					
	:					
	1 kHz		-	_____	-85	dBc/Hz
	10 kHz		-	_____	-95	dBc/Hz
	100 kHz		-	_____	-119	dBc/Hz
	1 MHz		-	_____	-135	dBc/Hz
	FSEA30 or FSEA20 with B4 :					
	100 Hz		-	_____	-87	dBc/Hz
	1 kHz		-	_____	-107	dBc/Hz
	10 kHz		-	_____	-120	dBc/Hz
	100 kHz		-	_____	-117 / 119 *)	dBc/Hz
	1 MHz		-	_____	-135 / 138 *)	dBc/Hz
	FSEB/M/K 20 without B4:					
	1 kHz		-	_____	-79	dBc/Hz
	10 kHz		-	_____	-90	dBc/Hz
	100 kHz		-	_____	-113	dBc/Hz
	1 MHz		-	_____	-129	dBc/Hz
	FSEB/M/K 30 or FSEB/M/K20 withB4:		-	_____	-81	dBc/Hz
	100 Hz		-	_____	-100	dBc/Hz
	1 kHz		-	_____	-114	dBc/Hz
	10 kHz		-	_____	-111 / 113 *)	dBc/Hz
	100 kHz		-	_____	-129 / 132 *)	dBc/Hz
	1 MHz					
*) The better values apply to models 25 / 35						
19	option tracking generator	1.24				
	output level					
	0 dBm		- 1	_____	+ 1	dBm
	-3 dBm		-4	_____	-2	dBm
	-6 dBm		-8	_____	-4	dBm
	-10 dBm		-12	_____	-8	dBm
	-20 dBm		- 21	_____	- 19	dBm

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
20	option tracking generator	1.24				
	frequency response					
	1 MHz to 1 GHz		-2	_____	2	dBm
	1 GHz to 3.5 GHz		-3	_____	3	dBm
	3.5 GHz to 7 GHz		-3	_____	3 (typ)	dBm
21	option tracking generator	1.24				
	I/Q-modulator					
	residual carrier		-	_____	-46	dBm
	imbalance		-10	_____	-8	dBm
	quadrature offset		- 7	_____	-5	dBm

Test Instructions (option FSE-B22 included)

The rated specifications of the analyzer are tested after a warm-up time of at least 30 minutes and overall calibration. Only in this case can the compliance with the guaranteed data be ensured.

Values given in the following sections are not guaranteed. Only the technical specifications of the data sheet are binding.

Additional equipment required for performance test (option FSE-B22 included)

Table 1-3 Additional equipment required for performance test (option FSE-B22 included)

Item	Type of equipment	Specifications recommended	Recommended equipment	R&S Order No.	Page
1	Power sensor	frequency 1 MHz to 2 GHz RSS referred to indicated power $\leq 0.8 \%$	NRV-Z51	0857.9004.02	1.43
2	6-dB divider (power splitter)	frequency 1 MHz to 2 GHz level imbalance $\leq 0.1 \text{ dB}$	RVZ	0800.6612.52	1.43

Checking the Calibration Source at 120 MHz

Test equipment:

- signal generator (table 1-1, item 3):
frequency 120 MHz
level -40 dBm
- power meter (table 1-1, item 8)
- power sensor (table 1-1, item 9)
frequency 120 MHz
maximum power $P_{\max} \geq 1 \mu\text{W}$
meter noise $\leq 20 \text{ pW}$
RSS $\leq 0.8\%$ referred to indicated power
impedance $Z = 50 \Omega$

Power meter settings:

- connect power sensor to power meter and carry out function 'ZERO' when no signal is applied to the power sensor.
- connect power sensor to RF output of signal generator.

Signal generator settings:

- frequency 120 MHz
- level -40 dBm $\pm 0.1 \text{ dB}$
Use power meter for exact level adjustment.

Test setup:

connect RF output of the signal generator to RF input of the FSE

FSE settings:

- [**SYSTEM PRESET**]
- [**FREQUENCY CENTER : 120 MHz**]
- [**FREQUENCY SPAN : 15 kHz**]
- [**SWEEP COUPLING : RES BW MANUAL : 5 kHz**]
- [**LEVEL REF : REF LEVEL : -10 dBm**]
- [**INPUT : RF ATTEN MANUAL : 20 dB**]

- set marker to peak of signal
[**MARKER SEARCH** : PEAK]
- set reference to peak of signal
[**MARKER DELTA** : REFERENCE FIXED]
- switch internal reference generator to RF input
[**CONFIGURATION SETUP** : SERVICE : INPUT CAL]
- set marker to peak of signal
[**MARKER SEARCH** : PEAK]

Evaluation: The reading 'Delta 1 [T1 FXD]' displays the difference between the output level of the signal generator and the level of the calibration source < 0.2 dB

Note: *The level of the calibration source can be adjusted with R22 on FracSyn module.*

Checking IF Filters

Test equipment: signal generator (table 1-1, item 3):
frequency 120 MHz
level ≥ -10 dBm

Test setup: connect RF output of the signal generator to the RF input of the FSE.

Checking the Level Error

Reference Measurement (RBW 5 kHz)

Signal generator settings: - frequency: 120 MHz
- level: -20 dBm

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **0 dBm**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**SWEEP COUPLING** : COUPLING RATIO : RBW/VBW SINE [1]]
- [**SWEEP COUPLING** : COUPLING RATIO : SPAN/RBW MANUAL :
5 : ENTER]
- resolution bandwidth 5 kHz
[**FREQUENCY SPAN** : **25 kHz**]
- set marker to peak of signal
[**MARKER SEARCH** : PEAK]
- set reference to peak of signal
[**MARKER DELTA** : REFERENCE FIXED]

Checking the Level Error

- FSE settings:
- [**FREQUENCY SPAN** : {5 x RBW}]
See table 1-4 (item 2) of performance test report for values of RBW.
 - set marker to peak of signal
[**MARKER SEARCH** : PEAK]
The level error is displayed by the reading
‘Delta 1 [T1 FXD] {level error} dB’.
- Evaluation:
- See table 1-4 (item 2) of performance test report for upper and lower limits of level error.

Checking the Frequency Response

- Test equipment:
- signal generator (table 1-1, item 3)
 - frequency range 1 MHz to 2 GHz
 - maximum level ≥ -10 dBm
 - power meter (table 1-1, item 8)
 - power sensor (table 1-3, item 1)
 - frequency range 1 MHz to 2 GHz
 - maximum power $P_{\max} \geq 100 \mu\text{W}$
 - RSS referred to indicated power $\leq 0.8 \%$
 - impedance $Z = 50 \Omega$
 - 6-dB divider (table 1-3, item 2)
 - frequency range 1 MHz to 2 GHz
 - level imbalance¹ ≤ 0.1 dB
- ¹If a power splitter with higher level imbalance is used correction of the measured frequency response is recommended.

Determining the absolute error at 120 MHz

- Test setup:
- connect power sensor (table 1-3, item 1) to the power meter and execute function ‘ZERO’ when there is no signal applied to the power sensor
 - connect power sensor to RF output of signal generator
- Signal generator settings:
- frequency 120 MHz
 - level -10 dBm
- Measurement:
- determine output power of the signal generator with the power meter
 - connect RF output of the signal generator to RF input of the FSE

- FSE settings:
- [**SYSTEM PRESET**]
 - [**INPUT : RF ATTEN MANUAL : {a_{FSE}}** **dB**]
 - See
 - [**LEVEL REF : -7 dBm**]
 - [**FREQUENCY SPAN : 15 kHz**]
 - [**SWEEP COUPLING : RES BW MANUAL : 5 kHz**]
 - [**FREQUENCY CENTER : 120 MHz**]
 - set marker to peak of signal
 - [**MARKER SEARCH : PEAK**]

Evaluation: The deviation between the signal levels measured with the power meter and the FSE (level reading of marker 1) reflects the absolute level error of the FSE. It can be calculated as

$$\text{absolute error}_{120\text{MHz}} = L_{\text{FSE}} - L_{\text{powermeter}}$$

Checking the frequency response

- Test setup:
- connect RF output of the signal generator to input of the divider
 - connect output 1 of the divider to the power sensor of the power meter
 - connect output 2 of the divider to RF input of the FSE

- Signal generator settings:
- level -10 dBm
 - frequency f_{fresp}
- see table 1-3 (item 3) of performance test report for values of f_{fresp}

- FSE settings:
- [**SYSTEM PRESET**]
 - [**INPUT : RF ATTEN MANUAL : 10 dB**]
 - [**LEVEL REF : -7 dBm**]
 - [**FREQUENCY SPAN : 30 kHz**]
 - [**SWEEP COUPLING : RES BW MANUAL : 5 kHz**]
 - [**FREQUENCY CENTER : {f_{fresp}}**]
 - see table 1-3 (item 3) of performance test report for values of f_{fresp}
 - activate 'preselector peak' if center frequency is higher than 7 GHz (only available for FSEM and FSEK)
 - [**SYSTEM CAL : PRESEL PEAK**]
 - set marker to peak of signal
 - [**MARKER SEARCH : PEAK**]
 - the signal level L_{FSE} is displayed by the level reading of marker 1.

Power meter settings: Determine signal level $L_{\text{powermeter}}$. To achieve higher accuracy it is recommended to compensate the frequency response of the power sensor.

Evaluation: The frequency response can be calculated as

$$\text{Frequency response} = L_{\text{FSE}} - L_{\text{powermeter}} - \text{absolute error}_{120\text{ MHz}}$$

Checking the Display Linearity

- Test equipment:
- signal generator (table 1-1, item 3)
 - frequency 5 MHz
 - maximum level ≥ 6 dBm
 - step attenuator (table 1-1, item 13)
 - frequency 5 MHz
 - attenuation 0 to 95 dB
 - steps 1 dB
 - maximum attenuation error < 0.01 dB
- Test setup:
- connect RF output of the signal generator to RF input of the step attenuator
 - connect RF output of the step attenuator to RF input of the FSE
- Signal generator settings:
- frequency 5 MHz
 - level +6 dBm
- Step attenuator settings:
- attenuation 16 dB
- FSE settings:
- [**SYSTEM PRESET**]
 - [**INPUT : RF ATTEN MANUAL : 10 dB**]
 - [**LEVEL REF : 0 dBm**]
 - [**FREQUENCY CENTER : 5 MHz**]
 - [**FREQUENCY SPAN : 500 Hz**]
 - [**SWEEP COUPLING : RES BW MANUAL : 3 kHz**]
 - [**SWEEP COUPLING : VIDEO BW MANUAL : 100 Hz**]
 - [**LEVEL RANGE : LOG 100 dB**]
 - set marker to peak of signal
 [**MARKER SEARCH : PEAK**]
 - set reference to peak of signal
 [**MARKER DELTA : REFERENCE FIXED**]

Measurement

- Step attenuator settings:
- attenuation $\{a_{ATT}\}$
- See table 1-4 (item 4) of performance test report for values of a_{ATT} .

- Evaluation:
- The difference between the level of the input signal of the FSE and the reference (about 10 dB below the reference level) is displayed by the reading 'Delta 1 [T1 FXD]'. Compare the measured values with the limits given in table 1-4 (item 4) of performance test report.

Checking the Attenuator

- Test equipment:
- signal generator (table 1-1, item 3)
 - frequency 5 MHz
 - maximum level ≥ 6 dBm
 - step attenuator (table 1-1, item 13)
 - frequency 5 MHz
 - attenuation 0 to 70 dB
 - steps 10 dB
 - maximum attenuation error < 0.05 dB
- Test setup:
- connect RF output of the signal generator to RF input the step attenuator
 - connect RF output of the step attenuator to RF input of the FSE
- Signal generator settings:
- frequency 5 MHz
 - level 0 dBm
- Step attenuator settings:
- attenuation 60 dB
- FSE settings:
- [**SYSTEM PRESET**]
 - [**FREQUENCY CENTER : 5 MHz**]
 - [**FREQUENCY SPAN : 500 Hz**]
 - [**SWEEP COUPLING : RES BW MANUAL : 3 kHz**]
 - [**SWEEP COUPLING : VIDEO BW MANUAL : 100 Hz**]
 - [**INPUT : RF ATTEN MANUAL : 10 dB**]
 - [**LEVEL REF : -30 dBm**]
 - [**MARKER SEARCH : PEAK**]
- adjust output level of the signal generator until the level reading of marker 1 is exactly -60.0 dBm.

Measurement

- Step attenuator settings:
- attenuation $\{a_{ATT}\}$
- See table below for values of a_{ATT} .
- FSE settings:
- [**INPUT : RF ATTEN MANUAL : $\{a_{FSE}\}$**]
 - [**LEVEL REF : {reference level} dBm**]
 - [**MARKER SEARCH : PEAK**]
- see table below for values of a_{FSE} and reference level.
- Evaluation:
- Compare level reading of marker 1 with the limits given in table 1-4 (item 5) of performance test report.

a_{ATT}	40 dB	30 dB	20 dB	10 dB
a_{FSE}	30 dB	40 dB	50 dB	60 dB
reference level	-10 dBm	0 dBm	+10 dBm	+20 dBm

Performance Test Report (option FSE-B22 included)

Note: The values given in the datasheet are the guaranteed limits. Due to measurement errors these limits must be extended by the tolerance of the measuring equipment used in this performance test.

Table 1-4 Performance test report

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
1	Calibration source at 120 MHz	1.41	-0.2	_____	+0.2	dB
2	IF bandwidths Level error reference (Ref): 5 kHz 100 Hz 1 kHz 2 kHz 3 kHz 5 kHz 10 kHz 20 kHz 30 kHz 300 kHz	1.4	- -0.15 -0.15 -0.15 -0.15 -0.15 -0.15 -0.15 -0.15 -0.15	_____ _____ _____ _____ _____ _____ _____ _____ _____	- +0.15 +0.15 +0.15 +0.15 +0.15 +0.15 +0.15 +0.15	dBm dB dB dB dB dB dB dB dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
3	Frequency response	1.43				
	RF-Attenuation					
	$a_{FSE} = 10 \text{ dB}$					
	120 MHz		-0.3	_____	+0.3	dB
	(absolute error)					
	f_{fresp}					
	1 MHz		-0.3	_____	+0.3	dB
	10 MHz		-0.3	_____	+0.3	dB
	50 MHz		-0.3	_____	+0.3	dB
	100 MHz		-0.3	_____	+0.3	dB
	200 MHz		-0.3	_____	+0.3	dB
	300 MHz		-0.3	_____	+0.3	dB
	400 MHz		-0.3	_____	+0.3	dB
	500 MHz		-0.3	_____	+0.3	dB
	600 MHz		-0.3	_____	+0.3	dB
	700 MHz		-0.3	_____	+0.3	dB
	800 MHz		-0.3	_____	+0.3	dB
	900 MHz		-0.3	_____	+0.3	dB
	1000 MHz		-0.3	_____	+0.3	dB
	1100 MHz		-0.3	_____	+0.3	dB
	1200 MHz		-0.3	_____	+0.3	dB
	1300 MHz		-0.3	_____	+0.3	dB
	1400 MHz		-0.3	_____	+0.3	dB
	1500 MHz		-0.3	_____	+0.3	dB
	1600 MHz		-0.3	_____	+0.3	dB
	1700 MHz		-0.3	_____	+0.3	dB
	1800 MHz		-0.3	_____	+0.3	dB
	1900 MHz		-0.3	_____	+0.3	dB
	2000 MHz		-0.3	_____	+0.3	dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
3	Frequency response	1.43				
	RF-Attenuation					
	$a_{FSE} = 20 \text{ dB}$					
	120 MHz		-0.3	_____	+0.3	dB
	(absolute error)					
	f_{fresp}					
	1 MHz		-0.45	_____	+0.45	dB
	10 MHz		-0.45	_____	+0.45	dB
	50 MHz		-0.45	_____	+0.45	dB
	100 MHz		-0.45	_____	+0.45	dB
	200 MHz		-0.45	_____	+0.45	dB
	300 MHz		-0.45	_____	+0.45	dB
	400 MHz		-0.45	_____	+0.45	dB
	500 MHz		-0.45	_____	+0.45	dB
	600 MHz		-0.45	_____	+0.45	dB
	700 MHz		-0.45	_____	+0.45	dB
	800 MHz		-0.45	_____	+0.45	dB
	900 MHz		-0.45	_____	+0.45	dB
	1000 MHz		-0.45	_____	+0.45	dB
	1100 MHz		-0.45	_____	+0.45	dB
	1200 MHz		-0.45	_____	+0.45	dB
	1300 MHz		-0.45	_____	+0.45	dB
	1400 MHz		-0.45	_____	+0.45	dB
	1500 MHz		-0.45	_____	+0.45	dB
	1600 MHz		-0.45	_____	+0.45	dB
	1700 MHz		-0.45	_____	+0.45	dB
	1800 MHz		-0.45	_____	+0.45	dB
	1900 MHz		-0.45	_____	+0.45	dB
	2000 MHz		-0.45	_____	+0.45	dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
3	Frequency response	1.43				
	RF-Attenuation					
	$a_{FSE} = 30 \text{ dB}$					
	120 MHz		-0.3	_____	+0.3	dB
	(absolute error)					
	f_{fresp}					
	1 MHz		-0.45	_____	+0.45	dB
	10 MHz		-0.45	_____	+0.45	dB
	50 MHz		-0.45	_____	+0.45	dB
	100 MHz		-0.45	_____	+0.45	dB
	200 MHz		-0.45	_____	+0.45	dB
	300 MHz		-0.45	_____	+0.45	dB
	400 MHz		-0.45	_____	+0.45	dB
	500 MHz		-0.45	_____	+0.45	dB
	600 MHz		-0.45	_____	+0.45	dB
	700 MHz		-0.45	_____	+0.45	dB
	800 MHz		-0.45	_____	+0.45	dB
	900 MHz		-0.45	_____	+0.45	dB
	1000 MHz		-0.45	_____	+0.45	dB
	1100 MHz		-0.45	_____	+0.45	dB
	1200 MHz		-0.45	_____	+0.45	dB
	1300 MHz		-0.45	_____	+0.45	dB
	1400 MHz		-0.45	_____	+0.45	dB
	1500 MHz		-0.45	_____	+0.45	dB
	1600 MHz		-0.45	_____	+0.45	dB
	1700 MHz		-0.45	_____	+0.45	dB
	1800 MHz		-0.45	_____	+0.45	dB
	1900 MHz		-0.45	_____	+0.45	dB
	2000 MHz		-0.45	_____	+0.45	dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
3	Frequency response	1.43				
	RF-Attenuation					
	$a_{FSE} = 40 \text{ dB}$					
	120 MHz		-0.3	_____	+0.3	dB
	(absolute error)					
	f_{fresp}					
	1 MHz		-0.45	_____	+0.45	dB
	10 MHz		-0.45	_____	+0.45	dB
	50 MHz		-0.45	_____	+0.45	dB
	100 MHz		-0.45	_____	+0.45	dB
	200 MHz		-0.45	_____	+0.45	dB
	300 MHz		-0.45	_____	+0.45	dB
	400 MHz		-0.45	_____	+0.45	dB
	500 MHz		-0.45	_____	+0.45	dB
	600 MHz		-0.45	_____	+0.45	dB
	700 MHz		-0.45	_____	+0.45	dB
	800 MHz		-0.45	_____	+0.45	dB
	900 MHz		-0.45	_____	+0.45	dB
	1000 MHz		-0.45	_____	+0.45	dB
	1100 MHz		-0.45	_____	+0.45	dB
	1200 MHz		-0.45	_____	+0.45	dB
	1300 MHz		-0.45	_____	+0.45	dB
	1400 MHz		-0.45	_____	+0.45	dB
	1500 MHz		-0.45	_____	+0.45	dB
	1600 MHz		-0.45	_____	+0.45	dB
	1700 MHz		-0.45	_____	+0.45	dB
	1800 MHz		-0.45	_____	+0.45	dB
	1900 MHz		-0.45	_____	+0.45	dB
	2000 MHz		-0.45	_____	+0.45	dB

Item No.	Characteristic	Test to page	Min. value	Actual value	Max. value	Unit
4	Display linearity	1.45				
	a_{ATT}					
	16 dB		-	Reference	-	-
	18 dB		-2,2	_____	-1,8	dB
	20 dB		-4,2	_____	-3,8	dB
	22 dB		-6,2	_____	-5,8	dB
	24 dB		-8,2	_____	-7,8	dB
	26 dB		-10,2	_____	-9,8	dB
	28 dB		-12,2	_____	-11,8	dB
	30 dB		-14,2	_____	-13,8	dB
	32 dB		-16,2	_____	-15,8	dB
	34 dB		-18,2	_____	-17,8	dB
	36 dB		-20,2	_____	-19,8	dB
	38 dB		-22,2	_____	-21,8	dB
	40 dB		-24,2	_____	-23,8	dB
	42 dB		-26,2	_____	-25,8	dB
	44 dB		-28,2	_____	-27,8	dB
	46 dB		-30,2	_____	-29,8	dB
	48 dB		-32,2	_____	-31,8	dB
	50 dB		-34,2	_____	-33,8	dB
	52 dB		-36,2	_____	-35,8	dB
	54 dB		-38,2	_____	-37,8	dB
	56 dB		-40,2	_____	-39,8	dB
5	Attenuator	1.46				
	a_{ATT}					
	40		-40,2	_____	-39,8	dBm
	30		-30,2	_____	-29,8	dBm
	20		-20,2	_____	-19,8	dBm
	10		-10,2	_____	-9,8	dBm

Contents - Chapter 2 "Adjustment"

2 Adjustment..... 2.1

2 Adjustment

All boards have been adjusted before being supplied and do not require readjustment after a board replacement in the instrument.

The correction and setting data for the boards are contained in an EEPROM on each board and are thus replaced with board replacement.

Switch off the instrument before replacing a board.

Some boards provide additional adjustment facilities which should be checked with servicing:

- Fracsyn: adjustment for calibration level -40dBm
- RF-Converter Unit: adjustment of the YIG oscillator characteristic and dynamic
- MW-Converter Unit: adjustment of the YIG filter characteristic and dynamic
- 2nd IF-Converter: no adjustment
- IF filter: no adjustment, all values are determined with calibration
- Detector: no adjustment
- LowPhaseNoise: no adjustment

Adjustment of the reference frequency is explained in Section 8 (Maintenance) of the Operating Manual.

Contents - Chapter 3 "Function Description/Selftest"

3 Function Description/Selftest

Function Description of Overall Instrument	3.1
Modules of the Analog Unit.....	3.1
Modules of the Digital Unit.....	3.1
Description of the Analog Unit	3.2
Processor Structure.....	3.3
Monitoring the Function of the FSE.....	3.4
Switch-on Test.....	3.4
Monitoring of the Synthesizers and Signal Levels	3.4
Error Messages of the Synthesizer.....	3.5
Overload Messages.....	3.5
Selftest.....	3.6
Operation	3.6
Testing the Processor Functions	3.6
Testing the Synthesizers	3.6
Testing the Signal Path.....	3.7

3 Function Description/Selftest

This chapter describes the design of the FSE and simple measures for monitoring the function of the instrument. A selftest is available for troubleshooting and diagnosis.

The firmware update and the installation of options are described in chapter 4 in this service manual.

Function Description of Overall Instrument

This section informs on the theory of operation of this instrument.

Modules of the Analog Unit

All modules of the analog unit contain an individually programmed EEPROM indicating the model and correction data, such as frequency response, filter parameters, insertion gain. The analog unit consists of the following modules:

- RF modules with RF converter and YIG sampler forming part of the RF module
- MW converter modules (for instruments with a frequency range > 7 GHz)
- 2nd IF converter
- IF filter
- Digital IF
- I/Q-demodulator (option FSE-B7)
- Fracsyn with static transputer module
- Low phase noise for instrument model 30
- Detector board with dynamic transputer module and DSP module
- Analog motherboard

Modules of the Digital Unit

The boards of the digital unit do not contain any particular correction data. The digital unit is independent of the type of instrument, the only difference is the amount and type of plug-in boards fitted such as network board or IEC/IEEE board. The digital unit consists of the following modules:

- Main processor
- Graphic board
- Digital motherboard (containing the interface drivers such as IEC bus, LPT and COM)
- Hard disk
- Floppy disk
- LC display
- Keypad
- Option VGA board
- Option 2nd IEEE-bus
- Option LAN interface

Description of the Analog Unit

The FSE has been conceived as analyzer with triple conversion. Special importance has been attached to reaching high display dynamics, i.e., the individual amplifier stages have not only been trimmed to minimum displayed noise level but adjusted such that they provide good intermodulation characteristics with an acceptable noise factor.

The input signal passes a switchable input divider (attenuation range 0 to 70dB in steps of 10dB), which also switches the internal calibration and test signal.

In the RF converter, the signal (7.9414 to 14.9414 GHz ;FSEA: 4,3414 to 7,8414GHz) is converted to the 1st IF (7.9414, FSEA: 4.3414)), using the 1st LO after having passed the input lowpass in the 1st mixer. Following the 1st IF filter and the IF gain, the signal is converted to the 2nd IF of 741.4MHz.

By those FSE models having a frequency range greater than 7 GHz, the signal is divided, after the input divider, in a switchable diplexer. The portions of the signal below 7 GHz are further processed in the RF converter. The portions of the signal above 7 GHz are fed via a YIG filter to the MW converter. The conversion of the IF of 741.4 MHz takes place in this module. The LO required for the conversion comes from the RF converter and, depending on the frequency range, is either fed directly or via a doubler to the mixer.

The next module in the signal path is the 2nd IF Converter, which provides for conversion of the second IF to the third IF of 21.4 MHz and generation of the second and third LO. Apart from several amplifiers it contains a filter on 741.4 MHz with a 3-dB bandwidth of 10 MHz. This filter serves as resolution filter if the resolution bandwidth is 10 MHz and it reflects the image frequency which might be generated by the third conversion.

The resolution filters for bandwidths between 1 kHz and 5 MHz are located on the IF filter board . With the 10-MHz bandwidth, the filter stages of the board are bypassed. Crystal filters are used for bandwidths between 1 and 30 kHz, LC filters are provided for bandwidths of 50 kHz or above. The individual filter stages have been decoupled from each other by means of amplifiers which is why they act as Gaussian filter. Subsequent to the first two filter stages, switchable IF amplifiers (Step Gain) and two independent calibration amplifiers are fitted. The step gain can be switched in 0.1-dB steps from 0 to 50 dB and is used to amplify the signal on the reference level. One of the two calibration amplifiers is used to compensate for the deviations of amplification with different bandwidth or step-gain settings. This amplifier is controlled via the serial interface of the level transputer and a D/A converter on the IF filter board. The second calibration amplifier is controlled by an analog voltage, which is modified by the frequency transputer during the sweep according to the frequency response of the input stages.

The IF filters are followed by the log module, which provides for a dynamic of 90 or 110 dB depending on the model. The video signal thus created is passed to the detector board. There, it is through-connected to the rear panel.

If resolution bandwidths are < 1kHz, the signal path via the log module remains unused. The signal is still filtered by the IF filter board to a bandwidth of 3 kHz, but then converted to a 25-kHz IF and filtered digitally on the module. An 18-bit A/D converter is provided on the digital IF for sampling with the 25-kHz IF.

A measuring A/D converter with a sampling rate of 20 MHz is provided on the detector board. Due to the high sampling rate of the A/D converter the analog peak detectors are not required, they are digitally simulated following the converter. Video filtering is carried out digitally, too, in the noise filter gate-array on the detector board. For video bandwidths ≤ 20 kHz, additional filtering is carried out using a DSP, which remains disabled above 20 kHz.

Processor Structure

Apart from a 586 CPU, the FSE is provided with three T805-32-bit transputers and a 32-bit transputer T425 (formerly 16-bit transputer T225). Two DSPs are provided in the basic instrument for digital signal processing.

The 586 CPU controls the complete data exchange with the periphery, such as keyboard entry, representation of the softkeys and operation via the IEC bus. The transputers independently control the test procedure, calculate correction factors and display the measuring curve on the screen. The transputers are provided with the current instrument settings by the 586 CPU via a link adapter, which connects the ISA bus of the CPU board with a transputer link of the T805 on the graphic board (called GTP = graphic transputer in the following). Other transputer links couple the T425 on the graphics board and the two T805 on the detector board (LTP = level transputer) and the Fracsyn (FTP = frequency transputer) to the GTP. T425 is exclusively used as interface between the GTP and the chipset for graphics.

Tasks of the Level Transputer

The PTP receives the level-dependent settings from the graphic transputer and causes the corresponding switchovers in the hardware to be made via a serial interface. The PTP has the following functions: making the level-dependent settings such as attenuation of the attenuator, the bandwidths on the IF filter and level correction with the calibration frequency (120 MHz) and, on the other hand, programming of the DSPs, obtaining the measured values and passing the measured values to the graphic transputer via the transputer link. To meet these requirements, the PTP is provided with its individual serial bus to those boards which require level-dependent settings. I.e., the modules IF filter, digital IF, attenuator control board.

Tasks of the Frequency Transputer

The FTP receives the current sweep setting from the graphic transputer via the PTP and calculates the required synthesizer settings. For settings which have to be made during a sweep, the FTP is fitted with a fast parallel bus on the fracsyn module, which also addresses the sweep synthesizer. The subsequent settings have to be made: the frequency-dependent level correction, coarse tuning of the YIG oscillator and control of the sweep output. The fracsyn module therefore accommodates D/A converters which are programmed parallelly during the sweep and which provide control voltages. The voltage for the sweep output is applied to the rear panel where it provides a sawtooth voltage which starts at 0V at the sweep start and increases to 10 V at the end of sweep. The voltage for frequency-response correction is passed to a voltage-controlled amplifier on the IF filter board which compensates for the frequency-dependent attenuation characteristic of the input stages. The third tuning voltage leads to the RF module where the main coil of the YIG oscillator which is integrated in the YIG sampler is controlled by means of a voltage-controlled current source, thus controlling the coarse tuning of the first LO. D/A converters which are required for options are provided in the basic FSE model. A serial bus is available for the FTP to use when controlling time-critical settings.

Monitoring the Function of the FSE

Switch-on Test

Following switch-on of the instrument a selftest of the processor functions is executed first. Subsequently, the transputer net is initialized, which adopts control of the analog modules.

Monitoring of the Synthesizers and Signal Levels

The FSE is provided with a large amount of selftest points which can be switched to an A/D converter via multiplexer. Most of these test points are located on the analog modules and, by means of level detectors, allow for monitoring the levels in the signal path, the output levels of the LO drivers and the tuning voltages of the oscillators. The selftest voltages which are required for proper functioning, are additionally monitored by comparators. The output signals of these comparators are stored and checked by the level transputer during each request of a measured value. If one of these comparators responds, one of the following error messages is output:

Message	Meaning	see Section
Reference unlock	Reference oscillator not synchronized	"Error Messages of the Synthesizer"
LO UNL	First LO not synchronized	"Error Messages of the Synthesizer"
2nd/3rd LO unlock	Second and third LO not synchronized	"Error Messages of the Synthesizer"
Level 1st LO	LO level at first mixer too small	"Error Messages of the Synthesizer"
Level 2nd LO	LO level at second mixer too small	"Error Messages of the Synthesizer"
Level 3rd LO	LO level at third mixer too small	"Error Messages of the Synthesizer"
OVLD	Input signal too large	"Overload Messages"
IF OVLD	Signal following IF amplifier too large	"Overload Messages"

Error Messages of the Synthesizer

When the message LO UNL is displayed, the instrument continues operating, however, the signals indicated may have been shifted on the frequency axis. In particular, when the instrument is operated at about the maximum or minimum operating temperature, it may occur, after ageing of the instrument, that the tuning voltage of the voltage-controlled oscillators drift at the limit of the permitted range. Therefore, correction of the pretuning is provided for the first LO (YIG oscillator) and the third LO (VCO) which is performed during total calibration of the instrument, thus eliminating the error. Correction is not required for the second LO, since it is obtained by multiplication of the third LO. For measuring accuracy reason, it is recommended with very cold or hot environment to call the total calibration of the instrument (after a warm-up period of at least 30 minutes).

When the message "Reference unlock" is output and if the analyzer is set to external reference, check that the latter is applied with the correct frequency and sufficient level at connector EXT REF IN/OUT. If the instrument is set to internal reference, the message should only occur during a short warm-up phase following switch-on.

The message Level Lo means that the level at the LO gate of one of the mixers is too low, which may lead to dips in the conversion attenuation. In any case, this message indicates a fault inside the instrument.

Overload Messages

The messages OVLD and IF-OVLD indicate an overload in the signal path of the instrument. These messages are a warning that the instrument indication will seem to be wrong, because one stage in the signal path is operated with the 1-dB compression or above.

The message OVLD indicates that one stage preceding the variable IF amplifier is operated with an exceeded level. The level can only be reduced by an increased attenuation of the input attenuator (RF Attenuation). Overload at the input mixer and in the subsequent stages frequently occurs, if pulsed or highly modulated signals are applied. Such signals have a high peak value compared to the input bandwidth and this may lead to compression of these stages.

If this message is output without an input signal being applied, the input mixer is defective. The LO feedthrough (= the level display with input frequency zero) depends to a large extent on the balance of the input mixer. Since a partially faulty mixer becomes very unbalanced, thus providing very high LO feedthrough, this may lead to overload of the subsequent stages and thus to output of the message OVLD.

The message IF-OVLD indicates compression in one stage following the switchable IF amplifier. This can be remedied even with fixed input attenuation by increasing the reference level. In analyzer mode, the IF amplification depends on the reference level and the RF attenuation.

Selftest

The selftest allows for checking the instrument functions without using additional test instruments. When an instrument error occurs, the module which caused the error is indicated on the screen. The following measures are taken to localize an error:

- An additional A/D converter is provided which allows for measuring voltages on the various modules.
- While the selftest is being performed, important dc voltages, on-board supply voltages and amplifier operating points are measured and compared to their rated values.
- Level detectors check the oscillator levels required for operating the mixers
- The calibration generator generates a 120-MHz signal with a level of 0 dBm at the RF input of the instrument. The on-board level detectors in the signal path allow for processing of the input signal in the individual RF and IF stages.

Operation

Operation of the selftest is explained in the Operation Manual , Chapter 2, Section "Selftest Functions".

Testing the Processor Functions

The test of the processor functions comprises testing of the interface chips and the dynamic RAM, test of the graphic board and the connected transputers.

If the CPU, the dynamic RAM or the hard disk are defective, the instrument may not be able any more to output a detailed error message.

Testing the Synthesizers

Correct functioning of all oscillators is absolutely necessary for checking the signal path. Therefore, all synthesizer modules are checked next. The synthesizer modules are tested in the following order:

1. Test of the reference frequencies with 10 MHz and 120 MHz and the derived signals with 20, 30 and 60 MHz.
2. Measurement of the signals applied to the YIG sampler (output signal of fracsyn and output signal of sampler)
3. Test of the YIG main loop with the cutoff frequencies by measuring the YIG tuning voltage
4. Check of the LO levels and of the operating points of the LO drivers

In case of an error the selftest is aborted since it does not make sense measuring the signal path if e.g., no LO level is provided.

Testing the Signal Path

Subsequently, the modules in the signal path are checked. The fracsyn module accommodates a 120-MHz calibration generator, the output power of which is checked using individual test points. This signal is connected into the signal path via a changeover switch in the input attenuator of the FSE. The test sequence is as follows:

1. Check of the RF attenuator
2. Check of the RF converter by testing the operating points of the amplifiers
3. Check of the 2nd IF converter by testing the operating point of the amplifier for the second IF and reading out of the level detectors in the signal path.
4. Check of the IF filters by testing the supply voltages for the individual filter circuits, the tuning voltages for the filter bandwidths and the level detectors.
5. Check of detector board

Though the selftest provides high measuring depth, it cannot be assumed that the module which has been found out to be faulty is always really faulty. A faulty cable, e.g., has the same effect as an interrupt in the input attenuator. Therefore, have the faulty function checked by an R&S servicing shop when an error message occurs.

Contents - Chapter 4 "Software Update/Installing Options"

4 Software Update/Installing Options..... 4.1

 New Installation of the FSE Software 4.1

 Installing the Options 4.2

4 Software Update/Installing Options

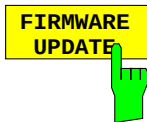
This chapter contains information on extension and modification of the FSE. Additional manuals obtained together with a software/firmware update or with subsequently acquired options can be filed here.

New Installation of the FSE Software

The installation of a new firmware version can be performed using the built-in diskette drive. The firmware update kit contains several diskettes.

The installation program is called up in the *SETUP* menu.

CONFIGURATION SETUP sidemenu:



The *FIRMWARE UPDATE* softkey starts the installation program and leads the user through the remaining steps of the update

Performing the update:

- Insert diskette 1 into the drive.
- Press the *SETUP* key.
- Press the menu change key  .
The *SETUP* side menu is called
- Press the *FIRMWARE UPDATE* key.
The update is started.



The *RESTORE FIRMWARE* softkey restores the previous firmware version

Installing the Options

The following options are available with the FSE:

Tracking Generator 3.5 GHz	FSE-B8	1066.4469.02
Tracking Generator 3.5 GHz with I/Q Modulator	FSE-B9	1066.4617.02
Tracking Generator 7 GHz	FSE-B10	1066.4769.02
Tracking Generator 7 GHz with I/Q Modulator	FSE-B11	1066.4917.02
Switchable Attenuator for Tracking Generator	FSE-B12	1066.5065.02
External Mixer Output	FSE-B21	1084.7243.02
1-dB Attenuator	FSE-B13	1119.6499.02
Ethernet Interface 15-contact AUI connector	FSE-B16	1073.5973.02
Thin-wire BNC connector	FSE-B16	1073.5973.03
2nd IEC/IEEE Bus Interface	FSE-B17	1066.4017.02

For retrofitting, please note the mounting instructions enclosed with the options. These mounting instructions can be filed at this place in the service manual and are thus easily available whenever they are required.

Caution!



Disconnect the instrument from the mains before opening the casing. Also note the safety instructions at the beginning of this manual.

The components used in the instrument are sensitive to electrostatic discharges which is why they are to be dealt with according to the ESD regulations.

When installing hardware options note the following:

- Switch off instrument and pull the mains plug.
- Unscrew the rear feet on left and right
- Push the top and bottom cover backwards using a thin screwdriver.
- After installing the option replace the tube and fasten the rear panel feet again.

Caution!



When replacing the covers take care not to damage or pull off cables.

- Switch on FSE.
- Install additional software, if supplied, according to the instructions enclosed with the option.
- If an adjustment is required for this option, the appropriate hints are to be found in the installation instructions for the option.

Contents - Chapter 5 "Documents"

5 Documents

- Shipping of Instrument and Ordering of Spare Parts 5.1
 - Shipping of Instrument..... 5.1
 - Shipping of a Module 5.1
 - Ordering Replacement Parts 5.2
 - Replaced Modules 5.2
 - Ordering and Delivery of Replaced Modules 5.2
 - Taking back Defective Replaced Modules 5.2
- Cable Exchange 5.3
 - Available Power Cables 5.3
- Documents for FSE 5.5

5 Documents

This chapter provides information on the ordering of spare parts and contains the documents for the FSE basic unit. The replacement of modules and the spare part list is described in the service manual, order number 1065.6016.24 (not included).

Shipping of Instrument and Ordering of Spare Parts

Please contact your Rohde & Schwarz support center or our spare parts express service if you need service or repair of your equipment or to order spare parts and modules.

The list of the Rohde & Schwarz representatives and the address of our spare parts express service are provided at the beginning of this service manual.

We require the following information in order to answer your inquiry fast and correctly and to decide whether the warranty still applies for your instrument:

- Instrument model
- Serial number
- Firmware version
- Detailed error description in case of repair
- Contact partner for checkbacks

Shipping of Instrument

When shipping the instrument, be careful to provide for sufficient mechanical and antistatic protection

- Repack the instrument as it was originally packed when transporting or shipping. The two protective caps for the front and rear panels prevent the control elements and connectors from being damaged. The antistatic packing foil avoids any undesired electrostatic charging to occur.
- If you do not use the original packaging, provide for sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

Shipping of a Module

When shipping a module, then, also be also careful to provide for sufficient mechanical and antistatistical protection

- Ship the module in a sturdy, padded box.
- Wrap the board into antistatic foil.
If the packaging is only antistatic but not conductive, additional conductive packaging is required. The additional packaging is not required if the enclosed packaging is conductive.
Exception: If the module contains a battery, the tightly fitting packaging must always consist of antistatic, non-chargeable material to protect the battery from being discharged.

Ordering Replacement Parts

To deliver replacement parts promptly and correctly we need the following indications:

- Stock number (see component lists in this chapter)
- Designation
- Component number according to component list
- Number of pieces
- Instrument type the replacement part belongs to
- Contact person for possible questions

The stock numbers necessary for ordering replacement parts and modules as well as power cables can be found further down.

Replaced Modules

Replaced modules are an economic alternative for original modules. It should be kept in mind that replaced modules are not new, but repaired and fully tested parts. They may have traces from use but they are electrically and mechanically equivalent to new modules.

To find out which replaced modules are available, please refer to your Rohde & Schwarz representative (or to the central service division, Rohde & Schwarz Munich).

Ordering and Delivery of Replaced Modules

For ordering replaced modules, the same indications as for ordinary parts are required.

Taking back Defective Replaced Modules

Defective modules of the replacement program which can be repaired are taken back within 3 months after delivery of the replaced module. A repurchasing value is credited.

Excluded are parts which can not be repaired, e.g. PCBs that are burnt, broken or damaged by repair attempts, incomplete modules, parts which are heavily damaged mechanically.

The defective parts must be sent back with a returned accompanying document containing the following information:

- Stock number, serial number and designation of the dismantled part,
- Precise description of the error,
- Stock number, serial number and designation of the instrument the part was dismantled from,
- Date of dismantling,

Name of the technician who exchanged the part.

A returned accompanying document is provided with each replacement module.

Cable Exchange

Table 5-1 at lists all power cables available. The stock numbers necessary for ordering replacement parts and modules can be found in the component lists further down.



Important Note!

When replacing a module please note the safety instructions and the repair instructions given in chapter 3 and at the beginning of this service manual.

Available Power Cables

Table 5-1 List of power cables available

Stock No.	Earthed-contact connector	Preferably used in
DS 006.7013	BS1363: 1967' complying with IEC 83: 1975 standard B2	Great Britain
DS 006.7020	Type 12 complying with SEV-regulation 1011.1059, standard sheet S 24 507	Switzerland
DS 006.7036	Type 498/13 complying with US-regulation UL 498, or with IEC 83	USA/Canada
DS 006.7107	Type SAA3 10 A, 250 V, complying with AS C112-1964 Ap.	Australia
DS 0025.2365 DS 0099.1456	DIN 49 441, 10 A, 250 V, angular DIN 49 441, 10 A, 250 V, straight	Europe (except Switzerland)

This page is intentionally left blank.

Documents for FSE

Overall Instrument

Circuit Diagram