

Dear Customer,

The Signal Generator includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (<http://www.openssl.org/>).

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Trade names are trademarks of the owners.



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



Safety Instructions

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standard of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for an intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that the product 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 product documentation	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 relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Tags and their meaning

DANGER	This tag indicates a definite hazard carrying a high risk of death or serious injury if not avoided.
WARNING	This tag indicates a possible hazard carrying a medium risk of death or (serious) injury if not avoided.
CAUTION	This tag indicates a hazard carrying a low risk of minor or moderate injury if not avoided.
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 in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and thus contribute to personal injury or material damage.

Basic safety instructions

1. The product may be operated only under the operating conditions and in the positions specified by the manufacturer. Its ventilation must not be obstructed during operation. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products:
prescribed operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude 2000 m above sea level, max. transport altitude 4500 m above sea level.
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 thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
5. If handling the product yields hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation.
6. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered by electromagnetic radiation. The employer/operator is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.
7. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.
8. Prior to switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
9. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with earthing contact and protective earth connection.
10. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
11. If the product has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply. If products without power switches are integrated in racks or systems, a disconnecting device must be provided at the system level.
12. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.
13. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
14. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, this can result in sparks, fire and/or injuries.
15. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
16. For measurements in circuits with voltages $V_{\text{rms}} > 30 \text{ V}$, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
17. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.
18. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.

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 license 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 for the user or damage to the product, which can also lead to personal injury.
24. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product was moved from a cold to a warm environment.
25. Do not close any slots or openings on the product, since they are necessary for ventilation and prevent the product from overheating. Do not place the product on soft surfaces such as sofas or rugs or inside a closed housing, unless this is well ventilated.
26. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.
27. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. Do not short-circuit batteries and storage batteries.
If batteries or storage batteries are improperly replaced, this can cause an explosion (warning: lithium cells). Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries must be recycled and kept separate from residual waste. Batteries and storage batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.
28. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.
29. The product can be very heavy. Be careful when moving it to avoid back or other physical injuries.
30. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves).
31. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.
32. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. The driver is always responsible for the safety of the vehicle. The manufacturer assumes no responsibility for accidents or collisions.
33. If a laser product (e.g. a CD/DVD drive) is integrated in a Rohde & Schwarz product, do not use any other settings or functions than those described in the product documentation. Otherwise this may be hazardous to your health, since the laser beam can cause irreversible damage to your eyes. Never try to take such products apart, and never look into the laser beam.



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



Informaciones de seguridad

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los standards de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el comprobante de conformidad adjunto según las normas de la CE y ha salido de nuestra planta en estado impecable según los standards técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las informaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto 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 mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones de la correspondiente documentación de producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos profundos y conocimientos parciales del idioma inglés. Por eso se deberá tener en cuenta de exclusivamente autorizar para el uso del producto a personas peritas 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 documentación de producto	Informaciones para maquinaria con un peso de > 18kg	Peligro de golpe de corriente	¡Advertencia! Superficie caliente	Conexión a conductor protector	Conexión a tierra	Conexión a masa conductora	¡Cuidado! Elementos de construcción con peligro de carga electrostática

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

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 el capítulo correspondiente de la documentación de producto y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por el grupo de empresas Rohde & Schwarz bajo la denominación de „producto“, entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Palabras de señal y su significado

PELIGRO	Identifica un peligro directo con riesgo elevado de provocar muerte o lesiones de gravedad si no se toman las medidas oportunas.
ADVERTENCIA	Identifica un posible peligro con riesgo medio de provocar muerte o lesiones (de gravedad) si no se toman las medidas oportunas.
ATENCIÓN	Identifica un peligro con riesgo reducido de provocar lesiones de gravedad media o leve si no se toman las medidas oportunas.
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 área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación de producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a malinterpretaciones y tener por consecuencia daños en personas u objetos.

Informaciones de seguridad elementales

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

Informaciones de seguridad

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/usuario está comprometido a valorar y señalar áreas de trabajo en las que se corra un riesgo aumentado de exposición a radiaciones para evitar riesgos.
7. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.
8. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la del la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso dabo cambiar los fusibles correspondientes del producto.
9. Productos de la clase de seguridad I con alimentación móvil y enchufe individual de producto solamente deberán ser conectados para el funcionamiento a tomas de corriente de contacto de seguridad y con conductor protector conectado.
10. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto. Puede tener como consecuencia el peligro de golpe de corriente por el producto. Si se utilizaran cables o enchufes de extensión se deberá poner al seguro, que es controlado su estado técnico de seguridad.
11. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurar de que el enchufe sea de fácil acceso y nabejo (según la medida del cable de distribución, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en construcciones o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

Informaciones de seguridad

12. No utilice nunca el producto si está dañado el cable eléctrico. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.
13. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A (utilización de fusibles de mayor amperaje sólo previa consulta con el grupo de empresas Rohde & Schwarz).
14. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.
15. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.
16. En las mediciones en circuitos de corriente con una tensión de entrada de $U_{\text{eff}} > 30 \text{ V}$ 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. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar heridas, fuego o daños en el producto.
19. Si un producto es instalado fijamente en un lugar, se deberá primero conectar el conductor protector fijo con el conductor protector del aparato antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
20. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, el circuito de suministro de corriente deberá estar protegido de manera que usuarios y productos estén suficientemente protegidos.
21. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir 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 para el usuario o de daños en el producto lo cual también puede llevar al peligro de personas.
24. No utilice el producto bajo condiciones en las que pueda producirse y se hayan producido líquidos de condensación en o dentro del producto como por ejemplo cuando se desplaza el producto de un lugar frío a un lugar caliente.
25. Por favor no cierre ninguna ranura u orificio del producto, ya que estas son necesarias para la ventilación e impiden que el producto se caliente demasiado. No pongan el producto encima de materiales blandos como por ejemplo sofás o alfombras o dentro de una caja cerrada, si esta no está suficientemente ventilada.
26. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.

Informaciones de seguridad

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

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Fading Simulation - Fader Block

Introduction - Fading Simulation

The R&S signal generator allows the user to superimpose fading on the baseband signal at the output of the baseband block in realtime. When fitted with all of the possible options, up to 40 fading paths are available for a single fader, or 20 fading paths each in case of dual-channel fading. The two channels can be configured differently for different test scenarios. Using the same input signal and two separate output signals, for example, frequency diversity can be simulated. Using separate input signals which are summed after fading, a network handover can be simulated, for example.

A wide range of presets based on the test specifications of the major mobile radio standards simplifies the use of the fader in research, development, and quality assurance involving mobile radio equipment. For more complex tests, all of the parameters of the supplied fading configurations can be user-defined as required.

To ensure the repeatability of the tests, the fading process is always initiated from a defined starting point. A restart can be triggered manually or using configurable internal or external trigger signals.

Frequency hopping which builds upon the prior fading process after a frequency hop allows realistic simulation of frequency hopping conditions.

Graphical presentation of the defined fading paths, along with a path delay wizard, provide support to the user when setting up the desired fading channel.

During transmission of a signal from the transmitter to the mobile receivers, diverse fading effects occur which can be simulated by the fading simulator separately or in combination.

In the **Standard Delay** and **Fine Delay 30/50MHz** stationary fading configurations, up to 40 fading paths are simulated with different delays as occur on a transmission channel due to different propagation paths. Several fading profiles are available for each path. **Pure Doppler Fading** simulates a direct transmission path on which Doppler shift is occurring due to movement of the receiver. **Rayleigh Fading** simulates a radio hop which arises as a result of scatter caused by obstacles in the signal path (buildings, etc.). **Rice Fading** simulates a Rayleigh radio hop along with a strong direct signal. These profiles are fast fading profiles, and they simulate fast fluctuations of the signal power level which arise due to variation between constructive and destructive interference during multipath propagation. **Lognormal** and **Suzuki Fading** are slow fading profiles which simulate slow level changes which can occur, say, due to shadowing effects (e.g. tunnels).

In the dynamic configurations **Birth Death Propagation** and **Moving Propagation**, dynamic propagation conditions are simulated in conformity with test cases 25.104xxx, annex B3 and annex B4 from the 3GPP Standard. Delay variations (whether sudden or slow) do not become important until we reach the fast modulation standards such as 3GPP. The reason is that in this case the delay variations can be on the order of magnitude of the transmitted symbols so that transmission errors can arise.

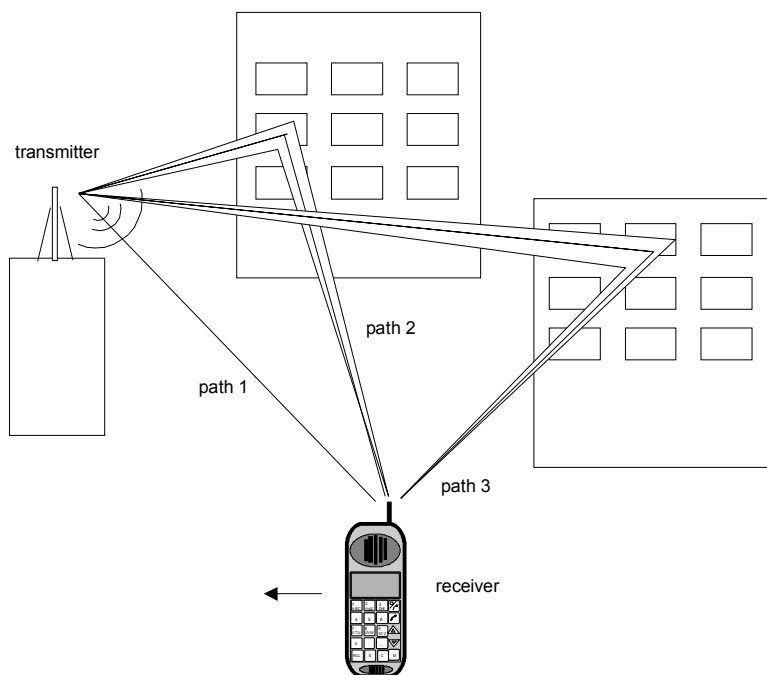
In the dynamic configuration **2 Channel Interferer**, the MediaFlo test cases 5 and 6 are simulated.

The following figure gives an example of single-channel fading with three transmission paths.

Path 1 represents the discrete component, i.e. a direct point-to-point transmission between the transmitter and receiver (pure Doppler fading profile).

Paths 2 and 3 represent the distributed components, i.e. signals which are scattered due to obstacles (Rayleigh fading profile).

When the Rice fading profile is selected, a combination of distributed and discrete components is generated in a path (see also the display of the spectrum of a QPSK signal which is subjected to Rician fading at the end of the parameter description).



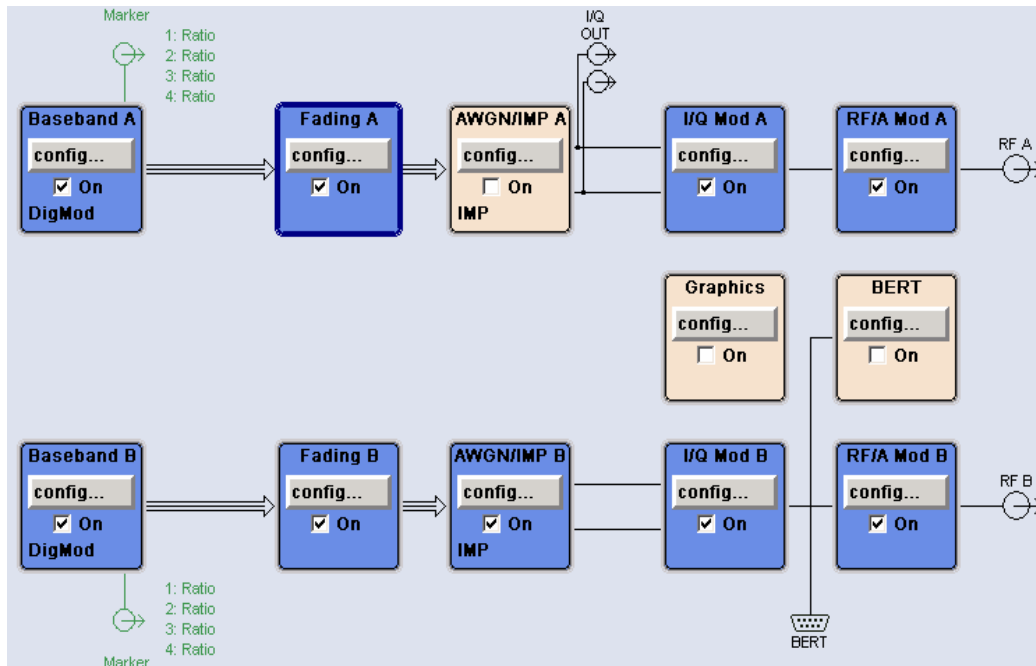
The fading process increases the crest factor of the signal, and this increase must be taken into account in the drive at the baseband level. When multiple paths are superimposed or in case of statistical influences on a path, an insertion loss is useful for providing a drive reserve. If the full drive level is reached nevertheless, the I/Q signals are limited to the maximum available level (clipping). The mode for determining the range for insertion loss is selectable (**Insertion Loss Configuration**). The insertion loss is automatically adjusted within this range to keep the output power constant. However, the maximum available output power of the R&S signal generator is reduced by up to 18 dB.

If statistically correlated processes occur, such as the fading of modulation signals with symbol rates approximating the delay differences of the fading paths, correct automatic adaptation of the insertion loss is not possible. In this case, the output power must be measured again.

During further signal routing, it is possible to additionally offset the faded signals or to apply noise to them (see the sections "[Impairment Settings Menu](#)" and "[AWGN Settings Menu](#)").

The fading settings are summarised in the block diagram in the **Fading** functional block as well as in the menu with the same name for the **MENU** key.

The figure below shows the block diagram for an R&S SMU.



Options for the base unit with the Frequency option (B10x) include the following: Baseband Main Module (B13), Baseband Generator (B10), and Fading Simulator for **Standard Delay** configuration (B14). Additional configurations - dynamic fading (**Birth Death, Moving Propagation, and 2 Channel Interferer**) and enhanced resolution (**Fine Delay** configurations) - require option K71.

The Path Extension option (B15) is used to double the number of fading paths from 20 to 40 or to configure dual-channel fading with 20 paths per channel.

In dual-path instruments where the Fading Simulator Option (B14) is fitted, only fader A or fader B can be switched on at one time, i.e. the 20 fading paths are available either for baseband path A or B.

If the Path Extension option (B15) is fitted additionally, either 40 fading paths are available for one of the two faders or 20 fading paths for each of the two faders (**dual-channel fading**).

The 2x2 MIMO (Multiple Input Multiple Output) Fading option (B74) is used to simulate a MIMO system with two transmitting antennas and two receiving antennas.

Signal Routing – Fading Simulator

In the **Fading** functional block, the Fading menu is called up to configure the fading and a selection is made about how to route the faded baseband signal at the output of the fader.

Note:

The following block diagrams are taken from a R&S SMU signal generator.

Signal Routing

Selects the signal routing for the fading signal at the output of the fading simulator.

The input signal to the fading simulator is specified in the routing menu of the respective baseband block (see the section “[Signal Routing and Frequency Offset](#)”). When fitted with two faders and two baseband blocks, the faders can be fed the signal from a single baseband block, the summation signal from both baseband blocks or each a signal from one of the two baseband blocks.

Note:

The processing time for the baseband signal is always the same for the two faders, regardless of the status of the faders (On or Off). The only exception is fading with 40 fading paths. In this case, the processing times are different: the signal from the 40-path fader has a longer processing time than the signal from the fader which is switched off.

The proposed routes for the fading output signal differ also depending on the options fitted in the instrument:

Instruments with the Fading Simulator (option B14)

For a single-path instrument, the output signal is always output on path A.

Remote-control command: n.a.

In dual-path instruments, the fader output signal can be assigned either to path A, path B, or to both paths. Only one of the faders, A or B, can be operated. In Standard Delay mode, 20 fading paths are available for this fader. The signal of the other fader is either output unfaded (selection (max paths) - (unfaded)) or the signal flow is interrupted (selection A and B - (open)). The following table describes the possible routing settings.

Fading	
Fading Settings...	
Signal Routing	
A → A (unfaded)	B → B (max paths)
<input checked="" type="checkbox"/> A → A (max paths)	B → B (unfaded)
A → A and B	B → (open)
A → (open)	B → A and B

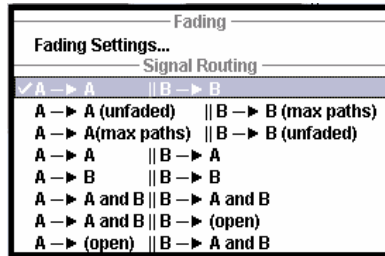
Remote-control command:

SOUR : F SIM : ROUT FAMAXA

Instruments with the Fading Simulator (option B14) and Path Extension (option B15)

For a single-path instrument, the output signal is always output on path A. In **Standard Delay** mode, 40 fading paths are available.

For dual-path instruments with two baseband modules (2 x option B13) and one or two baseband sources (1/2 x option B10) a selection menu for signal routing is offered:



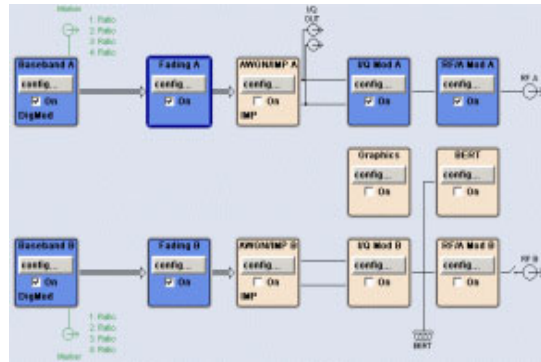
The following table shows all of the possible routing settings for dual-path instruments in a configuration with both fader options (B14 and B15).

A to A/ B to B

Dual-channel fading. The fading signal from fader A is output on baseband path A and the fading signal from fader B is output on baseband path B. In **Standard Delay** mode, **20** fading paths are available for each fader.

When fitted with a second baseband generator, the generator can be operated like two instruments; two independently configured signals are present at the signal generators output.

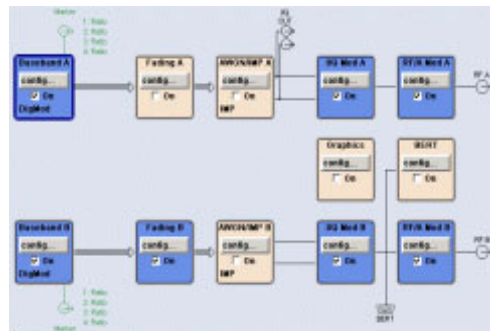
When using only a single baseband generator, the receiving conditions of a receiver (e.g. high-quality car radio, UMTS base station) with two antennas can be simulated (transmit or receive diversity). It is possible to correlate the paths of the two faders (the two fading channels) and thus simulate conditions which occur if a receiver has two antennas which receive statistically correlated signals (e.g. a car with two antennas in which the two received signals exhibit a certain degree of correlation due to a similar environment such as an underpass, hill, etc.)



Remote-control command:
 SOUR : F SIM : ROUT FAAFBB

A to A (unfaded) / B to B (max. paths)

The fading signal from fader B is output on baseband path B. Fader A cannot be activated. In **Standard Delay** mode, **40** fading paths are available for fader B.



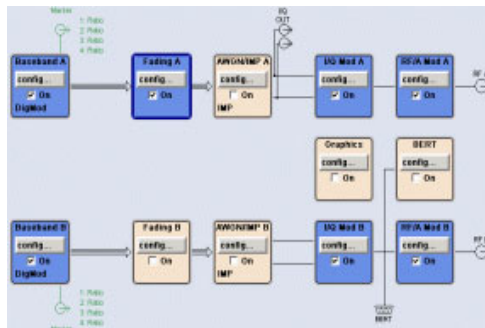
Note:

The signal from the 40-path fader has a longer processing time than the signal from the fader which is switched off.

Remote-control command:
 SOUR : F SIM : ROUT FBMAXB

**A to A (max. paths) /
B to B (unfaded)**

The fading signal from fader A is output on baseband path A. Fader B cannot be activated. In **Standard Delay** mode, **40** fading paths are available for fader A.



Note:

The signal from the 40-path fader has a longer processing time than the signal from the fader which is switched off.

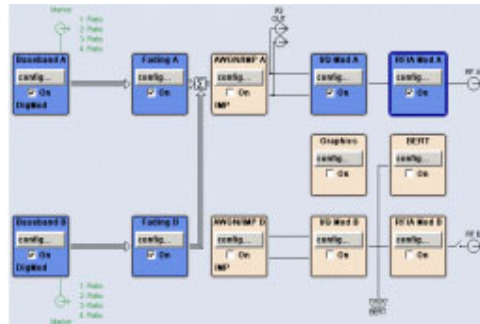
Remote-control command:

SOUR : F SIM : ROUT F AMAXA

A to A/B to A

Dual-channel fading. The fading signal from fader A and the fading signal from fader B are both output on baseband path A. In **Standard Delay** mode, **20** fading paths are available for each fader.

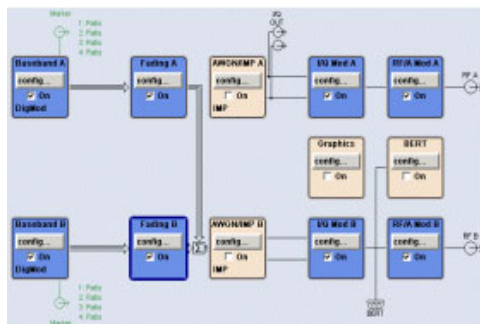
When fitted with a second baseband generator, for example, the conditions can be simulated for a mobile radio network handover in the handheld device or for filtering out the own signal in case of simultaneous presence of a strong signal from another standard. To do this, each baseband signal is configured according to the desired standard and passed to one fader in each case. After fading, the two signals with widely divergent signal strengths are output on a common output path.



Remote-control command:
 SOUR:FSIM:ROUT FAAFBA

A to B / B to B

Dual-channel fading. The fading signal from fader A and the fading signal from fader B are both output on baseband path B. In **Standard Delay** mode, **20** fading paths are available for each fader.

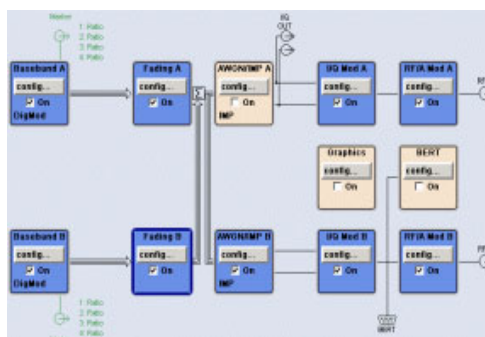


Remote-control command:
 SOUR:FSIM:ROUT FABFBB

A to A and B / B to A and B

Dual-channel fading. The fading signal from fader A and the fading signal from fader B are output on baseband path A and baseband path B. In **Standard Delay** mode, **20** fading paths are available for each fader.

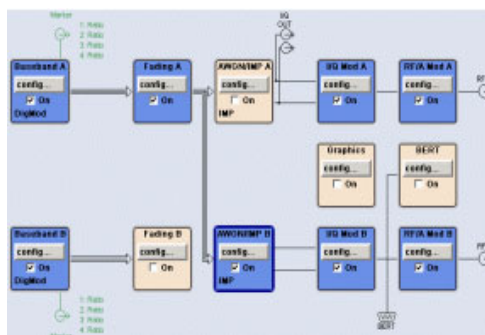
The possible applications are basically analogous to **A to A / B to A** routing, but here due to the splitting of the fader output signal among two paths, these two paths can also be processed differently after the fading. For example, a further degradation of the receiving conditions can be simulated for comparison purposes on a path by superimposing noise on the signal and distorting it.



Remote-control command:
 SOUR : F'SIM : ROU T FAABFBAB

A to A and B / B (open)

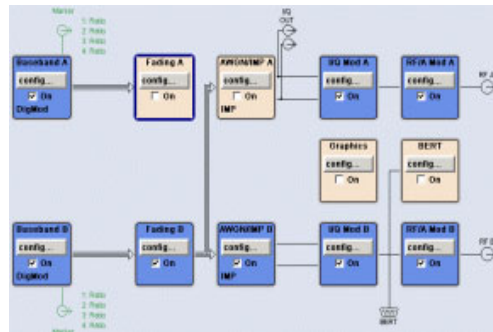
The fading signal from fader A is output on baseband path A and baseband path B. The signal from fader B is not output, the signal flow of baseband B is interrupted. In **Standard Delay** mode, **40** fading paths are available for fader A.



Remote-control command:
 SOUR : F'SIM : ROU T FAMAXAB

A (open)/ B to A and B

The fading signal from fader B is output on baseband path A and baseband path B. The signal from fader A is not output, the signal flow of baseband A is interrupted. In **Standard Delay** mode, **40** fading paths are available for fader A.



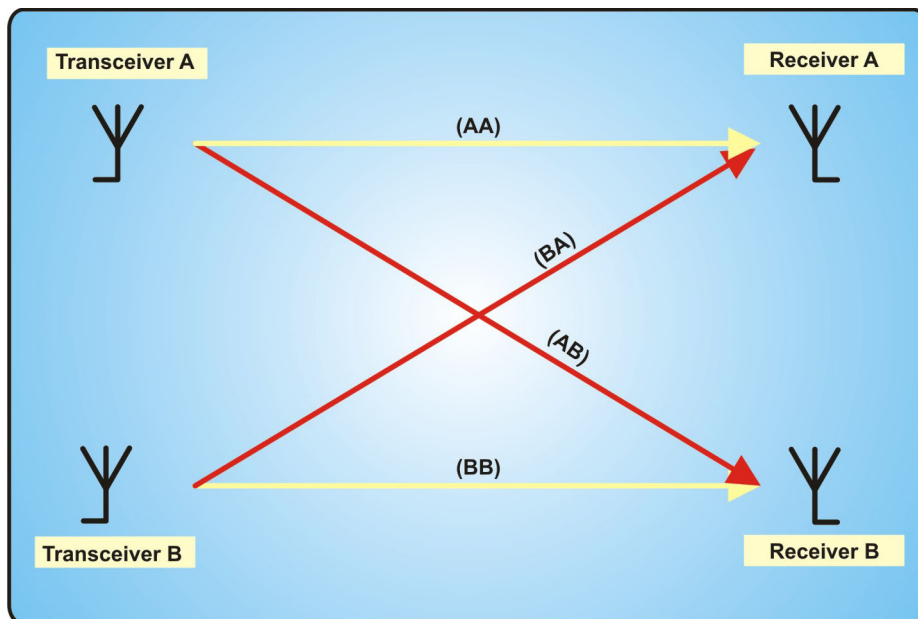
Remote-control command:
 SOUR : F'SIM : ROUT FBMXAB

Multiple Input Multiple Output - Fading

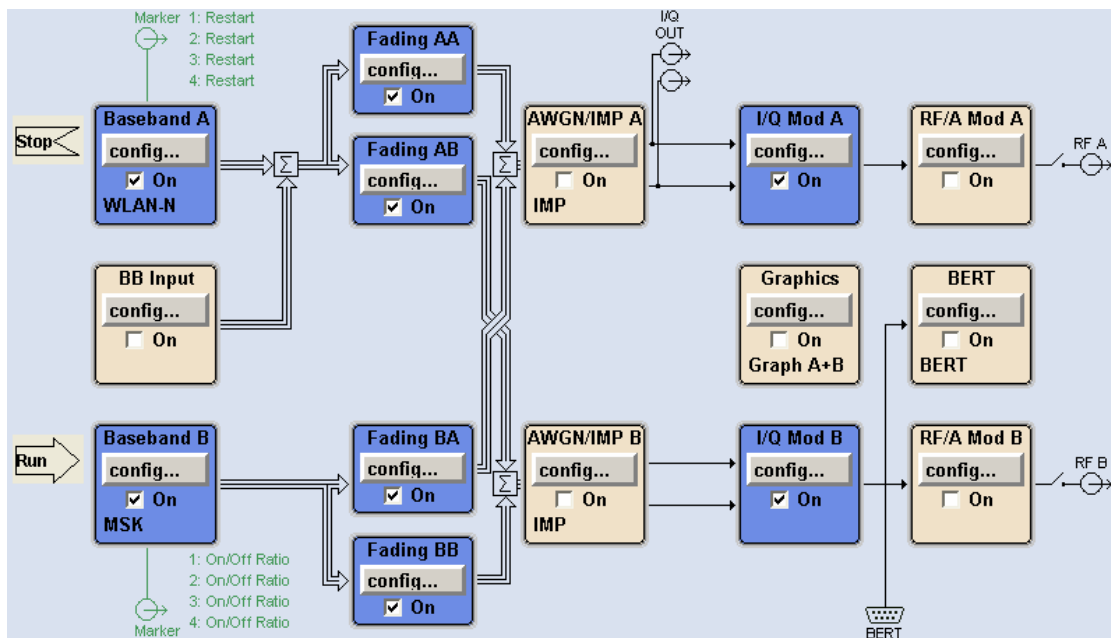
Multiple Input Multiple Output (MIMO) refers to a multi-channel method where two or more simultaneous channel inputs and channel outputs are being used for boosting data rates.

The benefits of an MIMO system became visible only if the data signal is tested in a fading simulation. The MIMO fading option takes account to this special form of multipath propagation in channel simulation.

The 2x2 MIMO fading option allows to simulate a test setup which normally requires two signal generators and four fading simulator in one single unit and simulates a system with two transmitting antennas and two receiving antennas:



The two fading channels are divided into four subchannels as shown below in the block diagramm:



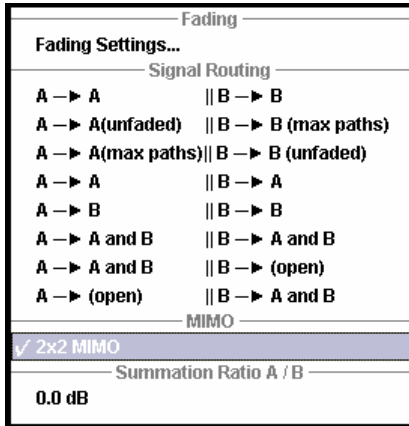
The number of the available fading paths in each of the four subchannels depends on the selected fading configuration:

Configuration	No. of fading paths per subchannel
Standard Delay	10
Fine Delay 30 MHz	6
Fine Delay 50 MHz	4

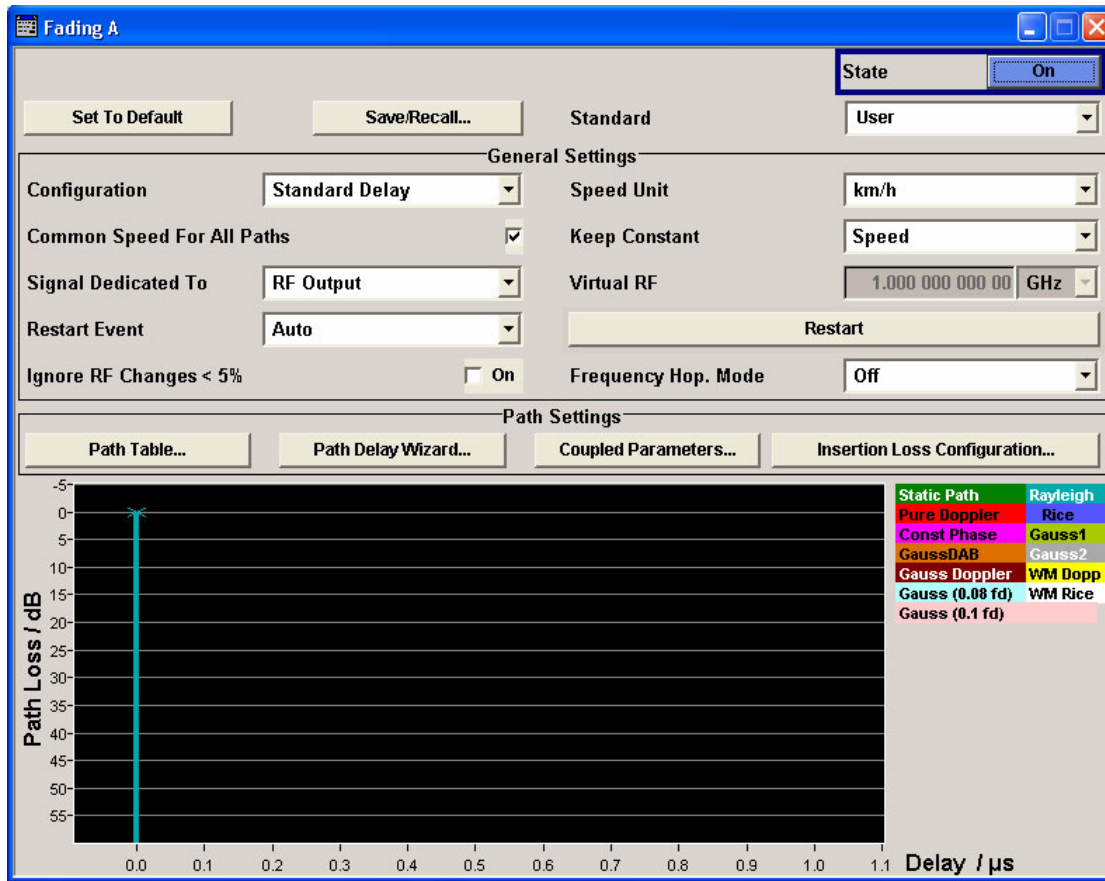
Example: For fading configuration **Standard Delay**, 10 fading paths can be configured for the four subchannels. The 10 paths can be configured from each of the four fading blocks and are valid for all subchannels.

The four subchannels cannot be configured differently, that is, all subchannels are running under the same fading configuration and the same path configuration and, as mentioned above, the same fading path configurations.

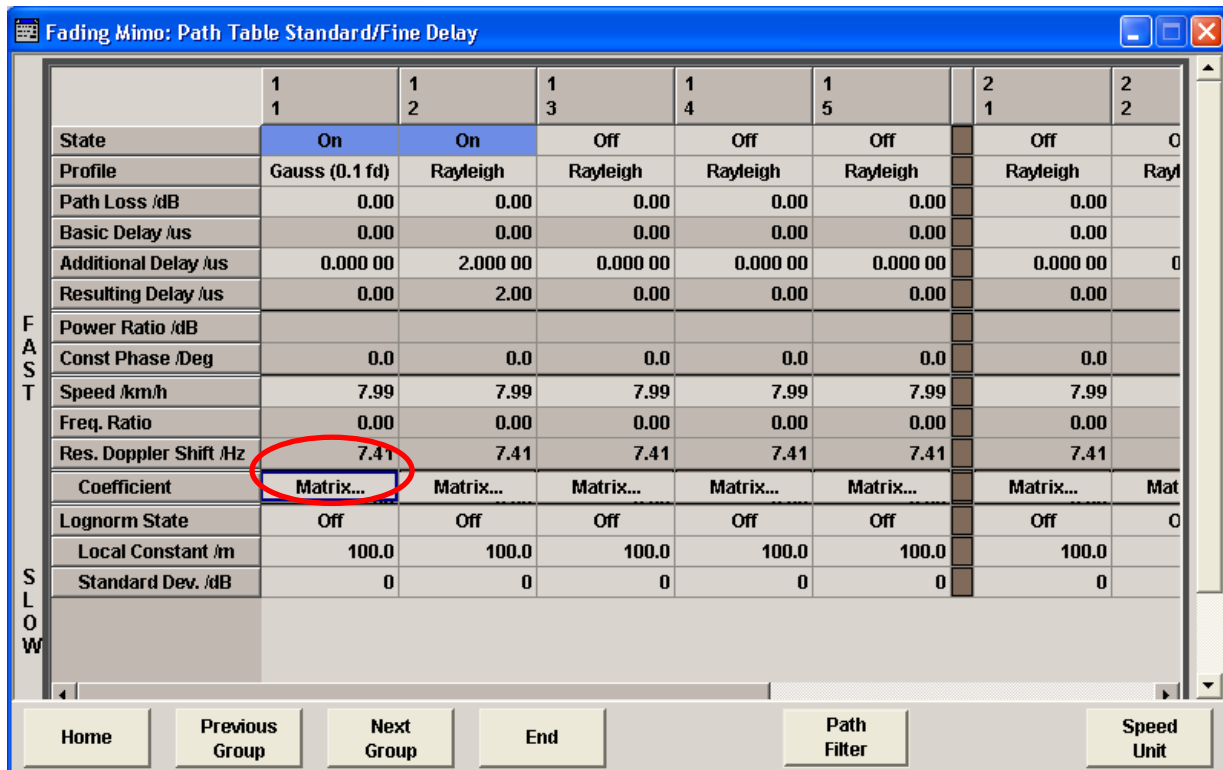
The 2x2 MIMO fading is set in the **Fading** functional block.



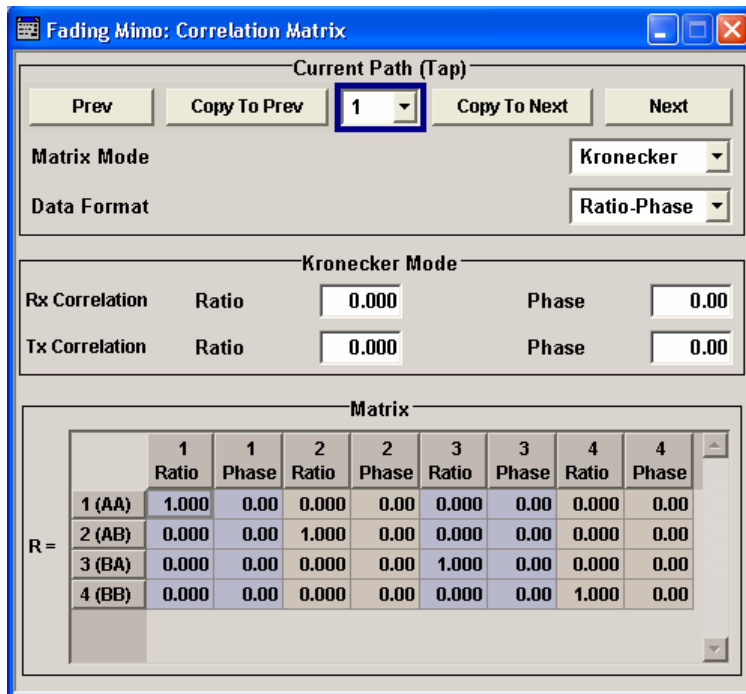
The **Fading MIMO** menu for the four subchannels can be called via the Fader menu of one of the four **Fader** blocks.



For MIMO fading, the Path Table offers an additional button **Matrix** in the **Coefficient** row to configure the correlation between the transceivers.



In the **Correlation Matrix** menu, the correlation between the four subchannels can be configured:

**Prev - Fading**

Displays the previous tab relativ to the current tap. If tap 1 is the current tap, this button is disabled.

Remote-control command: n.a.

Copy To Prev - Fading

Copies the matrix values of the current tap to the next lower tap. If tap 1 is the current tap, this button is disabled.

Remote-control command :
SOUR : F SIM : MIMO : COPY : PREV

Current Path (Tap) - Fading

Selects the tab to be displayed.

Remote-control command :
SOUR : F SIM : MIMO : TAP 5

Copy To Next - Fading

Copies the matrix values of the current tap to the next higher tap. If the current tab ist the last tap, this button is disabled.

Remote-control command :
SOUR : F SIM : MIMO : COPY : NEXT

Next - Fading

Displays the next tab relativ to the current tap. If the current tap is the last tap, this button is disabled.

Remote-control command: n.a.

Matrix Mode - Fading

Selects the input mode for the Rx and Tx correlation values.

Individual Allows to enter the correlation values individually.

Remote-control command :

SOUR:FSIM:MIMO:TAP1:MATR:MODE IND

Kronecker Opens additional input fields for entering the Rx correlation and Tx correlation values. In this mode, the matrix values are calculated automatically due to the values in the input fields.

Remote-control command :

SOUR:FSIM:MIMO:TAP1:MATR:MODE KRON

Data Format - Fading

Selects the data format for the matrix table. The matrix values can be expressed as value pairs of factor and phase or as a complex numbers. The data format can be changed at every time. The matrix table is updated immediately.

Ratio-Phase Displays the matrix values as value pairs of factor and phase.

Remote-control command : n.a.

Real-Imag Displays the matrix values as complex numbers.

Remote-control command : n.a.

Rx Correlation Ratio/Real - Fading (for Kronecker mode only)

Enters the value for the real/ratio part of the receiver correlation.

The Rx correlation is the correlation between AB <-> AA and BA <-> BB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

For Data Format = Ratio-Phase

Remote-control commands :

SOUR:FSIM:MIMO:TAP2:KRON:CORR:RX:RAT 0.5

For Data Format = Real-Imag

Remote-control commands:

SOUR:FSIM:MIMO:TAP2:KRON:CORR:RX:REAL -0.5

Rx Correlation Phase/Imag - Fading (for Kronecker mode only)

Enters the value for the phase/imaginary part of receiver correlation.
The Rx correlation is the correlation between AB <-> AA and BA <-> BB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

For Data Format = Ratio-Phase

Remote-control commands:

SOUR:FSIM:MIMO:TAP2:KRON:CORR:RX:IMAG 0.5

For Data Format = Real-Imag

Remote-control commands:

SOUR:FSIM:MIMO:TAP2:KRON:CORR:RX:PHAS 60

Tx Correlation Ratio/Real - Fading (for Kronecker mode only)

Enters the value for the real/ratio part of the transceiver correlation.
The Tx correlation is the correlation between AA <-> BA and BB <-> AB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

For Data Format = Ratio-Phase

Remote-control commands:

SOUR:FSIM:MIMO:TAP2:KRON:CORR:TX:RAT 0.5

For Data Format = Real-Imag

Remote-control commands:

SOUR:FSIM:MIMO:TAP2:KRON:CORR:TX:REAL -0.5

Tx Correlation Phase/Imag - Fading (for Kronecker mode only)

Enters the value for the phase/imaginary part of the transceiver correlation.

The Tx correlation is the correlation between AA <-> BA and BB <- > AB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

For Data Format = Ratio-Phase

Remote-control commands:

SOUR:FSIM:MIMO:TAP2:KRON:CORR:TX:PHAS 120

For Data Format = Real-Imag

Remote-control commands:

SOUR:FSIM:MIMO:TAP2:KRON:CORR:TX:IMAG -0.5

Correlation Matrix Table

The correlation matrix table displays the values for the transceiver/receiver correlation. The values can either be added by the aid of the Kronecker Mode or individually. The correlation matrix is valid for the selected fading path.

Note:

When entering the values individually, in some cases calculation may be impossible due to inappropriate values. In such cases, change the corresponding values.

		1		2		3		4	
		Real	Imag	Real	Imag	Real	Imag	Real	Imag
R =	1 (AA)	1.000	0.000	0.500	0.070	0.000	0.000	0.000	0.000
	2 (AB)	0.500	-0.070	1.000	0.000	0.000	0.000	0.000	0.000
	3 (BA)	0.000	0.000	0.000	0.000	1.000	0.000	0.500	0.070
	4 (BB)	0.000	0.000	0.000	0.000	0.500	-0.070	1.000	0.000

In case of individually added correlation values, a total of 10 value pairs (diagonal and upper triangle) need to be set. The remaining 6 value pairs (lower triangle) are determined automatically exploiting the complex conjugate symmetry across the diagonal.

	1	1	2	2	3	3	4	4
AA								
AB								
BA								
BB								

user specified values

automatically determined

In Kronecker mode, only one Tx and one Rx correlation needs to be specified per subchannel. The full correlation matrix is automatically computed as follows:

$$\mathbf{R}_l = \mathbf{R}_{Tx}^{(l)} \otimes \mathbf{R}_{Rx}^{(l)} \quad \text{with} \quad \mathbf{R}_{Tx}^{(l)} = \begin{bmatrix} 1 & \rho_{Tx}^{(l)} \\ \rho_{Tx}^{(l)*} & 1 \end{bmatrix} \quad \text{and} \quad \mathbf{R}_{Rx}^{(l)} = \begin{bmatrix} 1 & \rho_{Rx}^{(l)} \\ \rho_{Rx}^{(l)*} & 1 \end{bmatrix}$$

Evaluating the Kronecker product \otimes leads to

$$\mathbf{R}_l = \begin{bmatrix} 1 & \rho_{Rx}^{(l)} & \rho_{Tx}^{(l)} & \rho_{Tx}^{(l)} \rho_{Rx}^{(l)} \\ \rho_{Rx}^{(l)*} & 1 & \rho_{Tx}^{(l)} \rho_{Rx}^{(l)*} & \rho_{Tx}^{(l)} \\ \rho_{Tx}^{(l)*} & \rho_{Tx}^{(l)*} \rho_{Rx}^{(l)} & 1 & \rho_{Rx}^{(l)} \\ \rho_{Tx}^{(l)*} \rho_{Rx}^{(l)*} & \rho_{Tx}^{(l)*} & \rho_{Rx}^{(l)*} & 1 \end{bmatrix}$$

Real/Ratio - Fading

Enters the value for the real/ratio part of the correlation.

Remote-control command :

```
SOUR:FSIM:MIMO:TAP5:MATR:ROW1:COL:2:RAT 0.5
```

Phase/Imag - Fading

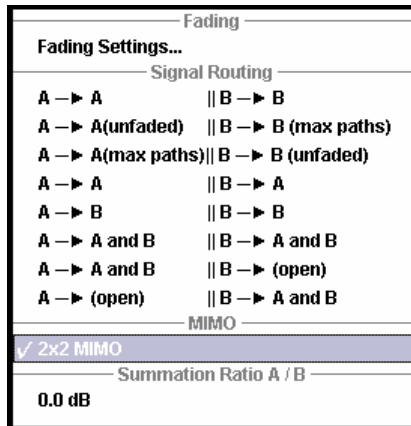
Enters the value for the phase/imaginary part of the correlation.

Remote-control command :

```
SOUR:FSIM:MIMO:TAP5:MATR:ROW1:COL:2:PHAS 90
```


Fading Menu

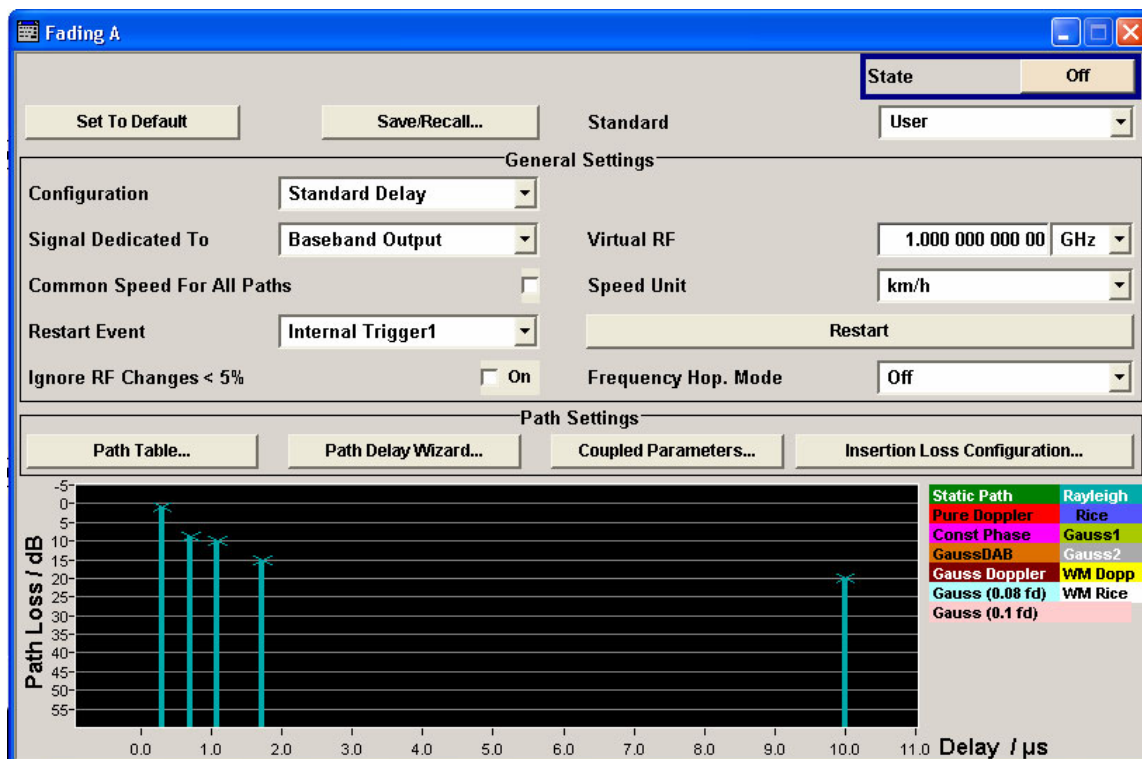
The **Fading** menu is used to configure multipath fading signals. It is called up either in the **Fader** block or using the **MENU** key.



Basic Settings - Fading

The **Fading** menu is divided into several sections:

The Fading Simulator is switched on in the upper section. By selecting a standard, a preset corresponding to different test cases from the common mobile radio standards is called up. Fading settings can be saved, recalled or reset to the default values.



In the **General Settings** section the configuration and the unit for the speed is selected.

It can be determined whether to use the existing RF frequency setting (in case of instruments with RF output) or a user-definable RF frequency for computing the Doppler shift. For instruments without RF output, this RF frequency is virtual. The (virtual) RF frequency is then used to set the modulation frequency of an external I/Q modulator.

The parameters are defined which determine under what conditions a restart of the fading simulation is triggered. For instruments with RF output, frequency hopping is also activated and configured in this section.

The **Path Settings** sections offers different submenus for the configuration of the fading paths depending on the selected fading configuration. The fading settings are displayed graphically.

The parameters are defined which determine under what conditions a restart of the fading simulation is triggered. For instruments with RF output, frequency hopping is also activated and configured in this section.

State - Fading

Powers the fading simulator on or off.

When powered on, the fading process is initiated for the paths which are switched on.

A selectable trigger (**Restart Event**) can be used to restart the fading process. The fading process always begins at a fixed starting point after each restart. This helps to achieve repeatable test conditions.

Remote-control command :
 SOUR : FSIM : STAT ON

Set to Default - Fading

Activates the default settings of the fading simulator.

By default, a path is activated with a Rayleigh profile and a slow speed. All of the other paths are switched off.

The following table provides an overview of the settings. The preset value is indicated for each parameter in the description of the remote-control commands.

Remote-control command:
 SOUR : FSIM : PRES

Parameter	Value
State	Off
Standard	User
Configuration	Standard Delay
Signal Dedicated to	Baseband/RF Output (depending on instrument)
Speed Unit	km/h
Restart Event	Auto
Ignore RF Changes	Off (SMU only)
Frequency Hop. Mode	Off (Smu only)
Insertion Loss	
Insertion Loss Mode	Normal
Coupled Parameters	
All States	Off

Parameter	Value
Path Configuration	
State of path 1	On
State of all other paths	Off
Profile	Rayleigh
Delays	0
Speed of path 1	Slow
Speed of all other paths	0

Save/Recall - Fading

Calls up the **Save/Recall** menu.

In the **Save/Recall** menu, the desired **File Select** window for loading and saving fading configurations as well as the **File Manager** for keeping tracking of files can be called up.



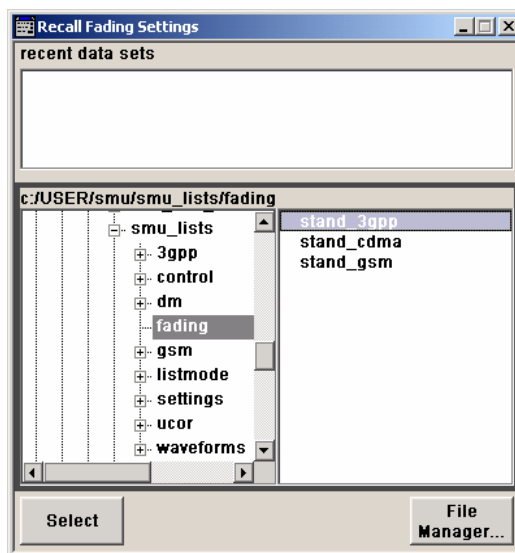
Fading configurations are saved with the file ending ***.fad**. The file name and the directory to store it can be chosen.

The entire settings of the **Fading** menu are always saved and loaded. When fitted with two faders, only the settings of the selected fader are stored.

Recall Fading Settings

Opens the **File Select** window for loading a saved **Fading** configuration.

Press the **Select** button to load the configuration of the selected (marked) file.



Remote-control command:

```
:M MEM:CDIR 'F:\smu\smu_lists\fading'
SOUR:FSIM:CAT?
```

Response:

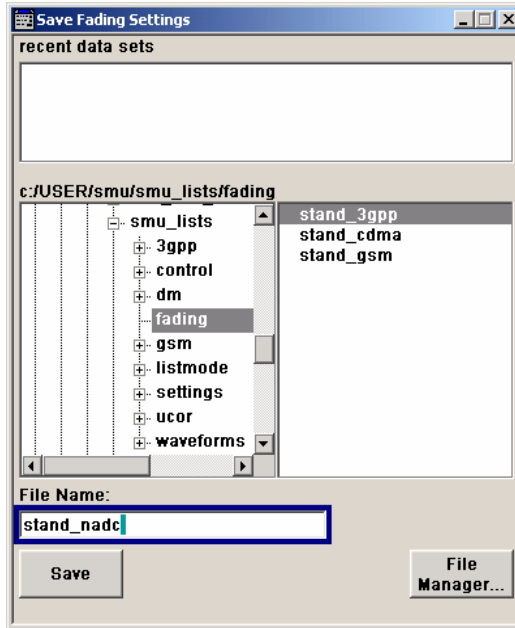
```
'stand_cdma,stand_gsm,stand_3gpp'
```

```
SOUR:FSIM:LOAD "stand_3gpp"
```

Save Fading Settings

Opens the **File Select** window for saving the current **Fading** configuration.

The name of the file is entered in the **File Name** input field, and the directory in the **save into** field. Press the **Save** button to save the file.



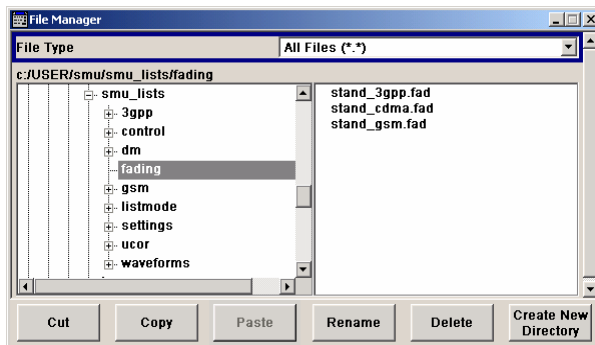
Remote-control command:

```
:MMEM:CDIR 'F:\smu\smu_lists\fading'  
SOUR:FSIM:STOR 'stand_nadc'
```

File Manager

Calls up the **File Manager**.

File Manager is used to perform general file operations such as copy, paste, rename, delete, and to create new directories.



Remote-control commands:

```
:MMEM:CDIR 'F:\smu\smu_lists\fading'  
SOUR:FSIM:DELETE 'stand_nadc'
```

**Standard / Test Case -
Fading**

Selects predefined fading settings.

These settings correspond to the test scenarios stipulated in the common mobile radio standards.

If one of the predefined parameters is modified, **User** is displayed. **User** is also the default setting.

File **fading_standard.pdf** on the CD-ROM provides a listing of the predefined standards along with the underlying test scenarios and the settings which are made.

Remote-control commands:

```
SOUR:FSIM:STAN G6TU3
```

```
SOUR:FSIM:STAN:REF?
```

```
Response: 'GSM_TS8916B'
```

Configuration - Fading

Selects the fading configuration.

Note:

The selection of fine delay and dynamic configurations is only possible with option K71.

For classical fading with simulation of the level fluctuations, the user can choose from three delay configurations:

- Standard Delay,
- Fine Delay 30 MHz and
- Fine Delay 50 MHz.

These delay configurations occur in the received signal as a result of a typical multipath propagation and the propagation conditions, which vary depending on the location and timing.

For classical fading with simulation of the level fluctuations which occur in the received signal as a result of typical multipath propagation and propagation conditions which vary depending on the location and timing, the user can choose from three delay configurations: Standard Delay, Fine Delay 30 MHz and Fine Delay 50 MHz.

The delay configurations differ in terms of the number of paths, the resolution of the path-specific delay, and the available RF bandwidth.

The paths are arranged in groups in the delay configurations. Each group is characterized by a common group delay (Basic Delay). The paths are assigned a path-specific delay (Additional Delay). The total delay of a path is calculated by adding the two values (Resulting Delay).

The number of groups is the same for all three configurations. This number doubles from 4 to 8 when the instrument is fitted with the Path Extension option (B15). There is a maximum of 40 fading paths available in 8 groups for Standard Delay.

For fading with delays which change dynamically, there are three configurations: Birth Death Propagation, Moving Propagation, and 2 Channel Interferer.

Depending on which configuration is selected, the lower sections of the fading menu will change, particularly the path table.

Important:

A separate path table is associated with each configuration, i.e. when changing the delay configuration not only the bandwidth is switched but a completely new path table is loaded.

*Changing the configuration causes an interruption in the fading process, followed by a restart after about one second since the FPGAs in the instrument are rebooted and loaded with the modified configuration. Therefore, the interruption applies to **both** faders if the instrument is fitted with two faders (options B14 and B15).*

Standard Delay

In the **Standard Delay** configuration, each group consists of five paths. This means that 20 or 40 paths can be simulated for a fading channel. The resolution for the path-specific delay is 10 ns (see section "[Delay Modes Path Table - Fading](#)").

Remote-control command:

SOUR:FSIM:DEL:STAT ON

Fine Delay 30 MHz

In the **Fine Delay 30 MHz** configuration, each of the groups consists of three paths. This means that 12 or 24 paths can be simulated for a fading channel. The resolution for the path-specific delay is 10 ps. The RF bandwidth is limited to 30 MHz.

Remote-control command:

SOUR:FSIM:DEL30:STAT ON

Fine Delay 50 MHz

In the **Fine Delay 50 MHz** configuration, each of the groups consists of two paths. This means that 8 or 16 paths can be simulated for a fading channel. The resolution for the path-specific delay is 10 ps. An RF bandwidth of 50 MHz is available.

Remote-control command:

SOUR:FSIM:DEL50:STAT ON

Birth Death Propagation

In the **Birth Death Propagation** configuration, the fading simulator simulates dynamic propagation conditions in conformity with the test case 3GPP, 25.104-320, annex B4. Two paths are simulated which appear (**Birth**) or disappear (**Death**) in alternation at arbitrary points in time (see section "[Birth Death Propagation Path Table - Fading](#)", page 46).

Remote-control command:

SOUR:FSIM:BIRT:STAT ON

Moving Propagation	<p>In the Moving Propagation configuration, the fading simulator simulates dynamic propagation conditions in conformity with the test case 3GPP, 25.104-320, annex B3.</p> <p>Two paths are simulated: Path 1 has fixed delay, while the delay of path 2 varies slowly in a sinusoidal fashion (see section "Moving Propagation Path Table - Fading", page 52).</p> <p>Remote-control command: SOUR:FSIM:MDEL:STAT ON</p>
2 Channel Interferer	<p>In the 2 Channel Interferer configuration, the fading simulator simulates test case 5 and 6 from MediaFlo.</p> <p>Two paths are simulated: Path 1 has fixed delay, while the delay of path 2 varies slowly in a sinusoidal fashion or appears or disappears in alternation at arbitrary points in time (hopping) (see section "2 Channel Interferer", page 55).</p> <p>Remote-control command: SOUR:FSIM:TCI:REF MOV:STAT ON</p>
User Dynamic	<p>The User Dynamic configuration is provided for future use.</p>
Signal Dedicated To - Fading (read-only)	<p>(R&S AMU only)</p> <p>The Doppler shift is computed based on a user-definable virtual RF frequency which is entered under Virtual RF.</p>
Signal Dedicated To - Fading	<p>(R&S SMU only)</p> <p>Selects the RF frequency for computing the Doppler shift.</p>
RF Output	<p>The Doppler shift is computed using the RF frequency set on the generator.</p> <p>Remote-control command: SOUR:FSIM:SDES RF</p>
Baseband Output	<p>The Doppler shift is computed based on a user-definable RF frequency which is entered under Virtual RF.</p> <p>This allows the user to have the Doppler shift computed using the modulation frequency of an external I/Q modulator on which the faded baseband signal is output.</p> <p>Remote-control command:n.a. SOUR:FSIM:SDES BB</p>

Virtual RF - Fading	<p>Sets the virtual RF frequency.</p> <p>For instruments with RF output, this input is possible only if Baseband Output is selected in the Signal Dedicated To field.</p> <p>The entered value is used as the basis for computing the Doppler shift.</p> <p>Remote-control command: SOUR:FSIM:FREQ 1GHz</p>
Common Speed For All Paths - Fading	<p>(only available for delay configurations)</p> <p>Activates/deactivates the same speed in all paths.</p> <p>The default is the On setting.</p> <p>A change of speed in a path automatically results in a change of speed in all of the other paths.</p> <p>When switching from Off to On, the speed entry for path 1 of group 1 is used for all of the paths.</p> <hr/> <p>Note: <i>If Speed Setting Coupling is activated, the setting of Common Speed for all Paths is also coupled in both faders.</i></p> <hr/> <p>Remote-control command: SOUR:FSIM:CSP ON</p>
Speed Unit - Fading	<p>Selects the unit for the speed. This setting is valid for all fading configurations.</p> <p>The speed is entered in the path table.</p> <p>Remote-control command: SOUR:FSIM:SPE:UNIT MPH</p>
Keep Constant	<p>Selects whether to keep the speed or the doppler shift constant in case of frequency changes.</p> <p>Remote-control command: SOUR:FSIM:KCON SPE</p>
Restart Event - Fading	<p>Selects the event which leads to a restart of fading.</p> <p>After each restart, the fading process starts at a fixed starting point and from there it passes through identical random processes for a given setting. This helps to achieve repeatable test conditions.</p> <p>Auto The modulation signal is continually faded.</p> <p>Remote-control command: SOUR:FSIM:REST:MODE AUTO</p>

	Manual	<p>A restart is triggered by pressing the Restart button.</p> <p>With dual-channel fading, pushing the Restart button causes both faders to restart if Restart Event Manual is selected for both faders.</p> <p>Remote-control command: SOUR:FSIM:REST:MODE MAN</p>
	Internal Trigger 1 / 2	<p>A restart is triggered by baseband A/B.</p> <p>Remote-control command: SOUR:FSIM:REST:MODE EXT1</p>
Restart - Fading	Triggers a restart of the fading simulation.	<p>A restart is triggered with this button only if Restart Event Manual is selected.</p> <p>With dual-channel fading, both faders are restarted if Restart Event Manual is selected for both faders.</p> <p>Remote-control command: SOUR:FSIM:REST</p>
Ignore RF Changes < 5PCT - Fading	(instruments with RF output only)	<p>Selects whether frequency changes < 5% are to be ignored or not for the fading.</p> <p>If this setting is activated (On), faster frequency hopping is possible since small frequency changes (which can occur, say, in GSM hopping) do not result in a short-term switch-off of the fader and a restart of the fading process.</p> <p>Remote-control command: SOUR:FSIM:IGN:RFCH ON</p>

Frequency Hop Mode - Fading

(instruments with RF output only)

Activates frequency hopping and determines the behavior of the fading simulator after a frequency hop.

Frequency hopping involves switching of the carrier frequency. The fading is switched off temporarily until the RF frequency is changed. The fading process is then restarted at the new frequency.

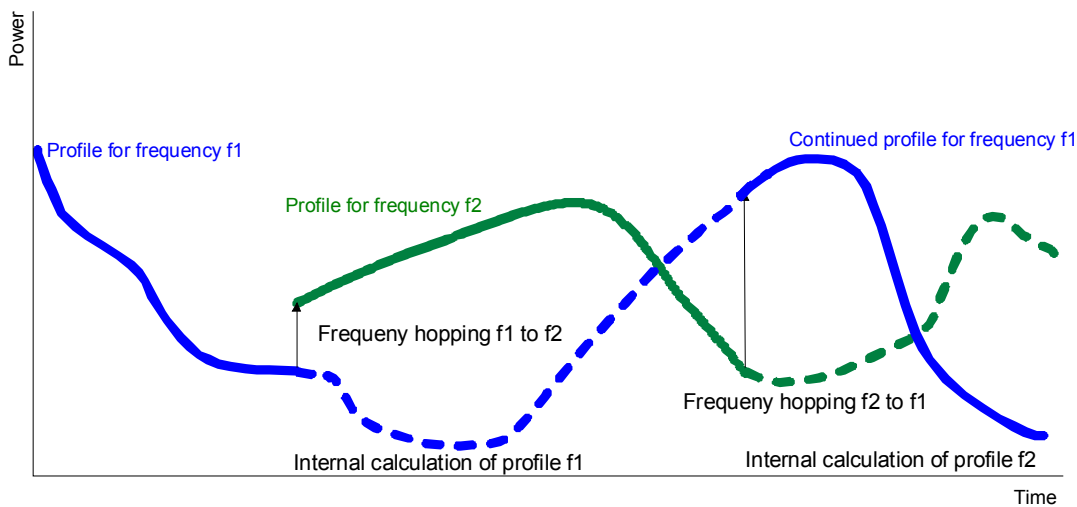
Frequency hopping occurs in real-world receivers, for example, if the original carrier is no longer accessible due to a change in the location of the receiver.

The instrument provides two modes for frequency hopping. The modes differ in terms of the behavior when hopping back to a prior frequency (see below).

Prior to activating frequency hopping, list mode must be activated in the List Mode menu (State On). The target frequencies of the hops are determined by the frequency values in the selected list. The time until the next frequency hop is determined by the entered Dwell Time (see section "[List Mode - List](#)"). The HOP signal which marks the time point of the frequency hop can be output on one of the USER jacks (see section "[User Marker - AUX IO - Setup-Environment-Global...Settings](#)"). This menu is available only for the delay configurations.

Off Frequency hopping is deactivated.
Remote-control command:
`SOUR:FSIM:HOPP:MODE OFF`

In Band Frequency hopping is activated. After hopping back to a previous hop frequency, the random process of the fader is resumed as if the fading had continued also at this frequency, i.e. the process is not restarted.



A situation is thus simulated in which the conditions after a return frequency hop have not changed substantially, i.e. the receiving conditions are the same as those from before the frequency hop (e.g. a pedestrian with a receiver that has moved only a few meters).

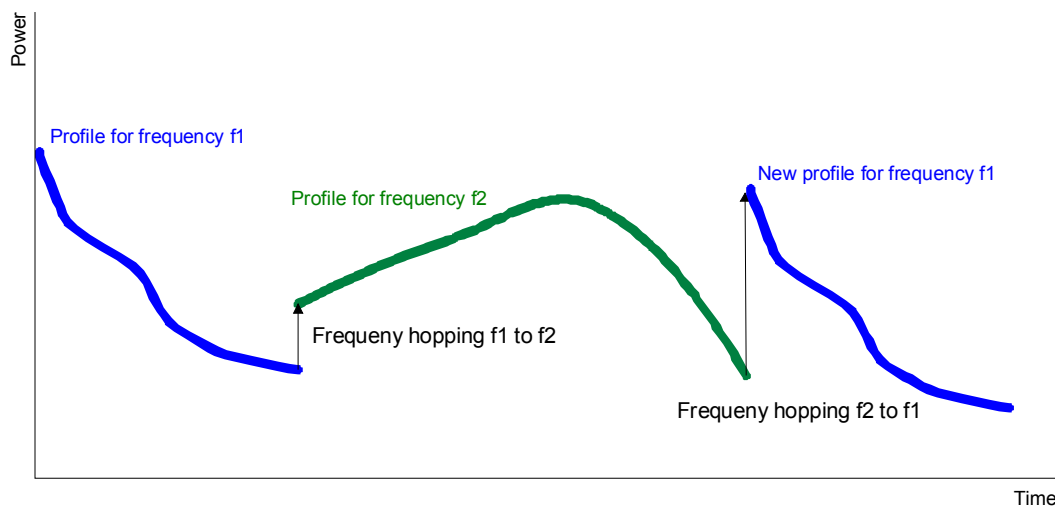
In this mode, the number of target hop frequencies and frequency hops is limited to four since the random processes for all of the prior hop frequencies are computed in parallel.

Remote-control command:

```
SOUR:FSIM:HOPP:MODE IBAN
```

Out Of Band

Frequency hopping is activated. The random process of the fader is restarted after a hop back to a previous target hop frequency and is thus not correlated with the random process which was underway prior to the frequency hop to this frequency.



In this mode, the number of target frequencies and frequency hops is unlimited since the random process is computed only on the current frequency.

Remote-control command:

```
SOUR:FSIM:HOPP:MODE OOB
```

Path Settings - Fading

The **Path Settings** sections offers different submenus for the configuration of the fading paths depending on the selected fading configuration. The fading settings are displayed graphically.

Path Table... - Fading	<p>Calls up the menu for setting the fading paths.</p> <p>See sections "Delay Modes Path Table - Fading", page 30, "Birth Death Propagation Path Table - Fading", page 46, "Moving Propagation Path Table - Fading", page 52, and "2 Channel Interferer Path Table - Fading", page 55.</p>
Path Delay Wizard- Fading	<p>Calls up the menu for modifying, inserting and deleting paths in the delay modes, see section "Path Delay Wizard- Fading", page 42.</p>
Coupled Parameters... - Fading	<p>(only for</p> <ul style="list-style-type: none"> - Delay configurations - Configuration with two faders (options B14 and B15) and - Signal routing A to A /B to B (split)) <p>Calls up the menu for setting the coupled parameters of the two faders A and B, see section "Coupled Parameters ... - Fading", page 45.</p>
Insertion Loss Configuration ... - Fading	<p>Calls up the menu for setting the insertion loss, see section "Insertion Loss Configuration ... - Fading", page 60.</p>

Delay Modes Path Table - Fading

Button **Path Table...** calls the path table for configuration of the fading paths.

The paths are grouped in the **Standard Delay**, **Fine Delay 30 MHz**, and **Fine Delay 50 MHz** delay configurations. Each group is characterized by a common group delay (**Basic Delay**). The paths are assigned a path-specific delay (**Additional Delay**). The **Resulting Delay** of a path is calculated by adding the two values. The delay configurations differ in terms of the number of paths, the resolution of the path-specific delay, and the available RF bandwidth. The remaining parameters are the same for the three configurations.

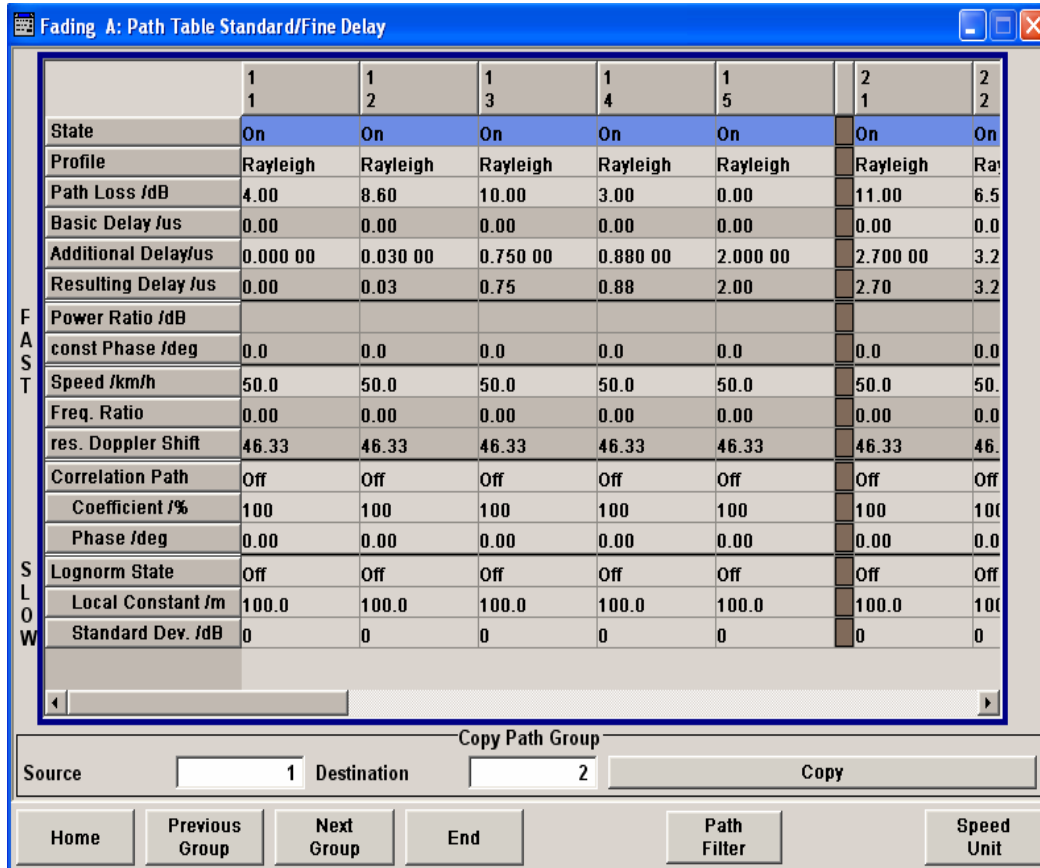
The maximum number of paths is doubled from 20 to 40 if the instrument is fitted with the Path Extension option (B15).

The individual path and group parameters can be set in the path table. The group number is displayed in the first row of the table header and the path number is displayed in the second row. The parameters are displayed row-by-row at the left edge of the table. The sections for fast and slow fading are indicated to the left next to the table.

A light background means that the parameter is adjustable. A dark background means that the parameter is not adjustable. Whether a parameter is configurable or not depends, for example, on the group (e.g. the Basic Delay is always 0 for group 1) and on the selected fading profile (e.g. the power ratio can be entered only for Rice fading). The pure display parameters such as the resulting Doppler shift are also shown with a dark background.

In the **Copy Path Group** section, the settings for a fading group can be copied to a second fading group.

The **buttons** facilitate navigation in the path table by moving the indicated area of the table and suppression of the indication of disabled paths. It is also possible to quickly change the speed unit with a softkey.



State Path - Fading

Activates a fading path.

After power-on, the fading process is initiated for this path with the selected fading profile. However, the fading simulator must be switched on.

Remote-control commands:

```
SOUR:FSIM:DEL:GRO1:PATH2:STAT ON
SOUR:FSIM:DEL30:GRO1:PATH2:STAT ON
SOUR:FSIM:DEL50:GRO1:PATH2:STAT ON
```

Profile - Fading

Determines the fading profile for the selected path. The fading profile determines which transmission path or which radio hop is simulated.

Depending on which profile is selected, certain parameters will be available in the path table and others will not be available.

With correlated paths, the profile setting must agree. When correlation is activated, the setting of the path for which correlation is switched on is accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).

Static Path	<p>A static transmission path is simulated which can undergo attenuation (loss) or delay.</p> <p>Remote-control commands: SOUR:FSIM:DEL:GRO1:PATH2:PROF SPAT SOUR:FSIM:DEL30:GRO1:PATH2:PROF SPAT SOUR:FSIM:DEL50:GRO1:PATH2:PROF SPAT</p>
Pure Doppler	<p>A transmission path is simulated in which there is an individual direct connection from the transmitter to the moving receiver (discrete component). The Doppler frequency shift is determined by the Speed and Frequency Ratio parameters (see the description of the Speed parameter).</p> <p>Remote-control commands: SOUR:FSIM:DEL:GRO1:PATH2:PROF PDOP SOUR:FSIM:DEL30:GRO1:PATH2:PROF PDOP SOUR:FSIM:DEL50:GRO1:PATH2:PROF PDOP</p>
Rayleigh	<p>A radio hop is simulated in which many highly scattered subwaves arrive at a moving receiver. The resulting received amplitude varies over time. The probability density function for the magnitude of the received amplitude is characterized by a Rayleigh distribution. This fading spectrum is "Classical".</p> <p>Remote-control commands: SOUR:FSIM:DEL:GRO1:PATH2:PROF RAYL SOUR:FSIM:DEL30:GRO1:PATH2:PROF RAYL SOUR:FSIM:DEL50:GRO1:PATH2:PROF RAYL</p>
Rice	<p>A radio hop is simulated in which a strong direct wave (discrete component) arrives at a moving receiver in addition to many highly scattered subwaves. The probability density of the magnitude of the received amplitude is characterized by a Rice distribution. The fading spectrum of an unmodulated signal involves the superimposition of the classic Doppler spectrum (Rayleigh) with a discrete spectral line (pure Doppler).</p> <p>The ratio of the power of the two components (Rayleigh and pure Doppler) is set with the Power Ratio parameter.</p> <p>Remote-control commands: SOUR:FSIM:DEL:GRO1:PATH2:PROF RICE SOUR:FSIM:DEL30:GRO1:PATH2:PROF RICE SOUR:FSIM:DEL50:GRO1:PATH2:PROF RICE</p>

Const. Phase A transmission path with the set constant phase rotation is simulated which can undergo attenuation (loss) or delay.

Remote-control commands:

```
SOUR:FSIM:DEL:GRO1:PATH2:PROF CPH
SOUR:FSIM:DEL30:GRO1:PATH2:PROF CPH
SOUR:FSIM:DEL50:GRO1:PATH2:PROF CPH
```

Gauss1 GAUS1 is the sum of two Gaussian functions and is used for excess delay times in the range of 0,5 μ s to 2 μ s ($0,5 \mu\text{s} \leq \tau_i \leq 2 \mu\text{s}$).

$$(GAUS1) \quad S(\tau, f) = G(A, -0,8f_d, 0,05f_d) + G(A_1, +0,4f_d, 0,1f_d)$$

where A_1 is 10 dB below A.

Remote-control commands:

```
SOUR:FSIM:DEL:GRO1:PATH2:PROF OGAU
SOUR:FSIM:DEL30:GRO1:PATH2:PROF OGAU
SOUR:FSIM:DEL50:GRO1:PATH2:PROF OGAU
```

Gauss2 GAUS2 is also the sum of two Gaussian functions and is used for paths with delays in excess of 2 μ s ($\tau_i \geq 2 \mu\text{s}$).

$$(GAUS2) \quad S(\tau, f) = G(B, +0,7f_d, 0,1f_d) + G(B_1, -0,4f_d, 0,15f_d)$$

where B_1 is 15 dB below B.

Remote-control commands:

```
SOUR:FSIM:DEL:GRO1:PATH2:PROF TGAU
SOUR:FSIM:DEL30:GRO1:PATH2:PROF TGAU
SOUR:FSIM:DEL50:GRO1:PATH2:PROF TGAU
```

GaussDAB GAUSDAB is composed of a Gaussian function and is used for special DAB profiles.

$$(GAUSDAB) \quad S(\tau, f) = G(A, \pm 0,7f_d, 0,1f_d)$$

Remote-control commands:

```
SOUR:FSIM:DEL:GRO1:PATH2:PROF DGAU
SOUR:FSIM:DEL30:GRO1:PATH2:PROF DGAU
SOUR:FSIM:DEL50:GRO1:PATH2:PROF DGAU
```

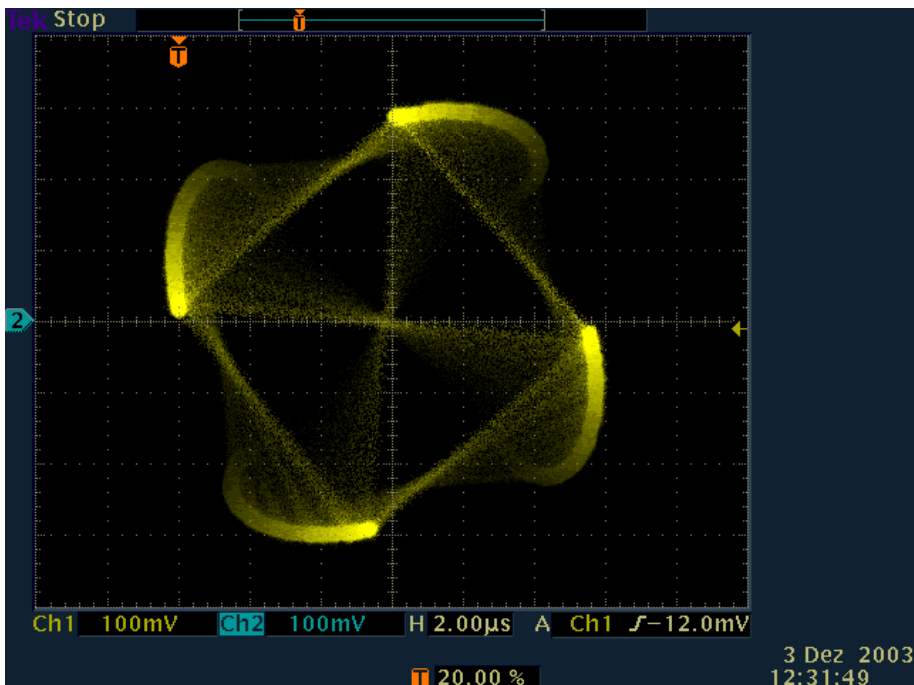
Gauss Doppler Selects the Gauss Doppler fading profile.

Remote-control commands:

```
SOUR:FSIM:DEL:GRO1:PATH2:PROF GDOP
SOUR:FSIM:DEL30:GRO1:PATH2:PROF GDOP
SOUR:FSIM:DEL50:GRO1:PATH2:PROF GDOP
```

Gauss (0.08 fd)	Selects the Gauss (0.08 fd) fading profile. Remote-control commands: SOUR:FSIM:DEL:GRO1:PATH2:PROF GFD8 SOUR:FSIM:DEL30:GRO1:PATH2:PROF GFD8 SOUR:FSIM:DEL50:GRO1:PATH2:PROF GFD8
Gauss (0.1 fd)	Selects the Gauss (0.1 fd) fading profile. Remote-control commands: SOUR:FSIM:DEL:GRO1:PATH2:PROF GFD1 SOUR:FSIM:DEL30:GRO1:PATH2:PROF GFD1 SOUR:FSIM:DEL50:GRO1:PATH2:PROF GFD1
WM Doppler	Selects the WM Doppler fading profile. Remote-control commands: SOUR:FSIM:DEL:GRO1:PATH2:PROF WDOP SOUR:FSIM:DEL30:GRO1:PATH2:PROF WDOP SOUR:FSIM:DEL50:GRO1:PATH2:PROF WDOP
WM Rice	Selects the WM Rice fading profile. Remote-control commands: SOUR:FSIM:DEL:GRO1:PATH2:PROF WRIC SOUR:FSIM:DEL30:GRO1:PATH2:PROF WRIC SOUR:FSIM:DEL50:GRO1:PATH2:PROF WRIC

The following figure shows a baseband signal with QPSK modulation and a rectangular filter which was subjected to Rician fading (one path). As a result of the luminescence setting on the oscilloscope, the variation in phase and amplitude of the constellation points caused by the fader is clearly visible.



Path Loss - Fading	<p>Enters the loss for the selected path.</p> <p>Remote-control commands: SOUR:FSIM:DEL:GRO1:PATH2:LOSS 2 dB SOUR:FSIM:DEL30:GRO1:PATH2:LOSS 2 dB SOUR:FSIM:DEL50:GRO1:PATH2:LOSS 2 dB</p>
Basic Delay - Fading	<p>Determines the Basic Delay.</p> <p>Within a path group, all of the paths are jointly delayed by this value. The Resulting Delay of a path is obtained by adding the Basic Delay and the Additional Delay. The Basic Delay for group 1 is always 0. Thus, for the paths in group 1, we always have a setting range for the Resulting Delay from 0 to 40 ns (= setting range for Additional Delay).</p> <p>Remote-control commands: SOUR:FSIM:DEL:GRO2:PATH:BDEL 2E-4 SOUR:FSIM:DEL30:GRO2:PATH:BDEL 2E-4 SOUR:FSIM:DEL50:GRO2:PATH:BDEL 2E-4</p>
Additional Delay - Fading	<p>Determines the Additional Delay.</p> <p>The Resulting Delay of a path is obtained by adding the Basic Delay and the Additional Delay. No Additional Delay can be entered for path 1 of group 1.</p> <p>Remote-control commands: SOUR:FSIM:DEL:GRO2:PATH2:ADEL 1E-6 SOUR:FSIM:DEL30:GRO2:PATH2:ADEL 1E-6 SOUR:FSIM:DEL50:GRO2:PATH2:ADEL 1E-6</p>
Resulting Delay - Fading	<p>Displays the Resulting Delay for the path.</p> <p>The Resulting Delay is obtained by adding the Basic Delay (see section "Basic Delay - Fading", page 35) and the Additional Delay, see section "Additional Delay - Fading", page 35.</p> <p>The Path Delay Wizard (see section "Path Delay Wizard- Fading", page 30) is very helpful when the user needs to position the paths at defined Resulting Delays.</p> <p>Remote-control commands: SOUR:FSIM:DEL:GRO2:PATH2:RDEL? SOUR:FSIM:DEL30:GRO2:PATH2:RDEL? SOUR:FSIM:DEL50:GRO2:PATH2:RDEL?</p>

**Power Ratio - Fading
(Rice Fading)**

Enters the power ratio of the discrete component and distributed component for Rice fading.

The total power consisting of the two components is always constant. At a high power ratio, the discrete (Doppler) component prevails. At a low power ratio, the distributed (Rayleigh) component prevails.

Remote-control commands:

```
SOUR:FSIM:DEL:GRO2:PATH2:PRAT -15
SOUR:FSIM:DEL30:GRO2:PATH2:PRAT -15
SOUR:FSIM:DEL50:GRO2:PATH2:PRAT -15
```

Const. Phase - Fading

(Static Path, Rayleigh, Constant Phase, Gauss1, Gauss2, GaussDAB,)

Enters the phase by which the path is multiplied for Static Path, Rayleigh, Constant Phase, Gauss1, Gauss2, and GaussDAB fading.

Remote-control commands:

```
SOUR:FSIM:DEL:GRO2:PATH2:CPH 5DEG
SOUR:FSIM:DEL30:GRO2:PATH2:CPH 5DEG
SOUR:FSIM:DEL50:GRO2:PATH2:CPH 5DEG
```

Start Phase - Fading

(Pure Doppler, Rice, Gauss Doppler)

A transmission path with the set start phase rotation is simulated which can undergo attenuation (loss) or delay.

Remote-control commands:

```
SOUR:FSIM:DEL:GRO1:PATH1:CPH 5DEG
SOUR:FSIM:DEL30:GRO1:PATH1:CPH 5DEG
SOUR:FSIM:DEL50:GRO1:PATH1:CPH 5DEG
```

Speed - Fading

(Pure Doppler, Rayleigh, and Rice Fading)

Enters the speed v of the moving receiver. Choose the desired Speed Unit in the upper section of the menu.

Based on the speed v and the frequency of the RF output signal f_{RF} (or the virtual RF frequency), the Doppler shift f_D is computed.

$$c = 2.998 \cdot 10^8 \text{ m/s} \quad \frac{v}{c} = \frac{f_D}{f_{RF}}$$

Example:

$$v = 100 \text{ km/h; } f_{RF} = 1 \text{ GHz; } f_D = 92.66 \text{ Hz}$$

The resulting Doppler shift is displayed in the **res. Doppler Shift** line. It may not exceed the maximum Doppler shift of 1600 Hz.

If the speed is changed, the resulting Doppler shift is automatically modified.

In the **Pure Doppler** and **Rice Fading** profiles, the resulting Doppler shift is dependent on the entered speed and also on the ratio of the actual Doppler shift to the (set) Doppler shift f_D .

This ratio is determined in the **Frequency Ratio** line.

The **Speed** parameter is not available for static path and constant phase fading.

A change of speed in one path automatically results in a change of speed in all of the other paths of the fader if **Common Speed in All Paths** is activated.

When fitted with the Path Extension option (B15), the speed for the paths of both faders A and B can be coupled.

With correlated paths, the speed setting must agree. When correlation is activated, the settings of the path for which correlation is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made). The same applies to all paths of the two faders when coupling is activated.

Remote-control commands:

```
SOUR:FSIM:SPE:UNIT MPS
SOUR:FSIM:DEL:GRO2:PATH2:SPE 100
SOUR:FSIM:DEL30:GRO2:PATH2:SPE 100
SOUR:FSIM:DEL50:GRO2:PATH2:SPE 100
```

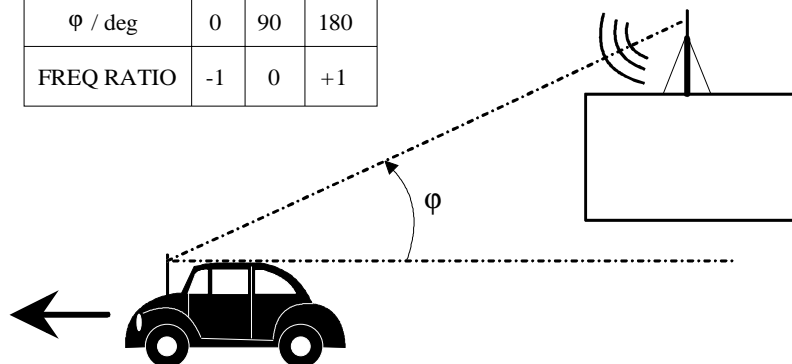
Frequency Ratio - Fading (Pure Doppler and Rice Fading)

Enters the ratio of the actual Doppler frequency to the Doppler frequency set with the Speed parameter for pure Doppler or Rice fading.

The actual Doppler shift is a function of the simulated angle of incidence of the discrete component (see following figure).

Negative values indicate a receiver that is going away from the transmitter, and positive values a receiver that is approaching the transmitter.

ϕ / deg	0	90	180
FREQ RATIO	-1	0	+1



With correlated paths, the speed setting of the Frequency Ratio must agree. When correlation is activated, the settings of the path for which correlation is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).

Remote-control commands:

```
SOUR:FSIM:DEL:GRO2:PATH2:FRAT 0.15
SOUR:FSIM:DEL30:GRO2:PATH2:FRAT 0.15
SOUR:FSIM:DEL50:GRO2:PATH2:FRAT 0.15
```

Resulting Doppler Shift - Fading**(Pure Doppler, Rayleigh, and Rice Fading only)**

Displays the Doppler shift.

The Doppler shift is determined by entering the **Speed**.

For the **Pure Doppler** and **Rice Fading** profiles, the actual Doppler shift is a function of the entered ratio of the actual Doppler shift to the Doppler shift set with the Speed parameter (**Frequency Ratio**).

Remote-control commands:

SOUR:FSIM:DEL:GRO2:PATH2:FDOP?

SOUR:FSIM:DEL30:GRO2:PATH2:FDOP?

SOUR:FSIM:DEL50:GRO2:PATH2:FDOP?

Correlation Path - Fading**(only for**

- **Configuration with two faders (options B14 and B15) and**
- **Signal routing A to A / B to B (split)**

Switches on correlation to the corresponding path of the second fader for dual-channel fading.

Setting correlation necessitates synchronous signal processing on both channels. This means the settings of the following parameters for the correlated fading paths must agree:

- **Profile**
- **Speed**
- **Frequency Ratio**
- **Lognormal Parameters**

When correlation is activated, the settings of the path for which correlation is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).

Correlated paths in dual-channel fading with the same input signal simulate the receiving conditions experienced by a receiver having two antennas in which the received signals exhibit a certain degree of correlation due to a similar environment.

This parameter is available only for the delay configurations with two faders (options B14 and B15) and selection of A to A / B to B signal routing (split) Each fader has a maximum of 20 fading paths.

Remote-control commands:

SOUR:FSIM:DEL:GRO2:PATH2:CORR:STAT ON

SOUR:FSIM:DEL30:GRO2:PATH2:CORR:STAT ON

SOUR:FSIM:DEL50:GRO2:PATH2:CORR:STAT ON

**Correlation Coefficient -
Fading**

- (only for**
- Delay configurations
- Configuration with two faders (options B14 and B15) and
- Signal routing A to A /B to B (split))

Enters the magnitude of the complex correlation coefficient as a percentage.

The higher the entered percentage, the greater the correlation of the statistical fading processes for the two correlated paths. Highly correlated ambient conditions for the signal are simulated in this manner.

Each fader has a maximum of 20 path.

With correlated paths, the coefficient setting must agree. When correlation is activated, the setting of the path for which correlation is switched on is accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).

Remote-control commands:

```
SOUR:FSIM:DEL:GRO2:PATH2:CORR:COEF 95
SOUR:FSIM:DEL30:GRO2:PATH2:CORR:COEF 95
SOUR:FSIM:DEL50:GRO2:PATH2:CORR:COEF 95
```

**Correlation Coefficient
Phase - Fading**

- (only for**
- Delay configurations
- Configuration with two faders (options B14 and B15) and
- Signal routing A to A /B to B (split))

Enters the phase of the complex correlation coefficient in degrees.

Each fader has a maximum of 20 fading paths.

With correlated paths, the coefficient phase setting must agree. When correlation is activated, the setting of the path for which correlation is switched on is accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).

Remote-control commands:

```
SOUR:FSIM:DEL:GRO2:PATH2:CORR:PHAS 5
SOUR:FSIM:DEL30:GRO2:PATH2:CORR:PHAS 5
SOUR:FSIM:DEL50:GRO2:PATH2:CORR:PHAS 5
```

Lognormal State - Fading

Switches lognormal fading on/off (slow fading).

With lognormal fading, an additional slow fluctuation of the received amplitude of a moving receiver is simulated. This can occur due to peculiarities in the landscape or topography (e.g. when driving through a depression). Lognormal fading has a multiplicative effect on the path loss. The multiplication factor is time-variable and logarithmically normally distributed. If a Rayleigh profile is set simultaneously, what we obtain is Suzuki fading.

Note:

Since the slow level fluctuation is not taken into account statistically in the computation of the insertion loss, the output power can deviate from the displayed power.

When fitted with the Path Extension option (B15), the status of lognormal fading for the paths of both faders A and B can be coupled. With correlated paths, the status setting must agree. When correlation is activated, the settings of the path for which correlation is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).

Remote-control commands:

```
SOUR:FSIM:DEL:GRO2:PATH2:LOGN:STAT ON
SOUR:FSIM:DEL30:GRO2:PATH2:LOGN:STAT ON
SOUR:FSIM:DEL50:GRO2:PATH2:LOGN:STAT ON
```

Local Constant - Fading

Enters the Local Constant for lognormal fading.

The Local Constant L and the speed v of the moving receiver determine the limit frequency f_L for lognormal fading:

$$f_L = v/L.$$

The power density spectrum of an unmodulated carrier consists of a discrete spectral line at f_{RF} and a frequency-dependent continuous component for which the following holds:

$$S(f) = const \cdot e^{-0.5 \left(\frac{f - f_{RF}}{f_L} \right)^2}$$

The lower setting limit is a function of the (virtual) RF frequency f_{RF} .

$$\text{The following holds: } L_{min} = \frac{12 \cdot 10^9 \text{ m/s}}{f_{RF}}$$

When fitted with the Path Extension option (B15), the Local Constant for the paths of both faders A and B can be coupled.

With correlated paths, the Local Constant setting must agree. When correlation is activated, the settings of the path for which correlation is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).

Remote-control commands:

```
SOUR:FSIM:DEL:GRO2:PATH2:LOGN:LCON 100
SOUR:FSIM:DEL30:GRO2:PATH2:LOGN:LCON 100
SOUR:FSIM:DEL50:GRO2:PATH2:LOGN:LCON 100
```

Standard Deviation - Fading Enters the standard deviation in dB for lognormal fading.

When fitted with the Path Extension option (B15), the standard deviation for the paths of both faders A and B can be coupled. With correlated paths, the standard deviation setting must agree. When correlation is activated, the settings of the path for which correlation is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).

Remote-control commands:
 SOUR:FSIM:DEL:GRO2:PATH2:LOGN:CSTD 1
 SOUR:FSIM:DEL30:GRO2:PATH2:LOGN:CSTD 1
 SOUR:FSIM:DEL50:GRO2:PATH2:LOGN:CSTD 1

In the Copy Path Group section, the settings for a fading group can be copied to a second fading group.

Copy Source - Fading Selects a group whose setting is to be copied.

Remote-control command:
 SOUR:FSIM:COPY:SOUR 1

Copy Destination - Fading Selects a group whose setting is to be overwritten.

Remote-control command:
 SOUR:FSIM:COPY:DEST 2

Copy - Fading Triggers a copy procedure.

Remote-control command:
 SOUR:FSIM:COPY:EXEC

The buttons facilitate navigation in the path table by moving the indicated area of the table and suppression of the indication of disabled paths. It is also possible to quickly change the speed unit with a softkey.

Home / End - Fading Moves the cursor to the first path (**Home**) or to the last path (**End**) of the table.

Remote-control command: n.a.

Previous / Next - Fading Moves the cursor to the first path of the preceding (**Previous**) or subsequent (**Next**) path group.

Remote-control command: n.a.

Path Filter - Fading Suppresses the indication of the disabled paths.

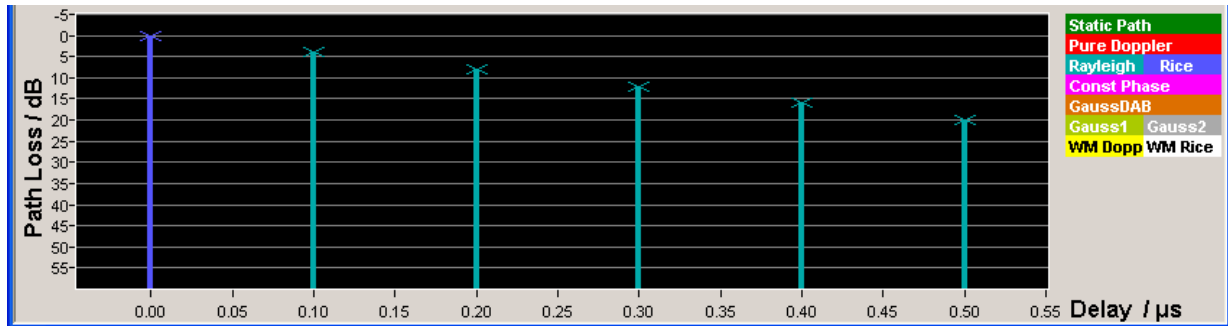
Remote-control command: n.a.

Speed Unit - Fading Toggles between the available units for speed. The value always remains unchanged but the display is automatically adapted to the selected unit.

Remote-control command: n.a.

Delay Modes Path Graph - Fading

The graphics in the lower menu section provide a fast overview of the paths which are set in the delay modes.



The signal delay is plotted on the X axis. The minimum value is 0 s. The maximum value is equal to the maximum delay which is set (max. Basic Delay + max. Path Delay). The relative path power is plotted on the Y axis, with 0 dB corresponding to the maximum power on the path (path loss = 0 dB).

Each path is represented by a bar. The color of the bar indicates the fading profile of the path. The color coding for the individual profiles is shown at the top right next to the graphics. The **Path Loss** can be read off from the height of the bar. The minimum value is 0 dB, and the maximum value is – 50 dB.

The groups and the range of signal delay values available for each group are indicated by a broken line. The groups are only indicated if at least one group has a **Basis Delay** other than 0 (i.e. for most Standards / "Test Cases" no groups are indicated as the Basic Delay is mostly 0).

The **Path Delay Wizards** is available to easily modify the settings of existing paths or insert new paths.

Remote-control command: n.a.

Path Delay Wizard- Fading

The menu for modifying, inserting, and deleting paths in the delay modes is called up in the **Fading** menu.

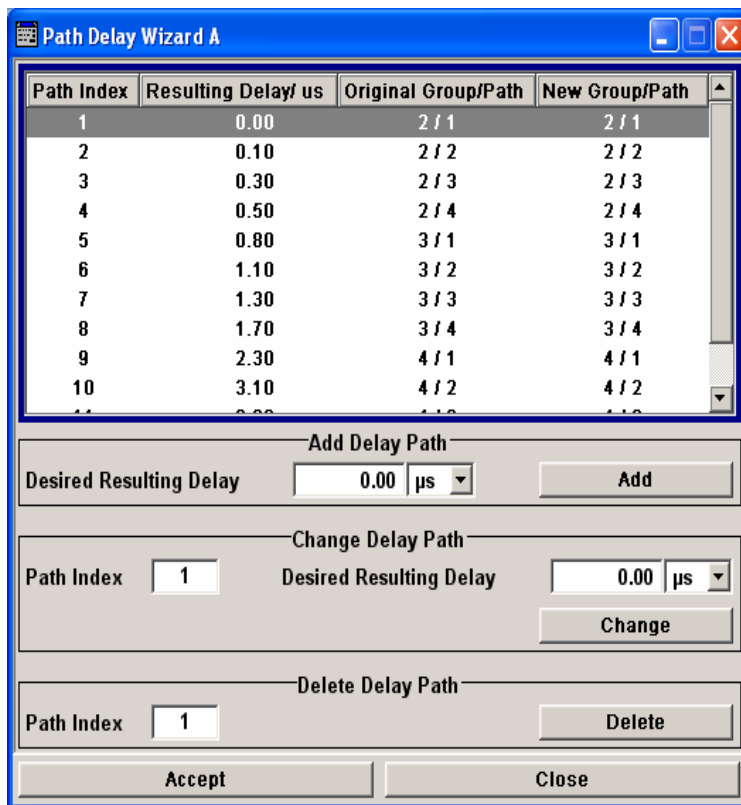
The **Path Delay Wizard** is not available for the **Birth Death** and **Moving Propagation** modes.

The total delay (**Resulting Delay**) of each path is a function of the group-specific delay (**Basic Delay**) and the path-specific delay (**Additional Delay**).

Since the **Additional Delay** has a maximum value of 40 μs , the range of values for the **Resulting Delay** of the individual paths of a group is limited to **Basic Delay + 40 μs** . In order to configure a path with a delay outside of this range of values, it must be activated in another group with a suitable **Basic Delay**.

When inserting new paths and modifying existing paths, the **Path Delay Wizard** provides support through automatic grouping of the paths based on the desired **Resulting Delays** of the paths.

Remote-control commands: n.a.

**Wizard Table - Fading**

The table shows the active paths sorted by their **Resulting Delays**. The paths are numbered sequentially (**Index**). This index does not correspond to the path number of the path in the respective group. This path number is displayed together with the group to which the path belongs (**Original Group / Path**). Also displayed is the group/path combination in which the path ends up after the modification has been carried out (**New Group Path**).

In the Add Delay Path section, a new path can be defined with a user-definable delay.

Wizard Desired Resulting Delay - Fading

Enters the Resulting Delay for the new path.

Wizard Add Path - Fading

Integrates the new path into the **Path Delay Table**.

If necessary, this will involve regrouping of the paths that were previously active. However, the modification is not made yet. First, the **Accept** button first has to be pressed.

If the new path cannot be integrated (e.g. if no group can be created with a suitable Basic Delay), the **Accept** button is not enabled and the line with the invalid path delay is marked with "ERROR".

In the Change Delay Path section, the delay of an existing path is modified.

Wizard Path Index - Fading Selects a path for which to modify the delay.

Wizard Desired Delay - Fading Enters the Resulting Delay for the selected path.

Wizard Change - Fading Integrates a path with modified delay into the **Path Delay Table**. If necessary, this will involve regrouping of the paths. However, the modification is not made yet. First, the **Accept** button has to be pressed.

The **Accept** button is only enabled when the path delays can be generated in the instrument. Path delays that cannot be assigned are marked with "ERROR" in the list. The restrictions are that a path group can only cover a range of 40 us and that the Basic Delay of the path groups 1 and 5 must be 0.

In the Delete Delay Path section, an existing path can be deleted.

Wizard Index - Fading Selects a path to be deleted.

Wizard Delete Path - Fading Removes a path from the **Path Delay Table**. If necessary, the remaining paths will be regrouped. However, the modification is not made yet. First, the **Accept** button first has to be pressed.

Wizard Accept Path - Fading Accepts the settings for the **Path Delay Table** in the instrument.

The path modifications are not made until the button is pressed. For the modified and shifted paths, all of the parameters for the original paths are accepted (except for the modified delay settings). Newly added paths are assigned the **On State** and the default values for all of the other parameters.

Deleted paths are assigned the **Off State** and the default values for all of the other parameters.

The **Accept** button is only enabled when the path delays can be generated in the instrument. Path delays that cannot be assigned are marked with "ERROR" in the list. The restrictions are that a path group can only cover a range of 40 us and that the Basic Delay of the path groups 1 and 5 must be 0.

Wizard Close - Fading Closes the **Path Delay Wizard** without making any modifications.

Coupled Parameters ... - Fading

The menu for setting the coupled parameters of the two faders A and B is called up in the **Fading** menu. This menu is available only for the delay configurations with two faders (options B14 and B15) and selection of signal routing A to A / B to B (split) Each fader has a maximum of 20 fading paths.

The option of coupling certain parameters is offered in order to simplify operation during dual-channel fading.

When coupling is activated, the setting of the fader for which coupling is activated is transferred to both faders. Afterwards, any change in one of the two faders is transferred to the other fader regardless of the changed fader.

The settings are summarized in the section **Coupled Parameters A => B** (Fader A) or **Coupled Parameters B => A**.

Coupled Parameters A => B	
Speed Setting Coupled	<input type="checkbox"/> On
Local Constant Coupled	<input type="checkbox"/> On
Standard Deviation Coupled	<input type="checkbox"/> On

Speed Setting Coupled - Fading

Sets the **Speed** of the paths for both faders. The **Common Speed for all Paths** setting is also coupled.

Remote-control command:
SOUR:FSIM:COUP:SPE ON

Local Constant Coupled - Fading

With lognormal fading, the setting for the **Local Constant** is coupled for the paths of both faders.

Remote-control command:
SOUR:FSIM:COUP:LOGN:LCON ON

Standard Deviation Coupled - Fading

With lognormal fading, the setting for the **Standard Deviation** is coupled for the paths of both faders.

Remote-control command:
SOUR:FSIM:COUP:LOGN:CSTD ON

In the **Global Fader Coupling** section, the value for the **Start Seed** can be set.

Start Seed - Fading

Enters the fading start seed. This value is global for the instrument.

Remote-control command:
SOUR:FSIM:GLOB:SEED 5

Birth Death Propagation Path Table - Fading

In the **Birth Death Propagation** configuration, the fading simulator simulates dynamic propagation conditions in conformity with the test case 3GPP, 25.104-xxx, annex B4. Here, the behavior of a receiver is tested when it is confronted with the sudden disappearance and reappearance of a signal. This can occur, for example, when a pedestrian making a call walks around the corner of a building.

Two paths are simulated which appear (**Birth**) or disappear (**Death**) in alternation at arbitrary points in time. The points in time fall within a grid of integer delays [-5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5] μ s. After a certain time (**Hopping Dwell**), a path disappears from a given grid position and appears simultaneously at another randomly chosen grid position. During this hop, the second path remains stable at its grid position. After a further **Hopping Dwell** elapses, the second path changes its position. Now, the first path remains at its position and so on. The two paths never appear at the same time position at the same time (see the following figure).

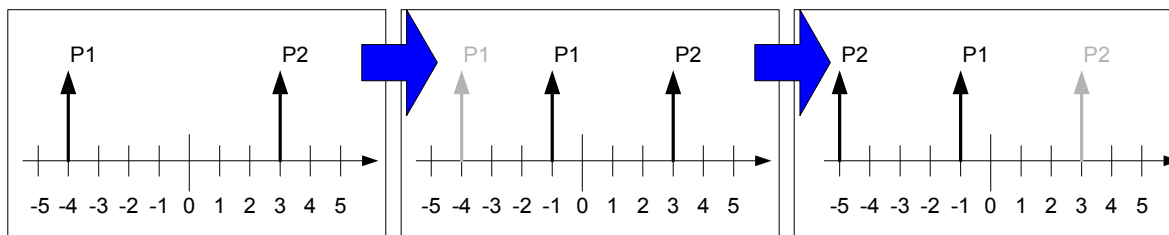


Figure 0-1 Example of a sequence of hops in **Birth Death Propagation**

Note:

Since it is not possible to generate negative time values (delays), the actual hop range is from 0 to 10 μ s.

According to annex B4, each path has the same loss and phase and no Doppler shift. The time until the position of a path is changed is also specified (see table).

Profile	Pure Doppler
Path Loss	0 dB
Min. Delay	0 μ s
Delay Grid	1 μ s
Positions	11
Max .Delay	10 μ s
Hopping Dwell	191 ms
Speed	0 m/s
Frequency Ratio	1.0

These values are the default values for Birth Death Propagation. However, these parameters can also be set for further tests in the fading path table.



Profile Birth Death - Fading

Displays the fading profile for birth death propagation. The fading profile has a fixed setting to **Pure Doppler**.

A transmission path is simulated in which there is an individual direct connection from the transmitter to the moving receiver (discrete component). The Doppler frequency shift is determined by the **Speed** and **Frequency Ratio** parameters.

Remote-control command:

SOUR:FSIM:BIRT:PATH2:PROF?

Response: 'PDOP'

Path Loss Birth Death - Fading

Enters the loss for the selected path.

Remote-control command:

SOUR:FSIM:BIRT:PATH2:LOSS 2dB

Min Delay Birth Death - Fading

Enters the minimum delay for the two fading paths.

The minimum delay corresponds to the start value of the delay range.

The delay range is defined by the minimum delay, the delay grid and the number of possible hop positions. It can be in the range between 0 and 40 μ s.

$$0 \mu\text{s} < (\text{Positions} - 1) \times \text{Delay Grid} + \text{Min. Delay} < 40 \mu\text{s}$$

The scaling of the X-axis is adapted according to the entry (see following section "[Birth Death Propagation Path Graph - Fading](#)").

Invalid entries are rejected, the next possible value is entered.

Remote-control command:

SOUR:FSIM:BIRT:DEL:MIN 6E-6

Delay Grid Birth Death - Fading

Enters the delay grid. The value defines the resolution for the possible hop positions of the two fading paths in the delay range.

The scaling of the X-axis is adapted according to the entry (see following section "[Birth Death Propagation Path Graph - Fading](#)").

Invalid entries are rejected, the next possible value is entered.

Remote-control command:

SOUR:FSIM:BIRT:DEL:GRID 2E-6

Positions Birth Death - Fading

Enters the number of possible hop positions in the delay range.

The scaling of the X-axis is adapted according to the entry (see following section "[Birth Death Propagation Path Graph - Fading](#)").

Invalid entries are rejected, the next possible value is entered.

Remote-control command:

SOUR:FSIM:BIRT:POS 9

Maximum Delay Birth Death - Fading

Indication of the maximum delay. The maximum delay corresponds to the stop value of the delay range (see following section "[Birth Death Propagation Path Graph - Fading](#)").

The maximum delay is defined by the minimum delay, the delay grid and the number of possible hop positions.

$$\text{Max Delay} = (\text{Positions} - 1) \times \text{Delay Grid} + \text{Min. Delay}$$

Remote-control command:

SOUR:FSIM:BIRT:DEL:MAX

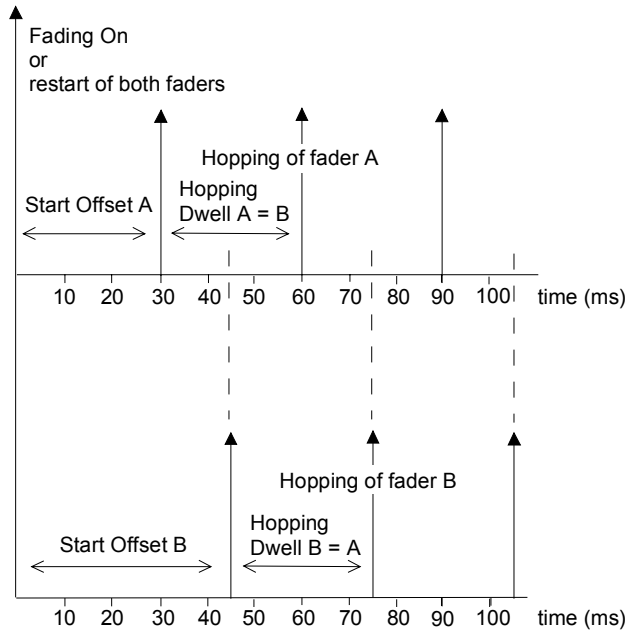
Response: 0.000022

Start Offset Birth Death - Fading

Enters the timing offset by which the start of **Birth Death Propagation** is offset with respect to when fading is switched on or a restart as a result of a restart trigger.

This allows the user to precisely displace birth death events with respect to one another during two-channel fading. This is required in some 3GPP base station tests.

If the same hopping dwell time is entered in both faders, the offset will take place by a constant value (see figure).

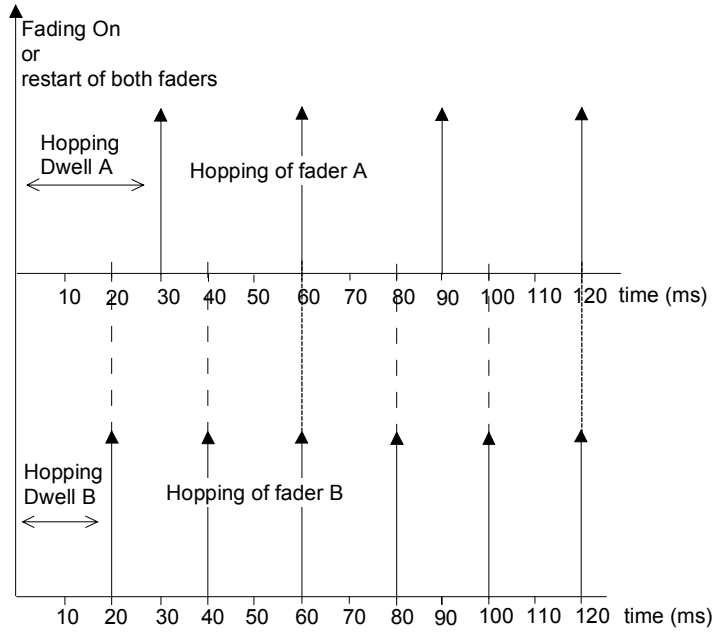


Remote-control command:
 SOUR:FSIM:BIRT:SOFF 30E-3
 SOUR2:FSIM:BIRT:SOFF 45E-3

Hopping Dwell Birth Death - Fading

Enters the time until the next change in the delay of a path (birth death event).

During two-channel fading, the dwell times of the two channels can be set independently. This causes the hop time points of the two channels to coincide repeatedly. This is a way of simulating tough receiving conditions as arise when two receiving channels simultaneously change frequency (see figure).



Remote-control command:

```
SOUR:FSIM:BIRT:HOPP:DWEL 30 ms
SOUR2:FSIM:BIRT:HOPP:DWEL 45 ms
```

Speed Birth Death - Fading

Enters the speed **v** of the moving receiver. The unit for entering the speed under **Speed Unit** can be chosen in the upper section of the menu.

Remote-control command:

```
SOUR:FSIM:BIRT:SPE 100
```

Frequency Ratio Birth Death - Fading

Enters the ratio of the actual Doppler shift to the Doppler shift set with the **Speed** parameter.

Remote-control command:

```
SOUR:FSIM:BIRT:FRAT 0.15
```

Resulting Doppler Shift Birth Death - Fading

Displays the actual Doppler shift.

The actual Doppler frequency is determined by the entered **Speed** and the entered ratio of the actual Doppler frequency to the set Doppler frequency (**Frequency Ratio**).

Remote-control command:

```
SOUR:FSIM:BIRT:FDOP?
```


Birth Death Propagation Path Graph - Fading

The graphical display of the fading paths in Birth Death Propagation mode shows as an example the changing positions of the two paths within the delay grid. The displayed position change does not correspond to the actual delay hops of the real signal. An arrow indicates the direction of the delay hop of the path that will next change its position, with the head of the arrow marking the new position.

The delay grid is plotted on the X axis. The permissible delay range is shown in the graphics. The path power is plotted on the Y axis, with 0 dB corresponding to the maximum power on the path (path loss = 0 dB). The scaling of the axes and the displayed path power match the real settings.

The scaling of the x-axis depends on the set delay range. It always starts at 0 μ s and ranges up to 40 μ s at the most (= maximum for delay range). The minimum delay corresponds to the start value of the delay range. The maximum delay is defined by the minimum delay, the delay grid and the number of possible hop positions.

$$\text{Max Delay} = (\text{Positions} - 1) \times \text{Delay Grid} + \text{Min. Delay}$$

The (mean) delay offset is calculated from the minimum and maximum delay ((max. delay - min. delay)/2).

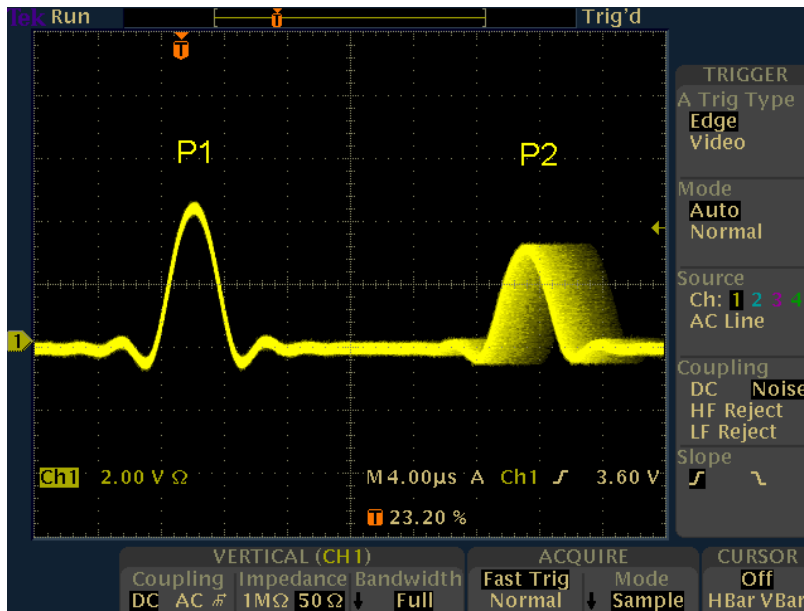


Remote-control command: n.a.

Moving Propagation Path Table - Fading

In the **Moving Propagation** configuration, the fading simulator simulates dynamic propagation conditions in conformity with the test case 3GPP, 25.104-xxx, annex B3. Here, the behavior of a receiver is tested in response to slow delay variations in a signal. Two paths are simulated: Path 1 has fixed delay (Reference Path, P1), while the delay of path 2 varies slowly in a sinusoidal fashion (Moving Path, P2). The two paths have no fading profile. They have the same level, the same phase and no Doppler shift.

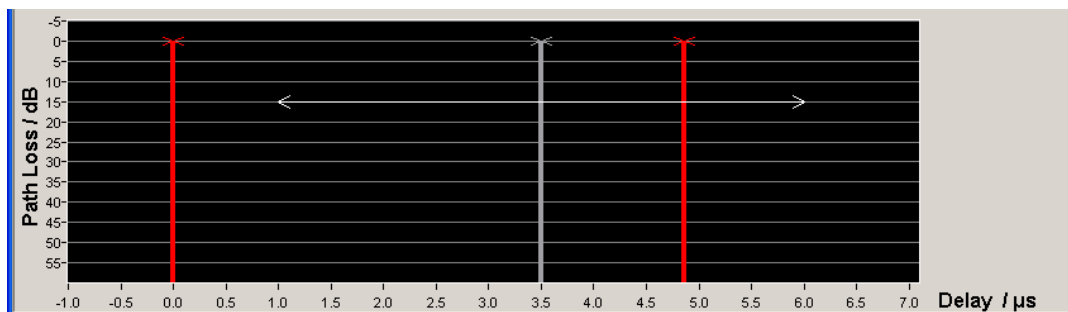
The following figure illustrates a baseband signal with ASK modulation (only one 1 bit, then many 0 bits) which was subjected to moving propagation. Path P1 remains still while path P2 moves in time relative to it. As a result of the luminescence setting on the oscilloscope, the way in which P2 wanders over time is clearly visible.



The **Path Graph** is shown below the path table.

The graphical display of the fading paths in Moving Propagation mode shows as an example the changing positions of the moving path with respect to the stationary reference path. The displayed position change does not correspond to the actual delay changes of the real signal.

The delay grid is plotted on the X axis. The permissible delay range for the moving path is shown in the graphics by the horizontal arrow. The grey path indicates the set start delay for the Moving Path. The path power is plotted on the Y axis, with 0 dB corresponding to the maximum power on the path (path loss = 0 dB). The scaling of the axes and the displayed path power match the real settings.



The delay Δt of the moving path obeys the following equation:

$$\Delta\tau = \left(DELAY + \frac{VARIATION(Pk Pk)}{2} \left(\sin\left(\frac{2\pi \cdot t}{VARIATION_PERIOD}\right) \right) \right)$$

Note:

The values relate to the values proposed in the test case 3GPP, 25.104xxx, annex B3 as follows:

$VARIATION(Pk Pk) = A$

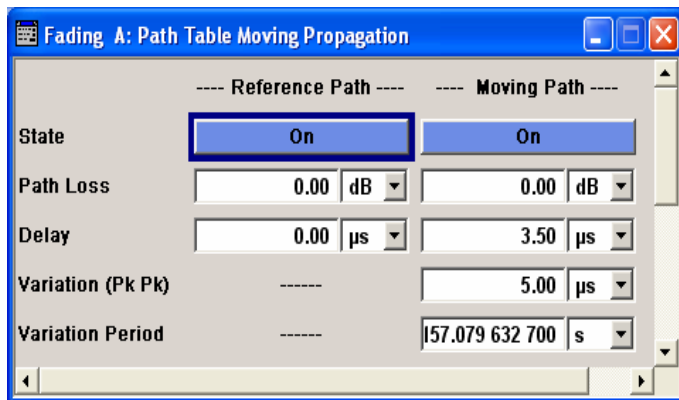
$DELAY = B + A/2$

$VARIATION_PERIOD = 2 \times \pi / \Delta \omega'$

The settings required to attain the values proposed in the test case 3GPP, 25.104xxx, annex B3 are given in the following table.

Reference Path:	Delay:	0 μ s
	Path Loss:	0 dB
	State:	On
Moving Path:	Variation (Pk Pk)	5 μ s
	Variation Period:	157 s
	Delay	3.5 μ s
	Path Loss	0 dB
	State:	On

These values are the default values for Moving Propagation. However, these parameters can also be set for further tests in the fading path table.



State Moving Propagation - Reference Path - Fading

Activates reference path P1 for moving propagation.

Remote-control command:
`SOUR:FSIM:MDEL:REF:STAT ON`

Path Loss Moving Propagation - Reference Path - Fading

Enters the loss for the reference path.

Remote-control command:
`SOUR:FSIM:MDEL:REF:LOSS 12 dB`

Delay Moving Propagation - Reference Path - Fading	Enters the delay for the reference path. Remote-control command: SOUR:FSIM:MDEL:REF:DEL 1E-6
State Moving Propagation - Moving Path - Fading	Activates moving fading path P2 for moving propagation. Remote-control command: SOUR:FSIM:MDEL:MOV:STAT ON
Path Loss Moving Propagation - Moving Path - Fading	Enters the loss for the moving fading path. Remote-control command: SOUR:FSIM:MDEL:MOV:LOSS 12 dB
Delay Moving Propagation - Moving Path - Fading	Enters the average delay for the moving fading path. The delay of the moving path slowly varies sinusoidally within the set variation range around this delay. Remote-control command: SOUR:FSIM:MDEL:MOV:DEL:MEAN?
Variation Moving Propagation - Moving Path - Fading	Enters the range for the delay of the moving fading path for moving propagation. The delay of the moving path slowly varies sinusoidally within this range around the set mean delay. Remote-control command: SOUR:FSIM:MDEL:MOV:DEL:VAR 5E-6
Variation Period Moving Propagation - Moving Path - Fading	Period duration for delay variation. A complete variation cycle is passed through in this time. Remote-control command: SOUR:FSIM:MDEL:MOV:VPER 157 s

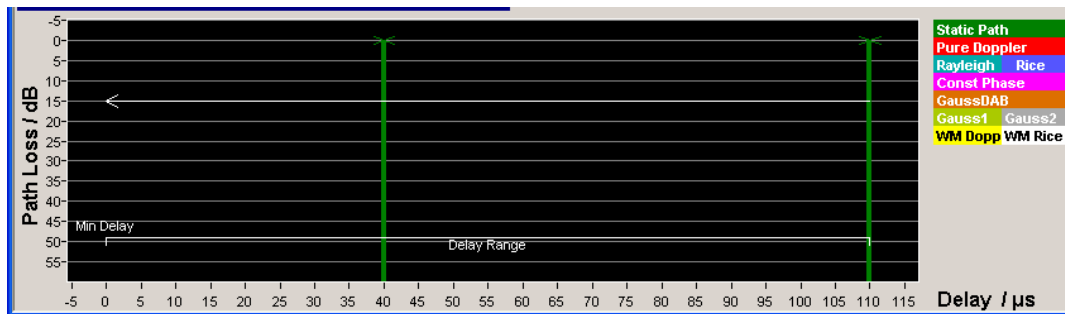
2 Channel Interferer Path Table - Fading

In the **2 Channel Interferer** configuration, the fading simulates dynamic propagation in conformity with the test cases 5 and 6 from MediaFlo. Here, path 1 has a fixed delay while the delay of path two either varies slowly in a sinusoidal way or appears in alternation at arbitrary points in time. Thus 2 channel interferer fading can be considered as a combination of birth death propagation fading and moving propagation fading. The main difference is the broader range of propagation obtainable with 2 channel interferer fading.

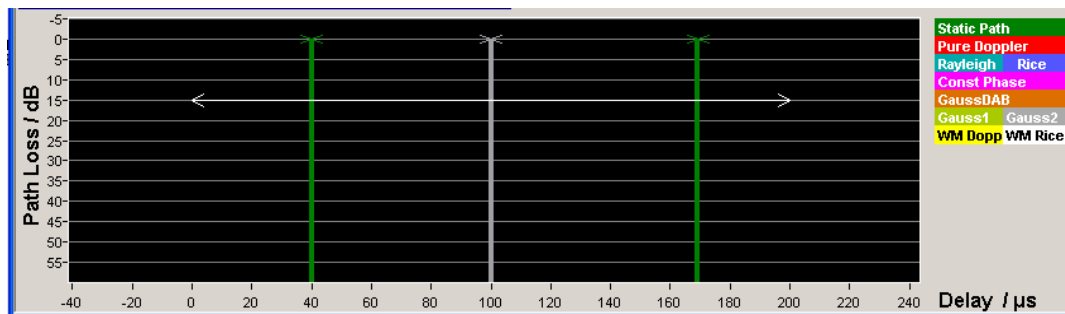
Different fading profiles (**Static Path**, **Pure Doppler**, and **Rayleigh**) can be allocated to the two path.

The following path graph shows an example with the following settings for moving mode **Hopping**:

Reference Path:	Delay Min:	30 μ s
	Profile:	Static Path
	Path Loss	0 dB
Moving Path:	Delay Min	30 μ s
	Profile:	Static Path
	Path Loss	0 dB
	Delay max:	100 μ s
	Moving Mode:	Hopping



The following graph shows the same setting with moving mode **Sliding**:



The moving path slides from the minimum delay (30 μ s) to the maximum delay (100 μ s) and back. The mean delay of the moving path (65 μ s) is indicated as a gray bar. The permissible delay range for the moving path is shown in the graphics by the horizontal arrow.

The displayed position change does not correspond to the actual delay changes of the real signal.

The settings required to attain the values proposed in the MediaFlo test case 5 and 6 are given in the following table:

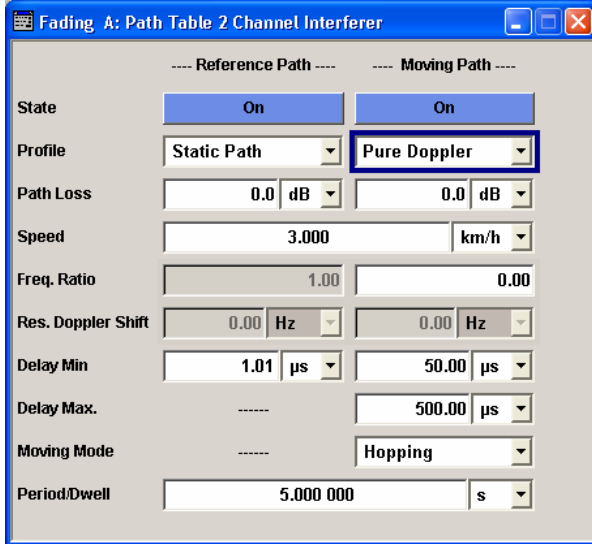
Test Case 5

Reference Path:	Profile:	Static Path
	Relativ Delay	10 μ s
	Average Power	-3 dB
	Fading Type	Rayleigh, 60 km/h
	Doppler Spectrum	Classic 6 dB
	Static Delay	40 μ s
Moving Path:	Profile:	Hopping
	Relativ Delay	0/110 μ s
	Average Power	-3 dB
	Fading Type	Static
	Doppler Spectrum	N/A
	Dwell Time	2.9 s

Test Case 6

Reference Path:	Profile:	Static Path
	Relativ Delay	100 μ s
	Average Power	-3 dB
	Fading Type	Static
	Doppler Spectrum	N/A
Moving Path:	Profile:	Sliding
	Relativ Delay	0/200 μ s
	Average Power	-3 dB
	Fading Type	Rayleigh, 3 km/h
	Doppler Spectrum	Classic 6 dB
	Period	160 s

These values are the default values for 2 Channel Interferer. However, these parameters can also be set for further tests in the fading path table.



State 2 Channel Interferer - Fading Activates/deactivates either the reference path or the moving path for 2 channel interferer fading.

Remote-control command:
SOUR:FSIM:TCI:REF:STAT ON

Profile 2 Channel Interferer - Fading Selects the fading profile either for the reference path or the moving path to be used for 2 channel interferer fading.

Remote-control command:
SOUR:FSIM:TCI:REF:PROF SPAT

Path Loss 2 Channel Interferer - Fading Sets the attenuation of either the reference path or moving path to be used for 2 channel interferer fading.

Remote-control command:
SOUR:FSIM:TCI:REF:LOSS 0

Speed 2 Channel Interferer - Fading **(Rayleigh only)**

Enters the speed v of the moving receiver. The unit for entering the speed under **Speed Unit** can be chosen in the upper section of the menu.

The resulting Doppler shift is dependent on the speed v and the entered ratio of the actual Doppler shift to the set Doppler shift f_b . This ratio is determined in the **Frequency Ratio** line. The resulting Doppler frequency can be read off from the **Res. Doppler Shift** line. It may not exceed the maximum Doppler frequency of 1600 Hz.

If the speed is changed, the resulting Doppler shift is automatically modified.

Remote-control command:
SOUR:FSIM:TCI:SPE 300

Freq. Ratio 2 Channel Interferer Path - Fading	<p>Enters the ratio of the actual Doppler shift to the Doppler shift set with the Speed parameter.</p> <p>Remote-control command: SOUR:FSIM:TCI:FRAT 1</p>
Res. Doppler Shift 2 Channel Interferer - Fading	<p>Displays the actual Doppler shift.</p> <p>The actual Doppler frequency is determined by the entered Speed and the entered ratio of the actual Doppler frequency to the set Doppler frequency (Frequency Ratio).</p> <p>Remote-control command: SOUR:FSIM:TCI:REF:FDOP?</p>
Delay Min 2 Channel Interferer - Fading	<p>Enters the minimum delay for either the reference path or the moving path.</p> <p>The minimum delay of the moving path corresponds to the start value of the delay range.</p> <p>The delay range is defined by the minimum delay and the maximum delay. It can be in the range between 0 and 1000 μs.</p> <p>The scaling of the X-axis is adapted according to the entry.</p> <p>Invalid entries are rejected, the next possible value is entered.</p> <p>Remote-control command: SOUR:FSIM:TCI:REF:DEL:MIN 200</p>
Delay Max 2 Channel Interferer - Moving Path - Fading	<p>Enters the maximum delay for the moving path.</p> <p>The maximum delay of the moving path corresponds to the end value of the delay range.</p> <p>The delay range is defined by the minimum delay and the maximum delay. It can be in the range between 0 and 1000 μs.</p> <p>The scaling of the X-axis is adapted according to the entry.</p> <p>Invalid entries are rejected, the next possible value is entered.</p> <p>Remote-control command: SOUR:FSIM:DEL:MAX 500</p>

Moving Mode 2 Channel Interferer - Moving Path - Fading

Selects the Type of moving applied to the moving path.

Sliding

The reference path has a fix delay while the delay of the moving path varies slowly in a sinusoidal way.

Remote-control command:

SOUR:FSIM:TCI:MMOD:SLID

Hopping

The reference path has a fix delay while the delay of the moving path appears or disappears in alternation at arbitrary points in time.

Remote-control command:

SOUR:FSIM:TCI:MMOD:HOPP

Period Dwell 2 Channel Interferer - Fading

Enters either the dwell time or the period of a complete cycle for the moving path depending on the setting in the **Moving Mode** field: If the moving mode is set to **Sliding**, the period for a complete cycle of the moving path can be set here. If the moving mode is set to **Hopping**, the dwell time of the moving path can be set here.

The gradient of the delay/period ratio may not fall und 6 us/s, that is, the minimum value of the period depends on the value of the delay.

If the value for the delay is increased in a way that the value for the gradient falls below 6us/s, the value for the period is recalculated automatically.

Example:

Delay min = 20 us, Delay max 120 us

$$6 \geq ((\text{Delay max} - \text{Delay min})/2) \times 2 \times \pi / T$$

$$6 \geq 314 \text{us} / T$$

$$T \geq 314 / 6$$

T is set to 52,33 s. The value of T can not be decreased below this value.

Note:

This recalculation of the period is a very computing power consumptive process. Therefore, no further operations should be performed until the calculation is finished.

Remote-control command:

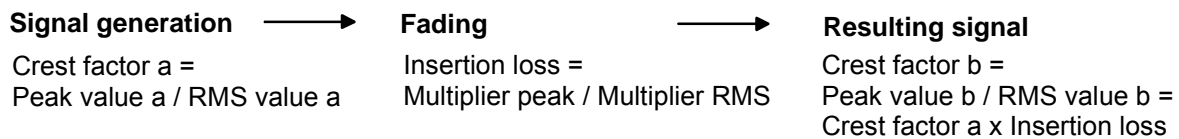
SOUR:FSIM:TCI:PER 50

Insertion Loss Configuration ... - Fading

The menu for setting the insertion loss is called in the **Fading** menu.

The fading process increases the crest factor of the signal, and this increase must be taken into account in the drive at the baseband level.

The crest factor gives the difference in level between the peak envelope power (PEP) and average power value (RMS) in dB. A higher crest factor can be achieved by either increasing the peak value or decreasing the RMS value. As the peak value is always kept as close as possible to the full drive level (multiplier peak ≈ 1), fading reduces the RMS value by the additional crest factor due to fading (multiplier RMS < 1). The insertion loss is determined from the ratio of these two multipliers. The crest factor of the signal at the fader output is derived from the crest factor of the signal at the fader input and the insertion loss. The output power is set using this crest factor.



If one of the available standards/test cases is selected, the optimal range for adapting the insertion loss is set.

In the case of a user-defined fading configuration, the mode with which the insertion loss range is determined can be selected.

In **Normal** mode, the insertion loss is set so that normally full drive does not occur, which avoids any clipping of the signal at the maximum level. The signal quality is very high, but the RMS level is lower than the maximum possible level. If a higher dynamic range is required (e.g. for adjacent channel measurements = ACP), a lower insertion loss can be selected (**Low ACP** mode). In that case, a higher level relative to the maximum drive is output (greater S/N ratio). However, this will decrease the signal quality because of a higher percentage of clipping. **Low ACP** mode is only recommended for fading paths with Raleigh profile as only in this case statistical distribution of level fluctuation is ensured. For other fading profiles, non-statistical level fluctuations occur which lead to an enormous increase of clipping. However, monitoring the percentage of clipped samples is recommended for Raleigh paths also.

Since it is possible to manually enter the insertion loss, the user can find a favorable **Insertion Loss** setting with the desired signal dynamic range and acceptable clipping rate for any application (**User** mode).

This is supported by displaying the current percentage of clipped samples.

The output level is always automatically adapted, regardless of the selected mode and the path loss settings, so that the set level is output as the summed level (RMS) of all paths.

The correct automatic adaptation of the insertion loss is possible only if the processes involved in fading (the paths among themselves as well as the paths relative to the input signal) are statistically independent of each other. If correlations occur, the output level must be measured again and perhaps manually taken into account as a level offset.

Examples:

Correlated processes resulting from the modulation signal used and the configuration of the fader:

A QPSK signal with a symbol rate of 1 Msymb/s is generated, using the PRBS9 sequence as the data source.

Two paths are set with a Rayleigh profile, identical speed and a resulting delay of 0 μ s and 1 μ s, respectively, on the fader.

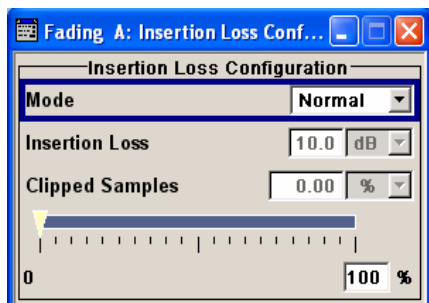
The symbol rates of the modulation signal are in the range of the delay differences of the fading paths; the autocorrelation of the modulation data (PRBS9) to the adjacent symbol is not equal to 0. The fading process is therefore statistically not independent of the process of generating the modulation signal, and an error occurs in the automatic calculation of the insertion loss.

Correlated processes within the fader:

Two paths have a pure doppler profile and a resulting doppler shift of 100 Hz. The start phases of the two paths differ.

This causes superimpositions, which can result in the deletion of the signal, e.g. with a phase setting of 0° and 180°; automatic calculation of the insertion loss is not possible.

The settings are summarized in the **Insertion Loss Configuration** section.

**Insertion Loss Mode - Fading**

Sets the mode for determining the insertion loss.

Mode Normal

The insertion loss for a path of the fading simulator is automatically chosen so that even when lognormal fading is switched on, overdrive will occur only very rarely in the fading simulator. This setting is recommended for bit error rate tests (BERTs).

The current insertion loss is displayed under **Insertion Loss**.

Remote-control command:
SOUR:FSIM:ILOS:MODE NORM

Mode Low ACP

The insertion loss is automatically chosen so that an overdrive will occur with an acceptable probability. **Low ACP** mode is only recommended for fading paths with Raleigh profile as only in this case statistical distribution of level fluctuation is ensured. For other fading profiles, non-statistical level fluctuations occur which lead to an enormous increase of clipping. However, monitoring the percentage of clipped samples is recommended for Raleigh paths also.

The current insertion loss is displayed under **Insertion Loss**.

Remote-control command:

SOUR:FSIM:ILOS:MODE LACP

Mode User

Any value for the minimum insertion loss in the range from 0 dB to 18 dB can be selected. Desired value is entered under **Insertion Loss**.

This mode is provided to ensure optimization of the dynamic range and signal quality for any application. Display of the clipping rate for any value which is entered enables estimation of the signal quality for the specified signal dynamic range.

Remote-control command:

SOUR:FSIM:ILOS:MODE USER

Insertion Loss - Fading

Displays the current insertion loss in the **Normal** and **Low ACP** modes.

Entry of the insertion loss in **User** mode.

Remote-control command:

SOUR:FSIM:ILOS 4 dB

Clipped Samples - Fading

Displays the samples whose level is clipped as a %.

If the full drive level is reached for an insertion loss which is too low, the I/Q signals are limited to the maximum available level (clipping).

Remote-control command:

SOUR:FSIM:ILOS:CSAM?

Response: '0'

0 ... 100 %

Graphically displays the samples whose level is clipped as a %. The scale resolution is determined by entering the maximum value as a %.

Predefined Fading Settings

The predefined fading settings correspond to the test scenarios stipulated in the common mobile radio standards. The following tables provide a listing of the predefined standards along with the underlying test scenarios and the settings which are made.

CDMA Test Scenarios

CDMA 1 (8km/h - 2 Path)

C.S0011-A_MS_Minimum_Performance_Spec.pdf

	Path 1	Path 2
Profile [type]	Rayleigh	Rayleigh
Loss [dB]:	0	0
Delay [ns]:	0	2000
LogNormal	off	off
Correlated with:	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	8	8

also with 15km/h in band class 5

CDMA 2 (30km/h - 2 Path)

C.S0011-A_MS_Minimum_Performance_Spec.pdf

	Path 1	Path 2
Profile [type]	Rayleigh	Rayleigh
Loss [dB]:	0	0
Delay [ns]:	0	2000
LogNormal	off	off
Correlated with:	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	30	30

also with 14km/h in band classes 1,4,6,8

also with 58km/h in band class 5

CDMA 3 (30km/h - 1 Path)

C.S0011-A_MS_Minimum_Performance_Spec.pdf

	Path 1
Profile [type]	Rayleigh
Loss [dB]:	0
Delay [ns]:	0
LogNormal	off
Correlated with:	off
Power Ratio [dB]:	0
Freq Ratio:	0
Speed [km/h]:	30

also with 58km/h in band class 5

CDMA 4 (100km/h - 3 Path)

C.S0011-A_MS_Minimum_Performance_Spec.pdf

	Path 1	Path 2	Path 3
Profile [type]	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0	3
Delay [ns]:	0	2000	14500
LogNormal	off	off	off
Correlated with:	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0	0	0
Speed [km/h]:	100	100	100

also with 192km/h in band class 5

CDMA 5 (0km/h - 2 Path)

C.S0011-A_MS_Minimum_Performance_Spec.pdf

	Path 1	Path 2
Profile [type]	Rayleigh	Rayleigh
Loss [dB]:	0	0
Delay [ns]:	0	2000
LogNormal	off	off
Correlated with:	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	0	0

CDMA 6 (3km/h - 1 Path)

C.S0011-A_MS_Minimum_Performance_Spec.pdf

	Path 1
Profile [type]	Rayleigh
Loss [dB]:	0
Delay [ns]:	0
LogNormal	off
Correlated with:	off
Power Ratio [dB]:	0
Freq Ratio:	0
Speed [km/h]:	3

also with 6km/h in band class 5

GSM Test Scenarios

GSM TU3 (6 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	3	0	2	6	8	10
Delay [ns]:	0	200	500	1600	2300	5000
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	3	3	3	3	3	3

GSM TU50 (6 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	3	0	2	6	8	10
Delay [ns]:	0	200	500	1600	2300	5000
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	50	50	50	50	50	50

GSM HT100 (6 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	1,5	4,5	7,5	8	17,7
Delay [ns]:	0	100	300	500	15000	17200
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	100	100	100	100	100	100

GSM RA250 (6 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rice	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	4	8	12	16	20
Delay [ns]:	0	100	200	300	400	500
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	6,88	0	0	0	0	0
Freq Ratio:	0,7	0	0	0	0	0
Speed [km/h]:	250	250	250	250	250	250

Note: There has been a change in the specifications TS8916B, Baseline Change from 5.1.0 to 5.2.0. The power ratio for path 1 with Rice fading is now no longer referred only to Rayleigh of path 1. Instead, it is referred to the total power of all of the paths. The preset value used in the R&S SMU of 6.88 fulfils this requirement. It does not conform to the value given in the specification since the R&S SMU always determines the power ratio for one path. By taking into account the power of the other paths in calculating this value, however, the required power ratio for all six paths is achieved.

GSM ET50 (6 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0	0	0	0	0
Delay [ns]:	0	3200	6400	9600	12800	16000
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	50	50	50	50	50	50

GSM ET100 (6 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0	0	0	0	0
Delay [ns]:	0	3200	6400	9600	12800	16000
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	100	100	100	100	100	100

GSM TU3 (12 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	4	3	0	2,6	3	5	7	5	6,5	8,6	11
Delay [ns]:	0	100	300	500	800	1100	1300	1700	2300	3100	3200
LogNormal	off	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	3	3	3	3	3	3	3	3	3	3	3

GSM TU50 (12 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	4	3	0	2,6	3	5	7	5	6,5	8,6	11
Delay [ns]:	0	100	300	500	800	1100	1300	1700	2300	3100	3200
LogNormal	off	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	50	50	50	50	50	50	50	50	50	50	50

GSM HT100 (12 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	10	8	6	4	0	0	4	8	9	10	12
Delay [ns]:	0	100	300	500	700	1000	1300	15000	15200	15700	17200
LogNormal	off	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	100	100	100	100	100	100	100	100	100	100	100

NADC Test Scenarios

NADC 8 (2 Path)

Note: Path 2 should be placed in its own group (delay max. 40 000 ns)

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	0
Delay [ns]:	0	41200
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	8	8

NADC 50 (2 Path)

Note: Path 2 should be placed in its own group (delay max. 40 000 ns)

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	0
Delay [ns]:	0	41200
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	50	50

NADC 100 (2 Path)

Note: Path 2 should be placed in its own group (delay max. 40 000 ns)

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	0
Delay [ns]:	0	41200
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	100	100

PCN Test Scenarios

PCN TU1.5 (6 Path)

Same as GSM Tux

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	3	0	2	6	8	10
Delay [ns]:	0	200	500	1600	2300	5000
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	1,5	1,5	1,5	1,5	1,5	1,5

PCN TU50 (6 Path)

Same as GSM TU50

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	3	0	2	6	8	10
Delay [ns]:	0	200	500	1600	2300	5000
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	50	50	50	50	50	50

PCN HT100 (6 Path)

Same as GSM

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	1,5	4,5	7,5	8	17,7
Delay [ns]:	0	100	300	500	15000	17200
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	100	100	100	100	100	100

PCN RA130 (6 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rice	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	4	8	12	16	20
Delay [ns]:	0	100	200	300	400	500
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	6,47	0	0	0	0	0
Freq Ratio:	0,7	0	0	0	0	0
Speed [km/h]:	130	130	130	130	130	130

PCN ET50 (6 Path)

Same as GSM

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0	0	0	0	0
Delay [ns]:	0	3200	6400	9600	12800	16000
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	50	50	50	50	50	50

PCN ET100 (6 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0	0	0	0	0
Delay [ns]:	0	3200	6400	9600	12800	16000
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	100	100	100	100	100	100

PCN TU1.5 (12 Path)

Same as GSM Tux

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	4	3	0	2,6	3	5	7	5	6,5	8,6	11	10
Delay [ns]:	0	100	300	500	800	1100	1300	1700	2300	3100	3200	5000
LogNormal	off	off	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5

PCN TU50 (12 Path)

Same as GSM

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	4	3	0	2,6	3	5	7	5	6,5	8,6	11	10
Delay [ns]:	0	100	300	500	800	1100	1300	1700	2300	3100	3200	5000
LogNormal	off	off	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	50	50	50	50	50	50	50	50	50	50	50	50

PCN HT100 (12 Path)

Same as GSM

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	10	8	6	4	0	0	4	8	9	10	12	14
Delay [ns]:	0	100	300	500	700	1000	1300	15000	15200	15700	17200	20000
LogNormal	off	off	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	100	100	100	100	100	100	100	100	100	100	100	100

TETRA Test Scenarios

TETRA TU50 (2 Path)

EN300 392-2, page 62

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	22,3
Delay [ns]:	0	5000
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	50	50

TETRA BU50 (2 Path)

EN300 392-2, page 62

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	3
Delay [ns]:	0	5000
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	50	50

TETRA HT200 (2 Path)

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	8,6
Delay [ns]:	0	15000
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	200	200

TETRA ET200 (4 Path)

EN300 392-2, page 62, Equalizer Test

Note: Path 3 and 4 should be placed in their own group (delay max. 40 000 ns)

	Path 1	Path 2	Path 3	Path 4
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0	10,2	16
Delay [ns]:	0	11600	73200	99300
LogNormal	off	off	off	off
Corr with	off	off	off	off
Power Ratio [dB]:	0	0	0	0
Freq Ratio:	0	0	0	0
Speed [km/h]:	200	200	200	200

3GPP Test Scenarios

3GPP Case 1 (mobile/base)

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2 and
3GPP TS 25.141 V6.3.0 (2003-09) annex D.2

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	10
Delay [ns]:	0	976
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	3	3

3GPP Case 2 (mobile/base)

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2 and
3GPP TS 25.141 V6.3.0 (2003-09) annex D.2

	Path 1	Path 2	Path 3
Profile [Type]	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0	0
Delay [ns]:	0	976	20000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0	0	0
Speed [km/h]:	3	3	3

3GPP Case 3 (mobile/base)

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2 and
3GPP TS 25.141 V6.3.0 (2003-09) annex D.2

	Path 1	Path 2	Path 3	Path 4
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	3	6	9
Delay [ns]:	0	260	521	781
LogNormal	off	off	off	off
Corr with	off	off	off	off
Power Ratio [dB]:	0	0	0	0
Freq Ratio:	0	0	0	0
Speed [km/h]:	120	120	120	120

3GPP Case 4 (mobile)

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	0
Delay [ns]:	0	976
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	3	3

3GPP Case 5 (mobile)

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	10
Delay [ns]:	0	976
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	50	50

3GPP Case 6 (mobile) and Case 4 (base)3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2 and
3GPP TS 25.141 V6.3.0 (2003-09) annex D.2

	Path 1	Path 2	Path 3	Path 4
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	3	6	9
Delay [ns]:	0	260	521	781
LogNormal	off	off	off	off
Corr with	off	off	off	off
Power Ratio [dB]:	0	0	0	0
Freq Ratio:	0	0	0	0
Speed [km/h]:	250	250	250	250

3GPP Mobile Case 7 (Sector)

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	4,3	6,6	2	7	7,5
Delay [ns]:	0	260	1040	4690	7290	14580
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	50	50	50	50	50	50

3GPP Mobile Case 7 (Beam)

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2

				Path 4	Path 5	Path 6
Profile [Type]				Rayleigh	Rayleigh	Rayleigh
Loss [dB]:				0	0,3	0,9
Delay [ns]:				4690	7290	14580
LogNormal				off	off	off
Corr with				off	off	off
Power Ratio [dB]:				0	0	0
Freq Ratio:				0	0	0
Speed [km/h]:				50	50	50

3GPP Mobile PA3

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2, ITU Pedestrian A (HSDPA)

	Path 1	Path 2	Path 3	Path 4
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	9,7	19,2	22,8
Delay [ns]:	0	110	190	410
LogNormal	off	off	off	off
Corr with	off	off	off	off
Power Ratio [dB]:	0	0	0	0
Freq Ratio:	0	0	0	0
Speed [km/h]:	3	3	3	3

3GPP Mobile PB3

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2, ITU Pedestrian B (HSDPA)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0,9	4,9	8	7,8	23,9
Delay [ns]:	0	200	800	1200	2300	3700
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	3	3	3	3	3	3

3GPP Mobile VA30

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2, ITU vehicular A (HSDPA)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	1	9	10	15	20
Delay [ns]:	0	310	710	1090	1730	2510
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	30	30	30	30	30	30

3GPP Mobile VA120

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2, ITU vehicular A (HSDPA)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	1	9	10	15	20
Delay [ns]:	0	310	710	1090	1730	2510
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	120	120	120	120	120	120

3GPP Mobile Case 8 (CQI)

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2, Table B.1C;

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	10
Delay [ns]:	0	976
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	30	30

3GPP Birth Death

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.4

	Path 1	Path 2
Profile [Type]	Static	Static
Loss [dB]:	0	0
Delay [ns]:	0...10us	0...10us
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	1	1
Speed [km/h]:	0	0

Dwell: 191ms

(Mean)-Offset: 5us

3GPP Moving Propagation

3GPP TS 25.101 V6.2.0 (2003-09), annex B2.3

	Path 1	Path 2
Profile [Type]	Static	Static
Loss [dB]:	0	0
Delay [ns]:	0	1... 6us
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	1	1
Speed [km/h]:	0	0

Period: 157,0796s =2*PI/0.04

(Mean)-Delay: 3.5us

3GPP TUx

3GPP TS 25.943 V5.1.0 (2002-06)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	5,7	7,6	10,1	10,2	10,2	11,5	13,4	16,3	16,9	17,1
Delay [ns]:	0	217	512	514	517	674	882	1230	1287	1311
LogNormal	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	3	3	3	3	3	3	3	3	3	3
	Path 11	Path 12	Path 13	Path 14	Path 15	Path 16	Path 17	Path 18	Path 19	Path 20
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	17,4	19	19	19,8	21,5	21,6	22,1	22,6	23,5	24,3
Delay [ns]:	1349	1533	1535	1622	1818	1836	1884	1943	2048	2140
LogNormal	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	3	3	3	3	3	3	3	3	3	3

3GPP RAX

3GPP TS 25.943 V5.1.0 (2002-06)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10
Profile [Type]	Pure Dop	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	5,2	6,4	8,4	9,3	10	13,1	15,3	18,5	20,4	22,4
Delay [ns]:	0	42	101	129	149	245	312	410	469	528
LogNormal	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0,7	0	0	0	0	0	0	0	0	0
Speed [km/h]:	250	250	250	250	250	250	250	250	250	250

3GPP HT

3GPP TS 25.943 V5.1.0 (2002-06)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	3,6	8,9	10,2	11,5	11,8	12,7	13	16,2	17,3	17,7
Delay [ns]:	0	356	441	528	546	609	625	842	916	941
LogNormal	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	100	100	100	100	100	100	100	100	100	100
	Path 11	Path 12	Path 13	Path 14	Path 15	Path 16	Path 17	Path 18	Path 19	Path 20
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	17,6	22,7	24,1	25,8	25,8	26,2	29	29,9	30	30,7
Delay [ns]:	15000	16172	16492	16876	16882	16978	17615	17827	17849	18016
LogNormal	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	100	100	100	100	100	100	100	100	100	100

WLAN Test Scenarios

WLAN / HyperLan/2 Model A

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12	Path 13	Path 14	Path 15	Path 16	Path 17	Path 18	
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0,9	1,7	2,6	3,5	4,3	5,2	6,1	6,9	7,8	4,7	7,3	9,9	12,5	13,7	18	22,4	26,7	
Delay [ns]:	0	10	20	30	40	50	60	70	80	90	110	140	170	200	240	290	340	390	
LogNormal	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	
Corr with	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Speed [km/h]:	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	

Corresponds to a typical office environment for NLOS conditions and an average rms delay spread of 50ns

WLAN / HyperLan/2 Model B

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12	Path 13	Path 14	Path 15	Path 16	Path 17	Path 18	
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	2,6	3	3,5	3,9	0	1,3	2,6	3,9	3,4	5,6	7,7	9,9	12,1	14,3	15,4	18,4	20,7	24,6	
Delay [ns]:	0	10	20	30	50	80	110	140	180	230	280	330	380	430	490	560	640	730	
LogNormal	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	
Corr with	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Speed [km/h]:	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	

Corresponds to a typical large open space and office environments for NLOS conditions and an average rms delay spread of 100ns

WLAN / HyperLan/2 Model C

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12	Path 13	Path 14	Path 15	Path 16	Path 17	Path 18	
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	3,3	3,6	3,9	4,2	0	0,9	1,7	2,6	1,5	3	4,4	5,9	5,3	7,9	9,4	13,2	16,3	21,2	
Delay [ns]:	0	10	20	30	50	80	110	140	180	230	280	330	400	490	600	730	880	1050	
LogNormal	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	
Corr with	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Speed [km/h]:	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	

Corresponds to a typical large open space environment for NLOS conditions and an average rms delay spread of 150ns

WLAN / HyperLan/2 Model D

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12	Path 13	Path 14	Path 15	Path 16	Path 17	Path 18
Profile [Type]	Rice	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	10	10,3	10,6	6,4	7,2	8,1	9	7,9	9,4	10,8	12,3	11,7	14,3	15,8	19,6	22,7	27,6
Delay [ns]:	0	10	20	30	50	80	110	140	180	230	280	330	400	490	600	730	880	1050
LogNormal	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8

Corresponds to a typical office environment for LOS conditions. A 10db spike at 0 delay has been added resulting in an average rms delay spread of 140ns

WLAN / HyperLan/2 Model E

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12	Path 13	Path 14	Path 15	Path 16	Path 17	Path 18
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	4,9	5,1	5,2	0,8	1,3	1,9	0,3	1,2	2,1	0	1,9	2,8	5,4	7,3	10,6	13,4	17,4	20,9
Delay [ns]:	0	10	20	40	70	100	140	190	240	320	430	560	710	880	1070	1280	1510	1760
LogNormal	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Speed [km/h]:	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8

Corresponds to a typical large open space environment for NLOS conditions and an average rms delay spread of 250ns

Remote-Control Commands

SOURce:FSIMulator-Subsystem

This subsystem contains the commands needed to configure the fading simulator.

Dual-channel fading is possible when the instrument is fitted with the options B14 (Fading Simulator) and B15 (Path Extension). Unlike the SOURce subsystem SOURce2, it is the second fader which responds here and not the second baseband or RF path in dual-path instruments.

SOURce<1> = Fader A

SOURce2 = Fader B

The dynamic fading configurations Birth Death and Moving Propagation and the Fine Delay configurations are available with option K71.

Command	Parameter	Default unit	Comment
[SOURce<1>]:FSIMulator:BIRThdeath:DELay:GRID	0 ... <10 μ s	s	
[SOURce<1>]:FSIMulator:BIRThdeath:DELay:MAXimum		s	Query only
[SOURce<1>]:FSIMulator:BIRThdeath:DELay:MINimum	0 ... < 40 μ s	s	
[SOURce<1>]:FSIMulator:BIRThdeath:FDOPpler			Query only
[SOURce<1>]:FSIMulator:BIRThdeath:FRATio	-1.0 ... +1.0		
[SOURce<1>]:FSIMulator:BIRThdeath:HOPPping:DWELl	1ms ... (2 ³² -1) ns	s	
[SOURce<1>]:FSIMulator:BIRThdeath:PATH<1>:LOSS	0.0 ... 50.0 dB	dB	
[SOURce<1>]:FSIMulator:BIRThdeath:PATH<1>:PROFile	PDOPpler		
[SOURce<1>]:FSIMulator:BIRThdeath:POSition	3 ... 11		
[SOURce<1>]:FSIMulator:BIRThdeath:SOFFset	1ms .. (2 ³² -1) us	s	
[SOURce<1>]:FSIMulator:BIRThdeath:SPEed	0 ... 479.67 m/s	Km/h	
[SOURce<1>]:FSIMulator:BIRThdeath:STATe	ON OFF		
[SOURce]:FSIMulator:CATalog?			Query only
[SOURce<1>]:FSIMulator:COPY:DESTination	1 ... 4 / 1... 8		
[SOURce<1>]:FSIMulator:COPY:EXECute			No query
[SOURce<1>]:FSIMulator:COPY:SOURce	1 ... 4 / 1... 8		
[SOURce<1>]:FSIMulator:COUPlE:LOGNormal:CSTD	ON OFF		
[SOURce<1>]:FSIMulator:COUPlE:LOGNormal:LCONstant	ON OFF		
[SOURce<1>]:FSIMulator:COUPlE:SPEed	ON OFF		
[SOURce<1>]:FSIMulator:CSPeed	ON OFF		
[SOURce<1>]:FSIMulator:DEL30:GROup<1>2...8>:PATH<1>2 3>:ADELay	0.0 ... 40.0E-6 s		
[SOURce<1>]:FSIMulator:DEL30:GROup<1>2...8>:PATH<1>2 3>:BDELay	0.0 ... 2.56E-3 s	s	
[SOURce<1>]:FSIMulator:DEL30:GROup<1>2...8>:PATH<1>2 3>:CORRelation:COEFFicient	0.0 ... 100.0 PCT	PCT	
[SOURce<1>]:FSIMulator:DEL30:GROup<1>2...8>:PATH<1>2 3>:CORRelation:PHASe	0.0 ... 359.9 DEG	RAD	
[SOURce<1>]:FSIMulator:DEL30:GROup<1>2...8>:PATH<1>2 3>:CORRelation:STATe	ON OFF		

Command	Parameter	Default unit	Comment
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:CPHase	0.0 ... 359.9 DEG	RAD	
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:FDOPpler	0.0 ... 1000.0 Hz	Hz	
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:FRATio	-1.0 ... +1.0		
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:LOGNormal:CSTD	0.0 ... 12.0 dB	dB	
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:LOGNormal:LCONstant	0.0 ... 200.0 m	Meter	
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:LOGNormal:STATe	ON OFF		
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:LOSS	0.0 ... 50.0 dB	dB	
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:PRATio	-30.0 ... +30.0 dB	dB	
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:PROFile	PDOPpler SPATH RAYLeigh RICE CPHase OGAUs TGAUs DGAUs GDOPpler GFD8 GFD1 WDOPpler WRICe		
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:RDELay			Query only
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:SPEed	0.0 ... 27778.0 m/s	M/s	
[SOURce<[1]2>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2 3>:STATe	ON OFF		
[SOURce<[1]2>:]FSIMulator:DEL30:STATe	ON OFF		
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:ADELay	0.0 ... 40.0E-6 s		
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:BDELay	0.0 ... 2.56E-3 s		
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:CORRelation:COEFficient	0.0 ... 100.0 PCT	PCT	
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:CORRelation:PHASe	0.0 ... 359.9 DEG	RAD	
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:CORRelation:STATe	ON OFF		
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:CPHase	0.0 ... 359.9 DEG	RAD	
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:FDOPpler	0.0 ... 1000.0 Hz	Hz	
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:FRATio	-1.0 ... +1.0		
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:LOGNormal:CSTD	0 ... 12 dB	dB	
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:LOGNormal:LCONstant	0.0 ... 200.0 m	Meter	
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:LOGNormal:STATe	ON OFF		
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:LOSS	0.0 ... 50.0 dB	dB	
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:PRATio	-30.0 ... +30.0	dB	

Command	Parameter	Default unit	Comment
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:PROFile	PDOPpler SPATH RAYLeigh RICE CPHase OGAUs TGAUs DGAUs GDOPpler GFD8 GFD1 WDOPpler WRICe		
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:RDElay			Query only
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:SPEed	0.0 ... 27778.0 m/s		
[SOURce<[1]2>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:STATE	ON OFF		
[SOURce<[1]2>:]FSIMulator:DEL50:STATE	ON OFF		
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:ADElay	0.0 ... 40.0E-6 s		
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:BDElay	0.0 ... 2.56E-3 s		
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:CORRelation:COEFficient	0.0 ... 100.0 PCT	PCT	
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:CORRelation:PHASe	0.0 ... 359.9 DEG	RAD	
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:CORRelation:STATE	ON OFF		
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:CPHase	0.0 ... 359.9 DEG	DEG	
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:FDOPpler	0.0 ... 1000.0 Hz	Hz	
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:FRATio	-1.0 ... +1.0		
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:LOGNormal:CSTD	0.0 ... 12.0 m/s		
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:LOGNormal:LCONstant	0.0 ... 200.0 m	Meter	
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:LOGNormal:STATE	ON OFF		
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:LOSS	0.0 ... 50.0 dB	dB	
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:PRATio	-30.0 ... +30.0	dB	
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:PROFile	PDOPpler SPATH RAYLeigh RICE CPHase OGAUs TGAUs DGAUs GDOPpler GFD8 GFD1 WDOPpler WRICe		
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:RDElay			Query only
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:SPEed	0.0 ... 27778.0 m/s		
[SOURce<[1]2>:]FSIMulator:DELay:GROup<[1]2...8>:PATH<[1]2...5>:STATE	ON OFF		
[SOURce<[1]2>:]FSIMulator:DELay:STATE	ON OFF		
[SOURce<[1]2>:]FSIMulator:DELETE	<file name>		No query
[SOURce]:FSIMulator:EXTension	A1 A1EXT B1EXT		

Command	Parameter	Default unit	Comment
[SOURce<[1]>:]FSIMulator:FREQuency	100.0E3 ... 6.0E9		
[SOURce<[1]>:]FSIMulator:GLOBal:SEED	1...10		
[SOURce<[1]>:]FSIMulator:HOPping:MODE	OFF RESume FRESH		
[SOURce<[1]>:]FSIMulator:IGNore:RFCHanges	ON OFF		
[SOURce<[1]>:]FSIMulator:ILOSs:CSAMples			Query only
[SOURce<[1]>:]FSIMulator:ILOSs:MODE	NORMAL LACP USER		
[SOURce<[1]>:]FSIMulator:ILOSs[:LOSS]	0.0 ... 10.0 dB	dB	
[SOURce<[1]>:]FSIMulator:KCONstant	SPEEd DSHift		
[SOURce<[1]>:]FSIMulator:LOAD	<file name>		No query
[SOURce<[1]>:]FSIMulator:MDELay:MOVing:DELay:MEAN	1.5 μ s ... 1688 μ s	s	
[SOURce<[1]>:]FSIMulator:MDELay:MOVing:DELay:VARiation	0.3 ... 100 μ s	s	
[SOURce<[1]>:]FSIMulator:MDELay:MOVing:LOSS	0.0 ... 50.0 dB	dB	
[SOURce<[1]>:]FSIMulator:MDELay:MOVing:STATe	ON OFF		
[SOURce<[1]>:]FSIMulator:MDELay:MOVing:VPERiod	10 ... 500 s	s	
[SOURce<[1]>:]FSIMulator:MDELay:REFerence:DELay	0.0 ... 1638 μ s	s	
[SOURce<[1]>:]FSIMulator:MDELay:REFerence:LOSS	0.0 ... 50.0 dB	dB	
[SOURce<[1]>:]FSIMulator:MDELay:REFerence:STATe	ON OFF		
[SOURce<[1]>:]FSIMulator:MDELay:STATe	ON OFF		
[SOURce<[1]>:]FSIMulator:MIMO:TAP	TAP1 TAP2 TAP3 TAP4 TAP5 TAP6 TAP7 TAP8 TAP9 TAP10		
[SOURce<[1]>:]FSIMulator:MIMO:TAP:COPY:NEXT			No query
[SOURce<[1]>:]FSIMulator:MIMO:TAP:COPY:PREVIOUS			No query
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:KRONecker:CORR elation:RX:IMAG	-1.000...1.000		
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:KRONecker:CORR elation:RX:PHASe	0.00...360.00		
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:KRONecker:CORR elation:RX:RATIo	0.000...1.000		
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:KRONecker:CORR elation:RX:REAL	-1.000...1.000		
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:KRONecker:CORR elation:TX:IMAG	-1.000...1.000		
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:KRONecker:CORR elation:TX:PHASe	0.00...360.00		
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:KRONecker:CORR elation:TX:RATIo	0.000...1.000		
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:KRONecker:CORR elation:TX:REAL	-1.000...1.000		
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:MATRix:MODE	INDividual KRONecker		
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:MATRix:ROW<1...4>:COLumn<1...4>:PHASe	0...360		
[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...8>:MATRix:ROW<1...4>:COLumn<1...4>:RATIo	0...1		
[SOURce<[1]>:]FSIMulator:PRESet			No query
[SOURce<[1]>:]FSIMulator:REStart			No query
[SOURce<[1]>:]FSIMulator:REStart:MODE	AUTO MANual EXT1 EXT2		

Command	Parameter	Default unit	Comment
[SOURce]:FSIMulator:ROUTE	FAA FAAFBA FAAFBB FABFBB FAABFBAB FAMAXA FAMAXAB FBMAXB FBMAXAB FA1A2BFB1A2B		
[SOURce<[1]2>:]FSIMulator:SDESTination	RF BB		
[SOURce<[1]2>:]FSIMulator:SPEEd:UNIT	MPS KMH MPH		
[SOURce<[1]2>:]FSIMulator:STANdard	<standard>		
[SOURce<[1]2>:]FSIMulator:STANdard:REFerence	<string>		
[SOURce<[1]2>:]FSIMulator:STORE	<file name>		No query
[SOURce<[1]2>:]FSIMulator[:STATe]	ON OFF		
[SOURce<[1]2>:]FSIMulator:TCInterferer:REFerence MOVing:DELay:MINimum	0 ... 1638 μ s	μ s	
[SOURce<[1]2>:]FSIMulator:TCInterferer:REFerence MOVing:DELay:MAXimum	0 ... 1638 μ s	μ s	Query only
[SOURce<[1]2>:]FSIMulator:TCInterferer:REFerence FDOPpler			Query only
[SOURce<[1]2>:]FSIMulator:TCInterferer:REFerence MOVing:FRATio	-1.0 ... +1.0		
[SOURce<[1]2>:]FSIMulator:TCInterferer:REFerence MOVing:LOSS	0 dB...50 dB	dB	
[SOURce<[1]2>:]FSIMulator:TCInterferer:REFerence MOVing:PROFile	SPATH PDOPpler RAYLeigh		
[SOURce<[1]2>:]FSIMulator:TCInterferer:REFerence MOVing:STATe	ON OFF		
[SOURce<[1]2>:]FSIMulator:TCInterferer:SPEEd	0.0 ... 479,67 m/s		
[SOURce<[1]2>:]FSIMulator:TCInterferer:MMODE	SLIDing HOPPing		
[SOURce<[1]2>:]FSIMulator:TCInterferer:PERiod	0.1 s...1000 s		

[SOURce<[1]2>:]FSIMulator:BIRTHdeath:DELay:GRID 0 ... 10 μ s

This command sets the delay grid for both paths with birth death propagation fading. The selected delay grid defines the resolution of the possible hopping positions for the two fading paths in the delay range. The delay range is defined by the minimum delay (FSIM:BIRTHdeath:DELay:MIN), the delay grid (FSIM:BIRTHdeath:DELay:GRID) and the number of possible hop positions (FSIM:BIRTHdeath:POSitioNs).

Example: "FSIM:BIRT:DEL:GRID 0.00001"
'sets a delay grid of 10 μ s.

*RST value	Resolution	Options	SCPI
1 μ s	1 ns	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]]2>:FSIMulator:BIRThdeath:DELay:MAXimum?

This command queries the maximum delay for both paths with birth death propagation fading. The maximum delay is defined by the minimum delay (FSIM:BIRThdeath:DELay:MIN), the delay grid (FSIM:BIRThdeath:DELay:GRID), and the number of possible hop positions (FSIM:BIRThdeath:POSitions).

The command represents a query and thus has no *RST value.

```

Example:      "FSIM:BIRT:DEL:MIN 0.000012"
                  'sets a minimum delay of 12 µs.

                  "FSIM:BIRT:DEL:GRID 0.000002"
                  'sets a delay grid of 2 µs.

                  "FSIM:BIRT:POS 9"
                  'sets 9 possible hop positions.

                  "FSIM:BIRT:DEL:MAX?"
                  'queries the maximum delay.
    
```

```

Response: "0.000028"
          'the maximum delay is 28 µs. The delay range lies between +12 and +28 µs.
          There are 9 hop positions on a 2 µs grid available.
    
```

*RST value	Resolution	Options	SCPI
-	-	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]]2>:FSIMulator:BIRThdeath:DELay:MINimum0 ... < 40 µs

This command sets the minimum delay for both paths with birth death propagation fading. The minimum delay corresponds to the start value of the delay range.

```

Example:      "FSIM:BIRT:DEL:MIN 0.000008"
                  'sets a 8 µs minimum delay.
    
```

*RST value	Resolution	Options	SCPI
0 µs	1 ns	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]>:]FSIMulator:BIRTHdeath:POSitions 3 ... 11

This command sets the number of possible hop positions in the delay range. The delay range is defined by the minimum delay (FSIM:BIRTHdeath:DELay:MIN), the delay grid (FSIM:BIRTHdeath:DELay:GRID) and the number of possible hop positions (FSIM:BIRTHdeath:POSitions).

$$0 \mu\text{s} < (\dots:\text{BIRT:POS} - 1) \times \dots:\text{DEL:GRID} + \dots:\text{DEL:MIN} < 40 \mu\text{s}$$

Example: "FSIM:BIRT:POS 11"
'sets 11 possible delay positions.

*RST value	Resolution	Options	SCPI
11	1	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]>:]FSIMulator:BIRTHdeath:FDOPpler?

This command queries the Doppler frequency with birth death propagation. The Doppler frequency is determined by the entered speed (command SOURce:FSIM:BIRT:SPEed) and by the entered ratio of the actual Doppler frequency to the set Doppler frequency (command SOURce:FSIM:BIRT:FRATio).

The command is a query and thus has no *RST value.

Example: "FSIM:BIRT:FDOP?"
'queries the resulting Doppler frequency.

Response: "55"
'the resulting Doppler frequency is 55 Hz.

*RST value	Resolution	Options	SCPI
		Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]>:]FSIMulator:BIRTHdeath:FRATio -1.0 ... +1.0

This command sets the ratio of the actual Doppler frequency to the set Doppler frequency with birth death propagation fading.

Example: "FSIM:BIRT:FRAT 0.5"
'sets a frequency ratio of 0.5 for both fading paths.

*RST value	Resolution	Options	SCPI
1	0.05	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:BIRThdeath:HOPPIng:DWELI 1ms.. (2^32-1) ns

This command enters the time until the next change in the delay of a path (birth death event).

Example: "FSIM:BIRT:HOPP:DWEL 210 ms"
 'sets a dwell time of 210 ms until the next change in the delay of a fading path.

*RST value	Resolution	Options	SCPI
191 ms	10 ns	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:BIRThdeath:PATH<[1]|2>:LOSS 0.0 ... 50.0 dB

This command sets the loss of the paths with birth death propagation.

Example: "FSIM:BIRT:PATH2:LOSS 4 dB"
 'sets a loss of 4 dB for the second fading path.

*RST value	Resolution	Options	SCPI
0 dB	0.1 dB	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:BIRThdeath:PATH<[1]|2>:PROFile PDOPpler

This command queries the fading profile. In birth death propagation, the pure Doppler profile is used.

The command represents a query and thus has no *RST value.

Parameter: PDOPpler

A transmission path is simulated in which there is an individual direct connection from the transmitter to the moving receiver (discrete component). The Doppler frequency shift is determined by two parameters: Speed (SOURce:FSIM:BIRThdeath:SPEEd) and Frequency Ratio (SOURce:FSIM:BIRThdeath:FRATio).

Example: "FSIM:BIRT:PATH2:PROF?"
 'queries the profile of the second fading path.

*RST value	Resolution	Options	SCPI
PDOPpler	-	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:BIRTHdeath:SOFFset 1ms .. (2^32-1) us

This command sets the time until the start of the next birth death event. With dual-channel fading, this allows the user to intentionally displace the birth death events of the two faders with respect to one another.

Example: "FSIM:BIRT:SOFF 21E-6"
'sets a start offset of 21 us.

*RST value	Resolution	Options	SCPI
0 s	10 ns	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:BIRTHdeath:SPEed 0 m/s ... 479.67 m/s

This command sets the speed *v* of the moving receiver for birth death propagation. Based on the speed *v* and the virtual RF frequency *f_{RF}*, the Doppler frequency *f_D* is computed. Based on the speed *v* and the frequency of the RF output signal *f_{RF}* (or the virtual RF frequency), the Doppler frequency *f_D* is computed.

$$c = 2.998 \cdot 10^8 \text{ m/s} \quad \frac{v}{c} = \frac{f_D}{f_{RF}}$$

If the speed is changed, the resulting Doppler shift is automatically modified. The resulting Doppler shift is a function of the speed *v* and the entered ratio of the actual Doppler shift to the set Doppler shift (Frequency Ratio - SOURce:FSIM:BIRT:FRATio) and can be queried with the command SOURce:FSIM:BIRT:FDOPler.

Available speed units are km/h, m/s and mph. The unit is selected with the command :SOURce:FSIMulator:SPEed:UNIT.

Example: "FSIM:SPE:UNIT MPS"
'sets the unit for entering the speed to m/s.
"FSIM:BIRT:SPE 2"
'sets a speed of 2 m/s on both fading paths.

*RST value	Resolution	Options	SCPI
0 m/s	0.1 m/s	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:BIRTHdeath:STATe ON | OFF

This command selects the birth death propagation fading configuration and switches the fading simulation on and off.

Example: "SOUR2:FSIM:BIRT:STAT ON"
'selects birth death propagation for fader B and switches on fading in path B.

*RST value	Resolution	Options	SCPI
OFF	-	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce]:FSIMulator:CATalog?

This command reads out the files with fading settings in the default directory. The default directory is set with the command `MMEM:CDIRectory`. A path can also be specified in command `:SOUR:CORR:CSET:CAT?`, in which case the files in the specified directory are read. Only files with the file ending `*.fad` are read out.

The command represents a query and thus has no `*RST` value.

Example:

```
"MMEM:CDIR 'D:\user\fading"
'sets the default directory to D:\user\fading.

"FSIM:CAT? "
'reads all files from the default directory with fading settings.

Response: "Birthdeath_3gpp"
'the file 'Birthdeath_3GPP' is available.
```

*RST value	Resolution	Options	SCPI
		Option B14 Options B13 and B10	Device-specific

[SOURce<[1]|2>]:FSIMulator:COPY:DESTination 1 ...4 / 1... 8

This command determines the destination for the copy operation for a fading path group. It is available only for the fading configurations **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** (`SOURce:FSIM:DElay:STATe ON` or `SOURce:FSIM:DEL30|50:STATe ON`).

Example:

```
"FSIM:DEL:STAT ON"
'activates the Standard Delay fading configuration.

"FSIM:COPY:DEST 4"
'sets fading group 4 as the destination for the copy operation.

"FSIM:COPY:SOUR 1"
'sets fading group 1 as the source for the copy operation.

"FSIM:COPY:EXEC"
'copies the settings from group 1 to group 4.
```

*RST value	Resolution	Options	SCPI
2		Option B14 Options B13 and B10 SOURce2 only with option B15 Range of values 5 to 8 only with option B15	Device-specific

[SOURce<[1]]2>:FSIMulator:COPY:EXECute

This command causes the copy operation to execute for a fading path group. The source group settings are copied to the destination group. This command is available only for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations (SOURce:FSIM:DELay:STATe ON or SOURce:FSIM:DEL30|50:STATe ON).

This command triggers an event and thus does not have a query format or an *RST value.

Example:

```
"FSIM:DEL:STAT ON"
'activates the Standard Delay fading configuration.

"FSIM:COPY:DEST 4"
'sets fading group 4 as the destination for the copy operation.

"FSIM:COPY:SOUR 1"
'sets fading group 1 as the source for the copy operation.

"FSIM:COPY:EXEC"
'copies the settings from group 1 to group 4.
```

*RST value	Resolution	Options	SCPI
-		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]]2>:FSIMulator:COPY:SOURce 1 ...4 / 1... 8

This command determines the source for the copy operation for a fading path group. It is available only for the fading configurations **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** (SOURce:FSIM:DELay:STATe ON or SOURce:FSIM:DEL30|50:STATe ON).

Example:

```
"FSIM:DEL:STAT ON"
'activates the Standard Delay fading configuration.

"FSIM:COPY:DEST 4"
'sets fading group 4 as the destination for the copy operation.

"FSIM:COPY:SOUR 1"
'sets fading group 1 as the source for the copy operation.

"FSIM:COPY:EXEC"
'copies the settings from group 1 to group 4.
```

*RST value	Resolution	Options	SCPI
1		Option B14 Options B13 and B10 SOURce2 only with option B15 Range of values 5 to 8 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:COUPlE:LOGNormal:CSTD ON | OFF

This command couples the setting for the lognormal standard deviation for the paths of both faders. A change in the standard deviation in one fader leads to a corresponding change in the other path.

Example:

```
"FSIM:ROUT FAAFB"
    'the fading signal from fader A is output on path A and the fading signal from
    fader B is output on path B.
"FSIM:DEL:STAT ON"
    'activates the Standard Delay fading configuration for fader A.
"SOUR2:FSIM:DEL:STAT ON"
    'activates the Standard Delay fading configuration for fader B.
"FSIM:DEL:GRO:PATH2:LOGN:STAT ON"
    'activates lognormal fading for fading path 2 of fader A.
"SOUR2:FSIM:DEL:GRO:PATH2:LOGN:STAT ON"
    'activates lognormal fading for fading path 2 of fader B.
"FSIM:COUP:LOGN:CSTD ON"
    'activates coupling of the standard deviation of the two paths. The settings in
    fader A are transferred to fader B.
```

*RST value	Resolution	Options	Dependencies	SCPI
Off	-	Options B14 and B15 Options B13 and B10	Activation of coupling sets the standard deviation setting (SOURce:FSIM: . . . :GROup:PATH:LOGN:CSTD) of the second fader to that of the first fader for which coupling was activated. After activation, any change in one of the two faders is automatically made in the other fader as well.	Device-specific

[SOURce<[1]|2>:]FSIMulator:COUPlE:LOGNormal:LCONstant ON | OFF

With lognormal fading, this command couples the setting of the **Local Constant** for the paths of both faders. A change in the local constant in one fader leads to a corresponding change in the second fader.

Example:

```
"FSIM:ROUT FAAFB"
    'the fading signal from fader A is output on path A and the fading signal from
    fader B is output on path B.
"FSIM:DEL:STAT ON"
    'activates the Standard Delay fading configuration for fader A.
"SOUR2:FSIM:DEL:STAT ON"
    'activates the Standard Delay fading configuration for fader B.
"FSIM:DEL:GRO:PATH2:LOGN:STAT ON"
    'activates lognormal fading for fading path 2 of fader A.
"SOUR2:FSIM:DEL:GRO:PATH2:LOGN:STAT ON"
    'activates lognormal fading for fading path 2 of fader B.
"SOUR2:FSIM:COUP:LOGN:LCON ON"
    'activates coupling of the local constants in both faders. The settings in fader B
    are transferred to fader A.
```

*RST value	Resolution	Options	Dependencies	SCPI
Off	-	Options B14 and B15 Options B13 and B10	Activation of coupling sets the local constant setting (SOURce:FSIM: . . . :GROup:PATH:LOGN:LCON) of the second fader to that of the first fader for which coupling was activated. After activation, any change in one of the two faders is automatically made in the other fader as well.	Device-specific

[SOURce<[1]|2>:]FSIMulator:COUPlE:SPEEd ON | OFF

This command couples the setting for the speed for the paths of both faders. A change in the speed in one fader leads to a corresponding change in the second fader. The **Common Speed for all Paths** setting is also coupled (SOURce:FSIM:CSPEEd).

Example:

```
"FSIM:ROUT FAAFBB"
```

'the fading signal from fader A is output on path A and the fading signal from fader B is output on path B.

```
"FSIM:DEL:STAT ON"
```

'activates the **Standard Delay** fading configuration for fader A.

```
"SOUR2:FSIM:DEL:STAT ON"
```

'activates the **Standard Delay** fading configuration for fader B.

```
"FSIM:COUP:SPE ON"
```

'activates coupling of the speed for the paths of both faders. The settings in fader A are transferred to fader B.

*RST value	Resolution	Options	Dependencies	SCPI
Off	-	Options B14 and B15 Options B13 and B10	Activation of coupling sets the speed settings (SOURce:FSIM: . . . :GROup:PATH:SPEEd and SOURce:FSIM:CSPEEd) of the second fader to that of the first fader for which coupling was activated. After activation, any change in one of the two faders is automatically made in the other fader as well.	Device-specific

[SOURce<[1]|2>:]FSIMulator:CSPEEd ON | OFF

This command determines whether or not the same speed is set for all of the activated fading paths. When set to On, a change in the speed for one path automatically leads in a change in the speed for all other paths.

This command is available only in the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations (SOURce:FSIM:DELay:STATe ON or SOURce:FSIM:DEL30|50:STATe ON).

Example:

```
"FSIM:DEL:STAT ON"
```

'activates the **Standard Delay** fading configuration.

```
"FSIM:CSP ON"
```

'activates coupling of the speed for all active fading paths.

*RST value	Resolution	Options	Dependencies	SCPI
ON	-	Option B14 Options B13 and B10 SOURce2 only with option B15	If coupling of the speed is activated in instruments with two faders (SOURce:FSIM:COUPlEd:SPEEd ON), this parameter is also coupled. When coupling is activated, the settings of the path for which coupling is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:ADELay 0.0 ... 40.0E-6 s

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:ADELay 0.0 ... 40.0E-6 s

[SOURce<[1]|2>:]FSIMulator:DElay:GROup<[1]|2...5>:ADELay 0.0 ... 40.0E-6 s

These commands determine the path-specific delay (**Additional Delay**) of the selected path for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations. The Resulting Delay of a path is obtained by adding the Basic Delay and the Additional Delay. No **Additional Delay** can be entered for path 1 of group 1.

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUTE FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example: "FSIM:DEL:STAT ON"
'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO:PATH2:ADEL 10E-6"
'sets an Additional Delay of 10 µs for fading path 2.

*RST value	Resolution	Options	SCPI
0	Standard Delay: 10 ns Fine Delay : 10 ps	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:BDELay 0.0 ... 2.56E-3 s

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:BDELay 0.0 ... 2.56E-3 s

[SOURce<[1]|2>:]FSIMulator:DElay:GROup<[1]|2...5>:BDELay 0.0 ... 2.56E-3 s

These commands determine the group delay (**Basic Delay**) for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations. Within a group, all of the paths are jointly delayed by this value. The Resulting Delay of a path is obtained by adding the Basic Delay and the Additional Delay. The Basic Delay of group 1 is always equal to 0.

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUTE FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example: "FSIM:DEL:STAT ON"
'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO2:PATH:BDEL 1E-3"
'sets a delay of 1 ms for fading group 2. This value applies to all of the paths in the group.

*RST value	Resolution	Options	SCPI
0.0 ns	10 ns	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	Device-specific

[SOURCE<[1]>:]FSIMulator:DEL30:GROup<[1]2...8>:PATH<[1]2|3>:CORRelation:COEFFicient
0.0 ... 100.0 PCT

[SOURCE<[1]>:]FSIMulator:DEL50:GROup<[1]2...8>:PATH<[1]2>:CORRelation:COEFFicient
0.0 ... 100.0 PCT

[SOURCE<[1]>:]FSIMulator:DELAy:GROup<[1]2...8>:PATH<[1]2...5>:CORRelation:COEFFicient
0.0 ... 100.0 PCT

These commands determine the magnitude of the complex correlation coefficient for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations (SOURCE:FSIM: . . . :GROup:PATH:CORR:STATe ON). The higher the entered percentage, the greater the correlation of the statistical fading processes for the two paths. Highly correlated ambient conditions for the signal are simulated in this manner.

GROup<5 . . . 8> is only available for the signal routings SOURCE:FSIMulator:ROUTE FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example:

"FSIM:DEL:STAT ON"

'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO2:PATH:CORR:STAT ON"

' switches on the correlation of fading path 1 of group 2 of fader A to fading path 1 of group 2 of fader B.

"FSIM:DEL:GRO2:PATH:CORR:COEF 95"

'specifies a correlation coefficient of 95% for the two paths.

*RST value	Resolution	Options	Dependencies	SCPI
100 PCT	5 PCT	Option B14 and option B15 Options B13 and B10 Fine Delay configurations only with option K71	Sets the correlation coefficient of the correlated path of the second fader also to the entered value.	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:CORRelation:PHASe 0.0... 359.9 DEG

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:CORRelation:PHASe 0.0... 359.9 DEG

[SOURce<[1]|2>:]FSIMulator:DELAy:GROup<[1]|2...8>:PATH<[1]|2...5>:CORRelation:PHASe 0.0... 359.9 DEG

These commands determine the phase of the complex correlation coefficient for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations.

GRoup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUte FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example:

"FSIM:DEL:STAT ON"

'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO2:PATH:CORR:STAT ON"

' switches on the correlation of fading path 1 of group 2 of fader A to fading path 1 of group 2 of fader B.

"FSIM:DEL:GRO2:PATH:CORR:PHAS 5"

'specifies a phase of the correlation coefficient equal to 5 DEG for the two paths.

*RST value	Resolution	Options	Dependencies	SCPI
0	0.1 DEG	Option B14 and option B15 Options B13 and B10 Fine Delay configurations only with option K71	Sets the phase of the correlation coefficient of the correlated path of the second fader also to the entered value.	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:CORRelation:STATe ON | OFF

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:CORRelation:STATe ON | OFF

[SOURce<[1]|2>:]FSIMulator:DELAy:GROup<[1]|2...8>:PATH<[1]|2...5>:CORRelation:STATe ON | OFF

These commands switch on correlation of the paths of the first fader to the corresponding paths of the second fader for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations. This command is available only if dual-channel mode is selected for the faders (FSIM:ROUT FAAFBB). The suffix in SOURce defines the fader on which path settings the correlation is based.

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUTE FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example: "FSIM:DEL:STAT ON"
'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO2:PATH:CORR:STAT ON"
'switches on the correlation of fading path 1 of group 2 of fader A to fading path 1 of group 2 of fader B.

*RST value	Resolution	Options	Dependencies	SCPI
0	0.1 DEG	Options B14 and B15 Options B13 and B10 Fine Delay configurations only with option K71	When correlation is activated, the settings of the correlation parameters, the profile, the speed and the lognormal parameters are the same for both paths (SOUR:FSIM: . . . :GROup:PATH:CORR:STAT SOUR:FSIM: . . . :GROup:PATH:CORR:COEF SOUR:FSIM: . . . :GROup:PATH:CORR:PHAS SOUR:FSIM: . . . :GROup:PATH:PROFile SOUR:FSIM: . . . :GROup:PATH:SPEed SOUR:FSIM: . . . :GROup:PATH:FRATio SOUR:FSIM: . . . :GROup:PATH:LOGN:STATe SOUR:FSIM: . . . :GROup:PATH:LOGN:LCON SOUR:FSIM: . . . :GROup:PATH:LOGN:CSTD). When correlation is activated, the settings of the path for which correlation is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).	Device-specific

```
[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:CPHase 0.0 ... 359.9 DEG
[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:CPHase 0.0 ... 359.9 DEG
[SOURce<[1]|2>:]FSIMulator:DElay:GROup<[1]|2...8>:PATH<[1]|2...5>:CPHase 0.0 ... 359.9 DEG
```

These commands determine the phase for constant phase and pure Doppler fading for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations
 (:SOURce:FSIMulator:DElay|DEL30|DEL50:GROup:PATH:PROfile CPHase|PDOpler).

GROup<5...8> is only available for the signal routings SOURce:FSIMulator:ROUTE FBMAXB|FAMAXA|FAMAXAB|FBMAXAB.

Example: "FSIM:DEL:STAT ON"
 'activates the **Standard Delay** fading configuration.
 "FSIM:DEL:GRO2:PATH:PROF CPH"
 'selects the **Constant Phase** fading profile for fading path 1 of group 2.
 "FSIM:DEL:GRO2:PATH:CPH 5DEG"
 'sets a phase of 5 DEG for fading path 1 of group 2. The path is multiplied by this phase.

*RST value	Resolution	Options	SCPI
0 DEG	0.1 DEG	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	Device-specific

```
[SOURce<[1]|2>:]FSIMulator:DEL30:GROup1:PATH:CPHase 0.0 ... 359.9 DEG
[SOURce<[1]|2>:]FSIMulator:DEL50:GROup1:PATH:CPHase 0.0 ... 359.9 DEG
[SOURce<[1]|2>:]FSIMulator:DElay:GROup1:PATH:CPHase 0.0 ... 359.9 DEG
```

These commands the set start phase rotation.

Example: "FSIM:DEL:STAT ON"
 'activates the **Standard Delay** fading configuration.
 "FSIM:DEL:GRO1:PATH1:PROF RICE"
 'selects the **Rice** fading profile for fading path 1 of group 1.
 "FSIM:DEL:GRO1:PATH:CPH 5DEG"
 'sets a start phase rotation of 5 DEG for fading path 1 of group 2. The path is multiplied by this phase.

*RST value	Resolution	Options	SCPI
0 DEG	0.1 DEG	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:FDOPpler?

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:FDOPpler?

[SOURce<[1]|2>:]FSIMulator:DELAy:GROup<[1]|2...8>:PATH<[1]|2...5>:FDOPpler?

This command queries the Doppler frequency for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations. The Doppler frequency is determined by the entered speed (command SOURce:FSIM:DELAy | DEL30 | DEL50:GROup:PATH:SPEed). For the **Pure Doppler** and **Rice Fading** profiles, the actual Doppler shift is a function of the entered ratio of the actual Doppler shift to the set Doppler frequency (**Frequency Ratio**, command SOURce:FSIM:DELAy | DEL30 | DEL50:GROup:PATH:FRATio).

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUte FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

The command represents a query and thus has no *RST value.

Example:

"FSIM:DEL:GRO:PATH:FDOP?"

'queries the resulting Doppler frequency of path 1 of group 1.

Response: "556"

'the resulting Doppler frequency is 556 Hz.

*RST value	Resolution	Options	SCPI
		Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:FRATio -1.0 ... +1.0

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:FRATio -1.0 ... +1.0

[SOURce<[1]|2>:]FSIMulator:DElay:GROup<[1]|2...8>:PATH<[1]|2...5>:FRATio -1.0 ... +1.0

These commands enter the ratio of the actual Doppler frequency to the set Doppler frequency for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations for Rice and pure Doppler fading. The Frequency Ratio serves as a measure of the angle of incidence between the transmitter and receiver.

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUTE FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

The command represents a query and thus has no *RST value.

Example:

"FSIM:DEL:STAT ON"

'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO:PATH2:PROF RICE"

'sets the Rice fading profile for the second fading path of group 1.

"FSIM:DEL:GRO:PATH2:FRAT -0.71"

'sets a frequency ratio of -0.71 for the second fading path of group 1. This corresponds to an angle of incidence of about 45° with respect to a receiver that is going away from the transmitter.

*RST value	Resolution	Options	Dependencies	SCPI
1	0.05	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	When two paths are correlated (SOUR:FSIM: . . . :GRO:PATH:CORR:STAT ON), the frequency ratio of both paths is set to the same value. When correlation is activated, the setting of the path for which correlation is switched on is accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:LOGNormal:CSTD 0.0 ... 12.0 dB

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:LOGNormal:CSTD 0.0 ... 12.0 dB

[SOURce<[1]|2>:]FSIMulator:DELAy:GROup<[1]|2...8>:PATH<[1]|2...5>:LOGNormal:CSTD 0.0 ... 12.0 dB

These commands enter the standard deviation for lognormal fading for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations.

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUTE FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example: "FSIM:DEL:STAT ON"
 'activates the **Standard Delay** fading configuration.
 "FSIM:DEL:GRO:PATH2:LOGN:STAT ON"
 'selects lognormal fading for fading path 2 of group 1.
 "FSIM:DEL:GRO:PATH2:LOGN:CSTD 2"
 'sets a standard deviation of 2 dB for fading path 2 of group 1.

*RST value	Resolution	Options	Dependencies	SCPI
0 dB	1dB	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	When two paths are correlated (SOUR:FSIM:...:GRO:PATH:CORR:STAT ON) or two faders are coupled (SOUR:FSIM:COUPLing:CSTD ON), the lognormal parameters of both paths/all paths are set to the same values. When correlation/coupling is activated, the settings of the path/fader for which correlation/coupling is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths/faders (no matter in which path/fader it was made).	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:LOGNormal:LCONstant 0.0 ... 200.0 m

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:LOGNormal:LCONstant 0.0 ... 200.0 m

[SOURce<[1]|2>:]FSIMulator:DELAy:GROup<[1]|2...8>:PATH<[1]|2...5>:LOGNormal:LCONstant 0.0 ... 200.0 m

These commands enter the Local Constant for lognormal fading for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations.

The lower setting limit is a function of the virtual RF frequency f_{RF} .

The following holds:
$$L_{min} = \frac{12 \cdot 10^9 \text{ m/s}}{f_{RF}}$$

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUTE FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example: "FSIM:DEL:STAT ON"
 'activates the **Standard Delay** fading configuration.
 "FSIM:DEL:GRO:PATH2:LOGN:STAT ON"
 'selects lognormal fading for fading path 2 of group 1.
 "FSIM:DEL:GRO:PATH2:LOGN:LCON 100"
 'sets a Local Constant of 100 m for the second fading path of group 1.

*RST value	Resolution	Options	Dependencies	SCPI
100 m	0.1 m	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	When two paths are correlated (SOUR:FSIM: . . . :GRO:PATH:CORR:STAT ON) or two faders are coupled (SOUR:FSIM:COUPLing:LCONstant ON), the lognormal parameters of both paths/all paths are set to the same values. When correlation/coupling is activated, the settings of the path/fader for which correlation/coupling is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths/faders (no matter in which path/fader it was made).	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:LOGNormal:STATe ON | OFF

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:LOGNormal:STATe ON | OFF

[SOURce<[1]|2>:]FSIMulator:DELAy:GROup<[1]|2...8>:PATH<[1]|2...5>:LOGNormal:STATe ON | OFF

These commands switch lognormal fading on or off for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations.

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUte FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example: "FSIM:DEL:STAT ON"
'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO:PATH2:LOGN:STAT ON"
'activates lognormal fading for fading path 2 of group 1.

*RST value	Resolution	Options	Dependencies	SCPI
OFF		Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	When two paths are correlated (SOUR:FSIM: . . . :GRO:PATH:CORR:STAT ON), the lognormal parameters of both paths are set to the same values. When correlation is activated, the settings of the path for which correlation is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:LOSS 0.0 ... 50.0 dB

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:LOSS 0.0 ... 50.0 dB

[SOURce<[1]|2>:]FSIMulator:DELAy:GROup<[1]|2...8>:PATH<[1]|2...5>:LOSS 0.0 ... 50.0 dB

These commands set the loss of the paths for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations.

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUte FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example: "FSIM:DEL:STAT ON"
'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO:PATH2:LOSS 2 dB"
'sets a loss of 2 dB for fading path 2 of group 1.

*RST value	Resolution	Options	SCPI
0 dB	0.1 dB	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:PRATio -30.0 ... + 30.0 dB

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:PRATio -30.0 ... + 30.0 dB

[SOURce<[1]|2>:]FSIMulator:DELaY:GROup<[1]|2...8>:PATH<[1]|2...5>:PRATio -30.0 ... + 30.0 dB

These commands set the power ratio of the discrete and distributed components for Rice fading (:SOURce:FSIMulator:DELaY:GROup:PATH2:PROFile RICE") for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations.

GROup<5. . . 8> is only available for the signal routings SOURce:FSIMulator:ROUte FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example:

"FSIM:DEL:STAT ON"

'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO:PATH2:PROF RICE"

'sets the Rice fading profile for fading path 2 of group 1.

"FSIM:DEL:GRO:PATH2:PRAT -15"

'sets a power ratio of -15 dB. The distributed (Rayleigh) component prevails. The total power of the two components remains constant.

*RST value	Resolution	Options	SCPI
0 dB	0.1 dB	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	Device-specific


```
[SOURCE<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:PROFile PDOPpler |
SPATH | RAYLeigh | RICE | CPHase | OGAUs | TGAUs | DGAUs | GDOPpler | GFD8 | GFD1 |
WDOPpler | WRICe
```

```
[SOURCE<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:PROFile PDOPpler | SPATH |
RAYLeigh | RICE | CPHase | OGAUs | TGAUs | DGAUs | GDOPpler | GFD8 | GFD1 | WDOPpler |
WRICe |
```

```
[SOURCE<[1]|2>:]FSIMulator:DELay:GROup<[1]|2...8>:PATH<[1]|2...5>:PROFile PDOPpler |
SPATH | RAYLeigh | RICE | CPHase | OGAUs | TGAUs | DGAUs | GDOPpler | GFD8 | GFD1 |
WDOPpler | WRICe
```

These commands select the fading profile for the paths for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations.

GROup<5 . . . 8> is only available for the signal routings SOURCE:FSIMulator:ROUTE
FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Parameter: **SPAT**

A static transmission path is simulated which can only undergo attenuation (loss) or delay.

PDOPpler

A transmission path is simulated in which there is an individual direct connection from the transmitter to the moving receiver (discrete component). The Doppler frequency shift is determined by two parameters: **Speed**

(SOURCE:FSIM:DELay | DEL30 | DEL50:GROup:PATH:SPEed)

and **Frequency Ratio**

(SOURCE:FSIM:DEL | DEL30 | DEL50:GROup:PATH:FRATio).

RAYLeigh

A radio hop is simulated in which many highly scattered subwaves arrive at a moving receiver. The resulting received amplitude varies over time. The probability density function of the magnitude of the received amplitude is characterized by a Rayleigh distribution. The fading spectrum is a classic Doppler spectrum.

RICE

A radio hop is simulated in which a strong direct wave (discrete component) arrives at a moving receiver in addition to many highly scattered subwaves. The probability density of the magnitude of the received amplitude is characterized by a Rice distribution. The fading spectrum of an unmodulated signal involves the superimposition of the classic Doppler spectrum with a discrete spectral line.

CPHase

A radio hop is simulated without any direct waves or randomly occurring waves (no discrete and no static component). The path is multiplied by a constant pointer corresponding to the path-specific parameter.

OGAUs

GAUS1 is the sum of two Gaussian functions and is used for excess delay times in the range of 0,5 μ s to 2 μ s ($0,5 \mu\text{s} \leq \tau \leq 2 \mu\text{s}$).

(GAUS1) $S(\tau, f) = G(A, -0,8f_d, 0,05f_d) + G(A_1, +0,4f_d, 0,1f_d)$

where A1 is 10 dB below A.

TGAUs

GAUS2 is also the sum of two Gaussian functions and is used for paths with delays in excess of 2 μs (τi ≥ 2 μs).

$$(GAUS2) \quad S(\tau_i, f) = G(B, +0,7f_{df}, 0,1f_{df}) + G(B_1, -0,4f_{df}, 0,15f_{df})$$

where B1 is 15 dB below B.

DGAUs

GAUSDAB is composed of a Gaussian function and is used for special DAB profiles.

$$(GAUSDAB) \quad S(\tau_i, f) = G(A, \pm 0,7f_{df}, 0,1f_{df})$$

DGAUs

GAUSDAB is composed of a Gaussian function and is used for special DAB profiles.

$$(GAUSDAB) \quad S(\tau_i, f) = G(A, \pm 0,7f_{df}, 0,1f_{df})$$

GDOPpler

Selects the Gauss Doppler fading profile.

GFD8

Selects the Gauss (0.08 fd) fading profile.

GFD1

Selects the Gauss (0.01 fd) fading profile.

WDOPpler

Selects the WM Doppler fading profile.

WRICe

Selects the WM Rice fading profile.

Example:

"FSIM:DEL:STAT ON"

'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO:PATH2:PROF RICE"

'sets the Rice fading profile for fading path 2 of group 1.

*RST value	Resolution	Options	Dependencies	SCPI
RAYLeigh		Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	When two paths are correlated (SOUR:FSIM: . . . :GRO:PATH:CORR:STAT ON), the same profile is set on both paths. When correlation is activated, the setting of the path for which correlation is switched on is accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:RDElay?

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:RDElay?

[SOURce<[1]|2>:]FSIMulator:DElay:GROup<[1]|2...8>:PATH<[1]|2...5>:RDElay?

These commands query the Resulting Delay of the paths for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations. The Resulting Delay is the sum of the Basic Delay (SOURce:FSIM:DElay|DElay30|DElay50:BDElay) and the Additional Delay (SOURce:FSIM:DElay|DElay30|DElay50:ADElay).

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUTE FBMAXB|FAMAXA|FAMAXAB |FBMAXAB.

The command represents a query and thus has no *RST value.

Example:

```
"FSIM:DEL:STAT ON"
'activates the Standard Delay fading configuration.

"FSIM:DEL:GRO2:PATH:BDEL 2E-4"
'sets a Delay Offset of 200 µs for group 2.

"FSIM:DEL:GRO2:PATH2:ADEL 1E-5"
'sets an Additional Delay of 10 µs for fading path 2 of group 2.

"FSIM:DEL:GRO2:PATH2:RDEL?"
'queries the Resulting Delay for fading path 2 of group 2.

Response: "0.00021"
'the Resulting Delay is 210 µs.
```

*RST value	Resolution	Options	SCPI
-	-	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	Device-specific

```
[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:SPEEd 0.0 ... 27778.0 m/s
[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:SPEEd 0.0 ... 27778.0 m/s
[SOURce<[1]|2>:]FSIMulator:DELay:GROup<[1]|2...8>:PATH<[1]|2...5>:SPEEd 0.0 ... 27778.0 m/s
```

These commands set the speed v of the moving receiver for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations. Based on the speed v and the virtual RF frequency f_{RF} , the Doppler frequency f_D is computed. Based on the speed v and the frequency of the RF output signal f_{RF} (or the virtual RF frequency), the Doppler frequency f_D is computed.

$$c = 2.998 \cdot 10^8 \text{ m / s} \qquad \frac{v}{c} = \frac{f_D}{f_{RF}}$$

The resulting Doppler shift for Rice and pure Doppler fading is a function of the speed v and the entered ratio of the actual Doppler shift to the set Doppler shift f_D (Frequency Ratio SOUR:FSIM:DEL|DEL30|DEL50:GROup:PATH:FRATio) and can be queried with the commands SOUR:FSIM:DELay|DEL30|DEL50:GROup:PATH:FDOPpler. The resulting Doppler frequency may not exceed the maximum Doppler frequency of 1600 Hz. If the speed is changed, the resulting Doppler shift is automatically modified.

The unit of speed is selected with the command :SOURce:FSIMulator:SPEEd:UNIT. Available speed units are km/h, m/s, and mph.

GROup<5 . . . 8> is only available for the signal routings SOURce:FSIMulator:ROUte FBMAXB|FAMAXA|FAMAXAB |FBMAXAB.

```
Example:      "FSIM:DEL:STAT ON"
                  'activates the Standard Delay fading configuration.
                  "FSIM:SPE:UNIT MPS"
                  'sets the unit for entering the speed to m/s.
                  "FSIM:DEL:GRO:PATH2:SPE 2"
                  'sets a speed of 2 m/s for the moving receiver for fading path 2 of group 1.
```

*RST value	Resolution	Options	Dependencies	SCPI
0 m/s	0.1 m/s	Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	When two paths are correlated (SOUR:FSIM:...:GRO:PATH:CORR:STAT ON) and when two faders are coupled (SOUR:FSIM:COUP:SPEEd ON), the same speed is set on both / all paths. When correlation/coupling is activated, the setting of the path/fader for which correlation/coupling is switched on is accepted for both paths/faders. Afterwards, the most recent modification applies to both paths/faders (no matter in which path/fader it was made).	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:GROup<[1]|2...8>:PATH<[1]|2|3>:STATe ON | OFF

[SOURce<[1]|2>:]FSIMulator:DEL50:GROup<[1]|2...8>:PATH<[1]|2>:STATe ON | OFF

[SOURce<[1]|2>:]FSIMulator:DELAy:GROup<[1]|2...5>:PATH<[1]|2...5>:STATe ON | OFF

These commands activate the selected path for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations.

GROup<5. . . 8> is only available for the signal routings SOURce:FSIMulator:ROUte FBMAXB | FAMAXA | FAMAXAB | FBMAXAB.

Example:

"FSIM:DEL:STAT ON"

'activates the **Standard Delay** fading configuration.

"FSIM:DEL:GRO:PATH2:STAT ON"

'activates fading path 2 in group 1.

*RST value	Resolution	Options	SCPI
OFF		Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 and GROup<5...8> only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:DEL30:STATe ON | OFF

[SOURce<[1]|2>:]FSIMulator:DEL50:STATe ON | OFF

[SOURce<[1]|2>:]FSIMulator:DELAy:STATe ON | OFF

These commands activate the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations. These three configurations differ in terms of the maximum number of paths (20 / 12 / 8 or 40 / 24 / 16), the resolution of the Additional Delay (10 ns / 5 ns / 10 ps), and the available RF bandwidth (limited to 30 MHz for Fine Delay 30 MHz).

At the same time the fading simulator is switched on or off.

Important:

Changing the configuration will cause an interruption in the fading process, followed by a restart after about one second. If the instrument is fitted with two faders (options B14 and B15), this applies to both faders since the FPGAs in the instrument are rebooted and loaded with the modified configuration.

Example:

"FSIM:DEL:STAT ON"

'activates the **Standard Delay** fading configuration for fader A and switches on fading for path A.

*RST value	Resolution	Options	SCPI
OFF		Option B14 Options B13 and B10 Fine Delay configurations only with option K71 SOURce2 only with option B15	Device-specific

[SOURce]:FSIMulator:DELETE <file name>

This command deletes the specified file containing a fading setting from the default directory. The default directory is set with the command `MMEM:CDIRectory`. A path can also be specified. Only files with the file ending `*.fad` are deleted.

This command triggers an event and thus does not have a query format or an `*RST` value.

Example:

```
"MMEM:CDIR 'D:\user\fading'"
'sets the default directory to D:\user\fading.

"FSIM:CAT?"
'reads all files from the default directory with fading settings.

Response: "Birth_3gpp"
'the file 'Birthdeath_3GPP' is available.

"FSIM:DELETE 'Birth_3gpp'"
'deletes the file 'Birthdeath_3GPP'.
```

*RST value	Resolution	Options	SCPI
		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>]:FSIMulator:FREQuency 100.0E3 ... 6.0E9

This command determines the virtual RF frequency if the baseband signal is output (and not the RF signal) on the instrument. The entered value is used as the basis for computing the Doppler shift.

Example:

```
"FSIM:SDES BB"
'specifies that the Doppler shift is computed on the basis of the virtual RF
frequency.

"FSIM:FREQ 2GHz"
'sets the virtual frequency to 2 GHz.
```

*RST value	Resolution	Options	SCPI
1 GHz	0.01 Hz	Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>]:FSIMulator:GLOBal:SEED 1...10

This command enters the fading start seed. This value is global for the instrument.

Example:

```
"FSIM:GLOB:SEED 2"
'sets the start seed to 2
```

*RST value	Resolution	Options	SCPI
10		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:HOPPing:MODE OFF | IBANd | OOBand

This command activates frequency hopping and determines how fading is resumed after a frequency hop. This command is available only for the **Standard Delay** and **Fine Delay 30 MHz / 50 MHz** fading configurations.

Prior to activating frequency hopping, list mode and the desired frequency table must be activated.

Parameter: **OFF**

Frequency hopping is deactivated.

IBANd

Frequency hopping is activated. After hopping back to a previous hop frequency, the fading process is resumed as if the fading had continued also at this frequency, i.e. the process is not restarted.

OOBand

Frequency hopping is activated. After hopping back to a previous hop frequency, the fading process is restarted and is thus not correlated with the fading process which was underway prior to the frequency hop to this frequency.

Example:

```
"MMEM:CDIR 'D:\user\fading"
  'sets the default directory to D:\user\fading.

"LIST:SEL 'fading1'"
  'selects the file 'fading1' with the frequency values for the frequency hops.

"LIST:DWEL 2E-3"
  'sets a dwell time of 2 ms between two frequency hops.

"LIST:MODE AUTO"
  'selects untriggered list mode.

"FREQ:MODE LIST"
  'activates list mode.

"FSIM:HOPP:MODE IBAN"
  'activates frequency hopping. The fading process is restarted after a hop back.
```

*RST value	Resolution	Options	SCPI
OFF		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:IGNore:RFCHanges ON | OFF

This command determines whether frequency changes < 5% are ignored. This enables faster frequency hopping.

Example:

```
"FSIM:IGN:RFCH ON"
  'Ignores frequency changes < 5% for the fading.
```

*RST value	Resolution	Options	SCPI
OFF		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:ILOSs:CSAMples

This command queries the share of samples which were clipped due to the insertion loss setting.

The command represents a query and thus has no *RST value.

Example: "FSIM:ILOS:CSAM?"
'queries the share of samples which were clipped.

Response: "11"
'11% of the samples were clipped.

*RST value	Resolution	Options	SCPI
-		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:ILOSs:MODE NORMAl | LACP | USER

This command sets the insertion loss of the fading simulator.

Parameter: NORMAl

The minimum insertion loss for a path of the fading simulator is set to a fixed value of 18 dB. The value is chosen so that even when lognormal fading is switched on, overdrive will occur only very rarely in the fading simulator. This setting is recommended for BERTs.

LACP

The minimum insertion loss is between 6 and 12 dB. This value is dependent upon the **Path Loss** setting of the fading paths which are switched on. **Low ACP** mode is only recommended for fading paths with Raleigh profile. Only in this case statistical distribution of level fluctuation is ensured. For other fading profiles, non-statistical level fluctuations occur which lead to an enormous increase of clipping. However, monitoring the percentage of clipped samples is recommended for Raleigh paths also.

USER

Any value for the minimum insertion loss in the range from 0 dB to 18 dB can be selected. Enter the value using the [SOURce]:FSIMulator:ILOSs[:LOSS] command.

Example: "FSIM:ILOS:MODE USER"
'chooses the user-defined setting for the insertion loss.

"FSIM:ILOS 4 dB"
'sets the minimum insertion loss to 4 dB.

*RST value	Resolution	Options	SCPI
NORMAl	-	Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:FSIMulator:ILOSs[:LOSS] 0.0 ... 10.0 dB

This command sets the user-defined insertion loss of the fading simulator when **User** is selected.

In the **Normal** and **Low ACP** modes, the current setting of the value can be queried.

Example:

```
"FSIM:ILOS:MODE USER"
```

'chooses the user-defined setting for the insertion loss.

```
"FSIM:ILOS 4 dB"
```

'sets the minimum insertion loss to 4 dB.

*RST value	Resolution	Options	SCPI
0.0 dB	0.1 dB	Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:FSIMulator:KCONstant SPEed | DSHift

This command selects whether to keep the speed or the doppler shift constant in case of frequency changes.

Example:

```
"FSIM:KCON SPE"
```

'keeps the speed constant in case of frequency changes.

*RST value	Resolution	Options	SCPI
SPEed	-	Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:FSIMulator:LOAD <file name>

This command loads the specified file containing a fading setting from the default directory. The default directory is set with the command `MMEM:CDIRECTory`. A path can also be specified. Only files with the file ending ***.fad** are loaded.

This command triggers an event and thus does not have a query format or an *RST value.

Example:

```
"MMEM:CDIR 'D:\user\fading"
```

'sets the default directory to D:\user\fading.

```
"FSIM:CAT? "
```

'reads all files from the default directory with fading settings.

```
Response: "Birth_3gpp"
```

'the file 'Birthdeath_3GPP' is available.

```
"FSIM:LOAD 'Birth_3gpp' "
```

'loads the fading settings from the file 'Birthdeath_3GPP'.

*RST value	Resolution	Options	SCPI
		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MDElay:MOVing:DElay:MEAN <numeric_value>

This command sets the mean delay of the moving fading path for moving propagation.

Example: "FSIM:MDEL:STAT ON"
 'sets moving propagation.

"FSIM:MDEL:MOV:DEL:VAR 1E-5"
 'sets the range 10 µs (+/- 5 µs) for the variation of the delay of the moving fading path.

"FSIM:MDEL:MOV:DEL:MEAN 9E-6"
 'sets the mean delay of the moving path to 9 µs.

"FSIM:MDEL:MOV:VPER 105"
 'sets a period of 105 s for the sinusoidal variation of the delay of the moving path. The delay of the moving path now varies once sinusoidally in 105 s between 4 µs and 14 µs.

*RST value	Resolution	Options	SCPI
3.5 µs	0.1 µs	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MDElay:MOVing:DElay:VARiation 0.3 ... 100 µs

This command enters the range for the delay of the moving fading path for moving propagation. The delay of the moving path slowly varies sinusoidally within this range.

Example: "FSIM:MDEL:MOV:DEL:VAR 1E-5"
 'sets the range 10 µs for the delay of the moving fading path.

*RST value	Resolution	Options	SCPI
5 µs	0.1 ns	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MDElay:MOVing:LOSS 0.0 ... 50.0 dB

This command enters the insertion loss of the moving path for moving propagation.

Example: "FSIM:MDEL:MOV:LOSS 12 dB"
 'sets the loss for the moving fading path.

*RST value	Resolution	Options	SCPI
0 dB	0.1 dB	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MDELay:MOVing:STATe ON | OFF

This command activates the moving fading path for moving propagation.

Example: "FSIM:MDEL:STAT ON"
'sets moving propagation.
"FSIM:MDEL:MOV:STAT ON"
'activates the moving path for moving propagation.

*RST value	Resolution	Options	SCPI
ON		Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MDELay:MOVing:VPERiod 10 ... 500 s

This command sets the speed of the delay variation of the moving fading path for moving propagation. A complete cycle comprises one pass through this **Variation Period**.

Example: "FSIM:MDEL:MOV:VPER 100 s"
'sets the period for the delay variation to 100 s.

*RST value	Resolution	Options	SCPI
157 s	0.01 s	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MDELay:REFerence:DELay 0.0 ... 1638 μ s

This command enters the delay of the reference path for moving propagation.

Example: "FSIM:MDEL:REF:DEL 1E-5"
'sets the range to 10 μ s for the delay of the reference path.

*RST value	Resolution	Options	SCPI
1 μ s	0.01 μ s	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MDELay:REFerence:LOSS 0.0 ... 50.0 dB

This command enters the loss of the reference path for moving propagation.

Example: "FSIM:MDEL:REF:LOSS 12 dB"
'sets the insertion loss for the reference path.

*RST value	Resolution	Options	SCPI
0 dB	0.1 dB	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MDElay:REFerence:STATe ON | OFF

This command activates the reference path for moving propagation.

Example: "FSIM:MDEL:STAT ON"
 'sets moving propagation.
 "FSIM:MDEL:REF:STAT ON"
 'activates the reference path for moving propagation.

*RST value	Resolution	Options	SCPI
ON		Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MDElay:STATe ON | OFF

This command activates the moving propagation fading configuration. The paths and the fading simulator must be switched on separately

(SOURce:FSIMulator:MDElay:MOVing | REFerence:STATe ON and SOURce:FSIMulator ON).

Example: "FSIM:MDEL:STAT ON"
 'sets moving propagation for fader A.

*RST value	Resolution	Options	SCPI
OFF		Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MIMO:TAP TAP1 | TAP2 | TAP3 | TAP4 | TAP5 | TAP6 | TAP7 | TAP8 | TAP9 | TAP10

This command selects the tab to be displayed.

This command triggers an event and thus does not have a query format or an *RST value.

Example: "FSIM:MIMO:TAP 3 "
 'displays tap 3.

*RST value	Resolution	Options	SCPI
		Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]]2>:FSIMulator:MIMO:COPY:NEXT

This command copies the matrix values of the current tap to the next higher tap. If the current tap is the last tap, this button is disabled.

This command triggers an event and thus does not have a query format or an *RST value.

Example: "FSIM:MIMO:COPY:NEXT"
'copies the settings of the current tap to the next higher tap.

*RST value	Resolution	Options	SCPI
		Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]]2>:FSIMulator:MIMO:COPY:PREVIOUS

This command copies the matrix values of the current tap to the next lower tap. If tap 1 is the current tap, this button is disabled.

This command triggers an event and thus does not have a query format or an *RST value.

Example: "FSIM:MIMO:COPY:PREV"
'copies the settings of the current tap to the next lower tap.

*RST value	Resolution	Options	SCPI
		Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]]2>:FSIMulator:MIMO:TAP<[1]...10>:KRONecker:CORRelation:RX:IMAGinary -1...1

This command enters the value for the imaginary part of the receiver correlation.

The Rx correlation is the correlation between AB <-> AA and BA <-> BB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

Example: "FSIM:MIMO:TAP2:KRON:CORR:RX:IMAG 0.5"
'sets the imaginary part of the Rx correlation value to 0.5.

*RST value	Resolution	Options	SCPI
0	0.001	Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MIMO:TAP<[1]...10>:KRONEcker:CORRelation:RX:PHASe 0...360

This command enters the value for the phase of the receiver correlation.

The Rx correlation is the correlation between AB <-> AA and BA <- > BB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

Example:

"FSIM:MIMO:TAP2:KRON:CORR:RX:PHAS 30"
 'sets the phase of the Rx correlation value to 30 degrees.

*RST value	Resolution	Options	SCPI
0	0.02	Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:MIMO:TAP<[1]...10>:KRONEcker:CORRelation:RX:RATIo 0...1

This command enters the ratio of the receiver correlation.

The Rx correlation is the correlation between AB <-> AA and BA <- > BB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

Example:

"FSIM:MIMO:TAP2:KRON:CORR:RX:RAT 0.5"
 'sets the ratio of the Rx correlation to 0.5.

*RST value	Resolution	Options	SCPI
0	0.001	Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...10>:KRONecker:CORRelation:RX:REAL -1...1

This command enters the value for the real part of the receiver correlation.

The Rx correlation is the correlation between AB <-> AA and BA <- > BB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

Example:

```
"FSIM:MIMO:TAP2:KRON:CORR:RX:REAL 0.5"
'sets the value for the real part of the Rx correlation to 0.5.
```

*RST value	Resolution	Options	SCPI
0	0.001	Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...10>:KRONecker:CORRelation:TX:IMAGinary -1...1

This command enters the value for the imaginary part of the transceiver correlation.

The Tx correlation is the correlation between AA <-> BA and BB <- > AB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

Example:

```
"FSIM:MIMO:TAP2:KRON:CORR:TX:IMAG 0.5"
'sets the imaginary part of the Tx correlation value to 0.5.
```

*RST value	Resolution	Options	SCPI
0	0.001	Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...10>:KRONEcker:CORRelation:TX:PHASe 0...360

This command enters the value for the phase of the transceiver correlation.

The Tx correlation is the correlation between AA <-> BA and BB <- > AB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

Example:

"FSIM:MIMO:TAP2:KRON:CORR:TX:PHAS 30"
 'sets the phase of the Tx correlation value to 30 degrees.

*RST value	Resolution	Options	SCPI
0	0.02	Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...10>:KRONEcker:CORRelation:TX:RATIo 0...1

This command enters the ratio of the transceiver correlation.

The Tx correlation is the correlation between AA <-> BA and BB <- > AB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

Example:

"FSIM:MIMO:TAP2:KRON:CORR:TX:RAT 0.5"
 'sets the ratio of the Tx correlation to 0.5.

*RST value	Resolution	Options	SCPI
0	0.001	Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]2>:]FSIMulator:MIMO:TAP<[1]...10>:KRONecker:CORRelation:TX:REAL -1...1

This command enters the value for the real part of the transceiver correlation.

The Tx correlation is the correlation between AA <-> BA and BB <- > AB.

Note:

In case that the values for the real part and the imaginary part are both set to 0, the phase value will also be set to 0 when changing the data format.

Example:

"FSIM:MIMO:TAP2:KRON:CORR:TX:REAL 0.5"
'sets the value for the real part of the Tx correlation to 0.5.

*RST value	Resolution	Options	SCPI
0	0.001	Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]2>:]FSIMulator:MIMO:TAP<[1]...10>:MATRix:MODE INDividual | KRONecker

This command selects the matrix mode.

Example:

"FSIM:MIMO:TAP2:MATR:MODE IND"
'selects the matrix mode **Individual**.

*RST value	Resolution	Options	SCPI
		Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]2>:]FSIMulator:MIMO:TAP<[1]...10>:MATRix:ROW<1...4>:COLumn<1...4>:PHASe 0...360

This command enters the value for the phase/imaginary part of the correlation.

Example:

"FSIM:MIMO:TAP2:MATR:ROW1:COL1:PHAS 90"
'sets the correlation value to the specified value.

*RST value	Resolution	Options	SCPI
0		Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]>:]FSIMulator:MIMO:TAP<[1]...10>:MATRix:ROW<1...4>:COLumn<1...4>:RATio 0...1

This command enters the value for the real/ratio part of the correlation.

Example: "FSIM:MIMO:TAP2:MATR:ROW1:COL1:PHAS 0.5"
'sets the correlation value to the specified value.

*RST value	Resolution	Options	SCPI
0		Options B14 and K71 Options B13 and B10 Option K74 SOURce2 only with option B15	Device-specific

[SOURce<[1]>:]FSIMulator:PRESet

This command sets the default settings (preset) for fading simulation.

This command triggers an event and thus does not have a query format or an *RST value.

Example: "FSIM:PRES"
'resets fading simulation to the default values.

*RST value	Resolution	Options	Dependencies	SCPI
		Option B14 Options B13 and B10 SOURce2 only with option B15	:FSIM:STAN CDMA8 :FSIM:DEL:STAT ON :FSIM:SDES RF :FSIM:SPE:UNIT KMH :FSIM:REST:MODE AUTO :FSIM:IGN:RFCH OFF :FSIM:HOPP:MODE OFF :FSIM:COUP:... OFF :FSIM:ILOS:MODE NORM :FSIM:DEL:GRO1:PATH1:STAT ON :FSIM:DEL:GRO1:PATH1:PROF RAYL :FSIM:DEL:GRO<n>:PATH<n>:STAT OFF	Device-specific

[SOURce<[1]>:]FSIMulator:REStart

This command triggers a restart of fading simulation if manual restart is chosen (FSIMulator:REStart:MODE MANual). For two-channel fading, a restart is triggered for both faders if manual restart is chosen for both faders.

This command triggers an event and thus does not have a query format or an *RST value.

Example: "FSIM:REST:MODE MAN"
'selects manual mode for triggering a restart.

"FSIM:REST"
'triggers a restart of fading simulation. The fading process begins at a defined start point.

*RST value	Resolution	Options	SCPI
		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:FSIMulator:REStart:MODE AUTO | MANual | EXT1 | EXT2

This command selects how a restart of fading simulation is triggered.

Parameter:	AUTO	The modulation signal is continually faded.
	MANual	A restart is triggered by the command [SOURce]:FSIMulator:REStart.
	EXT1 2	A restart is triggered by baseband A/B.

Example: "FSIM:RESt:MODE MAN"
'selects manual mode for triggering a restart.
"FSIM:RESt"
'triggers a restart of fading simulation.

*RST value	Resolution	Options	SCPI
AUTO		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce]:FSIMulator:ROUte FAA | FAAFBB | FAAFBA | FABFBB | FAABFBAB | FAMAXA | FBMAXB | FAMAXAB | FBMAXAB | FA1A2BFB1A2B

This command selects on which baseband path the faded signal is output (dual-path instruments only). The input signal of the fader is selected with command `SOURce:BB:ROUte`.

For one-path instruments this command is query only. It returns value `FAA` (Fader A always outputs the signal on baseband A).

Parameter:	FAA	The faded modulation signal of fader A is placed on baseband path A. If the instrument is equipment with option B15, 40 fading paths are available for fader A.
	FAAFBB	The faded modulation signal of fader A is placed on baseband path A and the faded modulation signal of fader B is placed on baseband path B. 20 fading paths are available for each fader (requires option B15).
	FAAFBA	The faded modulation signal of fader A and B is placed on baseband path A. 20 fading paths are available for each fader (requires option B15).
	FABFBB	The faded modulation signal of fader A and B is placed on baseband path B. 20 fading paths are available for each fader (requires option B15).
	FAABFBAB	The faded modulation signal of fader A and B is placed on baseband paths A and B. 20 fading paths are available for each fader (requires option B15).

FAMAXA

The faded modulation signal of fader A is placed on baseband path A. 40 fading paths are available for fader A. Fader B is switched off (requires option B15).

FBMAXB

The faded modulation signal of fader B is placed on baseband path B. 40 fading paths are available for fader B. Fader A is switched off (requires option B15).

FAMAXAB

The faded modulation signal of fader A is placed on baseband paths A and B. If the instrument is equipment with option B15, 40 fading paths are available for fader A and the signal from fader B is not output, the signal flow of baseband B is interrupted.

FBMAXAB

The faded modulation signal of fader B is placed on baseband paths A and B. 40 fading paths are available for fader B. The signal from fader A is not output, the signal flow of baseband A is interrupted (requires option B15).

FA1A2BFB1A2B

Fader A is split into fader AA and fader AB. The faded modulation signal of fader AA is placed on baseband path A. 10 fading path are available for fader AA. The faded modulation signal of fader AB is placed on baseband path B. 10 fading path are available for fader AB.

Fader B is split into fader BA and fader BB. The faded modulation signal of fader BA is placed on baseband path A. 10 fading path are available for fader BA. The faded modulation signal of fader BB is placed on baseband path B. 10 fading path are available for fader BB.

Example:

"FSIM:ROUT FAMAXA"

'places the faded baseband signal of fader A on baseband path A. 40 fading paths are available and fader B is switched off.

*RST value	Resolution	Options	SCPI
1 fader: FAA 2 faders: FAAFBB		Options B14 Options B13 and B10 FAAFBA FAAFBB FABFBB FAMAXA FBMAXB FBMAXAB: option B15 and second option B10 FAMAXAB: second option B10	Device-specific

[SOURce<[1]|2>:]FSIMulator:SDEStination RF | BB

This command selects the RF frequency which is used as a basis for computing the Doppler shift.

Parameter: RF

The Doppler shift is computed using the RF frequency set on the generator.

BB

The Doppler shift is computed based on a user-definable RF frequency which is entered using the command
SOURce:FSIM:FREQuency.

Example: "FSIM:SDES RF"
'selects the RF frequency as the basis for computing the Doppler shift.

*RST value	Resolution	Options	SCPI
RF		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:SPEEd:UNIT MPS | KMH | MPH

This command chooses the default unit for the speed (commands . . . :SPEEd).

Example: "FSIM:SPE:UNIT MPS"
'sets meters per second as the default unit for the speed.

*RST value	Resolution	Options	SCPI
MPS		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]>:]FSIMulator:STANdard USER | CDMA8 | CDMA30 | C1DMA30 | CDMA100 | CDMA0 | CDMA3 | G6TU3 | GTU3 | G6TU50 | GTU50 | G6HT100 | GHT100 | GRA250 | GET50 | GET100 | HL2A | HL2B | HL2C | HL2D | HL2C | NADC8 | NADC50 | NADC100 | P6TU1 | PTU1 | P6TU50 | PTU50 | P6HT100 | PHT100 | PRA130 | PET50 | PET100 | TTU | TBU | THT | T4ET | TDU | TDR | G3C1 | G3C2 | G3C3 | G3C4 | G3UEC1 | G3UEC2 | G3UEC3 | G3UEC4 | G3UEC5 | G3UEC6 | G3UEC7SE | G3UEC7BE | G3UEC8CQ | G3UEPA3 | G3UEPB3 | G3UEVA30 | G3UEVA120 | G3TU3 | G3TU50 | G3TU120 | G3HT120 | G3RA120 | G3RA250 | BD1 | MP1 | DABRA04 | DABRA06 | DABTU12 | DABTU06 | DABSFN | WMSUI1A360P90 | WMSUI1A360P75 | WMSUI1A030P90 | WMSUI1A030P75 | WMSUI2A360P90 | WMSUI2A360P75 | WMSUI2A030P90 | WMSUI2A030P75 | WMSUI3A360P90 | WMSUI3A360P75 | WMSUI3A030P90 | WMSUI3A030P75 | WMSUI4A360P90 | WMSUI4A360P75 | WMSUI4A030P90 | WMSUI4A030P75 | WMSUI5A360P90 | WMSUI5A360P75 | WMSUI5A360P50 | WMSUI5A030P90 | WMSUI5A030P75 | WMSUI5A030P50 | WMSUI6A360P90 | WMSUI6A360P75 | WMSUI6A360P50 | WMSUI6A030P90 | WMSUI6A030P75 | WMSUI6A030P50 | WMITUOIPA | WMITUOIPB | WMITUVA60 | WMITUVA120 | LMEPA5 | LMEVA5 | LMEVA70 | LMEVA900 | LMETU70 | LMETU900

This command selects a predefined fading simulator setting which complies with the test specifications found in the common mobile radio standards. For a detailed summary of all of the default settings, see description of the **Standard / Test Case** selection parameter.

Parameter: USER

USER parameter cannot be set. A query returns this value if a user-defined Fading setting was loaded or if one of the associated settings was changed subsequent to the selection of a standard

CDMA0 | CDMA3 | CDMA8 | CDMA30 | C1DMA30 | CDMA100
CDMA 1, 2 and 3 path

NADC8 | NADC50 | NADC100
NADC 2 path

G6TU3 | GTU3 | G6TU50 | GTU50
GSM Typical Urban 6 and 12 path

G6HT100 | GHT100
GSM Hilly Terrain 6 and 12 path

GRA250
GSM Rural Area 6 path

GET50 | GET100
GSM Equal Test 6 path

P6TU1 | PTU1 | P6TU50 | PTU50
DCS1800/PCS1900 Typical Urban 6 and 12 path

P6HT100 | PHT100
DCS1800/PCS1900 Hilly Terrain 6 and 12 path

PRA130	DCS1800/PCS1900 Rural Area 6 path.
PET50 PET100	DCS1800/PCS1900 Equal Test 6 path
TTU	Tetra Typical Urban 2 path
TBU	Tetra 2 path
THT	Tetra Hilly Terrain 2 path
TET T4ET	Tetra Equal Test 3 and 4 path
TDU	Tetra Mode Direct Mode Rural Propagation Model 1 path
TDR	Tetra Mode Urban Propagation Mode 1 path
G3C1 G3C2 G3C3 G3C4	3GPP FDD Test Case x (BS)
G3UEC1 G3UEC2 G3UEC3 G3UEC4 G3UEC5 G3UEC6	3GPP FDD UE Test Case x (UE)
G3UEC7SE	3GPP FDD UE Sector (UE)
G3UEC7BE	3GPP FDD Beam (UE)
G3UEC8CQ	3GPP FDD CQI (UE)
G3UEPA3	3GPP FDD Pedestrian A 4 path (UE)
G3UEPB3	3GPP FDD Pedestrian B 6 path (UE)
G3UEVA30 G3UEVA120	3GPP FDD Vehicular A 6 path (UE)

G3TU3 G3TU50 G3TU120	3GPP FDD Typical Urban 20 path
G3HT120	3GPP FDD Hilly Terrain 20 path
G3RA120 G3RA250	3GPP FDD Rural Area 10 path
HL2A HL2B HL2C HL2D HL2E	WLAN HyperLan 18 path
DABRA04 DABRA06	DAB Rural Area 4 and 6 path
BD1	3GPP Bith Death 2 path
MD1	3GPP Moving Propagation 2path
DABTU12 DABTU06	DAB Typical Urban 12 and 6 path
DABSFN	DAB Single Frequency Network (in the VHF range) 7 path
WMSUI1A360P90 WMSUI1A360P75 WMSUI1A030P90 WMSUI1A030P75	Modified Stanford University Interim Channel Model, Terrain Type C (Flat/light tree density) 3 path
WMSUI2A360P90 WMSUI2A360P75 WMSUI2A030P90 WMSUI2A030P75	Modified Stanford University Interim Channel Model, Terrain Type C (Flat/light tree density) 3 path
WMSUI3A360P90 WMSUI3A360P75 WMSUI3A030P90 WMSUI3A030P75	Modified Stanford University Interim Channel Model, Terrain Type B (Hilly, light tree density or flat/moderate-to-heavy tree density) 3 path
WMSUI4A360P90 WMSUI4A360P75 WMSUI4A030P90 WMSUI4A030P75	Modified Stanford University Interim Channel Model, Terrain Type B (Hilly, light tree density or flat/moderate-to-heavy tree density) 3 path
WMSUI5A360P90 WMSUI5A360P75 WMSUI5A360P50 WMSUI5A030P90 WMSUI5A030P75 WMSUI5A030P50	Modified Stanford University Interim Channel Model, Terrain Type A (Hilly, moderate-to-heavy tree density) 3 path

WMSUI6A360P90 | WMSUI6A360P75 | WMSUI6A360P50 | WMSUI6A030P90 |
 WMSUI6A030P75 | WMSUI6A030P50
 Modified Stanford University Interim Channel Model, Terrain
 Type A (Hilly, moderate-to-heavy tree density) 3 path

WMITUOIPA | WMITUOIPB | WMITUVA60 | WMITUVA120
 Wimax ITU

LMEPA5 | LMEVA5 | LMEVA70 | LMEVA900 | LMETU70 | LMETU900
 LTE MIMO

Example: "FSIM:STAN THT"
 'selects settings in conformity with Tetra Hilly Terrain 200 (with two fading paths).

*RST value	Resolution	Options	SCPI
USER		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:STANdard:REFerence <string>

This command queries the reference in the standard for the selected test case default.

Example: "FSIM:STAN WC1BUP2"
 'selects settings in conformity with 3GPP FDD Test Case 1 (with two fading paths).

"FSIM:STAN:REF?"
 'queries the reference in the standard.

Response: "3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2"
 'the test case is defined in the specified reference.

*RST value	Resolution	Options	SCPI
		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:STORE <file name>

This command saves the current fading simulator settings in the specified file in the default directory. The default directory is set with the command `MMEM:CDIRECTORY`. A path can also be specified. The file ending `*.fad` is automatically used.

This command triggers an event and thus does not have a query format or an `*RST` value.

Example:

```
"MMEM:CDIR 'D:\user\fading"
'sets the default directory to D:\user\fading.

"FSIM:STOR 'delay_3gpp' "
'saves the current fading simulator settings of fader A in the file
'delay_3gpp'.
```

*RST value	Resolution	Options	SCPI
		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator[:STATe] ON | OFF

This command activates fading simulation.

Example:

```
"FSIM ON"
'activates fading simulation in baseband path A with the current settings.
```

*RST value	Resolution	Options	SCPI
OFF		Option B14 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:TCInterferer:DELAy:MAXimum0 ... 1638 μs

This command sets the maximum delay for the moving path.

Example:

```
"FSIM:TCI:DEL:MAX 0.000200"
'sets a 200 μs maximum delay for the reference path.
```

*RST value	Resolution	Options	SCPI
110 μs (Reference Path)	1 ns	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:TCInterferer:REFerence | MOVing:DELay:MINimum0 ... 1638 μ s

This command sets the minimum delay for either the reference path or the moving path.

Example: "FSIM:TCl:REF:DEL:MIN 0.000008"
'sets a 8 μ s minimum delay for the reference path.

*RST value	Resolution	Options	SCPI
40 μ s (Reference Path)	0.1 μ s	Options B14 and K71	Device-specific
0 μ s (Moving Path)		Options B13 and B10 SOURce2 only with option B15	

[SOURce<[1]|2>:]FSIMulator:TCInterferer:REFerence | MOVing:FDOPpler?

This command queries the Doppler frequency with 2 channel interferer fading. The Doppler frequency is determined by the entered speed (command SOURce:FSIM:TCl:SPEed) and by the entered ratio of the actual Doppler frequency to the set Doppler frequency (command SOURce:FSIM:TCl:FRATio).

The command is a query and thus has no *RST value.

Example: "FSIM:TCl:REF:FDOP?"
'queries the resulting Doppler frequency for the reference path.
Response: "55"
'the resulting Doppler frequency is 55 Hz.

*RST value	Resolution	Options	SCPI
		Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:TCInterferer:FRATio -1.0 ... +1.0

This command sets the ratio of the actual Doppler frequency to the set Doppler frequency with 2 channel interferer fading.

Example: "FSIM:TCl:FRAT 0.5"
'sets a frequency ratio of 0.5 for both fading paths.

*RST value	Resolution	Options	SCPI
1	0.05	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:TCInterferer:REFerence | MOVing:LOSS 0.0 dB...50.0 dB

This command sets the loss of the paths for 2 channel interferer fading.

Example: "FSIM:TCl:REF:LOSS 10"
 'sets a loss of 10 db for the reference path for fader A.

*RST value	Resolution	Options	SCPI
0	0.1 dB	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:TCInterferer:REFerence | MOVing:PROFile SPATh | PDOPpler | RAYleigh

This command selects the fading profile to be used for 2 channel interferer fading.

Parameter: SPATh
 A static transmission path is simulated which can only undergo attenuation (loss) or delay.

PDOPpler
 A transmission path is simulated in which there is an individual direct connection from the transmitter to the moving receiver (discrete component). The Doppler frequency shift is determined by two parameters: **Speed** (SOURce:FSIM:TCl:SPEed) and **Frequency Ratio** (SOURce:FSIM:TCl:FRATio).

RAYleigh
 A radio hop is simulated in which many highly scattered subwaves arrive at a moving receiver. The resulting received amplitude varies over time. The probability density function of the magnitude of the received amplitude is characterized by a Rayleigh distribution. The fading spectrum is a classic Doppler spectrum.

Example: "FSIM:TCl:REF:PROF SPAT"
 'selects the static path profile for the reference path of the **2 Channel Interferer Fading** configuration for fader A.

*RST value	Resolution	Options	SCPI
SPATh		Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:TCInterferer:SPEEd 0 m/s ... 479.67 m/s

This command sets the speed v of the moving receiver for 2 channel interferer fading. Based on the speed v and the virtual RF frequency f_{RF} , the Doppler frequency f_D is computed. Based on the speed v and the frequency of the RF output signal f_{RF} (or the virtual RF frequency), the Doppler frequency f_D is computed.

$$c = 2.998 \cdot 10^8 \text{ m/s} \qquad \frac{v}{c} = \frac{f_D}{f_{RF}}$$

If the speed is changed, the resulting Doppler shift is automatically modified. The resulting Doppler shift is a function of the speed v and the entered ratio of the actual Doppler shift to the set Doppler shift (Frequency Ratio - SOURce:FSIM:TCI:FRATIo) and can be queried with the command SOURce:FSIM:TCI:FDOPpler.

Example: "FSIM:TCI:SPE 2"
'sets a speed of 2 m/s on both fading paths.

*RST value	Resolution	Options	SCPI
0.83 m/s	0.1 m/s	Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:TCInterferer:REFerence | MOVing:STATe ON | OFF

This command activates the 2 channel interferer fading configuration. The paths and the fading simulator must be switched on separately (SOURce:FSIMulator:TCInterferer:MOVing|REFerence:STATe ON and SOURce:FSIMulator ON).

Example: "FSIM:TCI:REF:STAT ON"
'activates the reference path of the 2 Channel Interferer Fading configuration for fader A.

*RST value	Resolution	Options	SCPI
OFF		Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

[SOURce<[1]|2>:]FSIMulator:TCInterferer:MMODE SLIDing | HOPPing

This command selects the type of moving applied to the moving path.

Parameter: **SPATH**

The reference path has a fix delay while the delay of the moving path varies slowly in a sinusoidal way.

HOPPing

The reference path has a fix delay while the delay of the moving path appears or disappears in alternation at arbitrary points.

Example: "FSIM:TCI:MMOD SLID"
 'selects the **Sliding** mode for the moving path.

*RST value	Resolution	Options	Dependencies	SCPI
HOPPing		Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	For FSIM:TCI:MMOD SLID, the command FSIM:TCI:PER sets the period for a complete cycle of the moving path. For FSIM:TCI:MMOD HOPP, the command FSIM:TCI:PER sets the dwell time of the moving path.	Device-specific

[SOURce<[1]|2>:]FSIMulator:TCInterferer:PERiod 0.1 s...1000 s

The command enters either the dwell time or the period for a complete cycle of the moving path.

The set time depends on the setting of the moving mode: FSIM:TCI:MMOD SLID selects the sliding mode for the moving path and therefore FSIM:TCI:PER sets the period for a complete cycle for the the moving path. FSIM:TCI:MMOD HOPP selects the hopping mode for the moving path and therefore FSIM:TCI:PER sets the dwell time for the moving path.

Example: "FSIM:TCI:MMOD SLID"
 'selects the **Sliding** mode for the moving path.
 "FSIM:TCI:PER 50 "
 'sets the time for a complete cycle of the moving path to 50 s.

*RST value	Resolution	Options	SCPI
2.9 s (for hopping mode) 160 s (for sliding mode)		Options B14 and K71 Options B13 and B10 SOURce2 only with option B15	Device-specific

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