

# Fading Simulator

# R&S<sup>®</sup>SMU200A and R&S<sup>®</sup>AMU200A

# Operating Manual



1171.5231.12 – 08

This document describes the following software options:

- R&S®AMU-B14/-B15/-K71/-K72/-K74/-K77  
1402.5600.02, 1402.5700.02, 1402.7302.02, 1402.6905.02, 1402.9857.02, 1403.0930.02
- R&S®SMU-B14/-B15/-K71/-K72/-K74/-K77  
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The following abbreviations are used throughout this manual: R&S®AMU is abbreviated as R&S AMU, R&S®SMU is abbreviated as R&S SMU.

# Basic Safety Instructions

## Always read through and comply with the following safety instructions!

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

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

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

## Symbols and safety labels

							
Notice, general danger location Observe product documentation	Caution when handling heavy equipment	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Be careful when handling electrostatic sensitive devices

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

### Tags and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

	indicates a hazardous situation which, if not avoided, will result in death or serious injury.
	indicates a hazardous situation which, if not avoided, could result in death or serious injury.
	indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
	indicates the possibility of incorrect operation which can result in damage to the product. In the product documentation, the word ATTENTION is used synonymously.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

### Operating states and operating positions

*The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.*

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of  $\pm 10\%$  shall apply to the nominal voltage and  $\pm 5\%$  to the nominal frequency.
2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or death.

### Electrical safety

*If the information on electrical safety is not observed either at all to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.*

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with an earthing contact and protective earth connection.
3. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
4. If the product does not have a power switch for disconnection from the AC supply network, the plug of the connecting cable is regarded as the disconnecting device. In such cases, always ensure that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, a disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, you can ensure that the cable will not be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.
6. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages  $V_{\text{rms}} > 30 \text{ V}$ , suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.

## Basic Safety Instructions

14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1. Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

### Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.
2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).

### Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.
2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

### Batteries and rechargeable batteries/cells

*If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.*

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Keep cells and batteries out of the hands of children. If a cell or a battery has been swallowed, seek medical aid immediately.
5. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
6. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
7. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
8. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

### Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.

2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

### **Waste disposal**

1. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
2. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

## Informaciones elementales de seguridad

### **Es imprescindible leer y observar las siguientes instrucciones e informaciones de seguridad!**

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

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.



## Informaciones elementales de seguridad

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios.

### Símbolos y definiciones de seguridad

							
Aviso: punto de peligro general  Observar la documentación del producto	Atención en el manejo de dispositivos de peso elevado	Peligro de choque eléctrico	Advertencia: superficie caliente	Conexión a conductor de protección	Conexión a tierra	Conexión a masa	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)

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

## Palabras de señal y su significado

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



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



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



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



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

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

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

## Estados operativos y posiciones de funcionamiento

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

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de  $\pm 10\%$  sobre el voltaje nominal y de  $\pm 5\%$  sobre la frecuencia nominal.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, pueden causarse lesiones o incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

## Seguridad eléctrica

*Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.*

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de conexión como interruptor. En estos casos se deberá asegurar que el enchufe siempre sea de fácil acceso (de acuerdo con la longitud del cable de conexión, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.
6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión  $U_{\text{eff}} > 30 \text{ V}$  se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.

12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

## Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados, los llamados alérgenos (p. ej. el níquel). Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación", punto 1.

5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).

### **Reparación y mantenimiento**

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.
2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

### **Baterías y acumuladores o celdas**

*Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.*

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Mantener baterías y celdas fuera del alcance de los niños. En caso de ingestión de una celda o batería, avisar inmediatamente a un médico.
5. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.

## Informaciones elementales de seguridad

6. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
7. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
8. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

### Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.
2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.
3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

### Eliminación

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

# Qualitätszertifikat

## Certificate of quality

## Certificat de qualité

Certified Quality System  
**ISO 9001**

Certified Environmental System  
**ISO 14001**

### **Sehr geehrter Kunde,**

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

### **Der Umwelt verpflichtet**

- ▮ Energie-effiziente, RoHS-konforme Produkte
- ▮ Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ▮ ISO 14001-zertifiziertes Umweltmanagementsystem

### **Dear Customer,**

You have decided to buy a Rohde&Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards. The Rohde&Schwarz quality management system is certified according to standards such as ISO9001 and ISO14001.

### **Environmental commitment**

- ▮ Energy-efficient products
- ▮ Continuous improvement in environmental sustainability
- ▮ ISO 14001-certified environmental management system

### **Cher client,**

Vous avez choisi d'acheter un produit Rohde&Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité. Le système de gestion qualité de Rohde&Schwarz a été homologué, entre autres, conformément aux normes ISO9001 et ISO14001.

### **Engagement écologique**

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

# Customer Support

## Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

## Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

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# 1 Preface

## 1.1 Documentation Overview

The user documentation for the R&S Signal Generator consists of the following parts:

- Online Help system on the instrument,
- "Quick Start Guide" printed manual,
- Documentation CD-ROM with:
  - Online help system (\*.chm) as a standalone help,
  - Operating Manuals for base unit and options,
  - Service Manual,
  - Data sheet and specifications,
  - Links to useful sites on the R&S internet.

### Online Help

The Online Help is embedded in the instrument's firmware. It offers quick, context-sensitive access to the complete information needed for operation and programming. The online help contains help on operating the R&S Signal Generator and all available options.

### Quick Start Guide

The Quick Start Guide is delivered with the instrument in printed form and in PDF format on the Documentation CD-ROM. It provides the information needed to set up and start working with the instrument. Basic operations and an example of setup are described. The manual includes also general information, e.g., Safety Instructions.

### Operating Manuals

The Operating Manuals are a supplement to the Quick Start Guide. Operating Manuals are provided for the base unit and each additional (software) option.

These manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the Operating Manual for the base unit, all instrument functions are described in detail. Furthermore, it provides an introduction to remote control and a complete description of the remote control commands with programming examples. Information on maintenance, instrument interfaces and error messages is also given.

In the individual option manuals, the specific instrument functions of the option are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S Signal Generator is not included in the option manuals.

These manuals can also be orderd in printed form (see ordering information in the data sheet).

### Service Manual

The Service Manual is available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. It describes how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the instrument by the replacement of modules.

This manual can also be orderd in printed form (see ordering information in the data sheet).

### Release Notes

The release notes describe new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes. The current release notes are provided in the Internet.

## 1.2 Typographical Conventions

The following text markers are used throughout this documentation:

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

## 2 Introduction

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, provides support to the user when setting up the desired fading channel.

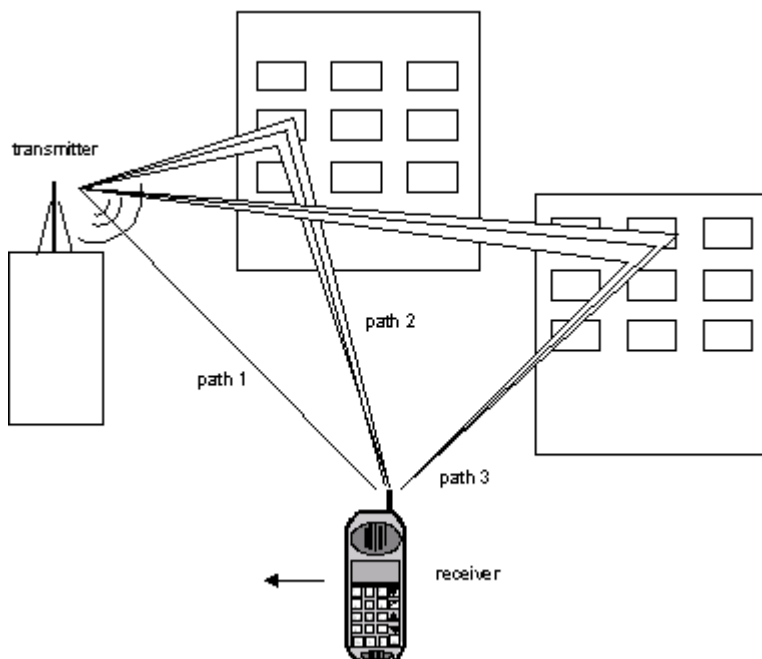
During transmission of a signal from the transmitter to the mobile receivers, diverse fading effects occur which can be simulated by the fading simulator separately or in combination.

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 25.104, annex B3 and annex B4 and test cases 36.141, 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.



**Fig. 2-1: 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).

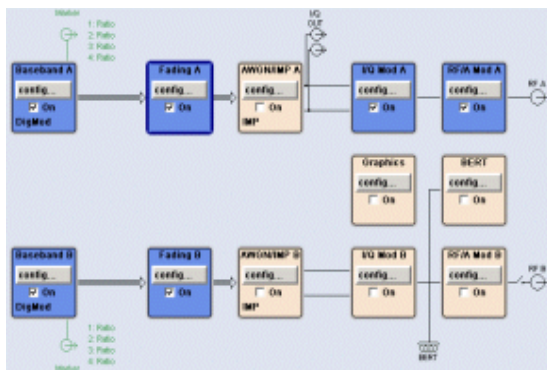
The fading process increases the crest factor of the signal, and this increase must be taken into account in the drive at the baseband level. When multiple paths are superimposed or in case of statistical influences on a path, an insertion loss is useful for providing a drive reserve. If the full drive 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.

For more information, see section "Impairment of Digital I/Q Signal and Noise Generator - AWGN/IMP Block" in the Operating Manual.

The fading settings are summarized 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", "2 Channel Interferer" and "High Speed Train") 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 MIMO (Multiple Input Multiple Output) Fading option (K74) is used to simulate a MIMO system with two transmitting antennas and two receiving antennas, i.e. system with four fading channels, as required for 1x2, 2x1 and 2x2 MIMO receiver tests. By combining two instruments, receiver tests scenarios for 1x3, 1x4, 2x3, 2x4, 3x1, 4x1, 3x2 and 4x2 MIMO could be simulated.

## 3 Signal Routing

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.



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.

**Note:** Signal routing for MIMO setups is performed with the settings provided in sections "MIMO" and "MIMO Subset" (see also [chapter 5.2, "MIMO Settings"](#), on page 107). In remote control, however, all available signal routings are configured with the command `[ :SOURce<hw> ] :FSIMulator:ROUte`.

The input signal to the fading simulator is specified in the routing menu of the respective baseband block (see section "Working with the Baseband Signal" in the Operating Manual).

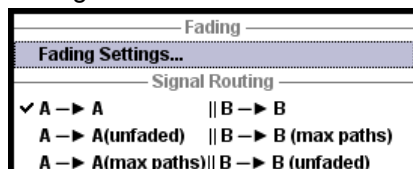
When fitted with two faders and two baseband blocks, the faders can be fed the signal from a single baseband block, the summation signal from both baseband blocks or each a signal from one of the two baseband blocks.

**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)**

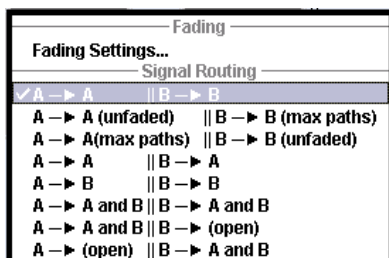
- For a single-path instrument, the output signal is always output on path A.
- In dual-path instruments, the fader output signal can be assigned either to path A, path B, or to both paths. Only one of the faders, A or B, can be operated. In Standard Delay mode, 20 fading paths are available for this 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 possible routing settings are described below.



- **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:



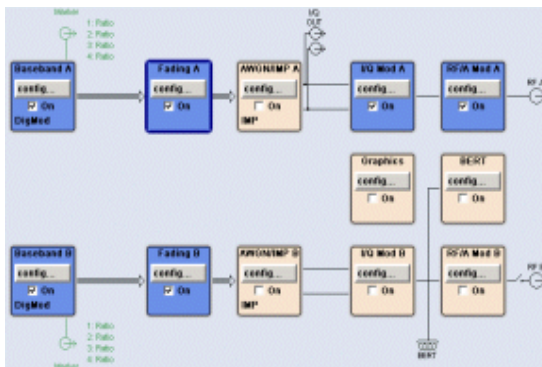
The following list shows all of the possible routing settings for dual-path instruments in a configuration with both fader options (B14 and B15).

"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.

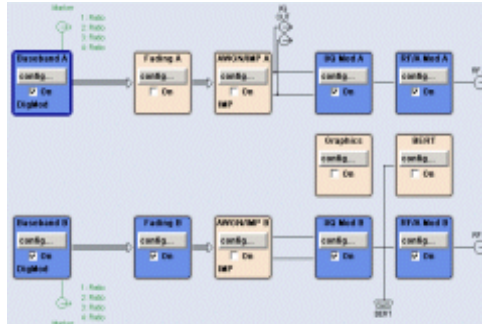
When fitted with a second baseband generator, the generator can be operated like two instruments; two independently configured signals are present at the signal generators output.

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.)



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

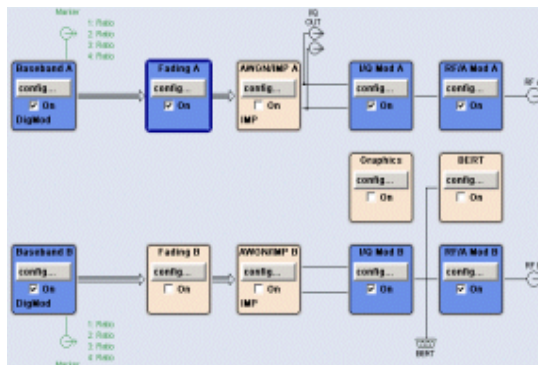
The fading signal from fader B is output on baseband path B. Fader A cannot be activated. In "Standard Delay" mode, 40 fading paths are available for fader B.



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

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

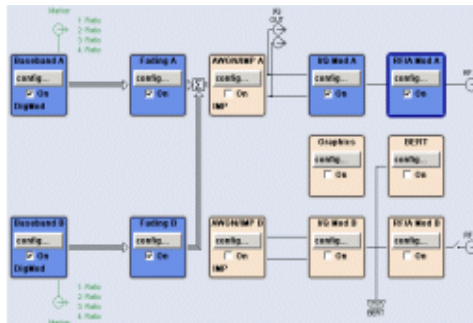
The fading signal from fader A is output on baseband path A. Fader B cannot be activated. In "Standard Delay" mode, 40 fading paths are available for fader A.



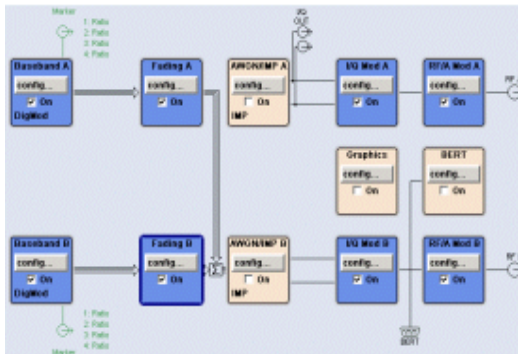
**Note:** The signal from the 40-path fader has a longer processing time than the signal from the fader which is switched off.



"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.

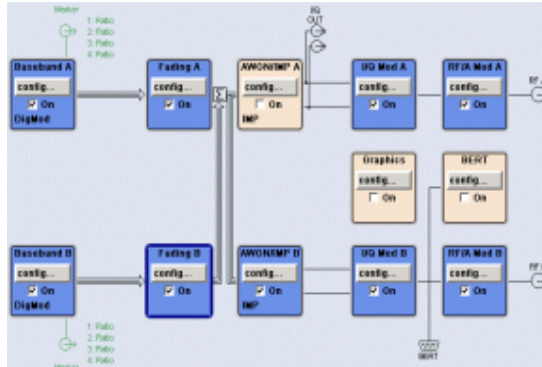


"A to B / B to B" Dual-channel fading. The fading signal from fader A and the fading signal from fader B are both output on baseband path B. In "Standard Delay" mode, 20 fading paths are available for each fader.



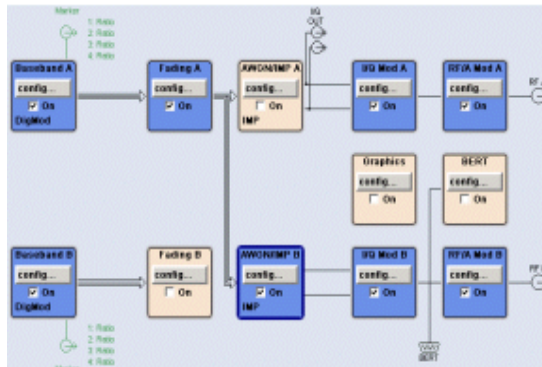
"A to A and B / B to A and B"

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.

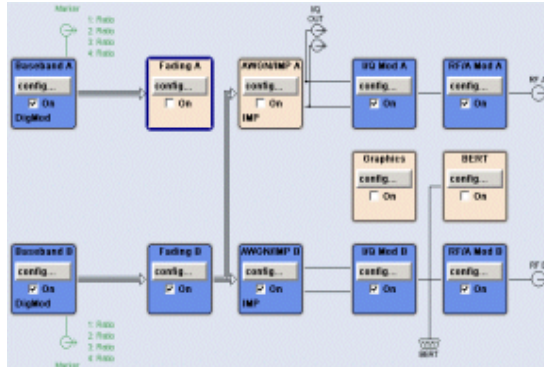


"A to A and B / B (open)"

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.



"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.

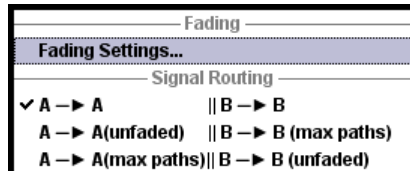


SCPI command:

[ :SOURCE<hw> ] :FSIMULATOR:ROUTE on page 207

# 4 Fading Settings

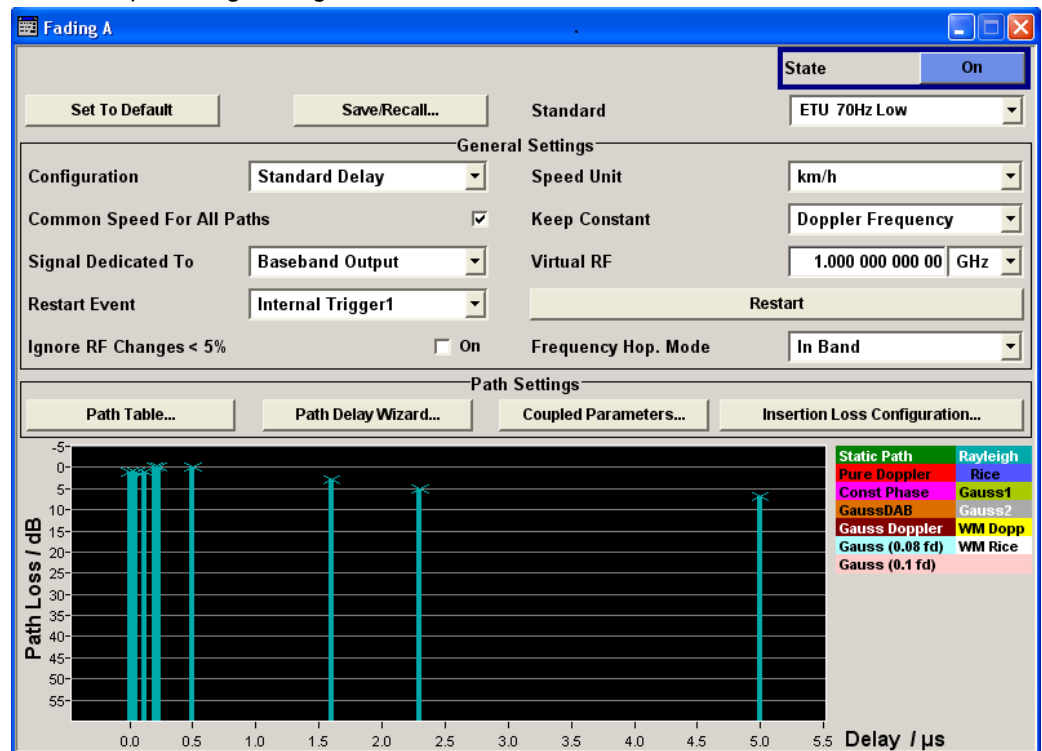
The "Fading" dialog is used to configure multipath fading signals. To access this dialog, select the "Fader" block or use the MENU key.



## 4.1 Basic Settings

The "Fading" dialog 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" section offers different submenus for the configuration of the fading paths depending on the selected fading configuration. The fading settings are displayed graphically.

### State

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.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator\[:STATe\]](#) on page 218

### Set to Default

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.

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 (R&S SMU only)
Frequency Hop. Mode	Off (R&S SMU only)
<b>Insertion Loss</b>	
Insertion Loss Mode	Normal
<b>Coupled Parameters</b>	
All States	Off
<b>Path Configuration</b>	
State of path 1	On
State of all other paths	Off
Profile	Rayleigh

Parameter	Value
Delays	0
Speed of path 1	Slow
Speed of all other paths	0

SCPI command:

[ :SOURce<hw> ] :FSIMulator:PRESet on page 206

**Save/Recall**

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.

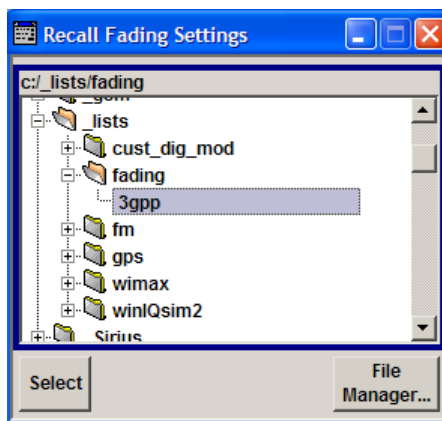


Fading configurations are saved with the file ending \*.fad. The file name and the directory to store it can be chosen.

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.



"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.

"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.

SCPI command:

`[ :SOURce ] :FSIMulator:CATalog` on page 218

`[ :SOURce<hw> ] :FSIMulator:LOAD` on page 218

`[ :SOURce<hw> ] :FSIMulator:STORe` on page 219

`[ :SOURce<hw> ] :FSIMulator:STORe:FAST` on page 219

`[ :SOURce ] :FSIMulator:DELETE` on page 219

### Standard / Test Case

Selects predefined fading settings according to the test scenarios stipulated in the common mobile radio standards.

For an overview of the predefined standards along with the underlying test scenarios and the settings which are made, see [chapter 7, "Predefined Fading Settings"](#), on page 120.

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

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:STANdard` on page 211

`[ :SOURce<hw> ] :FSIMulator:STANdard:REFerence` on page 217

### Configuration

Selects the fading configuration.

**Note:** The selection of fine delay and dynamic configurations is only possible with option K71; "Scenario Simulation" requires option K77.

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

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

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.

**Note:** 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 [chapter 4.3, "Delay Modes Path Table"](#), on page 32).

"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.

"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.

"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 [chapter 4.7, "Birth Death Propagation Path Table"](#), on page 48).

"Moving Propagation" In the "Moving Propagation" configuration and number of "Moving Channels" set to "One", the fading simulator simulates dynamic propagation conditions in conformity with the test case 3GPP TS25.104, annex B3. Two paths are simulated: Path 1 has fixed delay, while the delay of path 2 varies slowly in a sinusoidal fashion. Two additional predefined moving propagation scenarios according to the 3GPP TS36.141, annex B.4 can be configured: "ETU200Hz Moving" and the "Pure Doppler Moving". To configure one of these scenarios for 3GPP or LTE, select the corresponding item under "Standard > 3GPP or LTE > Moving Propagation".

**Note:** The moving propagation conditions enabled by selecting the "Standard > 3GPP or LTE > Moving Propagation > Ref. + Mov. Channels" are identical to the conditions configured by enabling of "Moving Propagation Configuration" and number of "Moving Channels" set to "One".

See [chapter 4.9, "Moving Propagation"](#), on page 53 for more information.



"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 <a href="#">chapter 4.10, "Two Channel Interferer Path Table"</a>, on page 60).</p>
"High Speed Train"	<p>In the High Speed Train configuration, the fading simulator simulates propagation conditions in conformity with the test case 3GPP 25.141, annex D.4A and 3GPP 36.141, annex B.3 (see <a href="#">chapter 4.11, "High Speed Train"</a>, on page 65).</p> <p>All the three scenarios as defined in the test specification are simulated. These predefined test scenarios can be selected in the "Standard / Test Case" menu in the corresponding 3GPP section.</p> <p>Additionally, user-defined HST conditions can be configured by selecting different profile and setting up the speed and the initial distances.</p>
"Scenario Simulation"	<p>The "Scenario Simulation" configuration is provided for the simulation of the dynamic propagation conditions such as the channel between a moving transmitter and/or a moving receiver, e.g. the channel between a tower and a departing and landing aircraft or the channel between two moving ships (see <a href="#">chapter 4.12, "Dynamic Scenario Simulation"</a>, on page 69).</p> <p>Additionally, user-defined dynamic fading conditions can be configured by adjusting the different transmitter and receiver settings.</p>
"User Dynamic"	<p>The "User Dynamic" configuration is provided for future use.</p>
SCPI command:	<p><a href="#">[:SOURce&lt;hw&gt;]:FSIMulator:CONFiguration</a> on page 197</p> <p><a href="#">[:SOURce&lt;hw&gt;]:FSIMulator:DEL30:STATe</a> on page 241</p> <p><a href="#">[:SOURce&lt;hw&gt;]:FSIMulator:DEL50:STATe</a> on page 241</p> <p><a href="#">[:SOURce&lt;hw&gt;]:FSIMulator:BIRThdeath:STATe</a> on page 224</p> <p><a href="#">[:SOURce&lt;hw&gt;]:FSIMulator:MDELay:STATe</a> on page 250</p> <p><a href="#">[:SOURce&lt;hw&gt;]:FSIMulator:TCInterferer[:STATe]</a> on page 267</p> <p><a href="#">[:SOURce&lt;hw&gt;]:FSIMulator:HSTRain:STATe</a> on page 244</p>

### Moving Channels

This parameter determines whether only one or several moving channels are simulated.

"One"	<p>In this mode the fading simulator simulates dynamic propagation conditions in conformity with the test case 3GPP TS25.104, annex B3.</p>
"All"	<p>Per default, one moving channel with Rayleigh distribution and one tap is simulated.</p> <p>Additional taps and paths can be enabled and configured in the "Path Table".</p>

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:MDELay:CHANnel:MODE](#) on page 246

### Signal Dedicated To (R&S AMU only)

The Doppler shift is computed based on a user-definable virtual RF frequency which is entered under "Virtual RF".

### Signal Dedicated To

(R&S SMU only)

Selects the RF frequency for computing the Doppler shift.

"RF Output" The Doppler shift is computed using the RF frequency set on the generator.

"Baseband Output" The Doppler shift is computed based on a user-definable RF frequency which is entered under "Virtual RF".

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.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:SDEStination](#) on page 210

### Virtual RF

Sets the virtual RF frequency.

For instruments with RF output, this input is possible only if "Baseband Output" is selected in the "Signal Dedicated To" field.

The entered value is used as the basis for computing the Doppler shift.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:FREQuency](#) on page 203

### Common Speed For All Paths

(only available for delay configurations)

Activates/deactivates the same speed in all paths.

The default is the "On" setting.

A change of speed in a path automatically results in a change of speed in all of the other paths.

When switching from "Off" to "On", the speed entry for path 1 of group 1 is used for all of the paths.

**Note:** If "Speed Setting Coupling" is activated, the setting of "Common Speed for all Paths" is also coupled in both faders.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:CSPeed](#) on page 202

### Speed Unit

Selects the units for speed. The speed is entered in the path table.

**Note:** The remote control command changes only the units displayed in the graphical user interface. While configuring the speed via remote control, the speed units must be specified.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:SPEed:UNIT](#) on page 211

**Keep Constant**

Selects whether to keep the speed or the Doppler shift constant in case of frequency changes. If a constant speed is selected, the Doppler shift is calculated as function of the speed and the frequency and vice versa.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:KCONstant](#) on page 206

**Restart Event**

Selects the event which leads to a restart of fading.

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.

"Auto"                    The modulation signal is continually faded.

"Manual"                A restart is triggered by pressing the "Restart" button.  
With dual-channel fading, pushing the "Restart" button causes both faders to restart if "Restart Event Manual" is selected for both faders.

"Internal Trig-  
ger 1 / 2"            A restart is triggered by baseband A/B.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:REStart:MODE](#) on page 207

**Restart**

Triggers a restart of the fading simulation.

A restart is triggered with this button only if "Restart Event Manual" is selected.

With dual-channel fading, both faders are restarted if "Restart Event Manual" is selected for both faders.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:REStart](#) on page 207

**Ignore RF Changes < 5PCT**

(instruments with RF output only)

Selects whether frequency changes < 5% are to be ignored or not for the fading.

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.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:IGNore:RFCHanges](#) on page 204

**Frequency Hop Mode**

(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.

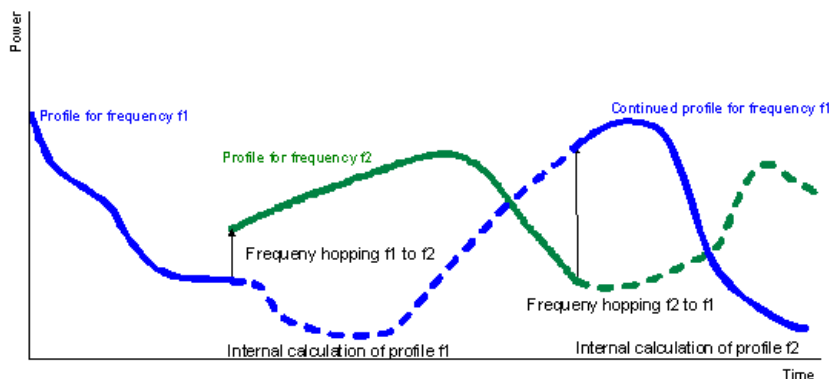
Frequency hopping occurs in real-world receivers, for example, if the original carrier is no longer accessible due to a change in the location of the receiver.

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" dialog (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". The HOP signal which marks the time point of the frequency hop can be output on one of the USER jacks. This settings are available only for the delay configurations.

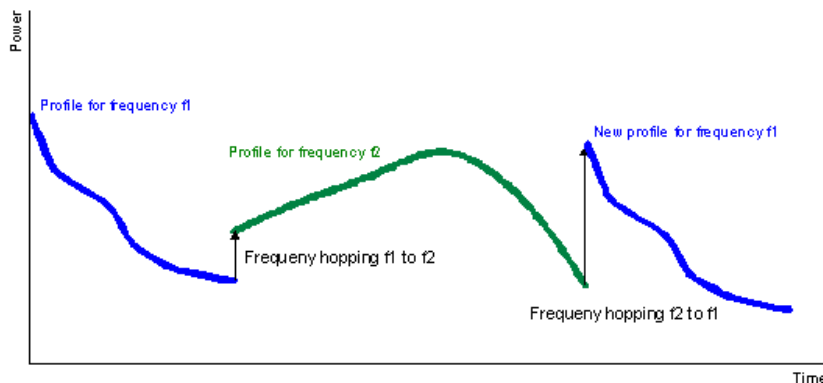
For more information, see sections "List Mode" and "User Marker / AUX I/O Settings" in the Operating Manual.

- "Off" Frequency hopping is deactivated.
- "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.

"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.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:HOPping:MODE` on page 203

## 4.2 Path Settings

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

### Path Table...

Calls up the menu for setting the fading paths.

See [chapter 4.3, "Delay Modes Path Table"](#), on page 32, [chapter 4.7, "Birth Death Propagation Path Table"](#), on page 48, [chapter 4.9, "Moving Propagation"](#), on page 53, [chapter 4.10, "Two Channel Interferer Path Table"](#), on page 60 and [chapter 4.11, "High Speed Train"](#), on page 65.

### Path Delay Wizard- Fading

(delay configurations only)

Calls up the menu for modifying, inserting and deleting paths in the delay modes, see [chapter 4.5, "Path Delay Wizard"](#), on page 45.

### Coupled Parameters...

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

Calls up the menu for setting the coupled parameters of the two faders A and B, see [chapter 4.6, "Coupled Parameters and Global Fader Coupling"](#), on page 47.

#### Insertion Loss Configuration ...

Calls up the menu for setting the insertion loss, see [chapter 4.13, "Insertion Loss Configuration..."](#), on page 93.

## 4.3 Delay Modes Path Table

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.

Delay Modes Path Table

	1	1	1	1	1	2	2
	1	2	3	4	5	1	2
State	On	On	On	On	On	On	On
Profile	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Path Loss /dB	4.00	8.60	10.00	3.00	0.00	11.00	6.5
Basic Delay /us	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Additional Delay/us	0.000 00	0.030 00	0.750 00	0.880 00	2.000 00	2.700 00	3.2
Resulting Delay /us	0.00	0.03	0.75	0.88	2.00	2.70	3.2
Power Ratio /dB							
const Phase /deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Speed /km/h	50.0	50.0	50.0	50.0	50.0	50.0	50.
Freq. Ratio	0.00	0.00	0.00	0.00	0.00	0.00	0.0
res. Doppler Shift	46.33	46.33	46.33	46.33	46.33	46.33	46.
Correlation Path	Off	Off	Off	Off	Off	Off	Off
Coefficient /%	100	100	100	100	100	100	100
Phase /deg	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Lognorm State	Off	Off	Off	Off	Off	Off	Off
Local Constant /m	100.0	100.0	100.0	100.0	100.0	100.0	100
Standard Dev. /dB	0	0	0	0	0	0	0

FAST

SLOW

Copy Path Group

Source  Destination

### 4.3.1 Delay Mode Settings

#### State Path

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.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator [ :STATe ]` on page 218

`[ :SOURce<hw> ] :FSIMulator :DELay | DEL:GROup<st> :PATH<ch> :STATe`  
on page 241

`[ :SOURce<hw> ] :FSIMulator :DEL30 :GROup<st> :PATH<ch> :STATe`  
on page 241

`[ :SOURce<hw> ] :FSIMulator :DEL50 :GROup<st> :PATH<ch> :STATe`  
on page 241

`[ :SOURce<hw> ] :FSIMulator :MDELay :DEL30 :GROup<st> :PATH<ch> :STATe`  
on page 241

`[ :SOURce<hw> ] :FSIMulator :HSTRain :PATH :STATe` on page 243

#### Profile

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

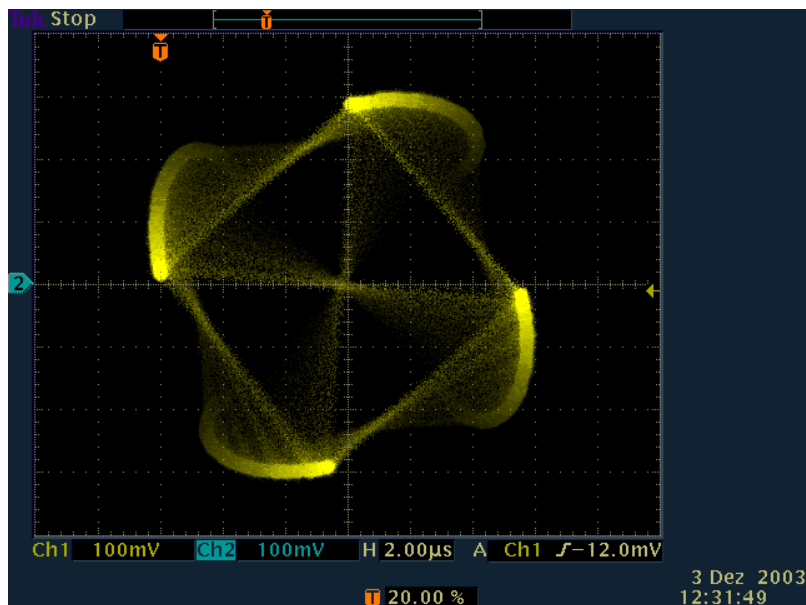
Depending on which profile is selected, certain parameters will be available in the path table and others will not be available.

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"	A static transmission path is simulated which can undergo attenuation (loss) or delay.
"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 <a href="#">Speed</a> and <a href="#">Frequency Ratio</a> parameters. <b>Tip:</b> In MIMO configuration, use the <a href="#">Relative Gain Vector Matrix</a> to configure beamforming.
"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 for the magnitude of the received amplitude is characterized by a Rayleigh distribution. This fading spectrum is "Classical".
"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 (Rayleigh) with a discrete spectral line (pure Doppler). The ratio of the power of the two components (Rayleigh and pure Doppler) is set with the "Power Ratio" parameter.
"Const. Phase"	A transmission path with the set constant phase rotation is simulated which can undergo attenuation (loss) or delay.
"Gauss1"	GAUS1 is the sum of two Gaussian functions and is used for excess delay times in the range of 0,5 us to 2 us (0,5 us = $t_i$ = 2 us). $GAUS1: S(\tau_j, f) = G(A, -0.8f_d, 0.05f_d) + G(A_1, +0.4f_d, 0.1f_d)$ where $A_1$ is 10 dB below A.
"Gauss2"	GAUS2 is also the sum of two Gaussian functions and is used for paths with delays in excess of 2 us ( $t_i$ = 2 us). $GAUS2: S(\tau_j, f) = G(B, -0.7f_d, 0.1f_d) + G(B_1, +0.4f_d, 0.15f_d)$ where $B_1$ is 15 dB below B.
"GaussDAB"	GAUSDAB is composed of a Gaussian function and is used for special DAB profiles. $GAUSDAB: S(\tau_j, f) = G(A \pm 0.7f_d, 0.1f_d)$
"Gauss Doppler"	Selects the Gauss Doppler fading profile.



"Gauss (0.08 fd)"	Selects the Gauss (0.08 fd) fading profile.
"Gauss (0.1 fd)"	Selects the Gauss (0.1 fd) fading profile.
"Gauss (Watters)"	Selects the Gauss (Watterson) fading profile.
"WM Doppler"	Selects the WiMAX Doppler fading profile, i.e. a rounded Doppler PSD model according to IEEE 802.16a.
"WM Rice"	Selects the WiMAX Rice fading profile according to IEEE 802.16a. The figure below 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.



SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:PROFile`  
on page 236

`[ :SOURCE<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:PROFile`  
on page 237

`[ :SOURCE<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:PROFile`  
on page 237

`[ :SOURCE<hw> ] :FSIMulator:MDElay:DEL30:GROup<st>:PATH<ch>:PROFile`  
on page 236

**Path Loss**

Enters the loss for the selected path.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DElay | DEL:GROup<st>:PATH<ch>:LOSS`

on page 235

`[ :SOURce<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:LOSS` on page 235

`[ :SOURce<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:LOSS` on page 235

**Basic Delay**

Determines the Basic Delay.

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, the "Resulting Delay" is equal to the "Additional Delay".

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DElay | DEL:GROup<st>:PATH<ch>:BDElay`

on page 227

`[ :SOURce<hw> ] :FSIMulator:MDElay:DEL30:GROup<st>:PATH<ch>:BDElay`

on page 227

`[ :SOURce<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:BDElay`

on page 227

**Additional Delay**

Determines the Additional Delay.

The Resulting Delay of a path is obtained by adding the Basic Delay and the Additional Delay.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DElay | DEL:GROup<st>:PATH<ch>:ADElay`

on page 227

`[ :SOURce<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:ADElay`

on page 227

`[ :SOURce<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:ADElay`

on page 227

**Resulting Delay**

Displays the Resulting Delay for the path.

The Resulting Delay is obtained by adding the "Basic Delay" and the "Additional Delay".

The "Path Delay Wizard" is very helpful when the user needs to position the paths at defined "Resulting Delays".

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DElay | DEL:GROup<st>:PATH<ch>:RDElay`

on page 239

`[ :SOURce<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:RDElay`

on page 239

`[ :SOURce<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:RDElay`

on page 239

**Power Ratio**

("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.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:PRATio`  
on page 236

`[ :SOURCE<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:PRATio`  
on page 236

`[ :SOURCE<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:PRATio`  
on page 236

**Const. Phase**

("Constant Phase")

Enters the phase by which the path is multiplied for Static Path, Rayleigh, Constant Phase, Gauss1, Gauss2, GaussDAB, Gauss Doppler, Gauss (0.08fd) and Gauss (0.1fd) fading.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:CPHase`  
on page 230

`[ :SOURCE<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:CPHase`  
on page 230

`[ :SOURCE<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:CPHase`  
on page 230

**Start Phase**

("Pure Doppler, Rice, WM Doppler, WM Rice")

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

**Start Phase**

("Gauss Watterson")

Sets the frequency spread for the Gauss Watterson fading.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:FSPRead`  
on page 233

`[ :SOURCE<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:FSPRead`  
on page 233

`[ :SOURCE<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:FSPRead`  
on page 233

**Speed**

("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.

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

**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.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:SPEed`  
on page 240

`[ :SOURCE<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:SPEed`  
on page 240

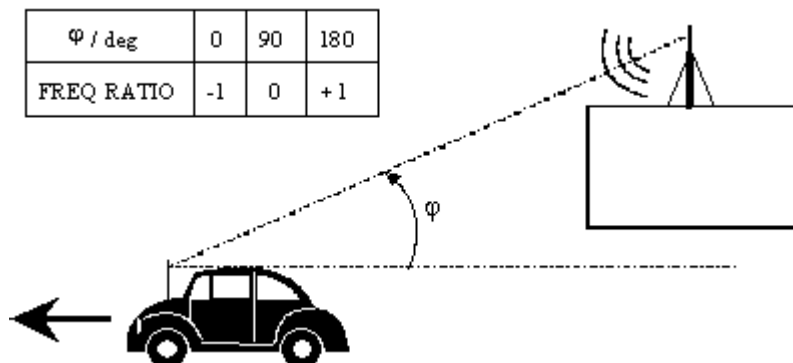
`[ :SOURCE<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:SPEed`  
on page 240

**Frequency Ratio**

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.



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).

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:FRATio`  
on page 231

`[ :SOURce<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:FRATio`  
on page 232

`[ :SOURce<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:FRATio`  
on page 232

**Frequency Shift**

Enters the frequency shift for the Gauss Watterson fading.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:FSHift`  
on page 232

`[ :SOURce<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:FSHift`  
on page 232

`[ :SOURce<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:FSHift`  
on page 232

**Resulting Doppler Shift**

("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").

A Doppler shift can also be entered, if the parameter **Keep Constant** is set to "Doppler Frequency". In this case, the Speed is calculated as a function of the selected Doppler Shift and the frequency of the RF output signal.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:FDOPpler`  
on page 231

`[ :SOURce<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:FDOPpler`  
on page 231

`[ :SOURce<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:FDOPpler`  
on page 231

### Correlation Path

(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.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:STATe`  
on page 241

`[ :SOURce<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:STATe`  
on page 241

`[ :SOURce<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:STATe`  
on page 241

### Correlation Coefficient

(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 paths.

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).

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:
```

```
CORRelation:COEfficent on page 228
```

```
[ :SOURce<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:CORRelation:
```

```
COEfficent on page 228
```

```
[ :SOURce<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:CORRelation:
```

```
COEfficent on page 228
```

### Correlation Coefficient Phase

(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).

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:
```

```
CORRelation:PHASe on page 229
```

```
[ :SOURce<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:CORRelation:
```

```
PHASe on page 229
```

```
[ :SOURce<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:CORRelation:
```

```
PHASe on page 228
```

### Lognormal State

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).

SCPI command:

`[ :SOURCE<hw> ] :FSIMULATOR:DElay|DEL:GROup<st>:PATH<ch>:LOGNormal:STATe` on page 234

`[ :SOURCE<hw> ] :FSIMULATOR:DEL30:GROup<st>:PATH<ch>:LOGNormal:STATe` on page 235

`[ :SOURCE<hw> ] :FSIMULATOR:DEL50:GROup<st>:PATH<ch>:LOGNormal:STATe` on page 235

### Local Constant

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  $f_{RF}$ .

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).

SCPI command:

`[ :SOURCE<hw> ] :FSIMULATOR:DElay|DEL:GROup<st>:PATH<ch>:LOGNormal:LCONstant` on page 234

`[ :SOURCE<hw> ] :FSIMULATOR:DEL30:GROup<st>:PATH<ch>:LOGNormal:LCONstant` on page 234

`[ :SOURCE<hw> ] :FSIMULATOR:DEL50:GROup<st>:PATH<ch>:LOGNormal:LCONstant` on page 234

### Standard Deviation

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).

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:LOGNormal:CSTD` on page 233

`[ :SOURCE<hw> ] :FSIMulator:DEL30:GROup<st>:PATH<ch>:LOGNormal:CSTD` on page 233

`[ :SOURCE<hw> ] :FSIMulator:DEL50:GROup<st>:PATH<ch>:LOGNormal:CSTD` on page 233

### 4.3.2 Copy Path Group

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.

#### Copy Source

Selects a group whose setting is to be copied.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:COPY:SOURCE` on page 200

#### Copy Destination

Selects a group whose setting is to be overwritten.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:COPY:DESTination` on page 199

#### Copy

Triggers a copy procedure.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:COPY:EXECute` on page 199

#### Home / End

Moves the cursor to the first path ("Home") or to the last path ("End") of the table.

SCPI command:

n.a.

#### Previous / Next

Moves the cursor to the first path of the preceding ("Previous") or subsequent ("Next") path group.

SCPI command:

n.a.

**Path Filter**

Suppresses the indication of the disabled paths.

SCPI command:

n . a .

**Speed Unit**

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

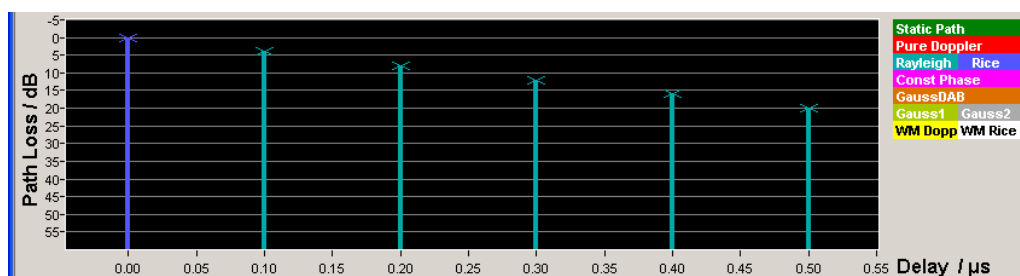
**Note:** The remote control command changes only the units displayed in the graphical user interface. While configuring the speed via remote control, the speed units must be specified.

SCPI command:

[ :SOURce<hw> ] :FSIMulator:SPEed:UNIT on page 211

## 4.4 Delay Modes Path Graph

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.

## 4.5 Path Delay Wizard

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  $\mu\text{s}$ , the range of values for the "Resulting Delay" of the individual paths of a group is limited to "Basic Delay + 40  $\mu\text{s}$ ". 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.

Path Index	Resulting Delay/ us	Original Group/Path	New Group/Path
1	0.00	2 / 1	2 / 1
2	0.10	2 / 2	2 / 2
3	0.30	2 / 3	2 / 3
4	0.50	2 / 4	2 / 4
5	0.80	3 / 1	3 / 1
6	1.10	3 / 2	3 / 2
7	1.30	3 / 3	3 / 3
8	1.70	3 / 4	3 / 4
9	2.30	4 / 1	4 / 1
10	3.10	4 / 2	4 / 2

**Add Delay Path**

Desired Resulting Delay:   $\mu\text{s}$

**Change Delay Path**

Path Index:  Desired Resulting Delay:   $\mu\text{s}$

**Delete Delay Path**

Path Index:

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

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

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

**Wizard Table**

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").

**Wizard Desired Resulting Delay**

Enters the Resulting Delay for the new path.

**Wizard Add Path**

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".

**Wizard Path Index**

Selects a path for which to modify the delay.

**Wizard Desired Delay**

Enters the Resulting Delay for the selected path.

**Wizard Change**

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.

**Wizard Index**

Selects a path to be deleted.

**Wizard Delete Path**

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**

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

Closes the "Path Delay Wizard" without making any modifications.

## 4.6 Coupled Parameters and Global Fader Coupling

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".

The screenshot shows a dialog box titled "Coupled Parameters A => B". It has three rows of settings, each with a checkbox and the text "On":

- Speed Setting Coupled  On
- Local Constant Coupled  On
- Standard Deviation Coupled  On

Below these is a section titled "Global Fader Coupling" with a "Start Seed" label and a text input field containing the number "1".

#### Speed Setting Coupled

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

SCPI command:

[\[:SOURCE<hw>\]:FSIMulator:COUPLE:SPEED](#) on page 202

#### Local Constant Coupled

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

SCPI command:

[\[:SOURCE<hw>\]:FSIMulator:COUPLE:LOGNormal:LCONSTant](#) on page 201

**Standard Deviation Coupled**

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

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:COUPlE:LOGNormal:CSTD` on page 200

**Start Seed**

Enters the start seed for random processes inside the fading imulator. The autocorrelation of different seeds is more than seven days apart. If two instruments run with the same seed, fading processes will be identical after a retrigger of the fading simulator. This value is global for the instrument.

While working in MIMO mode that requires two instruments, set the start seeds of the instruments to different values.

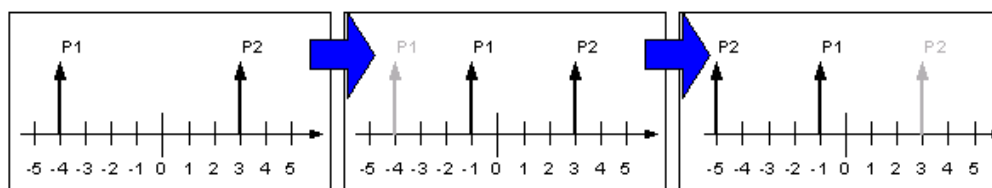
SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:GLOBal:SEED` on page 203

## 4.7 Birth Death Propagation Path Table

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]  $\mu$ 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).



**Fig. 4-1: Example of a sequence of hops in Birth Death Propagation**



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

Birth Death Propagation Path Table

"Profile"	Pure Doppler
"Path Loss"	0 dB
"Min. Delay"	0 $\mu$ s
"Delay Grid"	1 $\mu$ s
"Positions"	11
"Max. Delay"	10 $\mu$ 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.

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

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.

SCPI command:

`[ :SOURCE<hw> ] :FSIMULATOR: BIRTHdeath: PATH<ch>: PROFILE` on page 223

**Path Loss Birth Death**

Enters the loss for the selected path.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:BIRTHdeath:PATH<ch>:LOSS` on page 222

**Min Delay Birth Death**

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 us.

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

The scaling of the X-axis is adapted according to the entry (see [chapter 4.8, "Birth Death Propagation Path Graph"](#), on page 53).

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

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:BIRTHdeath:DElay:MINimum` on page 220

**Delay Grid Birth Death**

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 [chapter 4.8, "Birth Death Propagation Path Graph"](#), on page 53).

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

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:BIRTHdeath:DElay:GRID` on page 220

**Positions Birth Death**

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

The scaling of the X-axis is adapted according to the entry (see [chapter 4.8, "Birth Death Propagation Path Graph"](#), on page 53).

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

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:BIRTHdeath:POSitions` on page 223

**Maximum Delay Birth Death**

Indication of the maximum delay. The maximum delay corresponds to the stop value of the delay range (see [chapter 4.8, "Birth Death Propagation Path Graph"](#), on page 53).

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

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

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:BIRTHdeath:DElay:MAXimum` on page 220



**Start Offset Birth Death**

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.



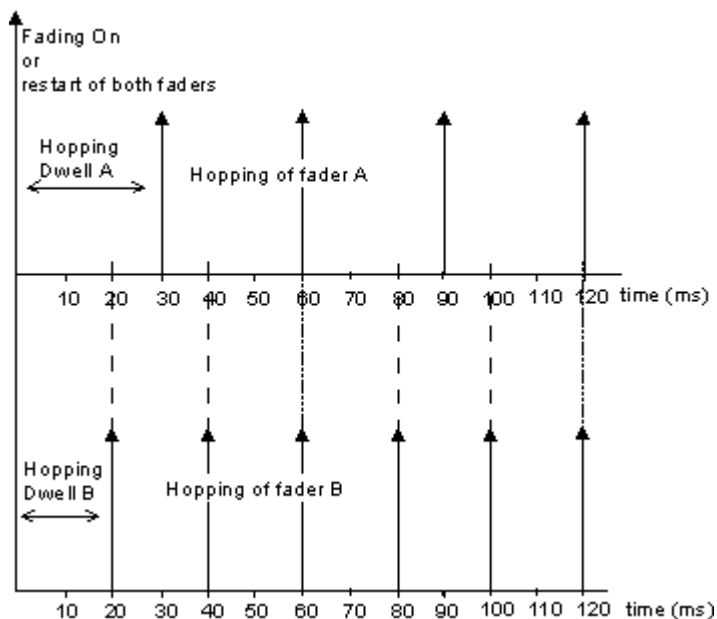
SCPI command:

`[ :SOURCE<hw> ] :FSIMULATOR:BIRTHdeath:SOFFset` on page 223

**Hopping Dwell Birth Death**

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).



SCPI command:

[\[:SOURCE<hw>\]:FSIMulator:BIRTHdeath:HOPping:DWELl](#) on page 221

**Speed Birth Death**

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<sub>D</sub>*. 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.

SCPI command:

[\[:SOURCE<hw>\]:FSIMulator:BIRTHdeath:SPeEd](#) on page 224

**Frequency Ratio Birth Death**

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

SCPI command:

[\[:SOURCE<hw>\]:FSIMulator:BIRTHdeath:FRATio](#) on page 221

**Resulting Doppler Shift Birth Death**

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).

SCPI command:

[\[:SOURCE<hw>\]:FSIMulator:BIRTHdeath:PATH<ch>:FDOPpler](#) on page 222

## 4.8 Birth Death Propagation Path Graph

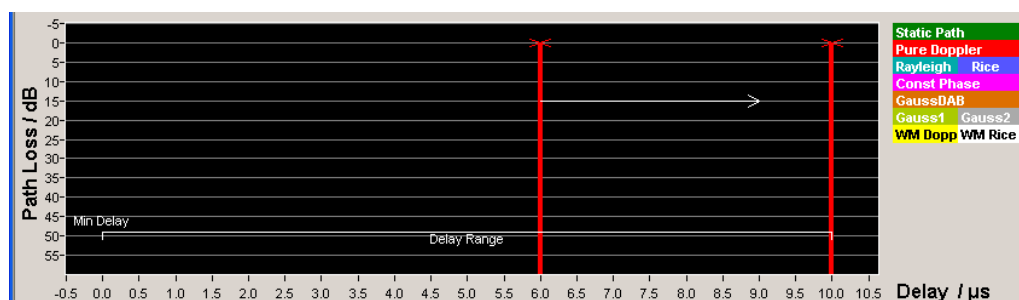
The graphical display of the fading paths in Birth Death Propagation mode shows as an example the changing positions of the two paths within the delay grid. The displayed position change does not correspond to the actual delay hops of the real signal. An arrow indicates the direction of the delay hop 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 and the delay offset are 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  $\mu\text{s}$  and ranges up to 40  $\mu\text{s}$  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.

Max Delay = (Positions – 1) x Delay Grid + Min. Delay

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



## 4.9 Moving Propagation

In the "3GPP/LTE Moving Propagation" configuration, the fading simulator simulates dynamic propagation conditions in conformity with the test case 3GPP TS25.104, annex B3 or 3GPP TS36.141, annex B.4.

The fading simulator enables configuration according to three predefined moving scenarios. The first one represents moving conditions with one reference and one moving channel whereas the by the other two all paths are moving.

The predefined scenarios are as follow:

- "Ref. + Mov. Channel" - Simulation of moving propagation conditions in accordance to the 3GPP TS25.104, annex B3 (see [chapter 4.9.1, "Moving Propagation Conditions for Testing of Baseband Performance"](#), on page 54).
- ETU200Hz Moving - Simulation of moving propagation conditions in accordance to the scenario 1 described in 3GPP TS36.141, annex B.4. (see [chapter 4.9.2, "Moving](#)

[Propagation Conditions for Testing the UL Timing Adjustment Performance](#)", on page 56 ).

- Pure Doppler Moving - Simulation of moving propagation conditions in accordance to the scenario 2 described in 3GPP TS36.141, annex B.4. (see [chapter 4.9.2, "Moving Propagation Conditions for Testing the UL Timing Adjustment Performance"](#), on page 56).

It is also possible to adjust some of the parameters of these predefined scenarios and simulate user-definable moving propagation conditions.

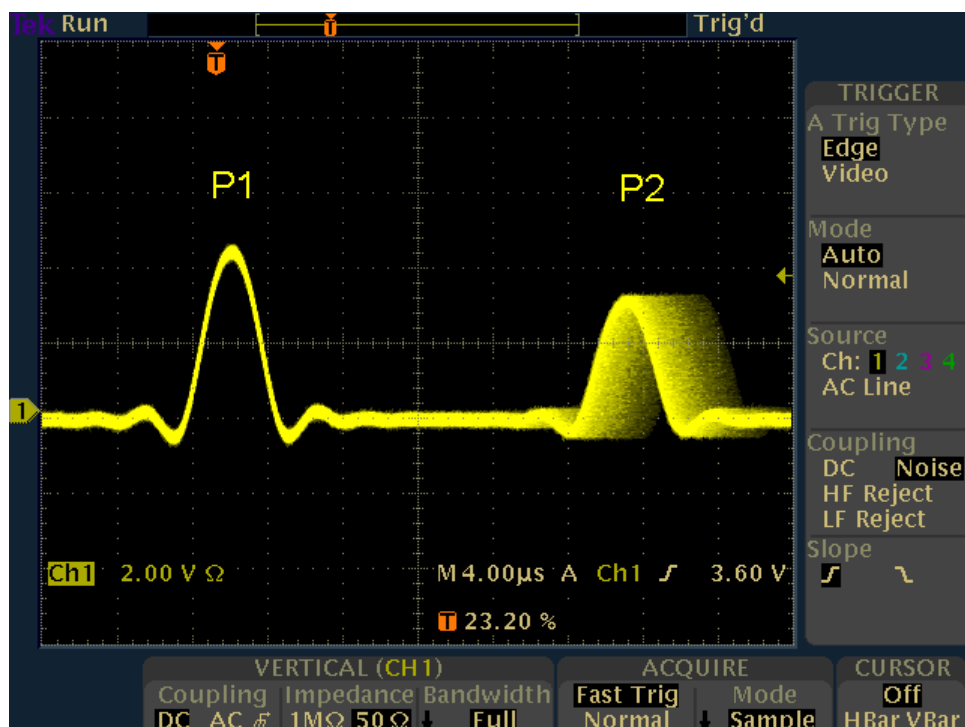
#### 4.9.1 Moving Propagation Conditions for Testing of Baseband Performance

To simulate moving propagation conditions for testing of baseband performance in accordance to the 3GPP TS25.104, annex B3:

- select "Configuration > Moving Propagation" and "Moving Channels > One" or
- select "Standard > 3GPP" or "LTE > Moving Propagation > Ref. + Mov. Channel".

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.

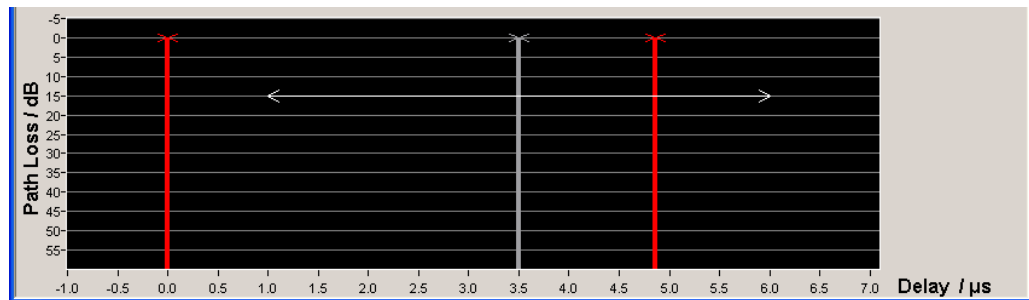
The following figure illustrates a baseband signal with ASK modulation (only one 1 bit, then many 0 bits) which was subjected to moving propagation. Path P1 remains still while path P2 moves in time relative to it. As a result of the luminescence setting on the oscilloscope, the way in which P2 wanders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

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



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

- $VARIATION(P_k P_k) = A$
- $DELAY = B + A/2$
- $VARIATION\_PERIOD = 2 \times \pi / \Delta \omega$

The settings required to attain the values proposed in the test case 3GPP TS25.104, annex B3 are given in the following table.

<b>Reference Path:</b>	"Delay"	0 us
	"Path Loss"	0 dB
	"State"	On
<b>Moving Path:</b>	"Variation (Pk Pk)"	5 us
	"Variation Period"	157 s
	"Delay"	3.5 us
	"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](#).

#### 4.9.2 Moving Propagation Conditions for Testing the UL Timing Adjustment Performance

The purpose of the uplink timing adjustments testing is to check whether the base station sends timing advance commands and whether the base station estimates appropriate the uplink transmission timing.

To simulate moving propagation conditions for testing the UL timing adjustment performance in conformity with the test cases "Moving propagation conditions", as defined in 3GPP 36.141, annex B.4:

- select **Standard > 3GPP or LTE > Moving Propagation > ETU200Hz Moving or Pure Doppler Moving**.

The figure below illustrates the moving propagation conditions for the test of the UL timing adjustment performance.

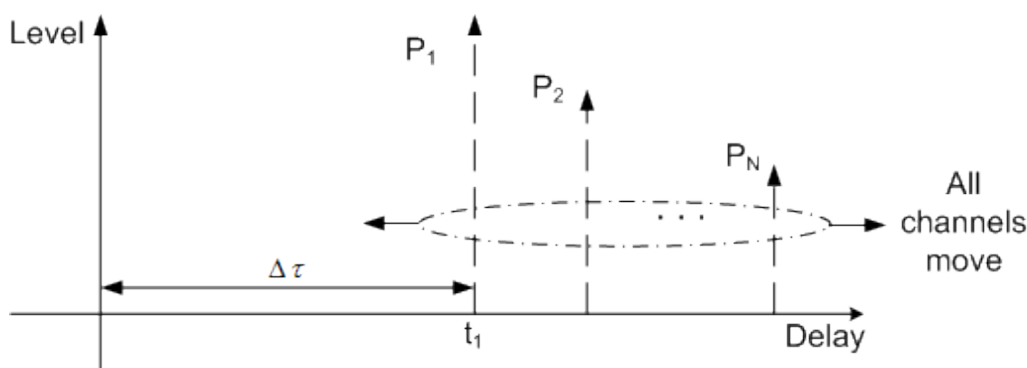


Fig. 4-2: Moving Propagation Conditions

The relative timing among all taps can be configured by means of the parameter **Additional Delay**. The time difference between the reference timing and the first tap is according to the following equation:

$$\Delta \tau = \frac{A}{2} \cdot \sin(\Delta \omega \cdot t)$$

, where  $A = 10 \text{ us}$ .

The 3GPP specification defines the uplink timing adjustments requirements for normal and extreme conditions. The following two scenarios for the testing of UL timing advance are specified:

- Scenario 1: ETU200 ("ETU200Hz Moving") is the scenario for testing in normal conditions. This scenario considers ETU channel model and UE speed of 120km/h.
- Scenario 2: AWGN ("Pure Doppler Moving") is the extreme conditions optional scenario. The scenario corresponds to AWGN channel model and UE speed of 350km/h.

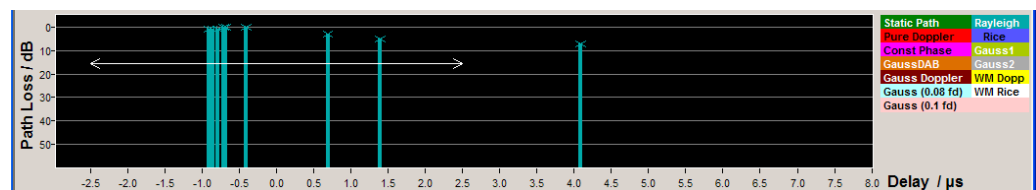
The R&S Fading Simulator generates the signals for these scenarios in according to the parameters defined in the 3GPP specification (see table below). However, the fading simulator also allows the re-configuration of some of the predefined values.

Parameter	Scenario 1	Scenario 2
Channel Model	ETU200Hz Moving	Pure Doppler
UE speed	120 km/h	350 km/h
CP length	Normal	Normal
A	10 $\mu$ s	10 $\mu$ s
delta omega	0.04 s <sup>-1</sup>	0.13 s <sup>-1</sup>

#### 4.9.2.1 Scenario 1

Here, the behavior of a moving receiver is tested, i.e. the simulated scenario represents a moving receiver that changes its distance to the base station. The R&S Fading Simulator generates the signal as a sequence of complete cycles of approach towards to the BS antenna and moving away from it.

Per default, three Rayleigh paths with three taps each are simulated. All paths move.



The path 1 has a fixed delay; the "Basic Delay" of the other two paths can be configured. The relative timing among all taps is determined by the parameter "Additional Delay".

The three paths have the same phase and speed; the Doppler shift is calculated as a function of the selected speed.

#### 4.9.2.2 Scenario 2

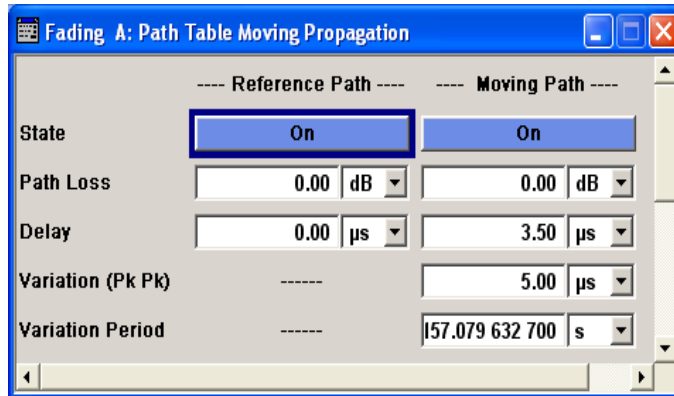
One path without a fading profile (Pure Doppler) and with one tap is simulated. The path has constant level and constant speed.

### 4.9.3 Path Tables Moving Propagation

The parameters available for configuration depend on the selected number of [Moving Channels](#), one or all.

### 4.9.3.1 One Moving Channel

Use the "Path Table Moving Propagation" to configure the moving and the reference path for the moving propagation with one moving channel ("Ref. + Mov. Channel" or "Moving Propagation" configuration and "Moving Channels" set to "One").



#### State Moving Propagation - Reference Path

Activates reference path P1 for moving propagation.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:MDELAY:REFERENCE:STATE](#) on page 249

#### Path Loss Moving Propagation - Reference Path

Enters the loss for the reference path.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:MDELAY:REFERENCE:LOSS](#) on page 249

#### Delay Moving Propagation - Reference Path

Enters the delay for the reference path.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:MDELAY:REFERENCE:DELAY](#) on page 249

#### State Moving Propagation - Moving Path

Activates moving fading path P2 for moving propagation.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:MDELAY:MOVING:STATE](#) on page 248

#### Path Loss Moving Propagation - Moving Path

Enters the loss for the moving fading path.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:MDELAY:MOVING:LOSS](#) on page 248

#### Delay Moving Propagation - Moving Path

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.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:MDElay:MOVing:DElay:MEAN` on page 247

**Variation Moving Propagation - Moving Path**

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.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:MDElay:MOVing:DElay:VARiation` on page 248

**Variation Period Moving Propagation - Moving Path**

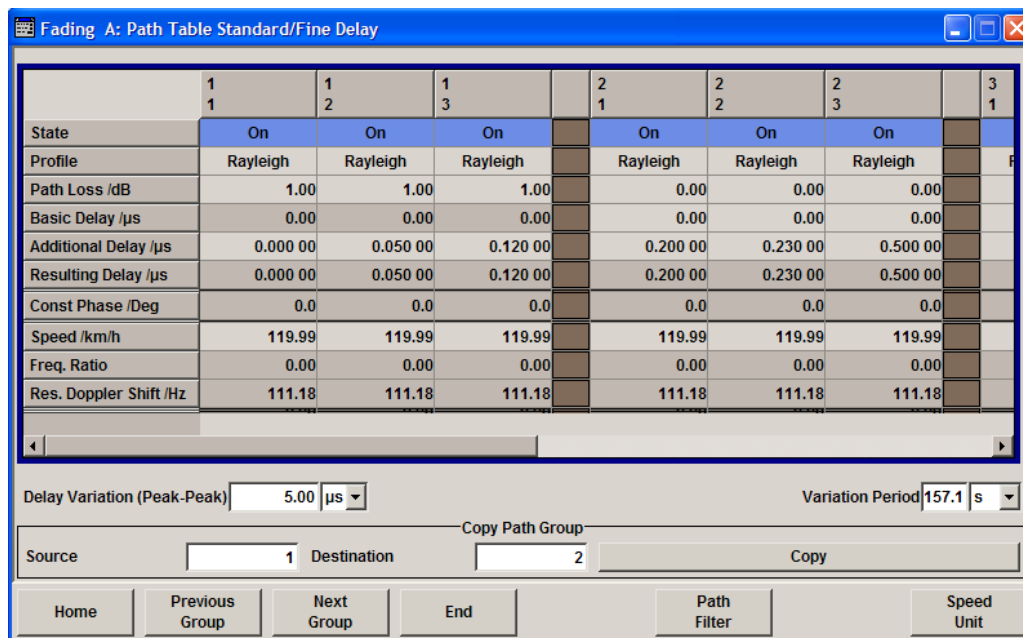
Period duration for delay variation. A complete variation cycle is passed through in this time.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:MDElay:MOVing:VPERiod` on page 249

**4.9.3.2 All Moving Channels**

Use the "Path Table" to configure the moving paths and their taps. The number and the parameters of the predefined paths depend whether a predefined scenario such as "ETU200Hz Moving" or "Pure Doppler Moving" or a user-defined "Moving Propagation" with "All Moving Channels" is selected.



The most parameters in the "Path Table" correspond to the parameter of a "Fine Delay 30MHz" configuration and are described in [chapter 4.3, "Delay Modes Path Table"](#), on page 32.

**Delay Variation (Peak-Peak) - Moving Propagation All Moving Channels**

Enters the range for the delay of the moving fading paths for moving propagation with all moving channels. The delay of the moving path slowly varies sinusoidally within this range around the set mean delay.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:MDElay:ALL:MOVing:DElay:VARiation`

on page 246

**Variation Period - Moving Propagation - All Moving Channels**

Period duration for delay variation. A complete variation cycle is passed through in this time.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:MDElay:ALL:MOVing::VPERiod` on page 245

## 4.10 Two Channel Interferer Path Table

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.

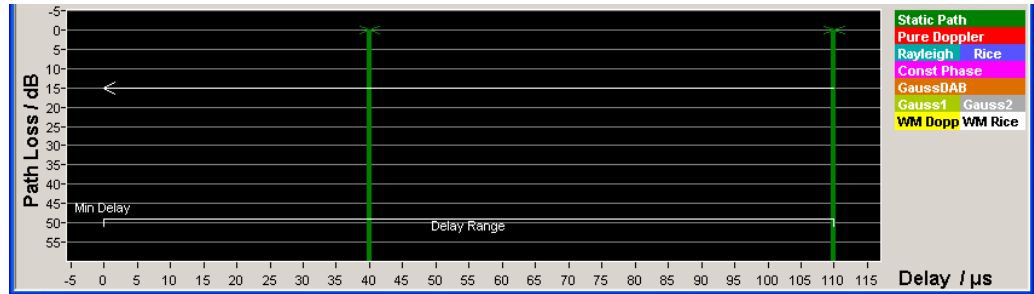
Different fading profiles ("Static Path", "Pure Doppler", and "Rayleigh") can be allocated to the two path.

**Example:**

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

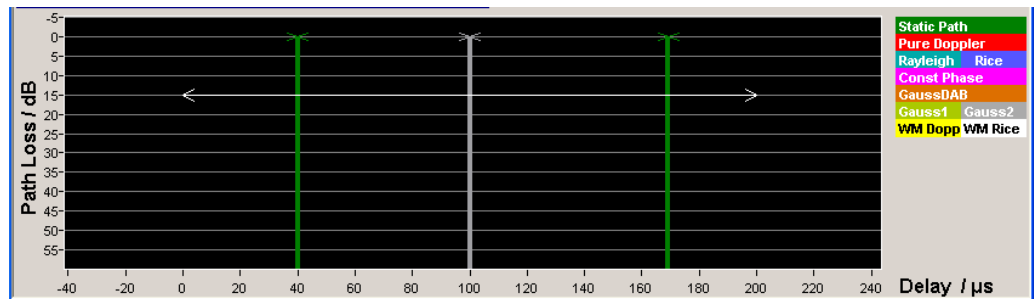
<b>Reference Path:</b>	"Delay Min"	30 $\mu$ s
	"Profile"	Static Path
	"Path Loss"	0 dB
<b>Moving Path</b>	"Delay Min"	30 $\mu$ s
	"Profile"	Static Path
	"Path Loss"	0 dB

	"Delay Max"	100 $\mu$ s
	"Moving Mode"	Hopping



**Example:**

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



The moving path slides from the minimum delay (30  $\mu$ s) to the maximum delay (100  $\mu$ s) and back. The mean delay of the moving path (65  $\mu$ 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 tables.

**Table 4-1: Test Case 5**

<b>Reference Path:</b>	"Profile"	Static Path
	"Relative Delay"	10 $\mu$ s
	"Average Power"	-3 dB
	"Fading Type"	Rayleigh, 60 km/h
	"Doppler Spectrum"	Classic 6 dB
	"Static Delay"	40 $\mu$ s
<b>Moving Path:</b>	"Profile"	Hopping
	"Relative Delay"	0/110 $\mu$ s
	"Average Power"	-3 dB

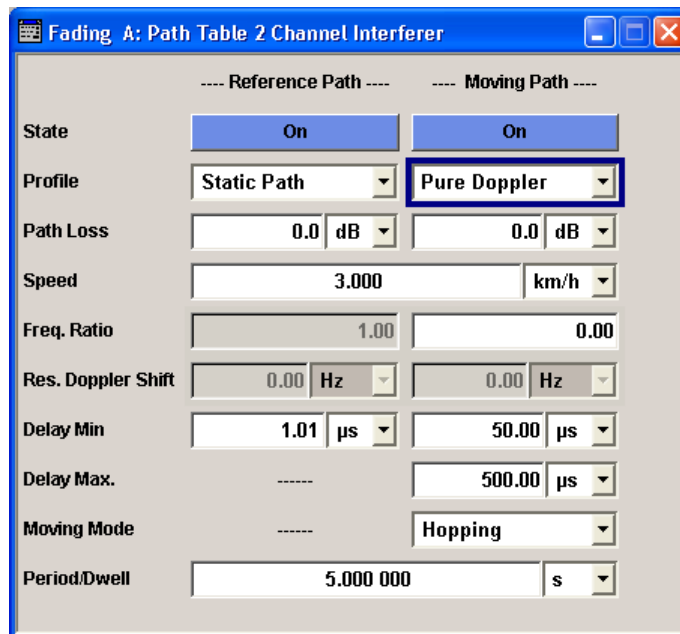
Two Channel Interferer Path Table

	"Fading Type"	Static
	"Doppler Spectrum"	N/A
	"Dwell Time"	2.9 s

Table 4-2: Test Case 6

<b>Reference Path:</b>	"Profile"	Static Path
	"Relative Delay"	100 us
	"Average Power"	-3 dB
	"Fading Type"	Static
	"Doppler Spectrum"	N/A
<b>Moving Path:</b>	"Profile"	Sliding
	"Relative Delay"	0/200 us
	"Average Power"	-3 dB
	<b>Fading Type</b>	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**

Activates/deactivates either the reference path or the moving path for 2 channel interferer fading.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:TCInterferer [ :STATe ]` on page 267  
`[ :SOURce<hw> ] :FSIMulator:TCInterferer:REFerence|MOVing:STATe`  
on page 272

**Profile 2 Channel Interferer**

Selects the fading profile either for the reference path or the moving path to be used for 2 channel interferer fading.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:TCInterferer:REFerence|MOVing:PROFile`  
on page 271

**Path Loss 2 Channel Interferer**

Sets the attenuation of either the reference path or moving path to be used for 2 channel interferer fading.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:TCInterferer:REFerence|MOVing:LOSS`  
on page 271

**Speed 2 Channel Interferer**

(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  $f_D$ . 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.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:TCInterferer:SPEed` on page 269

**Freq. Ratio 2 Channel Interferer Path**

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

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:TCInterferer:REFerence|MOVing:FRATio`  
on page 270

**Res. Doppler Shift 2 Channel Interferer**

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").

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:TCInterferer:REference|MOVing:FDOppler`

on page 270

#### Delay Min 2 Channel Interferer

Enters the minimum delay for either the reference path or the moving path.

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

The delay range is defined by the minimum delay and the maximum delay. It can be in the range between 0 and 1000  $\mu$ s.

The scaling of the X-axis is adapted according to the entry.

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

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:TCInterferer:REference|MOVing:DElay:`

`MINimum` on page 270

#### Delay Max 2 Channel Interferer - Moving Path

Enters the maximum delay for the moving path.

The maximum delay of the moving path corresponds to the end value of the delay range.

The delay range is defined by the minimum delay and the maximum delay. It can be in the range between 0 and 1000  $\mu$ s.

The scaling of the X-axis is adapted according to the entry.

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

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:TCInterferer:MOVing:DElay:MAXimum`

on page 268

#### Moving Mode 2 Channel Interferer - Moving Path

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.

"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.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:TCInterferer:MOVing:MMODE` on page 268

#### Period Dwell 2 Channel Interferer

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  $\mu$ s/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  $6\mu\text{s/s}$ , the value for the period is recalculated automatically.

**Example:**

Delay min = 20 us, Delay max 120 us

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

$6 = 314\mu\text{s}/T$

$T = 314/6$

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

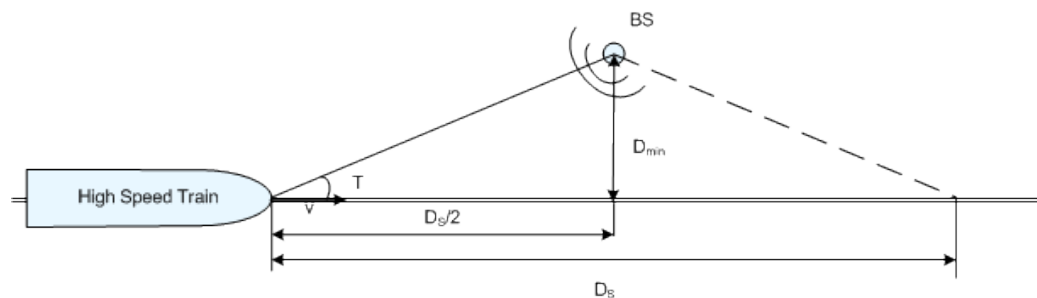
**Note:** This recalculation of the period is a very computing power consuming process. Therefore, no further operations should be performed until the calculation is finished.

SCPI command:

`[ :SOURCE<hw> ] :FSIMULATOR:TCINTERFERER:PERIOD` on page 269

## 4.11 High Speed Train

In the "High Speed Train" configuration, the fading simulator simulates propagation conditions in conformity with the test case "High speed train conditions", as defined in 3GPP 25.141, annex D.4A and 3GPP 36.141, annex B.3. Here, the behavior of a receiver in high speed train conditions is tested, i.e. the simulated scenario represents a very fast moving receiver that drives past an antenna. The R&S Fading Simulator generates the signal as a sequence of complete cycles of approach towards to the BS antenna and departure from it.



*Fig. 4-3: High Speed Train Propagation*

Three high speed scenarios are defined:

- Scenario 1: Open Space
- Scenario 2: Tunnel with leaky cable
- Scenario 3: Tunnel for multi-antennas

### 4.11.1 Scenario 1 and Scenario 3

For each of the scenarios 1 and 2, one path without a fading profile is simulated (Pure Doppler). The path has constant level, no delay and variable Doppler shift.

The Doppler shift for these scenarios is calculated as follow:

$$f_s(t) = f_d \cos \theta(t),$$

where  $f_s(t)$  is the Doppler shift and  $f_d$  is the maximum Doppler frequency.

The cosine of angle is given by:

$$\cos \theta(t) = \frac{D_s/2 - vt}{\sqrt{D_{\min}^2 + (D_s/2 - vt)^2}}, \quad 0 \leq t \leq D_s/v$$

where  $D_s/2$  is the distance between the train and the BS at the beginning of the simulation and  $D_{\min}$  is the distance between the BS and the railway track, both in meters;  $v$  is the velocity of the train in m/s,  $t$  is time in seconds.

For scenario 1 and for BS with receiver diversity, the Doppler shift variation is the same between the antennas.

#### 4.11.2 Scenario 2

Scenario 2 is not defined for EUTRA/LTE test cases.

For scenario 2, one Rician fading propagation channel with Rician factor  $K=10$  dB and with one tap is simulated. The Rician factor  $K$  is defined as the ratio between the dominant signal power and the variant of the other weaker signals (see [chapter 7, "Predefined Fading Settings"](#), on page 120).

#### 4.11.3 High Speed Train Scenario Parameters

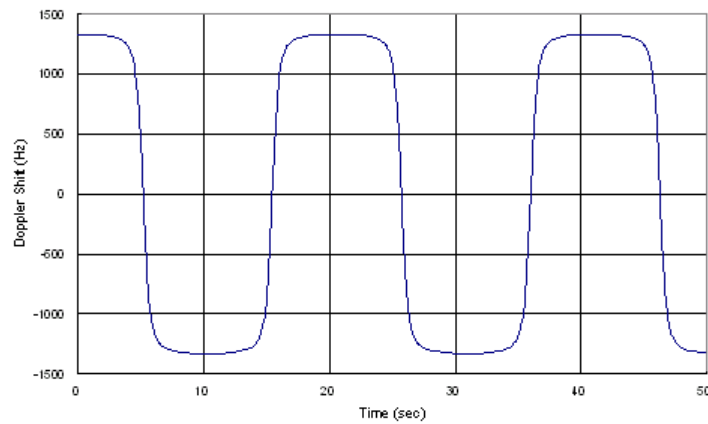
The following table gives an overview of the parameters of the HST test scenarios according to the test case "High speed train conditions".

**Table 4-3: Parameters for high speed train conditions**

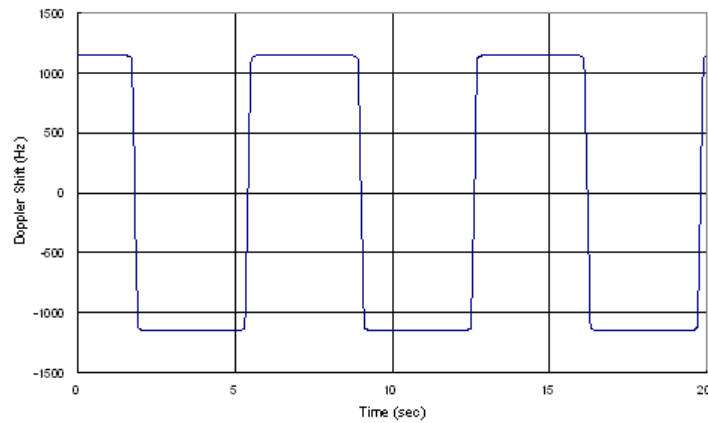
Parameter	Value		
	Scenario 1	Scenario 2	Scenario 3
$D_s$	1000 m	Infinity	300 m
$D_{\min}$	50 m	-	2 m
$K$	-	10 dB	-
$v$	350 km/h	300 km/h	300 km/h
$f_D$	1340 Hz	1150 Hz	1150 Hz

The figures below show the trajectory of the Doppler Shift for scenario 1 and 3 for the test parameters specified in the test case. For these two scenarios, the Doppler Shift trajectories for any user-defined parameters are also displayed in the "3GPP HST" dialog.



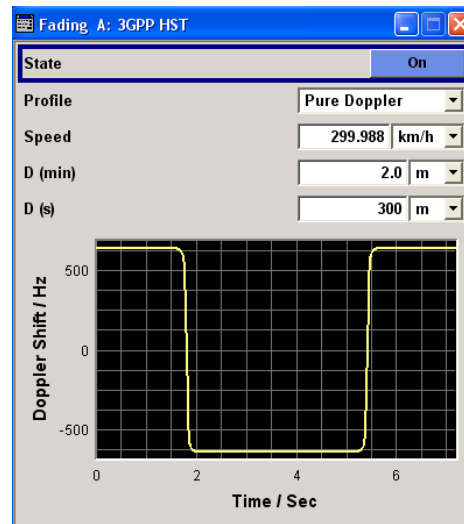
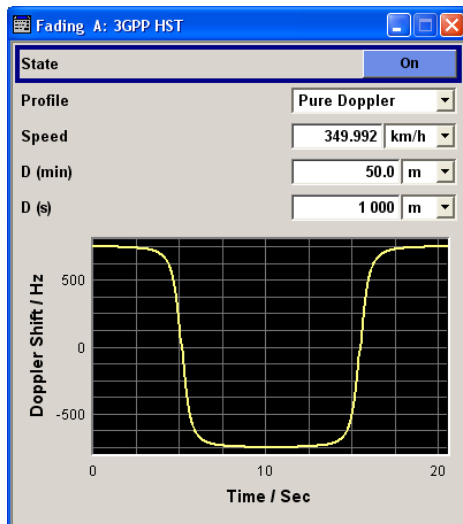


**Fig. 4-4: Doppler shift trajectory for scenario 1**



**Fig. 4-5: Doppler shift trajectory for scenario 3**

The default values for High Speed Train can also be set for further tests in the fading path table. For scenarios 1 and 3, the fading path table is a special "3GPP HST" dialog. Since scenario 2 is defined as one standard Rician fading propagation channel, the predefined settings for this scenario can be adjusted in the standard path table (see [chapter 4.3, "Delay Modes Path Table"](#), on page 32).



**State 3GPP HST**

Activates/deactivates simulation of High Speed Train propagation according to the selected scenario 1 or 3.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:HSTRain:STATe` on page 244

**Profile 3GPP HST**

Determines the fading profile for the selected scenario. The fading profile determines which transmission path is simulated.

Although both scenarios 1 and 3 are specified as Pure Doppler paths without a fading profile, the R&S Fading Simulator allows you to change the fading profile.

"Static Path" A static transmission path with no attenuation (loss) or delay is simulated.

"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 simulated path has a constant delay and attenuation (no loss). The Doppler frequency shift is determined only by the parameters **Speed**, **Dmin** and **Ds**.

**Example:**

```
SOUR:FSIM:HSTR:PROF PDOP
SOUR:FSIM:HSTR:SPE 100kmh
SOUR:FSIM:HSTR:DIST:STAR 2000
SOUR:FSIM:HSTR:DIST:MIN 20
SOUR:FSIM:HSTR:FDOP?
```

**Response:**215.56 Hz

"Rayleigh" A radio hop is simulated in which many highly scattered subwaves arrive at a moving receiver.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:HSTRain:PROFile](#) on page 244

#### Speed 3GPP HST

Sets the velocity parameter , i.e. the speed of the moving receiver.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:HSTRain:SPEEd](#) on page 244

#### D (min) 3GPP HST

Determines the parameter  $D_{min}$ , i.e. the distance between the BS and the railway track.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:HSTRain:DIStance:StARt](#) on page 242

#### D (S) 3GPP HST

Determines the parameter  $D_s$ , i.e. the initial distance  $D_s/2$  between the train and the BS at the beginning of the simulation.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:HSTRain:DIStance:MINimum](#) on page 242

## 4.12 Dynamic Scenario Simulation



The simulation of dynamic fading scenarios is enabled only for instruments equipped with option R&S SMU/AMU-K77.

The dynamic scenario simulation is a software option, provided to test and verify how the movement of two objects impacts on the communication channel between them. Instrument equipped with this option simulates fading propagation conditions in two simple predefined scenarios, the "Ship to Ship" and the "Tower to Aircraft" scenarios, and one additional user defined scenario with full customized settings.

In the [Ship to Ship scenario](#), the signal channel between two ships is simulated. The initial position of the ships, their vehicle type and moving direction are configurable parameters.

The [Tower to Aircraft scenario](#) is intended for simulation of signal transmission between a static transmitting antenna (tower) and moving receiver (aircraft). The flight trajectory, aircraft speed during the different flying phases and aircraft type are configurable parameters.

The simulation of the fading conditions caused by more complex dynamic scenarios and movements is provided by the [User Defined scenario](#). In this mode, the vehicle parameters and the trajectory of both the transmitter and the receiver are enabled for configuration. The firmware provides an interface for loading of trajectory description files with

predefined file formats, as well as the possibility to describe a trajectory by means of waypoints table.

### 4.12.1 Dynamic Scenario Simulation Common Settings

To enable the configuration of dynamic fading scenario, select "Fading > Configuration > Scenario Simulation".

The lower part of the dialog comprises the settings necessary to configure the desired dynamic fading scenario. The available settings depend on the selected dynamic fading "Scenario" and are described in the corresponding section.

The following describes the setting common for the available scenarios.



#### Scenario

Selects the dynamic fading scenario.

"User Defined" Enables a full configuration mode for flexible adjustment of the receiver's and transmitter's settings, like the "Vehicle" type, the position or the "Trajectory".

The dialog provides an interface for loading of files with preconfigured vehicle and/or trajectory setting. See also [chapter 4.12.4, "User Defined Scenario Settings"](#), on page 79.

"Ship To Ship" Enables a fading scenario with moving receiver and transmitter, see [chapter 4.12.2, "Ship To Ship Settings"](#), on page 72.

"Tower To Aircraft" Enables the simulation of the channel between a tower and an aircraft, see [chapter 4.12.3, "Tower To Aircraft Settings"](#), on page 74.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:SCENario` on page 272

#### Coordinate System

Defines the way the location coordinate are displayed. The conversion calculations between the different representations is performed automatically.

"ENU" The ENU (East, North, Up) Cartesian coordinate system is based on a plane tangent to the Earth's surface. The location coordinates are represented in X,Y,Z format, where X is the East axis, Y the North and Z represents Up.

The ENU coordinate system is suitable for simple applications.

- "Geodetic  
DEG:MIN:SEC  
/Decimal"
- In geodetic coordinates, the location coordinates are described with three coordinates, latitude, longitude and altitude. The first two can be displayed in decimal or DMS (DEG:MIN:SEC) format.
- "DEG:MIN:SEC"  
The display format is Degree:Minute:Second and Direction, i.e.  $XX^{\circ}XX'XX.XX$  Direction, where direction can be North/South and East/West.
  - "Decimal Degree"  
The display format is decimal degree, i.e.  $+/-XX.XXXXX^{\circ}$ , where "+" indicates North and East and "-" indicates South and West.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:CFORmat` on page 273

### Create

Triggers the instrument to load the selected settings, to start the signal calculation, to create and store the corresponding settings files (\*.fad\_udyn) and to update the trajectory visualization. Refer to [chapter 4.12.6, "File Management and File Formats"](#), on page 88 for detailed information.

**Note:** Even if the "Fading > State > ON", the configured settings are not considered until the signal calculation is triggered with "Create".

Signal calculation is time consuming operation.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:CREate` on page 273

### Load/Save Scenario

Opens the standard file dialog for storing or loading the scenario settings. Only files with extension \*.fad are displayed.

Refer to [chapter 4.12.6, "File Management and File Formats"](#), on page 88 for detailed information.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SAVE` on page 273

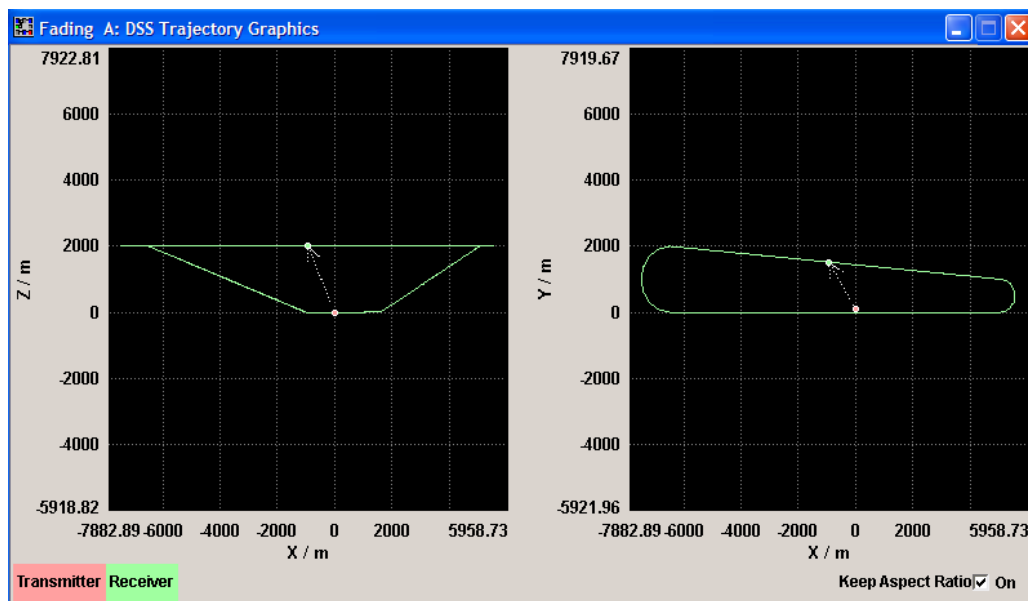
`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:CATalog` on page 273

`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:LOAD` on page 274

### Trajectory Graphics

Opens the dialog for dynamic display of the current transmitter's and receiver's location.

**Note:** Even if the "Fading > State" is switched on, the configured dynamic scenario settings are not considered until the signal calculation is triggered with "Create".



The current position of the transmitter and the trajectory of the receiver are displayed in two graphics, the x-z view and the x-y view, using different colors. An arrow shows the direct Line-of-Sight between the receiver (green) and the transmitter (red).

SCPI command:  
n.a.

#### Preset

Presets the scenario simulation settings to the their default values.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:PRESet`  
on page 274

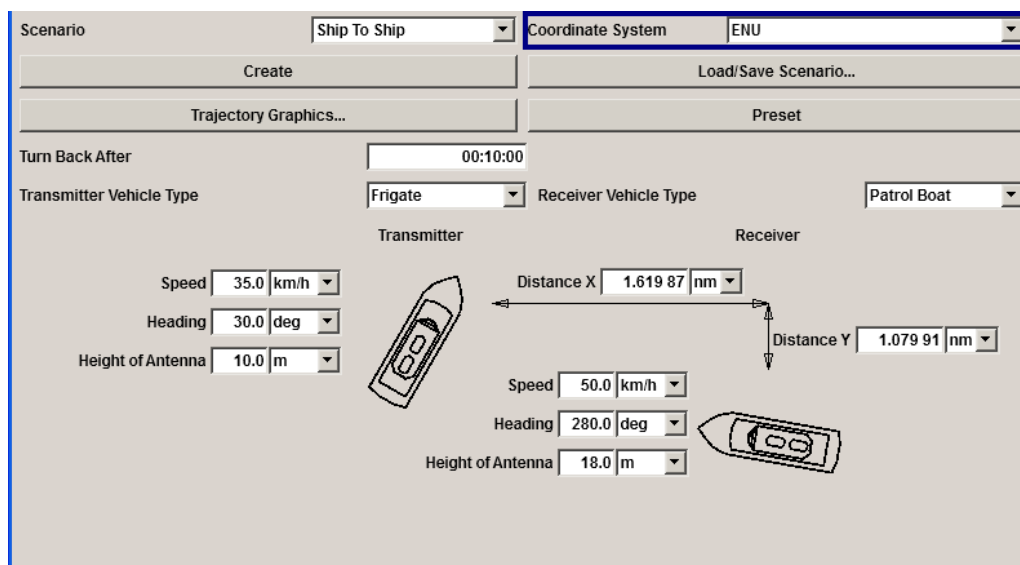
`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:TOWertoair:PRESet`  
on page 274

## 4.12.2 Ship To Ship Settings

The ship to ship scenario is a dynamic scenario with two moving locations, i.e. two ships. The first ship is assumed to be the transmitter and the second one, the receiver.

This dialog part comprises the settings to two ships, such as vehicle type, position, moving direction and speed.

Refer to [chapter 4.12.5, "Calculation of the Waypoints"](#), on page 85 for detailed description and background information on the calculations of each waypoint in the different coordinate systems.



### Turn Back After

Determines the time after that both ships turn their directions.

SCPI command:

[\[:SOURCE<hw>\]:FSIMulator:DSSimulation:SHIPtoShip:TTIME](#) on page 274

### Transmitter/Receiver Vehicle Type

Selects the vehicle type.

SCPI command:

[\[:SOURCE<hw>\]:FSIMulator:DSSimulation:SHIPtoShip:TX:TYPE](#)  
on page 275

[\[:SOURCE<hw>\]:FSIMulator:DSSimulation:SHIPtoShip:RX:TYPE](#)  
on page 275

### Distance X/Y

In the ENU coordinate system, the dialog displays the ships in the X/Y view. The distance between the ships is adjusted by these parameters.

The [Speed](#) and [moving direction](#) of each of the ships are configurable parameters. To adjust the third coordinate Z, use the parameter [Height of Antenna](#).

**Tip:** Use the [Trajectory Graphics](#) view to visualize the X/Y position of the ships to each other.

SCPI command:

[\[:SOURCE<hw>\]:FSIMulator:DSSimulation:SHIPtoShip:XDistance](#)  
on page 276

[\[:SOURCE<hw>\]:FSIMulator:DSSimulation:SHIPtoShip:YDistance](#)  
on page 276

### Latitude/Longitude

In the Geodetic DMS/Decimal coordinate system, sets the coordinate of each of the ships.

The [Speed](#) and [moving direction](#) of each of the ships are configurable parameters. To adjust the third coordinate Z, use the parameter [Height of Antenna](#).

The coordinates of the transmitting ship are used as reference waypoint for the calculation.

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:RX:COORDinates:
DMS on page 276
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:TX:COORDinates:
DMS on page 276
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:RX:
COORDinates [ :DECimal ] on page 277
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:TX:
COORDinates [ :DECimal ] on page 277
```

### Speed

Sets the transmitter/receiver speed.

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:RX:SPEEd
on page 275
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:TX:SPEEd
on page 275
```

### Heading

Defines the direction in that the corresponding ship is moving.

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:RX:HEADing
on page 275
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:TX:HEADing
on page 275
```

### Height of Antenna

Defines the height of the corresponding antenna.

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:RX:ANTenna:
HEIGHt on page 275
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:SHIPtoShip:TX:ANTenna:
HEIGHt on page 275
```

## 4.12.3 Tower To Aircraft Settings

The tower to aircraft scenario is a simulation of a simplified aerodrome, i.e. the fading simulator simulates propagation conditions of a receiver placed on an airplane that is starting from, flying by and landing near to an antenna tower. The user interface displays the trajectory of the airplane as seen from the tower. The display is divided into two parts: the upper part is the x-z representation of the trajectory; the down part is the x-y repre-



sentation. The red circle represents the tower and is assumed to be the start and end waypoint of the flight.

The x-z representation comprises the parameters necessary to adjust the speed of the aircraft during the different flight phases, i.e. the start, take-off and climb out phase, the cruise phase and the descend, approach and landing/touch-down phase. We assume a constant acceleration/deceleration between the phases; the speed values are changed once at the beginning of each phase and kept constant during the duration of the phase.

The x-y representation comprises the parameters necessary to geometrically describe the trajectory, i.e. filed length and radius of the curves. The length and the duration of the cruise are calculated automatically.

This realization uses a simplified phase model to describe the flight. The [table 4-4](#) gives an overview of the flight phases, short description of each of them with reference to the associated waypoints ([figure 4-6](#)) and list of the related parameters.

**Table 4-4: Flight phases**

Flight phase	Description	Related parameters
Taxiing	A movement along the ground Waypoints: P0-P1	<ul style="list-style-type: none"> <li>Start Speed</li> </ul>
Take-off	The phase during which the aircraft goes through a transition from taxiing to flying in the air. During take-off, the aircraft accelerates its speed from start speed to the rotation speed and takes off then with constant angle of 3°. The phase is concluded after the aircraft has achieved an altitude of 35m above ground. Waypoints: P1-P2	<ul style="list-style-type: none"> <li>Take-Off Speed (rotation speed)</li> <li>Take-Off Field Length (Ground)</li> <li>Constant Acceleration</li> </ul>
Climb out	The climb out phase follows the take-off phase and describes the time an aircraft increases its altitude until achieving the target level. Waypoints: P2-P3	<ul style="list-style-type: none"> <li>Climb Angle</li> <li>Climb Rate</li> <li>Departure Ground Speed</li> </ul>
Cruise	Cruise is the phase between ascent and descent, i.e. the actual flight phase. Waypoints: P3-P20	<ul style="list-style-type: none"> <li>Cruise Speed</li> <li>Cruise Altitude</li> <li>"Left/Right Turn Radius"</li> </ul>
Descent	The descent is the opposite of climb, i.e. is the phase an aircraft decreases its altitude Waypoints: P20-P21	<ul style="list-style-type: none"> <li>Descent Angle</li> <li>Descent Rate</li> <li>Descent Ground Speed</li> </ul>
Landing	The final phase of the flight during which the aircraft returns to the ground. Waypoints: P21-P0	<ul style="list-style-type: none"> <li>Touch-Down Speed</li> <li>Landing Field Length (Ground)</li> </ul>
Flight	Denotes the summary of all phases.	<ul style="list-style-type: none"> <li>Trip Length</li> <li>Trip Duration</li> </ul>



Refer to [chapter 4.12.5.3, "Waypoints in the Tower to Aircraft Scenario"](#), on page 86 for detailed description and background information on the calculations of each waypoint.

### Vehicle Type

Sets the vehicle type. The vehicle type determines the characteristic speeds and climb/decant rates, i.e. the maximum value of the parameters in the dialog.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:TOWertoair:TYPE` on page 278

### Start Speed

Sets the start speed  $v_{START}$ , i.e. determines whether the aircraft is already moving (taxiing) or not.

In scenarios without acceleration ([Constant Acceleration](#) = OFF), the  $v_{START}=v_{TO}$  (see [Take-Off Speed](#)).

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:TOWertoair:SPEed:START`  
on page 278

### Take-Off Speed

Sets the rotation speed during the take-off phase,  $v_{TO}$ .

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:TOWertoair:SPEed:TAKeoff`  
on page 278

**Take-Off Field Length (Ground)**

Sets the length of the runway used during the take-off phase  $S_{RWTO}$ .

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:FLENgth:TAKeoff`  
on page 281

**Constant Acceleration**

Enables speed calculation with constant acceleration. Otherwise, an unlimited acceleration in the waypoints is assumed.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:CACCeleration`  
on page 279

**Climb Angle**

Sets the angle of ascent during the climb out phase  $\varphi_C$ .

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:ANGLe:CLIMb`  
on page 279

**Climb Rate**

Sets the climb rate  $v_{CA}$ .

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:RATE:CLIMb`  
on page 279

**Departure Ground Speed**

Sets the ground speed  $v_{CGND}$  during the climbing out phase.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:SPEEd:DEParture`  
on page 279

**Cruise Speed**

Sets the speed during the cruise phase  $v_{GC}$ .

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:SPEEd:CRUise`  
on page 280

**Cruise Altitude**

Defines the aircraft's altitude during the cruise phase.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:ALTitude:CRUise`  
on page 280

**Radius**

Sets the values for the left/right turn radius  $r_1$  and  $r_2$ .

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:RADius:LTURn`  
on page 282

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:RADius:RTURn`  
on page 282

**Descent Angle**

Sets the angle during the descent phase  $\phi_D$ .

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:ANGLE:DESCent`  
on page 280

**Descent Rate**

Sets the decent rate  $v_D$ .

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:RATE:DESCent`  
on page 281

**Descent Ground Speed**

Sets the ground speed during the descent phase  $v_{DGND}$ .

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:SPEed:DESCent`  
on page 281

**Touch-Down Speed**

Sets the touch-down speed  $v_{TD}$  during the landing phase.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:SPEed:TOUChdown`  
on page 281

**Landing Field Length (Ground)**

Sets the length of the runway used during the landing/take-down phase  $S_{RWTD}$ .

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:FLENGth:LANDing`  
on page 281

**Trip Length**

Displays the resulting trip length. The value is calculated automatically.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:TOWertoair:TRIP:LENGth`  
on page 282

**Trip Duration**

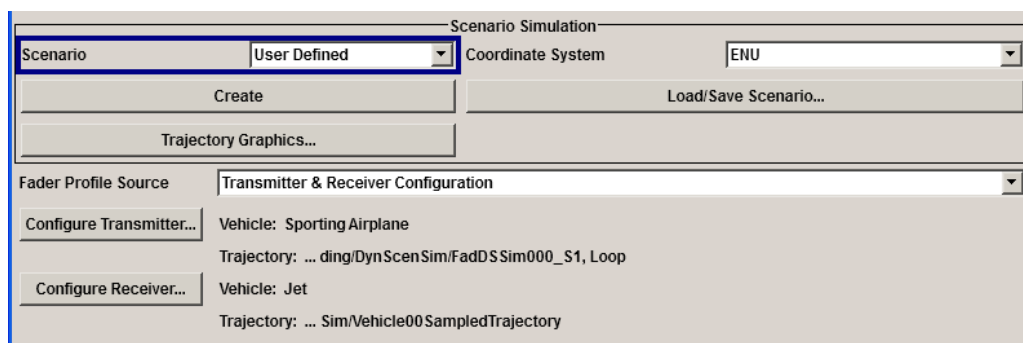
Displays the resulting trip duration. The value is calculated automatically.

SCPI command:

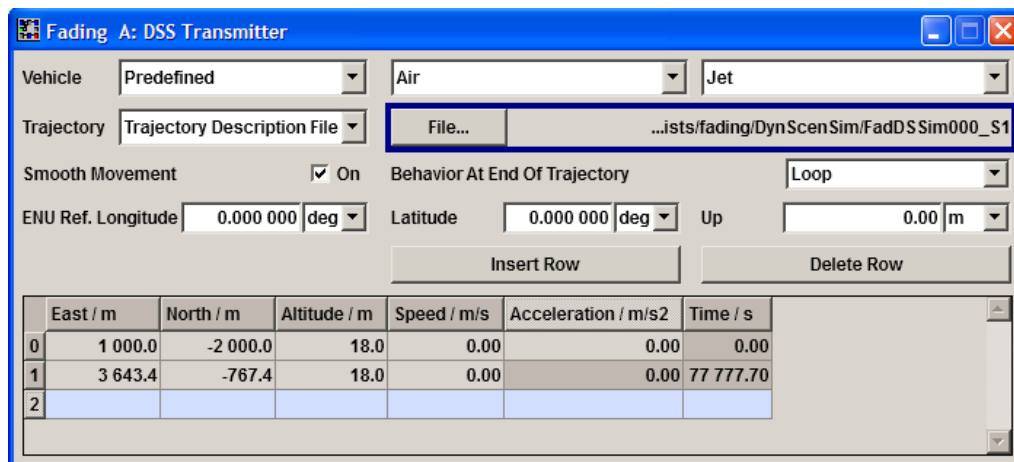
`[ :SOURCE<hw> ] :FSIMulator:DSSimulation:TOWertoair:TRIP:DURation`  
 on page 282

**4.12.4 User Defined Scenario Settings**

The user defined mode offers greater flexibility by the scenario configuration than the other two scenario configuration modes. The dialog provides an access to the settings of the transmitter and the receiver.



The transmitter and receiver settings are divided into two separated dialog, but in this document they are described together in [chapter 4.12.4.2, "Transmitter and Receiver Configuration"](#), on page 80.



**4.12.4.1 Profile Source**

This parameter determines the way the fading profile related settings are configured.

**Fader Profile Source**

Enables direct settings configuration or the use of predefined fader profile files.

"Transmitter and Receiver Configuration"	Enables the direct configuration of the settings. To access the corresponding settings, select "Configure Transmitter" or "Configure Receiver" respectively.
"TPA File (*.tpa)"	Describes the signal behavior by means of time, propagation delay and attenuation. The movement relation between transceiver and receiver is reflected in these values. Refer to <a href="#">chapter 4.12.6.4, "Time, Propagation Delay, Attenuation File Format (TPA)"</a> , on page 93 for description of the file format.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:TPA:CATalog` on page 285

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:TPA:SElect` on page 285

"Fader Profile (*fad_udyn)"	Loads the all scenario related settings as described by the selected fader profile *.fad_udyn file.
-----------------------------	---

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:PROFile:SOURce`

on page 283

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:PROFile:CATalog`

on page 285

`[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:PROFile:SElect`

on page 285

#### 4.12.4.2 Transmitter and Receiver Configuration

This section describes the settings available in the "DSS Transmitter" and "DSS Receiver" dialogs.

##### Vehicle

Sets the transmitting/receiving vehicle. The selected vehicle type determines the main features of the vehicle, like possible movement and speed limits.

"Not Specified/ No vehicle is selected  
No Limits"

"Predefined" Enables the selection of a predefined vehicle. The available values are grouped into categories and listed in the following table.

**Table 4-5: Predefined vehicle types**

Category	Vehicle Type
Air	As in the "Tower to Aircraft" scenario <ul style="list-style-type: none"> <li>• Jet</li> <li>• UAV</li> <li>• Transport Aircraft</li> <li>• Airliner</li> <li>• Sporting Airplane</li> <li>• Helicopter</li> </ul>
Land	<ul style="list-style-type: none"> <li>• Car</li> <li>• Train</li> <li>• Bicycle</li> <li>• Pedestrian</li> </ul>
Water	As in the "Ship to Ship" scenario <ul style="list-style-type: none"> <li>• Frigate</li> <li>• Patrol Boat</li> <li>• Aircraft Carrier</li> </ul>

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:VEHICLE:
PREDEFINED:CATegory on page 284
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:VEHICLE:
PREDEFINED:TYPE on page 284
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:VEHICLE:
PREDEFINED:CATegory on page 284
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:VEHICLE:
PREDEFINED:TYPE on page 284
```

"User" Enables the selection of a user defined vehicle description file. Select "File > Load Vehicle File" and select the user defined \*.xvd.

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:VEHICLE:USER:
CATalog on page 285
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:VEHICLE:USER:
SElect on page 286
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:VEHICLE:USER:
CATalog on page 285
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:VEHICLE:USER:
SElect on page 286
```

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:VEHICLE:MODE
on page 284
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:VEHICLE:MODE
on page 284
```

**Trajectory**

Determines whether the transmitter/receiver is a moving object or not and defines the type of the trajectory description file used.

For moving objects, open "File > New/Load File" and select the corresponding trajectory description file.

Depending on the selected trajectory type, several other parameters are enabled for configuration.

"None - Fixed At Point"	Selects a stationary transmitter/receiver. Depending on the selected <a href="#">Coordinate System</a> , the coordinates are set as Attitude, Latitude and Longitude or as Altitude, X, Y (see " <a href="#">Altitude/X/Y/Latitude/Longitude</a> " on page 83).
"Trajectory Description File"	Enables moving transmitter/receiver; the trajectory is described by the selected *.xtd file. The <a href="#">Waypoints Table</a> and the additional parameters are automatically filled with the values retrieved from the selected file. The number of rows corresponds to the number of the defined waypoints.

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory:TDF:CATalog on page 285
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory:TDF:SElect on page 285
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory:TDF:CATalog on page 285
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory:TDF:SElect on page 285
```

"AGI STK Ephemeris File (*.e)"	Enables moving transmitter/receiver; the trajectory is described by the selected *.e file. Refer to <a href="#">chapter 4.12.6.3, "AGI STK Ephemeris File Format"</a> , on page 92 for description of the file format.
--------------------------------	---

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory:EPHemeris:CATalog on page 285
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory:EPHemeris:SElect on page 285
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory:EPHemeris:CATalog on page 285
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory:EPHemeris:SElect on page 285
```

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory on page 285
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory on page 285
```



**Altitude/X/Y/Latitude/Longitude**

Depending on the selected [Coordinate System](#), i.e. ENU or Geodetic DMS/Decimal coordinate system, sets the coordinate of the static transmitter/receiver.

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory:
FAPoint:COORDinates:XYZ on page 287
```

```
[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory:
FAPoint:COORDinates:XYZ on page 287
```

```
[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory:
FAPoint:COORDinates:DMS on page 286
```

```
[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory:
FAPoint:COORDinates:DMS on page 286
```

```
[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory:
FAPoint:COORDinates[:DECimal] on page 288
```

```
[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory:
FAPoint:COORDinates[:DECimal] on page 288
```

**Smooth Movement**

The location of the waypoints defined in the waypoints table may cause sharp changes in the movement direction. This parameter uses an internal algorithm to put limits on the acceleration and smooth the trajectory to simulate more realistic movement.

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory:TDF:
MACCeleration:STATe on page 289
```

```
[ :SOURce<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory:TDF:
MACCeleration:STATe on page 289
```

**Behavior at End of Trajectory**

Determines the behavior of the moving transmitter/receiver at the end waypoint.

"Stop and Hold Position"	By reaching the end of the file, the last waypoint is assumed to be a static one.
"Loop"	The moving object returns to the initial waypoint via the shortest direct way. The speed and acceleration are averaged automatically according to the last used speed and the speed at the initial point. Using this mode is recommended for trajectory files that describe a circle trajectory or trajectory in which the start and end waypoints are close to each other.
"Return on Same Path"	By reaching the end waypoint, the waypoints are read out backwards, i.e. the moving object shuttles between the start and the end waypoint.

"Jump to Start/Restart" This possibility restarts the movement, i.e. after achieving the end waypoint, the object "jumps" to the start waypoint and moves on the same trajectory.  
Use this possibility to simulate repeating movement on the same trajectory for scenario with non-circular trajectory.

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory:TDF:EBEHavior on page 288
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory:TDF:EBEHavior on page 288
```

### ENU Ref. Coordinate

Chose the coordinates of the reference location in ENU coordination system (as Latitude, Longitude and Up) so that it is located within the observed area.

The ENU reference coordinate are stored in the [Trajectory Description Files](#) with the parameter <enurefpoint>.

SCPI command:

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:RX:TRAjectory:TDF:ENU:COORDinates[:DECimal] on page 289
```

```
[ :SOURCE<hw> ] :FSIMulator:DSSimulation:USER:TX:TRAjectory:TDF:ENU:COORDinates[:DECimal] on page 289
```

### Keep Fixed

For two consecutive waypoints  $P_n(x,y,z)$  and  $P_{n-1}(x,y,z)$ , there is a cross-reference between the values of the time, speed and acceleration.

This parameter defines which value is maintained while varying the coordinates of a waypoint in the [Waypoints Table](#). Starting from the adjusted location, the values of the subsequent waypoints are automatically calculated and updated.

Direct variations of one of the time, speed or acceleration values ignore this parameter.

SCPI command:

n.a

### Insert/Delete Row

Adds/removes a waypoint.

SCPI command:

n.a.

### Waypoints Table

The waypoints table list the waypoints with their position coordinates, selected "Speed", "Acceleration" and "Time". One row per waypoint is used. If a trajectory description file is selected, the values are retrieved automatically, but they can be edited if required.

SCPI command:

n.a

### 4.12.5 Calculation of the Waypoints

This section summarizes background information on how the calculation of the waypoints in the different scenarios and coordinate systems is performed.

#### 4.12.5.1 Waypoints in Cartesian Coordinate System

In the ENU Cartesian coordinate system, two waypoints are sufficient to describe a moving object. We assume, that the coordinates of the ship displayed on the left hand side, the transmitter, are  $X=0$ ,  $Y=0$  and  $Z=h$  (i.e. [Height of Antenna](#)). The ships are moving on a straight line with constant speed  $v = \text{Speed}$ ; after elapsing the selected time  $t = \text{Turn Back After}$ , both ships are returning to the initial start position/waypoint.

For time  $t = \text{Turn Back After}$  and  $\varphi = \text{Heading}$ , the coordinates of both ships are calculated according to the formulas in [table 4-6](#).

**Table 4-6: Calculation of the waypoints in the ENU coordinate system**

	Initial waypoint	Further waypoint
Ship#1	$\vec{P}_0 = \begin{pmatrix} 0 \\ 0 \\ h_0 \end{pmatrix}$	$\vec{P}_1 = \vec{P}_0 + \begin{pmatrix} \sin \varphi_0 \cdot v_0 \cdot t \\ \cos \varphi_0 \cdot v_0 \cdot t \\ 0 \end{pmatrix}$
Ship#2	$\vec{P}_0 = \begin{pmatrix} d_x \\ -d_y \\ h_1 \end{pmatrix}$	$\vec{P}_1 = \vec{P}_0 + \begin{pmatrix} \sin \varphi_1 \cdot v_1 \cdot t \\ \cos \varphi_1 \cdot v_1 \cdot t \\ 0 \end{pmatrix}$

#### 4.12.5.2 Waypoints in Geodetic Coordinate System

In geodetic coordinates, the location coordinates are described with three coordinates, latitude ( $\Phi$ ), longitude ( $\lambda$ ) and altitude ( $h$ ).

The calculation of the waypoints in the geodetic coordinate system are based on the **great-circle distance**, i.e. we assume that the covered distance is the shortest distance and is a fraction of the Earth's radius. The initial angle  $\alpha$  at the start position/waypoint is set by the parameter [Heading](#). Because the [Height of Antenna](#) of transmitting and the receiving antennas is a constant value during the simulation of one scenario, the altitude  $h$  is ignored by the calculations.

The ships are moving with constant speed  $v = \text{Speed}$ ; after elapsing the selected time  $t = \text{Turn Back After}$ , both ships are returning to the initial start position/waypoint.

For the selected  $v$  and  $t$ , the distance  $S_{AB}$  between the initial position A and the destination point B is:

$$S_{AB} = v \cdot t$$

The central angle, i.e the angle between the points A and B, is calculated as follow:

$$\zeta = \frac{S_{AB}}{2\pi r_{Earth}} 360^\circ$$

where  $r_{Earth}$  is the mean earth's radius.

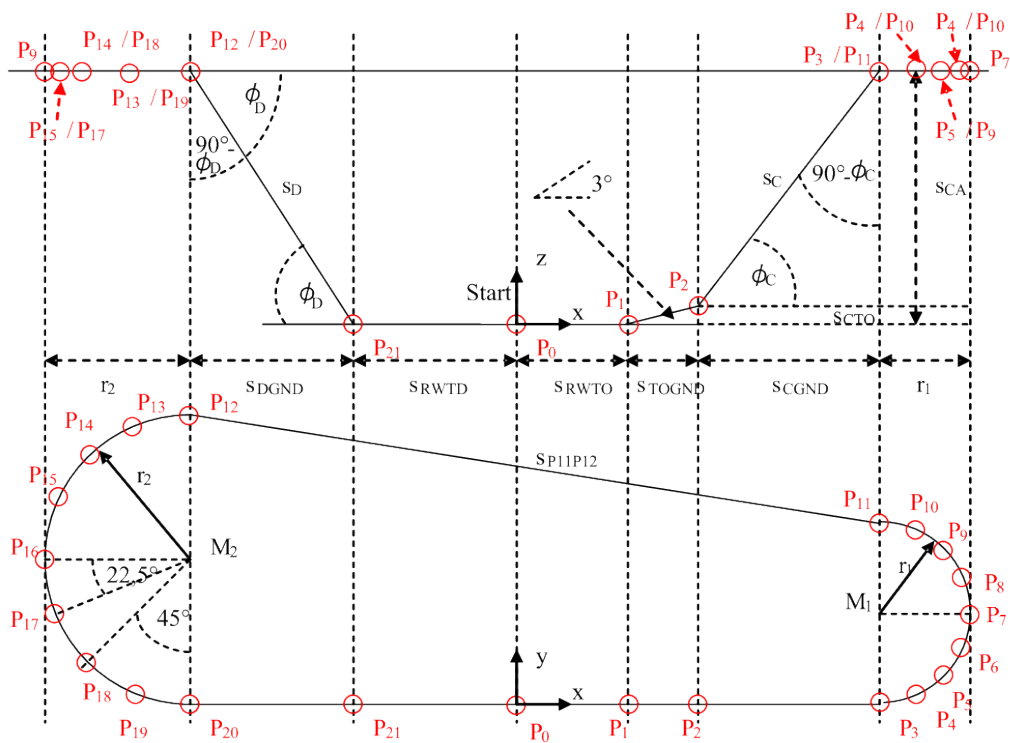
If the coordinates of the initial position A are known ( $\Phi_A, \lambda_A$ ), the coordinates of the destination point B ( $\Phi_B, \lambda_B$ ) are calculated as follow:

$$\phi_B = \arcsin(\cos \alpha \cos \phi_A \sin \zeta + \sin \phi_A \cos \zeta)$$

$$\lambda_B = \lambda_A + \arccos\left(\frac{\cos \zeta - \sin \phi_A \sin \phi_B}{\cos \phi_A \cos \phi_B}\right)$$

### 4.12.5.3 Waypoints in the Tower to Aircraft Scenario

In this scenario, a set of 22 waypoints is sufficient to describe the flight trajectory (see figure 4-6). The x, y and z axes are interpreted as ENU coordinates.



**Fig. 4-6: Trajectory in the tower to aircraft scenario**

- P<sub>0</sub>-P<sub>20</sub> = Waypoints
- $\phi_C, \phi_D$  = climb/descent angle
- S<sub>CTO</sub> = climb take-off length
- S<sub>CA</sub> = climb altitude
- S<sub>C</sub>, S<sub>D</sub> = climb/descent length
- S<sub>CGND</sub>, S<sub>DGND</sub> = climb/descent length (ground)

$S_{RWTO}, S_{RWTD}$  = runway take-off/touch-down field length  
 $S_{TOGND}$  = take-off field length (ground)  
 $r_1, r_2$  = left/right turn radius



The fading simulator does not consider the wind speed. Hence, we assume that the ground speed is equivalent to the True Air Speed (TAS) used in the avionic.

### Allowed maximum speed and acceleration values

The cross-reference between the allowed maximum speed and acceleration values. The allowed values must fulfill the following equation:

$$v_{CA} = v_{CGND} \tan \varphi$$

where  $\varphi$  is the climb/descent angle,  $v_{CA}$  is the climb rate and  $v_{CGND}$  is the ground speed.

### Calculations

The calculations are performed according to the following formulas.

- Lengths

$$S_C = \frac{S_{CA} - S_{CTO}}{\sin \varphi_C}; \quad S_{CGND} = \frac{S_{CA} - S_{CTO}}{\tan \varphi_C}$$

$$S_D = \frac{S_{CA}}{\sin \varphi_D}; \quad S_{DGND} = \frac{S_{CA}}{\tan \varphi_D}$$

- Waypoints

$$\vec{P}_0 = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}; \vec{P}_1 = \begin{pmatrix} S_{RWTO} \\ 0 \\ 0 \end{pmatrix}; \vec{P}_2 = \begin{pmatrix} S_{RWTO} + S_{TOGND} \\ 0 \\ S_{CO} \end{pmatrix}; \vec{P}_3 = \begin{pmatrix} S_{RWTO} + S_{TOGND} + S_{CGND} \\ 0 \\ S_{CA} \end{pmatrix}$$

$$\vec{P}_4 = \vec{P}_3 + \begin{pmatrix} \sin 22,5^\circ \cdot r_1 \\ r_1 - \cos 22,5^\circ \cdot r_1 \\ 0 \end{pmatrix}; \vec{P}_5 = \vec{P}_3 + \begin{pmatrix} \sin 45^\circ \cdot r_1 \\ r_1 - \cos 45^\circ \cdot r_1 \\ 0 \end{pmatrix}; \vec{P}_6 = \vec{P}_3 + \begin{pmatrix} \sin 67,5^\circ \cdot r_1 \\ r_1 - \cos 67,5^\circ \cdot r_1 \\ 0 \end{pmatrix}$$

$$\vec{P}_7 = \vec{P}_3 + \begin{pmatrix} r_1 \\ r_1 \\ 0 \end{pmatrix}$$

$$\begin{aligned} \vec{P}_8 &= \vec{P}_3 + \begin{pmatrix} \cos 22,5^\circ \cdot r_1 \\ r_1 + \sin 22,5^\circ \cdot r_1 \\ 0 \end{pmatrix}; \quad \vec{P}_9 = \vec{P}_3 + \begin{pmatrix} \cos 45^\circ \cdot r_1 \\ r_1 + \sin 45^\circ \cdot r_1 \\ 0 \end{pmatrix}; \quad \vec{P}_{10} = \vec{P}_3 + \begin{pmatrix} \cos 67,5^\circ \cdot r_1 \\ r_1 + \sin 67,5^\circ \cdot r_1 \\ 0 \end{pmatrix} \\ \vec{P}_{11} &= \vec{P}_3 + \begin{pmatrix} 0 \\ 2r_1 \\ 0 \end{pmatrix}; \quad \vec{P}_{12} = \vec{P}_{20} + \begin{pmatrix} 0 \\ 2r_2 \\ 0 \end{pmatrix} \\ \vec{P}_{13} &= \vec{P}_{20} + \begin{pmatrix} -\sin 22,5^\circ \cdot r_2 \\ r_1 + \cos 22,5^\circ \cdot r_2 \\ 0 \end{pmatrix}; \quad \vec{P}_{14} = \vec{P}_{20} + \begin{pmatrix} -\sin 45^\circ \cdot r_2 \\ r_1 + \cos 45^\circ \cdot r_2 \\ 0 \end{pmatrix}; \quad \vec{P}_{15} = \vec{P}_{20} + \begin{pmatrix} -\sin 67,5^\circ \cdot r_2 \\ r_1 + \cos 67,5^\circ \cdot r_2 \\ 0 \end{pmatrix} \\ \vec{P}_{16} &= \vec{P}_{20} + \begin{pmatrix} -r_2 \\ r_2 \\ 0 \end{pmatrix} \\ \vec{P}_{17} &= \vec{P}_{20} + \begin{pmatrix} -\cos 22,5^\circ \cdot r_2 \\ r_1 - \sin 22,5^\circ \cdot r_2 \\ 0 \end{pmatrix}; \quad \vec{P}_{18} = \vec{P}_{20} + \begin{pmatrix} -\cos 45^\circ \cdot r_2 \\ r_1 - \sin 45^\circ \cdot r_2 \\ 0 \end{pmatrix}; \quad \vec{P}_{19} = \vec{P}_{20} + \begin{pmatrix} -\cos 67,5^\circ \cdot r_2 \\ r_1 - \sin 67,5^\circ \cdot r_2 \\ 0 \end{pmatrix} \\ \vec{P}_{20} &= \begin{pmatrix} -S_{RWTD} - S_{DGND} \\ 0 \\ S_{CA} \end{pmatrix}; \quad \vec{P}_{21} = \begin{pmatrix} -S_{RWTD} \\ 0 \\ 0 \end{pmatrix} \end{aligned}$$

- Speed

$$v_C = \frac{v_{CGND}}{\cos \varphi_C}; \quad v_D = \frac{v_{DGND}}{\cos \varphi_C}$$

$$v_0 = v_{START}; \quad v_1 = v_{TO}; \quad v_2 = v_C; \quad v_3 \dots v_{20} = v_{GC}; \quad v_{11} = v_D; \quad v_{12} = v_{TD}$$

#### 4.12.6 File Management and File Formats

The file management concept of the dynamic scenario simulation option is designed to simplify the execution of repeatable tests. The file management allows you to:

- Store and load user data, i.e. store and load the complete scenario information as configured in the user interface. This applies for the true "User Defined" scenarios as well as for changes in the predefined scenarios.
- Store intermediate data  
Save the trajectory and/or vehicle description related settings into files with predefined file format. The process is executed whenever the [Create](#) function is triggered.
- Load your vehicle description files and/or trajectory description files created with external software.

**Note:** The dynamic scenario simulation option currently provides interface for loading of [AGI STK ephemeris files](#) and [TPA files](#). Other third parties files have to be converted to the internal waypoint file format prior to import into the instrument.

The figure 4-7 is a rough illustration of the file management concept.

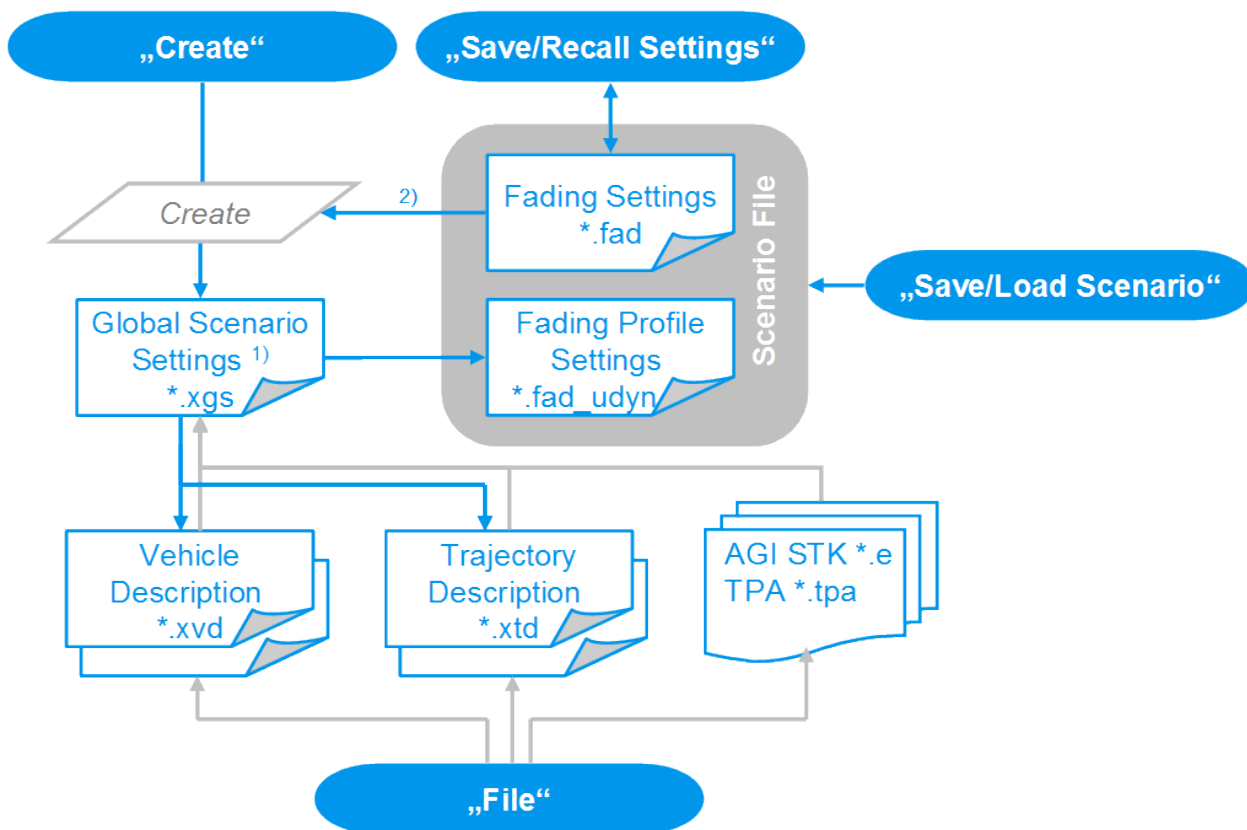


Fig. 4-7: Dynamic scenario simulation file management

1)

= The global scenario settings file (\*.xgs) is a predefined file format for internal use. The stored files are not accessible for the user; there is no interface for reloading of these files. The \*.xgs file format is not part of the user documentation. The global scenario settings file is shown on the figure to complete the description.

2)

= When using the "Save/Recall Settings" function, the create process is triggered only if file \*.fad\_udyn is not available.

"Create", "Save/Recall Settings", "Save/Load Scenario", "File" = function triggered by user interaction

Create

= internal process

The database contains all the information necessary to generate and re-generate a scenario. The information is stored into files with predefined file format and file extension. The table 4-7 gives an overview.

Table 4-7: File formats

File	File extension	Description
Scenario Files		<p>The generation of the scenario file is triggered by the <a href="#">Load/Save Scenario</a> function. The file name is user definable.</p> <p>The scenario file contains user data and bundles up the two files, the *.fad and the *.fad_udyn file associated with one particular scenario.</p> <p><b>Tip:</b> The scenario file is necessary and alone sufficient to reproduce the complete scenario settings. Loading of previously generated scenario file is the most quick and easy way for test reproduction.</p>
Save/Recall Settings	*.fad	<p>The file is created by the standard "Save/Recall" function of the instrument and contains the full set of fading related settings as configured by the user.</p> <p>Files created with this function can be reloaded at any further moment. With "Fading &gt; State &gt; ON", the firmware loads the *.fad file, searches for and loads the last created file *.fad_udyn and starts the signal generation without further calculations.</p> <p>To maintain simulation times, new calculation according to the current dynamic scenario simulation related settings is triggered only in case no *.fad_udyn file is available. The executed internal procedure is identical to the one triggered manually by means of the <a href="#">Create</a> function.</p>
Fader Profile	*.fad_udyn	<p>The fader profile file is created whenever the <a href="#">Create</a> function is triggered, internally or manually, and contains all the scenario related settings without the settings associated with the fading simulator itself.</p>
Vehicle Description	*.xvd	<p>The *.xvd file contains description of a vehicle as list of its significant parameters and their allowed maximum values.</p> <p>The currently selected *.xvd file or the vehicle related settings are considered only and whenever the <a href="#">Create</a> function is triggered.</p> <p>See <a href="#">chapter 4.12.6.1, "Vehicle Description files"</a>, on page 90 for description of the file format.</p>
Trajectory Description	*.xtd	<p>The files contains the description of the movement profile of a vehicle.</p> <p>The currently selected *.xtd file or the trajectory related settings are considered only and whenever the <a href="#">Create</a> function is triggered.</p> <p>See <a href="#">chapter 4.12.6.2, "Trajectory Description Files"</a>, on page 91 for description of the file format.</p>

The automatically generated files are stored in a predefined folder structure. The vehicle description files are stored in the corresponding folder under `..\Lists\Fad\DynScenSim\ResourceLib\`. The temporary trajectory description files are stored under `..\Lists\Fad\DynScenSim\`.

#### 4.12.6.1 Vehicle Description files

The vehicle description files use the file extension \*.xvd. The following is an example of the file format.



```

<vehicle>
  <info name="General Dynamics F-16E"/>
  <limits>
    <property maxspeed="555.0"/>
    <property minspeed="55.0"/>
    <property maxg="9"/>
    <property ming="-3"/>
    <property maxclimbrate="254"/>
    <property serviceceiling="18000"/>
    <property maxrange="4000"/>
  </limits>
</vehicle>

```

The [table 4-8](#) describes the used tags and parameters.

**Table 4-8: Format of \*.xvd file**

Container	Tag name	Parameter	Description
<b>&lt;info&gt;</b>			
	<name>		Vehicle name
<b>&lt;limits&gt;</b>			
	<property>	<maxspeed>	Maximal allowed speed; for aircrafts the airspeed
		<minspeed>	Minimal allowed speed; for aircrafts the airspeed
		<maxg>	Maximal G-Factor
		<ming>	Minimal G-Factor
		<maxclimbrate>	Maximal Climb Rate (for aircrafts)
		<serviceceiling>	Maximal operating altitude (for aircrafts)
		<maxrange>	Maximal range of coverage

#### 4.12.6.2 Trajectory Description Files

The Trajectory description files use the file extension \*.xtd. The following is an example of the file format.

```

<trajectory>
  <general>
    <info name="straight line"/>
    <property enurefpoint="0.0,0.0,0.0"/>
    <property endbehaviour="return"/>
    <property noofwaypoints="2"/>
    <property duration="60"/>
  </general>
  <waypoints>
    <enupoint coord="0,0,18" veloc=""/>
    <enupoint coord="5.59222e-10,-1800,18" veloc=""/>
  </waypoints>
</trajectory>

```

```
</waypoints>
</trajectory>
```

The [table 4-9](#) describes the used tags and parameters.

**Table 4-9: Format of \*.xtd file**

Container	Tag name	Parameter	Description
<general>			
	<info>	<name>	Name of the trajectory
	<property>	<enurefpoint>	Coordinates of the reference waypoint in the geodetic ENU format
		<endbehaviour>	Determines the behavior of the moving object at the end of the trajectory. The possible values are: "loop", "return", "stop", "restart"
		<noofwaypoints>	Number of the used waypoints
		<duration>	Duration of the trajectory in meter
<waypoints>			Description of the trajectory as a list of waypoints. The coordinates of a waypoint can be defined in ENU, Cartesian or geodetic coordinate system, as defined with the selected tag. One trajectory description may contains waypoints described in different coordinate systems.
	<enupoint> / <cartesianpoint> / <geodeticpoint>	<coord>	Coordinates of the waypoint in the corresponding format, defined with the tag
		<veloc>	Speed of the waypoint

### 4.12.6.3 AGI STK Ephemeris File Format

The AGI STK ephemeris file is a proprietary file format from the AGI company developed for the mission analyzing software application STK. The ephemeris file is a text file with an extension \*.e. The file contains keywords recognized by the STK software, e.g *EphemerisTimePosVel* and *ScenarioEpoch* and describes the position and velocity of the vehicle in form of a table.

A Cartesian position described with the *EphemerisTimePosVel* format has the following format:

```
<TimeInSeconds> <X> <Y> <Z> <xDot> <yDot> <zDot>, where
```

<TimeInSeconds> is the time value of the point in seconds (in the format xxxx.xxx) relative to the epoch as defined by the *ScenarioEpoch* keyword.

<X> <Y> <Z> - vehicle position, in meters

<xDot> <yDot> <zDot> - vehicle velocity, in m/s



For more detailed description of the AGI STK ephemeris file format, refer to <http://www.stk.com/resources/help/online/stk/source/stk/importfiles-02.htm>.

#### 4.12.6.4 Time, Propagation Delay, Attenuation File Format (TPA)

The TPA file format is a Rohde&Schwarz proprietary text file format using a single line description with the following structure:

```
<Time (hh:mm:ss:cc)/(dec seconds)> <Path delay (double)> <Path loss>
```

The firmware calculates the Doppler frequency internally.

Examples of the TPA file are given bellow.

```
00:00:01.30 5.0000e-6 9.1
00:00:03.90 5.0000e-6 9.1
00:00:06.50 5.0125e-6 9.3
00:00:09.10 5.0125e-6 9.3
00:00:11.70 5.0125e-6 9.2
00:00:14.30 5.0125e-6 9.2
00:00:16.90 5.0375e-6 9.0
00:00:18.20 5.0375e-6 8.9
00:00:19.50 5.0375e-6 8.9
00:00:20.80 5.0375e-6 8.8
```

or

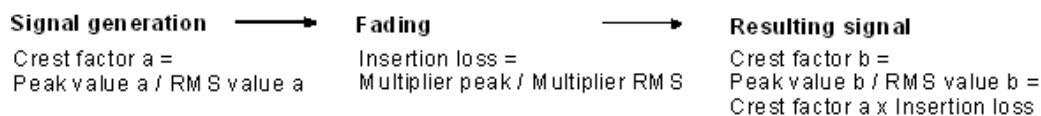
```
1.22 5.0000e-6 9.1
4.34 5.0000e-6 9.1
6.46 5.0125e-6 9.3
8.12 5.0125e-6 9.3
```

## 4.13 Insertion Loss Configuration...

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 Rayleigh 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 Rayleigh 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.

#### **Example: 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 us and 1 us, respectively, on the fader.

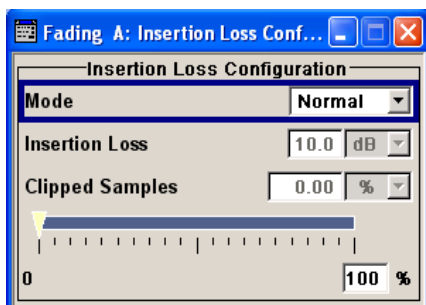
The symbol rates of the modulation signal are in the range of the delay differences of the fading paths; the autocorrelation of the modulation data (PRBS9) to the adjacent symbol data is not equal to 0. The fading process is therefore statistically not independent of the process of generating the modulation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

**Example: 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**

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".

"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".

"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.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:ILOSs:MODE](#) on page 205

**Insertion Loss**

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

Entry of the insertion loss in "User" mode.

SCPI command:

[\[:SOURce<hw>\]:FSIMulator:ILOSs\[:LOSS\]](#) on page 206

**Clipped Samples**

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).

SCPI command:

[\[:SOURCE<hw>\]:FSIMulator:ILOSs:CSAMples](#) on page 205

**0 ... 100 %**

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

## 5 Multiple Input Multiple Output

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.

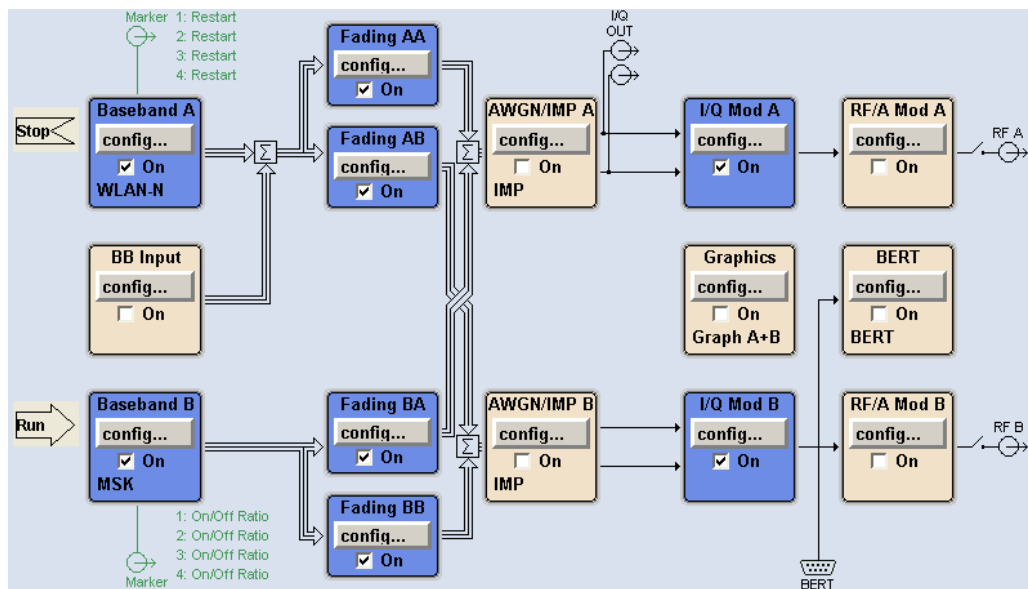
The benefits of an MIMO system became visible only if the data signal is tested in a fading simulation. The MIMO fading option takes account to this special form of multipath propagation in channel simulation.

Depending on the number of the transmitting and receiving antennas used in a MIMO system, different MIMO test configurations, such as 2x2, 2x3, 2x4, 3x2 or 4x2 MIMO systems, are specified.

Normally, the simulation of a system with two transmitting and two receiving antennas requires two signal generators and four fading simulator. The R&S MIMO (Multiple Input Multiple Output) Fading option (K74) enables the simulation of 1x2, 2x1 and 2x2 MIMO receiver tests scenarios with one single instrument.

By combining two instruments, receiver tests scenarios for 1x3, 1x4, 2x3, 2x4, 3x1, 4x1, 3x2 and 4x2 MIMO could be simulated. Refer to [chapter 5.1, "MxN MIMO Test Configurations"](#), on page 98 for information about how to enable two R&S Signal Generators to work in the different MIMO configurations.

In each of the MIMO test configurations, the two fading channels are divided into four subchannels (see block diagram). The four subchannels cannot be configured differently, i.e. all subchannels are running under the same fading configuration and the same path configuration and the same fading path configurations.



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

**Table 5-1: Available fading paths per subchannel and 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.

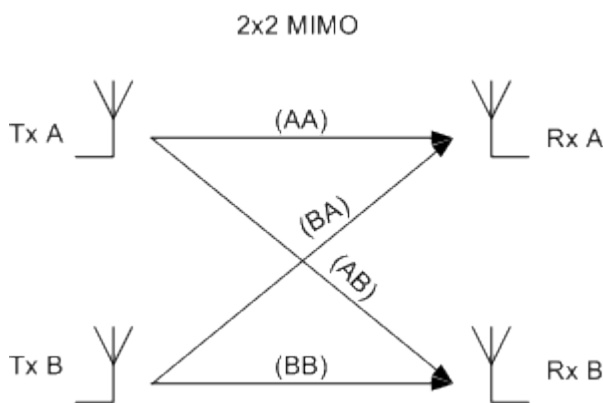
## 5.1 MxN MIMO Test Configurations

The R&S MIMO Fading option (K74) enables the simulation of 1x2, 2x1 and 2x2 MIMO receiver tests scenarios with one single instrument.

Two R&S Signal Generators are required for the simulation of 2x3, 2x4, 4x2 and 3x2 MIMO modes. To enable the R&S Signal Generators to work in one of this MIMO modes, the instruments have to be configured and connected as described in the following sections.

### 5.1.1 2x2 MIMO Configuration

2x2 MIMO is a system with two transmitting antennas (Tx A and Tx B), two receiving antennas (Rx A and Rx B) and four fading paths (AA, AB, BA and BB).



**Fig. 5-1: 2x2 MIMO system**

The following table gives an overview of the R&S Signal Generators and options required for the simulation of 2x2 MIMO systems.

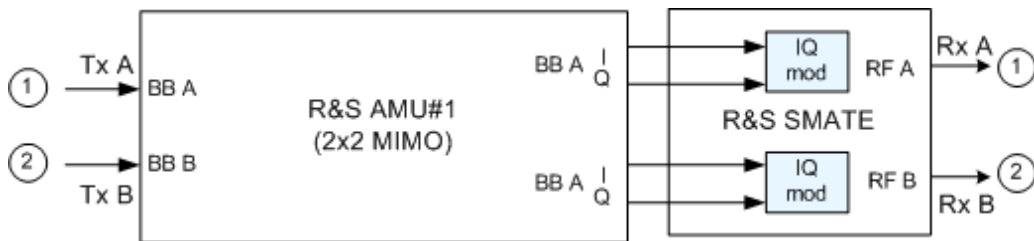


**Table 5-2: Prerequisites for 2x2 MIMO simulation**

Frequency	Instrument	Options	Additional Equipment
Up to 3 GHz	1x R&S SMU	SMU-B14, SMU-B15, SMU-K74	-
Up to 6 GHz	1x R&S AMU + 1x R&S SMATE	AMU-B14, AMU-B15, AMU-K74	4 connecting cables with the same length and type

For the simulation of 2x2 MIMO mode up to 3 GHz only one R&S SMU is required and no additional cabling is necessary.

The figure below shows the cabling of two R&S AMUs and one R&S SMATE for working in 2x2 MIMO mode for up to 6GHz.

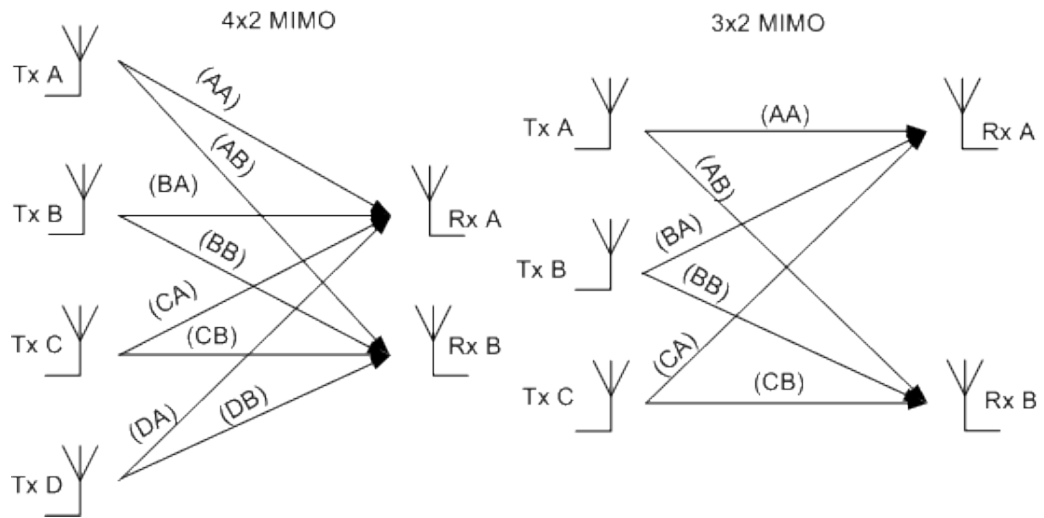


**Fig. 5-2: 2x2 MIMO up to 6GHz with two R&S AMUs and one R&S SMATE**

### 5.1.2 4x2 and 3x2 MIMO Configuration

4x2 MIMO is a system with four transmitting antennas (Tx A, Tx B, Tx C and Tx D), two receiving antennas (Rx A and Rx B) and eight fading paths (AA, AB, BA, BB, CA, CB, DA and DB).

In the R&S Signal Generator, the 3x2 MIMO configuration is implemented as a subsystem of 4x2 in that the fourth transmitting antenna and the last two fading paths are not considered.



**Fig. 5-3: 4x2 MIMO and 3x2 MIMO systems**

The following table gives an overview of the R&S Signal Generators and options required for the simulation of 4x2 and 3x2 MIMO system.

**Table 5-3: Prerequisites for 4x2 and 3x2 MIMO simulation with R&S Signal Generators**

Frequency	Instrument	Options	Additional Equipment
Up to 3 GHz	2x R&S SMU	SMU-B14, SMU-B15, SMU-K74 per instrument	<ul style="list-style-type: none"> <li>Connecting cables with the same length and type</li> <li>2x standard RF Combiner</li> <li>External Trigger Source</li> <li>External Ref. Frequency Source (optional)</li> </ul>
Up to 6 GHz	2x R&S AMU + 1x R&S SMATE	AMU-B14, AMU-B15, AMU-K74 per instrument	<ul style="list-style-type: none"> <li>Connecting cables with the same length and type</li> <li>1x R&amp;S AMU - Z7 (I/Q Combiner)</li> <li>External Trigger Source</li> <li>External Ref. Frequency Source (optional)</li> </ul>

The figure below shows the cabling of two R&S SMUs (up to 3 GHz) for working in 4x2 or 3x2 MIMO mode.

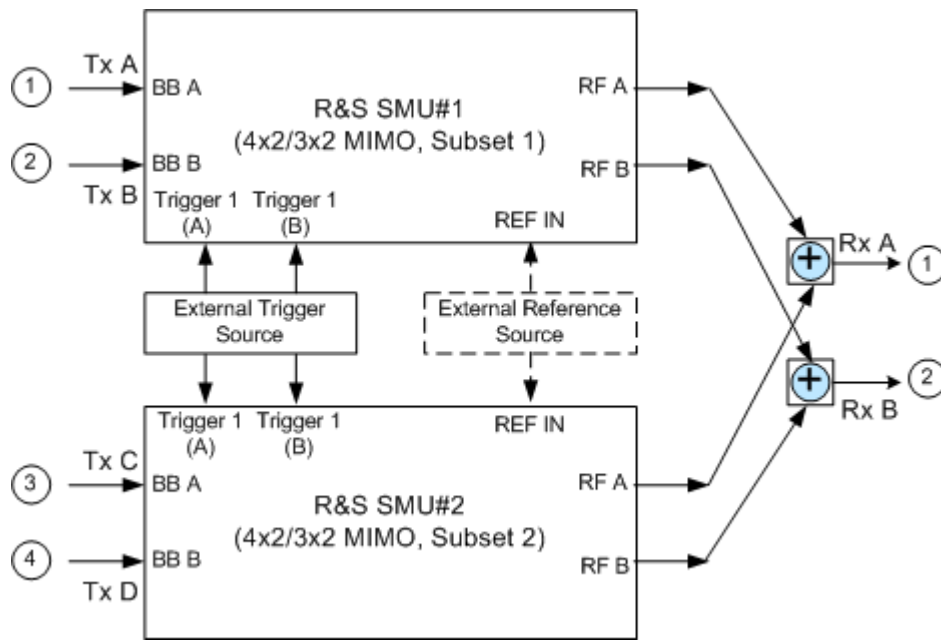


Fig. 5-4: 4x2/3x2 MIMO up to 3GHz with two R&S SMUs and two RF Combiners

The figure below shows the cabling of two R&S AMUs and one R&S SMATE for working in 4x2 or 3x2 MIMO mode for up to 6GHz.

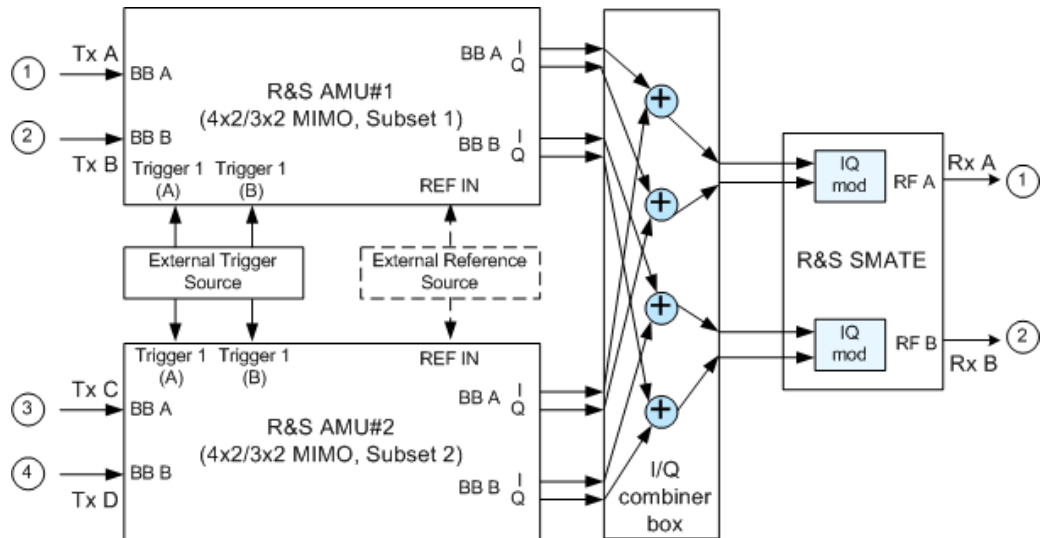


Fig. 5-5: 4x2/3x2 MIMO up to 6GHz with two R&S AMUs, one R&S SMATE and one I/Q combiner

Refer to [chapter 5.1.4, "Connecting two R&S Signal Generators for MxN MIMO Simulation"](#), on page 104 and [chapter 5.1.5, "Configuring two R&S Signal Generators for MxN MIMO Simulation"](#), on page 104 for detailed information on how to connect and configure the two R&S Signal Generators.

### 5.1.3 2x4 and 2x3 MIMO Configuration

2x4 MIMO is a system with two transmitting antennas (Tx A and Tx B), four receiving antennas (Rx A, Rx B, Rx C and Rx D) and eight fading paths (AA, AB, AC, AD, BA, BB, BC, and BD).

In the R&S Signal Generator, the 2x3 MIMO configuration is implemented as a subsystem of 2x4 in that the fourth receiving antenna and the two fading paths to this antenna are not considered.

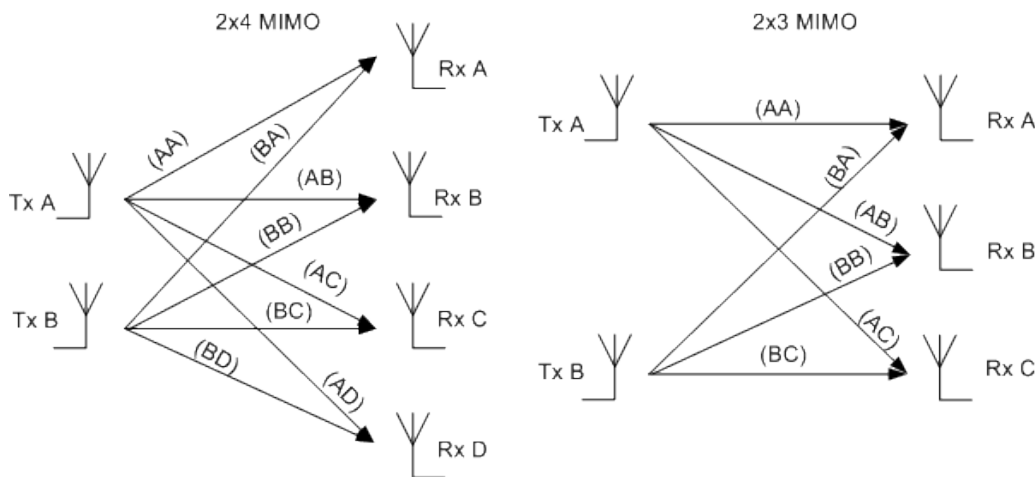


Fig. 5-6: 2x4 MIMO and 2x3 MIMO systems

The following table gives an overview of the R&S Signal Generators and options required for the simulation of 2x4 and 2x3 MIMO system.

Table 5-4: Prerequisites for 2x4 and 2x3 MIMO simulation with R&S Signal Generators

Frequency	Instrument	Options	Additional Equipment
Up to 3 GHz	2x R&S SMU	SMU-B14, SMU-B15, SMU-K74 per instrument	<ul style="list-style-type: none"> <li>Connecting cables with the same length and type</li> <li>External Trigger Source</li> <li>External Ref. Frequency Source (optional)</li> </ul>
Up to 6 GHz	2x R&S AMU + 2x R&S SMATE	AMU-B14, AMU-B15, AMU-K74 per instrument	<ul style="list-style-type: none"> <li>Connecting cables with the same length and type</li> <li>External Trigger Source</li> <li>External Ref. Frequency Source (optional)</li> </ul>

The figure below shows the cabling of two R&S SMUs (up to 3 GHz) for working in 2x4 or 2x3 MIMO mode.

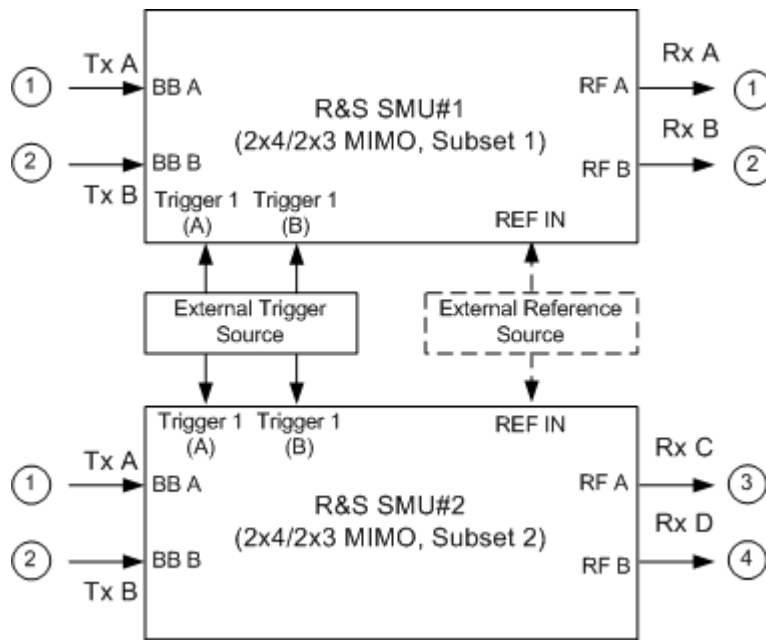


Fig. 5-7: 2x4/2x3 MIMO up to 3GHz with two R&S SMUs

The figure below shows the cabling of two R&S AMUs and two R&S SMATE for working in 2x4 or 2x3 MIMO mode for up to 6GHz.

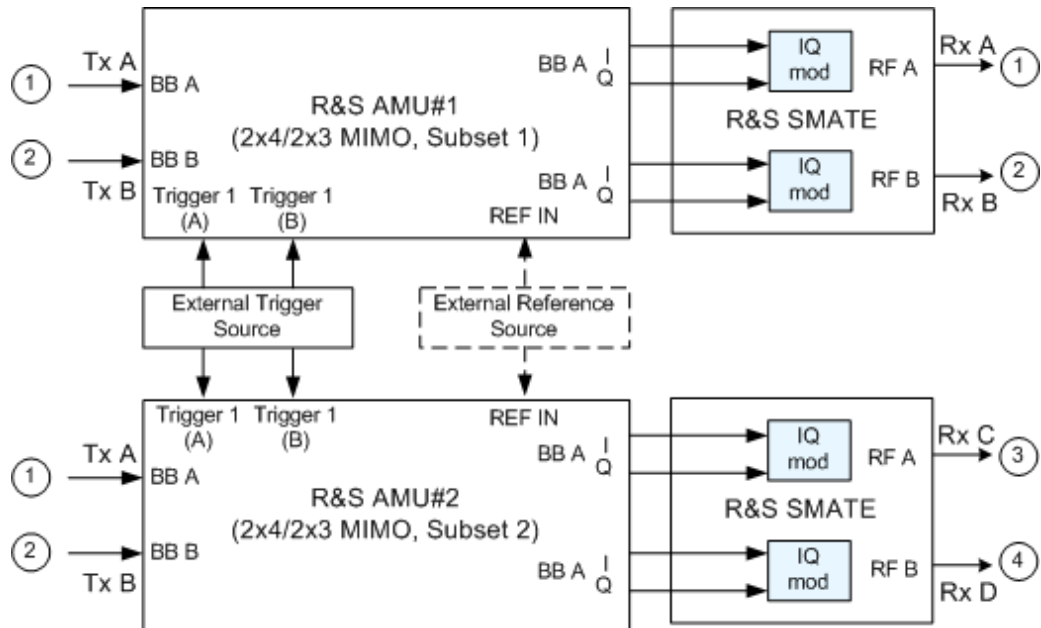


Fig. 5-8: 2x4/2x3 MIMO up to 6GHz with two R&S AMUs and two R&S SMATEs

Refer to [chapter 5.1.4, "Connecting two R&S Signal Generators for MxN MIMO Simulation"](#), on page 104 and [chapter 5.1.5, "Configuring two R&S Signal Generators for MxN MIMO Simulation"](#), on page 104 for detailed information on how to connect and configure the two R&S Signal Generators.

### 5.1.4 Connecting two R&S Signal Generators for MxN MIMO Simulation

For simulating of 2x3, 3x2, 2x4 or 4x2 MIMO system that requires two R&S Signal Generators, the instruments have to be connected as follow:

1. To provide the instruments with reference frequency, connect either the inputs REF IN of both instruments to the external reference source or connect the output REF OUT of the first instrument (the R&S Signal Generator that will simulate Tx 1) to the input REF IN of the second one.
2. The inputs TRIGGER 1 for both paths of both instruments have to be connected to the external trigger source.
3. For simulation of a 4x2 or 3x2 MIMO mode up to 3 GHz, the outputs RF A of both instrument have to be connected to the first RF Combiner and respectively the RF B outputs of both instruments to the second RF Combiner.
4. For simulation of a 4x2 or 3x2 MIMO mode up to 6 GHz, the I and Q outputs of both instrument have to be connected to the I/Q Combiner Box and the I and Q outputs of the I/Q Combiner Box have to be connected to the I and Q inputs of the R&S SMATE as shown on the [figure 5-5](#).
5. For simulation of a 2x4 or 2x3 MIMO mode up to 6 GHz, the two R&S AMUs and two R&S SMATEs have to be connected as a chain (see [figure 5-8](#)).
6. The connecting cables must have the same length and type, concerning all the REF OUT to REF IN, External Trigger Source to TRIGGER 1 and RF Outputs to RF Combiner connections.
7. Unnecessary cable lengths and branching points have to be avoided.

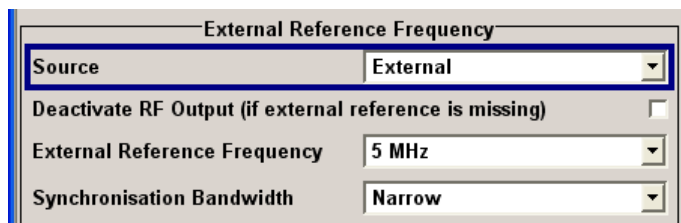
### 5.1.5 Configuring two R&S Signal Generators for MxN MIMO Simulation

After the instruments had been connected as described in [chapter 5.1.4, "Connecting two R&S Signal Generators for MxN MIMO Simulation"](#), on page 104 the instruments have to be configured.

For working in a MIMO configuration with two R&S Signal Generators, the instruments have to be configured as follow:

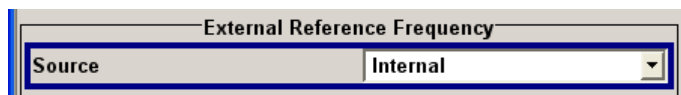
1. Configure the Reference Oscillator Settings, depending on whether an External Reference Source or the Reference Signal (REF OUT) of the first instrument is used.

- a) Select "External Reference Frequency Source" for both instruments and configure the "Synchronization Bandwidth" and the "External Reference Frequency" accordingly.



SCPI Command: `SOUR:ROSC:SOUR EXT`

- b) Use the Reference Frequency of the first instrument, i.e. select an "Internal Reference Frequency Source" for the first instrument and an External one for the second instrument.



SCPI command (R&S Signal Generator #1): `SOUR:ROSC:SOUR INT`

SCPI command (R&S Signal Generator #2): `SOUR:ROSC:SOUR EXT`

2. For both instruments, select an "External Trigger Source" for the selected digital standard.



SCPI command: `SOUR:BB:<Digital Standard>:TRIG:SOUR`

3. Set the MIMO Fading Settings:
- Select the "MIMO mode" (2x4, 4x2, 2x3 or 3x2)  
SCPI command:  
`SOUR:FSIM:ROUT FA1A2BFB1A2BM24|FA1A2BFB1A2BM42|FA1A2BFB1A2BM23|FA1A2BFB1A2BM32`
  - Set the "MIMO Subset" (Subset 1 for R&S Signal Generator #1 and Subset 2 for R&S Signal Generator #2 respectively)  
SCPI command:  
`SOUR:FSIM:MIMO:SUBS SET1|SET2`
  - Configure the MIMO Correlation Matrix  
SCPI command:  
`SOUR:FSIM:MIMO:TAP:MATR:ROW2:COL2:RAT 0,6`  
The values in the matrix diagonal are usually set to 1. Values different than 1 can be used to simulate antennas with different power level (steering).  
For information on how to calculate the resulting power level of each path, refer to "MIMO Fading Power Correction" in the Operating Manual.
4. Set the "Start Seed" of the instruments to different values.  
SCPI command (R&S Signal Generator #1): `SOUR:FSIM:GLOB:SEED 5`  
SCPI command (R&S Signal Generator #2): `SOUR:FSIM:GLOB:SEED 1`

5. Enable both instruments to calculate the same MIMO matrix:
  - a) Save the MIMO Settings of the Instrument#1, copy the settings file to USB stick, external USB HDD, or use a LAN connection to transfer the settings file.  
SCPI command (R&S Signal Generator #1):  
`SOUR:FSIM:MIMO:MDST "c:/MIMO_Settings/4_2_mimo_settings"`
  - b) Connect the USB stick or the USB HDD to USB connector of Instrument#2 and copy the MIMO Settings to the instrument's target directory, e.g. `c:/MIMO_Settings_Instrument1`.
  - c) Load the MIMO Settings of R&S Signal Generator #1 to R&S Signal Generator #2  
SCPI command (R&S Signal Generator #2):  
`SOUR:FSIM:MIMO:MDL "c:/MIMO_Settings_Instrument1/4_2_mimo_settings"`
  
6. Enable both instruments to generate the same Tx signal:
  - a) Enable the Path A and Path B of the first instrument to generate the signal according to the desired digital standard.
  - b) Save the settings of the selected digital standard by means of the "Save/Recall" function and copy the settings file to USB stick, external USB HDD, or use a LAN connection to transfer the settings file.  
SCPI command (R&S Signal Generator #1):  
`SOUR1|2:BB:<Digital Standard>:SETT:STOR "c:/MIMO_Settings/digital_standard_settings"`
  - c) Connect the USB stick or the USB HDD to USB connector of Instrument#2 and copy the settings file to the instrument's target directory, e.g. `c:/MIMO_Settings_Instrument1`.
  - d) Load the settings file of R&S Signal Generator #1 to R&S Signal Generator #2 and activate the digital standard in the second one.  
SCPI command (R&S Signal Generator #2):  
`SOUR1|2:BB:<Digital Standard>:SETT:LOAD "c:/MIMO_Settings_Instrument1/digital_standard_settings"`  
`SOUR:BB:<Digital Standard>:STAT ON`
  
7. For 4x2 and 3x2 MIMO configurations, enable the instruments to generate the signal of 4 different antennas.



## a) Example (EUTRA/LTE):

- For R&S Signal Generator #1: in the General DL Settings menu, select Global MIMO Configuration with 4 antennas and enable Path A and Path B to simulate Antenna 1 and Antenna 2 respectively.

MIMO	
Global MIMO Configuration	4 TxAntennas
Simulated Antenna Path A	Antenna 1
Simulated Antenna Path B	Antenna 2

SCPI command (R&S Signal Generator #1):

```
SOUR:BB:EUTR:DL:MIMO:CONF TX4
SOUR:BB:EUTR:DL:MIMO:ANTA ANT1
SOUR:BB:EUTR:DL:MIMO:ANTB ANT2
```

- For R&S Signal Generator #2, enable Path A and Path B to simulate Antenna 3 and Antenna 4 respectively.

SCPI command (R&S Signal Generator #2):

```
SOUR:BB:EUTR:DL:MIMO:CONF TX4
SOUR:BB:EUTR:DL:MIMO:ANTA ANT3
SOUR:BB:EUTR:DL:MIMO:ANTB ANT4
```

## b) Example (WiMAX):

- For R&S Signal Generator #1, select Space-Time Coding Mode with 4 antennas, enable configuration of Path B from Path A and enable Path A to simulate Antenna 0. Path B will automatically generate the signal of Antenna 1.

Configure Baseband B from Baseband A	<input checked="" type="checkbox"/>
Space-Time Coding Mode	4 Antennas, Matrix A
Space-Time Coding Antenna	Antenna 0

SCPI command (R&S Signal Generator #1):

```
SOUR:BB:WIM:PATH:COUP:STAT ON
SOUR:BB:WIM:AOFD:ZONE1:STC:MODE MA4|MB4|MC4
SOUR:BB:WIM:AOFD:ZONE1:STC:ANT ANT0
```

- For R&S Signal Generator #2, enable Path A to simulate Antenna 2. Path B will automatically generate the signal of Antenna 3.

SCPI command (R&S Signal Generator #2):

```
SOUR:BB:WIM:PATH:COUP:STAT ON
SOUR:BB:WIM:AOFD:ZONE1:STC:MODE MA4|MB4|MC4
SOUR:BB:WIM:AOFD:ZONE1:STC:ANT ANT3
```

## 5.2 MIMO Settings

The MIMO fading is set in the "Fading" functional block.

### 5.2.1 MIMO Mode and MIMO Subset

MIMO	
<input type="checkbox"/>	1x2 MIMO + Addition Baseband B
<input type="checkbox"/>	2x2 MIMO
<input type="checkbox"/>	2x4 MIMO
<input type="checkbox"/>	4x2 MIMO
<input type="checkbox"/>	2x3 MIMO
<input type="checkbox"/>	3x2 MIMO
MIMO Subset	
<input checked="" type="checkbox"/>	Subset 1
<input type="checkbox"/>	Subset 2

The MIMO mode selected in section "MIMO" defines the signal routing.



MIMO modes different than 2x2 or 2x1 MIMO require two R&S Signal Generators (see [chapter 5.1, "MxN MIMO Test Configurations"](#), on page 98).

#### MIMO Subset

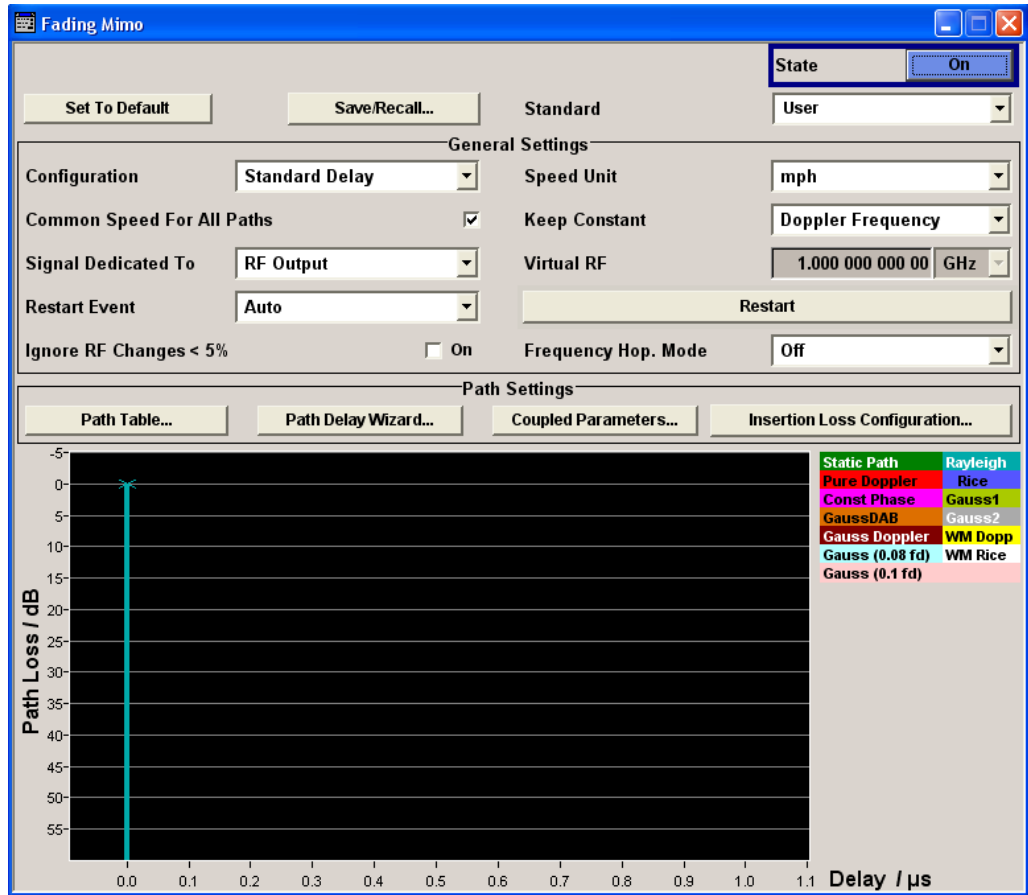
While simulating a MIMO mode with two R&S Signal Generators, the "MIMO Subset" defines which fading paths from the MIMO matrix are calculated by the selected instrument. The "MIMO Subset" selected in each of the two connected instrument has to be different.

SCPI command:

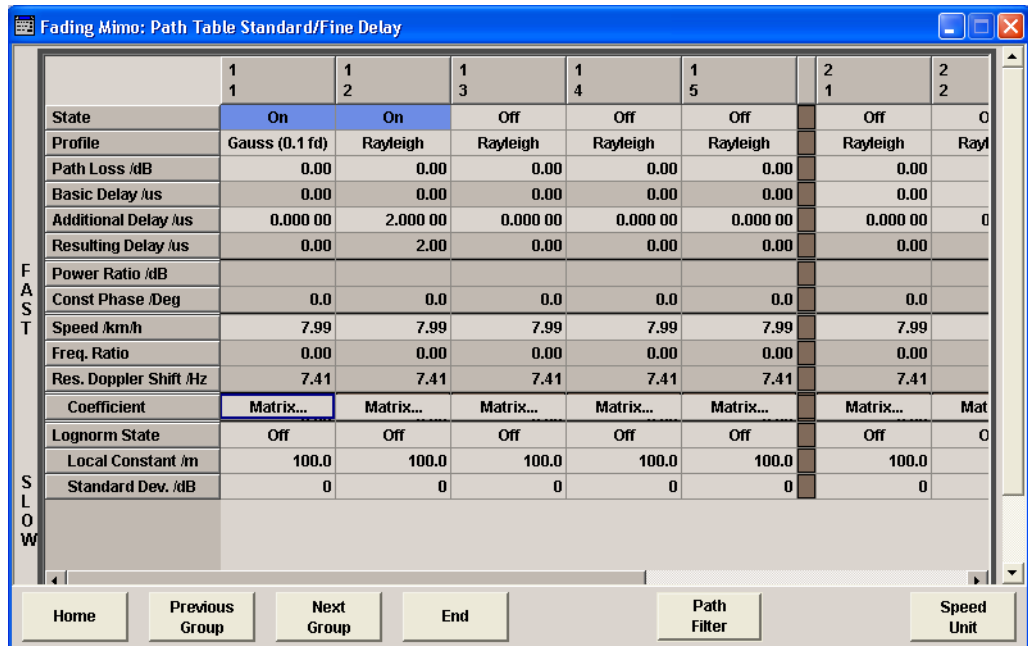
`[ :SOURce<hw> ] :FSIMulator:MIMO:SUBSet` on page 255

### 5.2.2 Fading MIMO

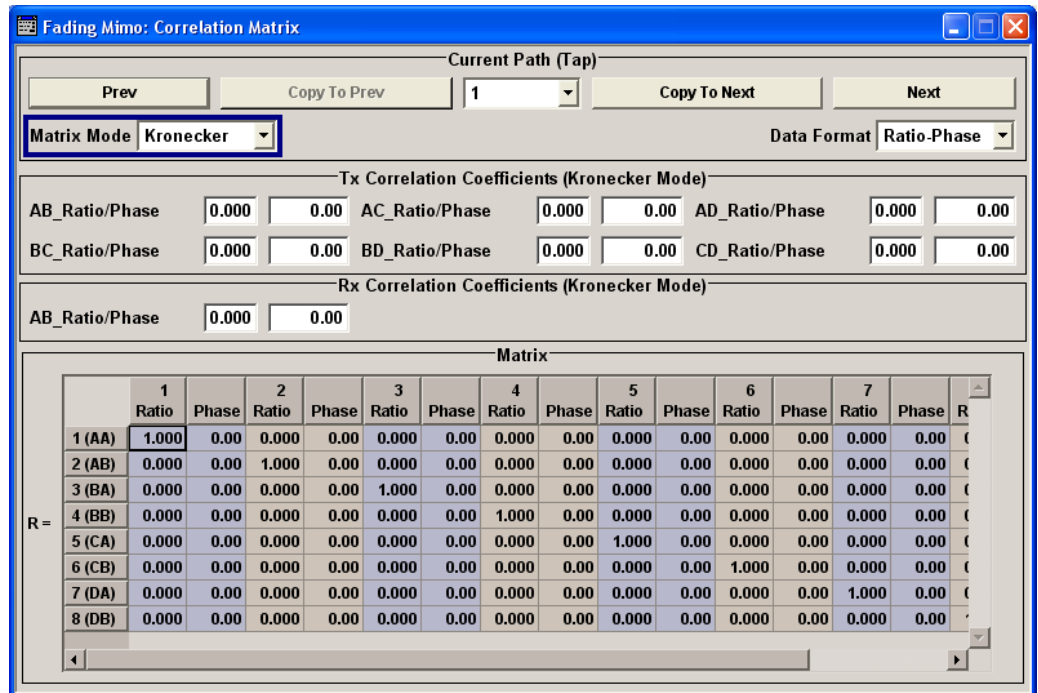
The "Fading MIMO" dialog for the four subchannels (per instrument) can be called via the Fader dialog of one of the four "Fader" blocks.



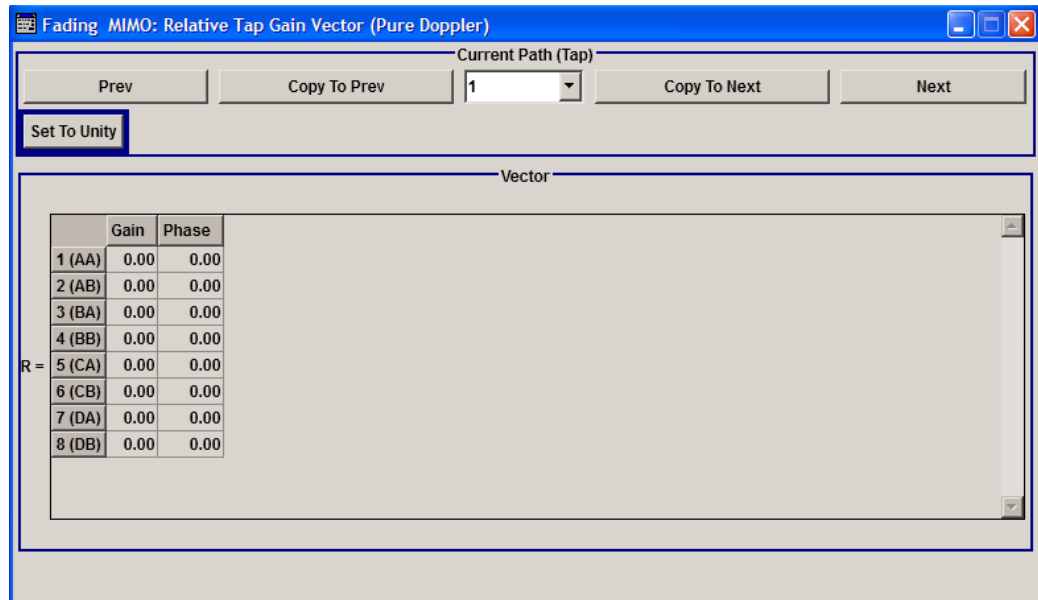
The "MIMO fading: Path Table" offers an additional button "Matrix/Vector" in the "Coefficient" row to configure the correlation between the transceivers.



- The "Fading MIMO: Correlation Matrix" dialog comprises the parameters necessary to adjust the correlation between the subchannels (maximum 8).



- The "Fading MIMO: Relative Tap Gain Vector" dialog is provided for the "Pure Doppler Fading Profile" only. This dialog provides additional parameters to simulate a phase shift between the signals with constant fading transmitted over the different Tx antennas, see [chapter 5.2.6, "Relative Gain Vector Matrix"](#), on page 117.



**Prev**

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

SCPI command:

n.a.

**Copy To Prev**

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

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:MIMO:COPY:PREVIOUS` on page 253

**Current Path (Tap)**

Selects the tap to be displayed.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:MIMO:TAP` on page 255

**Copy To Next**

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.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:MIMO:COPY:NEXT` on page 252

**Next**

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

SCPI command:

n.a.

**Matrix Mode**

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

- |              |   |
|--------------|---|
| "Individual" | Allows entering the correlation values individually.  |
| "Kronecker"  | <p>Opens additional input fields for entering the Rx correlation and Tx correlation values, see <a href="#">chapter 5.2.3, "Correlation Coefficients"</a>, on page 112.</p> <p>In this mode, the matrix values are calculated automatically due to the values in the input fields.</p>  |
| "AoA / AoD"  | <p>Opens additional input fields for defining the Rx and TX correlation parameters based on the Spatial Channel Model (SCM), see <a href="#">chapter 5.2.4, "Spatial Channel Model (SCM) Settings"</a>, on page 114.</p> <p>In this mode, the matrix values are calculated automatically due to the values in the input fields.</p> |

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:MATRIX:MODE` on page 261

**Data Format**

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.

"Real-Imag" Displays the matrix values as complex numbers.

SCPI command:

n . a .

**5.2.3 Correlation Coefficients****Rx Correlation Coefficients AA/AB/AC/AD/BC/BD/CD Ratio/Real**

(for "Kronecker" mode only)

Enters the value for the real/ratio part of the receiver correlation ( $\rho^{(l)}_{RX}$ ).

The available Rx Correlation Coefficients depends on the selected MIMO mode:

- For 2x2, 4x2, and 3x2 MIMO configurations, only one correlation coefficient AB is necessary.  
The Rx correlation AB is the correlation between AA $\leftrightarrow$ BA and BB $\leftrightarrow$ AB.
- There are six Rx correlation coefficients in case of 2x4 MIMO mode configuration.  
The Rx correlation coefficients AB, AC, AD, BC, BD and CD represent the correlations between A $\leftrightarrow$ B, A $\leftrightarrow$ C, A $\leftrightarrow$ D, B $\leftrightarrow$ C, B $\leftrightarrow$ D and C $\leftrightarrow$ D.
- Four Rx correlation coefficients are available for 2x3 MIMO mode configuration.  
The Rx correlation coefficients AA, AB, AC and BC represent the correlations between A $\leftrightarrow$ B and B $\leftrightarrow$ C.

**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.

SCPI command:

For "Data Format" = "Ratio-Phase"

`[ :SOURCE<hw> ] :FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AC:RATio` on page 257

For "Data Format" = "Real-Imag"

`[ :SOURCE<hw> ] :FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AC:REAL` on page 257

**Rx Correlation Coefficients AA/AB/AC/AD/BC/BD/CD Phase/Imag**

(for "Kronecker" mode only)

Enters the value for the phase/imaginary part of receiver correlation ( $\rho^{(l)}_{RX}$ ).

The available Rx Correlation Coefficients depends on the selected MIMO mode:

- For 2x2, 4x2, and 3x2 MIMO configurations, only one correlation coefficient AB is necessary.  
The Rx correlation AB is the correlation between AA $\leftrightarrow$ BA and BB $\leftrightarrow$ AB.
- There are six Rx correlation coefficients in case of 2x4 MIMO mode configuration.  
The Rx correlation coefficients AB, AC, AD, BC, BD and CD represent the correlations between A $\leftrightarrow$ B, A $\leftrightarrow$ C, A $\leftrightarrow$ D, B $\leftrightarrow$ C, B $\leftrightarrow$ D and C $\leftrightarrow$ D.

- Four Rx correlation coefficients are available for 2x3 MIMO mode configuration. The Rx correlation coefficients AA, AB, AC and BC represent the correlations between A $\leftrightarrow$ B and B $\leftrightarrow$ C.

**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.

SCPI command:

For "Data Format" = "Ratio-Phase"

`[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AC:IMAGinary` on page 256

For "Data Format" = "Real-Imag"

`[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AC:PHASE` on page 256

### Tx Correlation Coefficients AA/AB/AC/AD/BC/BD/CD Ratio/Real

(for "Kronecker" mode only)

Enters the value for the real/ratio part of the transceiver correlation ( $\rho_{Tx}^{(l)}$ ).

The available Tx Correlation Coefficients depends on the selected MIMO mode:

- For 2x2, 2x3 or 2x4 MIMO configurations, only one correlation coefficient AB is necessary. The Tx correlation AB is the correlation between AA $\leftrightarrow$ BA and BB $\leftrightarrow$ AB.
- There are six Tx correlation coefficients in case of 4x2 MIMO mode configuration. The Tx correlation coefficients AB, AC, AD, BC, BD and CD represent the correlations between A $\leftrightarrow$ B, A $\leftrightarrow$ C, A $\leftrightarrow$ D, B $\leftrightarrow$ C, B $\leftrightarrow$ D and C $\leftrightarrow$ D.
- Four Tx correlation coefficients are available for 3x2 MIMO mode configuration. The Tx correlation coefficients AA, AB, AC and BC represent the correlations between A $\leftrightarrow$ B and B $\leftrightarrow$ C.

**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.

SCPI command:

For "Data Format" = "Ratio-Phase"

`[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AC:RATio` on page 259

For "Data Format" = "Real-Imag"

`[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AC:REAL` on page 260

### Tx Correlation Coefficients AA/AB/AC/AD/BC/BD/CD Phase/Imag

(for "Kronecker" mode only)

Enters the value for the phase/imaginary part of the transceiver correlation ( $\rho_{Tx}^{(l)}$ ).

The available Tx Correlation Coefficients depends on the selected MIMO mode:

- For 2x2, 2x3 or 2x4 MIMO configurations, only one correlation coefficient AB is necessary. The Tx correlation AB is the correlation between AA $\leftrightarrow$ BA and BB $\leftrightarrow$ AB.
- There are six Tx correlation coefficients in case of 4x2 MIMO mode configuration. The Tx correlation coefficients AB, AC, AD, BC, BD and CD represent the correlations between A $\leftrightarrow$ B, A $\leftrightarrow$ C, A $\leftrightarrow$ D, B $\leftrightarrow$ C, B $\leftrightarrow$ D and C $\leftrightarrow$ D.

- Four Tx correlation coefficients are available for 3x2 MIMO mode configuration. The Tx correlation coefficients AA, AB, AC and BC represent the correlations between A->B and B->C.

**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.

SCPI command:

For "Data Format" = "Ratio-Phase"

`[ :SOURCE<hw> ] :FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AC:PHASE` on page 259

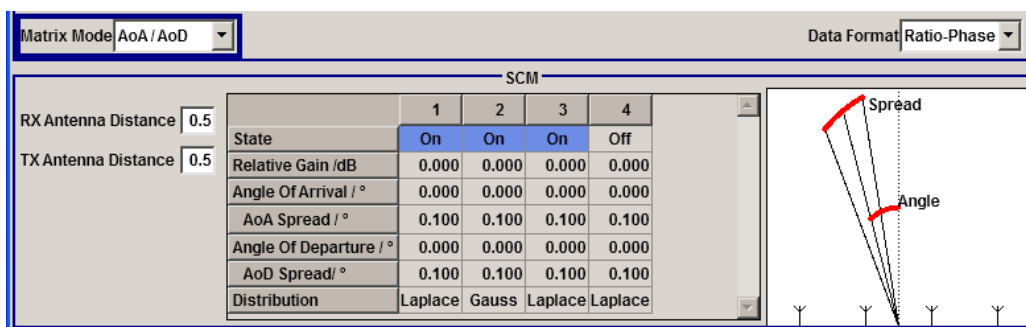
For "Data Format" = "Real-Imag"

`[ :SOURCE<hw> ] :FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AC:IMAGinary` on page 258

### 5.2.4 Spacial Channel Model (SCM) Settings

The spacial channel model (SCM) is specified as standard fading model in the 3GPP specifications, the IEEE 802.11n and the IEEE 802.20 standards. The spacial channel model is based on the so called rays, which are defined at the BS and MS side by their AoA (Angle of Arrival) and the AoD (Angle of Departure). The rays are distributed according to the selected statistic function and angle spread (AS).

In this implementation, one fading path consists by default of one ray but up to four rays may be enabled per path. The AoA (Angle of Arrival) / AoD (Angle of Departure) parameters, i.e. AoA/AoD angles, angle spreads (AS) and distribution of the rays, as well as the distances between the antennas at the Tx and the Rx side, are configurable.



#### RX/TX Antenna Distance

Determines the distance between the Tx and Rx antennas as function of the wave length lambda and is calculated as follow:

*Physical Antenna Distance* = "RX/TX Antenna Distance" \* lambda, where

the wave length  $\lambda = c / \text{"Frequency"}$  and  $c$  is the speed of light.

SCPI command:

`[ :SOURCE<hw> ] :FSIMulator:MIMO:SCM:ANTenna:DIStance:RX` on page 265

`[ :SOURCE<hw> ] :FSIMulator:MIMO:SCM:ANTenna:DIStance:TX` on page 265



**Ray State**

Enables/disables the selected ray.

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:STATe
```

on page 267

**Relative Gain /dB**

Sets the relative gain (in dB) of the selected ray.

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:GAIN on page 267
```

**Angle of Arrival (AoA)**

Sets the AoA (Angle of Arrival) of the selected ray.

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:ARRival:ANGLE
```

on page 266

**AoA Spread**

Sets the AoA (Angle of Arrival) spread (AS) of the selected ray.

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:ARRival:SPRead
```

on page 266

**Angle of Departure (AoD)**

Sets the AoD (Angle of Departure) of the selected ray.

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:DEParture:
```

```
ANGLE on page 266
```

**AoD Spread**

Sets the AoD (Angle of Departure) spread (AS) of the selected ray.

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:DEParture:
```

```
SPRead on page 266
```

**Distribution**

Select one of the proposed statistical functions to determine the distribution of the selected ray.

**Tip:** Use this parameter to simulate ray scattered due to obstacles with different surface (see also [example "Simulating one path SCM fading with two rays with different distributions"](#) on page 264).

SCPI command:

```
[ :SOURce<hw> ] :FSIMulator:MIMO:TAP<ch>:SCM:DISTriBution on page 265
```

### 5.2.5 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, the AoA /AoD mode or individually. The correlation matrix is valid for the selected fading path.



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		Con- flict
	Ratio	Phase	Ratio	Phase	Ratio	Phase	Ratio	Phase	
R = 1 (AA)	1.000	0.00	0.000	0.00	0.726	0.00	0.000	0.00	
2 (AB)	0.000	0.00	1.000	0.00	0.000	0.00	0.726	180.00	
3 (BA)	0.726	0.00	0.000	0.00	1.000	0.00	0.000	0.00	
4 (BB)	0.000	0.00	0.726	-180.00	0.000	0.00	1.000	0.00	

Accept

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

The values in the matrix diagonal are usually set to 1. Values different than 1 can be used to simulate antennas with different power level (steering).

For information on how to calculate the resulting power level of each path, refer to "MIMO Fading Power Correction" in the Operating Manual.

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

	user specified values
	automatically determined values
	steering matrix

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

$$R_j = R_{Tx}^{(j)} \otimes R_{Rx}^{(j)} \quad \text{with} \quad R_{Tx}^{(j)} = \begin{bmatrix} 1 & \rho_{Tx}^{(j)} \\ \rho_{Tx}^{(j)*} & 1 \end{bmatrix} \quad \text{and} \quad R_{Rx}^{(j)} = \begin{bmatrix} 1 & \rho_{Rx}^{(j)} \\ \rho_{Rx}^{(j)*} & 1 \end{bmatrix}$$

where  $\rho_{Rx}^{(j)}$  and  $\rho_{Tx}^{(j)}$  are the  $R_x$  and  $T_x$  correlations.

Evaluating the Kronecker product  $\otimes$  leads to:

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

**Real/Ratio**

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

SCPI command:

`[ :SOURCE<hw> ] :FSIMULATOR:MIMO:TAP<ch>:MATRIX:ROW<di>:COLUMN<st>:RATIO` on page 262

**Phase/Imag**

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

SCPI command:

`[ :SOURCE<hw> ] :FSIMULATOR:MIMO:TAP<ch>:MATRIX:ROW<di>:COLUMN<st>:PHASE` on page 261

**Conflict**

Indicates a matrix conflict.

SCPI command:

`[ :SOURCE<hw> ] :FSIMULATOR:MIMO:TAP<ch>:MATRIX:CONFLICT` on page 261

**Accept**

Accepts the values for the phase/imaginary and the real/ratio part of the correlation.

SCPI command:

`[ :SOURCE<hw> ] :FSIMULATOR:MIMO:TAP<ch>:MATRIX:ACCEPT` on page 260

## 5.2.6 Relative Gain Vector Matrix

The "Fading MIMO: Relative Tap Gain Vector" dialog is provided for the "Pure Doppler Fading Profile" only. This dialog provides additional parameters to simulate a phase shift between the signals with constant fading transmitted over the different Tx antennas.



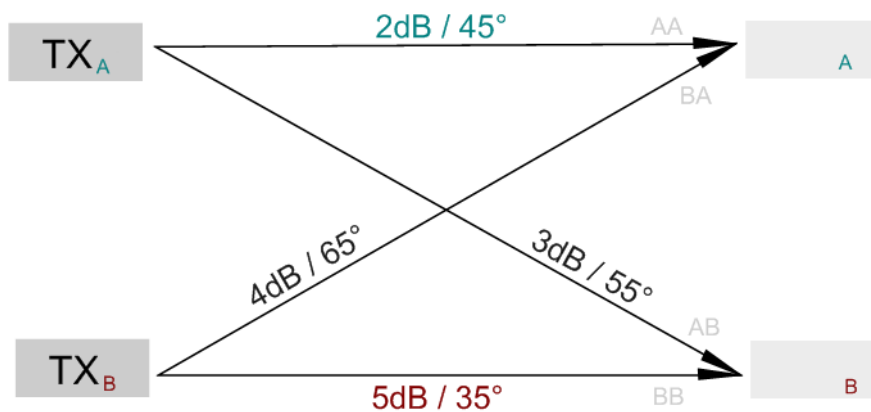
Use this function to simulate beamforming signal.

**Example:**

The following example illustrates the phase shift between the signals with a start phase of 45 degrees, PL = 2 dB, and the gain and phase settings shown below:

	Gain	Phase
1 (AA)	0.00	0.00
2 (AB)	-1.00	10.00
3 (BA)	-2.00	20.00
4 (BB)	-3.00	350.00

Resulting simulation:

**Set to Unity**

Presets the vector matrix to an unitary matrix.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:MIMO:TAP<ch>:GVECTOR:PRESet](#) on page 262

**Gain**

Defines the relative gain of the selected path.

A gain value of 0 dB means no loss, and e.g. -3 dB is loss in this path.

SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:MIMO:TAP<ch>:GVECTOR:AA:GAIN](#) on page 262

for the correct syntax of the SCPI command of the other paths, refer to the command description.

**Phase**

Defines the phase shift of the selected path.

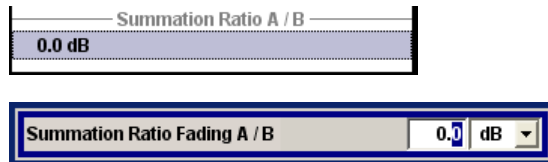
SCPI command:

[\[:SOURCE<hw>\]:FSIMULATOR:MIMO:TAP<ch>:GVECTOR:AA:PHASe](#) on page 263

for the correct syntax of the SCPI command of the other paths, refer to the command description.

## 6 Summation Ratio A/B

The "Summation Ratio A/B" menu is called up either in the "Fading" block or using the MENU key.



### Summation Ratio A/B

The "Summation Ratio A/B" setting is used to set the ratio of the output levels of both paths A and B in case the fader 1 and 2 are added.

Faded Signals are added in case one of the following signal routing configuration (see also [chapter 3, "Signal Routing"](#), on page 16):

- Signal Routing A to A / B to A
- Signal Routing A to B / B to B
- Signal Routing A to A&B / B to A&B

The "Summation Ration A/B" function is similar to the "Path Gain" function in the "Baseband" block (see section "Path Gain - Baseband" in the Operating Manual).

The "Path Gain" represents the relative gain of the selected path compared to the baseband signal of the other path and/or of the external baseband input. The "Path Gain" is measured at the output of the "Baseband" block and in case of any signal routing with summed signals.

However, if the baseband signal is additionally faded and routed at the output of the fading simulator, so that the faded signals from both paths are summed, the real path gain is measured at the output of the "Fading" block and set with the parameter "Summation Ratio A/B".

The relative gain set with the parameter "Path Gain" in the "Baseband" block is ignored.

A positive value of the parameter "Summation Ration A/B" indicates a stronger signal on path A; respectively a negative value indicates a stronger signal on path B.

SCPI command:

`[ :SOURce<hw> ] :FSIMulator:SUM:RATio` on page 217

## 7 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 Standards](#)..... 120
- [GSM Standards](#)..... 123
- [NADC Standards](#)..... 128
- [PCN Standards](#)..... 129
- [TETRA Standards](#)..... 134
- [3GPP Standards](#)..... 138
- [WLAN Standards](#)..... 148
- [DAB Standards](#)..... 153
- [WIMAX Standards](#)..... 156
- [LTE Standards](#)..... 169
- [LTE-MIMO Standards](#)..... 171
- [WIMAX-MIMO Standards](#)..... 172
- [1xEVDO Standards](#)..... 177
- [3GPP/LTE High Speed Train](#)..... 180
- [3GPP/LTE Moving Propagation](#)..... 182
- [Watterson Standards](#)..... 184
- [802.11n-MIMO Standards](#)..... 186

### 7.1 CDMA Standards

#### 7.1.1 CDMA 1 (8km/h - 2 Path)

*Table 7-1: C.S0011-A\_MS\_Minimum\_Performance\_Spec.pdf*

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

also with 15km/h in band class 5

### 7.1.2 CDMA 2 (30km/h - 2 Path)

Table 7-2: 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

### 7.1.3 CDMA 3 (30km/h - 1 Path)

Table 7-3: 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

### 7.1.4 CDMA 4 (100km/h - 3 Path)

Table 7-4: C.S0011-A\_MS\_Minimum\_Performance\_Spec.pdf

	Path 1	Path 2	Path 3
Profile [Type]	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0	3

	Path 1	Path 2	Path 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

### 7.1.5 CDMA 5 (0km/h - 2 Path)

Table 7-5: 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

### 7.1.6 CDMA 6 (3km/h - 1 Path)

Table 7-6: 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



## 7.2 GSM Standards

### 7.2.1 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

### 7.2.2 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

### 7.2.3 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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0
<b>Speed [km/h]:</b>	100	100	100	100	100	100

### 7.2.4 GSM RA250 (6 Path)

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



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 instrument of 6.88 fulfills this requirement. It does not conform to the value given in the specification since the instrument 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.

### 7.2.5 GSM ET50 (EQ50) (6 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	0	0	0	0	0	0
<b>Delay [ns]:</b>	0	3200	6400	9600	12800	16000
<b>LogNormal</b>	off	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Freq Ratio:</b>	0	0	0	0	0	0
<b>Speed [km/h]:</b>	50	50	50	50	50	50

### 7.2.6 GSM ET60 (EQ60) (6 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	0	0	0	0	0	0
<b>Delay [ns]:</b>	0	3200	6400	9600	12800	16000
<b>LogNormal</b>	off	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0
<b>Speed [km/h]:</b>	60	60	60	60	60	60

### 7.2.7 GSM ET100 (EQ100) (6 Path)

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

### 7.2.8 GSM TU3 (12 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	4	3	0	2,6	3	5
<b>Delay [ns]:</b>	0	100	300	500	800	1100

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
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
	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	7	5	6,5	8,6	11	10
Delay [ns]:	1300	1700	2300	3100	3200	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

### 7.2.9 GSM TU50 (12 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	4	3	0	2,6	3	5
Delay [ns]:	0	100	300	500	800	1100
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
	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	7	5	6,5	8,6	11	10
Delay [ns]:	1300	1700	2300	3100	3200	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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	50	50	50	50	50	50

### 7.2.10 GSM HT100 (12 Path)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	10	8	6	4	0	0
Delay [ns]:	0	100	300	500	700	1000
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
	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	4	8	9	10	12	14
Delay [ns]:	1300	15000	15200	15700	17200	20000
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

### 7.2.11 GSM TI5

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	0
Delay [ns]:	0	400
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0

	Path 1	Path 2
Freq Ratio:	0	0
Speed [km/h]:	5	5

## 7.3 NADC Standards



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

### 7.3.1 NADC 8 (2 Path)

	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

### 7.3.2 NADC 50 (2 Path)

	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

### 7.3.3 NADC 100 (2 Path)

	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

## 7.4 PCN Standards

### 7.4.1 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

### 7.4.2 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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
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

### 7.4.3 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

### 7.4.4 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



### 7.4.5 PCN ET50 (EQ50) (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

### 7.4.6 PCN ET60 (EQ60) (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]:	60	60	60	60	60	60

### 7.4.7 PCN ET100 (EQ100) (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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
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

### 7.4.8 PCN TU1.5 (12 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]:	4	3	0	2,6	3	5
Delay [ns]:	0	100	300	500	800	1100
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
	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	7	5	6,5	8,6	11	10
Delay [ns]:	1300	1700	2300	3100	3200	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

### 7.4.9 PCN TU50 (12 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]:	4	3	0	2,6	3	5
Delay [ns]:	0	100	300	500	800	1100
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
	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	7	5	6,5	8,6	11	10
Delay [ns]:	1300	1700	2300	3100	3200	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

### 7.4.10 PCN HT100 (12 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]:	10	8	6	4	0	0
Delay [ns]:	0	100	300	500	700	1000
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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Speed [km/h]:	100	100	100	100	100	100
	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	4	8	9	10	12	14
Delay [ns]:	1300	15000	15200	15700	17200	20000
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

## 7.5 TETRA Standards

### 7.5.1 TETRA TU50 (2 Path)

EN300 392-2

	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

### 7.5.2 TETRA 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]:	3.00	0	2.0	6.0	8.0	10.0
Delay [ns]:	0	0	0	0	0	0
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

### 7.5.3 TETRA BU50 (2 Path)

EN300 392-2

	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

### 7.5.4 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

	Path 1	Path 2
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	200	200

### 7.5.5 TETRA HT200 (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	2	4	7	6	12
Delay [ns]:	0	200	400	600	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]:	200.02	200.02	200.02	200.02	200.02	200.02

### 7.5.6 TETRA ET200 (4 Path)

EN300 392-2, 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

### 7.5.7 TETRA DU 50 (1Path)

ETSI EN 300 396-2 V1.2.1

	Path 1
Profile [Type]	Rice
Loss [dB]:	0
Delay [ns]:	0
LogNormal	off
Corr with	off
Power Ratio [dB]:	0
Freq Ratio:	0,7
Speed [km/h]:	50

### 7.5.8 TETRA DR 50 (1Path)

ETSI EN 300 396-2 V1.2.1

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

## 7.6 3GPP Standards



V<sub>A</sub>x are typical fading profiles, with x representing the speed, such as V<sub>A</sub>3 represents 3 km/h.

These standards define a certain combination of channels with a specific doppler frequency. Basically, the maximum possible doppler frequency of a path is determined by the RF output frequency and the speed of the moving mobile receiver. However, if you change the RF frequency in a V<sub>A</sub>x standard, the doppler frequency remains the same, thus resulting in individual speed settings.

Refer also to [chapter 7.6.12, "3GPP Mobile V<sub>A</sub>3, 3GPP Mobile V<sub>A</sub>30, 3GPP Mobile V<sub>A</sub>120"](#), on page 143 for V<sub>A</sub>x fading profiles.

### 7.6.1 3GPP Case 1 (mobile/base)

Table 7-7: 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

### 7.6.2 3GPP Case 2 (mobile/base)

Table 7-8: 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



	Path 1	Path 2	Path 3
Freq Ratio:	0	0	0
Speed [km/h]:	3	3	3

### 7.6.3 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

### 7.6.4 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

### 7.6.5 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

### 7.6.6 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

### 7.6.7 3GPP MBSFN Propagation Channel Profile

Table 7-9: 3GPP TS36.101 V9.8.0

	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	1.4	3.6	0.6	7.0
Delay [ns]:	0	30	150	310	370	1090
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Power Ratio [dB]:	0	0	0	0	0	0
Frequency [Hz]: *						

Table 7-10: 3GPP TS36.101 V9.8.0 (Cont.)

	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	10.0	11.5	11.4	13.6	10.6	17.0
Delay [ns]:	12490	12520	12640	12800	12860	13580
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Frequency [Hz]: *						

Table 7-11: 3GPP TS36.101 V9.8.0 (Cont.)

	Path 13	Path 14	Path 15	Path 16	Path 17	Path 18
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	20.0	21.5	21.4	23.6	20.6	27.0
Delay [ns]:	27490	27520	27640	27800	27860	28580
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Frequency [Hz]: *						

\* Possible frequency values are 70 Hz or 300 Hz

### 7.6.8 3GPP Mobile Case 7 (Sector)

Table 7-12: 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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Delay [ns]:</b>	0	260	1040	4690	7290	14580
<b>LogNormal</b>	off	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0
<b>Speed [km/h]:</b>	50	50	50	50	50	50

### 7.6.9 3GPP Mobile Case 7 (Beam)

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

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

### 7.6.10 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
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	0	9,7	19,2	22,8
<b>Delay [ns]:</b>	0	110	190	410
<b>LogNormal</b>	off	off	off	off
<b>Corr with</b>	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0
<b>Speed [km/h]:</b>	3	3	3	3

### 7.6.11 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

### 7.6.12 3GPP Mobile VA3, 3GPP Mobile VA30, 3GPP Mobile VA120

Table 7-13: 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]:	3   30   120 <sup>1)</sup>	3   30   120 <sup>1)</sup>	3   30   120 <sup>1)</sup>	3   30   120 <sup>1)</sup>	3   30   120 <sup>1)</sup>	3   30   120 <sup>1)</sup>

<sup>1)</sup> Speed of the respective standard VAX: VA3 = 3 km/h, VA30 = 30 km/h and VA120 = 120 km/h.

### 7.6.13 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

### 7.6.14 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: 5 us

### 7.6.15 HST1 Open Space, HST1 Open Space (DL+UL)

See [chapter 7.14.1, "HST1 Open Space, HST1 Open Space \(DL+UL\)"](#), on page 180.

### 7.6.16 HST2 Tunnel Leaky Cable

See [chapter 7.14.2, "HST2 Tunnel Leaky Cable, HST2 Tunnel Leaky Cable \(DL+UL\)"](#), on page 181.

### 7.6.17 HST3 Tunnel Multi Antennas, HST3 Tunnel Multi Antennas (DL+UL)

See [chapter 7.14.3, "HST3 Tunnel Multi Antennas, HST3 Tunnel Multi Antennas \(DL+UL\)"](#), on page 182.

### 7.6.18 3GPP TUx

*Table 7-14: 3GPP TS 25.943 V5.1.0 (2002-06)*

	Path 1	Path 2	Path 3	Path 4	Path 5
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	5,7	7,6	10,1	10,2	10,2
<b>Delay [ns]:</b>	0	217	512	514	517
<b>LogNormal</b>	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0
<b>Speed [km/h]:</b>	3	3	3	3	3

*Table 7-15: 3GPP TS 25.943 V5.1.0 (2002-06) (Cont.)*

	Path 6	Path 7	Path 8	Path 9	Path 10
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	11,5	13,4	16,3	16,9	17,1
<b>Delay [ns]:</b>	674	882	1230	1287	1311
<b>LogNormal</b>	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0
<b>Speed [km/h]:</b>	3	3	3	3	3

*Table 7-16: 3GPP TS 25.943 V5.1.0 (2002-06) (Cont.)*

	Path 11	Path 12	Path 13	Path 14	Path 15
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	17,4	19	19	19,8	21,5
<b>Delay [ns]:</b>	1349	1533	1535	1622	1818
<b>LogNormal</b>	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off

	Path 11	Path 12	Path 13	Path 14	Path 15
Power Ratio [dB]:	0	0	0	0	0
Freq Ratio:	0	0	0	0	0
Speed [km/h]:	3	3	3	3	3

Table 7-17: 3GPP TS 25.943 V5.1.0 (2002-06) (Cont.)

	Path 16	Path 17	Path 18	Path 19	Path 20
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	21,6	22,1	22,6	23,5	24,3
Delay [ns]:	1836	1884	1943	2048	2140
LogNormal	off	off	off	off	off
Corr with	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0
Freq Ratio:	0	0	0	0	0
Speed [km/h]:	3	3	3	3	3

## 7.6.19 3GPP RAX

Table 7-18: 3GPP TS 25.943 V5.1.0 (2002-06)

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

Table 7-19: 3GPP TS 25.943 V5.1.0 (2002-06) (Cont.)

	Path 6	Path 7	Path 8	Path 9	Path 10
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	13,1	15,3	18,5	20,4	22,4
Delay [ns]:	245	312	410	469	528



	Path 6	Path 7	Path 8	Path 9	Path 10
LogNormal	off	off	off	off	off
Corr with	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0
Freq Ratio:	0	0	0	0	0
Speed [km/h]:	250	250	250	250	250

## 7.6.20 3GPP HTx

Table 7-20: 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]	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh
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
Log-Normal	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

Table 7-21: 3GPP TS 25.943 V5.1.0 (2002-06) (Cont.)

	Path 11	Path 12	Path 13	Path 14	Path 15	Path 16	Path 17	Path 18	Path 19	Path 20
Profile [Type]	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh	Ray-leigh
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
Log-Normal	off	off	off	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off	off	off	off

	Path 11	Path 12	Path 13	Path 14	Path 15	Path 16	Path 17	Path 18	Path 19	Path 20
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0	0	0	0	0
<b>Speed [km/h]:</b>	100	100	100	100	100	100	100	100	100	100

## 7.7 WLAN Standards

### 7.7.1 WLAN / HyperLan/2 Model A

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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9
<b>Corr with</b>	off	off	off	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0	0	0	0
<b>Speed [km/h]:</b>	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8

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

### 7.7.2 WLAN / HyperLan/2 Model B

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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9
<b>Corr with</b>	off	off	off	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0	0	0	0
<b>Speed [km/h]:</b>	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8

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

### 7.7.3 WLAN / HyperLan/2 Model C

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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9
<b>Corr with</b>	off	off	off	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0	0	0	0
<b>Speed [km/h]:</b>	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8	10,8

### 7.7.4 WLAN / HyperLan/2 Model D

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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0	0	0	0
<b>Speed [km/h]:</b>	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

### 7.7.5 WLAN / HyperLan/2 Model E

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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8	Path 9
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0	0	0	0
<b>Speed [km/h]:</b>	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

## 7.8 DAB Standards

### 7.8.1 DAB RA (4Tabs)

	Path 1	Path 2	Path 3	Path 4
<b>Profile [Type]</b>	Rice	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	0	2	10	20
<b>Delay [ns]:</b>	0	200	400	600
<b>LogNormal</b>	off	off	off	off
<b>Corr with</b>	off	off	off	off
<b>Power Ratio [dB]:</b>		0	0	0
<b>Freq Ratio:</b>	0	0	0	0
<b>Speed [km/h]:</b>	120	120	120	120

Tap 2:  $S(d) = 0,1 \pm 0,02$

### 7.8.2 DAB RA (6 Tabs)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Profile [Type]</b>	Rice	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	0	4	8	12	16	20
<b>Delay [ns]:</b>	0	100	200	300	400	500
<b>LogNormal</b>	off	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off	off

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Power Ratio [dB]:</b>		0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0
<b>Speed [km/h]:</b>	120	120	120	120	120	120

### 7.8.3 DAB TU (12 Tabs)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Gaus1	Gaus1
<b>Loss [dB]:</b>	4	3	0	2,6	3	5
<b>Delay [ns]:</b>	0	100	300	500	800	1100
<b>LogNormal</b>	off	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0
<b>Speed [km/h]:</b>	25	25	25	25	25	25
	Path 7	Path 8	Path 9	Path 10	Path 11	Path 12
<b>Profile [Type]</b>	Gaus1	Gaus1	Gaus2	Gaus2	Gaus2	Gaus2
<b>Loss [dB]:</b>	7	5	6,5	8,6	11	10
<b>Delay [ns]:</b>	1300	1700	2300	3100	3200	5000
<b>LogNormal</b>	off	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0
<b>Speed [km/h]:</b>	25	25	25	25	25	25

Tap 6:  $S(d) = 1,0 \pm 0,1$



### 7.8.4 DAB TU (6 Tabs)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Gaus1	Gaus2	Gaus2
<b>Loss [dB]:</b>	3	0	2	6	8	10
<b>Delay [ns]:</b>	0	200	500	1600	2300	5000
<b>LogNormal</b>	off	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0
<b>Speed [km/h]:</b>	25	25	25	25	25	25

Tap 3:  $S(d) = 1,0 \pm 0,1$

### 7.8.5 DAB SFN (VHF)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7
<b>Profile [Type]</b>	Rayleigh	GausDAB	GausDAB	GausDAB	GausDAB	GausDAB	GausDAB
<b>Loss [dB]:</b>	0	13	18	22	26	31	32
<b>Delay [ns]:</b>	0	100000	220000	290000	385000	480000	600000
<b>LogNormal</b>	off	off	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0	0
<b>Speed [km/h]:</b>	60	60	60	60	60	60	60



Needs both Fading Boards combined, i.e. Signal Routing "A->A(max paths) || B->B(unfaded)" or "A->A(unfaded) || B->B(max paths)".

Do not use Group 5.

## 7.9 WIMAX Standards

### 7.9.1 SUI 1 (omni ant., 90%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	15	20
Delay [ns]:	0	400	900
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	6,0206	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

K-fact. = 4 ->>  $10\lg 4 = 6,02$

### 7.9.2 SUI 1 (omni ant., 75%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	15	20
Delay [ns]:	0	400	900
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	13,0103	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

### 7.9.3 SUI 1 (30° ant., 90%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	21	32
Delay [ns]:	0	400	900

	Path 1	Path 2	Path 3
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	12,0412	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

#### 7.9.4 SUI 1 (30° ant., 75%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	21	32
Delay [ns]:	0	400	900
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	18,57332	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

K-fact. = 72

#### 7.9.5 SUI 2 (omni ant., 90%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	12	15
Delay [ns]:	0	400	1100
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	3,0103	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=2

**7.9.6 SUI 2 (omni ant., 75%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	12	15
Delay [ns]:	0	400	1100
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	10,41393	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

**7.9.7 SUI 2 (30° ant., 90%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	18	27
Delay [ns]:	0	400	1100
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	9,0309	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=8

**7.9.8 SUI 2 (30° ant., 75%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	18	27
Delay [ns]:	0	400	1100
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	15,56303	0	0

	Path 1	Path 2	Path 3
<b>Freq Ratio:</b>	0,2	0,15	0,25
<b>Speed [km/h]:</b>	0.03	0.02	0.03

K=36

### 7.9.9 SUI 3 (omni ant., 90%)

	Path 1	Path 2	Path 3
<b>Profile [Type]</b>	WMRice	WMDopp	WMDopp
<b>Loss [dB]:</b>	0	5	10
<b>Delay [ns]:</b>	0	400	900
<b>LogNormal</b>	off	off	off
<b>Corr with</b>	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0
<b>Freq Ratio:</b>	0,4	0,3	0,5
<b>Speed [km/h]:</b>	0.05	0.04	0.06

### 7.9.10 SUI 3 (omni ant., 75%)

	Path 1	Path 2	Path 3
<b>Profile [Type]</b>	WMRice	WMDopp	WMDopp
<b>Loss [dB]:</b>	0	5	10
<b>Delay [ns]:</b>	0	400	900
<b>LogNormal</b>	off	off	off
<b>Corr with</b>	off	off	off
<b>Power Ratio [dB]:</b>	8,45098	0	0
<b>Freq Ratio:</b>	0,4	0,3	0,5
<b>Speed [km/h]:</b>	0.05	0.04	0.06

K=7

**7.9.11 SUI 3 (30° ant., 90%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	11	22
Delay [ns]:	0	400	900
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	4,771213	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

K=3

**7.9.12 SUI 3 (30° ant., 75%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	11	22
Delay [ns]:	0	400	900
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	12,78754	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

K=19

**7.9.13 SUI 4 (omni ant., 90%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMDopp	WMDopp	WMDopp
Loss [dB]:	0	4	8
Delay [ns]:	0	1500	4000
LogNormal	off	off	off
Corr with	off	off	off

	Path 1	Path 2	Path 3
Power Ratio [dB]:	0	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=0 (no Rice-component)

#### 7.9.14 SUI 4 (omni ant., 75%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	4	8
Delay [ns]:	0	1500	4000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=1

#### 7.9.15 SUI 4 (30° ant., 90%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	10	20
Delay [ns]:	0	400	1100
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=1

**7.9.16 SUI 4 (30° ant., 75%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	10	20
Delay [ns]:	0	400	1100
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	6,9897	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=5

**7.9.17 SUI 5 (omni ant., 90%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMDopp	WMDopp	WMDopp
Loss [dB]:	0	5	10
Delay [ns]:	0	4000	10000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=0 (no Rice-component)

**7.9.18 SUI 5 (omni ant., 75%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMDopp	WMDopp	WMDopp
Loss [dB]:	0	5	10
Delay [ns]:	0	4000	10000
LogNormal	off	off	off
Corr with	off	off	off



	Path 1	Path 2	Path 3
Power Ratio [dB]:	0	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=0 (no Rice-component)

### 7.9.19 SUI 5 (omni ant., 50%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	5	10
Delay [ns]:	0	4000	10000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	3,0103	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=2

### 7.9.20 SUI 5 (30° ant., 90%)

	Path 1	Path 2	Path 3
Profile [Type]	WMDopp	WMDopp	WMDopp
Loss [dB]:	0	11	22
Delay [ns]:	0	4000	10000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=0 (no Rice-component)

**7.9.21 SUI 5 (30° ant., 75%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	11	22
Delay [ns]:	0	4000	10000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	3,0103	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=2

**7.9.22 SUI 5 (30° ant., 50%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	11	22
Delay [ns]:	0	4000	10000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	8,45098	0	0
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=7

**7.9.23 SUI 6 (omni ant., 90%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMDopp	WMDopp	WMDopp
Loss [dB]:	0	10	14
Delay [ns]:	0	14000	20000
LogNormal	off	off	off
Corr with	off	off	off

	Path 1	Path 2	Path 3
Power Ratio [dB]:	0	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

K=0 (no Rice-component)

#### 7.9.24 SUI 6 (omni ant., 75%)

	Path 1	Path 2	Path 3
Profile [Type]	WMDopp	WMDopp	WMDopp
Loss [dB]:	0	10	14
Delay [ns]:	0	14000	20000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

K=0 (no Rice-component)

#### 7.9.25 SUI 6 (omni ant., 50%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	10	14
Delay [ns]:	0	14000	20000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

K=1

**7.9.26 SUI 6 (30° ant., 90%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMDopp	WMDopp	WMDopp
Loss [dB]:	0	16	26
Delay [ns]:	0	14000	20000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

K=0 (no Rice-component)

**7.9.27 SUI 6 (30° ant., 75%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	16	26
Delay [ns]:	0	14000	20000
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	3,0103	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

K=2

**7.9.28 SUI 6 (30° ant., 50%)**

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	16	26
Delay [ns]:	0	14000	20000
LogNormal	off	off	off
Corr with	off	off	off

	Path 1	Path 2	Path 3
Power Ratio [dB]:	6,9897	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	0.05	0.04	0.06

K=5

### 7.9.29 ITU OIP-A

	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]:	-	-	-	-

### 7.9.30 ITU OIP-B

	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]:	-	-	-	-	-	-

## 7.9.31 ITU V-A 60

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	0	1	9	10	15	20
<b>Delay [ns]:</b>	0	310	710	1090	1730	2510
<b>LogNormal</b>	off	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0
<b>Speed [km/h]:</b>	60	60	60	60	60	60

## 7.9.32 ITU V-A 120

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
<b>Profile [Type]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>Loss [dB]:</b>	0	1	9	10	15	20
<b>Delay [ns]:</b>	0	310	710	1090	1730	10000
<b>LogNormal</b>	off	off	off	off	off	off
<b>Corr with</b>	off	off	off	off	off	off
<b>Power Ratio [dB]:</b>	0	0	0	0	0	0
<b>Freq Ratio:</b>	0	0	0	0	0	0
<b>Speed [km/h]:</b>	120	120	120	120	120	120

## 7.10 LTE Standards

### 7.10.1 EPA (Extended Pedestrian A)

Table 7-22: 3GPP TR36.803

	Path 1	Path 2	Path 3	Path 4	Path 5
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	1	2	3	8
Delay [ns]:	0	30	70	90	110
LogNormal	off	off	off	off	off
Corr with	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0
Frequency [Hz]:	5	5	5	5	5
	Path 6	Path 7	Path 8	Path 9	Path 10
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	17,2	20,8			
Delay [ns]:	190	410			
LogNormal	off	off			
Corr with	off	off			
Power Ratio [dB]:	0	0			
Frequency [Hz]:	5	5			

### 7.10.2 EVA (Extended Vehicular A)

Table 7-23: 3GPP TR36.803

	Path 1	Path 2	Path 3	Path 4	Path 5
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	1,5	1,4	3,6	0,6
Delay [ns]:	0	30	150	310	370
LogNormal	off	off	off	off	off
Corr with	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0

	Path 1	Path 2	Path 3	Path 4	Path 5
Frequency [Hz]: *					
	Path 6	Path 7	Path 8	Path 9	Path 10
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	9,1	7	12	16,9	
Delay [ns]:	710	1090	1730	2510	
LogNormal	off	off	off	off	
Corr with	off	off	off	off	
Power Ratio [dB]:	0	0	0	0	
Frequency [Hz]: *					

\* Possible frequency values are 5 Hz or 70 Hz

### 7.10.3 ETU (Extended Typical Urban)

Table 7-24: 3GPP TR36.803

	Path 1	Path 2	Path 3	Path 4	Path 5
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	1	1	1	0	0
Delay [ns]:	0	50	120	200	230
LogNormal	off	off	off	off	off
Corr with	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0
Frequency [Hz]: *					
	Path 6	Path 7	Path 8	Path 9	Path 10
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	3	5	7	
Delay [ns]:	500	1600	2300	5000	
LogNormal	off	off	off	off	
Corr with	off	off	off	off	
Power Ratio [dB]:	0	0	0	0	
Frequency [Hz]: *					



\* Possible frequency values are 70 Hz or 300 Hz

#### 7.10.4 MBSFN Propagation Channel Profile

See [chapter 7.6.7, "3GPP MBSFN Propagation Channel Profile"](#), on page 140.

#### 7.10.5 HST1 Open Space

See [chapter 7.14.1, "HST1 Open Space, HST1 Open Space \(DL+UL\)"](#), on page 180.

#### 7.10.6 HST3 Tunnel Multi Antennas

See [chapter 7.14.3, "HST3 Tunnel Multi Antennas, HST3 Tunnel Multi Antennas \(DL+UL\)"](#), on page 182.

### 7.11 LTE-MIMO Standards

#### 7.11.1 EPA (Extended Pedestrian A)

See [chapter 7.10.1, "EPA \(Extended Pedestrian A\)"](#), on page 169.

#### 7.11.2 EVA (Extended Vehicular A)

See [chapter 7.10.2, "EVA \(Extended Vehicular A\)"](#), on page 169.

#### 7.11.3 ETU (Extended Typical Urban)

See [chapter 7.10.3, "ETU \(Extended Typical Urban\)"](#), on page 170.

#### 7.11.4 MIMO Parameter

*Table 7-25: R-High*

real	imaginary	real	imaginary	real	imaginary	real	imaginary
1	0	-0,4193	0,24	0,5297	0,7013	-0,3904	-0,1669
-0,4193	-0,24	1	0	-0,0538	-0,4212	0,5297	0,7013
0,5297	-0,7013	-0,0538	0,4212	1	0	-0,4193	0,24
-0,3904	0,1669	0,5297	-0,7013	-0,4193	-0,24	1	0

Table 7-26: R-Medium

real	imaginary	real	imaginary	real	imaginary	real	imaginary
1	0	0	0	0,7264	0	0	0
0	0	1	0	0	0	-0,7264	0
0,7264	0	0	0	1	0	0	0
0	0	-0,7264	0	0	0	1	0

Table 7-27: R-Low

real	imaginary	real	imaginary	real	imaginary	real	imaginary
1	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	0	0	0	1	0	0	0
0	0	0	0	0	0	1	0

The MIMO correlation matrices for the high, medium and low antenna correlation for the 1x2, 2x2 and 4x2 MIMO configurations are calculated according to 3GPP TS36.101, annex B2.3.2.

## 7.12 WIMAX-MIMO Standards

### 7.12.1 ITU Pedestrian B 3

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

Table 7-28: MIMO Parameter - High Correlation

	real	imagi- nary	real	imagi- nary	real	imagi- nary	real	imagi- nary
TAP 1	1	0	-0,1468	0,4156	0,0303	0,7064	-0,298	-0,0911
	-0,1468	-0,4156	1	0	0,28913	-0,1163	0,0303	0,7064
	0,0303	-0,7064	0,28913	0,11629	1	0	-0,1468	0,4156
	-0,298	0,09111	0,0303	-0,7064	-0,1468	-0,4156	1	0
TAP 2	1	0	-0,4467	0,4227	-0,4007	-0,6073	0,4357	0,10191
	-0,4467	-0,4227	1	0	-0,0777	0,44066	-0,4007	-0,6073
	-0,4007	0,6073	-0,0777	-0,4407	1	0	-0,4467	0,4227
	0,4357	-0,1019	-0,4007	0,6073	-0,4467	-0,4227	1	0
TAP 3	1	0	-0,2906	0,4347	-0,6664	0,262	0,07976	-0,3658
	-0,2906	-0,4347	1	0	0,30755	0,21355	-0,6664	0,262
	-0,6664	-0,262	0,30755	-0,2135	1	0	-0,2906	0,4347
	0,07976	0,36582	-0,6664	-0,262	-0,2906	-0,4347	1	0
TAP 4	1	0	-0,4273	0,4259	-0,6522	0,2088	0,18976	-0,367
	-0,4273	-0,4259	1	0	0,36761	0,18855	-0,6522	0,2088
	-0,6522	-0,2088	0,36761	-0,1886	1	0	-0,4273	0,4259
	0,18976	0,36699	-0,6522	-0,2088	-0,4273	-0,4259	1	0
TAP 5	1	0	-0,7026	-0,3395	-0,5378	-0,4866	0,21266	0,52447
	-0,7026	0,3395	1	0	0,54306	0,1593	-0,5378	-0,4866
	-0,5378	0,4866	0,54306	-0,1593	1	0	-0,7026	-0,3395
	0,21266	-0,5245	-0,5378	0,4866	-0,7026	0,3395	1	0
TAP 6	1	0	-0,45	0,4222	-0,4564	-0,5655	0,44413	0,06178
	-0,45	-0,4222	1	0	-0,0334	0,44717	-0,4564	-0,5655
	-0,4564	0,5655	-0,0334	-0,4472	1	0	-0,45	0,4222
	0,44413	-0,0618	-0,4564	0,5655	-0,45	-0,4222	1	0

Table 7-29: MIMO Parameter - Medium Correlation

	real	imagi- nary	real	imagi- nary	real	imagi- nary	real	imagi- nary
TAP 1- TAP 6	1	0	0	0	0,7264	0	0	0
	0	0	1	0	0	0	-0,7264	0
	0,7264	0	0	0	1	0	0	0
	0	0	-0,7264	0	0	0	1	0

Table 7-30: MIMO Parameter - Low Correlation

	real	imagi- nary	real	imagi- nary	real	imagi- nary	real	imagi- nary
TAP 1	1	0	0	0	0,02201	0,51313	0	0
	0	0	1	0	0	0	-0,022	-0,5131
	0,02201	-0,5131	0	0	1	0	0	0
	0	0	-0,022	0,51313	0	0	1	0
TAP 2	1	0	0	0	-0,2911	-0,4411	0	0
	0	0	1	0	0	0	0,29107	0,44114
	-0,2911	0,44114	0	0	1	0	0	0
	0	0	0,29107	-0,4411	0	0	1	0
TAP 3	1	0	0	0	-0,4841	0,19032	0	0
	0	0	1	0	0	0	0,48407	-0,1903
	-0,4841	-0,1903	0	0	1	0	0	0
	0	0	0,48407	0,19032	0	0	1	0
TAP 4	1	0	0	0	-0,4738	0,15167	0	0
	0	0	1	0	0	0	0,47376	-0,1517
	-0,4738	-0,1517	0	0	1	0	0	0
	0	0	0,47376	0,15167	0	0	1	0
TAP 5	1	0	0	0	-0,3907	-0,3535	0	0
	0	0	1	0	0	0	0,39066	0,35347
	-0,3907	0,35347	0	0	1	0	0	0
	0	0	0,39066	-0,3535	0	0	1	0
TAP 6	1	0	0	0	-0,3315	-0,4108	0	0
	0	0	1	0	0	0	0,33153	0,41078
	-0,3315	0,41078	0	0	1	0	0	0
	0	0	0,33153	-0,4108	0	0	1	0

### 7.12.2 ITU Vehicular A-60

	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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Speed [km/h]:	60	60	60	60	60	60

Table 7-31: MIMO Parameter - High Correlation

	real	imaginary	real	imaginary	real	imaginary	real	imaginary
TAP 1	1	0	-0,2366	0,4312	0,6883	0,1211	-0,2151	0,26814
	-0,2366	-0,4312	1	0	-0,1106	-0,3254	0,6883	0,1211
	0,6883	-0,1211	-0,1106	0,32545	1	0	-0,2366	0,4312
	-0,2151	-0,2681	0,6883	-0,1211	-0,2366	-0,4312	1	0
TAP 2	1	0	0,1388	0,2343	-0,3508	-0,5926	0,09016	-0,1644
	0,1388	-0,2343	1	0	-0,1875	-6E-05	-0,3508	-0,5926
	-0,3508	0,5926	-0,1875	6E-05	1	0	0,1388	0,2343
	0,09016	0,16445	-0,3508	0,5926	0,1388	-0,2343	1	0
TAP 3	1	0	-0,6443	0,365	0,3884	-0,5604	-0,0457	0,50283
	-0,6443	-0,365	1	0	-0,4548	0,2193	0,3884	-0,5604
	0,3884	0,5604	-0,4548	-0,2193	1	0	-0,6443	0,365
	-0,0457	-0,5028	0,3884	0,5604	-0,6443	-0,365	1	0
TAP 4	1	0	-0,362	0,4331	0,1899	0,6795	-0,363	-0,1637
	-0,362	-0,4331	1	0	0,22555	-0,3282	0,1899	0,6795
	0,1899	-0,6795	0,22555	0,32822	1	0	-0,362	0,4331
	-0,363	0,16373	0,1899	-0,6795	-0,362	-0,4331	1	0
TAP 5	1	0	-0,7074	0,3372	-0,3933	-0,565	0,46874	0,26706
	-0,7074	-0,3372	1	0	0,0877	0,5323	-0,3933	-0,565
	-0,3933	0,565	0,0877	-0,5323	1	0	-0,7074	0,3372
	0,46874	-0,2671	-0,3933	0,565	-0,7074	-0,3372	1	0
TAP 6	1	0	-0,4405	0,4238	-0,4383	-0,58	0,43888	0,06974
	-0,4405	-0,4238	1	0	-0,0527	0,44124	-0,4383	-0,58
	-0,4383	0,58	-0,0527	-0,4412	1	0	-0,4405	0,4238
	0,43888	-0,0697	-0,4383	0,58	-0,4405	-0,4238	1	0

Table 7-32: MIMO Parameter - Medium Correlation

	real	imagi- nary	real	imagi- nary	real	imagi- nary	real	imagi- nary
TAP 1- TAP 6	1	0	0	0	0,7264	0	0	0
	0	0	1	0	0	0	-0,7264	0
	0,7264	0	0	0	1	0	0	0
	0	0	-0,7264	0	0	0	1	0

Table 7-33: MIMO Parameter - Low Correlation

	real	imagi- nary	real	imagi- nary	real	imagi- nary	real	imagi- nary
TAP 1	1	0	0	0	0,49998	0,08797	0	0
	0	0	1	0	0	0	-0,5	-0,088
	0,49998	-0,088	0	0	1	0	0	0
	0	0	-0,5	0,08797	0	0	1	0
TAP 2	1	0	0	0	-0,2548	-0,4305	0	0
	0	0	1	0	0	0	0,25482	0,43046
	-0,2548	0,43046	0	0	1	0	0	0
	0	0	0,25482	-0,4305	0	0	1	0
TAP 3	1	0	0	0	0,28213	-0,4071	0	0
	0	0	1	0	0	0	-0,2821	0,40707
	0,28213	0,40707	0	0	1	0	0	0
	0	0	-0,2821	-0,4071	0	0	1	0
TAP 4	1	0	0	0	0,13794	0,49359	0	0
	0	0	1	0	0	0	-0,1379	-0,4936
	0,13794	-0,4936	0	0	1	0	0	0
	0	0	-0,1379	0,49359	0	0	1	0
TAP 5	1	0	0	0	-0,3907	-0,3535	0	0
	0	0	1	0	0	0	0,39066	0,35347
	-0,3907	0,35347	0	0	1	0	0	0
	0	0	0,39066	-0,3535	0	0	1	0
TAP 6	1	0	0	0	-0,3184	-0,4213	0	0
	0	0	1	0	0	0	0,31838	0,42131
	-0,3184	0,42131	0	0	1	0	0	0
	0	0	0,31838	-0,4213	0	0	1	0

## 7.13 1xEVDO Standards

According to 3GPP2 C.S0032-A v2.0

### 7.13.1 1xEVDO Chan. 1

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

### 7.13.2 1xEVDO Chan. 1 (Bd. 5, 11)

	Path 1	Path 2
Profile [Type]	Rayleigh	Rayleigh
Loss [dB]:	0	0
Delay [ns]:	0	2000
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
Freq Ratio:	0	0
Speed [km/h]:	15	15

### 7.13.3 1xEVDO Chan. 2

	Path 1
Profile [Type]	Rayleigh
Loss [dB]:	0
Delay [ns]:	0
LogNormal	off

	Path 1
Corr with	off
Power Ratio [dB]:	0
Freq Ratio:	0
Speed [km/h]:	3

#### 7.13.4 1xEVDO Chan. 2 (Bd. 5, 11)

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

#### 7.13.5 1xEVDO Chan. 3

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



### 7.13.6 1xEVDO Chan. 3 (Bd. 5, 11)

	Path 1
Profile [Type]	Rayleigh
Loss [dB]:	0
Delay [ns]:	0
LogNormal	off
Corr with	off
Power Ratio [dB]:	0
Freq Ratio:	0
Speed [km/h]:	58

### 7.13.7 1xEVDO Chan. 4

	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
Corr with	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0	0	0
Speed [km/h]:	100	100	100

### 7.13.8 1xEVDO Chan. 4 (Bd. 5, 11)

	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
Corr with	off	off	off
Power Ratio [dB]:	0	0	0

	Path 1	Path 2	Path 3
Freq Ratio:	0	0	0
Speed [km/h]:	192	192	192

### 7.13.9 1xEVDO Chan. 5

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

### 7.13.10 1xEVDO Chan. 5 (Bd. 5, 11)

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

## 7.14 3GPP/LTE High Speed Train

### 7.14.1 HST1 Open Space, HST1 Open Space (DL+UL)

3GPP TS25.141, annex D.4A "High Speed Train" and 3GPP TS36.141, annex B.3 "High Speed Train"



The standards (DL + UL) consider the downlink and the uplink, i.e. with twice the speed. That is, if a doppler shift occurs in the downlink, the mobile receiver synchronizes to that shifted frequency. The uplink to the base station then results in a doppler shift enlarged by factor two.

	Path 1
Profile [Type]	Pure Doppler
Loss [dB]:	0
Delay [ns]:	0
LogNormal	off
Corr with	off
Power Ratio [dB]:	-
Freq Ratio:	
Speed [km/h]:	350km/h
D <sub>min</sub>	50m
D <sub>s</sub>	1000m

#### 7.14.2 HST2 Tunnel Leaky Cable, HST2 Tunnel Leaky Cable (DL+UL)

3GPP TS25.141, annex D.4A "High Speed Train"



The standards (DL + UL) consider the downlink and the uplink, i.e. with twice the speed. That is, if a doppler shift occurs in the downlink, the mobile receiver synchronizes to that shifted frequency. The uplink to the base station then results in a doppler shift enlarged by factor two.

	Path 1
Profile [Type]	Rice
Loss [dB]:	10
Delay [ns]:	0
LogNormal	off
Corr with	off
Power Ratio [dB]:	0
Freq Ratio:	1
Speed [km/h]:	300km/h

### 7.14.3 HST3 Tunnel Multi Antennas, HST3 Tunnel Multi Antennas (DL+UL)

3GPP TS25.141, annex D.4A "High Speed Train" and 3GPP TS36.141, annex B.3A "High Speed Train"



The standards (DL + UL) consider the downlink and the uplink, i.e. with twice the speed. That is, if a doppler shift occurs in the downlink, the mobile receiver synchronizes to that shifted frequency. The uplink to the base station then results in a doppler shift enlarged by factor two.

	Path 1
Profile [Type]	Pure Doppler
Loss [dB]:	0
Delay [ns]:	0
LogNormal	off
Corr with	off
Power Ratio [dB]:	-
Freq Ratio:	
Speed [km/h]:	300km/h
D <sub>min</sub>	2m
D <sub>s</sub>	300m

## 7.15 3GPP/LTE Moving Propagation

### 7.15.1 Reference + Moving Channel

Table 7-34: 3GPP TS 25.101, 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:  $157,0796s = 2 \cdot \pi / 0.04$

(Mean)-Delay:  $3.5\mu s$

### 7.15.2 ETU 200Hz Moving (UL Timing Adjustment, Scenario 1)

Table 7-35: 3GPP TS36.141, annex B.4 "Moving Propagation Conditions"

	Path 1	Path 2	Path 3	Path 4	Path 5
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	1	1	1	0	0
Delay [ns]:	0	50	120	200	230
LogNormal	off	off	off	off	off
Corr with	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0
Doppler [Hz]:					
Speed [km/h]:	120	120	120	120	120

	Path 6	Path 7	Path 8	Path 9
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	3	5	7
Delay [ns]:	500	1600	2300	5000
LogNormal	off	off	off	off
Corr with	off	off	off	off
Power Ratio [dB]:	0	0	0	0
Doppler [Hz]:				
Speed [km/h]:	120	120	120	120

Period:  $157,0796s = 2 \cdot \pi / 0.04$

Amplitude:  $5\mu s = 10\mu s / 2$

### 7.15.3 Pure Doppler Moving (UL Timing Adjustment, Scenario 2)

Table 7-36: 3GPP TS36.141, annex B.4 "Moving Propagation Conditions"

	Path 1
Profile [Type]	Pure Doppler
Loss [dB]:	0
Delay [ns]:	0

	Path 1
LogNormal	off
Corr with	off
Power Ratio [dB]:	0
Doppler [Hz]:	
Speed [km/h]:	350

Period: 48,33s =  $2 \cdot \pi / 0.13$

Amplitude: 5 $\mu$ s = 10 $\mu$ s/2

## 7.16 Watterson Standards

### 7.16.1 Watterson I1

	Path 1	Path 2	Path 3	Path 4	Path 5
Profile [Type]	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson
Loss [dB]:	4.1	4.3	1.2	7.2	13.5
Delay [ns]:	40000	40000	40000	290000	1139000
LogNormal	off	off	off	off	off
Corr with	off	off	off	off	off
Freq. Spread:	0.0073	0.0318	0.0272	0.144	0.34
Freq Shift [Hz]:	0.0022	0.017	0.0094	0.0089	-0.167
Speed [km/h]:					

Tap 2:  $S(d) = 0,1 \pm 0,02$

### 7.16.2 Watterson I2

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson
Loss [dB]:	4.1	5.5	1.7	5.9	17.6	12.6
Delay [ns]:	40000	40000	40000	290000	590000	1126000
LogNormal	off	off	off	off	off	off

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Corr with	off	off	off	off	off	off
Freq. Spread:	0.0064	0.0084	0.0153	0.18	0.334	0.336
Freq Shift [Hz]:	-0.0008	0.0127	0.0071	0.0159	0.108	0.118
Speed [km/h]:						

Tap 3:  $S(d) = 0,1 \pm 0,02$

### 7.16.3 Watterson I3

	Path 1	Path 2	Path 3	Path 4	Path 5
Profile [Type]	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson
Loss [dB]:	3.8	5.7	1.6	10.8	10.6
Delay [ns]:	445000	445000	445000	750000	750000
LogNormal	off	off	off	off	off
Corr with	off	off	off	off	off
Freq. Spread:	0.034	0.032	0.0658	0.0104	0.013
Freq Shift [Hz]:	0.0764	0.0134	0.0989	0.121	0.141
Speed [km/h]:					

	Path 6	Path 7	Path 8	Path 9
Profile [Type]	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson	Gauss-Watterson
Loss [dB]:	7.7	12.9	10.4	8.5
Delay [ns]:	750000	1088000	1088000	1088000
LogNormal	off	off	off	off
Corr with	off	off	off	off
Freq. Spread:	0.0229	0.0149	0.0206	0.0335
Freq Shift [Hz]:	0.131	0.121	0.151	0.014
Speed [km/h]:				

Tap 6:  $S(d) = 1,0 \pm 0,1$

## 7.17 802.11n-MIMO Standards

According to IEEE 801.11-03/940r4

Rx Antenna Distance = 1

Tx Antenna Distance = 0.5

Distribution = Laplace

### 7.17.1 Model A

Tap:	<b>Pfad 1</b>
Cluster	
Profil [Typ]	Rayleigh
Loss [dB]	0
Delay [ns]	0
AoA	45
AS (A)	40
AoD	45
AS (D)	40

### 7.17.2 Model B

Tap:	Pfad 1	Pfad 2	Pfad 3		Pfad 4	
Cluster			1	2	1	2
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	0	5.4	10.8	3.2	16.2	6.3
Delay [ns]:	0	10	20	20	30	30
AoA:	4.3	4.3	4.3	118.4	4.3	118.4
AS (A):	14.4	14.4	14.4	25.2	14.4	25.2
AoD:	225.1	225.1	225.1	106.5	225.1	106.5
AS (D):	14.4	14.4	14.4	25.4	14.4	25.4
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace



Tap:	Pfad 5		Pfad 6	Pfad 7	Pfad 8	Pfad 9
Cluster	1	2				
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	21.7	9.4	12.5	15.6	18.7	21.8
Delay [ns]:	40	40	50	60	70	80
AoA:	4.3	118.4	118.4	118.4	118.4	118.4
AS (A):	14.4	25.2	25.2	25.2	25.2	25.2
AoD:	225.1	106.5	106.5	106.5	106.5	106.5
AS (D):	14.4	25.4	25.4	25.4	25.4	25.4
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

### 7.17.3 Model C

Tap:	Pfad 1	Pfad 2	Pfad 3	Pfad 4	Pfad 5	Pfad 6
Cluster						
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	0	2.1	4.3	6.5	8.6	10.8
Delay [ns]:	0	10	20	30	40	50
AoA:	290.3	290.3	290.3	290.3	290.3	290.3
AS (A):	24.6	24.6	24.6	24.6	24.6	24.6
AoD:	13.5	13.5	13.5	13.5	13.5	13.5
AS (D):	24.7	24.7	24.7	24.7	24.7	24.7
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 7	Pfad 7	Pfad 8	Pfad 8	Pfad 9	Pfad 9
Cluster	1	2	1	2	1	2
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	13	5	15.2	7.2	17.3	9.3
Delay [ns]:	60	60	70	70	80	80
AoA:	290.3	332.3	290.3	332.3	290.3	332.3
AS (A):	24.6	22.4	24.6	22.4	24.6	22.4
AoD:	13.5	56.4	13.5	56.4	13.5	56.4

<b>Tap:</b>	<b>Pfad 7</b>	<b>Pfad 7</b>	<b>Pfad 8</b>	<b>Pfad 8</b>	<b>Pfad 9</b>	<b>Pfad 9</b>
<b>AS (D):</b>	24.7	22.5	24.7	22.5	24.7	22.5
<b>Distribution</b>	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

<b>Tap:</b>	<b>Pfad 10</b>	<b>Pfad 10</b>	<b>Pfad 11*</b>	<b>Pfad 12*</b>	<b>Pfad 13*</b>	<b>Pfad 14*</b>
<b>Cluster</b>	1	2				
<b>Profil [Typ]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>(Relative) Loss [dB]:</b>	19.5	11.5	13.7	15.8	18	20.2
<b>Delay [ns]:</b>	90	90	110	140	170	200
<b>AoA:</b>	290.3	332.3	332.3	332.3	332.3	332.3
<b>AS (A):</b>	24.6	22.4	22.4	22.4	22.4	22.4
<b>AoD:</b>	13.5	56.4	56.4	56.4	56.4	56.4
<b>AS (D):</b>	24.7	22.5	22.5	22.5	22.5	22.5
<b>Distribution</b>	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

\*) this paths are not simulated by the instrument

#### 7.17.4 Model D

<b>Tap:</b>	<b>Pfad 1</b>	<b>Pfad 2</b>	<b>Pfad 3</b>	<b>Pfad 4</b>	<b>Pfad 5</b>	<b>Pfad 6</b>
<b>Cluster</b>						
<b>Profil [Typ]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>(Relative) Loss [dB]:</b>	0	0.9	1.7	2.6	3.5	4.3
<b>Delay [ns]:</b>	0	10	20	30	40	50
<b>AoA:</b>	158.9	158.9	158.9	158.9	158.9	158.9
<b>AS (A):</b>	27.7	27.7	27.7	27.7	27.7	27.7
<b>AoD:</b>	332.1	332.1	332.1	332.1	332.1	332.1
<b>AS (D):</b>	27.4	27.4	27.4	27.4	27.4	27.4
<b>Distribution</b>	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

<b>Tap:</b>	<b>Pfad 7</b>	<b>Pfad 8</b>	<b>Pfad 9</b>	<b>Pfad 10*</b>	<b>Pfad 11</b>	
<b>Cluster</b>					1	2
<b>Profil [Typ]</b>	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
<b>(Relative) Loss [dB]:</b>	5.2	6.1	6.9	7.8	9	6.6

Tap:	Pfad 7	Pfad 8	Pfad 9	Pfad 10*	Pfad 11	
Delay [ns]:	60	70	80	90	110	110
AoA:	158.9	158.9	158.9	158.9	158.9	320.2
AS (A):	27.7	27.7	27.7	27.7	27.7	31.4
AoD:	332.1	332.1	332.1	332.1	332.1	49.3
AS (D):	27.4	27.4	27.4	27.4	27.4	32.1
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 12*		Pfad 13*		Pfad 14*	
Cluster	1	2	1	2	1	2
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	11.1	9.5	13.7	12.1	16.3	14.7
Delay [ns]:	140	140	170	170	200	200
AoA:	158.9	320.2	158.9	320.2	158.9	320.2
AS (A):	27.7	31.4	27.7	31.4	27.7	31.4
AoD:	332.1	49.3	332.1	49.3	332.1	49.3
AS (D):	27.4	32.1	27.4	32.1	27.4	32.1
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 15*			Pfad 16*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	19.3	17.4	18.8	23.2	21.9	23.2
Delay [ns]:	240	240	240	290	290	290
AoA:	158.9	320.2	276.1	158.9	320.2	276.1
AS (A):	27.7	31.4	37.4	27.7	31.4	37.4
AoD:	332.1	49.3	275.9	332.1	49.3	275.9
AS (D):	27.4	32.1	36.8	27.4	32.1	36.8
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 17*		Pfad 18*
Cluster	2		3
Profil [Typ]	Rayleigh		Rayleigh

Tap:	Pfad 17*		Pfad 18*
(Relative) Loss [dB]:	25.5	25.2	26.7
Delay [ns]:	340	340	390
AoA:	320.2	276.1	276.1
AS (A):	31.4	37.4	37.4
AoD:	49.3	275.9	275.9
AS (D):	32.1	36.8	36.8
Distribution	Laplace	Laplace	Laplace

\*) this paths are not simulated by the instrument

### 7.17.5 Model E

Tap:	Pfad 1	Pfad 2	Pfad 3	Pfad 4	Pfad 5	
Cluster					1	2
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	2.6	3	3.5	3.9	4.5	1.8
Delay [ns]:	0	10	20	30	50	50
AoA:	163.7	163.7	163.7	163.7	163.7	251.8
AS (A):	35.8	35.8	35.8	35.8	35.8	41.6
AoD:	105.6	105.6	105.6	105.6	105.6	293.1
AS (D):	36.1	36.1	36.1	36.1	36.1	42.5
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 6		Pfad 7		Pfad 8	
Cluster	1	2	1	2	1	2
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	5.6	3.2	6.9	4.5	8.2	5.8
Delay [ns]:	80	80	110	110	140	140
AoA:	163.7	251.8	163.7	251.8	163.7	251.8
AS (A):	35.8	41.6	35.8	41.6	35.8	41.6
AoD:	105.6	293.1	105.6	293.1	105.6	293.1

Tap:	Pfad 6		Pfad 7		Pfad 8	
AS (D):	36.1	42.5	36.1	42.5	36.1	42.5
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 9			Pfad 10		
Cluster	1	2	3	1	2	3
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	9.8	7.1	7.9	11.7	9.9	9.6
Delay [ns]:	180	180	180	230	230	230
AoA:	163.7	251.8	80	163.7	251.8	80
AS (A):	35.8	41.6	37.4	35.8	41.6	37.4
AoD:	105.6	293.1	61.9	105.6	293.1	61.9
AS (D):	36.1	42.5	38	36.1	42.5	38
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 11*			Pfad 12*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	13.9	10.3	14.2	16.1	14.3	13.8
Delay [ns]:	280	280	280	330	330	330
AoA:	163.7	251.8	80	163.7	251.8	80
AS (A):	35.8	41.6	37.4	35.8	41.6	37.4
AoD:	105.6	293.1	61.9	105.6	293.1	61.9
AS (D):	36.1	42.5	38	36.1	42.5	38
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 13*			Pfad 14*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	18.3	14.7	18.6	20.5	18.7	18.1
Delay [ns]:	380	380	380	430	430	430
AoA:	163.7	251.8	80	163.7	251.8	80
AS (A):	35.8	41.6	37.4	35.8	41.6	37.4

Tap:	Pfad 13*			Pfad 14*		
AoD:	105.6	293.1	61.9	105.6	293.1	61.9
AS (D):	36.1	42.5	38	36.1	42.5	38
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 15*				Pfad 16*		Pfad 17*	Pfad 18*
Cluster	1	2	3	4	2	4	4	4
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	22.9	19.9	22.8	20.6	22.4	20.5	20.7	24.6
Delay [ns]:	490	490	490	490	560	560	640	730
AoA:	163.7	251.8	80	182	251.8	182	182	182
AS (A):	35.8	41.6	37.4	40.3	41.6	40.3	40.3	40.3
AoD:	105.6	293.1	61.9	275.7	293.1	275.7	275.7	275.7
AS (D):	36.1	42.5	38	38.7	42.5	38.7	38.7	38.7
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

\*) this paths are not simulated by the instrument

### 7.17.6 Model F

Tap:	Pfad 1	Pfad 2	Pfad 3	Pfad 4	Pfad 5	
Cluster					1	2
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	3.3	3.6	3.9	4.2	4.6	1.8
Delay [ns]:	0	10	20	30	50	50
AoA:	315.1	315.1	315.1	315.1	315.1	180.4
AS (A):	48	48	48	48	48	55
AoD:	56.2	56.2	56.2	56.2	56.2	183.7
AS (D):	41.6	41.6	41.6	41.6	41.6	55.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 6		Pfad 7		Pfad 8	
Cluster	1	2	1	2	1	2
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh

Tap:	Pfad 6		Pfad 7		Pfad 8	
(Relative) Loss [dB]:	5.3	2.8	6.2	3.5	7.1	4.4
Delay [ns]:	80	80	110	110	140	140
AoA:	315.1	180.4	315.1	180.4	315.1	180.4
AS (A):	48	55	48	55	48	55
AoD:	56.2	183.7	56.2	183.7	56.2	183.7
AS (D):	41.6	55.2	41.6	55.2	41.6	55.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 9			Pfad 10		
Cluster	1	2	3	1	2	3
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	8.2	5.3	5.7	9.5	7.4	6.7
Delay [ns]:	180	180	180	230	230	230
AoA:	315.1	180.4	74.7	315.1	180.4	74.7
AS (A):	48	55	42	48	55	42
AoD:	56.2	183.7	153	56.2	183.7	153
AS (D):	41.6	55.2	47.4	41.6	55.2	47.4
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 11*			Pfad 12*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	11	7	10.4	12.5	10.3	9.6
Delay [ns]:	280	280	280	330	330	330
AoA:	315.1	180.4	74.7	315.1	180.4	74.7
AS (A):	48	55	42	48	55	42
AoD:	56.2	183.7	153	56.2	183.7	153
AS (D):	41.6	55.2	47.4	41.6	55.2	47.4
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 13*				Pfad 14*			
Cluster	1	2	3	4	1	2	3	4
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	14.3	10.4	14.1	8.8	16.7	13.8	12.7	13.3
Delay [ns]:	400	400	400	400	490	490	490	490
AoA:	315.1	180.4	74.7	251.5	315.1	180.4	74.7	251.5
AS (A):	48	55	42	28.6	48	55	42	28.6
AoD:	56.2	183.7	153	112.5	56.2	183.7	153	112.5
AS (D):	41.6	55.2	47.4	27.2	41.6	55.2	47.4	27.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 15*				
Cluster	1	2	3	4	5
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	19.9	15.7	18.5	18.7	12.9
Delay [ns]:	600	600	600	600	600
AoA:	315.1	180.4	74.7	251.5	68.5
AS (A):	48	55	42	28.6	30.7
AoD:	56.2	183.7	153	112.5	291
AS (D):	41.6	55.2	47.4	27.2	33
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Pfad 16*		Pfad 17*	Pfad 18*
Cluster	2	5	6	6
Profil [Typ]	Rayleigh	Rayleigh	Rayleigh	Rayleigh
(Relative) Loss [dB]:	19.9	14.2	16.3	21.2
Delay [ns]:	730	730	880	1050
AoA:	180.4	68.5	246.2	246.2
AS (A):	55	30.7	38.2	38.2
AoD:	183.7	291	62.3	62.3
AS (D):	55.2	33	38	38
Distribution	Laplace	Laplace	Laplace	Laplace



\*) this paths are not simulated by the instrument

## 8 Remote-Control Commands

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

Dual-channel fading is possible when the instrument is fitted with the options R&S Signal Generator-B14 (Fading Simulator) and R&S Signal Generator-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 R&S Signal Generator-K71.

### 8.1 General Settings

<code>[:SOURCE&lt;hw&gt;]:FSIMulator:CONFIguration</code> .....	197
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---

**[ :SOURce<hw> ]:FSIMulator:CONFiguration <Configuration>**

Sets the fading configuration.

To activate the selected fading configuration, use the remote-control command for switching the state.

**Parameters:**

&lt;Configuration&gt;

STANdard | DEL30 | DEL50 | BIRThdeath | MDELay | UDYNamic | TCInterferer | HSTRain | DSSimulation

**STANdard**

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 10ns.

**DEL30**

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.

**DEL50**

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 10ps. An RF bandwidth of 50 MHz is available.

**BIRThdeath**

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.

**MDELay**

In the Moving Propagation configuration, the fading simulator simulates dynamic propagation conditions in conformity with the test case 3GPP, 25.104-320, annex B3.

Two paths are simulated: Path 1 has fixed delay, while the delay of path 2 varies slowly in a sinusoidal fashion.

**UDYNamic**

The User Dynamic configuration is provided for future use.

**TCInterferer**

In the 2 Channel Interferer configuration, the fading simulator simulates test case 5 and 6 from MediaFlo.

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).

**HSTRain**

In the High Speed Train Propagation configuration, the fading simulator simulates dynamic propagation conditions in conformity with the test case 3GPP, 25.141-xxx, annex D.4A. One path per scenario is simulated.

**DSSimulation**

Provided for the simulation of the dynamic propagation conditions, see [chapter 8.9, "Dynamic Scenario Simulation"](#), on page 272.

\*RST: STAN

**Example:**            `FSIM:CONF MDEL`  
                          selects a moving propagation configuration.  
                          `FSIM:MDEL:STAT ON`  
                          activates the moving propagation for fader A.

---

**[:SOURCE<hw>]:FSIMulator:COPY:DESTination <Destination>**

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`).

**Parameters:**

<Destination>            integer  
                          Range:        1 to 4 (Standard Delay)/ 8 (Fine Delay)  
                          Increment: 1  
                          \*RST:        2

**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.

**Options:**            Option B14; Options B13 and B10; `SOURCE2` only with option B15;  
                          Range of values 5 to 8 only with option B15

---

**[:SOURCE<hw>]: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`).

**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.

**Usage:**            Event

**Options:**            Option B14; Options B13 and B10; `SOURCE2` only with option B15

**[ :SOURce<hw> ]:FSIMulator:COPIY:SOURce <Source>**

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).

**Parameters:**

<Source> float  
 Range: 1 to 4 (Standard Delay) / 8 (Fine Delay)  
 \*RST: 1

**Example:**

```
FSIM:DEL:STAT ON
activates the "Standard Delay" fading configuration.
FSIM:COPIY:DEST 4
sets fading group 4 as the destination for the copy operation.
FSIM:COPIY:SOUR 1
sets fading group 1 as the source for the copy operation.
FSIM:COPIY:EXEC
copies the settings from group 1 to group 4.
```

**Options:** Option B14; Options B13 and B10; SOURce2 only with option B15; Range of values 5 to 8 only with option B15

**[ :SOURce<hw> ]:FSIMulator:COUPlE:LOGNormal:CSTD <Cstd>**

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.

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.

**Parameters:**

<Cstd> 0 | 1 | OFF | ON  
 \*RST: 0

**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: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.

**Options:**           Options B14 and B15; Options B13 and B10

**[:SOURce<hw>]:FSIMulator:COUPlE:LOGNormal:LCONstant <LConstant>**

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.

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.

**Parameters:**

<LConstant>           0 | 1 | OFF | ON  
\*RST:                 0

**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: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.

**Options:**           Options B14 and B15; Options B13 and B10

**[[:SOURce<hw>]:FSIMulator:COUPlE:SPEEd <Speed>**

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`).

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.

**Parameters:**

<Speed>            0 | 1 | OFF | ON  
\*RST:            0

**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:COUP:SPE ON
activates coupling of the speed for the paths of both faders. The
settings in fader A are transferred to fader B.
```

**Options:**            Option B14 and B15; Options B13 and B10

**[[:SOURce<hw>]:FSIMulator:CSPeEd <CSPeEd>**

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`).

If coupling of the speed is activated in instruments with two faders

(`SOURce:FSIM:COUPlE: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).

**Parameters:**

<CSPeEd>            0 | 1 | OFF | ON  
\*RST:            1

**Example:**

```
FSIM:DEL:STAT ON
activates the "Standard Delay" fading configuration.
FSIM:CSP ON
activates coupling of the speed for all active fading paths.
```



**Options:** Option B14; Options B13 and B10; SOURce2 only with option B15

---

**[[:SOURce<hw>]:FSIMulator:FREQuency <Frequency>**

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.

**Parameters:**

<Frequency> float  
 Range: 1E5 to 100E9  
 Increment: 0.01  
 \*RST: 1E9  
 Default unit: Hz

**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.

**Options:** Option B14; Options B13 and B10; SOURce2 only with option B15

---

**[[:SOURce<hw>]:FSIMulator:GLOBal:SEED <Seed>**

This command enters the fading start seed. This value is global for the instrument.

**Parameters:**

<Seed> float  
 Range: 0 to 9  
 \*RST: 0

**Example:**

FSIM:GLOB:SEED 2  
 sets the start seed to 2

**Options:** Option B14; Options B13 and B10; SOURce2 only with option B15

---

**[[:SOURce<hw>]:FSIMulator:HOPPIng:MODE <Mode>**

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.

**Parameters:**

&lt;Mode&gt;

OFF | IBANd | OOBand

**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.

**\*RST:** 0**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.

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:IGNore:RFCHanges <RfChanges>**

(instruments with RF output only)

This command determines whether frequency changes &lt; 5% are ignored. This enables faster frequency hopping.

**Parameters:**

&lt;RfChanges&gt;

0 | 1 | OFF | ON

**\*RST:** 0**Example:**

FSIM:IGN:RFCH ON

Ignores frequency changes &lt; 5% for the fading.

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:ILOSs:CSAMples?**

This command queries the share of samples which were clipped due to the insertion loss setting.

**Return values:**

<CSamples>                    string

**Example:**

```
FSIM:ILOS:CSAM?
```

queries the share of samples which were clipped.

```
Response: 11
```

11% of the samples were clipped.

**Usage:**                    Query only

**Options:**                Option B14; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:ILOSs:MODE <Mode>**

This command sets the insertion loss of the fading simulator.

**Parameters:**

<Mode>                    NORMal | LACP | USER

**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 12dB. 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.

```
*RST:            NORMal
```

**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.

**Options:**                Option B14; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:ILOSs[:LOSS] <Loss>**

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.

**Parameters:**

<Loss> float  
 Range: -3 to 30  
 Increment: 0.1  
 \*RST: 0  
 Default unit: dB

**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.
```

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:KCONstant <KConstant>**

This command selects whether to keep the speed or the Doppler shift constant in case of frequency changes.

**Parameters:**

<KConstant> SPEed | DSHift  
 \*RST: SPEed

**Example:**

```
FSIM:KCON SPE
keeps the speed constant in case of frequency changes.
```

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:PRESet**

This command sets the default settings (preset) for fading simulation.

- :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`

**Example:** `FSIM:PRES`  
resets fading simulation to the default values.

**Usage:** Event

**Options:** Option B14; Options B13 and B10; SOURce2 only with option B15

### **[SOURce<hw>]: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.

**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.

**Usage:** Event

**Options:** Option B14; Options B13 and B10; SOURce2 only with option B15

### **[SOURce<hw>]:FSIMulator:REStart:MODE <Mode>**

This command selects how a restart of fading simulation is triggered.

**Parameters:**

<Mode> AUTO | MANual | EXT1 | EXT2

**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.

\*RST: AUTO

**Example:** `FSIM:REST:MODE MAN`  
selects manual mode for triggering a restart.  
`FSIM:REST`  
triggers a restart of fading simulation.

**Options:** Option B14; Options B13 and B10; SOURce2 only with option B15

### **[SOURce<hw>]:FSIMulator:ROUte <Route>**

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).

**Parameters:**

&lt;Route&gt;

FAA | FAMAXAB | FAAFBA | FAMAXA | FBMAXB | FAAFBB |  
 FABFBB | FBMAXAB | FAABFBAB | FBA | FA1A2BFB1A2B |  
 FA1A2BFB1A2BM24 | FA1A2BFB1A2BM42 |  
 FA1A2BFB1A2BM23 | FA1A2BFB1A2BM32 |  
 FA1A2BFB1A2BM22 | FA1A2BFB1A2BM12

**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 | FA1A2BFB1A2BM22**

Sets 2x2 MIMO mode

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 paths are available for fader AA. The faded modulation signal of fader AB is placed on baseband path B. 10 fading paths 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 paths are available for fader BA. The faded modulation signal of fader BB is placed on baseband path B. 10 fading paths are available for fader BB.

**FA1A2BFB1A2BM24**

Sets 2x4 MIMO mode.

**FA1A2BFB1A2BM42**

Sets 4x2 MIMO mode

**FA1A2BFB1A2BM23**

Sets 2x3 MIMO mode

**FA1A2BFB1A2BM32**

Sets 3x2 MIMO mode

**FA1A2BFB1A2BM12**

sets "1x2 MIMO + Addition Baseband B" mode, i.e. the faded MIMO signal of fader A is routed on baseband paths A and B; the not faded signal of path B is added to both paths.

This mode is required for the test case 'Performance requirements for UL timing adjustment' according to TS 36.141, section 8.2.2. For detailed description on how to set up the instrument for this test case refer to the description 'Digital Standard EUTRA/LTE'.

\*RST: 1 fader: FAA / 2 faders: FAAFBB

**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.

**Options:**

Options B14; Options B13 and B10; FAAFBA | FAAFBB | FABFBB | FAMAXA | FBMAXB | FBMAXAB: option B15 and second option B10; FAMAXAB: second option B10

---

**[[:SOURCE<hw>]:FSIMulator:SDEstination <SDEstination>**

This command selects the RF frequency which is used as a basis for computing the Doppler shift.



**Parameters:**

&lt;SDestination&gt;

RF | BB

**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.
```

```
*RST: RF
```

**Example:**

```
FSIM:SDES RF
```

selects the RF frequency as the basis for computing the Doppler shift.

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

```
[:SOURce<hw>]:FSIMulator:SPEed:UNIT <Unit>
```

This command chooses the default unit for the parameter speed as displayed in the dialog.

**Note:** The remote control command changes only the units displayed in the graphical user interface. While configuring the speed via remote control, the speed units must be specified.

**Parameters:**

&lt;Unit&gt;

MPS | KMH | MPH | NMPH

```
*RST: KMH
```

**Example:**

```
FSIM:SPE:UNIT MPS
```

sets meters per second as the default unit for the speed parameter as displayed in the graphical user interface.

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

```
[:SOURce<hw>]:FSIMulator:STANdard <Standard>
```

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 [chapter 7, "Predefined Fading Settings"](#), on page 120.

Standard / Test Case	<Predefined_Standard>	Description
-	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
CDMA see <a href="#">chapter 7.1, "CDMA Standards"</a> , on page 120	CDMA0   CDMA3   CDMA8   CDMA30   C1DMA30   CDMA100	CDMA 5 (0 km/h), CDMA6 (3km/h), CDMA1 (8 km/h), CDMA2 (30 km/h), CDMA3 (30 km/h, 1 path), CDMA4 (100km/h)
GSM see <a href="#">chapter 7.2, "GSM Standards"</a> , on page 123	GTU1P5   G6TU1P5   GTU3P6   G6TU3P6   GTU3   G6TU3   GTU6   G6TU6   GTU50   G6TU50   G6TU100   G6TU60	GSM Typical Urban 1,5/3/3,6/6/50/60/100 km/h, 6 and 12 path
	GHT100   G6HT100   GHT120   G6HT120   GHT200   G6HT200	GSM Hilly Terrain 100/120 km/h, 6 and 12 path
	GRA130   GRA250   GRA300   GRA500	GSM Rural Area 130/250/300/500 km/h, 6 path
	GET50   GET60   GET100	GSM Equal Test 50/60/100 km/h, 6 path
	GTI5	GSM typical case for very small cells, 5km/h, 2 path
NADC see <a href="#">chapter 7.3, "NADC Standards"</a> , on page 128	NADC8   NADC50   NADC100	NADC 8/50/100 km/h, 2 path
DCS1800/PCS1900 see <a href="#">chapter 7.4, "PCN Standards"</a> , on page 129	P6TU1   PTU1   P6TU50   PTU50	Typical Urban 1/50m' km/h, 6 and 12 path
	P6HT100   PHT100	Hilly Terrain 100 km/h, 6 and 12 path
	PRA130	Rural Area 130 km/h, 6 path.
	PET50   PET100	Equal Test 50/100 km/h, 6 path
TETRA see <a href="#">chapter 7.5, "TETRA Standards"</a> , on page 134	TTU   T6TU	TETRA Typical Urban 50km/h, 2 path and 6 path
	TBU	TETRA 2 path
	THT   T6HT	TETRA Hilly Terrain 200 km/h, 2 path and 6 path
	T4ET	TETRA Equal Test 200 km/h, 4 path
	TDU	TETRA Mode Direct Mode Rural Propagation Model 1 path

Standard / Test Case	<Predefined_Standard>	Description
	TDR	TETRA Mode Urban Propagation Mode 1 path
3GPP FDD see <a href="#">chapter 7.6, "3GPP Standards"</a> , on page 138	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   G3UEPB3	3GPP FDD Pedestrian A 4 path / B 6 path (UE)
	G3UEVA3   G3UEVA30   G3UEVA120	3GPP FDD Vehicular A 6 path (UE)
	G3MBSFN3	3GPP MBSFN
	G3TU3   G3TU50   G3TU120	3GPP FDD Typical Urban 20 path
	G3HT120	3GPP FDD Hilly Terrain 20 path
	G3RA120   G3RA250	3GPP FDD Rural Area 10 path
	BD1	3GPP Birth Death 2 path
Moving Propagation see <a href="#">chapter 7.15, "3GPP/LTE Moving Propagation"</a> , on page 182	MD1	3GPP Moving Propagation "Ref. + Moving Channel", 2path
	MPLTEETU200	3GPP Moving Propagation scenario 1 "ETU200Hz", according to the test case 3GPP TS36.141, annex B4.
	MPLTEPDOPP	3GPP Moving Propagation scenario 2 "AWGN", according to the test case 3GPP TS36.141, annex B4.
3GPP High Speed Train scenarios see <a href="#">chapter 7.14, "3GPP/LTE High Speed Train"</a> , on page 180	G3HST1OS   G3HST1OSDU	3GPP HST1 "Open space", according to the test case 3GPP TS25.141, annex D.4A and 3GPP TS36.141, annex B.3
	G3HST2TLC   G3HST2TLCDU	3GPP HST2 "Tunnel with leaky cable", according to the test case 3GPP TS25.141, annex D.4A

Standard / Test Case	<Predefined_Standard>	Description
	G3HST3TMA   G3HST3TMADU	3GPP HST3 "Tunnel for multi-antennas", according to the test case 3GPP TS25.141, annex D.4A and 3GPP TS36.141, annex B.3
WLAN see <a href="#">chapter 7.7, "WLAN Standards"</a> , on page 148	HL2A   HL2B   HL2C   HL2D   HL2E	WLAN HyperLan 18 path
DAB see <a href="#">chapter 7.8, "DAB Standards"</a> , on page 153	DABRA04   DABRA06	DAB Rural Area 4 and 6 path
	DABTU12   DABTU06	DAB Typical Urban 12 and 6 path
	DABSFN	DAB Single Frequency Network (in the VHF range) 7 path
WiMAX  see <a href="#">chapter 7.9, "WiMAX Standards"</a> , on page 156	WMITUOIPA   WMITUOIPB   WMITUVA60   WMITUVA120	Wimax ITU OIP-A, ITU OIP-B, ITU V-A-60, ITU V-A-120
	WMSUI1A360P90   WMSUI1A360P75   WMSUI1A030P90   WMSUI1A030P75	SUI 1 (omi ant. 90/75%), SUI 1 (30 ant. 90/75%)
	WMSUI2A360P90   WMSUI2A360P75   WMSUI2A030P90   WMSUI2A030P75	SUI 2 (omi ant. 90/75%), SUI 2 (30 ant. 90/75%)
	WMSUI3A360P90   WMSUI3A360P75   WMSUI3A030P90   WMSUI3A030P75	SUI 3 (omi ant. 90/75%), SUI 3 (30 ant. 90/75%)
	WMSUI4A360P90   WMSUI4A360P75   WMSUI4A030P90   WMSUI4A030P75	SUI 4 (omi ant. 90/75%), SUI 4 (30 ant. 90/75%)
	WMSUI5A360P90   WMSUI5A360P75   WMSUI5A360P50   WMSUI5A030P90   WMSUI5A030P75   WMSUI5A030P50	SUI 5 (omi ant. 90/75/50%), SUI 5 (30 ant. 90/75/50%)
	WMSUI6A360P90   WMSUI6A360P75   WMSUI6A360P50   WMSUI6A030P90   WMSUI6A030P75   WMSUI6A030P50	SUI 6 (omi ant. 90/75/50%), SUI 6 (30 ant. 90/75/50%)
WiMAX-MIMO see <a href="#">chapter 7.12, "WiMAX-MIMO Standards"</a> , on page 172	WMITUPB3L   WMITUPB3M   WMITUPB3H   WMITUVA60L   WMITUVA60M   WMITUVA60H	ITU PB Low/Medium/High, ITU VA Low/Medium/High
LTE see <a href="#">chapter 7.10, "LTE Standards"</a> , on page 169	LTEEPA5   LTEEVA5   LTEEVA70   LTEETU70   LTEETU300   LTEMBSFN5	LTE EPA 5Hz , LTE EVA 5/70Hz, LTE ETU 70/300Hz, LTE MBSFN 5Hz

Standard / Test Case	<Predefined_Standard>	Description
LTE-MIMO see <a href="#">chapter 7.11, "LTE-MIMO Standards"</a> , on page 171	LMEPA5L   LMEPA5M   LMEPA5H   LMEVA5L   LMEVA5M   LMEVA5H   LMEVA70L   LMEVA70M   LMEVA70H   LMETU70L   LMETU70M   LMETU70H   LMETU300L   LMETU300M   LMETU300H	LTE EPA 5Hz Low/Medium/High, LTE EVA 5/70Hz Low/Medium/High, LTE ETU 70/300Hz Low/Medium/High,
1xEVDO see <a href="#">chapter 7.13, "1xEVDO Standards"</a> , on page 177	EVDO1CH1   EVDO1CH1BC5   EVDO1CH2   EVDO1CH2BC5   EVDO1CH3   EVDO1CH3BC5   EVDO1CH4   EVDO1CH4BC5   EVDO1CH5   EVDO1CH5BC5	1xEVDO Chan. 1/2/3/4/5
WATTERSON see <a href="#">chapter 7.16, "Watterson Standards"</a> , on page 184	WATTI1   WATTI3   WATTI2	Watterson I1, I2, I3
802.11n-MIMO see <a href="#">chapter 7.17, "802.11n-MIMO Standards"</a> , on page 186	WLANNMODA   WLANNMODB   WLANNMODC   WLANNMODD   WLANNMODE   WLANNMODF	802.11n Model A/B/C/D/E/F

**Parameters:**

&lt;Standard&gt;

USER | CDMA8 | CDMA30 | C1DMA30 | CDMA100 | CDMA0 |  
 CDMA3 | G6TU3 | GTU3 | G6TU50 | GTU50 | G6HT100 |  
 GHT100 | GRA250 | GET50 | GET100 | HL2A | HL2B | HL2C |  
 HL2D | HL2E | NADC8 | NADC50 | NADC100 | P6TU1 | PTU1 |  
 P6TU50 | PTU50 | P6HT100 | PHT100 | PRA130 | PET50 |  
 PET100 | TTU | TBU | THT | T4ET | G3C1 | G3C2 | G3C3 | G3C4 |  
 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 | TDU | TDR | WMITUVA120 |  
 GET60 | G6HT120 | G6HT200 | GRA130 | GRA300 | GRA500 |  
 G6TU1P5 | G6TU3P6 | G6TU6 | G6TU60 | G6TU100 | GHT120 |  
 GHT200 | GTU1P5 | GTU3P6 | GTU6 | GTU60 | GTU100 |  
 LMEPA5L | LMEPA5M | LMEPA5H | LMEVA5L | LMEVA5M |  
 LMEVA5H | LMEVA70L | LMEVA70M | LMEVA70H | LMETU70L |  
 LMETU70M | LMETU70H | LMETU300L | LMETU300M |  
 LMETU300H | WMITUPB3L | WMITUPB3M | WMITUPB3H |  
 WMITUVA60L | WMITUVA60M | WMITUVA60H | EVDO1CH1 |  
 EVDO1CH1BC5 | EVDO1CH2 | EVDO1CH2BC5 | EVDO1CH3 |  
 EVDO1CH3BC5 | EVDO1CH4 | EVDO1CH4BC5 | EVDO1CH5 |  
 EVDO1CH5BC5 | G3HST1OS | G3HST2TLC | G3HST3TMA |  
 MPLTEETU200 | MPLTEPDOPP | T6TU | T6HT | LTEEPA5 |  
 LTEEVA5 | LTEEVA70 | LTEETU70 | LTEETU300 | G3UEC1 |  
 G3UEC2 | G3UEC3 | G3UEVA3 | G3MBSFN3 | WATTI1 |  
 WATTI3 | WATTI2 | GTI5 | G3HST1OSDU | G3HST2TLCU |  
 G3HST3TMADU | LTEMBSFN5 | WLANNMODA |  
 WLANNMODB | WLANNMODC | WLANNMODD |  
 WLANNMODE | WLANNMODF

\*RST: USER

**Example:**

FSIM:STAN THT

selects settings in conformity with Tetra Hilly Terrain 200 (with two fading paths).

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:STANdard:REFerence <Reference>**

This command queries the reference in the standard for the selected test case default.

**Parameters:**

<Reference>                    string

**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.
```

**Options:**                    Option B14; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:SUM:RATio <Ratio>**

Set the ratio of the output levels of both paths A and B in case the fader 1 and 2 are added.

Faded Signals are added in case one of the following signal routing configuration:

- Signal Routing A to A / B to A
- Signal Routing A to B / B to B
- Signal Routing A to A&B / B to A&B

The "Summation Ration A/B" function is similar to the "Path Gain" function in the "Baseband" block. The Path Gain represents the relative gain of the selected path compared to the baseband signal of the other path and/or of the external baseband input. The "Path Gain" is measured at the output of the "Baseband" block and in case of any signal routing with summed signals.

However, if the baseband signal is additionally faded and routed at the output of the fading simulator, so that the faded signals from both paths are summed, the real path gain is measured at the output of the "Fading" block and set with the parameter "Summation Ratio A/B".

The relative gain set with the parameter "Path Gain" in the "Baseband" block is ignored.

A positive value of the parameter Summation Ration A/B indicates a stronger signal on path A; respectively a negative value indicates a stronger signal on path B.

**Parameters:**

<Ratio>                        float  
                                   Range:        -80 dB to 80 dB  
                                   \*RST:        0.0 dB

**Example:**

```
FSIM:SUM:RAT -30
sets the ratio to -30dB.
```

**[:SOURce<hw>]:FSIMulator[:STATe] <State>**

This command activates fading simulation.

**Parameters:**

<State>                    0 | 1 | OFF | ON  
 \*RST:                    0

**Example:**

FSIM ON  
 activates fading simulation in baseband path A with the current settings.

**Options:**                    Option B14; Options B13 and B10; SOURce2 only with option B15

**[: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`. Only files with the file ending `*.fad` are read out.

**Return values:**

<Catalog>                    string

**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.

**Usage:**                    Query only

**Options:**                    Option B14; Options B13 and B10

**[:SOURce<hw>]:FSIMulator:LOAD <Filename>**

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.

**Setting parameters:**

<Filename>                    string

**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.

**Usage:**                    Setting only



**Options:** Option B14; Options B13 and B10; SOURce2 only with option B15

---

**[:SOURce]:FSIMulator:DELETE** <Filename>

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.

**Note:** This command is only valid with DELETE in the long form as DEL is used as short form of header keyword DELay.

**Setting parameters:**

<Filename> string

**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.
```

**Usage:** Setting only

**Options:** Option B14; Options B13 and B10; SOURce2 only with option B15

---

**[:SOURce<hw>]:FSIMulator:STORe** <Filename>

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.

**Setting parameters:**

<Filename> string

**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.
```

**Usage:** Setting only

**Options:** Option B14; Options B13 and B10; SOURce2 only with option B15

---

**[:SOURce<hw>]:FSIMulator:STORe:FAST** <Fast>

Determines whether the instrument performs an absolute or a differential storing of the settings.

Enable this function to accelerate the saving process by saving only the settings with values different to the default ones.

**Note:** This function is not affected by the "Preset" function.

**Parameters:**

<Fast>                    0 | 1 | OFF | ON  
 \*RST:                    1

## 8.2 Birth Death

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---

### **[:SOURce<hw>]:FSIMulator:BIRTHdeath:DElay:GRID <Grid>**

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 ([\[:SOURce<hw>\]:FSIMulator:BIRTHdeath:DElay:MINimum](#)), the delay grid ([FSIM:BIRTHdeath:DElay:GRID](#)) and the number of possible hop positions ([\[:SOURce<hw>\]:FSIMulator:BIRTHdeath:POSitions](#)).

**Parameters:**

<Grid>                    float  
 Range:                    0  $\mu$ s to 10  $\mu$ s  
 Increment:                1ns  
 \*RST:                    1  $\mu$ s

**Example:**                `FSIM:BIRT:DEL:GRID 0.00001`  
 sets a delay grid of 10 us.

**Options:**                Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

### **[:SOURce<hw>]:FSIMulator:BIRTHdeath:DElay:MINimum <Minimum>**

### **[:SOURce<hw>]:FSIMulator:BIRTHdeath:DElay:MAXimum?**

Queries the minimum/maximum delay for both paths with birth death propagation fading. The minimum delay corresponds to the start value of the delay range.

The maximum delay is defined by the minimum delay (`[ :SOURCE<hw> ] :FSIMulator:BIRTHdeath:DELay:MINimum`), the delay grid (`[ :SOURCE<hw> ] :FSIMulator:BIRTHdeath:DELay:GRID`), and the number of possible hop positions (`[ :SOURCE<hw> ] :FSIMulator:BIRTHdeath:POSitions`).

**Return values:**

<Maximum> float  
Range: 0 to max

**Example:**

```
FSIM:BIRT:DEL:MIN 0.000012
sets a minimum delay of 12 us.
FSIM:BIRT:DEL:GRID 0.000002
sets a delay grid of 2 us.
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 us. The delay range lies between +12
and +28 us. There are 9 hop positions on a 2 us grid available.
```

**Usage:** Query only

**Options:** Options B14 and K71; Options B13 and B10; SOURCE2 only with option B15

**[ :SOURCE<hw> ] :FSIMulator:BIRTHdeath:FRATio <FRatio>**

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

**Parameters:**

<FRatio> float  
Range: -1 to 1  
Increment: 0.01  
\*RST: 1

**Example:**

```
FSIM:BIRT:FRAT 0.5
sets a frequency ratio of 0.5 for both fading paths.
```

**Options:** Options B14 and K71; Options B13 and B10; SOURCE2 only with option B15

**[ :SOURCE<hw> ] :FSIMulator:BIRTHdeath:HOPPing:DWELI <Dwell>**

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

**Parameters:**

<Dwell> float  
 Range: 1 ms to 2<sup>32</sup>-1 ns  
 Increment: 10 ns  
 \*RST: 191 ms

**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.

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[ :SOURce<hw> ]:FSIMulator:BIRThdeath:PATH<ch>:FDOPpler?**

This command queries the Doppler frequency with birth death propagation. The Doppler frequency is determined by the entered speed (`[ :SOURce<hw> ]:FSIMulator:BIRThdeath:SPEed`) and by the entered ratio of the actual Doppler frequency to the set Doppler frequency (`[ :SOURce<hw> ]:FSIMulator:BIRThdeath:FRATio`).

**Return values:**

<FDoppler> float  
 Range: 0 to 1000  
 Increment: 0.01  
 \*RST: 0

**Example:**

FSIM:BIRT:FDOP?  
 queries the resulting Doppler frequency.  
 Response: 55  
 the resulting Doppler frequency is 55 Hz.

**Usage:**

Query only

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[ :SOURce<hw> ]:FSIMulator:BIRThdeath:PATH<ch>:LOSS <Loss>**

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

**Parameters:**

<Loss> float  
 Range: 0 to 50  
 Increment: 0.01  
 \*RST: 0  
 Default unit: dB

**Example:**

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

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[[:SOURce<hw>]:FSIMulator:BIRThdeath:PATH<ch>:PROFile <Profile>**

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

**Parameters:**

<Profile> PDOPpler

**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).

\*RST: PDOPpler

**Example:**

FSIM:BIRT:PATH2:PROF?

queries the profile of the second fading path.

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[[:SOURce<hw>]:FSIMulator:BIRThdeath:POSitions <Positions>**

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 us < ( . . . :BIRT:POS - 1 ) x . . . :DEL:GRID + . . . :DEL:MIN < 40 us

**Parameters:**

<Positions> float

Range: 3 to 50

\*RST: 11

**Example:**

FSIM:BIRT:POS 11

sets 11 possible delay positions.

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[[:SOURce<hw>]:FSIMulator:BIRThdeath:SOFFset <Soffset>**

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.

**Parameters:**

<Soffset> float

Range: 1 ms to (2<sup>32</sup>-1) us

Increment: 10 ns

\*RST: 0

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

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:BIRThdeath:SPEEd <Speed>**

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.

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

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:FDOPpler.

The default speed unit is m/s. Units different than the default one must be specified.

**Parameters:**

<Speed> float  
Range: 0 to 479.67 m/s  
Increment: 0.1 m/s  
\*RST: 0 m/s

**Example:** `FSIM:BIRT:SPE 2KMH`  
sets a speed of 2 km/h on both fading paths.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:BIRThdeath:STATe <State>**

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

**Parameters:**

<State> 0 | 1 | OFF | ON  
\*RST: 0

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

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

## 8.3 Delay Modes

**GRoup<st>**

Value range: [1]|2...8

**PATH<ch>**

Value range: [1]|2|3

[ :SOURce<hw>]:FSIMulator:DEL50:GRoup<st>:PATH<ch>:ADELay.....	227
[ :SOURce<hw>]:FSIMulator:DELay DEL:GRoup<st>:PATH<ch>:ADELay.....	227
[ :SOURce<hw>]:FSIMulator:MDELay:DEL30:GRoup<st>:PATH<ch>:ADELay.....	227
[ :SOURce<hw>]:FSIMulator:DEL30:GRoup<st>:PATH<ch>:ADELay.....	227
[ :SOURce<hw>]:FSIMulator:DEL50:GRoup<st>:PATH<ch>:BDELay.....	227
[ :SOURce<hw>]:FSIMulator:DELay DEL:GRoup<st>:PATH<ch>:BDELay.....	227
[ :SOURce<hw>]:FSIMulator:MDELay:DEL30:GRoup<st>:PATH<ch>:BDELay.....	227
[ :SOURce<hw>]:FSIMulator:DEL30:GRoup<st>:PATH<ch>:BDELay.....	227
[ :SOURce<hw>]:FSIMulator:PATH<st>:CORRelation:COEFFicient.....	228
[ :SOURce<hw>]:FSIMulator:DEL50:GRoup<st>:PATH<ch>:CORRelation:COEFFicient.....	228
[ :SOURce<hw>]:FSIMulator:DELay DEL:GRoup<st>:PATH<ch>:CORRelation: COEFFicient.....	228
[ :SOURce<hw>]:FSIMulator:DEL30:GRoup<st>:PATH<ch>:CORRelation:COEFFicient.....	228
[ :SOURce<hw>]:FSIMulator:PATH<st>:CORRelation:PHASe.....	228
[ :SOURce<hw>]:FSIMulator:DEL50:GRoup<st>:PATH<ch>:CORRelation:PHASe.....	228
[ :SOURce<hw>]:FSIMulator:DELay DEL:GRoup<st>:PATH<ch>:CORRelation:PHASe.....	229
[ :SOURce<hw>]:FSIMulator:DEL30:GRoup<st>:PATH<ch>:CORRelation:PHASe.....	229
[ :SOURce<hw>]:FSIMulator:PATH<st>:CORRelation:STATe.....	229
[ :SOURce<hw>]:FSIMulator:DEL50:GRoup<st>:PATH<ch>:CORRelation:STATe.....	229
[ :SOURce<hw>]:FSIMulator:DELay DEL:GRoup<st>:PATH<ch>:CORRelation:STATe.....	229
[ :SOURce<hw>]:FSIMulator:DEL30:GRoup<st>:PATH<ch>:CORRelation:STATe.....	229
[ :SOURce<hw>]:FSIMulator:PATH<st>:CPHase.....	230
[ :SOURce<hw>]:FSIMulator:DELay DEL:GRoup<st>:PATH<ch>:CPHase.....	230
[ :SOURce<hw>]:FSIMulator:DEL50:GRoup<st>:PATH<ch>:CPHase.....	230
[ :SOURce<hw>]:FSIMulator:DEL30:GRoup<st>:PATH<ch>:CPHase.....	230
[ :SOURce<hw>]:FSIMulator:PATH<st>:FDOPpler.....	231
[ :SOURce<hw>]:FSIMulator:FDELay:PATH<ch>:FDOPpler.....	231
[ :SOURce<hw>]:FSIMulator:DELay DEL:GRoup<st>:PATH<ch>:FDOPpler.....	231
[ :SOURce<hw>]:FSIMulator:MDELay:DEL30:GRoup<st>:PATH<ch>:FDOPpler.....	231
[ :SOURce<hw>]:FSIMulator:DEL50:GRoup<st>:PATH<ch>:FDOPpler.....	231
[ :SOURce<hw>]:FSIMulator:DEL30:GRoup<st>:PATH<ch>:FDOPpler.....	231
[ :SOURce<hw>]:FSIMulator:PATH<st>:FRATio.....	231
[ :SOURce<hw>]:FSIMulator:FDELay:PATH<ch>:FRATio.....	231
[ :SOURce<hw>]:FSIMulator:DELay DEL:GRoup<st>:PATH<ch>:FRATio.....	231
[ :SOURce<hw>]:FSIMulator:MDELay:DEL30:GRoup<st>:PATH<ch>:FRATio.....	231
[ :SOURce<hw>]:FSIMulator:DEL50:GRoup<st>:PATH<ch>:FRATio.....	232
[ :SOURce<hw>]:FSIMulator:DEL30:GRoup<st>:PATH<ch>:FRATio.....	232
[ :SOURce<hw>]:FSIMulator:DELay DEL:GRoup<st>:PATH<ch>:FSHift.....	232
[ :SOURce<hw>]:FSIMulator:DEL50:GRoup<st>:PATH<ch>:FSHift.....	232
[ :SOURce<hw>]:FSIMulator:DEL30:GRoup<st>:PATH<ch>:FSHift.....	232
[ :SOURce<hw>]:FSIMulator:DELay DEL:GRoup<st>:PATH<ch>:FSPRead.....	233

[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:FSPRead.....	233
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:FSPRead.....	233
[:SOURce<hw>]:FSIMulator:PATH<st>:LOGNormal:CSTD.....	233
[:SOURce<hw>]:FSIMulator:DElay DEL:GROup<st>:PATH<ch>:LOGNormal:CSTD.....	233
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOGNormal:CSTD.....	233
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOGNormal:CSTD.....	233
[:SOURce<hw>]:FSIMulator:PATH<st>:LOGNormal:LCONstant.....	234
[:SOURce<hw>]:FSIMulator:DElay DEL:GROup<st>:PATH<ch>:LOGNormal: LCONstant.....	234
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOGNormal:LCONstant.....	234
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOGNormal:LCONstant.....	234
[:SOURce<hw>]:FSIMulator:PATH<st>:LOGNormal:STATe.....	234
[:SOURce<hw>]:FSIMulator:DElay DEL:GROup<st>:PATH<ch>:LOGNormal:STATe.....	234
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOGNormal:STATe.....	235
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOGNormal:STATe.....	235
[:SOURce<hw>]:FSIMulator:PATH<st>:LOSS.....	235
[:SOURce<hw>]:FSIMulator:FDElay:PATH<ch>:LOSS.....	235
[:SOURce<hw>]:FSIMulator:DElay DEL:GROup<st>:PATH<ch>:LOSS.....	235
[:SOURce<hw>]:FSIMulator:MDElay:DEL30:GROup<st>:PATH<ch>:LOSS.....	235
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOSS.....	235
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOSS.....	235
[:SOURce<hw>]:FSIMulator:PATH<st>:PRATio.....	236
[:SOURce<hw>]:FSIMulator:DElay DEL:GROup<st>:PATH<ch>:PRATio.....	236
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:PRATio.....	236
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:PRATio.....	236
[:SOURce<hw>]:FSIMulator:PATH<st>:PROFile.....	236
[:SOURce<hw>]:FSIMulator:FDElay:PATH<ch>:PROFile.....	236
[:SOURce<hw>]:FSIMulator:DElay DEL:GROup<st>:PATH<ch>:PROFile.....	236
[:SOURce<hw>]:FSIMulator:MDElay:DEL30:GROup<st>:PATH<ch>:PROFile.....	236
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:PROFile.....	237
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:PROFile.....	237
[:SOURce<hw>]:FSIMulator:PATH<st>:RDElay.....	239
[:SOURce<hw>]:FSIMulator:DElay DEL:GROup<st>:PATH<ch>:RDElay.....	239
[:SOURce<hw>]:FSIMulator:MDElay:DEL30:GROup<st>:PATH<ch>:RDElay.....	239
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:RDElay.....	239
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:RDElay.....	239
[:SOURce<hw>]:FSIMulator:PATH<st>:SPEed.....	240
[:SOURce<hw>]:FSIMulator:FDElay:PATH<ch>:SPEed.....	240
[:SOURce<hw>]:FSIMulator:DElay DEL:GROup<st>:PATH<ch>:SPEed.....	240
[:SOURce<hw>]:FSIMulator:MDElay:DEL30:GROup<st>:PATH<ch>:SPEed.....	240
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:SPEed.....	240
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:SPEed.....	240
[:SOURce<hw>]:FSIMulator:PATH<st>:STATe.....	241
[:SOURce<hw>]:FSIMulator:FDElay:PATH<ch>:STATe.....	241
[:SOURce<hw>]:FSIMulator:DElay DEL:GROup<st>:PATH<ch>:STATe.....	241
[:SOURce<hw>]:FSIMulator:MDElay:DEL30:GROup<st>:PATH<ch>:STATe.....	241
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:STATe.....	241
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:STATe.....	241
[:SOURce<hw>]:FSIMulator:DEL50:STATe.....	241
[:SOURce<hw>]:FSIMulator:DElay DEL:STATe.....	241



`[:SOURce<hw>]:FSIMulator:DEL30:STATe.....`241

```
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:ADELay <ADelay>
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:ADELay
  <ADelay>
[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROup<st>:PATH<ch>:ADELay
  <ADelay>
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:ADELay <Adelay>
```

These commands determine the path-specific delay ("Additional Delay") of the selected path for the "Standard Delay", "Fine Delay 30 MHz / 50 MHz" and "Moving Propagation All Moving Channels" fading configurations. The Resulting Delay of a path is obtained by adding the Basic Delay and the Additional Delay.

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

**Parameters:**

<ADelay> float  
 Range: 0 to 40.0E-6 s  
 \*RST: 0

**Example:**

```
FSIM:DEL:STAT ON
activates the "Standard Delay" fading configuration.
FSIM:DEL:GRO:PATH2:ADEL 10E-6
sets an Additional Delay of 10 us for fading path 2.
```

**Options:**

Option B14; Options B13 and B10; Fine Delay configurations only with option K71; `SOURce2` and `GROup<5...8>` only with option B15

```
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:BDELay <BDelay>
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:BDELay
  <BDelay>
[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROup<st>:PATH<ch>:BDELay
  <BDelay>
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:BDELay <BDelay>
```

These commands determine the group delay ("Basic Delay") for the "Standard Delay", "Fine Delay 30 MHz / 50 MHz" and "Moving Propagation All Moving Channels" 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`.

**Parameters:**

<BDelay> float  
 Range: 0.0 to 2.56E-3 s  
 Increment: 10 ns  
 \*RST: 0.0

- 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.
- Options:** Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROUp<5...8> only with option B15

`[:SOURce<hw>]:FSIMulator:PATH<st>:CORRelation:COEFFicient <Coefficient>`  
`[:SOURce<hw>]:FSIMulator:DEL50:GROUp<st>:PATH<ch>:CORRelation:COEFFicient <Coefficient>`  
`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROUp<st>:PATH<ch>:CORRelation:COEFFicient <Coefficient>`  
`[:SOURce<hw>]:FSIMulator:DEL30:GROUp<st>:PATH<ch>:CORRelation:COEFFicient <Coefficient>`

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`.

Sets the correlation coefficient of the correlated path of the second fader also to the entered value.

**Parameters:**  
 <Coefficient> float  
 Range: 0 to 100  
 Increment: 0.1  
 \*RST: 100  
 Default unit: PCT

- 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.

- Options:** Option B14 and option B15; Options B13 and B10; Fine Delay configurations only with option K71

`[:SOURce<hw>]:FSIMulator:PATH<st>:CORRelation:PHASe <Phase>`  
`[:SOURce<hw>]:FSIMulator:DEL50:GROUp<st>:PATH<ch>:CORRelation:PHASe <Phase>`

**[[:SOURce<hw>]:FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:CORRelation:PHASe <Phase>**

**[[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:CORRelation:PHASe <Phase>**

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.

Sets the phase of the correlation coefficient of the correlated path of the second fader also to the entered value.

**Parameters:**

<Phase> float  
 Range: 0 to 359.9  
 Increment: 0.05  
 \*RST: 0  
 Default unit: DEG

**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.

**Options:** Option B14 and option B15; Options B13 and B10; Fine Delay configurations only with option K71

**[[:SOURce<hw>]:FSIMulator:PATH<st>:CORRelation:STATe <State>**

**[[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:CORRelation:STATe <State>**

**[[:SOURce<hw>]:FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:CORRelation:STATe <State>**

**[[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:CORRelation:STATe <State>**

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.

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).

**Parameters:**

<State>                    0 | 1 | OFF | ON  
 \*RST:                    0

**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.
```

**Options:**

Options B14 and B15; Options B13 and B10; Fine Delay configurations only with option K71

```
[:SOURce<hw>]:FSIMulator:PATH<st>:CPHase <CPhase>
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:CPHase
  <CPhase>
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:CPHase <CPhase>
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:CPHase <CPhase>
```

These commands the set start phase rotation.

**Parameters:**

<CPhase>                    float  
 Range:                    0 to 359.9  
 Increment:                0.1  
 \*RST:                    0  
 Default unit: DEG

**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.
```

**Options:** Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

---

```
[:SOURce<hw>]:FSIMulator:PATH<st>:FDOPpler <FDoppler>
[:SOURce<hw>]:FSIMulator:FDELay:PATH<ch>:FDOPpler <FDoppler>
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:FDOPpler
  <FDoppler>
[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROup<st>:PATH<ch>:FDOPpler
  <FDoppler>
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:FDOPpler <FDoppler>
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:FDOPpler <FDoppler>
```

This command queries the Doppler frequency for the "Standard Delay", "Fine Delay 30 MHz / 50 MHz" and "Moving Propagation All Moving Channels" 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.

**Parameters:**

<FDoppler> float  
 Range: 0 to 1000  
 Increment: 0.01  
 \*RST: 0  
 Default unit: Hz

**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.

**Options:** Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

---

```
[:SOURce<hw>]:FSIMulator:PATH<st>:FRATio <FRatio>
[:SOURce<hw>]:FSIMulator:FDELay:PATH<ch>:FRATio <FRatio>
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:FRATio <FRatio>
[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROup<st>:PATH<ch>:FRATio
  <FRatio>
```

**[[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:FRATio <FRatio>  
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:FRATio <FRatio>**

These commands enter the ratio of the actual Doppler frequency to the set Doppler frequency for the "Standard Delay", "Fine Delay 30 MHz / 50 MHz" and "Moving Propagation All Moving Channels" 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:ROUTEFBMAXB|FAMAXA|FAMAXAB |FBMAXAB.

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).

**Parameters:**

<FRatio> float  
Range: -1 to 1  
Increment: 0.01  
\*RST: 0

**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.

**Options:**

Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

**[[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:FSHift <FShift>  
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:FSHift <FShift>  
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:FSHift <FShift>**

Sets the frequency shift for the Gauss Watterson fading.

**Parameters:**

<FShift> float  
Range: -10 to +10  
Increment: 0.01  
\*RST: 0

**Example:**

FSIM:DEL:GRO:PATH2:PROF WATT  
FSIM:DEL:GRO:PATH2:FS?

---

```
[:SOURce<hw>]:FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:FSPRead
<FSpread>
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:FSPRead <FSpread>
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:FSPRead <FSprea>
```

Sets the frequency spread for the Gauss Watterson fading.

**Parameters:**

```
<FSprea>          float
                  Range:    0 to 1
                  Increment: 0.1
                  *RST:     0.1
```

**Example:**           FSIM:DEL:GRO:PATH2:PROF WATT  
                       FSIM:DEL:GRO:PATH2:FSPR?

---

```
[:SOURce<hw>]:FSIMulator:PATH<st>:LOGNormal:CSTD <Cstd>
[:SOURce<hw>]:FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:LOGNormal:
CSTD <Cstd>
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOGNormal:CSTD
<Cstd>
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOGNormal:CSTD
<Cstd>
```

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.

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).

**Parameters:**

```
<Cstd>           float
                  Range:    0 to 12
                  Increment: 1
                  *RST:     0
                  Default unit: dB
```

**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.

**Options:** Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

---

```
[:SOURce<hw>]:FSIMulator:PATH<st>:LOGNormal:LCONstant <LConstant>
[:SOURce<hw>]:FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:LOGNormal:
  LCONstant <LConstant>
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOGNormal:
  LCONstant <LConstant>
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOGNormal:
  LCONstant <LConstant>
```

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

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

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).

**Parameters:**

<LConstant> float  
 Range: 0 to 200  
 Increment: 0.1  
 \*RST: 100  
 Default unit: m

**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.

**Options:** Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

---

```
[:SOURce<hw>]:FSIMulator:PATH<st>:LOGNormal:STATe <State>
[:SOURce<hw>]:FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:LOGNormal:
  STATe <State>
```



```
[[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOGNormal:STATe
<State>
```

```
[[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOGNormal:STATe
<State>
```

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.

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).

**Parameters:**

```
<State>          0 | 1 | OFF | ON
*RST:            0
```

**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.
```

**Options:**

Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

```
[[:SOURce<hw>]:FSIMulator:PATH<st>:LOSS <Loss>
```

```
[[:SOURce<hw>]:FSIMulator:FDELay:PATH<ch>:LOSS <Loss>
```

```
[[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:LOSS <Loss>
```

```
[[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROup<st>:PATH<ch>:LOSS
<Loss>
```

```
[[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOSS <Loss>
```

```
[[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOSS <Loss>
```

These commands set the loss of the paths for the "Standard Delay", "Fine Delay 30 MHz / 50 MHz" and "Moving Propagation All Moving Channels" fading configurations.

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

**Parameters:**

```
<Loss>          float
Range:          0 to 50
Increment:      0.01
*RST:           10|0
Default unit:  dB
```

- 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.
- Options:** Option B14; Options B13 and B10; Fine Delay configurations only with option K71; `SOURce2` and `GROup<5...8>` only with option B15

**[[:SOURce<hw>]:FSIMulator:PATH<st>:PRATio <PRatio>**  
**[[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:PRATio <PRatio>**  
**[[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:PRATio <PRatio>**  
**[[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:PRATio <PRatio>**

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`.

**Parameters:**

**<PRatio>** float  
 Range: -30 to 30  
 Increment: 0.01  
 \*RST: 0  
 Default unit: dB

- 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.
- Options:** Option B14; Options B13 and B10; Fine Delay configurations only with option K71; `SOURce2` and `GROup<5...8>` only with option B15

**[[:SOURce<hw>]:FSIMulator:PATH<st>:PROFile <Profile>**  
**[[:SOURce<hw>]:FSIMulator:FDELay:PATH<ch>:PROFile <Profile>**  
**[[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:PROFile <Profile>**  
**[[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROup<st>:PATH<ch>:PROFile <Profile>**

**[ :SOURCE<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:PROFile <Profile>**  
**[ :SOURCE<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:PROFile <Profile>**

These commands select the fading profile for the paths for the "Standard Delay", "Fine Delay 30 MHz / 50 MHz" and "Moving Propagation All Moving Channels" fading configurations.

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

When two paths are correlated (SOURCE: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).

**Parameters:**

&lt;Profile&gt;

SPATH | PDOPpler | RAYLeigh | RICE | CPHase | OGAUs | TGAUs | DGAUs | WDOPpler | WRICe | GDOPpler | GFD8 | GFD1 | WATTerson

**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: . . . :GROup:PATH:SPEed) and "Frequency Ratio" (SOURce:FSIM: . . . :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  $\mu$ s to 2  $\mu$ s ( $0,5 \mu\text{s} \leq \tau_i \leq 2 \mu\text{s}$ ).

GAUS1:  $S(\tau_j, f) = G(A, -0.8f_d, 0.05f_d) + G(A_1, +0.4f_d, 0.1f_d)$

where  $A_1$  is 10 dB below A.

**TGAUs**

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

GAUS2:  $S(\tau_j, f) = G(B, -0.7f_d, 0.1f_d) + G(B_1, +0.4f_d, 0.15f_d)$

where  $B_1$  is 15 dB below B.

**DGAUs**

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

GAUSDAB:  $S(\tau_j, f) = G(A, \pm 0.7f_d, 0.1f_d)$

**GDOPpler**

Selects the Gauss Doppler fading profile.

**GFD8**

Selects the Gauss (0.08  $f_d$ ) fading profile.

**GFD1**

Selects the Gauss (0.01  $f_d$ ) fading profile.

**WATTerson**

Selects the Gauss (Watterson) fading profile.

**WDOPpler**

Selects the WM Doppler fading profile.

**WRICe**

Selects the WM Rice fading profile.

\*RST: RAYLeigh

**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.
```

**Options:**

Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

---

**[:SOURce<hw>]:FSIMulator:PATH<st>:RDElay?**

**[:SOURce<hw>]:FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:RDElay?**

**[:SOURce<hw>]:FSIMulator:MDElay:DEL30:GROup<st>:PATH<ch>:RDElay?**

**[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:RDElay?**

**[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:RDElay?**

These commands query the Resulting Delay of the paths for the "Standard Delay", "Fine Delay 30 MHz / 50 MHz" and "Moving Propagation All Moving Channels" fading configurations. The Resulting Delay is the sum of the Basic Delay (SOURce:FSIM:...:BDElay) and the Additional Delay (SOURce:FSIM:...:ADElay).

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

**Return values:**

<RDElay> float  
 Range: 0 to max  
 Increment: 10E-12  
 \*RST: 0

<b>Example:</b>	<pre>FSIM:DEL:STAT ON</pre> <p>activates the "Standard Delay" fading configuration.</p> <pre>FSIM:DEL:GRO2:PATH:BDEL 2E-4</pre> <p>sets a Delay Offset of 200 us for group 2.</p> <pre>FSIM:DEL:GRO2:PATH2:ADEL 1E-5</pre> <p>sets an Additional Delay of 10 us for fading path 2 of group 2.</p> <pre>FSIM:DEL:GRO2:PATH2:RDEL?</pre> <p>queries the Resulting Delay for fading path 2 of group 2.</p> <p>Response: 0.00021</p> <p>the Resulting Delay is 210 us.</p>
<b>Usage:</b>	Query only
<b>Options:</b>	Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROUp<5...8> only with option B15

---

```
[:SOURce<hw>]:FSIMulator:PATH<st>:SPEEd <Speed>
[:SOURce<hw>]:FSIMulator:FDELay:PATH<ch>:SPEEd <Speed>
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROUp<st>:PATH<ch>:SPEEd <Speed>
[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROUp<st>:PATH<ch>:SPEEd
<Speed>
[:SOURce<hw>]:FSIMulator:DEL50:GROUp<st>:PATH<ch>:SPEEd <Speed>
[:SOURce<hw>]:FSIMulator:DEL30:GROUp<st>:PATH<ch>:SPEEd <Speed>
```

These commands set the speed  $v$  of the moving receiver for the "Standard Delay", "Fine Delay 30 MHz / 50 MHz" and "Moving Propagation All Moving Channels" 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.

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

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: . . . :GROUp:PATH:FRATio) and can be queried with the commands SOUR:FSIM: . . . :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 default speed unit is m/s. Units different than the default one must be specified.

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

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).

**Parameters:**

<Speed> float  
 Range: 0 m/s to 27778.0 m/s  
 Increment: 0.1 m/s  
 \*RST: 0

**Example:**

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

**Example:**

FSIM:DEL:GRO:PATH2:SPE 2MPS  
 sets a speed of 2 m/s for the moving receiver for fading path 2 of group 1.

**Options:**

Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

**[:SOURce<hw>]:FSIMulator:PATH<st>:STATe <State>**  
**[:SOURce<hw>]:FSIMulator:FDElay:PATH<ch>:STATe <State>**  
**[:SOURce<hw>]:FSIMulator:DElay|DEL:GROup<st>:PATH<ch>:STATe <State>**  
**[:SOURce<hw>]:FSIMulator:MDElay:DEL30:GROup<st>:PATH<ch>:STATe <State>**  
**[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:STATe <State>**  
**[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:STATe <State>**

These commands activate the selected path for the "Standard Delay", "Fine Delay 30 MHz / 50 MHz" and "Moving Propagation All Moving Channels" fading configurations.

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

**Parameters:**

<State> 0 | 1 | OFF | ON  
 \*RST: 0

**Example:**

FSIM:DEL:STAT ON  
 activates the "Standard Delay" fading configuration.  
 FSIM:DEL:GRO:PATH2:STAT ON  
 activates fading path 2 in group 1.

**Options:**

Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

**[:SOURce<hw>]:FSIMulator:DEL50:STATe <State>**  
**[:SOURce<hw>]:FSIMulator:DElay|DEL:STATe <State>**  
**[:SOURce<hw>]:FSIMulator:DEL30:STATe <State>**

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.

**Parameters:**

<State> 0 | 1 | OFF | ON  
\*RST: 0

**Example:**

FSIM:DEL:STAT ON  
activates the "Standard Delay" fading configuration for fader A and switches on fading for path A.

**Options:**

Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 only with option B15

## 8.4 High Speed Train

[SOURce<hw>]:FSIMulator:HSTRain:DISTance:MINimum.....	242
[SOURce<hw>]:FSIMulator:HSTRain:DISTance:START.....	242
[SOURce<hw>]:FSIMulator:HSTRain:FDOPpler.....	243
[SOURce<hw>]:FSIMulator:HSTRain:PATH:STATE.....	243
[SOURce<hw>]:FSIMulator:HSTRain:PROFile.....	244
[SOURce<hw>]:FSIMulator:HSTRain:SPEed.....	244
[SOURce<hw>]:FSIMulator:HSTRain:STATE.....	244

---

### [SOURce<hw>]:FSIMulator:HSTRain:DISTance:MINimum <Minimum>

Sets the parameter  $D_{\min}$ , i.e. the distance between the BS and the railway track.

**Parameters:**

<Minimum> float  
Range: 1 to 100  
Increment: 0.1  
\*RST: 2

**Example:**

FSIM:HSTR:DIST:MIN 20  
sets the parameter Dmin to 20m.

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

---

### [SOURce<hw>]:FSIMulator:HSTRain:DISTance:START <Start>

Sets the parameter  $D_S$ , i.e. the initial distance  $D_S/2$  between the train and the BS at the beginning of the simulation.



**Parameters:**

<Start> float  
 Range: 20 m to 2000 m  
 Increment: 1 m  
 \*RST: 300 m

**Example:**

FSIM:HSTR:DIST:STAR 1000  
 sets the parameter Ds to 1000m

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:HSTRain:FDOPpler?**

Queries the maximum Doppler Shift for the selected configuration.

**Return values:**

<FDoppler> float  
 Range: 0 to 1000  
 Increment: 0.01  
 \*RST: 0

**Example:**

FSIM:HSTR:DIST:MIN 20  
 sets the parameter Dmin to 20m  
 FSIM:HSTR:DIST:STAR 200  
 sets the parameter Ds to 200m  
 FSIM:HSTR:SPE 100kmh  
 sets the speed 100km/h  
 FSIM:HSTR:FDOP?  
 queries the maximum Doppler shift  
 Response: 215.56 Hz

**Usage:**

Query only

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:HSTRain:PATH:STATe <State>**

Activates/deactivates the selected path for the High Speed Train fading configurations.

**Parameters:**

<State> 0 | 1 | OFF | ON  
 \*RST: 1

**Example:**

FSIM:STAN G3HST2TLC  
 activates the HST Scenario 2 "Tunnel with leaky cable" fading configuration.  
 FSIM:HSTR:PATH:STAT OFF  
 deactivates fading path for this scenario

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

**[ :SOURce<hw>]:FSIMulator:HSTRain:PROFile <Profile>**

Determines the fading profile for the selected scenario. The fading profile determines which transmission path is simulated.

Although both scenarios 1 and 3 are specified as Pure Doppler paths without a fading profile, the R&S Fading Simulator allows you to change the fading profile.

**Parameters:**

&lt;Profile&gt;

SPATh | PDOPpler | RAYLeigh

**SPAT**

A static transmission path with no attenuation (loss) or delay is simulated.

**PDOPpler**

A transmission path is simulated in which there is an individual direct connection from the transmitter to the moving receiver (discrete component).

The simulated path has a constant delay and attenuation (no loss). The Doppler frequency shift is determined only by the parameters Speed (FSIM:HSTR:SPE),  $D_{\min}$  (FSIM:HSTR:DIST:MIN) and  $D_s$  (FSIM:HSTR:DIST:STAR).

**RAYLeigh**

A radio hop is simulated in which many highly scattered subwaves arrive at a moving receiver.

\*RST: PDOPpler

**Example:**

FSIM:HSTR:PROF PDOP

selects Pure Doppler as HST fading profile

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

**[ :SOURce<hw>]:FSIMulator:HSTRain:SPEed <Speed>**

Sets the velocity parameter , i.e. the speed of the moving receiver in m/s.

**Parameters:**

&lt;Speed&gt;

float

Range: 0 to 27778

\*RST: 300 km/h

**Example:**

FSIM:HSTR:SPE 100

sets the speed of the high speed train to 100m/s

**Options:**

Option B14; Options B13 and B10; SOURce2 only with option B15

**[ :SOURce<hw>]:FSIMulator:HSTRain:STATe <State>**

Activates/deactivates simulation of High Speed Train propagation according to the selected scenario 1 or 3.

<b>Parameters:</b>	
<State>	0   1   OFF   ON
	*RST: 0
<b>Example:</b>	FSIM:HSTR:STAT ON activates the HST simulation.
<b>Options:</b>	Option B14; Options B13 and B10; SOURce2 only with option B15

## 8.5 Moving Propagation

[SOURce<hw>]:FSIMulator:MDElay:ALL:MOVing::VPERiod.....	245
[SOURce<hw>]:FSIMulator:MDElay:ALL:MOVing:DElay:VARIation.....	246
[SOURce<hw>]:FSIMulator:MDElay:CHANnel:MODE.....	246
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[SOURce<hw>]:FSIMulator:MDElay:MOVing:DElay:MEAN.....	247
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[SOURce<hw>]:FSIMulator:MDElay:MOVing:STATe.....	248
[SOURce<hw>]:FSIMulator:MDElay:MOVing:VPERiod.....	249
[SOURce<hw>]:FSIMulator:MDElay:REfERence:DElay.....	249
[SOURce<hw>]:FSIMulator:MDElay:REfERence:LOSS.....	249
[SOURce<hw>]:FSIMulator:MDElay:REfERence:STATe.....	249
[SOURce<hw>]:FSIMulator:MDElay:STATe.....	250

---

### [SOURce<hw>]:FSIMulator:MDElay:ALL:MOVing::VPERiod <VPeriod>

This command sets the speed of the delay variation of the moving fading paths for moving propagation with all moving channels. A complete cycle comprises one pass through this "Variation Period".

<b>Parameters:</b>	
<VPeriod>	float
	Range: 5 to 200
	Increment: 0.1
	*RST: 25
<b>Example:</b>	FSIM:CONF MDEL selects a moving propagation configuration. FSIM:MDEL:CHAN:MODE ALL enables all moving channels. FSIM:MDEL:STAT ON activates the moving propagation for fader A. FSIM:MDEL:ALL:MOV:VPER 50 s sets the period for the delay variation to 100 s.
<b>Options:</b>	Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MDELay:ALL:MOVing:DELay:VARiation <Variation>**

This command enters the range for the delay of the moving fading paths for moving propagation with all moving channels. The delay of the moving path slowly varies sinusoidally within this range.

**Parameters:**

<Variation> float  
 Range: 0.3E-6 to 10E-6  
 Increment: 10E-9  
 \*RST: 5E-6

**Example:**

```
FSIM:CONF MDEL
selects a moving propagation configuration.
FSIM:MDEL:CHAN:MODE ALL
enables all moving channels.
FSIM:MDEL:STAT ON
activates the moving propagation for fader A.
FSIM:MDEL:ALL:MOV:DEL:VAR 1E-5
sets the range 10 us for the delay of the moving fading path.
```

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MDELay:CHANnel:MODE <Mode>**

Determines whether only one or several moving channels are simulated.

**Parameters:**

<Mode> ONE | ALL

**ONE**  
 In this mode the fading simulator simulates dynamic propagation conditions in conformity with the test case 3GPP TS25.104, annex B3.

**ALL**  
 Per default, one moving channel with Rayleigh distribution and one tap is simulated.  
 Additional taps and paths can be enabled and configured.

\*RST: ONE

**Example:**

```
FSIM:CONF MDEL
selects a moving propagation configuration.
FSIM:MDEL:CHAN:MODE ALL
enables all moving channels.
```

**Options:**

Options B14 and K71; Options B13 and B10, SOURce2 only with option B15

---

**[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROup<st>:PATH<ch>:CPHase <CPhase>**

These commands determine the phase for constant phase fading for the "Standard Delay", "Fine Delay 30 MHz / 50 MHz" and "Moving Propagation All Moving Channels" fading configurations.

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

**Parameters:**

<CPhase> float  
 Range: 0 to 359.9  
 Increment: 0.1  
 \*RST: 0

**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.

**Options:**

Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

---

**[:SOURce<hw>]:FSIMulator:MDELay:MOVing:DELay:MEAN <Mean>**

This command sets the mean delay of the moving fading path for moving propagation.

**Parameters:**

<Mean> float  
 Range: 0 to 40E-6  
 Increment: 10E-9  
 \*RST: 3.5E-6

**Example:**

FSIM:MDEL:STAT ON  
 sets moving propagation.  
 FSIM:MDEL:MOV:DEL:VAR 1E-5  
 sets the range 10 us (+/- 5 us) 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 us.  
 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 us and 14 us.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[:SOURce<hw>]:FSIMulator:MDELay:MOVing:DELay:VARiation <Variation>**

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.

**Parameters:**

<Variation> float  
 Range: 0.3 us to 100 us  
 Increment: 0.1 s  
 \*RST: 5 us

**Example:** FSIM:MDEL:MOV:DEL:VAR 1E-5  
 sets the range 10 us for the delay of the moving fading path.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[:SOURce<hw>]:FSIMulator:MDELay:MOVing:LOSS <Loss>**

This command enters the insertion loss of the moving path for moving propagation.

**Parameters:**

<Loss> float  
 Range: 0 to 50  
 Increment: 0.01  
 \*RST: 0

**Example:** FSIM:MDEL:MOV:LOSS 12 dB  
 sets the loss for the moving fading path.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[:SOURce<hw>]:FSIMulator:MDELay:MOVing:STATe <State>**

This command activates the moving fading path for moving propagation.

**Parameters:**

<State> 0 | 1 | OFF | ON  
 \*RST: 1

**Example:** FSIM:MDEL:STAT ON  
 sets moving propagation.  
 FSIM:MDEL:MOV:STAT ON  
 activates the moving path for moving propagation.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MDELay:MOVing:VPERiod <VPeriod>**

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".

**Parameters:**

<VPeriod> float  
 Range: 10 to 500  
 Increment: 0.1  
 \*RST: 157

**Example:** `FSIM:MDEL:MOV:VPER 100 s`  
 sets the period for the delay variation to 100 s.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MDELay:REFerence:DELay <Delay>**

This command enters the delay of the reference path for moving propagation.

**Parameters:**

<Delay> float  
 Range: 0 to 40E-6  
 Increment: 10E-9  
 \*RST: 0

**Example:** `FSIM:MDEL:REF:DEL 1E-5`  
 sets the range to 10 us for the delay of the reference path.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MDELay:REFerence:LOSS <Loss>**

This command enters the loss of the reference path for moving propagation.

**Parameters:**

<Loss> float  
 Range: 0 to 50  
 Increment: 0.01  
 \*RST: 0

**Example:** `FSIM:MDEL:REF:LOSS 12 dB`  
 sets the insertion loss for the reference path.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MDELay:REFerence:STATe <State>**

This command activates the reference path for moving propagation.

**Parameters:**  
 <State> 0 | 1 | OFF | ON  
 \*RST: 1

**Example:** FSIM:MDEL:STAT ON  
 sets moving propagation.  
 FSIM:MDEL:REF:STAT ON  
 activates the reference path for moving propagation.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:MDELay:STATe <State>**

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).

**Parameters:**  
 <State> 0 | 1 | OFF | ON  
 \*RST: 0

**Example:** FSIM:MDEL:STAT ON  
 sets moving propagation for fader A.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

## 8.6 MIMO Settings

**TAP<ch>**

Value range: [1]...10

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<a href="#">[:SOURce&lt;hw&gt;]:FSIMulator:MIMO:TAP</a> .....	255
<a href="#">[:SOURce&lt;hw&gt;]:FSIMulator:MIMO:TAP&lt;ch&gt;:KRONecker:CORRelation:RX[:AB]:IMAGinary</a> .....	256
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[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BD: IMAGinary.....	256
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[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BD:PHASe.....	256
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[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BC:RATio.....	257
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[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BD:REAL.....	258
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[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:BC:PHASe.....	259
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[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:CD:PHASe.....	259
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX[:AB]:RATio.....	259
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AC:RATio.....	259
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AD:RATio.....	259
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[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:CD:RATio.....	259

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[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AD:REAL.....260

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:BC:REAL.....260

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[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AC:GAIN.....262

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AD:GAIN.....262

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BA:GAIN.....262

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BB:GAIN.....262

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BC:GAIN.....262

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BD:GAIN.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CA:GAIN.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CB:GAIN.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CC:GAIN.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CD:GAIN.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DA:GAIN.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DB:GAIN.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DC:GAIN.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DD:GAIN.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AA:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AB:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AC:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AD:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BA:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BB:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BC:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BD:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CA:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CB:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CC:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CD:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DA:PHASe.....263

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DB:PHASe.....263

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**[:SOURce<hw>]: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.

**Example:** `FSIM:MIMO:COPY:NEXT`  
copies the settings of the current tap to the next higher tap.

**Usage:** Event

**Options:** Options B14 and K71; Options B13 and B10; Option K74;  
SOURCE2 only with option B15

**[:SOURCE<hw>]: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.

**Example:** `FSIM:MIMO:COPY:PREV`  
copies the settings of the current tap to the next lower tap.

**Usage:** Event

**Options:** Options B14 and K71; Options B13 and B10; Option K74;  
SOURCE2 only with option B15

**[:SOURCE<hw>]:FSIMulator:MIMO:MDLOAD <MDLoad>**

This command loads a file with saved MIMO settings.

**Setting parameters:**

<MDLoad> string

**Example:** `FSIM:MIMO:MDL 'MIMO_Settings'`  
loads the settings file.

**Usage:** Setting only

**Options:** Options B14 and K71; Options B13 and B10; Option K74;  
SOURCE2 only with option B15

**[:SOURCE<hw>]:FSIMulator:MIMO:MDSTORE <MDStore>**

This command save the MIMO settings in a file.

**Setting parameters:**

<MDStore> string

**Example:** `FSIM:MIMO:MDST 'MIMO_Settings'`  
saves the MIMO settings in a file.

**Usage:** Setting only

**Options:** Options B14 and K71; Options B13 and B10; Option K74;  
SOURCE2 only with option B15

**[:SOURCE<hw>]:FSIMulator:MIMO:MPower <MPower>**

This command sets the master power, i.e. the power level of the master path.

The master path is path A of the R&S Signal Generator for that the Subset 1 is selected.

The power level of the master path is displayed in on the header of the istrument as an absolute value.

The power levels of all other paths (second path of the selected instrument and both paths of the second instrument in one of the 2x4, 2x3, 3x2 or 4x2 MIMO configurations) are displayed as a relative values to the maste path.

**Parameters:**

<MPower> float  
 Range: -145 to 20  
 Increment: 0.01  
 \*RST: -30

**Example:**

FSIM:MIMO:MPOW -30  
 sets power level of -30 dB for the master path.

**Options:**

Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15

**[ :SOURce<hw> ]:FSIMulator:MIMO:POWer:COUPling:STATe <State>**

This command enables/disables coupling of the power level display to the MIMO matrix, i.e. the power level display in the header of the instrument displays the absolute power of the master path (path A of the R&S Signal Generator for that Subset 1 is selected) and the relative power of all other paths (second path of the selected instrument and both paths of the second instrument in one of the 2x4, 2x3, 3x2 or 4x2 MIMO configurations).

**Parameters:**

<State> 0 | 1 | OFF | ON  
 \*RST: 1

**Example:**

FSIM:MIMO:POW:COUP:STAT ON  
 enables the instrument to display the absolute power level of the master path and the relative power levels of the other paths.

**Options:**

Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15

**[ :SOURce<hw> ]:FSIMulator:MIMO:POWer:DISPlay:MODE <Mode>**

This command sets the display mode for power.

**Parameters:**

<Mode> RELative | ABSolute  
 \*RST: REL

**Example:**

FSIM:MIMO:POW:DISPl:MODE REL  
 selects relative power display.

**Options:**

Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MIMO:POWER:MASTER?**

This command queries the master path for power.

**Return values:**

<Master>            S1PA  
                       \*RST:        S1PA

**Example:**            FSIM:MIMO:POW:MAST?  
                           queries the master path.

**Usage:**                Query only

**Options:**              Options B14 and K71; Options B13 and B10; Option K74;  
                           SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MIMO:SUBSet <Subset>**

This command sets the MIMO subset.

While sumulating a MIMO mode with two R&S Signal Generators, the MIMO Subset defines which fading paths from the MIMO matrix are calculated by the selected instrument. The "MIMO Subset" selected in each of the two connected instrument has to be different.

**Parameters:**

<Subset>             SET1 | SET2  
                           \*RST:        S1

**Example:**            FSIM:MIMO:SUBS SET2  
                           sets MIMO Subset 2.

**Options:**              Options B14 and K71; Options B13 and B10; Option K74;  
                           SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MIMO:TAP <Tap>**

This command selects the tap to be displayed.

**Parameters:**

<Tap>                 TAP1 | TAP2 | TAP3 | TAP4 | TAP5 | TAP6 | TAP7 | TAP8 | TAP9 |  
                           TAP10  
                           \*RST:        -

**Example:**            FSIM:MIMO:TAP TAP3  
                           displays Tap 3.

**Options:**              Options B14 and K71; Options B13 and B10; Option K74;  
                           SOURce2 only with option B15

---

```

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX[:AB]:
  IMAGinary <Imaginary>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AC:
  IMAGinary <Imaginary>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AD:
  IMAGinary <Imaginary>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BC:
  IMAGinary <Imaginary>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BD:
  IMAGinary <Imaginary>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:CD:
  IMAGinary <Imaginary>

```

This command enters the value for the imaginary part of the receiver correlation.

**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.

**Parameters:**

<Imaginary>	float
	Range: -1 to 1
	Increment: 0.001
	*RST: 0

**Example:** FSIM:MIMO:TAP2:KRON:CORR:RX:AC:IMAG 0.5  
sets the imaginary part of the Rx correlation AC to 0.5.

**Options:** Options B14 and K71; Options B13 and B10; Option K74;  
SOURce2 only with option B15

---

```

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX[:AB]:
  PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AC:
  PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AD:
  PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BC:
  PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BD:
  PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:CD:
  PHASe <Phase>

```

This command enters the value for the phase of the receiver correlation.

**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.

**Parameters:**

<Phase> float  
 Range: 0 to 360  
 Increment: 0.02  
 \*RST: 0

**Example:**

FSIM:MIMO:TAP2:KRON:CORR:RX:AC:PHAS 30  
 sets the phase of the Rx correlation AC to 30 degrees.

**Options:**

Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX[:AB]:  
 RATio <Ratio>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AC:  
 RATio <Ratio>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AD:  
 RATio <Ratio>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BC:  
 RATio <Ratio>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BD:  
 RATio <Ratio>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:CD:  
 RATio <Ratio>**

This command enters the ratio of the receiver correlation.

**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.

**Parameters:**

<Ratio> float  
 Range: 0 to 1  
 Increment: 0.001  
 \*RST: 0

**Example:**

FSIM:MIMO:TAP2:KRON:CORR:RX:AC:RAT 0.5  
 sets the ratio of the Rx correlation AC to 0.5.

**Options:**

Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX[:AB]:  
 REAL <Real>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AC:  
 REAL <Real>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:AD:  
 REAL <Real>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BC:  
 REAL <Real>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:BD:**  
**REAL <Real>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:CD:**  
**REAL <Real>**

This command enters the value for the real part of the receiver correlation.

**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.

**Parameters:**

<Real> float  
 Range: -1 to 1  
 Increment: 0.001  
 \*RST: 0

**Example:** `FSIM:MIMO:TAP2:KRON:CORR:RX:AC:REAL 0.5`  
 sets the value for the real part of the Rx correlation AC to 0.5.

**Options:** Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX[:AB]:**  
**IMAGinary <Imaginary>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AC:**  
**IMAGinary <Imaginary>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AD:**  
**IMAGinary <Imaginary>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:BC:**  
**IMAGinary <Imaginary>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:BD:**  
**IMAGinary <Imaginary>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:CD:**  
**IMAGinary <Imaginary>**

This command enters the value for the imaginary part of the transceiver correlation.

**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.

**Parameters:**

<Imaginary> float  
 Range: -1 to 1  
 Increment: 0.001  
 \*RST: 0

**Example:** `FSIM:MIMO:TAP2:KRON:CORR:TX:AC:IMAG 0.5`  
 sets the imaginary part of the Tx correlation AC to 0.5.

**Options:** Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15



---

```

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX[:AB]:
  PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AC:
  PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AD:
  PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:BC:
  PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:BD:
  PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:CD:
  PHASe <Phase>

```

This command enters the value for the phase of the transceiver correlation.

**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.

**Parameters:**

<Phase>	float
	Range: 0 to 360
	Increment: 0.02
	*RST: 0

**Example:** `FSIM:MIMO:TAP2:KRON:CORR:TX:AC:PHAS 30`  
sets the phase of the Tx correlation AC to 30 degrees.

**Options:** Options B14 and K71; Options B13 and B10; Option K74;  
SOURce2 only with option B15

---

```

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX[:AB]:
  RATio <Ratio>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AC:
  RATio <Ratio>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AD:
  RATio <Ratio>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:BC:
  RATio <Ratio>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:BD:
  RATio <Ratio>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:CD:
  RATio <Ratio>

```

This command enters the ratio of the transceiver correlation.

**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.

**Parameters:**

<Ratio> float  
 Range: 0 to 1  
 Increment: 0.001  
 \*RST: 0

**Example:**

FSIM:MIMO:TAP2:KRON:CORR:TX:AC:RAT 0.5  
 sets the ratio of the Tx correlation AC to 0.5.

**Options:**

Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX[:AB]:**  
**REAL <Real>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AC:**  
**REAL <Real>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:AD:**  
**REAL <Real>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:BC:**  
**REAL <Real>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:BD:**  
**REAL <Real>**

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:CD:**  
**REAL <Real>**

This command enters the value for the real part of the transceiver correlation.

**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.

**Parameters:**

<Real> float  
 Range: -1 to 1  
 Increment: 0.001  
 \*RST: 0

**Example:**

FSIM:MIMO:TAP2:KRON:CORR:TX:AC:REAL 0.5  
 sets the value for the real part of the Tx correlation AC to 0.5.

**Options:**

Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:ACcept**

Accepts the values for the phase/imaginary and the real/ration part of the correlation.

**Example:**

FSIM:MIMO:TAP2:MATR:ACC  
 accepts the values for the phase/imaginary and the real/ration part  
 of the correlation

**Usage:**

Event

**Options:** Options B14 and K71; Options B13 and B10; Option K74; SOURCE2 only with option B15

---

**[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:CONFLICT?**

Queries whether there is a matrix conflict or not.

**Return values:**

<Conflict> 0 | 1 | OFF | ON

**Example:**

FSIM:MIMO:TAP2:MATR:CONF?

queries whether there is a matrix conflict or not

**Usage:**

Query only

**Options:**

Options B14 and K71; Options B13 and B10; Option K74; SOURCE2 only with option B15

---

**[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:MODE <Mode>**

This command selects the input mode for the Rx and Tx correlation values (matrix mode).

**Parameters:**

<Mode> INDividual | KRONEcker | AOAAod

**INDividual**

The correlation values are entered with commands

FSIM:MIMO:TAP:MATR:ROW:COL:RAT | PHAS.

**KRONEcker**

The matrix values are calculated automatically using the values entered with commands

FSIM:MIMO:TAP:KRON:CORR:RX|TX:RAT|REAL | IMAG|PHAS.

**AOAAod**

The matrix values are calculated automatically using the values entered with Space Channel Model (SCM) commands, see [chapter 8.7, "SCM Settings"](#), on page 264.

\*RST: INDividual

**Example:**

FSIM:MIMO:TAP2:MATR:MODE IND

selects the matrix mode **Individual**.

**Options:**

Options B14 and K71; Options B13 and B10; Option K74; SOURCE2 only with option B15

---

**[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:ROW<di>:COLumn<st>:PHASe <Phase>**

This command enters the value for the phase/imaginary part of the correlation.

**Suffix:**

<di> 1..4

<st> 1..4

**Parameters:**

<Phase> float  
 Range: 0 to 360  
 Increment: 0.02  
 \*RST: 0

**Example:** `FSIM:MIMO:TAP2:MATR:ROW1:COL1:PHAS 90`  
 sets the correlation value to the specified value.

**Options:** Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:ROW<di>:COLumn<st>:RATio <Ratio>**

This command enters the value for the real/ratio part of the correlation.

**Suffix:**

<di> 1..4

<st> 1..4

**Parameters:**

<Ratio> float  
 Range: 0 to 1  
 Increment: 0.001  
 \*RST: 0

**Example:** `FSIM:MIMO:TAP2:MATR:ROW1:COL1:PHAS 0.5`  
 sets the correlation value to the specified value.

**Options:** Options B14 and K71; Options B13 and B10; Option K74;  
 SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:PRESet**

The command presets the vector matrix to an unitary matrix.

**Example:** `FSIM:MIMO:TAP2:GVEC:PRES`  
 resets the gain vector matrix.

**Usage:** Event

**[[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AA:GAIN <Gain>**  
**[[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AB:GAIN <Gain>**  
**[[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AC:GAIN <Gain>**  
**[[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AD:GAIN <Gain>**  
**[[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BA:GAIN <Gain>**  
**[[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BB:GAIN <Gain>**  
**[[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BC:GAIN <Gain>**

```
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BD:GAIN <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CA:GAIN <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CB:GAIN <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CC:GAIN <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CD:GAIN <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DA:GAIN <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DB:GAIN <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DC:GAIN <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DD:GAIN <Gain>
```

The command sets the relative gain in the selected path.

**Parameters:**

```
<Gain>          float
                 Range:   -50 to 0
                 Increment: 0.01
                 *RST:    0
```

**Example:**

```
FSIM:MIMO:TAP2:GVEC:AA:GAIN -3dB
decreases the level in path AA by 3 dB.
```

```
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AA:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AB:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AC:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:AD:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BA:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BB:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BC:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:BD:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CA:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CB:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CC:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:CD:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DA:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DB:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DC:PHASe <Gain>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVEctor:DD:PHASe <Gain>
```

This command defines the phase shift of the selected path.

**Parameters:**

```
<Gain>          float
                 Range:    0 to 360
                 Increment: 0.02
                 *RST:    0
```

**Example:**

```
FSIM:MIMO:TAP2:GVEC:BB:PHAS 1
shifts the phase in path BB by 1 degree.
```

## 8.7 SCM Settings

### Suffixes

**RAY<st>**

Value range: [1]...4

### Programming example

This chapter provides simple programming example. The purpose of the example is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

The programming example has been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the example as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (e.g. comments) start with two // characters.

### Example: Simulating one path SCM fading with two rays with different distributions

In the following example we assume that MIMO fading configurations are enabled, e.g 2x2 MIMO. One MIMO path is activated, the default path settings are used.

```
// *****
// Enable the corresponding matrix mode and set the relevant SCM settings
// *****

SOURCE:FSIMulator:MIMO:TAP:MATRIX:MODE AOAaod
SOURCE:FSIMulator:MIMO:SCM:ANTenna:DISTance:RX 0.5
SOURCE:FSIMulator:MIMO:SCM:ANTenna:DISTance:TX 0.5

// *****
// Set ray#1 to simulate signal scattered by
// obstacles causing static fading distribution, e.g. a building
// *****
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY1:GAIN 0
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY1:ARRival:ANGLE 72
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY1:ARRival:SPRead 5
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY1:DEParture:ANGLE 15
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY1:DEParture:SPRead 3
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY1:DISTRibution EQUal
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY1:STATe ON

// *****
// Set ray#2 to simulate signal scattered by
// obstacles causing gaussian fading distribution, e.g. a tree
// *****
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY2:GAIN -10
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY2:ARRival:ANGLE 23
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY2:ARRival:SPRead 7
```

```

SOURCE:FSIMulator:MIMO:TAP:SCM:RAY2:DEParture:ANGLE 25
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY2:DEParture:SPRead 5
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY2:DISTriBution GAUSS
SOURCE:FSIMulator:MIMO:TAP:SCM:RAY2:STATe ON

// *****
// Query the resulting matrix correlation coefficients with the
// SOURCE:FSIMulator:MIMO:TAP:MATRIx:... commands
// *****

[:SOURCE<hw>]:FSIMulator:MIMO:SCM:ANTenna:DISTance:RX.....265
[:SOURCE<hw>]:FSIMulator:MIMO:SCM:ANTenna:DISTance:TX.....265
[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:SCM:DISTriBution.....265
[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:ARRival:ANGLE.....266
[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:DEParture:ANGLE.....266
[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:ARRival:SPRead.....266
[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:DEParture:SPRead.....266
[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:GAIN.....267
[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:STATe.....267
    
```

**[:SOURCE<hw>]:FSIMulator:MIMO:SCM:ANTenna:DISTance:RX <RxAntDist>**  
**[:SOURCE<hw>]:FSIMulator:MIMO:SCM:ANTenna:DISTance:TX <TxAntDist>**

Determines the RX/TX antenna distance in the SCM fading model.

**Parameters:**

<b>&lt;TxAntDist&gt;</b>	float
	Range: 0.1 to 2
	Increment: 0.1
	*RST: 0.5
<b>&lt;RxAntDist&gt;</b>	float
	Range: 0.1 to 2
	Increment: 0.1
	*RST: 0.5

**Example:** see [example "Simulating one path SCM fading with two rays with different distributions"](#) on page 264.

**[:SOURCE<hw>]:FSIMulator:MIMO:TAP<ch>:SCM:DISTriBution <Distribution>**

This commands selects one of the proposed statistical functions to determine the distribution of the selected ray.

**Parameters:**

<b>&lt;Distribution&gt;</b>	LAPLace   EQUal   GAUSS
	*RST: EQUal

**Example:** see [example "Simulating one path SCM fading with two rays with different distributions"](#) on page 264.

**Options:** Options B14 and K71; Options B13 and B10; Option K74; SOURCE2 only with option B15

---

**[:SOURCE<hw>]:FSIMULATOR:MIMO:TAP<ch>:SCM:RAY<st>:ARRIVAL:ANGLE**  
<ArrAngle>

**[:SOURCE<hw>]:FSIMULATOR:MIMO:TAP<ch>:SCM:RAY<st>:DEPARTURE:ANGLE**  
<DepAngle>

Sets the AoA (Angle of Arrival) / AoD (Angle of Departure) of the selected ray.

**Parameters:**

<DepAngle> float  
Range: 0 to 360  
Increment: 0.1  
\*RST: 0

<ArrAngle> float  
Range: 0 to 360  
Increment: 0.1  
\*RST: 0

**Example:** see [example "Simulating one path SCM fading with two rays with different distributions"](#) on page 264.

**Options:** Options B14 and K71; Options B13 and B10; Option K74; SOURCE2 only with option B15

---

**[:SOURCE<hw>]:FSIMULATOR:MIMO:TAP<ch>:SCM:RAY<st>:ARRIVAL:SPREAD**  
<ArrSpread>

**[:SOURCE<hw>]:FSIMULATOR:MIMO:TAP<ch>:SCM:RAY<st>:DEPARTURE:SPREAD**  
<DepSpread>

This commands sets the AoD (Angle of Departure) / AoA (Angle of Arrival) spread (AS) of the selected ray.

**Parameters:**

<DepSpread> float  
Range: 0.1 to 76  
Increment: 0.1  
\*RST: 0

<ArrSpread> float  
Range: 0.1 to 76  
Increment: 0.1  
\*RST: 0

**Example:** see [example "Simulating one path SCM fading with two rays with different distributions"](#) on page 264.

**Options:** Options B14 and K71; Options B13 and B10; Option K74; SOURCE2 only with option B15



---

```
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:GAIN <Gain>
```

This command sets the relative gain (in dB) of the selected ray.

**Parameters:**

```
<Gain>          float
                 Range:    -50 to 0
                 Increment: 0.1
                 *RST:      0
```

**Example:** see [example "Simulating one path SCM fading with two rays with different distributions"](#) on page 264.

**Options:** Options B14 and K71; Options B13 and B10; Option K74; SOURce2 only with option B15

---

```
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:SCM:RAY<st>:STATE <RayState>
```

This command enables/disables the selected ray.

**Parameters:**

```
<RayState>      0 | 1 | OFF | ON
                 *RST:    0
```

**Example:** see [example "Simulating one path SCM fading with two rays with different distributions"](#) on page 264.

**Options:** Options B14 and K71; Options B13 and B10; Option K74; SOURce2 only with option B15

## 8.8 2 Channel Interferer

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---

```
[:SOURce<hw>]:FSIMulator:TCInterferer[:STATE] <State>
```

This command activates the 2 channel interferer fading configuration. The paths and the fading simulator must be switched on separately (FSIM:TCI:MOV:STAT ON, FSIM:TCI:REF:STAT ON and FSIM ON).

**Parameters:**

<State> 0 | 1 | OFF | ON  
 \*RST: 0

**Example:**

FSIM:TCI:STAT ON  
 activates the "2 Channel Interferer Fading" configuration for fader A.

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:TCInterferer:MOVing:DELay:MAXimum <Maximum>**

This command sets the maximum delay for the moving path.

**Parameters:**

<Maximum> float  
 Range: 0.0 to 1638 us  
 Increment: 1 ns  
 \*RST: 110 us (Moving Path)

**Example:**

FSIM:TCI:MOV:DEL:MAX 0.000200  
 sets a 200 us maximum delay for the moving path.

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[:SOURce<hw>]:FSIMulator:TCInterferer:MOVing:MMODE <MMode>**

This command selects the type of moving applied to the moving path.

For FSIM:TCI:MOV:MMOD SLID, the FSIM:TCI:PER command sets the period for a complete cycle of the moving path.

For FSIM:TCI:MOV:MMOD HOPP, the FSIM:TCI:PER command sets the dwell time of the moving path.

**Parameters:**

<MMode> SLIDing | HOPPing

**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.

\*RST: HOPPing

**Example:**

FSIM:TCI:MOV:MMOD SLID  
 selects the "Sliding" mode for the moving path.

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:TCInterferer:PERiod <Period>**

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:TCl:MOV:MMOD SLID` selects the sliding mode for the moving path and therefore `FSIM:TCl:PER` sets the period for a complete cycle for the moving path. `FSIM:TCl:MOV:MMOD HOPP` selects the hopping mode for the moving path and therefore `FSIM:TCl:PER` sets the dwell time for the moving path.

**Parameters:**

<Period> float  
 Range: 0.1 to 10  
 Increment: 0.01  
 \*RST: 2.9 s (for hopping mode) / 160 s (for sliding mode)

**Example:**

`FSIM:TCl:MOV:MMOD SLID`  
 selects the "Sliding" mode for the moving path.  
`FSIM:TCl:PER 50`  
 sets the time for a complete cycle of the moving path to 50 s.

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:TCInterferer:SPEEd <Speed>**

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.

$$c = 2.998 \cdot 10^8 \text{ m/s}$$

$$v/c = f_D / f_{RF}$$

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:TCl:FRATio`) and can be queried with the command `SOURce:FSIM:TCl:FDOPpler`.

**Parameters:**

<Speed> float  
 Range: 0 m/s to 479.67 m/s  
 Increment: 0.1 m/s  
 \*RST: 0.83 m/s

**Example:**

`FSIM:TCl:SPE 2`  
 sets a speed of 2 m/s on both fading paths.

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[[:SOURce<hw>]:FSIMulator:TCInterferer:REFerence|MOVing:DELay:MINimum <Minimum>**

These commands set the minimum delay for the reference path and the moving path.

**Parameters:**

<Minimum> float  
 Range: 0.0 to 1638 us  
 Increment: 0.1 us  
 \*RST: 40 us (Reference Path) / 0 us (Moving Path)

**Example:** FSIM:TCl:REF:DEL:MIN 0.000008  
 sets an 8 us minimum delay for the reference path.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[[:SOURce<hw>]:FSIMulator:TCInterferer:REFerence|MOVing:FDOPpler?**

These commands query the Doppler frequency of the reference and moving path 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).

**Return values:**

<FDoppler> float  
 Range: 0 to 1000  
 Increment: 0.01  
 \*RST: 0

**Example:** FSIM:TCl:REF:FDOP?  
 queries the resulting Doppler frequency for the reference path.  
 Response: 55  
 the resulting Doppler frequency is 55 Hz.

**Usage:** Query only

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[[:SOURce<hw>]:FSIMulator:TCInterferer:REFerence|MOVing:FRATio <FRatio>**

These commands set the ratio of the actual Doppler frequency to the set Doppler frequency for the reference and moving path with 2 channel interferer fading.

**Parameters:**

<FRatio> float  
 Range: -1 to 1  
 Increment: 0.01  
 \*RST: 0

**Example:** FSIM:TCl:REF:FRAT 0.5  
 sets a frequency ratio of 0.5 for the reference path.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[:SOURce<hw>]:FSIMulator:TCInterferer:REFerence|MOVing:LOSS <Loss>**

These commands set the loss of the reference and moving path with 2 channel interferer fading.

**Parameters:**

<Loss> float  
 Range: 0 to 50  
 Increment: 0.1  
 \*RST: 0

**Example:** FSIM:TCI:REF:LOSS 10  
 sets a loss of 10 db for the reference path for fader A.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

---

**[:SOURce<hw>]:FSIMulator:TCInterferer:REFerence|MOVing:PROFile <Profile>**

These commands select the fading profile to be used for the reference and moving path with 2 channel interferer fading.

**Parameters:**

<Profile> SPATh | PDOPpler | RAYLeigh

**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:TCI:SPEed) and "Frequency Ratio" (SOURce:FSIM:TCI: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.

\*RST: SPATh

**Example:** FSIM:TCI:REF:PROF SPAT  
 selects the static path profile for the reference path of the "2 Channel Interferer Fading" configuration for fader A.

**Options:** Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

**[[:SOURce<hw>]:FSIMulator:TCInterferer:REFerence|MOVing:STATe <State>**

These commands activate the reference and moving path of the 2 channel interferer fading configuration. The 2 channel interferer fading configuration and the fading simulator must be switched on separately (SOURce:FSIMulator:TCInterferer:STATe ON and SOURce:FSIMulator ON).

**Parameters:**

<State>                   0 | 1 | OFF | ON  
\*RST:                    0

**Example:**

FSIM:TCI:REF:STAT ON  
activates the reference path of the "2 Channel Interferer Fading" configuration for fader A.

**Options:**

Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

## 8.9 Dynamic Scenario Simulation



The simulation of dynamic fading scenarios is enabled only for instruments equipped with option R&S SMU/AMU-K77.

### 8.9.1 Common Settings

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**[[:SOURce<hw>]:FSIMulator:DSSimulation:SCENario <Scenario>**

Selects the dynamic fading scenario (see "Scenario" on page 70).

**Parameters:**

<Scenario>               SHIPtoShip | TOWertoaircraft | USER  
\*RST:                    SHIPtoShip

**Options:**

R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:CFORmat <CoordFormat>**

Defines the coordinate system.

**Parameters:**

<CoordFormat>      ENU | DMS | DECimal  
 \*RST:              ENU

**Options:**              R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:CREate**

Triggers the instrument to load the selected settings, to start the signal calculation, to create and store the corresponding settings files (\*.fad and \*.fad\_udyn) and to update the trajectory visualization.

**Usage:**                  Event

**Options:**              R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:SAVE <ScenarioFileS>**

Stores the current scenario settings into the selected file. The directory is set using command `M MEM:CDIRectory`. Only the file name has to be entered. Scenario files are stored as files with the specific file extension \*.?????.

**Parameters:**

<ScenarioFileS>      string

**Options:**              R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:CATalog?**

This command reads out the scenario files in the default directory. The default directory is set using command `M MEM:CDIRectory`. Only files with the file extension \*.??? will be listed.

**Return values:**

<ScenarioFileC>      NString

**Example:**

```
M MEM:CDIR 'D:\user\dss\scenarios'
sets the default directory
SOUR:FSIM:DSS:CAT?
reads out all the scenario files in the default directory
Response:'scenario_1','scenario_2'
the files scenario_1 and scenario_2 are available.
```

**Usage:**                  Query only

**Options:**              R&S SMU/AMU-K77

**[:SOURce<hw>]:FSIMulator:DSSimulation:LOAD <ScenarioFileR>**

Loads the selected scenario file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension `*.?????` will be loaded.

**Parameters:**

<ScenarioFileR> string

**Options:** R&S SMU/AMU-K77

**[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:PRESet  
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:PRESet**

Presets the scenario simulation settings to the their default values.

**Usage:** Event

**Options:** R&S SMU/AMU-K77

### 8.9.2 Ship To Ship

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**[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:TTime <TurnTime>**

Determines the time after that both ships turn their directions.

**Parameters:**

<TurnTime> <hour>,<minutes>,<seconds>

\*RST: 1,0,0

**Options:** R&S SMU/AMU-K77



---

```
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoShip:RX:TYPE <ShipType>
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoShip:TX:TYPE <ShipType>
```

Selects the vehicle type.

**Parameters:**

```
<ShipType>          SFRigate | SPATrolboat | SCARrier
                    *RST:          SFRigate
```

**Options:** R&S SMU/AMU-K77

---

```
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoShip:RX:SPEEd <Speed>
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoShip:TX:SPEEd <Speed>
```

Sets the transmitter/receiver speed.

**Parameters:**

```
<Speed>             float
                    Range:        0 to 300
                    Increment:    0.1
                    *RST:        35
```

**Options:** R&S SMU/AMU-K77

---

```
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoShip:RX:HEADIng <Heading>
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoShip:TX:HEADIng <Heading>
```

Defines the direction in that the corresponding ship is moving.

**Parameters:**

```
<Heading>           float
                    Range:        0 to 359.9
                    Increment:    0.1
                    *RST:        0
```

**Options:** R&S SMU/AMU-K77

---

```
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoShip:RX:ANTenna:HEIGHt
<AntHeight>
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoShip:TX:ANTenna:HEIGHt
<AntHeight>
```

Defines the height of the corresponding antenna.

**Parameters:**

```
<AntHeight>        float
                    Range:        0 to 150
                    Increment:    0.1
                    *RST:        18
```

**Options:** R&S SMU/AMU-K77

---

```
[ :SOURCE<hw>]:FSIMulator:DSSimulation:SHIPtoShip:XDISTance <XDistance>
[ :SOURCE<hw>]:FSIMulator:DSSimulation:SHIPtoShip:YDISTance <YDistance>
```

Sets the X/Y distance between the ships in the ENU coordinate system.

**Parameters:**

```
<YDistance>      float
                  Range:    0 to 20000
                  Increment: 0.1
                  *RST:     2000
```

**Options:** R&S SMU/AMU-K77

---

```
[ :SOURCE<hw>]:FSIMulator:DSSimulation:SHIPtoShip:RX:COORDinates:DMS
  <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>,
  <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>
```

```
[ :SOURCE<hw>]:FSIMulator:DSSimulation:SHIPtoShip:TX:COORDinates:DMS
  <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>,
  <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>
```

Defines the coordinates of the Tx/Rx ship in degrees, minutes and seconds format.

To set the altitude, use command `[ :SOURCE<hw>]:FSIMulator:DSSimulation:SHIPtoShip:RX:HEADing/[ :SOURCE<hw>]:FSIMulator:DSSimulation:SHIPtoShip:TX:HEADing`.

**Parameters:**

```
<LongitudeDeg>   integer
                  Defines the longitude degrees.
                  Range:    0 to 180
                  Increment: 1
                  *RST:     0

<LongitudeMin>   integer
                  Defines the longitude minutes.
                  Range:    0 to 59
                  Increment: 1
                  *RST:     0

<LongitudeSec>   integer
                  Defines the longitude seconds.
                  Range:    0 to 59
                  Increment: 1
                  *RST:     0

<LongitudeDir>   EAST | WEST
                  Defines the longitude direction.
                  *RST:     EAST
```

<LatitudeDeg>	integer
	Defines the latitude degrees.
	Range: 0 to 90
	Increment: 1
	*RST: 0
<LatitudeMin>	integer
	Defines the latitude minutes.
	Range: 0 to 59
	Increment: 1
	*RST: 0
<LatitudeSec>	integer
	Defines the latitude seconds.
	Range: 0 to 59
	Increment: 1
	*RST: 0
<LatitudeDir>	NORT <sup>h</sup>   SOUT <sup>h</sup>
	Defines the latitude direction.
	*RST: NORT
<b>Options:</b>	R&S SMU/AMU-K77

---

**[[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoShip:RX:COORDinates[:DECimal] <Longitude>, <Latitude>**  
**[[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoShip:TX:COORDinates[:DECimal] <Longitude>, <Latitude>**

Defines the coordinates of the Tx/Rx ship in decimal format.

To set the altitude, use command [\[:SOURce<hw>\]:FSIMulator:DSSimulation:SHIPtoShip:RX:ANTenna:HEIGHT/\[:SOURce<hw>\]:FSIMulator:DSSimulation:SHIPtoShip:TX:ANTenna:HEIGHT](#).

**Parameters:**

<Longitude>	float
	Range: -180 to 180
	Increment: 1E-6
	*RST: 0
<Latitude>	float
	Range: -90 to 90
	Increment: 1E-6
	*RST: 0

**Options:** R&S SMU/AMU-K77

### 8.9.3 Tower To Aircraft

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---

**`[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:TYPE` <AirVehicleType>**

Sets the vehicle type.

**Parameters:**

<AirVehicleType>    AJET | AUAV | ATRansport | ALINer | ASPort | AHELicopter  
 \*RST:            AJET

**Options:**            R&S SMU/AMU-K77

---

**`[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:START`  
 <SpeedStart>**

Sets the start speed  $v_{START}$ , i.e. determines whether the aircraft is already moving (taxiing) or not.

**Parameters:**

<SpeedStart>            float  
                           Range:     0 to 1000  
                           Increment: 0.1  
                           \*RST:     0

**Options:**            R&S SMU/AMU-K77

---

**`[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:TAKeoff`  
 <SpeedTakeoff>**

Sets the speed during the take-off phase,  $v_{TO}$ .

**Parameters:**

<SpeedTakeoff> float  
 Range: 1 to 1000  
 Increment: 0.1  
 \*RST: 270

**Options:** R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:CACceleration**  
 <ConstAccel>

Enables speed calculation with constant acceleration. Otherwise, an unlimited acceleration in the waypoints is assumed.

**Parameters:**

<ConstAccel> 0 | 1 | OFF | ON  
 \*RST: 1

**Options:** R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:ANGLE:CLIMb**  
 <AngleClimb>

Sets the angle of ascent during the climb out phase

**Parameters:**

<AngleClimb> float  
 Range: 1 to 89.81  
 Increment: 0.01  
 \*RST: 7.59

**Options:** R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:RATE:CLIMb** <RateClimb>

Sets the climb rate.

**Parameters:**

<RateClimb> float  
 Range: 1 to 5000  
 Increment: 0.1  
 \*RST: 1000

**Options:** R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:DEParture**  
 <SpeedDeparture>

Sets the ground speed  $v_{CGND}$  during the climbing out phase.

**Parameters:**

<SpeedDeparture> float  
 Range: 1 to 5000  
 Increment: 0.1  
 \*RST: 450

**Options:** R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:CRUise**  
 <SpeedCruise>

Sets the speed during the cruise phase  $v_{GC}$ .

**Parameters:**

<SpeedCruise> float  
 Range: 1 to 5000  
 Increment: 0.1  
 \*RST: 1200

**Options:** R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:ALTitude:CRUise**  
 <AltitudeCruise>

Defines the aircraft's altitude during the cruise phase.

**Parameters:**

<AltitudeCruise> float  
 Range: 1 to 30000  
 Increment: 0.1  
 \*RST: 10000

**Options:** R&S SMU/AMU-K77

**[ :SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:ANGLE:DESCent**  
 <AngleDescent>

Sets the angle during the descent phase.

**Parameters:**

<AngleDescent> float  
 Range: 1 to 89.81  
 Increment: 0.01  
 \*RST: 7.59

**Options:** R&S SMU/AMU-K77

---

**[[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:RATE:DESCent  
<RateDescent>**

Sets the decent rate  $v_D$ .

**Parameters:**

<RateDescent> float  
 Range: 1 to 5000  
 Increment: 0.1  
 \*RST: 1000

**Options:** R&S SMU/AMU-K77

---

**[[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEEd:DESCent  
<SpeedDescent>**

Sets the ground speed during the descent phase.

**Parameters:**

<SpeedDescent> float  
 Range: 1 to 5000  
 Increment: 0.1  
 \*RST: 450

**Options:** R&S SMU/AMU-K77

---

**[[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:FLENgth:TAKeoff  
<FLenTakeoff>**

**[[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:FLENgth:LANDing  
<FLenLanding>**

Sets the length of the runway used during the landing phase.

**Parameters:**

<FLenLanding> float  
 Range: 1 to 5000  
 Increment: 0.1  
 \*RST: 500

**Options:** R&S SMU/AMU-K77

---

**[[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEEd:TOUChdown  
<SpeedTouchdown>**

Sets the touch-down speed  $v_{TD}$  during the landing phase.

**Parameters:**

<SpeedTouchdown> float  
 Range: 1 to 1000  
 Increment: 0.1  
 \*RST: 270

**Options:** R&S SMU/AMU-K77

**[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:RADIus:LTURn**  
 <RadiusLeftTurn>

**[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:RADIus:RTURn**  
 <RadiusRightTurn>

Sets the values for the left/right turn radius  $r_1$  and  $r_2$ .

**Parameters:**

<RadiusRightTurn> float  
 Range: 10 to 100000  
 Increment: 0.1  
 \*RST: 4000

**Options:** R&S SMU/AMU-K77

**[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:TRIP:LENGth?**

Queries the resulting trip length. The value is calculated automatically.

**Parameters:**

<TripLength> float  
 Range: 0 to 100000  
 Increment: 0.1  
 \*RST: 0

**Usage:** Query only

**Options:** R&S SMU/AMU-K77

**[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:TRIP:DURation?**

Queries the resulting trip duration. The value is calculated automatically.

**Parameters:**

<TripDuration> float  
 Range: 0 to 100000  
 Increment: 0.1  
 \*RST: 0

**Usage:** Query only

**Options:** R&S SMU/AMU-K77

### 8.9.4 User Scenario

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**[:SOURce<hw>]:FSIMulator:DSSimulation:USER:PROFile:SOURce <ProfSource>**

Determines the way the fading profile related settings are configured.

Use the the commands `[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:PROFile:CATalog` and `[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:PROFile:SElect` to query and select the available fader profile files.

**Parameters:**

<ProfSource> TXRXconfiguration | TPA | PROFile

**TXRXconfiguration**

Enables the direct configuration by means of the commands `...:DSS:USER:TX:...`  and `...:DSS:USER:RX:...`

**TPA | PROFile**

The scenario related settings are described in a file.

Use the commands `[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:TPA:CATalog` and `[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:TPA:SElect` to query and select the TPA file.

\*RST: TXRXconfiguration

**Options:** R&S SMU/AMU-K77

`[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:RX:VEHicle:MODE <VehMode>`  
`[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:TX:VEHicle:MODE <VehMode>`

Defines the transmitting/receiving vehicle.

**Parameters:**

<VehMode> USER | PREDefined | NONE

\*RST: NONE

**Options:** R&S SMU/AMU-K77

`[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:RX:VEHicle:PREDefined:CATegory <VehPredCat>`  
`[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:TX:VEHicle:PREDefined:CATegory <VehPredCat>`

Defines the category of the vehicle.

**Parameters:**

<VehPredCat> WATer | LAND | AIR

\*RST: AIR

**Options:** R&S SMU/AMU-K77

`[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:RX:VEHicle:PREDefined:TYPE <VehPredType>`  
`[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:TX:VEHicle:PREDefined:TYPE <VehPredType>`

Defines the type of vehicle.

**Parameters:**

<VehPredType> LPEDestrian | LBICycle | LTRain | LCar | AHElicopter | ASPort | ALINer | ATRansport | AUAV | AJET | SCARrier | SPATrolboat | SFRigate  
 \*RST: AJET

**Options:** R&S SMU/AMU-K77

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:RX:TRAjectory <Trajectory>**

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:TX:TRAjectory <Trajectory>**

Determines whether the transmitter/receiver is a moving object or not and defines the type of the trajectory description file used.

**Parameters:**

<Trajectory> TDF | FIXedatpoint | EPHemeris  
 \*RST: FIXedatpoint

**Options:** R&S SMU/AMU-K77

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:PROFile:CATalog?**

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:TPA:CATalog?**

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:RX:TRAjectory:EPHemeris:CATalog?**

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:TX:TRAjectory:EPHemeris:CATalog?**

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**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:RX:VEHicle:USER:CATalog?**

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:TX:VEHicle:USER:CATalog?**

The query returns list of files of the corresponding type. If no directory is specified, the default directory is used.

**Usage:** Query only

**Options:** R&S SMU/AMU-K77

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:PROFile:SElect <ProfSelect>**

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:TPA:SElect <TrajTpaSelect>**

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:RX:TRAjectory:EPHemeris:SElect <TrajEphSelect>**

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:TX:TRAjectory:EPHemeris:SElect <TrajEphSelect>**

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:RX:TRAjectory:TDF:SElect <TrajTdfSel>**

**[:SOURCE<hw>]:FSIMulator:DSSimulation:USER:TX:TRAjectory:TDF:SElect <TrajTdfSel>**

**[[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:VEHicle:USER:SElect**  
 <VehUserSelect>

**[[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:VEHicle:USER:SElect**  
 <VehUserSelect>

Selects file with corresponding settings.

**Parameters:**

<VehUserSelect> string

**Options:** R&S SMU/AMU-K77

**[[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:FAPoint:**  
**COORDinates:DMS** <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>,  
 <LongitudeDir>, <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>,  
 <Altitude>

**[[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:FAPoint:**  
**COORDinates:DMS** <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>,  
 <LongitudeDir>, <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>,  
 <Altitude>

Defines the coordinates of the Tx/Rx fixed vehicle in degrees, minutes and seconds format.

**Parameters:**

<LongitudeDeg> integer  
 Defines the longitude degrees.

Range: 0 to 180

Increment: 1

\*RST: 0

<LongitudeMin> integer  
 Defines the longitude minutes.

Range: 0 to 59

Increment: 1

\*RST: 0

<LongitudeSec> integer  
 Defines the longitude seconds.

Range: 0 to 59

Increment: 1

\*RST: 0

<LongitudeDir> EAST | WEST  
 Defines the longitude direction.

\*RST: EAST

<LatitudeDeg>	integer	Defines the latitude degrees. Range: 0 to 90 Increment: 1 *RST: 0
<LatitudeMin>	integer	Defines the latitude minutes. Range: 0 to 59 Increment: 1 *RST: 0
<LatitudeSec>	integer	Defines the latitude seconds. Range: 0 to 59 Increment: 1 *RST: 0
<LatitudeDir>	NORT <sup>h</sup>   SOUT <sup>h</sup>	Defines the latitude direction. *RST: NORT
<Altitude>	float	Defines the altitude. Range: 0 to 10000 Increment: 0.1 *RST: 0
<b>Options:</b>		R&S SMU/AMU-K77

---

**[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:TX:TRAJectory:FAPoint:  
COORdinate:XYZ <X>, <Y>, <Altitude>**

**[ :SOURce<hw> ]:FSIMulator:DSSimulation:USER:RX:TRAJectory:FAPoint:  
COORdinate:XYZ <X>, <Y>, <Altitude>**

Sets the Rx/Tx coordinates in ENU coordination system.

**Parameters:**

<X>	float	Range: 0 to 10000 Increment: 0.1 *RST: 0
<Y>	float	Range: 0 to 10000 Increment: 0.1 *RST: 0

<Altitude> float  
 Range: 0 to 10000  
 Increment: 0.1  
 \*RST: 0

**Options:** R&S SMU/AMU-K77

---

**[ :SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:FAPoint:  
 COORdinates[:DECimal] <Longitude>, <Latitude>, <Altitude>**

**[ :SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:FAPoint:  
 COORdinates[:DECimal] <Longitude>, <Latitude>, <Altitude>**

Defines the coordinates of the Tx/Rx fixed vehicle in decimal format.

**Parameters:**

<Longitude> float  
 Range: -180 to 180  
 Increment: 1E-6  
 \*RST: 0

<Latitude> float  
 Range: -90 to 90  
 Increment: 1E-6  
 \*RST: 0

<Altitude> float  
 Range: 0 to 10000  
 Increment: 0.1  
 \*RST: 0

**Options:** R&S SMU/AMU-K77

---

**[ :SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:TDF:EBEHavior  
 <TrajTdfBehavior>**

**[ :SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:TDF:EBEHavior  
 <TrajTdfBehavior>**

Determines the behavior of the moving transmitter/receiver defined by a trajectory description file the at the end waypoint (see "[Behavior at End of Trajectory](#)" on page 83).

**Parameters:**

<TrajTdfBehavior> JUMP | RETurn | LOOP | STOP  
 \*RST: LOOP

**Options:** R&S SMU/AMU-K77

---

**[[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:TDF:MACCeleration:STATE <TrajTdfAccState>**

**[[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:TDF:MACCeleration:STATE <TrajTdfAccState>**

Enables smoothing the trajectory to simulate more realistic movement by limiting the acceleration.

**Parameters:**

<TrajTdfAccState> 0 | 1 | OFF | ON  
\*RST: 0

**Options:** R&S SMU/AMU-K77

---

**[[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:TDF:ENU:COORDinates[:DECimal] <Longitude>, <Latitude>, <Altitude>**

**[[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:TDF:ENU:COORDinates[:DECimal] <Longitude>, <Latitude>, <Altitude>**

Sets the coordinates of the reference location in ENU coordination system.

**Parameters:**

<Longitude> float  
Range: -180 to 180  
Increment: 1E-6  
\*RST: 0

<Latitude> float  
Range: -90 to 90  
Increment: 1E-6  
\*RST: 0

<Altitude> float  
Range: 0 to 10000  
Increment: 0.1  
\*RST: 0

**Options:** R&S SMU/AMU-K77

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