Fading Simulator
R&S®SMU200A and R&S®AMU200A
Operating Manual

1171.5231.12 — 09

Test & Measurement

Operating Manual

ROHDE&SCHWARZ

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
  1160.1800.02, 1160.2288.02, 1160.9201.02, 1408.7062.02, 1408.7762.02, 1408.8598.02

This manual version corresponds to firmware version FW 3.20.286.xx and later of the R&S®SMU200A and R&S®AMU200A.

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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.

Contents

1 Preface

1.1 Documentation Overview

The user documentation for the R&S SMU/AMU consists of the following parts:

- Quick start guide, printed manual
- Online help system on the instrument
- Operating manuals and online manual for base unit and options provided on the product page
- Service manual provided for registered users, or on the product page
- Instrument security procedures provided on the product page
- Release notes provided on the product page
- Data sheet and brochures provided on the product page
- Application notes provided on the Rohde & Schwarz website

You find the user documentation on the mainly on the R&S SMU/AMU product page.

Additional download paths are stated directly in the following abstracts of the documentation types.

Quick Start Guide

Introduces the R&S SMU/AMU and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc.

Online Help

Offers quick, context-sensitive access to the information needed for operation and programming. It contains the description for the base unit and the software options.

Operating Manuals and Online Manual

Separate manuals are provided for the base unit and the software options:

- **Base unit** manual
  Contains the description of the graphical user interface, an introduction to remote control, the description of all SCPI remote control commands, programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the Quick Start Guide manual.
- **Software option** manuals
  Describe the specific functions of this option. Basic information on operating the base unit is not included.

The **online manual** provides the contents of the operating manual for immediate display on the internet.

Service Manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS).

Instrument Security Procedures

Deals with security issues when working with the R&S SMU/AMU in secure areas.

Data Sheet and Brochures

The data sheet contains the technical specifications of the software options, see "Digital Standards for Signal Generators - Data sheet" on the web site.

Release Notes

Describes the firmware installation, new and modified features and fixed issues according to the current firmware version. You find the latest version at the product page of the corresponding instrument > "Download" > "Firmware".

Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics, see http://www.rohde-schwarz.com/appnotes.

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.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.3 Notes on Screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as much as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic test situations.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2 Introduction

The R&S SMU/AMU 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.

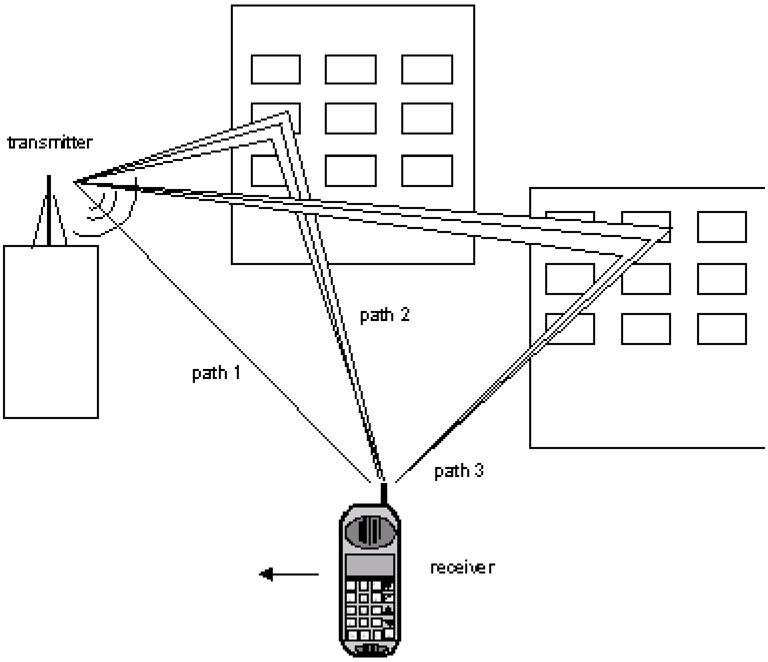


Figure 2-1: Example of single-channel fading with three transmission paths

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).

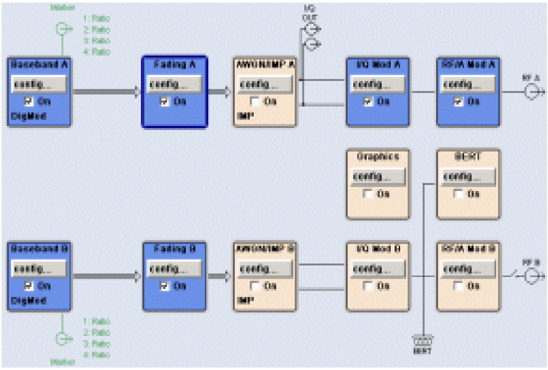
The fading process increases the crest factor of the signal, and this increase must be taken into account in the drive at the baseband level. When multiple paths are superimposed or in case of statistical influences on a path, an insertion loss is useful for providing a drive reserve. If the full drive 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 SMU/AMU 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 (R&S SMU-B10x) include the following: Baseband Main Module (R&S SMx/AMU-B13), Baseband Generator (R&S SMx/AMU-B10), and Fading Simulator for "Standard Delay" configuration (R&S SMx/AMU-B14). Additional configurations - dynamic fading ("Birth Death", "Moving Propagation", "2 Channel Interferer" and "High Speed Train") and enhanced resolution ("Fine Delay" configurations) - require option R&S SMx/AMU-K71.

The Path Extension option (R&S SMx/AMU-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 (R&S SMx/AMU-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 (R&S SMx/AMU-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 (R&S SMx/AMU-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 (non-MIMO) Settings

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 113).
In remote control, however, all avaliable signal routings are configured with the command [:SOURce<hw>]:FSIMulator:ROUTe.

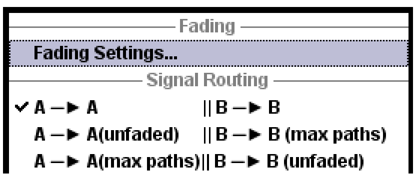
The input signal to the fading simulator is specified in the routing menu of the respective baseband block (see section "Working with the Baseband Signal" in the Operating Manual).

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.

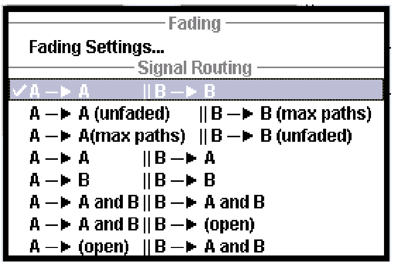
The proposed routes for the fading output signal differ also depending on the options fitted in the instrument:

- **Instruments with the Fading Simulator (option R&S SMx/AMU-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.



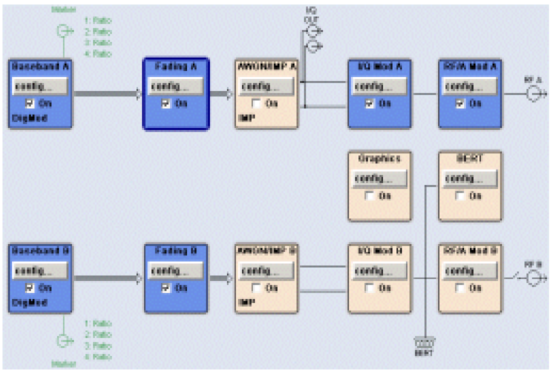
- **Instruments with the Fading Simulator (option R&S SMx/AMU-B14) and Path Extension (option R&S SMx/AMU-B15)**
  – For a single-path instrument, the output signal is always output on path A. In "Standard Delay" mode, 40 fading paths are available.

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



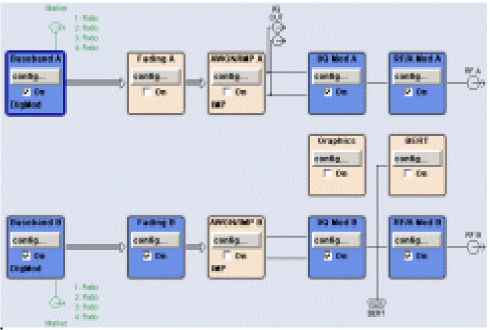
The following list shows all of the possible routing settings for dual-path instruments in a configuration with both fader options (B14 and B15).

"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)"

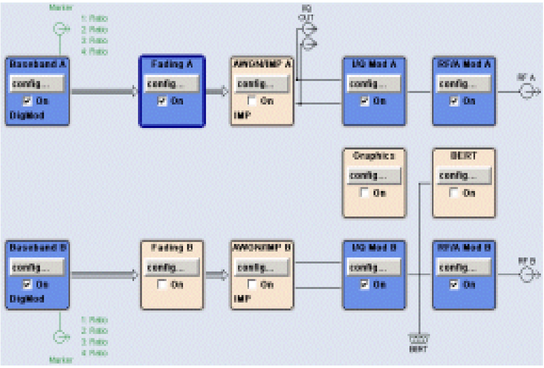
The fading signal from fader B is output on baseband path B. Fader A cannot be activated. In "Standard Delay" mode, 40 fading paths are available for fader B.



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

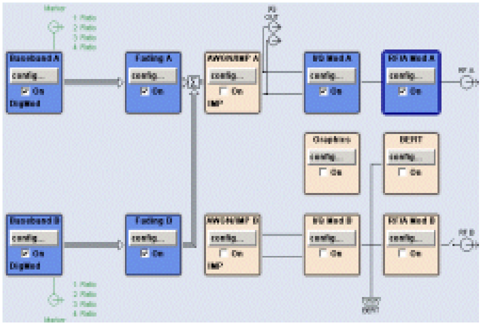
"A to A (max. paths) / B to B (unfaded)"

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.



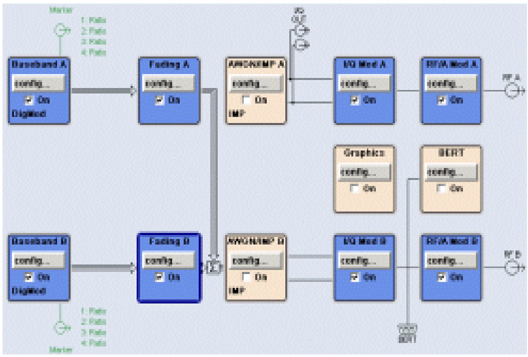
Note: The signal from the 40-path fader has a longer processing time than the signal from the fader which is switched off.

"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"

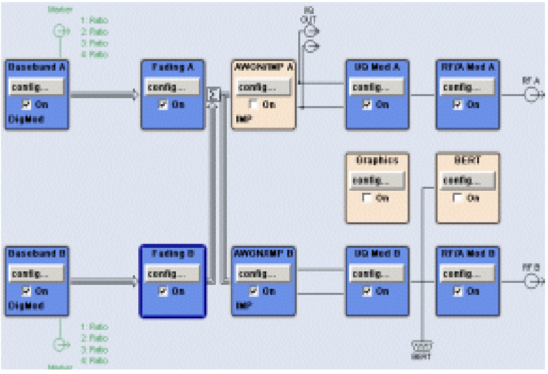
Dual-channel fading. The fading signal from fader A and the fading signal from fader B are both output on baseband path B. In "Standard Delay" mode, 20 fading paths are available for each fader.



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

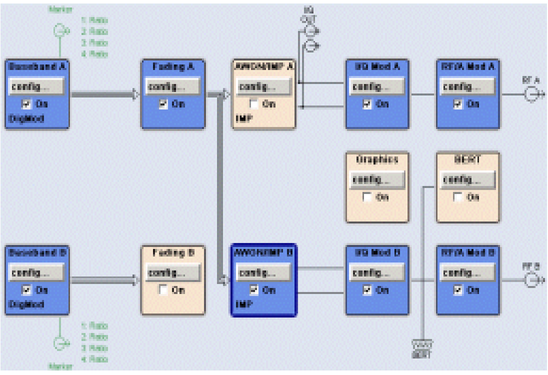
Dual-channel fading. The fading signal from fader A and the fading signal from fader B are output on baseband path A and baseband path B. In "Standard Delay" mode, 20 fading paths are available for each fader.

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.



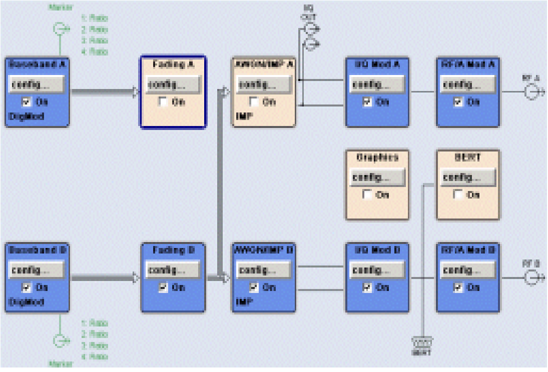
"A to A and B / B (open)"

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.



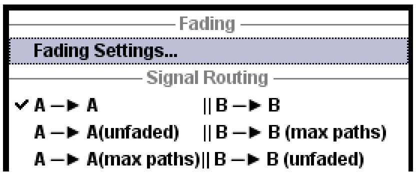
Remote command:

[:SOURce<hw>]:FSIMulator:ROUTe on page 226

4 Fading Settings

The "Fading" dialog is used to configure multipath fading signals. To access this dialog:

► Select "Block Diagram > Fading > Config > Fading Settings".



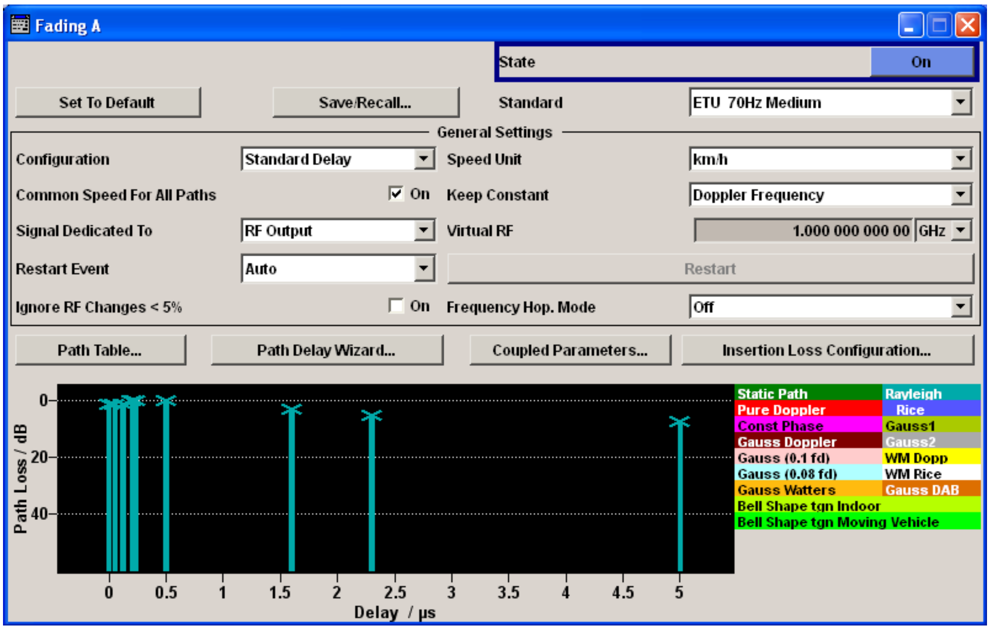
The remote commands required to define these settings are described in Chapter 8, "Remote-Control Commands", on page 216.

The screenshots provided in this description show parameter values that have been selected to illustrate as much as possible of the provided functions and possible interdependencies between them.

These values are not necessarily representative of realistic test situations.

4.1 General Settings

► To access this dialog, select the "Fading > Fading Settings".



Apart from the standard "Set to Default" and "Save/Recall" functions, the dialog provides the settings to:

- Select a predefined fading profile according to the common mobile radio standards
- Determine 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.
- In instruments with RF output, activate and configure a frequency hopping.
- The "Path Settings" section offers access to different dialogs for the configuration of the fading paths depending on the selected fading configuration. Current 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.

Remote command:
`[:SOURce<hw>]:FSIMulator[:STATe]` on page 235

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 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.

Table 4-1: Default values

Parameter	Value
State	Off
Standard	User
Configuration	Standard Delay
Signal Dedicated to	RF Output
Speed Unit	km/h
Restart Event	Auto
Ignore RF Changes	Off
Frequency Hop. Mode	Off
Insertion Loss	
Insertion Loss Mode	Normal
Coupled Parameters	

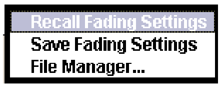
Parameter	Value
All States	Off
Path Configuration	
State of path 1	On
State of all other paths	Off
Profile	Rayleigh
Delays	0
Speed of path 1	Slow
Speed of all other paths	0

Remote command:
[:SOURce<hw>]:FSIMulator:PRESet on page 225

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 directories.

Remote command:
[:SOURce]:FSIMulator:CATalog? on page 236
[:SOURce<hw>]:FSIMulator:LOAD on page 236
[:SOURce<hw>]:FSIMulator:STORe on page 237

[:SOURce<hw>]:FSIMulator:STORe:FAST on page 238
[:SOURce]:FSIMulator:DELETE on page 237

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 enabled settings, see Chapter 7, "Predefined Fading Settings", on page 126.

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

Remote command:
[:SOURce<hw>]:FSIMulator:STANdard on page 229
[:SOURce<hw>]:FSIMulator:STANdard:REFerence on page 235

Configuration
Selects the fading configuration.

Note: The selection of fine delay and dynamic configurations is only possible with option R&S SMx/AMU-K71; "Scenario Simulation" requires option R&S SMx/AMU-K77.

For classical fading with simulation of the level fluctuations, select from the 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 (R&S SMx/AMU-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 further settings the "Fading" dialog change, particularly the path table.

Note: A separate path table is associated with each configuration, i.e. each time you select a new configuration, the instrument changes not only the bandwidth but loads a completely new path table.
Each changing in the configuration interrupts the fading process and restarts the calculation. If the instrument is fitted with more than one fading simulators, they are all affected.

"Standard/Fine Delay"

In the "Standard/Fine Delay" configuration, each group consists of five paths, 3 fine delay and 2 standard delay paths. This means that 20 paths can be simulated for a fading channel.

The standard and fine delay configurations differ in terms of the resolution of the path-specific delay:

- The resolution of the additional delay of a standard pat is 5 ns.
- The resolution of the additional delay of a fine delay pat is 2.5 ps.

The "Standard/Fine Delay" configuration is sufficient for classical fading with simulation of the level fluctuations. A delay configuration with the provided characteristics occurs in the received signal as a result of a typical multipath propagation and the propagation conditions, which vary depending on the location and timing.

"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 also Chapter 4.3, "Path Table", on page 33.

"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 4.6, "Birth Death Propagation", on page 49).

"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 configured the "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 4.7, "Moving Propagation", on page 54 for more information.

"2 Channel Interferer"

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).
See Chapter 4.8, "Two Channel Interferer", on page 62 for more information.

"High Speed Train"

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.
The instrument simulates all the three scenarios as defined in the test specification. Additionally, user-defined HST conditions can be configured by selecting different profile and setting up the speed and the initial distances.
See Chapter 4.9, "High Speed Train", on page 67 for more information.

"Scenario Simulation"

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.
Additionally, user-defined dynamic fading conditions can be configured by adjusting the different transmitter and receiver settings.
See Chapter 4.10, "Dynamic Scenario Simulation", on page 74for more information.

"User Dynamic"

The "User Dynamic" configuration is provided for future use.

Remote command:
[:SOURce<hw>]:FSIMulator:CONFiguration on page 218
[:SOURce<hw>]:FSIMulator:DEL30:STATe on page 260
[:SOURce<hw>]:FSIMulator:DEL50:STATe on page 260
[:SOURce<hw>]:FSIMulator:BIRThdeath:STATe on page 245
[:SOURce<hw>]:FSIMulator:MDELay:STATe on page 271
[:SOURce<hw>]:FSIMulator:TCINterferer[:STATe] on page 286
[:SOURce<hw>]:FSIMulator:HSTRain:STATe on page 265

Moving Channels

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

"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 in the "Path Table".

Remote command:
[:SOURce<hw>]:FSIMulator:MDELay:CHANnel:MODE on page 266

Signal Dedicated To

(R&S AMU only)

The Doppler shift is calculated based on a select "Virtual RF" frequency.

(R&S SMU only)

Sets the RF frequency for computing the Doppler shift.

"RF Output" The Doppler shift is calculated based on the selected RF frequency.

"Baseband Output"
The Doppler shift is calculated based on a select "Virtual RF" frequency.
If you use an external I/Q modulator to upconvert the generated faded baseband signal, set the value of the parameter Virtual RF to the modulation frequency of the external I/Q modulator.

Remote command:
[:SOURce<hw>]:FSIMulator:SDEStination on page 229

Virtual RF

Sets the virtual RF frequency to be used for the calculation of the Doppler shift, if:

- Your instrument is equipped with an RF output and the "Signal Dedicated To > Baseband Output".
- You use an external I/Q modulator to upconvert the generated faded baseband signal.

Remote command:
[:SOURce<hw>]:FSIMulator:FREQuency on page 221

Common Speed For All Paths

In delay configurations, activates/deactivates the same speed in all paths.

If Speed Setting Coupled is enabled, this parameter is also coupled in both faders.

"On" In this default state, a change of speed in a path automatically results in a change of speed in all of the other paths.

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

Remote command:
[:SOURce<hw>]:FSIMulator:CSPeed on page 239

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.

Remote command:
[:SOURce<hw>]:FSIMulator:SPEed:UNIT on page 229

Keep Constant

Selects whether to keep the speed or the resulting 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.

Remote command:
[:SOURce<hw>]:FSIMulator:KCONstant on page 225

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 Trigger 1 / 2"
A restart is triggered by baseband A/B.

Remote command:
[:SOURce<hw>]:FSIMulator:RESTart:MODE on page 226

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.

Remote command:
[:SOURce<hw>]:FSIMulator:RESTart on page 225

Ignore RF Changes < 5PCT
(instruments with RF output only)

Selects whether changes of the RF frequency that are smaller than 5% are to be ignored or not for the fading.

"On" Enables faster frequency hopping because small frequency changes (which can occur e.g. in GSM hopping) do not result in a short-term switch-off of the fader and a restart of the fading process.

Remote command:
[:SOURce<hw>]:FSIMulator:IGNore:RFCHanges on page 222

Freq. Hopping Mode
(instruments with RF output only)

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

In real-world receivers, one of the reasons for frequency hopping could be that due to a change in the location of the receiver, the original carrier is no longer accessible.

In the fading simulator, frequency hopping is implemented by switching of the carrier frequency. The fading simulator is temporarily deactivated until the variation in the RF frequency is completed. The fading process starts then again at the new frequency.

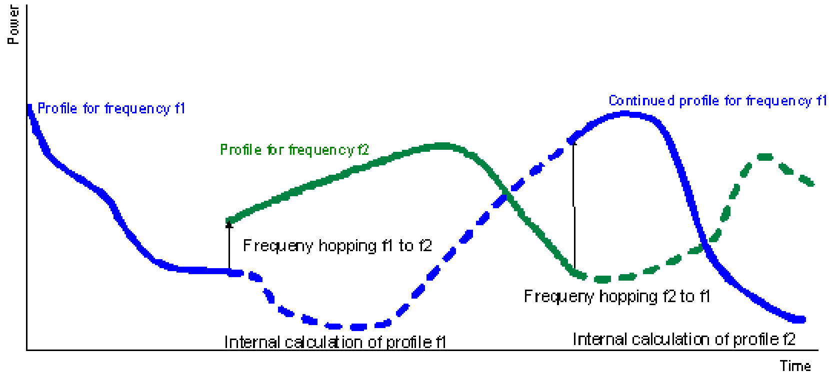
The instrument provides two modes for frequency hopping, that mainly differ in terms of the behavior when hopping back to a prior frequency.

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 connectors. These 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.

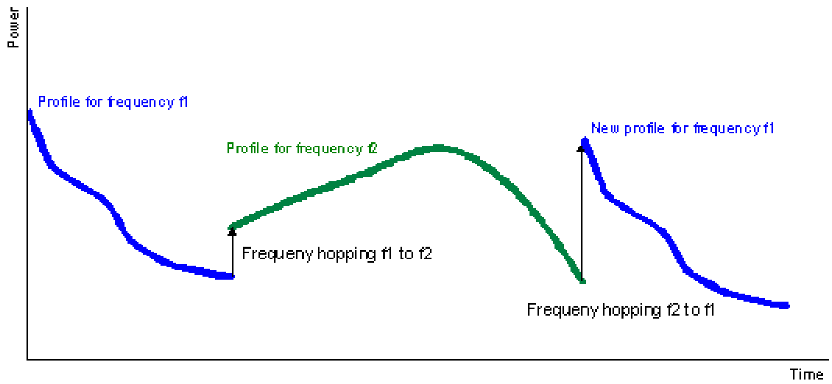
"In Band" Frequency hopping is activated. After hopping back to a previous hop frequency, the random process of the fading simulator is resumed as if the fading had continued also at this frequency, i.e. the process is not restarted.



The instrument simulates a situation 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. An example of a real-word situation is 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 because 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.

Remote command:
`[:SOURce<hw>]:FSIMulator:HOPPing:MODE` on page 222

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...
Accesses the dialog for setting the fading paths.

See
- Chapter 4.3, "Path Table", on page 33
- Chapter 4.6, "Birth Death Propagation", on page 49
- Chapter 4.7, "Moving Propagation", on page 54
- Chapter 4.8, "Two Channel Interferer", on page 62
- Chapter 4.9, "High Speed Train", on page 67.

Path Delay Wizard
(delay configurations only)

Accesses the dialog for modifying, inserting and deleting paths in the delay modes, see Chapter 4.5, "Path Delay Wizard", on page 46.

Coupled Parameters...
(only for Delay configurations, Configuration with two faders (options R&S SMx/AMU-B14/-B15) and Signal routing A to A /B to B (split))

Accesses the dialog for setting the coupled parameters of the two faders A and B, see Chapter 4.11.2, "Coupled Parameters and Global Fader Coupling Settings", on page 101.

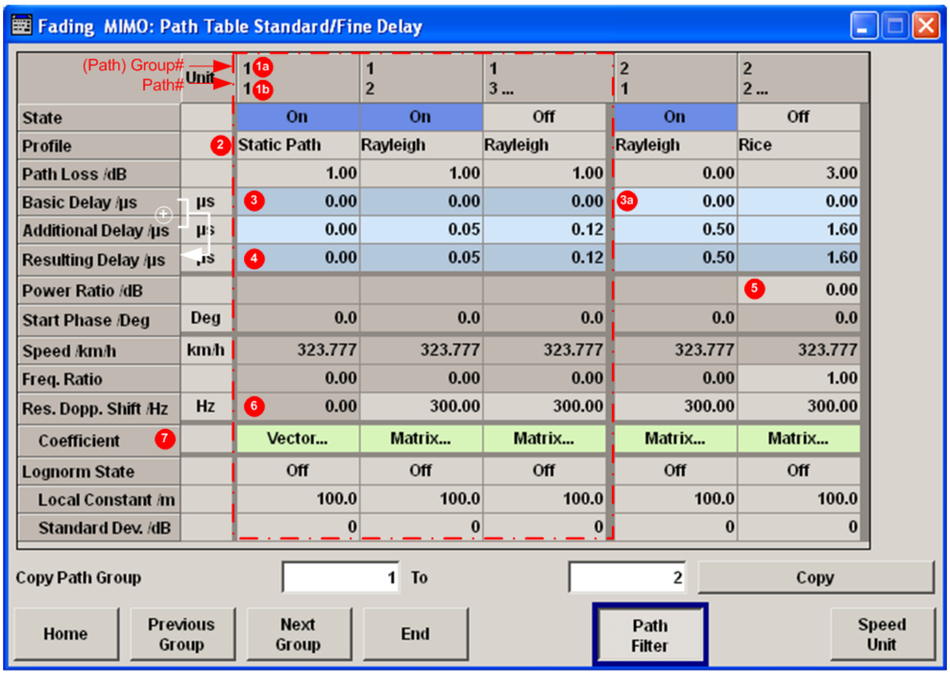
Insertion Loss Configuration ...
Accesses the dialog for setting the insertion loss, see Chapter 4.11.1, "Insertion Loss Configuration Settings", on page 100.

4.3 Path Table

The settings for configuration of the fading paths are grouped in a path table.

1. To access this dialog, select "Fading > Config > Fading Settings > Path Table".
2. To suppresses the indication of the disabled paths, select "Path Filter".

   The path table comprises the individual path and group parameters.



1a/1b = Path group number (displayed in the first row) and path number (second row in the table header); the example shows 2 groups with different number of active paths (the first group is marked with a blue border)
2 = Fading profile, assigned per fading path
3/3a = Common group delay of a path group ("Basic Delay" is always 0 for group 1); adjustable for the other groups (light grey background)
4 = Resulting delay per path, calculated as the sum of the common group delay and the path-specific delay.
5 = Adjustable parameter for paths with Rice fading
6 = Pure display parameters are on a dark background
7 = Access to a "Vector" or a "MIMO Matrix" for configuration of the correlation between the transceivers

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 equipped with the Path Extension option (R&S SMx/AMU-B15).

Use the "Copy Path Group" setting, to copy the settings for a fading group to a second one.

Use the provided navigation functions to move the indicated area of the table or to quickly change the speed unit.

4.3.1 Path Table Settings

State Path

Activates a fading path.

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

Remote command:
`[:SOURce<hw>]:FSIMulator[:STATe]` on page 235
`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:STATe` on page 260
`[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:STATe` on page 260
`[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:STATe` on page 260
`[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROup<st>:PATH<ch>:STATe` on page 260
`[:SOURce<hw>]:FSIMulator:HSTRain:PATH:STATe` on page 263

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" Simulated is a static transmission path which can undergo attenuation (loss) or delay.

"Pure Doppler" Simulated is a transmission path with an individual direct connection from the transmitter to the moving receiver (discrete component).
The actual Doppler shift is determined by the Speed and Frequency Ratio parameters.
Tip: In MIMO configuration, use the Relative Gain Vector Matrix Settings to configure beamforming.

"Rayleigh" Simulated is a radio hop 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" Simulated is a radio hop 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).

Use the parameter Power Ratio to set the ratio of the power of the two components (Rayleigh and pure Doppler).

Example:

The Figure 4-1 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.

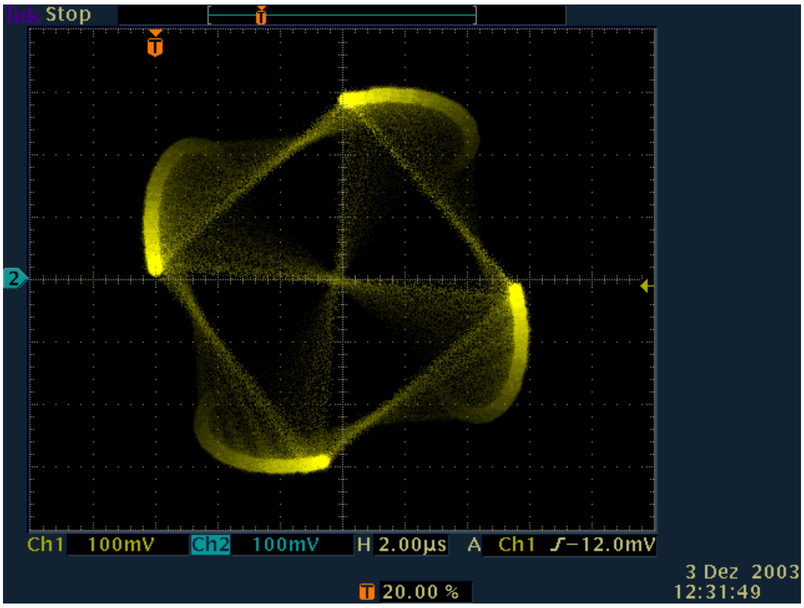


Figure 4-1: Effect of a Rician fading on a baseband signal with QPSK modulation

"Const. Phase" Simulated is one transmission path with the set constant phase rotation, attenuation (loss) or delay.

"Gauss1" Sum of two Gaussian functions and is used for excess delay times in the following range:

0.5 µs to 2 µs, (0.5 µs < τ_l < 2 µs).

$S(\tau_l,f) = G(A, -0.8f_d, 0.05f_d) + G(A_1, +0.4f_d, 0.1f_d)$

where A_1 is 10 dB below A.

"Gauss2" Sum of two Gaussian functions and is used for paths with delays in excess of 2 µs, (τ_l > 2 µs).

$S(\tau_l,f) = G(B, +0.7f_d, 0.1f_d) + G(B1, -0.4f_d, 0.15f_d)$

where B_1 is 15 dB below B.

"Gauss DAB" Composed of a Gaussian function and is used for special DAB profiles.
$S(\tau_l,f) = G(A, \pm 0.7f_d, 0.1f_d)$
where + $0.7f_d$ applies for even path numbers and $0.7f_d$ for odd, except path 1.

"Gauss Doppler"
Sum of a Gaussian function and a pure Doppler component.
$S(\tau_l,f) = G(0.1A; 0; 0.08f_d) + \delta(f-0.5f_d)$

"Gauss (0.08 fd)"
Composed of a Gaussian function with a standard deviation of $0.08*f_d$.
$S(\tau_l,f) = G(A; f; 0.08f_d)$

"Gauss (0.1 fd)"
Composed of a Gaussian function with a standard deviation of $0.1*f_d$.
$S(\tau_l,f) = G(A; f; 0.1f_d)$

"Gauss (Watters)"
Gauss (Watterson) fading profile.

"WM Doppler" The WiMAX Doppler fading profile is a rounded Doppler PSD model according to IEEE 802.16a.

"WM Rice" The WiMAX Rice fading profile is according to IEEE 802.16a.

"Bell Shape tgn Indoor/Bell Shape tgn Moving Vehicle"
Both Bell Shape fading profiles describe the indoor wireless channels according to IEEE 802.11n and IEEE 802.11ac.
The profiles are called after the resulting Doppler power spectrum that has a shape very similar to a "Bell". The second fading profile includes a Doppler component that represents a reflection from a moving vehicle.

Remote command:
`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:PROFile` on page 257
`[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:PROFile` on page 257
`[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:PROFile` on page 257
`[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROup<st>:PATH<ch>:PROFile` on page 257

Path Loss
Enters the loss for the selected path.

Remote command:
`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:LOSS` on page 256
`[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOSS` on page 256
`[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOSS` on page 256

Basic Delay

Sets the Basic Delay.

Within a path group, all of the paths are jointly delayed by this value.

The path delay is calculates as:

Resulting Delay = Basic Delay + 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".

Remote command:
`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:BDELay` on page 247
`[:SOURce<hw>]:FSIMulator:MDELay:DEL30:GROup<st>:PATH<ch>:BDELay` on page 248
`[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:BDELay` on page 247

Additional Delay

Sets the Additional Delay per path.

Remote command:
`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:ADELay` on page 247
`[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:ADELay` on page 247
`[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:ADELay` on page 247

Resulting Delay

Displays the Resulting Delay for the path.

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

Remote command:
`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:RDELay?` on page 258
`[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:RDELay?` on page 258
`[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:RDELay?` on page 258

Power Ratio

("Fading Profile > Rice, WM Rice, Gauss Doppler")

Enters the power ratio of the discrete component and distributed component.

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

Remote command:
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:PRATio on page 256
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:PRATio on page 257
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:PRATio on page 257

Frequency Spread
("Fading Profile > Gauss Watterson")

Sets the frequency spread for the Gauss Watterson fading.

Remote command:
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:FSPRead on page 253
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:FSPRead on page 253
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:FSPRead on page 253

Frequency Shift
("Fading Profile > Gauss Watterson")

Enters the frequency shift for the Gauss Watterson fading.

Remote command:
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:FSHift on page 253
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:FSHift on page 253
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:FSHift on page 253

Const. Phase
Enters the phase by which the path is multiplied.

Remote command:
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:CPHase on page 251
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:CPHase on page 251
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:CPHase on page 251

Start Phase
("Fading Profile > Pure Doppler, WM Doppler")

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

Remote command:
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:CPHase on page 251

Speed

Enters the speed *v* of the moving receiver.

To determine the unit, use the parameter "Speed Unit" on page 30.

The Resulting Doppler Shift f_D is calculated as:

$f_D = (v/c)*f_{RF}$, where

f_{RF} is the frequency of the RF output signal or the virtual RF frequency and $c=2.998*10^8$m/s is the speed of light

Example:

If v = 100 km/h and f_{RF} = 1 GHz, the f_D = 92.66 Hz

Consider the following interdependencies:

- If the speed is changed, the resulting Doppler shift is automatically modified.
- If "Path Table Settings > Common Speed in All Paths > On", a change of speed in one path automatically results in a change of speed in all of the other paths of the fader.
- In the "Fading Profile > Pure Doppler/Rice/Gauss Doppler", the actual Doppler Shift f_A is a function of the selected speed v and also of the parameter Frequency Ratio.
- When fitted with the Path Extension option (R&S SMx/AMU-B15), the speed for the paths of both faders A and B can be coupled.
- With correlated paths, the speed setting must agree. When correlation is activated, the settings of the path for which correlation is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made). The same applies to all paths of the two faders when coupling is activated.

Remote command:

`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:SPEed` on page 259

`[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:SPEed` on page 259

`[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:SPEed` on page 259

Resulting Doppler Shift

If "Table Settings > Keep Constant > Speed", this parameter displays the resulting Doppler shift f_D.

The value depends on the selected:

- Speed
- RF frequency f_{RF} or the Virtual RF
- For "Fading Profile > Pure, Gauss Doppler or Rice", the "Actual Doppler Shift" depends also on the selected Frequency Ratio.

To set the Doppler shift, enable "Table Settings > Keep Constant > Resulting Doppler Shift". In this case, the "Speed" is calculated as a function of the selected "Resulting Doppler Shift" and the RF frequency f_{RF}.

Remote command:
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:FDOPpler
on page 251
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:FDOPpler
on page 251
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:FDOPpler
on page 251

Frequency Ratio
("Fading Profile > Pure, Gauss Doppler or Rice")

Sets the ratio of the actual Doppler Shift f_A to the Resulting Doppler Shift f_D.

The actual Doppler shift is a function of the simulated angle of incidence of the discrete component (see Figure 4-2) and is calculated as:

$f_A = f_D * \cos\varphi t$, where:

$\cos\varphi t$ is the "Frequency Ratio" and $f_D = (v/c) * f_{RF}$ is the Resulting Doppler Shift.

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

φ / deg	0	90	180
FREQ RATIO	-1	0	+1

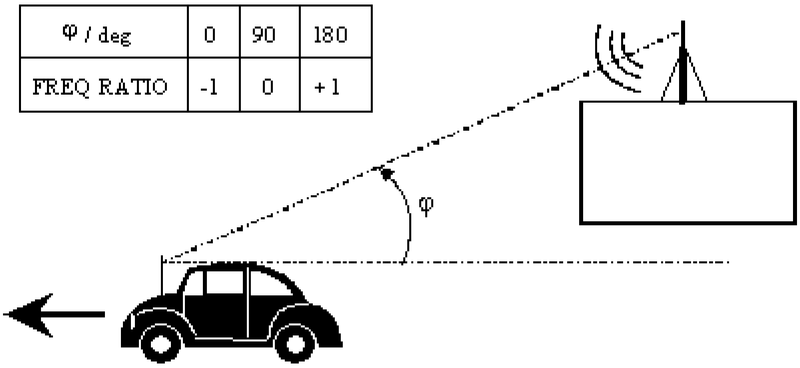


Figure 4-2: Doppler shift as a function of the angle of incidence

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

Remote command:
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:FRATio
on page 252
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:FRATio
on page 252
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:FRATio
on page 252

Correlation Path
(only for Configuration with two faders (options R&S SMx/AMU-B14 and R&S SMx/AMU-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"
- "Resulting Doppler Shift"
- "Actual Doppler Shift"

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 R&S SMx/AMU-B14 and R&S SMx/AMU-B15) and selection of A to A / B to B signal routing (split). Each fader has a maximum of 20 fading paths.

Remote command:
`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:CORRelation:STATe` on page 250
`[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:CORRelation:STATe` on page 250
`[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:CORRelation:STATe` on page 250

Correlation Coefficient
(only for Delay configurations, Configuration with two faders (options R&S SMx/AMU-B14 and R&S SMx/AMU-B15) and Signal routing A to A /B to B (split))

Sets 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).

Remote command:
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:CORRelation:COEFficient on page 248
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:CORRelation:COEFficient on page 248
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:CORRelation:COEFficient on page 248

Correlation Coefficient Phase

(only for Delay configurations, Configuration with two faders (options R&S SMx/AMU-B14 and R&S SMx/AMU-B15) and Signal routing A to A /B to B (split))

Sets the phase of the complex correlation coefficient in degrees.

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

Remote command:
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:CORRelation:PHASe on page 249
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:CORRelation:PHASe on page 249
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:CORRelation:PHASe on page 249

Lognormal State

Switches lognormal fading on/off (slow fading).

Simulated is an additional slow fluctuation of the received amplitude of a moving receiver. 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 (R&S SMx/AMU-B15), the status of lognormal fading for the paths of both faders A and B can be coupled. With correlated paths, the status setting must agree. When correlation is activated, the settings of the path for which correlation is switched on are accepted for both paths. Afterwards, the most recent modification applies to both paths (no matter in which path it was made).

Remote command:
[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:LOGNormal:STATe on page 255
[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOGNormal:STATe on page 255
[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOGNormal:STATe on page 255

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 applies:

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

The lower setting limit is a function of the (virtual) RF frequency f_{RF} and is calculated as follows:

$L_{min} = 12*10^9 / f_{RF}$

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

Remote command:

`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:LOGNormal:LCONstant` on page 254

`[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOGNormal:LCONstant` on page 254

`[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOGNormal:LCONstant` on page 254

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).

Remote command:

`[:SOURce<hw>]:FSIMulator:DELay|DEL:GROup<st>:PATH<ch>:LOGNormal:CSTD` on page 254

`[:SOURce<hw>]:FSIMulator:DEL30:GROup<st>:PATH<ch>:LOGNormal:CSTD` on page 254

`[:SOURce<hw>]:FSIMulator:DEL50:GROup<st>:PATH<ch>:LOGNormal:CSTD` on page 254

4.3.2 Copy Path Group Settings

The provided "Copy Path Group" settings enables you to copy the settings of one to a second fading group.

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

Remote command:
[:SOURce<hw>]:FSIMulator:COPY:SOURce on page 220

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

Remote command:
[:SOURce<hw>]:FSIMulator:COPY:DESTination on page 220

Copy
Triggers a copy procedure.

Remote command:
[:SOURce<hw>]:FSIMulator:COPY:EXECute on page 220

4.3.3 Navigation Functions

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

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

Remote command:
n.a.

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

Remote command:
n.a.

Path Filter
Suppresses the indication of the disabled paths.

Remote 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.

Remote command:

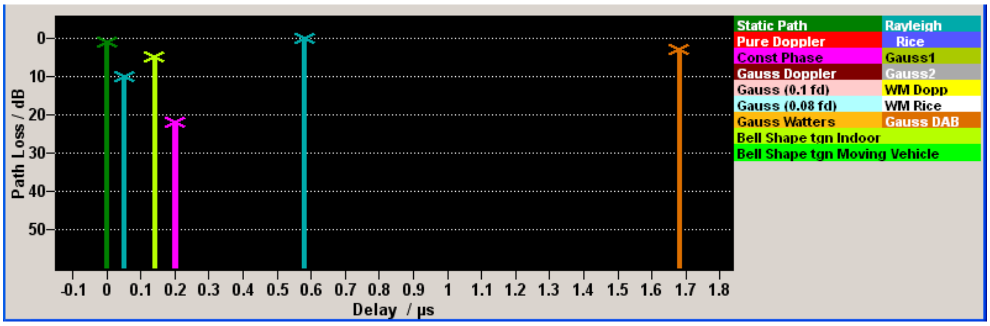
`[:SOURce<hw>]:FSIMulator:SPEed:UNIT` on page 229

4.4 Path Graph

To access the graphical representation of the configured path,

► select "Fading > Fading Settings".

The path graph provides a quick overview of the paths as they are configured 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, determined by the sum of max. Basic Delay and max. Additional 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 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 grsoups and the range of signal delay values available for each group are indicated by a dashed 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).

Use the "Path Delay Wizards" to modify the settings of existing paths or insert new paths ,see Chapter 4.5, "Path Delay Wizard", on page 46.

4.5 Path Delay Wizard

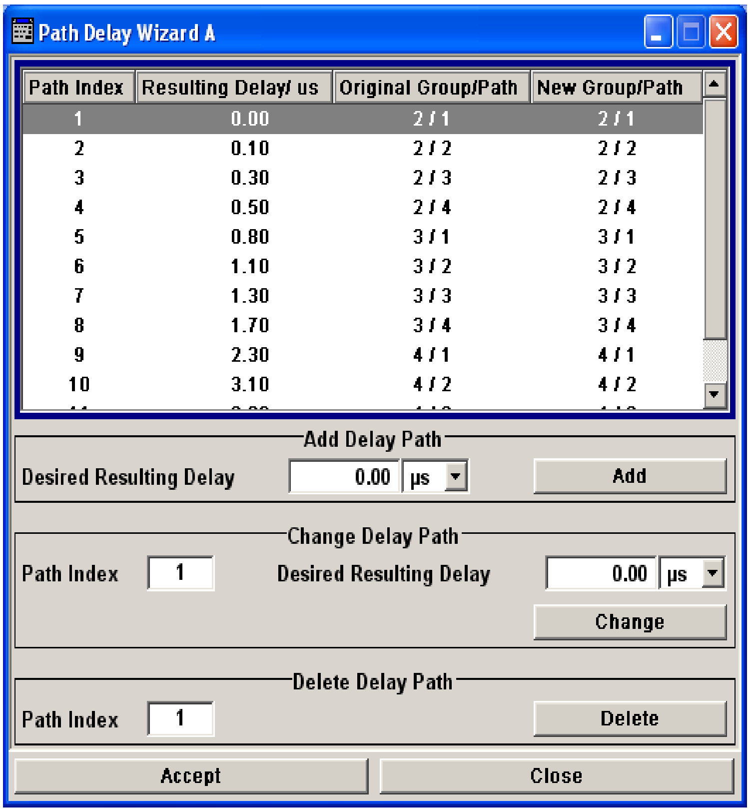
The dialog for modifying, inserting, and deleting paths in the delay modes is called up in the Fading menu.

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

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

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

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



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 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-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] µs. 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 Figure 4-3).

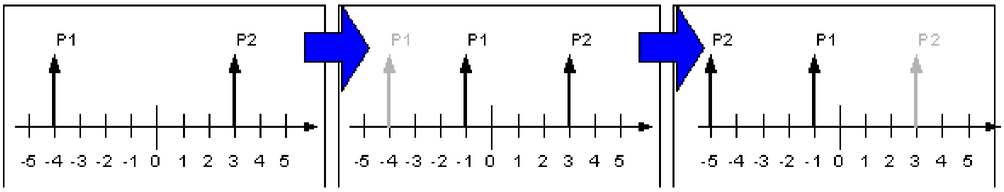


Figure 4-3: Example of a sequence of hops in Birth Death Propagation

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

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 4-2).

Table 4-2: Default parameter values (Birth Death Propagation)

"Profile"	Pure Doppler
"Path Loss"	0 dB
"Min. Delay"	0 µs

"Delay Grid"	1 µs
"Positions"	11
"Max. Delay"	10 µs
"Hopping Dwell"	191 ms
"Speed"	0 m/s
"Frequency Ratio"	1.0

Path Graph

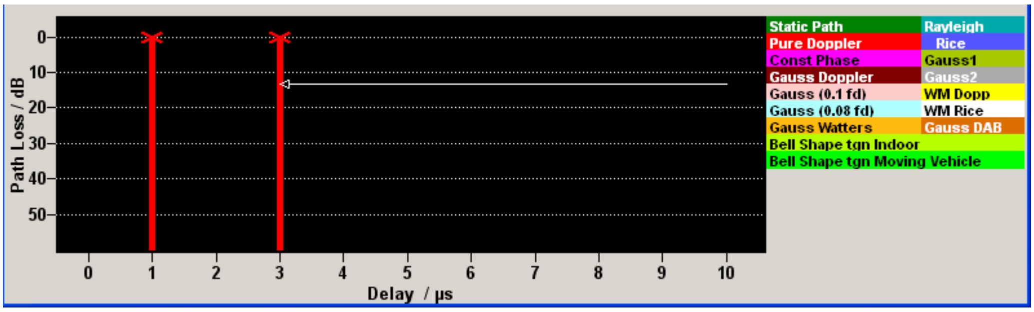
The graphical display of the fading paths in Birth Death Propagation mode shows as an example the changing positions of the two paths within the delay grid. The displayed position change does not correspond to the actual delay hops of the real signal. An arrow indicates the direction of the delay hop 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 (see the "Min Delay" and the "Delay Range" indication on the graph). 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.

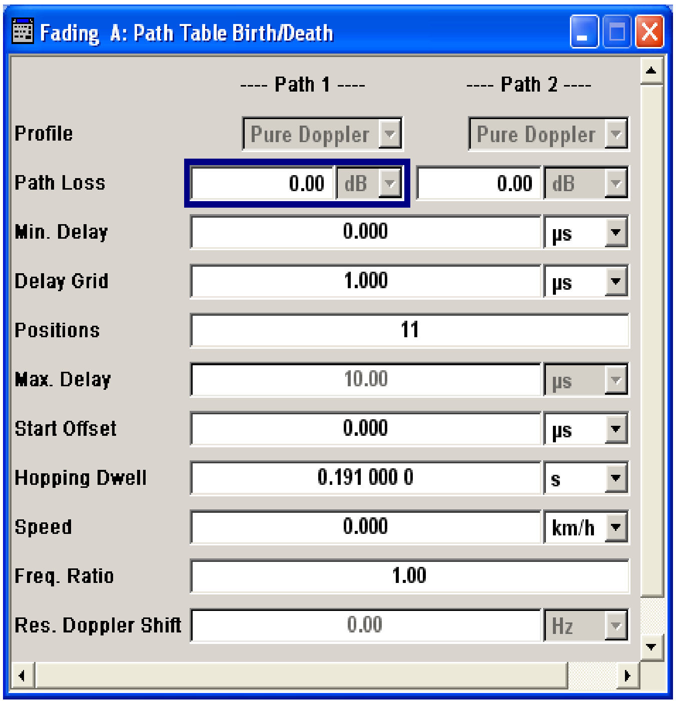
The scaling of the x-axis depends on the set delay range. It always starts at 0 µs and rages up to 40 µs at the most (= maximum for delay range). The minimum delay corresponds to the start value of the delay range. The maximum delay is defined by the minimum delay, the delay grid and the number of possible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



The Table 4-2 lists the default values for Birth Death Propagation. However, these parameters can also be set for further tests in the fading path table.



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

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

Remote command:
`[:SOURce<hw>]:FSIMulator:BIRThdeath:PATH<ch>:PROFile` on page 242

Path Loss
Enters the loss for the selected path.

Remote command:
`[:SOURce<hw>]:FSIMulator:BIRThdeath:PATH<ch>:LOSS` on page 241

Min Delay
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 us < (Positions – 1) x Delay Grid + Min. Delay < 40 us

The scaling of the X-axis is adapted according to the entry (see "Path Graph" on page 50).

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

Remote command:
`[:SOURce<hw>]:FSIMulator:BIRThdeath:DELay:MINimum` on page 240

Delay Grid
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 "Path Graph" on page 50).

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

Remote command:
`[:SOURce<hw>]:FSIMulator:BIRThdeath:DELay:GRID` on page 240

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

The scaling of the X-axis is adapted according to the entry (see "Path Graph" on page 50).

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

Remote command:
`[:SOURce<hw>]:FSIMulator:BIRThdeath:POSitions` on page 242

Maximum Delay
Indication of the maximum delay. The maximum delay corresponds to the stop value of the delay range (see "Path Graph" on page 50).

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

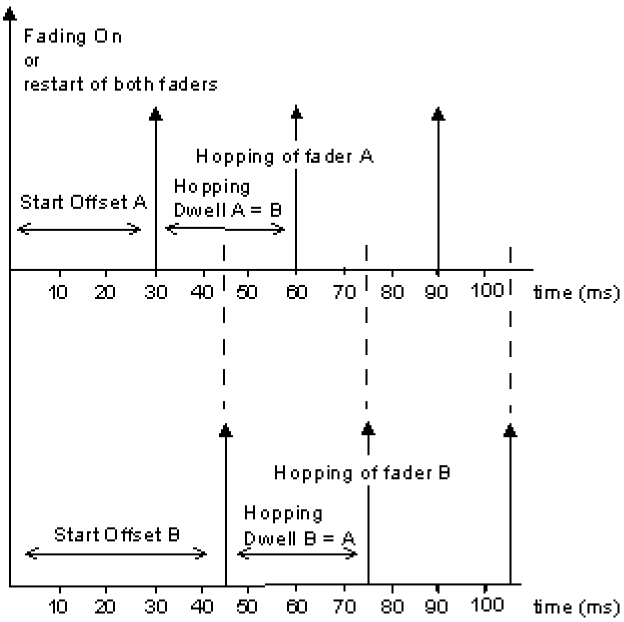
Max Delay = (Positions – 1) x Delay Grid + Min. Delay

Remote command:
`[:SOURce<hw>]:FSIMulator:BIRThdeath:DELay:MAXimum?` on page 240

Start Offset
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.

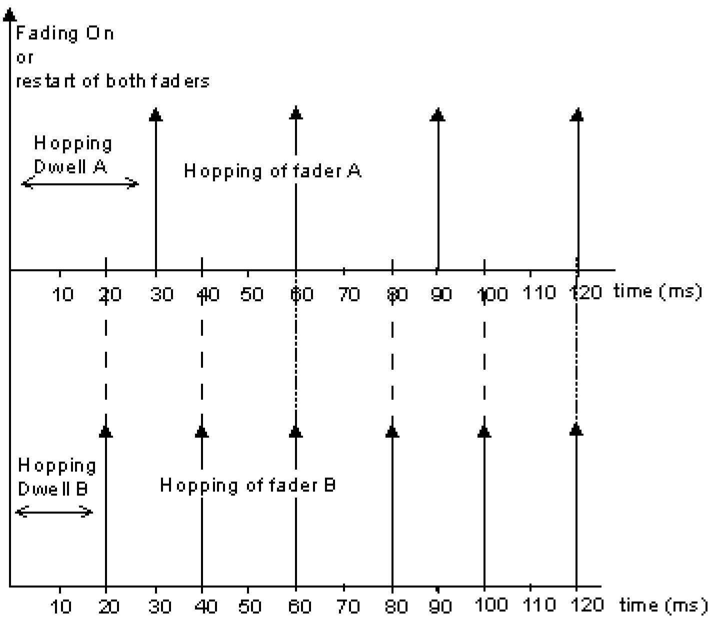


Remote command:
[:SOURce<hw>]:FSIMulator:BIRThdeath:SOFFset on page 243

Hopping Dwell

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

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



Remote command:
[:SOURce<hw>]:FSIMulator:BIRThdeath:HOPPing:DWELl on page 241

Speed

Enters the speed v of the moving receiver.

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.

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

Remote command:
`[:SOURce<hw>]:FSIMulator:BIRThdeath:SPEed` on page 243

Resulting Doppler Shift

Displays the resulting Doppler shift.

Remote command:
`[:SOURce<hw>]:FSIMulator:BIRThdeath:PATH<ch>:FDOPpler?` on page 244

Frequency Ratio

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

Remote command:
`[:SOURce<hw>]:FSIMulator:BIRThdeath:FRATio` on page 244

Actual Doppler Shift

Displays the actual Doppler shift.

The actual Doppler frequency is determined by the selected "Speed" and "Frequency Ratio" (i.e. the ratio of the actual Doppler frequency to the resulting Doppler frequency).

Remote command:
`[:SOURce<hw>]:FSIMulator:BIRThdeath:PATH<ch>:FDOPpler:ACTual?`
on page 244

4.7 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 in 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 4.7.1, "Moving Propagation Conditions for Testing of Baseband Performance", on page 55)

- "ETU200Hz Moving" - Simulation of moving propagation conditions in accordance to the scenario 1 described in 3GPP TS36.141, annex B.4.
  (see Chapter 4.7.2, "Moving Propagation Conditions for Testing the UL Timing Adjustment Performance", on page 57)
- "Pure Doppler Moving" - Simulation of moving propagation conditions in accordance to the scenario 2 described in 3GPP TS36.141, annex B.4.
  (see Chapter 4.7.2, "Moving Propagation Conditions for Testing the UL Timing Adjustment Performance", on page 57)

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

4.7.1 Moving Propagation Conditions for Testing of Baseband Performance

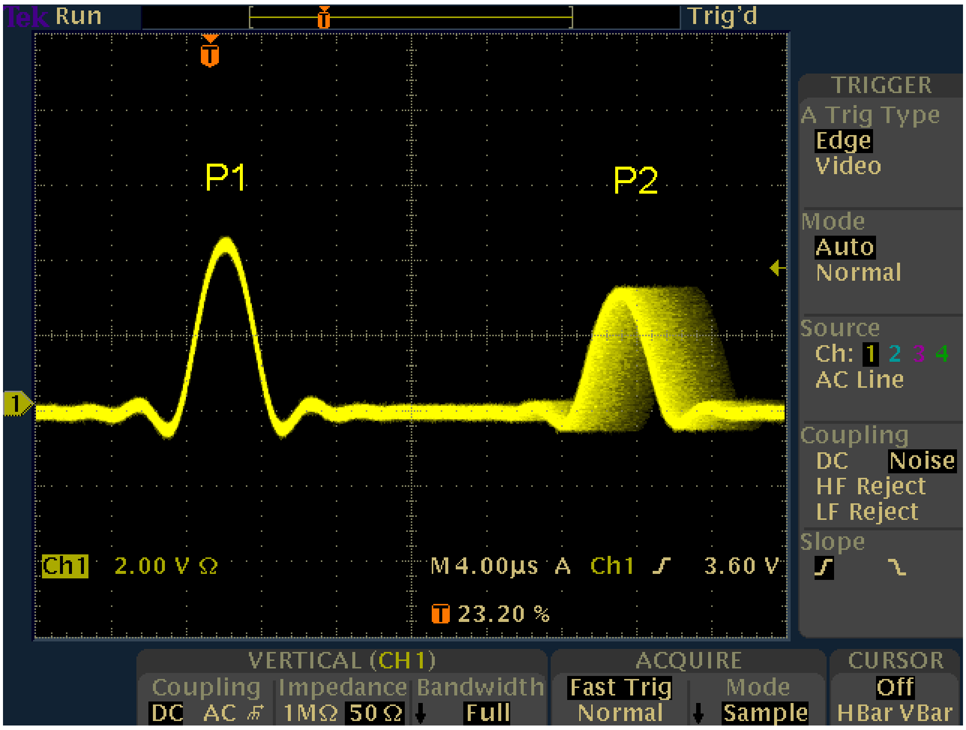
Simulating moving propagation conditions for testing of baseband performance

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

a) select "Configuration > Moving Propagation" and "Moving Channels > One" or
b) select "Standard > 3GPP > 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.

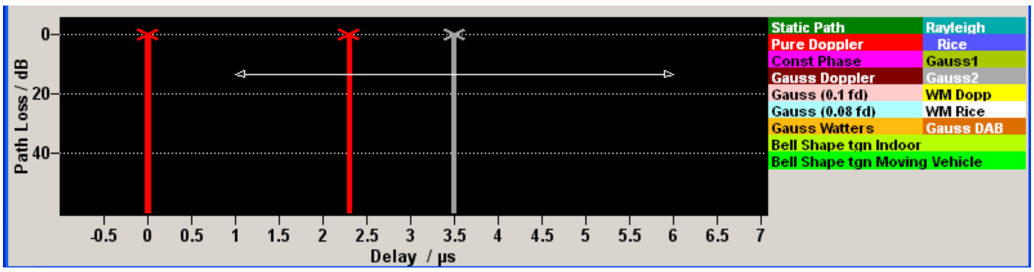
The following figure illustrates a baseband signal with ASK modulation (only one 1 bit, then many 0 bits) which was subjected to moving propagation. Path P1 remains still while path P2 moves in time relative to it. As a result of the luminescence setting on the oscilloscope, the way in which P2 wanders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

$$\Delta\tau_{one} = "Delay" + \frac{"Variation(Pk\,Pk)"}{2} * \sin\frac{2\pi t}{"VariationPeriod"}$$

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

- Variation (Peak-Peak) = A
- Delay = B + A/2
- Variation Period = 2π /Δ ω

The Table 4-3 list the settings required to attain the values proposed in the test case 3GPP TS25.104, annex B3.

Table 4-3: Default parameter values (Moving Propagation)

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

These default values can be changed in the Path Table dialog.

4.7.2 Moving Propagation Conditions for Testing the UL Timing Adjustment Performance

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

Simulating moving propagation conditions

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 > LTE > Moving Propagation > ETU200Hz Moving or Pure Doppler Moving"

The Figure 4-4 illustrates the moving propagation conditions for the test of the UL timing adjustment performance.

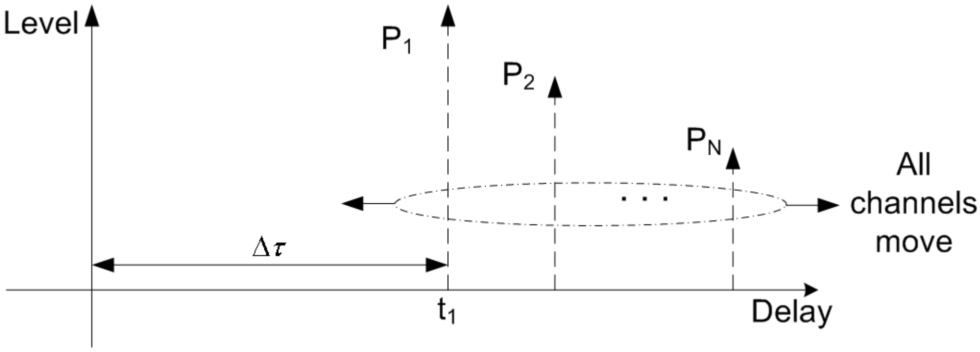


Figure 4-4: Moving Propagation Conditions

Use the parameter "Additional Delay" to configure the relative timing among all paths. The time difference between the reference timing and the first path is according to the following equation:

$$\Delta\tau_{all} = \frac{"Variation(Pk\ Pk)"}{2} * \sin\frac{2\pi t}{"Variation\ Period"}$$

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 fading simulator generates the signals for these scenarios in according to the parameters defined in the 3GPP specification (see table Table 4-4). However, the fading simulator also allows the re-configuration of some of the predefined values.

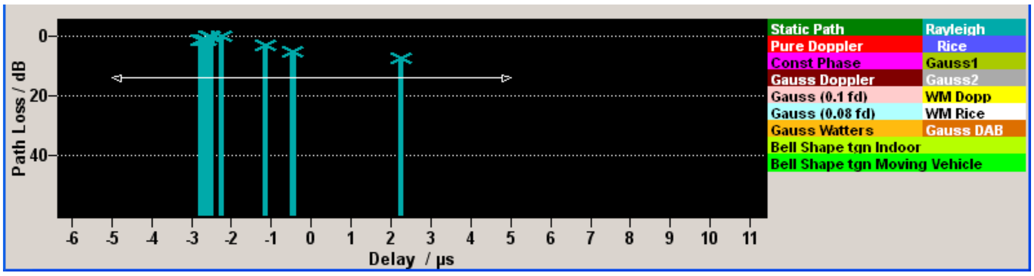
Table 4-4: Default parameter values

Parameter	Scenario 1	Scenario 2
Channel Model	ETU200Hz Moving	Pure Doppler
UE speed	120 km/h	350 km/h
CP length	Normal	Normal
"Variation (Peak-Peak)"	10 µs	10 µs
Δω	0.04 1/s	0.13 1/s
"Variation Period" = 2π/Δω	157.1 s	48.3 s

4.7.2.1 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 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 path groups with three paths each are simulated. All paths move.



The path group 1 has a fixed delay ("Basic Delay = 0 s"); the "Basic Delay" of the other two path groups can be configured. The relative timing among all paths is determined by the parameter "Additional Delay".

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

4.7.2.2 Scenario 2

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

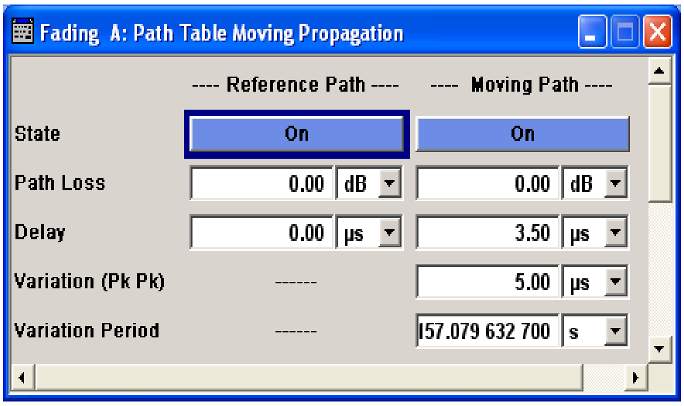
4.7.3 Path Tables Moving Propagation

The parameters available for configuration depend on the selected number of Moving Channels, one or all.

4.7.3.1 One Moving Channel

► To access the settings for configuring the moving and the reference path for the moving propagation with one moving channel, perform on of the following:

a) select "Fading > Standard > 3GPP > Ref. + Mov. Channel"
b) select "Fading > Configuration > Moving Propagation" and "Moving Channels > One".



Reference Path Settings
The following settings are provided:

State ← Reference Path Settings
Activates reference path P1 for moving propagation.

Remote command:
`[:SOURce<hw>]:FSIMulator:MDELay:REFerence:STATe` on page 270

Path Loss ← Reference Path Settings
Enters the loss for the reference path.

Remote command:
`[:SOURce<hw>]:FSIMulator:MDELay:REFerence:LOSS` on page 270

Delay ← Reference Path Settings
Enters the delay for the reference path.

Remote command:
`[:SOURce<hw>]:FSIMulator:MDELay:REFerence:DELay` on page 270

Moving Path Settings
The following settings are provided:

State ← Moving Path Settings
Activates moving fading path P2 for moving propagation.

Remote command:
`[:SOURce<hw>]:FSIMulator:MDELay:MOVing:STATe` on page 269

Path Loss ← Moving Path Settings
Enters the loss for the moving fading path.

Remote command:
`[:SOURce<hw>]:FSIMulator:MDELay:MOVing:LOSS` on page 268

Delay ← Moving Path Settings
Enters the average delay for the moving fading path.

The delay of the moving path slowly varies sinusoidal within the set variation range around this delay.

Remote command:
[:SOURce<hw>]:FSIMulator:MDELay:MOVing:DELay:MEAN on page 268

Variation (Peak-Peak) ← Moving Path Settings
Enters the range for the delay of the moving fading path for moving propagation. The delay of the moving path slowly varies sinusoidal within this range around the set mean delay.

Remote command:
[:SOURce<hw>]:FSIMulator:MDELay:MOVing:DELay:VARiation on page 268

Variation Period ← Moving Path Settings
Period duration for delay variation. A complete variation cycle is passed through in this time.

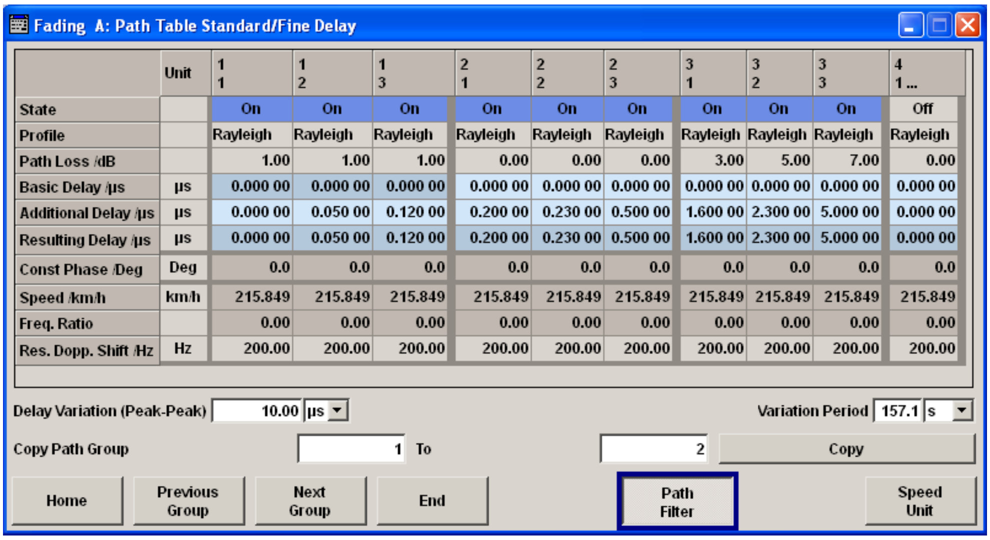
Remote command:
[:SOURce<hw>]:FSIMulator:MDELay:MOVing:VPERiod on page 269

4.7.3.2 All Moving Channels

► To access the settings for configuring the moving path groups and their paths, perform one of the following:

a) select "Fading > Standard > LTE > Moving Propagation > ETU200Hz Moving"
b) select "Fading > Standard > LTE > Moving Propagation > Pure Doppler Moving"
c) select "Fading > Configuration > Moving Propagation" and "Moving Channels > All".

The number and the parameters of the predefined paths depend on the selected scenario.



The most parameters in the "Path Table" correspond to the parameters described in Chapter 4.3, "Path Table", on page 33.

Delay Variation (Peak-Peak)

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 sinusoidal within this range around the set mean delay.

Remote command:
[:SOURce<hw>]:FSIMulator:MDELay:ALL:MOVing:DELay:VARiation
on page 266

Variation Period

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

Remote command:
[:SOURce<hw>]:FSIMulator:MDELay:ALL:MOVing:VPERiod on page 265

4.8 Two Channel Interferer

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.

Each of the fading profiles "Static Path", "Pure Doppler" and "Rayleigh" can be allocated to the two paths.

Predefined Setting

The Table 4-5 and Table 4-6 list the settings required to attain the values proposed in the MediaFlo test case 5 and 6.

Table 4-5: Test Case 5

Reference Path:	"Profile"	Static Path
	"Relative Delay"	10 us
	"Average Power"	-3 dB
	"Fading Type"	Rayleigh, 60 km/h
	"Doppler Spectrum"	Classic 6 dB
	"Static Delay"	40 us
Moving Path:	"Profile"	Hopping
	"Relative Delay"	0/110 us
	"Average Power"	-3 dB
	"Fading Type"	Static

	"Doppler Spectrum"	N/A
	"Dwell Time"	2.9 s

Table 4-6: Test Case 6

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

How to use the provides settings and configure a 2 channel interfering signal

The following are two examples on how to configure a "2 Channel Interferer" conditions. See how to:

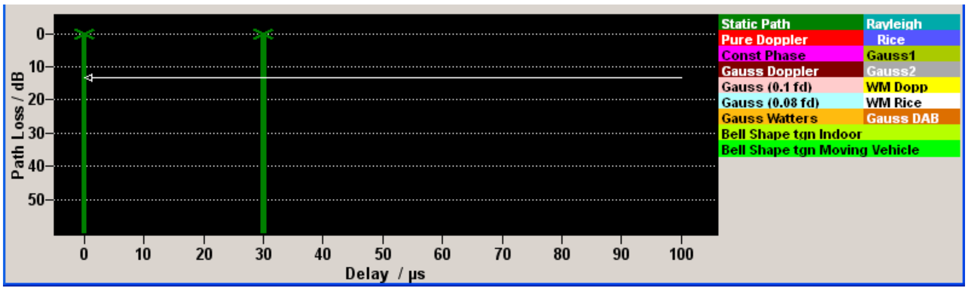
- "To enable a hopped moving mode" on page 63
- "To enable a sliding moving mode" on page 64

To enable a hopped moving mode

Enable a 2 channel interfering signal with the following settings:

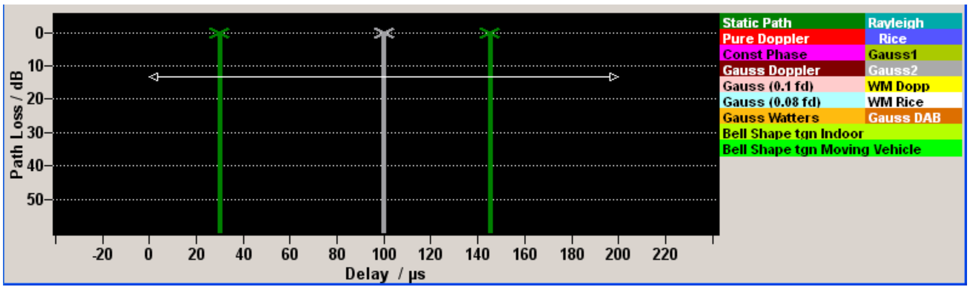
1. Reference Path:
   a) "Delay Min = 30 µs"
   b) "Profile = Static Path"
   c) "Path Loss = 0 dB"
2. Moving Path:
   a) "Delay Min = 0 µs"
   b) "Profile = Static Path"
   c) "Path Loss = 0 dB"
   d) "Delay Max = 100 µs"
   e) "Moving Mode > Hopping"
3. Enable "Reference Path > State > On" and "Moving Path > State > On"
4. Open the "Fading > Path Graph" view.

   The following figure shows the resulting path graph.



To enable a sliding moving mode

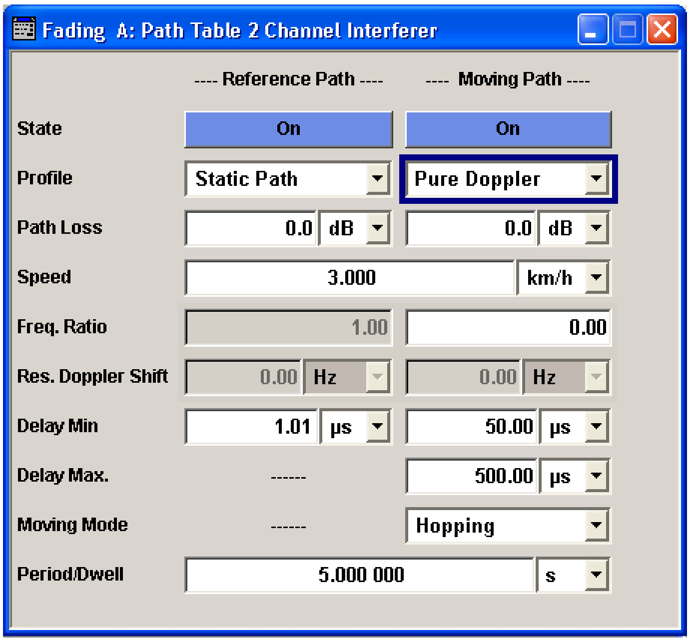
1. Use the settings of "To enable a hopped moving mode" on page 63.
2. Change the "Moving Mode > Sliding".
3. Open the "Fading > Path Graph" view.



The moving path slides from the minimum delay (30 us) to the maximum delay (100 us) and back. The grey bar indicates the mean delay of the moving path. The horizontal arrow indicates the permissible delay range for the moving path.
The displayed position change does not correspond to the actual delay changes of the real signal.

2 Channel Interferer Settings

The Table 4-5 and Table 4-6 list the default values for "2 Channel Interferer" configuration. You can use these default values and/or adjust the provided settings in the fading path table.



State

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

Remote command:
`[:SOURce<hw>]:FSIMulator:TCINterferer[:STATe]` on page 286
`[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:STATe` on page 289

Profile

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

Remote command:
`[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:FDOPpler?` on page 288

Path Loss

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

Remote command:
`[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:LOSS` on page 288

Speed

(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.

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

Remote command:
`[:SOURce<hw>]:FSIMulator:TCINterferer:SPEed` on page 287

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

Remote command:
`[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:FRATio` on page 288

Res. Doppler Shift
Displays the actual Doppler shift.

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

Remote command:
`[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:FDOPpler?` on page 288

Delay Min
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.

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

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

Remote command:
`[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:DELay:MINimum` on page 287

Delay Max (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.

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

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

Remote command:
`[:SOURce<hw>]:FSIMulator:TCINterferer:MOVing:DELay:MAXimum` on page 286

Moving Mode (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.

Remote command:
[:SOURce<hw>]:FSIMulator:TCINterferer:MOVing:MMODe on page 286

Period/Dwell

Enters either the dwell time or the period of a complete cycle for the moving path depending on the selected Moving Mode (Moving Path).

"Moving Mode"	"Period Dwell"
"Sliding"	sets the period for a complete cycle of the moving path
"Hopping"	sets the dwell time of the moving path

The gradient of the delay/period ratio may not fall below 6µs/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 6µs/s, the value for the period is recalculated automatically.

Example:

"Delay Min" = 20 us, "Delay Max" = 120 us, "Moving Mode = Sliding"

[("Delay max" - "Delay min")/2]*2π)/"Period/Dwell" = 6

"Period/Dwell" = 314/6 = 52.36 s

The value cannot be decreased below this value.

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

Remote command:
[:SOURce<hw>]:FSIMulator:TCINterferer:PERiod on page 287

4.9 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 fading simulator generates the signal as a sequence of complete cycles of approach towards to the BS antenna and departure from it.

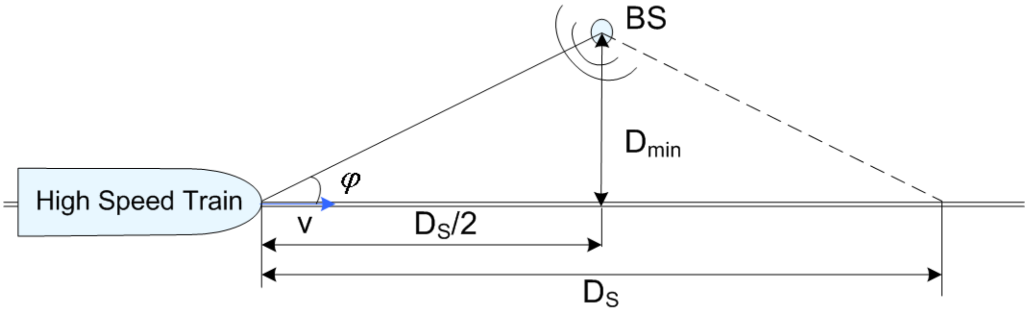


Figure 4-5: High Speed Train Propagation

Three high speed scenarios are defined:

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

4.9.1 Scenario 1 and Scenario 3

For each of the scenarios 1 and 3, 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:

$$f_A(t) = f_D \cos\varphi(t)$$

where $f_A(t)$ is the actial Doppler shift and f_D is the maximum Doppler frequency.

The cosine of angle is given by:

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

where:

- $D_S/2$ is the distance in meters between the train and the BS at the beginning of the simulation
- D_{min} is the minimum distance in meters between the BS and the railway track
- 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.

4.9.2 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 "K (Rician factor)" on page 73).

4.9.3 High Speed Train Scenario Parameters

The Table 4-7 gives an overview of the parameters of the HST test scenarios according to the test case "High speed train conditions".

Table 4-7: 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 Figure 4-6 and Figure 4-7 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.

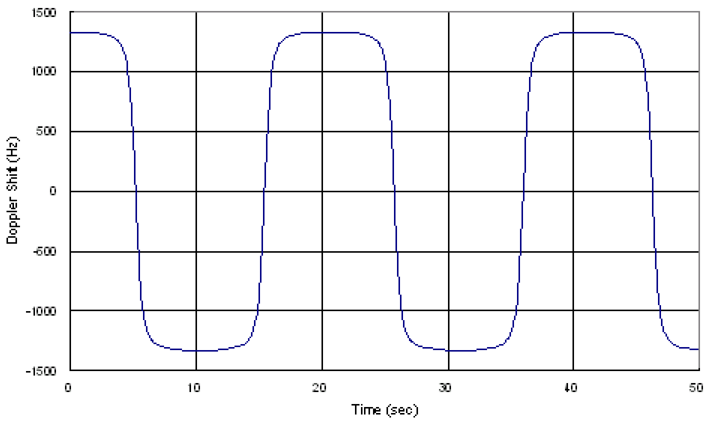


Figure 4-6: Doppler shift trajectory for scenario 1

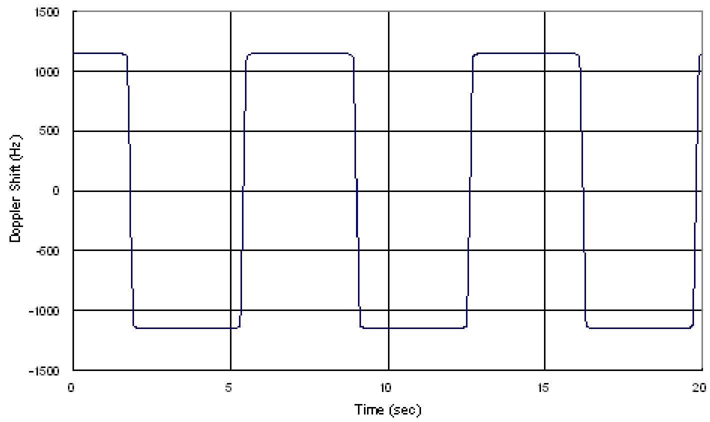


Figure 4-7: Doppler shift trajectory for scenario 3

Doppler shift calculation

The HST scenarios are defined for the UE and for the BS tests. In the fading simulator, the same standards are used for both test cases. Consider however, the following difference in the calculation of the Doppler shift:

- In *HST UE tests*, the resulting Doppler shift is based *only* on the used DL frequency.
- In *HST BS tests*, the DL signal itself already contains a Doppler shift. The UE synchronizes on this shifted DL frequency. The simulated UL signal contains a Doppler shift, too.
  The resulting Doppler shift is than based *on both*, the UL and the DL frequency.

To enable the fading simulator to consider the DL Doppler shift, use the following two parameters:

- Consider DL RF
- Virtual DL RF

General recommendations on performing HST BS tests

The following is a list of the general steps required to enable the fading simulator to generate the signal required for the HST BS tests

1. Set the "RF Frequency" of the instrument to the F_{UL}, as defined in the specification.
   In the R&S AMU, set the parameter "Fading > Virtual RF" to the F_{UL}, as defined in the specification.
2. Enable a high speed train scenario with extension "(DL+UL)" in its name.
3. If not enabled, activate the parameter "Fading > (HST) Path Table > Consider DL RF > On".
4. Set the value of the parameter "Fading > (HST) Path Table > Virtual DL RF" to the F_{DL}, as defined in the specification.

Example: Configuring the fading simulator to generate a HST BS test signal according to 3GPP TS36.104

For frequency Band 1 tests, the specification defines: F_{DL} = 2.14 GHz and F_{UL} = 1.95 GHz. The resulting Doppler shift is F_D = 1140 Hz.

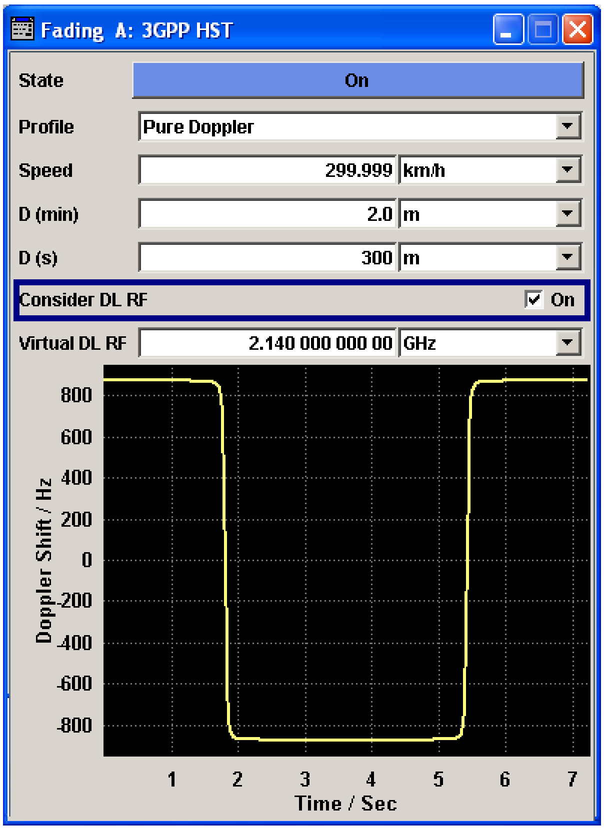
- In the status bar, select "Frequency = F_{UL} = 1.95 GHz"
- Select "Fading A > Fading Settings > Standards" and navigate to the required high speed train scenario "3GPP > High Speed Train > HST 3 Tunnel Multi Antenna (DL +UL)"
- If not enabled, activate the parameter "Fading > Path Table > Consider DL RF > On".
- Select "Fading > Path Table > Virtual DL RF = F_{DL} = 2.14 GHz"
- Select "Fading > Fading Settings > State > On"
- Use the command `[:SOURce<hw>]:FSIMulator:HSTRain:FDOPpler?` to query the resulting Doppler shift.

High Speed Train Scenario Settings

To access these settings:

1. Select "Fading > Fading Settings > Standards".
2. Navigate to the required high speed train scenario, e.g. "3GPP > High Speed Train > HST 3 Tunnel Multi Antenna (DL+UL)"

   The "3GPP HST" dialog displays the default values of the High Speed Train scenarios and allows you to adjust them for further tests.



State

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

Remote command:

[:SOURce<hw>]:FSIMulator:HSTRain:STATe on page 265

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 and scenario 2 as a Rician fading, in this fading simulator you can 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, D (min) and D (S).
Tip: Use the SCPI command [:SOURce<hw>]:FSIMulator:HSTRain:FDOPpler? to query the Doppler frequency shift.

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

"Rice" One Rician fading propagation channel with K (Rician factor) and with one tap is simulated.

Remote command:
[:SOURce<hw>]:FSIMulator:HSTRain:PROFile on page 263

Speed

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

Remote command:
[:SOURce<hw>]:FSIMulator:HSTRain:SPEed on page 262

D (min)

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

Remote command:
[:SOURce<hw>]:FSIMulator:HSTRain:DISTance:MINimum on page 262

D (S)

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.

Remote command:
[:SOURce<hw>]:FSIMulator:HSTRain:DISTance:STARt on page 262

K (Rician factor)

For scenario 2, sets the Rician factor K that is defined as the ratio between the dominant signal power and the variant of the other weaker signals.

Remote command:
[:SOURce<hw>]:FSIMulator:HSTRain:KFACtor on page 264

Consider DL RF

Enables the selection of virtual downlink frequency (DL RF).

By default, this parameter is enabled for the HST (DL+UL) standards. For detailed description, see "Doppler shift calculation" on page 70.

Note: While performing HST BS tests and "Consider DL RF > Off", the DL Doppler shift is not considered by the calculation of the UL Doppler shift.

Remote command:
[:SOURce<hw>]:FSIMulator:HSTRain:DOWNlink:FREQuency:STATe
on page 264

Virtual DL RF

Sets the virtual downlink frequency. For HST BS tests, enter the F_{DL} defined in the specification. The value is used by the calculation of the UL Doppler shift.

For detailed description, see "Doppler shift calculation" on page 70

Remote command:
[:SOURce<hw>]:FSIMulator:HSTRain:DOWNlink:FREQuency on page 264

4.10 Dynamic Scenario Simulation

The simulation of dynamic fading scenarios is enabled only for instruments equipped with option R&S SMx/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.

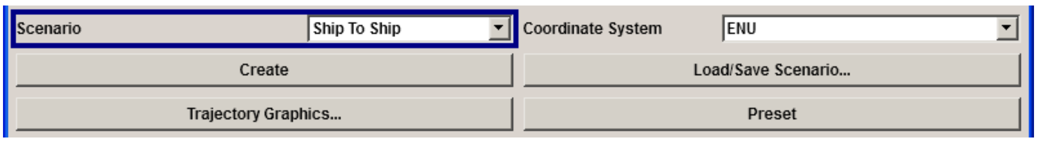
The simulation of the fading conditions caused by more complex dynamic scenarios and movements is provided by the User Defined scenario. In this mode, the vehicle parameters and the trajectory of both the transmitter and the receiver are enabled for configuration. The firmware provides an interface for loading of trajectory description files with predefined file formats, as well as the possibility to describe a trajectory by means of waypoints table.

4.10.1 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 4.10.4, "User Defined Scenario Settings", on page 83.
"Ship To Ship"	Enables a fading scenario with moving receiver and transmitter, see Chapter 4.10.2, "Ship To Ship Settings", on page 77.
"Tower To Aircraft"	Enables the simulation of the channel between a tower and an aircraft, see Chapter 4.10.3, "Tower To Aircraft Settings", on page 79.

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:SCENario` on page 290

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°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°`, where "+" indicates North and East and "-" indicates South and West.

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:CFORmat` on page 290

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 4.10.6, "File Management and File Formats", on page 92 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.

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:CREate` on page 290

Load/Save Scenario

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

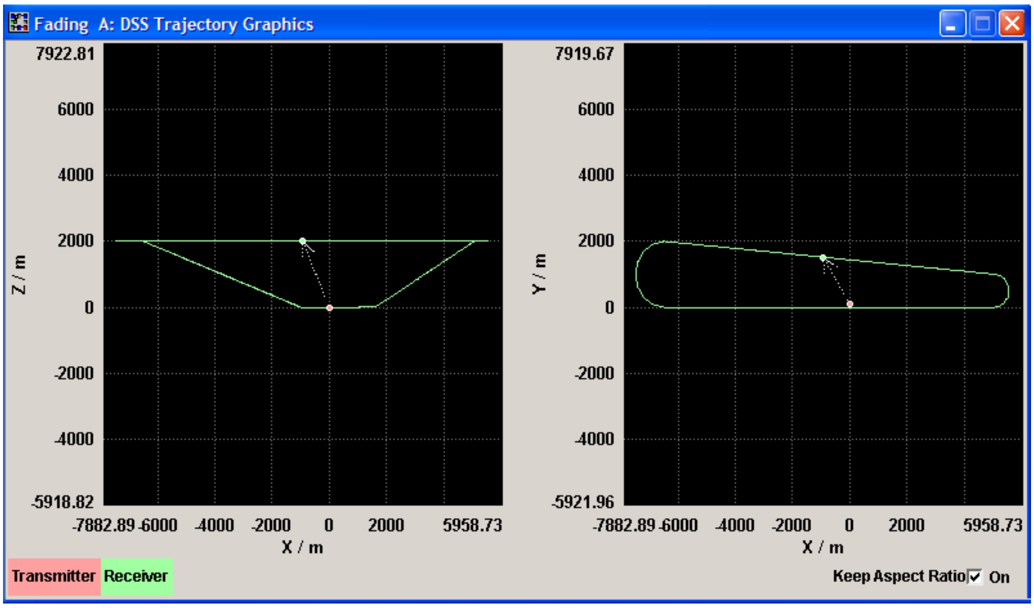
Refer to Chapter 4.10.6, "File Management and File Formats", on page 92 for detailed information.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:SAVE on page 290
[:SOURce<hw>]:FSIMulator:DSSimulation:CATalog? on page 291
[:SOURce<hw>]:FSIMulator:DSSimulation:LOAD on page 291

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).

Remote command:
n.a.

Preset

Presets the scenario simulation settings to the their default values.

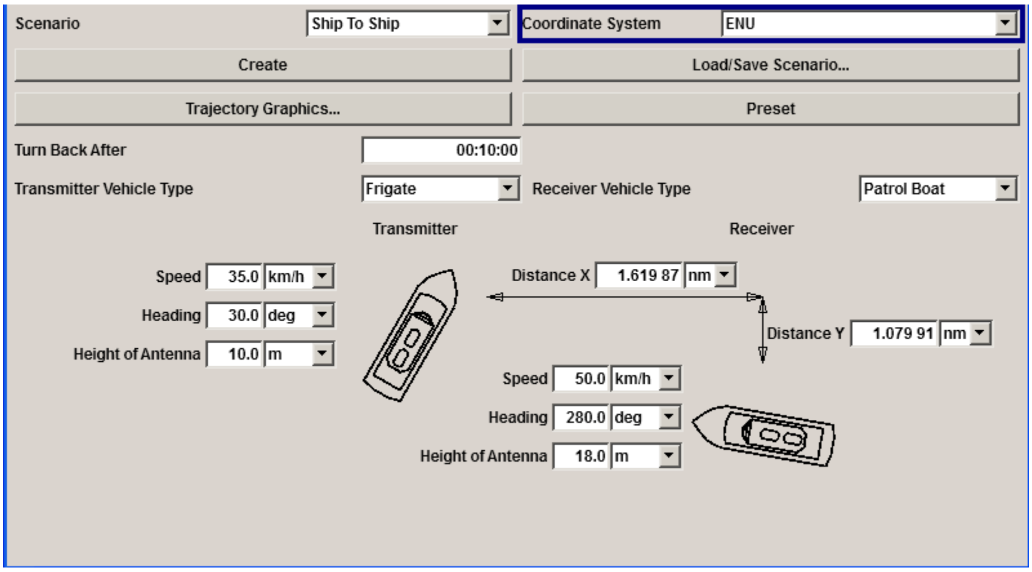
Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:PRESet
on page 291
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:PRESet
on page 291

4.10.2 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 4.10.5, "Calculation of the Waypoints", on page 88 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.

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:TTIMe` on page 292

Transmitter/Receiver Vehicle Type

Selects the vehicle type.

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:TX:TYPE`
on page 292
`[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:RX:TYPE`
on page 292

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.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:XDIStance on page 293
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:YDIStance on page 293

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.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:RX:COORdinates:DMS on page 294
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:TX:COORdinates:DMS on page 294
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:RX:COORdinates[:DECimal] on page 295
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:TX:COORdinates[:DECimal] on page 295

Speed
Sets the transmitter/receiver speed.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:RX:SPEed on page 292
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:TX:SPEed on page 292

Heading
Defines the direction in that the corresponding ship is moving.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:RX:HEADing on page 293
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:TX:HEADing on page 293

Height of Antenna
Defines the height of the corresponding antenna.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:RX:ANTenna:HEIGht on page 293
[:SOURce<hw>]:FSIMulator:DSSimulation:SHIPtoship:TX:ANTenna:HEIGht on page 293

4.10.3 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 representation. 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.

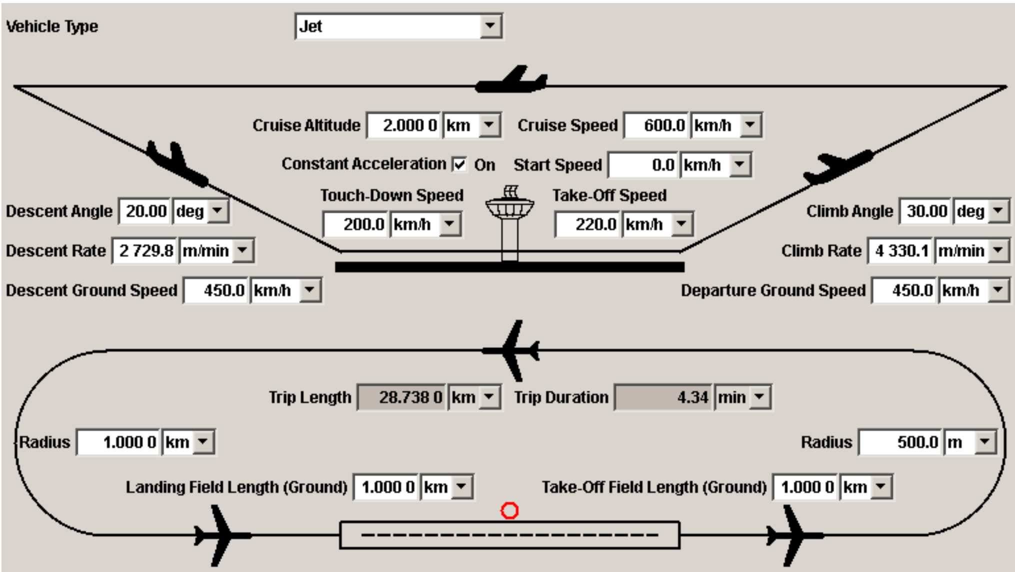
This realization uses a simplified phase model to describe the flight. The Table 4-8 gives an overview of the flight phases, short description of each of them with reference to the associated waypoints (Figure 4-8) and list of the related parameters.

Table 4-8: Flight phases

Flight phase	Description	Related parameters
Taxiing	A movement along the ground Waypoints: P0-P1	• Start Speed
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	• Take-Off Speed (rotation speed) • Take-Off Field Length (Ground) • Constant Acceleration
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	• Climb Angle • Climb Rate • Departure Ground Speed
Cruise	Cruise is the phase between ascent and descent, i.e. the actual fight phase. Waypoints: P3-P20	• Cruise Speed • Cruise Altitude • "Left/Right Turn Radius"
Descent	The descent is the opposite of climb, i.e. is the phase an aircraft decreases its altitude Waypoints: P20-P21	• Descent Angle • Descent Rate • Descent Ground Speed

Flight phase	Description	Related parameters
Landing	The final phase of the flight during which the aircraft returns to the ground. Waypoints: P21-P0	• Touch-Down Speed • Landing Field Length (Ground)
Flight	Denotes the summary of all phases.	• Trip Length • Trip Duration

Refer to Chapter 4.10.5.3, "Waypoints in the Tower to Aircraft Scenario", on page 90 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/decent rates, i.e. the maximum value of the parameters in the dialog.

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:TYPE` on page 296

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).

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:STARt`
on page 296

Take-Off Speed

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

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:TAKeoff
on page 296

Take-Off Field Length (Ground)
Sets the length of the runway used during the take-off phase S_{RWTO}.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:FLENgth:TAKeoff
on page 299

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

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:CACCeleration
on page 297

Climb Angle
Sets the angle of ascent during the climb out phase φ_C.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:ANGLe:CLIMb
on page 297

Climb Rate
Sets the climb rate v_{CA}.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:RATE:CLIMb
on page 297

Departure Ground Speed
Sets the grogung speed v_{CGND} during the climbing out phase.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:DEParture
on page 297

Cruise Speed
Sets the speed during the cruise phase v_{GC}.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:CRUise
on page 298

Cruise Altitude
Defines the aircraft's altitude during the cruise phase.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:ALTitude:CRUise
on page 298

Radius

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

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:RADius:LTURn
on page 300
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:RADius:RTURn
on page 300

Descent Angle

Sets the angle during the descent phase φ_D.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:ANGLe:DESCent
on page 298

Descent Rate

Sets the decent rate v_D.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:RATE:DESCent
on page 299

Descent Ground Speed

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

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:DESCent
on page 299

Touch-Down Speed

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

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:TOUChdown
on page 300

Landing Field Length (Ground)

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

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:FLENgth:LANDing
on page 299

Trip Length

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

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:TRIP:LENGth?
on page 300

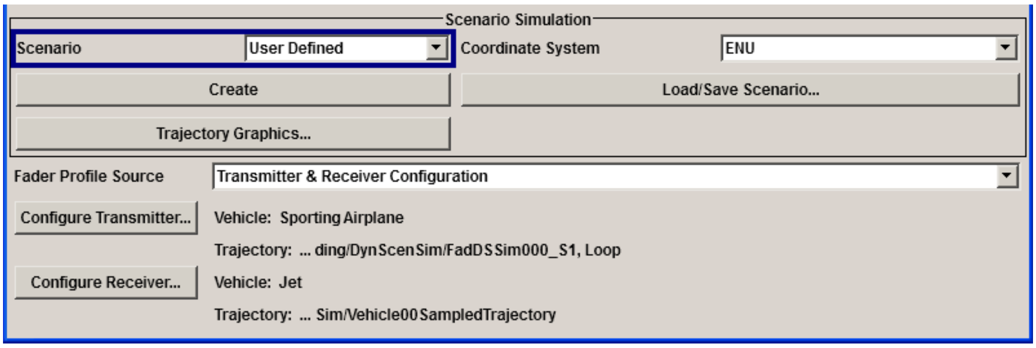
Trip Duration

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

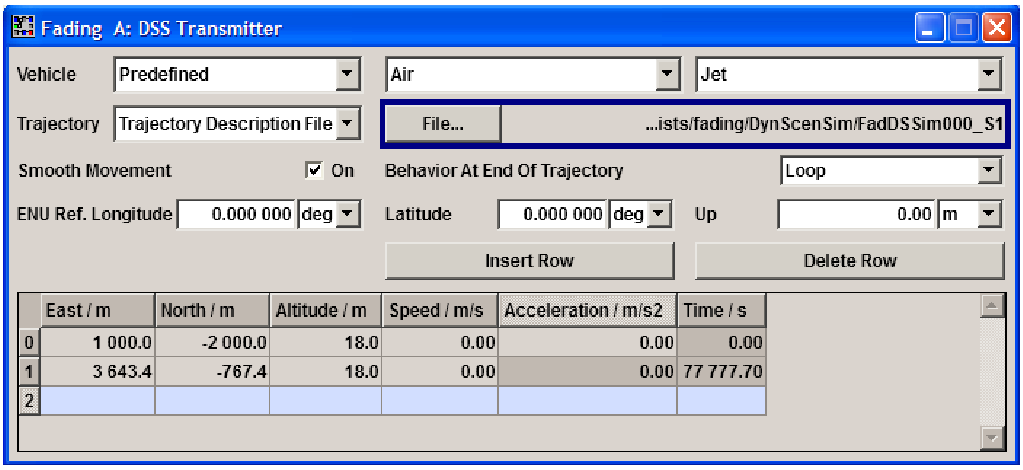
Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:TRIP:DURation?
on page 300

4.10.4 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 4.10.4.2, "Transmitter and Receiver Configuration", on page 84.



4.10.4.1 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 Chapter 4.10.6.4, "Time, Propagation Delay, Attenuation File Format (TPA)", on page 97 for description of the file format.

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TPA:CATalog?` on page 303
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TPA:SELect` on page 304

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

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:PROFile:SOURce` on page 302
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:PROFile:CATalog?` on page 303
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:PROFile:SELect` on page 304

4.10.4.2 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 Limits" No vehicle is selected

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

Table 4-9: Predefined vehicle types

Category	Vehicle Type
Air	As in the "Tower to Aircraft" scenario • Jet • UAV • Transport Aircraft • Airliner • Sporting Airplane • Helicopter
Land	• Car • Train • Bicycle • Pedestrian
Water	As in the "Ship to Ship" scenario • Frigate • Patrol Boat • Aircraft Carrier

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:VEHicle:PREDefined:CATegory on page 303
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:VEHicle:PREDefined:TYPE on page 303
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:VEHicle:PREDefined:CATegory on page 303
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:VEHicle:PREDefined:TYPE on page 303

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

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:VEHicle:USER:CATalog? on page 304
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:VEHicle:USER:SELect on page 304
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:VEHicle:USER:CATalog? on page 304
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:VEHicle:USER:SELect on page 304

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:VEHicle:MODE on page 302
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:VEHicle:MODE on page 302

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 Coordinate System, the coordinates are set as Attitude, Latitude and Longitude or as Altitude, X, Y (see "Altitude/X/Y/Latitude/Longitude" on page 86).

"Trajectory Description File" Enables moving transmitter/receiver; the trajectory is described by the selected `*.xtd` file.
The Waypoints Table 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.

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:TDF:CATalog?` on page 304
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:TDF:SELect` on page 304
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:TDF:CATalog?` on page 304
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:TDF:SELect` on page 304

"AGI STK Ephemeris File (*.e)" Enables moving transmitter/receiver; the trajectory is described by the selected `*.e` file.
Refer to Chapter 4.10.6.3, "AGI STK Ephemeris File Format", on page 96 for description of the file format.

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:EPHemeris:CATalog?` on page 303
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:EPHemeris:SELect` on page 304
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:EPHemeris:CATalog?` on page 303
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:EPHemeris:SELect` on page 304

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory` on page 303
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory` on page 303

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.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:FAPoint:COORdinates:XYZ on page 306
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:FAPoint:COORdinates:XYZ on page 306
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:FAPoint:COORdinates:DMS on page 304
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:FAPoint:COORdinates:DMS on page 304
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:FAPoint:COORdinates[:DECimal] on page 306
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:FAPoint:COORdinates[:DECimal] on page 306

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.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:TDF:MACCeleration:STATe on page 307
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:TDF:MACCeleration:STATe on page 307

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 possibilities 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.

Remote command:
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:TDF:EBEHavior on page 307
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:TDF:EBEHavior on page 307

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>.

Remote command:
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:TDF:ENU:COORdinates[:DECimal]` on page 307
`[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:TDF:ENU:COORdinates[:DECimal]` on page 307

Keep Fixed
For two consecutive waypoints $P_n(x,y,z)$ and $P_{-1}(x,y,z)$, 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.

Remote command:
n.a

Insert/Delete Row
Adds/removes a waypoint.

Remote 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.

Remote command:
n.a

4.10.5 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.

4.10.5.1 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* = Speed; after elapsing the selected time *t* = Turn Back After, both ships are returning to the initial start position/waypoint.

For time t="Turn Back After" and φ = Heading, the coordinates of both ships are calculated according to the formulas in Table 4-10.

Table 4-10: Calculation of the waypoints in the ENU coordinate system

	Initial waypoint	Further waypoint
Ship#1	$\vec{P}_0 = \begin{pmatrix} 0 \\ 0 \\ h_0 \end{pmatrix}$	$\vec{P}_1 = \vec{P}_0 + \begin{pmatrix} \sin\varphi_0.\upsilon_0.t \\ \cos\varphi_0.\upsilon_0.t \\ 0 \end{pmatrix}$
Ship#2	$\vec{P}_0 = \begin{pmatrix} d_x \\ -d_y \\ h_1 \end{pmatrix}$	$\vec{P}_1 = \vec{P}_0 + \begin{pmatrix} \sin\varphi_1.\upsilon_1.t \\ \cos\varphi_1.\upsilon_1.t \\ 0 \end{pmatrix}$

4.10.5.2 Waypoints in Geodetic Coordinate System

In geodetic coordinates, the location coordinates are described with three coordinates, latitude (Φ), longitude (λ) 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 α 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* = Speed; after elapsing the selected time *t* = 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:

$S_{AB} = v*t$

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

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

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

If the coordinates of the initial position A are known (Φ_A, λ_A), the coordinates of the destination point B (Φ_B, λ_B) are calculated as follow:

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

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

4.10.5.3 Waypoints in the Tower to Aircraft Scenario

In this scenario, a set of 22 waypoints is sufficient to describe the flight trajectory (see Figure 4-8). The x, y and z axes are interpreted as ENU coordinates.

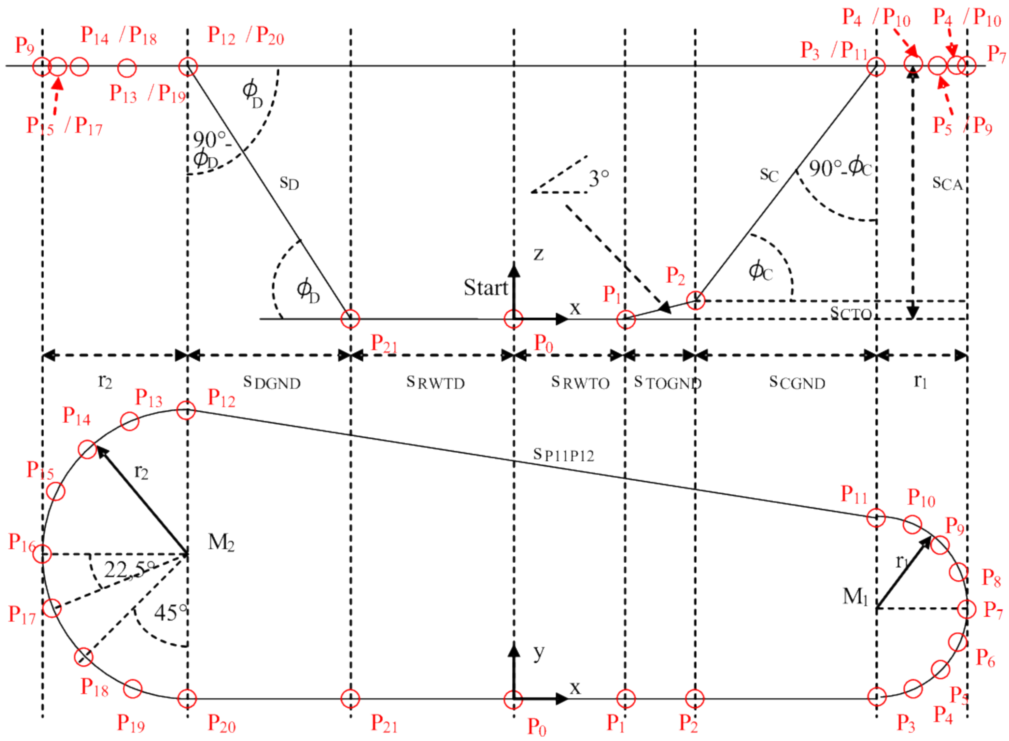


Figure 4-8: Trajectory in the tower to aircraft scenario

P_0-P_{20}	= Waypoints
φ_C, φ_D	= climb/descent angle
S_{CTO}	= climb take-off length
S_{CA}	= climb altitude
S_C, S_D	= climb/descent length
S_{CGND}, S_{DGND}	= 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:

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

where φ 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

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

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

- Waypoints

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

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

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

$$\vec{P}_8 = \vec{P}_3 + \begin{pmatrix} \cos 22{,}5°.r_1 \\ r_1 + \sin 22{,}5°.r_1 \\ 0 \end{pmatrix}; \vec{P}_9 = \vec{P}_3 + \begin{pmatrix} \cos 45°.r_1 \\ r_1 + \sin 45°.r_1 \\ 0 \end{pmatrix}; \vec{P}_{10} = \vec{P}_3 + \begin{pmatrix} \cos 67{,}5°.r_1 \\ r_1 + \sin 67{,}5°.r_1 \\ 0 \end{pmatrix}$$

$$\vec{P}_{11} = \vec{P}_3 + \begin{pmatrix} 0 \\ 2r_1 \\ 0 \end{pmatrix}; \vec{P}_{12} = \vec{P}_{20} + \begin{pmatrix} 0 \\ 2r_2 \\ 0 \end{pmatrix}$$

$$\vec{P}_{13} = \vec{P}_{20} + \begin{pmatrix} -\sin 22{,}5°.r_2 \\ r_1 + \cos 22{,}5°.r_2 \\ 0 \end{pmatrix}; \vec{P}_{14} = \vec{P}_{20} + \begin{pmatrix} -\sin 45°.r_2 \\ r_1 + \cos 45°.r_2 \\ 0 \end{pmatrix}; \vec{P}_{15} = \vec{P}_{20} + \begin{pmatrix} -\sin 67{,}5°.r_2 \\ r_1 + \cos 67{,}5°.r_2 \\ 0 \end{pmatrix}$$

$$\vec{P}_{16} = \vec{P}_{20} + \begin{pmatrix} -r_2 \\ r_2 \\ 0 \end{pmatrix}$$

$$\vec{P}_{17} = \vec{P}_{20} + \begin{pmatrix} -\cos 22{,}5°.r_2 \\ r_1 - \sin 22{,}5°.r_2 \\ 0 \end{pmatrix}; \vec{P}_{18} = \vec{P}_{20} + \begin{pmatrix} -\cos 45°.r_2 \\ r_1 - \sin 45°.r_2 \\ 0 \end{pmatrix}; \vec{P}_{19} = \vec{P}_{20} + \begin{pmatrix} -\cos 67{,}5°.r_2 \\ r_1 - \sin 67{,}5°.r_2 \\ 0 \end{pmatrix}$$

$$\vec{P}_{20} = \begin{pmatrix} -S_{RWTD} - S_{DGND} \\ 0 \\ S_{CA} \end{pmatrix}; \quad \vec{P}_{21} = \begin{pmatrix} -S_{RWTD} \\ 0 \\ 0 \end{pmatrix}$$

- Speed

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

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

4.10.6 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 4-9 is a rough illustration of the file management concept.

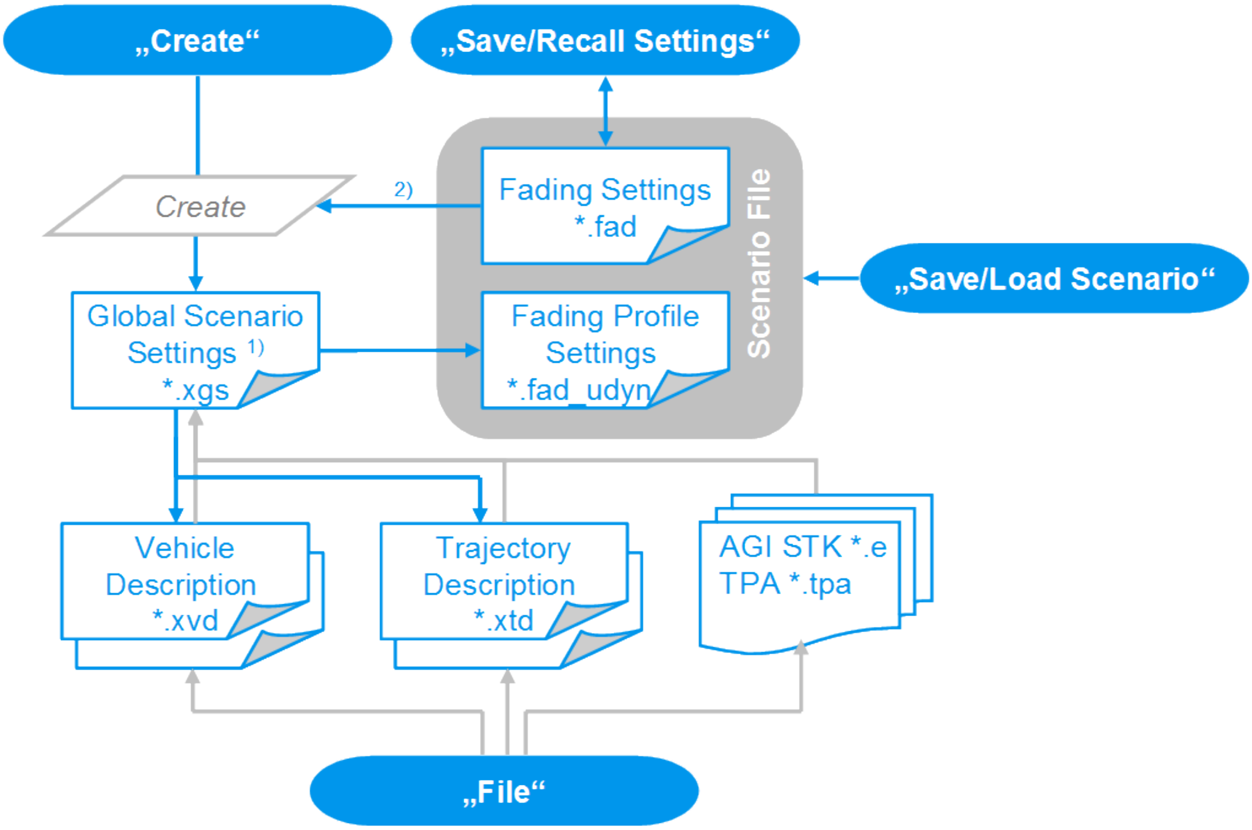


Figure 4-9: Dynamic scenario simulation file management

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 compete 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 4-11 gives an overview.

Table 4-11: File formats

File	File extension	Description
Scenario Files		The generation of the scenario file is triggered by the Load/Save Scenario function. The file name is user definable. The scenario file contains user data and bundles up the two files, the `*.fad` and the `*.fad_udyn` file associated with one particular scenario. **Tip:** 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.
Save/Recall Settings	`*.fad`	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. Files created with this function can be reloaded at any further moment. With "Fading > State > 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. 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 Create function.
Fader Profile	`*.fad_udyn`	The fader profile file is created whenever the Create function is triggered, internally or manually, and contains all the scenario related settings without the settings associated with the fading simulator itself.
Vehicle Description	`*.xvd`	The `*.xvd` file contains description of a vehicle as list of its significant parameters and their allowed maximum values. The currently selected `*.xvd` file or the vehicle related settings are considered only and whenever the Create function is triggered. See Chapter 4.10.6.1, "Vehicle Description files", on page 95 for description of the file format.
Trajectory Description	`*.xtd`	The files contains the description of the movement profile of a vehicle. The currently selected `*.xtd` file or the tajectory related settings are considered only and whenever the Create function is triggered. See Chapter 4.10.6.2, "Trajectory Description Files", on page 95 for description of the file format.

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\`.

4.10.6.1 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 4-12 describes the used tags and parameters.

Table 4-12: Format of *.xvd file

Container	Tag name	Parameter	Description
<info>			
	<name>		Vehicle name
<limits>			
	<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)
		<serviceceil-ing>	Maximal operating altitude (for aircrafts)
		<maxrange>	Maximal range of coverage

4.10.6.2 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 accel="0" coord="0,0,18" time="0" veloc=""/>
        <enupoint accel="0" coord="5.59222e-10,-1800,18" time="60" veloc=""/>
    </waypoints>
</trajectory>
```

The Table 4-13 describes the used tags and parameters.

Table 4-13: 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 sec
<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>	<accel>	Constant linear acceleration in m/s^2. The value applies from the current waypoint on and is calculated upon the `<time>` and `<veloc>` parameters.
		<coord>	Coordinates of the waypoint in the corresponding format, defined with the tag
		<time>	Absolute time (in sec.) the waypoint is passed trough; the value should be equal to or smaller than the `<duration>`
		<veloc>	Speed at the waypoint

4.10.6.3 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.

4.10.6.4 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
```

4.11 Insertion Loss Configuration, Coupled Parameters and Global Fader Coupling

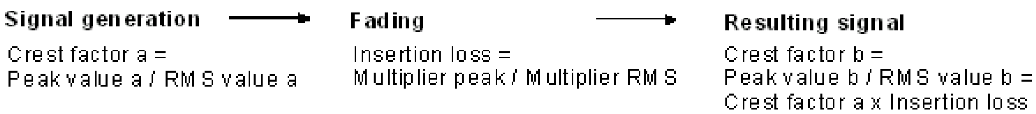
The fading process increases the crest factor of the signal, and this increase must be considered in the drive at the baseband level. Especially when multiple paths are superimposed or in case of statistical influences on a path, an insertion loss is required to provide a drive reserve. If the full drive level is reached nevertheless, the I/Q signals are limited to the maximum available level (clipping).

This section describes the setting, provided to control of the insertion loss and to simplify the operation in dual-channel fading.

Impact of the Fading Simulator on the Crest Factor of the Signal

The crest factor is a figure that measures the difference in level between the peak envelope power (PEP) and average power value (RMS) in dB. Hence, either increasing the peak value or decreasing the RMS value results in a higher crest factor. In this implementation, the instrument keeps the peak value as close as possible to the full drive level (multiplier peak > 1) but the fading simulator reduces the RMS value by the additional crest factor due to fading (multiplier RMS < 1). The ratio of these two multipliers is a value, known as the *insertion loss*.

The instrument derives the crest factor of the signal at the output of the fading simulator based on the crest factor of the signal at the input of the "Fading" block and the insertion loss.



Overview of the provided modes and the main differences between them

In the R&S SMU/AMU, the used insertion loss is not a fixed value but is dynamically adjusted for different measurement tasks. For any of the predefined standards/test cases, the instrument selects an optimal range for the insertion loss. In a user-defined fading configuration, you define the way the range for insertion loss is determined.

From the following available modes, select the one most fitting to your application:

- "Normal"
  In this mode, the instrument calculates the required insertion loss value in a way, that a full drive is permitted, i.e the signal is not clipped at the maximum level.
  The mode results in a very high signal quality, but the RMS level is lower than the maximum possible level. Adjacent channel power (ACP) measurements, however, require a higher dynamic range and a lower insertion loss.
- "Low ACP"
  In this mode, the instrument outputs the signal with a higher level relative to the maximum drive, i.e. greater S/N ratio. However, this mode decreases the signal quality because of a higher percentage of clipping.
  It is recommended that you enable this mode only for fading paths with Rayleigh profile, as only this profile ensures a statistical distribution of level fluctuation. The

other fading profiles are characterized by a non-statistical level fluctuations and a "Low ACP" mode leads to an enormous increase of clipping.
Irrespectively of the selected fading profile, you still can and have to monitor the percentage of clipped samples.

- "User"
  This mode relays on a manually defined value. Depending on you particular application, you can find a favorable insertion loss configuration with the desired signal dynamic range and acceptable clipping rate.

Regardless of the selected mode and the path loss settings, the instrument adjust the insertion loss within this range to keep the output power constant. However, the maximum available output power of the R&S SMU/AMU is reduced by up to 18 dB.

Prerequisites for correct insertion loss adaptation

For correct automatic adaptation of the insertion loss, the processes involved in the fading simulation, i.e. the paths among themselves as well as the paths relative to the input signal, have to be *statistically independent* of each other. 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. A correlation requires, that you measure the level again and manually corrected it, e.g. by enabling of a suitable level offset.

The following are two examples explaining the possible reasons for correlation.

Example: Correlated processes resulting from the used modulation signal and the selected fading configuration

The instrument is configured to generate a QPSK signal with a symbol rate of 1 Msymb/s is generated and the PRBS 9 sequence as the data source.

Enabled is a fading configuration, consisting of two paths with a Rayleigh profile, identical speed and a resulting delay of 0 us and 1 us, respectively.

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 (PRBS 9) to the adjacent symbol is not equal to 0. The fading process is therefore statistically not independent of the process of generating the modulation signal. The automatic calculation of the insertion loss is not correct.

Example: Correlated processes within the fading simulator

Enabled is a fading configuration, consisting of two paths with a pure Doppler profile and a resulting Doppler shift of 100 Hz. The start phases of the two paths differ.

This causes super impositions, which in the worst case (e.g. with a phase setting of 0° and 180°) may lead to the deletion of the signal; automatic calculation of the insertion loss is not possible.

The related settings are summarized in dialog "Fading > Insertion Loss Configuration", see Chapter 4.11.1, "Insertion Loss Configuration Settings", on page 100.

Coupling Fading Parameters

The menu for setting the coupled parameters of the two faders A and B 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.

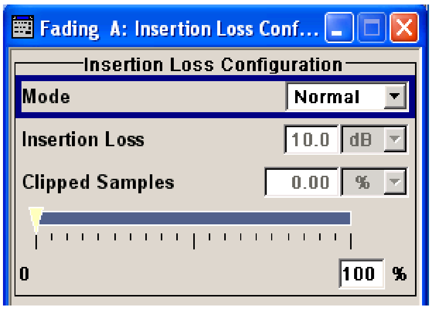
The option of coupling certain parameters is offered in order to simplify operation during dual-channel fading.

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 "Fading A > Coupled Parameters A => B" or "Fading B > Coupled Parameters B => A", see Chapter 4.11.2, "Coupled Parameters and Global Fader Coupling Settings", on page 101.

4.11.1 Insertion Loss Configuration Settings

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



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 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.
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.

Remote command:
`[:SOURce<hw>]:FSIMulator:ILOSs:MODE` on page 223

Insertion Loss

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

Entry of the insertion loss in "User" mode.

Remote command:
`[:SOURce<hw>]:FSIMulator:ILOSs[:LOSS]` on page 224

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).

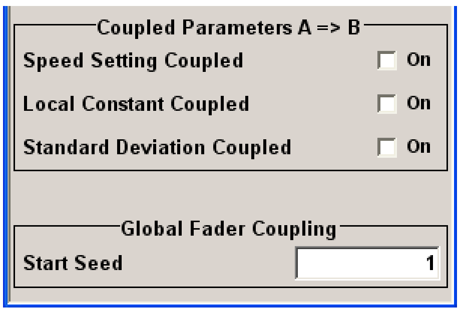
Remote command:
`[:SOURce<hw>]:FSIMulator:ILOSs:CSAMples?` on page 223

0 ... 100 %

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

4.11.2 Coupled Parameters and Global Fader Coupling Settings

The menu for setting the coupled parameters of the two faders A and B is called up in the "Fading" menu.



Coupled Parameters

The menu for setting the coupled parameters of the two faders A and B 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.

Speed Setting Coupled ← Coupled Parameters
Sets the speed of the paths for both faders. The parameter Common Speed For All Paths is also coupled.

Remote command:
[:SOURce<hw>]:FSIMulator:COUPle:SPEed on page 239

Local Constant Coupled ← Coupled Parameters
With lognormal fading, the parameter Local Constant is coupled for the paths of both faders.

Remote command:
[:SOURce<hw>]:FSIMulator:COUPle:LOGNormal:LCONstant on page 238

Standard Deviation Coupled ← Coupled Parameters
With lognormal fading, the parameter Standard Deviation is coupled for the paths of both faders.

Remote command:
[:SOURce<hw>]:FSIMulator:COUPle:LOGNormal:CSTD on page 238

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

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

Remote command:
[:SOURce<hw>]:FSIMulator:GLOBal:SEED on page 221

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.

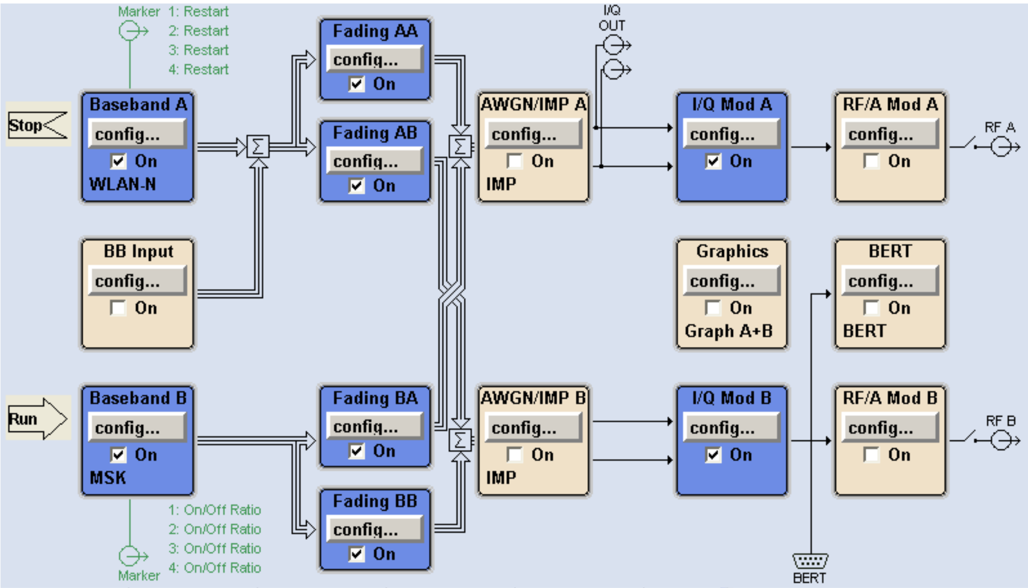
The benefits of an MIMO system became visible only if the data signal is tested in a fading simulation. The MIMO fading option takes account to this special form of multi-path propagation in channel simulation.

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 MIMO (Multiple Input Multiple Output) Fading option (R&S SMx/AMU-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 104 for information about how to enable two instruments 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 differ-ently, 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 MIMO Fading option (R&S SMx/AMU-K74) enables the simulation of 1x2, 2x1 and 2x2 MIMO receiver tests scenarios with one single instrument.

Two R&S SMU/AMU are required for the simulation of 2x3, 2x4, 4x2 and 3x2 MIMO modes. To enable the instrument 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).

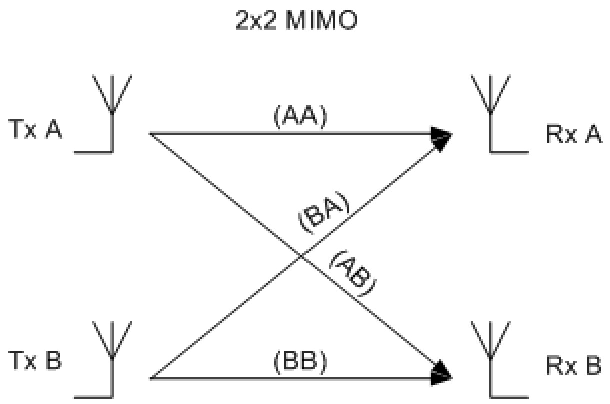


Figure 5-1: 2x2 MIMO system

The following table gives an overview of the instruments 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	R&S SMx/AMU-B14/-B15/-K74	-
Up to 6 GHz	1x R&S AMU + 1x R&S SMATE		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.

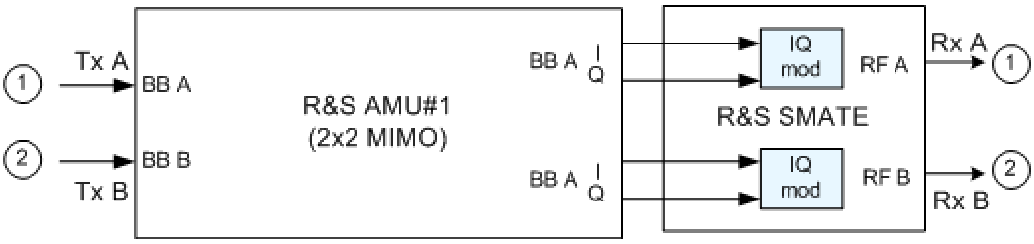


Figure 5-2: 2x2 MIMO up to 6GHz with two R&S AMUs and one R&S SMATE

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 SMU/AMU, 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.

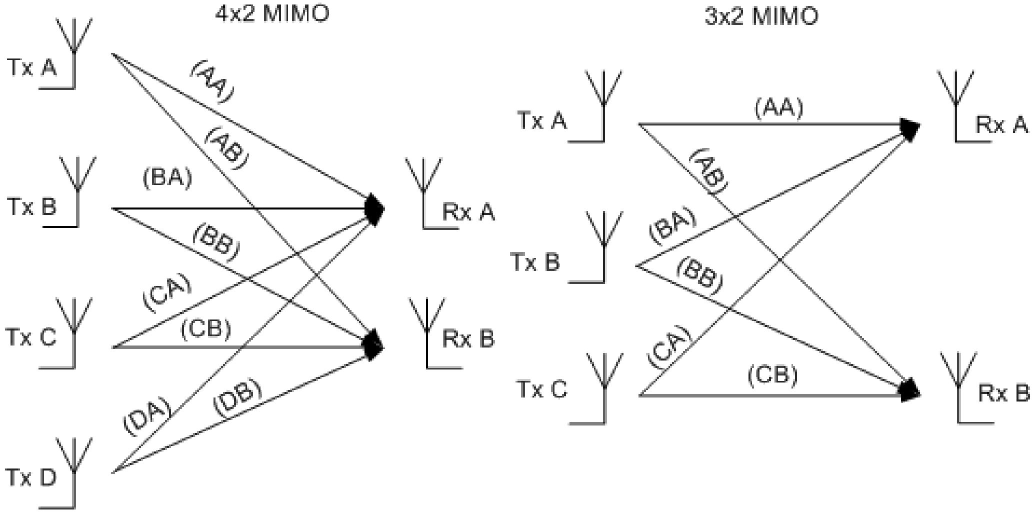


Figure 5-3: 4x2 MIMO and 3x2 MIMO systems

The following table gives an overview of the instruments and options required for the simulation of 4x2 and 3x2 MIMO system.

Table 5-3: Prerequisites for 4x2 and 3x2 MIMO simulation

Frequency	Instrument	Options	Additional Equipment
Up to 3 GHz	2x R&S SMU	R&S SMx/AMU-B14/-B15/-K74 per instrument	• Connecting cables with the same length and type • 2x standard RF Combiner • External Trigger Source • External Ref. Frequency Source (optional)
Up to 6 GH	2x R&S AMU + 1x R&S SMATE		• Connecting cables with the same length and type • 1x R&S AMU - Z7 (I/Q Combiner) • External Trigger Source • External Ref. Frequency Source (optional)

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

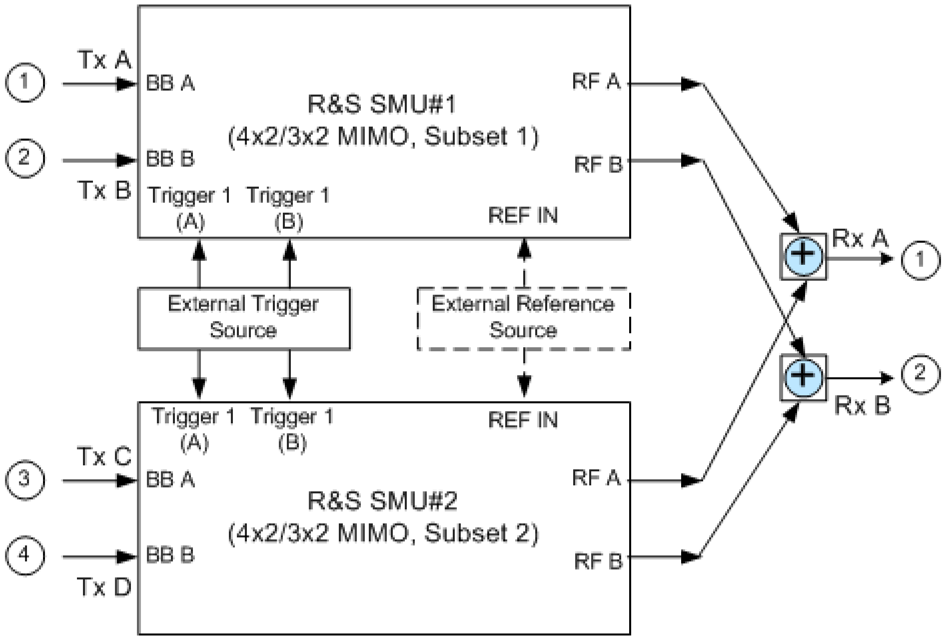


Figure 5-4: 4x2/3x2 MIMO up to 3GHz with two R&S SMUs and two RF Combiners

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.

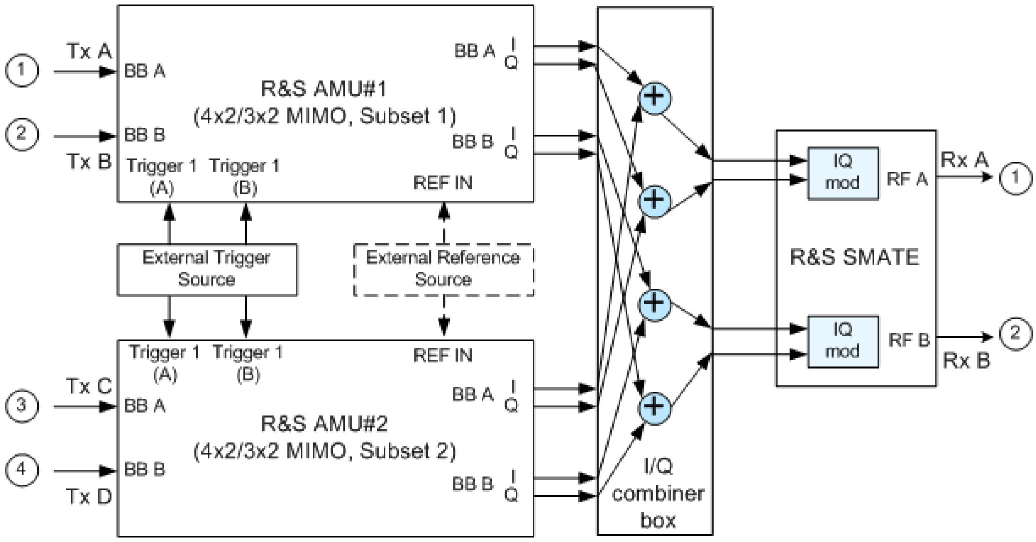


Figure 5-5: 4x2/3x2 MIMO up to 6GHz with two R&S AMUs, one R&S SMATE and one I/Q combiner

Refer to Chapter 5.1.4, "Connecting two R&S SMU/AMU for MxN MIMO Simulation", on page 110 and Chapter 5.1.5, "Configuring two R&S SMU/AMU for MxN MIMO Simulation", on page 110 for detailed information on how to connect and configure the two instruments.

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 SMU/AMU, 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.

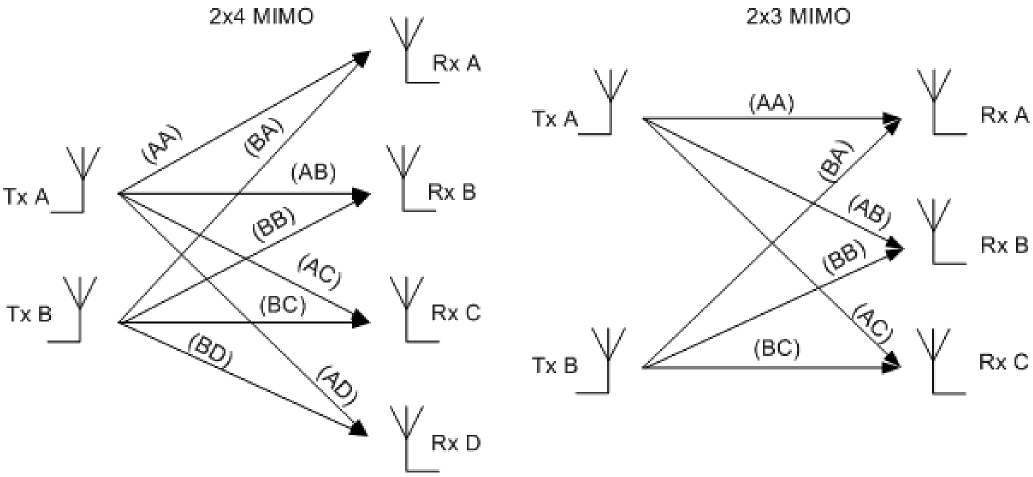


Figure 5-6: 2x4 MIMO and 2x3 MIMO systems

The following table gives an overview of the instruemnts and options required for the simulation of 2x4 and 2x3 MIMO system.

Table 5-4: Prerequisites for 2x4 and 2x3 MIMO simulation

Frequency	Instrument	Options	Additional Equipment
Up to 3 GHz	2x R&S SMU	R&S SMx/AMU-B14/-B15/-K74 per instrument	• Connecting cables with the same length and type • External Trigger Source • External Ref. Frequency Source (optional)
Up to 6 GH	2x R&S AMU + 2x R&S SMATE		• Connecting cables with the same length and type • External Trigger Source • External Ref. Frequency Source (optional)

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

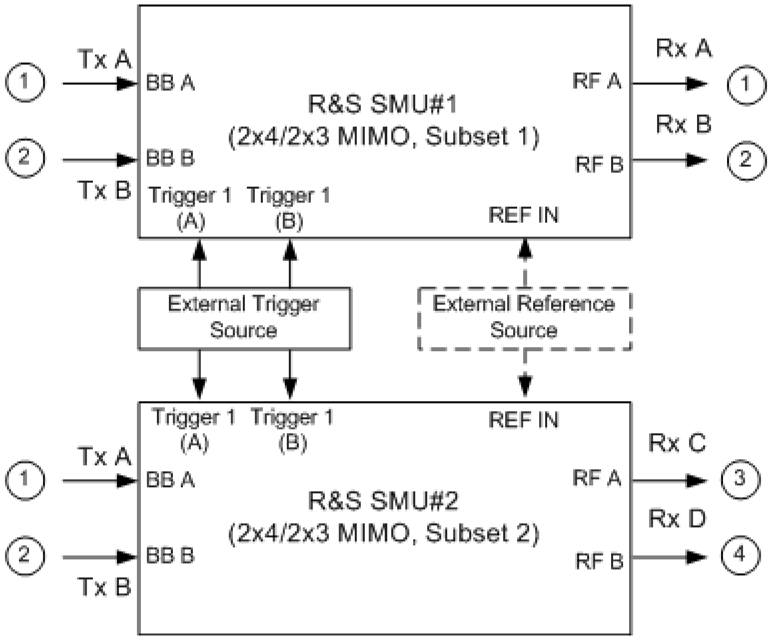


Figure 5-7: 2x4/2x3 MIMO up to 3GHz with two R&S SMUs

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.

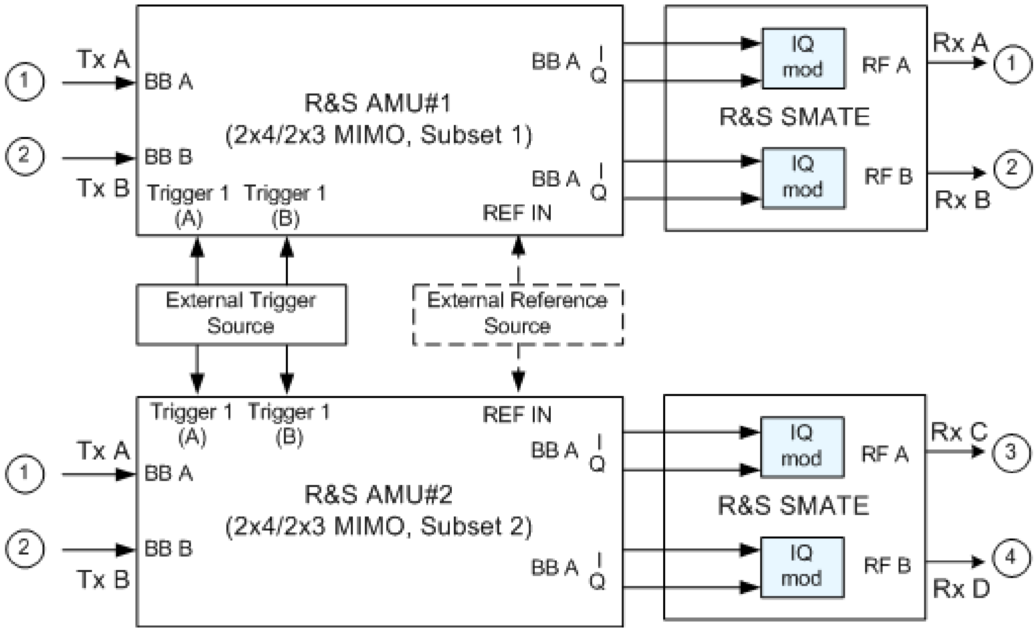


Figure 5-8: 2x4/2x3 MIMO up to 6GHz with two R&S AMUs and two R&S SMATEs

Refer to Chapter 5.1.4, "Connecting two R&S SMU/AMU for MxN MIMO Simulation", on page 110 and Chapter 5.1.5, "Configuring two R&S SMU/AMU for MxN MIMO Simulation", on page 110 for detailed information on how to connect and configure the two instruments.

5.1.4 Connecting two R&S SMU/AMU for MxN MIMO Simulation

For simulating of 2x3, 3x2, 2x4 or 4x2 MIMO system that requires two R&S SMU/AMU, 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.

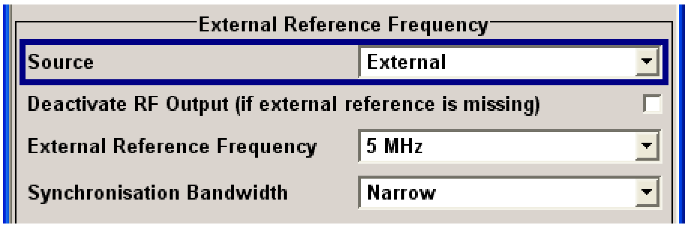
5.1.5 Configuring two R&S SMU/AMU for MxN MIMO Simulation

After the instruments had been connected as described in Chapter 5.1.4, "Connecting two R&S SMU/AMU for MxN MIMO Simulation", on page 110 the instruments have to be configured.

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

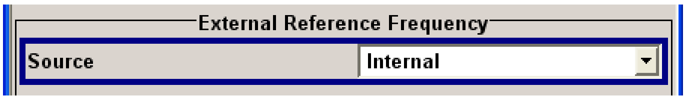
1. Configure the Reference Oscillator Settings, depending on whether an external reference dource or the reference dignal (REF OUT) of the first instrument is used.

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 (Instrument#1): `SOUR:ROSC:SOUR INT`
SCPI command (Instrument#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`

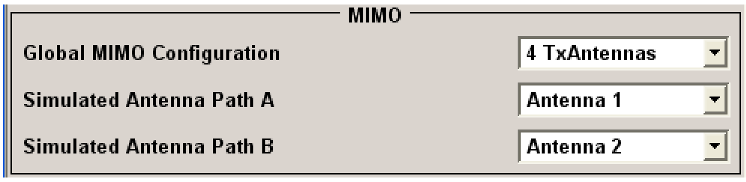
3. Set the MIMO Fading Settings:
   a) Select the "MIMO mode" (2x4, 4x2, 2x3 or 3x2)
   SCPI command:
   SOUR:FSIM:ROUT FA1A2BFB1A2BM24|FA1A2BFB1A2BM42|
   FA1A2BFB1A2BM23|FA1A2BFB1A2BM32
   b) Set the "MIMO Subset" (Subset 1 for Instrument#1 and Subset 2 for Instrument#2)
   SCPI command:
   SOUR:FSIM:MIMO:SUBS SET1|SET2
   c) Configure the MIMO Correlation Matrix
   SCPI command:
   SOUR:FSIM:MIMO:TAP:MATR:ROW2:COL2:MAGN 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 (Instrument#1): SOUR:FSIM:GLOB:SEED 5
   SCPI command (Instrument#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 (Instrument#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 Instrument#1 to Instrument#2
      SCPI command (Instrument#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 (Instrument#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 Instrument#1 to Instrument#2 and activate the digital standard in the second one.
      SCPI command (Instrument#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 Instrument#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.



  SCPI command (Instrument#1):
  `SOUR:BB:EUTR:DL:MIMO:CONF TX4`
  `SOUR:BB:EUTR:DL:MIMO:ANTA ANT1`
  `SOUR:BB:EUTR:DL:MIMO:ANTB ANT2`

- For Instrument#2, enable Path A and Path B to simulate Antenna 3 and Antenna 4 respectively.
  SCPI command (Instrument#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 Instrument#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.

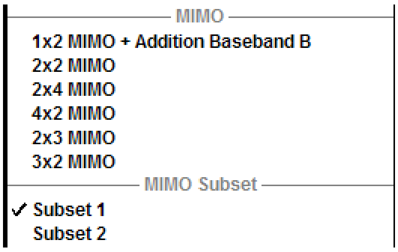
  SCPI command (Instrument#1):
  `SOUR:BB:WIM:PATH:COUP:STAT ON`
  `SOUR:BB:WIM:AOFD:ZONE1:STC:MODE MA4|MB4|MC4`
  `SOUR:BB:WIM:AOFD:ZONE1:STC:ANT ANT0`

- For Instrument#2, enable Path A to simulate Antenna 2.
  Path B will automatically generate the signal of Antenna 3.
  SCPI command (Instrument#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



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

MIMO modes different than 2x2 or 2x1 MIMO require two instruments (see Chapter 5.1, "MxN MIMO Test Configurations", on page 104).

MIMO Subset

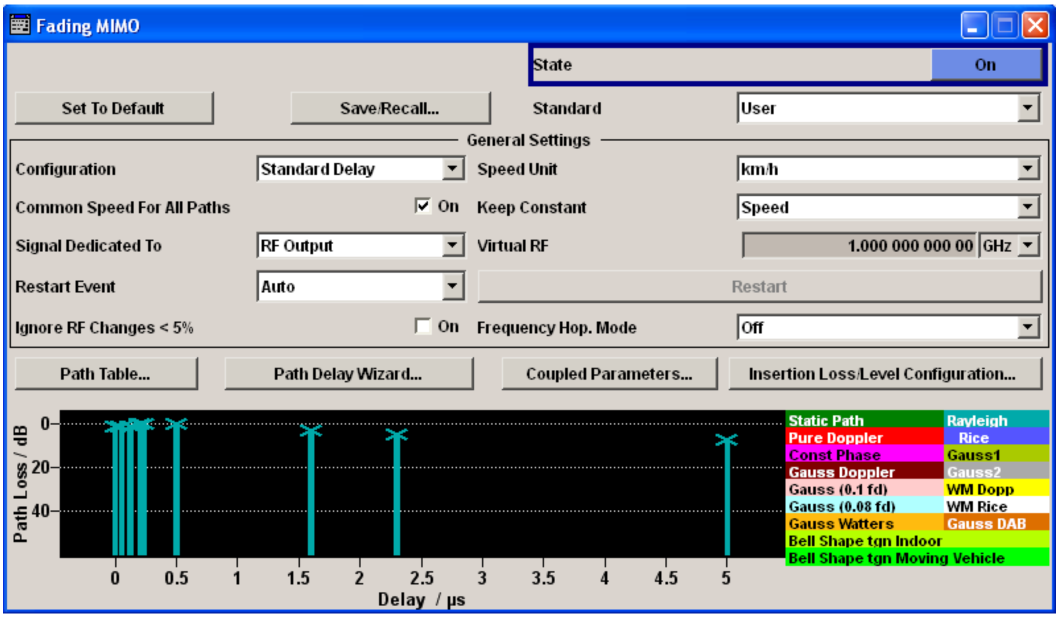
While simulating a MIMO mode with two instruments, the "MIMO Subset" defines which fading paths from the MIMO matrix are calculated by the selected instrument. The "MIMO Subset" selected in each of the two connected instrument has to be different.

Remote command:

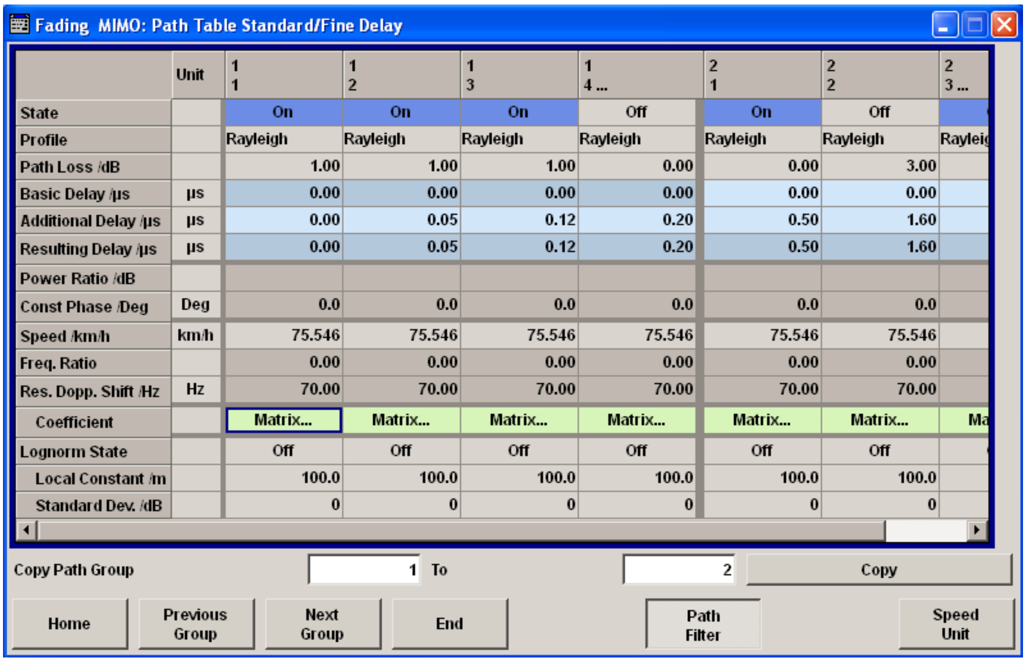
`[:SOURce<hw>]:FSIMulator:MIMO:SUBSet` on page 275

5.2.2 Fading MIMO

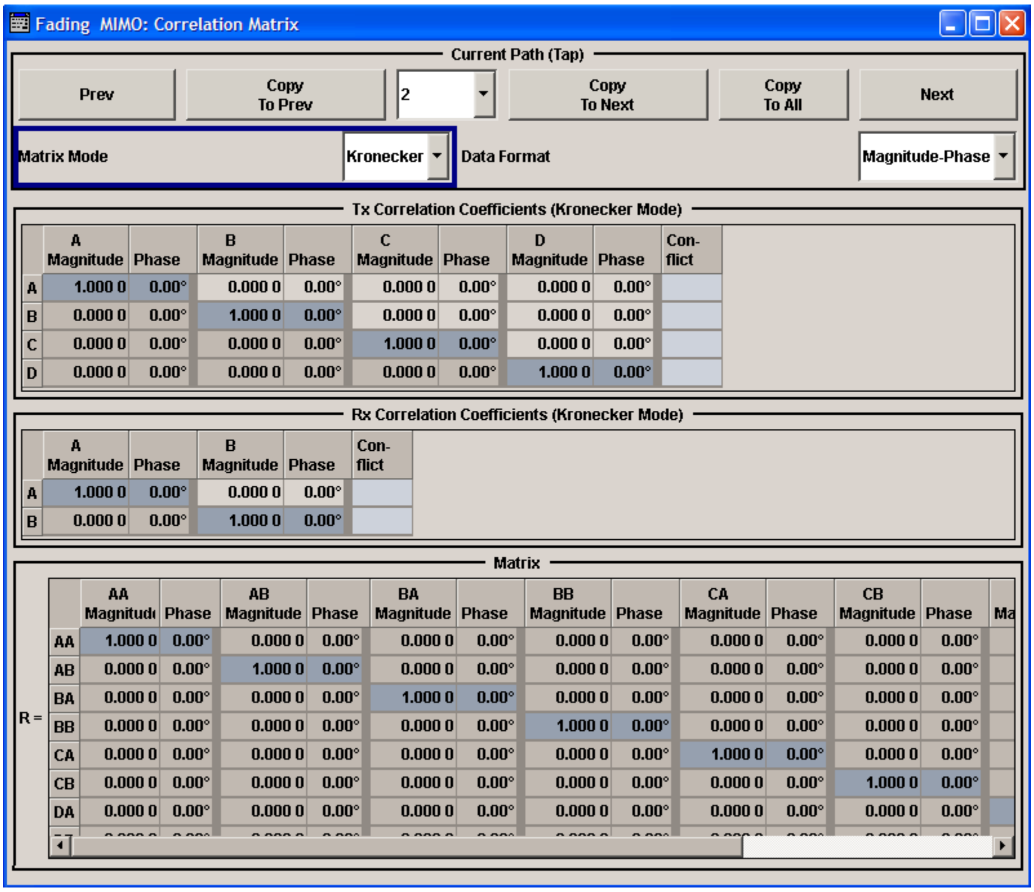
The "Fading MIMO" dialog for the four subchannels (per instrument) can be called via the Fader dialog of one of the four "Fader" blocks.



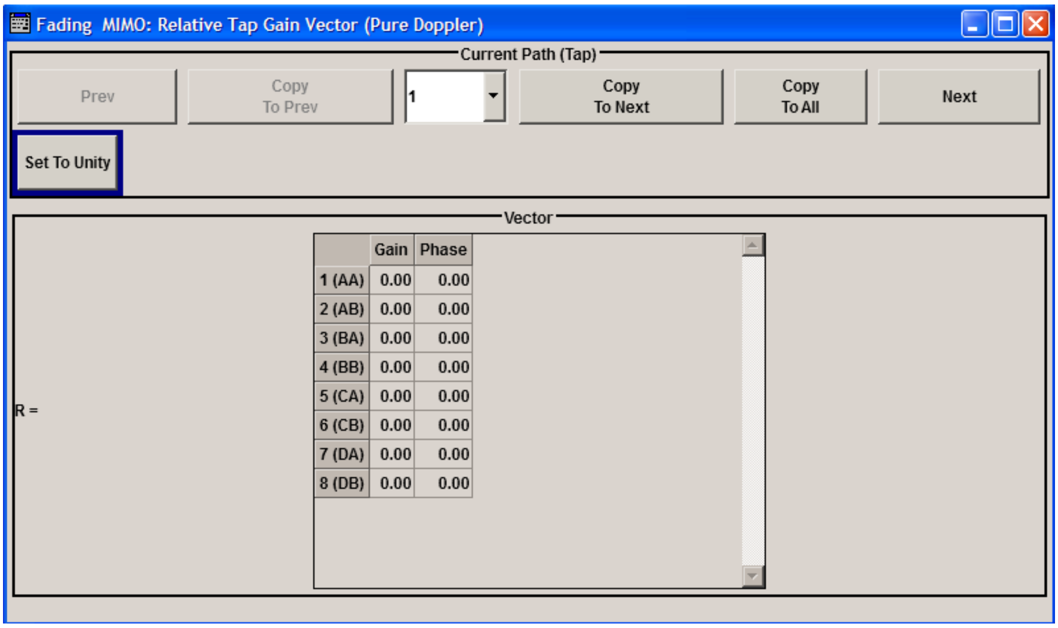
The "MIMO fading: Path Table" offers an additional button "Matrix/Vector" in the "Coefficient" row to configure the correlation between the transceivers.



- 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 Settings", on page 123.



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

Remote 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.

Remote command:
`[:SOURce<hw>]:FSIMulator:MIMO:COPY:PREVious` on page 273

Current Path (Tap) #
Selects the tap to be displayed.

Remote command:
`[:SOURce<hw>]:FSIMulator:MIMO:TAP` on page 275

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.

Remote command:
`[:SOURce<hw>]:FSIMulator:MIMO:COPY:NEXT` on page 272

Copy To All
Copies the matrix values of the current tap all taps.

Remote command:
`[:SOURce<hw>]:FSIMulator:MIMO:COPY:ALL` on page 272

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

Remote command:
`n.a.`

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

"Individual" Allows entering the correlation values individually.

"Kronecker" Opens additional input fields for entering the Rx correlation and Tx correlation values, see Chapter 5.2.3, "Kronecker Mode Correlation Coefficients", on page 118.
The matrix values are calculated automatically.

"AoA / AoD" Opens additional input fields for defining the Rx and TX correlation parameters based on the Spatial Channel Model (SCM), see Chapter 5.2.4, "TGn/TGac Channel Models Settings", on page 119.
The matrix values are calculated automatically.

Remote command:
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:MODE on page 278

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.

Remote command:
n.a.

5.2.3 Kronecker Mode Correlation Coefficients

Calculating of the matrix values based on the Kronecker assumption

In Kronecker mode, it is sufficient that you specify one Tx and one Rx correlation per MIMO channel. The instrument automatically computes the full correlation matrix according to the formula:

$$R_l = R_{\text{Tx}}^{(l)} \otimes R_{\text{Rx}}^{(l)}, \text{ where } R_{\text{Tx}}^{(l)} = \begin{bmatrix} 1 & \rho_{\text{Tx}}^{(l)} \\ \rho_{\text{Tx}}^{(l)*} & 1 \end{bmatrix} \text{ and } \mathrm{R}_{\text{Rx}}^{(l)} = \begin{bmatrix} 1 & \rho_{\text{Rx}}^{(l)} \\ \rho_{\text{Rx}}^{(l)*} & 1 \end{bmatrix}$$

where $\rho^{(l)}_{Rx}$ and $\rho^{(l)}_{Tx}$ are the R_x and T_x correlations.

The evaluation of the Kronecker product ⊗ leads to:

$$R_l = \begin{bmatrix} 1 & \rho_{\text{Rx}}^{(l)} & \rho_{\text{Tx}}^{(l)} & \rho_{\text{Tx}}^{(l)}\rho_{\text{Rx}}^{(l)} \\ \rho_{\text{Rx}}^{(l)*} & 1 & \rho_{\text{Tx}}^{(l)}\rho_{\text{Rx}}^{(l)*} & \rho_{\text{Tx}}^{(l)} \\ \rho_{\text{Tx}}^{(l)*} & \rho_{\text{Tx}}^{(l)*}\rho_{\text{Rx}}^{(l)} & 1 & \rho_{\text{Rx}}^{(l)} \\ \rho_{\text{Tx}}^{(l)*}\rho_{\text{Rx}}^{(l)*} & \rho_{\text{Tx}}^{(l)*} & \rho_{\text{Rx}}^{(l)*} & 1 \end{bmatrix}$$

Which and how many coefficients are available, depends on the selected MIMO configuration, e.g. any of the 2x2, 4x2, and 3x2 MIMO configurations, requires only one Rx correlation coefficient AB, whereas there are six Rx correlation coefficients in case of 2x4 MIMO configuration.

Tx Correlation Coefficients, Magnitude/Real
Enters the value for the real/ratio part of the transmitter correlation ($\rho^{(l)}_{Tx}$).

The available Tx correlation coefficients depends on the selected MIMO mode.

Remote command:
For "Data Format > Magnitude-Phase"
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:ROW<di>:COLumn<st>:MAGNitude on page 277
For "Data Format > Real-Imag"
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:ROW<di>:COLumn<st>:REAL on page 277

Tx Correlation Coefficients, Phase/Imag
Enters the value for the phase/imaginary part of the transmitter correlation ($\rho^{(l)}_{Tx}$).

The available Tx correlation coefficients depends on the selected MIMO mode.

Remote command:
For "Data Format > Ratio-Phase"
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:ROW<di>:COLumn<st>:PHASe on page 276
For "Data Format > Real-Imag"
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:ROW<di>:COLumn<st>:IMAGinary on page 276

Rx Correlation Coefficients, Magnitude/Real
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.

Remote command:
For "Data Format > Magnitude-Phase"
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:ROW<di>:COLumn<st>:MAGNitude on page 277
For "Data Format > Real-Imag"
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:ROW<di>:COLumn<st>:REAL on page 277

Rx Correlation Coefficients, Phase/Imag
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.

Remote command:
For "Data Format > Ratio-Phase"
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:ROW<di>:COLumn<st>:PHASe on page 276
For "Data Format > Real-Imag"
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:ROW<di>:COLumn<st>:IMAGinary on page 276

5.2.4 TGn/TGac Channel Models Settings

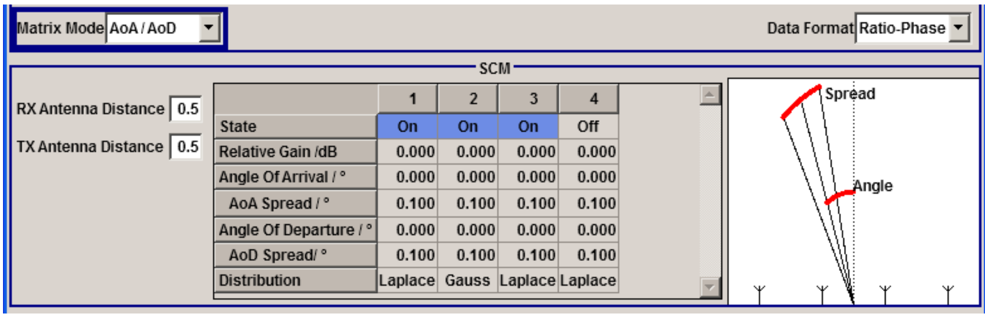
TGn and TGac channel models are specified for the evaluation of IEEE 802.11n and IEEE 802.11ac systems respectively.

These channel models are 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 you can define up to four rays 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.

To access the dialog with TGn/TGac settings

1. Enable a MIMO configuration, select the "Fading > Path Table > Matrix".
2. Select "Fading: Correlation Matrix > Matrix Mode > AoA/AoD".



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" * λ*, where

the wave length *λ = c / "Frequency"* and *c* is the speed of light.

Remote command:
[:SOURce<hw>]:FSIMulator:MIMO:TGN:ANTenna:DISTance:RX on page 283
[:SOURce<hw>]:FSIMulator:MIMO:TGN:ANTenna:DISTance:TX on page 283

Ray State

Enables/disables the selected ray.

Remote command:
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:STATe
on page 284

Relative Gain /dB

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

Remote command:
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:GAIN on page 284

Angle of Arrival (AoA)

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

Remote command:
`[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:ARRival:ANGLe` on page 283

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

Remote command:
`[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:ARRival:SPRead` on page 284

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

Remote command:
`[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:DEParture:ANGLe` on page 283

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

Remote command:
`[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:DEParture:SPRead` on page 284

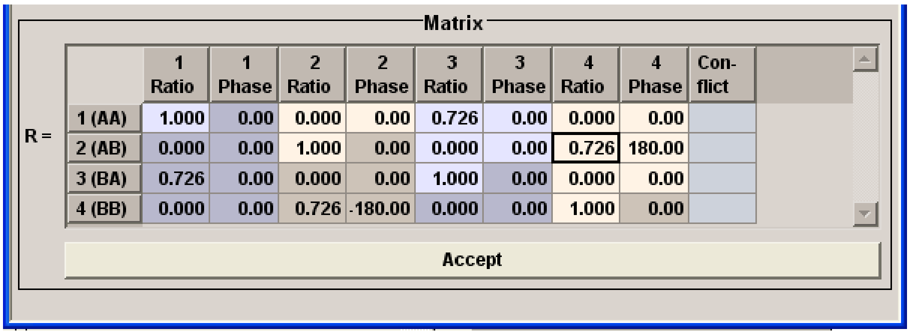
Distribution
Select one of the proposed statistical functions to determine the distribution of the selected ray.

Tip: Use this parameter to simulate ray scattering due to obstacles with different surface (see also Chapter 8.8, "TGn Settings", on page 281).

Remote command:
`[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:DISTribution` on page 283

5.2.5 Correlation Matrix Table

The correlation matrix table displays the values for the transmitter/receiver correlation. The correlation matrix is valid for the selected fading path. To adjust the values, edit the matrix elements directly, use the correlation coefficients of the Kronecker Mode, define the TGn/TGac parameters of the AoA /AoD mode or use the SCME/WINNER mode.



Matrix

R =

	1 Ratio	1 Phase	2 Ratio	2 Phase	3 Ratio	3 Phase	4 Ratio	4 Phase	Con-flict
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

Defining the matrix values individually

In individual matrix mode, you have to define the matrix values manually. Irrespectively of the selected data format, you have to enter valid correlation values.

Impossible calculation and conflict settings

The individual direct definition of the matrix elements may lead to impossible calculation due to inappropriate values and/or settings conflict.

You have to change the corresponding values.

The Figure 5-9 uses a 2x2 MIMO matrix to depict the basic configuration principle.

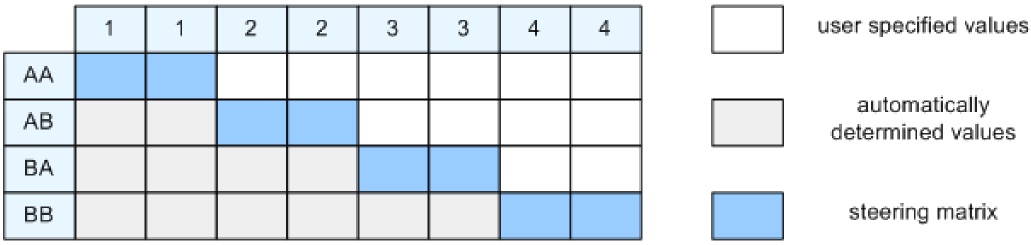


Figure 5-9: Simplified representation of a 2x2 MIMO matrix

To define the matrix, set the only the value pairs in the diagonal and upper triangle (a total of 10 value pairs in this example, see Figure 5-9). The instrument exploits the complex conjugate symmetry across the diagonal and determines automatically the remaining value pairs in the lower triangle.

By default, the values in the matrix diagonal are set to 1. Use values different than 1 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.

Real/Magnitude

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

Remote command:

`[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:ROW<di>:COLumn<st>:MAGNitude` on page 279

Phase/Imag

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

Remote command:
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:ROW<di>:COLumn<st>:PHASe on page 278

Conflict

Indicates a matrix conflict.

Remote command:
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:CONFlict? on page 278

Accept

Accepts the values for the phase/imaginary and the real/ration part of the correlation.

Remote command:
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:ACCept on page 277

5.2.6 Relative Gain Vector Matrix Settings

The "Fading MIMO: Relative Tap Gain Vector" dialog is available for the "Pure Doppler Fading Profile" only. This dialog provides additional parameters to simulate a gain weighting or phase shift between the signals with constant fading transmitted over the different Tx antennas.

Use this function to simulate beamforming signal.

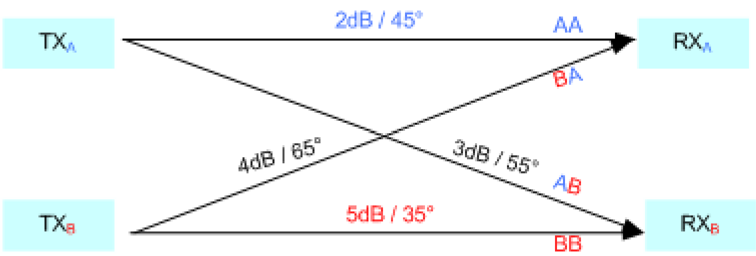
Example:

This example illustrates the phase shift between the signals with a start phase of 45 degrees, power level of 2 dB, and the gain and phase settings as follow:

- "AA Gain > 0", "AA Phase > 0"
- "AB Gain > -1", "AB Phase > 10"
- "BA Gain > -2", "BA Phase > 20"
- "BB Gain > -3", "BB Phase > 350"

	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.

Remote command:

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVECtor:PRESet on page 279

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.

Remote command:

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVECtor:AA:GAIN on page 280

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.

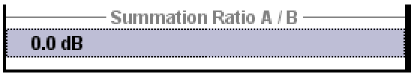
Remote command:

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVECtor:AA:PHASe on page 281

for the correct syntax of the SCPI command of the other paths, refer to the command description.

6 Summation Ratio A/B

► To access this settings, select "Fading > 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 two faded signals are added.

Faded signals are added in case one of the following signal routing configuration (see also Chapter 3, "Signal Routing (non-MIMO) Settings", on page 17):

- 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 supplied external baseband signal. The "Path Gain" is measured at the output of the "Baseband" blocks and is considered in 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" blocks 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 235

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 enabled settings.

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

also with 15km/h in band class 5

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
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

	Path 1
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
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

7.2.4 GSM RA250 (6 Path)

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

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
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0	0	0	0	0

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
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

7.2.6 GSM ET60 (EQ60) (6 Path)

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

7.2.8 GSM TU3 (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]:	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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
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

7.2.10 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

	Path 1	Path 2
Delay [ns]:	0	400
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0
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

	Path 1	Path 2
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
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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
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
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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
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

7.5 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

	Path 1	Path 2
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
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

	Path 1	Path 2	Path 3	Path 4
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

VAx are typical fading profiles, with x representing the speed, such as VA3 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 VAx standard, the doppler frequency remains the same, thus resulting in individual speed settings.

Refer also to Chapter 7.6.12, "3GPP Mobile VA3, 3GPP Mobile VA30, 3GPP Mobile VA120", on page 148 for VAx fading profiles.

7.6.1 3GPP Case 1 (UE/BS)

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 (UE/BS)

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 (UE/BS)

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 (UE)

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 (UE)

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 (UE) and Case 4 (BS)

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 Mobile Case 7 (UE-Sector)

Table 7-9: 3GPP TS 25.101 V6.2.0 (2003-09), annex B2.2

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	4.3	6.6	2	7	7.5
Delay [ns]:	0	260	1040	4690	7290	14580
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0

	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

7.6.8 3GPP Mobile Case 7 (UE-Beam)

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

	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	0.3	0.9
Delay [ns]:	4690	7290	14580
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	0	0	0
Freq Ratio:	0	0	0
Speed [km/h]:	50	50	50

7.6.9 3GPP Mobile Case 8 (UE, 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

7.6.10 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
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	9.7	19.2	22.8
Delay [ns]:	0	110	190	410
LogNormal	off	off	off	off
Corr with	off	off	off	off
Power Ratio [dB]:	0	0	0	0
Freq Ratio:	0	0	0	0
Speed [km/h]:	3	3	3	3

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 7-10: 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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	3 | 30 | 120 [1)]	3 | 30 | 120 [1)]	3 | 30 | 120 [1)]	3 | 30 | 120 [1)]	3 | 30 | 120 [1)]	3 | 30 | 120 [1)]

[1)] Speed of the respective standard VAx: VA3 = 3 km/h, VA30 = 30 km/h and VA120 = 120 km/h.

7.6.13 3GPP MBSFN Propagation Channel Profile (18 Path)

Table 7-11: 3GPP 3GPP TS 36.521-1 respectivelly 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
Power Ratio [dB]:	0	0	0	0	0	0
Frequency [Hz]: *	3	3	3	3	3	3

Table 7-12: 3GPP 3GPP TS 36.521-1 respectivelly 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]: *	3	3	3	3	3	3

Table 7-13: 3GPP 3GPP TS 36.521-1 respectivelly 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]: *	3	3	3	3	3	3

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 3GPP TUx

Table 7-14: 3GPP TS 25.943 V5.1.0 (2002-06)

	Path 1	Path 2	Path 3	Path 4	Path 5
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	5.7	7.6	10.1	10.2	10.2
Delay [ns]:	0	217	512	514	517
LogNormal	off	off	off	off	off

	Path 1	Path 2	Path 3	Path 4	Path 5
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

Table 7-15: 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]:	11.5	13.4	16.3	16.9	17.1
Delay [ns]:	674	882	1230	1287	1311
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

Table 7-16: 3GPP TS 25.943 V5.1.0 (2002-06) (Cont.)

	Path 11	Path 12	Path 13	Path 14	Path 15
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	17.4	19	19	19.8	21.5
Delay [ns]:	1349	1533	1535	1622	1818
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

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

	Path 16	Path 17	Path 18	Path 19	Path 20
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

7.6.16 3GPP HTx

Table 7-18: 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 7-19: 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
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

7.6.17 3GPP RAx

Table 7-20: 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 7-21: 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
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

7.6.18 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

7.6.19 Reference + Moving Channel

See Chapter 7.15.1, "Reference + Moving Channel", on page 190.

7.6.20 HST1 Open Space, HST1 Open Space (DL+UL)

See Chapter 7.14.1, "HST1 Open Space, HST1 Open Space (DL+UL)", on page 188.

7.6.21 HST2 Tunnel Leaky Cable

See Chapter 7.14.2, "HST2 Tunnel Leaky Cable, HST2 Tunnel Leaky Cable (DL+UL)", on page 189.

7.6.22 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 189.

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

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

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

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

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

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**
Profile [Type]	Rice	Rayleigh	Rayleigh	Rayleigh
Loss [dB]:	0	2	10	20
Delay [ns]:	0	200	400	600
LogNormal	off	off	off	off
Corr with	off	off	off	off
Power Ratio [dB]:		0	0	0
Freq Ratio:	0	0	0	0
Speed [km/h]:	120	120	120	120

Tap 2: S(d) = 0,1 +/- 0,02

7.8.2 DAB RA (6 Tabs)

	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]:		0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	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
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Gaus1	Gaus1
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]:	25	25	25	25	25	25
	Path 7	**Path 8**	**Path 9**	**Path 10**	**Path 11**	**Path 12**
Profile [Type]	Gaus1	Gaus1	Gaus2	Gaus2	Gaus2	Gaus2
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]:	25	25	25	25	25	25

Tap 6: S(d) = 1,0 +/- 0,1

7.8.4 DAB TU (6 Tabs)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Rayleigh	Rayleigh	Rayleigh	Gaus1	Gaus2	Gaus2
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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	25	25	25	25	25	25

Tap 3: S(d) = 1,0 +/- 0,1

7.8.5 DAB SFN (VHF)

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7
Profile [Type]	Rayleigh	GausDAB	GausDAB	GausDAB	GausDAB	GausDAB	GausDAB
Loss [dB]:	0	13	18	22	26	31	32
Delay [ns]:	0	100000	220000	290000	385000	480000	600000
LogNor-mal	off	off	off	off	off	off	off
Corr with	off	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0	0
Speed [km/h]:	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

	Path 1	Path 2	Path 3
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 ->> 10lg4 = 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
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

	Path 1	Path 2	Path 3
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
Freq Ratio:	0,2	0,15	0,25
Speed [km/h]:	0.03	0.02	0.03

K=36

7.9.9 SUI 3 (omni ant., 90%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	5	10
Delay [ns]:	0	400	900
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

7.9.10 SUI 3 (omni ant., 75%)

	Path 1	Path 2	Path 3
Profile [Type]	WMRice	WMDopp	WMDopp
Loss [dB]:	0	5	10
Delay [ns]:	0	400	900
LogNormal	off	off	off
Corr with	off	off	off
Power Ratio [dB]:	8,45098	0	0
Freq Ratio:	0,4	0,3	0,5
Speed [km/h]:	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

	Path 1	Path 2	Path 3
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
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

	Path 1	Path 2	Path 3
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
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

	Path 1	Path 2	Path 3
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
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

	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)

7.9.27 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
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
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

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
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

7.9.32 ITU V-A 120

	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	10000
LogNormal	off	off	off	off	off	off
Corr with	off	off	off	off	off	off
Power Ratio [dB]:	0	0	0	0	0	0
Freq Ratio:	0	0	0	0	0	0
Speed [km/h]:	120	120	120	120	120	120

7.10 LTE Standards

7.10.1 CQI 5Hz

CQI Tests according to 3GPP 36.521.1 Version 9.1.0, B2.4

	Path 1	Path 2
Profile [Type]	Const. Phase	Pure Doppler
Loss [dB]:	0	0
Delay [ns]:	0	450
LogNormal	off	off
Corr with	off	off
Power Ratio [dB]:	0	0

	Path 1	Path 2
Freq Ratio:	0	0
Speed [Hz]:	0	5 Hz

7.10.2 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			

7.10.3 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

	Path 1	Path 2	Path 3	Path 4	Path 5
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]:	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

7.10.4 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	

	Path 1	Path 2	Path 3	Path 4	Path 5
Power Ratio [dB]:	0	0	0	0	
Frequency [Hz]: *					

* Possible frequency values are 70 Hz or 300 Hz

7.10.5 MBSFN Propagation Channel Profile (5 Hz)

See Chapter 7.6.13, "3GPP MBSFN Propagation Channel Profile (18 Path)", on page 149.

* All fading paths use "Frequency = 5 Hz" and "Speed = 5.4 km/h".

7.10.6 HST1 Open Space

See Chapter 7.14.1, "HST1 Open Space, HST1 Open Space (DL+UL)", on page 188.

7.10.7 HST3 Tunnel Multi Antennas

See Chapter 7.14.3, "HST3 Tunnel Multi Antennas, HST3 Tunnel Multi Antennas (DL +UL)", on page 189.

7.10.8 ETU 200Hz Moving

See Chapter 7.15.2, "ETU 200Hz Moving (UL Timing Adjustment, Scenario 1)", on page 190.

7.10.9 Pure Doppler Moving

SeeChapter 7.15.3, "Pure Doppler Moving (UL Timing Adjustment, Scenario 2)", on page 191.

7.11 LTE-MIMO Standards

7.11.1 EPA (Extended Pedestrian A)

See Chapter 7.10.2, "EPA (Extended Pedestrian A)", on page 176.

7.11.2 EVA (Extended Vehicular A)

See Chapter 7.10.3, "EVA (Extended Vehicular A)", on page 176.

7.11.3 ETU (Extended Typical Urban)

See Chapter 7.10.4, "ETU (Extended Typical Urban)", on page 177.

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.

7.11.5 HST3 Tunnel Multi Antennas

See Chapter 7.14.3, "HST3 Tunnel Multi Antennas, HST3 Tunnel Multi Antennas (DL +UL)", on page 189.

7.12 WIMAX-MIMO Standards

7.12.1 ITU Pedestrian B 3

	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
Speed [km/h]:	3	3	3	3	3	3

Table 7-28: MIMO Parameter - High Correlation

	real	imaginary	real	imaginary	real	imaginary	real	imaginary
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

	real	imagi-nary	real	imagi-nary	real	imagi-nary	real	imagi-nary
	-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

	real	imagi-nary	real	imagi-nary	real	imagi-nary	real	imagi-nary
	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
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	imagi-nary	real	imagi-nary	real	imagi-nary	real	imagi-nary
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

	real	imaginary	real	imaginary	real	imaginary	real	imaginary
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	imaginary	real	imaginary	real	imaginary	real	imaginary
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	imaginary	real	imaginary	real	imaginary	real	imaginary
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

	real	imaginary	real	imaginary	real	imaginary	real	imaginary
	-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

	Path 1	Path 2
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
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

	Path 1
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
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

	Path 1	Path 2
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 HST DL+UL standards consider the downlink and the uplink. 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 a factor based on the sum of the DL and UL frequency.

	Path 1
Profile [Type]	Pure Doppler
Loss [dB]:	0
Delay [ns]:	0
LogNormal	off
Corr with	off
Power Ratio [dB]:	-

	Path 1
Freq Ratio:	
Speed [km/h]:	350km/h
D_{min}	50m
D_s	1000m

7.14.2 HST2 Tunnel Leaky Cable, HST2 Tunnel Leaky Cable (DL+UL)

3GPP TS25.141, annex D.4A "High Speed Train"

The HST DL+UL standards consider the downlink and the uplink. 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 a factor based on the sum of the DL and UL frequency.

	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 HST DL+UL standards consider the downlink and the uplink. 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 a factor based on the sum of the DL and UL frequency.

	Path 1
Profile [Type]	Pure Doppler
Loss [dB]:	0

	Path 1
Delay [ns]:	0
LogNormal	off
Corr with	off
Power Ratio [dB]:	-
Freq Ratio:	
Speed [km/h]:	300km/h
D_{min}	2m
D_s	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*PI/0.04

(Mean)-Delay: 3.5µs

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

	Path 1	Path 2	Path 3	Path 4	Path 5
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*PI/0.04

Amplitude: 5us = 10us/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
LogNormal	off
Corr with	off
Power Ratio [dB]:	0
Doppler [Hz]:	
Speed [km/h]:	350

Period: 48,33s = 2*PI/0.13

Amplitude: 5µs = 10µs/2

7.16 Watterson Standards

7.16.1 Watterson I1

	Path 1	Path 2	Path 3	Path 4	Path 5
Profile [Type]	Gauss-Watter-son	Gauss-Watter-son	Gauss-Watter-son	Gauss-Watter-son	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 +/- 0,02

7.16.2 Watterson I2

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Profile [Type]	Gauss-Wat-terson	Gauss-Wat-terson	Gauss-Wat-terson	Gauss-Wat-terson	Gauss-Watter-son	Gauss-Watter-son
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
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 +/- 0,02

7.16.3 Watterson I3

	Path 1	Path 2	Path 3	Path 4	Path 5
Profile [Type]	Gauss-Watter-son	Gauss-Watter-son	Gauss-Watter-son	Gauss-Watter-son	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 +/- 0,1

7.17 802.11n-SISO Standards

These fading profiles are implemented as the IEEE 802.11n-MIMO models, expect that:

- Correlation Path = Off
- Coefficient, % = 100
- Phase, deg = 0

See Chapter 7.18, "802.11n-MIMO Standards", on page 194.

7.18 802.11n-MIMO Standards

According to IEEE 801.11-03/940r4

Rx Antenna Distance = 1

Tx Antenna Distance = 0.5

Distribution = Laplace

Profile = Bell Shape tgn Indoor, exception Model F, Path 3 where the Profile = Bell Shape tgn Moving Vehicle

Speed = 1.2 km/h, exception Model F, Path 3 where Speed = 40 km/h

7.18.1 Model A

Tap:	Path 1
Cluster	
Profil [Typ]	Bell Shape tgn Indoor
Loss [dB]	0
Delay [ns]	0
AoA	45
AS (A)	40
AoD	45
AS (D)	40
Speed [km/h]	1.2

7.18.2 Model B

Tap:	Path 1	Path 2	Path 3		Path 4	
Cluster			1	2	1	2
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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

Tap:	Path 1	Path 2	Path 3		Path 4	
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 5		Path 6	Path 7	Path 8	Path 9
Cluster	1	2				
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

7.18.3 Model C

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Cluster						
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 7	Path 7	Path 8	Path 8	Path 9	Path 9
Cluster	1	2	1	2	1	2
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
AS (D):	24.7	22.5	24.7	22.5	24.7	22.5
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 10	Path 10	Path 11*	Path 12*	Path 13*	Path 14*
Cluster	1	2				
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(Relative) Loss [dB]:	19.5	11.5	13.7	15.8	18	20.2
Delay [ns]:	90	90	110	140	170	200
AoA:	290.3	332.3	332.3	332.3	332.3	332.3
AS (A):	24.6	22.4	22.4	22.4	22.4	22.4
AoD:	13.5	56.4	56.4	56.4	56.4	56.4
AS (D):	24.7	22.5	22.5	22.5	22.5	22.5
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

*) this paths are not simulated by the instrument

7.18.4 Model D

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Cluster						
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
(Relative) Loss [dB]:	0	0.9	1.7	2.6	3.5	4.3
Delay [ns]:	0	10	20	30	40	50
AoA:	158.9	158.9	158.9	158.9	158.9	158.9
AS (A):	27.7	27.7	27.7	27.7	27.7	27.7
AoD:	332.1	332.1	332.1	332.1	332.1	332.1
AS (D):	27.4	27.4	27.4	27.4	27.4	27.4
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 7	Path 8	Path 9	Path 10*	Path 11	
Cluster					1	2
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(Relative) Loss [dB]:	5.2	6.1	6.9	7.8	9	6.6
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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 12*		Path 13*		Path 14*	
Cluster	1	2	1	2	1	2
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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

Tap:	Path 12*		Path 13*		Path 14*	
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 15*			Path 16*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 17*		Path 18*
Cluster	2	3	
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace

*) this paths are not simulated by the instrument

7.18.5 Model E

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	
Cluster					1	2
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Moving Vehicle	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 6		Path 7		Path 8	
Cluster	1	2	1	2	1	2
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
AS (D):	36.1	42.5	36.1	42.5	36.1	42.5
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 9			Path 10		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(Relative) Loss [dB]:	9.8	7.1	7.9	11.7	9.9	9.6

Tap:	Path 9			Path 10		
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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 11*			Path 12*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 13*			Path 14*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
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

Tap:	Path 13*			Path 14*		
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 15*				Path 16*		Path 17*	Path 18*
Cluster	1	2	3	4	2	4	4	4
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Distribu-tion	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

*) this paths are not simulated by the instrument

7.18.6 Model F

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	
Cluster					1	2
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	
Speed [km/h]	1.2	1.2	40	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 6		Path 7		Path 8	
Cluster	1	2	1	2	1	2
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 9			Path 10		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 11*			Path 12*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2
Distribu-tion	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 13*				Path 14*			
Cluster	1	2	3	4	1	2	3	4
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Distribu-tion	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 15*				
Cluster	1	2	3	4	5
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(Relative) Loss [dB]:	19.9	15.7	18.5	18.7	12.9

Tap:	Path 15*				
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
Speed [km/h]	1.2	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 16*		Path 17*	Path 18*
Cluster	2	5	6	6
Profil [Typ]	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor	Bell Shape tgn Indoor
(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
Speed [km/h]	1.2	1.2	1.2	1.2
Distribution	Laplace	Laplace	Laplace	Laplace

*) this paths are not simulated by the instrument

7.19 802.11ac-MIMO Standards

The 802.11ac-MIMO channel models are conform for channel bandwidth ≤ 40 MHz.

According to IEEE 801.11-03/940r4

Rx Antenna Distance = 1

Tx Antenna Distance = 0.5

Distribution = Laplace

Profile = Bell Shape tgn Indoor, exception Model F, Path 3 where the Profile = Bell Shape tgn Moving Vehicle

Speed = 0.089 km/h, exception Model F, Path 3 where Speed = 40 km/h

7.19.1 Model A (≤ 40 MHz)

Tap:	Path 1
Cluster	
Profil [Typ]	Bell Shape tgn Indorr
Loss [dB]	0
Delay [ns]	0
AoA	45
AS (A)	40
AoD	45
AS (D)	40
Speed [km/h]	0.089

7.19.2 Model B (≤ 40 MHz)

Tap:	Path 1	Path 2	Path 3		Path 4	
Cluster			1	2	1	2
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 5		Path 6	Path 7	Path 8	Path 9
Cluster	1	2				
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr

Tap:	Path 5		Path 6	Path 7	Path 8	Path 9
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

7.19.3 Model C (≤ 40 MHz)

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Cluster						
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 7	Path 7	Path 8	Path 8	Path 9	Path 9
Cluster	1	2	1	2	1	2
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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

Tap:	Path 7	Path 7	Path 8	Path 8	Path 9	Path 9
AoD:	13.5	56.4	13.5	56.4	13.5	56.4
AS (D):	24.7	22.5	24.7	22.5	24.7	22.5
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 10	Path 10	Path 11*	Path 12*	Path 13*	Path 14*
Cluster	1	2				
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(Relative) Loss [dB]:	19.5	11.5	13.7	15.8	18	20.2
Delay [ns]:	90	90	110	140	170	200
AoA:	290.3	332.3	332.3	332.3	332.3	332.3
AS (A):	24.6	22.4	22.4	22.4	22.4	22.4
AoD:	13.5	56.4	56.4	56.4	56.4	56.4
AS (D):	24.7	22.5	22.5	22.5	22.5	22.5
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

*) this paths are not simulated by the instrument

7.19.4 Model D (≤ 40 MHz)

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Cluster						
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(Relative) Loss [dB]:	0	0.9	1.7	2.6	3.5	4.3
Delay [ns]:	0	10	20	30	40	50
AoA:	158.9	158.9	158.9	158.9	158.9	158.9
AS (A):	27.7	27.7	27.7	27.7	27.7	27.7
AoD:	332.1	332.1	332.1	332.1	332.1	332.1
AS (D):	27.4	27.4	27.4	27.4	27.4	27.4

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 7	Path 8	Path 9	Path 10*	Path 11	
Cluster					1	2
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(Relative) Loss [dB]:	5.2	6.1	6.9	7.8	9	6.6
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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 12*		Path 13*		Path 14*	
Cluster	1	2	1	2	1	2
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 15*			Path 16*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 17*		Path 18*
Cluster	2	3	
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace

*) this paths are not simulated by the instrument

7.19.5 Model E (≤ 40 MHz)

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	
Cluster					1	2
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 6		Path 7		Path 8	
Cluster	1	2	1	2	1	2
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
AS (D):	36.1	42.5	36.1	42.5	36.1	42.5
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 9			Path 10		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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

Tap:	Path 9			Path 10		
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 11*			Path 12*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 13*			Path 14*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 15*				Path 16*		Path 17*	Path 18*
Cluster	1	2	3	4	2	4	4	4
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089
Distribu-tion	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

*) this paths are not simulated by the instrument

7.19.6 Model F (≤ 40 MHz)

Tap:	Path 1	Path 2	Path 3	Path 4	Path 5	
Cluster					1	2
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Moving Vehicle	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	40	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 6		Path 7		Path 8	
Cluster	1	2	1	2	1	2
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 9			Path 10		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 11*			Path 12*		
Cluster	1	2	3	1	2	3
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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

Tap:	Path 11*			Path 12*		
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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089
Distribu-tion	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 13*				Path 14*			
Cluster	1	2	3	4	1	2	3	4
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089
Distribu-tion	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 15*				
Cluster	1	2	3	4	5
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace	Laplace

Tap:	Path 16*		Path 17*	Path 18*
Cluster	2	5	6	6
Profil [Typ]	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr	Bell Shape tgn Indorr
(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
Speed [km/h]	0.089	0.089	0.089	0.089
Distribution	Laplace	Laplace	Laplace	Laplace

*) this paths are not simulated by the instrument

7.20 802.11ac-SISO Standards

These fading profiles are implemented as the IEEE 802.11ac-MIMO models, expect that:

- Correlation Path = Off
- Coefficient, % = 100
- Phase, deg = 0

See Chapter 7.19, "802.11ac-MIMO Standards", on page 204.

8 Remote-Control Commands

This subsystem contains the commands necessary to configure the fading simulator in a remote environment. We assume that the R&S SMU/AMU has already been set up for remote operation in a network as described in the R&S SMU/AMU documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

Conventions used in SCPI command descriptions

For a description of the conventions used in the remote command descriptions, see section "Remote Control Commands" in the R&S SMU/AMU operating manual.

Dual-channel fading is possible when the instrument is fitted with the options R&S SMx/AMU-B14 (Fading Simulator) and R&S SMx/AMU-B15 (Path Extension).

The dynamic fading configurations (Birth Death, Moving Propagation, 2 Channel Interferer and High Speed Train) and the Fine Delay configurations are available with option R&S SMx/AMU-K71.

Common Suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`SOURce<hw>`	[1]|2	available faders
`GROup<st>`	[1]|2...8	available fading path groups
`PATH<ch>`	[1]|2|3	available fading paths
`TAP<ch>`	[1]...10	available MIMO taps
`RAY<st>`	[1]...4	available SCM clusters/rays

Programming examples

This description provides simple programming examples. The purpose of the examples 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 examples have 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.

At the beginning of the most remote control program, an instrument (p)reset is recommended to set the instrument to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

Tasks (in manual or remote operation) that are also performed in the base unit in the same way are not described here.

In particular, this includes:

- Managing settings and data lists, i.e. storing and loading settings, creating and accessing data lists, accessing files in a particular directory, etc.
- Information on regular trigger, marker and clock signals as well as filter settings, if appropriate.
- General instrument configuration, such as configuring networks and remote operation
- Using the common status registers

For a description of such tasks, see the R&S SMU/AMU operating manual.

The following commands specific to the fading simulator are described here:

8.1 General Settings

[: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:

<Configuration>

STANdard | BIRThdeath | MDELay | UDYNamic | TCInterferer | HSTRain | DEL30 | DEL50 | 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.

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 8.10, "Dynamic Scenario Simulation", on page 289.

UDYNamic

The User Dynamic configuration is provided for future use.

*RST: STANdard

Example: `SOURce1:FSIMulator:CONFiguration MDELay`
selects a moving propagation configuration.
`SOURce1:FSIMulator:MDELay:STATe ON`
activates the moving propagation for fader A.

Manual operation: See "Configuration" on page 26

[:SOURce<hw>]:FSIMulator:COPY:DESTination <Destination>

Selects a group whose settings will be overwritten.

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)
*RST: 2

Example: see [:SOURce<hw>]:FSIMulator:COPY:SOURce on page 220

Options: Option B14; Options B13 and B10; SOURce2 only with option B15; Range of values 5 to 8 only with option B15

Manual operation: See "Copy Destination" on page 45

[:SOURce<hw>]:FSIMulator:COPY:EXECute

Copies the settings of a fading path group to the selected one.

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: see [:SOURce<hw>]:FSIMulator:COPY:SOURce on page 220

Usage: Event

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Copy" on page 45

[:SOURce<hw>]:FSIMulator:COPY:SOURce <Source>

Sets the group whose settings are to be copied.

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> integer

Range: 1 to 8
*RST: 1

Example:

```
FSIM:DEL:STAT ON
FSIM:COPY:DEST 4
FSIM:COPY:SOUR 1
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

Manual operation: See "Copy Source" on page 45

[:SOURce<hw>]:FSIMulator:FREQuency <Frequency>

Sets 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:

```
SOURce1:FSIMulator:SDEStination BB
SOURce1:FSIMulator:FREQuency 2143200000
```

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Virtual RF" on page 29

[:SOURce<hw>]:FSIMulator:GLOBal:SEED <Seed>

This command enters the fading start seed. This value is global for the instrument.

Parameters:

<Seed> integer

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

Manual operation: See "Start Seed" on page 102

[:SOURce<hw>]:FSIMulator:HOPPing:MODE <Mode>

Activates frequency hopping and determines how fading is resumed after a frequency hop.

Note: Prior to activating frequency hopping, list mode and the desired frequency table must be activated.

This command is available only for the "Standard Delay" and "Fine Delay 30 MHz / 50 MHz" fading configurations.

Parameters:

<Mode> OFF | IBANd | OOBand

OFF
Frequency hopping is deactivated.

IBANd
Activates an in-band frequency hopping.

OOBand
Activates an out of band frequency hopping.

*RST: OFF

Example:

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

Manual operation: See "Freq. Hopping Mode" on page 31

[:SOURce<hw>]:FSIMulator:IGNore:RFCHanges <RfChanges>

(instruments with RF output only)

This command determines whether frequency changes < 5% are ignored. This enables faster frequency hopping.

Parameters:

<RfChanges> 0 | 1 | OFF | ON

*RST: 0

Example: `FSIM:IGN:RFCH ON`

Ignores frequency changes < 5% for the fading.

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Ignore RF Changes < 5PCT" on page 31

[: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

Manual operation: See "Clipped Samples" on page 101

[: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

Manual operation: See "Insertion Loss Mode" on page 100

[: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

Manual operation: See "Insertion Loss" on page 101

[:SOURce<hw>]:FSIMulator:KCONstant <KConstant>

Selects whether to keep the speed or the resulting 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

Manual operation: See "Keep Constant" on page 30

[:SOURce<hw>]:FSIMulator:PRESet

Sets the default settings (`*RST` values) for fading simulation.

Example: `SOURce1:FSIMulator:PRESet`

Usage: Event

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Set to Default" on page 24

[:SOURce<hw>]:FSIMulator:RESTart

Triggers a restart of fading simulation if manual restart is selected.

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

Manual operation: See "Restart" on page 30

[: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

Manual operation: See "Restart Event" on page 30

[:SOURce<hw>]:FSIMulator:ROUTe <Route>

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:

<Route> 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 path are available for fader AA. The faded modulation signal of fader AB is placed on baseband path B. 10 fading path are available for fader AB.
Fader B is split into fader BA and fader BB. The faded modulation signal of fader BA is placed on baseband path A. 10 fading path are available for fader BA. The faded modulation signal of fader BB is placed on baseband path B. 10 fading path are available for fader BB.

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

Manual operation: See "Signal Routing" on page 17

[:SOURce<hw>]:FSIMulator:SDEStination <SDestination>

Sets RF frequency which is used as a basis for computing the Doppler shift.

Parameters:

<SDestination> 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: see `[:SOURce<hw>]:FSIMulator:FREQuency` on page 221

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Signal Dedicated To" on page 29

[: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:

<Unit> 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

Manual operation: See "Speed Unit" on page 30

[:SOURce<hw>]:FSIMulator:STANdard <Standard>

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 126.

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 Chapter 7.1, "CDMA Standards", on page 126	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 Chapter 7.2, "GSM Standards", on page 129	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 Chapter 7.3, "NADC Standards", on page 134	NADC8 | NADC50 | NADC100	NADC 8/50/100 km/h, 2 path
DCS1800/PCS1900 see Chapter 7.4, "PCN Standards", on page 135	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 Chapter 7.5, "TETRA Standards", on page 140	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 Chapter 7.6, "3GPP Standards", on page 144	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	MD1	3GPP Moving Propagation "Ref. + Moving Channel", 2path
see Chapter 7.15, "3GPP/LTE Moving Propagation", on page 190	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	G3HST1OS | G3HST1OSDU	3GPP HST1 "Open space", according to the test case 3GPP TS25.141, annex D.4A and 3GPP TS36.141, annex B.3
see Chapter 7.14, "3GPP/LTE High Speed Train", on page 188	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 Chapter 7.7, "WLAN Standards", on page 155	HL2A | HL2B | HL2C | HL2D | HL2E	WLAN HyperLan 18 path
DAB see Chapter 7.8, "DAB Standards", on page 160	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 Chapter 7.9, "WIMAX Standards", on page 162	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 Chapter 7.12, "WIMAX-MIMO Standards", on page 180	WMITUPB3L | WMITUPB3M | WMITUPB3H | WMITUVA60L | WMITUVA60M | WMITUVA60H	ITU PB Low/Medium/High, ITU VA Low/Medium/High

Standard / Test Case	<Predefined_Standard>	Description
LTE see Chapter 7.10, "LTE Standards", on page 175	LTEEPA5 | LTEEVA5 | LTEEVA70 | LTEETU70 | LTEETU300 | LTEMBSFN5	LTE EPA 5Hz , LTE EVA 5/70Hz, LTE ETU 70/300Hz, LTE MBSFN 5Hz
LTE-MIMO see Chapter 7.11, "LTE-MIMO Standards", on page 178	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 Chapter 7.13, "1xEVDO Standards", on page 184	EVDO1CH1 | EVDO1CH1BC5 | EVDO1CH2 | EVDO1CH2BC5 | EVDO1CH3 | EVDO1CH3BC5 | EVDO1CH4 | EVDO1CH4BC5 | EVDO1CH5 | EVDO1CH5BC5	1xEVDO Chan. 1/2/3/4/5
WATTERSON see Chapter 7.16, "Watterson Standards", on page 192	WATTI1 | WATTI3 | WATTI2	Watterson I1, I2, I3
802.11n-SISO see Chapter 7.17, "802.11n-SISO Standards", on page 193	WLANNSMODA | WLANNSMODB | WLANNSMODC | WLANNSMODD | WLANNSMODE | WLANNSMODF	802.11n SISO Model A/B/C/D/E/F
802.11n-MIMO see Chapter 7.18, "802.11n-MIMO Standards", on page 194	WLANNMODA | WLANNMODB | WLANNMODC | WLANNMODD | WLANNMODE | WLANNMODF	802.11n MIMO Model A/B/C/D/E/F
802.11ac-SISO see Chapter 7.20, "802.11ac-SISO Standards", on page 215	WLANACSMODA|WLANACSMODB|WLANACSMODC|WLANACSMODD|WLANACSMODE|WLANACSMODF	802.11ac SISO Model A/B/C/D/E/F
802.11ac-MIMO see Chapter 7.19, "802.11ac-MIMO Standards", on page 204	WLANACMODA | WLANACMODB | WLANACMODC | WLANACMODD | WLANACMODE | WLANACMODF	802.11ac MIMO Model A/B/C/D/E/F

Parameters:

<Standard> 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 | G3HST2TLCDU | G3HST3TMADU | LTEMBSFN5 | LTECQI5 | LTEETU30 | LMETU30L | LMETU30M | LMETU30H | WLANNMODA | WLANNMODB | WLANNMODC | WLANNMODD | WLANNMODE | WLANNMODF | WLANACMODA | WLANACMODB | WLANACMODC | WLANACMODD | WLANACMODE | WLANACMODF | WLANNSMODA | WLANNSMODB | WLANNSMODC | WLANNSMODD | WLANNSMODE | WLANNSMODF | WLANACSMODA | WLANACSMODB | WLANACSMODC | WLANACSMODD | WLANACSMODE | WLANACSMODF

*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

Manual operation: See "Standard / Test Case" on page 26

[:SOURce<hw>]:FSIMulator:STANdard:REFerence <Reference>

Queries the reference in the standard for the selected test case.

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

Manual operation: See "Standard / Test Case" on page 26

[: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.

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 to 80
Increment: 0.1
*RST: 0

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

Manual operation: See "State" on page 24

[:SOURce]:FSIMulator:CATalog?

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:

<FileNames> 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 `Birth_3gpp` is available.

Usage: Query only

Options: Option B14; Options B13 and B10

Manual operation: See "Save/Recall" on page 25

[:SOURce<hw>]:FSIMulator:LOAD <Filename>

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 `Birth_3gpp` is available.

`FSIM:LOAD 'Birth_3gpp'`

loads the fading settings from the file `Birth_3gpp`.

Usage: Setting only

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Save/Recall" on page 25

[:SOURce]:FSIMulator:DELETE <Filename>

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 `Birth_3gpp` is available.
`FSIM:DELETE 'Birth_3gpp'`
deletes the file `Birth_3gpp`.

Usage: Setting only

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Save/Recall" on page 25

[:SOURce<hw>]:FSIMulator:STORe <Filename>

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

Manual operation: See "Save/Recall" on page 25

[: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

Manual operation: See "Save/Recall" on page 25

[:SOURce<hw>]:FSIMulator:COUPle:LOGNormal:CSTD <Cstd>
[:SOURce<hw>]:FSIMulator:COUPle:LOGNormal:LCONstant <LConstant>

Couples the lognormal fading setting.

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:

```
SOURce1:FSIMulator:CONFiguration STAN
SOURce1:FSIMulator:DEL:GROup1:PATH1:PROFile PDOP
SOURce1:FSIMulator:DEL:GROup1:PATH1:SPEed 1111.111
SOURce1:FSIMulator:STATe 1
SOURce1:FSIMulator:COUPle:SPEed 1
SOURce1:FSIMulator:CSPeed 1

SOURce2:FSIMulator:CONFiguration STAN
SOURce2:FSIMulator:STATe 1
SOURce2:FSIMulator:DEL:GROup1:PATH1:SPEed?
// 1111.111

SOURce1:FSIMulator:COUPle:LOGNormal:LCONstant 1
SOURce1:FSIMulator:COUPle:LOGNormal:CSTD 1
SOURce1:FSIMulator:DEL:GROup1:PATH1:LOGNormal:STATe 1
SOURce1:FSIMulator:DEL:GROup1:PATH1:LOGNormal:LCONstant 150
SOURce2:FSIMulator:DEL:GROup1:PATH1:LOGNormal:LCONstant?
// 150
SOURce1:FSIMulator:DEL:GROup1:PATH1:LOGNormal:CSTD 2
SOURce2:FSIMulator:DEL:GROup1:PATH1:LOGNormal:CSTD?
// 2
```

Options: Options B14 and B15; Options B13 and B10

Manual operation: See "Local Constant Coupled" on page 102

[:SOURce<hw>]:FSIMulator:COUPle:SPEed <Speed>

Couples the setting for the speed for the paths of both faders.

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: see `[:SOURce<hw>]:FSIMulator:COUPle:LOGNormal:LCONstant` on page 238

Options: Options B14 and B15; Options B13 and B10

Manual operation: See "Speed Setting Coupled" on page 102

[:SOURce<hw>]:FSIMulator:CSPeed <CSpeed>

Determines whether the same speed is set for all of the activated fading 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:COUPled:SPEed ON`), this parameter is also coupled.

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

Parameters:

<CSpeed> 0 | 1 | OFF | ON

*RST: 1

Example: see `[:SOURce<hw>]:FSIMulator:COUPle:LOGNormal:LCONstant` on page 238

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Common Speed For All Paths" on page 30

8.2 Birth Death

The Birth Death dynamic fading configurations are available with option R&S SMx/AMU-K71.

[:SOURce<hw>]:FSIMulator:BIRThdeath:DELay:GRID <Grid>

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: 1E-9 to dynamic
Increment: 1E-9
*RST: 1E-6

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

Manual operation: See "Delay Grid" on page 52

[: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

Manual operation: See "Maximum Delay" on page 52

[:SOURce<hw>]:FSIMulator:BIRThdeath:HOPPing:DWELl <Dwell>

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

Parameters:

<Dwell> float

Range: 1E-3 to 429.49672950
Increment: 100E-9
*RST: 191E-3

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

Manual operation: See "Hopping Dwell" on page 53

[:SOURce<hw>]:FSIMulator:BIRThdeath:PATH<ch>:LOSS <Loss>

Sets the loss of the paths with birth death propagation.

Parameters:

<Loss> float

Range: 0 to 50
Increment: 0.001
*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

Manual operation: See "Path Loss" on page 51

[: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

Manual operation: See "Profile" on page 51

[:SOURce<hw>]:FSIMulator:BIRThdeath:POSitions <Positions>

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> integer

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

Manual operation: See "Positions" on page 52

[:SOURce<hw>]:FSIMulator:BIRThdeath:SOFFset <Soffset>

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: 0 to 429
Increment: 100E-9
*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

Manual operation: See "Start Offset" on page 52

[:SOURce<hw>]:FSIMulator:BIRThdeath:SPEed <Speed>

Sets the speed of the moving receiver for birth death propagation.

The default speed unit is m/s. Units different than the default one must be specified.

Parameters:

<Speed> float

Range: 0 to dynamic
Increment: 0.001
*RST: 0
Default unit: m/s

Example:

```
SOURce1:FSIMulator:BIRThdeath:SPEed 100 KMH
SOURce1:FSIMulator:BIRThdeath:PATH1:FDOPpler?
// 92.6574343641427
SOURce1:FSIMulator:BIRThdeath:FRATio 1
SOURce1:FSIMulator:BIRThdeath:PATH1:FDOPpler:ACTual?
// 92.66
SOURce1:FSIMulator:BIRThdeath:FRATio 0.5
SOURce1:FSIMulator:BIRThdeath:PATH1:FDOPpler:ACTual?
// 46.33
```

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Speed" on page 54

[:SOURce<hw>]:FSIMulator:BIRThdeath:FRATio <FRatio>

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: 0.0001
*RST: 1

Example: See [:SOURce<hw>]:FSIMulator:BIRThdeath:SPEed on page 243

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Frequency Ratio" on page 54

[:SOURce<hw>]:FSIMulator:BIRThdeath:PATH<ch>:FDOPpler?

Queries the resulting Doppler frequency with birth death propagation.

Return values:

<FDoppler> float

Range: 0 to 1000
Increment: 0.01
*RST: 0

Example: see [:SOURce<hw>]:FSIMulator:BIRThdeath:SPEed on page 243

Usage: Query only

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Resulting Doppler Shift" on page 54

[:SOURce<hw>]:FSIMulator:BIRThdeath:PATH<ch>:FDOPpler:ACTual?

Queries the actuial Doppler frequency.

Return values:

<ActDoppler> float

Range: -1600 to 1600
Increment: 0.01
*RST: 0

Example: see [:SOURce<hw>]:FSIMulator:BIRThdeath:SPEed on page 243

Usage: Query only

Manual operation: See "Actual Doppler Shift" on page 54

[: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

Manual operation: See "Configuration" on page 26

8.3 Delay Modes

[: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

Manual operation: See "Additional Delay" on page 38

[: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 |FBMAXB`.

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 |FBMAXB`.

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

Manual operation: See "Correlation Coefficient" on page 42

[: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

Manual operation: See "Correlation Coefficient Phase" on page 43

[: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: OFF

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

Manual operation: See "Correlation Path" on page 41

[: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

Manual operation: See "Const. Phase" on page 39

[: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

Manual operation: See "Resulting Doppler Shift" on page 40

[: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>

Sets 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:ROUTe FBMAXB|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: 0.0001
*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

Manual operation: See "Frequency Ratio" on page 41

[: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: 0.0001
*RST: 0

Example:
`FSIM:DEL:GRO:PATH2:PROF WATT`
`FSIM:DEL:GRO:PATH2:FS?`

Manual operation: See "Frequency Shift" on page 39

[: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 10
Increment: 0.0001
*RST: 0.1

Example:
`FSIM:DEL:GRO:PATH2:PROF WATT`
`FSIM:DEL:GRO:PATH2:FSPR?`

Manual operation: See "Frequency Spread" on page 39

[: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> integer

Range: 0 to 12
*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

Manual operation: See "Standard Deviation " on page 44

[: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 fRF.

The following holds: $L_{min} = 12*10^9 m/s / f_{RF}$

`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

Manual operation: See "Local Constant" on page 44

[: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

Manual operation: See "Lognormal State" on page 43

[: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>

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: 0.001
*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

Manual operation: See "Path Loss" on page 37

[: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

Manual operation: See "Power Ratio" on page 38

[: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 (`SOUR:FSIM:...:GRO:PATH:CORR:STAT ON`), the same profile is set on both paths.

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

Parameters:

<Profile> SPATh | PDOPpler | RAYLeigh | RICE | CPHase | OGAUs | TGAUs | DGAUs | WDOPpler | WRICe | GDOPpler | GFD8 | GFD1 | WATTerson | BELLindoor | BELVehicle

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

PDOPpler
Pure Doppler

CPHase
Constant phase

OGAUs | TGAUs | DGAUs | GDOPpler | GFD8 | GFD1
GAUS1, GAUS2, GAUSDAB, Gauss Doppler, Gauss (0.08 f_d), Gauss (0.01 f_d)

WDOPpler | WRICe
WM Doppler, WM Rice

BELLindoor|BELVehicle
Bell Shape tgn Indoor, Bell Shape tgn Moving Vehicle

*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

Manual operation: See "Profile" on page 35

[: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

Example:
`FSIM:DEL:STAT ON`
activates the "Standard Delay" fading configuration.
`FSIM:DEL:GRO2:PATH:BDEL 2E-4`
sets a Delay Offset of 200 us for group 2.
`FSIM:DEL:GRO2:PATH2:ADEL 1E-5`
sets an Additional Delay of 10 us for fading path 2 of group 2.
`FSIM:DEL:GRO2:PATH2:RDEL?`
queries the Resulting Delay for fading path 2 of group 2.
`Response: 0.00021`
the Resulting Delay is 210 us.

Usage: Query only

Options: Option B14; Options B13 and B10; Fine Delay configurations only with option K71; SOURce2 and GROup<5...8> only with option B15

Manual operation: See "Resulting Delay" on page 38

[: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>

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.

Parameters:

<Speed> float

Increment: 0.001
*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

Manual operation: See "Speed" on page 40

[: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

Manual operation: See "State Path" on page 35

[: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

Manual operation: See "Configuration" on page 26

8.4 High Speed Train

The High Speed Train dynamic fading configurations are available with option R&S SMx/AMU-K71.

Example: Enabling and configuring a high speed train propagation

The following is an example on how to configure the settings without using a predefined standard.

```
SOURce1:FSIMulator:CONFiguration HSTRain
SOURce1:FSIMulator:HSTRain:PROFile PDOPpler
SOURce1:FSIMulator:HSTRain:SPEed 100kmh
SOURce1:FSIMulator:HSTRain:DISTance:MINimum 20m
SOURce1:FSIMulator:HSTRain:DISTance:STARt 2000m
SOURce1:FSIMulator:HSTRain:PATH:STATe ON
SOURce1:FSIMulator:HSTRain:STATe ON
SOURce1:FSIMulator:HSTRain:FDOPpler?
// 92.657 Hz
```

Example: Configuring a high speed train scenario for BS tests

The following is an example on how to configure fading simulator to generate a HST BS test signal according to 3GPP TS36.104.

For frequency Band 1 tests, the specification defines:

F_{DL} = 2.14 GHz, F_{UL} = 1.95 GHz

and F_D = 1140 Hz

```
SOURce1:FSIMulator:PRESet
SOURce1:FSIMulator:STANdard G3HST1OSDU
SOURce1:FREQuency:CW 1.95E9
SOURce1:FSIMulator:HSTRain:DOWNlink:FREQuency:STATe ON
SOURce1:FSIMulator:HSTRain:DOWNlink:FREQuency 2.14E9
SOURce1:FSIMulator:HSTRain:PATH:STATe ON
SOURce1:FSIMulator:HSTRain:STATe ON
SOURce1:FSIMulator:HSTRain:FDOPpler?
// 1136.89307687654
```

[: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: see Example "Enabling and configuring a high speed train propagation" on page 261

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "D (min)" on page 73

[: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> integer

Range: 20 to 2000
*RST: 300

Example: see Example "Enabling and configuring a high speed train propagation" on page 261

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "D (S)" on page 73

[:SOURce<hw>]:FSIMulator:HSTRain:SPEed <Speed>

Sets the velocity parameter , i.e. the speed of the moving receiver in m/s.

Parameters:

<Speed> float

Range: 0.001 to dynamic
Increment: 0.001
*RST: 83.333

Example: see Example "Enabling and configuring a high speed train propagation" on page 261

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Speed" on page 73

[: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: see Example "Configuring a high speed train scenario for BS tests" on page 261

Usage: Query only

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Profile" on page 72

[: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: see Example "Enabling and configuring a high speed train propagation" on page 261

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "State Path" on page 35

[:SOURce<hw>]:FSIMulator:HSTRain:PROFile <Profile>

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

Parameters:

<Profile> SPATh | PDOPpler | RAYLeigh

*RST: PDOPpler

Example: see Example "Enabling and configuring a high speed train propagation" on page 261

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Profile" on page 72

[:SOURce<hw>]:FSIMulator:HSTRain:KFACtor <KFactor>

Sets the Rician factor K for high speed train scenario 2.

Parameters:

<KFactor> float

Range: -30 to 30
Increment: 0.01
*RST: 10

Example:

```
SOURce1:FSIMulator:PRESet
SOURce1:FSIMulator:STANdard G3HST2TLC
SOURce1:FSIMulator:HSTRain:KFACtor 10
```

Manual operation: See "K (Rician factor)" on page 73

[:SOURce<hw>]:FSIMulator:HSTRain:DOWNlink:FREQuency:STATe <HstDlFreqState>

Enables the definition of virtual downlink frequency.

Parameters:

<HstDlFreqState> 0 | 1 | OFF | ON

*RST: 0

Example: see Example "Configuring a high speed train scenario for BS tests" on page 261

Manual operation: See "Consider DL RF" on page 73

[:SOURce<hw>]:FSIMulator:HSTRain:DOWNlink:FREQuency <HstDlFreq>

Sets the virtual downlink frequency, necessary to calculate the UL Doppler shift.

Parameters:

<HstDlFreq> float

Range: 100E3 to 6E9
Increment: 0.01
*RST: 1E9

Example: see Example "Configuring a high speed train scenario for BS tests" on page 261

Manual operation: See "Virtual DL RF" on page 73

[:SOURce<hw>]:FSIMulator:HSTRain:STATe <State>

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

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: see Example "Enabling and configuring a high speed train propagation" on page 261

Options: Option B14; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Configuration" on page 26

8.5 Moving Propagation

The moving propagation dynamic fading configurations are available with option R&S SMx/AMU-K71.

[:SOURce<hw>]:FSIMulator:MDELay:ALL:MOVing:VPERiod <VPeriod>

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".

Parameters:

<VPeriod> float

Range: 5 to 200
Increment: 0.1
*RST: 25

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:VPER 50 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

Manual operation: See "Variation Period" on page 62

[: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

Manual operation: See "Delay Variation (Peak-Peak)" on page 62

[: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 Rayligh 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

Manual operation: See "Moving Channels" on page 29

[: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 |FBMAXB`.

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>

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 sinusoidal in 105 s between 4 us and 14 us.

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Delay" on page 60

[:SOURce<hw>]:FSIMulator:MDELay:MOVing:DELay:VARiation <Variation>

Enters the range for the delay of the moving fading path for moving propagation. The delay of the moving path slowly varies sinusoidal within this range.

Parameters:

<Variation> float

Range: 0.3E-6 to dynamic
Increment: 10E-9
*RST: 5E-6

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

Manual operation: See "Variation (Peak-Peak)" on page 61

[:SOURce<hw>]:FSIMulator:MDELay:MOVing:LOSS <Loss>

Sets the insertion loss of the moving path for moving propagation.

Parameters:
<Loss> float

Range: 0 to 50
Increment: 0.001
*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

Manual operation: See "Path Loss" on page 60

[: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

Manual operation: See "State" on page 60

[: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

Manual operation: See "Variation Period" on page 61

[: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

Manual operation: See "Delay" on page 60

[:SOURce<hw>]:FSIMulator:MDELay:REFerence:LOSS <Loss>

Sets the loss of the reference path for moving propagation.

Parameters:

<Loss> float

Range: 0 to 50
Increment: 0.001
*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

Manual operation: See "Path Loss" on page 60

[: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

Manual operation: See "State" on page 60

[: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
Manual operation:	See "Configuration" on page 26

8.6 MIMO Settings

The MIMO configurations are available with option R&S SMx/AMU-K74.

Placeholder <path>

To simplify the description of the remote control commands, the placeholder `<path>` is introduced. Replace this placeholder `<path>` with `AB`, `AC`, etc.

The description of each command containing this placeholder provides a link to the related commands with their correct syntax.

> The replacement of the place holder `<path>` is mandatory, i.e. remote control commands containing this placeholder are not recognized and accepted by the instrument.

[:SOURce<hw>]:FSIMulator:MIMO:CAPability?

Queries the supported MIMO configurations.

Return values:

<MimoCapability> string

Example:
```
:SOURce1:FSIMulator:MIMO:CAPability?
Response: "M2X2,M2X4,M4X2,M2X3,M3X2,M1X2,..."
```

Usage: Query only

[:SOURce<hw>]:FSIMulator:MIMO:COPY:NEXT

Copies the matrix values of the current tap to the subsequent tap. If the current tap is the last tap, the command is discarded.

See also [:SOURce<hw>]:FSIMulator:MIMO:COPY:ALL on page 272.

Usage: Event

Options: Options B14 and K71; Options B13 and B10; Option K74; SOURce2 only with option B15

Manual operation: See "Copy To Next" on page 117

[:SOURce<hw>]:FSIMulator:MIMO:COPY:ALL

Applies the matrix values of the current tap to all taps.

Usage: Event

Options: Options B14 and K71; Options B13 and B10; Option K74; SOURce2 only with option B15

Manual operation: See "Copy To All" on page 117

[:SOURce<hw>]:FSIMulator:MIMO:COPY:PREVious

This command copies the matrix values of the current tap to the next lower tap.

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

Manual operation: See "Copy To Prev" on page 117

[: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 configura-tions) 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>

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: 0

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>

Sets the display mode for power.

Parameters:

<Mode> RELative | ABSolute

*RST: RELative

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>

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 instument. The MIMO subset selected in each of the two connected instrument has to be different.

Parameters:

<Subset> SET1 | SET2

*RST: SET1

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

Manual operation: See "MIMO Subset" on page 114

[:SOURce<hw>]:FSIMulator:MIMO:TAP <Tap>

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

Manual operation: See "Current Path (Tap) #" on page 117

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:ROW<di>:COLumn<st>:IMAGinary <Imaginary>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:ROW<di>:COLumn<st>:IMAGinary <Imaginary>

Sets the value for the imaginary part of the receiver/transmitter 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: `SOURce1:FSIMulator:MIMO:TAP2:KRONecker:CORRelation:TX:ROW1:COLumn2:IMAGinary 0.5`
sets the imaginary part of the Tx correlation AB to 0.5.

Options: Options B14 and K71; Options B13 and B10; Option K74; SOURce2 only with option B15

Manual operation: See "Tx Correlation Coefficients, Phase/Imag" on page 119

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:ROW<di>:COLumn<st>:PHASe <Phase>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:ROW<di>:COLumn<st>:PHASe <Phase>

Sets the value for the phase of the receiver/transmitter 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: `SOURce1:FSIMulator:MIMO:TAP2:KRONecker:CORRelation:TX:ROW1:COLumn2:PHASe 30`
sets the phase of the Tx correlation AB to 30 degrees.

Options: Options B14 and K71; Options B13 and B10; Option K74; SOURce2 only with option B15

Manual operation: See "Tx Correlation Coefficients, Phase/Imag" on page 119

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:ROW<di>:COLumn<st>:MAGNitude <Magnitude>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:ROW<di>:COLumn<st>:MAGNitude <Magnitude>

Sets the ratio of the receiver/transmitter 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:

<Magnitude> float

Range: 0 to 1
Increment: 0.001
*RST: 0

Example: `SOURce1:FSIMulator:MIMO:TAP2:KRONecker:CORRelation:TX:ROW1:COLumn2:MAGNitude 0.5`
sets the ratio of the Tx correlation AB to 0.5.

Options: Options B14 and K71; Options B13 and B10; Option K74; SOURce2 only with option B15

Manual operation: See "Tx Correlation Coefficients, Magnitude/Real" on page 118

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:RX:ROW<di>:COLumn<st>:REAL <Real>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:KRONecker:CORRelation:TX:ROW<di>:COLumn<st>:REAL <Real>

Sets the value for the real part of the receiver/transmitter 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: `SOURce1:FSIMulator:MIMO:TAP2:KRONecker:CORRelation:TX:ROW1:COLumn2:REAL 0.5`
sets the value for the real part of the Tx correlation AB to 0.5.

Options: Options B14 and K71; Options B13 and B10; Option K74; SOURce2 only with option B15

Manual operation: See "Tx Correlation Coefficients, Magnitude/Real" on page 118

[: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

Manual operation: See "Accept" on page 123

[: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

Manual operation: See "Conflict" on page 123

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:MODE <Mode>

Sets the input mode for the Rx and Tx correlation values (matrix mode).

Parameters:
<Mode> INDividual | KRONecker | AOAaod
*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

Manual operation: See "Matrix Mode" on page 117

[: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

Manual operation: See "Phase/Imag" on page 123

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:MATRix:ROW<di>:COLumn<st>:MAGNitude <Magnitude>

Determines the value for the real/magnitude part of the correlation.

Suffix:

<di> 1..4

<st> 1..4

Parameters:

<Magnitude> float

Range: 0 to 1
Increment: 0.0001
*RST: 1

Example: `FSIM:MIMO:TAP2:MATR:ROW1:COL1:MAGN 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

Manual operation: See "Real/Magnitude" on page 122

[: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

Manual operation: See "Set to Unity" on page 124

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVECtor:<path>:GAIN

Sets the relative gain in the selected path.

For the correct syntax of the other available commands, see Chapter 8.7.1, "Relative Gain", on page 280.

Parameters:

<Gain> float

Range: -50 to 0
Increment: 0.01
*RST: 0

Example: `SOURce1:FSIMulator:MIMO:TAP2:GVECtor:AA:GAIN -3`
decreases the level in path AA by 3 dB.

Options: Options B14 and K71; Options B13 and B10; Option K74;
SOURce2 only with option B15

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVECtor:<path>:PHASe

Sets the phase shift of the selected path.

For the correct syntax of the other available commands, see Chapter 8.7.2, "Phase Shift", on page 281.

Parameters:

<Phase> float

Range: 0 to 360
Increment: 0.02
*RST: 0

Example: `SOURce1:FSIMulator:MIMO:TAP2:GVECtor:AA:PHASe 45`
shifts the phase in path AA by 45 degree.

Options: Options B14 and K71; Options B13 and B10; Option K74;
SOURce2 only with option B15

8.7 MIMO Vector Settings

8.7.1 Relative Gain

[: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>

For description, refer to `[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVECtor:<path>:GAIN` on page 279.

Parameters:

<Gain>	float	
	Range:	-50 to 0
	Increment:	0.01
	*RST:	0

8.7.2 Phase Shift

[: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>

For description, refer to `[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:GVECtor:<path>:PHASe` on page 280.

Parameters:

<Gain>	float	
	Range:	0 to 360
	Increment:	0.02
	*RST:	0

8.8 TGn Settings

The MIMO configurations are available with option R&S SMx/AMU-K74.

Example: Simulating one path TGn fading with two rays with different distributions

In the following example we assume that a MIMO fading configuration is 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:TGN:ANTenna:DISTance:RX 0.5
SOURce:FSIMulator:MIMO:TGN: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:TGN:RAY1:GAIN 0
SOURce:FSIMulator:MIMO:TAP:TGN:RAY1:ARRival:ANGLe 72
SOURce:FSIMulator:MIMO:TAP:TGN:RAY1:ARRival:SPRead 5
SOURce:FSIMulator:MIMO:TAP:TGN:RAY1:DEParture:ANGLe 15
SOURce:FSIMulator:MIMO:TAP:TGN:RAY1:DEParture:SPRead 3
SOURce:FSIMulator:MIMO:TAP:TGN:DISTribution EQUal
SOURce:FSIMulator:MIMO:TAP:TGN:RAY1:STATe ON

// ******************************************************************
// Set ray#2 to simulate signal scattered by
// obstacles causing Gaussian fading distribution, e.g. a tree
// ******************************************************************
SOURce:FSIMulator:MIMO:TAP:TGN:RAY2:GAIN -10
SOURce:FSIMulator:MIMO:TAP:TGN:RAY2:ARRival:ANGLe 23
SOURce:FSIMulator:MIMO:TAP:TGN:RAY2:ARRival:SPRead 7
SOURce:FSIMulator:MIMO:TAP:TGN:RAY2:DEParture:ANGLe 25
SOURce:FSIMulator:MIMO:TAP:TGN:RAY2:DEParture:SPRead 5
SOURce:FSIMulator:MIMO:TAP:TGN:DISTribution GAUSs
SOURce:FSIMulator:MIMO:TAP:TGN:RAY2:STATe ON

// ******************************************************************
// Query the resulting matrix correlation coefficients with the
// SOURce:FSIMulator:MIMO:TAP:MATRix:... commands
// ******************************************************************
```

[:SOURce<hw>]:FSIMulator:MIMO:TGN:ANTenna:DISTance:RX <RxAntDist>
[:SOURce<hw>]:FSIMulator:MIMO:TGN:ANTenna:DISTance:TX <TxAntDist>

Sets the RX/TX antenna distance in the SCM fading model.

Parameters:

<TxAntDist> float

Range: 0.1 to 2
Increment: 0.1
*RST: 0.5

Example: see Example "Simulating one path TGn fading with two rays with different distributions" on page 282.

Manual operation: See "RX/TX Antenna Distance" on page 120

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:DISTribution <Distribution>

Selects one of the proposed statistical functions to determine the distribution of the selected cluster.

Parameters:

<Distribution> LAPLace | EQUal | GAUSs

*RST: EQUal

Example: see Example "Simulating one path TGn fading with two rays with different distributions" on page 282.

Manual operation: See "Distribution" on page 121

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:ARRival:ANGLe <ArrAngle>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN: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 359.9
Increment: 0.001
*RST: 0

<ArrAngle> float

Range: 0 to 359.9
Increment: 0.001
*RST: 0

Example: see Example "Simulating one path TGn fading with two rays with different distributions" on page 282.

Manual operation: See "Angle of Departure (AoD)" on page 121

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:ARRival:SPRead <ArrSpread>
[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:DEParture:SPRead <DepSpread>

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

Parameters:

<DepSpread> float

Range: 0.1 to 75
Increment: 0.001
*RST: 0.1

<ArrSpread> float

Range: 0.1 to 75
Increment: 0.001
*RST: 0.1

Example: see Example "Simulating one path TGn fading with two rays with different distributions" on page 282.

Manual operation: See "AoD Spread" on page 121

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:GAIN <Gain>

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

Parameters:

<Gain> float

Range: -50 to 0
Increment: 0.001
*RST: 0

Example: see Example "Simulating one path TGn fading with two rays with different distributions" on page 282.

Manual operation: See "Relative Gain /dB" on page 120

[:SOURce<hw>]:FSIMulator:MIMO:TAP<ch>:TGN:RAY<st>:STATe <RayState>

Enables/disables the selected ray.

Parameters:

<RayState> 0 | 1 | OFF | ON

*RST: 0

Example: see Example "Simulating one path TGn fading with two rays with different distributions" on page 282.

Manual operation: See "Ray State" on page 120

8.9 2 Channel Interferer

The 2 channel interferer fading configurations are available with option R&S SMx/AMU-K71.

Example: Enabling a two channel interferer fading configuration

The following is a simple example on how to configure and enable a two channel interferer fading configuration.

```
SOURce1:FSIMulator:CONFiguration TCI

SOURce1:FSIMulator:TCInterferer:REFerence:PROFile PDOP
SOURce1:FSIMulator:TCInterferer:REFerence:LOSS 1
SOURce1:FSIMulator:TCInterferer:REFerence:SPEed 2
SOURce1:FSIMulator:TCInterferer:REFerence:FRATio 0.5
SOURce1:FSIMulator:TCInterferer:REFerence:DELay:MINimum 0.00003
SOURce1:FSIMulator:TCInterferer:PERiod 160

SOURce1:FSIMulator:TCInterferer:MOVing:PROFile SPAT
SOURce1:FSIMulator:TCInterferer:REFerence:LOSS 0
SOURce1:FSIMulator:TCInterferer:MOVing:DELay:MINimum 0.00003
SOURce1:FSIMulator:TCInterferer:MOVing:DELay:MAXimum 0.00011
SOURce1:FSIMulator:TCInterferer:MOVing:MMODe SLID

SOURce1:FSIMulator:TCInterferer:REFerence:STATe 1
SOURce1:FSIMulator:TCInterferer:MOVing:STATe 1
SOURce1:FSIMulator:TCINterferer:STATe 0
SOURce1:FSIMulator:STATE 1

SOURce1:FSIMulator:TCINterferer:REFerence:FDOPpler?
// Response: 3.33564095198152
```

[:SOURce<hw>]:FSIMulator:TCINterferer[:STATe] <State>

Activates the 2 channel interferer fading configuration.

The paths and the fading simulator must be switched on separately, see `[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:STATe` and `[:SOURce<hw>]:FSIMulator[:STATe]`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: see Example "Enabling a two channel interferer fading configuration" on page 285

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Configuration" on page 26

[:SOURce<hw>]:FSIMulator:TCINterferer:MOVing:DELay:MAXimum <Maximum>

Sets the maximum delay for the moving path.

Parameters:

<Maximum> float

Range: dynamic to 0.001
Increment: 20E-9
*RST: 110E-6

Example: see Example "Enabling a two channel interferer fading configuration" on page 285

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Delay Max (Moving Path)" on page 66

[:SOURce<hw>]:FSIMulator:TCINterferer:MOVing:MMODe <MMode>

Selects the type of moving applied to the moving path.

Parameters:

<MMode> SLIDing | HOPPing

*RST: HOPPing

Example: see Example "Enabling a two channel interferer fading configuration" on page 285

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Moving Mode (Moving Path)" on page 67

[:SOURce<hw>]:FSIMulator:TCINterferer:PERiod <Period>

Sets either the dwell time or the period for a complete cycle of 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: see Example "Enabling a two channel interferer fading configuration" on page 285

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Period/Dwell" on page 67

[:SOURce<hw>]:FSIMulator:TCINterferer:SPEed <Speed>

Sets the speed *v* of the moving receiver for 2 channel interferer fading.

Parameters:

<Speed> float

Range: 0 to 27778 (dynamic)
Increment: 0.001
*RST: 0.83333

Example: see Example "Enabling a two channel interferer fading configuration" on page 285

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Speed" on page 65

[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:DELay:MINimum <Minimum>

Sets the minimum delay for the reference path and the moving path.

Parameters:

<Minimum> float

Range: 0 to dynamic
Increment: 20E-9
*RST: 0

Example: see Example "Enabling a two channel interferer fading configuration" on page 285

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Delay Min" on page 66

[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:FDOPpler?

Queries the Doppler frequency of the reference and moving path with 2 channel interferer fading.

Return values:

<FDoppler> float

Range: 0 to 1000
Increment: 0.01
*RST: 0

Example: see Example "Enabling a two channel interferer fading configuration" on page 285

Usage: Query only

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Profile" on page 65

[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:FRATio <FRatio>

Sets 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: 0.0001
*RST: 0

Example: see Example "Enabling a two channel interferer fading configuration" on page 285

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Freq. Ratio" on page 66

[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:LOSS <Loss>

Seta 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: see Example "Enabling a two channel interferer fading configuration" on page 285

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "Path Loss" on page 65

[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:PROFile <Profile>

Sets the fading profile to be used for the reference and moving path with 2 channel interferer fading.

Parameters:

<Profile> SPATh | PDOPpler | RAYLeigh

*RST: SPATh

Example: see Example "Enabling a two channel interferer fading configuration" on page 285

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

[:SOURce<hw>]:FSIMulator:TCINterferer:REFerence|MOVing:STATe <State>

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, see `[:SOURce<hw>]:FSIMulator:TCINterferer[:STATe]` on page 286 and . `[:SOURce<hw>]:FSIMulator[:STATe]`

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: see Example "Enabling a two channel interferer fading configuration" on page 285

Options: Options B14 and K71; Options B13 and B10; SOURce2 only with option B15

Manual operation: See "State" on page 65

8.10 Dynamic Scenario Simulation

The simulation of dynamic fading scenarios is available with option R&S SMx/AMU-K77.

8.10.1 Common Settings

[:SOURce<hw>]:FSIMulator:DSSimulation:SCENario <Scenario>

Selects the dynamic fading scenario (see "Scenario" on page 74).

Parameters:
<Scenario> SHIPtoship | TOWertoaircraft | USER
*RST: SHIPtoship

Options: R&S SMU/AMU-K77

Manual operation: See "Scenario" on page 74

[:SOURce<hw>]:FSIMulator:DSSimulation:CFORmat <CoorFormat>

Defines the coordinate system.

Parameters:
<CoorFormat> ENU | DMS | DECimal
*RST: ENU

Options: R&S SMU/AMU-K77

Manual operation: See "Coordinate System" on page 75

[: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

Manual operation: See "Create" on page 75

[:SOURce<hw>]:FSIMulator:DSSimulation:SAVE <ScenarioFile>

Stores the current scenario settings into the selected file. The directory is set using command `MMEM:CDIRectory`. Only the file name has to be entered.

Parameters:
<ScenarioFile> string

Options: R&S SMU/AMU-K77

Manual operation: See "Load/Save Scenario" on page 76

[:SOURce<hw>]:FSIMulator:DSSimulation:CATalog?

This command reads out the scenario files in the default directory. The default directory is set using command `MMEM:CDIRectory`.

Return values:

<ScenarioFiles>	string

Example:	`MMEM: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
Manual operation:	See "Load/Save Scenario" on page 76

[:SOURce<hw>]:FSIMulator:DSSimulation:LOAD <ScenarioFile>

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.

Parameters:

<ScenarioFile>	string
Options:	R&S SMU/AMU-K77
Manual operation:	See "Load/Save Scenario" on page 76

[: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
Manual operation:	See "Preset" on page 76

8.10.2 Ship To Ship

[: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

Manual operation: See "Turn Back After" on page 77

[: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

Manual operation: See "Transmitter/Receiver Vehicle Type" on page 77

[: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

Manual operation: See "Speed" on page 78

[: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

Manual operation: See "Heading" on page 78

[: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

Manual operation: See "Height of Antenna" on page 78

[: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

Manual operation: See "Distance X/Y" on page 77

[: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
*RST: 0

<LongitudeMin> integer

Defines the longitude minutes.

Range: 0 to 59
*RST: 0

<LongitudeSec> integer

Defines the longitude seconds.

Range: 0 to 59
*RST: 0

<LongitudeDir> EAST | WEST

Defines the longitude direction.

*RST: EAST

<LatitudeDeg> integer

Defines the latitude degrees.

Range: 0 to 90
*RST: 0

<LatitudeMin> integer

Defines the latitude minutes.

Range: 0 to 59
*RST: 0

<LatitudeSec> integer

Defines the latitude seconds.

Range: 0 to 59
*RST: 0

<LatitudeDir> NORTh | SOUTh

Defines the latitude direction.

*RST: NORT

Options: R&S SMU/AMU-K77

Manual operation: See "Latitude/Longitude" on page 78

[: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

Manual operation: See "Latitude/Longitude" on page 78

8.10.3 Tower To Aircraft

[: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

Manual operation: See "Vehicle Type" on page 80

[: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

Manual operation: See "Start Speed" on page 80

[: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

Manual operation: See "Take-Off Speed" on page 80

[: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

Manual operation: See "Constant Acceleration" on page 81

[: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

Manual operation: See "Climb Angle" on page 81

[: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

Manual operation: See "Climb Rate" on page 81

[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:SPEed:DEParture <SpeedDeparture>

Sets the groung 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

Manual operation: See "Departure Ground Speed" on page 81

[: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

Manual operation: See "Cruise Speed" on page 81

[: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: 5000

Options: R&S SMU/AMU-K77

Manual operation: See "Cruise Altitude" on page 81

[: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

Manual operation: See "Descent Angle" on page 82

[: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

Manual operation: See "Descent Rate" on page 82

[: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

Manual operation: See "Descent Ground Speed" on page 82

[: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

Manual operation: See "Landing Field Length (Ground)" on page 82

[: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

Manual operation: See "Touch-Down Speed" on page 82

[: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

Manual operation: See "Radius" on page 82

[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:TRIP:LENGth?

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

Return values:

<TripLength> float

Range: 0 to 100000
Increment: 0.1
*RST: 0

Usage: Query only

Options: R&S SMU/AMU-K77

Manual operation: See "Trip Length" on page 82

[:SOURce<hw>]:FSIMulator:DSSimulation:TOWertoair:TRIP:DURation?

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

Return values:

<TripDuration> float

Range: 0 to 100000
Increment: 0.1
*RST: 0

Usage: Query only

Options: R&S SMU/AMU-K77

Manual operation: See "Trip Duration" on page 82

8.10.4 User Scenario

[: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

Manual operation: See "Fader Profile Source" on page 83

[: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

Manual operation: See "Vehicle" on page 84

[: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

Manual operation: See "Vehicle" on page 84

[: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

Manual operation: See "Vehicle" on page 84

[: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

Manual operation: See "Trajectory" on page 85

[: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?

[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:TDF:CATalog?
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:TDF:CATalog?
[: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 correponding type. If no directory is specified, the default directory is used.

Return values:
<FileNames> string

Usage: Query only

Options: R&S SMU/AMU-K77

Manual operation: See "Vehicle" on page 84

[: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

Manual operation: See "Vehicle" on page 84

[: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
*RST: 0

<LongitudeMin> integer

Defines the longitude minutes.

Range: 0 to 59
*RST: 0

<LongitudeSec> integer

Defines the longitude seconds.

Range: 0 to 59
*RST: 0

<LongitudeDir> EAST | WEST

Defines the longitude direction.

*RST: EAST

<LatitudeDeg> integer

Defines the latitude degrees.

Range: 0 to 90
*RST: 0

<LatitudeMin> integer

Defines the latitude minutes.

Range: 0 to 59
*RST: 0

<LatitudeSec> integer

Defines the latitude seconds.

Range: 0 to 59
*RST: 0

<LatitudeDir> NORTh | SOUTh

Defines the latitude direction.

*RST: NORT

<Altitude> float

Defines the altitude.

Range: 0 to 10000
Increment: 0.1
*RST: 0

Options: R&S SMU/AMU-K77

Manual operation: See "Altitude/X/Y/Latitude/Longitude" on page 86

[:SOURce<hw>]:FSIMulator:DSSimulation:USER:TX:TRAJectory:FAPoint: COORdinates:XYZ <X>, <Y>, <Altitude>
[:SOURce<hw>]:FSIMulator:DSSimulation:USER:RX:TRAJectory:FAPoint: COORdinates: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

Manual operation: See "Altitude/X/Y/Latitude/Longitude" on page 86

[: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 foxed vechicle 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

Manual operation: See "Altitude/X/Y/Latitude/Longitude" on page 86

[: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 87).

Parameters:

<TrajTdfBehavior> JUMP | RETurn | LOOP | STOP

*RST: LOOP

Options: R&S SMU/AMU-K77

Manual operation: See "Behavior at End of Trajectory" on page 87

[: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

Manual operation: See "Smooth Movement" on page 87

[: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

Manual operation: See "ENU Ref. Coordinate" on page 88

List of Commands

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