

R&S[®]SMW-K550

Stream Extender

User Manual



1178326302
Version 10

ROHDE & SCHWARZ
Make ideas real



This document describes the following software options:

- R&S®SMW-K550 Stream Extender (1413.7315.xx)

This manual describes firmware version FW 5.00.044.xx and later of the R&S®SMW200A.

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Mühlhofstr. 15, 81671 München, Germany

Phone: +49 89 41 29 - 0

Email: info@rohde-schwarz.com

Internet: www.rohde-schwarz.com

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The following abbreviations are used throughout this manual: R&S®SMW200A is abbreviated as R&S SMW; the license types 02/03/07/11/13/16/12 are abbreviated as xx.

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1 Welcome to the R&S SMW-K550 option

The R&S SMW-K550 is a software option that allows you to duplicate generated baseband signals (streams) for specific system configurations. By that means, four baseband streams with real-time data sources can be generated in parallel. The generated signals are suitable for test cases such as the GSM AM Suppression Test as specified in 3GPP TS 51.021.

The duplicated baseband streams are of identical content. If shifted in frequency, they appear to the receiver under test as different signals.

R&S SMW-K550 key features:

- Generation of up to 8 streams out of 4 baseband signals
- Generation of 4 signals with real-time data source, for example to ensure non-truncated PN sequences
- Generation of wanted and interfering signals as required for the GSM AM suppression tests

This user manual contains a description of the functionality that the application provides, including remote control operation.

All functions not discussed in this manual are the same as in the base unit and are described in the R&S SMW user manual. The latest version is available at:

www.rohde-schwarz.com/manual/SMW200A

Installation

You can find detailed installation instructions in the delivery of the option or in the R&S SMW service manual.

1.1 Accessing the settings

To open the dialog with the required settings

- ▶ In the taskbar R&S SMW, select the "System Configuration > System Configuration".

1.2 What's new

This manual describes firmware version FW 5.00.044.xx and later of the R&S®SMW200A.

Compared to the previous version there are editorial changes only.

1.3 Documentation overview

This section provides an overview of the R&S SMW user documentation. Unless specified otherwise, you find the documents on the R&S SMW product page at:

www.rohde-schwarz.com/manual/smw200a

1.3.1 Getting started manual

Introduces the R&S SMW 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. A printed version is delivered with the instrument.

1.3.2 User manuals and help

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

- **Base unit manual**
Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- **Software option manual**
Contains the description of the specific functions of an option. Basic information on operating the R&S SMW is not included.

The contents of the user manuals are available as help in the R&S SMW. The help offers quick, context-sensitive access to the complete information for the base unit and the software options.

All user manuals are also available for download or for immediate display on the Internet.

1.3.3 Tutorials

The R&S SMW provides interactive examples and demonstrations on operating the instrument in form of tutorials. A set of tutorials is available directly on the instrument.

1.3.4 Service manual

Describes the performance test for checking compliance with rated specifications, firmware update, troubleshooting, adjustments, installing options and maintenance.

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

<https://gloris.rohde-schwarz.com>

1.3.5 Instrument security procedures

Deals with security issues when working with the R&S SMW in secure areas. It is available for download on the Internet.

1.3.6 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

1.3.7 Data sheets and brochures

The data sheet contains the technical specifications of the R&S SMW. It also lists the options and their order numbers and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/smw200a

1.3.8 Release notes and open source acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The open-source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/smw200a

1.3.9 Application notes, application cards, white papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/smw200a and www.rohde-schwarz.com/manual/smw200a

1.4 Scope



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

In particular, it includes:

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

For a description of such tasks, see the R&S SMW user manual.

1.5 Notes on screenshots

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

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 Stream extender related settings

Duplicating streams is a feature that requires the additional option R&S SMW-K550.

Access:

1. In the task bar R&S SMW, select the "System Configuration > System Configuration".
2. In the "Fading/Baseband Configuration" dialog, select "Mode > Advanced".
3. Enable a 3x1x1 or a 4x1x1 configuration
4. Select "Duplicate Streams > On".
Confirm with "Apply"

With the selected configuration the instrument generates 6 streams, where each two of them are of identical content.

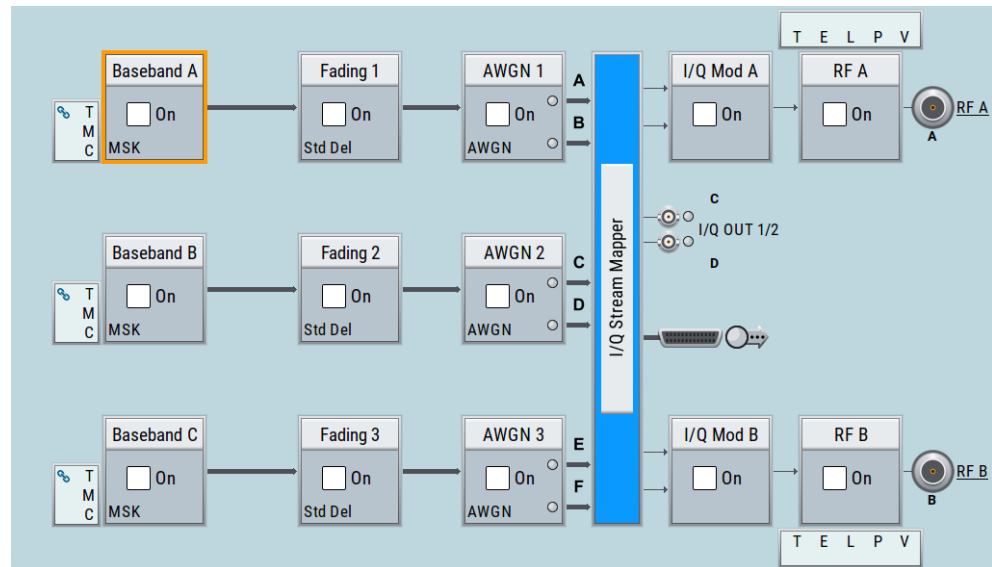
The streams are independently processed, i.e. noise can be added and the streams can be shifted in frequency.

The screenshot shows the 'System Configuration' dialog box with the following settings:

- Mode:** Advanced
- Signal Outputs:** Analog & Digital
- Entities (Users, Cells):** 3
- Basebands (Tx Antennas):** 1
- Streams (Rx Antennas):** 1
- Duplicate Streams:**
- BB Source Config:** Separate Sources

The block diagram illustrates the signal flow for three entities. Each entity (Entity 1, Entity 2, Entity 3) has a 'BB' block connected to a 'Fader' block. The output of the fader is split into two streams (A/B, C/D, E/F). The diagram also includes the text 'Common Applications: GSM AM Suppression Test'.

The block diagram confirms the configuration, too.



For step-by-step description on how to use the provided settings, refer to [Chapter 3](#), "Application example: GSM AM suppression test", on page 11.

Settings:

System Configuration > Fading/Baseband Configuration	10
↳ Duplicate Streams	10

System Configuration > Fading/Baseband Configuration

Available are the standard settings and the following parameter, dedicated for the option R&S SMW-K550.

Duplicate Streams ← System Configuration > Fading/Baseband Configuration

Option: R&S SMW-K550

This parameter is enabled in the configurations 3x1x1 and 4x1x1.

In a 3x1x1 configuration for example, there are (per default) 3 basebands and 3 streams. The first two basebands can generate signals with real-time data sources.

If "Duplicate Streams > On", created is a copy of each stream after baseband / fading block. Generated are 6 streams; 4 of them can use real-time data sources, for example to ensure non-truncated PN sequences.

The pair of streams created out of the same baseband are identical, in terms of content, power level and frequency. The streams are treated as individual streams in terms of adding AWGN and shifting within the available RF bandwidth.

This feature is useful, if your test setup requires a combination of max 4 signals with real-time data source and 4 ARB signals. For example, for performing GSM AM suppression tests according to 3GPP TS 51.021, chapter 8.

See user manual R&S SMW-K550 Stream Extender.

Remote command:

`:SCONfiguration:DUPLICATE[:STReam]` on page 20

3 Application example: GSM AM suppression test

AM suppression testing is one of the base station (BS) receiver tests, specified in 3GPP TS 51.021.

According to the specification, the testing of multi-carrier base stations (BS) equipped with multi-carrier receiver requires up to four wanted and one interfering signals.

A typical signal generator generates one or two test signals. The test setup for AM suppression tests of a multi-carrier BS would then require two or more signal generators. Such setup can require extensive configurations and complex synchronization.

In R&S SMW equipped with option R&S SMW-K550, the generation of 4 wanted and one interfering GSM signals is a straightforward solution. This section is a short introduction in the AM suppression testing. It also shows how to use the dedicated functions to generate, route and output the required signals.



The following example shows the configuration principle in general.

Not all required settings are shown. The used settings do not comply with the specification.

3.1 Required options

The equipment layout includes:

- Option standard Baseband Generator (R&S SMW-B10) per signal path and Option Baseband main module, with two I/Q paths (R&S SMW-B13T)
- Frequency option (e.g. R&S SMW-B1003)
- Frequency option (e.g. R&S SMW-B2003)
- Option Multiple Entities (R&S SMW-K76)
- Option Stream Extender (R&S SMW-K550)
- 2x option GSM/EDGE and EDGE Evolution (R&S SMW-K40/-K41)

For more information, refer to the instrument specification (data sheet).

3.2 About the AM suppression testing

Receiver measurements are tests of the ability of a BS receiver to demodulate signals while achieving specified minimum bit error rate (BER). Several test cases are specified. Their goal is to assure the GSM performance in different conditions, like for example low signal power or intermodulation. The AM suppression test for example is a receiver test that measure the receiver ability to cope with strong GSMK interfering signal.

Simplified test setup for base station receiver testing

The Figure 3-1 shows a simplified example of a test setup for AM suppression tests.

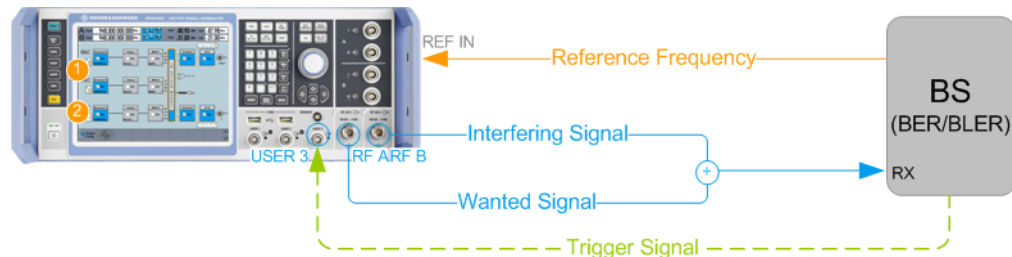


Figure 3-1: Simplified test setup for AM suppression tests of multi-carrier BS equipped with multi-carrier receiver

1	= Baseband A and B generate the wanted signals
2	= Baseband C generates the interfering signal. Signal is routed to the second RF output because of the difference in the power levels of the interfering and the wanted signals (high dynamic range)
BS	= Base station
BER/BLER	= Bit error rate (BER) and block error rate (BLER) measurements
Rx	= Receiver input
Reference Frequency	= 10 MHz synchronization signal from the BS to the R&S SMW
Trigger Signal	= Optional trigger signal from the BS to the R&S SMW
[RF A],[RF B],[USER]	= Front panel connectors
REF IN	= Rear panel connector
⊕	= RF combiner

The R&S SMW in this setup generates four GSM wanted signals and one interfering signal. The wanted signals are routed to and output at the [RF A] connector. The interfering signal to the [RF B] connector. The interfering signal and the wanted signals are routed to two separate RF outputs because of the difference in their power levels. Both RF signals are connected to a combiner. The sum signal is fed to the RX input of the BS.

The BS processes the signal and measures the bit error rate (BER) or the block error rate (BLER). The BLER measurements require that the data sources of the GSM signal are untruncated PN sequences. The measured error performance shall not exceed the specified limit values, where the minimum requirements are given per channel type.

Characteristics of the wanted and the interfering signals

The wanted signals are specified as framed GSM modulated signals with specific channel coding and low-power level.

The interfering signal is a GMSK-modulated signal with pseudo random bit sequence of at least 511 bits length. The interferer has one active timeslot; the signal is synchronized to and delayed in time relative to the wanted signals. The interfering signal is high in power. It does not need to have real-time data source, as no BLER measurements are specified for it.

The number of wanted signals and their distribution within the maximum BS bandwidth depends on the BS type and class. In the following, a wide area BS equipped with a multi-carrier receiver is assumed.

Within the available BS RF bandwidth, the up to 4 wanted signals are allocated symmetrically around the center frequency. The interfering signal is sent on the center frequency. The inner two wanted signals are spaced at 6 MHz away from the interferer. The remaining wanted signals are located at the edges of the maximum supported bandwidth and at least at 600 Hz away from the inner two.

The frequency distribution is illustrated on [Figure 3-2](#).

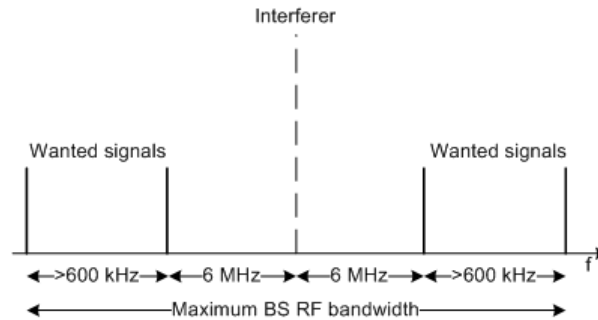


Figure 3-2: Frequency allocation of the wanted and the interfering signals

GSM frequency bands and channels

According to [TS 51.021](#), a GSM band contains a set of adjacent channels, each with a bandwidth of 200 kHz. The channel numbers and the assignment between channel numbers and frequencies are band-specific.

In all frequency bands, the downlink frequencies are higher than the corresponding uplink frequencies. The difference between downlink and uplink frequencies is termed the duplex spacing; it is also band-specific.

For an overview the GSM bands with their channel numbers and the downlink and uplink center frequencies, see [TS 51.021](#).

Cabling and synchronization issues

As a rule, always use short RF cables of equal length. If a trigger signal is required, feed the BS signal to the R&S SMW.

In test setups with more than one instrument, all instruments usually use the same reference clock. While testing BS receivers, the clock signal is provided by the DUT. Additional reference frequency is not required.

3.3 How to generate signals for GSM AM suppression tests

The following is an example on how to select the correct system configuration and configure the instrument in general. Not all GSM-related settings configurations are shown. The example uses predefined settings and PN sequences as data source; channel coding is not used.

Consider to load your own data lists and to configure the GSM bursts and frames according to the specification [TS 51.021](#).

The example assumes the following settings:

- 3x1x1 configuration with duplicated streams; generated are 6 streams, where 5 of them are used
- The 4 wanted signals are routed to RF A; the interfering signal to RF B (dynamic range reasons)
- The maximum RF BS Bandwidth is 24 MHz
- The absolute radio frequency channel number that needs to be tested is ARFCN 30; the BS center frequency is $f_{DL} = 941$ MHz
- The frequency of the interfering signal (f_i) is at least 6 MHz away from the ARFCN under test.
The interfering signal uses the frequency $f_i = 947.2$ MHz
- The wanted signals are arranged symmetrically around the center frequency, see [Figure 3-2](#)
The inner two wanted signals are at ± 6 MHz offset and the outer two at ± 12 MHz
- GSM transmission in timeslot 1 for both, the 4 wanted and the interfering signals
- The interfering signal is a GSMK modulated PN9 sequence of 511 bits length.
- The DUT is multi-carrier BS with a multi-carrier receiver. Assumed is a simultaneous test of two logical channels on different carriers.
The generated wanted signals are pairwise identical. The streams of each pair are frequency shifted so that their transmission is not on nearby carriers.

How to generate a 3x1x1 SISO signal with 6 output streams

1. Open the "System Configuration > Fading/Baseband Configuration".

Configure the following:

- Select "Mode > Advanced".
- Enable a 3x1x1 SISO scenario.
- Select "BB Sources Config > Separate Sources".
- Select "Duplicate Streams > On".
- Confirm with "Apply".

2. Select "I/Q Stream Mapper".

Shifts and route the streams as follows:

- "Stream A > Frequency Offset = - 12 MHz"
- "Stream B > Frequency Offset = 6 MHz"
- "Stream C > Frequency Offset = - 6 MHz"
- "Stream D > Frequency Offset = 12 MHz"
- "RF A > Combination > Add"
- Stream A, B, C, D to RF A and Stream E to RF B

System Configuration									
Fading/Baseband Config		I/Q Stream Mapper			External RF and I/Q			Overview	
	Frequency Offs /Hz	Phase Offs /°	RF A	RF B	I/Q OUT 1	I/Q OUT 2	BBMM 1	BBMM 2	FAD 3
Stream A	-12 000 000.00	0.00	!						
Stream B	6 000 000.00	0.00	!						
Stream C	-6 000 000.00	0.00	!						
Stream D	12 000 000.00	0.00	!						
Stream E	0.00	0.00		!					
Stream F	0.00	0.00							
Combination			Add	Single	Single	Single	Single	Single	Single

The four wanted signals are routed to the RF A; the interfering signal to RF B.

- In the status bar, set the frequency ("Freq A" and "Freq B") to the frequency of the interfering signal (f_i).

The wanted signals are shifted and arranged in pairs symmetrically around the interferer.

- In the status bar, set the level values as follows:
 - Level A is the sum power level of the 4 wanted signals. The required values are listed in [TS 51.021](#), table 7.8-1.
 - Level B is the signal level of the interfering signal, as listed in [TS 51.021](#), table 7.8-2.

In this example, the power levels of the wanted signals are -94 dBm and -98 dBm. The interfering signal level is -31 dBm.

A	Freq	947.200 000 000 MHz	RF On	Ext Ref	Mod On	PEP	-83.51 dBm	Lev	-89.53 dBm
B	Freq	947.200 000 000 MHz	RF On	1Q/2Q	Mod On	PEP	-31.00 dBm	Lev	-31.00 dBm

- In the baseband domain, signals are leveled relative to each other. We assume, that the -98 dBm signals are generated in "Baseband A". To boost the signals generated in "Baseband B", select "Baseband B > Baseband Offsets > Baseband B > Gain = 4 dB".

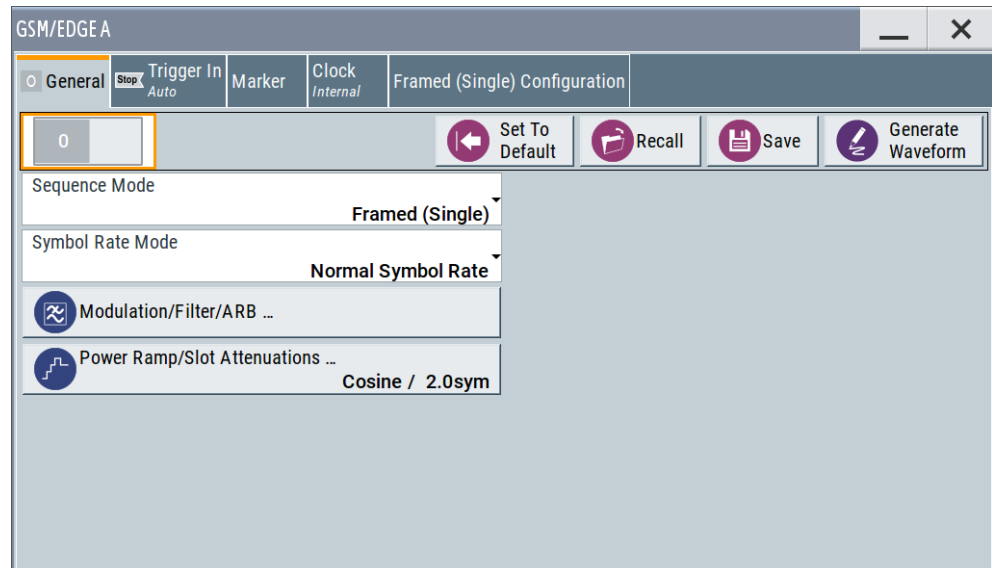
How to configure the GSM baseband signal

The following is a list with **general steps** for configuring the interfering signal. The interfering signal is GMSK modulated PN9 sequence signal.

Configure the wanted signals in the same way. Consider the coding requirements specified in the [TS 51.021](#).

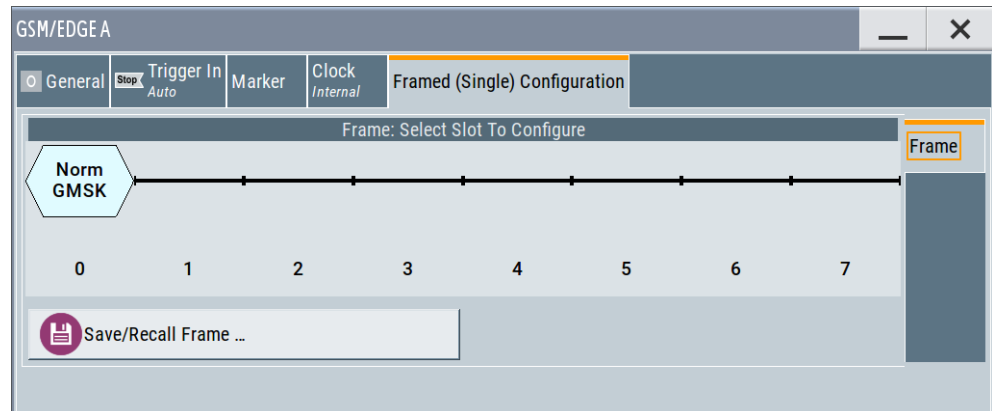
We assume that the wanted and the interfering signals are transmitted in timeslot 1.

1. Select "Baseband C > GSM"



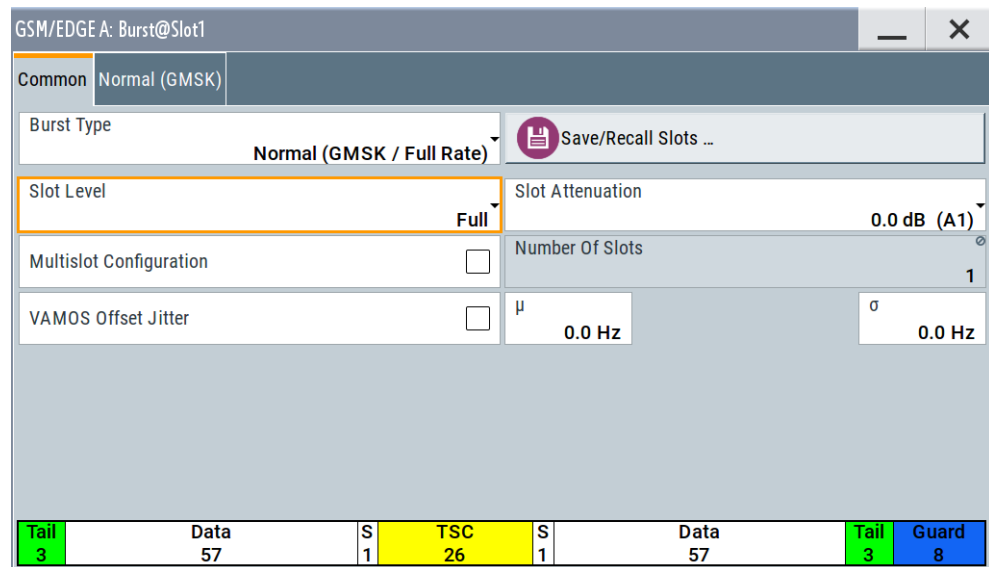
2. Select "Framed (Single) Configuration".

Per default, the first timeslot 0 is active.



3. To disable timeslot 0 and activate timeslot 1:

- In the frame graph, double-click slot 0.
Select "Slot Level > Off".
- Double-click slot 1.
Select "Slot Level > Full".



Tail	Data	S	TSC	S	Data	Tail	Guard
3	57	1	26	1	57	3	8

The default burst type is sufficient. It uses GMSK modulation and PN9 data source. ("Common > Burst Type = Normal (GMSK / Full Rate)" and "Normal (GMSK) > Data = PRBS 9")

4. If R&S SMW is triggered by the BS:
 - Select "Trigger In > Trigger Mode > Armed Auto"
 - Select "Source > External Global Trigger".
5. Interferer is delayed in time between 61 and 86 symbols.
To delay the interfering signal, select for example "Trigger Delay = 70 Symbols".
6. Configure the wanted signals in baseband A and B.
Load your own data lists as data source.
Configure the GSM bursts and frames according to the specification [TS 51.021](#).
Consider the required channel coding.
7. In all baseband blocks, select "GSM > State > On".

Both I/Q modulators are activated automatically.
For more information on the available GSM/EDGE settings:
See user manual R&S SMW-K40/-K41 GSM/EDGE, EDGE Evolution.

To activate the signal generation

1. If the BS reference frequency is fed to the R&S SMW, in the status bar select "Int Ref > Reference Frequency > External".
2. In the block diagram, activate the RF outputs.

The display resembles the one on the following figure. The additional information on [Figure 3-3](#) illustrates the routing and the frequency allocation of the wanted and the interfering signals.

Note that the streams generated from the same baseband are not transmitted on nearby carriers.

How to generate signals for GSM AM suppression tests

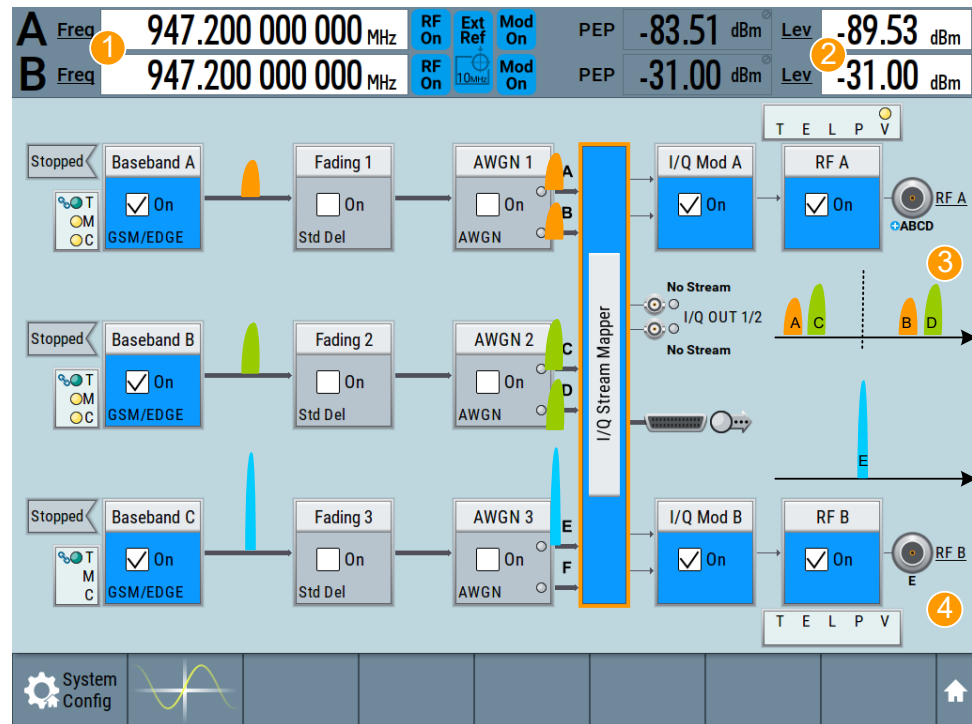


Figure 3-3: Block diagram: understanding the displayed information

- 1 = Interferer frequency
- 2 = Sum power level of the 4 wanted signals, interfering signal power level
- 3 = Streams A, B, C and D (i.e. the 4 wanted signals) are routed to output RF A
- 4 = Stream E (i.e. the interferer) is output at the RF B

4 Remote control commands

Example: Generating signals for GSM AM suppression testings

The following is an example on how to select the correct system configuration and configure the instrument in general. Not all GSM-related settings configurations are shown. The example uses predefined settings and PN sequences as data source; channel coding is not used.

Consider to load you own data lists and to configure the GSM bursts and frames according to the specification.

```
:SCONfiguration:APPLY
:SCONfiguration:MODE ADV
:SCONfiguration:FADing SISO3X1X1
:SCONfiguration:DUPLicate:STReam 1
:SCONfiguration:APPLY

:SCONfiguration:OUTPut:MAPPING:RF1:MODE ADD
:SCONfiguration:OUTPut:MAPPING:RF1:STReam2:STATE 1
:SCONfiguration:OUTPut:MAPPING:RF1:STReam3:STATE 1
:SCONfiguration:OUTPut:MAPPING:RF1:STReam4:STATE 1
:SCONfiguration:OUTPut:MAPPING:RF2:STReam5:STATE 1
:SCONfiguration:OUTPut:MAPPING:RF2:STReam2:STATE 0

:SCONfiguration:OUTPut:MAPPING:IQOutput1:STReam3:STATE 0
:SCONfiguration:OUTPut:MAPPING:IQOutput2:STReam4:STATE 0
:SCONfiguration:OUTPut:MAPPING:BBMM1:STReam3:STATE 0
:SCONfiguration:OUTPut:MAPPING:BBMM2:STReam4:STATE 0

:SCONfiguration:OUTPut:MAPPING:STReam1:FOFFset -12000000
:SCONfiguration:OUTPut:MAPPING:STReam2:FOFFset 6000000
:SCONfiguration:OUTPut:MAPPING:STReam3:FOFFset -6000000
:SCONfiguration:OUTPut:MAPPING:STReam4:FOFFset 12000000
:SCONfiguration:APPLY

:ENTity1:SOURcel:BB:GSM:MODE DOUB
:ENTity1:SOURcel:BB:GSM:FRAMe1:SLOT0:SUBChannel1:USER1:LEVel OFF
:ENTity1:SOURcel:BB:GSM:FRAMe1:SLOT1:TYPE EDGE
:ENTity1:SOURcel:BB:GSM:FRAMe1:SLOT1:SUBChannel1:USER1:LEVel FULL
:ENTity1:SOURcel:BB:GSM:FRAMe1:REPetitions 12
:ENTity1:SOURcel:BB:GSM:FRAMe2:SLOT0:SUBChannel1:USER1:LEVel OFF
:ENTity1:SOURcel:BB:GSM:FRAMe2:SLOT1:TYPE EDGE
:ENTity1:SOURcel:BB:GSM:FRAMe2:SLOT1:SUBChannel1:USER1:LEVel FULL
:ENTity1:SOURcel:BB:GSM:FRAMe2:REPetitions 12

:ENTity2:SOURcel:BB:GSM:MODE DOUB
:ENTity2:SOURcel:BB:GSM:FRAMe1:SLOT0:SUBChannel1:USER1:LEVel OFF
:ENTity2:SOURcel:BB:GSM:FRAMe1:SLOT1:SUBChannel1:USER1:LEVel FULL
:ENTity2:SOURcel:BB:GSM:FRAMe1:REPetitions 12
```

```

:ENTity2:SOURcel:BB:GSM:FRAMe2:SLOT0:SUBChannell:USER1:LEVel OFF
:ENTity2:SOURcel:BB:GSM:FRAMe2:SLOT1:TYPE EDGE
:ENTity2:SOURcel:BB:GSM:FRAMe2:SLOT1:SUBChannell:USER1:LEVel FULL
:ENTity2:SOURcel:BB:GSM:FRAMe2:REPetitions 12
:ENTity2:SOURcel:BB:GSM:STATe 1

:ENTity3:SOURcel:BB:GSM:FRAMe1:SLOT0:SUBChannell:USER1:LEVel OFF
:ENTity3:SOURcel:BB:GSM:FRAMe1:SLOT1:SUBChannell:USER1:LEVel FULL
:ENTity3:SOURcel:BB:GSM:FRAMe1:SLOT1:SUBChannell:USER1:SOURce:DATA PN9
:ENTity3:SOURcel:BB:GSM:STATe 1

:ENTity1:SOURcel:BB:GSM:TRIGger:SEQuence AAUT
:ENTity1:SOURcel:BB:GSM:TRIGger:SOURce EGT1
:ENTity3:SOURcel:BB:GSM:TRIGger:EXTernal1:DELay 70

:SOURce1:FREQuency:CW 947200000
:SOURce2:FREQuency:CW 947200000
:SOURce2:POWer:POWer -31
:SOURce1:POWer:POWer -89.53
:ENTity2:SOURcel:BB:PGAin 4

:SOURcel:ROSCillator:SOURce EXT
:SOURcel:ROSCillator:EXTernal:FREQuency 10MHZ
:SOURcel:ROSCillator:EXTernal:RFOFF:STATe 1

:SOURce1:IQ:STATe 1
:SOURce2:IQ:STATe 1
:OUTPut1:STATe 1
:OUTPut2:STATe 1

```

:SCONfiguration:DUPLICATE[:STREAM] <DuplicateStream>

In a 3x1x1 or 4x1x1 configuration, creates a copy of each stream. Generates are a total number of 6 or 8 streams, where 4 of them can be signals with real-time data source.

Parameters:

<DuplicateStream> 0 | 1 | OFF | ON
 *RST: 0

Example:

```

:SCONfiguration:APPLY
:SCONfiguration:MODE ADV
:SCONfiguration:FADING SISO3X1X1
:SCONfiguration:DUPLICATE:STREAM 1
:SCONfiguration:APPLY

```

Options: R&S SMW-K550

Manual operation: See "[Duplicate Streams](#)" on page 10

Glossary: 3GPP specifications, references, documents with further information

T

TS 51.021: " Technical Specification Group GSM/EDGE Radio Access Network; Base Station System (BSS) equipment specification; Radio aspects"

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