EUTRA/LTE
Digital Standard for R&S®Signal Generators
Operating Manual
EUTRA/LTE, LTE Rel. 9, LTE closed loop BS Test, LTE Logfile Generation, LTE-A Rel.10/Rel. 11, Enhanced Features

1171.5177.12 – 26

Test & Measurement

Operating Manual

ROHDE&SCHWARZ

This document describes the following software options:

- R&S®AMU-K55/-K69/-K81/-K84/-K85/-K112
  1402.9405.02, 1403.0501.02, 1403.0818.02, 1403.0853.02, 1403.0830.02, 1403.1095.02
- R&S®SMATE-K55/-K69/-K81/-K84/-K85/-K112
  1404.7851.02, 1403.0501.02, 1404.8612.02, 1404.8829.02, 1404.8841.02, 1404.8929.02
- R&S®SMBV-K55/-K84/-K85/-K112
  1407.9203.xx, 1415.8602.xx, 1415.8619.xx, 1419.1719.xx
- R&S®SMJ-K55/-K69/-K81/-K84/-K85/-K112
  1409.2206.02, 1409.3002.02, 1409.3054.02, 1409.3360.02, 1409.3383.02, 1409.3660.02
- R&S®SMU-K55/-K69/-K81/-K84/-K85/-K112
  1408.7310.02, 1408.8117.02, 1408.8169.02, 1408.8475.02, 1408.8498.02, 1408.8798.02

This manual version corresponds to firmware version:
FW 3.20.281.xx and later of the R&S®SMBV100A
FW 3.20.286.xx and later of the R&S®SMU200A, R&S®SMATE200A, R&S®SMJ100A and R&S®AMU200A

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The following abbreviations are used throughout this manual: R&S®SMBV100A is abbreviated as R&S SMBV, R&S®SMU200A is abbreviated as R&S SMU, R&S®AMU200A is abbreviated as R&S AMU, R&S®SMATE200A is abbreviated as R&S SMATE, R&S®SMJ100A is abbreviated as R&S SMJ, R&S®WinIQSIM2™ is abbreviated as R&S WinIQSIM2; the license types 02/03/07/11/13/16/12 are abbreviated as xx.

Contents

1 Preface

1.1 Documentation Overview

The user documentation for the R&S Signal Generator 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 Signal Generator product page.

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

Quick Start Guide

Introduces the R&S Signal Generator 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 Signal Generator 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 Conventions Used in the Documentation

1.2.1 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.

Convention	Description
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.2.2 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.

1.2.3 Naming of Software Options

In this operating manual, we explicitly refer to options required for specific functions of the digital standard.

The name of software options for signal generators vary in the name of the instrument, but the option name is identical. Therefore we use in this manual the placeholder R&S SMx/AMU.

Example:

Naming for an option of the vector signal generator R&S SMBV100A, e.g:

- R&S SMx/AMU-K99, stands for R&S SMBV-K99

The particular software options available for the corresponding instruments are listed on the back of the title page.

2 Preamble

All supported features are in line with 3GPP Release 11, i.e. the following official 3GPP specifications are implemented:

- 3GPP TS 36.211, Version 11.6.0
- 3GPP TS 36.212, Version 11.5.1
- 3GPP TS 36.213, Version 11.8.0

3 Introduction to the EUTRA/LTE Technology

This section provides an introduction to the EUTRA/LTE technology.

3.1 LTE Downlink Transmission Scheme

The downlink transmission scheme for E-UTRA FDD and TDD modes is based on conventional OFDM. In an OFDM system, the available spectrum is divided into multiple carriers, called subcarriers, which are orthogonal to each other. Each of these subcarriers is independently modulated by a low rate data stream.

OFDM is used as well in WLAN, WiMAX, and broadcast technologies like DVB. OFDM has several benefits including its robustness against multipath fading and its efficient receiver architecture.

The Figure 3-1 shows a representation of an OFDM signal (TR 25.892). In this figure, a signal with 5 MHz bandwidth is shown, but the principle is the same for the other E-UTRA bandwidths. Data symbols are independently modulated and transmitted over a high number of closely spaced orthogonal subcarriers. In E-UTRA, downlink modulation schemes QPSK, 16QAM, and 64QAM are available.

In the time domain, a guard interval may be added to each symbol to combat inter-OFDM-symbol-interference due to channel delay spread. In E-UTRA, the guard interval is a cyclic prefix which is inserted at the beginning of each OFDM symbol.

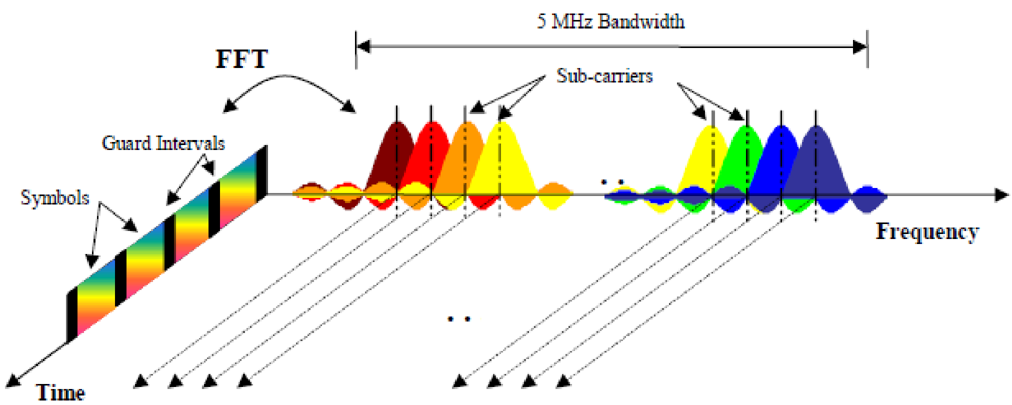


Figure 3-1: Frequency-Time Representation of an OFDM Signal (3GPP TR 25.892)

In practice, the OFDM signal can be generated using the inverse fast Fourier transform (IFFT) digital signal processing, as described in 3GPP TS 25.892, Feasibility Study for Orthogonal Frequency Division Multiplexing (OFDM) for UTRAN enhancement (Release 6). The IFFT converts a number N of complex data symbols used as frequency domain bins into the time domain signal. Such an N-point IFFT is illustrated in Figure 3-2, where $a(mN+n)$ refers to the n^{th} subchannel modulated data symbol, during the time period $mT_u < t \leq (m+1)T_u$.

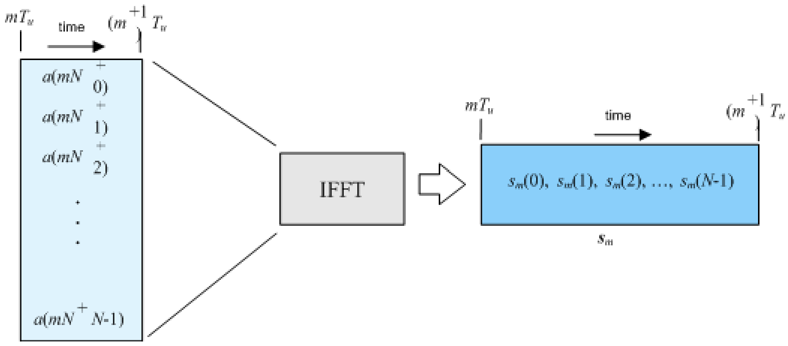


Figure 3-2: OFDM useful symbol generation using an IFFT (3GPP TR 25.892)

The vector s_m is defined as the useful OFDM symbol. It is the time superposition of the N narrowband modulated subcarriers. Therefore, from a parallel stream of N sources of data, each one independently modulated, a waveform composed of N orthogonal subcarriers is obtained, with each subcarrier having the shape of a frequency sinc function (see Figure 3-1).

The Figure 3-3 illustrates the mapping from a serial stream of QAM symbols to N parallel streams, used as frequency domain bins for the IFFT. The N-point time domain blocks obtained from the IFFT are then serialized to create a time domain signal. Not shown in the figure is the process of cyclic prefix insertion.

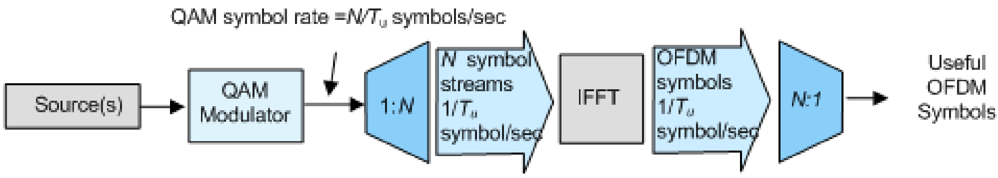


Figure 3-3: OFDM Signal Generation Chain (3GPP TR 25.892)

In contrast to an OFDM transmission scheme, OFDMA allows the access of multiple users on the available bandwidth. Each user is assigned a specific time-frequency resource. As a fundamental principle of E-UTRA, the data channels are shared channels, i.e. for each transmission time interval of 1 ms, a new scheduling decision is taken regarding which users are assigned to which time/frequency resources during this transmission time interval.

3.1.1 OFDMA Parameterization

Two radio frame structures, one for FDD (frame structure type 1) and one for TDD (frame structure type 2) mode are defined. These EUTRA frame structures are described in TS 36.211.

3.1.1.1 Frame structure type 1 (FDD)

The FDD frame structures type 1 is based on a 10 ms radio frame that is divided into 20 equally sized slots of 0.5 ms. A subframe consists of two consecutive slots, so one radio frame contains 10 subframes.

Frame format 1 (FDD mode) illustrates frame structure type 1 (Ts is expressing the basic time unit corresponding to 30.72 MHz). Frame format 1 is applicable to both full and half duplex FDD.

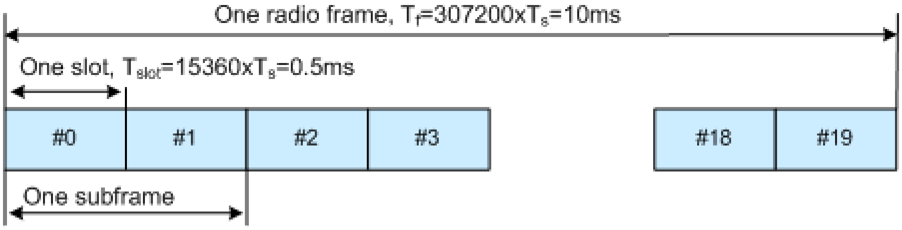


Figure 3-4: Frame format 1 (FDD mode)

For information on the related settings, refer to

- "Duplexing" on page 84
- Chapter 7.5, "DL Frame Configuration Settings", on page 144
- Chapter 7.12, "OFDMA Timeplan", on page 215.

3.1.1.2 Frame structure type 2 (TDD)

The TDD frame format 2 is also based on a 10 ms radio frame, but the frame is divided into two half-frames, 5 ms each. Each half-frame consists of five 1 ms long subframes, which are reserved either for downlink or uplink transmission or are caring special information (see Figure 3-5).

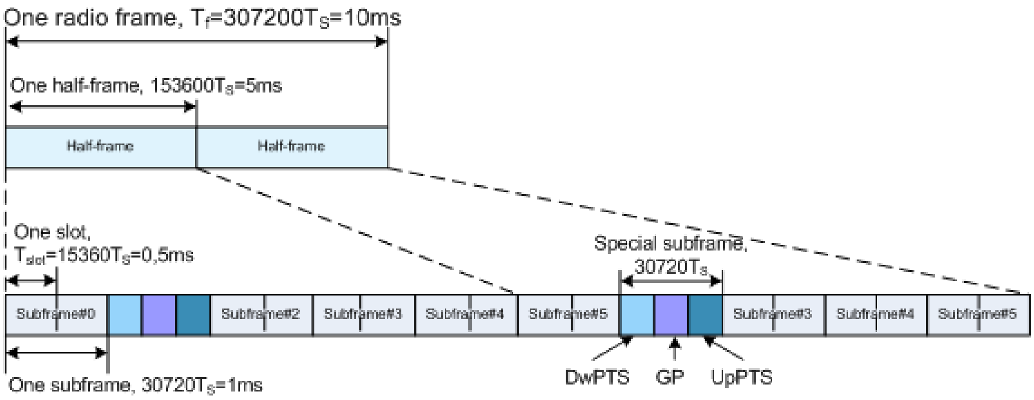


Figure 3-5: Frame format 2 (TDD mode), 5 ms switching periodicity

All non-special subframes are divided into two 0.5 ms long slots. The special subframes consist of three fields DwPTS (Downlink Pilot Timeslot), GP (Guard Period), and UpPTS (Uplink Pilot Timeslot) which length can vary in specified limits so that the total special subframe's length is maintained constant (1 ms). The 3GPP specification defines ten special subframe configurations for normal cyclic prefix type and eight for extended cyclic prefix type. These subframe configurations specify the allowed DwPTS/GP/UpPTS lengths' combinations.

The 3GPP specification defines seven different uplink-downlink configurations, i.e. defines the downlink-to-uplink switch-point periodicity (5 ms or 10 ms) and the allowed combination of downlink, uplink, and special slots. In all the uplink-downlink configurations and for any downlink-to-uplink switch-point periodicity, subframe 0, subframe 5, and DwPTS are always reserved for downlink transmission and UpPTS and the subframe following the special subframe are always reserved for uplink transmission.

Figure 3-6 shows the supported uplink-downlink configurations according to TS 36.211.

UL/DL Configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Figure 3-6: Uplink-downlink configurations

D = Denotes a subframe reserved for downlink transmission
U = Denotes a subframe reserved for uplink transmission
S = Denotes the special subframe

For information on the related settings, refer to:

- "Duplexing" on page 84
- Chapter 7.4.4, "TDD Frame Structure Settings", on page 127
- Chapter 7.19, "TDD Time Plan", on page 288.

3.1.2 Downlink Resource Grid

The Figure 3-7 shows the structure of the downlink resource grid for one downlink slot. The available downlink bandwidth consists of N_{BW}^{DL} subcarriers with a spacing of Δf = 15 kHz. In the case of multi-cell MBMS transmission, a subcarrier spacing of Δf = 7.5 kHz is also possible. N_{BW}^{DL} can vary to allow for scalable bandwidth operation up to 20 MHz.

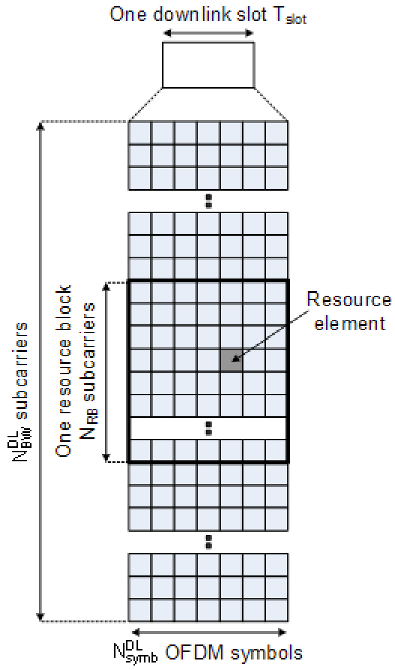


Figure 3-7: Downlink Resource Grid (3GPP TS 36.211)

One downlink slot consists of N_{symb}^{DL} OFDM symbols. To each symbol, a cyclic prefix (CP) is appended as guard time, compare Figure 3-1. N_{symb}^{DL} depends on the cyclic prefix length. The generic frame structure with normal cyclic prefix length contains N_{symb}^{DL} = 7 symbols. This translates into a cyclic prefix length of T_{CP}≈5.2µs for the first symbol and T_{CP}≈4.7µs for the remaining 6 symbols. Additionally, an extended cyclic prefix is defined to cover large cell scenarios with higher delay spread and MBMS transmission. The generic frame structure with extended cyclic prefix of T_{CP-E}≈16.7µs contains N_{symb}^{DL} = 6 OFDM symbols (subcarrier spacing 15 kHz). The generic frame structure with extended cyclic prefix of T_{CP-E}≈33.3µs contains N_{symb}^{DL} = 3 symbols (subcarrier spacing 7.5 kHz). The Table 3-1 gives an overview of the different parameters for the generic frame structure.

Table 3-1: Parameters for Downlink Generic Frame Structure

Configuration	Number of symbols N_{symb}^{UL}	Cyclic Prefix length, samples	Cyclic Prefix length, us
Normal cyclic prefix Δf=15 kHz	7	160 for first symbol 144 for other symbols	5.2 us for first symbol 4.7 us for other symbols
Extended cyclic prefix Δf=15 kHz	6	512	16.7 us
Extended cyclic prefix Δf=7.5 kHz	3	1024	33.3 us

For information on the related settings, refer to:

- Chapter 7.12, "OFDMA Timeplan", on page 215

- Chapter 7.19, "TDD Time Plan", on page 288

3.1.3 Downlink Data Transmission

Data is allocated to the UEs in terms of resource blocks. A physical resource block consists of 12 (24) consecutive subcarriers in the frequency domain for the Δf=15 kHz (Δf=7.5 kHz) case. In the time domain, a physical resource block consists of DL N_{symb} consecutive OFDM symbols, see Figure 3-7. N^{DL}_{symb} is equal to the number of OFDM symbols in a slot. The resource block size is the same for all bandwidths, therefore the number of available physical resource blocks depends on the bandwidth. Depending on the required data rate, each UE can be assigned one or more resource blocks in each transmission time interval of 1 ms. The scheduling decision is done in the base station (eNodeB). The user data is carried on the physical downlink shared channel (PDSCH).

For information on the related settings, refer to Chapter 7.6, "Enhanced PBCH, PDSCH and PMCH Settings", on page 164.

3.1.4 Downlink Control Information Transmission

Control Information is mapped to the resource elements in terms of resource elements groups (REG). A REG consists of four consequent resource elements within one resource block which are not used for cell-specific reference signals. Thus, there are two types of resource blocks, resource blocks containing three REGs and resource blocks containing only two REGs.

Two REGs are available within the OFDM symbols with allocated reference signals. These are the OFDM symbol 0 in the first slot in a subframe and in the OFDM symbol 1 in the four-antenna system case. 3 REGs are then available in the OFDM symbols 2, as well as in the OFDM symbol 1 in case of one- or two-antenna system (see Figure 3-8 and Figure 3-10).

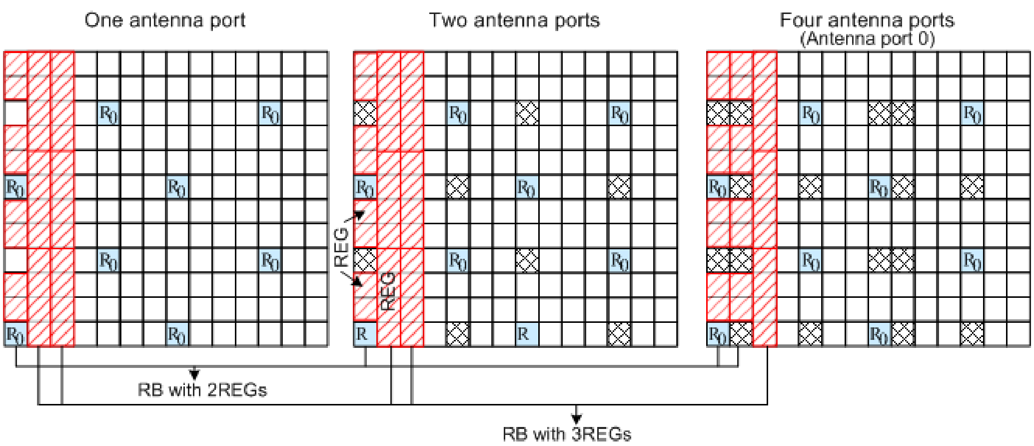


Figure 3-8: Resource elements groups (REG)

Three physical DL channels are carrying the control information: the Physical Control Format Indicator Channel (PCFICH), the Physical Hybrid ARQ Indicator Channel (PHICH) and the Physical Downlink Control Channel (PDCCH).

- The **PCFICH** carries the information about the number of OFDM Symbols used for transmission of PDCCH in a subframe and is mapped to four REGs within the first OFDM Symbol.
- The **PHICH** carries the HARQ ACK/NACK messages and is transmitted in terms of PHICH groups. A PHICH group uses three REGs. For normal CP, a PHICH group consists of up to eight ACK/NACK messages. Four ACK/NACK messages are carried by one PHICH group if an extended CP is used.
  For frame format 1 and non-MBSFN transmission, the PHICH can be transmitted over only the first OFDM symbol (this is the so called normal PHICH duration) or in case of extended PHICH duration, over the first three OFDM symbols.
- Downlink control signaling on the Physical Downlink Control Channel (**PDCCH**) is used to convey the scheduling decisions to individual UEs. The PDCCH is located in the first OFDM symbols of a slot.
  The maximum number of OFDM symbols used for the transmission of a PDCCH is determined by the number of RB used, i.e. for channel bandwidth with less than or equal to 10 RBs, four OFDM symbols are necessary (OFDM symbol 0...3) and respectively for channel bandwidths greater than 10 RBs three OFDM symbols are sufficient (OFDM symbol 0...2).
  The minimum number of OFDM symbols used for the transmission of a PDCCH is determined by the PHICH duration and the channel bandwidth.
  The PDCCH is mapped to the REGs not used for PHICH and PCFICH and transmitted on one or several control channel elements (CCEs), where a CCE corresponds to 9 REGs.

For information on the related settings, refer to:

- "PHICH Duration" on page 133
- Chapter 7.7, "Enhanced PCFICH, PHICH and PDCCH Channel Configuration", on page 174.

3.1.5 Downlink Reference Signal Structure and Cell Search

The downlink reference signal structure is important for cell search, channel estimation, and neighbor cell monitoring.

For the LTE downlink, five types of reference signals are defined:

- Cell-specific downlink reference signals
  The cell-specific reference signals are common signals in a cell, that are intended for all UE within this cell.
- MBSFN reference signals
  These reference signals are used for channel estimation and demodulation of signals transmitted by MBSFN.
- UE-specific reference signal (DM-RS)
  These reference signals are intended for a specific user.
- Positioning reference signals

- CSI reference signals
  These reference signals are intended channel quality measurements and frequency-dependent scheduling.

For information on the related settings, refer to:

- Chapter 7.4.8, "Downlink Reference Signal Structure", on page 134
- Chapter 7.4.10, "Positioning Reference Signal (PRS) Settings", on page 136
- Chapter 7.4.11, "CSI Settings", on page 140.

3.1.5.1 Mapping of Reference Signals to Antenna Ports

The LTE standard specifies so-called antenna ports (AP). Antenna ports are logical elements, used to describe identical propagation conditions. The mapping of these antenna ports to the physical antennas is not specified by 3GPP.

LTE specifies AP 0 .. AP 5 and defines one reference signal per downlink antenna port (see Table 3-2). LTE-Advanced introduces new reference signals and defines additional antenna ports, AP 6 .. AP 22.

Table 3-2: Mapping of reference signals to antenna ports

Antenna Port (AP)	Reference Signal
AP 0 .. AP 3	Cell-specific Reference Signals (CS-RS)
AP 4	MBSFN-RS
AP 5	UE-specific Reference Signals (DM-RS) for single-layer transmission (TM7)
AP 6	Positioning Reference Signals (PRS)
AP 7 .. AP 8	UE-specific Reference Signals (DM-RS) for up to 2 layers beamforming (TM8/TM9)
AP 9 .. AP 14	UE-specific Reference Signals (DM-RS) for multi-layer beamforming (TM9)
AP 15 .. AP 22	Channel State Information Reference Signals (CSI-RS)

The Figure 3-9 (from 1MA169) illustrates the mapping of the logical antenna ports to physical transmit antennas.

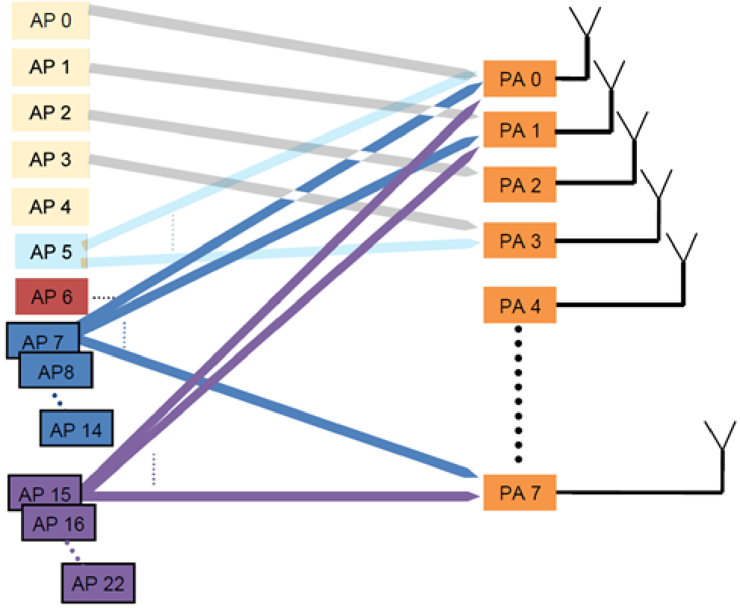


Figure 3-9: Mapping of logical antenna ports to physical transmit antennas (3GPP Rel. 10)

AP = antenna port
PA = physical antenna

See also:

- Table 3-4
- Chapter 3.5, "LTE-Advanced (3GPP Rel. 10) Introduction", on page 43

For information on the related settings, refer to Chapter 7.9, "DL Antenna Port Mapping Settings", on page 205.

3.1.5.2 Cell-specific downlink reference signals

The Figure 3-10 shows the principle of the downlink reference signal structure for one-antenna, two-antenna, and four-antenna transmission (antenna ports 0 .. 3, AP 0 .. AP 3). Specific predefined resource elements in the time-frequency domain carry the reference signal sequence. Besides first reference symbols, there may be a need for second reference symbols. The different colors in the figure represent the sequences transmitted from up to four transmit antennas.

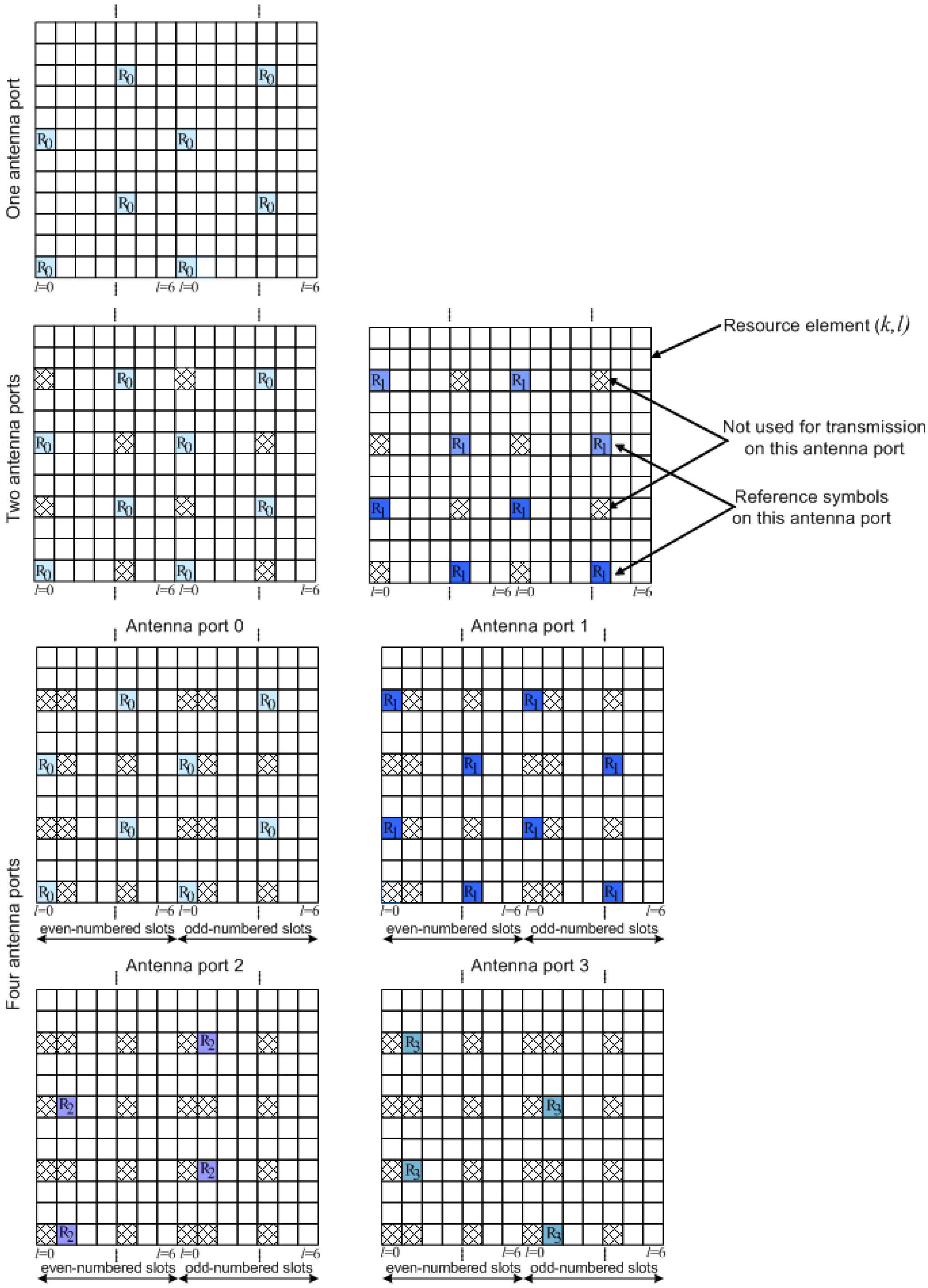


Figure 3-10: Downlink Reference Signal Structure (Normal Cyclic Prefix)

The reference signal sequence carries the cell identity. There are 504 unique physical layer cell identities, grouped into 168 unique physical cell identity groups that contain three unique identities each. Each reference signal is generated as a pseudo-random sequence that depends on the physical layer cell identity.

Frequency hopping can be applied to the downlink reference signals. The frequency hopping pattern has a period of one frame (10 ms).

During cell search, the handset identifies different types of information: symbol and radio frame timing, frequency, cell identification, overall transmission bandwidth, antenna configuration, and cyclic prefix length.

Besides the reference signals, synchronization signals are therefore needed during cell search. EUTRA uses a hierarchical cell search scheme similar to WCDMA. This means that the synchronization acquisition and the cell group identifier are obtained from different SYNC signals. Thus, a primary synchronization signal (**P-SYNC**) and a secondary synchronization signal (**S-SYNC**) are defined with a pre-defined structure. They are transmitted on the 72 center subcarriers (around DC subcarrier) within the same predefined slots (twice per 10 ms) on different resource elements, see Figure 3-11. This figure is taken from TS 36.211.

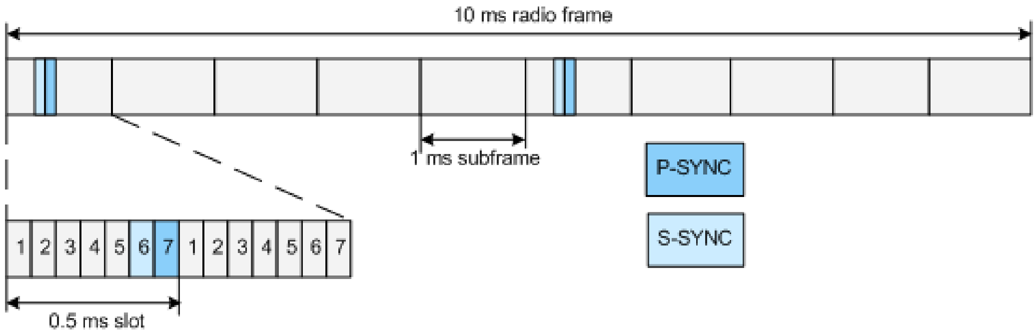


Figure 3-11: P-SYNC and S-SYNC Structure (Normal CP; 1.25 MHz bandwidth)

As additional help during cell search, a common control physical channel (CCPCH) is available which carries BCH type of information, e.g. system bandwidth. It is transmitted at predefined time instants on the 72 subcarriers centered around the DC subcarrier.

To enable the UE to support this cell search concept, it was agreed to have a minimum UE bandwidth reception capability of 20 MHz.

For information on the related settings, refer to Chapter 7.4.9, "Synchronization Signal Settings", on page 135.

3.1.5.3 MBSFN reference signals

MBSFN reference signals are defined fro extended cyclic prefix only. The MBSFN reference signals are transmitted on antenna port 4 (AP 4) and only when the PMCH is transmitted.

The Figure 3-12 shows the resource elements used by the MBSFN reference signal if Δf=15 kHz .

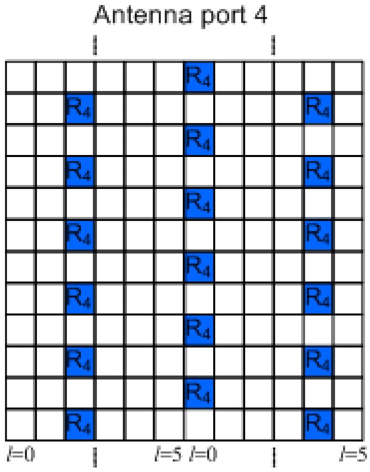


Figure 3-12: MBSFN reference signal structure (extended cyclic prefix, carrier spacing 15 KHz)

For information on the related settings, refer to Chapter 7.4.2, "MBSFN Settings", on page 112.

3.1.5.4 UE-specific reference signal (DM-RS)

These reference signals are intended for a specific user and mapped to predefined PDSCH RBs of this particular user. The resource elements predefined for the UE-specific RS do not overlap with the resource elements reserved for the cell-specific reference signals.

For single-antenna transmission, the UE-specific reference signals are transmitted on antenna port 5, 7 or 8 (AP 5, AP 7, and AP 8). If a spatial multiplexing is applied, the UE-specific reference signals are transmitted on antenna ports 7 and 8 (AP 7 and AP 8).

The UE-specific RS are also called demodulation reference signals (DM-RS) and are intended for channel estimation and demodulation instead of the common reference signals. One typical example of the application of UE-specific RS is the channel estimation and demodulation, if beamforming transmission is used. This is also called transmission using antenna port 5 (AP 5).

In contrary to the common reference signals that are not precoded, the UE-specific RS are precoded in the same way as the PDSCH they are mapped to.

See Figure 3-13 and Figure 3-14 for illustration of the mapping of the UE-specific reference signals to the resource elements.

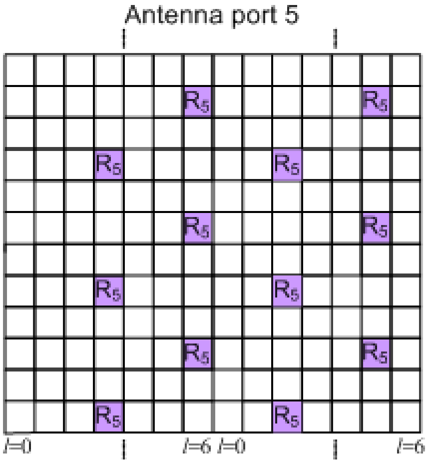


Figure 3-13: UE-specific reference signals, antenna port 5 (normal cyclic prefix)

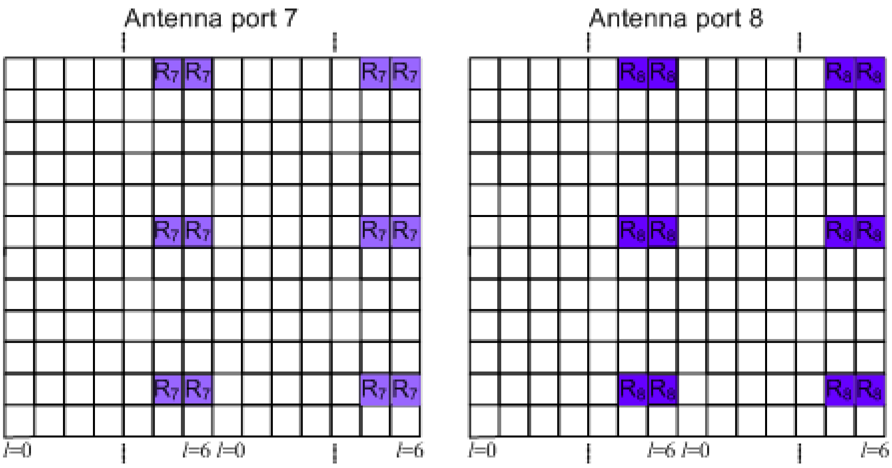


Figure 3-14: UE-specific reference signals, antenna ports 7 and 8 (normal cyclic prefix, downlink subframe)

3.1.5.5 Positioning reference signals

The positioning reference signals are transmitted only in downlink subframes configured for positioning reference signals transmission. Positioning reference signals are transmitted on antenna port 6 (AP 6).

The Figure 3-15 shows the mapping of the positioning reference signals for the one and two PBCH antenna ports case (normal cyclic prefix). Refer to the specification for information about the mapping in all other cases.

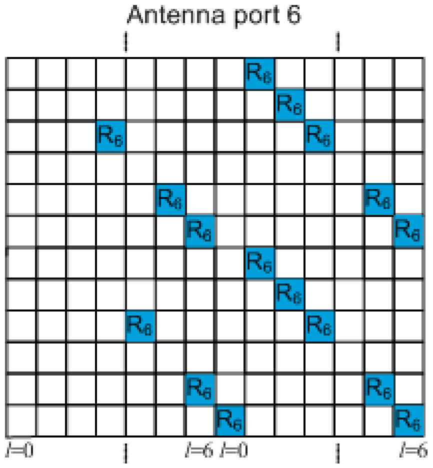


Figure 3-15: Mapping of PRS (normal cyclic prefix), one and two PBCH antenna ports.

For information on the related settings, refer to Chapter 7.4.10, "Positioning Reference Signal (PRS) Settings", on page 136 .

3.1.5.6 CSI reference signals

The CSI reference signals (CSI-RS) are intended for the acquisition of channel-state information (CSI) for UE working in transmission mode 9 (TM9), because in TM9, the DM-RS are used for channel estimation.

The CSI-RS structure depends on the number of CSI-RS (1, 2, 4 or 8) configured in a cell and can differ between the cells. This is illustrated on Figure 3-16 (from TS 36.211).

The CSI-RS are transmitted on antenna ports 15 to 22 (AP 15 .. AP 22).

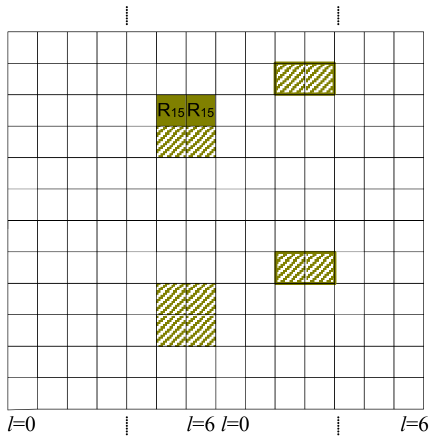


Figure 3-16: Mapping of a CSI-RS on antenna port 15 (CSI configuration 0, normal cyclic prefix)

pattern = example of possible position of the CSI-RSs
dark green = example of allocated CSI-RS signals in a cell
border = example of muted (ZeroTxPower) CSI-RSs

The CSI-RS can be configured with different transmission periods (5 ms - 80 ms) and per subframe (see Table 7-10).

In normal operation, the CSI-RS is transmitted on the allocated resource elements (dark green color on Figure 3-16) whereas the remaining possible but not allocated resource elements (the pattern elements on the figure) are used for PDSCH transmission. The 3GPP specification allows the configuration of an extra subset of resource elements, that are reserved for CSI-RS transmission, have the same structure as the CSI-RS but use a zero transmission power (ZeroTxPower). Nothing is transmitted during these resource elements.

For description of the related settings, refer to:

- Chapter 7.4.11, "CSI Settings", on page 140
- Chapter 7.6.3, "CSI-RS Settings", on page 169
- "CSI Awareness" on page 204

3.1.6 Downlink Physical Layer Procedures

For E-UTRA, the following downlink physical layer procedures are especially important:

- **Cell search and synchronization**
  See Chapter 3.1.5.2, "Cell-specific downlink reference signals", on page 25.
- **Scheduling**
  Scheduling is done in the base station (eNodeB). The downlink control channel PDCCH informs the users about their allocated time/frequency resources and the transmission formats to use. The scheduler evaluates different types of information, e.g. quality of service parameters, measurements from the UE, UE capabilities, and buffer status.
- **Link adaptation**
  Link adaptation is already known from HSDPA as adaptive modulation and coding. Also in E-UTRA, modulation and coding for the shared data channel is not fixed, but rather is adapted according to radio link quality. For this purpose, the UE regularly reports channel quality indications (CQI) to the eNodeB.
- **Hybrid automatic repeat request (ARQ)**
  Downlink hybrid ARQ is also known from HSDPA. It is a retransmission protocol. The UE can request retransmissions of incorrectly received data packets.

3.2 LTE Uplink Transmission Scheme

During the study item phase of LTE, alternatives for the optimum uplink transmission scheme were investigated. While OFDMA is seen optimum to fulfill the LTE requirements in downlink, OFDMA properties are less favorable for the uplink. This is due to weaker peak-to-average power ratio (PAPR) properties of an OFDMA signal, resulting in worse uplink coverage.

Thus, the LTE uplink transmission scheme for FDD and TDD mode is based on SC-FDMA (Single Carrier Frequency Division Multiple Access) with cyclic prefix. SC-FDMA signals have better PAPR properties compared to an OFDMA signal. This was one of the main reasons for selecting SC-FDMA as LTE uplink access scheme. The PAPR characteristics are important for cost-effective design of UE power amplifiers. Still, SC-FDMA signal processing has some similarities with OFDMA signal processing, so parameterization of downlink and uplink can be harmonized.

There are different possibilities how to generate an SC-FDMA signal. DFT-spread-OFDM (DFT-s-OFDM) has been selected for EUTRA. The principle is illustrated on Figure 3-17. This figure is taken from 3GPP R1-050584, "EUTRA Uplink Numerology and Design".

For DFT-s-OFDM, a size-M DFT is first applied to a block of M modulation symbols. QPSK, 16QAM and 64 QAM are used as uplink EUTRA modulation schemes, the latter being optional for the UE. The DFT transforms the modulation symbols into the frequency domain. The result is mapped onto the available subcarriers. In EUTRA uplink, only localized transmission on consecutive subcarriers is allowed. An N point IFFT where N>M is then performed as in OFDM, followed by addition of the cyclic prefix and parallel to serial conversion.

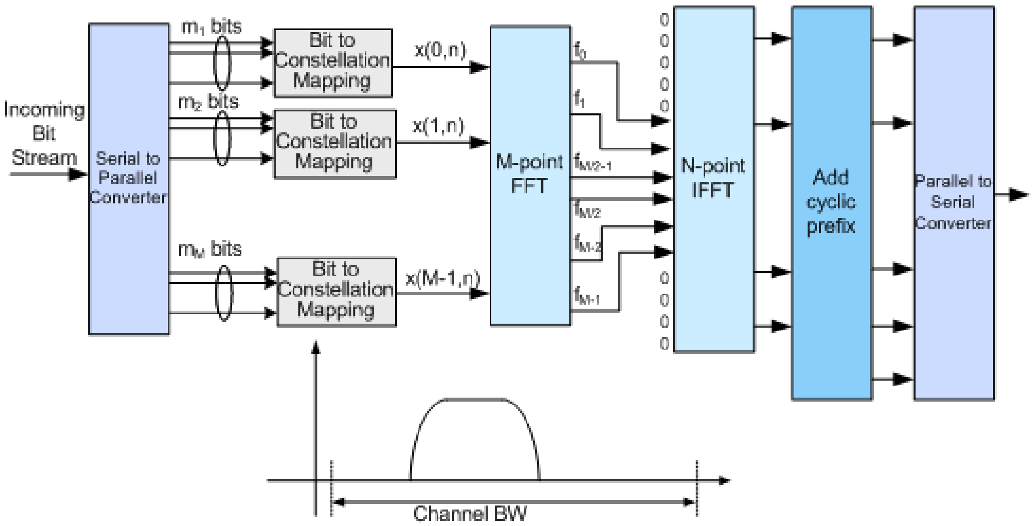


Figure 3-17: Block Diagram of DFT-s-OFDM (Localized Transmission)

The DFT processing is therefore the fundamental difference between SC-FDMA and OFDMA signal generation. This is indicated by the term DFT-spread-OFDM. In an SCFDMA signal, each sub-carrier used for transmission contains information of all transmitted modulation symbols, since the input data stream has been spread by the DFT transform over the available sub-carriers. In contrast to this, each sub-carrier of an OFDMA signal only carries information related to specific modulation symbols.

3.2.1 SC-FDMA Parameterization

The EUTRA uplink structure is similar to the downlink. An uplink radio frame consists of 20 slots of 0.5 ms each, and 1 subframe consists of 2 slots. The slot structure is shown on Figure 3-18 (taken from TS 36.211).

Each slot carries N_{symb}^{UL} SC-FDMA symbols, where N_{symb}^{UL} = 7 for the normal cyclic prefix and N_{symb}^{UL} = 6 for the extended cyclic prefix. SC-FDMA symbol number 3 (i.e. the 4th symbol in a slot) carries the reference signal for channel demodulation.

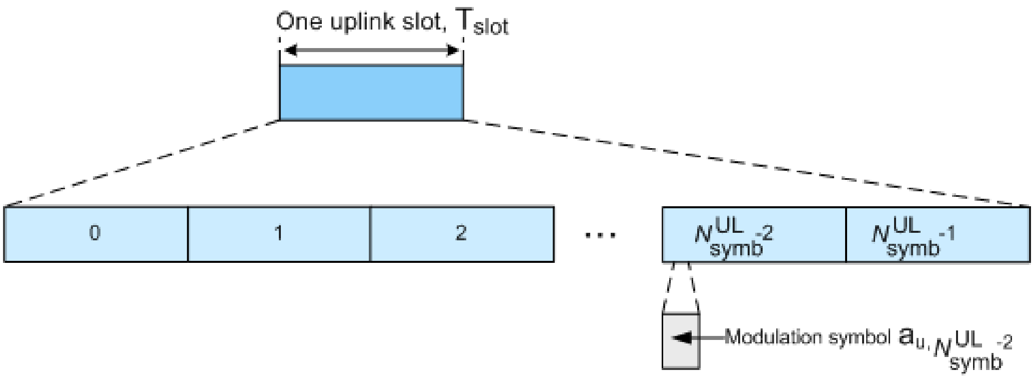


Figure 3-18: Uplink Slot Structure

Also for the uplink, a bandwidth agnostic layer 1 specification has been selected. The table below shows the configuration parameters in an overview table.

Configuration	Number of symbols N_{symb}^{UL}	Cyclic Prefix length in samples	Cyclic Prefix length in µs
Normal cyclic prefix Δf=15 kHz	7	160 for first symbol 144 for other symbols	5.2 us for first symbol 4.7 us for other symbols
Extended cyclic prefix Δf=15 kHz	6	512	16.7 us

For information on the related settings, refer to:

- "Link Direction" on page 85
- Chapter 7.4.4, "TDD Frame Structure Settings", on page 127
- Chapter 7.18, "SC-FDMA Time Plan", on page 286
- Chapter 7.19, "TDD Time Plan", on page 288.

3.2.2 Uplink Data Transmission

In uplink, data is allocated in multiples of one resource block. Uplink resource block size in the frequency domain is 12 sub-carriers, i.e. the same as in downlink. To simplify the DFT design in uplink signal processing only factors 2, 3, and 5 are allowed.

The uplink transmission time interval (TTI) is 1 ms (same as downlink).

User data is carried on the Physical Uplink Shared Channel (**PUSCH**).

For information on the related settings, refer to:

- Chapter 7.13.7, "PUSCH Structure", on page 229
- Chapter 7.15.5, "Physical Uplink Shared Channel (PUSCH)", on page 254

- Chapter 7.16, "Enhanced PUSCH Settings", on page 272

3.2.3 Uplink Control Information Transmission

Depending on whether an uplink resource has been assigned to the user or not, the uplink control information is carried by one of the following channels:

- Physical Uplink Shared Channel (PUSCH)
- Physical Uplink Control Channel (PUCCH)

Control information (CQI reports and ACK/NACK information related to data packets received in the downlink) is multiplexed with the PUSCH, if the user has been granted with UL-SCH transmission.

The PUCCH carries uplink control information, e.g. CQI reports, HARQ ACK/NACK information, or Scheduling Requests (SR), in case the user has not been assigned an UL-SCH transmission. The PUCCH is transmitted on a reserved frequency region at the edges of the total available bandwidth in the UL. One PUCCH resource comprises a pair of resource blocks within slot 0 and 1 that are located in the upper and the lower part of the spectrum. PUCCH is allocated as shown on the Figure 3-19 (taken from TS 36.211).

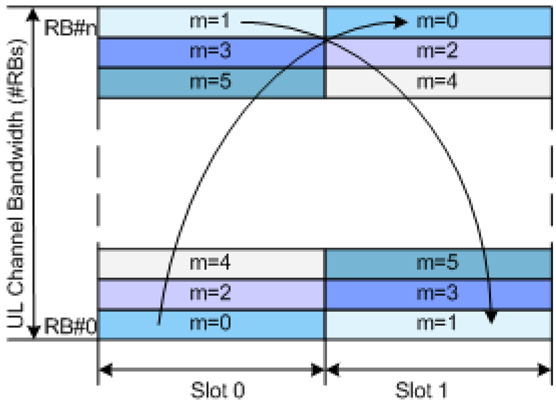


Figure 3-19: PUCCH Mapping

According to TS 36.211, seven PUCCH formats are defined (see Table 3-3).

Table 3-3: PUCCH formats

PUCCH format	Description	Physical Bits	Modulation Scheme	ODFM Symbols used for DRS (normal CP)	ODFM Symbols used for DRS (extended CP)
1	Scheduling Request (SR)	0	-	2, 3, 4	2, 3
1a	ACK/NACK ACK/NACK + SR	1	BPSK	2, 3, 4	2, 3

PUCCH format	Description	Physical Bits	Modulation Scheme	ODFM Symbols used for DRS (normal CP)	ODFM Symbols used for DRS (extended CP)
1b	ACK/NACK for MIMO ACK/NACK + SR	2 4	QPSK	2, 3, 4	2, 3
2	CQI CSI + ACK/NACK	20	QPSK	1, 5	3
2a	CSI + ACK/NACK	21	QPSK+BPSK	1, 5	-
2b	CSI + ACK/NACK for MIMO	22	QPSK+QPSK	1, 5	-
3	ACK/NACK (if DL carrier aggregation with more than 2 cell) ACK/NACK + SR	48	QPSK	1, 5	3

The different PUCCH formats are mapped to the reserved PUCCH region, so that there can be only one resource block per slot that supports a combination of PUCCH formats 1/1a/1b and 2/2a/2b.

For simultaneous transmission of multiple users on the PUCCH, different PUCCH resource indices are used. Multiple users are distinguished within one resource block by using different cyclic shifts (CS) of the CAZAC (Constant Amplitude Zero Auto-Correlation) sequence. For PUCCH formats 1/1a/1b additionally three different orthogonal cover sequences (OC) can be used. For the different PUCCH formats, different number of PUCCH resource indices are available within a resource block (see table below). The actual number of the used orthogonal sequences is additionally determinate by the parameter delta_shift, used to support working by different channel conditions.

PUCCH format	PUCCH resource indices	Number available within a resource block
1/1a/1b	N(1)_PUCCH	36 for normal CP 24 for extended CP
2/2a/2b	N(2)_PUCCH	12
3	N(3)_PUCCH	5

For information on the related settings, refer to:

- Chapter 7.13.8, "PUCCH Structure", on page 230
- Chapter 7.17, "Enhanced PUCCH Settings", on page 281

3.2.4 Uplink Reference Signal Structure

Uplink reference signals are used for two different purposes:

- For channel estimation in the eNodeB receiver to demodulate control and data channels
- To provide channel quality information as a basis for scheduling decisions in the base station.
  This purpose is also called channel sounding.

The uplink reference signals are based on CAZAC (Constant Amplitude Zero Auto-Correlation) sequences.

Sounding reference signals (SRS)

The specification defines two types of sounding reference signals (SRS), periodic SRS and aperiodic SRS. A user equeipment (UE) can be configured with both SRS trigger types.

- Periodic SRS occurs at regular time intervals.
  It is referred as "trigger type 0" SRS and is known form LTE Rel. 8
- The aperiodic SRS transmission is a single (one-shot) transmission
  It is referred as "trigger type 1" SRS and is introduced by LTE Rel. 10.
  Aperiodic SRS is triggered by the "SRS Request" flag in one of the DCI formats 0/1A/4/2B/2C/2D.
  Triggering aperiodic SRS by using DCI format 0 requieres one dedicated SRS set of parameters whereas the triggering by using DCI formats 1A/2A/2B/2C uses a common SRS set. For the triggering by DCI format 4 the specification defines 3 SRS sets.

For information on the related settings, refer to:

- Chapter 7.13.5, "UL Reference Signals", on page 226
- Chapter 7.13.9, "SRS Structure", on page 232
- Chapter 7.15.7, "Sounding Reference Signal (SRS)", on page 259
- "Aperiodic SRS" on page 204
- "DCI Format 1A" on page 192

3.2.5 Uplink Physical Layer Procedures

For EUTRA, the following uplink physical layer procedures are especially important:

Non-synchronized random access

The random access may be used to request initial access, as part of handover, when transiting from idle to connected, or to re-establish uplink synchronization. The structure is shown on Figure 3-20 (taken from TS 36.211).

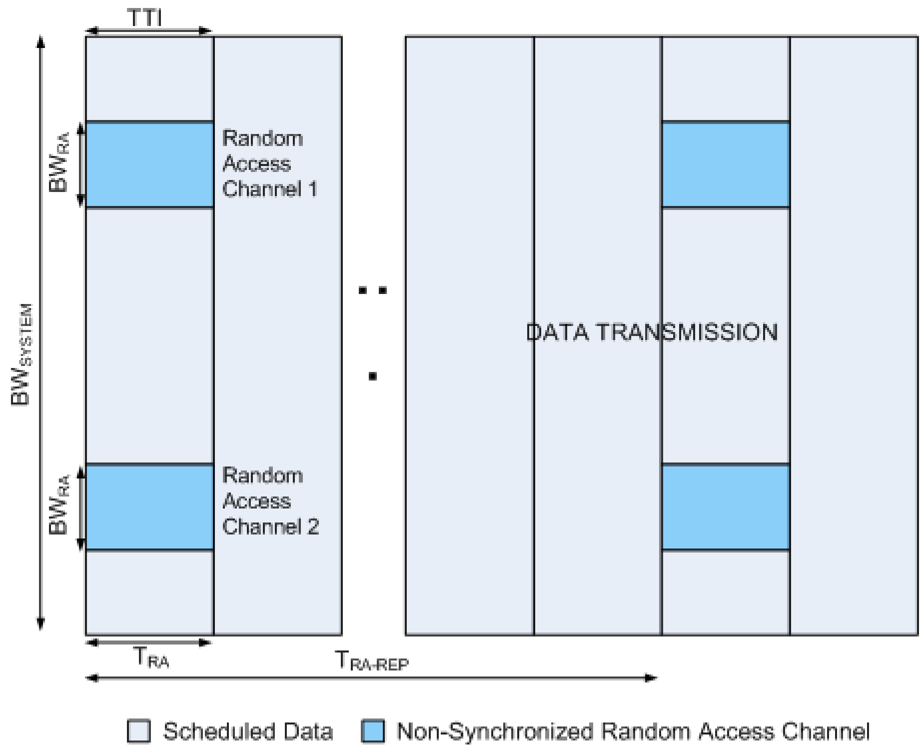


Figure 3-20: Random Access Structure, principle

Multiple random access channels may be defined in the frequency domain within one access period TRA to provide enough random access opportunities.

For the random access, a preamble is defined as shown on Figure 3-21 (taken from TS 36.211). The preamble length depends on the preamble format. The preamble bandwidth is 1.08 MHz (72 subcarriers). Higher layer signaling controls in which subframes the preamble transmission is allowed, and the location in the frequency domain. Per cell, there are 64 random access preambles. They are generated from Zadoff-Chu sequences.

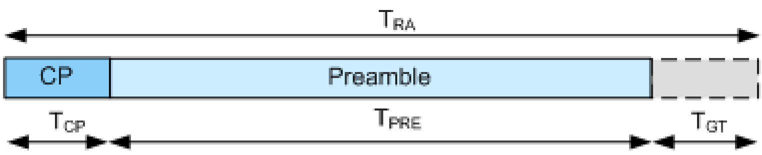


Figure 3-21: Random Access Preamble

The random access procedure uses open loop power control with power ramping similar to WCDMA. After sending the preamble on a selected random access channel, the UE waits for the random access response message. If no response is detected, then another random access channel is selected and a preamble is sent again.

For information on the related settings, refer to:
- Chapter 7.13.6, "PRACH Settings", on page 227
- Chapter 7.15.9, "PRACH Power Ramping", on page 268
- Chapter 7.15.10, "PRACH Configuration", on page 269

Uplink scheduling

As in the downlink direction, the uplink scheduling is *dynamical scheduling* of uplink resources performed by eNodeB on a subframe basis. The eNodeB assigns certain time/frequency resources to the UEs and informs UEs about transmission formats to use. Scheduling decisions affecting the uplink are communicated to the UEs via the Physical Downlink Control Channel (PDCCH) in the downlink. The scheduling decisions may be based on QoS parameters, UE buffer status, uplink channel quality measurements, UE capabilities, UE measurement gaps, etc.

The LTE specification defines a second uplink scheduling method, the *semi-persistent scheduling (SPS)*. The semi-persistent scheduling is used to reduce the control signaling overhead for regularly occurring services and transmissions of relative small payloads. With SPS, the scheduling decisions are not transmitted every subframe but once. Via the PDCCH, the UEs first receive information on the SPS periodicity, that is information about the SPS pattern or the subframes on which scheduling decisions can be transmitted. Semi-persistent scheduling is then activated and deactivated by an explicit trigger, the SPS C-RNTI. The dynamic scheduling commands have higher priority than the SPS.

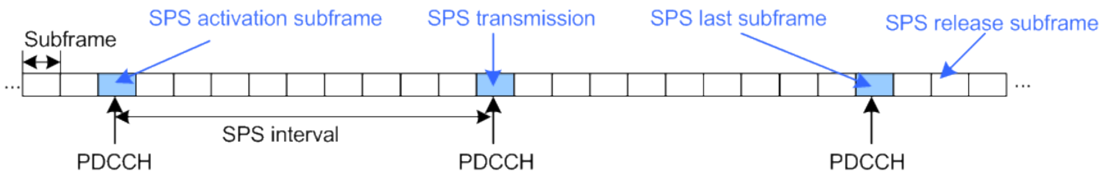


Figure 3-22: Semi-persistent scheduling (SPS)

In carrier aggregation transmission, SPS is allowed only on the primary component carrier.

For information on the related settings, refer to Chapter 7.10, "SPS Configuration Settings", on page 209.

Uplink link adaptation

As uplink link adaptation methods, transmission power control, adaptive modulation and channel coding rate, and adaptive transmission bandwidth can be used.

Uplink timing control

Uplink timing control is required to time align the transmissions from different UEs with the receiver window of the eNodeB. The eNodeB sends the appropriate timing-control commands to the UEs in the downlink, commanding them to adapt their respective transmit timing.

Hybrid automatic repeat request (ARQ)

The eNodeB uses the Uplink Hybrid ARQ protocol to request retransmissions of incorrectly received data packets.

3.3 LTE MIMO Concepts

Multiple Input Multiple Output (MIMO) systems form an essential part of LTE to achieve the ambitious requirements for throughput and spectral efficiency. MIMO refers to the use of multiple antennas at transmitter and receiver side.

3.3.1 Downlink MIMO

For the LTE downlink, a 2x2 configuration for MIMO is assumed as baseline configuration, i.e. 2 transmit antennas at the base station and 2 receive antennas at the terminal side. Configurations with 4 or more antennas are also being considered.

Different MIMO modes are envisaged. It has to be differentiated between spatial multiplexing and transmit diversity, and it depends on the channel condition which scheme to select.

For information on the related settings, refer to

- Chapter 7.4.6, "MIMO", on page 129
- Chapter 7.6.2, "Precoding Settings", on page 165
- Chapter 7.9, "DL Antenna Port Mapping Settings", on page 205.

3.3.1.1 Spatial Multiplexing

Spatial multiplexing allows transmitting different streams of data simultaneously on the same downlink resource blocks (see Figure 3-23 for illustration of the principle). These data streams can belong to one single user (single user MIMO / SU-MIMO) or to different users (multi-user MIMO / MU-MIMO). While SU-MIMO increases the data rate of one user, MU-MIMO allows increasing the overall capacity.

Spatial multiplexing is only possible if the mobile radio channel allows it.

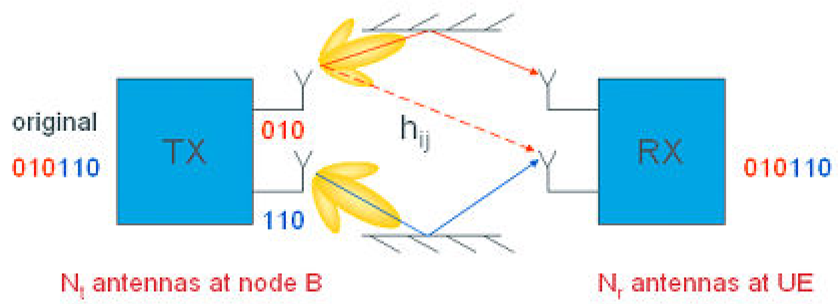


Figure 3-23: Spatial multiplexing

In the Figure 3-23, each transmit antenna transmits a different data stream. Each receive antenna may receive the data streams from all transmit antennas. The channel (for a specific delay) can thus be described by the following channel matrix H:

$$\begin{array}{cc} \overset{N_t}{\longleftrightarrow} & \\ \mathbf{H} = \begin{bmatrix} h_{11} & h_{12} & \cdots & h_{1N_t} \\ h_{21} & h_{22} & & h_{2N_t} \\ \vdots & & \ddots & \vdots \\ h_{N_r1} & h_{N_r2} & \cdots & h_{N_rN_t} \end{bmatrix} & \updownarrow N_r \end{array}$$

In this general description, N_t is the number of transmit antennas, N_r is the number of receive antennas, resulting in a 2x2 matrix for the baseline LTE scenario. The coefficients h_{ij} of this matrix are called channel coefficients from transmit antenna *j* to receive antenna *i*, thus describing all possible paths between transmitter and receiver side.

The number of data streams that can be transmitted in parallel over the MIMO channel is given by min $\{N_t, N_r\}$ and is limited by the rank of the matrix H. The transmission quality degrades significantly in case the singular values of matrix H are not sufficiently strong. This can happen in case the 2 antennas are not sufficiently de-correlated, for example in an environment with little scattering or when antennas are too closely spaced.

Codewords and spatial layers

A block of information bits that can be separately processed before it is transmitted in a subframe, is called codeword [17].

A spatial layer indicates the number of spatial streams that can be simultaneously transmitted [17]. The number of layers for transmission is less than or equal to the number of transmit antenna ports and depends on the rank of the matrix H.

In LTE Rel. 8/9, up to 2 codewords can be transmitted simultaneously and mapped onto up to four layers. There is a fixed mapping between codewords to layers, see Figure 3-24.

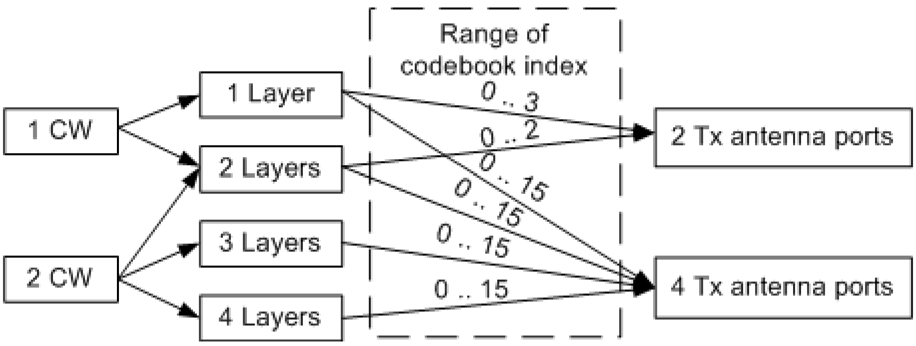


Figure 3-24: Codeword to layer mapping for downlink spatial multiplexing (LTE Rel. 8/9)

Precoding

Precoding on transmitter side is used to support spatial multiplexing, see Figure 3-25 (from TS 36.211). This is achieved by applying a precoding matrix W to the signal before transmission.

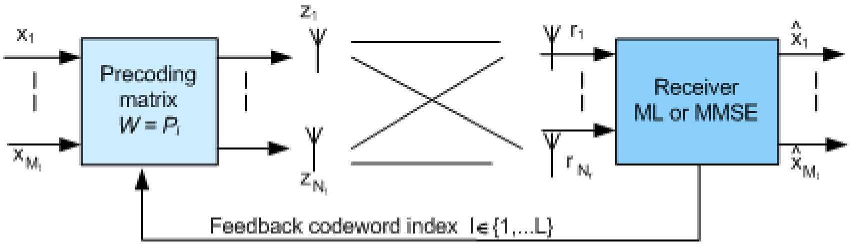


Figure 3-25: Precoding principle

The optimum precoding matrix W is selected from a predefined "codebook" which is known at eNodeB and UE side. Unitary precoding is used, i.e. the precoding matrices are unitary: $W^H W = I$. The UE estimates the radio channel and selects the optimum precoding matrix. The optimum precoding matrix is the one which offers maximum capacity. The UE provides feedback on the uplink control channel regarding the preferred precoding matrix (precoding vector as a special case). Ideally, this information is made available per resource block or at least group of resource blocks, since the optimum precoding matrix varies between resource blocks. The Figure 3-26 (from TS 36.211) gives an overview of EUTRA downlink baseband signal generation including the steps relevant for MIMO transmission.

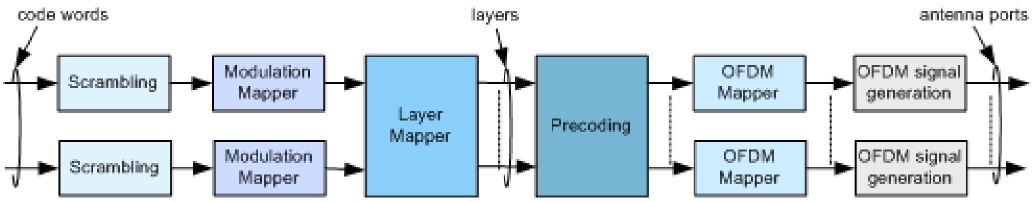


Figure 3-26: Overview of downlink baseband signal generation

Transmission modes

LTE defines the following transmission modes for the PDSCH (TS 36.213).

Table 3-4: Downlink transmission modes overview

Transmission mode	Transmission scheme
Tx Mode 1	Single-antenna transmission (AP 0); SISO/SIMO but no MIMO
Tx Mode 2	Transmit diversity
Tx Mode 3	• Transmit diversity • Open-loop spatial multiplexing with large delay CDD; SU-MIMO (Single User MIMO)
Tx Mode 4	• Transmit diversity • Closed-loop spatial multiplexing; SU-MIMO
Tx Mode 5	• Transmit diversity • MU-MIMO (Multi-User MIMO)
Tx Mode 6	• Transmit diversity • Closed-loop spatial multiplexing using a single transmission layer
Tx Mode 7	Single-antenna port transmission (AP 5); Single layer Beamforming

Transmission mode	Transmission scheme
Tx Mode 8	• Dual layer transmission (AP 7 and AP 8); Dual Layer Beamforming • Single-antenna port (AP 7 or AP 8)
Tx Mode 9	Multi-layer transmission (AP 9 and AP 14); MU-MIMO, SU-MIMO, 8 Layer Beamforming

See also Chapter 3.1.5.1, "Mapping of Reference Signals to Antenna Ports", on page 24.

3.3.1.2 Transmit Diversity

Instead of increasing data rate or capacity, MIMO can be used to exploit diversity. If the channel conditions do not allow spatial multiplexing, a transmit diversity scheme is used instead, so switching between these two MIMO modes is possible depending on channel conditions. Transmit diversity is used when the selected number of streams (rank) is one.

3.3.1.3 Beamforming

The beamforming is a method to shape the transmitted signal in the receiver's direction. In LTE, the beamforming is defined as transmission mode 7, 8 and 9 (Tx Mode 7/8/9). Beamforming uses the special antenna ports 5 and 7 to 14, see Table 3-4.

The channel estimation in a beamforming scenario is based on the UE-specific reference signal (DM-RS).

3.3.2 Uplink MIMO

Uplink MIMO schemes for LTE differ from downlink MIMO schemes. Up to LTE Release 9, only uplink MU-MIMO is specified. Multiple user terminals may transmit simultaneously on the same resource block. This is also referred to as spatial domain multiple access (SDMA). The scheme requires only one transmit antenna at UE side. The UEs sharing resource blocks have to apply mutually orthogonal pilot patterns.

For information on the SU-MIMO and the LTE-Advanced MIMO concept, see Chapter 3.5.3, "Enhanced MIMO Schemes", on page 46.

3.4 LTE MBMS Concepts

In LTE, MBMS transmission is performed as single-cell transmission or as multi-cell transmission. In case of multi-cell transmission the cells and content are synchronized to enable for the terminal to soft-combine the energy from multiple transmissions. The superimposed signal looks like multipath to the terminal. This concept is also known as Single Frequency Network (SFN). The EUTRAN can configure which cells are part of an SFN for transmission of an MBMS service. The MBMS traffic can share carrier with the unicast traffic or be sent on a separate carrier. For MBMS traffic, an extended cyclic prefix is provided. Specific reference signals are used in the subframes that carry MBMS SFN data (see Chapter 3.1.5.3, "MBSFN reference signals", on page 27).

MBMS data is carried on the MBMS traffic channel (MTCH) as logical channel. The MBMS control channel MCCH carries the MBMS control information. Both logical channels, the MTCH and the MCCH, are mapped onto the physical multicast channel PMCH in the multi-cell transmission case and on the PDSCH in case a single-cell transmission is used.

For information on the related settings, refer to Chapter 7.4.2, "MBSFN Settings", on page 112.

3.5 LTE-Advanced (3GPP Rel. 10) Introduction

This description gives a brief description only of the LTE-A features currently covered by the software option R&S SMx/AMU-K85. The full set of LTE-Advanced features is described in 1MA232.

For a complete LTE-Advanced technology introduction and an insight description of the LTE-A features, refer to the following Rohde & Schwarz documents:

- Withe Paper 1MA169 "LTE-Advanced Technology Introduction"
- Application Note 1MA166 "LTE-Advanced Signals Generation and –Analysis"

The last two documents can be found in the official Rohde & Schwarz internet site > Download Area > Application Notes: http://www2.rohde-schwarz.com/en/service_and_support/Downloads/Application_Notes/

3.5.1 Carrier Aggregation

The LTE-A Rel. 10 specification uses the aggregation of multiple LTE carriers. Two or more component carriers (CC) are grouped to support wider transmission bandwidths of up to 100 MHz. To an LTE Rel. 8 terminal, each component carrier appears as an LTE carrier. An LTE Rel. 10 terminal can exploit the total aggregated bandwidth. As backward compatibility is fulfilled, a LTE-advanced cell can serve both LTE Rel. 8 and LTE Rel. 10 terminals simultaneously.

Spectrum deployment can be either contiguous with adjacent component carriers, or non-contiguous with non-adjacent component carriers (see Figure 3-27, 1MA169). The individual component carriers can belong to the same frequency band (intra-band) or to different frequency bands (inter-band). Component carriers transmitted by the same eNodeB provide the same cell coverage.

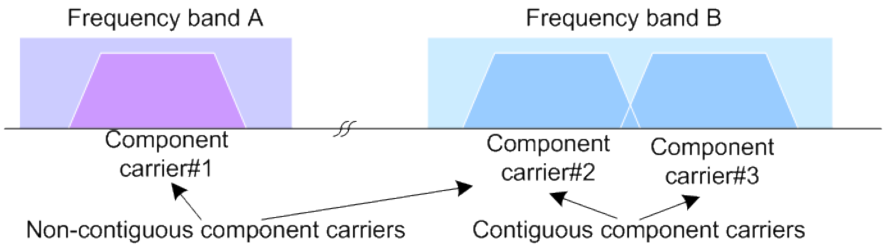


Figure 3-27: Carrier aggregation

The LTE-A specification defines two different approaches about informing the UE about the scheduling for each band: a separate PDCCH for each carrier or a common PDCCH for multiple carriers (cross-carrier scheduling).

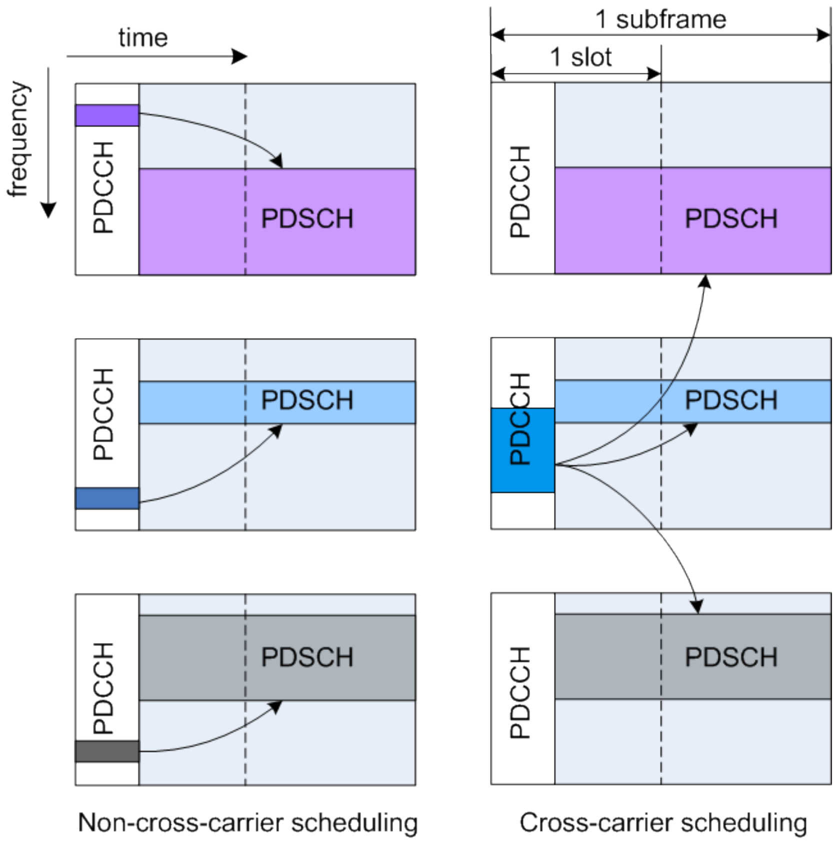


Figure 3-28: LTE-A scheduling approaches

In the dedicated/non-cross-carrier approach, the PDCCH on a component carrier assigns PDSCH resources on the same component carrier. The used PDCCH structure is identical to the LTE Rel. 8/9 PDCCH structure.

In the cross-carrier approach, the PDCCH on a component carrier assigns resources on one of multiple component carriers. The component carriers are identified by the new introduced DCI field, the CIF (carrier indicator field).

For information on the related settings, refer to:

- Chapter 7.4.1, "DL Carrier Aggregation Configuration", on page 106.

- Chapter 7.7, "Enhanced PCFICH, PHICH and PDCCH Channel Configuration", on page 174
- Chapter 7.8, "User Configuration Settings", on page 200.

3.5.2 Enhanced Uplink SC-FDMA

The LTE-A Rel. 10 enhances the uplink transmission scheme compared to the LTE Rel. 8 uplink with the following:

- Control-data decoupling
  In LTE Rel. 8/9 a UE only uses physical uplink control channel (PUCCH) when it does not have any data to transmit on PUSCH. If a UE has data to transmit on PUSCH, it would multiplex the control information with data on PUSCH. This behavior is not valid in LTE-Advanced, which means that simultaneous PUCCH and PUSCH transmission is possible in uplink direction.
- Non-contiguous data transmission
  LTE-Advanced extends the uplink transmission scheme by allowing clustered PUSCH. The uplink transmission is not restricted to the use of consecutive subcarriers; clusters of resource blocks can be allocated (two "Sets" of consecutive PUSCH resource block groups according to resource allocation type 1 as defined in TS 36.213).

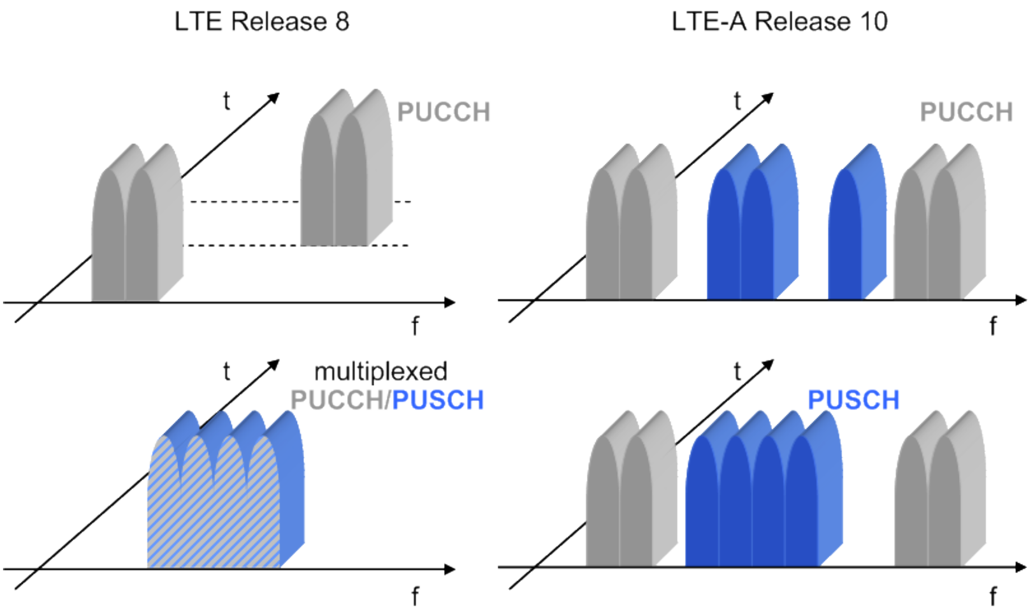


Figure 3-29: LTE release 8 and LTE-A Release 10 UL transmission schemes

For information on the related settings, refer to:

- Chapter 7.14, "UL Frame Configuration Settings", on page 234
- Chapter 7.15, "User Equipment Configuration", on page 242.

3.5.3 Enhanced MIMO Schemes

LTE Rel. 8 supports MIMO schemes in downlink direction. In downlink direction up to four transmit antennas can be used whereas the maximum number of codewords is two irrespective of the number of antenna ports. LTE-Advanced extends the MIMO capabilities of LTE Rel. 8/9 to now supporting eight downlink antennas (8x8 antenna configuration) and four uplink antennas (4x4 antenna configuration), see Figure 3-30, and Figure 3-31, 1MA169.

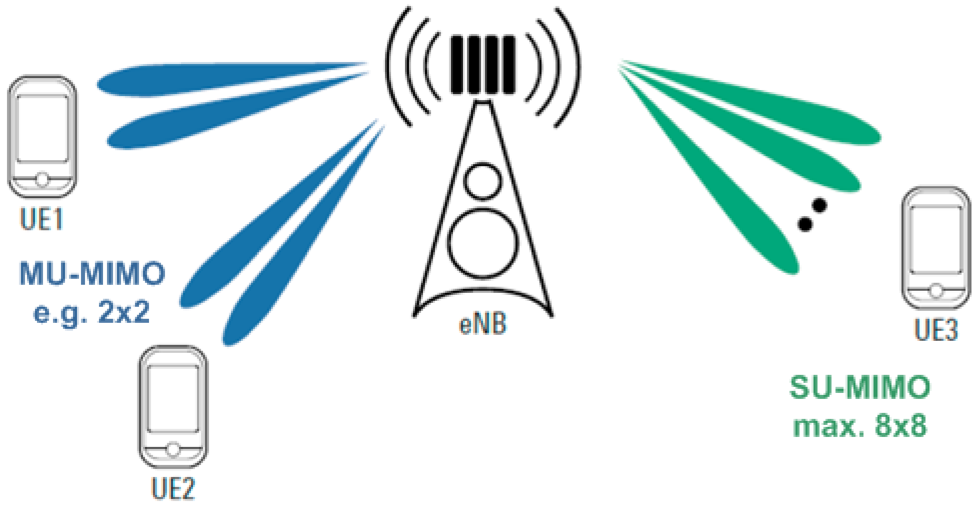


Figure 3-30: Supported transmit layers in LTE-Advanced (Downlink)

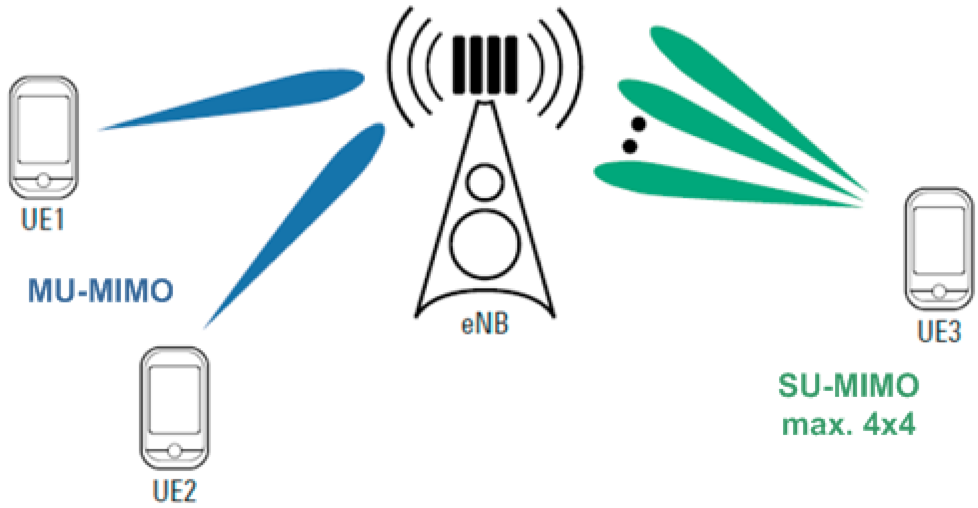


Figure 3-31: Supported transmit layers in LTE-Advanced (Uplink)

In addition to the spatial multiplexing schemes, transmit diversity is possible in both downlink and uplink direction.

Downlink MIMO

The following is a list of the main differences compared to LTE Rel. 8/9:

- Layer mapping for downlink spatial multiplexing that uses the AP 7 to AP 14 for the up to 8 layer PDSCH
  See Chapter 3.1.5.1, "Mapping of Reference Signals to Antenna Ports", on page 24 and Figure 3-24
- Scheduling of downlink resources uses the DCI format 2c and transmission mode 9 (TM9)
  See "Transmission modes" on page 41
- Introduced are the PDSCH demodulation reference signals DM-RS
  See Chapter 3.1.5.4, "UE-specific reference signal (DM-RS)", on page 28
- Channel state estimation reference signals (CSI-RS)
  See Chapter 3.1.5.6, "CSI reference signals", on page 30

Uplink MIMO

The following is a list of the main difference compared to LTE Rel. 8/9:

- PUSCH transmission uses up to two codewords, up to four layers and up to four antenna ports to support SU-MIMO
- If two PUSCH codewords are used, these codewords can use different modulation schemes
- Defined are different codebooks depending on the used number of antenna ports and layers

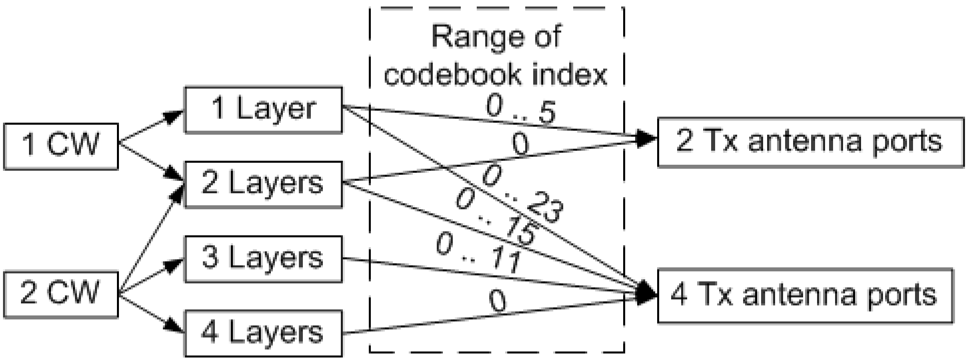


Figure 3-32: Codeword to layer mapping for uplink spatial multiplexing (LTE Rel. 10)

- PUCCH can be transmitted on up to two antenna ports
- SRS can be transmitted on up to four antenna ports
- Scheduling of uplink resources uses the DCI format 4 and transmission mode 2 (TM2)

See Table 3-5

Table 3-5: Uplink transmission modes overview

Transmission mode	Transmission scheme
Tx Mode 1	No spatial multiplexing; transmission on a single antenna port
Tx Mode 2	Spatial multiplexing

For information on the related settings, refer to:

- Chapter 7.14.3, "UL Allocation Table", on page 238
- Chapter 7.15.5, "Physical Uplink Shared Channel (PUSCH)", on page 254, Chapter 7.15.3, "Physical Uplink Control Channel (PUCCH)", on page 250, Chapter 7.15.6, "Demodulation Reference Signal (DRS)", on page 258, Chapter 7.15.7, "Sounding Reference Signal (SRS)", on page 259, and Chapter 7.15.8, "Antenna Port Mapping", on page 267
- Chapter 7.16, "Enhanced PUSCH Settings", on page 272
- Chapter 7.17, "Enhanced PUCCH Settings", on page 281
- Chapter 7.2, "LTE Logfile Generation", on page 87

3.6 LTE Release 11 Introduction

This section gives a brief description only of the LTE-A Rel. 11 features currently covered by the software option R&S SMx/AMU-K112.

For a complete LTE-Advanced (3GPP Rel. 11) technology introduction and an insight description of the LTE-A features, refer to the following Rohde & Schwarz documents:

- Withe Paper 1MA232 "LTE-Advanced (3GPP Rel. 11) Technology Introduction"

LTE Carrier Aggregation Enhancements

LTE-Advanced 3GPP Rel. 11 introduces the following new features:

- Multiple timing advances (TA) for uplink carrier aggregation
- Non-contiguous intra-band carrier aggregation
- Two special subframe configurations for LTE TDD
  - Special subframe configuration 9 with normal cyclic prefix in downlink
  - Special subframe configuration 7 with extended cyclic prefix in downlink
- Support of different UL/DL configurations on different bands
  If TDD carrier aggregation is used, the individual carriers can use different UL/DL configurations
- Enhanced TxD schemes for PUCCH format 1b with channel selection

New control channel Enhanced PDCCH (E-PDCCH)

LTE-Advanced 3GPP Rel. 11 introduces the new downlink control channel to support new features and to increase the control channel capacity.

R&S SMx/AMU-K112 does not support E-PDCCH.

4 EUTRA/LTE Parameterization

4.1 OFDMA Parameterization

- OFDMA physical layer parameterization is based on a bandwidth agnostic layer 1. However, current 3GPP specifications focus on the channel bandwidth listed in Table 4-1.
  Additionally, a user defined channel bandwidth can be configured. To configure the bandwidth of the signal to be generated, the desired number of resource blocks can be specified in a range from 6 to 110 resource blocks with a granularity of 1. This results in bandwidths from 1.095 MHz to 19.815 MHz.

Table 4-1: Channel Bandwidth for FDD mode according to 3GPP TS 36.804

Channel Bandwidth	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Number of Resource Blocks Per Slot	6	12	25	50	75	100
Number Of Occupied Subcarriers	73	181	301	601	901	1201
FFT Size	**128**, 256, 512, 1024, 2048	**256**, 512, 1024, 2048	**512**, 1024, 2048	**1024**, 2048	1536, **2048**	**2048**

- Both frame structure, frame structure type 1 for FDD and frame structure type 2 for TDD, are supported.
- For frame structure 2 (TDD mode), all special subframe configurations and all uplink-downlink configurations as defined in the 3GPP specification are supported.
- Both normal and extended cyclic prefix can be selected for a subcarrier spacing of 15 kHz. Parameterization of cyclic prefixes is according to TS 36.211.
  Note:
  In this version, subcarrier spacing is 15 kHz. Subcarrier spacing of 7.5 kHz will be supported in a later version.
- Resource block size is 12 subcarriers in the frequency domain and, depending on the cyclic prefix length, 7 or 6 consecutive OFDM symbols in the time-domain.
  Note:
  Resource block size of 24 subcarriers will be supported in a later version.

4.2 Reference Signals

- LTE defines one reference signal per downlink antenna port (see Table 3-2).
  In the R&S Signal Generator, the mapping of the logical antenna ports AP 4 to AP 22 to the physical Tx-antennas is configurable.
- There is a direct mapping of the CS-RS, i.e. antenna port 0 is mapped to Tx-antenna 1 solely, antenna port 1 is mapped to Tx-antenna 2 and so on.

- In R&S Signal Generator you select the cell-specific reference signals (AP 0 .. AP 3); the instrument adjusts the correct reference signal pattern accordingly. An example for the possible distribution of downlink reference signals for the normal cyclic prefix is shown in Figure 3-10. The reference signal pattern for the extended cyclic prefix is also done according to TS 36.211.
- Availability of secondary CS-RS reference signal, subcarrier offset of the reference signal sequence in the frequency domain and existence of empty resource elements depend on the antenna selected.
- Reference signal sequences are generated as a pseudo-random sequence. This sequence is determinate by the cell ID, i.e. the combination of 168 physical cell identity groups and the 3 physical layer identities within each physical layer group.
- Generation of reference signals for AP 4 .. AP 22 depend on the availability of MBSFN, PRS, beamformed PDSCHs and CSI-RS.

4.3 Synchronization Signal (SYNC)

- Primary and secondary synchronization signal (P-SYNC and S-SYNC) are supported.
- In the FDD mode, the P-SYNC and S-SYNC are located on the last two OFDM symbols of slot (see Figure 3-11). By default, the synchronization signals are transmitted in slots 0 and 10 of the radio frame.
- P-SYNC and S-SYNC are transmitted within the center 72/64 subcarriers. Resource blocks containing P-SYNC/ S-SYNC thus have less resource elements available for user data allocation.
- By default, P-SYNC and S-SYNC are enabled but the synchronization signals can be disabled independently in the signal generator.
- Power of the P-SYNC and S-SYNC can be set independently in the signal generator.

4.4 Physical Broadcast Channel (PBCH)

- By default, the PBCH is located over 4 consecutive OFDM symbols in the first four OFDM symbols (symbol number 0 .. 3) of slot 1 of subframe 0 for normal CP. The default location of the four PBCH symbols for extended CP start in the second OFDM symbol (symbol number 2..5) of slot 1 of subframe 0. The Figure 4-1 shows the default location of PBCH in case of normal CP.

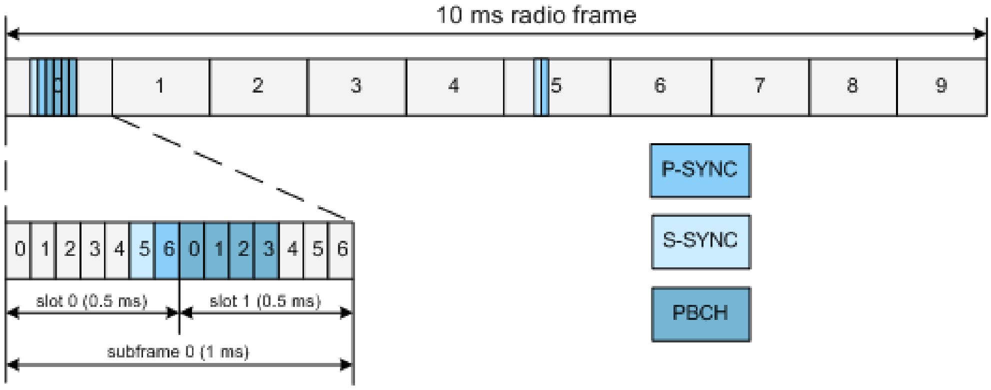


Figure 4-1: Default location of PBCH for normal CP

- PBCH repetition interval is once per frame of 10 ms. Position of PBCH within the subframe 0 is according to TS 36.211. However, the R&S Signal Generator allows you to modify the PBCH in terms of PBCH start symbol within the radio subframe (0..13 for normal CP) and length in symbols (1..14 for normal CP).
- PBCH is QPSK modulated; scrambling and channel coding can be additionally activated or deactivated.
- If channel coding is activated, one block of data (Transport Block Size of 24) is coded jointly and then spread over four frames. Hence, the ARB "Sequence Length" has to be set accordingly to be a multiple of four.
- PBCH is occupying the center 72 subcarriers around DC subcarrier.

4.5 Physical Control Format Indicator Channel (PCFICH)

- PCFICH is QPSK modulated; scrambling can be additionally activated or deactivated.
- PCFICH is layer mapped and precoded according to TS 36.211.
- The power of the PCFICH is configurable.

4.6 Physical Hybrid ARQ Indicator Channel (PHICH)

- PHICH is BPSK modulated.
- PHICH is layer mapped and precoded according to TS 36.211.
- Different orthogonal sequences are used for the PHICHs within the same PHICH group.
- The power of the PHICH is configurable.

4.7 Physical Downlink Control Channel (PDCCH)

- PDCCH is layer mapped, precoded and mapped to the resource elements (incl. permutation and cyclically shifting) according to TS 36.211.
- The power of the PDCCH is configurable.
- All DCI formats are supported and can be configured with full flexibility.

4.8 Physical Multicast Channel (PMCH)

In this version of the firmware, the following limitations apply:

- The simulated BS belongs to only one MBSFN areas.
  All radio resources reserved for MBSFN subframes are assigned to one MBSFN area, i.e. the MBSFN Area fills all MBSFN subframes signaled by SIB Type 2.
- Only one *MBSFN-SubframeConfig* is configurable.
- One MCCH per MBSFN is supported. The MCCH is mapped to the first active MBFSN subframe within one MCCH repetition period.
- The parameters "Radio frame allocation offset", "MCCH offset" and "Notification offset" are set to identical values in order to simplify the MBSFN configuration.

4.9 Data Allocations (DL)

- The Physical Resource Block size is 12 subcarriers in the frequency domain for all bandwidth options.
- Localized transmission is assumed.
  For localized transmission, the numbering of resource blocks starts with the left-most (lower frequency) used subcarrier of the frequency band. The numbering starts with zero. With the FFT-shift, the DC carrier is moved to the first position, which is required to be conform to the standard IFFT input. This is illustrated in the Figure 4-2.

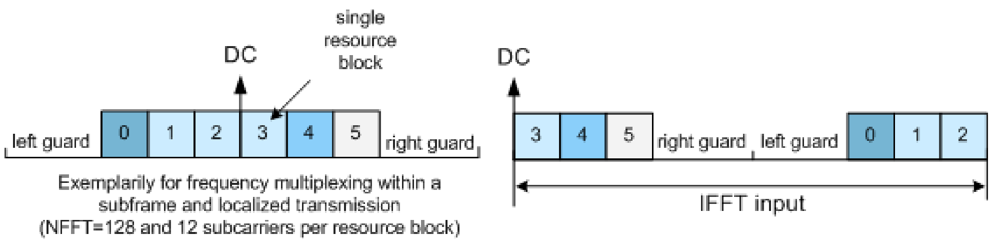


Figure 4-2: Numbering of Resource Blocks

- According to TS 36.211, the modulated data symbols are mapped onto the subcarriers first along the frequency axis starting with the lowest resource block number, then along the available OFDM symbols. This is true also for non-adjacent resource blocks for the same user. This is illustrated in the figure below.

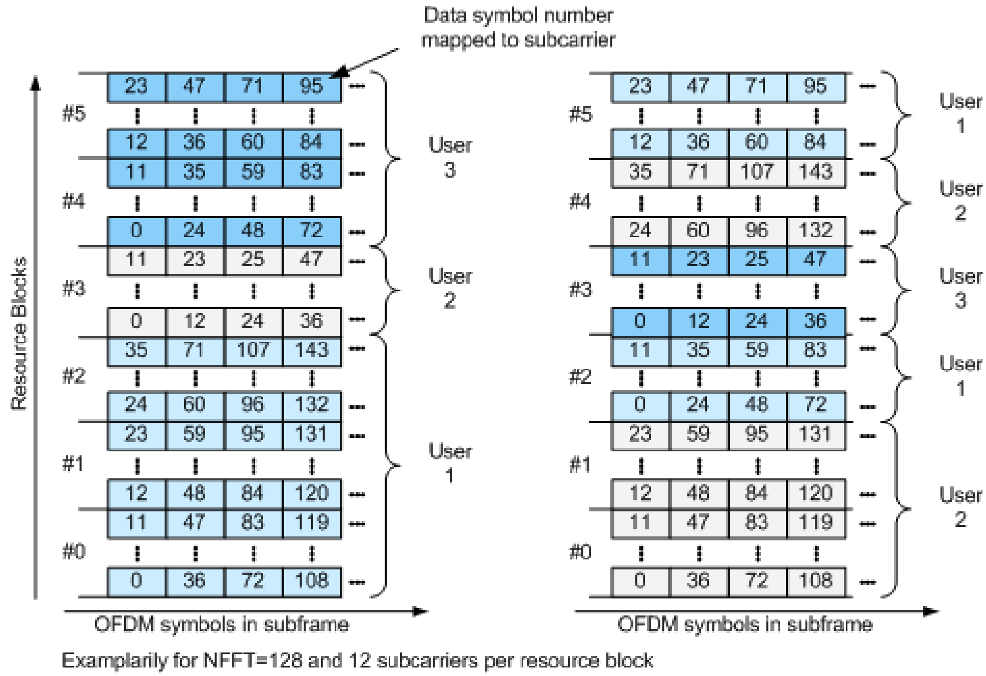


Figure 4-3: Data symbol numbering

- In case pre-defined symbols (e.g. reference symbols, P-SYNC/S-SYNC, PBCH) are transmitted in a subframe, the number of available data symbols for user data allocation is reduced in a resource block.
- Data allocation can be changed for each subframe.
- PDSCH is scrambled, channel coded, precoded and layer mapped according to TS 36.211. Additionally, channel coding configuration can be changed per PDSCH data allocations.

4.10 Modulation Mapping (DL)

The modulation mapping in downlink is done according to TS 36.211. All modulation schemes of TS 36.211 are supported.

4.11 MIMO

- R&S Signal Generator supports all precoding schemes of TS 36.211.
- R&S Signal Generator supports all layer mapping schemes of TS 36.211.

4.12 SC-FDMA Parameterization

- SC-FDMA physical layer parameterization is based on a bandwidth agnostic layer 1. However, current 3GPP specifications focus on the channel bandwidths listed in Table 4-1.
  Additionally, a user defined channel bandwidth can be configured. To configure the bandwidth of the signal to be generated, the desired number of resource blocks can be specified in a range from 6 to 110 resource blocks with a granularity of 1. This results in bandwidths from 1.08 MHz to 19.8 MHz.
- Both frame structures according to TS 36.211 are supported.
- Both normal and extended cyclic prefix are supported.

4.13 Demodulation Reference Signal (DRS)

- If the uplink demodulation reference signal (DRS) is multiplexed with the PUSCH, the DRS is carried within the 3rd or 4th SC-FDMA symbol of a slot (i.e. symbol number l = 2 or l=3), depending on the cyclic prefix type. If the DRS is multiplexed with the PUCCH, the SC-FDMA symbol the uplink DRS is carried within depends on the PUCCH format and the cyclic prefix (see Table 3-3).
- The demodulation reference signal (DRS) spans the same bandwidth as the data allocation.
- The generation of DRS sequence is according to TS 36.211. A CAZAC sequence is used and the DRS is derived from a Zadoff-Chu (ZC) sequence using the extension method.

4.14 Sounding Reference Signal (SRS)

- The generation of SRS sequence is according to TS 36.211.
- Orthogonality of the SRS signal can also be achieved when using different SRS cyclic shifts.
- No PUSCH is transmitted in the symbol where the sounding reference signal is transmitted.
- PUCCH and SRS are not transmitted in the same subframe, except the transmission of SRS and PUCCH format 1, 1a, 1b or 3 in the same subframe is explicitly enabled for a UE.

4.15 Physical Uplink Control Channel (PUCCH)

If R&S®FSQ Signal Analyzer is used for signal analysis of signal generated by the R&S Signal Generator equipped with option Digital Standard EUTRA/LTE, be aware that up to Release 2.1 of the LTE Option FSQ-K101 the two resource blocks at each edge of the spectrum are not analyzed.

- Position of PUCCH can be configured in terms of PUCCH region.
- The content of PUCCH can be set individually for each TTI.
- All seven PUCCH formats as defined in the TS 36.211 are supported.
- One of 12 cyclic shifts (5 for PUCCH format 3) and for PUCCH formats 1/1a/1b one of three orthogonal codes can be selected indirectly by choosing the appropriate PUCCH index.
- For configuration of multi user PUCCH tests according to TS 36.141, annex A9, set the n_PUCCH parameter to the value defined in table A.9-1, column "RS orthogonal cover / ACK/NACK orthogonal cover". The R&S Signal Generator calculates and configures automatically the values defined in the columns "Cyclic shift index" and "Orthogonal cover index".

4.16 Physical Random Access Channel (PRACH)

- All PRACH configurations for random access preamble timing for preamble format 0-4 and frame structure type 1 and 2 are supported.

4.17 Data Allocation (UL)

- Both resource allocation types type 0 and type 1 are supported
- Frequency hopping is supported.
- Resource block size is 12 subcarriers in the frequency domain.
- A generation of uplink signals for up to 4 UEs is supported.
- Data can be allocated per subframe.
- Channel coding is performed according to TS 36.212
- TTI length is 1 ms.
- The modulated data symbols are mapped onto the resource elements according to TS 36.211.
- Numbering of subcarriers is done according to the Figure 4-4.

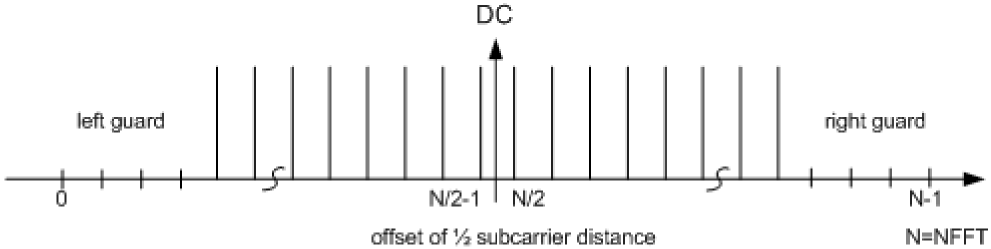


Figure 4-4: Numbering of the subcarriers

- The baseband signal is shifted in the frequency domain by half a subcarrier distance. According to TS 36.211, the spectral shift is carried out symbolwise, i.e. per SC-FDMA symbol.

4.18 Modulation Mapping (UL)

- The modulation mapping in uplink is done according to TS 36.211. All modulation schemes of TS 36.211 are supported.

5 R&S Signal Generator Specific Information

The different topics discussed in the following sections give essential information for better understanding of and effective work with an R&S Signal Generator equipped with options EUTRA/LTE R&S SMx/AMU-K55/-K69/-K84/-K85/-K112. The topics provide information about specific functions of the R&S Signal Generator.

To playback a signal from a waveform file created by the simulation software R&S WinIQSIM2, the corresponding R&S WinIQSIM2 digital standard option must be installed.

5.1 Conflict Handling

In TS 36.211, physical signals and physical channels are defined for the EUTRA/LTE system. Therefore the available resources in the time-frequency domain are shared by the different signals and different kinds of allocations (comparable to the different channel types in the 3GPP FDD mode).

5.1.1 Downlink

R&S Signal Generator supports the following types of downlink signals and channels:

- Reference Signals
- Primary Synchronization Signal (P-SYNC)
- Secondary Synchronization Signal (S-SYNC)
- Physical Broadcast Channel (PBCH)
- Physical Downlink Control Channel (PDCCH), including PCFICH and PHICH
- Physical Downlink Shared Channel (PDSCH)

Due to the concept of the R&S Signal Generator different situations may appear that need clarification. If several signals and/or channels (of the same or different type) partly share the same resources, a decision has to be made what bits are really mapped to the affected subcarriers. The general rule here is that the signal or channel with the higher priority is transmitted completely while the affected subcarriers are stamped out of the lower priority signal or channel respectively. Note that this reduces the number of available physical bits of a signal/channel.

The actual size of a certain allocation is displayed in the column Physical Bits of the resource allocation table.

The following picture shows the priorities of the different signal and channel types.

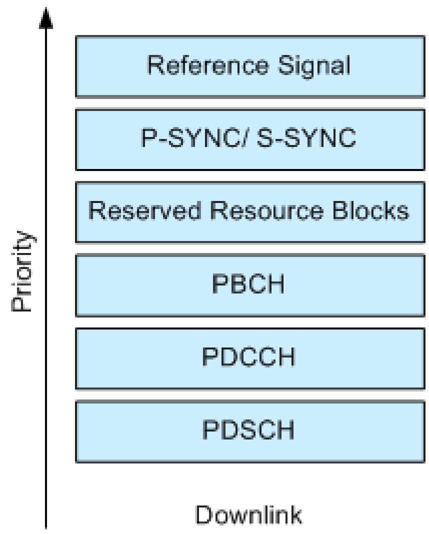


Figure 5-1: Priority of different allocations, channels and signals in the downlink

- Overlapping of signals and/or channels with different priorities
  In case signals and/or channels (like for example P-SYNC and PDSCH) of different priorities overlap, no conflict is displayed in the resource allocation table, as the signal/channel with the higher priority is transmitted completely.
- Overlapping of allocations with the same priority
  If different allocations of the same priority are overlapping, the one with the lower allocation index (i.e. which comes first) in the resource allocation table is treated with higher priority. In this case the reduced allocation is marked in the conflict column of the resource allocation table.

There is no way to configure a signal with overlapping reference signal and P-SYNC/S-SYNC.

If PRS and MBSFN is configured to be in the same subframe, MBSFN is skipped and PRS is transmitted solely.

If a PDSCH is configured to overlap partially with the PRS bandwidth in a PRS subframe, the PRS in these resource blocks are skipped then (see Example "Overlapping PDSCH, PRS and MBSFN" on page 137).

5.1.2 Uplink

In the uplink implementation of the R&S Signal Generator you can configure different user equipments (UEs) to use the same physical resources. The signals of the different UEs are simply added, but nevertheless a conflict is indicated in the resource allocation table.

Although a conflict is also displayed if the PUSCH and PUCCH allocations of one UE are overlapping, the signals of both allocations are added. However, a conflict can occur between the sounding reference signal of a certain UE and the PUSCH of another UE.

5.1.3 DCI Conflict Handling

The R&S Signal Generator allows you to configure multiple scheduling messages with their corresponding PDCCHs per subframe. Using the DCI table in the Enhanced PCFICH, PHICH and PDCCH Channel Configuration dialog, the position of the DCI/ PDCCH inside the multiplexed bit stream can be freely configured by setting the appropriate CCE index.

Because the number of CCEs for each PDCCH may vary, the 3GPP specification TS 36.211, chapter 6.8.1 defines some restriction on the aggregation of CCEs. An aggregation of eight CCEs for instance can only start on CCE numbers evenly dividable by eight. The same principle applies to the other aggregation levels. In this implementation, if the restriction is not fulfilled or two CCEs are overlapping, a conflict is displayed for the DCI/PDCCH with the greater number. This DCI/PDCCH is not considered by the multiplexing, i.e. it is not transmitted.

The R&S Signal Generator provides the operations "Append", "Insert", "Delete", "Up", "Down" and "Resolve Conf." for flexibly configuration of valid DCIs and for resolving of conflicts.

Example:

This example is based on a DCI table of a control channel with a total "Number of CCEs = 26".

The "DCI Table" indicates a conflict in the second DCI/PDCCH. The reason for this conflict is that the CCEs allocated for the second DCI/PDCCH are overlapping with the CCEs used by the first one. The second DCI/PDCCH is ignored by the multiplexing.

User	UE_ID n_RNTI	Cell Index	DCI Format	Search Space	Content	PDCCH Format	Number CCEs	CCE Index	No.Dummy CCEs	Conflict
User1	0	0	0	Common	Config...	2	4	0	4	
User1	0	0	1A	UE-Spec	Config...	0	1	1	-	●
User2	250	0	0	UE-Spec	Config...	1	2	16	8	
RA_RNTI	1	0	1C	Common	Config...	2	4	8	4	

One of the ways to overcome this problem and to resolve the DCI conflict is to use the Resolve Conflicts function of the software. The built-in algorithm re-assigns automatically the CCE values depending on the configured "Search Space"; previously configured CCE values will not be maintained. The calculated signal is suitable for receiver tests that demand conflict free CCEs but have no requirements on explicit CCE values. If the conflict cannot be resolved automatically, the values remain unchanged.

If however there is a requirement for CCE Indexes with explicit values, you can perform the corrections manually. In this particular example, you can set the CCE index of the third DCI/PDCCH to 4.

User	UE_ID n_RNTI	Cell Index	DCI Format	Search Space	Content	PDCCH Format	Number CCEs	CCE Index	No.Dummy CCEs	Conflict
User1	0	0	0	Common	Config...	2	4	4	0	
User1	0	0	1A	UE-Spec	Config...	0	1	1	2	
User2	250	0	0	UE-Spec	Config...	1	2	16	8	
RA_RNTI	1	0	1C	Common	Config...	2	4	8	4	

The CCEs used by the two subsequent DCIs/PDCCHs are not overlapping and the two DCIs/PDCCHS are configured to be transmitted consecutive, i.e. there is no gap between them ("No. Dummy CCEs" = 0).

The Figure 5-2 shows the resulting PDCCH after multiplexing.

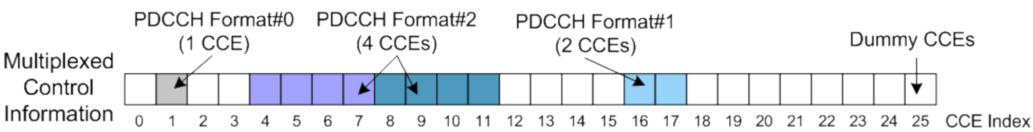


Figure 5-2: PDCCH multiplexing (example)

If "Activate Carrier Aggregation > ON", the parameter DCI Table determines the component carrier the corresponding User is mapped to. For this reason, there is no DCI conflict, if in the example above the second DCI belongs to a User enabled on an SCell.

User	UE_ID n_RNTI	Cell Index	DCI Format	Search Space	Content	PDCCH Format	Number CCEs	CCE Index	No.Dummy CCEs	Conflict
User1	0	0	0	Common	Config...	2	4	0	4	
User1	0	1	1A	UE-Spec	Config...	0	1	1	24	
User2	250	0	0	UE-Spec	Config...	1	2	16	8	
RA_RNTI	1	0	1C	Common	Config...	2	4	8	4	

5.2 Subframes Handling

The following sections explain the subframes handling concept and implementation in the R&S Signal Generator.

5.2.1 Copy/Paste Subframe

The required EUTRA/LTE test signal may consists of several subframes, possibly with the same or similar settings.

In these cases, you can:

- copy and paste settings from one subframe to another.
- configure a subset of subframes manually and use them periodically see Chapter 5.2.2, "Number of Configurable Subframes", on page 62

Consider, however, that with both methods only subset of settings are inherit.

Both methods maintain the following settings:

- cyclic prefix length
- structure of PDCCH and PDSCH allocations
- structure of PUSCH and PUCCH allocations

The following settings are not considered:

- P-SYNC/S-SYNC
  the P-SYNC/S-SYNC are global setting ("General DL Settings" dialog) and can therefore not be overwritten by the configuration of one particular frame
- PBCH
  the PBCH is transmitted in subframe#0 only
- PRACH and Sounding Reference Signals
  the Sounding Reference Signal and the PRACH are settings dedicated to the individual user equipments (User Equipment Configuration dialog)

Copying allocations from a subframe without P-SYNC/S-SYNC/PBCH to one with P-SYNC/S-SYNC/PBCH and vice versa might lead to conflict situations. In this case, the internal algorithm applies the rules discussed in Chapter 5.1, "Conflict Handling", on page 57.

However, configurations can occur where in different subframes allocations which are identical by means of scheduled resource blocks have a different amount of physical bits available, due to the out stamping of overlapping subcarriers.

5.2.2 Number of Configurable Subframes

As described in Chapter 5.2.1, "Copy/Paste Subframe", on page 61, you can simplify the configuration of the EUTRA/LTE test signal if you define a small number of sub-frames manually ("Number of Configurable Subframes") and use them periodically.

Internally, the R&S Signal Generator applies the Copy/Paste Subframe functionality and the same subset of settings are inherit.

5.2.3 Four Configurable Frames in Uplink and Downlink Direction

The R&S Signal Generator supports the configuration of up to four frames in uplink and downlink direction. However, there is a limitation for the maximum number of the real configurable subframes in this four frames depending on the transmission direction and several other parameters.

5.2.3.1 Uplink Direction

In uplink direction, the maximum number of the real configurable uplink subframes depends on the selected Duplexing mode (TDD or FDD), TDD Frame Structure Settings and whether Chapter 7.15.2, "Realtime Feedback Configuration Settings", on page 244 is enabled or not.

The maximum number of configurable subframes changes as function of the parameters in the following way:

- For **Disabled** Realtime Feedback
  - In FDD duplexing mode, the maximum number of configurable subframes is 40 subframes, where the maximum number of 40 subframes is available for sequence lengths of at least four frames
  - In a TDD frame only the uplink subframes are enabled for configuration. The maximum number of the configurable subframes is determined by the selected "UL/DL Configuration" and the possible values are listed in the corresponding column in the cross-reference table below.
- For **Enabled** Realtime Feedback
  The maximum number of configurable uplink subframes for the PUSCH channel of the first user equipment (UE 1) is determined by the "Number of HARQ Processes", that itself also depends on the duplexing mode and the UL/DL configuration.
  For an overview of the possible values, see the corresponding column in the cross-reference Table 5-1.

The current subframe to be configured is selected by means of the parameter Subframe.

The configurable range ("Number of configurable uplink subframes") can be selected independently for the individual user equipments. Furthermore, for Release 10 user equipments, the range can be selected independently for the PUCCH and the PUSCH channel.

Subframes behind the configurable range of the corresponding UE or channel are indicated as read-only.

Table 5-1: Value range for the parameter Number of Configurable UL Subframes

"Duplexing mode"	"UL/DL Configuration"	UL subframes in the first four frames (see Figure 3-6)	Number of UL subframes per frame	Number of HARQ processes	Value range for the parameter "Number of Configurable UL Subframes"	
					disabled realtime feedback	enabled realtime feedback
TDD	0	2, 3, 4, 7, 8, 9, 12, 13, 14, 17, 18, 19, 22, 23, 24, 27, 28, 29, 32, 33, 34, 37, 38, 39	6	7	1 .. 24	1, 7
	1	2, 3, 7, 8, 12, 13, 17, 18, 22, 23, 27, 28, 32, 33, 37, 38	4	4	1 .. 16	1, 2, 4
	2	2, 7, 12, 17, 22, 27, 32, 37	2	2	1 .. 8	1, 2
	3	2, 3, 4, 12, 13, 14, 22, 23, 24, 32, 33, 34	3	3	1 .. 12	1, 3
	4	2, 3, 12, 13, 22, 23, 32, 33	2	2	1 .. 8	1, 2
	5	2, 12, 22, 32	1	1	1 .. 4	1
	6	2, 3, 4, 7, 8, 12, 13, 14, 17, 18, 22, 23, 24, 27, 28, 32, 33, 34, 37, 38	5	6	1 .. 20	1, 2, 3, 6
FDD	-	0 .. 39	10	8	1 .. 40	1, 2, 4 ,8

Example:

- For selected FDD duplexing mode, disabled realtime feedback and **Number of Configurable Uplink Subframes** set to 13, "Subframes" 0 ... 12 are configurable. Subframes from 13 on are read-only.
- For selected TDD duplexing mode, "UL/DL Configuration = 6" and disabled realtime feedback the "Number of Configurable Uplink Subframes" is in the range 1 .. 20 (see Table 5-1).
  If for instance the "Number of Configurable Uplink Subframes" is set to 10, the following 10 subframes are configurable: 2,3,4,7,8,12,13,14,17,18.
  These are the first 10 uplink subframes. All other subframes (downlink subframes, special subframes and subframes from 19 on) are read-only.
- For selected TDD duplexing mode, "UL/DL Configuration = 6" and enabled realtime feedback, up to 6 HARQ processes can be configured and therefore 1, 2, 3 or 6 configurable uplink subframes are available for the PUSCH channel of the first user equipment.
  If for instance the "Number of Configurable Uplink Subframes" is set to 6, the following 6 subframes are configurable: 2,3,4,7,8,12.
  These are the first 6 uplink subframes. All other subframes (downlink subframes, special subframes and subframes from 13 on) are read-only.

5.2.3.2 Downlink Direction

In downlink direction, the maximum number of the real configurable subframes depends on the selected Duplexing mode (TDD or FDD), TDD Frame Structure Settings, whereas in downlink direction the special subframes are also configurable (in addition to the downlink subframes).

Because the realtime feedback functionality is an uplink feature, the maximal number of the configurable subframes in downlink direction is not additionally limited by the number of HARQ processes.

The subframe to be configured is selected by means of the parameter Subframe Selection. The maximum value for this parameter is then determined by the number of the last configurable subframe (see also Table 5-2).

Table 5-2: Value range for the parameter Number of Configurable DL Subframes

Duplexing mode	UL/DL Configuration	DL and Special subframes in the first four frames (see Figure 3-6)	Number of DL and special subframes per frame	Value range for the parameter Number of Configurable DL Subframes
TDD	0	0, 1, 5, 6, 10, 11, 15, 16, 20, 21, 25, 26, 30, 31, 35, 36	4	1 .. 16
	1	0, 1, 4, 5, 6, 9 10, 11, 14, 15, 16, 19 20, 21, 24, 25, 26, 29, 30, 31, 34, 35, 36, 39	6	1 .. 24

Duplexing mode	UL/DL Configuration	DL and Special subframes in the first four frames (see Figure 3-6)	Number of DL and special subframes per frame	Value range for the parameter Number of Configurable DL Subframes
	2	0, 1, 3, 4, 5, 6, 8, 9 10, 11, 13, 14, 15, 16, 18, 19 20, 21, 23, 24, 25, 26, 28, 29, 30, 31, 33, 34, 35, 36, 38, 39	8	1 .. 32
	3	0, 1, 5, 6, 7, 8, 9 10, 11, 15, 16, 17, 18, 19 20, 21, 25, 26, 27, 28, 29, 30, 31, 35, 36, 37, 38, 39	7	1 .. 28
	4	0, 1, 4, 5, 6, 7, 8, 9 10, 11, 14, 15, 16, 17, 18, 19 20, 21, 24, 25, 26, 27, 28, 29, 30, 31, 34, 35, 36, 37, 38, 39	8	1 .. 32
	5	0, 1, 3, 4, 5, 6, 7, 8, 9 10, 11, 13, 14, 15, 16, 17, 18, 19 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 37, 38, 39	9	1 .. 36
	6	0, 1, 5, 6, 9 10, 11, 15, 16, 19, 20, 21, 25, 26, 29, 30, 31, 35, 36, 39	5	1 .. 20
FDD	-	0 .. 39	10	1 .. 40

5.3 Power Setting

The R&S Signal Generator equipped with option Digital Standard EUTRA/LTE (R&S SMx/AMU-K55) provides several possibilities to adjust the power level of the generated LTE signal as well as to adjust the relations between the power levels of the channels and signals in the LTE signal itself.

5.3.1 General Power Settings

The general power settings are as follows:

- Output level (Pout) of the instrument
  To adjust the value, select "Status bar > Level".

- Power Offset Relative to Level Display is a parameter related to the level of the signal at the output of the baseband part of the instrument. The parameter sets the relative power offset of the selected baseband path compared to the power level displayed in the header of the instrument. A value of 0 dB refers to the level set in the main "Level" settings; a negative value lowers the level of the selected baseband.
  Use this parameter to adjust the baseband output power compared to the baseband power of the other baseband if the performed test case requires the signals of UEs with different SNR and the same AWGN block is used. An example of such a test scenario are the Multi user PUCCH tests as defined in the 3GPP specification TS 36.141.

5.3.2 Downlink Power Settings

In downlink direction, the value displayed in the "Level" display defines the RMS level of the output signal calculated upon several frames. In the FDD duplexing mode, the displayed RMS and the PEP values are valid for the whole frame, while in TDD duplexing mode, the calculation is based only on the downlink parts of the frame, i.e. the DL subframes and the DwPTS (see also parameter "Power Reference" on page 296).

Additionally to the general power settings, the following settings are influencing the power of the output signal in downlink direction:

- Downlink Reference Signal Structure
- Synchronization Signal Settings, Synchronization Signal Settings
- PBCH Power and PDSCH Power
- PCFICH Settings,PHICH Settings , PDCCH Settings
- Cell-Specific Settings (Cell-Specific Settings) and Cell-Specific Settings

All DL power configurations are set relative to each other and the absolute power level of one resource element during one sub-frame depends on the configuration during the remaining sub-frames. If for instance the PDCCH power is set to 2 dB and a certain PDSCH has a power of -3 dB, this means that the power level of the PDCCH sub-carriers is with 5 dB higher than the power level of the PDSCH sub-carriers.

The basis for the calculation of the absolute power level of the channels and the signals in DL direction is the power of one reference signal resource element. The value is displayed in the General DL Settings dialog by means of the parameter Downlink Reference Signal Structure. Use this parameter to configure a specific absolute power of one Reference Signal's sub-carrier, like for example to set a required SNR defined for a 15kHz sub-band.

To calculate the absolute power value of one single Reference Signal sub-carrier, consider the general power settings and the relative RS Power.

Example:

For the default setting of this firmware, the values of the related parameters are as follow:

"Level" = - 30 dB

"RS Power per RE relative to Level Display" = - 27.78 dB

"Power Offset relative to Level Display" = 0 dB

The absolute power level of one single Reference Signal sub-carrier is the sum of these values, i.e. -57.78 dBm.

If for instance the value of the PDSCH power is changed to - 3 dB, the absolute power level of a PDSCH sub-carrier calculated based on the absolute power level of a single Reference Signal is than -60.78 dBm.

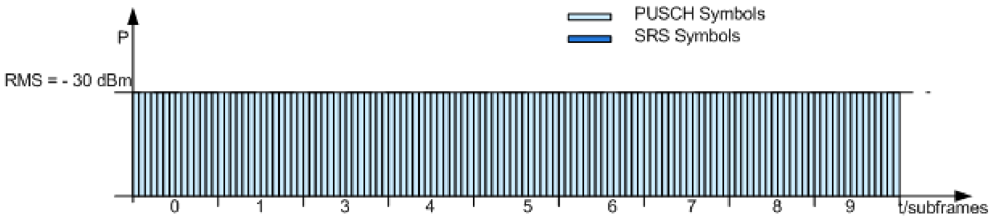
5.3.3 Uplink Power Settings

Additionally to the General Power Settings, the following settings are influencing the power of the output signal in uplink direction:

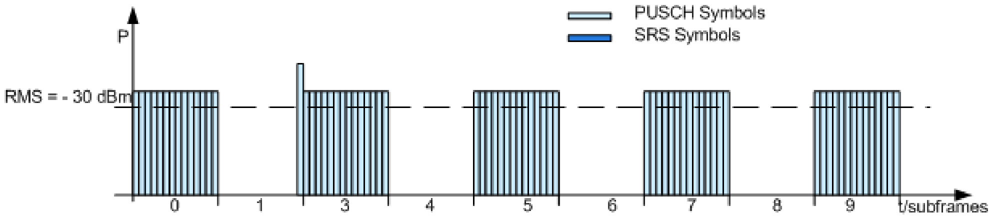
- Power Reference
- Power factors for PUSCH/PUCCH/PRACH/SRS
- DRMS Power Offset (available for PUSCH and PUCCH)
- UE Power

While generating an uplink signal, the power displayed in the "Level" display defines the current RMS level at the output. The RMS and PEP values however are calculated based upon different parts of the signal depending on the selected Power Reference in the Filter/Clipping/Power Settings dialog.

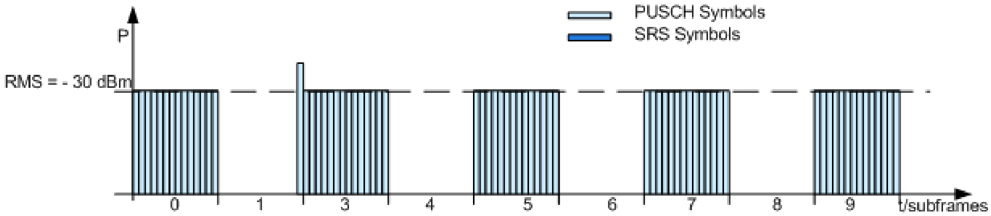
- "Power Reference" = "Frame RMS Power" (UL FDD) or "UL Part of Frame RMS Power" (UL TDD)
  In the FDD duplexing mode, the displayed RMS and the PEP values ("Level" and "PEP") are valid for the whole frame, while in TDD duplexing mode, the calculation is based only on the uplink parts of the frame, i.e. the UL subframes and the UpPTS.



  Note: The absolute power of a single subframe depends also on the signal within of the remaining subframes.



- "Power Reference" = "UE Burst RMS Power" (UL FDD and UL TDD)
  The displayed "Level" and "PEP" values are measured only for a certain burst of a single UE. See the description of the parameter Power Reference for description of the decision algorithm and how the reference bursts are selected.



Use this mode to simplify the setting up of the SNR required for the test cases defined in the 3GPP specification TS 36.141, in case the PUSCH is not transmitted in every subframe.

6 Realtime Feedback for Closed Loop BS Tests

The EUTRA/LTE uplink realtime feedback functionality requires the additional option R&S SMx/AMU-K69 Closed Loop BS Tests. This option extends the EUTRA/LTE option R&S SMx/AMU-K55 with the possibility to perform closed loop performance tests with feedback as defined in TS 36.141, chapter 8.

The Realtime Feedback Configuration is enabled only for UE1 in instruments equipped with the option R&S SMx/AMU-K69.

Realtime Feedback Configuration is not available for the R&S Signal Generator SMBV and for the simulation software R&S WinIQSIM2.

This feature allows the DUT to dynamically control the transmission of channel coded data packets. By means of the feedback sent from the DUT to the R&S SMx/AMU, ACK/NACK signaling (HARQ feedback) and timing adjustment is possible, similar to the feedback sent from a base station to a user equipment by means of the air interface (PDCCH/PHICH channels).

By means of ACK/NACK commands, the DUT can control the channel coding configuration (i.e. the redundancy version) of the transmitted PUSCH packets in real time. The behavior of the R&S SMx/AMU is similar to the behavior of the HARQ entity / the HARQ processes of a real user equipment (according to 3GPP TS 36.321).

By means of timing adjustment/timing advance commands, the DUT can request time shifts of the uplink signal generated by the R&S SMx/AMU and thus causing a delay or advance of the uplink signal in real time (according to TS 36.213).

6.1 Exemplary Testing Scenario

The testing specifications in TS 36.141, chapter 8, specifies the test setups. For example, the test "Performance requirements for UL timing adjustment" (TS 36.141, section 8.2.2) can be setup according to the Figure 6-1.

One single R&S SMU/AMU is sufficient.

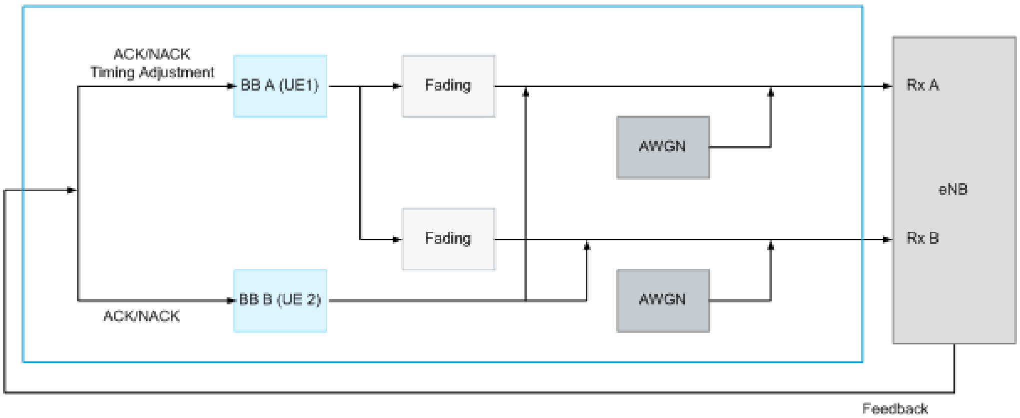
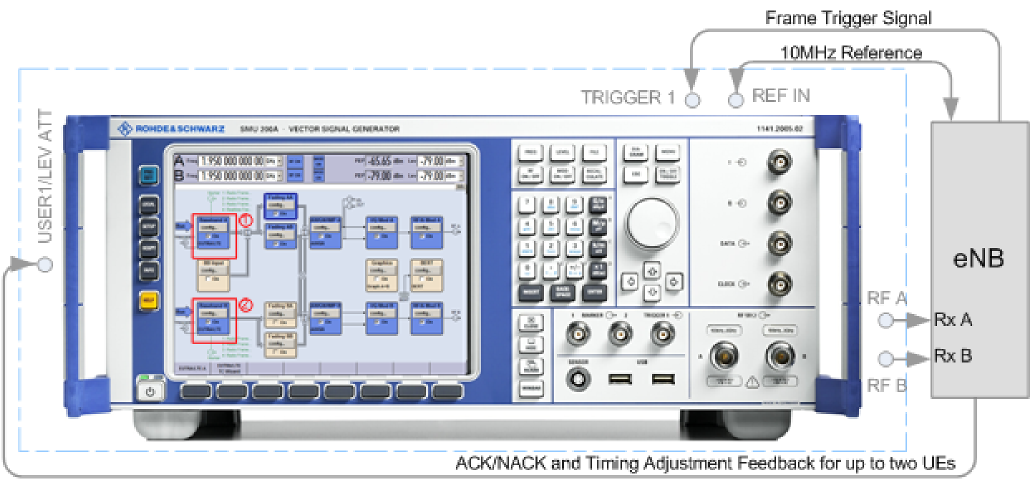


Figure 6-1: Exemplary test scenario

If your instrument is equipped with internal fading and AWGN generators, no more test equipment is required to perform the performance requirement test measurements. The simulation of the propagation conditions according to the specified test scenarios is achieved by selecting the required fading profiles and an additive white Gaussian noise. For more detailed description about the available fading profiles and how to work with the fading simulator, refer to the description "Fading Simulator".

The feedback is transmitted from the DUT to the R&S SMx/AMU by means of the serial protocol (serial mode). The test setup requires a 10 MHz external reference line between the DUT and R&S SMx/AMU, and a common trigger source (downlink timing) for synchronization of the R&S SMx/AMU and the DUT.



1 = Baseband A generates the signal of the moving UE
2 = Baseband B generates the signal of the stationary UE

6.2 Feedback Modes

The test setups for performance verification require a feedback line from the DUT (base station) to the signal source. The R&S SMx/AMU provides two interfaces for the necessary feedback line, a binary and a serial one, and two connectors, the LEVATT connector and the USER1 connector. Both interfaces are suitable for HARQ feedback tests; for testing of an UL timing adjustment however, a connection over a serial feedback line has to be established.

The input impedance of the connectors and the low/high threshold voltage are configurable parameters. Use the "Global Trigger/Clock Settings" dialog and adjust the parameters "Threshold Trigger/Control Input" and "Impedance Trigger/Control Input" as required.

6.2.1 Binary Mode

A binary line carries the information in form of a high and low voltage level and is sufficient for the transmission of ACK and NACK commands. In the binary mode, the instrument detects the voltage level at the input connector and depending on the configuration (see parameter "ACK Definition" on page 247), the input level is interpreted as ACK or NACK.

6.2.2 Serial Mode

The serial line carries the information in form of commands where a command consists of 16 data bits (D0..D15), 1 start bit (low level) and 1 stop bit (high level). No parity bit has to be transmitted. The least significant bit (D0) is transmitted first.

The feedback commands are transmitted with a "Serial Rate" of 115.2 kbps, 1.6 Mbps or 1.92 Mbps. Between two consecutive commands or before the very first command, the line has to be held on high level (idle).

6.2.3 Serial 3x8 Mode

In this mode, a command does not consist of one singular serial packet, but consists of three serial packets.

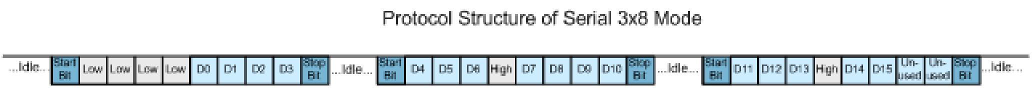


Figure 6-2: Structure of one feedback command in "Serial 3x8" mode

Each of the three packets consists of one start bit (low level), eight serial bits and one stop bit (high level). No parity bits have to be transmitted. The sixteen data bits D0 ... D15 are distributed among the three times eight serial bits according to figure. The remaining serial bits must have specified low or high levels according to the figure for synchronization purposes.

The three serial packets of the feedback commands are transmitted with a "Serial Rate" of 115.2 kbps, 1.6 Mbps or 1.92 Mbps. Between two consecutive packets or between two consecutive commands or before the very first command, the line has to be held on high level (idle).

6.2.4 Structure of a serial and 3x8 serial feedback command

The Table 6-1 shows the structure and the meaning of the 16 data bits (D0..D15) in a feedback command, where D15 refers to the most significant bit.

Table 6-1: Structure of one feedback command

D15-D14	D13-D11	D10-D0
BB Selector	Message Type Selector	Message Bits

- The **BB Selector** (D15-D14) determines for which of the baseband blocks the feedback command is for.
  The R&S SMU/AMU can be equipped with up to two baseband blocks, where each baseband block can simulate one UE with closed loop feedback. The BB selector takes value in the range from 0 to 3 and can be arbitrarily assigned to each baseband block. Therefore, you can send different feedback commands to different baseband blocks over one feedback line.
  Alternatively, several baseband blocks that use the same BB selector can share the feedback commands, even if these baseband blocks are in different instruments connected to the same feedback line.
- The **Message Type Selector** (D13-D11) determines the message type and the command that is signaled (see Table 6-2).

Table 6-2: Message types

Message Type Selector	Message Type	Description
0	HARQ Feedback Auto	Carries only ACK/NACK feedback. The redundancy version (RV) to be used in the next PUSCH transmission of the affected HARQ process is determined automatically
1	HARQ Feedback with RV request	Carries ACK/NACK feedback and a request for a specific redundancy version (RV). This RV is then applied in the next PUSCH transmission of the affected HARQ process. This command causes the instrument's HARQ process logic to "jump" to the first occurrence of the requested redundancy version in the configured redundancy version sequence (according to the HARQ process description in 3GPP TS 36.321).
2	Timing Advance Command (Absolute)	Requests an absolute timing advance of the uplink signal
3	Timing Adjustment Command (Relative)	Requests a relative timing adjustment of the uplink signal
4	Combined HARQ Feedback Auto and Relative Timing Adjustment Command	Combination of the both commands "HARQ Feedback Auto" and the "Timing Adjustment (Relative)". The instrument behaves exactly as if the HARQ feedback and the timing adjustment would be sent in two separate commands
5-7	reserved	-

- **Message Bits** (D10-D0)

The Figure 6-3 gives an overview of the structure of the different commands and the information they carry.

<table>
<tr><th rowspan="2">Message Type</th><th colspan="11">Message Bits</th></tr>
<tr><th>D10</th><th>D9</th><th>D8</th><th>D7</th><th>D6</th><th>D5</th><th>D4</th><th>D3</th><th>D2</th><th>D1</th><th>D0</th></tr>
<tr><td>HARQ Feedback Auto</td><td colspan="6" rowspan="2">reserved</td><td colspan="2" rowspan="2">For FDD mode: reserved
For TDD mode and UL/DL configurations 1..6: reserved
For TDD mode and UL/DL configuration 0:
– 1: adjust subframe "n+7"
– 2: adjust subframe "n+k"
– 0 or 3: adjust both subframes "n+k" and "n+7"</td><td rowspan="2">0: NACK
1: ACK</td><td colspan="2">reserved</td></tr>
<tr><td>HARQ Feedback with RV request</td><td colspan="2">Requested redundancy version (RV).
D1 is MSB, D0 is LSB</td></tr>
<tr><td>Timing Advance Command (Absolute)</td><td colspan="11">11-bit timing advance command T_A according to TS 36.213, chapter 4.2.3.
The D10 is MSB and D0 is the LSB.</td></tr>
<tr><td>Timing Adjustment Command (Relative)</td><td colspan="5">reserved</td><td colspan="6">6-bit timing adjustment command T_A according to TS 36.213, chapter 4.2.3.
– T_A = 31 means no adjustment
– T_A > 31 means an increasing advance of the uplink signal
– T_A < 31 means the advance of the uplink signal is decreased by delaying the signal
The D5 is MSB, the D0 is LSB.</td></tr>
<tr><td>Combined HARQ Feedback Auto and Relative Timing Adjustment Command</td><td colspan="6">6-bit timing adjustment command T_A according to TS 36.213, chapter 4.2.3.
– T_A = 31 means no adjustment
– T_A > 31 means an increasing advance of the uplink signal
– T_A < 31 means the advance of the uplink signal is decreased by delaying the signal
The D10 is MSB, the D5 is LSB.</td><td colspan="2">For FDD mode: reserved
For TDD mode and UL/DL configurations 1..6: reserved
For TDD mode and UL/DL configuration 0:
– 1: adjust subframe "n+7"
– 2: adjust subframe "n+k"
– 0 or 3: adjust both subframes "n+k" and "n+7"</td><td>0: NACK
1: ACK</td><td colspan="2">reserved</td></tr>
</table>

Figure 6-3: Message bits

Example:

The figure below depicts the example of a serial feedback command with the following settings:

- BB Selector = 01
- Message Type Selector = 000, i.e. HARQ Feedback Auto
- ACK/NACK bit = 1, i.e. ACK is transmitted
- Message Bits D3-D4 are reserved for FDD mode.

The least significant bit (LBS) is transmitted first.

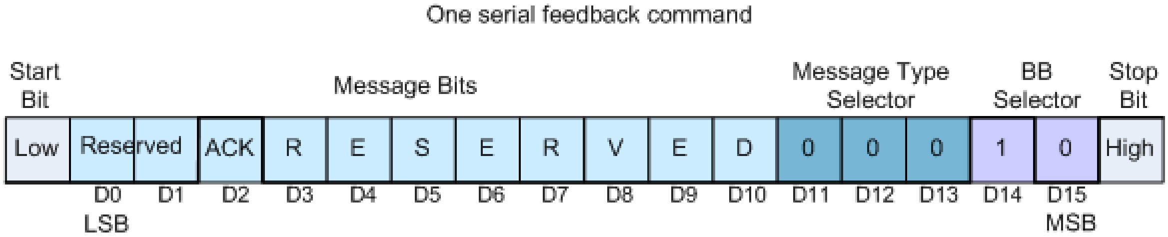


Figure 6-4: Example of a serial feedback command (HARQ Feedback Auto)

6.3 Timing Aspects

The available number of messages per subframe in the downlink timing depends on the feedback line used. A binary feedback line allows only one feedback message per subframe in downlink timing, whereas zero, one ore several feedback messages can be sent over the serial or the serial 3x8 one.

6.3.1 Parameterization of the feedback timing

The parameterization of the feedback timing depends on the "Feedback Mode" (binary, serial or serial 3x8) and the selected "Distance Mode" (3GPP or direct response).

6.3.1.1 Timing for binary mode with 3GPP Distance Mode, serial or serial 3x8 mode

The figure bellow illustrates the parameterization of the feedback timing. The example shows timing of feedback commands carrying the information that would be sent in a PDCCH/PHICH channel in downlink subframe n, in comparison to the downlink signal of the air interface. It is a prerequisite that the base station and the instrument are synchronized by means of a common trigger source and a 10 MHz reference line.

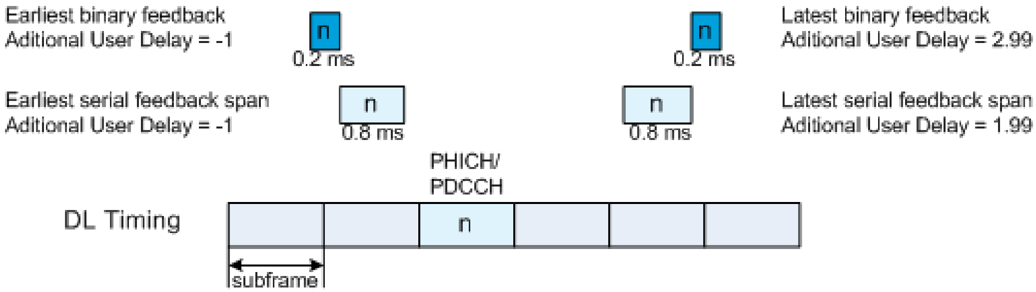


Figure 6-5: Parameterization of the feedback timing

The exact timing of the feedback commands can be adjusted by the parameter Additional User Delay.

- In **binary mode**, an "Additional User Delay" of 0 means, the instrument reads the binary feedback at the point in time that coincides with the beginning of the subframe (in downlink timing), in which the respective information would be sent in the PDCCH/PHICH channels over the air interface.
  Note that the feedback level has to be held constant from 0.1 ms before this point in time until 0.1 ms after this point in time.
  For binary mode, the additional user delay can vary between -1.00 and 2.99 subframes.
- In **serial** and **serial 3x8 mode**, an "Additional User Delay" of 0 means that all serial feedback commands that contain information which would be sent in the PDCCH/PHICH channels in one specific subframe, have to be sent inside a 0.8 ms time span starting 0.1 ms after the beginning of this PDCCH/PHICH subframe (downlink timing) and ending 0.1 ms before the end of this PDCCH/PHICH subframe.
  For serial and serial 3x8 mode, the additional user delay can vary between -1.00 and 1.99 subframes.

6.3.1.2 Maximum number of serial feedback commands

The serial feedback commands and the individual serial packets of the serial 3x8 feedback command can be transmitted asynchronously inside the serial feedback span. Technically, the instrument is able to process a maximum number of 40 serial commands in one serial feedback span, independently from the baseband selectors. For Serial Rate of 115.2 kbps, the number of commands is further limited due to their length and the low bit rate. A maximum number of 5 commands fit into the 0.8 ms serial feedback span. Up to three commands consisting each of three serial packets can be transmitted within the 0.8 ms while using the serial 3x8 feedback.

6.3.1.3 Timing for binary mode with Direct Response Distance Mode

In **binary mode**, there is also another possibility for determining the uplink subframe, in which the signaled feedback has the desired effect. In this "Direct Response Distance Mode", the influenced uplink subframe is calculated from the position of the last sent uplink packet of a HARQ process (see the example on Figure 6-6).

Supposing an initial timing advance of 0, an additional user delay of 0 would mean, that the binary feedback to a specific uplink HARQ packet is expected by the instrument at the point in time that coincides with the beginning of this uplink subframe, which does not make sense. Therefore, for the "Direct Response Distance Mode", the allowed range of the parameter "Additional User Delay" starts with +1.00 subframes.

The uplink subframe in which the signaled HARQ feedback has the desired effect is the next uplink subframe corresponding to the HARQ process the feedback was for.

Note that the feedback level has to be held constant from 0.1 ms before until 0.1 ms after the point in time when the instrument expects the binary feedback.

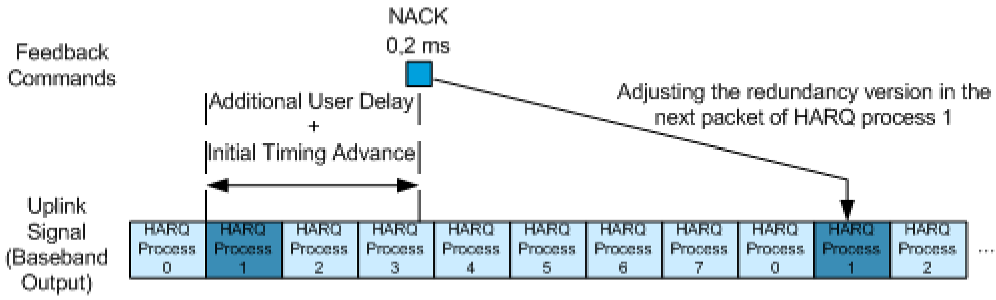


Figure 6-6: Timing of feedback commands in Direct Response Distance Mode (Example for FDD).

6.3.2 Uplink Timing

The uplink subframe in which the signaled feedback has the desired effect is calculated from the downlink subframe number n, according to 3GPP TS 36.213, section 4.2.3 (timing adjustment/timing advance commands) and chapter 8 (HARQ feedback commands). This does not apply if binary mode with direct response distance mode is used.

The figure bellow depicts the principle of the uplink timing by means of an example of a FDD mode with 8 active HARQ processes.

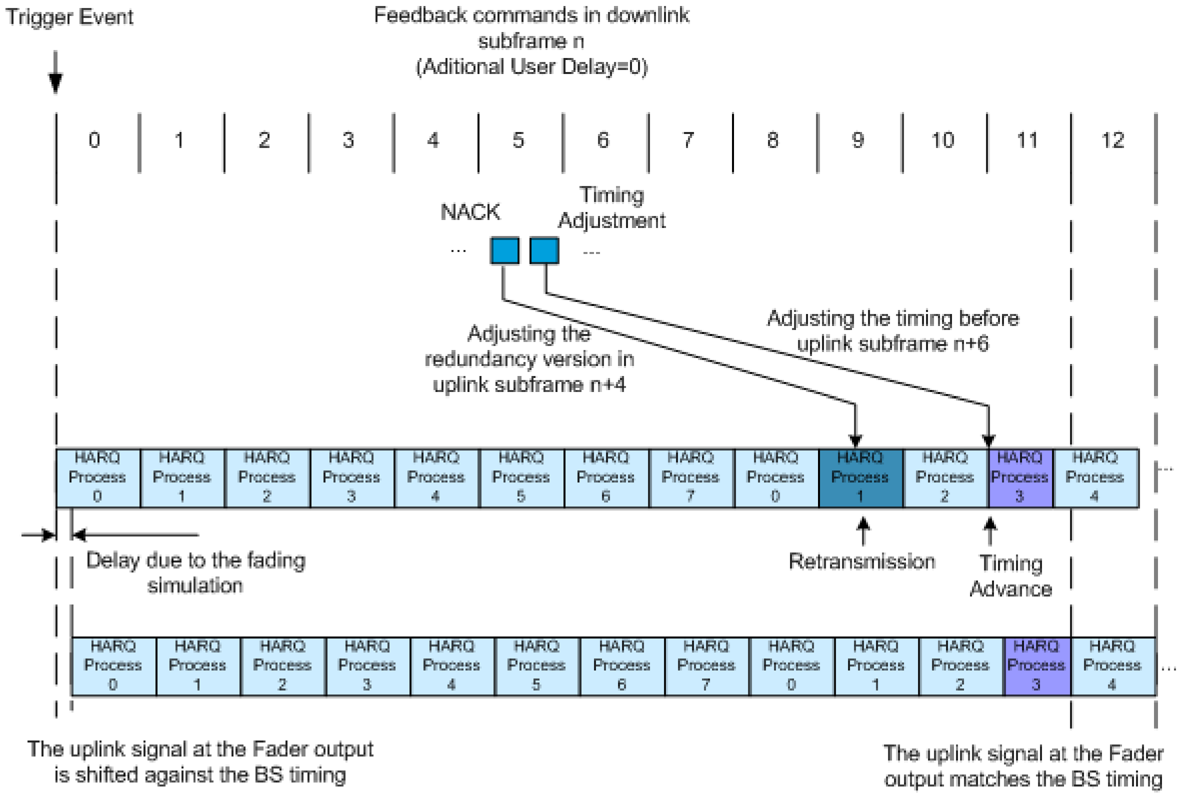


Figure 6-7: Timing of feedback commands for serial or serial 3x8 mode (Example for FDD).

In FDD, due to invariant DL and UL subframe configuration and continuous DL and UL transmission, the retransmission of data occurs in a predefined time after the initial transmission. In TDD however, such a fixed relation is not possible and the time varies depending on the active UL/DL configuration.

- A **timing adjustment command** corresponding to downlink subframe **n** causes a timing adjustment of the uplink signal at the beginning of uplink subframe **n+6**.
- A HARQ feedback command corresponding to downlink subframe n causes an adjustment of the redundancy version in:
  – uplink subframe **n+4**, if FDD is used without subframe bundling operation and if there is a PUSCH transmission scheduled in uplink subframe **n+4**.
  – uplink subframe **n+k**, with **k** given in table 8-2 of TS 36.213, if TDD is used with UL/DL configurations 1 to 6 without subframe bundling operation and if there is a PUSCH transmission scheduled in uplink subframe **n+k**
  – uplink subframe determined by the bits D4-D3 of the HARQ feedback command, "HARQ Feedback Auto" or "HARQ Feedback with RV request" (see Table 6-2), in case of TDD transmission with UL/DL configuration 0.
  – Note that for binary HARQ feedback, both the subframes **n+k** and **n+7** are modified, in case of TDD transmission with UL/DL configuration 0.

6.3.2.1 General timing rules

The first HARQ feedback recognized by the instrument after triggering is the feedback responding to the first uplink PUSCH transmission. For example, if a PUSCH is scheduled in uplink subframe 0 and if FDD without subframe bundling is used, the first HARQ feedback recognized by the instrument is the one affecting uplink subframe 8.

If no HARQ feedback command is received for a specific HARQ process in serial mode, the instrument behaves as if NACK was signaled in a "HARQ Feedback Auto" command. If there is a conflict between several HARQ feedback commands (because they would affect the same uplink PUSCH transmission), only the last received HARQ feedback command is considered.

The first timing advance or timing adjustment command that is recognized by the instrument after triggering is the one causing a timing adjustment at the beginning of uplink subframe 8.

If no timing advance or timing adjustment command is received, then no timing adjustment is applied, (i.e. the timing advance in subframe n+6 will not be modified). If there is a conflict between several timing advance or timing adjustment commands (because they would affect the same uplink subframe), only the last received timing advance / adjustment command is considered.

If the serial or serial 3x8 mode is used, the serial line has to be held idle (high) during downlink subframe 0.

6.4 Avoiding Synchronization Problems

In order to be able to successfully decode the transmitted uplink packets, both the signal generator and the device under test have to keep track of the redundancy versions used in the HARQ processes, because the device under test has to know which redundancy version to expect at a certain point in time (subframe). Using the Assume ACK until first received ACK command functionality may be necessary especially if the generator is triggered by a normal frame marker of the device under test (DUT) and if the device under test already is expecting uplink transmissions before the generator is triggered.

Examples

Consider the following examples:

- "Redundancy Version Sequence = 0,2,3,1"
- "Maximum Number of Transmissions = 4"
- One HARQ process is shown

The device under test (DUT) already is expecting uplink transmissions before the generator is triggered. But as no uplink transmissions take place before the generator starts its signal output, the DUT will not be able to successfully decode packets and therefore will expect retransmission with different redundancy versions. After triggering the generator by a frame marker, the following situation occurs, if - for example - the DUT expects RV 3 after the generator was triggered.

Example: Disabled parameter "Assume ACK until first received ACK command"

The following table shows the situation after triggering the generator if the parameter "Assume ACK until first received ACK command" is disabled.

The generator schedules a new transmission with RV 0.	The DUT expects a retransmission with RV 3.	The DUT sends a NACK to the generator.
The generator received NACK and schedules a retransmission with RV 2.	The DUT expects a retransmission with RV 1.	The DUT sends a NACK to the generator.
The generator received NACK and schedules a retransmission with RV 3.	The DUT reached the maximum number of transmissions and expects a new transmission with RV 0.	The DUT sends a NACK to the generator.
The generator received NACK and schedules a retransmission with RV 1.	The DUT expects a retransmission with RV 2.	The DUT sends a NACK to the generator.
The generator reached the maximum number of transmissions and schedules a new transmission with RV 0.	The DUT expects a retransmission with RV 3.	The DUT sends a NACK to the generator.

The generator and the DUT would keep on being out of synchronization.

Example: Enabled parameter "Assume ACK until first received ACK command"

This situation described in the first example does not occur if the generator is triggered by the device under test at a point in time when the DUT expects new transmissions (e.g. by a special marker indicating this). However, if only a frame marker is available from the DUT, the "Assume ACK until first received ACK command" functionality can be enabled, and the above example changes.

The generator schedules a new transmission with RV 0.	The DUT expects a retransmission with RV 3.	The DUT sends a NACK to the generator.
The generator ignores the NACK and schedules a new transmission with RV 0.	The DUT expects a retransmission with RV 1.	The DUT sends a NACK to the generator.
The generator ignores the NACK and schedules a new transmission with RV 0.	The DUT reached the maximum number of transmissions and expects a new transmission with RV 0.	The DUT sends an ACK to the generator.
The generator received ACK and schedules a new transmission with RV 0.	The DUT expects a new transmission with RV 0.	The DUT sends an ACK to the generator.
The generator received ACK and schedules a new transmission with RV 0.	The DUT expects a new transmission with RV 0.	The DUT sends an ACK to the generator.

Now the generator and the DUT are synchronized.

6.5 Limitation

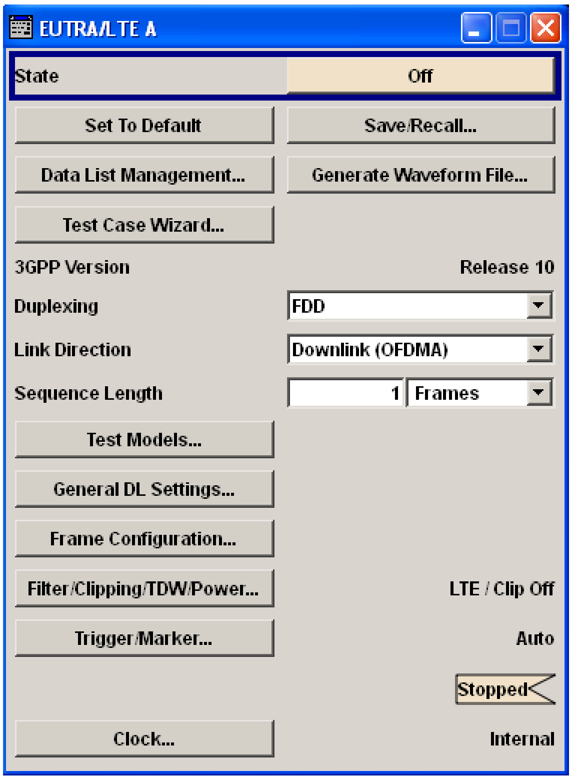
Although an arbitrary data source can be selected, the used user data before the channel coding is the same in all subframes for all HARQ processes and for all transmissions.

If for instance a Transport Block Size of 47520 is configured and the Data Source is set to PN9, then the first 47520 bits of the PN9 sequence are used as an input for all HARQ processes (even after an ACK), regardless of the performed transmission. However, since different redundancy versions are applied during the channel coding, the bit stream at the output of the channel coder is different for the different retransmissions.

7 EUTRA/LTE User Interface

To access the dialog for setting the EUTRA/LTE digital standard, select "Baseband block > EUTRA/LTE" or use the menu tree under "Baseband".

7.1 Main Dialog for EUTRA/LTE Signals



The dialog is split into several sections for configuring the standard:

- The upper menu section is where the EUTRA/LTE digital standard is enabled and reset, the default settings are called, and where the generated waveform file can be selected.
- The middle menu section is where EUTRA/LTE related settings such as the link direction and the sequence length can be selected.
- The buttons in the lower menu section lead to submenus to configure the EUTRA/LTE signal and setting the filter, trigger, and clock parameters.

State

Activates the standard and deactivates all the other digital standards and digital modulation modes in the same path.

Note: For two path instruments and configured antenna in path A for path B, enabling the LTE signal simulation will disable all other digital standards and digital modulation modes even in the path B.

Remote command:
[:SOURce<hw>]:BB:EUTRa:STATe on page 413

Set to Default

Calls the default settings. The values of the main parameters are listed in the following table.

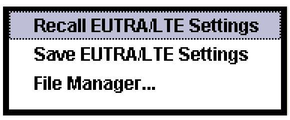
Parameter	Values
State	Not affected by "Set to Default"
Duplexing	FDD
Link Direction	Downlink (OFDMA)
Sequence Length	1 Frame
DL Channel Bandwidth	10 MHz
Physical Resource Block Bandwidth	12 * 15 kHz
Number Of Resource Blocks per Slot	50
Occupied Bandwidth /MHz	9.015
Sampling Rate /MHz	15.360
FFT Size	1024
Cell ID	0
Cyclic Prefix	Normal
PHICH Duration	Normal
Global MIMO Configuration	1 Tx Antenna
Simulated Antenna	Antenna 1

Remote command:
[:SOURce<hw>]:BB:EUTRa:PRESet on page 414

Save/Recall...

Calls the "Save/Recall" menu.

From the "Save/Recall" menu, the "File Select" windows for saving and recalling EUTRA/LTE configurations and the "File Manager" is called.



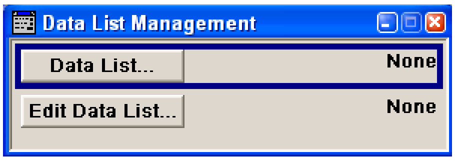
EUTRA/LTE configurations are stored as files with the predefined file extension `*.eutra`. The file name and the directory they are stored in are user-definable.

The complete settings in the "EUTRA/LTE" dialog are saved and recalled.

"Recall EUTRA/LTE Setting"	Opens the "File Select" window for loading a saved EUTRA/LTE configuration. The configuration of the selected (highlighted) file is loaded by pressing the "Select" button.
"Save EUTRA/LTE Setting"	Opens the "File Select" window for saving the current EUTRA/LTE signal configuration. The name of the file is specified in the "File name" entry field. The file is saved by pressing the "Save" button.
"File Manager"	Calls the "File Manager". The "File Manager "is used to copy, delete, and rename files and to create directories.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:SETTing:CATalog` on page 414
`[:SOURce<hw>]:BB:EUTRa:SETTing:LOAD` on page 415
`[:SOURce<hw>]:BB:EUTRa:SETTing:STORe` on page 415
`[:SOURce<hw>]:BB:EUTRa:SETTing:STORe:FAST` on page 416
`[:SOURce<hw>]:BB:EUTRa:SETTing:DEL` on page 415

Data List Management
Calls the "Data List Management" menu. This menu is used to create and edit a data list.



All data lists are stored as files with the predefined file extension `*.dm_iqd`. The file name and the directory they are stored in are user-definable.

The data lists must be selected as a data source from the submenus under the individual function.

Note: All data lists are generated and edited with the `SOURce:BB:DM` subsystem commands. Files containing data lists usually end with `*.dm_iqd`. The data lists are selected as a data source for a specific function in the individual subsystems of the digital standard.

Example: Creating and editing the data list:

```
SOUR:BB:DM:DLIS:SEL "eutra"
SOUR:BB:DM:DLIS:DATA 1,1,0,1,0,1,0,1,1,1,1,0,0,0
SOUR:BB:DM:DLIS:DATA:APP 1,1,0,1,0,1,0,1,1,1,1,0,0
```

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:DATA on page 473
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:DSELect on page 473
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DATA on page 572
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DSELect on page 573

Generate Waveform File…
Calls the "Generate Waveform" dialog used to store the current EUTRA/LTE signal as ARB signal in a waveform file.

This file can be loaded in the "ARB" dialog and processed as multi-carrier or multi-segment signal.

The file is stored with the predefined file extension `*.wv`. The file name and the directory it is stored in are user-definable.

Note: Even for enabled Realtime Feedback (see Chapter 7.15.2, "Realtime Feedback Configuration Settings", on page 244), the waveform file is generated as if this functionality is disabled.

Note: The Sequence Length of the generated ARB file is determined by the parameter SFN Restart Period

Remote command:
[:SOURce<hw>]:BB:EUTRa:WAVeform:CREate on page 417

Test Case Wizard
Opens the Test Case Wizard dialog (see Chapter 8, "Performing BS Tests According to TS 36.141", on page 310).

Logfile Generation
Opens the dialog for configuring the settings for generation of logfiles (see Chapter 7.2, "LTE Logfile Generation", on page 87).

Note: Logfile Generation requires an additional SW option and is enabled only for instruments equipped with R&S SMx/AMU-K81.

3GPP Version
Displays the current version of the 3GPP standard.

The default settings and parameters provided are oriented towards the specifications of the version displayed.

Remote command:
[:SOURce]:BB:EUTRa:VERSion? on page 417

Duplexing
Selects the duplexing mode. The duplexing mode determines how the uplink and downlink signals are separated.

"TDD" In TDD mode, the same frequency is used for both directions of transmission (uplink and downlink). With one baseband, either only downlink or only uplink can be generated.

"FDD"	In FDD mode, different frequencies are used for downlink and uplink directions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DUPLexing` on page 413

Link Direction
Selects the transmission direction.

"Downlink (OFDMA)"	The transmission direction selected is base station to user equipment. The signal corresponds to that of a base station. For the downlink, the physical layer mode is always set to OFDMA.
"Uplink (SC-FDMA)"	The transmission direction selected is user equipment to base station. The signal corresponds to that of a user equipment. For the uplink, the physical layer mode is always set to SC-FDMA.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:LINK` on page 414

Sequence Length
Sets the sequence length of the signal in number of frames. One frame corresponds to 10 ms. The signal is calculated in advance and output in the arbitrary waveform generator. The maximum number of frames is calculated as follows:

Max. No. of Frames = Arbitrary waveform memory size/(sampling rate x 10 ms).

If the Realtime Feedback functionality is enabled, the signal of UE1 does not depend on the sequence length, since this signal is not calculated in advance. The configuration of the sequence length is then only required, if also the signal of UE2, UE3 or UE4 is used.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:SLENgth` on page 416

Test Setups/Models
Calls dialog for selecting one of the test models defined in the 3GPP specification TS 36.141 and the self-defined test setups.

The dialog is described in Chapter 7.3, "Test Setups/Models", on page 102.

Remote command:
n.a.

General DL Settings…/ General UL Settings…
The name of the button depends on the chosen link direction.

Calls the "General DL Settings / General UL Settings" dialog for configuring the EUTRA/LTE system.

The dialogs are described respectively in Chapter 7.4, "General DL Settings / General TDD DL Settings", on page 103 and Chapter 7.13, "General UL Settings", on page 216.

Remote command:
n.a.

Frame Configuration…
Calls the "Frame Configuration" dialog for configuring the allocation of the resource blocks to the different users, and the configuration of the users.

The dialog depends on the chosen link direction. The menu is described in Chapter 7.5, "DL Frame Configuration Settings", on page 144 and Chapter 7.14, "UL Frame Configuration Settings", on page 234 respectively.

Remote command:
n.a.

Filtering/Clipping/Power...
Calls the menu for setting baseband filtering, clipping, and the general power settings. The current filter and the clipping state are displayed next to the button.

The menu is described in Chapter 7.20, "Filter/Clipping/Power Settings", on page 289.

Remote command:
n.a.

Trigger/Marker
(R&S SMx and R&S AMU instruments only)

Calls the dialog for selecting the trigger mode and trigger source, for configuring the marker signals, and for setting the time delay of an external trigger signal. This dialog is described in Chapter 7.21, "Trigger/Marker/Clock Settings", on page 298.

The currently selected trigger mode and trigger source are displayed next to the button.

Remote command:
n.a.

Execute Trigger
Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than "Auto" have been selected.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:EXECute` on page 432

Arm
Stops signal generation. This button appears only with "Running" signal generation in the "Armed_Auto" and "Armed_Retrigger" trigger modes.

Signal generation can be restarted by a new trigger (internally with "Execute Trigger" or externally).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:ARM:EXECute` on page 431

Clock
(R&S SMx and R&S AMU instruments only)

Calls the menu for selecting the clock source and for setting a delay.

This menu is described in Chapter 7.21.5, "Clock Settings", on page 306.

Remote command:
n.a.

7.2 LTE Logfile Generation

The generation of logfiles requires option R&S SMx/AMU-K81.

For generating logfiles for more than one transmission antenna simultaneously, two options R&S SMx/AMU-K81 are required.

This functionality enables you to generate logfiles for exchanging intermediate results of different logging points in the signal processing chain. Analyzing the content of the logfiles may help to verify the signal processing chain in both the DL and UL direction. The intermediate results provide a basis for enhanced debugging. To verify the FEC implementation of the DUT for instance, the coded bitstream from the instrument can be loaded into an Rx software module for offline analysis in a simulation environment, or it can be compared to the bitstreams from a Tx software module. Due to the full remote control of this functionality, optimization of the design flow with process automation can be achieved, too.

7.2.1 Signal Processing Chains and Logging Points

Logfile generation can be enabled after a completed processing step of the selected channel, at the so called logging point. Logging points (PTxx) are available after each completed processing stage up to the "Precoding", as shown on the figures bellow.

The results of the "Resource Element Mapping/OFDM Mapper" are not logged!

For detailed information about the signal processing of all channels, refer to TS 36.212 and TS 36.211.

Signal Processing in Downlink

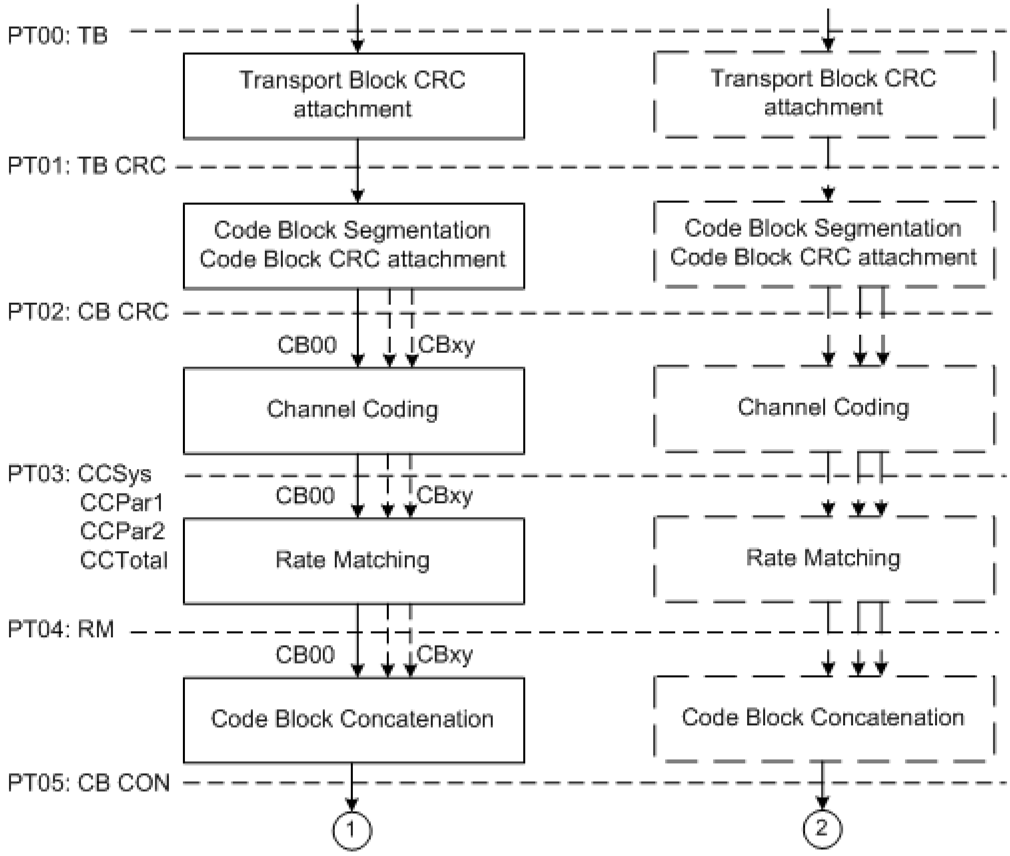


Figure 7-1: Transport channel processing for DL-SCH

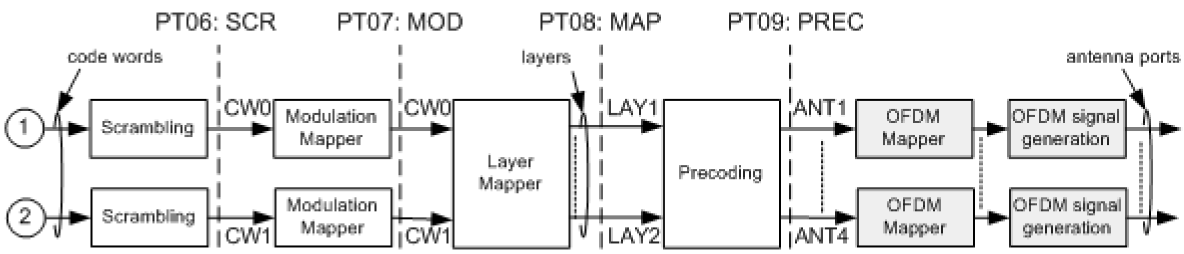


Figure 7-2: Overview of physical channel processing

The Table 7-1 gives an overview of the logging point available for the DL channels.

Table 7-1: Available logging points per DL channel

Point/ Channel	PT00 TB	PT01 TBCRC	PT02 CBCRC	PT03 CC	PT04 RM	PT05 CBCON	PT06 SCR	PT07 MOD	PT08 MAP	PT09 PREC
PDSCH	X	X	X	X	X	X	X	X	X	X
PBCH [1)]	X	X		X	X		X	X	X	X
PCFICH [1)]	X						X	X	X	X
PHICH [1)]	X							X [2)]	X [2)]	X [2)]

Point/ Channel	PT00 TB	PT01 TBCRC	PT02 CBCRC	PT03 CC	PT04 RM	PT05 CBCON	PT06 SCR	PT07 MOD	PT08 MAP	PT09 PREC
PDCCH [1)]	X [3)]	X [3)]		X [3)]	X [3)]	X	X	X	X	X
PMCH[1)]	X	X		X	X		X	X	X	X

[1)] The channel has one codeword and one code block

[2)] An individual file is generated per PHICH group

[3)] An individual file is generated per DCI

Signal Processing in Uplink

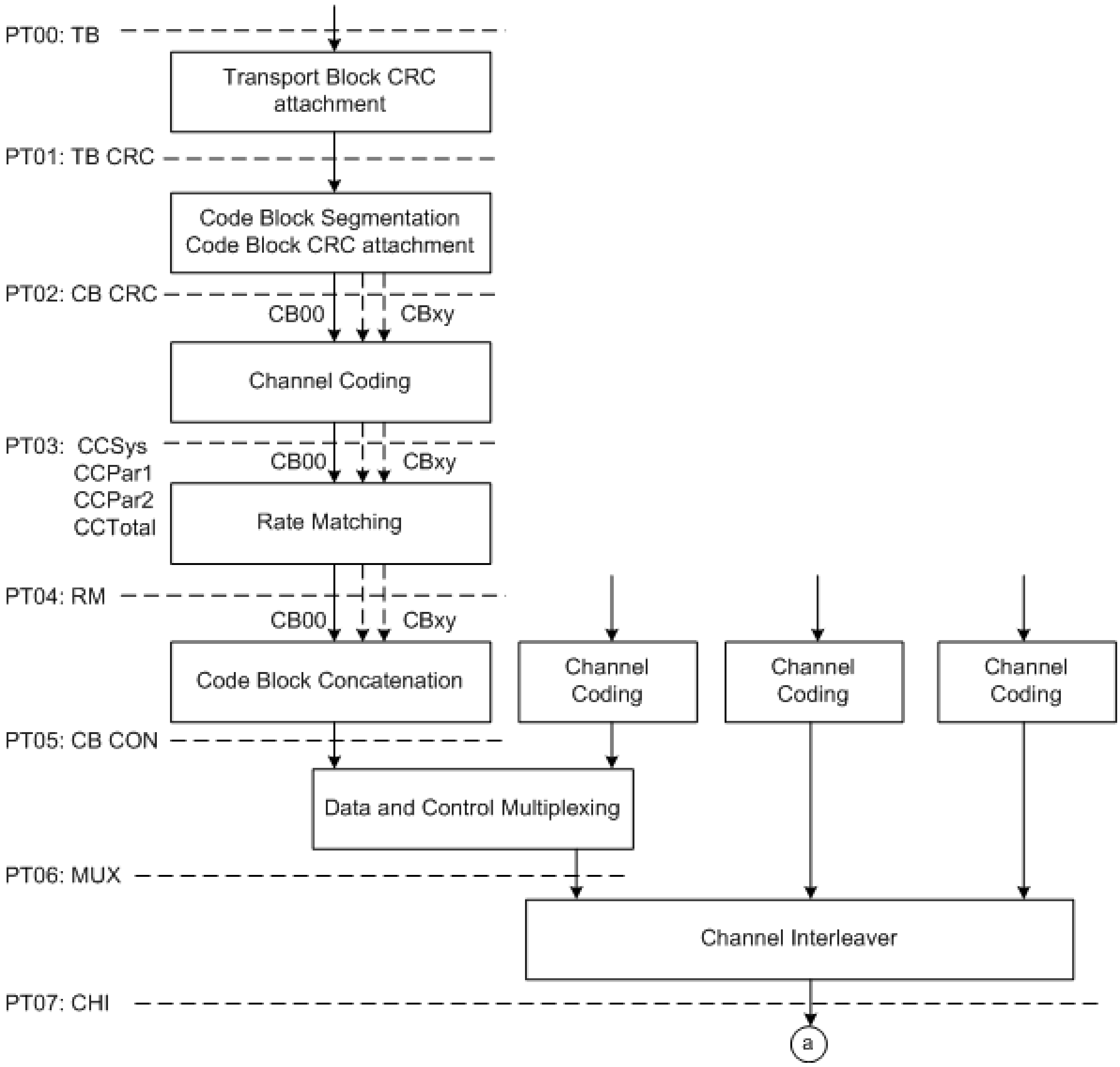


Figure 7-3: Transport channel processing for UL-SCH (according to 3GPP TS 36.212)

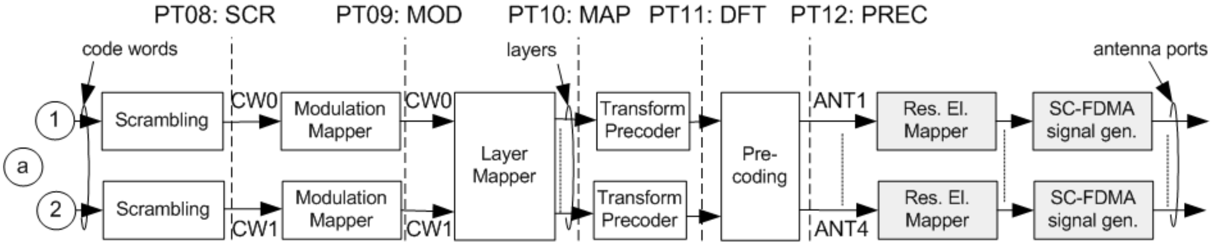


Figure 7-4: Overview of uplink physical shared channel processing (according to 3GPP TS 36.211)

For an overview of logging points available for the UL channels, see:

- Table 7-2
- Table 7-5
- Table 7-6
- There are no specific logging points for the SRS; a logfile with SRS information is always created.

Table 7-2: Available logging points per PUSCH channel

Point/ Channel	PT00 TB	PT01 TBCRC	PT02 CBCRC	PT03 CC	PT04 RM	PT05 CBCON	PT06 MUX	PT07 CHI	PT08 SCR	PT09 MOD	PT10 MAP	PT11 DFT	PT12 PREC
PUSCH	X	X	X	X	X	X	X	X	X	X	X	X	X

7.2.2 Output Files

The instrument stores the output logfiles in a user-defined network directory, selected with the parameter Output Path. The logfiles are named according to the naming conventions described in Chapter 7.2.2.1, "File Names", on page 90. Description of the available file formats is listed in "File Formats" on page 90.

File Formats

Generally, the logfiles are generated in two file formats:

- Bitstream
  The logfile contains a sequence of "1" and "0"; one value per line
  The logfile of the PHICH contains also the entry "-" that corresponds to DTX.
- IQ Samples
  The logfile contains pairs of I and Q samples; the I and Q components alternate at each line

File format IQ Samples is used for the logfiles generated for the logging points after "Modulation Mapping". The other logfiles are output in a Bitstream format.

Exceptions are the extended DCI/UCI logfiles, and the Summary Logfile (see "Extended DCI Logfile" on page 95 and "Extended UCI Logfile" on page 97).

7.2.2.1 File Names

The generated logging files are named according to the following naming structure:

```
[<Preamble>_]<Frame#>_<Subframe#>_<Channel>[-<Format>][_<User/
Allocation#>|<DCI#>|<Group#>]_<Point#>[_<CW#>|<LAY#>|<ANT#>]_
<PointName>[_<CodeBlock#>].dat
```

Exceptions are the extended DCI/UCI logfiles, and the Summary Logfile. The file names of these logfiles are as follows:

- [<Preamble>_]ExtendedDciLog_<BB#>.txt
- [<Preamble>_]ExtendedUciLog_<BB#>.txt
- [<Preamble>_]SummaryLogfile_<BB#>.txt

Table 7-3: Description of the File Name Structure

	Description	Value Range
<Preamble>	Preamble with default syntax EUtraLog_0	
<Frame#>	Frame number	F000 .. F873
<Subframe#>	Subframe number	SF0 .. SF9
<Channel>	Channel name	DL: PBCH | PCFICH | PHICH | PDCCH | PDSCH | PMCH UL: PUSCH | PUCCH PUSCHDRS | PUCCHDRS | SRS
<User>	PDSCH, PUSCH, PUCCH, PUSCH DRS, PUCCH DRS	USER1 .. USER4
<Allocation#>	PDSCH allocation only	ALL000 .. ALL101
<DCI#>	PDCCH allocation only Each PDCCH DCI is logged individually	DCI00 .. DCI19
<Group#>	PHICH Group An individual file is generated for each PHICH group	Group00 | Group01
<Format>	PUCCH format	F1 | F1A | F1B | F2 | F2A | F2B | F3
<Point#>	Logging point number	See Table 7-4
<CW#>	PDSCH and PUSCH allocations only Codeword	CW0 | CW1
<LAY#>	PDSCH, PUSCH, and PUSCH DRS allocations only Layer number	DL: LAY0 -- LAY7 UL: LAY0 .. LAY3
<ANT#> <AP#>	Antenna port number	DL: ANT1 .. ANT4 UL: AP10 | AP100 | AP20 | AP21 | AP40 | AP41 | AP42 | AP43 | AP200 | AP201
<PointName>	Logging point designation	See Table 7-4
<CodeBlock#>	PDSCH and PUSCH allocations only	CB00 .. CB20
<BB#>	Baseband	BBA .. BBH

There is a fixed cross-reference between the logging point number and the logging point designation:

- See Table 7-4.
- The PUCCH logging points depend on the PUCCH format, see Table 7-5
- See Table 7-6

Table 7-4: Logging Points Overview (DL and PUSCH)

`<Point#>`	`<PointName>`	**Description**
PT00	TB	Bits of the Transport Block
PT01	TBCRC	Bits after Transport Block CRC
PT02	CBCRC	Bits after Code Block CRC One file per code block is generated
PT03		Bits after Channel Coding (one file per code block)
	CCSys	Systematic Bits
	CCPar1	Parity 1 Bits
	CCPar2	Parity 2 Bits
	CCTotal	PDSCH and PUSCH allocation only Complete bit-stream after channel coding, incl. systematic, parity 1 and parity 2 bits
PT04	RM	Bits after Rate Matcher (one file per code block)
PT05	CBCON	Bits after Code Block Concatenation
PT06	DL: SCR	Bits after Scrambling
	UL: MUX	Bits after Data and Control Multiplexing
PT07	DL: MOD	IQ-Samples after Modulation
	UL: CHI	Bits after channel interleaver
PT08	DL: MAP	IQ-Samples after Layer Mapping (one file per layer)
	UL: SCR	Bits after Scrambling
PT09	DL: PREC	IQ-Samples after Precoding (one file per antenna)
	UL: MOD	IQ-Samples after Modulation
PT10	UL: MAP	IQ-Samples after Layer Mapping (one file per layer)
PT11	UL: DFT	IQ-Samples after DFT
PT12	UL: PREC	IQ-Samples after Precoding (one file per antenna)

Table 7-5: PUCCH Logging Points Overview per PUCCH format

PUCCH Format	`<Point#>`	`<PointName>`	**Description**
F1/F1a/F1b	PT00	SCR-BLOCK-WISE-SPREAD	Bits after scrambled block-wise spread operation
F2/F2a/F2b	PT00	UNCODED	Uncoded bits

PUCCH Format	<Point#>	<PointName>	Description
	PT01	SCR	Scrambled bits
	PT02	CYCLIC-SHIFTED	Bits after cyclic-shift operation
F3	PT00	UNCODED	Uncoded bits
	PT01	CODED	Coded bits
	PT02	SCR	Scrambled bits
	PT03	MOD	IQ-Samples after modulation
	PT04	BLOCK-WISE_SPREAD	Bits after block-wise spread operation
	PT05	CYCLIC-SHIFTED	Bits after cyclic-shift operation
	PT06	DFT-PREC	IQ-Samples after DFT transform precoding

Table 7-6: PUCCHDRS and PUSCHDRS Logging Points Overview

DRS	<Point#>	<PointName>	Description
PUCCHDRS	PT00	CYCLIC-SHIFTED	Bits after cyclic-shift operation
PUSCHDRS	PT00	CAZAC	IQ-Samples after CAZAC sequence generation
	PT01	OCC	IQ-Samples of OCC (Orthogonal Cover Code) sequence
	PT02	PREC	IQ-Samples after precoding

Example: List of the output logfiles for PDSCH

The following output files are generated for one PDSCH channel, configured on an allocation with index `ALL002` in the third subframe (`SF2`) of the first frame (`F000`). The instrument is configured to generate a MIMO signal with two antennas (`PREC_ANT1` and `PREC_ANT2`). Channel coding and scrambling are enabled (`CCPar1`, `CCPar2`, `CCSys`, `CCTotal` and `SCR`). Two codewords (`CW0` and `CW1`) and two layers (`LAY0` and `LAY1`) are used; three code blocks per code (`CB00`, `CB01`, `CB02`) are generated.

All logging points are enabled and a preamble (`EUtraLog_0`) is selected.

```
<User/
Allocation#>_<Point#>[_<CW#>|<LAY#>|<ANT#>]_<PointName>[_<CodeBlock#>].dat
```

```
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT00_CW0_TB.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT00_CW1_TB.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT01_CW0_TBCRC.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT01_CW1_TBCRC.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT02_CW0_CBCRC_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT02_CW1_CBCRC_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT02_CW0_CBCRC_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT02_CW1_CBCRC_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT02_CW0_CBCRC_CB02.dat
```

```
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT02_CW1_CBCRC_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCPar1_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCPar1_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCPar1_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCPar1_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCPar1_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCPar1_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCPar2_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCPar2_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCPar2_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCPar2_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCPar2_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCPar2_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCSys_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCSys_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCSys_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCSys_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCSys_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCSys_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCTotal_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCTotal_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCTotal_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCTotal_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW0_CCTotal_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT03_CW1_CCTotal_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT04_CW0_RM_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT04_CW1_RM_CB00.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT04_CW0_RM_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT04_CW1_RM_CB01.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT04_CW0_RM_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT04_CW1_RM_CB02.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT05_CW0_CBCON.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT05_CW1_CBCON.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT06_CW0_SCR.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT06_CW1_SCR.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT07_CW0_MOD.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT07_CW1_MOD.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT08_LAY0_MAP.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT08_LAY1_MAP.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT09_ANT1_PREC.dat
EUtraLog_0_F000_SF2_PDSCH_ALL002_PT09_ANT2_PREC.dat
```

7.2.2.2 Extended Logfiles Contents

The instrument generates only one logfile with extended information regarding the DCI/UCI mapping.

Extended DCI Logfile

An Extended DCI Logfile summarizes the information for the whole generated signal and may contain information for more than one frame. The information is grouped in rows with different syntax.

- PCFICH mapping, i.e the resource elements the PCFICH REGs are mapped to
  `<Frame#>_<Subframe#>_`
  `PCFICH: REG-Idx=<REG#>: Subcarrier=<Subcarrier#>,`
  `Symbol=<OFDMSymbol#>`
- PHICH mapping, i.e the resource elements the PHICH REGs of the individual PHICH groups are mapped to
  `<Frame#>_<Subframe#>_`
  `PHICH: Group=<Group#>: REG-Idx=<REG#>: Subcarrier=<Subcarrier#>`
  `, Symbol=<OFDMSymbol#>`
- PDCCH number of useful REGs
  `<Frame#>_<Subframe#>_PDCCH: Columns:<Columns#>, Rows:<Rows#>,`
  `Useful REGs:<REG#>`
  The Number of Useful REGs corresponds to the value displayed with the parameter Number of available REGs (PDCCH)Number of Available REGs.
- The start CCE-Index of the individual DCIs
  `<Frame#>_<Subframe#>_DCI: DCI Idx=<DCI#>, Start CCE-Idx=<CCE#>`
  The DCI Idx corresponds to the row in the DCI Table and the Start CCE-Idx is the CCE Index for the corresponding DCI.
- PDCCH mapping, i.e the resource elements the PDCCH REGs of the individual PDCCHs are mapped to
  `<Frame#>_<Subframe#>_`
  `PDCCH: Idx=<Symbol#>: REG-Idx=<REG#>: Subcarrier=<Subcarrier#>`
  `, Symbol=<OFDMSymbol#> [--- DTX REG]`
  The additional information DTX REG is assigned to all Dummy PDCCH REGs (see"Number of Dummy REGs" on page 181).

Sub-carrier with index 0 is the most left sub-carrier, i.e. the one belonging to the resource block 0.

Example: Content of an Extended DCI Logfile

The instrument is configured to generate a DL LTE signal with 1.4 MHz bandwidth (6 RBs), normal Cyclic Prefix, Extended PHICH Duration, and Control Region for PDCCH of 3 OFDM symbols. Two Antennas are selected, path A generate the signal of Antenna 1 and Path B, the signal of Antenna 2.

A PDCCH Format Variable is selected and the PDCCH is configured as given on the figure bellow.

	User	UE_ID n_RNTI	DCI Format	Content	PDCCH Format	Number CCEs	Search Space	CCE Index	No.Dummy CCEs	Conflict
0	User1	0	0	Config...	1	2	On	0	0	
1 >	SI-RNTI	65535	1A	Config...	0	1	On	2	1	

Generation of Extended DCI Logfile is enabled and the file contains the following information (only the beginning of the file is listed):

```
F00,SF0,PCFICH: REG-Idx=0: Subcarrier=1, Symbol=0
F00,SF0,PCFICH: REG-Idx=0: Subcarrier=2, Symbol=0
F00,SF0,PCFICH: REG-Idx=0: Subcarrier=4, Symbol=0
F00,SF0,PCFICH: REG-Idx=0: Subcarrier=5, Symbol=0
F00,SF0,PCFICH: REG-Idx=1: Subcarrier=19, Symbol=0
F00,SF0,PCFICH: REG-Idx=1: Subcarrier=20, Symbol=0
F00,SF0,PCFICH: REG-Idx=1: Subcarrier=22, Symbol=0
F00,SF0,PCFICH: REG-Idx=1: Subcarrier=23, Symbol=0
F00,SF0,PCFICH: REG-Idx=2: Subcarrier=37, Symbol=0
F00,SF0,PCFICH: REG-Idx=2: Subcarrier=38, Symbol=0
F00,SF0,PCFICH: REG-Idx=2: Subcarrier=40, Symbol=0
F00,SF0,PCFICH: REG-Idx=2: Subcarrier=41, Symbol=0
F00,SF0,PCFICH: REG-Idx=3: Subcarrier=55, Symbol=0
F00,SF0,PCFICH: REG-Idx=3: Subcarrier=56, Symbol=0
F00,SF0,PCFICH: REG-Idx=3: Subcarrier=58, Symbol=0
F00,SF0,PCFICH: REG-Idx=3: Subcarrier=59, Symbol=0

F00,SF0,PHICH: Group=0: REG-Idx=0: Subcarrier=7, Symbol=0
F00,SF0,PHICH: Group=0: REG-Idx=0: Subcarrier=8, Symbol=0
F00,SF0,PHICH: Group=0: REG-Idx=0: Subcarrier=10, Symbol=0
F00,SF0,PHICH: Group=0: REG-Idx=0: Subcarrier=11, Symbol=0
F00,SF0,PHICH: Group=0: REG-Idx=1: Subcarrier=24, Symbol=1
F00,SF0,PHICH: Group=0: REG-Idx=1: Subcarrier=25, Symbol=1
F00,SF0,PHICH: Group=0: REG-Idx=1: Subcarrier=26, Symbol=1
F00,SF0,PHICH: Group=0: REG-Idx=1: Subcarrier=27, Symbol=1
F00,SF0,PHICH: Group=0: REG-Idx=2: Subcarrier=48, Symbol=2
F00,SF0,PHICH: Group=0: REG-Idx=2: Subcarrier=49, Symbol=2
F00,SF0,PHICH: Group=0: REG-Idx=2: Subcarrier=50, Symbol=2
F00,SF0,PHICH: Group=0: REG-Idx=2: Subcarrier=51, Symbol=2

F00,SF0,PDCCH: Columns:32, Rows:2, Useful REGs:41
F00,SF0,DCI: DCI Idx=0: Start CCE-Idx=0
```

```
F00,SF0,DCI: DCI Idx=1: Start CCE-Idx=2
F00,SF0,PDCCH: Idx=0: REG-Idx=10: Subcarrier=0, Symbol=1
F00,SF0,PDCCH: Idx=0: REG-Idx=10: Subcarrier=1, Symbol=1
F00,SF0,PDCCH: Idx=0: REG-Idx=10: Subcarrier=2, Symbol=1
F00,SF0,PDCCH: Idx=0: REG-Idx=10: Subcarrier=3, Symbol=1
F00,SF0,PDCCH: Idx=1: REG-Idx=26: Subcarrier=0, Symbol=2
F00,SF0,PDCCH: Idx=1: REG-Idx=26: Subcarrier=1, Symbol=2
F00,SF0,PDCCH: Idx=1: REG-Idx=26: Subcarrier=2, Symbol=2
F00,SF0,PDCCH: Idx=1: REG-Idx=26: Subcarrier=3, Symbol=2
.......
```

The Figure 7-5 shows the resource allocation for this example. See also Chapter 3.1.4, "Downlink Control Information Transmission", on page 22.

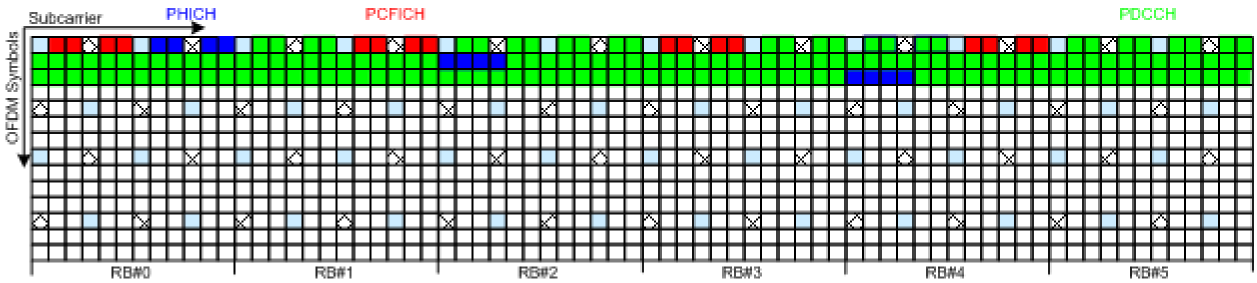


Figure 7-5: Example of Downlink Control Information Mapping

Extended UCI Logfile

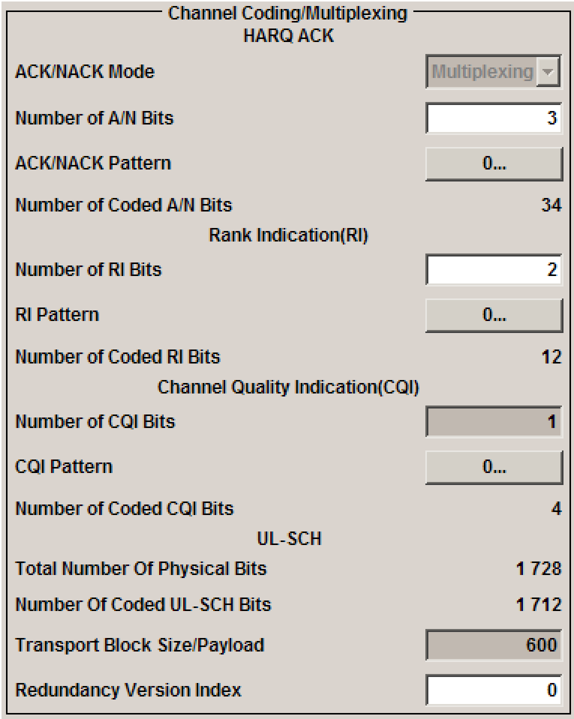
The Extended UCI Logfile summarizes the information for the whole generated signal and may contain information for more than one frame. The information is grouped in rows with the following syntax:

```
PUSCH_<Frame#>_<Subframe#>: <CW#>:
```

```
No.HARQ Bits=<HARQ#>,No.RI Bits=<RI#>,No.CQI Bits=<CQI#>,
No.coded A/N Bits=<CodedHARQ#>,No.coded RI Bits=<CodedRI#>,
No.coded CQI Bits=<CodedCQI#>,No.coded UL-SCH Bits=<UL-SCH#>
```

Example:

The PUSCH of a Release 8/9 UE carries multiplexed control information and data (`UCI+UL-SCH`) and the channel is configured as shown on the figure bellow:



The first line of the logfile is: `F00,SF0,`
`PUSCH UCI+UL-SCH Number of Bits: No.HARQ Bits=3,No.RI Bits=2,No.CQI Bits=1`
`,`
`No.coded HARQ Bits=34,No.coded RI Bits=12,No.coded CQI Bits=4,No.coded UL-S`

7.2.3 Working with the Logfile Generation Functionality

The R&S Signal Generator generates logfiles only if the logging state is enabled. Adjusting the settings in the "Logfile Generation" dialog does not affect the content of the generated EUTRA/LTE signal and does not cause a recalculation of the signal. The generation of new logfiles is triggered by changing of a signal relevant EUTRA/LTE parameter or by enabling/disabling the generation of EUTRA/LTE signal.

Activation of logfile generation slows down the calculation speed of the instrument. Enable this function only if logfiles are explicitly requested.

General Workflow

To enable the generation of logfiles proceed as follows:

1. In the "EUTRA/LTE > Logfile Generation > Output Path" dialog and select the network directory the logfiles are saved to, e.g. `<root>logfiles`.

   Note: The network directory should be empty. Existing logfiles are overwritten.

Use different preambles to assure that previous logfiles are not lost.

2. If required, enable "Extended DCI/UCI Logging".
3. Select the processing chain points for that logfiles are generated, e.g. "Point 3: Channel Coding".

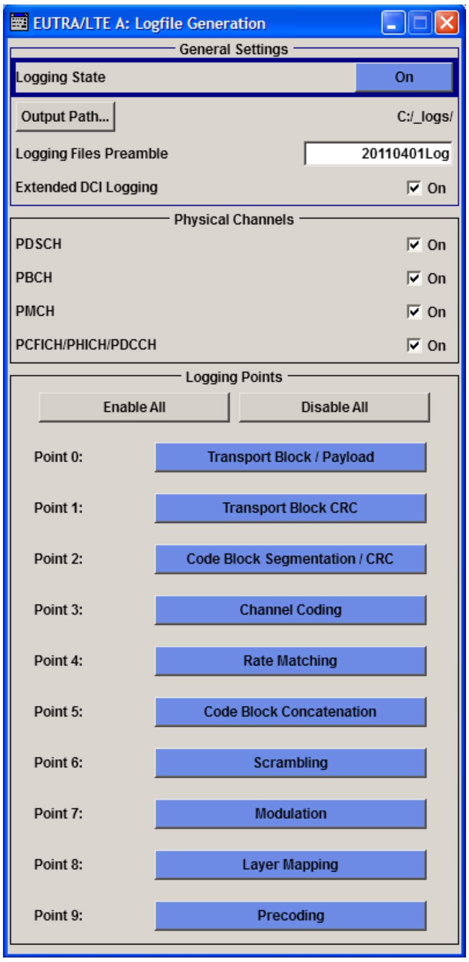
   Tip: Not all the available logging points are relevant for all channels. The processing of the PBCH for instance does not include the step "Code block segmentation / CRC", i.e. even if the Logging Point "Point 2: Code block segmentation / CRC" is enabled, no logfile is generated (see Table 7-1).
   No logfiles are generated also in case that the corresponding processing step is disabled in the EUTRA/LTE dialog. For example, if channel coding and/or scrambling are disabled for some channel, no logfiles for the Point 3 and/or Point 6/Point 8 are available for this channel as long as these processing steps are not enabled.
4. Set the "Logging State" to On to enable logfile generation.
5. Adjust the EUTRA/LTE Settings as required and enable signal generation.

7.2.4 Logfile Generation Settings

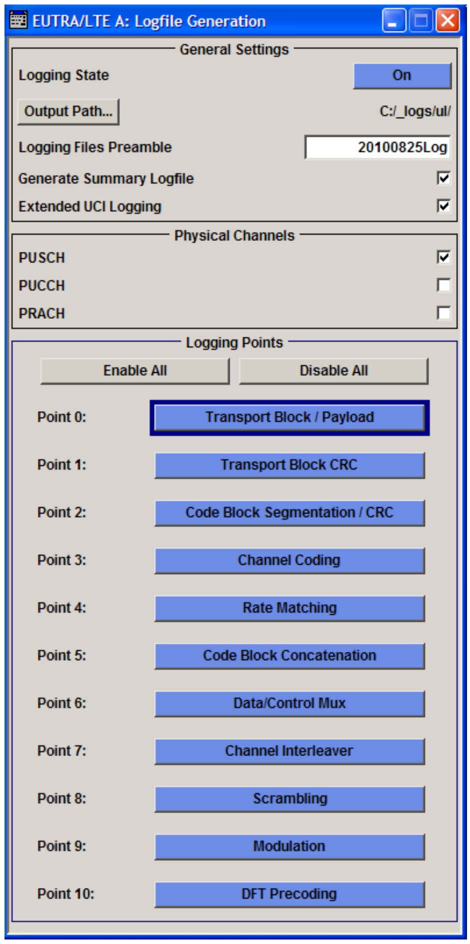
► To access this dialog, select "EUTRA/LTE > General > Logfile Generation".

The dialog is divided into three main areas. The first one is where the logfile generation is enabled and the settings of the output file are configured. In the second one, the channels are selected for which logfiles are generated. The last one enables the selection of the logging points for which logfiles are generated.

Downlink Settings



Uplink Settings



Logging State

Enables/disables logfile generation.

Note: Activation of logfile generation slows down the calculation speed of the instrument.

Enable this function only if logfiles are explicitly requested.

See also Chapter 7.2.3, "Working with the Logfile Generation Functionality", on page 98.

Remote command:
[:SOURce<hw>]:BB:EUTRa:LOGGen:STATe on page 603

Output Path
Selects the network directory the logged files are stored in.

Remote command:
[:SOURce<hw>]:BB:EUTRa:LOGGen:OUTPut on page 603

Logging Files Preamble
Adds a preamble to the file name.

Refer to Chapter 7.2.2.1, "File Names", on page 90 for a description of the file naming convention used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:LOGGen:LFP on page 603

Generate Summary Log
Enables the generation of a summary logfile with general information on the individual signal processing blocks, like the used rate matching parameters or allocation mapping.

Remote command:
[:SOURce<hw>]:BB:EUTRa:LOGGen:GSLogfile on page 604

Extended DCI/UCI Logging
Enables the generation of a logfile with extended information regarding the DCI/UCI mapping.

For description of the content of the generated file, see "Extended DCI Logfile" on page 95 and respectively "Extended UCI Logfile" on page 97.

Remote command:
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:EDLogging on page 604
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:EULogging on page 604

Physical Channels
Selects the channel for which logfiles are generated.

Remote command:
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:ENCC on page 605
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:PBCH on page 605
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:PDSCh on page 605
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:PMCH on page 605
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:PUSCh on page 605
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:PUSDrs on page 605
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:PUCCh on page 605
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:PUCDrs on page 605
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:SRS on page 605

Enable/Disable All
Enables/disables all logging points.

Remote command:
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:EALL on page 604
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:DALL on page 604
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:EALL on page 604
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:DALL on page 604

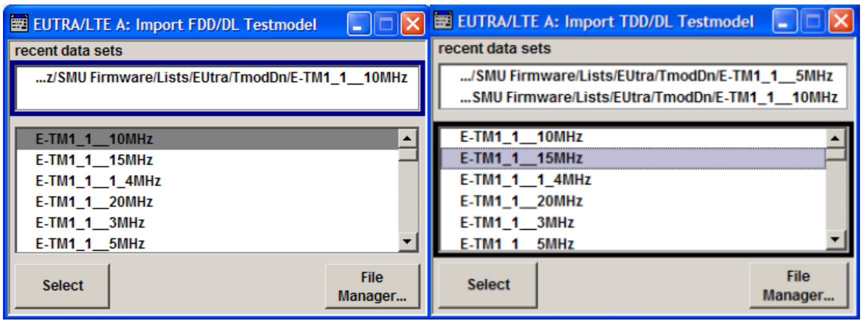
Logging Point
Enables/disables one particular logging point.

Refer to Chapter 7.2.1, "Signal Processing Chains and Logging Points", on page 87 for description on the available logging points.

Remote command:
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:LOGPoint<ch0> on page 604
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:LOGPoint<ch0> on page 604

7.3 Test Setups/Models

► To access this dialog, select "General > Test Setups/Models".



The dialog offers quick selection and settings adjustment according to one of the various EUTRA Test Models (E-TM) as defined in the 3GPP specification TS 36.141. The EUTRA Test Models are defined for FDD and TDD duplexing mode.

EUTRA Test Models (E-TM) Downlink
Access a list of EUTRA Test Models (E-TM) in accordance with the TS 36.141.

The DL test models are predefined configurations of LTE settings. Three main groups of test models are defined, the E-TM1, E-TM2 and E-TM3. All test models use the following parameters:

- Single antenna port, single codeword, single layer and no precoding
- Duration of one frame
- Normal cyclic prefix
- Localized virtual resource blocks, no intra-subframe hopping for PDSCH
- UE-specific reference signals are not used

The data content of the physical channels and signals are defined in the 3GPP specification. Each E-TM is defined for six different channel bandwidths, 1.4/3/5/10/15 MHz and 20 MHz. The test models are defined for specific test purpose (see Table 7-7).

Table 7-7: E-TM available for selection

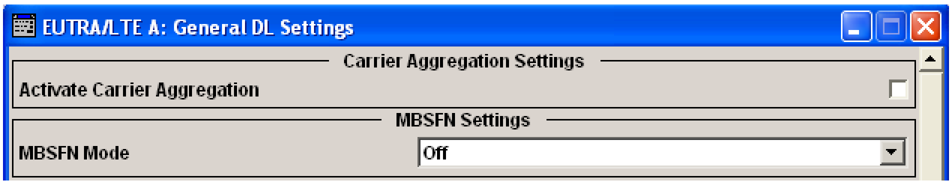
EUTRA Test Model	Defined for tests on
E-TM1.1	• BS output power • Unwanted emissions • Transmitter intermodulation • RS absolute accuracy
E-TM1.2	• ACLR • Operating band unwanted emissions
E-TM2	• Total power dynamic range (lower OFDM symbol power limit at min power) • EVM of single 64QAM PRB allocation (at min power) • Frequency error (at min power)
E-TM3.1	• Output power dynamics • Transmitted signal quality (Frequency error and EVM for 64QAM modulation, at max power)
E-TM3.2	Transmitted signal quality: • Frequency error • EVM for 16QAM modulation
E-TM3.3	Transmitted signal quality: • Frequency error • EVM for QPSK modulation

Remote command:
[:SOURce<hw>]:BB:EUTRa:SETTing:TMOD:DL on page 416
[:SOURce<hw>]:BB:EUTRa:SETTing:TMOD:TDD on page 416

7.4 General DL Settings / General TDD DL Settings

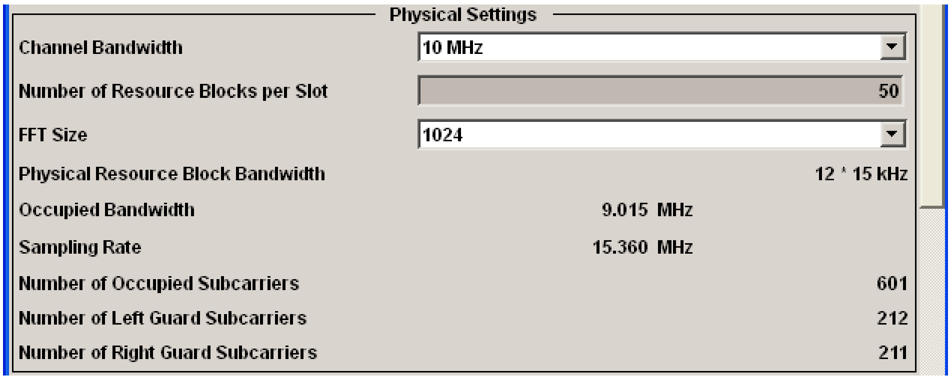
The "General DL Settings" dialog allows configuring the EUTRA/LTE system for transmission direction downlink, i.e. the signal of one BS or one cell.

The dialog consists of the sections DL Carrier Aggregation Configuration, MBSFN Settings,Chapter 7.4.3, "Physical Settings", on page 125,TDD Frame Structure Settings,PDSCH Scheduling Settings, MIMO, Cell-Specific Settings,Downlink Reference Signal Structure, Synchronization Signal Settings, Positioning Reference Signal (PRS) Settings

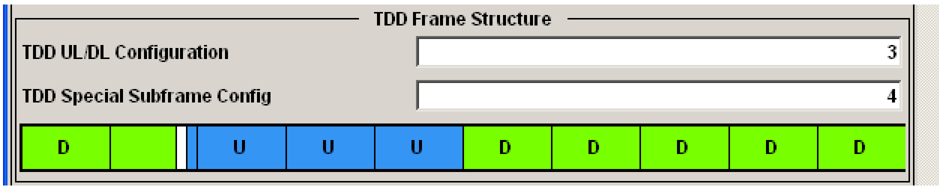


Because the EUTRA/LTE standard defines no differences between TDD and FDD signals on the physical layer if only one link direction is considered at once, the "General TDD DL Settings" dialog comes with the same parameters as the "General DL Settings" dialog and is only extended with the TDD Frame Structure Settings section.

In the "Physical Settings" section, the channel bandwidth respectively the number of resource blocks per slot is selected. The other parameters are fixed and read-only.

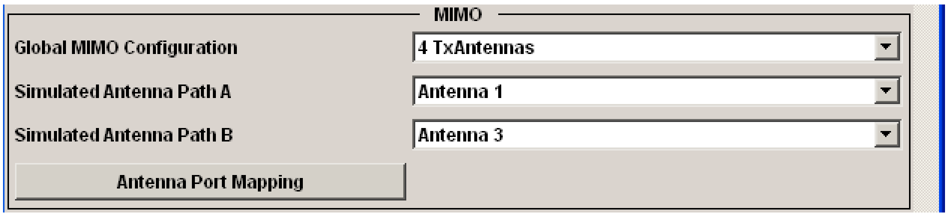


The "TDD Frame Structure" section is available only, if the TDD is selected as a duplexing mode. In this section, the TDD frame is configured by adjustment of the UL/DL configuration and the special subframe configuration.

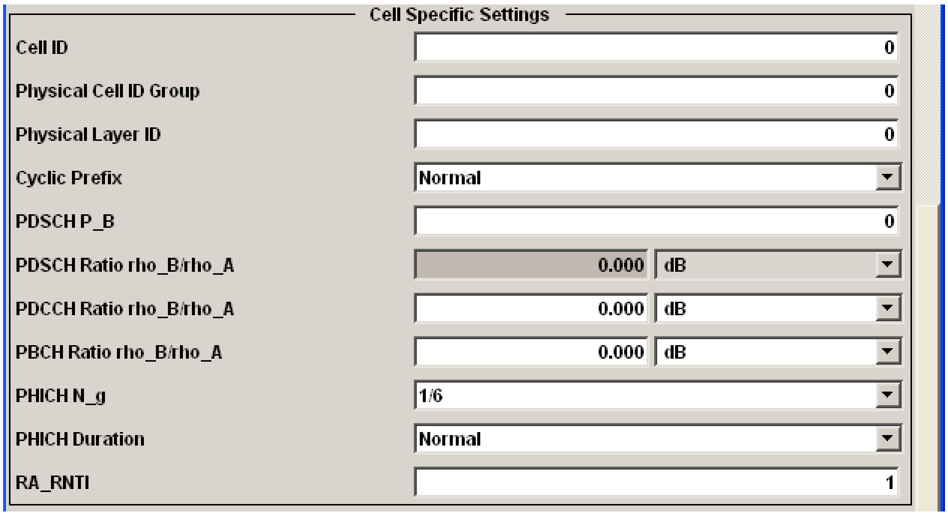


In the "K55 Configuration" section, a selection is made, whether the PDSCH Scheduling is performed manual or according to the configuration made for the DCIs.

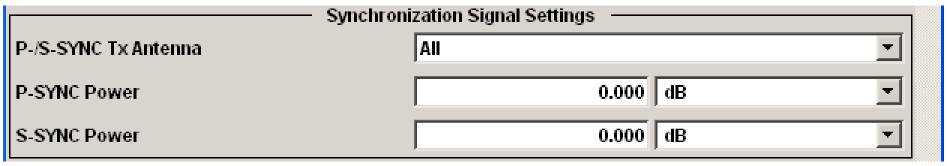
In the "MIMO" section, the global MIMO configuration and the simulated antenna are selected.



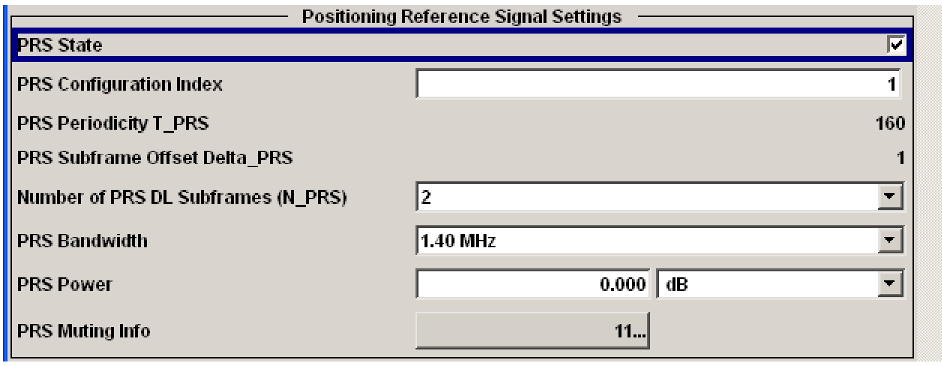
In the "Cell Specific Settings" section, the physical layer cell identity settings and the DL power control settings are configured.



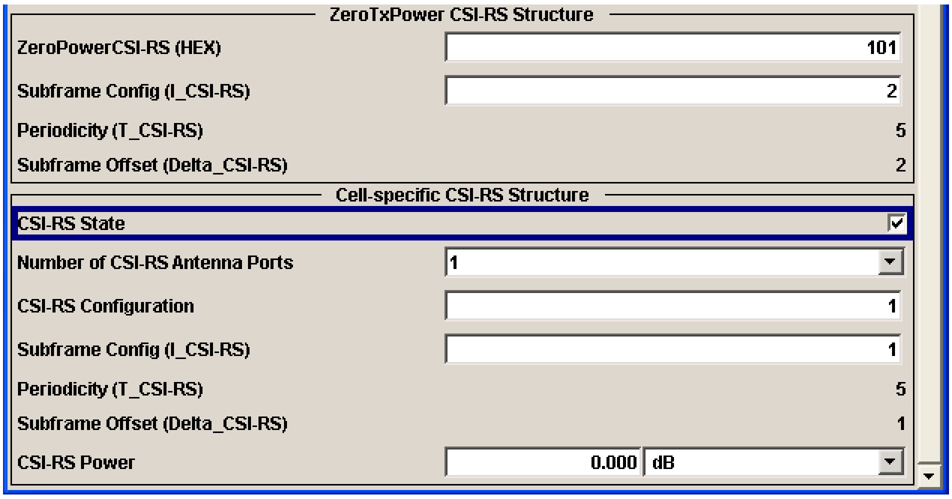
In the "Downlink Reference Signal Structure" and the "Synchronization Signal Settings" sections, the power level of the reference signals and the P-/S-SYNC can be set and the P-/S-SYNC can be enabled or disabled.



The "Positioning Reference Signal Settings" section comprises the related settings.



The "CSI-RS Structure" sections comprise the settings for configuring the channel-state information reference signal (CSI-RS) structure.



7.4.1 DL Carrier Aggregation Configuration

DL Carrier Aggregation is an LTE-A (LTE Rel. 10) feature that requires options R&S SMx/AMU-K55 and R&S SMx/AMU-K85.

The "DL Carrier Aggregation Configuration" dialog provides the settings for the configuration of one primary cell (PCell) and up to four secondary cells (SCell). In real system, the RRC messages signal all the relevant system information for a certain SCell. In this implementation, all relevant and configurable SCell settings are grouped in the "DL Carrier Aggregation Configuration" dialog. The remaining cell-specific settings are identical for all component carriers.

7.4.1.1 About DL Carrier Aggregation

This section lists implementation-related information. For background information on this topic, refer to Chapter 3.5, "LTE-Advanced (3GPP Rel. 10) Introduction", on page 43.

In this description, the terms cell and component carrier (CC) are used interchangeably.

SCell settings derivation

The settings of each component carrier are calculated automatically form the configured PCell settings and depending on the parameters in the "DL Carrier Aggregation Configuration" dialog. The following list provides an overview of the restrictions and interdependencies between related parameters if DL Carrier Aggregation is enabled:

- Combination of FDD and TDD is not possible.
- Simultaneous support of LTE and LTE-A users is provided

(see User Configuration Settings > Activate CA).

- The following configurations in the PCell are not supported:
  – "Channel Bandwidth = User"
  – "PDSCH Scheduling = Auto/DCI"
- To enable cross-carrier scheduling, the DCI formats are extended to support the CIF field. The DCIs have to be configured individually per component carrier.
  In this firmware version, the "PDSCH Scheduling = Auto/DCI" mode is always disabled and the component carriers of the SCells use the same frame configuration as the PCell.
- The "Control Region for PDCCH" of all SCells is set to the same value, unless the 3GPP standard specifies a specific value, as it is in the special subframes in TDD mode.
  The PHICH Duration of the SCells is adjusted automatically if required. For example if this parameter is set to "Extended" in the PCell, the SCell are generated with extended PHICH duration even if the "PDCCH Start" is not set properly for the SCell.
  However, the PHICH Duration in a SCell is adjusted if the selected narrow channel bandwidth in this SCell leads to unsufficient number of PDCCH symbols. Therefore, different channel bandwidth results in different Number of available CCEs (PDCCH).
- The parameter Number of PHICH Groups may have different values in the SCells, because it is calculated based on the parameter "N_g".
- If a SCell spans channel bandwidth with fewer RBs than the PCell, the instrument ignores the allocations or part of the them that is outside the channel bandwidth of the SCell.

Limitation of the LTE-A bandwidth

The LTE specification defines a maximum Channel Bandwidth of 20 MHz and aggregation of up to five component carriers to achieve 100 MHz bandwidth.

The R&S Signal Generator configured to generate more than one component carrier per baseband automatically applies the multi-carrier function. In this case, the maximum bandwidth of the generated LTE-A signal is restricted by the instrument's hardware.

In R&S SMU, the RF bandwidth of multi carrier signal is limited to 80 MHz.

Using the maximum sampling rate, the R&S SMBV equipped with the options R&S SMBV-B10/K522 can internally generate multi-carrier signals with up to 160 MHz RF bandwidth.

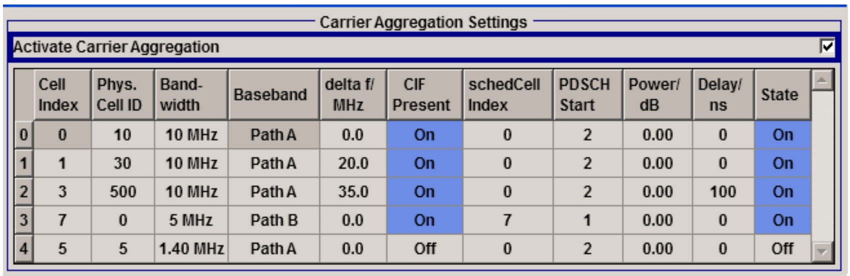
7.4.1.2 How to Enable Carrier Aggregation and Cross-Carrier Scheduling

This section provides step-by-step instructions on how to use the settings to generate an LTE-A signal.

To enable carrier aggregation and cross-carrier scheduling

In the following, a general example is provided. Only the related settings are discussed.

1. Select "Baseband Block A > EUTRA/LTE" and configure the settings of the PCell as required, e.g. select one of the predefined "Test Setups/Models".
2. To enable carrier aggregation:
   a) select "General DL Settings > DL Carrier Aggregation Configuration > Activate Carrier Aggregation > ON"
   b) select "DL Frame Configuration > Configure User" and enable/disable "Activate CA" per user as required.
3. In the "General DL Settings > DL Carrier Aggregation Configuration > Component Carrier Table" dialog, configure the settings of the SCells (see example on the following figure).



	Cell Index	Phys. Cell ID	Band-width	Baseband	delta f/ MHz	CIF Present	schedCell Index	PDSCH Start	Power/ dB	Delay/ ns	State
0	0	10	10 MHz	Path A	0.0	On	0	2	0.00	0	On
1	1	30	10 MHz	Path A	20.0	On	0	2	0.00	0	On
2	3	500	10 MHz	Path A	35.0	On	0	2	0.00	100	On
3	7	0	5 MHz	Path B	0.0	On	7	1	0.00	0	On
4	5	5	1.40 MHz	Path A	0.0	Off	0	2	0.00	0	Off

4. To enable cross-carrier scheduling for a certain component carrier:
   a) set the "DL Carrier Aggregation Configuration > SCell# > schedCell Index = 0"
   In the example, the component carriers SCell#1, SCell#2 and SCell#4 can be cross-scheduled over the PCell
   b) enable the "DL Carrier Aggregation Configuration > SCell# > CIF Present" parameter.
   In this example, the component carriers SCell#1 and SCell#2 is cross-scheduled over the PCell.
   c) To enable a component carrier, set "DL Carrier Aggregation Configuration > SCell# > State > ON".
5. Enable LTE signal generation "EUTRA/LTE State > ON".
6. If required, use the Fading Simulator to configure the propagation conditions.
7. If required, adjust the RF frequency of path A to the middle frequency of the resulting total signal bandwidth.

8. Activate the RF output.

   The instrument generates the signal in the path A as multi carrier signal. The signal is composed of 3 carriers, the PCell, the SCell#1 and SCell#2. Each of the component carriers spans "Channel Bandwidth = 10 MHz"; the SCells use carrier frequency offset of 20 MHz and 35 MHz.
   In two path instrument, the SCell#3 is generated by the path B. The instrument uses the internal coupled mode, that is path B is controlled via path A. The signal generated by path B has identical parameters with the settings made for path A. The component carrier-specific parameters, like the "Channel Bandwidth" are set automatically.
   The SCell#4 is disabled.
   Tip: How to configure an LTE-A signal with independent fading per component carrier
   If independent fading is required for each of the component carriers, configure one component carrier per path, use the "Save/Recall" function to transfer the settings file to further instruments and adjust the component carrier settings as required.

7.4.1.3 Carrier Aggregation Settings

Provided are the following settings:

Activate Carrier Aggregation

Enables/disables the generation of several component carriers.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:STATe` on page 487

Component Carrier Table

The table provides the settings of the component carriers. The first row displays the settings of the PCell as configured in the "General DL Settings" dialog. The following four rows provide the configurable settings of the up to four SCells.

Cell Index ← Component Carrier Table

Sets the cell index of the corresponding SCell, as specified in TS 36.331. The SCell Index is required for signaling on the DCI DCI Format Configuration field.

The cell index of the PCell is always 0.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:INDex on page 489

Physical Cell ID ← Component Carrier Table
Sets the physical Cell ID of the corresponding SCell. The physical Cell ID of the PCell is set by the parameter "General DL Settings > Cell ID".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:ID on page 489

Bandwidth ← Component Carrier Table
Sets the bandwidth of the corresponding component carrier/SCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:BW on page 488

Baseband ← Component Carrier Table
Determines the baseband block that generates the selected component carrier.

Note: For two path instruments, setting this parameter to "Path B", enables LTE signal simulation in the second path. All other digital standards and digital modulation modes are disabled in this path.

Enabling path B to simulate a component carrier automatically couples path A and path B, i.e. path B is controlled via path A. The signal generated by path B has identical parameters with the settings made for path A. The component carrier-specific parameters, like the "Channel Bandwidth", are set automatically.

If more than one component carriers are configured per baseband, the multi-carrier function of the R&S Signal Generator is automatically enabled. In this case, the maximum frequency offset "delta f" between the central frequencies of the cells is limited by the instrument's hardware.

Note: The LTE-A signal is generated as multi-carrier waveform by one baseband and hence all the component carriers/cells can only be faded jointly.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:BB on page 488

delta f / MHz ← Component Carrier Table
Sets the frequency offset between the central frequency of corresponding SCell and the frequency of the PCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:DFReq on page 488

CIF Present ← Component Carrier Table
Defines whether the DCI Format ConfigurationCarrier Indicator Field (CIF) is included in the PDCCH DCI formats transmitted from the corresponding SCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:CIF on page 488

schedCell Index ← Component Carrier Table
Defines the component carrier/cell that signals the UL and DL grants for the selected SCell. The signaling cell is determined by its Cell Index.

According to the LTE-A specification, cross-carrier scheduling has to be enabled per user and per component carrier.

To enable signaling for one particular SCell on the PCell, i.e. cross-carrier scheduling, set the "schedCell Index" to 0.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:SCINdex` on page 490

PDSCH Start ← Component Carrier Table
Sets the starting symbol of the PDSCH for the corresponding SCell, i.e. determines the "Control Region for PDCCH".

Note: All subframes use the same "Control region for PDCCH" as set here, regardless of the settings of the PCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:PSTart` on page 489

Power / dB ← Component Carrier Table
Sets the RS EPRE (Reference Signal Energy per Resource Element) of the SCell relative to the RS EPRE of the PCell.

The absolute power of the RS of a cell is calculated according to the following formula:

Absolute_RS_EPRE$_{Cell_X}$ = RS Power per RE relative to Level Display + "Level Display" + CA_Power$_{Cell_X}$

Example:

Set "EUTRA/LTE > Set to Default"

Set Activate Carrier Aggregation > ON

For the SCell1, set CA_Power$_{Cell_1}$ = Power / dB = -5 dB

Enable SCell1, i.e. set State > ON

The value of the parameter "General DL Settings > RS Power per RE relative to Level Display" is -30.736 dB

The power displayed in the status bar of the instrument is "Level = -30 dBm"

Absolute_RS_EPRE$_{Cell_1}$ = (-30.736 dB) + (-30.00 dBm) + (-5 dB) = -65.736 dBm

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:POFFset` on page 489

Delay / ns ← Component Carrier Table
Sets the time delay of the SCell relative to the PCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:TDELay` on page 490

State ← Component Carrier Table
Activates/deactivates the component carrier/SCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:STATe` on page 490

7.4.2 MBSFN Settings

Configuration of the "MBSFN Settings" requires the additional software option R&S SMx/AMU-K84.

The "MBSFN Settings" section comprises the parameters necessary to configure an MBSFN transmission. Refer to Chapter 3.4, "LTE MBMS Concepts", on page 42 for background information.

According to the MBMS LTE concept, one eNodeB may serve more than one MBSFN areas. In this implementation, the simulated cell belongs to only one MBSFN area. Hence, all radio resources reserved for MBSFN subframes are assigned to one MBSFN area.

In an LTE network, the MBSFN information is transmitted only during the specially reserved MBSFN subframes. Almost all MBMS control information is carried by a special control channel, the MCCH. There is one MCCH per MBSFN area. In this implementation, the MCCH is always mapped to the first active MBSFN subframe within one MCCH repetition period (see figure in Example "MBSFN Resource Allocation" on page 114).

A configurable "MCCH repetition period" determines how frequent the control information is transmitted within a defined "MCCH modification period" (see Figure 7-6).

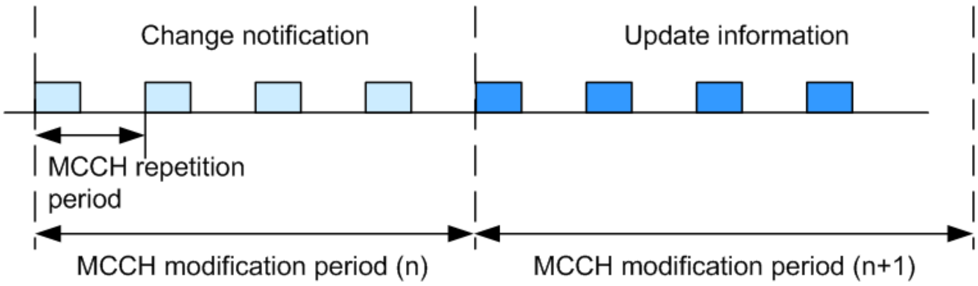


Figure 7-6: Change of MCCH information

The MCCH carries a single message, the *MBSFNAreaConfiguration* message, which provides information on the ongoing MBMS sessions and the corresponding radio resources, i.e. the mapping of the PMCHs. The BCCH also carries some of the MBMS control information by the special System Information Blocks SIB Type 13 and SIB Type 2.

For exact definition of control elements and messages such as *MBSFNAreaConfiguration*, refer to TS 36.331.

The following table provides an overview of the steps an UE performs to acquire the information about the resource configuration of reserved MBSFN subframes, the position of the MCCH within the MBSFN subframes as well as information necessary to demodulate the MCCH and to retrieve the information about the PMCH scheduling.

Table 7-8: Acquiring MBSFN information

Step	Information provided by	Description	User Interface
1	BCCH > SIB#2 ● *MBSFN-SubframeConfiguration*	The SIB#2 contains common radio configuration information and among other things a list (*mbsfn_SubframeConfigList*) with scheduling information for up to 8 MBSFN allocations (*MBSFN-SubframeConfiguration*). Hence, after receiving the SIB#2 each UE, also the MBSFN incapable UEs, are informed about the subframes that are reserved for MBSFN in the downlink.	Subframe Config (SIB Type 2)
2	BCCH > SIB#13 ● *MBSFN-AreaInfoList* ● *MBMS-NotificationConfiguration*	The SIB#13 carries the information necessary to acquire the MBMS control information for up to 8 MBSFN areas (*MBSFN-AreaInfoList*), as well as the common MBMS notification scheduling information (*MBMS-NotificationConfiguration*). After receiving the SIB#13 the MBSFN capable UE is able to find the MBSFN reference signals (*mbsfn-AreaID*) and to detect and demodulate the MCCH (*mcch-Config* and *MBMS-NotificationConfiguration*).	MBSFN-AreaInfoList Parameters MBSFN-Notification-Config Parameters
3	MCCH > *MBSFNAreaConfiguration* ● *PMCH-InfoList* ● *CommonSF-Allocation-PatternList*	The MCCH carries the single message *MBSFNAreaConfiguration* that determines which of the reserved MBSFN subframes (compare SIB#2) belong to which MBSFN area and provides a list with configuration information for up to 15 PMCHs (*PMCH-InfoList*) per an MBSFN area. **Note:** The *MBSFN-SubframeConfiguration* is equivalent to the summary of all *CommonSF-AllocationPatternList*. In this implementation, all MBSFN subframes are assigned to one MBSFN area. Hence, *MBSFN-SubframeConfiguration* equates the *CommonSF-AllocationPatternList* and configuration of the later one is done with the parameters of SIB#2. The *PMCH-InfoList* specifies the individual PMCHs, including MBMS sessions, used MCS, allocated subframes (*sf-AllocEnd*), and the periodicity for providing MCH scheduling information on MAC layer (*mch-SchedulingPeriod*).	Common Subframe Allocation Period PMCH-InfoList Parameters
4	PMCH	The UE receives the PMCHs.	

The illustrations on Figure 7-7 and Figure 7-8 show the signaling of MBSFN information during the acquisition steps.

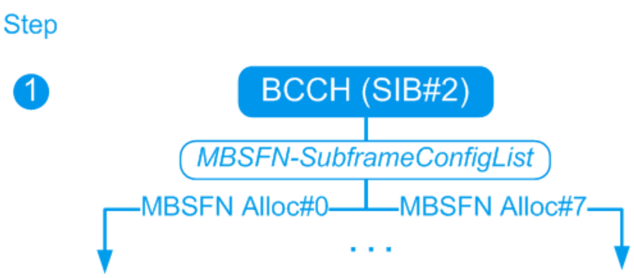


Figure 7-7: MBSFN Signaling (step 1)

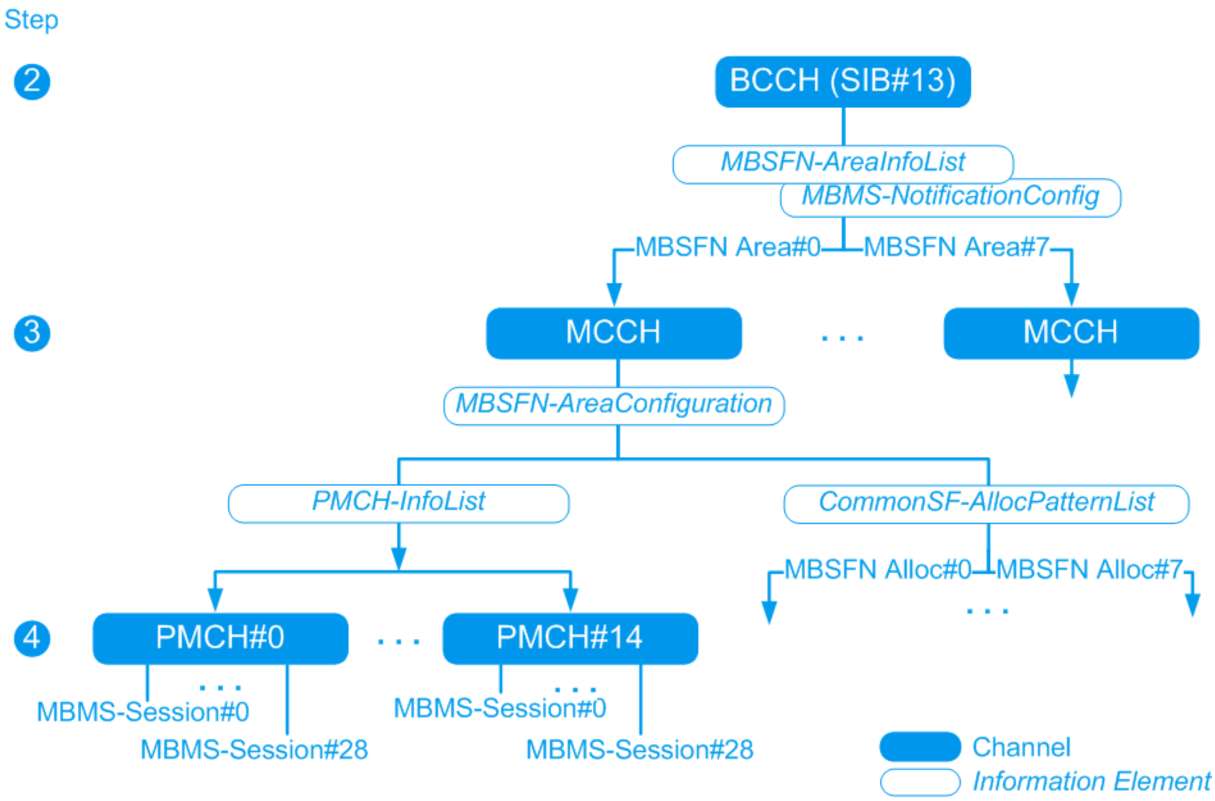


Figure 7-8: MBSFN Signaling (steps 2 to 4)

Example: MBSFN Resource Allocation

This example shows the MBSFN resource allocation for the settings listed in the following table. Use the default values for the other parameters.

ARB Sequence Length

The generation of a signal with cyclically repeating MBSFN pattern requires an "ARB sequence length" equal to the "MCCH repetition period" or to the "MCCH modification period".

The maximum value of the ARB sequence length depends on the selected channel bandwidth and on the memory size option of the generator.

Parameter	Value
EUTRA/LTE > Duplexing	FDD
EUTRA/LTE > Sequence Length	512 Frames
General DL Settings > Channel Bandwidth	1.4 MHz
General DL Settings > MBSFN Mode	Mixed
Radio Frame Allocation Period	8 Frames
Radio Frame Allocation Offset	2 Frames

Parameter	Value
Subframe Allocation Mode	4 Frames
Allocation value (HEX)	AAAAAA
MCCH State	On
MCCH Repetition Period	128 Frames
MCCH Modification Period	512 frames
Notification Repetition Coefficient	2 Frames
Notification Subframe Index	4, i.e. the MCCH change notification on PDCCH is transmitted on subframe#6
Common Subframe Allocation Period	64 Frames, i.e. the PMCH scheduling is repeated after 64 frames
Number of PMCHs	3
PMCH#0: SF Alloc Start/SF Alloc EndSF Alloc End	5
PMCH#0: MCH Scheduling Period	8
PMCH#1: SF Alloc End	7
PMCH#1: MCH Sched. Period	8
PMCH#2: SF Alloc End	95 (automatically calculated)
PMCH#2: MCH Sched. Period	8

See Figure 7-9 for an illustration of the resource allocation.

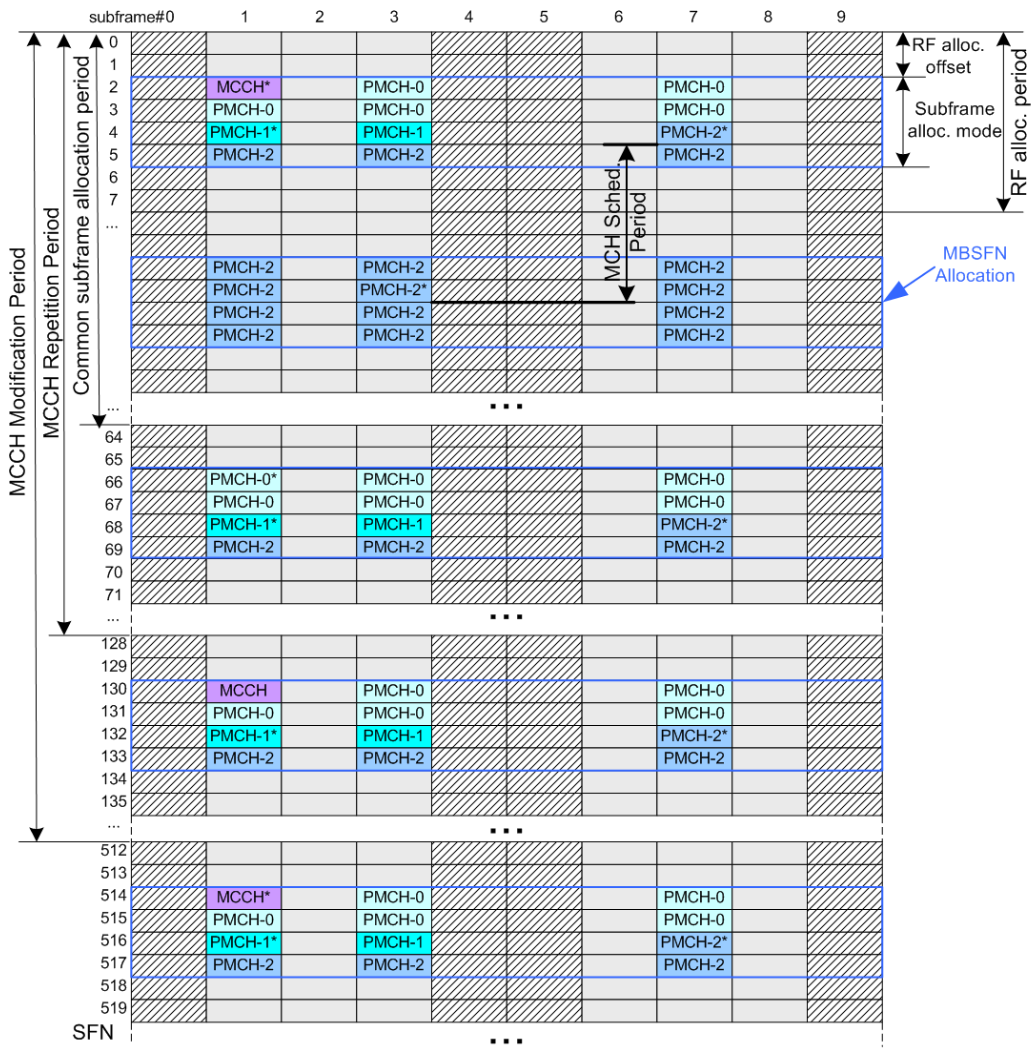


Figure 7-9: Example of MBSFN resource allocation

SFN	= System Frame Number
Pattern subframes	= Subframes not allowed to be scheduled as MBSFN subframes
Grey subframes	= MBSFN subframes not used for MBMS transmission, i.e. regular LTE subframes that can be used for allocation of DL signal
MCCH*	= First MCCH in a new MCCH modification period
PMCH-0*/PMCH-1*/ PMCH-2*	= First PMCH of one MCH scheduling period.

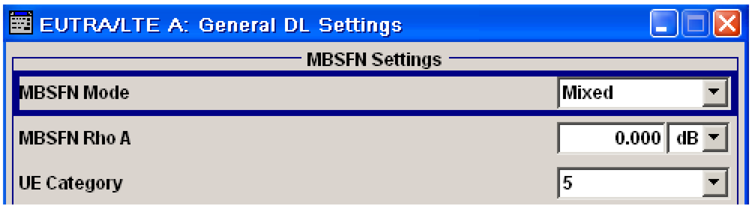
By default, the SFN (System Frame Number) starts with 0. Use the parameter SFN Offset to adjust the start value.

If PRS and MBSFN are configured to be in the same subframe, MBSFN is skipped and PRS is transmitted solely (see Example "Overlapping PDSCH, PRS and MBSFN" on page 137).

To access the MBSFN dialog:

1. Select "General > Link Direction > Downlink (OFDMA)".

2. Select "General DL Settings > MBSFN".
3. Select "MBSFN Mode > Mixed".



This dialog comprises the parameters necessary to configure an MBSFN transmission:

MBSFN Mode

Enables the MBSFN transmission and selects a mixed MBSFN Mode, i.e. the available subframes are shared between MBSFN and regular LTE operation.

Note: Dedicated MBSFN Mode (i.e. all subframes are used for MBSFN solely) will be supported in a later version.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MODE` on page 483

MBSFN Rho A

Defines the power of the MBSFN channels relative to the common Reference Signals.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:RHOA` on page 486

UE Category

Defines the UE category as defined in TS 36.306.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:UEC` on page 487

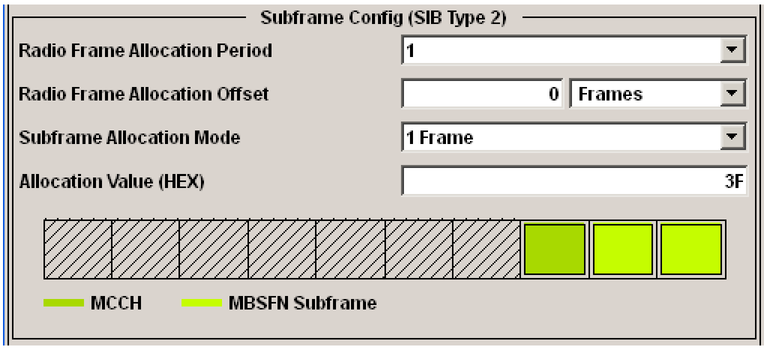
Subframe Config (SIB Type 2)

This section comprises settings for configuration of the general MBSFN structure, i.e. it defines which subframes are used for MBSFN transmission. In the “real” system, these values are transmitted via the System Information Block (SIB) Type 2.

The parameters in this section correspond to the MBMS information element *MBSFN-SubframeConfig*, as defined in TS 36.331.

The graph in this section displays the currently reserved MBSFN subframes. To select a subframe as MBSFN subframe, click on this subframe.

Note: The here described parameters are for configuration of the MBSFN structure only, the coding of the SIB#2 and the SIB#13 is not done automatically.
Also, the content of the MCCH is not generated automatically, but has to be set manually, by selecting the data source.



Radio Frame Allocation Period ← Subframe Config (SIB Type 2)

Radio-frames that contain MBSFN subframes occur when the following equation is satisfied:

```
SFN mod radioFrameAllocationPeriod = radioFrameAllocationOffset
```

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:APER` on page 486

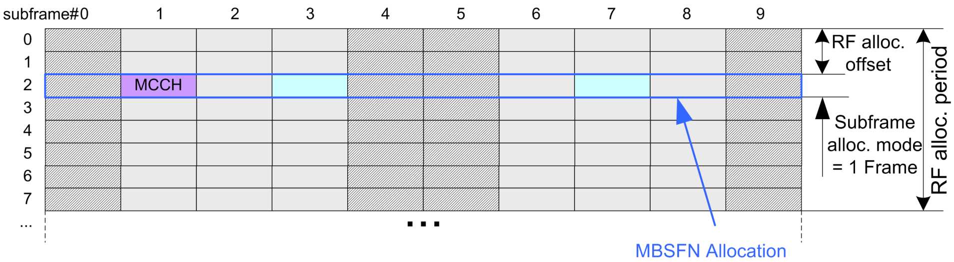
Radio Frame Allocation Offset ← Subframe Config (SIB Type 2)
Radio-frames that contain MBSFN subframes occur when the following equation is satisfied:

`SFN mod radioFrameAllocationPeriod = radioFrameAllocationOffset`

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AOFFset` on page 486

Subframe Allocation Mode ← Subframe Config (SIB Type 2)
Defines whether MBSFN periodic scheduling is 1 or 4 frames.

The figure in Example "MBSFN Resource Allocation" on page 114 shows an MBSFN allocation composed of 4 frames. The following figure displays an MBSFN allocation with "Subframe allocation mode" set to 1 frame.



Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AMODe` on page 486

Allocation value (HEX) ← Subframe Config (SIB Type 2)
Defines which MBSFN subframes are allocated.

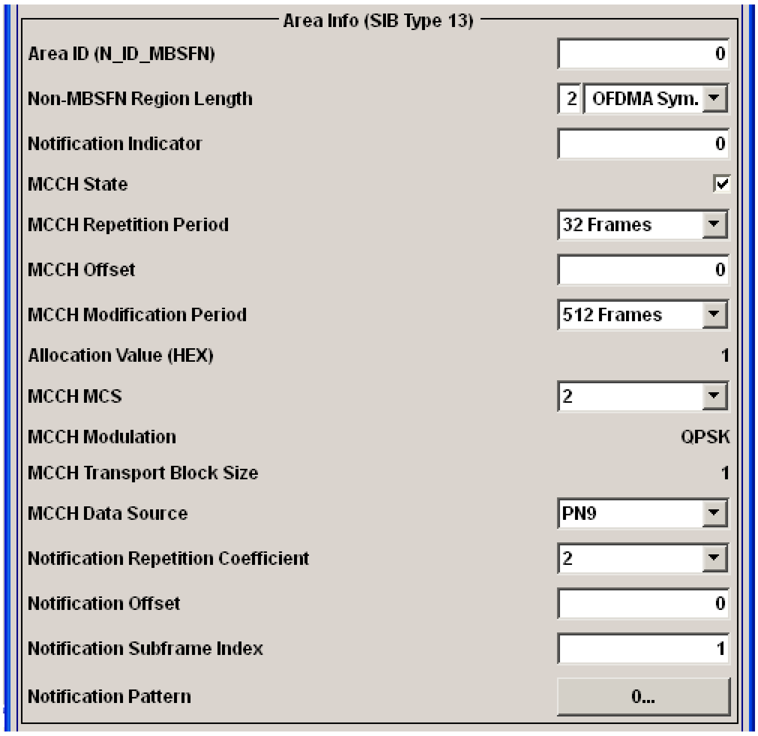
This parameter is identical to the bitmap defined by the field *subframeAllocation* of the MBMS information element *MBSFN-SubframeConfig*.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AVAL` on page 487

Area Info (SIB Type 13)
This section comprises settings for configuration of the general MBSFN area info, i.e. it defines where to find the MCCH. In the “real” system, these values are transmitted via the System Information Block (SIB) Type 13.

The parameters in this section correspond to the MBMS information elements *MBSFN-AreaInfoList* and *MBSFN-NotificationConfig*, as defined in TS 36.331.

Note: The here described parameters are for configuration of the MBSFN structure only, the coding of the SIB#2 and the SIB#13 is not done automatically.
Also the content of the MCCH is not generated automatically, but has to be set manually, by selecting of a data source.



MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
This section comprises the parameters of the MBMS information element *MBSFN-AreaInfoList*.

Area ID (N_ID_MBSFN) ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines the MBSFN area ID, parameter N_{id}^{MBSFN}.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:ID` on page 478

Non-MBSFN Region Length ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines how many symbols from the beginning of the subframe constitute the non-MBSFN region.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:NMRL` on page 482

Notification Indicator ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines which PDCCH bit is used to notify the UE about change of the MCCH applicable for this MBSFN area. Value 0 corresponds to the least significant bit as defined for the DCI Format 1C.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:NIND` on page 482

MCCH State ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Enables/disables the MCCH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:STATe` on page 482

MCCH Repetition Period ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines the interval between transmissions of MCCH information in radio frames.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:RPER` on page 481

MCCH Offset ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Indicates, together with the "MCCH repetition period", the radio frames in which MCCH is scheduled. MCCH is scheduled in radio frames for which:

SFN mod "MCCH repetition period" = "MCCH offset"

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:OFFS` on page 481

MCCH Modification Period ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines periodically appearing boundaries, i.e. radio frames for which the following equation is fulfilled:

SFN mod "MCCH modification period" = 0

The contents of different transmissions of MCCH information can only be different if there is at least one such boundary in-between them.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MPER` on page 479

Allocation Value (HEX) ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Indicates the subframes of the radio frames indicated by the "MCCH repetition period" and the "MCCH offset", that may carry MCCH.

Note: In the current implementation, the MCCH is always mapped to the first active MBSFN subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:AVAL?` on page 478

MCCH MCS ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines the Modulation and Coding Scheme (MCS) applicable for the subframes indicated by the "MCCH Allocation value" and for the first subframe of each MCH scheduling period (which may contain the MCH scheduling information provided by MAC).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MCS` on page 479

MCCH Modulation ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Displays the values as determined by the "MCCH MCS".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MODulation? on page 479

MCCH Transport Block Size ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Displays the values as determined by the "MCCH MCS".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:TBSize? on page 482

MCCH Data Source ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Sets the data source used for the MCCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:DATA on page 478
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:DLISt on page 478
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:PATTern on page 481

MBSFN-NotificationConfig Parameters ← Area Info (SIB Type 13)
This section comprises the parameters of the MBMS information element *MBSFN-NotificationConfig*.

Notification Repetition Coefficient ← MBSFN-NotificationConfig Parameters ← Area Info (SIB Type 13)
Selects the current change notification repetition period common for all MCCHs that are configured. The notification repetition period is calculated as follows:

change notification repetition period = shortest modification period/ "Notification repetition coefficient"

Where the *shortest modification period* corresponds with the value of the selected "MCCH modification period".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NRC on page 480

Notification Offset ← MBSFN-NotificationConfig Parameters ← Area Info (SIB Type 13)
Defines, together with the "Notification Repetition Coefficient", the radio frames in which the MCCH information change notification is scheduled, i.e. the MCCH information change notification is scheduled in radio frames for which:

SFN mod notification repetition period = "Notification offset"

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NOFFset on page 480

Notification Subframe Index ← MBSFN-NotificationConfig Parameters ← Area Info (SIB Type 13)
Defines the subframe used to transmit MCCH change notifications on PDCCH.

In FDD: Value 1, 2, 3, 4, 5 and 6 correspond with subframe #1, #2, #3, #6, #7 and #8 respectively

In TDD: Value 1, 2, 3, 4 and 5 correspond with subframe #3, #4, #7, #8 and #9respectively

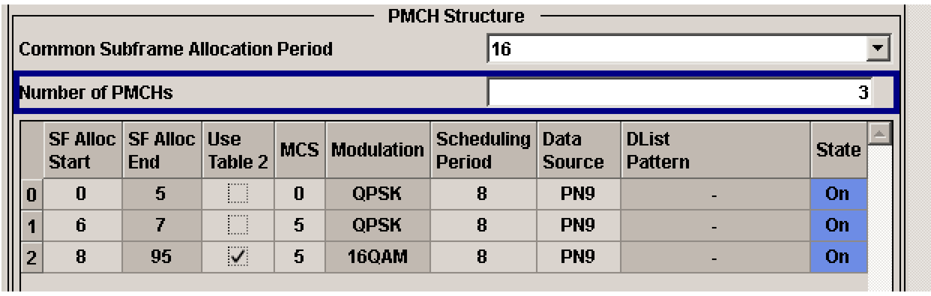
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NSI` on page 480

Notification Pattern ← MBSFN-NotificationConfig Parameters ← Area Info (SIB Type 13)
Sets the pattern for the notification bits sent on PDCCH DCI format 1c.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NPATtern` on page 480

PMCH Structure
This section comprises settings for configuration of the PMCH structure, i.e. where to find a PMCH carrying a certain MTCH. In the “real” system, these values are transmitted via the MCCH (*MBSFNAreaConfiguration*).

The parameters in this section correspond to the MBMS information elements *MBSFNAreaConfiguration* and *PMCH-InfoList*, as defined in TS 36.331.



Common Subframe Allocation Period ← PMCH Structure
Defines the period during which resources corresponding with field *commonSF-Alloc* are divided between the (P)MCHs that are configured for this MBSFN area.

The subframe allocation patterns, as defined by *commonSF-Alloc*, repeat continuously during this period.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MTCH:CSAP` on page 483

PMCH-InfoList Parameters ← PMCH Structure
Comprises the parameters of the *PMCH-InfoList*.

Number of PMCHs ← PMCH-InfoList Parameters ← PMCH Structure
Defines the number of PMCHs in this MBSFN area.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MTCH:NPMChs` on page 483

SF Alloc Start/SF Alloc End ← PMCH-InfoList Parameters ← PMCH Structure
Defines the first/last subframe allocated to this (P)MCH within a period identified by field *commonSF-Alloc*.

The subframes allocated to (P)MCH corresponding with the nth entry in *pmch-InfoList* are the subsequent subframes starting from either the subframe identified by "SF Alloc End" of the (–1)th listed (P)MCH or, for n=1, the first subframe, through the subframe identified by "SF Alloc End" of the nth listed (P)MCH. Value 0 corresponds with the first subframe defined by field *commonSF-Alloc*.

Note: Configuring the MCHs ("SF Allocation Start" values) from bottom to top. Although the 3GPP specification defines the "SF Alloc End" parameter as the only one required, in this implementation it is mandatory to define the "SF Alloc Start" instead. The implemented algorithm uses the selected "SF Alloc Start" and calculates automatically the "SF Alloc End" of the corresponding MCH. The algorithm applies the internal rule, that there is no gap between two consequent MCHs.

It is therefore recommended to configure the MCHs, i.e. define the "SF Alloc Start" values, from bottom to the top. This workaround prevents the configuration of overlapping MCHs.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SASTart` on page 485

`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SAENd` on page 485

MCS ← PMCH-InfoList Parameters ← PMCH Structure

Defines the value for parameter according to TS 36.213 Table 7.1.7.1-1 or Table 7.1.7.1-1A, which defines the Modulation and Coding Scheme (MCS) applicable for the subframes of this (P)MCH as indicated by the field *commonSF-Alloc*. The MCS does however neither apply to the subframes that may carry MCCH, i.e. the subframes indicated by the field *sf-AllocInfo* within System Information Block Type 13, nor for the first subframe of each MCH scheduling period (which may contain the MCH scheduling information provided by the MAC).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:MCS` on page 484

Modulation ← PMCH-InfoList Parameters ← PMCH Structure

Indicates the used modulation, as defined with:

- MCS

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:MOD?` on page 485

MCH Scheduling Period ← PMCH-InfoList Parameters ← PMCH Structure

Defines the MCH scheduling period, i.e. the periodicity used for providing MCH scheduling information at lower layers (MAC) applicable for an MCH.

Note: The first subframe of the scheduling period may contain the MAC control element and therefore uses MCS of MCCH (however, the data source from PMCH is still used).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SPERiod` on page 485

Data Source ← PMCH-InfoList Parameters ← PMCH Structure

Sets the data source for this PMCH/MTCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:DATA on page 484
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:DLISt on page 484
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:PATTern on page 484

State ← PMCH-InfoList Parameters ← PMCH Structure
Enables/disables the selected PMCH/MTCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:STATe on page 483

7.4.3 Physical Settings

In the "Physical Settings" section, the channel bandwidth respectively the number of resource blocks per slot is selected. The other parameters are fixed and read-only.

Channel Bandwidth
Sets the channel bandwidth of the EUTRA/LTE system.

Although the 3GPP specification bases on bandwidth agonistic layer 1 and channel bandwidth is determined by specifying the desired number of resource blocks, the current EUTRA standardization focuses on six bandwidths (1.4, 3, 5, 10, 15 and 20 MHz).

For backward compatibility with previous version of this software, this parameter allows the flexibility to choose, whether a user defined bandwidth or one of the pre-defined channel bandwidths is used.

If a pre-defined channel bandwidth is selected; the actual "Number of Resource Blocks Per Slot" is internally calculated for the selected "Channel Bandwidth" and "Physical Resource Block Bandwidth".

The sampling rate, occupied bandwidth and FFT size are therefore determined by the parameter "Number of Resource Blocks Per Slot". If required, the FFT Size can be adjusted.

See also Table 4-1 for an overview of this cross-reference between the parameters.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:BW on page 446

Physical Resource Block Bandwidth
Displays the bandwidth of one physical resource block.

Note: In this release, this value is fixed to 12 x 15 kHz.

Remote command:
n.a.

Number of Resource Blocks Per Slot
This parameter determines the channel bandwidth.

If the parameter "Channel Bandwidth" is set to one of the pre-defined channel bandwidths (1.4, 3, 5, 10, 15 or 20 MHz), the value "Number of Resource Blocks Per Slot" is read only and is automatically set according to the selected channel bandwidth and "Physical Resource Block Bandwidth".

If a user defined channel bandwidth is selected, the parameters "Number of Resource Blocks Per Slot" and "Physical Resource Blocks Bandwidth" determine the actual channel bandwidth.

However, the sampling rate and the occupied bandwidth are determined by the parameter "Number of Resource Blocks Per Slot". If required, the FFT Size can be adjusted.

See also Table 4-1 for an overview of this cross-reference between the parameters.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NORB` on page 446

FFT Size
Sets the FFT (Fast Fourier Transformation) size.

The FFT size can be freely selected for all bandwidth definitions under the following constrains:

- For a specific bandwidth, all FFT sizes are applicable as long as the size is greater than the number of occupied subcarriers.
  By default, the smallest available FFT size is selected.
- To decrease the number of unused guard subcarriers and the resulting sampling rate, for channel bandwidth of 15 MHz a DFT size of 1536 is provided along with the default FFT size of 2048.

See also Table 4-1 for an overview of the cross-reference between the parameter and the available FFT sizes.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:FFT` on page 447

Occupied Bandwidth
Displays the occupied bandwidth. The value is automatically set according to the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:OCCBandwidth?` on page 447

Sampling Rate
Displays the sampling rate. The value is automatically set according to the parameter "Number of Resource Blocks Per Slot."

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:SRATe?` on page 447

Number Of Occupied Subcarriers
Displays the number of occupied subcarriers. The value is automatically set according to the parameter "Number of Resource Blocks Per Slot".

See also Table 4-1 for an overview of this cross-reference between the parameters.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:OCCSubcarriers?` on page 447

Number Of Left Guard Subcarriers
Displays the number of left guard subcarriers. This value is set automatically according to the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:LGS?` on page 448

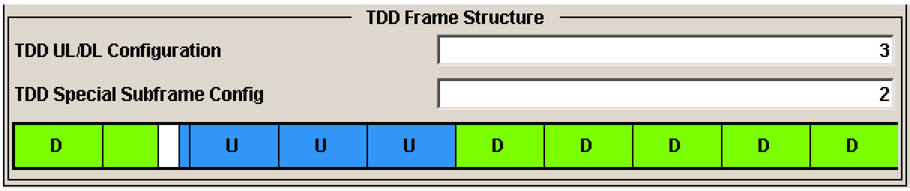
Number Of Right Guard Subcarriers
Displays the number of right guard subcarriers. This value is set automatically according to the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:RGS?` on page 448

7.4.4 TDD Frame Structure Settings

Access:

► Select "EUTRA/LTE > Duplexing > TDD".



The TDD frame is configured by adjusting the UL/DL configuration and the special subframe configuration (see also Chapter 3.1.1, "OFDMA Parameterization", on page 18).

TDD UL/DL Configuration
Sets the Uplink-Downlink Configuration number, i.e. defines which subframe is used for downlink respectively uplink, and where the special subframes are located.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TDD:UDConf` on page 441

TDD Special Subframe Config
Sets the Special Subframe Configuration number, i.e. together with the parameter Cyclic Prefix defines the lengths of the DwPTS, the Guard Period and the UpPTS.

The DwPTS length selected with this parameter determines the maximum number of the OFDM symbols available for PDSCH in the special subframe.

The UpPTS length selected with this parameter determines the maximum number of the SC-FDMA symbols available for SRS in the special subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TDD:SPSConf` on page 441

7.4.5 PDSCH Scheduling Settings

In the R&S Signal Generator, there are different approaches to configure and schedule the different PDSCH allocations:

- Manually and with full flexibility ("Manual")
  This is the default scheduling mode and the mode with full flexibility; you can configure any of the available settings.
  There is no cross-reference between the settings made for the PDCCH DCIs and the PDSCHs settings. The configuration is performed on a subframe basis and you are responsible for the content of the PDSCH allocations.
- According to the configuration made for the DCIs ("Auto/DCI")
  This is the mode supporting you to configure the precoding settings for spatial multiplexing according to TS 36.211.
  This mode assures a 3GPP compliant EUTRA/LTE signal and the PDSCH allocations are configured automatically according to the configuration of the PDCCH DCIs.
  There are however limitations in the configuration flexibility, especially regarding the power setting, see "Limitations and interdependencies in the "Auto/DCI" and "Auto Sequence" modes" on page 128.
  See also "Switching between "Auto/DCI" and "Manual" modes" on page 129.
- Creating signals from a sequence perspective ("Auto Sequence")
  This is a mode that extends the advantages of the "Auto/DCI" mode and supports you to configure:
  - the required HARQ processes and redundancy versions, without the time-consuming settings adjustment on a subframe basis
  - HARQ patterns that are longer than 40 subframes

  The sequence configuration has to be performed once per User; all related parameters are calculated automatically.
  See Chapter 7.5.3, "Auto Sequence Configuration", on page 148.

Limitations and interdependencies in the "Auto/DCI" and "Auto Sequence" modes

The generation of a compliant signal requires some limitations in the configuration flexibility, especially regarding the power setting:

- The value of the parameter Reference Signal Power is fixed to 0dB.
- The PDSCH Rho A of each allocation belonging to a user is set as configured with the parameter P_A for the corresponding user in the "Configure User" dialog.
- All four users are activated with enabled Scrambling and Channel Coding.
- Not all combinations of DCI Table, Users and UE_ID/n_RNTI are allowed, see Table 7-9.

Table 7-9: DCI Formats dependencies

User	UE ID/n_RNTI	DCI Format
User 1 .. 4	As defined for the corresponding user	0,1,1a,1b,1d,2,2a,2c,3,3a
P-RNTI	65534	1a,1c
SI-RNTI	65535	
RA-RNTI	As defined with the parameter RA_RNTI in the "General DL Setting" dialog	

Switching between "Auto/DCI" and "Manual" modes

Switching from "Auto/DCI" mode to "Manual" mode enables all parameters in the DL allocation table for configuration without to change their values.

Switching from "Manual" to "Auto/DCI" mode, however, triggers a reset of the subframe configuration prior to reconfiguration of the PDSCH allocations according to the settings made for the PDCCH DCIs, that is the settings made in the DL allocation table are lost.

How to access the settings

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Scheduling".

   In the "Scheduling" section, you define whether the PDSCH Scheduling is performed manually, according to the configuration made for the DCIs or according to the required HARQ processes and redundancy versions.

SCPI command:

`[:SOURce<hw>]:BB:EUTRa:DL:CONF:MODE` on page 443

7.4.6 MIMO

In the MIMO section, the MIMO configuration and the simulated antennas are defined.

Provided are the following settings:

Global MIMO Configuration
Determines the number of transmit antennas of the simulated EUTRA/LTE system. Depending on this parameter, the Downlink Reference Signal Structure is set accordingly (see also Figure 3-10).

Note: One baseband simulates one antenna.

"1 TxAntenna" Enables single antenna port transmission.

"2 TxAntennas/4 TxAntennas"
Enables a multiple antenna transmission. The transmission mode, transmit diversity or spatial multiplexing, is determined per allocation with the parameter Precoding Scheme.

"SISO + BF" This mode combines the 1 transmit antenna Single Input Single Output (SISO) transmission with beamforming (BF).
Beamforming is a method to increase the SNR of the signal received by the UE. In this mode, beamforming is implemented as a single layer PDSCH which is mapped to the different antennas with individual phase offsets. To simplify the configuration and to fulfill the requirements as specified in TS 36.101, Annex A, the same precoding vector as in a MIMO case can be used.

Note: While generating signal in this mode, the antennas simulated by path A and Path B are **not** MIMO antennas. The signal at the output of both paths is the same SISO signal with the same **cell-specific reference signals**.
To enable the instrument to generate a **transmission using antenna port 5** signal (transmission corresponding to the UE-specific reference signal) as defined in the 3GPP specification, set the parameter Precoding Scheme to "Beamforming (UE-spec.RS)".

In this case, the generated signal carries a combination of common signal part (PBCH, PDCCH, cell-specific RS,...), which is identical on all antennas, and UE-specific PDSCH, which is different on the antennas due to the applied precoding.

Note that, although the generation of a beamformed signal requires more than one antenna, for the UE it appears as a SISO signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration` on page 443

Simulated Antenna

Determines the simulated antenna in case the Global MIMO Configuration is set to 1 TX Antenna.

The configuration of the Downlink Reference Signal structure is set accordingly (see Figure 3-10).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:ANTenna` on page 443

Simulated Antenna Path A

Determines the simulated antenna for path A. The configuration of the Downlink Reference Signal Structure is set accordingly (see also Figure 3-10).

The possible values of this parameter depend on the setting of the parameter Global MIMO Configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:ANTenna` on page 443

Simulated Antenna Path B

(Available for two-path instruments only)

Determines the simulated antenna for path B.

Note: For two path instruments, setting the parameter "Simulated Antenna Path B" to any values but "None", enables LTE signal simulation for path B and will disable all other digital standards and digital modulation modes in this path.

Enabling path B to simulate an antenna automatically couples path A and path B, i.e. path B is controlled via path A. The signal generated by path B has identical parameters with the settings made for path A and the downlink reference signal's parameters "First Reference Signal Position", "Subcarrier Offset" and "Use Second Reference Signal" are set accordingly.

The configuration of the Downlink Reference Signal Structure is set accordingly (see also Figure 3-10).

The possible values of this parameter depend on the setting of the parameter Global MIMO Configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:ANTB` on page 444

Antenna Port Mapping
(enabled for instruments equipped with R&S SMx/AMU-K84)

Accesses the Cell-Specific Antenna Port Mapping settings for defining the mapping of the logical antenna ports to the available physical Tx antennas.

7.4.7 Cell-Specific Settings

In the "Cell-Specific Settings" section, the physical layer cell identity settings and the DL power control settings are configured.

Cell ID
Sets the cell identity.

There are 504 unique physical layer cell identities (Cell ID), grouped into 168 unique physical cell identity groups that contain three unique identities each. The Cell ID is calculated as following:

Cell ID = 3*Physical Cell ID Group + Physical Layer ID

There is a cross-reference between the values of these three parameters and changing of one of them results in adjustment in the values of the others.

The Cell ID determinates:
- The downlink reference signal pseudo-random sequence
- The frequency shifts of the reference signal
- The S-SYNC sequence

- The cyclic shifts for PCFICH, PHICH and PDCCH mapping
- The pseudo-random sequence used for scrambling

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CID` on page 448

Physical Cell ID Group
Sets the physical cell identity group.

To configure these identities within a cell ID group, set the parameter Physical Layer ID.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CIDGroup` on page 449

Physical Layer ID
Sets the identity of the physical layer within the selected physical cell identity group, set with parameter Physical Cell ID Group .

The Physical Layer ID determinates the Zadoff-Chu orthogonal sequence carried by the P-SYNC and used for cell search.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:PLID` on page 449

Cyclic Prefix (General DL Settings)
Sets the cyclic prefix length for all subframes.

The number of the OFDM symbols is set automatically.

"Normal"	Normal cyclic prefix, i.e. the DL slot contains 7 OFDM symbols.
"Extended"	Extended cyclic prefix, i.e. the DL slot contains 6 OFDM symbols. The extended cyclic prefix is defined to cover large cell scenarios with higher delay spread and MBMS transmission.
"User Defined"	The cyclic prefix length can vary over the subframes. The cyclic prefix length is set per subframe in the DL Frame Configuration menu with the parameter Cyclic Prefix.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CPC` on page 450

UL/DL Cyclic Prefix
In "Duplexing > TDD", determines the cyclic prefix for the appropriate opposite direction.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:DLCPc` on page 460
`[:SOURce<hw>]:BB:EUTRa:DL:ULCPc` on page 450

PDSCH P_B
Sets the parameter PDSCH P_B and defines the cell-specific ratio rho_B/rho_A according to 3GPP TS 36.213, Table 5.2-1.

The following table gives an overview of the resulting values of the parameter PBCH Ratio rho_B/rho_A as function of the values for the parameter PDSCH P_B and the number of configured antennas.

PDSCH P_B	1 Tx antenna	2 or 4 Tx antennas
0	0.000 dB	0.969 dB
1	-0.969 dB	0.000 dB
2	-2.218 dB	-1.249 dB
3	-3.979 dB	- 3.010 dB

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:PB` on page 451

PDSCH Ratio rho_B/rho_A
Displays the transmit energy ratio among the resource elements allocated for PDSCH in the OFDM symbols containing reference signal (P_B) and such not containing one (P_A).

The value displayed is determined by the parameter PDSCH P_B and additionally depends on the number of configured antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:RATBa` on page 451

PDCCH Ratio rho_B/rho_A
Sets the transmit energy ratio among the resource elements allocated for PDCCH in the OFDM symbols containing reference signal (P_B) and such not containing one (P_A).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PDCCh:RATBa` on page 451

PBCH Ratio rho_B/rho_A
Sets the transmit energy ratio among the resource elements allocated for PBCH in the OFDM symbols containing reference signal (P_B) and such not containing one (P_A).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PBCH:RATBa` on page 450

PHICH Duration
Sets the PHICH duration, i.e. the allocation of the PHICH resource element groups over the OFDM symbols.

The value selected puts the lower limit of the size of the PCFICH Settings that is signaled by the PCFICH.

"Normal" All resources element groups of PHICH (see Number of PHICH Groups) are allocated on the first OFDM symbol (OFDM Symbol 0).

"Extended" The resources element groups of PHICH are distributed over three OFDM symbols for a normal subframe or over two symbols within a special one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PHICh:DURation` on page 452

PHICH N_g

Sets the parameter N_g according to 3GPP TS 36.211, section 6.9.

"1/6, ½, 1, 2" The actual Number of PHICH Groups for the different subframes is calculated according to the following formula:

$$N_{PHICH}^{group} = \begin{cases} \left\lceil N_g (N_{RB}^{DL}/8) \right\rceil & \text{for normal cyclic prefix} \\ 2 \cdot \left\lceil N_g (N_{RB}^{DL}/8) \right\rceil & \text{for extended cyclic prefix} \end{cases}$$

In FDD mode, the calculated value corresponds directly to the parameter "Number of PHICH Groups".

In TDD mode however, the resulting value for the parameter Number of PHICH Groups is the value calculated according to the formula above, additionally multiplied with a coefficient selected from the following table.

UL/DL	**Subframe number**									
Configuration	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	2	1	-	-	-	2	1	-	-	-
1	0	1	-	-	1	0	1	-	-	1
2	0	0	-	1	0	0	0	-	1	0
3	1	0	-	-	-	0	0	0	1	1
4	0	0	-	-	0	0	0	0	1	1
5	0	0	-	0	0	0	0	0	1	0
6	1	1	-	-	-	1	1	-	-	1

The parameter "Number of PHICH Groups" is read-only.

"Custom" Enables the selection of user-defined value for the parameter "Number of PHICH Groups".

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:PHICh:NGParameter` on page 452

RA_RNTI

Sets the random-access response identity RA-RNTI.

The value selected here determined the value of the parameter UE_ID/n_RNTI in case a RA_RNTI "User" is selected.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:CSETtings:RARNti` on page 449

7.4.8 Downlink Reference Signal Structure

In the "Downlink Reference Signal Structure" section, the power of the reference signals is set.

For an overview of the provided power settings and detailed information on how to adjust them, refer to Chapter 5.3, "Power Setting", on page 65.

Reference Signal Power

Sets the power of the reference signal (PRS relative).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:REFSig:POWer` on page 445

RS Power per RE relative to Level Display

Displays the power of the reference signal (RS) per resource element (RE) relative to the power value, displayed in the Level display in the header of the instrument.

Note: The displayed value is actualized only if the EUTRA/LTE signal generation is enabled (State = On).

If a MIMO configuration is enabled, the value of this parameter is equal for all antennas; this applies also for the antenna configured in the path B.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:REFSig:EPRE?` on page 445

7.4.9 Synchronization Signal Settings

In the "Synchronization Signal Settings" section, the power of the P-SYNC/S-SYNC is set.

P-/S-SYNC Tx Antenna

Defines on which antenna port the P-/S-SYNC is transmitted.

The available values depend on the number of configured antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:SYNC:TXANtenna` on page 445

P-SYNC Power

Sets the power of the P-SYNC allocations.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:SYNC:PPOWer` on page 445

S-SYNC Power

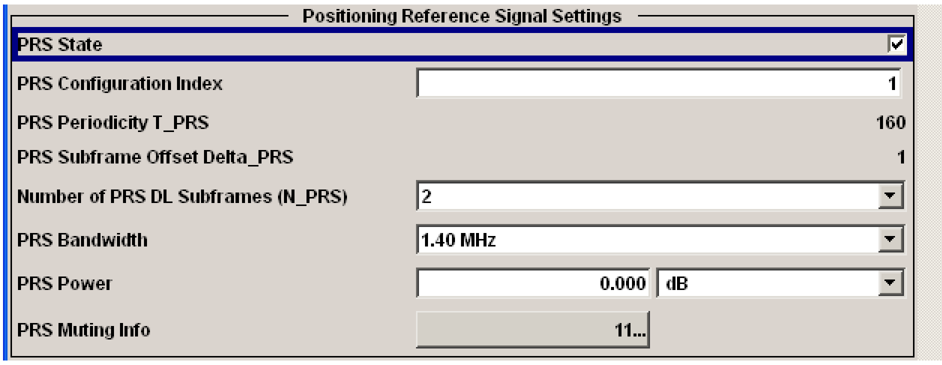
Sets the power of the S-SYNC allocations.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:SYNC:SPOWer` on page 446

7.4.10 Positioning Reference Signal (PRS) Settings

Configuration of the PRSs requires option R&S SMx/AMU-K84.

1. To access this dialog select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Positioning Reference Signal Settings".



This section comprises the setting necessary to configure the positioning reference signals (PRS). See also Chapter 3.1.5.5, "Positioning reference signals", on page 29.

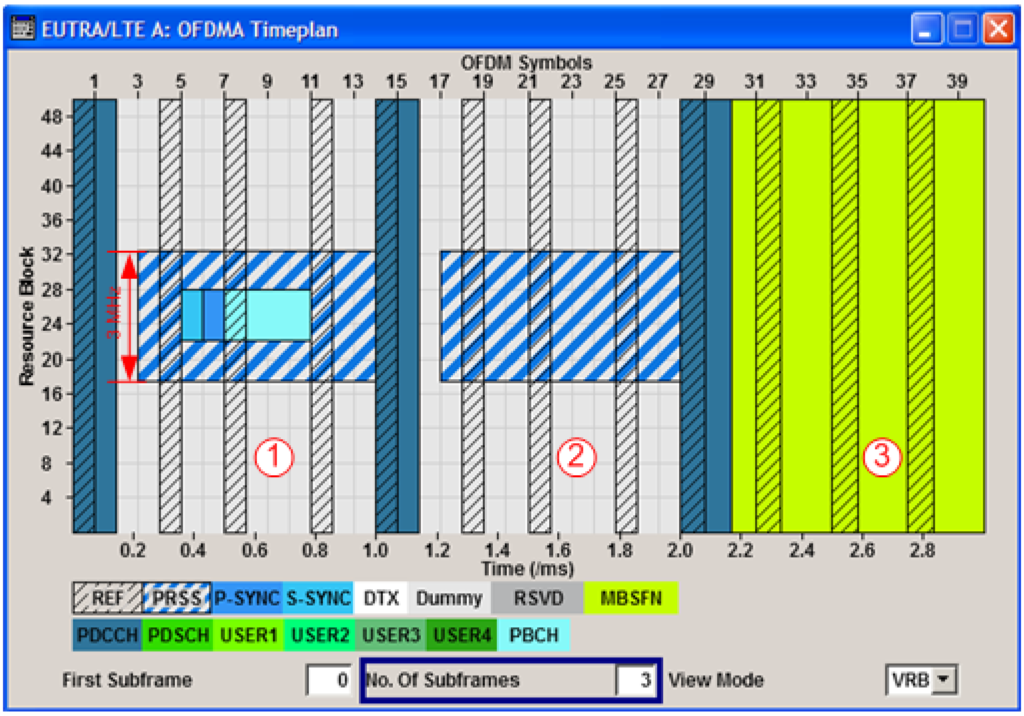
If PRS and MBSFN are configured to be in the same subframe, MBSFN is skipped and PRS is transmitted solely.

If a PDSCH is configured to overlap partially with the PRS bandwidth in a PRS sub-frame, the PRS in these resource blocks is skipped then.

Example: Overlapping PDSCH, PRS and MBSFN

Perform the following settings:

- PRS State = ON
- PRS Configuration Index = 0
- Number of PRS DL Subframes (N_PRS) = 2
- PRS Bandwidth = 3 MHz
- MBSFN Mode = Mixed
- Use the OFDMA Timeplan to visualize the allocation of the PRSs.



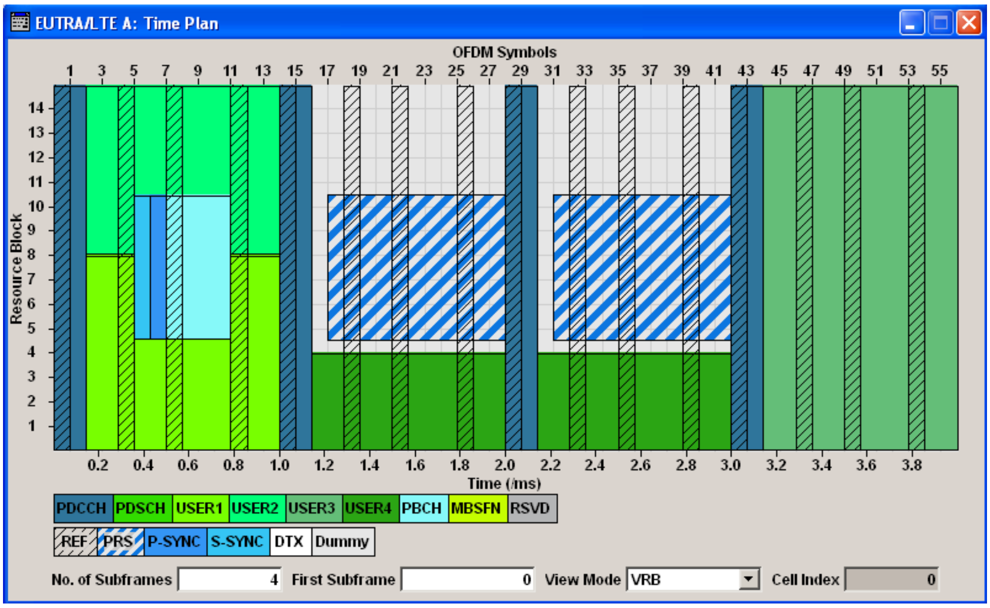
1 = PDSCH and PRS are overlapping in the subframe#0
2 = MBSFN is ignored in subframe#1
1+2 = two consequent PRS subframes with 3 MHz Bandwidth, i.e. one PRS occasion
3 = first MBSFN subframe

Example: How to visualize the effect of muting and omitting PRS transmission

Perform the following settings:

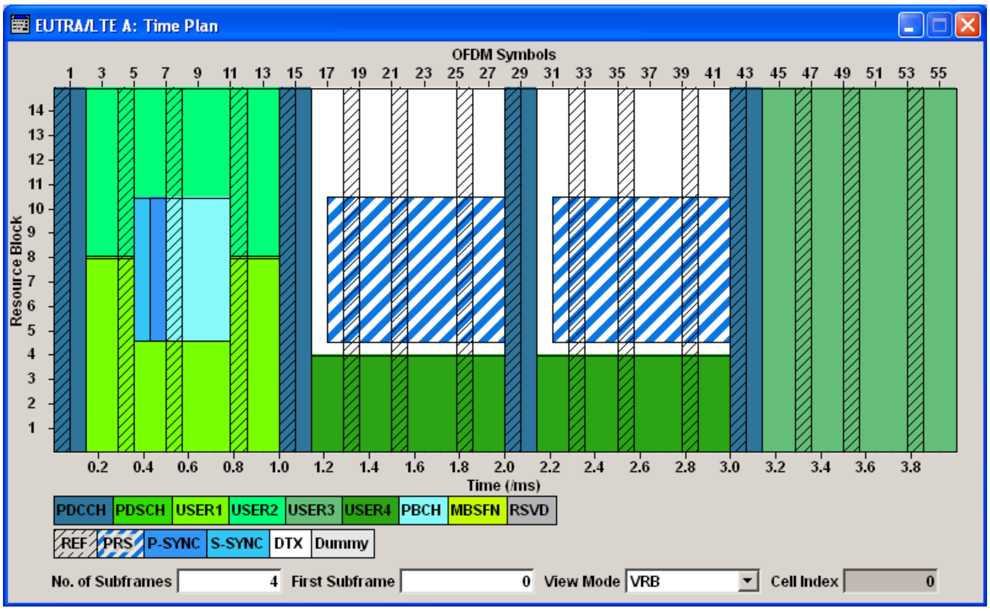
- Select "EUTRA/LTE > General DL Settings > Physical > Channel Bandwidth = 3 MHz"
- Select "EUTRA/LTE > DL Frame Configuration > Subframe Config" and configure the subframes.
- Select "EUTRA/LTE > General DL Settings > PRS", use the default settings, and enable the following:
  – "PRS Configuration Index = 1"
  – "Number of PRS DL Subframes (N_PRS) = 2"
  – "PRS State > On"

- Select "EUTRA/LTE > DL Frame Configuration" and open the OFDMA Timeplan to visualize the configured allocations.



The time plan confirms the transmission of one PRS occasion, consisting of two consequent PRS subframes with 1.4 MHz bandwidth, transmitted in subframe#1 and subframe#2.

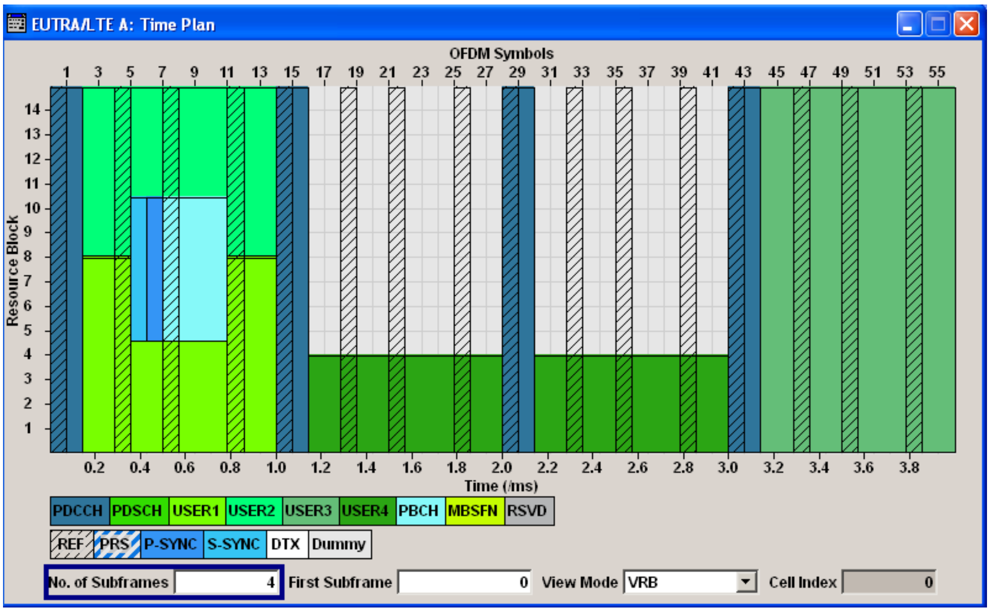
- Select "EUTRA/LTE > DL Frame Configuration > Behavior in Unsch. RE (OCGN) > Dummy Data"
- Select "EUTRA/LTE > DL Frame Configuration > Dummy Data Configuration > Omit PRS Subframes"
- Observe the allocations displayed on the time plan.



The time plan confirms that the PRS subframes are *not* filled in with DTX.

- Select "EUTRA/LTE > General DL Settings > PRS" and set "PRS Muting Info = 01"

- Observe the allocations displayed on the time plan.



The time plan confirms that the PRS is muted; there is no transmission of PRS in the subframe#1 and subframe#2. The muted PRS subframes are not omitted; the allocation-free resource blocks in these subframes are filled with DTX.

PRS State

Enables the generation of the PRS.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe` on page 454

PRS Configuration Index

Sets the PRS Configuration Index I_{PRS} as defined in 3GPP TS 36.211, table 6.10.4.3-1.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:CI` on page 453

PRS Periodicity T_PRS

Displays the periodicity of the PRS generation (T_{PRS}) as defined in 3GPP TS 36.211, table 6.10.4.3-1.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:TPRS?` on page 454

PRS Subframe offset Delta_PRS

Displays the subframe offset of the PRS generation ($Delta_{PRS}$) as defined in 3GPP TS 36.211, table 6.10.4.3-1.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:DPRS?` on page 453

Number of PRS DL Subframes (N_PRS)

Defines the number of consecutive DL subframes in that PRS are transmitted. Several consecutive DL subframes build one PRS occasion.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:NPRS` on page 453

PRS Bandwidth

Defines the RBs in which the PRS is transmitted.

Note: The PRS Bandwidth must not be bigger than channel bandwidth.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:BW` on page 452

PRS Power

Sets the power of a PRS resource element relative to the power of a common reference signal resource element.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:POW` on page 454

PRS Muting Info

Specifies a bit pattern that defines the muted and not muted PRS. The bit pattern can be 2, 4, 8 or 16 bit long, where each bit defines the PRS state of one PRS occasion. The parameter Number of PRS DL Subframes (N_PRS) defines the length of the PRS occasions.

See Example "How to visualize the effect of muting and omitting PRS transmission" on page 137

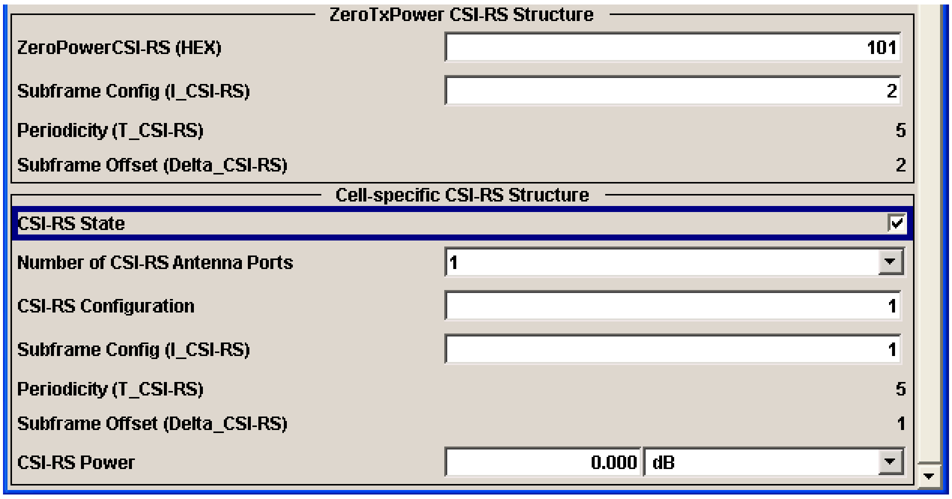
"0"	PRS is muted in the corresponding PRS occasion.
"1"	PRS is not muted, i.e. PRS is transmitted in the corresponding PRS occasion.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:MIPattern` on page 455

7.4.11 CSI Settings

To access this dialog:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > CSI-RS Structure".



This dialog comprises the settings for configuring the channel-state information reference signal (CSI-RS) structure. For detailed information, see Chapter 3.1.5.6, "CSI reference signals", on page 30.

The TS 36.211 specifies the occurrence of the CSI reference signal in the subframes as function of the subframe configuration period T_{CSI-RS} and the subframe offset $Delta_{CSI-RS}$. The available value ranges are listed in Table 7-10, TS 36.211. The parameter I_{CSI-RS} can be configured separately for the zero () and non-zero transmission power ("Cell-specific CSI-RS Structure" on page 143) cases.

Table 7-10: CSI reference signal structure configuration

CSI-RS subframe configuration I_{CSI-RS}	CSI-RS periodicity T_{CSI-RS} (subframes)	CSI-RS subframe offset $Delta_{CSI-RS}$ (subframes)
0 - 4	5	I_{CSI-RS}
5 - 14	10	I_{CSI-RS} - 5
15 - 34	20	I_{CSI-RS} - 15
35 - 74	40	I_{CSI-RS} - 35
75 - 154	80	I_{CSI-RS} - 75

How to enable and visualize a CSI-RS transmission

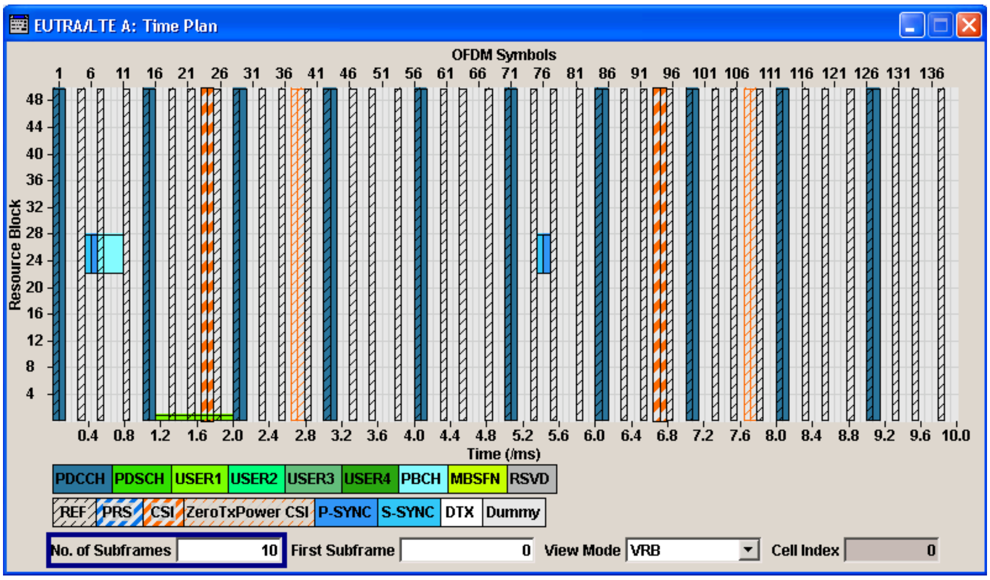
1. Select "EUTRA/LTE > Link Direction > Downlink (OFDMA)".
2. Select "EUTRA/LTE > State > On".
3. Select "EUTRA/LTE > General Downlink Settings".
4. In the "General Downlink Settings", select "CSI" and configure the settings as required.
   For example, enable the settings displayed in the figure above.
5. Enable "Cell-specific CSI-RS Structure > Subframe Config (I_CSI-RS) = 1".

6. Select "Cell-specific CSI-RS Structure > CSI-RS State > On" and close the dialog.
7. Select "EUTRA/LTE > Frame Configuration".
8. Select "Frame Configuration > Subframe = 1" to configure the subframe selected for the CSI-RS transmission.
9. Set "No. of Used Allocations = 2".

   The allocation table displays the activated PDSCH allocation with the corresponding number of used "Phys. Bits".
10. In the allocation table, for this PDSCH allocation, select "Ench. Settings > Config".
11. In the "Enhanced Settings" dialog, select "CSI-RS > Awareness > On".
12. In the allocation table, select the PDSCH allocation and compare the number of used "Phys. Bits".

    The displayed information confirms, that less physical bits are allocated for the PDSCH, because some resources are reserved for the CSI-RS transmission.

    Tip: Use the parameter CSI Awareness to inform an UE that a CSI-RS transmission is used.
13. Select "Frame Configuration > Time Plan" and set "No of Subframes = 10".



ZeroTxPower CSI-RS Structure
Comprises the following zero transmission power parameters:

ZeroPowerCSI-RS (HEX) ← ZeroTxPower CSI-RS Structure
Sets the used CSI-RS configurations in the zero transmission power subframes. Required is a 16-bit-long hexadecimal value (bitmap). The UE assumes a zero transmission power for each bit set to one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:ZP` on page 493

Subframe Config (I_CSI-RS) ← ZeroTxPower CSI-RS Structure
Sets the parameter I_{CSI-RS} for CSI-RS with zero transmission power, see Table 7-10.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:ZPI` on page 493

Periodicity (T_CSI-RS) ← ZeroTxPower CSI-RS Structure
Sets the parameter subframe configuration period T_{CSI-RS} for CSI-RS with zero transmission power, see Table 7-10.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:ZPT?` on page 494

Subframe Offset (Delta_CSI-RS) ← ZeroTxPower CSI-RS Structure
Sets the parameter subframe offset $Delta_{CSI-RS}$ for CSI-RS with zero transmission power, see Table 7-10.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:ZPDelta?` on page 493

Cell-specific CSI-RS Structure
Comprises the following cell-specific parameters:

CSI-RS State ← Cell-specific CSI-RS Structure
Enables the transmission of a CSI-RS, see also "How to enable and visualize a CSI-RS transmission" on page 141.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:STATe` on page 493

Number of CSI-RS Antenna Ports ← Cell-specific CSI-RS Structure
Defines the number of antenna ports (one, two, four or eight) the CSI-RS are transmitted on.

Use the Cell-Specific Antenna Port Mapping and configure the cell-specific antenna port mapping of the antenna ports AP15 - AP22.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:NAP` on page 491

CSI-RS Configuration ← Cell-specific CSI-RS Structure
Defines the CSI-RS configuration used for the current cell and for which the UE assumes non-zero transmission power. The zero transmission power subframes are determined by the ZeroPowerCSI-RS (HEX).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:CONFig` on page 491

Subframe Config (I_CSI-RS) ← Cell-specific CSI-RS Structure
Sets the parameter I_{CSI-RS} for cell-specific CSI-RS, see Table 7-10.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:SFI` on page 492

Periodicity (T_CSI-RS) ← Cell-specific CSI-RS Structure
Sets the parameter subframe configuration period T_{CSI-RS} for cell-specific CSI-RS, see Table 7-10.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:SFT?` on page 492

Subframe Offset (Delta_CSI-RS) ← Cell-specific CSI-RS Structure
Sets the parameter subframe offset $Delta_{CSI-RS}$ for cell-specific CSI-RS, see Table 7-10.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:SFDelta?` on page 492

CSI-RS Power ← Cell-specific CSI-RS Structure
Boosts the CSI-RS power compared to the cell-specific reference signals.

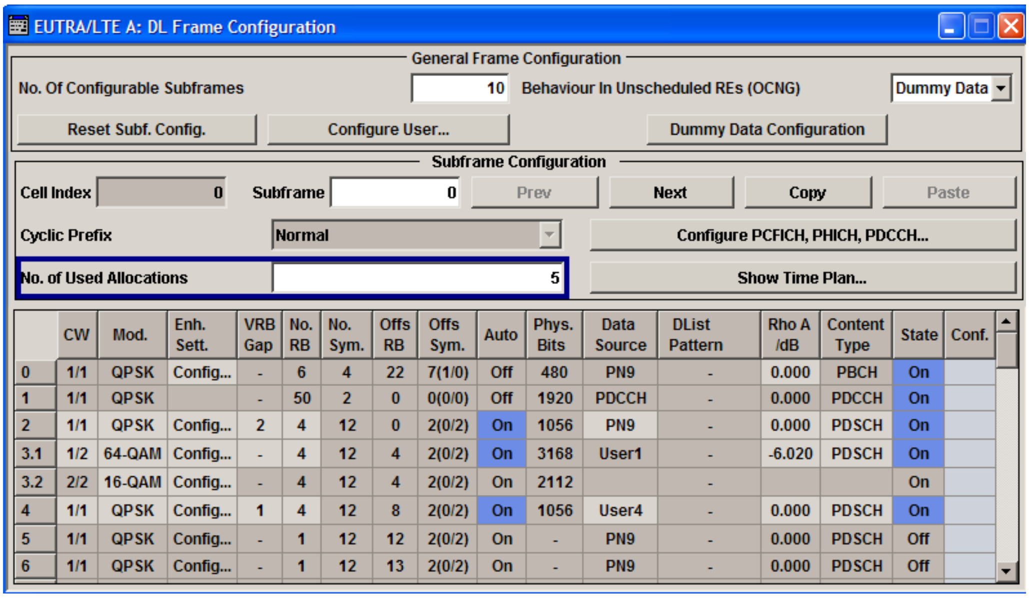
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS:POW` on page 492

7.5 DL Frame Configuration Settings

To access this dialog:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Scheduling > Manual".
3. Select "Frame Configuration".

   The "DL Frame Configuration" dialog allows you to configure the subframes and the OFDMA resource allocations. The dialog consists of several tabs.
   The "DL Frame Configuration" dialog consists of three sections, "General Frame Configuration", "Subframe Configuration", and the "Allocation Table".



7.5.1 General Frame Configuration Settings

Provided are the following settings:

No Of Configurable (DL) Subframes

Sets the number of configurable subframes. Only the downlink and the special subframes are enabled for configuration if TDD mode is selected.

All downlink/special subframes are filled periodically with the configured subframes except for the P-SYNC/S-SYNC. The last are set globally in the "General DL Settings" dialog. The PBCH can only be configured in subframe 0.

For more detailed information about the maximum number of configurable subframes and for description of the dependencies between the parameters, see Chapter 5.2.3, "Four Configurable Frames in Uplink and Downlink Direction", on page 62.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:CONSubframes` on page 468

Reset All Subframes

Resets settings of all subframes including cyclic prefix and number of used allocations to the default values.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:RSTFrame` on page 469

Configure User
Calls the "Configure User" menu for configuring allocations for different users.

The menu is described in Chapter 7.8, "User Configuration Settings", on page 200.

Remote command:
n.a.

Behavior In Unscheduled REs (OCNG)
Selects either to fill unscheduled resource elements and subframes with dummy data or DTX.

This function can be used as an OFDMA Channel Noise Generator (OCNG) according to TS 36.101.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:BUR` on page 468

Dummy Data Configuration
(Available for Dummy Data only)

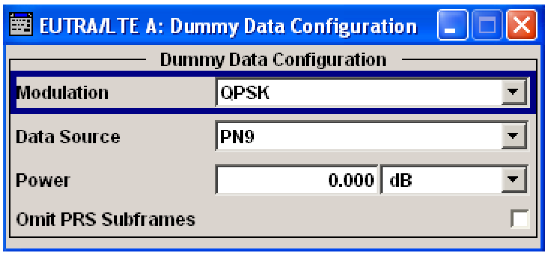
Access the "Dummy Data Configuration" dialog for setting the modulation, power, and data source for the dummy data.

The menu is described in Chapter 7.5.2, "Dummy Data Configuration Settings", on page 146.

Remote command:
n.a.

7.5.2 Dummy Data Configuration Settings

► To access this dialog, select "Frame Configuration > Behavior in Unsch. REs (OCNG) > Dummy Data ".



In this section, the dummy data for filling the unscheduled resource blocks and subframes are configured.

Modulation
Selects the modulation of the dummy data.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:MODulation on page 574

Data Source
Selects the data source for the dummy data configuration.

The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

  See also "Main Dialog > Data List Management".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:DATA on page 575
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:PATTern on page 575
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:DSELect on page 575

Power (Dummy Data)
Sets the power of the subcarriers allocated with dummy data.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:POWer on page 574

Omit PRS Subframes
(requires option R&S SMx/AMU-K84)

If the OCNG (OFDM Channel Noise Generator) is used, you can disable (omit) the OCNG transmission in the non-muted PRS subframes, as required for RSTD Performance Tests (TS 36.133, section A.9.8.1).

Tip: Use the OFDMA Timeplan to visualize the allocated resources.

See also Example "How to visualize the effect of muting and omitting PRS transmission" on page 137.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:OPSubframes on page 576

7.5.3 Auto Sequence Configuration

The "Auto Sequence" mode requires the additional software option R&S SMx/AMU-K112. This mode supports you to generate EUTRA/LTE signals from a sequence perspective.

In "Auto Sequence" mode, you configure the sequence-related settings once per active User; all related parameters are calculated automatically.

Impact of the "Auto Sequence" mode on the configuration of DCIs

The following applies for each active user (State > On) and for every active cell:

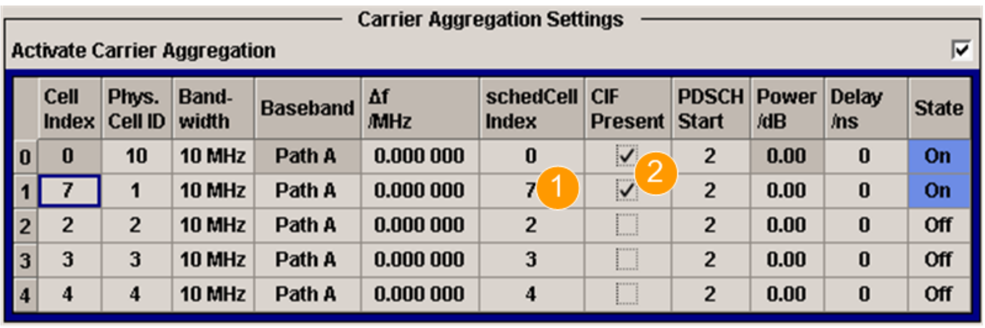
- There is one DL DCI and one UL DCI for the user and the cell in the PDCCH DCI table. Comprehend these as template DCIs. The DCIs which are used for the generated subframes are derived from them, with modifications according to the Auto Sequence DCI tables.
- Suitable DCI formats are selected automatically, according to the Tx Modes.
- If Activate Carrier Aggregation is enabled, the Cell Index for the DL-DCI and UL-DCI is set to the selected schedCell Index
- Several parameters of the DCI formats are automatically varied throughout the subframes (see DCI Format Configuration).

  For example:
  - The modulation and coding scheme (MCS) and HARQ-related parameters are indicated as "Auto"
  - If CIF Present is enabled, the CIF parameter in the DL-DCI and UL-DCI is set to the selected Cell Index

7.5.3.1 How to Enable and Use the Auto Sequence Mode

This example focuses on the "Auto Sequence" settings and their impact. For step-by-step instruction on how to enable the required configuration, see Chapter 7.4.1.2, "How to Enable Carrier Aggregation and Cross-Carrier Scheduling", on page 107.

1. Select "Baseband > EUTRA/LTE > General DL Setting > CA" and enable for example the following settings:



Carrier Aggregation Settings

Activate Carrier Aggregation ☑

	Cell Index	Phys. Cell ID	Band-width	Baseband	Δf /MHz	schedCell Index	CIF Present	PDSCH Start	Power /dB	Delay /ns	State
0	0	10	10 MHz	Path A	0.000 000	0	☑	2	0.00	0	On
1	7	1	10 MHz	Path A	0.000 000	7 (1)	☑ (2)	2	0.00	0	On
2	2	2	10 MHz	Path A	0.000 000	2	☐	2	0.00	0	Off
3	3	3	10 MHz	Path A	0.000 000	3	☐	2	0.00	0	Off
4	4	4	10 MHz	Path A	0.000 000	4	☐	2	0.00	0	Off

1 = Cross-carrier scheduling is disabled (SCell#1 uses "schedCellIndex = 7")
2 = "CIF Preset > On"

2. Select "General DL Setting > Scheduling > PDSCH Scheduling > Auto Sequence".
3. Select "EUTRA/LTE > DL Frame Configuration > General" and enable "User Configuration > User 1/User 2 > State > On".

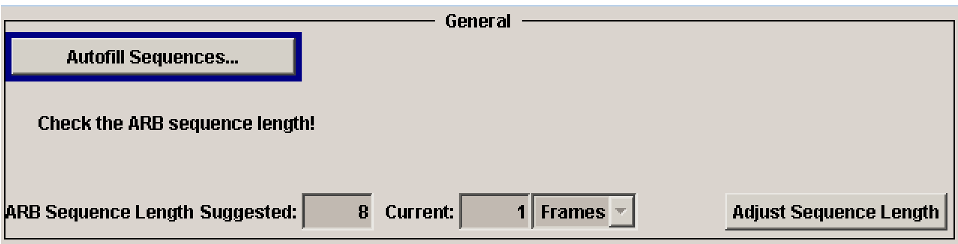
   The subframe-related settings are not displayed. Compare these settings to the setting described in Chapter 7.5, "DL Frame Configuration Settings", on page 144.

	User 1	User 2	User 3	User 4
State	☑	☑	☐	☐
Activate CA	☐	☐	☐	☐
Tx Modes	Mode 9	Mode 7	Mode 2	Mode 2
Auto Sequence	Config...	Config...	Config...	Config...
UE Category	User	User	User	User
Antenna Mapping	Config...	Config...	Config...	Config...
Scrambling	☑	☑	☑	☑
Channel Coding	☑	☑	☑	☑
UE ID	0	0	0	0
Data Source	PN9	PN9	PN9	PN9
DList/Pattern	-	-	-	-
P_A	0 dB	0 dB	0 dB	0 dB
SPS	Config...	Config...	Config...	Config...
Aperiodic SRS	☐	☐	☐	☐
CSI Awareness	☐	☐	☐	☐

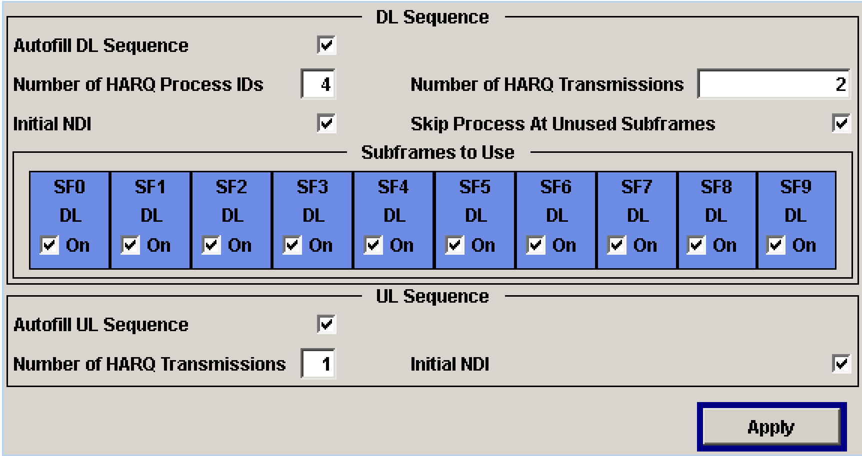
4. Select "DL Frame Configuration > PDCCH" and observe the settings.

   There are two active users, "User1" and "User2" and two active cells with "schedCell Index = 0 and 7". The DCI format "DCI format = 0 and 1A" is automatically selected, see "Impact of the "Auto Sequence" mode on the configuration of DCIs" on page 148.
5. In "DCI Table", select "User1 > DCI Format 1A > Content > Config" for the DCI with "Cell Index = 7".

   The "DCI Format Configuration" confirms the configuration: "CIF = 7", MCS and HARQ-related settings are set to "Auto".
6. To configure the HARQ transmission:
   a) Open the "DL Frame Configuration > General > User Configuration > User1 > Auto Sequence > Config" dialog.

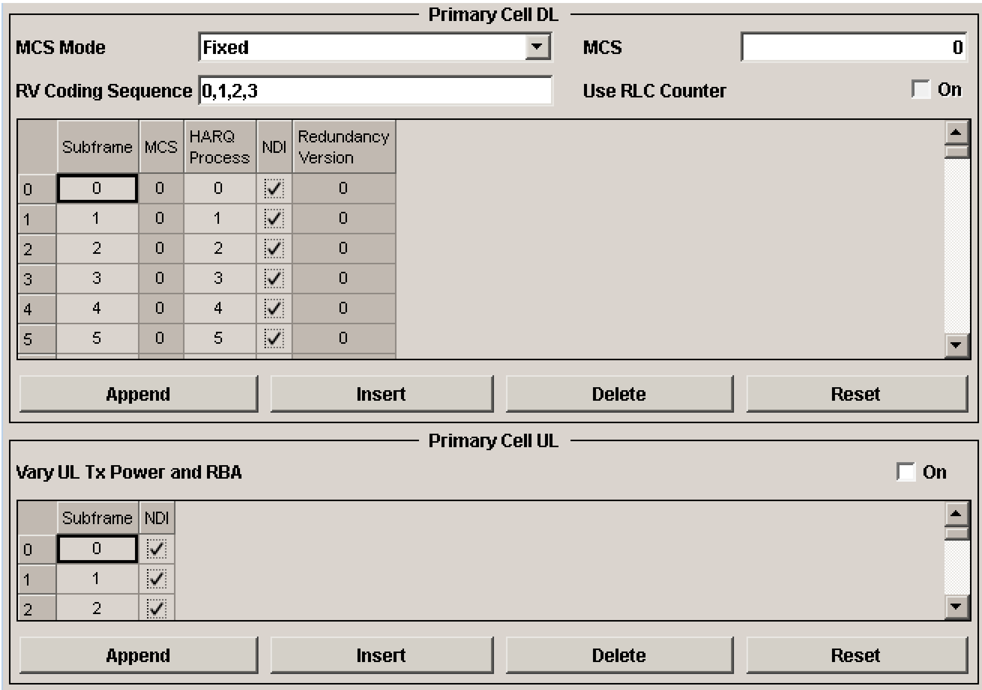


b) Select "Auto Sequence > Autofill Sequences", configure the HARQ transmission, and select "Apply".



c) If the current ARB sequence length deviates form the suggested one, select "Adjust Sequence Length".

Observe the resulting settings in the "Auto Sequence > Primary Cell DL/UL" sections.



7.5.3.2 Auto Sequence Settings

To access this dialog:

1. Select "EUTRA/LTE > General DL Setting > Scheduling > PDSCH Scheduling > Auto Sequence".

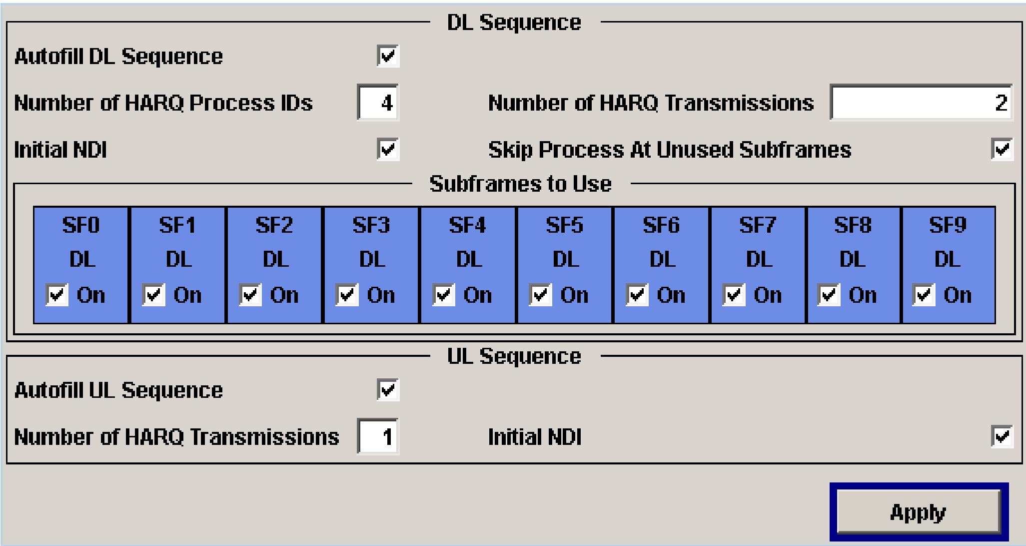
2. Select "DL Frame Configuration > General > User Configuration > User1 > Auto Sequence > Config."

   The "Auto Sequence" dialog opens.

   For instruction on how to use these settings, see Chapter 7.5.3.1, "How to Enable and Use the Auto Sequence Mode", on page 148.

Autofill Sequences...

Access a dialog with settings to configure the DL and UL DCIs.



To configure the Auto Sequence DCI tables of the user automatically, enable the "Autofill DL/UL Sequence" parameters, adjust the settings, and confirm with "Apply".

"Autofill DL/UL Sequence"
: Automatically fill the auto sequence DCI tables of the user in a meaningful and standard-compliant way.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:AFSeq` on page 535

`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:AFSeq` on page 535

"Number of HARQ Process IDs"
Sets the number of HARQ process IDs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:NHIDs on page 536

"Number fo HARQ Transmissions"
Sets the number of HARQ transmissions.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:NHTRans on page 536
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:NHTRans on page 536

"Initial NDI" Defines whether the "New Data Indicator" flag is set at the beginning of the sequence or cleared.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:INDI on page 536
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:INDI on page 536

"Skip Process at Unused Subframes"
Defines how the HARQ processes are distributed throughout the used subframes.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:SKPRocess on page 536

"Subframes to Use:"
Sets the downlink subframes to be used for the HARQ transmission as a pattern of "0" and "1", where 1 enables a subframe.
Do not set the uplink subframes; in FDD duplexing mode, used are all subframes and in TDD mode, all downlink and special subframes that are allowed to schedule uplink transmissions.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:USUBframe<st0>
on page 537

"Apply" Applies the settings

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:APPLy on page 537

ARB Sequence Length
Displays the suggested and currently used ARB sequence length.

If the current ARB sequence length deviates form the suggested one, select "Adjust Sequence Length".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:ARBLen? on page 535
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:ASLength on page 535

DL DCI Sequence
The DL DCIs are defined in table form that can be filled in manually, by adding rows and configuring them, or automatically, with the Autofill Sequences... settings.

MCS Mode ← DL DCI Sequence
Sets how the Modulation and Coding Scheme is configured.

"Manual" Enter the MCS value in the corresponding column

"Fixed" The MCS value is fixed and configured with the parameter MCS

"Target Code Rate"
The required MCS value is calculated based on the selected "Target Code Rate" and "Target Modulation".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:MCSMode`
on page 537

MCS ← DL DCI Sequence
In "MCS Mode > Fixed", sets the MCS value.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:FMCS`
on page 538

Target Code Rate, Target Modulation ← DL DCI Sequence
In "MCS Mode > Target Code Rate", sets the target code rate and modulation (QPSK, 16QAM, 64QAM).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:TCR` on page 538
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:TMOD`
on page 538

RV coding Sequence ← DL DCI Sequence
Sets the redundancy version sequence to be used.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:RVCSequence`
on page 538

Use RLC Counter ← DL DCI Sequence
Enables/disables the use of radio link control (RLC) counter.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:URLCounter`
on page 540

DL DCI Sequence Table ← DL DCI Sequence
The DCIs are configured in table form. If the Autofill Sequences... function is used, several parameters are preconfigured.

In TDD mode, the DCI table lists only the DL and special subframes.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:SUBFrame` on page 539
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:MCS` on page 539

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:HARQ on page 539
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:NDI on page 540
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:RV on page 540
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:RLCCounter on page 540

UL DCI Sequence

The UL DCIs are defined in table form, that can be filled in manually, by adding rows and configuring them, or automatically, with the Autofill Sequences... settings.

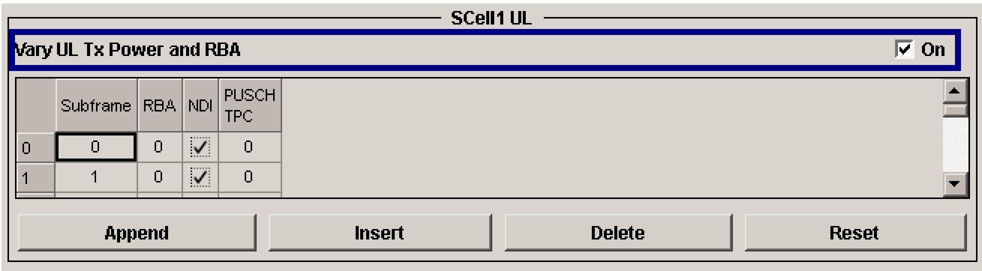


Figure 7-10: UL DCI Sequence settings in TDD mode ("UL/DL Configuration = 0")

Vary UL Tx Power and RBA ← UL DCI Sequence

Enables the "PUSCH TPC" column in the table.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:VULTxpow on page 542

UL DCI Sequence Table ← UL DCI Sequence

The DCIs are configured in table form. If the Autofill Sequences... function is used, several parameters are preconfigured.

In TDD mode, the DCI table lists only the DL and special subframes. The "UL Index" parameter is displayed if a TDD UL/DL Configuration = 0 is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:SUBFrame on page 539
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:RBA on page 541
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:NDI on page 540
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:PTPC on page 541
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:ULINdex on page 541

Append, Insert, Delete, Reset
Standard functions for handling of table elements.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement on page 542
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:APPend on page 542
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:INSert on page 542
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:DELete on page 543
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:RESet on page 543
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SELement on page 542
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:APPend on page 542
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:INSert on page 542
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:DELete on page 543
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:RESet on page 543

7.5.4 Subframe Configuration Settings

Provided are the following settings:

Cell Index
With enabled "General DL Settings > CA > Activate Carrier Aggregation > On" state, indicates to which cell index (i.e. component carrier) the settings apply.

Remote command:
n.a

Subframe Selection
Sets the subframe to be configured in the frame configuration table.

Remote command:
n.a

Cyclic Prefix
Configuration of the cyclic prefix per subframe is only enabled, if the parameter Cyclic Prefix is set to User Defined.

The number of the OFDM symbols per subframe is set automatically.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:CYCPrefix on page 469

No. Of Used Allocations
Sets the number of scheduled allocations in the selected subframe.

The number of available allocations depends on the allocation's content type for a subframe and the general channel bandwidth setting.

The default value depends on the existence of a PBCH channel in a subframe. In this case, the default value is set to 2, otherwise to 1. The second or the first allocation is reserved for the PDCCH, regardless whether this allocation is enabled or not.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALCount on page 469

Copy/Paste
Copies/pastes the settings of the selected subframe. P-SYNC/S-SYNC/PBCH settings are not considered.

For more detailed information, see Chapter 5.2.1, "Copy/Paste Subframe", on page 61.

Remote command:
n.a.

Next/Prev
Navigates through the subframes.

Remote command:
n.a.

Show Time Plan
Opens the time plan for the OFDMA resource allocation.

The menu is described in detail in Chapter 7.12, "OFDMA Timeplan", on page 215.

Remote command:
n.a.

Configure PCFICH, PHICH, PDCCH
Opens the dialog for configuring the PCFICH, PHICH and PDCCH.

The dialog is described in detail in Chapter 7.7, "Enhanced PCFICH, PHICH and PDCCH Channel Configuration", on page 174.

Remote command:
n.a.

7.5.5 DL Resource Allocation Table

The resource allocation table is located in the lower part of the "DL Frame Configuration" menu. The resource allocation table is where the individual allocation parameters for a subframe are set.

Allocation number

Displays the consecutive number of the allocation.

Remote command:
n.a.

Codeword

Determines whether one or two codewords use the same physical resource, and whether codeword 1/2 or 1/2 is configured with this allocation table entry

In case the data source for an allocation is set to User, changing this parameter sets also the parameter "Codeword" of all allocations, belonging to the same User in the subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>:CODWords`
on page 469

Mod.

Selects the modulation scheme for the allocation.

In case the data source for an allocation is set to User, changing this parameter sets also the parameter "Modulation" of all allocations, belonging to the same User in the subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:MODulation` on page 470

Enhanced Settings DL
Calls the "Enhanced Settings" dialog for configuration of precoding and channel coding (see Chapter 7.6, "Enhanced PBCH, PDSCH and PMCH Settings", on page 164).

Remote command:
n.a.

VRB Gap
Enables the utilization of Virtual Resource Blocks (VBR) of distributed type and determines whether the first or the second gap is applied. That is, it determines the distribution and the mapping of the VRB pairs to the Physical Resource Blocks (PRB) pairs.

The VRB-to-PRB mapping and the calculation of the VRB gap values are performed according to TS 36.211. The specification defines two types of VRBs, a localized distribution with a direct mapping and distributed VRBs for better frequency diversity. The distribution of the VRBs is performed in such a way, that consecutive VRBs are not mapped to frequency-consecutive PRBs. The VRBs are spread over the frequencies instead. Each single VRB pair is split into two parts and a frequency gap between these two VRB parts is introduced. That is, a frequency hopping on a slot basis is applied. For wider channel bandwidths (more than 50 RBs), a second VRB gap with smaller size may be applied.

Tip: Use the "DL Time Plan" to visualize the PDSCH mapping.

The information whether localized or distributed VBRs are applied is carried by the PDCCH. The DCI Formats 1A/1B/1D provide the special 1-bit flag "Localized/Distributed VBR Assignment" for this purpose. The selection whether the first or the second gap is applied, is determined by the additional bit "Gap Value".

Note: In case a "General DL Settings > Scheduling > PDSCH Scheduling > Auto/DCI" mode is used, the "VRB Gap" value is read-only and is set according to the configuration of the corresponding DCI format.

Example:

"DL Channel Bandwidth = 10 MHz" (50 RBs)

Three subframes are configured:

- Subframe#0
  PDSCH allocation#2 (User2): "VRB Gap = 0"
  PDSCH allocation#3 (User4): "VRB Gap = 0"

	CW	Mod.	Enh. Sett.	VRB Gap	No. RB	No. Sym.	Offs RB	Offs Sym.	Auto	Phys. Bits	Data Source	DList Pattern	Rho A /dB	Content Type	State	Conf.
0	1/1	QPSK	Config...	-	6	4	22	7(1/0)	Off	480	MIB	-	0.000	PBCH	On	
1	1/1	QPSK		-	50	2	0	0(0/0)	Off	1920	PDCCH	-	0.000	PDCCH	On	
2	1/1	QPSK	Config...	-	2	12	0	2(0/2)	On	552	User2	-	0.000	PDSCH	On	
3	1/1	QPSK	Config...	-	2	12	2	2(0/2)	On	552	User4	-	0.000	PDSCH	On	

- Subframe#1
- PDSCH allocation#2 (User2): "VRB Gap = 1"
  PDSCH allocation#3 (User4): "VRB Gap = 1"
  Both allocations use distributed VRBs; the first VRB gap is applied.
  According to TS 36.211, the first VRB gap for 10 MHz channel bandwidth is **27 RBs**

	CW	Mod.	Enh. Sett.	VRB Gap	No. RB	No. Sym.	Offs RB	Offs Sym.	Auto	Phys. Bits	Data Source	DList Pattern	Rho A /dB	Content Type	State	Conf.
0	1/1	QPSK		-	50	2	0	0(0/0)	Off	1920	PDCCH	-	0.000	PDCCH	On	
1	1/1	QPSK	Config...	1	2	12	0	2(0/2)	On	552	User2	-	0.000	PDSCH	On	
2	1/1	QPSK	Config...	1	2	12	2	2(0/2)	On	552	User4	-	0.000	PDSCH	On	
3	1/1	QPSK	Config...	-	1	12	4	2(0/2)	On	-	PN9	-	0.000	PDSCH	Off	

- Subframe#2
  PDSCH allocation#2 (User2): "VRB Gap = 1"
  PDSCH allocation#3 (User4): "VRB Gap = 2"
  Both allocations use distributed VRBs. The first VRB gap is applied for PDSCH allocation#2 (User2) and the second VRB gap for the allocation#3 (User4) .
  According to TS 36.211, the second VRB gap for 10 MHz channel bandwidth is **9 RBs**

	CW	Mod.	Enh. Sett.	VRB Gap	No. RB	No. Sym.	Offs RB	Offs Sym.	Auto	Phys. Bits	Data Source	DList Pattern	Rho A /dB	Content Type	State	Conf.
0	1/1	QPSK		-	50	2	0	0(0/0)	Off	1920	PDCCH	-	0.000	PDCCH	On	
1	1/1	QPSK	Config...	1	2	12	0	2(0/2)	On	552	User2	-	0.000	PDSCH	On	
2	1/1	QPSK	Config...	2	2	12	2	2(0/2)	On	552	User4	-	0.000	PDSCH	On	
3	1/1	QPSK	Config...	-	1	12	4	2(0/2)	On	-	PN9	-	0.000	PDSCH	Off	

Use the "DL Time Plan" to visualize the PDSCH mapping.

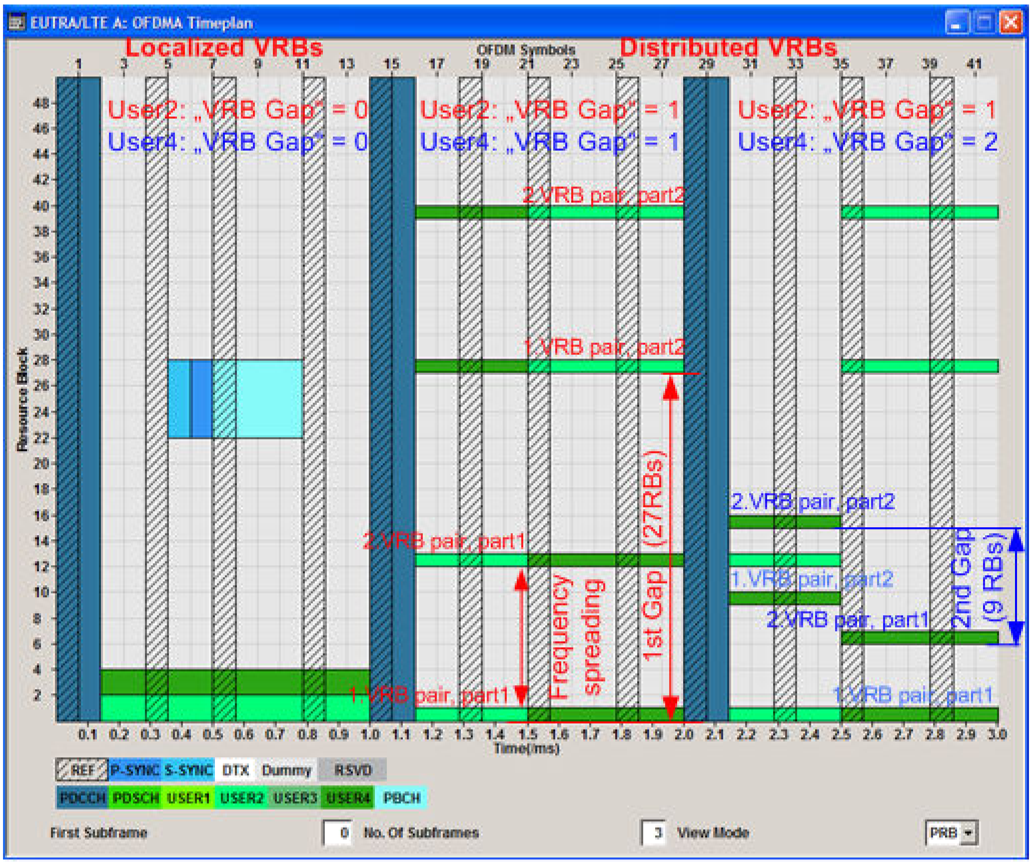


Figure 7-11: DL Time Plan

Subframe#0 = Localized VRB, direct mapping VRB-to-PRB
Subframe#1 = Distributed VRB: First Gap=27 RBs applied for User2 and User4
Subframe#2 = Distributed VRB: First Gap=27 RBs applied for User2, second Gap=9RBs applied for User4

"0"	A **localized distribution** is applied, i.e. the PDSCH mapping is performed on a direct VRB-to-PRB mapping.
"1"	Enables a **distributed** resource block allocation. The first VRB gap is used.
"2"	Enabled for "Channel Bandwidths" greater than 50 RBs. The mapping is based on the second (smaller) VRB gap.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:GAP` on page 470

No. RB (Resource Blocks)

Defines bandwidth of selected allocation in terms of resource blocks per slot.

In case two codewords are configured, the defined bandwidth of the allocation with the second codeword is determinate by the selected bandwidth of the first one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:RBCount` on page 471

No. Sym.
Sets the size of the selected allocation in OFDM symbols.

For FDD mode and content type PDSCH, this value is set automatically in a way that the allocation always fills the complete subframe with consideration of the symbol offset.

Example:

For Cyclic Prefix with normal length (14 OFDMA Symbols) and Symbol Offset = 2 the resulting "No. Of Symbols" is 12.

In case two codewords are configured, the size of the allocation with the second codeword is determinate by the size of the first one.

While configuring a special subframe for TDD mode, the maximum size of the PDSCH allocation is determined by the selected TDD Frame Structure Settings and depends on the selected Cyclic Prefix.

The following table shows the cross-reference between the special subframe configuration and the maximum number of OFDM symbols available for PUSCH (DwPTS) in a special subframe for normal and extended CP.

Configuration of Special Subframe	DwPTS (Normal CP)	DwPTS (Extended CP)
0	3	3
1	9	8
2	10	9
3	11	10
4	12	3
5	3	8
6	9	9
7	10	5
8	11	-
9	6	-

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SYMCount` on page 471

Offs RB
Sets the start resource block of the selected allocation.

Note: If the "Auto Offset Calculation" mode is activated, this value is read only.

In case two codewords are configured, the start resource block of the allocation with the second codeword is determinate by the selected start resource block of the first one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:RBOFfset` on page 471

Offs Sym.

Sets the start OFDM symbol of the selected allocation.

Note: If the "Auto Offset Calculation" mode is activated, this value is read only.

For extended cyclic prefix, the maximum symbol offset is 13.

Note: According to TS 36.211, up to first three OFDM symbols of a subframe are reserved for control information (PDCCH). Therefore, for PDSCH allocations the maximum value is 3, regardless of the cyclic prefix length.

In case two codewords are configured, the start OFDM symbol of the allocation with the second codeword is determinate by the selected start OFDM symbol of the first one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SYMoffset` on page 472

Auto

Sets whether automatic offset calculation is used or not.

Note: If the "Auto Offset Calculation" mode is activated, the resource block offset and the start symbol offset are set automatically and cannot be changed.

By setting new allocations or changing the number of RBs of an existing allocation, the Auto mode tries to distribute the allocations with activated Auto mode in an optimal manner to the available resource blocks by adjusting the parameters "Offset RB". The resulting "No. of Bits" of a certain allocation can vary, due to overlapping control channels.

If it is not possible to distribute the changed configuration to the available resources blocks, a conflict is displayed.

Note: "Auto Offset Calculation" mode is only available for PDSCH. For PDCCH, this parameter is always off.

In case two codewords are configured, the state of the "Auto Offset Calculation" mode of the second codeword is set to the state of the first one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:AOC` on page 472

Phys. Bits

Displays the size of the selected allocation in bits and considering the subcarriers that are used for other signals or channels with higher priority (see Chapter 5.1, "Conflict Handling", on page 57).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PHYSbits?` on page 472

Data Source

Selects the data source for the selected allocation.

For PBCH allocation with enabled parameter MIB (including SFN), the "Data Source" is set to "MIB".

Use the User Configuration Settings dialog to configure the data sources for "User 1 .. 4".

The following standard data sources are available:

- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  - Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  - Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  - Use the standard "File Manager" function to transfer external data lists to the instrument.

  See also "Main Dialog > Data List Management".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:DATA` on page 473
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:DSELect` on page 473
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PATTern` on page 473

Rho A

Sets the power P_{PDSCH} respectively P_{PBCH} for the selected allocation.

The power of the PDCCH allocation P_{PDCCH} is read-only. The value is set in the "Enhanced Channel Configuration" dialog of the corresponding subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:POWer` on page 474

Content Type

Selects the type of the selected allocation.

Note: There can be only one PBCH in subframe 0.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CONType` on page 474

State
Sets the allocation to active or inactive state.

In case two codewords are configured, the state of the allocation with the second codeword is determinate by the state of the first one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:STATe` on page 475

Conflict
Indicates a conflict between allocations.

For more information, see Chapter 5.1, "Conflict Handling", on page 57.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CONFlict` on page 475

7.6 Enhanced PBCH, PDSCH and PMCH Settings

To access this dialog:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "Frame Configuration > Subframe Configuration > No of Used Allocations = 3".
3. Select "Allocation Table > Allocation#3 > Content Type".
4. Select one of the following "Content Type":
   a) "PBCH"
   b) "PDSCH"
   c) "PMCH"
5. Select "Enhanced Settings > Config..."

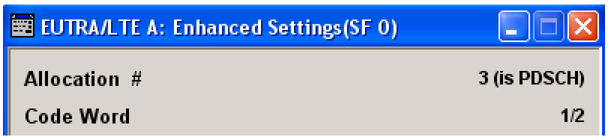
   In the "Enhanced Settings" dialog you can define the precoding and the channel coding settings for the DL channels PBCH and PDSCH. The settings are configurable on a subframe basis.

Consider the following interdependencies:

- The "Precoding" settings are available for the first codeword and applied for both codewords.
- The available "Precoding" settings depend on:
  – the global MIMO configuration
  – the content of the allocation
  – the selected codeword
- For all allocations, where the "Data Source > User 1..4":

– The following parameters are read-only: "Scrambling State", "UE ID" and "Channel Coding State".
  To configure these parameters, open the User Configuration Settings dialog for the corresponding user.
– You can access the "Enhanced Settings" of one particular "User 1..4" form any allocations belonging to this user.

7.6.1 Allocation Settings



Provided are the following settings:

Allocation #

Displays the number of the allocation and the channel type the enhanced settings are configured for.

Remote command:
n.a.

Codeword

Displays the number of the codeword and the total number of codewords used for the selected allocation.

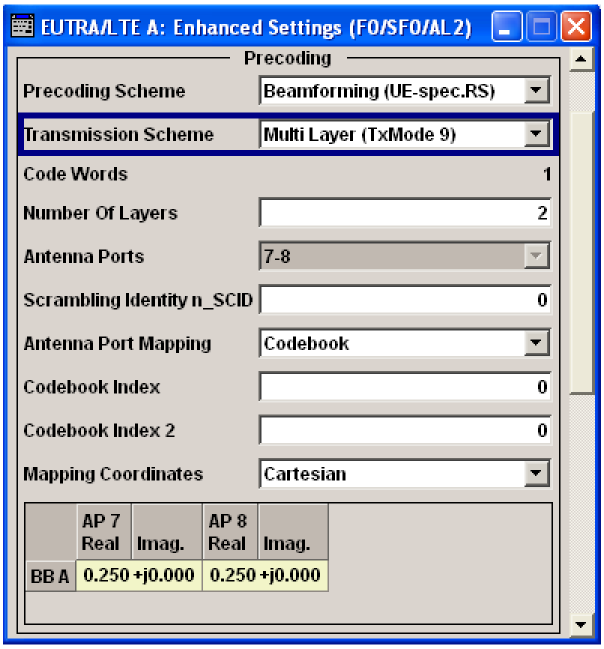
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>:CODWords`
on page 469

7.6.2 Precoding Settings

To access the precoding settings:

1. Select "General DL Configuration > MIMO"
2. Select "Global MIMO Configuration > 2 TxAntennas"
3. Select "General > Frame Configuration > Subframe Configuration > No of Used Allocations = 3".
4. Select "Allocation Table > Allocation#3 > Content Type".
5. Select "Content Type > PDSCH"

6. Select "Enhanced Settings > Config..."



Consider the following interdependencies:

- The "Precoding" settings are available for the first codeword and applied for both codewords.
- The available "Precoding" settings depend on:
  – the global MIMO configuration
  – the content of the allocation
  – the selected codeword

Precoding Scheme

Selects the precoding scheme.

Note: The available precoding schemes depend on Content Type and the MIMO Configuration.

"None" Disables precoding.

"Spatial Multiplexing/Tx Diversity"
Precoding for spatial multiplexing or transmit diversity will be performed according to TS 36.211 and the selected parameters.

"Beamforming (UE-spec.RS)"
Sets the PDSCH to transmission mode selected with the parameter Transmission Scheme.

"Antenna Port 4"
(for instruments equipped with R&S SMx/AMU-K84)
Default precoding scheme for the PMCH transmitted in MBFSN sub-frames.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:SCHeme` on page 499

Transmission Scheme
(for instruments equipped with R&S SMx/AMU-K84)

Determines the transmission scheme (see also Table 3-4).

"Transmission Scheme"	Available for Global MIMO Configuration	Description
"Single Layer (TxMode 7)"	SISO+BF 2Tx/4Tx-Antennas	Sets the PDSCH to transmission mode 7, as described in TS 36.213, i.e. UE-specific RS (DM-RS) will be added to the PDSCH. This special mode is defined for transmission using antenna port 5. In the R&S Signal Generator, antenna port 5 is simulated by all enabled antennas, depending on the selected Global MIMO Configuration. Note that for "SISO + BF" configuration mode, antenna port 5 is simulated by maximum two antennas. **Tip:** To enable the instrument to generate a **transmission using antenna port 5** signal (transmission corresponding to the UE-specific reference signal) as defined in the TS 36.101, chapter 8.3, select "Global MIMO Configuration > SISO + BF".
"Dual layer (TxMode 8)"	SISO+BF 2Tx/4Tx-Antennas	Sets the PDSCH to transmission mode 8, as described in TS 36.213, i.e. UE-specific RS will be added to the PDSCH. In this mode antenna ports 7 and 8 are used. In the R&S Signal Generator, antenna ports 7 and 8 are simulated by all enabled antennas, depending on the selected "Global MIMO Configuration". **Tip:** To enable the instrument to generate a transmission using antenna port 7 and 8, set the parameter "Global MIMO Configuration" to "SISO + BF", "2 Tx-antennas" or "4 Tx-antennas".
"Multi-layer (TxMode 9)"	SISO+BF 2Tx/4Tx-Antennas	Sets the PDSCH to transmission mode 9.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:TRSCheme` on page 500

Number of Layers
Sets/displays the number of layers for the selected allocation.

The number of available layers depends on selected Content Type and Precoding Scheme

The combination of number of codewords and number of layers determines the layer mapping for the selected precoding scheme, see also "Codewords and spatial layers" on page 40.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:NOLayers` on page 499

Scrambling Identity n_SCID
Sets the scrambling identity according to TS 36.211, section 6.10.3.1.

This value is used for initialization of the sequence used for generation of the UE-specific reference signals.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:SCID` on page 500

Antenna Ports
(for instruments equipped with R&S SMx/AMU-K84)

Displays and configures the antenna port(s) for the selected Transmission Scheme.

In case only one codeword and therefore only one layer is configured in the "Dual Layer (TxMode 8)", the mapping of the layer to antenna port 7 or antenna port 8 is configurable.

Tip: Use this configuration possibility to configure a dual-layer multi-user MIMO (MU-MIMO) scenario.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:AP` on page 497

Antenna Port Mapping
(for instruments equipped with R&S SMx/AMU-K84/K85)

Sets the way that the logical antenna ports are mapped to the physical Tx antennas, see Chapter 7.9, "DL Antenna Port Mapping Settings", on page 205.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:APM` on page 497

Codebook Index/Codebook Index 2
(Enabled for Precoding Scheme set to Tx Diversity or Spatial Multiplexing and codeword 1/2 only)

Sets the codebook index for the selected allocation, i.e. selects the predefined precoder matrix.

The number of available codebook indices depends on the Global MIMO Configuration, i.e. the number of used antennas.

The Figure 3-24 shows the range of the codebook index for downlink spatial multiplexing for LTE Rel. 8/9. The LTE Rel. 10 (R&S SMx/AMU-K85) defines up to 8 layers and uses the same principles.

The combination of codebook index and the selected Number of Layers determines the pre-coding matrix used for precoding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:CBINdex[<dir>] on page 498

Cyclic Delay Diversity
(Enabled for Precoding Scheme set to Tx Diversity or Spatial Multiplexing and codeword 1/2 only)

Sets the CDD for the selected allocation.

The combination of cyclic delay diversity and the selected Number of Layers determines the precoding parameters for spatial multiplexing.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:CDD on page 498

Mapping Coordinates
Switches between the Cartesian (Real/Imag.) and Cylindrical (Magn./Phase) coordinates representation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:DAFormat on page 499

Mapping Table
(for instruments equipped with R&S SMx/AMU-K84)

Defines the mapping of the antenna ports (AP) to the physical antennas, see "Mapping table" on page 208.

7.6.3 CSI-RS Settings

► To access this dialog, select "Enhanced Settings > CSI-RS".

In this dialog the CSI Awareness can be enabled/disabled.

CSI Awareness
Determines the way the PDSCH is processed.

"On" During the channel coding, the resource elements configured for the CSI-RS transmission are explicitly avoided and the PDSCH is mapped only on the available physical bits.

"Off" The channel coding is performed as if the CSI-RS will not be transmitted, i.e. the PDSCH mapping is not modified to avoid the resource elements on that the CSI-RS can be transmitted.
The modulation symbols necessary for the transmission of the CSI-RS are subsequently substituted by the CSI-RS information; the CSI-RS are transmitted instead of the PDSCH symbols.
This process leads to increased bit error rate, but an UE receiving this PDSCH will still decode the information correctly.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>:CAW on page 495

7.6.4 Scrambling Settings

► To access this dialog, select "Enhanced Settings > Scrambling".

This dialog comprises the settings needed for configuring the scrambling:

State Scrambling (DL)
Enables/disables the bit-level scrambling.

If a "User 1..4" is selected for the Data Source in the allocation table for the corresponding allocation, the "State Scrambling" is read only and the value is displayed as set in the User Configuration Settings dialog for the corresponding user.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SCRambling:STATe on page 501

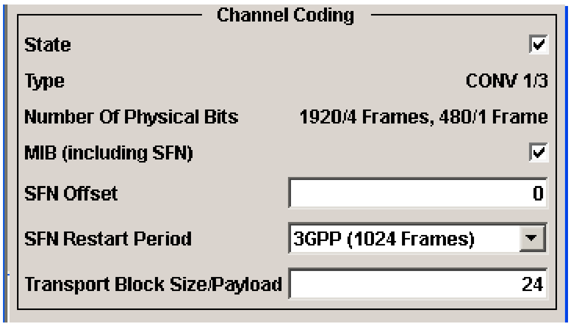
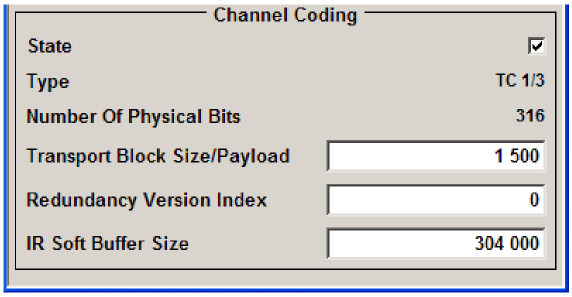
UE ID/n_RNTI (PDSCH)
Sets the user equipment identifier (n_RNTI) of the user to which the PDSCH transmission is intended. The UE ID is used to calculate the scrambling sequence.

If a "User 1..4" is selected for the Data Source in the allocation table for the corresponding allocation, the "UE ID" is read only and the value is displayed as set in the User Configuration Settings dialog for the corresponding user.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SCRambling:UEID on page 501

7.6.5 Channel Coding Settings

► To access this dialog, select "Enhanced Settings > Channel Coding".

"Channel Coding " settings for "PBCH".	"Channel Coding " settings for "PDSCH".
	

This dialog comprises the settings needed for configuring the channel coding. The settings vary according to the selected "Content Type"

State Channel Coding (DL)

Enables/disables channel coding for the selected allocation and codeword.

For any allocation with Data Source > "User 1..4", the "Channel Coding State" is read only and the value is displayed as set in the User Configuration Settings dialog for the corresponding user.

A PBCH can be generated in one of the following modes:

- Without channel coding, i.e. this parameter is disabled.
  Dummy data or user-defined data list are used.
- Channel coding with arbitrary transport block content
  Channel coding is activated and parameter MIB (including SFN) is disabled.
- Channel coding with real data (MIB) including SFN
  Channel coding and MIB are activated.

For the PBCH allocation with activated channel coding, one block of data (Transport Block Size of 24) is coded jointly and then spread over four frames. Hence, the ARB sequence length has to be set accordingly to be a multiple of four.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing:STATe` on page 496

Type Channel Coding (DL)
Displays the used channel coding scheme and channel coding rate.

PBCH uses always tail biting convolution coding with code rate 1/3; PDSCH uses always turbo code with code rate 1/3.

Remote command:
n.a.

Number of Physical Bits (DL)
Displays the size of the selected allocation in bits and considering the subcarriers that are used for other signals or channels with higher priority (see Chapter 5.1, "Conflict Handling", on page 57).

If a User 1...4 is selected for the Data Source in the allocation table for the corresponding allocation, the value of the parameter "Number of Physical Bits" is the sum of the "Physical Bits" of all single allocations that belong to the same user in the selected subframe.

For allocations with Data Source > "User 1..4", the value of the parameter "Number of Physical Bits" is the sum of the "Physical Bits" of all single allocations that belong to the same user in the selected subframe.

The size of the PBCH allocation is fixed to 1920/4 Frames, 480/1 Frame.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PHYSbits?` on page 472
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:USER<ch>:PHYSbits?` on page 475

MIB (including SFN)
(for PBCH only)

Enables/disables transmission of real MIB (master information block) data, calculated according to the values of the following "General Dl Settings" parameters:

- Channel Bandwidth
- PHICH Duration
- "PHICH N_g" on page 134

The SFN (System Frame Number) is included as well.

If this parameter is enabled, the "Transport Block Size" is fixed to 24 and the Data Source for the PBCH allocation is set to "MIB".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PBCH:MIB` on page 495

SFN Offset
(for PBCH only)

By default, the counting of the SFN (System Frame Number) starts with 0. Use this parameter to set a different start SFN value.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PBCH:SOFFset` on page 495

SFN Restart Period
(for instruments equipped with R&S SMx/AMU-K84)

not available for R&S SMBV and R&S WinIQSIM2

Determines the time span after which the SFN (System Frame Number) restarts.

"Sequence Length"
The SFN restart period is equal to the ARB sequence length.

"3GPP (1024 Frames)"
The PBCH including SFN is calculated independently from the other channels. The SFN restarts after 1024 frames and the generation process is fully 3GPP compliant, but the calculation may take very long time.
Tip: Use the "3GPP (1024 Frames)" mode only if 3GPP compliant SFN period is required.
This mode is disabled if a baseband generates more than one carrier.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PBCH:SRPeriod` on page 495

Transport Block Size/Payload (DL)
Defines the size of the transport block/payload in bits.

- Because only one transport block is generated and spread over all allocations, for allocations with "Data Source" set to User 1..4, the channel coding parameters "Transport Block Size", "Redundancy Version Index" and "IR Soft Buffer Size" are related to all allocations that belong to the same user in the corresponding sub-frame.
- In case a spatial multiplexing with two codewords is configured, individual transport blocks for the two code blocks are generated.
- For PBCH allocations with enabled parameter MIB (including SFN), the transport block size is fixed to 24.
  Set the transport block size to 24 if a generation compliant to the 3GPP specifications is required.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing:TBSize` on page 497

Redundancy Version Index (PDSCH)
Sets the redundancy version index.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing:RVINdex` on page 496

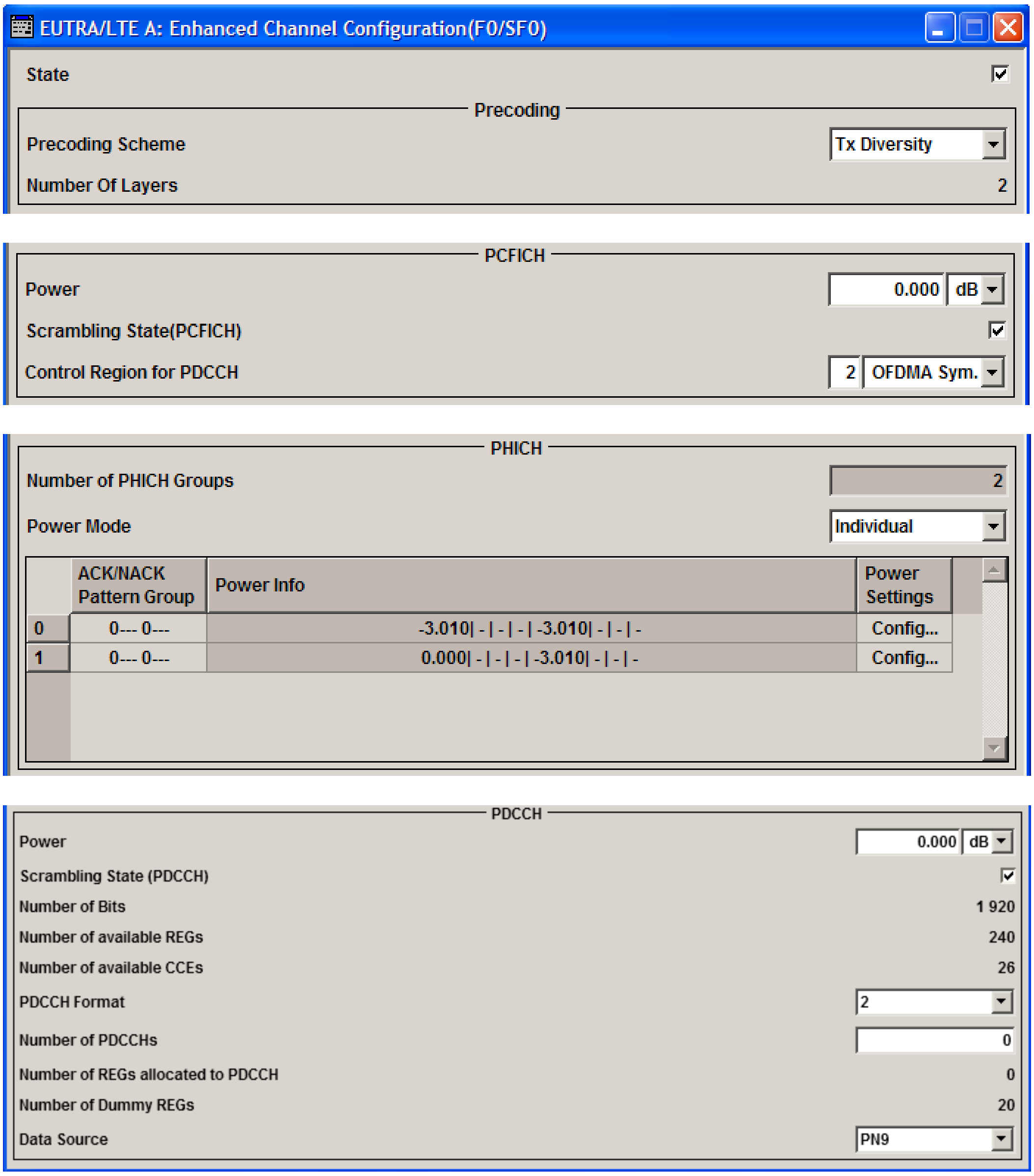
IR Soft Buffer Size (PDSCH)
Sets the size of the IR soft buffer for the selected transport block (N_IR from TS 36.212).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing:ISBSize` on page 496

7.7 Enhanced PCFICH, PHICH and PDCCH Channel Configuration

The "Enhanced Channel Configuration" dialog allows you to define and configure the PCFICH, PHICH and PDCCH settings per subframe. The subframe for which the PCFICH, PHICH and PDCCH settings are currently configured is indicated in the window name.

The parameters available for configuration in section "Precoding" depend on the Global MIMO Configuration.



7.7.1 General PCFICH/PHICH/PDCCH Configuration and Precoding Settings

Comprises the settings common to all DL enhanced channels.

State
Enables/disables the PDCCH, PCFICH and PHICH allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:STATe` on page 504

Precoding Scheme
Selects the precoding scheme for PDCCH, PCFICH and PHICH.

"None" Disables precoding.

"Tx Diversity" Precoding for transmit diversity will be performed according to TS 36.211 and the selected parameters.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PRECoding:SCHeme`
on page 504

Number of Layers (Enhanced Channels)
(Enabled for Precoding Scheme set to Tx Diversity)

Displays the number of layers for PDCCH, PCFICH and PHICH. This value is fixed to 1 for PDCCH, PCFICH and PHICH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PRECoding:NOLayers?`
on page 505

Scrambling State
Enables/disables the scrambling of all DL enhanced channels.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:SCRambling:STATe`
on page 504

7.7.2 PCFICH Settings

Provided are the following settings:

PCFICH Configuration
Comprises the PCFICH settings:

PCFICH Power ← PCFICH Configuration
Sets the power of the PCFICH (P_{PCFICH}).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PCFich:POWer
on page 505

Control Region for PDCCH ← PCFICH Configuration
Sets the size of the control region, i.e. the number of OFDM Symbols that the region spans.

Whether 1, 2, 3 or 4 OFDM Symbols can be reserved for PDCCH depends on the parameters given in the following table.

Channel Bandwidth	PHICH Duration	Duplex. Mode	OFDM Symbols in	The control region
			Normal Subframe	Special Subframe
No RB > 10	Normal	FDD	1, 2 ,3	-
	Normal	TDD	1, 2, 3	1, 2
	Extended	FDD	3	-
	Extended	TDD	3	2
No RB <=10	Normal	FDD	2, 3, 4	-
	Normal	TDD	2, 3, 4	2
	Extended	FDD	3, 4	-
	Extended	TDD	3, 4	2

The size of the control region can vary per subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:BW on page 446
[:SOURce<hw>]:BB:EUTRa:DL:PHICh:DURation on page 452
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PCFich:CREGion
on page 505

7.7.3 PHICH Settings

Provided are the following settings:

Number of PHICH Groups
Displays the number of available PHICH groups, depending on the value of the parameter PHICH N_g.

This parameter is enabled for configuration only if the parameter "PHICH N_g" is set to "Custom".

- For normal CP, one PHICH group consists of 8 ACK/NACK messages from several users.
- For extended CP, one PHICH group carries 4 ACK/NACK messages from several users.

Each PHICH group uses 3 resource element groups (REGs); hence the total number of REGs used for PHICH is 3 times the number of PHICH groups.

The number of the available OFDM symbols for the allocation of this total number of REGs depends on the selection made for the parameter PHICH Duration (normal or extended).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:NOGRoups`
on page 507

Power Mode
Determines whether all PHICHs in a PHICH group are sent with the same power or enables the adjustment of each P_{PHICH} individually.

The parameter Power Info displays the power values of the configured PHICHs.

"Constant" The power of a PHICH (P_{PHICH}) in a PHICH group is set with the parameter Power.

"Individual" The power of the individual PHICHs is set in the PHICH Power Config dialog.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:PMODe` on page 506

PHICH Power
Sets the power of one PHICH (P_{PHICH}) in a PHICH group, i.e. the total power of one PHICH group is the sum of the power of the transmitted PHICHs within this group.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:POWer` on page 506

PHICHs Table
Comprises the settings of the PHICHs.

ACK/NACK Pattern Group 0 .. 9 ← PHICHs Table
Sets the ACK/NACK pattern for the corresponding PHICH group.

A "1" indicates an ACK, a "0" - a NACK, a "-" indicates DTX.

DTX means that the corresponding PHICH is not transmitted, i.e. the orthogonal sequence is not used.

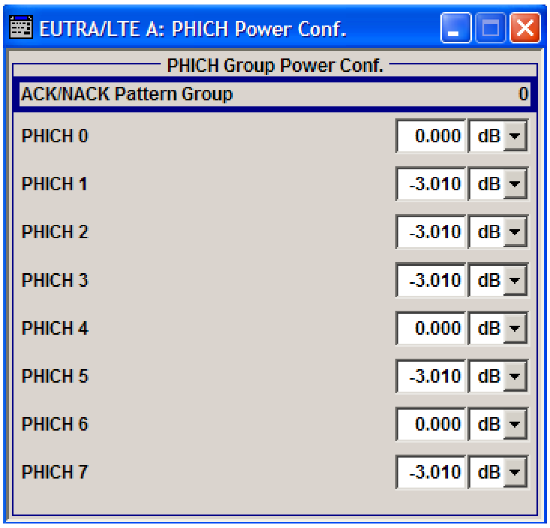
Since the number of ACK/NACK messages carried by a PHICH group depends on the Cyclic Prefix, a pattern group consists of 8 or 4 values for normal and extended CP respectively.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:ANPattern<ch0>
on page 507

Power Info ← PHICHs Table
Displays the power values of the configured PHICHs.

Remote command:
n.a.

Power Settings Config. ← PHICHs Table
Opens the "PHICH Power Config". dialog to configure the power of the PHICHs individual.



"ACK/NACK Pattern Group"	Displays the ACK/NACK pattern group the values are adjusted for.
"PHICH 0..7"	Sets the power of the individual PHICHs

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:GROup<ch0>:ITEM<dir0>:POW on page 507

7.7.4 PDCCH Settings

Provided are the following settings:

PDCCH Power
Sets the power of the PDCCH (P_{PDCCH}).

The value set with this parameter is also displayed in the allocation table for the corresponding allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:POWer on page 508

Number of Bits / REGs / CCEs (PDCCH)
Displays the number of bits / REGs / CCEs allocated for PDCCH.

The number of bits available for PDCCH allocation depends on the selected:
- Channel Bandwidth
- Global MIMO Configuration
  Number of PHICH Groups
- PHICH Duration
- Control Region for PDCCH

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:BITS on page 508

Number of available REGs (PDCCH)
Defines the number of the REGs that are available for the PDCCH allocation.

The number of REGs available for PDCCH allocation depends on the Number of Bits available for PDCCH ($\#Bits_{PDCCH}$) and is calculated as follows:

$\#REGs\ available_{PDCCH} = \#Bits_{PDCCH} / 8$

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:AVRegs
on page 508

Number of available CCEs (PDCCH)
Defines the number of the control channel elements (CCEs) that are available for the PDCCH allocation.

The PDCCH is mapped to the REGs not used for PHICH and PCFICH and transmitted on one or several CCEs, where a CCE corresponds to 9 REGs, i.e. the number of the available CCEs is calculated as follows:

$\#CCEs\ available_{PDCCH}$ = #REGs available PDCCH / 9

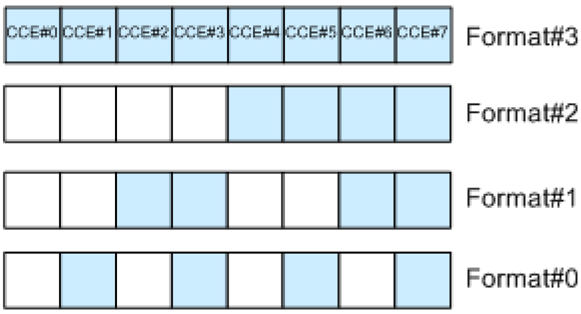
Note: If "Activate Carrier Aggregation > ON", the parameter "Number of available CCEs (PDCCH)" displays information about the PCell.
Information related to the SCells is displayed by the corresponding parameter Number of Dummy CCEs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:AVCCes
on page 509

PDCCH Format
Sets the PDCCH format.

The PDCCH format determines how many CCEs (control channel elements) are used for the transmission of the PDCCH, i.e. determines how many PDCCHs (#PDCCH) can be transmitted.

The following figure shows the distribution of the PDCCH over the CCEs for the different formats.



"Variable" Select this mode to enable full flexibility by the configuration of the downlink control information (DCI) format and content (see Chapter 7.7.5, "PDCCH Format Variable", on page 182).

"-1" Proprietary format for legacy support.

This format corresponds to the transmission of one PDCCH on all available REGs, i.e.
- REGs available PDCCH = #REGs allocated PDCCH,
- #PDCCH = 1,
- #DummyREGs = 0.

"0" One PDCCH is transmitted on one CCE, i.e. #REG=1.

"1" One PDCCH is transmitted on two CCEs, i.e. #REG=18.

"2" One PDCCH is transmitted on four CCEs, i.e. #REG=36.

"3" One PDCCH is transmitted on eight CCEs, i.e. #REG=72.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:FORMat`
on page 509

Number of PDCCHs
(for "PDCCH Format" different than "Variable")

Sets the number of PDCCHs to be transmitted.

The maximum number PDCCH that can be transmitted on the available REGs for PDCCH depends on the number of REGs (#REG) reserved for the transmission of one PDCCH, i.e. depends on the selected PDCCH Format and is calculated as follows:

#PDCCH = REGs available PDCCH / #REG.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:NOPDcchs`
on page 509

Number of REGs allocated to PDCCH
(for "PDCCH Format" different than "Variable")

Defines the number of REGs that are allocated for PDCCH transmission (#REGs allocated$_{PDCCH}$) and is calculated as follows:

#REGs allocated$_{PDCCH}$ = #PDCCH * #REG

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:ALRegs
on page 510

Number of Dummy REGs
(for "PDCCH Format" different than "Variable")

Displays the number of REGs that are available for the PDCCH allocation but are not allocated and is calculated as follows:

#DummyREGs = REGs available PDCCH - #REGs allocated PDCCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DREGs on page 510

Data Source
(for "PDCCH Format" different than "Variable")

Selects the data source for PDCCH.

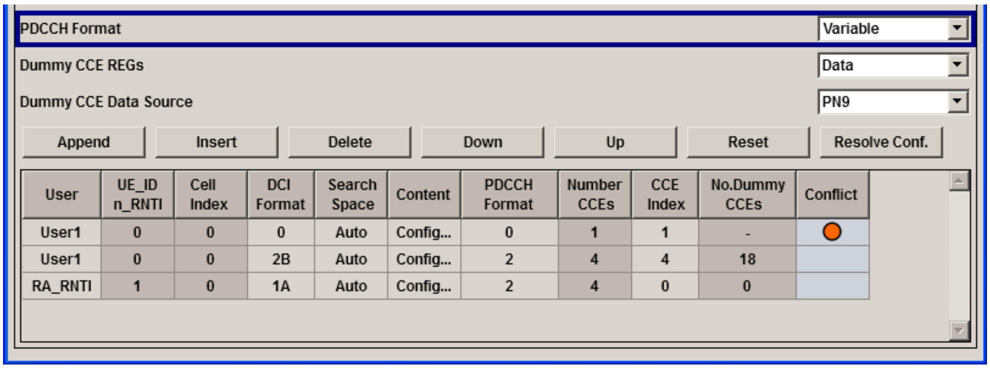
The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

  See also "Main Dialog > Data List Management".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DATA on page 511
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:PATTern
on page 511
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:PATTern
on page 511

7.7.5 PDCCH Format Variable

► To enable the settings described in this section, select "PDCCH Format > Variable".



Use these parameters and the DCI table to configure the multiple scheduling messages (DCIs) with the corresponding PDCCHs.

Dummy CCE REGs

Sets the behavior of the dummy REGs, i.e. determines whether dummy data or DTX is transmitted.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:TRSource`

on page 512

Dummy CCE Data Source

Selects the data source for the dummy CCE.

The following standard data sources are available:

- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

  See also "Main Dialog > Data List Management".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:DATA on page 512
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:PATTern on page 513
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:DSELect on page 513

Standard configuration functions

Standard configuration functions:

"Append" Adds a row at the end of the table.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:APPend on page 514

"Insert" Insert a new row before the current one.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:SITem on page 513
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:INSert on page 514

"Delete" Deletes the selected row.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:DELete on page 514

"Down/Up" Moves the selected row down or up.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:DOWN`
on page 515
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:UP`
on page 515

Reset
Resets the table.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:RESet`
on page 516

Resolve Conflicts
The "Resolve Conf." is a built-in algorithm that reassigns automatically the CCE values depending on the configured "Search Space"; previously configured CCE values are not maintained. If the conflict cannot be resolved automatically, the values are left unchanged.

For more information on how to solve DCI conflicts, see Chapter 5.1.3, "DCI Conflict Handling", on page 59.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:SOLVe?`
on page 516
To query the number of current conflicts:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:CONFlicts?`
on page 515

DCI Table
Comprises the settings concerning the PDCCH content.

Number of Used PDCCH Items ← DCI Table
Displays the number of the PDCCH items, i.e. the number of rows in the DCI table.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:UITems`
on page 516

User ← DCI Table
Selects the User the DCI is dedicated to. The available DCI Format depend on the value of this parameter.

Note: If "Activate Carrier Aggregation > ON", the Cell Index determines the component carrier the corresponding User is mapped to.
To enable one particular User in more than one component carrier, append several table rows and enable the same User in the different component carriers.

"User 1 .. 4" Selects one of the four users configured in the User Configuration Settings dialog.
The DCIs of an inactive user ("User State> Off") are not configurable and not considered by the calculation of "No. Dummy CCEs".

"P-RNTI/S-RNTI/RA-RNTI"
A group of users is selected.

"User x SPS"
Indicates an activated semi-persistent scheduling (SPS) for the corresponding user.

"None" Allows free definition of all settings

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:USER` on page 519

UE_ID/n_RNTI ← DCI Table
Displays the UE_ID or the n_RNTI for the selected PDCCH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:UEID` on page 517

Cell Index ← DCI Table
Determines the component carrier the corresponding DCI is transmitted on.

This parameter refers to the "DL Carrier Aggregation Configuration > Cell Index". The "Cell Index" of the PCell (Primary Cell) is always set to 0.

Example:

If the following settings are enabled in the "DL Carrier Aggregation Configuration" dialog, the value range of the parameter "Cell Index" is 0, 1, 3, 5 and 7.

Component Carrier	Cell Index
PCell	0
SCell#1	1
SCell#2	3
SCell#3	7
SCell#4	5

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CELL` on page 517

DCI Format ← DCI Table
Sets the DCI format for the selected PDCCH.

The downlink control information (DCI) is a message used to control the physical layer resource allocation in both the UL and DL direction and carries scheduling information as well as uplink power control commands. The DCI is mapped on the PDCCH and depending on the DCI message size and usage are categorized into four different formats that are further subdivided (see Table 7-11).

Table 7-11: Overview DCI Formats

DCI Format	Purpose
DCI Format 0	PUSCH allocation information
DCI Format 1 DCI Format 1A DCI Format 1B DCI Format 1C DCI Format 1D	PDSCH information with one codeword
DCI Format 2/2A/2B/2C	PDSCH information for MIMO configuration (two codewords)
DCI Format 3/3A	Uplink power control information

The fields of each DCI format are configurable parameters that can be adjusted in the corresponding dialog box. Select Content Config/ Content Act./Rel. to access this dialog box for the selected "DCI Format".

Not all DCI Formats are always enabled for selection. The following table gives an overview of the cross-reference between the available DCI Formats and the value of the parameter User.

User	DCI Format
P-RNTI/SI-RNTI/RA-RNTI	1A, 1C
User 1..4	1, 1A, 1B, 1D, 2, 2A, 2B, 2C
None	All formats

See also TS 36.212, chapter 5.3.3.1.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIFmt` on page 516

Search Space ← DCI Table
Defines the search space for the selected DCI, i.e. determines the valid CCE indexes.

The search space determines the set of CCEs a UE monitors. The UE can decode only the control information on a PDCCH that is transmitted over CCEs within the search space this UE monitors.

Note: The 3GPP specification defines two kinds of search spaces, the common and the UE-specific search space.
Avoid the use of the "Auto" and "Off" values; these values are provided for backwards compatibility reasons only.

"Off" No search space is determined, i.e. all CCEs are monitored.

"Auto" Provided for backward compatibility only.
An internal mapping to the common and UE-specific search space is applied depending on the selected user: for "User 1..4", "Auto" corresponds to "UE-spec"; in all other cases, "Auto" corresponds to "Common".

"Common" The DCI is mapped to the common search space.
A common search space is used when all or a group of UEs is addressed. The combination User 1 and common search space is enabled in PCell only.

"UE-spec" Non-common DCIs are mapped to the UE-specific search space.
Each UE has multiple UE-specific search space, determined as a function of the UE_ID and the subframe. A UE-specific search space applies for the User set to "User 1..4".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:SESPace` on page 519

Content Config/ Content Act./Rel. ← DCI Table

Opens the DCI Format Configuration dialog to configure the DCI fields of the selected DCI Format.

In the activation and release subframes of users that are semi-persistent scheduled (User > User x SPS), the function "Act./Rel." accesses the DCI Format Configuration dialog to configure the special fields for the SPS validation.

Remote command:
n.a.

PDCCH Format (Variable) ← DCI Table

Sets the PDCCH format.

The PDCCH format determines how many CCEs (control channel elements) are used for the transmission of the PDCCH.

The following table gives an overview of the supported PDCCH Formats, as defined in the 3GPP specification.

PDCCH format	Number of CCEs	Number of REGs	Number of PDCCH bits
0	1	9	72
1	2	18	144
2	4	36	288
3	8	72	576

"0" One PDCCH is transmitted on one CCE, i.e. #REG=1.

"1" One PDCCH is transmitted on two CCEs, i.e. #REG=18.

"2" One PDCCH is transmitted on four CCEs, i.e. #REG=36.

"3" One PDCCH is transmitted on eight CCEs, i.e. #REG=72.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:PFMT` on page 517

Number CCEs ← DCI Table

Defines the number of control channel elements used for the transmission of the PDCCH.

The value is determined by the selected PDCCH Format (Variable).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:NCCes on page 518

CCE Index ← DCI Table
Sets the CCE start index.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CINDex on page 518

Number of Dummy CCEs ← DCI Table
Defines the number of dummy CCEs that are appended to the corresponding PDCCH.

Note: If "Activate Carrier Aggregation > ON", the "Number of Dummy CCEs" is calculated per component carrier and depends on the selected Bandwidth.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:NDCCes on page 518

Conflict (DCI) ← DCI Table
Indicates a conflict between two DCI formats.

For more information on how to solve DCI conflicts, see Chapter 5.1.3, "DCI Conflict Handling", on page 59.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CONFlict? on page 519
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:CONFlicts? on page 515

7.7.6 DCI Format Configuration

For information on the provided settings, see also TS 36.212, chapter 5.3.3.1.

Carrier Indicator Field (CIF)
(Requires option R&S SMx/AMU-K85 LTE-A Rel. 10)

This field is enabled if:

- "Activate Carrier Aggregation > ON" and
- For each User with "Configure User > Activate CA".

The CIF is present in **each** DCI Format and identifies the component carrier that carries the PDSCH or PUSCH for the particular PDCCH in the cross-carrier approach (see Figure 3-28).

According to the LTE specification, cross-carrier scheduling is enabled by higher-level signaling. To simulate a cross-carrier scheduling in this implementation, enable the "DL Carrier Aggregation Configuration>CIF Present" per each component carrier/cell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 521

Bit Data

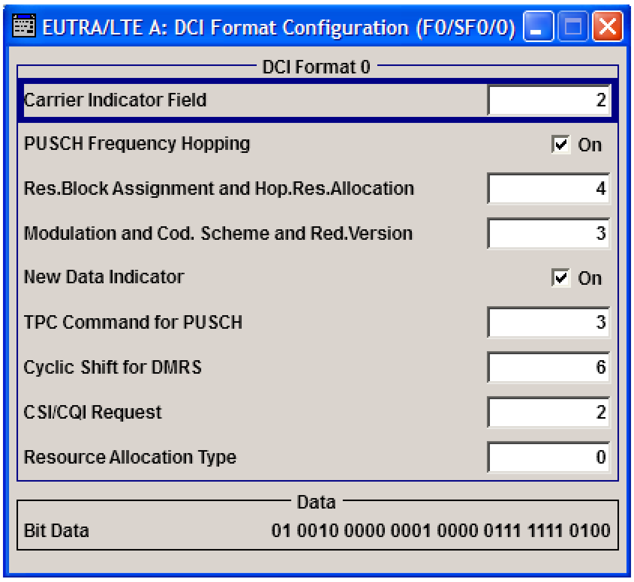
Displays the resulting bit data as selected with the DCI format parameters.

Mapping of the information bits is according to TS 36.212.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:BITData? on page 520

DCI Format 0

The DCI format 0 is used for scheduling uplink transmission on PUSCH and transmits the information listed in the following table.



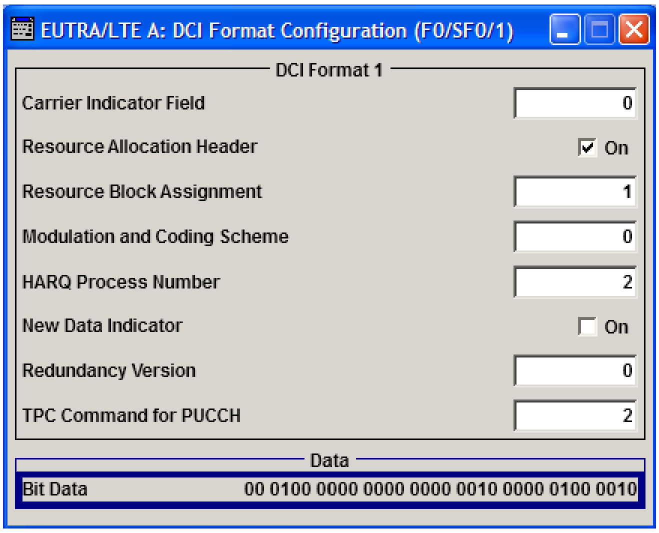
The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

If the DCI format is used for validation of the semi-persistent scheduling (SPS) activation or release, some special DCI fields are predefined according to Tables 9.2 in TS 36.213. See also Chapter 7.10, "SPS Configuration Settings", on page 209.

Control Information Field	SCPI command	Dependencies
"Carrier Indicator Field (CIF)"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 521	See "Carrier Indicator Field (CIF)" on page 188
"PUSCH Frequency Hopping"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PFHopping on page 525	
"Resource Block Assignment and Hopping Resource Allocation"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RAHR on page 527	
"Modulation and Coding Scheme and Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 525	
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI on page 525	
"TPC Command for PUSCH"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 530	
"Cyclic Shift for DMRS"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CSDMrs on page 523	
"UL Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:ULINdex on page 532	Enabled for TDD mode and TDD Frame Structure Settings 0
"Downlink Assignment Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 523	Enabled for TDD mode and UL/DL Configuration 1 to 6
"CSI/CQI Request"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CSIRequest on page 522	
"Resource Allocation Type"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RAType on page 527	

DCI Format 1

The DCI format 1 carries information for scheduling transmission of one codeword on PDSCH. The different fields of this format are summarized in the following table.



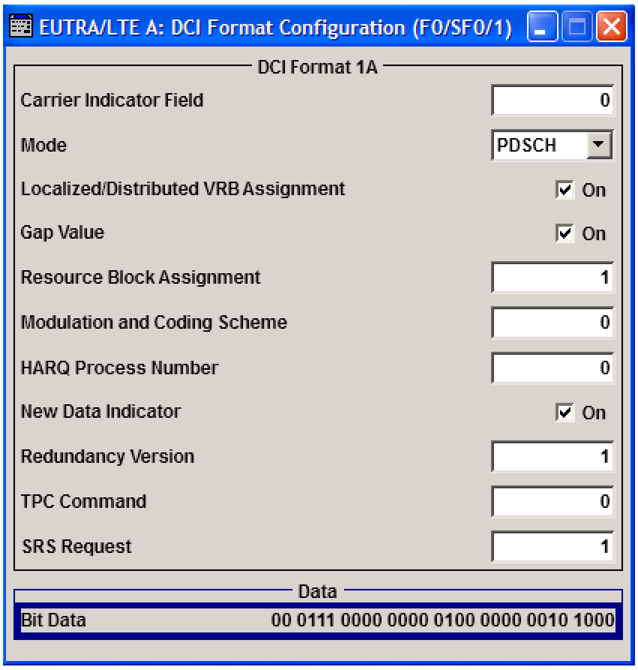
The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

If the DCI format is used for validation of the semi-persistent scheduling (SPS) activation or release, some special DCI fields are predefined according to Tables 9.2 in TS 36.213. See also Chapter 7.10, "SPS Configuration Settings", on page 209.

Control Information Field	SCPI command	Dependencies
"Carrier Indicator Field (CIF)"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 521	See "Carrier Indicator Field (CIF)" on page 188
"Resource Allocation Header"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RAH on page 526	Enabled for Channel Bandwidth > 10RBs
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 527	
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 525	
"HARQ Process Number"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN on page 524	
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI on page 525	
"Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RV on page 528	
"TPC Command for PUCCH"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 530	
"Downlink Assignment Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 523	Enabled for "TDD" mode

DCI Format 1A

DCI format 1A is used for the compact scheduling of one PDSCH codeword and random access procedure initiated by a PDCCH order.



The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

The contents of DCI Format 1A are listed in the following table; the available fields depend whether a PDSCH or PRACH is transmitted.

If the DCI format is used for validation of the semi-persistent scheduling (SPS) activation or release, some special DCI fields are predefined according to Tables 9.2 in TS 36.213. See also Chapter 7.10, "SPS Configuration Settings", on page 209.

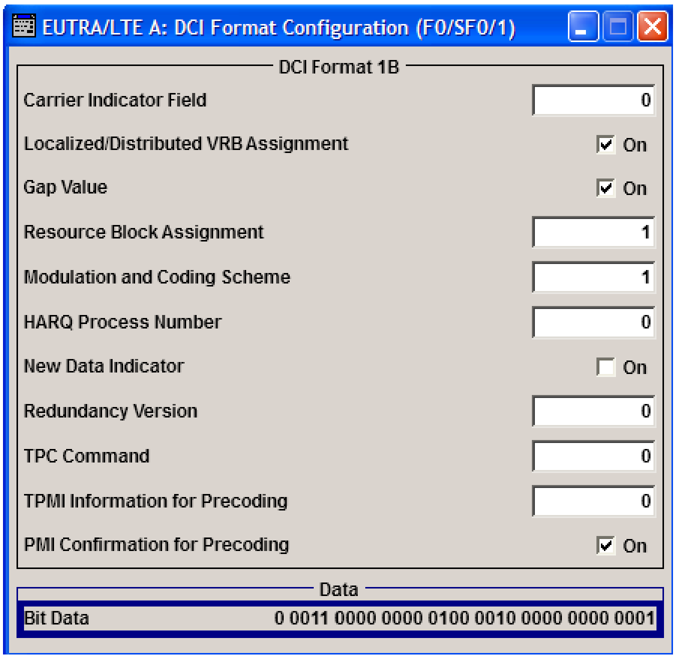
Control Information Field	SCPI command	Dependencies
"Carrier Indicator Field (CIF)"	`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField` on page 521	See "Carrier Indicator Field (CIF)" on page 188
"Mode"	`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:F1AMode` on page 521	
"Localized/Distributed VRB Assignment"	`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:VRBA` on page 532	
"GAP Value"	`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:GAP` on page 524	Enabled for "Channel Bandwidth >= 50RBs", Distributed VBR Assignment and User = User 1..4
"Resource Block Assignment"	`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA` on page 527	

Control Information Field	SCPI command	Dependencies
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 525	PDSCH Mode
"HARQ Process Number"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN on page 524	PDSCH Mode
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI on page 525	PDSCH Mode
"Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RV on page 528	PDSCH Mode
"TPC Command for PUCCH"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 530	PDSCH Mode
"Downlink Assignment Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 523	PDSCH Mode Enabled for "TDD" mode
"SRS Request"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:SRSRequest on page 528	Enabled for "User Configuration > User 1..4 > Aperiodic SRS > On"
"Preamble Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PRACh:PRINdex on page 521	PRACH Mode
"PRACH Mask Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PRACh:MINDex on page 522	PRACH Mode

DCI Format 1B

DCI format 1B is used for the compact scheduling of one PDSCH codeword with precoding information, i.e. when MIMO operation is involved.

The precoding information consists of 2 or 4 bits for 2 and 4 antennas respectively.



The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

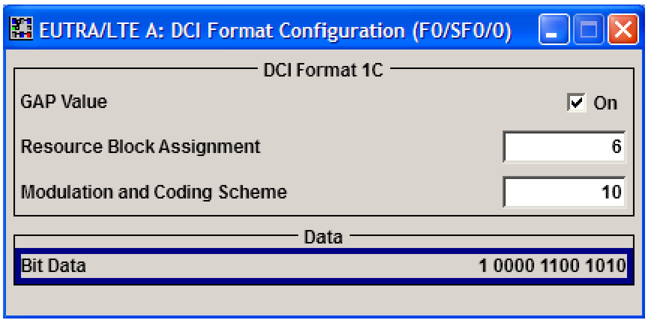
The DCI Format 1B transmits the information listed in the following table.

Control Information Field	SCPI command	Dependencies
"Carrier Indicator Field (CIF)"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 521	See "Carrier Indicator Field (CIF)" on page 188
"Localized/Distributed VRB Assignment"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:VRBA on page 532	
"GAP Value"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:GAP on page 524	Enabled for Channel Bandwidth >= 50RBs, Distributed VBR Assignment and User = User 1..4
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 527	
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 525	
"HARQ Process Number"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN on page 524	
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI on page 525	
"Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RV on page 528	

Control Information Field	SCPI command	Dependencies
"TPC Command for PUCCH"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 530	
"Downlink Assignment Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 523	Enabled for TDD mode
"TPMI Information for Precoding"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPMI on page 531	
"PMI Confirmation for Precoding"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PMI on page 526	

DCI Format 1C

DCI format 1C is used for compact scheduling of one PDSCH codeword.



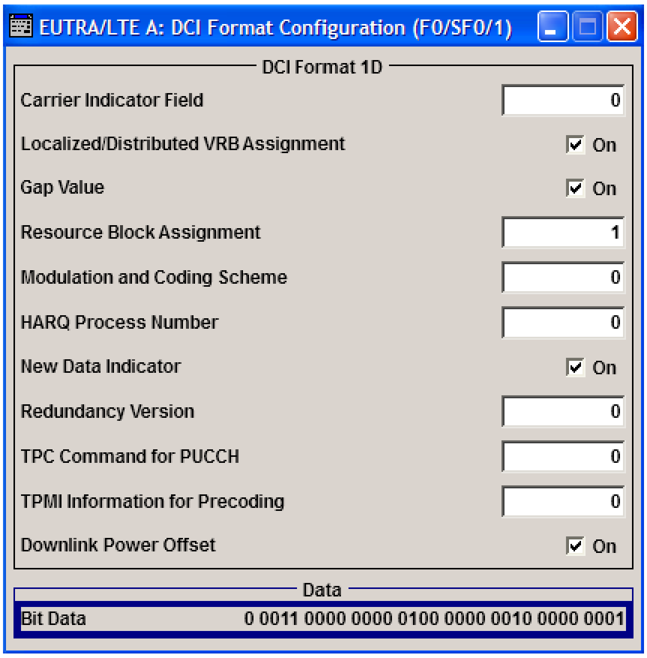
The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

The DCI Format 1C transmits the information listed in the following table.

Control Information Field	SCPI command	Dependencies
GAP Value	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:GAP on page 524	Enabled for Channel Bandwidth >= 50 RBs
Resource Block Assignment	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 527	
Modulation and Coding Scheme	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 525	

DCI Format 1D

DCI format 1D is used for the compact scheduling of one PDSCH codeword with precoding and power offset information.



The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

The DCI Format 1D transmits the information listed in the following table.

Control Information Field	SCPI command	Dependencies
"Carrier Indicator Field (CIF)"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 521	See "Carrier Indicator Field (CIF)" on page 188
Localized/Distributed	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:VRBA on page 532	
Resource Block Assignment	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 527	
GAP Value	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:GAP on page 524	Enabled for Channel Bandwidth >= 50RBs, Distributed VBR Assignment and User = User 1..4
Modulation and Coding Scheme	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 525	
HARQ Process Number	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN on page 524	
New Data Indicator	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI on page 525	
Redundancy Version	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RV on page 528	

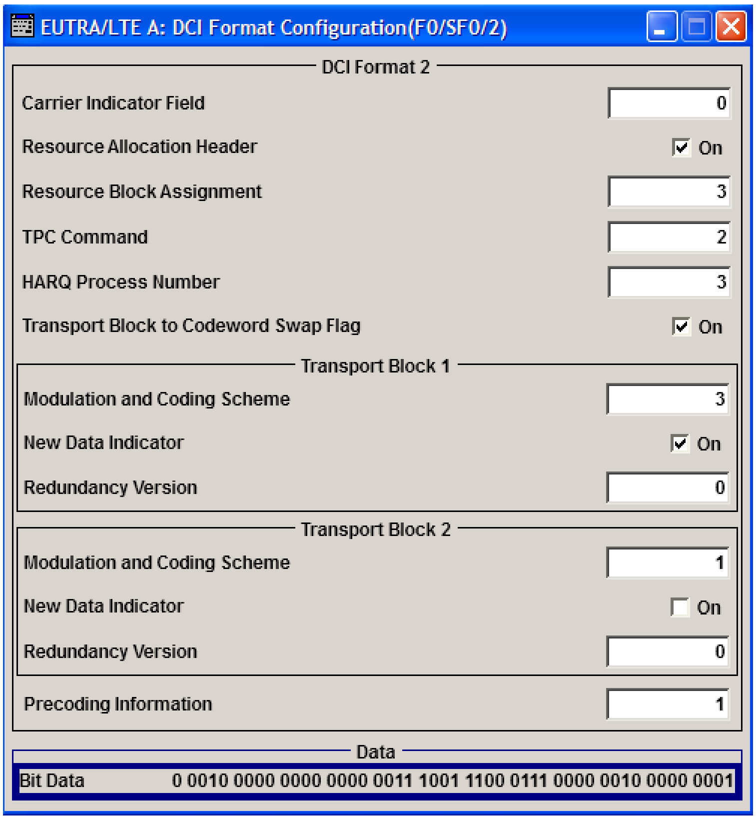
Control Information Field	SCPI command	Dependencies
TPC Command for PUCCH	`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC` on page 530	
Downlink Assignment Index	`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex` on page 523	Enabled for TDD mode
TPMI Information for Precoding	`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPMI` on page 531	
Downlink Power Offset	`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DPOFfset` on page 523	

DCI Format 2/2A/2B/2C

The DCI Format 2 is used for scheduling PDSCH when spatial multiplexing is configured. The DCI Format 2A is also used for the scheduling in a spatial multiplexing configuration, but without PMI feedback. The DCI Format 2B is enabled for 2-, 4-Tx-Antennas. The DCI Format 2C is enabled in a multi-layer transmissions (Tx Mode 9).

Since MIMO operation requires two codewords, the modulation and coding scheme, new data indicator and the redundancy version are signaled separately for each of the codewords. The spatial multiplexing also requires a transmission of precoding information.

The transport block to codeword mapping is performed according to the 3GPP specification, i.e. transport block 1 (TB1) is mapped to codeword 1/2 (CW1) and TB2 to codeword 2/2 (CW2). The "Transport Block to Codeword Swap Flag" determines the mapping in case both transport blocks are enabled. If this swap flag is enabled, the TB1 is mapped to CW2 and vice versa.



The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

If the DCI format is used for validation of the semi-persistent scheduling (SPS) activation or release, some special DCI fields are predefined according to Tables 9.2 in TS 36.213. See also Chapter 7.10, "SPS Configuration Settings", on page 209.

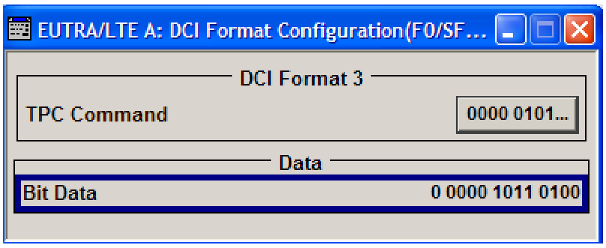
The DCI Format 2/2A/2B/2C transmits the information listed in the following table.

Control Information Field	**SCPI command**	**Dependencies**
"Carrier Indicator Field (CIF)"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 521	See "Carrier Indicator Field (CIF)" on page 188
Resource Allocation Header	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RAH on page 526	Enabled for Channel Bandwidth > 10 RBs
Resource Block Assignment	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 527	
TPC Command for PUCCH	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 530	
Downlink Assignment Index	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 523	Enabled for TDD mode
HARQ Process Number	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN on page 524	

Control Information Field	SCPI command	Dependencies
Ant. Port(s), Layers, SCID	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:APLayer on page 520	DCI Format 2C only
Transport Block to Codeword Swap Flag	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:SWAPflag on page 528	DCI Format 2/2A only
Scrambling Identity	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:SID on page 530	DCI Format 2B only
Precoding Information	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PRECinfo on page 526	DCI Format 2/2A only
	"Transport Block 1"	
Modulation and Coding Scheme	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB1:MCS on page 529	
New Data Indicator	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:NDI on page 529	
Redundancy Version	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB1:RV on page 530	
	"Transport Block 2"	
Modulation and Coding Scheme	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:MCS on page 529	
New Data Indicator	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:NDI on page 529	
Redundancy Version	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:RV on page 530	

DCI Format 3/3A

The DCI Format 3/3A is used for the transmission of TPC Commands for PUCCH and PUSCH with 2-bit and a single bit power adjustment respectively.



The "TPC Command" is set as a bit pattern.

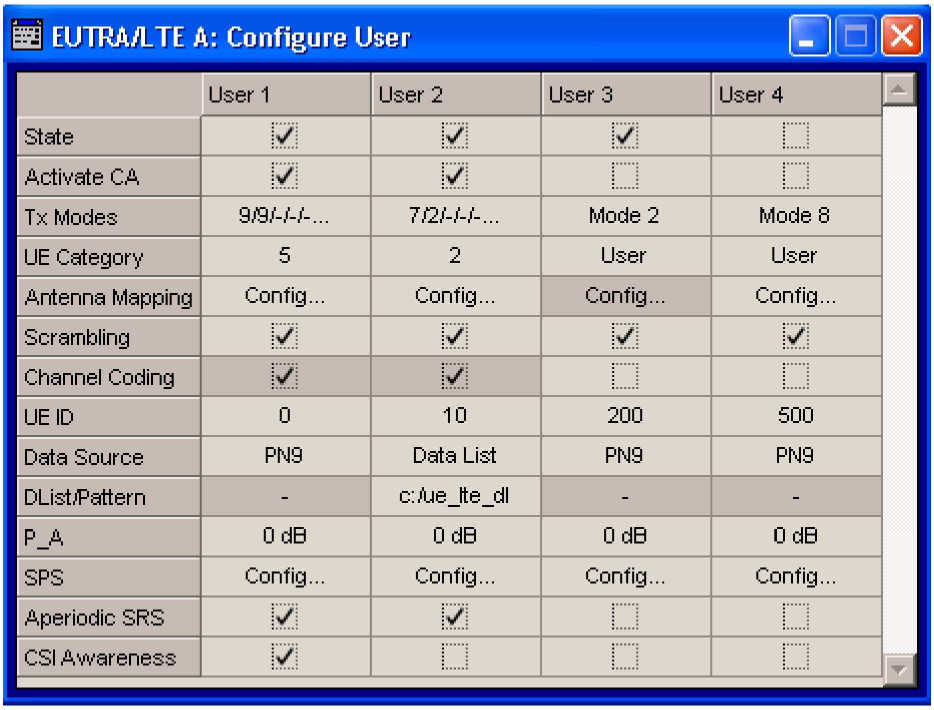
The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCinstr on page 531

7.8 User Configuration Settings

To access this dialog:

1. Select "General > Link Direction > Downlink (OFDMA)"
2. Select "General DL Settings > Scheduling > Manual".
3. Select "Frame Configuration > General > Configure User"


EUTRA/LTE A: Configure User

	User 1	User 2	User 3	User 4
State	☑	☑	☑	☐
Activate CA	☑	☑	☐	☐
Tx Modes	9/9/-/-/-...	7/2/-/-/-...	Mode 2	Mode 8
UE Category	5	2	User	User
Antenna Mapping	Config...	Config...	Config...	Config...
Scrambling	☑	☑	☑	☑
Channel Coding	☑	☑	☐	☐
UE ID	0	10	200	500
Data Source	PN9	Data List	PN9	PN9
DList/Pattern	-	c:/ue_lte_dl	-	-
P_A	0 dB	0 dB	0 dB	0 dB
SPS	Config...	Config...	Config...	Config...
Aperiodic SRS	☑	☑	☐	☐
CSI Awareness	☑	☐	☐	☐

Use the provided settings to configure up to 4 scheduled user equipments. To distribute them over the whole frame, set the data source of a certain allocation to "User 1 .. 4".
This makes sure that a common data source is used for allocations of one user equipment also in case that these allocations are non-adjacent.

In one subframe, all allocations belonging to the same User use identical settings. Changing for example the modulation of one of the allocations of user 1, changes the modulation in all other allocations of this user in the current subframe.

This applies for the following settings:

- Modulation
  Different modulations may be selected for the two codewords of an allocation.

	Code Word	Mod.	Enhanced Settings	No. RB	No. Sym.	Offs RB	Offs Sym.	Auto	Phys. Bits	Data Source	DList Pattern	Power /dB	Content Type	State	Confl.
0	1/1	QPSK	Config...	6	4	22	7(1/0)	Off	480	PN9	-	0.00	PBCH	On	
1	1/1	QPSK		50	2	0	0(0/0)	Off	-	PN9	-	0.00	PDCCH	Off	
2	1/1	QPSK	Config...	1	12	0	2(0/2)	On	264	PN9	-	0.00	PDSCH	On	
3	1/1	QPSK	Config...	1	12	1	2(0/2)	On	264	PN9	-	0.00	PDSCH	On	
4.1	1/2	16-QAM	Config...	1	12	2	2(0/2)	On	528	User3	-	0.00	PDSCH	On	
4.2	2/2	QPSK	Config...	1	12	2	2(0/2)	On	264		-			On	
5.1	1/2	16-QAM	Config...	1	12	3	2(0/2)	On	528	User3	-	0.00	PDSCH	On	
5.2	2/2	QPSK	Config...	1	12	3	2(0/2)	On	264		-			On	

- Complete Precoding Settings
- Scrambling Settings (Scrambling State, UE ID/n_RNTI) and Channel Coding State. See also the "Enhanced Settings" dialog of each allocation (Chapter 7.6, "Enhanced PBCH, PDSCH and PMCH Settings", on page 164).

For more details, see Chapter 4.9, "Data Allocations (DL)", on page 52.

User

Displays the consecutive number of the users.

Remote command:
n.a.

State

Enables/disables a user.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:STATe` on page 568

Activate CA

Requires software option R&S SMx/AMU-K85 (LTE-A Rel. 10)

Enables/disables carrier aggregation for the selected user.

If Activate Carrier Aggregation is enabled, carrier aggregation is activated automatically for all users, but can be deactivated afterwards.

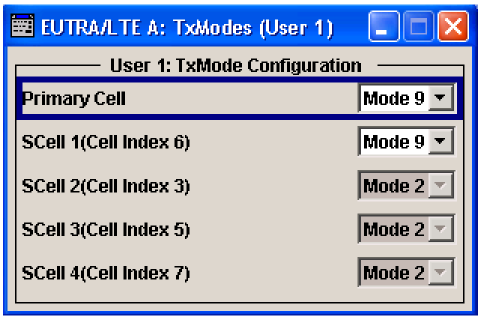
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CA:STATe` on page 568

Tx Modes

Sets the transmission mode of the user as defined in TS 36.213, section 7.1.

Consider the following prerequisites and interdependencies:

- "Tx Mode 8" and "Tx Mode 9" require the additional SW options R&S SMx/AMU-K84/K85.
- The selected "Tx Mode" determines the range of allowed DCI formats, that is you can only assign valid DCI formats to this user.
  For any PDSCH allocation, the software configures its "Precoding" as a function of the selected "Tx Mode" and the selected "DCI Format".
- In "Tx Mode > User", the range for valid DCI formats is not affected.
- If a carrier aggregation is enabled (Activate Carrier Aggregation = On and Activate CA = On), you access the "TxModes Configuration" dialog.



  You can define the transmission mode a user uses in the primary and the secondary cells.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:TXM on page 569
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:TXM on page 569

Configure Auto Sequence

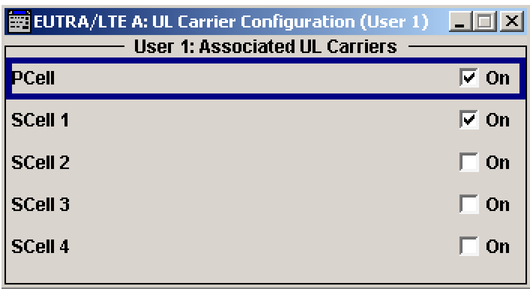
(requires option R&S SMx/AMU-K112)

If "General DL Settings > PDSCH Scheduling > Auto Sequence", access the "Auto Sequence" settings, see Chapter 7.5.3, "Auto Sequence Configuration", on page 148.

UL Carriers State

(requires option R&S SMx/AMU-K85)

If a carrier aggregation is enabled (Activate Carrier Aggregation = On), you can set the state of the associated UL carriers.



Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:ULCA<st0>:STATe on page 569

UE Category
Sets the UE Category.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEC` on page 569

Configure Ant. Mapping
For "Tx Mode = Tx Mode 7/Tx Mode 8/Tx Mode 9/User", use the DL Antenna Port Mapping Settings dialog to define the mapping of the logical antenna ports to the available physical Tx antennas.

Scrambling State
Enables/disables scrambling for all allocations belonging to the selected user.

That is, the parameter "Scrambling State" determines the "Enhanced Settings > Scrambling State" of all allocations for which you select the Data Source = "User 1..4".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:STATe` on page 571

Channel Coding State
Enables/disables channel coding for all allocations belonging to the selected user.

That is, the parameter "Channel Coding State" determines the "Enhanced Settings > Channel Coding State" of all allocations for which you select the Data Source = "User 1..4".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CCODing:STATe` on page 572

UE ID
Sets the user equipment ID.

The software uses this UE ID for the generation of the scrambling sequence for the allocations, for which you select the DL Frame Configuration Settings > Allocation Table > Data Source = "User 1..4".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEID` on page 572

Data Source, DList/Pattern
Selects the data source for the selected user.

The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.

– Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
– Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
– Use the standard "File Manager" function to transfer external data lists to the instrument.

See also "Main Dialog > Data List Management".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DATA on page 572
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DSELect on page 573
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:PATTern on page 573

P_A

Sets PDSCH power factor according to TS 36.213, chapter 5.2.

This power value is applied to all allocations that belong to the corresponding user. The power of an allocation is also determined by the parameter "PDSCH Scheduling Mode". In a normal operation, the power values in the allocation table are configurable parameters. In the "Auto/DCI" mode however, the power value is fixed and cannot be adjusted.

For the DCI format 1D, an additional level offset has to be considered.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:PA on page 573

SPS

Accesses the SPS Configuration Settings dialog to configure a semi-persistence scheduling for the selected user.

Aperiodic SRS

Configures if the user supports aperiodic transmission of SRS.

The aperiodic SRS transmission is a single (one-shot) transmission. Activate this parameter to be able to trigger SRS transmissions of the user by the DCIs.

Use the parameter DCI Format 1A > "SRS Request" to select one of the three SRS parameter sets.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:ASRS:STATe on page 574

CSI Awareness

Enables/disables the CSI awareness for the selected user, i.e. informs the UE that a CSI-RS are transmitted. See also Chapter 3.1.5.6, "CSI reference signals", on page 30.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CAW:STATe on page 574

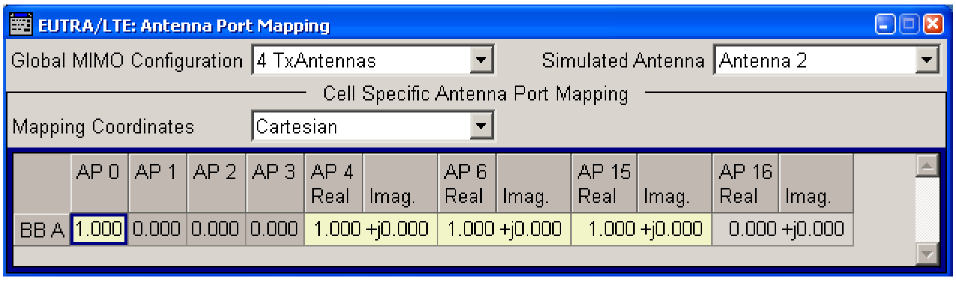
7.9 DL Antenna Port Mapping Settings

The 3GPP standard defines the different antenna ports for transmission in different transmission modes (TM, also "TxMode") and for the transmission of different reference signals. See Table 3-4 and Chapter 3.1.5, "Downlink Reference Signal Structure and Cell Search", on page 23.

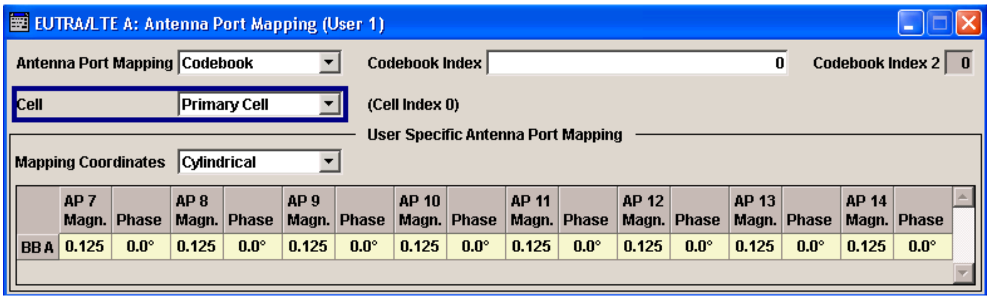
The settings necessary to configure the reference signals and to enable the transmission modes are distributed among different dialogs, depending on their type (cell-specific, user specific, etc.). The related antenna port mapping settings are distributed in these dialogs, too.

To access the antenna port mapping settings:

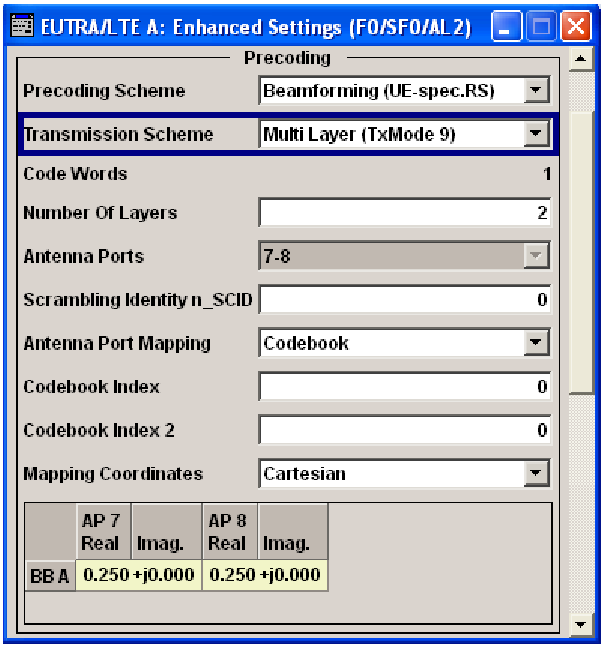
1. Select "General > Link Direction > Downlink (OFDMA)".
2. For configuration of the *cell-specific antenna port mapping*, select "General DL Settings > MIMO > Antenna Port Mapping".



3. For configuration of the *user-specific antenna port mapping*, select "Frame Configuration > General > Configure User > Antenna Mapping > Config".



4. For configuration of the PDSCH belonging to a particular user, for example an UE1:
   a) select "Frame Configuration > Subframe > Subframe Selection#0 > No. of Used Allocation = 3"
   b) select "Frame Configuration > Subframe > Allocation Table > All#2 > Data Source > UE1"
   c) select "Frame Configuration > Subframe > Allocation Table > All#2 > Enh. PDSCH Settings > Precoding"
   d) select "Precoding > Beamforming (UE-spec. RS)" and define the "Transmission Scheme"



Refer to Chapter 7.6.2, "Precoding Settings", on page 165 for description of the provided settings.

These dialogs comprise the settings necessary to configure the mapping of the logical antenna ports to the physical Tx antennas (Basebands). The number of physical antennas is set with the parameter "General DL Settings > Global MIMO Configuration".
The dialogs consist of two parts, a mapping table and a selection about the way the antenna mapping is performed.
The yellow matrix elements indicate the default antenna port to physical antenna (Tx antenna/baseband) mapping.

Mapping Methods

The antenna mapping can be performed according to one of the following three methods:

- "Codebook"
  The used precoding weights are according to the TS 36.211, table 6.3.4.2.3-1 resp. 6.3.4.2.3-2. The selected element is defined by the selected codebook index and the number of layers.
- "Random codebook"
  The precoding weights are selected randomly from the tables defined for the codebook method.
- "Fixed weight"
  A fixed precoding weight can be defined which is used for all allocations of the according “User” throughout the frame.

Depending on the selected mapping method, the mapping table is invisible ("Random codebook"), read-only ("Codebook") or full configurable ("Fixed weight").

Mapping Table

The mapping table is a matrix with number of rows equal to the number of physical Tx antennas and number of columns equal of the number of antenna ports (AP). The available antenna ports depend on the current configuration (see also Table 3-2).

- Antenna Ports AP0, AP1, AP2 and AP3 are always mapped to the four Tx antennas Tx1, Tx2, Tx3 and Tx4.
- Antenna Port AP4 is reserved for the MBSFN RS ("General DL Settings > MBSFN > State > Mixed") and per default mapped to "BB A".
- Antenna Port AP5 is reserved for the UE-specific RS (DM-RS) in TM7, AP7/AP8 are reserved for TM8
("Frame Configuration > General > User Configuration > Antenna Mapping > Config")
- Antenna Port AP6 is reserved for the PRS ("General DL Settings > PRS > State > ON") and per default mapped to "BB A".
- Antenna Ports AP9 - AP14 are used by TM9
("Frame Configuration > General > User Configuration > Antenna Mapping > Config")
- Antenna Ports AP15 - AP22 are reserved for and depends on the enabled antenna ports for the CSI-RS
("General DL Settings > CSI > State > ON" and "General DL Settings > CSI > Number of CSI-RS Antenna Ports").

Cell-Specific Antenna Port Mapping
(requires option R&S SMx/AMU-K84)

Comprises the settings for defining the mapping of the logical APs to the available physical Tx antennas.

Mapping Coordinates ← Cell-Specific Antenna Port Mapping
Switches representation between the "Cartesian (Real/Imag)" and "Cylindrical (Magn./Phase)" coordinates.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:MAPCoordinates` on page 444

Mapping table ← Cell-Specific Antenna Port Mapping
Defines the mapping of the antenna ports (AP) to the physical antennas, see "Mapping Table" on page 207.

The default mapping is selected to fit the current configuration but it can be changed afterwards.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:REAL on page 444
[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:IMAGinary on page 444

User Specific Antenna Port Mapping
Comprises the settings for defining the mapping of the logical APs to the available physical Tx antennas.

Antenna Port Mapping ← User Specific Antenna Port Mapping
Defines the antenna port mapping method, see Mapping Methods.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:MODE on page 571

Codebook Index/Codebook Index 2 ← User Specific Antenna Port Mapping
Sets the codebook index for codebook mapping method.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBINdex[<dir>] on page 570

Cell ← User Specific Antenna Port Mapping
Indicates the cell to that the antenna port mapping is related, if a carrier aggregation is enabled (Activate Carrier Aggregation = On and Activate CA = On).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CELL on page 570

Mapping Coordinates ← User Specific Antenna Port Mapping
Switches between the "Cartesian (Real/Imag.)" and "Cylindrical (Magn./Phase)" coordinates representation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:MAPCoordinates on page 570

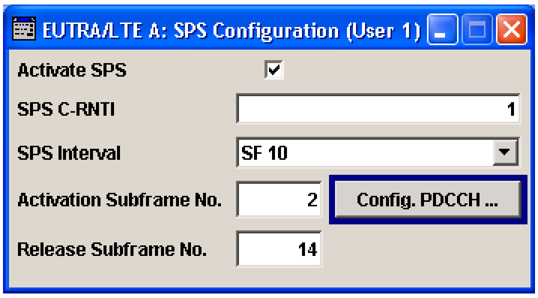
Mapping table ← User Specific Antenna Port Mapping
Defines the mapping of the antenna ports (AP) to the physical antennas, see also "Mapping Table" on page 207.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:AP<dir0>:TX<st0>:REAL on page 571
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:AP<dir0>:TX<st0>:IMAGinary on page 571

7.10 SPS Configuration Settings

To access this dialog:

1. Select "General > Link Direction > Downlink (OFDMA)"
2. Select "Frame Configuration > General > Configure User"
3. Select "User# > SPS > Config"



With the provided settings, you can enable and configure a semi-persistent scheduling (SPS) for the selected user.

Semi-persistent scheduling is a scheduling method used to reduce the control signaling overhead for regularly occurring services and transmissions of relative small payloads, see "Uplink scheduling" on page 38.

Related parameters

In this firmware, the configuration, the activation and the deactivation of an SPS transmission is implemented as following:

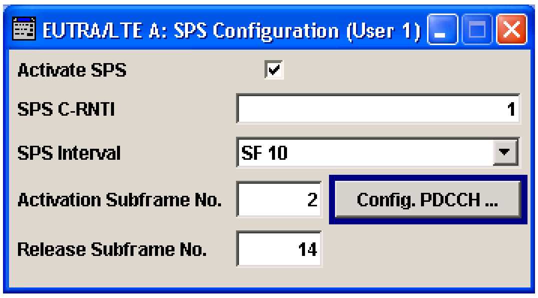
- Configuration of the SPS pattern is defined by:
  - SPS Interval
  - SPS C-RNTI
  - Activate SPS
- Activation of the SPS is defined by:
  - Activation Subframe No
  - Config PDCCH > "PDCCH Activation Subframe# > DCI Table > User > User x SPS > DCI Format" and
    "Content Act. > DCI Format Configuration > Special fields"
- Transmission
  Observe the scheduling in the OFDMA Timeplan
- Release of the SPS is defined by:
  - Release Subframe No
  - "Config PDCCH > PDCCH Release Subframe# > DCI Table > User > User x SPS > Content Rel > DCI Format Configuration > Special fields"

How to configure an SPS for User 1 and visualize the scheduling

The following is a simple example that demonstrates the necessary configuration steps and lists only the related settings. Setting beyond the scope of this example are not discussed.

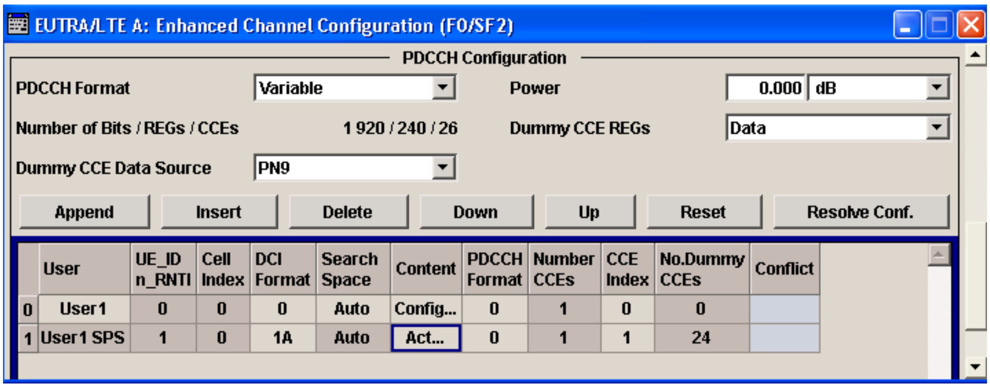
To enable a semi-persistent scheduling

1. Select "EUTRA/LTE > Filter/Clipping/ARB > ARB Sequence Length = 3 Frames".
2. Select "EUTRA/LTE > General DL Settings > PDSCH Scheduling > Auto/DCI".
3. Select "EUTRA/LTE > Frame Configuration" and enable "Number of Configurable Subframes = 30".
4. Select "Frame Configuration > General > Configure User" and enable "User 1 > SPS > Config".
5. In the "SPS Configuration" dialog, enable the following settings:



The User 1 is scheduled to start transmission in the subframe#2 and release it in subframe#14. The SPS interval is 10 SF. If the DCIs are configured correctly, the User 1 transmits in subframe#2 and subframe#12.

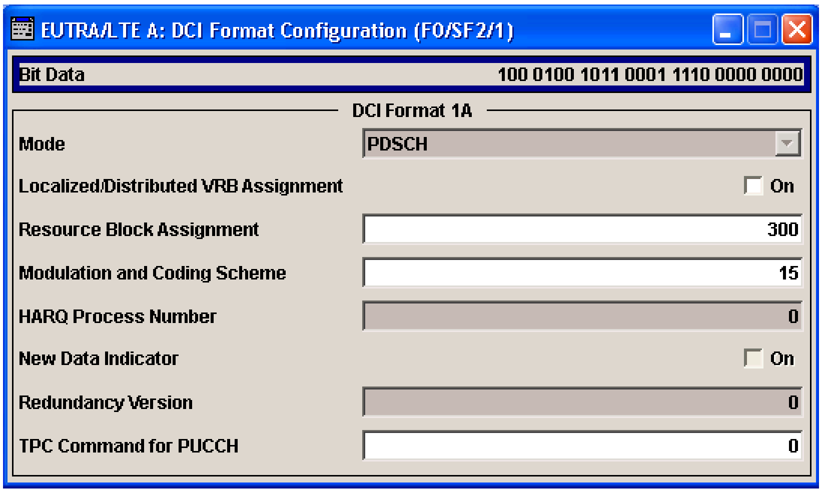
6. In the "SPS Configuration" dialog, select "Config. PDCCH".
In the "Frame Configuration" opens and displays the settings of subframe#2. Select "Configure PCFICH, PHICH, PDCCH", and navigate to the "PDCCH Configuration".



The second PDCCH item in the DCI table confirms that the User 1 is semi-persistent scheduled ("User > User 1 SPS") and subframe#2 is the activation subframe of this SPS ("User 1 SPS > Content > Act.").

7. In the "DCI Table", select "User 1 SPS > Content > Act."

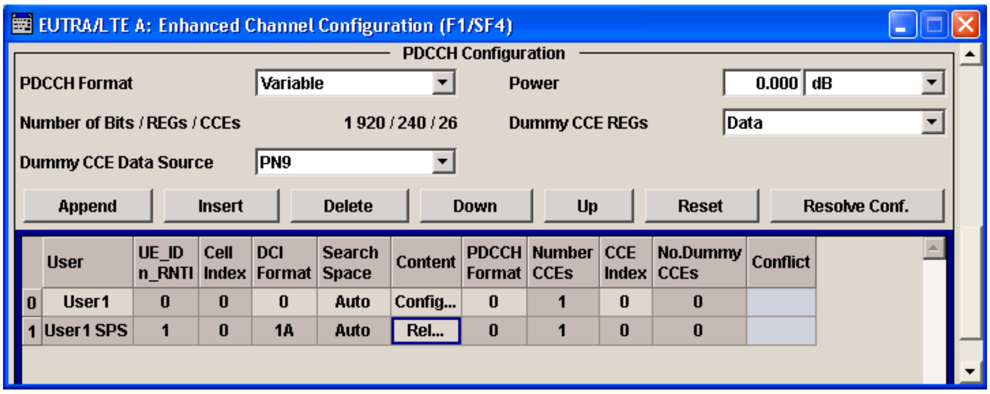
   The "DCI Configuration" dialog for DCI Format 1A opens. As defined in TS 36.213, same fields are predefined.



8. Adjust the DCI fields, for example set "Resource Block Assignment = 300" and "Modulation and Coding Scheme = 15".

   Note: In any SPS activation subframe, the maximum value allowed for the Modulation and Coding Scheme is 15; this corresponds to `0111` in binary form and is according to the requirements defined in TS 36.213.
   See also Table 7-12.

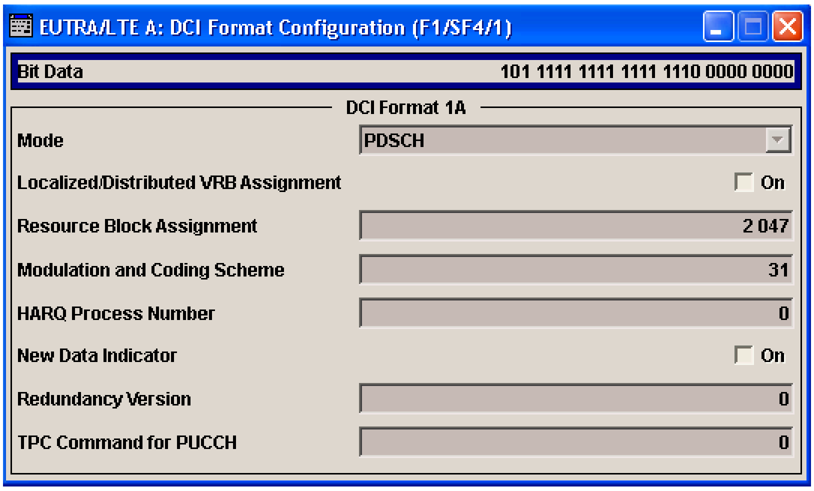
9. In the "Frame Configuration" dialog, select "Subframe = 14" and select "Configure PCFICH, PHICH, PDCCH > PDCCH Configuration".



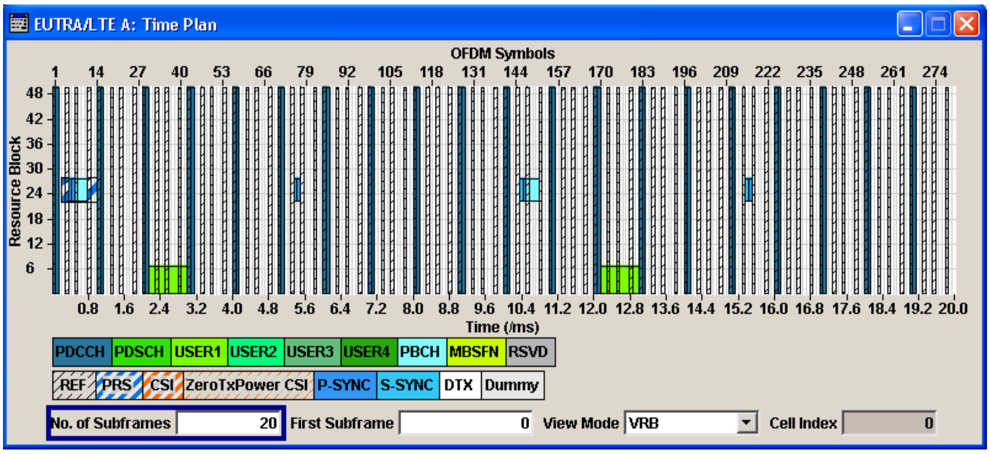
   The second PDCCH item in the DCI table confirms that the User 1 is semi-persistent scheduled ("User > User 1 SPS") and subframe#14 is the release subframe of this SPS ("User 1 SPS > Content > Rel.").

10. In the "DCI Table", select "User 1 SPS > Content > Rel."

    The "DCI Configuration" dialog for DCI Format 1A opens. The DCI fields are set as defined in TS 36.213; compare with the values in Table 7-12.



11. Open "Frame Configuration > OFDMA Timeplan" and enable:
    a) "No of Subframes = 20"
    b) "First Subframe = 0"



The time plan confirms User 1 transmission in subframe#2 and subframe#12.

12. Select "First Subframe = 10" to display the time plan of subframe#10 to subframe#20.

    There are no more subframes allocated to User 1; The SPS is released in subframe#14.

Activate SPS

Enables you to configure an SPS (semi-persistence scheduling) for the selected UE and triggers the instrument to generate the required DCIs.

Define the SPS pattern (SPS Interval) and select the exact subframe the SPS transmission starts and stops (Activation/Release Subframe No).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:STATe` on page 576

SPS C-RNTI
Sets the SPS C-RNTI parameter.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:CRNTi` on page 576

SPS Interval
Defines the SPS interval as number of subframes (SF).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SINTerval` on page 577

Activation/Release Subframe No
Defines the start and end subframes of the semi-persistent scheduling (SPS).

The UE validates an activation/deactivation request for an SPS only if the DCI fields are set as required, see "Config PDCCH" on page 213.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SACTivation` on page 577
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SRELease` on page 577

Config PDCCH
Accesses the PDCCH Format Variable dialog for configuring the required DCI settings in the activation subframe.

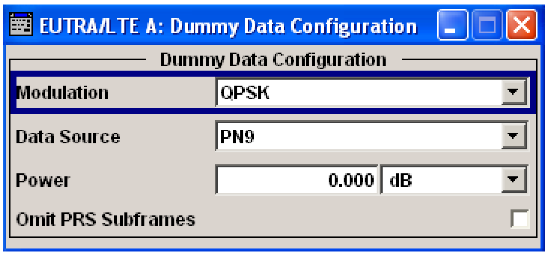
The UE validates an activation/deactivation request for an SPS only if the DCI fields are set according to Tables 9.2 in TS 36.213. The Table 7-12 is an example of the DCI format 1A fields (see also "DCI Format 1A" on page 192).

Table 7-12: PDCCH DCI format 1A fields for SPS activation and release/deactivation validation

Bit field	SPS activation value	SPS release value
"HARQ Process Number"	0	0
"Modulation and Coding Scheme"	0 .. 15	31
"Redundancy Version"	0	0
"Resource Block Assignment "	-	Set to all "1"

7.11 Dummy Data Configuration Settings

► To access this dialog, select "Frame Configuration > Behavior in Unsch. REs (OCNG) > Dummy Data ".



In this section, the dummy data for filling the unscheduled resource blocks and subframes are configured.

Modulation

Selects the modulation of the dummy data.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:DUMD:MODulation` on page 574

Data Source

Selects the data source for the dummy data configuration.

The following standard data sources are available:

- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

  See also "Main Dialog > Data List Management".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:DUMD:DATA` on page 575
`[:SOURce<hw>]:BB:EUTRa:DL:DUMD:PATTern` on page 575
`[:SOURce<hw>]:BB:EUTRa:DL:DUMD:DSELect` on page 575

Power (Dummy Data)

Sets the power of the subcarriers allocated with dummy data.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:DUMD:POWer` on page 574

Omit PRS Subframes
(requires option R&S SMx/AMU-K84)

If the OCNG (OFDM Channel Noise Generator) is used, you can disable (omit) the OCNG transmission in the non-muted PRS subframes, as required for RSTD Performance Tests (TS 36.133, section A.9.8.1).

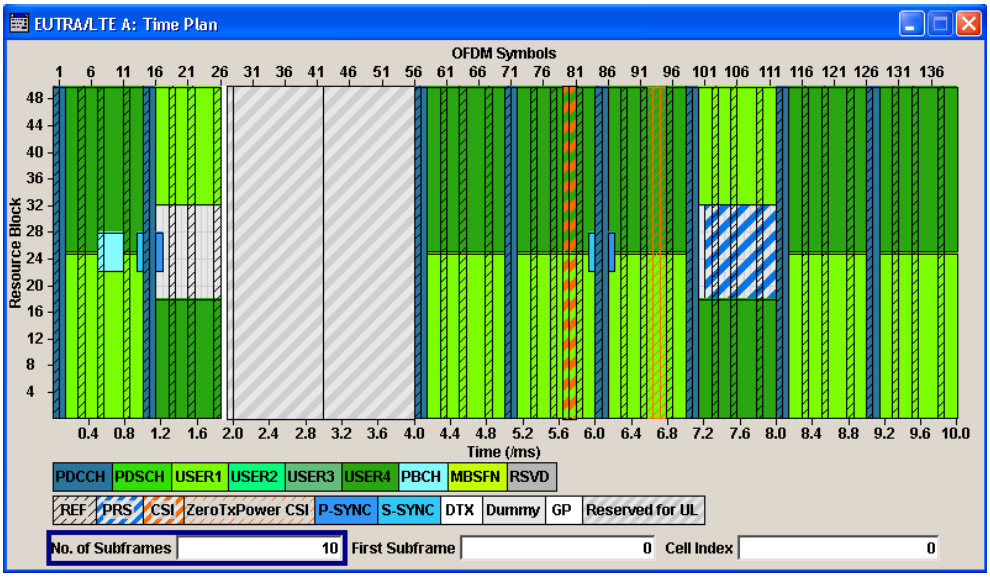
Tip: Use the OFDMA Timeplan to visualize the allocated resources.

See also Example "How to visualize the effect of muting and omitting PRS transmission" on page 137.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:DUMD:OPSubframes` on page 576

7.12 OFDMA Timeplan

1. To access this dialog, select "General > Link Direction > Downlink (OFDMA)".
2. Select "Frame Configuration > Time Plan".



The x-axis shows allocation in the time domain. The y-axis shows the resource blocks as smallest allocation granularity in the frequency domain. One allocation to a UE can span 1 to up to "No. of Resource Blocks" in the frequency domain.

P-SYNC/S-SYNC is automatically calculated according to the settings in General DL Settings dialog.

Cell Index
In enabled "General DL Settings > CA > Activate Carrie Aggregation > On" state, determines the time plan of which cell index (i.e. component carrier) is displayed.

Remote command:
n.a

First Subframe
Selects the first subframe to be displayed.

Remote command:
n.a.

No. of Subframes
Selects the number of subframes to be displayed.

Remote command:
n.a.

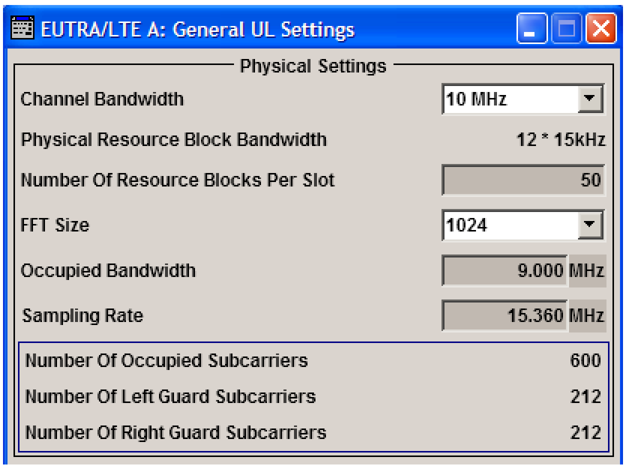
View Mode
Determines whether the time plan shows the allocated Virtual Resource Blocks (VRBs) or the Physical Resource Blocks (PRBs).

Remote command:
n.a.

7.13 General UL Settings

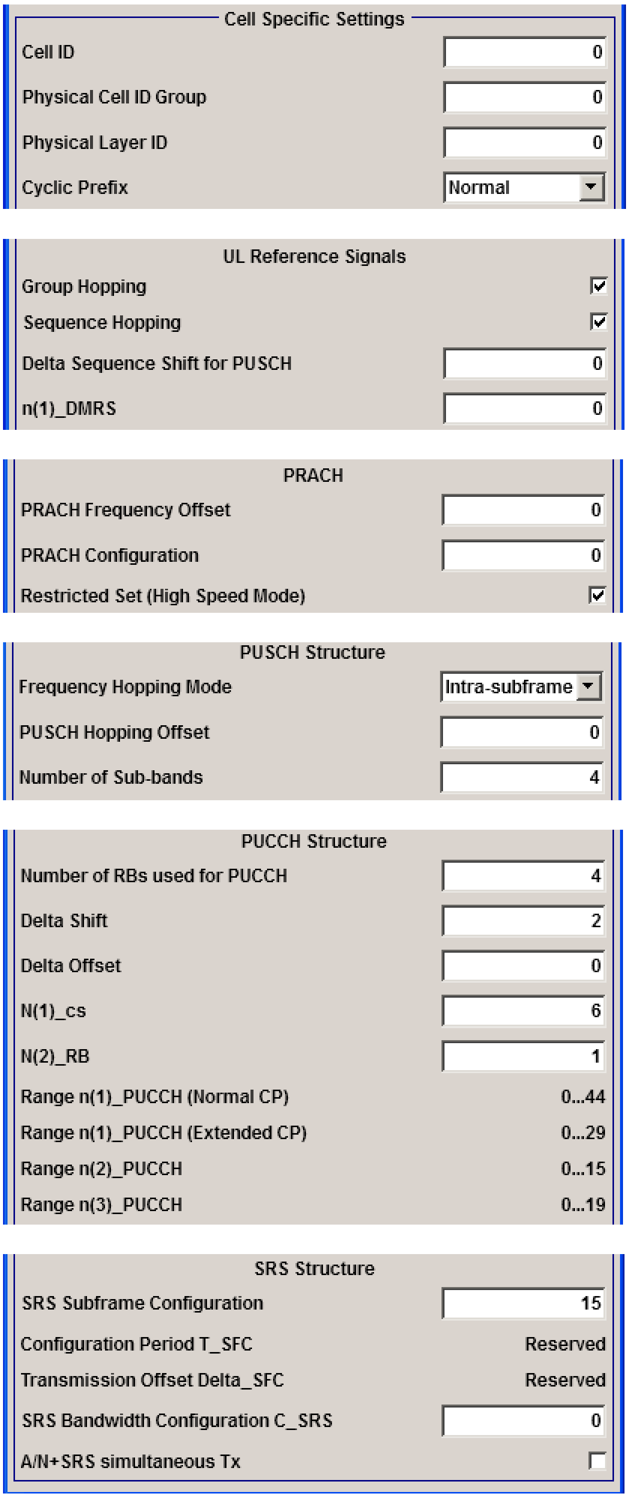
The General UL Settings menu allows configuring the EUTRA/LTE system for transmission direction uplink.

In the "Physical Settings" section, the channel bandwith respectively the number of resource blocks per slot is selected.



In the "Cell Specific Settings" section, the physical layer cell identity settings and the structure of the PUSCH, PUCCH, PRACH, SRS and the uplink reference signals are set.

The other parameters are fixed and read-only.

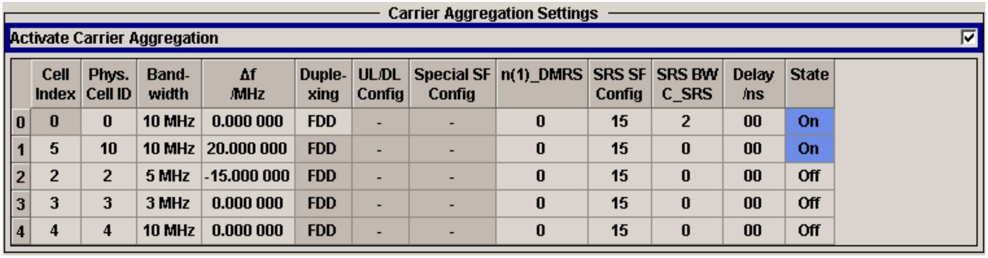


7.13.1 UL Carrier Aggregation Configuration

UL Carrier Aggregation is an LTE-A (LTE Rel 11) feature enabled for instruments equipped with software options R&S SMx/AMU-K55 and R&S SMx/AMU-K112.

To access this dialog:

1. Select "Baseband > EUTRA/LTE > General > Link Direction > Uplink (SC-FDMA)".
2. Select "General UL Settings > CA".



Carrier Aggregation Settings

Activate Carrier Aggregation

	Cell Index	Phys. Cell ID	Band-width	Δf /MHz	Duple-xing	UL/DL Config	Special SF Config	n(1)_DMRS	SRS SF Config	SRS BW C_SRS	Delay /ns	State
0	0	0	10 MHz	0.000 000	FDD	-	-	0	15	2	00	On
1	5	10	10 MHz	20.000 000	FDD	-	-	0	15	0	00	On
2	2	2	5 MHz	-15.000 000	FDD	-	-	0	15	0	00	Off
3	3	3	3 MHz	0.000 000	FDD	-	-	0	15	0	00	Off
4	4	4	10 MHz	0.000 000	FDD	-	-	0	15	0	00	Off

The "General UL Settings > CA" dialog provides the settings for the configuration of one primary cell (PCell) and up to four secondary cells (SCell). The most important SCell settings are grouped in the "Carrier Aggregation" dialog.

The cell-specific parameters, like the PUCCH and PUSCH configuration, the DRS and SRS transmission and the antenna port mapping are configurable in the User Equipment Configuration dialog of the corresponding UE.

7.13.1.1 About UL Carrier Aggregation

This section lists implementation related information.

The following apply, if UL Carrier Aggregation is enabled:

- Combination of FDD and TDD is not possible.
- Component carriers are configured independent from each other. Their settings are calculated automatically from the configured PCell settings and depending on the parameters in the "UL Carrier Aggregation Configuration" dialog.
- Simultaneous support of LTE and LTE-A UEs is provided
- UE settings are configurable; they are however the same for each cell
- Realtime Feedback is not supported

Limitation of the LTE-A bandwidth

The LTE specification defines a maximum Channel Bandwidth of 20MHz and aggregation of up to five component carriers to achieve 100MHz bandwidth.

The R&S Signal Generator configured to generate more than one component carrier per baseband automatically applies the multi carrier function. In this case, the maximum bandwidth of the generated LTE-A signal is restricted by the instrument's hardware.

In R&S SMU, the RF bandwidth of multi carrier signal is limited to 80MHz.

Using the maximum sampling rate, the R&S SMBV equipped with the options R&S SMBV-B10/K522 can internally generate multi carrier signals with up to 160 MHz RF bandwidth.

7.13.1.2 Carrier Aggregation Settings

The cell-specific parameters, like the PUCCH and PUSCH configuration, the DRS and SRS transmission and the antenna port mapping are configurable in the User Equipment Configuration dialog of the corresponding UE.

This section describes the following settings:

Activate Carrier Aggregation
Enables/disables the generation of several component carriers.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CA:STATe` on page 550

Component Carrier Table
The table provides the settings of the component carriers.

The first row displays the settings of the PCell as configured in the General UL Settings dialog.

The following four rows provide the configurable settings of the up to four SCells.

Cell Index ← Component Carrier Table
Sets the cell index of the corresponding SCell.

The cell index of the PCell is always 0.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:INDex` on page 550

Physical Cell ID ← Component Carrier Table
Sets the physical Cell ID of the corresponding component carrier.

The value of the parameter "General UL Settings > Cell ID (UL)" is set automatically to the physical cell ID of the PCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:ID` on page 550

Bandwidth ← Component Carrier Table
Sets the bandwidth of the corresponding component carrier.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:BW` on page 550

delta f / MHz ← Component Carrier Table
Sets the frequency offset between the central frequency of corresponding SCell and the frequency of the PCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DFReq` on page 551

Duplexing ← Component Carrier Table
Selects the duplexing mode of the PCell. The duplexing mode of the SCells is set accordingly.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DUPLexing` on page 551

TDD UL/DL Configuration ← Component Carrier Table
Sets the Uplink-Downlink Configuration number, i.e. defines which subframe is used for downlink respectively uplink, and where the special subframes are located.

The individual carriers may use different "UL/DL Configuration". Use the SC-FDMA Time Plan to visualize them.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:UDConf` on page 551

TDD Special Subframe Config ← Component Carrier Table
Sets the Special Subframe Configuration number, i.e. together with the parameter Cyclic Prefix defines the lengths of the DwPTS, the Guard Period and the UpPTS.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:SPSConf` on page 552

n(1)_DMRS ← Component Carrier Table
Sets the part of the demodulation reference signal (DMRS) index that is used by the calculation of the DMRS sequence, transmitted by the PCell/SCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DMRS` on page 552

SRS Subframe Configuration ← Component Carrier Table
Sets the cell-specific parameter SRS subframe configuration of the PCell/SCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:SUConfiguration on page 552

SRS Bandwidth Configuration C_SRS ← Component Carrier Table
Sets the cell-specific parameter SRS Bandwidth Configuration (C_{SRS}) of the PCell/SCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:CSRS on page 552

Delay / ns ← Component Carrier Table
Sets the time delay of the SCell relative to the PCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:TDELay on page 553

State ← Component Carrier Table
Activates/deactivates the component carrier.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:STATe on page 553

7.13.2 Physical Settings

Provided are the following settings:

Channel Bandwidth (UL)
Sets the channel bandwidth of the EUTRA/LTE system.

Although the 3GPP specification bases on bandwidth agonistic layer 1 and channel bandwidth is determined by specifying the desired number of resource blocks, the current EUTRA standardization focuses on six bandwidths (1.4, 3, 5, 10, 15 and 20 MHz).

For backward compatibility with previous version of the implementation, this parameter allows the flexibility to choose, whether a user defined bandwidth or one of the pre-defined channel bandwidths is used.

If a pre-defined channel bandwidth is selected; the actual "Number of Resource Blocks Per Slot" is internally calculated for the selected "Channel Bandwidth" and "Physical Resource Block Bandwidth".

The sampling rate, occupied bandwidth and FFT size are therefore determined by the parameter "Number of Resource Blocks Per Slot". If required, the FFT Size can be adjusted.

See also Table 4-1 for an overview of this cross-reference between the parameters.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:BW` on page 456

Physical Resource Block Bandwidth (UL)
Displays the bandwidth of one physical resource block.

Note: In this release, this value is fixed to 12 x 15 kHz.

Remote command:
n.a.

Number of Resource Blocks Per Slot (UL)
This parameter determines the channel bandwidth.

If the parameter "Channel Bandwidth" is set to one of the pre-defined channel bandwidths (1.4, 3, 5, 10, 15 or 20 MHz), the value "Number of Resource Blocks Per Slot" is read only and is automatically set according to the selected channel bandwidth and "Physical Resource Block Bandwidth".

If a user defined channel bandwidth is selected, the parameters "Number of Resource Blocks Per Slot" and "Physical Resource Blocks Bandwidth" determine the actual channel bandwidth.

The sampling rate and the occupied bandwidth are determined by the parameter "Number of Resource Blocks Per Slot". If required, the FFT Size can be adjusted.

See also Table 4-1 for an overview of this cross-reference between the parameters.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:NORB` on page 456

FFT Size (UL)
Sets the FFT (Fast Fourier Transformation) size. The available values depend on the selected "Number of Resource Blocks Per Slot".

See also Table 4-1 for an overview of this cross-reference between the parameters.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:FFT` on page 457

Occupied Bandwidth (UL)
Displays the occupied bandwidth. The value is automatically set according to the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:OCCBandwidth?` on page 457

Sampling Rate (UL)
Displays the sampling rate. The value is automatically set according to the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:SRATe?` on page 457

Number Of Occupied Subcarriers (UL)
Displays the number of occupied subcarriers. The value is automatically set according to the parameter "Number of Resource Blocks Per Slot".

See also Table 4-1 for an overview of this cross-reference between the parameters.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:OCCSubcarriers? on page 457

Number Of Left Guard Subcarriers (UL)
Displays the number of left guard subcarriers. This value is set automatically according to the parameter "Number of Resource Blocks Per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:LGS? on page 458

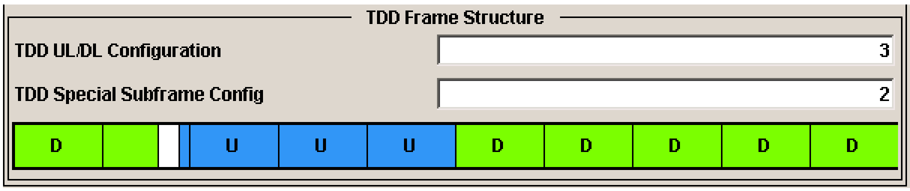
Number Of Right Guard Subcarriers (UL)
Displays the number of right guard subcarriers. This value is set automatically according to the parameter "Number of Resource Blocks Per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RGS? on page 458

7.13.3 TDD Frame Structure Settings

Access:

► Select "EUTRA/LTE > Duplexing > TDD".



The TDD frame is configured by adjusting the UL/DL configuration and the special subframe configuration (see also Chapter 3.1.1, "OFDMA Parameterization", on page 18).

TDD UL/DL Configuration
Sets the Uplink-Downlink Configuration number, i.e. defines which subframe is used for downlink respectively uplink, and where the special subframes are located.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TDD:UDConf on page 441

TDD Special Subframe Config
Sets the Special Subframe Configuration number, i.e. together with the parameter Cyclic Prefix defines the lengths of the DwPTS, the Guard Period and the UpPTS.

The DwPTS length selected with this parameter determines the maximum number of the OFDM symbols available for PDSCH in the special subframe.

The UpPTS length selected with this parameter determines the maximum number of the SC-FDMA symbols available for SRS in the special subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TDD:SPSConf` on page 441

7.13.4 Cell-Specific Settings

In the "Cell-Specific Settings" section, the physical layer cell ID settings, the UL Reference Signal settings, the PUSCH, PUCCH and PRACH structures are selected, as well as cell-specific SRS parameters.

Provided are the following settings:

Cell ID (UL)
Sets the cell identity.

There are 504 unique physical layer cell identities (Cell ID), grouped into 168 unique physical cell identity groups that contain three unique identities each. The Cell ID is calculated as following:

Cell ID = 3*Physical Cell ID Group + Physical Layer ID

There is a cross-reference between the values of this three parameters and changing of one of them results in adjustment in the values of the others.

The Cell ID determinates:
- the reference signal grouping hopping pattern,
- the reference signal sequence hopping,
- the PUSCH demodulation reference signal pseudo-random sequence,
- the cyclic shifts and scrambling sequences for all PUCCH formats
- the pseudo-random sequence used for scrambling
- the pseudo-random sequence used for type 2 PUSCH frequency hopping.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CID` on page 458

Physical Cell ID Group (UL)
Sets the ID of the physical cell identity group.

To configure these identities, set the parameter Physical Layer ID.

The physical layer cell identities determine the sequence shift pattern used for PUCCH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CIDGroup` on page 459

Physical Layer ID (UL)
Sets the identity of the physical layer within the selected physical cell identity group, set with parameter Physical Cell ID Group.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:PLID` on page 459

Cyclic Prefix (General UL Settings)
Sets the cyclic prefix length for all subframes.

The number of the SC-FDMA symbols is set automatically.

"Normal"	Normal cyclic prefix, i.e. the UL slot contains 7 SC-FDMA symbols.
"Extended"	Extended cyclic prefix, i.e. the UL slot contains 6 SC-FDMA symbols. The extended cyclic prefix is defined in order to cover large cell scenarios with higher delay spread and MBMS transmission.
"User Defined"	The cyclic prefix length can vary over the subframes. The cyclic prefix length is set per subframe in the "UL Frame Configuration" dialog with the parameter Cyclic Prefix.

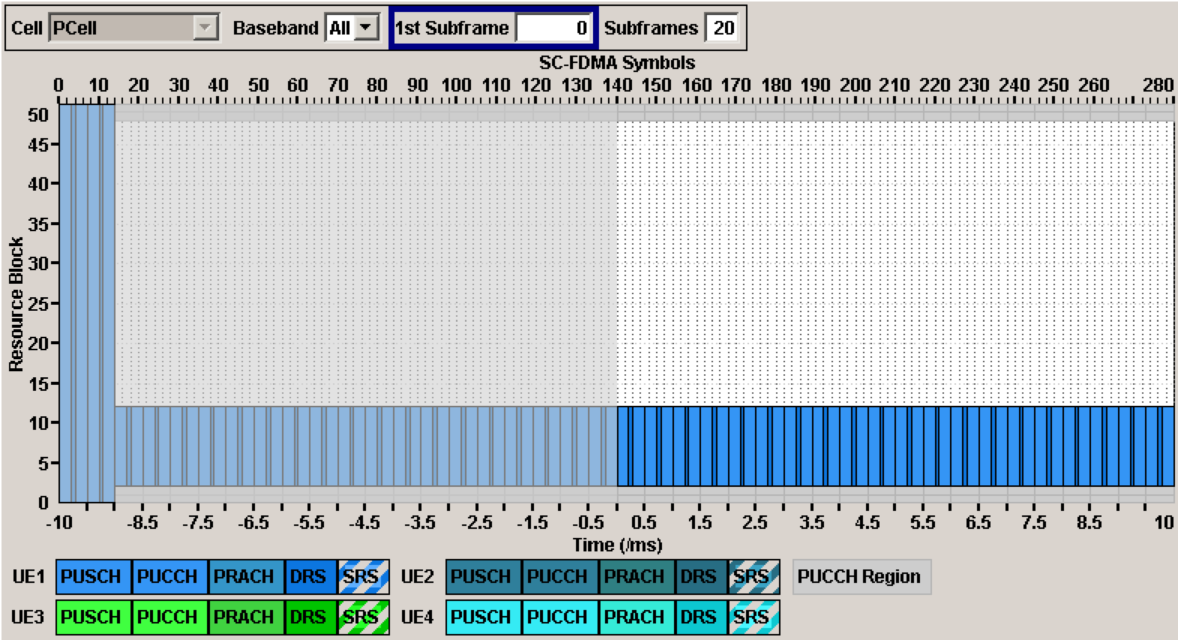
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CPC` on page 459

SFN Offset
By default, the counting of the SFN (System Frame Number) starts with 0. Use this parameter to set a different start SFN value, e.g. to skip a defined number of frames.

Example: Visualizing the SFN offset in the SC-FDMA time plan

Perform the following:

- Select "EUTRA/LTE > General > Filter/Clipping/ARB ...".
- Select "ARB > Sequence Length = 100 Frames".
- Select "General > Link Direction > Uplink (SC-FDMA)".
- Select "General > General Settings > Cell > SFN Offset = 1".
- Select "General > Frame Configuration > No. of PUCCH Config = No. PUSCH Config. = 40".
- Select "Frame Configuration > Subframe#0 > PUSCH > No. of RB = 50".
- Select "Frame Configuration > Time Plan" and set "Subframes = 20".



Remote command:

[:SOURce<hw>]:BB:EUTRa:UL:SOFFset on page 460

UL/DL Cyclic Prefix

In "Duplexing > TDD", determines the cyclic prefix for the appropriate opposite direction.

Remote command:

[:SOURce<hw>]:BB:EUTRa:UL:DLCPc on page 460

[:SOURce<hw>]:BB:EUTRa:DL:ULCPc on page 450

7.13.5 UL Reference Signals

Group Hopping

Enables/disables group hopping for the uplink reference signals demodulation reference signal (DMRS) and sounding reference signal (SRS).

17 different hopping patterns and 30 different sequence shift patterns are used for group hopping.

PUSCH and PUCCH use the same group hopping pattern that is calculated if the "Group Hopping" is enabled. The group hopping pattern is generated by a pseudo-random sequence generator.

The sequence shift pattern of PUCCH is derived from the physical layer cell ID set as a combination of the parameters Physical Cell ID Group and Physical Layer ID.

The PUSCH sequence shift pattern is determinate by the parameter Delta Sequence Shift for PUSCH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:GRPHopping` on page 460

Sequence Hopping

Enables/disables sequence hopping for the uplink reference signals demodulation reference signal (DRS) and sounding reference signal (SRS).

Sequence Hopping and Group Hopping can be activated simultaneously, but only group hopping will be applied in this case, as defined in TS 36.211.

The sequence hopping is generated by a pseudo-random sequence generator.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SEQHopping` on page 461

Delta Sequence Shift for PUSCH

Sets the delta sequence shift for PUSCH needed for the calculation of the group hopping pattern.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DSSHift` on page 461

n(1)_DMRS

Sets the part of the demodulation reference signal (DMRS) index which is broadcasted and therefore valid for the whole cell. This index applies when multiple shifts within a cell are used and is used by the calculation of the DMRS sequence.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DMRS` on page 461

7.13.6 PRACH Settings

The cell-specific parameters in this section determine the PRACH configuration according to the 3GPP TS 36.211.

The UE-specific parameters, necessary for the complete definition of the PRACH, are configurable in the User Equipment Configuration dialog of the corresponding UE.

PRACH Frequency Offset

For preamble formats 0-3, sets the prach-FrequencyOffset $n^{RA}_{PRBoffset}$ as defined in the 3GPP TS 36.211, i.e. determines the first physical resource block available for PRACH expressed as a physical resource block number that fulfills the equation:

$0 <= n^{RA}_{PRBoffset} <=$ Number of UL Resource Blocks - 6

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:FOFFset` on page 463

PRACH Configuration

Sets the PRACH configuration index as defined in the 3GPP TS 36.211, i.e. defines the time and frequency resources in which random access preamble transmission is allowed.

The PRACH allocation occupies a bandwidth of 6 RBs.

However, the PRACH distribution (subframe, length, offset) depends on several other parameters:

- selected "Cyclic Prefix"
- selected PRACH Frequency Offset
- selected frame format, i.e. on the selected "Duplexing" on page 84 mode
- selected Frequency Resource Index (for TDD mode).

Not all combinations of channel bandwidth, PRACH configuration and PRACH frequency offset are allowed.

The table below gives an overview on the dependency of the value range of the parameter "PRACH Configuration" and other parameters.

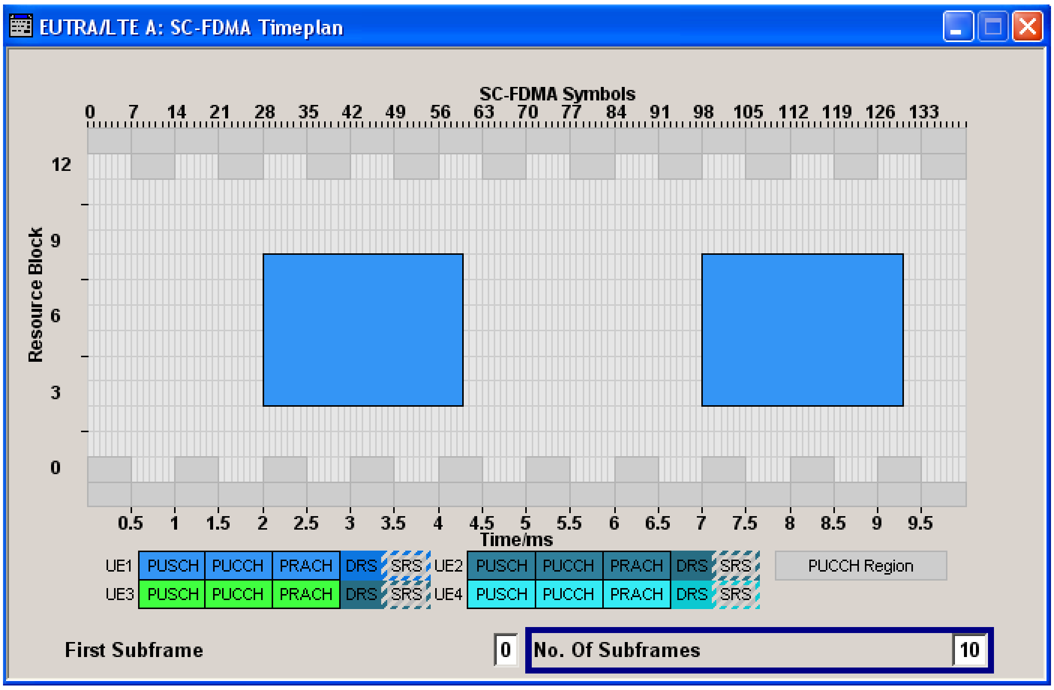
Duplexing Mode	TDD Special Subframe Config	(Global) Cyclic Prefix	PRACH Configuration
FDD	-	Normal/Extended	0 .. 63
TDD	0 .. 3	Normal/Extended	0 .. 47
	4	Normal	0 .. 47
	4	Extended	0 .. 57
	5 .. 8	Normal/Extended	0 .. 57

The Preamble Format is automatically derived form the "PRACH Configuration".

Use the SC-FDMA Time plan to display the PRACH distribution.

Example:

The timeplan below illustrates the PRACH distribution of a PRACH Configuration#55 (Preamble Format#3) for FDD duplexing mode and normal "Cyclic Prefix" with adjusted PRACH frequency Offset.



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:CONFiguration on page 463

Restricted Set (High Speed Mode)

Selects whether a restricted preamble set (high speed mode) or the unrestricted preamble set (normal mode) will be used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:RSET on page 464

7.13.7 PUSCH Structure

Provided are the following settings:

Frequency Hopping Mode

Sets the frequency hopping mode for PUSCH.

Frequency hopping is applied according to TS 36.213.

"Inter-sub-frame"	The PUSCH position in terms of used resource blocks is changed each subframe.

"Intra-sub-frame"	Both intra- and inter-subframe hopping are performed. The PUSCH position in terms of used resource blocks is changed each slot and each subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:FHMode on page 464

PUSCH Hopping Offset

Sets the PUSCH Hopping Offset N_{RB}^{HO}.

The PUSCH Hopping Offset determines the first physical resource block and the maximum number of physical resource blocks available for PUSCH transmission if PUSCH frequency hopping is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:FHOFfset on page 464

Number of Sub-bands

Sets the number of sub-bands (N_{sb}) into that the total range of physical resource blocks available for PUSCH transmission is divided. The frequency hopping is performed at sub-band level.

The size of one sub-band is determinate by the number of resource blocks available for PUSCH transmission, the "Number of Sub-bands" and the PUSCH hopping parameters.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NOSM on page 465

7.13.8 PUCCH Structure

Provided are the following settings:

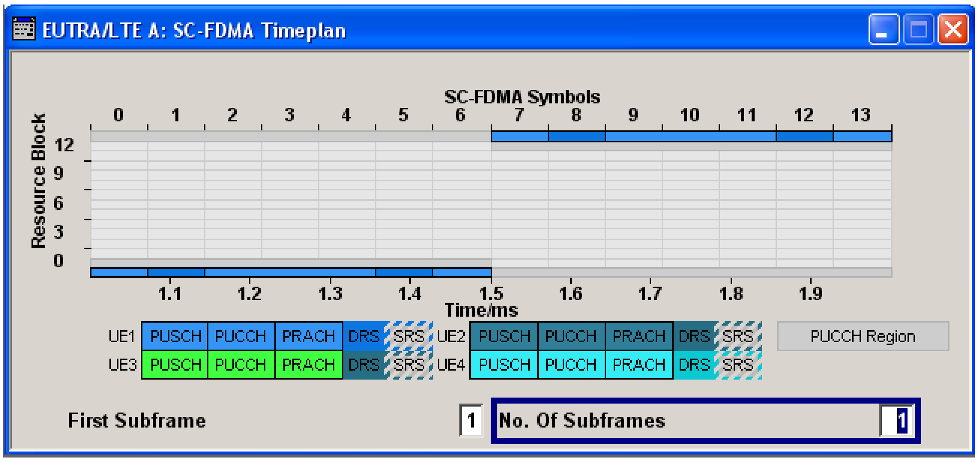
Number of RBs used for PUCCH

Sets the PUCCH region in terms of reserved resource blocks, located at the edges of the channel bandwidth (see Figure 3-19).

The PUCCH region is displayed on the SC-FDMA Timeplan.

Example:

The figure below shows an example of a subframe with PUCCH region with three reserved resource blocks and PUCCH Format 2a.



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:NORB on page 465

Delta Shift

Sets the delta shift parameter, i.e. the cyclic shift difference between two adjacent PUCCH resource indices with the same orthogonal cover sequence (OC).

The delta shift determinates the number of available sequences in a resource block that can be used for PUCCH formats 1/1a/1b (see also Chapter 3.2.3, "Uplink Control Information Transmission", on page 34).

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:DESHift on page 465

N(1)_cs

Sets the number of cyclic shifts used for PUCCH format 1/1a/1b in a resource block used for a combination of the formats 1/1a/1b and 2/2a/2b.

Only one resource block per slot can support a combination of the PUCCH formats 1/1a/1b and 2/2a/2b.

The number of cyclic shifts available for PUCCH format 2/2a/2b N(2)_cs in a block with combination of PUCCH formats is calculated as follow:

N(2)_cs = 12 - N(1)_cs -2

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1CS on page 466

N(2)_RB

Sets bandwidth in terms of resource blocks that are reserved for PUCCH formats 2/2a/2b transmission in each subframe.

Since there can be only one resource block per slot that supports a combination of the PUCCH formats 1/1a/1b and 2/2a/2b, the number of resource block(s) per slot available for PUCCH format 1/1a/1b is determinate by "N(2)_RB".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2RB on page 466

Range n(1)_PUCCH (Normal CP)
Displays the range of the possible PUCCH format 1/1a/1b transmissions from different users in one subframe and in case of normal CP.

Insufficient ranges are displayed as '-'.

This parameter determines the value range of index n_PUCCH for PUCCH format 1/1a/1b in case of normal cyclic prefix.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1NMax? on page 466

Range n(1)_PUCCH (Extended CP)
Displays the range of the possible PUCCH format 1/1a/1b transmissions from different users in one subframe and in case of Extended CP.

Insufficient ranges are displayed as '-'.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1EMax? on page 467

Range n(2)_PUCCH
Displays the range of possible number of PUCCH format 2/2a/2b transmissions from different users in one subframe.

Insufficient ranges are displayed as '-'.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2Max? on page 467

Range n(3)_PUCCH
Displays the range of possible number of PUCCH format 3 transmissions from different users in one subframe.

Insufficient ranges are displayed as '-'.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N3Max? on page 467

7.13.9 SRS Structure

The cell-specific parameters in this section determine the structure of the sounding reference signal (SRS) according to the TS 36.211.

To configure the UE-specific parameters, necessary for the complete definition of the SRS structure and SRS mapping, use the settings in the "User Equipment" > Sounding Reference Signal (SRS) dialog.

To enable an aperiodic SRS transmission, use the parameters:

- "DL Frame Configuration > Configure User" > Aperiodic SRS.
- "SRS Request" flag in the DCI formats "DL Frame Configuration > PDCCH > DCI Format > Config", for example DCI Format 1A.

- SRS set parameters in the "User Equipment" > Sounding Reference Signal (SRS) dialog.

SRS Subframe Configuration

Sets the cell-specific parameter SRS subframe configuration.

This parameter can also influence the shortening of PUCCH/PUSCH transmissions, regardless whether the UEs are configured to send a SRS in the according subframe or not.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:SUConfiguration` on page 463

Configuration Period T_SFC

Displays the value for the cell-specific parameter configuration period T_{SFC} in subframes, depending on the selected "SRS Subframe Configuration" and the "Duplexing" mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:TSFC?` on page 463

Transmission Offset Delta_SFC

Displays the value for the cell-specific parameter transmission offset $Delta_{SFC}$ in subframes, depending on the selected "SRS Subframe Configuration" and the "Duplexing" mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:DSFC?` on page 462

SRS Bandwidth Configuration C_SRS

Sets the cell-specific parameter SRS Bandwidth Configuration (C_{SRS}).

The SRS Bandwidth Configuration C_{SRS}, the SRS Bandwidth B_SRS and the Channel Bandwidth (UL) determine the length of the sounding reference signal sequence, calculated according to TS 36.211.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:CSRS` on page 462

A/N + SRS simultaneous Tx

Enables/disables simultaneous transmission of SRS (sounding reference signal) and ACK/NACK messages, i.e. transmission of SRS and PUCCH in the same subframe.

Simultaneous transmission of SRS and PUCCH is allowed only for PUCCH formats 1, 1a, 1b and 3, since CQI reports are never simultaneously transmitted with SRS.

If this parameter is disabled, the SRS is not transmitted in the corresponding subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:ANSTx on page 461

SRS MaxUpPTS
Enables/disables the cell-specific parameter srsMaxUpPts.

If enabled, an SRS transmission in the UpPTS field (TDD) is made only in the frequency area that does not overlap with the frequency resources reserved for a possible PRACH preamble format 4 transmission.

This is done by reconfiguring the number of SRS resource blocks in the special subframes, which would otherwise be determined by C_SRS and B_SRS.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:MUPTs on page 462

7.14 UL Frame Configuration Settings

To access these settings:

1. Select "LTE General > Link Direction > Uplink (SC-FDMA)".

2. Select "Frame Configuration"

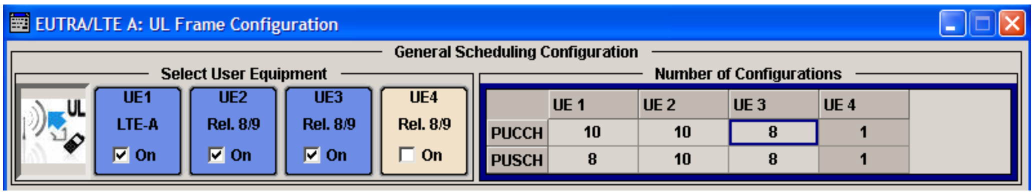
   This dialog allows you to configure the subframes and the SC-FDMA resource allocations.
   The dialog consists of the following sections:

7.14.1 General Scheduling Configuration Settings

To access these settings:

1. Select "General > Link Direction > Uplink (SC-FDMA)".

2. Select "Frame Configuration > General Scheduling Configuration"



This dialog provides access to the user equipment settings and settings concerning the UL scheduling, like configuring the subframes and adjusting the PUCCH/PUSCH scheduling.

Select User Equipment (UE1...UE4)

Accesses the User Equipment Configuration dialog for configuring the different users.

The check box activates or deactivates the selected UE. The 3GPP release the UE is compliant to is displayed.

Note: Disabling the UE deactivates the corresponding allocations. If an UE is deactivated, the reference signal, PUSCH/PUCCH allocations, and PRACH are not transmitted.

Remote command:
n.a.

Number Of PUCCH/PUSCH Configurations/Number Of Configurable Subframes

Sets the number of configurable subframes in the up to four configurable frames, i.e. determines the scheduling cycle per UE.

All uplink subframes are filled periodically with the configured subframes except for the Sounding Reference Signal. SRS is set individually for each UE in the User Equipment Configuration dialog.

The maximum number of configurable subframes depends on the selected Duplexing mode (TDD or FDD), TDD Frame Structure Settings and whether a realtime feedback is enabled or not.

For more detailed information about the maximum number of configurable subframes and for description of the dependencies between the parameters, see Chapter 5.2.3, "Four Configurable Frames in Uplink and Downlink Direction", on page 62.

For "Rel 8/9" UEs, the "No Of Configurable Uplink Subframes" is the same for PUCCH and PUSCH.

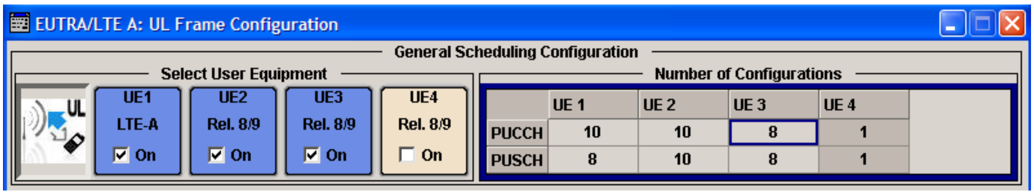
In instruments equipped with R&S SMx/AMU-K85, for the LTE_Advanced UEs, the scheduling cycles are also independent per PUSCH and PUCCH. The number of configurable subframes can be defined individually per PUCCH and per PUSCH. This enables the configuration of PUCCH and PUSCH with different repetition patterns.

Example: Independent cycles for PUSCH and PUCCH of the same LTE-Advanced UE

As described in the test case 8.2.4, TS 36.141, the PUCCH of the UE has to be transmitted once a frame and the PUSCH - once each eight subframes.

- Set "UE1 > User Equipment Configuration > 3GPP Release" = LTE-Advanced.
- In the "UL Frame Configuration > Number of Configurable Uplink Subframes" dialog, set "UE1 > PUCCH" = 10
- In the "UL Frame Configuration > Number of Configurable Uplink Subframes" dialog, set "UE1 > PUSCH" = 8
- Configure the PUCCH and PUSCH allocations of UE1 as required.

Example: Independent cycles for PUSCH and PUCCH of the same LTE Rel. 8/9 UE



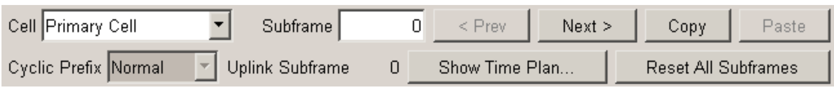
- Select "UE2 > User Equipment Configuration > UE ID/n_RNTI (User Equipment)" = UE ID_{UE2}.
- Set "UE3 > User Equipment Configuration > UE ID/n_RNTI (User Equipment)" = UE ID_{UE2}
- Configure the allocations of as required.
- In the "UL Frame Configuration > Number of Configurable Uplink Subframes" dialog, set "UE2 > PUCCH/PUSCH" = 10
- In the "UL Frame Configuration > Number of Configurable Uplink Subframes" dialog, set "UE3 > PUCCH/PUSCH" = 8

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CONSubframes:PUCCh` on page 544
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CONSubframes:PUSCh` on page 544

7.14.2 Subframe Configuration

To access these settings:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe Configuration"



Provided are the settings for selecting and configuring the subframes. In the allocation table section, the individual allocation parameters for a subframe are set.

Cell

In enabled "General UL Settings > CA > Activate Carrie Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

Subframe

Sets the subframe to be configured/displayed in the frame configuration table.

All uplink subframes are filled periodically with the configured subframes except for the Sounding Reference Signal. SRS is set individually for each UE in the User Equipment Configuration dialog.

Subframes behind the configurable range of the corresponding UE or channel (Number Of PUCCH/PUSCH Configurations/Number Of Configurable Subframes) are displayed as read-only.

Remote command:
n.a.

Next/Prev

Navigates through the subframes.

Remote command:
n.a.

Copy/Paste Subframe Settings

Copies/pastes the settings of the selected subframe. Sounding Reference Signals are not considered.

For more detailed information, see Chapter 5.2.1, "Copy/Paste Subframe", on page 61.

Remote command:
n.a.

Cyclic Prefix (UL)

Configuration of the cyclic prefix per subframe is only enabled, if the parameter Cyclic Prefix (General UL Settings) is set to User Defined.

The number of the SC-FDMA symbols per subframe is set automatically

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:CYCPrefix` on page 544

Subframe Information

Displays the kind of the selected subframe, i.e. "Special Subframe", "Uplink Subframe", "Downlink Subframe".

For "Uplink Subframe", it is also shown the uplink subframe number, which is especially useful for TDD duplexing mode.

Remote command:
n.a.

Show Time Plan

Calls the time plan for the SC-FDMA resource allocation.

The dialog is described in detail in section Chapter 7.18, "SC-FDMA Time Plan", on page 286.

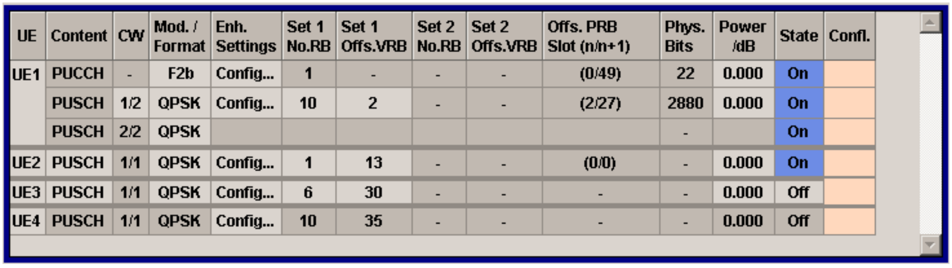
Remote command:
n.a.

Reset All Subframes
Resets settings of all subframes including cyclic prefix to the default values.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RSTFrame` on page 545

7.14.3 UL Allocation Table

The resource allocation table is where the individual allocation parameters for a subframe are set.



UE	Content	CW	Mod. / Format	Enh. Settings	Set 1 No.RB	Set 1 Offs.VRB	Set 2 No.RB	Set 2 Offs.VRB	Offs. PRB Slot (n/n+1)	Phys. Bits	Power /dB	State	Confl.
UE1	PUCCH	-	F2b	Config...	1	-	-	-	(0/49)	22	0.000	On	
	PUSCH	1/2	QPSK	Config...	10	2	-	-	(2/27)	2880	0.000	On	
	PUSCH	2/2	QPSK							-		On	
UE2	PUSCH	1/1	QPSK	Config...	1	13	-	-	(0/0)	-	0.000	On	
UE3	PUSCH	1/1	QPSK	Config...	6	30	-	-	-	-	0.000	Off	
UE4	PUSCH	1/1	QPSK	Config...	10	35	-	-	-	-	0.000	Off	

User Equipment
Accesses the settings of the UE the selected allocation belongs to, see Chapter 7.15, "User Equipment Configuration", on page 242.

Remote command:
n.a.

Content (UL)
Selects the content type of the selected allocation.

Data source settings for PUSCH are configurable in dialog Chapter 7.15, "User Equipment Configuration", on page 242.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONType`
on page 545

Codeword (UL)
(requires option R&S SMx/AMU-K85)

Determines whether one or two codewords use the same physical resource, and whether codeword 1/2 or codeword 2/2 is configured with the selected PUSCH allocation.

See also Figure 3-32.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CODWords on page 545

Modulation/Format

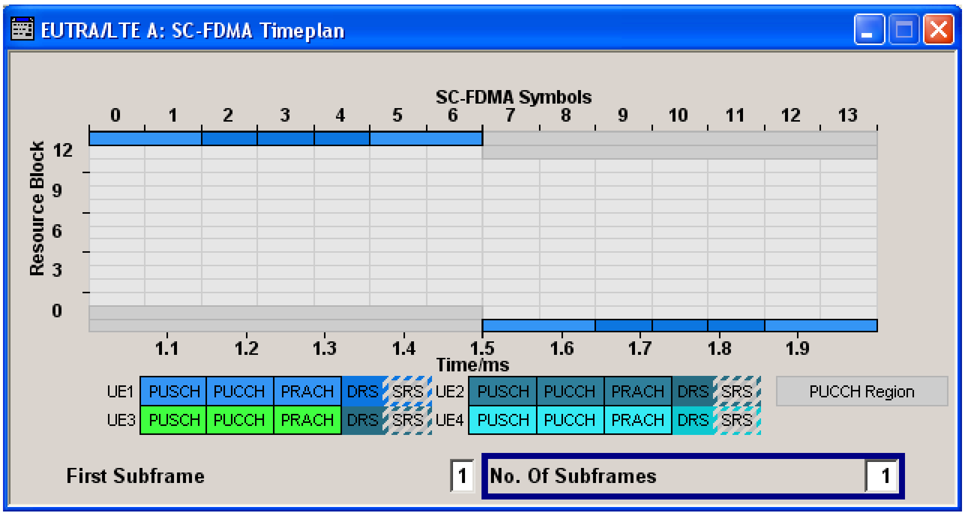
For PUSCH allocation, this parameter sets the modulation scheme (QPSK, 16QAM or 64QAM) for the allocation.

This parameter is read-only, if a predefined FRC is selected.

For PUCCH allocation, this parameter sets the PUCCH Format (1/1a/1b/2/2a/2b/3). See Chapter 3.2.3, "Uplink Control Information Transmission", on page 34 for an overview of the allowed PUCCH formats. Use the "SC-FDMA Time Plan" to visualize the position and structure of the configured PUCCH allocation.

Example:

The figure below shows an example of a subframe with PUCCH region with three reserved resource blocks and "PUCCH Format" on page 282 1/1a/1b.



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>][:PUSCh]:MODulation on page 546
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:PUCCh]:FORMat on page 546

Enhanced Settings UL

Accesses a dialog for configuration of PUSCH/PUCCH depending on the selected allocation (see Chapter 7.16, "Enhanced PUSCH Settings", on page 272 and Chapter 7.17, "Enhanced PUCCH Settings", on page 281).

Remote command:
n.a.

Set 1/Set 2 No. RB

Requires option R&S SMx/AMU-K85 LTE-A (Rel. 10)

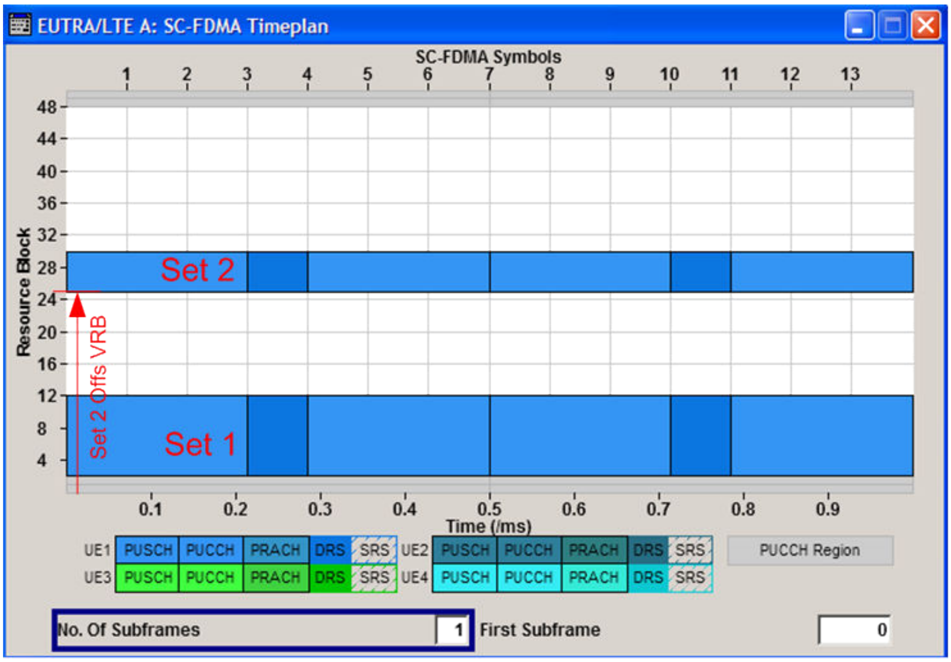
The LTE Rel. 10 specification defines PUSCH transmission not only in a continuous frequency region but also in two "sets" or "clusters" of resource blocks (see Figure 3-29).

The parameter defines the size of the selected allocation in resource blocks of the corresponding set.

This parameter is read-only, if a predefined FRC is selected.

Example: Clustered PUSCH Transmission

- Select "User Equipment Configuration (UE1) > 3GPP Release > Rel.10".
- In the "UL Frame Configuration > Allocation Table", configure the PUSCH allocation of UE1 as follow:
  - "Set 1 No. RB" = 10, "Set 1 Offs. VRB" = 2
  - "Set 2 No. RB" = 5, "Set 2 Offs. VRB" = 25
  - "State" = ON
- Select "Show Time Plan" to visualize the configured allocations



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:RBCount on page 546
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:RBCount? on page 546
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:SET<user>:RBCount on page 546

Set 1/Set 2 Offset VRB
Requires option R&S SMx/AMU-K85 LTE-A (Rel. 10)

For the corresponding set, sets the virtual resource block offset of the selected subframe (see also Example "Clustered PUSCH Transmission" on page 240).

This parameter is read-only, if a predefined FRC is selected.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:VRBoffset` on page 547
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:SET<user>:VRBoffset` on page 547

Offset PRB Slot (n/n+1)
Displays the start resource block of the selected allocation in the first and the second slot of the subframe.

Consider the following interdependencies, if frequency hopping is used:
- The start physical resource blocks in slot n and slot n+1 are set automatically These values can deviate from the Set 1/Set 2 Offset VRB
- If an intra-subframe hopping for hopping type 2 is applied, the start resource block in slot 1 is defined by the selected Number of Sub-bands

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:RBOFfset?` on page 547
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:PUCCh:RBOFfset?` on page 547
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:PUSCh:SET<gr>:RBOFfset?` on page 547

Phys. Bits / Total Number of Physical Bits
Displays the size of the selected allocation in bits. The value is set automatically according to the current allocation's settings.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PHYSbits?` on page 548
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:PHYSbits?` on page 548
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:PHYSbits?` on page 548

Power (UL)
Sets the power for the selected allocation, i.e. PUSCH or PUCCH power level.

The PUSCH power level (P_{PUSCH}) and the PUCCH power level (P_{PUCCH}) can vary per subframe.

Further power-related parameters:
- UE Power (P_{UE}) - for global adjustment of the transmit power of the UE
- DRS Power Offset (P_{DRS_offset}) and SRS Power Offset (P_{SRS_offset}) - for boosting the reference signals, DRS and SRS, per UE.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:POWer on page 548
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:POWer on page 548
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:POWer on page 548

State (UL)
Sets the allocation to active or inactive state.

Note: Disabling an allocation deactivates the PUSCH/PUCCH and the corresponding demodulation reference signal, but does not affect other allocations of the UE or the sounding reference signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:STATe on page 548
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:STATe on page 548
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:STATe on page 548

Conflict (UL)
Indicates a conflict between UEs and in case an allocation exceeds the available number of resource blocks.

For more information, see Chapter 5.1, "Conflict Handling", on page 57.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONFlict? on page 549
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CONFlict? on page 549
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CONFlict? on page 549

7.15 User Equipment Configuration

To access this dialog:

1. Select "LTE General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4".

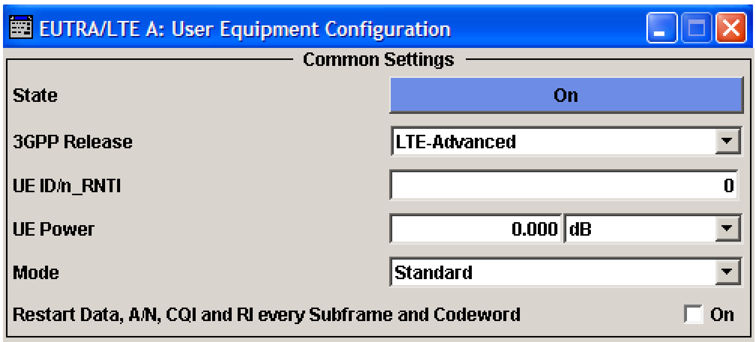
   You can configure up to four scheduled user equipment (UE), freely distribute them over the time, and configure the structure of the demodulation reference signal (DRS) and the sounding reference signal (SRS) per UE.

The dialog consists of the following sections:

7.15.1 Common Settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)"
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4".
3. Select "Common".



The available settings allow you to configure the state of the user equipment, the UE's release, UE ID, and the operational mode.

State (User Equipment)

Activates or deactivates the user equipment.

Note: Disabling the UE deactivates the corresponding allocations. Neither reference signal, nor PUSCH/PUCCH allocations, nor PRACH is transmitted if an UE is deactivated.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:STATe` on page 579

3GPP Release

Requires option R&S SMx/AMU-K85 (LTE-A Rel. 10)

Determines whether the selected UE is an LTE Release 8/9 or a LTE-Advanced UE. Several further settings are enabled only for LTE-Advanced UEs (e.g. see Chapter 7.14, "UL Frame Configuration Settings", on page 234).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:RELease` on page 579

UE ID/n_RNTI (User Equipment)

Sets the radio network temporary identifier (RNTI) of the UE.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:ID` on page 579

UE Power

Sets the power level of the selected UE (P_{UE}).

The P_{UE} determines the power levels of the reference signals (DRS and SRS) and of the allocations, PUSCH (P_{PUSCH}) and PUCCH (P_{PUCCH}). Use the P_{UE} for global adjustment of the transmit power of the UEs.

Further power-related parameters:
- Power: varies the PUSCH and PUCCH power per subframe.
- DRS Power Offset (P_{DSR_offset}) and SRS Power Offset (P_{SRS_offset}): boosts the reference signals DRS and SRS per UE.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:POWer` on page 580

Mode

Selects whether the user equipment is in standard or in PRACH mode.

"Standard"	Sets the operational mode of the user equipment to standard.
"PRACH"	Sets the operational mode of the user equipment to PRACH (see Chapter 7.15.10, "PRACH Configuration", on page 269).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:MODE` on page 580

Restart Data, A/N, CQI and RI Every Subframe and Codeword

If activated, the data source, the ACK/NACK pattern, the CQI pattern and RI are restarted every subframe and for every codeword.

This parameter is always enabled, if realtime feedback is active.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:DACRestart` on page 579

7.15.2 Realtime Feedback Configuration Settings

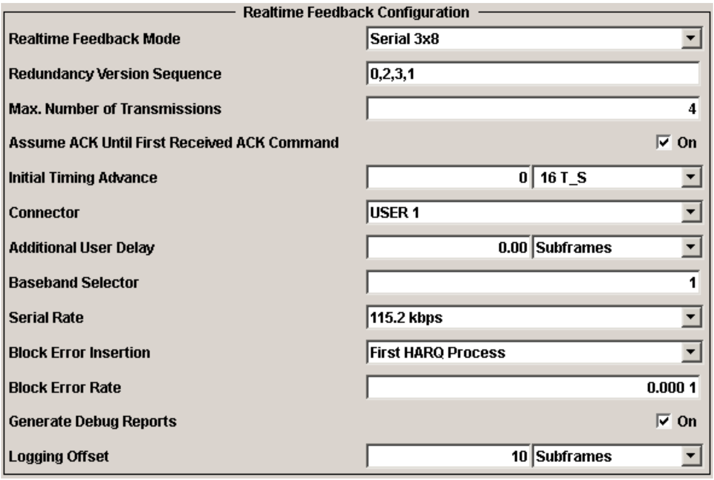
The EUTRA/LTE uplink realtime feedback functionality requires the additional option R&S SMx/AMU-K69 Closed Loop BS Tests. This option extends the EUTRA/LTE option R&S SMx/AMU-K55 with the possibility to perform closed loop performance tests with feedback as defined in TS 36.141, chapter 8.

The Realtime Feedback Configuration is enabled:
- Only for UE1 in instruments equipped with the option R&S SMx/AMU-K69
- Only in configurations with one Tx antenna
- If the UL carrier aggregation is disabled

Realtime Feedback Configuration is not available for the R&S Signal Generator SMBV and for the simulation software R&S WinIQSIM2.

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)"
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4"
3. Select "RT Feedback"
4. Enable the realtime feedback, i.e. set the "Realtime Feedback Mode" to a value different than "Off".

   This dialog provides access to the parameters required for generating signals in accordance to the HARQ feedback or UL timing adjustments test cases. The provided parameters depend on the selected Realtime Feedback Mode.
   The feedback functionality can be enabled once per baseband block.

For background information on the functionality, see Chapter 6, "Realtime Feedback for Closed Loop BS Tests", on page 69.

Realtime Feedback Mode

Enables realtime feedback and determines the mode (binary or serial).

"Off" Realtime feedback is disabled.

"Binary ACK/NACK"
The ACK/NACK feedback is implemented as low/high voltage level on the feedback line connector.
Use the parameter ACK Definition to determine whether a high or a low voltage level represents an ACK.
Timing Adjustments Feedback is not supported in this mode.

"Serial" ACK/NACK Feedback and Timing Adjustments Feedback are implemented by a serial protocol (see Chapter 6.2.2, "Serial Mode", on page 71).

"Serial 3x8" ACK/NACK Feedback and Timing Adjustments Feedback are implemented by serial commands, consisting of three serial packets (see Chapter 6.2.3, "Serial 3x8 Mode", on page 71).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ITADvance` on page 600

Redundancy Version Sequence

Determines the sequence of redundancy versions for the individual HARQ processes.

Unless otherwise requested by serial feedback commands, the first value in the sequence of redundancy versions is used each time an ACK is received or for the first transmission of a process.

The sequence of redundancy versions is read out cyclically, i.e. whenever a NACK is received and a retransmission is requested, the next redundancy version in the sequence is used.

The first value in the sequence is used again even in case a NACK is received, if the Max. Number of Transmissions in a process was reached.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:RVSequence` on page 601

Max. Number of Transmissions

After this maximum number of transmissions (incl. first transmission), the first redundancy version of the redundancy version sequence is used even in case of NACK.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:MAXTrans` on page 600

Assume ACK until first received ACK command
("Serial/Serial 3x8" mode only)

If this parameter is enabled, the signal generator does not use any external HARQ feedback from the device under test for its HARQ processes until an ACK command is received the first time. Until that, the generator behaves as if ACK was received for all transmissions - no matter if actually a NACK was received or if no HARQ feedback was received at all. It therefore does not schedule any retransmission until ACK is received the first time.

This function can be useful for synchronization purposes, see Chapter 6.4, "Avoiding Synchronization Problems", on page 78.

Note: This function applies independently for every HARQ process, i.e. if this parameter is enabled, an ACK has to be received in every HARQ process first, before the generator stops ignoring any NACKs.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:AACK` on page 597

Initial Timing Advance
The initial timing advance of the uplink signal (at the output of the instrument's baseband unit) in units of 16 TS.

An initial timing advance greater than zero means that the beginning of the first subframe of the uplink signal is omitted.

For binary feedback, the timing advance of the uplink signal stays constant (and equal to the initial timing advance) throughout the whole signal output.

The additional timing offset $N_{TA\ offset}$ for TDD, as defined in TS 36.211, is set by the parameter Signal Advance N_TA_offset.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ITADvance` on page 600

ACK Definition
("Binary ACK/NACK" mode only)

Determines whether a high or a low binary level on the feedback line connector represents an ACK.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ACKDefinition` on page 598

Connector
Determines the feedback line connector, see Chapter 6.2, "Feedback Modes", on page 70.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:CONNector` on page 600

Distance Mode
(Binary ACK/NACK mode only)

Determines how the number of the uplink subframe is calculated, in which the signaled feedback has the desired effect.

See also Chapter 6.3.1, "Parameterization of the feedback timing", on page 74.

"3GPP" The uplink subframe in which the signaled feedback has the desired effect is calculated from the downlink subframe number n, in which the feedback was received, according to TS 36.213.

"Direct Response"
The uplink subframe in which the signaled feedback has the desired effect is calculated from the last sent uplink packet of the HARQ processes.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:DMODe on page 600

Additional User Delay
Determines the point in time when the feedback can be sent to the instrument.

For more information, see Chapter 6.3, "Timing Aspects", on page 74.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ADUDelay on page 598

Baseband Selector
("Serial" and "Serial 3x8" mode only)

This parameter is required for multiplexing serial commands for different baseband units to one feedback line. If the selector n is configured in the GUI for a specific baseband unit, the baseband unit listens only to serial commands containing the selector n.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BBSelector on page 599

Serial Rate
(Serial and Serial 3x8 mode only)

Determines the bit rate of the serial transmission. Possible rates are 115.2 kbps, 1.6 Mbps and 1.92 Mbps.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:SERate on page 601

Block Error Insertion
Enables/disables the statistical insertion of block errors into PUSCH packets.

The block error insertion can be enabled for a single HARQ process or for all processes. In the single HARQ process case, the used process is always the one that corresponds to the first activated PUSCH.

If the block error insertion functionality is used, no further impairments should be activated (like "Fading" or "AWGN"), as this would cause the measured block error rate to deviate from the configured block error rate.

If block error insertion is enabled, the generator ignores any externally received HARQ ACK/NACK feedback. Instead, it behaves as if ACK was received for a HARQ process if no block error was generated for the previous transmission of that process and it behaves as if NACK was received for a HARQ process if a block error was generated for the previous transmission of that process.

If a block error is generated in a new transmission, block errors are also generated in all retransmissions, until the maximum number of transmissions is reached. The reason for this is that otherwise the measured block error rate could deviate from the configured one if for example a non-erroneous retransmission cannot be decoded by the device under test if the first transmission (which was erroneous) was impaired too much.

If the block error insertion functionality is used together with the Assume ACK until first received ACK command functionality, no block errors are inserted before the first received ACK, to speed up the synchronization process in this case. This is the only situation where an external HARQ feedback is needed if block error insertion is activated.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BEINsertion` on page 599

Block Error Rate
Block error rate for the statistical insertion of block errors.

The block error rate is defined as the ratio from the number of NACKs to the sum of the number of NACKs plus the number of ACKs.

As no external HARQ feedback is considered if Block Error Insertion is used, it is expected that the device under test does not send false ACK (ACK after erroneous packet) or false NACK (NACK after non-erroneous packet). Also it is expected that no further impairments like fading or AWGN are applied to the generated uplink signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BERate` on page 599

Generate Debug Reports
Enables the R&S Signal Generator to create and store debug reports, i.e. log files with detailed information on the realtime feedback.

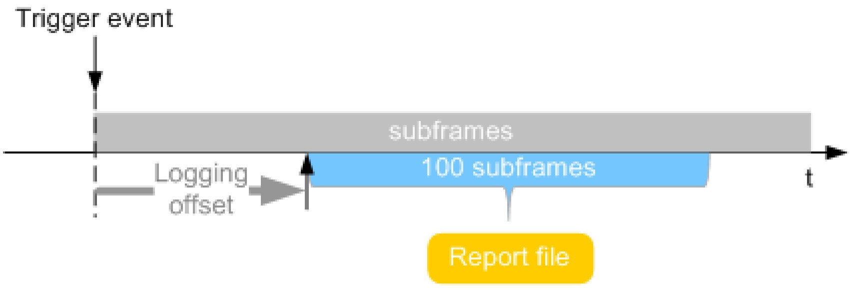
The instrument generates two type of reports:

- Transmission report
  – This file contains information about what is *sent* (e.g. redundancy versions,) during the first 100 subframes after triggering and elapsing the Logging Offset.
  – File is created after the 100 subframes are sent.
  – Default file name and location
    `C:\`
    `EUtraRealtimeUplinkFeedback_TransmissionReport_BBA_BBSel0.txt`
- Reception report
  – This file contains information about the first 100 *received* feedback commands, like serial value or binary value.
  – File is created after 100 commands are successfully received.
  – Default file name and location
    `C:\`
    `EUtraRealtimeUplinkFeedback_ReceptionReport_BBA_BBSel0.txt`

Use these debug files for troubleshooting of complex realtime feedback tests.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:GENReports` on page 602

Logging Offset
Per default, the generation of the debug report files starts with receiving a trigger event. To delay the start time and log other 100 subframes, enable a "Logging Offset".



Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:LOFFset` on page 602

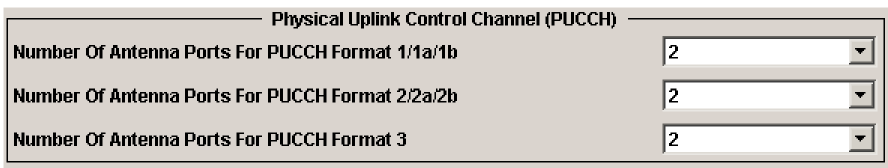
7.15.3 Physical Uplink Control Channel (PUCCH)

The generation of LTE signals with UL-MIMO is an LTE-Advanced feature that requires the additional option R&S SMx/AMU-K85. PUCCH is available in the primary cell (PCell) only.

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)"
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4"
3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced"
4. Select "PUCCH".

   With these settings, you define the number of antenna ports used for each of the PUCCH formats.

5. Set the number of available ports for PUCCH per PUCCH format.

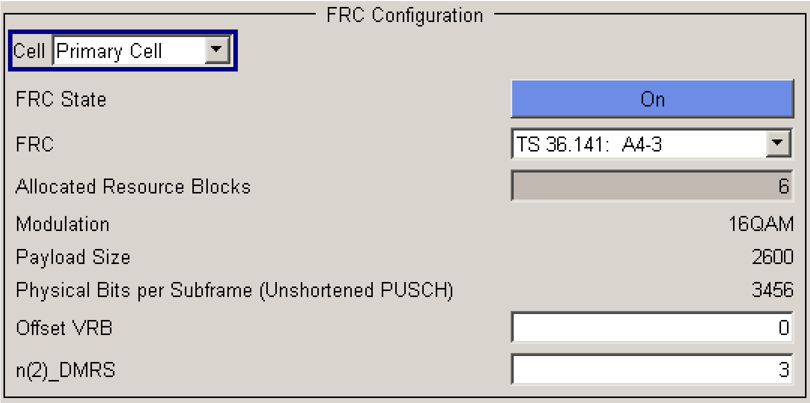
Number of Antenna Ports for PUCCH Format 1/1a/1b, 2/2a/2b, 3
For 3GPP Release = LTE-Advanced UEs, sets the number of antenna ports used for every PUCCH format transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F1Naport` on page 591
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F2Naport` on page 591
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F3Naport` on page 591

7.15.4 FRC Configuration

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4"
3. Select "FRC"



This dialog enables a quick configuration of the predefined fixed reference channels (FRC) according to TS 36.141, Annex A "Reference Measurement channels", respectively TS 36.521, Annex A.

When "FRC Configuration" is enabled, several parameters are predefined and their values are displayed as read-only. The following table gives an overview of the parameters that are affected by the FRC configuration.

Dialog	Parameter	Value
"UE Configuration"	Scrambling	On
	Channel Coding State	On
	Interleaver	On
	SRS State	Off (the SRS can be activated manually if FRC state is ON)
"UL Allocation Table"	Modulation	According to the selected FRC
PUSCH allocations of the corresponding UE in all subframes	No. RB	According to the selected FRC
"Enhanced PUSCH Settings"	Frequency Hopping	Off
For the corresponding UE in all subframes	HARQ ACK Type	None
	Number of CQI Bits	0

Dialog	Parameter	Value
	Number of coded CQI Bits	0
	Transport Block Size/Payload	According to the selected FRC

Cell

In enabled "General UL Settings > CA > Activate Carrie Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

FRC State

Enables/disables FRC configuration.

Enabling FRC configuration sets some parameters to their predefined values, i.e. several parameters are displayed as read-only. Reconfiguration of the values of these parameters is possible only after disabling the FRC configuration. An exception is the SRS state that can be changed even while an FRC configuration is enabled.

The FRC State is disabled and cannot be enabled, if a "User Defined"Cyclic Prefix is selected.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:STATe`
on page 582

FRC

Selects a predefined fixed reference channel according to TS 36.141, Annex A respectively TS 36.521, Annex A.

Since the predefined FRCs require minimum channel bandwidth and predefined cyclic prefix, the currently available FRCs are limited by the selected Number of RBs per Slot and Cyclic Prefix. The FRC State is disabled and there are no FRCs available for selection, if a "User Defined" cyclic prefix is selected.

Table 7-13: Supported FRCs from 3GPP TS 36.141

FRC	Description
A1_1 to A1_5	Fixed Reference Channels for reference sensitivity and in-channel selectivity (QPSK, R=1/3)
A2_1 to A2_3	Fixed Reference Channels for dynamic range (16QAM, R=2/3)
A3_1 to A3_7	Fixed Reference Channels for performance requirements (QPSK 1/3)
A4_1 to A4_8	Fixed Reference Channels for performance requirements (16QAM 3/4)

FRC	Description
A5_1 to A5_7	Fixed Reference Channels for performance requirements (64QAM 5/6)
A7_1 to A7_6	Fixed Reference Channels for UL timing adjustment (Scenario 1)
A8_1 to A8_6	Fixed Reference Channels for UL timing adjustment (Scenario 2)

Table 7-14: Supported FRCs from 3GPP TS 36.521-1

FRC	Description
A.2.2.1.1	Reference Channels for QPSK with full RB allocation
A.2.2.1.2	Reference Channels for 16-QAM with full RB allocation
A.2.2.2.1	Reference Channels for QPSK with partial RB allocation
A.2.2.2.2	Reference Channels for 16-QAM with partial RB allocation
A.2.2.3	Uplink Reference Channels for sustained data-rate test

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TYPE`
on page 582

Allocated Resource Blocks
Displays the number of the allocated resource blocks for the selected FRC. For FRCs "A.2.2.2.1" and "A.2.2.2.2" this parameter can also be set to different values according to TS 36.521.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:ALRB`
on page 580

Modulation (FRC)
Displays the modulation for the selected FRC.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:MODulation?`
on page 580

Payload Size (FRC)
Displays the payload size for the selected FRC.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:PASize?`
on page 581

Physical Bits Per Subframe (Unshortened PUSCH)
Displays the total number of physical bits available for the PUSCH allocation per sub-frame, in that unshortened PUSCH is transmitted. Shortened PUSCH transmission occurs in a cell-specific SRS subframe or in subframes where SRS is transmitted.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TNOBits?`
on page 582

Offset VRB (FRC)
Sets the virtual resource block (VRB) offset for all PUSCH allocation of the selected UE in all subframes.

The VRB Offset set for the individual subframes in the "UL Allocation Table" are overwritten.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:VRBoffset
on page 583

n(2)_DMRS (FRC)
Sets the UE-specific part of the demodulation reference signal (DMRS) index for all PUSCH allocation of the selected UE in all subframes.

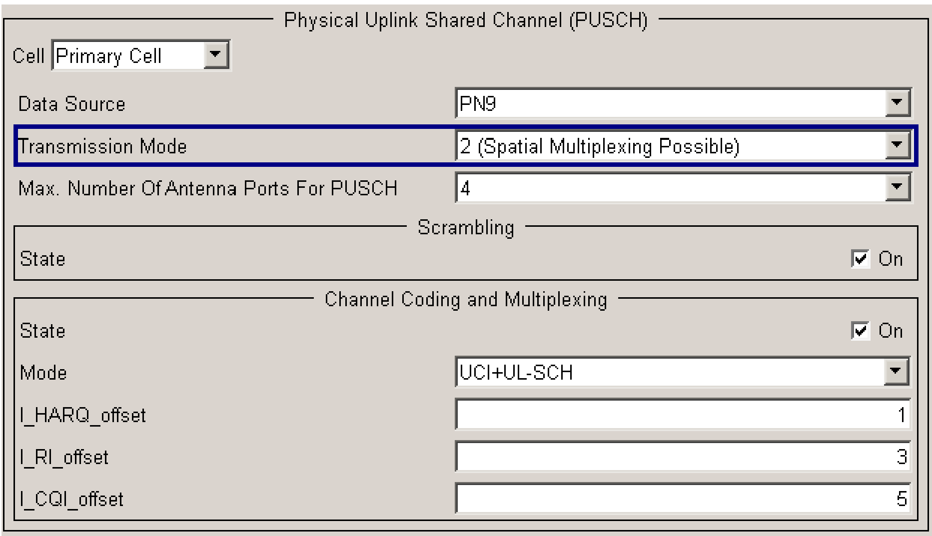
The "Enhanced PUSCH Settings" > n(2)_DMRS,λ (Layer λ) set for the individual subframes for the corresponding UE is overwritten.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:N2DMrs
on page 581

7.15.5 Physical Uplink Shared Channel (PUSCH)

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4"
3. Select "PUSCH"



In this dialog, the data source for the PUSCH can be selected and the channel coding can be configured. Use the Enhanced PUSCH Settings dialog to adjust the additional settings for channel coding of the control information and the multiplexing of the data and control information.

Cell

In enabled "General UL Settings > CA > Activate Carrie Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

Data Source

Selects the data source for the Physical Uplink Shared Channel (PUSCH) allocation of UE.

New data is retrieved from the data source for every subframe where PUSCH is configured, unless the parameter Restart Data, A/N, CQI and RI Every Subframe and Codeword is enabled.

The following standard data sources are available:

- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

  See also "Main Dialog > Data List Management".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DATA
on page 587
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:PATTern
on page 587
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DSELect
on page 587

Transmission Mode
(for instruments equipped with R&S SMx/AMU-K85)

For 3GPP Release = Release 10 UEs, sets the PUSCH transmission mode, "1 (Spatial Multiplexing not Possible)" or "2 (Spatial Multiplexing Possible)", according to TS 36.213.

For "FRC State > On", the value is always "1 (Spatial Multiplexing not Possible)".

See also "Uplink MIMO" on page 47.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:TXMode
on page 588

Max. Number of Antenna Ports for PUSCH
(for instruments equipped with R&S SMx/AMU-K85)

For 3GPP Release = Release 10 UEs, sets the number of antenna ports for PUSCH transmission for that the UE is configured.

Transmission Mode	"1 (Spatial Multiplexing not Possible)"	"2 (Spatial Multiplexing Possible)"
"Number of Antenna Ports for PUSCH"	1	2 or 4

To set the currently used number of antenna ports, use the parameter Number of Used Antenna Port.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:NAPort
on page 588

State Scrambling (PUSCH)
Enables/disables scrambling for all PUSCH allocations of the corresponding UE.

This parameter is always enabled, if a predefined FRC is selected.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:SCRambling:STATe on page 589

State Channel Coding and Multiplexing (PUSCH)
Enables/disables channel coding and multiplexing of data and control information for all PUSCH allocations of the corresponding UE.

If this parameter is disabled, the content retrieved from the Data Source is forwarded to the scrambler without any coding processing.

Additional parameters for the encoding of control information can be set in Enhanced PUSCH Settings dialog.

This parameter is always enabled, if a predefined FRC is selected.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:STATe` on page 589

Mode Channel Coding
Defines the information transmitted on the PUSCH.

"UCI+UL-SCH" Control information and data are multiplexed into the PUSCH.

"UL-SCH" Only data is transmitted on PUSCH.

"UCI only" Only uplink control information is transmitted on PUSCH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:MODE` on page 589

I_HARQ_offset
Sets the HARQ-ACK offset index for control information MCS offset determination according to TS 36.213, chapter 8.6.3.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:IHARqoffset` on page 590

I_RI_offset
Sets the RI offset index for control information MCS offset determination according to TS 36.213, chapter 8.6.3.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:IRIoffset` on page 590

I_CQI_offset
Sets the CQI offset index for control information MCS offset determination according to TS 36.213, chapter 8.6.3.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:ICQioffset` on page 590

O_CQI-Min
(Enabled in "UCI only" transmission)

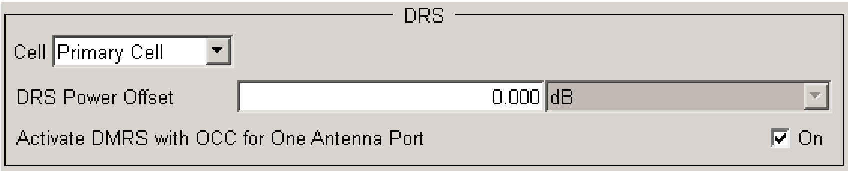
Sets the parameter O-CQI-Min, where O_CQI-Min is the number of CQI bits including CRC bits assuming rank equals to 1.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:OCQimin` on page 591

7.15.6 Demodulation Reference Signal (DRS)

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4".
3. Select "DRS".



Comprises the parameters of the demodulation reference signal.

Cell

In enabled "General UL Settings > CA > Activate Carrie Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

DRS Power Offset

Sets the power offset of the Demodulation Reference Signal (DRS) relative to the power level of the PUSCH or PUCCH allocation of the corresponding subframe.

The selected DRS power offset (P_{DRS_Offset}) applies for all subframes.

Depending on the allocation of the subframe, the effective power level of the DRS is calculated as following:

- For PUSCH allocation
  $P_{DRS}=P_{UE}+P_{PUSCH}+P_{DRS\_Offset}$
- For PUCCH allocation
  $P_{DRS}=P_{UE}+P_{PUCCH}+P_{DRS\_Offset}$

The PUSCH and PUCCH Power levels (P_{PUSCH} and P_{PUCCH}) can vary per subframe.

For global adjustment of the transmit power of the corresponding UE, use the parameter UE Power (P_{UE}).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:POWoffset` on page 591

Activate DRS with OCC for One Antenna Port

(requires option R&S SMx/AMU-K85)

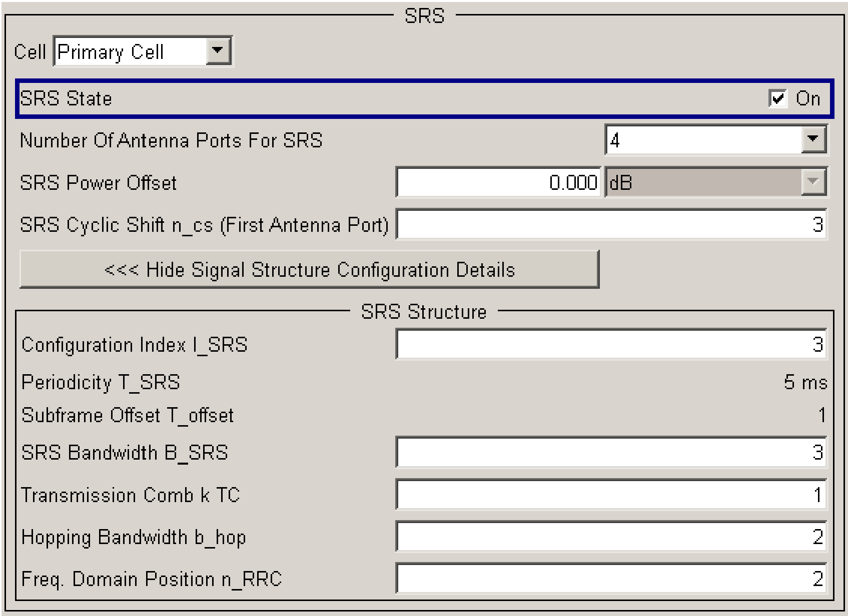
For 3GPP Release = Release 10 UEs, activate demodulation reference signal (DRS) with an orthogonal cover code (OCC) even if only one antenna port is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:DWOCc
on page 592

7.15.7 Sounding Reference Signal (SRS)

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4".
3. Select "3GPP Release > LTE-Advanced".
4. Select "SRS".



In the "SRS Structure" section, you can configure the **UE-specific sounding reference signal parameters** according to TS 36.213 and TS 36.211.

The **cell-specific parameters**, necessary for the complete definition of the SRS structure and SRS mapping, are configurable in the General UL Settings dialog.

To visualize the SRS transmission, use the SC-FDMA time plan.

Cell

In enabled "General UL Settings > CA > Activate Carrie Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

SRS State

Enables/disables sending of SRS for the corresponding UE.

In the symbols reserved for SRS transmission, PUSCH is not transmitted.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:STATe` on page 592

SRS Power Offset

Sets the power offset of the Sounding Reference Signal (SRS) relative to the power of the corresponding UE.

The selected SRS power offset applies for all subframes.

The effective power level of the SRS is calculated as follows:

$P_{SRS}=P_{UE}+P_{SRS\_Offset}$

For global adjustment of the transmit power of the corresponding UE, use the parameter UE Power (P_{UE}).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:POWoffset` on page 592

Number of Antenna Ports for SRS

(requires option R&S SMx/AMU-K85)

For 3GPP Release = LTE-Advanced UEs, sets the number of antenna ports used for every SRS transmission.

Max. Number of Antenna Ports for PUSCH	1	2	4
"Number of Antenna Ports for SRS"	1, 2, 4	1, 2	1, 4

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NAPort` on page 593

SRS Cyclic Shift n_CS (First Antenna Port)
Sets the cyclic shift n_CS used for the generation of the sounding reference signal CAZAC sequence for the first port. The n_cs for the other ports are calculated automatically; they have a fixed relation to the first one.

The different shifts of the same Zadoff-Chu sequence are orthogonal to each other. Thus, you can apply different SRS cyclic shifts to schedule different users to transmit simultaneously their sounding reference signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:CYCShift` on page 593

Show Signal Structure Configuration Details>>>
Expands the settings for configuring the sounding reference signal structure, see "SRS Structure" on page 261.

Remote command:
n.a.

SRS Structure
Use the following parameters to define the SRS structure:

Configuration Index I_SRS ← SRS Structure
Sets the UE-specific parameter SRS configuration index I_{SRS}.

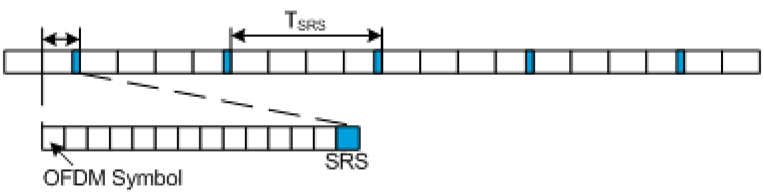
Depending on the selected "Duplexing Mode", this parameter determines the parameters SRS Periodicity T SRS and SRS Subframe Offset T_offset as defined in the TS 36.213, Table 8.2-1 (FDD) and 8.2-2 (TDD) respectively.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:ISRS` on page 594

Periodicity T_SRS ← SRS Structure
Displays the UE-specific parameter SRS periodicity T_{SRS}, i.e. displays the interval of milliseconds after which the SRS is transmitted. The displayed value depends on the selected SRS Configuration Index I_SRS and "Duplexing Mode" as defined in the TS 36.213, Table 8.2-1 (FDD) and 8.2-2 (TDD) respectively.

Adjust the SRS configuration index to enable more frequent SRS transmission like each 2 ms or an infrequently SRS transmission like each 320 ms for instance.

For TDD duplexing mode, a T_SRS of 2 ms means that SRS is transmitted two times in 5 ms.



Example:

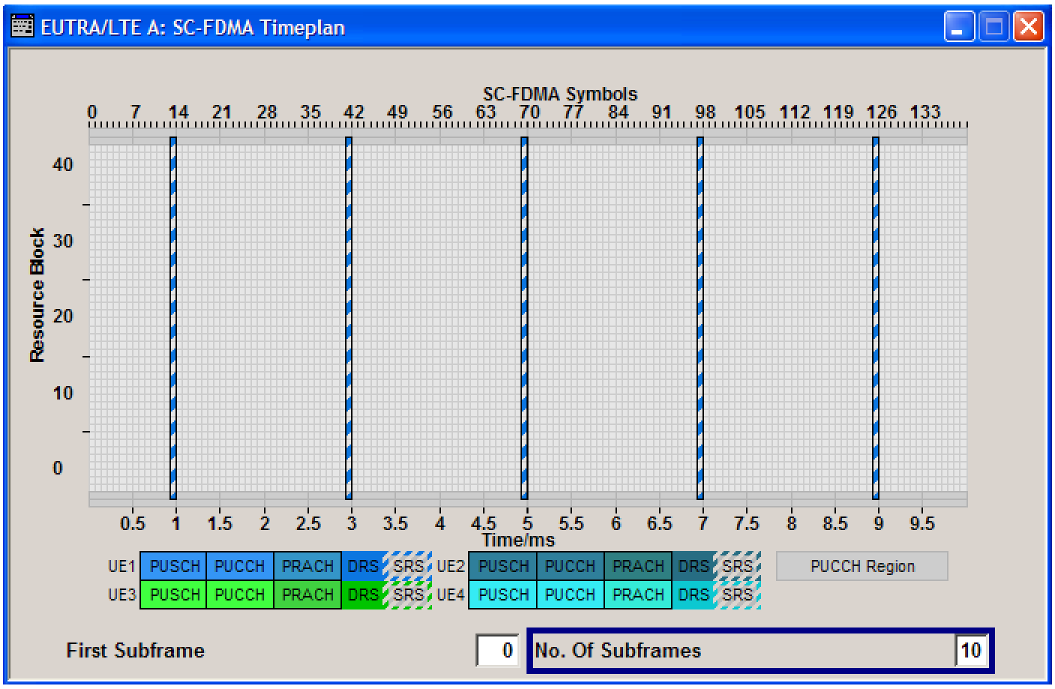
"Configuration Index = 0", i.e. "Periodicity T_SRS = 2 ms" and "Subframe Offset T_offset = 0"

"SRS State > On"

"Duplexing > FDD"

The default values of all other SRS parameters are left unchanged.

The SRS is transmitted every 2 ms and occupies the entire channel bandwidth, i.e. frequency hopping is not enabled.

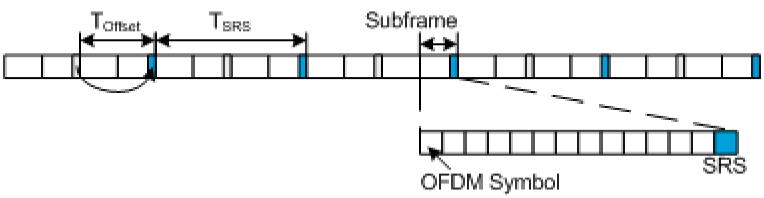


Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TSRS? on page 594

Subframe Offset T_offset ← SRS Structure

Displays the UE-specific parameter SRS subframe offset T_{offset}, depending on the selected SRS Configuration Index I_SRS and "Duplexing Mode" as defined in the TS 36.213, Table 8.2-1 (FDD) and 8.2-2 (TDD).

An SRS subframe offset shifts the SRS pattern, i.e. while SRS periodicity T_SRS remains constant, the SRS transmission is delayed with period of time equal to the SRS subframe offset T_offset.



Example:

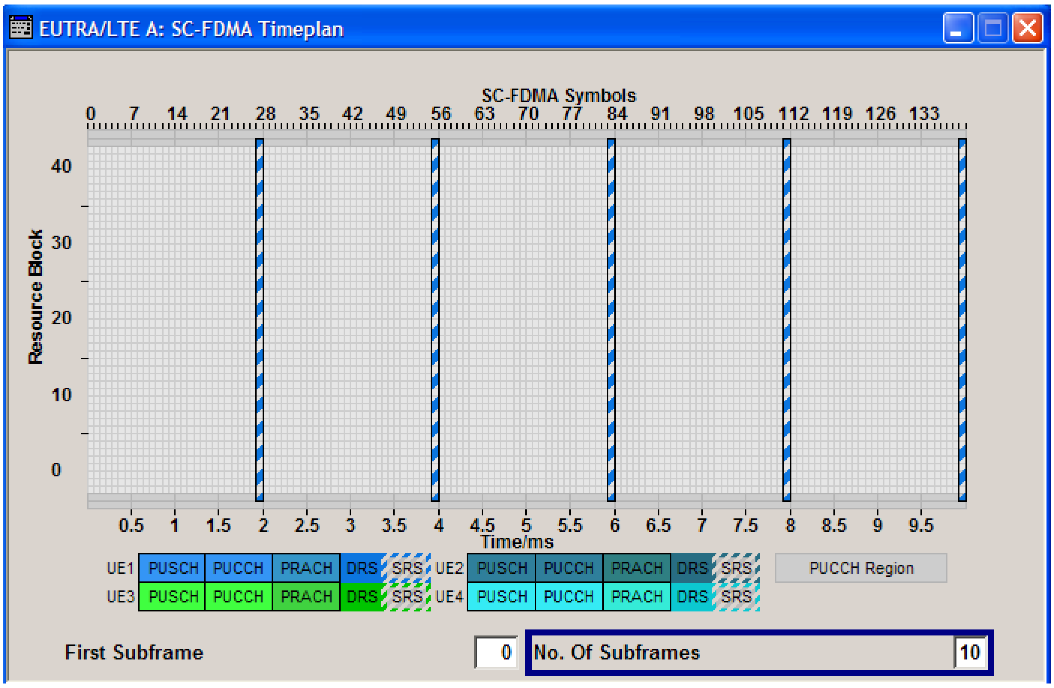
"Configuration Index = 1", i.e. "Periodicity T_SRS = 2 ms" and "Subframe Offset T_offset = 1"

"SRS State > On"

"Duplexing > FDD"

The default values of all other SRS parameters are left unchanged.

The SRS is transmitted every 2 ms and occupies the entire channel bandwidth, i.e. frequency hopping is not enabled. Compared to the SRS transmission with T_{offset} = 0, the SRS transmission is delayed with 1 ms.



For TDD duplexing mode, a T_offset of 0 or 5 means that SRS is transmitted in the second last symbol of the special subframe (in the UpPTS part). For this case, adjust the parameter TDD Special Subframe Config so that an UpPTS field length of two symbols is assured.

For TDD duplexing mode with T_SRS value of 2 ms, two T_offset values are displayed, corresponding to the two SRS transmissions per 5 ms. For example, the values 0,1 mean that two SRS transmissions occur, both in the special subframe. One of them is in the second last symbol and the other one, in the last symbol of the subframe.

Remote command:

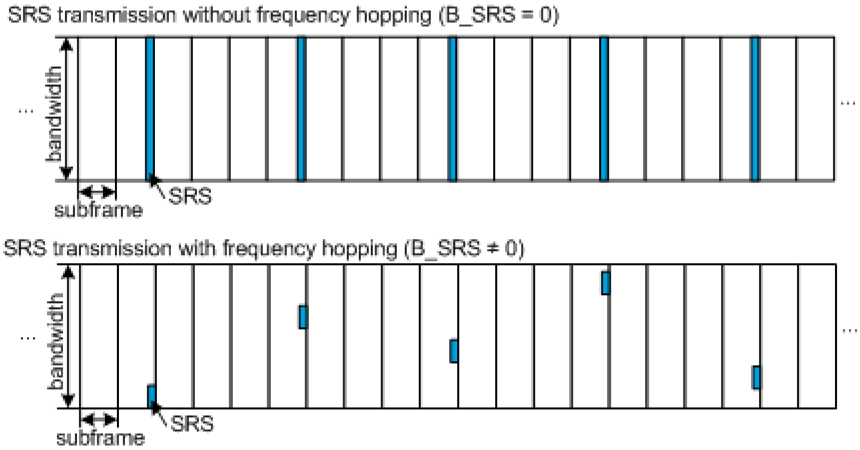
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TOFFset?` on page 595

SRS Bandwidth B_SRS ← SRS Structure

Sets the bandwidth covered by a single SRS transmission. That is the UE-specific parameter SRS Bandwidth B_{SRS}, as defined in the TS 36.211, chapter 5.5.3.2.

The SRS can span the entire frequency bandwidth or use frequency hopping where several narrowband SRSs cover the same total bandwidth.

There are 4 SRS bandwidths defined in the standard. The most narrow SRS bandwidth (B_SRS = 3) spans 4 resource blocks and is available for all channel bandwidths. The other 3 values of the parameter B_SRS define more wideband SRS bandwidths, available depending on the channel bandwidth.



The SRS transmission bandwidth is determined also by the "SRS Bandwidth Configuration C_{SRS}".

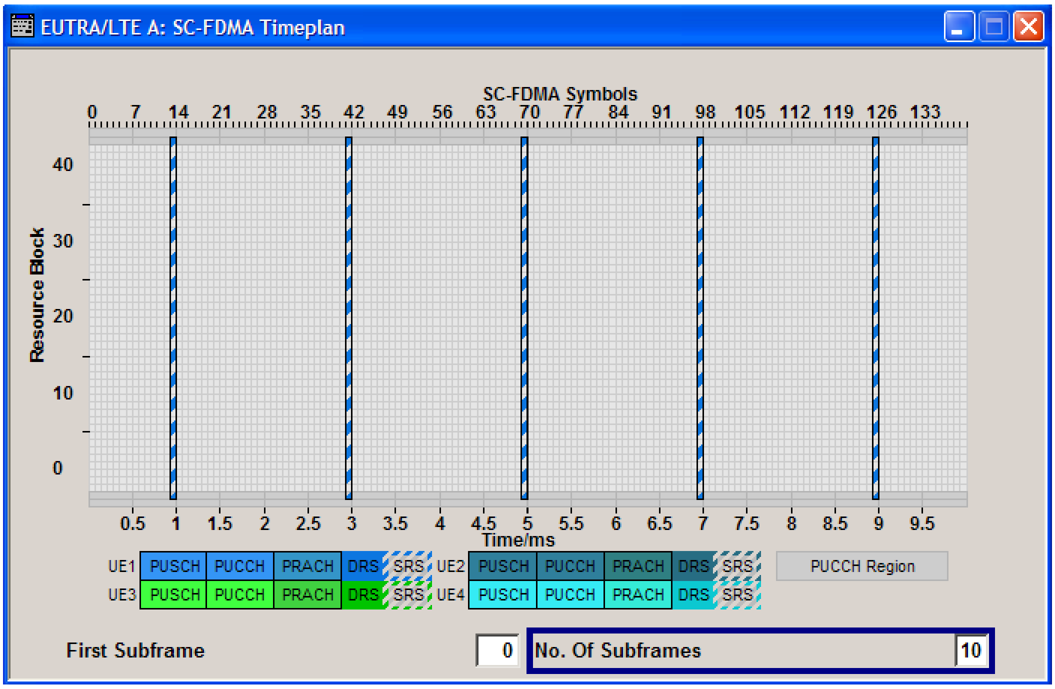
Example:

"SRS State > On"

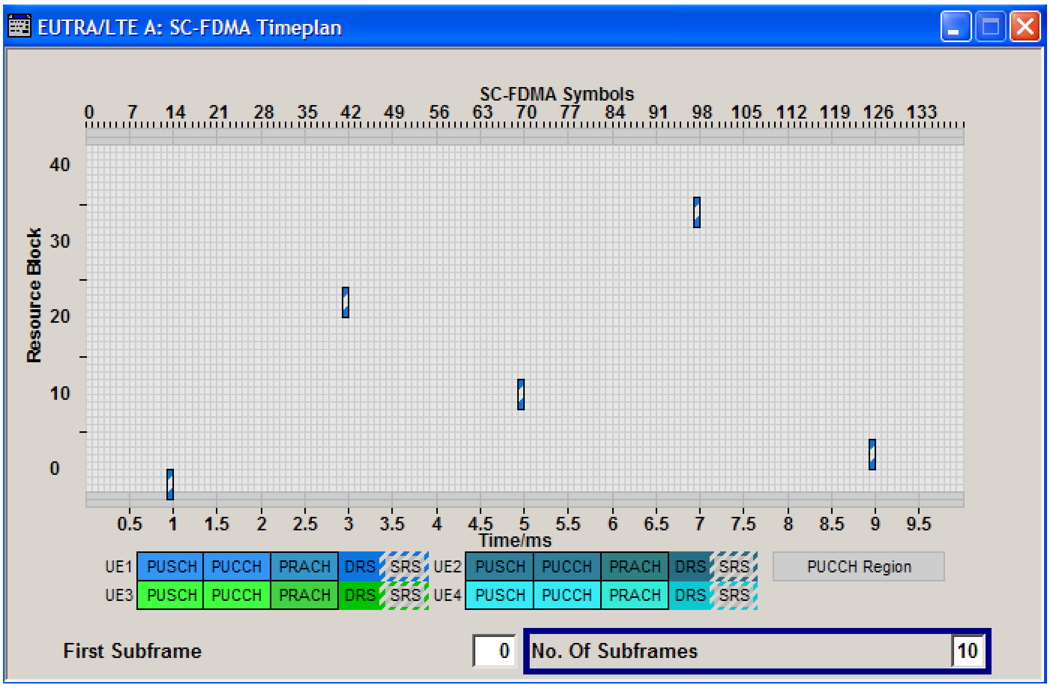
"Duplexing > FDD"

The default values of all other SRS parameters are left unchanged.

For "B_SRS = 0", the SC-FDMA time plan shows a wideband SRS without frequency hopping.



Changing the SRS bandwidth to "B_SRS = 3" results in the most narrowband SRS transmission with SRS bandwidth of 4 RBs and enabled frequency hopping.



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:BSRS on page 594

Transmission Comb k TC ← SRS Structure
Sets the UE-specific parameter transmission comb parameter k_{TC}, as defined in the TS 36.211, chapter 5.5.3.2.

The SRS is transmitted on alternating subcarriers, where with k_{TC} = 1 every odd and with k_{TC} = 0 every even subcarrier is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TRComb on page 595

Hopping Bandwidth b_hop ← SRS Structure
Sets the UE-specific parameter frequency hopping bandwidth b_{hop}, as defined in the TS 36.211, chapter 5.5.3.2.

SRS frequency hopping is enabled, if b_{HOP}<B_{SRS}. Hopping bandwidth is the frequency band in that the SRS hops.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:BHOP on page 593

Freq. Domain Position n_RRC ← SRS Structure
Sets the UE-specific parameter frqDomainPosition n_{RRC}, as defined in the TS 36.211, chapter 5.5.3.2.

This parameter determines the starting physical resource block of the SRS transmission.

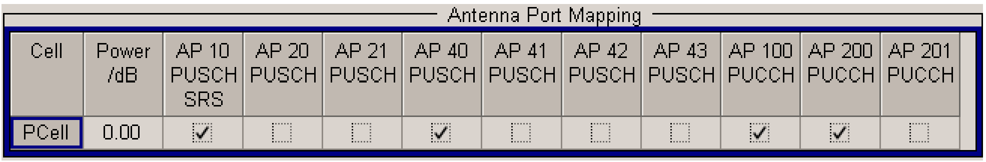
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NRRC on page 596

7.15.8 Antenna Port Mapping

The generation of LTE signals with UL-MIMO is an LTE Rel. 10 feature that requires the additional option R&S SMx/AMU-K85 LTE-Advanced.

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4"
3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced"
4. Select "Antenna Port Mapping"



The "Antenna Port Mapping" settings define which baseband generates which antenna port.

Cell
Indicates the cell (Primary Cell or Secondary Cell).

Power
Applies a power offset to the selected PCell or SCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CELL<dir0>:POFFset on page 597

Antenna port mapping table
The mapping table is a matrix with number of rows equal to the number of physical Tx antennas (Basebands) and number of columns equal of the number of antenna ports (AP).

The available antenna ports depend on:
- Max. Number of Antenna Ports for PUSCH
- Number of Antenna Ports for PUCCH Format 1/1a/1b, 2/2a/2b, 3
- Number of Antenna Ports for SRS

The Table 7-15 gives an overview of the available antenna port numbers as a function of the enabled "Number of Antenna Ports" per channel/signal.

Table 7-15: Available antenna port numbers

Number of antenna ports	1	2	4
Physical channel/signal			
PUSCH	10	20 21	40 41 42 43
PUCCH	100	200 201	-
SRS	10	20 21	40 41 42 43

Per activated baseband, you can activate exactly one PUSCH, one PUCCH, and one SRS antenna port.

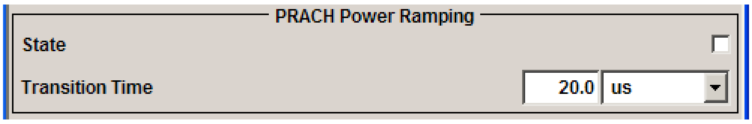
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP10Map:ROW<bbid>` on page 596
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP20Map:ROW<bbid>` on page 596
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP21Map:ROW<bbid>` on page 596
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP40Map:ROW<bbid>` on page 596
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP41Map:ROW<bbid>` on page 596
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP42Map:ROW<bbid>` on page 596
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP43Map:ROW<bbid>` on page 596
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP100Map:ROW<bbid>` on page 596
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP200Map:ROW<bbid>` on page 596
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP201Map:ROW<bbid>` on page 596

7.15.9 PRACH Power Ramping

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4"

3. Select "Common > Mode > PRACH"



This dialog comprises the settings needed for configuring the PRACH power ramping.

State PRACH Power Ramping

Activates Power Ramping for the PRACH preamble. The start and the end of the preamble is cyclically extended and multiplied with a ramping function (sin^2).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRSTate` on page 583

Transition Time

Defines the transition time from beginning of the extended preamble to the start of the preamble itself.

Remote command:

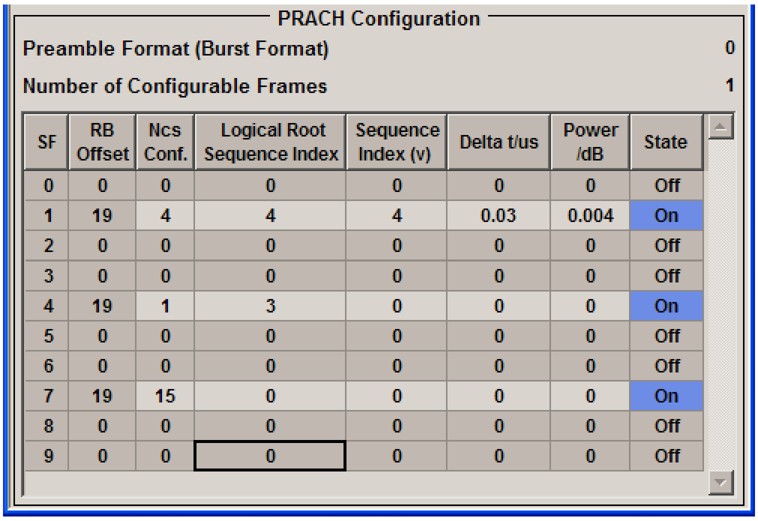
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRTT` on page 583

7.15.10 PRACH Configuration

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4"
3. Select "Common > Mode > PRACH"

4. Select "PRACH"



In this dialog, the UE-specific parameters according to TS 36.211 are enabled for configuration.
The cell-specific parameters, necessary for the complete definition of the PRACH, are configurable in the General UL Settings dialog.

Preamble Format (Burst Format)
Displays the preamble format.

The "Preamble Format" is automatically derived from the PRACH Configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRFormat?` on page 584

Number of Configurable Frames
Shows how many frames can be configured.

A maximum number of 20 frames are available for configuration; the currently available number of frames depends on the selected ARB Sequence Length.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:CFRames?` on page 584

SF
Displays the consecutive number of the subframe.

The subframes available for configuration depend on the selected "Duplexing" mode and "PRACH Configuration".

Remote command:
n.a.

RB Offset
Displays the starting RB, as set with the parameter PRACH Frequency Offset.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:RBOFfset`
on page 584

Frequency Resource Index
This parameter is enabled in TDD duplexing mode only.

Sets the frequency resource index f_{RA} for the selected subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:FRINdex`
on page 585

Ncs Configuration
Selects the Ncs configuration of the selected subframe, i.e. determines the Ncs value for the selected preamble set according to TS 36.211, table 5.7.2.-2 and 5.7.2-3.

The value range of this parameter depends on the selected Duplexing mode, PRACH configuration and whether a restricted preamble set is enabled or not.

Parameter	Value Range Ncs Configuration
Disabled Restricted Set (High Speed Mode)	0 .. 15
Enabled "Restricted Preamble Set"	0 .. 14
TDD + PRACH Configuration > 47	0 .. 6

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:NCSConf`
on page 585

Logical Root Sequence Index
Selects the logical root sequence index for the selected subframe.

The value range of this parameter depends on the combination of selected Duplexing mode and PRACH configuration.

Parameter	Value Range Logical Root Sequence Index
TDD + PRACH Configuration > 47 i.e. Preamble Format 4	0 .. 137
All other cases	0 .. 837

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:RSEQuence`
on page 585

Sequence Index (v)
Selects the sequence index **v** for the selected subframe, i.e. selects which one of the 64 preambles available in a cell is used.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:SINDex`
on page 586

Delta t/us
Sets the parameter Delta_t in us.

A value of delta t different than 0 causes a time shift of the configured preamble.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:DT` on page 586

Power (PRACH)
Sets the PRACH power relative to the UE power. The PRACH power can be adjusted independently for every configured preamble.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:POWer` on page 585

State (PRACH)
Enables/disables the PRACH for the selected subframe.

The subframes available for configuration depend on the selected PRACH configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:STATe` on page 586

7.16 Enhanced PUSCH Settings

This dialog allows you to define and configure PUSCH parameters, such as the settings of the uplink shared channel (UL-SCH), HARQ control information, and the Channel Quality Control Information (CQI).

1. To access this dialog, select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUSCH".
3. Select "Enhanced Settings > Configure".

   In this dialog you can:
   - Define the precoding parameters, see "Precoding" on page 274
   - Enable and configure frequency hopping, see "Frequency Hopping" on page 275

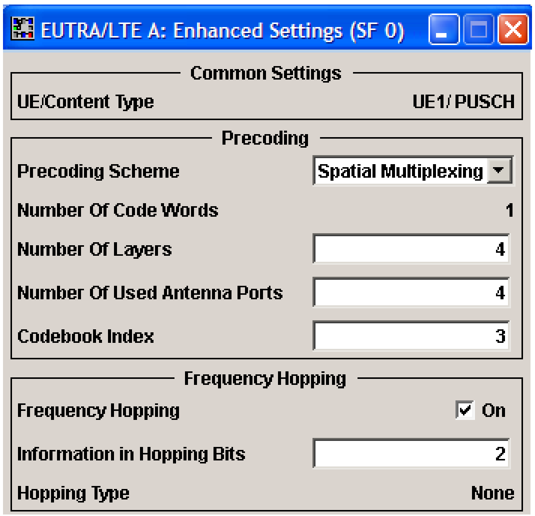
- Set the cyclic shift used by the demodulation reference signal (DRS), see Chapter 7.16.2, "Demodulation Reference Signal (DRS)", on page 276
- Adjust the parameters for channel coding of the control information (HARQ and CQI), see Chapter 7.16.3, "Channel Coding / Multiplexing", on page 277
- Configure the multiplexing of the control information with the data transmission over the UL-SCH

7.16.1 Common PUSCH Settings

To access this dialog:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUSCH".
3. Select "Enhanced Settings > Configure".
4. Select "Frequency Hopping".
5. To enable spatial multiplexing, select "Precoding > Precoding Scheme > Spatial Multiplex".
   a) Select "Frame Configuration > General > Select User Equipment > UE1... UE4"
   b) Select "3GPP Release = Release 10"
   c) Select "PUSCH"
   d) Select "Transmission Mode = 2 (Spatial Multiplexing)"
   e) Select "Number of Antenna Ports for PUSCH = 2 or 4"
   f) In the "Enhanced PUSCH Settings" dialog, select "Precoding > Precoding Scheme > Spatial Multiplexing"

   The frequency hopping is automatically disabled.



The provided further settings depend on the selected channel coding, see Chapter 7.16.3, "Channel Coding / Multiplexing", on page 277.

The common settings comprise the following precoding and frequency hopping settings:

UE/Content Type

Displays the UE number and the content type of the selected allocation.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONType` on page 545

Precoding

The generation of LTE signals with UL-MIMO is an LTE Rel. 10 feature that requires the additional option R&S SMx/AMU-K85 LTE-Advanced.

Precoding Scheme ← Precoding

For Max. Number of Antenna Ports for PUSCH > 1, enables spatial multiplexing for the PUSCH of the current user in the current subframe.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:SCHeme` on page 554

Number of Codewords ← Precoding

Displays the number of the used codewords.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CODWords` on page 545

Number of Layers ← Precoding

Sets the number of layers.

The combination of number of codewords and number of layers determines the layer mapping for the selected precoding scheme, see also Figure 3-32.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:NOLayers` on page 555

Number of Used Antenna Port ← Precoding

Sets the number of used antenna ports form the number of antenna ports that are configured for PUSCH transmission (see Max. Number of Antenna Ports for PUSCH).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:NAPused` on page 556

Codebook Index ← Precoding

Sets the codebook index and selects the predefined pre-coder matrix.

The number of available codebook indices depends on the number of used antenna ports.

The combination of the codebook index and the Number of Layers determines the precoding matrix used for precoding (see also Figure 3-32).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:CBINdex` on page 556

Frequency Hopping

Frequency hopping is applied according to TS 36.213.

Frequency hopping is disabled, if spatial multiplexing is used (see Precoding Scheme).

Frequency Hopping ← Frequency Hopping

Enables/disables frequency hopping for PUSCH.

Based on the Information in Hopping Bits, a UE performing PUSCH frequency hopping applies one of the two possible Hopping Type.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:STATe` on page 557

Information in Hopping Bits ← Frequency Hopping

Sets the information in hopping bits according to the PDCCH DCI format 0 hopping bit definition. This information determines whether type 1 or type 2 hopping is used in the subframe, and - in case of type 1 - also determines the exact hopping function to use.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:IIHBits` on page 557

Hopping Type ← Frequency Hopping

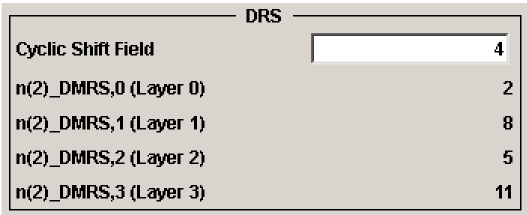
Displays the frequency hopping type used.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:TYPE?` on page 557

7.16.2 Demodulation Reference Signal (DRS)

The generation of LTE signals with UL-MIMO is an LTE Rel. 10 feature that requires the additional option R&S SMx/AMU-K85 LTE-Advanced.

1. To access this dialog, select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUSCH".
3. Select "Enhanced Settings > Configure".
4. Select "DRS".



Cyclic Shift Field

Cyclic shifts are used to separate the DRS signals of different users in the time domain. This parameter sets the cyclic shift field in the uplink-related DCI formats, see Table 7-16.

See also "DCI Format 3/3A" on page 199.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:CYCShift` on page 558

n(2)_DMRS,λ (Layer λ)

Displays the part of the demodulation reference signal (DMRS) index $n^{(2)}_{DMRS,\lambda}$ per layer, where the number of layers λ is defined with Number of Layers.

Table 7-16: DRS index n(2)_DMRS,λ as function of the cyclic shifts and number of layers λ

Cyclic Shift Field in DCI Formats	λ = 0 (1 layer)	λ = 1 (2 layers)	λ = 2 (3 layers)	λ = 3 (4 layers)
000	0	6	3	9
001	6	0	9	3
010	3	9	6	0
011	4	10	7	1
100	2	8	5	11
101	8	2	11	5
110	10	4	1	7
111	9	3	0	6

The DMRS index is part of the uplink scheduling assignment and valid for one UE in the subframe. This index applies when multiple shifts within a cell are used and is used by the calculation of the DRS sequence.

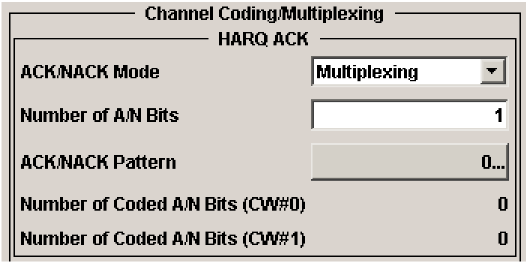
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:NDMRs<layer>?` on page 556

7.16.3 Channel Coding / Multiplexing

1. To access this dialog, select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4"
3. Select "PUSCH > Channel Coding and Multiplexing > State > On" (refer to Channel Coding)
4. Select "Mode > UCI+UL-SCH " or "Mode > UCI only" (refer to Mode Channel Coding)
5. Select "Frame Configuration > Subframe > Content > PUSCH"
6. Select "Enhanced Settings > Configure > Channel Coding/Multiplexing"

   In this dialog, you can adjust the parameters for channel coding of the control information (HARQ and CQI) and configure the multiplexing of this control information with the data transmission over the UL-SCH.

HARQ ACK Settings



The following HARQ ACK settings are available:

ACK/NACK Mode ← HARQ ACK Settings
Sets the ACK/NACK mode to Multiplexing or Bundling according to TS 36.212, chapter 5.2.2.6.

ACK/NACK mode Bundling is defined for TDD duplexing mode only.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:MODE` on page 559

N_bundled ← HARQ ACK Settings
For "ACK/NACK Mode Bundling", sets the parameter N_bundled according to TS 36.212, section 5.2.2.6.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:NBUNdled` on page 559

Number of A/N Bits ← HARQ ACK Settings
Sets the number of ACK/NACK bits.

Set this parameter to 0 to deactivate the ACK/NACK transmission for the corresponding subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:BITS` on page 559

ACK/NACK Pattern ← HARQ ACK Settings
Sets the ACK/NACK bits in form of a 64 bits long pattern.

A "1" indicates an ACK, a "0" - a NACK.

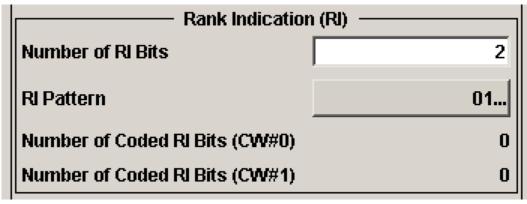
The pattern is read out cyclically and if the pattern is longer than the selected "Number of ACK/NACK Bits", different bits are transmitted in different subframes using this configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:PATTern` on page 560

Number of Coded A/N Bits (CW) ← HARQ ACK Settings
Displays the number of coded ACK/NACK bits per codeword.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:HARQ:CBITs? on page 560

Rank Indication (RI) Settings



Following RI settings are available:

Number of RI Bits ← Rank Indication (RI) Settings

Sets the number of rank indication (RI) bits.

Set this parameter to 0 to deactivate the RI for the corresponding subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:RI:BITS on page 562

RI Pattern ← Rank Indication (RI) Settings

Sets the RI bits in form of a 64 bits long pattern.

The pattern is read out cyclically and if the pattern is longer than the selected "Number of RI Bits", different bits are transmitted in different subframes using this configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:RI:PATTern on page 563

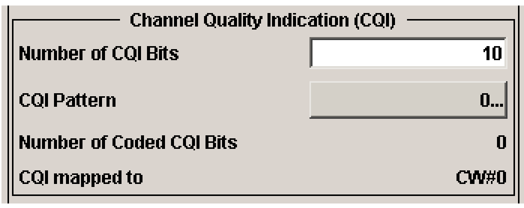
Number of Coded RI Bits (CW) ← Rank Indication (RI) Settings

Displays the number of coded RI bits per codeword.

If a "Channel Coding Mode UCI + UL-SCH" is selected, the Number of Physical Bits for UL-SCH is determinate by the number of coded bits used for CQI and RI transmission.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:RI:CBITs? on page 562

Channel Quality Indication (CQI) Settings



Following CQI settings are available:

Number of CQI Bits ← Channel Quality Indication (CQI) Settings
Sets the number of CQI bits before channel coding.

If a "Channel Coding Mode UCI + UL-SCH" is selected, the Number of Physical Bits for UL-SCH is determinate by the number of coded bits used for CQI and RI transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:BITS` on page 561

CQI Pattern ← Channel Quality Indication (CQI) Settings
Sets the CQI pattern for the PUSCH.

The pattern is read out cyclically and if the pattern is longer than the selected "Number of CQI Bits", different bits are transmitted in different subframes using this configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:PATTern` on page 561

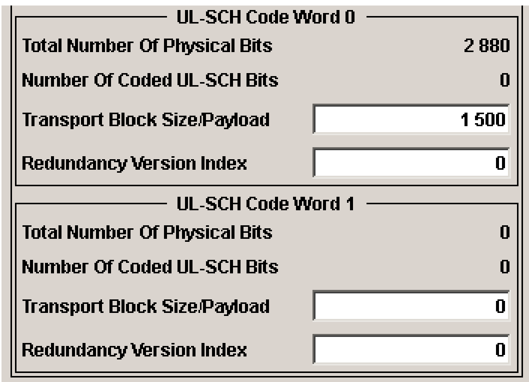
Number of Coded CQI Bits ← Channel Quality Indication (CQI) Settings
Displays the number of coded CQI bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:CBITs?` on page 560

CQI mapped to ← Channel Quality Indication (CQI) Settings
Indicates the codeword the CQI is mapped to.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:CODWord?` on page 562

UL-SCH Settings
Displays the UL-SCH parameters per codeword.



Phys. Bits / Total Number of Physical Bits ← UL-SCH Settings
Displays the size of the selected allocation in bits. The value is set automatically according to the current allocation's settings.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PHYSbits? on page 548
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:PHYSbits? on page 548
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:PHYSbits? on page 548

Number of Coded UL-SCH Bits ← UL-SCH Settings
Displays the number of physical bits used for UL-SCH transmission.

If a "Channel Coding Mode UCI + UL-SCH" is selected, the value is calculated as follow:

"Number of Coded UL-SCH Bits" = Total Number of Physical Bits - Number of Coded CQI Bits - Number of Coded RI Bits (CW)

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:ULSCh:BITS? on page 563

Transport Block Size/Payload (PUSCH) ← UL-SCH Settings
Sets the size of the transport block.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:CCODing:TBSize on page 564

Redundancy Version Index (PUSCH) ← UL-SCH Settings
Sets the redundancy version index.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:CCODing:RVINdex on page 564

7.17 Enhanced PUCCH Settings

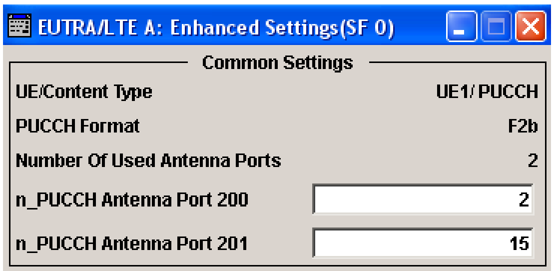
1. To access this dialog, select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUCCH".
3. Select "Enhanced Settings > Configure".

   This dialog displays the PUCCH relevant settings and allows you to define and configure the PUCCH resource index:
   - Chapter 7.17.1, "Common Settings", on page 282
   - Chapter 7.17.2, "Channel Coding / Multiplexing", on page 283

7.17.1 Common Settings

To access this dialog:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUCCH"
3. Select "Enhanced Settings > Configure > Common"



This dialog displays the PUCCH relevant settings and allows you to define and configure the PUCCH resource index.

Provided are the following settings:

UE/Content Type

Displays the UE number and the content type of the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONType`
on page 545

PUCCH Format

Displays the selected PUCCH Format.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:PUCCh]:FORMat`
on page 546

Number of Used Antenna Ports

(requires option R&S SMx/AMU-K85)

Displays the number of antenna ports used for transmissions of the current PUCCH format, see Number of Antenna Ports for PUCCH Format 1/1a/1b, 2/2a/2b, 3.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NAPused?`
on page 565

n_PUCCH
Sets the PUCCH resource index.

3GPP Release	Parameter name	Description
Release 8/9	"n_PUCCH"	Sets the PUCCH resource index
Release 10	"n_PUCCH Antenna Port 100/200"	Sets the resource index for the first or the only one PUCCH antenna port
Release 10	"n_PUCCH Antenna Port 201"	Sets the resource index for the second PUCCH antenna port

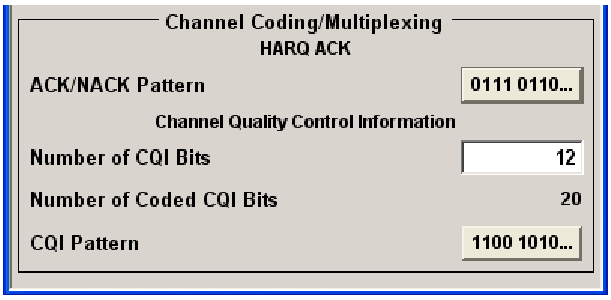
For configuration of multi-user PUCCH tests according to TS 36.141, annex A9, set the n_PUCCH parameter to the value defined in table A.9-1, column "RS orthogonal cover / ACK/NACK orthogonal cover". The R&S Signal Generator calculates and configures automatically the values defined in the columns "Cyclic shift index" and "Orthogonal cover index".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NPAR<ap>`
on page 565

7.17.2 Channel Coding / Multiplexing

To access this dialog:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUCCH"
3. Select "Enhanced Settings > Configure > Channel Coding/Multiplexing"



This dialog and the parameters available for configuration depend on the selected PUCCH Format for the corresponding allocation.
PUCCH Format 1 carries no control information, i.e. the entire "Channel Coding/ Multiplexing" section is not displayed.
CQI control information is carried only by PUCCH formats 2/2a/2b and the CQI parameters are enabled only if one of these formats is selected.

Provided are the following settings:

A/N Pattern / A/N+SR+CSI Pattern

("A/N Pattern" is enabled for PUCCH formats 1a/1b, 2a/2b; "A/N+SR+CSI Pattern" for PUCCH format 3)

Use this parameter to set the ACK/NACK pattern for the PUCCH for the selected subframe. A "1" indicates an ACK, a "0" - a NACK

In PUCCH format 3, the bits given by the "ACK/NACK+SR Pattern" represent the $o^{\sim ACK}$ bits according to TS 36.212, i.e. the up to 22 bits that contain ACK/NACK information for up to two codewords and optionally SR and CSI. The number of bits used per subframe is determinate by the value of the parameter "Number of A/N+SR+CSI Bits" on page 285.

To enable the generation of signals with ACK/NACK respectively ACK/NACK+SR information that varies not only per subframe but also differs over the frames, set a pattern with:

- More than 1 bit for the PUCCH formats 1a/2a
- More than 2 bits for the PUCCH formats 1b/2b
- More than "Number of A/N+SR+CSI Bits" on page 285 for PUCCH format 3

The ACK/NACK pattern has a maximal length of 32 bits and is read out cyclically.

Example:

"Duplexing Mode > FDD"

"Sequence Length = 4 Frames"

"Number of Configurable Subframes = 8"

"PUCCH Format = 1a or 2a"

"A/N Pattern = 01001"

The generated signal carries ACK/NACK information as shown on the figure bellow.

Example: PUCCH Format 1a/2a, ACK/NACK Pattern '01001'

Subframe	#0	#1	#2	#3	#4	#5	#6	#7	#8	#9
Frame#1	ACK/ NACK=0								ACK/ NACK=1	
Frame#2							ACK/ NACK=0			
Frame#3					ACK/ NACK=0					
Frame#4			ACK/ NACK=1							

By changing only the PUCCH Format to 1b or 2b, the ACK/NACK information per subframe changes as shown on the figure bellow.

Example: PUCCH Format 1b/2b, ACK/NACK Pattern '01001'

Subframe	#0	#1	#2	#3	#4	#5	#6	#7	#8	#9
Frame#1	ACK/ NACK=01								ACK/ NACK=00	
Frame#2							ACK/ NACK=10			
Frame#3					ACK/ NACK=10					
Frame#4			ACK/ NACK=01							

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:PATTern on page 566

Number of CQI Bits
(enabled for PUCCH formats 2/2a/2b only)

Sets the number of CQI bits before channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:BITS on page 567

PUCCH Format 3 Settings
The PUCCH format 3 is required for sending of the ACK/NACK messages in case DL carrier aggregation with more than two component carriers is used.

See also Chapter 3.5, "LTE-Advanced (3GPP Rel. 10) Introduction", on page 43 and Chapter 7.4.1, "DL Carrier Aggregation Configuration", on page 106.

Number of A/N+SR+CSI Bits ← PUCCH Format 3 Settings
Sets the number of ACK/NACK+SR+CSI bits before channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:BITS on page 566

A/N+SR+CSI Pattern ← PUCCH Format 3 Settings
See "A/N Pattern / A/N+SR+CSI Pattern" on page 284.

Number of Coded A/N+SR+CSI Bits ← PUCCH Format 3 Settings
Displays the number of coded ACK/NACK+SR bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:CBITs? on page 566

Number of Coded CQI Bits
Displays the number of coded CQI bits.

The number of coded CQI bits for PUCCH is always 20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:CBITs? on page 566

CQI Pattern
Sets the CQI pattern for the PUCCH.

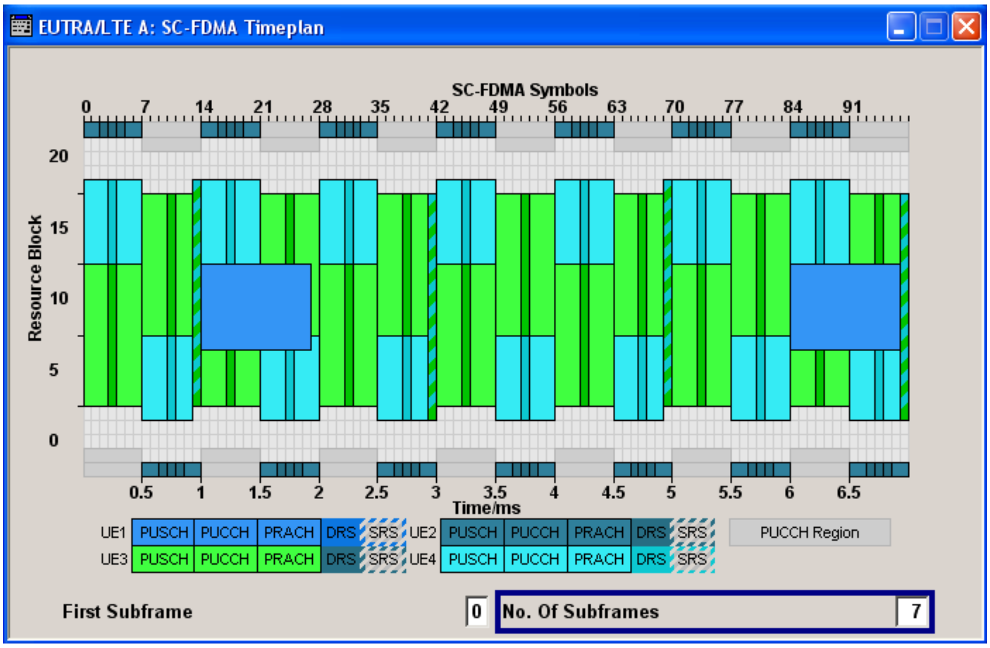
The length of the pattern is determinate by the value of the parameter Number of CQI Bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:PATTern on page 567

7.18 SC-FDMA Time Plan

1. To access this dialog, select "General > Link Direction > Uplink (SC-FDMA)".

2. Select "Frame Configuration > Time Plan".



This dialog shows the uplink time plan.

The x-axis shows allocation in the time domain. The y-axis shows the resource blocks as smallest allocation granularity in the frequency domain. One allocation of a UE can span 1 to up to "No. of Resource Blocks" in the frequency domain.

Sounding Reference Signals are automatically calculated according to the settings for signal structure in "User Equipment" dialog.

An enabled SFN offset is also displayed, see "SFN Offset" on page 225.

Cell
In enabled "General UL Settings > CA > Activate Carrie Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

Baseband
In two-path instrument, determines the time plan of which baseband is displayed.

Alternatively, the aggregated time plan of all basebands can be displayed.

First Subframe
Selects the first subframe to be displayed.

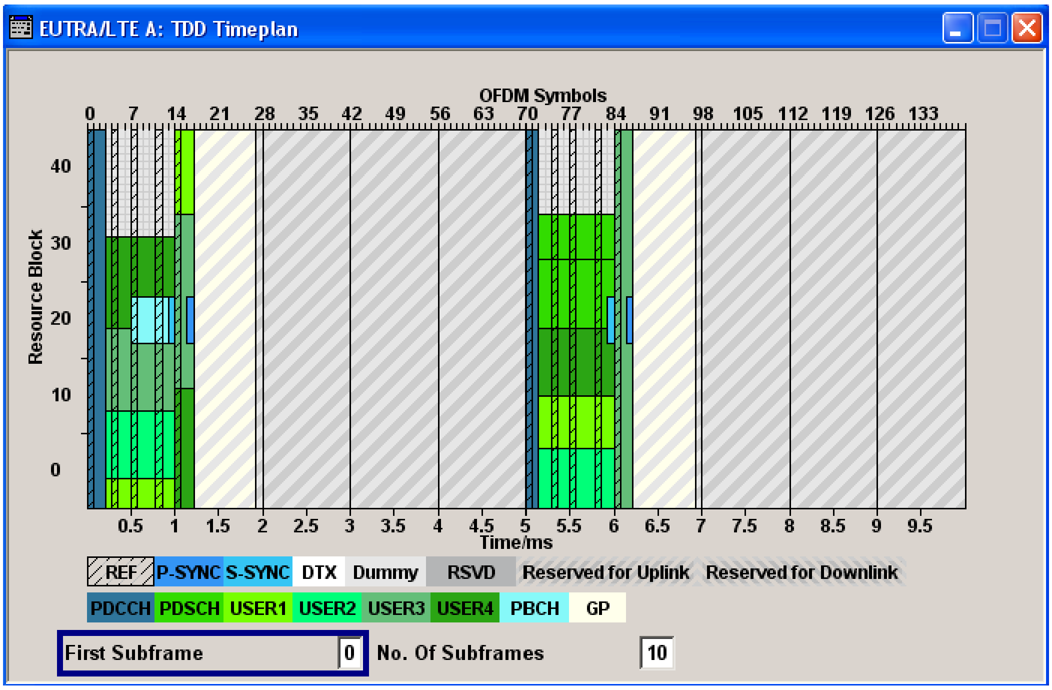
No. of Subframes
Selects the number of subframes to be displayed.

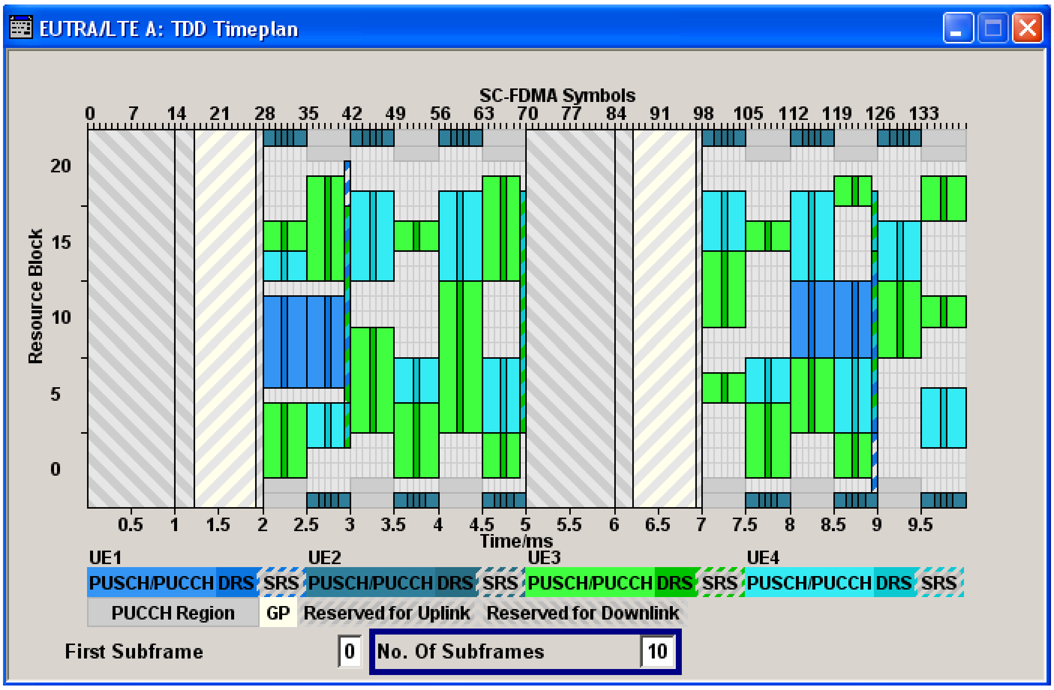
7.19 TDD Time Plan

The "TDD Timeplan" menu is called in the "DL" or "UL Frame Configuration" menu with the button "Show Time Plan" whenever TDD is selected as "Duplexing" mode.

The x-axis shows allocation in the time domain. The y-axis shows the resource blocks as smallest allocation granularity in the frequency domain.

The frame structure depends on the selected "DL/UL Configuration" and the "Configuration of Special Subframe".





First Subframe

Selects the first subframe to be displayed.

Remote command:
n.a.

No. of Subframes

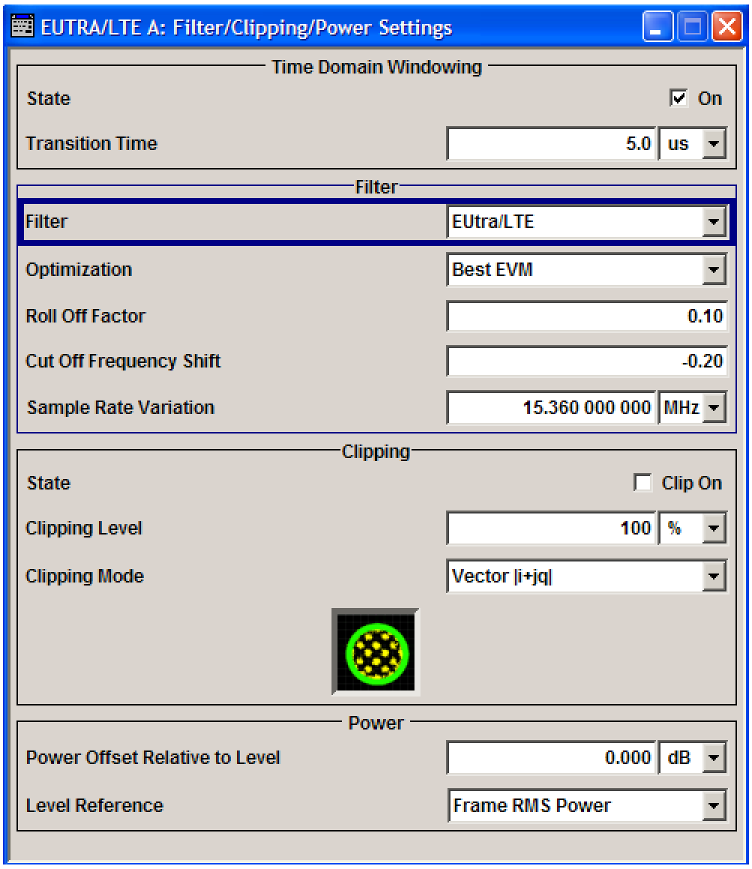
Selects the number of subframes to be displayed.

Remote command:
n.a.

7.20 Filter/Clipping/Power Settings

► To access this dialog, select "Main dialog > Filter/Clipping/ARB Settings".

The dialog comprises the settings, necessary to enable time domain windowing and clipping, to adjust the baseband filter and power settings.



7.20.1 Time Domain Windowing Settings

Provided are the following settings:

State (Time Domain Windowing)

Activates/deactivates the time domain windowing.

Time domain windowing is a method that influences the spectral characteristics of the signal. The method removes the spikes caused by the OFDM; it does not replace over-sampling and subsequent signal filtering.

Time domain windowing is not stipulated by the 3GPP standard.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TDW:STATe` on page 424

Transition Time

Sets the transition time when time domain windowing is active.

The transition time defines the overlap range of two OFDM symbols. At a setting of 1 us and if sample rate = 15.36 MHz, 15 samples overlap.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TDW:TRTime on page 424

7.20.2 Filter Settings

Provided are the following settings for configuring the baseband filter:

Filter

Sets the baseband filter.

Remote command:
[:SOURce<hw>]:BB:EUTRa:FILTer:TYPE on page 418

Optimization

Selects one of the provided EUTRA/LTE filters.

Each filter is designed for different application field and optimized for a particular performance. Depending on the filter implementation, these filters require different calculation time. The applied upsampling factor also influences the size of the calculated output waveform file. An output waveform is calculated with the "Generate Waveform File" function or by generating of an LTE waveform with R&S WinIQSIM2.

The following table outlines the difference between the provided EUTRA/LTE filters by comparing their major specifications.

Table 7-17: Overview of the EUTRA/LTE filters

Characteristic	"Best EVM"	"Best ACP" "Best ACP (Narrow)"	"Balanced EVM and ACP"	"Best EVM (no upsampling)"
Design goal	An excellent EVM performance while ignoring the effects on ACP	A combination of an excellent ACP performance and a good EVM performance "Best ACP (Narrow)" features additionally a smoother shape in frequency domain	A trade-off between EVM and ACP performance	A combination of an excellent ACP performance and a good EVM performance Small output waveform file size
Calculation time (in real-time processing)	By real-time processing, short calculation time	Long calculation time: the filtered signal is precalculated because of the filter complexity	By real-time processing, short calculation time	Long calculation time: the filtered signal is precalculated because of the filter complexity

Characteristic	"Best EVM"	"Best ACP" "Best ACP (Narrow)"	"Balanced EVM and ACP"	"Best EVM (no upsampling)"
Upsampling	Upsampling with factor 2 The sample rate of the output waveform is twice the LTE sample rate	Upsampling with factor 2 The sample rate of the output waveform is twice the LTE sample rate The signal processing requires twice as much internal memory. The available memory on the instrument is sufficient for the simulation of half as many frames compared to filter "Best EVM"	Upsampling with factor 2 The sample rate of the output waveform is twice the LTE sample rate	Upsampling is not applied The sample rate of the output waveform is not changed
Output waveform file size	Increased file size	Increased file size	Increased file size	File size is maintained The resulting file size is smaller than in the other cases
Recommended application field	Receiver and performance tests with internal real-time generation, where BLER is analyzed	Transmitter and components tests where excellent ACP is required		Receiver and performance tests with pre-generated waveform files, where BLER is analyzed

In some specific configurations, an internal ("Auto") filter is applied automatically. This filter is designed for best possible optimization in configurations, like for example a carrier aggregation with carriers that span different bandwidths.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:OPTimization`
on page 421

Load User Filter
(available for Filter Type user only)

Calls the menu "Select List File User Filter" for selecting a user-defined filter file with extension `*.vaf`.

For more information, refer to the description "Introduction to "filtwiz" Filter Editor" on the Rohde & Schwarz web page.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:USER` on page 422

Roll Off Factor or BxT
Sets the filter parameter.

The rolloff factor affects the steepness of the filter slopes. A "Rolloff Factor = 0" results in the steepest slopes; values near to 1 make the slopes more flat.

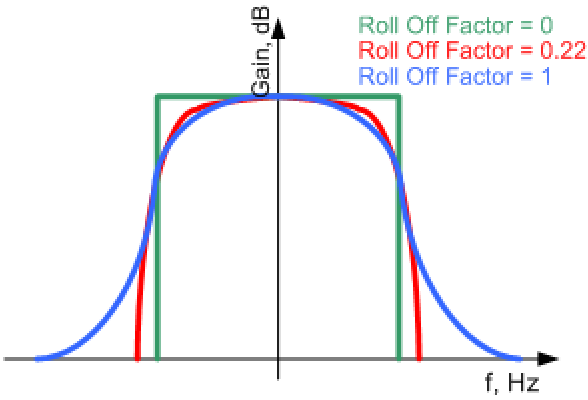


Figure 7-12: Example of the frequency response of a filter with different Roll Off Factors

For the default cosine filter, a roll off factor of 0.10 is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine on page 419
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:RCOSine on page 421
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:PGAuss on page 421
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:GAUSs on page 419
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:SPHase on page 422
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:APCO25 on page 418
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:ROFactor on page 421

Cut Off Frequency Shift
(available for filter parameter Cosine and EUTRA/LTE with EVM Optimization only)

The cut off frequency is a filter characteristic that defines the frequency at the 3 dB down point. The "Cut Off Frequency Shift" affects this frequency in the way that the filter flanks are "moved" and the transition band increases by "Cut Off Frequency Shift"*"Sample Rate".

- A "Cut Off Frequency Shift" = -1 results in a very narrow-band filter
- Increasing the value up to 1 makes the filter more broad-band
- By "Cut Off Frequency Shift" = 0, the -3 dB point is at the frequency determined by the half of the selected "Sample Rate".

Tip: Use this parameter to adjust the cut off frequency and reach spectrum mask requirements.

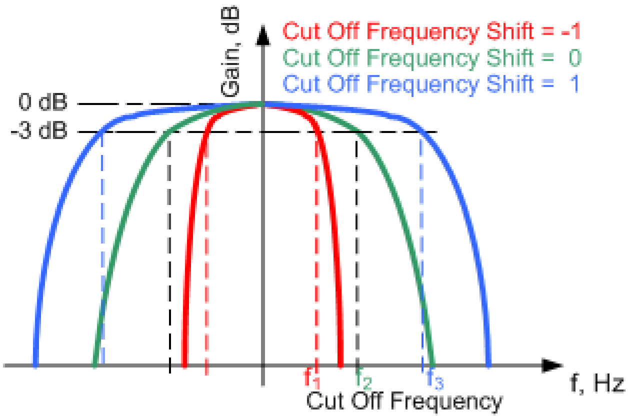


Figure 7-13: Example of the frequency response of a filter with different Cut Off Frequency Shift

Example:

"Channel Bandwidth" = 10 MHz

"Sample Rate" = 15.36 MHz

"Cut Off Frequency Shift" = 0

Frequency at 3 dB down point = +/- 7.68 MHz

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine:COFS` on page 419
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFS` on page 420

Cut Off Frequency Factor
(available for filter parameter Lowpass and EUTRA/LTE with ACP Optimization only)

Sets the value for the cut-off frequency factor. The cut-off frequency of the filter can be adjusted to reach spectrum mask requirements.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASs` on page 419
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFFactor` on page 420
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASSEVM` on page 420

Filter Mode
Selects an offline or realtime filter mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:MODE` on page 418

Sample Rate Variation
Sets the sample rate of the signal. A variation of this parameter only affects the ARB clock rate; all other signal parameters remain unchanged.

If the sampling rate in the "General Settings" menu is changed, this parameter is reset to the selected sampling rate.

If carrier aggregation is activated, the sample rate is set to a fixed value ("Auto") and cannot be changed.

Remote command:
[:SOURce<hw>]:BB:EUTRa:SRATe:VARiation on page 422

7.20.3 Clipping Settings

Provided are the following settings:

Clipping State
Switches baseband clipping on and off.

Baseband clipping is a very simple and effective way of reducing the crest factor of the signal. Since clipping is done prior to filtering, the procedure does not influence the spectrum. The EVM however increases.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLIPping:STATe on page 424

Clipping Level
Sets the limit for clipping.

This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLIPping:LEVel on page 423

Clipping Mode
Selects the clipping method. A graphic illustration of the way in which these two methods work is given in the dialog.

- "Vector | i + jq |"
  The limit is related to the amplitude | i + q |. The I and Q components are mapped together, the angle is retained.
- "Scalar | i | , | q |"
  The limit is related to the absolute maximum of all the I and Q values | i | + | q |. The I and Q components are mapped separately, the angle changes.

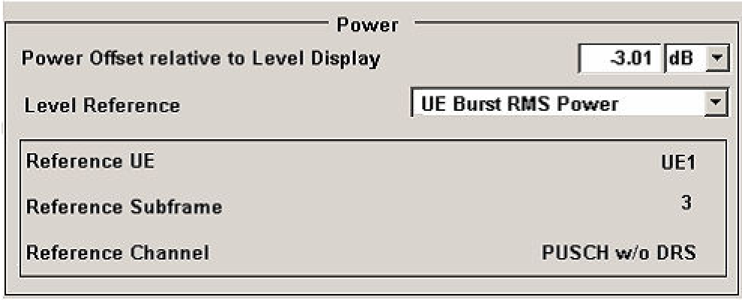
Selects the clipping method. A graphic illustrates how the two methods work.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLIPping:MODE on page 423

7.20.4 Power Settings

The "Power" section provides access to the settings necessary to adjust the global power level of the generated LTE signal.

For an overview of the provided power settings and detailed information on how to adjust them, refer to Chapter 5.3, "Power Setting", on page 65.



Power Offset Relative to Level Display

Sets the power offset of the baseband relative to the RMS level ("Level") displayed in the status bar.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:POWC:ORTLevel` on page 425

Power Reference

Defines the reference the "Level" display in the status bar is referring to.

"Frame RMS Power"
The displayed RMS and PEP are measured during the whole frame.
All frames are considered, not only the first one.

"DL Part of Frame RMS Power"
The displayed RMS and PEP are measured during the DL part of the frame (all DL subframes and the DwPTS).
All frames are considered, not only the first one.

"UL Part of Frame RMS Power"
The displayed RMS and PEP are measured during the UL part of the frame (all UL subframes and the UpPTS).
All frames are considered, not only the first one.

"UE Burst RMS Power"

The displayed RMS and PEP are measured during a single subframe of a certain UE. One of the following channels is used:
- PUSCH (without DRS)
- PUCCH (without DRS)
- PUCCH and PUSCH (both without DRS)
- PRACH or
- SRS.

The subframe, channel and reference used are displayed with the parameters Reference Subframe, Reference Channel, and Reference UE.

The instrument selects a suitable reference automatically according to the following algorithm:
- The first active UE is used
- The data part of the first PUSCH/PUCCH is used
- In PRACH mode, the first PRACH preamble is used
- If there is no active subframe, the SRS is used.

This power mode is required for setting the AWGN correctly (e.g. according to TS 36.141), in case not every possible subframe is used by the simulated UE. The actual part of the signal used for determining RMS and PEP are displayed in the graphical interface.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:POWC:LEVReference` on page 425

Reference UE

(enabled for Power Reference set to "UL Burst RMS Power")

Displays the UE the measured RMS and PEP is referring to.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:POWC:RUE?` on page 426

Reference Subframe

(enabled for Power Reference set to "UL Burst RMS Power")

Displays the subframe the measured RMS and PEP is referring to.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:POWC:REFSubframe?` on page 426

Reference Channel

(enabled for Power Reference set to "UL Burst RMS Power")

Displays the channel type the measured RMS and PEP is referring to.

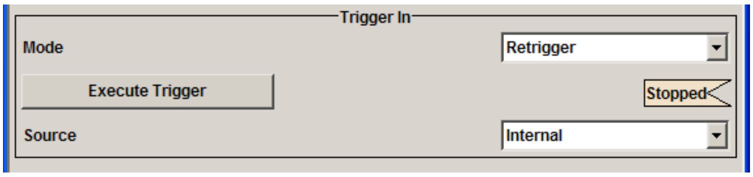
Remote command:
`[:SOURce<hw>]:BB:EUTRa:POWC:REFChannel` on page 426

7.21 Trigger/Marker/Clock Settings

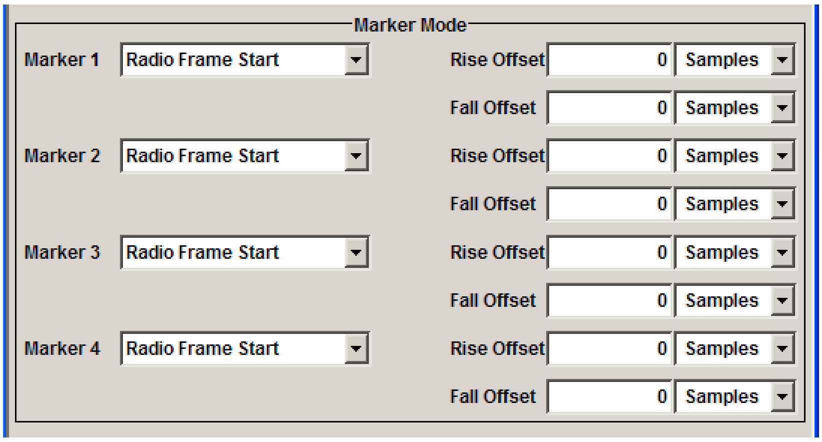
The trigger, clock, and marker delay functions are available for R&S SMx and R&S AMU instruments only.

To access this dialog, select "Main Menu > Trigger/Marker".

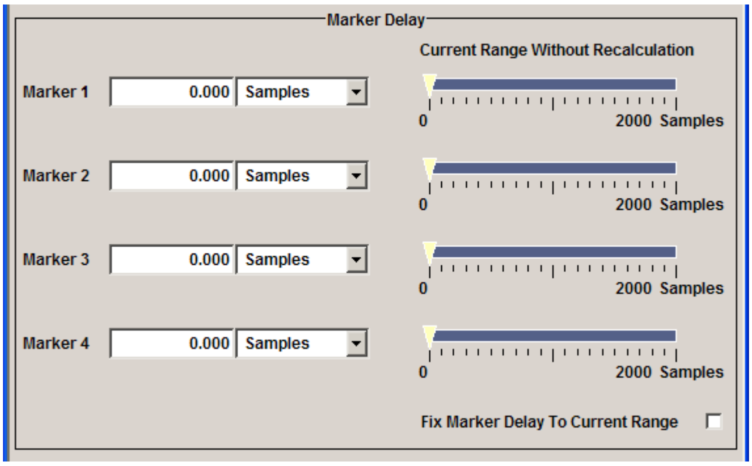
The "Trigger In" section is where the trigger for the signal is set. Various parameters are provided for the settings, depending on which trigger source - internal or external - is selected. The status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.



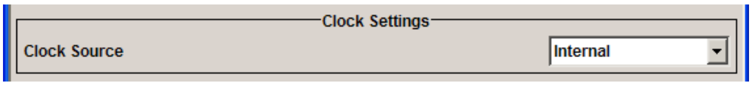
The "Marker Mode" section is where the marker signals at the MARKER output connectors are configured.



The "Marker Delay" section is where a marker signal delay can be defined, either without restriction or restricted to the dynamic section, i.e., the section in which it is possible to make settings without restarting signal and marker generation.



The "Clock Settings" section is where the clock source is selected and - in the case of an external source - the clock type.



The buttons in the last section lead to submenu for general trigger, clock and mapping settings.

7.21.1 Trigger In

The trigger functions are available for R&S SMx and R&S AMU instruments only.

The "Trigger In" section is where the trigger for the signal is set. Various parameters are provided for the settings, depending on which trigger source - internal or external - is selected. The status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.

Trigger Mode

Selects trigger mode, i.e. determines the effect of a trigger event on the signal generation.

- "Auto"
  The signal is generated continuously.
- "Retrigger"
  The signal is generated continuously. A trigger event (internal or external) causes a restart.
- "Armed_Auto"

The signal is generated only when a trigger event occurs. Then the signal is generated continuously.
An "Arm" stops the signal generation. A subsequent trigger event (internal with or external) causes a restart.
- "Armed_Retrigger"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.
  An "Arm" stops signal generation. A subsequent trigger event (internal with or external) causes a restart.
- "Single"
  The signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at "Signal Duration".
  Every subsequent trigger event (internal or external) causes a restart.

Use the "Armed_Auto" mode for Base Station Tests if a frame marker from the device under test starts the signal output. Subsequent frame markers does not cause a restart of the signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa[:TRIGger]:SEQuence` on page 430

Signal Duration Unit
Defines the unit for describing the length of the signal sequence to be output in the "Single" trigger mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:SLUNit` on page 435

Signal Duration
Enters the length of the signal sequence to be output in the "Single" trigger mode.

Use this parameter to deliberately output part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:SLENgth` on page 434

Running/Stopped
For enabled modulation, displays the status of signal generation for all trigger modes.

- "Running"
  The signal is generated; a trigger was (internally or externally) initiated in triggered mode.
- "Stopped"
  The signal is not generated and the instrument waits for a trigger event.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:RMODe?` on page 434

Arm
Stops signal generation. This button appears only with "Running" signal generation in the "Armed_Auto" and "Armed_Retrigger" trigger modes.

Signal generation can be restarted by a new trigger (internally with "Execute Trigger" or externally).

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:ARM:EXECute on page 431

Execute Trigger
Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than "Auto" have been selected.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:EXECute on page 432

Trigger Source
Selects trigger source. This setting is effective when a trigger mode other than "Auto" has been selected.

- "Internal"
  The trigger event is executed by "Execute Trigger".
- "Internal (Baseband A/B)"
  (two-path instruments)
  The trigger event is the trigger signal from the second path
- "External (Trigger 1/2)"
  The trigger event is the active edge of an external trigger signal, supplied at the TRIGGER 1/2 connector.
  Use the "Global Trigger/Clock Settings" dialog to define the polarity, the trigger threshold and the input impedance of the trigger signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:SOURce on page 431

Sync. Output to External Trigger
(enabled for "Trigger Source" External)

Enables/disables output of the signal synchronous to the external trigger event.

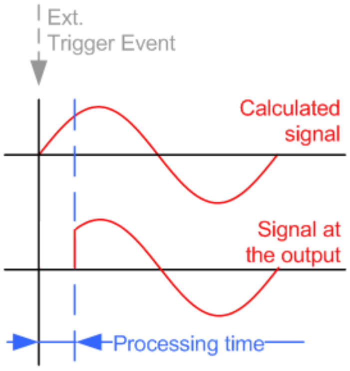
For R&S SMBV instruments:

For or two or more R&S SMBVs configured to work in a master-slave mode for synchronous signal generation, configure this parameter depending on the provided system trigger event and the properties of the output signal. See Table 7-18 for an overview of the required settings.

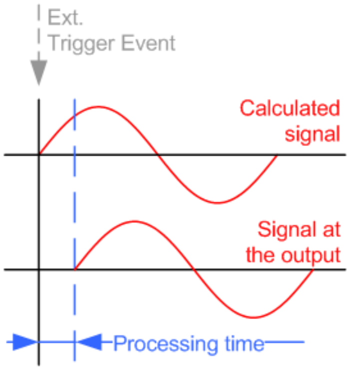
Table 7-18: Typical Applications

System Trigger	Application	"Sync. Output to External Trigger"
Common External Trigger event for the master and the slave instruments	All instruments are synchronous to the external trigger event	ON
	All instruments are synchronous among themselves but starting the signal from first symbol is more important than synchronicity with external trigger event	OFF
Internal trigger signal of the master R&S SMBV for the slave instruments	All instruments are synchronous among themselves	OFF

"On" Corresponds to the default state of this parameter.
The signal calculation starts simultaneously with the external trigger event but because of the instrument's processing time the first samples are cut off and no signal is outputted. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.



"Off" The signal output begins after elapsing of the processing time and starts with sample 0, i.e. the complete signal is outputted.
This mode is recommended for triggering of short signal sequences with signal duration comparable with the processing time of the instrument.



Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:SYNChronize:OUTPut`
on page 432

Trigger Delay Unit
Selects the unit ("Samples" or "Time") of the external and other baseband trigger delay.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:DELay:UNIT` on page 431

Trigger Delay
Delays the trigger event of the signal from:
- The external trigger source
- The other path

Use this setting to:

- Synchronize the instrument with the device under test (DUT) or other external devices

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal<ch>]:DELay on page 435
[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal<ch>:TDELay on page 436
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:DELay on page 432
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:TDELay on page 434

Actual External Delay
Indicates the resulting external trigger delay in "Time" unit.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal<ch>:RDELay? on page 436
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:RDELay? on page 433

Trigger Inhibit
Sets the duration for inhibiting a new trigger event after triggering. The input has to be expressed in samples.

In the "Retrigger" mode, every trigger signal causes signal generation to restart. This restart is inhibited for the specified number of samples.

This parameter is only available on external triggering or on internal triggering via the second path.

For two-path instruments, the trigger inhibit can be set separately for each of the two paths.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal<ch>]:INHibit on page 436
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:INHibit on page 433

7.21.2 Timing Configuration

Signal Advance N_TA_offset
(R&S SMx and R&S AMU instruments only)

Sets the parameter $N_{TA\ offset}$ as defined in the 3GPP TS 36.211.

The parameter is available in "Uplink" direction and enabled "TDD" mode.

The 3GPP TS 36.211 defines the signal advance parameter depending on the duplexing mode and specifies the following values:

- For FDD mode: $N_{TA\ offset} = 0$
- For TDD mode: $N_{TA\ offset} = 624$.

In the R&S Signal Generator, however, the signal advance for the TDD mode can also be set to 0.

According to the 3GPP specification, the value of 624 means, that the uplink signal is shifted against the downlink one. This instrument does not generate the uplink and downlink signal simultaneously and uses the marker signals to represent the downlink timing, i.e. setting the $N_{TA\ offset}$ to 624 is used like a "negative trigger delay" and shifts the uplink signal against the trigger and the markers.

To achieve the shifting, the R&S Signal Generator processes the signal differently, depending whether the "Realtime Feedback" mode is activated or not (see Figure 7-14).

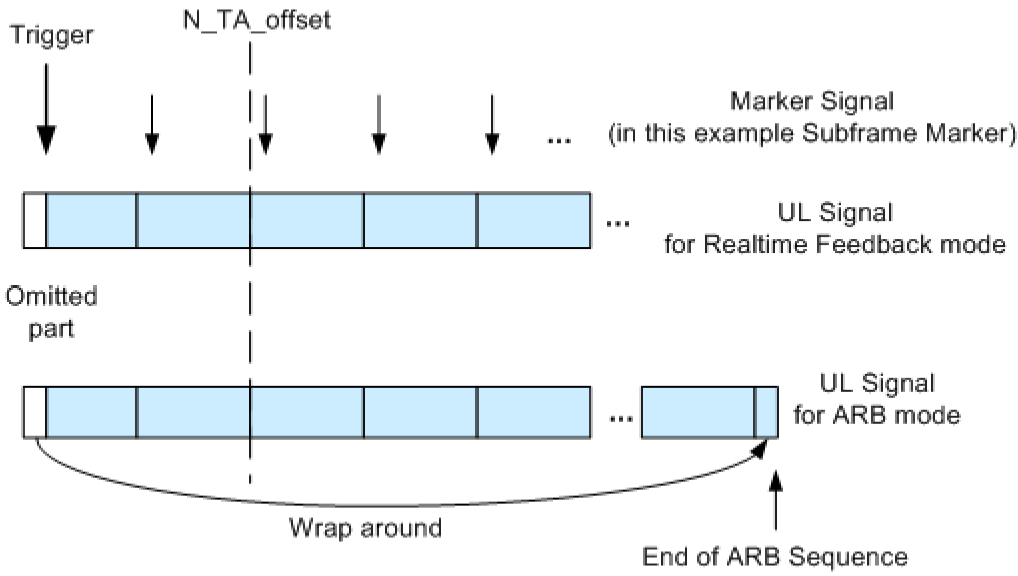


Figure 7-14: Signal Processing

- In Realtime Feedback mode, the shifting is achieved by omitting the beginning of the signal, where the omitted part is exactly 624xTs long.
- When the Realtime Feedback mode is disabled and the instrument is working in the normal ARB mode, the samples of the ARB sequence are shifted with "wrap around", i.e. the omitted samples are added to the end of the ARB sequence. The total length of the sequence remains unchanged and is equal to sequence length if $N_{TA\ offset} = 0$.

Note: The time shift due to the N_TA_offset is independent from the time shifts caused by the realtime feedback parameter Initial Timing Advance or by timing advance/ adjustment commands. According to 3GPP TS 36.211, the resulting time shift is the sum of the selected time shifts.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TIMC:NTAoffset` on page 430

7.21.3 Marker Mode

The marker output signal for synchronizing external instruments is configured in the "Marker settings" section "Marker Mode".

Marker Mode
Selects a marker signal for the associated "MARKER" output.

"Restart (ARB)"
A marker signal is generated at the start of each ARB sequence.

"Radio Frame Start"
A marker signal is generated at the start of each radio frame.

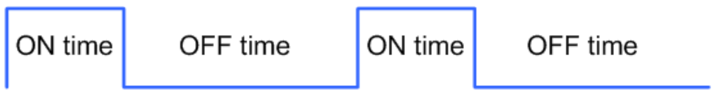
"Frame Active Part"
The marker signal is high whenever a burst is active and low during inactive signal parts (such as the gaps between bursts in uplink mode or the uplink subframe in downlink TDD mode).
This marker can be used to decrease the carrier leakage during inactive signal parts by feeding it into the pulse modulator.

"Subframe"
A marker signal is generated at the start of each subframe.

"User Period"
A marker signal is generated at the beginning of every user-defined period. The period is defined in "Period."

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:PERiod on page 440

"ON/OFF Period"
A regular marker signal that is defined by an ON/OFF ratio is generated. A period lasts one ON and OFF cycle.
The "ON Time" and "OFF Time" are each expressed as a number of samples and are set in an input field which opens when ON/OFF ratio is selected.



Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:OFFTime on page 440
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ONTime on page 440

"System Frame Number (SFN) Restart"
A marker signal is generated at the start of every SFN period.

"Internally Used"
Special marker signal for the realtime feedback mode (Chapter 6, "Realtime Feedback for Closed Loop BS Tests", on page 69) or for the "SFN Restart Period > 3GPP (1024 Frames)".

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:MODE on page 438

Rise/Fall Offset
(Available for marker mode Subframe, Radio Frame Start, and Restart (ARB) only)

Sets the value for the rise/fall offset. The rising ramp of the marker is shifted by the set value in samples. Positive values shift the rising ramp to later positions; negative values shift it to earlier positions.

The value range is -640000 to 640000.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ROFFset on page 440
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:FOFFset on page 440

7.21.4 Marker Delay

The delay of the signals on the MARKER outputs is set in the "Marker Delay" section.

The marker delay functions are available for R&S SMx and R&S AMU instruments only.

The R&S SMBV supports only two markers.

Marker x Delay
Enters the delay between the marker signal at the marker outputs and the start of the frame or slot.

Note: The R&S SMBV Vector Signal Generator supports only two markers.

The input is expressed as a number of symbols/samples. If the setting "Fix marker delay to dynamic range" is enabled, the setting range is restricted to the dynamic range. In this range, the delay of the marker signals can be set without restarting the marker and signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay on page 437

Current Range without Recalculation
Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and signal.

The delay can be defined by moving the setting mark.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay:MAXimum?
on page 438
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay:MINimum?
on page 438

Fix marker delay to current range
Restricts the marker delay setting range to the dynamic range. In this range, the delay can be set without restarting the marker and signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut:DELay:FIXed on page 437

7.21.5 Clock Settings

The "Clock Settings" are used to set the clock source and a delay if required.

The clock functions are available for R&S SMx and R&S AMU instruments only.

Sync. Mode
(for R&S SMBV only)

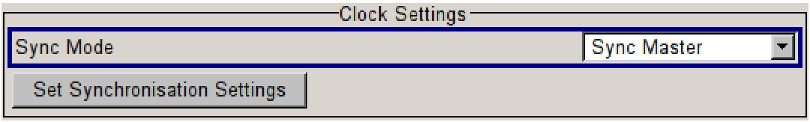
Selects the synchronization mode.

This parameter is used to enable generation of precise synchronous signal of several connected R&S SMBVs.

Note: If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.
Avoid unnecessary cable length and branching points.

"None" The instrument is working in stand-alone mode.

"Sync. Master" The instrument provides all connected instrument with its synchronization (including the trigger signal) and reference clock signal.



"Sync. Slave" The instrument receives the synchronization and reference clock signal from another instrument working in a master mode.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLOCk:SYNChronization:MODE on page 429

Set Synchronization Settings
(for R&S SMBV only)

Performs automatically adjustment of the instrument's settings required for the synchronization mode, selected with the parameter "Sync. Mode".

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLOCk:SYNChronization:MODE on page 429

Clock Source
Selects the clock source.

"Internal" The internal clock reference is used to generate the symbol clock.

"External" The external clock reference is fed in as the symbol clock or multiple thereof via the CLOCK connector.
The symbol rate must be correctly set to accuracy of +/-2 % (see data sheet).
The polarity of the clock input can be changed with the aid of "Global Trigger/Clock Settings".
In the case of two-path instruments, this selection applies to path A.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLOCk:SOURce on page 428

Clock Mode

Enters the type of externally supplied clock.

"Sample" A sample clock is supplied via the CLOCK connector.

"Multiple Sample" A multiple of the sample clock is supplied via the CLOCK connector; the sample clock is derived internally from this.

"Custom" (not for R&S SMBV)
An external custom clock is supplied via the CLOCK connector.
The exact frequency of the provided clock has to be defined with parameter "Custom External Clock".

Note: Custom External Clock source in baseband B is only supported if baseband A is configured with EUTRA/LTE too. Furthermore the same settings for clock source and clock mode have to be set in baseband A and B. The user needs to take care of the correct settings.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:CLOCk:MODE` on page 427

Clock Multiplier

Enters the multiplication factor for clock type "Multiple".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:CLOCk:MULTiplier` on page 428

Custom External Clock

Specifies the parameter for clock type "Custom" if an external clock source is used.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:CLOCk:CUSTom` on page 427

Expected Clock Frequency

If an external clock signal is used, this parameter indicates the expected clock frequency value.

The value is calculated as follows:

"Expected Clock Frequency" = * Clock Multiplier

Measured External Clock

Provided for permanent monitoring of the enabled and externally supplied clock signal.

Remote command:
`CLOCk:INPut:FREQuency?`

7.21.6 Global Settings

The buttons in this section lead to dialogs for general trigger, clock and mapping settings.

Global Trigger/Clock Settings

Calls the "Global Trigger/Clock/Input Settings" dialog.

This dialog is used among other things for setting the trigger threshold, the input impedance and the polarity of the clock and trigger inputs.

The parameters in this dialog affect all digital modulations and standards, and are described in chapter "Global Trigger/Clock/Input Settings" in the Operating Manual.

User Marker / AUX I/O Settings
Calls the "User Marker AUX I/O Settings" dialog, used to map the connector on the rear of the instruments.

See also "User Marker / AUX I/O Settings" in the Operating Manual.

8 Performing BS Tests According to TS 36.141

The "Test Case Wizard" is supported by R&S SMU, R&S SMATE, R&S SMJ and R&S SMBV.

The test setups and the hardcopies in this description assume a fully equipped R&S SMU.

The "Test Case Wizard" supports tests on base stations in conformance with the 3GPP specification for Base Station conformance testing. It offers a selection of predefined settings according to Test Cases in TS 36.141. For an overview of the test cases covered by the test case wizard, refer to Chapter 8.3, "Supported Test Cases", on page 312.

With the "Test Case Wizard", it is possible to create highly complex test scenarios with just a few keystrokes.

The "Test Case Wizard" has effect on frequency and level settings, link direction, filter, trigger, baseband clock source, marker settings and base station or user equipment configuration. Besides the EUTRA/LTE required settings also interfering signals (AWGN, CW interferer, co-located modulation signals) or fading profiles are set.

The "Test Case Wizard" presets the instrument for tests according to the test specification. If it is required, you can change the predefined settings by varying the corresponding parameter in the EUTRA/LTE dialogs.

8.1 Introduction to Conformance Testing

The main purpose of the conformance testing is to ensure that the base station (BS) and the user equipment (UE) are fulfilling a defined level of minimum performance.

The 3GPP organization defines three groups of conformance testing for the UE: Radio Frequency (RF), Radio Resource Management (RRM) and Signaling. There is only one group conformance testing for the BS, the RF conformance tests.

This chapter is intended to give an overview of the 3GPP test specifications dealing with the conformance tests. Only a brief description is provided.

8.1.1 UE Conformance Testing

The UE conformance tests are not in the scope of this description.

UE RF FDD/TDD Conformance Test Specifications

The UE RF conformance tests are based on the core specification TS 36.101 and are defined in the TS 36.521. The following list gives an overview of the related specifications:

- TS 36.124 "ElectroMagnetic Compatibility (EMC) requirements for mobile terminals and ancillary equipment"
- TS 36.521-1 "User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing"

  Overview of the test cases:

  – Subclause 6: UE RF transmitter test cases
    Transmit power, Output power dynamics, Transmit signal quality, Output RF spectrum emissions and Transmit intermodulation
  – Subclause 7: UE RF receiver test cases
    Diversity characteristics, Reference sensitivity power level, Maximum input level, Adjacent Channel Selectivity (ACS), In-band blocking, Out-of-band blocking, Narrow band blocking, Spurious response, Intermodulation characteristics, Spurious emissions
  – Subclause 8: UE RF FDD/TDD performance test cases
    Demodulation of PDSCH (Cell-Specific Reference Symbols), Demodulation of PDSCH (User-Specific Reference Symbols), Demodulation of PDCCH/PCFICH, Demodulation of PHICH, Demodulation of PBCH
- TS 36.521-2 "User Equipment (UE) conformance specification; Radio transmission and reception; Part 2: Implementation Conformance Statement (ICS)"
- TS 36.521-3 "User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Radio Resource Management (RRM) conformance testing"

UE RRM Conformance Test Specifications

The following specifications deal with UE RRM conformance testing:

- TS 36.133 "Requirements for support of radio resource management"
- TS 36.521-3 "User Equipment (UE) conformance specification; Part 3: Test suites"

UE Signaling Conformance Test Specifications

The UE signaling conformance tests are defined in the TS 36.523.

- TS 36.523-1 "User Equipment (UE) conformance specification; Part 1: Protocol conformance specification"
- TS 36.523-2 "User Equipment (UE) conformance specification; Part 2: Implementation Conformance Statement (ICS) pro-forma specification"
- TS 36.523-3 "User Equipment (UE) conformance specification; Part 3: Test suites"

8.1.2 BS Conformance Testing

BS RF FDD/TDD Conformance Test Specifications

The BS RF conformance tests are based on the core specification TS 36.101 and are defined in the TS 36.141

- TS 36.113 "Base Station (BS) and repeater ElectroMagnetic Compatibility (EMC)"
- TS 36.141 "Base Station (BS) conformance testing"
  The BS RF Conformance Tests are described in Chapter 8.3, "Supported Test Cases", on page 312.

8.1.3 Repeater Conformance Testing

The repeater conformance tests are based on the core specification TS 36.106 and defined in the TS 36.143 "FDD repeater conformance testing".

8.2 Basic Configuration

The basic equipment layout for preforming test with the "Test Case Wizard" is the same as for the EUTRA/LTE signal generation. It includes the options:

- Baseband Main Module (R&S SMU/SMJ/SMATE-B13)
- Baseband Generator (R&S SMx/AMU-B10)
- Digital Standard EUTRA/LTE (R&S SMx/AMU-K55)
- Frequency option (R&S SMx-B10x: RF 100kHz - x GHz)

However, some of the tests require further options. The additionally required hardware and/or software options are listed as a prerequisite in the description of the corresponding test case.

Test cases where the signal generator hardware and/or software equipment is not sufficient are shown in grey color but are not selectable.

RF power and frequency limitations of the hardware equipment restrict the setting ranges.

8.3 Supported Test Cases

The BS RF conformance tests defined in the TS 36.141 are divided into three main parts, the RF transmitter characteristics, the RF receiver characteristics and the RF performance requirements.

The "Test Case Wizard" supports the test cases listed in the tables below.

Only the test cases that require a signal generator are implemented in the "Test Case Wizard".

Table 8-1: Transmitter Tests

Chapter in TS 36.141	Test Case	Section in this document with further information
	Output power dynamics	this test case does not require a signal generator
6.3.1	RE Power control dynamic range	
6.3.2	Total power dynamic range	
6.4	Transmit ON/OFF power	
	Transmitted signal quality	
6.5.1	Frequency error	
6.5.2	Error Vector Magnitude	
6.5.3	Time alignment between transmitter branches	
6.5.4	DL RS power	
	Unwanted emissions	
6.6.1	Occupied bandwidth	
6.6.2	Adjacent Channel Leakage power Ratio (ACLR)	
6.6.3	Operating band unwanted emissions	
6.6.4	Transmitter spurious emissions	
6.7	Transmitter intermodulation	chap. 8.7.5, on page 334

Table 8-2: Receiver Characteristics

Chapter in TS 36.141	Test Case	Section in this document with further information
7.2	Reference sensitivity level	chap. 8.8.4, on page 342
7.3	Dynamic range	chap. 8.8.5, on page 343
7.4	In-channel selectivity	chap. 8.8.6, on page 346
7.5	Adjacent Channel Selectivity (ACS)	chap. 8.8.7, on page 349
	Narrow-band blocking	chap. 8.8.8, on page 352
7.6	Blocking	chap. 8.8.9, on page 355
7.7	Receiver spurious emissions	this test case does not require a signal generator
7.8	Receiver intermodulation	chap. 8.8.10, on page 359

Table 8-3: Performance Requirement

Chapter in TS 36.141	Test Case	Section in this document with further information
	Performance requirements for PUSCH	
8.2.1	Performance requirements of PUSCH in multipath fading propagation conditions	chap. 8.9.3, on page 367
8.2.2	Performance requirements for UL timing adjustment	chap. 8.9.4, on page 371
8.2.3	Performance requirements for HARQ-ACK multiplexed on PUSCH	chap. 8.9.5, on page 375
8.2.4	Performance requirements for High Speed Train conditions	chap. 8.9.6, on page 378
	Performance requirements for PUCCH	
8.3.1	ACK missed detection for single user PUCCH format 1a	chap. 8.9.7, on page 381
8.3.2	CQI performance requirements for PUCCH format 2	chap. 8.9.8, on page 384
8.3.3	ACK missed detection for multi user PUCCH format 1a	chap. 8.9.9, on page 386
8.3.4	ACK missed detection for PUCCH format 1b, channel selection	chap. 8.9.10, on page 391
8.3.5	ACK missed detection for PUCCH format 3	chap. 8.9.11, on page 394
8.3.6	NACK to ACK detection for PUCCH format 3	chap. 8.9.12, on page 397
8.3.7	ACK missed detection for PUCCH format 1a transmission on two antenna ports	chap. 8.9.13, on page 400
8.3.8	CQI performance requirements for PUCCH format 2 transmission on two antenna ports	chap. 8.9.14, on page 402
8.3.9	CQI Performance for PUCCH format 2 with DTX detection	chap. 8.9.15, on page 403
	Performance requirements for PRACH	
8.4.1	PRACH false alarm probability and missed detection	chap. 8.9.16, on page 406

8.3.1 Generic Structure of the Description of the Implemented Test Cases

The description of the test cases in this document follows a common structure.

- Test Case Number and Test Case Name
- Short Description and Test Purpose
  Some of the definitions are directly taken form the 3GPP test specification.
- Prerequisites, required hardware and software options
- Test setup

- Description of test case specific parameters

8.4 Standard Test Setups

The tests can be performed using the standard test setup according to TS 36.141. Test setups beside the three standard test setups described below are specified at the individual description of the corresponding test case.

8.4.1 Standard Test Setup - One Path

In case of two-path instruments signal routing to path A is assumed for the graph below. RF port A outputs the wanted signal (with or without fading and/or interference) and is connected to the Rx port of the base station. The signal generator will start signal generation at the first received eNB frame trigger.

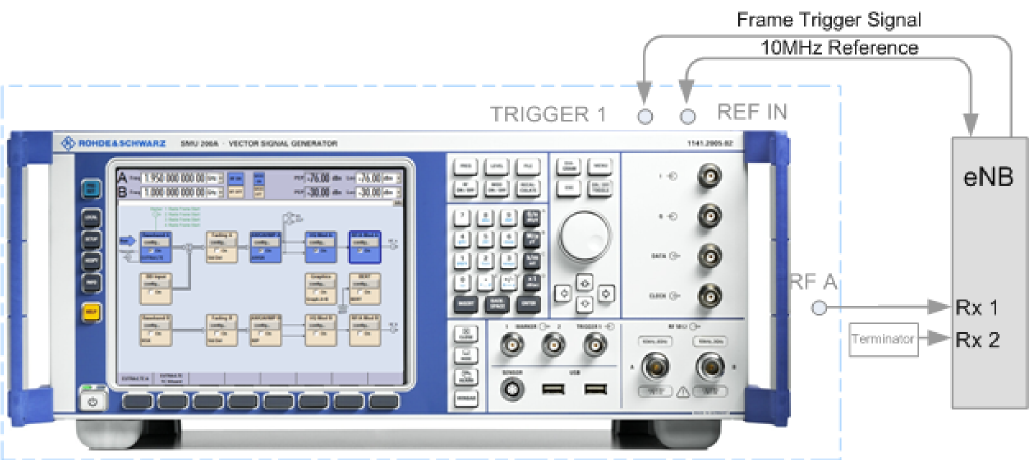


Figure 8-1: One Path Standard Test Setup (Example of R&S SMU simulating the test case 7.3 "Dynamic Range")

For two-path instruments it is also possible to route baseband signal A to RF output B and connect RF output B to the Rx port of the base station.

8.4.2 Standard Test Setup - Two Paths

For two-paths measurements, the test cases always require option Second RF path (R&S SMx-B20x), a second option Baseband Main Module (R&S SMx-B13) and at least one option to generate the interfering signal in addition to the basic configuration. The signal routing is fixed.

The signal generator outputs the reference measurement channel signal, i.e. the wanted signal at output RF A and the interfering signal(s) at output RF B. After combining the two (three) signals the sum signal is fed into the base station Rx port. The signal generator will start signal generation at the first received eNB frame trigger.

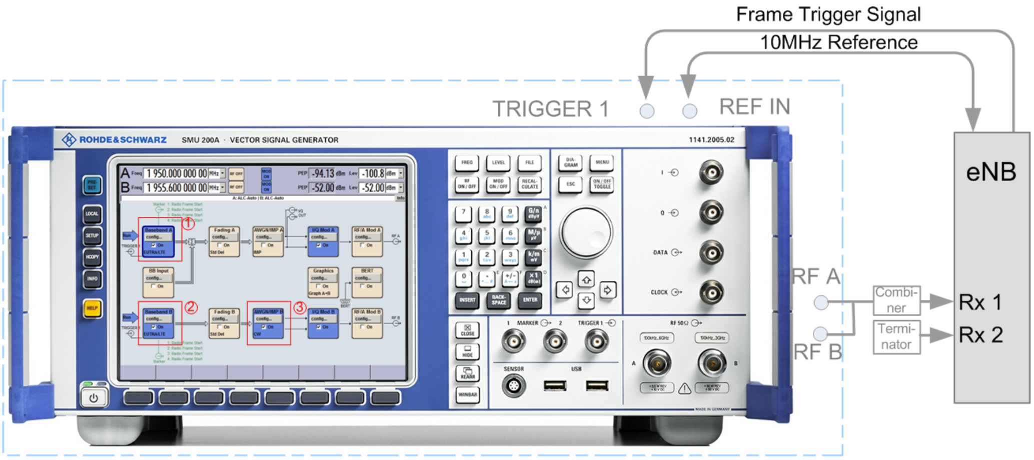


Figure 8-2: Two Paths Standard Test Setup (Example of R&S SMU simulating test case 7.8 "Receiver Intermodulation")

1 = Baseband A generates the wanted signal
2 = Baseband B generates the EUTRA/LTE interfering signal
3 = AWGN B generates the CW interfering signal

8.4.3 Test Setup - Diversity Measurements

For diversity measurements, the test cases always require at least option Second RF path (R&S SMx-B20x) and a second option Baseband Main Module (R&S SMx-B13) in addition to the basic configuration. The signal routing is fixed.

RF output A and RF output B transmit the corrupted reference measurement channel signal (wanted signal) and are connected to the Rx ports of the base station for diversity reception. The signal generator will start signal generation at the first received eNB frame trigger.

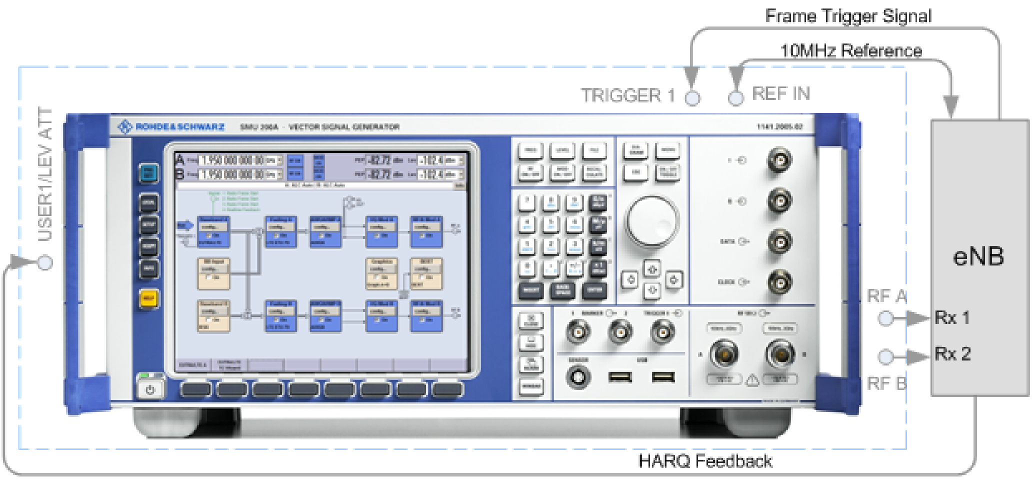


Figure 8-3: Test Setup for Diversity Measurements (Example of R&S SMU simulating test case 8.2.1 "PUSCH in Multipath Fading Propagation Conditions")

As signal routing takes place at the output of the baseband block, the interference settings of the two paths are identical for diversity measurements.

8.4.4 Test Setup - Four Rx Antennas

Test setup with four Rx antennas require a second signal generator, equipped with two paths (e.g. two R&S SMU). The required options of both signal generators are identical. The signal routing is fixed.

RF output A and RF output B transmit the corrupted reference measurement channel signal (wanted signal) and are connected to the Rx ports of the base station for diversity reception. The signal generator will start signal generation at the first received eNB frame trigger.

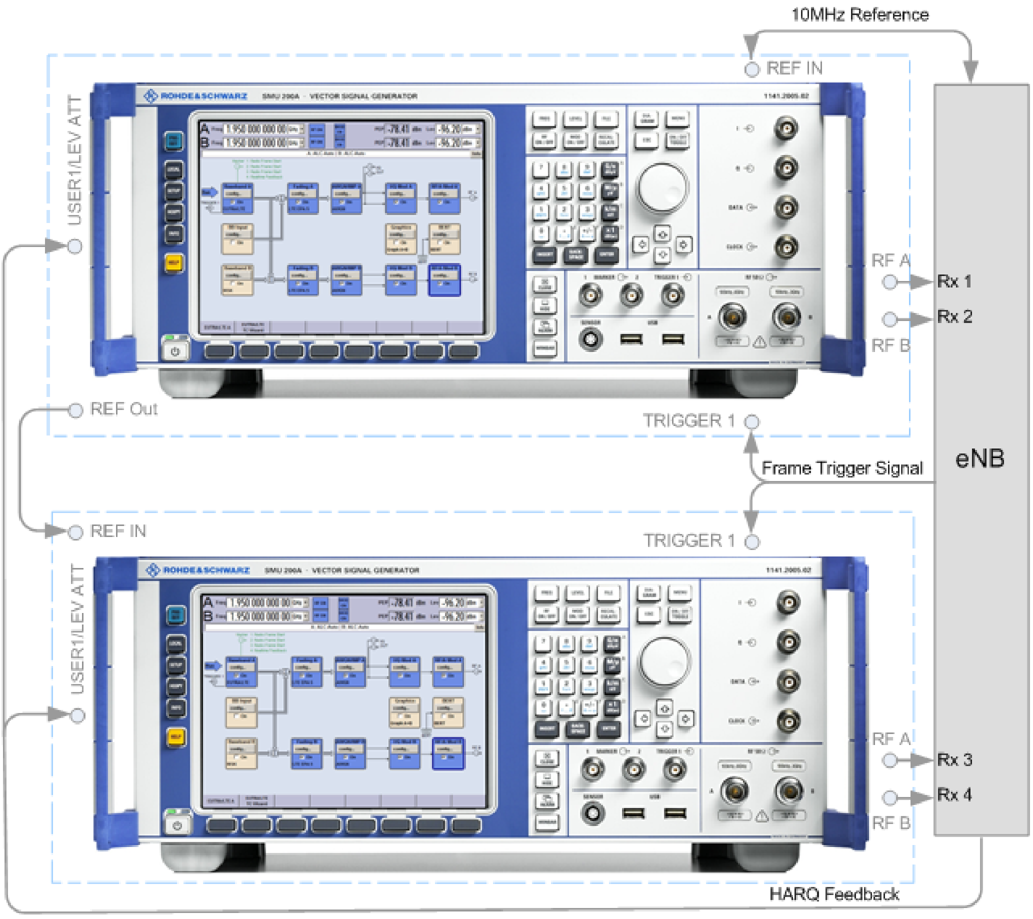


Figure 8-4: Test Setup for tests with four Rx antennas (Example of 2xR&S SMU simulating test case 8.2.1 "PUSCH in Multipath Fading Propagation Conditions")

As signal routing takes place at the output of the baseband block, the interference settings of the two paths are identical for diversity measurements.

8.5 General Considerations

This section lists some common topics for all BS RF conformance tests. Considerations specific to one conformance test part, are described at the corresponding section.

Test Frequencies

EUTRA/LTE is designed to operate in the operating bands defined in Table 8-4. The table shows the start and the stop frequencies of both uplink and downlink frequency bands according to TS 36.141.

Table 8-4: EUTRA/LTE operating bands

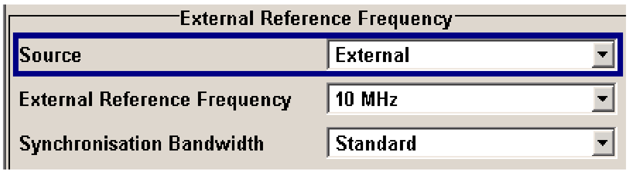
EUTRA Operating Band	Uplink (UL) band BS receive UE transmit F_{UL_low} to F_{UL_high}	Downlink (DL) operating band BS transmit UE receive F_{DL_low} to F_{DL_high}	Duplex Mode
1	1920 MHz to 1980 MHz	2110 MHz to 2170 MHz	FDD
2	1850 MHz to 1910 MHz	1930 MHz to 1990 MHz	FDD
3	1710 MHz to 1785 MHz	1805 MHz to 1880 MHz	FDD
4	1710 MHz to 1755 MHz	2110 MHz to 2155 MHz	FDD
5	824 MHz to 849 MHz	869 MHz to 894MHz	FDD
6	830 MHz to 840 MHz	875 MHz to 885 MHz	FDD
7	2500 MHz to 2570 MHz	2620 MHz to 2690 MHz	FDD
8	880 MHz to 915 MHz	925 MHz to 960 MHz	FDD
9	1749.9 MHz to 1784.9 MHz	1844.9 MHz to 1879.9 MHz	FDD
10	1710 MHz to 1770 MHz	2110 MHz to 2170 MHz	FDD
11	1427.9 MHz to 1447.9 MHz	1475.9 MHz to 1495.9 MHz	FDD
12	699 MHz to 716 MHz	729 MHz to 746 MHz	FDD
13	777 MHz to 787 MHz	746 MHz to 756 MHz	FDD
14	788 MHz to 798 MHz	758 MHz to 768 MHz	FDD
...			
17	704 MHz to 716 MHz	734 MHz to 746 MHz	FDD
...			
33	1900 MHz to 1920 MHz	1900 MHz to 1920 MHz	TDD
34	2010 MHz to 2025 MHz	2010 MHz to 2025 MHz	TDD
35	1850 MHz to 1910 MHz	1850 MHz to 1910 MHz	TDD
36	1930 MHz to 1990 MHz	1930 MHz to 1990 MHz	TDD
37	1910 MHz to 1930 MHz	1910 MHz to 1930 MHz	TDD
38	2570 MHz to 2620 MHz	2570 MHz to 2620 MHz	TDD

EUTRA Operating Band	Uplink (UL) band BS receive UE transmit F_{UL_low} to F_{UL_high}	Downlink (DL) operating band BS transmit UE receive F_{DL_low} to F_{DL_high}	Duplex Mode
39	1880 MHz to 1920 MHz	1880 MHz to 1920 MHz	TDD
40	2300 MHz to 2400 MHz	2300 MHz to 2400 MHz	TDD

The measurements that have to be performed according to TS 36.141 for verifying a proper operation of systems apply to appropriate frequencies in the bottom, middle and top of the operating frequency band of the base station (BS). These frequencies are denoted as RF channels B (bottom), M (middle) and T (top).

Reference Frequency

When building up the measurement setups according to TS 36.141 it might be useful that all the instruments share a common reference clock. When you feed an external clock, the RF module configuration should be switched to external reference frequency.



In the external reference mode an external signal with selectable frequency and defined level must be input at the REF IN connector. This signal is output at the REF OUT connector. The reference frequency setting is effective for both paths. For achieving very good reference sources of high spectral purity a wideband setting is provided.

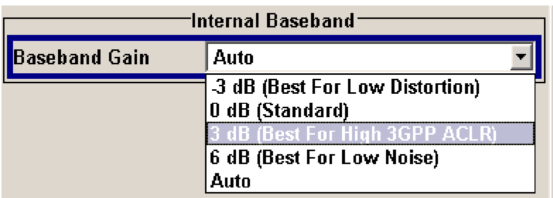
Baseband Clock

The clock source is automatically switched to internal when the test case settings are activated.

Improvement of signal quality

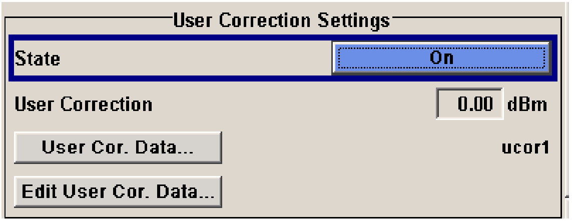
Improvement of signal quality is possible via several settings:

- In the "I/Q Settings" menu the internal baseband gain can be set to improved ACLR performance (3 dB or 6 dB)

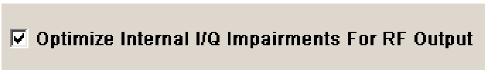
- In the "Automatic Level Control Settings" menu the RF output level can be recalibrated with "Search Once" in "Sample&Hold" mode. This is recommended if in CW mode the signal/intermodulation ratio is to be improved for multi-transmitter measurements. With setting "Auto", the level control is automatically adapted to the operating conditions, it may cause increased intermodulation, however.

- To consider the frequency response of the test setup, select "RF > User Correction" and crate a list of correction values.



- To compensate cable loss and additionally inserted attenuator, adjust the RF level ("Status Bar > Level").

- Additional settings in the impairments section of the AWGN block



Virtual Resource Block (VRB) Offset

In this implementation, the RBs are allocated by default at the left edge of the spectrum. However, some test cases do not require allocation of the entire bandwidth or RB allocation at a specific part of the bandwidth. Adjust the additional parameter "Offset VRB" to define the position of the RBs.

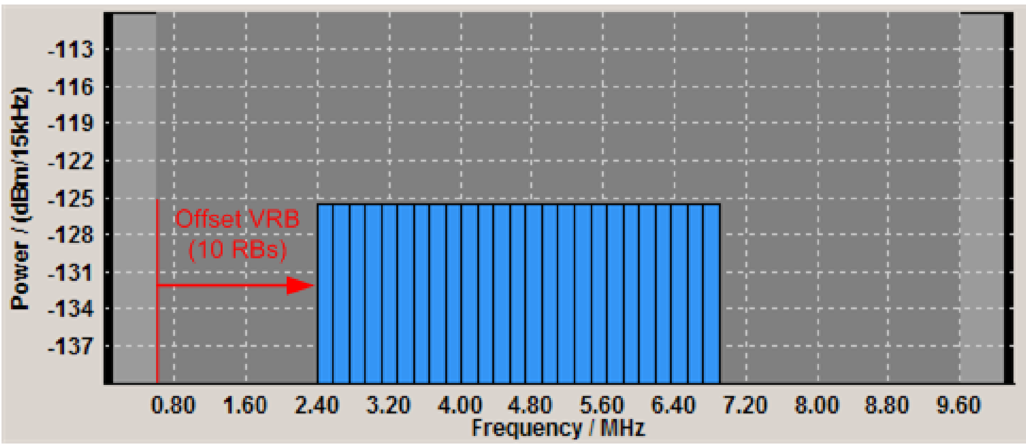
Example: Offset VRB

"Channel Bandwidth" = 10 MHz, i.e. 50 RBs

"Allocated Resource Blocks" = 25

"Offset VRB" = 10

The RBs are offset by 10 RBs and allocated RBs start at position 11.



Use also the SC-FDMA Time Plan to visualize the RB allocation for the wanted signal (path A) and the interfering signal (path B).

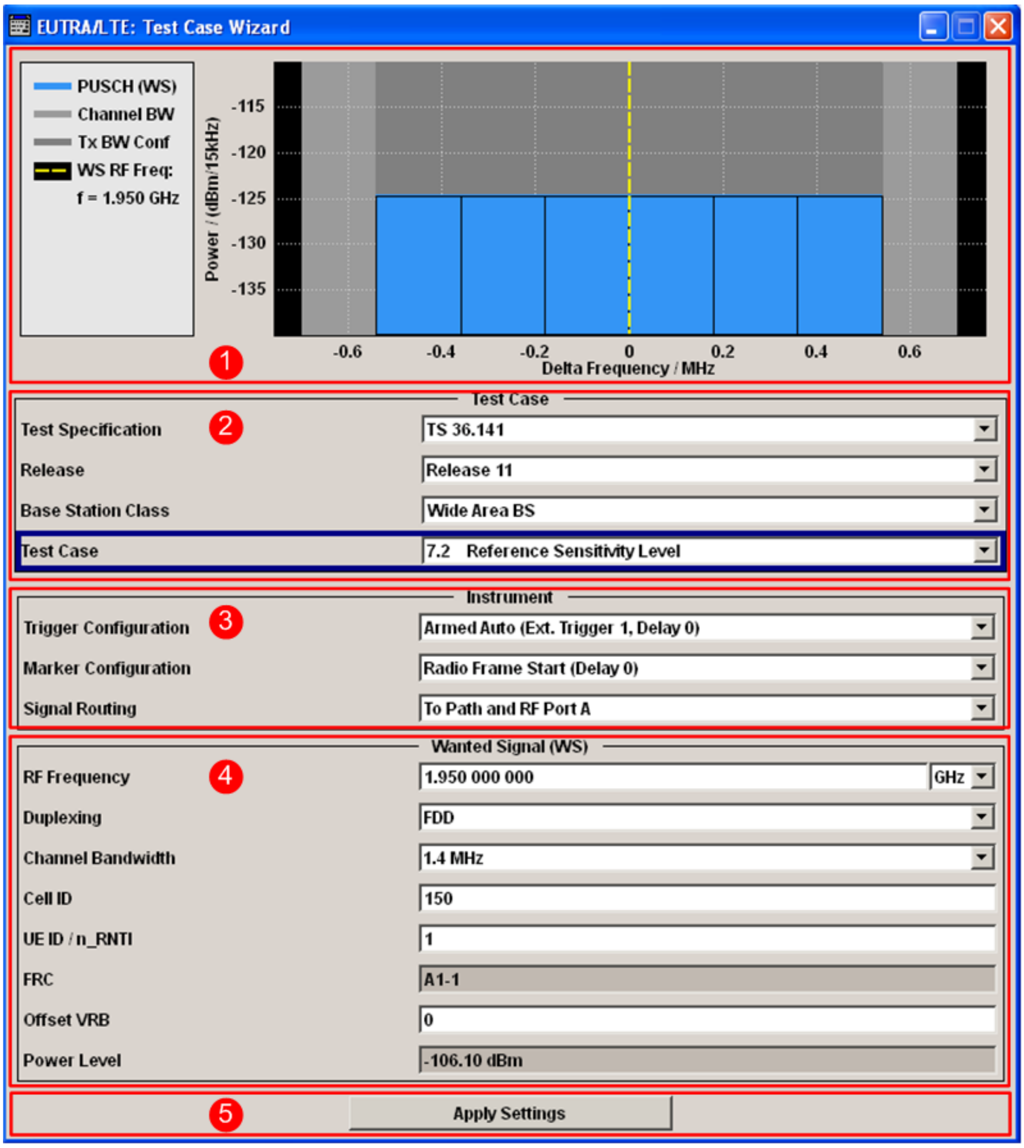
8.6 User Interface

► To access the "Test Case Wizard" dialog, select "Baseband Block > EUTRA/LTE > Test Case Wizard".

There is only one "Test Case Wizard" in the instrument, i.e. the same dialog can be accessed via each of the baseband blocks.

The "Test Case Wizard" dialog comprises three main parts, the "General Settings" area for selecting the test case and the settings regarding routing, trigger and marker configuration, an area with additional parameters like the configuration of the wanted and interfering signals, AWGN and fading settings and the "Apply Settings" button.

The graph symbolizes the interference scenario defined by power level and frequency offset.



1 = Graph
2 = Test Case settings
3 = Insrument settings
4 = Additional parameters
4 = Apply settings

8.6.1 Test Case Settings

The upper part of the dialog comprises the settings for selecting the test case.

Test Specification
Selects the 3GPP test specification used as a guide line for the test cases.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:SPEC` on page 608

Release
Displays the 3GPP test specification release version used as a guide line for the test cases.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:RELease on page 608

Base Station Class
Determines whether the test is to be performed for a local area, home area, medium range or a wide area base station. The different base station classes are specified for different output power ("Power Level" on page 327).

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:BSCLass on page 610

Test Case
Selects the test case.

Note: Not all test case are available for all instruments. The enabled test cases depend on the instrument's hardware (e.g. instrument equipped with one or two paths, etc) and/or the installed SW options (e.g. Fading Simulator, etc.).

See Chapter 8.3, "Supported Test Cases", on page 312 for an overview of the available test cases.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:TC on page 617

Number of Rx Antennas
For performance requirement tests, determines the number of the Rx antennas.

Note: Test cases with four antennas require two R&S SMUs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:RXANtennas on page 610

Number of Tx Antennas
For performance requirement tests, determines the number of the Tx antennas.

Note: Test cases with four antennas require two R&S SMUs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:TXANtennas on page 610

8.6.2 Instrument Settings

This section comprises the settings for configuring the general signal generators parameters.

Trigger Configuration
Selects the trigger configuration. The trigger is used to synchronize the signal generator to the other equipment.

"Armed Auto (Ext. Trigger 1, Delay 0)"
: The trigger settings are customized for the selected test case. The trigger setting "Armed Auto" with external trigger source "External Trigger 1" is used; the trigger delay is set equal to zero. Thus, the base station frame timing is able to synchronize the signal generator by a periodic trigger.

"Unchanged"
: The current trigger settings of the signal generator are retained unchanged.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:TRIGgerconfig` on page 611

Marker Configuration

Selects the marker configuration. The marker can be used to synchronize the measuring equipment to the signal generator.

"Radio Frame Start (Delay 0)"
: The marker settings are customized for the selected test case. "Radio Frame Start" markers are output; the marker delays are set equal to zero.

"Unchanged"
: The current marker settings of the signal generator are retained unchanged.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:MARKerconfig` on page 609

Instrument Setup

(two-path instruments only)

Determines whether only one or both paths are used.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:INSTsetup` on page 609

Signal Routing

Selects the signal routing for baseband A signal which in most test cases represents the wanted signal.

"To RF A"
: The baseband signal is routed to RF output A.

"To RF B"
: (two-path instruments only)
The baseband signal is routed to RF output B.
Tip: Some transmitter tests like test case 7.2 require separate measurements on both Rx port. Use this feature to route the same baseband signal to the second RF output and perform the measurements.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:SIGRout` on page 611

Antenna Subset

Enabled for test setups with four Rx antennas

Determines the signal of which antenna couple, "Antenna 1 and 2" or "Antenna 3 and 4", is generated by the instrument.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:ANTSubset on page 608

Frequency Allocation of the Interfering signal
Determines the frequency position of the wanted and the interfering signal.

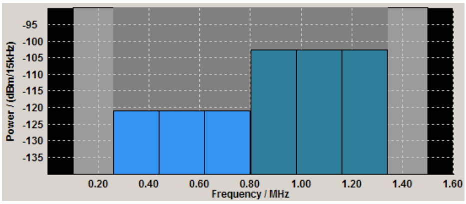
Example: Wanted and interfering signal within the same channel

"Test Case" = 7.4 "In Channel Selectivity"

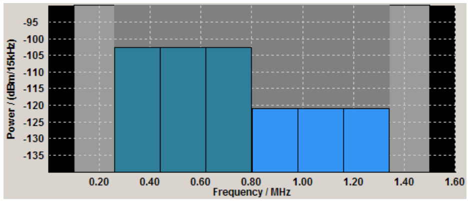
"Channel Bandwidth" = 1.4 MHz

The parameter "Frequency Allocation" determines the position of the allocated RBs within the channel. Allocation in the lower or higher frequencies is possible.

"Frequency Allocation of the Interfering signal" = At Higher Resource Blocks



"Frequency Allocation of the Interfering signal" = At Lower Resource Blocks



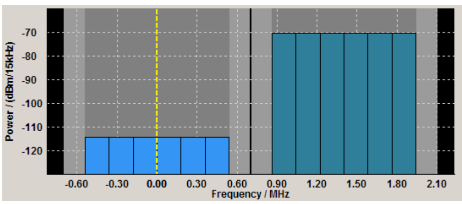
Example: Interfering signal in the adjacent channel

"Test Case" = 7.5A "Adjacent Channel Selectivity"

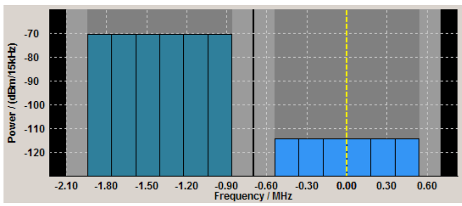
"Channel Bandwidth" = 1.4 MHz

The parameter "Frequency Allocation" determines the position of the wanted signal compared to the interfering signal. Allocation in the lower or higher frequencies is possible, i.e. the position of the allocated bandwidth of the wanted and the interfering signal can be mirrored.

"Frequency Allocation of the Interfering signal" = At Higher Resource Blocks



"Frequency Allocation of the Interfering signal" = At Lower Resource Blocks



Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:FA:FRALlocation on page 608
[:SOURce<hw>]:BB:EUTRa:TCW:FA:RBALlocation on page 608

8.6.3 Wanted Signal and Cell-Specific Settings

The following settings are available for almost all transmitter and receiver characteristics and performance requirements tests. Specific parameters are listed together with the description of the corresponding test case.

For the in-channel test cases 7.4, 8.2.2 and 8.3.3, the cell-specific settings apply also for the interfering signal, respectively for the signal of the stationary UE.

RF Frequency
Sets the RF frequency of the wanted signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:RFFRequency` on page 623

Duplexing
Selects whether TDD or FDD duplexing mode is used (see also "Duplexing" on page 84).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:DUPLex` on page 620

TDD UL/DL Configuration
For TDD mode, selects the UL/DL Configuration number (see also "TDD UL/DL Configuration" on page 127).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:TDDConfig` on page 623

Signal Advance N_TA_offset
Sets the parameter $N_{TAoffset}$ (see also "Signal Advance N_TA_offset" on page 303).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:NTAOffset` on page 621

Channel Bandwidth
Selects the channel bandwidth (see also Chapter 7.13.2, "Physical Settings", on page 221).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:CHBW` on page 619

Cell ID

Sets the Cell ID (see alsoChapter 7.13.4, "Cell-Specific Settings", on page 224).

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:CLID on page 619

Cyclic Prefix

Selects normal or extended cyclic prefix.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:CYCPrefix on page 619

UE ID/n_RNTI

Sets the UE ID/n_RNTI.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:UEID on page 624

FRC

Displays the fixed reference channel used. An overview of the FRCs and the cross-reference between the selected Channel Bandwidth and the FRC is given in the individual description of the test cases.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:FRC on page 620

Offset VRB

Sets the number of RB the allocated RB(s) are shifted with (see also Example "Offset VRB" on page 320).

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:OVRB on page 622

Power Level

Displays the power level, depending on the selected test case.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLEVel? on page 622

8.6.4 Apply

Button "Apply Settings" triggers a selective preset of the signal generator prior to presetting the setting according to the selected test case. Further modification of the generator settings is still possible. Signal generation starts with the first trigger event.

Apply Settings

Activates the current settings of the test case wizard.

Note: The settings of the selected test case becomes active only after selecting "Apply Settings".

Initialization of the signal generator with the test case settings is performed by a partial selective reset that includes only the baseband, fading and AWGN module and the RF frequency and RF level settings. Other settings of the signal generator are not altered.

Before triggering the signal generator the user still can change these other settings. This is particularly useful when compensating for cable loss and additionally inserted attenuators by adjusting the RF power level offset is required.

Signal generation is started at the first trigger received by the generator. The RF output is not activated /deactivated by the test case wizard. Activate the "RF > State > On" at the beginning of the measurement.

Note: For safety reasons the RF is not active unless the button "RF ON" has been selected.

Note: The settings in the dialogs "EUTRA/LTE > Trigger/Marker/Clock", in the "Global Trigger/Clock Settings" and in the "User Marker / AUX I/O Settings" are not affected by the selective preset, if the parameter "Trigger/Marker Configuration" is set to "Unchanged".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:APPLysettings` on page 607

8.7 Transmitter Characteristics (TS 36.141, Chapter 6)

The transmitter characteristics comprise the maximum output power, output power dynamics, transmitted signal quality, unwanted emissions and transmitter intermodulations. The "Test Case Wizard" supports the generation of signals in accordance with the transmitter intermodulations test case. A brief description about the unwanted emission tests is also provided (see Chapter 8.7.2, "Introduction to the Unwanted Emissions Tests", on page 329).

8.7.1 Prior Considerations

Test Models

For the transmitter characteristic tests EUTRA test models (E-TM) are specified. For an overview of the test models, see "EUTRA Test Models (E-TM) Downlink" on page 102.

Channels

According to the TS 36.141, the channels to test are located in the bottom (B), middle (M) and the top (T) of the supported frequency range of the base station. See Table 8-4 for an overview of the supported frequency operating bands.

Filter Settings

The 3GPP EUTRA/LTE specifications do not define a standardized transmit filter neither for the UE nor for the base station. Therefore, when a test case is activated, a filter type EUTRA/LTE with "Best ACP Optimization" is automatically selected.

Test Setup

Transmitter tests require a separate measuring equipment, e.g. the Vector Signal Analyzer R&S FSV.

8.7.2 Introduction to the Unwanted Emissions Tests

The unwanted emissions from the transmitter are divided into two main groups, the out-of-band (OOB) emissions and the spurious emissions. The out-of-band emissions are emissions on frequencies close to the frequency of the wanted signal. Spurious emissions are emissions caused by unwanted transmitter effects, like harmonics, parasitic emissions, intermodulation products and frequency conversion products.

- ACLR
  The Adjacent Channel Leakage power Ratio (ACLR) is defined as the ratio between the power transmitted in the channel bandwidth of the wanted signal to the power of the unwanted emissions transmitted on the adjacent channel.
  The corresponding receiver requirement is the Adjacent Channel Selectivity (ACS), described in Chapter 8.8.7, "Test Case 7.5A: Adjacent Channel Selectivity (ACS)", on page 349.
  The test specification defines ACLR requirements for LTE and UTRA receivers. Different setting applies for paired and unpaired spectrum (see Table 8-5 and Table 8-6).

Table 8-5: Base Station ACLR in paired spectrum

EUTRA transmitted signal channel bandwidth $BW_{Channel}$, MHz	BS adjacent channel center frequency offset below the first or above the last carrier center frequency transmitted	Assumed adjacent channel carrier (informative)	Filter on the adjacent channel frequency and corresponding filter bandwidth	ACLR limit
1.4 / 3 / 5 / 10 / 15 / 20	$BW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	44.2 dB
	$2xBW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	
	$BW_{Channel}$/2+ 2.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	
	$BW_{Channel}$/2+ 7.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	

Table 8-6: Base Station ACLR in unpaired spectrum with synchronized operation

EUTRA transmitted signal channel bandwidth $BW_{Channel}$, MHz	BS adjacent channel center frequency offset below the first or above the last carrier center frequency transmitted	Assumed adjacent channel carrier (informative)	Filter on the adjacent channel frequency and corresponding filter bandwidth	ACLR limit
1.4 / 3	$BW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	44.2 dB
	$2xBW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	
	$BW_{Channel}$/2+ 0.8 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	
	$BW_{Channel}$/2+ 2.4 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	

EUTRA transmitted signal channel bandwidth $BW_{Channel}$, MHz	BS adjacent channel center frequency offset below the first or above the last carrier center frequency transmitted	Assumed adjacent channel carrier (informative)	Filter on the adjacent channel frequency and corresponding filter bandwidth	ACLR limit
5 / 10 / 15 / 20	$BW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	
	2x$BW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	
	$BW_{Channel}$/2+ 0.8 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	
	$BW_{Channel}$/2+ 2.4 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	
	$BW_{Channel}$/2+ 2.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	
	$BW_{Channel}$/2+ 7.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	
	$BW_{Channel}$/2+ 5 MHz	7.68 Mcps UTRA	RRC (7.68 Mcps)	
	$BW_{Channel}$/2+ 15 MHz	7.68 Mcps UTRA	RRC (7.68 Mcps)	

- Operating Band Unwanted Emissions
  The 3GPP specification introduces the term operating band unwanted emissions instead of the spectrum mask. The operating band unwanted emissions requirements are defined from 10 MHz below the lowest frequency of the downlink operating band up to 10 MHz above the highest frequency of the operating band.

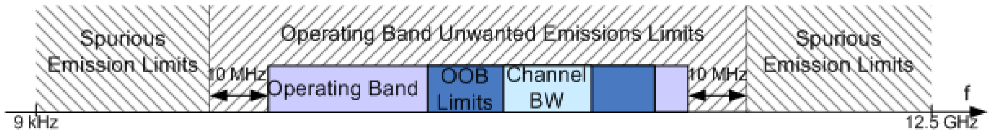


Figure 8-5: Transmitter tests frequency limits

  The operating band unwanted emissions require a 100 kHz measurement bandwidth.
- Spurious Emissions
  The transmitter spurious emissions limits apply from 9 kHz to 12.5 GHz, excluding the frequency range defined for the operating band unwanted emissions (see Figure 8-5).
  Refer to Table 8-7 for an overview of the general settings for the measurements.
  Additional requirements may apply for co-existence with other systems and/or co-location with other base stations. For detailed requirements, refer to the TS 36.141.

Table 8-7: Spurious emissions

Frequency range	Maximum level Category A	Maximum level Category B	Measurement Bandwidth
9kHz - 150kHz	-13 dBm	-36 dBm	1 kHz
150kHz - 30MHz			10 kHz
30MHz - 1GHz			100 kHz
1GHz - 12.75 GHz		-30 dBm	1 MHz

8.7.3 General Workflow for Carrying Out a Transmitter Test

The following describes the general workflow, only the basic steps are listed.

For detailed description about working with the analyzer and the base station, refer to the corresponding description.

The basic test setup is illustrated on Figure 8-6.

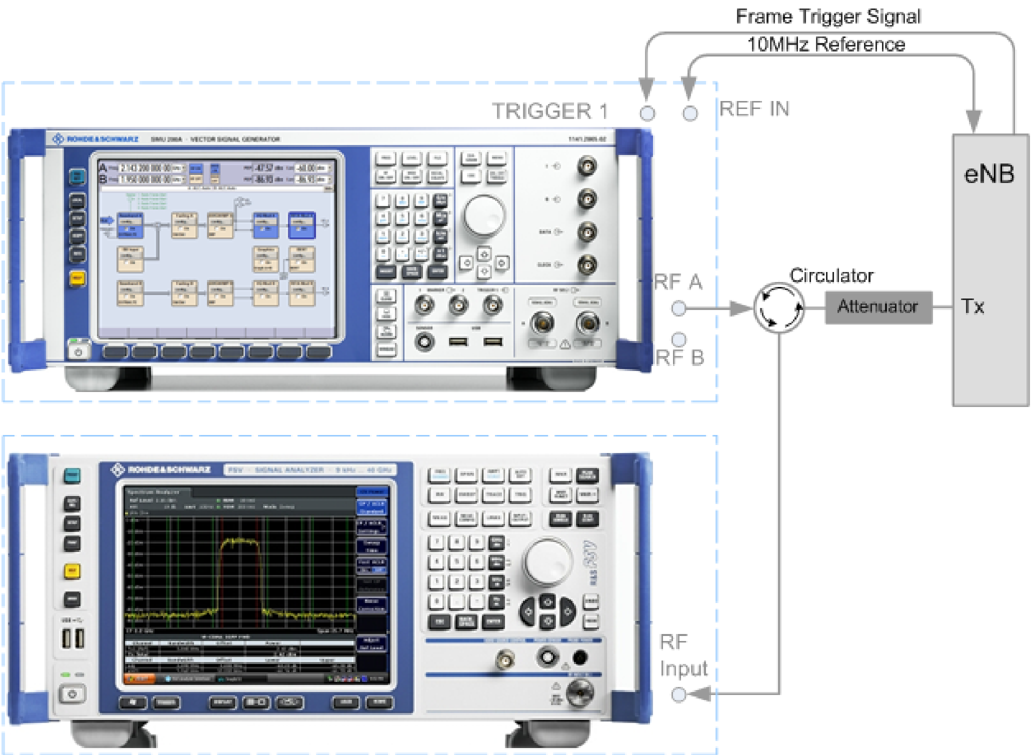


Figure 8-6: Test setup for Test case 6.7: Transmitter Intermodulation

1. Set the base station to the basic state and configure it for the selected test case.
   a) Initialize the base station,
   b) Set the base station to test model E-TM1.1,
   c) Set maximum transmit power,
   d) Set the frequency.
2. Set the signal generator to the basic state
   a) Preset the signal generator unless some settings (e.g. in terms of I/Q and RF blocks) have to be kept.
3. Set the analyzer to the basic state
4. Set the test case wizard
   a) Select "Baseband Block > EUTRA/LTE > Test Case Wizard"

b) Select "Test Case 6.7: Transmitter Intermodulation".
The parameters are preset according to TS 36.141
c) Adjust the settings of the wanted signal (RF level and Channel Bandwidth).
d) Enter the test frequency (e.g. M). It must be the same as the base station has been set to.
e) Enter the Interfering Signal parameters.
f) Activate the settings with the "Apply Settings" button.
The signal generator is now ready to start signal generation

5. Set the analyzer to the measurement frequency and perform further necessary settings.
Refer to the description of the analyzer for further information.

6. In the signal generator, switch on the RF output.

7. Start the measurement

a) Send a start trigger impulse from the base station to the signal generator and to the analyzer.

The signal generator outputs the test model interfering signal; Measurement procedures are started.

8. Calculate the result
The analyzer calculates the out-of-band emission and the spurious emission.

8.7.4 Interfering Signal Settings

The following settings are common for the transmitter tests that require interfering signal (IS). Specific parameters are listed together with the description of the corresponding test case.

The interfering signal is an E-TM1.1 signal with 5 MHz channel bandwidth and center frequency relative to the carrier frequency of the wanted signal.

Offset to Channel Edge
Defines the offset of the interfering signal center frequency relative to edge of the wanted channel bandwidth. This parameter determines the carrier frequency of the interfering signal (see RF Frequency).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:OCEDge` on page 613

RF Frequency
Displays the RF Frequency of the interfering signal, determined by the RF Frequency of the wanted signal and the selected Offset to Channel Edge.

The RF Frequency$_{\text{interfering signal}}$ is calculated as follows:

- For "Frequency Allocation > Interfering Signal > At Higher Frequencies"
"RF Frequency$_{\text{interfering signal}}$" = "RF Frequency$_{\text{wanted signal}}$" + Delta
- For "Frequency Allocation > Interfering Signal > At Lower Frequencies"
"RF Frequency$_{\text{interfering signal}}$" = "RF Frequency$_{\text{wanted signal}}$" - Delta

Where for both cases **Delta** is calculated as follows:

Delta = "$BW_{\text{wanted signal}}$"/2 + $Offset_{\text{interfering signal}}$

In "Test Case > 6.2.6", the $Offset_{\text{interfering signal}}$ = 2.5 MHz; in "Test Case > 6.2.7", Delta = "$BW_{\text{wanted signal}}$".

Example: Calculation of RF Frequency in Test Case 6.7

"$BW_{\text{wanted signal}}$" = 1.4 MHz

"RF $Frequency_{\text{wanted signal}}$" = 1 950 MHz

$Offset_{\text{interfering signal}}$ = 7.5 MHz

Delta = 1.4/2 + 7.5 = 8.2 MHz

For "Frequency Allocation > Interfering Signal > At Higher Frequencies": "RF $Frequency_{\text{interfering signal}}$" = 1 950 + 8.2 = 1 958.2 GHz

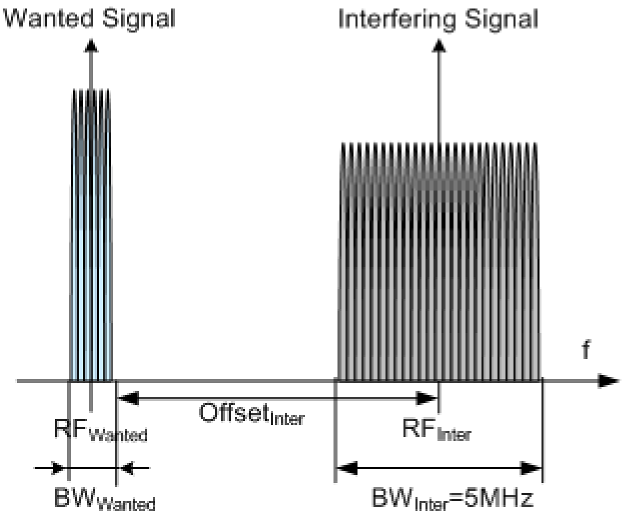


Figure 8-7: Example: Offset to Channel Edge (Channel Bandwidth = 1.4 MHz)

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:RFFRequency on page 614

Channel Bandwidth
Displays the channel bandwidth of the interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:CHBW? on page 612

Duplexing
Selects whether TDD or FDD duplexing mode is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:DUPLex on page 612

Test Model
Displays the test model. The interfering signal is generated according to E-TM1.1 test model.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:TMODel? on page 615

Power Level/Power Level P-CPICH

Displays the power level of the interfering signal.

Test Case	Power level
6.7	The power level is always 30 dB below the Output Power Level of the wanted signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:PLEVel? on page 614

8.7.5 Test Case 6.7: Transmitter Intermodulation

Test Purpose

The test purpose is to verify the ability of the BS transmitter to restrict the generation of intermodulation products in its nonlinear elements caused by presence of the own wanted signal and an interfering signal reaching the transmitter via the antenna (TS 36.141).

Required Options

See Chapter 8.2, "Basic Configuration", on page 312.

Test Setup

See Figure 8-6.

The RF output of the signal generator is connected to the analyzer via a circulator and external attenuator. The Tx signal of the base station is connected to the RF input of the analyzer via a circulator.

Short Description

The transmitter intermodulation test is intended to verify the ability of the BS transmitter to restrict the generation of intermodulation products in its nonlinear elements caused by presence of wanted signal and an interfering signal reaching the transmitter via the antenna.

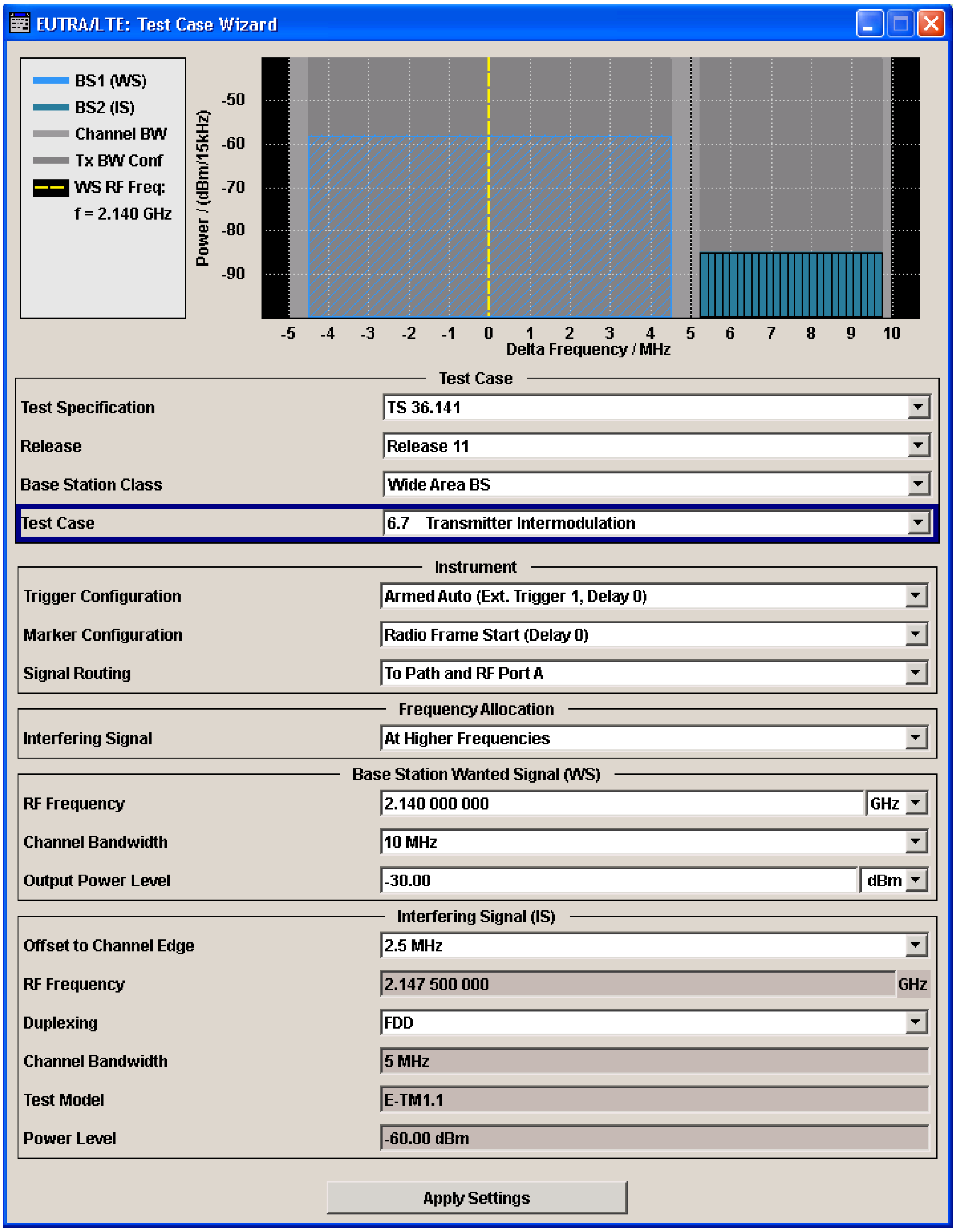
The BS transmits signals in accordance with E-TM1.1 at maximum power and with channel bandwidth $BW_{Channel}$ corresponding to the maximum bandwidth supported by the base station. The interfering signal is an E-TM1.1 signal with 5 MHz channel bandwidth. The interfering signal power shall be 30 dB lower than the power of the wanted signal at the frequency offsets of ±2.5 MHz, ±7.5 MHz and ±12.5 MHz.

The transmit intermodulation level shall not exceed the out-of-band emission requirements and transmitter spurious emissions requirements for all third and fifth order intermodulation products which appear in the frequency ranges defined in Table 8-5,

Table 8-6 and Table 8-7. For detailed information about the operating band unwanted emissions, refer to section 6.6.3.5 in TS 36.141.

The test shall be done on three channels (B, M and T).

User Interface



The settings of the interfering signal are described in Chapter 8.7.4, "Interfering Signal Settings", on page 332.

Base Station Wanted Signal

The common settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

Output Power Level ← Base Station Wanted Signal

Sets the output power level of the wanted signal. The power level of the interfering signal is always 30 dB lower than this level.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:WS:OUPLevel` on page 621

8.8 Receiver Characteristics (TS 36.141, Chapter 7)

Most of the receiver tests can be performed with the signal generator only, i.e. without additional measurement equipment.

The receiver requirements are divided into the following main categories, intended to

- Prove the receiver's ability to receive the wanted signal:
  - Chapter 8.8.4, "Test Case 7.2: Reference Sensitivity Level", on page 342
  - Chapter 8.8.5, "Test Case 7.3: Dynamic range", on page 343
- Prove how susceptible the receiver is to different types of interfering signals:
  - Chapter 8.8.6, "Test Case 7.4: In-channel selectivity (ICS)", on page 346
  - Chapter 8.8.7, "Test Case 7.5A: Adjacent Channel Selectivity (ACS)", on page 349
  - Chapter 8.8.8, "Test Case 7.5B: Narrow-band blocking", on page 352
  - Chapter 8.8.9, "Test Case 7.6: Blocking", on page 355
  - Chapter 8.8.10, "Test Case 7.8: Receiver intermodulation ", on page 359

  The several test cases shell cover a wide range of scenarios with different types of impairments on the wanted signal, that occur depending on the frequency offset between the wanted and the interfering signal.

8.8.1 Prior Considerations

Fixed Reference Channels (FRC)

The receiver tests use fixed reference channels (FRC) as defined in TS 36.141, Annex A "Reference Measurement channels".

The following FRCs are defined for the receiver tests:

- FRC A1: A1-1 .. A1-5 (QPSK)
- FRC A2: A2-1 .. A2-3 (16QAM)

Refer to Table 7-13 for an overview of all supported FRC.

Channels

According to the TS 36.141, the channels to test are located in the bottom (B), middle (M) and the top (T) of the supported frequency range of the base station. See Table 8-4 for an overview of the supported frequency operating bands.

Channel Bandwidth of the LTE Interfering Signal

For all test cases using an interfering LTE signal, the bandwidth of the interfering signal shall be the same as the wanted signal, but at the most 5 MHz.

Reference Sensitivity Power Level $P_{REFSENS}$

$P_{REFSENS}$ depends on the channel bandwidth and the base station class as specified in TS 36.104, subclause 7.2.1. The Table 8-8 gives an overview of the resulting power levels for the wanted signal per test case.

Table 8-8: BS reference sensitivity levels

Channel Bandwidth, MHz	Base Station Class	Reference sensitivity power level, $P_{REFSENS}$, dBm	ACS Test Case Wanted signal mean power, dBm	Narrow-band Blocking/ Blocking/Receiver Intermodulation Test Case Wanted signal mean power, dBm
1.4	Wide Area BS	-106.8	-95.8	-100.8
	Local Area BS / Home Area BS	-98.8	-87.8	-92.8
	Medium Range BS	-101.8	-90.8	-95.8
3	Wide Area BS	-103.0	-95.0	-97.0
	Local Area BS / Home Area BS	-95.0	-87.0	-89.0
	Medium Range BS	-98.0	-90.0	-92.0
5 /10 /15 /20	Wide Area BS	-101.5	-95.5	-95.5
	Local Area BS / Home Area BS	-93.5	-87.5	-87.5
	Medium Range BS	-96.5	-90.5	-90.5

Power Settings

The "Level Reference" parameter in the "Filter/Clipping/Power Settings" dialog is automatically set to "Frame RMS Power" for FDD Duplexing Mode and to "UL Part of Frame RMS Power" for TDD Duplexing Mode.

Filter Settings

The 3GPP EUTRA/LTE specifications do not define a standardized transmit filter neither for the UE nor for the base station. Therefore, when a test case is activated, a filter type EUTRA/LTE with "Best EVM Optimization" is automatically selected. Exceptions are the Test Case 7.5A: Adjacent Channel Selectivity (ACS) and the Test Case 7.5B: Narrow-band blocking where a "Best ACP Optimization" filter is applied for shaping the interfering signal.

8.8.2 General Workflow for Carrying Out a Receiver Test

The following instruction lists the general steps for performing a BS conformance test with the help of "Test Case Wizard". Specific requirements are described together with the individual test case.

For detailed description about the configuration of the base station, refer to the corresponding description.

1. Connect the instrument and the DUT according to the corresponding test case setup.
   See also Chapter 8.4, "Standard Test Setups", on page 315.
2. Set the base station to the basic state
   a) Initialize the base station
   b) Set the frequency
   c) Set the base station to receive the Fixed Reference Channel (for most receiver test cases)
3. Preset the signal generator to ensure a defined instrument state.
4. Configure the test case wizard
   a) Select "Baseband Block > EUTRA/LTE > Test Case Wizard".
   b) Select a test case, e.g. "TS 36.141: 7.3 Dynamic Range".
   c) Enter additional required parameters, e.g. power class of base station.
   d) Enter the test frequency, e.g. M.
      It must be the same as the base station has been set to.
   e) Select "Apply Settings" to activate the settings.

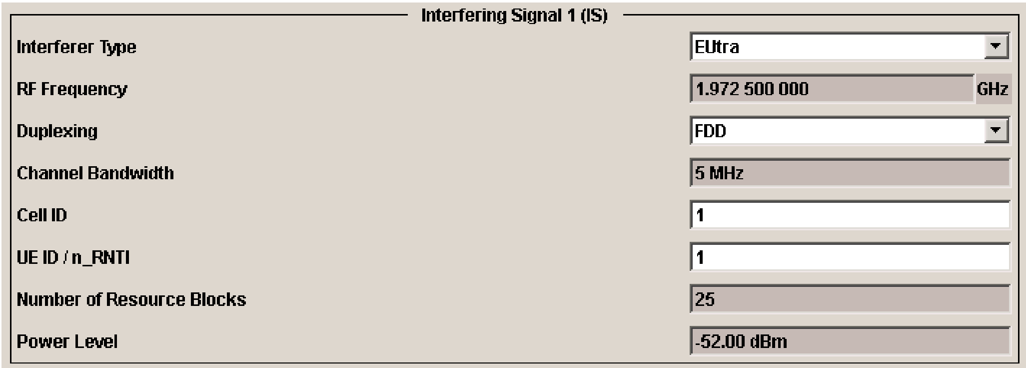
   The signal generator is now ready to start signal generation
5. Switch on RF output
6. If required, make additional settings (e.g. in the "I/Q Mod" or "RF" block) or change test case settings.
7. Start the measurement
   a) Send a start trigger impulse from the base station to the signal generator.

   The signal generator will start signal generation.
8. Calculate the result

The base station internally calculates the BER, BLER or Pd depending on the test case. This value is compared to the required value.

8.8.3 Interfering Signal Settings

The following settings are available for almost all receiver tests, requiring an interfering signal (IS). Specific parameters are listed together with the description of the corresponding test case.



Interferer Type
(enabled for Blocking and Receiver Intermodulation tests)

Selects the type of the interfering signal:

- For **Blocking** tests, the interfering signal can be an in-band EUTRA/LTE signal or out-of-band CW signal.
- For **Receiver Intermodulation** tests, the first interfering signal can be an EUTRA/LTE signal or narrow-band EUTRA signal.
  The second interfering signal is always a CW signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:IFTYpe` on page 612

RF Frequency
Display the center frequency of the interfering signal.

The center frequency is calculated as follows:

- For "Frequency Allocation > Interfering Signal > At Higher Frequencies"
  "RF Frequency$_{\text{interfering signal}}$" = "RF Frequency$_{\text{wanted signal}}$" + Delta
- For "Frequency Allocation > Interfering Signal > At Lower Frequencies"
  "RF Frequency$_{\text{interfering signal}}$" = "RF Frequency$_{\text{wanted signal}}$" - Delta

Where for both cases Delta is calculated as follows:

Delta = "Channel Bandwidth$_{\text{wanted signal}}$"/2 + Offset$_{\text{interfering signal}}$

See also "RF Frequency" on page 332.

Example:

"Channel Bandwidth$_{\text{wanted signal}}$" = 5 MHz

"RF Frequency$_{\text{wanted signal}}$" = 1 950 MHz

Offset$_{\text{interfering signal}}$ = 2.5025 MHz (see Table 8-11)

Delta = 5/2 + 2.5025 = 5.0025 MHz

For "Frequency Allocation > Interfering Signal > At Higher Frequencies": "RF Frequency$_{\text{interfering signal}}$" = 1 950 + 5.0025 = 1 955.0025 MHz

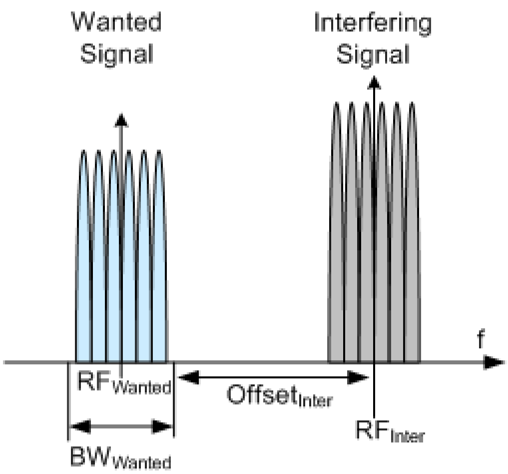


Figure 8-8: Example: Adjacent Channel Selectivity (ACS), Channel BW = 1.4 MHz

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:RFFRequency` on page 614

Duplexing

Selects whether TDD or FDD duplexing mode is used.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:DUPLex` on page 612

TDD UL/DL Configuration

For TDD mode, selects the UL/DL Configuration number.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:TDDConfig` on page 614

Signal Advance N_TA_offset

Sets the parameter $N_{TAoffset}$.

See also "Signal Advance N_TA_offset" on page 303.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:NTAOffset` on page 613

Channel Bandwidth

Displays the channel bandwidth of the interfering signal. The interfering signal has the same bandwidth as the wanted signal, but at the most 5 MHz.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:CHBW?` on page 612

Cell ID
Sets the Cell ID for the interfering signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:CLID` on page 612

UE ID/n_RNTI
Sets the UE ID/n_RNTI for the interfering signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:UEID` on page 615

Number of Resource Blocks
The number of RBs used by the LTE interfering signal is set automatically:
- For **ACS and In-channel Selectivity measurements**, the number of RBs depends on the selected channel bandwidth for the wanted signal. The bandwidth of the interfering signal is equal to the bandwidth allocated for the wanted signal, but at the most 5 MHz.
- For **Narrow-band Blocking** tests, the interfering signal is a single resource block LTE signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:NRBLock?` on page 613

Offset VRB
(Test Case 7.4 and 7.5 only)

The position of the RBs allocated by the LTE interfering signal is determined automatically, depending on the selected "Channel Bandwidth" and the RBs allocation of the wanted signal.

- For **in-channel testing**, the parameter "Offset VRB" is used to allocate the wanted and the interfering signal around the center frequency (see also Figure 8-9).
- For **ACS testing**, the "Offset VRB" is fixed to 0.
- For **narrow band blocking testing**, the "Offset VRB" is set in the way, that depending on the "Frequency Allocation" of the interfering signal, the narrow-band LTE interfering signal is allocated at the most left or the most right subcarrier in the allocated channel bandwidth

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:OVRB?` on page 613

Frequency Shift m
(Test Case 7.5 only)

By default, the narrow-band LTE interfering signal is allocated at the most left (interfering signal at higher frequencies)/ most right (interfering signal at lower frequencies) subcarrier in the allocated channel bandwidth. However, the position of the interfering signal can be set by means of the parameter "Frequency Shift m", i.e. the allocated RB can be offset to a different center frequency (see Figure 8-10).

The parameter Interfering RB Center Frequency displays the center frequency of the resource block the interfering signal is currently allocated on.

The value range of the parameter depends on the selected "Channel Bandwidth", as defined in Table 8-12.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:FRSHift` on page 612

Interfering RB Center Frequency
(for Narrow-band Block tests only)

Displays the center frequency of the single resource block interfering signal (see also Figure 8-10).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:RBCFrequency` on page 614

Power Level
The power level of the interfering LTE signal is set automatically depending on the selected channel bandwidth.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:PLEVel?` on page 614

8.8.4 Test Case 7.2: Reference Sensitivity Level

Test Purpose

To verify that at the BS Reference sensitivity level the throughput requirement shall be met for a specified reference measurement channel (TS 36.141).

Required Options

See Chapter 8.2, "Basic Configuration", on page 312.

Test Setup

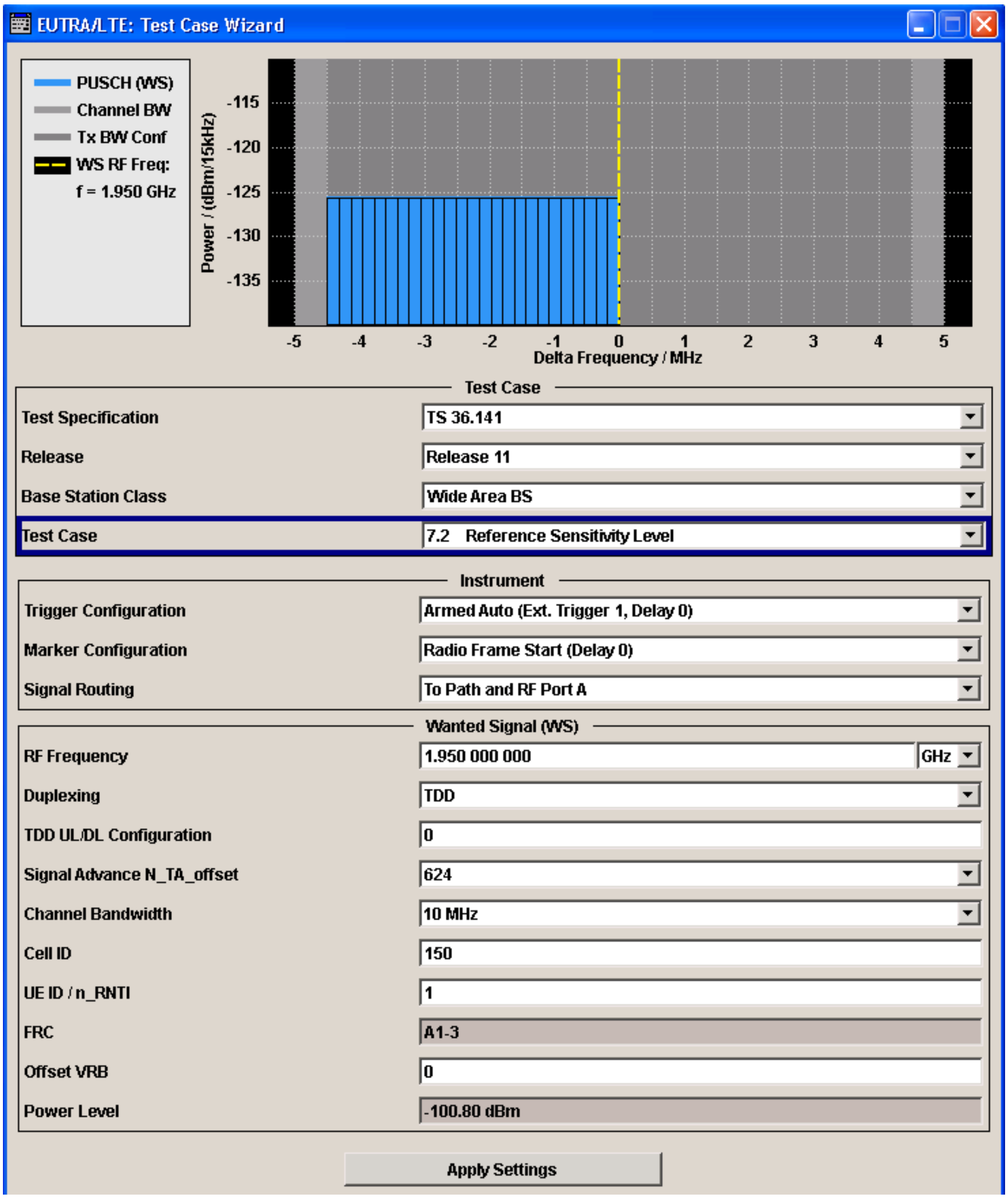
See Chapter 8.4.1, "Standard Test Setup - One Path", on page 315

Short Description

The reference sensitivity level measurement is a test case that aims to verify the Noise Figure of the receivers. The test case uses FRCs with QPSK modulation.

The test shall be done on three channels (B, M and T). The selected "Channel Bandwidth" determines the used FRC and the "Wanted Signal Power Level". For channels larger than 5 MHz not all RBs are allocated; to adjust the position of the allocated RBs within the selected channel bandwidth, use the parameter "Offset VRB".

For the parameter in the Table 8-8 the throughput measured shall be equal or greater than 95%.



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

8.8.5 Test Case 7.3: Dynamic range

Test Purpose

To verify that at the BS receiver dynamic range, the relative throughput shall fulfil the specified limit (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Option Additive White Gaussian Noise AWGN (R&S SMx/AMU-K62)

Test Setup

See Chapter 8.4.1, "Standard Test Setup - One Path", on page 315

Short Description

The dynamic range test case aims to stress the receiver and measure its capability to demodulate the useful signal even in the presence of a heavy interfering signal inside the received channel bandwidth. The test case uses FRCs with 16QAM modulation. The throughput measurements are performed for different level of the wanted and the interfering AWGN signals.

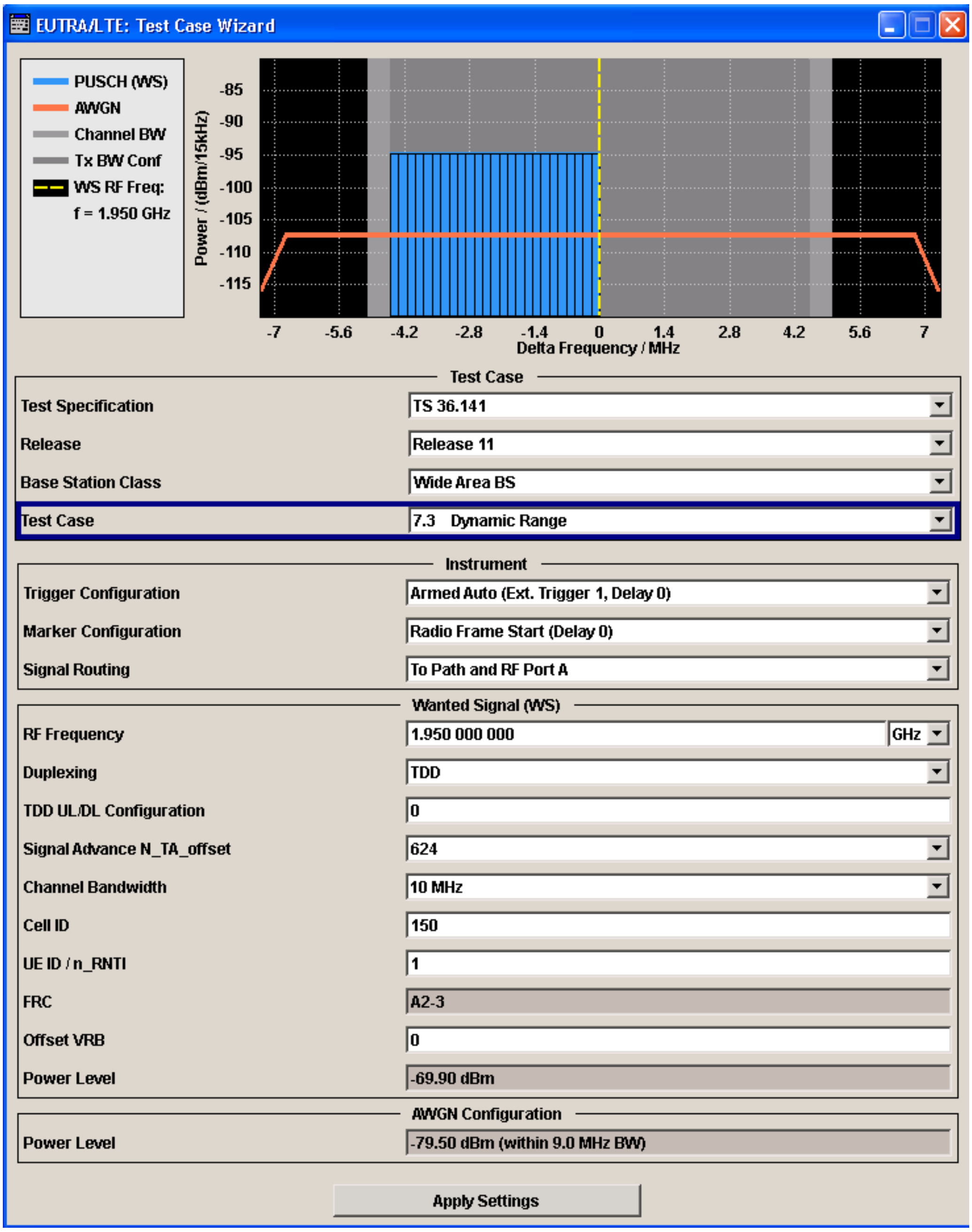
The test shall be done on three channels (B, M and T). The selected "Channel Bandwidth" determines the used FRC and the "Wanted Signal Power Level". For channels larger than 5 MHz not all RBs are allocated; to adjust the position of the allocated RBs within the selected channel bandwidth, use the parameter "Offset VRB".

For the parameter in the Table 8-9 the throughput shall be equal or greater than 95%.

Table 8-9: Dynamic range (Wide Area BS)

Channel Bandwidth, MHz	Reference Measurements Channel	Wanted signal mean power, dBm	Interfering signal mean power, dBm / BW_{Config}	Type of interfering signal
1.4	FRC A2-1	-76.0	-88.7	AWGN
3	FRC A2-2	-72.1	-84.7	AWGN
5	FRC A2-3	-69.9	-82.5	AWGN
10	FRC A2-3	-69.9	-79.5	AWGN
15	FRC A2-3	-69.9	-77.7	AWGN
20	FRC A2-3	-69.9	-76.4	AWGN

For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

AWGN Configuration

Comprises the settings of the interfering signal.

Power Level ← AWGN Configuration

Displays the power level of the AWGN signal. The value is set automatically according to Table 8-9 and depending on the selected Channel Bandwidth.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:AWGN:PLEVel?` on page 607

8.8.6 Test Case 7.4: In-channel selectivity (ICS)

Test Purpose

The purpose of this test is to verify the BS receiver ability to suppress the IQ leakage (TS 36.141).

Required Options

The required options depend on whether the test will be performed with an instrument equipped with one or two paths.

- Instrument equipped with one path, e.g. R&S SMU/SMJ/SMATE/SMBV:
  See Chapter 8.2, "Basic Configuration", on page 312.
- Instrument equipped with two paths, e.g. R&S SMU/SMATE:
  - See Chapter 8.2, "Basic Configuration", on page 312.
  - Option Second RF path (R&S SMx-B20x)
  - Second Option Baseband Generator (R&S SMx-B10)
  - Second Option Baseband Main Module (R&S SMx-B13)
  - Second Option Digital Standard EUTRA/LTE (R&S SMx-K55)

Test Setup

See Chapter 8.4.1, "Standard Test Setup - One Path", on page 315 or Chapter 8.4.2, "Standard Test Setup - Two Paths", on page 315

Short Description

In-channel selectivity (ICS) is a measure of the receiver ability to receive a "weak" wanted signal at its assigned Resource Block locations in the presence of a "strong" interfering signal. The interfering signal shall be an EUTRA/LTE signal with the same bandwidth as the wanted signal, but at the most 5 MHz. The wanted and the interfering signal are allocated around the center frequency (see Figure 8-9); to swap the position of the wanted and interfering signal, use the parameter "Frequency Allocation".

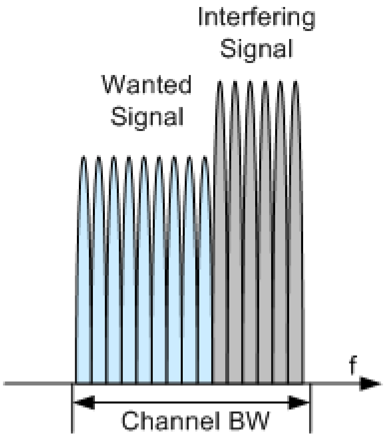


Figure 8-9: Example: In-channel selectivity (ICS), Channel BW = 3 MHz, Frequency Allocation = Lower Frequency

In a one-path instrument, the wanted and the interfering LTE signals are both generated using the same path. The interfering signal is simulated as an additional user equipment (UE). The level difference between the wanted and the interfering signals is handled in the baseband. As the interferer level is higher, it is used as a reference; the level of the wanted signal is set relatively lower to the interferer.

The test shall be done on three channels (B, M and T). The selected "Channel Bandwidth" determines the used FRC and the "Wanted Signal Power Level". For channels larger than 5 MHz not all RBs are allocated; to adjust the position of the allocated RBs within the selected channel bandwidth, use the parameter "Offset VRB".

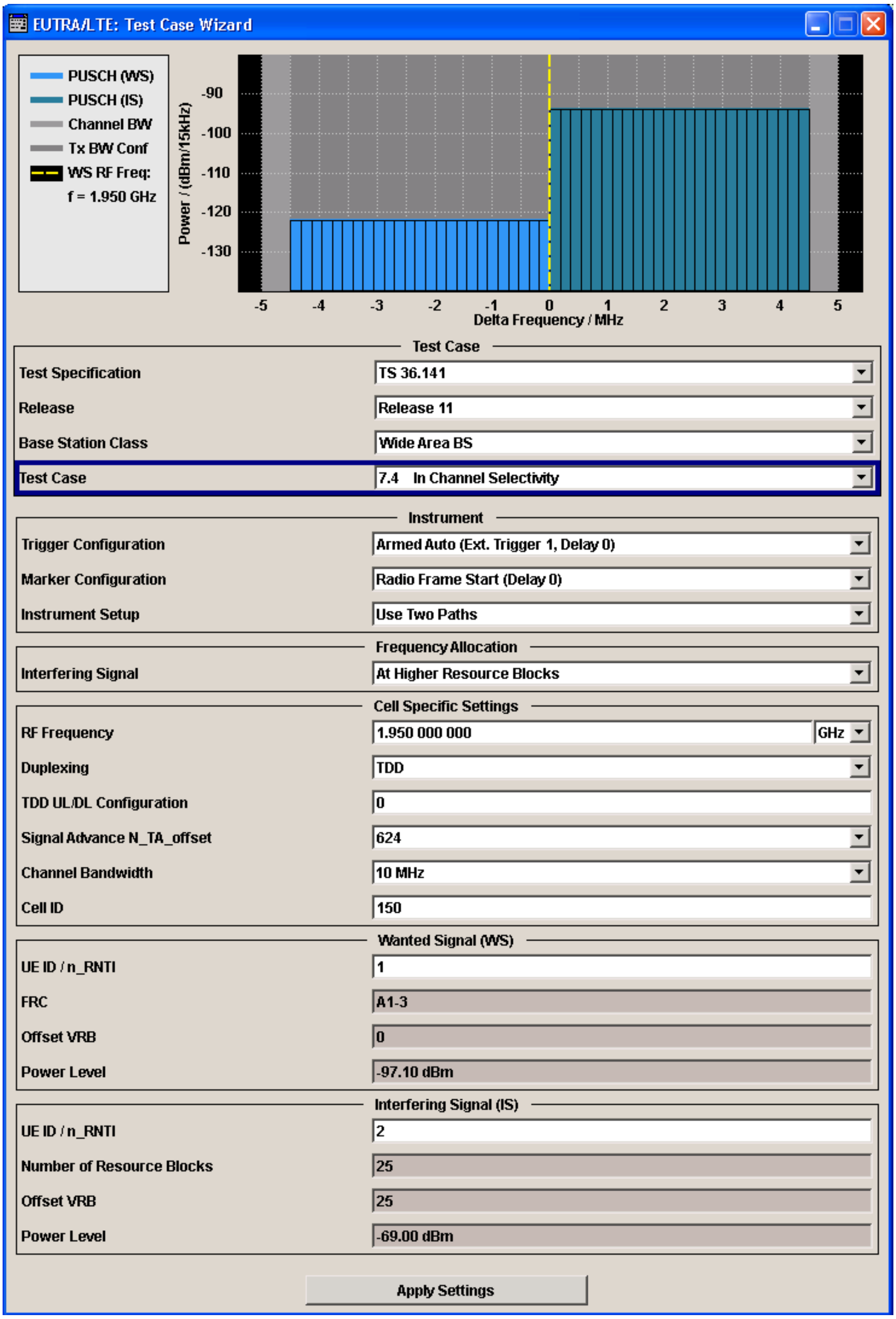
For the parameter in the Table 8-10 the throughput shall be equal or greater than 95%.

Table 8-10: In-channel selectivity (Wide Area BS)

Channel Bandwidth, MHz	Reference Measurements Channel	Wanted signal mean power, dBm	Interfering signal mean power, dBm / BW_{Config}	Type of interfering signal
1.4	FRC A1-4	-105.5	-87	1.4 MHz EUTRA signal, 3 RBs
3	FRC A1-5	-100.7	-84	3 MHz EUTRA signal, 6 RBs
5	FRC A1-2	-98.6	-81	5 MHz EUTRA signal, 10 RBs
10	FRC A1-3	-97.1	-77	10 MHz EUTRA signal, 25 RBs
15	FRC A1-3	-97.1	-77	15 MHz EUTRA signal, 25 RBs*
20	FRC A1-3	-97.1	-77	20 MHz EUTRA signal, 25 RBs*

*) Wanted and interfering signal are placed adjacently around the carrier frequency

For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.



The cell-specific settings and the settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

Refer to Chapter 8.8.3, "Interfering Signal Settings", on page 339 for description of the corresponding settings.

8.8.7 Test Case 7.5A: Adjacent Channel Selectivity (ACS)

Test Purpose

To verify the ability of the BS receiver filter to suppress interfering signals in the channels adjacent to the wanted channel (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Option Second RF path (R&S SMx/AMU-B20x)
- Second Option Baseband Generator (R&S SMx/AMU-B10)
- Second Option Baseband Main Module (R&S SMx/AMU-B13)
- Second Option Digital Standard EUTRA/LTE (R&S SMx/AMU-K55)

Test Setup

See Chapter 8.4.2, "Standard Test Setup - Two Paths", on page 315

Short Description

The Adjacent Channel Selectivity (ACS) is a test case intended to verifies that a BS receiver is able to demodulate a "weak" useful signal being superimposed by a "strong" interfering signal in the adjacent channel.

The wanted signal is a reference measurement channel FRC A1. The interfering signal shall be an EUTRA/LTE signal with the same bandwidth as the wanted signal, but at the most 5 MHz and a specified center frequency offset (see Figure 8-8). The test shall be done on three channels (B, M and T).

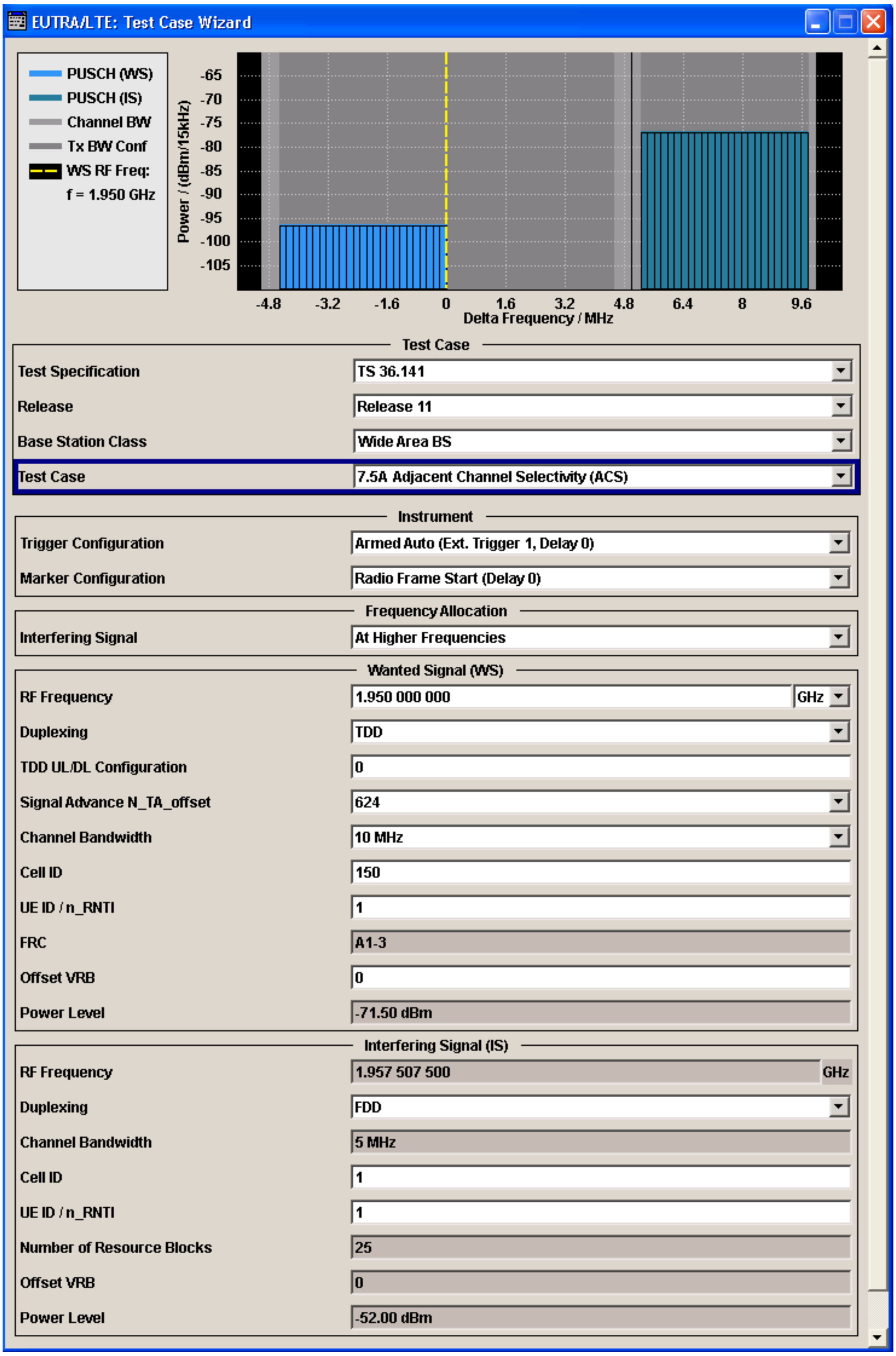
For the parameter in the Table 8-11 the throughput shall be equal or greater than 95%.

Table 8-11: Adjacent channel selectivity (Wide Area BS)

Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the lower (upper) edge of the wanted signal, MHz	Type of interfering signal
1.4	$P_{REFSENS}$ + 11dB	-52	±0.7025	1.4 MHz EUTRA signal, 3 RBs
3	$P_{REFSENS}$ + 8dB	-52	±1.5075	3 MHz EUTRA signal, 6 RBs
5	$P_{REFSENS}$ + 6dB	-52	±2.5025	5 MHz EUTRA signal, 10 RBs
10	$P_{REFSENS}$ + 6dB	-52	±2.5075	10 MHz EUTRA signal, 25 RBs
15	$P_{REFSENS}$ + 6dB	-52	±2.5125	15 MHz EUTRA signal, 25 RBs
20	$P_{REFSENS}$ + 6dB	-52	±2.5025	20 MHz EUTRA signal, 25 RBs

$P_{REFSENS}$ depends on the channel bandwidth and the base station class as specified in TS 36.104, subclause 7.2.1 (see Table 8-8).

For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

Refer to Chapter 8.8.3, "Interfering Signal Settings", on page 339 for description of the corresponding settings.

8.8.8 Test Case 7.5B: Narrow-band blocking

Test Purpose

To verify the ability of the BS receiver filter to suppress interfering signals in the channels adjacent to the wanted channel (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Option Second RF path (R&S SMx/AMU-B20x)
- Second Option Baseband Generator (R&S SMx/AMU-B10)
- Second Option Baseband Main Module (R&S SMx/AMU-B13)
- Second Option Digital Standard EUTRA/LTE (R&S SMx/AMU-K55)

Test Setup

See Chapter 8.4.2, "Standard Test Setup - Two Paths", on page 315

Short Description

The Narrow-band Blocking is a test case intended to verifies that a BS receiver is able to demodulate a "weak" useful signal being superimposed by a "strong" narrow-band interfering signal in the adjacent channel. The wanted signal is a reference measurement channel FRC A1. The interfering signal is a single resource block EUTRA/LTE signal in a channel with the same bandwidth as the wanted signal, but at the most 5 MHz. The interfering signal is located at a specified center frequency offset and the adjacently to the lower (upper) channel edge of the wanted signal (see Figure 8-10).

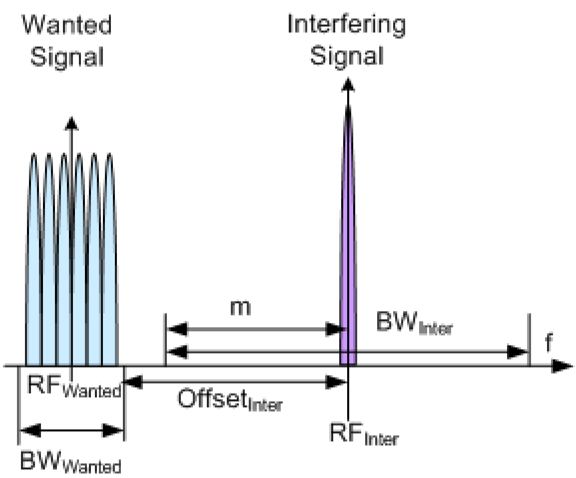


Figure 8-10: Example: Narrow-band Blocking

The test shall be done on three channels (B, M and T).

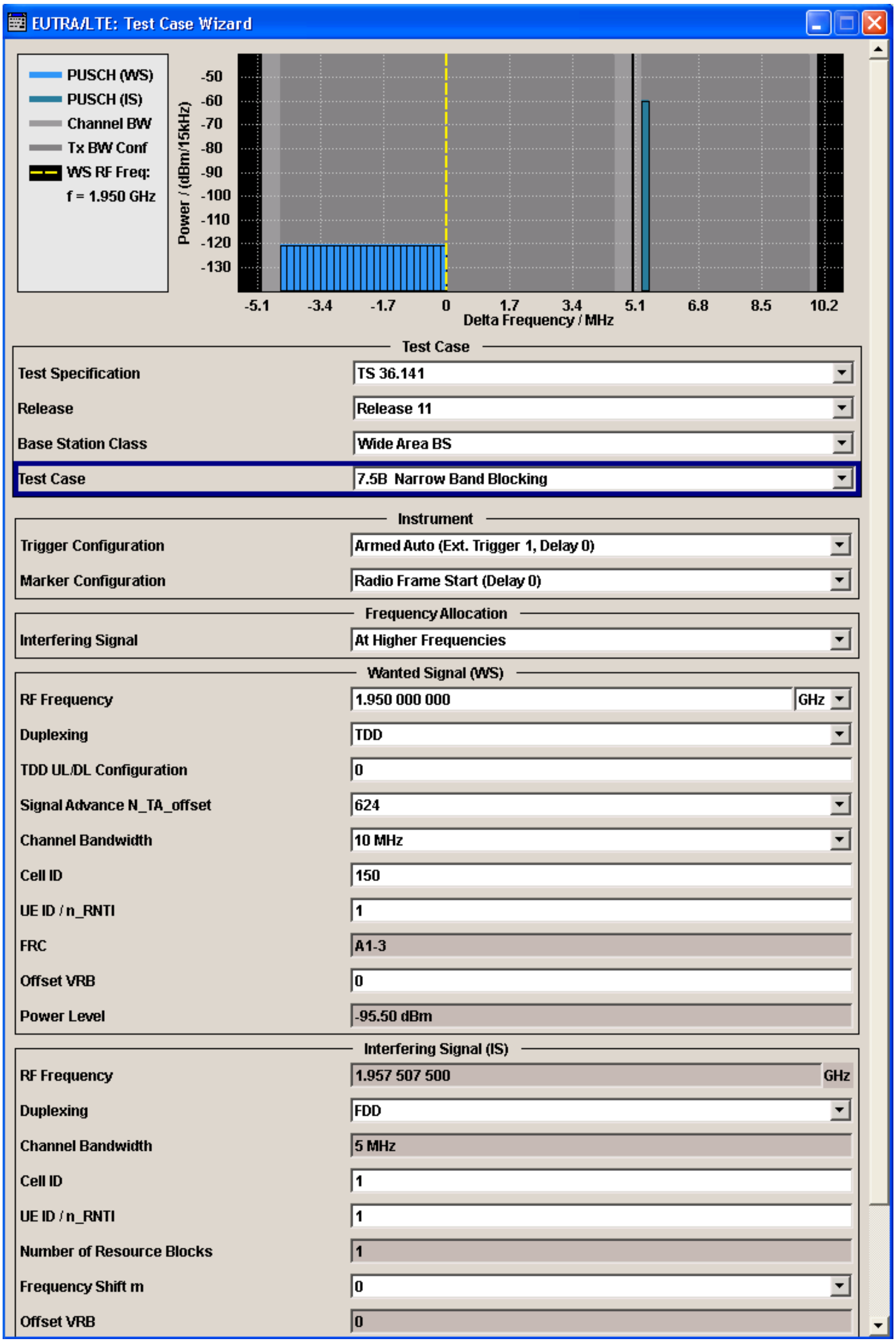
For the parameter in the Table 8-12 the throughput shall be equal or greater than 95%.

Table 8-12: Interfering signal for Narrowband blocking requirement (Wide Area BS)

Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering RB center frequency offset to the channel edge of the wanted signal, kHz	Type of interfering signal
1.4	$P_{REFSENS}$ + 6dB	-49	252.5+m*180, m=0, 1, 2, 3, 4, 5	1.4 MHz EUTRA signal, 1 RB
3			247.5+m*180, m=0, 1, 2, 3, 4, 7, 10, 13	3 MHz EUTRA signal, 1 RB
5 / 10 / 15 / 20			342.5+m*180, m=0, 1, 2, 3, 4, 9, 14, 19, 24	5 MHz EUTRA signal, 1 RB

$P_{REFSENS}$ depends on the channel bandwidth as specified in TS 36.104, subclause 7.2.1 (see Table 8-8).

For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

Refer to Chapter 8.8.3, "Interfering Signal Settings", on page 339 for description of the corresponding settings.

8.8.9 Test Case 7.6: Blocking

Test Purpose

The test stresses the ability of the BS receiver to withstand high-level interference from unwanted signals at specified frequency offsets without undue degradation of its sensitivity (TS 36.141).

Required Options

The following options are sufficient for tests with **CW interfering signal**:

- See Chapter 8.2, "Basic Configuration", on page 312.
- Option Second RF path (R&S SMx/AMU-B20x)

Additionally, the following options are necessary for tests with **LTE interfering signal**:

- Second Option Baseband Generator (R&S SMx/AMU-B10)
- Second Option Baseband Main Module (R&S SMx/AMU-B13)
- Second Option Digital Standard EUTRA/LTE (R&S SMx/AMU-K55)

Test Setup

The blocking test using a EUTRA/LTE interfering signal can be performed with one instrument, see Chapter 8.4.2, "Standard Test Setup - Two Paths", on page 315. This setup can also be used for the CW interfering signal case but only for the CW signals with up to 3 GHz or 6 GHz carrier, depending on the installed option. For tests with CW with frequency greater than 6 GHz a second signal generator is necessary, like R&S SMF for instance.

Short Description

The blocking characteristics is a test case that verifies the ability of the receiver to demodulate a wanted signal in the presence of a strong interfering signal. The test is split into two scenarios:

- Test of in-band blocking, performed with an LTE interfering signal inside the operating band (see Table 8-4), but not adjacent to the wanted signal.
- Test of out-of-band blocking, performed with a CW interfering signal with 1 MHz up to 12.750 GHz.
  There is an additional (optional) blocking requirement for co-location with other base station.

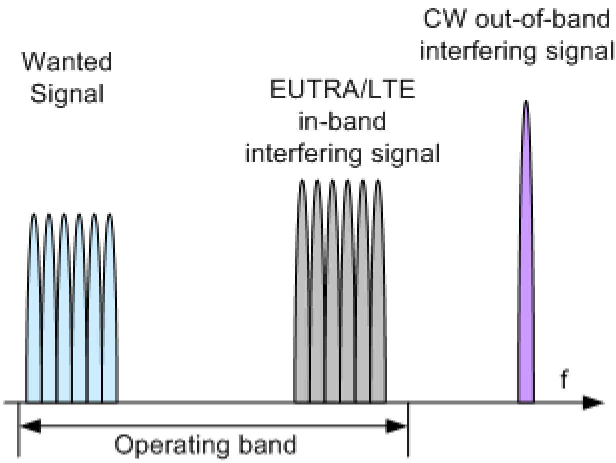


Figure 8-11: Example: Blocking

The test shall be done on one channel (M).

For the parameter in the Table 8-13 the throughput shall be equal or greater than 95%.

Table 8-13: Blocking performance requirement (Wide Area BS)

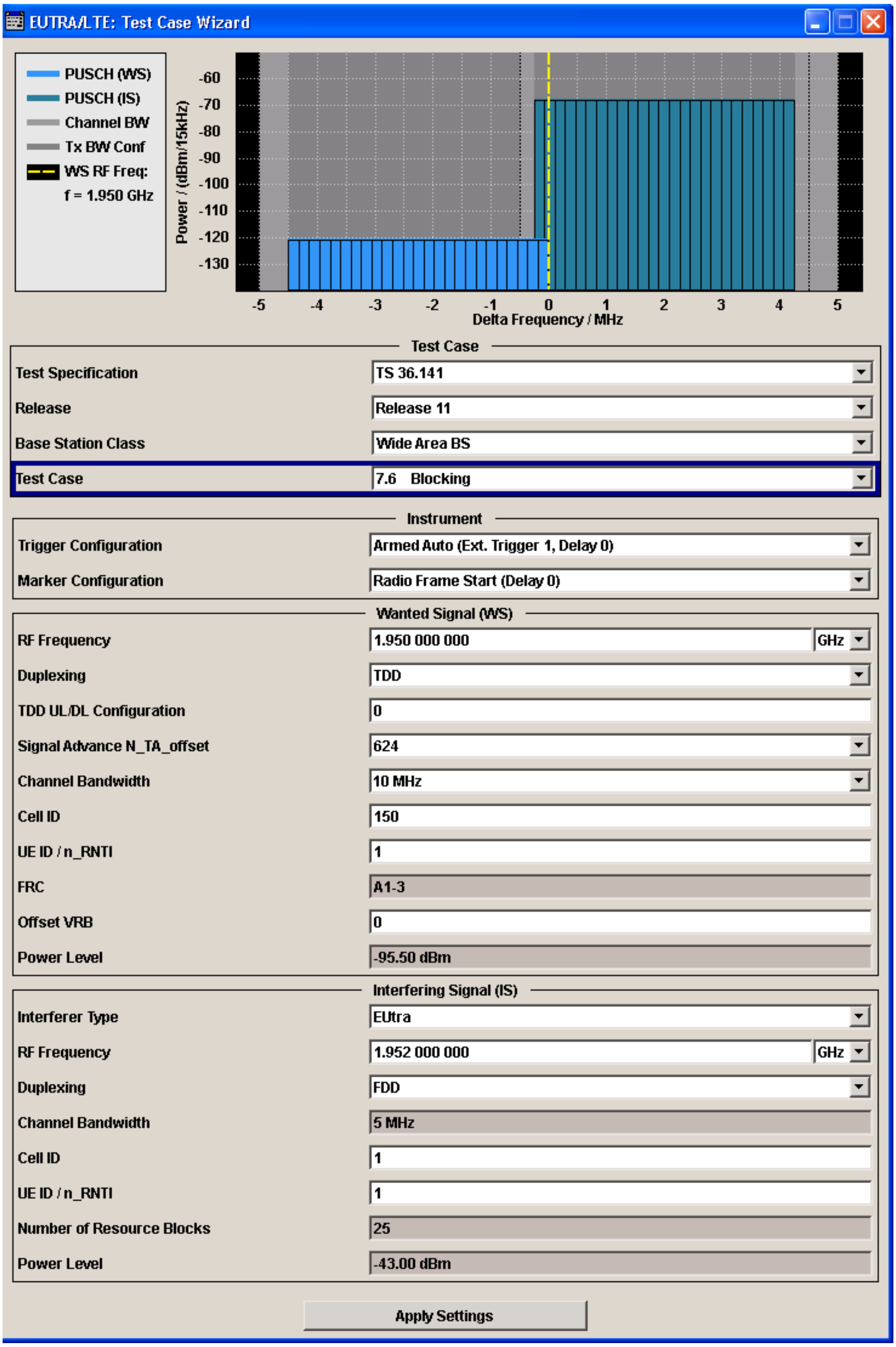
Operating Band	Center Frequency of Interfering Signal, MHz	Interfering Signal mean power, dBm	Wanted Signal mean power, dBm	Type of Interfering Signal
1-7, 9-11, 13-14, 33-40	(F_{UL_low} - 20) to (F_{UL_high} + 20)	-43	$P_{REFSENS}$ + 6dB	EUTRA/LTE*
	1 to (F_{UL_low} - 20) (F_{UL_high} + 20) to 12750	-15	$P_{REFSENS}$ + 6dB	CW
8	(F_{UL_low} - 20) to (F_{UL_high} + 10)	-43	$P_{REFSENS}$ + 6dB	EUTRA/LTE*
	1 to (F_{UL_low} - 20) (F_{UL_high} + 10) to 12750	-15	$P_{REFSENS}$ + 6dB	CW
12	(F_{UL_low} - 20) to (F_{UL_high} + 12)	-43	$P_{REFSENS}$ + 6dB	EUTRA/LTE*
	1 to (F_{UL_low} - 20) (F_{UL_high} + 12) to 12750	-15	$P_{REFSENS}$ + 6dB	CW
17	(F_{UL_low} - 20) to (F_{UL_high} + 18)	-43	$P_{REFSENS}$ + 6dB	EUTRA/LTE*
	1 to (F_{UL_low} - 20) (F_{UL_high} + 18) to 12750	-15	$P_{REFSENS}$ + 6dB	CW
	*) See Table 8-14			

Table 8-14: EUTRA/LTE interfering signals for Blocking performance requirement

Channel Bandwidth, MHz	Interfering signal center frequency minimum offset to the lower (upper) channel edge of the wanted signal, MHz	Type of interfering signal
1.4	±2.1	1.4 MHz EUTRA signal
3	±4.5	3 MHz EUTRA signal
5 / 10 / 15 / 20	±7.5	5 MHz EUTRA signal

$P_{REFSENS}$ depends on the channel bandwidth as specified in TS 36.104, subclause 7.2.1 (see Table 8-8).

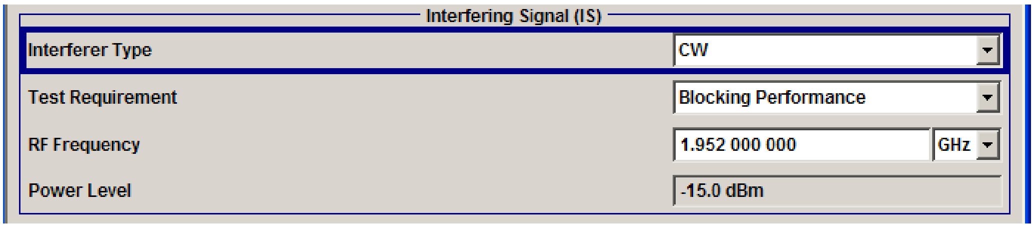
For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

Interfering Signal

The common settings of the interfering signal are described in Chapter 8.8.3, "Interfering Signal Settings", on page 339.



Test Requirement

For CW interfering signal, selects whether the standard out-of-band blocking requirements test is performed or the optional blocking scenario, when the BS is co-located with another BS in a different operating band.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:TREQuire` on page 615

8.8.10 Test Case 7.8: Receiver intermodulation

Test Purpose

The test purpose is to verify the ability of the BS receiver to inhibit the generation of intermodulation products in its non-linear elements caused by the presence of two high-level interfering signals at frequencies with a specific relationship to the frequency of the wanted signal (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Option Additive White Gaussian Noise AWGN (R&S SMx/AMU-K62)
- Option Second RF path (R&S SMx/AMU-B20x)
- Second Option Baseband Generator (R&S SMx/AMU-B10)
- Second Option Baseband Main Module (R&S SMx/AMU-B13)
- Second Option Digital Standard EUTRA/LTE (R&S SMx/AMU-K55)

Test Setup

See Chapter 8.4.2, "Standard Test Setup - Two Paths", on page 315.

Short Description

The receiver intermodulation test is a test scenario with two interfering signals, one CW and one EUTRA/LTE signal. The center frequency of the interfering signals is selected so that the third and higher order mixing products falls inside of the band of the wanted signal. There is also a second narrow-band intermodulation scenario defined, where the EUTRA/LTE interfering signal is a narrow-band signal with single resource block allocation and the CW interfering signal is placed very close to the wanted one.

The test shall be done on three channels (B, M and T).

For the parameter in the Table 8-15 and Table 8-16 the throughput shall be equal or greater than 95%.

Table 8-15: Intermodulation performance requirement (Wide Area BS)

Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the channel edge of the wanted signal, MHz	Type of interfering signal
1.4	$P_{REFSENS}$ + 6dB	-52	2.1	CW
	$P_{REFSENS}$ + 6dB	-52	4.9	1.4 MHz EUTRA signal
3	$P_{REFSENS}$ + 6dB	-52	4.5	CW
	$P_{REFSENS}$ + 6dB	-52	10.5	3 MHz EUTRA signal
5	$P_{REFSENS}$ + 6dB	-52	7.5	CW
	$P_{REFSENS}$ + 6dB	-52	17.5	5 MHz EUTRA signal
10	$P_{REFSENS}$ + 6dB	-52	7.5	CW
	$P_{REFSENS}$ + 6dB	-52	17.7	5 MHz EUTRA signal
15	$P_{REFSENS}$ + 6dB	-52	7.5	CW
	$P_{REFSENS}$ + 6dB	-52	18	5 MHz EUTRA signal
20	$P_{REFSENS}$ + 6dB	-52	7.5	CW
	$P_{REFSENS}$ + 6dB	-52	18.2	5 MHz EUTRA signal

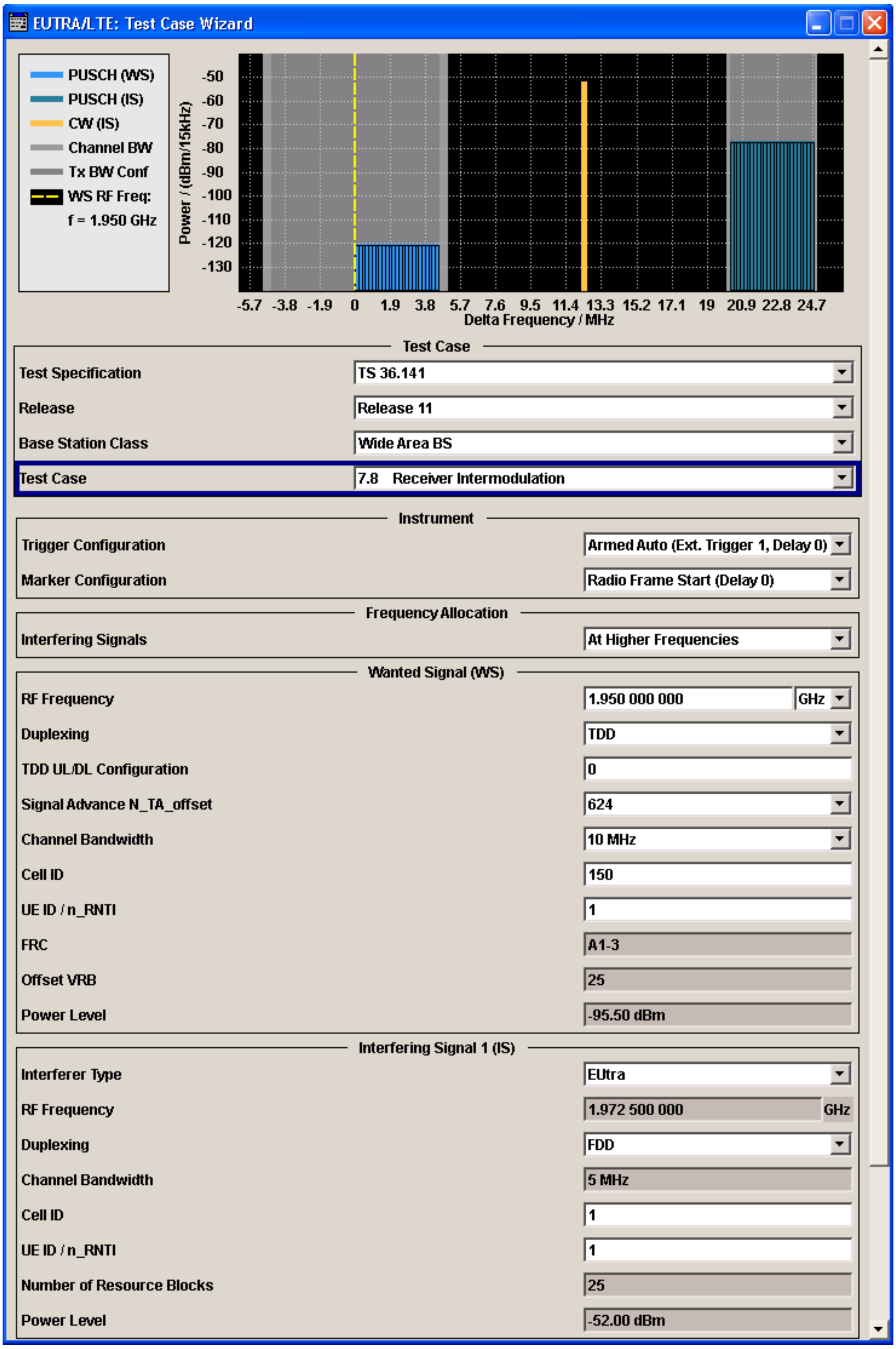
Table 8-16: Narrow-band intermodulation performance requirement (Wide Area BS)

Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the channel edge of the wanted signal, kHz	Type of interfering signal
1.4	$P_{REFSENS}$ + 6dB	-52	270	CW
	$P_{REFSENS}$ + 6dB	-52	790	1.4 MHz EUTRA signal, 1 RB
3	$P_{REFSENS}$ + 6dB	-52	275	CW
	$P_{REFSENS}$ + 6dB	-52	790	3 MHz EUTRA signal, 1 RB
5	$P_{REFSENS}$ + 6dB	-52	360	CW

Channel Band-width, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the channel edge of the wanted signal, kHz	Type of interfering signal
	$P_{REFSENS}$ + 6dB	-52	1060	5 MHz EUTRA signal, 1 RB
10	$P_{REFSENS}$ + 6dB	-52	415	CW
	$P_{REFSENS}$ + 6dB	-52	1420	5 MHz EUTRA signal, 1 RB
15	$P_{REFSENS}$ + 6dB	-52	380	CW
	$P_{REFSENS}$ + 6dB	-52	1600	5 MHz EUTRA signal, 1 RB
20	$P_{REFSENS}$ + 6dB	-52	345	CW
	$P_{REFSENS}$ + 6dB	-52	1780	5 MHz EUTRA signal, 1 RB

$P_{REFSENS}$ depends on the channel bandwidth as specified in TS 36.104, subclause 7.2.1 (see Table 8-8).

For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

Refer to Chapter 8.8.3, "Interfering Signal Settings", on page 339 for description of the corresponding settings.

8.9 Performance Requirements (TS 36.141, Chapter 8)

The BS RF performance requirements are divided into three main groups:

- Performance requirements for PUSCH:
  - Chapter 8.9.3, "Test Case 8.2.1: PUSCH in multipath fading propagation conditions on single antenna port", on page 367
  - Chapter 8.9.4, "Test Case 8.2.2: UL timing adjustment", on page 371
  - Chapter 8.9.5, "Test Case 8.2.3: HARQ-ACK multiplexed on PUSCH", on page 375
  - Chapter 8.9.6, "Test Case 8.2.4: High-Speed Train conditions", on page 378
- Performance requirements for PUCCH:
  - Chapter 8.9.7, "Test Case 8.3.1: ACK missed detection for single user PUCCH format 1a", on page 381
  - Chapter 8.9.8, "Test Case 8.3.2: CQI performance requirements for PUCCH format 2", on page 384
  - Chapter 8.9.9, "Test Case 8.3.3: ACK missed detection for multi-user PUCCH format 1a", on page 386
  - Chapter 8.9.10, "Test Case 8.3.4: ACK missed detection for PUCCH format 1b, channel selection", on page 391
  - Chapter 8.9.11, "Test Case 8.3.5: ACK missed detection for PUCCH format 3", on page 394
  - Chapter 8.9.12, "Test Case 8.3.6: NACK to ACK detection for PUCCH format 3", on page 397
  - Chapter 8.9.13, "Test Case 8.3.7: ACK missed detection for PUCCH format 1a transmission on two antenna ports", on page 400
  - Chapter 8.9.14, "Test Case 8.3.8: CQI performance requirements for PUCCH format 2 transmission on two antenna ports", on page 402
  - Chapter 8.9.15, "Test Case 8.3.9: CQI performance for PUCCH format 2 with DTX detection", on page 403
- Performance requirements for PRACH:
  - Chapter 8.9.16, "Test Case 8.4.1: PRACH false alarm probability and missed detection", on page 406

8.9.1 Prior Considerations

Fixed Reference Channels (FRC)

The receiver tests use fixed reference channels (FRC) as defined in TS 36.141, Annex A "Reference Measurement channels".

The following FRCs are defined for the performance tests:

- FRC A3: A3-1 .. A3-7 (QPSK)
- FRC A4: A4-1 .. A4-8 (16QAM)
- FRC A5: A5-1 .. A5-7 (64QAM)
- FRC A7: A7-1 .. A7-6 (16QAM for UL timing adjustment)
- FRC A8: A8-1 .. A8-6 (QPSK for UL timing adjustment)

Refer to Table 7-13 for an overview of all supported FRC.

Channels

According to the TS 36.141, the channels to test are located in the bottom (B), middle (M) and the top (T) of the supported frequency range of the base station. See Table 8-4 for an overview of the supported frequency operating bands.

Power Settings

The "Level Reference" parameter in the "Filter/Clipping/Power Settings" dialog is automatically set to "UL Part of Frame RMS Power".

Filter Settings

The 3GPP EUTRA/LTE specifications do not define a standardized transmit filter neither for the UE nor for the base station. Therefore, when a test case is activated, a filter type EUTRA/LTE with "Best EVM Optimization" is automatically selected.

AWGN Power Level

The performance requirements tests are performed for a given SNR where the AWGN power level is determined per channel bandwidth and test case according to Table 8-17.

Table 8-17: AWGN power level

Channel bandwidth, MHz	AWGN power level PUSCH tests	AWGN power level PUCCH and PRACH tests
1.4	-92.7 dBm / 1.08 MHz	-98.7 dBm / 1.08 MHz
3	-88.7 dBm / 2.7 MHz	-85.7 dBm / 2.7 MHz
5	-86.5 dBm / 4.5 MHz	-83.5 dBm / 4.5 MHz
10	-83.5 dBm / 9 MHz	-80.5 dBm / 9 MHz
15	-81.7 dBm / 13.5 MHz	-78.7 dBm / 13.5 MHz
20	-80.4 dBm / 18 MHz	-77.4 dBm / 18 MHz

SNR Correction Factor

The SNR correction factor is applied for **FRCs with not fully allocated RBs** and is calculated as follows:

$SNR_{CorrectionFactor}$=10*log_{10}(#Allocated RBs/#Possible RBs), dB

Table 8-18: SNR Correction Factor

Channel Band-width, MHz	#Possible RBs	$SNR_{CorrectionFactor}$, dB For FRC A3-1, A4-1, A4-2 and A5-1 with 1 allocated RB	$SNR_{CorrectionFactor}$, dB PRACH Burst Format 0 to 3	$SNR_{CorrectionFactor}$, dB PRACH Burst Format 4
1.4	6	-7.78	-0.13	-0.15
3	15	-11.76	-4.11	-4.13
5	25	-13.98	-6.33	-6.35
10	50	-16.99	-9.34	-9.36
15	75	-18.75	-11.10	-11.13
20	100	-20.00	-12.34	-12.37

The wanted signal power level is calculated according to the following formula:

Power $Level_{WantedSignal}$ = Power $Level_{AWGN}$ + SNR + $SNR_{CorrectionFactor}$

Example: Test Case 8.2.1

"Channel Bandwidth" = 1.4 MHz

"Number of Rx Antennas" = 2

"Cyclic Prefix" = Normal

"Propagation Conditions" = EVA 5Hz

"FRC" = A3-1

"Fraction of maximum throughput" = 30%

According to Table 8-20 the SNR = -2.1 dB

According to Table 8-18 the $SNR_{CorrectionFactor}$ = -7.78 dB

According to Table 8-17 the Power $Level_{AWGN}$ = -92.7 dBm

Power $Level_{WantedSignal}$ = Power $Level_{AWGN}$ + SNR + $SNR_{CorrectionFactor}$ = -92.7 - 2.1 - 7.78 = -102.6 dB

HARQ-Feedback

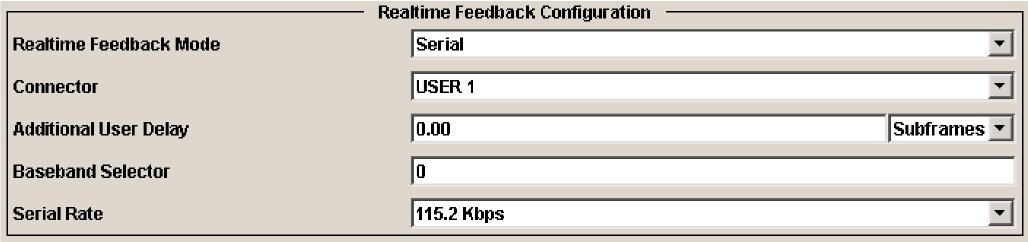
Some of the performance requirements test cases require a feedback signal from the base station. The R&S Signal Generator equipped with the option R&S SMx/AMU-K69 is able to perform HARQ retransmissions and/or timing shifts according to the 3GPP specification.

Refer to Chapter 6, "Realtime Feedback for Closed Loop BS Tests", on page 69 for explanation of the scope of this feature as well as for detailed description of the different feedback modes.

8.9.2 Realtime Feedback Configuration, AWGN and Propagation Condition Settings

Realtime Feedback Configuration

Comprises the settings of the realtime feedback message and the feedback line.



Realtime Feedback Mode ← Realtime Feedback Configuration

Determines the feedback mode.

"Binary ACK/NACK" The ACK/NACK feedback is implemented as low/high voltage level on the feedback line connector.
Timing Adjustments Feedback is not supported in this mode.

"Serial" ACK/NACK Feedback and Timing Adjustments Feedback are implemented by means of a serial protocol (see Chapter 6.2.2, "Serial Mode", on page 71).

"Serial 3x8" ACK/NACK Feedback and Timing Adjustments Feedback are implemented by means of serial commands, consisting of three serial packets (see Chapter 6.2.3, "Serial 3x8 Mode", on page 71).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:RTF:MODE` on page 617

Connector ← Realtime Feedback Configuration

Determines the feedback line connector.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONNector` on page 617

Additional User Delay ← Realtime Feedback Configuration

Determines the point in time when the feedback can be sent to the instrument.

For more information see Chapter 6.3, "Timing Aspects", on page 74.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:RTF:AUSDelay` on page 616

Baseband Selector ← Realtime Feedback Configuration

("Serial" and "Serial 3x8" mode only)

This parameter is required for multiplexing serial commands for different baseband units to one feedback line. If the selector n is configured in the GUI for a specific baseband unit, the baseband unit will listen only to serial commands containing the selector n.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSelector on page 616

Serial Rate ← Realtime Feedback Configuration
(Serial and Serial 3x8 mode only)

Determines the bit rate of the serial transmission. Possible rates are 115.2 kbps, 1.6 Mbps and 1.92 Mbps.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:SERRate on page 617

ACK Definition ← Realtime Feedback Configuration
("Binary ACK/NACK" mode only)

Determines whether a high or a low binary level on the feedback line connector represents an ACK.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:ACKDefinition on page 616

AWGN Configuration
Comprises the settings of the AWGN signal.

Power Level ← AWGN Configuration
Displays the AWGN power level. The value is determined according to Table 8-17 by the selected channel bandwidth.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:AWGN:PLEVel? on page 607

Propagation Conditions
Selects a predefined multipath fading propagation conditions. The settings of the fading simulator are adjusted according to the corresponding channel model as defined in TS 36.141, Annex B.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:PROCondition on page 623

8.9.3 Test Case 8.2.1: PUSCH in multipath fading propagation conditions on single antenna port

Test Purpose

The test shall verify the receiver’s ability to achieve throughput under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)

- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- 2 Options Fading Simulator and Fading Simulator Extension (R&S SMU-B14/-B15)
- Option LTE closed loop BS Test (R&S SMU-K69)
- For test setups with four Rx antennas, a second generator is required. The required options are identical.

Test Setup

The test setup for PUSCH tests with two Rx antennas is performed according to Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316.

The test setup with four Rx antennas requires two two-paths instruments and is performed according to Chapter 8.4.4, "Test Setup - Four Rx Antennas", on page 317 (HARQ feedback line is not required).

Short Description

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The throughput is measured by the base station under test and is expressed as a fraction of maximum throughput for the FRC's. HARQ retransmissions are assumed.

The characteristics of the wanted signal are adjusted according to the pre-defined FRC and the test parameter given in Table 8-19.

Table 8-19: Test parameters for testing PUSCH

Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)

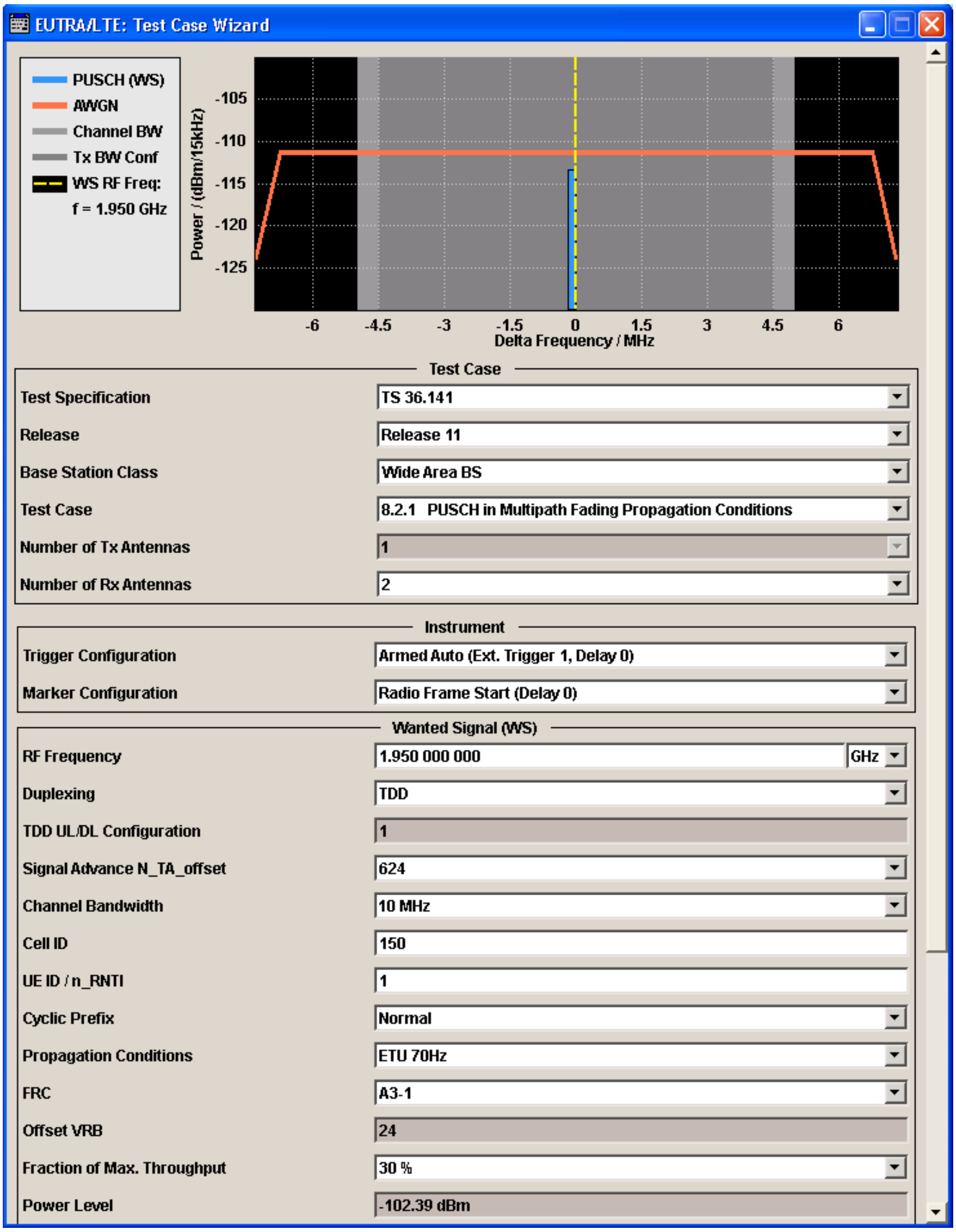
The Table 8-20 shows an example of the test requirements (channel bandwidth 1.4 MHz). Similar requirements exist for the different FRCs, channel bandwidths and antenna configurations. Refer to TS 36.141 for a detailed description of all test requirements.

Table 8-20: Test requirements for PUSCH, 1.4 MHz Channel Bandwidth (Number Tx Antennas = 1)

Cyclic prefix	Propagation conditions	FRC	Fraction of maximum throughput, %	SNR, dB 2 RX antennas	SNR, dB 4 RX antennas
Normal	EPA 5Hz	A3-2	30 70	-3.5 0.7	-6.0 -2.5
		A4-3	70	11.2	7.7
		A5-2	70	18.3	15.0
	EVA 5Hz	A3-1	30 70	-2.1 2.4	-4.4 -0.7
		A4-1	30 70	5.0 11.9	1.9 8.4

Cyclic prefix	Propagation conditions	FRC	Fraction of maximum throughput, %	SNR, dB 2 RX antennas	SNR, dB 4 RX antennas
		A5-1	70	19.2	16.0
	EVA 70Hz	A3-2	30 70	-3.3 1.3	-5.7 -2.1
		A4-3	30 70	4.6 12.5	1.4 8.9
	ETU 70Hz*	A3-1	30 70	-1.6 3.5	-4.2 -0.4
	ETU 300Hz*	A3-1	30 70	-1.6 3.5	-4.0 0.0
Extended	ETU 70Hz*	A4-2	30 70	5.4 14.1	2.2 10.5

*) Not applicable for Local Area BS and Home BS.



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings, the AWGN configuration, and the realtime feedback configuration refer to Chapter 8.9.2, "Realtime Feedback Configuration, AWGN and Propagation Condition Settings", on page 366.

Fraction of Max. Throughput
Selects the fraction of maximum throughput.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:FMTHroughput on page 620

8.9.4 Test Case 8.2.2: UL timing adjustment

Test Purpose

The test shall verify the receiver's ability to achieve throughput measured for the moving UE at given SNR under moving propagation conditions (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- Second Option Digital Standard EUTRA/LTE (R&S SMx-K55)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- Options Fading Simulator, Fading Simulator Extension and MIMO (R&S SMU-B14/-B15/-K71/-K74)
- Option LTE closed loop BS Test (R&S SMU-K69)

Test Setup

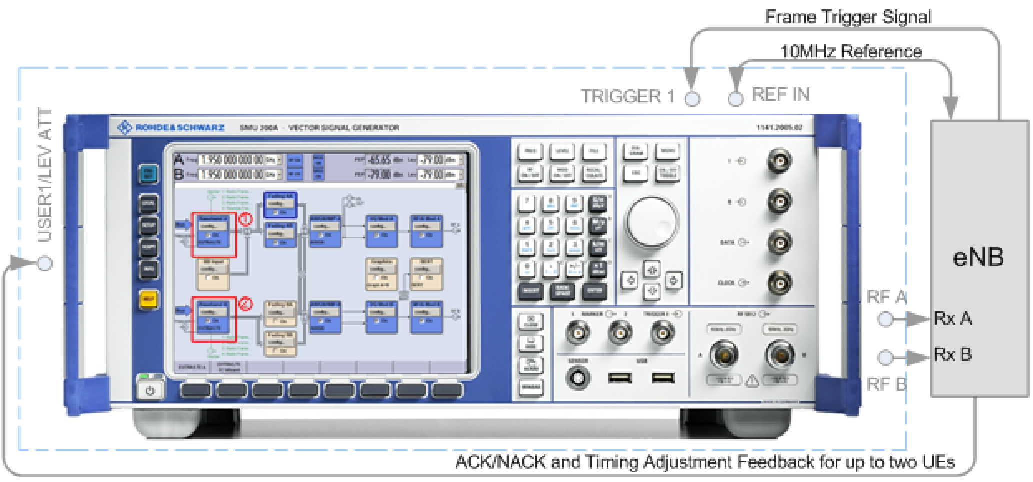


Figure 8-12: Test Setup for test case 8.2.2 "UL Timing Adjustment"

1 = Baseband A generates the signal of the moving UE
2 = Baseband B generates the signal of the stationary UE

Short Description

For the UL timing adjustment test, the signal generator generated the signal of two user equipment (UEs); path A generates the signal of a moving UE and path B the signal of the stationary one. The throughput is measured by the base station under test.

The performance requirement of PUSCH is expressed as 70% of maximum throughput for the FRC measured for the moving UE at given SNR (see Table 8-22). HARQ re-transmissions are assumed. The transmission of the sounding reference signal SRS is optional (see "Transmit SRS" on page 374).

Two moving propagation scenarios are defined; test with scenario 2 are optional. For detailed description of the moving propagation conditions, refer to the description operating manual "Fading Simulator".

The characteristics of the wanted signal (transmitted by moving UE) are adjusted according to the pre-defined FRC and the test parameter given in Table 8-21.

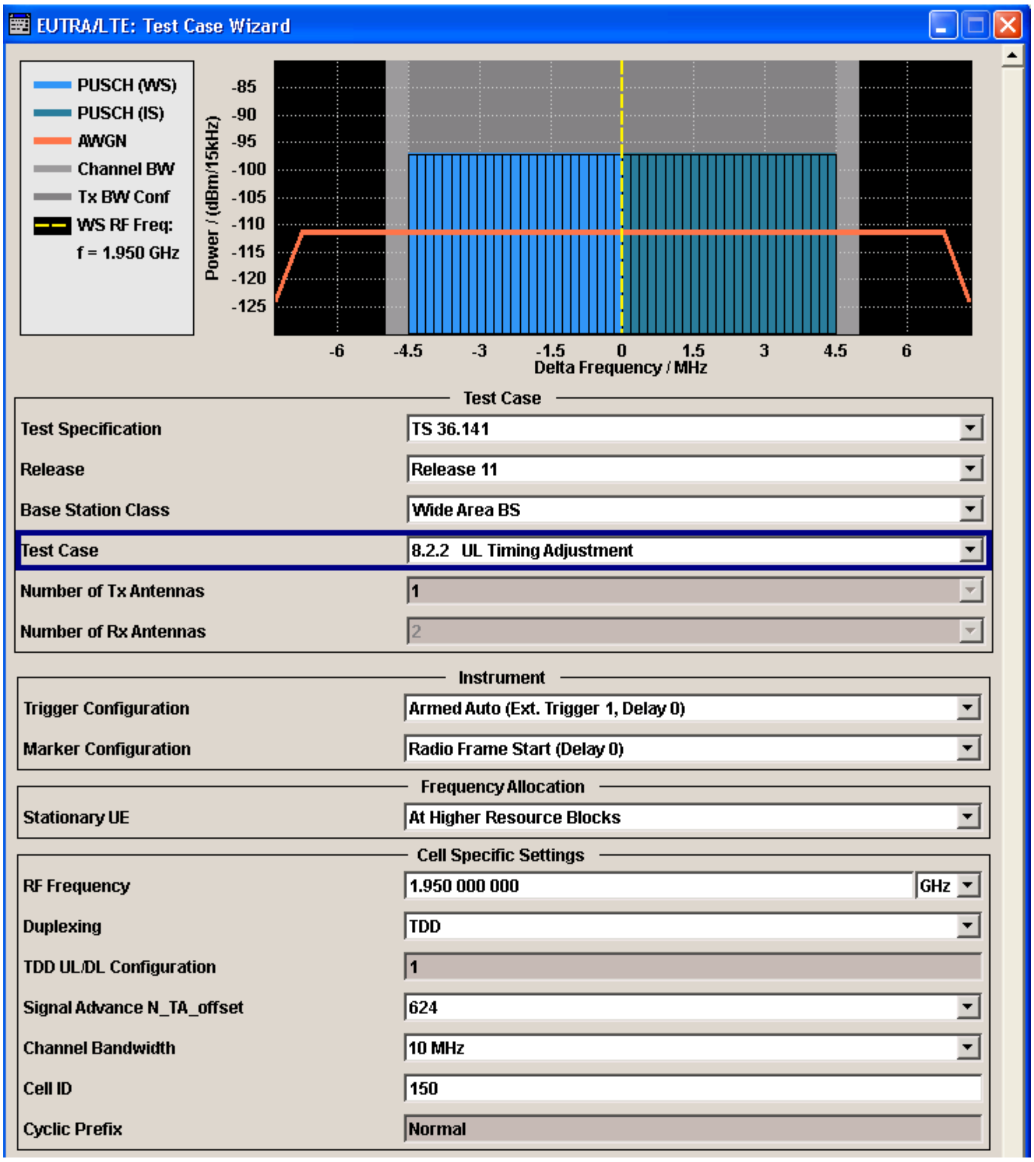
Table 8-21: Test parameters for testing UL timing adjustment

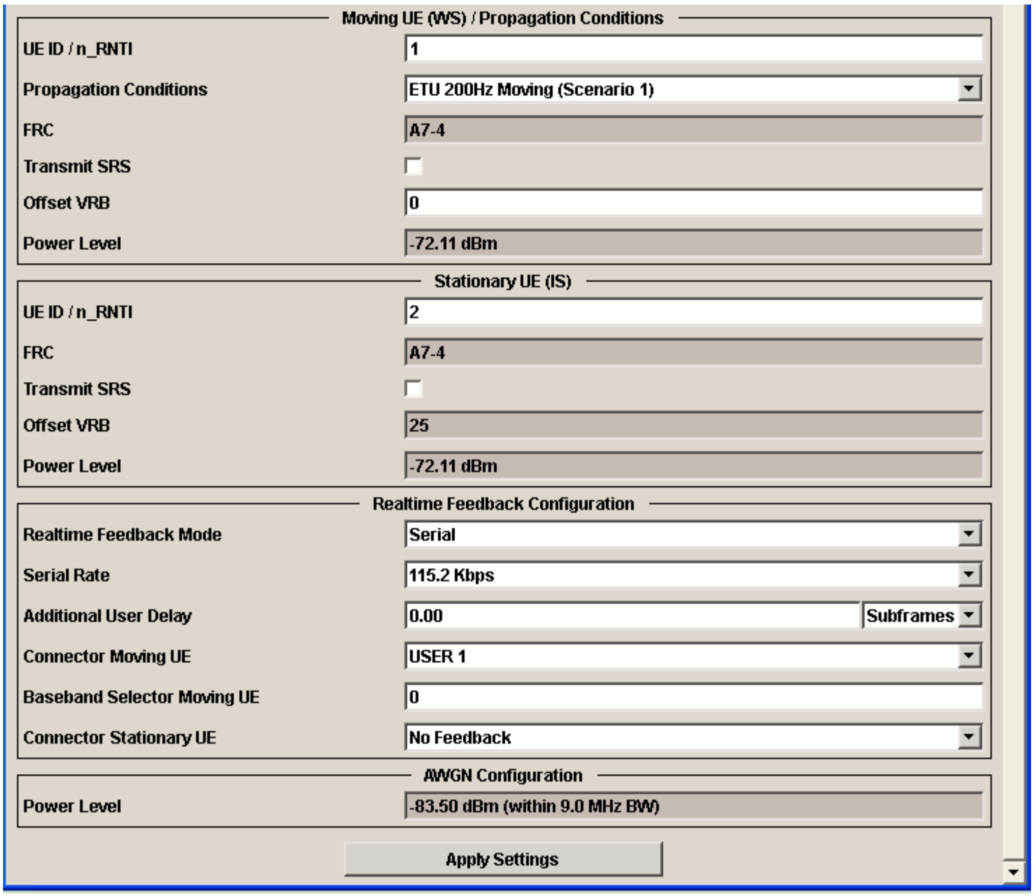
Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)
Subframes in which PUSCH is transmitted	• For FDD: Subframe #0, #2, #4, #6, and #8 in radio frames • For TDD: Subframe #2, #3, #7, #8 in each radio frame
Subframes in which SRS is transmitted (SRS transmission is optional)	• For FDD: Subframe #1 in radio frames • For TDD: UpPTS in each radio frame

The Table 8-22 shows the test requirements. The test is performed with two Rx antennas and a normal cyclic prefix.

Table 8-22: Test requirements for UL timing adjustment (two Rx antennas and normal cyclic prefix)

Channel Bandwidth, MHz	Moving propagation conditions	FRC	SNR, dB
1.4	Scenario 1 Scenario 2	A7-1 A8-1	13.7 -1.6
3	Scenario 1 Scenario 2	A7-2 A8-2	14.0 -1.2
5	Scenario 1 Scenario 2	A7-3 A8-3	13.8 -1.3
10	Scenario 1 Scenario 2	A7-4 A8-4	14.4 -1.5
15	Scenario 1 Scenario 2	A7-5 A8-5	14.6 -1.5
20	Scenario 1 Scenario 2	A7-6 A8-6	14.5 -1.5


EUTRA/LTE: Test Case Wizard
PUSCH (WS)
PUSCH (IS)
AWGN
Channel BW
Tx BW Conf
WS RF Freq:
f = 1.950 GHz
Power / (dBm/15kHz)
-85
-90
-95
-100
-105
-110
-115
-120
-125
-6
-4.5
-3
-1.5
0
1.5
3
4.5
6
Delta Frequency / MHz
Test Case
Test Specification
TS 36.141
Release
Release 11
Base Station Class
Wide Area BS
Test Case
8.2.2 UL Timing Adjustment
Number of Tx Antennas
1
Number of Rx Antennas
2
Instrument
Trigger Configuration
Armed Auto (Ext. Trigger 1, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)
Frequency Allocation
Stationary UE
At Higher Resource Blocks
Cell Specific Settings
RF Frequency
1.950 000 000
GHz
Duplexing
TDD
TDD UL/DL Configuration
1
Signal Advance N_TA_offset
624
Channel Bandwidth
10 MHz
Cell ID
150
Cyclic Prefix
Normal



The cell-specific settings and the settings of the moving UE are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings, the AWGN configuration, and the realtime feedback configuration refer to Chapter 8.9.2, "Realtime Feedback Configuration, AWGN and Propagation Condition Settings", on page 366.

UE ID/n_RNTI

Sets the UE ID/n_RNTI.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:MUE:UEID` on page 624
`[:SOURce<hw>]:BB:EUTRa:TCW:SUE:UEID` on page 624

Transmit SRS

Enables/disables the transmission of the SRS.

The SRS transmission is optional for this test case.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:MUE:TSRS` on page 616
`[:SOURce<hw>]:BB:EUTRa:TCW:SUE:TSRS` on page 616

Offset VRB

Displays the number of RB the allocated RB(s) are shifted with.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:MUE:OVRB on page 622
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:OVRB on page 622

Connector Moving UE/Stationary UE
Determines the feedback line connector.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONMue on page 617
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONSue on page 617

Baseband Selector Moving UE
("Serial" and "Serial 3x8" mode only)

This parameter is required for multiplexing serial commands for different baseband units to one feedback line. If the selector n is configured in the GUI for a specific baseband unit, the baseband unit will listen only to serial commands containing the selector n.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSMue on page 616
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSSue on page 616

8.9.5 Test Case 8.2.3: HARQ-ACK multiplexed on PUSCH

Test Purpose

The test shall verify the receiver's ability to detect HARQ-ACK information multiplexed on PUSCH under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- 2 Options Fading Simulator and Fading Simulator Extension (R&S SMU-B14/-B15)

Test Setup

See Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316 (HARQ feedback line is not required).

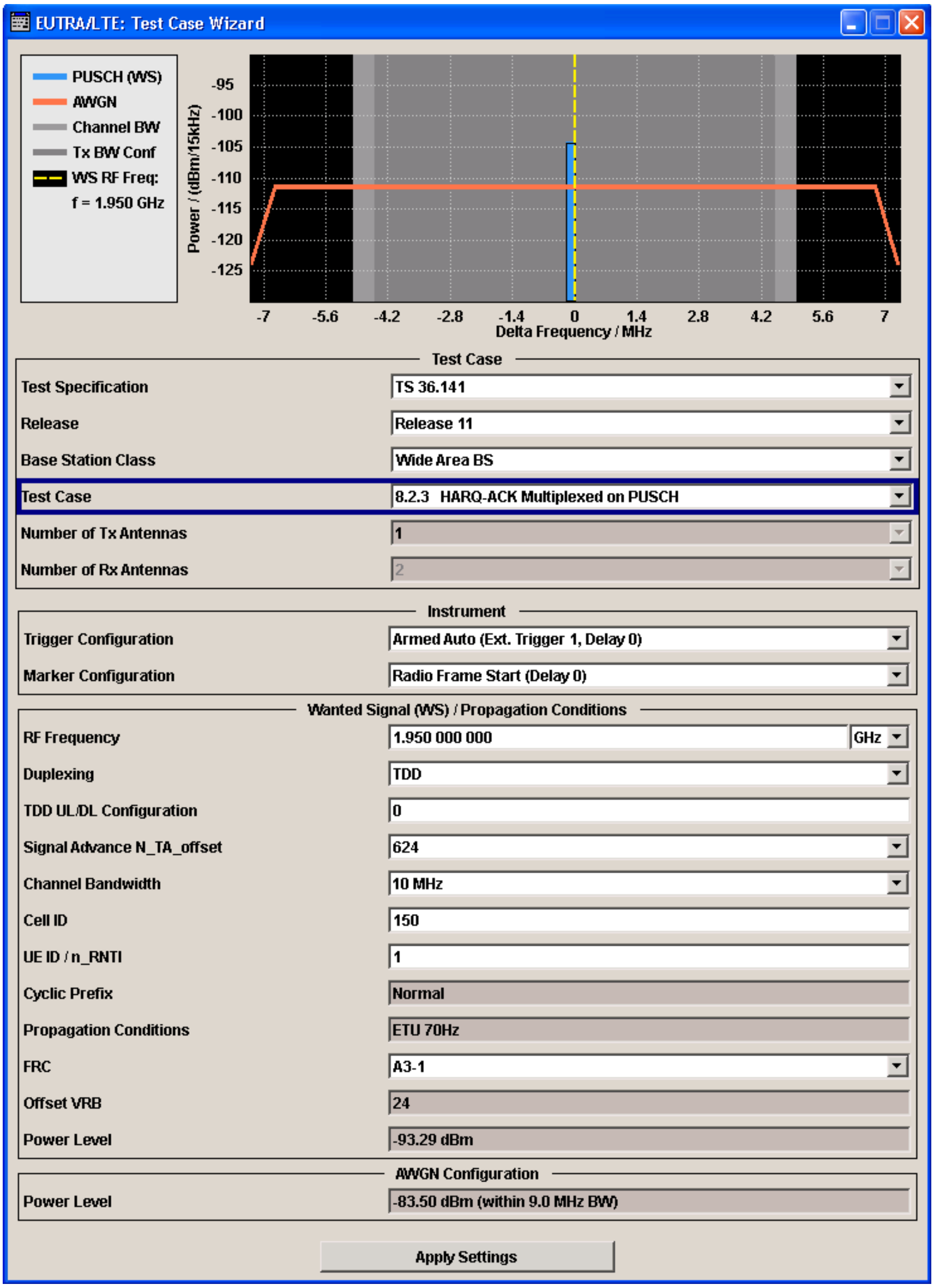
Short Description

The performance requirement of HARQ-ACK multiplexed on PUSCH is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The Table 8-23 shows the test requirements. The tests are performed with two Rx antennas, normal cyclic prefix and propagation condition ETU70.

Table 8-23: Test requirements for HARQ-ACK multiplexed on PUSCH (two Rx antennas, normal cyclic prefix and propagation condition ETU70)

Channel Bandwidth, MHz	FRC	Index HARQ Offset	SNR, dB
1.4	A3-1 A4-3	8 5	7.2 14.4
3	A3-1 A4-4	8 5	7.2 13.5
5	A3-1 A4-5	8 5	7.1 13.1
10	A3-1 A4-6	8 5	7.2 12.9
15	A3-1 A4-7	8 5	7.3 12.7
20	A3-1 A4-8	8 5	7.1 12.6



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 367 and "AWGN Configuration" on page 367.

8.9.6 Test Case 8.2.4: High-Speed Train conditions

Test Purpose

The test shall verify the receiver's ability to achieve throughput under High-Speed Train conditions for a given SNR (TS 36.141).

Required Options

The following options are sufficient for tests with one Rx Antenna:

- See Chapter 8.2, "Basic Configuration", on page 312.
- Option Additive White Gaussian Noise AWGN (R&S SMU-K62)
- Option Fading Simulator and Fading Simulator Extension (R&S SMU-B14/-K71)
- Option LTE closed loop BS Test (R&S SMU-K69)

For tests with more than one Rx Antenna, the following options are required additionally:

- Second Option Additive White Gaussian Noise AWGN (R&S SMU-K62)
- Second Baseband Main Module (R&S SMU-B13)
- Option Fading Simulator Extension (R&S SMU-B15)

Test Setup

See Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316 and Chapter 8.4.1, "Standard Test Setup - One Path", on page 315 (additionally, a feedback line is required).

Short Description

The performance requirement is determined by a minimum throughput for a given SNR. The requirement throughput is expressed as 30% and 70% of the maximum throughput for the FRC (see Table 8-24). HARQ retransmission is assumed. The tests are performed with one or two Rx antennas, normal cyclic prefix and propagation condition HST.

The test is optional.

The characteristics of the wanted signal are adjusted according to the pre-defined FRC and the test parameter given in Table 8-25.

Table 8-24: Test parameters for High-Speed Train conditions

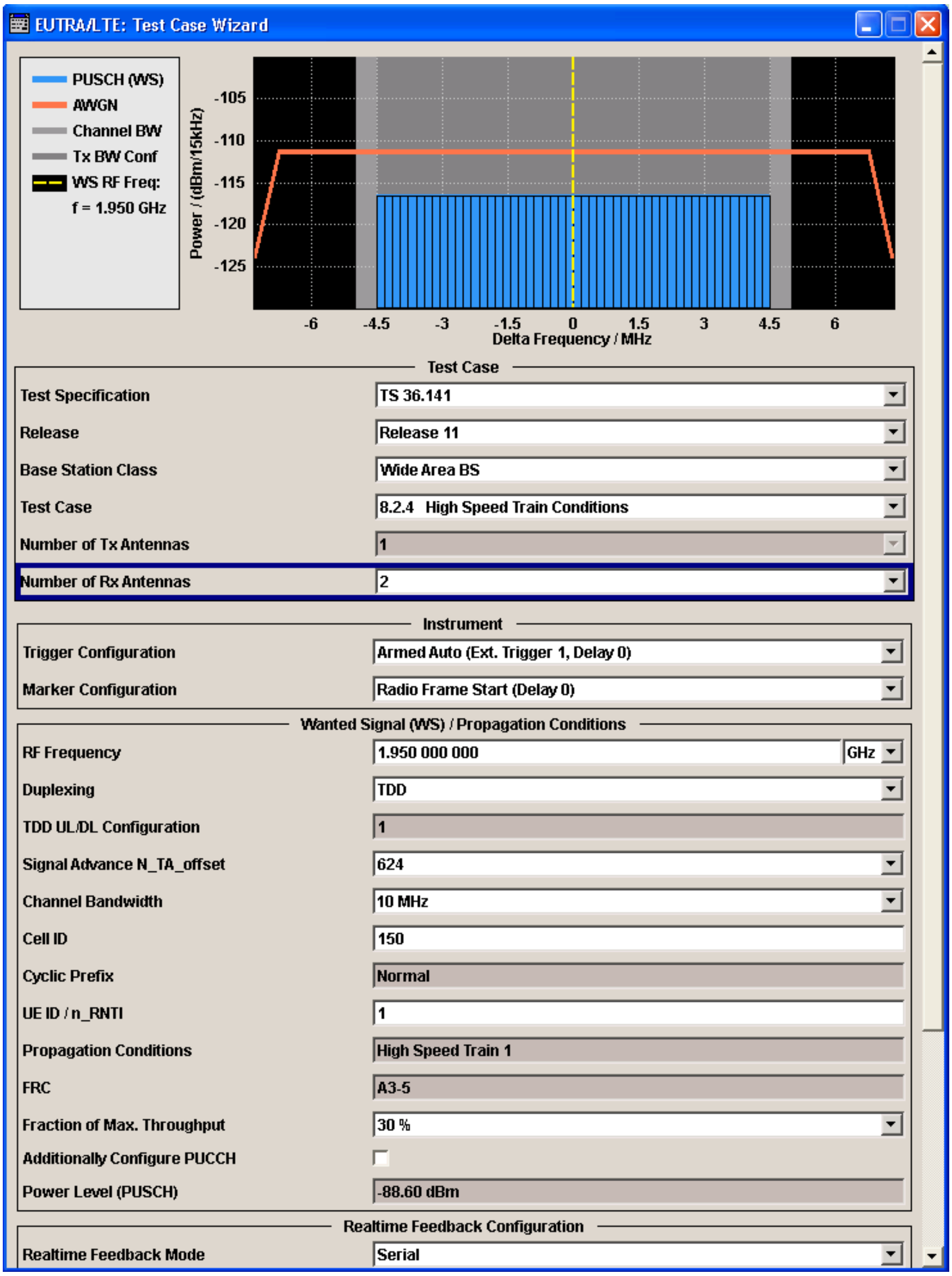
Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)
*) The configuration of PUCCH (format 2) is optional; The SNR values per antenna shall be set to [-4.5 dB and -1.5 dB] for Scenario 1 and 3, respectively.	

Parameter	Value
Subframes in which PUSCH is transmitted	For FDD: • Subframe #0 and #8 in radio frames for which SFN mod 4 = 0 • Subframe #6 in radio frames for which SFN mod 4 = 1 • Subframe #4 in radio frames for which SFN mod 4 = 2 • Subframe #2 in radio frames for which SFN mod 4 = 3 For TDD: • Subframe #2 in each radio frames
Subframes in which PUCCH is transmitted *	For FDD: • Subframe #5 in radio frames For TDD: • Subframe #3 in each radio frame
*) The configuration of PUCCH (format 2) is optional; The SNR values per antenna shall be set to [-4.5 dB and -1.5 dB] for Scenario 1 and 3, respectively.	

Table 8-25: Test requirements for High-Speed Train conditions

Channel Band-width, MHz	FRC	Number of RX antennas	Propagation conditions	Fraction of maximum throughput, %	SNR, dB
1.4	A3-2	1	HST Scenario 3	30 70	-1.2 2.2
		2	HST Scenario 1	30 70	-3.6 -0.3
3	A3-3	1	HST Scenario 3	30 70	-1.8 1.9
		2	HST Scenario 1	30 70	-4.2 -0.7
5	A3-4	1	HST Scenario 3	30 70	-2.3 1.6
		2	HST Scenario 1	30 70	-4.8 -1.1
10	A3-5	1	HST Scenario 3	30 70	-2.4 1.5
		2	HST Scenario 1	30 70	-5.1 -1.2
15	A3-6	1	HST Scenario 3	30 70	-2.4 1.5
		2	HST Scenario 1	30 70	-4.9 -1.1

Channel Band-width, MHz	FRC	Number of RX antennas	Propagation conditions	Fraction of maximum throughput, %	SNR, dB
20	A3-7	1	HST Scenario 3	30 70	-2.4 1.5
		2	HST Scenario 1	30 70	-5.0 -1.1



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings, the AWGN configuration, and the realtime feedback configuration refer to Chapter 8.9.2, "Realtime Feedback Configuration, AWGN and Propagation Condition Settings", on page 366.

Additionally Configure PUCCH
Enables the optional transmission of PUCCH format 2.

The settings are configured according to Table 8-25; the PUCCH Power Level is calculated automatically.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:ACPucch` on page 618

Power Level (PUSCH)
Displays the resulting PUSCH power level.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLPS?` on page 622

PUCCH Power Level
(enabled for activated optional transmission of PUCCH format 2)

Displays the resulting PUCCH power level.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLPC?` on page 622

8.9.7 Test Case 8.3.1: ACK missed detection for single user PUCCH format 1a

Test Purpose

The test shall verify the receiver's ability to detect ACK under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- 2 Options Fading Simulator and Fading Simulator Extension (R&S SMU-B14/-B15)
- For test setups with four Rx antennas, a second generator is required. The required options are identical.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316 (HARQ feedback line is not required).

The test setup with four Rx antennas requires two two-paths instruments and is performed according to Chapter 8.4.4, "Test Setup - Four Rx Antennas", on page 317 (HARQ feedback line is not required).

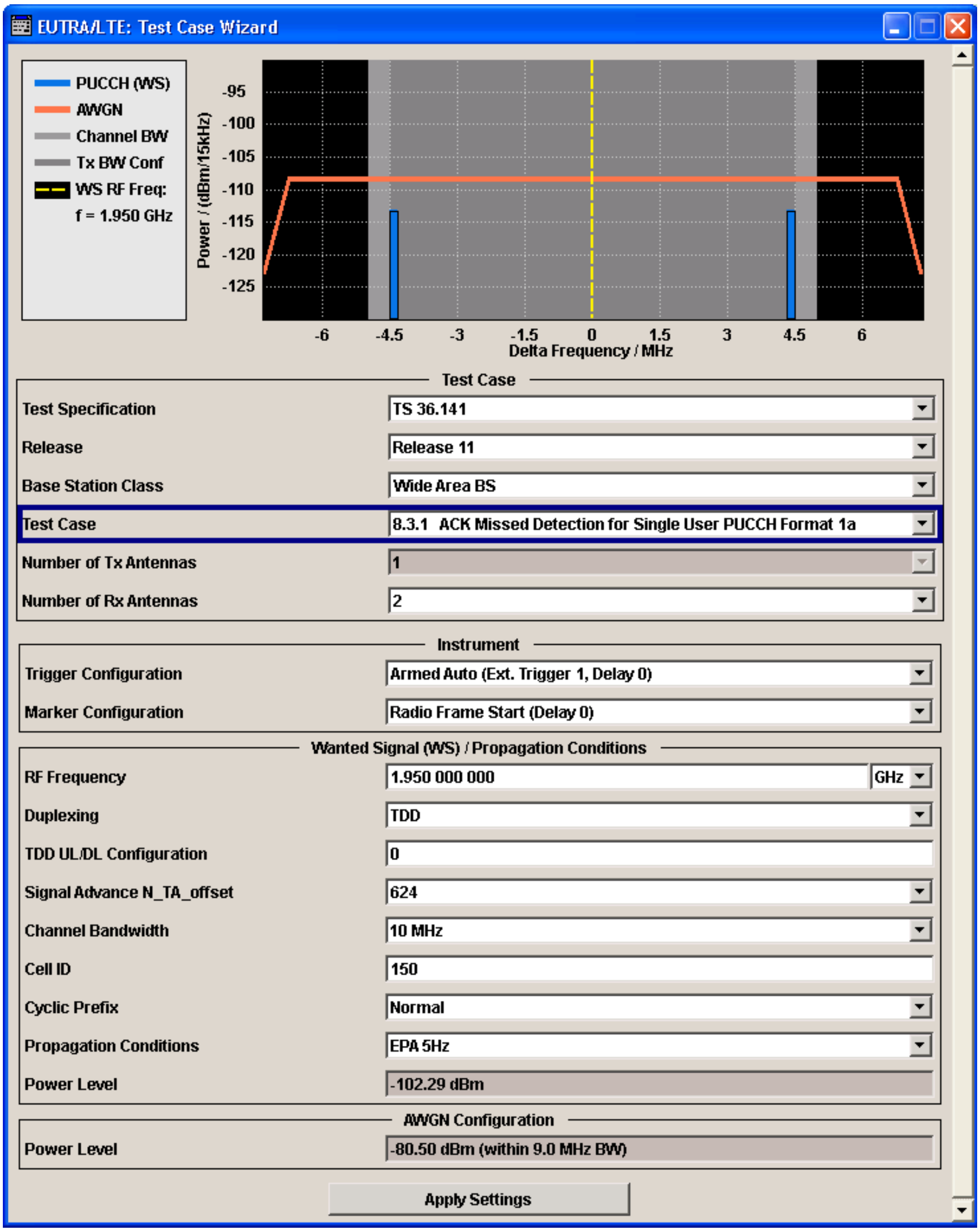
Short Description

The performance requirement of single user PUCCH for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The Table 8-26 shows the test requirements for two and four Rx antennas.

Table 8-26: Required SNR for single user PUCCH format 1a demodulation tests

Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4 MHz	BW=3MHz	BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5	-1.9	-3.3	-4.2	-4.8	-4.7	-4.5
		EVA 5	-3.9	-4.5	-4.5	-4.4	-4.5	-4.5
		EVA 70	-4.3	-4.6	-4.6	-4.5	-4.6	-4.5
		ETU 300	-4.4	-4.5	-4.3	-4.4	-4.6	-4.6
	Extended	ETU 70	-3.6	-3.7	-3.5	-3.7	-3.6	-3.7
4	Normal	EPA 5	-7.3	-7.8	-8.1	-8.3	-8.3	-8.4
		EVA 5	-8.2	-8.5	-8.5	-8.2	-8.3	-8.3
		EVA 70	-8.3	-8.4	-8.4	-8.2	-8.4	-8.2
		ETU 300	-8.1	-8.3	-8.1	-8.1	-8.3	-8.2
	Extended	ETU 70	-7.3	-7.5	-7.3	-7.5	-7.4	-7.4



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 367 and "AWGN Configuration" on page 367.

8.9.8 Test Case 8.3.2: CQI performance requirements for PUCCH format 2

Renamed Test Case

In TS 36.141 versions prior to version 8.9.0 this test case was called "CQI missed detection for PUCCH format 2".

Test Purpose

The test shall verify the receiver's ability to detect CQI under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- 2 Options Fading Simulator and Fading Simulator Extension (R&S SMU-B14/-B15)

Test Setup

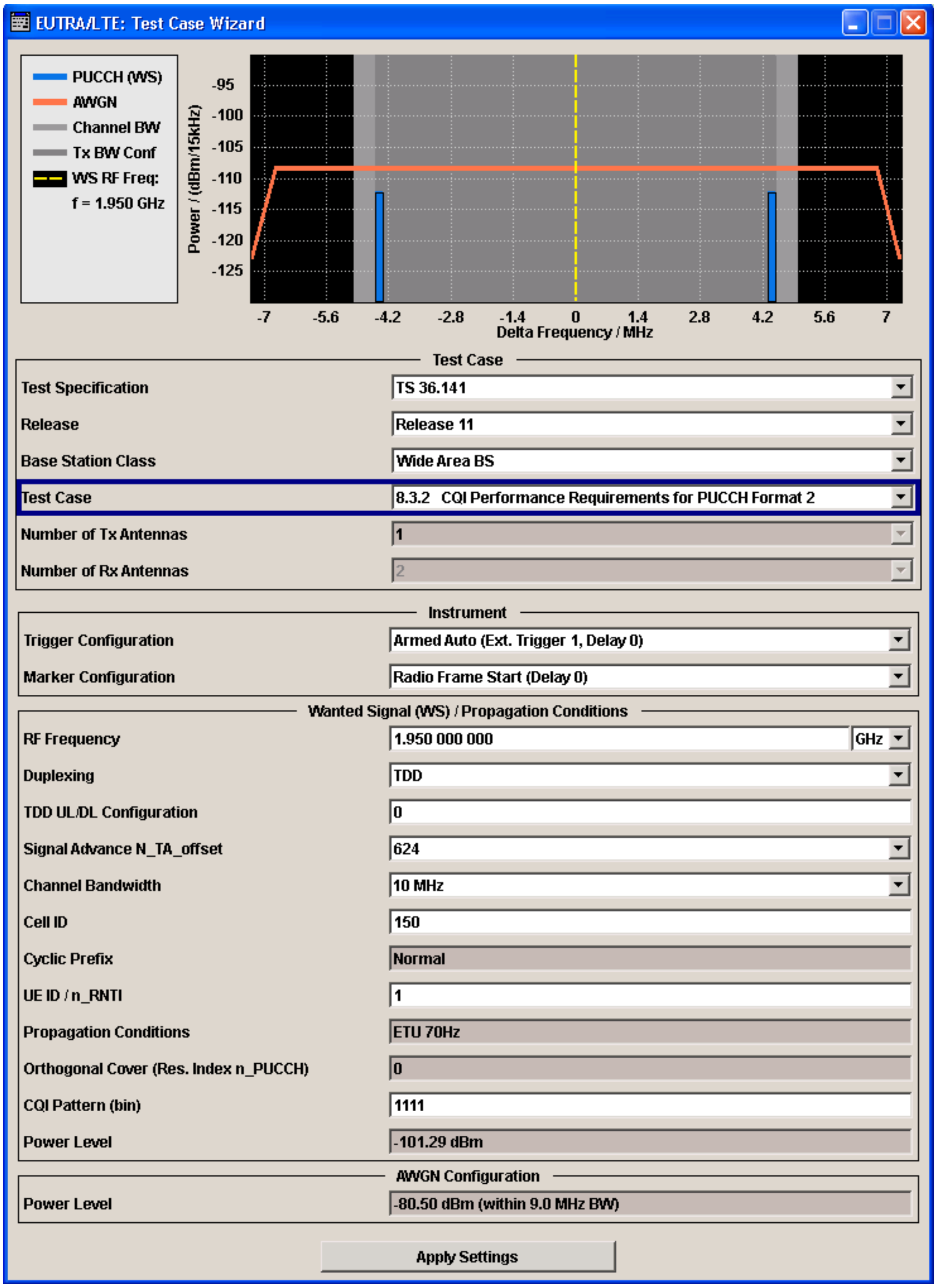
See Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316 (HARQ feedback line is not required).

Short Description

The performance requirement of PUCCH for CQI is determined by the BLER probability of detection of CQI. The performance is measured by the required SNR at BLER equal to 1%.

Table 8-27: Required SNR for PUCCH format 2 demodulation tests

Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4 MHz	BW=3MHz	BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	ETU70	-3.3	-3.8	-3.6	-3.8	-3.8	-3.8



The settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 367 and "AWGN Configuration" on page 367.

8.9.9 Test Case 8.3.3: ACK missed detection for multi-user PUCCH format 1a

Test Purpose

The test shall verify the receiver's ability to detect ACK on the wanted signal at presence of three interfering signals under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

Two R&S SMU equipped with:

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
  AWGN options are not required in the second R&S SMU.
- Second Option Digital Standard EUTRA/LTE (R&S SMx-K55)
- 2 Options Fading Simulator, Fading Simulator Extension and MIMO (R&S SMU-B14/-B15/-K74)

Test Setup

The test setup requires two two-paths instruments, synchronized via a reference frequency (see Figure 8-13). The base station provides its frame trigger signal to the signal generators (input TRIGGER 1).

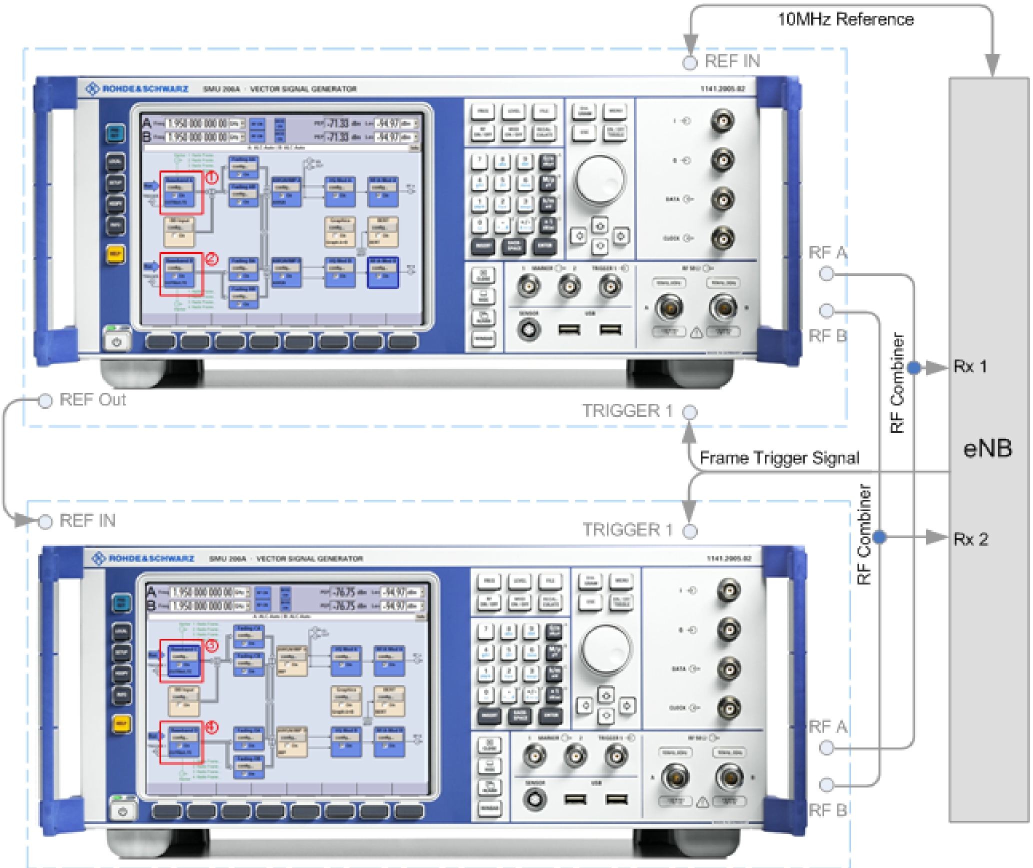


Figure 8-13: Test Setup for test case 8.3.3 "ACK missed detection for multi-user PUCCH format 1a"

1 = SMU#1: Baseband A generates the wanted UE signal
2 = SMU#1: Baseband B generates the interferer 1 signal
3 = SMU#2: Baseband A generates the interferer 2 signal
4 = SMU#2: Baseband B generates the interferer 3 signal

Short Description

The performance is measured on the wanted signal by the required SNR at probability of detection equal to or greater than 0.99. The probability of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

Multi-user PUCCH test is performed only for 2 Rx antennas, Normal CP and for ETU70 propagation conditions (see Table 8-28). ACK/NAK repetitions are disabled for PUCCH transmission.

Table 8-28: Required SNR for multi-user PUCCH demodulation tests

Number of RX antennas	Cyclic Prefix	Propagation Conditions	Chan. BW 1.4MHz	Chan. BW 3MHz	Chan. BW 5MHz	Chan. BW 10MHz	Chan. BW 15MHz	Chan. BW 20MHz
2	Normal	ETU70	-3.5	-3.8	-3.8	-4.0	-4.0	-3.8

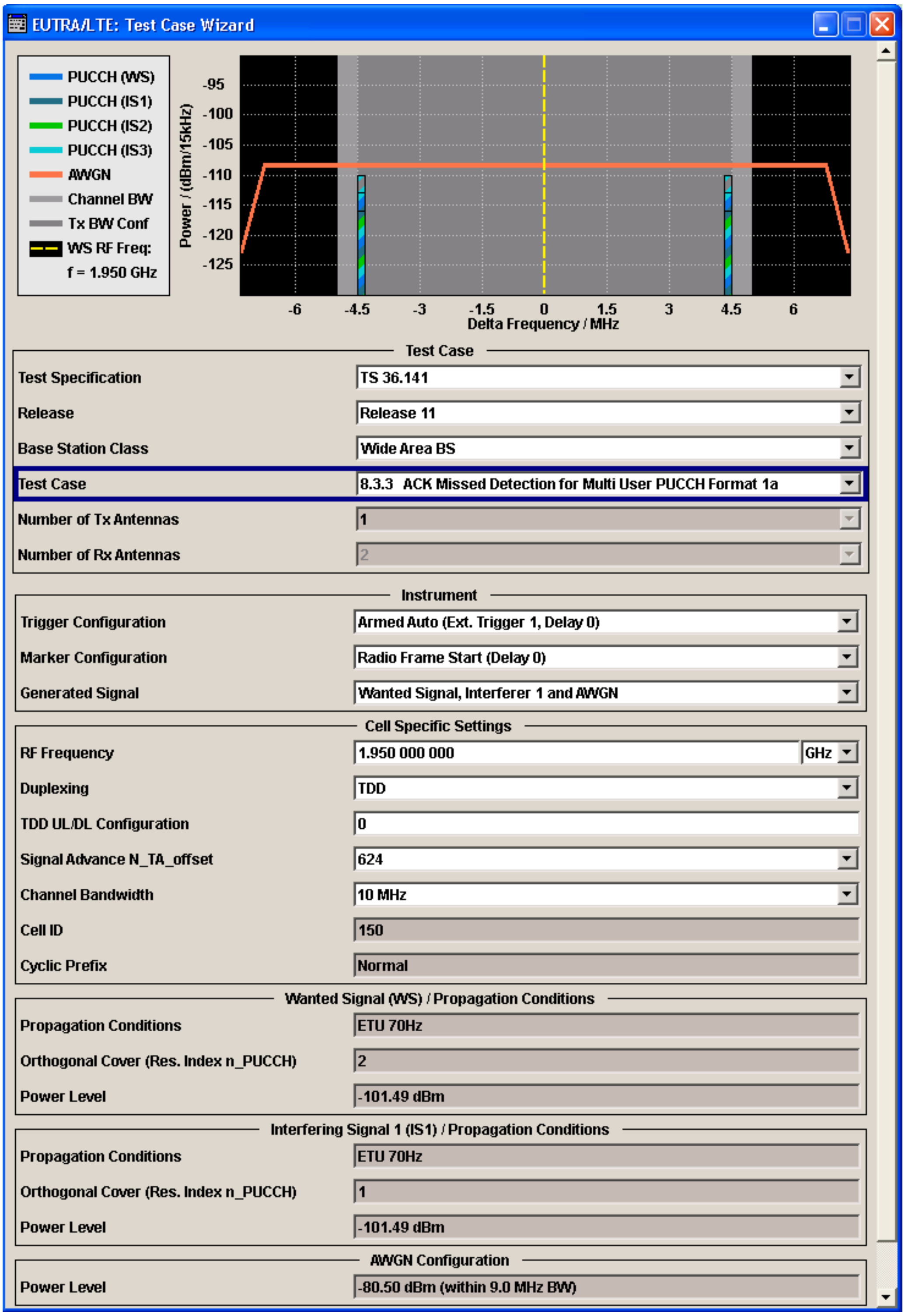
In multi-user PUCCH test, four signals are configured: one wanted signal and three interferers, which are transmitted via separate fading paths using relative power settings as defined in Table 8-29.

Table 8-29: Test parameters for multi-user PUCCH case

	Cyclic shift index (δ =0)	**Orthogonal cover index**	**RS orthogonal cover / ACK/NACK orthogonal cover**	**Relative power, dB**	**Relative timing, ns**
Tested signal	4	0	2	-	-
Interferer 1	2	0	1	0	0
Interferer 2	3	1	7	-3	0
Interferer 3	4	2	14	3	0

Presented resource index mapping for orthogonal cover and cyclic shift indices are for the first slot of the subframe. All above listed signals are transmitted on the same PUCCH resources, with different PUCCH channel indices as defined in Table 8-29.

In the multi-user PUCCH test, the Test Case Wizard also sets the "Number of Cyclic Shifts" for the mixed format resource block (N_cs^(1)) to 0 and the cyclic shift increment (Delta_shift^PUCCH) to 2, as specified in TS 36.141.



The common settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 367 and "AWGN Configuration" on page 367.

In the instrument, the power level of the interferer 3 is used as a reference, i.e. the power level of the wanted signal and the interferer 1 is 3 dB lower and the power level of the interferer 2 is 6 dB lower than the reference.

Generated Signal

Determines which signals are generated by the instrument. The first R&S SMU should generate the "Wanted Signal, Interfer 1 and AWGN" signal and the second R&S SMU, the signal of "Interferers 2 and 3".

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:GENSignals on page 609

Propagation Conditions

Displays the propagation conditions of the interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:PRCOndition? on page 622
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:PRCOndition? on page 622
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:PRCOndition? on page 623

Orthogonal Cover (Res. Index n_PUCCH) / Orthogonal Cover (Res. Index n_PUCCH) Port 0/1

Displays the used resource index n_PUCCH.

The value is set automatically according to the RS orthogonal cover in Table 8-29.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover? on page 621
[:SOURce<hw>]:BB:EUTRa:TCW:IS:ORTCover? on page 621
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:ORTCover? on page 621
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:ORTCover? on page 621
[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover[:PORT<ch0>]? on page 621

Interferer Type

Displays the type of the interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:IFTYpe? on page 612

RF Frequency

Displays the center frequency of interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:RFFRequency on page 614

Power Level

Displays the power level of the interfering signals.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:PLEVel? on page 614
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:PLEVel? on page 614

8.9.10 Test Case 8.3.4: ACK missed detection for PUCCH format 1b, channel selection

Test Purpose

The test shall verify the receiver's ability to detect ACK bits under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- Second Option Digital Standard EUTRA/LTE (R&S SMx-K55)
- 2 Options Fading Simulator, Fading Simulator Extension and MIMO (R&S SMU-B14/-B15/-K74)

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test Setup - Four Rx Antennas", on page 317 (HARQ feedback line is not required).

This test case is applicable to all BS.

The instrument generates a signal with 4 encoded ACK/NACK bits per subframe (AAAA).

Short Description

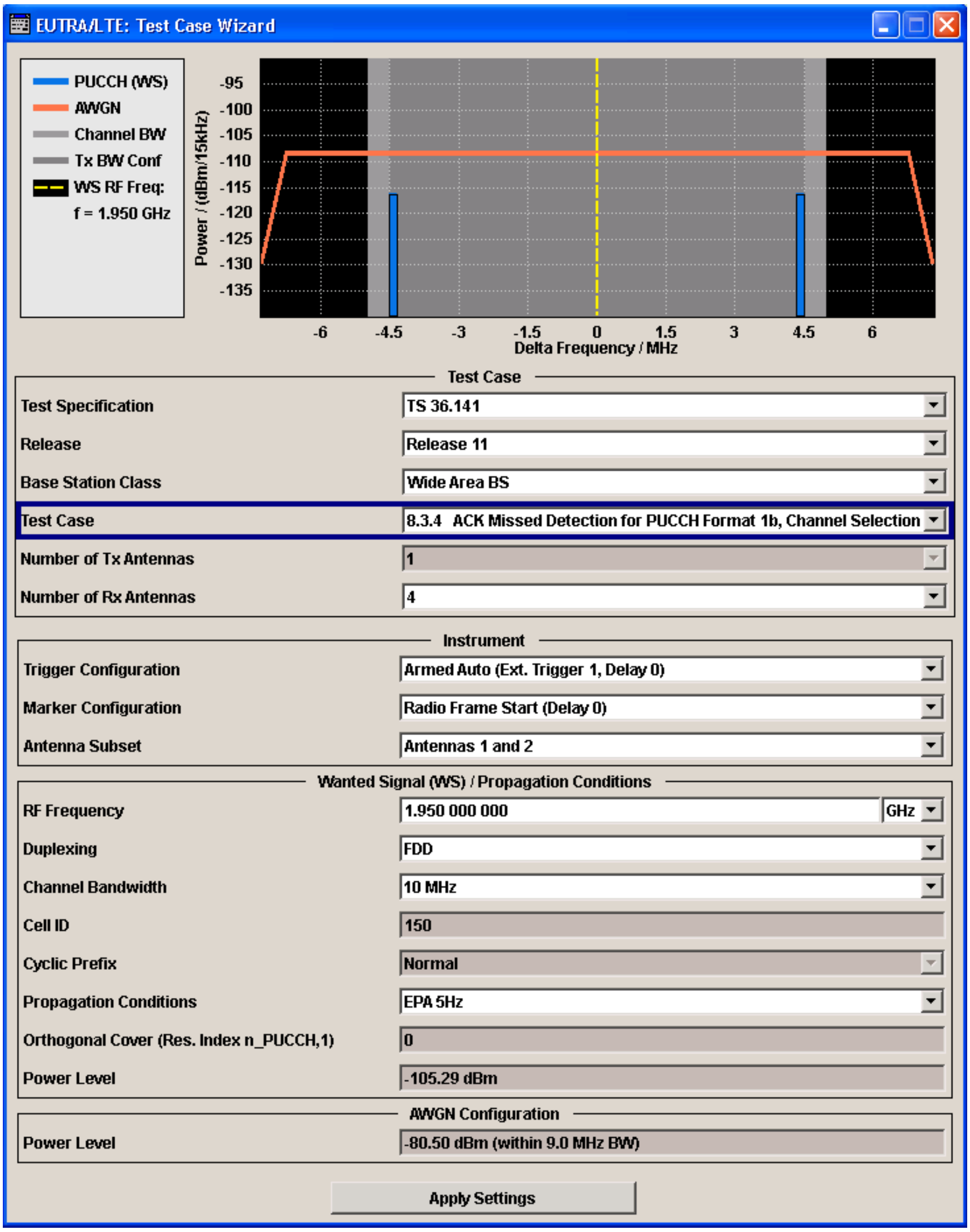
The performance requirement of PUCCH format 1b with Channel Selection for ACK missed detection is determined by:

- The probability of false detection of the ACK
- The probability of detection of ACK

The performance is measured on the wanted signal by the required SNR at probability of detection equal to 0.99. The fraction of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

Table 8-30: Required SNR for PUCCH format 1b with channel Selection demodulation tests (Number of Tx antennas = 1)

Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz BW=3MHz BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5 Low	-	-3.9	-4.0	-4.0
	Normal	EVA 70 Low	-	-3.7	-3.9	-3.9
4	Normal	EPA 5 Low	-	-7.8	-7.9	-8.0
	Normal	EVA 70 Low	-	-7.7	-7.9	-7.9



The common settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 367 and "AWGN Configuration" on page 367.

8.9.11 Test Case 8.3.5: ACK missed detection for PUCCH format 3

Test Purpose

The test shall verify the receiver's ability to detect ACK bits under codeword's from applicable codebook being randomly selected, multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- Option Digital Standard EUTRA/LTE Release 10 (LTE-Advanced) (R&S SMx/AMU-K85)
- 2 Options Fading Simulator, Fading Simulator Extension and MIMO (R&S SMU-B14/-B15/-K74)

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test Setup - Four Rx Antennas", on page 317 (HARQ feedback line is not required).

This test case is applicable to all BS.

The instrument generates the required signal with 4 or 16 encoded ACK/NACK bits (AN bits) per subframe, as defined with the parameter Number of ACK/NACK bits.

ACK/NACK repetition is disabled for PUCCH transmission. Random codewords selection is assumed.

Short Description

The performance requirement of PUCCH format 3 for ACK missed detection is determined by:

- The probability of false detection of the ACK
- The probability of detection of ACK

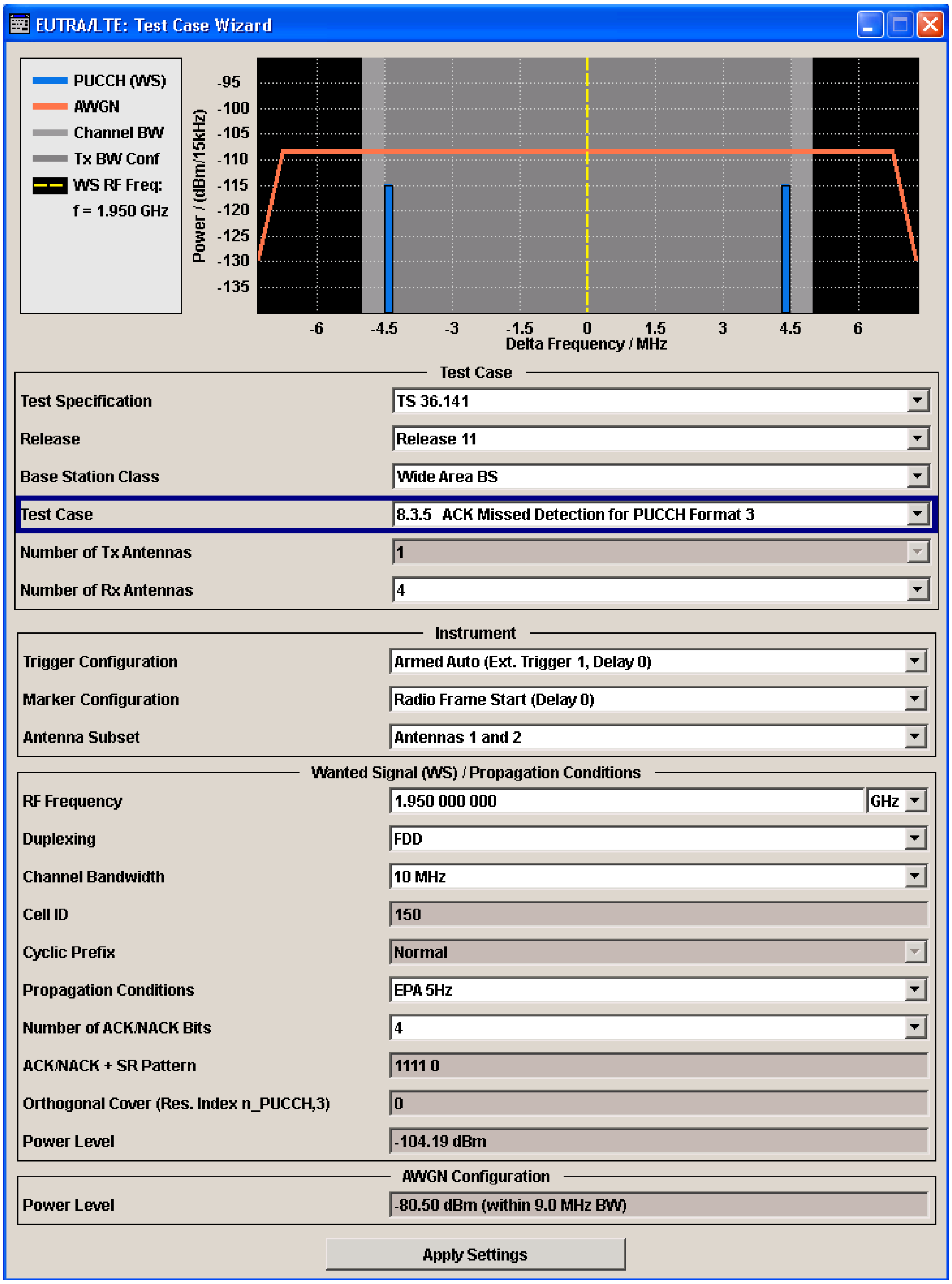
The performance is measured on the wanted signal by the required SNR at probability of detection equal to 0.99. The fraction of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

Table 8-31: Required SNR for PUCCH format 3 demodulation tests, 4AN bits (Number of Tx antennas = 1)

Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz BW=3MHz BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5 Low	-	-3.1	-3.2	-3.2
	Normal	EVA 70 Low	-	-2.9	-3.0	-3.1
4	Normal	EPA 5 Low	-	-6.7	-6.8	-6.9
	Normal	EVA 70 Low	-	-6.6	-6.7	-6.7

Table 8-32: Required SNR for PUCCH format 3 demodulation tests, 16AN bits (Number of Tx antennas = 1)

Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz BW=3MHz BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5 Low	-	-0.7	-0.6	-0.6
	Normal	EVA 70 Low	-	-0.2	-0.3	-0.3
4	Normal	EPA 5 Low	-	-4.7	-4.7	-4.8
	Normal	EVA 70 Low	-	-4.4	-4.5	-4.5



The common settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 367 and "AWGN Configuration" on page 367.

Number of ACK/NACK bits

Determines the number of encoded AN bits per subframe.

"4"	Applicable for TDD and FDD (see Duplexing)
"16"	Applicable for TDD

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:ANBits` on page 618

ACK/NACK + SR Pattern
Displays the used ACK/NACK + SR pattern, depending on the selected Number of ACK/NACK bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:ANPattern?` on page 618

8.9.12 Test Case 8.3.6: NACK to ACK detection for PUCCH format 3

Test Purpose

The test shall verify the receiver’s ability not to falsely detect NACK bits, transmitted in codeword randomly selected from applicable codebook, as ACK bits under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- Second Option Digital Standard EUTRA/LTE (R&S SMx-K55)
- 2 Options Fading Simulator, Fading Simulator Extension and MIMO (R&S SMU-B14/-B15/-K74)

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test Setup - Four Rx Antennas", on page 317 (HARQ feedback line is not required).

This test case is applicable to all BS.

The instrument generates the required signal with 16 encoded ACK/NACK bits (AN bits) per subframe.

ACK/NACK repetition is disabled for PUCCH transmission. Random codewords selection is assumed.

Short Description

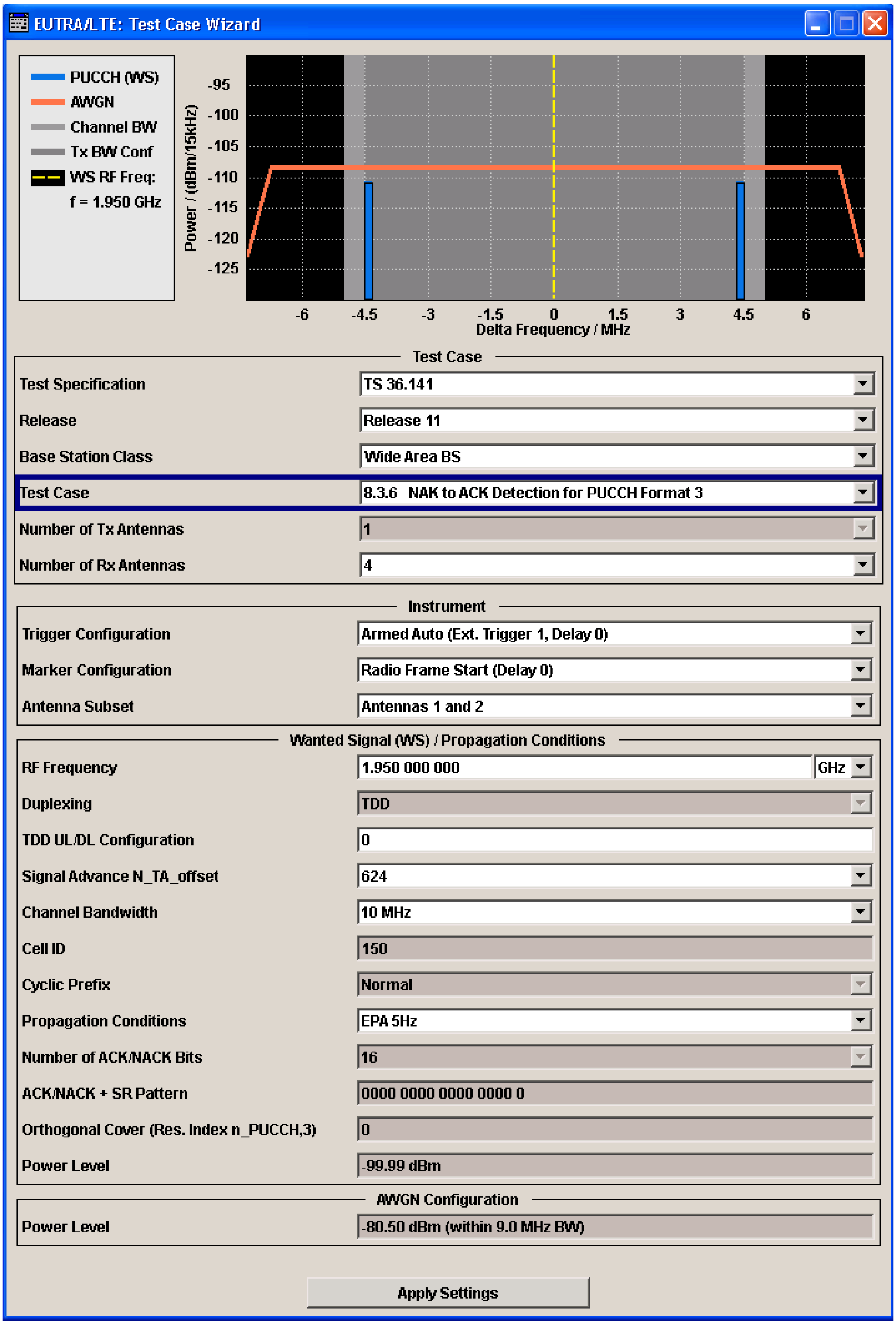
The performance requirement of PUCCH format 3 for NACK to ACK detection is determined by:

- The probability of false detection of the ACK
- The probability of detection of ACK

The performance is measured on the wanted signal by the required SNR at probability of detection equal to 0.99. The fraction of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

Table 8-33: Required SNR for PUCCH format 3 demodulation tests, 16AN bits (Number of Tx antennas = 1)

Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz BW=3MHz BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5 Low	-	2.0	2.2	-2.1
	Normal	EVA 70 Low	-	2.7	2.5	-2.5
4	Normal	EPA 5 Low	-	-2.5	-2.7	-2.9
	Normal	EVA 70 Low	-	-2.3	-2.5	-2.6



The common settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 367 and "AWGN Configuration" on page 367.

8.9.13 Test Case 8.3.7: ACK missed detection for PUCCH format 1a transmission on two antenna ports

Test Purpose

The test shall verify the receiver's ability to detect ACK on the wanted signal at presence of three interfering signals under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

Two R&S SMU equipped with:

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- Second Option Digital Standard EUTRA/LTE (R&S SMU-K55)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
  AWGN options are not required in the second R&S SMU.
- 2 Options Fading Simulator, Fading Simulator Extension and MIMO (R&S SMU-B14/-B15/-K74)

Test Setup

The test setup requires two two-paths instruments, synchronized via a reference frequency (see Figure 8-13). The base station provides its frame trigger signal to the signal generators (input TRIGGER 1).

Short Description

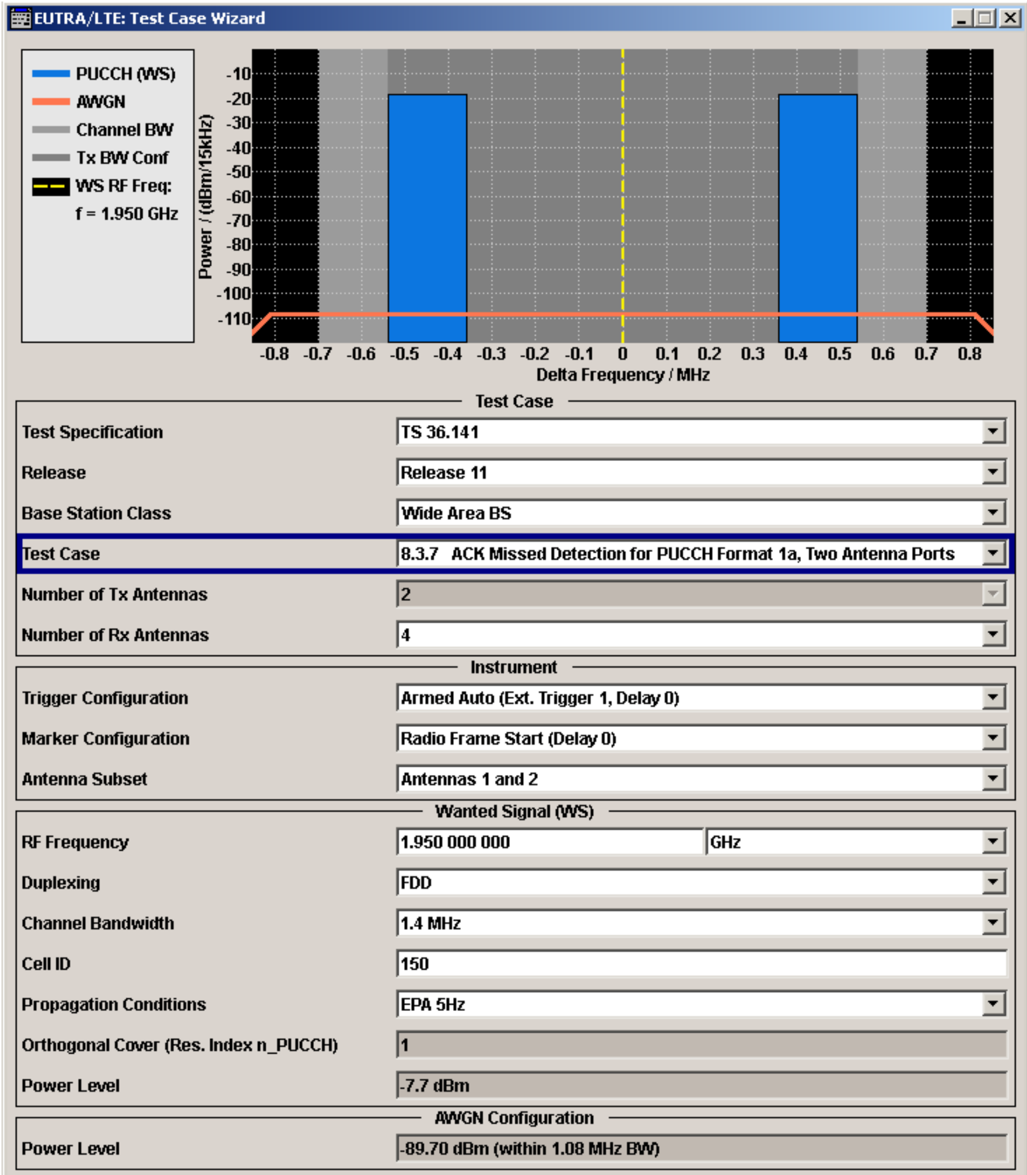
The performance is measured on the wanted signal by the required SNR at probability of detection equal to or greater than 0.99. The probability of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

Multi-user PUCCH test is performed for 2 and 4 Rx antennas and Normal CP (see Table 8-28). ACK/NAK repetitions are disabled for PUCCH transmission.

Table 8-34: Required SNR for multi-user PUCCH demodulation tests

Number of RX antennas	Cyclic Prefix	Propagation Conditions	Chan. BW 1.4MHz	Chan. BW 3MHz	Chan. BW 5MHz	Chan. BW 10MHz	Chan. BW 15MHz	Chan. BW 20MHz
2	Normal	EPA 5	-3.8	-4.1	-5.6	-5.7	-5.7	-5.9
		ETU70	-5.0	-5.1	-5.6	-5.1	-5.6	-5.6

Number of RX antennas	Cyclic Prefix	Propagation Conditions	Chan. BW 1.4MHz	Chan. BW 3MHz	Chan. BW 5MHz	Chan. BW 10MHz	Chan. BW 15MHz	Chan. BW 20MHz
4	Normal	EPA 5	-7.7	-7.7	-8.5	-8.7	-8.7	-8.7
		ETU70	-8.2	-8.4	-8.5	-8.5	-8.6	-8.7



8.9.14 Test Case 8.3.8: CQI performance requirements for PUCCH format 2 transmission on two antenna ports

Test Purpose

The test shall verify the receiver's ability to detect CQI under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- Second Option Digital Standard EUTRA/LTE (R&S SMU-K55)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- 2 Options Fading Simulator, Fading Simulator Extension and MIMO (R&S SMU-B14/-B15/-K74)

Test Setup

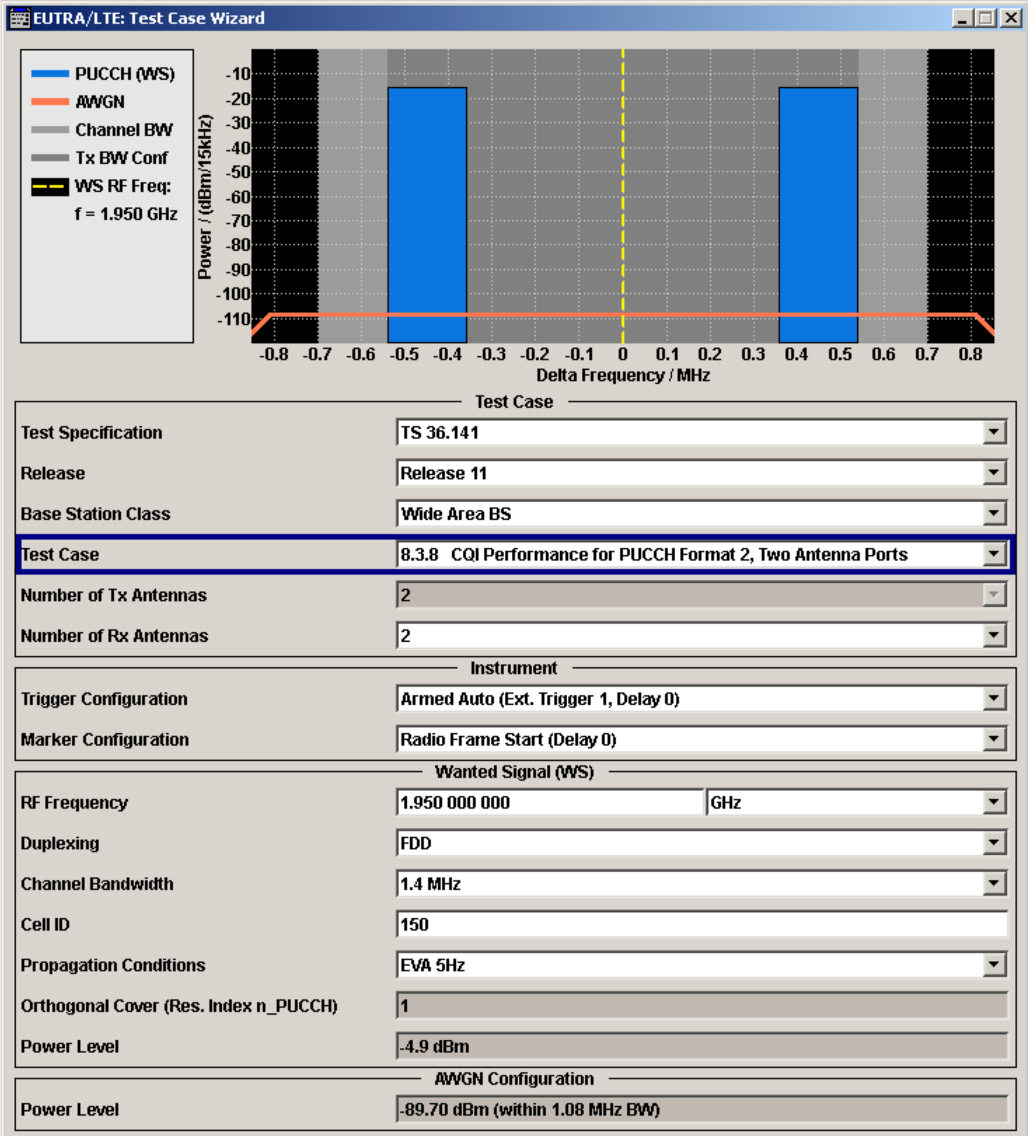
See Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316 (HARQ feedback line is not required).

Short Description

The performance requirement of PUCCH format 2 for CQI is determined by the block error probability (BLER) of CQI. The performance is measured by the required SNR at BLER equal to 1%.

Table 8-35: Required SNR for PUCCH format 2 demodulation tests

Number of TX antennas	Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz	BW=3 MHz	BW=5 MHz	BW=10 MHz	BW=15 MHz	BW=20 MHz
2	2	Normal	EVA 5 Low	-4.9	-4.8	-5.1	-5.0	-5.1	-5.1



8.9.15 Test Case 8.3.9: CQI performance for PUCCH format 2 with DTX detection

Test Purpose

The test shall verify the receiver's ability to detect CQI under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)

- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- Second Option Digital Standard EUTRA/LTE (R&S SMx-K55)
- 2 Options Fading Simulator, Fading Simulator Extension and MIMO (R&S SMU-B14/-B15/-K74)

Test Setup

The test setup is performed according to the standard setup, see Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316 (HARQ feedback line is not required).

This test case is optional and applicable to a BS supporting PUCCH format 2 with DTX.

Short Description

The performance requirement of PUCCH format 2 for CQI detection is determined by the block error probability (BLER) of CQI.

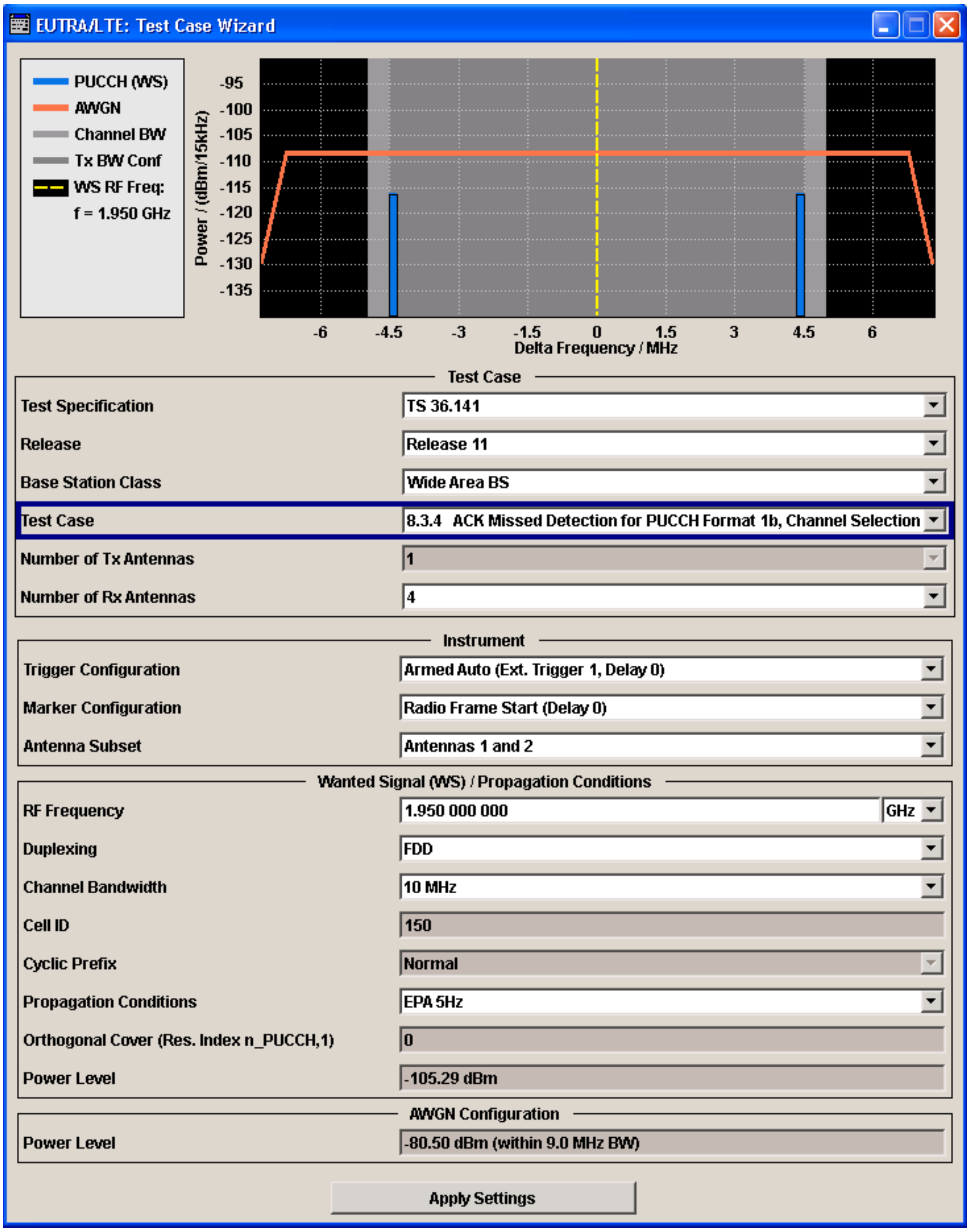
The performance is measured on the wanted signal by the required SNR at BLER of 1%.

Table 8-36: Required SNR for PUCCH format 2 demodulation tests with DTX detection (Number of Rx antennas = 2)

Number of TX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4 MHz	BW=3MHz	BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
1	Normal	EVA 5* Low	-3.1	-3.4	-3.8	-3.4	-3.6	-3.6
		ETU 70** Low	-3.1	-3.4	-3.2	-3.5	-3.3	-3.5
2		EVA 5 Low	-4.5	-4.4	-4.7	-4.6	-4.5	-4.7

*) Not applicable for Wide Area BS and Medium Range BS

**) Not applicable for Local Area BS and Home BS



The common settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 367 and "AWGN Configuration" on page 367.

Orthogonal Cover (Res. Index n_PUCCH) Port 0/1

Displays the used resource index n_PUCCH for port 0 and port 1 respectively.

The number of ports is determined by the selected Number of Tx Antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover[:PORT<ch0>]?` on page 621

CQI Pattern Port 0/1 (bin)
Sets the CQI pattern per enabled port.

The number of ports is determined by the selected Number of Tx Antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:CQIPattern:PORT<ch0>` on page 619

8.9.16 Test Case 8.4.1: PRACH false alarm probability and missed detection

Test Purpose

The test shall verify the receiver's ability to detect PRACH preamble under multipath fading propagation conditions for a given SNR (TS 36.141)

Required Options

- See Chapter 8.2, "Basic Configuration", on page 312.
- Second Option Baseband Main Module (R&S SMU-B13)
- Frequency Options (R&S SMU-B20x: RF 100kHz - x GHz)
- 2 Options Additive White Gaussian Noise AWGN (R&S SMU-K62)
- 2 Options Fading Simulator and Fading Simulator Extension (R&S SMU-B14/-B15)

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test Setup - Diversity Measurements", on page 316 (HARQ feedback line is not required).

The test setup with four Rx antennas requires two two-paths instruments and is performed according to Chapter 8.4.4, "Test Setup - Four Rx Antennas", on page 317 (HARQ feedback line is not required).

Short Description

The performance is measured by the total probability of false detection of the preamble (Pfa) and the probability of detection of preamble (Pd). For the SNRs defined in Table 8-37 and Table 8-38, the Pd shall be 99% or greater, Pfa shall be 0.1% or less. The statistics are kept by the base station under test. Ten preambles have to be transmitted.

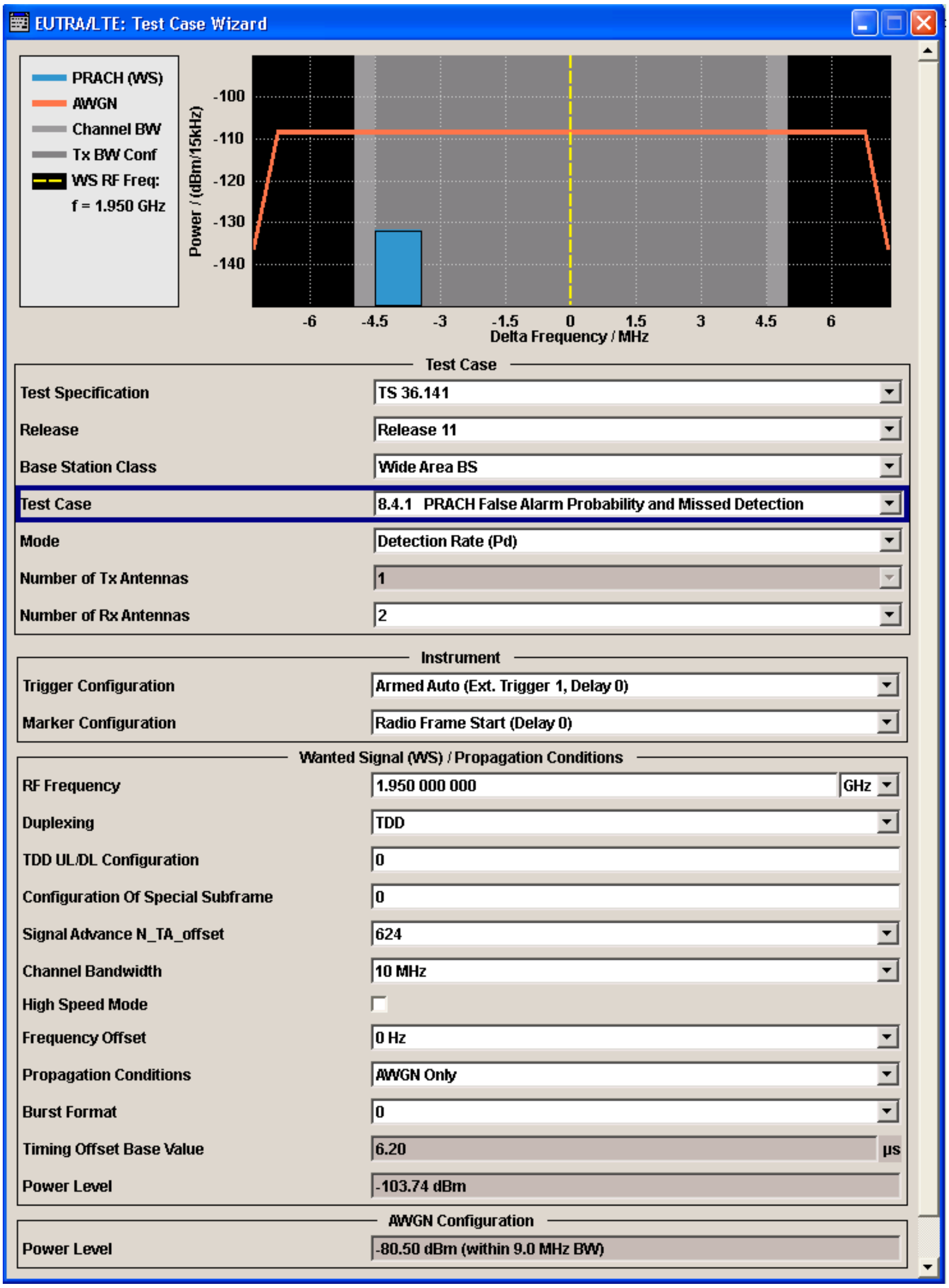
The normal mode test is applicable to all BS. The high-speed mode test is applicable to high-speed BS.

Table 8-37: PRACH missed detection test requirements for Normal Mode; the SNR [dB] is given per burst format

Number of RX antennas	Propagation conditions	Frequency offset, Hz	Burst format 0	Burst format 1	Burst format 2	Burst format 3	Burst format 4
2	AWGN	0	-13.9	-13.9	-16.1	-16.2	-6.9
	ETU 70	270	-7.4	-7.2	-9.4	-9.5	0.5
4	AWGN	0	-16.6	-16.4	-18.7	-18.5	-9.5
	ETU 70	270	-11.5	-11.1	-13.5	-13.3	-4.5

Table 8-38: PRACH missed detection test requirements for High-speed Mode; the SNR [dB] is given per burst format

Number of RX antennas	Propagation conditions	Frequency offset, Hz	Burst format 0	Burst format 1	Burst format 2	Burst format 3
2	AWGN	0	-13.8	-13.9	-16.0	-16.3
	ETU 70	270	-6.8	-6.7	-8.7	-8.9
	AWGN	625	-12.1	-12.0	-14.1	-14.1
	AWGN	1340	-13.1	-13.2	-15.2	-15.4
4	AWGN	0	-16.6	-16.3	-18.6	-18.5
	ETU 70	270	-11.2	-10.8	-13.1	-13.1
	AWGN	625	-14.6	-14.3	-16.5	-16.5
	AWGN	1340	-15.6	-15.2	-17.5	-17.5



The common settings of the wanted signal are described in Chapter 8.6.3, "Wanted Signal and Cell-Specific Settings", on page 326.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 367 and "AWGN Configuration" on page 367.

For detailed description of all available PRACH settings and the cross-reference between them, refer to Chapter 7.15.10, "PRACH Configuration", on page 269.

Mode

Determines the measurements type, Pfa or Pd, the signal is generated for.

In "Detection Rate (Pd)" and "Alternating Pd and Pfa" mode, the generated sequence is repeated cyclically. The first preamble is offset with start offset determined by Timing Offset Base Value. From preamble to preamble, the timing offset ("Delta t") of the preambles is increased by 0.1 us.

"False Detection Rate (Pfa)"	The generated signal is a noise like AWGN signal. This mode is intended for measurement of the total probability of false detection of the preamble (Pfa).
"Detection Rate (Pd)"	The generated signal is a sequence of 10 preamble and noise. The duration of one single sequence is 5 frames in FDD and 10 frames in TDD duplexing mode. This mode is intended for measurement of the probability of detection of preamble (Pd).
"Alternating Pd and Pfa"	The generated signal is a sequence of 10 enabled and 10 disabled preambles; during the latest only noise is transmitted. The duration of one single sequence is 10 FDD frames and 20 TDD frames. This mode is intended for measuring both the probability of detection of preamble (Pd) and the probability of false detection of the preamble (Pfa) in one run.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:MODE` on page 609

Configuration of Special Subframe

(enabled for TDD duplexing mode only)

Sets the Special Subframe Configuration number (see also Chapter 3.1.1, "OFDMA Parameterization", on page 18).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:SPSFrame` on page 623

High Speed Mode

Enables a high-speed mode (restricted preamble set) or the normal mode (unrestricted preamble set).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:HSMode` on page 621

Frequency Offset

Sets the frequency offset, as defined in Table 8-37 and Table 8-38.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:FROFfset` on page 620

Burst Format

Sets the burst format (see also "Preamble Format (Burst Format)" on page 270).

Burst format 4 is enabled only for TDD duplexing mode, special subframe configurations 5 to 8 and disabled high-speed mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:BFORmat` on page 619

Timing Offset Base Value

The timing offset base value is set to 50% of the Ncs. This value determines the start timing offset of the first preamble. From preamble to preamble, the timing offset ("Delta t") of the preambles is increased by 0.1 us and this sequence of timing offsets is restarted after 10 preambles.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:TIOBase?` on page 623

9 Remote-Control Commands

The following commands are required to perform signal generation with the EUTRA/LTE options in a remote environment. We assume that the R&S Signal Generator has already been set up for remote operation in a network as described in the R&S Signal Generator 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 Signal Generator operating manual.

This subsystem contains commands for the primary and general settings of the EUTRA/LTE standard. These settings concern activation of the standard, setting the transmission direction, filter, clock, trigger and clipping settings, defining the frame configuration and the sequence length, as well as the preset setting.

The commands for defining the frame configuration for physical layer mode OFDMA and SC-FDMA are described in the next sections. The commands are divided up in this way to make the comprehensive `SOURce:BB:EUTRa` subsystem clearer.

Common Suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`SOURce<hw>`	[1]|2	available baseband signals
`OUTPut<ch>`	1 .. 4	available markers R&S SMBV supports two markers
`EXTernal<ch>`	1|2	external trigger connectors
`SUBF<st0>`	• in DL 0 to 39 • in UL 0 to 199	subfame number The maximum value depends on the selected sequence length, see `[:SOURce<hw>]:BB:EUTRa:SLENgth`.
`ALLoc<ch0>`	• in DL – for subframes with PBCH, i.e. `SUBF0`, `SUBF10`, `SUBF20` and `SUBF30`: `<ch0>` = 0 to 111 – for all other subframes: `<ch0>` = 0 to 110 • in UL 0 to 3 where 0 refers to UE1	• allocation number • allocation number (user equipment number)

`CELL<ch0>`
`CELL<st0>`
`CELL<dir>`
`CELL<ccidx>`
	0 to 4	component carrier

Suffix	Value range	Description
CW<user> CW<cw> <cwid>	1 | 2	codeword
ITEM<ch0>	0 to 19	number of rows in the DCI table
UE<st>	[1]|2|3|4	user equipment (UL)
USER<ch>	1|2|3|4	DL user
PMCH<ch0>	0 to 15	PM channel number

Placeholder <root>

For commands that read out or save files in the default directory, the default directory is set using command MMEM:CDIRectory. The examples in this description use the place holder <root> in the syntax of the command.

- D:\ - for selecting the internal hard disk of a Windows instrument
- E:\ - for selecting the memory stick which is inserted at the USB interface of a Windows instrument
- /var/user/ - for selecting the internal flash card of a Linux instrument
- /usb/ - for selecting the memory stick which is inserted at the USB interface of a Linux instrument.

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 Signal Generator operating manual.

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.

The following commands specific to the EUTRA/LTE standard are described here:

9.1 Primary Commands

[:SOURce<hw>]:BB:EUTRa:STATe <State>

Activates the standard and deactivates all the other digital standards and digital modulation modes in the same path.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: SOURce1:BB:EUTRa:STATe ON

Manual operation: See "State" on page 82

[:SOURce<hw>]:BB:EUTRa:DUPLexing <Duplexing>

Selects the duplexing mode. The duplexing mode determines how the uplink and downlink signal are separated.

Parameters:

<Duplexing> TDD | FDD

TDD
The same frequency is used for both directions of transmission (uplink and downlink). With one baseband, either only downlink or only uplink signals can be generated.

FDD
Different frequencies are used for downlink and uplink directions.

*RST: FDD

Example: `BB:EUTR:DUPL FDD`
selects frequency division duplexing.

Manual operation: See "Duplexing" on page 84

[:SOURce<hw>]:BB:EUTRa:LINK <Link>

Defines the transmission direction. The signal either corresponds to that of a base station (`DOWN`) or that of a subscriber station (`UP`).

Parameters:

<Link> DOWN | UP

*RST: DOWN

Example: `BB:EUTR:LINK DOWN`
the transmission direction selected is base station to subscriber station. The signal corresponds to that of a base station.

Manual operation: See "Link Direction" on page 85

[:SOURce<hw>]:BB:EUTRa:PRESet

Sets the parameters of the digital standard to their default values (`*RST` values specified for the commands).

Not affected is the state set with the command `SOURce<hw>:BB:EUTRa:STATe`.

Example: `SOURce1:BB:EUTRa:PRESet`

Manual operation: See "Set to Default" on page 82

[:SOURce<hw>]:BB:EUTRa:SETTing:CATalog <Catalog>

This command reads out the files with EUTRA/LTE settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension `*.eutra` will be listed.

Parameters:

<Catalog> string

Example: `MMEM:CDIR '<root>eutra'`
sets the default directory to `<root>eutra`.
`BB:EUTR:SETT:CAT?`
reads out all the files with EUTRA/LTE settings in the default directory.
`Response:'eutra1','eutra2'`
the files `eutra1` and `eutra2` are available.

Manual operation: See "Save/Recall..." on page 82

[:SOURce<hw>]:BB:EUTRa:SETTing:DEL <Filename>

Deletes the selected file with EUTRA/LTE settings. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension `*.eutra` will be deleted.

Setting parameters:
<Filename> <file name>

Example: `BB:EUTR:SETT:DEL 'eutra_1'`
deletes file `eutra_1`.

Usage: Setting only

Manual operation: See "Save/Recall..." on page 82

[:SOURce<hw>]:BB:EUTRa:SETTing:LOAD <Filename>

Loads the selected file with EUTRA/LTE settings. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension `*.eutra` will be loaded.

Parameters:
<Filename> string

Example: `BB:EUTR:SETT:LOAD 'eutra_1'`
loads file `eutra_1`.

Manual operation: See "Save/Recall..." on page 82

[:SOURce<hw>]:BB:EUTRa:SETTing:STORe <Filename>

Stores the current EUTRA/LTE settings into the selected 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. Only the file name has to be entered. EUTRA/LTE settings are stored as files with the specific file extension `*.eutra`.

Parameters:
<Filename> string

Example: `BB:EUTR:SETT:STOR 'eutra_1'`
stores the current settings into file `eutra_1`.

Manual operation: See "Save/Recall..." on page 82

[:SOURce<hw>]:BB:EUTRa:SETTing:STORe:FAST <State>

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:

<State> 0 | 1 | OFF | ON

*RST: ON

Manual operation: See "Save/Recall..." on page 82

[:SOURce<hw>]:BB:EUTRa:SETTing:TMOD:TDD <Tdd>
[:SOURce<hw>]:BB:EUTRa:SETTing:TMOD:DL <Filename>

The command selects an EUTRA test model (E-TM) defined by the standard for the downlink.

Parameters:

<Filename> <test_model_name>

Example: `BB:EUTR:SETT:TMOD:DL 'E-TM1_1__20MHz'`
selects the test model.

Manual operation: See "EUTRA Test Models (E-TM) Downlink" on page 102

[:SOURce<hw>]:BB:EUTRa:SLENgth <SLength>

Sets the sequence length of the signal in number of frames. The signal is calculated in advance and output in the arbitrary waveform generator. The maximum number of frames is calculated as follows:

Max. No. of Frames = Arbitrary waveform memory size/(sampling rate x 10 ms).

Parameters:

<SLength> integer

Range: 1 to dynamic
*RST: 1

Example: `BB:EUTR:SLEN 4`
selects the generation of 4 frames.

Manual operation: See "Sequence Length" on page 85

[:SOURce<hw>]:BB:EUTRa:WAVeform:CREate <Filename>

Creates a waveform using the current settings of the "EUTRA/LTE" dialog. The file is stored with the predefined file extension `*.wv`. The file name and the directory it is stored in are user-definable.

Note: Even for enabled Realtime Feedback, the waveform file is generated as if this functionality is disabled.

Note: The sequence length of the generated ARB file is determined by the selected SFN restart period (`[:SOURce<hw>]:BB:EUTRa:DL:PBCH:SRPeriod`).

Setting parameters:

<Filename> string

Example: `MMEM:CDIR '<root>waveform'`
sets the default directory to `<root>waveform`.
`BB:EUTR:WAV:CRE 'eutra_1'`
creates the waveform file `eutra_1.wv` in the default directory.

Usage: Setting only

Manual operation: See "Generate Waveform File…" on page 84

[:SOURce]:BB:EUTRa:VERSion?

The command queries the version of the 3GPP standard underlying the definitions.

Return values:

<Version> string

Example: `BB:EUTR:VERS?`
queries the 3GPP version.

Usage: Query only

Manual operation: See "3GPP Version" on page 84

9.2 Filter/Clipping/Power Settings

9.2.1 Filter Settings

[:SOURce<hw>]:BB:EUTRa:FILTer:TYPE <Type>

Selects the baseband filter type.

Parameters:

<Type> RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | COFequalizer | C2K3x | RECTangle | PGAuss | LPASs | DIRac | ENPShape | EWPShape | LTEFilter | LPASSEVM | SPHase | APCO25 | USER

*RST: LTEFilter

Example: `SOURce1:BB:EUTRa:FILTer:TYPE COS`
sets the filter type.

Manual operation: See "Filter" on page 291

[:SOURce<hw>]:BB:EUTRa:FILTer:MODE <OptMode>

Selects an offline or realtime filter mode.

Parameters:

<OptMode> RTime | OFFLine

*RST: RTime

Example: `BB:EUTR:FILT:MODE RT`
selects real time filter mode.

Manual operation: See "Filter Mode" on page 294

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:APCO25 <Apco25>

Sets the roll-off factor for the APCO25 filter type.

Parameters:

<Apco25> float

Range: 0.05 to 0.99
Increment: 0.01
*RST: 0.2

Example: `BB:EUTR:FILT:PAR:APCO25 0.06`
the roll-off factor is set to 0.06.

Manual operation: See "Roll Off Factor or BxT" on page 292

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine <Cosine>

Sets the roll-off factor for the Cosine filter type.

Parameters:

<Cosine> float

Range: 0 to 1
Increment: 0.01
*RST: 0.1

Example: `BB:EUTR:FILT:PAR:COS 0.4`
the roll-off factor is set to 0.4.

Manual operation: See "Roll Off Factor or BxT" on page 292

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine:COFS <Cofs>

Sets the "cut of frequency shift" value for the Cosine filter type.

Parameters:

<Cofs> float

Range: -1 to 1
Increment: 0.01
*RST: -0.2

Example: `BB:EUTR:FILT:PAR:COS:COFS 0.04`
the "cut of frequency shift" value is set to 0.04.

Manual operation: See "Cut Off Frequency Shift" on page 293

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:GAUSs <Gauss>

Sets the BxT for the Gauss filter type (FSK).

Parameters:

<Gauss> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

Example: `BB:EUTR:FILT:PAR:GAUS 0.5`
the BxT is set to 0.5.

Manual operation: See "Roll Off Factor or BxT" on page 292

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASs <LPass>

Sets the cut off frequency factor for the Lowpass (ACP optimization) filter type.

Parameters:
<LPass> float

Range: 0.05 to 2
Increment: 0.01
*RST: 0.5

Example: `BB:EUTR:FILT:PAR:LPAS 0.5`
the cut of frequency factor is set to 0.5.

Manual operation: See "Cut Off Frequency Factor" on page 294

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASSEVM <CutoffFrequency>

Sets the cut off frequency factor for the Lowpass filter (EVM optimization) type.

Parameters:
<CutoffFrequency> float

Range: 0.05 to 2
Increment: 0.01
*RST: 0.29

Example: `BB:EUTR:FILT:PAR:LPASSEVM 0.5`
the cut of frequency factor is set to 0.5.

Manual operation: See "Cut Off Frequency Factor" on page 294

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFFactor <CutoffFactor>

Sets the cut off frequency factor for the LTE filter type.

Parameters:
<CutoffFactor> float

Range: 0.05 to 2
Increment: 0.01
*RST: 0.34

Example: `BB:EUTR:FILT:PAR:LTE:COFF 0.35`
the cut-off frequency factor is set to 0.35.

Manual operation: See "Cut Off Frequency Factor" on page 294

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFS <CutOffFreqShift>

Sets the "cut of frequency shift" value for the LTE filter type.

Parameters:
<CutOffFreqShift> float

Range: -1 to 1
Increment: 0.01
*RST: -0.2

Example: `BB:EUTR:FILT:PAR:LTE:COFS -0.3`
the cut-off frequency shift is set to -0.3.

Manual operation: See "Cut Off Frequency Shift" on page 293

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:OPTimization <Optimization>

Defines the applied EUTRA/LTE filter. Available are `EVM`, `ACP`, `ACPN` (ACP Narrow), `STD` (a trade\-off between ACP and EVM) and `BENU` (Best EVM, no upsampling).

Parameters:

<Optimization> STD | EVM | ACP | ACPN | BENU
*RST: EVM

Example: `BB:EUTR:FILT:PAR:LTE:OPT ACPN`
selects ACP (Narrow) optimization.

Manual operation: See "Optimization" on page 291

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:ROFactor <RollOffFactor>

Sets the roll-off factor for the LTE filter type.

Parameters:

<RollOffFactor> float
Range: 0 to 1
Increment: 0.01
*RST: 0.1

Example: `BB:EUTR:FILT:PAR:LTE:ROF 0.2`
the roll-off factor is set to 0.2.

Manual operation: See "Roll Off Factor or BxT" on page 292

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:PGAuss <PGauss>

Sets the BxT for the Gauss filter type (pure).

Parameters:

<PGauss> float
Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

Example: `BB:EUTR:FILT:PAR:PGA 0.5`
the BxT is set to 0.5.

Manual operation: See "Roll Off Factor or BxT" on page 292

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:RCOSine <RCosine>

Sets the roll-off factor for the Root Cosine filter type.

Parameters:

<RCosine> float

Range: 0 to 1
Increment: 0.01
*RST: 0.22

Example: `BB:EUTR:FILT:PAR:RCOS 0.4`
the roll-off factor is set to 0.4.

Manual operation: See "Roll Off Factor or BxT" on page 292

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:SPHase <SPhase>

Sets the BxT for the Split Phase filter type.

Parameters:

<SPhase> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 2

Example: `BB:EUTR:FILT:PAR:SPH 2`
the BxT is set to 2.0

Manual operation: See "Roll Off Factor or BxT" on page 292

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:USER <Filename>

The command selects the user-defined filter (`*.vaf`).

The directory applicable to the following command is defined with the command `MMEMory:CDIR`. To access the files in this directory, only the file name is required, without the path and the file extension.

Parameters:

<Filename> string

Example: `BB:EUTR:FILT:TYPE USER`
selects the User filter type.
`MMEM:CDIR '<root>Filter_List'`
selects the directory for the user-defined filters.
`BB:EUTR:FILT:PAR:USER eutra_user_filter`
selects the user-defined filter.

Manual operation: See "Load User Filter" on page 292

[:SOURce<hw>]:BB:EUTRa:SRATe:VARiation <Variation>

Enters the output sample rate.

A variation of this parameter only affects the ARB clock rate; all other signal parameters remain unchanged. If the sampling rate in the "General Settings" menu is changed, this parameter is reset to the chosen sampling rate.

Parameters:

<Variation> float

Range: 400 to 4E7
Increment: 0.001
*RST: 15.360000E6
Default unit: Hz

Example: `BB:EUTR:SRAT:VAR 400Hz`
sets the output sample rate to 400 Hz.

Manual operation: See "Sample Rate Variation " on page 294

9.2.2 Clipping Settings

[:SOURce<hw>]:BB:EUTRa:CLIPping:LEVel <Level>

Sets the limit for level clipping.

Parameters:

<Level> integer

Range: 1 to 100
*RST: 100

Example: `BB:EUTR:CLIP:LEV 80PCT`
sets the limit for level clipping to 80% of the maximum level.
`BB:EUTR:CLIP:STAT ON`
activates level clipping.

Manual operation: See "Clipping Level" on page 295

[:SOURce<hw>]:BB:EUTRa:CLIPping:MODE <Mode>

Sets the method for level clipping.

Parameters:

<Mode> VECTor | SCALar

VECTor
The reference level is the amplitude | i+jq |.

SCALar
The reference level is the absolute maximum of the I and Q values.

*RST: VECTor

Example:
`BB:EUTR:CLIP:MODE SCAL`
selects the absolute maximum of all the I and Q values as the reference level.
`BB:EUTR:CLIP:LEV 80PCT`
sets the limit for level clipping to 80% of this maximum level.
`BB:EUTR:CLIP:STAT ON`
activates level clipping.

Manual operation: See "Clipping Mode" on page 295

[:SOURce<hw>]:BB:EUTRa:CLIPping:STATe <State>

Activates level clipping (Clipping). The value is defined with the command `[SOURce:]BB:EUTRa:CLIPping:LEVel`, the mode of calculation with the command `[SOURce:]BB:EUTRa:CLIPping:MODE`.

Parameters:
<State> ON | OFF
*RST: 0

Example:
`BB:EUTR:CLIP:STAT ON`
activates level clipping.

Manual operation: See "Clipping State" on page 295

9.2.3 Time Domain Windowing Settings

[:SOURce<hw>]:BB:EUTRa:TDW:STATe <State>

Activates/deactivates the time domain windowing.

Parameters:
<State> ON | OFF
*RST: OFF

Example:
`BB:EUTR:TDW:STAT ON`
activates time domain windowing.

Manual operation: See "State (Time Domain Windowing)" on page 290

[:SOURce<hw>]:BB:EUTRa:TDW:TRTime <TransitionTime>

Sets the transition time when time domain windowing is active.

Parameters:
<TransitionTime> float
Range: 0 to 1E-5
Increment: 1E-7
*RST: 5E-6

Example:
`BB:EUTR:TDW:TDT 2us`
sets the transition time to 2us.

Manual operation: See "Transition Time" on page 290

9.2.4 Power Settings

[:SOURce<hw>]:BB:EUTRa:POWC:LEVReference <LevelReference>

Defines the reference the "Level" display in the status bar is referring to.

Parameters:

<LevelReference> FRMS | DRMS | URMS | UEBurst

FRMS
The displayed RMS and PEP are measured during the whole frame.
All frames are considered, not only the first one.

DRMS
The displayed RMS and PEP are measured during the DL part of the frame (all DL subframes and the DwPTS).
All frames are considered, not only the first one.

URMS
The displayed RMS and PEP are measured during the UL part of the frame (all UL subframes and the UpPTS).
All frames are considered, not only the first one.

UEBurst
The displayed RMS and PEP are measured during a single sub-frame of a certain UE.

*RST: FRMS

Example:
```
BB:EUTR:POWC:LEVR UEB
```
sets level reference to UE Burst RMS Power

Manual operation: See "Power Reference" on page 296

[:SOURce<hw>]:BB:EUTRa:POWC:ORTLevel <OffsRelatLevel>

Sets the power offset of the according baseband relative to the RMS level displayed in the instrument's global Level display in the header of the instrument.

Parameters:

<OffsRelatLevel> float

Range: -20 to 0
Increment: 0.001
*RST: 0

Example: `BB:EUTR:POWC:ORTL -1.0 dB`
sets the power offset of the baseband part

Manual operation: See "Power Offset Relative to Level Display" on page 296

[:SOURce<hw>]:BB:EUTRa:POWC:REFChannel <RefChannel>

Queries the channel type the measured RMS and PEP is referring to, if the Level Reference is set to "UE Burst RMS Power"

Parameters:
<RefChannel> NF | PUSCH | PUCCH | PRACH | SRS | PUCPUS
*RST: NF

Example: `BB:EUTR:POWC:LEVR UEB`
sets level reference to UE Burst RMS Power
`BB:EUTR:POWC:RUE?`
queries the channel type

Manual operation: See "Reference Channel" on page 297

[:SOURce<hw>]:BB:EUTRa:POWC:REFSubframe?

Queries the subframe the measured RMS and PEP is referring to, if the Level Reference is set to "UE Burst RMS Power"

Return values:
<RefSubframe> integer
Range: 0 to 39
*RST: 0

Example: `BB:EUTR:POWC:LEVR UEB`
sets level reference to UE Burst RMS Power
`BB:EUTR:POWC:REFS?`
queries the reference subframe

Usage: Query only

Manual operation: See "Reference Subframe" on page 297

[:SOURce<hw>]:BB:EUTRa:POWC:RUE?

Queries the UE the measured RMS and PEP is referring to, if the Level Reference is set to "UE Burst RMS Power".

Return values:
<ReferenceUe> UE1 | UE2 | UE3 | UE4
*RST: UE1

Example: `BB:EUTR:POWC:LEVR UEB`
sets level reference to UE Burst RMS Power
`BB:EUTR:POWC:RUE?`
queries the reference UE

Usage: Query only

Manual operation: See "Reference UE" on page 297

9.3 Clock Settings

This section lists the remote control commands, necessary to configure the clock.

The clock settings are available for R&S SMx and R&S AMU instruments only.

[:SOURce<hw>]:BB:EUTRa:CLOCk:MODE <Mode>

Enters the type of externally supplied clock.

Parameters:

<Mode> SAMPle | MSAMp | CUSTom

SAMPle
The sample clock is supplied via the clock connector.

MSAMp
A multiple of the clock is supplied and the clock is derived internally from it.

CUSTom
(not for R&S SMBV)
An external customer-specific clock is supplied via the clock connector. The sample clock is derived internally from it.
Note: Custom external clock source in baseband B is supported, if the following prerequisites are fulfilled: EUTRA/LTE is configured in both baseband blocks, and the clock source and clock mode settings are the same in both basebands.

*RST: SAMPle

Example: `SOURce1:BB:EUTRa:CLOCk:MODE SAMPle`

Manual operation: See "Clock Mode" on page 308

[:SOURce<hw>]:BB:EUTRa:CLOCk:CUSTom <Custom>

Specifies the sample clock for clock type Custom (`BB:EUTRa:CLOCk:MODE CUSTom`) in the case of an external clock source.

Note: Custom External Clock source in baseband B is only supported if baseband A is configured with EUTRA/LTE too. Furthermore the same settings for clock source and clock mode have to be set in baseband A and B. The user needs to take care of the correct settings.

Parameters:

<Custom> integer

Range: 25000 to 40E6
*RST: 38.4E6

Example: `BB:EUTR:CLOC:SOUR EXT`
selects an external clock reference.
`BB:EUTR:CLOC:MODE CUSTom`
selects clock type Custom.
`BB:EUTR:CLOC:CUSTom 38400000`
the custom external clock is 38.4MHz.

Manual operation: See "Custom External Clock" on page 308

[:SOURce<hw>]:BB:EUTRa:CLOCk:SOURce <Source>

Selects the clock source.

Parameters:

<Source> INTernal | EXTernal

INTernal
The internal clock reference is used.

EXTernal
The external clock reference is supplied to the CLOCK connector. The type of the external clock is specified with command `BB:EURA:CLOCk:MODE`

*RST: INTernal

Example: `BB:EUTR:CLOC:SOUR EXT`
selects an external clock reference. The clock is supplied via the CLOCK connector.
`BB:EUTR:CLOC:MODE SAMP`
specifies that a sample clock is supplied via the CLOCK connector:

Manual operation: See "Clock Source" on page 307

[:SOURce<hw>]:BB:EUTRa:CLOCk:MULTiplier <Multiplier>

Specifies the multiplier for clock type multiplied.

Parameters:

<Multiplier> integer

Range: 1 to 64
*RST: 4

Example: `SOURce1:BB:EUTRa:CLOCk:SOURce EXT`
`SOURce1:BB:EUTRa:CLOCk:MODE MSAMple`
selects clock type
`SOURce1:BB:EUTRa:CLOCk:MULTiplier 12`
the multiplier for the external clock rate is 12.

Manual operation: See "Clock Multiplier" on page 308

[:SOURce<hw>]:BB:EUTRa:CLOCk:SYNChronization:EXECute

For R&S SMBV only

Performs automatically adjustment of the instrument's settings required for the synchronization mode, set with the command `BB:EUTR:SYNC:MODE`.

Example: `BB:EUTR:CLOC:SYNC:MODE MAST`
the instrument is configured to work as a master one.
`BB:EUTR:CLOCK:SYNC:EXEC`
all synchronization's settings are adjusted accordingly.

[:SOURce<hw>]:BB:EUTRa:CLOCk:SYNChronization:MODE <Mode>

For R&S SMBV only

Selects the synchronization mode.

This parameter is used to enable generation of very precise synchronous signal of several connected R&S SMBVs.

Note: If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.

Avoid unnecessary cable length and branching points.

Parameters:

<Mode> NONE | MASTer | SLAVe

NONE
The instrument is working in stand-alone mode.

MASTer
The instrument provides all connected instrument with its synchronisation (including the trigger signal) and reference clock signal.

SLAVe
The instrument receives the synchronisation and reference clock signal from another instrument working in a master mode.

*RST: NONE

Example: `BB:EUTR:CLOC:SYNC:MODE MAST`
the instrument is configured to work as a master one.

Manual operation: See "Sync. Mode" on page 307

9.4 Timing Configuration

[:SOURce<hw>]:BB:EUTRa:TIMC:NTAoffset <NtaOffset>

For R&S SMU and R&S AMU instruments only

Sets the parameter $N_{TA\ offset}$ as defined in the 3GPP TS 36.211.

Parameters:

<NtaOffset> NTA0 | NTA624 | 0

*RST: NTA0

Example: `BB:EUTR:TIMC:NTA NTA0`
sets parameter $N_{TA\ offset}$

Manual operation: See "Signal Advance N_TA_offset" on page 303

9.5 Trigger Settings

The trigger settings are available for R&S SMx and R&S AMU instruments only.

`EXTernal<ch>`

The numeric suffix to `EXTernal<ch>` distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

[:SOURce<hw>]:BB:EUTRa[:TRIGger]:SEQuence <TriggerMode>

Selects the trigger mode.

Parameters:

<TriggerMode> AUTO | RETRigger | AAUTo | ARETrigger | SINGle

*RST: AUTO

Example: `BB:EUTR:SEQ AAUT`
sets the "Armed_auto" trigger mode

Manual operation: See "Trigger Mode" on page 299

[:SOURce<hw>]:BB:EUTRa:TRIGger:SOURce <Source>

Selects the trigger source.

Parameters:

<Source> INTernal|OBASeband|BEXTernal|EXTernal

INTernal
manual trigger or `*TRG`.
EXTernal|BEXTernal
trigger signal on the TRIGGER 1/2 connector.
OBASeband
trigger signal from the other path

*RST: INTernal

Example: `SOURce1:BB:EUTRa:TRIGger:SOURce EXTernal`
sets external triggering via the TRIGGER 1 connector.

Manual operation: See "Trigger Source" on page 301

[:SOURce<hw>]:BB:EUTRa:TRIGger:ARM:EXECute

Stops signal generation for trigger modes "Armed_Auto" and "Armed_Retrigger". A subsequent internal or external trigger event restarts signal generation.

Example: `BB:EUTR:TRIG:SOUR INT`
sets internal triggering.
`BB:EUTR:TRIG:SEQ ARET`
sets Armed_Retrigger mode, i.e. every trigger event causes signal generation to restart.
`BB:EUTR:TRIG:EXEC`
executes a trigger, signal generation is started.
`BB:EUTR:TRIG:ARM:EXEC`
signal generation is stopped.
`BB:EUTR:TRIG:EXEC`
executes a trigger, signal generation is started again.

Usage: Event

Manual operation: See "Arm" on page 86

[:SOURce<hw>]:BB:EUTRa:TRIGger:DELay:UNIT <DelUnit>

Defines the unit of the external and other baseband trigger delay.

Parameters:

<DelUnit> SAMPle | TIME

*RST: SAMPle

Example: `SOURce1:BB:EUTRa:TRIGger:DELay:UNIT SAMPle`
sets the external trigger delay to samples.

Manual operation: See "Trigger Delay Unit" on page 302

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXECute

Executes a trigger.

The internal trigger source must be selected using the command `BB:EUTR:TRIG:SOUR INT` and a trigger mode other than AUTO must be selected using the command `BB:EUTR:TRIG:SEQ`.

Example: `BB:EUTR:TRIG:SOUR INT`
Sets internal triggering.
`BB:EUTR:TRIG:SEQ RETR`
Sets Retrigger mode, i.e. every trigger event causes signal generation to restart.
`BB:EUTR:TRIG:EXEC`
Executes a trigger.

Usage: Event

Manual operation: See "Execute Trigger" on page 86

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:SYNChronize:OUTPut <OutputState>

(enabled for Trigger Source External)

Enables/disables output of the signal synchronous to the external trigger event.

Parameters:

<OutputState> 0 | 1 | OFF | ON

*RST: 1

Example: `BB:EUTR:TRIG:SOUR EXT`
sets external triggering.
`BB:EUTR:TRIG:EXT:SYNC:OUTP ON`
enables synchrounous output to external trigger

Manual operation: See "Sync. Output to External Trigger" on page 301

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:DELay <Delay>

Specifies the trigger delay (expressed as a number of samples) for triggering by the trigger signal from the second path (two-path instruments only).

Parameters:

<Delay> float

Range: 0 to dynamic
Increment: 0.01
*RST: 0

Example: `BB:EUTR:TRIG:SOUR OBAS`
sets for path A the internal trigger executed by the trigger signal from the second path (path B).
`BB:EUTR:TRIG:OBAS:DEL 50`
sets a delay of 50 samples for the trigger.

Manual operation: See "Trigger Delay" on page 302

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:INHibit <Inhibit>

Specifies the number of samples by which a restart is to be inhibited following a trigger event. This command applies only for triggering by the second path.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

Example: `BB:EUTR:TRIG:SOUR OBAS`
sets for path A the internal trigger executed by the trigger signal from the second path (path B).
`BB:EUTR:TRIG:OBAS:INH 200`
sets a restart inhibit for 200 samples following a trigger event.

Manual operation: See "Trigger Inhibit" on page 303

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:RDELay?

Queries the actual trigger delay (expressed in time units) of the trigger signal from the second path (two-path instruments only).

Return values:

<IntOthRDelay> float

Range: 0 to 688
Increment: 250E-12
*RST: 0

Example: `BB:EUTR:TRIG:SOUR OBAS`
sets for path A the internal trigger executed by the trigger signal from the second path (path B).
`BB:EUTR:TRIG:OBAS:RDEL?`
Response: `3.2E-6` the resulting delay of the internal trigger signal is 3.2 micro seconds.

Usage: Query only

Manual operation: See "Actual External Delay" on page 303

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:TDELay <IntOthTDelay>

Specifies the trigger delay (expressed in time units) for triggering by the trigger signal from the other path (two-path instruments only).

Parameters:

<IntOthTDelay> float

Range: 0 to depends on other values
Increment: 250E-12
*RST: 0

Example: `BB:EUTR:TRIG:SOUR OBAS`
sets for path A the internal trigger executed by the trigger signal from the second path (path B).
`BB:EUTR:TRIG:OBAS:TDEL 1.5E-6`
sets a delay of 1.5 micro seconds for the trigger.

Manual operation: See "Trigger Delay" on page 302

[:SOURce<hw>]:BB:EUTRa:TRIGger:RMODe?

The command queries the current status of signal generation for all trigger modes with EUTRA/LTE modulation on.

Return values:

<RunMode> STOP | RUN

Example: `BB:EUTR:TRIG:RMOD?`
`Response: RUN`

Usage: Query only

Manual operation: See "Running/Stopped" on page 300

[:SOURce<hw>]:BB:EUTRa:TRIGger:SLENgth <SequenceLength>

Defines the length of the signal sequence to be output in the single trigger mode.

It is possible to output deliberately just part of the frame, an exact sequence of the frame, or a defined number of repetitions of the frame. The unit is defined with command `[:SOURce<hw>]:BB:EUTRa:TRIGger:SLUNit`.

If the selected unit is changed, the selected sequence length is automatically recalculated in the new unit.

Parameters:

<SequenceLength> integer

Range: 1 to 4294967295
*RST: 1

Example:
`BB:EUTR:TRIG:SEQ SING`
`BB:EUTR:TRIG:SLUN FRAM`
sets the unit Frame length for the entry of the sequence length.
`BB:EUTR:TRIG:SLEN 200`
sets a sequence length of 200 frames. The first 200 samples of the current frame will be output after the next trigger event.
`BB:EUTR:TRIG:SLUN SLOT`
sets the unit slot length for the entry of the sequence length
`BB:EUTR:TRIG:SLEN?`
queries the sequence length.
`Response: 40`

Manual operation: See "Signal Duration" on page 300

[:SOURce<hw>]:BB:EUTRa:TRIGger:SLUNit <SeqLenUnit>

Defines the unit for the entry of the signal sequence length.

Parameters:

<SeqLenUnit> SEQuence | FRAMe | SUBFrame | SLOT | SAMPle

FRAMe
Unit Frame. A single frame is generated after a trigger event.

SEQuence
Unit Sequence Length. A single sequence is generated after a trigger event.

SUBFrame
Unit Subframe. A single subframe is generated after a trigger event.

SLOT
Unit Slot. A single slot is generated after a trigger event.

SAMPle
Unit Sample. Number of samples are generated after a trigger event.

*RST: SEQuence

Example: See `[:SOURce<hw>]:BB:EUTRa:TRIGger:SLENgth` on page 434

Manual operation: See "Signal Duration Unit" on page 300

[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal<ch>]:DELay <Delay>

Specifies the trigger delay (expressed as a number of samples) for external triggering.

Parameters:

<Delay> float

Range: 0 to dynamic
Increment: 0.01
*RST: 0

Example:
```
SOURce1:BB:EUTRa:TRIGger:SOURce EXT
SOURce1:BB:EUTRa:TRIGger:EXTernal:DELay 50
```

Manual operation: See "Trigger Delay" on page 302

[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal<ch>]:INHibit <Inhibit>

Specifies the number of samples by which a restart is to be inhibited following a trigger event. This command applies only in the case of external triggering.

Parameters:

<Inhibit> integer

Range: 0 to dynamic
*RST: 0

Example:
```
SOURce1:BB:EUTRa:TRIGger:SOURce EXT
SOURce1:BB:EUTRa:TRIGger:EXTernal:INHibit 200
```

Manual operation: See "Trigger Inhibit" on page 303

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal<ch>:RDELay?

Queries the actual external trigger delay (expressed in time unit).

Return values:

<ExtResultDelay> float

Range: 0 to 688
Increment: 250E-12
*RST: 0

Example: `BB:EUTR:TRIG:EXT:RDEL?`
Response: `5.12E-6` the resulting delay of the external trigger signal is 5.12 micro seconds.

Usage: Query only

Manual operation: See "Actual External Delay" on page 303

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal<ch>:TDELay <Delay>

Defines the trigger delay (expressed in time units) for external triggering.

Parameters:

<Delay> float

Range: 0 to depends on other values
Increment: 250E-12
*RST: 0

Example: `BB:EUTR:TRIG:EXT:TDEL 5E-6`
sets a delay of 5 micro seconds for the trigger.

Manual operation: See "Trigger Delay" on page 302

9.6 Marker Settings

This section lists the remote control commands, necessary to configure the markers.

The marker delay settings are available for R&S SMx and R&S AMU instruments only.

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut:DELay:FIXed <Fixed>

For R&S SMx/AMU instruments only.

Restricts the marker delay setting range to the dynamic range. In this range, the delay can be set without restarting the marker and signal (see `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay`).

If the selected delay is outside this range, the maximum possible delay is set and an error message is generated.

Parameters:

<Fixed> 0 | 1 | OFF | ON

*RST: 0

Example:

```
SOURce1:BB:EUTRa:TRIGger:OUTPut:DELay:FIXed 1
// restricts the marker signal delay setting range to the dynamic range
SOURce1:BB:EUTRa:TRIGger:OUTPut2:DELay 1600
// sets a delay of 1600 samples for the corresponding marker signal
```

Manual operation: See "Fix marker delay to current range" on page 306

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay <Delay>

Defines the delay between the signal on the marker outputs and the start of the signal, expressed in terms of samples.

Parameters:

<Delay> float

Range: 0 to 16777215
Increment: 1E-3
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut:DELay:FIXed on page 437

Manual operation: See "Marker x Delay" on page 306

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay:MINimum?
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay:MAXimum?

Queries the maximum marker delay for setting `BB:EUTRa:TRIG:OUTP:DEL:FIX ON`.

Return values:

<Maximum> float

Example:
`BB:EUTR:TRIG:OUTP:DEL:FIX ON`
Restricts the marker signal delay setting range to the dynamic range.
`BB:EUTR:TRIG:OUTP:DEL:MAX?`
Queries the maximum of the dynamic range.
`Response: 20000`
The maximum for the marker delay setting is 2000 samples.

Usage: Query only

Manual operation: See "Current Range without Recalculation" on page 306

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:MODE <Mode>

Defines the signal for the selected marker output.

Parameters:

<Mode> SUBFram | FRAM | RESTart | PERiod | RATio | FAP | | INTernal | | TRIGger

SUBFram
A marker signal is generated at the start of each subframe. The rise and fall offsets are defined with the commands `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:FOFFset` and `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ROFFset`.

FAP
The marker signal is high whenever a burst is active and low during inactive signal parts (such as the gaps between bursts in uplink mode or the uplink subframe in downlink TDD mode).
This marker can be used to decrease the carrier leakage during inactive signal parts by feeding it into the pulse modulator.

FRAM
A marker signal is generated at the start of each radio frame.
The rise and fall offsets are defined with the commands `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:FOFFset` and `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ROFFset`.

RESTart
A marker signal is generated at the start of each ARB sequence.
The rise and fall offsets are defined with the commands `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:FOFFset` and `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ROFFset`.

PERiod
A marker signal is generated at the beginning of every user-defined period. The period is defined with the command `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:PERiod` on page 440.

RATio
A marker signal corresponding to the Time Off / Time On specifications in the commands `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ONTime` and `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:OFFTime` is generated.

INTernal
Special marker signal for the real time feedback mode (Chapter 6, "Realtime Feedback for Closed Loop BS Tests", on page 69) or for SFN Restart Period "3GPP (1024 Frames)".

TRIGer
A received internal or external trigger signal is output at the marker connector.

*RST: FRAM

Example: `BB:EUTR:TRIG:OUTP:MODE FRAMe`
selects the frame marker for the corresponding marker signal.
`BB:EUTR:TRIG:OUTP:ROFF 20`
sets a rise offset of 20 samples for the corresponding marker signal.
`BB:EUTR:TRIG:OUTP:FOFF 2000`
sets a fall offset of 2000 samples for the corresponding marker signal on path A.

Manual operation: See "Marker Mode" on page 305

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:FOFFset <FallOffset>
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ROFFset <RiseOffset>

Sets the rise offset for on/off ratio marker in number of samples.

Parameters:

<RiseOffset> integer

Range: -640000 to 640000
*RST: 0

Example: `BB:EUTR:TRIG:OUTP2:ROFF 20`
sets a rise offset of 20 samples for marker signal 2.

Manual operation: See "Rise/Fall Offset" on page 305

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:OFFTime <OffTime>
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ONTime <OnTime>

Sets the number of samples in a period (ON time + OFF time) during which the marker signal in setting `BB:EUTR:TRIGger:OUTPut:MODE RATio` on the marker outputs is ON.

Parameters:

<OnTime> integer

Range: 1 to 16777215
*RST: 1

Example: `BB:EUTR:TRIG:OUTP:MODE RAT`
selects the ratio marker for the corresponding marker signal.
`BB:EUTR:TRIG:OUTP:ONT 200`
sets an ON time of 200 samples for the corresponding marker signal.

Manual operation: See "Marker Mode" on page 305

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:PERiod <Period>

Sets the repetition rate for the signal at the marker outputs, expressed in terms of samples. The setting is only valid for selection "USER" in `BB:EUTR:TRIG:OUTP:MODE`.

Parameters:

<Period> unsigned integer

Range: 1 sample to 2^32-1 samples
Increment: 1 sample
*RST: 2 samples

Example: `BB:EUTR:TRIG:OUTP2:MODE PER`
selects the user marker for the corresponding marker signal.
`BB:EUTR:TRIG:OUTP2:PER 1600`
sets a period of 1600 samples, i.e. the marker signal is repeated every 1600th sample.

Manual operation: See "Marker Mode" on page 305

9.7 General EUTRA/LTE Settings

[:SOURce<hw>]:BB:EUTRa:TDD:SPSConf <SpecSubfrConf>

(enabled for TDD duplexing mode only)

Sets the Special Subframe Configuration number, i.e. together with the parameter `[:SOURce<hw>]:BB:EUTRa:DL:CPC` defines the lengths of the DwPTS, the Guard Period and the UpPTS.

Parameters:

<SpecSubfrConf> integer

Range: 0 to 9
*RST: 0

Example: `SOURce1:BB:EUTRa:TDD:SPSConf 2`
sets the special subframe configuration

Options: Special subframe configuration 9 requires R&S SMx/AMU-K112

Manual operation: See "TDD Special Subframe Config" on page 127

[:SOURce<hw>]:BB:EUTRa:TDD:UDConf <ULDLConf>

(enabled for TDD duplexing mode only)

Sets the Uplink-Downlink Configuration number, i.e. defines which subframe is used for downlink respectively uplink, and where the special subframes are located.

Parameters:

<ULDLConf> integer

Range: 0 to 6
*RST: 0

Example: `:SOURce1:BB:EUTRa:TDD:UDConf 2`
sets the UL/DL configuration

Manual operation: See "TDD UL/DL Configuration" on page 127

9.8 General EUTRA/LTE Downlink Settings

[:SOURce<hw>]:BB:EUTRa:DL:CONF:MODE <Scheduling>

Determines how the scheduling of the different PDSCH allocations inside of the DL allocation table is performed.

Parameters:

<Scheduling> MANual | AUTO | ASEQuence

MANual
No cross-reference between the settings made for the PDCCH DCIs and the PDSCHs settings. Configure the PDSCH allocations manually.

AUTO
Precoding for spatial multiplexing according to 3GPP TS 36.211 and the selected parameters.

ASEQuence
According to the required HARQ processes and redundancy versions

*RST: MANual

Example: `BB:EUTR:DL:CONF:MODE AUTO`
enables the generation of 3GPP compliant EUTRA/LTE signal and the PDSCH allocations are configured automatically according to the configuration of the PDCCH DCIs.

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration <Configuration>

Sets the global MIMO configuration.

Parameters:

<Configuration> TX1 | TX2 | TX4 | SIBF

*RST: TX1

Example:
```
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:ANTenna TX1
:BB:EUTRa:DL:MIMO:APM:MAPCoordinates CARTesian
SOURce1:BB:EUTRa:DL:MIMO:APM:CS:AP0:ROW0:REAL 1
```

Manual operation: See "Global MIMO Configuration" on page 129

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:ANTenna <Antenna>

Sets the simulated antenna.

Parameters:

<Antenna> ANT1 | ANT2 | ANT3 | ANT4

*RST: ANT1

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration` on page 443

Manual operation: See "Simulated Antenna" on page 130

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:ANTB <AntennaB>

Sets the simulated antenna for path B. The available selections depend on the current MIMO configuration.

Parameters:

<AntennaB> NONE | ANT1 | ANT2 | ANT3 | ANT4

*RST: NONE

Example: `BB:EUTR:DL:MIMO:CONF TX4`
Sets the MIMO configuration to 2 TxAntennas.
`BB:EUTR:DL:MIMO:ANTB ANT3`
Sets the configuration to antenna 3.

Manual operation: See "Simulated Antenna Path B" on page 130

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:MAPCoordinates <Type>

Switches between the Cartesian (Real/Imag.) and Cylindrical (Magn./Phase) coordinates representation.

Parameters:

<Type> CARTesian | CYLindrical

*RST: CARTesian

Example: See [:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration on page 443

Options: R&S SMx/AMU-K84

Manual operation: See "Mapping Coordinates" on page 207

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:REAL <AntPortMapDat>
[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:IMAGinary <AntPortMapDat>

Define the mapping of the antenna ports to the physical antennas.

Suffix:

<dir0> 0 | 1 | 2 | 3 | 4 | 6 | 15 | .. 22
antenna port
The mapping of `AP0` to `AP3` to the `TX0` to `TX3` is fixed.

Parameters:

<AntPortMapDat> float

Range: -1 to 1
Increment: 0.01
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration on page 443

Manual operation: See "Mapping table" on page 207

[:SOURce<hw>]:BB:EUTRa:DL:REFSig:POWer <Power>

Sets the reference signal power.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:REFS:POW -10.00`
sets the reference signal power to -10.00dB.

Manual operation: See "Reference Signal Power" on page 135

[:SOURce<hw>]:BB:EUTRa:DL:REFSig:EPRE?

Queries the RS Power per RE relative to Level Display.

Return values:

<RelToLevelDispl> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:REFS:EPRE?`
queries the RS Power per RE relative to Level Display.

Usage: Query only

Manual operation: See "RS Power per RE relative to Level Display" on page 135

[:SOURce<hw>]:BB:EUTRa:DL:SYNC:TXANtenna <TxAntenna>

Defines on which antenna port the P-/S-SYNC is transmitted.

The available values depend on the number of configured antennas.

Parameters:

<TxAntenna> NONE | ANT1 | ANT2 | ANT3 | ANT4 | ALL

*RST: ALL

Example: `BB:EUTR:DL:SYNC:TXAN ALL`
enables all antenna ports to transmit P-/S-SYNC

Manual operation: See "P-/S-SYNC Tx Antenna" on page 135

[:SOURce<hw>]:BB:EUTRa:DL:SYNC:PPOWer <PPower>

Sets the power of the primary synchronization signal (P-SYNC).

Parameters:

<PPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:SYNC:PPOWer -10.00`
sets the P-SYNC power to -10.00dB.

Manual operation: See "P-SYNC Power" on page 135

[:SOURce<hw>]:BB:EUTRa:DL:SYNC:SPOWer <SPower>

Sets the power of the secondary synchronization signal (S-SYNC).

Parameters:

<SPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:SYNC:SPOWer -10.00`
sets the S-SYNC power to -10.00dB.

Manual operation: See "S-SYNC Power" on page 135

[:SOURce<hw>]:BB:EUTRa:DL:BW <Bw>

Sets the DL channel bandwidth.

Parameters:

<Bw> USER | BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00

*RST: BW10_00

Example: `BB:EUTR:DL:BW BW20_00`

Manual operation: See "Channel Bandwidth" on page 125

[:SOURce<hw>]:BB:EUTRa:DL:NORB <Norb>

Selects the number of physical resource blocks per slot.

Parameters:

<Norb> integer

Range: 6 to 110
*RST: 50

Example: `BB:EUTR:DL:BW USER`
sets the bandwidth mode to USER in downlink.
`BB:EUTR:DL:NORB 7`
sets the number of resource blocks to 7.

Manual operation: See "Number of Resource Blocks Per Slot" on page 126

[:SOURce<hw>]:BB:EUTRa:DL:SRATe?

Queries the sampling rate.

Return values:

<SampleRate> float

Range: 192E4 to 3072E4
Increment: 1000
*RST: 1536E4

Example: `BB:EUTR:DL:SRAT?`
queries the automatically set sampling rate.

Usage: Query only

Manual operation: See "Sampling Rate" on page 126

[:SOURce<hw>]:BB:EUTRa:DL:FFT <Fft>

Sets the FFT (Fast Fourier Transformation) size. The available values depend on the selected number of resource blocks per slot.

Parameters:

<Fft> integer

Range: 64 to 2048
*RST: 1024

Example: `BB:EUTR:DL:FFT?`
Queries the automatically set fast Fourier transformation parameter.

Manual operation: See "FFT Size" on page 126

[:SOURce<hw>]:BB:EUTRa:DL:OCCBandwidth?

Queries the of occupied bandwidth.

Return values:

<OccupBandwidth> float

Example: `BB:EUTR:DL:OCCB?`
queries the automatically set occupied bandwidth in downlink.

Usage: Query only

Manual operation: See "Occupied Bandwidth" on page 126

[:SOURce<hw>]:BB:EUTRa:DL:OCCSubcarriers?

Queries the occupied subcarriers.

Return values:

<OccupSubcarr>	integer		
	Range:	72 to 1321	
	*RST:	601	

Example: `BB:EUTR:DL:OCCS?`
queries the number of occupied subcarriers.

Usage: Query only

Manual operation: See "Number Of Occupied Subcarriers" on page 127

[:SOURce<hw>]:BB:EUTRa:DL:LGS?

Queries the number of left guard subcarriers.

Return values:

<Lgs>	integer		
	Range:	28 to 364	
	*RST:	212	

Example: `BB:EUTR:DL:LGS?`
queries the number of left guard subcarriers.

Usage: Query only

Manual operation: See "Number Of Left Guard Subcarriers" on page 127

[:SOURce<hw>]:BB:EUTRa:DL:RGS?

Queries the number of right guard subcarriers.

Return values:

<Rgs>	integer		
	Range:	27 to 364	
	*RST:	211	

Example: `BB:EUTR:DL:RGS?`
queries the number of right guard subcarriers.

Usage: Query only

Manual operation: See "Number Of Right Guard Subcarriers" on page 127

[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CID <CellId>

Sets the cell identity.

Parameters:

<CellId>	integer		
	Range:	0 to 503	
	*RST:	0	

Example: `BB:EUTR:DL:PLC:CID 100`
sets the Cell ID.

Manual operation: See "Cell ID" on page 131

[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CIDGroup <CellIdGroup>

Sets the ID of the physical cell identity group.

Parameters:

<CellIdGroup> integer

Range: 0 to 167
*RST: 0

Example: `BB:EUTR:DL:PLC:CIDG 100`
sets the ID of the physical cell identity group.

Manual operation: See "Physical Cell ID Group" on page 132

[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:PLID <PhysLayId>

Sets the identity of the physical layer within the selected physical cell identity group, set with the command `[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CIDGroup`.

Parameters:

<PhysLayId> integer

Range: 0 to 2
*RST: 0

Example: `BB:EUTR:DL:PLC:PLID 2`
sets the identity of the physical layer.

Manual operation: See "Physical Layer ID" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:CSETtings:RARNti <RaRnti>

Sets the random-access response identity RA-RNTI.

The value selected here determines the value of the parameter "UE_ID/n_RNTI" in case a RA_RNTI "User" is selected.

Parameters:

<RaRnti> integer

Range: 1 to 60
*RST: 1

Example: `BB:EUTR:DL:PLC:CSET:RARN 5`
sets the RA-RNTI

Manual operation: See "RA_RNTI" on page 134

[:SOURce<hw>]:BB:EUTRa:DL:CPC <CyclicPrefix>

Sets the cyclic prefix length for all subframes.

Parameters:

<CyclicPrefix> NORMal | EXTended | USER

*RST: NORMal

Example:
`BB:EUTR:DL:CPC NORM`
a normal prefix is used in all subframes in downlink.
`BB:EUTR:DL:CPC USER`
the cyclic prefix has to be adjusted on subframe basis.
`BB:EUTR:DL:SUBF6:CYCP NORM`
a normal prefix is used in subframe 6 in downlink.
`BB:EUTR:DL:SUBF1:CYCP EXT`
an extended prefix is used in subframe 1 in downlink.

Manual operation: See "Cyclic Prefix (General DL Settings)" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:ULCPc <GSCpcOppDir>

In TDD duplexing mode, sets the cyclic prefix for the opposite direction.

Parameters:

<GSCpcOppDir> NORMal | EXTended

*RST: NORMal

Example:
`:SOURce1:BB:EUTRa:DUPLexing TDD`
`:SOURce1:BB:EUTRa:DL:ULCPc EXTended`

Manual operation: See "UL/DL Cyclic Prefix" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:PBCH:RATBa <RatioPbPa>

Sets the transmit energy ratio among the resource elements allocated for PBCH in the OFDM symbols containing reference signal (P_B) and such not containing one (P_A).

Parameters:

<RatioPbPa> float

Range: -10 to 10
Increment: 0.001
*RST: 0
Default unit: dB

Example:
`BB:EUTR:DL:PBCH:RATB -5.0`
sets the transmit energy ratio

Manual operation: See "PBCH Ratio rho_B/rho_A" on page 133

[:SOURce<hw>]:BB:EUTRa:DL:PDCCh:RATBa <RatioPbBa>

Sets the transmit energy ratio among the resource elements allocated for PDCCH in the OFDM symbols containing reference signal (P_B) and such not containing one (P_A).

Parameters:

<RatioPbBa> float

Range: -10 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:PDCC:RATB -5.0`
sets the transmit energy ratio

Manual operation: See "PDCCH Ratio rho_B/rho_A" on page 133

[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:PB <Pb>

Sets the parameter PDSCH P_B and defines the cell-specific ratio rho_B/rho_A according to 3GPP TS 36.213, Table 5.2-1.

Parameters:

<Pb> integer

Range: 0 to 3
*RST: 0

Example: `BB:EUTR:DL:PDSC:PB 1`
sets the parameter PDSCH P_B

Manual operation: See "PDSCH P_B" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:RATBa <RatioPbPa>

Sets the transmit energy ratio among the resource elements allocated for PDSCH in the OFDM symbols containing reference signal (P_B) and such not containing one (P_A).

Parameters:

<RatioPbPa> float

Range: -10 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:PDSC:RATB -5.0`
sets the transmit energie ratio

Manual operation: See "PDSCH Ratio rho_B/rho_A" on page 133

[:SOURce<hw>]:BB:EUTRa:DL:PHICh:DURation <Duration>

Sets the PHICH duration, i.e. the allocation of the PHICH resource element groups over the OFDM symbols.

The value selected puts the lower limit of the size of the Control Region for PUCCH (`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PCFich:CREGion`) that is signaled by the PCFICH.

Parameters:

<Duration> NORMal | EXTended

NORMal
All resources element groups of PHICH (`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:NOGRoups`) are allocated on the first OFDM symbol (OFDM Symbol 0).

EXTended
The resource element groups of PHICH are distributed over three OFDM symbol (OFDM Symbols 0 .. 2).

*RST: NORMal

Example: `BB:EUTR:DL:PHIC:DUR NORM`
sets PHICH normal duration

Manual operation: See "PHICH Duration" on page 133

[:SOURce<hw>]:BB:EUTRa:DL:PHICh:NGParameter <NgParameter>

Sets the parameter N_g according to 3GPP TS 36.211, section 6.9 or enables the selection of user-defined value for the parameter "Number of PHICH Groups" (command `[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:NOGRoups` on page 507).

Parameters:

<NgParameter> NG1_6 | NG1_2 | NG1 | NG2 | NGCustom

NG1_6 | NG1_2 | NG1 | NG2
the actual "Number of PHICH Groups" for the different subframes is calculated according to 3GPP TS 36.211, section 6.9.

NGCustom
enables the selection of user-defined value for the parameter "Number of PHICH Groups".

*RST: NG1_6

Example: `BB:EUTR:DL:PHIC:NGP NG1_2`
sets PHICH N_g

Manual operation: See "PHICH N_g" on page 134

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:BW <PrsBandwidth>

Defines the bandwidth in which the PRS is transmitted.

Parameters:

<PrsBandwidth> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00

*RST: BW1_40

Example: see `[:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe` on page 454

Options: R&S SMx/AMU-K84/K284

Manual operation: See "PRS Bandwidth" on page 140

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:CI <ConfIdx>

Sets the PRS Configuration Index I_{PRS} as defined in 3GPP TS 36.211, table 6.10.4.3-1.

Parameters:

<ConfIdx> integer

Range: 0 to 2399
*RST: 0

Example: see `[:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe` on page 454

Options: R&S SMx/AMU-K84/K284

Manual operation: See "PRS Configuration Index" on page 139

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:DPRS?

Queries the subframe offset of the PRS generation ($Delta_{PRS}$) as defined in 3GPP TS 36.211, table 6.10.4.3-1.

Return values:

<DeltaPRS> integer

Range: 0 to 1279
*RST: 0

Example: see `[:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe` on page 454

Usage: Query only

Options: R&S SMx/AMU-K84/K284

Manual operation: See "PRS Subframe offset Delta_PRS" on page 140

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:NPRS <NumberPRS>

Defines the number of consecutive DL subframes in that PRS are transmitted.

Parameters:

<NumberPRS> N1 | N2 | N4 | N6

*RST: N1

Example: see [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 454

Options: R&S SMx/AMU-K84

Manual operation: See "Number of PRS DL Subframes (N_PRS)" on page 140

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:POW <PrsPower>

Sets the power of a PRS resource element relative to the power of a common reference signal resource element.

Parameters:

<PrsPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: see [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 454

Options: R&S SMx/AMU-K84/K284

Manual operation: See "PRS Power" on page 140

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe <PrsState>

Enables the generation of the PRS.

Parameters:

<PrsState> 0 | 1 | OFF | ON

*RST: OFF

Example:

```
:SOURce1:BB:EUTRa:DL:PRSS:CI 1
:SOURce1:BB:EUTRa:DL:PRSS:BW BW1_40
:SOURce1:BB:EUTRa:DL:PRSS:POW 0
:SOURce1:BB:EUTRa:DL:PRSS:MIPattern #H1,2
:SOURce1:BB:EUTRa:DL:PRSS:NPRS 2
:SOURce1:BB:EUTRa:DL:PRSS:STATe 1
```

Options: R&S SMx/AMU-K84/K284

Manual operation: See "PRS State" on page 139

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:TPRS? <PeriodicityTPRS>

Queries the periodicity of the PRS generation (T_{PRS}) as defined in 3GPP TS 36.211, table 6.10.4.3-1.

Parameters:

<PeriodicityTPRS> integer

Range: 160 to 1280
*RST: 160

Example: see [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 454

Usage: Query only

Options: R&S SMx/AMU-K84/K284

Manual operation: See "PRS Periodicity T_PRS" on page 139

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:MIPattern <PrsMutingInfo>

Specifies a bit pattern that defines the muted and not muted PRS.

Parameters:

<PrsMutingInfo> bit pattern in hex format; 2, 4, 8 or 16 bit long

each bit defines the PRS state of one PRS occasion

0
PRS is muted

1
PRS is transmitted

*RST: #H3

Example: see [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 454

Options: R&S SMx/AMU-K84/K284

Manual operation: See "PRS Muting Info" on page 140

9.9 General EUTRA/LTE Uplink Settings

[:SOURce<hw>]:BB:EUTRa:UL:BW <BandWidth>

Sets the UL channel bandwidth.

Parameters:

<BandWidth> USER | BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00

*RST: BW10_00

Example: `BB:EUTR:UL:BW BW1_40`
selects a uplink frequency band of 1.4 MHz.

Manual operation: See "Channel Bandwidth (UL)" on page 221

[:SOURce<hw>]:BB:EUTRa:UL:NORB <NumResBlocks>

Selects the number of physical resource blocks per slot.

Parameters:

<NumResBlocks> integer

Range: 6 to 110
*RST: 50

Example: `BB:EUTR:UL:BW USER`
sets the bandwidth mode to USER in downlink.
`BB:EUTR:UL:NORB 7`
sets the number of resource blocks to 7.

Manual operation: See "Number of Resource Blocks Per Slot (UL)" on page 222

[:SOURce<hw>]:BB:EUTRa:UL:SRATe?

Queries the sampling rate.

Return values:

<SampRate> float

Range: 192E4 to 3072E4
Increment: 1000
*RST: 1536E4

Example: `BB:EUTR:UL:SRAT?`
queries the automatically set sampling rate.

Usage: Query only

Manual operation: See "Sampling Rate (UL)" on page 222

[:SOURce<hw>]:BB:EUTRa:UL:FFT <FftSize>

Sets the FFT (Fast Fourier Transformation) size. The available values depend on the selected number of resource blocks per slot.

Parameters:

<FftSize> integer

Range: 64 to 2048
*RST: 1024

Example: `BB:EUTR:UL:FFT?`
queries the automatically set FFT size.

Manual operation: See "FFT Size (UL)" on page 222

[:SOURce<hw>]:BB:EUTRa:UL:OCCBandwidth?

Queries the occupied bandwidth. This value is set automatically according to the selected number of resource blocks per slot.

Return values:

<OccBandwidth> float

Default unit: MHz

Example: `BB:EUTR:UL:OCCB?`
queries the automatically set occupied bandwidth in uplink.

Usage: Query only

Manual operation: See "Occupied Bandwidth (UL)" on page 222

[:SOURce<hw>]:BB:EUTRa:UL:OCCSubcarriers?

Queries the occupied subcarriers. The value is set automatically according to the selected number of resource blocks per slot.

Return values:

<OccSubcarriers> integer

Range: 72 to 1320
*RST: 600

Example: `BB:EUTR:UL:OCCS?`
queries the number of occupied subcarriers.

Usage: Query only

Manual operation: See "Number Of Occupied Subcarriers (UL)" on page 223

[:SOURce<hw>]:BB:EUTRa:UL:LGS?

Queries the number of left guard subcarriers. The value is set automatically according to the selected number of resource blocks per slot.

Return values:

<LgSubCarr> integer

Range: 28 to 364
*RST: 212

Example: `BB:EUTR:UL:LGS?`
queries the number of left guard subcarriers.

Usage: Query only

Manual operation: See "Number Of Left Guard Subcarriers (UL)" on page 223

[:SOURce<hw>]:BB:EUTRa:UL:RGS?

Queries the number of right guard subcarriers. The value is set automatically according to the selected number of resource blocks per slot.

Return values:

<RgSubCarr> integer

Range: 28 to 364
*RST: 212

Example: `BB:EUTR:UL:RGS?`
queries the number of right guard subcarriers.

Usage: Query only

Manual operation: See "Number Of Right Guard Subcarriers (UL)" on page 223

[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CID <CellId>

Sets the cell identity.

Parameters:

<CellId> integer

Range: 0 to 503
*RST: 0

Example: `BB:EUTR:UL:PLC:CID 100`
sets the Cell ID.

Manual operation: See "Cell ID (UL)" on page 224

[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CIDGroup <PhysCellIdGroup>

Sets the ID of the physical cell identity group.

Parameters:

<PhysCellIdGroup> integer

Range: 0 to 167
*RST: 0

Example: `BB:EUTR:UL:PLC:CIDG 100`
sets the UL physical cell ID group

Manual operation: See "Physical Cell ID Group (UL)" on page 224

[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:PLID <PhysicalLayerId>

Sets the identity of the physical layer within the selected physical cell identity group, set with the command `[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CIDGroup`.

Parameters:

<PhysicalLayerId> integer

Range: 0 to 2
*RST: 0

Example: `BB:EUTR:UL:PLC:PLID 2`
sets the UL physical layer ID

Manual operation: See "Physical Layer ID (UL)" on page 225

[:SOURce<hw>]:BB:EUTRa:UL:CPC <CyclicPrefix>

Sets the cyclic prefix length for all subframes.

Parameters:

<CyclicPrefix> NORMal | EXTended | USER

*RST: NORMal

Example: `BB:EUTR:UL:CPC NORM`
a normal prefix is used in all subframes in uplink.

Example: `BB:EUTR:UL:CPC USER`
the cyclic prefix has to be adjusted on subframe basis.
`BB:EUTR:UL:SUBF6:CYCP NORM`
a normal prefix is used in subframe 6 in uplink.
`BB:EUTR:UL:SUBF1:CYCP EXT`
an extended prefix is used in subframe 1 in uplink.

Manual operation: See "Cyclic Prefix (General UL Settings)" on page 225

[:SOURce<hw>]:BB:EUTRa:UL:DLCPc <GSCpcOppDir>

In TDD mode, determines the cyclic prefix for the appropriate opposite direction.

Parameters:

<GSCpcOppDir> NORMal | EXTended

*RST: NORMal

Example: `:SOURce1:BB:EUTRa:DUPLexing TDD`
`:SOURce1:BB:EUTRa:UL:DLCPc EXTended`

Manual operation: See "UL/DL Cyclic Prefix" on page 132

[:SOURce<hw>]:BB:EUTRa:UL:SOFFset <SfnOffset>

Set the start SFN value.

Parameters:

<SfnOffset> integer

Range: 0 to 4095
*RST: 0
Default unit: Frames

Example: `:SOURce1:BB:EUTRa:UL:SOFFset 10`
Sets the SFN start value

Manual operation: See "SFN Offset" on page 225

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:GRPHopping <GroupHopping>

Enables/disables group hopping for the uplink reference signals demodulation reference signal (DRS) and sounding reference signal (SRS).

Parameters:

<GroupHopping> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:EUTR:UL:REFS:GRPH ON`
enables group hopping

Manual operation: See "Group Hopping" on page 227

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SEQHopping <SequenceHopping>

Enables/disables sequence hopping for the uplink reference signals demodulation reference signal (DRS) and sounding reference signal (SRS).

Parameters:

<SequenceHopping> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:EUTR:UL:REFS:SEQH ON`

enables sequence hopping

Manual operation: See "Sequence Hopping" on page 227

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DSSHift <DeltaSeqShift>

Sets the delta sequence shift for PUSCH needed for the calculation of the group hopping pattern.

Parameters:

<DeltaSeqShift> integer

Range: 0 to 29

*RST: 0

Example: `BB:EUTR:UL:REFS:DSSH 3`

sets the delta sequence shift for PUSCH

Manual operation: See "Delta Sequence Shift for PUSCH" on page 227

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DMRS <DrsDmrs>

Sets the part of the demodulation reference signal (DMRS) index which is broadcasted and therefore valid for the whole cell. This index applies when multiple shifts within a cell are used and is used by the calculation of the DMRS sequence.

Parameters:

<DrsDmrs> integer

Range: 0 to 11

*RST: 0

Example: `BB:EUTR:UL:REFS:DMRS 4`

sets the demodulation reference signal index to 4

Manual operation: See "n(1)_DMRS" on page 227

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:ANSTx <AnSrsSimTxState>

Enables/disables simultaneous transmission of SRS (sounding reference signal) and ACK/NACK messages, i.e. transmission of SRS and PUCCH in the same subframe.

Parameters:

<AnSrsSimTxState> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:EUTR:UL:REFS:SRS:ANST ON`

Manual operation: See "A/N + SRS simultaneous Tx" on page 233

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:MUPTs <MaxUpPts>

Enables/disables the cell-specific parameter srsMaxUpPts.

If enabled, a SRS transmission in the UpPTS field (TDD) is made only in the frequency area that does not overlap with the frequency resources reserved for a possible PRACH preamble format 4 transmission.

This is done by reconfiguring the number of SRS resource blocks in the special sub-frames, which would otherwise be determined by C_SRS and B_SRS.

Parameters:

<MaxUpPts> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:EUTR:UL:REFS:SRS:MUPT ON`
enables the parameter srsMaxUpPts

Manual operation: See "SRS MaxUpPTS" on page 234

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:CSRS <Csrs>

Sets the cell-specific parameter SRS Bandwidth Configuration (C_{SRS}).

Parameters:

<Csrs> integer

Range: 0 to 7
*RST: 0

Example: `BB:EUTR:UL:REFS:SRS:CSRS 4`
sets the SRS bandwidth configuration

Manual operation: See "SRS Bandwidth Configuration C_SRS" on page 233

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:DSFC?

Queries the value for the cell-specific parameter transmission offset $Delta_{SFC}$ in sub-frames, depending on the selected SRS Subframe Configuration (`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:CSRS`)and the Duplexing mode (`[:SOURce<hw>]:BB:EUTRa:DUPLexing`).

Return values:

<DeltSFC> string

Example: `BB:EUTR:UL:REFS:SRS:SUC 4`
sets the SRS configuration
`BB:EUTR:UL:REFS:SRS:DSFC?`
queries the Delta_SFC parameter

Usage: Query only

Manual operation: See "Transmission Offset Delta_SFC" on page 233

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:SUConfiguration <SubFrameConfig>

Sets the cell-specific parameter SRS subframe configuration.

Parameters:

<SubFrameConfig> integer

Range: 0 to 15
*RST: 15

Example: `BB:EUTR:UL:REFS:SRS:SUC 4`
sets the SRS configuration

Manual operation: See "SRS Subframe Configuration" on page 233

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:TSFC?

Queries the value for the cell-specific parameter configuration period T_{SFC} in sub-frames, depending on the selected SRS Subframe Configuration (`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:CSRS`)and the Duplexing mode (`[:SOURce<hw>]:BB:EUTRa:DUPLexing`).

Return values:

<Tsfc> string

Example: `BB:EUTR:UL:REFS:SRS:SUC 4`
sets the SRS configuration
`BB:EUTR:UL:REFS:SRS:TSFC?`
queries the T_SFC parameter

Usage: Query only

Manual operation: See "Configuration Period T_SFC" on page 233

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:CONFiguration <Configuration>

Sets the PRACH configuration number.

Parameters:

<Configuration> integer

Range: 0 to 63
*RST: 0

Example: `BB:EUTR:UL:PRAC:CONF 10`
sets the PRACH configuration

Manual operation: See "PRACH Configuration" on page 228

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:FOFFset <FrequencyOffset>

Sets the prach-FrequencyOffset $n^{RA}_{PRBoffset}$

Parameters:

<FrequencyOffset> integer

Range: 0 to dynamic
*RST: 0

Example: `BB:EUTR:UL:PRAC:FOFF 2`
sets the frequency offset

Manual operation: See "PRACH Frequency Offset" on page 228

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:RSET <RestrictedSet>

Enables/disables using of a restricted preamble set.

Parameters:

<RestrictedSet> 0 | 1 | OFF | ON

*RST: 0

Example: `BB:EUTR:UL:PRAC:RSET ON`
enables using of restricted set

Manual operation: See "Restricted Set (High Speed Mode)" on page 229

[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:FHMode <FreqHoppingMode>

Sets the frequency hopping mode for PUSCH.

Frequency hopping is applied according to 3GPP TS36.213.

Parameters:

<FreqHoppingMode> INTRa | INTer

INTer
An inter subframe hopping is performed.

INTRa
Both intra- and inter-subframe subframe hopping are performed.

*RST: INTRa

Example: `BB:EUTR:UL:PUSC:FHM INT`
selects inter subframe hopping mode

Manual operation: See "Frequency Hopping Mode" on page 229

[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:FHOFfset <FHoppOffset>

Sets the PUSCH Hopping Offset N_{RB}^{HO}.

The PUSCH Hopping Offset determines the first physical resource block and the maximum number of physical resource blocks available for PUSCH transmission if PUSCH frequency hopping is used.

Parameters:

<FHoppOffset> integer

Range: dynamic to dynamic
*RST: 0

Example: `BB:EUTR:UL:PUSC:FHOF 2`
set the PUSCH hopping offset

Manual operation: See "PUSCH Hopping Offset" on page 230

[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NOSM <SubBandCount>

Sets the number of sub-bands (Nsb) into that the total range of physical resource blocks available for PUSCH transmission is divided. The frequency hopping is performed at sub-band level.

Parameters:

<SubBandCount> integer

Range: 1 to 110
*RST: 4

Example: `BB:EUTR:UL:PUSC:NOSM 3`
sets the number of sub-bands

Manual operation: See "Number of Sub-bands" on page 230

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:NORB <RbCount>

Sets the PUCCH region in terms of reserved resource blocks, located at the edges of the channel bandwidth.

Parameters:

<RbCount> integer

Range: 0 to 110
*RST: 4

Example: `BB:EUTR:UL:PUCC:NORB 3`
reserves 3 RBs for PUCCH

Manual operation: See "Number of RBs used for PUCCH" on page 230

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:DESHift <DeltaShift>

Sets the delta shift parameter.

Parameters:

<DeltaShift> integer

Range: 1 to 3
*RST: 2

Example: `BB:EUTR:PUCC:DESH 3`
sets the delta shift parameter

Manual operation: See "Delta Shift" on page 231

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1CS <N1Cs>

Sets the number of cyclic shifts used for PUCCH format 1/1a/1b in a resource block used for a combination of the formats 1/1a/1b and 2/2a/2b.

Parameters:

<N1Cs> integer

Range: 0 to dynamic
*RST: 6

Example: `BB:EUTR:UL:PUCC:N1CS 5`
5 cyclic shifts will be used for PUCCH format 1/1a/1b in a RB used for a combination of the PUCCH formats 1/1a/1b and 2/2a/2b

Manual operation: See "N(1)_cs" on page 231

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2RB <N2Rb>

Sets bandwidth in terms of resource blocks that are reserved for PUCCH formats 2/2a/2b transmission in each subframe.

Parameters:

<N2Rb> integer

Range: 0 to dynamic
*RST: 1

Example: `BB:EUTR:UL:PUCC:N2RB 3`
reserves 3 RB for PUCCH formats 2/2a/2b

Manual operation: See "N(2)_RB" on page 231

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1NMax?

Queries the range of the possible PUCCH format 1/1a/1b transmissions from different users in one subframe and in case of normal CP.

Return values:

<N1NormCP> integer

Range: 0 to 110
*RST: 44

Example: `BB:EUTR:UL:PUCC:N1NM?`
queries the range of the possible PUCCH formats 1/1a/1b transmissions.
`Response: 24`

Usage: Query only

Manual operation: See "Range n(1)_PUCCH (Normal CP)" on page 232

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1EMax?

Queries the range of the possible PUCCH format 1/1a/1b transmissions from different users in one subframe and in case of extended CP.

Return values:

<N1emax> integer

Range: 0 to 110
*RST: 29

Example: `BB:EUTR:UL:PUCC:N1EM?`
queries the range of the possible PUCCH formats 1/1a/1b transmissions.
`Response: 10`

Usage: Query only

Manual operation: See "Range n(1)_PUCCH (Extended CP)" on page 232

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2Max?

Queries the range of possible number of PUCCH format 2/2a/2b transmissions from different users in one subframe.

Return values:

<N2Max> integer

Range: 0 to 110
*RST: 15

Example: `BB:EUTR:UL:PUCC:N2M?`
queries the range of the possible PUCCH formats 2/2a/2b transmissions.
`Response: 16`

Usage: Query only

Manual operation: See "Range n(2)_PUCCH" on page 232

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N3Max?

Queries the range of possible number of PUCCH format 3 transmissions from different users in one subframe.

Return values:

<N3Max> integer

Range: 0 to 549
*RST: 19

Usage: Query only

Manual operation: See "Range n(3)_PUCCH" on page 232

9.10 DL Frame Configuration

[:SOURce<hw>]:BB:EUTRa:DL:BUR <Bur>

Selects either to fill unscheduled resource elements and subframes with dummy data or DTX.

Parameters:

<Bur> DUData | DTX

*RST: DUData

Example: `SOURce1:BB:EUTRa:DL:BUR DUData`

the unscheduled resource elements are filled with dummy data.

Manual operation: See "Behavior In Unscheduled REs (OCNG)" on page 146

[:SOURce<hw>]:BB:EUTRa:DL:CONSubframes <ConSubFrames>

Sets the number of configurable subframes.

Parameters:

<ConSubFrames> integer

Range: 1 to 40

*RST: 10

Example: `BB:EUTR:DL:CONS 10`

ten subframes are configurable in downlink.

Manual operation: See "No Of Configurable (DL) Subframes" on page 145

[:SOURce<hw>]:BB:EUTRa:DL:RSTFrame

Resets all subframe settings of the selected link direction to the default values.

Example: `BB:EUTR:DL:RSTF`
resets the downlink subframe parameters of path A to the default settings.

Manual operation: See "Reset All Subframes" on page 145

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:CYCPrefix <CycPrefix>

(enabled for `BB:EUTR:DL:CPC USER` only)

Sets the cyclic prefix for the according subframe.

Parameters:

<CycPrefix> NORMal | EXTended

*RST: NORMal

Example: `BB:EUTR:DL:CPC USER`
the cyclic prefix has to be adjusted on subframe basis.
`BB:EUTR:DL:SUBF6:CYCP NORM`
a normal prefix is used in subframe 6 in downlink.

Manual operation: See "Cyclic Prefix" on page 156

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALCount <AllocCount>

Sets the number of scheduled allocations in the selected subframe. The maximum number of allocations that can be scheduled depends on the number of the selected resource blocks.

Parameters:

<AllocCount> integer

Range: 0 to dynamic
*RST: 2 (SUBF0, SUBF10,SUBF20,SUBF30); 1(all other subframes)

Example: `BB:EUTR:DL:SUBF4:ALC 5`
five scheduled allocations are assigned to subframe four.

Manual operation: See "No. Of Used Allocations" on page 156

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>:CODWords <CodeWords>

Sets the number of codewords for an allocation.

Two codewords are available for global MIMO configuration with two or more antennas.

Parameters:

<CodeWords> 1 | 2

Range: 1 to 2
*RST: 1

Manual operation: See "Codeword" on page 157

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:MODulation <Modulation>

Sets the modulation scheme for the allocation.

Parameters:

<Modulation> QPSK | QAM16 | QAM64

*RST: QPSK

Example:
```
BB:EUTR:DL:SUBF4:ALL5:CW2:MOD QPSK
```
selects QPSK as modulation scheme for the allocation.

Example:
```
SOUR:BB:EUTR:DL:SUBF1:ALL5:CW2:MOD QPSK
SOUR:BB:EUTR:DL:SUBF1:ALL5:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF1:ALL7:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF1:ALL5:CW2:MOD?
Response: QPSK
```

Manual operation: See "Mod." on page 157

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:GAP <VrbGap>

Enables/disables the unitization of distributed Virtual Resource Blocks (VBR) and determines whether the first or the second VRB gap is applied. The VRB-to-PRB mapping and the calculation of the VRB gap values are performed according to 3GPP TS 36.211.

Parameters:

<VrbGap> integer

0
A **localized distribution** is applied, i.e. the PDSCH mapping is performed on a direct VRB-to-PRB mapping.

1
Enables a **distributed** ressource block allocation. The first VRB gap is used.

2
Enabled for "Channel Bandwidths" greater than 50 RBs.
The mapping is based on the second (smaller) VRB gap.

Range: 0 to 2
*RST: 0

Example:
```
SOUR:BB:EUTR:DL:BW BW10_00
SOUR:BB:EUTR:SUBF0:ALL2:GAP2
```

Manual operation: See "VRB Gap" on page 158

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:RBCount <ResBlockCount>

Sets the size of the selected allocation in resource blocks (per slot).

For allocations with two codewords, the number of resource blocks for the second codeword is automatically set to the number of resource blocks set for the first one.

Parameters:

<ResBlockCount> integer

Range: 1 to 110
*RST: 1

Example:
```
BB:EUTR:DL:SUBF4:ALL5:CW:RBC 3
```

Manual operation: See "No. RB (Resource Blocks)" on page 160

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SYMCount <SymCount>

Sets the size of the selected allocation in OFDM symbols.

For content type PBCH, PDCCH and PDSCH, this value is set automatically.

For allocations with two codewords, the number of symbols for the second codeword is automatically set to number of symbols set for the first one.

Parameters:

<SymCount> integer

Range: 1 to 14
*RST: 6 (PBCH); 12 (PDSCH)

Example: For FDD mode and content type PDSCH, this value is set automatically in a way that the allocation always fills the complete subframe with consideration of the symbol offset.
```
SOUR:BB:EUTR:DL:SUBF1:CYCP NORM
SOUR:BB:EUTR:DL:SUBF2:ALL2:CW2:SYM 2
SOUR:BB:EUTR:DL:SUBF1:ALL2:CW2:SYMC 12
```

Manual operation: See "No. Sym." on page 161

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:RBOFfset <ResBlockOffset>

Queries the start resource block of the selected allocation.

Parameters:
<ResBlockOffset> integer

Range: 0 to dynamic
*RST: dynamic

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:RBOF?`

Manual operation: See "Offs RB" on page 161

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SYMoffset <SymOffset>

Sets the start OFDM symbol of the selected allocation.

Parameters:
<SymOffset> integer

Range: 0 to 13
*RST: 2

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:SYM 5`
OFDM symbol five is the start OFDM symbol for allocation five in subframe four.

Manual operation: See "Offs Sym." on page 162

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:AOC <Aoc>

Sets whether automatic offset calculation is used or not.

Parameters:
<Aoc> 0 | 1 | OFF | ON

*RST: ON

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:AOC ON`
activates the automatic offset calculation for the selected allocation.

Manual operation: See "Auto" on page 162

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]: PHYSbits?

Queries the number of physical bits for the selected allocation. The value is set automatically according to the current allocation settings.

Return values:
<PhysicalBits> integer

Range: 0 to 105600
*RST: 0

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:PHYS?`
queries the number of physical bits for allocation five in subframe four.

Usage: Query only

Manual operation: See "Phys. Bits" on page 162

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:DATA <Data>

Sets the data source for the selected allocation.

For allocations with two codewords, the data source for the second codeword is automatically set to the data source set for the first one.

Parameters:

<Data> USER1 | USER2 | USER3 | USER4 | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE | MIB | MCCH | MTCH

MIB
for PBCH allocation only
Indicates that the PBCH transmits real MIB data (see also `[:SOURce<hw>]:BB:EUTRa:DL:PBCH:MIB` on page 495).

*RST: dynamic

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:DATA PN9`
PN9 is the data source for the selected allocation.

Manual operation: See "Data List Management" on page 83

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PATTern <Pattern>

Selects the bit pattern for the `PATTern` selection. The maximum length is 64 bits.

Parameters:

<Pattern> <bit pattern>

*RST: #H0,1

Example:
```
BB:EUTR:DL:SUBF4:ALL5:CW:DATA PATT
BB:EUTR:DL:SUBF4:ALL5:CW:PATT #H3F,8
```
defines the bit pattern.

Manual operation: See "Data Source" on page 163

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:DSELect <DSelect>

Selects the data list for the `DLISt` data source selection.

The lists are stored as files with the fixed file extensions `*.dm_iqd` in a directory of the user's choice. The directory applicable to the following commands is defined with the command `MMEMory:CDIR`. To access the files in this directory, you only have to give the file name, without the path and the file extension.

Parameters:

<DSelect> string

Example:

```
BB:EUTR:DL:SUBF2:ALL5:CW:DATA DLISt
MMEM:CDIR '<root>Lists'
BB:EUTR:DL:SUBF2:ALL5:CW:DSELect 'eutra_list1'
```

selects file 'eutra_list1' as the data source. This file must be in the directory `<root>Lists` and have the file extension `*.dm_iqd`.

Manual operation: See "Data List Management" on page 83

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:POWer <Power>

Sets the power P_{PDSCH} respectively P_{PBCH} for the selected allocation. The power of the PDCCH allocation P_{PDCCH} is read-only. The value is set with the command `[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:POWer`.

For allocations with two codewords, the power for the second codeword is automatically set to the power set for first one.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example:

P_{PDSCH}, P_{PBCH}

```
SOUR:BB:EUTR:DL:SUBF1:ALL2:POW 10.00
```

Example:

P_{PDCCH}

```
SOUR:BB:EUTR:DL:SUBF1:ENCC:PDCC:POW 2.00
SOUR:BB:EUTR:DL:SUBF1:ALL1:POW?
Response: 2
```

Manual operation: See "Rho A" on page 163

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CONType <ConType>

Selects the type for the selected allocation.

PBCH can be configured in subframe 0 only.

Parameters:

<ConType> PDSCh | PBCH | PDCCh | PMCH

*RST: PDSCh

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:CONT PDSC`
selects PDSCH as type for the selected allocation.

Options: R&S SMx/AMU-K84/-K284

Manual operation: See "Content Type" on page 163

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:STATe <State>

Sets the allocation state to active or inactive.

Parameters:

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

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:STAT OFF`
deactivates the selected allocation.

Manual operation: See "State" on page 164

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CONFlict <Conflict>

Indicates a conflict between two allocations.

Parameters:

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

Example: `BB:EUTR:DL:SUBF4:ALL5:CW2:CONF?`
queries for the selected allocation whether there is a conflict with another allocation.

Manual operation: See "Conflict" on page 164

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:USER<ch>:PHYSbits?

Queries the size of the selected allocation in bits and considering the subcarriers that are used for other signals or channels with higher priority.

If a User 1...4 is selected for the "Data Source" in the allocation table for the corresponding allocation, the value of the parameter "Number of Physical Bits" is the sum of the "Physical Bits" of all single allocations that belong to the same user in the selected subframe.

Return values:

<PhysicalBits> integer
Range: 0 to 100000
*RST: 0

Example: `BB:EUTR:DL:SUBF1:USER3:PHYS?`
queries the number of physical bits

Usage: Query only

Manual operation: See "Number of Physical Bits (DL)" on page 172

9.11 DL MBFSN Settings

Configuration of the MBSFN settings requires the option R&S SMx/AMU-K84.

Example: Enabling and configuring MBSFN transmission

The following is a simple example on how to configure an MBSFN signal.

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:SLENgth 512
SOURce1:BB:EUTRa:DL:BW BW1_40
SOURce1:BB:EUTRa:DL:MBSFn:MODE MIX
SOURce1:BB:EUTRa:DL:MBSFn:UEC C5
SOURce1:BB:EUTRa:DL:MBSFn:RHOA 0

SOURce1:BB:EUTRa:DL:MBSFn:SC:APER AP8
SOURce1:BB:EUTRa:DL:MBSFn:SC:AOFFset 2
SOURce1:BB:EUTRa:DL:MBSFn:SC:AMODe F4
SOURce1:BB:EUTRa:DL:MBSFn:SC:AVAL 11184810

SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:STATe 1
SOURce1:BB:EUTRa:DL:MBSFn:AI:ID 0
SOURce1:BB:EUTRa:DL:MBSFn:AI:NMRL 2
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:RPER RP128
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:MPER MP512
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:NRC NRC2
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:NSI 4
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:OFFS 0
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:MCS MCS2
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:DATA PN9
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:NPATtern #H0,1
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:NOFFset 0
SOURce1:BB:EUTRa:DL:MBSFn:AI:NIND?
// Response:  2
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:AVAL?
// Response:  11184810
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:MODulation?
Response:  QPSK
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:TBSize?
// Response: 2216
```

```
SOURce1:BB:EUTRa:DL:MBSFn:MTCH:CSAP AP64
SOURce1:BB:EUTRa:DL:MBSFn:MTCH:NPMChs 3
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:SASTart 0
SOURce1:BB:EUTRa:DL:MBSFn:PMCH1:SPERiod SPRF8
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:MCSTwo 0
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:MCS 5
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:MOD?
// QPSK
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:MCSTwo 1
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:MOD?
// QAM16
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:DATA PN9
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:STATe 1
SOURce1:BB:EUTRa:DL:MBSFn:PMCH1:SPERiod SPRF8
SOURce1:BB:EUTRa:DL:MBSFn:PMCH2:SPERiod SPRF8

SOURce1:BB:EUTRa:STATe 1
```

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:ID <AreaID>

Defines the MBSFN area ID, parameter N_{id}^{MBSFN}.

Parameters:

<AreaID> integer

Range: 0 to 255
*RST: 0

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Area ID (N_ID_MBSFN)" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:AVAL? <AllocationValue>

Indicates the subframes of the radio frames indicated by the "MCCH repetition period" and the "MCCH offset", that may carry MCCH.

Parameters:

<AllocationValue> integer

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Usage: Query only

Manual operation: See "Allocation Value (HEX)" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:DATA <DataSource>

Sets the data source used for the MCCH.

Parameters:

<DataSource> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MCCH Data Source" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:DLISt <DataList>

Sets the data list used as data source for MCCH.

Parameters:

<DataList> string

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MCCH Data Source" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MCS <MCS>

Defines the Modulation and Coding Scheme (MCS) applicable for the subframes indicated by the "MCCH Allocation value" and for the first subframe of each MCH scheduling period (which may contain the MCH scheduling information provided by MAC).

Parameters:

<MCS> MCS19 | MCS13 | MCS7 | MCS2

*RST: MCS2

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MCCH MCS" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MODulation? <Modulation>

Queries the values as determined by the "MCCH MCS".

Parameters:

<Modulation> QPSK | QAM16 | QAM64

*RST: QPSK

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Usage: Query only

Manual operation: See "MCCH Modulation" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MPER <ModifPeriod>

Sets the MCCH Modification Period.

Parameters:

<ModifPeriod> MP512 | MP1024

*RST: MP512

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MCCH Modification Period" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NOFFset <NotifOffset>

Defines, together with the `[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NRC`, the radio frames in which the MCCH information change notification is scheduled.

Parameters:

<NotifOffset> integer

Range: 0 to 10

*RST: 0

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Notification Offset" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NPATtern <NotifPattern>

Sets the pattern for the notification bits sent on PDCCH DCI format 1c.

Parameters:

<NotifPattern> 64 bits

*RST: #H0

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Notification Pattern" on page 123

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NRC <NotifRepetCoeff>

Selects the current change notification repetition period common for all MCCHs that are configured.

Parameters:

<NotifRepetCoeff> NRC2 | NRC4

*RST: NRC2

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Notification Repetition Coefficient" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NSI <Index>

Defines the subframe used to transmit MCCH change notifications on PDCCH.

In FDD: Value 1, 2, 3, 4, 5 and 6 correspond with subframe #1, #2, #3, #6, #7 and #8 respectively

In TDD: Value 1, 2, 3, 4 and 5 correspond with subframe #3, #4, #7, #8 and #9respectively

Parameters:

<Index>	integer	
	Range:	1 to dynamic
	*RST:	1

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Notification Subframe Index" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:OFFS <McchOffset>

Indicates, together with the `[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:RPER`, the radio frames in which MCCH is scheduled.

Parameters:

<McchOffset>	integer	
	Range:	0 to 10
	*RST:	0

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MCCH Offset" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:PATTern <Pattern>

Sets the pattern used as data source for the MCCH.

Parameters:

<Pattern>	64 bits	
	*RST:	#H0,1

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MCCH Data Source" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:RPER <RepetPeriod>

Defines the interval between transmissions of MCCH information in radio frames.

Parameters:

<RepetPeriod>	RP64 | RP32 | RP128 | RP256	
	*RST:	RP32

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MCCH Repetition Period" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:STATe <McchState>

Enables/disables the MCCH.

Parameters:

<McchState>	0 | 1 | OFF | ON *RST: 1
Example:	see Example "Enabling and configuring MBSFN transmission" on page 476
Manual operation:	See "MCCH State" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:TBSize? <TB_Size>

Queries the values as determined by the "MCCH MCS".

Parameters:

<TB_Size>	integer
Example:	see Example "Enabling and configuring MBSFN transmission" on page 476
Usage:	Query only
Manual operation:	See "MCCH Transport Block Size" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:NIND <NotifIndicator>

Defines which PDCCH bit is used to notify the UE about change of the MCCH applicable for this MBSFN area.

Parameters:

<NotifIndicator>	integer Range: 0 to 7 *RST: 0
Example:	see Example "Enabling and configuring MBSFN transmission" on page 476
Manual operation:	See "Notification Indicator" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:NMRL <RegionLength>

Defines how many symbols from the beginning of the subframe constitute the non-MBSFN region.

Parameters:

<RegionLength>	integer Range: 1 to 2 *RST: 2
Example:	see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Non-MBSFN Region Length" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MODE <MbsfnMode>

Enables the MBSFN transmission and selects a mixed MBSFN Mode.

Parameters:

<MbsfnMode> OFF | MIXed

*RST: OFF

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MBSFN Mode" on page 118

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MTCH:CSAP <AllocPeriod>

Defines the period during which resources corresponding with field *commonSF-Alloc* are divided between the (P)MCH that are configured for this MBSFN area.

Parameters:

<AllocPeriod> AP4 | AP8 | AP16 | AP32 | AP64 | AP128 | AP256

*RST: AP4

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Common Subframe Allocation Period" on page 123

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MTCH:NPMChs <NumOfPMCHs>

Defines the number of PMCHs in this MBSFN area.

Parameters:

<NumOfPMCHs> int

Range: 1 to 15
Increment: 1
*RST: 1

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Number of PMCHs" on page 123

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:STATe <PmchState>

Enables/disables the selected PMCH/MTCH.

Parameters:

<PmchState> 0 | 1 | OFF | ON

*RST: 1

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "State" on page 125

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:DATA <DataSource>

Sets the data source for the selected PMCH/MTCH.

Parameters:

<DataSource> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Data Source" on page 124

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:DLISt <DataList>

Sets the data list of the data source for the selected PMCH/MTCH.

Parameters:

<DataList> string

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Data Source" on page 124

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:PATTern <Pattern>

Sets the pattern of the data source for the selected PMCH/MTCH.

Parameters:

<Pattern> 64 bits

*RST: #H0,1

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Data Source" on page 124

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:MCS <MCS>

Sets the modulation and coding scheme (MCS) applicable for the subframes of the (P)MCH.

Parameters:

<MCS> integer

Range: 0 to 28
*RST: 0

Example: See Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MCS" on page 124

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:MOD?

Queries the used modulation.

Return values:

<PmchMod> QPSK | QAM16 | QAM64

*RST: QPSK

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Usage: Query only

Manual operation: See "Modulation" on page 124

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SPERiod <SchedPeriod>

Defines the MCH scheduling period, i.e. the periodicity used for providing MCH scheduling information at lower layers (MAC) applicable for an MCH.

Parameters:

<SchedPeriod> SPM | SPRF8 | SPRF16 | SPRF32 | SPRF64 | SPRF128 | SPRF256 | SPRF512 | SPRF1024

*RST: SPM

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MCH Scheduling Period" on page 124

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SASTart <AllocStart>
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SAENd <AllocEnd>

Defines the first/last subframe allocated to this (P)MCH within a period identified by field *commonSF-Alloc*.

Parameters:

<AllocEnd> integer

Range: 0 to 1535
*RST: 23

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "SF Alloc Start/SF Alloc End" on page 123

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:RHOA <RhoA>

Defines the power of the MBSFN channels relative to the common Reference Signals.

Parameters:

<RhoA> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "MBSFN Rho A" on page 118

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AMODe <AllocationMode>

Defines whether MBSFN periodic scheduling is 1 or 4 frames.

Parameters:

<AllocationMode> F1 | F4

*RST: F1

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Subframe Allocation Mode" on page 119

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AOFFset <Offset>

Sets the Radio Frame Allocation Offset

Parameters:

<Offset> integer

Range: 0 to 31
*RST: 0

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Radio Frame Allocation Offset" on page 119

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:APER <AllocPeriod>

Sets the Radio Frame Allocation Period.

Parameters:

<AllocPeriod> AP1 | AP2 | AP4 | AP8 | AP16 | AP32

*RST: AP1

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Radio Frame Allocation Period" on page 118

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AVAL <AllocationValue>

Defines which MBSFN subframes are allocated.

Parameters:

<AllocationValue> integer

Range: 0 to #HFFFFFF
*RST: #H3F

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "Allocation value (HEX)" on page 119

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:UEC <UeCategory>

Defines the UE category as defined in 3GPP TS 36.306.

Parameters:

<UeCategory> USER | C1 | C2 | C3 | C5 | C4

*RST: C5

Example: see Example "Enabling and configuring MBSFN transmission" on page 476

Manual operation: See "UE Category" on page 118

9.12 DL Carrier Aggregation Settings

Carrier Aggregation is LTE-A (LTE Rel. 10) feature enabled for instruments equipped with software options R&S SMx/AMU-K55 and R&S SMx/AMU-K85.

[:SOURce<hw>]:BB:EUTRa:DL:CA:STATe <CaGlobalState>

Enables/disables the generation of several component carriers.

Parameters:

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

Manual operation: See "Activate Carrier Aggregation" on page 109

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:BB <BasebandPath>

Determines the baseband block that generates the selected component carrier.

Parameters:

<BasebandPath>	A | B	
	*RST:	A

Options: R&S SMx/AMU-K85

Manual operation: See "Baseband" on page 110

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:BW <Bandwidth>

Sets the bandwidth of the corresponding component carrier/SCell.

Parameters:

<Bandwidth>	BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00	
	*RST:	BW10_00

Manual operation: See "Bandwidth" on page 110

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:CIF <CifPresent>

Defines whether the CIF is included in the PDCCH DCI formats transmitted from the corresponding SCell.

Parameters:

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

Manual operation: See "CIF Present" on page 110

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:DFReq <DeltaFreq>

Sets the frequency offset between the central frequency of corresponding SCell and the frequency of the PCell.

Parameters:

<DeltaFreq>	float	
	Range:	-40 to 40
	Increment:	0.1
	*RST:	0

Manual operation: See "delta f / MHz" on page 110

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:ID <PhysicalCellId>

Sets the physical Cell ID of the corresponding SCell.

Parameters:

<PhysicalCellId> integer

Range: 0 to 503
*RST: 0

Manual operation: See "Physical Cell ID" on page 110

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:INDex <CellIndex>

Sets the cell index of the corresponding SCell.

The cell index of the PCell is always 0.

Parameters:

<CellIndex> integer

Range: 1 to 7
*RST: 1

Manual operation: See "Cell Index" on page 109

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:POFFset <PowerOffset>

Sets the power offset of the SCells relative to the power level of the PCell.

Parameters:

<PowerOffset> float

Range: -80 to 10
Increment: 0.01
*RST: 0

Options: R&S SMx/AMU-K85

Manual operation: See "Power / dB" on page 111

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:PSTart <PdschStart>

Sets the starting symbol of the PDSCH for the corresponding SCell.

Parameters:

<PdschStart> integer

Range: 1 to 4
*RST: 2

Manual operation: See "PDSCH Start" on page 111

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:SCINdex <SchedCellIndex>

Defines the component carrier/cell that signals the UL and DL grants for the selected SCell.

Parameters:

<SchedCellIndex> integer

Range: 0 to 7
*RST: 0

Manual operation: See "schedCell Index" on page 110

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:STATe <CellState>

Activates/deactivates the component carrier/SCell.

Parameters:

<CellState> 0 | 1 | OFF | ON

*RST: OFF

Example: `:SOURce1:BB:EUTRa:DL:CA:CELL1:STATe ON`

Manual operation: See "State" on page 111

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:TDELay <TimeDelay>

Sets the time delay of the SCell relative to the PCell.

Parameters:

<TimeDelay> integer

Range: 0 to 700000
*RST: 0

Manual operation: See "Delay / ns" on page 111

9.13 CSI-RS Settings

Example: Enabling a CSI-RS transmission

The following is a simple example on how to configure a CSI-RS transmission.

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:DL:CSIS:ZP 4112
SOURce1:BB:EUTRa:DL:CSIS:ZPI 5
SOURce1:BB:EUTRa:DL:CSIS:ZPDelta?
// Response: 0
SOURce1:BB:EUTRa:DL:CSIS:ZPT?
// Response: 10
```

```
SOURce1:BB:EUTRa:DL:CSIS:STATe ON
SOURce1:BB:EUTRa:DL:CSIS:NAP AP1
SOURce1:BB:EUTRa:DL:CSIS:SFI 1
SOURce1:BB:EUTRa:DL:CSIS:CONFig 0
SOURce1:BB:EUTRa:DL:CSIS:SFDelta?
// Response: 1
SOURce1:BB:EUTRa:DL:CSIS:SFT?
// Response: 5
SOURce1:BB:EUTRa:DL:CSIS:POW 0.5

SOURce1:BB:EUTRa:DL:SFSelection 1
SOURce1:BB:EUTRa:DL:SUBF1:ALCount 2
SOURce1:BB:EUTRa:DL:SUBF1:ALLoc1:CW1:PHYSbits?
// Response: 276
SOURce1:BB:EUTRa:DL:SUBF1:ALLoc1:CAW ON
// Response: 272
SOURce1:BB:EUTRa:DL:USER1:CAW:STATe ON
SOURce1:BB:EUTRa:STATe 1
```


[:SOURce<hw>]:BB:EUTRa:DL:CSIS:CONFig <CsiRsConfig>

Defines the CSI-RS configuration used for the current cell and for which the UE assumes non-zero transmission power.

Parameters:

<CsiRsConfig> integer

Range: 0 to 31
*RST: 0

Example: see Example "Enabling a CSI-RS transmission" on page 490

Manual operation: See "CSI-RS Configuration" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:CSIS:NAP <CsiRsNumAp>

Defines the number of antenna ports the CSI-RS are transmitted on.

Parameters:

<CsiRsNumAp> AP1 | AP2 | AP4 | AP8

*RST: AP1

Example: see Example "Enabling a CSI-RS transmission" on page 490

Manual operation: See "Number of CSI-RS Antenna Ports" on page 143

[:SOURce<hw>]:BB:EUTRa:DL:CSIS:POW <CsiRsPow>

Boosts the CSI-RS power compared to the cell-specific reference signals.

Parameters:

<CsiRsPow> float

Range: -8 to 15
Increment: 0.001
*RST: 0

Example: see Example "Enabling a CSI-RS transmission" on page 490

Manual operation: See "CSI-RS Power" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:CSIS:SFDelta?

Sets the parameter subframe offset Δ_{CSI-RS} for cell-specific CSI-RS.

Return values:

<CsiRsOffs> integer

Range: 0 to 79
*RST: 0

Example: see Example "Enabling a CSI-RS transmission" on page 490

Usage: Query only

Manual operation: See "Subframe Offset (Delta_CSI-RS)" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:CSIS:SFI <CsiRsSfConf>

Sets the parameter I_{CSI-RS} for cell-specific CSI-RS.

Parameters:

<CsiRsSfConf> integer

Range: 0 to 154
*RST: 0

Example: see Example "Enabling a CSI-RS transmission" on page 490

Manual operation: See "Subframe Config (I_CSI-RS)" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:CSIS:SFT?

Sets the parameter subframe configuration period T_{CSI-RS} for cell-specific CSI-RS.

Return values:
<CsiRsPeriod> integer

Range: 5 to 80
*RST: 5

Example: see Example "Enabling a CSI-RS transmission" on page 490

Usage: Query only

Manual operation: See "Periodicity (T_CSI-RS)" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:CSIS:STATe <CsiRsState>

Enables the transmission of a CSI-RS.

Parameters:
<CsiRsState> OFF | ON | 1 | 0

*RST: OFF

Example: see Example "Enabling a CSI-RS transmission" on page 490

Manual operation: See "CSI-RS State" on page 143

[:SOURce<hw>]:BB:EUTRa:DL:CSIS:ZP <ZeroPow>

Sets the used CSI-RS configurations in the zero transmission power subframes.

Parameters:
<ZeroPow> 16 bit

Range: 0 to #HFFFF
Increment: 1
*RST: 0

Example: see Example "Enabling a CSI-RS transmission" on page 490

Manual operation: See "ZeroPowerCSI-RS (HEX)" on page 143

[:SOURce<hw>]:BB:EUTRa:DL:CSIS:ZPDelta?

Sets the parameter subframe offset Δ_{CSI-RS} for CSI-RS with zero transmission power.

Return values:
<ZeroPowOffs> integer

Example: see Example "Enabling a CSI-RS transmission" on page 490

Usage: Query only

Manual operation: See "Subframe Offset (Delta_CSI-RS)" on page 143

[:SOURce<hw>]:BB:EUTRa:DL:CSIS:ZPI <ZeroPowConf>

Sets the parameter I_{CSI-RS} for CSI-RS with zero transmission power.

Parameters:

<ZeroPowConf> integer

Range: 0 to 154

*RST: 0

Example: see Example "Enabling a CSI-RS transmission" on page 490

Manual operation: See "Subframe Config (I_CSI-RS)" on page 143

[:SOURce<hw>]:BB:EUTRa:DL:CSIS:ZPT?

Sets the parameter subframe configuration period T_{CSI-RS} for CSI-RS with zero transmission power.

Return values:

<ZeroPowPer> integer

Example: see Example "Enabling a CSI-RS transmission" on page 490

Usage: Query only

Manual operation: See "Periodicity (T_CSI-RS)" on page 143

9.14 Enhanced PBCH, PDSCH, PMCH Settings

[:SOURce<hw>]:BB:EUTRa:DL:PBCH:MIB <State>

(for PBCH only)

Enables/disables transmission of real MIB data.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `SOUR:BB:EUTR:DL:PBCH:MIB ON`

Manual operation: See "MIB (including SFN)" on page 172

[:SOURce<hw>]:BB:EUTRa:DL:PBCH:SOFFset <SfnOffset>

Sets an offset for the start value of the SFN (System Frame Number).

Parameters:

<SfnOffset> integer

Range: 0 to 1020

Increment: 4

*RST: 0

Manual operation: See "SFN Offset" on page 172

[:SOURce<hw>]:BB:EUTRa:DL:PBCH:SRPeriod <SfnRestPeriod>

Determines the time span after which the SFN (System Frame Number) restarts.

Parameters:

<SfnRestPeriod> PER3gpp | PERSlength

`PER3gpp` = "3GPP (1024 Frames)"

`PERSlength` = SFN restart period to the ARB sequence length

*RST: PERSlength

Example: `BB:EUTR:DL:PBCH:SRP PERS`

sets the restart period to the ARB sequence length.

Manual operation: See "SFN Restart Period" on page 173

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>:CAW <DlCsiAware>

Determines the way the PDSCH is processed.

Parameters:

<DlCsiAware> OFF | ON | 1 | 0

*RST: OFF

Example: see Example "Enabling a CSI-RS transmission" on page 490

Manual operation: See "CSI Awareness" on page 169

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing: ISBSize <SoftBufSize>

Sets the size of the IR soft buffer.

Parameters:

<SoftBufSize> integer

Range: 800 to 3667200
*RST: 3667200

Example:
```
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF9:ALL5:PHYS?
Response: 2400
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW2:CCOD:TBS 1500
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW2:CCOD:ISBS 1600
SOUR:BB:EUTR:DL:SUBF9:ALL4:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF9:ALL4:CW2:CCOD:ISBS?
Response: 1600
```

Manual operation: See "IR Soft Buffer Size (PDSCH)" on page 173

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing: RVINdex <RedundVersIndex>

Sets the redundancy version index.

Parameters:

<RedundVersIndex> integer

Range: 0 to 3
*RST: 0

Example:
```
BB:EUTR:DL:SUBF4:ALL5:CW2:CCOD:RVIN 2
```
sets the redundancy version index to 2

Manual operation: See "Redundancy Version Index (PDSCH)" on page 173

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing: STATe <State>

Enables/disables channel coding for the selected allocation and codeword.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example:
```
BB:EUTR:DL:SUBF4:ALL5:CW2:CCOD:STAT OFF
```

Manual operation: See "State Channel Coding (DL)" on page 171

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing:TBSize <TranspBlockSize>

Sets the size of the transport block.

Note: The parameter depends on the content type and the global MIMO configuration.

Parameters:

<TranspBlockSize> integer

Range: 1 to 1E7
*RST: 1500

Example:
```
BB:EUTR:DL:SUBF9:ALL5:PHYS?
```
queries the number of physical bits of allocation 5
```
Response: 2400
BB:EUTR:DL:SUBF4:ALL5:CW2:CCOD:TBS 1500
```
sets the transport block size to of allocation 5 to 1500 bits

Example:
```
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF9:ALL5:PHYS?
Response: 2400
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW:CCOD:TBS 1000
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW2:CCOD:TBS 1500
SOUR:BB:EUTR:DL:SUBF9:ALL4:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF9:ALL4:CW:CCOD:TBS?
Response: 1000
SOUR:BB:EUTR:DL:SUBF9:ALL4:CW2:CCOD:TBS?
Response: 1500
```

Manual operation: See "Transport Block Size/Payload (DL)" on page 173

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:AP <AntennaPorts>

Sets the antenna port(s) for the selected transmission mode.

Parameters:

<AntennaPorts> AP7 | AP5 | AP8 | AP78 | AP79 | AP710 | AP711 | AP712 | AP713 | AP714

*RST: AP5

Options: R&S SMx/AMU-K84/-K284

Manual operation: See "Antenna Ports" on page 168

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:APM <AntPortMap>

Sets the way that the logical antenna ports are mapped to the physical Tx-antennas. See Chapter 7.9, "DL Antenna Port Mapping Settings", on page 205.

Parameters:

<AntPortMap> CB | RCB | FW

*RST: CB

Options: R&S SMx/AMU-K84/-K284

Manual operation: See "Antenna Port Mapping" on page 168

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:CBINdex[<dir>] <CodeBookIndex>

Sets the codebook index for the selected allocation.

The combination of codebook index and the selected number of layers determines the codebook matrix used for precoding.

Suffix:

<dir> 1|2
In a multi layer transmission scheme (TxMode 9), determines the codebook index

Parameters:

<CodeBookIndex> integer

Range: 0 to 15
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW1:CONType
PDSCh
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW:PRECoding:
SCHeme BF
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW:PRECoding:
TRSCheme TM9
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW:PRECoding:
CBINdex2 2
```

Manual operation: See "Codebook Index/Codebook Index 2" on page 168

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:CDD <CyclicDelayDiv>

Sets the CDD for the selected allocation.

The combination of cyclic delay diversity and the selected number of layers determines the precoding parameters for spatial multiplexing.

Parameters:

<CyclicDelayDiv> NOCDd | SMDelay | LADelay

NOCDd
Zero CDD

SMDelay
Small CDD

LADelay
Large CDD

*RST: NOCDd

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:PREC:CDD SMD`
selects small CDD

Manual operation: See "Cyclic Delay Diversity" on page 169

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:DAFormat <DataFormat>

Switches between the Cartesian (Real/Imag.) and Cylindrical (Magn./Phase) coordinates representation.

Parameters:

<DataFormat> CARTesian | CYLindrical

*RST: CARTesian

Manual operation: See "Mapping Coordinates" on page 169

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:NOLayers <NoLayers>

Sets the number of layers for the selected allocation.

Parameters:

<NoLayers> integer

Range: 1 to 4
*RST: 1

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:PREC:NOL 2`
sets the number of layers to 2

Manual operation: See "Number of Layers" on page 168

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:SCHeme <Scheme>

(available for the first codeword only)

Selects the precoding scheme.

The available selections depend on the selected content type.

Parameters:

<Scheme> NONE | SPM | TXD | BF

NONE
Disables precoding.

SPM
Spatial multiplexing

TXD
Transmit diversity

BF
Sets the PDSCH to transmission mode selected with the command `[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:TRSCheme`.

*RST: NONE

Example:
```
SOURce1:BB:EUTRa:DL:SUBF4:ALLoc5:CONType PDSCh
SOURce1:BB:EUTRa:DL:SUBF4:ALLac5:CW1:PRECoding:
SCHeme SPM
```
sets the precoding scheme to spatial multiplexing

Manual operation: See "Precoding Scheme" on page 166

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:SCID <ScrambIdentity>

Sets the scrambling identity according to 36.211, sec. 6.10.3.1.

This value is used for initialization of the sequence used for generation of the UE-specific reference signals.

Parameters:

<ScrambIdentity> integer

Range: 0 to 1
*RST: 0

Manual operation: See "Scrambling Identity n_SCID" on page 168

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:TRSCheme <TransmissScheme>

Determines the transmission mode (see also Table 3-4).

Parameters:

<TransmissScheme> TM7 | TM8

*RST: TM7

Options: R&S SMx/AMU-K84/-K284

Manual operation: See "Transmission Scheme" on page 167

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]: SCRambling:STATe <State>

Enables/disables the bit-level scrambling.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example:
```
SOUR:BB:EUTR:DL:SUBF0:ALL5:CW:DATA PN9
SOUR:BB:EUTR:DL:SUBF0:ALL5:CW:SCR:STAT ON
```
enables scrambling

Example: If a "User 1..4" is selected for the Data Source for the corresponding allocation, this command is query only and the return value corresponds the state determined with the command [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:STATe.
```
SOUR:BB:EUTR:DL:SUBF0:ALL4:CW:DATA USER3
SOUR:BB:EUTR:DL:USER3:SCR:STAT ON
SOUR:BB:EUTR:DL:SUBF0:ALL4:CW:SCR:STAT?
Response: On
```

Manual operation: See "State Scrambling (DL)" on page 170

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]: SCRambling:UEID <Ueid>

Sets the user equipment identifier (n_RNTI) of the user to which the PDSCH transmission is intended. The UE ID is used to calculate the scrambling sequence.

Parameters:

<Ueid> integer

Range: 0 to 65535
*RST: 0

Example:
```
BB:EUTR:DL:SUBF0:ALL5:CW:UEID 120
```
sets the user equipment identifier.

Manual operation: See "UE ID/n_RNTI (PDSCH)" on page 170

9.15 Enhanced PCFICH, PHICH and PDCCH Configuration

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:STATe <State>

Enables/disables the PDCCH, PCFICH and PHICH allocation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `BB:EUTR:DL:SUBF1:ENCC:STAT ON`

enables PDCCH

Manual operation: See "State" on page 175

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:SCRambling:STATe <State>

Enables/disables the scrambling of the enhanced channels.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `SOURce1:BB:EUTRa:DL:SUBF1:ENCC:SCRambling:STATe ON`

Manual operation: See "Scrambling State " on page 175

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PRECoding:SCHeme <Scheme>

Selects the precoding scheme for PDCCH.

Parameters:

<Scheme> NONE | TXD

NONE
Disables precoding.

TXD
Precoding for transmit diversity will be performed according to 3GPP TS 36.211 and the selected parameters

*RST: NONE

Example: `BB:EUTR:DL:SUBF1:ENCC:PREC:SCH TXD`
selects the precoding scheme

Manual operation: See "Precoding Scheme" on page 175

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PRECoding:NOLayers?

Queries the number of layers for PDCCH.

This value is fixed to 1 for PDCCH.

Return values:

<LayerCount> integer

Range: 1 to 2
*RST: 1

Example: `BB:EUTR:DL:SUBF1:ENCC:PREC:NOL?`
queries the number of layers
`Response: 1`

Usage: Query only

Manual operation: See "Number of Layers (Enhanced Channels)" on page 175

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PCFich:POWer <Power>

Sets the power of the PCFICH (P_{PCFICH}).

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:PCF:POW -5`
sets the power of the PCFICH to -5 dBm

Manual operation: See "PCFICH Power" on page 175

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PCFich:CREGion <ControlRegion>

Sets the number of OFDM Symbols to be used for PDCCH.

Parameters:

<ControlRegion> integer

Range: 1 to 4
*RST: 2

Example: `BB:EUTR:PHIC:DUR NORM`
selects PHICH normal duration
`BB:EUTR:DL:SUBF1:ENCC:PCF:CREG 1`
sets the control region

Manual operation: See "Control Region for PDCCH" on page 176

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:PMODe <PowerMode>

Determines whether all PHICH in a PHICH group are send with the same power or enables the adjustment of each P_{PHICH} individually.

Parameters:

<PowerMode> CONSt | IND

CONSt
The power of a PHICH (PPHICH) in a PHICH group is set with the command `SOUR:BB:EUTR:DL:ENCC:PHIC:POW`.

IND
The power of the individual PHICHs is set with the command

*RST: CONSt

Example: `BB:EUTR:DL:SUBF1:ENCC:PHIC:PMOD CONS`
sets the power mode
`BB:EUTR:DL:SUBF1:ENCC:PHIC:POW -5`
sets the power of one PHICHs to -5 dB; all PHICHs in the PHICH group are send with this power.

Manual operation: See "Power Mode" on page 177

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:POWer <Power>

Sets the power of one PHICH (P_{PHICH}) in a PHICH group, i.e. the total power of one PHICH group is the sum of the power of the transmitted PHICHs within this group.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: -3.010

Example:

```
SOUR:BB:EUTR:DL:SUBF2:ENCC:PHIC:PMOD CONS
SOUR:BB:EUTR:DL:SUBF2:ENCC:PHIC:NOGR 1
SOUR:BB:EUTR:DL:SUBF2:CYCP NORM
SOUR:BB:EUTR:DL:SUBF2:ENCC:PHIC:ANP1 '1---1---'
SOUR:BB:EUTR:DL:SUBF2:ENCC:PHIC:POW - 3
```

sets the power of one PHICHs in a PHICH group to -3 dB

Manual operation: See "PHICH Power" on page 177

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:GROup<ch0>:ITEM<dir0>:POW <Power>

Sets the power of the individual PHICHs.

Suffix:

<ch0> PHICH group

<dir0> 0 .. 7
PHICH number within the PHICH group

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: -3.010

Example: `BB:EUTR:DL:SUBF1:ENCC:PHIC:PMOD IND`
sets the power mode
`BB:EUTR:DL:SUBF1:ENCC:PHIC:GRO1:ITEM4:POW -5`
sets the power of the PHICH#5 in the second PHICH group to -5 dB

Manual operation: See "Power Settings Config." on page 178

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:NOGRoups <GroupCount>

Sets the number of available PHICH groups.

Parameters:

<GroupCount> integer

Range: 0 to dynamic
*RST: 2

Example: `BB:EUTR:DL:SUBF1:ENCC:PHIC:NOGR 4`
sets the number of PHICH groups

Manual operation: See "Number of PHICH Groups" on page 176

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:ANPattern<ch0> <AnPattern>

Sets the ACK/NACK pattern for the corresponding PHICH group.

A "1" indicates an ACK, a "0" - a NACK, a "-" indicates DTX.

Suffix:

<ch0> 0 .. 59

Parameters:

<AnPattern> string

Example: `BB:EUTR:DL:SUBF1:ENCC:PHIC:ANP2 '1010--11'`

sets the ACK/NACK pattern for PHICH Group number 2

Manual operation: See "ACK/NACK Pattern Group 0 .. 9" on page 177

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:POWer <Power>

Sets the power of the PDCCH (P_{PDCCH}).

The value set with this parameter is also displayed in the allocation table for the corresponding allocation.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:POW -5`

sets the power of the PDCCH to -5dB

Manual operation: See "PDCCH Power" on page 179

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:BITS <PhysBits>

Defines the number of bits allocated for PDCCH.

Parameters:

<PhysBits> integer

Range: 0 to 1E5
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:STAT ON`

enables PDCCH.

`BB:EUTR:DL:SUBF1:ENCC:PDCC:BITS?`

queries the number of bits

`Response: 3144`

Manual operation: See "Number of Bits / REGs / CCEs (PDCCH)" on page 179

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:AVRegs <AvailRegionCoun>

Defines the number of the REGs that are available for the PDCCH allocation.

Parameters:

<AvailRegionCoun> integer

Range: 0 to 1E5
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:STAT ON`
enables PDCCH.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:AVR?`
queries the number of REGs
`Response: 393`

Manual operation: See "Number of available REGs (PDCCH)" on page 179

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:AVCCes <AvailCceCount>

Queries the number of the control channel elements (CCEs) that are available for the PDCCH allocation.

Parameters:

<AvailCceCount> integer

Range: 0 to 1E5
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:STAT ON`
enables PDCCH.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:AVCC?`
queries the number of CCEs
`Response 43`

Manual operation: See "Number of available CCEs (PDCCH)" on page 179

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:FORMat <Format>

Sets the PDCCH format.

Parameters:

<Format> VAR | -1 | 0 | 1 | 2 | 3

VAR
Enables full flexibility by the configuration of the downlink control information (DCI) format and content.

-1
Proprietary format for legacy support.

0 | 1 | 2 | 3
One PDCCH is transmitted on one, two, four or eight CCEs

*RST: VAR

Example: `BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0`
sets the PDCCH format.

Manual operation: See "PDCCH Format" on page 179

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:NOPDcchs <PdcchCount>

Sets the number of PDCCHs to be transmitted.

Parameters:

<PdcchCount> integer

Range: 0 to dynamic
*RST: 0

Example:
`BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0`
sets the PDCCH format.
`BB:EUTR:DL:SUBF2:ENCC:PDCC:NOPD 20`
sets the number of PDCCHs.

Manual operation: See "Number of PDCCHs" on page 180

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:ALRegs <AllocRegionCoun>

Defines the number of REGs that are actually allocated for PDCCH transmission (#REGs allocated$_{PDCCH}$).

Parameters:

<AllocRegionCoun> integer

Range: 0 to 1E5
*RST: 0

Example:
`BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0`
sets the PDCCH format.
`BB:EUTR:DL:SUBF2:ENCC:PDCC:NOPD 20`
sets the number of PDCCHs.
`BB:EUTR:DL:SUBF2:ENCC:PDCC:ALR?`
queries the number of REGs
`Response: 180`

Manual operation: See "Number of REGs allocated to PDCCH" on page 180

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DREGs <DummyRegsCount>

Defines the number of REGs that are available for the PDCCH allocation but are not allocated.

Parameters:

<DummyRegsCount> integer

Range: 0 to 1E5
Increment: 1
*RST: 0

Example: `BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0`
sets the PDCCH format.
`BB:EUTR:DL:SUBF2:ENCC:PDCC:NOPD 20`
sets the number of PDCCHs.
`BB:EUTR:DL:SUBF2:ENCC:PDCC:ALR?`
queries the number of REGs
`Response: 180`
`BB:EUTR:DL:SUBF2:ENCC:PDCC:DREG?`
queries the number of dummy REGs
`Response: 213`

Manual operation: See "Number of Dummy REGs" on page 181

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DATA <Data>

Selects the data source for PDCCH.

Parameters:

<Data> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example: `BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DATA PN9`
PN9 is selected as data source

Manual operation: See "Data Source" on page 181

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:PATTern <Pattern>

Selects the bit pattern for the `PATT` selection.

Parameters:

<Pattern> <bit pattern>

*RST: #H0,1

Example: `BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DATA PATT`
Pattern is selected as data source
`BB:EUTR:DL:SUBF1:ENCC:PDCC:PATT #H3F,8`
defines the bit pattern.

Manual operation: See "Data Source" on page 181

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DSELect <Filename>

Selects the data list for the DLISt data source selection.

The lists are stored in a directory of the user's choice. The directory applicable to the following commands is defined with the command `MMEMory:CDIR`. To access the files in this directory, you only have to give the file name, without the path and the file extension.

Parameters:

<Filename> string

Example: `BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DATA DLIS`
selects the Data Lists data source.
`MMEM:CDIR '<root>Lists'`
selects the directory for the data lists.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DSEL 'eutra_pdcch'`
selects file `eutra_pdcch` as the data source. This file must be in the directory `<root>Lists`

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:TRSource <TranSource>

Sets the behavior of the dummy REGs, i.e. determines whether dummy data or DTX is transmitted.

Parameters:

<TranSource> DATA | DTX

*RST: DATA

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DCR:TRS DATA`

Manual operation: See "Dummy CCE REGs" on page 182

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:DATA <Data>

Selects the data source for PDCCH.

Parameters:

<Data> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DCR:DATA PN9`
PN9 is selected as data source

Manual operation: See "Dummy CCE Data Source" on page 182

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:DSELect <Filename>

Selects the data list for the DLISt data source selection.

The lists are stored in a directory of the user's choice. The directory applicable to the following commands is defined with the command `MMEMory:CDIR`. To access the files in this directory, you only have to give the file name, without the path and the file extension.

Parameters:

<Filename>	string

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DCR:DATA DLIS`
selects the Data Lists data source.
`MMEM:CDIR '<root>Lists'`
selects the directory for the data lists.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DCR:DSEL 'eutra_pdcch'`
selects file `eutra_pdcch` as the data source. This file must be in the directory `<root>Lists`

Manual operation: See "Dummy CCE Data Source" on page 182

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:PATTern <Pattern>

Selects the bit pattern for the `PATT` selection.

Parameters:

<Pattern>	<bit pattern>
	*RST: #H0,1

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DCR:DATA PATT`
Pattern is selected as data source
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DCR:PATT #H3F,8`
defines the bit pattern.

Manual operation: See "Dummy CCE Data Source" on page 182

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:SITem <SelectedItem>

Selects an PDCCH item, i.e. a row in the DCI table.

Parameters:

<SelectedItem> integer

Range: 0 to 39

*RST: 0

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`

sets the PDCCH format.

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:SIT 2`

selects the third row in the DCI table

Manual operation: See "Standard configuration functions" on page 183

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:APPend

Adds a new row at the end of the DCI table.

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`

sets the PDCCH format.

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:APP`

adds a new row

Manual operation: See "Standard configuration functions" on page 183

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:INSert

Insert a new row before the currently selected item.

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`

sets the PDCCH format.

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:SIT 2`

selects the third row in the DCI table

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:INS`

inserts a new row before the third one

Manual operation: See "Standard configuration functions" on page 183

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:DELete

Deletes the selected row.

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`

sets the PDCCH format.

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:SIT 2`

selects the third row in the DCI table

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:DEL`

deletes the third row

Usage: Event

Manual operation: See "Standard configuration functions" on page 183

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:DOWN
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:UP

Moves the selected row down or up.

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:SIT 2`
selects the third row in the DCI table
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:UP`
moves the third row one row up

Manual operation: See "Standard configuration functions" on page 183

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:CONFlicts?

Queries the number of conflicts between the DCI formats.

To query whether there is a conflict in one particular PDCCH item, use the command `[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CONFlict?` on page 519.

Return values:

<NoOfConf> integer

Range: 0 to 20
*RST: 0

Example:
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat VARiable`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:CONFlicts?`
Response: `1`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:UITems?`
Response: `2`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM0:CONFlict?`
Response: `0`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:CONFlict?`
Response: `1`
The DCI conflict is in the second PDCCH item
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:SOLVe`

Usage: Query only

Manual operation: See "Resolve Conflicts" on page 184

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:SOLVe?

Triggers a built-in algorithm that re-assigns automatically the CCE values depending on the configured "Search Space"; previously configured CCE values will not be maintained.

If the conflict cannot be resolved automatically, the values are left unchanged.

Example: `:SOURce:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:SOLVe`

Usage: Query only

Manual operation: See "Resolve Conflicts" on page 184

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:RESet

Resets the table.

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:RES`
resets the table

Manual operation: See "Reset" on page 184

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:UITems <UsedItems>

Queries the number of used PDCCH items.

Parameters:

<UsedItems> integer

Range: 0 to 20
*RST: 0

Example: `SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat VARiable`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:APPend`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:UITems?`
Response: `2`

Manual operation: See "Number of Used PDCCH Items" on page 184

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIFmt <DciFormat>

Sets the DCI format for the selected PDCCH.

Parameters:

<DciFormat> F0 | F1 | F1A | F1B | F1C | F1D | F2 | F2A | F3 | F3A | F2B | F2C

*RST: F0

Example: `SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat VARiable`
sets the PDCCH format.
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:DCIFmt F1`
sets the DCI format

Manual operation: See "DCI Format" on page 185

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: UEID <Ueid>

Sets the n_RNTI for the selected PDCCH.

Parameters:

<Ueid> integer

Range: 0 to 100000
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:UEID 100`
sets the n_RNTI

Manual operation: See "UE_ID/n_RNTI" on page 185

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: CELL <CellIdx>

Determines the component carrier the corresponding DCI is transmitted on.

Parameters:

<CellIdx> integer

Range: 0 to 7
*RST: 0

Options: R&S SMx/AMU-K85

Manual operation: See "Cell Index" on page 185

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: PFMT <Format>

Sets the PDCCH format for the selected PDCCH.

Parameters:

<Format> integer

Range: 0 to 3
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets PDCCH format variable.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:PFMT 0`
sets the PDCCH format.

Manual operation: See "PDCCH Format (Variable)" on page 187

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: NCCes <CceCount>

Defines the number of control channel elements used for the transmission of the PDCCH.

Parameters:

<CceCount> integer

Range: 0 to 1E5
*RST: 1

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:NCC?`
queries the number of CCEs

Manual operation: See "Number CCEs" on page 187

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: CINDex <CceIndex>

Sets the CCE start index.

Parameters:

<CceIndex> integer

Range: 0 to 1E5
*RST: 0

Example: `SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat VAR`
sets the PDCCH format.
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:CINDex 10`
sets the CCE start index

Manual operation: See "CCE Index" on page 188

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: NDCCes <DummyCceCount>

Defines the number of dummy CCEs that are appended to the PDCCH.

Parameters:

<DummyCceCount> integer

Range: 0 to 1E5
*RST: 25

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:NDCC?`
queries the number of dummy CCEs

Manual operation: See "Number of Dummy CCEs" on page 188

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CONFlict?

Indicates a conflict between two DCI formats.

Return values:
<Conflict> 0 | 1 | OFF | ON
*RST: OFF

Example: `SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:CONFlict?`
queries whether there is a conflict or not.

Usage: Query only

Manual operation: See "Conflict (DCI)" on page 188

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:USER <User>

Selects the User the DCI is dedicated to.

The available DCI Formats depend on the value of this parameter.

Parameters:
<User> USER1 | USER2 | USER3 | USER4 | PRNTi | SIRNti | RARNti | NONE
*RST: USER1

Return values:
<User> USER1 | USER2 | USER3 | USER4 | PRNTi | SIRNti | RARNti | NONE | U1SPs | U2SPs | U3SPs | U4SPs
Range: USER1 to NONE
*RST: USER1

Example: `SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:USER USER2`
the DCI is dedicated to User 2

Manual operation: See "User" on page 184

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:SESPace <SearchSpace>

If enabled, this parameter configures the PDCCH DCI to be transmitted within the common or UE-specific search space.

Parameters:

<SearchSpace> OFF | AUTO | COMMon | UE | ON | 0 | 1

COMMon|UE
Common and UE-specific search spaces, as defined in the 3GPP specification

OFF|AUTO
For backwards compatibility only.

*RST: AUTO

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:SESP UE`
The DCI is transmitted within the UE-specific search space.

Manual operation: See "Search Space" on page 186

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:APLayer <ApLayerId>

Sets the DCI Format 2C field antenna port(s), layer, scrambling Id.

Parameters:

<ApLayerId> integer

Range: 0 to 7
*RST: 0

Example:
```
SOURce1:BB:EUTRa:DL:USER1:TXM M9
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat
VARiable
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:
ITEM1:DCIFmt F2C
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:
ITEM1:DCIConf:APLayer 2
```

Manual operation: See "DCI Format 2/2A/2B/2C" on page 197

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:BITData?

Queries the resulting bit data as selected with the DCI format parameters.

Return values:

<BitData> string

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:BITD?`
queries the bit data

Usage: Query only

Manual operation: See "Bit Data" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:CIField <CaIndField>

The CIF is present in **each** DCI Format and identifies the component carrier that carries the PDSCH or PUSCH for the particular PDCCH in the cross-carrier approach (see Figure 3-28).

Parameters:

<CaIndField> integer

Range: 0 to 7
*RST: 0

Example:
```
BB:EUTR:DL:CA:STAT ON
BB:EUTR:DL:USER2:CA:STAT ON
BB:EUTR:DL:CA:CELL0:CIF ON
BB:EUTR:DL:ENCC:PDCC:EXTC:ITEM1:DCIC:CIF 1
```

Options: R&S SMx/AMU-K85

Manual operation: See "Carrier Indicator Field (CIF)" on page 188

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:F1AMode <Format1aMode>

Selects the mode of the DCI format.

Parameters:

<Format1aMode> PDSCh | PRACh

*RST: PDSCh

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1A`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:F1AM PRAC`
sets the mode

Manual operation: See "DCI Format 1A" on page 192

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:PRACh:PRINdex <PreambleIndex>

(PRACH mode only)

Sets the DCI Format 1A field Preamble index.

Parameters:

<PreambleIndex> integer

Range: 0 to 63
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1A`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:F1AM PRAC`
sets the mode
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:PRAC:PRIN 10`
sets the preamble index

Manual operation: See "DCI Format 1A" on page 192

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PRACh:MINDex <MaskIndex>

(PRACH mode only)

Sets the DCI Format 1A field PRACH Mask Index.

Parameters:

<MaskIndex> integer

Range: 0 to 15
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1A`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:F1AM PRAC`
sets the mode
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:PRAC:MIND 10`
sets the preamble index

Manual operation: See "DCI Format 1A" on page 192

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CSIRequest <CsiRequest>

Sets the DCI Format 0 field CSI/CQI Request.

Parameters:

<CsiRequest> integer

Range: 0 to 3
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0`
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:CSIR 1`

Manual operation: See "DCI Format 0" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:CSDMrs <CyclicShftDmRs>

Sets the DCI Format 0 field cyclic shift for DMRS.

Parameters:

<CyclicShftDmRs> integer

Range: 0 to 7
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:CSDM 1`
sets the cyclic shift

Manual operation: See "DCI Format 0" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:DLAindex <DlAssignIndex>

(Enabled for TDD mode only)

Sets the DCI Format 0/1A/1B/1D/2/2A field downlink assignment index.

Parameters:

<DlAssignIndex> integer

Range: 0 to 3
*RST: 0

Example:
`BB:EUTR:DUPL TDD`
selects TDD mode.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:DLA 1`
sets the downlink assignment index

Manual operation: See "DCI Format 0" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:DPOFfset <DpOffset>

Sets the DCI Format 1D field downlink power offset.

Parameters:

<DpOffset> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1D`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:DPOF ON`
enables downlink power offset

Manual operation: See "DCI Format 1D" on page 195

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:GAP <Gap>

Sets the DCI Format 1A/1B/1C/1D field GAP value.

Parameters:

<Gap> ON | OFF

*RST: OFF

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1C`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:GAP ON`
enables gap value

Manual operation: See "DCI Format 1A" on page 192

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:HPN <HarqProcessNumb>

Sets the DCI Format 1/1A/1B/1D/2/2A field HARQ process number.

Parameters:

<HarqProcessNumb> integer

Range: 0 to 15
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:HPN 5`
sets the HARQ process number

Manual operation: See "DCI Format 1" on page 190

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR <Mcsr>

Sets the DCI Format 0/1/1A/1B/1C/1D field Modulation and Coding Scheme.

Parameters:

<Mcsr> integer

Range: 0 to 31

*RST: 0

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:MCSR
5
```

Manual operation: See "DCI Format 0" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI <NewDataIndicat>

Sets the DCI Format 0/1/1A/1B/1D field New Data Indicator.

Parameters:

<NewDataIndicat> ON | OFF

*RST: OFF

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```
sets the PDCCH format.
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B
```
sets the DCI format
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:NDI
ON
```
sets the New Data Indicator

Manual operation: See "DCI Format 0" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PFHopping <FreqHopState>

Sets the DCI Format 0 field PUSCH Frequency Hopping.

Parameters:

<FreqHopState> 0 | 1 | OFF | ON

*RST: OFF

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```
sets the PDCCH format.
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0
```
sets the DCI format
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:PFH
ON
```
enables PUSCH Frequency Hopping

Manual operation: See "DCI Format 0" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PMI <PmiState>

Sets the DCI Format 1B field PMI Confirmation for Precoding.

Parameters:

<PmiState> 0 | 1 | OFF | ON

*RST: OFF

Example:
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:PMI
ON
```

Manual operation: See "DCI Format 1B" on page 193

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PRECinfo <PrecodingInfo>

Sets the DCI Format 2/2A field Precoding Information.

Parameters:

<PrecodingInfo> integer

Range: 0 to 63
*RST: 0

Example:
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```
sets the PDCCH format.
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2
```
sets the DCI format
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:PREC
10
```
sets Precoding Information

Manual operation: See "DCI Format 2/2A/2B/2C" on page 197

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RAH <ResAllocHeader>

(Enabled for Channel Bandwidth > 10RBs)

Sets the DCI Format 1/2/2A field Resource Allocation Header.

Parameters:

<ResAllocHeader> 0 | 1 | OFF | ON

*RST: OFF

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:RAH
ON
```

Manual operation: See "DCI Format 1" on page 190

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:RAHR <Rahr>

Sets the DCI Format 0 field Resource Block Assignment and Hopping Resource Allocation.

Parameters:

<Rahr> integer

Range: 0 to dynamic
*RST: 0

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```

sets the PDCCH format.

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0
```

sets the DCI format

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:RAHR
100
```

sets Resource Block Assignment and Hopping Resource Allocation

Manual operation: See "DCI Format 0" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:RAType <ResAllocType>

Sets the DCI Format 0 field Resource Allocation Type.

Parameters:

<ResAllocType> integer

Range: 0 to 1
*RST: 0

Manual operation: See "DCI Format 0" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:RBA <ResBlockAssign>

Sets the DCI Format 0/1/1A/1B/1C/1D/2/2A field Resource Block Assignment.

Parameters:

<ResBlockAssign> integer

Range: 0 to 268435455
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:RBA 100`
sets Resource Block Assignment

Manual operation: See "DCI Format 1" on page 190

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:RV <RedundVersion>

Sets the DCI Format 1/1A/1B/1D field Redundancy Version.

Parameters:
<RedundVersion> integer
Range: 0 to 3
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:RV 1`
sets the Redundancy Version

Manual operation: See "DCI Format 1" on page 190

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:SRSRequest <SrsRequest>

Sets the DCI Format 1A field SRS Request.

Parameters:
<SrsRequest> integer
Range: 0 to 1
*RST: 0

Manual operation: See "DCI Format 1A" on page 192

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:SWAPflag <SwapFlag>

Sets the DCI Format 2/2A field Transport Block to Codeword Swap Flag.

Parameters:
<SwapFlag> ON | OFF
*RST: OFF

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:SWAP ON`
enables Transport Block to Codeword Swap Flag

Manual operation: See "DCI Format 2/2A/2B/2C" on page 197

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB1:MCS <Mcs>
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:MCS <Mcs>

Sets the DCI Format 2/2A field Modulation and Coding Scheme.

Parameters:
<Mcs> integer

Range: 0 to 31
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TB1:MCS 5`
sets the Modulation and Coding Scheme for TB1

Manual operation: See "DCI Format 2/2A/2B/2C" on page 197

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB1:NDI <NewDataIndicat>
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:NDI <NewDataIndicat>

Sets the DCI Format 2/2A field New Data Indicator.

Parameters:
<NewDataIndicat> ON | OFF

*RST: OFF

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TB2:NDI ON`
sets the New Data Indicator for TB2

Manual operation: See "DCI Format 2/2A/2B/2C" on page 197

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB1:RV <RedundVersion>
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:RV <RedundVersion>

Sets the DCI Format 2/2A field Redundancy Version.

Parameters:

<RedundVersion> integer

Range: 0 to 3
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TB1:RV 1`
sets the Redundancy Version for TB1

Manual operation: See "DCI Format 2/2A/2B/2C" on page 197

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:SID <ScramIdent>

Enables/disables the DCI Format 2B field Scrambling Identity.

Parameters:

<ScramIdent> 0 | 1 | OFF | ON

*RST: OFF

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2B`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:SID ON`
enables the Scrambling Identity

Options: R&S SMx/AMU-K84/-K284

Manual operation: See "DCI Format 2/2A/2B/2C" on page 197

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC <TpcCommand>

Sets the DCI Format 0/1/1A/1B/1D/2/2A field TPC Command for PUSCH.

Parameters:

<TpcCommand> integer

Range: 0 to 3
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TPCC 1`
sets the TPC Command for PUSCH

Manual operation: See "DCI Format 0" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCinstr <TpcCommand>

Sets the DCI Format 3/3A field TPC Command.

Parameters:
<TpcCommand> bit pattern

The bit pattern length depends on the selected channel bandwidth and is automatically adjusted

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F3`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TPC #B101,3`
sets the TPC Command

Manual operation: See "DCI Format 3/3A" on page 199

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPMI <Tpmi>

Sets the DCI Format 1B/1D field TPMI Information for Precoding.

Parameters:
<Tpmi> integer

Range: 0 to 15
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B`
sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TPMI 10`
sets the TPMI Information for Precoding

Manual operation: See "DCI Format 1B" on page 193

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:ULINdex <UlIndex>

(Enabled for TDD mode and UL/DL Configuration 0)

Sets the DCI Format 1B/1D field UL Index.

Parameters:

<UlIndex> integer

Range: 0 to 3

*RST: 0

Example:

`BB:EUTR:DUPL TDD`

selects TDD mode.

`BB:EUTR:TDD:UDC 0`

sets the UL/DL configuration

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`

sets the PDCCH format.

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B`

sets the DCI format

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:ULIN 1`

sets the UL Index

Manual operation: See "DCI Format 0" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:VRBA <VrbAssignState>

Sets the DCI Format 1A/1B/1D field Localized/Distributed VRB Assignment.

Parameters:

<VrbAssignState> ON | OFF

*RST: OFF

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`

sets the PDCCH format.

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B`

sets the DCI format

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:VRBA ON`

enables the Localized VRB Assignment

Manual operation: See "DCI Format 1A" on page 192

9.16 Auto Sequence Settings

Using the auto sequence mode requires the option R&S SMx/AMU-K112.

Example: How to enable and configure the auto sequence mode

```
:SCONfiguration:MODE ADV
:SCONfiguration:FADing MIMO2X2x2
:SCONfiguration:BASeband:SOURce COUP
:SCONfiguration:APPLy

:SOURce1:BB:EUTRa:DL:CONF:MODE ASEQ
:SOURce1:BB:EUTRa:DL:CA:CELL0:CIF 1
:SOURce1:BB:EUTRa:DL:CA:CELL1:CIF 1
:SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM M9
:SOURce1:BB:EUTRa:DL:USER1:CELL1:TXM M9
:SOURce1:BB:EUTRa:DL:USER2:CELL0:TXM M7
:SOURce1:BB:EUTRa:DL:USER2:CELL1:TXM M7
:SOURce1:BB:EUTRa:DL:USER1:STATe 1
:SOURce1:BB:EUTRa:DL:USER2:STATe 1

:SOURce1:BB:EUTRa:DL:USER1:AS:DL:AFSeq 1
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:NHIDs 8
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:NHTRans 4
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:INDI 1
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:SKPRocess 1
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:USUBframe0 1
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:USUBframe1 1
:SOURce1:BB:EUTRa:DL:USER1:AS:UL:AFSeq 1
:SOURce1:BB:EUTRa:DL:USER1:AS:UL:NHTRans 4
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:SNDI 1
:SOURce1:BB:EUTRa:DL:USER1:AS:APPLy
:SOURce1:BB:EUTRa:DL:USER1:AS:ARBLen?
// 32
:SOURce1:BB:EUTRa:DL:USER1:AS:ASLength

:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:MCSMode FIX
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:FMCS 30
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:RVCSequence "0,1,2,3"
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SEQelem0:SUBFrame?
// 0
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SEQelem0:HARQ?
// 0
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SEQelem0:TB1:NDI?
// 1
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SEQelem1:TB1:NDI?
```

```
// 1
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:URLCounter?
// 0

:SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:VULTxpow 1
:SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:SEQelem2:SUBFrame?
// 2
:SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:SEQelem2:RBA?
// 0
:SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:SEQelem2:NDI?
// 1
:SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:SEQelem2:PTPC 2

:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL1:MCSMode TCR
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL1:TCR 0.333
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL1:TMOD QAM64
:SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL1:SELement 2
```

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:ARBLen?

Queries the suggested ARB sequence length.

Return values:

<SugArbLen> integer

Range: 1 to 1E4
*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Usage: Query only

Manual operation: See "ARB Sequence Length" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:ASLength

Adjusts the ARB sequence length.

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Usage: Event

Manual operation: See "ARB Sequence Length" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:AFSeq <AutofillSeq>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:AFSeq <AutofillSeq>

Enables the automatic configuration of the DCIs.

Parameters:

<AutofillSeq> 0 | 1 | OFF | ON

*RST: 1

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "Autofill Sequences..." on page 151

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:NHIDs <NumHARQIds>

Sets the number of HARQ process IDs.

Parameters:

<NumHARQIds> integer

Range: 1 to 15
*RST: 8

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "Autofill Sequences..." on page 151

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:NHTRans <NumHARQTrans>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:NHTRans <NumHARQTrans>

Sets the number of HARQ transmissions.

Parameters:

<NumHARQTrans> integer

Range: 1 to 32
*RST: 4

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "Autofill Sequences..." on page 151

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:SKPRocess <SkipProc>

Skips HARQ process at unused subframes.

Parameters:

<SkipProc> 0 | 1 | OFF | ON

*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "Autofill Sequences..." on page 151

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:INDI <StartingNDI>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:INDI <StartingNDI>

Sets the new data indicator flag at the beginning of the sequence.

Parameters:

<StartingNDI> 0 | 1 | OFF | ON

*RST: 1

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "Autofill Sequences..." on page 151

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:USUBframe<st0> <UseSubfr>

Sets the downlink subframes to be used for the HARQ transmission.

Suffix:

<st0> 0 .. 9

DL subframe number

Parameters:

<UseSubfr> 0 | 1 | OFF | ON

*RST: 1

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "Autofill Sequences..." on page 151

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:APPLy

Applies the selected auto sequence settings.

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Usage: Event

Manual operation: See "Autofill Sequences..." on page 151

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:MCSMode <McsMode>

Sets how the Modulation and Coding Scheme is configured.

Parameters:

<McsMode> MANual | FIXed | TCR

*RST: TCR

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "MCS Mode" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:FMCS <FixedMcs>

Sets the MCS value.

Parameters:

<FixedMcs> integer

Range: 0 to 31
*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "MCS" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:TCR <TargetCR>

Sets the target code rate.

Parameters:

<TargetCR> float

Range: 0 to 1
Increment: 0.001
*RST: 0.333

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "Target Code Rate, Target Modulation" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:TMOD <TargetMod>

Sets the target moduilation.

Parameters:

<TargetMod> QPSK | QAM16 | QAM64

*RST: QPSK

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "Target Code Rate, Target Modulation" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:RVCSequence <RVCodingSeq>

Sets the redundancy version sequence.

Parameters:

<RVCodingSeq> string

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "RV coding Sequence" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: HARQ <HARQProc>

Sets the HARQ process.

Parameters:

<HARQProc> integer

Range: 0 to 15

*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "DL DCI Sequence Table" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: SUBFrame <DLSubfrNo>

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>: SUBFrame <ASeqSubfrNo>

Sets the subframe number.

Parameters:

<ASeqSubfrNo> integer

Range: 0 to 100000

*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "UL DCI Sequence Table" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: TB1:MCS <DlMcs>

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: TB2:MCS <DlMcs>

Sets the MCS.

Parameters:

<DlMcs> integer

Range: 0 to 31

*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:NDI <DINdi>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB2:NDI <DINdi>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:NDI <UINDI>

Enables the new data indicator flag.

Parameters:

<UINDI> 0 | 1 | OFF | ON

*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "UL DCI Sequence Table" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:RLCCounter <RLCCounter>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB2:RLCCounter <RLCCounter>

Sets the RLC counter.

Parameters:

<RLCCounter> integer

Range: 0 to 31
*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:RV <DIRV>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB2:RV <DIRV>

Sets the redundancy version.

Parameters:

<DIRV> integer

Range: 0 to 3
*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:URLCounter <UseRLCCounter>

Enables/disables the use of RLC counter.

Parameters:

<UseRLCCounter> 0 | 1 | OFF | ON

*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "Use RLC Counter" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:RBA <UlRBA>

Sets the UL RBA.

Parameters:

<UlRBA> integer

Range: 0 to 2047

*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "UL DCI Sequence Table" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:PTPC <PuschTpc>

Sets the PUSCH TPC.

Parameters:

<PuschTpc> integer

Range: 0 to 3

*RST: 0

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "UL DCI Sequence Table" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:ULINdex <UlIndex>

In TDD mode and with "UL/DL Configuration = 0", sets the parameter UL Index.

Parameters:

<UlIndex> integer

Range: 0 to 3

*RST: 0

Example:

```
:SOURce1:BB:EUTRa:TDD:UDConf 0
:SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL1:SEQelem1:ULINdex 0
```

Manual operation: See "UL DCI Sequence Table" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:VULTxpow <VaryULTxPow>

Enables variation of the UL Tx power.

Parameters:

<VaryULTxPow> 0 | 1 | OFF | ON

*RST: 1

Example: see Example "How to enable and configure the auto sequence mode" on page 533

Manual operation: See "Vary UL Tx Power and RBA" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SELement <SelElem>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement <SelElem>

Selects a table element (i.e. table row).

Parameters:

<SelElem> integer

Range: 0 to 1499
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:APPend
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SELement
1
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:INSert
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SELement
3
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:DELete
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:RESet
```

Manual operation: See "Append, Insert, Delete, Reset" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:APPend
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:APPend

Appends a table element at the end of the table.

Example: see [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement on page 542

Usage: Event

Manual operation: See "Append, Insert, Delete, Reset" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:INSert
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:INSert

Inserts a table element before the selected one.

Example: see [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement on page 542

Usage: Event

Manual operation: See "Append, Insert, Delete, Reset" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:DELete
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:DELete

Deletes the selected table element.

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement on page 542

Usage: Event

Manual operation: See "Append, Insert, Delete, Reset" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:RESet
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:RESet

Resets the DCI table, i.e. removes all table elements.

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement on page 542

Usage: Event

Manual operation: See "Append, Insert, Delete, Reset" on page 155

9.17 UL Frame Configuration

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CONSubframes:PUCCh <ConfSubf>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CONSubframes:PUSCh <ConfSubframes>

Sets the number of configurable subframes.

Parameters:

<ConfSubframes> integer

Range: 1 to 40
*RST: 1

Example:

```
SOURce1:BB:EUTRa:UL:UE1:ID 100
SOURce1:BB:EUTRa:UL:UE2:ID 100
SOURce1:BB:EUTRa:UL:UE1:CONSubframes:PUCCh 10
SOURce1:BB:EUTRa:UL:UE1:CONSubframes:PUSCh 10
SOURce1:BB:EUTRa:UL:UE2:CONSubframes:PUCCh 8
SOURce1:BB:EUTRa:UL:UE2:CONSubframes:PUSCh 8
```

Manual operation: See "Number Of PUCCH/PUSCH Configurations/Number Of Configurable Subframes" on page 235

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:CYCPrefix <CyclicPrefix>

(enabled for `BB:EUTR:UL:CPC USER` only)

Sets the cyclic prefix for the selected subframe.

Parameters:

<CyclicPrefix> NORMal | EXTended

*RST: NORMal

Example: `BB:EUTR:UL:CPC USER`
the cyclic prefix has to be adjusted on subframe basis.
`BB:EUTR:UL:SUBF6:CYCP NORM`
a normal prefix is used in subframe 6 in uplink.

Manual operation: See "Cyclic Prefix (UL)" on page 237

[:SOURce<hw>]:BB:EUTRa:UL:RSTFrame

Resets all subframe settings of the selected link direction to the default values.

Example: `BB:EUTR:UL:RSTF`
resets the uplink subframe parameters of path A to the default settings.

Manual operation: See "Reset All Subframes" on page 238

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONType <ContentType>

Selects the content type for the selected allocation.

Parameters:
<ContentType> PUSCh | PUCCh
*RST: PUSCh

Example: `BB:EUTR:UL:SUBF4:ALL2:CONT PUSC`
selects PUSCH as type for the selected allocation.

Manual operation: See "Content (UL)" on page 238

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CODWords <NumOfCodeWords>

Sets the number of the used codeword.

Parameters:
<NumOfCodeWords> integer
Range: 1 to 2
*RST: 1

Example: `SOURce1:BB:EUTRa:UL:UE1:RELease LADV`
`SOURce1:BB:EUTRa:UL:CELL0:SUBF0:ALLoc0:PUSCh:CODWords?`

Options: R&S SMx/AMU-K85/-K112

Manual operation: See "Codeword (UL)" on page 238

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>][:PUSCh]:MODulation <Modulation>

Selects the modulation scheme for the allocation.

Suffix:

<cwid> 1..2
Codeword

Parameters:

<Modulation> QPSK | QAM16 | QAM64
*RST: QPSK

Example:

```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:CONType PUSCh
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:CODWords 1
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:CW1:MODulation QPSK
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PHYSbits?
```

Manual operation: See "Modulation/Format" on page 239

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:PUCCh]:FORMat <Format>

Sets the PUCCH Format.

Parameters:

<Format> F1 | F1A | F1B | F2 | F2A | F2B | F3
*RST: F1

Example:

```
SOUR:BB:EUTR:UL:SUBF4:ALL2:CONT PUCC
SOUR:BB:EUTR:UL:SUBF4:ALL2:FORM F2A
```

sets the PUCCH format

Manual operation: See "Modulation/Format" on page 239

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:RBCount <ResBlockCount>
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:RBCount?
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:SET<user>:RBCount <NumberOfRBs>

Sets the size of the selected allocation in resource blocks (per slot).

Suffix:

<user> 1..2
Set

Parameters:

<NumberOfRBs> integer
Range: 0 to 110
*RST: 0

Example:
```
BB:EUTR:UL:UE1:REL R89
BB:EUTR:UL:SUBF0:ALL1:RBC 3
```

Example:
```
BB:EUTR:UL:UE2:REL R10
BB:EUTR:UL:SUBF0:ALL2:PUCH:RBC ?
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET1:RBC 4
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET1:VRB 5
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET2:RBC 3
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET2:VRB 15
```

Manual operation: See "Set 1/Set 2 No. RB" on page 240

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:VRBoffset <VrbOffset>
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:SET<user>:VRBoffset <NumberOfVRBs>

Sets the virtual resource block offset of the selected subframe.

Suffix:
<user> 1..2

Parameters:
<NumberOfVRBs> integer

Range: 0 to 49
*RST: 0

Example:
```
BB:EUTR:UL:SUBF0:ALL1:VRB 6
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET1:VRB 5
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET1:VRB 15
```

Manual operation: See "Set 1/Set 2 Offset VRB" on page 241

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:RBOFfset?
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:PUCCh:RBOFfset?
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:PUSCh:SET<gr>:RBOFfset?

Queries the start resource block of the selected allocation in slot n of the subframe.

Suffix:
<user0> 0..1

<s2us> 1..2

Return values:
<RbOffs> integer

Range: 0 to 49
*RST: 2

Usage: Query only

Manual operation: See "Offset PRB Slot (n/n+1)" on page 241

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PHYSbits?
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:PHYSbits?
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:PHYSbits?

Queries the number of physical bits for the selected allocation.

Suffix:

<cwid> 1..2
Codeword

Return values:

<PuscPhysBits> integer

Range: -1 to 105600
*RST: -1

Example: `SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:CW1:PUSCh:PHYSbits?`

Usage: Query only

Manual operation: See "Phys. Bits / Total Number of Physical Bits" on page 241

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:POWer <Power>
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:POWer <PuccPower>
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:POWer <PuscPower>

Sets the power for the selected allocation.

Parameters:

<PuscPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example:

```
BB:EUTR:UL:SUBF4:ALL1:POW 3.00
BB:EUTR:UL:SUBF4:ALL2:PUSH:POW -1.00
BB:EUTR:UL:SUBF4:ALL2:PUCH:POW -1.00
```

Manual operation: See "Power (UL)" on page 241

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:STATe <State>
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:STATe <PuccState>
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:STATe <PuscState>

Sets the allocation state to active or inactive.

Note: Disabling an allocation deactivate the PUSCH/PUCCH and the corresponding demodulation reference signal, but does not affect other allocations of the UE or the sounding reference signal.

Parameters:

<PuscState> 0 | 1 | OFF | ON

*RST: dynamic

Manual operation: See "State (UL)" on page 242

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONFlict?
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CONFlict?
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CONFlict?

Indicates a conflict between two allocations.

Return values:

<PuscConflict> 0 | 1 | OFF | ON

*RST: OFF

Usage: Query only

Manual operation: See "Conflict (UL)" on page 242

9.18 UL Carrier Aggregation Settings

UL Carrier Aggregation is an LTE-A (LTE Rel. 11) feature enabled for instruments equipped with software options R&S SMx/AMU-K55 and R&S SMx/AMU-K112.

Example: Activating UL carrier aggregation

```
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:CA:CELL0:DUPLexing FDD

SOURce1:BB:EUTRa:UL:CA:CELL1:INDex 5
SOURce1:BB:EUTRa:UL:CA:CELL1:ID 10
SOURce1:BB:EUTRa:UL:CA:CELL1:BW BW20_00
SOURce1:BB:EUTRa:UL:CA:CELL1:SUConfiguration 0
SOURce1:BB:EUTRa:UL:CA:CELL1:CSRS 7
SOURce1:BB:EUTRa:UL:CA:CELL1:DMRS 0
SOURce1:BB:EUTRa:UL:CA:CELL1:TDELay 0

SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:STATe 1
SOURce1:BB:EUTRa:STATe 1
OUTPut1:STATe 1
OUTPut2:STATe 1
```

[:SOURce<hw>]:BB:EUTRa:UL:CA:STATe <ULCaGlobState>

Enables UL carrier aggregation.

Parameters:

<ULCaGlobState> 0 | 1 | OFF | ON

*RST: 0

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "Activate Carrier Aggregation" on page 219

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:INDex <ULCaCellIndex>

Sets the cell index of the corresponding SCell.

Parameters:

<ULCaCellIndex> integer

Range: 1 to 7

*RST: 1

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "Cell Index" on page 219

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:ID <ULCaPhyCellId>

Sets the physical Cell ID of the PCell and the SCells.

Parameters:

<ULCaPhyCellId> integer

Range: 0 to 503

*RST: 0

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "Physical Cell ID" on page 220

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:BW <ULCaBw>

Sets the bandwidth of the corresponding component carrier.

Parameters:

<ULCaBw> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00

*RST: BW10_00

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "Bandwidth" on page 220

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DFReq <ULCaDeltaF>

Sets the frequency offset between the central frequency of corresponding SCell and the frequency of the PCell.

Parameters:

<ULCaDeltaF> float

Range: -55 to 55 (depends on the installed options)
Increment: 0.1
*RST: 0
Default unit: MHz

<ULCaDeltaF> float

Range: -35 to 35
Increment: 0.1
*RST: 0
Default unit: MHz

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "delta f / MHz" on page 220

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DUPLexing <ULCaDuplexMode>

Selects the duplexing mode of the component carriers.

Parameters:

<ULCaDuplexMode> TDD | FDD

*RST: FDD

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "Duplexing" on page 220

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:UDConf <ULCaTddULDLConf>

Sets the Uplink-Downlink Configuration number.

Parameters:

<ULCaTddULDLConf> integer

Range: 0 to 6
*RST: 0

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "TDD UL/DL Configuration" on page 220

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:SUConfiguration <ULCaSrsSubfConf>

Sets the SRS subframe configuration per component carrier.

Parameters:

<ULCaSrsSubfConf> integer

Range: 0 to 15
*RST: 15

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "SRS Subframe Configuration" on page 220

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DMRS <ULCaN1Dmrs>

Sets the parameter n(1)_DMRS per component carrier.

Parameters:

<ULCaN1Dmrs> integer

Range: 0 to 11
*RST: 0

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "n(1)_DMRS" on page 220

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:SPSConf <ULCaTddSSConf>

Sets the Special Subframe Configuration number.

Parameters:

<ULCaTddSSConf> integer

Range: 0 to 9
*RST: 0

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "TDD Special Subframe Config" on page 220

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:CSRS <ULCaSrsCSRS>

Sets the parameter SRS Bandwidth Configuration per component carrier.

Parameters:

<ULCaSrsCSRS> integer

Range: 0 to 7
*RST: 0

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "SRS Bandwidth Configuration C_SRS" on page 221

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:TDELay <TimeDelay>

Sets the time delay of the SCell relative to the PCell.

Parameters:

<TimeDelay> integer

Range: 0 to 7E5

*RST: 0

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "Delay / ns" on page 221

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:STATe <ULCaCellState>

Activates the corresponding component carrier.

Parameters:

<ULCaCellState> 0 | 1 | OFF | ON

*RST: 0

Example: see Chapter 9.18, "UL Carrier Aggregation Settings", on page 549

Manual operation: See "State" on page 221

9.19 UL Enhanced Settings

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:SCHeme <PrecodingScheme>

Sets the PUSCH precoding scheme.

Parameters:

<PrecodingScheme> NONE | SPM

*RST: NONE

Example:

```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:UE1:PUSCh:TXMode M2
SOURce1:BB:EUTRa:UL:UE1:PUSCh:NAP AP2
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:PRECoding:SCHeme SPM
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:CODWords 2
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:PRECoding:NOLayers 4
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:PRECoding:NAPused?
// Response: AP2
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:PRECoding:CBINdex?
```

Options: R&S SMx/AMU-K85

Manual operation: See "Precoding Scheme" on page 274

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CODWords <NumOfCodeWords>

Sets the number of the used codeword.

Parameters:

<NumOfCodeWords> integer

Range: 1 to 2
*RST: 1

Example:

```
SOURce1:BB:EUTRa:UL:UE1:RELease LADV
SOURce1:BB:EUTRa:UL:CELL0:SUBF0:ALLoc0:PUSCh:
CODWords?
```

Options: R&S SMx/AMU-K85/-K112

Manual operation: See "Codeword (UL)" on page 238

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:NOLayers <NumberOfLayers>

Sets the number of layers used by the PUSCh precoding.

Parameters:

<NumberOfLayers> integer

Range: 1 to 4
*RST: 1

Example: see [:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:SCHeme on page 554

Options: R&S SMx/AMU-K85

Manual operation: See "Number of Layers" on page 274

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:NAPused <NumUsedAntPorts>

Sets the number of antenna ports the PUSCH transmission uses.

Parameters:

<NumUsedAntPorts> AP1 | AP2 | AP4
*RST: AP1

Example: see `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:NAPort` on page 588

Options: R&S SMx/AMU-K85

Manual operation: See "Number of Used Antenna Port" on page 275

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:CBINdex <CodeBookIndex>

Sets the codebook index.

Parameters:

<CodeBookIndex> integer
Range: 0 to 23
*RST: 0

Example: see `[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:SCHeme` on page 554

Options: R&S SMx/AMU-K85

Manual operation: See "Codebook Index" on page 275

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:NDMRs<layer>?

Queries the parameter n(2)_DMRS,λ (Layer λ).

Suffix:

<st0> 0..39

<ch0> 0..3

<layer> 0..3
Layer

Return values:

<Ndmrs> integer
Range: 0 to 11
*RST: 0

Example: `SOURce1:BB:EUTRa:UL:SUBF0:ALLoc1:PUSCh:DRS:CYCShift 1`
`SOURce1:BB:EUTRa:UL:SUBF0:ALLoc1:PUSCh:DRS:NDMRs1?`
`Response: 6`

Usage: Query only

Options: R&S SMx/AMU-K85

Manual operation: See "n(2)_DMRS,λ (Layer λ)" on page 276

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:STATe <State>

Enables/disables frequency hopping for PUSCH.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:FHOP:STAT ON`
enables frequency hopping

Manual operation: See "Frequency Hopping" on page 275

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:TYPE?

Queries the frequency hopping type used, as defined in 3GPP TS36.213.

Return values:

<Type> TP1 | TP2 | NONE

*RST: NONE

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:FHOP:TYPE?`
queries the frequency hopping type
`Response: TP2`

Usage: Query only

Manual operation: See "Hopping Type" on page 275

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:IIHBits <InfoInHoppBits>

Sets the information in hopping bits according to the PDCCH DCI format 0 hopping bit definition.

Parameters:

<InfoInHoppBits> integer

Range: 0 to 3
*RST: 1

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:FHOP:IIHB 0`
sets the information in hopping bits

Manual operation: See "Information in Hopping Bits" on page 275

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:NDMRs<layer>?

Queries the parameter n(2)_DMRS,λ (Layer λ).

Suffix:

<st0> 0..39

<ch0> 0..3

<layer> 0..3
Layer

Return values:

<Ndmrs> integer

Range: 0 to 11
*RST: 0

Example:
```
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc1:PUSCh:DRS:
CYCShift 1
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc1:PUSCh:DRS:
NDMRs1?
Response: 6
```

Usage: Query only

Options: R&S SMx/AMU-K85

Manual operation: See "n(2)_DMRS,λ (Layer λ)" on page 276

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:CYCShift <Cyclicshift>

Sets the cyclic shift field in the uplink related DCI formats.

Suffix:

<st0> 0..39
Subframe

<ch0> 0..3
Allocation

Parameters:

<Cyclicshift> int

Range: 0 to 7
Increment: 1
*RST: 0

Example: see [:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:NDMRs<layer>? on page 556

Options: R&S SMx/AMU-K85

Manual operation: See "Cyclic Shift Field" on page 276

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:MODE <Mode>

Sets the ACK/NACK mode to Multiplexing or Bundling according to 3GPP TS 36.212, chapter 5.2.2.6.

ACK/NACK mode Bundling is defined for TDD duplexing mode only.

Parameters:

<Mode> MUX | BUNDling

*RST: MUX

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:MODE MUX`

selects multiplexing HARQ mode

Manual operation: See "ACK/NACK Mode" on page 278

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:NBUNdled <N_Bundled>

Sets the parameter N_bundled.

Parameters:

<N_Bundled> integer

Range: 1 to 6

*RST: 1

Example:

```
BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:MODE BUND
BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:NBUN 2
```

Manual operation: See "N_bundled" on page 278

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:BITS <Bits>

Sets the number of ACK/NACK bits.

Set this parameter to 0 to deactivate the ACK/NACK transmission for the corresponding subframe.

Parameters:

<Bits> integer

Range: 0 to dynamic

*RST: 1

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:BITS 2`
sets the number of A/N bits

Manual operation: See "Number of A/N Bits" on page 278

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:HARQ:CBITs?

Queries the number of coded ACK/NACK bits per codeword.

Suffix:

<cwid> 1..2
Codeword

Return values:

<Codedbits> integer

Range: 0 to max
Increment: 0
*RST: 2

Example: `SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUSCh:HARQ:BITS 2`
sets the number of A/N bits
`SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:CW1:PUSCh:HARQ:CBITs?`
`Response: 8`

Usage: Query only

Manual operation: See "Number of Coded A/N Bits (CW)" on page 278

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:PATTern <Pattern>

Sets the ACK/NACK pattern for the PUSCH.

Parameters:

<Pattern> <bit pattern>

*RST: #H0,1

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:ACKT BIT2`
selects 2-bit HARQ-ACK control information
`BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:PATT #B10,2`
sets the ACK/NACK Pattern

Manual operation: See "ACK/NACK Pattern" on page 278

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:CBITs?

Queries the number of coded CQI bits.

Return values:

<CodedBits> integer

Range: 0 to max
*RST: 22

Example: `SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUSCh:CQI:CBITs?`
queries the number of coded CQI bits

Usage: Query only

Manual operation: See "Number of Coded CQI Bits" on page 280

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:BITS <Bits>

Sets the number of CQI bits before channel coding.

Parameters:

<Bits> integer

Range: dynamic to 1024
*RST: 10

Example: see `[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:PATTern` on page 561

Manual operation: See "Number of CQI Bits" on page 280

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:PATTern <Pattern>

Sets the CQI pattern for the PUSCH.

The length of the pattern is determined by the number of CQI bits (`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:BITS`).

Parameters:

<Pattern> bit pattern

*RST: #H0,1

Example: `SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUSCh:CQI:BITS 6`
sets the number of CQI bits
`SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUSCh:CQI:PATTern #B100100,6`
sets the CQI pattern

Manual operation: See "CQI Pattern" on page 280

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:CODWord?

Queries the codeword the CQI is mapped to.

Return values:
<CqiCodeWord> CW1 | CW2
*RST: CW1

Example:
```
SOURce1:BB:EUTRa:UL:UE1:RELease LADV
:SOURce1:BB:EUTRa:UL:UE1:PUSCh:TXMode M2
:SOURce1:BB:EUTRa:UL:UE1:PUSCh:CCODing:STATe 1
:SOURce1:BB:EUTRa:UL:UE1:PUSCh:CCODing:MODE COMB
:SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:CODWords 2
:SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:CQI:CODWord?
// Response: CW1
```

Usage: Query only

Options: R&S SMx/AMU-K85

Manual operation: See "CQI mapped to" on page 280

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:RI:CBITs?

Queries the number of coded RI bits per codeword.

Suffix:
<cwid> 1..2
Codeword

Return values:
<CodedRiBits> integer
Range: 0 to max
*RST: 4

Example:
```
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:RI:BITS 6
:SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:CW1:PUSCh:RI:CBITs?
// Response: 14
```

Usage: Query only

Manual operation: See "Number of Coded RI Bits (CW)" on page 279

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:RI:BITS <Bits>

Sets the number of rank indication (RI) bits.

Set this parameter to 0 to deactivate the RI for the corresponding subframe.

Parameters:

<Bits> integer

Range: 0 to 512
*RST: 1

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:CQI:BITS 2`
sets the number of RI bits

Manual operation: See "Number of RI Bits" on page 279

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:RI:PATTern <Pattern>

Sets the RI pattern for the PUSCH.

Parameters:

<Pattern> bit pattern

*RST: #B0,1

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:RI:BITS 2`
sets the number of RI bits
`BB:EUTR:UL:SUBF4:ALL2:PUSC:RI:PATT #B10,2`
sets the RI pattern

Manual operation: See "RI Pattern" on page 279

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:ULSCh:BITS?

Queries the number of physical bits used for UL-SCH transmission.

Suffix:

<cwid> 1..2
Codeword

Return values:

<PhysBitCount> integer

Range: 0 to max
*RST: 1500

Example: `SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:CW1:PUSCh:ULSCh:BITS?`
queries the number of physical bits for UL-SCH
`Response: 5688`

Usage: Query only

Manual operation: See "Number of Coded UL-SCH Bits" on page 281

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUSCh:ULSCh:BITS<cw>?

Queries the number of physical bits used for UL-SCH transmission.

Suffix:
<cw> 1..2
Codeword

Return values:
<PhysBitCount> integer

Range: 0 to max
Increment: 1
*RST: 1500

Example: `SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:ULSCh:BITS1?`
queries the number of physical bits for UL-SCH
`Response: 5688`

Usage: Query only

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:CCODing:TBSize <TranspBlockSize>

Sets the size of the transport block.

Suffix:
<cwid> 1..2
Codeword

Parameters:
<TranspBlockSize> integer

Range: 1 to 100000
*RST: 1500

Example: `SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:CW1:PUSCh:CCODing:TBSize 1500`
sets the size of the transport block

Manual operation: See "Transport Block Size/Payload (PUSCH)" on page 281

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:CCODing:RVINdex <RedundVersIndex>

Sets the redundancy version index.

Suffix:
<cwid> 1..2
Codeword

Parameters:
<RedundVersIndex> integer

Range: 0 to 3
*RST: 0

Example: `SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:CW1:PUSCh:CCODing:RVINdex 2`
sets the redundancy version index

Manual operation: See "Redundancy Version Index (PUSCH)" on page 281

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NAPused?

Queries the number of antenna ports used for transmissions of the current PUCCH format.

Return values:

<NumAntennaPorts> integer

Range: 1 to 2
*RST: 1

Example:

```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:UE1:PUCCh:F1Naport AP2
SOURce1:BB:EUTRa:UL:UE1:PUCCh:F2Naport AP1
SOURce1:BB:EUTRa:UL:UE1:PUCCh:F3Naport AP1
SOURce1:BB:EUTRa:UL:SUBF0:Alloc0:PUCCh:NAPused?
// Response: 2
SOURce1:BB:EUTRa:UL:SUBF0:Alloc0:FORMat F2B
SOURce1:BB:EUTRa:UL:SUBF0:Alloc0:PUCCh:NAPused?
// Response: 1
```

Usage: Query only

Options: R&S SMx/AMU-K85

Manual operation: See "Number of Used Antenna Ports" on page 282

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NPAR<ap> <NPar>

Sets the resource index for PUCCH format 1/1a/1b, 2/2a/2b and 3.

Suffix:

<ap> 0..1
Antenna port index

Parameters:

<NPar> integer

Range: 0 to n(1)_PUCCH_max / n(2)_PUCCH_max / n(3)_PUCCH_max
*RST: 0

Example: `SOURce1:BB:EUTRa:UL:SUBF1:ALLoc2:PUCCh:NPAR0 10`
sets the n_PUCCH parameter

Manual operation: See "n_PUCCH" on page 283

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:BITS <Bits>

(enabled for PUCCH format 3 only)

Sets the number of ACK/NACK+SR+CSI bits before channel coding.

Parameters:

<Bits> integer

Range: 1 to dynamic
*RST: 1

Manual operation: See "Number of A/N+SR+CSI Bits" on page 285

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:CBITs?

(enabled for PUCCH format 3 only)

Queries the number of coded ACK/NACK+SR+CSI bits.

Return values:

<CBits> integer

Range: 0 to 48
*RST: 0

Usage: Query only

Manual operation: See "Number of Coded A/N+SR+CSI Bits" on page 286

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:PATTern <Pattern>

Sets the PUCCH ACK/NACK pattern or ACK/NACK + SR pattern per subframe.

Parameters:

<Pattern> <32-bit pattern>

*RST: #H0,1

Example:

```
SOURce1:BB:EUTRa:SLENgth 4
SOURce1:BB:EUTRa:UL:UE1:CONSubframes:PUCCh 8
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc1:FORMat F1A
SOURce1:BB:EUTRa:UL:SUBF4:ALL2:PUCCh:HARQ:
PATTern #B01001,5
```

sets the ACK/NACK Pattern

```
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc1:FORMat F1B
```

Manual operation: See "A/N Pattern / A/N+SR+CSI Pattern" on page 284

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:CBITs?

Queries the number of coded CQI bits.

Return values:

<CodedBits> integer

Range: 0 to max
*RST: 20

Example:
```
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUCCh:CQI:
CBITs?
```
queries sets the number of coded CQI bits
```
Response: 20
```

Usage: Query only

Manual operation: See "Number of Coded CQI Bits" on page 286

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:BITS <Bits>

Sets the number of CQI bits before channel coding.

Parameters:

<Bits> integer

Range: 1 to 13
*RST: 4

Example: see `[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:PATTern` on page 567

Manual operation: See "Number of CQI Bits" on page 285

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:PATTern <Pattern>

Sets the CQI pattern for the PUCCH.

The length of the pattern is determined by the number of CQI bits (`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:BITS`).

Parameters:

<Pattern> <bit pattern>

*RST: #B0,1

Example:
```
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUCCh:CQI:BITS
6
```
sets the number of CQI bits
```
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUCCh:CQI:
PATTern #B100100,6
```
sets the CQI pattern

Manual operation: See "CQI Pattern" on page 286

9.20 Configure User

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:STATe <UserState>

Enables/disables an user.

Parameters:

<UserState> 0 | 1 | OFF | ON

*RST: 1

Example: `SOURce1:BB:EUTRa:DL:USER1:STATe OFF`

Manual operation: See "State" on page 201

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CA:STATe <State>

Enables/disables carrier aggregation for the selected user.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Options: R&S SMx/AMU-K85

Manual operation: See "Activate CA" on page 201

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:TXM <TxMode>

Sets the transmission mode of the according user as defined in 3GPP TS 36.213, section 7.1.

Parameters:

<TxMode> USER | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9

*RST: USER

Example: `SOURce1:BB:EUTRa:DL:USER1:TXM M7`

Options: Tx Mode 8 and Tx Mode 9 require R&S SMx/AMU-K84/-K284 and R&S SMx/AMU-K85/-K285 respectively

Manual operation: See "Tx Modes" on page 202

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:TXM <TxMode>

Sets the transmission mode of the user per cell.

Suffix:

<st0> 0 to 4
0 = PCell, 1 to 4 = SCell1 to SCell4

Parameters:

<TxMode> USER | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9

*RST: USER

Example:
```
SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM M9
SOURce1:BB:EUTRa:DL:USER1:CELL1:TXM M7
```

Manual operation: See "Tx Modes" on page 202

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEC <UECategory>

Sets the UE Category.

Parameters:

<UECategory> USER | C1 | C2 | C3 | C4 | C5

*RST: USER

Manual operation: See "UE Category" on page 203

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:ULCA<st0>:STATe <CuUlCaState>

Sets the state of the associated UL carriers, if carrier aggregation is enabled.

Suffix:

<st0> 0 to 4
0 = PCell, 1 to 4 = SCell1 to SCell4

Parameters:

<CuUlCaState> 0 | 1 | OFF | ON

*RST: 0

Example:
```
SOURce1:BB:EUTRa:DL:CA:STATe 1
SOURce1:BB:EUTRa:DL:USER1:ULCA0:STATe 1
SOURce1:BB:EUTRa:DL:USER1:ULCA1:STATe 1
```

Options: R&S SMx/AMU-K85

Manual operation: See "UL Carriers State" on page 202

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CELL <SelCompCar>

Sets the cell the antenna port mapping is related to, if a carrier aggregation is enabled.

Parameters:

<SelCompCar> PC0 | SC1 | SC2 | SC3 | SC4

*RST: PC0

Example:
```
:SOURce1:BB:EUTRa:DL:USER1:APM:CELL?
```

Manual operation: See "Cell" on page 208

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBINdex[<dir>] <CodeBookIndex>

Sets the codebook index for mapping mode Codebook.

Suffix:

<dir> 1|2

In TxMode 9, determines the codebook index

Parameters:

<CodeBookIndex> integer

Range: 0 to 15

*RST: 0

Example:
```
SOURce1:BB:EUTRa:DL:USER1:APM:MODE CB
SOURce1:BB:EUTRa:DL:USER1:APM:CBINdex1 5
```

Options: R&S SMx/AMU-K84/-K284

Manual operation: See "Codebook Index/Codebook Index 2" on page 208

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:MAPCoordinates <MapCoord>

Switches between the Cartesian (Real/Imag.) and Cylindrical (Magn./Phase) coordinates representation.

Parameters:

<MapCoord> CARTesian | CYLindrical

*RST: CARTesian

Options: R&S SMx/AMU-K84/-K284

Manual operation: See "Mapping Coordinates" on page 208

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:MODE <AntPortMap>

Defines the antenna port mapping method, see "Mapping Methods" on page 206.

Parameters:

<AntPortMap> CB | RCB | FW

CB
Codebook

RCB
Random codebook

FW
Fixed weight

*RST: FW

Options: R&S SMx/AMU-K84/-K284

Manual operation: See "Antenna Port Mapping" on page 208

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:AP<dir0>:TX<st0>:REAL <AntPortMapData>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:AP<dir0>:TX<st0>:IMAGinary <AntPortMapData>

Defines the mapping of the antenna ports to the physical antennas.

Suffix:

<dir0> 5 | 7 | .. 14
antenna port

Parameters:

<AntPortMapData> float

Range: -1 to 1
Increment: 0.01
*RST: 0

Manual operation: See "Mapping table" on page 208

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:STATe <State>

Enables/disables scrambling for all allocations belonging to the selected user.

In the allocation table, the scrambling state of all allocations for which User 1...4 is selected as "Data Source" is set to the value set with this parameter.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example:
`SOUR:BB:EUTR:DL:USER3:SCR:STAT OFF`
disables scrambling for allocations belonging to user 3.
`SOUR:BB:EUTR:DL:SUBF0:ALL4:CW:DATA USER3`
`SOUR:BB:EUTR:DL:SUBF0:ALL5:CW:DATA USER3`
`SOUR:BB:EUTR:DL:SUBF0:ALL4:CW:SCR:STAT?`
`Response: Off`
`SOUR:BB:EUTR:DL:SUBF0:ALL5:CW:SCR:STAT?`
`Response: Off`

Manual operation: See "Scrambling State" on page 203

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CCODing:STATe <State>

Enables/disables channel coding for all allocations belonging to the selected user.

In the allocation table, the Channel Coding State of all allocations for which User 1...4 is selected as "Data Source" is set to the value set with this parameter.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: OFF

Example:
`BB:EUTR:DL:USER2:CCOD:STAT ON`
enables channel coding for allocations belonging to user 2.

Manual operation: See "Channel Coding State" on page 203

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEID <Ueid>

Sets the user equipment ID.

Parameters:
<Ueid> integer
Range: 0 to 65535
*RST: 0

Example:
`BB:EUTR:DL:USER2:UEID 3308`
sets the UE ID.

Manual operation: See "UE ID" on page 203

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DATA <Data>

Selects the data source for the selected user configuration.

Parameters:
<Data> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE
*RST: PN9

Example:
`BB:EUTR:DL:USER2:DATA PN9`
PN9 is selected as data source for the user configuration.

Manual operation: See "Data List Management" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DSELect <DSelect>

Selects the data list for the DLISt data source selection.

The lists are stored as files with the fixed file extensions `*.dm_iqd` in a directory of the user's choice. The directory applicable to the following commands is defined with the command `MMEMory:CDIR`. To access the files in this directory, you only have to give the file name, without the path and the file extension.

Parameters:

<DSelect> string

Example:

`BB:EUTR:DL:USER2:DATA DLIS`
selects the Data Lists data source.
`MMEM:CDIR '<root>Lists'`
selects the directory for the data lists.
`BB:EUTR:DL:USER2:DSEL 'eutra_list1'`
selects file `eutra_list1` as the data source. This file must be in the directory `<root>Lists` and have the file extension `*.dm_iqd`.

Manual operation: See "Data List Management" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:PATTern <Pattern>

Selects the bit pattern for the `PATT` selection. The maximum length is 64 bits.

Parameters:

<Pattern> <64-bit pattern>

*RST: #H0,1

Example:

`BB:EUTR:DL:USER2:PATT #H3F,8`
defines the bit pattern.

Manual operation: See "Data Source, DList/Pattern" on page 203

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:PA <Power>

Sets PDSCH power factor according to TS 36.213, chapter 5.2.

Parameters:

<Power> -6.02 | -4.77 | -3.01 | -1.77 | 0 | 0.97 | 2.04 | 3.01

*RST: 0

Example:

`BB:EUTR:DL:USER2:PA 2.04`
selects the P_A

Manual operation: See "P_A" on page 204

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:ASRS:STATe <CuApSrsState>

Enables/disables an aperiodic transmission of SRS for the selected user.

Parameters:

<CuApSrsState> 0 | 1 | OFF | ON

*RST: 0

Example: `SOURce1:BB:EUTRa:DL:USER2:ASRS:STATe ON`

Manual operation: See "Aperiodic SRS" on page 204

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CAW:STATe <CuCsiAware>

Enables/disables the CSI awareness for the selected user.

Parameters:

<CuCsiAware> OFF | ON | 1 | 0

*RST: OFF

Example: see Example "Enabling a CSI-RS transmission" on page 490

Manual operation: See "CSI Awareness" on page 204

9.21 Dummy Data Configuration

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:MODulation <Modulation>

Selects modulation for dummy data.

Parameters:

<Modulation> QPSK | QAM16 | QAM64

*RST: QPSK

Example: `BB:EUTR:DL:DUMD:MOD QAM16`

16QAM is selected as modulation for dummy data.

Manual operation: See "Modulation" on page 146

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:POWer <Power>

Sets the power for dummy data.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:DUMD:POWer 10.00`
sets the power for dummy data to 10 dB.

Manual operation: See "Power (Dummy Data)" on page 147

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:DATA <Data>

Selects the data source for dummy data.

Parameters:

<Data> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example: `BB:EUTR:DL:DUMD:DATA PN9`
PN9 is selected as data source for dummy data.

Manual operation: See "Data Source" on page 147

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:DSELect <Filename>

Selects the data list for the DLISt data source selection.

The lists are stored as files with the fixed file extensions `*.dm_iqd` in a directory of the user's choice. The directory applicable to the following commands is defined with the command `MMEMory:CDIR`. To access the files in this directory, you only have to give the file name, without the path and the file extension.

Parameters:

<Filename> string

Example: `BB:EUTR:DL:DUMD:DATA DLIS`
selects the Data Lists data source.
`MMEM:CDIR '<root>Lists'`
selects the directory for the data lists.
`BB:EUTR:DL:DUMD:DSELect 'eutra_list1'`
selects file `eutra_list1` as the data source. This file must be in the directory `<root>Lists` and have the file extension `*.dm_iqd`.

Manual operation: See "Data Source" on page 147

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:PATTern <Pattern>

Selects the bit pattern for the `PATTern` selection. The maximum length is 64 bits.

Parameters:

<Pattern> <bit pattern>

*RST: #H0,1

Example: `BB:EUTR:DL:DUMD:PATTern #H1E,8`
defines the bit pattern to #H1E,8.

Manual operation: See "Data Source" on page 147

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:OPSubframes <OmitPrsSf>

If the OCNG is used, you can disable (omit) the OCNG transmission in the non-muted PRS subframes.

Parameters:

<OmitPrsSf> 0 | 1 | OFF | ON

*RST: 0

Example:
```
SOURce1:BB:EUTRa:DL:BUR DUData
SOURce1:BB:EUTRa:DL:PRSS:MIPattern #H2,2
SOURce1:BB:EUTRa:DL:DUMD:OPSubframes ON
```

Manual operation: See "Omit PRS Subframes" on page 147

9.22 SPS Configuration

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:STATe <UsrSpsState>

Enables SPS (semi-persistence scheduling).

Parameters:

<UsrSpsState> 0 | 1 | OFF | ON

*RST: 0

Example:
```
SOURce1:BB:EUTRa:DL:USER2:SPS:STATe ON
SOURce1:BB:EUTRa:DL:USER2:SPS:CRNTi 250
SOURce1:BB:EUTRa:DL:USER2:SPS:SINTerval S20
SOURce1:BB:EUTRa:DL:USER2:SPS:SACTivation 1
SOURce1:BB:EUTRa:DL:USER2:SPS:SRELease 3
```

Manual operation: See "Activate SPS" on page 212

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:CRNTi <UserSpsCRnti>

Sets the SPS C-RNTI parameter.

Parameters:

<UserSpsCRnti> integer

Range: 1 to 65523
*RST: 1

Example: see [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:STATe on page 576

Manual operation: See "SPS C-RNTI" on page 213

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SINTerval <UserSpsInt>

Defines the SPS interval.

Parameters:

<UserSpsInt> S10 | S20 | S32 | S40 | S64 | S80 | S128 | S160 | S320 | S640

*RST: S10

Example: see [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:STATe on page 576

Manual operation: See "SPS Interval" on page 213

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SACTivation <UsrSpsActSubfr>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SRELease <UsrSpsRelSubfr>

Defines the start and end subframes of the semi-persistent scheduling.

Parameters:

<UsrSpsRelSubfr> integer

Range: 0 to 65535
*RST: 1

Example: see [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:STATe on page 576

Manual operation: See "Activation/Release Subframe No" on page 213

9.23 User Equipment

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:RELease <Release>

Determines whether the selected UE is a LTE Release 8/9 or a LTE-Advanced UE.

Parameters:

<Release> R89 | LADV

*RST: R89

Example: `SOURce1:BB:EUTRa:UL:UE1:RELease LADV`

Options: R&S SMx/AMU-K85

Manual operation: See "3GPP Release" on page 244

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:DACRestart <RestartState>

If activated, the data source, the ACK/NACK pattern, the CQI pattern and RI are restarted every subframe.

Parameters:

<RestartState> 0 | 1 | OFF | ON

*RST: 0

Example: `BB:EUTR:UL:UE2:PUSC:DACR ON`

enables restarting of the data source every subframe

Manual operation: See "Restart Data, A/N, CQI and RI Every Subframe and Codeword" on page 244

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:ID <Id>

Sets the radio network temporary identifier (RNTI) of the UE.

Parameters:

<Id> integer

Range: 0 to 65535

*RST: 0

Example: `BB:EUTR:UL:UE3:ID 303`

sets the UE ID

Manual operation: See "UE ID/n_RNTI (User Equipment)" on page 244

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:STATe <State>

Selects the user equipment state.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON (UE1); OFF (UE2..UE4)

Example: `BB:EUTR:UL:UE2:STAT ON`

activates UE2.

Manual operation: See "State (User Equipment)" on page 243

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:MODE <Mode>

Selects whether the user equipment is in standard or in PRACH mode.

Parameters:

<Mode> STD | PRACh

*RST: STD

Example: `BB:EUTR:UL:UE:MODE STD`
selects the standard mode for UE1.

Manual operation: See "Mode" on page 244

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:POWer <Power>

Sets the power level of the selected UE.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:UL:UE2:POW -5.0`
sets the power of UE2

Manual operation: See "UE Power" on page 244

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:ALRB <AllocResBlocks>

Queries the number of the allocated resource blocks for the selected FRC.

Parameters:

<AllocResBlocks> integer

Range: 0 to 110
*RST: 0

Example: `BB:EUTR:UL:UE2:FRC:TYPE A34`
sets the FRC
`BB:EUTR:UL:UE2:FRC:ALRB?`
`Response: 25`

Manual operation: See "Allocated Resource Blocks" on page 253

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:MODulation?

Queries the modulation for the selected FRC (`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TYPE` on page 582).

Return values:

<Modulation> QPSK | QAM16 | QAM64

*RST: QPSK

Example:
`BB:EUTR:UL:UE2:FRC:TYPE A34`
sets the FRC
`BB:EUTR:UL:UE2:FRC:MOD?`
`Response: QPSK`

Usage: Query only

Manual operation: See "Modulation (FRC)" on page 253

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:N2DMrs <N2Dmrs>

Sets the UE specific part of the demodulation reference signal (DMRS) index for all PUSCH allocation of the selected UE in all subframes.

Parameters:

<N2Dmrs> integer

Range: 0 to 10
*RST: 0

Example:
`SOUR:BB:EUTR:UL:SUBF4:ALL0:PUSC:NDMR 3`
sets the n(2)_DMRS
`SOUR:BB:EUTR:UL:UE1:FRC:STAT ON`
enables FRC
`SOUR:BB:EUTR:UL:UE1:FRC:N2DM 5`
sets the DMRS index for all PUSCH allocation of the selected UE in all subframes
`SOUR:BB:EUTR:UL:SUBF4:ALL0:PUSH:N2DM?`
`Response: 5`

Manual operation: See "n(2)_DMRS (FRC)" on page 254

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:PASize?

Queries the payload size for the selected FRC (`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TYPE` on page 582).

Return values:

<PayloadSize> integer

Range: 0 to 2E5
*RST: 0

Example:
`BB:EUTR:UL:UE2:FRC:TYPE A34`
sets the FRC
`BB:EUTR:UL:UE2:FRC:PAS?`
`Response: 2216`

Usage: Query only

Manual operation: See "Payload Size (FRC)" on page 253

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:STATe <State>

Enables/disables FRC configuration.

Enabling FRC configuration sets some parameters to their predefined values, i.e. several parameters are displayed as read-only. Reconfiguration of the values of this parameters is possible only after disabling the FRC configuration.

The FRC State is disabled and cannot be enabled, if a user defined cyclic prefix (`BB:EUTR:UL:CPC USER`) is selected.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:EUTR:UL:UE2:FRC:STAT ON`
enables FRC

Manual operation: See "FRC State" on page 252

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TNOBits?

Queries the total number of physical bits available for the PUSCH allocation per subframe in case the PUSCH is not shortened because of SRS or because it is transmitted in a cell-specific SRS subframe.

Return values:

<TotalBitCount> integer

Range: 0 to max
*RST: 0

Example: `BB:EUTR:UL:UE2:FRC:TYPE A34`
sets the FRC
`BB:EUTR:UL:UE2:FRC:TNOB?`
`Response: 7200`

Usage: Query only

Manual operation: See "Physical Bits Per Subframe (Unshortened PUSCH)" on page 253

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TYPE <Type>

Selects a predefined fixed reference channel according to 3GPP TS 36.141, Annex A, respectively 3GPP TS 36.521-1, Annex A.

Parameters:

<Type> A11 | A12 | A13 | A14 | A15 | A21 | A22 | A23 | A31 | A32 | A33 | A34 | A35 | A36 | A37 | A41 | A42 | A43 | A44 | A45 | A46 | A47 | A48 | A51 | A52 | A53 | A54 | A55 | A56 | A57 | A71 | A72 | A73 | A74 | A75 | A76 | A81 | A82 | A83 | A84 | A85 | A86 | UE11 | UE12 | UE21 | UE22 | UE3

*RST: A11

Example: `BB:EUTR:UL:UE2:FRC:TYPE A34`
selects FRC A3_4

Manual operation: See "FRC" on page 252

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:VRBoffset <VrbOffset>

Sets the virtual resource block (VRB) offset for all PUSCH allocation of the selected UE in all subframes.

Parameters:

<VrbOffset> integer

Range: 0 to dynamic
*RST: 2

Example:
```
SOUR:BB:EUTR:UL:SUBF4:ALL0:VRB 6
SOUR:BB:EUTR:UL:UE1:FRC:STAT ON
SOUR:BB:EUTR:UL:UE1:FRC:VRB 3
SOUR:BB:EUTR:UL:SUBF4:ALL0:VRB?
Response: 3
```

Manual operation: See "Offset VRB (FRC)" on page 254

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRSTate <State>

Activates Power Ramping for the PRACH preamble. The start and the end of the preamble is cyclically extended and multiplied with a ramping function (sin^2).

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example:
```
BB:EUTR:UL:UE1:MODE PRAC
BB:EUTR:UL:UE1:PRAC:PRST ON
```

Manual operation: See "State PRACH Power Ramping" on page 269

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRTT <TransitionTime>

Defines the transition time from beginning of the extended preamble to the start of the preamble itself.

Parameters:

<TransitionTime> float

Range: 0 to 3E-5
Increment: 1E-7
*RST: 2E-5
Default unit: s

Example: `BB:EUTR:UL:UE1:MODE PRAC`
`BB:EUTR:UL:UE1:PRAC:PRST ON`
`BB:EUTR:UL:UE1:PRAC:PRTT 15us`

Manual operation: See "Transition Time" on page 269

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRFormat?

Queries the preamble format.

Return values:
<PreaFormat> integer

Range: 0 to 3
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:PRF?`
queries the preamble format.

Usage: Query only

Manual operation: See "Preamble Format (Burst Format)" on page 270

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:CFRames?

Queries the number of configurable frames.

Return values:
<ConfigFrameCoun> integer

Range: 1 to 10
*RST: 1

Example: `BB:EUTR:UL:UE1:PRAC:CRF?`
queries the number of frames

Usage: Query only

Manual operation: See "Number of Configurable Frames" on page 270

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:RBOFfset <RbOffset>

Queries the starting RB, as set with the command `[:SOURce<hw>]:BB:EUTRa:UL:PRACh:FOFFset`.

Parameters:
<RbOffset> integer

Range: 0 to 109
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:RBOF?`
queries the RB offset.

Manual operation: See "RB Offset" on page 271

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:FRINdex <FreqResIndex>

(enabled in TDD duplexing mode only)

Sets the frequency resource index f_{RA} for the selected subframe.

Parameters:

<FreqResIndex> integer

Range: 0 to dynamic
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:FRIN 2`
sets the frequency resource index

Manual operation: See "Frequency Resource Index" on page 271

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:POWer <Power>

Sets the PRACH power relative to the UE power. The PRACH power can be adjusted independently for every configured preamble.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:POW -3`
sets the power

Manual operation: See "Power (PRACH)" on page 272

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:NCSConf <NcsConfig>

Selects the Ncs configuration of the selected subframe.

Parameters:

<NcsConfig> integer

Range: 0 to 15
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:NCSC 2`
sets the Ncs Configuration

Manual operation: See "Ncs Configuration" on page 271

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:RSEQuence <RootSequence>

Selects the logical root sequence index for the selected subframe.

Parameters:

<RootSequence> integer

Range: 0 to 838
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:RSEQ 200`
sets the root sequence

Manual operation: See "Logical Root Sequence Index" on page 271

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:SINDex <SequenceIndex>

Selects the sequence index v.

Parameters:

<SequenceIndex> integer

Range: 0 to 63
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:SIND 30`
sets the sequence index

Manual operation: See "Sequence Index (v)" on page 272

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:DT <DeltaTime>

Sets the parameter delta_t in us.

Parameters:

<DeltaTime> float

Range: -500 to 500
Increment: 0.01
*RST: 0
Default unit: us

Example: `SOURce1:BB:EUTRa:UL:UE1:PRACh:SUBF2:DT 300`

Manual operation: See "Delta t/us" on page 272

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:STATe <State>

Enables/disables the PRACH for the selected subframe.

The subframes available for configuration depend on the selected PRACH configuration.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:STAT ON`
activates PRACH in subframe 2 for UE1.

Manual operation: See "State (PRACH)" on page 272

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DATA <Data>

Selects the data source for Physical Uplink Shared Channel (PUSCH) of the selected UE. For the selected UE, this data source will be used for the PUSCH channel in every subframe where this channel is configured.

Parameters:

<Data> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example: `BB:EUTR:UL:SUBF4:ALL2:CONT PUSC`
sets the content type for the allocation 2 (UE3) to PUSCH.
`BB:EUTR:UL:UE3:PUSC:DATA PN11`
PN11 is selected as data source for PUSCH channel of UE3.

Manual operation: See "Data Source" on page 255

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:PATTern <Pattern>

Selects the bit pattern for the `PATTern` selection. The maximum length is 64 bits.

Parameters:

<Pattern> <bit pattern>

*RST: #H0,1

Example: `BB:EUTR:UL:UE2:PUSC:DATA PATT`
`BB:EUTR:UL:UE2:PUSC:PATT #H3F,8`

Manual operation: See "Data Source" on page 255

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DSELect <Filename>

Selects the data list for the DLISt data source selection.

The lists are stored as files with the fixed file extensions `*.dm_iqd` in a directory of the user's choice. The directory applicable to the following commands is defined with the command `MMEMory:CDIR`. To access the files in this directory, you only have to give the file name, without the path and the file extension.

Parameters:

<Filename> string

Example: `BB:EUTR:UL:UE:PUSC:DATA DLIS`
selects the Data Lists data source.
`MMEM:CDIR '<root>Lists'`
selects the directory for the data lists.
`BB:EUTR:UL:UE:PUSC:DSELect 'eutra_list1'`
selects file `eutra_list1` as the data source. This file must be in the directory `<root>Lists` and have the file extension `*.dm_iqd`.

Manual operation: See "Data Source" on page 255

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:TXMode <TxMode>

For Release 10 UEs, sets the PUSCH transmission mode according to 3GPP TS 36.213 [5].

Parameters:

<TxMode> M1 | M2

M1
Spatial Multiplexing not Possible

M2
Spatial Multiplexing Possible

*RST: M1

Example:
```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:UE1:PUSCh:TXMode M2
```

Options: R&S SMx/AMU-K85

Manual operation: See "Transmission Mode" on page 256

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:NAPort <NumAPs>

Sets the number of antenna ports for PUSCH transmission the UE is general configured for.

Use the command `[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:NAPused` on page 556 to query the number of used antenna ports.

Parameters:

<NumAPs> AP1 | AP2 | AP4

*RST: AP1

Example:
```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:UE1:PUSCh:NAP AP2
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:PRECoding:NAPused?
// Response: AP2
```

Options: R&S SMx/AMU-K85

Manual operation: See "Max. Number of Antenna Ports for PUSCH" on page 256

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:SCRambling:STATe <State>

Enables/disables scrambling for all PUSCH allocations of the corresponding UE.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:EUTR:UL:UE2:PUSC:SCR:STAT ON`

enables scrambling for UE2

Manual operation: See "State Scrambling (PUSCH)" on page 256

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:STATe <State>

Enables/disables channel coding and multiplexing of data and control information for all PUSCH allocations of the corresponding UE.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:EUTR:UL:UE2:PUSC:CCOD:STAT ON`

enables channel coding for UE2

Manual operation: See "State Channel Coding and Multiplexing (PUSCH)" on page 256

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:MODE <Mode>

Defines the information transmitted on the PUSCH.

Parameters:

<Mode> COMBined | ULSChonly | UCIonly

COMBined
Control information and data is multiplexed into the PUSCH.

ULSChonly
Only data is transmitted on PUSCH.

UCIonly
Only uplink control information is transmitted on PUSCH.

*RST: ULSChonly

Example: `BB:EUTR:UL:UE2:PUSC:CCOD:MODE COMB`

enables multiplexing of the control information (UCI) and data (UL-SCH) on the PUSCH for UE2

Manual operation: See "Mode Channel Coding" on page 257

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing: ICQioffset <IcqiOffset>

Sets the CQI offset index for control information MCS offset determination according to 3GPP TS 36.213, chapter 8.6.3.

Parameters:

<IcqiOffset> integer

Range: 2 to 15
*RST: 2

Example:
`BB:EUTR:UL:UE2:PUSC:CCOD:MODE COMB`
enables multiplexing of the control information (UCI) and data (UL-SCH) on the PUSCH for UE2
`BB:EUTR:UL:UE2:PUSC:CCOD:ICQ 5`
sets the CQI offset index

Manual operation: See "I_CQI_offset" on page 257

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing: IHARqoffset <IHarqOffset>

Sets the HARQ-ACK offset index for control information MCS offset determination according to 3GPP TS 36.213, chapter 8.6.3.

Parameters:

<IHarqOffset> integer

Range: 0 to 14
*RST: 0

Example:
`BB:EUTR:UL:UE2:PUSC:CCOD:MODE COMB`
enables multiplexing of the control information (UCI) and data (UL-SCH) on the PUSCH for UE2
`BB:EUTR:UL:UE2:PUSC:CCOD:IHAR 5`
sets the HARQ-ACK offset index

Manual operation: See "I_HARQ_offset" on page 257

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing: IRIoffset <IRIOffset>

Sets the RI offset index for control information MCS offset determination.

Parameters:

<IRIOffset> integer

Range: 0 to 12
*RST: 0

Example:
```
BB:EUTR:UL:UE2:PUSC:CCOD:MODE COMB
```
enables multiplexing of the control information (UCI) and data (UL-SCH) on the PUSCH for UE2
```
BB:EUTR:UL:UE2:PUSC:CCOD:IRI 5
```
sets the RI offset index

Manual operation: See "I_RI_offset" on page 257

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:OCQimin <ChanCodOCQIMin>

For PUSCH channel coding and multiplexing mode UCI only, sets the parameter O_CQI-Min.

Parameters:

<ChanCodOCQIMin> integer

Range: 1 to 472
*RST: 1

Example:
```
SOURce1:BB:EUTRa:UL:UE1:PUSCh:CCODing:MODE UCI
SOURce1:BB:EUTRa:UL:UE1:PUSCh:CCODing:OCQimin 7
```

Manual operation: See "O_CQI-Min" on page 257

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F1Naport <NumAPs>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F2Naport <NumAPs>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F3Naport <NumAPs>

For Release 10 UEs, sets the number of antenna ports used for every PUCCH format transmission.

Parameters:

<NumAPs> AP1 | AP2

*RST: AP1

Example: see `[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NAPused?` on page 565

Options: R&S SMx/AMU-K85

Manual operation: See "Number of Antenna Ports for PUCCH Format 1/1a/1b, 2/2a/2b, 3" on page 250

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:POWoffset <PowerOffset>

Sets the power offset of the Demodulation Reference Signal (DRS) relative to the power level of the PUSCH/PUCCH allocation of the corresponding subframe.

Parameters:
<PowerOffset> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:DRS:POW -2`

Manual operation: See "DRS Power Offset" on page 258

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:DWOCc <DmrsWithOcc>

For Release 10 UEs, activate demodulation reference signal (DRS) with an orthogonal cover code (OCC) for one antenna port.

Parameters:
<DmrsWithOcc> 0 | 1 | OFF | ON

*RST: 0

Example:
```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:UE1:REFSig:DRS:DWOCc ON
```

Options: R&S SMx/AMU-K85

Manual operation: See "Activate DRS with OCC for One Antenna Port" on page 258

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:STATe <State>

Enables sending of SRS for the corresponding UE.

Parameters:
<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:EUTR:UL:UE2:REFS:SRS:STAT ON`
enables the SRS for UE2

Manual operation: See "SRS State" on page 260

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:POWoffset <PowerOffset>

Sets the power offset of the Sounding Reference Signal (SRS) relative to the power of the corresponding UE.

Parameters:

<PowerOffset> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:SRS:POW -2`
sets the sounding reference symbol power offset to -2 dB.

Manual operation: See "SRS Power Offset" on page 260

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NAPort <NumAPs>

Sets the number of antenna ports (N_{ap}) used for every SRS transmission.

Parameters:

<NumAPs> AP1 | AP2 | AP4

*RST: AP1

Example: see `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:NAPort` on page 588

Options: R&S SMx/AMU-K85

Manual operation: See "Number of Antenna Ports for SRS" on page 260

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:CYCShift <CyclicShift>

Sets the cyclic shift used for the generation of the sounding reference signal CAZAC sequence.

Parameters:

<CyclicShift> integer

Range: 0 to 7
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:SRS:CYCS 5`
sets the SRS cyclic shift for UE2

Manual operation: See "SRS Cyclic Shift n_CS (First Antenna Port)" on page 261

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:BHOP <BandwidthHopp>

Sets the UE specific parameter frequency hopping bandwidth b_{hop}.

Parameters:

<BandwidthHopp> integer

Range: 0 to 3
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:SRS:BHOP 2`
sets the SRS hopping bandwidth

Manual operation: See "Hopping Bandwidth b_hop" on page 266

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:BSRS <Bsrs>

Sets the UE specific parameter SRS Bandwidth B_{SRS}.

Parameters:

<Bsrs> integer

Range: 0 to 3
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:SRS:BSRS 2`
sets the SRS bandwidth configuration

Manual operation: See "SRS Bandwidth B_SRS" on page 263

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:ISRS <Isrs>

Sets the UE specific parameter SRS configuration index I_{SRS}.

Parameters:

<Isrs> integer

Range: 0 to 1023
*RST: 0

Example: `BB:EUTR:DUPL FDD`
sets the duplexing mode
`BB:EUTR:UL:UE2:REFS:SRS:ISRS 22`
sets the SRS configuration index

Manual operation: See "Configuration Index I_SRS" on page 261

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TSRS?

Queries the UE specific parameter SRS periodicity T_{SRS}.

The value depends on the selected SRS configuration index I_{SRS} (`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:ISRS`) and duplexing mode (`[:SOURce<hw>]:BB:EUTRa:DUPLexing`) as defined in the 36.213, Table 8.2-1 (FDD) and 8.2-2 (TDD) respectively.

Return values:

<PeriodTsrs> integer

Range: 0 to 65535
*RST: 0

Example:
`BB:EUTR:DUPL FDD`
sets the duplexing mode
`BB:EUTR:UL:UE2:REFS:SRS:ISRS 22`
sets the SRS configuration index
`BB:EUTR:UL:UE2:REFS:SRS:TSRS?`
queries the SRS periodicity
`Response: 20 ms`

Usage: Query only

Manual operation: See "Periodicity T_SRS" on page 261

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TOFFset?

Queries the UE specific parameter SRS subframe offset T_{offset}.

Return values:

<TOffset> integer

Range: 0 to 320
*RST: 0

Example:
`BB:EUTR:DUPL FDD`
sets the duplexing mode
`BB:EUTR:UL:UE2:REFS:SRS:ISRS 22`
sets the SRS configuration index
`BB:EUTR:UL:UE2:REFS:SRS:TOFF?`
queries the SRS subframe offset
`Response: 5`

Usage: Query only

Manual operation: See "Subframe Offset T_offset" on page 262

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TRComb <TransmComb>

Sets the UE specific parameter transmission combn k_{TC}.

Parameters:

<TransmComb> 0 | 1

Range: 0 to 1
*RST: 0

Example:
`BB:EUTR:UL:UE2:REFS:SRS:TRC 1`
sets the SRS transmission comb

Manual operation: See "Transmission Comb k TC" on page 266

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]: NRRC <Nrrc>

Sets the UE specific parameter frqDomainPosition n_{RRC}

Parameters:

<Nrrc> integer

Range: 0 to 23
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:SRS:NRRC 10`
sets the SRS frequency domain position

Manual operation: See "Freq. Domain Position n_RRC" on page 266

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP10Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP20Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP21Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP40Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP41Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP42Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP43Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP100Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP200Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP201Map:ROW<bbid> <AntPortMapping>

Sets which antenna port will be generated by which baseband.

Suffix:

<bbid> 0..7
Baseband

Parameters:

<AntPortMapping> 0 | 1 | OFF | ON

*RST: 0

Example: `SOURce1:BB:EUTRa:UL:UE1:APMap:AP10Map:ROW0 1`

Manual operation: See "Antenna port mapping table" on page 267

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CELL<dir0>:POFFset <UeCcPowerOffs>

Sets a power offset of the selected PCell or SCell.

Parameters:

<UeCcPowerOffs> float

Range: -80 to 10
Increment: 0.01
*RST: 0

Manual operation: See "Power" on page 267

9.24 Realtime Feedback

The Realtime Feedback Configuration is enabled only for UE1 in instruments equipped with the option R&S SMx/AMU-K69.

Realtime Feedback Configuration is not available for the R&S SMBV.

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:AACK <AssumeACK>

If this parameter is enabled, the signal generator will not use any external HARQ feedback from the device under test for its HARQ processes until an ACK command is received the first time.

For detailed description, refer to "Assume ACK until first received ACK command" on page 247.

Parameters:
<AssumeACK> 0 | 1 | OFF | ON
*RST: OFF

Options: R&S SMx/AMU-K69

Manual operation: See "Assume ACK until first received ACK command" on page 247

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ACKDefinition <AckDefinition>

(Binary ACK/NACK mode only)

Determines whether a high or a low binary level on the feedback line connector represents an ACK.

Parameters:
<AckDefinition> HIGH | LOW
*RST: HIGH

Example:
```
BB:EUTR:UL:RTFB:MODE BAN
BB:EUTR:UL:RTFB:ACKD HIGH
```

Options: R&S SMx/AMU-K69

Manual operation: See "ACK Definition" on page 247

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ADUDelay <AddUserDelay>

Determines the point in time when the feedback can be sent to the instrument.

Mode	Value Range	
Binary	3GPP Distance Mode	-1.00 .. 2.99 subframes
	Direct Response Distance Mode	+1.00 .. 6.99 subframes
Serial and Serial 3x8	-	-1.00 .. 1.99 subframes

Parameters:
<AddUserDelay> float
Range: -1 to 6.99
Increment: 0.01
*RST: 0
Default unit: subframes

Example:
```
BB:EUTR:UL:RTFB:ADUD 1
```
sets the additional user delay

Options: R&S SMx/AMU-K69

Manual operation: See "Additional User Delay" on page 248

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BBSelector <BasebandSelect>

(Serial mode only)

Needed for multiplexing serial commands for different baseband units to one feedback line. If the selector n is configured in the GUI for a specific baseband unit, the baseband unit will listen only to serial commands containing the selector n.

Parameters:

<BasebandSelect> integer

Range: 0 to 3
*RST: 0 (for Baseband A); 1 (for Baseband B)

Example: `BB:EUTR:UL:RTFB:MODE SER`
enables realtime feedback on a serial line
`BB:EUTR:UL:RTFB:BBS 1`
sets the baseband selector

Options: R&S SMx/AMU-K69

Manual operation: See "Baseband Selector" on page 248

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BEINsertion <BlockErrInsert>

Enables/disables the statistical insertion of block errors into PUSCH packets.

The block error insertion can be enabled for a single HARQ process or for all processes.

In the single HARQ process case, the used process is always the one that corresponds to the first activated PUSCH.

Parameters:

<BlockErrInsert> OFF | FPRocess | APRocesses

*RST: OFF

Example: `BB:EUTR:UL:RTFB:BEIN FPR`
enables block error insertion for the first process

Options: R&S SMx/AMU-K69

Manual operation: See "Block Error Insertion" on page 248

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BERate <BlockErrRate>

Block error rate for the statistical insertion of block errors.

Parameters:

<BlockErrRate> float

Range: 0.0001 to 1
Increment: 0.0001
*RST: 0.0001

Example: `BB:EUTR:UL:RTFB:BER 0.5`
sets the block error rate

Options: R&S SMx/AMU-K69

Manual operation: See "Block Error Rate" on page 249

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:CONNector <Connector>

Determines the feedback line connector (LEVATT or USER1).

Parameters:

<Connector> LEVatt | USER1

*RST: USER1

Example: `BB:EUTR:UL:RTFB:CONN USER1`

sets the connector

Options: R&S SMx/AMU-K69

Manual operation: See "Connector" on page 247

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:DMODe <DistanceMode>

Determines how the number of the uplink subframe is calculated, in which the signaled feedback has the desired effect.

Parameters:

<DistanceMode> STD | DIRect

*RST: STD

Example: `BB:EUTR:UL:RTFB:DMOD DIR`

Options: R&S SMx/AMU-K69

Manual operation: See "Distance Mode" on page 247

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ITADvance <InitTimAdvance>

The initial timing advance of the uplink signal (at the output of the instrument's baseband unit) in units of 16 T_S.

Parameters:

<InitTimAdvance> integer

Range: 0 to 1282

*RST: 0

Example: `BB:EUTR:UL:RTFB:ITAD 16`

Options: R&S SMx/AMU-K69

Manual operation: See "Realtime Feedback Mode" on page 246

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:MAXTrans <MaxTransmission>

After this maximum number of transmissions (incl. first transmission), the first redundancy version of the redundancy version sequence is used even in case of NACK.

Parameters:

<MaxTransmission>	integer Range: 1 to 20 *RST: 4

Example: `BB:EUTR:UL:RTFB:MAXT 5`
sets the maximum number of transmissions

Options: R&S SMx/AMU-K69

Manual operation: See "Max. Number of Transmissions" on page 246

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:MODE <Mode>

Enables realtime feedback and determines the mode (binary or serial).

Parameters:

<Mode>	OFF | BAN | SERial | S3X8 *RST: OFF

Example: `BB:EUTR:UL:RTFB:MODE SER`
enables realtime feedback on a serial line

Options: R&S SMx/AMU-K69

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:RVSequence <RedVersSequence>

Determines the sequence of redundancy versions for the individual HARQ processes.

Unless otherwise requested by serial feedback commands, the first value in the sequence of redundancy versions is used each time an ACK is received or for the very first transmission of a process.

The sequence of redundancy versions is read out cyclically, i.e. whenever a NACK is received and a retransmission is requested, the next redundancy version in the sequence is used.

The first value in the sequence is used again even in case a NACK is received, if the maximum number of transmissions (`BB:EUTR:UL:RTFB:MAXT`) in a process was reached.

Parameters:

<RedVersSequence>	string

Example: `BB:EUTR:UL:RTFB:RVS '0,2,3,1'`
sets the redundancy version sequence

Options: R&S SMx/AMU-K69

Manual operation: See "Redundancy Version Sequence" on page 246

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:SERate <SerialRate>

(Serial mode only)

Determines the bit rate of the serial transmission.

Parameters:

<SerialRate> SR115_2K | SR1_92M | SR1_6M

*RST: SR115_2K

Example: `BB:EUTR:UL:RTFB:MODE SER`

enables realtime feedback on a serial line

`BB:EUTR:UL:RTFB:SER SR115_2K`

sets the serial rate

Options: R&S SMx/AMU-K69

Manual operation: See "Serial Rate" on page 248

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:GENReports <GenDebugReports>

Triggers the instrument to create and store transmission and/or reception realtime feedback debug reports.

Parameters:

<GenDebugReports> 0 | 1 | OFF | ON

*RST: 0

Example: `:SOURce1:BB:EUTRa:UL:RTFB:GENReports ON`

enables the generation of debug report files

Manual operation: See "Generate Debug Reports" on page 249

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:LOFFset <LoggingOffs>

Delays the start time for generation of the debug report files.

Parameters:

<LoggingOffs> integer

Range: 0 to 100000000

*RST: 0

Example: `:SOURce1:BB:EUTRa:UL:RTFB:GENReports ON`

`:SOURce1:BB:EUTRa:UL:RTFB:LOFFset 100`

Manual operation: See "Logging Offset" on page 250

9.25 LTE Logfiles Generation

Logfile generation requires the SW option R&S SMx/AMU-K81.

Example: Logfiles Generation

```
SOURce1:BB:EUTRa:LOGGen:OUTPut '<root>logfiles'
SOURce1:BB:EUTRa:LOGGen:LFP "EUtraLog_0"
SOURce1:BB:EUTRa:LOGGen:DL:EDLoggong ON
SOURce1:BB:EUTRa:LOGGen:DL:PBCH ON
SOURce1:BB:EUTRa:LOGGen:DL:LOGP9 ON
SOURce1:BB:EUTRa:LOGGen:STATe ON
SOURce1:BB:EUTRa:STATe ON
```

[:SOURce<hw>]:BB:EUTRa:LOGGen:STATe <LoggingState>

Enables/disables logfile generation.

Parameters:

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

Example: Example "Logfiles Generation" on page 603

Options: R&S SMx/AMU-K81

Manual operation: See "Logging State" on page 100

[:SOURce<hw>]:BB:EUTRa:LOGGen:OUTPut <OutputPath>

Selects the network directory the logged files are stored in.

Parameters:

<OutputPath> string
*RST: C:\Documents and Settings\<user>\Application Data\Rohde-Schwarz\SMUFirmware\Log

Example: Example "Logfiles Generation" on page 603

Options: R&S SMx/AMU-K81

Manual operation: See "Output Path" on page 101

[:SOURce<hw>]:BB:EUTRa:LOGGen:LFP <Preamble>

Sets the preamble added to the file name.

See Chapter 7.2.2.1, "File Names", on page 90 for a description of the file naming convention used.

Parameters:

<Preamble> string
*RST: K55Log

Example: Example "Logfiles Generation" on page 603

Options: R&S SMx/AMU-K81

Manual operation: See "Logging Files Preamble" on page 101

[:SOURce<hw>]:BB:EUTRa:LOGGen:GSLogfile <GenSumLog>

Enables the generation of a summary logfile.

Parameters:

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

Example: `SOURce:BB:EUTRa:LOGGen:GSLogfile 1`

Manual operation: See "Generate Summary Log" on page 101

[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:EDLogging <ExtDciLog>
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:EULogging <ExtUciLog>

Enables the generation of a logfile with extended information regarding the DCI/UCI mapping.

Parameters:

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

Example: Example "Logfiles Generation" on page 603

Options: R&S SMx/AMU-K81

Manual operation: See "Extended DCI/UCI Logging" on page 101

[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:EALL
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:EALL
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:DALL
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:DALL

Enables/disables all logging points.

Example: Example "Logfiles Generation" on page 603

Options: R&S SMx/AMU-K81

Manual operation: See "Enable/Disable All" on page 101

[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:LOGPoint<ch0> <LogPointState>
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:LOGPoint<ch0> <LogPointState>

Enables/disables one particular logging point.

Refer to Chapter 7.2.1, "Signal Processing Chains and Logging Points", on page 87 for description on the available logging points.

Parameters:

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

Example: Example "Logfiles Generation" on page 603

Options: R&S SMx/AMU-K81

Manual operation: See "Logging Point" on page 102

[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:ENCC <EnccLogState>
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:PBCH <PbchLogState>
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:PDSCh <PdschLogState>
[:SOURce<hw>]:BB:EUTRa:LOGGen:DL:PMCH <State>
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:PUSDrs <PuschDrsLog>
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:PUCDrs <PuschDrsLog>
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:SRS <SrsState>
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:PUCCh <PucchLogState>
[:SOURce<hw>]:BB:EUTRa:LOGGen:UL:PUSCh <PuschLogState>

Enables the channel or reference signal for that logfiles are generated.

Parameters:

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

Example: Example "Logfiles Generation" on page 603

Options: R&S SMx/AMU-K81

Manual operation: See "Physical Channels" on page 101

9.26 Test Case Wizard Remote-Control Commands

The "Test Case Wizard" is supported by R&S SMU, R&S SMATE, R&S SMJ and R&S SMBV.

The signal generator gives you the opportunity to generate predefined settings which enable tests on base stations in conformance with the 3G standard EUTRA/LTE. It offers a selection of predefined settings according to Test Cases in TS 36.141. The settings take effect only after execution of command `[:SOURce<hw>]:BB:EUTRa:TCW:APPLysettings`.

[:SOURce<hw>]:BB:EUTRa:TCW:APPLysettings

Activates the current settings of the test case wizard.

Note: The settings of the selected test case becomes active only after executing this command.

Usage: Event

Manual operation: See "Apply Settings" on page 327

[:SOURce<hw>]:BB:EUTRa:TCW:AWGN:PLEVel?

Queries the AWGN power level.

Return values:

<PowerLevel> string

Usage: Query only

Manual operation: See "Power Level" on page 345

[:SOURce<hw>]:BB:EUTRa:TCW:FA:FRALlocation <FrequencyAlloc>
[:SOURce<hw>]:BB:EUTRa:TCW:FA:RBALlocation <ResBlockAlloc>

Determines the frequency position of the wanted and interfering signal.

Parameters:

<ResBlockAlloc> HIGHer | LOWer

*RST: HIGHer

Manual operation: See "Frequency Allocation of the Interfering signal" on page 325

[:SOURce<hw>]:BB:EUTRa:TCW:GS:SPEC <GsSpec>

Selects the 3GPP test specification used as a guide line for the test cases.

Parameters:

<GsSpec> TS36141

*RST: TS36141

Example: `SOURce1:BB:EUTRa:TCW:GS:SPEC TS36141`

Manual operation: See "Test Specification" on page 322

[:SOURce<hw>]:BB:EUTRa:TCW:GS:RELease <Release>

Sets the 3GPP test specification used as a guide line for the test cases.

Parameters:

<Release> REL8 | REL9 | REL10 | REL11

*RST: REL8

Manual operation: See "Release" on page 323

[:SOURce<hw>]:BB:EUTRa:TCW:GS:ANTSubset <AntennaSubset>

Enabled for test setups with four Rx antennas

Determines the signal of which antenna couple, Antenna 1 and 2 (`AS12`) or Antenna 3 and 4 (`AS34`), is generated by the instrument.

Parameters:

<AntennaSubset> AS34 | AS12 | ALL

*RST: AS12

Manual operation: See "Antenna Subset" on page 324

[:SOURce<hw>]:BB:EUTRa:TCW:GS:GENSignals <GeneratedSignal>

Determines the signal is generated by the instrument. The first R&S SMU should generate the "Wanted Signal, Interfer 1 and AWGN" (`WSIF1AWGN`) signal and the second R&S SMU, the signal of "Interferes 2 and 3" (`IF23`).

Parameters:

<GeneratedSignal> IF23 | WSIF1AWGN

*RST: WSIF1AWGN

Manual operation: See "Generated Signal" on page 390

[:SOURce<hw>]:BB:EUTRa:TCW:GS:INSTsetup <InstrumentSetup>

Determines whether one or both paths are used.

Parameters:

<InstrumentSetup> U2PATH | U1PATH

*RST: U2PATH

Manual operation: See "Instrument Setup" on page 324

[:SOURce<hw>]:BB:EUTRa:TCW:GS:MODE <Mode>

Determines the measurements type, Pfa or Pd, the signal is generated for, see "Mode" on page 409.

Parameters:

<Mode> DRATe | FDRate | ADRate

FDRate
False Detection Rate (Pfa)

DRATe
Detection Rate (Pd)

ADRate
Alternating Pd and Pfa

*RST: DRATe

Example: `SOUR:BB:EUTR:TCW:GS:MODE ADRate`

Manual operation: See "Mode" on page 409

[:SOURce<hw>]:BB:EUTRa:TCW:GS:MARKerconfig <MarkerConfig>

Selects the marker configuration. The marker can be used to synchronize the measuring equipment to the signal generator.

Parameters:

<MarkerConfig> UNCHanged | FRAMe

FRAMe
The marker settings are customized for the selected test case. "Radio Frame Start" markers are output; the marker delays are set equal to zero.

UNCHanged
The current marker settings of the signal generator are retained unchanged.

*RST: FRAMe

Manual operation: See "Marker Configuration" on page 324

[:SOURce<hw>]:BB:EUTRa:TCW:GS:BSCLass <BsClass>

Sets the base station class.

Parameters:

<BsClass> WIDE | LOCal | HOME | MEDium

*RST: WIDE

Example:
```
SOURce1:BB:EUTRa:TCW:GS:RELease REL10
SOURce1:BB:EUTRa:TCW:TC TS36141_TC72
SOURce1:BB:EUTRa:TCW:GS:BSCLass LOCal
SOURce1:BB:EUTRa:TCW:WS:PLevel?
```
Response: "-98.10 dBm"

Manual operation: See "Base Station Class" on page 323

[:SOURce<hw>]:BB:EUTRa:TCW:GS:RXANtennas <NumOfRXAntennas>

For performance requirement tests, determines the number of the Rx antennas.

Parameters:

<NumOfRXAntennas>ANT4 | ANT2 | ANT1

*RST: ANT1

Manual operation: See "Number of Rx Antennas" on page 323

[:SOURce<hw>]:BB:EUTRa:TCW:GS:TXANtennas <NumOfTxAntennas>

For performance requirement tests, determines the number of the Tx antennas.

Parameters:

<NumOfTxAntennas> ANT1 | ANT2

*RST: ANT1

Example:
```
SOURce1:BB:EUTRa:TCW:GS:TXANtennas ANT1
```

Manual operation: See "Number of Tx Antennas" on page 323

[:SOURce<hw>]:BB:EUTRa:TCW:GS:SIGRout <SignalRouting>

Selects the signal routing for baseband A signal which in most test cases represents the wanted signal.

Parameters:

<SignalRouting> PORTB | PORTA

*RST: PORTA

Manual operation: See "Signal Routing" on page 324

[:SOURce<hw>]:BB:EUTRa:TCW:GS:TRIGgerconfig <TriggerConfig>

Selects the trigger configuration. The trigger is used to synchronize the signal generator to the other equipment.

Parameters:

<TriggerConfig> UNCHanged | AAUTo

UNCHanged
The current trigger settings of the signal generator are retained unchanged.

AAUTo
The trigger settings are customized for the selected test case. The trigger setting "Armed Auto" with external trigger source "External Trigger 1" is used; the trigger delay is set equal to zero. Thus, the base station frame timing is able to synchronize the signal generator by a periodic trigger.

*RST: AAUTo

Manual operation: See "Trigger Configuration" on page 323

[:SOURce<hw>]:BB:EUTRa:TCW:GS:OPTion <Option>

Selects one of the two test case options.

Parameters:

<Option> OPT1 | OPT2

*RST: OPT1

[:SOURce<hw>]:BB:EUTRa:TCW:GS:STC <SubtestCase>

Selects the subtest case.

Parameters:

<SubtestCase> STC1 | STC2 | STC4 | STC3

*RST: STC1

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:CHBW?
[:SOURce<hw>]:BB:EUTRa:TCW:IS:CHBW?

Queries the channel bandwidth of the interfering signal.

Return values:

<ChanBandwidth> BW20_00 | BW10_00 | BW5_00 | BW3_00 | BW1_40 | BW15_00

Usage: Query only

Manual operation: See "Channel Bandwidth" on page 333

[:SOURce<hw>]:BB:EUTRa:TCW:IS:CLID <CellID>

Sets the Cell ID for the interfering signal.

Parameters:

<CellID> integer

Range: 0 to 503
*RST: 1

Manual operation: See "Cell ID" on page 341

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:DUPLex <Duplexing>
[:SOURce<hw>]:BB:EUTRa:TCW:IS:DUPLex <Duplex>

Selects whether TDD or FDD duplexing mode is used.

Parameters:

<Duplex> TDD | FDD

*RST: FDD

Manual operation: See "Duplexing" on page 333

[:SOURce<hw>]:BB:EUTRa:TCW:IS:FRSHift <FrequencyShift>

Sets the value of the parameter Frequency Shift m.

Parameters:

<FrequencyShift> FS24 | FS19 | FS14 | FS13 | FS10 | FS9 | FS7 | FS5 | FS4 | FS3 | FS2 | FS1 | FS0

*RST: FS0

Manual operation: See "Frequency Shift m" on page 341

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:IFTYpe?
[:SOURce<hw>]:BB:EUTRa:TCW:IS:IFTYpe <InterfererType>

Selects the type of the interfering signal:

- For **Blocking** tests, the interfering signal can be an in-band EUTRA/LTE signal (`EUTra`) or out-of-band CW signal (`CW`).

- For **Receiver Intermodulation** tests, the first interfering signal can be an EUTRA/LTE signal (`EUTra`) or narrow-band EUTRA signal (`NEUTra`).
  The second interfering signal is always a CW signal (`CW`).

Parameters:

<InterfererType> NEUTra | EUTra | CW

*RST: EUTra

Manual operation: See "Interferer Type" on page 339

[:SOURce<hw>]:BB:EUTRa:TCW:IS:NRBLock?

Queries the number of RBs used by the LTE interfering signal.

Return values:

<NumResBlock> integer

Range: 3 to 25
*RST: 3

Usage: Query only

Manual operation: See "Number of Resource Blocks" on page 341

[:SOURce<hw>]:BB:EUTRa:TCW:IS:NTAOffset <SigAdvNTAoffset>

Sets the parameter $N_{TAoffset}$.

Parameters:

<SigAdvNTAoffset> NTA624 | NTA0

*RST: NTA624

Manual operation: See "Signal Advance N_TA_offset" on page 340

[:SOURce<hw>]:BB:EUTRa:TCW:IS:OCEDge <OffsChannelEdge>

Defines the offset of the interfering signal center frequency relative to edge of the wanted channel bandwidth.

Parameters:

<OffsChannelEdge> OCE12_5 | OCE7_5 | OCE2_5

*RST: OCE2_5

Manual operation: See "Offset to Channel Edge" on page 332

[:SOURce<hw>]:BB:EUTRa:TCW:IS:OVRB?

Sets the offset VRB.

Return values:

<OffsetVRB> integer

Range: 0 to 75
*RST: 0

Usage: Query only

Manual operation: See "Offset VRB" on page 341

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:PLEVel?
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:PLEVel?
[:SOURce<hw>]:BB:EUTRa:TCW:IS:PLEVel?

Queries the power level of the interfering signal.

Return values:
<PowerLevel> string

Usage: Query only

Manual operation: See "Power Level/Power Level P-CPICH" on page 334

[:SOURce<hw>]:BB:EUTRa:TCW:IS:RBCFrequency <RBlockCentFreq>

Queries the center frequency of the single resource block interfering signal.

Parameters:
<RBlockCentFreq> integer
Range: 100E3 to 6E9
*RST: 1.95E9

Manual operation: See "Interfering RB Center Frequency" on page 342

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:RFFRequency <RfFrequency>
[:SOURce<hw>]:BB:EUTRa:TCW:IS:RFFRequency <RfFrequency>

Queries the center frequency of the interfering signal.

Parameters:
<RfFrequency> integer
Range: 100E3 to 6E9
*RST: 1.95E9

Manual operation: See "RF Frequency" on page 332

[:SOURce<hw>]:BB:EUTRa:TCW:IS:TDDConfig <TddConfig>

For TDD mode, selects the UL/DL Configuration number.

Parameters:
<TddConfig> integer
Range: 0 to 6
*RST: 0

Manual operation: See "TDD UL/DL Configuration" on page 340

[:SOURce<hw>]:BB:EUTRa:TCW:IS:TMODel?

Queries the test model. The interfering signal is generated according to E-TM1.1 test model.

Return values:

<TestModel> TM1_1

Usage: Query only

Manual operation: See "Test Model" on page 333

[:SOURce<hw>]:BB:EUTRa:TCW:IS:TREQuire <TestRequire>

Selects whether the standard out-of-band blocking requirements test is performed (BLPE) or the optional blocking scenario, when the BS is co-located with another BS in a different operating band (COBS).

Parameters:

<TestRequire> COBS | BLPE

*RST: BLPE

Manual operation: See "Test Requirement" on page 359

[:SOURce<hw>]:BB:EUTRa:TCW:IS:UEID <UE_ID_nRNTI>

Sets the UE ID/n_RNTI for the interfering signal.

Parameters:

<UE_ID_nRNTI> integer

Range: 0 to 65535

*RST: 1

Manual operation: See "UE ID/n_RNTI" on page 341

[:SOURce<hw>]:BB:EUTRa:TCW:IS:PLEVel?

Queries the power level of the AWGN signal (I_{oh})

Return values:

<PowerLevel> string

Usage: Query only

[:SOURce<hw>]:BB:EUTRa:TCW:IS:TMCodes <TestModel1Codes>

Selects a predefined test model 1 signal.

Parameters:

<TestModel1Codes> COD4 | COD8 | COD16 | COD32 | COD64

*RST: COD4

[:SOURce<hw>]:BB:EUTRa:TCW:MUE:TSRS <TransmitSRS>
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:TSRS <TransmitSRS>

Enables/disables the transmission of the SRS.

The SRS transmission is optional for this test case.

Parameters:

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

Manual operation: See "Transmit SRS" on page 374

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:ACKDefinition <AckDefinition>

Determines whether a high or a low binary level on the feedback line connector represents an ACK.

Parameters:

<AckDefinition>	LOW | HIGH	
	*RST:	HIGH

Manual operation: See "ACK Definition" on page 367

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:AUSDelay <AddUserDelay>

Determines the point in time when the feedback can be sent to the instrument.

Parameters:

<AddUserDelay>	float	
	Range:	-1 to 2.99
	Increment:	0.01
	*RST:	0

Manual operation: See "Additional User Delay" on page 366

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSMue <BBSelectMovUE>
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSSue <BBSelectStatUE>
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSelector <BBSelector>

This parameter is required for multiplexing serial commands for different baseband units to one feedback line. If the selector n is configured in the GUI for a specific baseband unit, the baseband unit will listen only to serial commands containing the selector n.

Parameters:

<BBSelector>	integer	
	Range:	0 to 3
	*RST:	0

Manual operation: See "Baseband Selector" on page 366

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONMue <ConnectorMovUE>
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONSue <ConnectorStatUE>
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONNector <Connector>

Determines the feedback line connector (LEVATT or USER1).

Parameters:

<Connector> LEVatt | USER1 | NOFB

*RST: USER1

Manual operation: See "Connector" on page 366

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:MODE <Mode>

Determines the feedback mode.

Parameters:

<Mode> SER3X8 | SER | BIN

BIN
Binary ACK/NACK
The ACK/NACK feedback is implemented as low/high voltage level on the feedback line connector.

SER
Serial
ACK/NACK Feedback and Timing Adjustments Feedback are implemented by means of a serial protocol.

SER3X8
Serial 3x8
ACK/NACK Feedback and Timing Adjustments Feedback are implemented by means of a serial commands, consisting of three serial packets.

*RST: SER

Manual operation: See "Realtime Feedback Mode" on page 366

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:SERRate <SerialRate>

Sets the bit rate of the serial transmission. Possible rates are 115.2 kbps, 1.6 Mbps and 1.92 Mbps.

Parameters:

<SerialRate> SR1_92M | SR1_6M | SR115_2K

*RST: SR115_2K

Manual operation: See "Serial Rate" on page 367

[:SOURce<hw>]:BB:EUTRa:TCW:TC <TestCase>

Selects the test case.

Parameters:
<TestCase> TS36141_TC839 | TS36141_TC834 | TS36141_TC835 | TS36141_TC836 | TS36141_TC67 | TS36141_TC72 | TS36141_TC73 | TS36141_TC74 | TS36141_TC75A | TS36141_TC75B | TS36141_TC76 | TS36141_TC78 | TS36141_TC821 | TS36141_TC822 | TS36141_TC823 | TS36141_TC824 | TS36141_TC831 | TS36141_TC832 | TS36141_TC833 | TS36141_TC841 | TS36141_TC838 | TS36141_TC837

*RST: TS36141_TC72

Manual operation: See "Test Case" on page 323

[:SOURce<hw>]:BB:EUTRa:TCW:WS:ACPucch <AddConfigPUCCH>

Enables the optional transmission of PUCCH format 2.

Parameters:
<AddConfigPUCCH> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "Additionally Configure PUCCH" on page 381

[:SOURce<hw>]:BB:EUTRa:TCW:WS:ANBits <AckNackBits>

In performance requirement test cases, sets the number of encoded ACK/NACK bits per subframe.

Parameters:
<AckNackBits> ANB4 | ANB16

*RST: ANB4

Example:
```
SOURce1:BB:EUTRa:TCW:TC TS36141_TC836
SOURce1:BB:EUTRa:TCW:WS:ANBits?
Response: ANB16
```

Manual operation: See "Number of ACK/NACK bits" on page 396

[:SOURce<hw>]:BB:EUTRa:TCW:WS:ANPattern?

In performace requirement test cases, queries the ACK/NACK + SR pattern bits.

Return values:
<AckNackPattern> 17 bits

*RST: #H0

Example:
```
SOURce1:BB:EUTRa:TCW:TC TS36141_TC836
SOURce1:BB:EUTRa:TCW:WS:ANPattern?
Response: "00000000000000000"
```

Usage: Query only

Manual operation: See "ACK/NACK + SR Pattern" on page 397

[:SOURce<hw>]:BB:EUTRa:TCW:WS:BFORmat <BurstFormat>

Sets the burst format.

Parameters:

<BurstFormat> BF4 | BF3 | BF2 | BF1 | BF0

*RST: BF0

Manual operation: See "Burst Format" on page 409

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CHBW <ChanBandwidth>

Selects the channel bandwidth.

Parameters:

<ChanBandwidth> BW20_00 | BW10_00 | BW5_00 | BW3_00 | BW1_40 | BW15_00

*RST: BW1_40

Manual operation: See "Channel Bandwidth" on page 326

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CLID <CellId>

Sets the Cell ID.

Parameters:

<CellId> integer

Range: 0 to 503
*RST: 150

Manual operation: See "Cell ID" on page 327

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CYCPrefix <CyclicPrefix>

Selects normal or extended cyclic prefix.

Parameters:

<CyclicPrefix> EXTended | NORMal

*RST: NORMal

Manual operation: See "Cyclic Prefix" on page 327

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CQIPattern:PORT<ch0> <CqiPattern>

In performance test cases, sets the CQI Pattern.

Parameters:

<CqiPattern> 4 bits

Example:
```
SOURce1:BB:EUTRa:TCW:TC TS36141_TC839
SOURce1:BB:EUTRa:TCW:GS:TXANtennas ANT2
SOURce1:BB:EUTRa:TCW:WS:CQIPattern:PORT0 #H5,4
SOURce1:BB:EUTRa:TCW:WS:CQIPattern:PORT1 #H5,4
```

Manual operation: See "CQI Pattern Port 0/1 (bin)" on page 406

[:SOURce<hw>]:BB:EUTRa:TCW:WS:DUPLex <Duplex>

Selects whether TDD or FDD duplexing mode is used.

Parameters:

<Duplex> TDD | FDD

*RST: FDD

Manual operation: See "Duplexing" on page 326

[:SOURce<hw>]:BB:EUTRa:TCW:WS:FMTHroughput <FractMaxThrough>

Selects the fraction of maximum throughput.

Parameters:

<FractMaxThrough> FMT70 | FMT30

*RST: FMT30

Manual operation: See "Fraction of Max. Throughput" on page 370

[:SOURce<hw>]:BB:EUTRa:TCW:WS:FRC <FRC>

Queries the fixed reference channel used.

Parameters:

<FRC> A11 | A12 | A13 | A14 | A15 | A21 | A22 | A23 | A31 | A32 | A33 | A34 | A35 | A36 | A37 | A41 | A42 | A43 | A44 | A45 | A46 | A47 | A48 | A51 | A52 | A53 | A54 | A55 | A56 | A57 | A71 | A72 | A73 | A74 | A75 | A76 | A81 | A82 | A83 | A84 | A85 | A86 | UE11 | UE12 | UE21 | UE22 | UE3

*RST: A11

Manual operation: See "FRC" on page 327

[:SOURce<hw>]:BB:EUTRa:TCW:WS:FROFfset <FreqOffset>

Sets the frequency offset.

Parameters:

<FreqOffset> FO_1340 | FO_625 | FO_270 | FO_0

*RST: FO_0

Manual operation: See "Frequency Offset" on page 409

[:SOURce<hw>]:BB:EUTRa:TCW:WS:HSMode <HighSpeedMode>

Enables/disables high speed mode.

Parameters:

<HighSpeedMode> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "High Speed Mode" on page 409

[:SOURce<hw>]:BB:EUTRa:TCW:WS:NTAOffset <SigAdvNTAoffset>

Sets the parameter $N_{TAoffset}$.

Parameters:

<SigAdvNTAoffset> NTA624 | NTA0

*RST: NTA624

Manual operation: See "Signal Advance N_TA_offset" on page 326

[:SOURce<hw>]:BB:EUTRa:TCW:IS:ORTCover?
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:ORTCover?
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:ORTCover?
[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover[:PORT<ch0>]?
[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover?

Queries the used resource index n_PUCCH.

Return values:

<OrthoCover> integer

Range: 2 to 2
Increment: 1
*RST: 2

Usage: Query only

Manual operation: See "Orthogonal Cover (Res. Index n_PUCCH) / Orthogonal Cover (Res. Index n_PUCCH) Port 0/1" on page 390

[:SOURce<hw>]:BB:EUTRa:TCW:WS:OUPLevel <OutPowerLevel>

The settings of the selected test case becomes active only after selecting "Apply Settings".

Parameters:

<OutPowerLevel> float

Range: -115 to 0
Increment: 0.01
*RST: -30

Manual operation: See "Output Power Level" on page 336

[:SOURce<hw>]:BB:EUTRa:TCW:MUE:OVRB <OffsetVRB>
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:OVRB <OffsetVRB>
[:SOURce<hw>]:BB:EUTRa:TCW:WS:OVRB <OffsetVRB>

Sets the number of RB the allocated RB(s) are shifted with.

Parameters:

<OffsetVRB> integer

Range: 0 to 75
*RST: 0

Manual operation: See "Offset VRB" on page 327

[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLEVel?

Queries the Power Level.

Return values:

<PowerLevel> string

Usage: Query only

Manual operation: See "Power Level" on page 327

[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLPC?

Queries the resulting PUCCH power level by activated optional transmission of PUCCH format 2.

Return values:

<PowerLevelPUCCH>string

Usage: Query only

Manual operation: See "PUCCH Power Level" on page 381

[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLPS?

Queries the resulting PUSCH power level.

Return values:

<PowerLevelPUSCH>string

Usage: Query only

Manual operation: See "Power Level (PUSCH)" on page 381

[:SOURce<hw>]:BB:EUTRa:TCW:IS:PRCOndition?
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:PRCOndition?

[:SOURce<hw>]:BB:EUTRa:TCW:IS3:PRCOndition?
[:SOURce<hw>]:BB:EUTRa:TCW:WS:PROCondition <PropagationCond>

Selects a predefined multipath fading propagation conditions. The settings of the fading simulator are adjusted according to the corresponding channel model as defined in 3GPP TS 36.141, Annex B.

Parameters:

<PropagationCond> AWGNonly | HST3 | HST1 | PDMov | ETU200Mov | ETU300 | EVA70 | EVA5 | EPA5 | ETU70

*RST: EPA5

Manual operation: See "Propagation Conditions" on page 367

[:SOURce<hw>]:BB:EUTRa:TCW:WS:RFFRequency <RfFrequency>

Sets the RF frequency of the wanted signal.

Parameters:

<RfFrequency> integer

Range: 100E3 to 6E9
*RST: 1.95E9

Manual operation: See "RF Frequency" on page 326

[:SOURce<hw>]:BB:EUTRa:TCW:WS:SPSFrame <SpecSubframe>

In TDD duplexing mode, sets the Special Subframe Configuration number.

Parameters:

<SpecSubframe> integer

Range: 0 to 8
*RST: 0

Manual operation: See "Configuration of Special Subframe" on page 409

[:SOURce<hw>]:BB:EUTRa:TCW:WS:TDDConfig <TddConfig>

For TDD mode, selects the UL/DL Configuration number.

Parameters:

<TddConfig> integer

Range: 0 to 6
*RST: 0

Manual operation: See "TDD UL/DL Configuration" on page 326

[:SOURce<hw>]:BB:EUTRa:TCW:WS:TIOBase?

Queries the timing offset base value.

Return values:
<TimingOffsBase> float

Range: 0 to 500
Increment: 0.01
*RST: 0

Usage: Query only

Manual operation: See "Timing Offset Base Value" on page 410

[:SOURce<hw>]:BB:EUTRa:TCW:MUE:UEID <UE_ID_nRNTI>
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:UEID <UE_ID_nRNTI>
[:SOURce<hw>]:BB:EUTRa:TCW:WS:UEID <UE_ID_nRNTI>

Sets the UE ID/n_RNTI.

Parameters:
<UE_ID_nRNTI> integer

Range: 0 to 65535
*RST: 1

Manual operation: See "UE ID/n_RNTI" on page 327

Glossary: 3GPP Specifications, References, Documents with Further Information

Symbols

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C. Gessner, "Long Term Evolution. A concise introduction to LTE and its measurement requirements", ISBN 978-3-939837-11-4, First edition 2011

1MA166: Rohde&Schwarz
Application Note 1MA166 “Testing LTE-Advanced”

1MA169: Rohde&Schwarz
White Paper 1MA169 "LTE-Advanced Technology Introduction"

1MA232: Rohde&Schwarz
White Paper 1MA232 “LTE-Advanced (3GPP Rel. 11) Technology Introduction”

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T

TR 25.892: "Feasibility study for Orthogonal Frequency Division Multiplexing (OFDM) for UTRAN enhancement"

TR 25.913: "Requirements for Evolved UTRA (E-UTRA) and Evolved UTRAN (E-UTRAN)"

TR 36.912 V 9.1.0: "Technical Specification Group Radio Access Network; Feasibility study for further advancements for E-UTRA (LTE-Advanced), Release 9", December 2009

TS 25.141: "Base Station (BS) conformance testing (FDD)"

TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception"

TS 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception"

TS 36.106: "Evolved Universal Terrestrial Radio Access (E-UTRA); FDD repeater radio transmission and reception"

TS 36.113: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) and repeater ElectroMagnetic Compatibility (EMC)"

TS 36.124: "Evolved Universal Terrestrial Radio Access (E-UTRA); ElectroMagnetic Compatibility (EMC) requirements for mobile terminals and ancillary equipment"

TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management"

TS 36.141: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing"

TS 36.143: "Evolved Universal Terrestrial Radio Access (E-UTRA); FDD repeater conformance testing"

TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation"

TS 36.212: "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding"

TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures"

TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements"

TS 36.306: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities"

TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification"

TS 36.521: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1, 2, 3"

TS 36.523: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Part 1, 2, 3"

List of Commands

Index

A

B

C

Q

R

V

W

Z