Cellular IoT eMTC and NB-IoT R&S®SMW-K115/-K143/-K146/-K175/-K69 User Manual

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Version 19

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This document describes the following software options:

- R&S®SMW-K69, LTE closed-loop BS test (1413.4480.xx)
- R&S®SMW-K115, Cellular IoT eMTC and NB-IoT Rel. 13 (1414.2723.xx)
- R&S®SMW-K143, Cellular IoT eMTC and NB-IoT Rel. 14 (1414.6064.xx)
- R&S®SMW-K146, Cellular IoT eMTC and NB-IoT Rel. 15/16/17 (1414.6564.xx)
- R&S®SMW-K175, U-plane data generation (1413.3261.xx)

This manual describes firmware version FW 5.30.047.xx and later of the R&S®SMW200A.

Muehldorfstr. 15, 81671 Muenchen, Germany
Phone: +49 89 41 29 - 0
Email: info@rohde-schwarz.com
Internet: www.rohde-schwarz.com

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The following abbreviations are used throughout this manual: R&S®SMW200A is abbreviated as R&S SMW, 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 Welcome to the cellular IoT option

The R&S SMW-K115/143/-K146 are a firmware application that adds functionality to generate signals in accordance with the 3GPP specifications.

1.1 Key features

If option R&S SMW-K143 is installed, the **eMTC** and **NB-IoT** features are in line with 3GPP Release 15. The following official 3GPP specifications are implemented:

- 3GPP TS 36.211, version 15.6.0
- 3GPP TS 36.212, version 15.6.0
- 3GPP TS 36.213, version 15.6.0

The R&S SMW-K115 key features

The R&S SMW simulates eMTC and NB-IoT at the physical channel level. The following is an overview of provided functions:

- Supports uplink eMTC and NB-IoT configuration and downlink NB-IoT configuration
- Supports IoT standalone configuration and mixed configuration with LTE
- Supports NB-IoT in-band and guard band opiating modes, incl. suppression of LTE channels in in-band operating
- Intuitive user interface with graphical display of time plan
- Support of coverage enhancement CE modes A and B and CE levels 0 to 3
- Support of the new NB channels and synchronization signals (NPSS, NSSS and DL reference signal derived from NCell ID)
- Support of PBCH (including SIB type 1), PDSCH and the new eMTC channel MPDCCH
- DCI-based configuration of NPDCCH/NPDSCH and MPDCCH/PDSCH
- Channel coding and scrambling for NPDCCH, NPDSCH and NPBCH (including SIB type 1)
- Supports NPUSCH with channel coding and scrambling
- NPRACH configuration
- Manual NPUSCH scheduling
- Support of all specified modulation schemes

The R&S SMW-K143 key features

This option extends the R&S SMW-K115 with 3GPP Rel. 14 features:

- Supports uplink eMTC wideband operation, incl. configuration of the retuning symbols
- Supports downlink eMTC wideband operation
- Support of eMTC SRS configuration

- DCI format N0 and N1 extended to support the Rel. 14 fields
- Support of extended transport block sizes and PUCCH/PUSCH repetitions.

The R&S SMW-K146 key features

This option extends the R&S SMW-K115 with 3GPP Rel. 15/16/17 features:

- Supports uplink NB-IoT operation in TDD mode, incl. NPUSCH
- Supports NPUSCH modulation up to 16QAM
- Supports FDD NPRACH formats
- Supports NB-IoT wake up signal
- Supports early data transmission in uplink
- Supports scheduling request in uplink for NPUSCH format 2

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

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

www.rohde-schwarz.com/manual/SMW200A

Installation

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

1.2 What's new

This manual describes firmware version FW 5.30.047.xx and later of the R&S®SMW200A.

Compared to the previous version 5.20.43, the cellular IoT eMTC and NB-IoT firmware applications provide the following new features and changes:

- Support of 16QAM with NPUSCH for NB-IoT, see "Modulation" on page 177
- Time-based trigger added, see "Time Based Trigger" on page 367

1.3 Accessing the eMTC/NB-IoT dialog

To open the dialog with eMTC/NB-IoT settings

1. In the block diagram of the R&S SMW, select "Baseband > EUTRA/LTE/IoT".
2. In the "General" tab, select **"Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT"**

   A dialog box opens that display the provided general settings.

The signal generation is not started immediately. To start signal generation with the default settings, select "State > On".

1.4 Documentation overview

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

www.rohde-schwarz.com/manual/smw200a

1.4.1 Getting started manual

Introduces the R&S SMW and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

1.4.2 User manuals and help

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

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

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

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

1.4.3 Tutorials

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

1.4.4 Service manual

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

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

https://gloris.rohde-schwarz.com

1.4.5 Instrument security procedures

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

1.4.6 Printed safety instructions

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

1.4.7 Data sheets and brochures

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

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

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

1.4.8 Release notes and open source acknowledgment (OSA)

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

The software makes use of several valuable open source software packages. An open-source acknowledgment document provides verbatim license texts of the used open source software.

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

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

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

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

1.4.10 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: https://www.youtube.com/@RohdeundSchwarz

On the menu bar, search for your product to find related videos.

Figure 1-1: Product search on YouTube

1.5 Scope

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

In particular, it includes:

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

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

1.6 Notes on screenshots

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

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

2 About the internet of things (IoT)

The introduction of mobile communications extended the variety and the requirements on the way machines communicate with each other. The machine communication is known as machine type communication (MTC), the machine to machine communication (M2M) or the Internet of things (IoT).

Related 3GPP specifications

Because LTE was primarily optimized for the mobile broadband market, the specifications had to be extended to cover possible MTC solution. The following specifications specify IoT related features:

- 3GPP **LTE Rel. 12 (MTC)**
  First MTC specification, based on the existing LTE standard. Introduces new type CAT0 devices
- 3GPP **LTE Rel. 13 (eMTC or LTE-M)**
  Further development of MTC to eMTC (enhanced MTC). Introduces new type CAT-M1 devices.
- 3GPP **LTE Rel. 13 (NB-IoT)**
  First dedicated IoT specification, regarded as new radio access technology. Introduces new type CAT-NB1 devices.
- 3GPP **LTE Rel. 14 (eMTC and NB-IoT)**
  Introduces eMTC widebands and new types CAT-M2 and CAT-NB2 devices.
- 3GPP **LTE Rel. 15 (NB-IoT)**
  Introduces NB-IoT TDD mode in UL, FDD NPRACH formats, early data transmission, NB-IoT wake up signal and scheduling request in uplink for NPUSCH F2.
- 3GPP **GERAN (EC-GSM)**
  Extension in the GSM standard

Overview of the main characteristics

	eMTC (LTE-M)	**NB-IoT**
Based on	existing LTE standard	new radio access technology
UE category	CAT0 CAT-M1 CAT-M2	CAT-NB1 CAT-NB2
Channel bandwidth	1.4 MHz	180 KHz
Number of RB	6	1
Coverage extension (CE)	CE mode A and CE mode B	CE level 0, CE level 1 and CE level 2

LTE features not supported by eMTC or NB-IoT

Consider the following differences between eMTC and LTE/LTE-A.

- eMTC does not support:

  - Spatial multiplexing
  - Simultaneous PUCCH/PUSCH
  - Higher-order modulation schemes
  - CSI feedback
  - Transmission modes 3, 4, 8 and 10
  - PUCCH format 3, 4 and 5
  - ACK/NACK bundling multiplexing in TDD
- eMTC supports:
  - 2 HARQ processes
  - Contiguous resource allocations for UL and DL
- Among other, NB-IoT does not support:
  - Carrier aggregation
  - Home eNB, closed subscriber group (CSG)
  - Relaying
  - Dual connectivity
  - MBMS/eMBMS

Scope of this description

This section gives a brief description of the LTE Rel. 13 and somer Rel. 14 features that are related to the eMTC and NB-IoT technology. The following section list the subset of features that are covered by the software option R&S SMW-K115/-K143:

- Chapter 2.2, "About eMTC", on page 18
- Chapter 2.3, "About NB-IoT", on page 34

For an insight description of the NB-IoT features, refer to:

- White Paper 1MA266 "Narrowband Internet of Things"
- Application Note 1MA296 "Narrowband Internet of Things Measurements"

2.1 Required options

The basic equipment layout for generating eMTC/NB-IoT signals includes the options:

- Standard or wideband Baseband Generator (R&S SMW-B10/-B9)
- Baseband Main Module (R&S SMW-B13) or Wideband baseband main module (R&S SMW-B13XT)
- Option cellular IoT release 13 (R&S SMW-K115)
- Optional, option cellular IoT release 14 (R&S SMW-K143)
- Optional, option cellular IoT releases 15/16/17 (R&S SMW-K146)
- Frequency option (e.g. R&S SMW-B1003)
- Optional, option logfile generation (R&S SMW-K81)
- Optional, option LTE closed loop BS test (R&S SMW-K69)

You can generate signals via play-back of waveform files at the signal generator. To create the waveform file using R&S WinIQSIM2, you do not need a specific option.

To play back the waveform file at the signal generator, you have two options:

- Install the R&S WinIQSIM2 option of the digital standard, e.g. R&S SMW-K255 for playing LTE waveforms
- If supported, install the real-time option of the digital standard, e.g. R&S SMW-K55 for playing LTE waveforms

For more information, see data sheet.

2.2 About eMTC

Short summary

eMTC is an extension of the LTE standard.

eMTC main characteristics are:

- Channel bandwidth splitting into narrowbands
  Min channel bandwidth is a narrowband with 1.4 MHz or 6 RBs. 16 narrowbands can be allocated within the 20 MHz channel bandwidth.
- Four non-overlapping consequent narrowbands can be grouped into wideband with 5 MHz carrier bandwidth or 24 RBs
- Two coverage extension (CE) modes: CEModeA and CEModeB

Coverage extension modes

CE mode	CE level	Description	Optional/mandatory
CEModeA	0, 1	Supports small number of PUSCH or PUCCH repetitions	Mandatory in eMTC Rel. 13
CEModeB	2, 3	Enables large number of PUSCH or PUCCH repetitions	Optional in eMTC Rel. 13

Overview of the physical signals and channels

Because eMTC is an extension of the LTE standard, it reuses the LTE concept, including reference signals and channels. eMTC, however, does not support MIMO and MBFSN.

eMTC uses the following signals and channels:

- UL reference signals: SRS, DMRS
- DL physical channels:
  PDSCH, PBCH, PDCCH, and the new MPDCCH (MTC physical downlink control channel)
- UL physical channels:
  PUSCH (modulation QPSK, 16QAM, 64QAM), PUCCH, PRACH

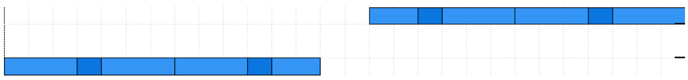
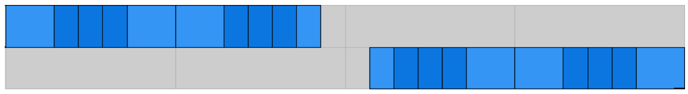
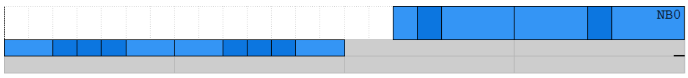
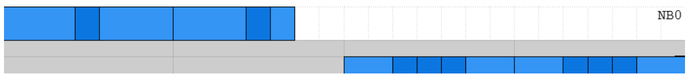
See:

– Chapter 2.2.5, "PUSCH", on page 29
– Chapter 2.2.6, "PUCCH", on page 32
– Chapter 2.2.7, "PRACH", on page 33

Guard period for narrowband and wideband retunning

According to TS 36.211, an eMTC transmission cannot switch the used narrowband/ wideband immediately but it needs time to **retune** to the new frequency. This retuning time is referred as guard time and is defined as number of unused symbols depending on the channel type and the link direction. In any of the combinations, two symbols are left unused, see the illustrations in Table 2-1.

Table 2-1: Symbols used as guard period for retuning

Link direction	Transition	Visualization on the "Time Plan"
UL	PUSCH-to-PUSCH	
	PUCCH-to-PUCCH	
	PUCCH-to-PUSCH	
	PUSCH-to-PUCCH	

Related settings

- "Retuning Symbols" on page 167

2.2.1 Physical layer

Narrowbands

In eMTC, a narrowband is defined as a set of six non-overlapping consecutive physical resource blocks in the frequency domain. The number of narrowbands N_{NB} is calculated as follows:

$N_{NB} = N_{RB} / 6$, where N_{RB} is the number of the available resource blocks.

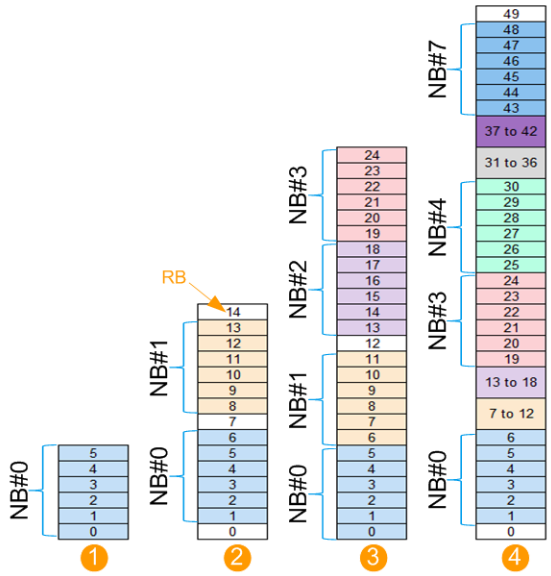


Figure 2-1: eMTC narrowbands

NB# = Narrowband number
RB = Resource block number
1 = "Channel Bandwidth = 1.4 MHz", N_{RB} = 6, N_{NB} = 1
2 = "Channel Bandwidth = 3 MHz", N_{RB} = 15, N_{NB} = 2
3 = "Channel Bandwidth = 5 MHz", N_{RB} = 25, N_{NB} = 4
4 = "Channel Bandwidth = 10 MHz", N_{RB} = 50, N_{NB} = 8
White RB = Not allocated RBs

eMTC transmission is always subframe-wise. That is, the smallest resource that can be allocated is 1 RB and one subframe.

Related settings

- Chapter 3.8, "eMTC DL valid subframes and frequency hopping", on page 116
- "Number of eMTC Narrowbands" on page 163
- "Valid Subframes" on page 167

Widebands

Four non-overlapping consequent narrowbands can be grouped into wideband with 5 MHz carrier bandwidth or 24 RBs. If the number of narrowband $N_{NB} \geq 4$, the number of widebands N_{WB} is calculated as follows:

$N_{WB} = N_{NB} / 4$, where N_{RB} is the number of the available resource blocks.

If the number of narrowband $N_{NB} < 4$, all available resource blocks are allocated to the same wideband.

Related settings

- "Wideband Config" on page 164
- "Number of eMTC Widebands" on page 163

2.2.2 PBCH

eMTC reuses the PBCH structure of LTE and is hence backward compatible. The PBCH in eMTC supports merely additional repetitions for enhanced frequency tracking. A further difference is the PBCH content (i.e. MIB), that is extended with a information regarding the scheduling of the SIB1-BR paging message.

If enabled, PBCH is repeated in subframe#0 and one additional subframe in all subframes in every 40ms cycle. The additional subframe is subframe#9 for FDD or subframe#5 for TDD.

PBCH repetition is not supported if the occupied bandwidth is 1.4 MHz.

Related settings

- Chapter 3.10.5, "PBCH channel coding and SIB-BR configuration", on page 146

2.2.3 PDSCH

A block of N_{acc} subframes is scrambled with the PDSCH scrambling sequence. The scrambling sequence is function of the N_{Cell}ID and the $N_{PDSCH,abs}$.

Where:

- $N_{PDSCH,abs}$ is the number of consecutive subframes that the PDSCH transmission spans, including the invalid subframes.
- Invalid are subframes in that the PDSCH transmission is postponed.

According to TS 36.211, N_{acc} depends on the CE mode and the frame type as listed in Table 2-2.

Table 2-2: N_{acc} depending on the CE level and frame type

CE mode	CE level	Frame type 1	Frame type 2
CEModeA	0, 1	1	1
CEModeB	2, 3	4	10

For example on the $N_{PDSCH,abs}$ calculation, see Example"Calculation of $N_{PUSCH,abs}$" on page 29. $N_{PDSCH,abs}$ is calculated similar to $N_{PUSCH,abs}$.

PDSCH start subframe

The PDSCH transmission starts two valid subframes after the end of the last repetition of the scheduling MPDCCH, see Figure 2-4.

Repetition of PDSCH not carrying SIB1-BR

The PDSCH repetition is defined as combination of cell-specific higher-level parameters `pdsch-maxNumRepetitionCEmodeA`/`pdsch-maxNumRepetitionCEmodeB` and the UE-specific parameter PDSCH repetition number. The latter is part of the DCI formats 6-1A/B or 6-2.

TS 36.211 specifies the PDSCH repetition levels for all three DCI format. Table 2-3 show an example of the DCI format 6-1A case.

Table 2-3: PDSCH repetition levels, defined with DCI format 6-1A [TS 36.211]

Higher-level parameter pdsch-maxNumRepetitionCEmodeA (cell-specific)	**PDSCH Repetition Number n1 to n4 (UE-specific)**
Not configured	1, 2, 4, 8
16	1, 4, 8, 16
32	1, 4, 16, 32

For information on the PDSCH repetitions, if PDSCH carries SIB1-BR, see "System information MIB" on page 23.

PDSCH hopping

PDSCH hopping is the process where the PDSCH changes the occupied narrowband on a per subframe basis. The occupied physical resource blocks (PRB) within the narrowband are maintained, merely changed is the narrowband.

Two hopping rules are defined depending on whether the PDSCH carries or not system information SIB1-BR:

- PDSCH **not carrying SIB1-BR**
  Information on the PRB within a narrowband on that the PDSCH is mapped in the first subframe is transmitted by the DCI.
  The hopping pattern is defined as a function of the absolute subframe number i_0 and the cell-specific higher-layer parameters $N_{NB}^{ch,DL}$, $N_{NB,hop}^{ch,DL}$ and $f_{NB,hop}^{DL}$, where:
  – $N_{NB}^{ch,DL}$ is the number of consecutive subframes during which MPDCCH or PDSCH stays at the same narrowband before hopping to another narrowband
  – $N_{NB,hop}^{ch,DL}$ is the number of narrowbands over which MPDCCH or PDSCH hops
  – $f_{NB,hop}^{DL}$ is the hopping offset, i.e. number of narrowbands between two consecutive MPDCCH or PDSCH hops

  See Example"PDSCH not carrying SIB1-BR hopping" on page 24.

- PDSCH **carrying SIB1-BR**
  PDSCH transmission is repeated periodically, every 8 radio frames. If n_f is the system frame number (SFN), a period starts at frames for that $n_f$mod8 = 0.

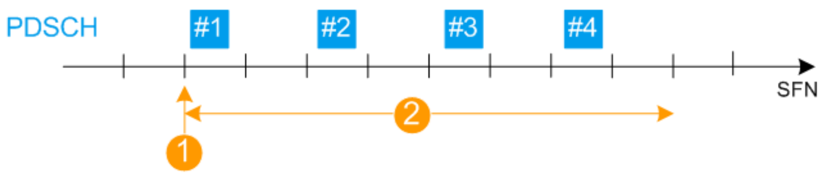


Figure 2-2: PDSCH carrying SIB1-BR transmission (Channel Bandwidth = 10 MHz)

SFN = System frame number
1 = PDSCH period starts at frames for that $n_f$mod8 = 0
2 = Period of 8 radio frames
PDSCH #1 to #4 = 4 PDSCH repetitions, configured with the parameter "eMTC > Bitmap > Schedulung Info SIB1-BR = 1", see Table 2-5.

Within each period, the PDSCH is repeated $N_{PDSCH}^{SIB1-BR}$ times, where the set of used frames and subframes n_{sf} depends on the channel bandwidth, the cell ID N_{ID}^{cell} and the frame structure type, see Table 2-4.

Table 2-4: Set of frames and subframes n_{sf} for SIB1-BR [TS 36.211]

Channel bandwidth	$N_{PDSCH}^{SIB1bis}$	N_{ID}^{cell} mod 2	Frame structure 1 n_f mod 2	Frame structure 1 n_{sf}	Frame structure 2 n_f mod 2	Frame structure 2 n_{sf}
$N_{RB}^{DL} \leq 15$	4	0	0	4	1	5
	4	1	1	4	1	5
$N_{RB}^{DL} > 15$	4	0	0	4	1	5
	4	1	1	4	1	0
	8	0	0, 1	4	0, 1	5
	8	1	0, 1	9	0, 1	0
	16	0	0, 1	4, 9	0, 1	0, 5
	16	1	0, 1	0, 9	0, 1	0, 5

System information MIB

PDSCH carries the system information SIB1-BR (`SystemInformationBlockType1-BR`). The PDSCH allocation that carries the SIB1-BR block comprises of six contiguous localized RB within a narrowband and is repeated as defined with the parameter `schedulingInfoSIB1-BR-r13`.

See:

- Table 2-5
- Figure 2-2

Table 2-5: Number of repetitions for PDSCH carrying SIB1-BR [TS 36.213]

Value of `schedulingInfoSIB1-BR-r13`	Number of PDSCH repetitions
0	SIB1-BR is not scheduled
1, 4, 7, 10, 13, 16	4
2, 5, 8, 11, 14, 17	8
3, 6, 9, 12, 15, 18	16
19 to 31	Reserved

Example: PDSCH not carrying SIB1-BR hopping

Configure for example:

- "User 1 > 3GPP Release = eMTC CE: A"
- "Channel Bandwidth = 10 MHz" or "Number of Narrowbands = 8".
- "eMTC > Narrowband > Number of Narrowbands for Hopping $N_{NB,hop}^{ch,DL}$ = 4"
- "eMTC > Narrowband > Hopping Offset $f_{NB,hop}^{DL}$ = 2"
- "eMTC > Narrowband > Hopping Interval for CE Mode A $N_{NB}^{ch,DL}$ = 4"
- "eMTC > Bitmap > Bitmap Subframes = 10" and "SF#0 to SF#9 = On".
- "eMTC > Search Space > Max. Repetition of PDSCH for CE Mode A = 32"
- "eMTC > DCI Configuration > User 1 > DCI format 6-1A > Config > PDSCH Frequency Hopping > On", "Repetition Number = 2" and "Ressource Block Assigment = 32".
  Hence, the n3 value from Table 2-3 is used and "Repetitions of PDSCH = 16".
  In this configuration, the first used narrowband is NB#1.
- "eMTC > Allocations > PDSCH > Num. Abs. SF $N_{PDSCH,abs}$ = 16", i.e. one PDSCH transmission last 16 subframes
- "eMTC > Allocations > PDSCH > Start Subframe = 3"

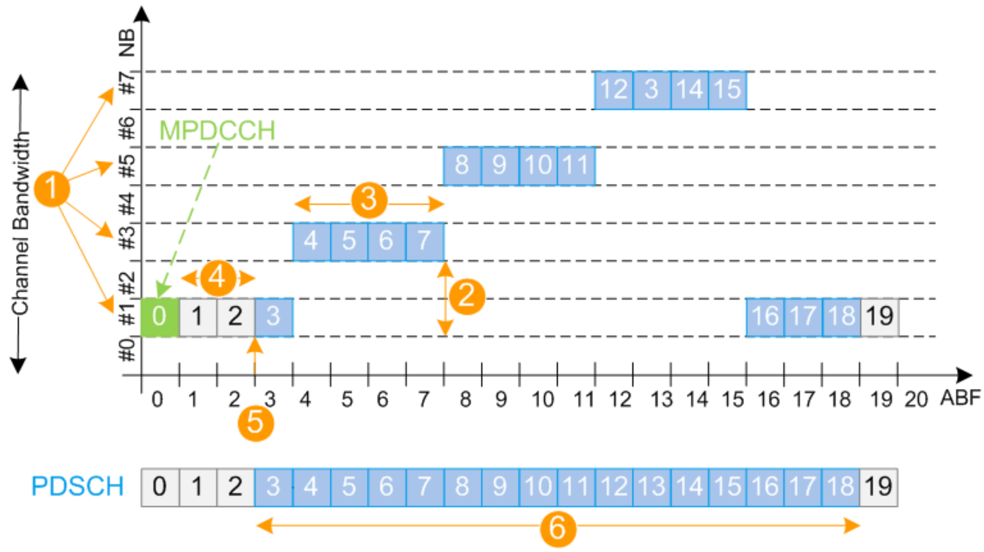


Figure 2-3: Example of PDSCH hopping

ABF	= Absolute subframe number, counted from the first subframe in SFN = 0.
NB	= Narrowband
#0 to #7	= Narrowband number, calculated automatically for the selected channel bandwidth
MPDCCH	= One single repetition and "Start Subframe = 0"
NB#1	= "Start NB = 1", as set with the DCI field "Ressource Block Assigment".
1	= $N_{NB,hop}^{ch,DL}$ = 4
2	= $f_{NB,hop}^{DL}$ = 2
3	= $N_{NB}^{ch,DL}$ = 4

4 = PDSCH always starts 2 subframes after the last repetition of the MPDCCH the shared channel is scheduled
5 = "PDSCH Start Subframe = 3" i.e. 2 subframes after the MPDCCH transmission
6 = $N_{PDSCH,abs}$ = 16

Related settings

- "Narrowbands" on page 119
- "Max. Repetitions of PDSCH for CE Mode A/B" on page 127
- "DCI Format 6-1A/6-1B" on page 135
- Chapter 3.10.6, "PDSCH channel coding and scrambling", on page 149
- Chapter 3.10.4, "eMTC allocations (PBCH, MPDCCH, PDSCH)", on page 142

2.2.4 MPDCCH

The eMTC physical downlink shared channel MPDCCH in eMTC is similar to the LTE EPDCCH in terms of structure and purpose. In both cases, this control channel carries scheduling assignments. It is transmitted in an MPDCCH set, mapped to group of resource elements called ECCEs (enhanced control channel elements) and it can use localized or distributed transmission scheme. EPDCCH is user-specific but MPDCCH also includes common search spaces (Type1 and Type2).

Other than in LTE, in eMTC the MPDCCH set consists of 2, 4, or 6 physical resource block (PRB) pairs. There is also the additional MPDCCH format 5, see Table 2-6.

Table 2-6: MPDCCH formats and number of ECCEs for one MPDCCH N^{MPDCCH}_{ECCE} [TS 36.211]

MPDCCH format	Case A	Case B
0	2	1
1	4	2
2	8	4
3	16	8
4	32*	16*
5	24	12

*) MPDCCH format 4 is supported if distributed transmission is used.

The MPDCCH is transmitted over N_{rep}^{MPDCCH} consecutive valid downlink subframes and spans $N_{MPDCCH,abs}$ consecutive subframes, including the invalid subframes where the transmission is postponed.

MPDCCH hopping

If frequency hopping is enabled, the narrowband for the MPDCCH transmission (NB_{start}) in the first subframe is given by higher-layer; it can be different per MPDCCH set. The hopping pattern is defined as a function of the absolute subframe number i_0 and the cell-specific higher-layer parameters $N_{NB}^{ch,DL}$

(`interval-DLHoppingConfigCommon`), $N_{NB,hop}^{ch,DL}$ (`mpdcch-pdsch-HoppingNB-r13`) and $f_{NB,hop}^{DL}$ (`mpdcch-pdsch-HoppingOffset-r13`), where $N_{NB,hop}^{ch,DL}$ = 2 or 4 narrowbands.

See Example"PDSCH not carrying SIB1-BR hopping" on page 24.

Search spaces

eMTC UE monitors the following MPDCCH search spaces:

- Type 0 common search space, if configured with CE Mode A
- Type 1 common search space, used for paging
- Type 2 common search space, used for random access (RA)
- UE-specific search space

The search space defines the MPDCCH candidates that the UE has to monitor. The UE is expected to decode only the control information on an MPDCCH that is transmitted over ECCEs within the search space the UE monitors.

MPDCCH starting subframe

The MPDCCH starting subframe depends on the used search space and is calculated similar to the NPDCCH starting subframe, see "Calculating the NPDCCH starting subframe" on page 42.

MPDCCH repetition number

The number of times the MPDCCH is repeated N_{rep}^{MPDCCH} is defined as a function of the R_{max} value and the repetition level r1 to r4, where:

- R_{max} gives the maximum number of MPDCCH repetitions and is defiend per search space, see Table 2-8 and Table 2-9.
- Repetition level is set by the DCI field "Subframe Repetition Number" of the corresponding DCI format, see Table 2-7.

Table 2-7: Repetition level r1 to r4 as function of the DCI subframe repetition number field

R	r1	r2	r3	r4
"DCI Subframe Repetition Number"	0	1	2	3

Table 2-8: MPDCCH repetition number for Search Space = UE-specific or Type 0/Type 2 Common

R_{max}	r1	r2	r3	r4
1	1			
2	1	2		
4	1	2	4	
≥ 8	$R_{max}/8$	$R_{max}/4$	$R_{max}/2$	R_{max}

Table 2-9: MPDCCH repetition number for Search Space = Type 1 Common

R_{max}	r1	r2	r3	r4
1	1			
2	1	2		
4	1	2	4	
8	1	2	4	8
16	1	4	8	16
32	1	4	16	32
64	2	8	32	64
128	2	16	64	128
256	2	16	64	256

Example: MPDCCH repetitions (UE-specific search space)

Configure for example:

- "eMTC > Bitmap > Bitmap Subframes = 10" and "SF#0 to SF#9 = On".
- "eMTC > Search Space > Max. Repetition of MPDCCH Rmax (Type 2 Common) = 4".
- "User Configuration > User 1 > 3GPP Release = eMTC CE: A".
- "User Configuration > User 1 > MPDCCH Config:": "Max. Repetition of MPDCCH Rmax (User-Specific search space) = 4", "MPDCCH Hopping > On" and "Search Space Start Subframe = 1".
- "eMTC > DCI Configuration > User 1 > DCI format 6-1A > Search Space = UE-Specific" and "DCI format 6-1A > Config > DCI Subframe Repetition Number = 2". Hence the r3 value from Table 2-8 is used and "MPDCCH Repetitions = 4".
- "eMTC > Allocations > MPDCCH > Start Subframe = 1"

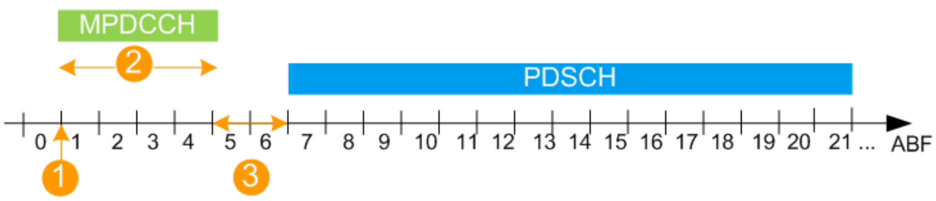


Figure 2-4: Example of MPDCCH repetitions and PDSCH cross-scheduling (UE-specific search space)

1 = MPDCCH start subframe
2 = MPDCCH Repetitions
3 = PDSCH always starts 2 subframes after the last repetition of the MPDCCH the shared channel is scheduled

DCI formats, decoding and content

Table 2-10 gives an overview of the defined DCI formats.

Table 2-10: DCI formats

DCI format	Purpose	CE Mode	"User x"/ P-RNTI/ RA-RNTI	Search space
3 3A	As in LTE Transmission of TPC Commands for MPUCCH and MPUSCH 2 bits and 1-bit power adjustment respectively	CE Mode A	"User x"	UE-specific Type 2 common
6-0A	Scheduling of PUSCH in one UL cell Resource allocation type 0	CE Mode A	"User x"	UE-specific Type 0 common
6-0B	Scheduling of PUSCH in one UL cell Resource allocation type 2, without TPC and CSI request	CE Mode B	"User x"	UE-specific
6-1A	Scheduling of one PUSCH codeword in one cell Random access procedure initiated by a PDSCH order Resource allocation type 2	CE Mode A	"User x" RA-RNTI	UE-specific Type 0 common Type 2 common
6-1B	Scheduling of one PUSCH codeword in one cell Random access procedure initiated by a PDSCH order Resource allocation with 1 bit	CE Mode B	"User x" RA-RNTI	UE-specific Type 2 common
6-2	Paging and direct indication	-	P-RNTI	Type 1 common

Table 2-11 gives the DCI formats **decoding** for MPDCCH and PDSCH.

Table 2-11: DCI decoding [TS 36.213]

MPDCCH and PDSCH configured with:	Transmission Mode	DCI format	Search space	PDSCH transmission scheme, corresponding to MPDCCH
P-RNTI	-	6-2	Type 1 common	• If number of PBCH antenna ports = 1, Single-antenna port, port 0 • Otherwise, Transmit diversity
RA-RNTI	-	6-1A 6-1B	Type 2 common	• If number of PBCH antenna ports = 1, Single-antenna port, port 0 • Otherwise, Transmit diversity
C-RNTI	Mode 1	• 6-1A • 6-1A or 6-1B	• Type 0 common • UE-specific	Single-antenna port, port 0
	Mode 2	• 6-1A • 6-1A or 6-1B	• Type 0 common • UE-specific	Transmit diversity
	Mode 6	6-1A	• Type 0 common • UE-specific	• Transmit diversity • Closed-loop spatial multiplexing, single layer transmission
	Mode 9	• 6-1A • 6-1A or 6-1B	• Type 0 common • UE-specific	• Single-antenna port, port 0 or transmitt diversity • Single-antenna port, port 7 or 8

Related settings

- [Chapter 3.10.1, "Search space settings"](#), on page 125
- [Chapter 3.10.3, "eMTC DCI configuration"](#), on page 130
- [Chapter 3.10.4, "eMTC allocations (PBCH, MPDCCH, PDSCH)"](#), on page 142

2.2.5 PUSCH

A block of N_{acc} subframes is scrambled with the PUSCH scrambling sequence. The scrambling sequence is function of the $N_{Cell}ID$ and the $N_{PUSCH,abs}$.

Where:

- $N_{PUSCH,abs}$ is the number of consecutive subframes that the PUSCH transmission spans, including the invalid subframes.
- Invalid are subframes in that the PUSCH transmission is postponed.

According to TS 36.211, N_{acc} depends on the CE mode and the frame type as listed in Table 2-12.

Table 2-12: N_{acc} depending on the CE level and frame type

CE mode	CE level	Frame type 1	Frame type 2
CEModeA	0, 1	1	1
CEModeB	2, 3	4	5

Example: Calculation of $N_{PUSCH,abs}$

If:

- ValidSF = 0, 2, 3, 4, 5
- $n_{invalidSF}$ = 1

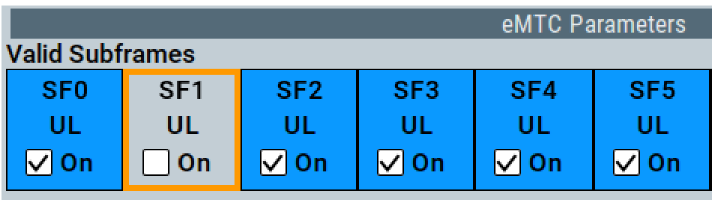


Figure 2-5: Valid subframes configuration ("General UL Settings > Cell > eMTC Parameters")

- StartSF = 0
- n_{Rep}^{PUSCH} = 4

Then $N_{PUSCH,abs}$ = 4 +1 = 5

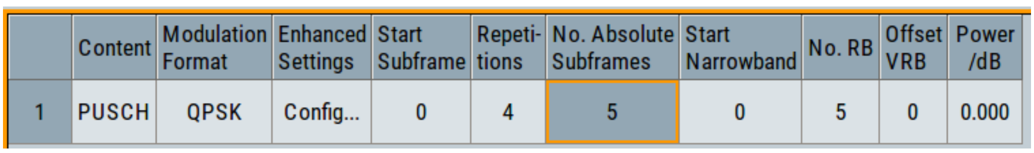


Figure 2-6: No. absolute subframes ("UL Frame Configuration > UE x > eMTC Allocation")

PUSCH frequency hopping

PUSCH can utilize frequency hopping.

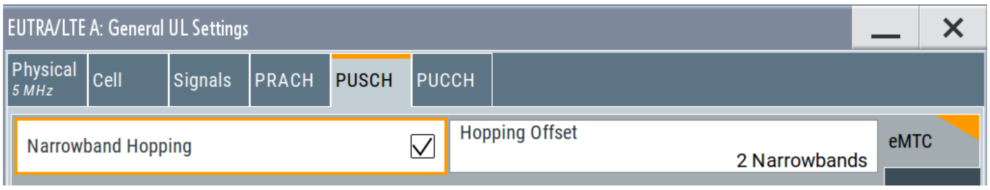
- If hopping is disabled, the PUSCH repetitions are located in the same resource block at the same narrowband.
- If hopping is enabled, then PUSCH is transmitted in a given NB for a selected number of consecutive subframes ($N_{PUSCH,abs}$)

  The frequency-hopping pattern is calculated depending on the following:
  - Absolute subframe number (ASF) of the first UL subframe in that the PSUCH is scheduled
  - The cell-specific higher-level parameter $f_{NB,hop}$ that defines the hopping offset between the current and the subsequent narrowband
  - The cell-specific higher-level parameter $N_{NB,ch}$ that set the number of subframes the hopping pattern remains in the same narrowband
  - Number of absolute subframes $N_{PUSCH,abs}$

Example: PUSCH hopping

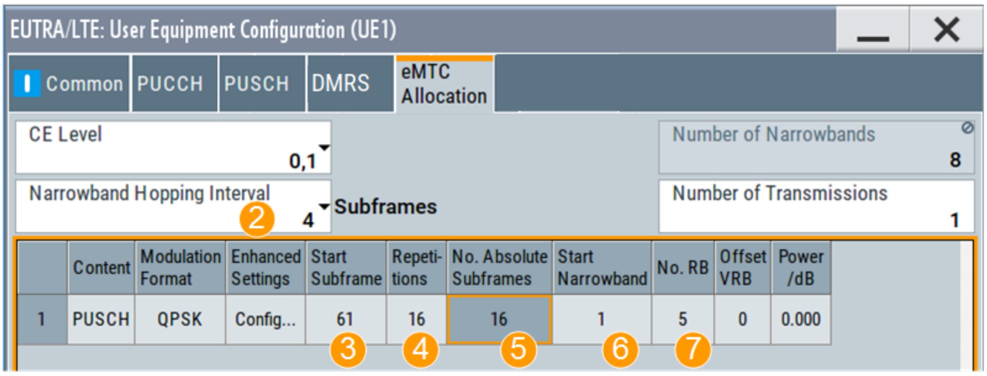
Configure, for example, the following settings:

- "ARB > Sequence Length = 10 Frames"
- In the "General UL Settings" dialog:
  - "Cell > eMTC Parameters > Valid Subframes > SF x UL > On" (all UL subframes)
  - "PUSCH Narrowband Hopping > On" and "Hopping Offset = 2" ($f_{NB,hop}$ = 2)



- "UL Frame Configuration > UE 1 > 3GPP Release > eMTC" and "UE 1 > State > On"
- In the "UE 1 > User Configuration > eMTC Allocation" dialog, configure one PUSCH transmission:
  - "Narrowband Hopping Interval = 4" ($N_{NB,ch}$ = 4)
  - "Start Subframe = 61" ("Frame = 60", "Subframe = 1"), "Repetitions = 16", "Start Narrowband = 1"

  The calculated number of absolute subframes is $N_{PUSCH,abs}$ = 16



2, 3, 4, 5, 6, 7 = The effect on the settings is illustrated on Figure 2-7

- In the "Time Plan", select "1st Subframe = 60" and "Subframes = 20".

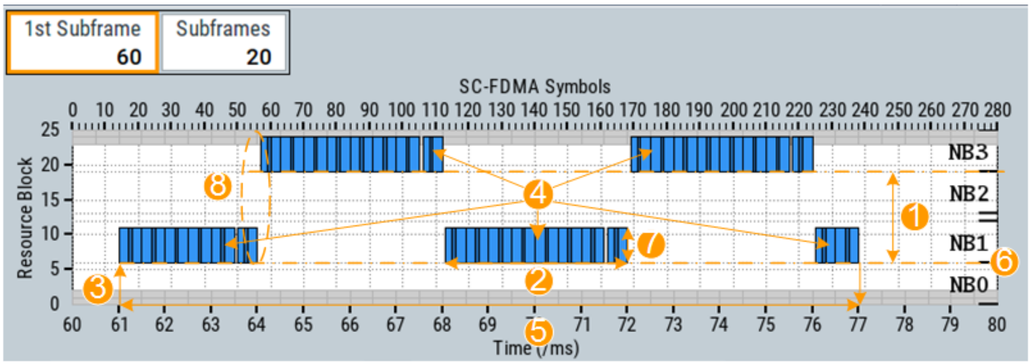


Figure 2-7: PUSCH hopping: understanding the displayed information

1 = $f_{NB,hop}$ = 2 (the offset between the start of two subsequent narrowbands is 2)
2 = $N_{NB,ch}$ = 4 (PUSCH remains in the same narrowband for four subframes)
3 = StartSF = 61 (start subframe number)
4 = n_{Rep}^{PUSCH} = 16 (PUSCH is repeated a total number of 16 times)
5 = $N_{PUSCH,abs}$ = 16 (number of absolute subframes)
6 = Start narrowband = NB1
7 = Number of RB per narrowband
6 = Guard period for retuning, see Figure 2-7

- To observe the unused slots at each narrowband hop at greater detail, select "1st Subframe = 61" and "Subframes = 7".

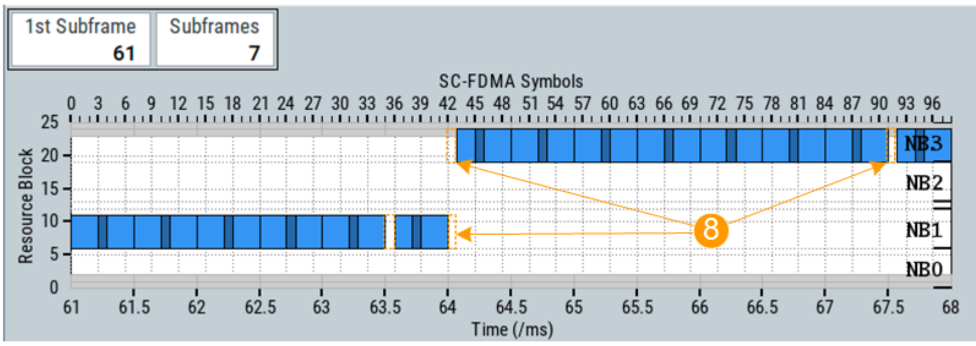


Figure 2-8: Narrowband hop with PUSCH-to-PUSCH transition

8 = The last and the first symbols are unused at each narrowband hop in a PUSCH-to-PUSCH transition (see also "Guard period for narrowband and wideband retunning" on page 19)

2.2.6 PUCCH

PUCCH can be transmitted once or repeated defined number of times. It is transmitted during defined number of consecutive subframes and is postponed during the invalid subframes.

PUCCH allocation in terms of resource blocks is calculated depending on the:

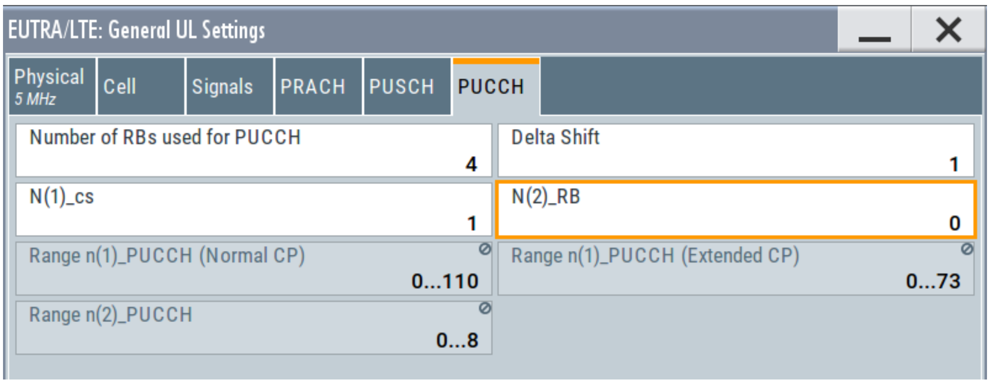
- Absolute subframe number (ASF) of the first UL subframe in that the PSUCH is scheduled
- The cell-specific higher-level parameter $N_{NB,ch}$ that set the number of subframes the hopping pattern remains in the same narrowband.
- Number of absolute subframes $N_{PUCCH,abs}$

For more information on the $N_{NB,ch}$, $N_{PUCCH,abs}$ and the term invalid subframes, see Chapter 2.2.5, "PUSCH", on page 29.

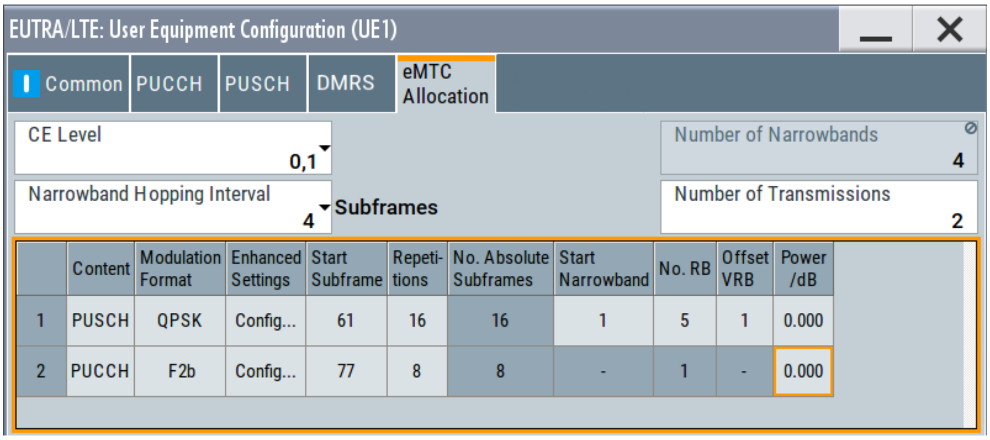
Example: PUCCH configuration

This example extends the configuration used in Example"PUSCH hopping" on page 30.

- In the "General UL Settings > PUCCH" dialog, select "Number of RBs used for PUCCH = 4" and "Delta Shift = 1".



- In the "UE 1 > User Configuration > eMTC Allocation" dialog, add one PUCCH transmission with "Repetitions = 8" ($n_{Rep}{}^{PUCCH}$ = 8)
  The start subframe is set automatically.



- Observe the "Time Plan".

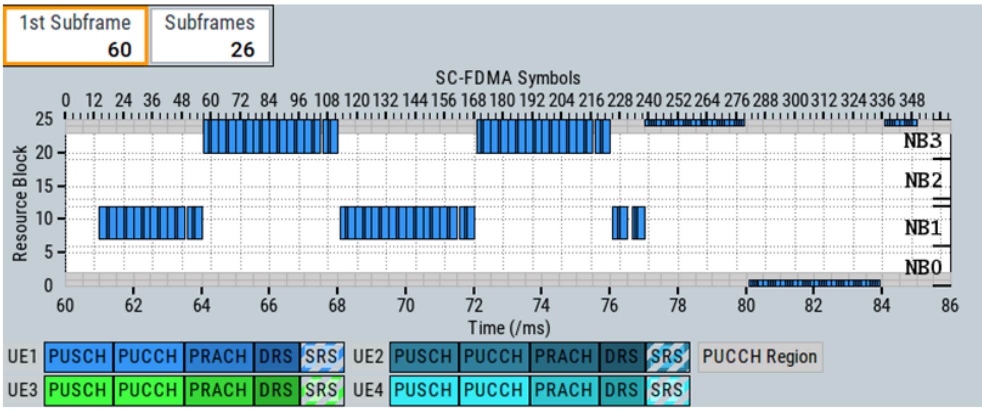


Figure 2-9: PUCCH hopping: understanding the displayed information

1 = "PUCCH Region = 4 RBs" (two RBs at each channel bandwidth end)
2 = $N_{NB,ch}$ = 4 (PUCCH remains in the same RB four subframes)
3 = StartSF = 77 (start subframe number)
4 = $n_{Rep}{}^{PUCCH}$ = 8 (PUCCH is repeated eight times)
5 = $N_{PUCCH,abs}$ = 8 (number of absolute subframes)

2.2.7 PRACH

As in LTE, eMTC PRACH configuration comprises cell-specific and UE-specific parameters. Different than in LTE that defines one single PRACH configuration, in eMTC there are four eMTC PRACH configurations, one per CE level.

The following cell-specific parameters define the eMTC PRACH configurations:

- PRACH hopping offset $f_{PRB,hop}{}^{PRACH}$ (`prach-HoppingOffset`) in terms of RBs and common for all PRACH allocations
- One PRACH configuration per CE level, configured with:

– PRACH configuration index (`prach_ConfigurationIndex`) that selects the predefined PRACH distribution pattern
– PRACH frequency offset ($n_{PRBoffset}^{RA}$) (`prach_FrequencyOffset`) in terms of RBs that shift the PRACH allocation in the frequency domain
The physical RBs used for the PRACH allocation ($n_{PRBoffset}^{RA}$) depend also on the system frame number (SFN). If frequency hopping is used for frame type 2, also on the UL/DL configuration.
– PRACH frequency hopping (`prach_HoppingConfig`)
– Number of PRACH repetitions per attempt (N_{rep}^{PRACH}) (`numRepetitionPerPreambleAttempt`)
See Table 2-13
– Optionally, PRACH starting subframe periodicity N_{start}^{PRACH} (`prach_StartingSubframe`)

Table 2-13: Number of PRACH repetitions per attempt depending on the PRACH format

PRACH configuration index		**PRACH format**	**N_{rep}^{PRACH}**
(Frame type 1)	**(Frame type 2)**		
0 to 15	0 to 19	0	≥ 1
16 to 31	20 to 29	1	≥ 1
32 to 47	30 to 39	2	≥ 1
48 to 63	40 to 47	3	≥ 1
-	48 to 57	4	1

A UE can start up to 40 preamble attempts, where each subsequent of them has to use a PRACH configuration that corresponds to a higher CE level. The frequency allocation of each preamble is retrieved from the cell-specific PRACH configuration of the selected CE level. UEs can merely postpone the preamble in time by defining the first subframe it appears. Preamble attempts do not overlap; any subsequent preamble attempt starts after the previous one is completed.

Each preamble occupies 6 consecutive resource blocks. Preambles are generated from Zadoff-Chu sequences.

2.3 About NB-IoT

Short summary

NB-IoT addresses the low-cost requirement of the IoT market. It does not support complex LTE features like carrier aggregation.

NB-IoT is new air interface with the following main characteristics:

- 180kHz carrier bandwidth (or 200 KHz channel bandwidth) in both uplink and downlink.

This bandwidth corresponds to one resource block in LTE transmission

- Three different operating modes, see "Operating modes" on page 36
- Three kinds of coverage extension (CE) levels: CE level 0, CE level 1 and CE level 2
  Where the CE level 2 indicates the worst coverage situation
- UE that support NB-IoT are tagged with the category CAT-NB1
- NB-IoT is defined for FDD and half duplexing mode

Overview of the physical signals and channels

Defined are:

- DL narrowband primary and secondary synchronization signals (NPSS and NSSS)
  See Chapter 2.3.2, "NPSS and NSSS", on page 38.
- DL narrowband reference signals (NRS)
  See Chapter 2.3.3, "NRS", on page 39
- DL physical channels:
  NPBSCH (narrowband physical broadcast channel), NPDSCH (narrowband physical downlink shared channel), NPDCCH (narrowband physical downlink control channel)

  See:
  – Chapter 2.3.4, "NPBCH", on page 40
  – Chapter 2.3.6, "NPDSCH", on page 45
  – Chapter 2.3.5, "NPDCCH", on page 41
- UL narrowband demodulation reference signals (NDRS)
  See Chapter 2.3.7, "NDRS", on page 47.
- UL physical channels:
  NPUSCH (narrowband physical uplink shared channel), NPRACH (narrowband physical uplink random access channel)

  See:
  – Chapter 2.3.8, "NPUSCH", on page 48
  – Chapter 2.3.9, "NPRACH", on page 51

2.3.1 Physical layer

NB-IoT reuses the LTE resource grid:

- The time domain structure of LTE is reused. There are 7 OFDM symbols within a slot, as it is in the normal CP case.
- Per OFDM DL symbol, there are 12 subcarriers spaced at 15 KHz and hence occupying 180 kHz bandwidth.
- In UL, the eNB decides which of the two allowed subcarrier spacings to apply (see Table 2-14)
  For the spacing of 3.75 KHz, for instance, there are 48 subcarriers available within a resource block of 180 kHz.
- One subcarrier in one OFDM symbol is referred as a resource element.

Table 2-14: Number of subcarriers in downlink N_{SC}^{DL} and uplink N_{SC}^{UL}

Subcarrier spacing	N_{SC}^{DL}	N_{SC}^{UL}	Slot duration, ms
Δf = 3.75 KHz	-	48	2
Δf = 15 KHz	12	12	0.5

In DL, NB-IoT supports transmission over up to two antenna ports (AP2000 and AP2001), where the same transmission scheme applies for all DL physical channels

Operating modes

Figure 2-10 illustrates the three different NB-IoT operating modes.

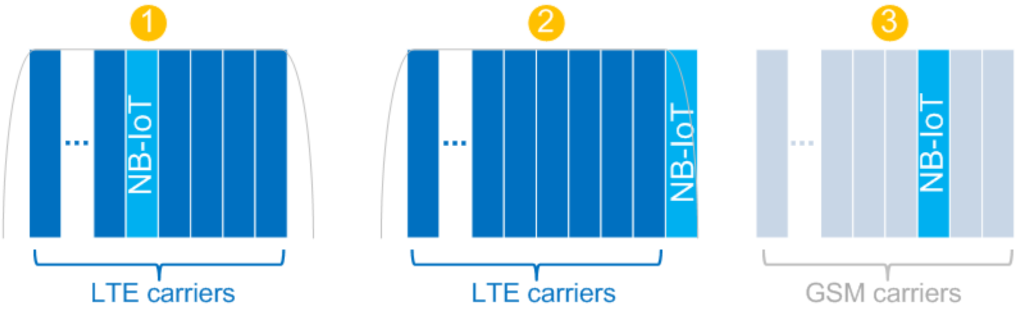


Figure 2-10: NB-IoT operating modes

1 = In-band operation by reusing free LTE resource blocks (supported in LTE bandwidths larger than 200 kHz)*
2 = Guard band operation by using the spectrum between neighboring LTE carriers (unused LTE guard band resource blocks)
3 = Standalone operation in free GSM spectrum
* = In-band operation in DL is not supported in the 1.4 MHz bandwidth

NCell ID N^{Ncell}_{ID}

NB-IoT maintains the concept of up to 504 physical cell IDs (PCI). It is refereed as NCell ID or N^{Ncell}_{ID}.

Regarding the PCI, the specification defines two modes:

- **In-band operation with same PCI (N^{NCell}_{ID} = PCI)**
  Where N^{NCell}_{ID} is the NB-IoT cell ID and PCI is the physical cell ID of the LTE cell.
  In this mode, NB-IoT and LTE share the same PCI and use the same number of CRS and NRS ports:
  There can be a maximum number of two CRS ports, because the number of narrowband reference signals $N_{NRS} \leq 2$.
  (see NRS)
- **In-band different PCI operation (N^{NCell}_{ID} ≠ PCI)**
  The LTE cell and the NB-IoT cell operate in the same band but have a different PCI.
  The number of CRS ports could be different than the N_{NRS}

Examples

Example: Configuring an NB-IoT allocation in standalone operating mode

Standalone NB-IoT operation is the default and the only one possible mode when the channel bandwidth is set to 200 kHz.

In DL:

- Select "General DL Settings > Physical > Channel Bandwidth = 200 kHz".
- Select "NB-IoT Carrier Allocation".
  The parameter "Mode = Standalone" confirms that in the selected channel bandwidth, only NB-IoT standalone operation in possible.

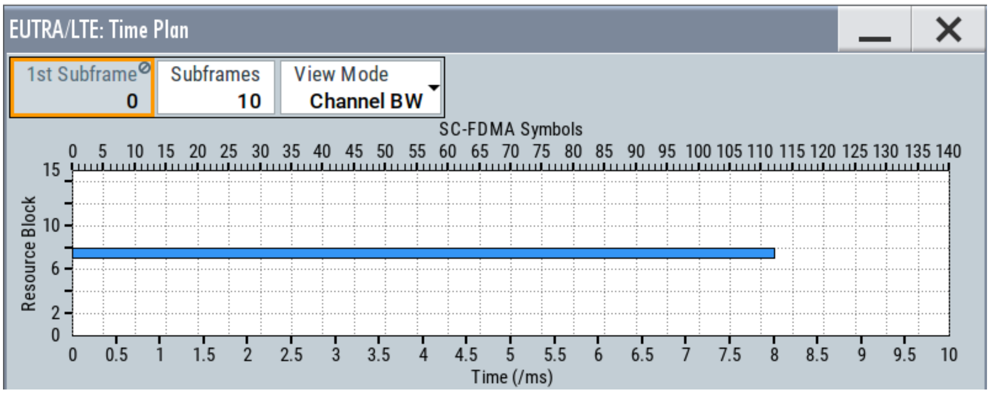
In UL:

- Select "General UL Settings > Physical > Channel Bandwidth = 200 kHz".
- Select "UL Frame Configuration > UEx > 3GPP Release = NB-IoT".
- Select "UEx > User Equipment Configuration > NB-IoT Allocation".
  The parameter "Mode = Standalone" confirms that in the selected channel bandwidth, only NB-IoT standalone operation is possible.

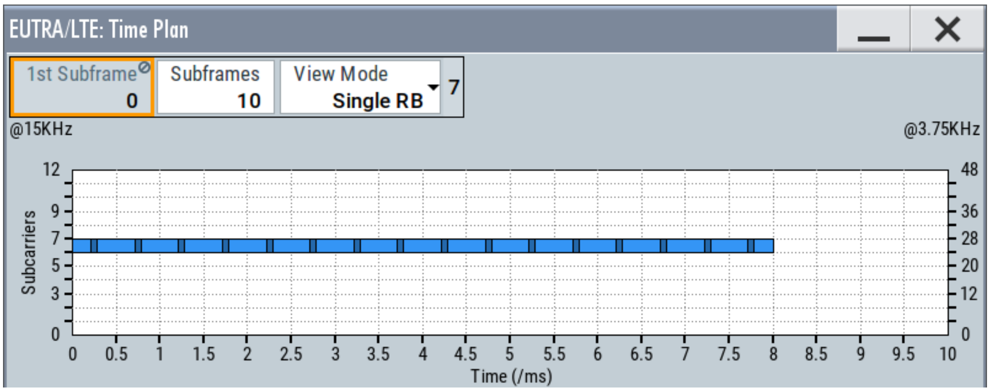
Example: Enabling an NB-IoT UL in-band operation

An NB-IoT in-band or guard-band operation requires channel bandwidth wider than 200 kHz, 1.4 MHz or wider for UL (and 3MHz or wider for DL). The following example shows you how to allocate the NB-IoT transmission around the DC carrier.

1. Select a channel bandwidth wider than 200 kHz and containing even number of resource blocks.
   For example "General UL Settings > Physical > Channel Bandwidth = 3 MHz".
   The 3 MHz channel bandwidth consists of 15 resource blocks.
2. Select "UL Frame Configuration > UEx > 3GPP Release = NB-IoT".
3. Select "UEx > User Equipment Configuration > NB-IoT Allocation".
4. Select "Mode = In-band".
5. Select "Resource Block Index = 7".
6. Observe the "Time Plan".
   Use the "View Mode > Channel BW".



7. To shift the default NPUSCH allocation within the resource block, select "NB-IoT Allocation > NPUSCH#1 > Subcarrier Indication = 6".
8. In the "Time Plan", set the "View Mode = Single RB".



Example: Enabling mixed LTE and NB-IoT configuration

Extend the configuration in Example"Enabling an NB-IoT UL in-band operation" on page 37 with the following:

- Select "General > LTE/IoT Standard > LTE/eMTC/NB-IoT".
- In the "UL Frame Configuration > General" dialog, enable second UE with "3GPP Release = LTE/LTE-A".
- In the "UL Frame Configuration > Subframe" dialog, enable at least the PUSCH allocation of the LTE UE.
- Set for example:
  – "PUCCH/PUSCH > State > On"
  – "PUSCH > Set 1 No. RB = 12" to allocate the entire channel bandwidth
- Observe the time plan in both view modes.

2.3.2 NPSS and NSSS

As in the LTE, the DL primary and secondary synchronization signals (NPSS and NSSS) are used for cell search, time and frequency synchronization, and obtaining the cell ID.

The carrier on which the UE detects the NPSS/NSSS/NPBCH/SIB-NB is referred as **anchor carrier**.

The NPSS and NSSS have the following transmission patterns:

- NPSS is transmitted in the sixth subframe (SF#5) of every frame.
  It spans 11 subcarriers and uses one fixed 11-bit log Zhadof-Chu sequence.
- NSSS is transmitted in the tenth subframe (SF#9) in the even-numbered frames, that fulfill the following condition:
  n_f mod 2 = 0, where n_f is the frame number.

NSSS spans 12 subcarriers and is generated form a 131-bit length Zhadof-Chu sequence, that is scrambled and cyclically shifted also with the NCell ID, see "NCell ID N^{Ncell}_{ID}" on page 36.

No other signals can be scheduled during the subframes NPSS or NSSS are transmitted.

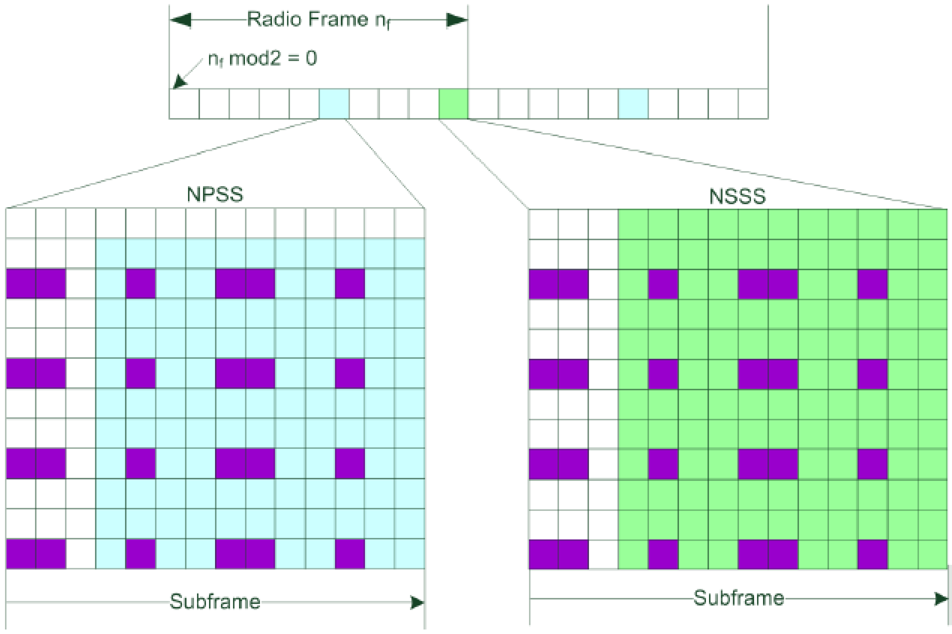


Figure 2-11: NPSS and NSSS allocation with 4 antenna port LTE CRS transmission* [1MA266]

Blue = NPSS
Green = NSSS
White = First three OFDM symbols are reserved for the LTE PDCCH and hence omitted by NB-IoT
Violet = LTE CRS; in in-band mode, all possible LTE CRS resource elements are omitted by NB-IoT
* = NRS is not transmitted in the NPSS and NSSS subframes

2.3.3 NRS

- NRS is transmitted in the last two OFDM symbols of each slot, if these slots are not used for NPSS or NSSS.
- Can be transmitted on one or two antenna ports (AP2000/AP2001), depending on the transmission scheme.
- NRS is mapped on a similar way as the RS in LTE, see Figure 2-12.
- NRS is cyclically shifted by the NCell ID

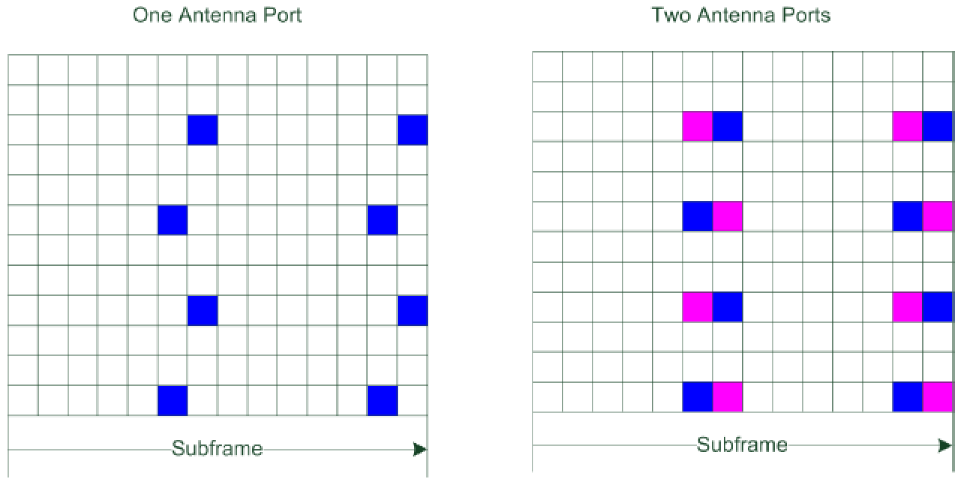


Figure 2-12: NRS mapping to the resource elements (one and two antenna ports) [1MA266]

With this structure, there is no overlap between the NRS and the LTE CRS.

The NRS position depends on the duplexing mode; in TDD mode, it depends on the special subframe configuration. Observe the timeplan for current allocation.

2.3.4 NPBCH

The narrowband physical broadcast channel (NPBCH) is QPSK modulated and carries narrowband master information block MIB-NB information.

MIB-NB

MIB-NB is scrambled with the N^{Ncell}_{ID}. It contains 34 bits and is transmitted over 64 frames. The MIB-NB is split into 8 blocks, where each block is transmitted on the first subframe (SF#0) in a frame and is repeated in the subsequent 7 frames.

MIB-NB carries important information and among other, it indicates the starting frame of SIB1-NB and repetitions, see "SIB1-NB" on page 46.

Figure 2-13 shows the subframe structure of the NPBCH.

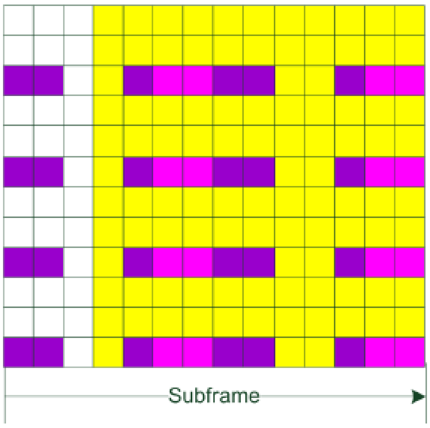


Figure 2-13: NPBCH mapping on the resource elements in SF#0 [1MA266]

Yellow = NPBCH resource elements = 100, excluding the LTE CRS and NRS symbols and the symbols in the PDCCH region
Violet = LTE CRS
Magenta = NRS
White = First three OFDM symbols are reserved for the LTE PDCCH

2.3.5 NPDCCH

The narrowband physical downlink control channel (NPDCCH) controls the data transfer between UE and eNB. It indicates the UE for that the NPDSCH carries data, the data allocation and the number of times it is repeated. NPDCCH is QPSK modulated.

NPDCCH is transmitted on an aggregation of one or two consecutive narrowband control channel elements (NCCE), distinguished by their NCCE index. Each NCCE is defined as a set of 6 subcarriers and occupies two slots. NPDCCH can occupy one or two NCCEs, where the first case is referred to as NPCCH format 0 and the later as NPDCCH format 1.

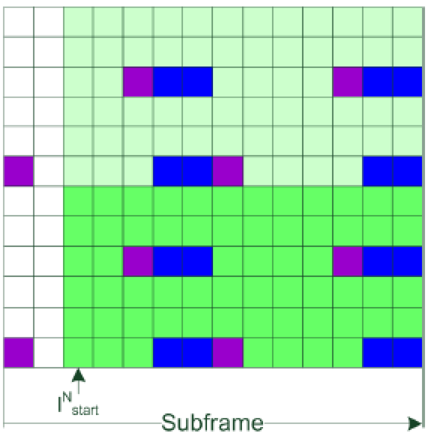


Figure 2-14: NPDCCH mapping [1MA266]

Green = NPDCCH resource elements (NCCE#0 and NCCE#1), excluding the LTE CRS and NRS symbols and the symbols in the PDCCH region
Violet = LTE CRS
Blue = NRS
White = OFDM symbols are reserved for the LTE PDCCH
$l_{NDPCCHStart}$ = Start Symbol

Search spaces

NPDCCH is grouped into three search spaces:

- Type 1 common search space, used for paging
- Type 2 common search space, used for random access
- UE-specific search space

The search space defines the NPDCCH candidates that the UE has to monitor. The UE can decode only the control information on an NPDCCH that is transmitted over NCCEs within the search space the UE monitors.

An NPDCCH search space is defined at aggregation level (L) and as a set of NPDCCH candidates. Each candidate is repeated R times over consecutive NB-IoT downlink subframes, where:

- SFs used for the transmission of system messages are omitted.
- The starting subframe is calculated to fulfill the conditions listed in "Calculating the NPDCCH starting subframe" on page 42.
- The aggregation level L = {0, 1} defines the number of NCCEs allocated for the NPDCCH (see also Figure 2-14)
- The repetition R is selected per search space type from:
  – Table 2-15 and
  – Table 2-16

Calculating the NPDCCH starting subframe

Possible values are calculated automatically to fulfill the:

- Validity of the subframes, see "Valid Subframes" on page 77
- Configured NB-IoT allocations, see Chapter 3.7, "NPBCH, NPDCCH and NPDSCH settings", on page 86
- NPDCCH condition, per search space type, as defined in :
  – Type 1 common
    Determined form locations of NB-IoT paging opportunity subframe
  – Type 2 common and UE-Specific
    $(10n_f + floor(n_s/2))modT = alpha_{offset}.T$
    $T = G.R_{max} \geq 4$

  Where:
  – n_f is the system frame number SFN
  – n_s is the slot number
  – G is search space start subframe
  – R_{Max} is max number of NPDCCH repetitions

– $alpha_{offset}$ is the search space offset

G, R_{Max} and $alpha_{offset}$ are search space-specific value, set with the following settings:

– UE-Specific, see "UE-Specific Search Space" on page 90
– Type 2 common, see "Common Search Space" on page 89

Table 2-15: Type 1 common search space NPDCCH candidates [TS 36.213]

R_{Max}	**R**								**NCCE indices of monitored NPDCCH candidates L = 2**
"Repetitions of DCI"	000	001	010	011	100	101	110	111	
1	1								{0,1}
2	1	2							{0, 1}
4	1	2	4						{0, 1}
8	1	2	4	8					{0, 1}
16	1	2	4	8	16				{0, 1}
32	1	2	4	8	16	32			{0, 1}
64	1	2	4	8	16	32	64		{0, 1}
128	1	2	4	8	16	32	64	128	{0, 1}
256	1	4	8	16	32	64	128	256	{0, 1}
512	1	4	16	32	64	128	256	512	{0, 1}
1024	1	8	32	64	128	256	512	1024	{0, 1}
2048	1	8	64	128	256	512	1024	2048	{0, 1}

Table 2-16: UE-specific and Type 2 common search space NPDCCH candidates

R_{Max}	**R**	**"Repetitions of DCI"**	**NCCE indices of monitored NPDCCH candidates L = 2**	**UE-specific search space only** **NCCE indices of monitored NPDCCH candidates L = 1**
1	1	00	{0,1}	{0}, {1}
2	1	00	{0, 1}	{0}, {1}
2	2	01	{0, 1}	-
4	1	00	{0, 1}	-
4	2	01	{0, 1}	-
4	4	10	{0, 1}	-
≥8	$R_{Max}/8$	00	{0, 1}	-
≥8	$R_{Max}/4$	01	{0, 1}	-
≥8	$R_{Max}/2$	10	{0, 1}	-
≥8	R_{Max}	11	{0, 1}	-

DCI formats, decoding and content

Table 2-17 gives an overview of the defined DCI formats.

Table 2-17: DCI formats

DCI format	Size, bits	Purpose	User / RNTI	Search space
N0	23	Scheduling of NPUSCH in one UL cell	User x (C-RNTI)	UE-specific Type 2 common
N1	23	Scheduling of one NPUSCH codeword in one cell Random access procedure initiated by an NPUSCH order	User x (C-RNTI) RA-RNTI	UE-specific Type 2 common
N2	15	Paging and direct indication	P-RNTI	Type 1 common

The DCI formats decoding is as follows:

- Scrambling with P-RNTI: DCI format N2
- Scrambling with RA-RNTI: DCI format N1
- Scrambling with C-RNTI: evaluated is the first bit called flag for format N0/format N1 differentiation:
  – First bit = 0: N0
  – First bit = 1: N1

Among other, the DCIs carry information on scheduling delay I_{Delay}, where scheduling delay is the time between the NPDCCH end and the NPDSCH or NPUSCH start.

When signaled over DCI format N0 and N1:

- $I_{Delay}^{NPDSCH} \geq 5$ SFs
- $I_{Delay}^{NPUSCH} \geq 8$ SFs

In DCI format N2, $I_{Delay}^{NPDSCH} = 5$ SFs

Example: NPDCCH candidates calculation

- Current frame $n_f = 16$ and subframe = 0 (16, 0)
- $R_{Max} = 4$
- G = 4
- $\alpha_{offset} = 1/8$
- $T = G*R_{Max} = 16$
- $(10n_f + \lfloor n_s/2 \rfloor) \text{mod } T = \alpha_{offset}.T = 2$

The following starting subframes fullfill the condition:

- For R = 1: (16, 2), (16, 3), (16, 4) and (16, 6)
- For R = 2: (16, 2), (16, 4)
- For R = 4: (16, 2)

Example: NPDCCH scheduling based on DCI format N1

- "Search Space = UE-specific"
  - $R_{max} = 4$
  - $G = 1.5$
  - $\alpha_{offset} = 1/8$
- "Repetitions of DCI Subframes = 2" and therefore R = 4
- NPDCCH "Start Subframe = 2"
  (See also Example"NPDCCH candidates calculation" on page 44)

NPDCCH is transmitted in four subframes, where the first subframe is subframe 2.

Figure 2-15 shows this configuration as observed on the "Timeplan".

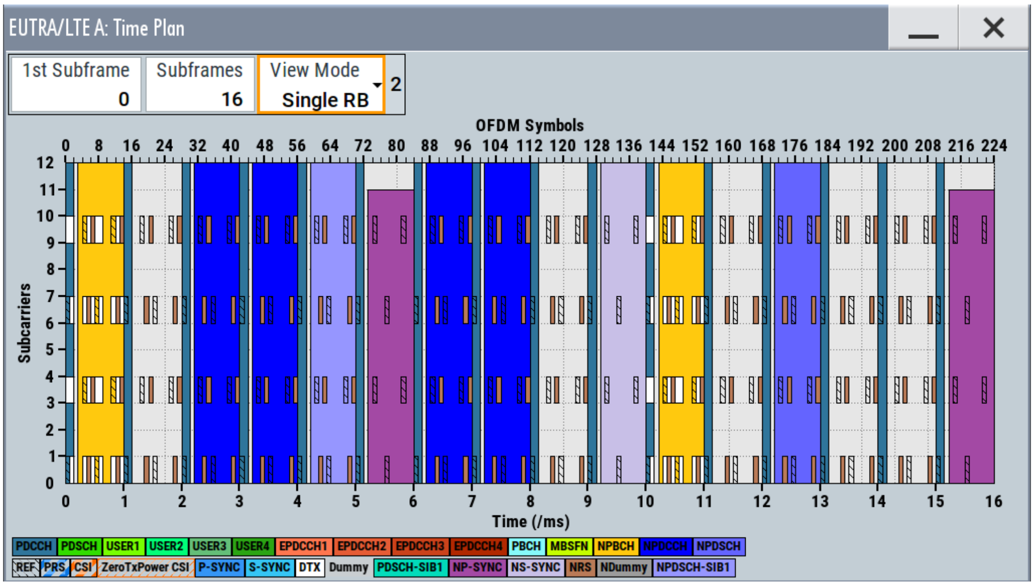


Figure 2-15: NPDCCH scheduling based on DCI format N1

NPDCCH is not allocated in subframe#4 because this subframe is reserved for the SIB1-NB transmission over NPDSCH.

For details, observe the NB-IoT allocation information in NB-IoT Allocation dialog.

2.3.6 NPDSCH

The narrowband physical downlink shared channel (NPDSCH) transmits signal information other than MIB. The channel is QPSK modulated, has the same structure as the NPDCCH (see Figure 2-14) and the same conditions apply for the $l_{NDPSCHStart}$.

NPDSCH is mapped to N_{SF}^{NPDSCH} number of subframes, where each mapped subframe is repeated N_{Rep}^{NPDSCH} times. One NPDSCH transmission lasts $N_{SF}^{NPDSCH}*N_{Rep}^{NPDSCH}$ subframes. NPDSCH transmission starts at least 5 subframes after the NPDCCH and can be additionally delayed by number of subframes k_0, where k_0 is referred as scheduling delay. The maximum transport block size TBS is 680 bits.

SIB1-NB

NPDSCH carries the system information SIB1-NB. The message is repeated 4, 8 or 16 times, has a period of 256 frames and predefined TBS of up to 680 bits. It is transmitted on subframe SF#4 of every second frame in a number of consecutive frames, depending on the selected repetition interval.

SIB1-NB can be modified at each modification period of 4096 frames, where the modification is indicated in DCI format N2.

NPDSCH scheduling

Scheduling and TBS depend on whether the NPDSCH carries SIB1-NB message or not:

- No SIB1-NB
  The N_{SF}, N_{Rep} and k_0 values are defined with the "Resource Assignment I_{SF}", "Repetition Number I_{Rep}" and "Scheduling Delay I_{Delay}" fields in the DCI format.
  See Table 3-6, Table 3-7 and Table 3-5 for the corresponding mapping.
- SIB1-NB
  – NPDSCH number of repetitions N_{Rep}^{NPDSCH} is set with the `schedulingInfoSIB1` parameter of MIB-NB.
  – The starting frame in that the SIB1-NB (i.e. NDPSCH) is transmitted is defined as function of the N_{Rep}^{NPDSCH} and the NCell ID N_{ID}^{Cell}.

Example: NPDSCH scheduling based on DCI format N1

This example extends the configuration described in Example"NPDCCH scheduling based on DCI format N1" on page 45.

- "Search Space = UE-specific" with R_{max} = 4
- DCI format N1 configuration:
  – I_{SF}^{NPDSCH} = 2 therefore N_{SF} = 3
  – I_{Rep}^{NPDSCH} = 2 therefore N_{Rep} = 4
  – I_{Delay} = 2 therefore k_0 = 8

NPDSCH is transmitted over $N_{SF}^{NPDSCH}*N_{Rep}^{NPDSCH}$ = 12 consecutive subframes, where the first NPDSCH subframe is 5 + 8 = 13 subframes after the NPDCCH transmission.

Figure 2-16 shows this configuration as observed on the "Timeplan".

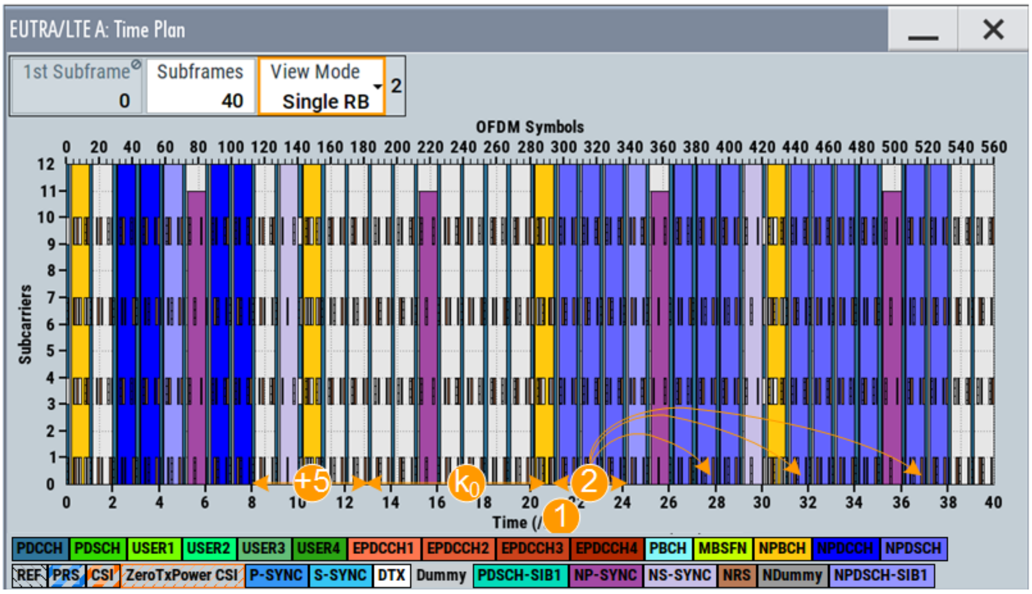


Figure 2-16: NPDSCH scheduling based on DCI format N1

+5 = NPDSCH starts at least five subframes after NPDCCH
k_0 = Eight subframes additional delay (because I_{Delay} = 2)
1 = NPDSCH start subframe = 21 (5 + 8 = 13 SFs after NPDCCH); SF#20 is used for NPSS
2 = NPDSCH is transmitted over three consecutive subframes, that in turn are repeated four times

In TDD duplexing mode, NPDSCH is transmitted in the downlink or in the DwPTS symbols. Observe the timeplan for current allocation.

2.3.7 NDRS

The narrowband demodulation reference signals (NDRS) are transmitted in the resources units containing data transmission. NDRS uses the same modulation as the associated data. All transmissions use a single antenna port, because MIMO is not defined for the UL direction.

The NDRS allocation, both as slot assignment and duration, depends on the used NPUSCH format and subcarrier spacing, see Table 2-18.

Table 2-18: NDRS duration and symbol assignment depending on the NPUSCH format and subcarrier spacing [TS 36.211]

NPUSCH format	NDRS duration (symbol per slot)	Symbol assignment for subcarrier spacing Δf = 3.75 KHz	Symbol assignment for subcarrier spacing Δf = 15 KHz	Number of subcarriers
F1	1	4	3	1 (@3.75kHz) 1, 3, 6, 12 (@15kHz)
F2	3	0, 1, 2	2, 3, 4	1

The NDRS is generated form a base sequence that is frequency shifted by a phase factor. If NDRS is transmitted with NPUSCH format F2, the NDRS is spread with the sequence known from LTE PUCCH formats 1, 1 and 1b.

2.3.8 NPUSCH

Other that in LTE, the NPUSCH carries the UL data, including UL control information (UCI). There is no channel like the LTE PUCCH channel defined in NB-IoT .

Resource units (RU)

In NB-IoT , the resource units (RU) are used to describe the mapping of the NPUSCH to resource element.

NPUSCH formats

TS 36.211 specifies two NPUSCH formats, each transporting the following information:

- F1: UL channel data over UL-SCH
- F2: UL control information UCI, restricted to acknowledgment of a DL transmission

For overview information of the NPUSCH formats and the number of used UL carriers per resource unit (RU), see Table 2-19.

Table 2-19: NPUSCH formats [TS 36.211]

NPUSCH format	Subcarrier spacing Δf	Number of subcarriers N_{SC}^{RU}	Number of slots N_{slots}^{UL}	RU duration, ms	Modulation	Resource elements per RU	Bits per RU
F1	3.75 KHz	1	16	32	π/2-BPSK π/4-QPSK	96	96 192
	15 KHz	1	16	8	QPSK	96	96 192
		3	8	4	QPSK, 16QAM	144	288
		6	4	2	QPSK, 16QAM	144	288
		12	2	1	QPSK, 16QAM	144	288
F2	3.75 KHz	1	4	8	π/2-BPSK	16	16
	15 KHz	1	4	2	π/2-BPSK	16	16

In the time domain, the NPUSCH transmission is defined as NPUSCH format, number of RU (N_{RU}), number of repetitions (N_{rep}^{NPUSCH}), and scheduling delay. An NPUSCH allocation is then $N_{rep}^{NPUSCH}N_{RU}N_{slots}^{UL}$ long. After the transmission of 256 ms, the NPUSCH transmission is postponed for 40 ms, see Table 2-20.

Table 2-20: NPUSCH gap duration expressed as number of slots

Subcarrier spacing	Slot length, ms	256 ms expressed as number of slots	40 ms expressed as number of slots
3.75 kHz	2	128	20
15 kHz	0.5	512	80

The RU size is not constant (Table 2-19). It is signaled with the DCI format N0, that carries also information on the NPUSCH start time, number of NPUSCH repetitions N_{Rep}^{PUSCH} and subcarrier indication field (I_{SC}).

See:
- "DCI formats, decoding and content" on page 44
- "DCI Format N0" on page 94

Physical dimension of the NPUSCH allocation

Table 2-19 lists also the resource elements and the resulting physical bits per RU, depending on the modulation. This information is required for the calculation of the total physical bits per NPUSCH allocation.

The following applies:
- Resource elements per RU = Resource elements per slot per subcarrier * N_{slots}^{UL} * N_{SC}^{RU}

  Where:
  – For F1: Resource elements per slot per subcarrier = 6
  – For F2: Resource elements per slot per subcarrier = 4
- Number of bits per RU = {Resource elements per RU (for BPSK); 2 * Resource elements per RU (for QPSK)}
- Total number of physical bits per NPUSCH allocation = N_{RU} * Number of bits per RU

  Where N_{RU} is set with the parameter "NB-IoT Allocation > Allocation# > Resource Units" and displayed with the parameter "Enchanced Settings > Config > Number of RU".

Example: NPUSCH configuration

The following is a simple example, intended to explain the parameters interdependency. It does not represent a meaningful configuration.

1. Select "Channel Bandwidth = 3 MHz".
2. Configure two UEs with the following settings:

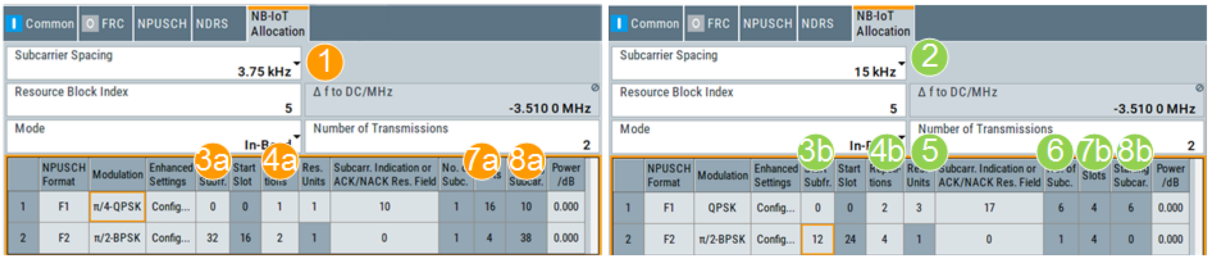


Figure 2-17: Example: NB-IoT allocations of two UEs with carrier spacing of 3.75 kHz and 15 kHz in the same resource block (Resource Block Index = 5)

1 = UE1: Δf = 3.75 kHz, two NPUSCH transmissions with F1 and F2, "Resource Block Index = 5"
2 = UE2: Δf = 15 kHz, two NPUSCH transmissions with F1 and F2, "Resource Block Index = 5"
3a, 3b = "Start Subframe" - offsets the allocation start in the time domain
4a, 4b = Repetitions (different values per NPUSCH format and UE)
5 = Number of resource units (for NPUSCH F2 RU = 1; for NPUSCH F1 variable)
6 = "Number of Subcarriers" (for NPUSCH F2 N_{SC}^{RU} = 1; for NPUSCH F1 N_{SC}^{RU} depends on the "Subcarrier Indication"
7a, 7b = NPUSCH duration as number of slots (calculated)
8a, 8b = "Starting Subcarrier" - offsets the allocation in the frequency domain

3. Use the "Adjust Length" function to set the "ARB Sequence Length = 4 Frames"
4. Observe the NPUSCH and NDRS allocations in the "Time Plan":
   a) Display subframes in the range "1st Subframe = 0" and "Subframes = 40".
   b) Select "View Mode = Single RB".
   c) Select "RB = Resource Block Index = 5".

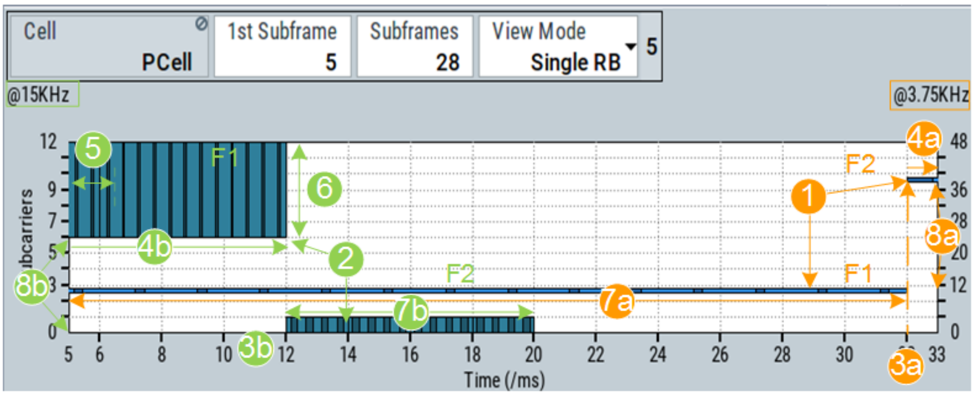


Figure 2-18: Time plan: understanding the displayed information

1 = NPUSCH transmissions of UE1
2 = NPUSCH transmissions of UE2
3a = NPUSCH F2 transmission of UE1 with "Start Subframe = 32"
3b = NPUSCH F2 transmission of UE2 with "Start Subframe = 12"
4a, 4b = UE1 NPUSCH F2 and UE2 NPUSCH F1 with "Repetitions = 2" (the repetitions are not shown completely)
5 = Resource unit RU = 3 (all other transmissions use RU = 1)
6 = NPUSCH F1 with N_{SC}^{RU} = 6; all other use N_{SC}^{RU} = 1
7a, 7b = NPUSCH F1 allocations of UE1 an UE2, both are 16 slots long; compare the time duration
7a = UE1 NPUSCH F1 duration = 16 slots*1 repetition*Slot duration = 16*2 ms = 32 ms

7b = UE2 NPUSCH F2 duration = 4 slots*4 repetitions*Slot duration = 16*0.5 ms = 8 ms
8a = "Starting Subcarrier = 10 and 38" (observe subcarrier numbering at the right y-axis ("@3.75kHz")
8b = "Starting Subcarrier = 6 and 0" (observe subcarrier numbering at the left y-axis ("@15kHz")

2.3.9 NPRACH

The NPRACH channel is used during the random access procedure. One random access channel spans one subcarrier within a symbol group.

Symbol group

The term symbol group describes the set of subcarriers reserved for the narrowband random access preamble. A symbol group comprises of a cyclic prefix and five identical symbols. Four consecutive symbol groups that are repeated defined number of times (N_{rep}^{NPRACH}) build a preamble.

CP*	Symbol	Symbol	Symbol	Symbol	Symbol

Figure 2-19: Random access symbol group

CP = Cyclic prefix (variable length)
Symbol = Sequence of five identical symbols

NPRACH configuration

The NPRACH configuration `NPRACH-ConfigSIB-NB-r13` is signaled by higher levels with the SIB2-NB.

NPRACH is configured per coverage level and is based on the following parameters:

- NPRACH configuration index: indicates the coverage level
- NPRACH preamble format: two formats with different cyclic prefix length, where the second is four times longer than the first one.
- $N_{periodicity}^{NPRACH}$: NPRACH resource periodicity (`mprach-periodicity-r13`)
- NPRACH starting time (`nprach-StartTime-r13`)
- N_{rep}^{NPRACH}: number of NPRACH repetitions per preamble attempt (`maxNumPreambleAttemptCE-r13`)
- Number of NPRACH subcarriers N_{sc}^{NPRACH} (`nprach-NumSubcarrierres-r13`)
- $N_{scoffset}^{NPRACH}$: frequency location of the first NPRACH subcarrier (`nprach-SubcarrierrOffset-r13`)

NPRACH allocation

Depending on the preamble format, the symbol group duration is as follows:

- Preamble format 0: 1.4 ms

- Preamble format 1: 1.6 ms

The signaled parameters are sufficient to calculate the location of the first symbol group. Locations of the subsequent symbol groups are frequency hopped (shifted) versions of the first one. Their location is derived according to a predefined algorithm, that assures that hopping patterns do not overlap. The frequency hopping is applied within 12 subcarriers ($N_{SC}^{RA} = 12$).

The location of the first symbol group is given by the NPRACH starting time and the parameter n_{start}, calculated from the subcarrier index n_{int}. The subcarrier index is the resource block index for the 3.75 KHz subcarrier spacing case.

The frequency allocation of the group is calculated as follows:

- $n_{sc}^{RA}(i) = n_{start} + \tilde{n}_{SC}^{RA}(i)$

  Where:

  – $n_{start} = N_{scoffset}^{NPRACH} + [n_{int}/N_{sc}^{RA}].N_{SC}^{RA}$

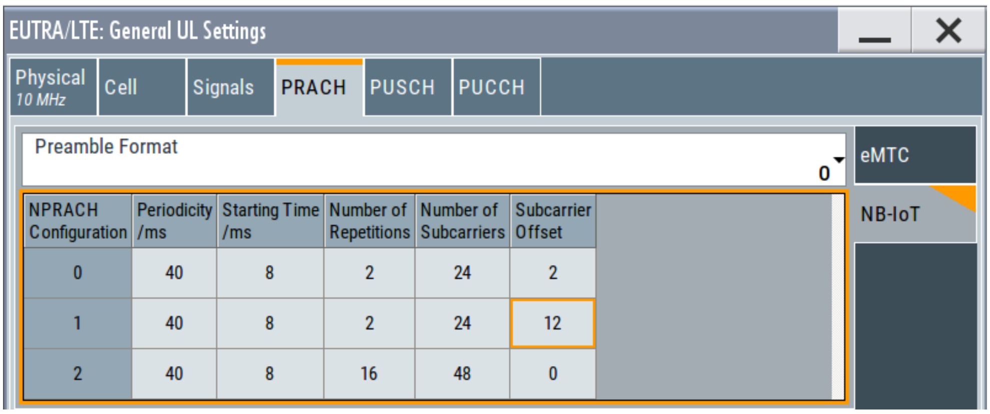
  – $\tilde{n}_{SC}^{RA}(0) = n_{int} mod N_{sc}^{RA}$

  – $\tilde{n}_{SC}^{RA}(i) = f(\tilde{n}_{SC}^{RA}(i-1); k_h)$
  Where k_h = { +1, -1, +6, -6} is a hopping index that describes the frequency hopping pattern.
  For details, see TS 36.211.

Example: NPRACH configuration

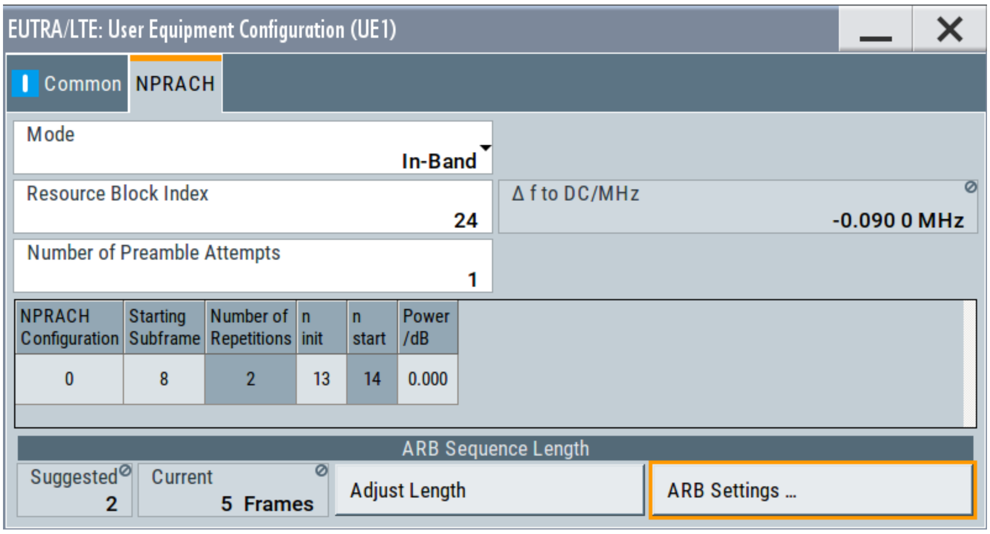
The following is an example on the NPRACH allocation calculation.

1. Select "UL General Settings > PRACH" and configure:
   - NPRACH "Preamble Format = 0"
   - NPRACH "Starting Time = 8 ms"
   - "NPRACH Configuration = 0" with:
     – $N_{rep}^{NPRACH} = 2$
     – $N_{sc}^{NPRACH} = 24$
     – $N_{scoffset}^{NPRACH} = 2$
   - $N_{SC}^{RA} = 12$



2. Select "UL Frame Configuration > UE1 > 3GPP Release = NB-IoT".

3. Select "UE1 Settings > Common > Mode = PRACH".
4. In the "NPRACH" dialog, select n_{int} = 13.



5. Open the "UL Frame Configuration > Time Plan".

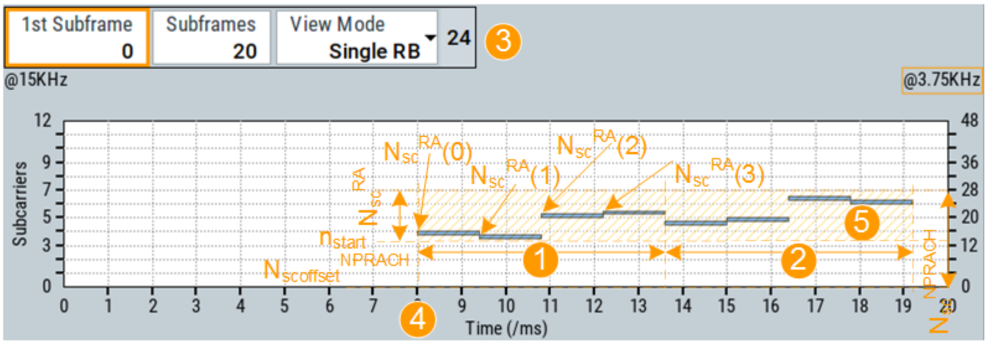


Figure 2-20: NPRACH configuration visualized in the Time Plan

1 = First repetition
2 = Second repetition
3 = "Time Plan > View Mode = Single RB", "RB# = 24" (zooms in the NPRACH allocation)
4 = Starting time = 8 ms
5 = NPRACH transmission area: spans N_{SC}^{RA} = 12 subcarriers starting from start subcarrier n_{start} = 14 (observe the subcarrier numbering on the right y-axis"@3.75kHz")
$N_{scoffset}^{NPRACH}$ = 2
N_{sc}^{NPRACH} = 24

The NPRACH configuration calculation in the first repetition is as follows:

- First symbol group (i = 0):
  - $\tilde{n}_{sc}^{RA}(0) = 13 \bmod 12 = 1$
  - $n_{start} = 2 + [13/12].12 = 2 + 12 = 14$
  - $n_{sc}^{RA}(0) = 14 + 1 = 15$
- Second symbol group (i = 1):
  - $\tilde{n}_{sc}^{RA}(1) = 1 - k_h = 1 - 1 = 0$ (for details, see TS 36.211)

  - $n_{sc}^{RA}(1) = 14 + 0 = 14$
- Third symbol group (i = 2):
  - $\tilde{n}_{sc}^{RA}(2) = 0 + 6 = 0$
  - $n_{sc}^{RA}(2) = 14 + 6 = 20$
- Fourth symbol group (i = 3):
  - $\tilde{n}_{sc}^{RA}(3) = 6 + 1 = 7$
  - $n_{sc}^{RA}(3) = 14 + 7 = 21$

Set the "UL General Settings > PRACH > Preamble Format = 1" and observe the changed symbol length in the "Time Plan".

3 eMTC / NB-IoT configuration and settings

Access:

1. Select "Baseband > EUTRA/LTE/IoT".
2. Select "General" > **"Mode > eMTC/NB-IoT"**.

   There provided settings are grouped into several dialogs depending whether they are cell-specific (that is common to all UEs in a cell) or user-specific:
   - The underlying physical and cell-specific settings are grouped in the "General Settings" dialogs.
   - The user-specific DL settings are split among the dialogs "DL Frame Configuration > General > User Configuration", "DL Frame Configuration > NB-IoT DCI Configuration" and "NB-IoT Allocations"
   - The user-specific UL settings are grouped in the "UL Frame Configuration > UEx > User Equipment Configuration" dialog.
   - The configuration of one Dl or UL channel often requires that you configure settings in several dialogs.
   - Finally, there are also dialogs providing general functions for signal shaping and triggering, or storing your configuration.

The following sections list and explain the configuration and settings provided for and per channel. The description does not always follow the menu navigation but rather shows you the settings needed for the configuration of a particular channel.

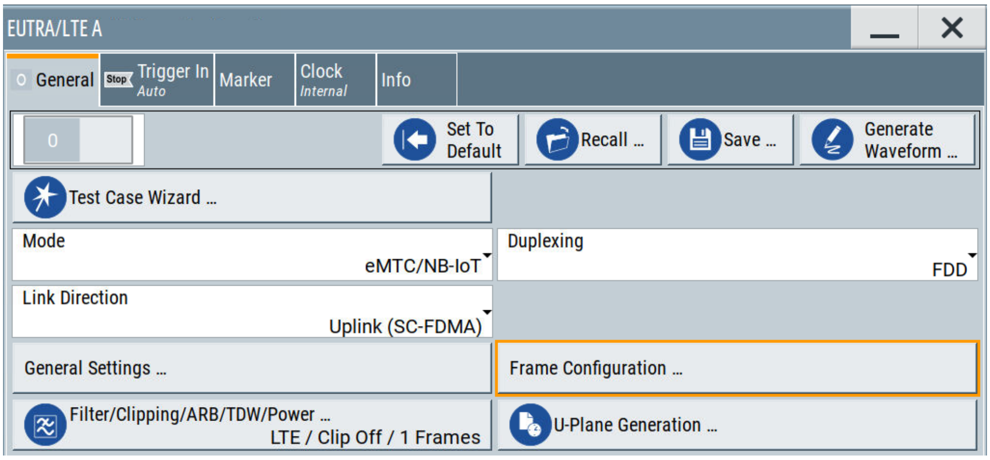
The remote commands required to define these settings are described in Chapter 9, "Remote-Control commands", on page 376.

3.1 Configuring the general IoT settings

This section shows you how to access and configure general settings, like selecting the duplexing mode and the link direction. It also explains how to access the user equipment settings or configure other settings that are common for the different channels or signal processing.

Access:

1. Select "General" > **"Mode > eMTC/NB-IoT"**.



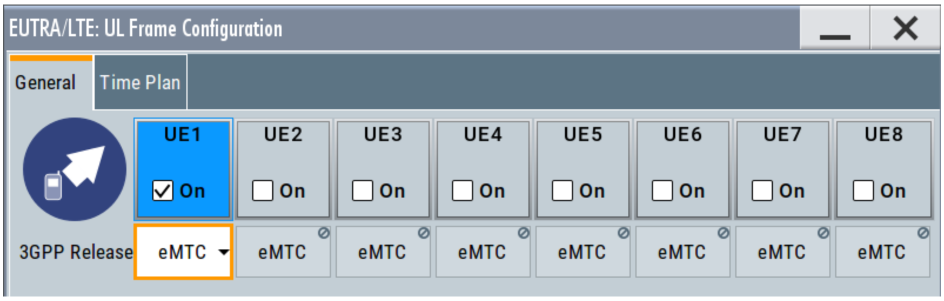
2. Set the **"Duplexing"** and the **"Link Direction"**.
3. **To access the physical and cell-related DL settings**:
   a) Select "Link Direction > Downlink"
   b) Select "General Settings"

   For description, see Chapter 3.2, "DL physical layer settings", on page 62.
4. **To access the DL user-specific settings**:
   a) Select "Link Direction > Downlink"
   b) Select "Frame Configuration > General".
   c) To access and configure the allocation of the NB-IoT DL channels, **select the "NB-IoT DCI Config" and "NB-IoT Allocation"**.

   For description, see Chapter 3.7, "NPBCH, NPDCCH and NPDSCH settings", on page 86.
5. **To access the physical and cell-related UL settings**:
   a) Select "Link Direction > Uplink"
   b) Select "General Settings"

For description, see Chapter 3.12, "UL physical layer settings", on page 160.

6. **To access the UL UE-specific settings**:
   a) Select "Link Direction > Uplink"
   b) Select "Frame Configuration > General".



   c) To access the settings of the individual UEs, **click the "UE x" block**.

   You can enable up to 4 UEs, where each UE can work in a different mode, as set with the parameter 3GPP Release.

Settings:

State

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

Remote command:
`[:SOURce<hw>]:BB:EUTRa:STATe` on page 401

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	Uplink
Sequence length	1 frame
Channel bandwidth	10 MHz
Cell ID	0
Cyclic prefix	Normal

Remote command:
[:SOURce<hw>]:BB:EUTRa:PRESet on page 402

Save/Recall
Accesses the "Save/Recall" dialog, i.e. the standard instrument function for storing and recalling the complete dialog-related settings in a file. The provided navigation possibilities in the dialog are self-explanatory.

The filename and the directory it is stored in are user-definable; the file extension is however predefined.

See also, chapter "File and Data Management" in the R&S SMW user manual.

Remote command:
[:SOURce<hw>]:BB:EUTRa:SETTing:CATalog on page 402
[:SOURce<hw>]:BB:EUTRa:SETTing:LOAD on page 403
[:SOURce<hw>]:BB:EUTRa:SETTing:STORe on page 403
[:SOURce<hw>]:BB:EUTRa:SETTing:DEL on page 403

Generate Waveform File
With enabled signal generation, triggers the instrument to save the current settings of an arbitrary waveform signal in a waveform file with predefined extension `*.wv`. You can define the filename and the directory, in that you want to save the file.

Using the ARB modulation source, you can play back waveform files and/or process the file to generate multi-carrier or multi-segment signals.

Remote command:
[:SOURce<hw>]:BB:EUTRa:WAVeform:CREate on page 403

Test Case Wizard
Accesses the "Test Case Wizard" dialog, see Chapter 6, "Performing BS tests according to TS 36.141", on page 247.

Logfile Generation
Option: R&S SMW-K81

Accesses the logfiles generation settings.

For description, see R&S SMW LTE/5G Logfile Generation user manual.

Mode
In instruments equipped with options R&S SMW-K55 and R&S SMW-K115, selects the standard to that the displayed settings belong.

If the instrument is equipped with one of these two options, the corresponding mode is selected automatically but the parameter "Mode" is not displayed.

"Mode"	Description	Required options
"LTE"	Standalone LTE IoT related settings and parameters are hidden.	R&S SMW-K55 (optionally also R&S SMW-K85)
"eMTC/NB-IoT"	Standalone IoT Configuration of parameters specified only for LTE is not possible.	R&S SMW-K115
"LTE/eMTC/NB-IoT"	Mixed LTE and IoT Allows mixed LTE and IoT configurations, for example for interoperability tests.	R&S SMW-K55 and R&S SMW-K115

Remote command:
`[:SOURce<hw>]:BB:EUTRa:STDMode` on page 402

Duplexing
Selects the duplexing mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DUPLexing` on page 401

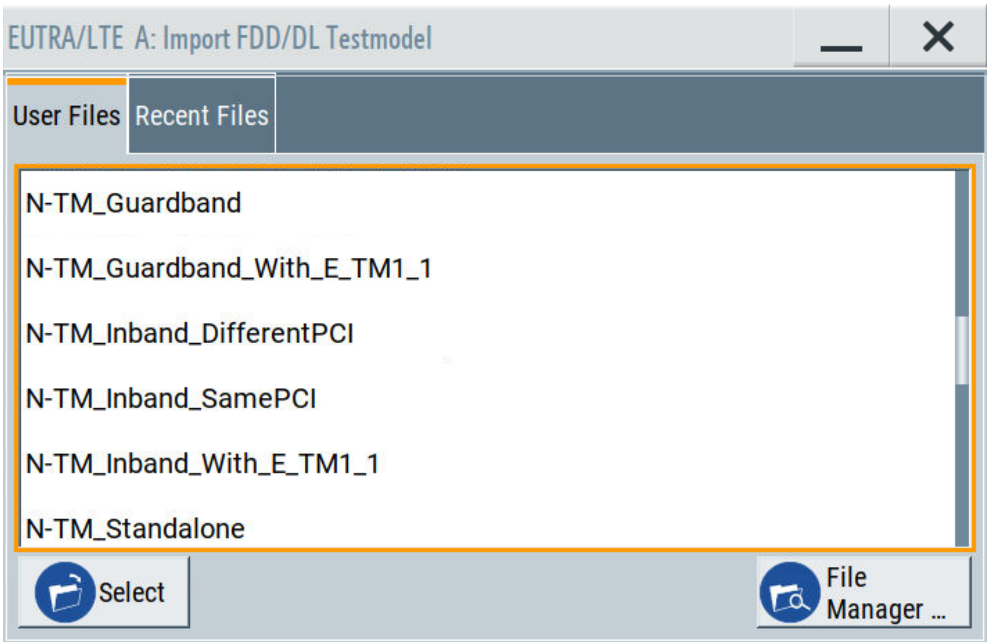
Link Direction
Selects the transmission direction.

"Downlink (OFDMA)"
The transmission direction selected is base station to user equipment. The signal corresponds to that of a base station.

"Uplink (SC-FDMA)"
The transmission direction selected is user equipment to base station. The signal corresponds to that of a user equipment (UE).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:LINK` on page 401

Test Models
Accesses a dialog for selecting of:
- One of the NB-IoT Test Models (N-TM) defined in TS 36.141.



- Self-defined test setups
  Use "Recent Files" button to display the files last used.
  "File Manager" button opens the dialog to load or save configuration files. See also the section File and Data Management in the R&S SMW user manual.

The data content of the physical channels and signals is defined in the 3GPP specification. Each test model is defined for six different channel bandwidths: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz and 20 MHz. The test models are defined for specific test purpose.

The NB-IoT DL test models (N-TM) are predefined configurations of settings for NB-IoT tests. Supported are the following N-TMs:

- NB-IoT guard band operation
- NB-IoT guard band operation in combination with LTE E-TM1.1 carriers
- NB-IoT in-band operation, where NB-IoT and LTE use different PCIs
- NB-IoT in-band operation, where NB-IoT and LTE share the same PCI
- NB-IoT in-band operation in combination with LTE E-TM1.1 carriers
- NB-IoT standalone operation

According to TS 36.141, all test models use the following parameters:

- Single antenna port
- Duration of 10 subframes or 10 ms
- Normal cyclic prefix
- The ration of synchronization signal EPRE and NRS EPRE is 0 dB
- NPDCCH format 1

Remote command:
`[:SOURce<hw>]:BB:EUTRa:SETTing:TMOD:DL` on page 404

General Settings

Accesses the "General DL/UL Settings" dialog.

See:

- Chapter 3.2, "DL physical layer settings", on page 62

- Chapter 3.4, "NB-IoT carrier allocation", on page 72
- Chapter 3.8, "eMTC DL valid subframes and frequency hopping", on page 116 and Chapter 3.9, "eMTC synchronization and cell-specific reference signals (CRS/ SYNC) settings", on page 120
- Chapter 3.11, "eMTC DL antenna port mapping settings", on page 154
- Chapter 3.12, "UL physical layer settings", on page 160

Frame Configuration

Accesses the "Frame Configuration" dialog.

See:

- Chapter 3.3, "DL user configuration", on page 69
- Chapter 3.7, "NPBCH, NPDCCH and NPDSCH settings", on page 86
- Chapter 3.10, "eMTC DL allocations settings", on page 122
- Chapter 3.15.1, "NB-IoT allocation settings", on page 175
- Chapter 3.18, "eMTC PUSCH settings", on page 192, Chapter 3.19, "eMTC PUCCH settings", on page 205 and Chapter 3.20, "eMTC PRACH settings", on page 210

UEx ← Frame Configuration

Accesses the "User Equipment" dialog for configuring the UE-related settings.

The checkbox activates or deactivates the UE.

Disabling the UE deactivates its allocations: the reference signal, PUSCH (or PUCCH) allocations, and PRACH are not transmitted.

3GPP Release ← Frame Configuration

Sets the 3GPP release version supported by the UE.

Generally, each UE can work in one of the modes: LTE, LTE-A, eMTC or NB-IoT. The available values depend on the installed options and the value of the parameter Mode.

"Mode"	Description	Required options	"3GPP Release"
"LTE"	Standalone LTE	R&S SMW-K55 R&S SMW-K85	"Release 8/9" "LTE-Advanced"
"eMTC/NB-IoT"	Standalone IoT	R&S SMW-K115	"eMTC, NB-IoT"
"LTE/eMTC/NB-IoT"	Mixed LTE and IoT	R&S SMW-K55 and R&S SMW-K115	"Release 8/9, LTE-Advanced, eMTC, NB-IoT"

Several further settings are enabled only for LTE-A or IoT UEs.

In MIMO configurations, the "3GPP Release" is set automatically to LTE-Advanced.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:RELease` on page 513

Filter / Clipping / ARB /TDW/Power Settings

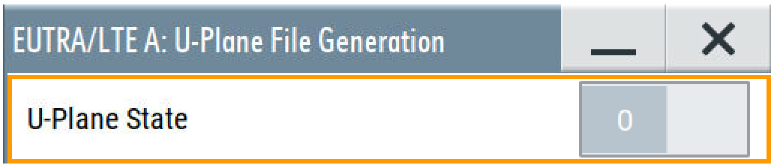
Accesses the dialog for setting baseband filtering, clipping, and the sequence length of the arbitrary waveform component.

See Chapter 8, "Signal control and signal characteristics", on page 351.

U-Plane Generation
Option: R&S SMW-K175

Opens a dialog to turn user plane data generation according to the O-RAN standard on and off.

The selected mode (Baseband > EUTRA/LTE > General > Mode) specifies the type of data to be generated: LTE, NB-IoT, or both.



For the supported O-RAN test models, see "Test Models" on page 59

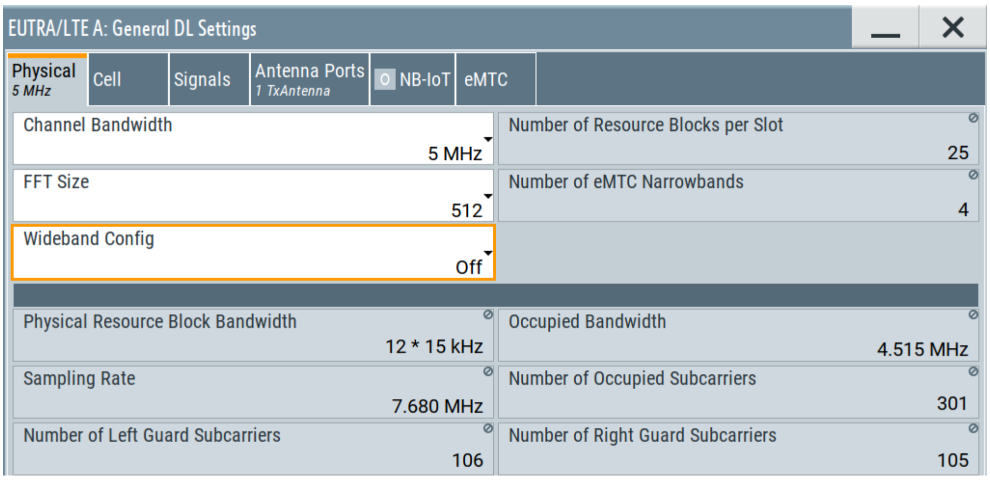
For more information, see Chapter 7, "Generating user plane data", on page 349.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UPLane:STATe` on page 405

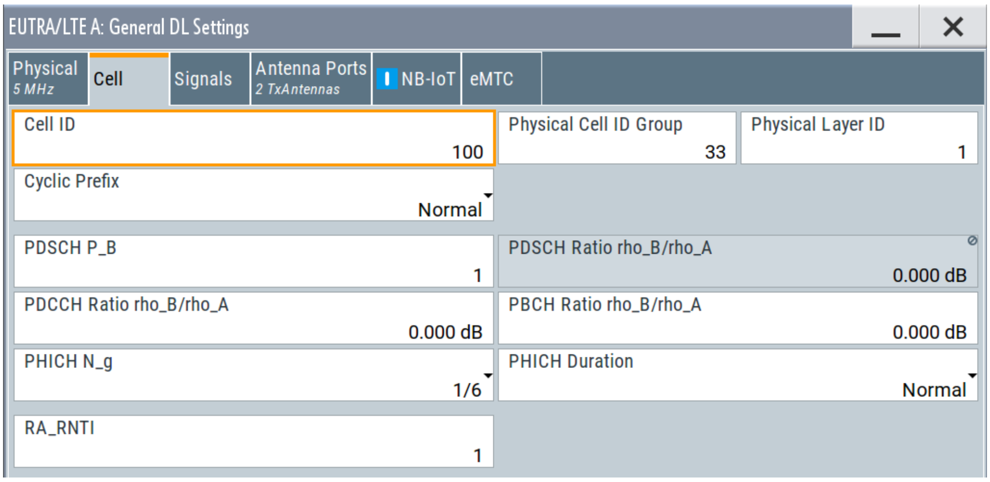
3.2 DL physical layer settings

Access:

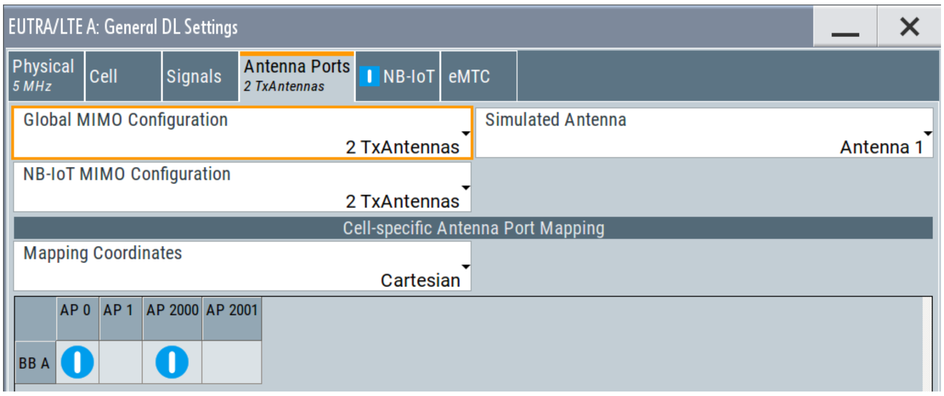
1. In the "General" dialog, select "Mode > eMTC/NB-IoT".
2. Select "Link Direction > Downlink".
3. Select "Duplexing > FDD".
4. Select "General Settings > Physical".



5. Select "General Settings > Cell".



6. To set the number of antenna ports:
   a) Select "General DL Settings > Antenna Ports".
   b) To enable Tx diversity, set **"NB-IoT MIMO Configuration = 2 Tx Antennas"**.
   c) To define the antenna port used by the NB-IoT channels and signals, select "AP2000" or "AP2001".



7. Use the "Time Plan" to visualize the narrowbands allocation.

Both IoT approaches eMTC and NB-IoT are designed as extension to the LTE standard. Therefore, their physical settings are extension to the LTE physical settings, too.
There are merely the additional antenna ports dedicated to the NB-IoT channels and signals and the definition of the NB-IoT carriers and the eMTC transmission in terms of valid subframes and frequency hopping settings.

This section described the underlying physical settings, that are common for the simulated cell. For description of the NB-IoT and eMTC specific settings and signals, and for description of the antenna port mapping, see:

- Chapter 3.9, "eMTC synchronization and cell-specific reference signals (CRS/SYNC) settings", on page 120 and
  Chapter 3.5, "NB-IoT downlink reference and synchronization signals structure", on page 79
- Chapter 3.4, "NB-IoT carrier allocation", on page 72
- Chapter 3.8, "eMTC DL valid subframes and frequency hopping", on page 116

- Chapter 3.11, "eMTC DL antenna port mapping settings", on page 154

Settings:

Physical
Settings:

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

The 3GPP specification defines bandwidth agonistic layer 1 where the channel bandwidth is determined by specifying the desired number of resource blocks. However, the current EUTRA standardization focuses on six bandwidths.

- "1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz"
  Select a predefined channel bandwidth.
  The parameter "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 necessary, adjust the "FFT Size".
  See also Table A-1 for an overview of the cross-reference between the parameters.
  If "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected, the "1.4 MHz" bandwidth is supported by LTE and eMTC; the NB-IoT-specific settings are not available for configuration.

- "200 kHz"
  Option: R&S SMW-K115
  This channel bandwidth is **dedicated to NB-IoT**. It is available, if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.
  If channel bandwidth of 200 kHz is used, the LTE or eMTC-specific settings are not available for configuration. Available is only one NB-IoT carrier which works in standalone mode (Mode = "Standalone").

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:BW on page 406

Number of Resource Blocks Per Slot ← Physical
Indicates the number of used resource blocks for the selected "Channel Bandwidth".

See also Table A-1.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NORB on page 410

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

You can change the FFT size for all bandwidth definitions if the following conditions are met:

- 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 an FFT size of 1536 is provided, too.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:FFT on page 410

Number of eMTC Narrowbands ← Physical
This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It indicates amount of eMTC narrowbands N_{RB}^{DL} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Narrowbands" = "Number of Resource Blocks" / 6

For more information, see "Narrowbands" on page 19.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NNBands? on page 407

Number of eMTC Widebands ← Physical
Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" and Wideband Config > "5 MHz/20 MHz" is selected.

It indicates the number of eMTC widebands N_{WB} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Widebands" = "Channel Bandwidth" / Wideband Config

For more information, see "Widebands" on page 20.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NWBands?` on page 407

Wideband Config ← Physical
Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

If enabled, the available channel bandwidth is split into eMTC widebands with the selected bandwidth. The resulting number of widebands is indicated by the parameter Number of eMTC Widebands.

For more information, see "Widebands" on page 20.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:WBCFg` on page 407

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

Remote command:
n.a.

Occupied Bandwidth ← Physical
Displays the occupied bandwidth, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:OCCBandwidth?` on page 411

Sampling Rate ← Physical
Displays the sampling rate, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:SRATe?` on page 410

Number Of Occupied Subcarriers ← Physical
Displays the number of occupied subcarriers, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:OCCSubcarriers?` on page 411

Number of Left/Right Guard Subcarriers ← Physical
Displays the number of left/right guard subcarriers, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:LGS?` on page 497
`[:SOURce<hw>]:BB:EUTRa:UL:RGS?` on page 497

TDD frame structure ← Physical
Access: select "Duplexing > TDD".

TDD UL/DL Configuration ← TDD frame structure ← Physical
Sets the UL/DL configuration number and 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 405

TDD Special Subframe Config ← TDD frame structure ← Physical
Sets the special subframe configuration number and together with the parameter "Cyclic Prefix" defines the lengths of the DwPTS, the guard period (GP) 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 404

Number of UpPTS Symbols ← TDD frame structure ← Physical
Option: R&S SMW-K143 (if "Mode = eMTC/NB-IoT")

For TDD Special Subframe Config = 10, sets the number of UpPTS symbols.

In all other configurations, the number of UpPTS symbols is set automatically depending on:
- "TDD UL/DL Configuration" on page 67
- "TDD Special Subframe Config" on page 67.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TDD:UPTS` on page 405

Cell
Settings:

Cell ID ← Cell
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 pseudo-random sequence used for scrambling

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CID on page 412

Physical Cell ID Group ← Cell
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 412

Physical Layer ID ← Cell
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 PSS (P-SYNC) and used for cell search.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:PLID on page 412

Cyclic Prefix ← Cell
Sets the cyclic prefix length for all **LTE** allocations.

The number of the symbols is set automatically.

"Normal"	A slot contains 7 symbols.
"Extended"	A slot contains 6 symbols. NB-IoT allocations cannot be activated.

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

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

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:DLCPc on page 499

PDSCH P_B ← Cell
Defines the cell-specific ratio rho_B/rho_A according to TS 36.213 (Table 5.2-1).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:PB on page 413

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

The PDSCH value is calculated form the parameter PDSCH P_B. It also depends on the number of configured antennas.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:RATBa on page 413
[:SOURce<hw>]:BB:EUTRa:DL:PDCCh:RATBa on page 413
[:SOURce<hw>]:BB:EUTRa:DL:PBCH:RATBa on page 413

PHICH Duration, PHICH N_g ← Cell
(not supported in this firmware version)

RA_RNTI ← Cell
Sets the random-access response identity RA-RNTI for the users.

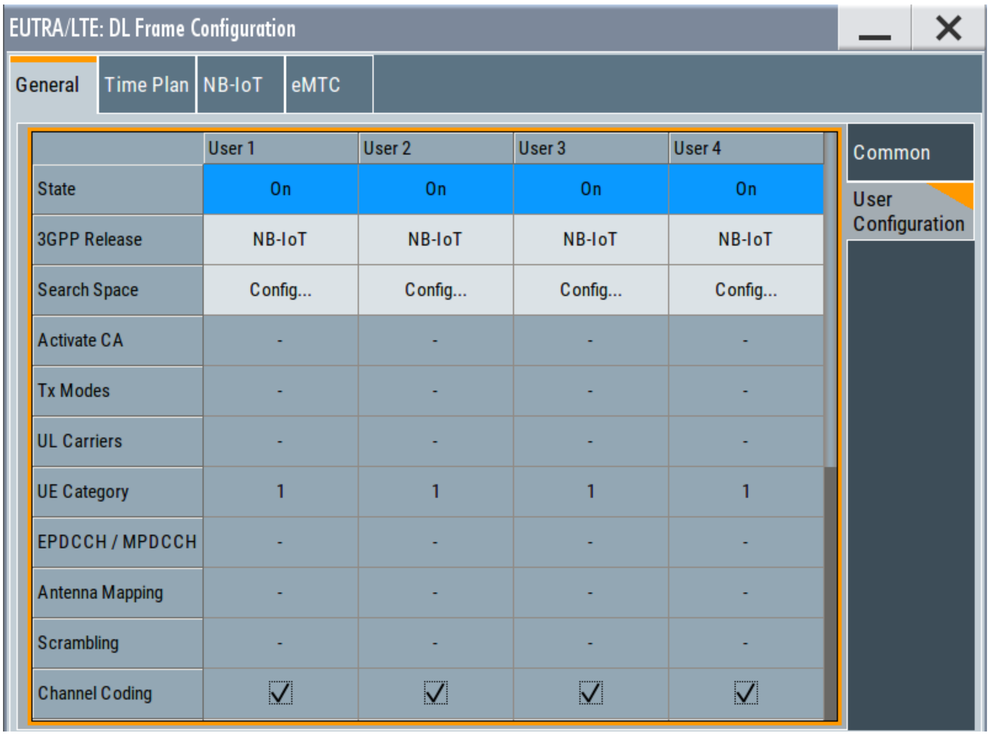
See UE_ID/n_RNTI.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSETtings:RARNti on page 413

3.3 DL user configuration

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > General > User Configuration > UEx" > **"3GPP Release = NB-IoT"**.



The respective "UE Category" is set automatically.

3. For NB-IoT UEs, select "User Configuration > UEx > Search Space > Config".
4. Set the "User Configuration > UEx > UE ID".

   This UE ID is used for the generation of the scrambling sequence for the IoT allocations, for which the "Data Source = User x".
5. Set the "User Configuration > UEx > Data Source".

Behavior In Unscheduled REs (OCNG)

Unscheduled resource elements are filled with DTX.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:BUR` on page 490

3GPP Release

Sets the 3GPP release version the UE supports.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:RELease` on page 486

Tx Modes

For "UE > 3GPP Release = eMTC CE Mode A/B", sets the transmission mode of the user as defined in TS 36.213.

The eMTC UEs support a subset of the LTE Tx modes. Tx modes are used in and for a specified configuration, depending on the number of used Tx antennas. The resulting precoding and the used transmission schemes are configured automatically, see Table 2-11.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:TXM` on page 488

UE Category

Sets the UE category.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEC` on page 488

EPDCCH/MPDCCH Config
For "UE > 3GPP Release = eMTC CE Mode A/B", opens the "MPDCCH Configuration" dialog.

See Chapter 3.10.2, "MPDCCH configuration", on page 127.

Antenna Mapping Configuration
For "UE > 3GPP Release = eMTC CE Mode A/B", opens the "Antenna Port Mapping" dialog.

See "User-Specific Antenna Port Mapping" on page 159.

Scrambling Configuration
For "UE > 3GPP Release = eMTC > CE Mode A/B", opens the "Scrambling Configuration" dialog.

You can change the scrambling state. Further parameters are not supported.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:STATe` on page 478

Channel Coding State
Sets channel coding for all allocations belonging to the selected user.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CCODing:STATe` on page 489

UE ID
Sets the user equipment ID.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEID` on page 488

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:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DATA on page 489
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DSELect on page 489
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:PATTern on page 490

UL Carriers, P_A, SPS, Aperiodic SRS
Option: R&S SMW-K55

Access to LTE-specific settings.

Support two HARQ Processes
Indicates if a NB-IoT UE is capable of understanding the HARQ process bit.
- Option: R&S SMW-K115
  The parameter is disabled and cannot be changed.
- Option: R&S SMW-K143
  Enables the UE to support the HARQ process bit.
  To set the HARQ process number bit (twoHARQ-Processes), use the DCI parameter "DL Frame Configuration > NB-IoT > DCI table > DCI Format = 0 > User = User x > Content > Config > HARQ Process Number", see"DCI Format N0" on page 94.

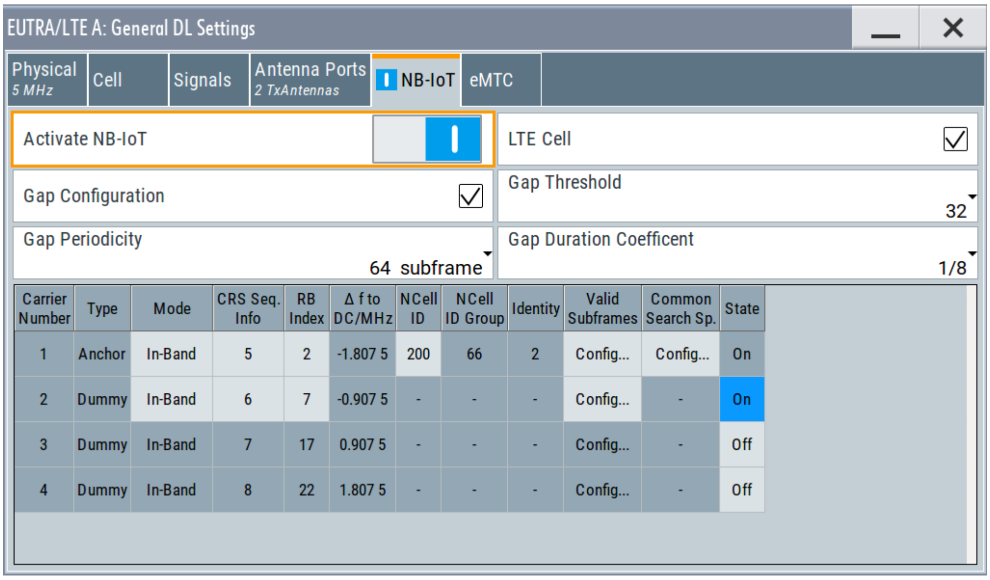
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:STHP:STATe on page 487

3.4 NB-IoT carrier allocation

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General > Duplexing > FDD".
3. Select "General DL Settings > NB-IoT".

   With these settings, you configure the **anchor carrier** used by all NB-IoT channels.



4. Define the anchor carrier in terms of operating mode, allocated resource block, used NB-IoT cell ID and valid subframes.
5. To configure the subframes that are enabled for NB-IoT transmission:
   a) Select "Valid Subframes > Config"
   b) For in-band operation, select, for example "Bitmap Subframes = 40"
   c) Select a subframe (SF) to enable it for NB-IoT transmission.

   Suframes in that the NPBCH, NPSS or NSSS are transmitted can not be used for other NB-IoT DL channels.
   NB-IoT transmission is postponed during invalid subframes.
6. Set the "State = On" to enable each of the up to 3 **secondary carriers**.
7. Set **"Activate NB-IoT = On"** to activate the configuration.
8. To observe the NB-IoT carrier allocations, open the "Time Plan".

   In standalone and in-band modes, the "Time Plan" indicates the anchor carrier.
   In in-band mode, activated secondary carriers and the LTE synchronization signals PSS/SSS are also indicated.
9. To observe the anchor carrier in greater detail, set "View Mode = Single RB".
   See for example Figure 5-1.

Settings:

Activate NB-IoT

For "Physical > Channel Bandwidth ≥ 3 MHz", enables the NB-IoT anchor carrier and generally the NB-IoT channels.

If disabled, all downlink NB-IoT allocations are deactivated.

Option: R&S SMW-K146

To enable NB-IoT in TDD mode, select TDD UL/DL Configuration = "1 to 5"

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:STATe` on page 429

LTE Cell

In "General DL Settings > NB-IoT > Mode > In-Band" operation, defines how the LTE channels are handled.

If enabled, all LTE channels are deactivated. However, LTE reference signals are still transmitted.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:LTECell:STATe` on page 423

Gap Configuration

If activated, a gap between the NPDCCH and NPDSCH with the specified duration is applied.

The gap (`DL-GapConfig`) is applied to all NPDCCH and NPDSCH transmission but BCCH, as defined in TS 36.331.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:CONFig:STATe` on page 424

Gap Threshold

If Gap Configuration > "On", sets the gap threshold, as defined in TS 36.331.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:THReshold` on page 424

Gap Periodicity

If Gap Configuration > "On", sets the number of subframes after that the configured gap is repeated.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:PERiodicity on page 424

Gap Duration Coefficient
If Gap Configuration > "On", sets the gap duration coefficient, as defined in TS 36.331.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:DURation:COEFficent on page 424

Puncture LTE at Inband Carriers
In mixed LTE and IoT mode ("LTE > Mode > LTE/eMTC/NB-IoT") and in in-band or guard band operation ("General DL Settings > NB-IoT > Mode > In-Band/Guard Band"), punctures the LTE signal at the NB-IoT carriers.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:PUNCture on page 423

Carrier Number
Indicates the NB-IoT carrier.

Remote command:
n.a.

Type
The first carrier is the anchor carrier.

Anchor carrier is the carrier where the UE assumes that NPSS/NSSS, NPBCH and SIB1-NB are transmitted.

In in-band and guard band operation, you can enable and configure up to 3 secondary carriers. The secondary carriers are filled in with dummy data.

DL NB-IoT carriers span one resource block. To observe their allocation, use the "Time Plan" with "View Mode = Single RB".

Remote command:
n.a.

Mode
Selects the operating mode, see Figure 2-10.

See also Example"Configuring an NB-IoT allocation in standalone operating mode" on page 37.

"Standalone"	Available if "Physical > Channel Bandwidth = 200 kHz".
"In-band/ Guardband"	Available if "Physical > Channel Bandwidth ≥ 3MHz".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:MODE on page 424

CRS Sequence Info
For "Mode > In-Band/Guardband", sets the `eutra-CRS-SequenceInfo` parameter of the MIB-NB message.

It indicates the carrier containing NPSS/NSSS/NPBCH, where the value gives the LTE RB index.

The parameters CRS Sequence Info and RB Index are interdependent. Their values are calculated automatically according to TS 36.213.

Example: CRS sequence info and RB index values for 5MHz channel bandwidth

The following applies for example for "Physical > Channel Bandwitth = 5 MHz".

"CRS Sequence Info"	"RB Index"
5	2
6	7
7	17
8	22

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CRSSeq` on page 425

RB Index

Sets the resource block number in that the NB-IoT transmissions are allocated.

The available resource blocks depend on the used "Channel Bandwidth" (or "Number of Available Resource Blocks") and the operating "Mode".

Table 3-1: Resource block index value ranges

Operation mode	Resource block allocation	Value range
In-band	Within the "Channel Bandwidth"	See Table 3-2
Guard band	Left guard band	< 0
	Right guard band	> "Number of Available Resource Blocks"

Table 3-2: RB indexes allowed for NB-IoT synchronization in in-band operation

LTE system band-width	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
RB index	2, 12	2, 7, 17, 22	4, 9, 14, 19, 30, 35, 40, 45	2, 7, 12, 17, 22, 27, 32, 42, 47, 52, 57, 62, 67, 72	4, 9, 14, 19, 24, 29, 34, 39, 44, 55, 60, 65, 70, 75, 80, 85, 90, 95

The parameters CRS Sequence Info and RB Index are interdependent. Their values are calculated automatically according to TS 36.213.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:RBIDx` on page 425
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:GBRBidx` on page 427

Delta Frequency to DC, MHz

In "Mode > In-band/Guard Band", indicates the delta frequency with that the NB-IoT carrier is offset form the LTE center frequency.

The value depends on "RB Index" and in in-band mode and per default in the guard-band mode it is calculated as follows:

"Delta Frequency to DC" = $\Delta f_{NB\text{-}IoT}$*("RB Index"*N_{SC}^{RB} - floor(N_{RB}^{DL}*N_{SC}^{RB}/2) + N_{SC}^{RB}/2) ± 7500

Where:

- $\Delta f_{NB\text{-}IoT}$ = 15 kHz is the NB-IoT subcarrier spacing
- N_{RB}^{DL} is the "Number of Resource Blocks per Slot"
- N_{SC}^{RB} = 12 is the number of subcarrier per RB
- ± 7500 is a frequency shift of half subcarrier bandwidth to avoid the center frequency

Thus, the possible values for the center frequencies of the NB-IoT channels are at 180 kHz offset to each other. In guard band mode, the you can change this spacing and set different "Delta Frequency to DC". If the set value does not correspond to a valid RB index, than the "RB Index = User".

According to the specification, the center frequencies of the NB-IoT channels in guard band mode must satisfy the following conditions:

- The first allocated NB-IoT RB must be orthogonal to the LTE RBs, whereas the following NB-IoT can be at 180 kHz or 15 kHz offset.
- The center frequencies of the NB-IoT carriers must satisfy the EARFCN conditions and hence be an integer multiple of 100 kHz; a raster of ±2.5 kHz and ±7.5 kHz is allowed, too.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:DFReq` on page 425

NCell ID

Sets the narrowband physical cell identifier, N^{NCell}_{ID}.

Defined are 504 unique physical layer cell identities (NCell ID), where the NSSS carries the N^{NCell}_{ID} value.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CELL` on page 425

NCell ID Group

Indicates the physical cell identity group.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CIDGroup` on page 426

Identity

Indicates the identity of the physical layer within the "NCell ID Group".

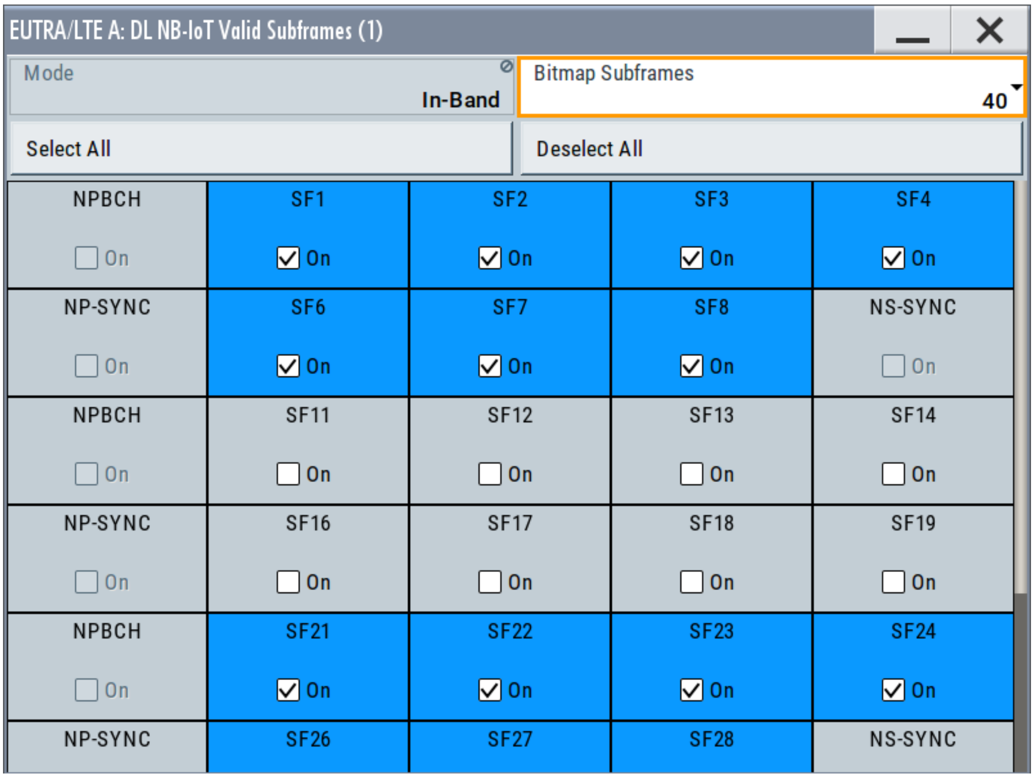
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ID?` on page 426

Valid Subframes

Sets the subframes bitmap carried by SIB1-NB (`downlinkBitmap-r13`) and defines the valid subframes (SF) that can be used for NB-IoT transmission.

If an SF is set to invalid or it contains NPSS, NSSS, NPBCH, or SIB1-NB, the NB-IoT transmission is postponed during this SF.

The selected subframes influence the scheduling of the NB-IoT transmissions.



According to TS 36.213, the valid SF in the secondary carriers (`DL-CarrierConfigDedicated-NB-r13`) can be defined in one of the following ways:

- No bitmap defined means that all DL subframes are valid
- To apply the bitmap of the anchor carrier
- To define an explicit bitmap configuration per secondary carrier.

In this implementation, the valid subframes in the secondary carriers are set individually.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:NVSF` on page 426
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SF<st0>:VALSf`
on page 427

Mode ← Valid Subframes
Indicates the operation mode of the selected carrier.

Bitmap Subframes ← Valid Subframes
Sets the valid subframes configuration over 10ms or 40ms (`subframePattern10-r13, subframePattern40-r13`), where 40ms configuration is available in the in-band mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:NVSF` on page 426

Select All/Deselect All ← Valid Subframes
Sets all SFs to valid or invalid SFs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SFALl on page 427
[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SFNN on page 427

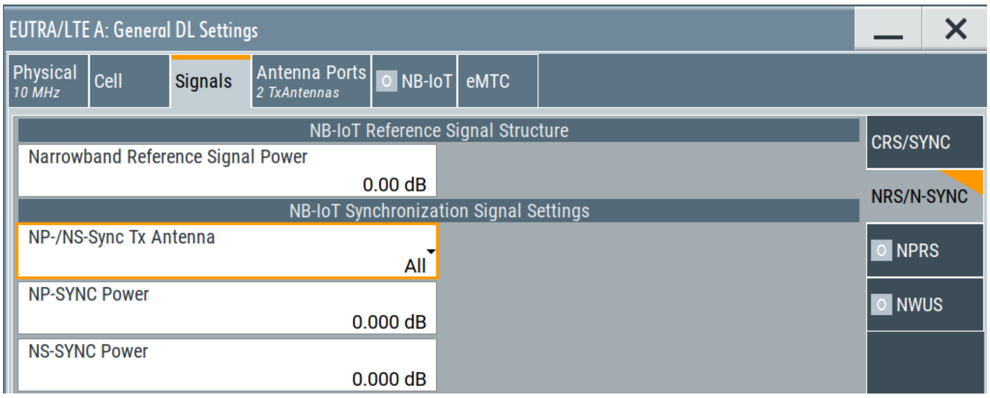
State
Enables secondary NB-IoT carrier.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:STATe on page 429

3.5 NB-IoT downlink reference and synchronization signals structure

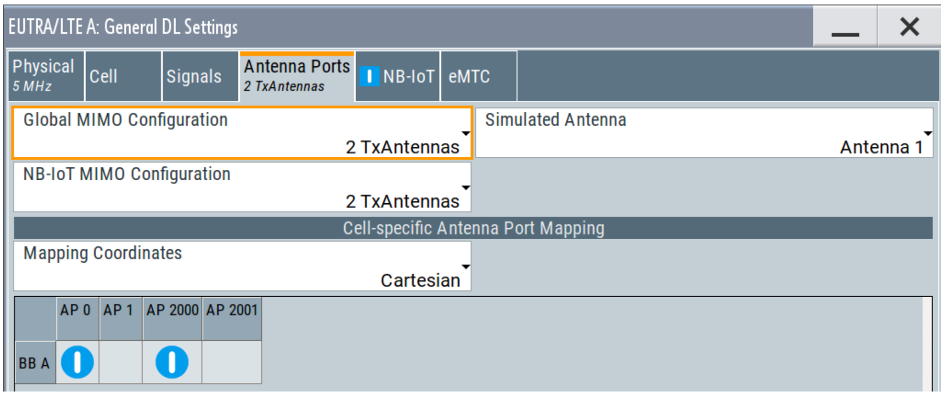
Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. To enable and set the antennas used for the NPSS/NSSS transmission and to set the **power of the NRS and the synchronization signals**, select:
   a) "General DL Settings > Physical > Channel Bandwidth ≥ 3 MHz"
   b) "General DL Settings > Signals > NRS/N-SYNC".

   For an overview of the power-related settings, refer to Chapter 8.3, "Adjusting the signal power", on page 361.
3. To set the **antenna port** used for the NRS transmission:
   a) Select "General DL Settings > Antenna Ports".
   b) To enable Tx diversity, set "NB-IoT MIMO Configuration = 2 Tx Antennas".

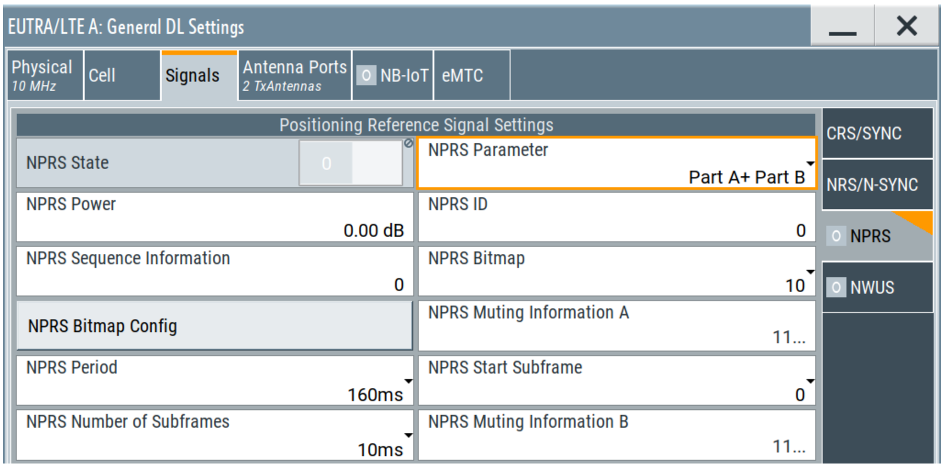
c) To define the antenna port used for the NRS transmission, select "AP2000" or "AP2001".



4. To configure the narrowband positioning reference signals (**NPRS**):

a) Select "General DL Settings > Signals > NPRS".

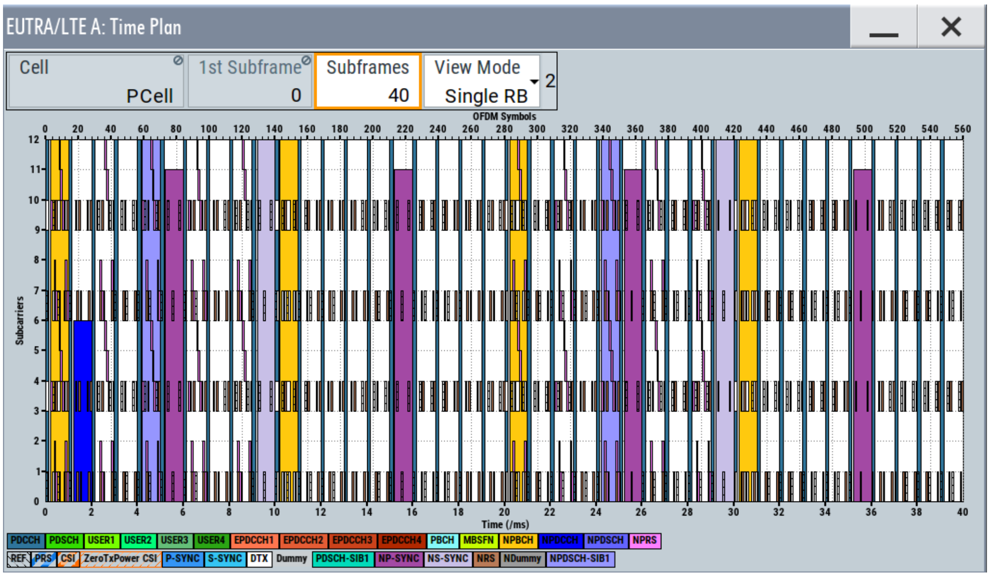
b) Select "NPRS State > On".



c) Configure the NPRS occasions, for example set "NPRS Bitmap = 10".
Select "NPRS Parameter = Part A".
Select "NPRS Bitmap Config" and enbable the NPRS transmission in every second SF.
Select "NPRS Muting Information A = 1010".

d) Extend the number of generates frames to 40, select "LTE > General > Filter/Clipping/ARB/TDW/Power > ARB > Sequence Length = 40 Frames".

e) To observe the NPRS allocations on the time plan, select "Frame Configuration > Time Plan > View Mode = Single RB" and select "Subframes = 40".



The time plan confirms that in unmutted frames (Frame#1 and Frame#3) the NPRS is transmitted every second SF. The NPRS is not transmitted in Frame#2 and Frame#4 at all, as set with the parameter "NPRS Muting Information A".

Settings:

NRS/N-SYNC (NPSS/NSSS)

Access: "General DL Settings > Physical > Channel Bandwidth ≥ 3 MHz" and "Signals > NRS/N-SYNC".

Comprises the NB-IoT Signals NRS and NPSS/NSSS settings.

Narrowband Reference Signal Power ← NRS/N-SYNC (NPSS/NSSS)

Sets the power of the narrowband reference signal (NRS).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:REFSig:NIOT:POWer` on page 414

NP-/NS-Sync Tx Antenna ← NRS/N-SYNC (NPSS/NSSS)
Defines on which antenna port the NPSS/NSSS are transmitted.

The available values depend on the number of configured antennas, see NB-IoT MIMO Configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:TXANtenna on page 414

NP-SYNC Power/NS-SYNC Power ← NRS/N-SYNC (NPSS/NSSS)
Sets the power of the NPSS/NSSS allocations.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:NPPWr on page 415
[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:NSPWr on page 415

NPRS
Access: "General DL Settings > Physical > Channel Bandwidth ≥ 3 MHz" and "Signals > NPRS".

Comprises the settings for configuring the content of the PRS-Info-NB message, as defined in TS 36.355. This message contains information related to the configuration of the NB-IoT narrowband positioning reference signals (NPRS) in a cell.

NPRS State ← NPRS
Enables using the narrowband positioning reference signals (NPRS).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:STATe on page 417

NPRS Parameter ← NPRS
Defines which type of NPRS is used.

"Part A" Indicates a NPRS that is configured based on a bitmap of subframes, which are not NB-IoT downlink subframes.

"Part B" Enabled if "General DL Settings > NB-IoT > Carrier Type = Anchor" and "Carrier Mode = Standalone/Guard Band".
Indicates that a NPRS is configured based on a NPRS Period, subframe offset (NPRS Start Subframe) and a number of consecutive NPRS DL subframes per position occasion (NPRS Number of Subframes).

"Part A+B" A subframe contains NPRS if both conditions for part A and Part B are fulfilled.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:CONF on page 417

NPRS Power ← NPRS
Sets the power of the narrowband positioning reference signal (NPRS).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:POW on page 417

NPRS ID ← NPRS

Sets the NPRS-ID used for the generation of the NPRS instead of using the physical cell ID (PCI).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:ID` on page 417

NPRS Sequence Information ← NPRS

Sets the parameter `nprsSequenceInfo` that specifies the index of the physical ressource block (PRB) containing the NPRS.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:SEIN` on page 418

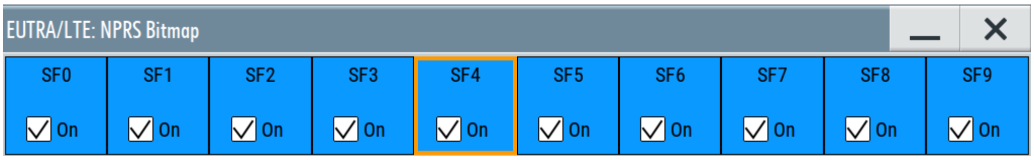
NPRS Bitmap ← NPRS

Sets if the NPRS subframe Part A configuration lasts 10 ms or 40 ms (`subframePattern10`, `subframePattern40`).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:BMP:CONF` on page 418

NPRS Bitmap Config ← NPRS

Opens a configuration dialog and sets the NPRS bitmap.



The dialog indicates whether a subframe (SF) is used for NPRS transmission. If an SF is disabled, it does not contain NPRS; such subframes are indicated with value `'0'` in the bitmap.

The selected subframes influence the scheduling of the NPRS transmissions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:BMP:VALSubframes<ch>`
on page 418

NPRS Muting Information A/B ← NPRS

Sets the `nprs-MutingInfoA`/`nprs-MutingInfoB` parameter, required if muting is used for the NPRS part A (and Part B) configurations.

"NPRS MutingInfo B" is displayed if "NPRS Parameter" on page 82 = "Part B" or "Part A+B".

The `nprs-MutingInfo` field is a periodically repeating bit sequence with a length of 2, 4, 8 or 16 NPRS position occurrences, where:

"1" indicates that the NPRS is transmitted in the corresponding occasion; a "0" indicates a muted NPRS.

For Type A configuration, a NPRS position occasion comprises one radio frame (10 subframes). The muting sequence is applied to all subframes that follow the `nprs-MutingInfoA` message.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:MTIA on page 419
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:MTIB on page 419

NPRS Period ← NPRS
For NPRS Part B configuration, sets the parameter `nprs-Period`, that defines the NPRS occasion period T_{NPRS}.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:PERiod on page 419

NPRS Start Subframe ← NPRS
For NPRS Part B configuration, sets the parameter `nprs-startSF`, that defines the subframe offset α_{NPRS}.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:STSFrame on page 419

NPRS Number of Subframes ← NPRS
For NPRS Part B configuration, sets the parameter `nprs-NumSF`, that defines the number of consecutive DL subframes N_{NPRS} within one NPRS positioning occasion.

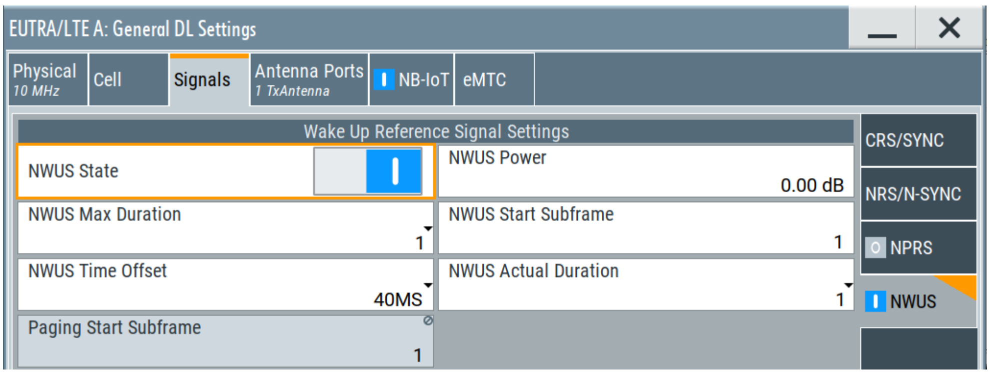
If $N_{NPRS} > T_{NPRS}$, the UE should that NPRS is not transmitted in the cell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:SFNM on page 420

3.6 NB-IoT wake-up signal (NWUS) settings

Access:

1. Select "General > Link Direction > Downlink".
2. Select "General DL Settings > Signals > NWUS".



Option: R&S SMW-K146

Settings:

NWUS State

Enables the NB-IoT wake up signal. If enabled, the wake-up signal (WUS) configuration is provided in system information.

WUS events are displayed in logging data.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:STATe` on page 422

NWUS Max Duration

Sets the maximum WUS duration, expressed as a ratio of R_{max}.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:MAXDuration` on page 420

NWUS Power

Sets the transmit power of NB-IoT wake up signal

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:POW` on page 421

NWUS Start Subframe

Specifies the first subframe for paging associated with a WUS transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:SF` on page 421

NWUS Time Offset

Sets the offset from the end of the configured maximum WUS duration to the associated paging occasion.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:TO` on page 422

NWUS Actual Duration

Sets the duration of WUS in subframes.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:ACD` on page 420

Paging Start Subframe

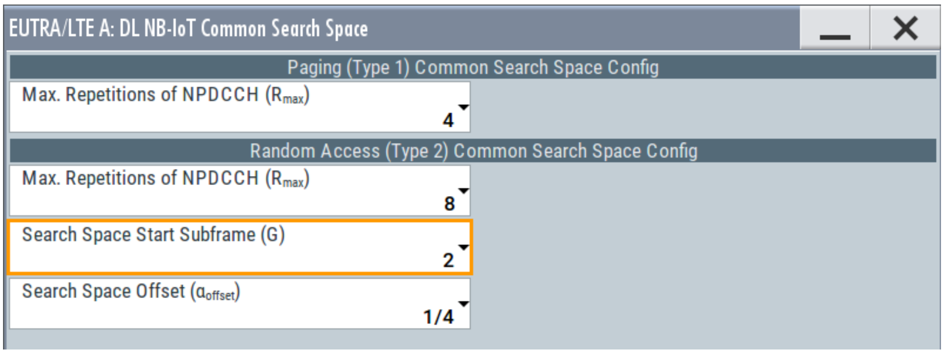
Queries the first paging occasion in subframes associated with WUS.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:PSF?` on page 421

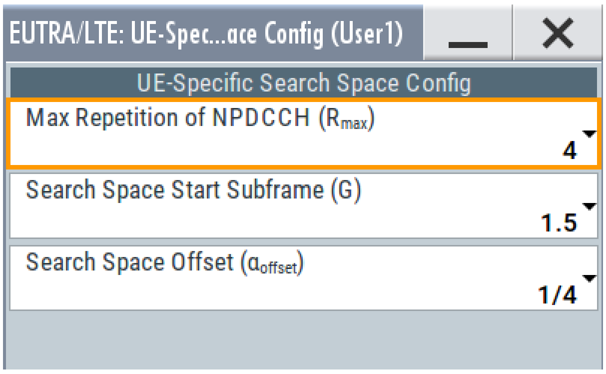
3.7 NPBCH, NPDCCH and NPDSCH settings

Access:

1. Select "General > Link Direction > Downlink".
2. To configure the **common and UE-specific search spaces**:
   a) Select "General DL Settings > NB-IoT Carrier Allocation > Common Search Space".

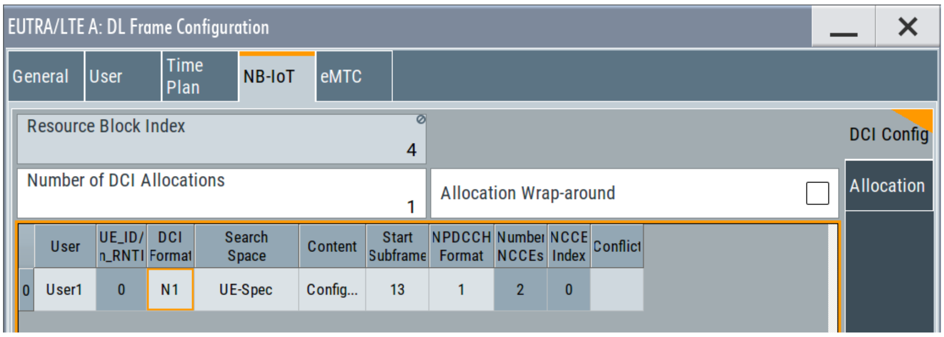


   b) Select "Frame Configuration > General > User Configuration > UEx > Search Space > Config".



3. Enable at least one NB-IoT UE, i.e. select "Frame Configuration > General > User > User 3" > **"3GPP Release = NB-IoT"**.
4. To adjust the **DCI content** for example to configure the **NPDSCH and NPDCCH scheduling**:
   a) Select "Frame Configuration > NB-IoT > DCI Configuration".
   b) Select "Number of DCI Allocations = 1".

c) Configure the DCI allocations, for example the DCI of one of the NB-IoT UEs: "User > User 3", "DCI Format = N1", "Search Space = UE-Specific".



d) Select "Content > Config".

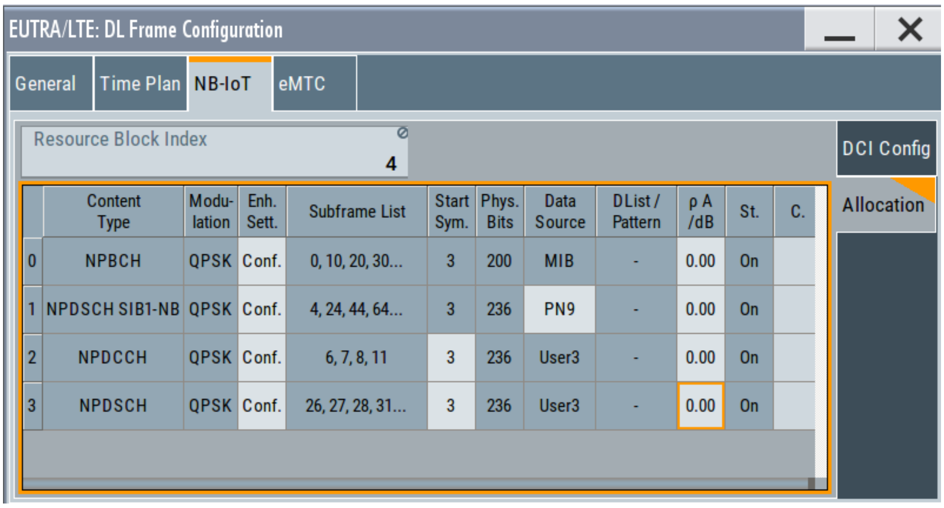
e) In the "DCI Format Configuration" dialog, set "Repetitions of DCI Subframe = 2", I_{SF}^{NPDSCH} = 2, I_{Rep}^{NPDSCH} = 2 and I_{Delay} = 2

f) Observe the information on the resulting configuration: "Repetitions of NPDCCH (R) = 4", "Repetitions of NPDSCH (N_{Rep}) = 4", "Number of NPDSCH Subframes (N_{SF}) = 4"

g) In the "NB-IoT > DCI Configuration" dialog, set a "Start Subframe".

5. To display the automatically configured **NPBCH, NPDCCH and NPDSCH allocations in the anchor carrier** according to the current DCI configuration:

a) Select "Frame Configuration > NB-IoT > Allocation".



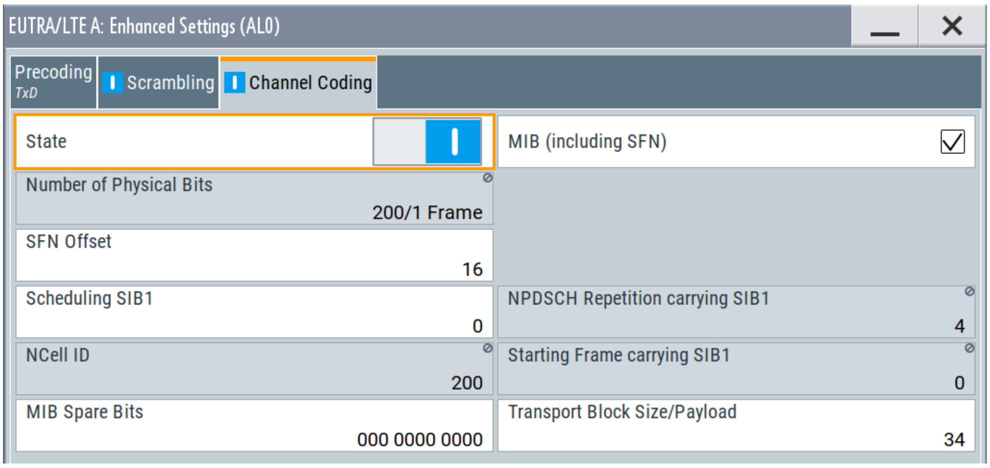
b) For the NPDCCH and NPDSCH allocations, observe the subframes displayed in the "Subframe List".

6. Observe the NB-IoT channels and signals on the "Time Plan".

See the example on Figure 2-16.
The time plan confirms the NPDCCH start subframe and the subframes in that NPDCCH is transmitted.

It also confirms the that the NPDSCH allocation starts with the defined sheduling delay after the NPDCCH allocation and spans the configured number of subframes.

7. To change information in the **MIB-NB**, like for example the **SIB1-NB scheduling**, select "NPBCH > Enchanced Settings > Config".



See Chapter 3.7.4, "NPBCH channel coding and MIB-NB configuration", on page 109.

Settings:

3.7.1 Search space settings

Access:

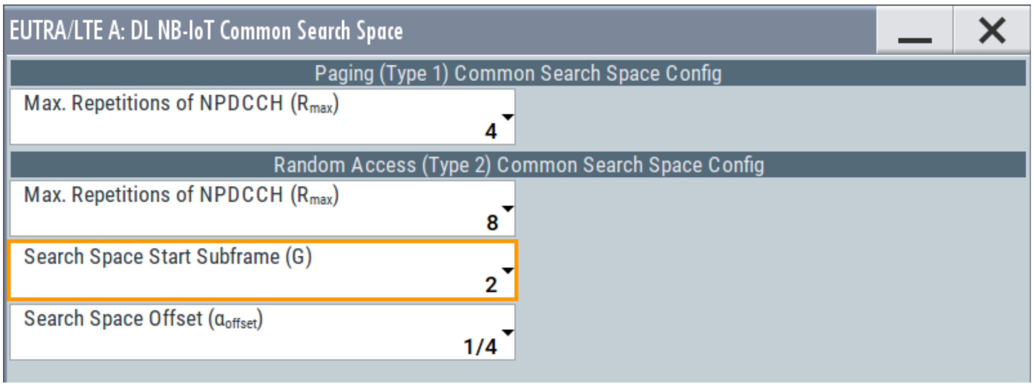
1. Select "General > Link Direction > Downlink".
2. Select "General DL Settings > NB-IoT Carrier Allocation > Common Search Space".
3. Select "Frame Configuration > General > User Configuration > UEx > Search Space > Config"

Settings:

Common Search Space

Configures the Type 1 (paging) and Type 2 (random access) common search space.

The common search space defines the NPDCCH candidates that the UE has to monitor, see "Search spaces" on page 42.



Max. Repetitions of NPDCCH (Rmax) for Type 1 common search space ← Common Search Space

Sets the maximum number NPDCCH is repeated R_{Max} (npdcch-NumRepetitionPaging-r13).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:PAG:RMAX on page 428

Max. Repetitions of NPDCCH (Rmax) for Type 2 common search space ← Common Search Space

Sets the maximum number NPDCCH is repeated R_{Max} (npdcch-NumRepetitions-RA-r13).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:RMAX on page 428

Search Space Start Subframe (G) ← Common Search Space

Sets the start SF for the random access common search space (npdcch-StartSF-CSS-RA-r13).

The following applies:

$G*R_{Max} \geq 4$

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:STSFrame on page 429

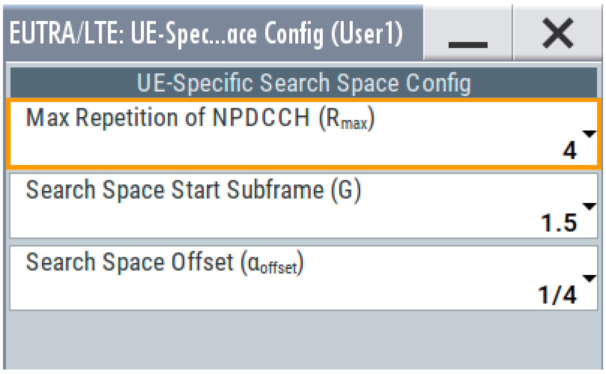
Search Space Offset (α_{offset}) ← Common Search Space

Shifts the search space start (npdcch-Offset-RA-r13).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:SSOFfset on page 428

UE-Specific Search Space

Configures the user-specific search space.



Max. Repetitions of NPDCCH (Rmax) (UE-specific search space) ← UE-Specific Search Space

Sets the maximum number NPDCCH is repeated R_{Max} (npdcch-NumRepetitions-r13).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:RMAX on page 487

Search Space Start Subframe (G) ← UE-Specific Search Space

Sets the start SF for the random access common search space (npdcch-StartSF-USS-r13).

The following applies:

$G*R_{Max} \geq 4$

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:STSFrame on page 487

Search Space Offset (α_{offset}) ← UE-Specific Search Space

Shifts the search space start (npdcch-Offset-USS-r13).

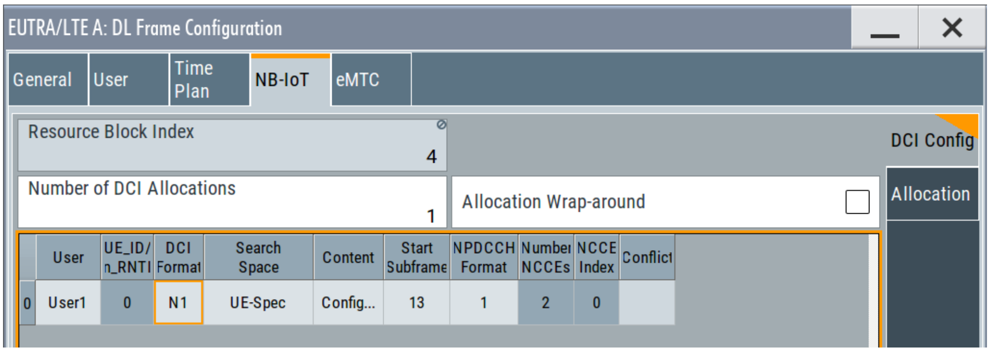
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:SSOFfset on page 488

3.7.2 NB-IoT DCI configuration

Access:

1. Select "General > Link Direction > Downlink".
2. Enable at least one NB-IoT UE, i.e. select "Frame Configuration > General > User > User 3" > **"3GPP Release = NB-IoT"**.

3. Select "Frame Configuration > NB-IoT > DCI Configuration".



4. Select "Number of DCI Allocations = 1".
5. Configure the DCI allocations, e.g. select "User > User 3" and select "Start Subframe = 6"
6. For each DCI, select "Content > Config".

Settings:

Resource Block Index

Indicates the resource block number of the anchor NB-IoT carrier.

The value is set with the parameter RB Index.

Number of DCI Allocations
Sets up to 100 configurable DCIs.

There is one table row per DCI in the DCI table.

The default "Number of DCI Allocations" value depends on the availability of NB-IoT users:

- 0: if all "User" are set to eMTC.
  Changing the value to "Number of DCI Allocations = 1", enables you to configure P-RNTI or RA-RNTI DCIs.
- 1: if there is at least one "User" with "3GPP Release = NB-IoT".

Set "Number of DCI Allocations = 0" to disable the DCI-based NB-IoT configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:NALLoc` on page 435

Allocation Wrap-around
An NPDCCH can schedule a NPDSCH outside of the selected "ARB Sequence Length".

Enable this parameter to ensure a consistent signal, where the NPDSCH allocations are relocated at the beginning of the ARB sequence.

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:AWARound` on page 435

User
Selects the user the DCI is dedicated to. The available DCI formats depend on the value of this parameter.

Other than in LTE, there is no NPDCCH indication of the system information (SI-RNTI).

"User x" Selects one of the four users with "3GPP Release = NB-IoT", as configured in the "Frame Configuration > General > User" dialog.

"P-RNTI/RA-RNTI"
A group of users is selected.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:USER` on page 435

UE_ID/n_RNTI
Displays the UE_ID of the "User x" or the n_RNTI for the selected DCI.

The UE_ID is set with the parameter "Frame Configuration > General > User Configuration > User x" > UE ID/n_RNTI.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:UEID?` on page 436

DCI Format
Sets the DCI format for the selected allocation.

The downlink control information (DCI) is a message used to control the physical layer resource allocation in the UL and DL direction. It carries scheduling information and uplink power control commands.

Depending on the DCI message usage, they are categorized into three different formats: N0, N1 and N2.

See "DCI formats, decoding and content" on page 44.

To configure the parameters per DCI format, select "Content > Config".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:FMT` on page 436

Search Space
Defines the search space for the selected DCI.

The search space defines the NPDCCH candidates that the UE has to monitor. The UE can decode only the control information on an NPDCCH that is transmitted over NCCEs within the search space the UE monitors.

Table 3-3 lists different scheduling situations and the required configuration of "Search Space" and DCI Format.

Table 3-3: Scheduling situation

Situation	"DCI Format"	"Search Space"
NPDCCH and NPDSCH configured by P-RNTI	N2	Type 1 common
NPDCCH and NPDSCH configured by RA-RNTI	N1	Type 2 common
NPDCCH and NPDSCH configured by C-RNTI	N1	UE-specific by C-RNTI
NPDCCH and NPDSCH configured by temporary C-RNTI and/or C-RNTI during random access procedure	N1	Type 2 common
NPDCCH and NPUSCH configured by C-RNTI	N0	UE-specific by C-RNTI
NPDCCH configured as "PDCCH order" to initiate random access procedure	N1	UE-specific by C-RNTI
NPDCCH and NPUSCH configured by temporary C-RNTI and/or C-RNTI during random access procedure	N0	Type 2 common

"UE-spec" Non-common DCIs are mapped to the UE-specific search space. Each UE has multiple UE-specific search spaces, determined as a function of the UE ID and the subframe.

"Type 1 Common/Type 2 Common"
The DCI is mapped to the common search space, where Type 1 common search space is used for paging and Type 2 for random access. A common search space is used to address all or a group of UEs.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SSP` on page 436

DCI Content Configuration
Configure the parameters per DCI format.

The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification.

The resulting "Bit Data", N_{SF}, N_{Rep} and R values are displayed.

Bit Data ← DCI Content Configuration
Displays the resulting bit data as selected with the DCI format parameters.

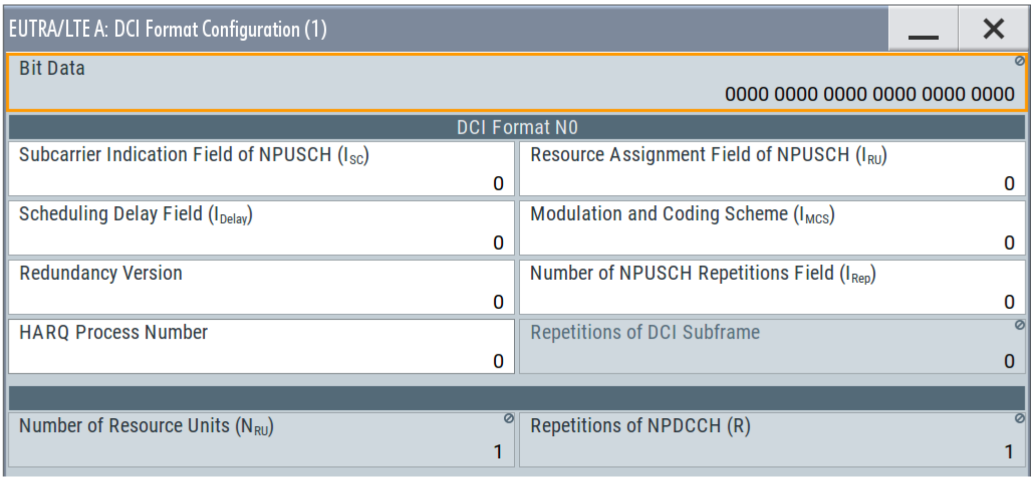
The first bit in DCI formats N0 and N1 is used as flag to distinguish between the two formats. It is set as follows:
- DCI format N0: First bit = 0
- DCI format N1: First bit = 1

Mapping of the information bits is according to TS 36.212.

See also "DCI formats, decoding and content" on page 44.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:BITS? on page 438

DCI Format N0 ← DCI Content Configuration
The DCI format N0 is 23-bits long and used for scheduling of NPUSCH in one UL cell.



DCI format N0 and transmits the following information.

"Subcarrier Identification Field of NPUSCH (I_{SC})"

6 bits
Define the starting frequency and resource unit of the NPUSCH allocation, see Table 3-23.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SCINd on page 443

"Resource Assignment Field of NPUSCH (I_{RU})"

3 bits

The resulting number of resource units for NPUSCH N_{RU}^{NPUSCH} is indicated by the parameter Number of Resource Units (N_{RU}).

I_{RU}	0	1	2	3	4	5	6	7
N_{RU}	1	2	3	4	5	6	8	10

See also "Number of Resource Units N_{RU}" on page 178.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IRU on page 438

"Scheduling Delay Field (I_{Delay})"

2 bits

Determines the number of DL subframes with that the NPDSCH is delayed after the NPDCCH transmission.

Table 3-4: Number of subframes NPDSCH is delayed (k_0 for DCI format N0)

I_{Delay}	k_0
0	8
1	16
2	32
3	64

See also Chapter 2.3.6, "NPDSCH", on page 45.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IDELay on page 439

"Modulation and Coding Scheme (I_{MSC})"

4 bits

Define the modulation order Q_m and the transport block index I_{TBS}.
The TBS is set automatically for Q_m = 2 according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:MCSCheme on page 439

"Redundancy Version"

1 bit

Sets if the transmission start with RV0 or RV2.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:RVERsion on page 443

"Number of NPUSCH Repetition Fields (I_{Rep})"

3 bits
Gives number of times NPUSCH is repeated N_{Rep}^{NPUSCH}.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPUSch:IREP` on page 442

"New Data Indicator"

1 bit
As in LTE.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NDINd` on page 442

"Repetitions of DCI Subframes"

2 bits
Used to configure the NPDCCH mapping, see Table 2-16.
The resulting number of repetitions $N_{RepNPDCCH}$ (R) is indicated by the parameter Repetitions of NPDCCH (R).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SFRPt` on page 444

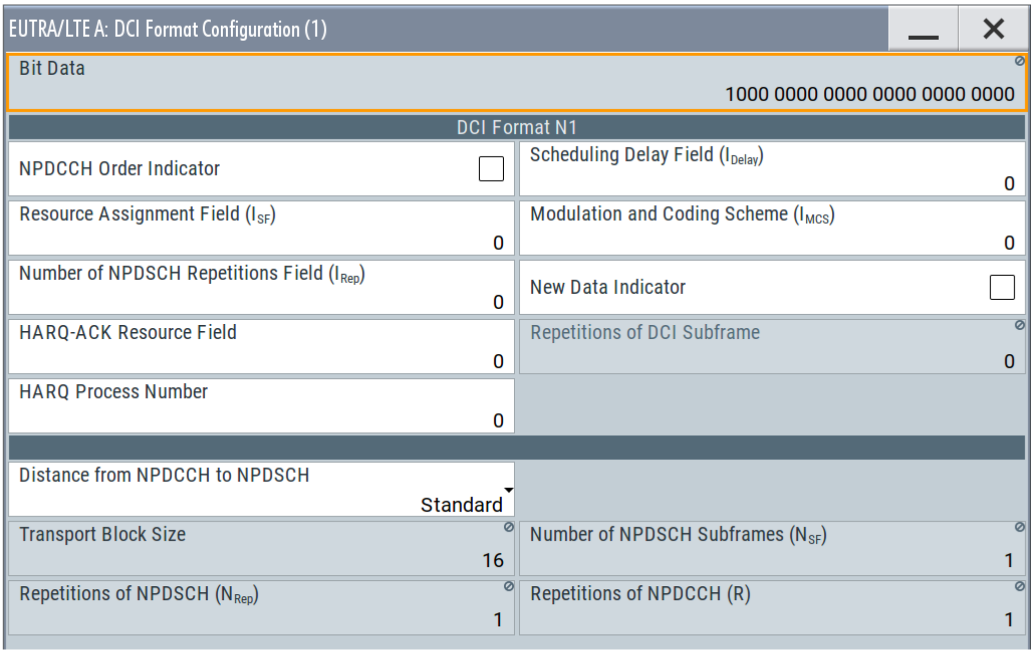
"HARQ Process Number"

1 bit
Sets the HARQ process number, if "DL Frame Configuration > User" > Support two HARQ Processes = "On"

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:HPNMber` on page 442

DCI Format N1 ← DCI Content Configuration

The DCI format N1 is used for scheduling of one NPUSCH codeword in one cell and random access procedure initiated by an NPUSCH order.



DCI format N1 is 23-bits long and transmits the following information.

"NPDCCH Order Indicator"

1 bit

- 0: indicates scheduling one NPDSCH codeword in one cell
- 1: indicates random access procedure initiated by an NPDCCH order
  The remaining bits are set to 1.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:OIND on page 439

"Starting Number of NPRACH Repetitions (I_{Rep})"

2 bits

Used if "NPDCCH Order Indicator = 1" and DCI format N1 CRC is scrambled with C-RNTI

Defines the number of NPRACH repetitions N_{Rep} following a PDCCH order.

I_{Rep}	0	1	2	3
N_{Rep}^{NPRACH}	R1	R2	R3	reserved

Where R1 < R2 < R3 and N_{Rep} = {1, 2, 4, 8, 16, 32, 64, 128}, see "Number of Repetitions" on page 189.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPRach:SNUMber on page 441

"Subcarrier Indication Field of NPRACH (I_{SC})"
6 bits
Used if "NPDCCH Order Indicator = 1" and DCI format N1 CRC is scrambled with C-RNTI
Indicates the subcarrier allocated for NPRACH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPRach:SCINd on page 441

"Scheduling Delay Field (I_{Delay})"
2 bits
Determines the number of DL subframes with that the NPDSCH is delayed after the NPDCCH transmission. This delay is added to the minimum delay of 5 subframes.

Table 3-5: Number of subframes NPDSCH is delayed (k_0 for DCI format N1 depending on R_{max})

I_{Delay}	R_{max} < 128	R_{max} > 128
0	0	0
1	4	1
2	8	32
3	12	64
4	16	128
5	32	256
6	64	512
7	128	1024

See also Chapter 2.3.6, "NPDSCH", on page 45.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IDELay on page 439

"Resource Assignment Field (I_{SF})"
3 bits
Defines the number of subframes of NPDSCH (N_{SF}^{NPDSCH}). The resulting value is indicated by the parameter Number of NPDSCH Subframes (N_{SF}).

Table 3-6: Number of subframes N_{SF}^{NPDSCH} for NPDSCH

I_{SF}	0	1	2	3	4	5	6	7
N_{SF}^{NPDSCH}	1	2	3	4	5	6	8	10

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:ISF on page 440

"Modulation and Coding Scheme (I_{MSC})"

4 bits

Define the modulation order Q_m and the transport block index I_{TBS}.

The TBS is set automatically for Q_m = 2 according to TS 36.213.

Remote command:

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:MCSCheme on page 439

"Number of NPDSCH Repetition Fields (I_{Rep})"

4 bits

Defines the number of times NPDSCH is repeated N_{Rep}^{NPDSCH}. The resulting value is indicated by the parameter Repetitions of NPDSCH (N_{Rep}).

Table 3-7: Number of repetitions N_{Rep}^{NPDSCH} for NPDSCH

I_{Rep}	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
N_{Rep}^{NPDSCH}	1	2	4	8	16	32	64	128	192	256	284	512	768	1024	1536	2048

Remote command:

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:IREP on page 440

"New Data Indicator"

1 bit; as in LTE.

Field is reserved, if DCI format N1 CRC is scrambled with RA-RNTI.

Remote command:

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NDINd on page 442

"HARQ-ACK Resource Field"

4 bits

Field is reserved, if DCI format N1 CRC is scrambled with RA-RNTI.

Defines the subcarrier and the subframe number ($n+k_0-1$) used by the NPUSCH that carries the ACK/NACK acknowledgment of the NPDSCH reception.

Where:

- n is the end subframe of the NPDSCH
- k_0 is the delay selected depending on the "HARQ-ACK Resource Field" value and the UL subcarrier spacing

Remote command:

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:HACK on page 438

"Repetitions of DCI Subframes"
2 bits
Used to configure the NPDCCH mapping, see Table 2-16.
The resulting number of repetitions $N_{RepNPDCCH}$ (R) is indicated by the parameter Repetitions of NPDCCH (R).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SFRPt on page 444

"HARQ Process Number"
1 bit
Can be set if at least 2 HARQ processes are configured.

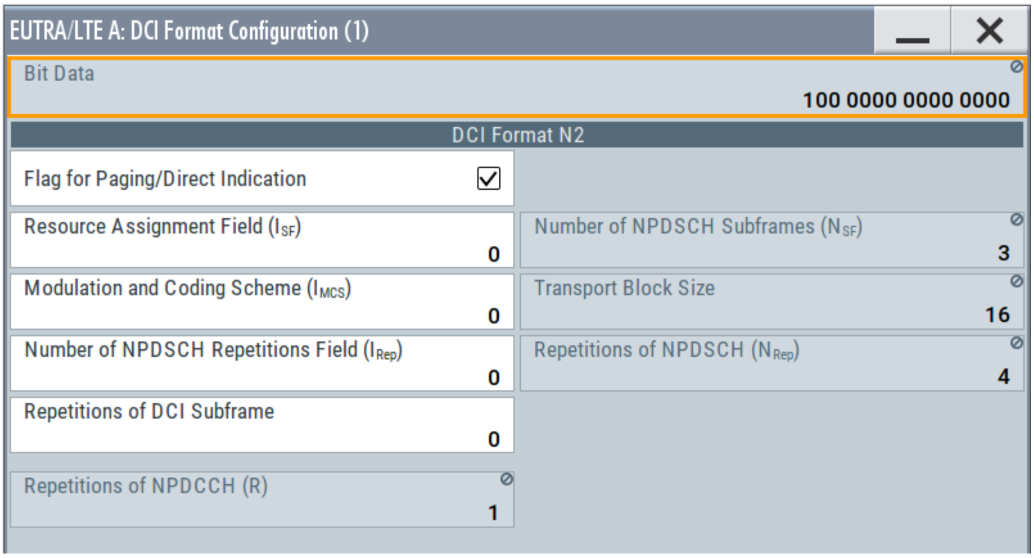
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:HPNMber on page 442

"Transport Block Size"
Indicates the TBS, calculated for the selected "Modulation and Coding Scheme (I_{MSC})" and "Resource Assignment Field (I_{SF})".
The TBS is set automatically for Q_m = 2 according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:TBSZ? on page 444

DCI Format N2 ← DCI Content Configuration

The DCI format N2 is used for paging and direct indication. It is available for "User = P-RNTI".



DCI format N2 is 15-bits long and transmits the following information.

"Flag for Paging/Direct Indication"
1 bit

- 1: Paging
- 0: Direct indication
  8 bits that provide direct indication of system information update and other fields;
  Direct indication information is transmitted on NPDCCH using P-RNTI but without an associated paging message.

Bit (in LSB order)	Field in direct indication information
1	"System Info Modification"
2	"System Info Modification - Extended Discontinuous Reception"
3 to 8	not used

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:PAG` on page 443

"System Info Modification - Extended Discontinuous Reception"
1 bit (`systemInfoModification-eDRX`)
Used if "Flag for Paging/Direct Indication = 1" and DCI format N2 CRC is scrambled with P-RNTI

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SIME` on page 444

"System Info Modification"
1 bit (`systemInfoModification`)
Used if "Flag for Paging/Direct Indication = 1" and DCI format N2 CRC is scrambled with P-RNTI

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SINF` on page 444

"Resource Assignment Field (I_{SF})"
3 bits
Defines the number of subframes of NPDSCH, see Table 3-6.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:ISF` on page 440

"Modulation and Coding Scheme (I_{MSC})"
4 bits
Define the modulation order Q_m and the transport block index I_{TBS}.
The TBS is set automatically for Q_m = 2 according to TS 36.213.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:MCSCheme` on page 439

"Number of NPDSCH Repetition Fields (I_{Rep})"
4 bits
Defines the number of times NPDSCH is repeated N_{Rep}, see Table 3-7.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:IREP` on page 440

"Repetitions of DCI Subframes"
2 bits
Used to configure the NPDCCH mapping, see Table 2-15.
The resulting number of repetitions $N_{RepNPDCCH}$ (R) is indicated by the parameter Repetitions of NPDCCH (R).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SFRPt` on page 444

Distance from NPDCCH to NPDSCH ← DCI Content Configuration

For "DCI Format = N1", sets how the distance between the NPDCCH to NPDSCH is determined.

"Standard" NPDSCH starts at least five subframes after NPDCCH, i.e. there is a gap of 4 subframes between both channels.

"Minimum" In subframes without synchronization signals, PBCH or SIB transmissions, NPDSCH starts in the first valid subframe right after the NPDCCH.

"Zero" Disables the NPDSCH SIB1-NR and NPUCCH transmissions. The NPDSCH is transmitted immediately after the NPDCCH.
Use this value to increase the number of NPDSCH allocations.
To observe the allocated subframes, select "DL frame Configuration > NB-IoT > Allocation" > Suframe List.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:DIST` on page 445

Transport Block Size ← DCI Content Configuration

Indicates the TBS, calculated for the selected "Modulation and Coding Scheme (I_{MSC})" and "Resource Assignment Field (I_{SF})".

The TBS is set automatically for Q_m = 2 according to TS 36.213.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:TBSZ?` on page 444

Number of Resource Units (N_{RU}) ← DCI Content Configuration

Displays the resulting number of NPUSCH resource units N_{RU}^{NPUSCH}, retrieved from the selected "Resource Assignment Field of NPUSCH (I_{RU})".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NRUNits?` on page 442

Number of NPDSCH Subframes (N_{SF}) ← DCI Content Configuration
Displays the resulting number of NPDSCH subframes (N_{SF}), see Table 3-6.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:NSF?
on page 441

Repetitions of NPDSCH (N_{Rep}) ← DCI Content Configuration
Displays the resulting number of NPDSCH repetitions (N_{Rep}), see Table 3-7.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:NREP?
on page 440

Repetitions of NPDCCH (R) ← DCI Content Configuration
Displays the resulting number of NPDCCH repetitions (R), depending on:
- "Search Space" on page 93
- R_{max}, set per search space in the dialogs Common Search Space and UE-Specific Search Space
- "Repetitions of DCI Subframes" DCI field of corresponding DCI format.

See:
- Table 2-15
- Table 2-16

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:REP?
on page 439

Start Sufbrame
Sets the next valid starting subframe for the particular NPDCCH, see "Calculating the NPDCCH starting subframe" on page 42.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:STSFrame on page 437

NPDCCH Format
Sets the NPDCCH format.

Table 3-8: NPDCCH formats

NPDCCH format	Number of NCCEs	Search space
0	1	UE-specific
1	2	UE-specific Type 1 common Type 2 common

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:FMT
on page 437

Number NCCEs

NPDCCH is transmitted on an aggregation of one or two consecutive narrowband control channel elements (NCCE), see Figure 2-14.

The value is calculated from the selected "NPDCCH Format" and "NCCE Index", see Table 3-8.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:CCES? on page 437

NCCE Index

For UE-specific search space, sets the NCCE start index.

NCCE index	Occupied subcarriers per subframe
0	0 to 5
1	6 to 11

See also Figure 2-14.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IDCCe on page 437

Conflict

Indicates a conflict between two DCI formats, for example if they have the same NCCE index and start subframe.

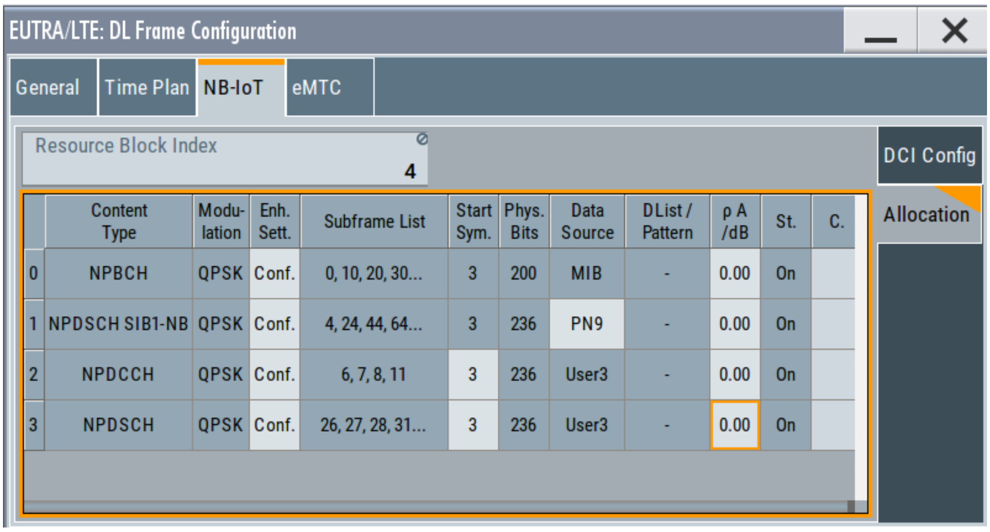
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:CONFlict?
on page 438

3.7.3 NB-IoT allocations (NPBCH, NPDCCH, NPDSCH)

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > General > NB-IoT Allocation".
3. Select "ρ A" to boost the power of a particular allocation.

   The dialog displays the NB-IoT allocations in the **anchor carrier**.



The NPBCH allocation and the SIB1-NB transmissions are configured automatically, but can be changed. See Chapter 3.7.4, "NPBCH channel coding and MIB-NB configuration", on page 109.

The NPDSCH and NPDCCH allocations are configured according to the current DCI configuration, see Chapter 3.7.2, "NB-IoT DCI configuration", on page 90.

Settings:

Resource Block Index

Indicates the resource block number of the anchor NB-IoT carrier.

The value is set with the parameter RB Index.

Allocation number

Consecutive number of the allocation.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NALLoc?` on page 445

Content Type

Indicates the channel type.

Allocation number	Channel	Description
0	NPBCH	Narrowband broadcast channel
1	• NPDSCH SIB1-NB • NPDCCH • NPDSCH	• If MIB (including SFN) > "On", one NPDSCH that carries the SIB1-NB message is automatically configured If MIB (including SFN) > "Off", NPDCCH is configured • If Distance from NPDCCH to NPDSCH > "Zero", because NPDSCH SIB1-NB and NPDCCH are not transmitted
> 1	• NPDCCH • NPDCCH and NPSCH	Allocated automatically, depending on the current DCI configuration, Chapter 3.7.2, "NB-IoT DCI configuration", on page 90: • One narrowband DL control channel per active NB-IoT user, see "Configure User" > 3GPP Release • One pair per paging and random access RNTI

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CONType? on page 446

Modulation
All DL NB-IoT channels are QPSK modulated.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:MODulation? on page 446

Enhanced Settings > Config
Accesses the precoding, scrambling and channel coding settings of the selected channel, see:
- Chapter 3.7.4, "NPBCH channel coding and MIB-NB configuration", on page 109
- Chapter 3.7.5, "NPDSCH and NPDCCH channel coding and scrambling", on page 113

Suframe List
Indicates the subframes in that the channel is allocated.

The subframes are calculated depending on the duplexing mode, the channel type, the number of repetitions and the valid subframes, see "Valid Subframes" on page 77.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SFList? on page 446

Start Symbol
Indicates the first symbol (l_{Start}) in a subframe where NB-IoT channels can be allocated.

Table 3-9: Start symbol l_{Start}

Channel	Data	Start symbol $l_{NDPCCHStart}$	Mode
NPBCH	MIB	• 3 *)	• Regardless
NPDCCH	any	• 1, 2, 3 • 0	• "In-band" • "Guard Band"/ "Standalone"
NPDSCH	• SIB1-NB • other	• 3 *) • 1, 2, 3 0	• Regardless • "In-band" "Guard Band"/ "Standalone"

*) To avoid collisions with control information in the LTE system, NPBCH and NPDSCH carrying SIB-NB are allocated after the LTE PDCCH control region.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:STSYmbol` on page 446

Phys. Bits

Displays the allocation size in bits ($N_{PhysBits}$).

For QPSK modulation, the allocated number of bits is calculated as follows:

Number of Physical Bits = 2*Number of RE per PRB or

$N_{PhysBits} = 2*N_{RE}$

Where:

- N_{RE} are number of available resource elements RE per resource blocks PRB after the "Start Symbol" and excluding reference RE reserved for LTE CRS and NRS.
- For NPDSCH, N_{RE} is N_{RE}^{NPDSCH} is selected form Table 3-10.
- For NPDCCH format 0 with one NCCE, N_{RE} is $2*N_{RE}^{NPDCCH,0} = N_{RE}^{NPDSCH}$
- For NPDCCH format 1 with two NCCEs), N_{RE} is $N_{RE}^{NPDCCH,1} = N_{RE}^{NPDSCH}$

Table 3-10: Number of available resource elements RE per resource blocks PRB (N_{RE}) after the Start Symbol $l_{NDPCCHStart}$

Mode	Number of NB APs (NB-IoT MIMO Configuration)	Number of LTE APs ("Global MIMO Configuration")	$l_{NDPCCHStart}$ = 0	$l_{NDPCCHStart}$ = 1	$l_{NDPCCHStart}$ = 2	$l_{NDPCCHStart}$ = 3
Guard Band/ Standalone	1 2	0	160 152	-	-	-
In-band	1	1	-	142	130	118
	1	2	-	136	124	112
	1	4	-	128	120	108
	2	1	-	134	122	110
	2	2	-	128	116	104
	2	4	-	120	112	100

NPBCH carries 200 bits per frame.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PHYSbits?` on page 447

Data Source

Indicates the data source depending on the "Content Type".

The data source can be changed in the following cases:

- For NPDSCH allocations that are configured for "NB-IoT DCI Config > User = P-RNTI or RA-RNTI"
- If "NPBCH > Enhanced Settings > Config > Channel Coding = Off"
- For the NPDSCH SIB1-NB allocation
  Use this function to load data lists as source for the SIB messages.

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:

- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:DATA` on page 447
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:DSELect` on page 448
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PATTern` on page 448

ρ A
Sets the power P_{NPBCH}, P_{NPDCCH} or P_{NPDSCH} (ρ A) of the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:POWer` on page 447

State
Indicates that the allocation is active.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:STATe?` on page 448

Conflict
Indicates a conflict between allocations.

If conflict occurs, change used NCCE index and the change starting subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CONFlict?` on page 449

3.7.4 NPBCH channel coding and MIB-NB configuration

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > NB-IoT Allocation".
3. Select "NPBCH > Enchanced Settings > Config".

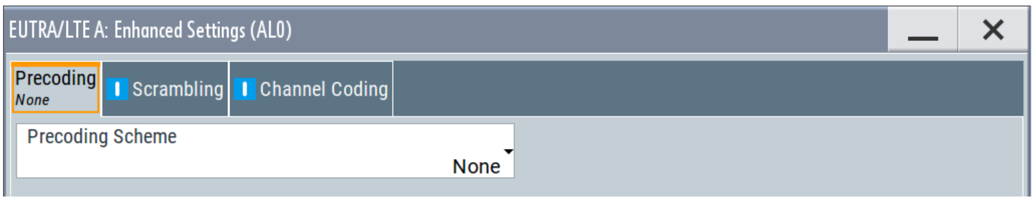
NPBCH can be generated in one of the following modes:

- Without channel coding, if "Channel Coding > State > Off"
  Dummy data or user-defined data lists are used.
- Channel coding with arbitrary transport block content
  If channel coding is activated ("Channel Coding > State > On") and parameter "MIB (including SFN) > Off"
- Channel coding with real data (MIB-NB) including SFN
  If channel coding and "MIB (including SFN)" are activated
  This mode is required for the generation of SIB1-NB message.

Settings:

Precoding settings

Access: select "Frame Configuration > NB-IoT Allocation > NPBCH > Enchanced Settings > Config > Precoding".



Precoding Scheme ← Precoding settings

Selects the precoding scheme.

"None" Disables precoding.

"Tx Diversity"
If NB-IoT MIMO Configuration = "2 Tx Antennas", select precoding for transmit diversity.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:SCHeme`
on page 449

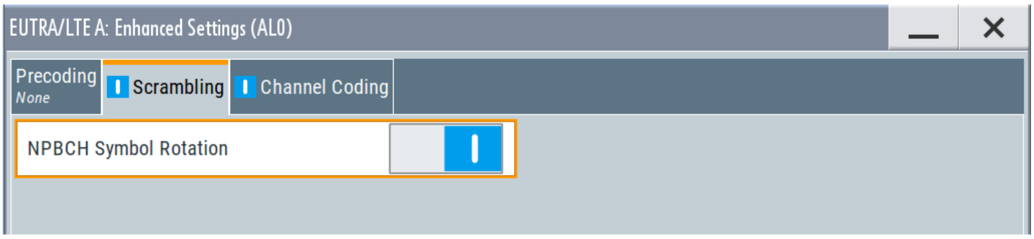
Number of Layers ← Precoding settings

Displays the number of layers for the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:NOLayers?`
on page 450

Scrambling settings

Access: select "Frame Configuration > NB-IoT Allocation > NPBCH > Enchanced Settings > Config > Scrambling".



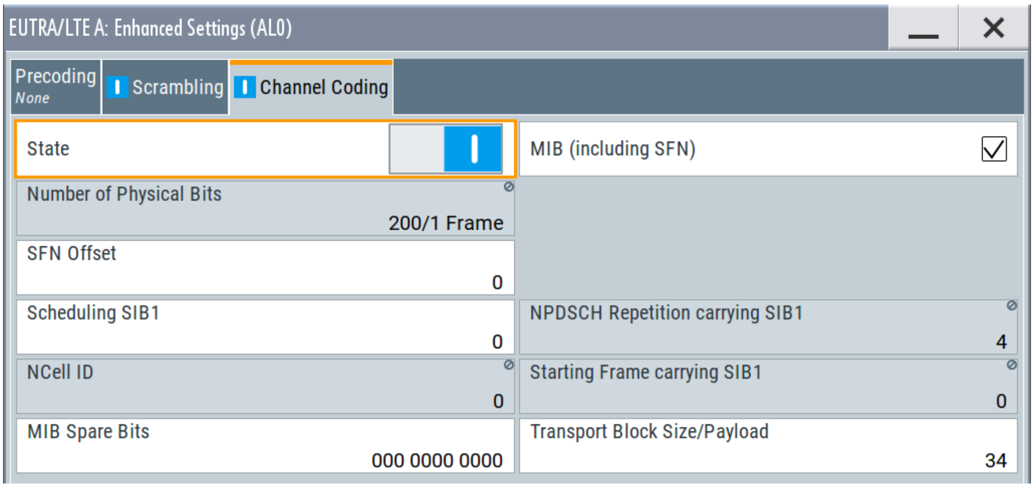
NPBCH Symbol Rotation ← Scrambling settings

Enables NPBCH scrambling with symbol rotation, as specified in LTE Rel. 13.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:SROT`
on page 450

Channel coding settings

Access: select "Frame Configuration > NB-IoT Allocation > NPBCH > Enchanced Settings > Config > Channel Coding".



Channel Coding State ← Channel coding settings
Enables channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:STATe
on page 451

Number of Physical Bits ← Channel coding settings
Indicates the calculated number of physical bits; resembles the information displayed with parameter Phys. Bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PHYSbits? on page 447

MIB (including SFN) ← Channel coding settings
Enables transmission of real MIB (master information block) data. The SFN (system frame number) is included as well.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:MIB on page 452

SFN Offset ← Channel coding settings
By default, the counting of the SFN (system frame number) starts with 0. This parameter sets a different start SFN value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:SOFFset on page 454

Scheduling SIB1 ← Channel coding settings
Sets the parameter `schedulingInfoSIB1` that defines the NPDSCH number of repetitions N_{Rep}^{NPDSCH}, see NPDSCH repetition carrying SIB1.

Table 3-11: Number of repetitions N_{Rep}^{NPDSCH} for NPDSCH carrying SIB1-NB

`schedulingInfoSIB1`	0	1	2	3	4	5	6	7	8	9	10	11	12 to 15
"Duplexing = FDD" N_{Rep}^{NPDSCH}	4	8	16	4	8	16	4	8	16	4	8	16	reserved
Option: R&S SMW-146 "Duplexing = TDD" N_{Rep}^{NPDSCH}	4	8	16	4	8	16	4	8	16	4	8	16	16

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:SIB` on page 453

NPDSCH repetition carrying SIB1 ← Channel coding settings
Indicates the number of NPDSCH repetitions, if this NPDSCH carries SIB1-NB (see Table 3-11).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:RSIB?` on page 453

NCell ID ← Channel coding settings
Indicates the NCell ID N_{ID}^{Cell}, as selected with the parameter NCell ID.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:NCID?` on page 453

Starting Frame carrying SIB1 ← Channel coding settings
Indicates the first frame in that the NPDSCH transmission carrying SIB1-NB is allocated.

The value is calculated for the selected NPDSCH repetition carrying SIB1 and NCell ID.

N_{Rep}^{NPDSCH}	N_{ID}^{Cell}	**Starting frame for SIB1-NB repetitions**
4	N_{ID}^{Cell} mod 4 = 0	0
4	N_{ID}^{Cell} mod 4 = 1	16
4	N_{ID}^{Cell} mod 4 = 2	32
4	N_{ID}^{Cell} mod 4 = 3	48
8	N_{ID}^{Cell} mod 2 = 0	0
8	N_{ID}^{Cell} mod 2 = 1	16
16	N_{ID}^{Cell} mod 2 = 0	0
16	N_{ID}^{Cell} mod 2 = 1	1

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:STFSib1?` on page 454

MIB Spare Bits ← Channel coding settings
Sets the 11 spare bits in the NPBCH transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:MSPare` on page 453

Transport Block Size/Payload (DL) ← Channel coding settings
Displays the size of the transport block/payload in bits.

For NPBCH, the transport block size is always 34 bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:TBSize?`
on page 452

3.7.5 NPDSCH and NPDCCH channel coding and scrambling

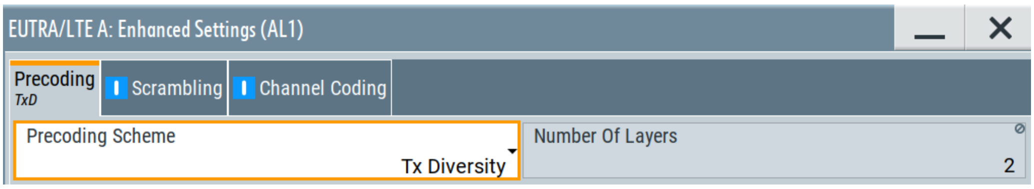
Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > NB-IoT Allocation".
3. Select "NPDSCH/NPDCCH > Enchanced Settings > Config".

   Access settings of "Precoding", "Scrambling" and "Channel Coding".

Settings:

Precoding settings
Access: select "Frame Configuration > NB-IoT Allocation > NPDSCH > Enchanced Settings > Config > Precoding".



Precoding Scheme ← Precoding settings

Selects the precoding scheme.

"None" Disables precoding.

"Tx Diversity" If NB-IoT MIMO Configuration = "2 Tx Antennas", select precoding for transmit diversity.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:SCHeme`
on page 449

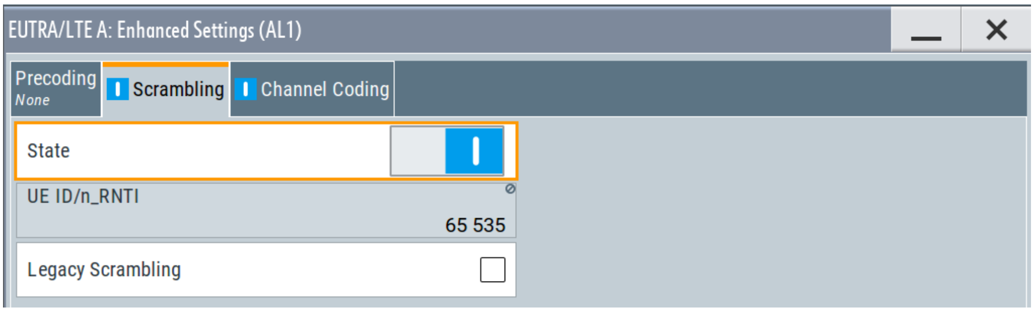
Number of Layers ← Precoding settings

Displays the number of layers for the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:NOLayers?`
on page 450

Scrambling settings

Access: select "Frame Configuration > NB-IoT Allocation > NPDSCH > Enchanced Settings > Config > Scrambling".



Scrambling State ← Scrambling settings

Enables scrambling.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:STATe`
on page 450

UE ID/n_RNTI ← Scrambling settings

Indicates the user equipment identifier (n_RNTI) or UE ID of the user to which the NPDSCH transmission is intended. The displayed "UE ID/n_RNTI" value is used to calculate the scrambling sequence.

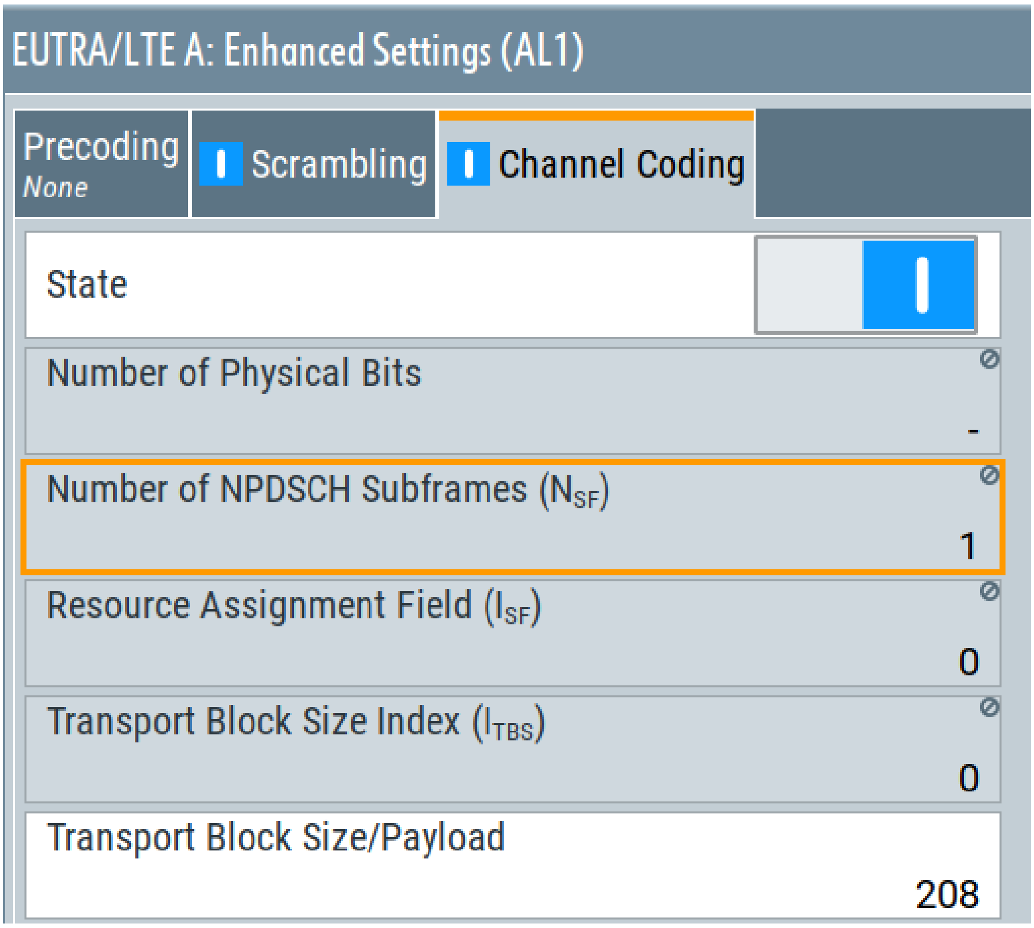
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:UEID?
on page 450

Legacy Scrambling ← Scrambling settings
Option: R&S SMW-K143

If disabled, scrambling according to LTE Rel. 14 is applied.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:LEGacy:STATe on page 451

Channel coding settings
Access: select "Frame Configuration > NB-IoT Allocation > NPDSCH > Enchanced Settings > Config > Channel Coding".



Channel Coding State ← Channel coding settings
Enables channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:STATe
on page 451

Number of Physical Bits ← Channel coding settings
Indicates the calculated number of physical bits; resembles the information displayed with parameter Phys. Bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PHYSbits?` on page 447

Number of NPDSCH Subframes (N_{SF}) ← Channel coding settings
Indicates the value calculated from the current DCI configuration.

See:
- "NPDSCH scheduling" on page 46
- E.g. "DCI Format N1" on page 96

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:NSF?` on page 452

Resource Assignment Field (I_{SF}) ← Channel coding settings
Indicates the value calculated from the current DCI configuration.

See:
- "NPDSCH scheduling" on page 46
- E.g. "DCI Format N1" on page 96

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:ISF?` on page 451

Transport Block Size Index (I_{TBS}) ← Channel coding settings
Sets the transport block size index.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:TBSI` on page 452

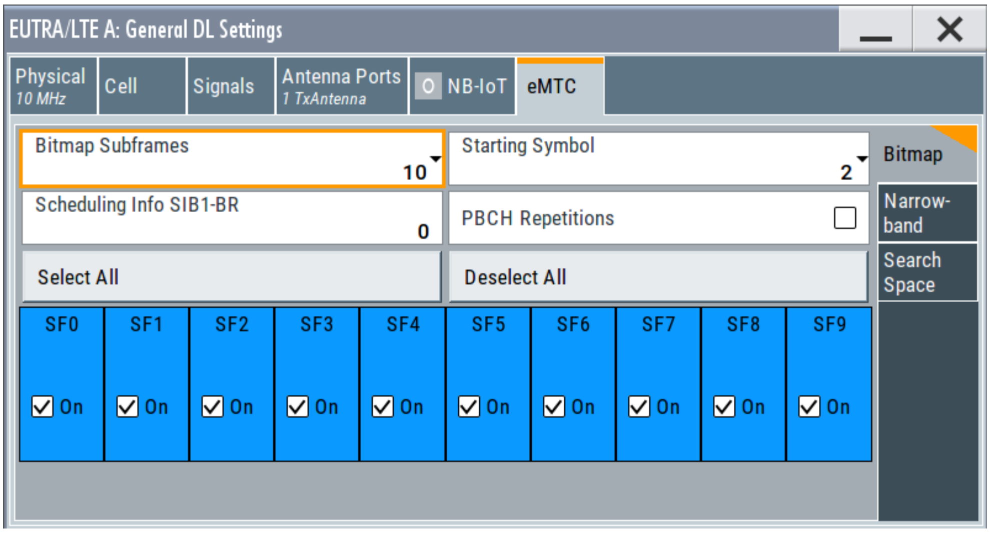
Transport Block Size/Payload (DL) ← Channel coding settings
Displays the size of the transport block/payload in bits for the current Transport Block Size Index (I_{TBS}).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:TBSize?`
on page 452

3.8 eMTC DL valid subframes and frequency hopping

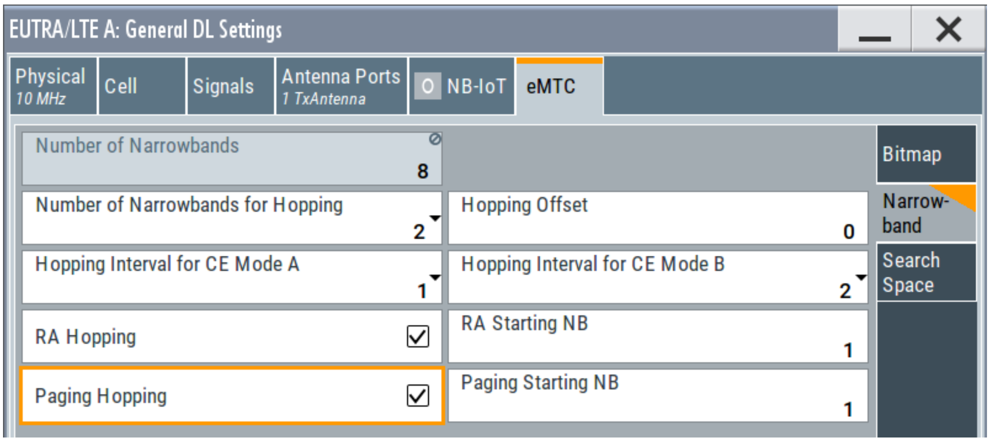
Access:

1. Select "General > Link Direction > Downlink".
2. Select "General > Duplexing > FDD".
3. Select "General DL Settings > eMTC > Bitmap".



4. To configure subframe allocation for eMTC transmission, select:
   a) "Bitmap Subframes = e.g. 10"
   b) A subframe (SF) to enable it for eMTC transmission.

   eMTC transmission is postponed during invalid subframes.
5. To define the cell-specific frequency-hopping patterns of PDSCH and MPDCCH, select "eMTC > Narrowbands".



For description of the common search space settings, see Chapter 3.10.1, "Search space settings", on page 125.

Settings:

Bitmap

Comprises general eMTC configuration settings. These settings include defining the valid subframes (SF) that can be used for eMTC transmission, reserving several symbols for the LTE control region, enabling PBCH repetition.

Bitmap Subframes ← Bitmap

Sets the valid subframes configuration over 10ms or 40ms (`subframePattern10-r13`, `subframePattern40-r13`).

The selected subframes influence the scheduling of the eMTC transmissions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SUBFrames` on page 430

Starting Symbol ← Bitmap

Defines the first symbol within a frame that can be used for eMTC. The parameter is used to protect the LTE control region.

The LTE control region length and thus the eMTC start symbol depends on the channel bandwidth:
- For "Channel Bandwidth ≥ 3MHz": 1, 2 or 3 symbols
- For "Channel Bandwidth = 1.4 MHz": 2, 3 or 4 symbols

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:STARt` on page 430

Scheduling Info SIB1-BR ← Bitmap

Sets the higher-level parameter `schedulingInfoSIB1-BR-r13` and defines the number of times the PDSCH allocation carrying the SIB1-BR is repeated, see Table 2-5.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SIBBr` on page 430

PBCH Repetition ← Bitmap

For "Channel Bandwidth ≥ 3MHz", configures the cell for PBCH repetition.

If enabled, the PBCH is repeated as defined in TS 36.211.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:PBCHrep` on page 430

Select All/Deselect All ← Bitmap

Sets all SFs as valid or invalid.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SELectlall|DESelectall
on page 431

SF State ← Bitmap
Sets an SF as valid or invalid.

If TDD duplexing is used, the UL subframes cannot be used for eMTC transmission.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:VALSubframes<ch> on page 431

Narrowbands
Comprises settings for frequency-hopping configuration.

Number of eMTC Narrowbands ← Narrowbands
This parameter is **dedicated to eMTC**.

It indicates the number of eMTC narrowbands N_{RB}^{DL} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Narrowbands" = "Number of Resource Blocks" / 6

For more information, see "Narrowbands" on page 19.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:NNBands? on page 431

Number of Narrowbands for Hopping ← Narrowbands
Set the parameter `mpdcch-pdsch-HoppingNB-r13` ($N_{NB,hop}^{ch,DL}$) and defines the number of narrowbands (2 or 4) over which MPDCCH or PDSCH hops.

See also "PDSCH hopping" on page 22.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:HOPPing on page 431

Hopping Offset ← Narrowbands
Set the parameter `mpdcch-pdsch-HoppingOffset-r13` ($f_{NB,hop}^{DL}$) and defines the number of narrowbands between two consecutive MPDCCH or PDSCH hops.

See also "PDSCH hopping" on page 22.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:HOFFset on page 432

Hopping Interval for CE Mode A/B ← Narrowbands
Set the parameter `interval-DLHoppingConfigCommon` ($N_{NB}^{ch,DL}$) and defines the number of consecutive subframes during which MPDCCH or PDSCH stays at the same narrowband before hopping to another narrowband.

Table 3-12: Hopping interval $N_{NB}^{ch,DL}$ value range per CE Mode

Duplexing	CE Mode A	CE Mode B
FDD	1, 2, 4, 8	2, 4, 8, 16
TDD	1, 5, 10, 20	5, 10, 20, 40

See also "PDSCH hopping" on page 22.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:IVLA on page 432
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:IVLB on page 432

RA Hopping ← Narrowbands
Enables hopping for the random access.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:RHOPpping on page 432

RA Starting NB ← Narrowbands
If "RA Hopping > On", sets the first used narrowband.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:RSTNb on page 432

Paging Hopping ← Narrowbands
Enables paging hopping.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:PHOPping on page 432

Paging Starting NB ← Narrowbands
If "Paging Hopping > On", sets the first used narrowband.

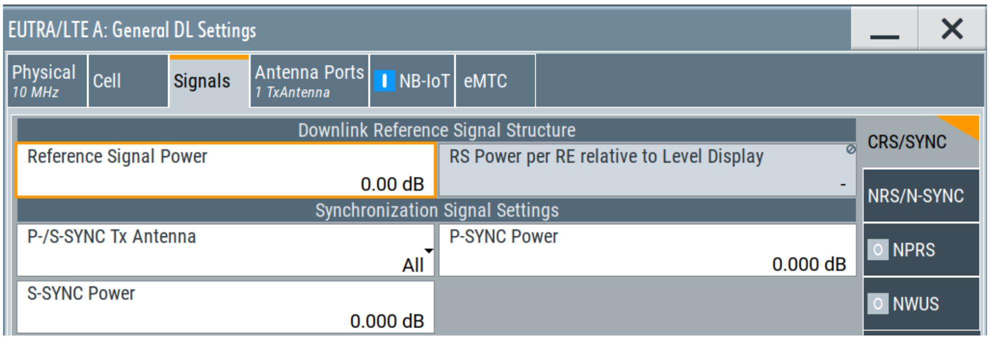
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:PSTNb on page 432

3.9 eMTC synchronization and cell-specific reference signals (CRS/SYNC) settings

Access:

1. Select "General > Link Direction > Downlink".

2. Select "General DL Settings > Signals > CRS/SYNC".



eMTC reuses the legacy signals, known from LTE: PSS/SSS (primary and secondary synchronization signals), CRS (cell-specific reference signal) and DMRS (demodulation reference signal).
For an overview of the power-related settings, refer to Chapter 8.3, "Adjusting the signal power", on page 361.

Settings:

Downlink Reference Signal Structure
Comprises the downlink reference signal settings, like the power of the reference signals.

For an overview of the provided power settings and detailed information on how to adjust them, refer to Chapter 8.3, "Adjusting the signal power", on page 361.

Reference Signal Power ← Downlink Reference Signal Structure
Sets the power of the reference signal (PRS relative).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:REFSig:POWer` on page 415

RS Power per RE relative to Level Display ← Downlink Reference Signal Structure
If "EUTRA/LTE > State = On", displays the power of the reference signal (RS) per resource element (RE) relative to the power value, displayed in the status bar ("Level").

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 415

Synchronization Signal Settings
In the "Synchronization Signal Settings" section, the power of the P-SYNC/S-SYNC is set.

P-/S-SYNC Tx Antenna ← Synchronization Signal Settings
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 415

P-SYNC Power ← Synchronization Signal Settings
Sets the power of the P-SYNC allocations.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:SYNC:PPOWer on page 416

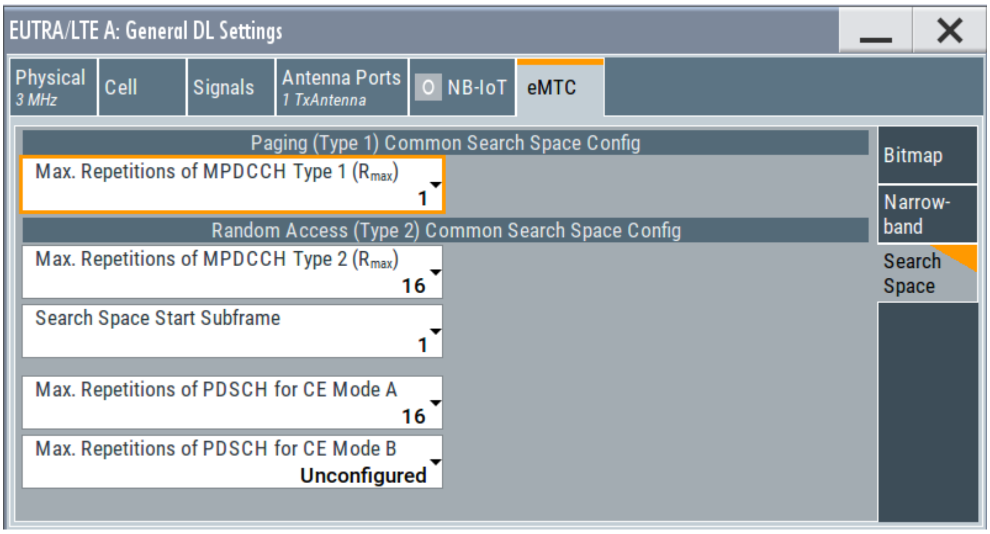
S-SYNC Power ← Synchronization Signal Settings
Sets the power of the S-SYNC allocations.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:SYNC:SPOWer on page 416

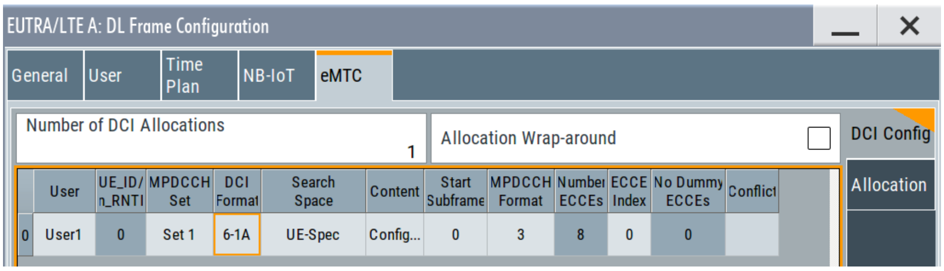
3.10 eMTC DL allocations settings

Access:

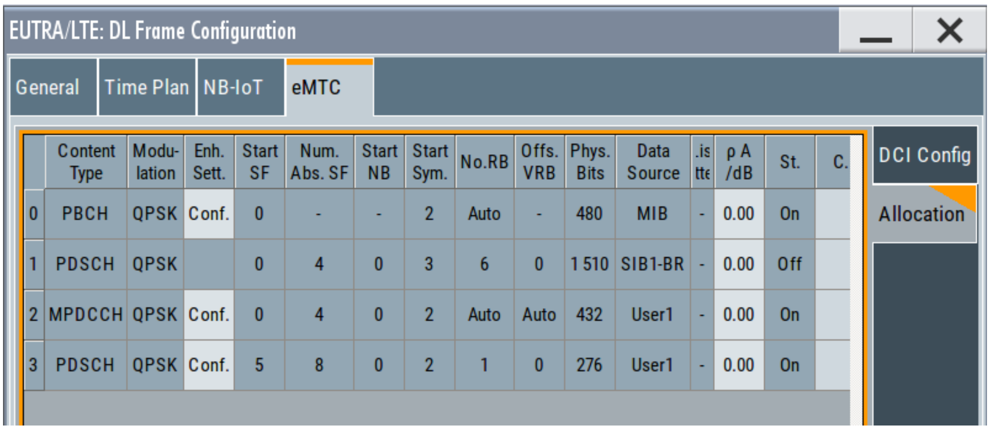
1. Select "General > Link Direction > Downlink".
2. To configure the **common search space**, select "General DL Settings > eMTC > Search Space".



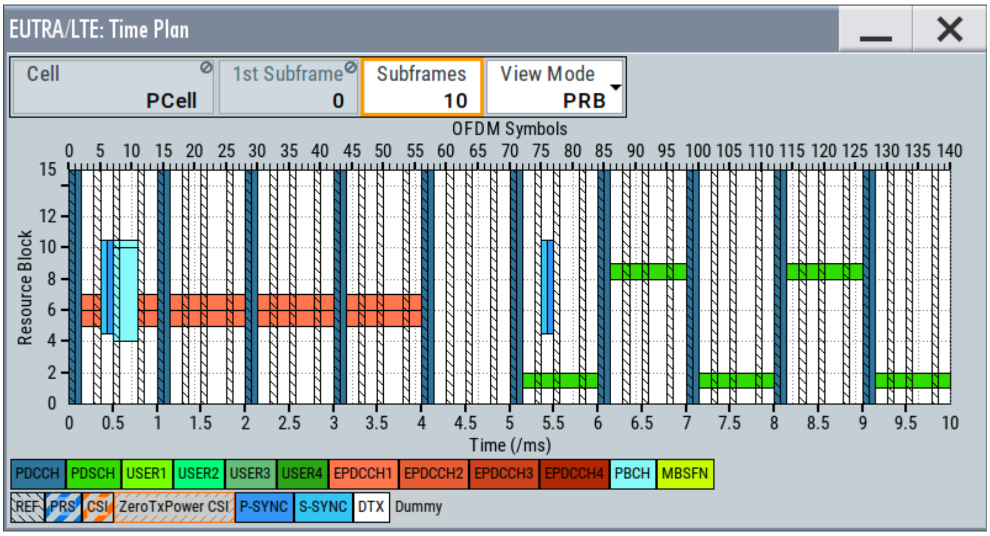
3. Enable at least one eMTC UE, i.e. select "Frame Configuration > General > User > User 1" > **"3GPP Release = eMTC CE: A/B"**.
4. To configure the **UE-specific search space** for MPDCCH:
   a) Select "MPDCCH Config".
   b) Select "Max. Repetition MPDCCH (Rmax) = 8".
   c) Select "Search Space Start Subframe = 1".
5. To adjust the **DCI content** for example to configure the **PDSCH and MPDCCH scheduling**:
   a) Select "Frame Configuration > eMTC > DCI Configuration".
   b) Select "Number of DCI Allocations = 1".
   c) Configure the DCI allocations, e.g. select "User > User 1", "DCI Format = 6-1A", "Search Space = UE-Specific".



   d) Select "Content > Config".
   In the "DCI Format Configuration" dialog, set "Repetition number = 2", "PDSCH Frequency Hopping = On", "DCI Subframe Repetition Number = 2".
   Observe the information on the resulting configuration:
   "Repetitions of MPDCCH = 4", "Repetitions of PDSCH = 8", "PDSCH Hopping = On".
   e) In the "eMTC > DCI Configuration" dialog, set "Start Subframe = 0" and "MPDCCH Format = 3".
6. To display the automatically configured **MPDCCH and PDSCH allocations** according to the current DCI configuration, select "Frame Configuration > eMTC > Allocation".
   Optional, set also "LTE > DL General Settings > eMTC > Bitmap > Scheduling Info SIB1-BR = 1".

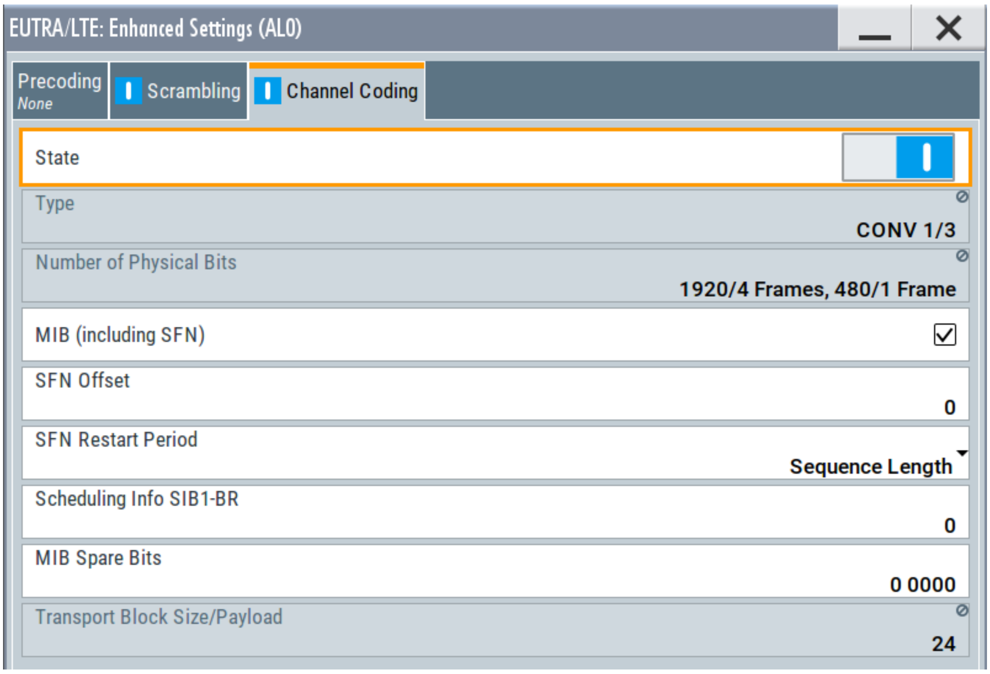


7. Observe the NB-IoT channels and signals on the "Time Plan".



The time plan confirms the MPDCCH start subframe and the subframes in that MPDCCH is transmitted.

8. To change information in the **MIB**, like for example the **SIB1-BR scheduling** and thus activating the PDSCH carrying SIB1-BR, select "PBCH > Enhanced Settings > Config".



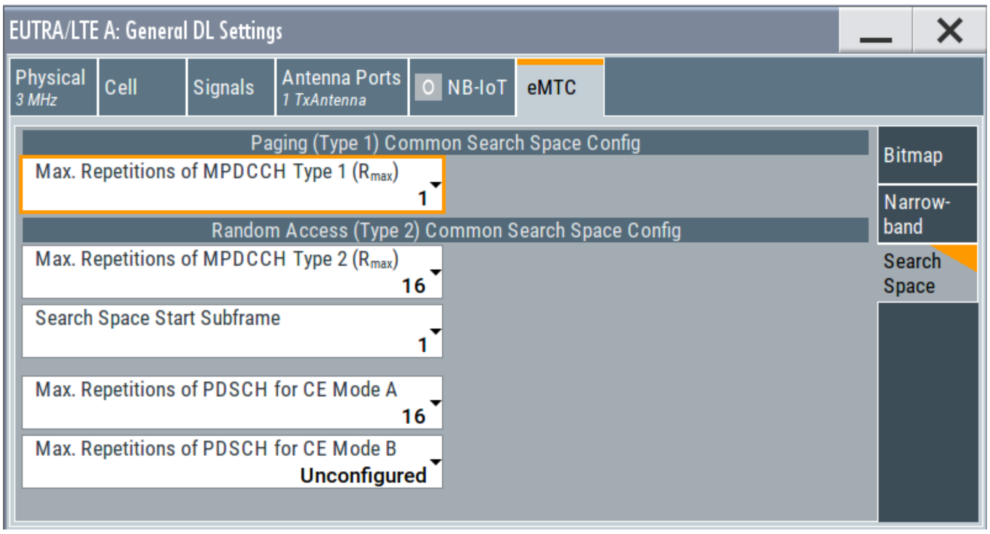
See Chapter 3.10.5, "PBCH channel coding and SIB-BR configuration", on page 146.

Settings:

3.10.1 Search space settings

Access:

1. Select "General > Link Direction > Downlink".
2. Select "General DL Settings > eMTC > Search Space".
3. Select "Frame Configuration > General > User > UEx > Search Space > Config".



Settings:

Common Search Space

Configures the Type 1 (paging) and Type 2 (random access) common search space.

The common search space defines the MPDCCH candidates that the UE has to monitor.

Max. Repetitions of MPDCCH (Rmax) for Type 1 common search space ← Common Search Space

Sets the maximum number MPDCCH is repeated R_{Max} (`mpdcch-NumRepetitionPaging-r13`).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:MPD1` on page 433

Max. Repetitions of MPDCCH (Rmax) for Type 2 common search space ← Common Search Space

Sets the maximum number MPDCCH is repeated R_{Max} (`mpdcch-NumRepetitions-RA`).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:MPD2` on page 433

Search Space Start Subframe ← Common Search Space

Sets the start SF for the random access common search space (`mpdcch-StartSF-CSS-RA`).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:STSF` on page 433

Max. Repetitions of PDSCH for CE Mode A/B ← Common Search Space

Sets the cell-specific higher-layer parameter `pdsch-maxNumRepetitionCEmodeA`/`pdsch-maxNumRepetitionCEmodeB` that defines the PDSCH subframe assignment, if the MPDCCH with DCI format 6-1A/6-1B/6-2 is detected.

- DCI format 6-1A: `pdsch-maxNumRepetitionCEmodeA` = {Unconfigured, 16, 32}
- DCI format 6-1B/6-2: `pdsch-maxNumRepetitionCEmodeB` = {Unconfigured, 192, 256, ..., 2048}

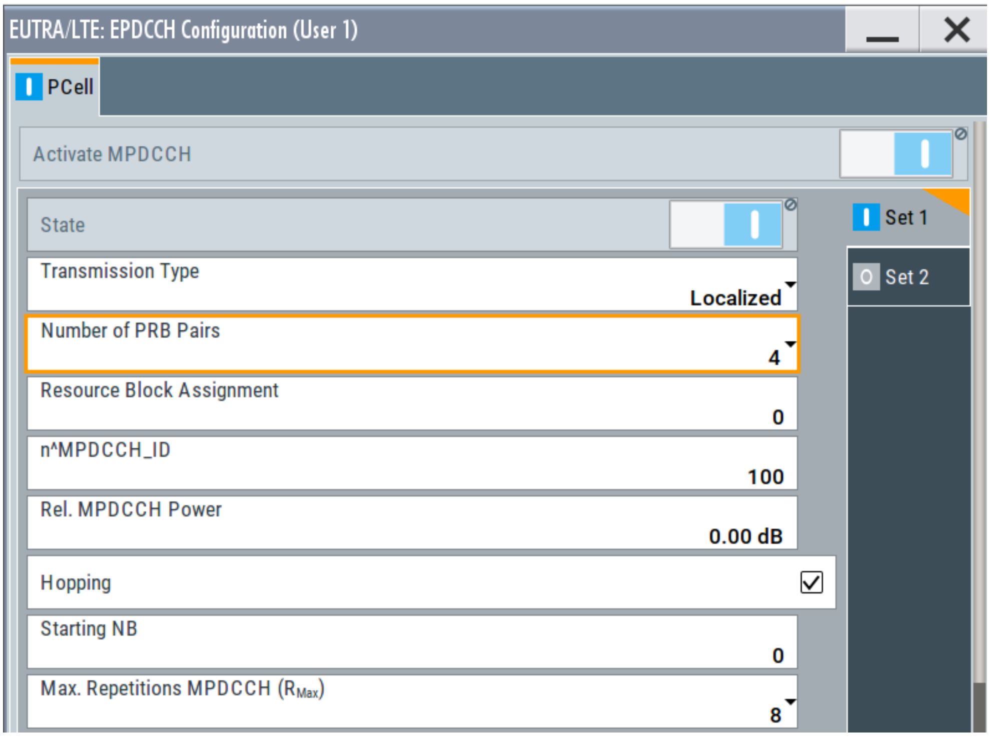
These parameters together with the DCI field PDSCH repetition number define the PDSCH repetitions, see "Repetition of PDSCH not carrying SIB1-BR" on page 21.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:PDSA` on page 433
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:PDSB` on page 434

3.10.2 MPDCCH configuration

Access:

1. Select "Frame Configuration > General > User".
2. Select "User > 3GPP Release = eMTC CE: A/B > MPDCCH > Config".



3. To activate the secon state, select "Set 2 > State > On".
4. Select "Frame Configuration > eMTC > Allocation" to observe the MPDCCH allocation.

5. Configure the *cell-specific antenna port mapping* and *user-specific antenna port mapping* for the MPDCCH transmission.
   See "To access the antenna port mapping settings" on page 154.

Settings:

Activate EPDCCH
Option: R&S SMW-K115

The EPDCCH and EPDCCH set 1 are always active.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:STATe` on page 482

Set 1/2 State
Option: R&S SMW-K115

The EPDCCH and EPDCCH set 1 are always active.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STATe` on page 482

Transmission Type
Select whether localized or distributed EPDCCH transmission is used.

"Localized" Subsequent EREGs are allocated within the same PRB as long as there are physical resources available.
Localization transmission is useful if the channel conditions are known, so that the scheduling and MIMO precoding can be optimized.

"Distributed" EREGs are allocated in the separate (subsequent) PRBs.
This transmission type applies frequency diversity and distributed the REGs among the available channel bandwidth. Distributed transmission is used if the channel conditions are unknown.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:TTYP` on page 482

Number of PRB Pairs
Sets the number of physical resource block (PRB) pairs.

Per PRB pair, there are 16 enhanced resource element groups (EREG), that are numbered from 0 to 15.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:PRBS on page 483

Resource Block Assignment
Shifts the EPDCCH allocations in the frequency domain and defines the resource blocks used for the EPDCCH transmission.

The EPDCCH PRBs are distributed among the available resource blocks according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:RBA on page 483

N^EPDCCH_ID
Unlike the PDCCH that is a cell-specific control channel, the EPDCCH is a user-specific control channel.

This parameter sets the user-specific identifier $n^{EPDCCH}_{ID,m}$ used to initialize the DMRS scrambling sequences of the EPDCCH sets.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:NID on page 483

Relative EPDCCH Power
Sets the power of the EPDCCH allocations.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:POWer on page 484

Hopping
Enables MPDCCH hopping.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:HOPPing on page 484

Starting NB
Sets the first narrowbands in which MPDCCH is allocated.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STNB on page 485

Max. Repetitions MPDCCH (Rmax)
Sets the maximum number the MPDCCH is repeated.

The actual number of repetitions is calculated as function ofhte repetition level, as described in "MPDCCH repetition number" on page 26.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:REPMpdcch on page 485

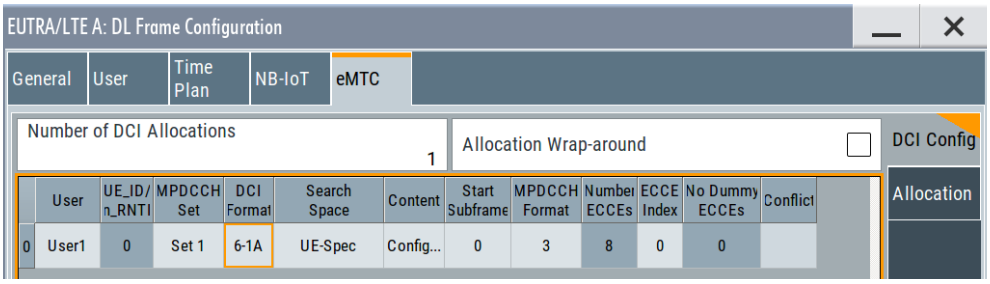
Search Space Start Subframe
Sets the first subframe of the search space.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STSF on page 485

3.10.3 eMTC DCI configuration

Access:

1. Select "General > Link Direction > Downlink".
2. Enable at least one eMTC UE, i.e. select "Frame Configuration > General > User > User 1" > **"3GPP Release = eMTC CE: A/B"**.
3. Select "Frame Configuration > General > eMTC > DCI Configuration".
4. Select "Number of DCI Allocations = 1".
5. Configure the DCI allocations, e.g. select "User > User 1", "DCI Format = 6-1A" and "Start Subframe = 0".



6. For each DCI, select "Content > Config".

Settings:

Number of DCI Allocations

Sets up to 100 configurable DCIs.

There is one table row per DCI in the DCI table.

The default "Number of DCI Allocations" value depends on the availability of eMTC UEs:

- 0: if all "User" are set to NB-IoT.
  Changing the value to "Number of DCI Allocations = 1", enables you to configure P-RNTI or RA-RNTI DCIs.
- 1: if there is at least one "User" with "3GPP Release = eMTC CE: A/B".

Set "Number of DCI Allocations = 0" to disable the DCI-based eMTC configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:NALLoc on page 455

Allocation Wrap-around

An MPDCCH can schedule a PDSCH outside of the selected "ARB Sequence Length".

Enable this parameter to ensure a consistent signal, where the PDSCH allocations are relocated at the beginning of the ARB sequence.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:AWARound on page 455

User

Selects the user the DCI is dedicated to. The available DCI formats depend on the value of this parameter.

"User x" Selects one of the four users with "3GPP Release = eMTC CE: A/B", as configured in the "Frame Configuration > General > User" dialog.

"P-RNTI/RA-RNTI"
A group of users is selected.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:USER on page 456

UE_ID/n_RNTI

Displays the UE_ID of the "User x" or the n_RNTI for the selected DCI.

The UE_ID is set with the parameter "Frame Configuration > General > User > User x" > UE ID/n_RNTI

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:UEID? on page 456

MPDCCH Set
Selects the MPDCCH set by which the DCI is carried.

To enable the second set for "User = User x":

- Select "Frame Configuration > General > User > User x > EPDCCH/MPDCCH > Config"
- Set "Set 2 > State > On".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MPDCchset on page 456

DCI Format
Sets the DCI format for the selected allocation.

The downlink control information (DCI) is a message used to control the physical layer resource allocation in the UL and DL direction. It carries scheduling information and uplink power control commands.

Depending on the DCI message usage, they are categorized into the following formats: 3/3A, 6-0A/6-0B, 6-1A/6-1B, 6-2.

See Table 2-10.

To configure the parameters per DCI format, select "Content > Config".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:FMT on page 456

Search Space
Defines the search space for the selected DCI.

The search space defines the MPDCCH candidates that the UE has to monitor. The UE can decode only the control information on an MPDCCH that is transmitted over ECCEs within the search space the UE monitors.

"UE-spec" Non-common DCIs are mapped to the UE-specific search space. Each UE has multiple UE-specific search spaces, determined as a function of its UE ID.

"Type 0 Common/Type 1 Common/Type 2 Common"
The DCI is mapped to the common search space, where:

- Type 1 common search space is used for paging
- Type 2 for random access
- Type 0 common search space is available for "User x > 3GPP Release = eMTC CE-Mode A".

A common search space is used to address all or a group of UEs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SSP on page 457

DCI Content Configuration
Configure the parameters per DCI format.

The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification.

The resulting Transport Block Size, Repetitions of MPDCCH, Repetitions of PDSCH, PDSCH Hopping and Starting Redundancy Version values are displayed.

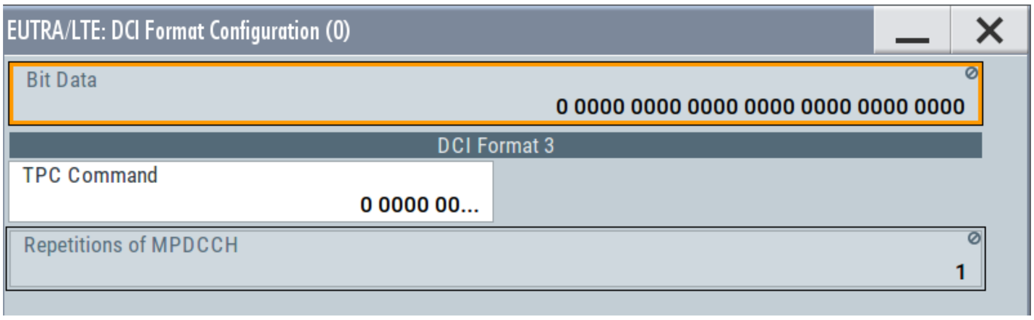
Bit Data ← DCI Content Configuration
Displays the resulting bit data as selected with the DCI format parameters.

The first bit in DCI formats pairs 6-0A and 6-1A, and 6-0B and 6-1B is used as flag to distinguish between the two formats in a pair. It is set as follows:
- DCI format 6-0A/6-0B: First bit = 0
- DCI format 6-1A/6-1B: First bit = 1

Mapping of the information bits is according to TS 36.212.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:BITS?` on page 458

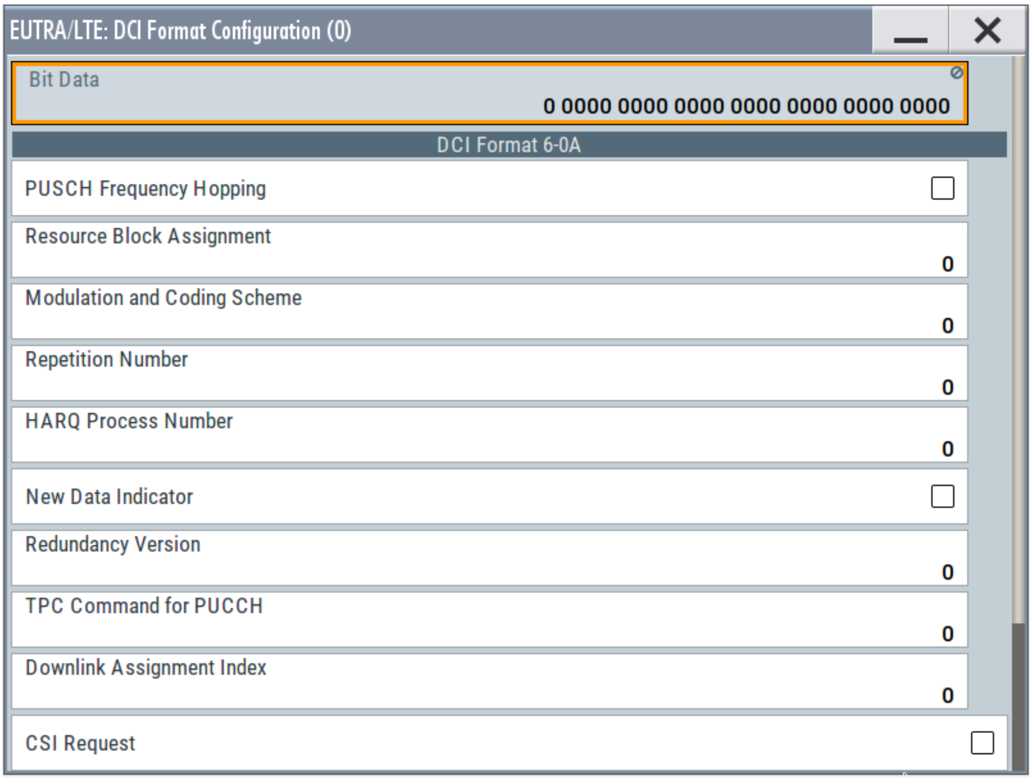
DCI Format 3/3A ← DCI Content Configuration
The DCI Format 3/3A is used for the transmission of TPC Commands for MPUCCH and PUSCH with 2-bit and a single bit power adjustment respectively.



The "TPC Command" is set as a bit pattern.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TCMD` on page 460

DCI Format 6-0A/6-0B ← DCI Content Configuration
The DCI formats 6-0A and 6-0B are used for scheduling of PUSCH in one UL cell, where the formats are used in CE Mode A and CE Mode B respectively.



DCI format 6-0A and 6-0B transmit the information listed in Table 3-13.

Among other, these DCIs carry information on:

- "PUSCH Frequency Hopping": sets the hopping dynamically on a per transmission basis.
  This filed has higher priority as the cell-specific hopping configuration, see Chapter 3.18.1, "Cell-specific eMTC PUSCH settings", on page 193.
- "Repetition Number": sets the PUSCH repetition level (n_1 to n_4 or n_8 in DCI formats 6-0A and 6-0B)
- "DCI Subframe Repetition Number": sets the MPDCCH repetition level (r_1 to r_4), see "MPDCCH repetition number" on page 26.

Table 3-13: DCI format 6-0A and 6-0B control information fields

Control Information Field	SCPI command	Dependencies
"PUSCH Frequency Hopping"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PFRHopp on page 461	DCI Format 6-0A
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBA on page 461	See Table 3-14.
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MCS on page 461	
"Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NREP on page 462	"DCI Format 6-0A": 0 to 3 "DCI Format 6-0B": 0 to 7

Control Information Field	SCPI command	Dependencies
"HARQ Process Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:HARQ on page 462	"DCI Format 6-0A": 0 to 7 "DCI Format 6-0B": 0 to 1
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NDINd on page 462	
"Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RVER on page 462	DCI Format 6-0A
"TPC Command for Scheduled PUSCH"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TPCPusch on page 463	DCI Format 6-0A
"UL Index"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:ULINdex on page 463	DCI Format 6-0A TDD mode and "UL/DL Configuration = 0"
"Downlink Assignment Index (DAI)"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:DAINdex on page 463	DCI Format 6-0A TDD mode and "UL/DL Configuration = 1 to 6"
"CSI Request"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CSIRequest on page 464	DCI Format 6-0A
"SRS Request"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SRSRequest on page 464	DCI Format 6-0A
"DCI Subframe Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SFRNumber on page 464	For "MPDCCH > Max. Repetitions for MPDCCH Rmax ≥ 2"

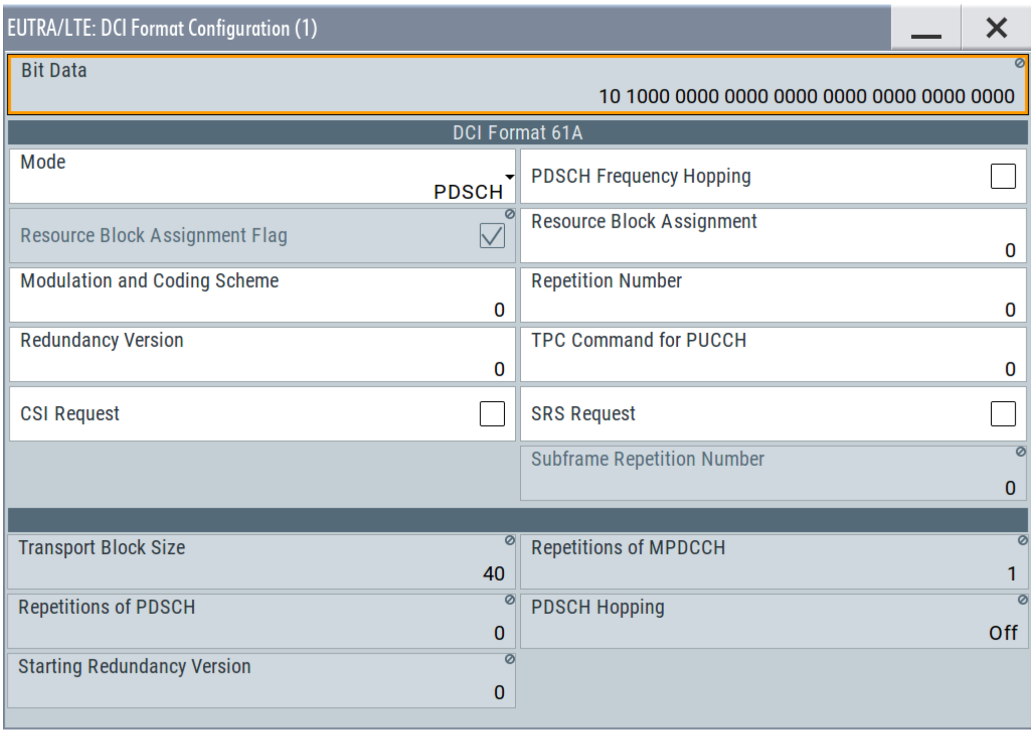
Table 3-14: Control information field Resource Block Assignment value range

Channel Bandwidth	DCI Format 6-0A	DCI Format 6-0B
1.4 MHz	0 to 31	0 to 7
3 MHz	0 to 63	0 to 15
5 MHz	0 to 127	0 to 31
10 MHz	0 to 255	0 to 63
15/20 MHz	0 to 511	0 to 127

In certain cases defined in TS 36.212, zeros are appended to the DCI format 6-0B until its payload size is equal to the size of DCI format 6-0A.

DCI Format 6-1A/6-1B ← DCI Content Configuration

DCI formats 6-1A and 6-1B are used for the compact scheduling of one PDSCH codeword in one cell and random access procedure initiated by a PDCCH order. The two formats are used in CE Mode A and CE Mode B respectively.



DCI format 6-1A and 6-1B transmit the information listed in Table 3-15 and Table 3-16, for PDSCH or PRACH mode respectively.

In certain cases defined in TS 36.212, zeros are appended to:
- DCI format 6-1A until its payload size is equal to the size of DCI format 6-0A
- DCI format 6-1B until its payload size is equal to the size of DCI format 6-0B.

Among other, these DCIs carry information on:
- "PDSCH Frequency Hopping": sets the hopping dynamically on a per transmission basis.
  This filed has higher priority as the cell-specific hopping configuration.
- "Repetition Number": sets the PDSCH repetition level (n_1 to n_4 or n_8 in DCI formats 6-0A and 6-0B), see "Repetition of PDSCH not carrying SIB1-BR" on page 21.
- "DCI Subframe Repetition Number": sets the MPDCCH repetition level (r_1 to r_4), see "MPDCCH repetition number" on page 26.
- "Resource Block Assignment": defines the PDSCH Start NB and No. RB

Table 3-15: Control information fields in Mode = PDSCH

Control Information Field	SCPI command	Dependencies
"Mode"	`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:UEMode` on page 464	
"Frequency Hopping"	`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PFRHopp` on page 461	DCI Format 6-1A

Control Information Field	SCPI command	Dependencies
"Resource Block Assignment Flag"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBAF? on page 461	Option: R&S SMW-K143 DCI Format 6-1A "Channel Bandwidth = 20 MHz" and "Wideband Config = 20 MHz"
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBA on page 461	See Table 3-17.
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MCS on page 461	• DCI Format 6-1A: 0 to 15 • DCI Format 6-1B: 0 to 10
"Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NREP on page 462	
"HARQ Process Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:HARQ on page 462	"User x" • FDD: 0 to 7 • TDD: 0 to 15
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NDINd on page 462	"User x"
"Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RVER on page 462	DCI Format 6-1A
"TPC Command for PUCCH"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TPCPusch on page 463	DCI Format 6-1A
"Downlink Assignment Index (DAI)"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:DAINdex on page 463	DCI Format 6-1A "User x" TDD mode and "UL/DL Configuration = 1 to 6"
"Antenna Ports and Scrambling Identity"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:APSI on page 465	DCI Format 6-1A "User x" with "Tx Mode = TM9" and "Search Space = UE-specific"
"CSI Request"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CSIRequest on page 464	DCI Format 6-1A
"SRS Request"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SRSRequest on page 464	DCI Format 6-1A
"TPMI Information for Precoding"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TPMPrec on page 465	DCI Format 6-1A "User x" with "Tx Mode = TM6" and "Search Space = UE-specific"

Control Information Field	SCPI command	Dependencies
"PMI Confirmation for Precoding"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PMIConfirm on page 465	DCI Format 6-1A "User x" with "Tx Mode = TM6" and "Search Space = UE-specific"
"HARQ-ACK Ressource Offset"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:HRESoffset on page 465	"User x"
"DCI Subframe Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SFRNumber on page 464	For "MPDCCH > Max. Repetitions for MPDCCH Rmax ≥ 2"

Table 3-16: Control information fields in Mode = PRACH

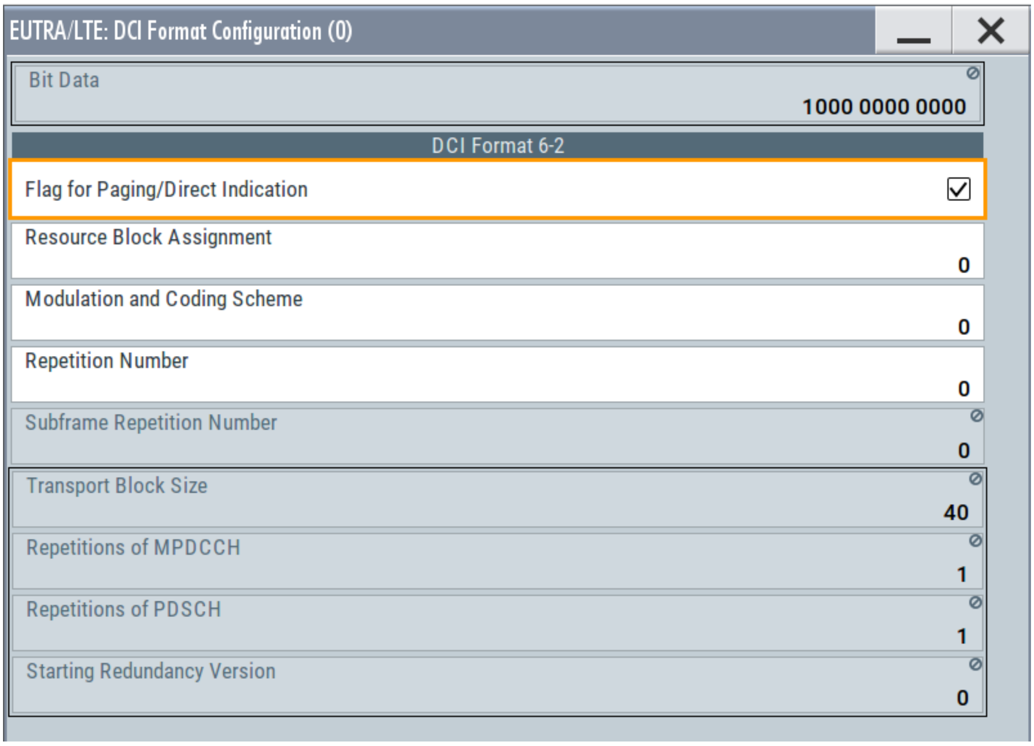
Control Information Field	SCPI command	Dependencies
"Mode"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:UEMode on page 464	
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBA on page 461	DCI Format 6-1A See Table 3-17.
"Preamble Index"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAPreamble on page 466	
"PRACH Mask Index"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAMask on page 466	
"Starting CE Level"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAStart on page 466	

Table 3-17: Control information field Resource Block Assignment value range

Channel Bandwidth	DCI Format 6-1A PDSCH and PRACH modes	DCI Format 6-1B
1.4 MHz	0 to 31	0 to 1
3 MHz	0 to 63	0 to 3
5 MHz	0 to 127	0 to 7
10 MHz	0 to 255	0 to 15
15/20 MHz	0 to 511	0 to 31

DCI Format 6-2 ← DCI Content Configuration

The DCI format 6-2 is used for paging and direct indication. It is available for "User = P-RNTI".



DCI format 6-2 transmits the following information.

Control Information Field	SCPI command	Dependencies
"Flag for Paging/ Direct Indication"	`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PAGNg` on page 466	
"Direct Indication Information"	`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:DIINfo` on page 467	
"Modulation and Coding Scheme"	`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MCS` on page 461	
"Resource Block Assignment"	`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBA` on page 461	Value range depends on the "Channel Bandwidth": • 1.4 MHz: 0 • 3 MHz: 0 to 1 • 5 MHz: 0 to 3 • 10 MHz: 0 to 7 • 15 MHz: 0 to 12 • 20 MHz: 0 to 15

Control Information Field	SCPI command	Dependencies
"Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NREP on page 462	See "Repetition of PDSCH not carrying SIB1-BR" on page 21.
"DCI Subframe Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SFRNumber on page 464	For "MPDCCH > Max. Repetitions for MPDCCH Rmax ≥ 2"

Transport Block Size ← DCI Content Configuration
Indicates the TBS, calculated for the selected "Modulation and Coding Scheme" and "Resource Assignment Field".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TBS? on page 459

Repetitions of MPDCCH ← DCI Content Configuration
Displays the resulting number of MPDCCH repetitions, calculated for the selected "DCI Subframe Repetition Number".

See "MPDCCH repetition number" on page 26.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:REPMpdcch?
on page 459

Repetitions of PDSCH ← DCI Content Configuration
Displays the resulting number of PDSCH repetitions, calculated from the selected "Repetition Number".

See "Repetition of PDSCH not carrying SIB1-BR" on page 21.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:REPPdsch?
on page 460

PDSCH Hopping ← DCI Content Configuration
Indicates if PDSCH hopping is enabled or not, as set with the DCI form 6-1A/B field "PDSCH Frequency Hopping".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PDSHopping?
on page 460

Starting Redundancy Version ← DCI Content Configuration
Indicates the starting RV, calculated from the value of the "Redundancy Version" field.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:STRV? on page 460

Start Sufframe
Sets the next valid starting subframe for the particular MPDCCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:STSFrame on page 457

MPDCCH Format
Selects one of the five MPDCCH formats, where the available values depend on the "Search Space":
- "Search Space = UE-spec": MPDCCH formats 0 to 5
- "Search Space = Type 0 common": MPDCCH formats 2, 3 and 5
- "Search Space = Type 1 common": MPDCCH format 5
- "Search Space = Type 2 common": MPDCCH formats 2, 3 and 5

MPDCCH format defines the "Number ECCEs", see Table 2-6.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PDCCh on page 457

Number ECCEs
MPDCCH is transmitted on an aggregation of one or two consecutive control channel elements (ECCE).

The value is selected automatically, depending on the selected MPDCCH format, see Table 2-6.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CCES? on page 458

ECCE Index
For UE-specific search space, sets the ECCE start index.

The available ECCEs depend on the selected MPDCCH Format.

ECCE index	Occupied subcarriers per subframe
0	0 to 5
1	6 to 11

See also Figure 2-14.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:IDCCe on page 458

No. Dummy ECCEs
Indicates the number of dummy ECCEs that are appended to the corresponding MPDCCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NDCCes? on page 458

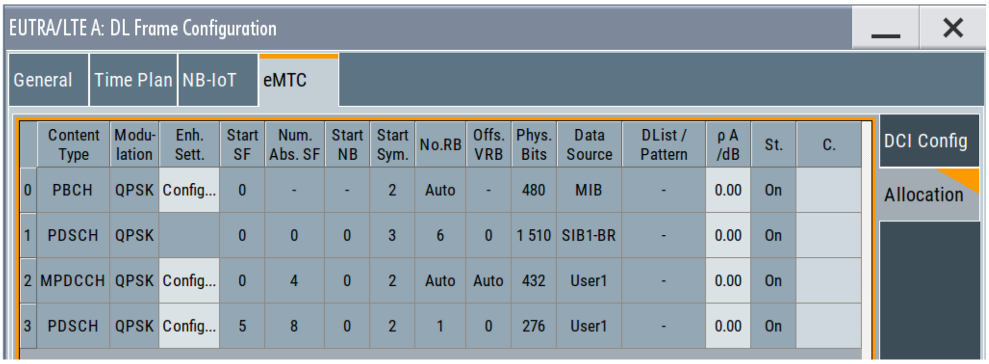
Conflict
Indicates a conflict between two DCI formats, for example if they have the same ECCE index and start subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CONFlict?
on page 459

3.10.4 eMTC allocations (PBCH, MPDCCH, PDSCH)

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > General > eMTC > Allocation".
3. Select "ρ A" to boost the power of a particular allocation.



The PBCH allocation and the SIB1-BR transmissions are configured automatically, but the PBCH allocation can be changed.
The PDSCH and MPDCCH allocations are configured according to the current DCI configuration, see Chapter 3.10.3, "eMTC DCI configuration", on page 130. Merely some of the PDSCH precoding settings can be adjusted and scrambling and channel coding disabled.

Settings:

Allocation number
Consecutive number of the allocation.

Content Type
Indicates the channel type.

Allocation number	Channel	Description
0	PBCH	Broadcast channel
1	• PDSCH SIB1-BR • MPDCCH	• If PBCH is scheduled and Scheduling Info SIB1-RB ≥ 1, one PDSCH that carries the SIB1-BR message is automatically configured Otherwise, MPDCCH is configured
> 1	• MPDCCH • MPDCCH and PDSCH	Allocated automatically, depending on the current DCI configuration, Chapter 3.10.3, "eMTC DCI configuration", on page 130: • One MPDCCH per P-RNTI, RA-RNTI and DCI of an active eMTC user, see "Configure User" > 3GPP Release • One pair per: – DCI format 6-1A/B used for PDSCH scheduling of an active eMTC user or RA-RNTI – DCI format 6-2 with "Flag for Paging/Direct Indication = On".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CONType? on page 467

Modulation

Indicates the modulation per channel.

eMTC allocations are QPSK modulated, but the PDSCH allocations not carrying SIB1-BR can also use 16QAM. The modulation scheme in the latter case is defined by the DCI filed "Modulation and Coding Scheme".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:MODulation? on page 468

Enhanced Settings > Config

Accesses the precoding, scrambling and channel coding settings of the selected channel, see Chapter 3.10.6, "PDSCH channel coding and scrambling", on page 149.

To configure the MPDCCH settings, select "Frame Configuration > General > User > User x > 3GPP Release = CE Mode A/B > EPDCCH/MPDCCH > Config".

Start SF

Indicates the first subframe where the channel can be allocated.

PBCH and PDSCH carrying SIB1-BR always start in the first subframe.

The start subframe of a PDSCH allocation associated with an MPDCCH transmission is calculated as follows:

$\text{Start SF}_{PDSCH} = \text{Start SF}_{MPDCCH} + N_{abs}^{MPDCCH} + 2$

Where N_{abs}^{MPDCCH} depends on the N_{rep}^{MPDCCH} and the valid eMTC DL subframes, see:

- "Repetitions of MPDCCH" on page 140
- "SF State" on page 119

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STSFrame? on page 468

Num. Abs. SF
Indicates the number of absolute subframes, i.e. number of subframes the allocation spans.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:ABSFrames?` on page 468

Start NB
Indicates the first narrowband where the channel can be allocated.

- For MPDCCH, the value resembles the one set with the parameter "User > MPDCCH Config" > Starting NB
- For PDSCH not carrying SIB1-BR, the value is determined by the DCI field "3GPP Release = CE Mode A".
- The scheduling and hopping pattern of the PDSCH carrying SIB1-BR incl. all related parameter is performed automatically, as defined in TS 36.211.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STNB?` on page 469

Start Symbol
Indicates the first symbol where the channel can be allocated.

The PDSCH carrying SIB1-BR starts always at symbol#3. The start symbol for all other allocations resembles the value set with "General Settings > eMTC > Bitmap" > Starting Symbol.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STSYmbol?` on page 469

No. RB
Indicates used number of resource blocks and thus the allocation's bandwidth.

For PDSCH not carrying SIB1-BR, the value is determined by the DCI field "3GPP Release = CE Mode A".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:NORB?` on page 469

Offset VRB
Values different than 0 indicate resource block shift within the narrowbands.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:OVRB?` on page 469

Phys. Bits
Displays the allocation size in bits. The value is calculated similar to the physical bits value in NB-IoT, see "Phys. Bits" on page 107.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PHYSbits?` on page 470

Data Source
Indicates the data source depending on the "Content Type".

The data source is configurable for:
- PBCH with "PBCH > Config > Channel Coding > MIB (including SFN) = Off"
- PDSCH SIB1-BR allocation
- PDSCH allocations that are configured for "eMTC > DCI Config > User = P-RNTI or RA-RNTI"

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:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:DATA` on page 470
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:DSELect` on page 470
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PATTern` on page 471

ρ A

Sets the power P_{MPDCCH} or P_{PDSCH} (ρ A) of the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:POWer` on page 471

State

Indicates that the allocation is active.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STATe?` on page 471

Conflict

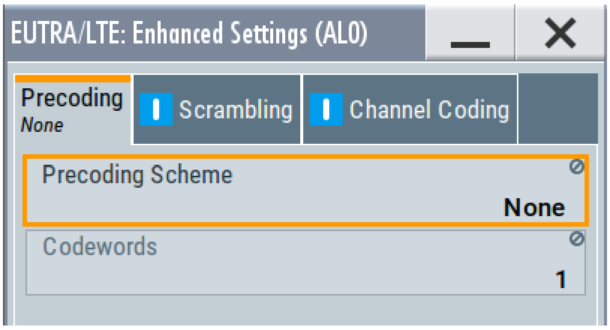
Indicates a conflict between allocations.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CONFlict?` on page 472

3.10.5 PBCH channel coding and SIB-BR configuration

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > eMTC > Allocation".
3. Select "PBCH > Enchanced Settings > Config".



PBCH can be generated in one of the following modes:

- Without channel coding, if "Channel Coding > State > Off"
  Dummy data or user-defined data lists are used.
- Channel coding with arbitrary transport block content
  If channel coding is activated ("Channel Coding > State > On") and parameter "MIB (including SFN) > Off"
- Channel coding with real data (MIB) including SFN
  If channel coding and "MIB (including SFN)" are activated
  This mode is required for the generation of SIB1-BR message.

Settings:

Precoding
Comprises the precoding settings.

Most of the parameters are set automatically, depending on the selected:
- [Tx Mode] of the corresponding UE ("Frame Configuration > UEx > Tx Mode")
- Number of Tx antennas ("General DL Settings > Antenna Ports > Global MIMO Configuration"

See also Table 2-11.

Precoding Scheme ← Precoding
Selects the precoding scheme.

"None" Disables precoding.

"Tx Diversity"
If "Global MIMO Configuration ≥ 2 Tx Antennas", select precoding for transmit diversity.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:SCHeme`
on page 473

Number of Layers ← Precoding
Displays the number of layers for the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:NOLayers?`
on page 473

Scrambling
Comprises the scrambling settings.

Scrambling State ← Scrambling
Enables scrambling.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:STATe`
on page 478

UE ID/n_RNTI ← Scrambling
Indicates the user equipment identifier (n_RNTI) or UE ID of the user to which the PDSCH transmission is intended. The displayed "UE ID/n_RNTI" value is used to calculate the scrambling sequence.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:UEID?`
on page 478

Channel Coding
Comprises the channel coding settings. Channel coding state is configurable. All other settings are configured automatically.

Channel Coding State ← Channel Coding
Enables channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:STATe
on page 478

Type Channel Coding ← Channel Coding
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 ← Channel Coding
Indicates the calculated number of physical bits; resembles the information displayed with parameter Phys. Bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PHYSbits? on page 470

MIB (including SFN) ← Channel Coding
Enables transmission of real MIB (master information block) data. The SFN (system frame number) is included as well.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:MIB on page 479

SFN Offset ← Channel Coding
By default, the counting of the SFN (system frame number) starts with 0. This parameter sets a different start SFN value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SOFFset
on page 480

SFN Restart Period ← Channel Coding
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 can take 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.
Depending on the configured "System Configuration > Mode > Advanced", this parameter is not available in all baseband blocks.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SRPeriod
on page 481

Scheduling Info SIB1-RB ← Channel Coding

Sets the parameter `schedulingInfoSIB1-RB` that defines the PDSCH number of repetitions N_{Rep}^{PDSCH}. the resulting value is indicated with PDSCH Repetitions SIB1-RB.

The parameter works like the setting "General DL > eMTC > Bitmap" > Scheduling Info SIB1-BR.

For "Scheduling Info SIB1-RB = 0" there is no PDSCH carrying SIB1-BR scheduled and hence no such allocation in the eMTC allocation table.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SIB` on page 479

PDSCH Repetitions SIB1-RB ← Channel Coding

Indicates the number of PDSCH repetitions N_{Rep}^{PDSCH}, as defined with the parameter Scheduling Info SIB1-RB.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:RSIB?`
on page 480

MIB Spare Bits ← Channel Coding

Sets the 5 spare bits in the PBCH transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:MSPare`
on page 480

Transport Block Size/Payload (DL) ← Channel Coding

Displays the size of the transport block/payload in bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:TBSize?`
on page 478

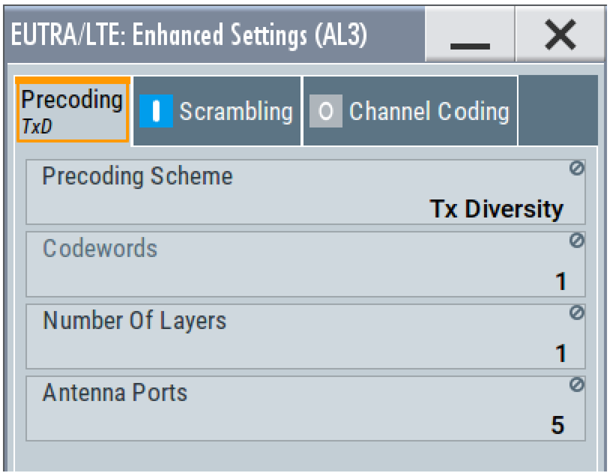
3.10.6 PDSCH channel coding and scrambling

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > General > eMTC > Allocation".
3. Select "PDSCH > Enchanced Settings > Config".

   The displayed settings depends on the:
   - Number of Tx antennas ("General DL Settings > Antenna Ports > Global MIMO Configuration")
   - "Tx Mode" of the corresponding UE.

   See also Table 2-11.



Settings:

Precoding

Comprises the precoding settings.

Most of the parameters are set automatically, depending on the selected:
- "Tx Mode" of the corresponding UE ("Frame Configuration > UEx > Tx Mode")
- Number of Tx antennas ("General DL Settings > Antenna Ports > Global MIMO Configuration"

See also Table 2-11.

Precoding Scheme ← Precoding

Indicates the precoding scheme.

"None" Precoding is disabled.

"Spatial Multiplexing/Tx Diversity/Beamforming (UE-spec.RS)"
For "General DL Settings > Antenna Ports > Global MIMO Configuration ≥ 2 Tx Antennas", indicates that precoding for spatial multiplexing, beamforming or transmit diversity is performed according to TS 36.211.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:SCHeme
on page 473

Transmission Scheme ← Precoding
For "Precoding Scheme = Beamforming (UE-spec.RS)", indicates the used transmission scheme.

See Table 2-11.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:TRSCheme?
on page 474

Number of Layers ← Precoding
Displays the number of layers for the selected allocation.

See also Table 2-11.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:NOLayers?
on page 473

Codeword ← Precoding
Displays the number of the codeword and the total number of codewords used for the selected allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CODWords? on page 473

Cyclic Delay Diversity ← Precoding
If "Precoding Scheme = Spatial Multiplexing", sets the CDD for the selected allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:CCD
on page 474

Codebook Index ← Precoding
If "Precoding Scheme = Spatial Multiplexing/Beamforming (UE-spec.RS)", sets the codebook index for the selected allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:CBINdex
on page 474

Antenna Ports ← Precoding
For "Precoding Scheme = Beamforming (UE-spec.RS)", indicates the antenna ports for the current "Transmission Scheme".

The value is selected from the Tx Mode of the corresponding UE and the number of Tx antennas ("General DL Settings > Antenna Ports > Global MIMO Configuration").

See Table 2-11.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP?
on page 475

Scrambling Identity n_SCID ← Precoding
For "Precoding Scheme = Beamforming (UE-spec.RS)", indicates the scrambling identity (as of TS 36.211).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:SCID?
on page 476

Antenna Port Mapping ← Precoding
For "Precoding Scheme = Beamforming (UE-spec.RS)", indicates the way that the logical antenna ports are mapped to the physical TX antennas.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:APM?
on page 476

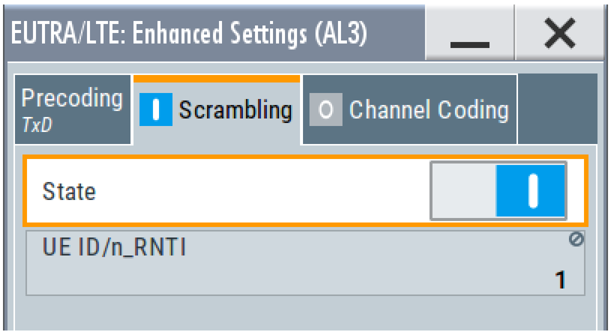
Mapping Coordinates ← Precoding
For "Precoding Scheme = Beamforming (UE-spec.RS)", switches between the "Cartesian" and "Cylindrical" coordinates representation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:DAFormat
on page 476

Mapping Table ← Precoding
Defines the mapping of the antenna ports (AP) to the physical antennas

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP<dir0>:BB<st0>:REAL? on page 476
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP<dir0>:BB<st0>:IMAGinary? on page 477

Scrambling
Comprises the scrambling settings.



Scrambling State ← Scrambling

Enables scrambling.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:STATe`
on page 478

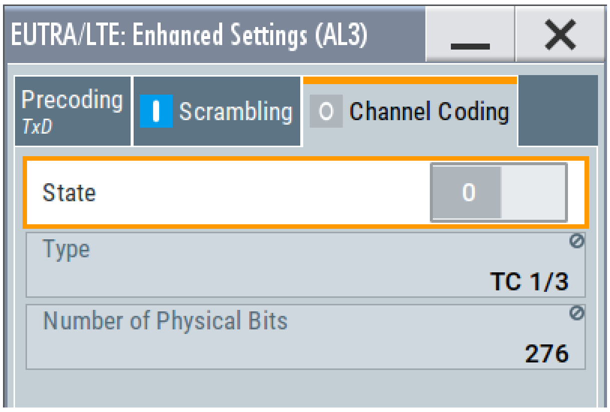
UE ID/n_RNTI ← Scrambling

Indicates the user equipment identifier (n_RNTI) or UE ID of the user to which the PDSCH transmission is intended. The displayed "UE ID/n_RNTI" value is used to calculate the scrambling sequence.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:UEID?`
on page 478

Channel Coding

Comprises the channel coding settings. Channel coding state is configurable. All other settings are configured automatically.



Channel Coding State ← Channel Coding

Enables channel coding.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:STATe`
on page 478

Type Channel Coding ← Channel Coding
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 ← Channel Coding
Indicates the calculated number of physical bits; resembles the information displayed with parameter Phys. Bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PHYSbits? on page 470

Transport Block Size I_{TBS} ← Channel Coding
Displays the resulting transport block size index.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:TBSI on page 479

Transport Block Size/Payload (DL) ← Channel Coding
Displays the size of the transport block/payload in bits, calculated from the selected "Resource Assignment Field" and "Modulation and Coding Scheme".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:TBSize?
on page 478

3.11 eMTC DL antenna port mapping settings

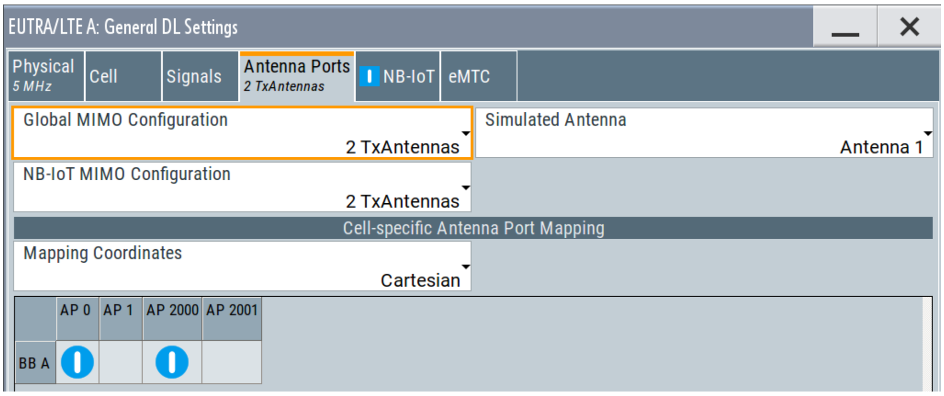
The 3GPP standard defines the different antenna ports for transmission in different transmission modes (TM, also "TxMode"), see "DCI formats, decoding and content" on page 27.

The settings necessary to configure 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".
2. To configure the *cell-specific antenna port mapping*, select "General DL Settings > Antenna Ports".
3. To enable Tx diversity, select MIMO configuration with more than one antenna:
   a) Set, for example, "Global MIMO Configuration = 2 Tx Antennas".
   b) For NB IoT, set **"NB-IoT MIMO Configuration = 2 Tx Antennas"**.

c) To define the antenna port used by the NB-IoT channels and signals, select "AP2000" or "AP2001".

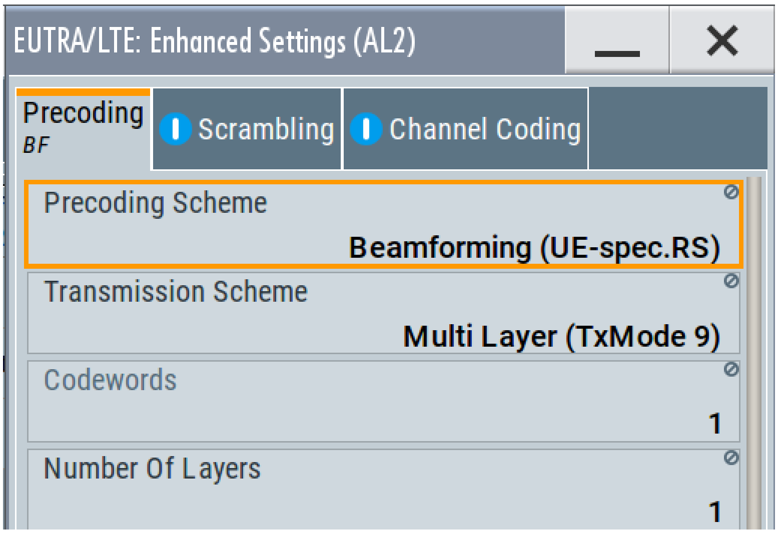


4. To configure the *user-specific antenna port mapping* in **eMTC**:

a) Configure the PDSCH belonging to a particular **eMTC** user, for example a User 1:

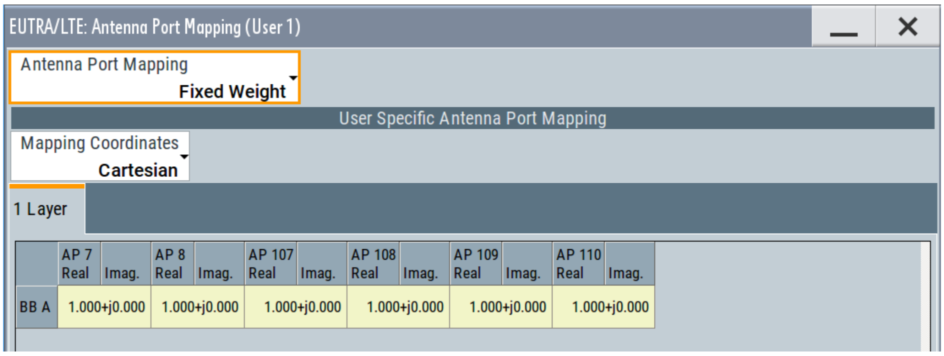
- Select "Frame Configuration > General > User > User 1 > 3GPP Release = eMTC CE: A"
  See Table 2-11.
- Select Tx mode that supports Tx diversity, for example "User 1 > Tx Mode = e.g. Mode 9".
- Configure a DCI that schedules PDSCH.
  For example, set "Frame Configuration > eMTC > DCI Configuration > User 1 > DCI Format = 6-1A".
- For "Tx Mode = Mode 9", the antenna port mapping is defined by a DCI field.
  Select "DCI > Config > Antenna Port(s) and Scrambling Identity = e.g. 1".
- Select "Frame Configuration > eMTC > Allocations > Alloc = PDSCH > Enhanced Settings > Config".
  Observe the configuration in "Precoding > Precoding Scheme".

Precoding scheme and for TM9 also antenna ports and scrambling identity are set automatically depending on the Tx mode and the DCI configuration.



For description of the settings, see Chapter 3.10.6, "PDSCH channel coding and scrambling", on page 149.

b) Select "Frame Configuration > General > User > Antenna Mapping > Config".



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 in the mapping table 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. 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 particular "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.

- Antenna Ports AP0, AP1, AP2 and AP3 are always mapped to the four Tx antennas "BB A", "BB B", "BB C" and "BB D".
- Option: R&S SMW-K115
  Antenna Ports AP7 or AP8 are used for the transmission of eMTC PDSCH
  Antenna Ports AP107 to AP110 are reserved for MPDCCH

Antenna Ports AP2000 and AP2001 are reserved for the NB-IoT reference signal NRS

Cell-Specific Antenna Port Mapping
Comprises settings for mapping the logical antenna ports to the available physical Tx antennas (basebands).

Global MIMO Configuration ← Cell-Specific Antenna Port Mapping
For "Channel Bandwidth ≥ 1.4 MHz", sets the number of transmit antennas of the simulated LTE system. The downlink reference signals structure is set accordingly.

"1 TxAntenna" Single antenna port transmission.

"2 TxAntennas/4 TxAntennas"
Multiple antenna transmissions.
The transmission mode, transmit diversity or spatial multiplexing, is set per **LTE allocation** with the parameter "Precoding Scheme".

"SISO + BF" This mode combines the 1 transmit antenna single input single output (SISO) transmission with beamforming (BF).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration` on page 407

NB-IoT MIMO Configuration ← Cell-Specific Antenna Port Mapping
For "Channel Bandwidth = 200 kHz or ≥ 3 MHz", sets the number of transmit antennas used for the simulated NB-IoT system.

The NRS structure is set automatically.

To use Tx diversity:
- Select "NB-IoT MIMO Configuration = 2 Tx Antennas"
- In the mapping table, define the antenna port: select AP2000 or AP20001

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:NIOT:CONFig` on page 423

Simulated Antenna ← Cell-Specific Antenna Port Mapping
In "System Configuration > Fading/Baseband Configuration > Mode > Standard", defines which antenna is simulated in the current baseband.

The DL reference signals structure is set accordingly.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MIMO:ANTenna on page 408

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 408

Mapping table ← Cell-Specific Antenna Port Mapping
Defines the mapping of the antenna ports (AP) to the physical antennas.

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.

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:CELL:BB<st0> on page 410
[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:REAL on page 408
[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:IMAGinary on page 409

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 490

Constant Codebook Index ← User-Specific Antenna Port Mapping
For "Antenna Port Mapping > Codebook", defines whether the codebook index is set globally or per channel.

"On"	Set the codebook index with the parameters Codebook Index. The values are constant and are used for all allocations of the particular user.
"Off"	Set the codebook index with the parameters "eMTC > Allocations > PDSCH > Enhanced Settings > Config" > Codebook Index.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBCI on page 490

Codebook Index ← User-Specific Antenna Port Mapping
For "Antenna Port Mapping > Codebook" and "Constant Codebook Index > On", sets the codebook index for codebook mapping method.

The codebook index values are constant and used for any PDSCH transmission of the particular eMTC user.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBINdex[<dir>] on page 491

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 491

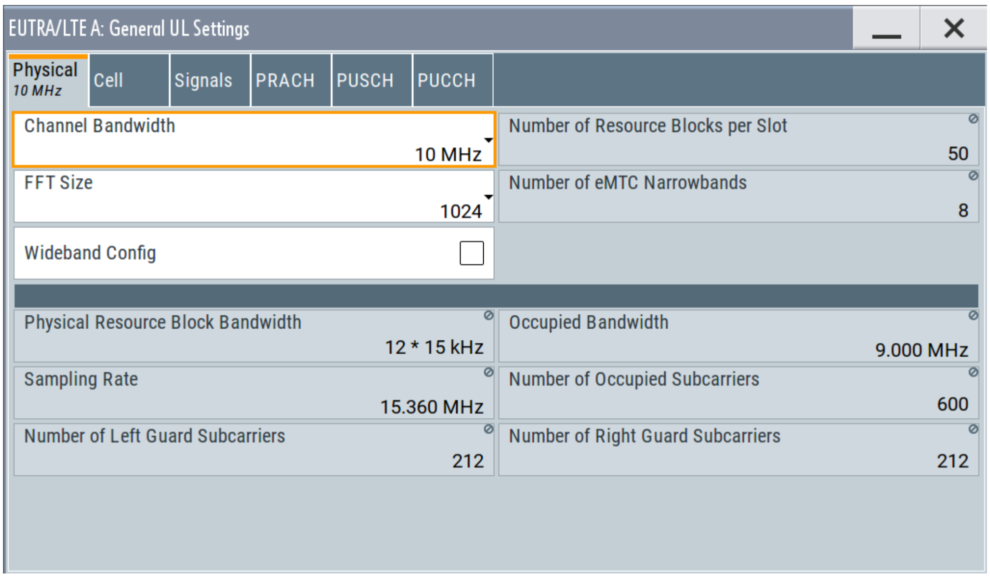
Mapping table ← User-Specific Antenna Port Mapping
Defines the mapping of the antenna ports (AP) to the physical antennas, see "Mapping table" on page 157.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM[:LAYer<user>]:AP<dir0>:BB<st0>:REAL on page 491
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM[:LAYer<user>]:AP<dir0>:BB<st0>:IMAGinary on page 492

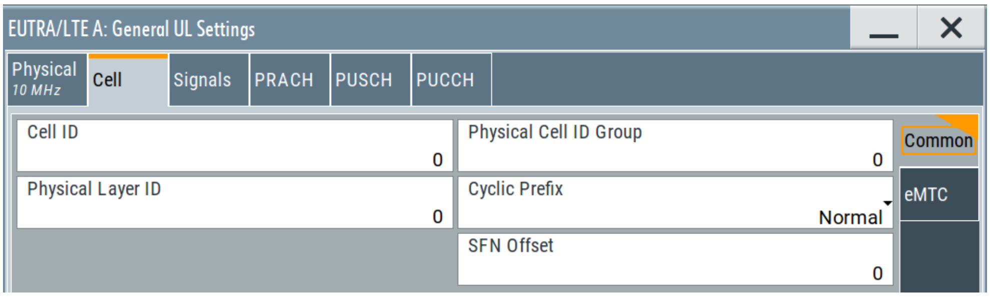
3.12 UL physical layer settings

Access:

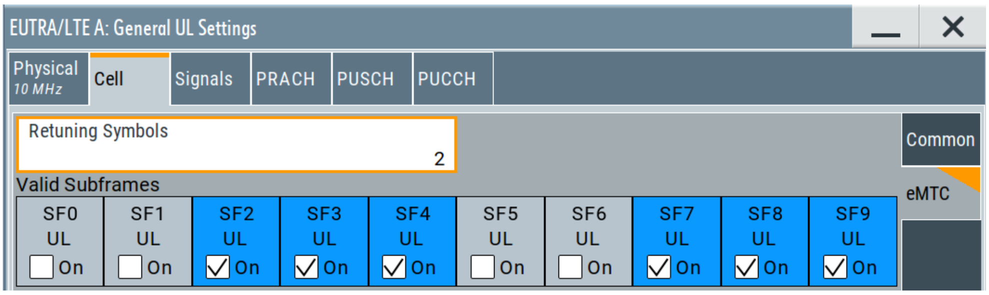
1. In the "General" dialog, select "Mode > eMTC/NB-IoT".
2. Select "Link Direction > Uplink (SC-FDMA)".
3. Select "General Settings > Physical".



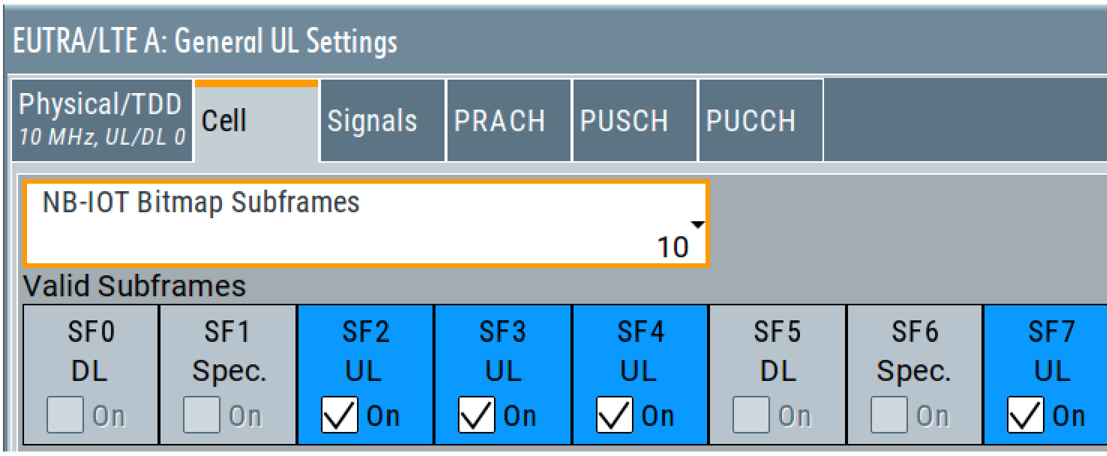
4. Select "General Settings > Cell".



5. Select "Cell > eMTC".



6. To enable NB-IoT transmission:
   a) Select "Duplexing > TDD".
   b) Select "General UL Settings > Physical > TDD UL/DL Configuration = 1 to 5".
   c) Select "Cell > NB-IoT".



7. Use the "Time Plan" to visualize the narrowbands allocation.

   Both IoT approaches eMTC and NB-IoT are designed as extension to the LTE standard. Therefore, their physical settings are extension to the LTE physical settings, too.
   There are merely the additional eMTC-specific parameters "Number of eMTC Narrowbands/Widebands", "Wideband Config" and the per cell definition of UL subframes allowed for eMTC allocations ("Valid Subframes").

Settings:

Physical
Settings:

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

The 3GPP specification defines bandwidth agonistic layer 1 where the channel bandwidth is determined by specifying the desired number of resource blocks. However, the current EUTRA standardization focuses on six bandwidths.

- "1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz"
  Select a predefined channel bandwidth.
  The parameter "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 necessary, adjust the "FFT Size".
  See also Table A-1 for an overview of the cross-reference between the parameters.

If "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected, the "1.4 MHz" bandwidth is supported by LTE and eMTC; the NB-IoT-specific settings are not available for configuration.

- "200 kHz"
  Option: R&S SMW-K115
  This channel bandwidth is **dedicated to NB-IoT**. It is available, if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.
  If channel bandwidth of 200 kHz is used, the LTE or eMTC-specific settings are not available for configuration. Available is only one NB-IoT carrier which works in standalone mode (Mode = "Standalone").

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:BW` on page 493

Number of Resource Blocks Per Slot ← Physical
Indicates the number of used resource blocks for the selected "Channel Bandwidth".

"Channel Bandwidth"	"Number of Resource Blocks Per Slot (UL)"
"1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz"	Read-only value, set automatically as function of the "Channel Bandwidth" and "Physical Resource Block Bandwidth"
"User"	"Channel Bandwidth" depends on the "Number of Resource Blocks Per Slot" and "Physical Resource Blocks Bandwidth"

See also Table A-1.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:NORB` on page 495

FFT Size ← Physical
Sets the FFT (Fast Fourier Transformation) size. The available values depend on the selected "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:FFT` on page 496

Number of eMTC Narrowbands ← Physical
This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It indicates the number of eMTC narrowbands N_{NB} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Narrowbands" = "Number of Resource Blocks" / 6

For more information, see "Narrowbands" on page 19.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NNBands?` on page 494

Number of eMTC Widebands ← Physical
Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" and Wideband Config > "On" is selected.

It indicates the number of eMTC widebands N_{WB} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Widebands" = Number of eMTC Narrowbands / 4

For more information, see "Widebands" on page 20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NWBands? on page 494

Wideband Config ← Physical

Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

If enabled, the available channel bandwidth is split into eMTC widebands, where the resulting number of widebands is indicated by the parameter "Number of eMTC Wide-bands" on page 163.

For more information, see "Widebands" on page 20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:EMTC:WBCFg on page 494

Physical Resource Block Bandwidth ← Physical

Displays the bandwidth of one physical resource block.

Remote command:
n.a.

Occupied Bandwidth ← Physical

Displays the occupied bandwidth, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:OCCBandwidth? on page 496

Sampling Rate ← Physical

Displays the sampling rate, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:SRATe? on page 496

Number Of Occupied Subcarriers ← Physical

Displays the number of occupied subcarriers, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:OCCSubcarriers? on page 497

Number of Left/Right Guard Subcarriers ← Physical
Displays the number of left/right guard subcarriers, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:LGS?` on page 497
`[:SOURce<hw>]:BB:EUTRa:UL:RGS?` on page 497

TDD frame structure ← Physical
Access: Select "Duplexing > TDD".

TDD UL/DL Configuration ← TDD frame structure ← Physical
Sets the UL/DL configuration number and 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 405

TDD Special Subframe Config ← TDD frame structure ← Physical
Sets the special subframe configuration number and together with the parameter "Cyclic Prefix" defines the lengths of the DwPTS, the guard period (GP) 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 404

Number of UpPTS Symbols ← TDD frame structure ← Physical
Option: R&S SMW-K143 (if "Mode = eMTC/NB-IoT")

For TDD Special Subframe Config = 10, sets the number of UpPTS symbols.

In all other configurations, the number of UpPTS symbols is set automatically depending on:

- "TDD UL/DL Configuration" on page 67
- "TDD Special Subframe Config" on page 67.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TDD:UPTS` on page 405

Cell
Settings:

Cell ID ← Cell
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 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

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CID` on page 498

Physical Cell ID Group ← Cell
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 498

Physical Layer ID ← Cell
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 498

Cyclic Prefix ← Cell
Sets the cyclic prefix length for all **LTE** allocations.

The number of the symbols is set automatically.

"Normal"	A slot contains 7 symbols.
"Extended"	A slot contains 6 symbols. NB-IoT allocations cannot be activated.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CPC` on page 498

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

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:DLCPc` on page 499

SFN Offset ← Cell
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.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:SOFFset` on page 499

eMTC Parameters ← Cell
Comprises cell-specific parameters, dedicated to eMTC.

Retuning Symbols ← eMTC Parameters ← Cell
Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It sets the number of symbols used for the transmission between the eMTC narrowbands or widebands.

For details, see "Guard period for narrowband and wideband retunning" on page 19.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:EMTC:RSYMbol` on page 495

Valid Subframes ← eMTC Parameters ← Cell
This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It indicates that a subframe (SF) is used for eMTC transmission. If an SF is set to invalid, the eMTC transmission is postponed during this SF.

The selected subframes influence the scheduling of the eMTC transmissions (see Start Subframe).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:EMTC:VALid:SUBFrame<dir>` on page 495

NB-IoT Parameters ← Cell
Option: R&S SMW-K146

Access: select "Duplexing = TDD" and "General UL Settings > Cell > NB-IoT".

Comprises cell-specific parameters, dedicated to NB-IoT in TDD mode.

NB-IoT Bitmap Subframes ← NB-IoT Parameters ← Cell
Sets the valid subframes configuration over 10ms or 40ms.

The selected subframes influence the scheduling of the NB-IoT transmissions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:NIOT:SUBConfig` on page 495

Valid Subframes ← NB-IoT Parameters ← Cell
This parameter is **dedicated to NB-IoT** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It indicates that a subframe (SF) is used for Nb-IoT transmission. If an SF is set to invalid, the NB-IoT transmission is postponed during this SF.

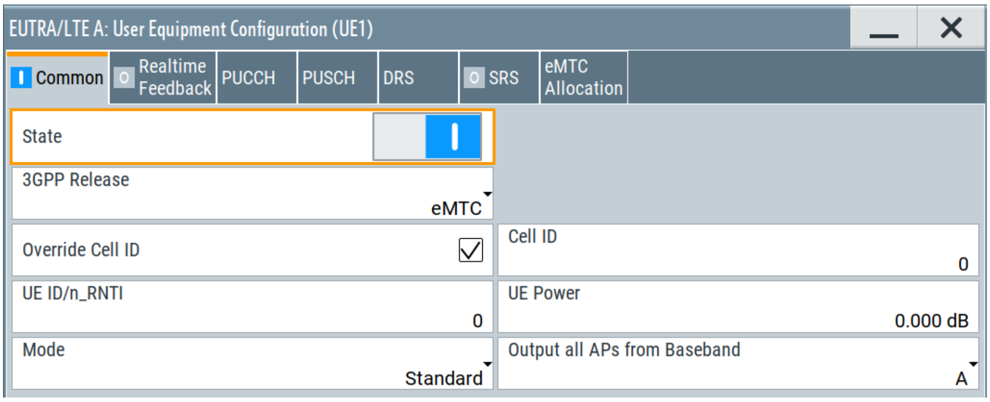
The selected subframes influence the scheduling of the NB-IoT transmissions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:NIOT:VALid:SUBFrame<dir>` on page 495

3.13 UE settings common to all UL channels and signals

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > UEx".



You can configure up to four scheduled user equipments (UE) and freely distribute them over the time.
In this dialog you set the **general settings of a UE**, like the 3GPP it is compliant to or its power.

Settings:

State
Activates or deactivates the user equipment.

Disabling the UE deactivates its allocations: the reference signal, PUSCH (or PUCCH) allocations, and PRACH are not transmitted.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:STATe on page 512

3GPP Release
Sets the 3GPP release version supported by the UE.

Generally, each UE can work in one of the modes: LTE, LTE-A, eMTC or NB-IoT. The available values depend on the installed options and the value of the parameter Mode.

"Mode"	Description	Required options	"3GPP Release"
"LTE"	Standalone LTE	R&S SMW-K55 R&S SMW-K85	"Release 8/9" "LTE-Advanced"
"eMTC/NB-IoT"	Standalone IoT	R&S SMW-K115	"eMTC, NB-IoT"
"LTE/eMTC/NB-IoT"	Mixed LTE and IoT	R&S SMW-K55 and R&S SMW-K115	"Release 8/9, LTE-Advanced, eMTC, NB-IoT"

Several further settings are enabled only for LTE-A or IoT UEs.

In MIMO configurations, the "3GPP Release" is set automatically to LTE-Advanced.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:RELease` on page 513

Override Cell ID

If carrier aggregation is disabled, you can enable this parameter and set an user-defined cell ID for the selected user.

This cell ID value is used in the signal calculation for the particular UE instead of the common cell ID, set with the parameter "General UL Settings > Cell" > Cell ID.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:OCID:STATe` on page 486

Cell ID

If "Override Cell ID" on page 169 > "On", with this parameter you set an user-defined cell ID for the selected user.

This cell ID value is used in the signal calculation of UE instead of the common cell ID, set with the parameter "General UL Settings > Cell" > Cell ID.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CID` on page 486

UE ID/n_RNTI

Sets the radio network temporary identifier (RNTI) of the UE.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:ID` on page 513

UE Power

Sets the power level of the selected UE (P_{UE}).

The P_{UE} determines the power levels of the reference signals (DMRS 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, dB: varies the PUSCH and PUCCH power per eMTC transmission
  Power, dB: varies the NPUSCH (P_{NPUSCH}) power per NB-IoT transmission
- DMRS Power Offset (P_{DMRS_offset}): boosts the reference signals DMRS per UE.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:POWer on page 513

Mode

Selects whether the user equipment is in standard or in PRACH mode.

See:

- Chapter 3.20, "eMTC PRACH settings", on page 210
- Chapter 3.17, "NPRACH settings", on page 186

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:MODE on page 513

Restart Data, A/N, CQI and RI Every Subframe and Codeword/Restart Data and A/N Every Subframe

If activated, the indicated values are restarted at the specified intervals.

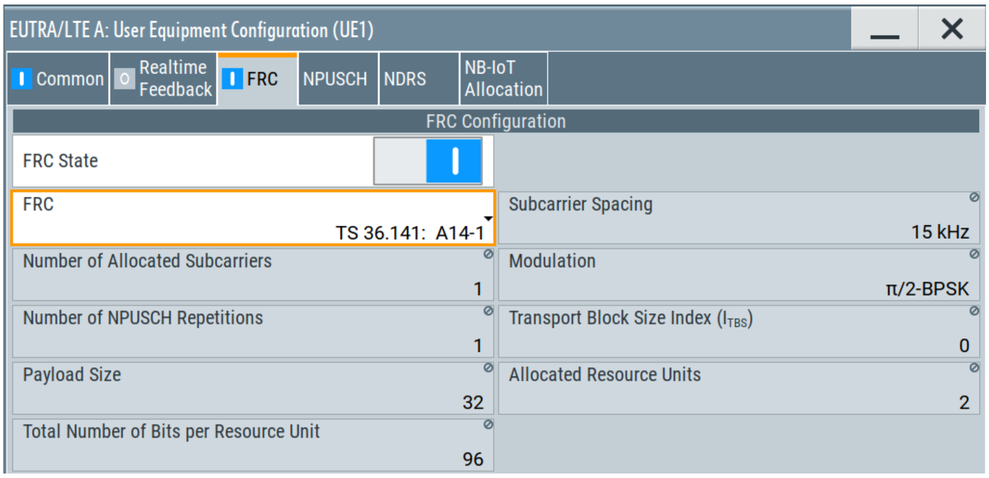
This parameter is always enabled, if real-time feedback is active.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:DACRestart on page 514

3.14 FRC settings

Access:

1. Select "General > UL Frame Configuration > UE x > 3GPP Release = NB-IoT".
2. Select "UE x > FRC".



This dialog provides a quick configuration of the predefined fixed reference channels (FRC) according to:

- TS 36.141, Annex A "Reference measurement channels"
- TS 36.521, Annex A "Measurement channels".

If "FRC" is enabled, several parameters are predefined and their values are displayed as read-only values.

Settings:

FRC State

Enables FRC configuration.

If "FRC" is enabled, several parameters are predefined and their values are displayed as read-only values. To reconfigure any of these parameters, disable the FRC configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:STATe on page 533

FRC

Selects a predefined fixed reference channel according to TS 36.141 or to TS 36.521.

3GPP specifies the FRCs for a specific channel bandwidth (i.e. number of resource blocks). Depending on the current configuration, some FRCs are not listed.

Table 3-18: Supported FRCs from 3GPP TS 36.141

FRC	Description
A14-1 to A14-4	FRC for NB-IOT reference sensitivity (π/2 BPSK, R=1/3)
A15-1 to A15-2	FRC for NB-IoT dynamic range (π/4 QPSK, R=2/3)
A16-1 to A16-5	FRC for NB-IoT NPUSCH format 1

Table 3-19: Supported FRCs from 3GPP TS 36.521-1

FRC (Duplexing = FDD)	FRC (Duplexing = TDD)	Description
A.2.4-1 to A2.4-7	-	Reference channels for category NB1

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:TYPE on page 533

Subcarriers Spacing

Displays the subcarrier spacing.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:SCSPacing? on page 535

Number of Allocated Subcarriers

Displays the number of the allocated subcarriers.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:NOSCarriers? on page 534

Modulation
Displays the modulation for the selected FRC.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:MODulation? on page 534

Number of NPUSCH Repetitions
Displays the number of NPUSCH repetitions.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:NNPRep on page 534

Transport Block Size Index I_{TBS}
Displays the transport block size index I_{TBS}.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:TBSSindex? on page 535

Payload Size
Displays the payload size for the selected FRC.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:PASize? on page 535

Allocated Resource Units
Displays the total number of physical bits available for the NPUSCH allocation per resource unit.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:ALResunits? on page 533

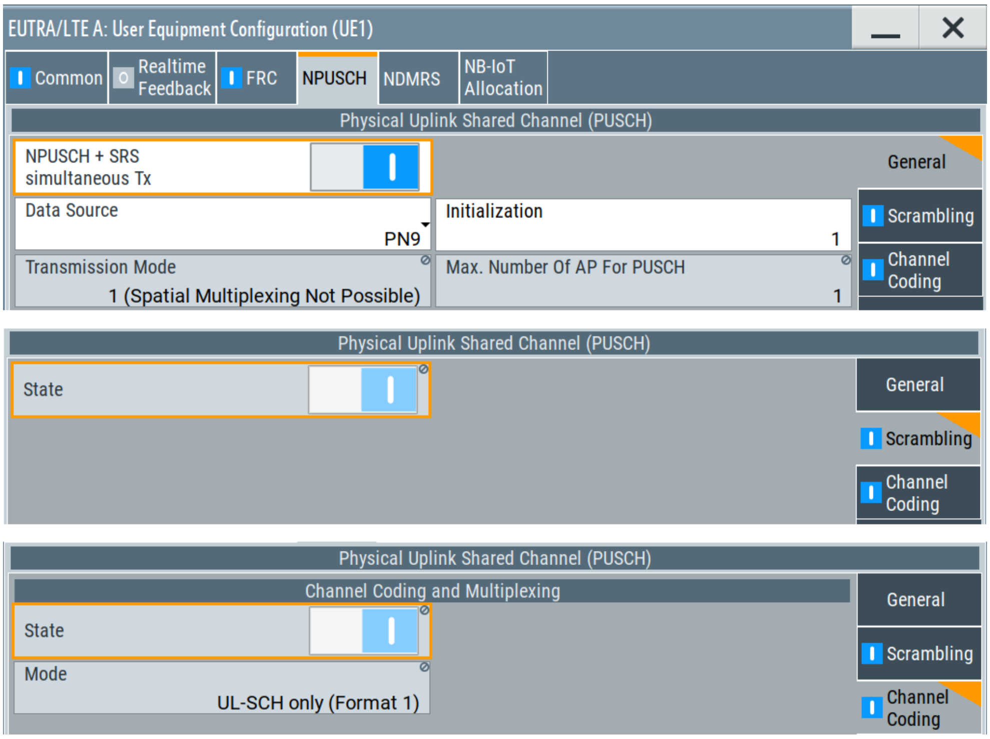
Total Number of Bits per Resource Unit
Displays the total number of physical bits available for the NPUSCH allocation per resource unit.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:BPResunit? on page 534

3.15 NPUSCH settings

Access:

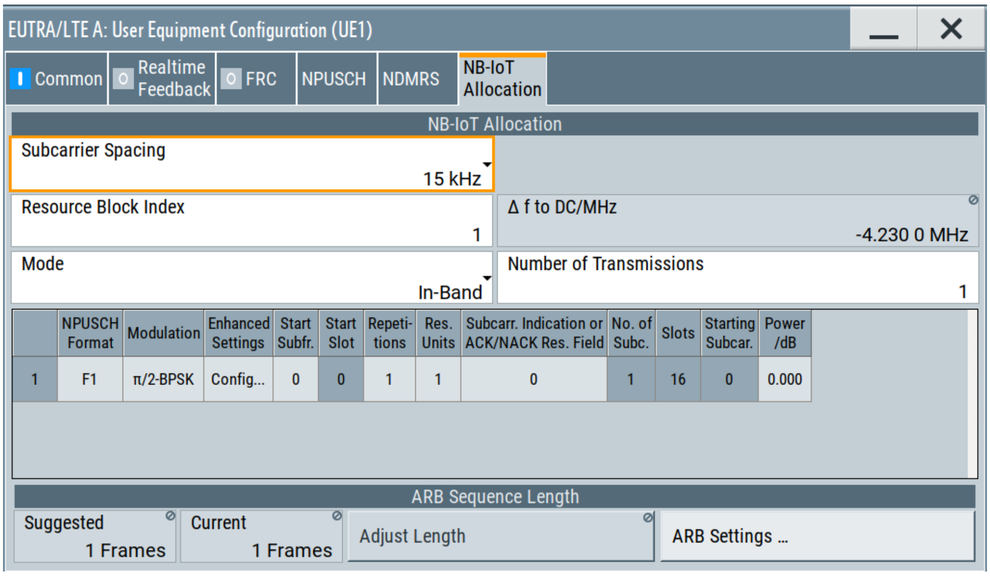
1. Select "General > UL Frame Configuration > UE x > 3GPP Release = NB-IoT".
2. Select "UE x > NPUSCH".



The provided settings are the same as for LTE, expect that NB-IoT does not support MIMO.
Hence, the "Transmission Mode = TM 1" and "Max. Number of AP for PUSCH = 1".
You can enable NPUSCH scrambling and channel coding and multiplexing, where the multiplexing mode is selected automatically, depending on the NPUSCH format. (See "NPUSCH formats" on page 48).

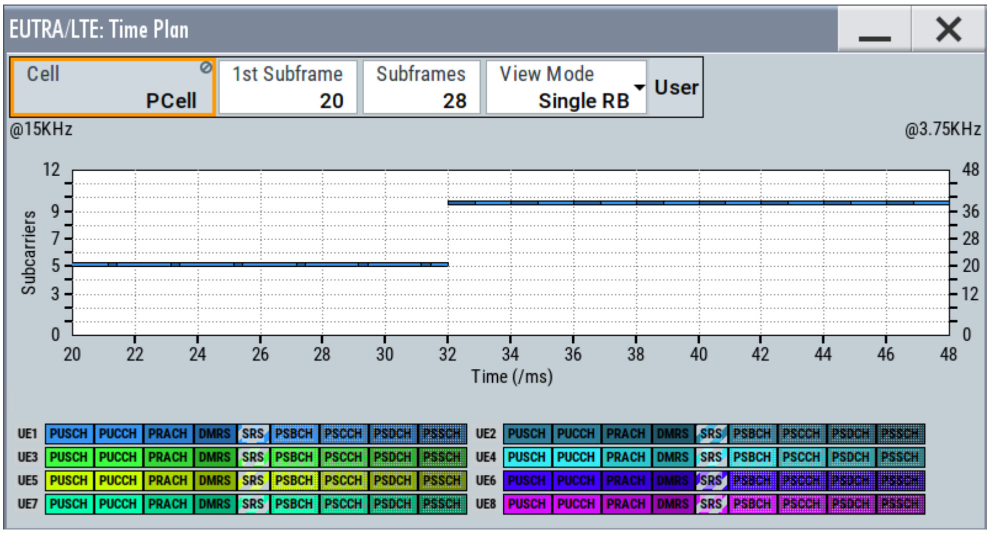
3. To configure the **NPUSCH transmission per UE**, select "Frame Configuration > UE x > NB-IoT Allocation"

   Other than in LTE, in NB-IoT the NB-IoT allocations (NPUSCH and NDMRS) are configured per UE.



The NB-IoT allocation is individual per UE, in terms of subcarrier spacing, operating mode and used resource block. There can be up to 10 NPUSCH transmissions per UE, each of them using different NPUSCH format and occupying different resources in the time and in the frequency domain.

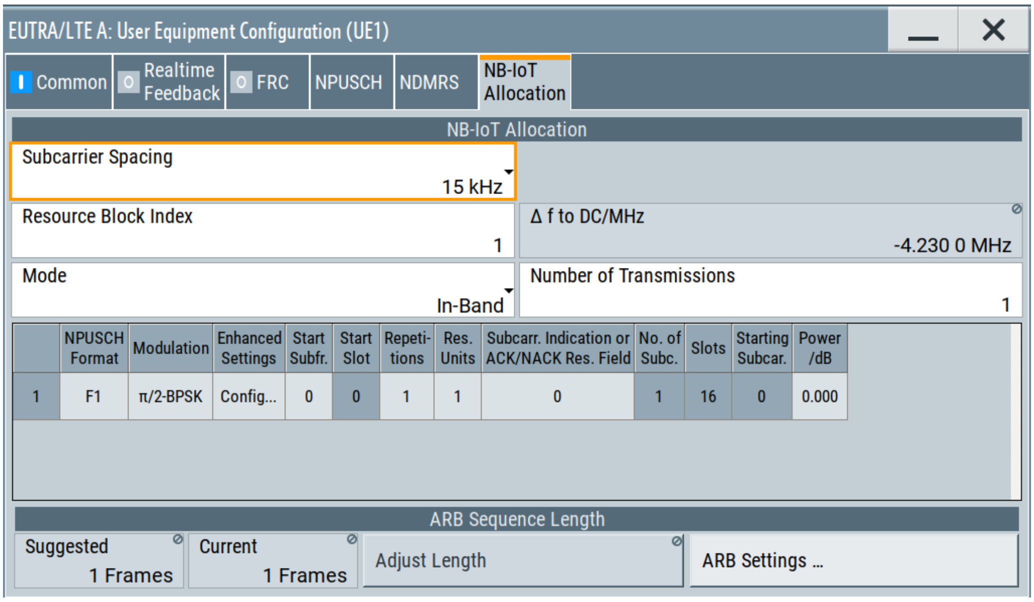
4. In the "NB-IoT Allocation" table, select "Transmission # > Enhanced Settings > Config" to configure the channel coding and multiplexing of an NB-IoT allocation. See Chapter 3.15.2, "NPUSCH enhanced settings", on page 180.
5. To observe the NPUSCH allocations, select "EUTRA/LTE > Frame Configuration > Time Plan".
   To zoom in and display a particular resource block, select "View Mode = Single RB".
   Select the resource block index used in the "NB-IoT Allocation" dialog.



Settings:

3.15.1 NB-IoT allocation settings

Access: see Chapter 3.15, "NPUSCH settings", on page 172.



Settings:

Subcarrier Spacing
Sets the subcarrier spacing Δf per UE.

See also Table 2-14.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:SCSPacing` on page 524

Resource Block Index
Sets the resource block number in that the NB-IoT transmissions are allocated.

The available resource blocks depend on the used "Channel Bandwidth" (or "Number of Available Resource Blocks") and the operating "Mode".

Table 3-20: Resource block index value ranges

Operation mode	Resource block allocation	Value range
In-band	Within the "Channel Bandwidth"	0 to "Number of Available Resource Blocks"
Guard band	Left guard band	< 0
	Right guard band	> "Number of Available Resource Blocks"

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:RBINdex` on page 524

Delta Frequency to DC, MHz
In "Mode > In-band/Guardband", indicates the delta frequency with that the NB-IoT carrier is offset form the LTE center frequency.

The value depends on "Resource Block Index" and in in-band mode and per default in the guardband mode it is calculated as follows:

"Delta Frequency" = $\Delta f_{NB\text{-}IoT}$*("RB Index"*N_{SC}^{RB} - floor(N_{RB}^{UL}*N_{SC}^{RB}/2) + N_{SC}^{RB}/2)

Where:
- $\Delta f_{NB\text{-}IoT}$ = "Subcarrier Spacing" = 15 kHz or 3.75 kHz is the NB-IoT subcarrier spacing
- N_{RB}^{UL} is the "Number of Resource Blocks per Slot"
- N_{SC}^{RB} = 12 is the number of subcarriers per RB

Thus, the possible values for the center frequencies of the NB-IoT channels are at 180 kHz offset to each other. In guard band mode, the you can change this spacing and set different "Delta Frequency to DC". If the set value does not correspond to a valid RB index, than the "RB Index = User".

According to the specification, the center frequencies of the NB-IoT channels in guard band mode must satisfy the following conditions:
- The first allocated NB-IoT RB must be orthogonal to the LTE RBs, whereas the following NB-IoT can be at 180 kHz or 15 kHz offset.
- The center frequencies of the NB-IoT carriers must satisfy the EARFCN conditions and hence be an integer multiple of 100 kHz; a raster of ±2.5 kHz and ±7.5 kHz is allowed, too.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:DFReq on page 525

Mode
Selects the operating mode, see Figure 2-10.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:MODE on page 525

Number of Transmissions
Enables up to 20 individual NPUSCH transmissions, where each transmission is configured in a separate row in the NPUSCH allocation table.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:NTRansmiss on page 525

NPUSCH Format
Sets the NPUSCH transmission format.

See "NPUSCH formats" on page 48.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:FORMat on page 525

Modulation
Selects the modulation scheme for the NPUSCH transmission.

The available modulation schemes depend on the NPUSCH format, see Table 2-19.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:MODulation
on page 526

Enhanced Setting > Config
Access dialogs with further channel coding and multiplexing settings.

The displayed settings depend on the selected NPUSCH format, see Chapter 3.15.2, "NPUSCH enhanced settings", on page 180

Starting Subframe (SF)
Sets the first subframe in that the NPUSCH transmission occurs and defines the NPUSCH position in the time domain.

Per default, each subsequent NPUSCH transmission of the same UE is allocated in the first possible SF following the end of the previous transmission. The following applies:

$StartSF_{NPUSCH,i+1} = StartSF_{NPUSCH,i} + (N_{Rep}^{NPUSCH,i} * N_{RU}^{NPUSCH,i} * N_{slot}^{RU}) + 1$

Use the "Time Plan" to observe the NPUSCH allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSFrame
on page 526

Starting Slot
Indicates the starting slot of the first subframe in that the NPUSCH transmission occurs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSLot?
on page 528

Repetitions
Sets how many times an NPUSCH transmission is repeated (N_{Rep}^{NPUSCH}).

N_{Rep}^{NPUSCH} = {1, 2, 4, 8, 16, 32, 64, 128}

The value is set automatically, if an FRC is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:REPetitions
on page 526

Number of Resource Units N_{RU}
Sets the number of allocated resource units (N_{RU}^{NPUSCH}):

- For "NPUSCH Format = F1", N_{RU}^{NPUSCH} = {1, 2, 3, 4, 5, 6, 8, 10}
- For "NPUSCH Format = F2", N_{RU}^{NPUSCH} = 1

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NRUNits
on page 526

Subcarrier Indication or ACK/NACK Resource Field
Sets the parameter that defines the NPUSCH position in the frequency domain, see Table 3-21.

Table 3-21: Parameters (without FRC) as function of NPUSCH format and subcarrier spacing

NPUSCH format	Parameter	Δf = 3.75 kHz	Δf = 15 kHz
F1	Subcarrier indication field I_{SC}	0 to 47	0 to 18
F2	ACK/NACK resource field	0 to 15	0 to 15

If a fixed reference channel (FRC) for NB-IoT is enabled, the values of subcarrier indication field depend on the selected FRC as follows. (See also Chapter 3.14, "FRC settings", on page 170).

Table 3-22: Subcarrier indication field I_{SC} values for FPC

FRC	A14-1	A14-2	A14-3	A14-4	A15-1	A15-2
I_{SC}	0 to 11	0 to 47	0 to 11	0 to 47	0 to 11	0 to 47

FRC	A16-1	A16-2	A16-3	A16-4	A16-5	A2.4-1
I_{SC}	0 to 47	0 to 11	12 to 15	16 to 17	18	0 to 47

FRC	A2.4-2	A2.4-3	A2.4-4	A2.4-5	A2.4-6	A2.4-7
I_{SC}	0 to 47	0 to 11	0 to 11	12 to 15	16 to 17	18

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:SIRF on page 527

Number of Subcarriers

Display the allocated number of subcarriers (N_{SC}^{RU}).

- For "NPUSCH Format = F2" and for "NPUSCH Format = F1" with Δf = 3.75 kHz, n_{SC} = 1
- For "NPUSCH Format = F1" with Δf = 15 kHz, n_{SC} is calculated from the Subcarrier Indication Field I_{SC}.
  See Table 3-23

Table 3-23: Number of subcarriers (N_{SC}^{RU}) [TS 36.211]

Subcarrier indication field I_{SC}	**Set of allocated subcarriers** n_{SC}
0 to 11	I_{SC}
12	{0, 1, 2}
13	{3, 4, 5}
14	{6, 7, 8}
15	{9, 10, 11}
16	{0, 1, 2, 3, 4, 5}
17	{6, 7, 8, 9, 10, 11}
18	{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11}
19 to 63	reserved

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NSCarriers?
on page 527

Slots

Indicates the allocated number of slots per RU N_{slot}^{RU}.

See Table 2-19.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NSLTs? on page 527

Starting Subcarrier

Indicates the subcarrier number of the first subcarrier in the NPUSCH transmission.

The value is calculated automatically for the allocated "Number of Subcarriers" and according to Table 3-23.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSCarrier?
on page 527

Power, dB
Sets the power of the NPUSCH transmission P_{NPUSCH} relative to the UE power.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:POWer on page 528

ARB Sequence Length
Comprises setting for automatic adjustment of the ARB sequence length.

Suggested ← ARB Sequence Length
- NB-IoT allocations:
  Indicates the ARB sequence length that is required for the selected NPUSCH transmissions.
- eMTC allocations:
  Number of frames required for the one complete transmission.
  The value is calculated as the sum of the Start_SF and n_{abs_SF}.

Use the "Adjust Length" function to apply the suggested value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:ARB:SUGGested? on page 528
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:ARB:SUGGested? on page 543

Current ← ARB Sequence Length
Indicates the current ARB sequence length.

Adjust Length ← ARB Sequence Length
Sets the ARB sequence length to the suggested value.

ARB Settings ← ARB Sequence Length
Opens the ARB dialog.

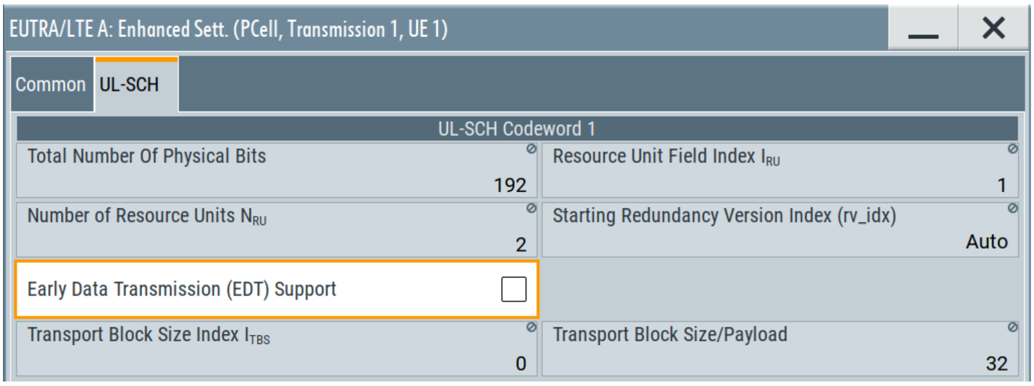
3.15.2 NPUSCH enhanced settings

Common

The "Common" settings dialog indicates the type of the selected channel and allows you to set the NPUSCH format, see "NPUSCH Format" on page 177.

UL-SCH

For "NPUSCH Format = F1", the "UL-SCH" dialog comprises settings concerning the transport block size.



Total Number of Physical Bits ← UL-SCH

Indicates the number of physical bits of the selected NPUSCH transmission.

The value is calculated as described in "Physical dimension of the NPUSCH allocation" on page 49.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:PHYSbits?`

on page 531

Resource Unit Field Index I_{RU} ← UL-SCH

Indicates the resource unit (RU) field index I_{RU} selected depending on the used Number of RU N_{RU}^{NPUSCH}, see Table 3-24.

Table 3-24: RU field index [TS 36.213]

I_{RU}	N_{RU}^{NPUSCH}
0	1
1	2
2	3
3	4
4	5
5	6
6	8
7	10

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:RUINdex?
on page 531

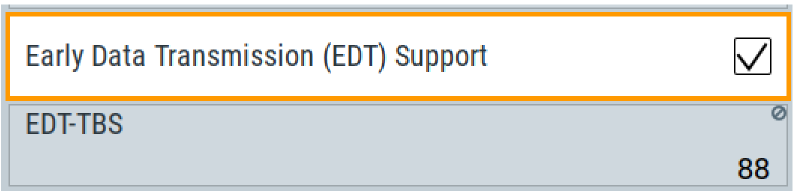
Number of Resource Units N_{RU} ← UL-SCH
Sets the number of allocated resource units (N_{RU}^{NPUSCH}):
- For "NPUSCH Format = F1", N_{RU}^{NPUSCH} = {1, 2, 3, 4, 5, 6, 8, 10}
- For "NPUSCH Format = F2", N_{RU}^{NPUSCH} = 1

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NRUNits
on page 526

Starting Redundancy Version Idex (rv_ix) ← UL-SCH
Sets the starting redundancy version index.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:RVINdex
on page 532

Early Data Transmission (EDT) Support ← UL-SCH
Enables or disables early data transmission.



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ESUPport
on page 530

EDT-TBS ← Early Data Transmission (EDT) Support ← UL-SCH
Sets the transport block size for early data transmission in UL.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ETBS
on page 531
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ETRSize
on page 531

Transport Block Size Index I_{TBS} ← UL-SCH
Sets the transport block size index I_{TBS}.

The value is used to retrieve the Transport Block Size/Payload.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:TBINdex
on page 532

Transport Block Size/Payload ← UL-SCH

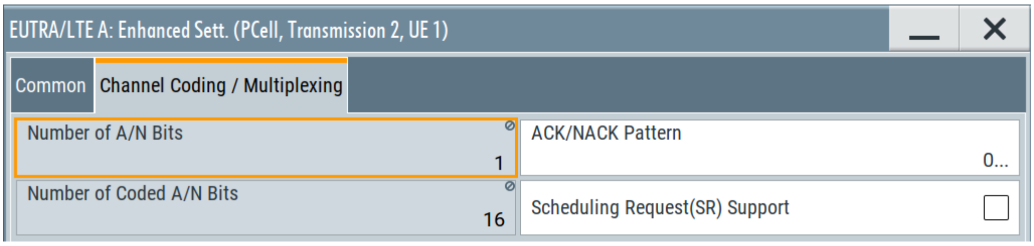
Indicates the transport block size.

The value is retrieved form the selected I_{RU} (Resource Unit Field Index I_{RU}) and I_{TBS} (Transport Block Size Index I_{TBS}), as defined in TS 36.211.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:TBSize?`
on page 532

Channel Coding / Multiplexing

For "NPUSCH Format = F2", the "Channel Coding / Multiplexing" dialog displays the predefined ACK/NACK configuration.



Number of A/N Bits ← Channel Coding / Multiplexing

NPUSCH format F2 uses 1 ACK/NACK bit.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:BITS?`
on page 529

ACK/NACK Pattern ← Channel Coding / Multiplexing

Set the ACK/ANCK pattern as a sequence of 0 and 1.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:PATTern`
on page 530

Number of Coded A/N Bits ← Channel Coding / Multiplexing

For NPUSCH format F2, the number of coded bits is 16.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:CBITs?`
on page 529

Scheduling Request (SR) Support ← Channel Coding / Multiplexing

Option: R&S SMW-K146

If enabled, the SR symbols are multiplied with the C_{SR} sequence. The multilication is perfomed block-wise and according to TS 36.211.

Enabled "Scheduling Request (SR) Support" corresponds transmission of the `sr-WithHRAQ-ACK-Config` field in the `ScheduligRequenst Config-NB` information element, according to TS 36.213.

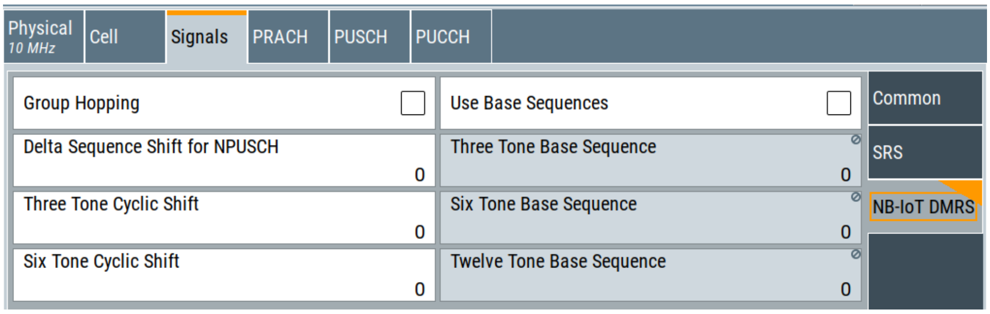
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:SR
on page 530

3.16 NDMRS settings

Access:

1. Select "General > General UL Settings > Signals".

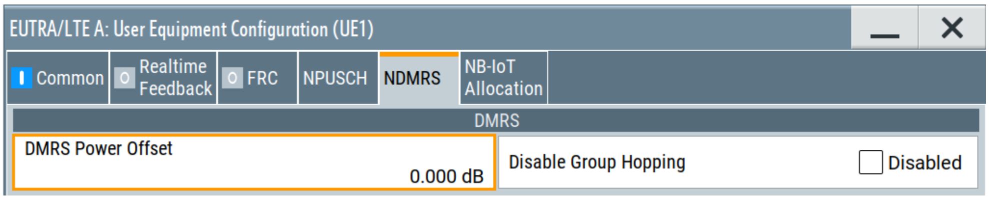
   The NDMRS settings are grouped in the "NB-IoT DMRS" section.



2. To configure the NDMRS setting per UE, select "EUTRA/LTE > Frame Configuration > General > UE1".

3. Select "User Equipment Configuration > NDMRS".

   You can boost the NDMRS signal compared to the NPUSCH allocation and disable the NPUSCH group hopping for a particular UE.



The NDMRS allocation, both as slot assignment and duration, depends on the NPUSCH allocation of the particular UE. In particular, it depends on the NPUSCH format per allocation and the subcarrier spacing.

- To configure the NPUSCH allocation, select "User Equipment Configuration > NB-IoT Allocation".
- To observe the NDMRS allocation, including duration and slot assignment, select "EUTRA/LTE > Frame Configuration > Time Plan".
  Select "View Mode = Single RB" and select the resource block index used in the "NB-IoT Allocation" dialog.
  For example, see Example"NPUSCH configuration" on page 49.

NDMRS settings:

NB-IoT DMRS general settings

The following are the NDRM settings, common to all UEs. They are related to NDMRS generation and hopping.

Group Hopping ← NB-IoT DMRS general settings

Enables group hopping (`groupHoppingEnabled`) for the uplink demodulation reference signal (DMRS).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:GHOPping` on page 502

Delta Sequence Shift for NPUSCH ← NB-IoT DMRS general settings

Sets the delta sequence shift α for NPUSCH required for the calculation of the group hopping pattern.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:DSEQshift` on page 502

Three/Six-Tone Cyclic Shift ← NB-IoT DMRS general settings

Sets the higher layer parameters `threeTone-CyclicShift` and `sixTone-CyclicShift`.

In combination with the base sequence, these parameters define the sequence with which the demodulation reference signal (NDMRS) is transmitted.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TTCShift` on page 503
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:STCShift` on page 503

Use Base Sequences ← NB-IoT DMRS general settings

Enables using base sequences for the generation of the NB-IoT DMRS sequence hopping pattern.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:USEBase` on page 503

Three/Six/Twelve-Tone Base Sequence ← NB-IoT DMRS general settings

Sets the higher layer parameters `threeTone-BaseSequence`, `sixTone-BaseSequence`, and `twelveTone-BaseSequence`. They define the base sequence with which the demodulation reference signal (NDMRS) is transmitted.

Each of the three sequences is used in case the signal is modulated onto three, six or 12 carriers.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TTBSequence on page 503
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:STBSequence on page 504
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TWBSequence on page 504

UE-specific NDMRS settings
With the provided settings, you can boost the NDMRS signal compared to the NPUSCH allocation or disable the NPUSCH group hopping for the particular UE.

Disable Group Hopping ← UE-specific NDMRS settings
NDMRS group hopping is not applied for the selected UE.

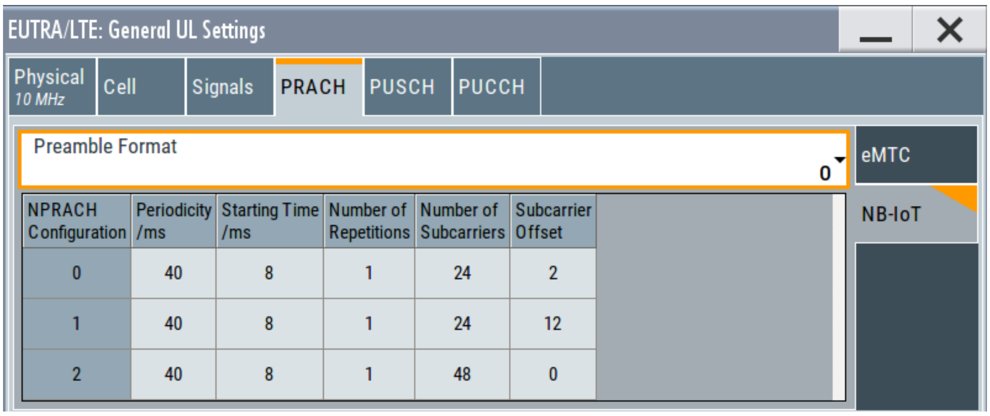
This parameter works like sending the higher-level parameter `groupHoppingDisabled`.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:GHDisable on page 524

3.17 NPRACH settings

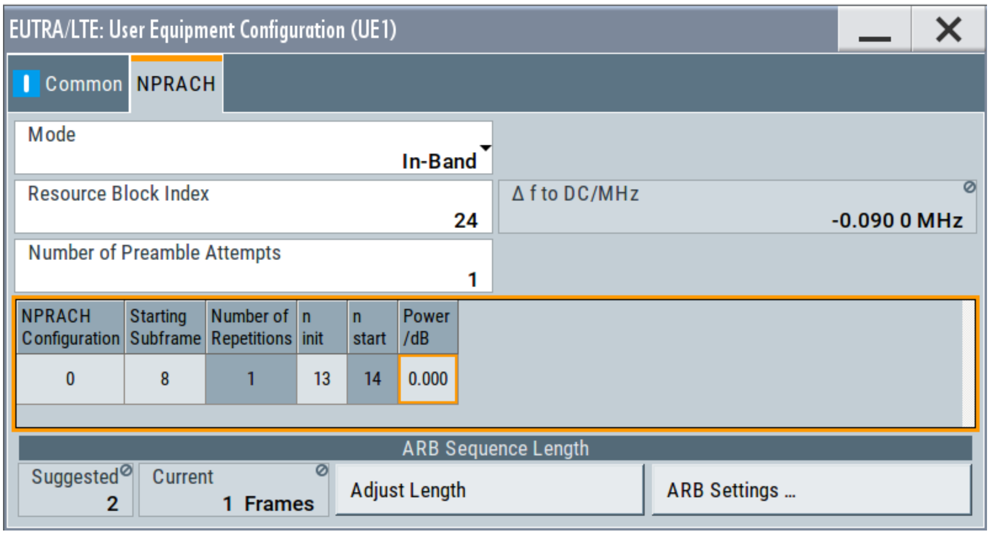
Access:

1. In the "General" dialog, select "Mode > eMTC/NB-IoT".
2. Select "Link Direction > Uplink (SC-FDMA)".
3. Select "General > General UL Settings > PRACH > NB-IoT".



   With the provided settings, you can configure three NPRACH configurations for the different coverage levels.
   For description of the related settings, see "NB-IoT NPRACH configurations" on page 188.

4. To allocate the NPRACH for a specific UE, use the following parameters:
   a) Select "UL Frame Configuration > UE1 > 3GPP Release = NB-IoT".
   b) Select "UE1 > Settings > Common > Mode = PRACH".
   c) Select "NPRACH".



You can change the number of preamble attempts, select one of the three NPRACH configurations and set the parameter n_{int} to define the start of the first symbol group.

For description of the related settings, see "NB-IoT NPRACH allocation per UE" on page 189.

5. If necessary, use the "Adjust Length" function to enable larger number of frames automatically so that the NPRACH frequency hopping pattern is completed.
6. Open the "Time Plan" to visualize the NPRACH allocation:
   a) Select "UL Frame Configuration > Time Plan".
   b) Select "View Mode > Single RB".
   c) Select the resource block index as configured in the "NPRACH" dialog.
      For example, select "RB = 24".
   d) Configure the subframes to be displayed, for example "1st Subframe = 0" and "Subframes = 20".

   The "Time Plan" shows the NPRACH.
   For example, see Figure 2-20.

NPRACH settings:

NB-IoT NPRACH configurations

Use the provided settings to configure three NPRACH configurations for the different coverage levels (CE).

See also:

- "NPRACH configuration" on page 51
- Example"NPRACH configuration" on page 52

The following parameters are specified in TS 36.211 as part of the SIB2-NB message:

Preamble Format ← NB-IoT NPRACH configurations

Select the preamble format.

The preamble formats use different cyclic prefix length, which results in different symbol group lengths.

Option: R&S SMW-K146

- To enable format 2, select "Duplexing = FDD"
- To enable formats 0-A and 1-A, select "Duplexing = TDD" and "TDD UL/DL Configuration = 1 to 5".

To observe the influence of this parameter, use the "Time Plan".

See also Figure 2-20.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:PFMT` on page 504

NPRACH configuration ← NB-IoT NPRACH configurations

Displays the NPRACH configuration number.

There are three NPRACH configurations, one per CE level. Each configuration is described with its time and frequency allocation and periodicity of occupancy.

Periodicity, ms ← NB-IoT NPRACH configurations

Sets the parameter $N_{periodicity}^{NPRACH}$ (`mprach-periodicity`).

It defines how often the NPRACH is scheduled. Available are periodicities between 40 ms and 2.56 s

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:PERD` on page 505

Starting Time, ms ← NB-IoT NPRACH configurations

Define the start time of the specific NPRACH configuration (`nprach-StartTime`).

See Figure 2-20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:STTM on page 505

Number of Repetitions ← NB-IoT NPRACH configurations

Indicates the number of NPRACH repetitions per preamble attempt N_{rep}^{NPRACH} (maxNumPreambleAttemptCE-r13).

See Figure 2-20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:REP on page 505

Number of Subcarriers ← NB-IoT NPRACH configurations

Sets the number of NPRACH subcarriers N_{sc}^{NPRACH} (nprach-NumSubcarrierres).

See Figure 2-20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:SUBC on page 505

Subcarrier Offset ← NB-IoT NPRACH configurations

Sets the parameter $N_{scoffset}^{NPRACH}$ (nprach-SubcarrierrOffset) and defines the frequency location of the first NPRACH subcarrier.

See Figure 2-20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:SCOF on page 506

NB-IoT NPRACH allocation per UE

Use this setting to can change the NPRACH allocation per UE, for example:
- The number of preamble attempts
- To select one of the three NPRACH configurations
- To set the parameter n_{int} to define the start of the first symbol group.

See also:
- "NPRACH configuration" on page 51
- Example"NPRACH configuration" on page 52

Mode ← NB-IoT NPRACH allocation per UE

Selects the operating mode, see Figure 2-10.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:MOD on page 536

Resource Block Index ← NB-IoT NPRACH allocation per UE

Defines the resource block in that the NPRACH is allocated.

The number of resource blocks depends on the selected "Channel Bandwidth" and is indicated with the parameter "UL General Settings > Physical > Number of Resource Blocks per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:RBID on page 536

Delta Frequency to DC, MHz ← NB-IoT NPRACH allocation per UE
In "Mode > In-band/Guardband", indicates the delta frequency with that the NB-IoT carrier is offset form the LTE center frequency.

The value depends on "Resource Block Index" and in in-band mode and per default in the guardband mode it is calculated as follows:

"Delta Frequency" = $\Delta f_{NB\text{-}IoT}$*("RB Index"*N_{SC}^{RB} - floor(N_{RB}^{UL}*N_{SC}^{RB}/2) + N_{SC}^{RB}/2)

Where:
- $\Delta f_{NB\text{-}IoT}$ = "Subcarrier Spacing" = 15 kHz or 3.75 kHz is the NB-IoT subcarrier spacing
- N_{RB}^{UL} is the "Number of Resource Blocks per Slot"
- N_{SC}^{RB} = 12 is the number of subcarriers per RB

Thus, the possible values for the center frequencies of the NB-IoT channels are at 180 kHz offset to each other. In guard band mode, the you can change this spacing and set different "Delta Frequency to DC". If the set value does not correspond to a valid RB index, than the "RB Index = User".

According to the specification, the center frequencies of the NB-IoT channels in guard band mode must satisfy the following conditions:
- The first allocated NB-IoT RB must be orthogonal to the LTE RBs, whereas the following NB-IoT can be at 180 kHz or 15 kHz offset.
- The center frequencies of the NB-IoT carriers must satisfy the EARFCN conditions and hence be an integer multiple of 100 kHz; a raster of ±2.5 kHz and ±7.5 kHz is allowed, too.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:DFReq` on page 538

Number of Preamble Attempts ← NB-IoT NPRACH allocation per UE
Sets the parameter N_{rep}^{NPRACH} (`maxNumPreambleAttemptCE-r13`) to define how many times a preamble is repeated.

Each attempt can use different NPRACH configuration and different NPRACH time and frequency allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:PRATtempts` on page 536

NPRACH Configuration ← NB-IoT NPRACH allocation per UE
For each preamble attempt, selects one of the NPRACH configurations configured in the NB-IoT NPRACH configurations dialog.

Any subsequent preamble attempt must use an equal or bigger NPRACH configuration number as the previous one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:CONFig`
on page 537

Starting Subframe ← NB-IoT NPRACH allocation per UE
For each preamble attempt, select the subframe (SF) number the first NPRACH symbol group appears for the first time.

See Figure 2-20.

The available subframes depend on the selected NPRACH Configuration in the current and the previous preamble attempts.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:SFSTart`
on page 537

Number of Repetitions ← NB-IoT NPRACH allocation per UE
Indicates the number of NPRACH repetitions per preamble attempt N_{rep}^{NPRACH} (`maxNumPreambleAttemptCE-r13`).

See Figure 2-20.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:REP` on page 505

n_{int} ← NB-IoT NPRACH allocation per UE
For each preamble attempt, sets the subcarrier index n_{int}, see "NPRACH allocation" on page 51.

The available subcarriers depend on the number of subcarriers in the selected "NPRACH Configuration", see "Number of Subcarriers" on page 189.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:INIT`
on page 537

n_{start} ← NB-IoT NPRACH allocation per UE
Indicates the value n_{start}, calculated as function of the selected n_{int}.

To observe the influence of this parameter, use the "Time Plan".

See Figure 2-20.

See "NPRACH allocation" on page 51 for details on the calculation and information on all related parameters.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:STRT?`
on page 537

Power ← NB-IoT NPRACH allocation per UE
Sets the preamble attempt power relative to the UE power.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:POWer`
on page 538

ARB Sequece Length > Sugested
Indicates the ARB sequence length that is required for the NPRACH configuration.

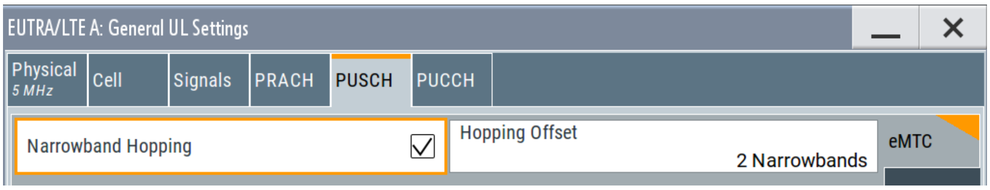
Use the "Adjust Length" function to apply the suggested value.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:ARB:SUGGested?`
on page 538

3.18 eMTC PUSCH settings

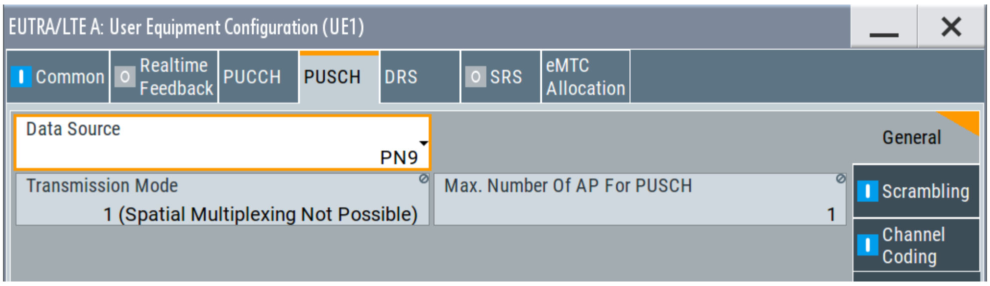
Access:

1. Select "General > General UL Settings > PUSCH > eMTC Parameters".



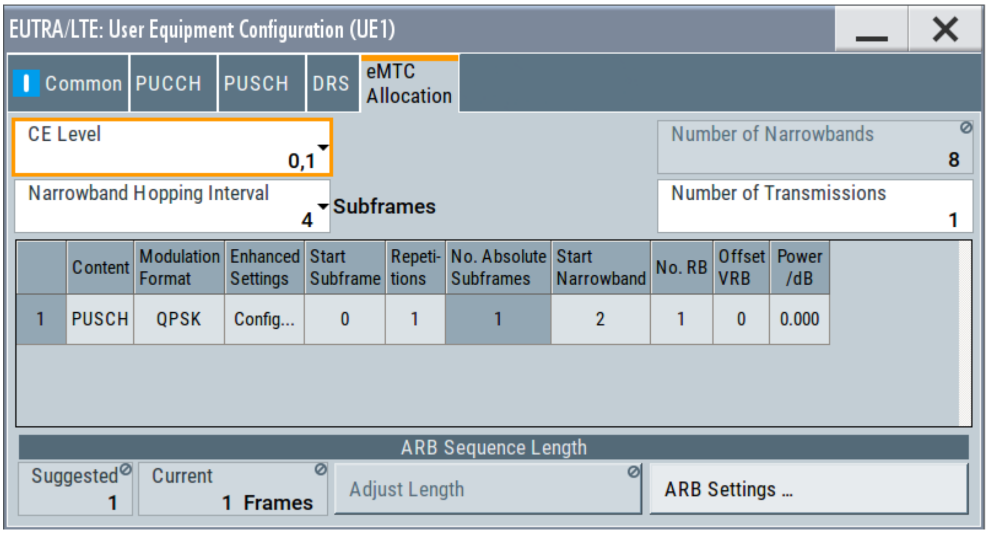
The dialog displays general PUSCH configuration parameters.
To access the UE-specific PUSCH settings, follow the following instructions.

2. Select "Frame Configuration > UE x > 3GPP Release" = **"eMTC"**.
3. To access the settings of the individual UE, click the "UE x" block.
4. Select "UE x > PUSCH".



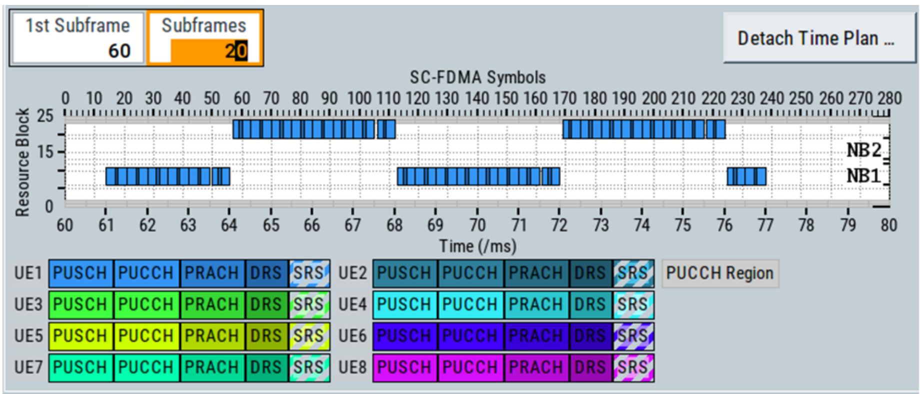
You can enable PUSCH scrambling and channel coding and multiplexing.
The provided settings are the same as for LTE, expect that eMTC UEs do not support MIMO and the rank indication (RI) concept.
The "Transmission Mode = TM 1" and "Max. Number of AP for PUSCH = 1" are fixed.

5. To configure the **PUSCH transmission per UE**, select "Frame Configuration > UE x > eMTC Allocation".



The eMTC allocation is individual per UE, in terms of used CE level, frequency hopping and number of transmissions.
There can be up to 20 PUSCH or PUCCH transmissions per UE, each of them using different format and occupying different resources in the time and in the frequency domain.

6. In the "eMTC Allocation" table, select "Transmission # > Content = PUSCH > Enhanced Settings > Config" to configure the channel coding and multiplexing of an eMTC allocation.
   See Chapter 3.18.3, "eMTC PUSCH channel coding and multiplexing settings", on page 200.
7. To observe the PUSCH allocations, select "EUTRA/LTE > Frame Configuration > Time Plan".



3.18.1 Cell-specific eMTC PUSCH settings

Access: see Chapter 3.18, "eMTC PUSCH settings", on page 192.

Narrowband Hopping
Enables narrowband hopping so that PUSCH allocations can change the used narrowband.

PUSCH hopping pattern is individual per UE. The number of subframes the PUSCH allocation remains in the same NB is defined with the UE-specific parameter Narrowband Hopping Interval.

If hopping is disabled, the PUSCH repetitions are located in the same resource block at the same narrowband.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NHOPping on page 508

Hopping Offset
If "Narrowband Hopping > On", sets the value of the cell-specific higher-level parameter f_{hop}^{NB} required to calculate the PUSCH frequency hopping pattern. The hopping offset is difference in narrowbands between the narrowband number of the current and the subsequent narrowband.

The max possible hopping offset depends on the number of available narrowbands (see Number of eMTC Narrowbands).

Use the "Time Plan" to visualize the PUSCH allocation.

For example, see Example"PUSCH hopping" on page 30.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NHOFfset on page 508

3.18.2 UE-specific eMTC PUSCH transmissions settings

Access: see Chapter 3.18, "eMTC PUSCH settings", on page 192.

The eMTC allocation configuration is individual per UE and is defined **per coverage extension level CE**. eMTC allocation is composed of up to 20 PUCCH or PUSCH transmissions, each one described in a row in the eMTC allocation table.

Settings:

CE Level

Sets the coverage extension level (CE).

3GPP defines two CE modes for eMTC, CEModeA and CEModeB:

- "CE Level = 0, 1" corresponds to CEModeA
  This mode uses small number of PUSCH or PUCCH repetitions.
- "CE Level = 2, 3" corresponds to CEModeB
  This mode enables large number of PUSCH or PUCCH repetitions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:CELevel` on page 539

Number of eMTC Narrowbands

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It indicates the number of eMTC narrowbands N_{NB} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Narrowbands" = "Number of Resource Blocks" / 6

For more information, see "Narrowbands" on page 19.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NNBands?` on page 494

Number of eMTC Widebands

Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" and Wideband Config > "On" is selected.

It indicates the number of eMTC widebands N_{WB} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Widebands" = Number of eMTC Narrowbands / 4

For more information, see "Widebands" on page 20.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NWBands?` on page 494

Narrowband Hopping Interval

Sets the higher-level parameter N_{ch}^{NB}.

It defines the number of consecutive subframes the hopping pattern remains in the same narrowband.

Table 3-25: Hopping intervals N_{ch}^{NB} per CE level and duplexing mode

"CE Level"	"Duplexing > FDD"	"Duplexing > TDD"
0, 1	1, 2, 4, 8	1, 5, 10, 20
2, 3	2, 4, 8, 16	5, 10, 20, 40

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:HOPP on page 539

Number of Transmissions
Enables up to 20 individual PUSCH and PUCCH transmissions, where each transmission is configured in a separate row in the eMTC allocation table.

Use the "Time Plan" to visualize the eMTC allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:NTRansmiss on page 539

Content
Selects the channel type and defines whether PUSCH or PUCCH is transmitted.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CONTent
on page 540

Modulation/Format
For PUSCH transmission, this parameter sets the used modulation scheme (QPSK, 16QAM or 64QAM).

For PUCCH transmission, this parameter sets the PUCCH format.

Table 3-26: PUCCH formats depending on the CE mode and duplexing mode

"CE Level"	"Duplexing > FDD"	"Duplexing > TDD"
0, 1	1, 1a, 2, 2a, 2b	1, 1a, 1b, 2, 2a, 2b
2, 3	1, 1a	1, 1a

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:MODulation
on page 540
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:FORMat on page 540

Enhanced Setting > Config
Access dialogs with further channel coding and multiplexing settings.

The displayed settings depend on the transmission content, see:
- Chapter 3.18.3, "eMTC PUSCH channel coding and multiplexing settings", on page 200
- Chapter 3.19.3, "eMTC PUCCH channel coding and multiplexing settings", on page 208

Start Subframe
Sets the subframe number in that the PUSCH/PUCCH allocation is scheduled for the first time.

The following applies for each subsequent allocation:

$Start\_SF_{PUSCH,i+1} = Start\_SF_{PUSCH,i} + n_{Rep}^{PUSCH} + n_{invalid\_SF} + 1$

Where:
- $n_{invalidSF}$ is the number of SF that is set as not valid for eMTC in the "General UL Settings" dialog (see "Valid Subframes" on page 167).
- n_{Rep}^{PUSCH} is set with the parameter Repetitions.

Example:
- Allocation#1
PSUCH with Start_SF = 0, $n_{Rep}^{PUSCH} = 8$ and $n_{invalid\_SF} = 2$
- The first possible "Start Subframe" for allocation#2
Start_SF = 0 + 8 + 2 + 1 = 11

Note: If more than one UE are configured, the UEs have to use different "Start Subframe".
Otherwise, a conflict is indicated in the "UL Frame Configuration > Subframe > Allocation Table" dialog.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STSFrame
on page 540

Repetitions
Sets how many times a transmission is repeated.

Table 3-27: Possible number of repetitions (n_{Rep}^{PUSCH} and n_{Rep}^{PUCCH}) depending on the CE mode and the channel type

"CE Level"	PUSCH	PUCCH
0, 1	1, 2, 4, 8, 16, 32 Option: R&S SMW-K143 12, 24	1, 2, 4, 8
2, 3	1, 4, 8, 16, 32, 64, 128, 192, 256, 384, 512, 768, 1024, 1536, 2048	4, 8, 16, 32 Option: R&S SMW-K143 64, 128

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:REPetitions
on page 541

No. Absolute Subframes
Number of absolute subframes (n_{abs_SF}) is calculated as follows:

$n_{abs\_SF} = n_{Rep}^{PUSCH} + n_{invalid\_SF}$

Where:
- $n_{invalidSF}$ is the number of SF that is set as not valid for eMTC in the "General UL Settings" dialog (see "Valid Subframes" on page 167).
- n_{Rep}^{PUSCH} is set with the parameter Repetitions.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:ASFRrame?
on page 541

Start Narrowband
Sets the first NB used for the PSUCH/PUCCH transmission.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STNBand
on page 541

No. RB
Sets the number of used resource blocks (RB) within one narrowband.

According to TS 36.211, a UE can allocate between one RB and the whole narrow-band, where:
- For CEModeA UE, the used number of RBs is configurable value between 1 and 6 RBs
- For CEModeB UE, the allocations are predefined, see Table 3-28.

Table 3-28: Resource blocks allocation for UE configured in CEModeB [TS 36.213]

Value of resource allocation field	Allocated resource blocks
000	0
001	1
010	2
110	3
100	4
101	5
110	0 and 1
111	2 and 3

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NRBLocks
on page 541

Offset VRB
For allocations that span less than 6 RB, this parameter shifts the selected No. RB within the NB.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:RBOFfset
on page 542

Start Wideband
Option: R&S SMW-K143

Sets the first wideband used for the PSUCH/PUCCH transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STWBand`
on page 542

No. RB
Option: R&S SMW-K143

Sets the number of used resource blocks (RB) within one wideband.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:WRBLocks`
on page 542

Offset VRB
Option: R&S SMW-K143

Shifts the selected No. RB within the wideband.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:WBRBoffset`
on page 542

Power, dB
Sets the power of the eMTC PUSCH and PUCCH transmission (P_{PUSCH} or P_{PUCCH}).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:POWer` on page 543

ARB Sequence Length
Comprises setting for automatic adjustment of the ARB sequence length.

Suggested ← ARB Sequence Length
- NB-IoT allocations:
  Indicates the ARB sequence length that is required for the selected NPUSCH transmissions.
- eMTC allocations:
  Number of frames required for the one complete transmission.
  The value is calculated as the sum of the Start_SF and n_{abs_SF}.

Use the "Adjust Length" function to apply the suggested value.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:ARB:SUGGested?` on page 528
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:ARB:SUGGested?` on page 543

Current ← ARB Sequence Length
Indicates the current ARB sequence length.

Adjust Length ← ARB Sequence Length
Sets the ARB sequence length to the suggested value.

ARB Settings ← ARB Sequence Length
Opens the ARB dialog.

3.18.3 eMTC PUSCH channel coding and multiplexing settings

Access: see Chapter 3.18, "eMTC PUSCH settings", on page 192.

In this dialog you can:

- Set the cyclic shift used by the demodulation reference signal (DMRS)
- Adjust the parameters for channel coding of the control information (HARQ and CQI)
- Configure the multiplexing of the control information with the data transmission over the uplink shared channel (UL-SCH)

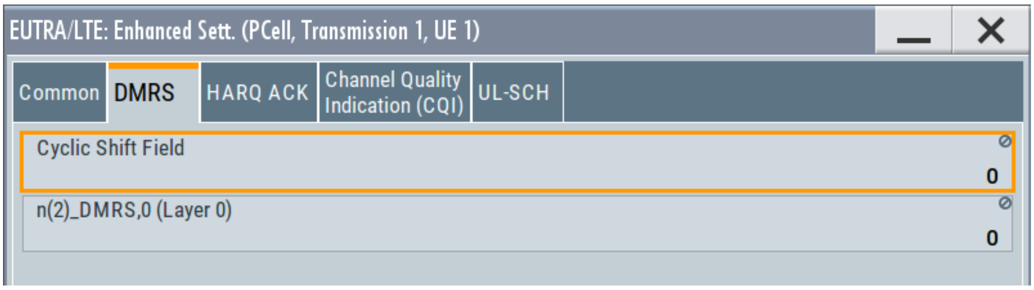
The eMTC PUSCH configuration reuses the LTE concept, expect:

- In eMTC, PUSCH frequency hopping is configured in a different way.
- eMTC does not support rank indication (RI)
- eMTC uses different parameter "Starting Redundancy Version Index (rv_idx)".

Settings:

Common
The "Common" dialog indicates the type of the selected channel.

DMRS



The provided settings are identical to the LTE demodulation reference signal (DMRS) settings.

Cyclic Shift Filed ← DMRS

Sets the cyclic shift field in the uplink-related DCI formats.

Cyclic shifts are used to separate the DMRS signals of different users in the time domain.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:DRS:CYCShift?
on page 544

n(2)_DMRS,0 (Layer 0) ← DMRS

Displays the part of the demodulation reference signal (DMRS) index $n^{(2)}_{DMRS,\,0}$ for layer 0.

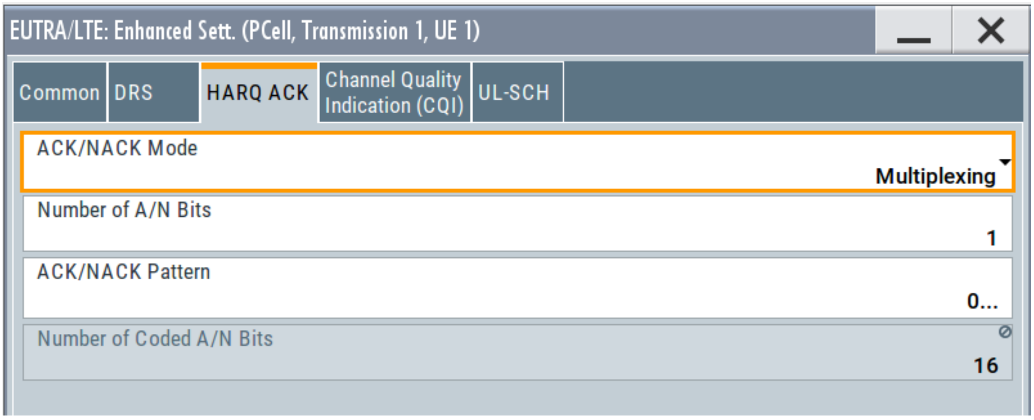
"Cyclic Shift Field"	n(2)_DMRS, 0
000	0
001	6
010	3
011	4
100	2
101	8
110	10
111	9

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 DMRS sequence.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NDMRs? on page 544

HARQ ACK

Access: "UEx > PUSCH > Channel Coding and Multiplexing > State > On" and "Mode = UCI only/UCI + UL-SCH".



The provided settings are identical to the LTE HARQ ACK settings.

ACK/NACK Mode ← HARQ ACK
Sets the ACK/NACK mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:MODE`
on page 545

Number of A/N Bits ← HARQ ACK
Sets the number of ACK/NACK bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:BITS`
on page 547

ACK/NACK Pattern ← HARQ ACK
Sets the ACK/NACK bit pattern.

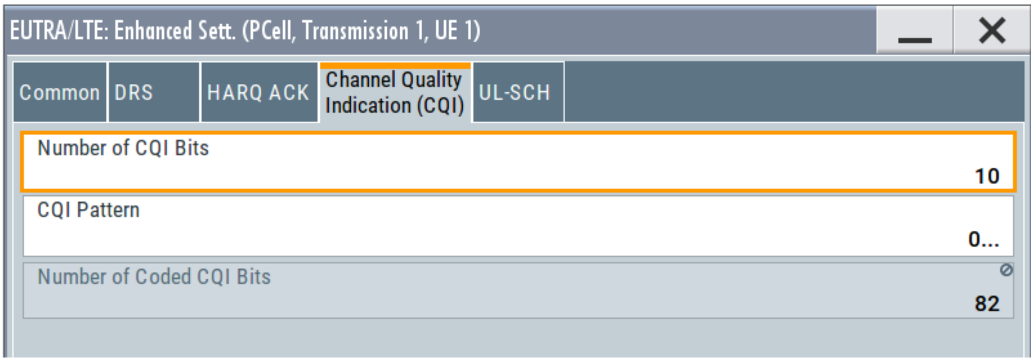
A "1" indicates an ACK, a "0" - a NACK.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:PATTern`
on page 547

Number of Coded A/N Bits ← HARQ ACK
Displays the number of coded ACK/NACK bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:CBITs?`
on page 547

Channel Quality Indication CQI
Access:
- "UEx > PUSCH > Channel Coding and Multiplexing > State > On"
- "Mode = UCI only/UCI + UL-SCH".



The provided settings are identical to the LTE CQI settings.

Number of CQI Bits ← Channel Quality Indication CQI
Sets the number of CQI bits before channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:BITS
on page 544

CQI Pattern ← Channel Quality Indication CQI
Sets the CQI pattern for the PUSCH.

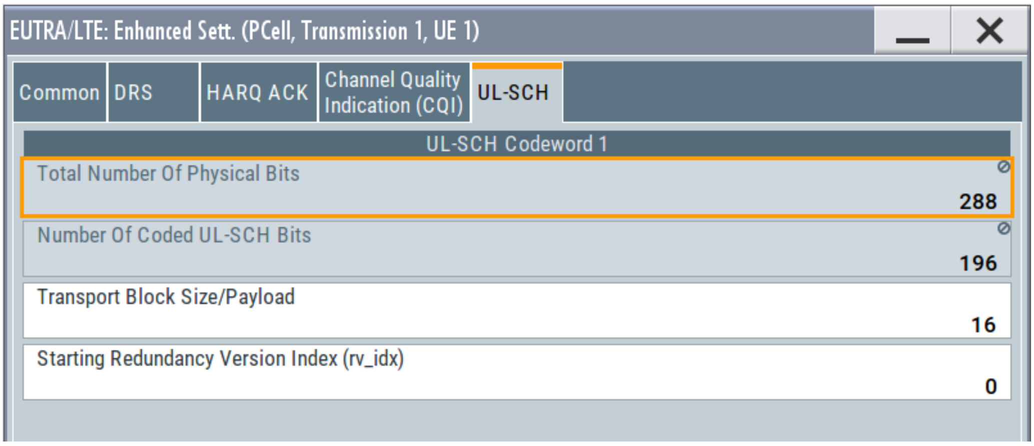
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:PATTern on page 545

Number of Coded CQI Bits ← Channel Quality Indication CQI
Displays the number of coded CQI bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:CBITs?
on page 545

Enhanced Setting > UL-SCH
Access:
- "UEx > PUSCH > Channel Coding and Multiplexing > State > On"
- "Mode = UL-SCH only/UCI + UL-SCH".

The eMTC PUSCH configuration reuses the LTE concept.



The same settings and interdependency apply expect the used "Starting Redundancy Version Index (rv_idx)".

Total Number of Physical Bits ← Enhanced Setting > UL-SCH
Displays the size of the eMTC allocation in bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PHYSbits?`
on page 547

Number of Coded UL-SCH Bits ← Enhanced Setting > UL-SCH
Displays the number of physical bits used for UL-SCH transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:ULSCh:BITS?`
on page 545

Transport Block Size/Payload ← Enhanced Setting > UL-SCH
Sets the size of the transport block.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CCODing:TBSize`
on page 546

Starting Redundancy Version Index (rv_idx) ← Enhanced Setting > UL-SCH
Sets the redundancy version index.

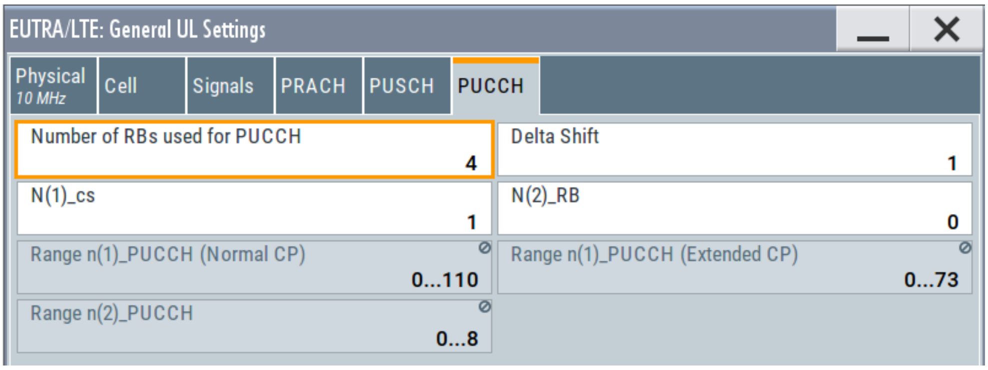
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CCODing:RVINdex`
on page 548

3.19 eMTC PUCCH settings

Access:

1. Select "General > General UL Settings > PUCCH" to access the **cell-specific PUCCH** settings.

   eMTC reuses the LTE PUCCH configuration.

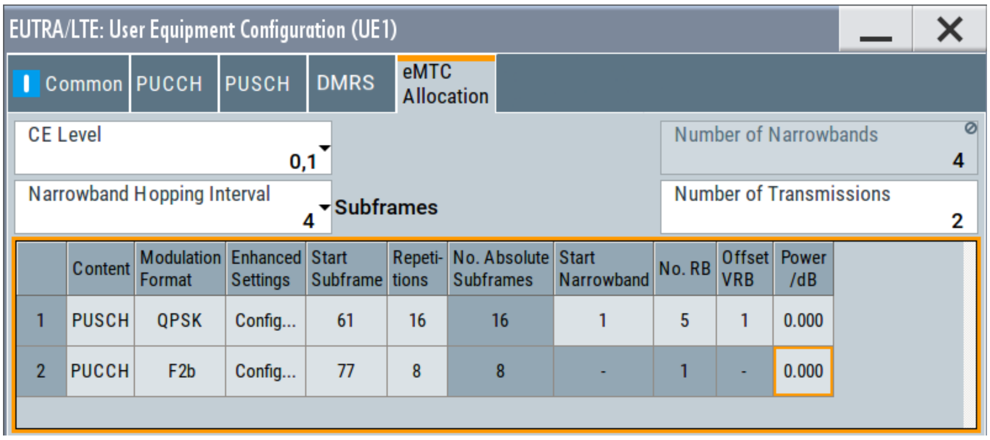


   To access the **UE-specific PUCCH settings**, follow the following instructions.

2. Select "Frame Configuration > UE" > **"3GPP Release = eMTC"**.
3. Select "UE x > PUCCH".

   eMTC reuses the UE-specific PUCCH configuration, except that eMTC UEs do not support MIMO and PUCCH format 3.
   Hence "Number of AP for PUCCH Formats = 1".

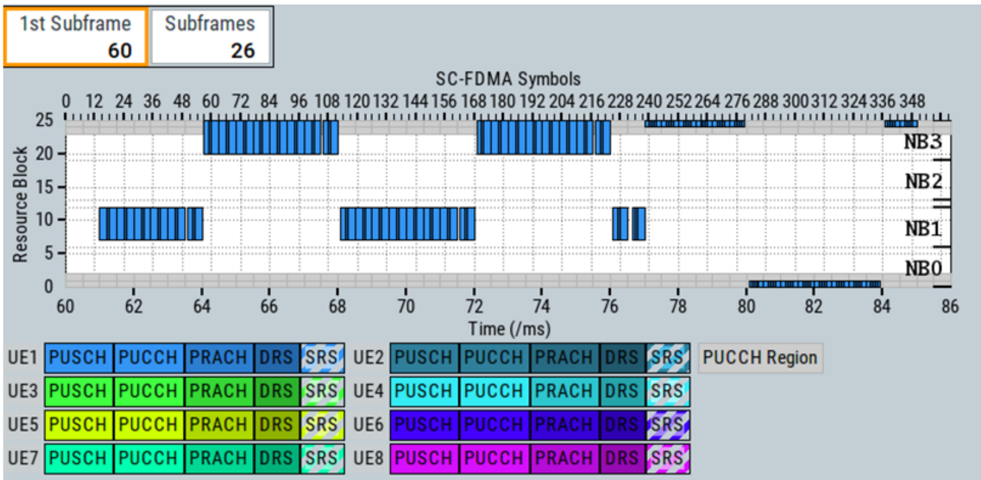
4. To configure the **PUCCH transmission per UE**, select "Frame Configuration > UE x" > **"eMTC Allocation"**.



   The eMTC allocation is individual per UE, in terms of used CE level, frequency hopping and number of transmissions. There can be up to 10 PUSCH or PUCCH transmissions per UE, each of them using different format and occupying different resources in the time and in the frequency domain.

For settings description, see Chapter 3.18.2, "UE-specific eMTC PUSCH transmissions settings", on page 194.

5. In the "eMTC Allocation" table, select "Transmission # > Content = PUCCH > Enhanced Settings > Config" to configure the **channel coding and multiplexing of an eMTC allocation**.
   See Chapter 3.19.3, "eMTC PUCCH channel coding and multiplexing settings", on page 208.
6. To observe the PUCCH allocations, select "EUTRA/LTE > Frame Configuration > Time Plan".



3.19.1 Cell-specific eMTC PUCCH settings

Access: see Chapter 3.19, "eMTC PUCCH settings", on page 205.

Settings:

Number of RBs used for PUCCH

Sets the PUCCH region in terms of reserved resource blocks, at the edges of the channel bandwidth (see Figure A-3).

The PUCCH region is displayed on the time plan.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:NORB` on page 508

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 Table A-3).

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:DESHift on page 509

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 follows:

N(2)_cs = 12 - N(1)_cs -2

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1CS on page 509

N(2)_RB
Sets bandwidth in terms of resource blocks that are reserved for PUCCH formats 2/2a/2b transmission in each subframe.

There can be only one resource block per slot that supports a combination of the PUCCH formats 1/1a/1b and 2/2a/2b. Hence, the number of RBs 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 509

Range n(1)_PUCCH (Normal/Extended CP)
Displays the range of the possible PUCCH format 1/1a/1b transmissions from different UEs in one subframe and per cyclic prefix.

Insufficient ranges are displayed as '-'.

The parameter "Range n(1)_PUCCH (Normal CP)" determines the value range of the index "n_PUCCH" for PUCCH format 1/1a/1b.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1NMax? on page 509
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1EMax? on page 510

Range n(2)_PUCCH
Displays the range of possible number of PUCCH format 2/2a/2b transmissions from different UEs in one subframe.

Insufficient ranges are displayed as '-'.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2Max? on page 510

3.19.2 UE-specific eMTC PUCCH settings

Access: see Chapter 3.19, "eMTC PUCCH settings", on page 205.

Number of Antenna Ports for PUCCH per PUCCH Format

eMTC UEs ("3GPP Release = eMTC") support transmission with one antenna port.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F1Naport` on page 517

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F2Naport` on page 517

3.19.3 eMTC PUCCH channel coding and multiplexing settings

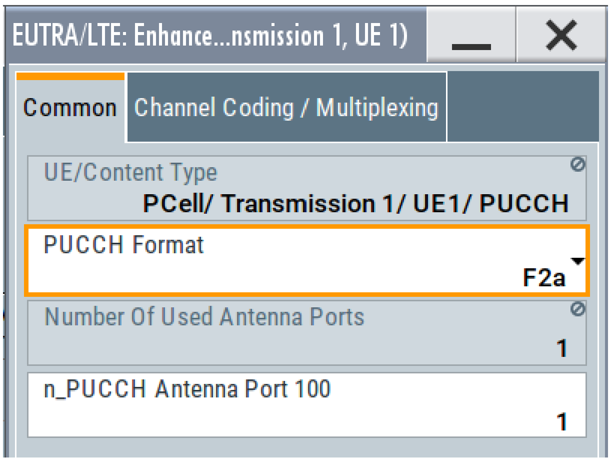
Access: see Chapter 3.19, "eMTC PUCCH settings", on page 205.

The eMTC PUCCH configuration reuses the LTE concept.

Settings:

Common

The "Common" settings dialog indicates the type and format of the selected channel.



The "UE/Content" indication resembles related information from the "eMTC Allocation" table.

Format ← Common

For PUCCH transmission, this parameter sets the PUCCH format.

Table 3-29: PUCCH formats depending on the CE mode and duplexing mode

"CE Level"	"Duplexing > FDD"	"Duplexing > TDD"
0, 1	1, 1a, 2, 2a, 2b	1, 1a, 1b, 2, 2a, 2b
2, 3	1, 1a	1, 1a

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:FORMat on page 540

Number of Used Antenna Port ← Common
Indicates that one antenna port is used.

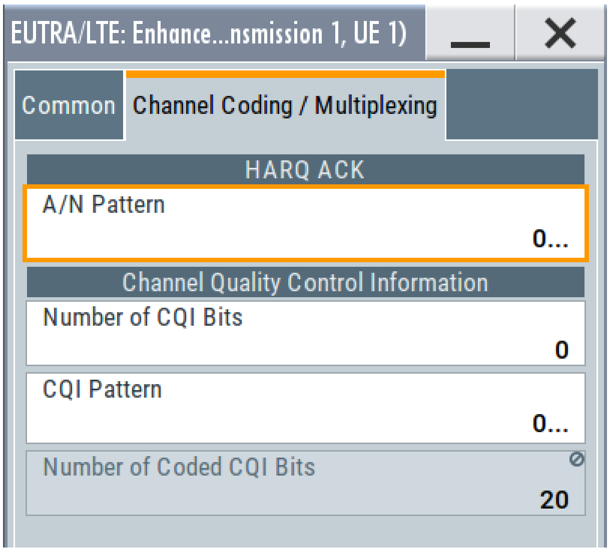
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NAPused?
on page 546

n_PUCCH Antenna Port 100 ← Common
Sets the PUCCH resource index.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NPUCch on page 546

Channel Coding and Multiplexing
Access: "UEx > eMTC Allocation > PUCCH > Format = F2b".

The provided settings are identical to the LTE settings.



A/N Pattern ← Channel Coding and Multiplexing
Sets the PUCCH ACK/NACK pattern.

A "1" indicates an ACK, a "0" - a NACK.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:HARQ:PATTern on page 548

Number of CQI Bits ← Channel Coding and Multiplexing
Sets the number of CQI bits before channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:BITS
on page 548

CQI Pattern ← Channel Coding and Multiplexing
Sets the CQI pattern for the PUCCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:PATTern on page 549

Number of Coded CQI Bits ← Channel Coding and Multiplexing
Displays the number of coded CQI bits.

The number of coded CQI bits for PUCCH is always 20.

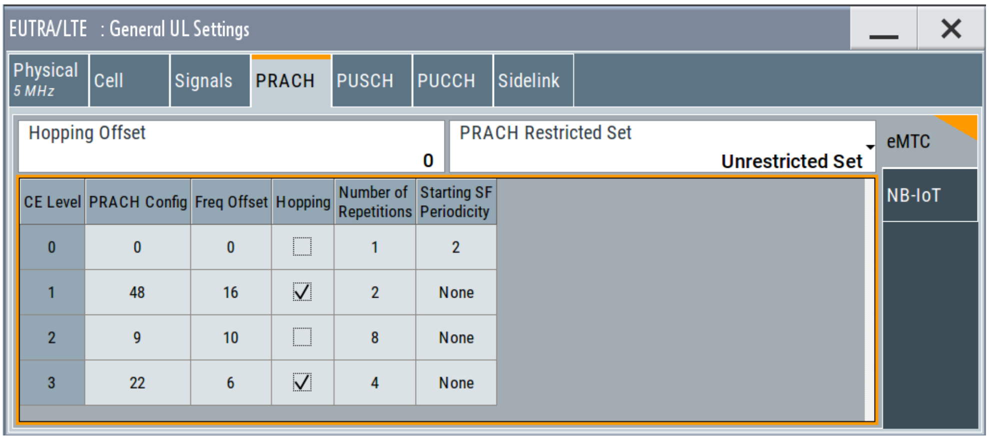
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:CBITs?
on page 549

3.20 eMTC PRACH settings

Access:

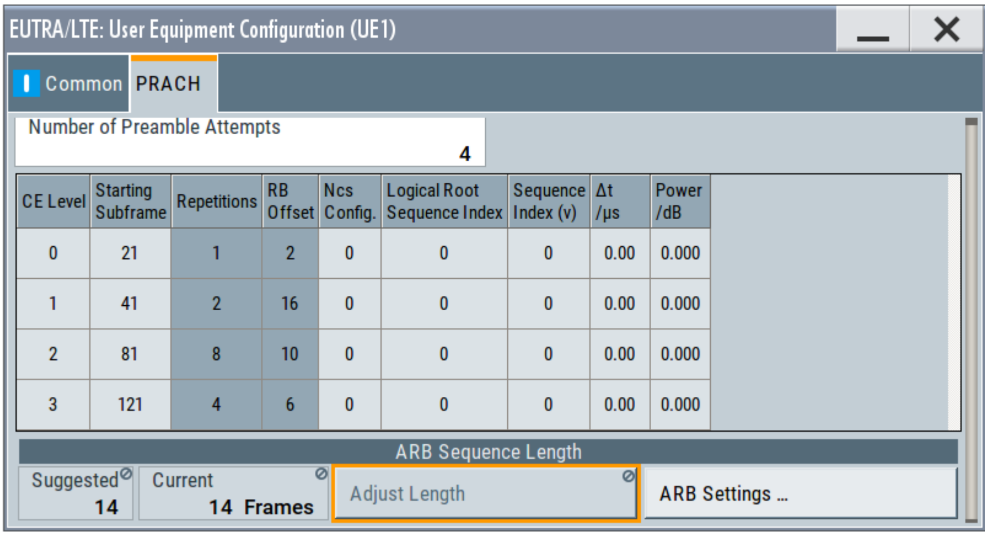
1. Select "General > General UL Settings > PRACH".
2. Select the "eMTC" side tab.

   The dialog comprises the parameters to define the PRACH per coverage extension level (CE level).

   The group of LTE parameters has no effect on the eMTC PRACH configuration.
3. To allocate the NPRACH for a specific UE, use the following parameters:
   a) Select "UL Frame Configuration > UE1 > 3GPP Release = eMTC".

b) Select "UE1 > Settings > Common > Mode = PRACH".
c) Select "PRACH".



You can change the number of preamble attempts, select one of the PRACH configurations per attempt and PRACH allocation.
For description of the related settings, see "eMTC PRACH allocation per UE" on page 213.

4. If necessary, use the "Adjust Length" function to enable larger number of frames automatically so that the PRACH frequency hopping pattern is completed.

5. Open the "Time Plan" to visualize the PRACH allocation:
   a) Select "UL Frame Configuration > Time Plan".
   b) Configure the subframes to be displayed.
      For example "1st Subframe = 80" and "Subframes = 30".

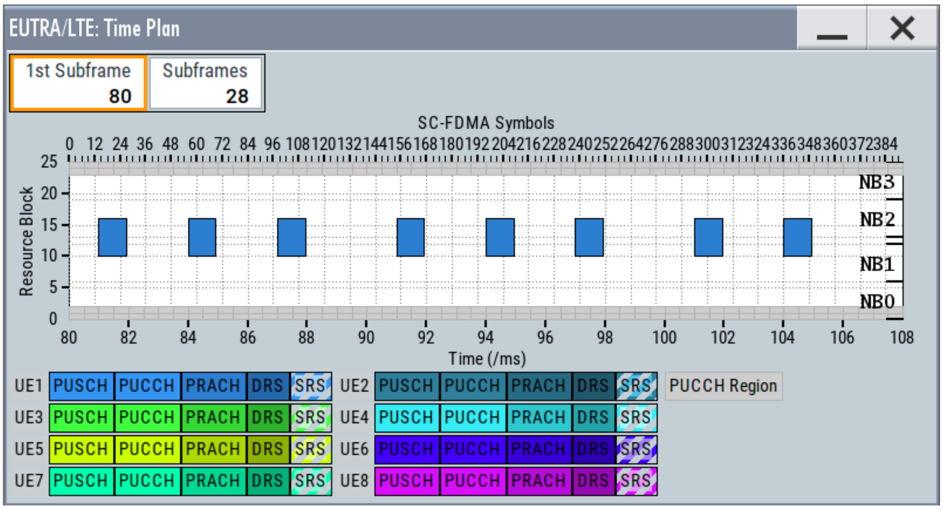


Figure 3-1: PRACH configuration visualization in the "Time Plan" ("PRACH Configuration = 9", "Repetitions = 8"; PRACH bandwidth = 6 RB)

PRACH settings:

eMTC PRACH configurations

Use the provided settings to configure three PRACH configurations for the different coverage levels (CE).

Hopping Offset ← eMTC PRACH configurations

Sets a PRACH hopping offset as number of resource blocks (RB).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:HOFF` on page 506

Restricted Set ← eMTC PRACH configurations

Set the higher-layer parameter `High-speed-flag` and defines whether unrestricted set or one of the restricted sets ("Type A" or "Type B") is used.

The value influences the PRACH generation out of the Zadoff-Chu sequence.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:RSET` on page 506

CE Level ← eMTC PRACH configurations

Indicates the CE level.

PRACH Configuration ← eMTC PRACH configurations

Selects one of the predefined 64 PRACH configurations.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:CONFig` on page 507

Freq. Offsets ← eMTC PRACH configurations
Shifts the PRACH allocation in the frequency domain in terms of resource blocks (RB).

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:FOFFset on page 507

Hopping ← eMTC PRACH configurations
Enables frequency hopping per CE level and PRACH configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:HOPPing on page 507

Number of Repetitions ← eMTC PRACH configurations
Defines how many times a PRACH is repeated.

According to TS 36.211, PRACH can be repeated N_{rep}^{PRACH} = 1, 2, 4, 8, 16, 32, 64 or 128 times.

If "Hopping > On", the repetitions use different frequency allocations.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:REPetit on page 507

Starting SF Periodicity ← eMTC PRACH configurations
Sets the higher-layer parameter N_{start}^{PRACH}:

"2, 4, 8, 16, 32, 64, 128 or 256"
Indicates the periodicity of the starting subframes in terms of subframes that are allowed for PRACH transmission.
The following applies:
"Starting SF Periodicity" ≥ Number of Repetitions.

"None"
The periodicity of the allowed starting subframes is N_{rep}^{PRACH}, as set with the parameter Number of Repetitions.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:SSFPeriod
on page 508

eMTC PRACH allocation per UE
Comprises the UE-specific PRACH configuration.

Use this setting to can change the PRACH allocation per UE, for example:
- The number of preamble attempts
- To select starting subframe and configure PRACH allocations.

Number of Preamble Attempts ← eMTC PRACH allocation per UE
Each preamble attempt is defined in a row in the PRACH table.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:EMTC:PRATtempts on page 549

CE Level ← eMTC PRACH allocation per UE
Selects the CE level. Several PRACH settings are set as configured in the common PRACH setting for the particular CE level, see "eMTC PRACH configurations" on page 212.

Each subsequent preamble attempt (i.e. subsequent row in the PRACH table) has to use a higher CE level.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:CELV`
on page 550

Starting Subframe ← eMTC PRACH allocation per UE
The value is calculated automatically, based on the CE level and the CE level and the CE level used by the previous preamble attempt.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:SFSTart`
on page 550

Repetitions ← eMTC PRACH allocation per UE
Displays the values set in the general PRACH settings dialog for the selected CE level, see Number of Repetitions.

Frequency Resource Index ← eMTC PRACH allocation per UE
For "Duplexing > TDD", sets the frequency resource index f_{RA} for the selected subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:FRINdex`
on page 550

RB Offset ← eMTC PRACH allocation per UE
Indicates the starting RB. The value is calculated form the parameter Freq. Offsets.

Ncs Configuration ← eMTC PRACH allocation per UE
Sets the Ncs configuration and determines the Ncs value for the preamble attempt according to TS 36.211.

Table 3-30: Value range Ncs configuration

Parameter	Ncs configuration
"PRACH > Restricted Set = Off"	0 to 15
"PRACH > Restricted Set = Type A"	0 to 14
"PRACH > Restricted Set = Type B"	0 to 12
"Duplexing > TDD" and "PRACH Configuration" > 47	0 to 6

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:NCSConf`
on page 551

Logical Root Sequence Index ← eMTC PRACH allocation per UE
Sets the logical root sequence index.

Parameter	Root sequence (u)
"Duplexing > TDD" and "PRACH OCnfiguration" > 47	0 to 137
Otherwise	0 to 838

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:RSEQuence
on page 551

Sequence Index (v) ← eMTC PRACH allocation per UE
Sets the sequence index **v**.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:SINDex
on page 551

Delta t /us ← eMTC PRACH allocation per UE
Sets the parameter Delta_t in us.

Any Δt value different than 0 shifts the preamble in the time domain.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:DT
on page 551

Power, dB ← eMTC PRACH allocation per UE
Sets the preamble attempt power relative to the UE power.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:POWer
on page 552

ARB Sequece Length > Sugested
Indicates the ARB sequence length that is required for the current PRACH configuration.

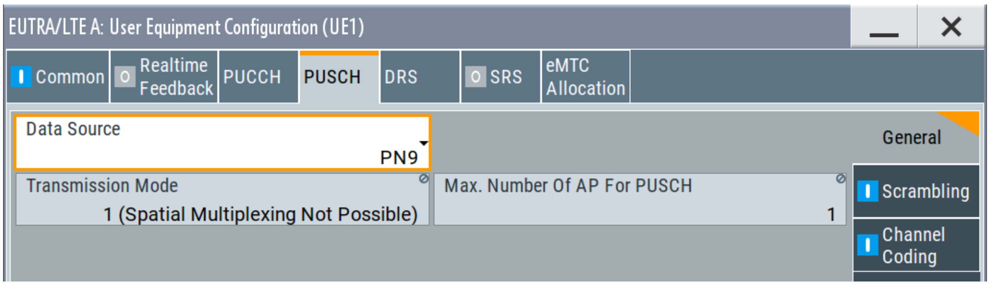
Use the "Adjust Length" function to apply the suggested value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:EMTC:ARB:SUGGested?
on page 552

3.21 eMTC PUSCH/NPUSCH UE-specific settings

Access:

1. Select "General > UL Frame Configuration > UE x > 3GPP Release > eMTC/NB-IoT".
2. Select "UE x > PUSCH/NPUSCH".



Settings:

NPUSCH + SRS simultaneous Tx

For "UEx > 3GPP Release = NB-IoT", enables simultaneous transmission of NPUSCH and SRS.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:NPSSim` on page 529

Data Source

Selects the data source for the PUSCH allocation.

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:

- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.

- Section "Data List Editor" in the R&S SMW user manual

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DATA on page 514
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:PATTern on page 514
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DSELect on page 515

Transmission Mode, Max. Number of Antenna Ports for PUSCH
eMTC/NB-IoT UEs do not support MIMO.

They use "Transmission Mode = 1 (Spatial Multiplexing not Possible)" and one antenna port for PUSCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:TXMode on page 515
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:NAPort on page 515

Scrambling > State
Enables scrambling for all PUSCH allocations of the corresponding UE.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:SCRambling:STATe on page 515

Channel Coding and Multiplexing > State
Enables 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 PUSCH data source is forwarded to the scrambler without any coding processing.

To set further parameters for the encoding of control information, use the following settings:
- "UEx > eMTC Allocation > Content = PUSCH > Enhanced Settings > Config"
- "UEx > NB-IoT Allocation > Enhanced Settings > Config"

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:STATe on page 516

Mode Channel Coding
Defines the information transmitted on the PUSCH/NPUSCH.

"UCI+UL-SCH"	Control information and data are multiplexed into the PUSCH.
"UL-SCH"	Only data is transmitted on PUSCH(NPUSCH.
"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 516

I_HARQ_offset
Sets the HARQ-ACK offset index for control information MCS offset determination according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:IHARqoffset on page 517

I_CQI_offset
Sets the CQI offset index for control information MCS offset determination according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:ICQioffset on page 516

O_CQI-Min
(Enabled in "UCI only" transmission)

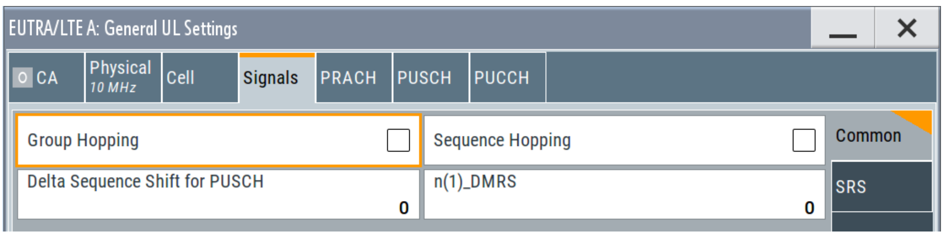
Sets the parameter O-CQI-Min, where O_CQI-Min is the number of CQI bits including CRC bits assuming rank equal to 1.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:OCQimin on page 517

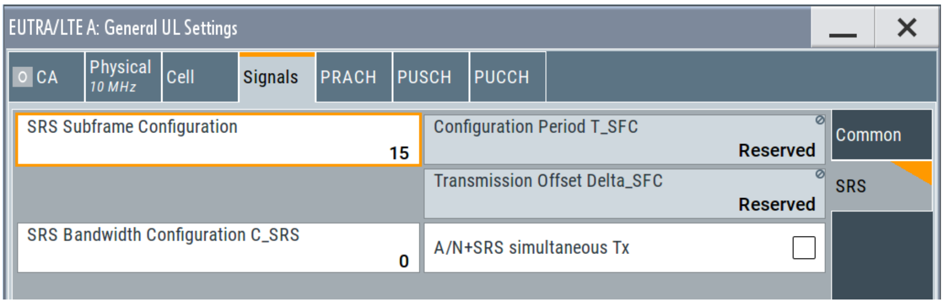
3.22 eMTC reference signals and SRS settings

Access:

1. To access the **cell-specific reference signals and SRS settings**:
   a) Select "General UL Settings > Signals > Common".

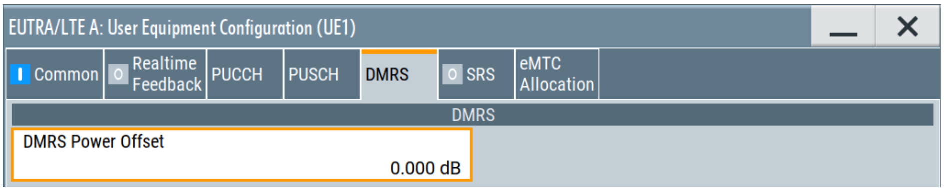


b) Select "Signals > SRS".



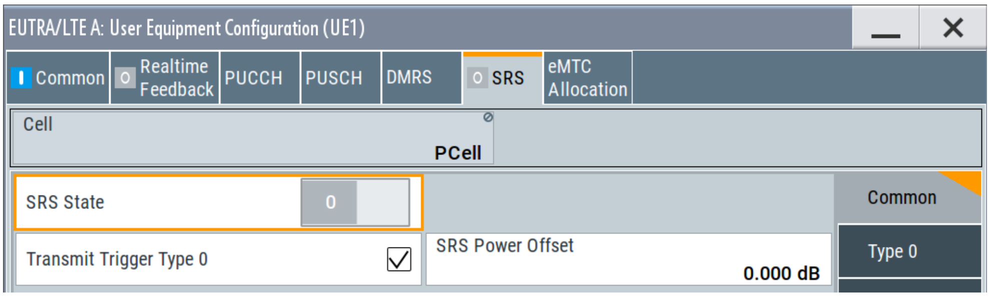
This dialog comprises the settings needed for configuring the uplink reference signals and the SRS structure.

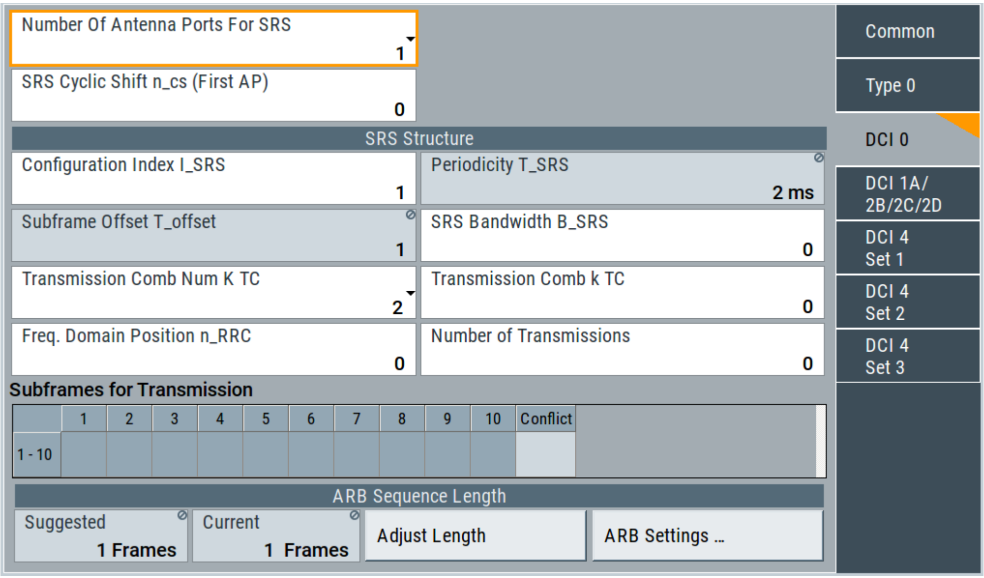
2. To access the **user-specific DMRS settings**:
   a) Select "UL Frame Configuration > General > UEx > 3GPP Release > eMTC".
   b) Select "UEx > UE Configuration > DMRS".



3. Likewise, to access the **user-specific SRS settings**, select "SRS".

   The dialog consists of 6 subtabs, one for the "trigger type 0" SRS and 5 for the SRS sets.

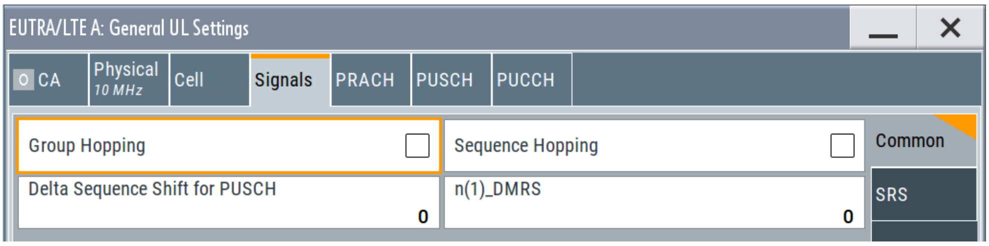




3.22.1 UL reference signals

Access:

1. Select "LTE > Link Direction > Uplink".
2. Select "General Settings > Signals > Common".



Settings:

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 patterns are derived as follows:

- PUCCH
  From the physical layer cell ID set as a combination of the parameters Physical Cell ID Group and Physical Layer ID.
- PUSCH
  By the parameter Delta Sequence Shift for PUSCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:GRPHopping on page 499

Sequence Hopping

Enables/disables sequence hopping for the uplink reference signals demodulation reference signal (DMRS) and sounding reference signal (SRS).

If sequence hopping and Group Hopping are be activated simultaneously, only group hopping is applied 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 500

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 500

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. It is used for the calculation of the DMRS sequence.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DMRS on page 500

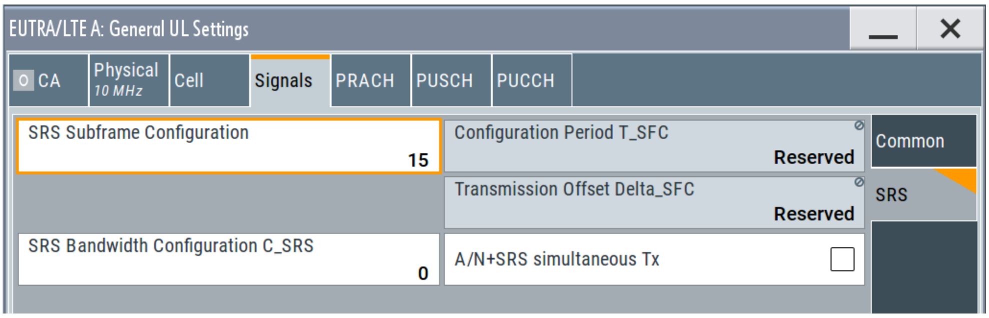
3.22.2 Cell-specific SRS settings

The cell-specific parameters in this section determine the structure of the sounding reference signal (SRS) according to the TS 36.211.

Access:

1. Select "LTE > Link Direction > Uplink".

2. Select "General Settings > Signals > SRS"



To configure the UE-specific parameters, necessary for the complete definition of the SRS structure and SRS mapping, use the settings in the "UEx > User Equipment > SRS" dialog.

Settings:

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 an SRS in the subframe or not.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:SUConfiguration` on page 500

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 501

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 501

SRS Bandwidth Configuration C_SRS

Sets the cell-specific parameter SRS bandwidth configuration (C_{SRS}).

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:CSRS on page 501

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 502

SRS MaxUpPTS
In TDD duplexing mode, enables the cell-specific parameter `srsMaxUpPts`.

If enabled, an SRS is transmitted in the frequency area of the UpPTS field that does not overlap with the frequency resources reserved for a possible PRACH preamble format 4 transmission.

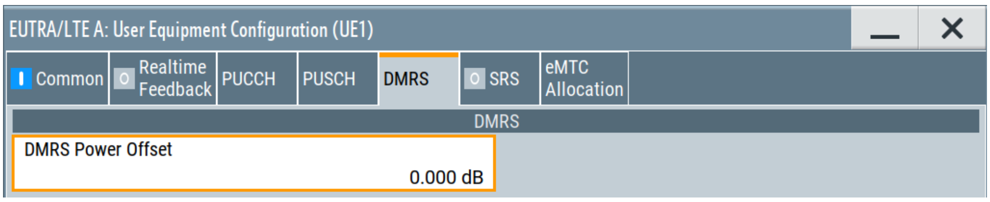
This is done by reconfiguring the number of SRS resource blocks in the special subframes, which would otherwise be determined by C_SRS and B_SRS.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:MUPTs on page 502

3.22.3 UE-specific eMTC DMRS settings

Access:

1. In the "EUTRA/LTE > General" dialog, select "Mode > eMTC/NB-IoT".
2. Select "Link Direction > Uplink (SC-FDMA)".
3. Select "Frame Configuration > General > UEx > 3GPP Release > eMTC".
4. Select "UEx > UE Configuration > DMRS".



DMRS Power Offset
Sets the power offset of the DMRS relative to the power level of the PUSCH or PUCCH allocation of the corresponding subframe.

The selected DMRS power offset (P_{DMRS_Offset}) applies for all subframes.

Depending on the allocation of the subframe, the effective power level of the DMRS is calculated as following:

$P_{DMRS}=P_{UE}+P_{PUSCH/PUCCH}+P_{DMRS\_Offset}$

The PUSCH and PUCCH power levels (P_{PUSCH} and P_{PUCCH}) can vary per subframe.

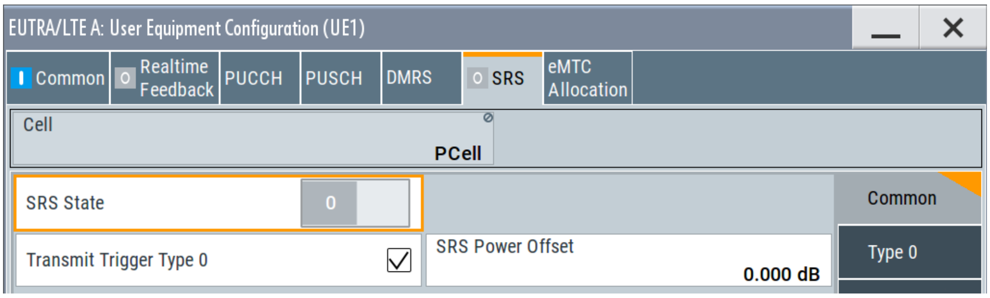
For global adjustment of the transmit power of the corresponding UE, use the parameter UE Power (P_{UE}).

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:POWoffset on page 518

3.22.4 UE-specific eMTC SRS settings

Access:

1. In the "EUTRA/LTE > General" dialog, select "Mode > eMTC/NB-IoT".
2. Select "Link Direction > Uplink (SC-FDMA)".
3. Select "Frame Configuration > General > UEx > 3GPP Release > eMTC".
4. Select "UEx > UE Configuration > SRS".



In the "SRS Structure" section, you can configure the **UE-specific SRS 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 (see Chapter 3.22.2, "Cell-specific SRS settings", on page 221).

Settings:

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 518

Transmit Trigger Type 0

The 3GPP specification defines two types of SRS transmission:

- **Periodic SRS**
  SRS occurs at regular time intervals.
  Periodic SRS is referred as "trigger type 0" SRS. It is known form LTE Rel. 8
- **Aperiodic SRS**
  The aperiodic SRS transmission is a single (one-shot) transmission.
  Aperiodic SRS is referred as "trigger type 1" SRS. It is introduced by LTE Rel. 10.

"On" Trigger type 0 is used.
The SRS is configured by higher levels.
To configure the SRS structure, use the settings in the "Type 0" dialog .

"Off" Trigger type 1 is used.
The SRS is triggered by the PDCCH DCI content, in particular by the DCI format 0/4/1A/2B/2C/2D (DCI formats 2B/2C for TDD only).
To configure the SRS structure, use the dedicated settings in the "DCI 0/1A/2B/2C/2D/4 Set 1 to 3" dialogs.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:TT0`
on page 519

SRS Power Offset

Sets the power offset of the 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 519

SRS Set Configuration
For LTE-Advanced/eMTC UEs, the 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 requires one dedicated SRS set of parameters ("DCI 0")
- The triggering by using DCI formats 1A/2A/2B/2C uses a common SRS set ("DCI 1A/2B/2C/2D")
- For the triggering by DCI format 4, the specification defines 3 SRS sets ("DCI 4 Set 1", "DCI 4 Set 2" and "DCI 4 Set 3")

Number of Antenna Ports for SRS ← SRS Set Configuration
For 3GPP Release = "LTE-Advanced/eMTC" 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 520

SRS Cyclic Shift n_CS (First AP) ← SRS Set Configuration
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 520

SRS UpPTS Add ← SRS Set Configuration
In TDD mode, sets the higher layer parameter `srs-UpPtsAdd`, as specified in TS 36.211.

This parameter defines the number of additional SC-FDMA symbols in UpPTS and thus determines the total length of GP and UpPTS.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:UPPTsadd on page 523

SRS Structure ← SRS Set Configuration
Use the following parameters to define the SRS structure:

Configuration Index I_SRS ← SRS Structure ← SRS Set Configuration
Sets the UE-specific parameter SRS configuration index I_{SRS}.

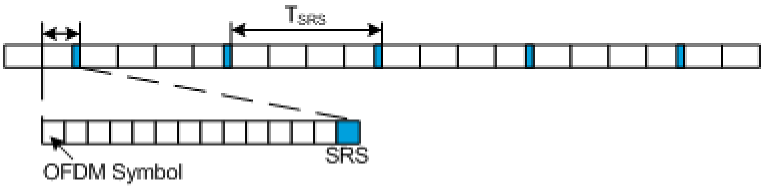
Depending on the selected "Duplexing Mode", this parameter determines the parameters SRS Periodicity T SRS and SRS Subframe Offset T_offset as defined in the TS 36.213, table 8.2-1 (FDD) and 8.2-2 (TDD) respectively.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:ISRS on page 520

Periodicity T_SRS ← SRS Structure ← SRS Set Configuration
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"

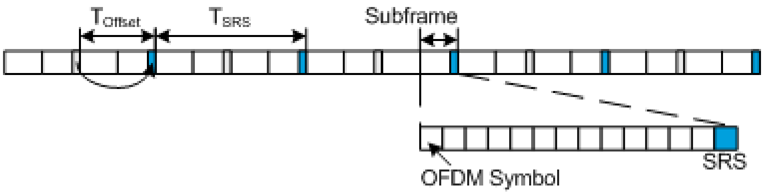
The default values of all other SRS parameters are left unchanged.

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 520

Subframe Offset T_offset ← SRS Structure ← SRS Set Configuration
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. 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.

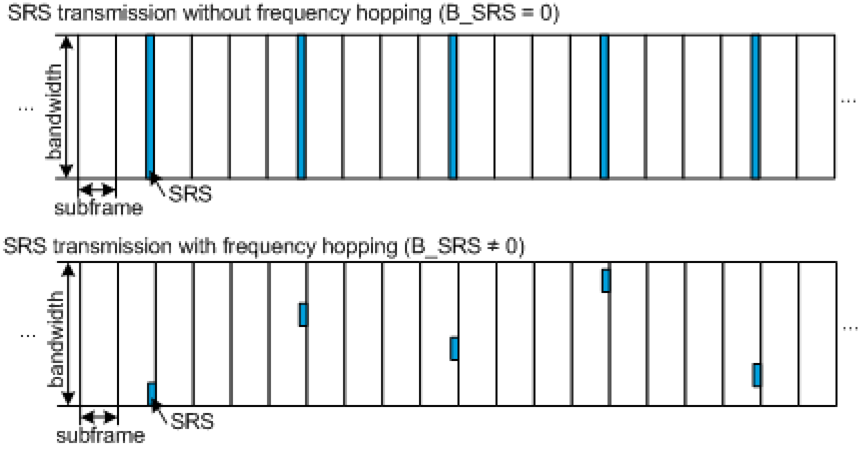
For TDD duplexing mode with T_SRS value of 2 ms, two T_offset values are displayed, corresponding to the two SRS transmissions per 5 ms. For example, the values 0, 1 mean that two SRS transmissions occur, both in the special subframe. One of them is in the second last symbol and the other one, in the last symbol of the subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TOFFset?` on page 521

SRS Bandwidth B_SRS ← SRS Structure ← SRS Set Configuration
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 521

Transmission Comb k TC ← SRS Structure ← SRS Set Configuration

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 522

Hopping Bandwidth b_hop ← SRS Structure ← SRS Set Configuration

(for trigger type 0 SRS ("Type 0"))

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 522

Freq. Domain Position n_RRC ← SRS Structure ← SRS Set Configuration
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 522

Number of Transmissions ← SRS Structure ← SRS Set Configuration
Sets the number of SRS transmissions.

That is, the number of cells in the table Subframes for Transmission.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NTRans on page 522

Subframes for Transmission ← SRS Structure ← SRS Set Configuration
Sets the subframes in that the SRS is transmitted. The values correspond to the values of the SRS parameter Configuration Index I_SRS.

A conflict is indicated in the following situations:
- The subframe number is already used in the SRS set
- The subframe number is used in another SRS set of the same UE

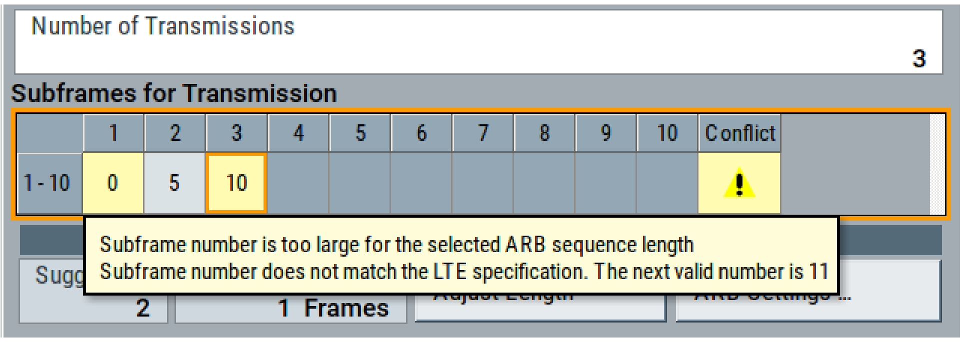


Figure 3-2: Example of conflict indication: DCI 4 Set 2 and DCI 1A/2B/2C/2D SRS sets use configuration index (subframe number) = 2

- The subframe number is outside the current ARB sequence length.

Note: If there is conflict, observe the tooltip.
Change the subframe index or select Adjust Length to set the "ARB Sequence Length" to the proposed value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:SUBF<subfidx> on page 523

Suggested ← SRS Structure ← SRS Set Configuration
Indicates the suggest ARB sequence length as number of frames.

Select "Adjust Length" to set the ARB sequence length to the proposed value.

Adjust Length ← SRS Structure ← SRS Set Configuration
Set the ARB sequence length to the proposed value.

This function is active, if an SRS transmission is configured in subframe number that is outside of the frames in the current "ARB Sequence Length".

ARB Settings ← SRS Structure ← SRS Set Configuration
Access the "ARB" dialog and displays the "ARB Sequence Length" value.

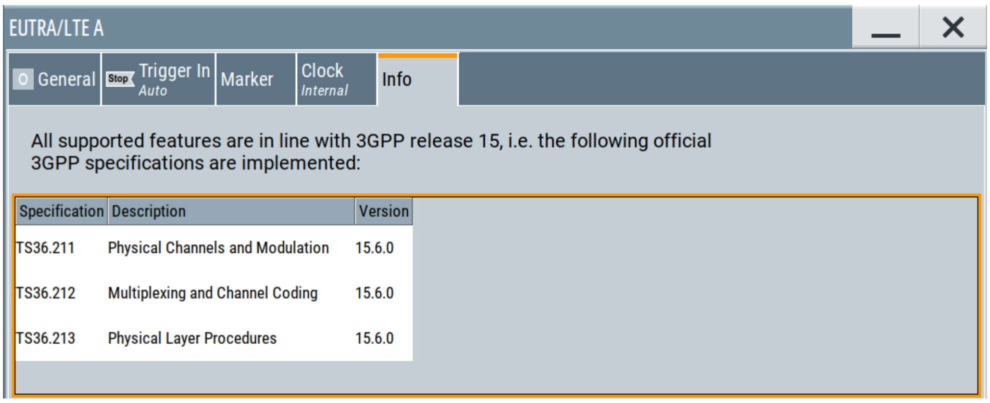
See Chapter 8.2.3, "ARB settings", on page 359.

3.23 Find out the implemented 3GPP specification

The Info dialog displays the currently supported version of the 3GPP standard.

Access:

► Select "EUTRA/LTE > Info".



The default settings and parameters provided are oriented towards the specifications of the version displayed.
Remote command:
`[:SOURce]:BB:EUTRa:VERSion?` on page 404

4 Real-time feedback for eMTC/NB-IoT testing

Some test scenarios, like for example the performance test cases specified in TS 36.141, require a feedback line. With R&S SMW equipped with the following options, you can perform closed loop performance tests with feedback.

Required options

Option:

- R&S SMW-K69
- R&S SMW-K115
- Further options, like R&S SMW-K62 or R&S SMW-B14/-K71/-K72/-K73/-K74

Real-time feedback principle in the context of eMTC/NB-IoT testing

The real-time feedback functionality in the eMTC/NB-IoT case is similar to the one for the LTE/LTE-A testing. Consider, however, the following differences:

- Redundancy version (RV) signaling
  In the eMTC/NB-IoT case, there are no HARQ messages transmitted over the feedback line. The DUT merely sends feedback signal carrying the **redundancy version (RV)** to be applied for the subsequent PUSCH bundle or NPUSCH F1 transmission.
  Within a PUSCH bundle, the redundancy versions are determined automatically, according to TS 36.213.
- Asynchronous HARQ
  Signaling only the RV is necessary, because the eMTC/NB-IoT relays on an **asynchronous HARQ**.
- Feedback timing
  In eMTC/NB-IoT, the feedback timing reference point is derived from the uplink transmission.
  If your test situation requires it, you can set an Additional User Delay and back shift feedback timing.
  See Chapter 4.2, "Feedback timing for eMTC/NB-IoT tests", on page 235.

For details on the realtime feedback functionality in LTE/LTE-A, see the R&S SMW EUTRA/LTE user manual

4.1 Feedback modes

Some test setups, like for example the performance verification tests, require a feedback line from the DUT (base station) to the signal source.

Input connectors

The R&S SMW expects the feedback signal at one of the input connectors:

- Option: R&S SMW-B10
  - "T/M 3"
  - "T/M 6"
- Option: R&S SMW-B9
  - "T/M 2"
  - "T/M 4"

How to route and enable feedback signal

The R&S SMW uses a flexible signal-to-connector mapping concept. In the default instrument state, the local "T/M x" connector is not configured as inputs of the feedback and the baseband feedback signal.

1. Select "Feedback > Connector" = "Local".
2. If R&S SMW-B10 is available, configure the connectors as follows:
   a) "Local Connectors > Connector > T/M 3 > Direction > Input".
   b) "Local Connectors > Connector > T/M 3 > Signal > Feedback".
3. If R&S SMW-B9 is available, configure the connectors as follows:
   a) "Local Connectors > Connector > T/M 2 > Direction > Input".
   b) "Local Connectors > Connector > T/M 2 > Signal > Feedback".
4. Connect the feedback line to the configured connector.

4.1.1 Serial modes

The serial line uses a serial protocol that is similar but not identical to the RS232.

It carries information in form of serial commands that are transmitted as a sequence of 1-bit long symbols. Symbols are interpreted as 1, if the signal voltage level exceeds a certain threshold, or as 0, if the voltage level is below this threshold.

The input impedance of the input connectors for the feedback line and the low/high threshold voltage are configurable parameters. Use the Local and global connectors settings dialog and adjust the parameters "Threshold Clock/Trigger Input" and "Impedance Clock/Trigger Input" as required.

Symbol rate

The serial feedback commands can be transmitted with a symbol rate of 115.2 kbps, 1.6 Mbps or 1.92 Mbps.

See "Serial Rate" on page 238.

The R&S SMW starts the sampling process at middle of the start bit. It then samples the subsequent received bits according to the selected sampling rate. Deviations between the selected sampling rate and the actual sampling rate are tolerated, if the used sampling point for each of the bits is within the stable bit duration.

Structure

Serial commands consist of *16 data bits (D0 to D15)*. These commands can be transmitted in **serial** or **serial 3x8** modes. Serial commands start with one low-level start bit and ends with one high-level stop bit. Between two consecutive commands (or packets) or before the first command, the line has to be held on high level (idle). Parity bit are not used. The least significant bit (LSB) is transmitted first.

Figure 4-1: Structure of a serial command (Serial mode)

Idle = Always high
SB = Start bit, always low
EB = Stop bit, always high
D0 to D15 = Data bits, LBS first; see Chapter 4.1.2, "Structure of a serial and 3x8 serial feedback command", on page 234
D0 = LSB (least significant bit)
D15 = MSB (most significant bit)

In the serial 3x8 mode, a command does not consist of one singular serial packet, but is distributed over *three serial packets*, see Figure 4-2.

Figure 4-2: Structure of one feedback command in Serial 3x8 mode

Idle = Always high
SB = Start bit, always low
EB = Stop bit, always high
L, H = Low/high bits, used for synchronization purposes
D0 to D15 = Data bits, LSB first; see Chapter 4.1.2, "Structure of a serial and 3x8 serial feedback command", on page 234
D0 = LSB (least significant bit)
D15 = MSB (most significant bit)

The structure illustrated on Figure 4-2 is mandatory. The 16 data bits (D0 to D15) are distributed among the three 8-bits long packets. The remaining serial bits must comply with the specified low or high levels for synchronization purposes.

4.1.2 Structure of a serial and 3x8 serial feedback command

Table 4-1 shows the structure and the meaning of the 16 data bits (D0 to D15) in a feedback command; the LSB is D0, the MSB - D15.

Table 4-1: Structure of one feedback command

D15 to D14	D13 to D11	D10 to D0
BB selector	Message type selector	Message bits

Meaning of the bits for UE1 > 3GPP Release = eMTC/NB-IoT

- The **BB selector** (D15 to D14) determines for which of the baseband blocks the feedback command is for.

The R&S SMW 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. Each baseband processes only the feedback commands that are labeled with its BB selector. To set the BB selector per baseband, use the parameter Baseband Selector.
You can send (i.e. multiplex) different feedback commands to different baseband blocks over the same shared feedback line. To provide the feedback signal to all related basebands, use a T-connector to split the feedback line form the DUT and feed the signals to the corresponding T/M connectors simultaneously.
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 to D11) determines the message type and the command that is signaled.
  The message type selector is always **1**.
- **Message bits** (D10 to D0) have the following meaning:
  - D10 to D2: reserved
  - D1 to D0: Requested **starting redundancy version**, where the value range is as follows:
    "UE1 > 3GPP Release = eMTC": 0 to 3
    "UE1 > 3GPP Release = NB-IoT": 0 or 2

  The specified starting redundancy version corresponds to the parameter *rv_idx* defined in TS 36.213, not to the counter *rv*, as it is signaled in a DCI6-0A or DCI N0.
  For example, for eMTC transmission with enabled repetitions and message bits set to 0, the RV = 0 is used in the first repetition. RV = 2, 3, 1 are used for the subsequent repetitions, as defined in TS 36.213.

4.2 Feedback timing for eMTC/NB-IoT tests

Depending on the time a serial feedback command arrives at the instrument, it is associated with a specific PUSCH bundle or NPUSCH format 1 transmission. The received starting redundancy version is then applied for this PUSCH or NPUSCH F1 transmission, see Figure 4-3.

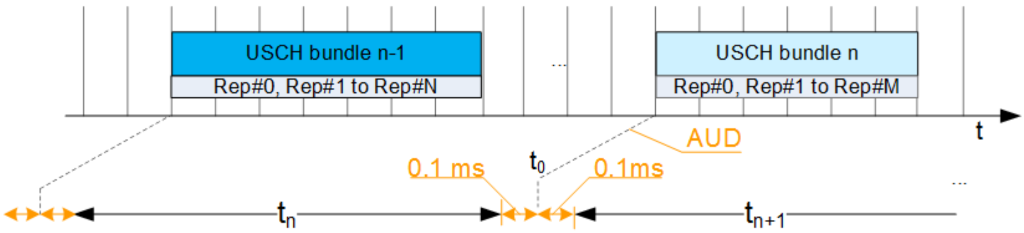


Figure 4-3: Feedback timing for PUSCH and NPUSCH F1 transmissions

t	= Uplink timing (subframes)
USCH bundle n-1 and n	= PUSCH/NPUSCH bundles, can be of different duration. Duration in time depends on the number of repetitions and on the availability of invalid subframes
t_0	= Subframe border
t_n, t_{n+1}	= Time periods during which an arrived serial command is applied to bundle n and n+1 respectively
AUD	= "Additional User Delay", negative values shift the feedback timing back in time
0.1 ms	= Fixed guard period before and after subframe border
	= No feedback command should arrive in the time period (t_0 - 0.1 ms) to (t_0 + AUD)

As shown on Figure 4-3, the UL feedback timing t_0 depends on the UL transmission. You can, however, use the parameter "Additional User Delay" to shift the feedback timing, if it is required in your particular test situation. The starting point of the time period corresponds to the moment t_0 + AUD.

The R&S SMW expects and uses one feedback command per PUSCH or NPUSCH F1 bundle. The following applies, if there is a deviation:

- If no feedback command is received, a starting RV = 0 is assumed.
- If more than one feedback commands are received for a bundle, the last one is evaluated and the starting RV signaled by its message bits is applied.

4.3 Real-time feedback configuration settings

Option: R&S SMW-K69

See also "Required options" on page 232.

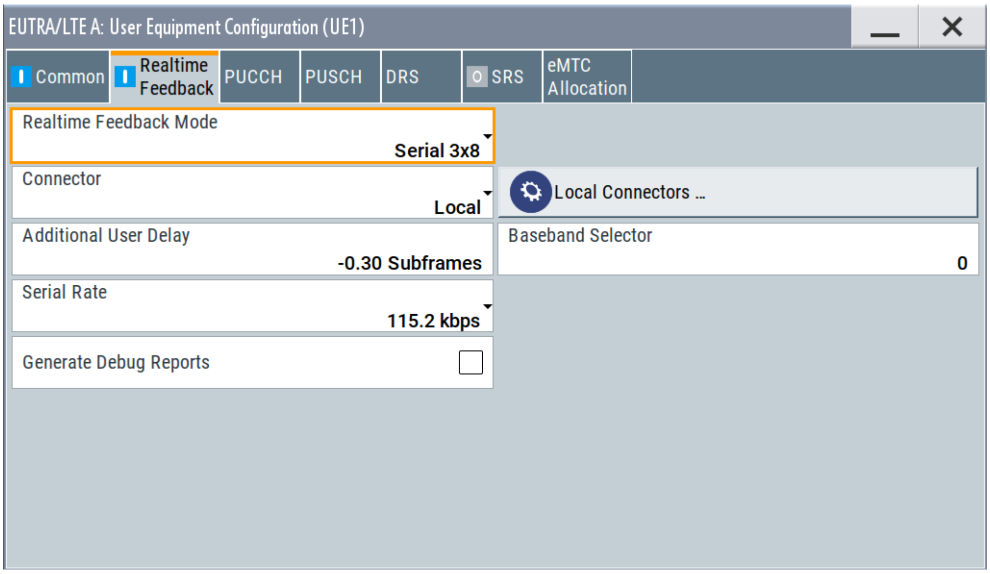
Interdependencies

- The real-time feedback configuration is enabled only for UE1
- With enabled real-time feedback for UE1:
  – UE2, UE3 and UE4 are disabled
  – "Starting Redundancy Version" for the PUSCH/NPUSCH F1 transmission is set to "Auto".

Access:

1. Select "System Configuration > Fading/Baseband Configuration > Mode > Standard"
2. Select "General > Link Direction > Uplink"
3. Select "Frame Configuration > General > Select User Equipment" > **"UE1"**
4. Select "Realtime Feedback"

5. To enable the real-time feedback, set the "Realtime Feedback Mode" to a value different than "Off".



You can enable realtime feedback once per baseband block.
If realtime feedback is active for UE1, than UE2, UE3 and UE4 are disabled. The parameter "Starting Redundancy Version" for the PUSCH/NPUSCH F1 transmission is set to "Auto".

For background information, see Chapter 4, "Real-time feedback for eMTC/NB-IoT testing", on page 232.

The remote commands required to define these settings are described in Chapter 9.18, "Realtime feedback", on page 574.

Settings:

Realtime Feedback Mode

Enables real-time feedback and determines the mode of the feedback line.

"Off" Real-time feedback is disabled.

"Serial/Serial 3x8"
The feedback is implemented by a serial protocol.
In "Serial 3x8" mode, a serial command consists of three serial packets.
See Chapter 4.1.1, "Serial modes", on page 233.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:MODE` on page 575

Connector
Determines the feedback line connector, Chapter 4.1, "Feedback modes", on page 232.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:CONNector` on page 575

Additional User Delay
Determines the point in time when the feedback can be sent to the instrument.

See also:
- Chapter 4.2, "Feedback timing for eMTC/NB-IoT tests", on page 235

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ADUDelay` on page 576

Baseband Selector
In "Serial/Serial 3x8" mode, this parameter is required for multiplexing serial commands for different baseband units to one feedback line.

Configuring different baseband selectors for the different basebands enables you to send different feedback commands to two basebands even if they share a common feedback line (i.e. the same physical cable). A baseband receives only the feedback commands that contain the same baseband selector as configured in its dialog (with the parameter "Baseband Selector"). A baseband ignores all feedback commands with different baseband selectors.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BBSelector` on page 576

Serial Rate
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 576

Generate Debug Reports
Enables the R&S SMW to create and store debug reports, i.e. log files with detailed information on the real-time feedback.

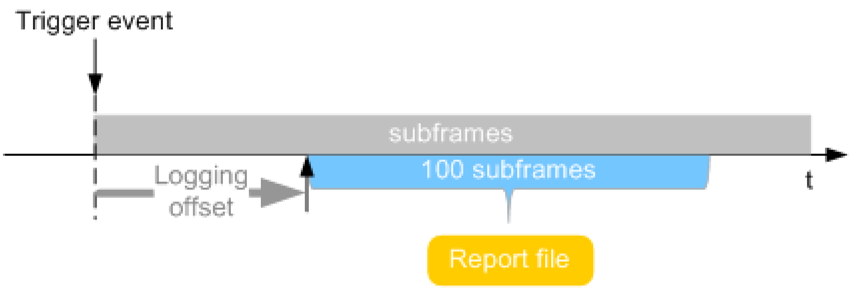
The instrument generates two types of reports:
- Transmission report
  – This file contains information about what is *sent* (e.g. redundancy versions,) during the first 100 subframes after triggering and elapsing the Logging Offset.
  – File is created after the 100 subframes are sent.
  – Default filename and location
    `/var/user/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 filename and location
`/var/user/EUtraRealtimeUplinkFeedback_ReceptionReport_BBA_BBSel0.txt`

Use these debug files for troubleshooting of complex real-time feedback tests.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:GENReports` on page 577

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 577

5 Observing current allocations on the time plan

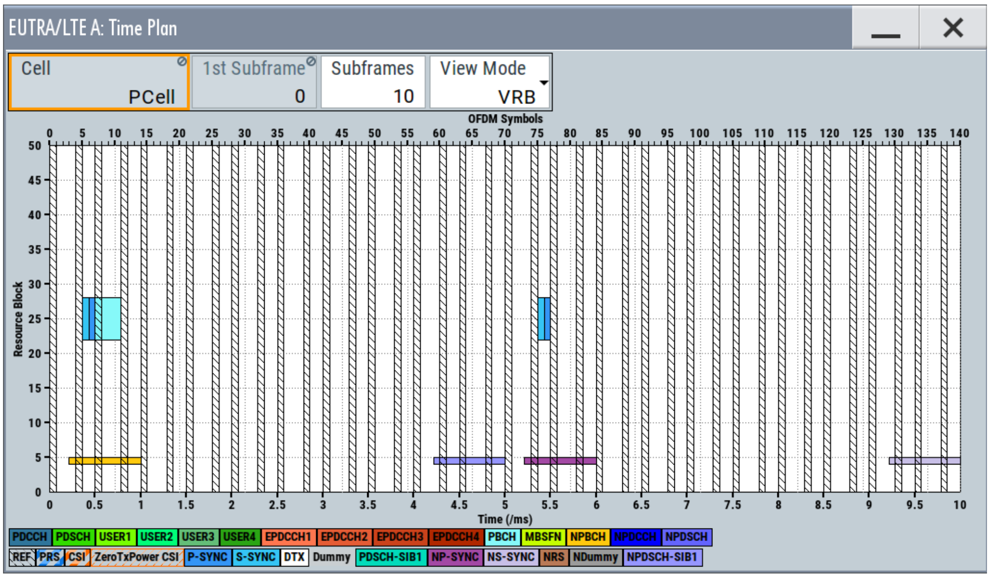
You can observe the current allocations on the time plan. There are dedicated uplink and downlink time plans and, if TDD duplexing mode is used, the time plan also visualizes the special subframes.

The time plan shows active channels and signals, the allocations of the active UEs and indicates the cell it applies for if a carrier aggregation is used. Per default, the time plan shows the allocation per used channel bandwidth and one subframe but you can extend the displayed time region to up to 40 subframes. You can also scroll over all available subframes and open the time plan in a separate window.

5.1 eMTC/NB-IoT indication in the DL time plan

Access:

1. In the "General" dialog, select "Mode > LTE/eMTC/NB-IoT".
2. Select **"Link Direction > Downlink"**.
3. In the "General DL Settings > NB-IoT Carriers" dialog, for the anchor carrier set "Mode = In-Band"
4. Select "Frame Configuration > Time Plan".



5. To display the NB-IoT allocations in greater detail:
   a) Select "View Mode > Single RB".
   b) Select the RB number in that the anchor carrier is allocated, for example "RB = 2".

   This dialog shows the downlink time plan.

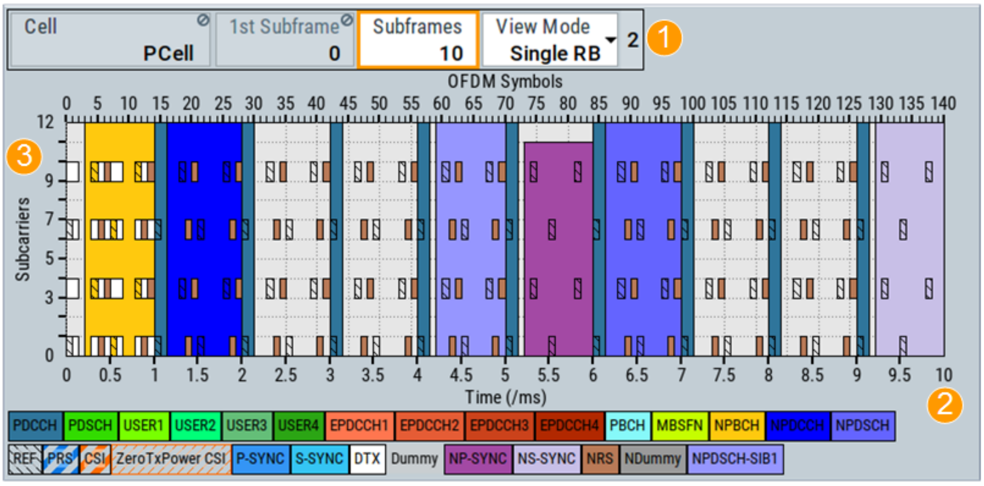


Figure 5-1: Time Plan: understanding the displayed information

1 = "View Mode > Single RB"
2 (x-axis) = Shows the allocations in the time domain
3 (y-axis) = Shows the allocations in the frequency domain, expressed in the smallest allocation granularity

Note that the y-axis indicates the frequency allocation in terms of **number of subcarriers**.

Allocations are calculated as configured in the "DL Frame Configuration > NB-IoT Allocations" dialog.
With the default settings as in this example, displayed are only the NPBCH and the NPSS/NSSS; other downlink channels are not configured.

Settings:

First Subframe

Selects the first subframe to be displayed.

Remote command:
n.a.

Subframes

Selects the number of subframes to be displayed.

Remote command:
n.a.

View Mode
Determines how the allocations are displayed.

If at least one NB-IoT UE is enabled, you use this parameter to zoom in and out in the frequency domain.

"PRB/VRB" The "Time Plan" displays the entire channel bandwidth. It shows the allocated virtual resource blocks (VRBs) or the physical resource blocks (PRBs).
In this granularity, an in-band or guard band NB-IoT allocation is indicated as one resource block; NRS are not visible. This mode is not available in standalone NB-IoT operation.

"Single RB" The "Time Plan" displays the allocation of the anchor carrier (one single RB) as selected in the RB index field.
The NRS, NPSS/NSSS and the downlink channels are shown in greater detail.
Note that the y-axis indicates the frequency allocation in terms of number of subcarriers.

Remote command:
n.a.

Detach Time Plan
Enlarges the time plan display.

5.2 eMTC/NB-IoT indication in the UL time plan

Access:

1. In the "General" dialog, select "Mode > LTE/eMTC/NB-IoT".
2. Select **"Link Direction > Uplink (SC-FDMA)"**.
3. Select "Frame Configuration > Time Plan".
4. Select "View Mode > Channel BW".

   This dialog shows the uplink time plan.

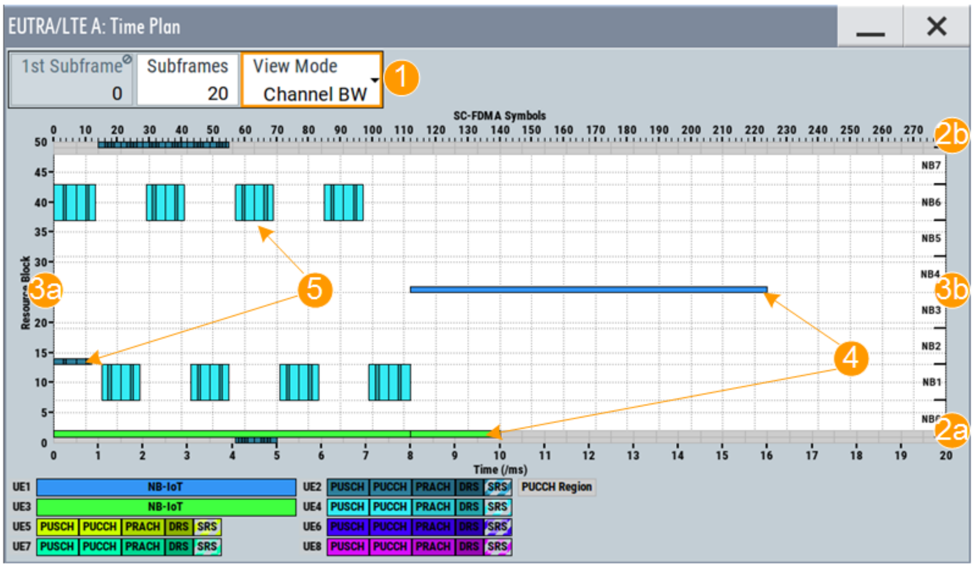


Figure 5-2: Time Plan: understanding the displayed information

1	=	"View Mode > Channel BW"
x-axis	=	Shows the allocations in the time domain
2a, 2b	=	Time, expressed in the time units and as number of SC-FDMA symbols
y-axis	=	Shows the allocations in the frequency domain, expressed in the smallest allocation granularity
3a, 3b	=	Frequency, expressed as number of resource blocks (RB) for the LTE and eMTC UEs and narrowband (NB) for the NB-IoT UEs
4	=	NB-IoT allocations of UE1 and UE3
5	=	eMTC allocations of UE2

Allocations are calculated as configured in the "User Equipment" dialog.

5. To display the NB-IoT allocations in greater detail:
   a) Select "View Mode > Single RB".
   b) Select the number of RB, for example "RB = 1" or "RB = 24".

   See for example the time plan on Figure 2-20.
   Note that the y-axis indicates the frequency allocation in terms of number of subcarriers. The left and the right y-axis shows the subcarrier numbering depending on the subcarrier spacing ("@15kHz" and "@3.75kHz").

Settings:

First Subframe

Selects the first subframe to be displayed.

Remote command:
n.a.

Subframes
Selects the number of subframes to be displayed.

Remote command:
n.a.

View Mode
If at least one NB-IoT UE is enabled, you use this parameter to zoom in and out in the frequency domain.

"Channel BW" The "Time Plan" displays the entire channel bandwidth.
In this granularity, an NB-IoT allocation is indicated as one resource block. NPUSCH or NPRACH hops are not visible.

"Single RB" The "Time Plan" displays one single RB as selected in the RB index field.
The NPRACH and NPUSCH incl. the NDRS signals are shown in greater detail. Frequency hops are visible.
Note that the y-axis indicates the frequency allocation in terms of number of subcarriers.

The left and the right y-axis shows the subcarrier numbering depending on the subcarrier spacing:
- "@15kHz", one RB consists of 12 subcarrieres.
- "@3.75kHz", there are 48 subcarriers.

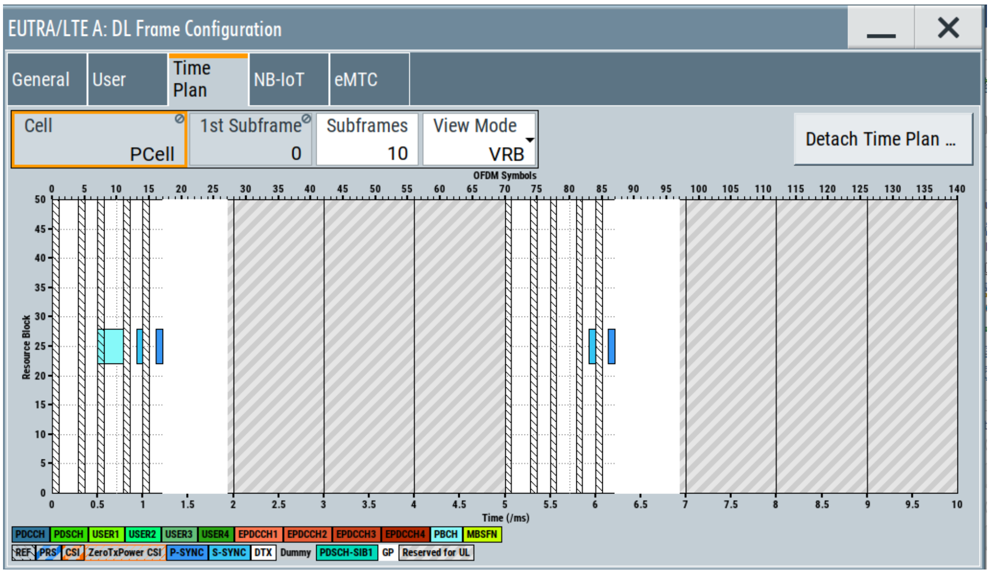
Detach Time Plan
Enlarges the time plan display.

5.3 TDD time plan

Access:

1. Select "General > Duplexing > TDD".

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.
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.

Subframes
Selects the number of subframes to be displayed.

Remote command:
n.a.

View Mode
Determines how the allocations are displayed.

If at least one NB-IoT UE is enabled, you use this parameter to zoom in and out in the frequency domain.

"PRB/VRB" The "Time Plan" displays the entire channel bandwidth. It shows the allocated virtual resource blocks (VRBs) or the physical resource blocks (PRBs).
In this granularity, an in-band or guard band NB-IoT allocation is indicated as one resource block; NRS are not visible. This mode is not available in standalone NB-IoT operation.

"Single RB" The "Time Plan" displays the allocation of the anchor carrier (one single RB) as selected in the RB index field.
The NRS, NPSS/NSSS and the downlink channels are shown in greater detail.
Note that the y-axis indicates the frequency allocation in terms of number of subcarriers.

Remote command:
n.a.

Detach Time Plan
Enlarges the time plan display.

6 Performing BS tests according to TS 36.141

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 6.3, "Supported test cases", on page 250.

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.

The "Test Case Wizard" also effects:

- AWGN
- Co-located modulation signals
- Fading profiles
- CW interferers.

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 dialogs.

The test setups and the hardcopies in this description assume a fully equipped R&S SMW.

6.1 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.

6.1.1 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"

6.1.2 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 6.3, "Supported test cases", on page 250.

6.1.3 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".

6.2 Required options

The basic equipment layout for preforming test with the aid of "Test Case Wizard" is the same as for the EUTRA/LTE signal generation. It includes the options:

- Standard or wideband Baseband Generator (R&S SMW-B10/-B9)
- Baseband Main Module (R&S SMW-B13) or Wideband baseband main module (R&S SMW-B13XT)
- Digital Standard EUTRA/LTE (R&S SMW-K55)
- Frequency option (e.g. R&S SMW-B1003)

Some of the tests require further options. You find a list of the required option at the beginning of each section that describes a group of test cases.

The following equipment and options are required to support **all test cases**:

- 2x option Baseband Generator (R&S SMW-B10)
- 1x option Baseband Main Module (R&S SMW-B13T)
- 1x option Frequency (e.g. R&S SMW-B1003)
- 1x option Frequency (e.g. R&S SMW-B2003)
- 4x option Fading Simulator (R&S SMW-B14/B15)
- 1x option Fading Simulator Extension (R&S SMW-K71)
- 1x option MIMO Fading and Routing (R&S SMW-K74)
- 2 option Additive White Gaussian Noise AWGN (R&S SMW-K62)
- 2x option Digital Standard EUTRA/LTE (R&S SMW-K55)
- 2x option Digital Standard EUTRA/LTE Release 10, LTE-Advanced (R&S SMW-K85)
- 1x option LTE closed loop BS Test (R&S SMW-K69)

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.

6.3 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 6-1: Transmitter Tests

Chapter in TS 36.141	Test Case	Section in this document with further information
	Output power dynamics	these test cases do 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. 6.7.6, on page 273

Table 6-2: Receiver Characteristics

Chapter in TS 36.141	Test Case	Section in this document with further information
7.2	Reference sensitivity level	chap. 6.8.5, on page 282
7.3	Dynamic range	chap. 6.8.6, on page 283
7.4	In-channel selectivity	chap. 6.8.7, on page 285
7.5A	Adjacent Channel Selectivity (ACS)	chap. 6.8.8, on page 288
7.5B	Narrow-band blocking	chap. 6.8.9, on page 290
7.6	Blocking	chap. 6.8.10, on page 293
7.7	Receiver spurious emissions	this test case does not require a signal generator
7.8	Receiver intermodulation	chap. 6.8.11, on page 296

Table 6-3: 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. 6.9.4, on page 306
8.2.2	Performance requirements for UL timing adjustment	chap. 6.9.5, on page 308
8.2.3	Performance requirements for HARQ-ACK multiplexed on PUSCH	chap. 6.9.6, on page 313
8.2.4	Performance requirements for High-Speed Train conditions	chap. 6.9.7, on page 315
	Performance requirements for PUCCH	
8.3.1	ACK missed detection for single user PUCCH format 1a	chap. 6.9.8, on page 319
8.3.2	CQI performance requirements for PUCCH format 2	chap. 6.9.9, on page 321
8.3.3	ACK missed detection for multi user PUCCH format 1a	chap. 6.9.10, on page 323
8.3.4	ACK missed detection for PUCCH format 1b, channel selection	chap. 6.9.11, on page 327
8.3.5	ACK missed detection for PUCCH format 3	chap. 6.9.12, on page 329
8.3.6	NACK to ACK detection for PUCCH format 3	chap. 6.9.13, on page 332
8.3.7	ACK missed detection for PUCCH format 1a transmission on two antenna ports	chap. 6.9.14, on page 334
8.3.8	CQI performance requirements for PUCCH format 2 transmission on two antenna ports	chap. 6.9.15, on page 336
8.3.9	CQI Performance for PUCCH format 2 with DTX detection	chap. 6.9.16, on page 337

Chapter in TS 36.141	Test Case	Section in this document with further information
	Performance requirements for PRACH	
8.4.1	PRACH false alarm probability and missed detection	chap. 6.9.17, on page 340
8.5.1	Performance requirements for NPUSCH format 1	chap. 6.9.18, on page 343
8.5.2	ACK missed detection for NPUSCH format 2	chap. 6.9.19, on page 345
8.5.3	Performance requirements for NPRACH	chap. 6.9.20, on page 347

6.3.1 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 from the 3GPP test specification.
- Prerequisites, required hardware and software options
- Test setup
- Description of test case-specific parameters

6.4 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.

6.4.1 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.

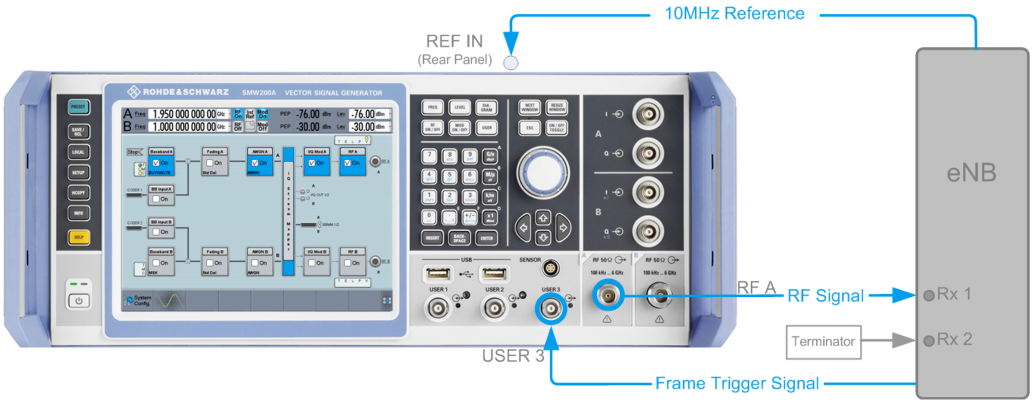


Figure 6-1: One Path Standard Test Setup (Example of R&S SMW simulating the test case 7.3 "Dynamic Range")

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.

6.4.2 Standard test setup - two paths

For two-paths measurements, the test cases always require option Second RF path (R&S SMW-B20x), an option Baseband Main Module (R&S SMW-B13T) 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.

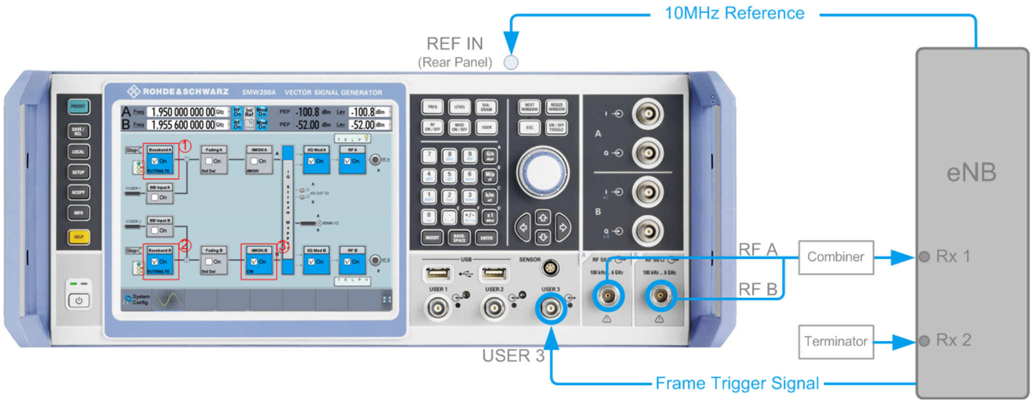


Figure 6-2: Two Paths Standard Test Setup (Example of R&S SMW simulating test case 7.8 "Receiver Intermodulation")

1 = Baseband A generates the wanted signal
2 = Baseband B generates the EUTRA/LTE interfering signal
3 = AWGN B generates the CW interfering signal

6.4.3 Test setup - diversity measurements

For diversity measurements, the test cases always require at least option Second RF path (R&S SMW-B20x) and an option Baseband Main Module (R&S SMW-B13T) 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.

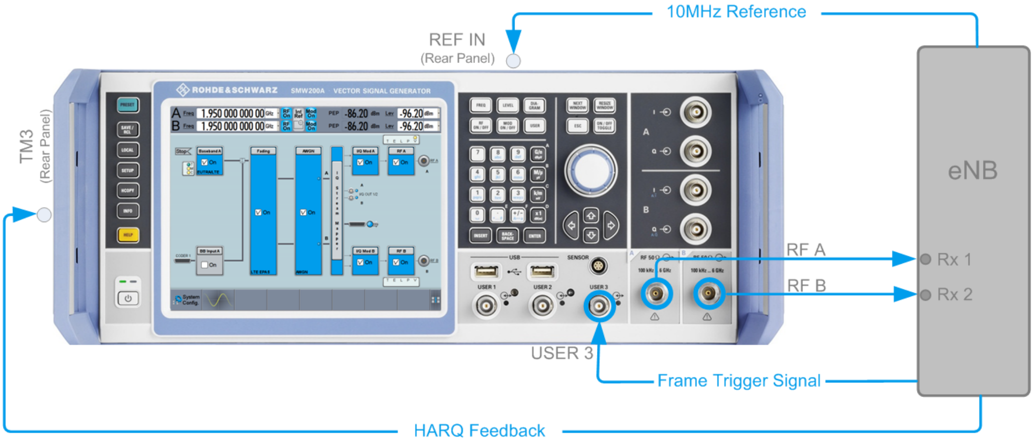


Figure 6-3: Test Setup for Diversity Measurements (Example of R&S SMW simulating test case 8.2.1 "PUSCH in Multipath Fading Propagation Conditions" with two Rx antennas)

As signal routing takes place at the output of the baseband block, the interference settings of the two paths are identical for diversity measurements.

6.4.4 Test setup - four RX antennas

Test setup with four RX antennas require additional instrument(s) that act as external RF outputs for the R&S SMW, for example:

- two R&S SGS100A connected to the analog [I/Q OUT 1/2] connectors of the instrument
- two R&S SMBV100A connected to the digital I/Q interfaces [BBMM 1/2 OUT] of the instrument
- one two-path signal generator, e.g. a R&S SMU200A or a second R&S SMW

The external instruments have to be equipped with the suitable frequency options. 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.

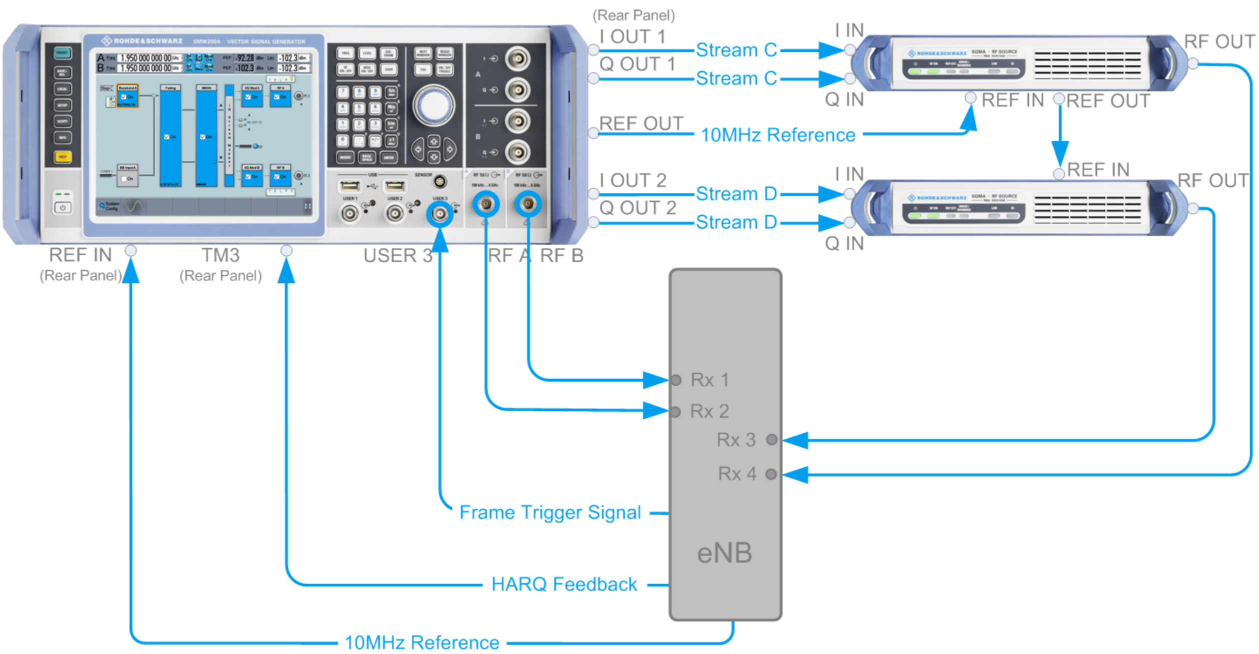


Figure 6-4: Test Setup for tests with four Rx antennas (Example of R&S SMW and 2xR&S SGS simulating test case 8.2.1 "PUSCH in Multipath Fading Propagation Conditions")

grey connectors = rear panel connectors
blue connectors = front panel connectors

As signal routing takes place at the output of the baseband block, the interference settings of the two paths are identical for diversity measurements.

6.5 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 6-4. The table shows the start and the stop frequencies of both uplink and downlink frequency bands according to TS 36.141.

Table 6-4: EUTRA/LTE operating bands

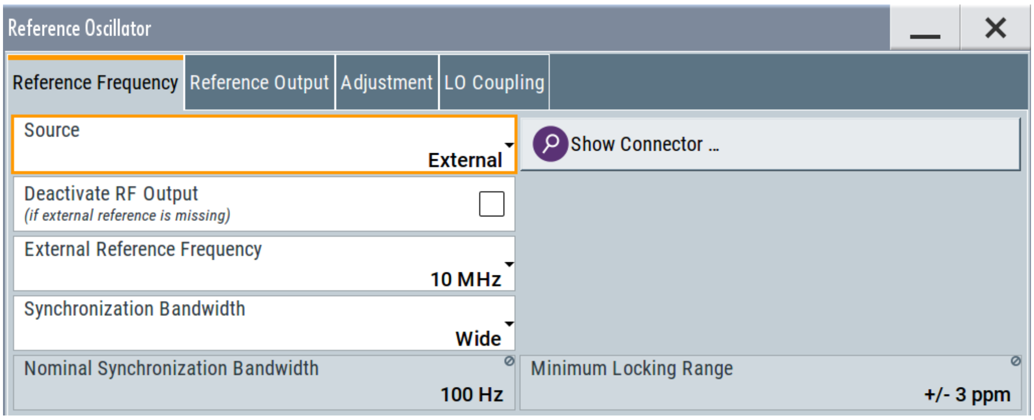
EUTRA Operating Band	Uplink (UL) band BS receive UE transmit F_{UL_low} to F_{UL_high}	Downlink (DL) operating band BS transmit UE receive F_{DL_low} to F_{DL_high}	Duplex Mode
1	1920 MHz to 1980 MHz	2110 MHz to 2170 MHz	FDD
2	1850 MHz to 1910 MHz	1930 MHz to 1990 MHz	FDD
3	1710 MHz to 1785 MHz	1805 MHz to 1880 MHz	FDD

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
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
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.

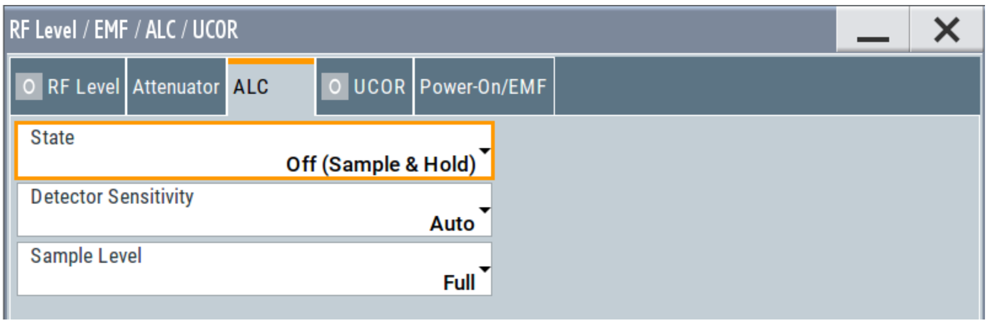
Baseband Clock

The clock source is automatically switched to internal when the test case settings are activated.

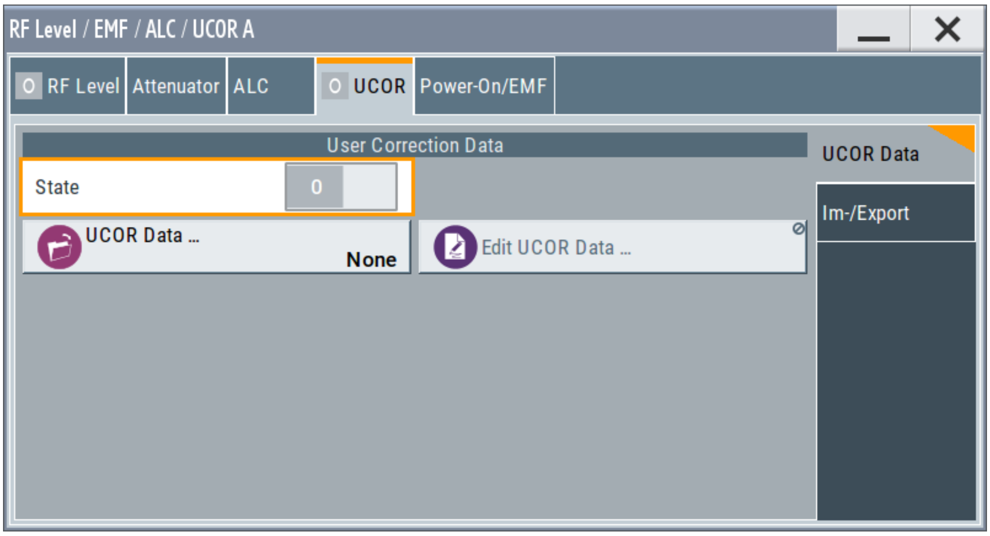
Improvement of signal quality

Improvement of signal quality is possible via several settings:

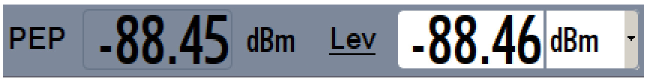
- In the "I/Q Mod > I/Q Settings > General" dialog, select a "Baseband Gain = 2 dB" to improve the ACLR performance
- In the "RF > RF Level > Automatic Level Control Settings" dialog, select "State > Off (Sample&Hold)".
  This is recommended for multi-transmitter measurements if in CW mode the signal/intermodulation ratio is to be improved.
  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").



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.

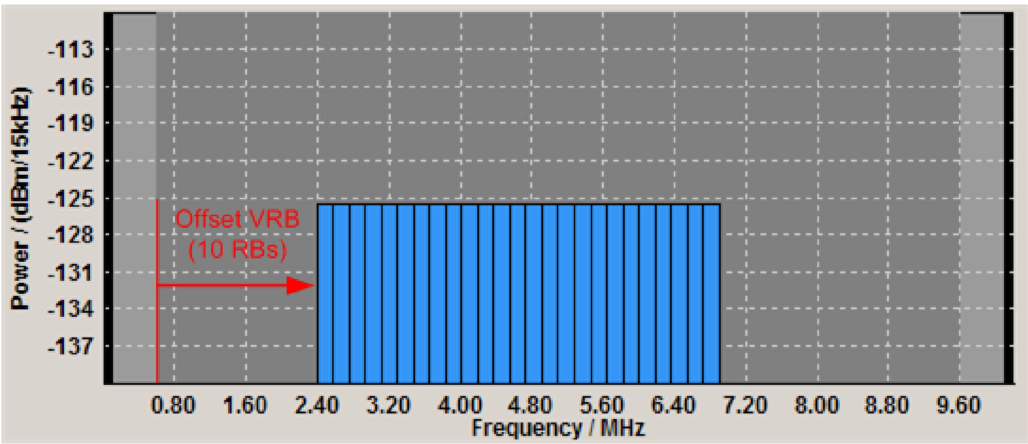
Example: Offset VRB

"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.



6.6 User interface

Access:

► 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.

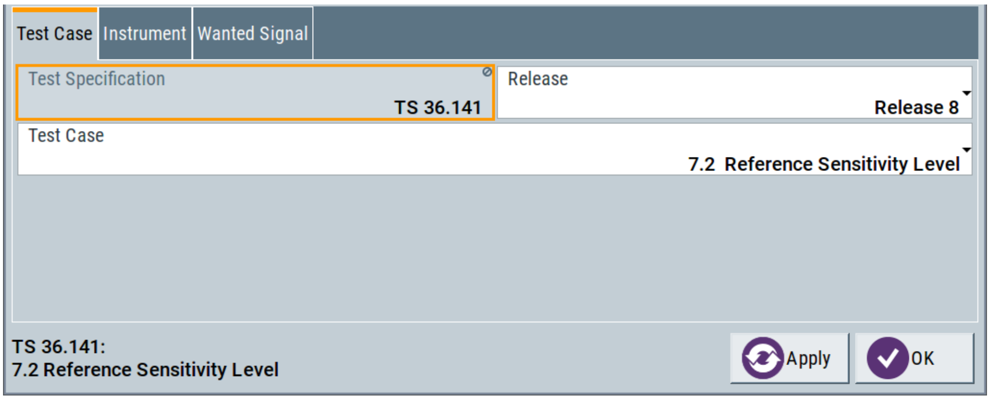
The "Test Case Wizard" dialog is divided into several tabs: the "Test Case" tab for selecting the test case, the "TMR" tab for settings regarding routing, trigger and marker configuration, one or more tabs with corresponding names comprising the additional parameters like the configuration of the wanted and interfering signals, AWGN and fading settings and the "Apply" button.

The graph indicates the interference scenario defined by power level and frequency offset. A permanent display shows a graph of the currently selected test case.

6.6.1 Test case settings

Access:

1. Select "Baseband Block > EUTRA/LTE > Test Case Wizard".
2. Select "Test Case".



This dialog comprises the settings for selecting the test case, the 3GPP test specification and release as well as other general settings.

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 580

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 580

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 265).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:BSCLass` on page 582

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 6.3, "Supported test cases", on page 250 for an overview of the available test cases.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:TC` on page 590

Number of Rx Antennas
For performance requirement tests, determines the number of the Rx antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:RXANtennas` on page 583

Number of Tx Antennas
For performance requirement tests, determines the number of the Tx antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:TXANtennas` on page 583

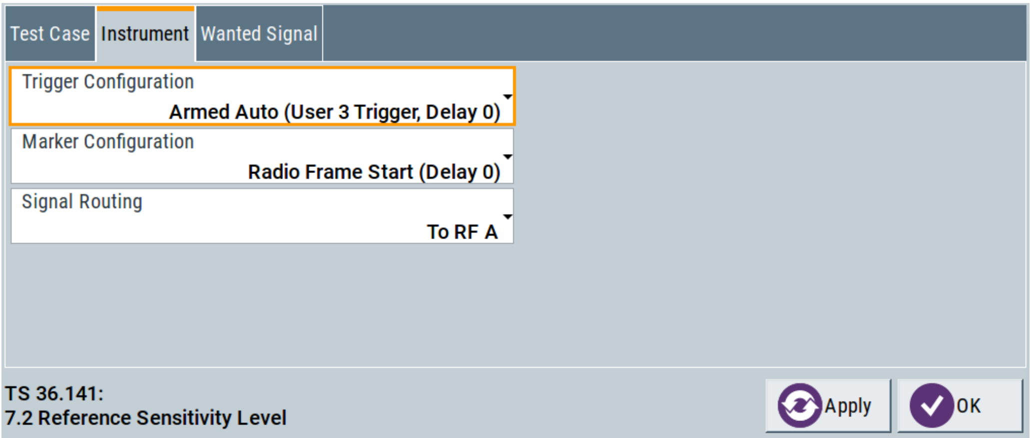
6.6.2 Instrument settings

Access:

1. Select "Baseband Block > EUTRA/LTE > Test Case Wizard".

2. Select "Instrument".

   The "Instrument" dialog comprises instrument-related settings, like trigger and marker settings or routing related settings.



Trigger Configuration

Selects the trigger configuration. The trigger is used to synchronize the signal generator to the other equipment.

"Armed Auto (User 3 Trigger, Delay 0)"

The trigger settings are customized for the selected test case. The following settings apply:

- "Trigger Mode > Armed Auto"
- "Trigger Source > External Global Trigger 1"
- "Global Connector Settings > User 3 > Direction > Input" and "User 3 > Signal > Global Trigger 1"
- "Trigger Delay = 0"
  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 583

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. The following settings apply:

- "Marker Mode 1/2/3 > Radio Frame Start"
- "Global Connector Settings > User 1/2 > Direction > Output" and "User 1/2 > Signal > Baseband A Marker 1/2"
  "Local Connector Settings > T/M 2/3 > Direction > Output" and "T/M 2/3 > Signal > Marker A 1/2"
  Marker signals Marker 1 and Marker 2 are output at the local T/M 2/3 and global USER1/2 connectors
- "Marker Delay = 0"

"Unchanged" The current marker settings of the signal generator are retained unchanged.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:MARKerconfig on page 582

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 581

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"
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.

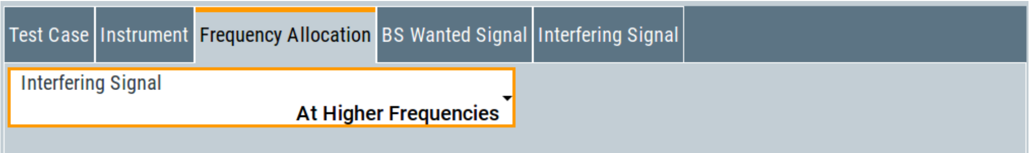
Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:SIGRout on page 583

Antenna Subset
In test setups with more than two Rx antennas, determines the signal of which antenna couple ("Antenna 1 and 2" or "Antenna 3 and 4") or of all antennas is generated by the instrument.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:ANTSubset on page 581

6.6.3 Frequency allocation settings

Determines the frequency position of the wanted and the interfering signal.



Frequency Allocation of the Interfering signal
Determines the frequency position of the wanted and the interfering signal.

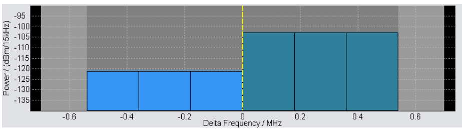
Example: Wanted and interfering signal within the same channel

"Test Case" = 7.4 "In Channel Selectivity"

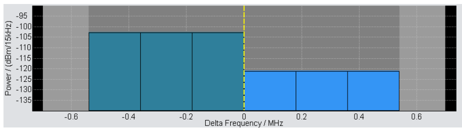
"Channel Bandwidth" = 1.4 MHz

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



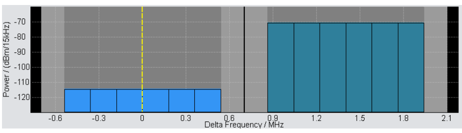
Example: Interfering signal in the adjacent channel

"Test Case" = 7.5A "Adjacent Channel Selectivity"

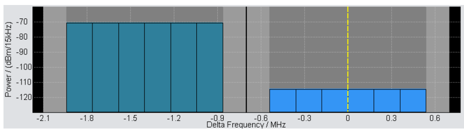
"Channel Bandwidth" = 1.4 MHz

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

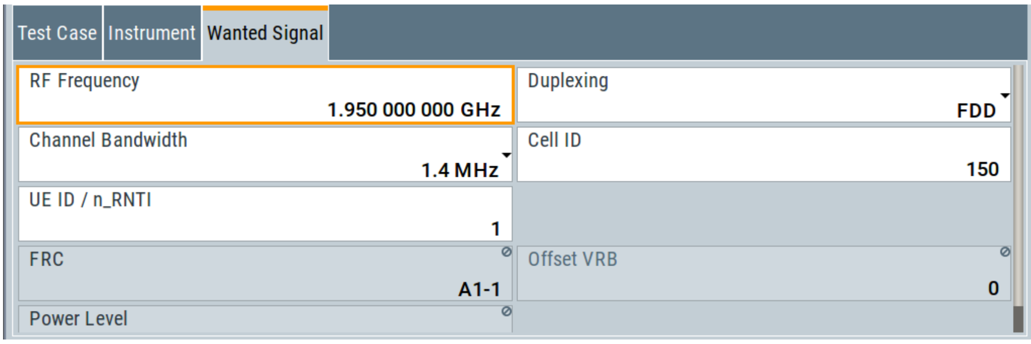


Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:FA:FRALlocation` on page 580
`[:SOURce<hw>]:BB:EUTRa:TCW:FA:RBALlocation` on page 580

6.6.4 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 596

Duplexing

Selects whether TDD or FDD duplexing mode is used.

Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:WS:DUPLex on page 593

TDD UL/DL Configuration

For TDD mode, selects the UL/DL Configuration number (see also "TDD UL/DL Configuration" on page 67).

Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:WS:TDDConfig on page 596

Signal Advance N_TA_offset

Sets the parameter $N_{TAoffset}$.

See also "Signal Advance N_TA_offset" on page 371.

Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:WS:NTAOffset on page 594

Channel Bandwidth
Selects the channel bandwidth.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:CHBW on page 592

Cell ID
Sets the Cell ID.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:CLID on page 592

Cyclic Prefix
Selects normal or extended cyclic prefix.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:CYCPrefix on page 592

UE ID/n_RNTI
Sets the UE ID/n_RNTI.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:UEID on page 597

FRC
Displays the fixed reference channel used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:FRC on page 593

Offset VRB
Sets the number of RB the allocated RB(s) are shifted with (see also Example"Offset VRB" on page 258).

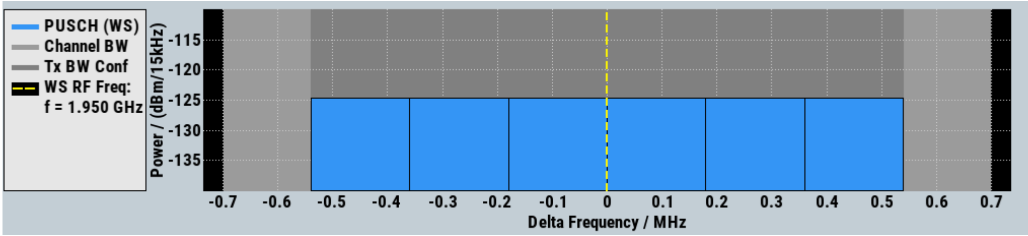
Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:OVRB on page 595

Power Level
Displays the power level, depending on the selected test case.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLEVel? on page 595

6.6.5 Diagram

The graph displays the interference scenario defined by power level and frequency offset of the currently selected test case.



6.6.6 Apply settings

The "Apply" trigger 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.

Use "Ok" to apply the settings and close the dialog.

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" and in the "Global/Local Connector 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 579

6.7 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 6.7.3, "Introduction to the unwanted emissions tests", on page 267).

6.7.1 Required options

Table 6-5 lists the required options for performing the test cases according to TS 36.141, Chapter 6.

Table 6-5: Required options

Chapter in TS 36.141-1	Hardware options					Software options	
	RF path		Baseband		BB generator	AWGN	LTE
	A	B	1 path	2 paths			
	e.g. B1003	e.g. B2003	B13 B13XT	B13T B13XT	B10 B9	K62	K55
6.7 Transmitter intermodulation	1	-	1	-	1	-	1

6.7.2 Prior considerations

Test Models

3GPP specifies EUTRA test models (E-TM) for testing the transmitter characteristic. For an overview, see "Test Models" on page 59.

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 6-4 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.

6.7.3 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 6.8.8, "Test case 7.5A: adjacent channel selectivity (ACS)", on page 288.
The test specification defines ACLR requirements for LTE and UTRA receivers. Different setting applies for paired and unpaired spectrum (see Table 6-6 and Table 6-7).

Table 6-6: 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 6-7: 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)	
5 / 10 / 15 / 20	$BW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	
	$2xBW_{Channel}$	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)	
	$BW_{Channel}$/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.

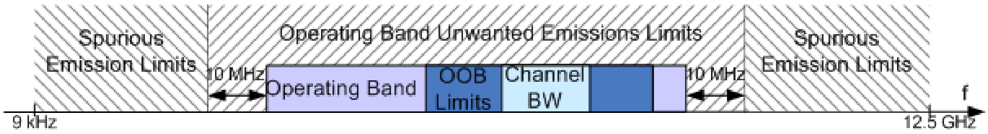


Figure 6-5: Transmitter tests frequency limits

  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 6-5).
  Refer to Table 6-8 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 6-8: 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

6.7.4 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 6-6.

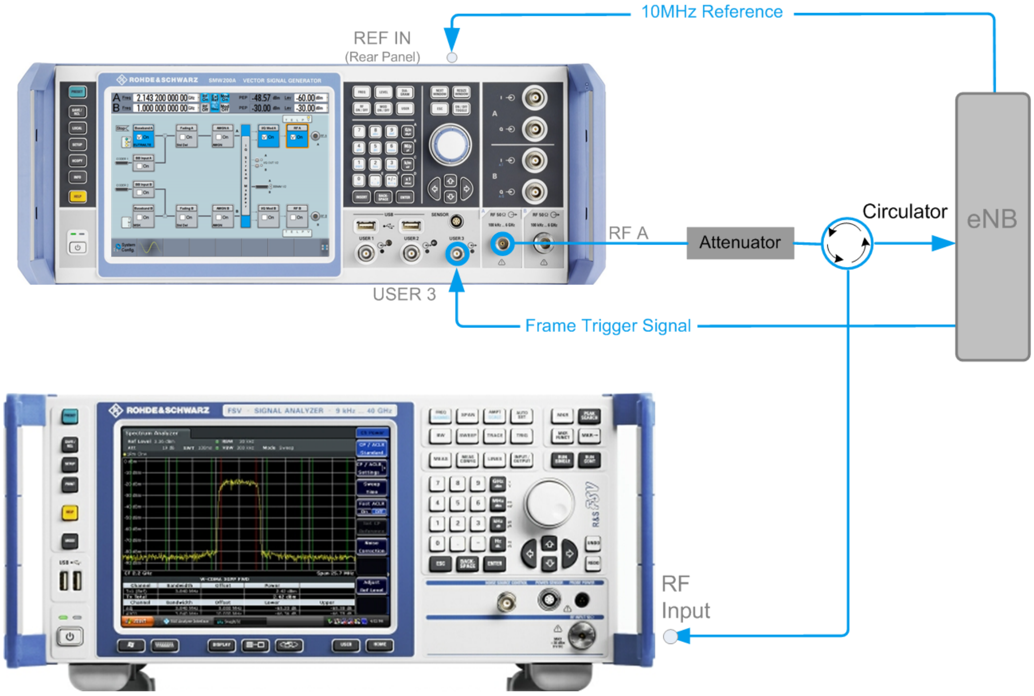


Figure 6-6: Test setup for Test case 6.7: Transmitter Intermodulation

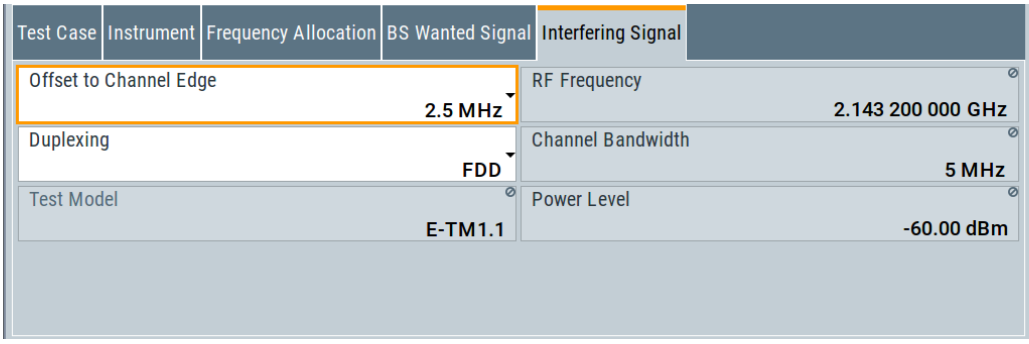
1. Set the base station to the basic state and configure it for the selected test case.
   a) Initialize the base station,
   b) Set the base station to test model E-TM1.1,
   c) Set maximum transmit power,
   d) Set the frequency.
2. Set the signal generator to the basic state
   a) Preset the signal 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.

6.7.5 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 586

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 $\text{Frequency}_{\text{interfering signal}}$ is calculated as follows:
- For "Frequency Allocation > Interfering Signal > At Higher Frequencies"
  "RF $\text{Frequency}_{\text{interfering signal}}$" = "RF $\text{Frequency}_{\text{wanted signal}}$" + Delta
- For "Frequency Allocation > Interfering Signal > At Lower Frequencies"
  "RF $\text{Frequency}_{\text{interfering signal}}$" = "RF $\text{Frequency}_{\text{wanted signal}}$" - Delta

Where for both cases **Delta** is calculated as follows:

Delta = "$\text{BW}_{\text{wanted signal}}$"/2 + $\text{Offset}_{\text{interfering signal}}$

Example: Calculation of RF Frequency in Test Case 6.7

"$BW_{wanted\ signal}$" = 1.4 MHz

"RF $Frequency_{wanted\ signal}$" = 1 950 MHz

$Offset_{interfering\ signal}$ = 7.5 MHz

Delta = 1.4/2 + 7.5 = 8.2 MHz

For "Frequency Allocation > Interfering Signal > At Higher Frequencies": "RF $Frequency_{interfering\ signal}$" = 1 950 + 8.2 = 1 958.2 GHz

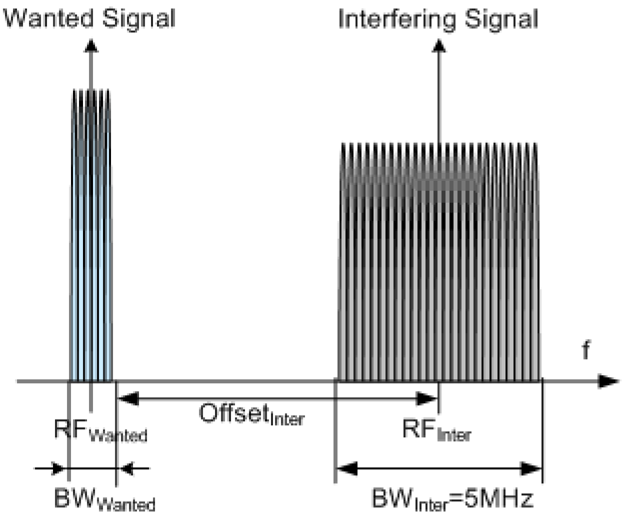


Figure 6-7: Example: Offset to Channel Edge (Channel Bandwidth = 1.4 MHz)

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:RFFRequency on page 587

Channel Bandwidth

Displays the channel bandwidth of the interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:CHBW? on page 584
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:CHBW? on page 584

Duplexing

Selects whether TDD or FDD duplexing mode is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:DUPLex on page 585
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:DUPLex on page 585

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 587

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 586

6.7.6 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 6.7.1, "Required options", on page 267.

Test Setup

See Figure 6-6.

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

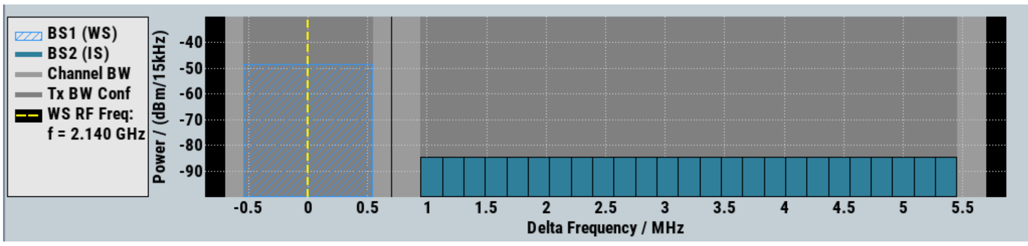
The transmitter intermodulation test is intended to verify the ability of the BS transmitter to restrict the generation of intermodulation products in its nonlinear elements caused by presence of wanted signal and an interfering signal reaching the transmitter via the antenna.

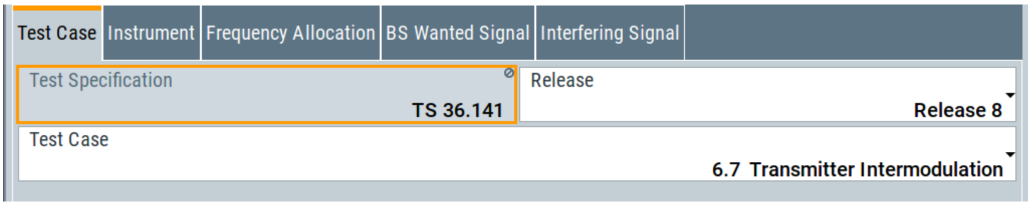
The BS transmits signals in accordance with E-TM1.1 at maximum power and with channel bandwidth $BW_{Channel}$ corresponding to the maximum bandwidth supported by the base station. The interfering signal is an E-TM1.1 signal with 5 MHz channel bandwidth. The interfering signal power shall be 30 dB lower 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 6-6, Table 6-7 and Table 6-8. 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

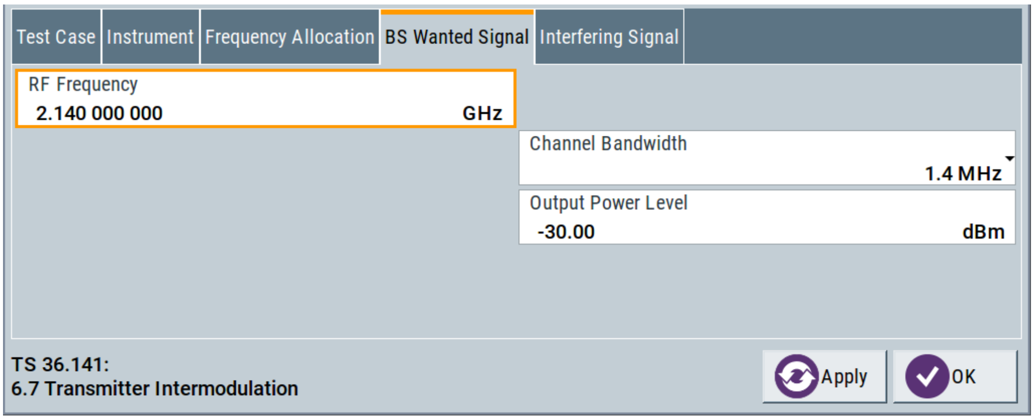




The settings of the interfering signal are described in Chapter 6.7.5, "Interfering signal settings", on page 271.

Base Station Wanted Signal

The common settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.



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 594

6.8 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 6.8.5, "Test case 7.2: reference sensitivity level", on page 282
  - Chapter 6.8.6, "Test case 7.3: dynamic range", on page 283
- Prove how susceptible the receiver is to different types of interfering signals:
  - Chapter 6.8.7, "Test case 7.4: in-channel selectivity (ICS)", on page 285
  - Chapter 6.8.8, "Test case 7.5A: adjacent channel selectivity (ACS)", on page 288
  - Chapter 6.8.9, "Test case 7.5B: narrow-band blocking", on page 290
  - Chapter 6.8.10, "Test case 7.6: blocking", on page 293
  - Chapter 6.8.11, "Test case 7.8: receiver intermodulation", on page 296

  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.

6.8.1 Required options

Table 6-9 lists the required options for performing the test cases according to TS 36.141, Chapter 7.

Table 6-9: Required options

Chapter in TS 36.141-1	**Hardware options**					**Software options**	
	RF path		**Baseband**		**BB generator**	**AWGN**	**LTE**
	A	**B**	**1 path**	**2 paths**			
	e.g. B1003	**e.g. B2003**	**B13 B13XT**	**B13T B13XT**	**B10 B9**	**K62**	**K55**
7.2 Reference sensitivity	1		1		1		1
7.3 Dynamic range	1		1		1	1	1
7.4 In-channel selectivity	1	1		1	2		2
7.5Adjacent channel selectivity (ACS) and narrow-band blocking	1	1		1	2		2
7.6Blocking 1)	1	1		1	2		2
7.8 Receiver intermodulation	1	1		1	2	1	2

1) An additional R&S®SGS100A required for CW signal

2) No signal generator required

The following equipment and options are required, if **receiver characteristics tests** should be supported:

- 2x option Baseband Generator (R&S SMW-B10/B9)
- 1x option Baseband Main Module (R&S SMW-B13T/-B13XT)

- 1x option Frequency (e.g. R&S SMW-B1003)
- 1x option Frequency (e.g. R&S SMW-B2003)
- 1x option Additive White Gaussian Noise AWGN (R&S SMW-K62)
- 2x option Digital Standard EUTRA/LTE (R&S SMW-K55)
- For CW blocking interferer tests:
  – 1x R&S SMW-B0120 or
  – 1x R&S®SGS100A

6.8.2 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 to A1-5 (QPSK)
- FRC A2: A2-1 to A2-3 (16QAM)

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 6-4 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 6-10 gives an overview of the resulting power levels for the wanted signal per test case.

Table 6-10: 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

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
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 following test cases where a "Best ACP Optimization" filter is applied for shaping the interfering signal:

- Test case 7.5A: adjacent channel selectivity (ACS)
- Test case 7.5B: narrow-band blocking

6.8.3 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 6.4, "Standard test setups", on page 252.

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.

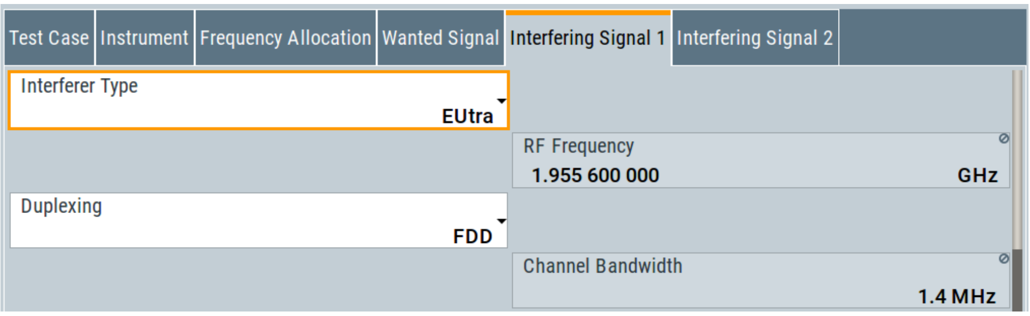
   The signal generator is now ready to start signal generation
5. Switch on RF output
6. If required, make additional settings (e.g. in the "I/Q Mod" or "RF" block) or change test case settings.
7. Start the measurement
   a) Send a start trigger impulse from the base station to the signal generator.

   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.

6.8.4 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 585

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 $\text{Frequency}_{\text{interfering signal}}$" = "RF $\text{Frequency}_{\text{wanted signal}}$" + Delta
- For "Frequency Allocation > Interfering Signal > At Lower Frequencies"
  "RF $\text{Frequency}_{\text{interfering signal}}$" = "RF $\text{Frequency}_{\text{wanted signal}}$" - Delta

Where for both cases Delta is calculated as follows:

Delta = "Channel $\text{Bandwidth}_{\text{wanted signal}}$"/2 + $\text{Offset}_{\text{interfering signal}}$

See also "RF Frequency" on page 271.

Example:

"Channel $\text{Bandwidth}_{\text{wanted signal}}$" = 5 MHz

"RF $\text{Frequency}_{\text{wanted signal}}$" = 1 950 MHz

$\text{Offset}_{\text{interfering signal}}$ = 2.5025 MHz

(see Table 6-13)

Delta = 5/2 + 2.5025 = 5.0025 MHz

For "Frequency Allocation > Interfering Signal > At Higher Frequencies": "RF $\text{Frequency}_{\text{interfering signal}}$" = 1 950 + 5.0025 = 1 955.0025 MHz

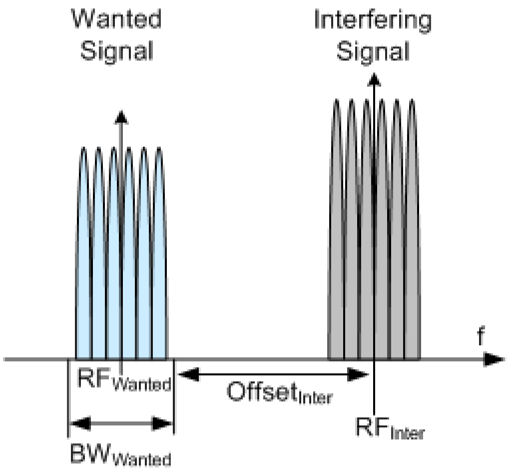


Figure 6-8: Example: Adjacent Channel Selectivity (ACS), Channel BW = 1.4 MHz

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:RFFRequency on page 587

Duplexing
Selects whether TDD or FDD duplexing mode is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:DUPLex on page 585

TDD UL/DL Configuration
For TDD mode, selects the UL/DL Configuration number.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:TDDConfig on page 587

Signal Advance N_TA_offset
Sets the parameter $N_{TAoffset}$.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:NTAOffset on page 586

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 584

Cell ID
Sets the Cell ID for the interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:CLID on page 584

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 588

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 585

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 6-9).
- 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 586

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 6-10).

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 6-14.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:FRSHift` on page 585

Interfering RB Center Frequency
(for Narrow-band Block tests only)

Displays the center frequency of the single resource block interfering signal (see also Figure 6-10).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:RBCFrequency` on page 586

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 586

6.8.5 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 6.8.1, "Required options", on page 275.

Test Setup

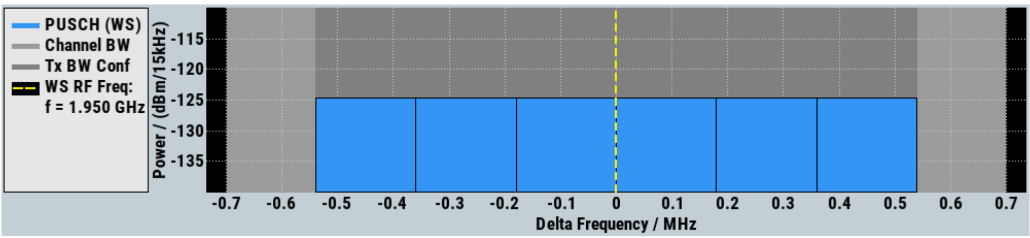
See Chapter 6.4.1, "Standard test setup - one path", on page 252

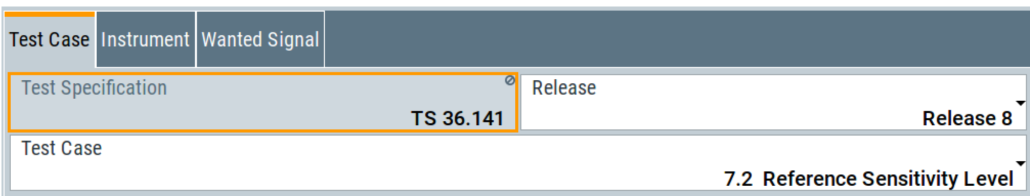
Short Description

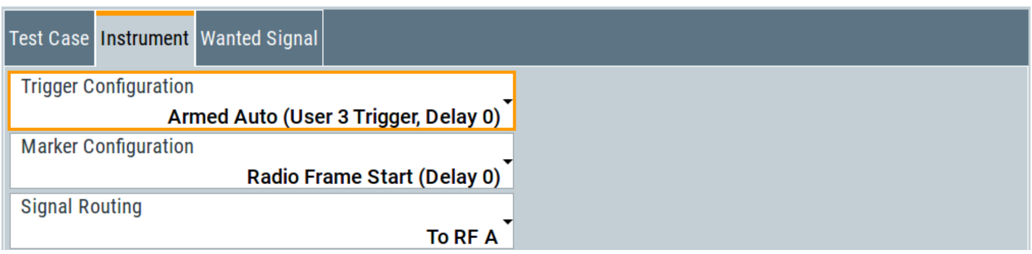
The reference sensitivity level measurement is a test case that aims to verify the Noise Figure of the receivers. The test case uses FRCs with QPSK modulation.

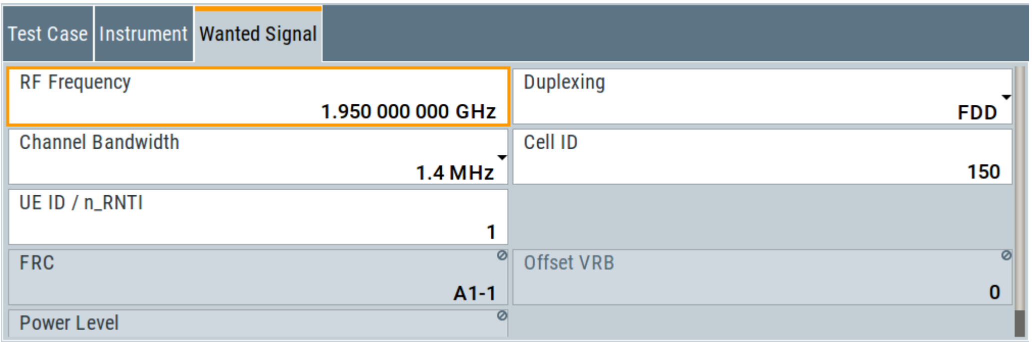
The test shall be done on three channels (B, M and T). The selected "Channel Bandwidth" determines the used FRC and the "Wanted Signal Power Level". For channels larger than 5 MHz not all RBs are allocated; to adjust the position of the allocated RBs within the selected channel bandwidth, use the parameter "Offset VRB".

For the parameter in the Table 6-10 the throughput measured shall be equal or greater than 95%.









The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

6.8.6 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 6.8.1, "Required options", on page 275.

Test Setup

See Chapter 6.4.1, "Standard test setup - one path", on page 252

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.

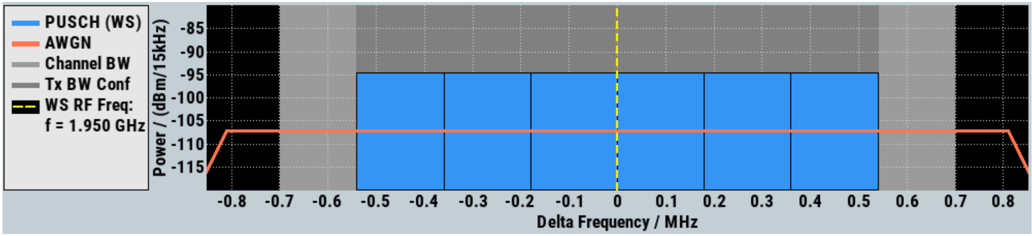
The test shall be done on three channels (B, M and T). The selected "Channel Bandwidth" determines the used FRC and the "Wanted Signal Power Level". For channels larger than 5 MHz not all RBs are allocated; to adjust the position of the allocated RBs within the selected channel bandwidth, use the parameter "Offset VRB".

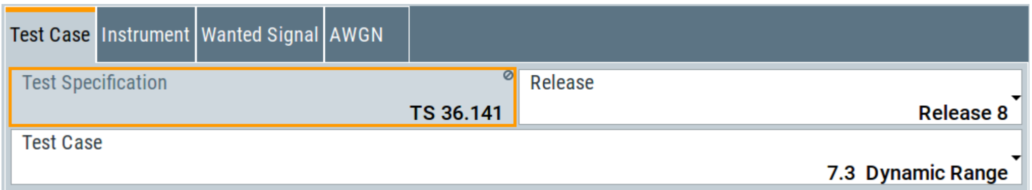
For the parameter in the Table 6-11 the throughput shall be equal or greater than 95%.

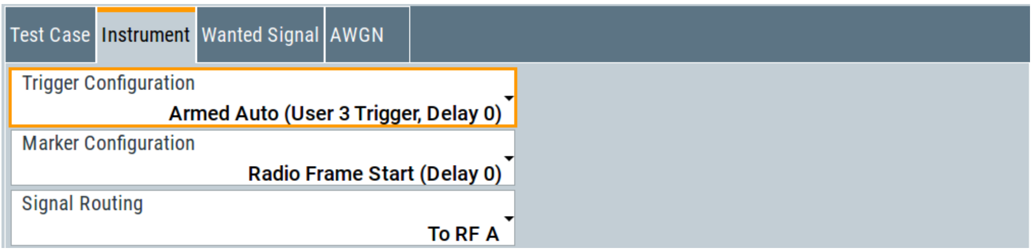
Table 6-11: Dynamic range (Wide Area BS)

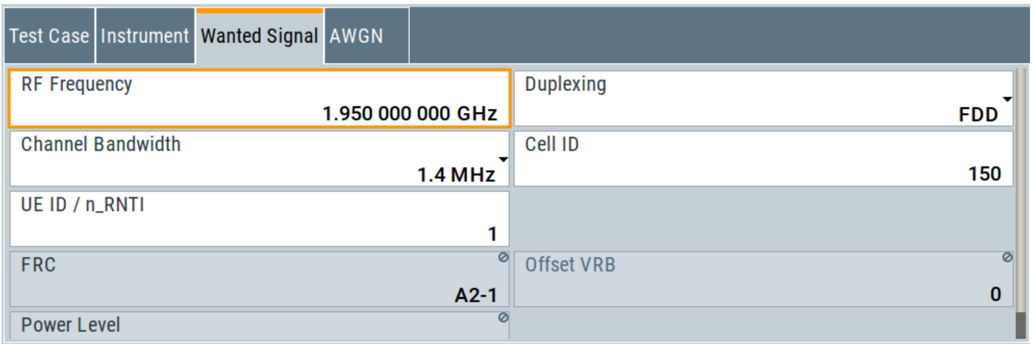
Channel Bandwidth, MHz	Reference Measurements Channel	Wanted signal mean power, dBm	Interfering signal mean power, dBm / BW_{Config}	Type of interfering signal
1.4	FRC A2-1	-76.0	-88.7	AWGN
3	FRC A2-2	-72.1	-84.7	AWGN
5	FRC A2-3	-69.9	-82.5	AWGN
10	FRC A2-3	-69.9	-79.5	AWGN
15	FRC A2-3	-69.9	-77.7	AWGN
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.





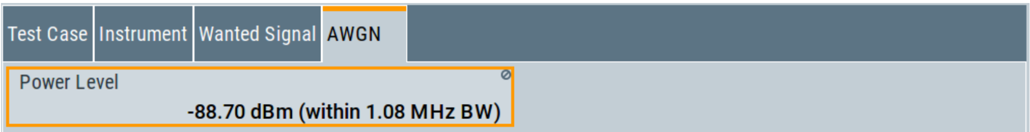




The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

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 6-11 and depending on the selected Channel Bandwidth.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:AWGN:PLEVel?` on page 580

6.8.7 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

See Chapter 6.8.1, "Required options", on page 275.

Test Setup

See Chapter 6.4.1, "Standard test setup - one path", on page 252.

For two paths measurements, see Chapter 6.4.2, "Standard test setup - two paths", on page 253

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 6-9); to swap the position of the wanted and interfering signal, use the parameter "Frequency Allocation".

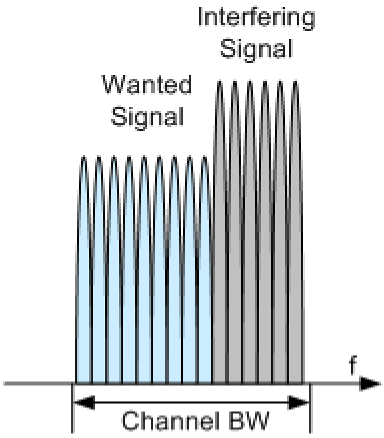


Figure 6-9: Example: In-channel selectivity (ICS), Channel BW = 3 MHz, Frequency Allocation = Lower Frequency

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".

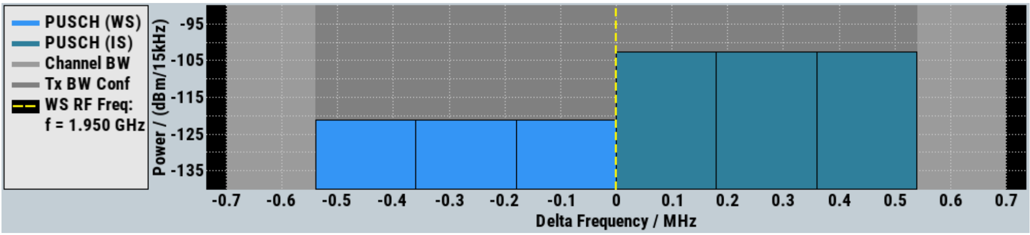
For the parameter in the Table 6-12 the throughput shall be equal or greater than 95%.

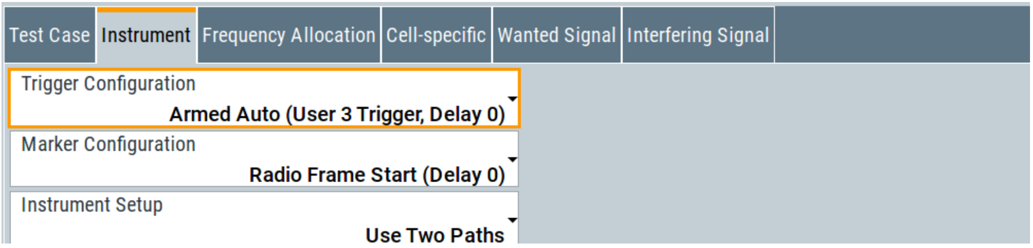
Table 6-12: In-channel selectivity (Wide Area BS)

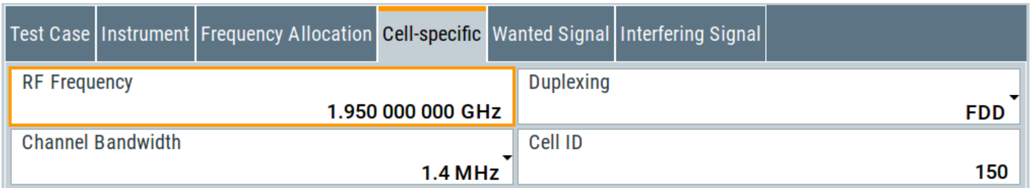
Channel Bandwidth, MHz	Reference Measurements Channel	Wanted signal mean power, dBm	Interfering signal mean power, dBm / BW_{Config}	Type of interfering signal
1.4	FRC A1-4	-105.5	-87	1.4 MHz EUTRA signal, 3 RBs
3	FRC A1-5	-100.7	-84	3 MHz EUTRA signal, 6 RBs
5	FRC A1-2	-98.6	-81	5 MHz EUTRA signal, 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*

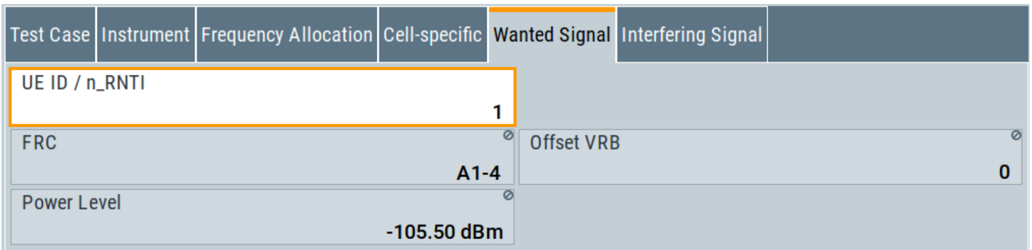
*) Wanted and interfering signal are placed adjacently around the carrier frequency

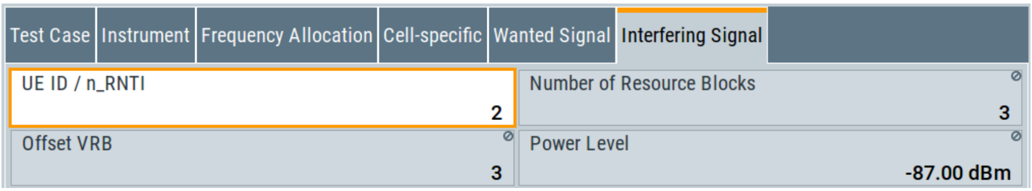
For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.











The general and instrument related settings are described in Test case settings and Instrument settings

The cell-specific settings and the settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

Refer to Chapter 6.8.4, "Interfering signal settings", on page 278 for description of the corresponding settings.

6.8.8 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 6.8.1, "Required options", on page 275.

Test Setup

See Chapter 6.4.2, "Standard test setup - two paths", on page 253

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 6-8). The test shall be done on three channels (B, M and T).

For the parameter in the Table 6-13 the throughput shall be equal or greater than 95%.

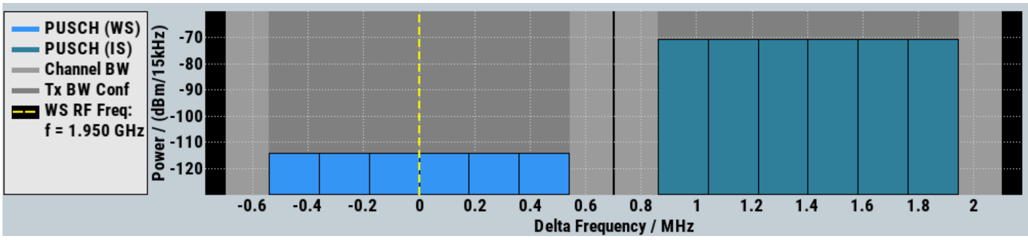
Table 6-13: Adjacent channel selectivity (Wide Area BS)

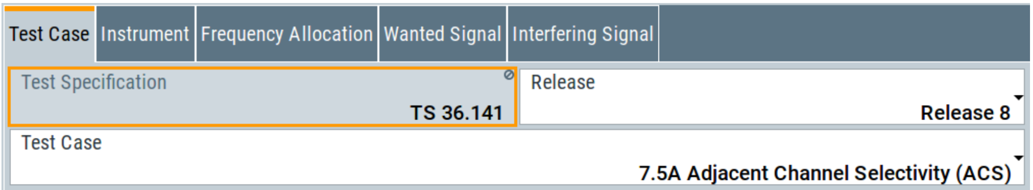
Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the lower (upper) edge of the wanted signal, MHz	Type of interfering signal
1.4	$P_{REFSENS}$ + 11dB	-52	±0.7025	1.4 MHz EUTRA signal, 3 RBs
3	$P_{REFSENS}$ + 8dB	-52	±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

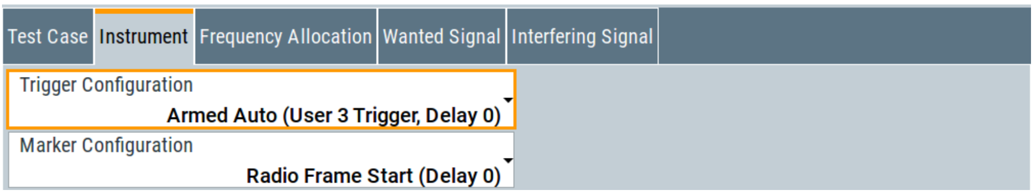
Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the lower (upper) edge of the wanted signal, MHz	Type of interfering signal
15	$P_{REFSENS}$ + 6dB	-52	±2.5125	15 MHz EUTRA signal, 25 RBs
20	$P_{REFSENS}$ + 6dB	-52	±2.5025	20 MHz EUTRA signal, 25 RBs

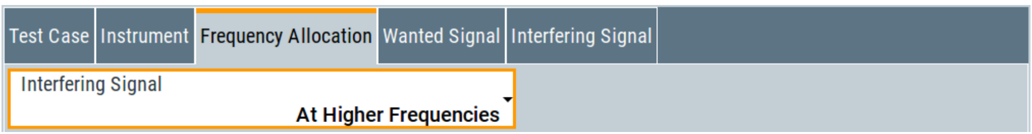
$P_{REFSENS}$ depends on the channel bandwidth and the base station class as specified in TS 36.104, subclause 7.2.1 (see Table 6-10).

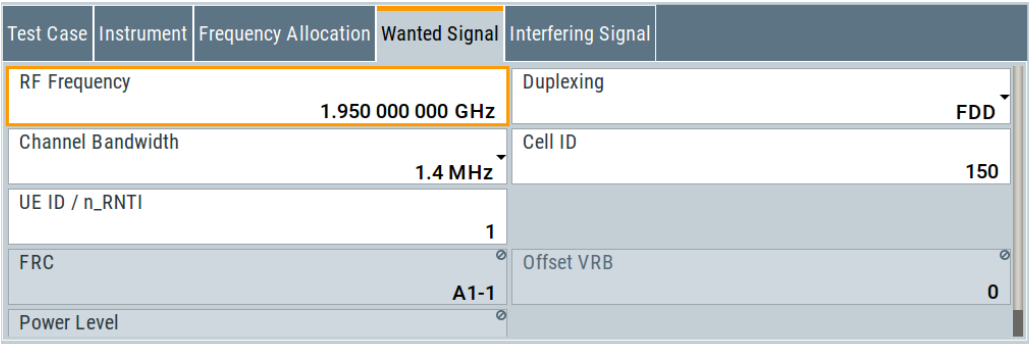
For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.

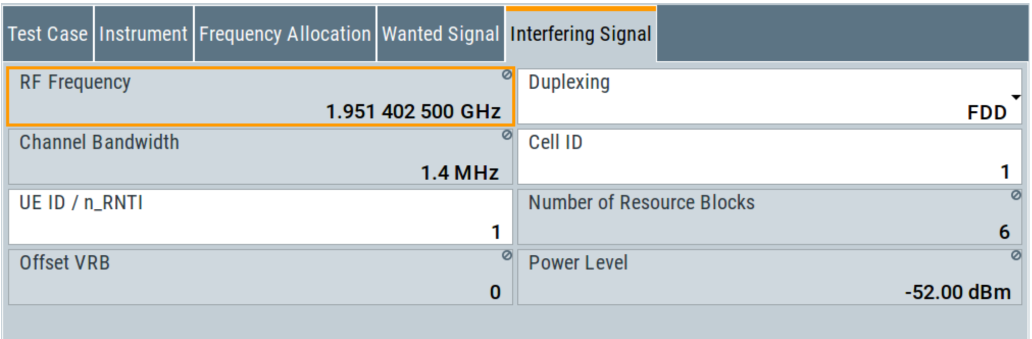












The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

Refer to Chapter 6.8.4, "Interfering signal settings", on page 278 for description of the corresponding settings.

6.8.9 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 6.8.1, "Required options", on page 275.

Test Setup

See Chapter 6.4.2, "Standard test setup - two paths", on page 253

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 6-10).

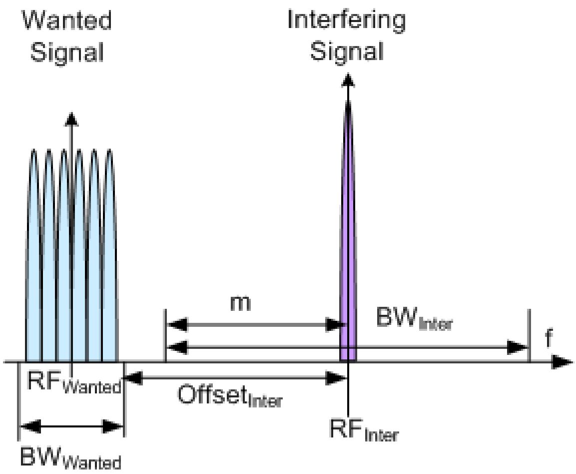


Figure 6-10: Example: Narrow-band Blocking

The test shall be done on three channels (B, M and T).

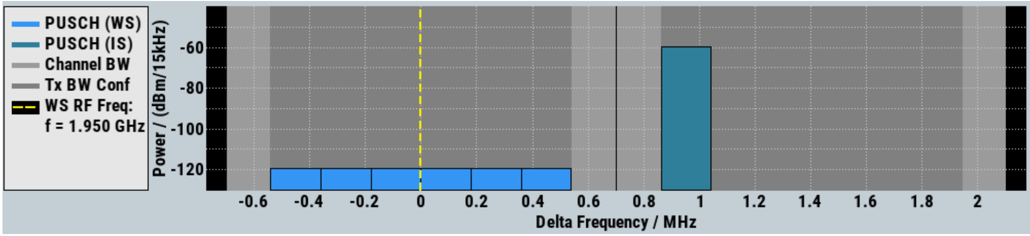
For the parameter in the Table 6-14 the throughput shall be equal or greater than 95%.

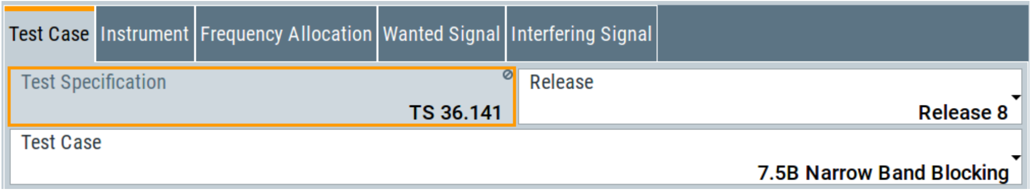
Table 6-14: Interfering signal for Narrowband blocking requirement (Wide Area BS)

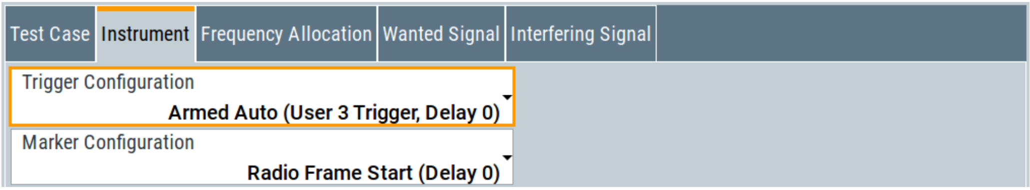
Channel Band-width, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering RB center frequency offset to the channel edge of the wanted signal, kHz	Type of inter-fering signal
1.4	$P_{REFSENS}$ + 6dB	-49	252.5+m*180, m=0, 1, 2, 3, 4, 5	1.4 MHz EUTRA signal, 1 RB
3			247.5+m*180, 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

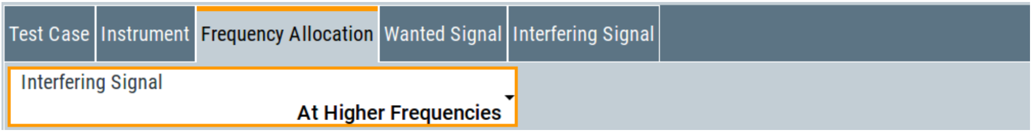
$P_{REFSENS}$ depends on the channel bandwidth as specified in TS 36.104, subclause 7.2.1 (see Table 6-10).

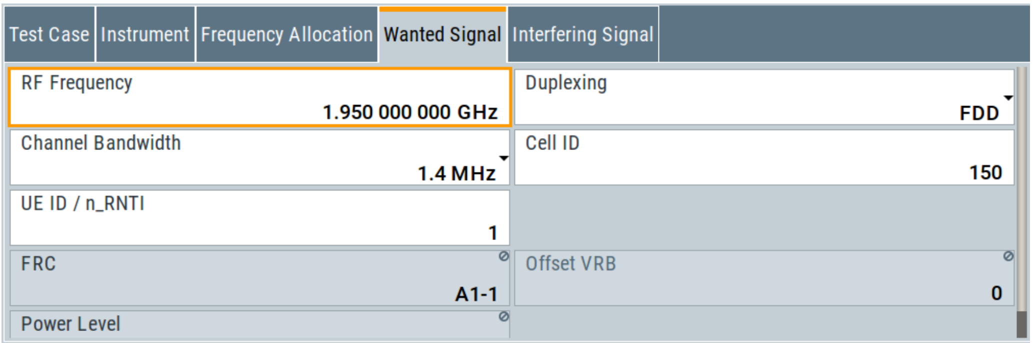
For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.

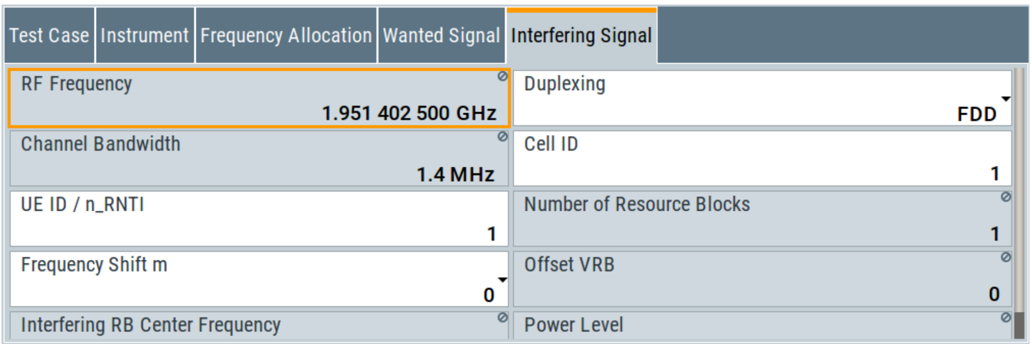












The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

Refer to Chapter 6.8.4, "Interfering signal settings", on page 278 for description of the corresponding settings.

6.8.10 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

See Chapter 6.8.1, "Required options", on page 275.

Test Setup

The blocking test using a EUTRA/LTE interfering signal can be performed with one instrument, see Chapter 6.4.2, "Standard test setup - two paths", on page 253. 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 6-4), 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.

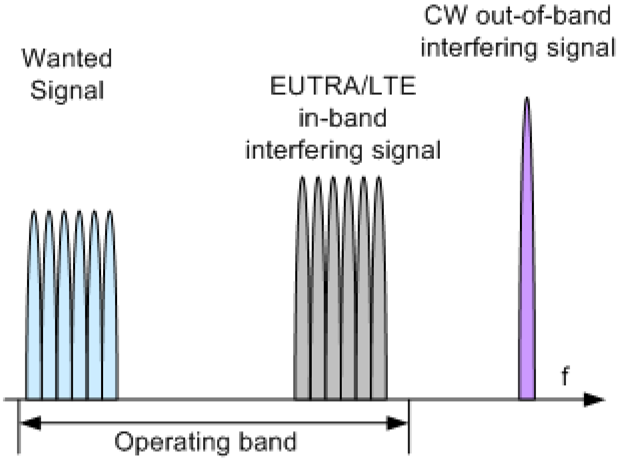


Figure 6-11: Example: Blocking

The test shall be done on one channel (M).

For the parameter in the Table 6-15 the throughput shall be equal or greater than 95%.

Table 6-15: Blocking performance requirement (Wide Area BS)

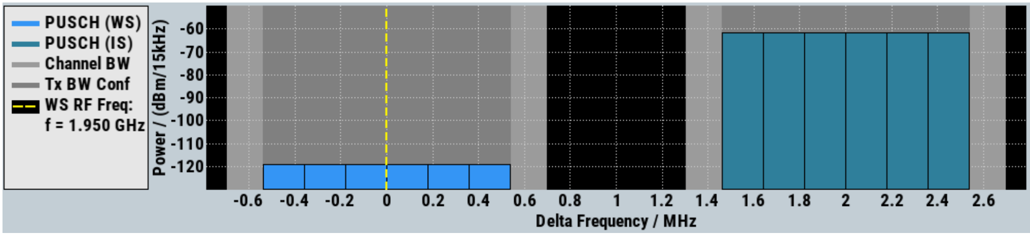
Operating Band	Center Frequency of Interfering Signal, MHz	Interfering Signal mean power, dBm	Wanted Signal mean power, dBm	Type of Interfering Signal
1-7, 9-11, 13-14, 33-40	$(F_{UL\_low} - 20)$ to $(F_{UL\_high} + 20)$	-43	$P_{REFSENS}$ + 6dB	EUTRA/LTE*
	1 to $(F_{UL\_low} - 20)$ $(F_{UL\_high} + 20)$ 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 6-16			

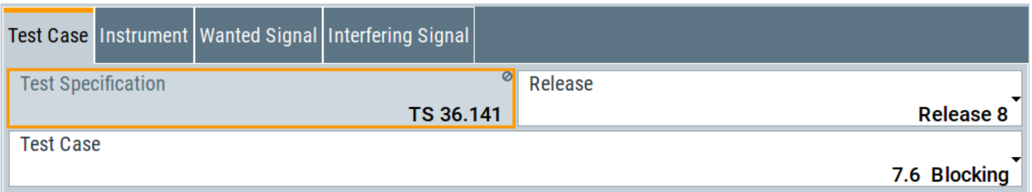
Table 6-16: EUTRA/LTE interfering signals for Blocking performance requirement

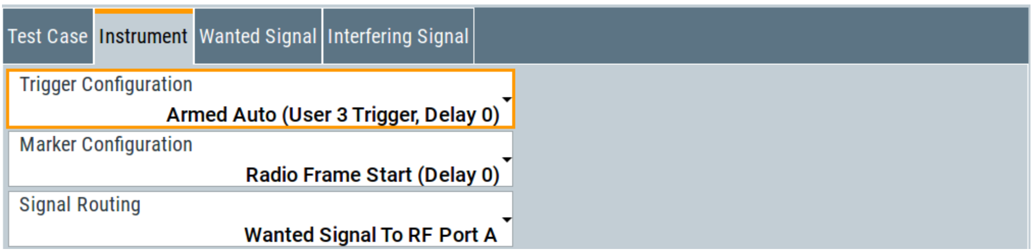
Channel Bandwidth, MHz	Interfering signal center frequency minimum offset to the lower (upper) channel edge of the wanted signal, MHz	Type of interfering signal
1.4	±2.1	1.4 MHz EUTRA signal
3	±4.5	3 MHz EUTRA signal
5 / 10 / 15 / 20	±7.5	5 MHz EUTRA signal

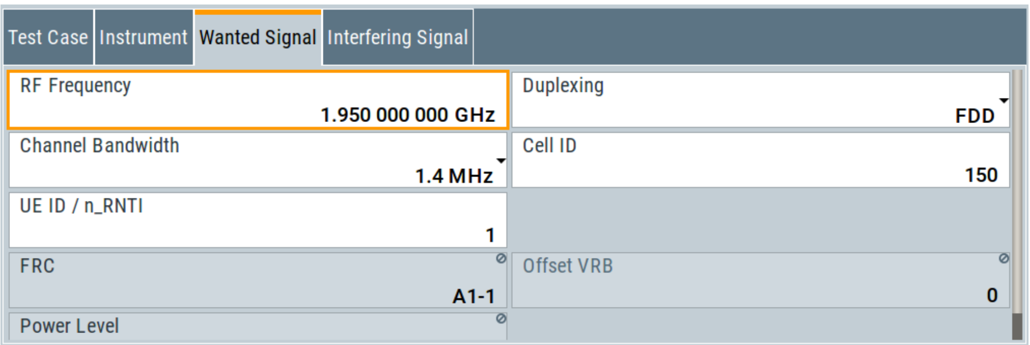
$P_{REFSENS}$ depends on the channel bandwidth as specified in TS 36.104, subclause 7.2.1 (see Table 6-10).

For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.





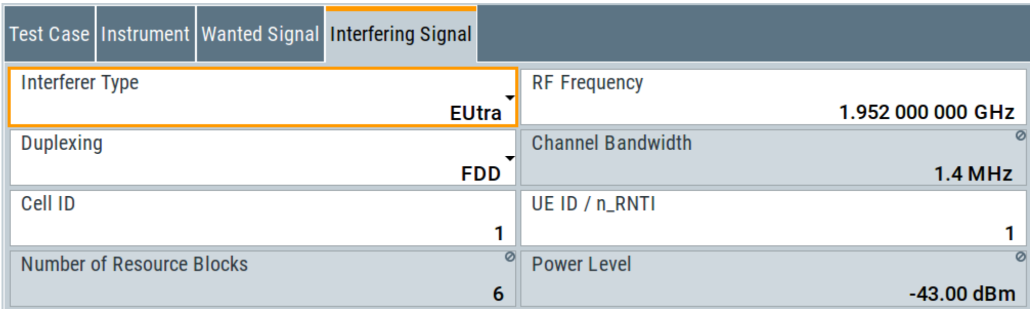




The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

Interfering Signal
The common settings of the interfering signal are described in Chapter 6.8.4, "Interfering signal settings", on page 278.



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 587

6.8.11 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 6.8.1, "Required options", on page 275.

Test Setup

See Chapter 6.4.2, "Standard test setup - two paths", on page 253.

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 6-17 and Table 6-18 the throughput shall be equal or greater than 95%.

Table 6-17: 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

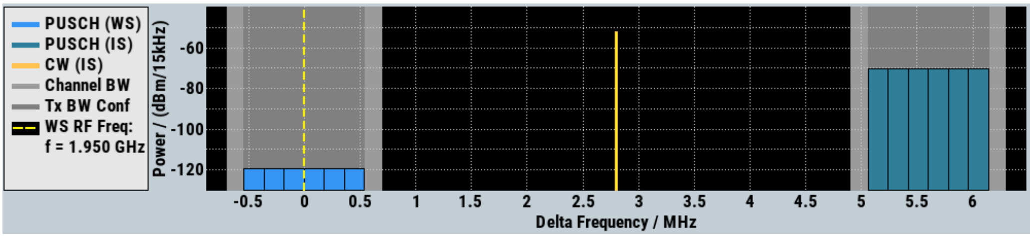
Table 6-18: Narrow-band intermodulation performance requirement (Wide Area BS)

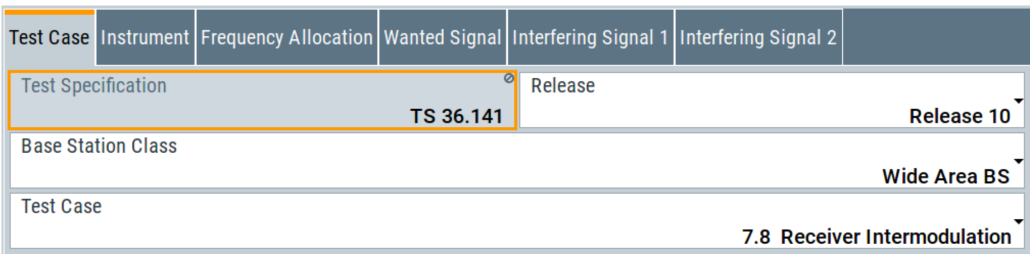
Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the channel edge of the wanted signal, kHz	Type of interfering signal
1.4	$P_{REFSENS}$ + 6dB	-52	270	CW
	$P_{REFSENS}$ + 6dB	-52	790	1.4 MHz EUTRA signal, 1 RB
3	$P_{REFSENS}$ + 6dB	-52	275	CW
	$P_{REFSENS}$ + 6dB	-52	790	3 MHz EUTRA signal, 1 RB

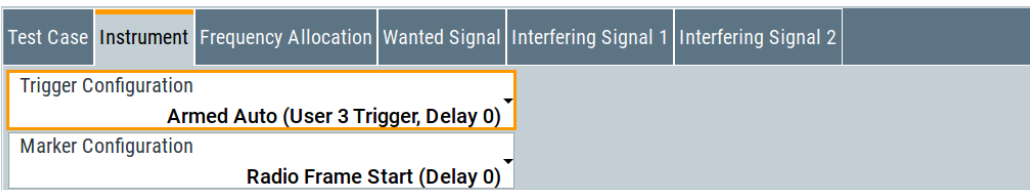
Channel Band-width, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the channel edge of the wanted signal, kHz	Type of interfering signal
5	$P_{REFSENS}$ + 6dB	-52	360	CW
	$P_{REFSENS}$ + 6dB	-52	1060	5 MHz EUTRA sig-nal, 1 RB
10	$P_{REFSENS}$ + 6dB	-52	415	CW
	$P_{REFSENS}$ + 6dB	-52	1420	5 MHz EUTRA sig-nal, 1 RB
15	$P_{REFSENS}$ + 6dB	-52	380	CW
	$P_{REFSENS}$ + 6dB	-52	1600	5 MHz EUTRA sig-nal, 1 RB
20	$P_{REFSENS}$ + 6dB	-52	345	CW
	$P_{REFSENS}$ + 6dB	-52	1780	5 MHz EUTRA sig-nal, 1 RB

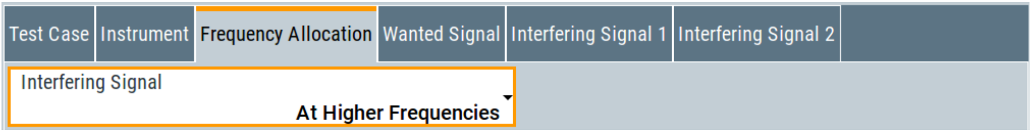
$P_{REFSENS}$ depends on the channel bandwidth as specified in TS 36.104, subclause 7.2.1 (see Table 6-10).

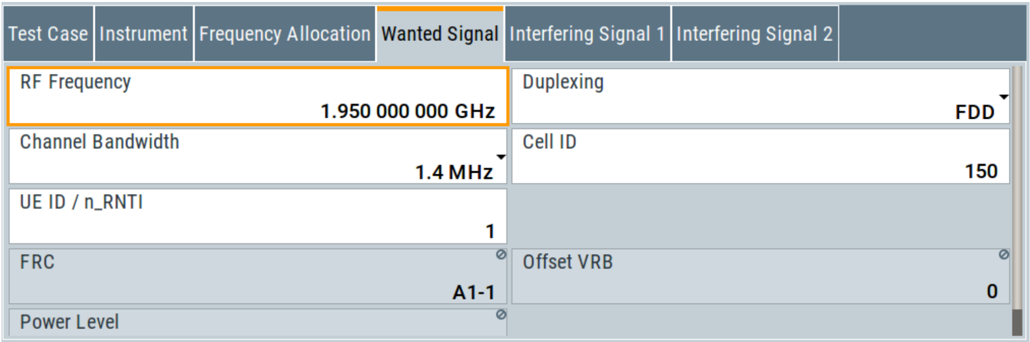
For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.

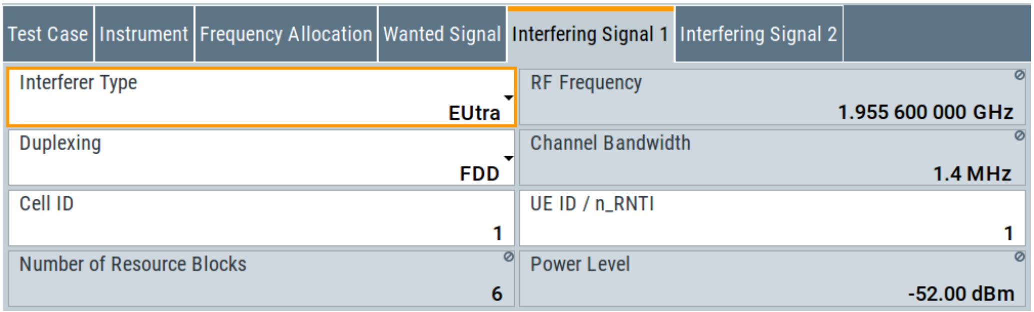


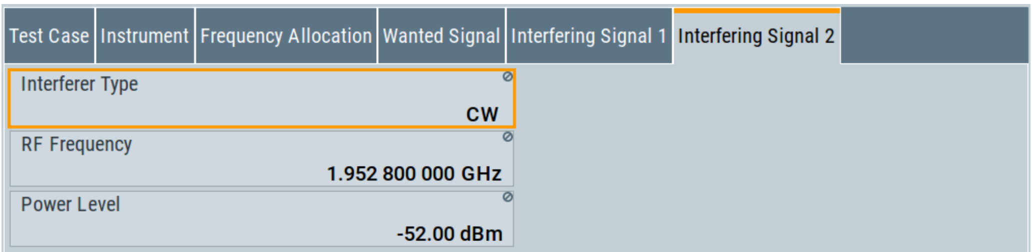












The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

Refer to Chapter 6.8.4, "Interfering signal settings", on page 278 for description of the corresponding settings.

6.9 Performance requirements (TS 36.141, chapter 8)

The BS RF performance requirements are divided into three main groups:

- Performance requirements for PUSCH:

- Chapter 6.9.4, "Test case 8.2.1: PUSCH in multipath fading propagation conditions", on page 306
- Chapter 6.9.5, "Test case 8.2.2: UL timing adjustment", on page 308
- Chapter 6.9.6, "Test case 8.2.3: HARQ-ACK multiplexed on PUSCH", on page 313
- Chapter 6.9.7, "Test case 8.2.4: high-speed train conditions", on page 315
- Chapter 6.9.18, "Test case 8.5.1: performance requirements for NPUSCH", on page 343
- Chapter 6.9.19, "Test case 8.5.2: ACK missed detection for NPUSCH format 2", on page 345

- Performance requirements for PUCCH:

  - Chapter 6.9.8, "Test case 8.3.1: ACK missed detection for single user PUCCH format 1a", on page 319
  - Chapter 6.9.9, "Test case 8.3.2: CQI performance requirements for PUCCH format 2", on page 321
  - Chapter 6.9.10, "Test case 8.3.3: ACK missed detection for multi-user PUCCH format 1a", on page 323
  - Chapter 6.9.11, "Test case 8.3.4: ACK missed detection for PUCCH format 1b, channel selection", on page 327
  - Chapter 6.9.12, "Test case 8.3.5: ACK missed detection for PUCCH format 3", on page 329
  - Chapter 6.9.13, "Test case 8.3.6: NACK to ACK detection for PUCCH format 3", on page 332
  - Chapter 6.9.14, "Test case 8.3.7: ACK missed detection for PUCCH format 1a transmission on two antenna ports", on page 334
  - Chapter 6.9.15, "Test case 8.3.8: CQI performance requirements for PUCCH format 2 transmission on two antenna ports", on page 336
  - Chapter 6.9.16, "Test case 8.3.9: CQI performance for PUCCH format 2 with DTX detection", on page 337

- Performance requirements for PRACH:

  - Chapter 6.9.17, "Test case 8.4.1: PRACH false alarm probability and missed detection", on page 340
  - Chapter 6.9.20, "Test case 8.5.3: performance requirements for NPRACH", on page 347

6.9.1 Required options

The table on Figure 6-12 lists the required options for performing test cases according to TS 36.141, Chapter 8.

Chapter in TS 36.141	Test case	Hardware options: RF path A	RF path B	Baseband 1 path	Baseband 2 paths	BB Generator	Fading Simulator	Software options: AWGN	Dyn. Fading	MIMO Fad./Rout	Multiple entities	LTE Rel. 8	LTE Rel. 9	LTE Rel. 10	LTE Rel. 13 - 15	Closed loop BS Test	NB-IoT Rel. 13	NB-IoT Rel. 15	Remark
		B10x	B20x	B13	B13T/B13XT	B10/B9	B14/B15	K62	K71	K74	K76	K55	K84	K85	K119	K69	K115	K145	
8.2.1	Perf. requirements of PUSCH in multipath fading propagation (on single ant. port)	1	1	-	1	1(2)	2(4)	2	-	(1)	-	1	-	-	-	1	-	-	2, 4, or 8 RX antennas 1)
8.2.2	Perf. requirements for UL timing adjustments	1	1	-	1	2	2	2	1	1	-	2	-	-	-	1	-	-	2 RX antennas
8.2.3	Perf. requirements for HARQ-ACK multiplexed on PUSCH	1	1	-	1	1	2	2	-	-	-	1	-	-	-	-	-	-	2 RX antennas
8.2.4	Perf. requirements for High Speed Train conditions	1	(1)	1	(1)	1	1(2)	1(2)	1	-	-	1	-	-	-	1	-	-	1 or 2 RX antennas
8.2.6	PUSCH in multipath fading propagation with synchronous interference	1	1	-	1	2	2	2	1	1	1	2	-	-	2	1	-	-	2, 4, or 8 RX antennas 1)
8.2.6A	PUSCH in multipath fading propagation with asynchronous interference	1	1	-	1	2	2	2	1	1	1	2	-	-	2	1	-	-	2, 4, or 8 RX antennas 1)
8.2.7	PUSCH in multipath fading propagation for coverage enhancement	1	1	-	1	1	2	2	1	(1)	-	1	-	-	1	1	-	-	2 RX antennas
8.2.9	Type B for PUSCH in multipath fading propagation conditions	1	1	-	1	2	2	2	1	1	1	2	-	-	2	2	-	-	2 or 4 RX antennas 1)
8.3.1	ACK missed detection for single user PUCCH format 1a (on single ant. port)	1	1	-	1	1(2)	2(4)	2	-	(1)	-	1	-	-	-	-	-	-	2 or 4 RX antennas 1)
8.3.2	CQI perf. requirements for PUCCH format 2 (on single ant. port)	1	1	-	1	1	2	2	-	-	-	1	-	-	-	-	-	-	2 RX antennas
8.3.3	ACK missed detection for multi user PUCCH format 1a	1	1	-	1	2	4	2	-	1	-	2	-	-	-	-	-	-	All signals with one SMW
8.3.4	ACK missed detection for PUCCH format 1b with channel selection	1	1	-	1	1	2(4)	2	-	(1)	-	1	-	-	-	-	-	-	2 or 4 RX antennas 1)
8.3.5	ACK missed detection for PUCCH format 3	1	1	-	1	1	2(4)	2	-	(1)	-	1	-	1	-	-	-	-	2 or 4 RX antennas 1)
8.3.6	NACK to ACK detection for PUCCH format 3	1	1	-	1	1	2(4)	2	-	(1)	-	1	-	1	-	-	-	-	2 or 4 RX antennas 1)
8.3.7	ACK missed detection for PUCCH format 1a transmission on 2 ant. ports	1	1	-	1	2	2(4)	2	-	(1)	-	2	-	2	-	-	-	-	2 or 4 RX antennas 1)
8.3.8	CQI perf. requirements for PUCCH format 2 transmission on 2 ant. ports	1	1	-	1	2	2	2	-	-	-	2	-	2	-	-	-	-	2 RX antennas
8.3.9	CQI perf. requirements for PUCCH format 2 with DTX detection	1	1	-	1	1(2)	2	2	-	-	-	1(2)	-	-	-	-	-	-	2 RX antennas
8.3.10	ACK missed detection for PUCCH format 1a for coverage enhancements	1	1	-	1	1	2	2	-	(1)	-	1	-	-	1	-	-	-	2 RX antennas
8.3.11	CQI performance for PUCCH format 2 for coverage enhancements	1	1	-	1	1	2	2	-	(1)	-	1	-	-	1	-	-	-	2, 4, or 8 RX antennas 1)
8.3.12	ACK missed detection for PUCCH format 4	1	1	-	1	1	2	2	-	(1)	-	1	-	-	1	-	-	-	2, 4, or 8 RX antennas 1)
8.3.13	ACK missed detection for PUCCH format 5	1	1	-	1	1	2	2	-	(1)	-	1	-	-	1	-	-	-	2, 4, or 8 RX antennas 1)
8.4.1	PRACH False Alarm Probability and Missed Detection	1	1	-	1	1(2)	2(4)	2	-	(1)	-	1	-	-	-	-	-	-	2 or 4 RX antennas 1)
8.5.1	Performance requirements for NPUSCH	1	1	-	1	1	2	2	-	(1)	-	-	-	-	-	1	1	-	2 RX antennas
8.5.2	ACK missed detection for NPUSCH format 2	1	1	-	1	1	2	2	-	(1)	-	-	-	-	-	-	1	-	2 RX antennas
8.5.3	Performance requirements for NPRACH	1	1	-	1	1	2	2	-	(1)	-	-	-	-	-	-	1	-	2 RX antennas

Figure 6-12: Performance requirements testing with R&S SMW: Required options

1) = Tests cases with more than 2 RX require additional RF upconverters. For example, 2xR&S®SGS100A or up to 6xR&S®SGT100A + 2xR&S SMW-K18

The following equipment and options are required to support **all performance requirements tests**:

- 2x option Baseband Generator (R&S SMW-B10)
- 1x option Baseband Main Module (R&S SMW-B13T)
- 1x option Frequency (e.g. R&S SMW-B1003)
- 1x option Frequency (e.g. R&S SMW-B2003)
- 4x option Fading Simulator (R&S SMW-B14)
- 1x option Fading Simulator Extension (R&S SMW-K71)
- 1x option MIMO Fading and Routing (R&S SMW-K74)
- 2 option Additive White Gaussian Noise AWGN (R&S SMW-K62)
- 2x option Digital Standard EUTRA/LTE (R&S SMW-K55)
- 2x option Digital Standard EUTRA/LTE Release 10 (LTE-Advanced) (R&S SMW-K85)
- 1x option LTE closed loop BS Test (R&S SMW-K69)
- For tests cases with more than 2 RX:
  – 2xR&S®SGS100A or

– Up to 6xR&S®SGT100A + 2xR&S SMW-K18

6.9.2 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 to A3-7 (QPSK)
- FRC A4: A4-1 to A4-8 (16QAM)
- FRC A5: A5-1 to A5-7 (64QAM)
- FRC A7: A7-1 to A7-6 (16QAM for UL timing adjustment)
- FRC A8: A8-1 to A8-6 (QPSK for UL timing adjustment)

Channels

According to 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 BS. See Table 6-4 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 for both, the UE and 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. The AWGN power level is set per channel bandwidth and test case, according to Table 6-19.

Table 6-19: 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

Channel bandwidth, MHz	AWGN power level PUSCH tests	AWGN power level PUCCH and PRACH tests
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 6-20: 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 For-mat 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 6-22 the SNR = -2.1 dB

According to Table 6-20 the $SNR_{CorrectionFactor}$ = -7.78 dB

According to Table 6-19 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 SMW equipped with the option R&S SMW-K69 is able to perform HARQ retransmissions and/or timing shifts according to the 3GPP specification.

6.9.3 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/Serial 3x8"
ACK/NACK feedback and timing adjustments feedback are implemented by a serial protocol.
In "Serial 3x8" mode, a serail command consists of three serial packets.
See Chapter 4.1.1, "Serial modes", on page 233.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:RTF:MODE` on page 590

Connector ← Realtime Feedback Configuration
Determines the feedback line connector.

"Global (User 6)"
The following settings apply:
- "EUTRA/LTE > User Equipment > Realtime Feedback > Connector > Global"
- "Global Connector Settings > User 6 > Direction > Input" and "User 6 > Signal > Feedback"

"Local (TM3)"
The following settings apply:
- "EUTRA/LTE > User Equipment > Realtime Feedback > Connector > Local"
- "Local Connector Settings > T/M 3 > Direction > Input" and "T/M 3 > Signal > Feedback"

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONNector` on page 589

Additional User Delay ← Realtime Feedback Configuration
Determines the point in time when the feedback can be sent to the instrument.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:AUSDelay on page 589

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 for a specific baseband unit, the baseband unit listens only to serial commands containing the selector n.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSelector on page 589

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 590

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 588

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 6-19 by the selected channel bandwidth.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:AWGN:PLEVel? on page 580

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 596

6.9.4 Test case 8.2.1: PUSCH in multipath fading propagation conditions

Test Purpose

The test verifies the receiver's ability to achieve throughput under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

The test setup for PUSCH tests with two Rx antennas is performed according to Chapter 6.4.3, "Test setup - diversity measurements", on page 254.

The test setup with four Rx antennas requires additional instruments, see Chapter 6.4.4, "Test setup - four RX antennas", on page 254 (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. 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 6-21.

Table 6-21: 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)

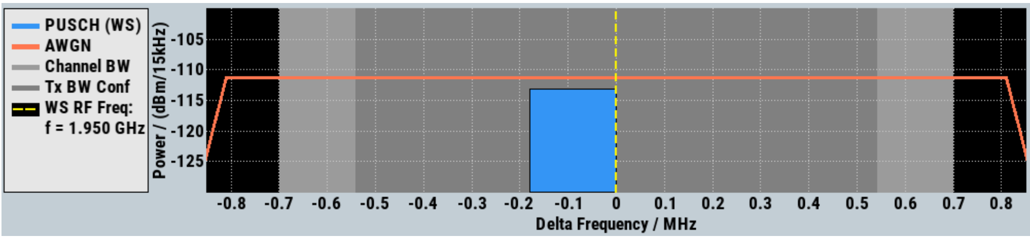
The Table 6-22 shows an example of the test requirements (channel bandwidth 1.4 MHz). Similar requirements exist for the different FRCs, channel bandwidths and antenna configurations. Refer to TS 36.141 for a detailed description of all test requirements.

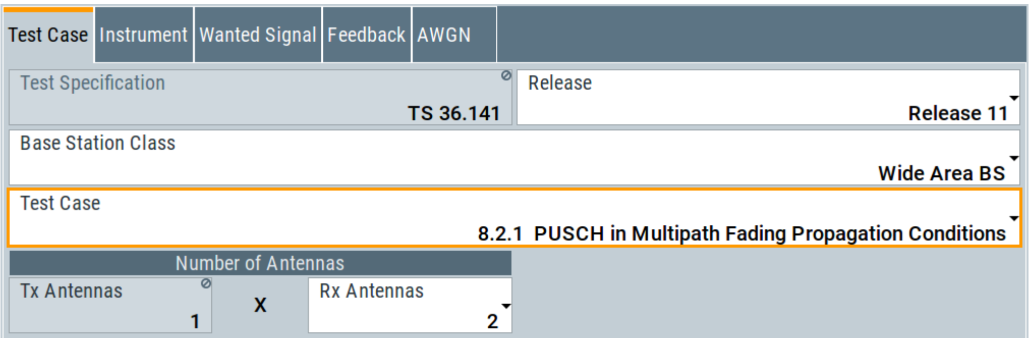
Table 6-22: Test requirements for PUSCH, 1.4 MHz Channel Bandwidth (Number Tx Antennas = 1)

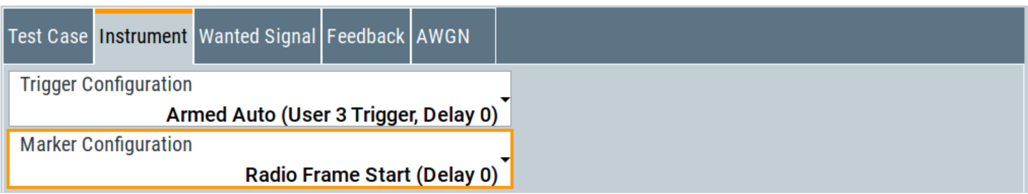
Cyclic prefix	Propagation conditions	FRC	Fraction of maximum throughput, %	SNR, dB 2 RX antennas	SNR, dB 4 RX antennas
Normal	EPA 5Hz	A3-2	30 70	-3.5 0.7	-6.0 -2.5
		A4-3	70	11.2	7.7
		A5-2	70	18.3	15.0

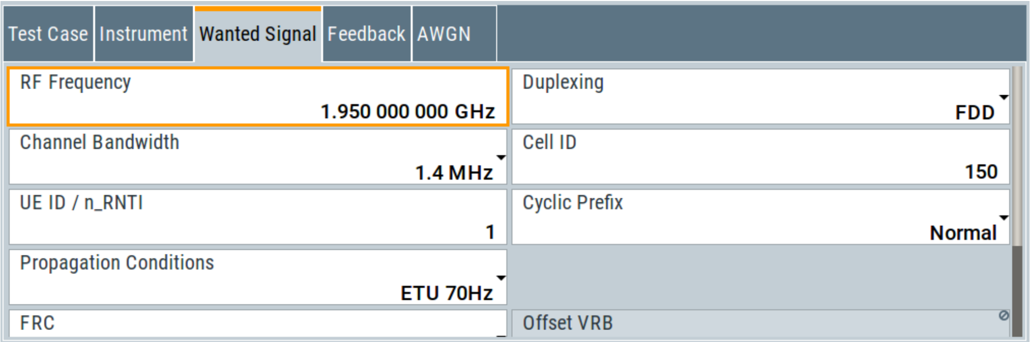
Cyclic prefix	Propagation conditions	FRC	Fraction of maximum throughput, %	SNR, dB 2 RX antennas	SNR, dB 4 RX antennas
	EVA 5Hz	A3-1	30 70	-2.1 2.4	-4.4 -0.7
		A4-1	30 70	5.0 11.9	1.9 8.4
		A5-1	70	19.2	16.0
	EVA 70Hz	A3-2	30 70	-3.3 1.3	-5.7 -2.1
		A4-3	30 70	4.6 12.5	1.4 8.9
	ETU 70Hz*	A3-1	30 70	-1.6 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

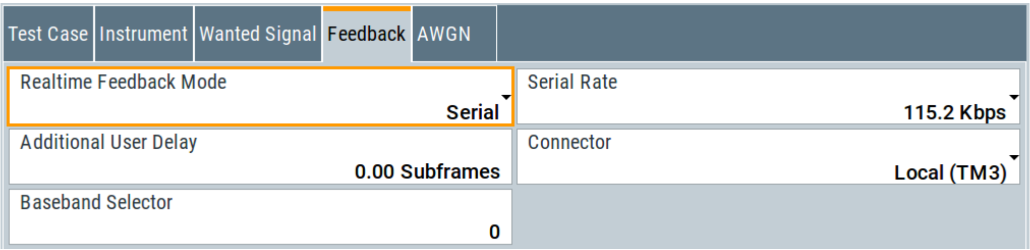
*) Not applicable for Local Area BS and Home BS.

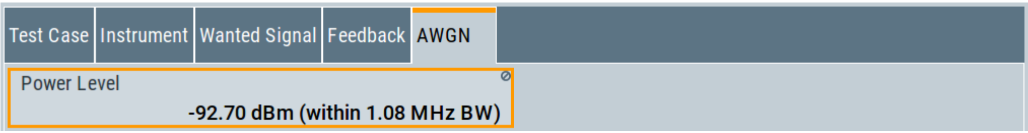












The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings, the AWGN configuration, and the realtime feedback configuration refer to Chapter 6.9.3, "Realtime feedback configuration, AWGN and propagation condition settings", on page 304.

Fraction of Max. Throughput
Selects the fraction of maximum throughput.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:FMTHroughput` on page 593

6.9.5 Test case 8.2.2: UL timing adjustment

Test Purpose

The test verifes 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 6.9.1, "Required options", on page 300.

Test Setup

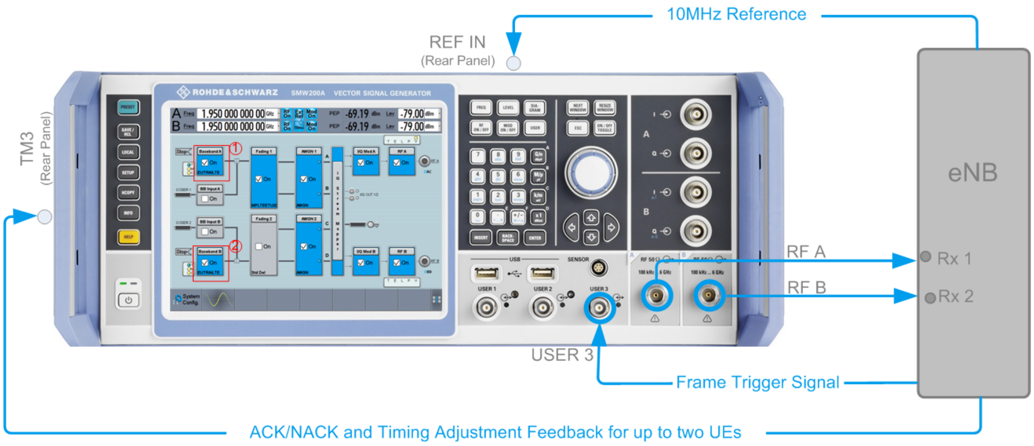


Figure 6-13: Test Setup for test case 8.2.2 "UL Timing Adjustment"

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 6-24). HARQ retransmissions are assumed. The transmission of the sounding reference signal SRS is optional (see "Transmit SRS" on page 312).

Two moving propagation scenarios are defined; tests with scenario 2 are optional. For detailed description of the moving propagation conditions, refer to the description user 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 6-23.

Table 6-23: Test parameters for testing UL timing adjustment

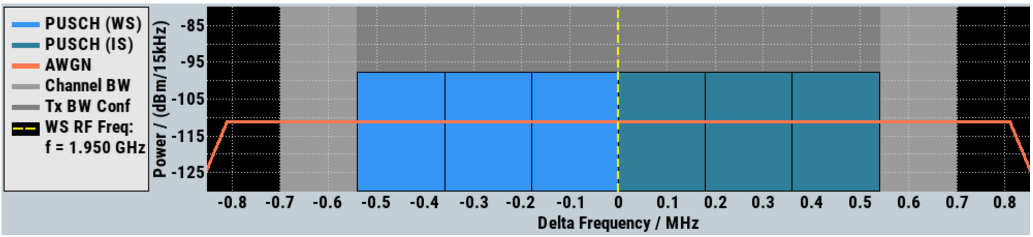
Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)

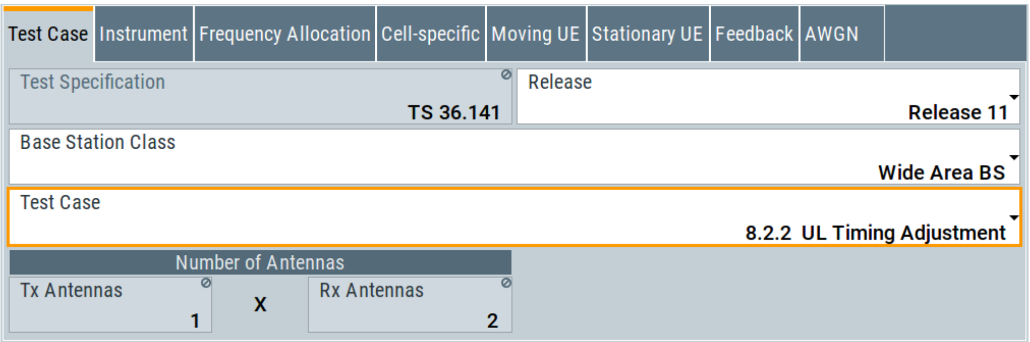
Parameter	Value
Subframes in which PUSCH is transmitted	• For FDD: Subframe #0, #2, #4, #6, and #8 in radio frames • For TDD: Subframe #2, #3, #7, #8 in each radio frame
Subframes in which SRS is transmitted (SRS transmission is optional)	• For FDD: Subframe #1 in radio frames • For TDD: UpPTS in each radio frame

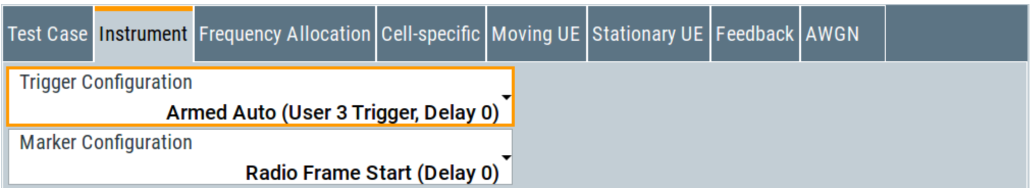
The Table 6-24 shows the test requirements. The test is performed with two Rx antennas and a normal cyclic prefix.

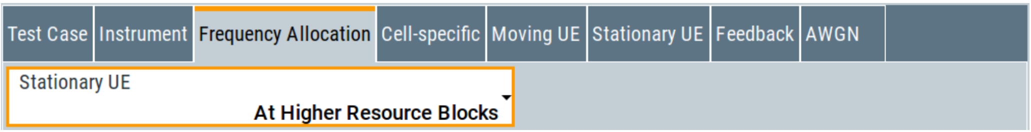
Table 6-24: Test requirements for UL timing adjustment (two Rx antennas and normal cyclic prefix)

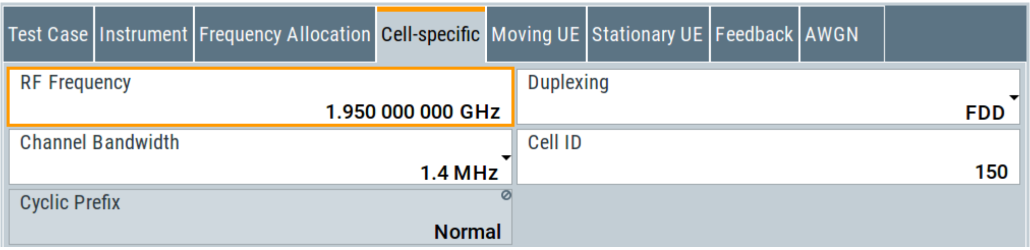
Channel Bandwidth, MHz	Moving propagation conditions	FRC	SNR, dB
1.4	Scenario 1 Scenario 2	A7-1 A8-1	13.7 -1.6
3	Scenario 1 Scenario 2	A7-2 A8-2	14.0 -1.2
5	Scenario 1 Scenario 2	A7-3 A8-3	13.8 -1.3
10	Scenario 1 Scenario 2	A7-4 A8-4	14.4 -1.5
15	Scenario 1 Scenario 2	A7-5 A8-5	14.6 -1.5
20	Scenario 1 Scenario 2	A7-6 A8-6	14.5 -1.5

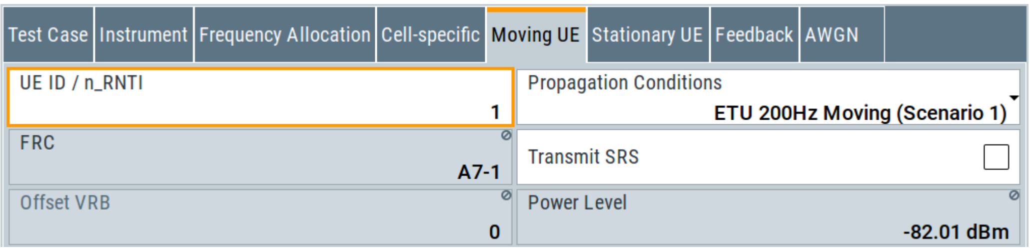


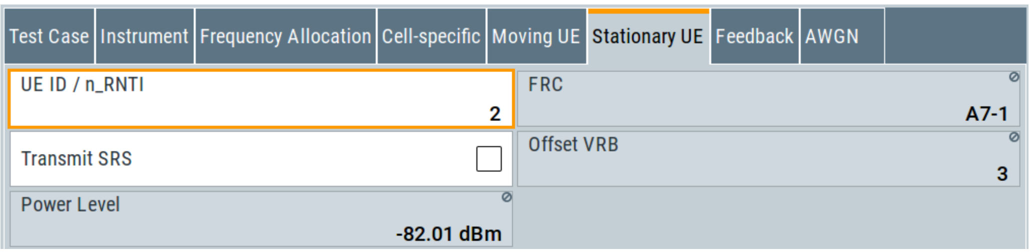

Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
Test Specification
TS 36.141
Release
Release 11
Base Station Class
Wide Area BS
Test Case
8.2.2 UL Timing Adjustment
Number of Antennas
Tx Antennas
1
X
Rx Antennas
2

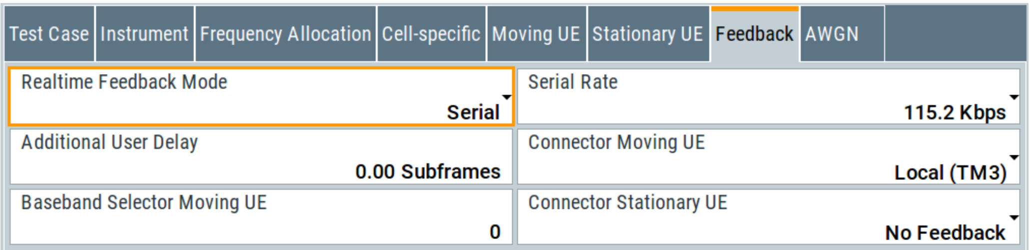

Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
Trigger Configuration
Armed Auto (User 3 Trigger, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)

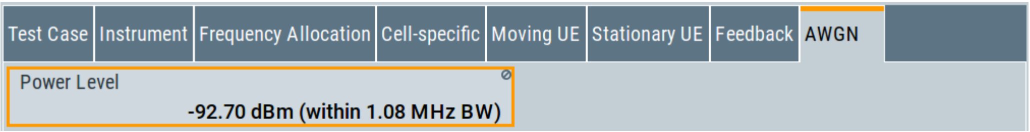

Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
Stationary UE
At Higher Resource Blocks


Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
RF Frequency
1.950 000 000 GHz
Duplexing
FDD
Channel Bandwidth
1.4 MHz
Cell ID
150
Cyclic Prefix
Normal


Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
UE ID / n_RNTI
1
Propagation Conditions
ETU 200Hz Moving (Scenario 1)
FRC
A7-1
Transmit SRS
Offset VRB
0
Power Level
-82.01 dBm


Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
UE ID / n_RNTI
2
FRC
A7-1
Transmit SRS
Offset VRB
3
Power Level
-82.01 dBm





The general and instrument related settings are described in Test case settings and Instrument settings

The cell-specific settings and the settings of the moving UE are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings, the AWGN configuration, and the realtime feedback configuration refer to Chapter 6.9.3, "Realtime feedback configuration, AWGN and propagation condition settings", on page 304.

UE ID/n_RNTI
Sets the UE ID/n_RNTI.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:MUE:UEID on page 597
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:UEID on page 597

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 588
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:TSRS on page 588

Offset VRB
Displays the number of RB with that the allocated RB are shifted.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:MUE:OVRB on page 595
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:OVRB on page 595

Connector Moving UE/Stationary UE
Determines the feedback line connector.

"Global (User 6)"	(will be supported in future firmware release) The following settings apply: ● "EUTRA/LTE > User Equipment > Realtime Feedback > Connector > Global" ● "Global Connector Settings > User 6 > Direction > Input" and "User 6 > Signal > Feedback"
"Local (TM3)"	The following settings apply: ● "EUTRA/LTE > User Equipment > Realtime Feedback > Connector > Local" ● "Local Connector Settings > T/M 3 > Direction > Input" and "T/M 3 > Signal > Feedback"

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONMue on page 589
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONSue on page 589

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 listens only to serial commands containing the selector n.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSMue on page 589
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSSue on page 589

6.9.6 Test case 8.2.3: HARQ-ACK multiplexed on PUSCH

Test Purpose

The test verifies 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 6.9.1, "Required options", on page 300.

Test Setup

See Chapter 6.4.3, "Test setup - diversity measurements", on page 254 (HARQ feedback line is not required).

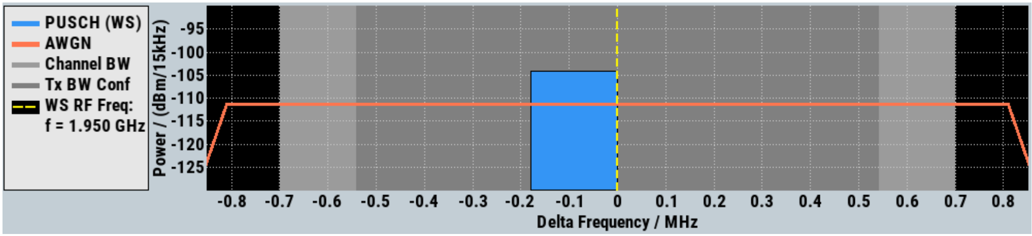
Short Description

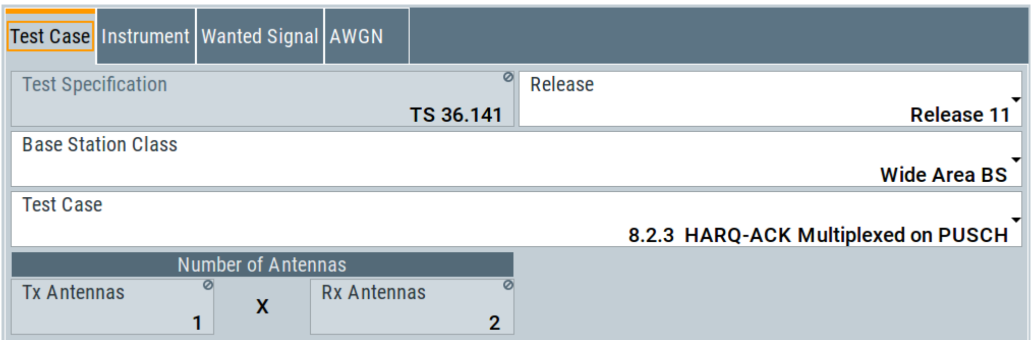
The performance requirement of HARQ-ACK multiplexed on PUSCH is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

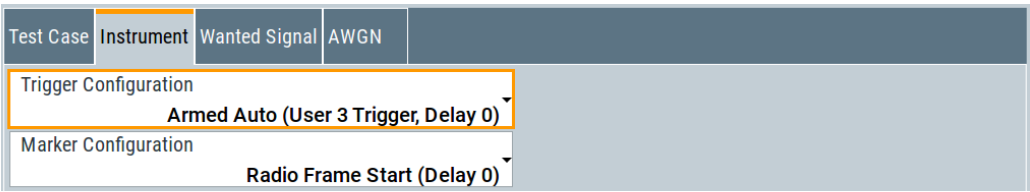
The Table 6-25 shows the test requirements. The tests are performed with two Rx antennas, normal cyclic prefix and propagation condition ETU70.

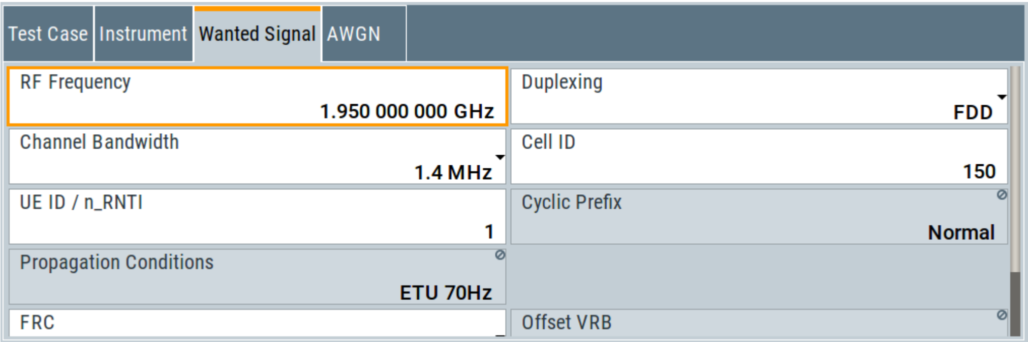
Table 6-25: Test requirements for HARQ-ACK multiplexed on PUSCH (two Rx antennas, normal cyclic prefix and propagation condition ETU70)

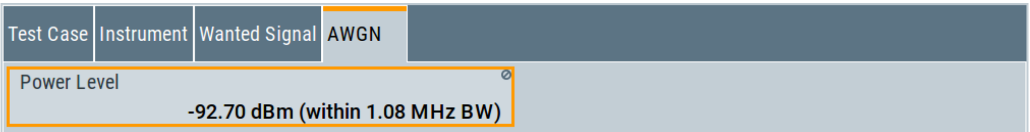
Channel Bandwidth, MHz	FRC	Index HARQ Offset	SNR, dB
1.4	A3-1 A4-3	8 5	7.2 14.4
3	A3-1 A4-4	8 5	7.2 13.5
5	A3-1 A4-5	8 5	7.1 13.1
10	A3-1 A4-6	8 5	7.2 12.9
15	A3-1 A4-7	8 5	7.3 12.7
20	A3-1 A4-8	8 5	7.1 12.6











The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 305 and "AWGN Configuration" on page 305.

6.9.7 Test case 8.2.4: high-speed train conditions

Test Purpose

The test verifies the receiver’s ability to achieve throughput under High-Speed Train conditions for a given SNR (TS 36.141).

Required Options

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

See Chapter 6.4.3, "Test setup - diversity measurements", on page 254 and Chapter 6.4.1, "Standard test setup - one path", on page 252 (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 6-26). 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 6-27.

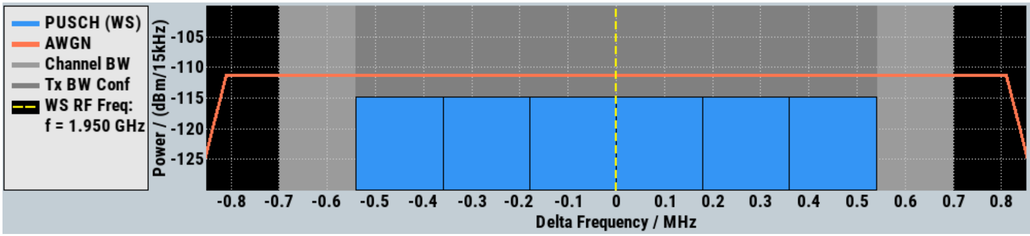
Table 6-26: Test parameters for High-Speed Train conditions

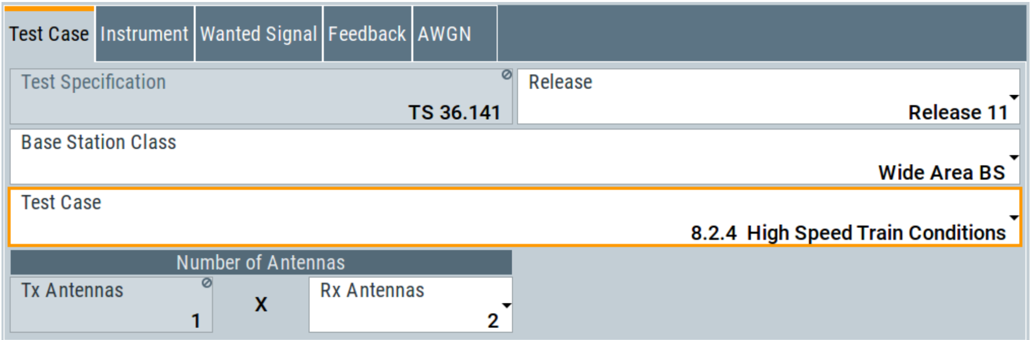
Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)
Subframes in which PUSCH is transmitted	For FDD: ● Subframe #0 and #8 in radio frames for which SFN mod 4 = 0 ● Subframe #6 in radio frames for which SFN 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 are set to [-4.5 dB and -1.5 dB] for Scenario 1 and 3.	

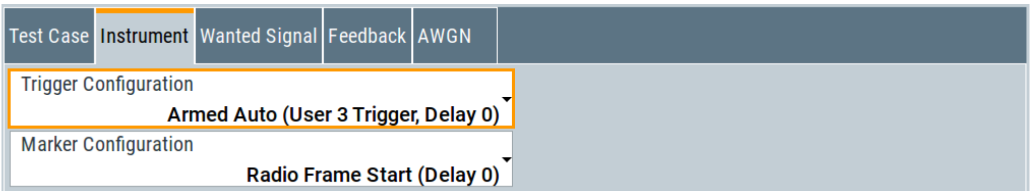
Table 6-27: Test requirements for High-Speed Train conditions

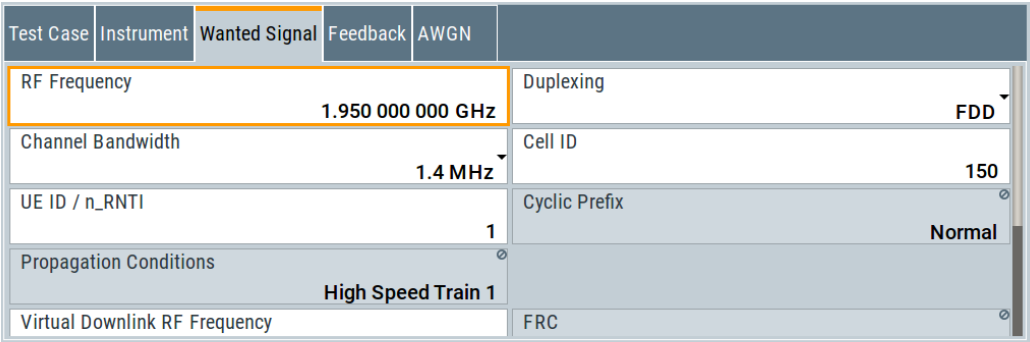
Channel Band-width, MHz	FRC	Number of RX antennas	Propagation conditions	Fraction of maximum throughput, %	SNR, dB
1.4	A3-2	1	HST Scenario 3	30 70	-1.2 2.2
		2	HST Scenario 1	30 70	-3.6 -0.3
3	A3-3	1	HST Scenario 3	30 70	-1.8 1.9
		2	HST Scenario 1	30 70	-4.2 -0.7
5	A3-4	1	HST Scenario 3	30 70	-2.3 1.6
		2	HST Scenario 1	30 70	-4.8 -1.1
10	A3-5	1	HST Scenario 3	30 70	-2.4 1.5

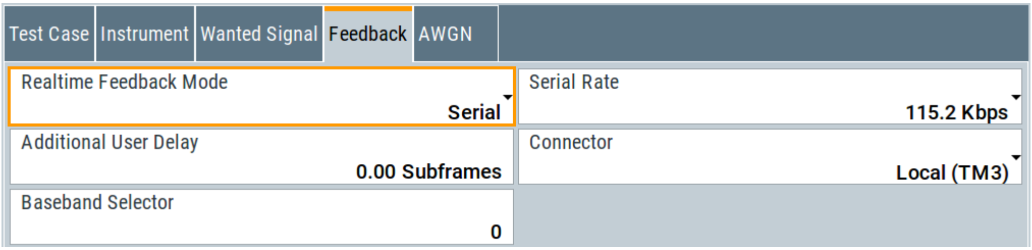
Channel Band-width, MHz	FRC	Number of RX antennas	Propagation conditions	Fraction of maximum throughput, %	SNR, dB
		2	HST Scenario 1	30 70	-5.1 -1.2
15	A3-6	1	HST Scenario 3	30 70	-2.4 1.5
		2	HST Scenario 1	30 70	-4.9 -1.1
20	A3-7	1	HST Scenario 3	30 70	-2.4 1.5
		2	HST Scenario 1	30 70	-5.0 -1.1

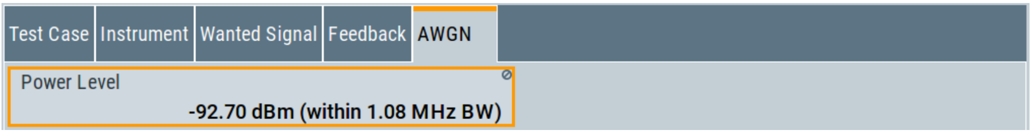












The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings, the AWGN configuration, and the realtime feedback configuration refer to Chapter 6.9.3, "Realtime feedback configuration, AWGN and propagation condition settings", on page 304.

Virtual Downlink RF Frequency
In *high-speed train BS tests*, the DL signal itself already contains a Doppler shift. The UE synchronizes on this shifted DL frequency. The simulated UL signal contains a Doppler shift, too.

The resulting Doppler shift is then based *on both*, the UL and the DL frequency.

- This parameter "Virtual Downlink RF Frequency" defines the downlink frequency F_{DL}.
  For HST BS tests, enter the F_{DL} as defined in the specification. The value is used by the calculation of the UL Doppler shift.
- The uplink RF frequency F_{UL} is set with the parameter RF Frequency.

For more information on the Doppler shift calculation and the high-speed train conditions:

See user manual R&S®SMW-B14/-K71/-K72/-K73/-K74/-K75/-K820/-K821/-K822/-K823 Fading Simulation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:VDRFrequency on page 597

Additionally Configure PUCCH
Enables the optional transmission of PUCCH format 2.

The settings are configured according to Table 6-27; the PUCCH Power Level is calculated automatically.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:ACPucch on page 590

Power Level (PUSCH)
Displays the resulting PUSCH power level.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLPS? on page 595

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 595

6.9.8 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 6.9.1, "Required options", on page 300.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 6.4.3, "Test setup - diversity measurements", on page 254 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 6.4.4, "Test setup - four RX antennas", on page 254 (HARQ feedback line is not required).

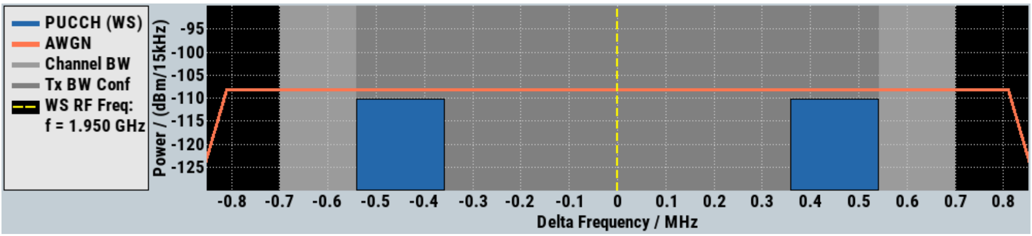
Short Description

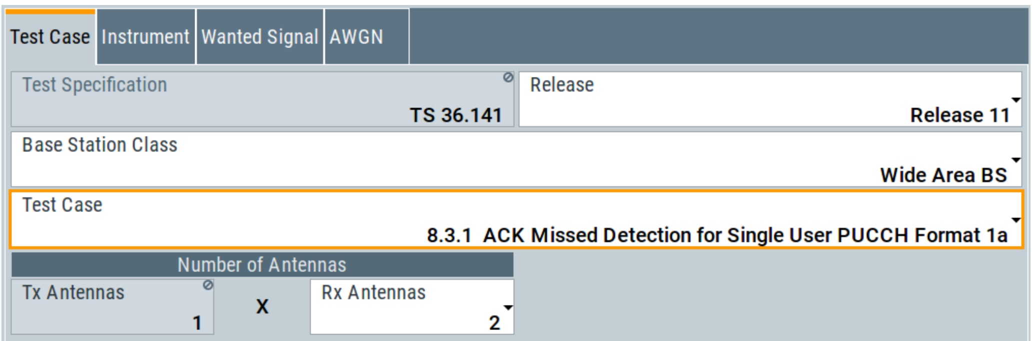
The performance requirement of single user PUCCH for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

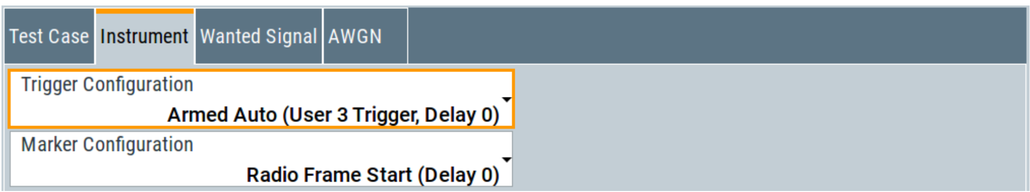
The Table 6-28 shows the test requirements for two and four Rx antennas.

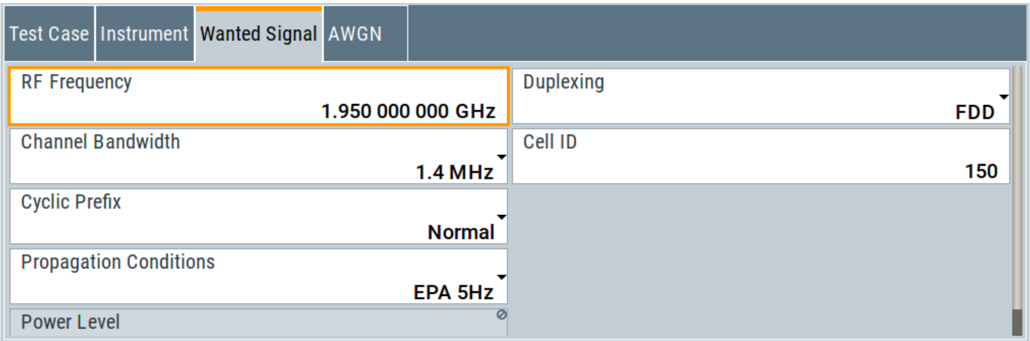
Table 6-28: Required SNR for single user PUCCH format 1a demodulation tests

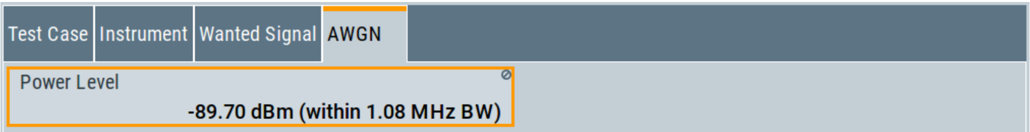
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4 MHz	BW=3MHz	BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5	-1.9	-3.3	-4.2	-4.8	-4.7	-4.5
		EVA 5	-3.9	-4.5	-4.5	-4.4	-4.5	-4.5
		EVA 70	-4.3	-4.6	-4.6	-4.5	-4.6	-4.5
		ETU 300	-4.4	-4.5	-4.3	-4.4	-4.6	-4.6
	Extended	ETU 70	-3.6	-3.7	-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 general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 305 and "AWGN Configuration" on page 305.

6.9.9 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 verifies the receiver’s ability to detect CQI under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

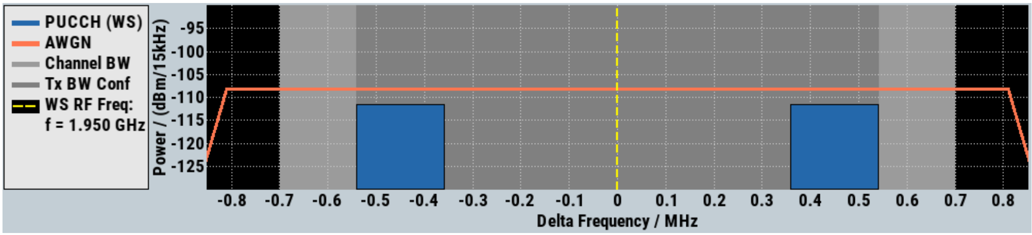
See Chapter 6.4.3, "Test setup - diversity measurements", on page 254 (HARQ feed-back line is not required).

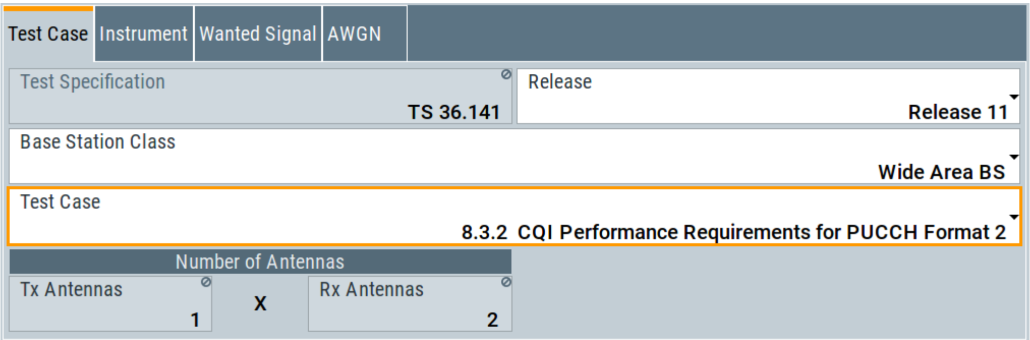
Short Description

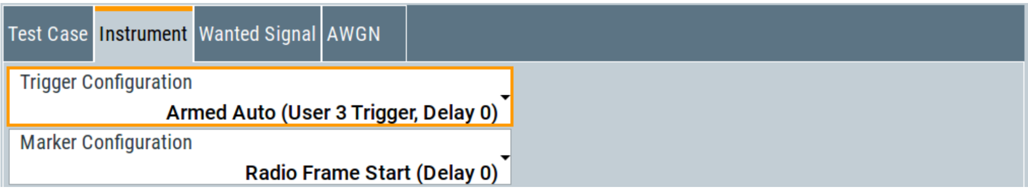
The performance requirement of PUCCH for CQI is determined by the BLER probability of detection of CQI. The performance is measured by the required SNR at BLER equal to 1%.

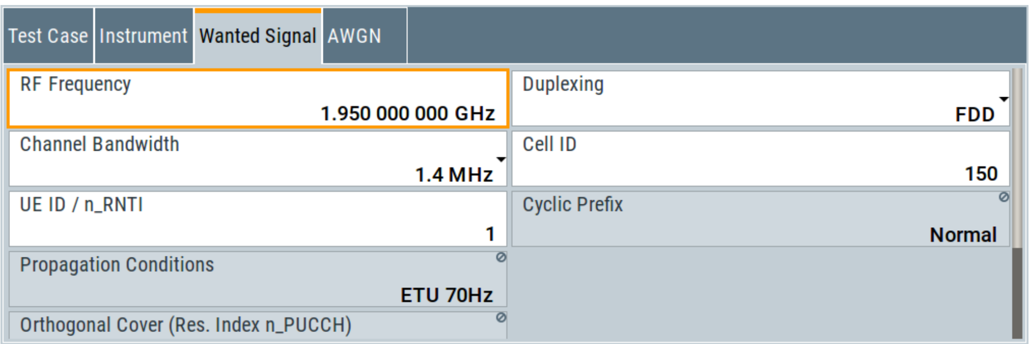
Table 6-29: Required SNR for PUCCH format 2 demodulation tests

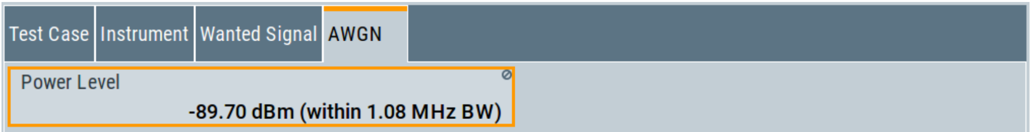
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4 MHz	BW=3MHz	BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	ETU70	-3.3	-3.8	-3.6	-3.8	-3.8	-3.8











The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 305 and "AWGN Configuration" on page 305.

6.9.10 Test case 8.3.3: ACK missed detection for multi-user PUCCH format 1a

Test Purpose

The test verifies 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

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

The test setup requires a two-path instrument, synchronized via a reference frequency (see Figure 6-14). The base station provides its frame trigger signal to the signal generators.

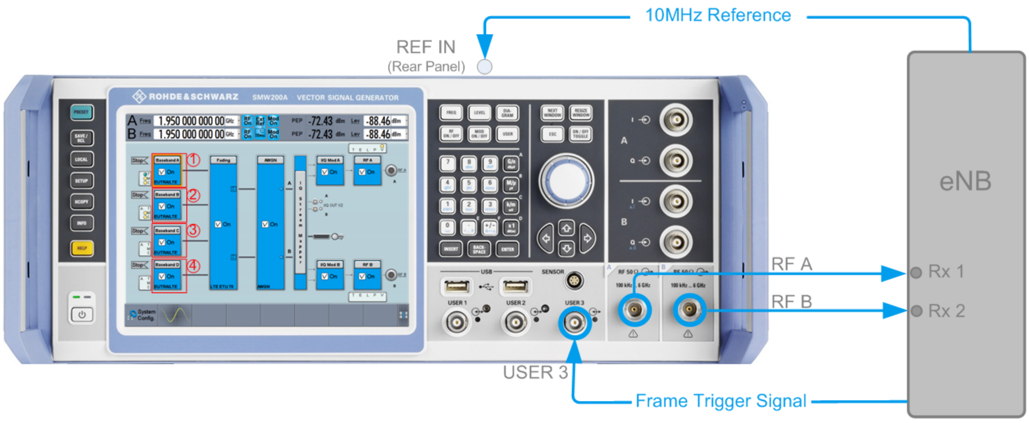


Figure 6-14: Test Setup for test case 8.3.3 "ACK missed detection for multi-user PUCCH format 1a"

1 = Baseband A generates the wanted UE signal
2 = Baseband B generates the interferer 1 signal
3 = Baseband C generates the interferer 2 signal
4 = Baseband D 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 6-30). ACK/NAK repetitions are disabled for PUCCH transmission.

Table 6-30: 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

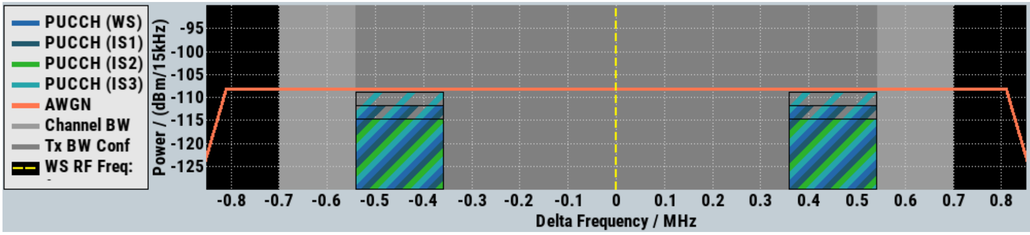
In multi-user PUCCH test, four signals are configured: one wanted signal and three interferers, which are transmitted via separate fading paths using relative power settings as defined in Table 6-31.

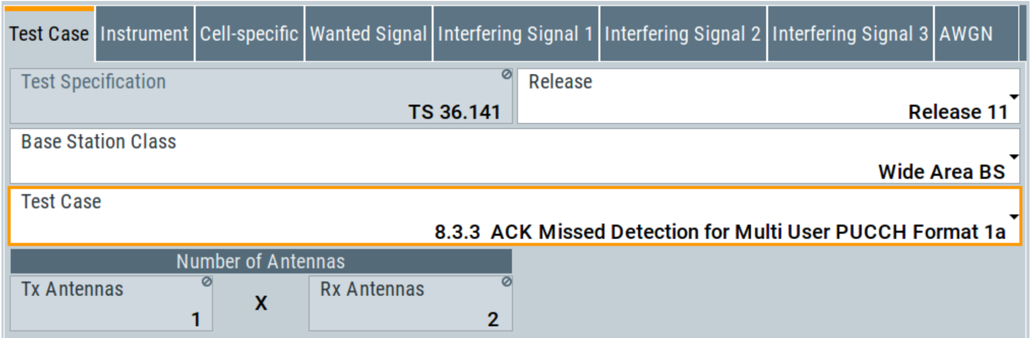
Table 6-31: Test parameters for multi-user PUCCH case

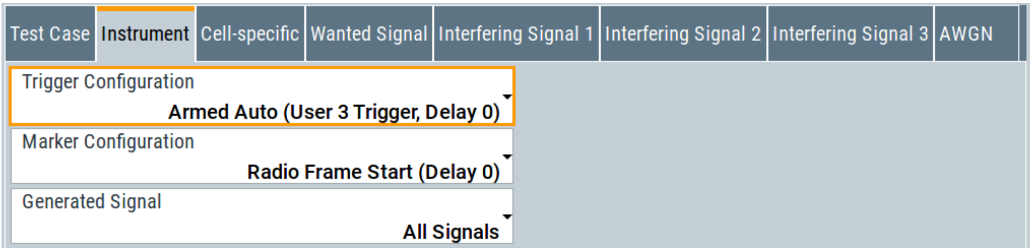
	Cyclic shift index (δ =0)	Orthogonal cover index	RS orthogonal cover / ACK/NACK orthogonal cover	Relative power, dB	Relative timing, ns
Tested signal	4	0	2	-	-
Interferer 1	2	0	1	0	0
Interferer 2	3	1	7	-3	0
Interferer 3	4	2	14	3	0

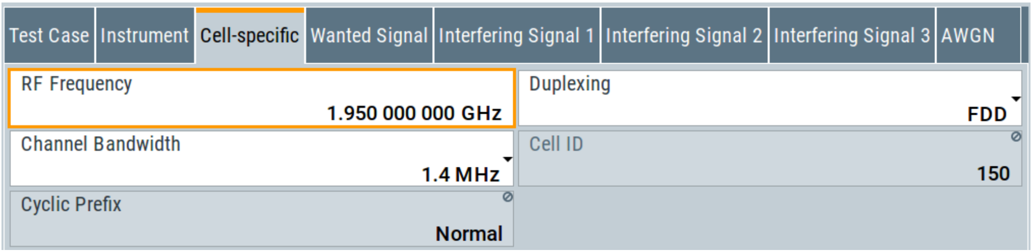
Presented resource index mapping for orthogonal cover and cyclic shift indices are for the first slot of the subframe. All above listed signals are transmitted on the same PUCCH resources, with different PUCCH channel indices as defined in Table 6-31.

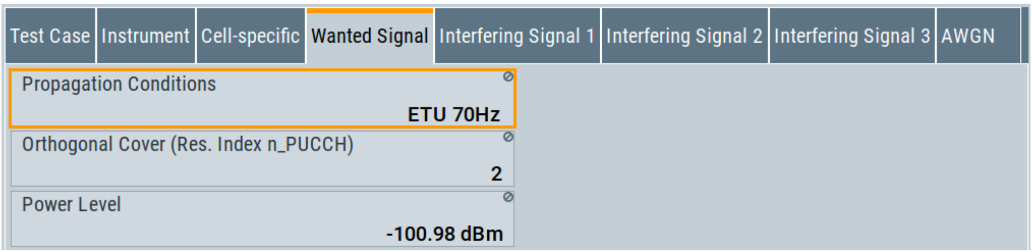
In the multi-user PUCCH test, the Test Case Wizard also sets the "Number of Cyclic Shifts" for the mixed format resource block (N_cs^(1)) to 0 and the cyclic shift increment (Delta_shift^PUCCH) to 2, as specified in TS 36.141.

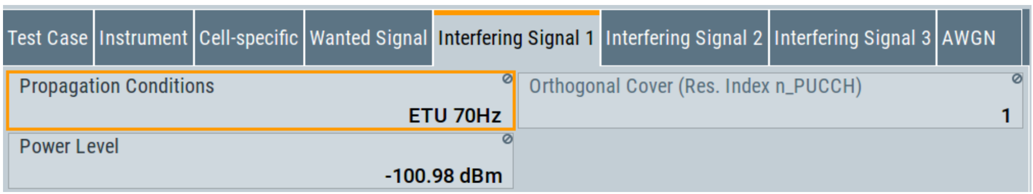

PUCCH (WS)
PUCCH (IS1)
PUCCH (IS2)
PUCCH (IS3)
AWGN
Channel BW
Tx BW Conf
WS RF Freq:
Power / (dBm/15kHz)
-95
-100
-105
-110
-115
-120
-125
-0.8 -0.7 -0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
Delta Frequency / MHz

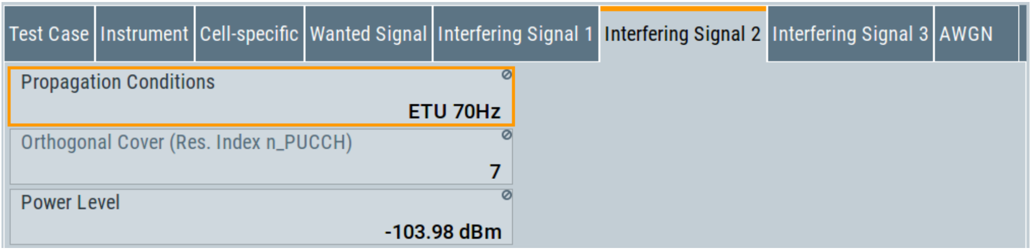

Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
Test Specification
TS 36.141
Release
Release 11
Base Station Class
Wide Area BS
Test Case
8.3.3 ACK Missed Detection for Multi User PUCCH Format 1a
Number of Antennas
Tx Antennas
1
x
Rx Antennas
2

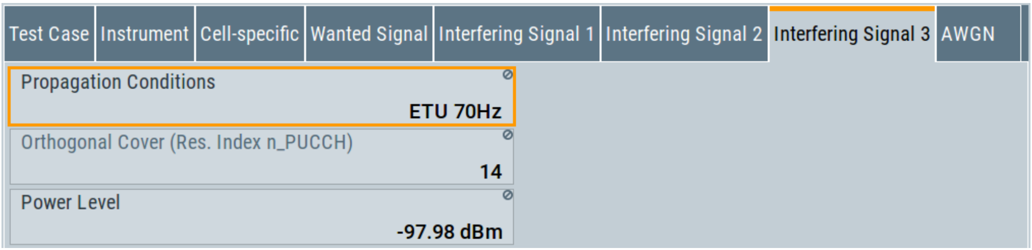

Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
Trigger Configuration
Armed Auto (User 3 Trigger, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)
Generated Signal
All Signals

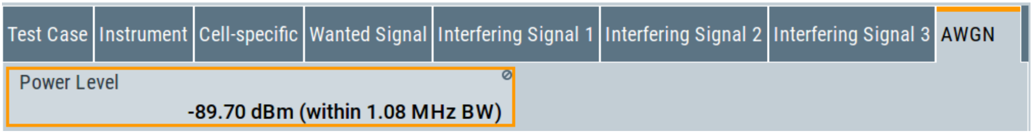

Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
RF Frequency
1.950 000 000 GHz
Duplexing
FDD
Channel Bandwidth
1.4 MHz
Cell ID
150
Cyclic Prefix
Normal


Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
Propagation Conditions
ETU 70Hz
Orthogonal Cover (Res. Index n_PUCCH)
2
Power Level
-100.98 dBm


Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
Propagation Conditions
ETU 70Hz
Orthogonal Cover (Res. Index n_PUCCH)
1
Power Level
-100.98 dBm







The general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 305 and "AWGN Configuration" on page 305.

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 R&S SMW can generate all required signals out of one box.

In test setup with two instruments, the first R&S SMW should generate the "Wanted Signal, Interferer 1 and AWGN" signal and the second R&S SMW, the signal of "Interferers 2 and 3".

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:GS:GENSignals` on page 581

Propagation Conditions

Displays the propagation conditions of the interfering signal.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:IS:PRCOndition?` on page 595

`[:SOURce<hw>]:BB:EUTRa:TCW:IS2:PRCOndition?` on page 595

`[:SOURce<hw>]:BB:EUTRa:TCW:IS3:PRCOndition?` on page 596

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 6-31.

In test case 8.3.9, the number of ports is set with the selected Number of Tx Antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover?` on page 594
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:ORTCover?` on page 594
`[:SOURce<hw>]:BB:EUTRa:TCW:IS2:ORTCover?` on page 594
`[:SOURce<hw>]:BB:EUTRa:TCW:IS3:ORTCover?` on page 594
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover[:PORT<ch0>]?` on page 594

Interferer Type
Displays the type of the interfering signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS2:IFTYpe?` on page 585

RF Frequency
Displays the center frequency of interfering signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS2:RFFRequency` on page 587

Power Level
Displays the power level of the interfering signals.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS2:PLEVel?` on page 586
`[:SOURce<hw>]:BB:EUTRa:TCW:IS3:PLEVel?` on page 586

6.9.11 Test case 8.3.4: ACK missed detection for PUCCH format 1b, channel selection

Test Purpose

The test verifies the receiver's ability to detect ACK bits under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 6.4.3, "Test setup - diversity measurements", on page 254 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 6.4.4, "Test setup - four RX antennas", on page 254 (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

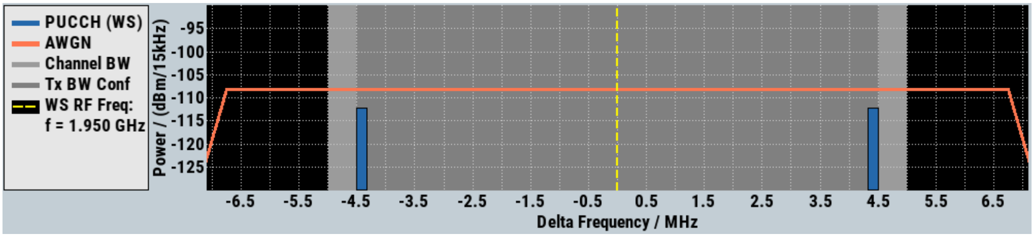
The performance requirement of PUCCH format 1b with Channel Selection for ACK missed detection is determined by:

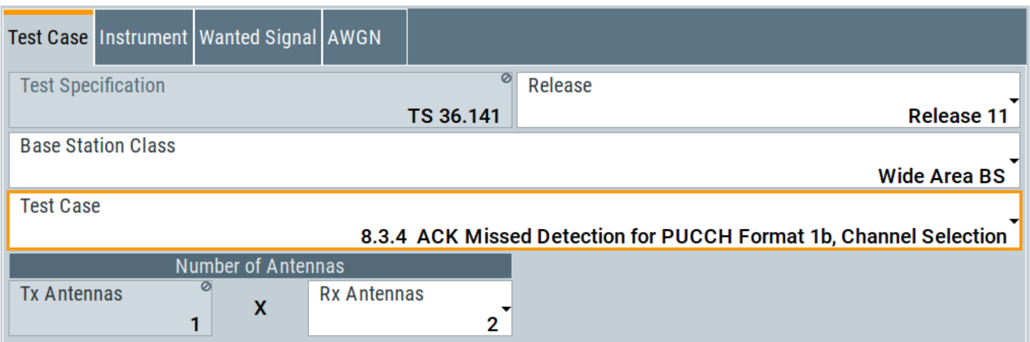
- The probability of false detection of the ACK
- The probability of detection of ACK

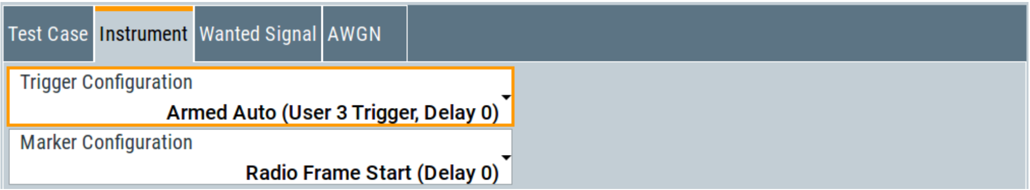
The performance is measured on the wanted signal by the required SNR at probability of detection equal to 0.99. The fraction of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

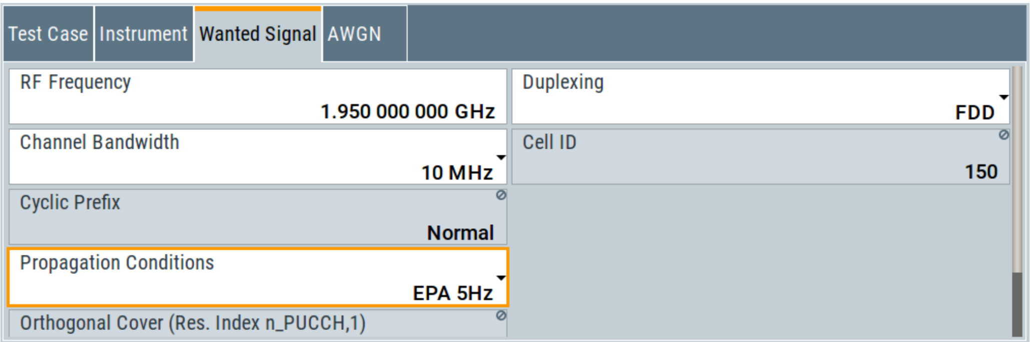
Table 6-32: Required SNR for PUCCH format 1b with channel Selection demodulation tests (Number of Tx antennas = 1)

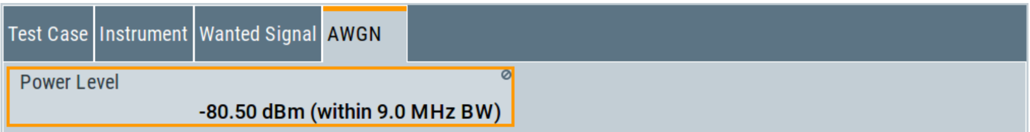
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz BW=3MHz BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5 Low	-	-3.9	-4.0	-4.0
	Normal	EVA 70 Low	-	-3.7	-3.9	-3.9
4	Normal	EPA 5 Low	-	-7.8	-7.9	-8.0
	Normal	EVA 70 Low	-	-7.7	-7.9	-7.9











The general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 305 and "AWGN Configuration" on page 305.

6.9.12 Test case 8.3.5: ACK missed detection for PUCCH format 3

Test Purpose

The test verifies 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 6.9.1, "Required options", on page 300.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 6.4.3, "Test setup - diversity measurements", on page 254 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 6.4.4, "Test setup - four RX antennas", on page 254 (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

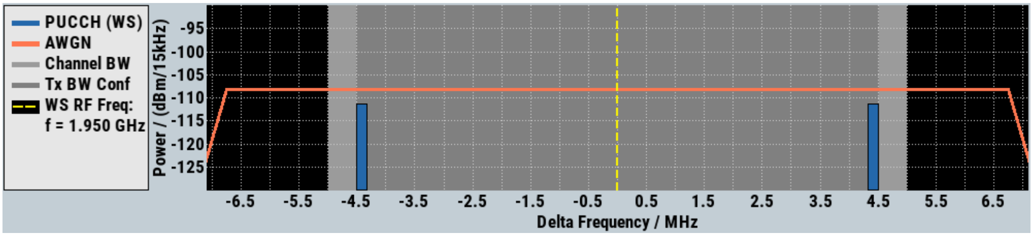
The performance is measured on the wanted signal by the required SNR at probability of detection equal to 0.99. The fraction of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

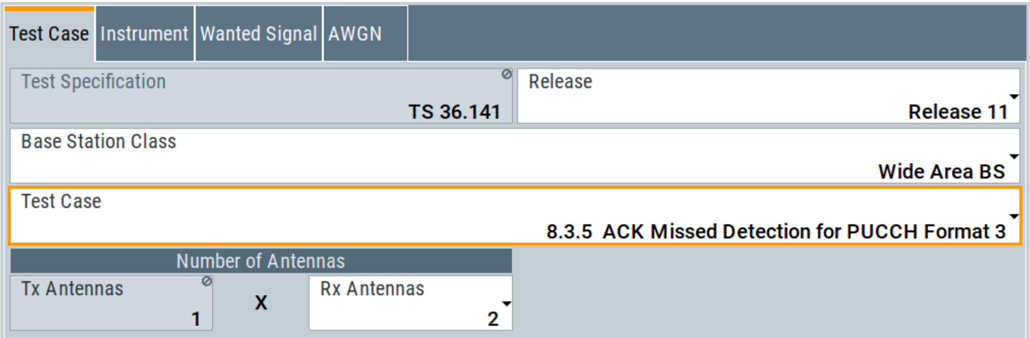
Table 6-33: Required SNR for PUCCH format 3 demodulation tests, 4AN bits (Number of Tx antennas = 1)

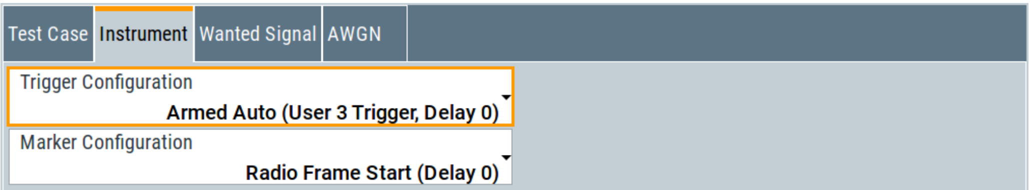
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz BW=3MHz BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5 Low	-	-3.1	-3.2	-3.2
	Normal	EVA 70 Low	-	-2.9	-3.0	-3.1
4	Normal	EPA 5 Low	-	-6.7	-6.8	-6.9
	Normal	EVA 70 Low	-	-6.6	-6.7	-6.7

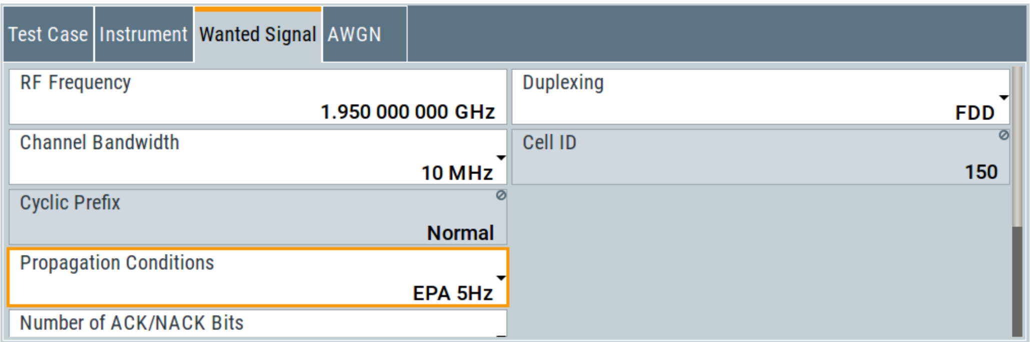
Table 6-34: Required SNR for PUCCH format 3 demodulation tests, 16AN bits (Number of Tx antennas = 1)

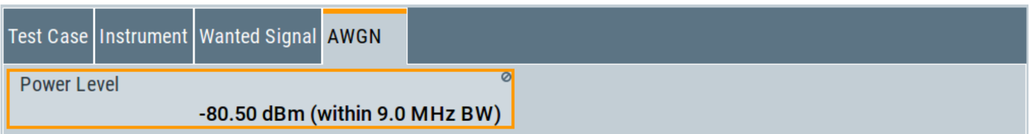
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW= 1.4MHz BW= 3MHz BW= 5MHz	BW= 10MHz	BW= 15MHz	BW= 20MHz
2	Normal	EPA 5 Low	-	-0.7	-0.6	-0.6
	Normal	EVA 70 Low	-	-0.2	-0.3	-0.3
4	Normal	EPA 5 Low	-	-4.7	-4.7	-4.8
	Normal	EVA 70 Low	-	-4.4	-4.5	-4.5











The general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 305 and "AWGN Configuration" on page 305.

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 591

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 591

6.9.13 Test case 8.3.6: NACK to ACK detection for PUCCH format 3

Test Purpose

The test verifies 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 6.9.1, "Required options", on page 300.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 6.4.3, "Test setup - diversity measurements", on page 254 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 6.4.4, "Test setup - four RX antennas", on page 254 (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

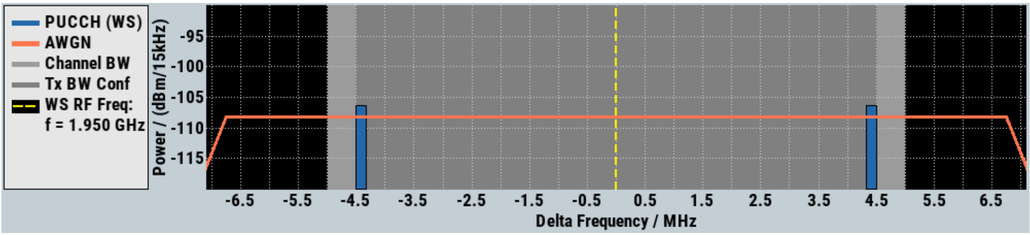
The performance requirement of PUCCH format 3 for NACK to ACK detection is determined by:

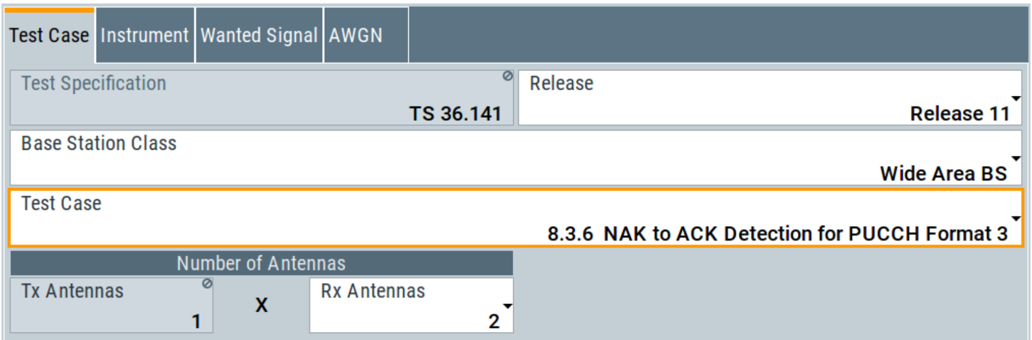
- The probability of false detection of the ACK
- The probability of detection of ACK

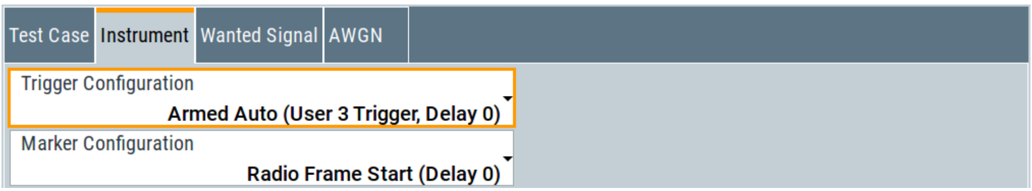
The performance is measured on the wanted signal by the required SNR at probability of detection equal to 0.99. The fraction of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

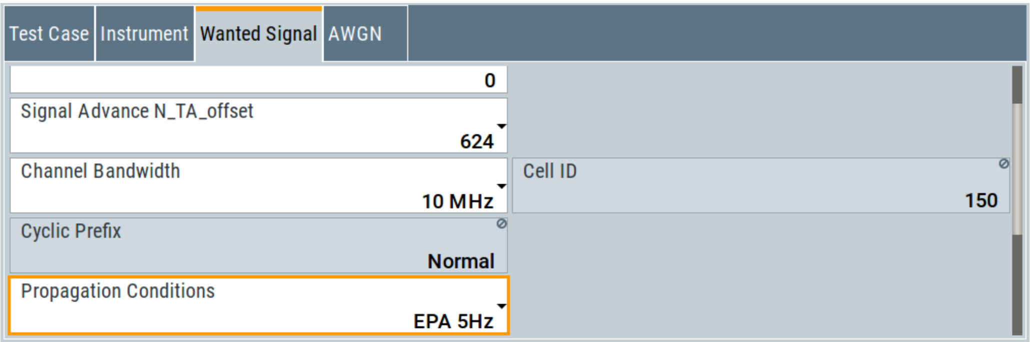
Table 6-35: Required SNR for PUCCH format 3 demodulation tests, 16AN bits (Number of Tx antennas = 1)

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 general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 305 and "AWGN Configuration" on page 305.

6.9.14 Test case 8.3.7: ACK missed detection for PUCCH format 1a transmission on two antenna ports

Test Purpose

The test verifies 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

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

The test setup requires a two-path instrument, synchronized via a reference frequency (see Figure 6-14). The base station provides its frame trigger signal to the signal generators.

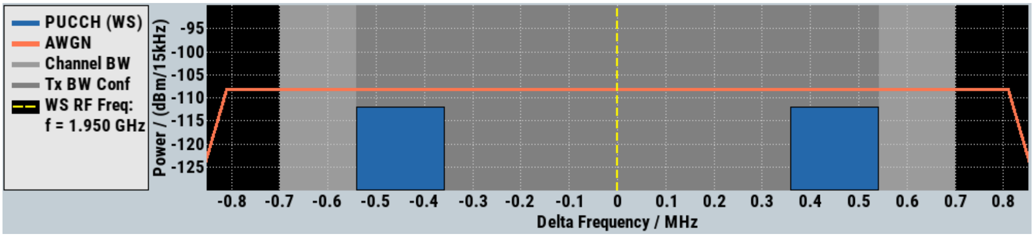
Short Description

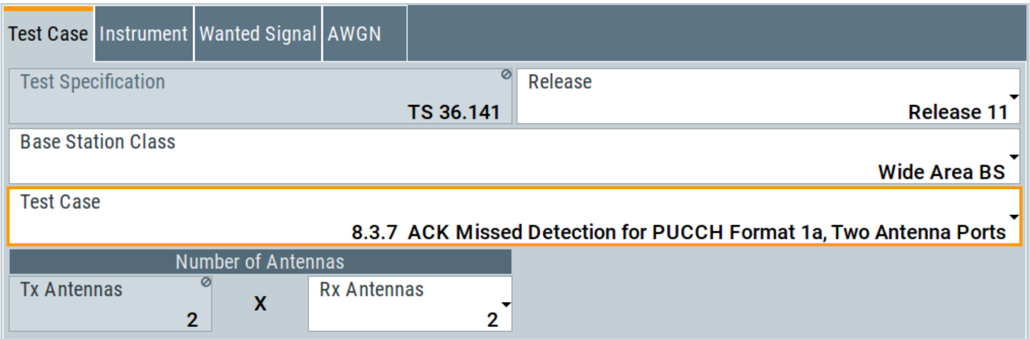
The performance is measured on the wanted signal by the required SNR at probability of detection equal to or greater than 0.99. The probability of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

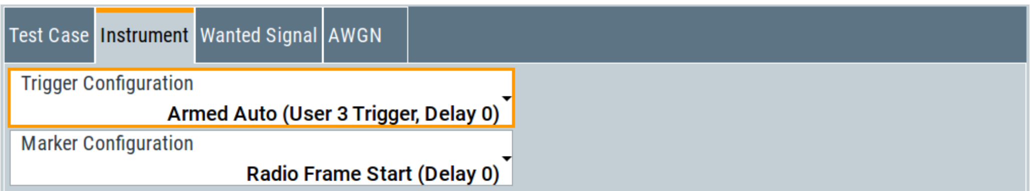
Multi-user PUCCH test is performed for 2 and 4 Rx antennas and Normal CP (see Table 6-30). ACK/NAK repetitions are disabled for PUCCH transmission.

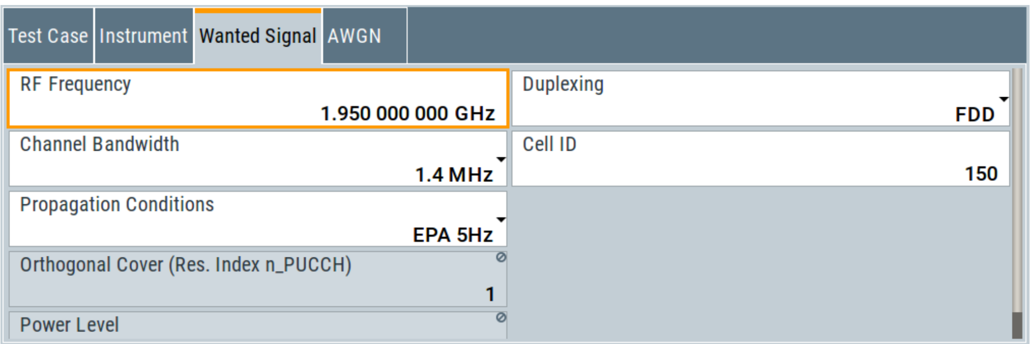
Table 6-36: Required SNR for multi-user PUCCH demodulation tests

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
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









6.9.15 Test case 8.3.8: CQI performance requirements for PUCCH format 2 transmission on two antenna ports

Test Purpose

The test verifies the receiver's ability to detect CQI under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

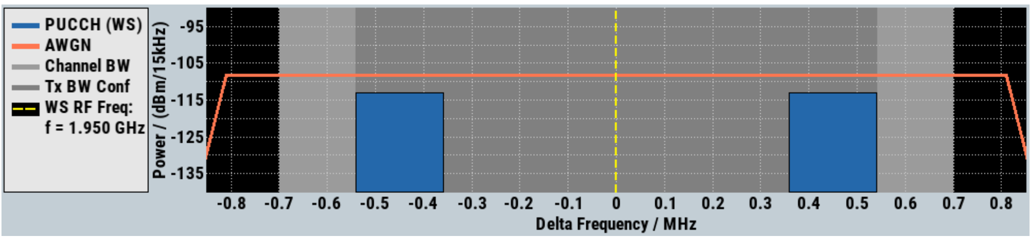
See Chapter 6.4.3, "Test setup - diversity measurements", on page 254 (HARQ feedback line is not required).

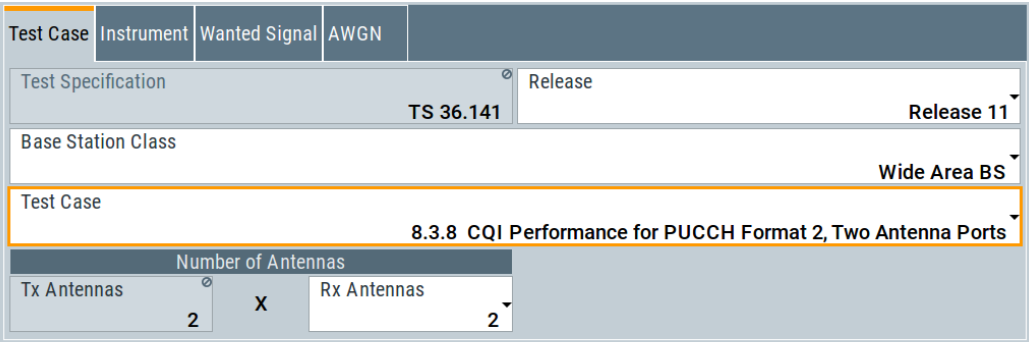
Short Description

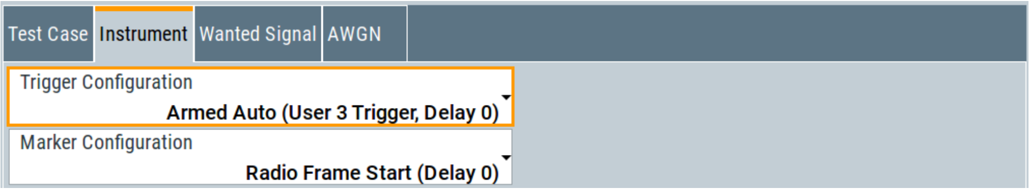
The performance requirement of PUCCH format 2 for CQI is determined by the block error probability (BLER) of CQI. The performance is measured by the required SNR at BLER equal to 1%.

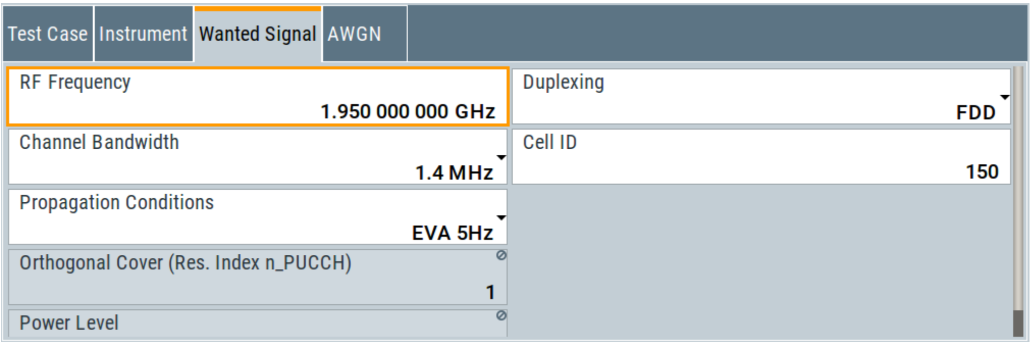
Table 6-37: Required SNR for PUCCH format 2 demodulation tests

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









6.9.16 Test case 8.3.9: CQI performance for PUCCH format 2 with DTX detection

Test Purpose

The test verifies the receiver's ability to detect CQI under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

The test setup is performed according to the standard setup, see Chapter 6.4.3, "Test setup - diversity measurements", on page 254 (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.

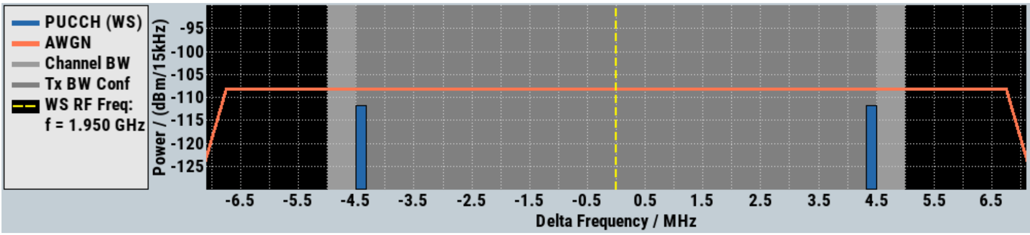
The performance is measured on the wanted signal by the required SNR at BLER of 1%.

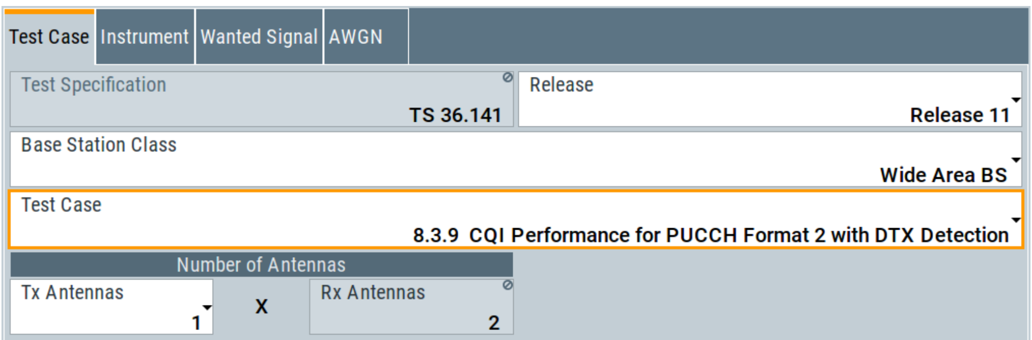
Table 6-38: Required SNR for PUCCH format 2 demodulation tests with DTX detection (Number of Rx antennas = 2)

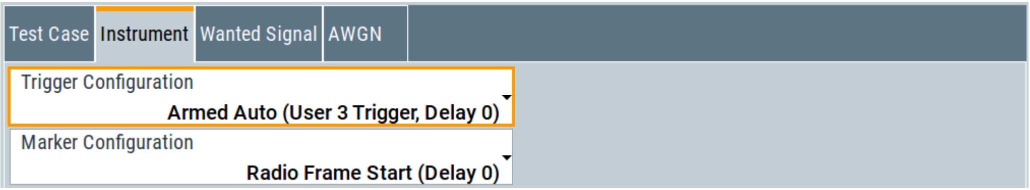
Number of TX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4 MHz	BW=3MHz	BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
1	Normal	EVA 5* Low	-3.1	-3.4	-3.8	-3.4	-3.6	-3.6
		ETU 70** Low	-3.1	-3.4	-3.2	-3.5	-3.3	-3.5
2		EVA 5 Low	-4.5	-4.4	-4.7	-4.6	-4.5	-4.7

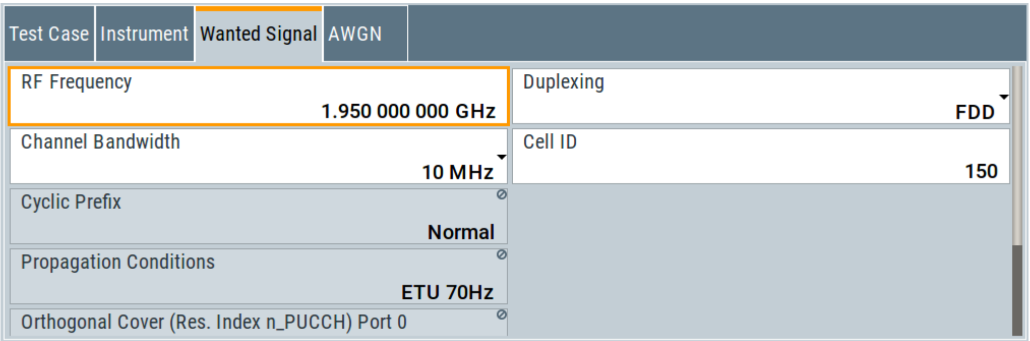
*) Not applicable for Wide Area BS and Medium Range BS

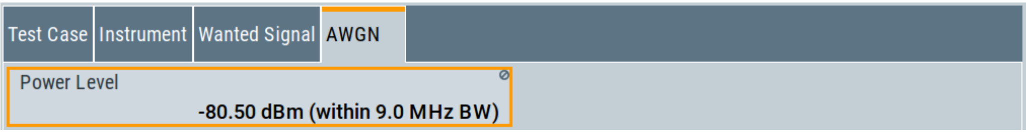
**) Not applicable for Local Area BS and Home BS











The general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 305 and "AWGN Configuration" on page 305.

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 set with the selected Number of Tx Antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover[:PORT<ch0>]?` on page 594

CQI Pattern Port 0/1 (bin)

Sets the CQI pattern per enabled port.

The number of ports is set with the selected Number of Tx Antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:CQIPattern:PORT<ch0>` on page 592

6.9.17 Test case 8.4.1: PRACH false alarm probability and missed detection

Test Purpose

The test verifies the receiver's ability to detect PRACH preamble under multipath fading propagation conditions for a given SNR (TS 36.141)

Required Options

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 6.4.3, "Test setup - diversity measurements", on page 254 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 6.4.4, "Test setup - four RX antennas", on page 254 (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 6-39 and Table 6-40, 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.

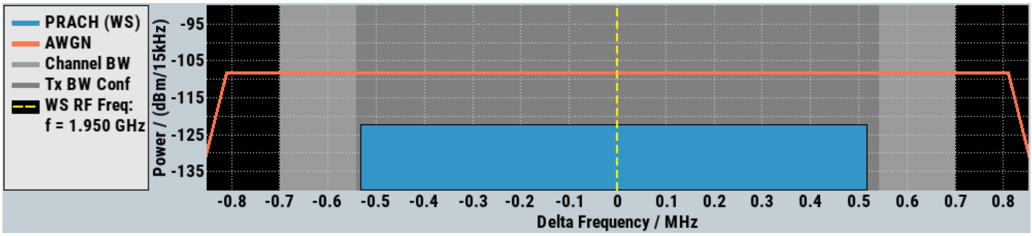
Table 6-39: PRACH missed detection test requirements for Normal Mode; the SNR [dB] is given per burst format

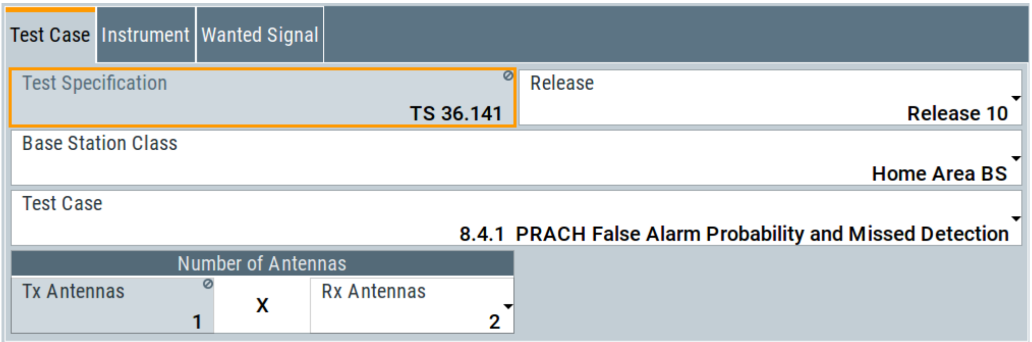
Number of RX antennas	Propagation conditions	Frequency offset, Hz	Burst format 0	Burst format 1	Burst format 2	Burst format 3	Burst format 4
2	AWGN	0	-13.9	-13.9	-16.1	-16.2	-6.9
	ETU 70	270	-7.4	-7.2	-9.4	-9.5	0.5
4	AWGN	0	-16.6	-16.4	-18.7	-18.5	-9.5
	ETU 70	270	-11.5	-11.1	-13.5	-13.3	-4.5

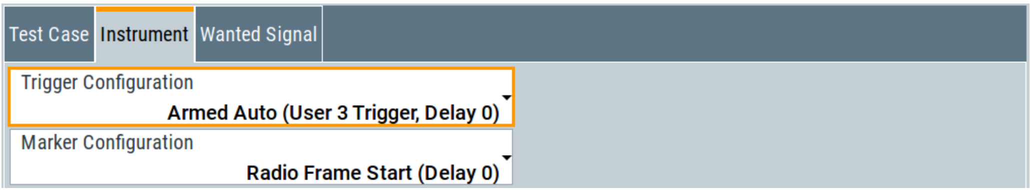
Table 6-40: PRACH missed detection test requirements for High-speed Mode; the SNR [dB] is given per burst format

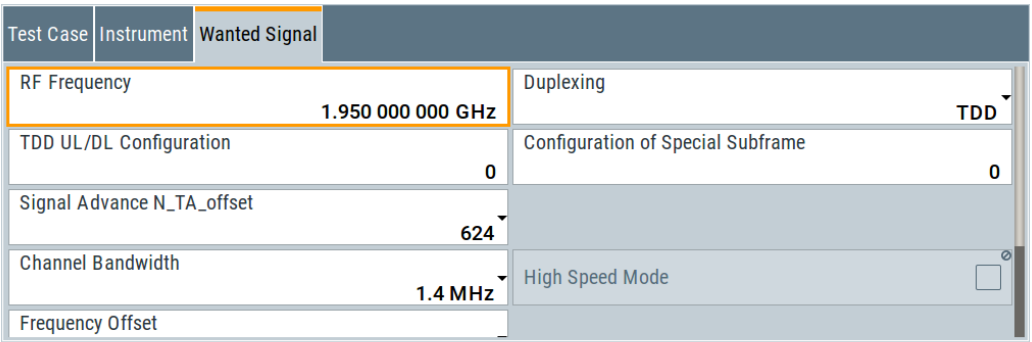
Number of RX antennas	Propagation conditions	Frequency offset, Hz	Burst format 0	Burst format 1	Burst format 2	Burst format 3
2	AWGN	0	-13.8	-13.9	-16.0	-16.3
	ETU 70	270	-6.8	-6.7	-8.7	-8.9

Number of RX antennas	Propagation conditions	Frequency offset, Hz	Burst format 0	Burst format 1	Burst format 2	Burst format 3
	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 general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 6.6.4, "Wanted signal and cell-specific settings", on page 263.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 305 and "AWGN Configuration" on page 305.

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 increases 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 582

Configuration of Special Subframe

(enabled for TDD duplexing mode only)

Sets the Special Subframe Configuration number.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:SPSFrame` on page 596

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 594

Frequency Offset
Sets the frequency offset, as defined in Table 6-39 and Table 6-40.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:FROFfset on page 593

Burst Format
Sets the burst format.

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 591

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 increases by 0.1 us. This sequence of timing offsets is restarted after 10 preambles.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:TIOBase? on page 596

6.9.18 Test case 8.5.1: performance requirements for NPUSCH

Test Purpose

The test verifies the receiver’s ability to achieve the throughput under multipath fading propagation conditions for a given SNR (TS 36.141 Performance requirements for NPUSCH format 1).

Required Options

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

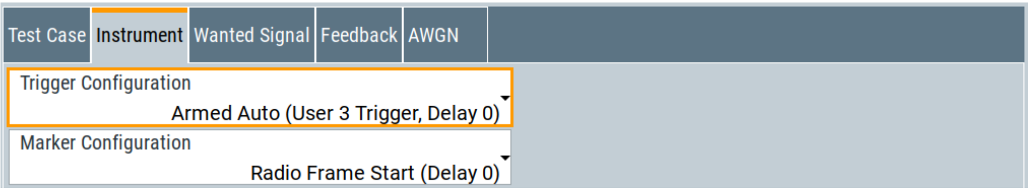
The test setup for NPUSCH tests with two Rx antennas is performed according to Chapter 6.4.3, "Test setup - diversity measurements", on page 254.

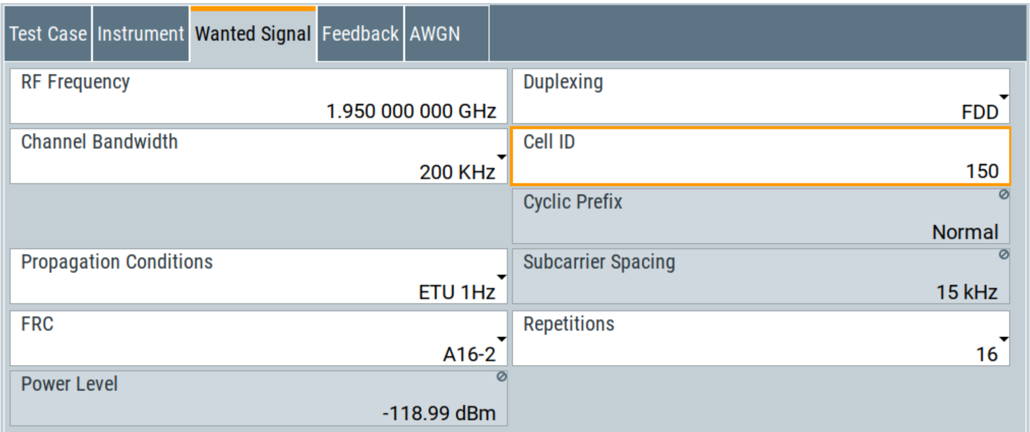
The test setup with four Rx antennas requires additional instruments, see Chapter 6.4.4, "Test setup - four RX antennas", on page 254.

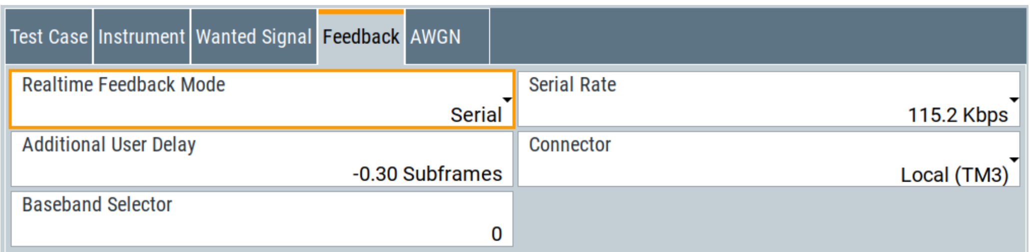
Short Description

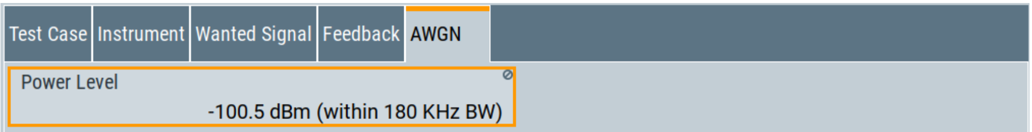
The performance requirement of NPUSCH format 1 is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in Annex A of TS 36.141. The performance requirements assume HARQ retransmissions.


EUTRA/LTE: Test Case Wizard
PUSCH (WS)
AWGN
Channel BW
Tx BW Conf
WS RF Freq:
f = 1.950 GHz
Power / (dBm/15kHz)
-105
-110
-115
-120
-125
-0.0001
-5E-5
0
5E-5
0.0001
Delta Frequency / MHz
Test Case
Instrument
Wanted Signal
Feedback
AWGN
Test Specification
TS 36.141
Release
Release 13-15
Base Station Class
Wide Area BS
Test Case
8.5.1 Performance requirements for NPUSCH format 1
Number of Antennas
Tx Antennas
1
x
Rx Antennas
2
TS 36.141:
8.5.1 Performance requirements for NPUSCH format 1
Apply
OK


Test Case
Instrument
Wanted Signal
Feedback
AWGN
Trigger Configuration
Armed Auto (User 3 Trigger, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)


Test Case
Instrument
Wanted Signal
Feedback
AWGN
RF Frequency
1.950 000 000 GHz
Duplexing
FDD
Channel Bandwidth
200 KHz
Cell ID
150
Cyclic Prefix
Normal
Propagation Conditions
ETU 1Hz
Subcarrier Spacing
15 kHz
FRC
A16-2
Repetitions
16
Power Level
-118.99 dBm


Test Case
Instrument
Wanted Signal
Feedback
AWGN
Realtime Feedback Mode
Serial
Serial Rate
115.2 Kbps
Additional User Delay
-0.30 Subframes
Connector
Local (TM3)
Baseband Selector
0



FRC

Sets the FRC of NPUSCH wanted signal.

Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:WS:NIOT:FRC on page 597

Subcarrier Spacing

Sets the subcarier spacing of NB-IoT wanted signal.

Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:WS:SCSPacing on page 598

6.9.19 Test case 8.5.2: ACK missed detection for NPUSCH format 2

Test Purpose

The test verifies the receiver's ability to detect ACK under multipath fading propagation conditions for a given SNR (TS 36.141 ACK missed detection for NPUSCH format 2).

Required Options

See Chapter 6.9.1, "Required options", on page 300.

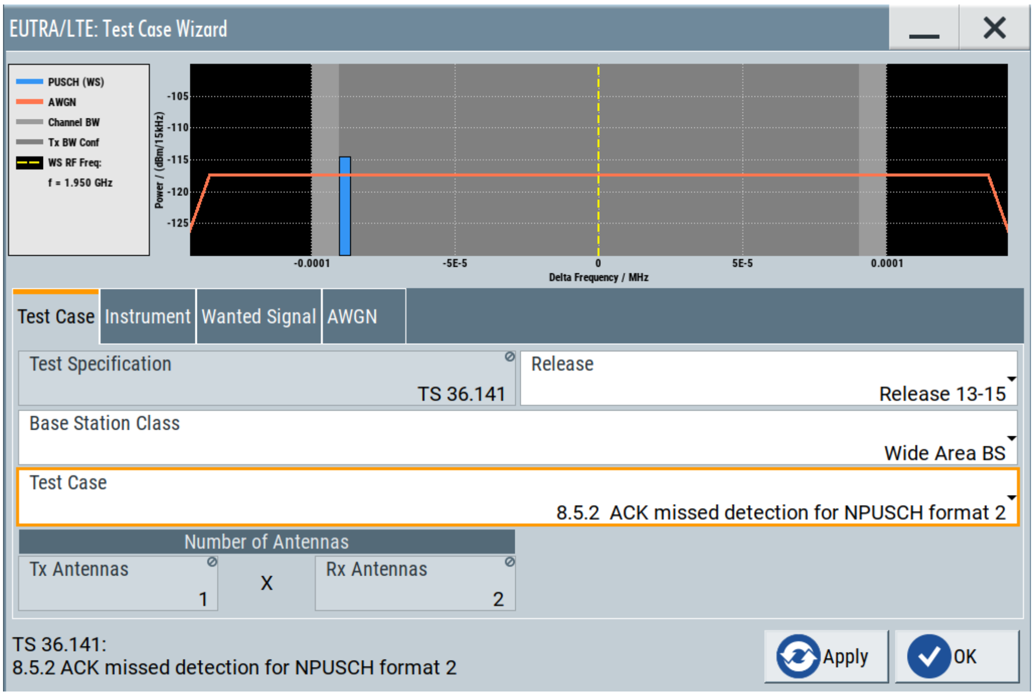
Test Setup

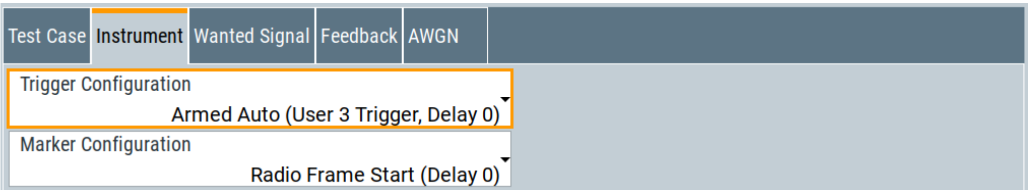
The test setup for NPUSCH tests with two Rx antennas is performed according to Chapter 6.4.3, "Test setup - diversity measurements", on page 254.

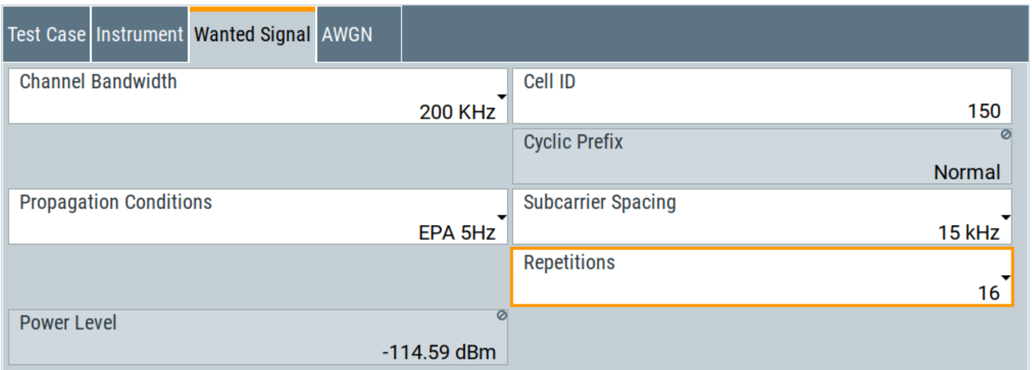
The test setup with four Rx antennas requires additional instruments, see Chapter 6.4.4, "Test setup - four RX antennas", on page 254 (HARQ feedback line is not required).

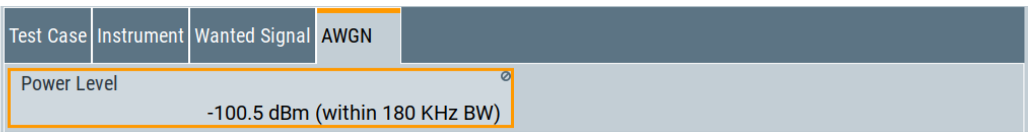
Short Description

The performance requirement of NPUSCH format 2 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 must be 0.01 or less.









Subcarrier Spacing

Sets the subcarier spacing of NB-IoT wanted signal.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:WS:SCSPacing` on page 598

6.9.20 Test case 8.5.3: performance requirements for NPRACH

Test Purpose

The test verifies the receiver's ability to detect NPRACH preamble under multipath fading propagation conditions for a given SNR (TS 36.141 Performance requirements for NPRACH)

Required Options

See Chapter 6.9.1, "Required options", on page 300.

Test Setup

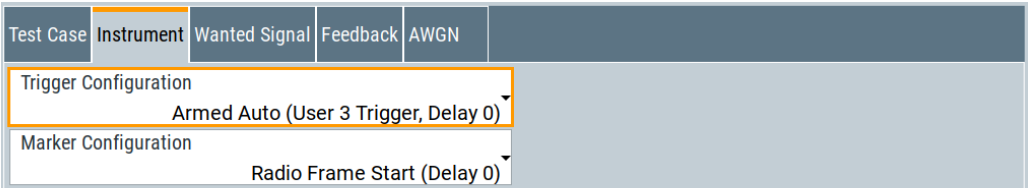
The test setup with two Rx antennas is performed according to the standard setup, see Chapter 6.4.3, "Test setup - diversity measurements", on page 254.

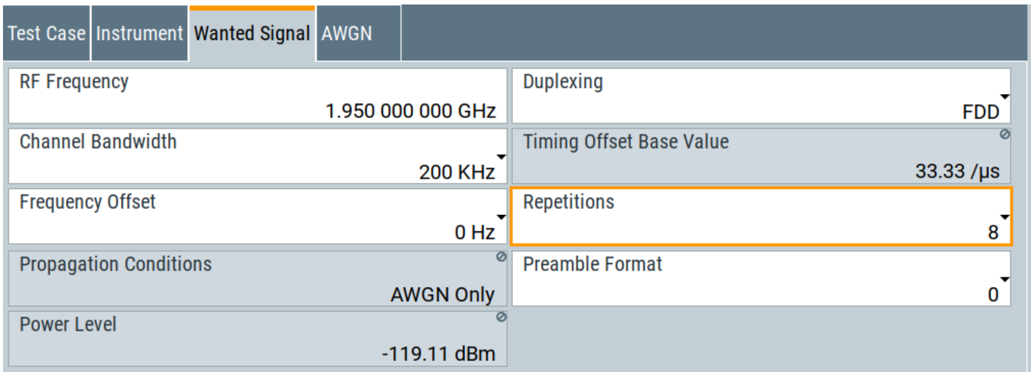
The test setup with four Rx antennas requires additional instruments, see Chapter 6.4.4, "Test setup - four RX antennas", on page 254.

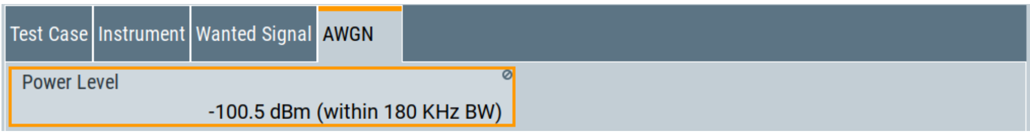
Short Description

The performance requirement of NPRACH for preamble detection is determined by two parameters: the total probability of false detection of the preamble (Pfa) and the probability of detection of the preamble (Pd). The performance is measured for the required SNR at following probabilities:

- Pd must be 99% or larger
- Pfa must be 0.1% or smaller







Preamble Format

Selects the preamble format of the wanted signal according to tables 8.5.3.5-1 (FDD) or 8.5.3.5-2 (TDD) of TS 36.141.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:WS:PFMT` on page 597

7 Generating user plane data

If equipped with the option R&S SMW-K175, your R&S SMW can generate and export user plane (U-plane) data based on the O-RAN specifications.

The O-RAN alliance defines a standardized data format for 3GPP signals. Data is exported into a set of `.json` files which contains the raw frequency domain I/Q-samples.

The `.json` files can be parsed into a file format that you use for postprocessing.

For detailed information about the specifications, refer to the documents of the O-RAN alliance.

Access to U-plane data generation

You can activate U-plane data generation in the "General Settings" dialog. For details, see "U-Plane Generation" on page 62.

To select one of the predefined configurations via O-RAN test models, refer to "Test Models" on page 59

Note that U-plane data generation slows down the calculation speed of the instrument. Therefore, turn on U-plane data generation only if necessary.

7.1 Required options

The generation of U-plane data requires:

- Standard or wideband baseband generator (R&S SMW-B10/-B9)
- Baseband main module (R&S SMW-B13) or wideband baseband main module (R&S SMW-B13XT)
- Digital standard NB-IoT release 15/16/17 (R&S SMW-K146)
- Option U-plane data generation (R&S SMW-K175)

7.2 File format and folder structure

When exporting the user plane, the R&S SMW stores the data in the `\user\U-Plane\` directory on its harddisk. A U-plane dataset itself consists of a set of subdirectories.

```
\Output_0
 \Carrier_0
 \Carrier_1
 \Carrier_N
\Output_1
 ...
\Output_N
```

Every folder contains a set of n .json files (SF_<xx>.json), where n= 10 * No_of_rf_frames. The number of values in the file depends on the number of symbols. This number depends on the number of FFT samples:

number of I/Q values = number of symbols * FFT samples

- I/Q values within a symbol are separated by a comma
- The end of a symbol is indicated by a new line character (\n)
  Example:
  `0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j\n`

Note that the R&S SMW always generates a complete set of data, even for symbols that are not allocated. Those I/Q data have the value 0 ("0+0j"), while the I/Q data for symbols that are allocated have the actual real and imaginary values (e.g. "-0.707106781+0.707106781j").

8 Signal control and signal characteristics

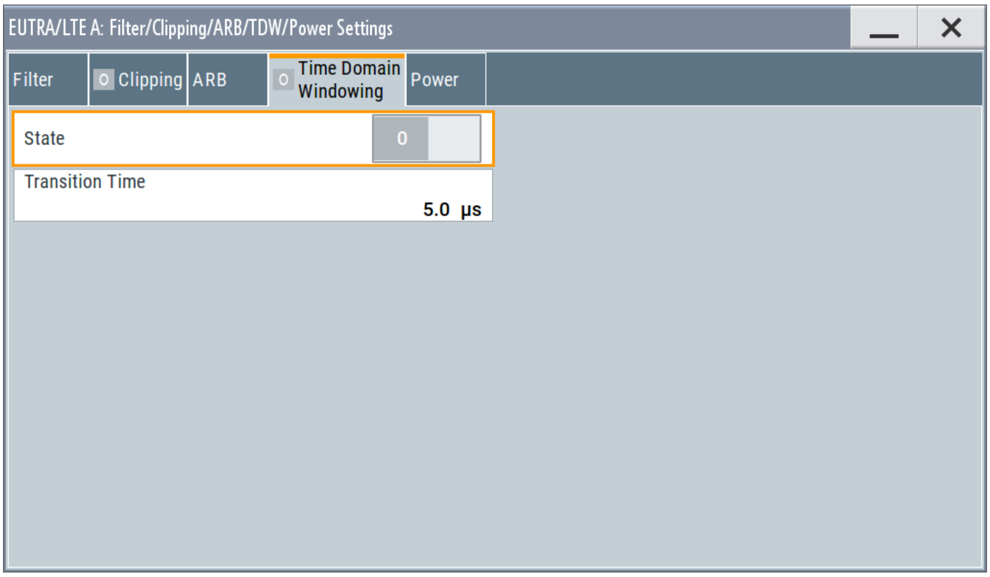
This section lists settings provided for improving the signal and spectrum characteristics of the generated signal, defining the signal power and the signal generation start.

It covers the following topics:

8.1 Time domain windowing settings

Access:

► Select "Filter/Clipping/ARB/TDW/Power > Time Domain Windowing".



This dialog comprises the settings required for configuring the time domain windowing.

Settings:

State

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 559

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 560

8.2 Filter/clipping/ARB settings

Access:

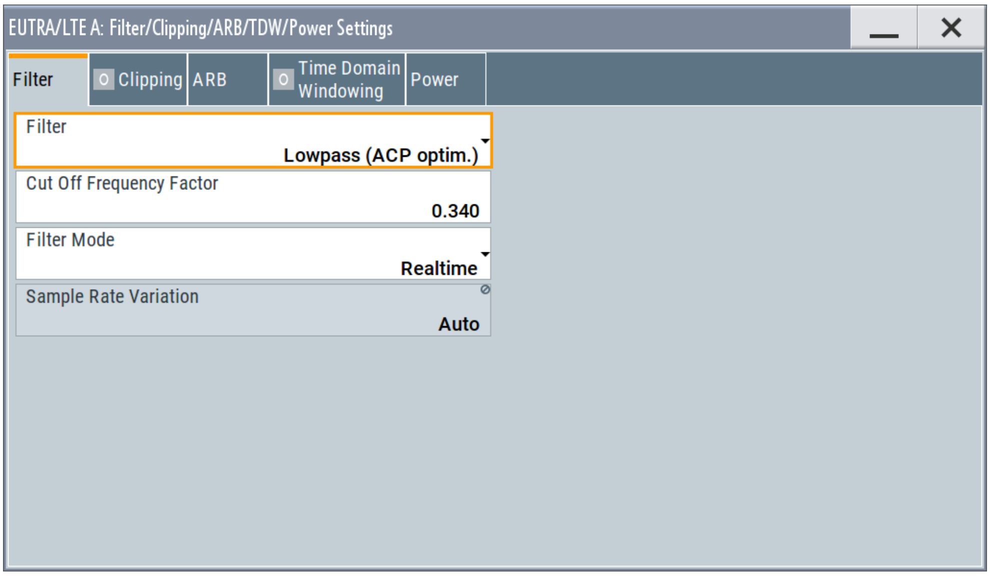
► Select "EUTRA/LTE > General > Filter/Clipping/ARB/TDW/Power Settings".

The dialog comprises the settings, for enabling time domain windowing and clipping, and adjusting the filter and power settings.

8.2.1 Filter settings

Access:

► Select "Filter/Clipping/ARB/TDW/Power > Filter".



This dialog comprises the settings required for configuring the baseband filter.

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 553

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.

Waveforms can be calculated in the following ways:

- With the "Generate Waveform File" function
- With the signal generation software R&S WinIQSIM2

The following table outlines the difference between the provided EUTRA/LTE filters by comparing their major specifications.

Table 8-1: Overview of the EUTRA/LTE filters

Characteristic	"Best EVM"	"Best ACP" "Best ACP (Narrow)"	"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 also a smoother shape in frequency domain	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	Long calculation time: the filtered signal is precalculated because of the filter complexity
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 is not applied The sample rate of the output waveform is not changed
Output waveform 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 specific configurations, an internal ("Auto") filter is applied automatically. This filter is designed for best possible optimization in configurations, like the carrier aggregation with carriers that span different bandwidths.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:OPTimization`
on page 554
`[:SOURce<hw>]:BB:EUTRa:FILTer:AUTO?` on page 555

Load User Filter
If Filter > "User" is selected, it opens the standard dialog "Select List File User Filter" for loading a user-defined filter file.

User filters are used as offline filters. The following types are supported:

- Files with predefined file format and extensions `VAF`
  For information, refer to the description "Introduction to "filtwiz" Filter Editor" on the Rohde & Schwarz web page.
- ASCII files with simple format and file extension `DAT`
  These files describe filters as a sequence of normalized filter coefficients. Each coefficient is defined as a pair of I and Q samples. The I and Q components alternate at each file line. The I and Q values vary between - 1 and + 1.
  A user filter can contain up to 2560 coefficients.
  The user filter must be real-valued. For both I and Q components of the coefficients, only real coefficients different than 0 are allowed.

You can create user filter files for example with MATLAB, see Example"Script that generates user filter file" on page 355.

Example: Script that generates user filter file

This MATLAB script creates a user filter file that fits the LTE default settings: "Channel Bandwidth = 10 MHz", "Number of Resource Blocks = 50", "FFT Size = 1024".

```
n_fft = 1048; %10MHz
n_scs = 50*12; %50RBs*12 subcarriers per RB

trans_region = 0.02 * n_fft/2; %in %, controls steepness of filter slopes,
relative to nyquist frequency

%cutoff frequencies
f = [n_scs/2 n_scs/2+trans_region];

%ripples in dB
rp = 0.01; %passband
rs = 80; %stopband
dev = [(10^(rp/20)-1)/(10^(rp/20)+1) 10^(-rs/20)];

%estimate filter order
[n,fo,ao,w] = firpmord(f,[1 0],dev,n_fft);

%generate filter coefficients
b = firpm(n,fo,ao,w);

fvtool(b); %displays filter response

%write filter out into .dat filter coefficient file
coeffs_out = zeros(2*length(b),1);
coeffs_out(1:2:end) = real(b);
coeffs_out(2:2:end) = imag(b);

dlmwrite(['smw_user_filter_' num2str(n) 'coeffs_' num2str(n_scs)
'scs_' num2str(n_fft) 'fft.dat'],coeffs_out);
```

Remote command:
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:USER on page 555

Rolloff 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.

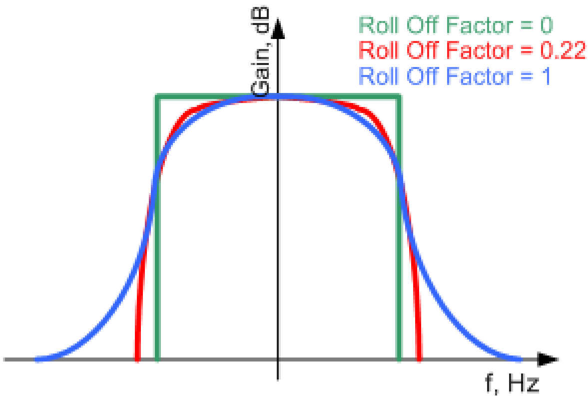


Figure 8-1: Example of the frequency response of a filter with different rolloff factors

For the default cosine filter, a rolloff factor of 0.10 is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine on page 553
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:RCOSine on page 553
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:PGAuss on page 553
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:GAUSs on page 553
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:SPHase on page 553
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:APCO25 on page 553
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:ROFactor on page 555

Cutoff frequency shift
(available for filter parameter cosine and EUTRA/LTE with EVM optimization only)

The cutoff 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 cutoff frequency and reach spectrum mask requirements.

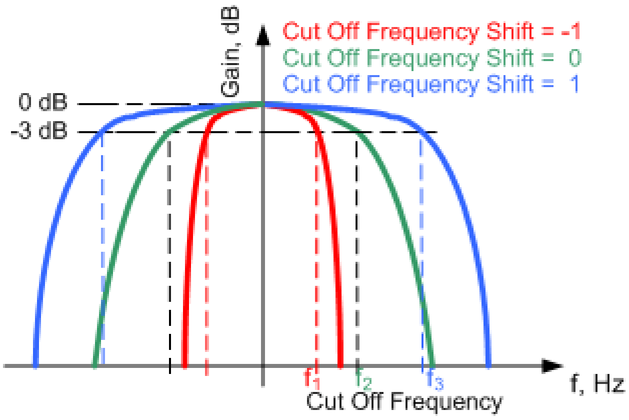


Figure 8-2: Example of the frequency response of a filter with different cutoff frequency shift

Example:

"Channel Bandwidth" = 10 MHz

"Sample Rate" = 15.36 MHz

"Cutoff frequency shift" = 0

Frequency at 3 dB down point = +/- 7.68 MHz

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine:COFS` on page 554
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFS` on page 554

Cutoff Frequency Factor
(available for filter parameter lowpass and EUTRA/LTE with ACP optimization only)

Sets the value for the cutoff frequency factor.

The cutoff frequency of the filter can be adjusted to reach spectrum mask requirements.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASs` on page 553
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFFactor` on page 554
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASSEVM` on page 553

Filter Mode
Selects an offline or real-time filter mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:MODE` on page 553

Sample Rate Variation
Sets the sample rate of the signal. A variation of this parameter affects the ARB clock rate; all other signal parameters remain unchanged.

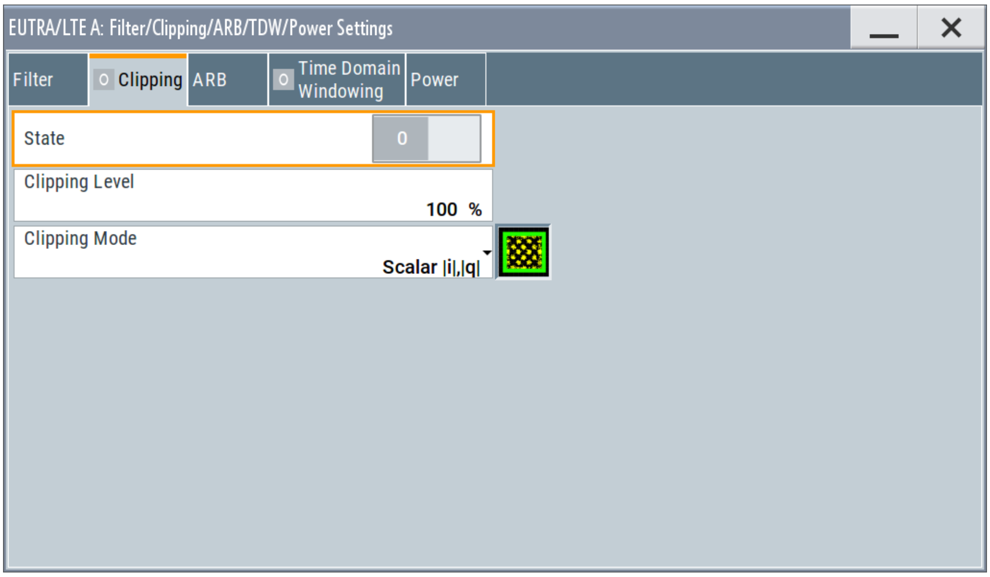
The value of this parameter is set according to the current physical settings, like the channel bandwidth.

Remote command:
[:SOURce<hw>]:BB:EUTRa:SRATe:VARiation on page 556

8.2.2 Clipping settings

Access:

► Select "Filter/Clipping/ARB/TDW/Power > Clipping".



This dialog comprises the settings required for configuring the clipping.

Settings:

Clipping State

Switches baseband clipping on and off.

Baseband clipping is a simple and effective way of reducing the crest factor of the signal. Since clipping is done before to filtering, the procedure does not influence the spectrum. The EVM however increases.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLIPping:STATe on page 557

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 556

Clipping Mode
Selects the clipping method. The dialog displays a graphical illustration on how this two methods work.

- "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.

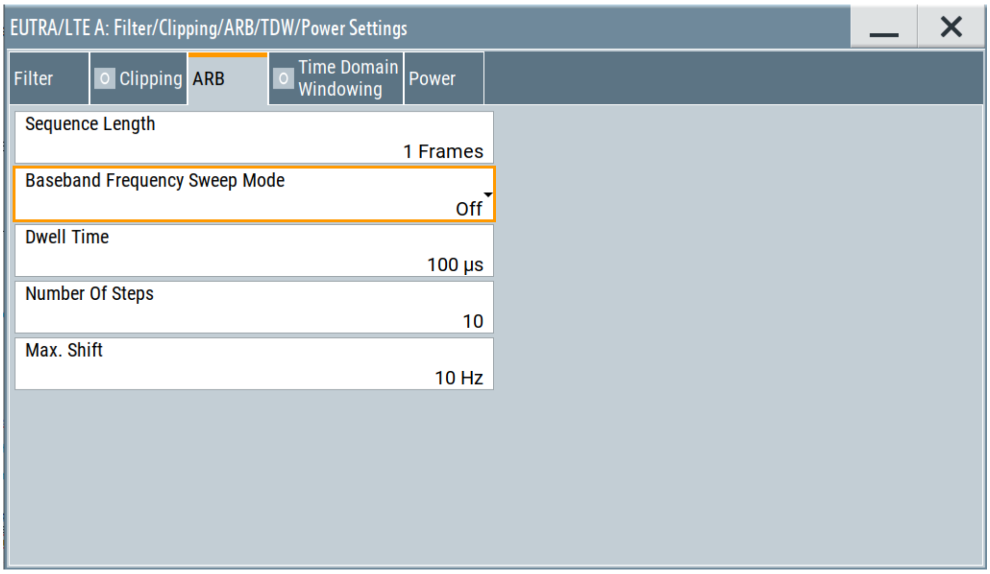
Selects the clipping method. A graphic illustrates how the two methods work.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:CLIPping:MODE` on page 557

8.2.3 ARB settings

Access:

► Select "Filter/Clipping/ARB/TDW/Power > ARB".



This dialog comprises the settings required for configuring the arbitrary waveform. Frequency sweep can be configured also.

Settings:

(Current) Sequence Length
Sets the sequence length of the signal.

- The sequence length is set per default 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 = ARB waveform memory size/("Sampling Rate" x 10 ms).
- You can also select unit subframes.
  Note that for the sequence length in number of subframes is not supported in combination with the following features:
  – eMTC / NB-IoT
  – LAA (frame structure type 3)
  – "SFN Restart Period" = *3GPP (1024 Frames)*
  – Time domain windowing
  – "Power Reference" different from *Frame RMS Power*, *UL Part of Frame RMS Power*, and *DL Part of Frame RMS Power*

Remote command:
[:SOURce<hw>]:BB:EUTRa:SLENgth on page 558
[:SOURce<hw>]:BB:EUTRa:SUSLen on page 558

Baseband Frequency Sweep Mode
Disables or enables the frequency sweep.

For NB-IoT signals, the frequency sweep is configured as shown in the following figure.

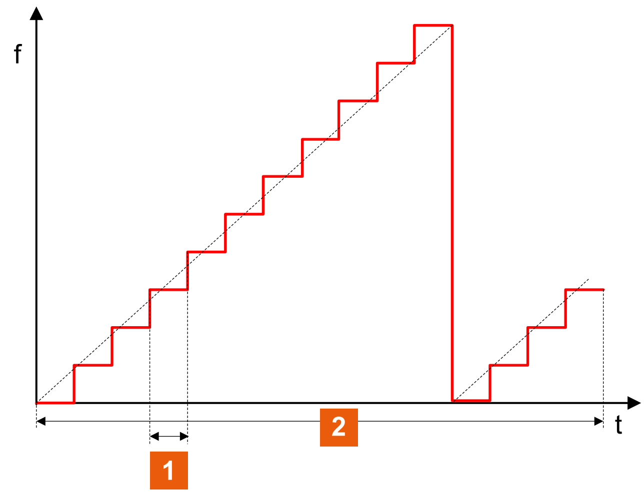


Figure 8-3: Sweep signal sawtooth shape

1 = Dwell time
2 = Sequence length

The frequency sweep can be enabled in one of the two modes:
- Before filter: The shift is calculated in the waveform.
- After filter: The shift is added after the signal filtering.

See also Chapter 8.2.1, "Filter settings", on page 352.

Remote command:
[:SOURce<hw>]:BB:EUTRa:BBFS:MODE on page 559

Dwell Time
Sets the dwell time for each frequency step of the sweep.

Remote command:
[:SOURce<hw>]:BB:EUTRa:BBFS:DTIMe on page 558

Number of Steps
Sets the number of iterations for increasing the frequency using the step of 0.1171875 Hz (90/768 ms).

Remote command:
[:SOURce<hw>]:BB:EUTRa:BBFS:STEPs on page 559

Max. Shift
Sets the maximal total frequency sweep (summary for all steps).

Remote command:
[:SOURce<hw>]:BB:EUTRa:BBFS:MAXShift on page 559

8.3 Adjusting the signal power

The R&S SMW equipped with option EUTRA/LTE (R&S SMW-K55) provides several possibilities to adjust the power level of the generated LTE signal. It also provides settings to adjust the relations between the power levels of the channels and signals in the LTE signal itself.

8.3.1 General power-related settings overview

The general power settings are as follows:

- Output level (P_{out}) of the instrument
  To adjust the value, select "Status bar > Level".

8.3.2 Downlink power-related settings overview

In downlink direction, the value displayed in the "Level" display defines the RMS level of the output signal calculated upon several frames.

- FDD duplexing mode
  The displayed RMS and the PEP values are valid for the whole frame.
- 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).

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

- NRS/N-SYNC (NPSS/NSSS)
- NPBCH, NPDCCH and NPDSCH settings

All DL power configurations are set relative to each other. The absolute power level of one resource element during one subframe depends on the configuration during the remaining subframes.

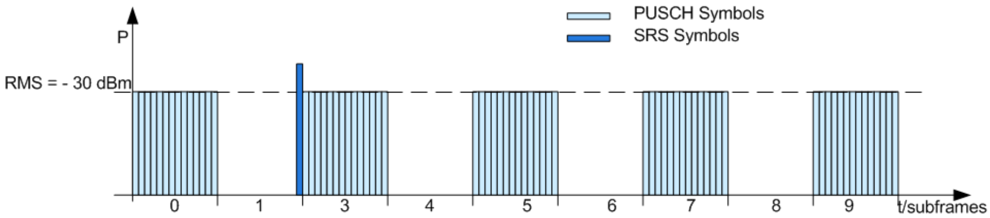
8.3.3 Uplink power-related settings overview

Additionally to the general power settings listed in General power-related settings overview, 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 value of the parameter Power Reference

- "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.

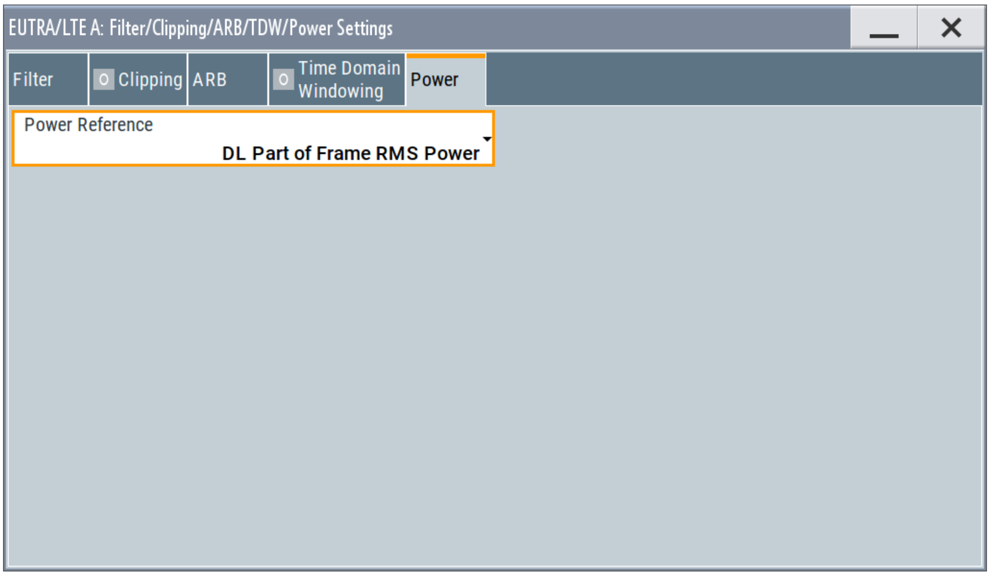


  Use this mode to simplify the configuration of the SNR required for the test cases defined in TS 36.141, in case the PUSCH is not transmitted in every subframe.

8.3.4 Power settings

Access:

► Select "Filter/Clipping/ARB/TDW/Power > Power".



This dialog comprises the settings required for configuring the global power level of the generated LTE signal.

Settings:

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.

"UE Burst RMS Power"
The displayed RMS and PEP are measured during an automatically selected **reference time span**, that is selected according to the following algorithm:
- For the first active UE, find the first active subframe.
  In case of eMTC/NB-IoT, find the first transmission of the first active UE. Omit invalid subframes.
- Find the first PUSCH, PUCCH or both.
  Exclude the DMRS.
- In PRACH mode, find the first PRACH preamble.
- If there is no active subframe, use the SRS.

The signal portion (subframe or slot number), the channel and the first active UE used as reference are displayed with the parameters Reference Subframe/Slot, Reference Channel, and Reference UE.
If at least one UL eMTC or NB-IoT UE is active, "UE Burst RMS Power" is the default level reference.

"NPBCH Symbols Power"
Option: R&S SMW-K115
Enabled in standalone NB-IoT operation (Downlink FDD mode, "Channel Bandwidth = 200 kHz" and "Activate NB-IoT = On")
The displayed RMS and PEP are measured during the NPBCH symbols 3, 9 and 11.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:POWC:LEVReference` on page 560

Reference UE
If Power Reference = "UL Burst RMS Power", indicates the **first active UE** used as reference of the RMS and PEP measurement.

If several UEs are active during the measurement time, the displayed RMS and PEP values apply **to all UEs** that are active during the reference measurement time.

Example:

Standard SISO configuration, standard signal routing, no additional baseband gain:
- Two active UEs with "UE1 > UE Power = 0 dB" and "UE2 > UE Power = 0 dB".
  UE1 and UE2 have active allocations in subframe = 0
- "Power Reference = UL Burst RMS Power"
- Reference time indicated as "Reference UE = UE1" and "Reference Subframe = 0"
- RMS value "Status bar > Level = -30 dBm"

Because during the reference subframe both UEs are active, the power of each UE during this subframe is -33 dBm. The indication "Reference UE = UE1" is merely information on the reference time span.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:POWC:RUE?` on page 561

Reference Subframe/Slot
If Power Reference = "UL Burst RMS Power", displays the signal portion (subframe or slot) to that the measured RMS and PEP are referring.

Remote command:
[:SOURce<hw>]:BB:EUTRa:POWC:REFSubframe? on page 561

Reference Channel
If Power Reference = "UL Burst RMS Power", displays the channel type the measured RMS and PEP are referring to.

Remote command:
[:SOURce<hw>]:BB:EUTRa:POWC:REFChannel on page 561

8.4 Trigger settings

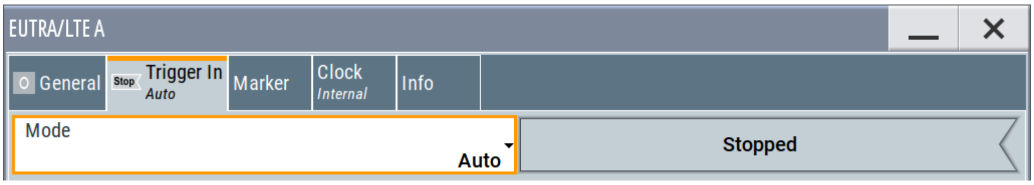
Access:

► Select "Baseband > EUTRA/LTE > Trigger In"

This dialog provides access to the settings necessary to select and configure the trigger, like trigger source, mode, trigger delay, trigger suppression, and to arm or trigger an internal trigger manually. The current signal generation status is displayed in the header of the tab together with information on the enabled trigger mode. As in the "Marker" and "Clock" tabs, this tab provides also access to the settings of the related connectors.

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMW user manual.



The provided trigger signals are not dedicated to a particular connector. Trigger signals can be mapped to one or more USER x or T/M connectors.

Use the Local and global connectors settings to configure the signal mapping, the polarity, the trigger threshold and the input impedance of the input connectors.

To route and enable a trigger signal, proceed as follows:

- Define the signal source and the effect of a trigger event.
  Select "Trigger In" > "Mode" and "Trigger In" > "Source".
- Define the connector where the selected signal is provided.
  Use the "Global Connectors" settings.

Settings:

Trigger Settings Common to All Basebands

To enable simultaneous signal generation in all basebands, the R&S SMW couples the trigger settings in the available basebands in any instrument's configuration involving signal routing with signal addition. For example, in MIMO configuration, routing and summing of basebands or of streams.

The icon indicates that common trigger settings are applied.

You can access and configure the common trigger source and trigger mode settings in any of the basebands. An arm or a restart trigger event applies to all basebands, too. You can still apply different delay to each of the triggers individually.

Trigger Mode

Selects trigger mode, i.e. determines the effect of a trigger event on the signal generation.

For more information, refer to chapter "Basics" in the R&S SMW user manual.

- "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 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 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.

Remote command:
[:SOURce<hw>]:BB:EUTRa[:TRIGger]:SEQuence on page 565

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 568

Trigger Signal Duration
Requires trigger "Mode" > "Single".

Enters the length of the trigger signal sequence.

Use this parameter, for example, for the following applications:
- To output the trigger signal partly.
- To output a predefined sequence of the trigger signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:SLENgth on page 569

Running/Stopped
With 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 568

Time Based Trigger
Requires trigger "Mode" > "Armed Auto"/"Single".

Activates time-based triggering with a fixed time reference.

The R&S SMW triggers signal generation when its operating system time ("Current Time") matches a specified time trigger ("Trigger Time"). As trigger source, you can use an internal trigger or an external global trigger.

How to: Chapter "Time-based triggering" in the R&S SMW user manual.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME[:STATe] on page 570

Trigger Time
Requires trigger "Mode" > "Armed Auto"/"Single".

Sets date and time for a time-based trigger signal.

Set a trigger time that is later than the "Current Time". The current time is the operating system time of the R&S SMW. If you set an earlier trigger time than the current time, time-based triggering is not possible.

How to: Chapter "Time-based triggering" in the R&S SMW user manual.

"Date" Sets the date of the time-based trigger in format YYYY-MM-DD.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME:DATE on page 569

"Time" Sets the time of the time-based trigger in format hh:mm:ss.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME:TIME on page 569

Arm

Stops the signal generation until subsequent trigger event occurs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:ARM:EXECute on page 566

Execute Trigger

For internal trigger source, executes trigger manually.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:EXECute on page 566

Trigger Source

The following sources of the trigger signal are available:

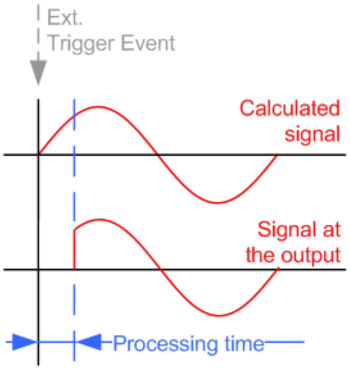
- "Internal"
  The trigger event is executed manually by the "Execute Trigger".
- "Internal (Baseband A/B)"
  The trigger event is provided by the trigger signal from the other basebands.
  If common trigger settings are applied, this trigger source is disabled.
- "External Global Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the USER x connectors.
- "External Local Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the local T/M/C connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C1/2/3 connectors.
- "External Local Clock"
  The trigger event is the active edge of an external local clock signal provided and configured at the local T/M/C connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C1 connector.
- "Baseband Sync In"
  Option: R&S SMW-B9
  In primary-secondary instrument mode, secondary instruments are triggered by the active edge of the synchronization signal.

"External Local Clock/Trigger" require R&S SMW-B10.

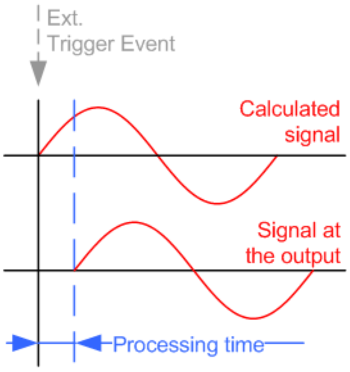
Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:SOURce on page 565

Sync. Output to External Trigger/Sync. Output to Trigger
Enables signal output synchronous to the trigger event.

- "On"
  Corresponds to the default state of this parameter.
  The signal calculation starts simultaneously with the trigger event. Because of the processing time of the instrument, the first samples are cut off and no signal is output. 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. Signal output starts with sample 0. The complete signal is output.
  This mode is recommended for triggering of short signal sequences. Short sequences are sequences with signal duration comparable with the processing time of the instrument.



In primary-secondary instrument mode, this setting ensures that once achieved, synchronization is not lost if the baseband signal sampling rate changes.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:SYNChronize:OUTPut
on page 566

External / Trigger Inhibit
Applies for external trigger signal or trigger signal from the other path.

Sets the duration with that any following trigger event is suppressed. In "Retrigger" mode, for example, a new trigger event does not cause a restart of the signal generation until the specified inhibit duration does not expire.

For more information, see chapter "Basics" in the R&S SMW user manual.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal]:INHibit on page 571
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:INHibit on page 567

(External) Delay Unit
Determine whatever the trigger delay is expressed in samples or directly defined as a time period (seconds).

To specify the delay, use the parameter (Specified) External Trigger Delay/(Specified) Trigger Delay.

The parameter Actual Trigger Delay/Actual External Delay displays the delay converted in time.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:DELay:UNIT on page 566

(Specified) External Trigger Delay/(Specified) Trigger Delay
The name of the parameter and the units the delay is expressed in, changes depending on the parameter (External) Delay Unit.

Delays the trigger event of the signal from:
- The external trigger source
- The other path
- The other basebands (internal trigger), if common trigger settings are used.

Use this setting to:
- Synchronize the instrument with the device under test (DUT) or other external devices
- Postpone the signal generation start in the basebands compared to each other
- Compensate delays and align the signal generation start in multi-instrument setup

For more information, see chapter "Basics on ..." in the R&S SMW user manual.

The parameter Actual Trigger Delay/Actual External Delay displays the delay converted in time.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal]:DELay on page 570
[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:TDELay on page 571
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:DELay on page 567
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:TDELay on page 568

Actual Trigger Delay/Actual External Delay
Indicates the resulting external trigger delay in "Time" unit.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:RDELay? on page 571
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:RDELay? on page 567

Timing Configuration
Comprises settings related to the timing configuration.

Signal Advance N_TA_offset ← Timing Configuration
Sets the parameter $N_{TA\ offset}$ as defined in the TS 36.211.

The parameter is available in "Uplink" direction and enabled "TDD" mode.

The 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.

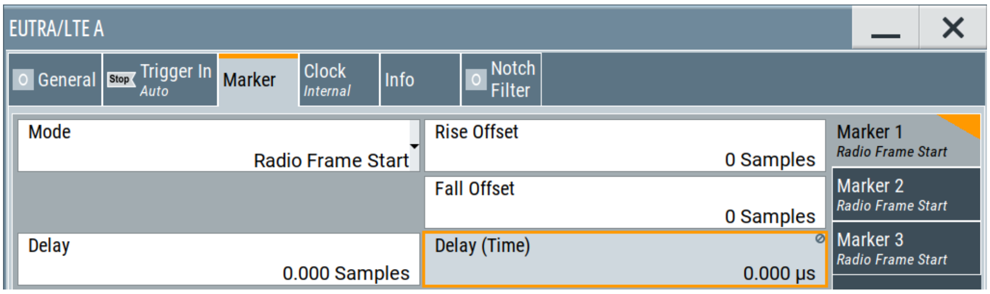
In this implementation, however, the signal advance for the TDD mode can also be set to 0.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TIMC:NTAoffset` on page 563

8.5 Marker settings

Access:

► Select "Baseband" > "EUTRA/LTE" > "Marker".



This tab provides settings to select and configure the marker output signal including marker mode and marker delay.

Routing and activating a marker signal

1. To define the signal shape of an individual marker signal "x", select "Marker" > "Marker x" > "Mode".
2. Optionally, define the connector for signal output. See Chapter 8.7, "Local and global connectors settings", on page 375.
   You can map marker signals to one or more USER x or T/M connectors.
3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".
   The R&S SMW adds the marker signal to the baseband signal. Also, R&S SMW outputs this signal at the configured USER x connector.

About marker output signals

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMW user manual.

Settings:

Marker Mode

Marker configuration for up to 3 markers. The settings are used to select the marker mode defining the shape and periodicity of the markers. The contents of the dialog change with the selected marker mode.

How to: "Routing and activating a marker signal" on page 371

"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.

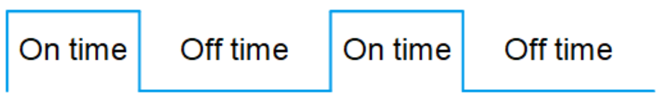
"Frame Active Part"
The marker signal is high whenever a burst is active and low during inactive signal parts.
For example, during the gaps between bursts in uplink mode or the uplink subframe in downlink TDD mode.
Feed this marker signal into a pulse modulator to decrease the carrier leakage during inactive signal parts.

"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, as set with the parameter "Period."

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:PERiod
on page 573

"ON/OFF Period"
A regular marker signal that is defined by an ON/OFF ratio. A period lasts one ON and OFF cycle.



Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:OFFTime
on page 573
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ONTime
on page 573

"System Frame Number (SFN) Restart"
A marker signal is generated at the start of every SFN period.

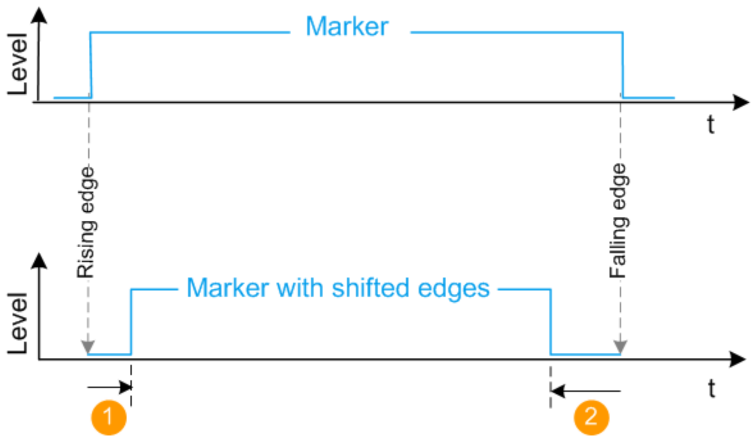
"Internally Used"
Special automatically set marker signal for the realtime feedback mode or for the "SFN Restart Period = 3GPP (1024 Frames)".

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:MODE on page 572

Rise/Fall Offset
(For marker modes Subframe, Radio Frame Start, and Restart (ARB))

Sets the value for the rise/fall offset.

The ramps of the marker signal are shifted by the specified number of a samples. Positive values delay the rising ramp; negative values - shift it back.



1 = Positive rise offest
2 = Positive fall offest

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ROFFset on page 573
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:FOFFset on page 573

Marker x Delay
Delays the marker signal at the marker output relative to the signal generation start.

Variation of the parameter "Marker x" > "Delay" causes signal recalculation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay on page 574

Delay (Time)
Shows the marker delay time in microseconds, milliseconds or seconds depending on the set marker delay.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DINSec? on page 574

8.6 Clock settings

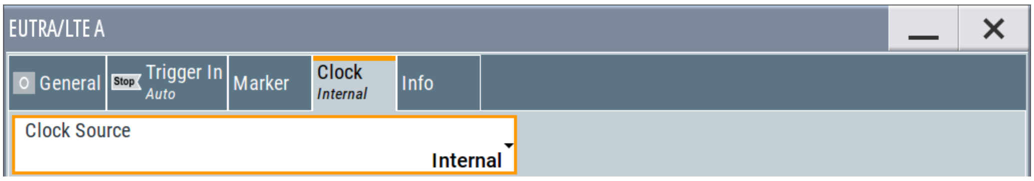
Access:

► Select "Baseband > EUTRA/LTE > Clock"

This tab provides access to the settings necessary to select and configure the clock signal, like the clock source and clock mode.

This section focuses on the available settings.

For information on how the settings affect the signal, refer to chapter "Basics" in the R&S SMW user manual.



Defining the clock

The provided clock signals are not dedicated to a particular connector. They can be mapped to one or more USER x and T/M/C connectors.

Use the Local and global connectors settings to configure the signal mapping, the polarity, the trigger threshold, and the input impedance of the input connectors.

To route and enable a trigger signal, perform the following *general steps*:

- Define the signal source, that is select the "Clock > Source".
- Define the connector where the selected signal is provided.
  Use the Local and global connectors settings.

Settings:

Clock Source

Selects the clock source.

- "Internal"
  The instrument uses its internal clock reference.
- "External Local Clock"
  Option: R&S SMW-B10
  The instrument expects an external clock reference at the local T/M/C connector.

"External Local Clock" requires R&S SMW-B10.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLOCk:SOURce on page 562

Clock Mode
Option: R&S SMW-B10

Sets the type of externally supplied clock.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLOCk:MODE on page 562

Expected Clock Frequency
Option: R&S SMW-B10

If an external clock signal is used, this parameter indicates the expected clock frequency value.

Where "Expected Clock Frequency" = Sample Rate Variation

Measured External Clock
Provided for permanent monitoring of the enabled and externally supplied clock signal.

Remote command:
CLOCk:INPut:FREQuency?

8.7 Local and global connectors settings

Accesses a dialog to configure local connectors or global connectors.

The button is available in the following dialogs or tabs:

- "Trigger / Marker / Clock" dialog that is accessible via the "TMC" block in the block diagram.
- "Trigger In", "Marker" and "Clock" tabs that are accessible via the "Baseband" block in the block diagram.

See also chapter "Local and global connectors settings" in the user manual.

9 Remote-Control commands

The following commands are required to generate signals with the Cellular IoT option in a remote environment. We assume that the R&S SMW has already been set up for remote operation in a network as described in the R&S SMW documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

We assume that you are familiar with the commands required to generate signals with the LTE options. Commands that are the same as in the LTE options are not described here. For description, see the R&S SMW EUTRA/LTE user manual.

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 SMW user manual.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`ENTity<ch>`	1 to 4	entity in a multiple entity configuration `ENTity3|4` require option R&S SMW-K76
`SOURce<hw>`	[1] to 4	available baseband signals
`OUTPut<ch>`	1 to 3	available markers
`UE<st>` `USER<st>`	[1]|2|3|4	user (DL) and user equipment (UL)
`ALLoc<ch>`	0 to 100	NB-IoT DCI allocation
`CARRier<ch>`	0 to 4	NB-IoT DL carrier
`CELV<ch0>`	0 to 3	CE level
`CFG<ch0>`	0 to 2	NPRACH configuration
`TRANs<ch>`	0 to 10	eMTC/NB-IoT allocation
`ATT<ch0>`	0 to 40 0 to 30	eMTC PRACH preamble attempt NPRACH preamble attempt

Using SCPI command aliases for advanced mode with multiple entities

You can address multiple entities configurations by using the SCPI commands starting with the keyword `SOURce` or the alias commands starting with the keyword `ENTity`.

Note that the meaning of the keyword `SOURce<hw>` changes in the second case.

For details, see section "SCPI Command Aliases for Advanced Mode with Multiple Entities" in the R&S SMW user manual.

The following commands specific to the Cellular IoT options are described here:

9.1 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.

Example: NB-IoT anchor carrier in standalone mode

```
*RST
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:SLENgth 40
SOURce1:BB:EUTRa:DL:BW BW0_20

// Antenna ports configuration
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:NIOT:CONFig TX2
SOURce1:BB:EUTRa:DL:MIMO:APM:MAPCoordinates CART
```

```
SOURce1:BB:EUTRa:DL:MIMO:APM:CS:AP2000:ROW0:REAL 1
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1

// PCI, NPSS and NSSS configuration
SOURce1:BB:EUTRa:DL:PLCI:CID 100
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:CELL 200
SOURce1:BB:EUTRa:DL:SYNC:TXANtenna ALL
SOURce1:BB:EUTRa:DL:SYNC:NIOT:TXANtenna TX2
SOURce1:BB:EUTRa:DL:SYNC:NIOT:TXANtenna ALL
SOURce1:BB:EUTRa:DL:SYNC:NIOT:NPPWr 0
SOURce1:BB:EUTRa:DL:SYNC:NIOT:NSPWr 0

// NB-IoT carrier configuration
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:MODE?
// ALON
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:STATe?
// 1
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:NVSF?
// N10
// enable all subframes
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SFALl
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SF0:VALSf?
// 0
// reserved for NPBCH
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SF1:VALSf?
// 1
// common serach space configration
SOURce1:BB:EUTRa:DL:NIOT:PAG:RMAX R4
SOURce1:BB:EUTRa:DL:NIOT:RAND:RMAX R4
SOURce1:BB:EUTRa:DL:NIOT:RAND:STSFrame S4
SOURce1:BB:EUTRa:DL:NIOT:RAND:SSOFfset O1_8

SOURce1:BB:EUTRa:STATe 1
```

Example: NB-IoT carriers in in-band mode

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:SLENgth 40
SOURce1:BB:EUTRa:DL:BW BW5_00

SOURce1:BB:EUTRa:DL:NIOT:LTECell:STATe 1

// SOURce1:BB:EUTRa:DL:NIOT:GAP:CONFig:STATe 1
// SOURce1:BB:EUTRa:DL:NIOT:GAP:PERiodicity 64
// SOURce1:BB:EUTRa:DL:NIOT:GAP:THReshold 32
// SOURce1:BB:EUTRa:DL:NIOT:GAP:DURation:COEFficent 1_8

// Enabling the anchor carrier and one dummy carrier
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:STATe 1
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:MODE INBD
```

```
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:MODE INBD
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:RBIDx 2
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:DFReq?
// -1807500
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:RBIDx 7
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:DFReq?
// -907500
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:CRSSeq?
// 5
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:CELL 200
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:CIDGroup?
// 66
SOURce1:BB:EUTRa:DL:NIOT:ID?
// 2
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:NVSF N40
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SFALl
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:STATe 1
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:NVSF N10
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:SFALl

SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SF0:VALSf?
// 0
// reserved for NPBCH
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SF1:VALSf?
// 1
// common search space configration
SOURce1:BB:EUTRa:DL:NIOT:PAG:RMAX R4
SOURce1:BB:EUTRa:DL:NIOT:RAND:RMAX R4
SOURce1:BB:EUTRa:DL:NIOT:RAND:STSFrame S4
SOURce1:BB:EUTRa:DL:NIOT:RAND:SSOFfset O1_8

SOURce1:BB:EUTRa:STATe 1
SOURce1:BB:EUTRa:SETTing:STORe "/var/user/iot_inband"
```

Example: NPRS part A+B configuration in in-band mode

Option: R&S SMW-K143

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:SLENgth 40
SOURce1:BB:EUTRa:DL:BW BW5_00

SOURce1:BB:EUTRa:DL:CARRier1:NIOT:MODE INBD
SOURce1:BB:EUTRa:DL:NPRS:STATe 1
SOURce1:BB:EUTRa:DL:NPRS:CONF PA_AB
SOURce1:BB:EUTRa:DL:NPRS:POW 3
SOURce1:BB:EUTRa:DL:NPRS:ID 100
SOURce1:BB:EUTRa:DL:NPRS:SEIN 10
SOURce1:BB:EUTRa:DL:NPRS:BMP:CONF BMP_10
SOURce1:BB:EUTRa:DL:NPRS:BMP:VALSubframes1 0
SOURce1:BB:EUTRa:DL:NPRS:BMP:VALSubframes0 1
SOURce1:BB:EUTRa:DL:NPRS:MTIA #H6,3
// for NPRS Part B configuration
SOURce1:BB:EUTRa:DL:NPRS:PERD PD_160
SOURce1:BB:EUTRa:DL:NPRS:STSF STSF0_8
SOURce1:BB:EUTRa:DL:NPRS:SFNM SFNM_20
SOURce1:BB:EUTRa:DL:NPRS:MTIB?
```

Example: NB-IoT wake up signal

Option: R&S SMW-K146

```
SOURce1:BB:EUTRa:DL:NIOT:WUS:MAXDuration DN_256
SOURce1:BB:EUTRa:DL:NIOT:WUS:POW -40
SOURce1:BB:EUTRa:DL:NIOT:WUS:PSF?
SOURce1:BB:EUTRa:DL:NIOT:WUS:SF 0
SOURce1:BB:EUTRa:DL:NIOT:WUS:TO TO_80
SOURce1:BB:EUTRa:DL:NIOT:WUS:ACD DN_1
SOURce1:BB:EUTRa:DL:NIOT:WUS:STATe ON
```

Example: NB-IoT UE configuration

```
SOURce1:BB:EUTRa:DL:USER1:RELease NIOT
// UE-specific search space
SOURce1:BB:EUTRa:DL:USER1:NIOT:RMAX R4
SOURce1:BB:EUTRa:DL:USER1:NIOT:STSFrame S1_5
SOURce1:BB:EUTRa:DL:USER1:NIOT:SSOFfset O0
SOURce1:BB:EUTRa:DL:USER1:UEID 50
SOURce1:BB:EUTRa:DL:USER1:UEC?
// NB1
SOURce1:BB:EUTRa:DL:USER1:CCODing:STATe?
// 1
SOURce1:BB:EUTRa:DL:USER1:DATA PN9
// SOURce1:BB:EUTRa:DL:USER1:DATA DLIS
// SOURce1:BB:EUTRa:DL:USER1:DSELect "/var/user/UE1_NBIoT.dm_iqd"
```

Example: DCI format N0 configuration

DCI format N0 is used for scheduling of NPUSCH in one UL cell. If DCI format N0 is activated, one NPDCCH is configured and activated automatically.

```
SOURce1:BB:EUTRa:DL:USER1:STHP:STATe 1

SOURce1:BB:EUTRa:DL:NIOT:DCI:NALLoc 1

SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER USER1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:UEID?
// 50
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:FMT N0
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SSP UE
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:STSF 0
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:STSF?
// 6
// first allowed subframe number is calculated automatically
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:FMT?
// 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:CCES?
// 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDCCe?
// 0

SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SCINd 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IRU 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDELay 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:MCScheme 6
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:RVERsion 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NDINd 0
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPUSch:IREP 3
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:HPNMber 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:REP?
// 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NRUNits?
// 3
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:BITS?
// "000 0010 0101 0011 0101 1010"

// NPDCCH allocation is the third allocation
// NPBCH is always the first allocation
// NPDSCH carring SIB1-NB is the second one
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CONType?
// NPDC
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:MODulation?
// QPSK
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:SFList?
// "6, 7, 8, 11"
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:STSYmbol SYM1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PHYSbits?
```

```
// 232
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:DATA?
// USER1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:POWer 0
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:STATe?
// 1

SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PRECoding:SCHeme TXD
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PRECoding:NOLayers?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CCODing:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CCODing:TBSize?
// 88
```

Example: NPDCCH and NPDSCH DCI-based configuration (DCI format N1)

```
SOURce1:BB:EUTRa:DL:NIOT:DCI:NALLoc 1

SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER USER1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:UEID?
// 50
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:FMT N1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SSP UE
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:STSF 6
// first allowed subframe number is calculated automatically
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:FMT?
// 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:CCES?
// 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDCCe?
// 0

// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:OIND 1
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPRach:SNUMber 2
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPRach:SCINd 2
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:BITS?
// "111 0000 0101 1111 1111 1111"

SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:OIND 0
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDELay 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:ISF 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:MCScheme 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:IREP 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NDINd 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:HACK 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:NREP?
// 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:NSF?
```

```
// 3
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:TBSZ?
// 208
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:BITS?
// "100 1001 0010 0001 0100 0110"

SOURce1:BB:EUTRa:DL:NIOT:NALLoc?
// 4
// NPDCCH allocation is the third allocation
// NPBCH is always the first allocation
// NPDSCH carring SIB1-NB is the second one
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:RBIDx?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CONType?
// NPDC
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:MODulation?
// QPSK
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:SFList?
// "6, 7, 8, 11"
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:STSYmbol SYM1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PHYSbits?
// 256
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:DATA?
// USER1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:POWer 0
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:STATe?
// 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CONFlict?
// 0

SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PRECoding:SCHeme TXD
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PRECoding:NOLayers?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CCODing:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CCODing:TBSize?
// 208

// NPDSCH allocation is the fourth allocation
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CONType?
// NPDS
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SFList?
// "26, 27, 28, 31..."
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:PHYSbits?
// 232
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:DATA?
// USER1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:STSYmbol SYM3
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:POWer 0
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:STATe?
// 1
```

```
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:PRECoding:SCHeme NONE
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SCRambling:STATe 1

SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SCRambling:LEGacy:STATe 0

SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SCRambling:UEID?
// 50
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:STATe?
// 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:ISF?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:NSF?
// 3
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:TBSI?
// 4
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:TBSize?
// 208
```

Example: DCI format N2 configuration

DCI format N2 is paging and direct indication. If DCI format N2 is activated, one NPDCCH is configured and activated automatically.

```
SOURce1:BB:EUTRa:DL:NIOT:DCI:NALLoc 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:UEID?
// 65534
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:FMT?
// N2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SSP?
// T1CM
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:STSF 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:FMT?
// 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:CCES?
// 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDCCe?
// 0

// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:PAG 0
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SIME 1
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SINF 1
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2

SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:PAG 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:ISF 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:MCSCheme 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:IREP 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:TBSZ?
// 208
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:NSF?
// 3
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:NREP?
// 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:REP?
// 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:BITS?
// "101 0010 0001 0010"
```

Example: NPBCH and SIB1-NB configuration

```
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:SFList?
// "0, 10, 20, 30..."
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:STSYmbol?
// SYM3
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:PHYSbits?
// 200
// NPBCH always uses 200 bits
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:DATA?
// MIB
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:POWer 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:STATe?
// 1

SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:PRECoding:SCHeme NONE
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:SCRambling:SROT 0
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:PHYSbits?
// 200
SOURce1:BB:EUTRa:DL:NIOT:CCODing:MIB 1
SOURce1:BB:EUTRa:DL:NIOT:CCODing:SOFFset 16
SOURce1:BB:EUTRa:DL:NIOT:CCODing:SIB 0
SOURce1:BB:EUTRa:DL:NIOT:CCODing:RSIB?
// 4
SOURce1:BB:EUTRa:DL:NIOT:CCODing:NCID?
// 200
// as set for the anchor carrier with the command
// SOURce1:BB:EUTRa:DL:CARRier1:NIOT:CELL
SOURce1:BB:EUTRa:DL:NIOT:CCODing:STFSib1?
// 0
SOURce1:BB:EUTRa:DL:NIOT:CCODing:MSPare #H000,11
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:CCODing:TBSize?
// 34

SOURce1:BB:EUTRa:DL:NIOT:ALLoc1:SFList?
// "4, 24, 44, 64..."
SOURce1:BB:EUTRa:DL:NIOT:ALLoc1:STSYmbol?
// SYM3
SOURce1:BB:EUTRa:DL:NIOT:ALLoc1:PHYSbits?
// 208
// numer of bits used by NPDSCH carring SIB-NB
SOURce1:BB:EUTRa:DL:NIOT:ALLoc1:DATA?
// SIB1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc1:STATe?
// 1
```

Example: NPUSCH and NDRS configuration

```
SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:BW BW1_40

SOURce1:BB:EUTRa:UL:UE1:STATe 1
SOURce1:BB:EUTRa:UL:UE1:RELease NIOT
SOURce1:BB:EUTRa:UL:UE1:MODE STD
SOURce1:BB:EUTRa:UL:UE1:NIOT:SCSPacing S375
SOURce1:BB:EUTRa:UL:UE1:NIOT:MODE INBD
SOURce1:BB:EUTRa:UL:UE1:NIOT:RBINdex 5
SOURce1:BB:EUTRa:UL:UE1:NIOT:DFReq?
// 450000
SOURce1:BB:EUTRa:UL:UE1:NIOT:NTRansmiss 2
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:FORMat F1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:MODulation PI4Q
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:STSFrame 0
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:REPetitions R1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:NRUNits RU1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:SIRF 10
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:POW 0
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:NSCarriers?
// 1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:NSLTs?
// 16
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:STSCarrier?
// 10
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:STSLot?
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:FORMat F2
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:MODulation PI2B
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:STSFrame 32
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:REPetitions R2
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:SIRF 0
SOURce1:BB:EUTRa:UL:UE1:NIOT:ARB:SUGGested?
// 5
SOURce1:BB:EUTRa:SLENgth 5

SOURce1:BB:EUTRa:UL:UE2:STATe 1
SOURce1:BB:EUTRa:UL:UE2:MODE STD
SOURce1:BB:EUTRa:UL:UE2:RELease NIOT
SOURce1:BB:EUTRa:UL:UE2:NIOT:SCSPacing S15
SOURce1:BB:EUTRa:UL:UE2:NIOT:MODE INBD
SOURce1:BB:EUTRa:UL:UE2:NIOT:RBINdex 5
SOURce1:BB:EUTRa:UL:UE2:NIOT:NTRansmiss 2
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:FORMat F1
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs1:MODulation QPSK
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs1:REPetitions R2
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs1:NRUNits RU3
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs1:SIRF 17
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs2:FORMat F2
```

```
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs2:STSFrame 12
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs2:REPetitions R4
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs2:SIRF 0

SOURce1:BB:EUTRa:UL:UE1:NIOT:NPSSim 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:DATA PN9
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:SCRambling:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:STATe 1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:HARQ:PATTern #H1,1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:HARQ:BITS?
// 1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:HARQ:CBITs?
// 16

SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:HARQ:SR 0

SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:TBINdex 10
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:RVINdex 2
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:PHYSbits?
// 192
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:RUINdex?
// 0
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:TBSize?
// 144

SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:ESUPport ON
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:ETBS 88

SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:DRS:POWoffset 0
SOURce1:BB:EUTRa:UL:UE1:NIOT:GHDisable 0

SOURce1:BB:EUTRa:UL:REFSig:DRS:GHOPping 1
SOURce1:BB:EUTRa:UL:REFSig:DRS:DSEQshift 1
SOURce1:BB:EUTRa:UL:REFSig:DRS:TTCShift 2
SOURce1:BB:EUTRa:UL:REFSig:DRS:STCShift 3
SOURce1:BB:EUTRa:UL:REFSig:DRS:USEBase 1
SOURce1:BB:EUTRa:UL:REFSig:DRS:TTBSequence 10
SOURce1:BB:EUTRa:UL:REFSig:DRS:STBSequence 11
SOURce1:BB:EUTRa:UL:REFSig:DRS:TWBSequence 20
```

Example: NPRACH configuration

```
SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:BW BW5_00
SOURce1:BB:EUTRa:UL:PRACh:NIOT:PFMT F0
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG0:PERD 80
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG0:STTM 8
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG0:REP R2
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG0:SUBC 24
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG0:SCOF 2
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG1:REP R2
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG1:SUBC 24
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG1:SCOF 12
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG2:REP R16
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG2:SUBC 48
SOURce1:BB:EUTRa:UL:UE1:RELease NIOT
SOURce1:BB:EUTRa:UL:UE1:MODE PRAC
SOURce1:BB:EUTRa:UL:UE1:PRACh:NIOT:MOD INBD
SOURce1:BB:EUTRa:UL:UE1:PRACh:NIOT:RBID 24
SOURce1:BB:EUTRa:UL:UE1:PRACh:NIOT:DFReq?
// 2.16  (value in MHz)
SOURce1:BB:EUTRa:UL:UE1:PRACh:NIOT:PRATtempts 1
SOURce1:BB:EUTRa:UL:UE1:PRACh:ATT0:NIOT:CONFig 0
SOURce1:BB:EUTRa:UL:UE1:PRACh:ATT0:NIOT:SFSTart 8
SOURce1:BB:EUTRa:UL:UE1:PRACh:ATT0:NIOT:POWer 0
SOURce1:BB:EUTRa:UL:UE1:PRACh:ATT0:NIOT:INIT 13
SOURce1:BB:EUTRa:UL:UE1:PRACh:ATT0:NIOT:STRT?
// 14
SOURce1:BB:EUTRa:UL:UE1:PRACh:NIOT:ARB:SUGGested?
// 2
SOURce1:BB:EUTRa:SLENgth 2
SOURce1:BB:EUTRa:STATe 1
```

Example: Using FRC

Activate a predefined fixed reference channel.

```
SOURce1:BB:EUTRa:UL:UE1:RELease NIOT
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:STATe 1
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:TYPE A141
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:SCSPacing?
// S15
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:NOSCarriers?
// 1
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:MODulation?
// PI2Bpsk
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:NNPRep?
// 1
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:TBSSindex?
// 0
```

```
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:PASize?
// 32
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:ALResunits?
// 2
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:BPResunit?
// 96
```

Example: eMTC UE configuration

```
// Transmission antennas and antenna port mapping
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1

SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:DL:USER1:RELease EM_A
SOURce1:BB:EUTRa:DL:USER1:UEID 10
SOURce1:BB:EUTRa:DL:USER1:UEC?
// M1
SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM M6
SOURce1:BB:EUTRa:DL:USER1:CCODing:STATe?
// 1
SOURce1:BB:EUTRa:DL:USER1:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:USER1:DATA PN11
// SOURce1:BB:EUTRa:DL:USER1:DATA DLIS
// SOURce1:BB:EUTRa:DL:USER1:DSELect "/var/user/UE1_eMTC.dm_iqd"
```

Example: eMTC valid subframes and hopping configuration

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:SLENgth 40
SOURce1:BB:EUTRa:DL:BW BW5_00

// set cell-specific settings
SOURce1:BB:EUTRa:DL:PLCI:CID 110
SOURce1:BB:EUTRa:DL:PLCI:CIDGroup 36
SOURce1:BB:EUTRa:DL:PLCI:PLID 2
SOURce1:BB:EUTRa:DL:CPC NORM
SOURce1:BB:EUTRa:DL:PDSCh:PB 1
SOURce1:BB:EUTRa:DL:PBCH:RATBa 0
SOURce1:BB:EUTRa:DL:CSETtings:RARNti 25
SOURce1:BB:EUTRa:DL:REFSig:FPOWer 0

// PSS and SS settings
SOURce1:BB:EUTRa:DL:SYNC:TXANtenna ALL
SOURce1:BB:EUTRa:DL:SYNC:PPOWer 0
SOURce1:BB:EUTRa:DL:SYNC:SPOWer 0

// eMTC valid subframes
SOURce1:BB:EUTRa:DL:EMTC:BMP:SUBFrames 10
SOURce1:BB:EUTRa:DL:EMTC:BMP:STARt 2
SOURce1:BB:EUTRa:DL:EMTC:BMP:VALSubframes0 OFF
```

```
SOURce1:BB:EUTRa:DL:EMTC:BMP:VALSubframes1 ON
// Alternatively, select all subframe setting them as valid.
SOURce1:BB:EUTRa:DL:EMTC:BMP:SELectlall
// Deselect all subframe setting them to invalid.
SOURce1:BB:EUTRa:DL:EMTC:BMP:DESelectlall

// PBCH scheduling and hopping
SOURce1:BB:EUTRa:DL:EMTC:BMP:SIBBr 1
SOURce1:BB:EUTRa:DL:EMTC:BMP:PBCHrep 1

// PDSCH and MPDCC hopping
SOURce1:BB:EUTRa:DL:EMTC:NB:NNBands?
// 4
SOURce1:BB:EUTRa:DL:EMTC:NB:HOPPing 2
SOURce1:BB:EUTRa:DL:EMTC:NB:HOFFset 1
SOURce1:BB:EUTRa:DL:EMTC:NB:IVLA H1
SOURce1:BB:EUTRa:DL:EMTC:NB:IVLB H2
SOURce1:BB:EUTRa:DL:EMTC:NB:RHOPpping 1
SOURce1:BB:EUTRa:DL:EMTC:NB:PHOPping 1
SOURce1:BB:EUTRa:DL:EMTC:NB:RSTNb 2
SOURce1:BB:EUTRa:DL:EMTC:NB:PSTNb 2

// common search space configuration
SOURce1:BB:EUTRa:DL:EMTC:SSP:MPD1 8
SOURce1:BB:EUTRa:DL:EMTC:SSP:MPD2 16
SOURce1:BB:EUTRa:DL:EMTC:SSP:STSF S1
SOURce1:BB:EUTRa:DL:EMTC:SSP:PDSA 16
SOURce1:BB:EUTRa:DL:EMTC:SSP:PDSB NON

// Transmission antennas and antenna port mapping
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1

SOURce1:BB:EUTRa:STATe 1
SOURce1:BB:EUTRa:SETTing:STORe "/var/user/emtc_hopping"
```

Example: eMTC widebands configuration

Option: R&S SMW-K143

```
// UL
SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:BW BW10_00
SOURce1:BB:EUTRa:UL:EMTC:WBCFg 1
SOURce1:BB:EUTRa:UL:EMTC:NWBands?
// 2
SOURce1:BB:EUTRa:UL:EMTC:VALid:SUBFrame1 1
SOURce1:BB:EUTRa:UL:EMTC:RSYMbol 2
SOURce1:BB:EUTRa:UL:UE1:RELease EMTC
SOURce1:BB:EUTRa:UL:UE1:STATe 1

SOURce1:BB:EUTRa:UL:UE1:EMTC:NTRansmiss 1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:CONTent PUSC
```

```
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:MODulation QPSK
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:STSFrame 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:REPetitions R2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:STWBand 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:WRBLocks CN6
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:WBRBoffset OS0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:POW 0

// DL
// SOURce1:BB:EUTRa:STDMode IOT
// SOURce1:BB:EUTRa:LINK DOWN
// SOURce1:BB:EUTRa:DL:BW BW10_00
// SOURce1:BB:EUTRa:DL:EMTC:WBCFg BW5
// SOURce1:BB:EUTRa:DL:EMTC:NWBands?
// 2
```

Example: Configuring the MPDCCH sets

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:STDMode IOT

// enable an eMTC UE, e.g. supporting eMTC CE Mode A
SOURce1:BB:EUTRa:DL:USER1:RELease EM_A

SOURce1:BB:EUTRa:DL:USER1:EPDCch1:STATe 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET1:STATe 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET2:STATe 1

SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:TTYP LOC
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:PRBS PRB2
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:RBA 2
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:NID 22
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:POWer 0
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:HOPPing 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STNB 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:REPMpdcch 16
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STSF S1

// MPDCCH allocations are configured automatically,
// depending on the eMTC DCI configuration
```

Example: MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)

The user UE1 is configured as described in Example"eMTC UE configuration" on page 390.

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:NALLoc 1
// DCI configuration
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER USER1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:UEID?
// 10
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:MPDCchset MPD1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F61A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:SSP UE
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:STSFrame 0
// first allowed subframe number is calculated automatically
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PDCCh 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:IDCCe 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:CCES?
// 4
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:NDCCes?
// 4

// UE-specific search space for MPDCCH
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:HOPPing 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STNB 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:REPMpdcch 16
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STSF S1

// PDSCH configuration via DCI format 6-1A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:UEMode STD
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PFRHopp 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:RBA 32
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:MCS 5
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:NREP 3
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:HARQ 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:NDINd 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:RVER 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:TPCPusch 1
// SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:DAINdex 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:TPCPusch 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PMIConfirm 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:TPMPrec 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:CSIRequest 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:SRSRequest 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:HRESoffset 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:SFRNumber 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:BITS?
// "011 0101 0101 0101 0110 1010 1000 0011"
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:TBS?
// 72
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:REPMpdcch?
// 4
```

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:REPPdsch?
// 16
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PDSHopping?
// 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:STRV?
// 3

SOURce1:BB:EUTRa:DL:EMTC:NALLoc?
// 4
// MPDCCH allocation is the third allocation
// PBCH is always the first allocation
// if activated, PDSCH carring SIB1-BR is the second one

// MPDCCH allocation
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:CONType?
// MPD
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:MODulation?
// QPSK
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:STSFrame?
// 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:ABSFrame?
// 4
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:STNB?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:STSYmbol?
// 2
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:PHYSbits?
// 436
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:DATA?
// USER1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:POWer 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:STATe?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:CONFlict?
// 0

// PDSCH allocation not carrying SIB-BR is the fourth allocation
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CONType?
// PDSC
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PHYSbits?
// 264
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:DATA?
// USER1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:ABSFrame?
// 16
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:STSFrame?
// 5
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:NORB?
// 6
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:OVRB?
// 0
```

```
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:STSYmbol?
// 2
...
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:POWer 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:STATe?
// 1

SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:SCHeme?
// SPM
// because User 1 uses Tx mode TM6
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:NOLayers?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:CCD NOCD
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:CBINdex 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:SCRambling:UEID?
// 10
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CCODing:STATe 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CCODing:TBSI?
// 5
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CCODing:TBSize?
// 72
```

Example: PBCH and SIB1-BR configuration

```
// PBCH scheduling and hopping
SOURce1:BB:EUTRa:DL:EMTC:BMP:SIBBr 1
SOURce1:BB:EUTRa:DL:EMTC:BMP:PBCHrep 1

SOURce1:BB:EUTRa:DL:EMTC:DCI:NALLoc 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER USER1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:UEID?
// 10
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F61A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:SSP UE
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:STSFrame 0
// first allowed subframe number is calculated automatically
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PDCCh 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:IDCCe 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:CCES?
// 2

SOURce1:BB:EUTRa:DL:EMTC:NALLoc?
// 4
// PBCH is always the first allocation
// if enabled, PDSCH carring SIB1-BR is the second one

// PBCH allocation
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CONType?
// PBCH
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:MODulation?
// QPSK
```

```
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:STSFrame?
// 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:STSYmbol?
// 2
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:PHYSbits?
// 480
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:DATA?
// MIB
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:POWer 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:STATe?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CONFlict?
// 0

// Transmission antennas and antenna port mapping
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1


// Precoding for two Tx antennas
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:PRECoding:SCHeme TXD
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:PRECoding:NOLayers?
// 2
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:SCRambling:UEID?
// 10

SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:STATe 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:MIB 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:SOFFset 60

SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:SRPeriod PER3gpp

SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:SIB?
// 1
// resembles the value set with SOURce1:BB:EUTRa:DL:EMTC:BMP:SIBBr
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:RSIB?
// 4
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:MSPare #H00,5
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:TBSize?

SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:CONType?
// PSIB
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:MODulation?
// QPSK
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:STSFrame?
// 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:ABSFrame?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:STNB?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:STSYmbol?
```

```
// 3
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:NORB?
// 6
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:PHYSbits?
// 1510
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:DATA?
// SIBB
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:STATe?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:CONFlict?
// 0
```

Example: DCI format 6-2 configuration

DCI format 6-2 carries paging and direct indication. If DCI format 6-2 is used, one MPDCCH is configured and activated automatically.

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:NALLoc 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:UEID?
// 65534
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT?
// F62
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:SSP?
// T1CM
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:STSF 0
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PDCCh?
// 5
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:CCES?
// 10
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:IDCCe?
// 0

// SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PAGNg 0
// SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:DIINfo 100

SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PAGNg 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:RBA 3
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:MCScheme 3
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:NREP 3
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:BITS?
// "000 1100 0111"
```

Example: eMTC PUSCH configuration

```
SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:EMTC:VALid:SUBFrame1 1
SOURce1:BB:EUTRa:UL:BW BW5_00
SOURce1:BB:EUTRa:UL:EMTC:NNBands?
// 4
SOURce1:BB:EUTRa:UL:UE1:RELease EMTC
SOURce1:BB:EUTRa:UL:UE1:STATe 1

SOURce1:BB:EUTRa:UL:UE1:MODE STD
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:REPetitions R4
SOURce1:BB:EUTRa:UL:PUSCh:NHOPping 1
SOURce1:BB:EUTRa:UL:PUSCh:NHOFfset 2

SOURce1:BB:EUTRa:UL:UE1:EMTC:HOPP H4
SOURce1:BB:EUTRa:UL:UE1:EMTC:CELevel CE01
SOURce1:BB:EUTRa:UL:UE1:EMTC:NTRansmiss 1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:CONTent PUSC
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:MODulation QPSK
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:STSFrame 61
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:REPetitions R16
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:STNBand 1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:NRBLocks 5
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:RBOFfset 1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:POW 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:ASFRrame?
// 16

SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:DATA PN9
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:SCRambling:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:MODE COMB
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:IHARqoffset 0
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:ICQioffset 2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:DRS:CYCShift?
// 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:NDMRs?
// 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:HARQ:MODE MUX
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:HARQ:BITS 2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:HARQ:PATTern #H2,2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:HARQ:CBITs?
// 144
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:PUSCh:CQI:BITs 12
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:PUSCh:CQI:PATTern #HC,4
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:PUSCh:CQI:CBITs?
// 810
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:CCODing:TBSize 16
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:CCODing:RVINdex 2
```

```
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:PHYSbits?
// 1440
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:ULSCh:BITS?
// 584

SOURce1:BB:EUTRa:UL:UE1:EMTC:ARB:SUGGested?
SOURce1:BB:EUTRa:SLENgth 10
SOURce1:BB:EUTRa:STATe 1
```

Example: eMTC PUCCH configuration

```
SOURce1:BB:EUTRa:UL:PUCCh:NORB 4
SOURce1:BB:EUTRa:UL:PUCCh:N1CS 1
SOURce1:BB:EUTRa:UL:PUCCh:DESHift 1
SOURce1:BB:EUTRa:UL:PUCCh:N2RB 0

SOURce1:BB:EUTRa:UL:UE1:MODE STD
SOURce1:BB:EUTRa:UL:UE1:EMTC:NTRansmiss 2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:CONTent PUCC
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:FORMat F2B
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:STSFrame 77
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:REPetitions R8
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:ASFRrame?
// 8
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:POWer 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:NAPused?
// 1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:NPUCch 2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:PUCCh:HARQ:PATTern #H3,2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:PUCCh:CQI:BITS 2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:PUCCh:CQI:PATTern #H1,1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:PUCCh:CQI:CBITs?
// 20
SOURce1:BB:EUTRa:SLENgth 10
```

Example: eMTC PRACH configuration

```
SOURce1:BB:EUTRa:UL:PRACh:EMTC:HOFF 6
SOURce1:BB:EUTRa:UL:PRACh:EMTC:RSET OFF
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV0:FOFFset 2
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV0:SSFPeriod 2
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV1:CONFig 48
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV1:FOFFset 16
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV1:HOPPing 1
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV1:REPetit R2
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV1:SSFPeriod NONE
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV2:CONFig 9
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV2:FOFFset 10
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV2:REPetit R8
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV2:SSFPeriod NONE
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV3:CONFig 22
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV3:FOFFset 6
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV3:HOPPing 1
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV3:REPetit R4
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV3:SSFPeriod NONE

SOURce1:BB:EUTRa:UL:UE2:STATe 1
SOURce1:BB:EUTRa:UL:UE2:RELease EMTC
SOURce1:BB:EUTRa:UL:UE2:MODE PRAC
SOURce1:BB:EUTRa:UL:UE2:PRACh:EMTC:PRATtempts 4
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:SFSTart 21
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:NCSConf 0
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:RSEQuence 10
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:SINDex 12
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:DT 0
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:POWer 0
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT1:EMTC:CELV 1
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT1:EMTC:SFSTart 41
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT2:EMTC:CELV 2
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT2:EMTC:SFSTart 81
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT3:EMTC:CELV 3
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT3:EMTC:SFSTart 121

SOURce1:BB:EUTRa:UL:UE2:PRACh:EMTC:ARB:SUGGested?
SOURce1:BB:EUTRa:SLENgth 14
```

9.2 General 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> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:STATe ON`

Manual operation: See "State" on page 57

[:SOURce<hw>]:BB:EUTRa:DUPLexing <Duplexing>

Sets the duplexing mode.

Parameters:

<Duplexing> TDD | FDD

*RST: FDD

Example: `SOURce1:BB:EUTRa:DUPLexing FDD`

Manual operation: See "Duplexing" on page 59

[:SOURce<hw>]:BB:EUTRa:LINK <Link>

Sets the transmission direction.

Parameters:

<Link> UP | DOWN

*RST: DOWN

Example: `SOURce:BB:EUTRa:LINK DOWN`

Manual operation: See "Link Direction" on page 59

[:SOURce<hw>]:BB:EUTRa:STDMode <StandardMode>

Sets the supported 3GPP standard.

Parameters:

<StandardMode> LTE | IOT | LIOT

LTE
Standalone LTE mode.
IoT-specific commands containing the keywords `EMTC` or `NIOT` are discarded.

IOT
Standalone IoT mode.
The commands related to LTE-specific features like carrier aggregation or MBSFN are discarded.

LIOT
Mixed LTE and IoT configuration, for example for interoperability tests.

*RST: LTE

Example: See Example"NPRACH configuration" on page 389.

Options: LTE requires R&S SMW-K55
IOT|LIOT require R&S SMW-K115

Manual operation: See "Mode" on page 59

[: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 57

[:SOURce<hw>]:BB:EUTRa:SETTing:CATalog <Catalog>

Queries the files with settings in the default directory. Listed are files with the file extension `*.lte`.

Parameters:

<Catalog> <filename1>,<filename2>,...

Returns a string of filenames separated by commas.

Example:

```
MMEM:CDIR /var/user/lte
SOURce1:BB:EUTRa:SETTing:CATalog?
// lte, test
SOURce1:BB:EUTRa:SETTing:DEL "test"
SOURce1:BB:EUTRa:SETTing:LOAD "lte"
// SOURce1:BB:EUTRa:SETTing:STORe "lte_2"
```

Manual operation: See "Save/Recall" on page 58

[:SOURce<hw>]:BB:EUTRa:SETTing:DEL <Filename>

Deletes the selected file from the default or the specified directory. Deleted are files with extension `*.lte`.

Setting parameters:

<Filename> string
Filename or complete file path; file extension can be omitted

Example: See `[:SOURce<hw>]:BB:EUTRa:SETTing:CATalog` on page 402.

Usage: Setting only

Manual operation: See "Save/Recall" on page 58

[:SOURce<hw>]:BB:EUTRa:SETTing:LOAD <Filename>

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.lte`.

Parameters:

<Filename> string
Filename or complete file path; file extension can be omitted

Example: See `[:SOURce<hw>]:BB:EUTRa:SETTing:CATalog` on page 402.

Manual operation: See "Save/Recall" on page 58

[:SOURce<hw>]:BB:EUTRa:SETTing:STORe <Filename>

Stores the current settings into the selected file; the file extension (`*.lte`) is assigned automatically.

Parameters:

<Filename> string
Filename or complete file path

Example: See `[:SOURce<hw>]:BB:EUTRa:SETTing:CATalog` on page 402.

Manual operation: See "Save/Recall" on page 58

[:SOURce<hw>]:BB:EUTRa:WAVeform:CREate <Filename>

Stores the current settings as an ARB signal in a waveform file (`*.wv`).

Setting parameters:

<Filename> string

Filename or complete file path; file extension is assigned automatically

Example:
```
MMEM:CDIR /var/user/lte
SOURce1:BB:EUTRa:STATe 1
SOURce1:BB:EUTRa:WAVeform:CREate "lte_test"
```

Usage: Setting only

Manual operation: See "Generate Waveform File" on page 58

[:SOURce]:BB:EUTRa:VERSion?

Queries the version of the 3GPP standard underlying the definitions.

Return values:

<Version> string

Example: `BB:EUTR:VERS?`

Usage: Query only

[:SOURce<hw>]:BB:EUTRa:SETTing:TMOD:DL <Filename>

Selects a predefined test model as defined in TS 36.141.

Parameters:

<Filename> <test_model_name>

Example: `SOURce1:BB:EUTRa:SETTing:TMOD:DL 'N-TM_Standalone'`

Options: NB-IoT test models (N-TM) require R&S SMW-K115

Manual operation: See "Test Models" on page 59

[:SOURce<hw>]:BB:EUTRa:TDD:SPSConf <SpecSubfrConf>

In TDD mode, sets the special subframe configuration number.

Parameters:

<SpecSubfrConf> integer

Range: 0 to 9
*RST: 0

Example: `SOURce1:BB:EUTRa:TDD:SPSConf 2`

Options: R&S SMW-K143: Special subframe configuration 10 (if "Mode = eMTC/NB-IoT")

Manual operation: See "TDD Special Subframe Config" on page 67

[:SOURce<hw>]:BB:EUTRa:TDD:UDConf <ULDLConf>

In TDD mode, sets the uplink/downlink configuration number.

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 67

[:SOURce<hw>]:BB:EUTRa:TDD:UPTS <UpPtsSymbol>

If `[:SOURce<hw>]:BB:EUTRa:TDD:SPSConf` 10, sets the number of UpTPS symbols.

Parameters:

<UpPtsSymbol> 1 | 2

*RST: 1

Example:

```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce:BB:EUTRa:TDD:SPSConf 10
SOURce:BB:EUTRa:TDD:UPTS 2
```

Options: R&S SMW-K143 (if "Mode = eMTC/NB-IoT")

Manual operation: See "Number of UpPTS Symbols" on page 67

[:SOURce<hw>]:BB:EUTRa:UPLane:STATe <UPlaneState>

Turns user plane data generation according to the O-RAN standard on and off.

Parameters:

<UPlaneState> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:UPLane:STATe ON`

Options: R&S SMW-K175

Manual operation: See "U-Plane Generation" on page 62

9.3 General downlink

9.3.1 Physical settings

[:SOURce<hw>]:BB:EUTRa:DL:BW <Bw>

Sets the DL channel bandwidth.

Parameters:

<Bw> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00 | BW0_20

*RST: BW10_00

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Options: BW0_20 requires R&S SMW-K115

Manual operation: See "Channel Bandwidth" on page 64

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NNBands?

Queries the number of narrowbands.

Return values:

<NumNarrowbands> integer

Range: 0 to 18
*RST: 1

Example: `SOURce1:BB:EUTRa:DL:EMTC:NNBands?`

Usage: Query only

Manual operation: See "Number of eMTC Narrowbands" on page 65

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:WBCFg <WideBandCfg>

If enabled, the available channel bandwidth is split into eMTC widebands with the selected bandwidth.

Parameters:

<WideBandCfg> OFF | BW5_00 | BW20_00

*RST: OFF

Example: See Example"eMTC widebands configuration" on page 391.

Options: R&S SMW-K143

Manual operation: See "Wideband Config" on page 66

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NWBands?

Queries the number of widebands.

Return values:

<NumWideBands> integer

Range: 0 to 4
*RST: 1

Example: See Example"eMTC widebands configuration" on page 391.

Usage: Query only

Options: R&S SMW-K143

Manual operation: See "Number of eMTC Widebands" on page 65

[: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 ANT1
SOURce1: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 158

[: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 407

Manual operation: See "Simulated Antenna" on page 158

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:MAPCoordinates <Type>

Switches between the cartesian and cylindrical coordinates representation.

Parameters:

<Type> CARTesian | CYLindrical

*RST: CARTesian

Example: See [:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration on page 407

Manual operation: See "Mapping Coordinates" on page 159

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:REAL <AntPortMapDat>

Define the mapping of the antenna ports to the physical antennas.

Suffix:

<dir0> 0 | 1 | 2 | 3 | 4 | 6 | 15 to 46 | 2000 to 2001
Antenna port
`AP0|1|2|3` can only be mapped to the `BB0|1|2|3`

<st0> 0 to 7
Available basebands

Parameters:

<AntPortMapDat> 0 | 1 (for AP = 0 to 3); float (for AP = 4 | 6 | 15 to 46)

The mapping of the first four APs `AP0|1|2|3` depends on the system configuration as follows:
If `SCONfiguration:BASeband:SOURce SEParate`, then exactly one single AP can be mapped to a BB.

If SCONfiguration:BASeband:SOURce COUPled|CPENtity, then none or exactly one single AP can be mapped to a BB.
To map an AP, use the command SOURce1:BB:EUTRa:DL:MIMO:APM:CS:AP0|1|2|3:ROW0|1|2|3:**REAL** 1. The corresponding ...:CS:AP0|1|2|3:ROW0|1|2|3:IMAG command has no effect.
The REAL (Magnitude) and IMAGinary (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows:
|REAL+j*IMAGinary| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 360
Increment: 0.001
*RST: dynamic

Example: See [:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration on page 407.

Options: AP = 2000/2001 require R&S SMW-143

Manual operation: See "Mapping table" on page 159

[: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> 4 | 6 | 15 to 46 | 2000 to 2001
Antenna port

<st0> 0 to 7
Available basebands

Parameters:

<AntPortMapDat> float

The REAL (Magnitude) and IMAGinary (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows:
|REAL+j*IMAGinary| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 360
Increment: 0.001
*RST: dynamic

Example: See [:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration on page 407.

Options: AP = 2000/2001 require R&S SMW-143

Manual operation: See "Mapping table" on page 159

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:CELL:BB<st0> <AntPortCCIndex>

Maps a component carrier to a baseband.

Suffix:

<st0>	0 to 7 baseband identifier, where <st0>=0 indicates BB A

Parameters:

<AntPortCCIndex>	PC | SC1 | SC2 | SC3 | SC4 Component carrier *RST: PC

Manual operation: See "Mapping table" on page 159

[: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:

```
SOURce1:BB:EUTRa:DL:BW BW5_00
SOURce1:BB:EUTRa:DL:NORB?
// 25
```

Manual operation: See "Number of Resource Blocks Per Slot" on page 65

[: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 66

[:SOURce<hw>]:BB:EUTRa:DL:FFT <Fft>

Sets the FFT size.

Parameters:

<Fft>	integer Range: 64 to 2048 *RST: 1024

Example: `SOURce1:BB:EUTRa:DL:FFT?`

Manual operation: See "FFT Size" on page 65

[:SOURce<hw>]:BB:EUTRa:DL:OCCBandwidth?

Queries the 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 66

[: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 66

[: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

[: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

[: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 67

[: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 68

[: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 68

[:SOURce<hw>]:BB:EUTRa:DL:CPC <CyclicPrefix>

Sets the cyclic prefix length for all LTE subframes.

Parameters:
<CyclicPrefix> NORMal | EXTended
*RST: NORMal

Example: `SOURce1:BB:EUTRa:DL:CPC NORM`

Manual operation: See "Cyclic Prefix" on page 68

[:SOURce<hw>]:BB:EUTRa:DL:CSETtings:RARNti <RaRnti>

Sets the random-access response identity RA-RNTI.

Parameters:
<RaRnti> integer
Range: 1 to 60
*RST: 1

Example: `SOURce1:BB:EUTRa:DL:CSETtings:RARNti 5`

Manual operation: See "RA_RNTI" on page 69

[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:PB <Pb>

Sets the cell-specific ratio rho_B/rho_A according to TS 36.213.

Parameters:
<Pb> integer
Range: 0 to 3
*RST: 0

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:PBCH:RATBa` on page 413.

Manual operation: See "PDSCH P_B" on page 68

[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:RATBa <RatioPbPa>
[:SOURce<hw>]:BB:EUTRa:DL:PDCCh:RATBa <RatioPbBa>
[:SOURce<hw>]:BB:EUTRa:DL:PBCH:RATBa <RatioPbPa>

Sets the transmit energy ratio among the resource elements allocated for teh channel 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:

```
SOURce1:BB:EUTRa:DL:PDSCh:PB 1
SOURce1:BB:EUTRa:DL:PDSCh:RATBa?
// -0.969
SOURce1:BB:EUTRa:DL:PBCH:RATBa -5.0
SOURce1:BB:EUTRa:DL:PDCCh:RATBa -1.0
```

Manual operation: See "PDSCH/PDCCH/PBCH Ratio rho_B/rho_A" on page 68

9.3.2 Reference and synchronization signals

[:SOURce<hw>]:BB:EUTRa:DL:REFSig:NIOT:POWer <NbRefSigSymPowe>

Sets the power of the narrowband reference signal (NRS).

Parameters:

<NbRefSigSymPowe>float

Range: -80 to 10
Increment: 0.01
*RST: 0

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "Narrowband Reference Signal Power" on page 81

[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:TXANtenna <NpNsSyncTxAnt>

Defines on which antenna the NPSS/NSSS are transmitted.

Parameters:

<NpNsSyncTxAnt> NONE | ANT1 | ANT2 | ALL

*RST: ALL

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "NP-/NS-Sync Tx Antenna" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:NPPWr <NPSyncPower>
[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:NSPWr <NsSyncPower>

Sets the power of the NPSS/NSSS allocations.

Parameters:

<NsSyncPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "NP-SYNC Power/NS-SYNC Power" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:REFSig:POWer <Power>

Sets the reference signal power.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.01
*RST: 0

Example: `SOURce1:BB:EUTRa:DL:REFSig:POWer -10.00`

Manual operation: See "Reference Signal Power" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:REFSig:EPRE?

Queries the RS Power per RE relative to Level Display.

Return values:

<RelToLevelDispl> float

Range: -1e3 to 1e3
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 121

[: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 122

[: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 122

[: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 122

9.3.3 NPRS

Option: R&S SMW-K143

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:STATe <NprsState>

Enables the NPRS transmission.

Parameters:

<NprsState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS State" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:CONF <NprsParaCfg>

Defines which type of NPRS is used.

Parameters:

<NprsParaCfg> PA_A | PA_B | PA_AB

*RST: PA_A

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS Parameter" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:POW <NprsPower>

Sets the power of the narrowband positioning reference signal (NPRS).

Parameters:

<NprsPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS Power" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:ID <NprsId>

Sets the NPRS-ID used for the generation of the NPRS.

Parameters:

<NprsId> Integer

Range: 0 to 4095
Increment: 1
*RST: 0

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS ID" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:SEIN <NprsSeqInfo>

Specifies the index of the physical ressource block (PRB) containing the NPRS.

Parameters:

<NprsSeqInfo> integer

Range: 0 to 174
*RST: 0

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS Sequence Information" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:BMP:CONF <NprsBmp>

Sets if the NPRS subframe Part A configuration lasts 10 ms or 40 ms.

Parameters:

<NprsBmp> 10 | 40

*RST: 10

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS Bitmap" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:BMP:VALSubframes<ch> <NprsBmpValidSf>

Sets a subframe as valid and used for NPRS transmission.

Suffix:

<dir> 0 to 9
Subframe number

Parameters:

<NprsBmpValidSf> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS Bitmap Config" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:MTIA <NprsMutingInfoA>, <BitCount>
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:MTIB <NprsMutingInfoB>, <BitCount>

Sets the `nprs-MutingInfoA`/`nprs-MutingInfoB` parameter, required if muting is used for the NPRS part A (and Part B) configurations.

Parameters:

<NprsMutingInfoB> numeric

"1" indicates that the NPRS is transmitted in the corresponding occasion; a "0" indicates a muted NPRS.

*RST: #H3

<BitCount> integer

Sets the length of the periodically repeating NPRS bit sequence in number of NPRS position occurrences.
Allowed are the following values: 2, 4, 8 or 16

Range: 2 to 16
*RST: 2

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS Muting Information A/B" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:PERiod <NprsPeriod>

For NPRS Part B configuration, sets the NPRS occasion period T_{NPRS}.

Parameters:

<NprsPeriod> PD_160 | PD_320 | PD_640 | PD_1280

*RST: PD_160

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS Period" on page 84

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:STSFrame <NprsStartSf>

For NPRS Part B configuration, sets the subframe offset α_{NPRS}.

Parameters:

<NprsStartSf> STSF0_8 | STSF1_8 | STSF2_8 | STSF3_8 | STSF4_8 | STSF5_8 | STSF6_8 | STSF7_8

*RST: STSF0_8

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS Start Subframe" on page 84

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:SFNM <NprsSfNumber>

For NPRS Part B configuration, sets the number of consecutive DL subframes N_{NPRS} within one NPRS positioning occasion.

Parameters:

<NprsSfNumber> SFNM_10 | SFNM_20 | SFNM_40 | SFNM_80 | SFNM_160 | SFNM_320 | SFNM_640 | SFNM_1280

*RST: SFNM_10

Example: See Example"NPRS part A+B configuration in in-band mode" on page 380.

Manual operation: See "NPRS Number of Subframes" on page 84

9.3.4 NB-IoT wake-up signal

Option: R&S SMW-K146

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:ACD <NwusActD>

Sets the duration of WUS in subframes.

Parameters:

<NwusActD> DN_1 | DN_2 | DN_4 | DN_8 | DN_16 | DN_32 | DN_64 | DN_128 | DN_256 | DN_512 | DN_1024

*RST: DN_1

Example: See Example"NB-IoT wake up signal" on page 380

Options: R&S SMW-K146

Manual operation: See "NWUS Actual Duration" on page 85

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:MAXDuration <NwusMaxDur>

Sets the maximum WUS duration in subframes.

Parameters:

<NwusMaxDur> DN_1 | DN_2 | DN_4 | DN_8 | DN_16 | DN_32 | DN_64 | DN_128 | DN_256 | DN_512 | DN_1024

*RST: DN_1

Example: See Example"NB-IoT wake up signal" on page 380

Options: R&S SMW-K146

Manual operation: See "NWUS Max Duration" on page 85

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:POW <NwusPower>

Sets the transmit power of NB-IoT wake up signal

Parameters:

<NwusPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0
Default unit: dB

Example: See Example"NB-IoT wake up signal" on page 380

Options: R&S SMW-K146

Manual operation: See "NWUS Power" on page 85

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:PSF?

Queries the first paging occasion in subframes associated with WUS.

Return values:

<NwusPSF> integer

Range: 0 to 534593
*RST: 40

Example: See Example"NB-IoT wake up signal" on page 380

Usage: Query only

Options: R&S SMW-K146

Manual operation: See "Paging Start Subframe" on page 85

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:SF <NwusSF>

Specifies the first subframe for paging associated with a WUS transmission.

Parameters:

<NwusSF> Integer

Range: 0 to 533329
Increment: 1
*RST: 0

Example: See Example"NB-IoT wake up signal" on page 380

Options: R&S SMW-K146

Manual operation: See "NWUS Start Subframe" on page 85

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:STATe <NwusState>

Enables or disables the NB-IoT wake up signal.

Parameters:

<NwusState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NB-IoT wake up signal" on page 380

Options: R&S SMW-K146

Manual operation: See "NWUS State" on page 85

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:TO <NwusTO>

Sets the offset in ms from the end of the configured maximum WUS duration to the associated paging occasion.

Parameters:

<NwusTO> TO_40 | TO_80 | TO160 | TO240

*RST: TO_40

Example: See Example"NB-IoT wake up signal" on page 380

Options: R&S SMW-K146

Manual operation: See "NWUS Time Offset" on page 85

9.3.5 NB-IoT carrier allocation

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:NIOT:CONFig <NbiotMimoConf>

Set the number of transmit antennas used for the simulated NB-IoT system.

Parameters:

<NbiotMimoConf> TX2 | TX1

*RST: TX1

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "NB-IoT MIMO Configuration" on page 158

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:PUNCture <PunctureInband>

Punctures the LTE signal at the NB-IoT in-band or guard band carriers.

Parameters:

<PunctureInband> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:STDMode LIOT
SOURce1:BB:EUTRa:DL:BW BW5_00
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:STATe 1
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:MODE INBD
SOURce1:BB:EUTRa:DL:NIOT:PUNCture 1
```

Manual operation: See "Puncture LTE at Inband Carriers" on page 75

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:LTECell:STATe <LTECell>

In in-band mode, defines how the LTE channels are handled.

If enabled, all LTE channels are deactivated. However, LTE reference signals are still transmitted.

Parameters:

<LTECell> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NB-IoT carriers in in-band mode" on page 378.

Manual operation: See "LTE Cell" on page 74

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:CONFig:STATe <GapConfig>

If activated, a gap between the NPDCCH and NPDSCH with the specified duration is applied.

Parameters:

<GapConfig> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NB-IoT carriers in in-band mode" on page 378.

Manual operation: See "Gap Configuration" on page 74

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:THReshold <GapThreshold>

Sets the gap threshold.

Parameters:

<GapThreshold> 32 | 64 | 128 | 256

*RST: 32

Example: See Example"NB-IoT carriers in in-band mode" on page 378.

Manual operation: See "Gap Threshold" on page 74

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:PERiodicity <GapPeriodicity>

Sets the number of subframes after that the configured gap is repeated.

Parameters:

<GapPeriodicity> 64 | 128 | 256 | 512

*RST: 64

Example: See Example"NB-IoT carriers in in-band mode" on page 378.

Manual operation: See "Gap Periodicity" on page 74

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:DURation:COEFficent <GapDurCoeff>

Sets the gap duration coefficient.

Parameters:

<GapDurCoeff> 1_8 | 1_4 | 3_8 | 1_2

*RST: 1_8

Example: See Example"NB-IoT carriers in in-band mode" on page 378.

Manual operation: See "Gap Duration Coefficient" on page 75

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:MODE <Mode>

Sets the operating mode.

Parameters:

<Mode> INBD | ALON | GBD

*RST: INBD

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "Mode" on page 75

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CRSSeq <CrsSeqInfo>

Sets the CRS sequence info.

Parameters:

<CrsSeqInfo> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31

Example: See Example"NB-IoT carriers in in-band mode" on page 378.

Manual operation: See "CRS Sequence Info" on page 75

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:RBIDx <RbIndex>

Sets the resource block number in that the NB-IoT transmissions are allocated.

Parameters:

<RbIndex> 2 | 4 | 7 | 9 | 12 | 14 | 17 | 19 | 22 | 27 | 24 | 29 | 30 | 32 | 34 | 35 | 39 | 42 | 44 | 40 | 45 | 47 | 52 | 55 | 57 | 60 | 62 | 65 | 67 | 70 | 72 | 75 | 80 | 85 | 90 | 95 | USER

*RST: 40

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "RB Index" on page 76

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:DFReq <DeltaFreq>

Sets the frequency offset between the NB-IoT carrier and the LTE center frequency.

Parameters:

<DeltaFreq> float

Range: -10000000 to 10000000
*RST: 0
Default unit: MHz

Example: See Example"NB-IoT carriers in in-band mode" on page 378.

Manual operation: See "Delta Frequency to DC, MHz" on page 76

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CELL <CellID>

Sets the narrowband physical cell identifier.

Parameters:

<CellID> integer

Range: 0 to 503
*RST: 0

Example: See Example"NB-IoT carriers in in-band mode" on page 378.

Manual operation: See "NCell ID" on page 77

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CIDGroup <CellIdGr>

Queries the physical cell identity group.

Parameters:

<CellIdGr> integer

Range: 0 to 111
*RST: 0

Example: See Example"NB-IoT carriers in in-band mode" on page 378.

Manual operation: See "NCell ID Group" on page 77

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ID?

Queries the physical layer identity.

Return values:

<Identity> integer

Range: 0 to 111
*RST: 0

Example: See Example"NB-IoT carriers in in-band mode" on page 378.

Usage: Query only

Manual operation: See "Identity" on page 77

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:NVSF <NoValidSubframe>

Sets the subframes bitmap.

Parameters:

<NoValidSubframe> N10 | N40

*RST: N10

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "Valid Subframes" on page 77
See "Bitmap Subframes" on page 78

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:GBRBidx <RbIndexGB>

In guardband opration, sets the resource block number in that the NB-IoT transmissions are allocated.

Parameters:
<RbIndexGB> integer

Example:
```
SOURce1:BB:EUTRa:DL:BW BW5_00
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:MODE GBD
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:GBRBidx 26
```

Manual operation: See "RB Index" on page 76

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SFALI

Sets all SFs to valid.

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Usage: Event

Manual operation: See "Select All/Deselect All" on page 78

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SFNN

Sets all SFs to invalid.

Example:
```
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:SFNN
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:SF1:VALSf?
// 0
```

Usage: Event

Manual operation: See "Select All/Deselect All" on page 78

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SF<st0>:VALSf <Valid>

Sets the valid subframes.

Suffix:
<st0> 0 to 9/ 0 to 39
Subframe number, where the max number of subframes depends on the selected bitmap
[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:NVSF N10: 0 to 9
[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:NVSF N40: 0 to 39

Parameters:
<Valid> 1 | ON | 0 | OFF

1
Valid subframe

0
Not valid subframe

*RST: 1

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "Valid Subframes" on page 77

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:PAG:RMAX <PagingRmax>

Sets the maximum number NPDCCH is repeated R_{Max} (paging).

Parameters:

<PagingRmax> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128 | R256 | R512 | R1024 | R2048

*RST: R1

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "Max. Repetitions of NPDCCH (Rmax) for Type 1 common search space" on page 89

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:RMAX <RandomRmax>

Sets the maximum number NPDCCH is repeated R_{Max} (random access).

Parameters:

<RandomRmax> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128 | R256 | R512 | R1024 | R2048

*RST: R1

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "Max. Repetitions of NPDCCH (Rmax) for Type 2 common search space" on page 89

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:SSOFfset <RandomOffset>

Sets the serach space offset (α_{offset}).

Parameters:

<RandomOffset> O0 | O1_8 | O1_4 | O3_8

*RST: O0

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "Search Space Offset (α_{offset})" on page 89

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:STSFrame <StartSf>

Sets the start SF for the random access common search space.

Parameters:

<StartSf> S1_5 | S2 | S4 | S8 | S16 | S32 | S48 | S64

*RST: S4

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "Search Space Start Subframe (G)" on page 89

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:STATe <State>

Enables the selected NB-IoT carrier.

To enable the NB-IoT configuration, enable the anchor carrier (`SOURce1:BB:EUTRa:DL:CARRier0:NIOT:STATe 1`)

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 377.

Manual operation: See "Activate NB-IoT" on page 74
See "State" on page 79

9.3.6 eMTC bitmap, valid subframes, hopping and common search space

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SUBFrames <BitmapSubframes>

Sets the valid subframes configuration over 10ms or 40ms.

Parameters:

<BitmapSubframes> 10 | 40

*RST: 10

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "Bitmap Subframes" on page 118

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:STARt <StartingSymbol>

Defines the first symbol within a frame that can be used for eMTC.

Parameters:

<StartingSymbol> 1 | 2 | 3 | 4

*RST: 2

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "Starting Symbol" on page 118

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SIBBr <SchedInfoSIB1BR>

Sets the number of times the PDSCH allocation carrying the SIB1-BR is repeated.

Parameters:

<SchedInfoSIB1BR> integer

Range: 0 to 18
*RST: 0

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "Scheduling Info SIB1-BR" on page 118

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:PBCHrep <PbchRepetitions>

Configures the cell for PBCH repetition.

Parameters:

<PbchRepetitions> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "PBCH Repetition" on page 118

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:VALSubframes<ch> <ValidSubFrames>

Sets a SF as valid or invalid.

Parameters:

<ValidSubFrames> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "SF State" on page 119

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SELectall|DESelectall

Sets all SFs as valid or invalid.

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Usage: Event

Manual operation: See "Select All/Deselect All" on page 118

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:NNBands?

Queries the number of narrowbands.

Return values:

<NumNarrowBands> integer

Range: 1 to 16
*RST: 8

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Usage: Query only

Manual operation: See "Number of eMTC Narrowbands" on page 119

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:HOPPing <NumNBHopping>

Sets the number of narrowbands over which MPDCCH or PDSCH hops.

Parameters:

<NumNBHopping> 2 | 4

*RST: 2

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "Number of Narrowbands for Hopping" on page 119

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:HOFFset <HoppingOffset>

Sets the number of narrowbands between two consecutive MPDCCH or PDSCH hops.

Parameters:

<HoppingOffset> integer

Range: 1 to 16
*RST: 8

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "Hopping Offset" on page 119

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:IVLA <HoppingIvlA>
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:IVLB <HoppingIvlB>

Sets the number of consecutive subframes during which MPDCCH or PDSCH stays at the same narrowband before hopping to another narrowband.

Parameters:

<HoppingIvlB> H1 | H2 | H4 | H5 | H8 | H10 | H16 | H20 | H40

*RST: H2

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "Hopping Interval for CE Mode A/B" on page 119

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:PHOPping <PagingHopping>
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:RHOPpping <RaHopping>

Enables hopping for the random access.

Parameters:

<RaHopping> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "RA Hopping" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:PSTNb <PagingStartingN>
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:RSTNb <RaStartingNB>

Sets the first used narrowband, if hoping is enabeld.

Parameters:

<RaStartingNB> integer

Range: 0 to 15
*RST: 8

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "RA Starting NB" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:MPD1 <MaxRepMPDCCH1>
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:MPD2 <MaxRepMPDCCH2>

Sets the maximum number of MPDCCH repetitons for type 1 and type 2 common seach spaces.

Parameters:

<MaxRepMPDCCH2> 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256

*RST: 1

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "Max. Repetitions of MPDCCH (Rmax) for Type 2 common search space" on page 126

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:STSF <SpStartSf>

Sets the start SF for the random access common search space.

Parameters:

<SpStartSf> S1 | S1_5 | S2 | S2_5 | S5 | S8 | S10 | S20 | S4

*RST: S1

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "Search Space Start Subframe" on page 126

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:PDSA <MaxRepPDSCHA>

Sets the parameter `pdsch-maxNumRepetitionCEmodeA` that defines the PDSCH subframe assigment.

Parameters:

<MaxRepPDSCHA> 16 | 32 | 64 | NON | 192 | 256 | 384 | 512 | 786 | 1024 | 1536 | 2048

*RST: NON

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "Max. Repetitions of PDSCH for CE Mode A/B" on page 127

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:PDSB <MaxRepPDSCHB>

Sets the parameter `pdsch-maxNumRepetitionCEmodeB` that defines the PDSCH subframe assigment.

Parameters:

<MaxRepPDSCHB> 16 | 32 | 64 | NON | 192 | 256 | 384 | 512 | 786 | 1024 | 1536 | 2048

*RST: NON

Example: See Example"eMTC valid subframes and hopping configuration" on page 390.

Manual operation: See "Max. Repetitions of PDSCH for CE Mode A/B" on page 127

9.4 DL frame configuration

9.4.1 NB-IoT DCI configuration

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:NALLoc <NoAlloc>

Sets the number of configurable DCIs.

Parameters:

<NoAlloc> integer

Range: 0 to 100
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "Number of DCI Allocations" on page 92

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:AWARound <AllocWrapAround>

If enabled, the NPDSCH allocations are relocated at the beginning of the ARB sequence to ensure a consistent signal.

Parameters:

<AllocWrapAround> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:DL:NIOT:DCI:AWARound 1`

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:USER <User>

Selects the user the DCI is dedicated to.

Parameters:

<User> USER1 | USER2 | USER3 | USER4 | PRNTi | RARNti

*RST: USER1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "User" on page 92

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:UEID?

Queries the UE_ID or the n_RNTI for the selected DCI.

Return values:

<UeID> integer

Range: 0 to 65535
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "UE_ID/n_RNTI" on page 92

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:FMT <Format>

Sets the DCI format for the selected allocation.

Parameters:

<Format> N0 | N1 | N2

*RST: N0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format" on page 92

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SSP <SearchSpace>

Sets the search space for the selected DCI.

Parameters:

<SearchSpace> UE | T1CM | T2CM

*RST: UE

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "Search Space" on page 93

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:STSFrame <StartSf>

Sets the next valid starting subframe for the selected allocation.

Parameters:

<StartSf> integer

Range: 1 to 20
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "Start Sufbrame" on page 103

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:FMT <NPdcchFmt>

Sets the NPDCCH format.

Parameters:

<NPdcchFmt> integer

Range: 0 to 1
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "NPDCCH Format" on page 103

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:CCES?

queries the number NCCEs.

Return values:

<NoCCEs> integer

Range: 1 to 2
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Number NCCEs" on page 104

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IDCCe <NcceIndex>

Sets the NCCE start index.

Parameters:

<NcceIndex> integer

Range: 0 to 1
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "NCCE Index" on page 104

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:CONFlict?

Queries if there is a conflict between two DCI formats.

Return values:

<Conflict> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc1:CONFlict?`

Usage: Query only

Manual operation: See "Conflict" on page 104

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:BITS?

Queries the resulting bit data as selected with the DCI format parameters.

Return values:

<BitData> string

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Bit Data" on page 94

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IRU <DciIRU>

Sets the DCI field resource assignment field of NPUSCH (I_{RU}).

Parameters:

<DciIRU> integer

Range: 0 to 7

*RST: 0

Example: See Example"DCI format N0 configuration" on page 381.

Manual operation: See "DCI Format N0" on page 94

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:HACK <HackResource>

Sets the DCI field HARQ-ACK resource field.

Parameters:

<HackResource> integer

Range: 0 to 15

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format N1" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IDELay <SchedDelay>

Sets the DCI field scheduling delay field (I_{Delay}).

Parameters:

<SchedDelay> integer

Range: 0 to 7
*RST: 0

Example: See Example"DCI format N0 configuration" on page 381.

Manual operation: See "DCI Format N0" on page 94
See "DCI Format N1" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:MCSCheme <Scheme>

Sets the DCI field modulation and coding scheme (I_{MSC}).

Parameters:

<Scheme> integer

Range: 0 to 13
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format N0" on page 94
See "DCI Format N1" on page 96
See "DCI Format N2" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:OIND <OrderInd>

Sets the DCI field NPDCCH order indicator.

Parameters:

<OrderInd> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format N1" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:REP?

Queries the number of repetitions of NPDCCH (R).

Return values:

<NPdcchRpt> integer

Range: 1 to 2048
*RST: 1

Example: See Example"DCI format N2 configuration" on page 385.

Usage: Query only

Manual operation: See "Repetitions of NPDCCH (R)" on page 103

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:IREP <DciINPDSCH>

Sets the DCI field number of NPDSCH repetition fields (I_{Rep}).

Parameters:

<DciINPDSCH> integer

Range: 0 to 15
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format N1" on page 96
See "DCI Format N2" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:ISF <DciISF>

Sets the DCI feild resource assignment field (I_{SF}).

Parameters:

<DciISF> integer

Range: 0 to 7
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format N1" on page 96
See "DCI Format N2" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:NREP?

Queries the number of repetitions of NPDSCH (N_{Rep}.)

Return values:

<NPdschRpt> integer

Range: 1 to 2048
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Repetitions of NPDSCH (N_{Rep})" on page 103

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:NSF?

queries the number of NPDSCH subframes (N_{SF}).

Return values:

<NoSubframes> integer

Range: 1 to 10
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Number of NPDSCH Subframes (N_{SF})" on page 103

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPRach:SCINd <SubcarrierInd>

Sets the DCI field subcarrier indication field of NPRACH (I_{SC}).

Parameters:

<SubcarrierInd> integer

Range: 0 to 47
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format N1" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPRach:SNUMber <StartingNumber>

Sets the DCI field starting number of NPRACH repetitions (I_{Rep}).

Parameters:

<StartingNumber> integer

Range: 0 to 2
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format N1" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPUSch:IREP <DciINPUSCH>

Sets the DCI field number of NPUSCH repetition fields (I_{Rep}).

Parameters:

<DciINPUSCH> integer

Range: 0 to 7
*RST: 0

Example: See Example"DCI format N0 configuration" on page 381.

Manual operation: See "DCI Format N0" on page 94

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NRUNits?

Queries the number of resource units (N_{RU}).

Return values:

<NoResUnits> integer

Range: 1 to 10
*RST: 1

Example: See Example"DCI format N0 configuration" on page 381.

Usage: Query only

Manual operation: See "Number of Resource Units (N_{RU})" on page 102

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NDINd <NewDataInd>

Sets the DCI field new data indicator.

Parameters:

<NewDataInd> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format N0" on page 94
See "DCI Format N1" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:HPNMber <HarqProcessNum>

Sets the HARQ processes number, for UEs for that `[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:STHP:STATe1`.

Parameters:

<HarqProcessNum> integer

Range: 0 to 1
*RST: 0

Example: See Example"DCI format N0 configuration" on page 381.

Options: R&S SMW-K143

Manual operation: See "DCI Format N0" on page 94
See "DCI Format N1" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:PAG <Paging>

Sets the DCI field flag for paging/direct indication.

Parameters:

<Paging> 1 | ON | 0 | OFF

1
Paging

0
Direct indication

*RST: 0

Example: See Example"DCI format N2 configuration" on page 385.

Manual operation: See "DCI Format N2" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:RVERsion <RedundancyVers>

Sets the DCI field redundancy version.

Parameters:

<RedundancyVers> integer

Range: 0 to 1
*RST: 0

Example: See Example"DCI format N0 configuration" on page 381.

Manual operation: See "DCI Format N0" on page 94

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SCINd <SubcarrierInd>

Sets teh DCI field subcarrier identification field of NPUSCH (I_{SC}).

Parameters:

<SubcarrierInd> integer

Range: 0 to 47
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format N0" on page 94

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SFRPt <SfRepetition>

Sets the DCI field repetitions of DCI subframes.

Parameters:

<SfRepetition> integer

Range: 0 to 7
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "DCI Format N0" on page 94
See "DCI Format N1" on page 96
See "DCI Format N2" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SIME <SysInfModExt>

Sets the DCI field system info modification - extended discontinuous reception.

Parameters:

<SysInfModExt> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"DCI format N2 configuration" on page 385.

Manual operation: See "DCI Format N2" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SINF <SysInfMod>

Sets the DCI field system info modification.

Parameters:

<SysInfMod> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"DCI format N2 configuration" on page 385.

Manual operation: See "DCI Format N2" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:TBSZ?

Queries the transport block size.

Return values:

<TransportBlockS> integer

Max transport block size depends on the installed options
Option:R&S SMW-K115: Max = 680
Option:R&S SMW-K143: Max = 2536

Range: 16 to max
*RST: 16

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "DCI Format N1" on page 96
See "Transport Block Size" on page 102

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:DIST <DistNpdcchNpdsc>

Sets how the distance between the NPDCCH to NPDSCH is determined.

Parameters:
<DistNpdcchNpdsc> STD | MIN | ZERO

`ZERO` disables the NPDSCH SIB1-NR and NPUCCH transmissions. The NPDSCH is transmitted immediately after the NPDCCH.
Use this value to increase the number of NPDSCH allocations.

*RST: STD

Example:
```
SOURce1:BB:EUTRa:DL:NOIT:DCI:ALLoc0:FMT N1
SOURce1:BB:EUTRa:DL:NOIT:DCI:ALLoc0:DIST STD
```

Manual operation: See "Distance from NPDCCH to NPDSCH" on page 102

9.4.2 NB-IoT allocation

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NALLoc?

Queries the number of NB-IoT allocations.

Return values:
<NbIoTNAlloc> integer

Range: 0 to 42
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Allocation number" on page 105

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CONType?

Queries the channel type.

Return values:

<ContentType> NPBCh | NSIB | NPDCch | NPDSch

*RST: NPBCh

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Content Type" on page 105

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:MODulation?

Queries the used modulation scheme.

Return values:

<Modulation> QPSK

*RST: QPSK

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Modulation" on page 106

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SFList?

Queries the subframes in that the channel is allocated.

Return values:

<SubframeList> "<SF#>, <SF#>, <SF#>, <SF#>..."

String of four comma-separated integer values, indicating sub-frame numbers

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Suframe List" on page 106

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:STSYmbol <StartSymbol>

Sets the first symbol in a subframe where NB-IoT channels can be allocated.

Parameters:

<StartSymbol> SYM0 | SYM1 | SYM2 | SYM3

*RST: SYM0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "Start Symbol" on page 106

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PHYSbits?

Queries the used number of physical bits.

Return values:

<PhysicalBits> integer

Range: 0 to 320
*RST: 200

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Phys. Bits" on page 107
See "Number of Physical Bits" on page 111
See "Number of Physical Bits" on page 116

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:POWer <Power>

Sets the power of the selected allocation.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.01
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "ρ A" on page 108

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:DATA <DataSource>

Queries the data source or sets the data source for NPDSCH allocations configured for P-RNTI or RA-RNTI.

Parameters:

<DataSource> USER1 | USER2 | USER3 | USER4 | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE | MIB | SIB1nb | PRNTi | RARNti

*RST: MIB

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "Data Source" on page 107

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:DSELect <DataList>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<DataList> string

Filename incl. file extension or complete file path

Example:

```
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:DATA DLIS
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:DSELect "/var/user/IoT.dm_iqd"
```

Manual operation: See "Data Source" on page 107

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PATTern <Pattern>, <BitCount>

Sets a bit pattern as data source.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example:

```
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:DATA PATT
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:PATTern #H735,12
```

Manual operation: See "Data Source" on page 107

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:STATe?

Queries the allocation state.

Return values:

<State> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "State" on page 108

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CONFlict?

Queries if there is a conflict between allocations.

Return values:

<Conflict> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Conflict" on page 108

9.4.3 NPBCH, NPDCCH, NPDSCH enhanced settings

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:SCHeme <PrecAntScheme>

Sets the precoding scheme.

Parameters:

<PrecAntScheme> NONE | TXD

*RST: NONE

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "Precoding Scheme" on page 110
See "Precoding Scheme" on page 114

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:NOLayers?

Queries the number of layers for the selected allocation.

Return values:

<NoLayers> integer

Range: 1 to 2
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Number of Layers" on page 110
See "Number of Layers" on page 114

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:STATe <ScramblingState>

Enables scrambling.

Parameters:

<ScramblingState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "Scrambling State" on page 114

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:SROT <SymbolRotation>

Enables NPBCH scrambling with symbol rotation.

Parameters:

<SymbolRotation> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NPBCH and SIB1-NB configuration" on page 386.

Manual operation: See "NPBCH Symbol Rotation" on page 110

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:UEID?

Queries the user equipment identifier (n_RNTI) or UE ID of the user to which the NPDSCH transmission is intended.

Return values:

<UEIDnRNTI> integer

Range: 0 to 65535
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "UE ID/n_RNTI" on page 114

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:LEGacy:STATe <ScramState>

If disabled, scrambling according to LTE Rel. 14 is applied.

Parameters:

<ScramState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Options: R&S SMW-K143

Manual operation: See "Legacy Scrambling" on page 115

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:STATe <ChanCodState>

Enables channel coding.

Parameters:

<ChanCodState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "Channel Coding State" on page 111
See "Channel Coding State" on page 115

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:ISF?

Queries the resource assignment field (I_{SF}).

Return values:

<RAssinField> integer

Range: 0 to 100
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Resource Assignment Field (I_{SF})" on page 116

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:NSF?

Queries the number of NPDSCH subframes (N_{SF}).

Return values:

<NumSF> integer

Range: 1 to 100
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Usage: Query only

Manual operation: See "Number of NPDSCH Subframes (N_{SF})" on page 116

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:TBSI <TBSindex>

Sets the transport block size index.

Parameters:

<TBSindex> integer

Range: 0 to 15
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 382.

Manual operation: See "Transport Block Size Index (I_{TBS})" on page 116

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:TBSize?

Queries the size of the transport block/payload in bits.

Return values:

<TranBlckSize> integer

Range: 16 to 1500
*RST: 16

Example: See Example"NPBCH and SIB1-NB configuration" on page 386.

Usage: Query only

Manual operation: See "Transport Block Size/Payload (DL)" on page 113
See "Transport Block Size/Payload (DL)" on page 116

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:MIB <MibState>

Enables transmission of MIB data.

Parameters:

<MibState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NPBCH and SIB1-NB configuration" on page 386.

Manual operation: See "MIB (including SFN)" on page 111

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:MSPare <MibSpareBits>

Sets the 11 spare bits in the NPBCH transmission.

Parameters:

<MibSpareBits> 11-bits

Example: See Example"NPBCH and SIB1-NB configuration" on page 386.

Manual operation: See "MIB Spare Bits" on page 113

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:NCID?

Queries the NCell ID.

Return values:

<NCellId> integer

Range: 0 to 503

Example: See Example"NPBCH and SIB1-NB configuration" on page 386.

Usage: Query only

Manual operation: See "NCell ID" on page 112

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:RSIB?

Queries the number of repetitions of the NDPSCH that carries SIB1-NB.

Return values:

<RepetitionSIB1> integer

Range: 0 to 16
*RST: 0

Example: See Example"NPBCH and SIB1-NB configuration" on page 386.

Usage: Query only

Manual operation: See "NPDSCH repetition carrying SIB1" on page 112

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:SIB <SchedulingSIB1>

Sets the parameter scheduling info SIB1.

Parameters:

<SchedulingSIB1> integer

Range: 0 to 15
*RST: 0

Example: See Example"NPBCH and SIB1-NB configuration" on page 386.

Manual operation: See "Scheduling SIB1" on page 111

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:SOFFset <SfnOffset>

Sets the start SFN value.

Parameters:

<SfnOffset> float

Range: 0 to 1020
Increment: 4
*RST: 0

Example: See Example"NPBCH and SIB1-NB configuration" on page 386.

Manual operation: See "SFN Offset" on page 111

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:STFSib1?

Queries the first frame in that the NPDSCH transmission carrying SIB1-NB is allocated.

Return values:

<SIB1StartFrame> integer

Range: 0 to 11
*RST: 0

Example: See Example"NPBCH and SIB1-NB configuration" on page 386.

Usage: Query only

Manual operation: See "Starting Frame carrying SIB1" on page 112

9.4.4 eMTC DCI configuration

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:NALLoc <DciNumberAlloc>

Sets the number of configurable DCIs.

Parameters:

<DciNumberAlloc> integer

Range: 0 to 400
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "Number of DCI Allocations" on page 131

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:AWARound <AllocWrapAround>

If enabled, the PDSCH allocations are relocated at the beginning of the ARB sequence to ensure a consistent signal.

Parameters:

<AllocWrapAround> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:DL:EMTC:DCI:AWARound 1`

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:USER <DciUser>

Selects the user the DCI is dedicated to.

Parameters:

<DciUser> USER1 | USER2 | USER3 | USER4 | PRNTi | RARNti

USER1|USER2|USER3|USER4
Available are only eMTC users (`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:RELease` `EM_A|EM_B`).

PRNTi|RARNti
Selects a group of users.

*RST: USER1

Example: See Example"DCI format 6-2 configuration" on page 397.

Manual operation: See "User" on page 131

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:UEID?

Queries the UE_ID of the selected user or the n_RNTI for the selected DCI.

Return values:

<DciUeID> integer

Range: 0 to 65535
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "UE_ID/n_RNTI" on page 131

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MPDCchset <DciMpdcchSet>

Selects the MPDCCH set by which the DCI is carried.

Parameters:

<DciMpdcchSet> MPD1 | MPD2

*RST: MPD1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "MPDCCH Set" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:FMT <DciFormat>

Sets the DCI format for the selected allocation.

Parameters:

<DciFormat> F3 | F3A | F60A | F60B | F61A | F61B | F62

*RST: F60A

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "DCI Format" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SSP <DciSearchSpace>

Sets the search space for the selected DCI.

Parameters:

<DciSearchSpace> UE | T1CM | T2CM | T0CM

*RST: UE

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "Search Space" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:STSFrame <DciStartSf>

Sets the next valid starting subframe for the particular MPDCCH.

Parameters:

<DciStartSf> integer

Range: 1 to 1E6

*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "Start Sufbrame" on page 140

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PDCCh <DciPdcchFmt>

Selects one of the five MPDCCH formats

Parameters:

<DciPdcchFmt> 0 | 1 | 2 | 3 | 4 | 5

The available values depend on the search space.

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "MPDCCH Format" on page 141

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CCES?

Queries the number of consecutive control channel elements (ECCE) on that MPDCCH is transmitted.

Return values:

<DciNumCCEs> integer

Range: 1 to 24
*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Number ECCEs" on page 141

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:IDCCe <DciCCEIndex>

For UE-specific search space, sets the ECCE start index.

Parameters:

<DciCCEIndex> integer

Range: 0 to 24
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "ECCE Index" on page 141

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:BITS?

Queries the resulting bit data as selected with the DCI format parameters.

Return values:

<DciBitData> string

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Bit Data" on page 133

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NDCCes?

Queries the number of dummy ECCEs that are appended to the corresponding MPDCCH.

Return values:

<NoDummyCCEs> integer

Range: 0 to 1E5
*RST: 25

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "No. Dummy ECCEs" on page 141

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CONFlict?

Queries whether a conflict between allocations occurs.

Return values:
<Conflict> 1 | ON | 0 | OFF
*RST: 0

Example:
```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc2:CONFlict?
// 0
```

Usage: Query only

Manual operation: See "Conflict" on page 141

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TBS?

Queries the resulting transport block size.

Return values:
<DciTranBlkSize> integer
Range: 0 to 2000
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Transport Block Size" on page 140

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:REPMpdcch?

Queries the resulting number of MPDCCH repetitions.

Return values:
<DciRepMPDCCH> integer
Range: 1 to 256
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Repetitions of MPDCCH" on page 140

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:REPPdsch?

Queries the resulting number of PDSCH repetitions.

Return values:
<DciRepPDSCH> integer

Range: 1 to 2048
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Repetitions of PDSCH" on page 140

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PDSHopping?

Queries if PDSCH hopping is enabled or not.

Return values:
<DciPDSCHHopping> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "PDSCH Hopping" on page 140

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:STRV?

Queries the starting redundancy version (RV).

Return values:
<DciStartingRV> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Starting Redundancy Version" on page 140

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TCMD <TpcCmd3>

Sets the TCP command field of the DCI format 3/3A.

Parameters:
<TpcCmd3> 64 bits

Example:
```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F3
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:TCMD #H0,64
```

Manual operation: See "DCI Format 3/3A" on page 133

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PFRHopp <DciPuschFreqHop>

Sets the DCI format 6-0A and 6-1A filed frequency hopping flag that applies to PUSCH and PDSCH respectively.

Parameters:

<DciPuschFreqHop> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBAF?

If `[:SOURce<hw>]:BB:EUTRa:DL:BW` on page 406 `BW20_00` and `[:SOURce<hw>]:BB:EUTRa:DL:EMTC:WBCFg` on page 407 `BW20` sets the DCI format 6-1A field resource block assignment index.

Return values:

<DciPuschRBAF> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc1:RBAF 1`

Usage: Query only

Options: R&S SMW-K143

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBA <DciRBA>

Sets the DCI filed resource block assignment.

Parameters:

<DciRBA> integer

Range: 0 to depends on the installed options*
*RST: 0
max = 2047 (R&S SMW-K115)
max = 4095 (R&S SMW-K143)

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MCS <DciMCS>

Sets the DCI field modulation and coding scheme.

Parameters:

<DciMCS> integer

Range: 0 to 15
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NREP <DciRepNum>

Sets the DCI field repetition number.

Parameters:

<DciRepNum> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:HARQ <DciHarqProcNum>

Sets the DCI field HARQ process number.

Parameters:

<DciHarqProcNum> integer

In FDD mode: 0 to 7
In TDD mode: 0 to 15

Range: 0 to 15
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NDINd <DciNewDataInd>

Sets the DCI field new data indicator.

Parameters:

<DciNewDataInd> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RVER <DciRedVersion>

Sets the DCI field redundancy version.

Parameters:

<DciRedVersion> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TPCPusch <DciTpcCmdPusch>

Sets the DCI field TPC command for scheduled PUSCH.

Parameters:

<DciTpcCmdPusch> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:ULINdex <DciUlIndex>

In TDD mode and if UL/DL Configuration 0 is used, sets the DCI field UL index.

Parameters:

<DciUlIndex> integer

Range: 0 to 3
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce1:BB:EUTRa:TDD:UDConf 0
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F60A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:ULINdex 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:DAINdex 1
```

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:DAINdex <DLAssignIndex>

In TDD mode and if UL/DL Configuration 0 is used, sets the DCI field downlink assignment index (DAI).

Parameters:

<DLAssignIndex> integer

Range: 0 to 3
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:ULINdex on page 463.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CSIRequest <DciCSIRequest>

Sets the DCI field CSI request.

Parameters:

<DciCSIRequest> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SRSRequest <DciSRSRequest>

Sets the DCI field SRS request.

Parameters:

<DciSRSRequest> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SFRNumber <DciSfRepNumber>

If `[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:REPMpdcch` ≥ `2`, sets the DCI field DCI subframe repetition number.

Parameters:

<DciSfRepNumber> integer

Range: 0 to 3

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:UEMode <UEMode>

Sets the DCI field mode and defines if the DCI format 6-1A/B is used for PDSCH or PRACH.

Parameters:

<UEMode> STD | PRACh

*RST: STD

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:HRESoffset <DciHarqResOffs>

Sets the DCI field HARQ-ACK ressource offset.

Parameters:

<DciHarqResOffs> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:APSI <DciAPsSI>

For users working in transmission mode TM9 and if UE-specific search space is used, sets the DCI format 6-1A field antenna ports and scrambling identity.

Parameters:

<DciAPsSI> integer

Range: 0 to 3
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:USER1:TXM TM9
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F61A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:APSI 1
```

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PMIConfirm <DciPmiConfirm>

Sets the DCI field PMI confirmation for precoding.

Parameters:

<DciPmiConfirm> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TPMPrec <DciTpmiPrec>

Sets the DCI field TPMI information for precoding.

Parameters:

<DciTpmiPrec> integer

Range: 0 to 15
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAPreamble <DciPrachPreambl>

Sets the DCI field preamble index.

Parameters:

<DciPrachPreambl> integer

Range: 0 to 63
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F61A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:UEMode PRACh
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:RBA 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PRAPreamble 8
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PRAMask 5
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PRAStart 1
```

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAMask <DciPrachMaskIdx>

Sets the DCI field PRACH mask index.

Parameters:

<DciPrachMaskIdx> integer

Range: 0 to 15
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAPreamble on page 466.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAStart <DciPrachStartCe>

Sets the DCI field starting CE level.

Parameters:

<DciPrachStartCe> integer

Range: 0 to 3
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAPreamble on page 466.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PAGNg <DciPaging>

Sets the DCI bit that defines if the DCI format 6-2 is used for paging or for direct indication.

Parameters:

<DciPaging> 1 | ON | 0 | OFF

*RST: 0

Firmware/software: See Example"DCI format 6-2 configuration" on page 397.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:DIINfo <DciDiInfo>

Sets the DCI field direct indication information.

Parameters:

<DciDiInfo> integer

Range: 0 to 255
*RST: 0

Example: SeeExample"DCI format 6-2 configuration" on page 397 .

9.4.5 eMTC allocations

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NALLoc?

Queries the number of automatically configured allocations.

Return values:

<NoAlloc> integer

Range: 0 to 100
*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CONType?

Queries the channel type.

Return values:

<ContentType> MPD1 | MPD2 | PSIB | PDSCh | PBCH

*RST: PDSCh

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Content Type" on page 142

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:MODulation?

Queries the used modulation scheme.

Return values:

<Modulation> QAM16 | QPSK

*RST: QPSK

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Modulation" on page 143

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STSFrame?

Queries the first subframe where the channel can be allocated.

Return values:

<StartSf> integer

Range: 0 to 39
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Start SF" on page 143

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:ABSFrames?

Queries the number of absolute subframes.

Return values:

<NumAbsSf> integer

Range: 0 to 39
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Num. Abs. SF" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STNB?

Queries the first narrowband where the channel can be allocated.

Return values:

<StartNarrowBand> integer

Range: 0 to 15
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Start NB" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STSYmbol?

Queries the first symbol where the channel can be allocated.

Return values:

<StartSymbol> 1 | 2 | 3 | 4

*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Start Symbol" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:NORB?

Queries the number of resource blocks the allocation spans.

Return values:

<NumberResBlk> integer

Range: 1 to 6
*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "No. RB" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:OVRB?

Queries the start resource block of the selected allocation.

Return values:

<OffsetVRB> integer

Range: 0 to 5
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Offset VRB" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PHYSbits?

Queries the allocation size in bits.

Return values:

<PhysBits> integer

Range: 0 to 4032
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Phys. Bits" on page 144
See "Number of Physical Bits" on page 148
See "Number of Physical Bits" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:DATA <DataSource>

Queries the data source or sets the data source for the following allocations:

- PBCH if MIB is disabled
- PDSCH SIB1-BR allocation
- PDSCH allocations configured for P-RNTI or RA-RNTI.

Parameters:

<DataSource> USER1 | USER2 | USER3 | USER4 | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE | MIB | PRNTi | RARNti | SIBBr

*RST: MIB

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "Data Source" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:DSELect <DataList>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<DataList> string

Filename incl. file extension or complete file path

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:DATA DLIS
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:DSELect "/var/user/IoT.dm_iqd"
```

Manual operation: See "Data Source" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PATTern <Pattern>, <BitCount>

Sets a bit pattern as data source.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example:

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:DATA PATT
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PATTern #H735,12
```

Manual operation: See "Data Source" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:POWer <Power>

Sets the power of the selected allocation.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.01
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "ρ A" on page 145

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STATe?

Queries whether the allocation is activated.

Return values:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "State" on page 145

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CONFlict?

Queries if there is a conflict between the allocations.

Return values:

<Conflict> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Conflict" on page 145

9.4.6 PBCH and PDSCH enhanced settings

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:SCHeme <PrecMultAntSche>

Selects the precoding scheme.

Parameters:

<PrecMultAntSche> NONE | SPM | TXD | BF

*RST: NONE

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "Precoding Scheme" on page 147
See "Precoding Scheme" on page 150

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CODWords?

Queries the number of the codewords.

Return values:

<CodeWord> CW11 | CW12

*RST: CW11

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:TRSCheme?` on page 474.

Usage: Query only

Manual operation: See "Codeword" on page 151

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:NOLayers?

Queries the number of layers for the selected allocation.

Return values:

<PrecLayCnt> integer

Range: 1 to 2
*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Number of Layers" on page 147
See "Number of Layers" on page 151

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:CCD <CycDelDiv>

Sets the cyclic delay diversity for the selected allocation.

Parameters:

<CycDelDiv> NOCDd | LADelay

*RST: NOCDd

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "Cyclic Delay Diversity" on page 151

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:CBINdex <PrecCodeBookIdx>

Sets the codebook index.

Parameters:

<PrecCodeBookIdx> integer

Range: 0 to 15
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "Codebook Index" on page 151

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:TRSCheme?

Queries the transmsission scheme.

Return values:

<TranScheme> TM9

*RST: TM9

Example:

```
// Transmission antennas and antenna port mapping
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1

SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:DL:USER4:RELease EM_A
SOURce1:BB:EUTRa:DL:USER4:UEC?
// M1
SOURce1:BB:EUTRa:DL:USER4:CELL0:TXM M9

SOURce1:BB:EUTRa:DL:EMTC:DCI:NALLoc 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER USER4
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F61A

SOURce1:BB:EUTRa:DL:EMTC:NALLoc?
// 4
// PDSCH allocation not carrying SIB-BR is the fourth allocation
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CONType?
// PDSC

SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:SCHeme?
// BF
// because User 1 uses Tx mode TM9
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:TRSCheme?
// TM9
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CODWords?
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:NOLayers?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:AP?
// AP7
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:SCID?
// 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:APM?
// FW
```

Usage: Query only

Manual operation: See "Transmission Scheme" on page 151

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP?

Queries the used antenna ports.

Return values:

<AntPorts> AP7 | AP5 | AP8 | AP78 | AP79 | AP710 | AP711 | AP712 | AP713 | AP714 | AP107 | AP108 | AP109 | AP110 | AP107108 | AP107109

*RST: AP7

Example: See [:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:TRSCheme? on page 474.

Usage: Query only

Manual operation: See "Antenna Ports" on page 151

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:SCID?

Queries the scrambling identity.

Return values:

<ScramIdent> integer

Range: 0 to 1
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Scrambling Identity n_SCID" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:APM?

Queries the antenna port mapping method.

Return values:

<AntPortMap> CB | RCB | FW

`CB` = codebook
`RCB` = random codebook
`FW` = fixed weights

*RST: CB

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:TRSCheme?` on page 474.

Usage: Query only

Manual operation: See "Antenna Port Mapping" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:DAFormat <CoordMapMode>

Switches between the cartesian and cylindrical coordinates representation.

Parameters:

<CoordMapMode> CARTesian | CYLindrical

*RST: CARTesian

Manual operation: See "Mapping Coordinates" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP<dir0>:BB<st0>:REAL?

Defines the mapping of the antenna ports to the physical antennas.

Suffix:

<dir0> 5 | 7 to 14
antenna port

<st0> 0 to 3
available basebands

Return values:

<DataReal> float

The REAL (Magnitude) and IMAGinary (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows:
|REAL+j*IMAGinary| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 1
Increment: 0.001
*RST: 0

Usage: Query only

Manual operation: See "Mapping Table" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP<dir0>:BB<st0>:IMAGinary?

Defines the mapping of the antenna ports to the physical antennas.

Suffix:

<dir0> 5 | 7 to 14
antenna port

<st0> 0 to 3
available basebands

Return values:

<DataImag> float

The REAL (Magnitude) and IMAGinary (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows:
|REAL+j*IMAGinary| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 360
Increment: 0.001
*RST: 0

Usage: Query only

Manual operation: See "Mapping Table" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:STATe <ScramState>

Enables scrambling.

Parameters:

<ScramState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "Scrambling Configuration" on page 71
See "Scrambling State" on page 147
See "Scrambling State" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:UEID?

Queries the user equipment identifier (n_RNTI) or UE ID of the user to which the PDSCH transmission is intended.

Return values:

<UEID> integer

Range: 0 to 65535
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "UE ID/n_RNTI" on page 147
See "UE ID/n_RNTI" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:STATe <ChanCodState>

Enables channel coding.

Parameters:

<ChanCodState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "Channel Coding State" on page 147
See "Channel Coding State" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:TBSize?

Queries the size of the transport block/payload in bits.

Return values:

<ChanCodTranBlck> integer

Range: 34 to 1E4
*RST: 16

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Usage: Query only

Manual operation: See "Transport Block Size/Payload (DL)" on page 149
See "Transport Block Size/Payload (DL)" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:TBSI <ChanCodTBSIndex>

Queries the resulting transport block size index.

Parameters:

<ChanCodTBSIndex> integer

Range: 34 to 34
*RST: 34

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 393.

Manual operation: See "Transport Block Size I_{TBS}" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:MIB <ChanCodMibState>

Enables transmission of real MIB (master information block) data.

Parameters:

<ChanCodMibState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"PBCH and SIB1-BR configuration" on page 395.

Manual operation: See "MIB (including SFN)" on page 148

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SIB <SchedulingSIB1>

Sets the parameter `schedulingInfoSIB1-RB` and defines the PDSCH number of repetitions.

Query the resulting number of repetitions with the command `[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:RSIB?`.

Parameters:
<SchedulingSIB1> integer

Range: 0 to 18
*RST: 0

Example: See Example"PBCH and SIB1-BR configuration" on page 395.

Manual operation: See "Scheduling Info SIB1-RB" on page 149

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:RSIB?

Queries the number of PDSCH repetitions N_{Rep}^{PDSCH}, as defined with the command `[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SIB`.

Return values:
<PDSCHRepSIB1> integer

Range: 0 to 11
*RST: 0

Example: See Example"PBCH and SIB1-BR configuration" on page 395.

Usage: Query only

Manual operation: See "PDSCH Repetitions SIB1-RB" on page 149

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:MSPare <MibSpareBits>

Sets the spare bits in the PBCH transmission.

Parameters:
<MibSpareBits> 5 bits

Example: See Example"PBCH and SIB1-BR configuration" on page 395.

Manual operation: See "MIB Spare Bits" on page 149

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SOFFset <ChanCodSfnOffse>

Sets the start SFN value.

Parameters:
<ChanCodSfnOffse> float

Range: 0 to 1020
Increment: 4
*RST: 0

Example: See Example"PBCH and SIB1-BR configuration" on page 395.

Manual operation: See "SFN Offset" on page 148

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SRPeriod <SfnRestPeriod>

Determines the time span after which the SFN (System Frame Number) restarts.

Parameters:

<SfnRestPeriod> PERSlength | PER3gpp

`PER3gpp` = "3GPP (1024 Frames)"

`PERSlength` = SFN restart period to the ARB sequence length

*RST: PERSlength

Example: See Example"PBCH and SIB1-BR configuration" on page 395.

Options: R&S SMW-K84

Manual operation: See "SFN Restart Period" on page 148

9.4.7 MPDCCH configuration

Example: Configuring the MPDCCH sets

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:STDMode IOT

// enable an eMTC UE, e.g. supporting eMTC CE Mode A
SOURce1:BB:EUTRa:DL:USER1:RELease EM_A

SOURce1:BB:EUTRa:DL:USER1:EPDCch1:STATe 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET1:STATe 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET2:STATe 1

SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:TTYP LOC
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:PRBS PRB2
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:RBA 2
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:NID 22
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:POWer 0
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:HOPPing 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STNB 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:REPMpdcch 16
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STSF S1

// MPDCCH allocations are configured automatically,
// depending on the eMTC DCI configuration
```

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:STATe <State>

Enables the EPDCCH transmission for the select user and component carrier.

Suffix:

<dir> 1|2
EPDCCH set

Parameters:

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

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "Activate EPDCCH" on page 128

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STATe <State>

Enables the EPDCCH set.

Suffix:

<dir> 1|2
EPDCCH set

Parameters:

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

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "Set 1/2 State" on page 128

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:TTYP <TransType>

Select the EPDCCH transmission type.

Suffix:

<dir> 1|2
EPDCCH set

Parameters:

<TransType> LOCalized | DISTributed

*RST: LOCalized

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "Transmission Type" on page 128

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:PRBS <NumPRBs>

Sets the number of used physical resource block (PRB) pairs.

Suffix:

<dir> 1|2
EPDCCH set

Parameters:

<NumPRBs> PRB2 | PRB4 | PRB8

*RST: PRB2

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "Number of PRB Pairs" on page 129

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:RBA <RBA>

Defines the resource blocks used for the EPDCCH transmission.

Suffix:

<dir> 1|2
EPDCCH set

Parameters:

<RBA> integer

Range: 0 to 1000
*RST: 0

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "Resource Block Assignment" on page 129

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:NID <EpdcchId>

Sets the identifier $n^{EPDCCH}_{ID,m}$ used to calculate the UE-specific scrambling sequence.

Suffix:

<dir> 1|2
EPDCCH set

Parameters:

<EpdcchId> integer

Range: 0 to 503
*RST: 0

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "N^EPDCCH_ID" on page 129

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:POWer <RelPower>

Sets the power of the EPDCCH allocations relative to the power of the reference signals.

See `[:SOURce<hw>]:BB:EUTRa:DL:REFSig:POWer` on page 415.

Suffix:

<dir> 1|2
EPDCCH set

Parameters:

<RelPower> float

Range: -80 to 10
Increment: 0.01
*RST: 0

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "Relative EPDCCH Power" on page 129

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:HOPPing <Hopping>

Enables MPDCCH hopping.

Parameters:

<Hopping> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "Hopping" on page 129

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:REPMpdcch <MaxRepMPDCCH>

Sets the maximum number the MPDCCH is repeated.

Parameters:

<MaxRepMPDCCH> 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256

*RST: 1

Example: See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "Max. Repetitions MPDCCH (Rmax)" on page 129

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STNB <StartingNB>

Sets the first narrowbands in which MPDCCH is allocated.

Parameters:

<StartingNB> integer

Range: 0 to 15
*RST: 0

Example: See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "Starting NB" on page 129

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STSF <SearchSpStartSf>

Sets the first subframe of the search space.

Parameters:

<SearchSpStartSf> S1 | S1_5 | S2 | S2_5 | S5 | S8 | S10 | S20 | S4

*RST: S1

Example: See Example"Configuring the MPDCCH sets" on page 392.

Manual operation: See "Search Space Start Subframe" on page 130

9.5 User configuration

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:RELease <Release>

Sets the 3GPP release version the UE supports.

Parameters:

<Release> R89 | EM_A | NIOT | EM_B

*RST: R89 (in LTE/eMTC/NB-IoT mode)/ EM_A (in eMTC/NB-IoT mode)

`EM_A` = eMTC CE: A and `EM_B` = eMTC CE: B

Options: R89 requires R&S SMW-K55
EM_A|NIOT|EM_B require R&S SMW-K115

Manual operation: See "3GPP Release" on page 70

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:OCID:STATe <OverrideCellID>

if enabled, you can set an user-defined cell ID for the selected user.

Parameters:

<OverrideCellID> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:CA:STATe 0
SOURce1:BB:EUTRa:UL:PLCI:CID 20

SOURce1:BB:EUTRa:UL:UE1:OCID:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CID 10
```

Manual operation: See "Override Cell ID" on page 169

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CID <ULUECELLID>

Sets the UE-specific cell ID.

Parameters:

<ULUECELLID> integer

Range: 0 to 503
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:UL:UE<st>:OCID:STATe on page 486.

Manual operation: See "Cell ID" on page 169

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:STHP:STATe <State>

Sets if NB-IoT UEs are capable of understanding the HARQ process bit.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"DCI format N0 configuration" on page 381.

Options: R&S SMW-K115
1|ON requires R&S SMW-K143

Manual operation: See "Support two HARQ Processes" on page 72

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:RMAX <MaxRepNPDCCH>

Sets the maximum number NPDCCH is repeated R_{Max}.

Parameters:

<MaxRepNPDCCH> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128 | R256 | R512 | R1024 | R2048

*RST: R1

Example: See Example"NB-IoT UE configuration" on page 380.

Manual operation: See "Max. Repetitions of NPDCCH (Rmax) (UE-specific search space)" on page 90

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:STSFrame <SearchSpStartSF>

Sets the serach space start subframe (G).

Parameters:

<SearchSpStartSF> S1_5 | S2 | S4 | S8 | S16 | S32 | S48 | S64

*RST: S4

Example: See Example"NB-IoT UE configuration" on page 380.

Manual operation: See "Search Space Start Subframe (G)" on page 90

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:SSOFfset <SearchSpaceOffs>

Shifts the search space start.

Parameters:

<SearchSpaceOffs> O0 | O1_8 | O1_4 | O3_8

*RST: O0

Example: See Example"NB-IoT UE configuration" on page 380.

Manual operation: See "Search Space Offset ($α_{offset}$)" on page 90

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:TXM <TxMode>

Sets the transmission mode of the according user as defined in TS 36.213.

Parameters:

<TxMode> USER | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M10

*RST: USER

Option:R&S SMW-K115

<TxMode> = USER|M1|M2|M6|M9

Example: `SOURce1:BB:EUTRa:DL:USER1:TXM M6`

Options: M10 requires R&S SMW-K112

Manual operation: See "Tx Modes" on page 70

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEC <UECategory>

Sets the UE Category.

Parameters:

<UECategory> USER | M1 | NB1 | M2 | NB2

*RST: USER

Options: M1|NB1 require R&S SMW-K115

M2|NB2 require R&S SMW-K143

Manual operation: See "UE Category" on page 70

[: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 71

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:STATe <State>

Enables/disables scrambling for all allocations belonging to the selected user.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: ON

Example:

```
SOUR:BB:EUTR:DL:USER3:SCR:STAT OFF
// Disables scrambling for allocations belonging to user 3
```

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CCODing:STATe <State>

Sets the channel coding for all allocations belonging to the selected user.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example:

```
BB:EUTR:DL:USER2:CCOD:STAT ON
```

Enables channel coding for the allocations belonging to user 2.

Manual operation: See "Channel Coding State" on page 71

[: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:

```
SOURce1:BB:EUTRa:USER0:DATA PN23
// file lte_datalist.dm_iqd must exsist in the default directory
SOURce1:BB:EUTRa:USER2:DATA DLISt
SOURce1:BB:EUTRa:USER2:LIST "/var/user/lte_datalist.dm_iqd"
SOURce1:BB:EUTRa:USER4:DATA PATTern
SOURce1:BB:EUTRa:USER4:PATTern #H1C4A9,17
```

Manual operation: See "Data Source, DList/Pattern" on page 71

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DSELect <DSelect>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<DSelect> string

File name incl. file extension or complete file path

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DATA on page 489.

Manual operation: See "Data Source, DList/Pattern" on page 71

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:PATTern <Pattern>, <BitCount>

Sets a bit pattern as data source.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DATA on page 489.

Manual operation: See "Data Source, DList/Pattern" on page 71

[:SOURce<hw>]:BB:EUTRa:DL:BUR <Bur>

In "Mode > eMTC/NB-IoT", unused resource elements are filled in with DTX.

Parameters:

<Bur> DUData | DTX

*RST: DUData

Manual operation: See "Behavior In Unscheduled REs (OCNG)" on page 70

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:MODE <AntPortMap>

Defines the antenna port mapping method.

Parameters:

<AntPortMap> CB | RCB | FW

CB
Codebook

RCB
Random codebook

FW
Fixed weight

*RST: FW

Manual operation: See "Antenna Port Mapping" on page 159

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBCI <CbConstIdx>

Defines whether the codebook index is set globally or per subframe.

Parameters:

<CbConstIdx> 1 | ON | 0 | OFF

Manual operation: See "Constant Codebook Index" on page 159

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBINdex[<dir>] <CodeBookIndex>

Sets the codebook index for mapping mode Codebook.

Parameters:

<CodeBookIndex> integer

Range: 0 to 15
*RST: 0

Manual operation: See "Codebook Index" on page 159

[: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 SMW-K84

Manual operation: See "Mapping Coordinates" on page 160

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM[:LAYer<user>]:AP<dir0>:BB<st0>:REAL <AntPortMapData>

Defines the mapping of the antenna ports to the physical antennas.

Suffix:

<user> 0 to 7
layer

<dir0> 5 | 7 to 14
antenna port

<st0> 0 to 3
available basebands

Parameters:

<AntPortMapData> float

The `REAL` (Magnitude) and `IMAGinary` (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows:
|`REAL`+j*`IMAGinary`| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 360
Increment: 0.001
*RST: dynamic

Manual operation: See "Mapping table" on page 160

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM[:LAYer<user>]:AP<dir0>:BB<st0>:IMAGinary <AntPortMapData>

Defines the mapping of the antenna ports to the physical antennas.

Suffix:

<user> 0 to 7
layer

<dir0> 5 | 7 to 14
antenna port

<st0> 0 to 3
available basebands

Parameters:

<AntPortMapData> float

The `REAL` (Magnitude) and `IMAGinary` (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows:
|`REAL`+j*`IMAGinary`| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 360
Increment: 0.001
*RST: 0

Manual operation: See "Mapping table" on page 160

9.6 General uplink

[:SOURce<hw>]:BB:EUTRa:UL:BW <BandWidth>

Sets the UL channel bandwidth.

Parameters:

<BandWidth> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00 | BW0_20

*RST: BW10_00

Example: `SOURce:BB:EUTRa:UL:BW BW20_00`

Options: BW0_20 requires R&S SMW-K115

Manual operation: See "Channel Bandwidth" on page 162

[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NNBands?

Queries the number of eMTC narrowbands N_{RB}^{UL} available within the selected channel bandwidth.

Return values:

<NumNarrowbands> integer

Range: 0 to 18
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Usage: Query only

Manual operation: See "Number of eMTC Narrowbands" on page 163

[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NWBands?

Queries the number of widebands.

Return values:

<NumWideBands> integer

Range: 0 to 4
*RST: 1

Example: See Example"eMTC widebands configuration" on page 391.

Usage: Query only

Options: R&S SMW-K143

Manual operation: See "Number of eMTC Widebands" on page 163

[:SOURce<hw>]:BB:EUTRa:UL:EMTC:WBCFg <WBConfig>

If enabled, the available channel bandwidth is split into eMTC widebands.

Parameters:

<WBConfig> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"eMTC widebands configuration" on page 391.

Options: R&S SMW-K143

Manual operation: See "Wideband Config" on page 164

[:SOURce<hw>]:BB:EUTRa:UL:EMTC:RSYMbol <RetuningSymbol>

Sets the number of retuning symbols.

Parameters:

<RetuningSymbol> integer

Range: 0 to 2
*RST: 2

Example: See Example"eMTC widebands configuration" on page 391.

Options: R&S SMW-K143

Manual operation: See "Retuning Symbols" on page 167

[:SOURce<hw>]:BB:EUTRa:UL:NIOT:SUBConfig <SfConfig>

Sets the number of subframes in the bitmap.

Parameters:

<SfConfig> N10 | N40

*RST: N10

Options: R&S SMW-K146

Manual operation: See "NB-IoT Bitmap Subframes" on page 167

[:SOURce<hw>]:BB:EUTRa:UL:NIOT:VALid:SUBFrame<dir> <ValidSubframe>
[:SOURce<hw>]:BB:EUTRa:UL:EMTC:VALid:SUBFrame<dir> <ValidSubFrames>

Sets a subframe as valid and used for eMTC transmission.

Suffix:

<dir> 0 to 9
Subframe number

Parameters:

<ValidSubFrames> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Valid Subframes" on page 167

[: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" on page 163

[: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" on page 164

[: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" on page 163

[: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" on page 164

[: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" on page 164

[: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/Right Guard Subcarriers" on page 66

[: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: 35 to 601
*RST: 211

Example: `BB:EUTR:UL:RGS?`
Queries the number of right guard subcarriers.

Usage: Query only

Manual operation: See "Number of Left/Right Guard Subcarriers" on page 66

[: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" on page 165

[: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" on page 166

[: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" on page 166

[:SOURce<hw>]:BB:EUTRa:UL:CPC <CyclicPrefix>

Sets the cyclic prefix length for all subframes.

Parameters:
<CyclicPrefix> NORMal | EXTended
*RST: NORMal

Example: `SOURce1:BB:EUTRa:UL:CPC NORM`

Manual operation: See "Cyclic Prefix" on page 166

[: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 68

[: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 166

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:GRPHopping <GroupHopping>

Enables/disables group hopping for the uplink reference signals demodulation reference signal (DMRS) and sounding reference signal (SRS).

Parameters:
<GroupHopping> 1 | ON | 0 | OFF
*RST: 0

Example: `BB:EUTR:UL:REFS:GRPH ON`
Enables group hopping

Manual operation: See "Group Hopping" on page 220

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SEQHopping <SequenceHopping>

Enables/disables sequence hopping for the uplink reference signals demodulation reference signal (DMRS) and sounding reference signal (SRS).

Parameters:

<SequenceHopping> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:UL:REFS:SEQH ON`

Enables sequence hopping

Manual operation: See "Sequence Hopping" on page 221

[: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 221

[: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 221

[: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 222

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:TSFC?

Queries the value for the cell-specific parameter configuration period T_{SFC} in subframes, 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 222

[: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 222

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:DSFC?

Queries the value for the cell-specific parameter transmission offset $Delta_{SFC}$ in subframes, depending on the selected SRS subframe configuration ([:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:CSRS) and the dduplexing 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 222

[: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> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:UL:REFS:SRS:ANST ON`

Manual operation: See "A/N + SRS simultaneous Tx" on page 223

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:MUPTs <MaxUpPts>

Enables/disables the cell-specific parameter srsMaxUpPts.

Parameters:

<MaxUpPts> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:UL:REFS:SRS:MUPT ON`

Manual operation: See "SRS MaxUpPTS" on page 223

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:GHOPping <GroupHopping>

Enables NDRS group hopping.

Parameters:

<GroupHopping> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Group Hopping" on page 185

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:DSEQshift <DeltaSeqShift>

Sets the delta sequence shift for NPUSCH required for the calculation of the NDRS group hopping pattern.

Parameters:

<DeltaSeqShift> integer

Range: 0 to 29

*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Delta Sequence Shift for NPUSCH" on page 185

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TTCShift <ThreeToneCycShi>

Sets the three tone cyclic shift.

Parameters:
<ThreeToneCycShi> integer

Range: 0 to 2
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Three/Six-Tone Cyclic Shift" on page 185

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:STCShift <SixToneCycShift>

Sets the six tone cyclic shift.

Parameters:
<SixToneCycShift> integer

Range: 0 to 3
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Three/Six-Tone Cyclic Shift" on page 185

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:USEBase <UseBaseSequence>

Enables using base sequences for the generation of the NB-IoT DMRS sequence hopping pattern.

Parameters:
<UseBaseSequence> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Use Base Sequences" on page 185

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TTBSequence <ThreeToneBaseSq>

Sets the three tone base sequence.

Parameters:
<ThreeToneBaseSq> integer

Range: 0 to 12
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Three/Six/Twelve-Tone Base Sequence" on page 185

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:STBSequence <SixToneBaseSeq>

Sets the six tone base sequence.

Parameters:

<SixToneBaseSeq> integer

Range: 0 to 14
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Three/Six/Twelve-Tone Base Sequence" on page 185

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TWBSequence <TwelfeToneBaseS>

Sets the 12 tone base sequence.

Parameters:

<TwelfeToneBaseS> integer

Range: 0 to 30
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Three/Six/Twelve-Tone Base Sequence" on page 185

[: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

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:PFMT <PreambleFormat>

Select the preamble format.

Parameters:

<PreambleFormat> F0 | F1 | 0 | 1 | F2 | F0A | F1A

`0|1` backward compatibility; use `F0|F1` instead.

*RST: 0

Example: See Example"NPRACH configuration" on page 389.

Options: 2|0A|1A require R&S SMW-K146

Manual operation: See "Preamble Format" on page 188

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:PERD <Periodicity>

Sets NPRACH periodicity.

Parameters:

<Periodicity> 40 | 80 | 160 | 240 | 320 | 640 | 1280 | 2560 | 5120 | 10240

*RST: 40

Example: See Example"NPRACH configuration" on page 389.

Options: 5120|10240 require R&S SMW-K146

Manual operation: See "Periodicity, ms" on page 188

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:STTM <StartTime>

Sets the start time of the specific NPRACH configuration.

Parameters:

<StartTime> 8 | 16 | 64 | 128 | 32 | 256 | 512 | 1024 | 10 | 20 | 40 | 80 | 160 | 320 | 640 | 1280 | 2560 | 5120

*RST: 8

Example: See Example"NPRACH configuration" on page 389.

Options: 10|20|40|80|160|320|640|1280|2560|5120 require R&S SMW-K146

Manual operation: See "Starting Time, ms" on page 188

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:REP <Repetitions>

Queries the number of NPRACH repetitions per preamble attempt.

Parameters:

<Repetitions> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128 | R192 | R256 | R384 | R512 | R768 | R1024 | R1536 | R2048 | R12 | R24

*RST: R1

Example: See Example"NPRACH configuration" on page 389.

Options: R192|R256|R384|R512|R768|R1024|R1536|R2048|R12|R24 require R&S SMW-K146

Manual operation: See "Number of Repetitions" on page 189

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:SUBC <Subcarriers>

Sets the number of NPRACH subcarriers.

Parameters:

<Subcarriers> 12 | 24 | 36 | 48

*RST: 12

Example: See Example"NPRACH configuration" on page 389.

Manual operation: See "Number of Subcarriers" on page 189

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:SCOF <SubcarrierOffse>

Sets the NPRACH subcarrier offset.

Parameters:

<SubcarrierOffse> 0 | 2 | 12 | 18 | 24 | 34 | 36 | 6 | 42 | 48 | 54 | 60 | 72 | 78 | 84 | 90 | 102 | 108

*RST: 0

Example: See Example"NPRACH configuration" on page 389.

Options: 6|42|48|54|60|72|78|84|90|102|108 require R&S SMW-K146

Manual operation: See "Subcarrier Offset" on page 189

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:RSET <RestrictedSet>

Enables using the restricted set.

Parameters:

<RestrictedSet> URES | ARES | BRES | OFF | ON

URES|OFF
Unrestricted preamble set.

ARES|ON
Restricted set type A.

BRES
Restricted set type B.

*RST: URES

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Restricted Set" on page 212

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:HOFF <HoppingOffset>

Sets a PRACH hopping offset as number of resource blocks (RB).

Parameters:

<HoppingOffset> integer

Range: 1 to 110
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Hopping Offset" on page 212

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:CONFig <Config>

Selects the PRACH configuration index.

Parameters:

<Config> integer

Range: 0 to 63
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "PRACH Configuration" on page 212

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:HOPPing <Hopping>

Enables frequency hopping.

Parameters:

<Hopping> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Hopping" on page 213

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:REPetit <Repetitions>

Sets the PRACH number of repetitions.

Parameters:

<Repetitions> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128

*RST: R1

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Number of Repetitions" on page 213

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:FOFFset <FrequencyOffset>

Sets a frequency offset in terms of resource blocks.

Parameters:

<FrequencyOffset> integer

Range: 0 to 94
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Freq. Offsets" on page 213

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:SSFPeriod <StartSfPeriod>

Sets the starting subframe periodicity.

Parameters:

<StartSfPeriod> NONE | 4 | 2 | 8 | 16 | 32 | 64 | 128 | 256

*RST: NONE

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Starting SF Periodicity" on page 213

[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NHOPping <NBHopping>

Enables narrowband hopping.

Parameters:

<NBHopping> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Narrowband Hopping" on page 194

[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NHOFfset <NBHoppingOffset>

Sets the narrowband hopping offset.

Parameters:

<NBHoppingOffset> integer

Range: 1 to 16

*RST: 3

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Hopping Offset" on page 194

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:NORB <RbCount>

Sets the PUCCH region in terms of reserved resource blocks, 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 206

[: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 207

[: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 are used for PUCCH format 1/1a/1b in an RB used for a combination of the PUCCH formats 1/1a/1b and 2/2a/2b

Manual operation: See "N(1)_cs" on page 207

[: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 207

[: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 for 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/Extended CP)" on page 207

[: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 for 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 (Normal/Extended CP)" on page 207

[: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 207

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N3Max?

Queries the range of possible number of PUCCH format x transmissions from different users in one subframe.

Return values:

<N3Max> integer

Range: 0 to 549
*RST: 19

Usage: Query only

9.7 UL frame configuration

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:CYCPrefix <CyclicPrefix>

If `BB:EUTR:UL:CPC USER`, sets the cyclic prefix for the selected subframe.

Parameters:

<CyclicPrefix> NORMal | EXTended

*RST: NORMal

Example:
```
BB:EUTR:UL:CPC USER
BB:EUTR:UL:SUBF6:CYCP NORM
```
A normal prefix is used in subframe 6 in uplink.

[: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.

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONType <ContentType>

Selects the content type for the selected allocation.

Parameters:

<ContentType> PUSCh | PUCCh | EMTC | NIOT

*RST: PUSCh

Example:
```
BB:EUTR:UL:SUBF4:ALL2:CONT PUSC
```

Options: EMTC|NIOT require R&S SMW-K115

9.8 UE configuration

9.8.1 Common

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:STATe <State>

Selects the user equipment state.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 1 (UE1); 0 (UE2 to UE7)

Example: `BB:EUTR:UL:UE2:STAT ON`
Activates UE2.

Manual operation: See "State" on page 168

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:RELease <Release>

Sets which LTE release version the UE supports.

Parameters:

<Release> R89 | LADV | EMTC | NIOT

*RST: R89 (R&S SMW-K55) | EMTC (R&S SMW-K115)

Example: `SOURce1:BB:EUTRa:UL:UE1:RELease LADV`

Options: R89 requires R&S SMW-K55
LADV requires R&S SMW-K85
EMTC|NIOT require R&S SMW-K115

Manual operation: See "3GPP Release" on page 61

[: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" on page 169

[: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 169

[: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 170

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:DACRestart <RestartState>

If activated, the indicated values are restarted at the specified intervals.

Parameters:

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

Example: `SOURce1:BB:EUTRa:UL:UE1:DACRestart 1`

Manual operation: See "Restart Data, A/N, CQI and RI Every Subframe and Codeword/Restart Data and A/N Every Subframe" on page 170

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DATA <Data>

Selects the PUSCH data source of the selected UE. For the selected UE, this data source is 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: `SOURce1:BB:EUTRa:UL:UE3:PUSCh:DATA PN11`

Manual operation: See "Data Source" on page 216

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:PATTern <Pattern>, <BitCount>

Sets the bit pattern.

Parameters:

<Pattern> numeric
*RST: #H0

<BitCount> integer
Range: 1 to 64
*RST: 1

Example:
```
BB:EUTR:UL:UE2:PUSC:DATA PATT
BB:EUTR:UL:UE2:PUSC:PATT #H3F,8
```

Manual operation: See "Data Source" on page 216

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DSELect <Filename>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<Filename> string

Filename incl. file extension or complete file path

Example:
```
SOURce1:BB:EUTRa:UL:UE3:PUSCh:DATA DLISt
SOURce1:BB:EUTRa:UL:UE3:PUSCh:DSELect "/var/user/lte_data_list"
```

Manual operation: See "Data Source" on page 216

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:TXMode <TxMode>

eMTC UEs support PUSCH transmission mode M1 only.

Parameters:

<TxMode> M1 | M2

M1
Spatial multiplexing not possible

*RST: M1

Manual operation: See "Transmission Mode, Max. Number of Antenna Ports for PUSCH" on page 217

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:NAPort <NumAPs>

Sets the number of antenna ports for PUSCH transmission.

Parameters:

<NumAPs> AP1

*RST: AP1

Manual operation: See "Transmission Mode, Max. Number of Antenna Ports for PUSCH" on page 217

[: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> 1 | ON | 0 | OFF

*RST: OFF

Example:
```
BB:EUTR:UL:UE2:PUSC:SCR:STAT ON
```
Enables scrambling for UE2

Manual operation: See "Scrambling > State" on page 217

[: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> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:UL:UE2:PUSC:CCOD:STAT ON`

Enables channel coding for UE2

Manual operation: See "Channel Coding and Multiplexing > State" on page 217

[: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 are 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 217

[: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 218

[: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 TS 36.213.

Parameters:
<IHarqOffset> integer
Range: 0 to 14
*RST: 0

Example:
```
// enable multiplexing of the control information (UCI) and data (UL-SCH)
BB:EUTR:UL:UE2:PUSC:CCOD:MODE COMB
// set the HARQ-ACK offset index
BB:EUTR:UL:UE2:PUSC:CCOD:IHAR 5
```

Manual operation: See "I_HARQ_offset" on page 218

[: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 218

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F1Naport <NumAPs>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F2Naport <NumAPs>

eMTC/NB-IoT UEs support transmission with one antenna port.

Parameters:
<NumAPs> AP1
*RST: AP1

Manual operation: See "Number of Antenna Ports for PUCCH per PUCCH Format" on page 208

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:POWoffset <PowerOffset>

Sets the power offset of the demodulation reference signal (DMRS) 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 "DMRS Power Offset" on page 223

9.8.2 SRS

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:STATe <State>

Enables sending of SRS for the corresponding UE.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example: See `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:TT0` on page 519

Manual operation: See "SRS State" on page 225

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:TT0 <TType0>

Enables transmission of trigger type 0.

Parameters:

<TType0> 1 | ON | 0 | OFF

*RST: 1

Example:

```
:SOURce1:BB:EUTRa:LINK UP
:SOURce1:BB:EUTRa:UL:UE1:RELease LADV

:SOURce1:BB:EUTRa:UL:UE1:STATe 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:STATe 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:TT0 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:NAPort AP1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:CYCShift 3
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:ISRS 3
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:TRComb 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:BHOP 2

:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS2:NAPort AP2
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS2:NTRans 2
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS2:ISRS 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS2:SUBF1 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS2:SUBF2 3

:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS3:NAPort AP2
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS3:NTRans 1
```

Manual operation: See "Transmit Trigger Type 0" on page 225

[: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 225

[: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 11
*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 AP)" on page 226

[: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 515

Manual operation: See "Number of Antenna Ports for SRS" on page 226

[: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 227

[: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 TS 36.213.

Return values:

<PeriodTsrs> integer

Range: 0 to 65535
*RST: 0

Example:

```
BB:EUTR:DUPL FDD
BB:EUTR:UL:UE2:REFS:SRS:ISRS 22
BB:EUTR:UL:UE2:REFS:SRS:TSRS?
// 20
```

Usage: Query only

Manual operation: See "Periodicity T_SRS" on page 227

[: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 227

[: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 228

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TRComb <TransmComb>

Sets the UE-specific parameter transmission comb k_{TC}.

Parameters:

<TransmComb> integer

Range: 0 to 1
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:SRS:TRC 1`

Manual operation: See "Transmission Comb k TC" on page 229

[: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 229

[: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 230

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NTRans <Transmissions>

Sets the number of SRS transmissions.

Parameters:

<Transmissions> integer

Range: 0 to (10*SeqLengthARB - 1)
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:TT0 on page 519

Manual operation: See "Number of Transmissions" on page 230

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:UPPTsadd <SrsUpPtsAdd>

In TDD mode, sets the parameter `srs-UpPtsAdd` and defines the number of additional SC-FDMA symbols in UpPTS.

Parameters:

<SrsUpPtsAdd> 0 | 2 | 4

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:UPPTsadd 2
```

Manual operation: See "SRS UpPTS Add" on page 226

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:SUBF<subfidx> <Subframe>

Sets the subframes in that SRS is transmitted.

Suffix:

<subfidx> 1 to 50
Transmission number, as set with [:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NTRans

Parameters:

<Subframe> integer

Range: 0 to (10*SeqLengthARB - 1)
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:TT0 on page 519

Manual operation: See "Subframes for Transmission" on page 230

9.8.3 NB-IoT NPUSCH allocation

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:GHDisable <NbiotDisGH>

Disables NDRS group hopping for the selected UE.

Parameters:

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

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Disable Group Hopping" on page 186

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:SCSPacing <SubcarrSpacing>

Sets the subcarrier spacing.

Parameters:

<SubcarrSpacing> S15 | S375
*RST: S15

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Subcarrier Spacing" on page 176

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:RBINdex <ResBlkIndex>

Sets the resource block number in that the NB-IoT transmissions are allocated.

Parameters:

<ResBlkIndex> integer
Range: Depends on other values
*RST: 20

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Resource Block Index" on page 176

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:DFReq <DeltaFreq>

Sets the frequency offset between the NB-IoT carrier and the LTE center frequency.

Parameters:

<DeltaFreq> float

Range: -1E7 to 1E7
Increment: 1000
Default unit: MHz

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Delta Frequency to DC, MHz" on page 176

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:MODE <Mode>

Selects the operating mode.

Parameters:

<Mode> INBD | ALON | GBD

*RST: INBD

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Mode" on page 177

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:NTRansmiss <NumTransmission>

Sets the number of NPUSCH transmissions.

Parameters:

<NumTransmission> integer

Range: 1 to 20
*RST: 1

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Number of Transmissions" on page 177

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:FORMat <Format>

Sets the NPUSCH transmission format.

Parameters:

<Format> F1 | F2

*RST: F1

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "NPUSCH Format" on page 177

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:MODulation <Modulation>

Sets the modulation scheme for the NPUSCH transmission.

Parameters:

<Modulation> QPSK | PI2Bpsk | PI4Qpsk | QAM16

*RST: PI2Bpsk

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Modulation" on page 177

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSFrame <StartSubframe>

Sets the NPUSCH starting subframe.

Parameters:

<StartSubframe> integer

Range: 0 to 10000
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Starting Subframe (SF)" on page 177

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:REPetitions <Repetitions>

Sets the number of repetitions.

Parameters:

<Repetitions> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128

*RST: R1

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Repetitions" on page 178

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NRUNits <ResourceUnits>

Sets the number of allocated resource units.

Parameters:

<ResourceUnits> RU1 | RU2 | RU3 | RU4 | RU5 | RU6 | RU8 | RU10

*RST: RU1

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Number of Resource Units N_{RU}" on page 178

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:SIRF <SCarrIndAckNack>

Sets the subcarrier indication field.

Parameters:

<SCarrIndAckNack> integer

Range: 0 to 47
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Subcarrier Indication or ACK/NACK Resource Field" on page 178

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NSCarriers?

Queries the allocated number of subcarriers.

Return values:

<NumSubcarriers> integer

Range: 0 to 63
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Usage: Query only

Manual operation: See "Number of Subcarriers" on page 179

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NSLTs?

Queries the allocated number of slots per RU.

Return values:

<NumSlots> integer

Range: 1 to 16
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Usage: Query only

Manual operation: See "Slots" on page 179

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSCarrier?

Queries the starting subcarrier.

Return values:

<NbiotStartSc> integer

Range: 0 to 1000
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Usage: Query only

Manual operation: See "Starting Subcarrier" on page 179

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSLot?

Queries the starting slot.

Return values:

<StartSlot> integer

Range: 0 to 2E5
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Usage: Query only

Manual operation: See "Starting Slot" on page 178

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:POWer <Power>

Sets the power of the NPUSCH transmission.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Power, dB" on page 180

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:ARB:SUGGested?

Queries the ARB sequence length that is required for the selected NPUSCH transmissions.

Return values:

<NbiotSuggSeqLen> integer

Range: 0 to 1E4
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Usage: Query only

Manual operation: See "Suggested" on page 180

9.8.4 NB-IoT NPUSCH enhanced settings

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:NPSSim <NPuschAllSymb>

Enables simultaneous transmission of NPUSCH and SRS.

Parameters:

<NPuschAllSymb> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "NPUSCH + SRS simultaneous Tx" on page 216

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:BITS?

Queries the number of used ACK/NACK bits.

NPUSCH format F2 uses 1 ACK/NACK bit.

Return values:

<NbiotAnBits> integer

Range: 1 to 1
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Usage: Query only

Manual operation: See "Number of A/N Bits" on page 183

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:CBITs?

Queries the number of coded bits.

NPUSCH format F2 uses 16 coded bits.

Return values:

<NbiotCodANBits> integer

Range: 16 to 16
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Usage: Query only

Manual operation: See "Number of Coded A/N Bits" on page 183

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:PATTern <NbiotANPat>, <BitCount>

Set the ACK/ANCK pattern.

Parameters:

<NbiotANPat> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 1
*RST: 1

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "ACK/NACK Pattern" on page 183

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:SR <NbSchedulingReq>

If enabled, the SR symbols are block-wise multiplied with the C_{SR} sequence.

Parameters:

<NbSchedulingReq> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Options: R&S SMW-K146

Manual operation: See "Scheduling Request (SR) Support" on page 183

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ESUPport <EdtSupport>

Enables or disables early data transmission.

Parameters:

<EdtSupport> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387

Options: R&S SMW-K146

Manual operation: See "Early Data Transmission (EDT) Support" on page 182

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ETBS <EdtTbs>

Sets the maximum transport block size for early data transmission in UL.

Parameters:

<EdtTbs> 88 | 328 | 408 | 504 | 584 | 680 | 808 | 936 | 1000

*RST: 88
Default unit: bit

Example: See Example"NPUSCH and NDRS configuration" on page 387

Options: R&S SMW-K146

Manual operation: See "EDT-TBS" on page 182

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ETRSize <EdtTranBlckSize>

Specifies the used transport block size for early data transmission in UL.

Parameters:

<EdtTranBlckSize> 88 | 328 | 408 | 456 | 504 | 536 | 584 | 680 | 712 | 776 | 808 | 936 | 1000

*RST: 88
Default unit: bit

Example: See Example"NPUSCH and NDRS configuration" on page 387

Options: R&S SMW-K146

Manual operation: See "EDT-TBS" on page 182

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:PHYSbits?

Queries the number of physical bits of the selected NPUSCH transmission.

Return values:

<NBiotPhysBits> integer

Range: 1 to 1E5
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Usage: Query only

Manual operation: See "Total Number of Physical Bits" on page 181

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:RUINdex?

Queries the resource unit (RU) field index.

Return values:

<NbiotRuFInd> integer

Range: 1 to 16
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Usage: Query only

Manual operation: See "Resource Unit Field Index I_{RU}" on page 181

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:RVINdex <NbiotRVIdx>

Sets the starting redundancy version index.

Parameters:

<NbiotRVIdx> integer

Range: 0 to 2
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Starting Redundancy Version Idex (rv_ix)" on page 182

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:TBINdex <NbiotTBSizeIdx>

Sets the transport block size index.

Parameters:

<NbiotTBSizeIdx> integer

Range: 0 to 12
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Manual operation: See "Transport Block Size Index I_{TBS}" on page 182

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:TBSize?

Queries the transport block size.

Return values:

<NbiotTBSize> integer

Max transport block size depends on the installed options
Option:R&S SMW-K115: Max = 1000
Option:R&S SMW-K143: Max = 2536

Range: 16 to max
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 387.

Usage: Query only

Manual operation: See "Transport Block Size/Payload" on page 183

9.8.5 FRC

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:TYPE <FrcID>

Selects the FRC.

Parameters:

<FrcID> A141 | A142 | A143 | A151 | A144 | A152 | A161 | A162 | A163 | A164 | A165 | A241 | A242 | A243 | A244 | A245 | A246 | A247

*RST: A141

Example: See Example"Using FRC" on page 389.

Manual operation: See "FRC" on page 171

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:STATe <State>

Enables the FRC.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Using FRC" on page 389.

Manual operation: See "FRC State" on page 171

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:ALResunits?

Queries the number of allocated resource units.

Return values:

<AllocResUnits> integer

Range: 1 to 2
*RST: 2

Example: See Example"Using FRC" on page 389.

Usage: Query only

Manual operation: See "Allocated Resource Units" on page 172

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:BPResunit?

Queries the number of bits per resource unit.

Return values:

<BitsPerResUnit> integer

Range: 96 to 288
*RST: 96

Example: See Example"Using FRC" on page 389.

Usage: Query only

Manual operation: See "Total Number of Bits per Resource Unit" on page 172

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:MODulation?

Queries the modulation scheme.

Return values:

<Modulation> QPSK | PI2Bpsk | PI4Qpsk

*RST: PI2Bpsk

Example: See Example"Using FRC" on page 389.

Usage: Query only

Manual operation: See "Modulation" on page 172

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:NNPRep <NoNPUSCHRep>

Queries the number of NPUSCH repetitions.

Parameters:

<NoNPUSCHRep> 1 | 2 | 16 | 64

*RST: 1

Example: See Example"Using FRC" on page 389.

Manual operation: See "Number of NPUSCH Repetitions" on page 172

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:NOSCarriers?

Queries the number of allocated subcarriers.

Return values:

<NoSubCarriers> integer

Range: 1 to 12
*RST: 1

Example: See Example"Using FRC" on page 389.

Usage: Query only

Manual operation: See "Number of Allocated Subcarriers" on page 171

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:PASize?

Queries the payload size.

Return values:

<PayloadSize> integer

Range: 32 to 136
*RST: 32

Example: See Example"Using FRC" on page 389.

Usage: Query only

Manual operation: See "Payload Size" on page 172

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:SCSPacing?

Queries the subcarrier spacing.

Return values:

<SubCarrSpacing> S15 | S375

*RST: S15

Example: See Example"Using FRC" on page 389.

Usage: Query only

Manual operation: See "Subcarriers Spacing" on page 171

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:TBSSindex?

Queries the transport block size index.

Return values:

<TBSSizeIndex> integer

Range: 0 to 9
*RST: 0

Example: See Example"Using FRC" on page 389.

Usage: Query only

Manual operation: See "Transport Block Size Index I_{TBS}" on page 172

9.8.6 NPRACH

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:MOD <Mode>

Selects the operating mode.

Parameters:

<Mode> INBD | ALON | GBD

*RST: INBD

Example: See Example"NPRACH configuration" on page 389.

Manual operation: See "Mode" on page 189

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:PRATtempts <PreambleAttempt>

Sets the number of preamble attempts.

Parameters:

<PreambleAttempt> integer

Range: 0 to 30
*RST: 0

Example: See Example"NPRACH configuration" on page 389.

Manual operation: See "Number of Preamble Attempts" on page 190

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:RBID <RbIndex>

Sets the resource block in that the NPRACH is allocated.

Parameters:

<RbIndex> integer

Range: 0 to 100
*RST: 0

Example: See Example"NPRACH configuration" on page 389.

Manual operation: See "Resource Block Index" on page 189

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:CONFig <Configuration>

Selects the NPRACH configuration.

Parameters:

<Configuration> integer

Range: 0 to 2
*RST: 0

Example: See Example"NPRACH configuration" on page 389.

Manual operation: See "NPRACH Configuration" on page 190

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:SFSTart <StartingSf>

Sets the starting subframe.

Parameters:

<StartingSf> integer

Range: 0 to 1E4
*RST: 8

Example: See Example"NPRACH configuration" on page 389.

Manual operation: See "Starting Subframe" on page 190

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:INIT <Ninit>

Sets the subcarrier index.

Parameters:

<Ninit> integer

Range: 0 to 47
*RST: 0

Example: See Example"NPRACH configuration" on page 389.

Manual operation: See "n_{int}" on page 191

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:STRT?

Queries the value n_{start}.

Return values:

<Nstart> integer

Range: 0 to 47
*RST: 0

Example: See Example"NPRACH configuration" on page 389.

Usage: Query only

Manual operation: See "n_{start}" on page 191

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:POWer <Power>

Sets the preamble attempt power relative to the UE power.

Parameters:

<Power> float

Range: -80.000 to 10.000
Increment: 0.001
*RST: 0

Example: See Example"NPRACH configuration" on page 389.

Manual operation: See "Power" on page 191

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:ARB:SUGGested?

Queries the ARB sequence length that is required for the selected NPRACH transmissions.

Return values:

<PracNbiotSugg> integer

Range: 0 to 1E4
*RST: 0

Example: See Example"NPRACH configuration" on page 389.

Usage: Query only

Manual operation: See "ARB Sequece Length > Sugested" on page 191

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:DFReq <DeltaFreq>

Sets the frequency offset between the NB-IoT carrier and the LTE center frequency.

Parameters:

<DeltaFreq> float

Range: -1E7 to 1E7
Increment: 1000
Default unit: MHz

Example: See Example"NPRACH configuration" on page 389.

Manual operation: See "Delta Frequency to DC, MHz" on page 190

9.8.7 eMTC PUSCH and PUCCH allocations

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:CELevel <CeLevel>

Set the coverage extension level (CE).

Parameters:

<CeLevel> CE01 | CE23

*RST: CE01

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "CE Level" on page 195

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:HOPP <HoppingInterval>

Sets the narrowband hopping interval.

Parameters:

<HoppingInterval> H1 | H2 | H4 | H5 | H8 | H10 | H16 | H20 | H40

*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Narrowband Hopping Interval" on page 195

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:NTRansmiss <NumTransmission>

Sets the number of PUSCH and PUCCH eMTC transmission for the selected UE.

Parameters:

<NumTransmission> integer

Range: 1 to 20

*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Number of Transmissions" on page 196

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CONTent <ContentType>

Sets the channel type.

Parameters:

<ContentType> PUSCh | PUCCh

*RST: PUSCh

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Content" on page 196

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:MODulation <Modulation>

Sets the modulation scheme of the PUSCH transmission.

Parameters:

<Modulation> QPSK | QAM16 | QAM64

*RST: QPSK

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Modulation/Format" on page 196

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:FORMat <Format>

Sets the PUCCH format.

Parameters:

<Format> F1 | F1A | F1B | F2 | F2A | F2B

*RST: F1

Example: See Example"eMTC PUCCH configuration" on page 399.

Manual operation: See "Modulation/Format" on page 196
See "Format" on page 208

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STSFrame <StartSubframe>

Sets the subframe number in that the PUSCH/PUCCH allocation is scheduled for the first time.

Parameters:

<StartSubframe> integer

Range: 0 to 10000
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Start Subframe" on page 197

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:ASFRrame?

Queries the number of absolute subframes.

Return values:
<NumAbsSubframe> integer

Range: 1 to 10000
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Usage: Query only

Manual operation: See "No. Absolute Subframes" on page 197

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:REPetitions <Repetitions>

Sets the number of repetitions.

Parameters:
<Repetitions> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128 | R192 | R256 | R384 | R512 | R768 | R1024 | R1536 | R2048 | R12 | R24

*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Repetitions" on page 197

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STNBand <StartNarrowBand>

Sets the start NB of the PSUCH/PUCCH transmission.

Parameters:
<StartNarrowBand> integer

Range: 0 to number of available narrowbands
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Start Narrowband" on page 198

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NRBLocks <NumberResBlocks>

Sets the number of used resource blocks (RB) within one narrowband.

Parameters:
<NumberResBlocks> integer

Range: 1 to 6
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "No. RB" on page 198

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:RBOFfset <ResBlockOffset>

For allocations that span less than 6 RB, this parameter shifts the allocated RBs within the NB.

Parameters:

<ResBlockOffset> integer

Range: 0 to 5
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Offset VRB" on page 198

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STWBand <StartWideBand>

Sets the first wideband used for the PSUCH/PUCCH transmission.

Parameters:

<StartWideBand> integer

*RST: 1

Example: See Example"eMTC widebands configuration" on page 391.

Options: R&S SMW-K143

Manual operation: See "Start Wideband" on page 199

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:WBRBoffset <WideBandRBOffs>

Shifts the selected number of resource blocks within the wideband.

Parameters:

<WideBandRBOffs> OS0 | OS3 | OS6 | OS9 | OS12 | OS15 | OS18 | OS21

Example: See Example"eMTC widebands configuration" on page 391.

Options: R&S SMW-K143

Manual operation: See "Offset VRB" on page 199

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:WRBLocks <NumberRBWB>

Sets the number of used resource blocks (RB) within one wideband.

Parameters:

<NumberRBWB> CN3 | CN6 | CN9 | CN12 | CN15 | CN18 | CN21 | CN24

*RST: CN3

Example: See Example"eMTC widebands configuration" on page 391.

Options: R&S SMW-K143

Manual operation: See "No. RB" on page 199

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:POWer <Power>

Sets the power of the eMTC PUSCH and PUCCH transmission

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Power, dB" on page 199

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:ARB:SUGGested?

Queries the ARB sequence length that is required for the selected PUSCH transmissions.

Return values:

<Suggested> integer

Range: 0 to 10000
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 398.

Usage: Query only

Manual operation: See "Suggested" on page 180

9.8.8 eMTC PUSCH and PUCCH enhanced settings

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:DRS:CYCShift?

Sets the cyclic shift field.

Return values:

<Cyclicshift> integer

Range: 0 to 7
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 398.

Usage: Query only

Manual operation: See "Cyclic Shift Filed" on page 201

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NDMRs?

Queries the parameter n(2)_DMRS,λ (Layer λ).

Return values:

<Ndmrs> integer

Range: 0 to 10
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 398.

Usage: Query only

Manual operation: See "n(2)_DMRS,0 (Layer 0)" on page 201

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:BITS <NumCQIBits>

Sets the number of CQI bits before channel coding.

Parameters:

<NumCQIBits> integer

Range: 0 to 1024
*RST: 10

Example: See Example"eMTC PUCCH configuration" on page 399.

Manual operation: See "Number of CQI Bits" on page 203

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:PATTern <EmtcCqiPat>, <BitCount>

Sets the CQI pattern for the PUSCH.

The length of the pattern is determined by the number of CQI bits as set with the command `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:BITS`.

Parameters:

<EmtcCqiPat> numeric
*RST: #H0

<BitCount> integer
Range: 1 to 1024
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "CQI Pattern" on page 203

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:CBITs?

Queries the number of coded CQI bits.

Return values:

<NumCodedCQIBits> integer
Range: 0 to 1E5
*RST: 20

Example: See Example"eMTC PUSCH configuration" on page 398.

Usage: Query only

Manual operation: See "Number of Coded CQI Bits" on page 203

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:MODE <Mode>

Sets the ACK/NACK mode.

Parameters:

<Mode> MUX
*RST: MUX

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "ACK/NACK Mode" on page 202

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:ULSCh:BITS?

Queries the number of physical bits used for UL-SCH transmission.

Return values:
<PhysBitULSCH> integer

Range: 0 to 1E5
*RST: 1500

Example: See Example"eMTC PUSCH configuration" on page 398.

Usage: Query only

Manual operation: See "Number of Coded UL-SCH Bits" on page 204

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CCODing:TBSize <TranspBlockSize>

Sets the size of the transport block.

Parameters:
<TranspBlockSize> integer

Range: 1 to 1E5
*RST: 16

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Transport Block Size/Payload" on page 204

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NAPused?

Queries the number of antenna ports used for transmissions of the selected PUCCH format.

Return values:
<NumAntennaPorts> integer

Range: 1 to 1
*RST: 1

Example: See Example"eMTC PUCCH configuration" on page 399.

Usage: Query only

Manual operation: See "Number of Used Antenna Port" on page 209

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NPUCch <NPucchAP100>

Sets the PUCCH resource index.

Parameters:
<NPucchAP100> integer

Range: 0 to 65535
*RST: 0

Example: See Example"eMTC PUCCH configuration" on page 399.

Manual operation: See "n_PUCCH Antenna Port 100" on page 209

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:BITS <Bits>

Sets the number of ACK/NACK bits.

Parameters:

<Bits> integer

Range: 0 to 20
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Number of A/N Bits" on page 202

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:CBITs?

Queries the number of coded ACK/NACK bits.

Return values:

<Codedbits> integer

Range: 0 to 1E5
*RST: 20

Example: See Example"eMTC PUSCH configuration" on page 398.

Usage: Query only

Manual operation: See "Number of Coded A/N Bits" on page 202

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:PATTern <EmtcAckNackPat>, <BitCount>

Sets the ACK/NACK pattern for the PUSCH.

Parameters:

<EmtcAckNackPat> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "ACK/NACK Pattern" on page 202

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PHYSbits?

Queries the number of physical bits of the selected PUSCH transmission.

Return values:

<PuscPhysBits> integer

Range: 1 to 1E5
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 398.

Usage: Query only

Manual operation: See "Total Number of Physical Bits" on page 204

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CCODing:RVINdex <RedundVersIndex>

Sets the redundancy version index.

Parameters:

<RedundVersIndex> integer

Range: 0 to 3
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 398.

Manual operation: See "Starting Redundancy Version Index (rv_idx)" on page 204

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:HARQ:PATTern <EmtcAckNackPat>, <BitCount>

Sets the PUCCH ACK/NACK pattern.

Parameters:

<EmtcAckNackPat> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See Example"eMTC PUCCH configuration" on page 399.

Manual operation: See "A/N Pattern" on page 209

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:BITS <NumCQIBits>

Sets the number of CQI bits before channel coding.

Parameters:

<NumCQIBits> integer

Range: 0 to 1024
*RST: 10

Example: See Example"eMTC PUCCH configuration" on page 399.

Manual operation: See "Number of CQI Bits" on page 210

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:PATTern <Pattern>, <BitCount>

Sets the CQI pattern for the PUCCH.

Parameters:

<Pattern> numeric
*RST: #H0

<BitCount> integer
Range: 1 to 13
*RST: 1

Example: See Example"eMTC PUCCH configuration" on page 399.

Manual operation: See "CQI Pattern" on page 210

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:CBITs?

Queries the number of coded CQI bits.

Return values:

<NumCodedCQIBits> integer
Range: 0 to 1E5
*RST: 20

Example: See Example"eMTC PUCCH configuration" on page 399.

Usage: Query only

Manual operation: See "Number of Coded CQI Bits" on page 210

9.8.9 eMTC PRACH

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:EMTC:PRATtempts <PreambleAttempt>

Sets the number of preamble attempts.

Parameters:

<PreambleAttempt> integer

Range: 0 to 40
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Number of Preamble Attempts" on page 213

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:CELV <CeLevel>

Sets the CE level.

Parameters:

<CeLevel> integer

Range: 0 to 3
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "CE Level" on page 213

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:SFSTart <StartingSf>

Sets the starting subframe.

Parameters:

<StartingSf> integer

Range: 0 to 1E5
*RST: 1

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Starting Subframe" on page 214

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:FRINdex <FreqResIndex>

For "Duplexing > TDD", sets the frequency resource index.

Parameters:

<FreqResIndex> integer

Range: 0 to 1E5
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:FRINdex 10
```

Manual operation: See "Frequency Resource Index" on page 214

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:NCSConf <NcsConfig>

Selects the Ncs configuration.

Parameters:

<NcsConfig> integer

For detail on the value range, see Table 3-30.

Range: 0 to 15
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Ncs Configuration" on page 214

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:RSEQuence <RootSequence>

Sets the logical root sequence index.

Parameters:

<RootSequence> integer

Range: 0 to 838
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Logical Root Sequence Index" on page 214

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:SINDex <SequenceIndex>

Sets the sequence index **v**.

Parameters:

<SequenceIndex> integer

Range: 0 to 63
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Sequence Index (v)" on page 215

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:DT <DeltaTime>

Sets the parameter Delta_t in us.

Parameters:

<DeltaTime> float

Range: -500 to 500
Increment: 0.01
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Delta t /us" on page 215

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:POWer <Power>

Sets the preamble attempt power relative to the UE power.

Parameters:

<Power> float

Range: -80.000 to 10.000
Increment: 0.001
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Manual operation: See "Power, dB" on page 215

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:EMTC:ARB:SUGGested?

Queries the ARB sequence length that is required for the PRACH configuration.

Return values:

<Suggested> integer

Range: 0 to 10000
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 400.

Usage: Query only

Manual operation: See "ARB Sequece Length > Sugested" on page 215

9.9 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 353

[:SOURce<hw>]:BB:EUTRa:FILTer:MODE <OptMode>

Selects an offline or real-time filter mode.

Parameters:

<OptMode> RTime | OFFLine

*RST: RTime

Example: See `[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:SPHase` on page 553

Manual operation: See "Filter Mode" on page 357

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:APCO25 <Apco25>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine <Cosine>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:GAUSs <Gauss>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASs <LPass>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASSEVM <CutoffFrequency>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:PGAuss <PGauss>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:RCOSine <RCosine>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:SPHase <SPhase>

Sets the filter parameter.

Filter type	Parameter	Parameter name	Min	Max	Incre-ment	Default
`APCO25`	Rolloff factor	`<Apco25>`	0.05	0.99	0.01	0.2
`COSine`	Rolloff factor	`<Cosine>`	0	1	0.01	0.1
`GAUSs`	BxT	`<Gauss>`	0.15	2.5	0.01	0.5
`LPASs`	Cutoff frequency	`<LPass>`	0.02	2	0.01	0.34

Filter type	Parameter	Parameter name	Min	Max	Incre-ment	Default
LPASSEVM	Cutoff frequency	<CutoffFrequency>	0.05	2	0.01	0.29
PGAuss	BxT	<PGauss>	0.15	2.5	0.01	0.5
RCOSine	Rolloff factor	<RCosine>	0	1	0.01	0.22
SPHase	BxT	<SPhase>	0.15	2.5	0.01	2

Example:
```
SOURce:BB:EUTRa:FILTer:TYPE COS
SOURce:BB:EUTRa:FILTer:PARameter:COSine 0.1
SOURce:BB:EUTRa:FILTer:PARameter:COSine:COFS -0.2
SOURce:BB:EUTRa:FILTer:MODE RTime
```

Manual operation: See "Rolloff factor or BxT" on page 355

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine:COFS <Cofs>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFS <CutOffFreqShift>

Sets the filter parameter.

Parameters:

<CutOffFreqShift> float

Range: -1 to 1
Increment: 0.01
*RST: -0.2

Example:
```
SOURce:BB:EUTRa:FILTer:TYPE LTEF
SOURce:BB:EUTRa:FILTer:PARameter:LTE:OPTimization ACP
SOURce:BB:EUTRa:FILTer:PARameter:LTE:COFS 0.34
```

Manual operation: See "Cutoff frequency shift" on page 356

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:OPTimization <Optimization>

Defines the applied LTE filter.

Parameters:

<Optimization> EVM | ACP | ACPN | BENU

Available are EVM, ACP, ACPN (ACP narrow) and BENU (Best EVM, no upsampling).

*RST: EVM

Example: See [:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFS on page 554

Manual operation: See "Optimization" on page 353

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFFactor <CutoffFactor>

Sets the cutoff frequency factor for the LTE filter type.

Parameters:

<CutoffFactor> float

Range: 0.02 to 2
Increment: 0.001
*RST: 0.34

Example:

```
SOURce:BB:EUTRa:FILTer:TYPE LTEF
SOURce:BB:EUTRa:FILTer:PARameter:LTE:OPTimization EVM
SOURce:BB:EUTRa:FILTer:PARameter:LTE:COFFactor 0.1
SOURce:BB:EUTRa:FILTer:PARameter:LTE:ROFactor -0.2
```

Manual operation: See "Cutoff Frequency Factor" on page 357

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:ROFactor <RollOffFactor>

Sets the rolloff factor for the LTE filter type.

Parameters:

<RollOffFactor> float

Range: 0 to 1
Increment: 0.01
*RST: 0.1

Example: See `[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFFactor` on page 554

Manual operation: See "Rolloff factor or BxT" on page 355

[:SOURce<hw>]:BB:EUTRa:FILTer:AUTO?

Queries if the internal ("Auto") filter is applied.

This filter is selected automatically, if carrier aggregation with carriers that span different bandwidths is used.

Return values:

<Auto> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:FILTer:AUTO?`

Usage: Query only

Manual operation: See "Optimization" on page 353

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:USER <Filename>

Loads the file from the default or the specified directory.

Loaded are files with extension `VAF` or `DAT`.

Parameters:

<Filename> string

Complete file path incl. filename and extension

Example:

```
SOURce:BB:EUTRa:FILTer:TYPE USER
SOURce:BB:EUTRa:FILTer:PARameter:USER "/var/user/my_filter.dat"
```

Manual operation: See "Load User Filter" on page 354

[:SOURce<hw>]:BB:EUTRa:SRATe:VARiation <Variation>

Sets the output sample rate.

A variation of this parameter affects the ARB clock rate; all other signal parameters remain unchanged.

The current value of this parameter depends on the current physical settings, like the channel bandwidth.

Parameters:

<Variation> float

Range: 400 to 4E7
Increment: 0.001
*RST: 15.360000E6
Default unit: Hz

Example:

```
SOURce:BB:EUTRa:LINK DOWN
SOURce:BB:EUTRa:DL:BW BW10_00
SOURce:BB:EUTRa:SRATe:VARiation?
//  15360000
```

Manual operation: See "Sample Rate Variation" on page 357

9.10 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 358

[: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 359

[: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 358

9.11 ARB settings

[: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 "(Current) Sequence Length" on page 359

[:SOURce<hw>]:BB:EUTRa:SUSLen <subLen>

Sets the sequence length of the signal in number of subframes. The signal is calculated in advance and output in the arbitrary waveform generator.

Parameters:

<SubLen> integer

Range: 1 to 1E5
*RST: 1

Example: `BB:EUTR:SUSL 10`
Selects the generation of 10 subframes.

Manual operation: See "(Current) Sequence Length" on page 359

[:SOURce<hw>]:BB:EUTRa:BBFS:DTIMe <DwellTime>

Sets the dwell time for each frequency step of the sweep.

Parameters:

<DwellTime> float

Range: 0.0001 to 0.005
Increment: 0.000001
*RST: 0.0001
Default unit: s

Example: `SOURce1:BB:EUTRa:BBFS:DTIMe 1E-3`

Manual operation: See "Dwell Time" on page 360

[:SOURce<hw>]:BB:EUTRa:BBFS:MAXShift <MaxShift>

Sets the maximal total frequency sweep (summary for all steps).

Parameters:

<MaxShift> float

Range: 10 to 100
Increment: 1
*RST: 10
Default unit: Hz

Example: `SOURce1:BB:EUTRa:BBFS:MAXShift 50`

Manual operation: See "Max. Shift" on page 361

[:SOURce<hw>]:BB:EUTRa:BBFS:MODE <Mode>

Disables or enables the frequency sweep. The frequency sweep can be enbled before or after filtering.

Parameters:

<Mode> OFF | BEFore | AFTer

*RST: OFF

Example: `SOURce1:BB:EUTRa:BBFS:MODE AFT`

Manual operation: See "Baseband Frequency Sweep Mode" on page 360

[:SOURce<hw>]:BB:EUTRa:BBFS:STEPs <NumSteps>

Sets the number of iteration for increasing the frequency using the step of 0.1171875 Hz (90/768 ms).

Parameters:

<NumSteps> integer

Range: 10 to 1000
*RST: 10

Example: `SOURce1:BB:EUTRa:BBFS:STEPs 5`

Manual operation: See "Number of Steps" on page 361

9.12 Time domain windowing settings

[:SOURce<hw>]:BB:EUTRa:TDW:STATe <State>

Activates/deactivates the time domain windowing.

Parameters:
<State> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:TDW:STAT ON`
Activates time domain windowing.

Manual operation: See "State" on page 351

[: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
Default unit: s

Example: `SOURce1:BB:EUTRa:TDW:TRTime 0.000002`
Sets the transition time to 2us.

Manual operation: See "Transition Time" on page 352

9.13 Power settings

[:SOURce<hw>]:BB:EUTRa:POWC:LEVReference <LevelReference>

Defines the reference for the "Level" display in the status bar.

Parameters:
<LevelReference> FRMS | DRMS | UEBurst | NPBCH

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.

UEBurst
The displayed RMS and PEP are measured during a single subframe (or slot) of a certain UE.

NPBCH
In NB-IoT standalone operation, the displayed RMS and PEP are measured during the NPBCH symbols 3, 9 and 11.

*RST: FRMS

Example: `SOURce1:BB:EUTRa:POWC:LEVReference UEBurst`
Sets level reference to UE burst RMS power

Options: NPBCH requieres R&S SMW-K115

Manual operation: See "Power Reference" on page 363

[:SOURce<hw>]:BB:EUTRa:POWC:REFChannel <RefChannel>

If `[:SOURce<hw>]:BB:EUTRa:POWC:LEVReferenceUEBurst`, queries the channel type to that the measured RMS and PEP are referring.

Parameters:
<RefChannel> NF | PUSCH | PUCCH | PRACH | SRS | PUCPUS

*RST: NF

Example:
```
BB:EUTR:POWC:LEVR UEB
BB:EUTR:POWC:RUE?
```

Manual operation: See "Reference Channel" on page 365

[:SOURce<hw>]:BB:EUTRa:POWC:REFSubframe?

If `[:SOURce<hw>]:BB:EUTRa:POWC:LEVReferenceUEBurst`, queries the subframe or slot number used as reference for measuring the RMS and PEP values.

Return values:
<RefSubframe> integer

Range: 0 to 39
*RST: 0

Example:
```
SOURce1:BB:EUTRa:POWC:LEVReference UEB
SOURce1:BB:EUTRa:POWC:REFSubframe?
```

Usage: Query only

Manual operation: See "Reference Subframe/Slot" on page 364

[:SOURce<hw>]:BB:EUTRa:POWC:RUE?

If `[:SOURce<hw>]:BB:EUTRa:POWC:LEVReferenceUEBurst`, queries the UE to that the measured RMS and PEP are referring.

Return values:
<ReferenceUe> UE1 | UE2 | UE3 | UE4

*RST: UE1

Example:	`BB:EUTR:POWC:LEVR UEB`
	`BB:EUTR:POWC:RUE?`
	Queries the reference UE

Usage:	Query only
Manual operation:	See "Reference UE" on page 364

9.14 Clock

[:SOURce<hw>]:BB:EUTRa:CLOCk:SOURce <Source>

Selects the clock source:

- `INTernal`: Internal clock reference
- `ELCLock`: External local clock
- `EXTernal = ELCLock`: Setting only
  Provided for backward compatibility with other Rohde & Schwarz signal generators

Parameters:

<Source>	INTernal|ELCLock|EXTernal *RST: INTernal
Example:	`SOURce1:BB:EUTRa:CLOCk:SOURce INTernal` Selects an internal clock reference.
Options:	ELCLock requires R&S SMW-B10
Manual operation:	See "Clock Source" on page 374

[:SOURce<hw>]:BB:EUTRa:CLOCk:MODE <Mode>

Sets the type of externally supplied clock.

Parameters:

<Mode>	SAMPle *RST: SAMPle
Example:	`SOURce1:BB:EUTRa:CLOCk:MODE SAMPle`
Options:	R&S SMW-B10
Manual operation:	See "Clock Mode" on page 375

[: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.

9.15 Timing configuration

[:SOURce<hw>]:BB:EUTRa:TIMC:NTAoffset <NtaOffset>

Sets the parameter $N_{TA\ offset}$ as defined in the 3GPP TS 36.211.

Parameters:

<NtaOffset> NTA0 | NTA624

*RST: NTA0

Example:

`BB:EUTR:TIMC:NTA NTA0`

Sets parameter $N_{TA\ offset}$

Manual operation: See "Signal Advance N_TA_offset" on page 371

9.16 Trigger

Example: Configure and enable triggering

```
SOURce1:BB:EUTRa:TRIGger:SEQuence SINGle
SOURce1:BB:EUTRa:TRIGger:SLENgth 200
// the first 200 samples of the current waveform will be output after
// the next trigger event

// SOURce1:BB:EUTRa:TRIGger:SOURce INTB
// the internal trigger signal from the other path must be used
// SOURce1:BB:EUTRa:TRIGger:OBASeband:DELay 25
// SOURce1:BB:EUTRa:TRIGger:OBASeband:INHibit 10

SOURce1:BB:EUTRa:TRIGger:SOURce INT
SOURce1:BB:EUTRa:TRIGger:SEQuence ARETrigger
SOURce1:BB:EUTRa:STAT ON
SOURce1:BB:EUTRa:TRIGger:EXEcute
// executes a trigger, signal generation starts
SOURce1:BB:EUTRa:TRIGger:ARM:EXECute
// signal generation stops
SOURce1:BB:EUTRa:TRIGger:EXEcute
// executes a trigger, signal generation starts again
```

Example: Specifying delay and inhibit values in time units

```
SOURce1:BB:EUTRa:CLOCk 1000000
SOURce1:BB:EUTRa:TRIGger:SEQuence ARET
SOURce1:BB:EUTRa:TRIGger:SOURce EGT1
// external trigger signal must be provided at the USER connector
// SOURce1:BB:EUTRa:TRIGger:EXTernal:SYNChronize:OUTPut 1
SOURce1:BB:EUTRa:TRIGger:DELay:UNIT SAMP
SOURce1:BB:EUTRa:TRIGger:EXTernal:DELay 100
SOURce1:BB:EUTRa:TRIGger:EXTernal:RDELay?
// Response: 100

SOURce1:BB:EUTRa:TRIGger:DELay:UNIT TIME
SOURce1:BB:EUTRa:TRIGger:EXTernal:TDELay 0.00001
SOURce1:BB:EUTRa:TRIGger:EXTernal:RDELay?
// Response: 0.00001

SOURce1:BB:EUTRa:TRIGger:DELay:UNIT SAMP
SOURce1:BB:EUTRa:TRIGger:EXTernal:DELay 10
```

[:SOURce<hw>]:BB:EUTRa[:TRIGger]:SEQuence <TriggerMode>

Selects the trigger mode:

- `AUTO` = auto
- `RETRigger` = retrigger
- `AAUTo` = armed auto
- `ARETrigger` = armed retrigger
- `SINGle` = single

Parameters:

<TriggerMode> AUTO | RETRigger | AAUTo | ARETrigger | SINGle

*RST: AUTO

Example: See Example"Configure and enable triggering" on page 564

Manual operation: See "Trigger Mode" on page 366

[:SOURce<hw>]:BB:EUTRa:TRIGger:SOURce <Source>

Selects the trigger signal source and determines the way the triggering is executed. Provided are:

- Internal triggering by a command (`INTernal`)
- External trigger signal via one of the local or global connectors
  - `EGT1|EGT2`: External global trigger
  - `EGC1|EGC2`: External global clock
  - `ELTRigger`: External local trigger
  - `ELCLock`: External local clock
- Internal triggering by a signal from the other basebands (`INTA|INTB`)
- In primary-secondary instrument mode, the external baseband synchronization signal (`BBSY`)
- `OBASeband|BEXTernal|EXTernal`: Setting only

Provided only for backward compatibility with other Rohde & Schwarz signal generators.
The R&S SMW accepts these values and maps them automatically as follows:
`EXTernal = EGT1`, `BEXTernal = EGT2`, `OBASeband = INTA or INTB` (depending on the current baseband)

Parameters:

<Source> INTB|INTernal|OBASeband|EGT1|EGT2|EGC1|EGC2|ELTRigger|INTA|ELCLock|BEXTernal|EXTernal | BBSY

*RST: INTernal

Example: See Example"Configure and enable triggering" on page 564.

Options: ELTRigger|ELCLock require R&S SMW-B10
BBSY require R&S SMW-B9

Manual operation: See "Trigger Source" on page 368

[:SOURce<hw>]:BB:EUTRa:TRIGger:ARM:EXECute

Stops signal generation; a subsequent trigger event restarts signal generation.

Example: See Example"Configure and enable triggering" on page 564

Usage: Event

Manual operation: See "Arm" on page 368

[:SOURce<hw>]:BB:EUTRa:TRIGger:DELay:UNIT <DelUnit>

Sets the units in that the trigger delay is expressed.

Parameters:

<DelUnit> SAMPle | TIME

*RST: SAMPle

Example: See Example"Configure and enable triggering" on page 564

Manual operation: See "(External) Delay Unit" on page 370

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXECute

Executes a trigger.

Example: See Example"Configure and enable triggering" on page 564

Usage: Event

Manual operation: See "Execute Trigger" on page 368

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:SYNChronize:OUTPut <OutputState>

Enables signal output synchronous to the trigger event.

Parameters:

<OutputState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"Configure and enable triggering" on page 564

Manual operation: See "Sync. Output to External Trigger/Sync. Output to Trigger" on page 369

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:DELay <Delay>

When triggering via the other basebands, delays the trigger event compared to the one in the other baseband.

Parameters:

<Delay> float

Range: 0 to 2147483647
Increment: 0.01
*RST: 0

Manual operation: See "(Specified) External Trigger Delay/(Specified) Trigger Delay" on page 370

See Example"Configure and enable triggering" on page 564

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:INHibit <Inhibit>

For triggering via the other path, specifies the number of samples by which a restart is inhibited.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

Example: See Example"Configure and enable triggering" on page 564

Manual operation: See "External / Trigger Inhibit" on page 369

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:RDELay?

Queries the actual trigger delay (expressed in time units) of the trigger signal from the second path.

Return values:

<IntOthRDelay> float

Range: 0 to 688
Increment: 250E-12
*RST: 0

Example: See Example"Specifying delay and inhibit values in time units" on page 564.

Usage: Query only

Manual operation: See "Actual Trigger Delay/Actual External Delay" on page 370

[: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.

Parameters:

<IntOthTDelay> float

Range: 0 to depends on other values
Increment: 250E-12
*RST: 0
Default unit: s

Example: See Example"Specifying delay and inhibit values in time units" on page 564.

Manual operation: See "(Specified) External Trigger Delay/(Specified) Trigger Delay" on page 370

[:SOURce<hw>]:BB:EUTRa:TRIGger:RMODe?

Queries the signal generation status.

Return values:

<RunMode> STOP | RUN

Example: `SOURce1:BB:EUTRa:TRIGger:RMODe?`

Usage: Query only

Manual operation: See "Running/Stopped" on page 367

[: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
A single frame is generated after a trigger event.

SEQuence
A single sequence is generated after a trigger event.

SUBFrame
A single subframe is generated after a trigger event.

SLOT
A single slot is generated after a trigger event.

SAMPle
Number of samples are generated after a trigger event.

*RST: SEQuence

Example: See Example"Configure and enable triggering" on page 564.

Manual operation: See "Signal Duration Unit" on page 367

[:SOURce<hw>]:BB:EUTRa:TRIGger:SLENgth <SequenceLength>

Defines the length of the signal sequence that is output in the `SINGle` trigger mode.

Parameters:

<SequenceLength> integer

Range: 1 to 4294967295
*RST: 1

Example: See Example"Configure and enable triggering" on page 564.

Manual operation: See "Trigger Signal Duration" on page 367

[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME:DATE <Year>, <Month>, <Day>

Sets the date for a time-based trigger signal. For trigger modes single or armed auto, you can activate triggering at this date via the following command:

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:STATe`

`<DigStd>` is the mnemonic for the digital standard, for example, `ARB`. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:

<Year> integer

Range: 1980 to 9999

<Month> integer

Range: 1 to 12

<Day> integer

Range: 1 to 31

Example: See example "Configure a time-based trigger signal" in the sub-chapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMW user manual.

Manual operation: See "Trigger Time" on page 367

[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME:TIME <Hour>, <Minute>, <Second>

Sets the time for a time-based trigger signal. For trigger modes single or armed auto, you can activate triggering at this time via the following command:

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:STATe`

`<DigStd>` is the mnemonic for the digital standard, for example, `ARB`. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:

<Hour> integer

Range: 0 to 23

<Minute> integer

Range: 0 to 59

<Second> integer

Range: 0 to 59

Example: See example "Configure a time-based trigger signal" in the sub-chapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMW user manual.

Manual operation: See "Trigger Time" on page 367

[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME[:STATe] <State>

Activates time-based triggering with a fixed time reference. If activated, the R&S SMW triggers signal generation when its operating system time matches a specified time.

Specify the trigger date and trigger time with the following commands:

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:DATE`

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:TIME`

`<DigStd>` is the mnemonic for the digital standard, for example, `ARB`. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See example "Configure a time-based trigger signal" in the sub-chapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMW user manual.

Manual operation: See "Time Based Trigger" on page 367

[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal]:DELay <Delay>

Sets the trigger delay.

Parameters:

<Delay> float

Range: 0 to 2147483647
Increment: 0.01
*RST: 0
Default unit: Samples

Example: See Example"Specifying delay and inhibit values in time units" on page 564.

Manual operation: See "(Specified) External Trigger Delay/(Specified) Trigger Delay" on page 370

[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal]:INHibit <Inhibit>

Specifies the number of symbols by which a restart is inhibited.

Parameters:

<Inhibit> integer

Range: 0 to dynamic
*RST: 0

Example: See Example"Specifying delay and inhibit values in time units" on page 564.

Manual operation: See "External / Trigger Inhibit" on page 369

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:RDELay?

Queries the time (in seconds) of an external trigger event is delayed for.

Return values:

<ExtResultDelay> float

Range: 0 to 688
Increment: 250E-12
*RST: 0

Example: See Example"Specifying delay and inhibit values in time units" on page 564.

Usage: Query only

Manual operation: See "Actual Trigger Delay/Actual External Delay" on page 370

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:TDELay <Delay>

Specifies the trigger delay for external triggering. The value affects all external trigger signals.

Parameters:

<Delay> float

Range: 0 to 688
Increment: 250E-12
*RST: 0
Default unit: s

Example: See Example"Specifying delay and inhibit values in time units" on page 564.

Manual operation: See "(Specified) External Trigger Delay/(Specified) Trigger Delay" on page 370

9.17 Marker

Example: Configure and enable standard marker signals

```
SOURce1:BB:EUTRa:TRIGger:OUTPut1:MODE FRAM
// selects a frame marker
SOURce1:BB:EUTRa:TRIGger:OUTPut1:ROFFset 20
// sets a rise offset of 20 samples
SOURce1:BB:EUTRa:TRIGger:OUTPut1:FOFFset 200
// sets a fall offset of 200 samples

SOURce1:BB:EUTRa:TRIGger:OUTPut2:MODE RAT
SOURce1:BB:EUTRa:TRIGger:OUTPut2:ONTime 20
SOURce1:BB:EUTRa:TRIGger:OUTPut2:OFFTime 200

SOURce1:BB:EUTRa:TRIGger:OUTPut3:MODE PERiod
SOURce1:BB:EUTRa:TRIGger:OUTPut3:PERiod 1600
// sets a period of 1600 samples
//  the marker signal is repeated every 1600th sample

SOURce1:BB:EUTRa:TRIGger:OUTPut3:DELay 1000
// Sets a delay of 1000 samples.
SOURce1:BB:EUTRa:TRIGger:OUTPut3:DINsec?
// Response in microseconds: 65.1041666666667
// Corresponds to a delay of about 65.104 microseconds.
```


[: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 | SFNRestart

*RST: FRAM

Example: See Example"Configure and enable standard marker signals" on page 572.

Manual operation: See "Marker Mode" on page 372

[: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: See Example"Configure and enable standard marker signals" on page 572.

Manual operation: See "Rise/Fall Offset" on page 373

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ONTime <OnTime>
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:OFFTime <OffTime>

Sets the number of samples during which the marker output is on or off.

*) If R&S SMW-B9 is installed, the minimum marker duration depends on the sample/symbol rate.

See chapter "Basics on ..." in the R&S SMW user manual.

Parameters:

<OffTime> integer

Range: 1 (R&S SMW-B10) / 1* (R&S SMW-B9) to 16777215
*RST: 1

Example: See Example"Configure and enable standard marker signals" on page 572.

Manual operation: See "Marker Mode" on page 372

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:PERiod <Period>

Sets the repetition rate for the signal at the marker outputs.

*) If R&S SMW-B9 is installed, the minimum marker duration depends on the sample/symbol rate.

See chapter "Basics on ..." in the R&S SMW user manual.

Parameters:

<Period> unsigned integer

Range: 1 (R&S SMW-B10) / 1* (R&S SMW-B9) to 4294967295
Increment: 1
*RST: 2
Default unit: Samples

Example: See Example"Configure and enable standard marker signals" on page 572.

Manual operation: See "Marker Mode" on page 372

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay <Delay>

Defines the delay between the signal on the marker outputs and the start of the signals.

Parameters:

<Delay> float

Range: 0 to 16777215
Increment: 1E-3
*RST: 0

Example: See Example"Configure and enable standard marker signals" on page 572.

Manual operation: See "Marker x Delay" on page 373

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DINSec?

Queries the marker delay in microseconds.

You can define a marker delay in samples via `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay`.

Return values:

<DelayInS> float

Range: 0 to 16777215
Increment: 1E-3
*RST: 0

Example: See Example"Configure and enable standard marker signals" on page 572.

Usage: Query only

Manual operation: See "Delay (Time)" on page 373

9.18 Realtime feedback

Option: R&S SMW-K69

Example: Realtime feedback configuration (serial 3x8 mode)

```
:SOURce1:BB:EUTRa:DUPLexing FDD
:SOURce1:BB:EUTRa:LINK UP

:SOURce1:BB:EUTRa:UL:RTFB:MODE S3X8
:SOURce1:BB:EUTRa:UL:RTFB:CONNector LOC
:SOURce1:BB:EUTRa:UL:RTFB:ADUDelay 0
:SOURce1:BB:EUTRa:UL:RTFB:BBSelector 0
:SOURce1:BB:EUTRa:UL:RTFB:SERate SR115_2K
:SOURce1:BB:EUTRa:UL:RTFB:GENReports 1
:SOURce1:BB:EUTRa:UL:RTFB:LOFFset 10
```

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:MODE <Mode>

Enables realtime feedback and determines the mode (binary or serial).

Parameters:

<Mode> OFF | SERial | S3X8

*RST: OFF

Example: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 575.

Options: R&S SMW-K69

Manual operation: See "Realtime Feedback Mode" on page 237

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:CONNector <Connector>

Determines the feedback line connector.

Parameters:

<Connector> LOCal | GLOBal

LOCal
T/M 3 connector for R&S SMW-B10
T/M 2 connector for R&S SMW-B9

GLOBal
(reserved for future use)
USER 6 connector

*RST: LOCal

Example: Enabling the feedback signal at the local [TM3] or [TM2] connector of Baseband A.

```
SOURce1:INPut:TM3:DIRection INPut
SOURce1:INPut:TM3:SIGNal FEEDback
SOURce1:BB:EUTRa:UL:RTFB:CONNector LOCal
```

Options: R&S SMW-K69

Manual operation: See "Connector" on page 238

[: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
Serial and Serial 3x8	"UE x > Config > 3GPP Release = Release 8/9 or LTE-Advanced": -1 to 1.99 subframes "UE x > Config > 3GPP Release = eMTC/NB-IoT": -18 to -0.3 subframes

Parameters:

<AddUserDelay> float

Range: depends on the feedback mode and the installed options
Increment: 0.01
*RST: 0
Default unit: Subframes

Example: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 575.

Options: R&S SMW-K69

Manual operation: See "Additional User Delay" on page 238

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BBSelector <BasebandSelect>

In serial mode, required for multiplexing serial commands for different basebands to one feedback line.

Parameters:

<BasebandSelect> integer

Range: 0 to 3
*RST: 0 (for Baseband A); 1 (for Baseband B)

Example: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 575.

Options: R&S SMW-K69

Manual operation: See "Baseband Selector" on page 238

[: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: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 575.

Options: R&S SMW-K69

Manual operation: See "Serial Rate" on page 238

[: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> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 575.

Options: R&S SMW-K69

Manual operation: See "Generate Debug Reports" on page 238

[: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: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 575.

Options: R&S SMW-K69

Manual operation: See "Logging Offset" on page 239

9.19 Test case wizard remote-control commands

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 become active only after executing this command.

Usage: Event

Manual operation: See "Apply Settings" on page 266

[: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 285
See "Power Level" on page 305

[: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 263

[:SOURce<hw>]:BB:EUTRa:TCW:GS:SPEC <GsSpec>

Selects the 3GPP test specification used as a guideline for the test cases.

Parameters:
<GsSpec> TS36141
*RST: TS36141

Example: `SOURce1:BB:EUTRa:TCW:GS:SPEC TS36141`

Manual operation: See "Test Specification" on page 260

[:SOURce<hw>]:BB:EUTRa:TCW:GS:RELease <Release>

Sets the 3GPP test specification used as a guideline for the test cases.

Parameters:
<Release> REL8 | REL9 | REL10 | REL11
*RST: REL8

Manual operation: See "Release" on page 260

[:SOURce<hw>]:BB:EUTRa:TCW:GS:ANTSubset <AntennaSubset>

Enabled for test setups with eight Rx antennas

Determines the signal of which antenna couple, Antenna 1 and 2 (`AS12`), Antenna 3 and 4 (`AS34`), Antenna 5 and 6 (`AS56`) or Antenna 7 and 8 (`AS78`), is generated by the instrument.

Parameters:

<AntennaSubset> AS34 | AS12 | ALL | AS56 | AS78

*RST: AS12

Manual operation: See "Antenna Subset" on page 262

[:SOURce<hw>]:BB:EUTRa:TCW:GS:GENSignals <GeneratedSignal>

Determines the signal generated by the instrument.

Parameters:

<GeneratedSignal> WSIF1AWGN | IF23 | ALL | WSUE1UE2AWGN | WSUE3UE4 | IF

WSIF1AWGN
Wanted Signal, Interferer 1 and AWGN only; required in test setup with two instruments

IF23
Interferes 2 and 3 only; required in test setup with two instruments

ALL
The instrument generates all required signals

WSUE1UE2AWGN
Only Wanted Signal UE 1, Wanted Signal UE 2 and AWGN

WSUE3UE4
Only Wanted Signal UE 3 and Wanted Signal UE 4

IF
Interferer signal only

*RST: WSIF1AWGN

Manual operation: See "Generated Signal" on page 326

[: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 262

[:SOURce<hw>]:BB:EUTRa:TCW:GS:MODE <Mode>

Determines the measurements type, Pfa or Pd, the signal is generated for, see "Mode" on page 342.

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 342

[: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 261

[: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 260

[: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 260

[: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 260

[:SOURce<hw>]:BB:EUTRa:TCW:GS:SIGRout <SignalRouting>

Selects the signal routing for baseband A signal which usually represents the wanted signal.

Parameters:

<SignalRouting> PORTA | PORTB

*RST: PORTA

Example: `SOURce1:BB:EUTRa:TCW:GS:SIGRout PORTA`

Manual operation: See "Signal Routing" on page 262

[: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 is used; the trigger delay is set 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 261

[: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 in MHz: 20, 10, 5, 3, 1.4, 15, or 0.2 MHz.

Return values:

<ChanBandwidth> BW20_00 | BW10_00 | BW5_00 | BW3_00 | BW1_40 | BW15_00 | BW00_20

Usage: Query only

Manual operation: See "Channel Bandwidth" on page 272
See "Channel Bandwidth" on page 280

[: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 280

[: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 272
See "Duplexing" on page 280

[: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 281

[: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 narrowband EUTRA signal (`NEUTra`).
  The second interfering signal is always a CW signal (`CW`).

Parameters:

<InterfererType> NEUTra | EUTra | CW | UTRA

*RST: EUTra

Manual operation: See "Interferer Type" on page 278

[: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 280

[: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 280

[: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 271

[:SOURce<hw>]:BB:EUTRa:TCW:IS:OVRB?

Queries the offset VRB.

Return values:

<OffsetVRB> integer

Range: 0 to 75
*RST: 0

Usage: Query only

Manual operation: See "Offset VRB" on page 280

[: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 273
See "Power Level" on page 281

[: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 281

[: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 271
See "RF Frequency" on page 279

[: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 280

[: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 272

[: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 296

[: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 280

[: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> 1 | ON | 0 | OFF

*RST: 0

Manual operation: See "Transmit SRS" on page 312

[: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 305

[: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 304

[: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 305

[: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

[: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.

Parameters:

<Connector> NOFB | LOCal | GLOBal

*RST: LOCal

Manual operation: See "Connector" on page 304

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:MODE <Mode>

Determines the feedback mode.

Parameters:

<Mode> SER3X8 | SER | BIN

BIN
Binary ACK/NACK

SER
Serial

SER3X8
Serial 3x8

*RST: SER

Manual operation: See "Realtime Feedback Mode" on page 304

[: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 305

[: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 | TS36141_TC826 | TS36141_TC826A | TS36141_TC827 | TS36141_TC829 | TS36141_TC8310 | TS36141_TC8311 | TS36141_TC8312 | TS36141_TC8313 | TS36141_TC851 | TS36141_TC852 | TS36141_TC853

*RST: TS36141_TC72

Manual operation: See "Test Case" on page 260

[:SOURce<hw>]:BB:EUTRa:TCW:WS:ACPucch <AddConfigPUCCH>

Enables the optional transmission of PUCCH format 2.

Parameters:
<AddConfigPUCCH> 1 | ON | 0 | OFF
*RST: 0

Manual operation: See "Additionally Configure PUCCH" on page 319

[: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 | ANB24 | ANB64
*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 332

[:SOURce<hw>]:BB:EUTRa:TCW:WS:ANPattern? <BitCount>

In performance requirement test cases, queries the ACK/NACK + SR pattern bits.

Parameters:
<BitCount> integer
Range: 17 to 17
*RST: 17

Return values:
<AckNackPattern> numeric
*RST: #H00000

Example:
```
SOURce1:BB:EUTRa:TCW:TC TS36141_TC836
SOURce1:BB:EUTRa:TCW:WS:ANPattern?
// "00000000000000000"
```

Usage: Query only

Manual operation: See "ACK/NACK + SR Pattern" on page 332

[: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 343

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CHBW <ChanBandwidth>

Selects the channel bandwidth in MHz: 20, 10, 5, 3, 1.4, 15, or 0.2 MHz.

Parameters:

<ChanBandwidth> BW20_00 | BW10_00 | BW5_00 | BW3_00 | BW1_40 | BW15_00 | BW00_20

*RST: BW1_40

Manual operation: See "Channel Bandwidth" on page 265

[: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 265

[: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 265

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CQIPattern:PORT<ch0> <Pattern>, <BitCount>

In performance test cases, sets the CQI Pattern.

Parameters:

<Pattern> numeric

*RST: #HF

<BitCount> integer

Range: 4 to 4
*RST: 4

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 339

[: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 264

[: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 308

[: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 | A16 | A17 | A121 | A122 | A123 | A124 | A125 | A126 | A131 | A132 | A133 | A134 | A135 | A136 | A171 | A172 | A173 | A174 | A175 | A176 | A181 | A182 | A183 | A184 | A185 | A186 | A191 | A192 | A193 | A194 | A195 | A196 | A211 | A212 | A213 | A214 | A215 | A216 | A221 | A222 | A223 | A224

*RST: A11

Example: `SOURce1:BB:EUTRa:TCW:WS:FRC?`

Manual operation: See "FRC" on page 265

[:SOURce<hw>]:BB:EUTRa:TCW:WS:FROFfset <FreqOffset>

Sets the frequency offset.

Parameters:

<FreqOffset> FO_1340 | FO_625 | FO_270 | FO_0 | FO_200

*RST: FO_0

Manual operation: See "Frequency Offset" on page 343

[:SOURce<hw>]:BB:EUTRa:TCW:WS:HSMode <HighSpeedMode>

Enables/disables high-speed mode.

Parameters:

<HighSpeedMode> 1 | ON | 0 | OFF

*RST: 0

Manual operation: See "High Speed Mode" on page 342

[: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 264

[: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 327

[:SOURce<hw>]:BB:EUTRa:TCW:WS:OUPLevel <OutPowerLevel>

The settings of the selected test case become 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 274

[: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 265

[: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 265

[: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 319

[: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 319

[: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 | ETU5 | ETU200 | ETU1 | EPA1

*RST: EPA5

Manual operation: See "Propagation Conditions" on page 305

[: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 264

[: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 342

[: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 264

[: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 343

[: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 265

[:SOURce<hw>]:BB:EUTRa:TCW:WS:VDRFrequency <VirtDlRF>

Sets the virtual downlink frequency, used to calculate the UL Doppler shift.

Parameters:

<VirtDlRF> integer

Range: 100E+03 to 6E+09
*RST: 1E+09

Manual operation: See "Virtual Downlink RF Frequency" on page 318

[:SOURce<hw>]:BB:EUTRa:TCW:WS:NIOT:FRC <NBIOTFRC>

Sets the FRC of NPUSCH wanted signal (A16-1 to A16-5).

Parameters:

<NBIOTFRC> A161 | A162 | A163 | A164 | A165

*RST: A162

Example: `SOURce1:BB:EUTRa:TCW:WS:NIOT:FRC A163`

Options: R&S SMW-K115

Manual operation: See "FRC" on page 345

[:SOURce<hw>]:BB:EUTRa:TCW:WS:PFMT <PreambleFormat>

Selects the NPRACH preamble format for test case 8.5.3 according to tables 8.5.3.5-1 (FDD) or 8.5.3.5-2 (TDD) of TS 36.141.

Parameters:

<PreambleFormat> F0 | F1 | F2 | F0A | F1A | 0 | 1

*RST: F0

Example: `SOURce1:BB:EUTRa:TCW:WS:PFMT F1A`

Options: R&S SMW-K115

Manual operation: See "Preamble Format" on page 348

[:SOURce<hw>]:BB:EUTRa:TCW:WS:SCSPacing <SubcarrierSpac>

Sets the NB-IoT subcarrier spacing of 15 kHz or 3.75 kHz.

Parameters:

<SubcarrierSpac> S15 | S375

*RST: S15

Example: Set the subcarrier spacing of NB-IoT wanted signal to 3.75 kHz.

`SOURce1:BB:EUTRa:TCW:WS:SCSPacing S375`

Options: R&S SMW-K115

Manual operation: See "Subcarrier Spacing" on page 345

See "Subcarrier Spacing" on page 346

Annex

A Overview of EUTRA/LTE concepts reused by eMTC/NB-IoT

This section provides background information on the EUTRA/LTE technology.

This section is a short summary that explains only the terms and concept reused in the context of eMTC/NB-IoT. This section does not provide comprehensive description of the EUTRA/LTE technology.

Interdependency between channel bandwidth, FFT size and number of resource blocks

LTE physical layer parameterization is based on a bandwidth agnostic layer 1. 3GPP specifications, however, focus on a subset of channel bandwidths (see Table A-1).

The bandwidth is expressed as number of resource blocks in the range from 6 to 110 resource blocks (RB), which results in bandwidths from 1.08 MHz to 19.8 MHz.

Table A-1: Channel bandwidth according to 3GPP TS 36.804

Channel bandwidth	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Number of RBs	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**

TDD frame structure type 2

The TDD frame format 2 is 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 A-1).

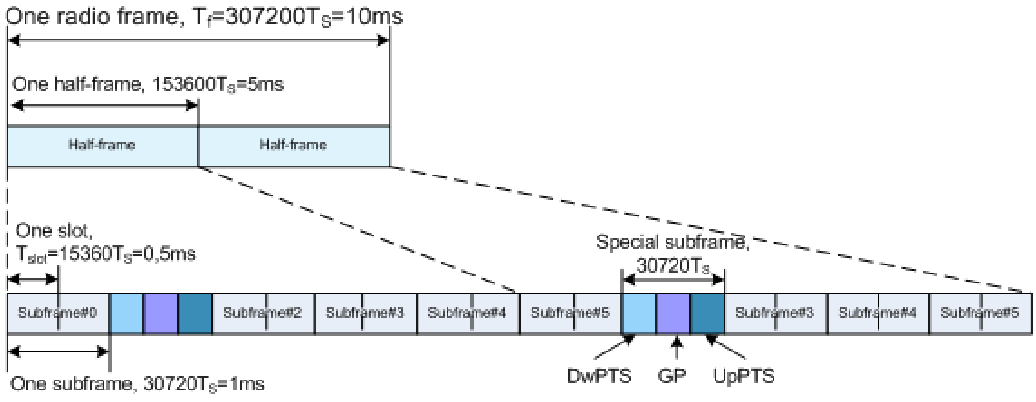


Figure A-1: Frame format 2 (TDD mode), 5 ms switching periodicity

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). The length of these fields can vary in specified limits so that the total special subframe's length is maintained constant (1 ms). The 3GPP specification defines 10 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. UpPTS and the subframe following the special subframe are always reserved for uplink transmission.

Figure A-2 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 A-2: Uplink-downlink configurations

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

Transmission of uplink control information (UCI)

According to the LTE specifications, one of the following channels carries the uplink control information depending on whether an uplink resource has been assigned to the UE or not:

- 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 UE 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 UE has not been assigned an UL-SCH transmission. The PUCCH is transmitted on a reserved frequency region at the edges of the total available UL bandwidth. 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 A-3 [TS 36.211].

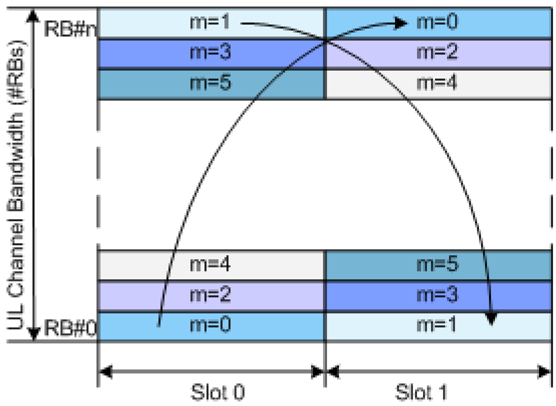


Figure A-3: PUCCH mapping

TS 36.211 specifies seven PUCCH formats, see Table A-2.

Table A-2: PUCCH formats

PUCCH format	Description	Physical bits	Modulation scheme	ODFM symbols used for DMRS (normal CP)	ODFM symbols used for DMRS (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
1b	ACK/NACK for MIMO ACK/NACK + SR	2 4	QPSK	2, 3, 4	2, 3

PUCCH format	Description	Physical bits	Modulation scheme	ODFM symbols used for DMRS (normal CP)	ODFM symbols used for DMRS (extended CP)
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 cells) ACK/NACK + SR	48	QPSK	1, 5	3

*) eMTC does not support PUCCH formats 3, 4 and 5

The different PUCCH formats are mapped to the reserved PUCCH region. The mapping is performed 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 UEs 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, three different orthogonal cover sequences (OC) can also be used. For the different PUCCH formats, different number of PUCCH resource indices are available within a resource block (see Table A-3). The actual number of the used orthogonal sequences is also determinated by the parameter delta_shift, used to support working in different channel conditions.

Table A-3: PUCCH resource indices per PUCCH format

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

*) eMTC does not support PUCCH formats 3, 4 and 5

Uplink reference signal (RS) 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 equipment (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 requires 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 three SRS sets.

Glossary: 3GPP specifications, references

Symbols

1MA266: Rohde&Schwarz
White Paper 1MA266 “Narrowband Internet of Things”

1MA296: Rohde&Schwarz
White Paper 1MA296 “Narrowband Internet of Things Measurements”

T

TS 36.141: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) 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 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification"

TS 36.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)"

TS 36.521: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1, 2, 3"

List of commands

Index

A

B

C

D

E

F

G

U

V

W