Rohde & Schwarz products: R&S®SMU200A, R&S®SMJ100A, R&S®SMATE vector signal generators, R&S®FSQ signal analyzer, R&S®FSU, R&S®FSP spectrum analyzers, R&S®FSMR measuring receiver, R&S®FSUP signal source analyzer

TD-SCDMA Test Signals in Accordance with Standards TS 34.122 and TS 25.142

Application Note 1MA104

Application Note 1MA104 shows you how to quickly and easily create TD-SCDMA test signals for user equipment and base station tests as stipulated in the standards TS 34.122 and TS 25.142.

ROHDE&SCHWARZ

Subject to change – Detlev Liebl – May 2007 – 1MA104_0E

Contents

The following abbreviations are used in this Application Note for Rohde & Schwarz test equipment:

- The R&S®SMU200A vector signal generator is referred to as the SMU.
- The R&S®SMJ100A vector signal generator is referred to as the SMJ.
- The R&S®SMATE vector signal generator is referred to as the SMJ.
- The R&S®FSQ signal analyzer is referred to as the FSQ.
- The R&S®FSU spectrum analyzer is referred to as the FSU.
- The R&S®FSP spectrum analyzer is referred to as the FSP.
- The R&S®FSMR measuring receiver is referred to as the FSMR.
- The R&S®FSUP signal source analyzer is referred to as the FSUP.

You can generate all test signals described below with either SMU, SMJ, or SMATE. You can analyze them with either FSQ, FSU, FSP, FSMR, or FSUP. To simplify the reading only 'SMU' and 'FSQ' are used on the following pages.

1 Overview

When dealing with downlink and uplink signals of advanced mobile radio standards, several physical and logical channels are usually active at the same time. There is a variety of channel combinations, and the individual channels have individual settings. Even if two signals seem to be identical in the spectrum, they may significantly differ with regard to crest factor or peak code domain error.

Tests on mobile radio devices with different channel configurations therefore usually result in quite different test results. This is not acceptable for conformance tests, which is why all advanced mobile radio standards provide very exact specifications for the applicable test signals. The standards also specify which test signals are to be used for each test and which limits are valid for the individual test signals.

This Application Note shows you how to quickly and easily create TD-SCDMA test signals for user equipment and base station tests as stipulated in the standards TS 34.122 and TS 25.142.

The following sections first introduce the uplink and downlink reference measurement channels (RMCs).

The signals for the performance tests, which are then described, use these RMCs; but further fill channels are added to simulate intracell interferers.

Intercell interferers, simulating traffic from neighboring cells, are imitated by additional white Gaussian noise (AWGN). A separate section shows you how to create this signal.

The simulation of multipath conditions will be described at the end of the Application Note.

Note: Application Note 1MA104 refers to ETSI TS 34.122 version 5.3.0 Release 5, and ETSI TS 25.142 version 7.3.0 Release 7.

2 Uplink RMC 12.2 kbps for TX and RX Tests

UL RMC 12.2 is the "simplest" test signal in the TD-SCDMA standard. It is used for all tests that mainly check the RF characteristics, i.e. power measurement, frequency and spectrum measurement, as well as RX sensitivity tests.

To create UL RMC 12.2, start from the SMU diagram window:

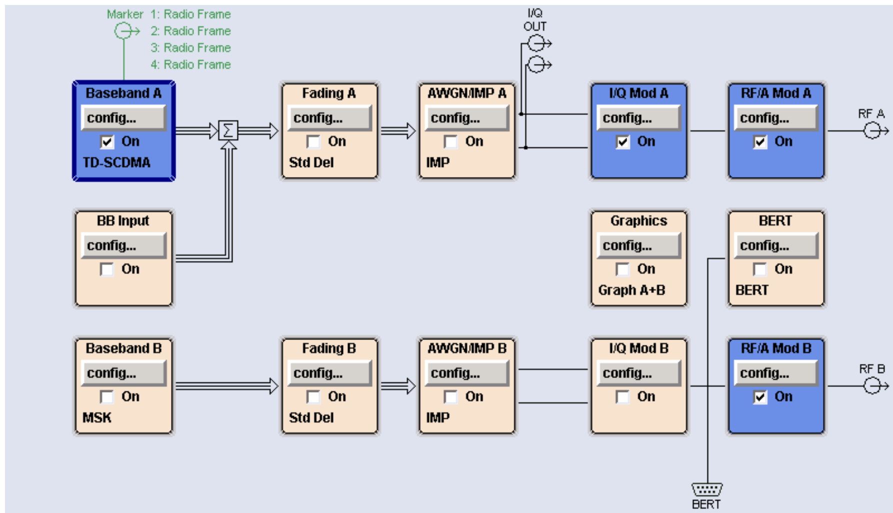

Fig. 2_1: Function blocks in the SMU (diagram window)

➢ In the *Baseband A* function block, click *config.*

When selecting the standards (Fig. 2_2)

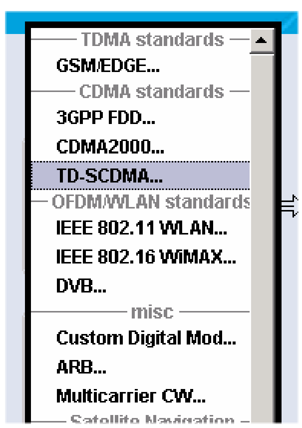

Fig. 2_2: Selecting the standard

➢ Choose *TD-SCDMA*.

The following menu is displayed:

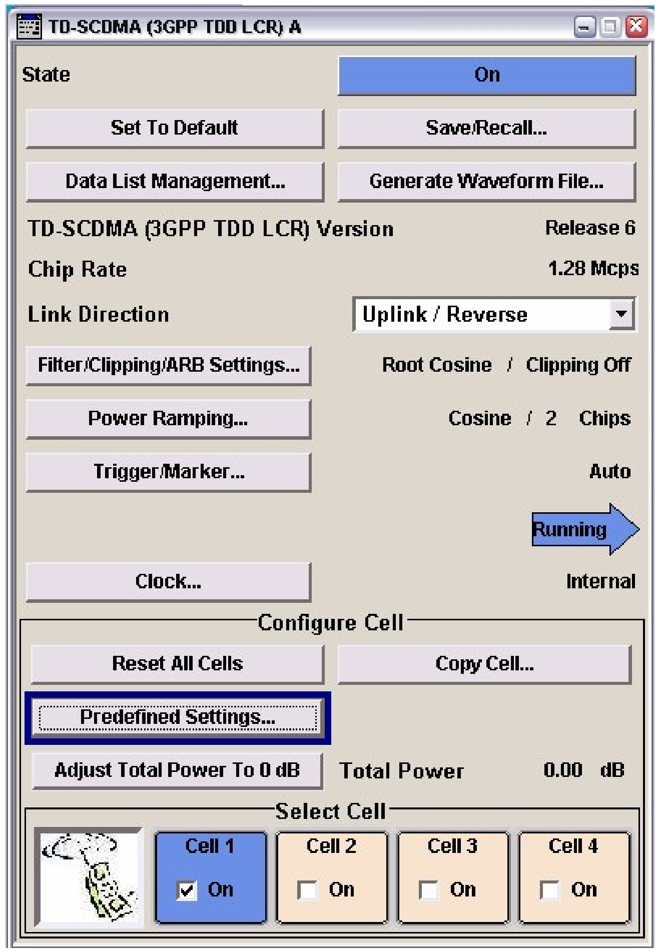

Fig. 2_3: Basic TD-SCDMA menu

- Switch *State to On.*
- Set *Link Direction* to *Uplink / Reverse*.
- Select *Reset All Cells*.
- Select *Predefined Settings*.

The following window is displayed (Fig. 2_4):

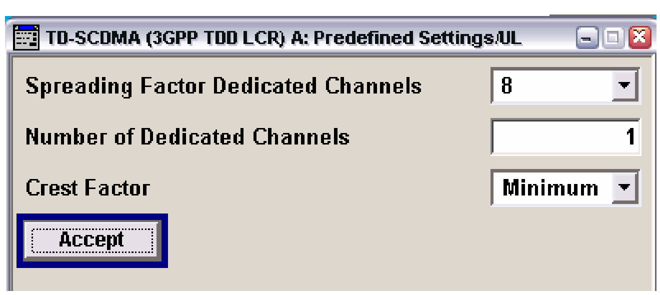

Fig. 2_4: Predefined settings for uplink

- Enter 8 as *Spreading Factor*.
- Set *Number of Dedicated Channels* to 1.
- Select *Accept*.
- Close the window.

You are again in the basic TD-SCDMA menu (Fig. 2_5).

Now specify the individual channels.

- Select *Cell 1*.

The following window is displayed.

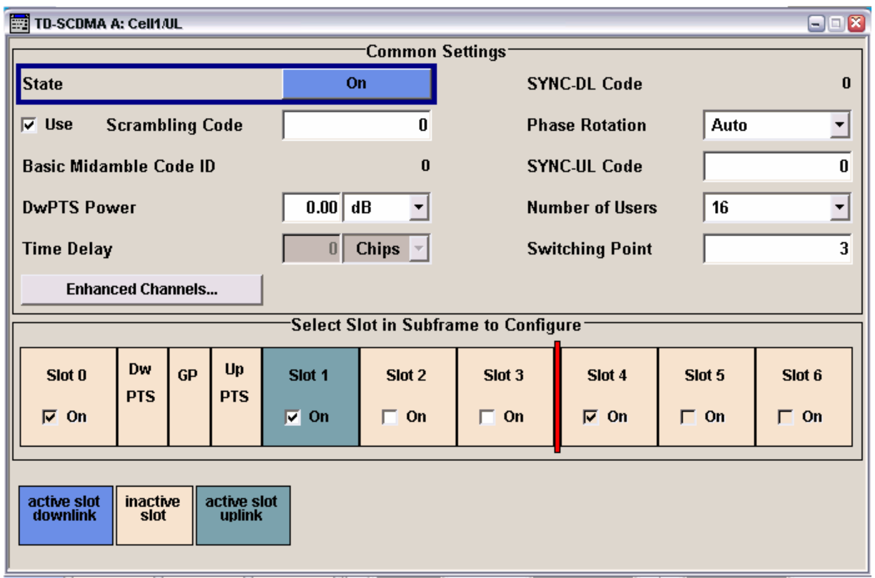

Fig. 2_5: TD-SCDMA slot menu of the SMU

- Switch *State to On*.
- Select *Enhanced Channels*.

The menu shown by Fig. 2_6 is displayed. Use it to configure the RMC that is calculated by the SMU in realtime.

- Switch *State to On* for the dedicated channels (DCHs).
- Select RMC 12.2 kbps.

Slot 1 - the first uplink slot - is thus enabled.

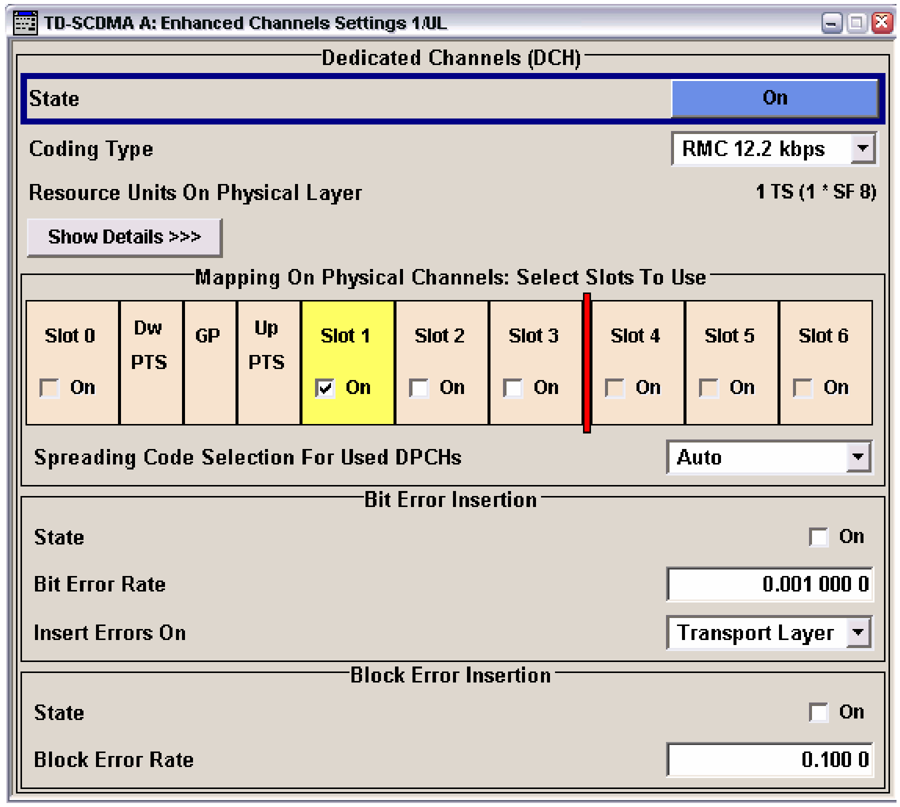

Fig. 2_6: Specifying the RMC

➢ Close the window.

You are again in the TD-SCDMA slot menu (Fig. 2_5).

Power of code channels

➢ Select *Slot 1* in the TD-SCDMA slot menu.

The following window is displayed.

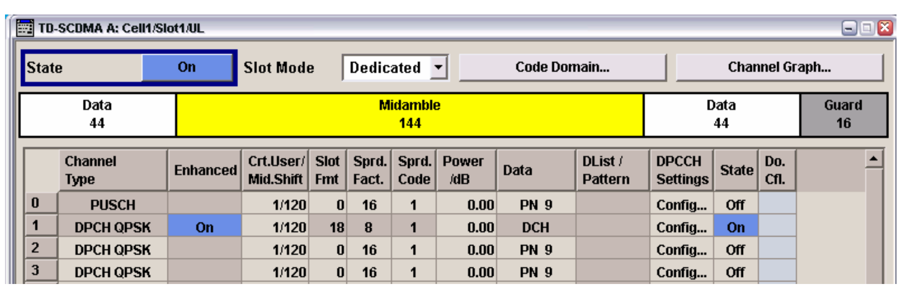

Fig. 2_7: Channel configuration in slot 1

UL RMC 12.2 (SF 8) occupies one (enhanced) code channel.

➢ Enter the relative *Power* for the DPCH.

The relative level relates to the absolute total SMU level (displayed at the top right of the SMU screen).

Fig. 2_8: Display of absolute total SMU level

With the entry of *0 dB* in Fig. 2_7, the slot power is the total SMU level.

➢ Close the window.

You have now established UL RMC 12.2 in accordance with the TS 25.142 standard. If the RF output stage of the SMU is switched on, the TD-SCDMA signal is provided at the RF connector. Fig. 2_9 and Fig. 2_10 show the test signal on the analyzer.

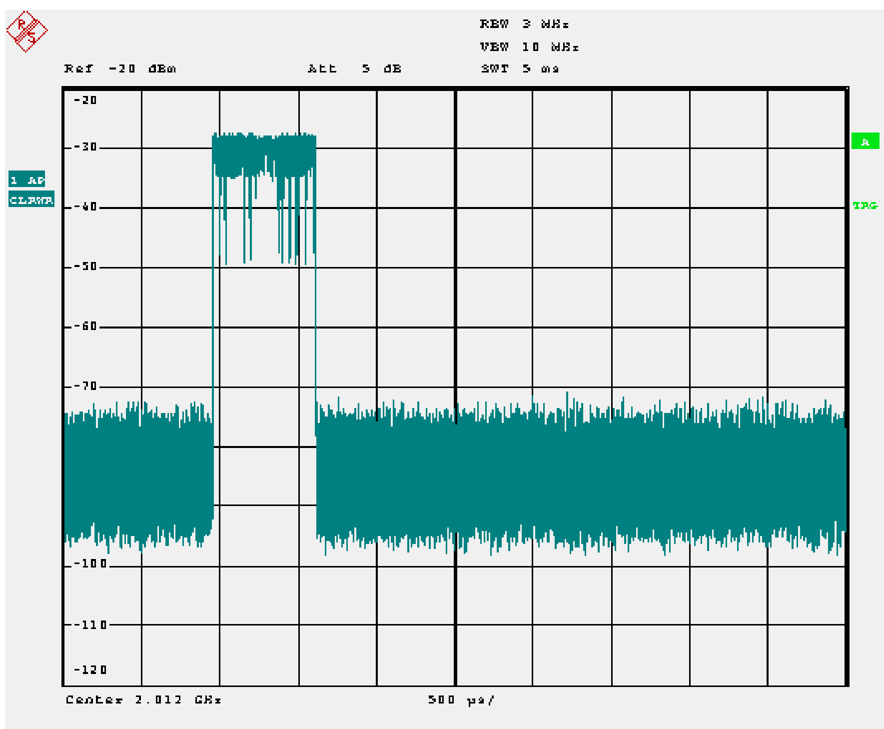

Fig. 2_9: Power versus time of the UL RMC 12.2. The analyzer shows 1 frame. It was triggered at the start of the frame. The RMC uses slot 1.

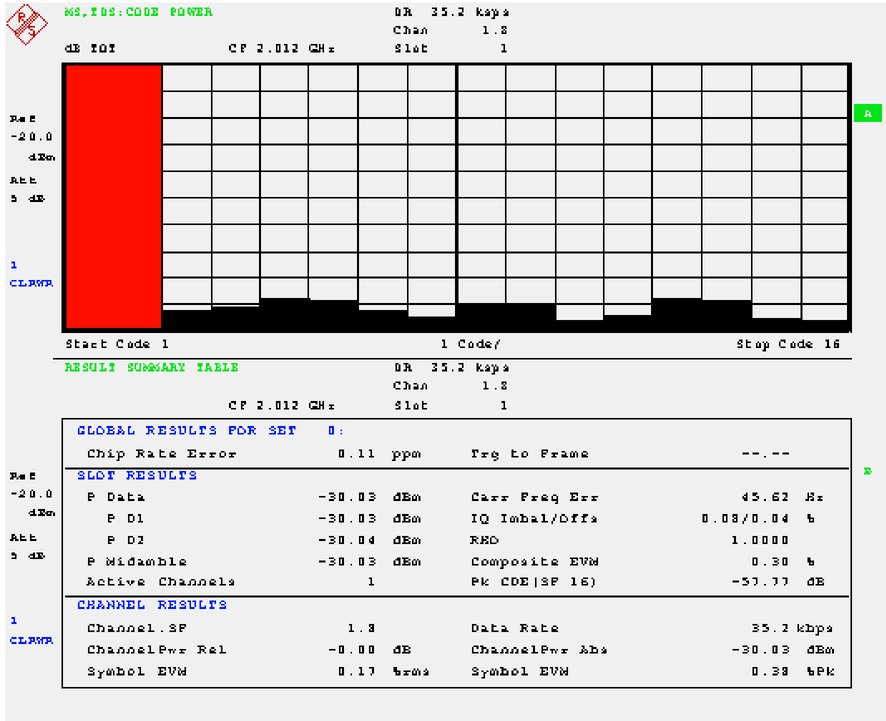

Fig. 2_10: Code Domain representation and numeric measurement results of the UL RMC 12.2. The RMC 12.2 has a brutto data rate of 35.2 kbps. It uses 1 code channel with spreading factor 8.

3 Downlink RMC 12.2 kbps for TX and RX Tests

The DL RMC is created in the same way as the UL RMC. But you additionally set the two control channels PCCPCH1 and 2 in slot 0 as well as the DL pilot signal.

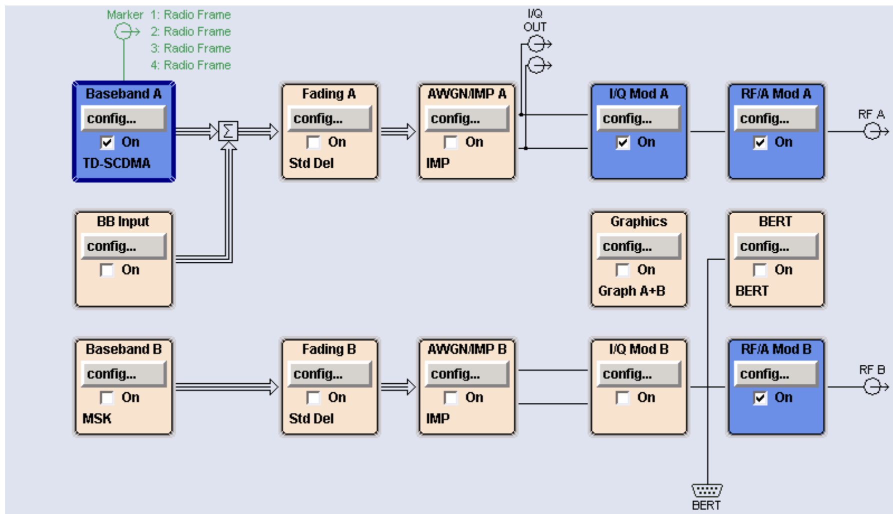

Fig. 3_1: Function blocks in the SMU (diagram window)

➢ In the diagram window (Fig. 3_1), click *config* in the *Baseband A* block.

When selecting the standards (Fig. 3_2)

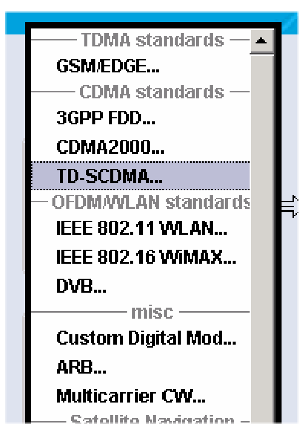

Fig. 3_2: Selecting the standard

➢ Choose *TD-SCDMA*.

The following menu is displayed:

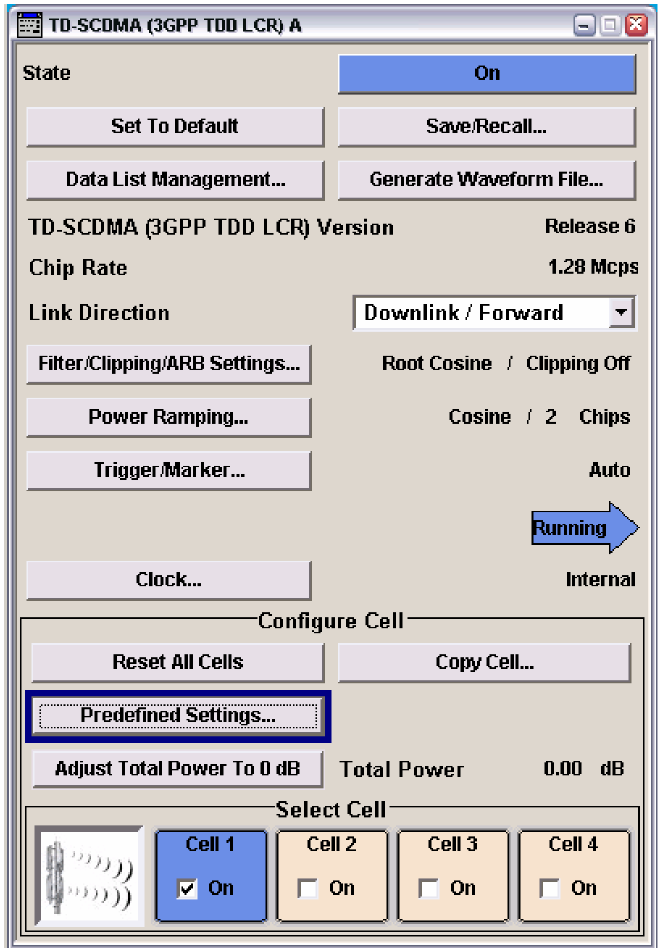

Fig. 3_3: Basic TD-SCDMA menu

- Switch *State to On.*
- Set *Link Direction* to *Downlink / Forward*.
- Select *Reset All Cells.*
- Select *Predefined Settings*.

The following window is displayed (Fig. 3_4).

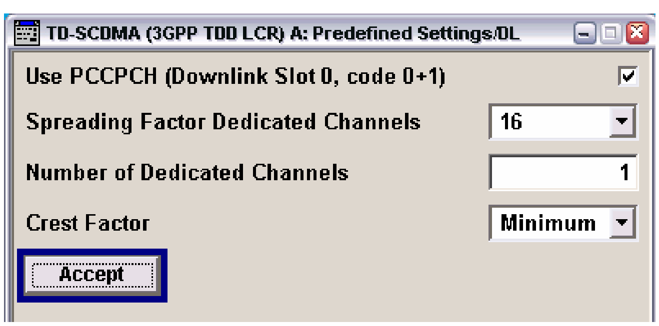

Fig. 3_4: TD-SCDMA predefined settings in slot 0.

At first establish the two control channels PCCPCH1 and 2 in slot 0 (the RMC will be set up afterwards in slot 4).

- ➢ Enable the checkbox *Use PCCPCH*.

Then

- ➢ Enter 16 as *Spreading Factor*.
- ➢ Set *Number of Dedicated Channels* to 1.
- ➢ Select *Accept*.
- ➢ Close the window.

You are again in the basic TD-SCDMA menu (Fig. 3_3).

Now specify the individual channels.

- ➢ Select *Cell 1*.

The following window is displayed.

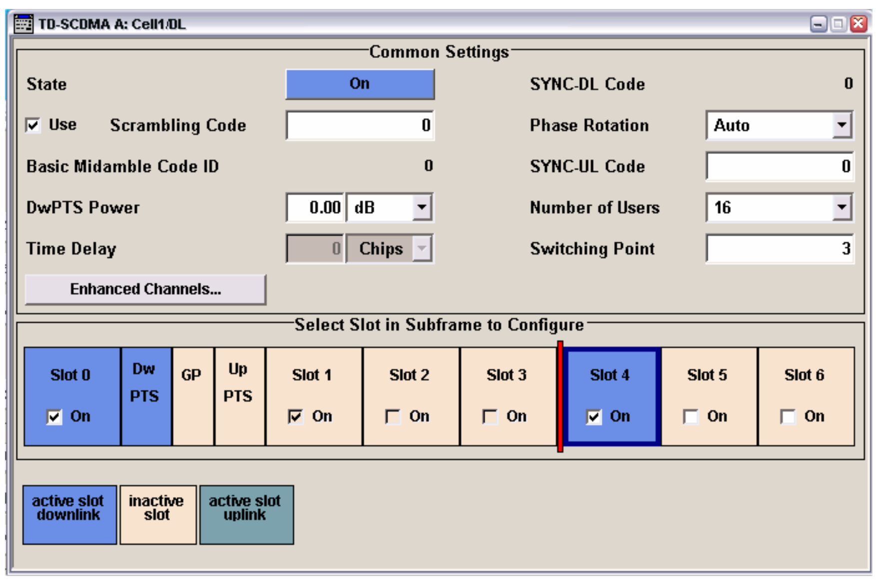

Fig. 3_5: TD-SCDMA slot menu of the SMU

- ➢ Switch *State to On*.
- ➢ Select *Enhanced Channels*.

The menu of Fig. 3_6 is displayed. There you can configure the channels that are calculated in realtime in the SMU: the broadcast channels (BCH) with a continuous system frame number (SFN) in slot 0 and the RMC in slot 4.

- ➢ Switch *State to On* for the broadcast channels (BCHs).
- ➢ Switch *State to On* for the dedicated channels (DCHs).
- ➢ Select RMC 12.2 kbps.

The downlink slots number 0, pilot (PTS), and number 4 are thus enabled.

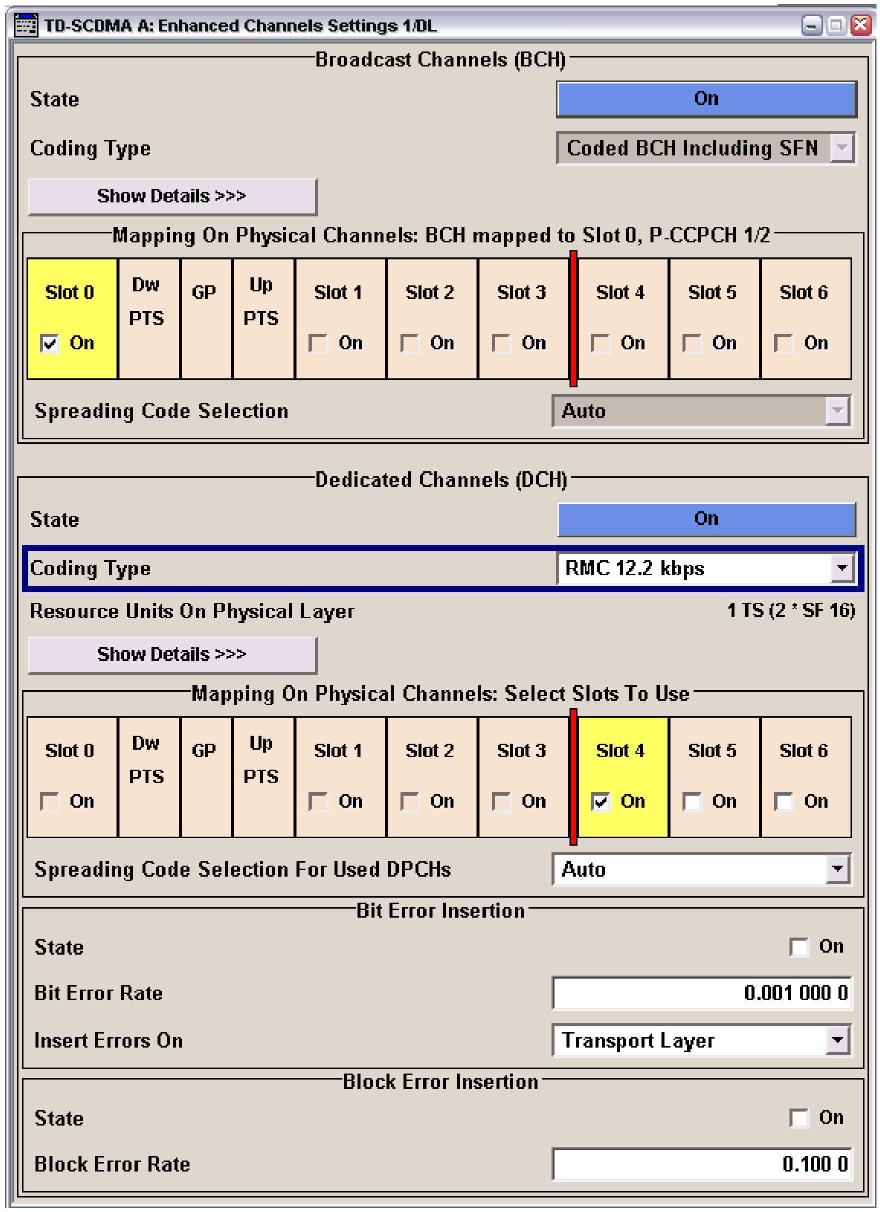

Fig. 3_6: Specifying enhanced channels

➢ Close the window.

You are again in the TD-SCDMA slot menu (Fig. 3_5).

Power of the code channels

Now define the levels of the individual channels. These levels are relative to the absolute total SMU level (displayed at the top right of the SMU screen, Fig. 3_7).

Fig. 3_7: Display of the absolute total SMU level

Note: If the individual slots have a different power, the total SMU level displays the power of the most powerful slot.

First enter the relative levels of the channels in slot 0. In the TD-SCDMA slot menu (Fig. 3_8)

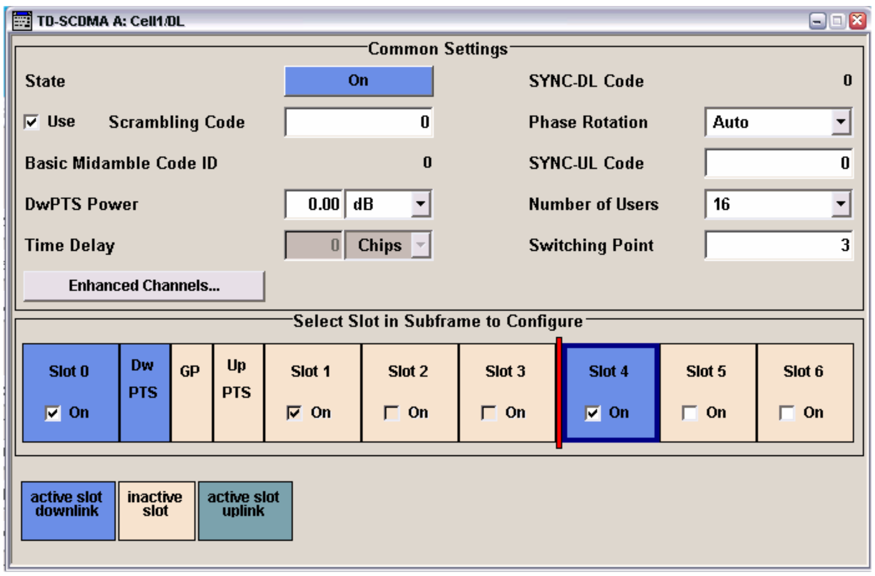

Fig. 3_7: TD-SCDMA slot menu of the SMU

➢ Select *Slot 0.*

The following window is displayed.

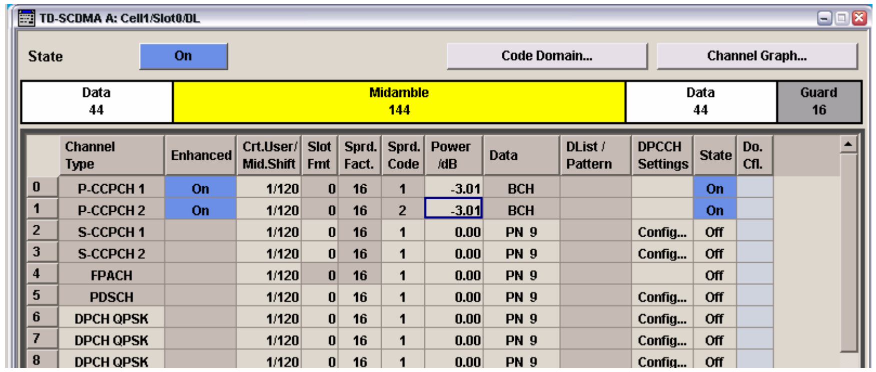

Fig. 3_9: Channel configuration in slot 0

➢ Enter the *Power* of the P-CCPCHs relative to the absolute total SMU power

With the entry of *-3.01 dB* for each of the two P-CCPCHs, the total power in slot 0 exactly corresponds to 0 dB, i.e. the absolute total SMU power.

➢ Close the window.

Now specify the level of RMC 12.2 kbps in slot 4.

➢ Select *Slot 4* in the TD-SCDMA slot menu.

The following window is displayed.

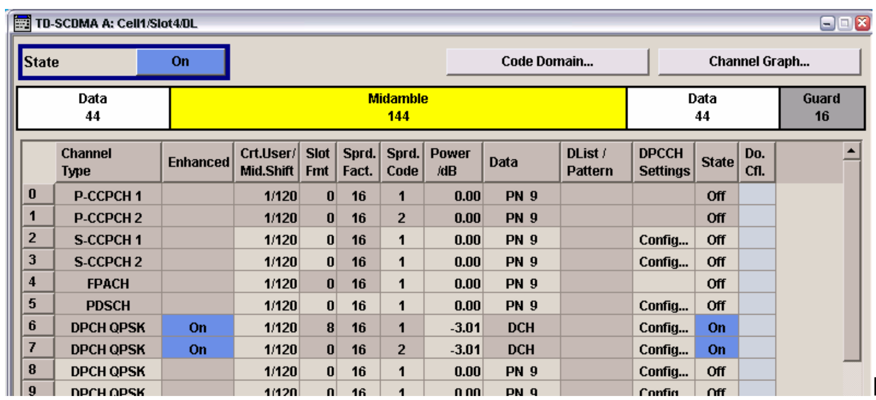

Fig. 3_10: Channel configuration in slot 4

DL RMC 12.2 (SF 16) occupies two code channels.

➢ Enter the relative *Power*.

With the entry of *-3.01 dB* for each of the two code channels, the total power in slot 4 (similar to slot 0) corresponds to the absolute total SMU power.

➢ Close the window.

You have now established DL RMC 12.2 in accordance with the TS 34.122 standard. Íf the RF output stage of the SMU is switched on, the TD-SCDMA signal is provided at the RF connector. Fig. 3_11 to Fig. 3_13 show the test signal on the analyzer.

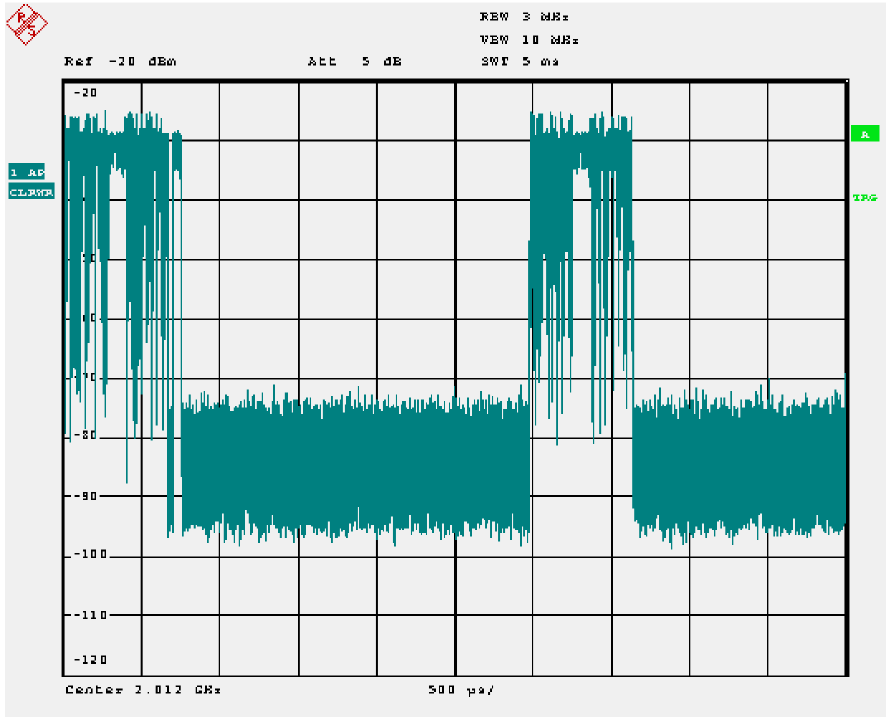

Fig. 3_11: Power versus time of the DL RMC 12.2. The analyzer shows 1 frame. It was triggered at the start of the frame. Slot 0 is occupied by the PCCPCH. It is followed by the short downlink pilot slot. The RMC appears in slot 4.

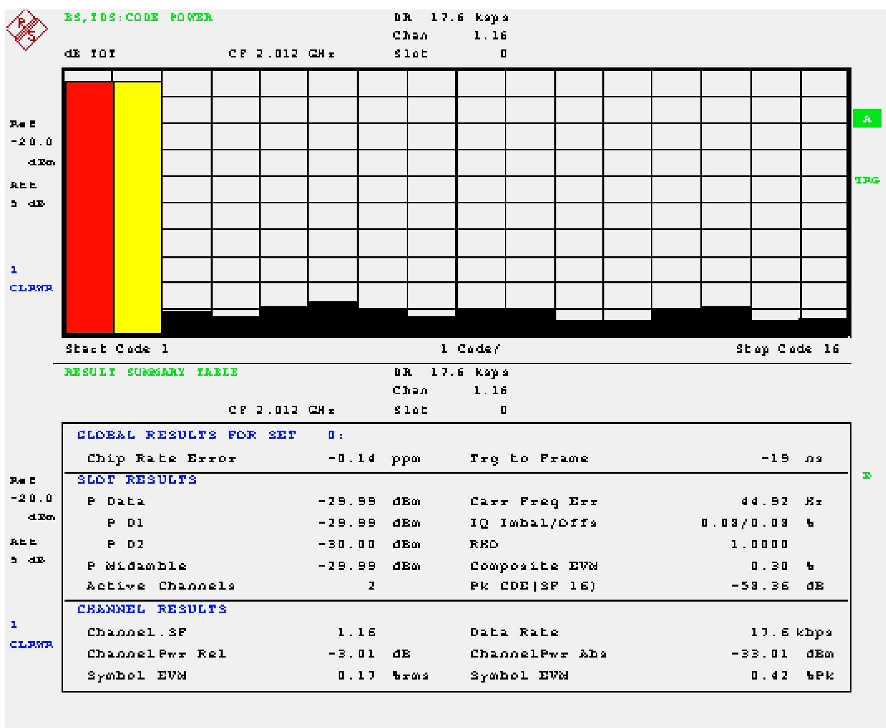

Fig. 3_12: Code Domain representation and numeric measurement results of slot 0. You see the PCCPCH1 and 2, each with spreading factor 16.

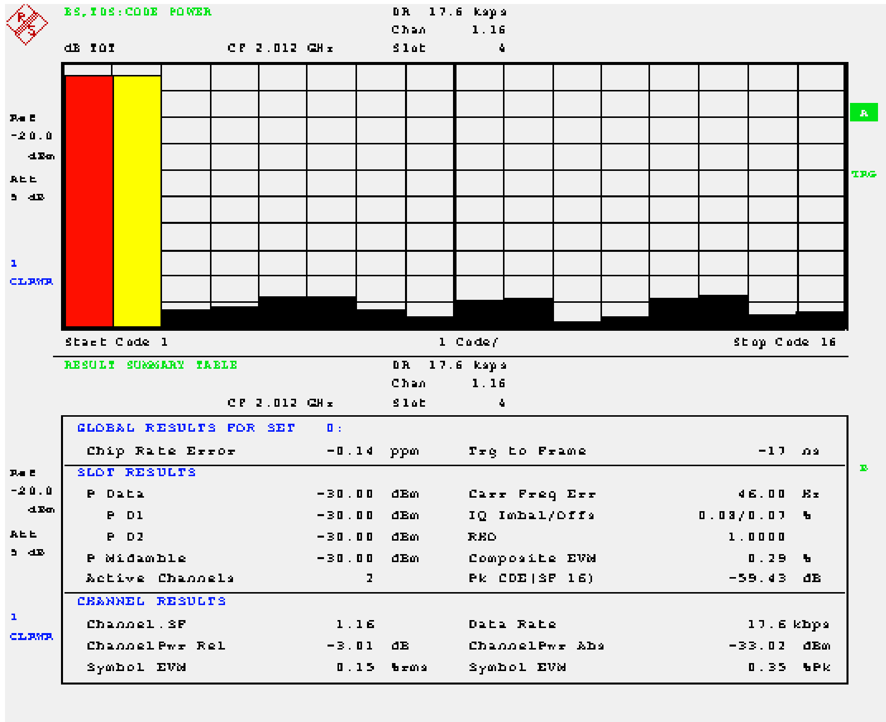

Fig. 3_13: Code Domain representation and numeric measurement results of the downlink data in slot 4. The DL RMC 12.2 uses two code channels, each with spreading factor 16.

4 Test Signals for UE Performance Tests

Overview

UE performance tests are block error (BLER) measurements on downlink RMCs. There are (sub-)tests for data rates of 12.2 kbps, 64 kbps, 144 kbps, and 384 kbps.

An RMC is always composed of a number of code channels (DPCHs). In addition to these DPCHs, further $DPCH_0$ fill channels are superimposed as intracell interferers.

Table 4_1 provides the combinations of DPCH and $DPCH_0$ for each data rate. The ratios of DPCH and $DPCH_0$, the codes that are used, and the relative power of the channels are the same for all UE performance tests.

	Unit	Sub-Test 1	Sub-Test 2	Sub-Test 3	Sub-Test 4
Information Data Rate / RMC	kbps	12.2 RMC 12.2	64 RMC 64	144 RMC 144	384 RMC 384
Number of DPCH		2	8	16 / 2 slots	40 / 4 slots
Number of $DPCH_0$		8	2	4 / 2 slots	0
DPCH Channelization Codes	C(k,Q)	C(i,16) i = 1, 2	C(i,16) i = 1...8	C(i,16) i = 1...8	C(i,16) i = 1...10
$DPCH_0$ Channelization Codes	C(k,Q)	C(i,16) i = 3...10	C(i,16) i = 9, 10	C(i,16) i = 9, 10	-

Table 4_1: Channel configurations for UE performance tests

Fig. 4_2 shows the channel combinations graphically:

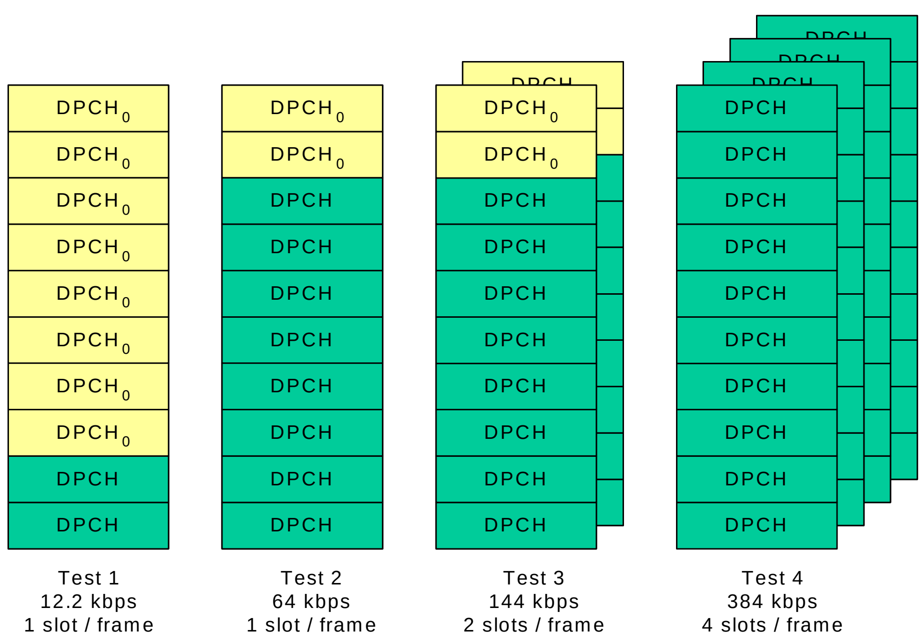

Fig. 4_2: Code channel combinations for UE performance tests

Test 1 with RMC 12.2 kbps uses two DPCH channels (two codes) in one timeslot per frame. Eight $DPCH_0$ fill channels (eight codes) are added.

Test 2 with RMC 64 kbps uses eight DPCH channels in one timeslot per frame. Two $DPCH_0$ fill channels are added.

Test 3 with RMC 144 kbps uses 16 DPCHs in two timeslots per frame (two times eight codes). Two $DPCH_0$ fill channels per slot are added.

Test 4 with RMC 384 kbps uses 40 DPCHs in four timeslots per frame (four times ten code channels). No $DPCH_0$ channels are added.

In all tests, ten codes channels are present in the active slot(s). All channels use a spreading factor of 16 and, with -10 dB, equally contribute to the total power.

Note: DPCH and $DPCH_0$ channels represent a coded TD-SCDMA signal. For the performance tests, uncorrelated AWGN is also superimposed, and different multipath propagation conditions (fading) are simulated. For further information on generating the AWGN, see section *Generating an AWGN Signal* on page 39. For activating fading functions in the generator, see section *Generating Multipath Fading Signals* on page 44.

The structure of the TD-SCDMA signal - as described in table 4_1 - is the same for all UE performance tests in the TS 34.122 standard. The test signals only differ in the levels of TD-SCDMA signal and AWGN, and in the selection of the fading profile.

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Step by step

This section shows the required steps for generating the DPCH and $DPCH_0$ channels as described in table 4_1.

To allow DUT synchronization, you also generate the two primary common control physical channels P-CCPCH 1/2 in timeslot 0, and the downlink pilot signal.

The generation of the test signals is similar to that described for RX measurements.

You start in the diagram window of the SMU:

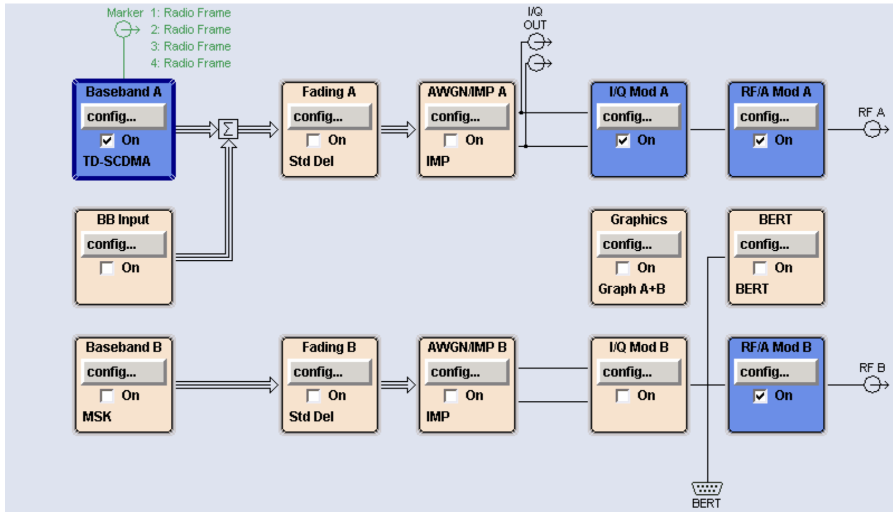


Fig. 4_3: Function blocks in the SMU (diagram window)

➢ In the diagram window (Fig. 4_3), click *config* in the *Baseband A* block

When selecting the standards (Fig. 4_4)

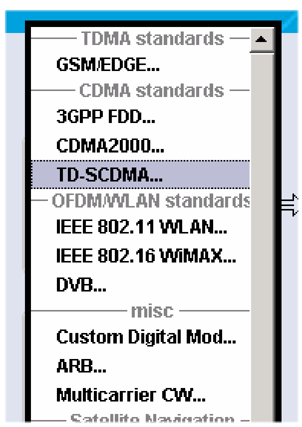


Fig. 4_4: Selecting the standard

➢ Choose *TD-SCDMA*.

The following menu is displayed:

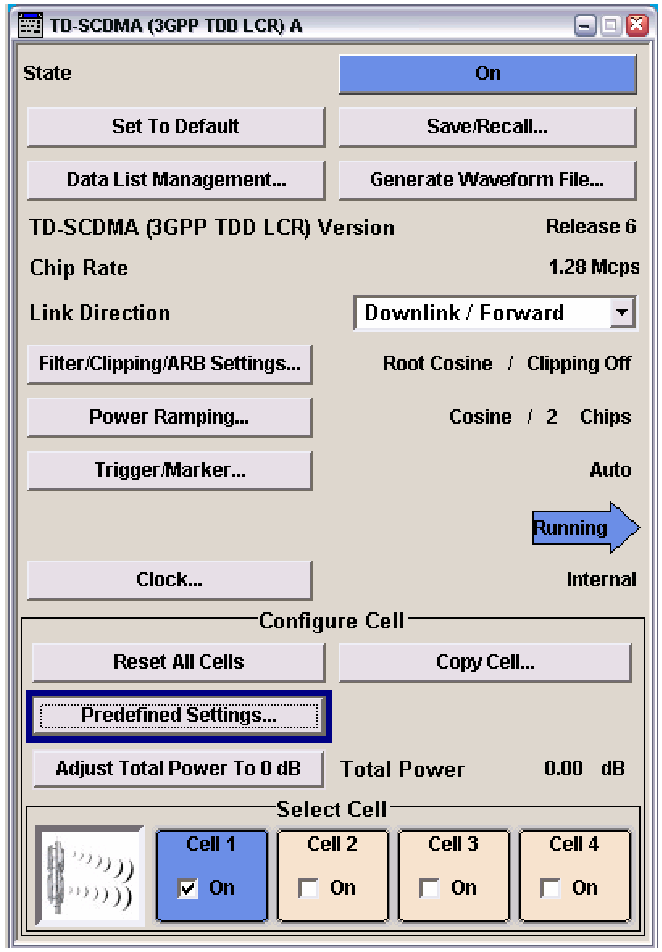


Fig. 4_5: Basic TD-SCDMA menu

- Switch *State to On.*
- Set *Link Direction* to *Downlink/Forward*.
- Select *Reset All Cells*.
- Select *Predefined Settings*.

The following window is displayed.

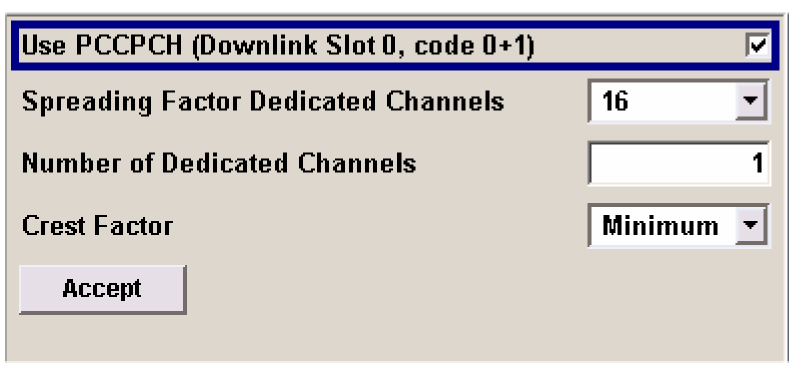


Fig. 4_6: Predefined settings for downlink

- Enable the *Use PCCPCH* checkbox.

- Enter 16 as *Spreading Factor*.
- Set *Number of Dedicated Channels* to 1.
- Click *Accept*.
- Close the window.

Now specify the individual channels:

- In the basic TD-SCDMA menu, double-click *Cell 1*.

The following window is displayed.

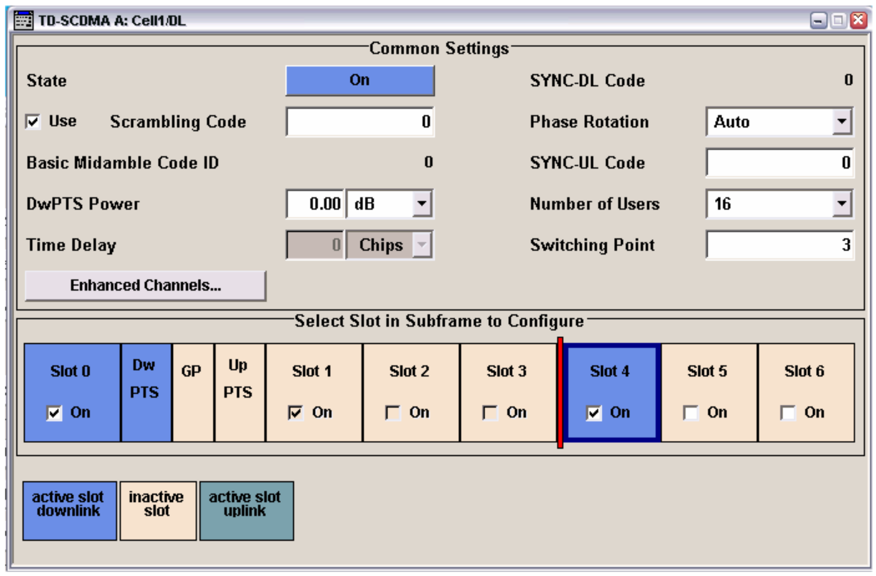


Fig. 4_7: TD-SCDMA slot menu of the SMU

- Switch *State to On*.
- Select *Enhanced Channels*.

The menu of Fig. 3_8 is displayed. Configure the broadcast channels (BCH) with a continuous system frame number (SFN) in slot 0 and the RMC in slot 4. These channels are calculated in realtime.

- Switch *State to On* for the broadcast channels (BCHs).
- Switch *State to On* for the dedicated channels (DCHs).
- Select the suitable RMC for your test.

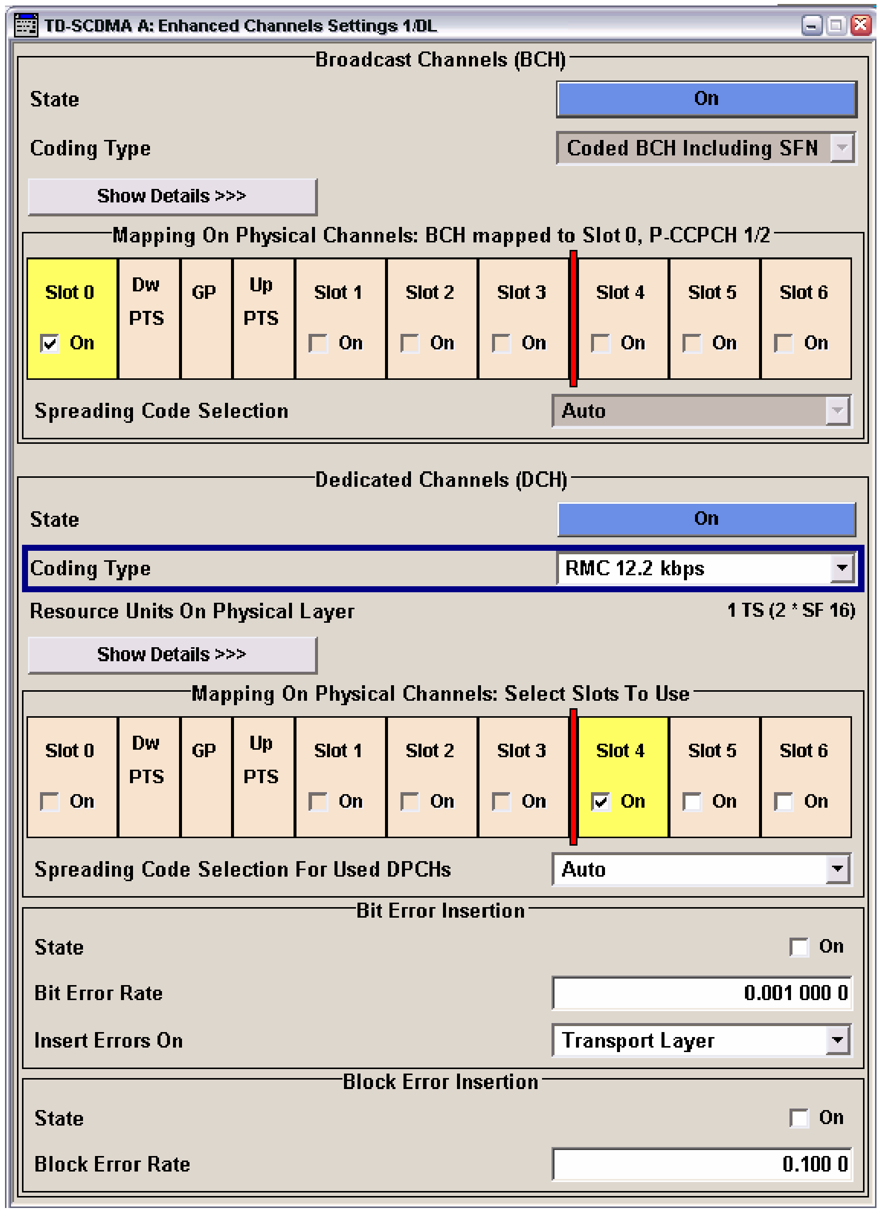


Fig. 4_8: Specifying enhanced channels

Only slot 4 is enabled for RMC 12.2 and RMC 64. The selection of RMC 144 kbps enables the two slots 4 and 5. For 384 kbps, the switching point is shifted to position 2, and the four slots 3 to 6 are enabled.

➢ Close the window.

You are again in the TD-SCDMA slot menu (Fig. 4_7).

Now set the level of the two control channels PCCPCH1 and 2 in slot 0:

➢ Select *Slot 0* in the TD-SCDMA slot menu.

The following window is displayed.

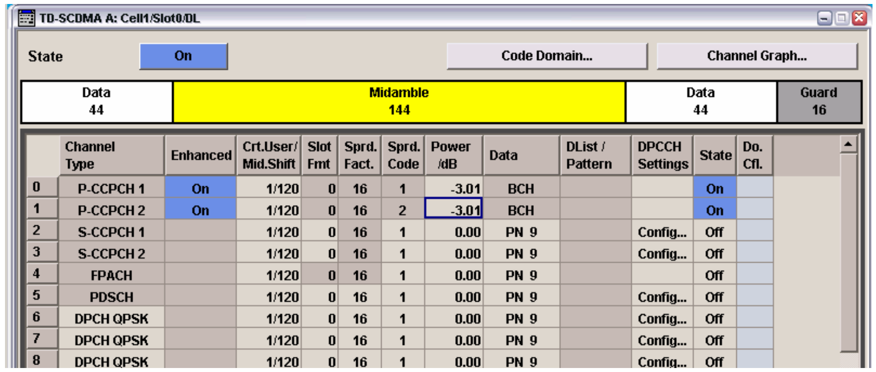


Fig. 4_9: Channel configuration in slot 0

- ➢ Enter the relative *Power*.

Enter the levels relative to the absolute total SMU level (displayed at the top right of the SMU screen). With the entry of *-3.01 dB* for each of the two P-CCPCHs, the total power in slot 0 corresponds to the absolute total SMU power.

- ➢ Close the window.

Now specify the DPCH and $DPCH_0$ channels:

- ➢ Select *Slot 4* in the TD-SCDMA slot menu.

The following window is displayed for 12.2 kbps:

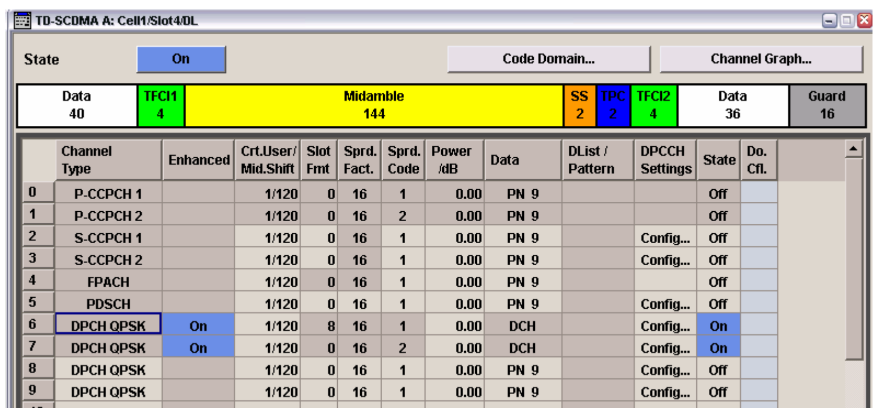
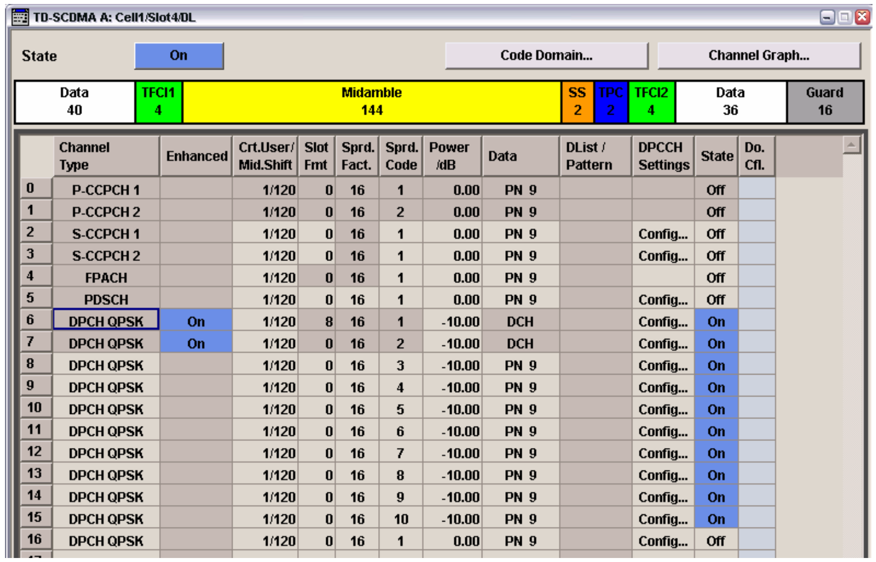


Fig. 4_10: Channel configuration in slot 4 for RMC 12.2 kbps.

DL RMC 12.2 (SF 16) uses two enhanced code channels.

- ➢ Activate another eight channels ($DPCH_0$ fill channels).
- ➢ Enter continuous spreading *codes*.
- ➢ Set the relative *power* in each channel to -10 dB.

Fig. 4_11 shows the complete configuration for test 1 (RMC 12.2):

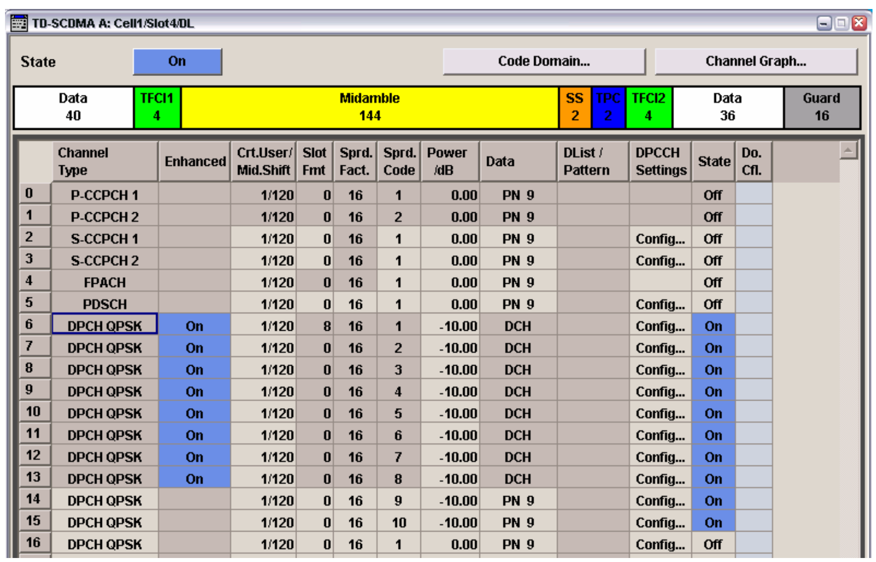


	Channel Type	Enhanced	Crt.User/ Mid.Shift	Slot Fmt	Sprd. Fact.	Sprd. Code	Power /dB	Data	DList / Pattern	DPCCH Settings	State	Do. Cfl.
0	P-CCPCH 1		1/120	0	16	1	0.00	PN 9			Off	
1	P-CCPCH 2		1/120	0	16	2	0.00	PN 9			Off	
2	S-CCPCH 1		1/120	0	16	1	0.00	PN 9		Config...	Off	
3	S-CCPCH 2		1/120	0	16	1	0.00	PN 9		Config...	Off	
4	FPACH		1/120	0	16	1	0.00	PN 9			Off	
5	PDSCH		1/120	0	16	1	0.00	PN 9		Config...	Off	
6	DPCH QPSK	On	1/120	8	16	1	-10.00	DCH		Config...	On	
7	DPCH QPSK	On	1/120	0	16	2	-10.00	DCH		Config...	On	
8	DPCH QPSK		1/120	0	16	3	-10.00	PN 9		Config...	On	
9	DPCH QPSK		1/120	0	16	4	-10.00	PN 9		Config...	On	
10	DPCH QPSK		1/120	0	16	5	-10.00	PN 9		Config...	On	
11	DPCH QPSK		1/120	0	16	6	-10.00	PN 9		Config...	On	
12	DPCH QPSK		1/120	0	16	7	-10.00	PN 9		Config...	On	
13	DPCH QPSK		1/120	0	16	8	-10.00	PN 9		Config...	On	
14	DPCH QPSK		1/120	0	16	9	-10.00	PN 9		Config...	On	
15	DPCH QPSK		1/120	0	16	10	-10.00	PN 9		Config...	On	
16	DPCH QPSK		1/120	0	16	1	0.00	PN 9		Config...	Off	

Fig. 4_11: Channel configuration in slot 4 for test 1. Test 1 with 12.2 kbps uses two codes (enhanced code channels) for the DPCH in one timeslot per frame. Eight $DPCH_0$ channels are added. The power of each channel is one tenth (-10 dB).

➢ Close the window.

Fig. 4_12 shows the complete configuration for test 2 (RMC 64):

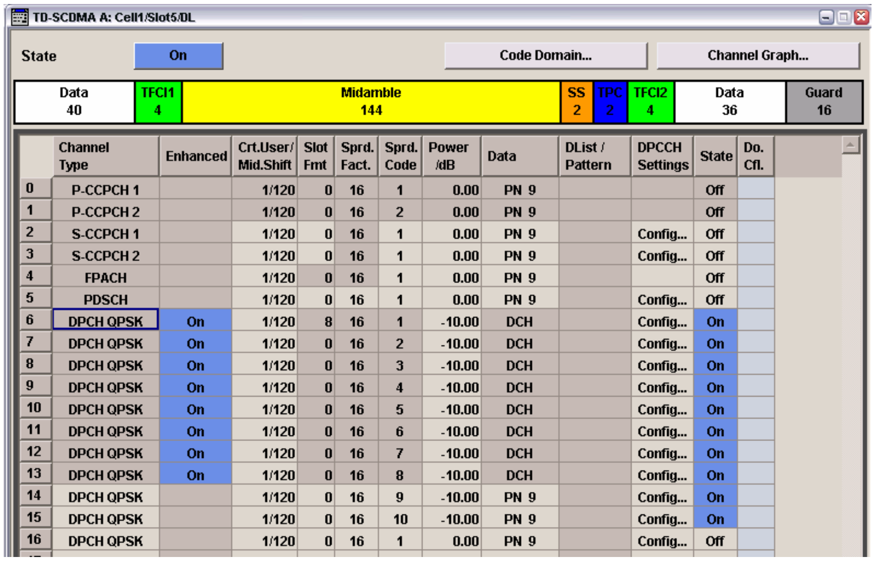


	Channel Type	Enhanced	Crt.User/ Mid.Shift	Slot Fmt	Sprd. Fact.	Sprd. Code	Power /dB	Data	DList / Pattern	DPCCH Settings	State	Do. Cfl.
0	P-CCPCH 1		1/120	0	16	1	0.00	PN 9			Off	
1	P-CCPCH 2		1/120	0	16	2	0.00	PN 9			Off	
2	S-CCPCH 1		1/120	0	16	1	0.00	PN 9		Config...	Off	
3	S-CCPCH 2		1/120	0	16	1	0.00	PN 9		Config...	Off	
4	FPACH		1/120	0	16	1	0.00	PN 9			Off	
5	PDSCH		1/120	0	16	1	0.00	PN 9		Config...	Off	
6	DPCH QPSK	On	1/120	8	16	1	-10.00	DCH		Config...	On	
7	DPCH QPSK	On	1/120	0	16	2	-10.00	DCH		Config...	On	
8	DPCH QPSK	On	1/120	0	16	3	-10.00	DCH		Config...	On	
9	DPCH QPSK	On	1/120	0	16	4	-10.00	DCH		Config...	On	
10	DPCH QPSK	On	1/120	0	16	5	-10.00	DCH		Config...	On	
11	DPCH QPSK	On	1/120	0	16	6	-10.00	DCH		Config...	On	
12	DPCH QPSK	On	1/120	0	16	7	-10.00	DCH		Config...	On	
13	DPCH QPSK	On	1/120	0	16	8	-10.00	DCH		Config...	On	
14	DPCH QPSK		1/120	0	16	9	-10.00	PN 9		Config...	On	
15	DPCH QPSK		1/120	0	16	10	-10.00	PN 9		Config...	On	
16	DPCH QPSK		1/120	0	16	1	0.00	PN 9		Config...	Off	

Fig. 4_12: Channel configuration for test 2. Test 2 with 64 kbps uses eight enhanced code channels for the DPCH in one timeslot per frame. Two $DPCH_0$ channels are added. The power of each channel is a tenth (-10 dB).

For RMC 144, add two $DPCH_0$ fill channels both in slot 4 and in slot 5. Increment the codes in both slots accordingly and set the power for all active channels to -10 dBm. Slots 4 and 5 have an identical configuration.

Fig. 4_13 shows the complete configuration for test 3 (RMC 144):

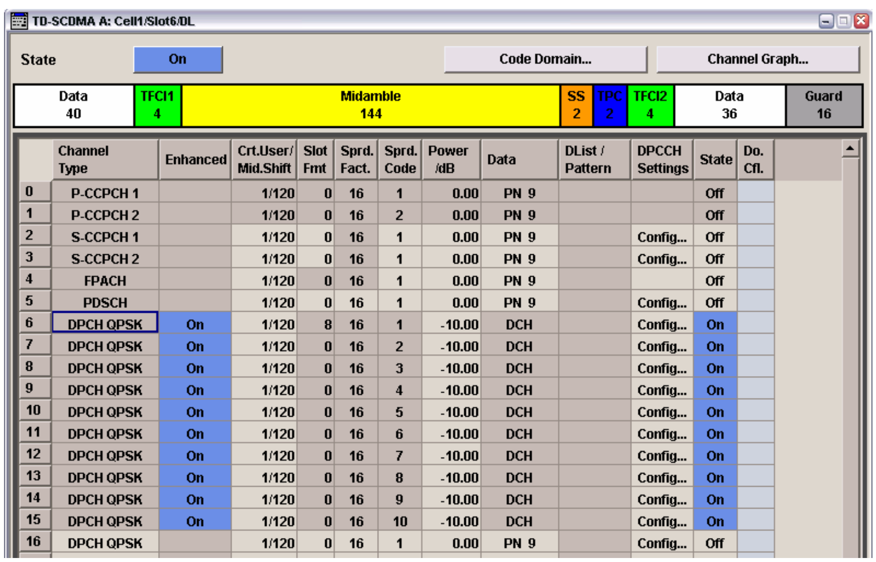


	Channel Type	Enhanced	Crt.User/ Mid.Shift	Slot Fmt	Sprd. Fact.	Sprd. Code	Power /dB	Data	DList / Pattern	DPCCH Settings	State	Do. Cfl.
0	P-CCPCH 1		1/120	0	16	1	0.00	PN 9			Off	
1	P-CCPCH 2		1/120	0	16	2	0.00	PN 9			Off	
2	S-CCPCH 1		1/120	0	16	1	0.00	PN 9		Config...	Off	
3	S-CCPCH 2		1/120	0	16	1	0.00	PN 9		Config...	Off	
4	FPACH		1/120	0	16	1	0.00	PN 9			Off	
5	PDSCH		1/120	0	16	1	0.00	PN 9		Config...	Off	
6	DPCH QPSK	On	1/120	8	16	1	-10.00	DCH		Config...	On	
7	DPCH QPSK	On	1/120	0	16	2	-10.00	DCH		Config...	On	
8	DPCH QPSK	On	1/120	0	16	3	-10.00	DCH		Config...	On	
9	DPCH QPSK	On	1/120	0	16	4	-10.00	DCH		Config...	On	
10	DPCH QPSK	On	1/120	0	16	5	-10.00	DCH		Config...	On	
11	DPCH QPSK	On	1/120	0	16	6	-10.00	DCH		Config...	On	
12	DPCH QPSK	On	1/120	0	16	7	-10.00	DCH		Config...	On	
13	DPCH QPSK	On	1/120	0	16	8	-10.00	DCH		Config...	On	
14	DPCH QPSK		1/120	0	16	9	-10.00	PN 9		Config...	On	
15	DPCH QPSK		1/120	0	16	10	-10.00	PN 9		Config...	On	
16	DPCH QPSK		1/120	0	16	1	0.00	PN 9		Config...	Off	

Fig. 4_13: Channel configuration in slot 5 for test 3. Test 3 with 144 kbps uses eight enhanced codes channels each for the DPCH in two timeslots per frame. Two $DPCH_0$ channels are added. The power of each channel is one tenth (-10 dB).

No fill channels are required for RMC 384. Four slots with ten enhanced code channels each are occupied. The four slots 3 to 6 are of identical configuration. Set the power of all active channels to -10 dBm.

Fig. 4_14 shows the complete configuration for test 4 (RMC 384).



	Channel Type	Enhanced	Crt.User/ Mid.Shift	Slot Fmt	Sprd. Fact.	Sprd. Code	Power /dB	Data	DList / Pattern	DPCCH Settings	State	Do. Cfl.
0	P-CCPCH 1		1/120	0	16	1	0.00	PN 9			Off	
1	P-CCPCH 2		1/120	0	16	2	0.00	PN 9			Off	
2	S-CCPCH 1		1/120	0	16	1	0.00	PN 9		Config...	Off	
3	S-CCPCH 2		1/120	0	16	1	0.00	PN 9		Config...	Off	
4	FPACH		1/120	0	16	1	0.00	PN 9			Off	
5	PDSCH		1/120	0	16	1	0.00	PN 9		Config...	Off	
6	DPCH QPSK	On	1/120	8	16	1	-10.00	DCH		Config...	On	
7	DPCH QPSK	On	1/120	0	16	2	-10.00	DCH		Config...	On	
8	DPCH QPSK	On	1/120	0	16	3	-10.00	DCH		Config...	On	
9	DPCH QPSK	On	1/120	0	16	4	-10.00	DCH		Config...	On	
10	DPCH QPSK	On	1/120	0	16	5	-10.00	DCH		Config...	On	
11	DPCH QPSK	On	1/120	0	16	6	-10.00	DCH		Config...	On	
12	DPCH QPSK	On	1/120	0	16	7	-10.00	DCH		Config...	On	
13	DPCH QPSK	On	1/120	0	16	8	-10.00	DCH		Config...	On	
14	DPCH QPSK	On	1/120	0	16	9	-10.00	DCH		Config...	On	
15	DPCH QPSK	On	1/120	0	16	10	-10.00	DCH		Config...	On	
16	DPCH QPSK		1/120	0	16	1	0.00	PN 9		Config...	Off	

Fig. 4_14: Channel configuration in slot 6 for test 4. Test 4 with 384 kbps uses 10 enhanced code channels each for the DPCH in four timeslots per frame. No $DPCH_0$ channels are added. The power of each channel is one tenth (-10 dB).

You have now established the part of the *wanted signal* in the test signal. For further information on generating the AWGN, see section *Generating an AWGN Signal* on page 39. For activating fading functions in the generator, see section *Generating Multipath Fading Signals* on page 44.

Absolute and relative levels

If you use the above-mentioned channel configurations, the sum of the relative levels of all code channels is 0 dB. You only have to enter the total level I_{or} which may differ from one measurement to the next.

In the standard, the total level I_{or} of the TD-SCDMA signal is always specified relative to the AWGN signal I_{oc}, e.g. for test 7.2.1:

Test Number	$\frac{\hat{I}_{or}}{I_{oc}}$ [dB]	BLER
1	3.6	10^{-2}
2	2.4	10^{-1}
	2.7	10^{-2}
3	2.8	10^{-1}
	3.2	10^{-2}
4	3.2	10^{-1}

Table 4_15: Level ratios I_{or} / I_{oc} for test 7.2.1.

For test 7.2.1 (for wide-area BS), I_{oc} is to be -60 dBm.

The following is thus obtained for test number 1:

$I_{or} = I_{oc} + 3.6$ dB = - 56.4 dBm

and for tests number 2:

I_{or} = - 57.6 dBm or I_{or} = - 57.3 dBm, etc.

➢ Enter this figure as the SMU level.

The absolute levels of the individual channels, as specified relative to I_{or}, will automatically be set correctly.

The level of the useful signal is displayed in the level window.

Fig. 4_16: Display in the level window

Since the AWGN signal I_{oc} in the SMU is added to the TD-SCDMA signal I_{or}, the actual output power of the SMU will be higher than the value displayed for I_{or} in the level window.

Fig. 4_17 and Fig. 4_18 show the wanted signal for Test 3 / 144 kbps on the analyzer. See also Fig. 4_2 and Fig. 4_13.

AWGN is not yet applied.

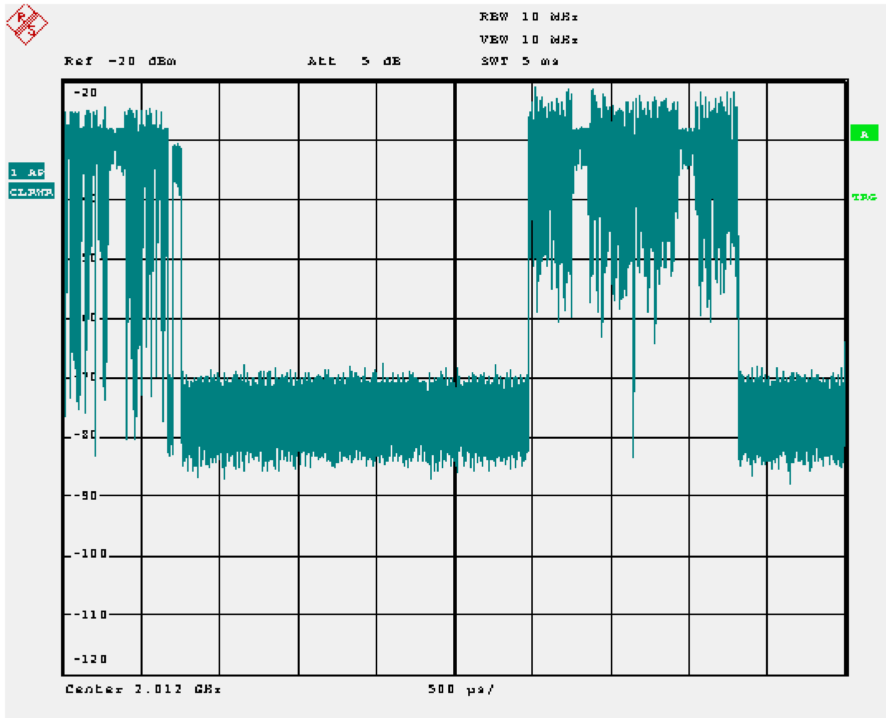


Fig. 4_17: Power versus time for UE performance test 3. The analyzer shows 1 frame. Slot 0 is occupied by the PCCPCH. It is followed by the short downlink pilot slot. The data channels use slot 4 and 5.

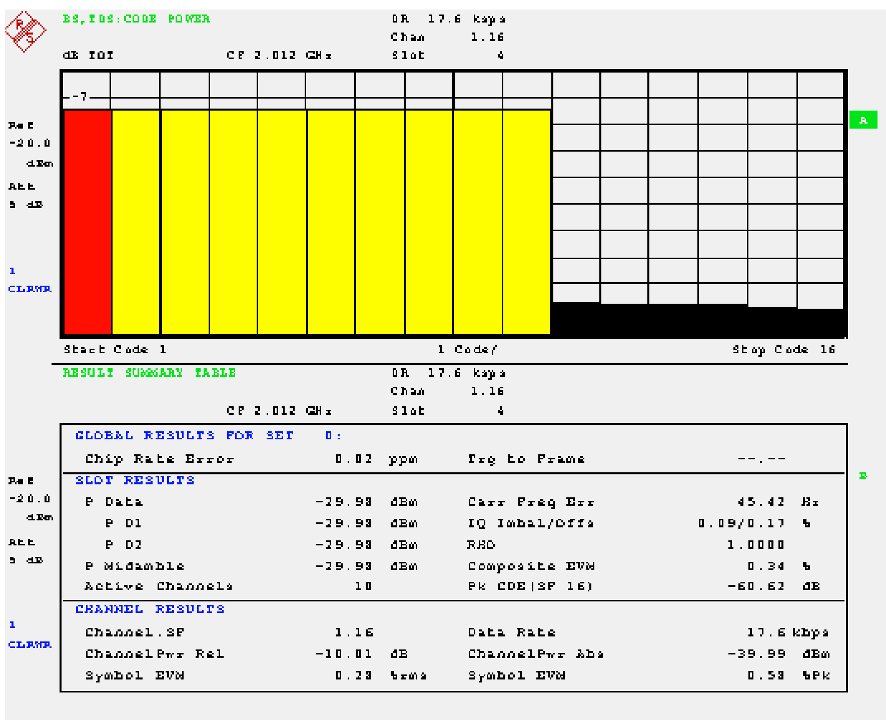


Fig. 4_18: Code Domain representation and numeric measurement results of slot 4 (slot 5 looks the same). In both slots the signal uses ten code channels, each with spreading factor 16, and a power of -10 dB.

5 Test Signals for BS Performance Tests

Overview

In contrast to the UE tests, the generator has to produce two RF signals for the two RX antennas of the BS. This can be done with two single-path SMUs; the easiest way to do this would be using a two-channel SMU. This solution is assumed in the following.

Fig. 5_1 shows the signal routing in the (two-path) generator.

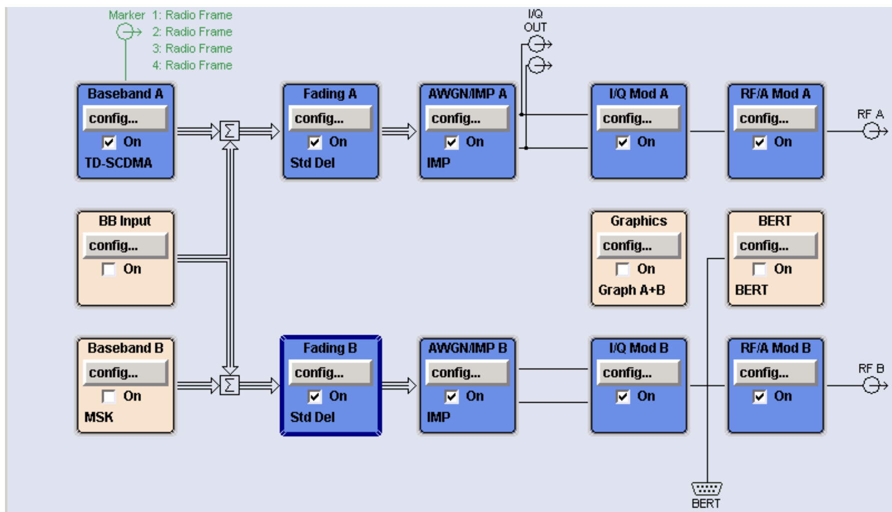


Fig. 5_1: Signal routing inside the SMU for BS performance tests

Both test signals are derived from the same baseband module (A). This block has to be configured only once. Set the frequency, the total level, the AWGN level and, if required, the fading profile for each path separately.

Performance tests are block error (BLER) measurements on uplink reference measurement channels (UL RMCs). All performance tests are specified for data rates of 12.2 kbps, 64 kbps, 144 kbps, and 384 kbps (sub-tests 1 to 4). The UL RMC makes use of one or two dedicated physical channels ($DPCH_1$ and $DPCH_2$) with different spreading factors (SF).

In addition to $DPCH_1$ and $DPCH_2$ (if applicable), whose BLER is measured, further $DPCH_0$ fill channels are superimposed as intracell interferers. AWGN is also added and multipath propagation conditions (fading) are simulated.

Table 5_2 provides the configuration of the $DPCH_0$, $DPCH_1$ and $DPCH_2$ for each of the four data rates (four sub-tests). The ratios of the channels, the codes that are used, and the relative power of the channels are the same for all BS performance tests.

	Unit	Sub-Test 1	Sub-Test 2	Sub-Test 3	Sub-Test 4
Information Data Rate / RMC	kbps	12.2 RMC 12.2	64 RMC 64	144 RMC 144	384 RMC 384
Number of $DPCH_1$		1 / SF 8	1 / SF 2	2 / SF 2 2 slots	4 / SF 8 4 slots
Number of $DPCH_2$		-	-	-	4 / SF 2 4 slots
Number of $DPCH_0$		4	1	2 / 2 slots	0

Table 5_2: Configuration for BS performance tests

Test 1 has four $DPCH_0$ intracell interferers, tests 2 and 3 only one, tests 4 none. The power of each $DPCH_0$ is always one fifth (-7 dB) of the power in the slot.

Fig. 5_3 shows the channel combinations graphically:

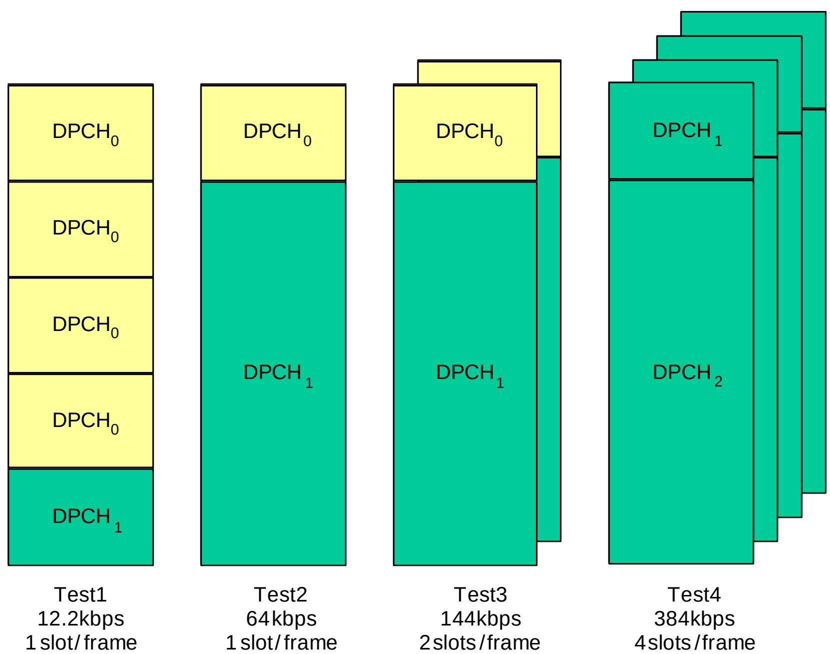


Fig. 5_3: Code channel combinations for performance tests

The RMCs with information data rates of 12.2 kbps and 64 kbps occupy one timeslot per frame. The RMC 144 kbps occupies two timeslots, the RMC 384 kbps four.

Test 1 with 12.2 kbps uses one code channel for the $DPCH_1$. Four $DPCH_0$ channels are added. The spreading factor (SF) is 8. The power of each channel is one fifth (-7 dB).

Test 2 with 64 kbps uses one code channel for the $DPCH_1$ with SF 2. One $DPCH_0$ channel with SF 8 is added. The power of the $DPCH_1$ is four fifths (-1 dB), and the power of the $DPCH_0$ one fifth (-7 dB).

Test 3 with 144 kbps uses one code channel each for the $DPCH_1$, with SF 2 (in both occupied timeslots). One $DPCH_0$ channel with SF 8 is added (in each timeslot). The power of the $DPCH_1$ is four fifths (-1 dB), and the power of the $DPCH_0$ one fifth (-7 dB).

Test 4 with 384 kbps uses one $DPCH_1$ code channel with SF 8 and one $DPCH_2$ code channel each with SF 2 (in each of the four occupied timeslots). No $DPCH_0$ channels are added. The power of the $DPCH_1$ is one fifth (-7 dB), and the power of the $DPCH_2$ four fifths (-1 dB).

The four performance tests 8.2.1, 8.3.1, 8.3.2, and 8.3.3 in the TS 25.142 standard only differ in a few parameters, i.e. the levels for the signal and superimposed additional white Gaussian noise (AWGN) and the fading profiles to be used.

For further information on generating the AWGN, see section *Generating an AWGN Signal* on page 39. For activating fading functions in the generator, see section*Generating Multipath Fading Signals* on page 44.

Step by step

The generation of test signals is similar to that described for the RX measurements. You first have to configure the paths in the diagram window of the SMU:

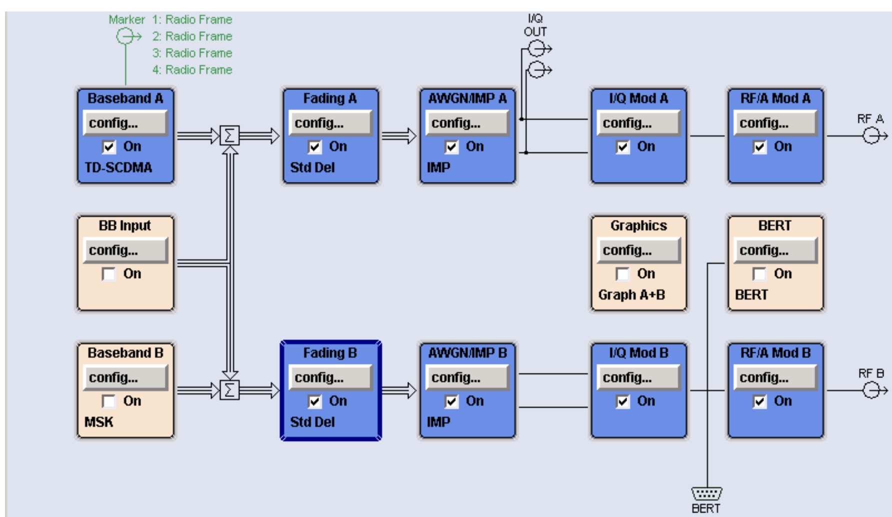


Fig. 5_4: Path configuration for BS performance tests

➢ Open the SMU baseband window and select *TD-SCDMA*.

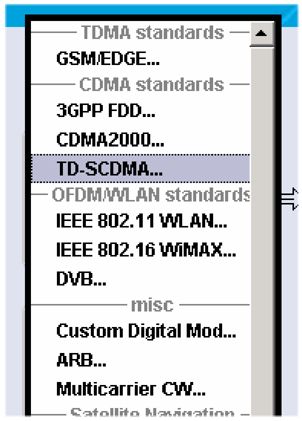


Fig. 5_5: Selecting the mobile radio standard

The following menu is displayed:

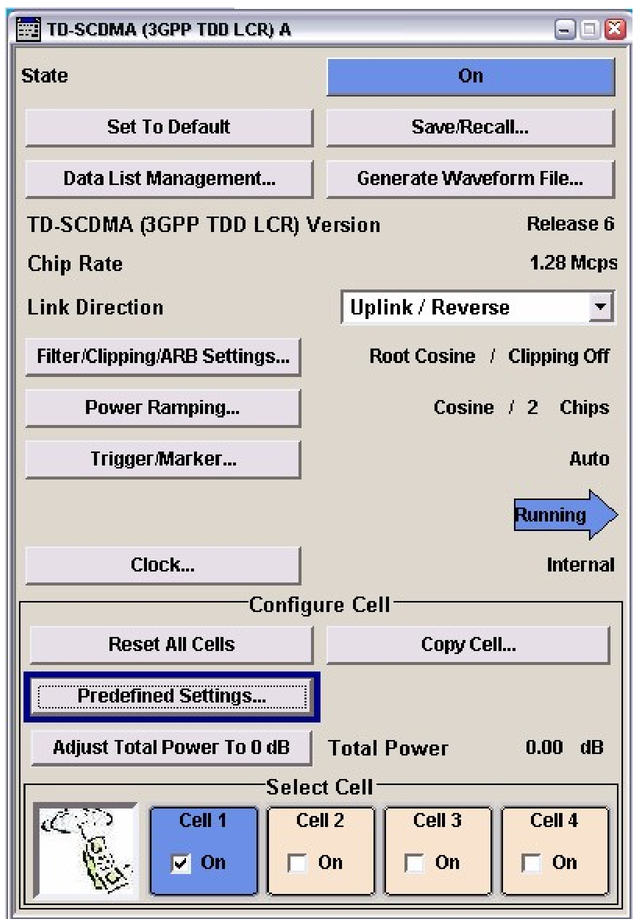


Fig. 5_6: Basic TD-SCDMA menu

- Switch State to *On.*
- Set *Link Direction* to *Uplink / Reverse*.
- Select *Reset All Cells*.
- Select *Predefined Settings*.

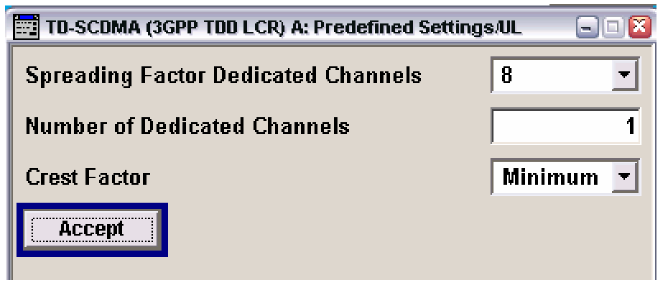


Fig. 5_7: Predefined settings for uplink

- ➢ Enter 8 as *Spreading Factor*.
- ➢ Set *Number of Dedicated Channels* to 1.
- ➢ Select *Accept*.
- ➢ Close the window.

Now specify the individual channels.

- ➢ Select *Cell 1*.

The following window is displayed.

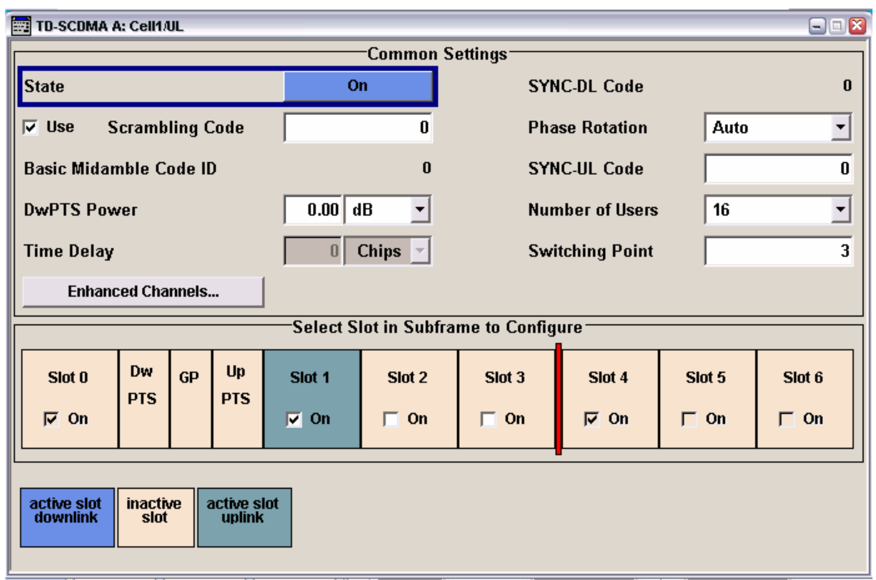


Fig. 5_8: TD-SCDMA slot menu on the SMU

- ➢ Switch *State to On*.
- ➢ Select *Enhanced Channels*.

The menu of Fig 5_9 is displayed. You can configure the RMC that is calculated by the SMU in realtime.

- Switch *State to On* for the dedicated channels (DCHs).
- Select the RMC with the required data rate.

Test 1 always uses RMC 12.2, test 2 RMC 64, test 3 RMC 144, and test 4 RMC 384.

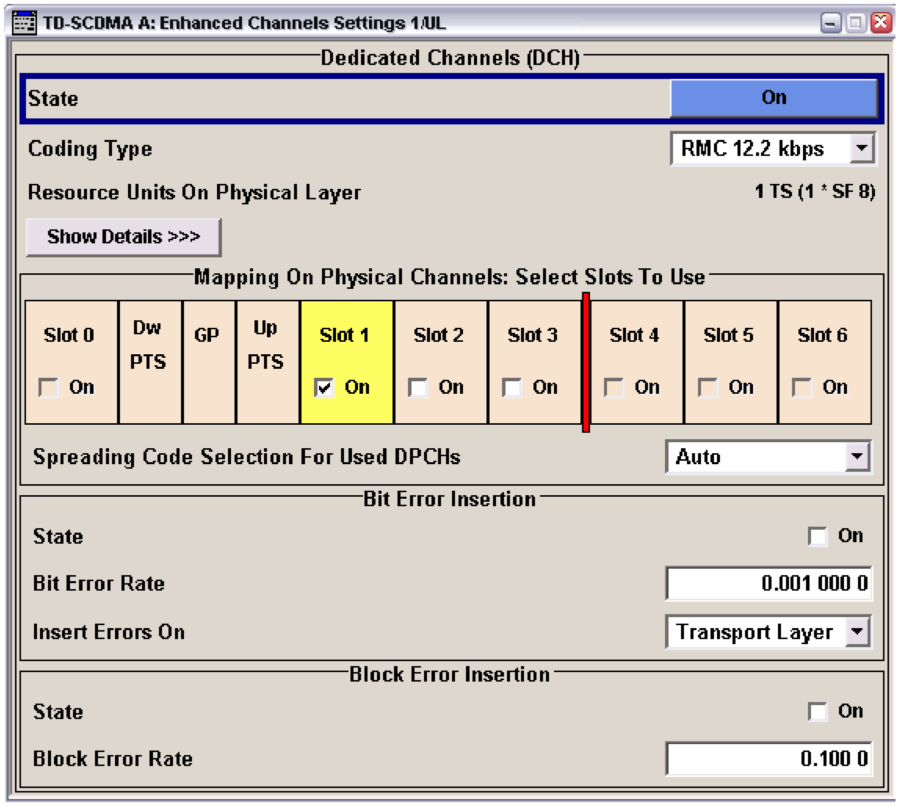


Fig. 5_9: Selecting the RMC

Only slot 1 is enabled for UL RMC 12.2 and RMC 64. The selection of RMC 144 kbps enables the two slots 1 and 2. For 384 kbps, the switching point is shifted to position 4, and the four slots 1 to 4 are enabled.

- Close the window.

You are again in the TD-SCDMA slot menu (Fig. 5_8).

- Select *Slot 1*.

The following window is displayed for 12.2 kbps:

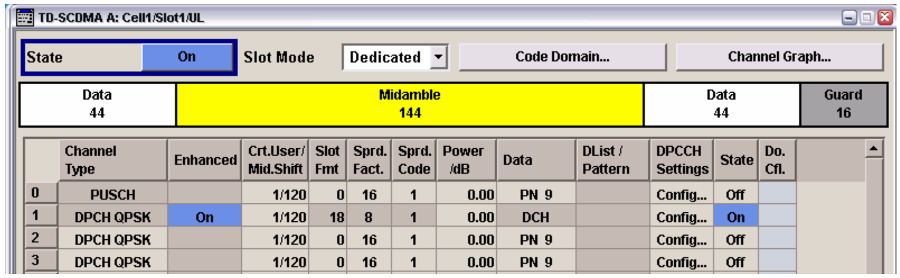


Fig. 5_10: Channel configuration in slot 1 for RMC 12.2

UL RMC 12.2 occupies one code channel with SF 8. For test 1 (RMC 12.2):

- Activate the four other DPCHs (*State set to on*).
- Set the *Spreading Codes* of the activated channels to 8.
- Set the relative power in each channel to -7 dB.

The total power in slot 1 corresponds to the absolute total SMU power. Fig. 5_11 shows the complete configuration for test 1.

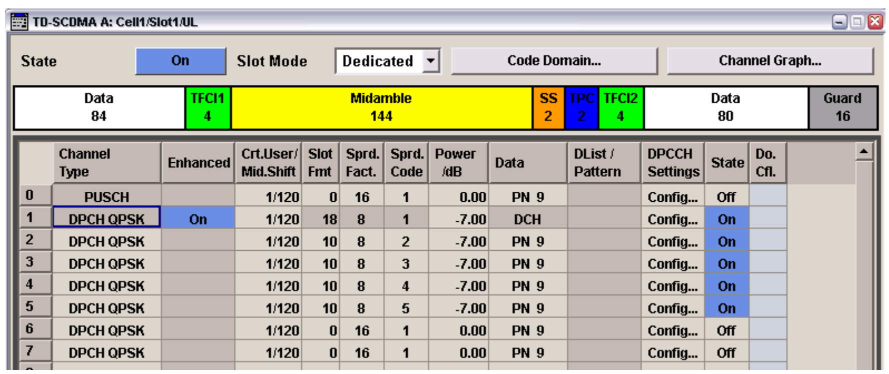


Fig. 5_11: Channel configuration for test 1 (RMC 12.2). Test 1 with 12.2 kbps uses one code channel for the $DPCH_1$ in one timeslot per frame. Four $DPCH_0$ channels are added. The spreading factor (SF) is 8. The power of each channels is one fifth (-7 dB).

- Close the window.

Fig. 5_12 shows the complete configuration of test 2 (RMC 64).

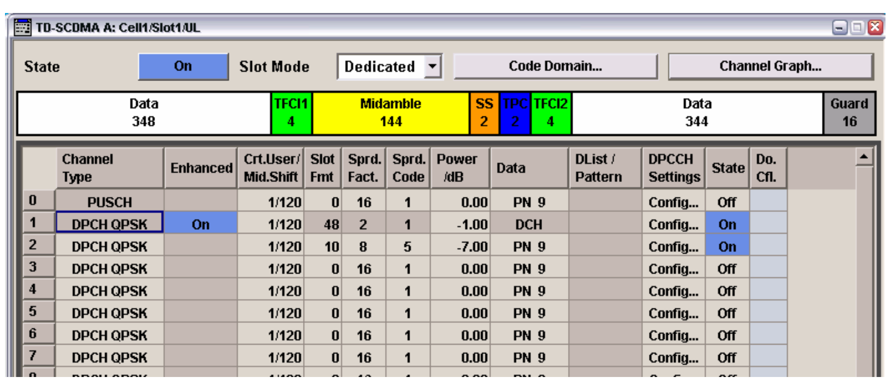


Fig. 5_12: Channel configuration for test 2 (RMC 64). Test 2 with 64 kbps uses one code channel for the $DPCH_1$ with SF 2 in one timeslot per frame. One $DPCH_0$ channel with SF 8 is added. The power of the $DPCH_1$ is four fifths (-1 dB) and the power of the $DPCH_0$ one fifth (-7 dB).

Fig. 5_13 shows the complete configuration for test 3 (RMC 144).

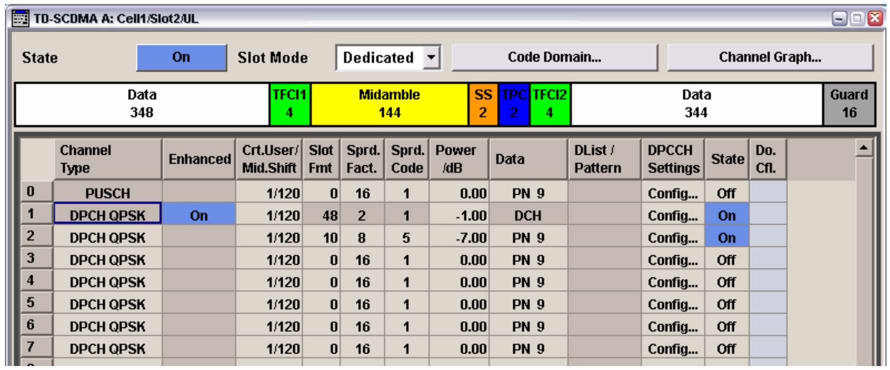


Fig. 5_13: Channel configuration for test 3 (RMC 144). Test 3 with 144 kbps uses one code channel each for the $DPCH_1$ with SF 2 in two timeslots per frame. One $DPCH_0$ channel with SF 8 is added. The power of the $DPCH_1$ is four fifths (-1 dB), and the power of the $DPCH_0$ one fifth (-7 dB).

Fig. 5_14 shows the complete configuration for test 4 (RMC 384).

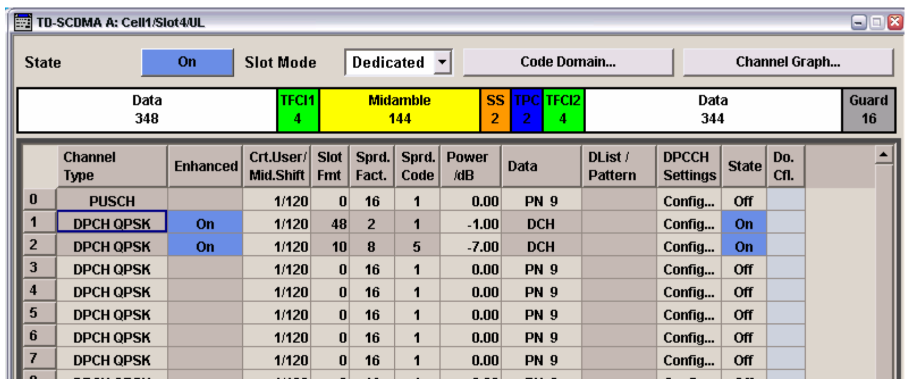


Fig. 5_14: Channel configuration for test 4 (RMC 384). Test 4 with 384 kbps uses one $DPCH_1$ code channel with SF 8 and one $DPCH_2$ code channel with SF 2 each in four timeslots per frame. No $DPCH_0$ channels are added. The power of the $DPCH_1$ is one fifth (-7 dB), and the power of the $DPCH_2$ four fifths (-1 dB).

You have now established the wanted signal. If the RF output stage of the SMU is switched on, the TD-SCDMA signal is provided at the RF connector.

Absolute and relative levels

If you use the above-mentioned channel configurations, the sum of the relative levels of all code channels is 0 dB. You only have to enter the total level I_{or}, which may differ from one measurement to the next.

In the standard, the total level I_{or} of the TD-SCDMA signal is always specified relative to the AWGN signal I_{oc}, e.g. for test 8.2.1:

Test Number	$\frac{\hat{I}_{or}}{I_{oc}}$ [dB]	BLER
1	0.6	10^{-2}
2	-0.9	10^{-1}
	-0.4	10^{-2}
3	-0.3	10^{-1}
	-0.1	10^{-2}
4	0.5	10^{-1}
	0.6	10^{-2}

Table 5_15: I_{or} / I_{oc} level ratios or test 8.2.1.

For test 8.2.1 (for wide-area BS), I_{oc} is to be -91 dBm (see Table 5_2 on page 30).

The following is thus obtained for test number 1:

$I_{or} = I_{oc} + 0.6$ dB = - 90.4 dBm

and for tests number 2:

I_{or} = -91.9 dBm or I_{or} = -91.4 dBm, etc

➢ Enter this figure as the SMU level.

The absolute levels of the individual channels, as specified relative to I_{or}, will automatically be set correctly.

The level of the useful signal is displayed in the level window.

Fig. 5_16: Display in the level window

Since the AWGN signal I_{oc} in the SMU is added to the TD-SCDMA signal I_{or}, the actual output power of the SMU will be higher than the value displayed for I_{or} in the level window.

Fig. 5_17 and Fig. 5_18 show the signal for Test 3 / 144 kbps on the analyzer. See also Fig. 5_3 and Fig. 5_13.

AWGN is not yet applied.

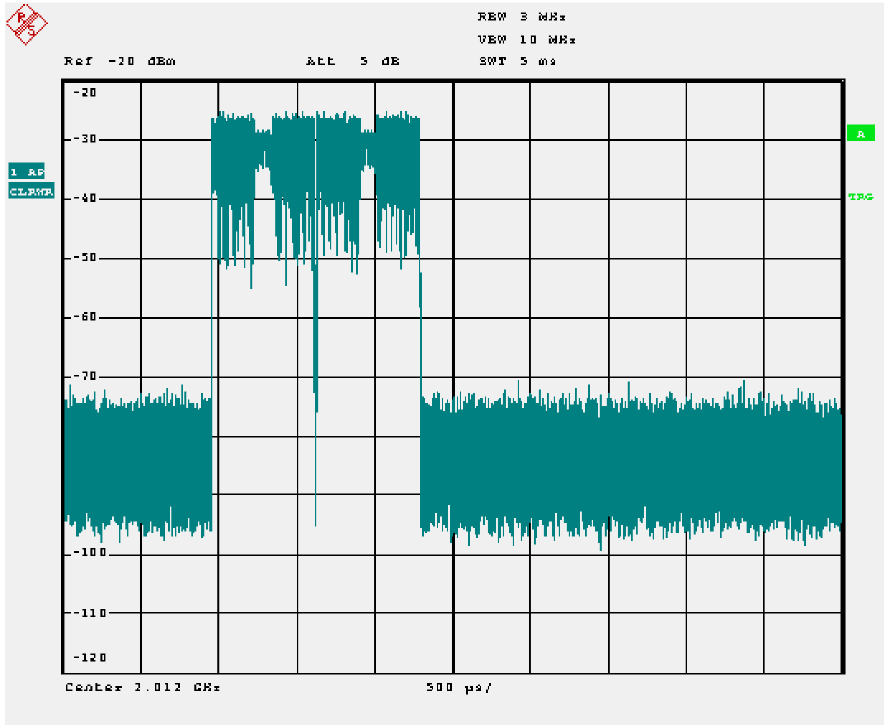


Fig. 5_17: Power versus time for BS performance test 3. The analyzer shows 1 frame. The data channels use the two time slots 1 and 2.

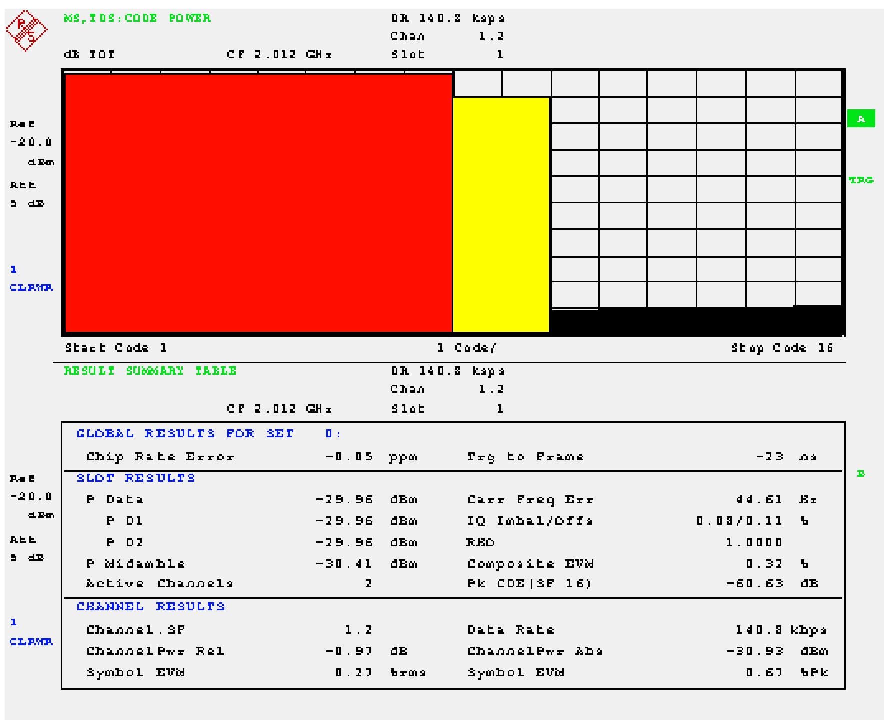


Fig. 5_18: Code Domain representation and numeric measurement results of slot 1 (slot 2 looks the same). In both slots the signal uses two code channels, one with spreading factor 2 and -1 dB power, the second with spreading factor 8 and -7 dB power.

6 Generating a Continuous CDMA Interferer

This signal is required for measuring *adjacent channel selectivity* and the *intermodulation characteristics*.

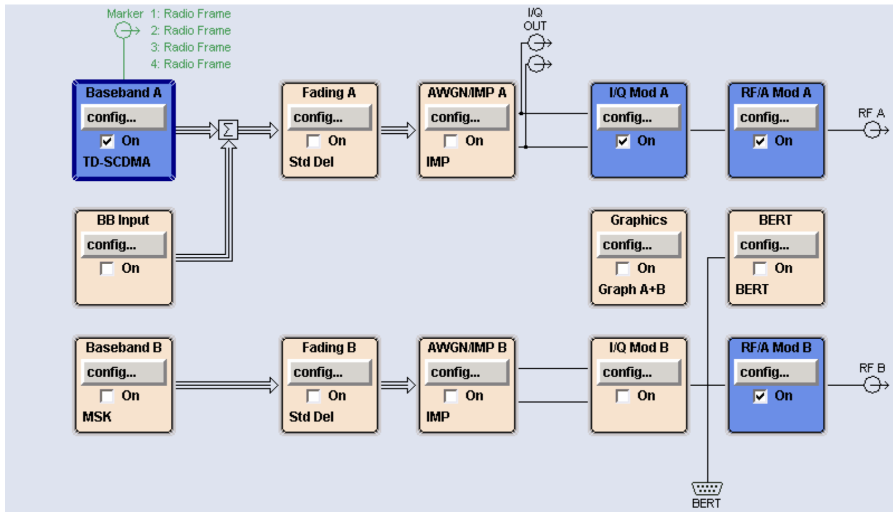


Fig. 6_1: Function blocks in the SMU (diagram window)

➢ In the diagram window (Fig. 6_1) click *config* in the *Baseband A* block.

When selecting the standards (Fig. 6_2)

➢ Choose *Custom Digital Mod...*.

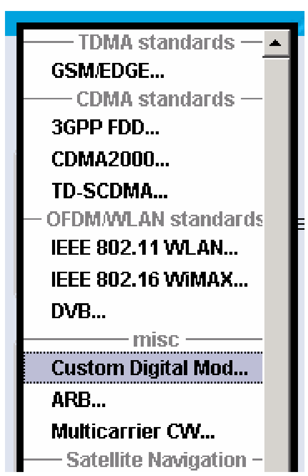


Fig. 6_2: Selecting the modulation

The following menu is displayed:

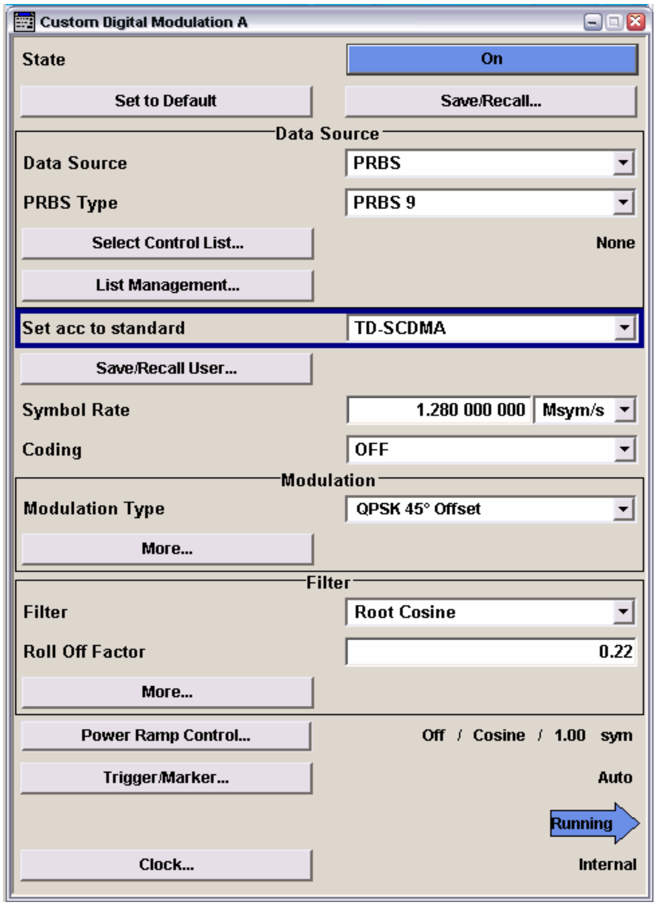


Fig. 6_3: Basic menu for custom digital modulation.

- Switch *State to On.*
- Select *Set acc to standard* to*TD-SCDMA*.

You thus set all the parameters to the correct default values:

Symbol rate 1.28 Msps, QPSK modulation, root cosine filter with roll off factor 0.22. The *Power Ramp Control* is switched off; the signal is thus continuous.

- Close the window.

You have now established the desired CDMA interferer. If the RF output stage of the SMU is switched on, the signal is provided at the RF connector.

7 AWGN Signal

The AWGN is added for the RX and performance tests to simulate interference from neighboring cells.

To generate the AWGN signal, use the SMU-K62 option.

➢ In the SMU diagram (Fig. 7_50), click *config* in the *AWGN/IMP block.*

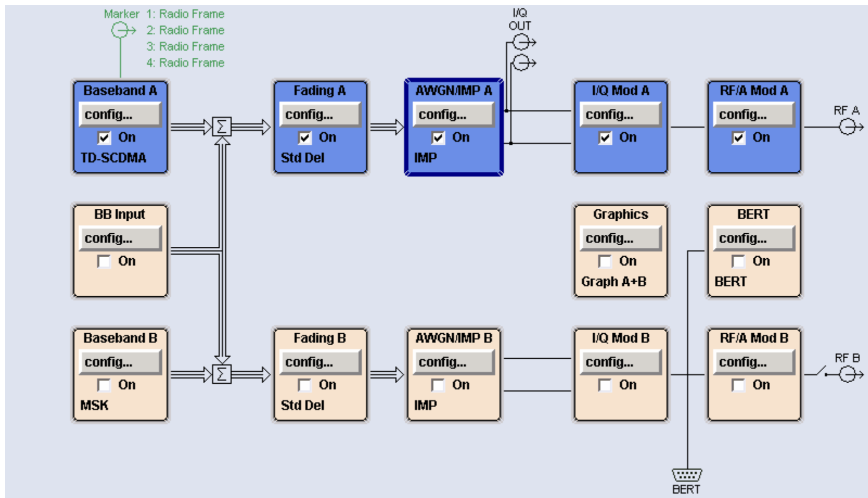


Fig. 7_1: SMU diagram

The following menu is displayed:

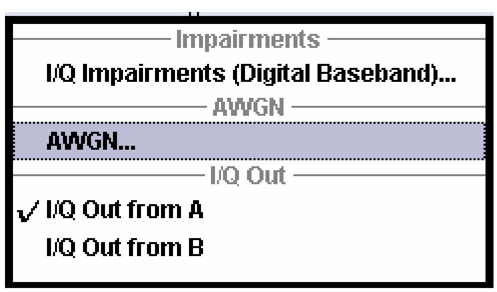


Fig. 7_2: Impairment selection

➢ Select AWGN.

The AWGN menu is displayed (see Fig. 7_3).

➢ Switch *State to on*.

➢ Set *System Bandwidth* to 1.28 MHz.

➢ Set *Min. Noise / System Bandwidth* to 1.5.

➢ Set *Set Noise Level Via* to C/N.

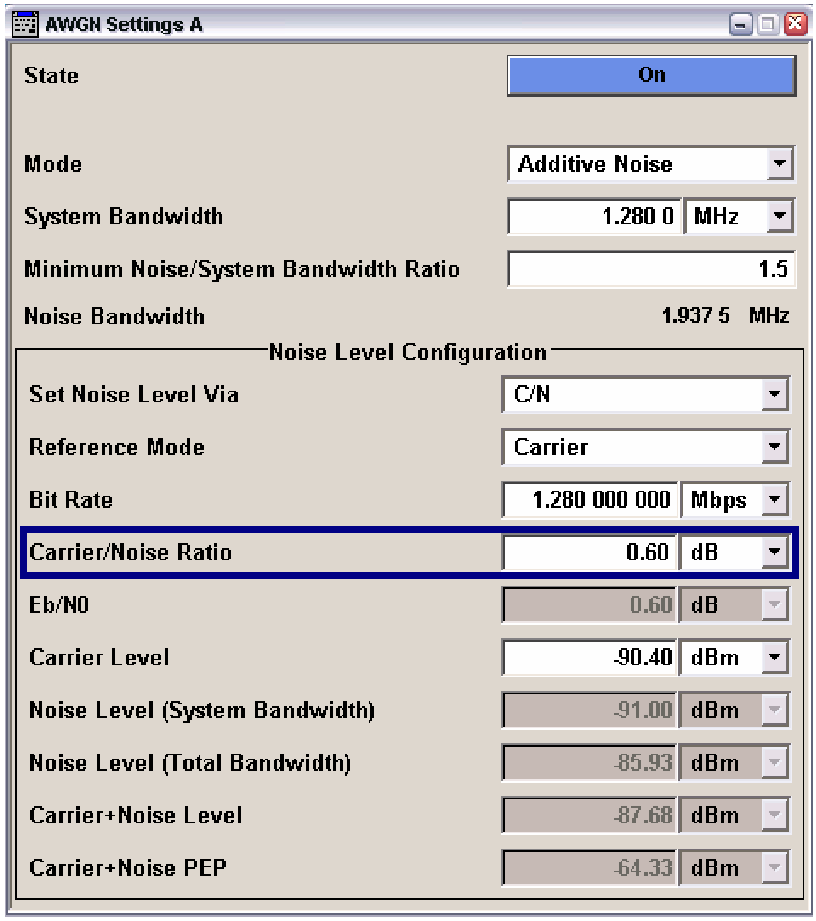


Fig. 7_3: AWGN menu

In the standard, the *carrier / noise* (C/N) ratio is designated as $\hat{I}_{or} / I_{oc}$ and is specified for each test. In Table 6_4, the values for the first of the UE performance tests, 7.2.1, are provided as an example.

Test Number	$\frac{\hat{I}_{or}}{I_{oc}}$ [dB]	BLER
1	3.6	10^{-2}
2	2.4	10^{-1}
	2.7	10^{-2}
3	2.8	10^{-1}
	3.2	10^{-2}
4	3.2	10^{-1}

Table 7_4: $\hat{I}_{or} / I_{oc}$ for UE performance test 7.2.1

➢ Enter the stipulated value for $\hat{I}_{or} / I_{oc}$ as *Carrier / Noise Ratio* on the SMU.

The C*arrier Level* is automatically set; the desired AWGN signal is now applied.

For BS tests, activate the AWGN in both signal paths. Fig. 7_5 shows the spectrum of the intercell interferer.

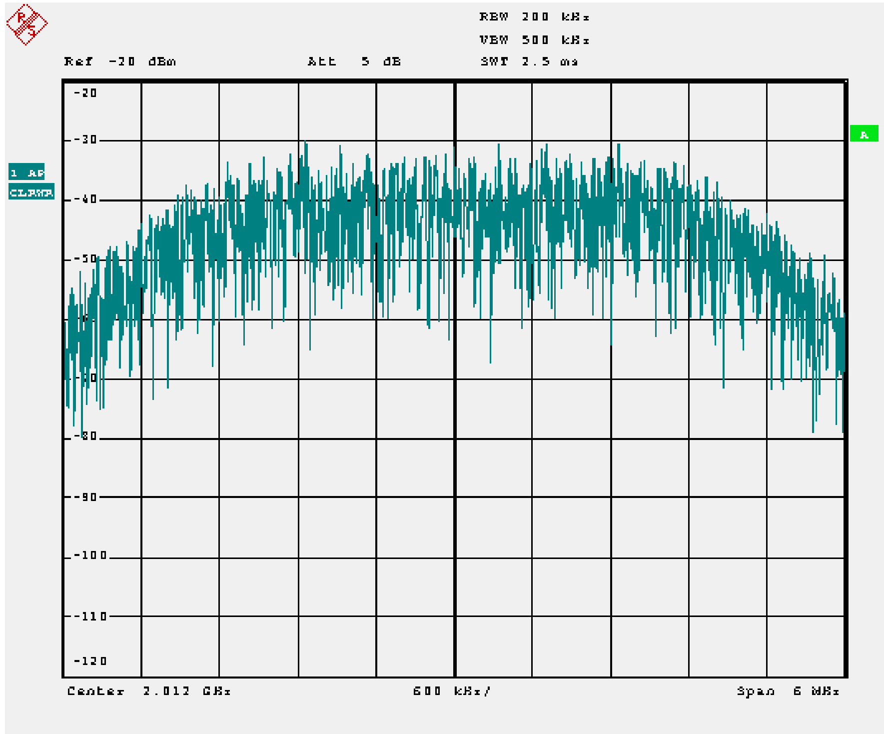


Fig. 7_5: Spectrum of the AWGN interferer. The noise is band-limited with a ratio of noise to system bandwidth > 1.5.

8 Multipath Fading Profiles for TD-SCDMA

Multipath fading profiles simulate the real-world conditions of mobile radios: The DUTs are moving, and multipath reception is caused by reflections along the propagation path.

The TD-SCDMA standard specifies three fading profiles (cases 1, 2, and 3). These fading profiles only differ with regard to path delay compared to cases 1, 2, and 3 for 3GPP-FDD preprogrammed in the SMU. So use the 3GPP profiles as a template to generate the TD-SCDMA profiles.

To generate the multipath fading profile, use the SMU-B14 and SMU-B15 options. Start in the SMU diagram window (Fig. 8_1):

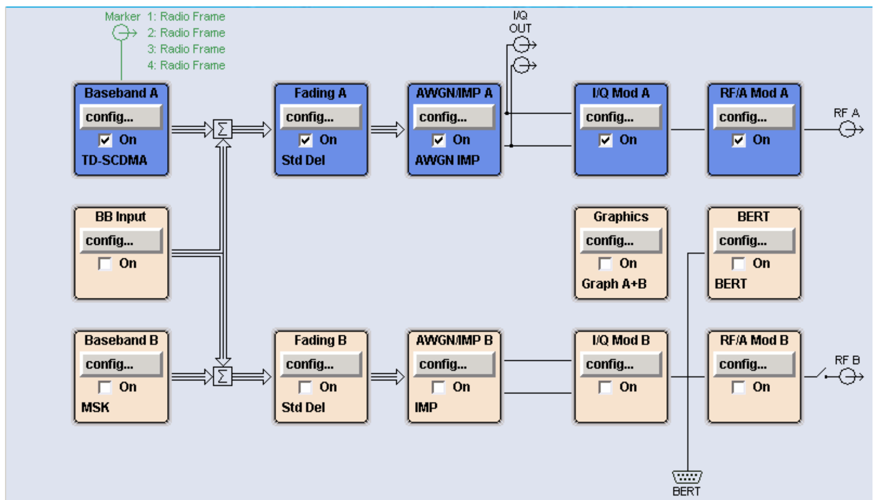


Fig. 8_1: SMU diagram

➢ Click *config* in the *Fading A.* block.

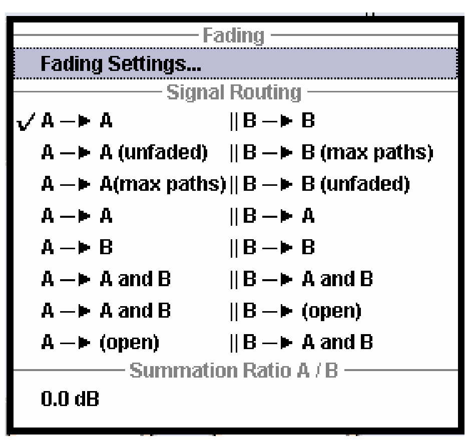


Fig. 8_2: Intermediate dialog

Access the basic Fading menu (Fig. 8_3) via *Fading Settings*.

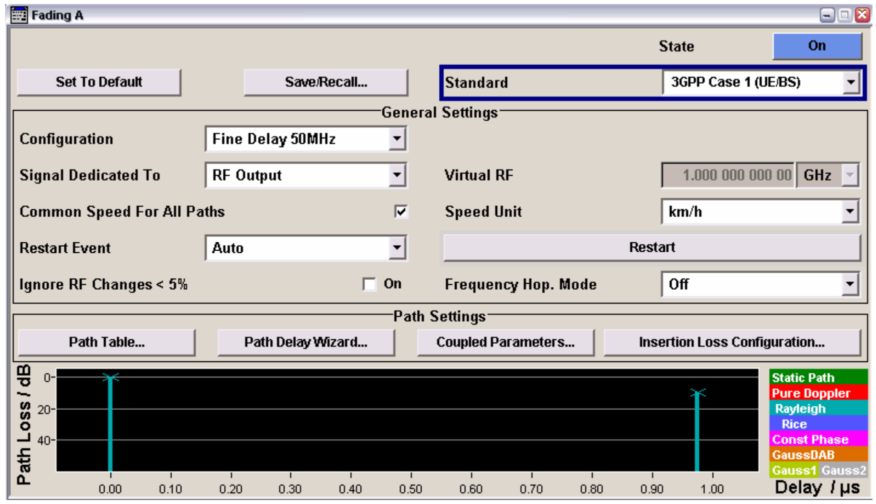
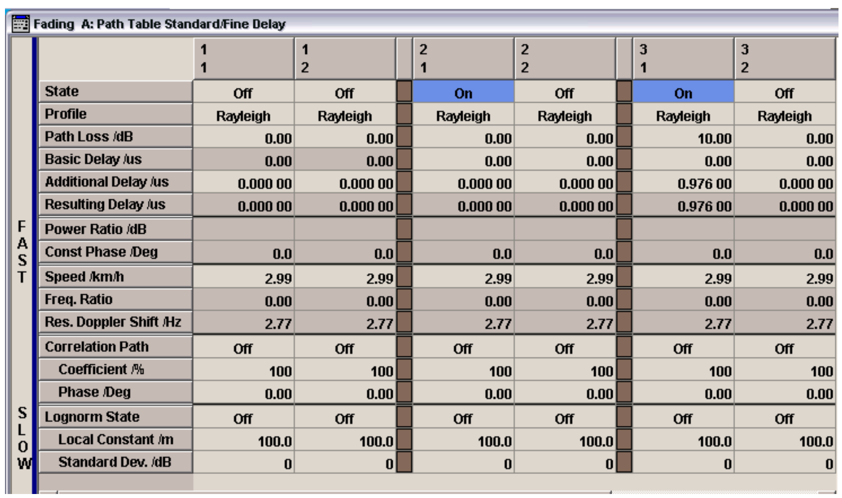


Fig. 8_3: Basic Fading menu

- ➢ Switch *State to on*.
- ➢ In the basic Fading menu, select one of the three GPP cases 1, 2, or 3 from the *Standard* list.
- ➢ Click *Path Table*.

The following window is opened (for 3GPP case 1):



Fading A: Path Table Standard/Fine Delay

	1 1	1 2	2 1	2 2	3 1	3 2
State	Off	Off	On	Off	On	Off
Profile	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Path Loss /dB	0.00	0.00	0.00	0.00	10.00	0.00
Basic Delay /us	0.00	0.00	0.00	0.00	0.00	0.00
Additional Delay /us	0.000 00	0.000 00	0.000 00	0.000 00	0.976 00	0.000 00
Resulting Delay /us	0.000 00	0.000 00	0.000 00	0.000 00	0.976 00	0.000 00
Power Ratio /dB						
Const Phase /Deg	0.0	0.0	0.0	0.0	0.0	0.0
Speed /km/h	2.99	2.99	2.99	2.99	2.99	2.99
Freq. Ratio	0.00	0.00	0.00	0.00	0.00	0.00
Res. Doppler Shift /Hz	2.77	2.77	2.77	2.77	2.77	2.77
Correlation Path	Off	Off	Off	Off	Off	Off
Coefficient /%	100	100	100	100	100	100
Phase /Deg	0.00	0.00	0.00	0.00	0.00	0.00
Lognorm State	Off	Off	Off	Off	Off	Off
Local Constant /m	100.0	100.0	100.0	100.0	100.0	100.0
Standard Dev. /dB	0	0	0	0	0	0

Fig. 8_4: Fading table in SMU for 3 GPP case 1

For case 1, two paths with approx. 3 km/h each are specified. The first path has a path loss of 0 dB and the second a path loss of 10 dB.

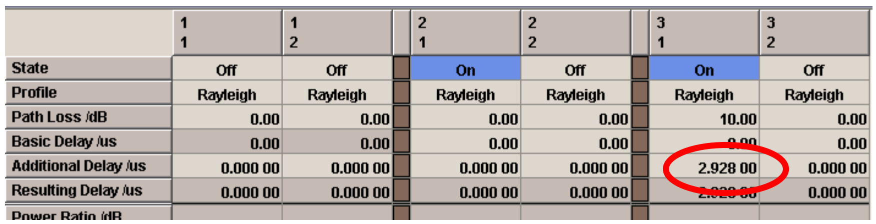
Table 8_5 shows the fading parameters for TD-SCDMA. The number of paths, the path losses, and the speeds are identical; but the values for the delay are different.

Case 1, speed 3km/h		Case 2, speed 3km/h		Case 3, speed 120km/h	
Relative Delay [ns]	Relative Mean Power [dB]	Relative Delay [ns]	Relative Mean Power [dB]	Relative Delay [ns]	Relative Mean Power [dB]
0	0	0	0	0	0
2928	-10	2928	0	781	-3
		12000	0	1563	-6
				2344	-9

Table 8_5: Fading parameters for TD-SCDMA

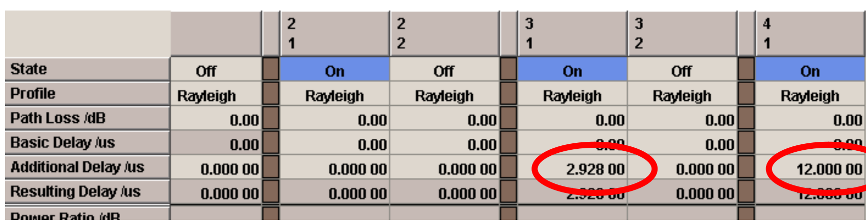
➢ Enter the *Delay* values from Table 8_5 on the SMU.

Fig. 8_6_1 to Fig 8_6_3 show the settings modified for TD-SCDMA.



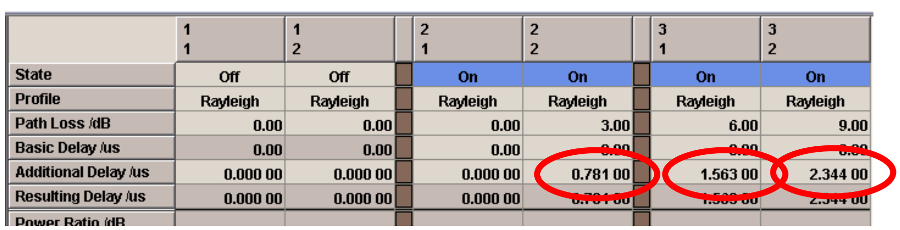
	1 1	1 2	2 1	2 2	3 1	3 2
State	Off	Off	On	Off	On	Off
Profile	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Path Loss /dB	0.00	0.00	0.00	0.00	10.00	0.00
Basic Delay /us	0.00	0.00	0.00	0.00	0.00	0.00
Additional Delay /us	0.000 00	0.000 00	0.000 00	0.000 00	2.928 00	0.000 00
Resulting Delay /us	0.000 00	0.000 00	0.000 00	0.000 00	2.928 00	0.000 00
Power Ratio /dB						

Fig. 8_6_1: Setting for TD-SCDMA fading case 1



		2 1	2 2	3 1	3 2	4 1
State	Off	On	Off	On	Off	On
Profile	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Path Loss /dB	0.00	0.00	0.00	0.00	0.00	0.00
Basic Delay /us	0.00	0.00	0.00	0.00	0.00	0.00
Additional Delay /us	0.000 00	0.000 00	0.000 00	2.928 00	0.000 00	12.000 00
Resulting Delay /us	0.000 00	0.000 00	0.000 00	2.928 00	0.000 00	12.000 00
Power Ratio /dB						

Fig. 8_6_2: Setting for TD-SCDMA fading case 2



	1 1	1 2	2 1	2 2	3 1	3 2
State	Off	Off	On	On	On	On
Profile	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh	Rayleigh
Path Loss /dB	0.00	0.00	0.00	3.00	6.00	9.00
Basic Delay /us	0.00	0.00	0.00	0.00	0.00	0.00
Additional Delay /us	0.000 00	0.000 00	0.000 00	0.781 00	1.563 00	2.344 00
Resulting Delay /us	0.000 00	0.000 00	0.000 00	0.781 00	1.563 00	2.344 00
Power Ratio /dB						

Fig. 8_6_3: Setting for TD-SCDMA fading case 3

If you close the window, you will be returned to *3 GPP*, but you will see *User* in the basic Fading menu under standard.

The required profile is now generated in realtime.

For BS tests, activate fading in both signal paths.

Fig. 8_7 and Fig. 8_8 show the power versus time representation of ten frames, at first without fading, then with fading switches to *ON*. No AWGN was applied. The test signal is the same as used for UE performance tests 3 / 144 kbps, see section 4. To smooth the curve the RMS detector was selected.

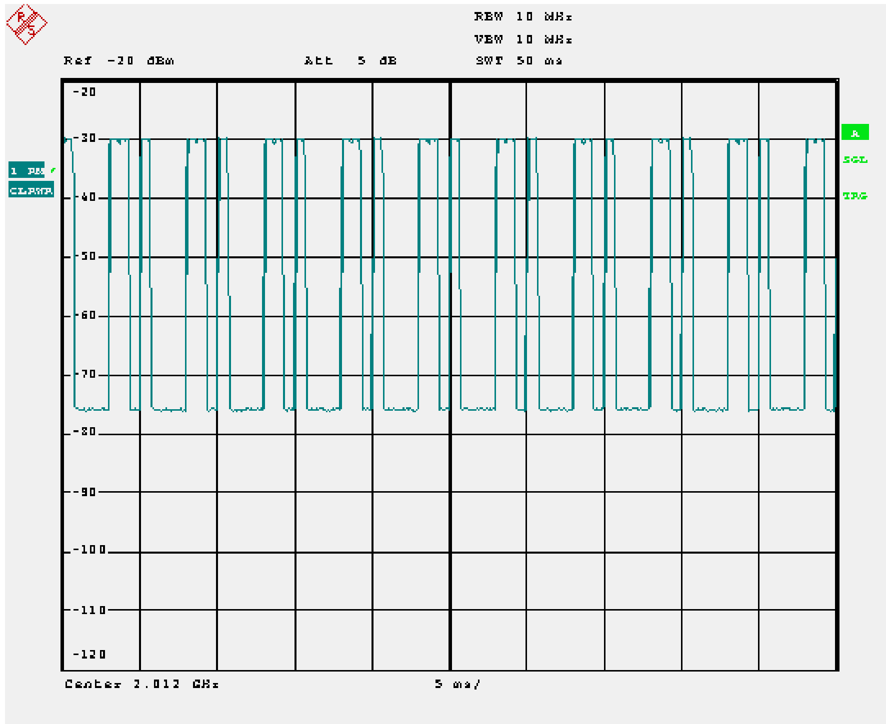


Fig. 8_7: Ten frames without fading, one frame per division. Used slots are no 0, 4, and 5.

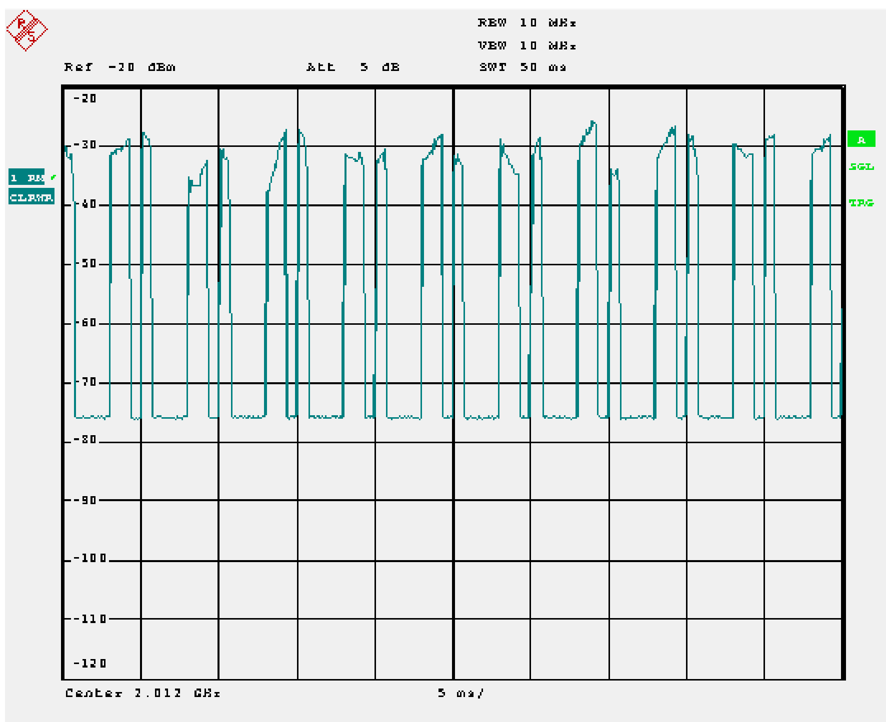


Fig. 8_8: Ten frames, fading Case 3 switched on.

9 References

[1] ETSI TS 134 122 version 5.3.0 Release 5 (2006-03)
[2] ETSI TS 125 142 version 7.3.0 Release 7 (2006-10)
[3] Operating manual R&S®SMU vector signal generator 1007.9845.32-09-I
[4] Software manual R&S®FS–K76 TD–SCDMA BTS analyzer
[4] Software manual R&S®FS–K77 TD–SCDMA MS analyzer

10 Additional Information

Please send any comments or suggestions about this Application Note to **TM-Applications@rsd.rohde-schwarz.com**.

For additional information about power meters, signal generators, spectrum analyzers, and signal analyzers, visit the Rohde & Schwarz website at www.rohde-schwarz.com.

11 Ordering Information

Signal analyzer, spectrum analyzer, measuring receiver, and options

R&S® FSQx	20 Hz to 40 GHz	1155.5001.x
R&S® FSUx	20 Hz to 50 GHz	1166.1660.x
R&S® FSPx	9 kHz to 40 GHz	1064.4391.x
R&S® FSMRx	20 Hz to 26 GHz	1166.3311.x
R&S® FSUPx	1 MHz to 26 GHz	1166.3505.x
R&S® FS-K76	3GPP TD-SCDMA BTS Application Firmware	1300.7291.02
R&S®FS-K77	3GPP TD-SCDMA MS Application Firmware	1300.8100.02
R&S® FSP-B25	Electronic Attenuator, 0 dB to 30 dB, 5 dB steps, integrated preamplifier for FSP3 and FSP7	1129.7746.02

Vector signal generator and options

R&S® SMU200A	Vector Signal Generator	1141.2005.02
R&S® SMU-B102	RF path A: 100 kHz to 2.2 GHz	1141.8503.02
R&S® SMU-B103	RF path A: 100 kHz to 3 GHz	1141.8603.02
R&S® SMU-B104	RF path A: 100 kHz to 4 GHz	1141.8703.02
R&S® SMU-B106	RF path A: 100 kHz to 6 GHz	1141.8803.02
R&S® SMU-B9	Baseband with ARB (128 Msample)	1404.1501.02
R&S® SMU-B10	Baseband with ARB (64 Msample)	1141.7007.02
R&S® SMU-B11	Baseband with ARB (16 Msample)	1159.8411.02
R&S® SMU-B13	Baseband Main Module	1141.8003.02
R&S® SMU-K50	Digital Standard TD-SCDMA	1161.0966.02
R&S® SMU-B31	High-Power Output	1159.8011.02
R&S® SMU-K250	Digital Standard TD-SCDMA (with WINIQSIM2™)	1408.6314.02
R&S® SMJ100A	Vector Signal Generator	1404.4507.02
R&S® SMJ-B103	RF path B: 100 kHz to 3 GHz	1403.8502.02
R&S® SMJ-B9	Baseband with ARB (128 Msample)	1404.1501.02
R&S® SMJ-B10	Baseband with ARB (64 Msample)	1403.8902.02
R&S® SMJ-B11	Baseband with ARB (16 Msample)	1403.9009.02
R&S® SMJ-B13	Baseband Main Module	1403.9109.02
R&S® SMJ-K50	Digital Standard TD-SCDMA	1404.1660.02
R&S® SMJ-K250	Digital Standard TD-SCDMA (with WINIQSIM2™)	1404.1316.02

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