



Products: SMIQ, FSU, FSQ

# Remote Setup for 3G High Dynamic Multi Carrier Signals with SMIQ03HD and FSU / FSQ

## Application Note

Testing multi carrier power amplifiers of the 3rd Generation requires test signals with a high dynamic range. This application note describes how a 4 carrier 3G WCDMA signal can be generated and measured with the application software SET\_MC4. The software sets up to 4 SMIQ03HDs to generate the signal, and an FSU or FSQ to immediately evaluate and analyze the Adjacent Channel Leakage Ratio (ACLR) of the power amplifier. The setups are controlled remotely.

The SET\_MC4 source code is also included. Modify the code to meet your individual requirements or adopt the IEEE-commands into your own setup script.



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## 1 Overview

Most base station manufacturers target an Adjacent Channel Leakage Ratio (ACLR) of about 50 dB for the entire base station. To achieve this value, a base station amplifier has to be typically 10 dB better. To keep a measurement margin of another 10 dB, the test generators have to provide an ACLR of at least 70 dB [2].

For such a demanding application, R&S SMIQ03HD signal generators as well as the high dynamic FSU / FSQ spectrum and signal analyzers are the ideal measurement tools. Combining four SMIQ03HDs (with option SMIQB57 - High ACLR for WCDMA 2110 MHz to 2170 MHz) gives typically 74 dB ACLR at an offset of 5 MHz for a four carrier 3G signal. FSU / FSQ analyzers offer a multi carrier ACP function to measure and display the individual power of each channel, the total power of all tx channels, and the power of the adjacent and alternate channels simultaneously (from firmware version 1.70 or 1.65 respectively).

This Application Note describes how a 4 carrier 3G WCDMA signal can be generated and measured with the application software SET\_MC4. The application sets up to 4 SMIQ03HDs to generate the signal, and an FSU or FSQ to immediately evaluate and analyze the ACLR of the power amplifier. The setups are controlled remotely.

The SET\_MC4 source code is also included. Modify the code to meet your individual requirements or adopt the IEEE-commands into your own setup script.

**Note:** For a detailed description of how to use SMIQHDs to get the best performance with 3GPP multicarrier signals, see Application Note 1GP52, Generating 3GPP Multi Carrier Signals for Amplifier Tests with R&S SMIQ03HD and WinIQSIM<sup>®</sup> [2].

## **2 Operation**

### **How to setup the Hardware**

#### **PC Hardware and Software Requirements**

The software runs on a PC with the following minimum features:

- CPU: 486, Pentium
- RAM: 16 Mbytes
- Graphic resolution: 1024 x 768, colour monitor
- IEC/IEEE bus: IEC/IEEE-bus interface Rohde & Schwarz IEEE 488.2 bus interface PS-B4, 1006.6207.04 or National Instruments AT-GPIB/TNT
- Windows 95/98, Windows NT (version 4.0 or later), or Windows2000
- GPIB (IEC/IEEE-bus) driver installed
- VISA library version. 6.1 from National Instruments

If the VISA library is not already installed on your PC, download it from the National Instruments homepage ([www.ni.com](http://www.ni.com), search for VISA 6.1). The download is free of charge.

To modify the code of SET\_MC4 and to generate a version for your own requirements, you need the LabWindows CVI software from National Instruments version 6.0 or later.

#### **Options required for SMIQ and FSU / FSQ**

For the SMIQs, HD-Models are required for the generators, e.g. SMIQ03HD, equipped with options

- SMIQB45 - Digital Standard WCDMA
- SMIQB20 - Modulation Coder
- SMIQB11 - Data Generator 16 Mbit
- SMIQB57 - High ACLR for WCDMA 2110 MHz to 2170 MHz

For the FSU / FSQ analyzers, the following option is required:

- FS-K72 - Application Firmware 3GPP-FDD BTS Transmitter Test for FSU / FSQ Spectrum and Signal Analyzer.

The FSU has to run at least firmware version 1.70, the FSQ at least version 1.65.

### Hardware Test Setup

Two trigger modes are provided by the program SET\_MC4:

The mode *Trigger free run* is set as the default mode. *Trigger free run* requires no external cables between the generators (except the GPIB-cables and an RF combiner). In this mode, the four SMIQ generator signals are not correlated. *Trigger free run* is intended for quick signal presentation.

Use the trigger mode *Synchronized* for more sophisticated applications, see [2]. In this mode, adjust the chip offset between the bitstreams of the four generator signals. To synchronize the four generators, additional cables are required, see figure 1.

Figure 1 shows the hardware test setup for trigger mode *Synchronized*. SMIQ 1 is triggered manually, and provides a master trigger output signal. This trigger output will be accepted with a time delay by SMIQ 2, providing a time delayed modulation data stream. SMIQ 2 again triggers SMIQ 3, and so on. Coupling of the 10 MHz references and the bit clock guarantees the synchronisation.

A power combiner combines the four RF signals.

All instruments have to be set to different IEEE addresses, and have to be connected via the GPIB-bus to the controller PC (not shown in figure 1) running the program SET\_MC4.

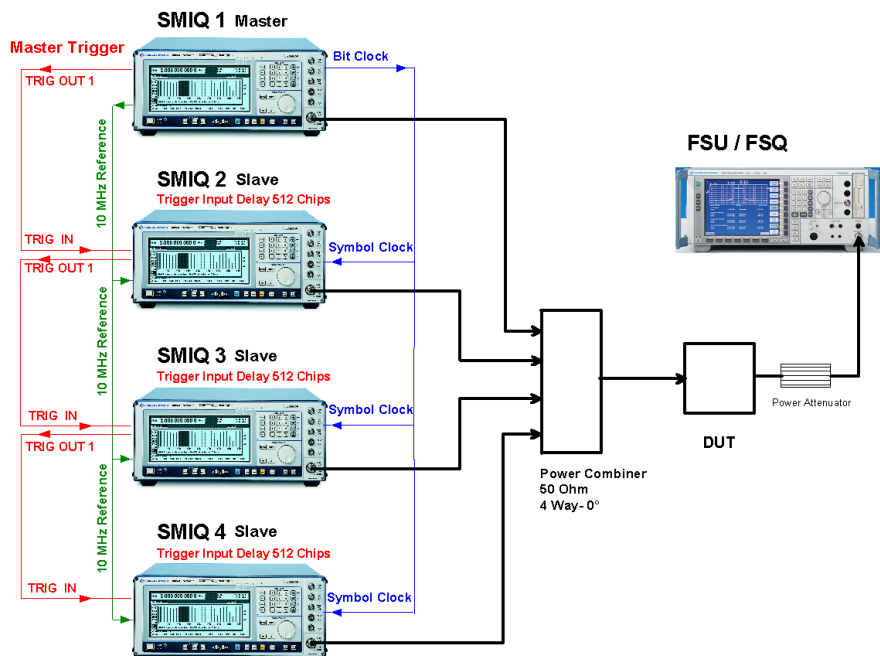


Figure 1: Hardware test setup for multi carrier generation

## Remote Setup for 3G Multi Carrier Signals

For *Trigger free run*, you do not need the cables for TRIG OUT, 10 MHz Reference, and for the bit clock. All instruments are set to free run, to internal 10 MHz references, and to internal bit clocks.

Although intended to establish a four-carrier signal with four SMIQ generators, the program also works with a smaller number of SMIQs, and no analyzer. At least SMIQ 1 has to be present.

**Note:** Use for trigger coupling adapters SMIQ-Z5.

1. Setup the hardware as described on page 4.
2. Power up the instruments.
3. Install the program SET\_MC4 on your PC. See section *Installing SET\_MC4* in the appendix.
4. Run SET\_MC4.

## How to run the program SET\_MC4

The program SET\_MC4 initially starts with the user panel in a default configuration. At program exit, SET\_MC4 stores the current settings for the next run. To reset, reload the default configuration by clicking *File*, and *Load Default* in the menu bar.

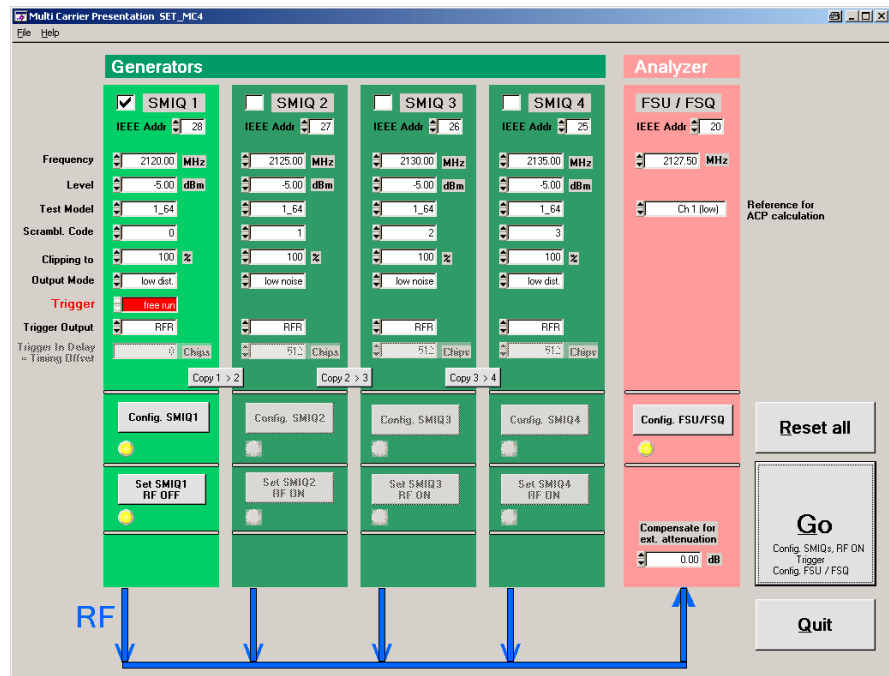


Figure 2: User Panel of the program SET\_MC4

### Principles of Operation

Always use the same order of operation in the software:

1. Before configuring the instruments, reset your instruments by clicking the *Reset*-button.
2. Now, configure your SMIQ03HDs, and the FSU / FSQ analyzer individually at the user panel.
3. Use the *Go*-button to automatically setup the entire hardware. *Go* subsequently transfers your settings from the user panel to each of the SMIQs and activates the calculation of the testmodels inside the generators. Then, in *Synchronized* mode, SMIQ 1 will be triggered. Finally, *Go* configures the analyzer.

If you want to individually transfer your panel setting for each instrument, click the separate *Config. SMIQ* and the *Set SMIQ RF on* buttons.

Once, generator parameters are changed, and SMIQs are configured and enabled manually, do not forget to reconfigure the analyzer afterwards. This is necessary to activate the analyzer's automatic input level adjustment. The RF signals have to be present at this time.

(In synchronized mode, click the *Trigger*-button to establish the multi carrier signal before configuring the analyzer.)

### How to proceed for the very first time:

To get familiar with the program, work without a DUT at first.

1. Connect the output of the combiner with the input of the analyzer.
2. Enable all SMIQs you are currently using by setting the checkboxes for SMIQ 2, SMIQ 3, and SMIQ 4 as appropriate.
3. Enter your *IEEE device addresses* for the generators and the analyzer.
4. Set *Trigger* to *free run*.
5. Click the button *Reset all*.

During the reset procedure, the mouse cursor changes to the hour glass and the *Reset* button is dimmed. When the reset procedure is completed, the mouse cursor becomes an arrow again and the *Reset* button is no longer dimmed.

6. Click the button *Go*.

During the *Go* procedure, the mouse cursor changes to the hour glass and the *Go* button is dimmed. When the procedure is completed, the mouse cursor becomes an arrow again and the *Go* button is no longer dimmed.

7. Check the results at the analyzer screen.

You will get measurement results similar to figure 3.

## Measurement results

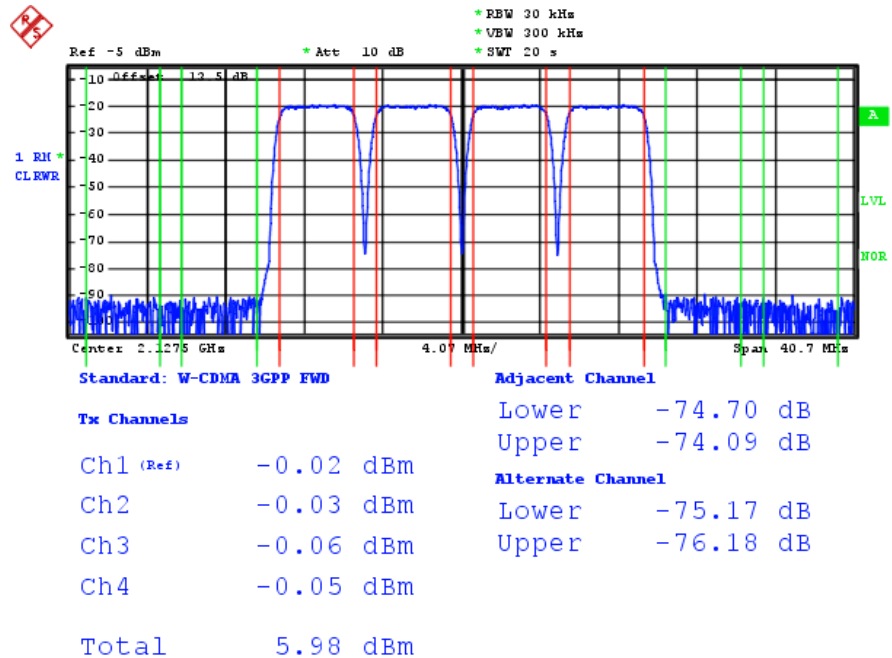


Figure 3: High dynamic four channel 3G multicarrier signal

In the figure above, the analyzer displays a typical measurement result with four SMIQ03HDs set to the SET\_MC4 program defaults, using the hardware setup shown in figure 2. The combiner attenuation was compensated for.

The adjacent channel and alternate channel power is far below the 70dB stipulated for testing of e.g. 3G power amplifiers. (The power values are referenced to channel 1.)

## 3 Additional Information

### Channels and frequencies

The program SET\_MC4 configures the analyzer to expect a signal combination of four 3G forward channels with a channel separation of 5 MHz. The channel with the lowest frequency is called channel 1, followed by channel 2 and so on. Adjacent channels are the channels that are below tx channel 1 and above tx channel 4. Alternate channels are the channels next to the adjacent channels.

- Set the SMIQ frequencies to generate a block of four neighbouring signals.
- Always set SMIQ 1 to the lowest frequency, followed by SMIQ 2, and so on.
- Set the analyzer frequency to the middle of the four carriers.

### Adjusting the reference level

The program SET\_MC4 makes use of the analyzer function ADJUST REFERENCE LEVEL automatically. This guarantees the best analyzer dynamic for all four channels present with 5MHz spacing and the same power.

If you have a different channel constellation, carefully adjust reference and input attenuation manually.

### Reference for the Adjacent Channel Power calculation

The measurement results for the Adjacent Channel Power (ACP) are referenced to a signal level.

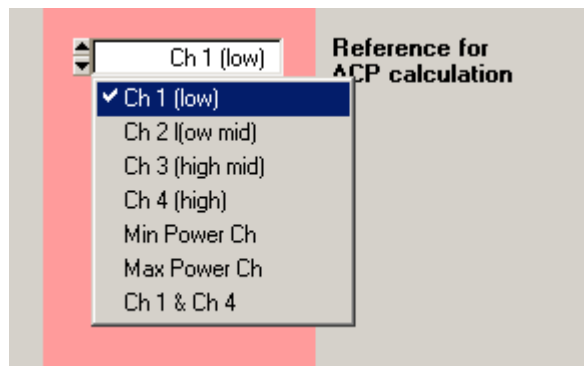


Figure 4: Reference for the Adjacent Channel Power calculation

Select one of the four channel signals as reference in the field *Reference for ACP calculation*. Or select the maximum signal, the minimum signal, or Channel 1 and channel 4 as reference for the evaluation of the adjacent and alternate channel power.

### Output Modes

Two filter characteristics are implemented in the SMIQ with option SMIQB57:

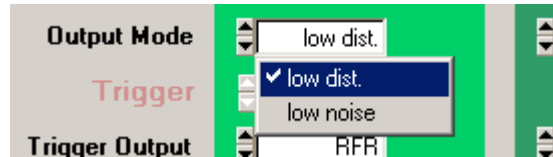


Figure 5: SMIQ output modes

- Select *low dist* for minimum noise power immediately below and above the current channel. This results in higher noise power in channels further away.
- Select *low noise* for minimum noise power in the channels further away, at the expense of higher noise in the two channels immediately below and above the current channel.

For minimum ACLR, set the channels with the lowest and the highest frequency to *low dist*, and the channels between to *low noise*, see Application Note 1GP52 [2].

### Trigger Delay

The trigger input delay can be incremented in steps of 512 chips, which corresponds to an increment of 1/5 slot.

If the trigger input delay of SMIQ 2 is set to 512 chips, the SMIQ 2 signal will be delayed by 512 chips against SMIQ 1. If the trigger input delay of SMIQ 3 is also set to 512 chips, SMIQ 3 will be delayed by 1024 chips against SMIQ 1, because SMIQ 3 gets the delayed trigger signal from SMIQ 2 (see figure 1).

For a detailed discussion of trigger delay setting, see application note 1GP52 [2].

### Trigger Output

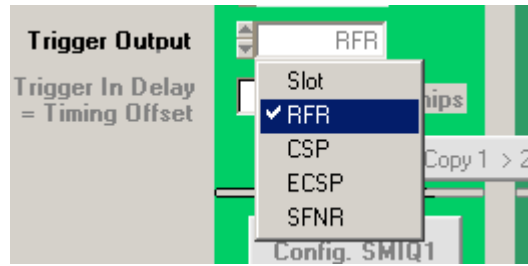


Figure 6: SMIQ trigger output signals

- *Slot* A trigger signal is provided for each Slot start (667 $\mu$ s)
- *RFR* A trigger signal is provided for Radio Frame (RFR) start
- *CSP* A trigger signal is provided for each Chip Sequence Period (CSP)
- *ECSP* A trigger signal is provided for each Enhanced Chip Sequence Period (ECSP)
- *SFNR* A trigger signal is provided for each Super Frame Number Restart (SFNR)

### Compensation for external attenuation

Compensate for the attenuation of the power combiner and the cables in the analyzer field of the user panel in SET\_MC4.

## 4 Appendix

### How to install SET\_MC4

1. Download the file 1ma62\_x.x.exe (x.x is the program version) from:  
*http://www.rohde-schwarz.com* --> products --> Application Notes, search for 1MA62.
2. Run 1ma62\_x.x.exe. This will extract the four files:  
MultiCarrier.msi, DistFile.cap, setup.ini, and setup.exe
3. If the Microsoft Installer is not yet available at your PC, download it from the R&S website, and install it first.
4. Run setup.exe.
5. Follow the instructions of the installation dialog.

**Note:** If the installation program finds an older version of SET\_MC4 on your computer, this version will be deinstalled first. After the deinstallation, run setup.exe again to install the new version.

### References

- [1] 3GPP specifications: TS25.104 v4.2.0, TS25.141 v4.2.0, 2002
- [2] Generating 3GPP Multi Carrier Signals for Amplifier Tests with R&S SMIQ03HD and WinIQSIM, Application Note 1GP52, Rohde & Schwarz, 2002
- [3] Generating and Analyzing 3GPP Multicarrier Signals with High Dynamic Range, Application Note 1MA48, Rohde & Schwarz, 2002
- [4] Measurements on 3GPP Base Station Transmitter Signals, , Application Note 1EF44, Rohde & Schwarz, 2002

### Ordering Information

#### Vector Signal Generator and Options

SMIQ03HD	0,3 MHz...3,3 GHz	1125.5555.33
SMIQB11	Data Generator 16 Mbit	1085.4502.04
SMIQB12	Memory Extension	1085.2800.04
SMIQB14	Fading Simulator	1085.4002.02
SMIQB15	Second Fading Simulator	1085.4402.02
SMIQB17	Noise Generator and Distortion Simulator	1104.9000.02
SMIQB20	Modulation Coder	1125.5190.02
SMIQB45	Dig. Standard WCDMA (3GPP, FDD)	1104.8232.02
SMIQ-B47	Low ACP for CDMA and WCDMA	1125.5090.02
SMIQB48	Extended Functions for WCDMA (3GPP)	1105.0587.02
SMIQB49	Extended Fading Function for WCDMA	1105.1083.02
SMIQB57	High ACLR for WCDMA/3GPP	1105.1831.02
SMIQ-Z5	PAR DATA BNC ADAPTER	1104.8584.02

#### Spectrum Analyzer and Options

FSU3	20 Hz... 3 GHz	1129.9003.03
FSU8	20 Hz... 8 GHz	1129.9003.08
FSU26	20 Hz... 26,5 GHz	1129.9003.26
FSQ3	20 Hz... 3,5 GHz	1155.5001.03
FSQ8	20 Hz... 8 GHz	1155.5001.08
FSQ26	20 Hz... 26.5 GHz	1155.5001.26
FS-K72	Application Firmware 3GPP-FDD BTS Transmitter Test for Spectrum Analyzer	1154.7000.02

Further instruments from the Rohde & Schwarz product line, which are useful for 3GPP measurements:

TS8950 B1	RF Precompliance Tester for WCDMA FDDa Node B	
CMU200	Universal Radio Communication Tester	1100.0008.02
CMU300		1100.0008.03

### Contact

Please contact [TM-Applications@rsd.rohde-schwarz.com](mailto:TM-Applications@rsd.rohde-schwarz.com) for comments and further suggestions.



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