BER Measurements on
GSM Receivers
under Conditions of Fading

Application Note 1MA04_0E

Products:

Signal Generator SMIQ

Digital Radiocommunication Tester CMD55/57

ROHDE & SCHWARZ

Contents

1. Overview

Bit error rate measurements under conditions of fading (multipath reception) allow an assessment of the sensitivity of GSM receivers and furnish information about the equalizer quality in the decoder. The combination of a Digital Radiocommunication Tester CMD55 or CMD57 with option CMD-B17 and a Signal Generator SMIQ allows simple performance of these measurements on GSM mobile or base stations.

2. Principle of Operation

There are two RF channels for a GSM call setup: the broadcast (BCCH) and the traffic channel (TCH).

Bit error measurements using the CMD are always carried out in the traffic channel. The transmit signal of the measuring instrument is varied with defined level spacing from the sensitivity threshold of the DUT. This transmit signal is now to be conditioned with a fading profile.

In the subsequent application the TCH output stage in the CMD is switched off for this purpose and the complete processing of the RF multipath signal handled by Signal Generator SMIQ.

With the options SMIQ-B14 (6 fading channels) and, where required, SMIQ-B15 (another 6 fading channels) the SMIQ already provides preprogrammed fading profiles required for the various mobile radio standards. For GSM900, for instance, the user will find TU, HT, RA and ET, each with different speeds.

The SMIQ is modulated by IQ vector signals which are made available by option CMD-B17.

3. Test Setup

Fig. 1a shows how SMIQ and CMD55 have to be connected to an MS as device under test. Fig. 1b shows the cable connections for SMIQ, CMD57 and a BS with common connector for RX and TX.

In both cases a directional coupler is inserted into the RF path between CMD and DUT. The faded channel generated by the SMIQ is fed in at this point.

(The insertion loss of this path has to be taken into account in subsequent setting of the SMIQ output level.)

There is no need for a directional coupler if the BS offers seperate connectors for RX input and TX output, see fig. 1c.

The Abis cable enables the CMD57 to control the basestation. If not switched to RF loopback it is possible to run an Abis RX loopback via this interface.

Two BNC cables are used to feed the I/Q signals from option CMD-B17 to the I/Q modulation inputs of the SMIQ.

For locking the frequencies of CMD and SMIQ, the 10 MHz reference connectors of the two instruments must be linked with one another. CMD is the source; SMIQ is switched to an external reference.
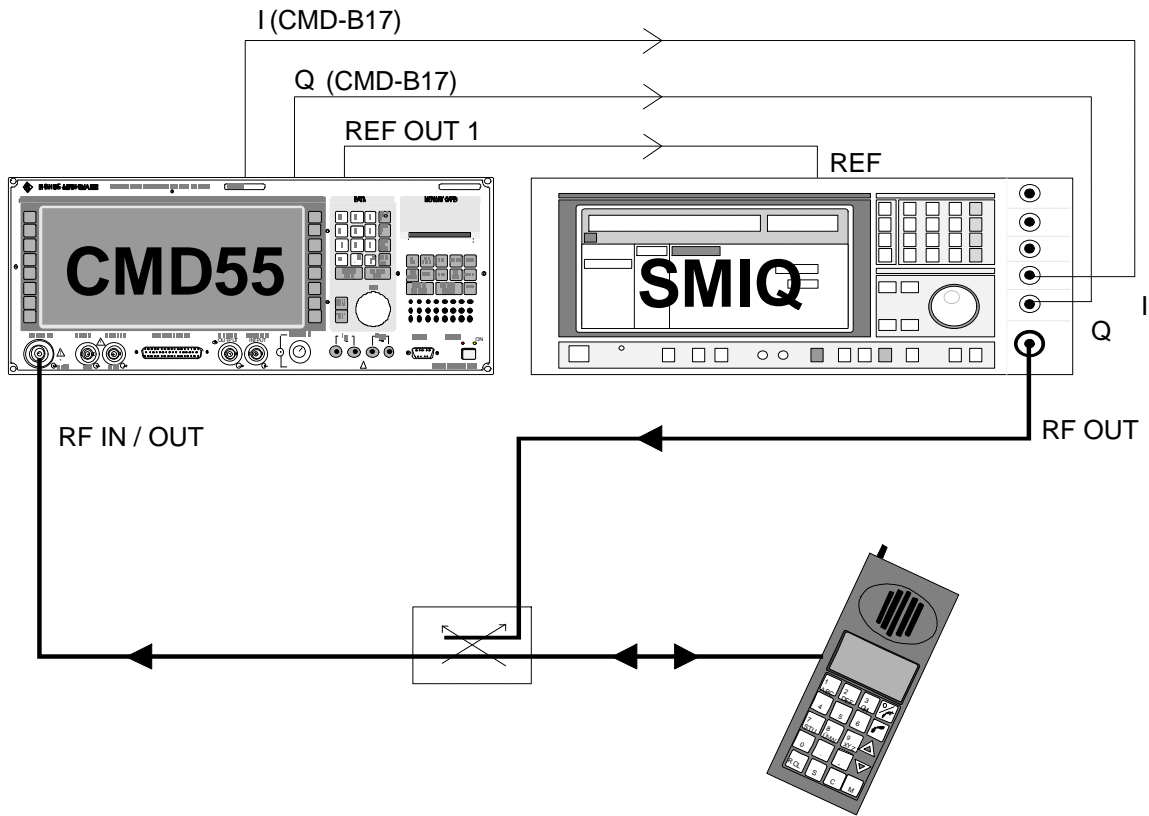
I (CMD-B17)

Q (CMD-B17)

REF OUT 1

REF

CMD55

SMIQ

I

Q

RF IN / OUT

RF OUT

Fig. 1a: Setup for MS test

Abis

I (CMD-B17)

Q (CMD-B17)

REF OUT 1

REF

CMD57

SMIQ

I

Q

RF IN / OUT

RF OUT

RX / TX

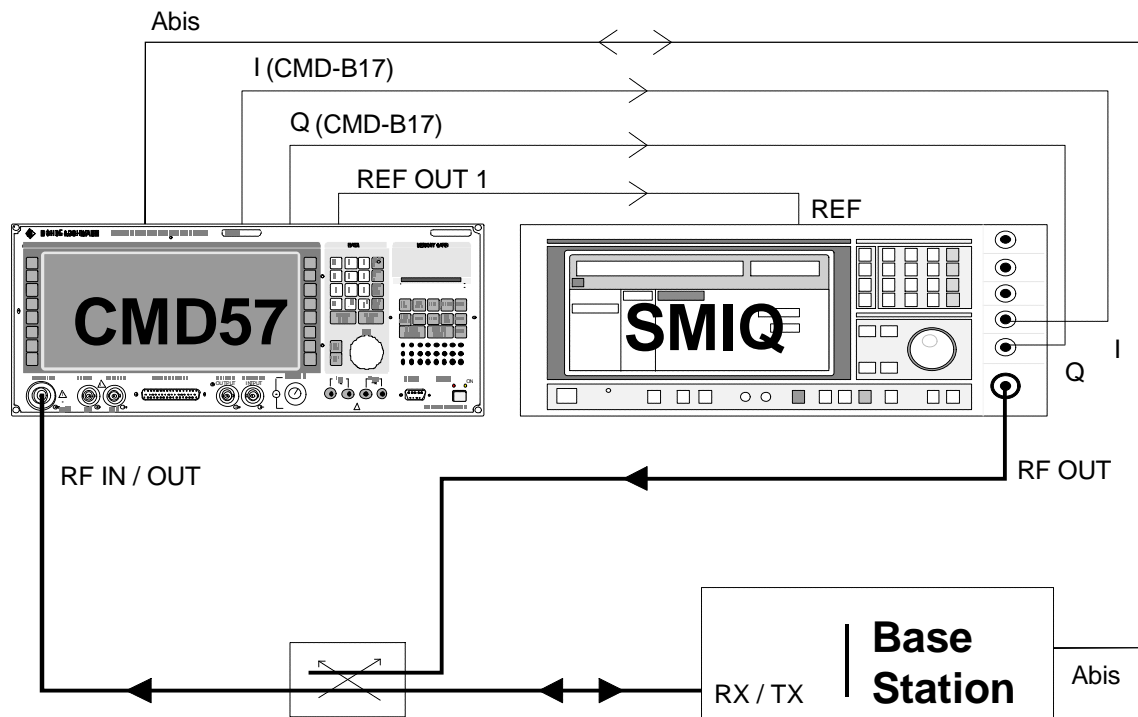**Base Station**

Abis

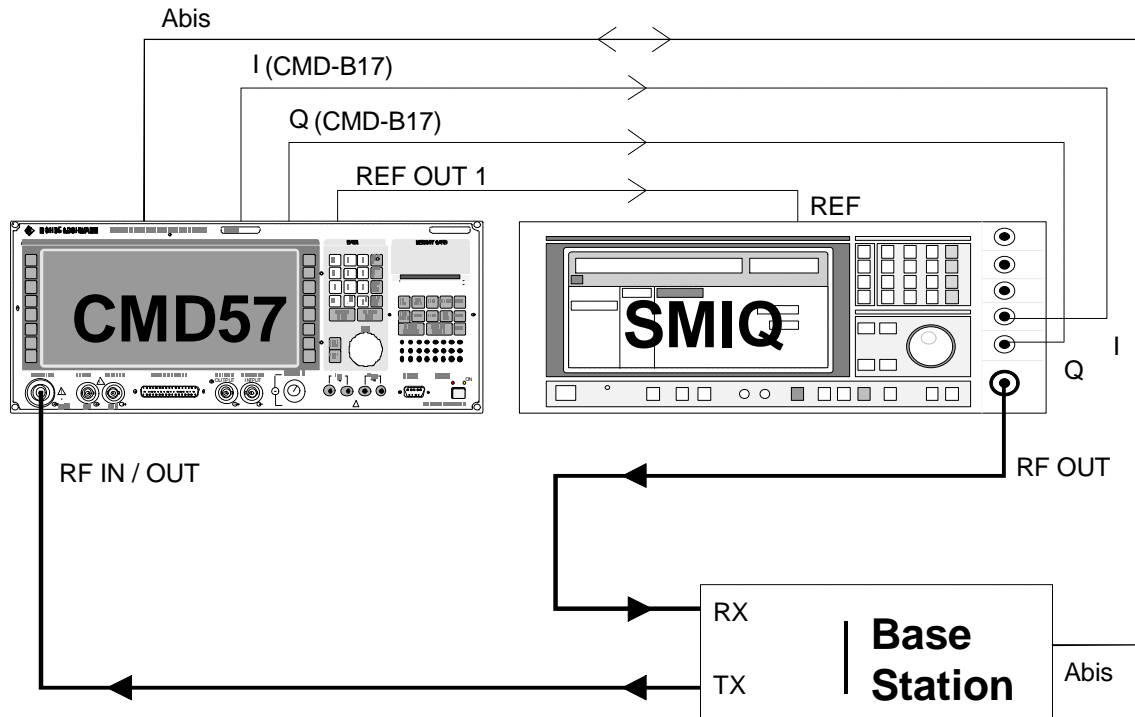Fig. 1b: Setup for BS test with common connector for RX / TX

Fig. 1c: Setup for BS test with seperate connectors for RX / TX

4.   Presettings

4.1.   CMD

The CMD is operated in the same way as for measurements without fading conditions. The only difference is the subsequent reduction of the TCH output level. This reduction must be preset on the CMD both for the call setup and the subsequent bit error rate measurement. For this purpose press the RESET key to start from the default configuration of the CMD.

Sequence of keys to be pressed:

(Hardkey) RESET, (softkey) ALL DATA.

You get to the basic menu.

For CMD55:

(Softkeys) MANUAL TEST, BS SIGNAL,

UNUSED TIMESLOT: Enter 0 dB,

USED TIMESLOT: Enter -140 dBm.

For CMD57:

(Softkeys) MANUAL TEST, MS SIGNAL

RF LEVEL: Enter -140 dBm

Then (for CMD55 and CMD57):

(Hardkey) MENU HOME, (softkeys) CONFIG MENU, BER TEST.

It is now possible to enter continuous measurement or single measurement for each of the 7 programmable configurations (TEST1 to 7).

UNUSED TIMESLOT: Enter 0 dB,

USED TIMESLOT: Enter -140 dBm.

(Only the actually used configurations need to be programmed.)

Note: With the reduction to -140 dBm the TCH signal is sufficiently attenuated. Since TCH and

BCCH level of the CMD55 cannot differ by an arbitrary amount, a further reduction of the TCH signal would automatically also reduce the BCCH level.

4.2. SMIQ

Start from the default configuration of the SMIQ after pressing the PRESET key. Make the following settings first:

PRESET

FREQUENCY: TCH frequency in MHz

For GSM900 uplink (CMD57) the frequency is calculated from the channel number displayed on the CMD for the TCH (RF CHAN) using the formula

890 MHz + channel number * 0.2 MHz.

For channel 110, for example, this yields 912 MHz.

The uplink frequency (CMD55) is 45 MHz higher (eg 957 MHz for channel 110).

LEVEL: desired level +
                     attenuation of
                     directional coupler

VECTOR MOD, STATE, ON

FADING SIM, STANDARD, eg GSM TU 50

UTILITIES, REF OSC, SOURCE, EXT

5. Measurement

First make the connection to the DUT as usual. Then select on the SMIQ the menu items

⇒

FADING SIM and CONFIGURATION

to switch on either 12-channel or 6-channel fading.

Bit error measurements can now be started and carried out in the same way as without fading. However, level variations are only made on the SMIQ.

Note: The bit error rate increases briefly as the attenuator is switched during the variation of the SMIQ output level. This can be avoided by selecting the operating mode ATTENUATOR MODE FIXED for a specific variation range, see operating manual section 2.5.2.

6. Test Setup Requirements

All RF signals must be routed via low-loss coaxial cables with tight shielding. The cable loss must be taken into account in the level measurement.

7. References

- GSM 11.10-1 Sec. 14, GSM 05.05, Annex C

- Mittermaier, W.; Holzmann, G.: GSM and PCS testers in one compact unit. News from Rohde & Schwarz, No. 145, p. 18

- Schindlmeier, R.: GSM/PCN base station testers for production, installation and service. News from Rohde & Schwarz, No. 146, p. 16

- Klier, J.: High-quality digital modulation. News from Rohde & Schwarz, No. 154, p. 4

- Operating manual of Digital Radiocommunication Tester CMD

- Operating Manual of Vector Signal Generator SMIQ

8. Ordering Information

Vector Signal Generator	SMIQ	1084.8004.02
Fading Simulator	SMIQB14	1085.4002.02
Second Fading Simulator	SMIQB15	1085.4402.02
Digital Radiocommunication Tester	CMD55	1050.9008.55
Digital Radiocommunication Tester	CMD57	1050.9008.57
I/Q Mod. Output	CMD-B17	1099.3003.02

Note: Models valid from software version

⇒ 3.22 for CMD with 8 Mbyte

⇒ 2.50 for CMD with 4 Mbyte

⇒ 3.30 for SMIQ

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