



Products: CMU300

# GSM / EDGE Base Station Bit Error Rate Testing with CMU300

## Application Note

This Application Note provides an overview of the Bit Error Rate (BER) test capabilities of the Universal Radiocommunication Tester CMU300 on GSM / EDGE Base Stations. It includes information about measurement principles, the supported test environment and channels, CMU settings, operation, and ordering information.



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# **1 Introduction**

### **About this document**

This Application Note provides an overview of the Bit Error Rate (BER<sup>\*)</sup> test capabilities of the Universal Radiocommunication Tester CMU300 for testing GSM / EDGE Base Stations. It includes information about measurement principles, the supported test environment and channels, CMU settings, operation and ordering information.

### **BER – a measurement of receiver sensitivity**

The transmitter characteristics of a GSM / EDGE Base Transceiver Station (BTS) are relatively simple to measure, since the physical effects can be checked directly by the tester. But when it comes to receiver characteristics, the physical effects appear in the Device Under Test (DUT) itself, so no direct measurement is possible. GSM standardisation committees therefore defined test-modes for measuring the receiver characteristics of a BTS (Technical Specification "3GPP TS 11.21" [3]).

The major characteristic of a receiver is its sensitivity, which in digital systems is determined through the Bit Error Rate (BER). The receiver is fed a test signal with a Pseudo-Random Bit Sequence (PRBS) and defined level. The number of bit errors is measured at its output.

In both development and conformance testing of a BTS the receiver characteristics have to be tested under various aspects like fading, multipath reception, or intermodulation. In production it is sufficient to stimulate the receiver with a low-level GSM signal. Usually, either Reference Sensitivity or Absolute Receiver Sensitivity is measured.

#### **Reference or Absolute Receiver Sensitivity?**

To check the Reference Sensitivity, a signal with a defined level (such as – 106 dBm for GSM900) is applied to the receiver. If the measured BER is below the specified limit, the receiver has passed the test. To determine the Absolute Receiver Sensitivity the level of the test signal is varied until a defined BER is obtained.

Obviously, Absolute Receiver Sensitivity takes longer to measure than Reference Sensitivity. So in production, where maximum throughput is a critical criteria, measuring the Reference Sensitivity is often preferred.

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\*) The abbreviation BER is used here as general parameter for testing digital receivers. A more detailed distinction between different test methods (BER / FER / RBER / BLER etc.) is given later. The current document represents the status of September 2002 and is subject to future modifications.

**General aspects of BTS- Testing**

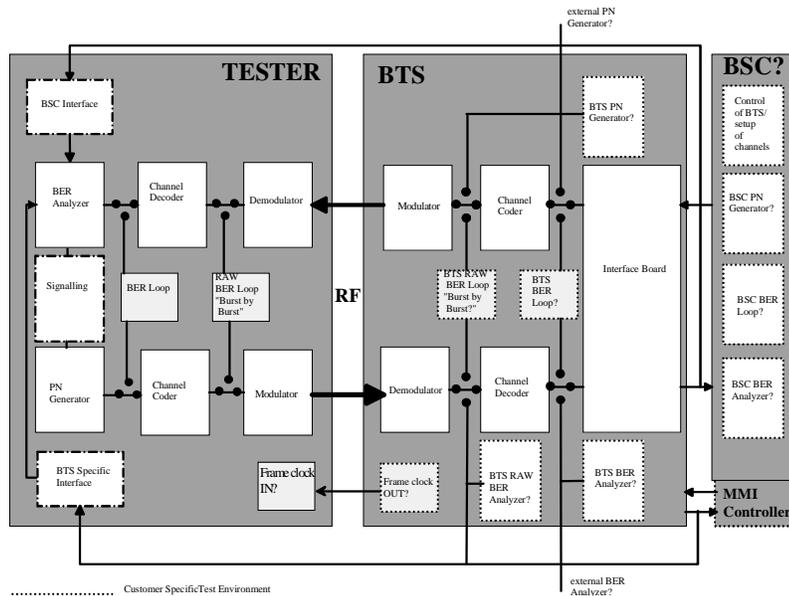


Fig. 1 BTS test-environment

**Controlling the BTS**

For RF tests the BTS can be controlled in 2 different ways:

- A Base Station Controller (BSC) or BSC-simulator can be used for control via a standard E1/T1 line interface (Abis). In most cases special test modes (loop switching inside the BTS) are not supported. The BTS can be tested in the same way as it is used in field operation.
- Usually a BTS is equipped with specific interfaces, which can be controlled by external maintenance-terminals. This approach enables test modes, not used during standard operation.

The requirements for controller-functionality in the RF test-equipment depends on the application addressed and the manufacturer-specific test concept. Due to the growing complexity of both the RF tester and the controller itself, there is currently a tendency to provide separate solutions for controlling and measuring. (Fig. 1 illustrates a standard BTS test environment.)

**The RF Connection between the DUT and the test equipment**

The test equipment must provide flexible, configurable RF Input and Outputs. Both combined (duplex) and separate links with different configurations for up- and downlink paths must be considered. The following level ranges have to be taken into account:

- BTS transmitter output level (main output; test output): 47..-30 dBm
- BTS receiver input level (main input; test input): 10...-130 dBm

**Synchronising the DUT and the test equipment**

TDMA receivers are gated; the fed test signal with pseudo-random bit sequence has to be forwarded to the receiver input at exactly the correct moment. Depending on the BTS-specific test concept, the test equipment should support the following procedures to synchronise the TDMA frame structure of the receiver under test:

- The test equipment triggers on the 26-multiframe-clock of the BTS. The corresponding BTS-frame-clock output and the additional cable have to be considered.
- The test equipment synchronises to the C0 carrier in a similar procedure to a normal mobile phone. Only RF-connections are necessary. The C0 carrier must be activated at least once before starting traffic channel tests.

### **Type of BER Test**

The following approaches for receiver BER tests are dependent on manufacturer specific test requirements:

- With or without channel coding and decoding. With coding it is possible to measure the complete receiver path including the channel decoder.
- With a recorded data string or real time generation of the test signal: Real time generation is a precondition for tests on higher signalling layers and for easy implementation of extended BER test functionality such as an automatic search routine for absolute sensitivity.

### **Test Path**

Independent from manufacturer specific test concepts, the test path "PRBS-source / DUT=Receiver / Analysis of BER" must be considered. The following test paths are used very often for receiver BER tests in GSM / EDGE test environments:

*BTS Test Mode with internal loop: (Fig. 13)*

- PRBS generation, channel coding and modulation by the tester.
- Demodulation and channel decoding by the BTS receiver; loopback inside the BTS behind the channel decoder; channel coding and modulation at the BTS transmitter; "return" of the bit sequence to the tester via the RF downlink.
- Demodulation, channel decoding and calculation of BER by the tester.

*Normal operation of the BTS with Abis loop: (Fig. 14)*

- PRBS generation, channel coding and modulation by the Tester.
- Demodulation and channel decoding by the BTS receiver; "return" of the bit sequence to the tester via Abis<sup>\*)</sup>.
- Calculation of BER by the tester.

### **Setting up the channel to be measured**

There are different approaches for channel activation procedure:

- The channel is set up without any call procedure ("forced set-up"; the channel activation is forced by the BTS controller). This method has advantages regarding speed and is often used in production of transceiver modules.
- The traffic channel is activated via standard call procedures, as used in normal network operation mode (GSM: MOC / MTC). The BTS has to be controlled by a BSC; the test equipment has to provide the same signalling functionality as a standard mobile phone.

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<sup>\*)</sup> permanent monitoring of the Abis uplink (BTS...BSC) has to be provided by the test equipment

## 2 Preparing BER Tests: the pop-up menu CONNECTION CONTROL for general settings

The following section is a brief description of the necessary settings to complete before activating the RF connection.

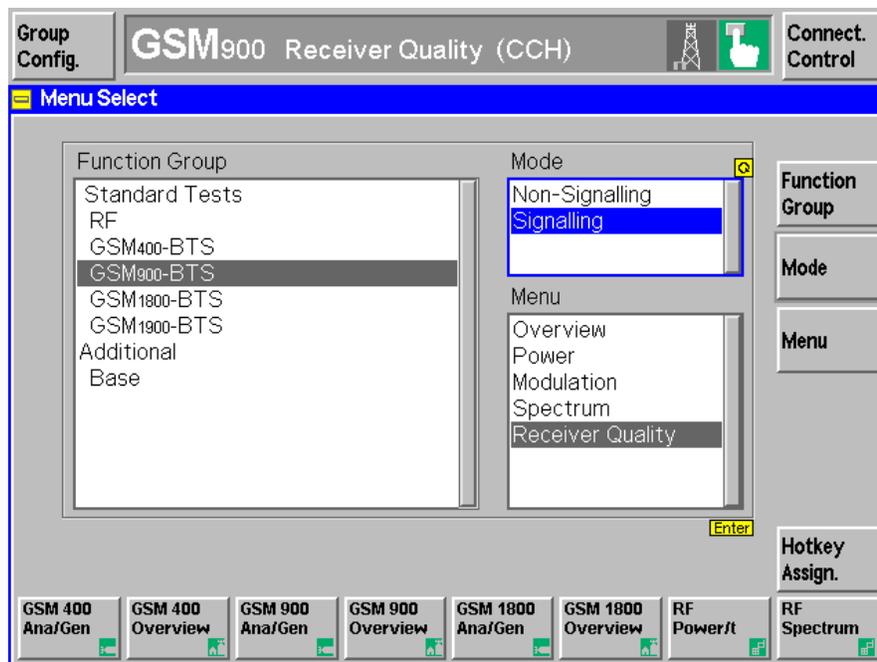


Fig. 2 “Menu Select”

The CMU300 performs BER tests in SIGNALLING MODE. The following information and the menus for manual operation describe this mode. The CONNECTION CONTROL pop-up menu defines main settings for BER tests. Most important settings are also accessible directly at related measurement menus. The Connection Control pop-up menu (permanently accessible using the hard key on the front panel) handles all parameters for RF connection. This menu comes up automatically if the RF connection is established incorrectly. Pressing the key Connect. Control opens or closes the corresponding popup menu (see Fig. 2).

### Controlling the BTS

The CMU300 does not provide any BTS control functionality. This must be performed by manufacturer specific controllers via Abis interface / MMI / LMT.

### Connecting the BTS to the CMU300

The CMU300 is equipped with a RF frontend including the following RF inputs and outputs (N-Connectors; see [1] for more detailed information):

- RF1: freely configurable input / output (Duplex) for connecting directly to the high power output from a “standard” BTS; ranges: 47...6dBm (Continuous) for transmitter tests; -31...-130 dBm for receiver tests)
- RF2: freely configurable input / output (Duplex) for connecting directly to the high power output from a Micro BTS; ranges: 33...-8 dBm (Continuous) for transmitter tests; -14...-130 dBm for receiver tests)

## BER TESTING WITH CMU300

- RF3: high level output: +9...-90 dBm
- RF4: sensitive input: 0...-30 dBm

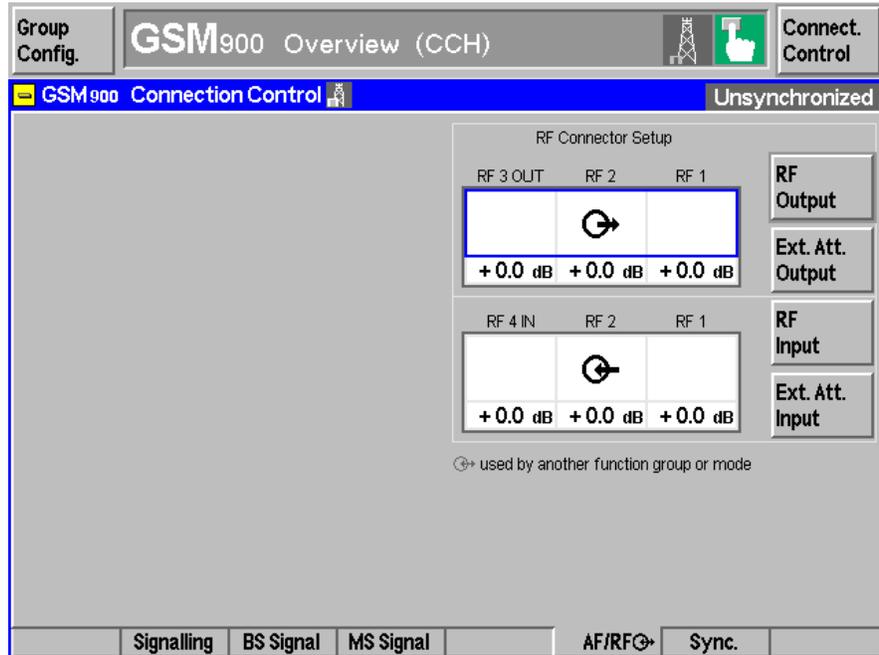


Fig. 3 The Connection Control> AF/RF menu

Use the Connection Control> AF/RF menu to configure the CMU300 RF interface.

Attention: Do not apply high RF power (> 13 dBm) to RF3 and RF4!

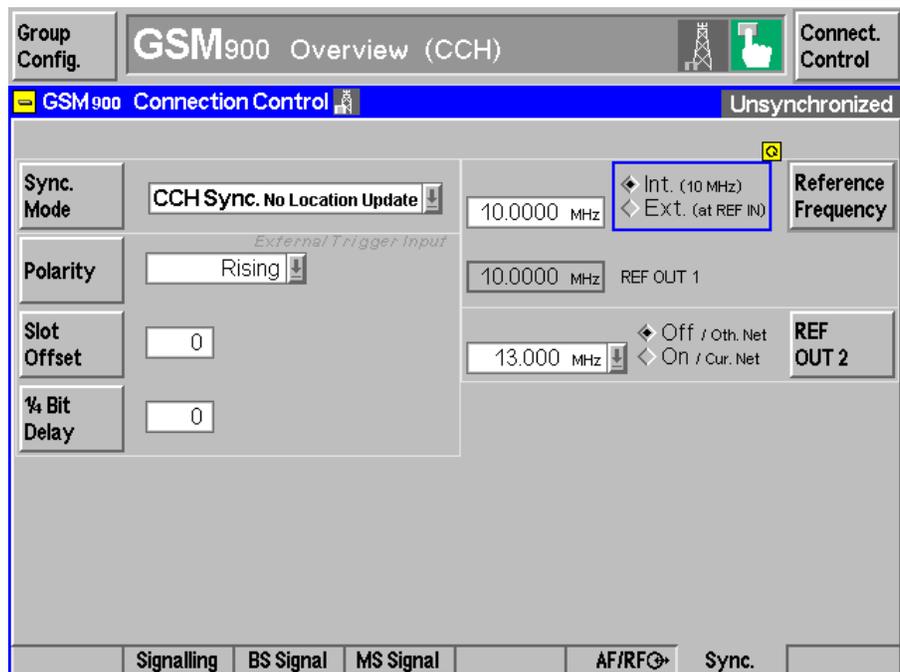


Fig. 4 Menu "Connection Control">Sync.

Inputs / Outputs for connection of reference frequency are located on the rear panel. Option CMU-B12 (high stability OXCO) is recommended for BTS applications. The reference frequency can be configured in the Connection Control> Sync. menu.

### Determining uplink and downlink signals (channel numbers; level settings; channel types etc.) and the test path

It is not possible to combine every selectable channel type with all the illustrated test environments and BER measurement modes. After selecting the channel type, incompatible functionality will be disabled (i.e. supported internal / external loops, available BER measurement modes, call functionality). A „yellow box“ will indicate test environments, which are not possible.

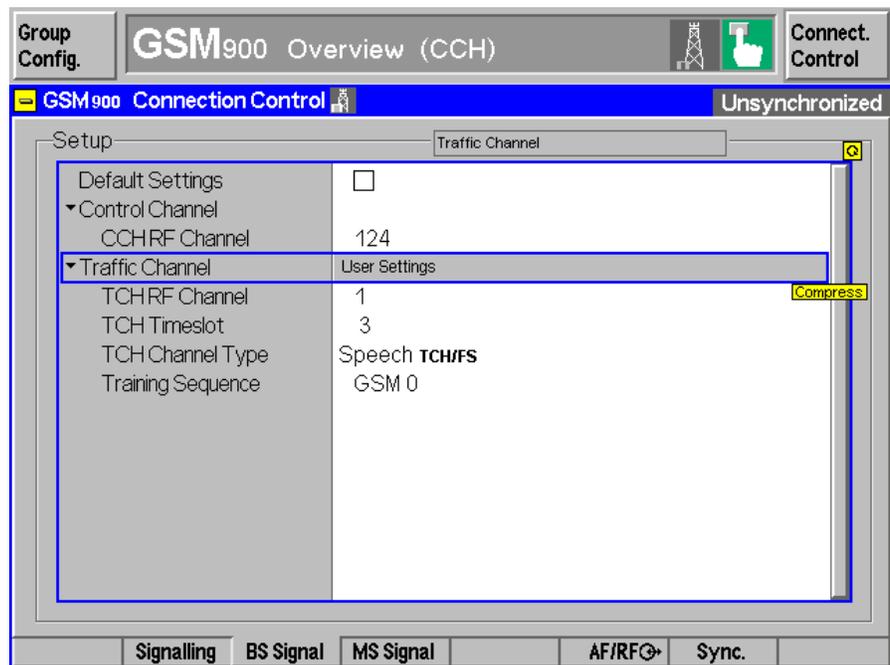


Fig. 5 The Connection Control> BS Signal menu

Use the Connection Control> BS Signal to adapt the tester to the received BTS downlink signal: parameters such as C0 / TCH channel numbers and used channel coders.

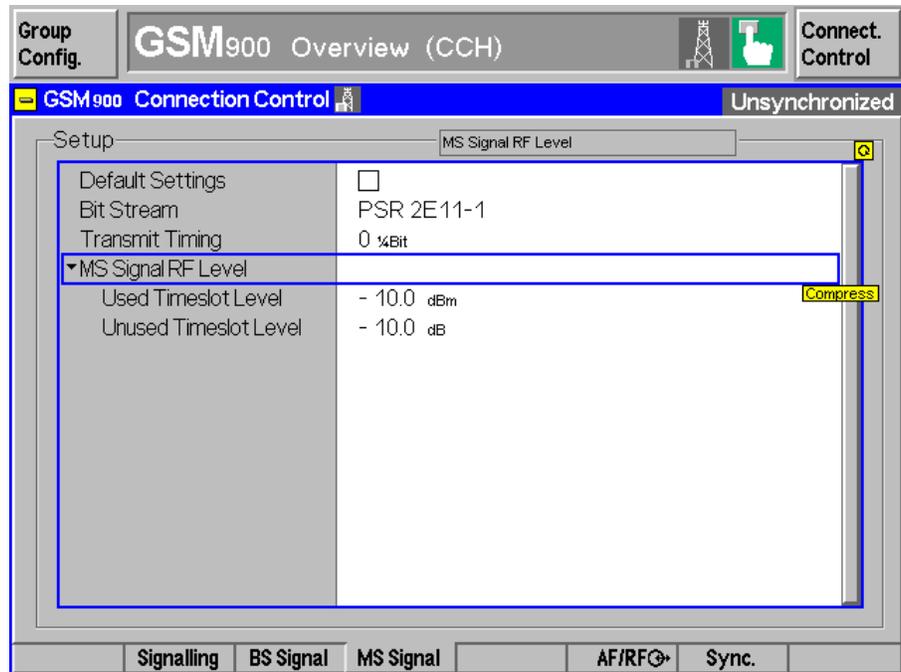


Fig. 6 The Connection Control > MS Signal menu

Use Connection Control > MS Signal menu to define the uplink related parameters (tester output level). More settings can be made from the Receiver Quality (TCH) menu. The test environment can be adapted by configuring the parameter BIT STREAM:

- PSR xxxx: the CMU generates the corresponding CCITT PN sequence and evaluates the BER via the RF downlink or the Abis interface. The “return path” of the bit pattern can be selected later from the BER measurement menu.
- LOOP / ECHO: the CMU is used as the RF loop, the instrument loops back the downlink signal including the channel decoding and coding. The Echo setting delays the incoming signal additionally for a fixed period (2 to 3 seconds).
- LOOP BURST BY BURST: The downlink signal is looped back to the uplink without channel decoding and coding.

### Synchronisation Procedure

For real-time BER measurements synchronise the CMU to the GSM TDMA timing 26-multiframe structure. This is necessary to avoid incorrect BER measurements during SACCH and IDLE frame periods. Select the SIGNALLING MODE on the main menu for “synchronised” measurements.

Two modes are supported:

“**CCH SYNC.**” synchronisation via RF signal only; the BTS has to provide the following C0 carrier:

- TS0: BCCH (including system information 1...4, FCCH , SCH)
- TS1...7: Dummy Bursts or TCHs including SACCH

“**WIRED SYNC.**” Synchronisation via an external trigger signal, provided by the 26 multi-frame clock interface from the BTS. The TTL clock

has to be connected to the CMU front panel; connector AUX3 (SUB D15), Pin 6.



Fig. 7 The Connection Control> Signalling menu

Choose the synchronisation mode from the Connection Control> Signalling popup menu. To start the synchronisation procedure press the softkey START SYNC. The CMU automatically displays the Connection Control > CCH-Test popup menu once synchronisation is successful.

- It is only necessary to synchronise once. If afterwards the CCH is switched off, the CMU re-synchronises to the GMSK modulated SACCH midamble (activated TCH on downlink). The same approach is applicable for "Wired Sync." after pressing the softkey START SYNC. Once the CMU triggers to 26-multiframe-trigger and afterwards permanently re-synchronises to SACCH midamble.
- To avoid synchronisation loss due to high frequency error (>500 Hz approx.) it is recommended to run the BTS and the tester on the same reference frequency.
- A successful CCH synchronisation procedure can be achieved in multi-carrier conditions, if the second carrier has a spacing of at least 10 GSM channels to the CCH signal (equal levels).

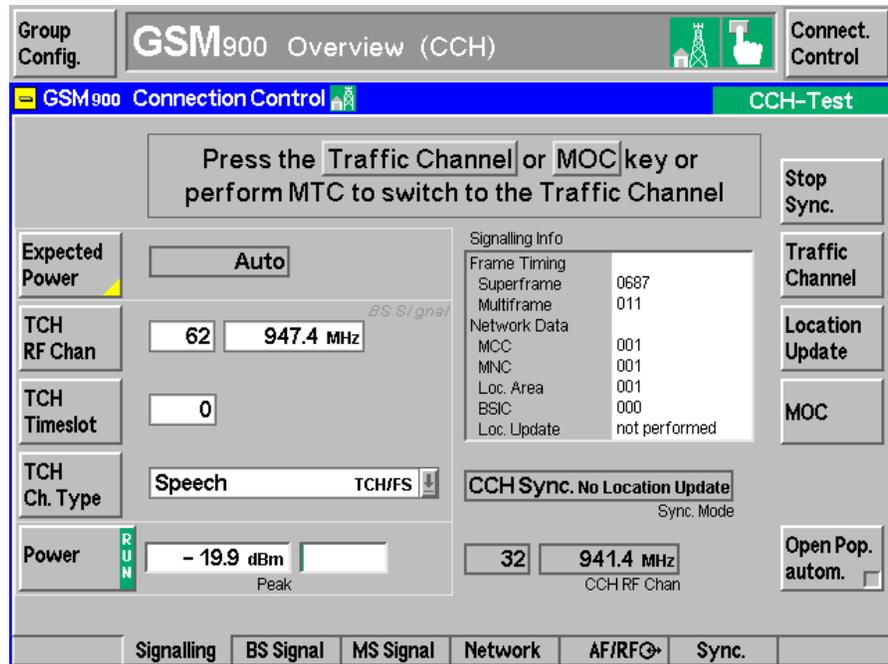


Fig. 8 Connection Control > Signalling menu

The frame timing information (permanently counting superframes and multiframes on Signalling Info window; see Fig. 8) can be used as a direct indicator for correct synchronisation. A stopped synchronisation can be reactivated by pressing the softkeys STOP / START SYNC.

Two procedures to activate a traffic channel are supported:

- Press the softkey Traffic Channel from the Connection Control > Signalling menu. “Forced” channel set-up without RF signalling must be supported by the BSS. The CMU changes to the Connection Control > TCH-Test menu automatically.
- Start a standard call procedure (circuit switched) by pressing the softkey MOC. (option CMU-K39 additionally required). The CMU changes automatically to the Connection Control > Call Established menu.

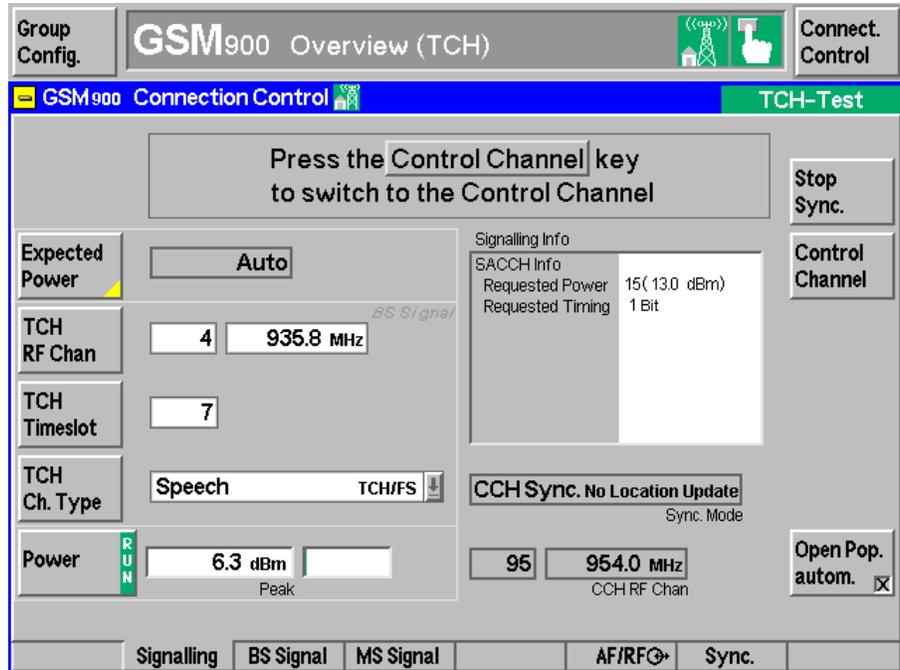


Fig. 9 The Connection Control > Signalling menu

Press the softkey CONNECT. CONTROL the popup menu disappears. Now the BER measurement itself can be started.

Configure the WIRED SYNC functionality in menu SYNC. (see Fig. 4). The CMU triggers only once to the input 26-multiframe trigger. Afterwards there is permanent re-synchronisation procedure to SACCH. In this mode it is recommended to use the same reference frequency for BTS and Tester.

### 3 Testing without channel coding (RAW BER Test / “BURST BY BURST”)

#### Test method description

The basic principle of the BER test modes is simple: the tester sends a data stream to the BTS, which then sends it back to the tester (loop). The tester compares sent and received uncoded data bits to determine the number of bit errors. The BTS has to provide a loop from receiver demodulator to the transmitter modulator without channel decoding and coding inside the BTS.

*Independent from the RAW BER Test method select a corresponding GMSK channel coder (TCH/FS, TCH/EFS, TCH/HS) or 8PSK channel coder (E-TCH/F43.2NT). To demodulate 8PSK signals a special measurement filter must be implemented into the CMU receiver path (in accordance with [3]).*

#### Supported test-path

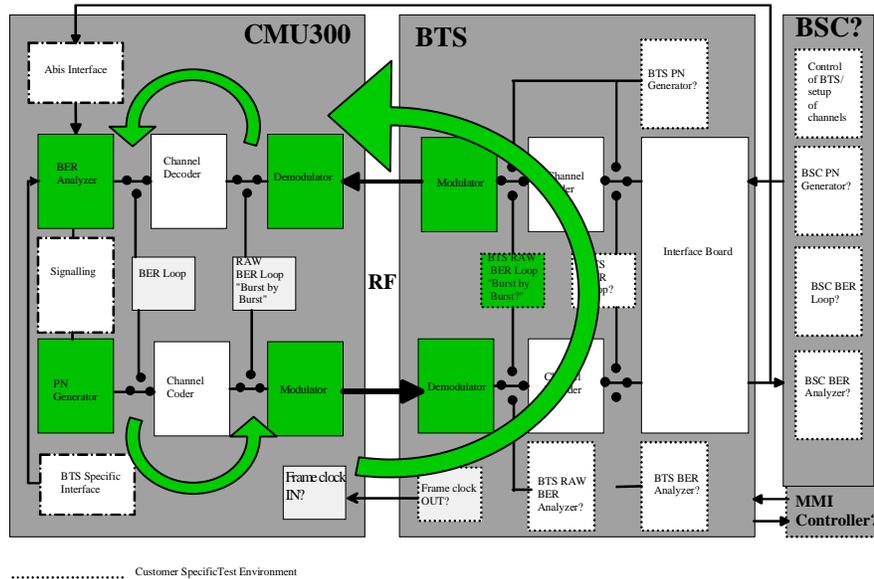


Fig. 10 RAW BER test-environment

## Running the raw BER test

1. Prepare the CMU as described in section 2 using the Connection Control popup menu.
2. Choose the appropriate channel type :  
For GSMK RAW BERT: TCH/FS  
For 8PSK RAW BERT: E-TCH/F43.2NT
3. Synchronise the instrument.
4. Switch to the GSMxxx Receiver quality (TCH) menu and select Application / Meas. Mode / Burst by Burst.

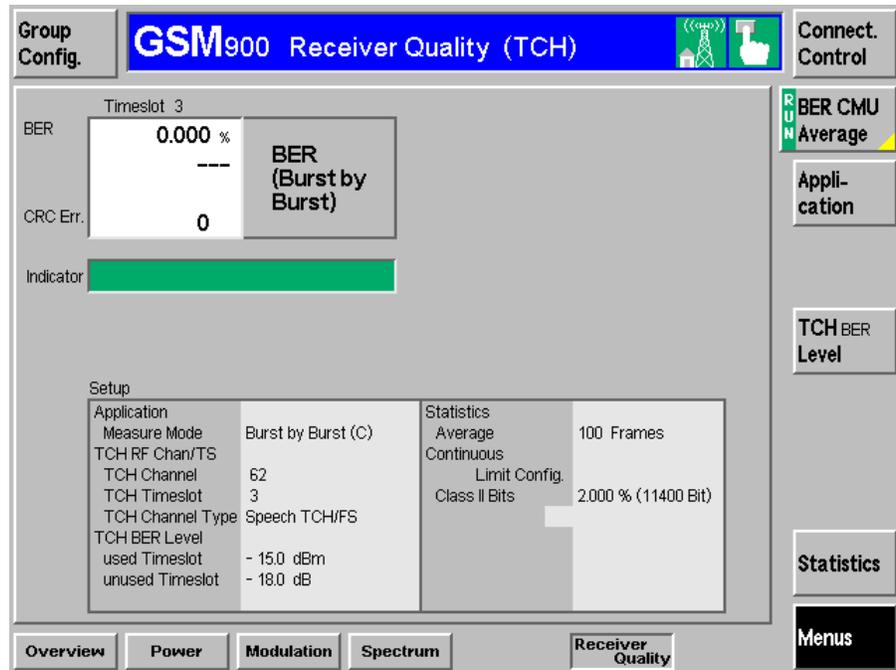


Fig. 11 The Receiver Quality (TCH) menu

## 4 Testing Circuit Switched Traffic Channels (TCHs)

### Test method description

#### BER test modes

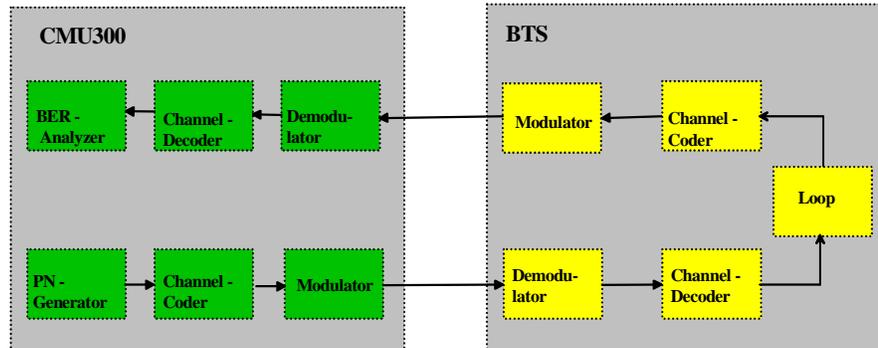


Fig. 12 Test-path with channel - coding / - decoding

All GSM traffic is protected by bits so that bit errors can be corrected. Depending on their significance, the protection bits are divided into the following classes:

- Class 1a bits: very good protection
- Class 1b bits: little protection
- Class 2 bits: no protection

Two loop types inside the BTS are supported, Type A and Type B. The CMU generates a pseudo-random bit stream, which is channel-coded and input via the RF interface to the BTS receiver. The data stream passes through the channel decoder and – via the channel coder, RF interface and channel decoder – is sent back to the CMU. What the BTS sends back depends on the type of loop:

- Loop A) Voice frames received with non-correctable class 1a errors are not returned but marked as erased frames. For erased frames the BTS sends back a voice frame consisting entirely of zeroes. On receiving such a voice frame, the CMU increments the FER (frame error rate) counter by checking the CRC. With this type of loop only voice frames with a certain minimum quality are considered in the BER. This explains the curious side effect with this loop type. With decreasing receive level the BER suddenly improves. The lower the level, the more erased frames occur. So only voice frames with a very low number of bit errors will be considered in the BER measurement.
- Loop B) The BTS returns exactly what it has received. The CRC checksum of erroneous frames is corrected in the BTS Channel – Coder. The CMU compares transmitted and received class 1a bits. If a difference in class 1a bits is detected the FER counter is incremented.

The CMU performs the following measurements depending on the selected measurement mode.

Measurement Mode Setting: BER (Fig. 16)

- The parameter “BER of class 1b / 2 bits“ indicates errors for class 1b/2 bits detected by the CMU BER analyser related to the total amount of these class 1b / 2 bits transmitted.

- The parameter “CRC Err.” is related to possible errors on the downlink path; i.e. between the BTS channel coder and the CMU channel decoder.

Measurement Mode Setting: RBER / FER (Fig. 17)

- The parameter FER takes into account all class 1a bits, independently from the BTS loop type (A or B)
- The parameter RBER takes into account errors of class 1b and 2 bits for non-erroneous frames
- The parameter “CRC Err.” is related to possible errors on the downlink path; i.e. between the BTS channel coder and the CMU channel decoder.

### Absolute Receiver Sensitivity

For determining the absolute receiver sensitivity the CMU provides an optimised routine that can pre-set the desired averaging depth for the BER measurement. During a measurement the sliding BER average is measured with the aid of this window. Vary the transmitter level at the same time by a value or with the spinwheel. This is a fast and easy way to determine absolute receiver sensitivity.

### Automatic Gain Control (AGC) test

To test the AGC of a receiver, CMU300 provides different transmitter levels for the active timeslot and for the unused timeslots (dummy bursts). The BTS receiver can be subjected to unfavourable conditions in the unused timeslots. Plus, it is possible to define a delay for AGC settling in the BTS.

### Pseudo Random Bit Streams

The CMU uses a choice of four true pseudo-random bit sequences for BER measurement. You will especially appreciate this feature if you have ever overlooked a faulty channel coder as a result of using a fixed bit pattern, because a pseudo-random sequence is the only reliable means of detecting it.

For transmitter measurements the BER loop can also be kept closed even BER measurement is not taking place. This is a simple way of meeting the requirement for a transmitter signal modulated with pseudo-random bits, as needed for spectrum and power measurements.

Supported test environment

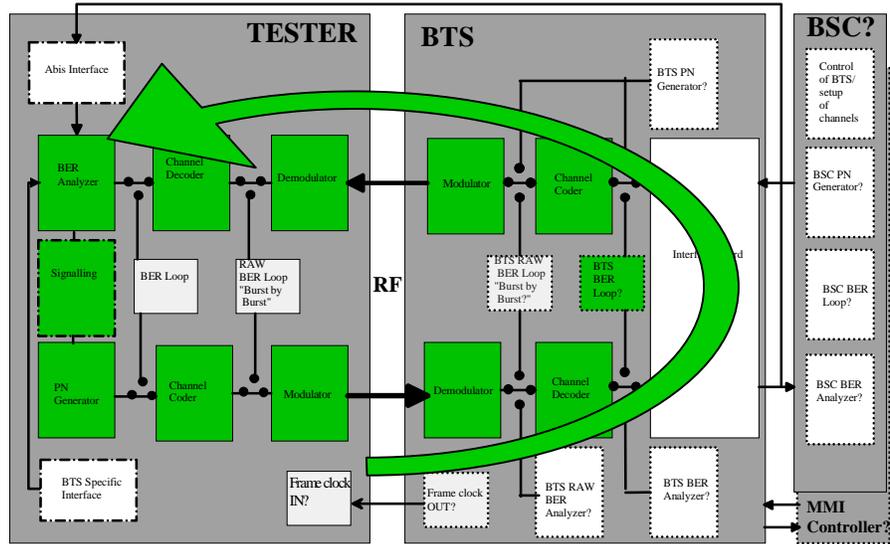


Fig. 13 BER test environment: loop inside the BTS

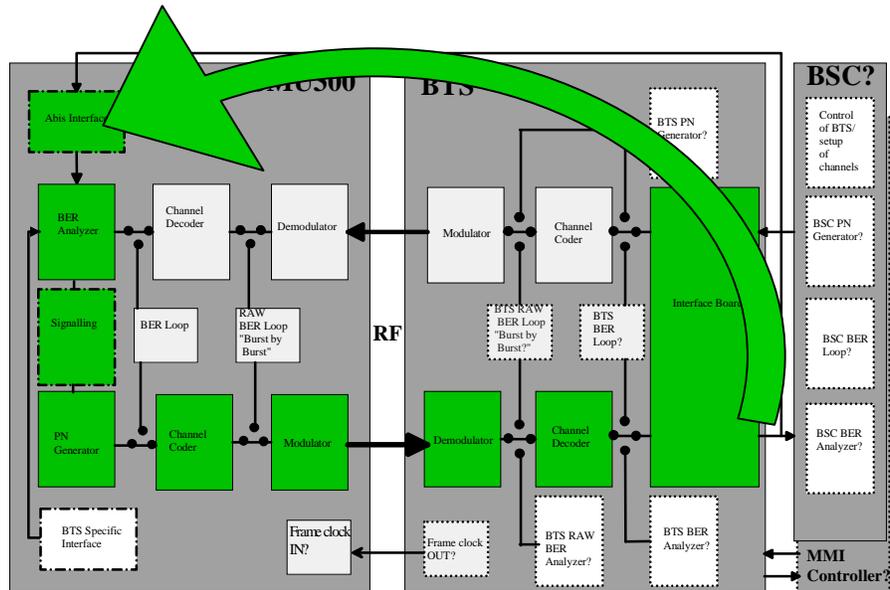


Fig. 14 BER test-environment: loop via Abis

Running the TCH BER test

1. Prepare the CMU as described in section 2 using the Connection Control popup menu.
2. Choose the channel type required.
3. Synchronise the CMU.

4. From the GSMxxx Overview (TCH) menu select the PN sequence required. The CMU is acting as PN generator. The BER evaluation is performed via the BTS RF downlink.

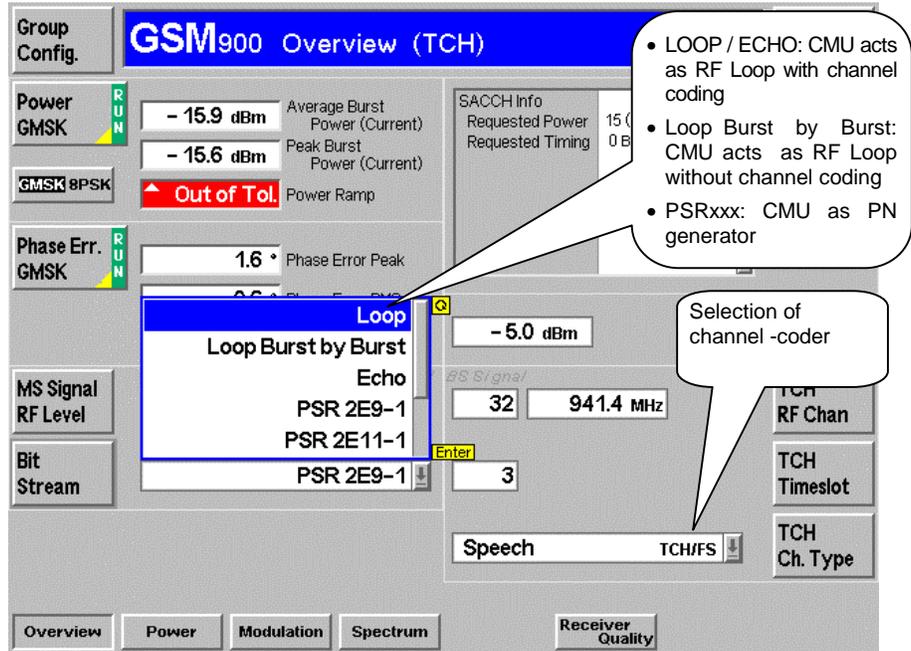


Fig. 15 The GSM900 Overview (TCH) menu

5. Switch to measurement menu GSMxxx RECEIVER QUALITY (TCH) and select APPLICATION / MEAS. MODE / BER or RBER / FER.

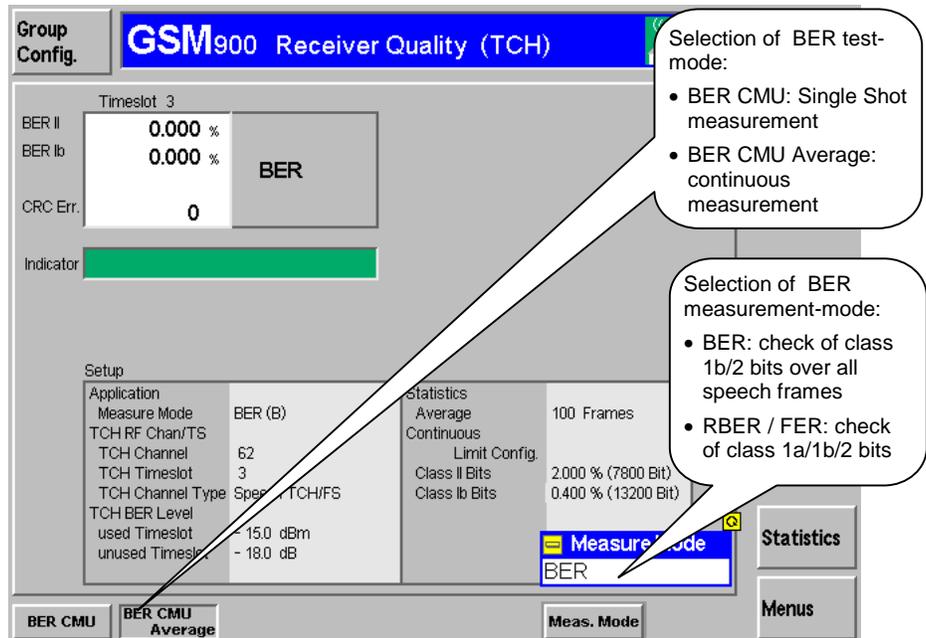


Fig. 16 The GSM900 Receiver Quality (TCH) > measurement mode BER test menu

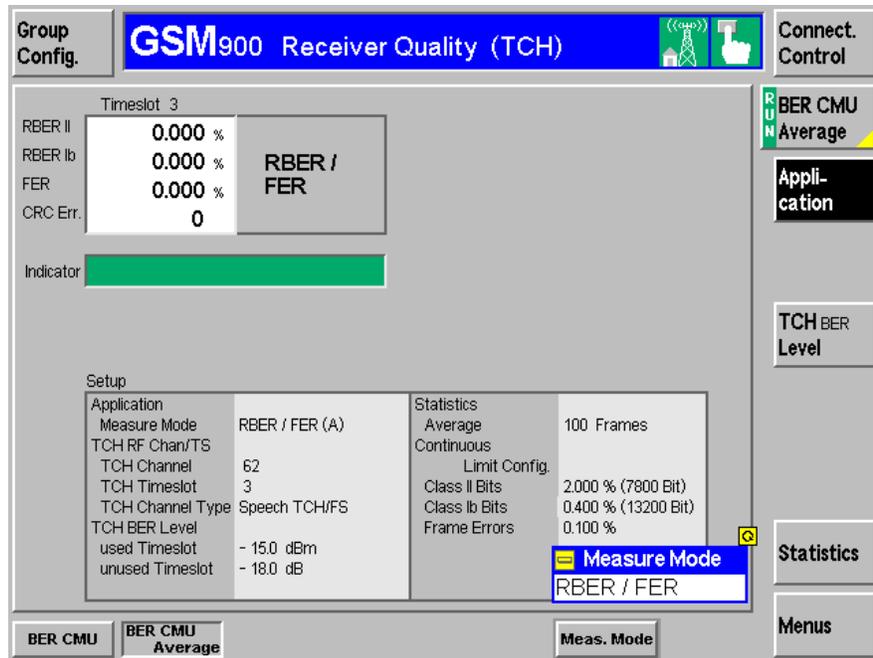


Fig. 17 The GSM900 Receiver Quality (TCH) > RBER / FER test menu

**BER Test via Abis with option CMU-B71**

If the CMU is equipped with option CMU-B71, the BER path can be closed via the BTS Abis – interface. Select the BTS Abis - interface from the Connection Control > Abis menu.

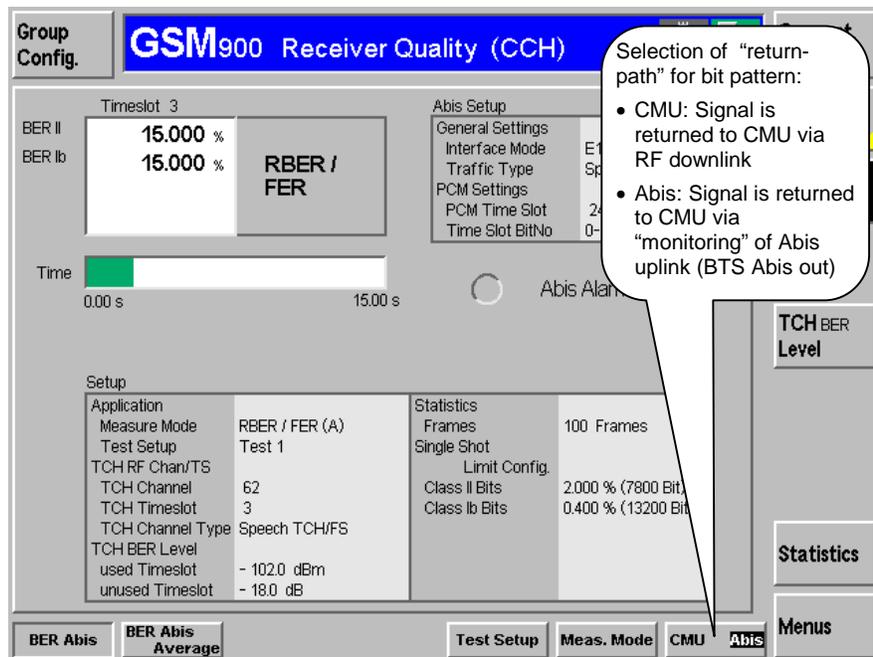


Fig. 18 The GSM900 Receiver Quality (CCH / TCH) > BER loop via Abis menu

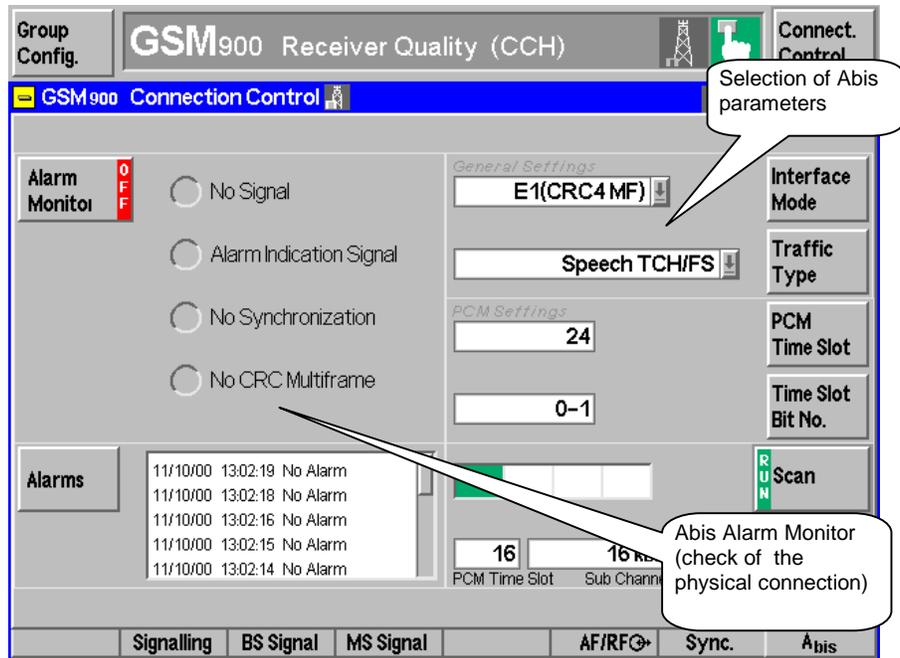


Fig. 19 The Connection Control > register Abis menu

To find the traffic timeslot used on the Abis link press softkey SCAN.

The RF uplink level of the timeslot used has to be set to a suitable value for successful search; -80 dBm is recommended.

## 5 Testing packet switched traffic-channels (PDTCHs)

### Test method description

A simple method for BER measurements on GPRS / EGPRS channels is shown below. The benefit of this method is that the RLC / MAC layer is not involved so that setting up the channel to be measured is faster and easier.

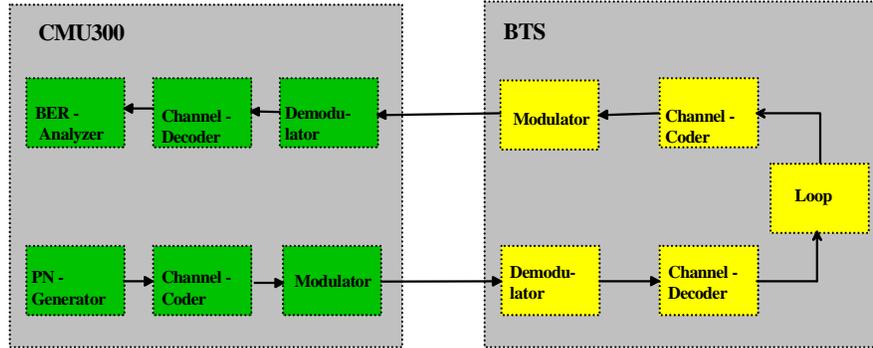


Fig. 20 Test set-up

Test method:

1. The CMU synchronises to a normal BCCH as described in section 2.
2. The CMU establishes a TBF according to the rules below without any signalling; a test mode is required.

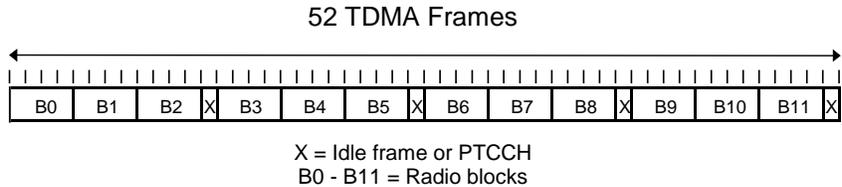


Fig. 21 52 - Multiframe for PDCH

3. The CMU transmits GPRS/EGPRS coded radio blocks to the BTS with the multiframe structure shown in Fig. 21. All radio blocks of the 52-Multiframe are used. All radio blocks are coded with the same coding scheme and the same puncturing. For EGPRS all data blocks are punctured with scheme P1.
4. The BTS closes the loop after the channel decoder and before the channel coder (Fig. 20). The received data bits are coded and modulated with the same coding and puncturing scheme and sent back to the CMU. The loop back is done on a block by block basis. The coding and puncturing scheme used is set with a command on the BTS test interface. Please note that MCS7, MCS8, and MCS9 carry 2 RLC/MAC frames which are coded separately.



Fig. 22 GPRS/EGPRS Radio Block Structure

5. The CMU ignores the downlink header. Only the data bits of a radio block (Fig. 22) are used for the BER / DBLER calculation.

6. The contents of the up link header sent by the CMU are fixed.
7. The BTS sends the received data back in all cases even if the block check sequence indicates that the block was not decoded correctly. If the block was not decoded correctly the BTS calculates a new block check sequence for the received data.

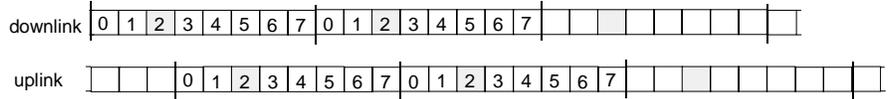


Fig. 23 Active timeslots for Uplink and Downlink

8. The same timeslot is used for Uplink and Downlink (Fig. 23).

The CMU decodes the received data bits and compares them with the original data bits. The CMU counts the bit errors and calculates the BER.

In addition to the BER, a block error rate can be calculated by counting the RLC blocks that contain at least one error in the data field. In real life, blocks will be rejected by the receiving RLC layer that also contain errors only in the block header. The DBLER doesn't take these blocks into account. The difference between BLER and DBLER depends on the different probabilities of bit errors in the data field alone compared to that of the whole RLC block, i.e. the data field plus header. This varies from one coding scheme to another.

The easiest case is CS4, which has no coding at all. This makes it easy to calculate BLER and DBLER from a given bit error rate. The difference is simply determined by comparing the data field size to the complete RLC block size (figure 24).

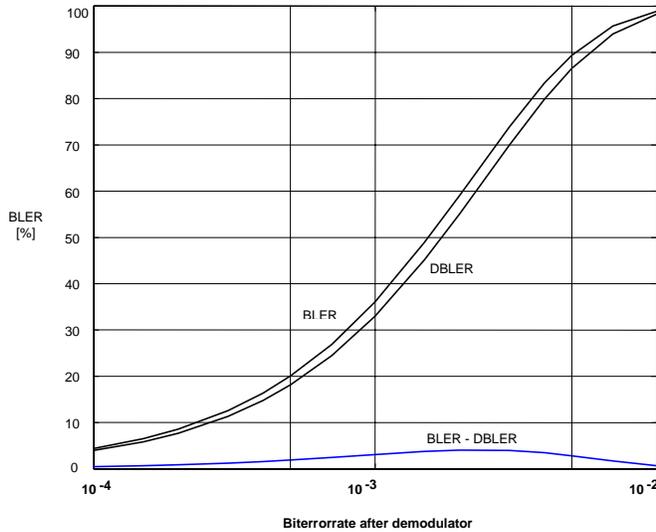


Fig. 24 BLER / DBELR comparison for PDTCH-CS4

In this case the DBLER is quite a good approximation to the BLER. It is especially useful as the difference between the curves is fixed and can therefore be compensated. The calculation of BLER/DBLER curves for other coding schemes is a little bit more complicated. One reason is that header and data fields are coded differently in some coding schemes (EGPRS). A second reason is that the assumption of equally spread bit errors is no longer valid after the channel decoder. But simulations show that the difference between BLER and DBLER is even less when this affect is taken into account.

**Supported test environment**

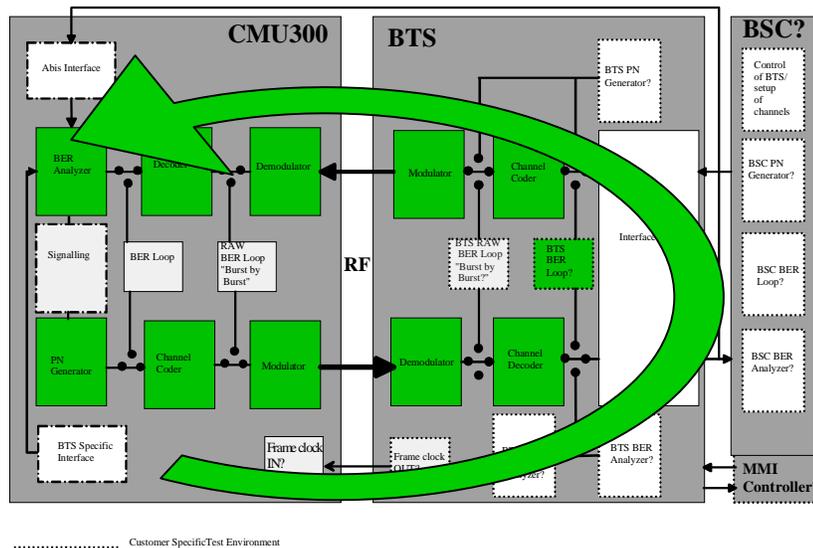


Fig. 25 Test environment for PDTCHs

**Running the test**

1. Prepare the CMU as described in section 2 from the Connection Control popup menu.
2. Chose the channel type needed.
3. Synchronise the CMU.
4. Check whether the needed PN sequence is chosen using the Bitstream softkey.
5. Switch to the GSMxxx Receiver Quality (TCH) menu and select measurement mode RBER / FER<sup>\*)</sup>.

<sup>\*)</sup> The menu shown is for actual firmware release V2.84/2.94. The result RBERII is indicating a BER, related to data fields of frames. The value FER is indicating the BLER of the data fields.

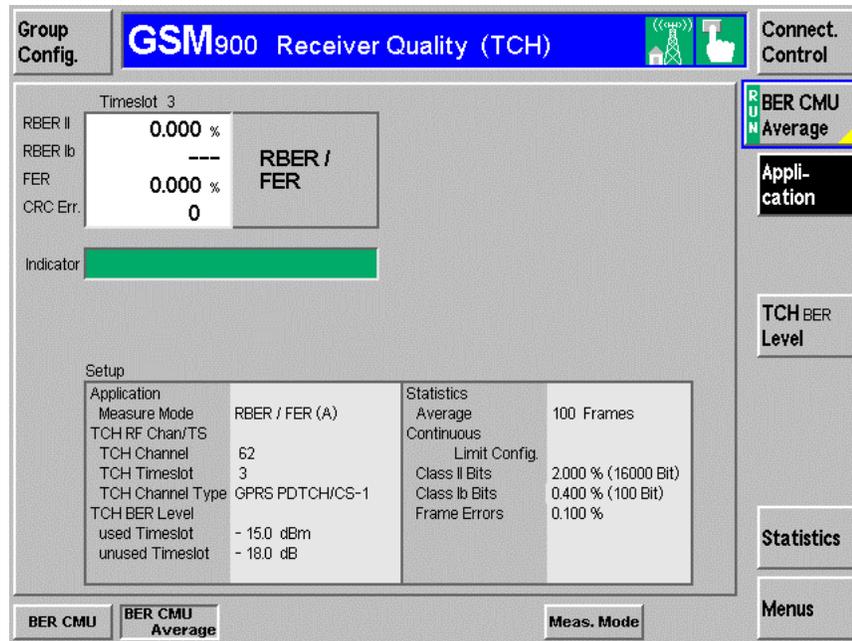


Fig. 26 Preliminary menu for PDTCH tests

## 6 Abbreviation

AGC	Automatic Gain Control
BER	Bit Error Rate
BLER	Block Error Rate
BSC	Base Station Controller
BSS	Base Station System (BTS + BSC)
BTS	Base Transceiver Station
DUT	Device Under Test
FER	Frame Erasure Rate
HW	Hard Ware
LMT	Local Maintenance Terminal
MMI	Men Machine Interface
MOC	Mobile Originated Call
MS	Mobile Station
MTC	Mobile Terminated Call
PRBS	Pseudo Random Bit Sequence
RAW BER Test	BER Test without channel coding
RBER	Residual Bit Error Rate
RF	Radio Frequency
RX	Receiver
SSU	Signal Switching Unit
SW	Soft Ware
TX	Transmitter
TRX	Transceiver

## 7 References

- [1] Universal Radio Communication Tester CMU300, Datasheet
- [2] News from Rohde & Schwarz; No. 169, S 11-13
- [3] Technical Specification 3GPP TS 11.21

## 8 Ordering information

Type of instrument	Description	Comments	Part no.	Requirement for BER Test
CMU300	Universal Radio Communication Tester Base unit including multiple-input RF facilities	Includes multi-frequency reference in/output. The CMU provides up to +13 dBm output level for driving of a conventional fading simulator. The output level accuracy is about $\pm 0.6$ dB.	1100.0008.03	mandatory
CMU-B12	High Stability OCXO, aging 3.5 X 10E-8		1100.5100.02	optional, recommended
CMU-B21	Versatile Signalling Unit for CMU	provides multi-standard signalling hardware; only in combination with CMU-K30...K34	1100.5200.02	mandatory
CMU-K30	GSM400 BTS measurement software	CMU-B21 necessary; GPRS data-channel-coders included	1115.4004.02	mandatory for GMSK BER tests
CMU-K31	GSM900 BTS measurement software	CMU-B21 necessary; GPRS data-channel-coders included	1115.4104.02	mandatory for GMSK BER tests
CMU-K32	GSM1800 BTS measurement software	CMU-B21 necessary; GPRS data-channel-coders included	1115.4204.02	mandatory for GMSK BER tests
CMU-K33	GSM1900 BTS measurement software	CMU-B21 necessary; GPRS data-channel-coders included	1115.4304.02	mandatory for GMSK BER tests
CMU-K34	GSM850 BTS measurement software	CMU-B21 necessary; GPRS data-channel-coders included	1115.4404.02	mandatory for GMSK BER tests
CMU-K39	Software for GSM Signalling Procedure MOC / MTC (circuit switched)	CMU-B21, CMU-K31..34 necessary	1115.4791.02	optional; mandatory for channel set-up procedure with signalling
CMU-K41	EDGE / 8PSK measurements	CMU-B21, CMU-K31..34 necessary; EGPRS data-channel-coders included	1115.4504.02	mandatory for 8PSK BER tests
CMD-B71	Abis Interface for BER Measurement	CMU-B21, CMU-K31/32/33/34 necessary;	1115.8500.02	optional; mandatory for BER measurement at BTS Abis Out

## 9 Appendix

Channel Type	Possible Tests	Supported BTS - / BSC - Loops	Supported Loops "inside" CMU (CMU as "RF Loop")	Channel Set-up-Procedure	Required Options	Comments
-	Burst by Burst (RAW BER)	BTS Loop demodulator / modulator	CMU "RAW BER LOOP" (GMSK / 8PSK)	forced channel set-up without signalling	CMU-B21, CMU-K30..K34 and CMU-K41 (K41 optional for 8PSK)	TCH/FS and E-TCH/F43.2NT channels have to be established
<b>TCH/FS TCH/HS TCH/EFS</b>	BER / RBER / FER	BTS (BSC) BER Loop with channel decoding; (optional Loop via Abis)	"CMU BER LOOP" with channel decoding	forced channel set-up without call procedure (optional, MOC / MTC)	CMU-B21, CMU-K30..K34; (CMU-B71 and CMU-K39 optional)	
<b>TCH/F14.4 TCH/F9.6 TCH/F4.8 TCH/H4.8 TCH/H2.4</b>	BER	BTS (BSC) BER Loop with channel decoding	"CMU BER LOOP" with channel decoding	forced channel set-up without signalling	CMU-B21, CMU-K30..K34	BTS test mode required
<b>E-TCH/F43.2 NT</b>	BER	BTS (BSC) BER Loop with channel decoding	"CMU BER LOOP" with channel decoding	forced channel set-up without signalling	CMU-B21, CMU-K30..K34 and CMU-K41	BTS test mode required
<b>PDTCH-CS1 PDTCH-CS2 PDTCH-CS3 PDTCH-CS4</b>	BER / DBLER	BTS BER Loop with channel decoding, without RLC MAC	-	forced channel set-up without signalling (one static TS active on up- / downlink)	CMU-B21, CMU-K30..K34	BTS test mode required
<b>PDTCH-MCS1 PDTCH-MCS2 PDTCH-MCS3 PDTCH-MCS4 PDTCH-MCS5 PDTCH-MCS6 PDTCH-MCS6 PDTCH-MCS7 PDTCH-MCS8 PDTCH-MCS9</b>	BER / DBLER	BTS BER Loop with channel decoding, without RLC MAC	-	forced channel set-up without signalling (one static TS active on up- / downlink)	CMU-B21, CM-K30..K34 and CMU-K41	BTS test mode required



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