TSG RAN Meeting #19 **RP-030041**
Birmingham, United Kingdom, 11 - 14 March, 2003

Title **CRs (Rel-5 and Rel-6 Category A) to TS 25.141**
Source **TSG RAN WG4**
Agenda Item **8.4.5**

RAN4 Tdoc	Spec	CR	R	Cat	Rel	Curr Ver	Title	Work Item
R4-020289	25.141	279	1	F	Rel-5	5.5.0	Statistical approach for BER BLER tests	TEI5
R4-020292	25.141	280	1	A	Rel-6	6.0.0	Statistical approach for BER BLER tests	TEI5

3GPP TSG RAN WG4 (Radio) Meeting #26 **R4-030289**
Madrid, Spain 17 - 22 February, 2003

CR-Form-v7

CHANGE REQUEST

⌘	**25.141**	**CR**	**279**	⌘ **rev**	**1**	⌘ Current version:	**5.5.0** ⌘

For ***HELP*** *on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [ ] Radio Access Network [X] Core Network [ ]

Title:	⌘	Statistical approach for BER BLER tests		
Source:	⌘	RAN WG4		
Work item code:	⌘	TEI5	***Date:*** ⌘	05/03/2003
Category:	⌘	**F**	***Release:*** ⌘	Rel-5
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change:	⌘	BER/BLER measurements have statistical nature. The current test requirements specify only a single BER BLER value without statistical significance.
Summary of change:	⌘	It introduces the statistical requirements and lays down how to carry out BER BLER tests taking into account test time optimisation. Isolated impact analysis: Does not affect BS implementation
Consequences if not approved:	⌘	Infinite test time, or if the test is finished after finite time, the results bear unknown statistical significance

Clauses affected:	⌘	7.1 7.2.4.2 7.5.4.2 7.5.5 8.1 Annex C			
		Y	**N**		
Other specs affected:	⌘		X	Other core specifications	⌘
			X	Test specifications	
			X	O&M Specifications	
Other comments:	⌘	Revised from R4-030104 Equivalent CRs in other Releases: CR280r1 cat. A to 25.141 v6.0.0			

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

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3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

7 Receiver characteristics

7.1 General

Unless otherwise stated, all tests in this clause shall be performed at the BS antenna connector (test port A) with a full complement of transceivers for the configuration in normal operating conditions. If any external apparatus such as a RX amplifier, a diplexer, a filter or the combination of such devices is used, the tests according to subclauses 4.6.2 and/or 4.6.4, depending on the device added, shall be performed to ensure that the requirements are met at test port B.

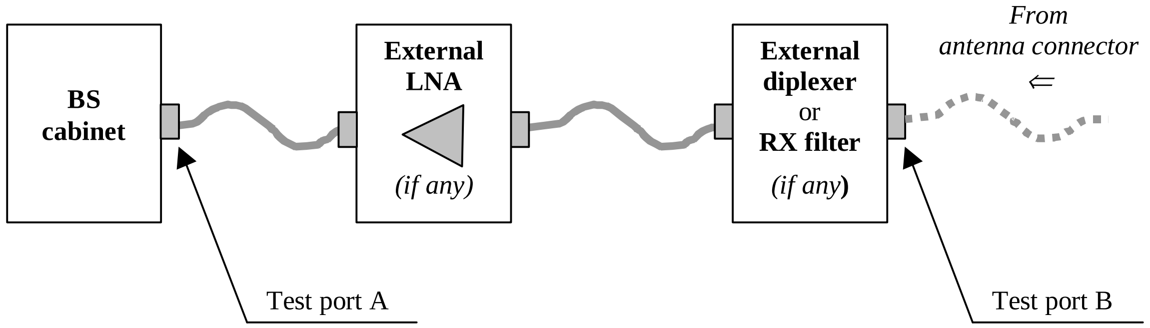

Figure 7.1: Receiver test ports

The tests in clause 7 assume that the receiver is not equipped with diversity. For receivers with diversity, unless otherwise stated, tests shall be performed by applying the specified signals to one of the receiver inputs, and terminating or disabling the other(s). The tests and requirements are otherwise unchanged.
In all the relevant subclauses in this clause all Bit Error Ratio (BER), Residual BER (RBER) and Block Error Ratio (BLER) measurements shall be carried out according to the general rules for statistical testing defined in ITU-T Recommendation O.153 [5] and Annex C.
If external BER measurement is not used then the internal BER calculation shall be used instead. When internal BER calculation is used, the requirements of the verification test according to 7.8 shall be met in advance.
In tests performed with signal generators a synchronization signal may be provided, from the base station to the signal generator, to enable correct timing of the wanted signal.

7.2 Reference sensitivity level

7.2.1 Definition and applicability

The reference sensitivity level is the minimum mean power received at the antenna connector at which the BER shall not exceed the specific value indicated in subclause 7.2.2. The test is set up according to Figure B.7 and performed without interfering signal power applied to the BS antenna connector . For duplex operation , the measurement configuration principle is indicated for one duplex branch in Figure B.7. For internal BER calculation an example of the test connection is as shown in figure B.7. The reference point for signal power is at the input of the receiver (antenna connector).

7.2.2 Minimum Requirement

The BER shall not exceed 0,001 for the parameters specified in table 7.1.

Table 7.1: BS reference sensitivity levels

Reference measurement channel data rate	BS reference sensitivity level (dBm)	BER
12,2 kbps	-121	BER shall not exceed 0,001

The normative reference for this requirement is in TS 25.104[1] subclause 7.2.

7.2.3 Test purpose

To verify that at the BS Reference sensitivity level the BER shall not exceed the specified limit.

7.2.4 Method of testing

7.2.4.1 Initial conditions

Test environment: normal; see subclause 4.4.1
RF channels to be tested: B, M and T; see subclause 4.8.
The following additional tests shall be performed:

a) On each of B, M and T, the test shall be performed under extreme power supply as defined in subclause 4.4.2

NOTE: Tests under extreme power supply also test extreme temperature.

1) Connect BS to be tested to RF signal source.
2) Set frequency.
3) Start transmit 12,2kbps DPCH with reference measurement channel defined in annex A to the BS under test (PN-9 data sequence or longer).
4) Disable TPC function.

7.2.4.2 Procedure

1) Calculate BER according to annex C ~~from at least 30000 received data bits.~~
2) Set the test signal mean power as specified in table 7.1A.
3) Measure BER.

7.2.5 Test requirement

The BER measurement result in step 3 of 7.2.4.2 shall not be greater than the limit specified in table 7.1A.

Table 7.1A: BS reference sensitivity levels

Reference measurement channel data rate	BS reference sensitivity level (dBm)	BER
12,2 kbps	-120.3	BER shall not exceed 0,001

NOTE: If the above Test Requirement differs from the Minimum Requirement then the Test Tolerance applied for this test is non-zero. The Test Tolerance for this test is defined in subclause 4.2 and the explanation of how the Minimum Requirement has been relaxed by the Test Tolerance is given in Annex F.

7.5 Blocking characteristics

7.5.1 Definition and applicability

The blocking characteristics is a measure of the receiver ability to receive a wanted signal at is assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the adjacent channels. The blocking performance requirement applies as specified in tables 7.4(a) to 7.4(g).
The requirements in Table 7.4(a) shall apply to base stations intended for general-purpose applications, depending on which frequency band is used. The requirements in Tables 7.4 (b) to 7.4 (g) may be applied when the FDD BS is co-located with GSM900, GSM850, PCS1900 and/or BS operation in DCS1800 band (UTRA or GSM).

7.5.2 Minimum Requirements

The BER shall not exceed 0.001 for the parameters specified in table 7.4.

Table 7.4(a): Blocking characteristics

Operating Band	Center Frequency of Interfering Signal	Interfering Signal Level	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I	1920 - 1980 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1900 - 1920 MHz 1980 - 2000 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz -1900 MHz 2000 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
II	1850 - 1910 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1830 - 1850 MHz 1910 - 1930 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz - 1830 MHz 1930 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
III	1710 – 1785 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1690 - 1710 MHz 1785 – 1805 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz - 1690 MHz 1805 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier

Table 7.4(b): Blocking performance requirement when co-located with GSM900

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I, III	921 -960 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4(c): Blocking performance requirement for operation when co-located with BTS operating inDCS1800 band (GSM or UTRA)

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I, III	1805 – 1880 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4(d): Blocking performance requirement for operation when co-located with UTRA BS operating in Frequency band I

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
III	2110 – 2170 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4(e): Blocking performance requirement for operation when co-located with PCS1900 BTS

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1930 – 1990 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4(f): Blocking performance requirement (narrowband)

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1850 - 1910 MHz	- 47 dBm	-115 dBm	2.7 MHz	GMSK modulated*
III	1710 – 1785 MHz	- 47 dBm	-115 dBm	2.8 MHz	GMSK modulated*
* GMSK modulation as defined in TS 45.004 [12].					

Table 7.4(g): Blocking performance requirement for operation when co-located with GSM850 BTS

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal Level	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	869 – 894 MHz	+16 dBm	-115 dBm	—	CW carrier

The normative reference for these requirements is in TS 25.104[1] subclause 7.5

7.5.3 Test purpose

The test stresses the ability of the BS receiver to withstand high-level interference from unwanted signals at frequency offsets of 10 MHz or more, without undue degradation of its sensitivity.

7.5.4 Method of test

7.5.4.1 Initial conditions

Test environment: normal; see subclause 4.4.1.
RF channels to be tested: M see subclause 4.8. The BS shall be configured to operate as close to the centre of the operating band as possible.

1) Connect WCDMA signal generator at the assigned channel frequency of the wanted signal and a signal generator to the antenna connector of one Rx port.

2) Terminate any other Rx port not under test.

3) Transmit a signal from the WCDMA signal generator to the BS. The characteristics of the signal shall be set according to the UL reference measurement channel (12,2 kbit/s) specified in annex A subclause A.2.1. The level of the WCDMA signal measured at the BS antenna connector shall be set to the level specified in subclause 7.5.5.

7.5.4.2 Procedure

1) Adjust the signal generators to the type of interfering signals and the frequency offsets as specified in Tables 7.4A(a) to 7.4A(g). Note that the GMSK modulated interfering signal shall have an ACLR of at least 72 dB in order to eliminate the impact of interference signal adjacent channel leakage power on the blocking characteristics measurement. For the tests defined in Table 7.4A(a), the interfering signal shall be at a frequency offset Fuw from the assigned channel frequency of the wanted signal which is given by:

$$Fuw = \pm (n \times 1 \text{ MHz}),$$

where n shall be increased in integer steps from n = 10 up to such a value that the center frequency of the interfering signal covers the range from 1 MHz to 12,75 GHz.

2) Measure the BER of the wanted signal at the BS receiver.

~~NOTE: The test procedure as defined in steps (1) and (2) requests to carry out more than 10 000 BER measurements. To reduce the time needed for these measurements, it may be appropriate to conduct the test in two phases: During phase 1, BER measurements are made on all center frequencies of the interfering signal as requested but with a reduced confidence level, with the aim to identify those frequencies which require more detailed investigation. In phase 2, detailed measurements are made only at those critical frequencies identified before, applying the required confidence level.~~

3) Interchange the connections of the BS Rx ports and repeat the measurements according to steps (1) to (2).

7.5.5 Test Requirements

The BER shall not exceed 0.001 for the parameters specified in table 7.4A.

Table 7.4A(a): Blocking characteristics

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I	1920 - 1980 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1900 - 1920 MHz 1980 - 2000 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz -1900 MHz 2000 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
II	1850 - 1910 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1830 - 1850 MHz 1910 - 1930 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz - 1830 MHz 1930 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
III	1710 – 1785 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1690 - 1710 MHz 1785 – 1805 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz - 1690 MHz 1805 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier

Table 7.4A(b): Blocking performance requirementwhen co-located with GSM900

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I, III	921 -960 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4A(c): Blocking performance requirement when co-located with Base Station operating in DCS1800 band (GSM or UTRA)

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I, III	1805 – 1880 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4A(d): Blocking performance requirement for operation when co-located with UTRA BS operating in Frequency band I

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
III	2110 – 2170 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4A(e): Blocking performance requirement for operation when co-located with PCS1900 BTS

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1930 – 1990 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4A(f): Blocking performance requirement (narrowband)

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1850 - 1910 MHz	- 47 dBm	-115 dBm	2.7 MHz	GMSK modulated*
III	1710 – 1785 MHz	- 47 dBm	-115 dBm	2.8 MHz	GMSK modulated*
* GMSK modulation as defined in TS 45.004 [12].					

Table 7.4A(g): Blocking performance requirement for operation when co-located with GSM850 BTS

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	869 – 894 MHz	+16 dBm	-115 dBm	—	CW carrier

NOTE1: If the above Test Requirement differs from the Minimum Requirement then the Test Tolerance applied for this test is non-zero. The Test Tolerance for this test is defined in subclause 4.2 and the explanation of how the Minimum Requirement has been relaxed by the Test Tolerance is given in Annex F.

NOTE 2: Annex C describes the procedure for BER tests taking into account the statistical consequence of frequent repetition of BER measurements within the blocking test . The consequence is: a DUT exactly on the limit may fail due to the statistical nature 2.55 times(mean value) in 12750 BER measurements using the predefined wrong decision probability of 0.02%. If the fail cases are ≤12, it is allowed to repeat the fail cases 1 time before the final verdict.

8 Performance requirement

8.1 General

All Bit Error Ratio (BER) and Block Error ratio (BLER) measurements shall be carried out according to the general rules for statistical testing defined in ITU-T Recommendation O.153 [5] and Annex C.
If external BLER measurement is not used then the internal BLER calculation shall be used instead. When internal BLER calculation is used, the requirements of the verification test according to 8.6 shall be met in advance.
Performance requirements are specified for a number of test environments and multi-path channel classes.
The requirements only apply to those measurement channels that are supported by the base station.
The requirements only apply to a base station with dual receiver antenna diversity. The required E_b/N_0 shall be applied separately at each antenna port.
In tests performed with signal generators a synchronization signal may be provided, from the base station to the signal generator, to enable correct timing of the wanted signal.

Annex C (normative):
~~Detailed definition of error events~~

~~1) Block Error Ratio (BLER):~~

- ~~the block is defined as erased if the error detection functions using Cyclic Redundancy Check (CRC) in layer 1.~~

~~<Editor's note: Tentative definition of BLER is given. >~~

~~2) Bit Error Ratio (BER):~~

- ~~the BER is the overall Bit Error Ratio (BER) independent of frame erasures or when erased frames are not defined.~~

General rules for statistical testing

C.1 Statistical testing of receiver BER/BLER performance

C.1.1 Error Definition

1) Bit Error Ratio (BER)

The Bit Error Ratio is defined as the ratio of the bits wrongly received to all data bits sent. The bits are the data bits above the convolutional/turbo decoder. The BER is the overall BER independent of frame erasures or when erased frames are not defined.

2) Block Error Ratio (BLER)

A Block Error Ratio is defined as the ratio of the number of erroneous blocks received to the total number of blocks sent. An erroneous block is defined as a Transport Block, the cyclic redundancy check (CRC) of which is wrong.

C.1.2 Test Method

Each test is performed in the following manner:

a) Setup the required test conditions.

b) Record the number of samples tested and the number of occurred events (bit error or block error)

c) Stop the test at a stop criterion which is minimum test time or an early pass or an early fail event.

d) Once the test is stopped decide according to the pass fail decision rules (subclause C.1.7)

C.1.3 Test Criteria

The test shall fulfil the following requirements:

a) good pass fail decision

   1) to keep reasonably low the probability (risk) of passing a bad unit for each individual test;

   2) to have high probability of passing a good unit for each individual test;

b) good balance between testtime and statistical significance

   3) to perform measurements with a high degree of statistical significance;

   4) to keep the test time as low as possible.

C.1.4 Calculation assumptions

C.1.4.1 Statistical independence

(a) It is assumed, that error events are rare (lim BER BLER → 0) independent statistical events. However the memory of the convolutional /turbo coder is terminated after one TTI. Samples and errors are summed up every TTI. So the assumption of independent error events is justified.

(b) In the BLER test with fading there is the memory of the multipath fading channel which interferes the statistical independence. A minimum test time is introduced to average fluctuations of the multipath fading channel. So the assumption of independent error events is justified approximately.

C.1.4.2 Applied formulas

The formulas, applied to describe the BER BLER test, are based on the following experiments:

(1) After having observed a certain number of errors (**ne**) the number of samples are counted to calculate BER BLER. Provisions are made (note 1) such that the complementary experiment is valid as well:
(2) After a certain number of samples (**ns**) the number of errors, occurred, are counted to calculate BER BLER.
Experiment (1) stipulates to use the following Chi Square Distribution with degree of freedom ne:
2*dchisq(2*NE,2*ne).
Experiment (2) stipulates to use the Poisson Distribution: dpois(ne,NE)
(NE: mean of the distribution)
To determine the early stop conditions, the following inverse cumulative operation is applied:
0.5 * qchisq(D,2*ne). This is applicable for experiment (1) and (2).
D: wrong decision risk per test step
Note: other inverse cumulative operations are available, however only this is suited for experiment (1) and (2).

C.1.4.3 Approximation of the distribution

The test procedure is as follows:
During a running measurement for a UE ns (number of samples) and ne (number of errors) are accumulated and from this the preliminary BER BLER is calculated. Then new samples up to the next error are taken. The entire past and the new samples are basis for the next preliminary BER BLER. Depending on the result at every step, the UE can pass, can fail or must continue the test.
As early pass- and early fail-UEs leave the statistical totality under consideration, the experimental conditions are changed every step resulting in a distribution that is truncated more and more towards the end of the entire test. Such a distribution can not any more be handled analytically. The unchanged distribution is used as an approximation to calculate the early fail and early pass bounds.

C.1.5 Definition of good pass fail decision.

This is defined by the probability of wrong decision F at the end of the test. The probability of a correct decision is 1-F.
The probability (risk) to fail a good DUT shall be ≤ F according to the following definition: The failed DUT is still better than the specified error ratio (Test requirement)with a probability of ≤ F.
The probability to pass a bad DUT shall be ≤ F according to the following definition: The passed DUT is still worse than M times the specified error ratio (M>1 is the bad DUT factor) with a probability of ≤ F.
This definitions lead to an early pass and an early fail limit:
Early fail: ber≥ $berlim_{fail}$

$$ber\lim_{fail}(D,ne) = \frac{2*ne}{qchisq(D,2*ne)} \qquad (1)$$

For ne≥ 7

Early pass: ber ≤$berlimbad_{pass}$

$$ber\lim bad_{pass}(D,ne) = \frac{2*ne*M}{qchisq(1-D,2*ne)} \qquad (2)$$

For ne ≥ 1

With

ber (normalized BER,BLER): BER,BLER according to C.1.1 divided by Test requirement

D: wrong decision probability for a test step . This is a numerically evaluated fraction of F, the wrong decision probability at the end of the test. See table C.1.6.1.

ne: Number of error events

M: bad DUT factor see table C.1.6.1.

qchisq: inverse-cumulative-function of the chi-squared-distribution

C.1.6 Good balance between test time and statistical significance

Three independent test parameters are introduced into the test and shown in Table C.1.6.1. These are the obvious basis of test time and statistical significance. From the first two of them four dependent test parameters are derived. The third independent test parameter is justified separately.

Table C.1.6.1 independent and dependent test parameters

Independent test parameters			Dependent test parameters		
Test Parameter	Value	Reference	Test parameter	Value	Reference
Bad DUT factor M	1.5	Table C.1.8	Early pass/fail condition	Curves	Subclause C.1.5 Figure C.1.9
Final probability of wrong pass/fail decision F	0.2%, (0.02%, note 2)	Subclause C.1.5	Target number of error events	345	Table C.1.8
			Probability of wrong pass/fail decision per test step D	0.0085%, (0.0008% and 0.008%, note 2)	
			Test limit factor TL	1.234	Table C.1.8
Minimum test time		Table C.1.6.2			

The minimum test time is derived from the following justification:

1) For no propagation conditions and static propagation condition

   No early fail calculated from fractional number of errors <1 (see note 1)

2) For multipath fading condition

   No stop of the test until 990 wavelengths are crossed with the speed given in the fading profile.

3) For birth death propagation conditions

   No stop of the test until 200 birth death transitions occur

4) For moving propagation conditions: 628 sec

   This is necessary in order to pass all potential critical points in the moving propagation profile 4 times:

   Maximum rake window

   Maximum adjustment speed

   Intersection of moving taps

Table C.1.6.2 : minimum Test time

Fading profile	Minimum test time
Multipath propagation 3 km/h	164 sec
Multipath propagation 50 km/h	9.8 sec
Multipath propagation 120 km/h	4.1 sec
Multipath propagation 250 km/h	2 sec
Birth Death propagation	38.2 sec
Moving propagation	628 sec

In table C.1.8the minimum test time is converted in minimum number of samples.

C.1.7 Pass fail decision rules

No decision is allowed before the minimum test time is elapsed.

1) If minimum Test time < time for target number of error events then the following applies: The required confidence level 1-F (= correct decision probability) shall be achieved. This is fulfilled at an early pass or early fail event.

For BER:

For every TTI (Transmit Time Interval) sum up the number of bits (ns) and the number if errors (ne) from the beginning of the test and calculate

BER_1 (including the artificial error at the beginning of the test (Note 1))and

BER_0 (excluding the artificial error at the beginning of the test (Note 1)).

If BER_0 is above the early fail limit, fail the DUT.

If BER_1 is below the early pass limit, pass the DUT.

Otherwise continue the test

For BLER:

For every TTI sum up the number of blocks (ns) and the number of erroneous blocks (ne) from the beginning of the test and calculate

$BLER_1$ (including the artificial error at the beginning of the test (Note 1))and

$BLER_0$ (excluding the artificial error at the beginning of the test (Note 1)).

If $BLER_1$ is below the early pass limit, pass the DUT.

If $BLER_0$ is above the early fail limit, fail the DUT.

Otherwise continue the test

2) If the minimum test time ≥ time for target error events, then the test runs for the minimum test time and the decision is done by comparing the result with the test limit.

For BER:

For every TTI (Transmit Time Interval) sum up the number of bits (ns) and the number if errors (ne) from the beginning of the test and calculate BER_0

For BLER:

For every TTI sum up the number of blocks (ns) and the number of erroneous blocks (ne) from the beginning of the test and calculate $BLER_0$

If BER_0/$BLER_0$ is above the test limit, fail the DUT.

If BER_0/$BLER_0$ is on or below the test limit, pass the DUT.

C.1.8. Test conditions for BER,BLER,Pd tests

Table C.1.8: Test conditions for BER/BLER tests

Table C.1.8-1: Test conditions for BER tests Type of test **(BER)**	**Propagation conditions**	**Test requirement (BER)**	**Test limit (BER)= Test requirement (BER)x TL TL**	**Target number of error events** (time)	**Minimum number of samples**	**Prob that good unit will fail = Prob that bad unit will pass (%)**	**Bad unit BER factor M**
Reference Sensitivity Level	-	0.001	1.234	345 (22.9s)	Note 1	0.2	1.5
Dynamic Range	-	0.001	1.234	345 (22.9~~13.2~~s)	Note 1	0.2	1.5
Adjacent Channel Selectivity	-	0.001	1.234	345 (22.9s)	Note 1	0.2	1.5
Blocking Characteristics Pass condition Note 2	-	0.001	1.251	402 (26.3s)	Note 1	0.2	1.5
Blocking Characteristics Fail condition Note 2	-	0.001	1.251	402 (26.3s)	Note 1	0.02	1.5
Intermodulation Characteristics	-	0.001	1.234	345 (22.9s)	Note 1	0.2	1.5
Verification of internal BER calculation	Not applicable, TS 34.121 Annex F.6.1.10 Dual limit BLER Tests may be applied in principle						

Table C.1.8-2: Test conditions for BLER tests **Type of test (BLER)**	**Information Bit rate**	**Test requirement (BLER)**	**Test limit (BLER)= Test requirement (BLER)x TL** **TL**	**Target number of error events** (time)	**Minimum number of samples (time)**	**Prob that bad unit will pass = Prob that good unit will fail (%)**	**Bad un BLER fa M**
Demodulation in Static Propagation conditions	 12.2 64 144 384	 0.01 0.1 0.01 0.1 0.01 0.1 0.01	1.234	345 (559s) (112s) (1118s) (55.9s) (559s) (28s) (280s)	Note1	0.2	1.5
Demodulation of DCH in Multi-path Fading Propagation conditions							
3km/h (Case 1, Case 2)	 12.2 64 144 384	 0.01 0.1 0.01 0.1 0.01 0.1 0.01	1.234	345 (559s) (112s) (1118s) (55.9s) (559s) (28s) (280s)	(164s) 8200 4100 4100 8200 8200 16400 16400	0.2	1.5
120 km/h (Case3)	 12.2 64 144 384	 0.01 0.001 0.1 0.01 0.001 0.1 0.01 0.001 0.1 0.01 0.001	1.234	345 (559s) (5592s) (112s) (1118s) (11183s) (55.9s) (559s) (5592s) (28s) (280s) (2796s)	(4.1s) 205 205 103 103 103 205 205 205 410 410 410	0.2	1.5
250 km/h (Case 4)	 12.2 64 144 384	 0.01 0.001 0.1 0.01 0.001 0.1 0.01 0.001 0.1 0.01 0.001	1.234	345 (559s) (5592s) (112s) (1118s) (11183s) (55.9s) (559s) (5592s) (28s) (280s) (2796s)	(2s) 100 100 50 50 50 100 100 100 200 200 200	0.2	1.5
Demodulation of DCH in moving propagation conditions	 12.2 64	 0.01 0.1 0.01	1.234	345 (559s) (112s) (1118s)	(628s) 31400 15700 15700	0.2	1.5
Demodulation of DCH in birth/death propagation conditions	 12.2 64	 0.01 0.1 0.01	1.234	345 (559s) (112s) (1118s)	(38.2s) 1910 955 955	0.2	1.5
Verification of internal BLER calculation	Not applicable, TS 34.121 Annex F.6.1.10 Dual limit BLER Tests may be applied in principle						
Table C.1.8-3: Test conditions for Pd tests (Probability of detection) **Type of test**	**Information Bit rate** **Not applicable**	**Test requirement (1-Pd)**	**Test limit (1-Pd)= Test requirement (1-Pd)x TL** **TL**	**Target number of error events** (time)	**Minimum number of samples (time)**	**Prob that bad unit will pass = Prob that good unit will fail (%)**	**Bad un BLER fa M**

RACH preamble detection in static propagation conditions		0.01 0.001	1.234	345 (29.8s) (298s) (net preamble TX time)	Note 1	0.2	1.5
RACH preamble detection in multipath fading conditions case3 (120 km/h)		0.01 0.001	1.234	345 (29.8s) (298s) (net preamble TX time)	3844 preambles (4.1s)	0.2	1.5
Table C.1.8-4: Test conditions for BLER tests **Type of test (BLER)**	**Information Bits**	**Test requirement (BLER)**	**Test limit (BLER)= Test requirement (BLER)x TL** **TL**	**Target number of error events** (time)	**Minimum number of samples (time)**	**Prob that bad unit will pass = Prob that good unit will fail (%)**	**Bad un BLER fa M**
Demodulation of RACH message in static propagation conditions	168 bits 360 bits	0.1 0.01 0.1 0.01	1.234	345 (55.9s) (559s) (55.9s) (559s) (net message TX time)	Note 1	0.2	1.5
Demodulation of RACH message in multipath fading case 3	168 bits 360 bits	0.1 0.01 0.1 0.01	1.234	345 55.9s) (559s) (55.9s) (559s) (net message TX time)	205 messages (4.1s)	0.2	1.5
Table C.1.8-5: Test conditions for Pd tests (Probability of detection) **Type of test**	**Information Bit rate** **Not applicable**	**Test requirement (1-Pd)**	**Test limit (1-Pd)= Test requirement (1-Pd)x TL** **TL**	**Target number of error events** (time)	**Minimum number of samples (time)**	**Prob that bad unit will pass = Prob that good unit will fail (%)**	**Bad un BLER fa M**
CPCH access preamble and collision detection preamble in static propagation conditions		0.01 0.001	1.234	345 (29.8s) (298s) (net preamble TX time)	Note 1	0.2	1.5
CPCH access preamble and collision detection preamble in multipath fading conditions case3 (120 km/h)		0.01 0.001	1.234	345 (29.8s) (298s) (net preamble TX time)	3844 preambles	0.2	1.5
Table C.1.8-6: Test conditions for BLER tests **Type of test (BLER)**	**Information Bits**	**Test requirement (BLER)**	**Test limit (BLER)= Test requirement (BLER)x TL** **TL**	**Target number of error events** (time)	**Minimum number of samples (time)**	**Prob that bad unit will pass = Prob that good unit will fail (%)**	**Bad un BLER fa M**

Demodulation of CPCH message in static propagation conditions	168 bits 360 bits	0.1 0.01 0.1 0.01	1.234	345 (55.9s) (559s) (55.9s) (559s) (net message TX time)	Note 1	0.2	1.5
Demodulation of RACH message in multipath fading case 3	168 bits 360 bits	0.1 0.01 0.1 0.01	1.234	345 (55.9s) (559s) (55.9s) (559s) (net message TX time)	(4.1s) 205 messages	0.2	1.5

C.1.9 Practical Use (informative)

See figure C.1.9:
The early fail limit represents formula (1) in C.1.5. The range of validity is ne≥ 7 (≥8 in case of blocking test) to ne =345
The early pass limit represents formula (2) in C.1.5. The range of validity is ne=1 to ne =345. See note 1
The intersection co-ordinates of both curves are : target number of errors ne = 345 and test limit TL = 1.234.
The range of validity for TL is ne>345.
A typical BER BLER test, calculated form the number of samples and errors (C.1.2.(b)) using experimental method (1) or (2) (see C.1.4.2 calculation assumptions) runs along the yellow trajectory. With an errorless sample the trajectory goes down vertically. With an erroneous sample it jumps up right. The tester checks if the BER BLER test intersects the early fail or early pass limits. The real time processing can be reduced by the following actions:

- $BLER_0$ (excluding the artificial error at the beginning of the test (Note 1)). is calculated only in case of an error event.

- BER_0 (excluding the artificial error at the beginning of the test (Note 1)). is calculated only in case of an error event within a TTI.

So the early fail limit cannot be missed by errorless samples.
The check against the early pass limit may be done by transforming formula (2) in C.1.5 such that the tester checks against a Limit-Number-of-samples (NL(ne)) depending on the current number of errors (including the artificial error at the beginning of the test (Note 1)).
Early pass if

$$NL(ne) \geq \frac{qchisq(1-D,2*ne)}{2*TR*M}$$

TR: test requirement (0.001)

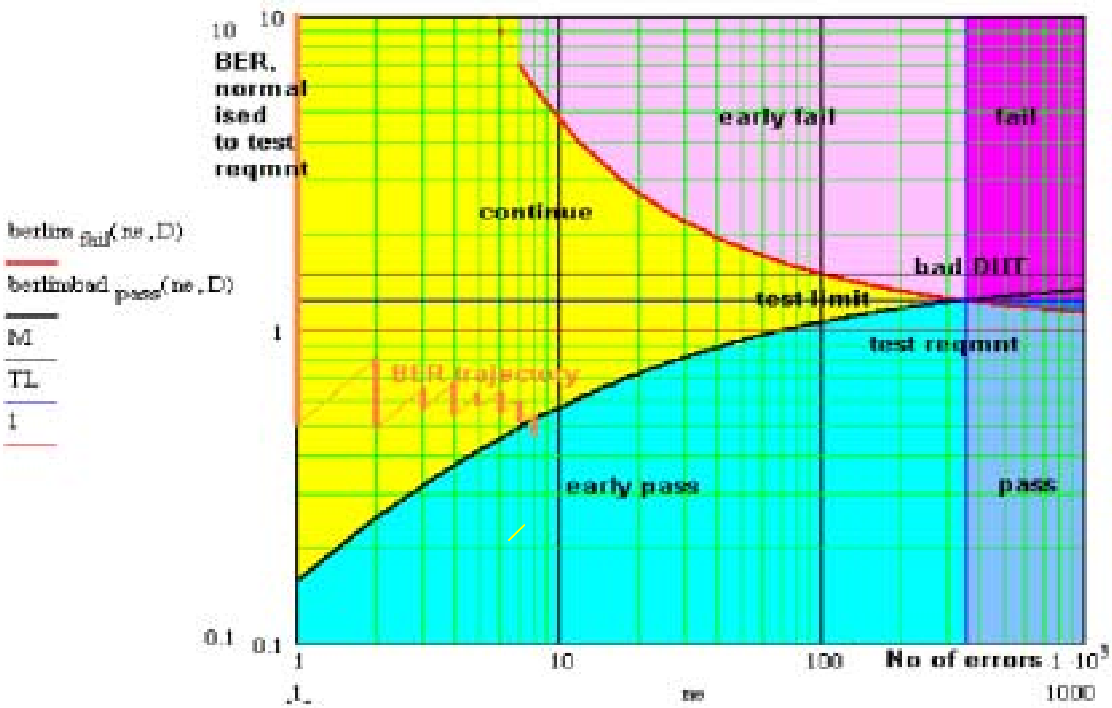

Figure C.1.9

Note 1: At the beginning of the test, an artificial error is introduced. This ensures that an ideal DUT meets the valid range of the early pass limit. In addition this ensures that the complementary experiment (C.1.4.2 bullet point (2)) is applicable as well.

For the check against the early fail limit the artificial erroneous sample, introduced at the beginning of the test , is disregarded.

Due to the nature of the test, namely discrete error events, the early fail condition shall not be valid, when fractional errors <1 are used to calculate the early fail limit: Any early fail decision is postponed until number of errors ne ≥7. In the blocking test any early fail decision is postponed until number of errors ne ≥ 8.

Note2: F=0.2% is intended to be used for a test containing a few BER/BLER tests (e.g. receiver sensitivity is repeated 12 times(3 RF Channels * 2 Power-supplies * 2 Temperatures). For a test containing many BER/BLER tests (e.g. blocking test) this value is not appropriate for a single BER/BLER test.

The blocking test contains approx. 12750 single BER tests. A DUT on the limit will fail approx. 25 to 26 times due to statistical reasons using wrong decision probability at the end of the test F= 0.2%. This shall be solved by the following rule:

All passes (based on F=0.2%) are accepted, including the wrong decisions due to statistical reasons.

An early fail limit based on F=0.02% instead of 0.2% is established. That ensures that wrong decisions due to statistical reasons are reduced to 2 to 3 in 12750 BER measurements. If the fail cases are ≤12, it is allowed to repeat each fail cases 1 time before the final verdict.

These asymmetric test conditions ensure that a DUT on the limit consumes hardly more test time for a blocking test than in the symmetric case and reduces the wrong decision probability considerably and on the other hand the repetition allowance sufficiently suppresses the residual statistically caused wrong verdict for the aggregate test.

3GPP TSG RAN WG4 (Radio) Meeting #26 **R4-030292**
Madrid, Spain 17 - 22 February, 2003

CR-Form-v7

CHANGE REQUEST

⌘ **25.141** **CR** **280**	⌘ **rev** **1** ⌘	Current version:	**6.0.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [ ] Radio Access Network [X] Core Network [ ]

Title: ⌘	Statistical approach for BER BLER tests		
Source: ⌘	RAN WG4		
Work item code: ⌘	TEI5	***Date:*** ⌘	05/03/2003
Category: ⌘	**A**	***Release:*** ⌘	Rel-6
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change: ⌘	BER/BLER measurements have statistical nature. The current test requirements specify only a single BER BLER value without statistical significance.
Summary of change: ⌘	It introduces the statistical requirements and lays down how to carry out BER BLER tests taking into account test time optimisation. Isolated impact analysis: Does not affect BS implementation
Consequences if not approved: ⌘	Infinite test time, or if the test is finished after finite time, the results bear unknown statistical significance

Clauses affected: ⌘	7.1 7.2.4.2 7.5.4.2 7.5.5 8.1 Annex C				
	Y	**N**			
Other specs affected: ⌘		X	Other core specifications	⌘	
		X	Test specifications		
		X	O&M Specifications		
Other comments: ⌘	Revised from R4-030105 Equivalent CRs in other Releases: CR279r1 cat. F to 25.141 v5.5.0				

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

7 Receiver characteristics

7.1 General

Unless otherwise stated, all tests in this clause shall be performed at the BS antenna connector (test port A) with a full complement of transceivers for the configuration in normal operating conditions. If any external apparatus such as a RX amplifier, a diplexer, a filter or the combination of such devices is used, the tests according to subclauses 4.6.2 and/or 4.6.4, depending on the device added, shall be performed to ensure that the requirements are met at test port B.

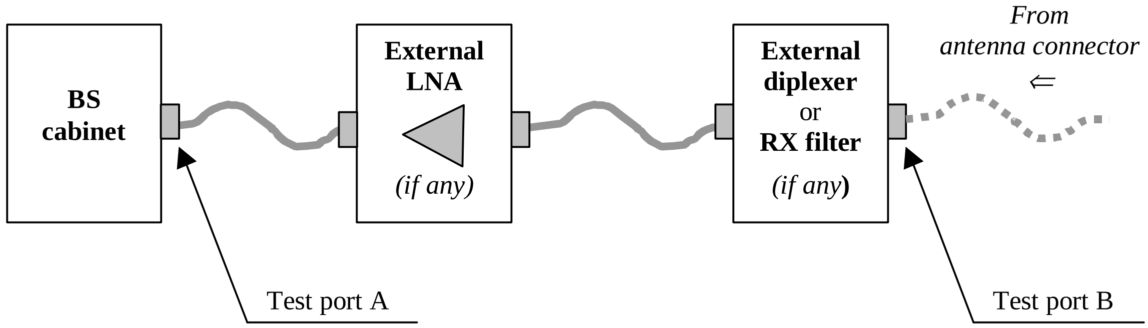

Figure 7.1: Receiver test ports

The tests in clause 7 assume that the receiver is not equipped with diversity. For receivers with diversity, unless otherwise stated, tests shall be performed by applying the specified signals to one of the receiver inputs, and terminating or disabling the other(s). The tests and requirements are otherwise unchanged.
In all the relevant subclauses in this clause all Bit Error Ratio (BER), Residual BER (RBER) and Block Error Ratio (BLER) measurements shall be carried out according to the general rules for statistical testing defined in ITU-T Recommendation O.153 [5] and Annex C.
If external BER measurement is not used then the internal BER calculation shall be used instead. When internal BER calculation is used, the requirements of the verification test according to 7.8 shall be met in advance.
In tests performed with signal generators a synchronization signal may be provided, from the base station to the signal generator, to enable correct timing of the wanted signal.

7.2 Reference sensitivity level

7.2.1 Definition and applicability

The reference sensitivity level is the minimum mean power received at the antenna connector at which the BER shall not exceed the specific value indicated in subclause 7.2.2. The test is set up according to Figure B.7 and performed without interfering signal power applied to the BS antenna connector . For duplex operation , the measurement configuration principle is indicated for one duplex branch in Figure B.7. For internal BER calculation an example of the test connection is as shown in figure B.7. The reference point for signal power is at the input of the receiver (antenna connector).

7.2.2 Minimum Requirement

The BER shall not exceed 0,001 for the parameters specified in table 7.1.

Table 7.1: BS reference sensitivity levels

Reference measurement channel data rate	BS reference sensitivity level (dBm)	BER
12,2 kbps	-121	BER shall not exceed 0,001

The normative reference for this requirement is in TS 25.104[1] subclause 7.2.

7.2.3 Test purpose

To verify that at the BS Reference sensitivity level the BER shall not exceed the specified limit.

7.2.4 Method of testing

7.2.4.1 Initial conditions

Test environment: normal; see subclause 4.4.1
RF channels to be tested: B, M and T; see subclause 4.8.
The following additional tests shall be performed:

a) On each of B, M and T, the test shall be performed under extreme power supply as defined in subclause 4.4.2

NOTE: Tests under extreme power supply also test extreme temperature.

1) Connect BS to be tested to RF signal source.
2) Set frequency.
3) Start transmit 12,2kbps DPCH with reference measurement channel defined in annex A to the BS under test (PN-9 data sequence or longer).
4) Disable TPC function.

7.2.4.2 Procedure

1) Calculate BER according to annex C ~~from at least 30000 received data bits.~~
2) Set the test signal mean power as specified in table 7.1A.
3) Measure BER.

7.2.5 Test requirement

The BER measurement result in step 3 of 7.2.4.2 shall not be greater than the limit specified in table 7.1A.

Table 7.1A: BS reference sensitivity levels

Reference measurement channel data rate	BS reference sensitivity level (dBm)	BER
12,2 kbps	-120.3	BER shall not exceed 0,001

NOTE: If the above Test Requirement differs from the Minimum Requirement then the Test Tolerance applied for this test is non-zero. The Test Tolerance for this test is defined in subclause 4.2 and the explanation of how the Minimum Requirement has been relaxed by the Test Tolerance is given in Annex F.

7.5 Blocking characteristics

7.5.1 Definition and applicability

The blocking characteristics is a measure of the receiver ability to receive a wanted signal at is assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the adjacent channels. The blocking performance requirement applies as specified in tables 7.4(a) to 7.4(g).
The requirements in Table 7.4(a) shall apply to base stations intended for general-purpose applications, depending on which frequency band is used. The requirements in Tables 7.4 (b) to 7.4 (g) may be applied when the FDD BS is co-located with GSM900, GSM850, PCS1900 and/or BS operation in DCS1800 band (UTRA or GSM).

7.5.2 Minimum Requirements

The BER shall not exceed 0.001 for the parameters specified in table 7.4.

Table 7.4(a): Blocking characteristics

Operating Band	Center Frequency of Interfering Signal	Interfering Signal Level	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I	1920 - 1980 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1900 - 1920 MHz 1980 - 2000 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz -1900 MHz 2000 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
II	1850 - 1910 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1830 - 1850 MHz 1910 - 1930 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz - 1830 MHz 1930 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
III	1710 – 1785 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1690 - 1710 MHz 1785 – 1805 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz - 1690 MHz 1805 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier

Table 7.4(b): Blocking performance requirement when co-located with GSM900

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I, III	921 -960 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4(c): Blocking performance requirement for operation when co-located with BTS operating inDCS1800 band (GSM or UTRA)

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I, III	1805 – 1880 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4(d): Blocking performance requirement for operation when co-located with UTRA BS operating in Frequency band I

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
III	2110 – 2170 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4(e): Blocking performance requirement for operation when co-located with PCS1900 BTS

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1930 – 1990 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4(f): Blocking performance requirement (narrowband)

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1850 - 1910 MHz	- 47 dBm	-115 dBm	2.7 MHz	GMSK modulated*
III	1710 – 1785 MHz	- 47 dBm	-115 dBm	2.8 MHz	GMSK modulated*
* GMSK modulation as defined in TS 45.004 [12].					

Table 7.4(g): Blocking performance requirement for operation when co-located with GSM850 BTS

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal Level	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	869 – 894 MHz	+16 dBm	-115 dBm	—	CW carrier

The normative reference for these requirements is in TS 25.104[1] subclause 7.5

7.5.3 Test purpose

The test stresses the ability of the BS receiver to withstand high-level interference from unwanted signals at frequency offsets of 10 MHz or more, without undue degradation of its sensitivity.

7.5.4 Method of test

7.5.4.1 Initial conditions

Test environment: normal; see subclause 4.4.1.
RF channels to be tested: M see subclause 4.8. The BS shall be configured to operate as close to the centre of the operating band as possible.

1) Connect WCDMA signal generator at the assigned channel frequency of the wanted signal and a signal generator to the antenna connector of one Rx port.

2) Terminate any other Rx port not under test.

3) Transmit a signal from the WCDMA signal generator to the BS. The characteristics of the signal shall be set according to the UL reference measurement channel (12,2 kbit/s) specified in annex A subclause A.2.1. The level of the WCDMA signal measured at the BS antenna connector shall be set to the level specified in subclause 7.5.5.

7.5.4.2 Procedure

1) Adjust the signal generators to the type of interfering signals and the frequency offsets as specified in Tables 7.4A(a) to 7.4A(g). Note that the GMSK modulated interfering signal shall have an ACLR of at least 72 dB in order to eliminate the impact of interference signal adjacent channel leakage power on the blocking characteristics measurement. For the tests defined in Table 7.4A(a), the interfering signal shall be at a frequency offset Fuw from the assigned channel frequency of the wanted signal which is given by:

   $$Fuw = \pm (n \times 1 \text{ MHz}),$$

   where n shall be increased in integer steps from n = 10 up to such a value that the center frequency of the interfering signal covers the range from 1 MHz to 12,75 GHz.

2) Measure the BER of the wanted signal at the BS receiver.

~~NOTE: The test procedure as defined in steps (1) and (2) requests to carry out more than 10 000 BER measurements. To reduce the time needed for these measurements, it may be appropriate to conduct the test in two phases: During phase 1, BER measurements are made on all center frequencies of the interfering signal as requested but with a reduced confidence level, with the aim to identify those frequencies which require more detailed investigation. In phase 2, detailed measurements are made only at those critical frequencies identified before, applying the required confidence level.~~

3) Interchange the connections of the BS Rx ports and repeat the measurements according to steps (1) to (2).

7.5.5 Test Requirements

The BER shall not exceed 0.001 for the parameters specified in table 7.4A.

Table 7.4A(a): Blocking characteristics

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I	1920 - 1980 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1900 - 1920 MHz 1980 - 2000 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz -1900 MHz 2000 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
II	1850 - 1910 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1830 - 1850 MHz 1910 - 1930 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz - 1830 MHz 1930 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier
III	1710 – 1785 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1690 - 1710 MHz 1785 – 1805 MHz	-40 dBm	-115 dBm	10 MHz	WCDMA signal with one code
	1 MHz - 1690 MHz 1805 MHz - 12750 MHz	-15 dBm	-115 dBm	—	CW carrier

Table 7.4A(b): Blocking performance requirementwhen co-located with GSM900

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I, III	921 -960 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4A(c): Blocking performance requirement when co-located with Base Station operating in DCS1800 band (GSM or UTRA)

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
I, III	1805 – 1880 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4A(d): Blocking performance requirement for operation when co-located with UTRA BS operating in Frequency band I

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
III	2110 – 2170 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4A(e): Blocking performance requirement for operation when co-located with PCS1900 BTS

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1930 – 1990 MHz	+16 dBm	-115 dBm	—	CW carrier

Table 7.4A(f): Blocking performance requirement (narrowband)

Operating Band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	1850 - 1910 MHz	- 47 dBm	-115 dBm	2.7 MHz	GMSK modulated*
III	1710 – 1785 MHz	- 47 dBm	-115 dBm	2.8 MHz	GMSK modulated*
* GMSK modulation as defined in TS 45.004 [12].					

Table 7.4A(g): Blocking performance requirement for operation when co-located with GSM850 BTS

Operating band	Center Frequency of Interfering Signal	Interfering Signal mean power	Wanted Signal mean power	Minimum Offset of Interfering Signal	Type of Interfering Signal
II	869 – 894 MHz	+16 dBm	-115 dBm	—	CW carrier

NOTE1: If the above Test Requirement differs from the Minimum Requirement then the Test Tolerance applied for this test is non-zero. The Test Tolerance for this test is defined in subclause 4.2 and the explanation of how the Minimum Requirement has been relaxed by the Test Tolerance is given in Annex F.

NOTE 2: Annex C describes the procedure for BER tests taking into account the statistical consequence of frequent repetition of BER measurements within the blocking test . The consequence is: a DUT exactly on the limit may fail due to the statistical nature 2.55 times(mean value) in 12750 BER measurements using the predefined wrong decision probability of 0.02%. If the fail cases are ≤12, it is allowed to repeat the fail cases 1 time before the final verdict.

8 Performance requirement

8.1 General

All Bit Error Ratio (BER) and Block Error ratio (BLER) measurements shall be carried out according to the general rules for statistical testing defined in ITU-T Recommendation O.153 [5] and Annex C.
If external BLER measurement is not used then the internal BLER calculation shall be used instead. When internal BLER calculation is used, the requirements of the verification test according to 8.6 shall be met in advance.
Performance requirements are specified for a number of test environments and multi-path channel classes.
The requirements only apply to those measurement channels that are supported by the base station.
The requirements only apply to a base station with dual receiver antenna diversity. The required E_b/N_0 shall be applied separately at each antenna port.
In tests performed with signal generators a synchronization signal may be provided, from the base station to the signal generator, to enable correct timing of the wanted signal.

Annex C (normative):
~~Detailed definition of error events~~

~~1) Block Error Ratio (BLER):~~

- ~~the block is defined as erased if the error detection functions using Cyclic Redundancy Check (CRC) in layer 1.~~

~~<Editor's note: Tentative definition of BLER is given.>~~

~~2) Bit Error Ratio (BER):~~

- ~~the BER is the overall Bit Error Ratio (BER) independent of frame erasures or when erased frames are not defined.~~

General rules for statistical testing

C.1 Statistical testing of receiver BER/BLER performance

C.1.1 Error Definition

1) Bit Error Ratio (BER)

The Bit Error Ratio is defined as the ratio of the bits wrongly received to all data bits sent. The bits are the data bits above the convolutional/turbo decoder. The BER is the overall BER independent of frame erasures or when erased frames are not defined.

2) Block Error Ratio (BLER)

A Block Error Ratio is defined as the ratio of the number of erroneous blocks received to the total number of blocks sent. An erroneous block is defined as a Transport Block, the cyclic redundancy check (CRC) of which is wrong.

C.1.2 Test Method

Each test is performed in the following manner:

a) Setup the required test conditions.

b) Record the number of samples tested and the number of occurred events (bit error or block error)

c) Stop the test at a stop criterion which is minimum test time or an early pass or an early fail event.

d) Once the test is stopped decide according to the pass fail decision rules (subclause C.1.7)

C.1.3 Test Criteria

The test shall fulfil the following requirements:

a) good pass fail decision

   1) to keep reasonably low the probability (risk) of passing a bad unit for each individual test;

   2) to have high probability of passing a good unit for each individual test;

b) good balance between testtime and statistical significance

   3) to perform measurements with a high degree of statistical significance;

   4) to keep the test time as low as possible.

C.1.4 Calculation assumptions

C.1.4.1 Statistical independence

(a) It is assumed, that error events are rare (lim BER BLER → 0) independent statistical events. However the memory of the convolutional /turbo coder is terminated after one TTI. Samples and errors are summed up every TTI. So the assumption of independent error events is justified.

(b) In the BLER test with fading there is the memory of the multipath fading channel which interferes the statistical independence. A minimum test time is introduced to average fluctuations of the multipath fading channel. So the assumption of independent error events is justified approximately.

C.1.4.2 Applied formulas

The formulas, applied to describe the BER BLER test, are based on the following experiments:

(1) After having observed a certain number of errors (**ne**) the number of samples are counted to calculate BER BLER. Provisions are made (note 1) such that the complementary experiment is valid as well:
(2) After a certain number of samples (**ns**) the number of errors, occurred, are counted to calculate BER BLER.
Experiment (1) stipulates to use the following Chi Square Distribution with degree of freedom ne:
2*dchisq(2*NE,2*ne).
Experiment (2) stipulates to use the Poisson Distribution: dpois(ne,NE)
(NE: mean of the distribution)
To determine the early stop conditions, the following inverse cumulative operation is applied:
0.5 * qchisq(D,2*ne). This is applicable for experiment (1) and (2).
D: wrong decision risk per test step
Note: other inverse cumulative operations are available, however only this is suited for experiment (1) and (2).

C.1.4.3 Approximation of the distribution

The test procedure is as follows:
During a running measurement for a UE ns (number of samples) and ne (number of errors) are accumulated and from this the preliminary BER BLER is calculated. Then new samples up to the next error are taken. The entire past and the new samples are basis for the next preliminary BER BLER. Depending on the result at every step, the UE can pass, can fail or must continue the test.
As early pass- and early fail-UEs leave the statistical totality under consideration, the experimental conditions are changed every step resulting in a distribution that is truncated more and more towards the end of the entire test. Such a distribution can not any more be handled analytically. The unchanged distribution is used as an approximation to calculate the early fail and early pass bounds.

C.1.5 Definition of good pass fail decision.

This is defined by the probability of wrong decision F at the end of the test. The probability of a correct decision is 1-F.
The probability (risk) to fail a good DUT shall be ≤ F according to the following definition: The failed DUT is still better than the specified error ratio (Test requirement)with a probability of ≤ F.
The probability to pass a bad DUT shall be ≤ F according to the following definition: The passed DUT is still worse than M times the specified error ratio (M>1 is the bad DUT factor) with a probability of ≤ F.
This definitions lead to an early pass and an early fail limit:
Early fail: ber≥ $berlim_{fail}$

$$ber\lim_{fail}(D,ne) = \frac{2*ne}{qchisq(D,2*ne)} \qquad (1)$$

For ne≥ 7

Early pass: ber ≤$berlimbad_{pass}$

$$ber\lim bad_{pass}(D,ne) = \frac{2*ne*M}{qchisq(1-D,2*ne)} \qquad (2)$$

For ne ≥ 1

With

ber (normalized BER,BLER): BER,BLER according to C.1.1 divided by Test requirement

D: wrong decision probability for a test step . This is a numerically evaluated fraction of F, the wrong decision probability at the end of the test. See table C.1.6.1.

ne: Number of error events

M: bad DUT factor see table C.1.6.1.

qchisq: inverse-cumulative-function of the chi-squared-distribution

C.1.6 Good balance between test time and statistical significance

Three independent test parameters are introduced into the test and shown in Table C.1.6.1. These are the obvious basis of test time and statistical significance. From the first two of them four dependent test parameters are derived. The third independent test parameter is justified separately.

Table C.1.6.1 independent and dependent test parameters

Independent test parameters			Dependent test parameters		
Test Parameter	Value	Reference	Test parameter	Value	Reference
Bad DUT factor M	1.5	Table C.1.8	Early pass/fail condition	Curves	Subclause C.1.5 Figure C.1.9
Final probability of wrong pass/fail decision F	0.2%, (0.02%, note 2)	Subclause C.1.5	Target number of error events	345	Table C.1.8
			Probability of wrong pass/fail decision per test step D	0.0085%, (0.0008% and 0.008%, note 2)	
			Test limit factor TL	1.234	Table C.1.8
Minimum test time		Table C.1.6.2			

The minimum test time is derived from the following justification:

1) For no propagation conditions and static propagation condition

   No early fail calculated from fractional number of errors <1 (see note 1)

2) For multipath fading condition

   No stop of the test until 990 wavelengths are crossed with the speed given in the fading profile.

3) For birth death propagation conditions

   No stop of the test until 200 birth death transitions occur

4) For moving propagation conditions: 628 sec

   This is necessary in order to pass all potential critical points in the moving propagation profile 4 times:

   Maximum rake window

   Maximum adjustment speed

   Intersection of moving taps

Table C.1.6.2 : minimum Test time

Fading profile	Minimum test time
Multipath propagation 3 km/h	164 sec
Multipath propagation 50 km/h	9.8 sec
Multipath propagation 120 km/h	4.1 sec
Multipath propagation 250 km/h	2 sec
Birth Death propagation	38.2 sec
Moving propagation	628 sec

In table C.1.8the minimum test time is converted in minimum number of samples.

C.1.7 Pass fail decision rules

No decision is allowed before the minimum test time is elapsed.

1) If minimum Test time < time for target number of error events then the following applies: The required confidence level 1-F (= correct decision probability) shall be achieved. This is fulfilled at an early pass or early fail event.

For BER:

For every TTI (Transmit Time Interval) sum up the number of bits (ns) and the number if errors (ne) from the beginning of the test and calculate

BER_1 (including the artificial error at the beginning of the test (Note 1))and

BER_0 (excluding the artificial error at the beginning of the test (Note 1)).

If BER_0 is above the early fail limit, fail the DUT.

If BER_1 is below the early pass limit, pass the DUT.

Otherwise continue the test

For BLER:

For every TTI sum up the number of blocks (ns) and the number of erroneous blocks (ne) from the beginning of the test and calculate

$BLER_1$ (including the artificial error at the beginning of the test (Note 1))and

$BLER_0$ (excluding the artificial error at the beginning of the test (Note 1)).

If $BLER_1$ is below the early pass limit, pass the DUT.

If $BLER_0$ is above the early fail limit, fail the DUT.

Otherwise continue the test

2) If the minimum test time $\geq$ time for target error events, then the test runs for the minimum test time and the decision is done by comparing the result with the test limit.

For BER:

For every TTI (Transmit Time Interval) sum up the number of bits (ns) and the number if errors (ne) from the beginning of the test and calculate BER_0

For BLER:

For every TTI sum up the number of blocks (ns) and the number of erroneous blocks (ne) from the beginning of the test and calculate $BLER_0$

If $BER_0/BLER_0$ is above the test limit, fail the DUT.

If $BER_0/BLER_0$ is on or below the test limit, pass the DUT.

C.1.8. Test conditions for BER,BLER,Pd tests

Table C.1.8: Test conditions for BER/BLER tests

Table C.1.8-1: Test conditions for BER tests Type of test **(BER)**	**Propagation conditions**	**Test requirement (BER)**	**Test limit (BER)= Test requirement (BER)x TL TL**	**Target number of error events** (time)	**Minimum number of samples**	**Prob that good unit will fail = Prob that bad unit will pass (%)**	**Bad unit BER factor M**
Reference Sensitivity Level	-	0.001	1.234	345 (22.9s)	Note 1	0.2	1.5
Dynamic Range	-	0.001	1.234	345 (22.9s)	Note 1	0.2	1.5
Adjacent Channel Selectivity	-	0.001	1.234	345 (22.9s)	Note 1	0.2	1.5
Blocking Characteristics Pass condition Note 2	-	0.001	1.251	402 (26.3s)	Note 1	0.2	1.5
Blocking Characteristics Fail condition Note 2	-	0.001	1.251	402 (26.3s)	Note 1	0.02	1.5
Intermodulation Characteristics	-	0.001	1.234	345 (22.9s)	Note 1	0.2	1.5
Verification of internal BER calculation	Not applicable, TS 34.121 Annex F.6.1.10 Dual limit BLER Tests may be applied in principle						

Table C.1.8-2: Test conditions for BLER tests **Type of test (BLER)**	**Information Bit rate**	**Test requirement (BLER)**	**Test limit (BLER)= Test requirement (BLER)x TL** **TL**	**Target number of error events** (time)	**Minimum number of samples (time)**	**Prob that bad unit will pass = Prob that good unit will fail (%)**	**Bad un BLER fa M**
Demodulation in Static Propagation conditions	 12.2 64 144 384	 0.01 0.1 0.01 0.1 0.01 0.1 0.01	1.234	345 (559s) (112s) (1118s) (55.9s) (559s) (28s) (280s)	Note1	0.2	1.5
Demodulation of DCH in Multi-path Fading Propagation conditions							
3km/h (Case 1, Case 2)	 12.2 64 144 384	 0.01 0.1 0.01 0.1 0.01 0.1 0.01	1.234	345 (559s) (112s) (1118s) (55.9s) (559s) (28s) (280s)	(164s) 8200 4100 4100 8200 8200 16400 16400	0.2	1.5
120 km/h (Case3)	 12.2 64 144 384	 0.01 0.001 0.1 0.01 0.001 0.1 0.01 0.001 0.1 0.01 0.001	1.234	345 (559s) (5592s) (112s) (1118s) (11183s) (55.9s) (559s) (5592s) (28s) (280s) (2796s)	(4.1s) 205 205 103 103 103 205 205 205 410 410 410	0.2	1.5
250 km/h (Case 4)	 12.2 64 144 384	 0.01 0.001 0.1 0.01 0.001 0.1 0.01 0.001 0.1 0.01 0.001	1.234	345 (559s) (5592s) (112s) (1118s) (11183s) (55.9s) (559s) (5592s) (28s) (280s) (2796s)	(2s) 100 100 50 50 50 100 100 100 200 200 200	0.2	1.5
Demodulation of DCH in moving propagation conditions	 12.2 64	 0.01 0.1 0.01	1.234	345 (559s) (112s) (1118s)	(628s) 31400 15700 15700	0.2	1.5
Demodulation of DCH in birth/death propagation conditions	 12.2 64	 0.01 0.1 0.01	1.234	345 (559s) (112s) (1118s)	(38.2s) 1910 955 955	0.2	1.5
Verification of internal BLER calculation	Not applicable, TS 34.121 Annex F.6.1.10 Dual limit BLER Tests may be applied in principle						
Table C.1.8-3: Test conditions for Pd tests (Probability of detection) **Type of test**	**Information Bit rate** **Not applicable**	**Test requirement (1-Pd)**	**Test limit (1-Pd)= Test requirement (1-Pd)x TL** **TL**	**Target number of error events** (time)	**Minimum number of samples (time)**	**Prob that bad unit will pass = Prob that good unit will fail (%)**	**Bad un BLER fa M**

RACH preamble detection in static propagation conditions		0.01 0.001	1.234	345 (29.8s) (298s) (net preamble TX time)	Note 1	0.2	1.5
RACH preamble detection in multipath fading conditions case3 (120 km/h)		0.01 0.001	1.234	345 (29.8s) (298s) (net preamble TX time)	3844 preambles (4.1s)	0.2	1.5
Table C.1.8-4: Test conditions for BLER tests **Type of test (BLER)**	**Information Bits**	**Test requirement (BLER)**	**Test limit (BLER)= Test requirement (BLER)x TL** **TL**	**Target number of error events** (time)	**Minimum number of samples (time)**	**Prob that bad unit will pass = Prob that good unit will fail (%)**	**Bad un BLER fa M**
Demodulation of RACH message in static propagation conditions	168 bits 360 bits	0.1 0.01 0.1 0.01	1.234	345 (55.9s) (559s) (55.9s) (559s) (net message TX time)	Note 1	0.2	1.5
Demodulation of RACH message in multipath fading case 3	168 bits 360 bits	0.1 0.01 0.1 0.01	1.234	345 55.9s) (559s) (55.9s) (559s) (net message TX time)	205 messages (4.1s)	0.2	1.5
Table C.1.8-5: Test conditions for Pd tests (Probability of detection) **Type of test**	**Information Bit rate** **Not applicable**	**Test requirement (1-Pd)**	**Test limit (1-Pd)= Test requirement (1-Pd)x TL** **TL**	**Target number of error events** (time)	**Minimum number of samples (time)**	**Prob that bad unit will pass = Prob that good unit will fail (%)**	**Bad un BLER fa M**
CPCH access preamble and collision detection preamble in static propagation conditions		0.01 0.001	1.234	345 (29.8s) (298s) (net preamble TX time)	Note 1	0.2	1.5
CPCH access preamble and collision detection preamble in multipath fading conditions case3 (120 km/h)		0.01 0.001	1.234	345 (29.8s) (298s) (net preamble TX time)	3844 preambles	0.2	1.5
Table C.1.8-6: Test conditions for BLER tests **Type of test (BLER)**	**Information Bits**	**Test requirement (BLER)**	**Test limit (BLER)= Test requirement (BLER)x TL** **TL**	**Target number of error events** (time)	**Minimum number of samples (time)**	**Prob that bad unit will pass = Prob that good unit will fail (%)**	**Bad un BLER fa M**

Demodulation of CPCH message in static propagation conditions	168 bits 360 bits	0.1 0.01 0.1 0.01	1.234	345 (55.9s) (559s) (55.9s) (559s) (net message TX time)	Note 1	0.2	1.5
Demodulation of RACH message in multipath fading case 3	168 bits 360 bits	0.1 0.01 0.1 0.01	1.234	345 (55.9s) (559s) (55.9s) (559s) (net message TX time)	(4.1s) 205 messages	0.2	1.5

C.1.9 Practical Use (informative)

See figure C.1.9:
The early fail limit represents formula (1) in C.1.5. The range of validity is ne≥ 7 (≥8 in case of blocking test) to ne =345
The early pass limit represents formula (2) in C.1.5. The range of validity is ne=1 to ne =345. See note 1
The intersection co-ordinates of both curves are : target number of errors ne = 345 and test limit TL = 1.234.
The range of validity for TL is ne>345.
A typical BER BLER test, calculated form the number of samples and errors (C.1.2.(b)) using experimental method (1) or (2) (see C.1.4.2 calculation assumptions) runs along the yellow trajectory. With an errorless sample the trajectory goes down vertically. With an erroneous sample it jumps up right. The tester checks if the BER BLER test intersects the early fail or early pass limits. The real time processing can be reduced by the following actions:

- $BLER_0$ (excluding the artificial error at the beginning of the test (Note 1)). is calculated only in case of an error event.

- BER_0 (excluding the artificial error at the beginning of the test (Note 1)). is calculated only in case of an error event within a TTI.

So the early fail limit cannot be missed by errorless samples.
The check against the early pass limit may be done by transforming formula (2) in C.1.5 such that the tester checks against a Limit-Number-of-samples (NL(ne)) depending on the current number of errors (including the artificial error at the beginning of the test (Note 1)).
Early pass if

$$NL(ne) \geq \frac{qchisq(1-D, 2*ne)}{2*TR*M}$$

TR: test requirement (0.001)

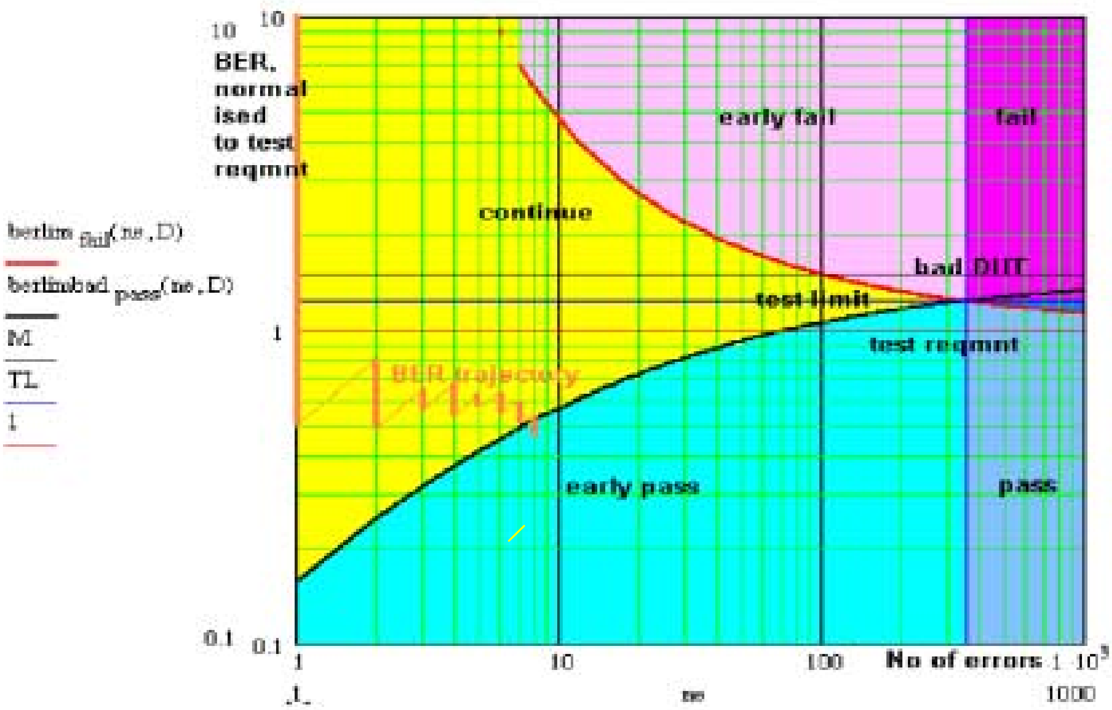

Figure C.1.9

Note 1: At the beginning of the test, an artificial error is introduced. This ensures that an ideal DUT meets the valid range of the early pass limit. In addition this ensures that the complementary experiment (C.1.4.2 bullet point (2)) is applicable as well.

For the check against the early fail limit the artificial erroneous sample, introduced at the beginning of the test , is disregarded.

Due to the nature of the test, namely discrete error events, the early fail condition shall not be valid, when fractional errors <1 are used to calculate the early fail limit: Any early fail decision is postponed until number of errors ne ≥7. In the blocking test any early fail decision is postponed until number of errors ne ≥ 8.

Note2: F=0.2% is intended to be used for a test containing a few BER/BLER tests (e.g. receiver sensitivity is repeated 12 times(3 RF Channels * 2 Power-supplies * 2 Temperatures). For a test containing many BER/BLER tests (e.g. blocking test) this value is not appropriate for a single BER/BLER test.

The blocking test contains approx. 12750 single BER tests. A DUT on the limit will fail approx. 25 to 26 times due to statistical reasons using wrong decision probability at the end of the test F= 0.2%. This shall be solved by the following rule:

All passes (based on F=0.2%) are accepted, including the wrong decisions due to statistical reasons.

An early fail limit based on F=0.02% instead of 0.2% is established. That ensures that wrong decisions due to statistical reasons are reduced to 2 to 3 in 12750 BER measurements. If the fail cases are ≤12, it is allowed to repeat each fail cases 1 time before the final verdict.

These asymmetric test conditions ensure that a DUT on the limit consumes hardly more test time for a blocking test than in the symmetric case and reduces the wrong decision probability considerably and on the other hand the repetition allowance sufficiently suppresses the residual statistically caused wrong verdict for the aggregate test.