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*Technical Specification*

## Digital cellular telecommunications system (Phase 2+); Radio Transmission and Reception (3GPP TS 05.05 version 7.9.0 Release 1998)

GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

Reference
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# Foreword

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# Contents

# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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# 1 Scope

The present document defines the requirements for the transceiver of the pan-European digital mobile cellular and personal communication systems operating in the GSM 900 MHz and 1 800 MHz band (GSM 900 and DCS 1 800), and in the PCS 1 900 MHz band.

Requirements are defined for two categories of parameters:

- those that are required to provide compatibility between the radio channels, connected either to separate or common antennas, that are used in the system. This category also includes parameters providing compatibility with existing systems in the same or adjacent frequency bands;

- those that define the transmission quality of the system.

The present document defines RF characteristics for the Mobile Station (MS) and Base Station System (BSS). The BSS will contain either Base Transceiver Stations (BTS) or microcell base transceiver stations (micro-BTS). The precise measurement methods are specified in 3GPP TS 11.10 and 3GPP TS 11.20.

Unless otherwise stated, the requirements defined in the present document apply to the full range of environmental conditions specified for the equipment (see annex D).

In the present document some relaxation's are introduced for GSM 900 MSs which pertain to power class 4 or 5 (see subclause 4.1.1).

In the present document these Mobile Stations are referred to as "small MS".

MSs may operate on more than one of the frequency bands specified in clause 2. These MSs, defined in 3GPP TS 02.06, are referred to as "Multi band MSs" in the present document. Multi band MSs shall meet all requirements for each of the bands supported. The relaxation on GSM 900 for a "small MS" are also valid for a multi band MS if it complies with the definition of a small MS.

The RF characteristics of repeaters are defined in annex E of the present document. Annexes D and E are the only clauses of the present document applicable to repeaters. Annex E does not apply to the MS or BSS.

## 1.1 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.


[1] 3GPP TR 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] 3GPP TS 02.06: "Digital cellular telecommunications system (Phase 2+); Types of Mobile Stations (MS)".

[3] 3GPP TS 03.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); GPRS Radio Interface Stage 2".

[4] 3GPP TS 05.01: "Digital cellular telecommunications system (Phase 2+); Physical layer on the radio path General description".

[5] 3GPP TS 05.04: "Digital cellular telecommunications system (Phase 2+); Modulation".

[6] 3GPP TS 05.08: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".

[7] 3GPP TS 05.10: "Digital cellular telecommunications system (Phase 2+); Radio subsystem synchronization".

[8] 3GPP TS 11.10: "Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformity specification".

[9] 3GPP TS 11.11: "Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface".

[10] ITU-T Recommendation O.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate".

[11] ETSI EN 300 019-1-3: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions Stationary use at weather protected locations".

[12] ETSI EN 300 019-1-4: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions Stationary use at non-weather protected locations".

[13] 3GPP TS 04.14: "Digital cellular telecommunications system (Phase 2+); Individual equipment type requirements and interworking; Special conformance testing functions".

[14] ANSI T1.610 (1990): "Generic Procedures for Supplementary Services".

[15] 3GPP TS 03.52: "Digital cellular telecommunications system (Phase 2+); GSM Cordless Telephony System (CTS); Lower layers of the CTS radio interface; Stage 2".

## 1.2 Abbreviations

Abbreviations used in the present document are listed in 3GPP TR 01.04.

# 2 Frequency bands and channel arrangement

i) Standard or primary GSM 900 Band, P-GSM:

- for Standard GSM 900 band, the system is required to operate in the following frequency band:
  - 890 MHz to 915 MHz: mobile transmit, base receive;
  - 935 MHz to 960 MHz: base transmit, mobile receive.

ii) Extended GSM 900 Band, E-GSM (includes Standard GSM 900 band):

- for Extended GSM 900 band, the system is required to operate in the following frequency band:
  - 880 MHz to 915 MHz: mobile transmit, base receive;
  - 925 MHz to 960 MHz: base transmit, mobile receive.

iii) Railways GSM 900 Band, R-GSM (includes Standard and Extended GSM 900 Band);

- for Railways GSM 900 band, the system is required to operate in the following frequency band:
  - 876 MHz to 915 MHz: mobile transmit, base receive;
  - 921 MHz to 960 MHz: base transmit, mobile receive.

iv) DCS 1 800 Band:

- for DCS 1 800, the system is required to operate in the following band:

- 1 710 MHz to 1 785 MHz: mobile transmit, base receive;
- 1 805 MHz to 1 880 MHz: base transmit, mobile receive.

v) PCS 1 900 Band:

- for PCS 1 900, the system is required to operate in the following band:
  - 1850 MHz to 1910 MHz: mobile transmit, base receive;
  - 1930 MHz to 1990 MHz base transmit, mobile receive.

NOTE 1: The term GSM 900 is used for any GSM system which operates in any 900 MHz band.

NOTE 2: The BTS may cover the complete band, or the BTS capabilities may be restricted to a subset only, depending on the operator needs.

Operators may implement networks which operates on a combination of the frequency bands above to support multi band mobile terminals which are defined in 3GPP TS 02.06.

The carrier spacing is 200 kHz.

The carrier frequency is designated by the absolute radio frequency channel number (ARFCN). If we call Fl(n) the frequency value of the carrier ARFCN n in the lower band, and Fu(n) the corresponding frequency value in the upper band, we have:

| | | | |
|---|---|---|---|
| P-GSM 900 | Fl(n) = 890 + 0.2*n | 1 ≤ n ≤ 124 | Fu(n) = Fl(n) + 45 |
| E-GSM 900 | Fl(n) = 890 + 0.2*n<br>Fl(n) = 890 + 0.2*(n-1024) | 0 ≤ n ≤ 124<br>975 ≤ n ≤ 1 023 | Fu(n) = Fl(n) + 45 |
| R-GSM 900 | Fl(n) = 890 + 0.2*n<br>Fl(n) = 890 + 0.2*(n-1024) | 0 ≤ n ≤ 124<br>955 ≤ n ≤ 1023 | Fu(n) = Fl(n) + 45 |
| DCS 1 800 | Fl(n) = 1710.2 + 0.2*(n-512) | 512 ≤ n ≤ 885 | Fu(n) = Fl(n) + 95 |
| PCS 1 900 | Fl(n) = 1850.2 + .2*(n-512) | 512 ≤ n ≤ 810 | Fu(n) = Fl(n) + 80 |

Frequencies are in MHz.

# 3 Reference configuration

The reference configuration for the radio subsystem is described in 3GPP TS 05.01.

The micro-BTS is different from a normal BTS in two ways. Firstly, the range requirements are much reduced whilst the close proximity requirements are more stringent. Secondly, the micro-BTS is required to be small and cheap to allow external street deployment in large numbers. Because of these differences the micro-BTS needs a different set of RF parameters to be specified. Where the RF parameters are not different for the micro-BTS the normal BTS parameters shall apply.

The pico-BTS is an extension of the micro-BTS concept to the indoor environments. The very low delay spread, low speed, and small cell sizes give rise to a need for a different set of RF parameters to be specified.

# 4 Transmitter characteristics

Throughout this clause, unless otherwise stated, requirements are given in terms of power levels at the antenna connector of the equipment. For equipment with integral antenna only, a reference antenna with 0 dBi gain shall be assumed.

The term output power refers to the measure of the power when averaged over the useful part of the burst (see annex B).

The term peak hold refers to a measurement where the maximum is taken over a sufficient time that the level would not significantly increase if the holding time were longer.

# 4.1 Output power

## 4.1.1 Mobile Station

The MS maximum output power and lowest power control level shall be, according to its class, as defined in the following table (see also 3GPP TS 02.06).

| Power class | GSM 900 Nominal Maximum output power | DCS 1 800 Nominal Maximum output power | PCS 1 900 Nominal Maximum output power | Tolerance (dB) for conditions | |
|---|---|---|---|---|---|
| | | | | normal | extreme |
| 1 | - - - - - - | 1 W (30 dBm) | 1 W (30 dBm) | ±2 | ±2.5 |
| 2 | 8 W (39 dBm) | 0.25 W (24 dBm) | 0.25 W (24 dBm) | ±2 | ±2.5 |
| 3 | 5 W (37 dBm) | 4 W (36 dBm) | 2 W (33 dBm) | ±2 | ±2.5 |
| 4 | 2 W (33 dBm) | | | ±2 | ±2.5 |
| 5 | 0.8 W (29 dBm) | | | ±2 | ±2.5 |
| NOTE: The lowest nominal output power for all classes of GSM 900 MS is 5 dBm and for all classes of DCS 1 800 and PCS 1 900 MS is 0 dBm. | | | | | |

A multi band MS has a combination of the power class in each band of operation from the table above. Any combination may be used.

The PCS 1 900 MS, including its actual antenna gain, shall not exceed a maximum of 2 Watts (+33 dBm) EIRP per the applicable FCC rules for wideband PCS services [ANSI T1.610 (1990): "Generic Procedures for Supplementary Services"]. Power Class 3 is restricted to transportable or vehicular mounted units.

The different power control levels needed for adaptive power control (see 3GPP TS 05.08) shall have the nominal output power as defined in the table below, starting from the power control level for the lowest nominal output power up to the power control level for the maximum nominal output power corresponding to the class of the particular MS as defined in the table above. Whenever a power control level commands the MS to use a nominal output power equal to or greater than the maximum nominal output power for the power class of the MS, the nominal output power transmitted shall be the maximum nominal output power for the MS class, and the tolerance of ±2 or 2,5 dB (see table above) shall apply.

**GSM 900**

| Power control level | Nominal Output power (dBm) | Tolerance (dB) for conditions | |
|---|---|---|---|
| | | normal | extreme |
| 0-2 | 39 | ±2 | ±2,5 |
| 3 | 37 | ±3 | ±4 |
| 4 | 35 | ±3 | ±4 |
| 5 | 33 | ±3 | ±4 |
| 6 | 31 | ±3 | ±4 |
| 7 | 29 | ±3 | ±4 |
| 8 | 27 | ±3 | ±4 |
| 9 | 25 | ±3 | ±4 |
| 10 | 23 | ±3 | ±4 |
| 11 | 21 | ±3 | ±4 |
| 12 | 19 | ±3 | ±4 |
| 13 | 17 | ±3 | ±4 |
| 14 | 15 | ±3 | ±4 |
| 15 | 13 | ±3 | ±4 |
| 16 | 11 | ±5 | ±6 |
| 17 | 9 | ±5 | ±6 |
| 18 | 7 | ±5 | ±6 |
| 19-31 | 5 | ±5 | ±6 |

**DCS 1 800**

| Power control level | Nominal Output power (dBm) | Tolerance (dB) for conditions | |
|---|---|---|---|
| | | normal | extreme |
| 29 | 36 | ±2 | ±2,5 |
| 30 | 34 | ±3 | ±4 |
| 31 | 32 | ±3 | ±4 |
| 0 | 30 | ±3 | ±4 |
| 1 | 28 | ±3 | ±4 |
| 2 | 26 | ±3 | ±4 |
| 3 | 24 | ±3 | ±4 |
| 4 | 22 | ±3 | ±4 |
| 5 | 20 | ±3 | ±4 |
| 6 | 18 | ±3 | ±4 |
| 7 | 16 | ±3 | ±4 |
| 8 | 14 | ±3 | ±4 |
| 9 | 12 | ±4 | ±5 |
| 10 | 10 | ±4 | ±5 |
| 11 | 8 | ±4 | ±5 |
| 12 | 6 | ±4 | ±5 |
| 13 | 4 | ±4 | ±5 |
| 14 | 2 | ±5 | ±6 |
| 15-28 | 0 | ±5 | ±6 |

NOTE 1: For DCS 1 800, the power control levels 29, 30 and 31 are not used when transmitting the parameter MS_TXPWR_MAX_CCH on BCCH, for cross phase compatibility reasons. If levels greater than 30 dBm are required from the MS during a random access attempt, then these shall be decoded from parameters broadcast on the BCCH as described in 3GPP TS 05.08.

Furthermore, the difference in output power actually transmitted by the MS between two power control levels where the difference in nominal output power indicates an increase of 2 dB (taking into account the restrictions due to power class), shall be +2 ± 1,5 dB. Similarly, if the difference in output power actually transmitted by the MS between two power control levels where the difference in nominal output power indicates an decrease of 2 dB (taking into account the restrictions due to power class), shall be -2 ± 1,5 dB.

NOTE 2: A 2 dB nominal difference in output power can exist for non-adjacent power control levels e.g. power control levels 18 and 22 for GSM 900; power control levels 31 and 0 for class 3 DCS 1 800 and power control levels 3 and 6 for class 4 GSM 900.

A change from any power control level to any power control level may be required by the base transmitter. The maximum time to execute this change is specified in 3GPP TS 05.08.

**PCS 1 900**

| Power Control Level | Output Power (dBm) | Tolerance (dB) for conditions | |
|---|---|---|---|
| | | **Normal** | **Extreme** |
| 22-29 | Reserved | Reserved | Reserved |
| 30 | 33 | ±2 dB | ±2,5 dB |
| 31 | 32 | ±2 dB | ±2,5 dB |
| 0 | 30 | ±3 dB[1] | ±4 dB[1] |
| 1 | 28 | ±3 dB | ±4 dB |
| 2 | 26 | ±3 dB | ±4 dB |
| 3 | 24 | ±3 dB[1] | ±4 dB[1] |
| 4 | 22 | ±3 dB | ±4 dB |
| 5 | 20 | ±3 dB | ±4 dB |
| 6 | 18 | ±3 dB | ±4 dB |
| 7 | 16 | ±3 dB | ±4 dB |
| 8 | 14 | ±3 dB | ±4 dB |
| 9 | 12 | ±4 dB | ±5 dB |
| 10 | 10 | ±4 dB | ±5 dB |
| 11 | 8 | ±4 dB | ±5 dB |
| 12 | 6 | ±4 dB | ±5 dB |
| 13 | 4 | ±4 dB | ±5 dB |
| 14 | 2 | ±5 dB | ±6 dB |
| 15 | 0 | ±5 dB | ±6 dB |
| 16-21 | Reserved | Reserved | Reserved |
| NOTE: Tolerance for MS Power Classes 1 and 2 is ±2 dB normal and ±2,5 dB extreme at Power Control Levels 0 and 3 respectively. | | | |

The output power actually transmitted by the MS at each of the power control levels shall form a monotonic sequence, and the interval between power steps shall be 2 dB ± 1,5 dB except for the step between power control levels 30 and 31 where the interval is 1 dB ± 1 dB.

The MS transmitter may be commanded by the BTS to change from any power control level to any other power control level. The maximum time to execute this change is specified in 3GPP TS 05.08.

For CTS transmission, the nominal maximum output power of the MS shall be restricted to:

- 11 dBm (0,015 W) in GSM 900 i.e. power control level 16;
- 12 dBm (0,016 W) in DCS 1 800 i.e. power control level 9.

## 4.1.2 Base station

The Base Station Transmitter maximum output power, measured at the input of the BSS Tx combiner, shall be, according to its class, as defined in the following tables:

**GSM 900**

| TRX power class | Maximum output power |
|---|---|
| 1 | 320 - (< 640) W |
| 2 | 160 - (< 320) W |
| 3 | 80 - (< 160) W |
| 4 | 40 - (< 80) W |
| 5 | 20 - (< 40) W |
| 6 | 10 - (< 20) W |
| 7 | 5 - (< 10) W |
| 8 | 2.5 - (< 5) W |

**DCS 1 800 & PCS 1 900**

| TRX power class | Maximum output power |
|---|---|
| 1 | 20 - (< 40) W |
| 2 | 10 - (< 20) W |
| 3 | 5 - (< 10) W |
| 4 | 2.5 - (< 5) W |

The micro-BTS maximum output power per carrier measured at the antenna connector after all stages of combining shall be, according to its class, defined in the following table.

| GSM 900 micro and pico-BTS | | DCS 1 800 & PCS 1 900 micro and pico-BTS | |
|---|---|---|---|
| **TRX power class** | **Maximum output power** | **TRX power class** | **Maximum output power** |
| **Micro** | | **Micro** | |
| M1<br>M2<br>M3 | (> 19) - 24 dBm<br>(> 14) - 19 dBm<br>(> 9) - 14 dBm | M1<br>M2<br>M3 | (> 27) - 32 dBm<br>(> 22) - 27 dBm<br>(> 17) - 22 dBm |
| **Pico**<br>P1 | (> 13) - 20 dBm | **Pico**<br>P1 | (> 16) - 23 dBm |

The tolerance of the actual maximum output power of the BTS shall be ±2 dB under normal conditions and ±2,5 dB under extreme conditions. Settings shall be provided to allow the output power to be reduced from its maximum level in at least six steps of nominally 2 dB with an accuracy of ±1 dB to allow a fine adjustment of the coverage by the network operator. In addition, the actual absolute output power at each static RF power step (N) shall be 2*N dB below the absolute output power at static RF power step 0 with a tolerance of ±3 dB under normal conditions and ±4 dB under extreme conditions. The static RF power step 0 shall be the actual output power according to the TRX power class.

As an option the BSS can utilize downlink RF power control. In addition to the static RF power steps described above, the BSS may then utilize up to 15 steps of power control levels with a step size of 2 dB ± 1,5 dB, in addition the actual absolute output power at each power control level (N) shall be 2*N dB below the absolute output power at power control level 0 with a tolerance of ±3 dB under normal conditions and ±4 dB under extreme conditions. The power control level 0 shall be the set output power according to the TRX power class and the six power settings defined above.

Network operators or manufacturers may also specify the BTS output power including any Tx combiner, according to their needs.

#### 4.1.2.1 Additional requirements for PCS 1 900 Base stations (PCS 1 900)

The BTS transmitter maximum rated output power per carrier, measured at the input of the transmitter combiner, shall be, according to its TRX power class, as defined in the table above. The base station output power may also be specified by the manufacturer or system operator at a different reference point (e.g. after transmitter combining).

The maximum radiated power from the BTS, including its antenna system, shall not exceed a maximum of 1640 W EIRP, equivalent to 1000 W ERP, per the applicable FCC rules for wideband PCS services [14].

## 4.2 Output RF spectrum

The specifications contained in this subclause apply to both BTS and MS, in frequency hopping as well as in non frequency hopping mode, except that beyond 1800 kHz offset from the carrier the BTS is not tested in frequency hopping mode.

Due to the bursty nature of the signal, the output RF spectrum results from two effects:

- the modulation process;
- the power ramping up and down (switching transients).

The two effects are specified separately; the measurement method used to analyse separately those two effects is specified in 3GPP TS 11.10 and 11.20. It is based on the "ringing effect" during the transients, and is a measurement in the time domain, at each point in frequency.

The limits specified thereunder are based on a 5-pole synchronously tuned measurement filter.

Unless otherwise stated, for the BTS, only one transmitter is active for the tests of this subclause.

### 4.2.1 Spectrum due to the modulation and wide band noise

The output RF modulation spectrum is specified in the following tables. A mask representation of this specification is shown in annex A. This specification applies for all RF channels supported by the equipment.

The specification applies to the entire of the relevant transmit band and up to 2 MHz either side.

The specification shall be met under the following measurement conditions:

- for BTS up to 1 800 kHz from the carrier and for MS in all cases:

  - zero frequency scan, filter bandwidth and video bandwidth of 30 kHz up to 1800 kHz from the carrier and 100 kHz at 1 800 kHz and above from the carrier, with averaging done over 50 % to 90 % of the useful part of the transmitted bursts, excluding the midamble, and then averaged over at least 200 such burst measurements. Above 1 800 kHz from the carrier only measurements centred on 200 kHz multiples are taken with averaging over 50 bursts.

- for BTS at 1 800 kHz and above from the carrier:

  - swept measurement with filter and video bandwidth of 100 kHz, minimum sweep time of 75 ms, averaging over 200 sweeps. All slots active, frequency hopping disabled.

- when tests are done in frequency hopping mode, the averaging shall include only bursts transmitted when the hopping carrier corresponds to the nominal carrier of the measurement. The specifications then apply to the measurement results for any of the hopping frequencies.

The figures in tables a) and b) below, at the vertically listed power level (dBm) and at the horizontally listed frequency offset from the carrier (kHz), are then the maximum allowed level (dB) relative to a measurement in 30 kHz on the carrier.

NOTE: This approach of specification has been chosen for convenience and speed of testing. It does however require careful interpretation if there is a need to convert figures in the following tables into spectral density values, in that only part of the power of the carrier is used as the relative reference, and in addition different measurement bandwidths are applied at different offsets from the carrier. Appropriate conversion factors for this purpose are given in 3GPP TS 05.50.

For the BTS, the power level is the "actual absolute output power" defined in subclause 4.1.2. If the power level falls between two of the values in the table, the requirement shall be determined by linear interpolation.

a1) GSM 900 MS:

| | 100 | 200 | 250 | 400 | ≥ 600<br><1 800 | ≥ 1 800<br><3 000 | ≥ 3 000<br><6 000 | ≥ 6 000 |
|---|---|---|---|---|---|---|---|---|
| ≥ 39 | +0,5 | -30 | -33 | -60 | -66 | -69 | -71 | -77 |
| 37 | +0,5 | -30 | -33 | -60 | -64 | -67 | -69 | -75 |
| 35 | +0,5 | -30 | -33 | -60 | -62 | -65 | -67 | -73 |
| ≤ 33 | +0,5 | -30 | -33 | -60 | -60 | -63 | -65 | -71 |

a2) GSM 900 normal BTS:

| | 100 | 200 | 250 | 400 | ≥ 600<br>< 1 200 | ≥ 1 200<br>< 1 800 | ≥ 1 800<br>< 6 000 | ≥ 6 000 |
|---|---|---|---|---|---|---|---|---|
| ≥ 43 | +0,5 | -30 | -33 | -60 | -70 | -73 | -75 | -80 |
| 41 | +0,5 | -30 | -33 | -60 | -68 | -71 | -73 | -80 |
| 39 | +0,5 | -30 | -33 | -60 | -66 | -69 | -71 | -80 |
| 37 | +0,5 | -30 | -33 | -60 | -64 | -67 | -69 | -80 |
| 35 | +0,5 | -30 | -33 | -60 | -62 | -65 | -67 | -80 |
| ≤ 33 | +0,5 | -30 | -33 | -60 | -60 | -63 | -65 | -80 |

a3) GSM 900 micro-BTS:

| | 100 | 200 | 250 | 400 | ≥ 600<br>< 1 200 | ≥ 1 200<br>< 1 800 | ≥ 1 800 |
|---|---|---|---|---|---|---|---|
| ≤ 33 | +0,5 | -30 | -33 | -60 | -60 | -63 | -70 |

a4) GSM 900 pico-BTS:

| | 100 | 200 | 250 | 400 | ≥ 600<br>< 1 200 | ≥ 1 200<br>< 1 800 | ≥ 1 800<br>< 6 000 | ≥ 6 000 |
|---|---|---|---|---|---|---|---|---|
| ≤ 20 | +0,5 | -30 | -33 | -60 | -60 | -63 | -70 | -80 |

b1) DCS 1 800 MS:

| | 100 | 200 | 250 | 400 | ≥ 600<br>< 1 800 | ≥ 1 800<br>< 6 000 | ≥ 6 000 |
|---|---|---|---|---|---|---|---|
| ≥ 36 | +0,5 | -30 | -33 | -60 | -60 | -71 | -79 |
| 34 | +0,5 | -30 | -33 | -60 | -60 | -69 | -77 |
| 32 | +0,5 | -30 | -33 | -60 | -60 | -67 | -75 |
| 30 | +0,5 | -30 | -33 | -60 | -60 | -65 | -73 |
| 28 | +0,5 | -30 | -33 | -60 | -60 | -63 | -71 |
| 26 | +0,5 | -30 | -33 | -60 | -60 | -61 | -69 |
| ≤ 24 | +0,5 | [tdb] | -33 | -60 | -60 | -59 | -67 |

b2) DCS 1 800 normal BTS:

| | 100 | 200 | 250 | 400 | ≥ 600<br>< 1 200 | ≥ 1 200<br>< 1 800 | ≥ 1 800<br>< 6 000 | ≥ 6 000 |
|---|---|---|---|---|---|---|---|---|
| ≥ 43 | +0,5 | -30 | -33 | -60 | -70 | -73 | -75 | -80 |
| 41 | +0,5 | -30 | -33 | -60 | -68 | -71 | -73 | -80 |
| 39 | +0,5 | -30 | -33 | -60 | -66 | -69 | -71 | -80 |
| 37 | +0,5 | -30 | -33 | -60 | -64 | -67 | -69 | -80 |
| 35 | +0,5 | -30 | -33 | -60 | -62 | -65 | -67 | -80 |
| ≤ 33 | +0,5 | -30 | -33 | -60 | -60 | -63 | -65 | -80 |

b3) DCS 1 800 micro-BTS:

| | 100 | 200 | 250 | 400 | ≥ 600<br>< 1 200 | ≥ 1 200<br>< 1 800 | ≥ 1 800 |
|---|---|---|---|---|---|---|---|
| 35 | +0,5 | -30 | -33 | -60 | -62 | -65 | -76 |
| ≤ 33 | +0,5 | -30 | -33 | -60 | -60 | -63 | -76 |

b4) DCS 1 800 pico-BTS:

| | 100 | 200 | 250 | 400 | ≥ 600<br>< 1 200 | ≥ 1 200<br>< 1 800 | ≥ 1 800<br>< 6 000 | ≥ 6 000 |
|---|---|---|---|---|---|---|---|---|
| ≤ 23 | +0,5 | -30 | -33 | -60 | -60 | -63 | -76 | -80 |

c1) PCS 1 900 MS:

| | 100 | 200 | 250 | 400 | ≥ 600<br>< 1 200 | ≥ 1 200<br>< 1 800 | ≥ 1 800<br>< 6 000 | ≥ 6 000 |
|---|---|---|---|---|---|---|---|---|
| ≥ 33 | +0,5 | -30 | -33 | -60 | -60 | -60 | -68 | -76 |
| 32 | +0,5 | -30 | -33 | -60 | -60 | -60 | -67 | -75 |
| 30 | +0,5 | -30 | -33 | -60 | -60 | -60 | -65 | -73 |
| 28 | +0,5 | -30 | -33 | -60 | -60 | -60 | -63 | -71 |
| 26 | +0,5 | -30 | -33 | -60 | -60 | -60 | -61 | -69 |
| ≤ 24 | +0,5 | -30 | -33 | -60 | -60 | -60 | -59 | -67 |

c2) PCS 1 900 normal BTS:

| | 100 | 200 | 250 | 400 | ≥ 600<br>< 1 200 | ≥ 1 200<br>< 1 800 | ≥ 1 800<br>< 6 000 | ≥ 6 000 |
|---|---|---|---|---|---|---|---|---|
| ≥ 43 | +0,5 | -30 | -33 | -60 | -70 | -73 | -75 | -80 |
| 41 | +0,5 | -30 | -33 | -60 | -68 | -71 | -73 | -80 |
| 39 | +0,5 | -30 | -33 | -60 | -66 | -69 | -71 | -80 |
| 37 | +0,5 | -30 | -33 | -60 | -64 | -67 | -69 | -80 |
| 35 | +0,5 | -30 | -33 | -60 | -62 | -65 | -67 | -80 |
| ≤ 33 | +0,5 | -30 | -33 | -60 | -60 | -63 | -65 | -80 |

c3) PCS 1 900 micro-BTS.

The PCS 1 900 micro-BTS spectrum due to modulation and noise at all frequency offsets greater than 1.8 MHz from carrier shall be -76 dB for all micro-BTS classes. These are average levels in a measurement bandwidth of 100 kHz relative to a measurement in 30 kHz on carrier. The measurement will be made in non-frequency hopping mode under the conditions specified for the normal BTS.

The following exceptions shall apply, using the same measurement conditions as specified above:

i) in the combined range 600 kHz to 6 MHz above and below the carrier, in up to three bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz, exceptions at up to -36 dBm are allowed;

ii) above 6 MHz offset from the carrier in up to 12 bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz, exceptions at up to -36 dBm are allowed. For the BTS only one transmitter is active for this test.

Using the same measurement conditions as specified above, if a requirement in tables a) and b) is tighter than the limit given in the following, the latter shall be applied instead.

iii) For MS:

| Frequency offset from the carrier | GSM 900 | DCS 1 800 &PCS 1 900 |
|---|---|---|
| < 600 kHz | -36 dBm | -36 dBm |
| ≥ 600 kHz, < 1 800 kHz | -51 dBm | -56 dBm |
| ≥ 1 800 kHz | -46 dBm | -51 dBm |

iv) For normal BTS, whereby the levels given here in dB are relative to the output power of the BTS at the lowest static power level measured in 30 kHz:

| Frequency offset from the carrier | GSM 900 | DCS 1 800 & PCS 1 900 |
|---|---|---|
| < 1 800 kHz | max {-88 dB, -65 dBm} | max {-88 dB, -57 dBm} |
| ≥ 1 800 kHz | max {-83 dB, -65 dBm} | max {-83 dB, -57 dBm} |

v) For micro and pico -BTS, at 1 800 kHz and above from the carrier:

| Power Class | GSM 900 | DCS 1 800 & PCS 1 900 |
|---|---|---|
| M1 | -59 dBm | -57 dBm |
| M2 | -64 dBm | -62 dBm |
| M3 | -69 dBm | -67 dBm |
| P1 | -68dBm | -65dBm |

## 4.2.2 Spectrum due to switching transients

Those effects are also measured in the time domain and the specifications assume the following measurement conditions: zero frequency scan, filter bandwidth 30 kHz, peak hold, and video bandwidth 100 kHz.

The example of a waveform due to a burst as seen in a 30 kHz filter offset from the carrier is given thereunder (figure 1).

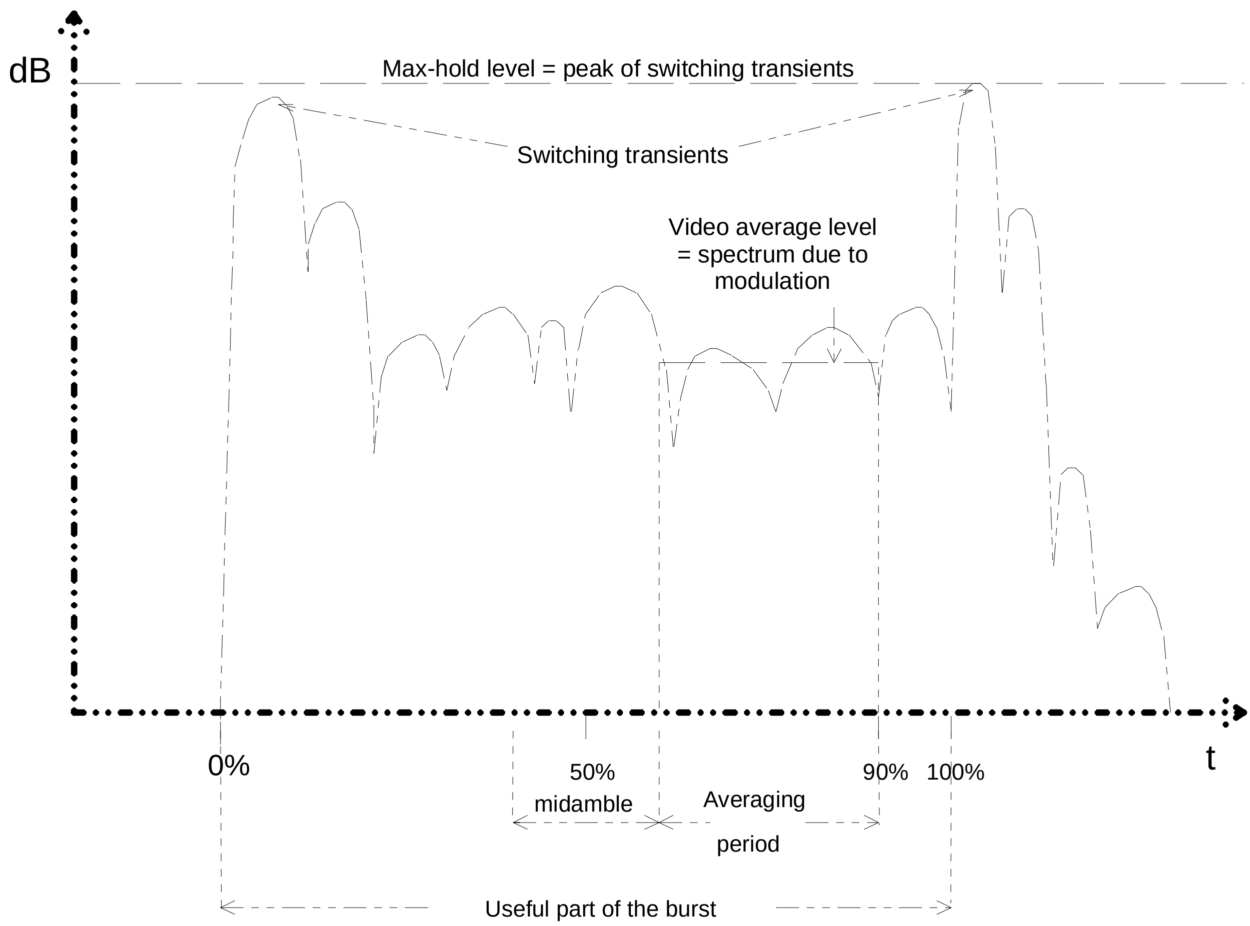



**Figure 1: Example of a time waveform due to a burst as seen in a 30 kHz filter offset from the carrier**

a) Mobile Station:

| Power level | Maximum level measured | | | |
|---|---|---|---|---|
| | 400 kHz | 600 kHz | 1 200 kHz | 1 800 kHz |
| 39 dBm | -21 dBm | -26 dBm | -32 dBm | -36 dBm |
| ≤ 37 dBm | -23 dBm | -26 dBm | -32 dBm | -36 dBm |

NOTE 1: The relaxation's for power level 39 dBm is in line with the modulated spectra and thus causes negligible additional interference to an analogue system by a GSM signal.

NOTE 2: The near-far dynamics with this specification has been estimated to be approximately 58 dB for MS operating at a power level of 8 W or 49 dB for MS operating at a power level of 1 W. The near-far dynamics then gradually decreases by 2 dB per power level down to 32 dB for MS operating in cells with a maximum allowed output power of 20 mW or 29 dB for MS operating at 10 mW.

NOTE 3: The possible performance degradation due to switching transient leaking into the beginning or the end of a burst, was estimated and found to be acceptable with respect to the BER due to cochannel interference (C/I).

b) Base transceiver station:

The maximum level measured, after any filters and combiners, at the indicated offset from the carrier, is:

| | Maximum level measured | | | |
|---|---|---|---|---|
| | 400 kHz | 600 kHz | 1 200 kHz | 1 800 kHz |
| GSM 900 | -57 dBc | -67 dBc | -74 dBc | -74 dBc |
| DCS 1 800 & PCS 1 900 | -50 dBc | -58 dBc | -66 dBc | -66 dBc |

or -36 dBm, whichever is the higher.

dBc means relative to the output power at the BTS, measured at the same point and in a filter bandwidth of at least 300 kHz.

NOTE 4: Some of the above requirements are different from those specified in subclause 4.3.2.

# 4.3 Spurious emissions

The limits specified thereunder are based on a 5-pole synchronously tuned measurement filter.

In addition to the requirements of this subclause, the PCS 1 900 BTS and PCS 1 900 MS shall also comply with the applicable limits for spurious emissions established by the FCC rules for wideband PCS services [14].

## 4.3.1 Principle of the specification

In this subclause, the spurious transmissions (whether modulated or unmodulated) and the switching transients are specified together by measuring the peak power in a given bandwidth at various frequencies. The bandwidth is increased as the frequency offset between the measurement frequency and, either the carrier, or the edge of the MS or BTS transmit band, increases. The effect for spurious signals of widening the measurement bandwidth is to reduce the allowed total spurious energy per MHz. The effect for switching transients is to effectively reduce the allowed level of the switching transients (the peak level of a switching transient increases by 6 dB for each doubling of the measurement bandwidth). The conditions are specified in the following table, a peak-hold measurement being assumed.

The measurement conditions for radiated and conducted spurious are specified separately in 3GPP TS 11.10 and 11.2x series. The frequency bands where these are actually measured may differ from one type to the other (see 3GPP TS 11.10 and 11.2x series).

a)

| Band | Frequency offset | Measurement bandwidth |
|---|---|---|
| relevant transmit band | (offset from carrier)<br>≥ 1.8 MHz<br>≥ 6 MHz | 30 kHz<br>100 kHz |

b)

| Band | Frequency offset | Measurement bandwidth |
|---|---|---|
| 100 kHz to 50 MHz<br>50 MHz to 500 MHz<br>above 500 MHz outside the relevant transmit band | -<br>-<br>(offset from edge of the relevant above band)<br>≥ 2 MHz<br>≥ 5 MHz<br>≥ 10 MHz<br>≥ 20 MHz<br>≥ 30 MHz | 10 kHz<br>100 kHz<br><br>30 kHz<br>100 kHz<br>300 kHz<br>1 MHz<br>3 MHz |

The measurement settings assumed correspond, for the resolution bandwidth to the value of the measurement bandwidth in the table, and for the video bandwidth to approximately three times this value.

NOTE: For radiated spurious emissions for MS with antenna connectors, and for all spurious emissions for MS with integral antennas, the specifications currently only apply to the frequency band 30 MHz to 4 GHz. The specification and method of measurement outside this band are under consideration.

### 4.3.2 Base Transceiver Station

The power measured in the conditions specified in subclause 4.3.1a shall be no more than -36 dBm.

The power measured in the conditions specified in subclause 4.3.1b shall be no more than:

- 250 nW (-36 dBm) in the frequency band 9 kHz to 1 GHz;

- 1 µW (-30 dBm) in the frequency band 1 to 12,75 GHz.

NOTE 1: For radiated spurious emissions for BTS, the specifications currently only apply to the frequency band 30 MHz to 4 GHz. The specification and method of measurement outside this band are under consideration.

In the BTS receive band, the power measured using the conditions specified in subclause 4.2.1, with a filter and video bandwidth of 100 kHz shall be no more than:

| | GSM (dBm) | DCS & PCS (dBm) |
|---|---|---|
| Normal BTS | -98 | -98 |
| Micro BTS M1 | -91 | -96 |
| Micro BTS M2 | -86 | -91 |
| Micro BTS M3 | -81 | -86 |
| Pico BTS P1 | -70 | -80 |
| R-GSM 900 BTS | -89 | |

These values assume a 30 dB coupling loss between transmitter and receiver. If BTSs of different classes are co-sited, the coupling loss must be increased by the difference between the corresponding values from the table above.

Measures must be taken for mutual protection of receivers when GSM 900 and DCS 1 800 BTS are co-sited.

NOTE 2: Thus, for this case, assuming the coupling losses are as above, then the power measured in the conditions specified in subclause 4.2.1, with a filter and video bandwidth of 100 kHz should be no more than the values in the table above for the GSM 900 transmitter in the band 1 710 MHz to 1 785 MHz and for DCS 1 800 transmitter in the band 876 MHz to 915 MHz.

In any case, the powers measured in the conditions specified in subclause 4.2.1, with a filter and video bandwidth of 100 kHz shall be no more than -47 dBm for the GSM BTS in the band 1 805 MHz to 1 880 MHz and -57 dBm for a DCS 1 800 BTS in the band 921 MHZ to 960 MHz.

## 4.3.3 Mobile Station

### 4.3.3.1 Mobile Station GSM 900 and DCS 1 800

The power measured in the conditions specified in subclause 4.3.1a, for a MS when allocated a channel, shall be no more than -36 dBm. For R-GSM 900 MS except small MS the corresponding limit shall be -42 dBm.

The power measured in the conditions specified in subclause 4.3.1b for a MS, when allocated a channel, shall be no more than (see also note in subclause 4.3.1b above):

- 250 nW (-36 dBm) in the frequency band 9 kHz to 1 GHz;

- 1 µW (-30 dBm) in the frequency band 1 to 12,75 GHz.

The power measured in a 100 kHz bandwidth for a mobile, when not allocated a channel (idle mode), shall be no more than (see also note in subclause 4.3.1 above):

- 2 nW (-57 dBm) in the frequency bands 9 kHz MHz to 880 MHz, 915 MHz to 1 000 MHz;

- 1.25 nW (-59 dBm) in the frequency band 880 MHz to 915 MHz;

- 5 nW (-53 dBm) in the frequency band 1.71 GHz to 1,785 GHz;

- 20 nW (-47 dBm) in the frequency bands 1 GHz to 1,71 GHz, 1,785 GHz to 12,75 GHz.

NOTE: The idle mode spurious emissions in the receive band are covered by the case for MS allocated a channel (see below).

When allocated a channel, the power emitted by the MS, when measured using the measurement conditions specified in subclause 4.2.1, but with averaging over at least 50 burst measurements, with a filter and video bandwidth of 100 kHz, for measurements centred on 200 kHz multiples, in the band 935 MHz to 960 MHz shall be no more than -79 dBm, in the band 925 MHz to 935 MHz shall be no more than -67 dBm and in the band 1 805 MHz to 1 880 MHz, shall be no more than -71 dBm. For R-GSM 900 mobiles, in addition, a limit of -60 dBm shall apply in the frequency band 921 MHz to 925 MHz.

As exceptions up to five measurements with a level up to -36 dBm are permitted in each of the bands 925 MHz to 960 MHz and 1 805 MHz to 1 880 MHz for each ARFCN used in the measurements.

When hopping, this applies to each set of measurements, grouped by the hopping frequencies as described in subclause 4.2.1.

### 4.3.3.2 Mobile Station PCS 1 900

The peak power measured in the conditions specified in subclause 4.3.1a, for a MS when allocated a channel, shall be no more than -36 dBm.

The peak power measured in the conditions specified in subclause 4.3.1b for a MS, when allocated a channel, shall be no more than:

- -36 dBm in the frequency band 9 kHz to 1 GHz;

- -30 dBm in all other frequency bands 1 GHz to 12,75 GHz.

The peak power measured in a 100 kHz bandwidth for a mobile, when not allocated a channel (idle mode), shall be no more than:

- -57 dBm in the frequency bands 9 kHz to 1 000 MHz;
- -53 dBm in the frequency band 1 850 MHz to 1 910 MHz;
- -47 dBm in all other frequency bands 1 GHz to 12,75 GHz.

The power emitted by the MS in a 100 kHz bandwidth using the measurement techniques for modulation and wide band noise (subclause 4.2.1) shall not exceed:

- -71 dBm in the frequency band 1 930 MHz to 1 990 MHz.

A maximum of five exceptions with a level up to -36 dBm are permitted in the band 1 930 MHz to 1 990 MHz for each ARFCN used in the measurements.

## 4.4 Radio frequency tolerance

The radio frequency tolerance for the base transceiver station and the MS is defined in 3GPP TS 05.10.

## 4.5 Output level dynamic operation

NOTE: The term "any transmit band channel" is used here to mean:

- any RF channel of 200 kHz bandwidth centred on a multiple of 200 kHz which is within the relevant transmit band.

### 4.5.1 Base Transceiver Station

The BTS shall be capable of not transmitting a burst in a time slot not used by a logical channel or where DTX applies. The output power relative to time when sending a burst is shown in annex B. In the case where the bursts in two (or several) consecutive time slots are actually transmitted, at the same frequency, the template of annex B shall be respected during the useful part of each burst and at the beginning and the end of the series of consecutive bursts. The output power during the guard period between every two consecutive active timeslots shall not exceed the level allowed for the useful part of the first timeslot, or the level allowed for the useful part of the second timeslot plus 3 dB, whichever is the highest. The residual output power, if a timeslot is not activated, shall be maintained at, or below, a level of -30 dBc on the frequency channel in use. All emissions related to other frequency channels shall be in accordance with the wide band noise and spurious emissions requirements.

A measurement bandwidth of at least 300 kHz is assumed.

### 4.5.2 Mobile Station

The output power can be reduced by steps of 2 dB as listed in subclause 4.1.

The transmitted power level relative to time when sending a burst is shown in annex B. In the case of Multislot Configurations where the bursts in two or more consecutive time slots are actually transmitted at the same frequency, the template of annex B shall be respected during the useful part of each burst and at the beginning and the end of the series of consecutive bursts. The output power during the guard period between every two consecutive active timeslots shall not exceed the level allowed for the useful part of the first timeslot, or the level allowed for the useful part of the second timeslot plus 3 dB, whichever is the highest.The timing of the transmitted burst is specified in 3GPP TS 05.10. Between the active bursts, the residual output power shall be maintained at, or below, the level of:

- -59 dBc or -54 dBm, whichever is the greater for GSM 900, except for the time slot preceding the active slot, for which the allowed level is -59 dBc or -36 dBm whichever is the greater;
- -48 dBc or -48 dBm, whichever is the greater for DCS 1 800 and PCS 1 900;

in any transmit band channel.

A measurement bandwidth of at least 300 kHz is assumed.

The transmitter, when in idle mode, will respect the conditions of subclause 4.3.3.

## 4.6 Phase accuracy

When transmitting a burst, the phase accuracy of the signal, relative to the theoretical modulated waveforms as specified in 3GPP TS 05.04, is specified in the following way.

For any 148-bits subsequence of the 511-bits pseudo-random sequence, defined in CCITT Recommendation O.153 fascicle IV.4, the phase error trajectory on the useful part of the burst (including tail bits), shall be measured by computing the difference between the phase of the transmitted waveform and the phase of the expected one. The RMS phase error (difference between the phase error trajectory and its linear regression on the active part of the time slot) shall not be greater than 5° with a maximum peak deviation during the useful part of the burst less than 20°.

NOTE: Using the encryption (ciphering mode) is an allowed means to generate the pseudo-random sequence.

The burst timing of the modulated carrier in the active part of the time slot shall be chosen to ensure that all the modulating bits in the useful part of the burst (see 3GPP TS 05.04) influence the output phase in a time slot.

## 4.7 Intermodulation attenuation

The intermodulation attenuation is the ratio of the power level of the wanted signal to the power level of an intermodulation component. It is a measure of the capability of the transmitter to inhibit the generation of signals in its non-linear elements caused by the presence of the carrier and an interfering signal reaching the transmitter via the antenna.

### 4.7.1 Base transceiver station

An interfering CW signal shall be applied within the relevant BTS TX band at a frequency offset of ≥ 800 kHz, and with a power level 30 dB below the power level of the wanted signal.

The intermodulation products shall meet the requirements in subclause 4.7.2.

### 4.7.2 Intra BTS intermodulation attenuation

In a BTS intermodulation may be caused by combining several RF channels to feed a single antenna, or when operating them in the close vicinity of each other. The BTS shall be configured with each transmitter operating at the maximum allowed power, with a full complement of transceivers and with modulation applied. For the measurement in the transmit band the equipment shall be operated at equal and minimum carrier frequency spacing specified for the BSS configuration under test. For the measurement in the receive band the equipment shall be operated with such a channel configuration that at least $3^{rd}$ order intermodulation products fall into the receive band.

All the following requirements relate to frequency offsets from the uppermost and lowermost carriers. The peak hold value of intermodulation components over a timeslot, shall not exceed -70 dBc or -36 dBm, whichever is the higher, for frequency offsets between 6 MHz and the edge of the relevant Tx band measured in a 300 kHz bandwidth. 1 in 100 timeslots may fail this test by up to a level of 10 dB. For offsets between 600 kHz to 6 MHz the requirements and the measurement technique is that specified in subclause 4.2.1.

The other requirements of subclause 4.3.2 in the band 9 kHz to 12,75 GHz shall still be met.

### 4.7.3 Intermodulation between MS (DCS 1 800 & PCS 1 900 only)

The maximum level of any intermodulation product, when measured as peak hold in a 300 kHz bandwidth, shall be 50 dB below the wanted signal when an interfering CW signal is applied within the MS transmit band at a frequency offset of 800 kHz with a power level 40 dB below the power level of the wanted (DCS 1 800 and PCS 1 900 modulated) signal.

### 4.7.4 Mobile PBX (GSM 900 only)

In a mobile PBX intermodulation may be caused when operating transmitters in the close vicinity of each other. The intermodulation specification for mobile PBXs (GSM 900 only) shall be that stated in subclause 4.7.2.

# 5 Receiver characteristics

In this clause, the requirements are given in terms of power levels at the antenna connector of the receiver. Equipment with integral antenna may be taken into account by converting these power level requirements into field strength requirements, assuming a 0 dBi gain antenna. This means that the tests on equipment on integral antenna will consider fields strengths (E) related to the power levels (P) specified, by the following formula (derived from the formula E = P + 20log$F_{(MHz)}$ + 77,2):

assuming F = 925 MHz : E (dBµV/m) = P (dBm) + 136,5 for GSM 900;

assuming F = 1 795 MHz : E (dBµV/m) = P (dBm) + 142,3 for DCS 1 800;

assuming F = 1 920 MHz : E (dBuV/m) = P (dBm) + 142,9 for PCS 1 900.

Static propagation conditions are assumed in all cases, for both wanted and unwanted signals. For subclauses 5.1 and 5.2, values given in dBm are indicative, and calculated assuming a 50 ohms impedance.

## 5.1 Blocking characteristics

The blocking characteristics of the receiver are specified separately for in-band and out-of-band performance as identified in the following tables.

| Frequency band | Frequency range (MHz) | | | |
|---|---|---|---|---|
| | GSM 900 | | E-GSM 900 | R-GSM 900 |
| | MS | BTS | BTS | BTS |
| in-band | 915 - 980 | 870 - 925 | 860 - 925 | 856 - 921 |
| out-of-band (a) | 0,1 - < 915 | 0,1 - < 870 | 0,1 - < 860 | 0,1 - < 856 |
| out-of-band (b) | N/A | N/A | N/A | N/A |
| out-of band (c) | N/A | N/A | N/A | N/A |
| out-of band (d) | > 980 - 12,750 | > 925 - 12,750 | > 925 - 12,750 | > 921 - 12,750 |

| Frequency band | Frequency range (MHz) DCS 1 800 | |
|---|---|---|
| | MS | BTS |
| in-band | 1 785 - 1 920 | 1 690 - 1 805 |
| out-of-band (a) | 0,1 - 1705 | 0,1 - < 1 690 |
| out-of-band (b) | > 1 705 - < 1 785 | N/A |
| out-of band (c) | > 1 920 - 1 980 | N/A |
| out-of band (d) | > 1 980 - 12,750 | > 1 805 - 12,750 |

| Frequency band | Frequency range (MHz) PCS 1 900 | |
|---|---|---|
| | MS | BTS |
| in-band | 1910 - 2010 | 1830 - 1930 |
| out-of-band (a) | 0,1 - < 1830 | 0,1 - < 1830 |
| out-of-band (b) | 1830 - < 1910 | N/A |
| out-of band (c) | > 2010 - 2070 | N/A |
| out-of band (d) | > 2070 - 12,750 | > 1930 - 12,750 |

The reference sensitivity performance as specified in table 1 shall be met when the following signals are simultaneously input to the receiver:

- a useful signal at frequency $f_o$, 3 dB above the reference sensitivity level as specified in subclause 6.2;
- a continuous, static sine wave signal at a level as in the table below and at a frequency (f) which is an integer multiple of 200 kHz.

with the following exceptions, called spurious response frequencies:

a) GSM 900: in band, for a maximum of six occurrences (which if grouped shall not exceed three contiguous occurrences per group);

DCS 1 800 and PCS 1 900: in band, for a maximum of twelve occurrences (which if grouped shall not exceed three contiguous occurrences per group);

b) out of band, for a maximum of 24 occurrences (which if below $f_0$ and grouped shall not exceed three contiguous occurrences per group).

where the above performance shall be met when the continuous sine wave signal (f) is set to a level of 70 dBμV (emf) (i.e. -43 dBm).

| Frequency band | P-, E- and R-GSM 900 | | | | | | DCS 1 800 & PCS 1 900 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | other MS | | small MS | | BTS | | MS | | BTS | |
| | dBμV (emf) | dBm | dBμV (emf) | dBm | dBμV (emf) | dBm | dBμV (emf) | dBm | dBμV (emf) | dBm |
| in-band | | | | | | | | | | |
| 600 kHz ≤ $\|f-f_o\|$ < 800 kHz | 75 | -38 | 70 | -43 | 87 | -26 | 70 | -43 | 78 | -35 |
| 800 kHz ≤ $\|f-f_o\|$ < 1.6 MHz | 80 | -33 | 70 | -43 | 97 | -16 | 70 | -43 | 88 | -25 |
| 1.6 MHz ≤ $\|f-f_o\|$ < 3 MHz | 90 | -23 | 80 | -33 | 97 | -16 | 80 | -33 | 88 | -25 |
| 3 MHz ≤ $\|f-f_o\|$ | 90 | -23 | 90 | -23 | 100 | -13 | 87 | -26 | 88 | -25 |
| out-of-band | | | | | | | | | | |
| (a) | 113 | 0 | 113 | 0 | 121 | 8 | 113 | 0 | 113 | 0 |
| (b) | - | - | - | - | - | - | 101 | -12 | - | - |
| (c) | - | - | - | - | - | - | 101 | -12 | - | - |
| (d) | 113 | 0 | 113 | 0 | 121 | 8 | 113 | 0 | 113 | 0 |
| NOTE: For definition of small MS, see subclause 1.1. | | | | | | | | | | |

The following exceptions to the level of the sine wave signal (f) in the above table shall apply:

| | |
|---|---|
| for E-GSM MS, in the band 905 MHz to 915 MHz | **-5 dBm** |
| for R-GSM 900 MS, in the band 880 MHz to 915 MHz | -5 dBm |
| for R-GSM 900 small MS, in the band 876 MHz to 915 MHz | -7 dBm |
| for GSM 900 and E-GSM 900 BTS, in the band 925 MHz to 935 MHz | 0 dBm |
| for R-GSM 900 BTS at offsets 600 KHz <= abs (f-f0) < 3 MHz, in the band 876 MHz to 880 MHz | Level reduced by 5 dB |

The blocking characteristics of the micro-BTS receiver are specified for in-band and out-of-band performance. The out-of-band blocking remains the same as a normal BTS and the in-band blocking performance shall be no worse than in the table below.

| Frequency band | GSM 900 micro and pico-BTS | | | | DCS 1 800 & PCS 1 900 micro and pico-BTS | | | |
|---|---|---|---|---|---|---|---|---|
| | M1 (dBm) | M2 (dBm) | M3 (dBm) | P1 (dBm) | M1 (dBm) | M2 (dBm) | M3 (dBm) | P1 (dBm) |
| in-band | | | | | | | | |
| 600 kHz ≤ $\|f-f_0\|$ < 800 kHz | -31 | -26 | -21 | -34 | -40 | -35 | -30 | -41 |
| 800 kHz ≤ $\|f-f_0\|$ < 1.6 MHz | -21 | -16 | -11 | -34 | -30 | -25 | -20 | -41 |
| 1.6 MHz ≤ $\|f-f_0\|$ < 3 MHz | -21 | -16 | -11 | -26 | -30 | -25 | -20 | -31 |
| 3 MHz ≤ $\|f-f_0\|$ | -21 | -16 | -11 | -18 | -30 | -25 | -20 | -23 |

The blocking performance for the pico-BTS attempts, for the scenario of a close proximity uncoordinated MS, to balance the impact due to blocking by the MS with that due to wideband noise overlapping the wanted signal.

## 5.2 AM suppression characteristics

The reference sensitivity performance as specified in table 1 shall be met when the following signals are simultaneously input to the receiver.

- A useful signal at $f_o$, 3dB above reference sensitivity level as specified in subclause 6.2.

- A single frequency (f), in the relevant receive band, $| f-f_o | > 6$ MHz, which is an integer multiple of 200 kHz, a GSM TDMA signal modulated by any 148-bit sequence of the 511-bit pseudo random bit sequence, defined in CCITT Recommendation 0.153 fascicle IV.4, at a level as defined in the table below. The interferer shall have one timeslot active and the frequency shall be at least 2 channels separated from any identified spurious response. The transmitted bursts shall be synchronized to but delayed in time between 61 and 86 bit periods relative to the bursts of the wanted signal.

NOTE: When testing this requirement, a notch filter may be necessary to ensure that the co-channel performance of the receiver is not compromised.

| | | | Micro and pico-BTS | | | |
|---|---|---|---|---|---|---|
| | **MS (dBm)** | **BTS (dBm)** | **M1 (dBm)** | **M2 (dBm)** | **M3 (dBm)** | **P1 (dBm)** |
| GSM 900 | -31 | -31 | -34 | -29 | -24 | -21 |
| DCS 1 800 | -29 / -31* | -35 | -33 | -28 | -23 | -26 |
| PCS 1 900 | -29 | -35 | -33 | -28 | -23 | -26 |

* The -31 dBm level shall only apply to DCS 1800 class 1 and class 2 MS meeting the -102 dBm reference sensitivity level requirement according to subclause 6.2.

## 5.3 Intermodulation characteristics

The reference sensitivity performance as specified in table 1 shall be met when the following signals are simultaneously input to the receiver:

- a useful signal at frequency $f_o$, 3 dB above the reference sensitivity level as specified in subclause 6.2;

- a continuous, static sine wave signal at frequency $f_1$ and a level of 70 dBμV (emf) (i.e. -43 dBm):

  - for GSM 900 small MSs, both DCS 1 800 and PCS 1 900 MS and DCS 1 800 and PCS 1 900 BTS this value is relaxed to 64 dBμV (emf) (i.e. -49 dBm);

  - for the DCS 1 800 class 3 MS this value is relaxed to 68 dBμV (emf) (i.e. -45 dBm).

- any 148-bits subsequence of the 511-bits pseudo-random sequence, defined in CCITT Recommendation O.153 fascicle IV.4 modulating a signal at frequency $f_2$, and a level of 70 dBμV (emf) (i.e. -43 dBm):

  - for GSM 900 small MSs, both DCS 1 800 and PCS 1 900 MS and DCS 1 800 and PCS 1 900 BTS this value is relaxed to 64 dBμV (emf) (i.e. -49 dBm);

  - for the DCS 1 800 class 3 MS this value is relaxed to 68 dBμV (emf) (i.e. -45 dBm);

such that $f_0 = 2f_1 - f_2$ and $|f_2-f_1| = 800$ kHz.

NOTE: For subclauses 5.2 and 5.3 instead of any 148-bits subsequence of the 511-bits pseudo-random sequence, defined in CCITT Recommendation 0.153 fascicle IV.4, it is also allowed to use a more random pseudo-random sequence.

## 5.4 Spurious emissions

The spurious emissions for a BTS receiver, measured in the conditions specified in subclause 4.3.1, shall be no more than:

- 2 nW (-57 dBm) in the frequency band 9 kHz to 1 GHz;
- 20 nW (-47 dBm) in the frequency band 1 to 12,75 GHz.

NOTE: For radiated spurious emissions for the BTS, the specifications currently only apply to the frequency band 30 MHz to 4 GHz. The specification and method of measurement outside this band are under consideration.

# 6 Transmitter/receiver performance

In order to assess the error rate performance that is described in this clause it is required for a mobile equipment to have a "loop back" facility by which the equipment transmits back the same information that it decoded, in the same mode. This facility is specified in 3GPP TS 04.14.

This clause aims at specifying the receiver performance, taking into account that transmitter errors must not occur, and that the transmitter shall be tested separately (see subclause 4.6). In the case of base transceiver stations the values apply for measurement at the connection with the antenna of the BTS, including any external multicoupler. All the values given are valid if any of the features: discontinuous transmission (DTx), discontinuous reception (DRx), or slow frequency hopping (SFH) are used or not. The received power levels under multipath fading conditions given are the mean powers of the sum of the individual paths.

In this clause power levels are given also in terms of field strength, assuming a 0 dBi gain antenna, to apply for the test of MS with integral antennas.

The requirements specified in this clause shall be met by a MS in CTS mode. In particular the requirement of subclause 6.6 on frequency hopping performance shall be met by a MS performing CTS frequency hopping (as specified in 3GPP TS 05.02 subclause 6.2).

## 6.1 Nominal Error Rates (NER)

This subclause describes the transmission requirements in terms of error rates in nominal conditions i.e. without interference and with an input level of 20 dB above the reference sensitivity level. The relevant propagation conditions appear in annex C.

Under the following propagation conditions, the chip error rate, equivalent to the bit error rate of the non protected bits (TCH/FS, class II) shall have the following limits:

- static channel: BER $\leq 10^{-4}$;
- EQ50 channel: BER $\leq$ 3 %.

For the pico-BTS the nominal error rates need only be met in the static channel.

This performance shall be maintained up to -40 dBm input level for static and multipath conditions.

This performance shall also be maintained by the MS under frequency hopping conditions, for input levels up to -40 dBm in timeslots on the C0 carrier, with equal input levels in timeslots on non C0 carriers up to 30 dB less than on the C0 carrier.

NOTE: This scenario may exist when BTS downlink power control and frequency hopping are used.

Furthermore, for static conditions, a bit error rate of $10^{-3}$ shall be maintained up to -15 dBm for GSM 900, -23 dBm for DCS 1 800 and PCS 1 900.

For static conditions, a bit error rate of $10^{-3}$ shall also be maintained for input levels on the C0 carrier of up to -15 dBm for GSM 900, -23 dBm for DCS 1 800 and PCS 1 900, with equal input levels on non C0 carriers, up to 30 dB less than on the C0 carrier.

For pico-BTS, for static conditions, a bit error rate of $10^{-3}$ shall be maintained with input levels up to -5 dBm for GSM 900, and -14 dBm for DCS 1 800 and PCS 1 900.

## 6.2 Reference sensitivity level

The reference sensitivity performance in terms of frame erasure, bit error, or residual bit error rates (whichever appropriate) is specified in table 1, according to the type of channel and the propagation condition. The actual sensitivity level is defined as the input level for which this performance is met. The actual sensitivity level shall be less than a specified limit, called the reference sensitivity level. The reference sensitivity level shall be:

GSM 900 MS
- for GSM 900 small MS : -102 dBm
- for other GSM 900 MS : -104 dBm

DCS 1 800 MS
- for DCS 1 800 class 1 or class 2 MS : -100 / -102 dBm *
- for DCS 1 800 class 3 MS : -102 dBm

PCS 1 900 MS
- for PCS 1 900 MS : -102 dBm
- for other PCS 1 900 MS : -104 dBm

GSM 900 BTS
- for normal BTS : -104 dBm
- for micro BTS M1 : -97 dBm
- for micro BTS M2 : -92 dBm
- for micro BTS M3 : -87 dBm
- for pico BTS P1 : -88 dBm

DCS 1 800 BTS

- for normal BTS : -104 dBm
- for micro BTS M1 : -102 dBm
- for micro BTS M2 : -97 dBm
- for micro BTS M3 : -92 dBm
- for pico BTS P1 : -95 dBm

PCS 1 900 BTS
- for normal BTS : -104 dBm
- for micro BTS M1 : -102 dBm
- for micro BTS M2 : -97 dBm
- for micro BTS M3 : -92 dBm

* For all DCS 1 800 class 1 and class 2 MS to be type approved after 1st December 1999, the -102 dBm level shall apply for the reference sensitivity performance as specified in table 1 for the normal conditions defined in Annex D and -100 dBm level shall be used to determine all other MS performances.

For packet switched channels, the minimum input signal level for which the reference performance shall be met is specified in table 1a, according to the type of channel and the propagation condition. The levels are given for normal BTS. For other equipment, the levels shall be corrected by the following values:

| | | | |
|---|---|---|---|
| - | for DCS 1 800 class 1 or class 2 MS | : | +2/+4 dB** |
| - | for DCS 1 800 class 3 MS | : | +2 dB |
| - | for GSM 900 small MS | : | +2 dB |
| - | for other GSM 900 MS and normal BTS | : | 0 dB |
| - | for GSM 900 micro BTS M1 | : | +7 dB |
| - | for GSM 900 micro BTS M2 | : | +12 dB |
| - | for GSM 900 micro BTS M3 | : | +17 dB |
| - | for GSM 900 pico BTS P1 | : | +16 dB |
| - | for DCS 1 800 micro BTS M1 | : | +2 dB |
| - | for DCS 1 800 micro BTS M2 | : | +7 dB |
| - | for DCS 1 800 micro BTS M3 | : | +12 dB |
| - | for DCS 1 800 pico BTS P1 | : | +9 dB |

** For all DCS 1 800 class 1 and class 2 MS, a correction offset of +2dB shall apply for the reference sensitivity performance as specified in table 1 for the normal conditions defined in Annex D and an offset of +4 dB shall be used to determine all other MS performances.

The reference performance shall be:

| | | | |
|---|---|---|---|
| - | for packet data channels (PDCH) | : | BLER ≤ 10% |
| - | for uplink state flags (USF) | : | BLER ≤ 1% |
| - | for packet random access channels (PRACH), | : | BLER ≤ 15% |

The reference sensitivity performance specified above need not be met in the following cases:

- for BTS if the received level on either of the two adjacent timeslots to the wanted exceed the wanted timeslot by more than 50 dB;
- for MS at the static channel, if the received level on either of the two adjacent timeslots to the wanted exceed the wanted timeslot by more than 20 dB;
- for MS on a multislot configuration, if the received level on any of the timeslots belonging to the same multislot configuration as the wanted time slot, exceed the wanted time slot by more than 6 dB.

The interfering adjacent time slots shall be static with valid GSM signals in all cases.

The pico-BTS 900MHz and 1800MHz shall meet the reference sensitivity performance specified for the static channel. The only other channel that is specified is the TI5 propagation condition and this need only be tested for the no FH case. The performance requirement for both GSM 900 and DCS 1 800 pico-BTS with the TI5 propagation condition is the same as the TU50 performance requirement for GSM 900. The level of input signal at which this requirement shall be met is 3dB above the level specified above in this sub-clause (in combination with Table 1a for packet service).

## 6.3 Reference interference level

The reference interference performance (for cochannel, C/Ic, or adjacent channel, C/Ia) in terms of frame erasure, bit error or residual bit error rates (whichever appropriate) is specified in table 2, according to the type of channel and the propagation condition. The actual interference ratio is defined as the interference ratio for which this performance is met. The actual interference ratio shall be less than a specified limit, called the reference interference ratio. The reference interference ratio shall be, for BTS and all types of MS:

| | | | | | |
|---|---|---|---|---|---|
| - | for cochannel interference | : | C/Ic | = | 9 dB |
| - | for adjacent (200 kHz) interference | : | C/Ia1 | = | -9 dB |
| - | for adjacent (400 kHz) interference | : | C/Ia2 | = | -41 dB |
| - | for adjacent (600 kHz) interference | : | C/Ia3 | = | -49 dB |

For packet switched channels, the minimum interference ratio for which the reference performance for cochannel interference (C/Ic) shall be met is specified in table 2a, according to the type of channel and the propagation condition. The reference performance is the same as defined in subclause 6.2. The corresponding interference ratio for adjacent channel interference shall be:

| | | | | | |
|---|---|---|---|---|---|
| - | for adjacent (200 kHz) interference | : | C/Ia1 | = | C/Ic - 18 dB |
| - | for adjacent (400 kHz) interference | : | C/Ia2 | = | C/Ic - 50 dB |
| - | for adjacent (600 kHz) interference | : | C/Ia3 | = | C/Ic - 58 dB |

NOTE: The C/Ia3 figure is given for information purposes and will not require testing. It was calculated for the case of an equipment with an antenna connector, operating at output power levels of +33 dBm and below. Rejection of signals at 600 kHz is specified in subclause 5.1.

These specifications apply for a wanted signal input level of 20 dB above the reference sensitivity level, and for a random, continuous, GSM-modulated interfering signal. For packet switched channels the wanted input signal level shall be: -93 dBm + Ir + Corr, where:

- Ir = the interference ratio according to table 2a
  Corr = the correction factor for reference performance according to subclause 6.2.

In case of frequency hopping, the interference and the wanted signals shall have the same frequency hopping sequence. In any case the wanted and interfering signals shall be subject to the same propagation profiles (see annex C), independent on the two channels.

For a GSM 900 MS, a DCS 1 800 MS and a PCS 1 900 MS the reference interference performance according to table 2 for co-channel interference (C/Ic) shall be maintained for RA250/130 propagation conditions if the time of arrival of the wanted signal is periodically alternated by steps of 8μs in either direction. The period shall be 32 seconds (16 seconds with the early and 16 seconds with the late time of arrival alternately).

For pico-BTS, propagation conditions other than static and T15 are not specified and only the no FH case need be tested. The performance requirement for both GSM 900 and DCS 1 800 pico-BTS with TI5 propagation condition is the same as theTU50 no FH (900MHz) performance requirement. The interference ratio at which this requirement shall be met is 4dB above the interference ratio specified above in this sub-clause (in combination with Table 2a for packet service).For adjacent channel interference propagation conditions other than TU50 need not be tested. There is an exception in the case of the pico-BTS in that the specified propagation condition is TI5 instead of TU50; the respective test for pico-BTS is described in the paragraph following the table below. If, in order to ease measurement, a TU50 (no FH) faded wanted signal, and a static adjacent channel interferer are used, the reference interference performance shall be:

| | GSM 900 | DCS 1 800 & PCS 1 900 |
|---|---|---|
| TCH/FS (FER): | 10,2α % | 5,1α % |
| Class Ib (RBER): | 0,72/α % | 0,45/α % |
| Class II (RBER): | 8,8 % | 8,9 % |
| FACCH (FER): | 17,1 % | 6,1 % |

For pico-BTS, adjacent channel interference propagation conditions other than TI5 need not be tested. If, in order to ease measurement, a TI5 (no FH) faded wanted signal, and a static adjacent channel interferer are used, the interference performance shall be the same as that specified above for a TU50 no FH channel (900MHz). The interference ratio at which this performance shall be met is 4dB above the reference interference ratio specified above in this sub-clause.

# 6.4 Erroneous frame indication performance

a) On a speech TCH (TCH/FS, TCH/EFS, TCH/HS, TCH/AFS or TCH/AHS) or a SDCCH with a random RF input, of the frames believed to be FACCH, SACCH, or SDCCH frames, the overall reception performance shall be such that no more than 0,002 % of the frames are assessed to be error free.

b) On a speech TCH (TCH/FS, TCH/EFS, TCH/HS, TCH/AFS or TCH/AHS) with a random RF input, the overall reception performance shall be such that, on average, less than one undetected bad speech frame (false bad frame indication BFI) shall be measured in one minute.

c) On a speech TCH (TCH/FS, TCH/EFS, TCH/HS, TCH/AFS or TCH/AHS), when DTX is activated with frequency hopping through C0 where bursts comprising SID frames, SACCH frames and Dummy bursts are received at a level 20 dB above the reference sensitivity level and with no transmission at the other bursts of the TCH, the overall reception performance shall be such that, on average less than one undetected bad speech frame (false bad frame indication BFI) shall be measured in one minute for MS. This performance shall also be met in networks with one of the configurations described in 3GPP TS 05.02 - annex A, excepted combinations #1 and #6 of table A.2.5.1 for which there is no performance requirement.

d) On a speech TCH (TCH/FS, TCH/EFS, TCH/HS, TCH/AFS or TCH/AHS), when DTX is activated with SID frames and SACCH frames received 20 dB above the reference sensitivity level and with no transmission at the other bursts of the TCH, the overall reception shall be such that, on average, less than one undetected bad speech frame (false bad frame indication BFI) shall be measured in one minute for BTS.

e) For a BTS on a RACH or PRACH with a random RF input, the overall reception performance shall be such that less than 0,02 % of frames are assessed to be error free.

f) For a BTS on a PRACH with a random RF input, the overall reception performance shall be such that less than 0,02 % of frames are assessed to be error free.

g) For an MS allocated a USF on a PDCH with a random RF input or a valid PDCH signal with a random USF not equal to the allocated USF, the overall reception shall be such that the MS shall detect the allocated USF in less than 1% of the radio blocks. This requirement shall be met for all input levels up to –40 dBm.

h) The FER on an SACCH associated to an adaptive speech traffic channel (TCH/AFS or TCH/AHS) received at 3 dB below the reference co-channel interference level shall be less than [40%] tested under TU 3 / TU 1.5 propagation conditions.

i) On a speech TCH (TCH/AFS or TCH/AHS), a RATSCCH message, respectively a RATSCCH marker, shall be detected if more than 72% of the bits of the RATSCCH identification field (defined in 3GPP TS 05.03) are matched by the corresponding gross bits of the received frame. If the corresponding bits of the received frame match less than 68% of the identification field, the frame shall not be classified as RATSCCH message, respectively RATSCCH marker.

# 6.5 Random access and paging performance at high input levels

a) Under static propagation conditions with a received input level from 20 dB above the reference sensitivity level up to -15 dBm for GSM900 and -23 dBm for DCS1800 and PCS 1 900, the MS FER shall be less than 0.1% for PCH.

b) Under static propagation conditions with a received input level from 20 dB above the reference sensitivity level up to -15 dBm for GSM900 and -23 dBm for DCS1800 and PCS 1 900, and a single MS sending an access burst, the BTS FER shall be less than 0.5% for RACH.

# 6.6 Frequency hopping performance under interference conditions.

Under the following conditions:

- a useful signal, cyclic frequency hopping over four carriers under static conditions, with equal input levels 20 dB above reference sensitivity level;

- a random, continuous, GMSK-modulated interfering signal on only one of the carriers at a level 10 dB higher than the useful signal.

The FER for TCH/FS shall be less than 5%.

**Table 1: Reference sensitivity performance**

| GSM 900 | | | | | | |
|---|---|---|---|---|---|---|
| **Type of channel** | | **Propagation conditions** | | | | |
| | | **static** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA250 (no FH)** | **HT100 (no FH)** |
| FACCH/H | (FER) | 0,1 % | 6,9 % | 6,9 % | 5,7 % | 10,0 % |
| FACCH/F | (FER) | 0,1 % | 8,0 % | 3,8 % | 3,4 % | 6,3 % |
| SDCCH | (FER) | 0,1 % | 13 % | 8 % | 8 % | 12 % |
| RACH | (FER) | 0,5 % | 13 % | 13 % | 12 % | 13 % |
| SCH | (FER) | 1 % | 16 % | 16 % | 15 % | 16 % |
| TCH/F14,4 | (BER) | $10^{-5}$ | 2,5 % | 2 % | 2 % | 5 % |
| TCH/F9,6 & H4,8 | (BER) | $10^{-5}$ | 0,5 % | 0,4 % | 0,1 % | 0,7 % |
| TCH/F4,8 | (BER) | - | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ |
| TCH/F2,4 | (BER) | - | $2\ 10^{-4}$ | $10^{-5}$ | $10^{-5}$ | $10^{-5}$ |
| TCH/H2,4 | (BER) | - | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ |
| TCH/FS | (FER) | 0,1α % | 6α % | 3α % | 2α % | 7α % |
| | class Ib (RBER) | 0,4/α % | 0,4/α % | 0,3/α % | 0,2/α % | 0,5/α % |
| | class II (RBER) | 2 % | 8 % | 8 % | 7 % | 9 % |
| TCH/EFS | (FER) | < 0,1 % | 8 % | 3 % | 3 % | 7 % |
| | (RBER Ib) | < 0,1 % | 0,21 % | 0,11 % | 0,10 % | 0,20 % |
| | (RBER II) | 2,0 % | 7 % | 8 % | 7 % | 9 % |
| TCH/HS | (FER) | 0,025 % | 4,1 % | 4,1 % | 4,1 % | 4,5 % |
| | class Ib (RBER, BFI=0) | 0,001 % | 0,36 % | 0,36 % | 0,28 % | 0,56 % |
| | class II (RBER, BFI=0) | 0,72 % | 6,9 % | 6,9 % | 6,8 % | 7,6 % |
| | (UFR) | 0,048 % | 5,6 % | 5,6 % | 5,0 % | 7,5 % |
| | class Ib (RBER,(BFI or UFI)=0) | 0,001 % | 0,24 % | 0,24 % | 0,21 % | 0,32 % |
| | (EVSIDR) | 0,06 % | 6,8 % | 6,8 % | 6,0 % | 9,2 % |
| | (RBER, SID=2 and (BFI or UFI)=0) | 0,001 % | 0,01 % | 0,01 % | 0,01 % | 0,02 % |
| | (ESIDR) | 0,01 % | 3,0 % | 3,0 % | 3,2 % | 3,4 % |
| | (RBER, SID=1 or SID=2) | 0,003 % | 0,3 % | 0,3 % | 0,21 % | 0,42 % |
| MS TCH/AFS12.2 | (FER) | - | 4,9 % | 2,4 % | 2,8 % | 8,0 % |
| | Class Ib (RBER) | < 0,001 % | 1,5 % | 1,5 % | 1,7 % | 2,8 % |
| MS TCH/AFS10.2 | (FER) | - | 2,1 % | 0,85 % | 1,0 % | 3,5 % |
| | Class Ib (RBER) | < 0,001 % | 0,23 % | 0,15 % | 0,17 % | 0,46 % |
| MS TCH/AFS7.95 | (FER) | - | 0,36 % | 0,045 % | 0,06 % | 0,39 % |
| | Class Ib (RBER) | - | 0,11 % | 0,032 % | 0,04 % | 0,15 % |
| MS TCH/AFS7.4 | (FER) | - | 0,41 % | 0,069 % | 0,07 % | 0,44 % |
| | Class Ib (RBER) | - | 0,054 % | 0,016 % | 0,02 % | 0,08 % |
| MS TCH/AFS6.7 | (FER) | - | 0,27 % | 0,017 % | 0,019 % | 0,14 % |
| | Class Ib (RBER) | - | 0,11 % | 0,022 % | 0,028 % | 0,11 % |
| MS TCH/AFS5.9 | (FER) | - | 0,18 % | < 0,01 %(*) | 0,025 % | 0,053 % |
| | Class Ib (RBER) | - | 0,023 % | 0,001 % | 0,003 % | 0,02 % |
| MS TCH/AFS5.15 | (FER) | - | 0,12 % | < 0,01 %(*) | < 0,01 %(*) | 0,04 % |
| | Class Ib (RBER) | - | 0,02 % | < 0,001 % | 0,002 % | 0,015 % |
| MS TCH/AFS4.75 | (FER) | - | 0,072 % | < 0,01 %(*) | - | 0,02 % |
| | Class Ib (RBER) | - | 0,0072 % | < 0,001 % | < 0,001 % | 0,0027 % |
| BTS TCH/AFS12.2 | (FER) | - | 4,9 % | 2,4 % | 1,4 % | 4,5 % |
| | Class Ib (RBER) | < 0,001 % | 1,5 % | 1,5 % | 1,2 % | 2,1 % |
| BTS TCH/AFS10.2 | (FER) | - | 2,1 % | 0,85 % | 0,45 % | 1,6 % |
| | Class Ib (RBER) | < 0,001 % | 0,23 % | 0,15 % | 0,092 % | 0,26 % |
| BTS TCH/AFS7.95 | (FER) | - | 0,36 % | 0,045 % | 0,024 % | 0,096 % |
| | Class Ib (RBER) | - | 0,11 % | 0,032 % | 0,02 % | 0,06 % |
| BTS TCH/AFS7.4 | (FER) | - | 0,41 % | 0,069 % | 0,028 % | 0,13 % |
| | Class Ib (RBER) | - | 0,054 % | 0,016 % | 0,009 % | 0,033 % |
| BTS TCH/AFS6.7 | (FER) | - | 0,16 % | 0,017 % | < 0,01 %(*) | 0,026 % |
| | Class Ib (RBER) | - | 0,082 % | 0,022 % | 0,013 % | 0,044 % |
| BTS TCH/AFS5.9 | (FER) | - | 0,094 % | < 0,01 %(*) | < 0,01 %(*) | 0,011 % |
| | Class Ib (RBER) | - | 0,014 % | 0,001 % | 0,001 % | 0,003 % |

| | | | | | | |
|---|---|---|---|---|---|---|
| BTS TCH/AFS5.15 | (FER) | - | 0,07 % | < 0,01 %(*) | < 0,01 %(*) | < 0,01 %(*) |
| | Class Ib (RBER) | - | 0,014 % | < 0,001 % | < 0,001 % | 0,002 % |

Continued

**Table 1 (continued): Reference sensitivity performance**

| GSM 900 | | | | | | |
|---|---|---|---|---|---|---|
| **Type of Channel** | | **Propagation conditions** | | | | |
| | | **Static** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA250 (no FH)** | **HT100 (no FH)** |
| BTS TCH/AFS4.75 | (FER) | - | 0,029 % | < 0,01 %(*) | - | < 0,01 %(*) |
| | Class Ib (RBER) | - | 0,005 % | < 0,001 % | < 0,001 % | < 0,001 % |
| MS TCH/AFS-INB | (FER) | - | 0,034 % | 0,013 % | 0,008 % | 0,07 % |
| MS TCH/AFS | (EVSIDUR) | - | 0,82 % | 0,17 % | 0,17 % | 0,5 % |
| MS TCH/AFS | (EVRFR) | - | 0,37 % | 0.007 % | 0,015 % | 0,2 % |
| BTS TCH/AFS-INB | (FER) | - | 0,034 % | 0,013 % | 0,006 % | 0,019 % |
| BTS TCH/AFS | (EVSIDUR) | - | 0,82 % | 0,17 % | 0,17 % | 0,17 % |
| BTS TCH/AFS | (EVRFR) | - | 0,095 % | 0.007 % | 0,007 % | 0,011 % |
| MS TCH/AHS7.95 | (FER) | < 0,01 %(*) | 20 % | 20 % | 24 % | 34,3 % |
| | Class Ib (RBER) | 0,004 % | 2,3 % | 2,3 % | 3,0 % | 3,7 % |
| | Class II (RBER) | 0,66 % | 5 % | 5 % | 5,9 % | 6,5 % |
| MS TCH/AHS7.4 | (FER) | < 0,01 %(*) | 16 % | 16 % | 18,6 % | 27,8 % |
| | Class Ib (RBER) | < 0,001 %(*) | 1,4 % | 1,4 % | 2,0 % | 2,8 % |
| | Class II (RBER) | 0,66 % | 5,3 % | 5,3 % | 6,1 % | 6,9 % |

| | | | | | | |
|---|---|---|---|---|---|---|
| MS TCH/AHS6.7 | (FER) | < 0,01 %(*) | 9,2 % | 9,2 % | 11,6 % | 18,7 % |
| | Class Ib (RBER) | < 0,001 % | 1,1 % | 1,1 % | 1,5 % | 2,0 % |
| | Class II (RBER) | 0,66 % | 5,8 % | 5,8 % | 6,5 % | 7,2 % |
| MS TCH/AHS5.9 | (FER) | - | 5,7 % | 5,7 % | 7,2 % | 12,8 % |
| | Class Ib (RBER) | - | 0,51 % | 0,51 % | 0,74 % | 1,2 % |
| | Class II (RBER) | 0,66 % | 6 % | 6 % | 6,6 % | 8,3 % |
| MS TCH/AHS5.15 | (FER) | - | 2,5 % | 2,5 % | 3,4 % | 6,7 % |
| | Class Ib (RBER) | - | 0,51 % | 0,51 % | 0,7 % | 1,2 % |
| | Class II (RBER) | 0,66 % | 6,3 % | 6,3 % | 7,0 % | 7,9 % |
| MS TCH/AHS4.75 | (FER) | - | 1,2 % | 1,2 % | 1,7 % | 3,8 % |
| | Class Ib (RBER) | - | 0,17 % | 0,17 % | 0,26 % | 0,49% |
| | Class II (RBER) | 0,66 % | 6,4 % | 6,4 % | 7,2 % | 8,2 % |
| BTS TCH/AHS7.95 | (FER) | < 0,01 %(*) | 20 % | 20 % | 17 % | 28 % |
| | Class Ib (RBER) | 0,004 % | 2,3 % | 2,3 % | 2 % | 2,9 % |
| | Class II (RBER) | 0,66 % | 5 % | 5 % | 4,7 % | 5,7 % |
| BTS TCH/AHS7.4 | (FER) | < 0,01 %(*) | 16 % | 16 % | 14 % | 22 % |
| | Class Ib (RBER) | < 0,001 %(*) | 1,4 % | 1,4 % | 1,1 % | 1,8 % |
| | Class II (RBER) | 0,66 % | 5,3 % | 5,3 % | 5 % | 6 % |
| BTS TCH/AHS6.7 | (FER) | < 0,01 %(*) | 9,2 % | 9,2 % | 8 % | 13 % |
| | Class Ib (RBER) | < 0,001 % | 1,1 % | 1,1 % | 0,93 % | 1,5 % |
| | Class II (RBER) | 0,66 % | 5,8 % | 5,8 % | 5,5 % | 6,6 % |
| BTS TCH/AHS5.9 | (FER) | - | 5,7 % | 5.7 % | 4,9 % | 8,6 % |
| | Class Ib (RBER) | - | 0,51 % | 0,51 % | 0,42 % | 0,73 % |
| | Class II (RBER) | 0,66 % | 6 % | 6 % | 5,7 % | 6,8 % |
| BTS TCH/AHS5.15 | (FER) | - | 2,5 % | 2,5 % | 2,2 % | 4 % |
| | Class Ib (RBER) | - | 0,51 % | 0,51 % | 0,43 % | 0,78 % |
| | Class II (RBER) | 0,66 % | 6,3 % | 6,3 % | 6 % | 7,2 % |
| BTS TCH/AHS4.75 | (FER) | - | 1,2 % | 1,2 % | 1,2 % | 1,8 % |
| | Class Ib (RBER) | - | 0,17 % | 0,17 % | 0,14 % | 0,26 % |
| | Class II (RBER) | 0,66 % | 6,4 % | 6,4 % | 6,2 % | 7,4 % |
| MS TCH/AHS-INB | (FER) | 0,013 % | 0,72 % | 0,64 % | 0,53 % | 1, 4 % |
| MS TCH/AHS | (EVSIDUR) | - | 1,5 % | 1,5 % | 2,1 % | 2,1 % |
| MS TCH/AHS | (EVRFR) | - | 0,25 % | 0,24 % | 0,33 % | 0,6 % |
| BTS TCH/AHS-INB | (FER) | 0,013 % | 0,72 % | 0,64 % | 0,53 % | 0,94 % |
| BTS TCH/AHS | (EVSIDUR) | - | 1,5 % | 1,5 % | 2,1 % | 1,5 % |
| BTS TCH/AHS | (EVRFR) | - | 0.25 % | 0.24 % | 0.33 % | 0,28 % |

Continued

**Table 1 (continued): Reference sensitivity performance**

| DCS 1 800 & PCS 1 900 | | | | | |
|---|---|---|---|---|---|
| **Type of channel** | **Propagation conditions** | | | | |
| | **static** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA130 (no FH)** | **HT100 (no FH)** |
| FACCH/H (FER) | 0,1 % | 7,2 % | 7,2 % | 5,7 % | 10,4 % |
| FACCH/F (FER) | 0,1 % | 3,9 % | 3,9 % | 3,4 % | 7,4 % |
| SDCCH (FER) | 0,1 % | 9 % | 9 % | 8 % | 13 % |
| RACH (FER) | 0,5 % | 13 % | 13 % | 12 % | 13 % |
| SCH (FER) | 1 % | 19 % | 19 % | 15 % | 25 % |
| TCH/F14,4 (BER) | $10^{-5}$ | 2,1 % | 2 % | 2 % | 6,5 % |
| TCH/F9,6 & H4,8 (BER) | $10^{-5}$ | 0,4 % | 0,4 % | 0,1 % | 0,7 % |
| TCH/F4,8 (BER) | - | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ |
| TCH/F2,4 (BER) | - | $10^{-5}$ | $10^{-5}$ | $10^{-5}$ | $10^{-5}$ |
| TCH/H2,4 (BER) | - | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ |
| TCH/FS (FER) | 0,1α % | 3α % | 3α % | 2α % | 7α % |
| class Ib (RBER) | 0,4/α % | 0,3/α % | 0,3/α % | 0,2/α % | 0,5/α % |
| class II (RBER) | 2 % | 8 % | 8 % | 7 % | 9 % |
| TCH/EFS (FER) | < 0,1 % | 4 % | 4 % | 3 % | 7 % |
| (RBER Ib) | < 0,1 % | 0,12 % | 0,12 % | 0,10 % | 0,24 % |
| (RBER II) | 2,0 % | 8 % | 8 % | 7 % | 9 % |
| TCH/HS (FER) | 0,025 % | 4,2 % | 4,2 % | 4,1 % | 5,0 % |
| class Ib (RBER, BFI=0) | 0,001 % | 0,38 % | 0,38 % | 0,28 % | 0,63 % |
| class II (RBER, BFI=0) | 0,72 % | 6,9 % | 6,9 % | 6,8 % | 7,8 % |
| (UFR) | 0,048 % | 5,7 % | 5,7 % | 5,0 % | 8,1 % |
| class Ib (RBER, (BFI or UFI)=0) | 0,001 % | 0,26 % | 0,26 % | 0,21 % | 0,35 % |
| (EVSIDR) | 0,06 % | 7,0 % | 7,0 % | 6,0 % | 9,9 % |
| (RBER, SID=2 and (BFI or UFI)=0) | 0,001 % | 0,01 % | 0,01 % | 0,01 % | 0,02 % |
| (ESIDR) | 0,01 % | 3,0 % | 3,0 % | 3,2 % | 3,9 % |
| (RBER, SID=1 or SID=2) | 0,003 % | 0,33 % | 0,33 % | 0,21 % | 0,45 % |
| MS TCH/AFS12.2 (FER) | - | 3 % | 2,0 % | 2,8 % | 9,8 % |
| Class Ib (RBER) | < 0,001 % | 1,5 % | 1,4 % | 1,7 % | 2,9 % |
| MS TCH/AFS10.2 (FER) | - | 1,2 % | 0,65 % | 1,0 % | 4,5 % |
| Class Ib (RBER) | < 0,001 % | 0,17 % | 0,12 % | 0,17 % | 0,55 % |
| MS TCH/AFS7.95 (FER) | - | 0,06% | 0,025 % | 0,06 % | 0,51 % |
| Class Ib (RBER) | - | 0,049 % | 0,023 % | 0,04 % | 0,2 % |
| MS TCH/AFS7.4 (FER) | - | 0,13 % | 0,036 % | 0,07 % | 0,62 % |
| Class Ib (RBER) | - | 0,026 % | 0,013 % | 0,02 % | 0,11 % |
| MS TCH/AFS6.7 (FER) | - | 0,034 % | < 0,01 %(*) | 0,019 % | 0,18 % |
| Class Ib (RBER) | - | 0,037 % | 0,017 % | 0,028 % | 0,14 % |
| MS TCH/AFS5.9 (FER) | - | 0,015 % | < 0,01 %(*) | 0,025 % | 0,078 % |
| Class Ib (RBER) | - | 0,003 % | < 0,001 % | 0,002 % | 0,017 % |
| MS TCH/AFS5.15 (FER) | - | 0,01 % | < 0,01 %(*) | < 0,01 % | 0,053 % |
| Class Ib (RBER) | - | 0,0034 % | < 0,001 % | 0,002 % | 0,016 % |
| MS TCH/AFS4.75 (FER) | - | < 0,01 %(*) | - | - | < 0,01 %(*) |
| Class Ib (RBER) | - | < 0,001 % | < 0,001 % | < 0,001 % | < 0,001 % |

Continued

**Table 1 (continued): Reference sensitivity performance**

| DCS 1 800 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Type of Channel** | | **Propagation conditions** | | | | | |
| | | **Static** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA130 (no FH)** | **HT100 (no FH)** | |
| BTS TCH/AFS12.2 | (FER) | - | 2 % | 2,0 % | 1,3 % | 4,6 % | |
| | Class Ib (RBER) | < 0,001 % | 1,4 % | 1,4 % | 1,2 % | 2,1 % | |
| BTS TCH/AFS10.2 | (FER) | - | 0,65 % | 0,65 % | 0,41 % | 1,6 % | |
| | Class Ib (RBER) | < 0,001 % | 0,12 % | 0,12 % | 0,084 % | 0,26 % | |
| BTS TCH/AFS7.95 | (FER) | - | 0,025 % | 0,025 % | 0,018 % | 0,089 % | |
| | Class Ib (RBER) | - | 0,023 % | 0,023 % | 0,016 % | 0,061 % | |
| BTS TCH/AFS7.4 | (FER) | - | 0,036 % | 0,036 % | 0,023 % | 0,13 % | |
| | Class Ib (RBER) | - | 0,013 % | 0,013 % | 0,007 % | 0,031 % | |
| BTS TCH/AFS6.7 | (FER) | - | < 0,01 %(*) | < 0,01 %(*) | < 0,01 %(*) | 0,031 % | |
| | Class Ib (RBER) | - | 0,017 % | 0,017 % | 0,01 % | 0,041 % | |
| BTS TCH/AFS5.9 | (FER) | - | < 0,01 %(*) | < 0,01 %(*) | < 0,01 %(*) | < 0,01 %(*) | |
| | Class Ib (RBER) | - | < 0,001 % | < 0,001 % | < 0,001 % | 0,002 % | |
| BTS TCH/AFS5.15 | (FER) | - | < 0,01 %(*) | < 0,01 %(*) | - | < 0,01 %(*) | |
| | Class Ib (RBER) | - | < 0,001 % | < 0,001 % | < 0,001 % | 0,003 % | |
| BTS TCH/AFS4.75 | (FER) | - | < 0,01 %(*) | - | - | < 0,01 %(*) | |
| | Class Ib (RBER) | - | < 0,001 % | < 0,001 % | < 0,001 % | < 0,001 % | |
| MS TCH/AFS-INB | (FER) | - | 0,034 % | 0,011 % | 0,008 % | 0,08 % | |
| MS TCH/AFS | (EVSIDUR) | - | 0,19 % | 0,19 % | 0,17 % | 0,8 % | |
| MS TCH/AFS | (EVRFR) | - | 0,027 % | 0,007 % | 0,015 % | 0,11 % | |
| BTS TCH/AFS-INB | (FER) | - | 0,011 % | 0,011 % | 0,006 % | 0,021 % | |
| BTS TCH/AFS | (EVSIDUR) | - | 0,19 % | 0,19 % | 0,17 % | 0,25 % | |
| BTS TCH/AFS | (EVRFR) | - | 0,007 % | 0.007 % | 0,002 % | 0,01 % | |
| MS TCH/AHS7.95 | (FER) | < 0,01 %(*) | 20 % | 20 % | 24 % | 38 % | |
| | Class Ib (RBER) | 0,004 % | 2,3 % | 2,3 % | 3,0 % | 3,9 % | |
| | Class II (RBER) | 0,66 % | 5 % | 5 % | 5,9 % | 6,8 % | |
| MS TCH/AHS7.4 | (FER) | < 0,01 %(*) | 16 % | 16 % | 18,6 % | 31,1 % | |
| | Class Ib (RBER) | < 0,001 %(*) | 1,4 % | 1,4 % | 2,0 % | 3,0 % | |
| | Class II (RBER) | 0,66 % | 5,3 % | 5,3 % | 6,1 % | 7,1 % | |
| MS TCH/AHS6.7 | (FER) | < 0,01 %(*) | 9,4 % | 9,4 % | 11,6 % | 21 % | |
| | Class Ib (RBER) | < 0,001 % | 1,1 % | 1,1 % | 1,5 % | 2,3 % | |
| | Class II (RBER) | 0,66 % | 5,8 % | 5,8 % | 6,5 % | 7,6 % | |
| MS TCH/AHS5.9 | (FER) | - | 5,9 % | 5,9 % | 7,2 % | 14,6 % | |
| | Class Ib (RBER) | - | 0,52 % | 0,52 % | 0,74 % | 1,3 % | |
| | Class II (RBER) | 0,66 % | 6,1 % | 6,1 % | 6,6 % | 8,4 % | |
| MS TCH/AHS5.15 | (FER) | - | 2,6 % | 2,6 % | 3,4 % | 7,8 % | |
| | Class Ib (RBER) | - | 0,53 % | 0,53 % | 0,7 % | 1,4 % | |
| | Class II (RBER) | 0,66 % | 6,3 % | 6,3 % | 7,0 % | 8,3 % | |
| MS TCH/AHS4.75 | (FER) | - | 1,7 % | 1,2 % | 1,7 % | 4,6 % | |
| | Class Ib (RBER) | - | 0,25 % | 0,18 % | 0,26 % | 0,57 % | |
| | Class II (RBER) | 0,66 % | 6,5 % | 6,5 % | 7,2 % | 8,6 % | |
| BTS TCH/AHS7.95 | (FER) | < 0,01 %(*) | 20 % | 20 % | 17 % | 27 % | |
| | Class Ib (RBER) | 0,004 % | 2,3 % | 2,3 % | 2 % | 2,9 % | |
| | Class II (RBER) | 0,66 % | 5 % | 5 % | 4,8 % | 5,7 % | |

| | | | | | |
|---|---|---|---|---|---|
| BTS TCH/AHS7.4 (FER) | < 0,01 %(*) | 16 % | 16 % | 13 % | 22 % |
| Class Ib (RBER) | < 0,001 %(*) | 1,4 % | 1,4 % | 1,1 % | 1,9 % |
| Class II (RBER) | 0,66 % | 5,3 % | 5,3 % | 5,1 % | 6 % |
| BTS TCH/AHS6.7 (FER) | < 0,01 %(*) | 9,4 % | 9,4 % | 7,5 % | 13 % |
| Class Ib (RBER) | < 0,001 % | 1,1 % | 1,1 % | 0,92 % | 1,5 % |
| Class II (RBER) | 0,66 % | 5,8 % | 5,8 % | 5,5 % | 6,6 % |
| BTS TCH/AHS5.9 (FER) | - | 5,9 % | 5,9 % | 4,6 % | 8,5 % |
| Class Ib (RBER) | - | 0,52 % | 0,52 % | 0,39 % | 0,72 % |
| Class II (RBER) | 0,66 % | 6,1 % | 6,1 % | 5,8 % | 6,8 % |
| BTS TCH/AHS5.15 (FER) | - | 2,6 % | 2,6 % | 2 % | 3,7 % |
| Class Ib (RBER) | - | 0,53 % | 0,53 % | 0,4 % | 0,76 % |
| Class II (RBER) | 0,66 % | 6,3 % | 6,3 % | 6,1 % | 7,2 % |
| BTS TCH/AHS4.75 (FER) | - | 1,2 % | 1,2 % | 1,1 % | 1,7 % |
| Class Ib (RBER) | - | 0,18 % | 0,18 % | 0,13 % | 0,25 % |
| Class II (RBER) | 0,66 % | 6,5 % | 6,5 % | 6,2 % | 7,3 % |

**Table 1 (concluded): Reference sensitivity performance**

| DCS 1 800 | | | | | |
|---|---|---|---|---|---|
| Type of Channel | Propagation conditions | | | | |
| | Static | TU50 (no FH) | TU50 (ideal FH) | RA130 (no FH) | HT100 (no FH) |
| MS TCH/AHS-INB (FER) | 0,013 % | 0,7 % | 0,64 % | 0,53 % | 1,4 % |
| MS TCH/AHS (EVSIDUR) | - | 1,3 % | 1,3 % | 2,1 % | 2,1 % |
| MS TCH/AHS (EVRFR) | - | 0,24 % | 0,24 % | 0,33 % | 0,44 % |
| BTS TCH/AHS-INB (FER) | 0,013 % | 0,64 % | 0,64 % | 0,53 % | 0,94 % |
| BTS TCH/AHS (EVSIDUR) | - | 1,3 % | 1,3 % | 2,1 % | 1,5 % |
| BTS TCH/AHS (EVRFR) | - | 0,24 % | 0,24 % | 0,25 % | 0,24 % |

NOTE 1: The specification for SDCCH applies also for BCCH, AGCH, PCH, SACCH. The actual performance of SACCH, should be better.

NOTE 2: Definitions:

- FER: Frame erasure rate (frames marked with BFI=1).
- UFR: Unreliable frame rate (frames marked with (BFI or UFI)=1).
- EVSIDR: Erased Valid SID frame rate (frames marked with (SID=0) or (SID=1) or ((BFI or UFI)=1) if a valid
- SID frame was transmitted).
- EVSIDUR: Erased Valid SID_UPDATE frame rate associated to an adaptive speech traffic channel.
- ESIDR: Erased SID frame rate (frames marked with SID=0 if a valid SID frame was transmitted).
- EVRFR: Erased Valid RATSCCH frame rate associated to an adaptive speech traffic channel. This relates to the erasure of the RATSCCH message due to the failure to detect the RATSCCH identifier or due to a CRC failure.
- BER: Bit error rate.
- RBER, BFI=0: Residual bit error rate (defined as the ratio of the number of errors detected over the frames defined as "good" to the number of transmitted bits in the "good" frames).
- RBER, (BFI or UFI)=0: Residual bit error rate (defined as the ratio of the number of errors detected over the frames defined as "reliable" to the number of transmitted bits in the "reliable" frames).
- RBER, SID=2 and (BFI or UFI)=0: Residual bit error rate of those bits in class I which do not belong to the SID codeword (defined as the ratio of the number of errors detected over the frames that are defined as "valid SID frames" to the number of transmitted bits in these frames, under the condition that a valid SID frame was sent).
- RBER, SID=1 or SID=2: Residual bit error rate of those bits in class I which do not belong to the SID codeword (defined as the ratio of the number of errors detected over the frames that are defined as "valid SID frames" or as "invalid SID frames" to the number of transmitted bits in these frames, under the condition that a valid SID frame was sent).
- TCH/AxS-INB FER: The frame error rate for the in-band channel. Valid for both Mode Indication and Mode Command/Mode Request. When testing all four code words shall be used an equal amount of time and the mode of both in-band channels (Mode Indication and Mode Command/Mode Request) shall be changed to a neighbouring mode not more often than every 22 speech frames (440 ms).

NOTE 3: $1 \leq \alpha \leq 1.6$. The value of $\alpha$ can be different for each channel condition but must remain the same for FER and class Ib RBER measurements for the same channel condition.

NOTE 4: FER for CCHs takes into account frames which are signalled as being erroneous (by the FIRE code, parity bits, or other means) or where the stealing flags are wrongly interpreted.

NOTE 5: Ideal FH case assumes perfect decorrelation between bursts. This case may only be tested if such a decorrelation is ensured in the test. For TU50 (ideal FH), sufficient decorrelation may be achieved with 4 frequencies spaced over 5 MHz.

NOTE 6: For AMR, the complete conformance should not be restricted to the channels identified with (*).

**Table 1a: Input signal level (for normal BTS) at reference performance**

| GSM 900 | | | | | | |
|---|---|---|---|---|---|---|
| **Type of channel** | | **Propagation conditions** | | | | |
| | | **static** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA250 (no FH)** | **HT100 (no FH)** |
| PDTCH/CS-1 | dBm | -104(x) | -104 | -104(x) | -104(x) | -103 |
| PDTCH/CS-2 | dBm | -104(x) | -100 | -101 | -101 | -99 |
| PDTCH/CS-3 | dBm | -104(x) | -98 | -99 | -98 | -96 |
| PDTCH/CS-4 | dBm | -101 | -90 | -90 | * | * |
| USF/CS-1 | dBm | -104(x) | -101 | -103 | -103 | -101 |
| USF/CS-2 to 4 | dBm | -104(x) | -103 | -104(x) | -104(x) | -104 |
| PRACH/11 bits | dBm | -104(x) | -104 | -104 | -103 | -103 |
| PRACH/8 bits | dBm | -104(x) | -104 | -104 | -103 | -103 |
| **DCS 1 800** | | | | | | |
| **Type of channel** | | **Propagation conditions** | | | | |
| | | **static** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA130 (no FH)** | **HT100 (no FH)** |
| PDTCH/CS-1 | dBm | -104(x) | -104 | -104 | -104(x) | -103 |
| PDTCH/CS-2 | dBm | -104(x) | -100 | -100 | -101 | -99 |
| PDTCH/CS-3 | dBm | -104(x) | -98 | -98 | -98 | -94 |
| PDTCH/CS-4 | dBm | -101 | -88 | -88 | * | * |
| USF/CS-1 | dBm | -104(x) | -103 | -103 | -103 | -101 |
| USF/CS-2 to 4 | dBm | -104(x) | -104(x) | -104(x) | -104(x) | -103 |
| PRACH/11 bits | dBm | -104(x) | -104 | -104 | -103 | -103 |
| PRACH/8 bits | dBm | -104(x) | -104 | -104 | -103 | -103 |

NOTE 1: The specification for PDTCH/CS-1 applies also for PACCH, PBCCH, PAGCH, PPCH, PTCCH/D, PNCH.

NOTE 2: Ideal FH case assumes perfect decorrelation between bursts. This case may only be tested if such a decorrelation is ensured in the test. For TU50 (ideal FH), sufficient decorrelation may be achieved with 4 frequencies spaced over 5 MHz.

NOTE 3: PDTCH/CS-4 can not meet the reference performance for some propagation conditions (*).

NOTE 4: The complete conformance should not be restricted to the logical channels and channel models identified with (x)

**Table 2: Reference interference performance**

| GSM 900 | | | | | |
|---|---|---|---|---|---|
| **Type of channel** | **Propagation conditions** | | | | |
| | **TU3 (no FH)** | **TU3 (ideal FH)** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA250 (no FH)** |
| FACCH/H (FER) | 22 % | 6,7 % | 6,7 % | 6,7 % | 5,7 % |
| FACCH/F (FER) | 22 % | 3,4 % | 9,5 % | 3,4 % | 3,5 % |
| SDCCH (FER) | 22 % | 9 % | 13 % | 9 % | 8 % |
| RACH (FER) | 15 % | 15 % | 16 % | 16 % | 13 % |
| SCH (FER) | 17 % | 17 % | 17 % | 17 % | 18 % |
| TCH/F14,4 (BER) | 10 % | 3 % | 4,5 % | 3 % | 3 % |
| TCH/F9,6 & H4,8 (BER) | 8 % | 0,3 % | 0,8 % | 0,3 % | 0,2 % |
| TCH/F4,8 (BER) | 3 % | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ |
| TCH/F2,4 (BER) | 3 % | $10^{-5}$ | $10^{-5}$ | $10^{-5}$ | $10^{-5}$ |
| TCH/H2,4 (BER) | 4 % | $10^{-4}$ | $2\ 10^{-4}$ | $10^{-4}$ | $10^{-4}$ |
| TCH/FS (FER) | 21$\alpha$ % | 3$\alpha$ % | 6$\alpha$ % | 3$\alpha$ % | 3$\alpha$ % |
| class Ib (RBER) | 2/$\alpha$ % | 0,2/$\alpha$ % | 0,4/$\alpha$ % | 0,2/$\alpha$ % | 0,2/$\alpha$ % |
| class II (RBER) | 4 % | 8 % | 8 % | 8 % | 8 % |
| TCH/EFS (FER) | 23 % | 3 % | 9 % | 3 % | 4 % |
| (RBER Ib) | 0,20 % | 0,10 % | 0,20 % | 0,10 % | 0,13 % |
| (RBER II) | 3 % | 8 % | 7 % | 8 % | 8 % |
| TCH/HS (FER) | 19,1 % | 5,0 % | 5,0 % | 5,0 % | 4,7 % |
| class Ib (RBER, BFI=0) | 0,52 % | 0,27 % | 0,29 % | 0,29 % | 0,21 % |
| class II (RBER, BFI=0) | 2,8 % | 7,1 % | 7,1 % | 7,1 % | 7,0 % |
| (UFR) | 20,7 % | 6,2 % | 6,1 % | 6,1 % | 5,6 % |
| class Ib (RBER,(BFI or UFI)=0) | 0,29 % | 0,20 % | 0,21 % | 0,21 % | 0,17 % |
| (EVSIDR) | 21,9 % | 7,1 % | 7,0 % | 7,0 % | 6,3 % |
| (RBER, SID=2 and (BFI or UFI)=0) | 0,02 % | 0,01 % | 0,01 % | 0,01 % | 0,01 % |
| (ESIDR) | 17,1 % | 3,6 % | 3,6 % | 3,6 % | 3,4 % |
| (RBER, SID=1 or SID=2) | 0,5 % | 0,27 % | 0,26 % | 0,26 % | 0,20 % |
| MS TCH/AFS12.2 (FER) | 22 % | 3,5 % | 6 % | 3,5 % | 3,4 % |
| Class Ib (RBER) | 0,9 % | 1,7 % | 1,7 % | 1,7 % | 1,8 % |
| MS TCH/AFS10.2 (FER) | 18 % | 1,4 % | 2,9 % | 1,4 % | 1,4 % |
| Class Ib (RBER) | 0,53 % | 0,22 % | 0,3 % | 0,21 % | 0,24 % |
| MS TCH/AFS7.95 (FER) | 13 % | 0,13 % | 0,9% | 0,12 % | 0,13 % |
| Class Ib (RBER) | 0,66 % | 0,071 % | 0,22 % | 0,065 % | 0,05 % |
| (FER@-3dB) | 26 % | 2,7 % | 7,5 % | 2,7 % | 2,8 % |
| Class Ib (RBER@-3dB) | 1,2 % | 0,79 % | 1,5 % | 0,78 % | 0,94 % |
| MS TCH/AFS7.4 (FER) | 14 % | 0,16 % | 0,85 % | 0,16 % | 0,15 % |
| Class Ib (RBER) | 0,43 % | 0,032 % | 0,1 % | 0,032 % | 0,029 % |
| (FER@-3dB) | 26 % | 3 % | 6,5 % | 3,1 % | 3,0 % |
| Class Ib (RBER@-3dB) | 0,79 % | 0,38 % | 0,52% | 0,38 % | 0,43 % |
| MS TCH/AFS6.7 (FER) | 11 % | 0,045 % | 0,45 % | 0,041 % | 0,05 % |
| Class Ib (RBER) | 0,75 % | 0,044 % | 0,19 % | 0,042 % | 0,03 % |
| (FER@-3dB) | 23 % | 1,2 % | 3,9 % | 1,2 % | 1,2 % |
| Class Ib (RBER@-3dB) | 1,4 % | 0,6 % | 0,86 % | 0,6 % | 0,69 % |
| MS TCH/AFS5.9 (FER) | 10 % | 0,018 % | 0,33 % | 0,018 % | 0,04 % |
| Class Ib (RBER) | 0,38 % | 0,005 % | 0,036 % | 0,005 % | 0,0035 % |
| (FER@-3dB) | 21 % | 0,71 % | 3,2 % | 0,7 % | 0,6 % |
| Class Ib (RBER@-3dB) | 0,74 % | 0,11 % | 0,29 % | 0,12 % | 0,12 % |
| MS TCH/AFS5.15 (FER) | 9,2 % | 0,011 % | 0,21 % | 0,011 % | 0,013 % |
| Class Ib (RBER) | 0,44 % | 0,004 % | 0,036 % | 0,003 % | 0,0027 % |
| (FER@-3dB) | 19 % | 0,45 % | 1,8 % | 0,47 % | 0,37 % |
| Class Ib (RBER@-3dB) | 0,85 % | 0,1 % | 0,29 % | 0,11 % | 0,1 % |
| MS TCH/AFS4.75 (FER) | 7,9 % | < 0,01 %(*) | 0,12 % | < 0,01 %(*) | 0,02 %(*) |
| Class Ib (RBER) | 0,32 % | 0,001 % | 0,01 % | 0,001 % | < 0,001 % |
| (FER@-3dB) | 17 % | 0,21 % | 1,7 % | 0,23 % | 0,2 % |
| Class Ib (RBER@-3dB) | 0,62 % | 0,036 % | 0,15 % | 0,033 % | 0,03 % |
| (continued) | | | | | |

**Table 2 (continued): Reference interference performance**

| GSM 900 | | | | | | |
|---|---|---|---|---|---|---|
| **Type of Channel** | | **Propagation conditions** | | | | |
| | | **TU3 (no FH)** | **TU3 (ideal FH)** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA250 (no FH)** |
| BTS TCH/AFS12.2 | (FER) | 22 % | 3,5 % | 6 % | 3,5 % | 2,5 % |
| | Class Ib (RBER) | 0,9 % | 1,7 % | 1,7 % | 1,7 % | 1,5 % |
| BTS TCH/AFS10.2 | (FER) | 18 % | 1,4 % | 2,7 % | 1,4 % | 0,92 % |
| | Class Ib (RBER) | 0,53 % | 0,22 % | 0,3 % | 0,21 % | 0,16 % |
| BTS TCH/AFS7.95 | (FER) | 13 % | 0,13 % | 0,51 % | 0,12 % | 0,073 % |
| | Class Ib (RBER) | 0,66 % | 0,071 % | 0,15 % | 0,065 % | 0,044 % |
| | (FER@-3dB) | 26 % | 2,7 % | 5,3 % | 2,7 % | 1,8 % |
| | Class Ib (RBER@-3dB) | 1,2 % | 0,79 % | 1 % | 0,78 % | 0,6 % |
| BTS TCH/AFS7.4 | (FER) | 14 % | 0,16 % | 0,56 % | 0,16 % | 0,09 % |
| | Class Ib (RBER) | 0,43 % | 0,032 % | 0,072 % | 0,032 % | 0,018 % |
| | (FER@-3dB) | 26 % | 3 % | 5,4 % | 3,1 % | 2 % |
| | Class Ib (RBER@-3dB) | 0,79 % | 0,38 % | 0,52 % | 0,38 % | 0,28 % |
| BTS TCH/AFS6.7 | (FER) | 11 % | 0,045 % | 0,21 % | 0,041 % | 0,021 % |
| | Class Ib (RBER) | 0,75 % | 0,044 % | 0,11 % | 0,042 % | 0,028 % |
| | (FER@-3dB) | 23 % | 1,2 % | 2,9 % | 1,2 % | 0,75 % |
| | Class Ib (RBER@-3dB) | 1,4 % | 0,6 % | 0,86 % | 0,6 % | 0,44 % |
| BTS TCH/AFS5.9 | (FER) | 10 % | 0,018 % | 0,12 % | 0,018 % | < 0,01 %(*) |
| | Class Ib (RBER) | 0,38 % | 0,005 % | 0,022 % | 0,005 % | 0,003 % |
| | (FER@-3dB) | 21 % | 0,71 % | 2 % | 0,7 % | 0,4 % |
| | Class Ib (RBER@-3dB) | 0,74 % | 0,11 % | 0,23 % | 0,12 % | 0,079 % |
| BTS TCH/AFS5.15 | (FER) | 9,2 % | 0,011 % | 0,081 % | 0,011 % | < 0,01 %(*) |
| | Class Ib (RBER) | 0,44 % | 0,004 % | 0,019 % | 0,003 % | 0,002 % |
| | (FER@-3dB) | 19 % | 0,45 % | 1,4 % | 0,47 % | 0,25 % |
| | Class Ib (RBER@-3dB) | 0,85 % | 0,1 % | 0,22 % | 0,11 % | 0,069 % |
| BTS TCH/AFS4.75 | (FER) | 7,9 % | < 0,01 %(*) | 0,036 % | < 0,01 %(*) | < 0,01 %(*) |
| | Class Ib (RBER) | 0,32 % | 0,001 % | 0,006 % | 0,001 % | < 0,001 % |
| | (FER@-3dB) | 17 % | 0,21 % | 0,82 % | 0,23 % | 0,11 % |
| | Class Ib (RBER@-3dB) | 0,62 % | 0,036 % | 0,11 % | 0,033 % | 0,019 % |
| MS TCH/AFS-INB | (FER) | 1,5 % | 0,019 % | 0,08 % | 0,018 % | 0,027 % |
| | (FER@-3dB) | 3,5 % | 0,15 % | 0,3 % | 0,16 % | 0,15 % |
| MS TCH/AFS | (EVSIDUR) | 11 % | 0,37 % | 2,4 % | 0,39 % | 0,46 % |
| | (EVSIDUR@-3dB) | 21 % | 3,4 % | 9 % | 3,4 % | 3,4 % |
| MS TCH/AFS | (EVRFR) | 10 % | 0,026 % | 1 % | 0,024 % | 0,02 % |
| | (EVRFR @ -3dB) | 21 % | 0,77 % | 6 % | 0,77 % | 0,9 % |
| BTS TCH/AFS-INB | (FER) | 1,5 % | 0,019 % | 0,025 % | 0,018 % | 0,009 % |
| | (FER@-3dB) | 3,5 % | 0,15 % | 0,22 % | 0,16 % | 0,1 % |
| BTS TCH/AFS | (EVSIDUR) | 11 % | 0,37 % | 1,4 % | 0,39 % | 0,46 % |
| | (EVSIDUR@-3dB) | 21 % | 3,4 % | 6,3 % | 3,4 % | 3,1 % |
| BTS TCH/AFS | (EVRFR) | 10 % | 0,026 % | 0,15 % | 0,024 % | 0,01 % |
| | (EVRFR @ -3dB) | 21 % | 0,77 % | 2,08 % | 0,77 % | 0,48 % |
| (continued) | | | | | | |

**Table 2 (continued): Reference interference performance**

| GSM 900 | | | | | | |
|---|---|---|---|---|---|---|
| **Type of Channel** | | **Propagation conditions** | | | | |
| | | **TU3 (no FH)** | **TU3 (ideal FH)** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA250 (no FH)** |
| MS TCH/AHS7.95 | (FER) | 27 % | 23 % | 22 % | 22 % | 24 % |
| | Class Ib (RBER) | 0,84 % | 2,2 % | 2,3 % | 2,3 % | 2,5 % |
| | Class II (RBER) | 1,7 % | 5,1 % | 5,3 % | 5,3 % | 5,5 % |
| | (FER@+3dB) | 14 % | 7 % | 6,7 % | 6.7 % | 7,9 % |
| | Class Ib (RBER@+3dB) | 0,48 % | 1 % | 1 % | 1 % | 1,2 % |
| | Class II (RBER@+3dB) | 1 % | 3,2 % | 3,2 % | 3,2 % | 3,5 % |
| MS TCH/AHS7.4 | (FER) | 25 % | 19 % | 18 % | 18 % | 19 % |
| | Class Ib (RBER) | 0,68 % | 1,4 % | 1,4 % | 1,4 % | 1,5 % |
| | Class II (RBER) | 1,9 % | 5,4 % | 5,6 % | 5,6 % | 6,1 % |
| | (FER@+3dB) | 13 % | 5 % | 4,8 % | 4.8 % | 5,9 % |
| | Class Ib (RBER@+3dB) | 0,38 % | 0,52 % | 0,51 % | 0,51 % | 0,55 % |
| | Class II (RBER@+3dB) | 1,2 % | 3,3 % | 3,3 % | 3,3 % | 3,8 % |
| MS TCH/AHS6.7 | (FER) | 23 % | 12 % | 11 % | 11 % | 13% % |
| | Class Ib (RBER) | 0,71 % | 1,2 % | 1,2 % | 1,2 % | 1,5 % |
| | Class II (RBER) | 2,3 % | 6 % | 6,2 % | 6,2 % | 6,9 % |
| | (FER@+3dB) | 11 % | 2,6 % | 2,3 % | 2,3 % | 2,9 % |
| | Class Ib (RBER@+3dB) | 0,39 % | 0,39 % | 0,39 % | 0,39 % | 0,49 % |
| | Class II (RBER@+3dB) | 1,4 % | 3,5 % | 3,6 % | 3,6 % | 4,2 % |
| MS TCH/AHS5.9 | (FER) | 21 % | 7,9 % | 7,1 % | 7,1 % | 7 % |
| | Class Ib (RBER) | 0,55 % | 0,58 % | 0,57 % | 0,57 % | 0,59 % |
| | Class II (RBER) | 2,6 % | 6,4 % | 6,5 % | 6,5 % | 6,9 % |
| MS TCH/AHS5.15 | (FER) | 17 % | 3,9 % | 3,3 % | 3,3 % | 3,8 % |
| | Class Ib (RBER) | 0,8 % | 0,65 % | 0,6 % | 0,6 % | 0,57 % |
| | Class II (RBER) | 3,1 % | 6,8 % | 6,9 % | 6,9 % | 7,5 % |
| MS TCH/AHS4.75 | (FER) | 15 % | 2,2 % | 2,5 % | 1,8 % | 2,5 % |
| | Class Ib (RBER) | 0,6 % | 0,25 % | 0,29 % | 0,22 % | 0,26 % |
| | Class II (RBER) | 3,6 % | 6,9 % | 7,5 % | 7 % | 8,3 % |
| BTS TCH/AHS7.95 | (FER) | 27 % | 23 % | 22 % | 22 % | 21 % |
| | Class Ib (RBER) | 0,84 % | 2,2 % | 2,3 % | 2,3 % | 2,1 % |
| | Class II (RBER) | 1,7 % | 5,1 % | 5,3 % | 5,3 % | 5 % |
| | (FER@+3dB) | 14 % | 7 % | 6,7 % | 6.7 % | 7 % |
| | Class Ib (RBER@+3dB) | 0,48 % | 1 % | 1 % | 1 % | 1 % |
| | Class II (RBER@+3dB) | 1 % | 3,2 % | 3,2 % | 3,2 % | 3,2 % |
| BTS TCH/AHS7.4 | (FER) | 25 % | 19 % | 18 % | 18 % | 17 % |
| | Class Ib (RBER) | 0,68 % | 1,4 % | 1,4 % | 1,4 % | 1,3 % |
| | Class II (RBER) | 1,9 % | 5,4 % | 5,6 % | 5,6 % | 5,4 % |
| | (FER@+3dB) | 13 % | 5 % | 4,8 % | 4.8 % | 5,3 % |
| | Class Ib (RBER@+3dB) | 0,38 % | 0,52 % | 0,51 % | 0,51 % | 0,5 % |
| | Class II (RBER@+3dB) | 1,2 % | 3,3 % | 3,3 % | 3,3 % | 3,4 % |
| BTS TCH/AHS6.7 | (FER) | 23 % | 12 % | 11 % | 11 % | 11 % |
| | Class Ib (RBER) | 0,71 % | 1,2 % | 1,2 % | 1,2 % | 1,1 % |
| | Class II (RBER) | 2,3 % | 6 % | 6,2 % | 6,2 % | 6 % |
| | (FER@+3dB) | 11 % | 2,6 % | 2,3 % | 2,3 % | 2,9 % |
| | Class Ib (RBER@+3dB) | 0,39 % | 0,39 % | 0,39 % | 0,39 % | 0,4 % |
| | Class II (RBER@+3dB) | 1,4 % | 3,5 % | 3,6 % | 3,6 % | 3,6 % |

(continued)

**Table 2 (continued): Reference interference performance**

| GSM 900 | | | | | |
|---|---|---|---|---|---|
| **Type of Channel** | **Propagation conditions** | | | | |
| | **TU3 (no FH)** | **TU3 (ideal FH)** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA250 (no FH)** |
| BTS TCH/AHS5.9 (FER) | 21 % | 7,9 % | 7,1 % | 7,1 % | 7 % |
| Class Ib (RBER) | 0,55 % | 0,58 % | 0,57 % | 0,57 % | 0,51 % |
| Class II (RBER) | 2,6 % | 6,4 % | 6,5 % | 6,5 % | 6,3 % |
| BTS TCH/AHS5.15 (FER) | 17 % | 3,9 % | 3,3 % | 3,3 % | 3,5 % |
| Class Ib (RBER) | 0,8 % | 0,65 % | 0,6 % | 0,6 % | 0,57 % |
| Class II (RBER) | 3,1 % | 6,8 % | 6,9 % | 6,9 % | 6,7 % |
| BTS TCH/AHS4.75 (FER) | 15 % | 2,2 % | 1,8 % | 1,8 % | 2,1 % |
| Class Ib (RBER) | 0,6 % | 0,25 % | 0,22 % | 0,22 % | 0,22 % |
| Class II (RBER) | 3,6 % | 6,9 % | 7 % | 7 % | 6,9 % |
| MS TCH/AHS-INB (FER) | 2,7 % | 0,76 % | 0,83 % | 0,7 % | 1 % |
| (FER@-3dB) | 6 % | 2,2 % | 2,2 % | 2,2 % | 2,5 % |
| MS TCH/AHS (EVSIDUR) | 15 % | 3,2 % | 2,5 % | 2,5 % | 3,8 % |
| (EVSIDUR@-3dB) | 28 % | 15 % | 15 % | 15 % | 15 % |
| MS TCH/AHS (EVRFR) | 11 % | 0,53 % | 1,5 % | 0,51 % | 0,61 % |
| (EVRFR @ -3dB) | 22 % | 4,5 % | 7 % | 4,4 % | 5 % |
| BTS TCH/AHS-INB (FER) | 2,7 % | 0,76 % | 0,7 % | 0,7 % | 0,63 % |
| (FER@-3dB) | 6 % | 2,2 % | 2,2 % | 2,2 % | 2 % |
| BTS TCH/AHS (EVSIDUR) | 15 % | 3,2 % | 2,5 % | 2,5 % | 3,8 % |
| (EVSIDUR@-3dB) | 28 % | 15 % | 15 % | 15 % | 15 % |
| BTS TCH/AHS (EVRFR) | 11 % | 0.53 % | 0,51 % | 0.51 % | 0.61 % |
| (EVRFR @ -3dB) | 22 % | 4.5 % | 4,4 % | 4.4 % | 4,1 % |
| FACCH/H (FER) | 22 % | 6,7 % | 6,9 % | 6,9 % | 5,7 % |
| FACCH/F (FER) | 22 % | 3,4 % | 3,4 % | 3,4 % | 3,5 % |
| SDCCH (FER) | 22 % | 9 % | 9 % | 9 % | 8 % |
| RACH (FER) | 15 % | 15 % | 16 % | 16 % | 13 % |
| SCH (FER) | 17 % | 17 % | 19 % | 19 % | 18 % |
| TCH/F14,4 (BER) | 10 % | 3 % | 4 % | 3,1 % | 3 % |
| TCH/F9,6 & H4,8 (BER) | 8 % | 0,3 % | 0,8 % | 0,3 % | 0,2 % |
| TCH/F4,8 (BER) | 3 % | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ |

(continued)

**Table 2 (continued): Reference interference performance**

| DCS 1 800 & PCS 1 900 | | | | | | |
|---|---|---|---|---|---|---|
| **Type of channel** | | **Propagation conditions** | | | | |
| | | **TU1,5 (no FH)** | **TU1,5 (ideal FH)** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA130 (no FH)** |
| TCH/F2,4 | (BER) | 3 % | $10^{-5}$ | $10^{-5}$ | $10^{-5}$ | $10^{-5}$ |
| TCH/H2,4 | (BER) | 4 % | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ |
| TCH/FS | (FER) | 21α % | 3α % | 3α % | 3α % | 3α % |
| | class Ib (RBER) | 2/α % | 0,2/α % | 0,25/α % | 0,25/α % | 0,2/α % |
| | class II (RBER) | 4 % | 8 % | 8,1 % | 8,1 % | 8 % |
| TCH/EFS | (FER) | 23 % | 3 % | 3 % | 3 % | 4 % |
| | (RBER Ib) | 0,20 % | 0,10 % | 0,10 % | 0,10 % | 0,13 % |
| | (RBER II) | 3 % | 8 % | 8 % | 8 % | 8 % |
| TCH/HS | (FER) | 19,1 % | 5,0 % | 5,0 % | 5,0 % | 4,7 % |
| | class Ib (RBER, BFI=0) | 0,52 % | 0,27 % | 0,29 % | 0,29 % | 0,21 % |
| | class II (RBER, BFI=0) | 2,8 % | 7,1 % | 7,2 % | 7,2 % | 7,0 % |
| | (UFR) | 20,7 % | 6,2 % | 6,1 % | 6,1 % | 5,6 % |
| | class Ib (RBER, (BFI or UFI)=0) | 0,29 % | 0,20 % | 0,21 % | 0,21 % | 0,17 % |
| | (EVSIDR) | 21,9 % | 7,1 % | 7,0 % | 7,0 % | 6,3 % |
| | (RBER, SID=2 and (BFI or UFI)=0) | 0,02 % | 0,01 % | 0,01 % | 0,01 % | 0,01 % |
| | (ESIDR) | 17,1 % | 3,6 % | 3,6 % | 3,6 % | 3,4 % |
| | (RBER, SID=1 or SID=2) | 0,5 % | 0,27 % | 0,26 % | 0,26 % | 0,20 % |
| MS TCH/AFS12.2 | (FER) | 22 % | 3,5 % | 3,5 % | 2,7 % | 3,4 % |
| | Class Ib (RBER) | 0,92 % | 1,7 % | 1,8 % | 1,6 % | 1,8 % |
| MS TCH/AFS10.2 | (FER) | 18 % | 1,4 % | 1,4 % | 0,98 % | 1,4 % |
| | Class Ib (RBER) | 0,54 % | 0,21 % | 0,21 % | 0,17 % | 0,24 % |
| MS TCH/AFS7.95 | (FER) | 13 % | 0,13 % | 0,18 % | 0,07 % | 0,13 % |
| | Class Ib (RBER) | 0,67 % | 0,068 % | 0,08 % | 0,042 % | 0,05 % |
| | (FER@-3dB) | 25 % | 2,7 % | 3,4 % | 2 % | 2,8 % |
| | Class Ib (RBER@-3dB) | 1,2 % | 0,8 % | 0,78 % | 0,68 % | 0,94 % |
| MS TCH/AFS7.4 | (FER) | 14 % | 0,17 % | 0,2 % | 0,083 % | 0,13 % |
| | Class Ib (RBER) | 0,43 % | 0,032 % | 0,032 % | 0,02 % | 0,029 % |
| | (FER@-3dB) | 26 % | 3 % | 3,1 % | 2,3 % | 3,0 % |
| | Class Ib (RBER@-3dB) | 0,8 % | 0,38 % | 0,38 % | 0,32 % | 0,43 % |
| MS TCH/AFS6.7 | (FER) | 11 % | 0,051 % | 0,06 % | 0,025 % | 0,05 % |
| | Class Ib (RBER) | 0,76 % | 0,047 % | 0,042 % | 0,028 % | 0,03 % |
| | (FER@-3dB) | 22 % | 1,2 % | 1,4 % | 0,82 % | 1,2 % |
| | Class Ib (RBER@-3dB) | 1,4 % | 0,61 % | 0,6 % | 0,51 % | 0,69 % |
| MS TCH/AFS5.9 | (FER) | 10 % | 0,018 % | 0,03 % | < 0,01 %(*) | 0,028 % |
| | Class Ib (RBER) | 0,38 % | 0,005 % | 0,005 % | 0,002 % | 0,0035 % |
| | (FER@-3dB) | 21 % | 0,68 % | 1 % | 0,41 % | 0,6 % |
| | Class Ib (RBER@-3dB) | 0,72 % | 0,12 % | 0,12 % | 0,079 % | 0,12 % |
| MS TCH/AFS5.15 | (FER) | 9,2 % | 0,013 % | 0,022 % | < 0,01 %(*) | 0,013 % |
| | Class Ib (RBER) | 0,45 % | 0,004 % | 0,005 % | 0,002 % | 0,0027 % |
| | (FER@-3dB) | 19 % | 0,45 % | 0,55 % | 0,26 % | 0,37 % |
| | Class Ib (RBER@-3dB) | 0,84 % | 0,11 % | 0,11 % | 0,072 % | 0,1 % |
| MS TCH/AFS4.75 | (FER) | 7,9 % | < 0,01 %(*) | 0,015 % | < 0,01 %(*) | - |
| | Class Ib (RBER) | 0,31 % | < 0,001 % | 0,0015 % | < 0,001 % | < 0,001 % |
| | (FER@-3dB) | 17 % | 0,2 % | 0,35 % | 0,1 % | 0,19 % |
| | Class Ib (RBER@-3dB) | 0,61 % | 0,033 % | 0,033 % | 0,021 % | 0,03 % |
| (continued) | | | | | | |

**Table 2 (continued): Reference interference performance**

| DCS 1 800 & PCS 1 900 | | | | | | |
|---|---|---|---|---|---|---|
| Type of channel | | Propagation conditions | | | | |
| | | TU1,5 (no FH) | TU1,5 (ideal FH) | TU50 (no FH) | TU50 (ideal FH) | RA130 (no FH) |
| BTS TCH/AFS12.2 | (FER) | 22 % | 3,5 % | 2,7 % | 2,7 % | 1,8 % |
| | Class Ib (RBER) | 0,92 % | 1,7 % | 1,6 % | 1,6 % | 1,4 % |
| BTS TCH/AFS10.2 | (FER) | 18 % | 1,4 % | 0,98 % | 0,98 % | 0,56 % |
| | Class Ib (RBER) | 0,54 % | 0,21 % | 0,17 % | 0,17 % | 0,12 % |
| BTS TCH/AFS7.95 | (FER) | 13 % | 0,13 % | 0,07 % | 0,07 % | 0,029 % |
| | Class Ib (RBER) | 0,67 % | 0,068 % | 0,042 % | 0,042 % | 0,03 % |
| | (FER@-3dB) | 25 % | 2,7 % | 2 % | 2 % | 1,2 % |
| | Class Ib (RBER@-3dB) | 1,2 % | 0,8 % | 0,68 % | 0,68 % | 0,48 % |
| BTS TCH/AFS7.4 | (FER) | 14 % | 0,17 % | 0,083 % | 0,083 % | 0,047 % |
| | Class Ib (RBER) | 0,43 % | 0,032 % | 0,02 % | 0,02 % | 0,012 % |
| | (FER@-3dB) | 26 % | 3 % | 2,3 % | 2,3 % | 1,4 % |
| | Class Ib (RBER@-3dB) | 0,8 % | 0,38 % | 0,32 % | 0,32 % | 0,22 % |
| BTS TCH/AFS6.7 | (FER) | 11 % | 0,051 % | 0,025 % | 0,025 % | < 0,01 %(*) |
| | Class Ib (RBER) | 0,76 % | 0,047 % | 0,028 % | 0,028 % | 0,016 % |
| | (FER@-3dB) | 22 % | 1,2 % | 0,82 % | 0,82 % | 0,41 % |
| | Class Ib (RBER@-3dB) | 1,4 % | 0,61 % | 0,51 % | 0,51 % | 0,34 % |
| BTS TCH/AFS5.9 | (FER) | 10 % | 0,018 % | < 0,01 %(*) | < 0,01 %(*) | < 0,01 %(*) |
| | Class Ib (RBER) | 0,38 % | 0,005 % | 0,002 % | 0,002 % | 0,001 % |
| | (FER@-3dB) | 21 % | 0,68 % | 0,41 % | 0,41 % | 0,2 % |
| | Class Ib (RBER@-3dB) | 0,72 % | 0,12 % | 0,079 % | 0,079 % | 0,046 % |
| BTS TCH/AFS5.15 | (FER) | 9,2 % | 0,013 % | < 0,01 %(*) | < 0,01 %(*) | < 0,01 %(*) |
| | Class Ib (RBER) | 0,45 % | 0,004 % | 0,001 % | 0,001 % | < 0,001 % |
| | (FER@-3dB) | 19 % | 0,45 % | 0,26 % | 0,26 % | 0,13 % |
| | Class Ib (RBER@-3dB) | 0,84 % | 0,11 % | 0,072 % | 0,072 % | 0,038 % |
| BTS TCH/AFS4.75 | (FER) | 7,9 % | < 0,01 %(*) | < 0,01 %(*) | < 0,01 %(*) | - |
| | Class Ib (RBER) | 0,31 % | < 0,001 % | < 0,001 % | < 0,001 % | < 0,001 % |
| | (FER@-3dB) | 17 % | 0,2 % | 0,1 % | 0,1 % | 0,051 % |
| | Class Ib (RBER@-3dB) | 0,61 % | 0,033 % | 0,021 % | 0,021 % | 0,009 % |
| MS TCH/AFS-INB | (FER) | 1,5 % | 0,016 % | 0,08 % | 0,013 % | 0,027 % |
| | (FER@-3dB) | 3,5 % | 0,16 % | 0,28 % | 0,12 % | 0,15 % |
| MS TCH/AFS | (EVSIDUR) | 11 % | 0,41 % | 1,1 % | 0,3 % | 0,46 % |
| | (EVSIDUR@-3dB) | 21 % | 3,5 % | 6 % | 2,8 % | 3,4 % |
| MS TCH/AFS | (EVRFR) | 10 % | 0.028 % | 0,3 % | 0.022 % | 0,02 % |
| | (EVRFR @ -3dB) | 21 | 0,73 % | 3 % | 0.78 % | 0,9 % |
| BTS TCH/AFS-INB | (FER) | 1,5 % | 0,016 % | 0,013 % | 0,013 % | 0,008 % |
| | (FER@-3dB) | 3,5 % | 0,16 % | 0,12 % | 0,12 % | 0,1 % |
| BTS TCH/AFS | (EVSIDUR) | 11 % | 0,41 % | 0,3 % | 0,3 % | 0,36 % |
| | (EVSIDUR@-3dB) | 21 % | 3,5 % | 2,8 % | 2,8 % | 2,8 % |
| BTS TCH/AFS | (EVRFR) | 10 % | 0.028 % | 0,022 % | 0.022 % | 0,005 % |
| | (EVRFR @ -3dB) | 21 | 0.73 % | 0,78 % | 0.78 % | 0,28 % |
| (continued) | | | | | | |

**Table 2 (continued): Reference interference performance**

| DCS 1 800 & PCS 1 900 | | | | | | |
|---|---|---|---|---|---|---|
| **Type of channel** | | **Propagation conditions** | | | | |
| | | **TU1,5 (no FH)** | **TU1,5 (ideal FH)** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA130 (no FH)** |
| MS TCH/AHS7.95 | (FER) | 27 % | 23 % | 23 % | 23 % | 24 % |
| | Class Ib (RBER) | 0,85 % | 2,2 % | 2,3 % | 2,3 % | 2,5 % |
| | Class II (RBER) | 1,7 % | 5,1 % | 5,1 % | 5,1 % | 5,5 % |
| | (FER@+3dB) | 14 % | 7 % | 6,7 % | 6,7 % | 7,9 % |
| | Class Ib (RBER@+3dB) | 0,49 % | 1 % | 1 % | 1 % | 1,2 % |
| | Class II (RBER@+3dB) | 1 % | 3,1 % | 3,3 % | 3,1 % | 3,5 % |
| MS TCH/AHS7.4 | (FER) | 26 % | 18 % | 18 % | 18 % | 19 % |
| | Class Ib (RBER) | 0,69 % | 1,4 % | 1,4 % | 1,4 % | 1,5 % |
| | Class II (RBER) | 1,9 % | 5,4 % | 5,5 % | 5,5 % | 6,1 % |
| | (FER@+3dB) | 13 % | 5,2 % | 5,4 % | 4,9 % | 5,9 % |
| | Class Ib (RBER@+3dB) | 0,39 % | 0,51 % | 0,6 % | 0,51 % | 0,55 % |
| | Class II (RBER@+3dB) | 1,2 % | 3,3 % | 3,5 % | 3,3 % | 3,8 % |
| MS TCH/AHS6.7 | (FER) | 23 % | 12 % | 12 % | 12 % | 11 % |
| | Class Ib (RBER) | 0,71 % | 1,2 % | 1,2 % | 1,2 % | 1,2 % |
| | Class II (RBER) | 2,3 % | 6 % | 6 % | 6 % | 6,9 % |
| | (FER@+3dB) | 11 % | 2,7 % | 2,5 % | 2,5 % | 2,9 % |
| | Class Ib (RBER@+3dB) | 0,39 % | 0,39 % | 0,38 % | 0,38 % | 0,49 % |
| | Class II (RBER@+3dB) | 1,4 % | 3,5 % | 3,9 % | 3,5 % | 4.2 % |
| MS TCH/AHS5.9 | (FER) | 21 % | 7,8 % | 7,7 % | 7,7 % | 7.0 % |
| | Class Ib (RBER) | 0,55 % | 0,59 % | 0,6 % | 0,6 % | 0,59 % |
| | Class II (RBER) | 2,6 % | 6,3 % | 6,9 % | 6,4 % | 6,9 % |
| MS TCH/AHS5.15 | (FER) | 17 % | 3,8 % | 3,8 % | 3,8 % | 3,8 % |
| | Class Ib (RBER) | 0,8 % | 0,65 % | 0,66 % | 0,66 % | 0,57 % |
| | Class II (RBER) | 3,1 % | 6,7 % | 6,8 % | 6,8 % | 7,5 % |
| MS TCH/AHS4.75 | (FER) | 15 % | 2,2 % | 2,8 % | 2,1 % | 2,5 % |
| | Class Ib (RBER) | 0,6 % | 0,25 % | 0,25 % | 0,25 % | 0,26 % |
| | Class II (RBER) | 3,6 % | 6,9 % | 7,5 % | 7 % | 8,3 % |
| BTS TCH/AHS7.95 | (FER) | 27 % | 23 % | 23 % | 23 % | 20 % |
| | Class Ib (RBER) | 0,85 % | 2,2 % | 2,3 % | 2,3 % | 2,1 % |
| | Class II (RBER) | 1,7 % | 5,1 % | 5,1 % | 5,1 % | 5,1 % |
| | (FER@+3dB) | 14 % | 7 % | 6,7 % | 6,7 % | 6,5 % |
| | Class Ib (RBER@+3dB) | 0,49 % | 1 % | 1 % | 1 % | 0,98 % |
| | Class II (RBER@+3dB) | 1 % | 3,1 % | 3,1 % | 3,1 % | 3,1 % |
| BTS TCH/AHS7.4 | (FER) | 26 % | 18 % | 18 % | 18 % | 16 % |
| | Class Ib (RBER) | 0,69 % | 1,4 % | 1,4 % | 1,4 % | 1,3 % |
| | Class II (RBER) | 1,9 % | 5,4 % | 5,5 % | 5,5 % | 5,4 % |
| | (FER@+3dB) | 13 % | 5,2 % | 4,9 % | 4,9 % | 4,8 % |
| | Class Ib (RBER@+3dB) | 0,39 % | 0,51 % | 0,51 % | 0,51 % | 0,47 % |
| | Class II (RBER@+3dB) | 1,2 % | 3,3 % | 3,3 % | 3,3 % | 3,3 % |
| BTS TCH/AHS6.7 | (FER) | 23 % | 12 % | 12 % | 12 % | 9,9 % |
| | Class Ib (RBER) | 0,71 % | 1,2 % | 1,2 % | 1,2 % | 1 % |
| | Class II (RBER) | 2,3 % | 6 % | 6 % | 6 % | 6 % |
| | (FER@+3dB) | 11 % | 2,7 % | 2,5 % | 2,5 % | 2,5 % |
| | Class Ib (RBER@+3dB) | 0,39 % | 0,39 % | 0,38 % | 0,38 % | 0,37 % |
| | Class II (RBER@+3dB) | 1,4 % | 3,5 % | 3,5 % | 3,5 % | 3,5 % |
| BTS TCH/AHS5.9 | (FER) | 21 % | 7,8 % | 7,7 % | 7,7 % | 6,4 % |
| | Class Ib (RBER) | 0,55 % | 0,59 % | 0,6 % | 0,6 % | 0,48 % |
| | Class II (RBER) | 2,6 % | 6,3 % | 6,4 % | 6,4 % | 6,3 % |
| (continued) | | | | | | |

### Table 2 (concluded): Reference interference performance

| DCS 1 800 & PCS 1 900 | | | | | |
|---|---|---|---|---|---|
| **Type of channel** | **Propagation conditions** | | | | |
| | **TU1,5 (no FH)** | **TU1,5 (ideal FH)** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA130 (no FH)** |
| BTS TCH/AHS5.15 (FER) | 17 % | 3,8 % | 3,8 % | 3,8 % | 3,1 % |
| Class Ib (RBER) | 0,8 % | 0,65 % | 0,66 % | 0,66 % | 0,53 % |
| Class II (RBER) | 3,1 % | 6,7 % | 6,8 % | 6,8 % | 6,6 % |
| BTS TCH/AHS4.75 (FER) | 15 % | 2,2 % | 2,1 % | 2,1 % | 1,8 % |
| Class Ib (RBER) | 0,6 % | 0,25 % | 0,25 % | 0,25 % | 0,19 % |
| Class II (RBER) | 3,6 % | 6,9 % | 7 % | 7 % | 6,8 % |
| MS TCH/AHS-INB (FER) | 2,8 % | 0,76 % | 0,83 % | 0,71 % | 1 % |
| (FER@-3dB) | 5,9 % | 2,2 % | 2,2 % | 2,2 % | 2,5 % |
| MS TCH/AHS (EVSIDUR) | 15 % | 3,1 % | 3,1 % | 3,1 % | 3,5 % |
| (EVSIDUR@-3dB) | 28 % | 15 % | 15 % | 15 % | 14 % |
| MS TCH/AHS (EVRFR) | 11 % | 0,55 % | 1,1 % | 0,53 % | 0,52 % |
| (EVRFR @ -3dB) | 22 % | 4,3 % | 7 % | 4,5 % | 5 % |
| BTS TCH/AHS-INB (FER) | 2,8 % | 0,76 % | 0,71 % | 0,71 % | 0,6 % |
| (FER@-3dB) | 5,9 % | 2,2 % | 2,2 % | 2,2 % | 1,8 % |
| BTS TCH/AHS (EVSIDUR) | 15 % | 3,1 % | 3,1 % | 3,1 % | 3,5 % |
| (EVSIDUR@-3dB) | 28 % | 15 % | 15 % | 15 % | 14 % |
| BTS TCH/AHS (EVRFR) | 11 % | 0,55 % | 0,53 % | 0,53 % | 0,52 % |
| (EVRFR @ -3dB) | 22 % | 4,3 % | 4,5 % | 4,5 % | 3,8 % |

NOTE 1: The specification for SDCCH applies also for BCCH, AGCH, PCH, SACCH. The actual performance of SACCH, particularly for the C/I TU3 (no FH) and TU 1.5 (no FH) cases should be better.

NOTE 2: Definitions:

- FER: Frame erasure rate (frames marked with BFI=1).
- FER@-3dB: Frame erasure rate for an input signal level 3 dB below the reference interference level.
- FER@+3dB: Frame erasure rate for an input signal level 3 dB above the reference interference level.
- UFR: Unreliable frame rate (frames marked with (BFI or UFI)=1).
- EVSIDR: Erased Valid SID frame rate (frames marked with (SID=0) or (SID=1) or ((BFI or UFI)=1) if a valid SID frame was transmitted).
- EVSIDUR: Erased Valid SID_UPDATE frame rate associated to an adaptive speech traffic channel.
- EVSIDUR@-3dB:Erased Valid SID_UPDATE frame rate associated to an adaptive speech traffic channel for an input signal level 3 dB below the reference interence level.
- ESIDR: Erased SID frame rate (frames marked with SID=0 if a valid SID frame was transmitted).
- EVRFR: Erased Valid RATSCCH frame rate associated to an adaptive speech traffic channel. This relates to the erasure of the RATSCCH message due to the failure to detect the RATSCCH identifier or due to a CRC failure.
- EVRFR@-3dB: Erased Valid RATSCCH frame rate associated to an adaptive speech traffic channel for an input signal level 3 dB below the reference interence level.
- BER: Bit error rate.
- RBER, BFI=0: Residual bit error rate (defined as the ratio of the number of errors detected over the frames defined as "good" to the number of transmitted bits in the "good" frames).
- RBER@-3dB: Residual bit error rate for an input signal level 3 dB below the reference interference level.
- RBER@+3dB: Residual bit error rate for an input signal level 3 dB above the reference interference level.
- RBER, (BFI or UFI)=0: Residual bit error rate (defined as the ratio of the number of errors detected over the frames defined as "reliable" to the number of transmitted bits in the "reliable" frames).
- RBER, SID=2 and (BFI or UFI)=0: Residual bit error rate of those bits in class I which do not belong to the SID codeword (defined as the ratio of the number of errors detected over the frames that are defined as "valid SID frames" to the number of transmitted bits in these frames, under the condition that a valid SID frame was sent).
- RBER, SID=1 or SID=2: Residual bit error rate of those bits in class I which do not belong to the SID codeword (defined as the ratio of the number of errors detected over the frames that are defined as "valid SID frames" or as "invalid SID frames" to the number of transmitted bits in these frames, under the condition that a valid SID frame was sent).
- TCH/AxS-INB FER: The frame error rate for the in-band channel. Valid for both Mode Indication and Mode Command/Mode Request. When testing all four code words shall be used an equal amount of time and the mode of both in-band channels (Mode Indication and Mode Command/Mode Request) shall be changed to a neighbouring mode not more often than every 22 speech frames (440 ms).

NOTE 3: $1 \leq \alpha \leq 1.6$. The value of $\alpha$ can be different for each channel condition but must remain the same for FER and class Ib RBER measurements for the same channel condition.

NOTE 4: FER for CCHs takes into account frames which are signalled as being erroneous (by the FIRE code, parity bits, or other means) or where the stealing flags are wrongly interpreted.

NOTE 5: Ideal FH case assumes perfect decorrelation between bursts. This case may only be tested if such a decorrelation is ensured in the test. For TU50 (ideal FH), sufficient decorrelation may be achieved with 4

| | |
|---|---|
| | frequencies spaced over 5 MHz. The TU3 (ideal FH) and TU1.5 (ideal FH), sufficient decorrelation cannot easily be achieved. These performance requirements are given for information purposes and need not be tested. |
| NOTE 6: | For AMR, the complete conformance should not be restricted to the channels identified with (*). |

**Table 2a: Interference ratio at reference performance**

| GSM 900 | | | | | | |
|---|---|---|---|---|---|---|
| **Type of channel** | | **Propagation conditions** | | | | |
| | | **TU3 (no FH)** | **TU3 (ideal FH)** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA250 (no FH)** |
| PDTCH/CS-1 | dB | 13 | 9 | 10 | 9 | 9 |
| PDTCH/CS-2 | dB | 15 | 13 | 14 | 13 | 13 |
| PDTCH/CS-3 | dB | 16 | 15 | 16 | 15 | 16 |
| PDTCH/CS-4 | dB | 21 | 23 | 24 | 24 | * |
| USF/CS-1 | dB | 19 | 10 | 12 | 10 | 10 |
| USF/CS-2 to 4 | dB | 18 | 9 | 10 | 9 | 8 |
| PRACH/11 bits | dB | 8 | 8 | 8 | 8 | 10 |
| PRACH/8 bits | dB | 8 | 8 | 8 | 8 | 9 |
| **DCS 1 800** | | | | | | |
| **Type of channel** | | **Propagation conditions** | | | | |
| | | **TU1,5 (no FH)** | **TU1,5 (ideal FH)** | **TU50 (no FH)** | **TU50 (ideal FH)** | **RA130 (no FH)** |
| PDTCH/CS-1 | dB | 13 | 9 | 9 | 9 | 9 |
| PDTCH/CS-2 | dB | 15 | 13 | 13 | 13 | 13 |
| PDTCH/CS-3 | dB | 16 | 15 | 16 | 16 | 16 |
| PDTCH/CS-4 | dB | 21 | 23 | 27 | 27 | * |
| USF/CS-1 | dB | 19 | 10 | 10 | 10 | 10 |
| USF/CS-2 to 4 | dB | 18 | 9 | 9 | 9 | 7 |
| PRACH/11 bits | dB | 9 | 9 | 9 | 9 | 10 |
| PRACH/8 bits | dB | 8 | 8 | 8 | 8 | 9 |

| | |
|---|---|
| NOTE 1: | The specification for PDTCH/CS-1 applies also for PACCH, PBCCH, PAGCH, PPCH, PTCCH/D, PNCH. |
| NOTE 2: | Ideal FH case assumes perfect decorrelation between bursts. This case may only be tested if such a decorrelation is ensured in the test. For TU50 (ideal FH), sufficient decorrelation may be achieved with 4 frequencies spaced over 5 MHz. The TU3 (ideal FH) and TU1.5 (ideal FH), sufficient decorrelation cannot easily be achieved. These performance requirements are given for information purposes and need not be tested. |
| NOTE 3: | PDTCH/CS-4 can not meet the reference performance for some propagation conditions (*). |

# Annex A (informative): Spectrum characteristics (spectrum due to the modulation)

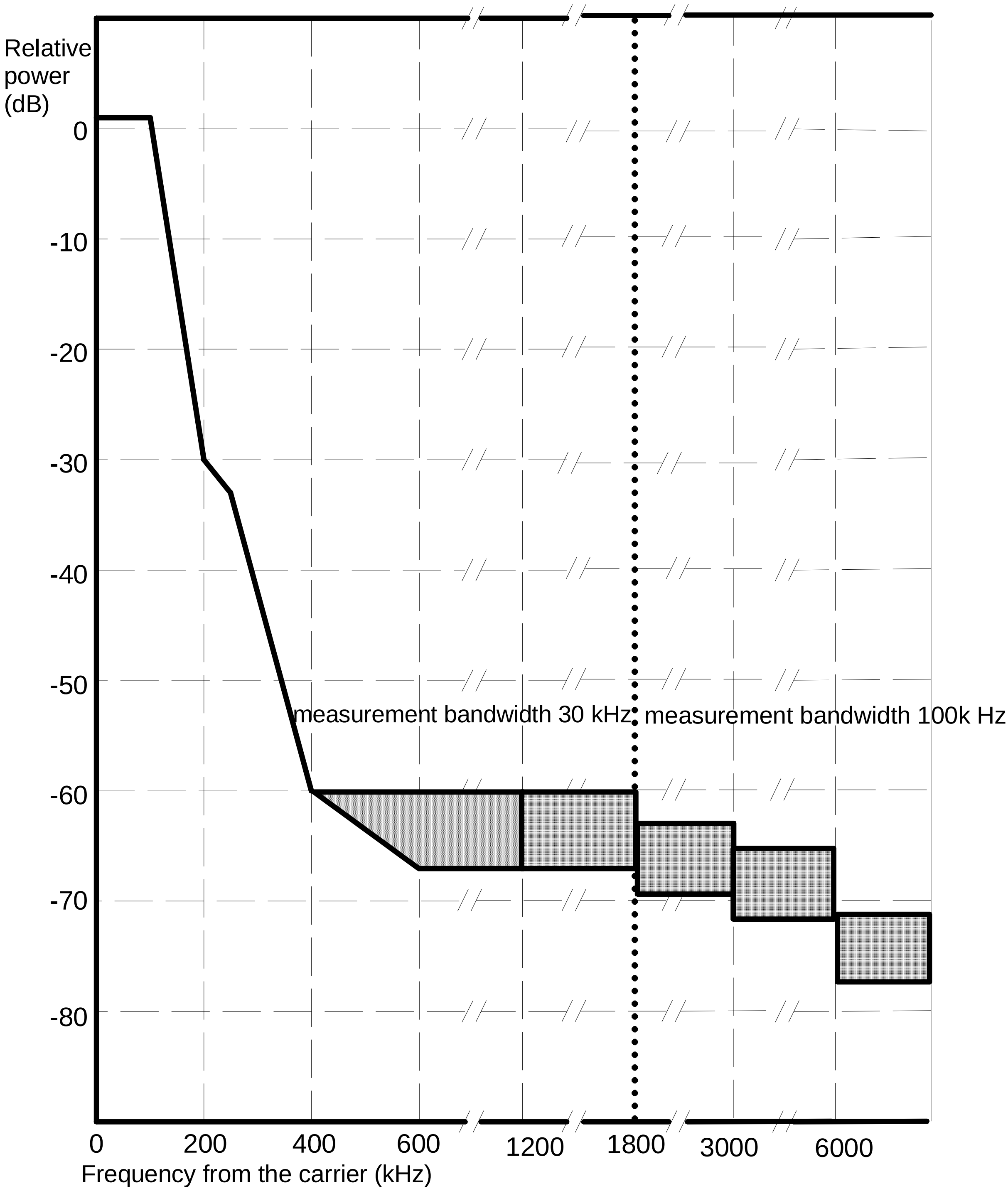



**Figure A.1: GSM 900 MS spectrum due to modulation**

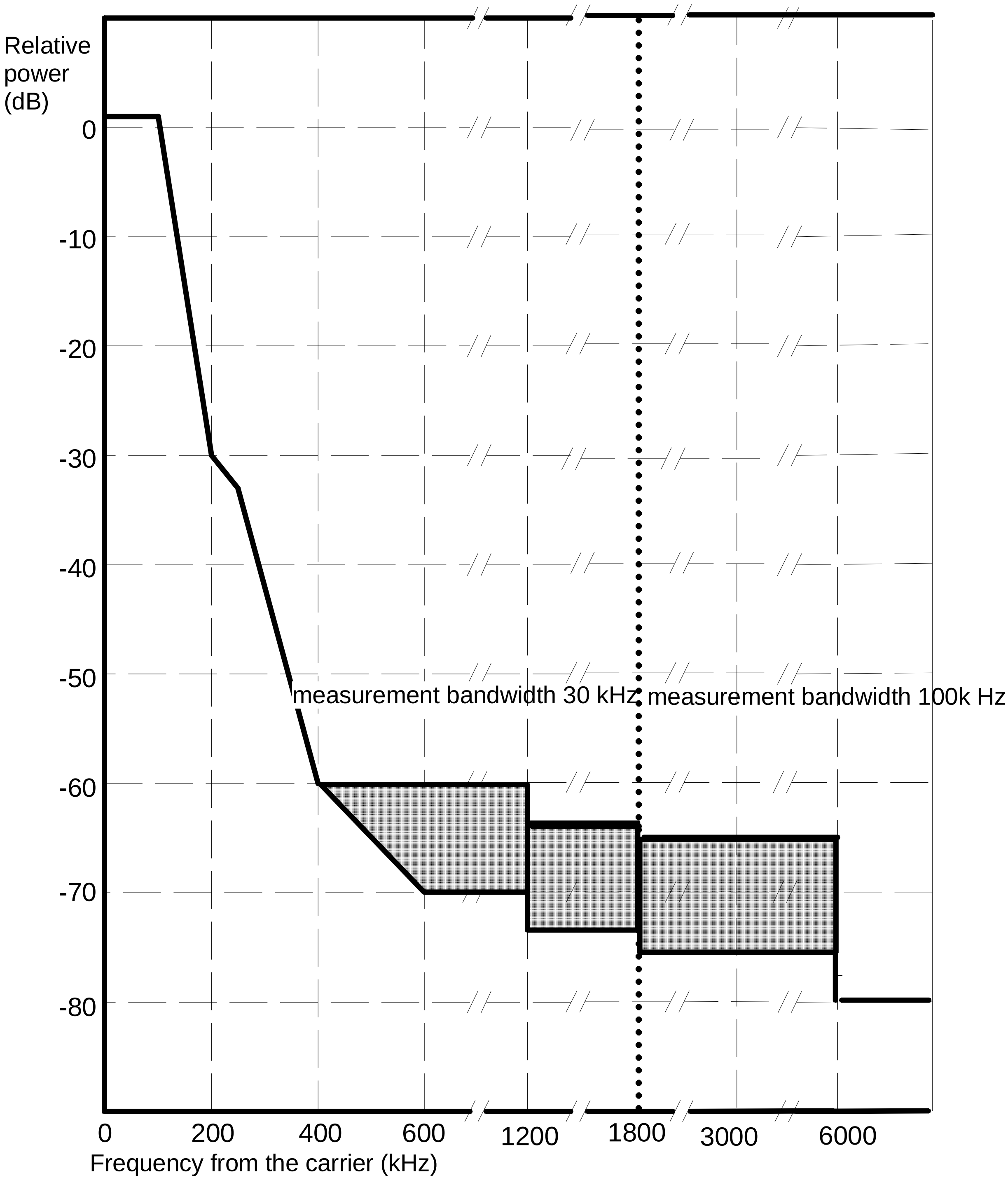



**Figure A.2: GSM 900 BTS spectrum due to modulation**

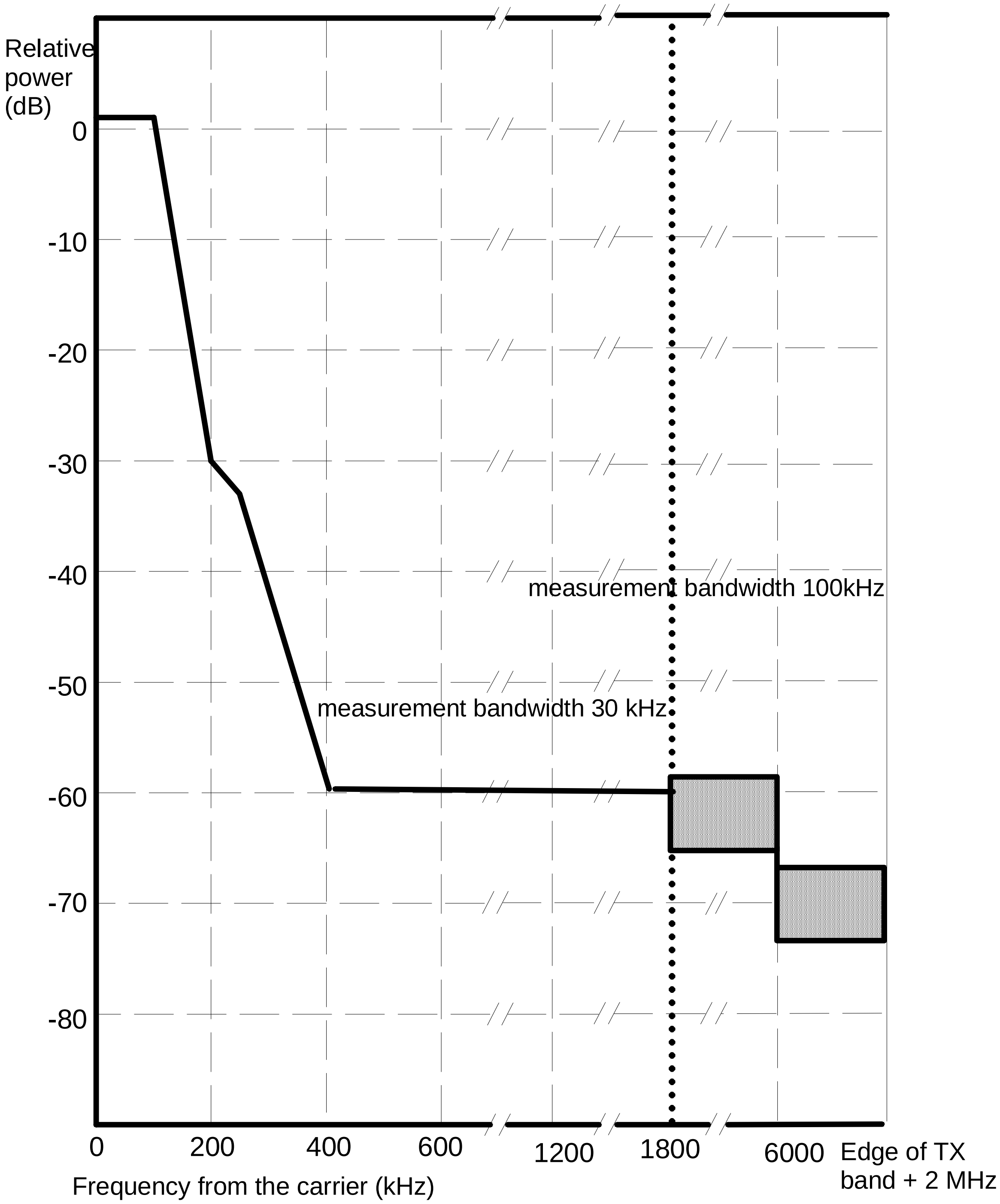



**Figure A.3: DCS 1 800 MS spectrum due to modulation**

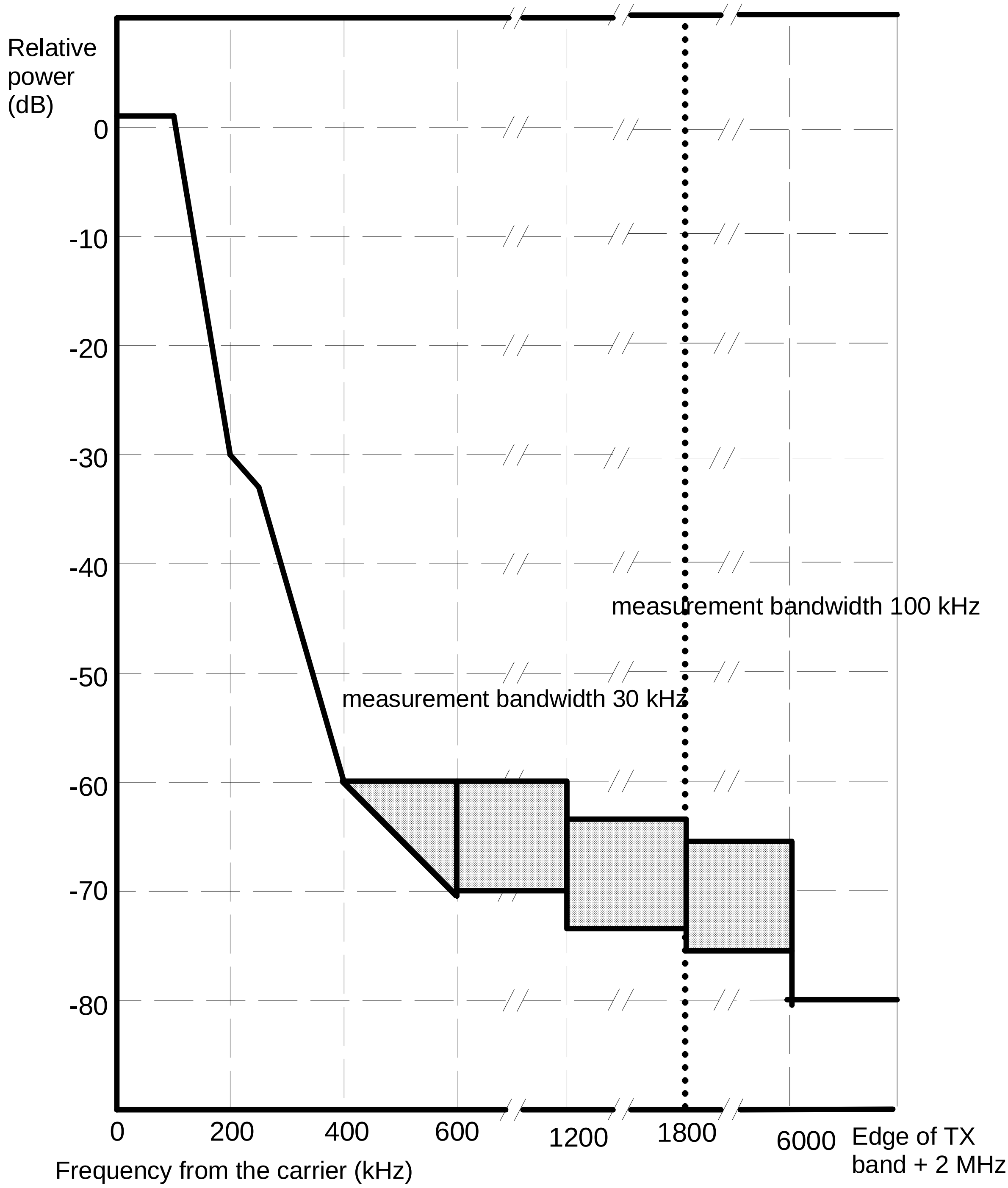



**Figure A.4: DCS 1 800 BTS spectrum due to modulation**

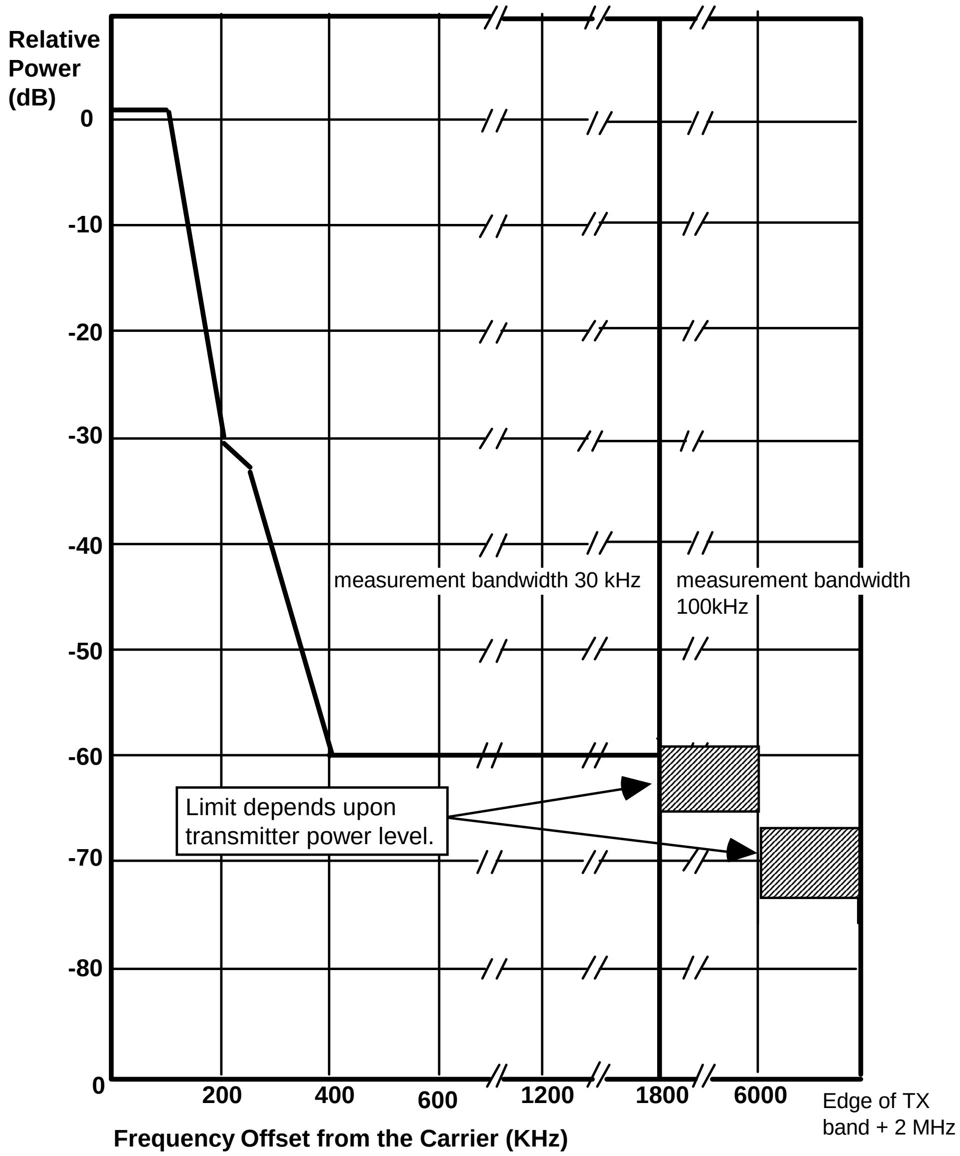



**Figure A.5 PCS 1 900 MS Modulation & Noise Spectrum Mask**

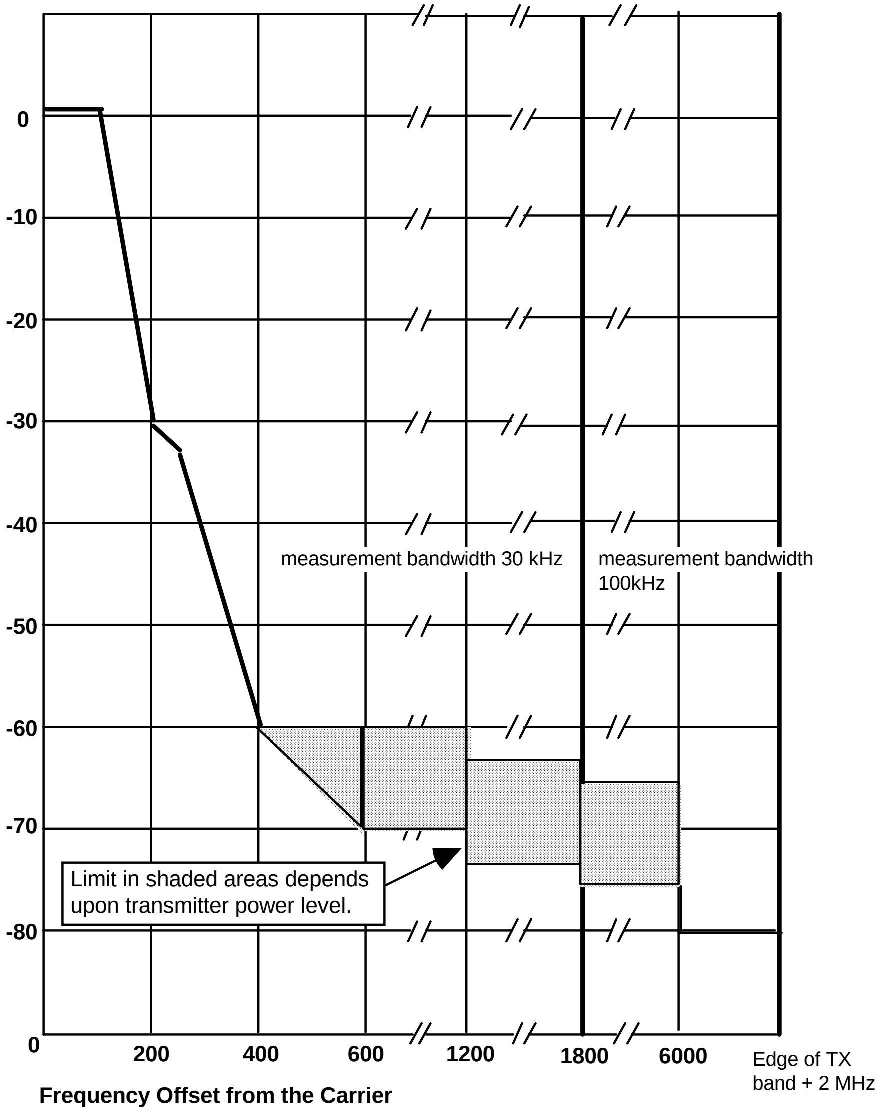
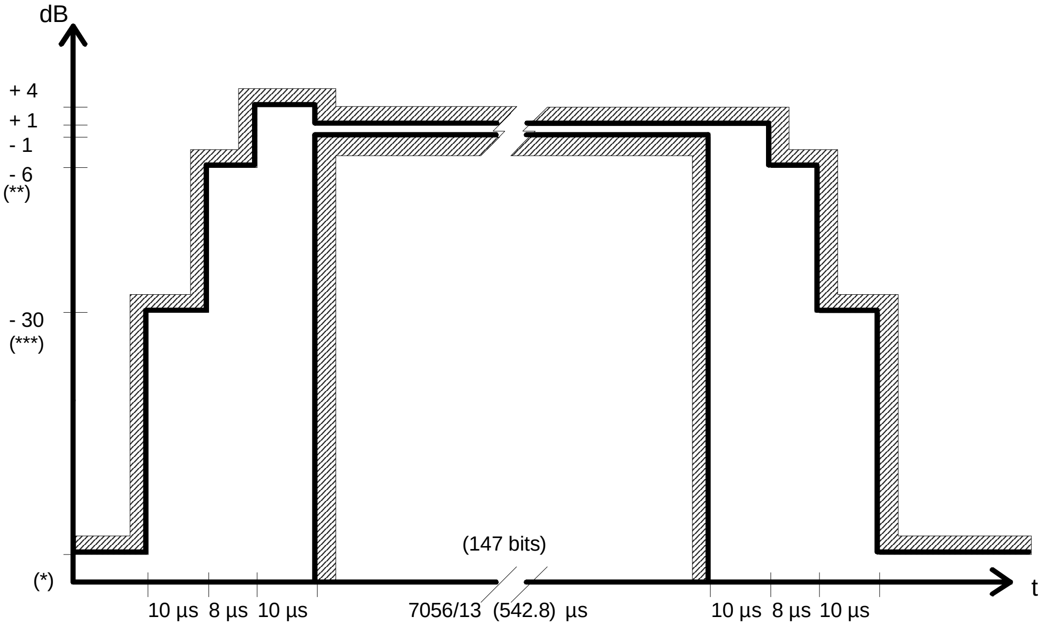
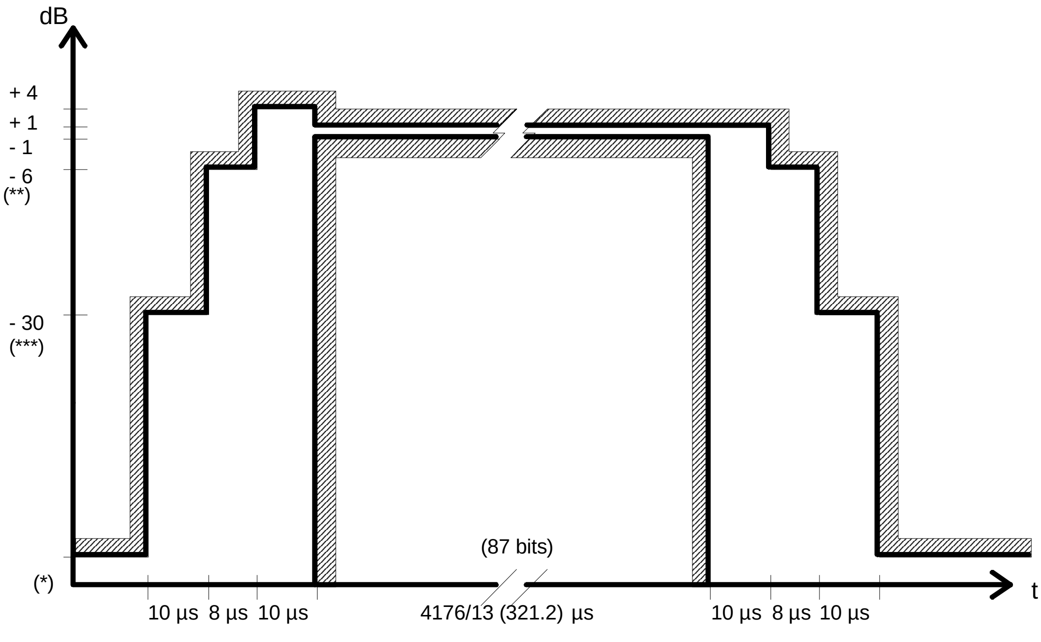



**Figure A.6 PCS 1 900 BTS Modulation & Noise Spectrum Mask**

# Annex B (normative): Transmitted power level versus time

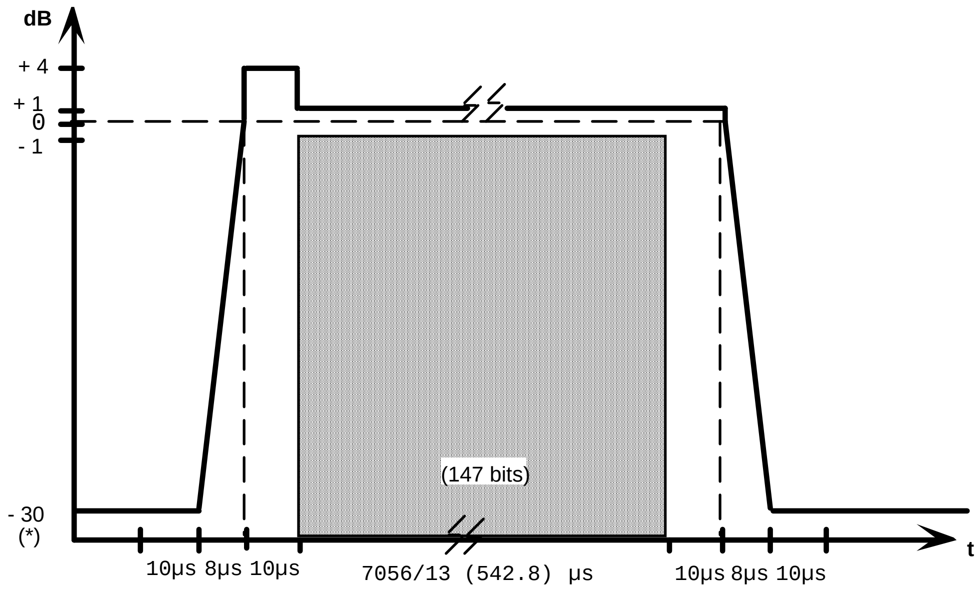



**Time mask for normal duration bursts (NB, FB, dB and SB)**




Time mask for access burst (AB)

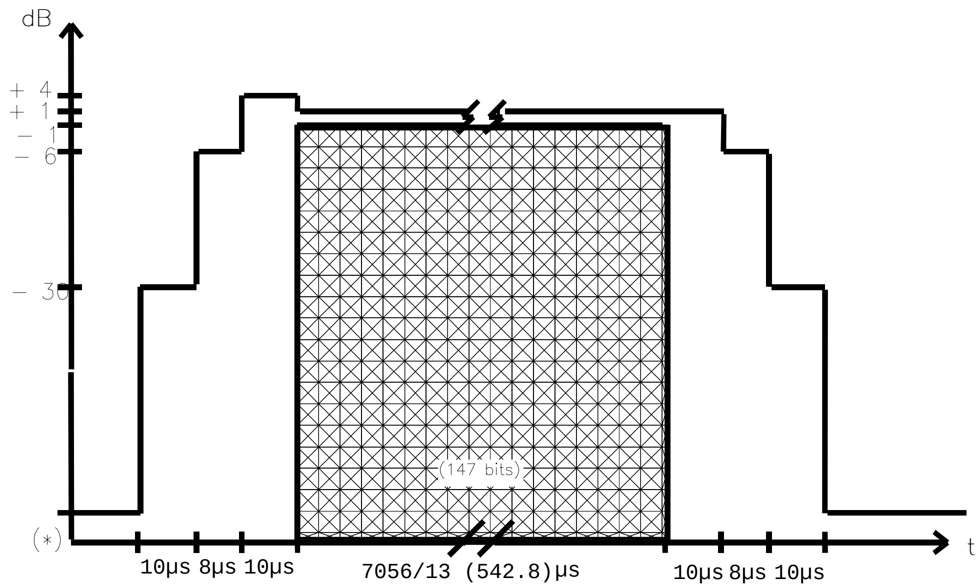
| | | | |
|---|---|---|---|
| (*) | For GSM 900 MS | : | see subclause 4.5.2. |
| | For DCS 1 800 MS | : | -48 dBc or -48 dBm, whichever is the higher. |
| | For GSM 900 BTS and DCS 1 800 BTS | : | no requirement below -30 dBc (see subclause 4.5.1). |
| (**) | For GSM 900 MS | : | -4 dBc for power control level 16;<br>-2 dBc for power level 17;<br>-1 dBc for power level controls levels 18 and 19. |
| | For DCS 1 800 MS | | -4dBc for power control level 11,<br>-2dBc for power level 12,<br>-1dBc for power control levels 13,14 and 15 |
| (***) | For GSM 900 MS | : | -30 dBc or -17 dBm, whichever is the higher. |
| | For DCS 1 800 MS | | -30dBc or -20dBm, whichever is the higher. |




(*) For BTS: -30 dBc referenced to dynamic power step 0
See text in 5.3.7.1 above for exceptions.

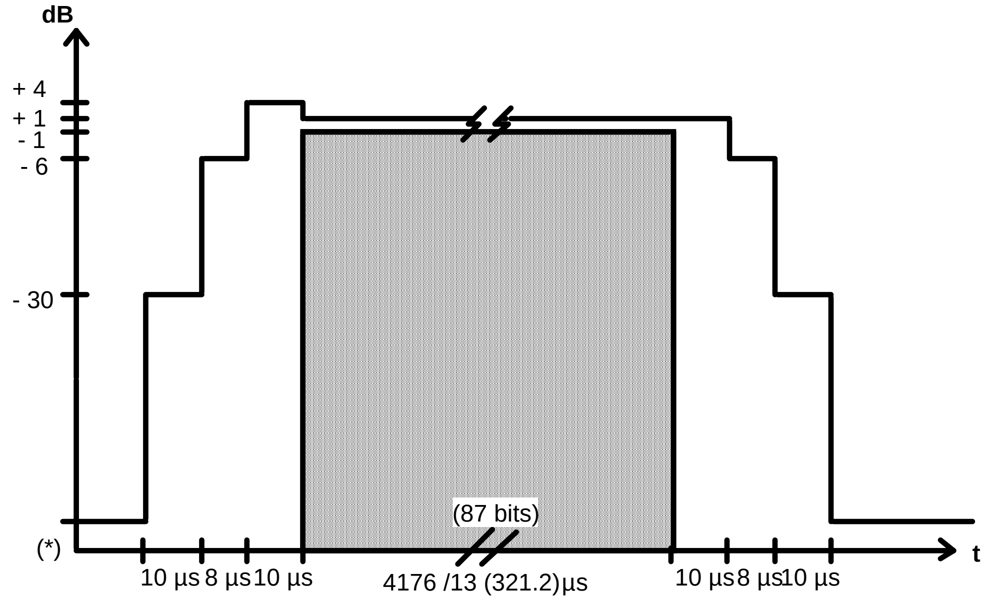
Dashed Lines indicate reference points only

**PCS 1 900 BTS Transmitter Time Mask**




(*) For MS: − 48 dBc or − 48 dBm, whichever is the higher.

**PCS 1 900 MS Normal Burst Time Mask**




(*) For MS: - 48 dBc or - 48 dBm, whichever is the higher.

**PCS 1 900 MS Access Burst Time Mask**

# Annex C (normative): Propagation conditions

# C.1 Simple wideband propagation model

Radio propagation in the mobile radio environment is described by highly dispersive multipath caused by reflection and scattering. The paths between base station and MS may be considered to consist of large reflectors and/or scatterers some distance to the MS, giving rise to a number of waves that arrive in the vicinity of the MS with random amplitudes and delays.

Close to the MS these paths are further randomized by local reflections or diffractions. Since the MS will be moving, the angle of arrival must also be taken into account, since it affects the doppler shift associated with a wave arriving from a particular direction. Echos of identical delays arise from reflectors located on an ellipse.

The multipath phenomenon may be described in the following way in terms of the time delays and the doppler shifts associated with each delay:

$$z(t) = \iint_{R^2} y(t - T)S(T, f)\exp(2i\pi fT)dfdT$$

where the terms on the right-hand side represent the delayed signals, their amplitudes and doppler spectra.

It has been shown that the criterion for wide sense stationarity is satisfied for distances of about 10 metres. Based on the wide sense stationary uncorrelated scattering (WSSUS) model, the average delay profiles and the doppler spectra are necessary to simulate the radio channel.

In order to allow practical simulation, the different propagation models will be presented here in the following terms:

1) a discrete number of taps, each determined by their time delay and their average power;

2) the Rayleigh distributed amplitude of each tap, varying according to a doppler spectrum S(f).

# C.2 Doppler spectrum types

In this clause, we define the two types of doppler spectra which will be used for the modelling of the channel. Throughout this clause the following abbreviations will be used:

- $f_d = v/\lambda$, represents the maximum doppler shift, with v (in $ms^{-1}$) representing the vehicle speed, and $\lambda$ (in m) the wavelength.

The following types are defined:

a) CLASS is the classical doppler spectrum and will be used in all but one case;

(CLASS) $S(f) = A/(1-(f/f_d)^2)^{0.5}$ for $f \in -f_d, f_d$;

b) RICE is the sum of a classical doppler spectrum and one direct path, such that the total multipath contribution is equal to that of the direct path. This power spectrum is used for the shortest path of the RA model;

(RICE) $S(f) = 0{,}41/(2\pi f_d(1-(f/f_d)^2)^{0{,}5}) + 0{,}91\,\delta(f - 0{,}7 f_d)$ for $f \in ]-f_d, f_d.[$

# C.3 Propagation models

In this clause the propagation models that are mentioned in the main body of 3GPP TS 05.05 are defined. As a general principle those models are referred to as NAMEx, where NAME is the name of the particular model, which is defined thereunder, and x is the vehicle speed (in km/h) which impacts on the definition of fd (see clause C.2) and hence on the doppler spectra.

Those models are usually defined by 12 tap settings; however, according to the simulators available it may not be possible to simulate the complete model. Therefore a reduced configuration of 6 taps is also defined in those cases. This reduced configuration may be used in particular for the multipath simulation on an interfering signal. Whenever possible the full configuration should be used. For each model two equivalent alternative tap settings, indicated respectively by (1) and (2) in the appropriate columns, are given.

## C.3.1 Typical case for rural area (RAx): (6 tap setting)

| **Tap number** | **Relative time (μs)** | | **Average relative power (dB)** | | **doppler spectrum** |
|---|---|---|---|---|---|
| | (1) | (2) | (1) | (2) | |
| 1 | 0,0 | 0,0 | 0,0 | 0,0 | RICE |
| 2 | 0,1 | 0,2 | -4,0 | -2,0 | CLASS |
| 3 | 0,2 | 0,4 | -8,0 | -10,0 | CLASS |
| 4 | 0,3 | 0,6 | -12,0 | -20,0 | CLASS |
| 5 | 0,4 | - | -16,0 | - | CLASS |
| 6 | 0,5 | - | -20,0 | - | CLASS |

## C.3.2 Typical case for hilly terrain (HTx): (12 tap setting)

| **Tap number** | **Relative time (μs)** | | **Average relative power (dB)** | | **doppler spectrum** |
|---|---|---|---|---|---|
| | (1) | (2) | (1) | (2) | |
| 1 | 0,0 | 0,0 | -10,0 | -10,0 | CLASS |
| 2 | 0,1 | 0,2 | -8,0 | -8,0 | CLASS |
| 3 | 0,3 | 0,4 | -6,0 | -6,0 | CLASS |
| 4 | 0,5 | 0,6 | -4,0 | -4,0 | CLASS |
| 5 | 0,7 | 0,8 | 0,0 | 0,0 | CLASS |
| 6 | 1,0 | 2,0 | 0,0 | 0,0 | CLASS |
| 7 | 1,3 | 2,4 | -4,0 | -4,0 | CLASS |
| 8 | 15,0 | 15,0 | -8,0 | -8,0 | CLASS |
| 9 | 15,2 | 15,2 | -9,0 | -9,0 | CLASS |
| 10 | 15,7 | 15,8 | -10,0 | -10,0 | CLASS |
| 11 | 17,2 | 17,2 | -12,0 | -12,0 | CLASS |
| 12 | 20,0 | 20,0 | -14,0 | -14,0 | CLASS |

The reduced setting (6 taps) is defined thereunder.

| **Tap number** | **Relative time (μs)** | | **Average relative power (dB)** | | **doppler spectrum** |
|---|---|---|---|---|---|
| | (1) | (2) | (1) | (2) | |
| 1 | 0,0 | 0,0 | 0,0 | 0,0 | CLASS |
| 2 | 0,1 | 0,2 | -1,5 | -2,0 | CLASS |
| 3 | 0,3 | 0,4 | -4,5 | -4,0 | CLASS |
| 4 | 0,5 | 0,6 | -7,5 | -7,0 | CLASS |
| 5 | 15,0 | 15,0 | -8,0 | -6,0 | CLASS |
| 6 | 17,2 | 17,2 | -17,7 | -12,0 | CLASS |

## C.3.3 Typical case for urban area (TUx): (12 tap setting)

| Tap number | Relative time (µs) | | Average relative power (dB) | | doppler spectrum |
|---|---|---|---|---|---|
| | (1) | (2) | (1) | (2) | |
| 1 | 0,0 | 0,0 | -4,0 | -4,0 | CLASS |
| 2 | 0,1 | 0,2 | -3,0 | -3,0 | CLASS |
| 3 | 0,3 | 0,4 | 0,0 | 0,0 | CLASS |
| 4 | 0,5 | 0,6 | -2,6 | -2,0 | CLASS |
| 5 | 0,8 | 0,8 | -3,0 | -3,0 | CLASS |
| 6 | 1,1 | 1,2 | -5,0 | -5,0 | CLASS |
| 7 | 1,3 | 1,4 | -7,0 | -7,0 | CLASS |
| 8 | 1,7 | 1,8 | -5,0 | -5,0 | CLASS |
| 9 | 2,3 | 2,4 | -6,5 | -6,0 | CLASS |
| 10 | 3,1 | 3,0 | -8,6 | -9,0 | CLASS |
| 11 | 3,2 | 3,2 | -11,0 | -11,0 | CLASS |
| 12 | 5,0 | 5,0 | -10,0 | -10,0 | CLASS |

The reduced TUx setting (6 taps) is defined thereunder.

| Tap number | Relative time (µs) | | Average relative power (dB) | | doppler spectrum |
|---|---|---|---|---|---|
| | (1) | (2) | (1) | (2) | |
| 1 | 0,0 | 0,0 | -3,0 | -3,0 | CLASS |
| 2 | 0,2 | 0,2 | 0,0 | 0,0 | CLASS |
| 3 | 0,5 | 0,6 | -2,0 | -2,0 | CLASS |
| 4 | 1,6 | 1,6 | -6,0 | -6,0 | CLASS |
| 5 | 2,3 | 2,4 | -8,0 | -8,0 | CLASS |
| 6 | 5,0 | 5,0 | -10,0 | -10,0 | CLASS |

## C.3.4 Profile for equalization test (EQx): (6 tap setting)

| Tap number | Relative time (µs) | Average relative power (dB) | doppler spectrum |
|---|---|---|---|
| 1 | 0,0 | 0,0 | CLASS |
| 2 | 3,2 | 0,0 | CLASS |
| 3 | 6,4 | 0,0 | CLASS |
| 4 | 9,6 | 0,0 | CLASS |
| 5 | 12,8 | 0,0 | CLASS |
| 6 | 16,0 | 0,0 | CLASS |

## C.3.5 Typical case for very small cells (TIx): (2 tap setting)

| Tap number | Relative time (µs) | Average relative power (dB) | Doppler spectrum |
|---|---|---|---|
| 1 | 0.0 | 0.0 | CLASS |
| 2 | 0.4 | 0.0 | CLASS |

# Annex D (normative): Environmental conditions

# D.1 General

This normative annex specifies the environmental requirements of GSM 900 and DCS 1 800, both for MS and BSS equipment, Within these limits the requirements of the GSM specifications shall be fulfilled.

# D.2 Environmental requirements for the MSs

The requirements in this clause apply to all types of MSs.

## D.2.1 Temperature (GSM 900 and DCS 1 800)

The MS shall fulfil all the requirements in the full temperature range of:

+15°C - +35°C for normal conditions (with relative humidity of 25 % to 75 %);

-10°C - +55°C for DCS 1 800 MS and small MS units extreme conditions (see IEC publications 68-2-1 and 68-2-2);

-20°C - +55°C for other units extreme conditions (see IEC publications 68-2-1 and 68-2-2).

Outside this temperature range the MS, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the MS exceed the transmitted levels as defined in 3GPP TS 05.05 for extreme operation.

### D.2.1.1 Environmental Conditions (PCS 1 900)

Normal environmental conditions are defined as any combination of the following:

| | |
|---|---|
| Temperature Range | +15°C to +35°C |
| Relative Humidity | 35% to 75% |
| Air Pressure | 86 kPa to 106 kPa |

Extreme operating temperature ranges depend on the specific manufacturer and application, but typical ranges are as follows:

MS Temperature Range: -10°C to +55°C

## D.2.2 Voltage

The MS shall fulfil all the requirements in the full voltage range, i.e. the voltage range between the extreme voltages.

The manufacturer shall declare the lower and higher extreme voltages and the approximate shut-down voltage. For the equipment that can be operated from one or more of the power sources listed below, the lower extreme voltage shall not be higher, and the higher extreme voltage shall not be lower than that specified below.

| Power source | Lower extreme voltage | Higher extreme voltage | Normal cond. voltage |
|---|---|---|---|
| AC mains | 0,9 * nominal | 1,1 * nominal | nominal |
| Regulated lead acid battery | 0,9 * nominal | 1,3 * nominal | 1,1 * nominal |
| Non regulated batteries: | | | |
| Leclanché/lithium | 0,85 * nominal | nominal | nominal |
| mercury/nickel cadmium | 0,9 * nominal | nominal | nominal |

Outside this voltage range the MS, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the MS exceed the transmitted levels as defined in 3GPP TS 05.05 for extreme operation. In particular, the MS shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shut-down voltage.

### D.2.3 Vibration (GSM 900 and DCS 1 800)

The MS shall fulfil all the requirements when vibrated at the following frequency/amplitudes:

| **Frequency** | **ASD (Acceleration Spectral Density) random vibration** |
|---|---|
| 5 Hz to 20 Hz | 0,96 $m^2/s^3$ |
| 20 Hz to 500 Hz | 0,96 $m^2/s^3$ at 20 Hz, thereafter -3 dB/Octave |

(see IEC publication 68-2-36)

Outside the specified frequency range the MS, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the MS exceed the transmitted levels as defined in 3GPP TS 05.05 for extreme operation.

#### D.2.3.1 Vibration (PCS 1 900)

10 Hz to 100 Hz: 3 m2/s3 (0.0132 g2/Hz)

100 Hz to 500 Hz: -3 dB/Octave

## D.3 Environmental requirements for the BSS equipment

This clause applies to both GSM 900 and DCS 1 800 BSS equipment.

The BSS equipment shall fulfil all the requirements in the full range of environmental conditions for the relevant environmental class from the relevant ETSs listed below:

EN 300 019-1-3: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment, Part 1-3: Classification of environmental conditions, Stationary use at weather protected locations".

EN 300 019-1-4: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment, Part 1-4: Classification of environmental conditions, Stationary use at non-weather protected locations".

The operator can specify the range of environmental conditions according to his needs.

Outside the specified range for any of the environmental conditions, the BTS shall not make ineffective use of the radio frequency spectrum. In no case shall the BTS exceed the transmitted levels as defined in 3GPP TS 05.05 for extreme operation.

## D.3.1 Environmental requirements for the BSS equipment

The following clause applies to the PCS 1 900 BSS.

Normal environmental conditions are defined as any combination of the following:

| | |
|---|---|
| Temperature Range | +15°C to +35°C |
| Relative Humidity | 35% to 75% |
| Air Pressure | 86 kPa to 106 kPa |

Extreme operating temperature ranges depend on the specific manufacturer and application, but typical ranges are as follows:

| | |
|---|---|
| BSS Indoor Temperature Range: | -5°C to +50°C |
| BSS Outdoor Temperature Range: | -40°C to +50°C |

# Annex E (normative): Repeater characteristics (GSM 900 and DCS 1800)

## E.1 Introduction

A repeater receives amplifies and transmits simultaneously both the radiated RF carrier in the downlink direction (from the base station to the mobile area) and in the uplink direction (from the mobile to the base station).

This annex details the minimum radio frequency performance of GSM/DCS 1 800 repeaters. The environmental conditions for repeaters are specified in annex D.3, of 3GPP TS 05.05. Further application dependant requirements on repeaters need to be considered by operators before they are deployed. These network planning aspects of repeaters are covered in 3GPP TS 03.30.

The following requirements apply to the uplink and downlink directions.

In clauses 2 and 3 the maximum output power per carrier is the value declared by the manufacturer.

BTS and MS transmit bands are as defined in clause 2 of 3GPP TS 05.05.

## E.2 Spurious emissions

At maximum repeater gain, with or without a continuous static sine wave input signal in the operating band of the repeater, at a level which produces the manufacturers maximum rated power output, the following requirements shall be met

The average power of any single spurious measured in a 3 kHz bandwidth shall be no greater than:

- 250 nW (-36 dBm) in the relevant MS and BTS transmit frequency bands for a GSM repeater at offsets of > 100 kHz from the carrier.

- 1 μW (-30 dBm) in the relevant MS and BTS transmit frequency bands for a DCS 1 800 repeater at offsets of > 100 kHz from the carrier.

Outside of the relevant transmit bands the power measured in the bandwidths according to table E.1 below, shall be no greater than:

- 250 NW (-36 dBm) in the frequency band 9 kHz to 1 GHz;

- 1 μW (-30 dBm) in the frequency band 1 GHz to 12,75 GHz.

**Table E.1**

| Band | Frequency offset | Measurement bandwidth |
|---|---|---|
| 100 kHz - 50 MHz | - | 10 kHz |
| 50 MHz - 500 MHz | - | 100 kHz |
| above 500 MHz outside the relevant BTS Transmit band or MS transmit band | (offset from edge of the relevant above band) | |
| | > 0 MHz | 10 kHz |
| | ≥ 2 MHz | 30 kHz |
| | ≥ 5 MHz | 100 kHz |
| | ≥ 10 MHz | 300 kHz |
| | ≥ 20 MHz | 1 MHz |
| | ≥ 30 MHz | 3 MHz |

The requirement applies to all ports of the repeater.

NOTE: For radiated spurious emissions, the specifications currently only apply to the frequency band 30 MHz to 4 GHz. The specification and method of measurement outside this band are under consideration.

# E.3 Intermodulation products

At maximum repeater gain, with two continuous static sine wave input signals in the operating band of the repeater, at equal levels which produce the maximum rated power output per carrier, the average power of any intermodulation products measured in a 3 kHz bandwidth shall be no greater than:

- 250 nW (-36 dBm) in the frequency band 9 kHz to 1 GHz;
- 1 μW (-30 dBm) in the frequency band 1 GHz to 12,75 GHz.

When the two input signals are simultaneously increased by 10 dB each, the requirements shall still be met.

The requirement applies to all ports of the repeater.

# E.4 Out of band gain

The following requirements apply at all frequencies from 9 kHz to 12.75 GHz excluding the relevant transmit bands.

The net out of band gain in both directions through the repeater shall be less than +50 dB at 400 kHz. +40 dB at 600 kHz, +35 dB at 1 MHz and +25 dB at 5 MHz offset and greater from the edges of the BTS and MS transmit bands.

In special circumstances additional filtering may be required out of band and reference should be made to 3GPP TS 03.30.

# E.5 Frequency error and phase error

This clause applies only to repeater systems using frequency shift. The single repeater as a sub unit within this repeater system has to comply with all specifications in this annex E.

The average frequency deviation of the output signal with respect to the input signal of the repeater system shall not be more than 0,1 ppm. The specified value applies to a complete repeater system signal path. Consequently a single repeater unit is limited to an average frequency deviation of not more than 0,05 ppm with respect to its wanted output frequency.

For a complete repeater system operating at the nominal output power as specified by the manufacturer shall the increase in phase error of a GSM input signal, which meets the phase error requirements of subclause 4.6, not exceed the values in subclause 4.6 by 2 degrees RMS and by 8 degrees peak. For a single repeater unit operating at the nominal output power as specified by the manufacturer shall the increase in phase error of a GSM input signal, which meets the phase error requirements of subclause 4.6, not exceed the values insubclause 4.6 by 1.1 degrees RMS and by 4.5 degrees peak.

# Annex F (normative): Antenna Feeder Loss Compensator Characteristics (GSM 900 and DCS 1800)

## F.1 Introduction

An Antenna Feeder Loss Compensator (AFLC) is physically connected between the MS and the antenna in a vehicle mounted installation. It amplifies the signal received in the downlink direction and the signal transmitted in the uplink direction, with a gain nominally equal to the loss of the feeder cable. Unless otherwise stated, the requirements defined in this specification apply to the full range of environmental conditions specified for the AFLC (see annex D2 of 3GPP TS 05.05).

This specification details the minimum radio frequency performance of GSM AFLC devices. The environmental conditions for the AFLC are specified in annex D.2 of 3GPP TS 05.05. It also includes informative guidelines on the use and design of the AFLC.

The following requirements apply to AFLC devices intended for use in the GSM 900 and DCS 1 800 frequency bands. For GSM 900, the requirements apply to an AFLC intended for use with a GSM 900 class mark 4 MS. For DCS 1 800, the requirements apply to an AFLC intended for use with a DCS 1 800 class mark 1 MS. For compatibility reasons, a GSM 900 AFLC is required to support the Extended GSM band.

The requirements apply to the AFLC, including all associated feeder and connecting cables. A 50 ohm measurement impedance is assumed.

When referred to in this specification:

- the maximum rated output power for a GSM 900 AFLC is +33 dBm and for a DCS 1 800 AFLC is +30 dBm;
- a GSM input signal, is a GMSK signal modulated with random data, which meets the performance requirements of 3GPP TS 05.05, for an MS of equivalent output power. The power level specified for the GSM input signal, is the power averaged over the useful part of the burst.

## F.2 Transmitting path

Unless otherwise stated, the requirements in this clause apply at all frequencies in the transmit band 880 MHz to 915 MHz for a GSM 900 AFLC, and at all frequencies in the transmit band 1 710 MHz to 1 785 MHz, for a DCS 1 800 AFLC. For a dual band AFLC, which supports both the GSM and DCS bands, the requirements apply in both transmit bands.

### F.2.1 Maximum output power

With a GSM input signal at a level of X dBm, the maximum output power shall be less than a level of Y dBm. The values of X and Y for GSM 900 and DCS 1 800 are given in table F.1.

**Table F.1: Input and output levels for testing maximum output power**

| | GSM 900 | DCS 1 800 |
|---|---|---|
| X | +39 dBm | +36 dBm |
| Y | +35 dBm | +32 dBm |

### F.2.2 Gain

With a GSM input signal, at a level which produces the maximum rated output power, the AFLC gain shall be 0 dB with a tolerance of ±1 dB, over the relevant transmit band.

For a GSM 900 AFLC, with the input level reduced in 14 steps of 2 dB, the net path gain over the relevant transmit band shall be 0 dB, with a tolerance of ±1 dB, for the first 10 reduced input levels and ±2 dB for the 4 lowest input levels.

For a DCS 1 800 AFLC, with the input level reduced in 15 steps of 2 dB, the net path gain over the relevant transmit band shall be 0 dB, with a tolerance of ±1 dB, for the first 13 reduced input levels and ±2 dB for the 2 lowest input levels.

In frequency bands which are not supported, the gain shall be no greater than the maximum value in the relevant transmit band.

# F.2.3 Burst transmission characteristics

With a GSM input signal, the shape of the GSM AFLC output signal related to this input signal shall meet the tolerances of tables F2a and F3. With a DCS input signal, the shape of the DCS AFLC shall meet the tolerances of tables F2b and F3.

NOTE: The tolerances on the output signal correspond to the time mask of 3GPP TS 05.05, with the input signal in the middle of the tolerance field.

**Table F.2a: Timing tolerances between input and output signals for a GSM AFLC**

| Input signal level | Input signal time | Output signal level | Tolerances - output signal time |
|---|---|---|---|
| -59 dBc (or -54 dBm whichever is greater) | t59 | -59 dBc | t59 ± 14 µs |
| -30 dBc | t30 | -30 dBc | t30 ± 9 µs |
| -6 dBc | t6 | -6 dBc | t6 ± 5 µs |

**Table F.2b: Timing tolerances between input and output signals for a DCS AFLC**

| Input signal level | Input signal time | Output signal level | Tolerances - output signal time |
|---|---|---|---|
| -48 dBc (or -48 dBm. whichever is greater) | t48 | -48 dBc | t48 ± 14 µs |
| -30 dBc | t30 | -30 dBc | t30 ± 9 µs |
| -6 dBc | t6 | -6 dBc | t6 ± 5 µs |

The input signal time is the time at which the input level crosses the corresponding signal level. The above requirements apply to both the rising and falling edge of the burst.

**Table F.3: Signal level tolerances for both GSM and DCS AFLC**

| Range | Tolerances - output signal level |
|---|---|
| t6..........t6 ± 5 µs (rising edge) | -6..........+4 dB |
| t6..........t6 ± 5 µs (falling edge) | -6..........+1 dB |
| 147 useful bits | ± 1 dB |

All input signal levels are relative to the average power level over the 147 useful bits of the input signal. All output signal levels are relative to the average power level over the 147 useful bits of the output signal.

# F.2.4 Phase error

The increase in phase error of a GSM input signal, which meets the phase error requirements of 3GPP TS 05.05, shall be no greater than 2 degrees RMS and 8 degrees peak.

## F.2.5 Frequency error

The increase in frequency error of a GSM input signal, which meets the frequency accuracy requirements of 3GPP TS 05.10, shall be no greater than 0,05 ppm.

## F.2.6 Group delay

The absolute value of the group delay (signal propagation delay) shall not exceed 500 ns.

## F.2.7 Spurious emissions

With a GSM input signal corresponding to a GSM classmark 2 MS, transmitting at +39 dBm for a GSM 900 AFLC, and a DCS classmark 3 MS, transmitting at +36 dBm for a DCS 1 800 AFLC, the peak power of any single spurious emission measured in a bandwidth according to table F.4, shall be no greater than -36 dBm in the relevant transmit band.

**Table F.4: Transmit band spurious emissions measurement conditions**

| Band | Frequency | Measurement bandwidth |
|---|---|---|
| relevant transmit band and < 2 MHz offset from band edge | offset from test signal freq.<br>≥ 1,8 MHz<br>≥ 6,0 MHz | <br>30 kHz<br>100 kHz |

Outside of this transmit band, the power measured in the bandwidths according to table F.5 below, shall be no greater than:

- 250 nW (-36 dBm) in the frequency band 9 kHz to 1 GHz;
- 1 mW (-30 dBm) in the frequency band 1 GHz to 12,75 GHz

**Table F.5: Out of band spurious emissions measurement conditions**

| Band | Frequency offset | Measurement Bandwidth |
|---|---|---|
| 100 kHz - 50 MHz | - | 10 kHz |
| 50 MHz -500 MHz | - | 100 kHz |
| above 500 MHz but excluding the transmit band | (offset from edge of the transmit band) | |
| | ≥ 2 MHz | 30 kHz |
| | ≥ 5 MHz | 100 kHz |
| | ≥ 10 MHz | 300 kHz |
| | ≥ 20 MHz | 1 MHz |
| | ≥ 30 MHz | 3 MHz |

In the band 935 MHz to 960 MHz, the power measured in any 100 kHz band shall be no more than -79 dBm, in the band 925 MHz to 935 MHz, shall be no more than -67 dBm and in the band 1 805 MHz to 1 880 MHz, shall be no more than -71 dBm.

With no input signal and the MS input port terminated and unterminated, the peak power of any single spurious emission measured in a 100 kHz bandwidth shall be no greater than:

- 2 nW (-57 dBm) in the frequency bands 9 kHz to 880 MHz, 915 MHz to 1 000 MHz;
- 1,25 nW (-59 dBm) in the frequency band 880 MHz to 915 MHz;
- 5 nW (-53 dBm) in the frequency band 1 710 MHz to 1 785 MHz;
- 20 nW (-47 dBm) in the frequency bands 1 000 MHz to 1 710 MHz, 1 785 MHz to 12 750 MHz.

### F.2.8 VSWR

The VSWR shall be less than 1.7:1 at the RF port of the device which is intended to be connected to the MS. The VSWR shall be less than 2:1 at the RF port of the device which is intended to be connected to the antenna.

### F.2.9 Stability

The AFLC shall be unconditionally stable.

## F.3 Receiving path

Unless otherwise stated, the requirements in this clause apply at all frequencies in the receive band 925 MHz to 960 MHz for a GSM 900 AFLC, and at all frequencies in the receive band 1 805 MHz to 1 880 MHz, for a DCS 1 800 AFLC. For a dual band AFLC, which supports both the GSM and DCS bands, the requirements apply in both receive bands.

### F.3.1 Gain

With a GSM input signal at any level in the range -102 dBm to -20 dBm for an GSM 900 AFLC and -100 dBm to -20 dBm for a DCS 1 800 AFLC, the gain shall be 0 dB with a tolerance of ±1 dB.

For test purposes, it is sufficient to use a CW signal to test this requirement.

### F.3.2 Noise figure

The noise figure shall be less than 7 dB for a GSM 900 AFLC and less than 7 dB for a DCS 1 800 AFLC.

### F.3.3 Group delay

The absolute value of the group delay (signal propagation delay) shall not exceed 500 ns.

### F.3.4 Intermodulation performance

The output third order intercept point shall be greater than -10 dBm.

### F.3.5 VSWR

The VSWR shall be less than 1.7:1 at the RF port of the device which is intended to be connected to the MS. The VSWR shall be less than 2:1 at the RF port of the device which is intended to be connected to the antenna.

### F.3.6 Stability

The AFLC shall be unconditionally stable.

# F.4 Guidelines (informative)

The specifications of the AFLC, have been developed to ensure that a generic AFLC causes minimal degradation of the parametric performance of the MS, to which it is connected.

The following should be clearly marked on the AFLC:

- the intended band(s) of operation;

- the classmark of the MS, to which it designed to be connected.

When installed correctly the AFLC can provide enhancement of the MS to BTS link in vehicular installations. However, it is not guaranteed that an AFLC, which meets the requirements of this specification, will provide a performance improvement for all of the different GSM MS implementations and installations.

Some MS implementations significantly exceed the performance requirements of 3GPP TS 05.05, e.g. with respect to reference sensitivity performance. A purely passive feeder of low loss cable, may provide the best performance for some implementations. The benefits of installing an AFLC in a vehicular application, can only be assessed on a case by case basis.

When used, the AFLC should only be installed in the type approved configuration, with the minimum amount of additional cabling.

When designing an AFLC to be used with a GSM MS, the best downlink performance will be obtained if the low noise amplifier is situated as closely as possible to the output of the antenna.

# Annex G:
# Not Used

# Annex H (normative): Requirements on Location Measurement Unit

Location Services utilizes Location Measurement Units (LMU) to support its positioning mechanisms. An LMU is additional measurement hardware in the GSM network. Time Of Arrival (TOA) positioning mechanism requires LMUs to make accurate measurement of the TOA of the access bursts emitted by the MS. Enhanced Observed Time Difference positioning mechanism requires LMUs in unsynchronized networks to measure the time difference of BTS signals received.

Clause H.1 and its subsubclauses specify LMU requirements to support the Time Of Arrival positioning mechanism.

Clause H.2 and its subsubclauses specifiy LMU requirements to support the Enhanced Observed Time Difference positioning mechanism.

An LMU may contain a control mobile station to communicate with the network. In that case, the requirements for a normal mobile station shall apply to this control mobile station.

# H.1 TOA LMU Requirements

A TOA Location Measurement Unit (LMU) is a unit for making accurate Time-of-Arrival (TOA) measurements. Specifically, the LMU shall be capable of measuring the Time-of-Arrival of access bursts that are transmitted from a mobile station on request. The measurement results are used by the system for determining the location of the mobile station as described in 3GPP TS 03.71. This clause defines the requirements for the receiver of an LMU deployed in the GSM system. Requirements are defined for the Time-of-Arrival measurement accuracy of the LMU.

In addition, an LMU shall be capable of performing Radio Interface Timing (RIT) measurements, comprising Absolute Time Differences (ATD), as described in 3GPP TS 03.71.

## H.1.1 Void

## H.1.2 LMU characteristics

In this clause, the requirements are given in terms of power levels at the antenna connector of an LMU. Equipment with an integral antenna may be taken into account in a similar manner as described in clause 5 of 3GPP TS 05.05.

### H.1.2.1 Blocking characteristics

This subclause defines receiver blocking requirements. The reference sensitivity performance as specified in table H.1.2 shall be met when the following signals are simultaneously input to the LMU.

- A carrier signal as described in H.1.3.1 at frequency f0, 9 dB above the reference sensitivity level as specified in table H.1.1.
- A continuous static sine wave signal as described in subclause 5.1 of 3GPP TS 05.05. The requirements for "normal BTS" shall be used, however the signal strength shall be 6 dB higher than the requirements for "normal BTS".

The exceptions listed in subclause 5.1 of 3GPP TS 05.05 apply also for the LMU requirements.

### H.1.2.2 AM suppression characteristics

This subclause defines AM suppression requirements. The reference sensitivity performance as specified in table H.1.2 shall be met when the following signals are simultaneously input to the LMU.

- A carrier signal as described in H.1.3.1 at frequency $f_0$, 9 dB above the reference sensitivity level as specified in table H.1.1.

- A single frequency signal as described in subclause 5.2 of 3GPP TS 05.05. The requirements for " normal BTS" shall be used, however the signal strength shall be 6 dB higher than the requirements for "normal BTS".

### H.1.2.3 Intermodulation characteristics

This subclause defines intermodulation requirements. The reference sensitivity performance as specified in table H.1.2 shall be met when the following signals are simultaneously input to the LMU.

- A carrier signal as described in H.1.3.1 at frequency $f_0$, 9 dB above the reference sensitivity level as specified in table H.1.1.

- A continuous static sine wave signal and any 148-bit subsequence of the 511-bits pseudo-random sequence in CCITT O.153. The signal strength shall be 6 dB higher than as described in subclause 5.3 of 3GPP TS 05.05.

### H.1.2.4 Spurious emissions

The requirements for a BTS receiver as specified in subclause 5.4 of 3GPP TS 05.05 shall apply also to the receiver of an LMU.

## H.1.3 Time-of-Arrival Measurement Performance

This subclause specifies the required Time-of-Arrival (TOA) measurement accuracy of the LMU, with and without interference, and for different channel conditions. The requirements are given in terms of Time-of-Arrival measurement error (in microseconds), as a function of the carrier and interference input power levels, at the antenna connector of the receiver. Equipment with an integral antenna may be taken into account in a similar manner as described in clause 5 of 3GPP TS 05.05.

The power level, under multipath fading conditions, is the mean power of the sum of the individual paths.

### H.1.3.1 Sensitivity Performance

With the following configuration and propagation conditions, the LMU shall meet the requirements for 90% RMS TOA error ($RMS_{90}$) defined in table H.1.2.

- A carrier signal of GMSK modulated random access bursts is fed into the LMU. The duration of the carrier signal is 320 ms. The access bursts occur once every TDMA frame in a 26-frame multiframe, except in frame number 12 and 25.
  NOTE: Since it is an implementation option in the MS whether or not a MS transmits access bursts during SACCH frames (i.e. frame number 12 or 25 in a 26-frame multiframe), this test carrier signal specifies the worst case under which the requirements shall be met.

- The access bursts consist of a fixed training sequence according to 3GPP TS 05.02 and a data part. The data part of the access burst is random but constant over one 320 ms measurement trial. The data part of the access burst is made known to the LMU before a measurement starts.

- The power up and power down ramping for the bursts is in accordance with Annex B of 3GPP TS 05.05.

- The measurement accuracy of the LMU is defined as the root-mean-square (RMS) value of the most accurate 90% of TOA measurements. As an example, if $\{x_1..x_N\}$is a set of the absolute square Time-of-Arrival measurement errors for N trials, sorted in ascending order, the RMS of 90% is defined as

  $RMS_{90}$ = sqrt( sum($x_1..x_M$)/M ) where M is the largest integer such that M < 0,9 N.

  For the test, N > 500 trials is recommended.

- Measurements shall be performed at two signal strength levels for each of two different propagation conditions. The signal strength level requirement in table H.1.2 is expressed relative to the reference sensitivity level defined in table H.1.1.

- For each signal strength, the two channel conditions are:
  1) Static
  2) Rayleigh (the signal fades with a Rayleigh amplitude distribution and perfect decorrelation between the bursts).

NOTE: Perfect decorrelation between bursts may be attained using a 100 km/hr mobile velocity for the Rayleigh faded channel.

- The LMU is informed of the true Time-of-Arrival value - with an uncertainty of 20 bit periods (approx. 70μs ) - prior to the measurement. This defines a search window of +/-10 bit periods during which the true Time-of-Arrival will occur (per 3GPP TS 04.71 Annex B, paragraph 3.5). The true Time-of-Arrival value shall be uniformly distributed within the search window for each measurement trial. The TOA measurement error is then defined as the difference between this true Time-of-Arrival value minus the measured TOA value at the LMU.

**Table H.1.1: Reference Sensitivity Level**

| Signal strength at antenna connector | |
|---|---|
| GSM 900, DCS 1800, PCS 1900 | -123 dBm |

**Table H.1.2: Sensitivity performance (RMS$_{90}$ of Time-of-Arrival error in microseconds)**

| Carrier signal strength relative to reference sensitivity level | Static | Rayleigh |
|---|---|---|
| 0 dB | 0,37 | 0,37 |
| 20 dB | 0,18 | 0,18 |

## H.1.3.2 Interference Performance

In this subclause, requirements are given in terms of the TOA measurement accuracy (in microseconds) for a specified carrier to interference ratio (C/I) at the antenna connector of the receiver. The input carrier signal shall be as defined in subclause H.1.3.1 and shall be set to a level 40 dB above the reference sensitivity level defined in table H.1.1. The C/I requirements shall be met for an interference signal which is co-channel, adjacent channel (200 kHz offset), and alternate channel (400 kHz offset) to the desired signal as specified in table H.1.3.

The interference signal properties and propagation conditions are defined below.

- One interfering signal is present which consists of a sequence of GMSK modulated normal bursts. The training sequence is chosen randomly from the 8 possible normal burst TSC's defined in 3GPP TS 05.02, but kept fixed during one 320 ms measurement trial.

- The time offset between the carrier and the interferer signal is uniformly distributed random between 0 and 156.25 bit periods, but fixed during one 320 ms measurement trial. The length of the carrier burst (access burst) is 88 bit periods, the length of one burst period is 156.25 bit periods, and the length of the interferer training sequence is 26 bit periods. The probability that the interference training sequence overlaps with some part of the carrier burst is therefore (88+26)/156.25 = 73%.

- Each interference condition shall meet the C/I requirements in Table H.1.3 for the following channel conditions:

  1) Static
  2) Rayleigh (the signal and interference fade independently with a Rayleigh amplitude distribution that has perfect decorrelation between bursts.)

NOTE 1: Perfect decorrelation between bursts may be attained using a 100 km/hr mobile velocity for the Rayleigh faded channel.

- A search window of 20 bit periods shall be used as defined in subclause H.1.3.1.

NOTE 2: In the case of frequency hopping, the interference and carrier signal shall have the same frequency hopping sequence.

**Table H.1.3: Interference performance**
**($RMS_{90}$ of Time-of-Arrival error in microseconds)**

| Interference type | 90% RMS TOA Error | | Carrier to Interference Level (dB) |
|---|---|---|---|
| | Static | Rayleigh | |
| Co-channel | 0.37 | 0.37 | -9 dB |
| | 0.18 | 0.18 | 5 dB |
| Adjacent channel (200 kHz) | 0.37 | 0.37 | -20 dB |
| | 0.18 | 0.18 | -10 dB |
| Adjacent channel (400 kHz) | 0.37 | 0.37 | -50 dB |
| | 0.18 | 0.18 | -40 dB |

### H.1.3.3 Multipath Performance

This subclause defines TOA estimation accuracy under multipath conditions. The test setup is per H.1.3.1 (sensitivity performance) with the following changes:

- each burst propagates through the TU multipath channel specified in Annex C of 3GPP TS 05.05. The true Time-of-Arrival value is the time of the first tap (tap number 1);
- ideal FH is assumed, i.e. perfect decorrelation between bursts.

NOTE: Perfect decorrelation between bursts may be approximated by using frequency hopping or a 100 km/hr mobile velocity with the TU channel model.

The performance requirements are specified in table H.1.4.

**Table H.1.4: Multipath performance**
**($RMS_{90}$ of Time-of-Arrival error in microseconds)**

| Carrier signal strength relative to reference (Table G.1) | TU3/100 (12 tap setting) |
|---|---|
| 0 dB | 0,5 |
| 20 dB | 0,4 |

## H.1.4 Radio Interface Timing Measurement Performance

A Location Measurement Unit shall be capable of performing Radio Interface Timing (RIT) measurements as described in 3GPP TS 03.71 to support one or more positioning methods. RIT measurements comprise measurements of the synchronization difference between two base transceiver stations. An LMU shall therefore be capable of monitoring multiple base transceiver stations. The measurements of BTS synchronization differences can either be performed relative to a reference BTS (i.e. RTD measurement) or relative to some absolute time scale (i.e. ATD measurement).

The RIT measurement shall be made with an accuracy of ±2 bit periods.

# H.2 E-OTD LMU Requirements

An E-OTD Location Measurement Unit (LMU) is a unit that makes accurate observed time difference measurements of signals from BTSs. Specifically, the LMU shall be capable of measuring the Time-of-Arrival of bursts transmitted from a BTS on a periodic and predictable basis. The measurement results are used by the system for determining location of a MS. This clause defines the requirements to be put on the receiver of an LMU deployed in the GSM System. Requirements are defined for the E-OTD measurement accuracy of the LMU.

# H.2.1 LMU Characteristics

In this subclause, the requirements are given in terms of power levels at the antenna connector of the E-OTD LMU. Equipment with an integral antenna may be taken into account in a similar manner as described in Chapter 5 of 3GPP TS 05.05.

## H.2.1.1 Blocking characteristics

This subclause defines E-OTD LMU receiver blocking requirements. The reference sensitivity performance as specified in table H.2.2 shall be met when the following signals are simultaneously input to the LMU.

- A neighbour BCCH carrier as described in subclause H.2.2.1 at frequeny $f_o$, 11 dB above the reference sensitivity level as specified in table H.2.1.
- A continuous static sine wave signal as described in subclause 5.1 of 3GPP TS 05.05. For GSM 900, the requirements for "other MS" shall be used. For DCS 1800 and PCS 1900, the requirements for "MS" shall be used.

The exceptions listed in subclause 5.1 of 3GPP TS 05.05 apply also for the E-OTD LMU requirements.

## H.2.1.2 AM suppression characteristics

This subclause defines AM suppression requirements. The reference sensitivity performance as specified in table H.2.2 shall be met when the following signals are simultaneously input to the LMU.

- A neighbour BCCH carrier as described in subclause H.2.2.1 at frequency $f_o$, 11 dB above the reference sensitivity level as specified in table H.2.1.
- A single frequency signal as described in subclause 5.2 of 3GPP TS 05.05. The requirements for "MS" shall be used.

## H.2.1.3 Intermodulation characteristics

This subclause defines intermodulation requirements. The reference sensitivity performance as specified in table H.2.2 shall be met when the following signals are simultaneously input to the LMU.

- A neighbour BCCH carrier as described in subclause H.2.2.1 at frequency $f_0$, 11 dB above the reference sensitivity level as specified in table H.2.1.
- A continuous static sine wave signal and any 148-bit subsequence of the 511-bits pseudo-random sequence in CCITT Recommendation O.153, as described in subclause 5.3 of 3GPP TS 05.05.

# H.2.2 Sensitivity and Interference Performance

This subclause specifies the required E-OTD measurement accuracy of the LMU with and without interference. The requirements are given in terms of E-OTD measurement error (in microseconds), as function of the carrier and interference input power levels, at the antenna connector of the receiver. Equipment with an integral antenna may be taken into account in a similar manner as described in clause 5 of 3GPP TS 05.05.

The power level, under multipath fading condition, is the mean power of the sum of the individual paths.

# H.2.2.1 Sensitivity Performance

With the following configuration and propagation conditions, the LMU shall meet the requirements of 90% RMS E-OTD error defined in table H.2.2.

- The E-OTD LMU receives a reference BCCH carrier with a power level of 28 dB above the reference sensitivity level defined in table H.2.1.

- The E-OTD measurements (relative to the reference BCCH carrier) are done on a neighbour BCCH carrier at power levels relative to the reference sensitivity level defined in Table H.2.1. The measurement power levels are given in table H.2.2.
- The network requests an E-OTD measurement by commanding the LMU to report the E-OTD measurement with shortest possible reporting period (see 3GPP TS 04.71 Annex A).
- The measurement performance shall also be achieved with the reference BCCH and the neighbour BCCH carriers having 8-PSK modulated bursts. 8-PSK modulation and the 8-PSK normal bursts are defined in 3GPP TS 05.04 clause 3 and 3GPP TS 05.02 subclause 5.2.3, respectively.
- The measurement accuracy of the LMU is defined as the root-mean-square (RMS) value of 90% of the measurements that result in the least E-OTD error. As an example, if $\{x_1..x_N\}$is a set of the absolute square E-OTD measurement errors for N trials, sorted in ascending order, the RMS of 90% is defined as:

$$RMS_{90} = sqrt( sum(x_1..x_M)/M )$$

where M is the largest integer such that M < 0.9 N. For the test, N > 250 trials is recommended . The channels shall be static, i.e. at a constant signal level throughout the measurements.

**Table H.2.1: Reference Sensitivity Level**

| Signal strength at antenna connector | |
|---|---|
| GSM 900, DCS 1800, PCS 1900 | -110 dBm |

**Table H.2.2: Sensitivity performance (RMS$_{90}$ of E-OTD error in microseconds)**

| Minimum neighbour carrier signal strength relatively to E-OTD LMU reference sensitivity level (Table H.2.1) | Static channel |
|---|---|
| 0 dB | 0.3 µs |
| 20 dB | 0.1 µs |

## H.2.2.2 Interference Performance

This subclause defines E-OTD measurement accuracy (in microseconds) for specified carrier-to-interference ratios of the neighbor BCCH carrier. The reference BCCH carrier is as defined in subclause H.2.2.1. The neighbour BCCH carrier shall be as defined in subclause H.2.2.1 and shall be set to a level 28 dB above the reference sensitivity level defined in table H.2.1. The C/I requirements shall be met for an interference signal which is co-channel, adjacent channel (200 kHz offset), and alternate channel (400 kHz offset) to the desired neighbour BCCH carrier as shown in table H.2.3.

- The interference signal consists of a random, continuous GMSK modulated signal.

**Table H.2.3: Interference performance (RMS$_{90}$ of E-OTD error in microseconds)**

| Interference type | Static channel | Minimum carrier to Interference Level (dB) |
|---|---|---|
| Co-channel | 0,3 µs | 0 dB |
| | 0,1 µs | 10 dB |
| Adjacent channel (200 kHz) | 0,5 µs | -18 dB |
| | 0,2 µs | -8 dB |
| Adjacent channel (400 kHz) | 0,1 µs | -41dB |
| | | |

### H.2.2.3 Multipath Performance

This clause defines E-OTD measurement accuracy under multipath conditions. The test setup is as under subclause H.2.2.1 (sensitivity performance) with the following changes:

- Each burst of the neighbour BCCH carrier propagates through the TU multipath channel specified in annex C of 3GPP TS 05.05. The reference carrier remains static.

The performance requirements are specified in table H.2.4.

**Table H.2.4: Multipath performance ($RMS_{90}$ of E-OTD error in microseconds)**

| Minimum neighbour carrier signal strength relative to reference sensitivity (Table H.2.1) | TU3 (12 tap setting) |
|---|---|
| 0 dB | 1,5 µs |

# Annex I (normative): E-OTD Mobile Station Requirements

# I.1 Introduction

To measure Enhanced Observed Timing Difference (E-OTD) location the MS must make accurate Observed-Time-Difference measurements (OTD - the time interval that is observed by a MS between the reception of signals (bursts) from two BTSs). Specifically, the E-OTD MS shall be capable of measuring the reception of bursts transmitted from a BTS on a periodic and predictable basis. The measurement results are used by the system or the E-OTD capable MS for determining location of the MS. This clause defines E-OTD measurement accuracy requirements of an E-OTD capable MS deployed in the GSM System. Requirements for dedicated mode E-OTD measurements are specified below. An E-OTD MS, supporting the MS based E-OTD method, shall be capable of doing idle mode E-OTD measurements with the same accuracy as in dedicated mode, but this needs not to be tested.

# I.2 Sensitivity and Interference Performance

This clause specifies the required E-OTD measurement accuracy for an E-OTD capable MS with and without interference. The requirements are given in terms of E-OTD measurement error (in microseconds), as function of the carrier and interference input power levels, at the antenna connector of the receiver. Equipment with an integral antenna may be taken into account in a similar manner as described in clause 5 of 3GPP TS 05.05.

The power level, under multipath fading condition, is the mean power of the sum of the individual paths.

## I.2.1 Sensitivity Performance

With the following configuration and propagation conditions, the E-OTD capable MS shall meet the requirements of 90% RMS E-OTD error defined in table I.2.1.

- The E-OTD capable MS is in dedicated mode receiving a carrier signal at a power level of at least 20 dB above the reference sensitivity level defined in subclause 6.2.
- The E-OTD measurements are done on a neighbour BCCH carrier at power levels relative to the reference sensitivity level defined in subclause 6.2. The measurement power levels are given in Table I.2.1. The E-OTD measurements are referenced to a reference BCCH carrier at a power level at least 20 dB above the reference sensitivity level defined in subclause 6.2. The reference BCCH carrier and the neighbour BCCH carrier shall be in the same frequency band. The BA list contains the reference BCCH carrier and the neighbour BCCH carrier.
- The network requests an E-OTD measurement by commanding the E-OTD capable MS to report the E-OTD measurement with a response time equal to 2 seconds. The E-OTD capable MS does not need to perform E-OTD measurements prior to receiving the command.
- The measurement performance shall also be achieved with the reference BCCH and the neighbour BCCH carriers having 8-PSK modulated bursts. 8-PSK modulation and the 8-PSK normal bursts are defined in 3GPP TS 05.04 clause 3 and 3GPP TS 05.02 subclause 5.2.3, respectively.
- The measurement accuracy of the E-OTD capable MS is defined as the root-mean-square (RMS) value of 90% of the measurements that result in the least E-OTD error. As an example, if $\{x_1..x_N\}$is a set of the absolute square E-OTD measurement errors for N trials, sorted in ascending order, the RMS of 90% is defined as

$$RMS_{90} = sqrt( sum(x_1..x_M)/M )$$

where M is the largest integer such that $M < 0.9$ N. For the test, $N > 250$ trials is recommended.

The channels shall be static, i.e. at a constant signal level throughout the measurements.

**Table I.2.1: Sensitivity performance**
**($RMS_{90}$ of E-OTD error in microseconds)**

| Minimum neighbour carrier signal strength relative to reference sensitivity level | Staticchannel |
|---|---|
| –8 dB | 0.3 µs |
| 12 dB | 0.1 µs |

## I.2.2 Interference Performance

In this clause, requirements are given in terms of the E-OTD measurement accuracy (in microseconds) for specified carrier-to-interference ratios of the neighbour BCCH carrier. The carrier the MS uses for communication and the reference BCCH carrier shall be as defined in subclause I.2.1. The input neighbour BCCH carrier signal shall be as defined in subclause I.2.1 and shall be set to a level at least 20 dB above the reference sensitivity signal level defined in subclause 6.2. The C/I requirements shall be met for an interference signal which is co-channel, adjacent channel (200 kHz offset), and alternate channel (400 kHz offset) to the desired neighbour BCCH carrier as shown in table I.2.2.

- The interference signal consists of a random, continuous GMSK modulated signal.

**Table I.2.2: Interference performance**
**($RMS_{90}$ of E-OTD error in microseconds)**

| Interference type | Static Channel | Minimum carrier to Interference Level (dB) |
|---|---|---|
| Co-channel | 0,3 µs | 0 dB |
| | 0,1 µs | 10 dB |
| Adjacent channel (200 kHz) | 0,5 µs | -18 dB |
| | 0,2 µs | -8 dB |
| Adjacent channel (400 kHz) | 0,1 µs | -41 dB |
| | | |

## I.2.3 Multipath Performance

This subclause defines E-OTD measurement accuracy under multipath conditions. The test setup is as under subclause I.2.1 (sensitivity performance) with the following changes:

- Each burst of the neighbour BCCH carrier propagates through the TU multipath channel specified in annex C of 3GPP TS 05.05. The reference carrier remains static.

The performance requirements are specified in table I.2.3.

**Table I.2.3: Multipath performance**
**($RMS_{90}$ of E-OTD error in microseconds)**

| Minimum neighbour carrier signal strength relative to reference sensitivity | TU3 (12 tap setting) |
|---|---|
| -8 dB | 1,5 µs |
| | |

# Annex L (informative): Change history

| SPEC | SMG# | CR | Rev | PHASE | VERS | NEW_VERS | SUBJECT |
|---|---|---|---|---|---|---|---|
| 05.05 | s24 | A063 | | R97 | 5.6.0 | 6.0.0 | Reference performance for GPRS |
| 05.05 | s25 | A067 | | R97 | 6.0.0 | 6.1.0 | 14.4kbps Data Service |
| 05.05 | s26 | A065 | | R97 | 6.1.0 | 6.2.0 | Repeater Systems using Frequency Shift |
| 05.05 | s26 | A071 | | R97 | 6.1.0 | 6.2.0 | Adjacent time slot rejection performance |
| 05.05 | s26 | A073 | | R97 | 6.1.0 | 6.2.0 | Frequency hopping performance under interference conditions |
| 05.05 | s26 | A074 | | R97 | 6.1.0 | 6.2.0 | Possibility for operators and manufacturers to define BTS output power |
| 05.05 | s26 | A075 | | R97 | 6.1.0 | 6.2.0 | Introducing performance requirement for the 11 bit PRACH |
| 05.05 | s26 | A045 | | R98 | 6.4.0 | 7.0.0 | Pico BTS |
| 05.05 | s27 | A076 | | R97 | 6.2.0 | 6.3.0 | False USF detection |
| 05.05 | s27 | A077 | | R97 | 6.2.0 | 6.3.0 | Power control levels 29-31 for DCS 1800 |
| 05.05 | s27 | A078 | | R97 | 6.2.0 | 6.3.0 | DCS 1800 MS sensitivity for GPRS |
| 05.05 | s27 | A080 | | R97 | 6.2.0 | 6.3.0 | Correction of reference for MS test loop |
| 05.05 | s28 | A083 | | R97 | 6.3.0 | 6.4.0 | Signal level for reference interference measurements in GPRS |
| 05.05 | s28 | A081 | | R98 | 6.4.0 | 7.0.0 | BTS performance requirements for Picocells |
| 05.05 | s28 | A082 | | R98 | 6.4.0 | 7.0.0 | Harmonization between GSM and PCS 1 900 standard |
| 05.05 | s28 | A084 | | R98 | 6.4.0 | 7.0.0 | Introduction of CTS in 3GPP TS 05.05 |
| 05.05 | s28 | A091 | | R98 | 6.4.0 | 7.0.0 | Transmitter / receiver performance in CTS |
| 05.05 | s29 | A098 | | R98 | 7.0.0 | 7.1.0 | Micro BTS: Deletion of Max output power per carrier values expressed in Watts |
| 05.05 | s29 | A099 | | R98 | 7.0.0 | 7.1.0 | Correction to pico-BTS interference performance |
| 05.05 | s29 | A143 | | R98 | 7.0.0 | 7.1.0 | AMR reference sensitivity and interference |
| 05.05 | s30 | A113 | | R98 | 7.1.0 | 7.2.0 | AMR reference sensitivity and interference |
| 05.05 | s30 | A123 | | R98 | 7.1.0 | 7.2.0 | Introduction of RATSCCH for AMR |
| 05.05 | s30 | A128 | | R98 | 7.1.0 | 7.2.0 | Allowed power level between two consecutive active time slots |
| 05.05 | s31 | A146 | | R98 | 7.2.0 | 7.3.0 | Relaxation of C/I performance requirement for CS4 |
| 05.05 | s31 | A236 | | R98 | 7.2.0 | 7.3.0 | RF Requirements for TOA LMU |
| 05.05 | s31 | A238 | | R98 | 7.2.0 | 7.3.0 | Requirements on E-OTD LMU and E-OTD MS |
| 05.05 | s31b | A246 | | R98 | 7.3.0 | 7.4.0 | Conforming requirements for LMUs containing a control mobile station |

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **TSG GERAN#** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 2000-09 | 1 | GP-000372 | A167 | 1 | Definition of "small MS" | 7.4.0 | 7.5.0 |
| 2000-09 | 1 | GP-000322 | A171 | | Correction on CS-4 performance requirements | 7.4.0 | 7.5.0 |
| 2001-08 | 6 | GP-011907 | A193 | 1 | Incorrect references in sub-clause H.2.2.2 | 7.5.0 | 7.6.0 |
| 2001-08 | 6 | GP-011906 | A197 | 1 | Corrections for clarifications regarding PCS 1900 MS requirements on spurious emissions | 7.5.0 | 7.6.0 |
| 2002-04 | 9 | GP-021157 | A205 | 1 | Correction of AMR FR inband performance requirement | 7.6.0 | 7.7.0 |
| 2002-06 | 10 | GP-021543 | A209 | | Reference sensitivity and interference performance requirements for TCH/AFS and TCH/AHS | 7.7.0 | 7.8.0 |
| 2002-06 | 10 | GP-022028 | A212 | | AMR AHS7.4 static channel performance correction | 7.7.0 | 7.8.0 |
| 2002-08 | 11 | GP-022817 | A214 | 3 | Relaxation of AMR-Inband, RATSCCH and SID_UPDATE | 7.8.0 | 7.9.0 |

# History

| Document history | | | | |
|---|---|---|---|---|
| V7.1.0 | July 1999 | One-step Approval Procedure: | OAP 9952: | 1999-07-28 to 1999-11-26 |
| V7.1.1 | December 1999 | Publication as EN 300 910 | | |
| V7.3.0 | May 2000 | One-step Approval Procedure: | OAP 20000901: | 2000-05-03 to 2000-09-01 |
| V7.4.0 | May 2000 | One-step Approval Procedure | OAP 20000929: | 2000-05-31 to 2000-09-29 |
| V7.5.0 | September 2000 | Publication | | |
| V7.3.1 | October 2000 | Publication as EN 300 910 | | |
| V7.4.1 | October 2000 | Publication as EN 300 910 | | |
| V7.6.0 | August 2001 | Publication | | |
| V7.7.0 | April 2002 | Publication | | |
| V7.8.0 | June 2002 | Publication | | |
| V7.9.0 | September 2002 | Publication | | |