3GPP TS 05.05 V8.20.0 (2005-11)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group GSM/EDGE
Radio Access Network;
Radio transmission and reception
(Release 1999)

GLOBAL SYSTEM FOR
MOBILE COMMUNICATIONS

Keywords

GSM, radio, mux, access

3GPP

Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet

http://www.3gpp.org

Contents

Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document defines the requirements for the transceiver of the pan-European digital cellular telecommunications systems GSM.

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.

This EN defines RF characteristics for the Mobile Station (MS) and Base Station System (BSS). The BSS will contain Base Transceiver Stations (BTS), which can be normal BTS, micro-BTS or pico-BTS. The precise measurement methods are specified in 3GPP TS 11.10 and 3GPP TS 11.21.

Unless otherwise stated, the requirements defined in this EN 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 400 MSs, GSM 900 MSs and GSM 850 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 this EN. Multi band MSs shall meet all requirements for each of the bands supported. The relaxation on GSM 400 MSs, GSM 900 MSs and GSM 850 MSs 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 this EN. Annexes D and E are the only clauses of this EN applicable to repeaters. Annex E does not apply to the MS or BSS.

This document also includes specification information for mixed mode operation at 850 MHz and 1900 MHz. (MXM 850 and MXM 1900). 850 MHz and 1900 MHz mixed-mode is defined as a network that deploys both 30 kHz RF carriers and 200 kHz RF carriers in geographic regions where the Federal Communications Commission (FCC) regulations are applied or adopted.

The requirements for a MS in a mixed-mode system, MXM 850 and MXM 1900, correspond to the requirements for GSM 850 MS and PCS 1900 MS respectively.

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".

[3a] 3GPP TS 03.71: "Digital cellular telecommunication system (Phase 2+); Location Services; Functional description – 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] FCC Title 47 CFR Part 24: "Personal Communication Services", Subpart E "Broadband 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".

[16] ITU-T Recommendation O.151 (1992): "Error performance measuring equipment operating at the primary rate and above".

[17] TIA/EIA-136-C: "TDMA Third Generation Wireless".

1.2 Abbreviations

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

2 Frequency bands and channel arrangement

i) GSM 450 Band:

- for GSM 450, the system is required to operate in the following band:
  - 450,4 MHz to 457,6 MHz: mobile transmit, base receive;
  - 460,4 MHz to 467,6 MHz base transmit, mobile receive.

ii) GSM 480 Band;

- for GSM 480, the system is required to operate in the following band:
  - 478,8 MHz to 486 MHz: mobile transmit, base receive;

- 488,8 MHz to 496 MHz base transmit, mobile receive.

iii) GSM 850 Band:

- for GSM 850, the system is required to operate in the following band:
  - 824 MHz to 849 MHz: mobile transmit, base receive;
  - 869 MHz to 894 MHz: base transmit, mobile receive.

iv) 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.

v) 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.

vi) 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.

vii)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.

viii) PCS 1 900 Band:

- for PCS 1 900, the system is required to operate in the following band:
  - 1 850 MHz to 1 910 MHz: mobile transmit, base receive;
  - 1 930 MHz to 1 990 MHz base transmit, mobile receive.

NOTE 1: The term GSM 400 is used for any GSM system, which operates in any 400 MHz band.

NOTE 2: The term GSM 850 is used for any GSM system which operates in any 850 MHz band.

NOTE 3: The term GSM 900 is used for any GSM system, which operates in any 900 MHz band.

NOTE 4: The BTS may cover a complete band, or the BTS capabilities may be restricted to a subset only, depending on the operator needs.

Operators may implement networks that operate on a combination of the frequency bands above to support multi band mobile terminals.

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 Fl(n) = 890 + 0.2*(n-1024)	0 ≤ n ≤ 124 975 ≤ n ≤ 1 023	Fu(n) = Fl(n) + 45
R-GSM 900	Fl(n) = 890 + 0.2*n Fl(n) = 890 + 0.2*(n-1024)	0 ≤ n ≤ 124 955 ≤ 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
GSM 450	Fl(n) = 450.6 + 0.2*(n-259)	259 ≤ n ≤ 293	Fu(n) = Fl(n) + 10
GSM 480	Fl(n) = 479 + 0.2*(n-306)	306 ≤ n ≤ 340	Fu(n) = Fl(n) + 10
GSM 850	Fl(n) = 824.2 + 0.2*(n-128)	128 ≤ n ≤ 251	Fu(n) = Fl(n) + 45

Frequencies are in MHz.

A multi-band MS shall interpret ARFCN numbers 512 to 810 as either DCS 1800 or PCS 1900 frequencies according to the parameter BAND_INDICATOR when received in other than the DCS 1800 or PCS 1900 bands. If received in the DCS 1800 or PCS 1900 bands, those ARFCN numbers shall be interpreted as frequencies in the same band. The BAND_INDICATOR is broadcast on BCCH, PBCCH and SACCH. The most recently received value shall be applied by the mobile station. If the parameter is not broadcast, the default value is DCS 1800 frequencies.

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.

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

For 8-PSK modulation, the term output power refers to a measure that, with sufficient accuracy, is equivalent to the long term average of the power when taken over the useful part of the burst for random data.

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 tables (see also 3GPP TS 02.06).

For GMSK modulation

Power class	GSM 400 & GSM 900 & GSM 850 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

For 8-PSK modulation

Power class	GSM 400 and GSM 900 & GSM 850 Nominal Maximum output Power	GSM 400 and GSM 900 & GSM 850 Tolerance (dB) for conditions		DCS 1 800 Nominal Maximum output power	PCS 1 900 Nominal Maximum output power	DCS 1 800 & PCS 1 900 Tolerance (dB) for conditions	
		normal	extreme			normal	extreme
E1	33 dBm	±2	±2,5	30 dBm	30 dBm	±2	±2,5
E2	27 dBm	±3	±4	26 dBm	26 dBm	-4/+3	-4,5/+4
E3	23 dBm	±3	±4	22 dBm	22 dBm	±3	±4

Maximum output power for 8-PSK in any one band is always equal to or less than GMSK maximum output power for the same equipment in the same band.

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, 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 [FCC Part 24, Subpart E, Section 24.232]. Power Class 3 is restricted to transportable or vehicular mounted units.

For GSM 850 MS, including its actual antenna gain, shall not exceed a maximum of 7 Watts (+38,5 dBm) ERP per the applicable FCC rules for public mobile services. [FCC Part 22, Subpart H, Section 22.913]

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 specified for that class (see table above) shall apply.

GSM 400 and GSM 900 and GSM 850

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 400 and 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 400 and 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.

In order to manage mobile terminal heat dissipation resulting from transmission on multiple uplink timeslots, the mobile station shall reduce its maximum output power by the following values on a per-assignment basis:

Number of timeslots in uplink assignment	Permissible nominal reduction of maximum output power, (dB)
1	0
2	0 to 3,0
3	1,8 to 4,8
4	3,0 to 6,0

The supported maximum output power for each number of uplink timeslots shall form a monotonic sequence. The maximum reduction of maximum output power from an allocation of n uplink timeslots to an allocation of n+1 uplink timeslots shall be equal to the difference of maximum permissible nominal reduction of maximum output power for the corresponding number of timeslots, as defined in the table above.

As an exception, in case of a multislot uplink assignment, the first power control step down from the maximum output power is allowed to be in the range 0…2 dB.

In case the MS transmits on more uplink slots than assigned (e.g. due to a polling response, see 3GPP TS 04.60), the MS may reduce uplink power as above for a multislot uplink configuration but as a function of the number of active uplink slots on a TDMA frame basis.

4.1.2 Base station

For a normal BTS, the maximum output power measured at the input of the BSS Tx combiner, shall be, according to its class, as defined in the following table.

GSM 400 & GSM 900 & GSM 850 & MXM 850		DCS 1 800 & PCS 1 900 & MXM 1900	
TRX power class	**Maximum output power**	**TRX power class**	**Maximum output power**
1	320 - (< 640) W	1	20 - (< 40) W
2	160 - (< 320) W	2	10 - (< 20) W
3	80 - (< 160) W	3	5 - (< 10) W
4	40 - (< 80) W	4	2,5 - (< 5) W
5	20 - (< 40) W		
6	10 - (< 20) W		
7	5 - (< 10) W		
8	2,5 - (< 5) W		

For a micro-BTS or a pico-BTS, the 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 & GSM 850 & MXM 850 micro and pico-BTS		DCS 1 800 & PCS 1 900 & MXM 1900 micro and pico-BTS	
TRX power class	**Maximum output power**	**TRX power class**	**Maximum output power**
Micro		**Micro**	
M1	(> 19) - 24 dBm	M1	(> 27) - 32 dBm
M2	(> 14) - 19 dBm	M2	(> 22) - 27 dBm
M3	(> 9) - 14 dBm	M3	(> 17) - 22 dBm
Pico		**Pico**	
P1	(> 13) - 20 dBm	P1	(> 16) - 23 dBm

For BTS supporting 8-PSK, the manufacturer shall declare the maximum output power capability for GMSK and 8-PSK modulation. The TRX power class is defined by the highest output power capability for either modulation.

The tolerance of the actual maximum output power of the BTS for each supported modulation 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 the maximum level for the modulation with the highest output power capability in at least six steps of nominally 2 dB with an accuracy of ±1 dB for each modulation to allow a fine adjustment of the coverage by the network operator. In addition, the actual absolute output power for each supported modulation at each static RF power step (N), with the exception below for the highest RF power level for 8-PSK, shall be 2*N dB below the absolute output power at static RF power step 0 for the modulation with the highest output power capability 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 for each supported modulation 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 for each supported modulation at each power control level (N), with the exception below for the highest power level for 8-PSK, shall be 2*N dB below the absolute output power at power control level 0 for the modulation with the highest output power capability 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.

The output power for both GMSK and 8-PSK shall be nominally the same for any supported static RF power step and power control level. An exception is allowed for the maximum output power of 8-PSK, which may be lower than the GMSK output power for the same power step or power control level, i.e. the nominal size of the first step down from maximum power level for 8-PSK may be in the range 0…2 dB. The output power for the GMSK and 8-PSK at this power control level shall still be considered the same when required in 3GPP TS 05.08. The output power of 8-PSK for the second highest power step or power control level shall be the same as the GMSK power for the same power step or power control level within a tolerance of ±1 dB. The number of static RF power steps and the total number of power control steps may be different for GMSK and 8-PSK.

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 and MXM 1900 Base stations

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 1 640 W EIRP, equivalent to 1 000 W ERP, per the applicable FCC rules for wideband PCS services [FCC part 24, subpart E, section 24.237].

4.1.2.2 Additional requirements for GSM 850 and MXM 850 Base stations

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 500 W ERP, per the applicable FCC rules for public mobile services [FCC part 22, subpart H, section 22.913].

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 11.21. 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 1800 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 1800 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 1800 kHz from the carrier only measurements centred on 200 kHz multiples are taken with averaging over 50 bursts.
- for BTS at 1800 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), b) and c) 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 400 and GSM 900 and GSM 850 MS:

	100	200	250	400	≥ 600 < 1 800	≥ 1 800 < 3 000	≥ 3 000 < 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
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -54 dB.							

a2) GSM 400 and GSM 900 and GSM 850 and MXM 850 normal BTS:

	100	200	250	400	≥ 600 < 1 200	≥ 1 200 < 1 800	≥ 1 800 < 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
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -56 dB.							

a3) GSM 900 and GSM 850 and MXM 850 micro-BTS:

	100	200	250	400	≥ 600 < 1 200	≥ 1 200 < 1 800	≥ 1 800
≤ 33	+0,5	-30	-33	-60*	-60	-63	-70
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -56 dB.						

a4) GSM 900 and GSM 850 and MXM 850 pico-BTS:

	100	200	250	400	≥ 600 < 1 200	≥ 1 200 < 1 800	≥ 1 800 < 6 000	≥ 6 000
≤ 20	+0,5	-30	-33	-60*	-60	-63	-70	-80
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -56 dB.							

b1) DCS 1 800 MS:

	100	200	250	400	≥ 600 < 1 800	≥ 1 800 < 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	-30	-33	-60*	-60	-59	-67
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -54 dB.						

b2) DCS 1 800 normal BTS:

	100	200	250	400	≥ 600 < 1 200	≥ 1 200 < 1 800	≥ 1 800 < 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
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -56 dB.							

b3) DCS 1 800 micro-BTS:

	100	200	250	400	≥ 600 < 1 200	≥ 1 200 < 1 800	≥ 1 800
35	+0,5	-30	-33	-60*	-62	-65	-76
≤ 33	+0,5	-30	-33	-60*	-60	-63	-76
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -56 dB.						

b4) DCS 1 800 pico-BTS:

	100	200	250	400	≥ 600 < 1 200	≥ 1 200 < 1 800	≥ 1 800 < 6 000	≥ 6 000
≤ 23	+0,5	-30	-33	-60*	-60	-63	-76	-80
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -56 dB.							

c1) PCS 1 900 MS:

	100	200	250	400	≥ 600 < 1 200	≥ 1 200 < 1 800	≥ 1 800 < 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
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -54 dB.							

c2) PCS 1 900 & MXM 1900 normal BTS:

	100	200	250	400	≥ 600 < 1 200	≥ 1 200 < 1 800	≥ 1 800 < 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
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -56 dB.							

c3) PCS 1 900 & MXM 1900 micro-BTS:

	100	200	250	400	≥ 600 < 1 200	≥ 1 200 < 1 800	≥ 1 800
35	+0,5	-30	-33	-60*	-62	-65	-76
≤ 33	+0,5	-30	-33	-60*	-60	-63	-76
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -56 dB.						

c4) PCS 1 900 and MXM 1900 pico-BTS:

	100	200	250	400	≥ 600 < 1 200	≥ 1 200 < 1 800	≥ 1 800
≤ 23	+0,5	-30	-33	-60*	-60	-63	-76
NOTE:	* For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -56 dB.						

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 ax), bx) and cx) is tighter than the limit given in the following, the latter shall be applied instead.

iii) For MS:

Frequency offset from the carrier	GSM 400 & GSM 900& GSM 850	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 400 & GSM 900 & GSM 850 & MXM 850	DCS 1 800 & PCS 1 900 & MXM 1900
< 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 & GSM 850 & MXM 850	DCS 1 800 & PCS 1 900 & MXM 1900
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).

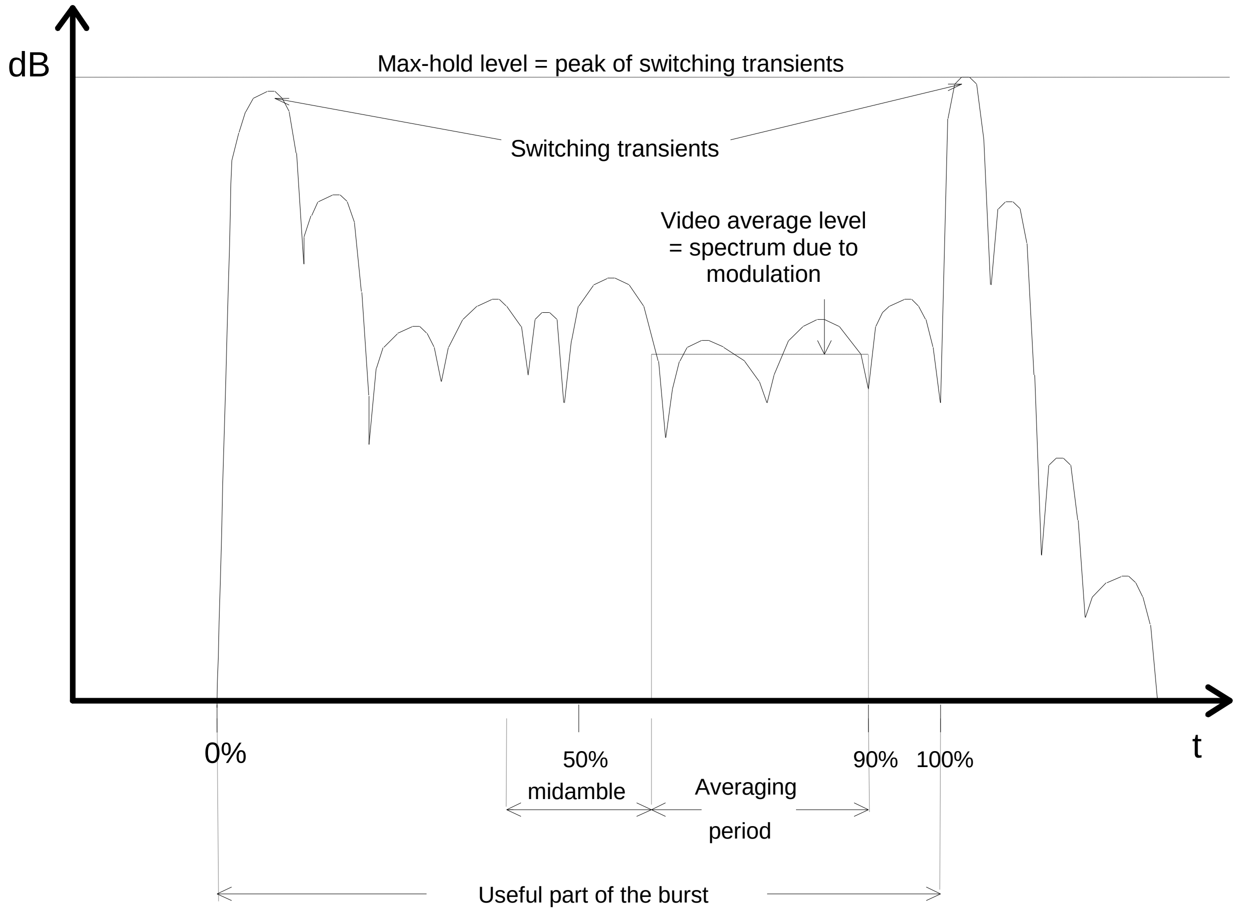

Figure 1: Example of a time waveform due to a burst as seen in a 30 kHz filter offset from the carrier

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 400 & GSM 900 & GSM 850 & MXM 850 (GMSK)	-57 dBc	-67 dBc	-74 dBc	-74 dBc
GSM 400 & GSM 900 & GSM 850 & MXM 850 (8-PSK)	-52 dBc	-62 dBc	-74 dBc	-74 dBc
DCS 1 800 & PCS 1 900 & MXM 1900 (GMSK)	-50 dBc	-58 dBc	-66 dBc	-66 dBc
DCS 1 800 & PCS 1 900 & MXM 1900 (8-PSK)	-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 section, the PCS 1 900 & MXM 1900 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].

In addition to the requirements of this section, the GSM 850 & MXM 850 BTS and GSM 850 MS shall also comply with the applicable limits for spurious emissions established by the FCC rules for public mobile services [FCC Part 22, Subpart H].

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) ≥ 1,8 MHz ≥ 6 MHz	 30 kHz 100 kHz

b)

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

4.3.2.1 General requirements

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 GHz 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 900 & GSM 850 & MXM 850 (dBm)	DCS 1800 & PCS 1900 & MXM 1900 (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 BTS of different bands 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 400 and GSM 900 transmitter in the band 1 710 MHz to 1 785 MHz, for GSM 400 and DCS 1 800 transmitter in the band 876 MHz to 915 MHz and for GSM 900 and DCS 1800 transmitter in the bands 450,4 MHz to 457,6 MHz and 478,8 MHz to 486,0 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 400 and GSM 900 BTS in the band 1 805 MHz to 1 880 MHz and -57 dBm for a GSM 400 and DCS 1 800 BTS in the band 921 MHz to 960 MHz.

Measures must be taken for mutual protection of receivers when MXM 850 and MXM 1900 BTS, or GSM 850 and PCS 1900 BTS are co-sited.

NOTE 3: 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 MXM 850 (or GSM 850 BTS) transmitter in the band 1 850 MHz to 1 910 MHz and for MXM 1900 (or PCS 1900 BTS) transmitter in the band 824 MHz to 849 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 an MXM 850 BTS (or GSM 850 BTS) in the band 1 930 MHz to 1 990 MHz and -57 dBm for an MXM 1900 BTS (or PCS 1900 BTS) in the band 869 MHz to 894 MHz.

NOTE 4: In addition, to protect co-coverage systems, the powers measured in the conditions specified in subclause 4.2.1, with a filter and video bandwidth of 100 kHz should be no more than -57 dBm for the GSM 900 and DCS 1800 BTS in the band 460,4 MHz to 467,6 MHz and 488,8 MHz to 496,0 MHz.

4.3.2.1 Additional requirements for co-existence with 3 G

In geographic areas where GSM and UTRA networks are deployed, the power measured in the conditions specified in subclause 4.2.1, with a filter and videobandwidth of 100 kHz shall be no more than:

Band (MHz)	power (dBm)	Note
1900 – 1920	-62	UTRA/TDD band
1920 – 1980	-62	UTRA/FDD BS Rx band
2010 – 2025	-62	UTRA/TDD band
2110 – 2170	-62	UTRA/FDD UE Rx band

When GSM and UTRA BS are co-located, the power measured in the conditions specified in subclause 4.2.1, with a filter and videobandwidth of 100 kHz shall be no more than:

Band (MHz)	power (dBm)	Note
1900 – 1920	-96	UTRA/TDD band
1920 – 1980	-96	UTRA/FDD BS Rx band
2010 – 2025	-96	UTRA/TDD band
2110 – 2170	-62	UTRA/FDD UE Rx band

Note 1: The requirements in this subclause should also be applied to BTS built to a hardware specification for R98 or earlier. For a BTS built to a hardware specification for R98 or earlier, with an 8-PSK capable transceiver installed, the 8-PSK transceiver shall meet the R99 requirement.

4.3.3 Mobile Station

4.3.3.1 Mobile Station GSM 400, 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 GHz to 12,75 GHz.

The power measured in a 100 kHz bandwidth for a MS, 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 to 1 000 MHz;
- 20 nW (-47 dBm) in the frequency bands 1 - 12.75 GHz,

with the following exceptions:

- 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;
- -76 dBm in the frequency bands 1900 – 1920 MHz, 1920 – 1980 MHz, 2010 – 2025 MHz, and 2210 - 2170 MHz.

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 shall be no more than:

- -67 dBm in the bands 460.4 – 467.6 MHz and 488.8 - 496 MHz for GSM400 MS only;
- -60 dBm in the band 921 - 925 MHz for R-GSM MS only;
- -67 dBm in the band 925 - 935 MHz;
- -79 dBm in the band 935 –960 MHz;
- -71 dBm in the band 1805 - 1880 MHz;

- -66 dBm in the bands 1900 - 1920 MHz, 1920 - 1980 MHz, 2010 - 2025 MHz, and 2110 - 2170 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, 1 805 MHz to 1 880 MHz, 1900 - 1920 MHz, 1920 - 1980 MHz, 2010 - 2025 MHz, and 2110 - 2170 MHz for each ARFCN used in the measurements. For GSM 400 MS, in addition, exceptions up to three measurements with a level up to -36 dBm are permitted in each of the bands 460,4 MHz to 467,6 MHz and 488,8 MHz to 496 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 GSM 850 and 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 1000 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:

- -79 dBm in the frequency band 869 MHz to 894 MHz;
- -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 each of the band 869 MHz to 894 MHz and 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. The reference level 0 dB corresponds to the output power level according to subclause 4. 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. The reference level 0 dB corresponds to the output power level according to subclause 4. 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 400, GSM 900, and GSM 850, 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 Modulation accuracy

4.6.1 GMSK modulation

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.

4.6.2 8-PSK modulation

The modulation accuracy is defined by the error vector between the vector representing the actual transmitted signal and the vector representing the error-free modulated signal. The magnitude of the error vector is called Error Vector Magnitude (EVM). For definition of the different measures of EVM, see annex G.

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

The magnitude of the error vector shall be computed by measuring the error vector between the vector representing the transmitted waveform and the vector representing the ideal one on the useful part of the burst (excluding tail symbols). When measuring the error vector a receive filter at baseband shall be used, defined as a raised-cosine filter with roll-off 0,25 and single side-band 6 dB bandwidth 90 kHz.

The measurement filter is windowed by multiplying its impulse response by a raised cosine window given as:

$$\mathrm{w}(t)=\begin{cases}1, & 0\le |t|\le 1.5T\\ 0.5\left(1+\cos\left[\pi(|t|-1.5T)/2.25T\right]\right), & 1.5T\le |t|\le 3.75T\\ 0, & |t|\ge 3.75T\end{cases}$$

where T is the symbol interval.

The transmitted waveforms shall be Normal Bursts for 8-PSK as defined in 3GPP TS 05.02, with encrypted bits generated using consecutive bits from the 32767 bit length pseudo random sequence defined in ITU-T Recommendation O.151 (1992) [16].

4.6.2.1 RMS EVM

When transmitting a burst, the magnitude of the error vector of the signal, relative to the theoretical modulated waveforms as specified in 3GPP TS 05.04, is specified in the following way:

- the measured RMS EVM over the useful part of any burst, excluding tail bits, shall not exceed;
- for MS: under normal conditions 9,0 %
  under extreme conditions 10,0 %
- for BTS; after any active element and excluding the effect of any passive combining equipment:
- under normal conditions 7,0 %
  under extreme conditions 8,0 %
- after any active element and including the effect of passive combining equipment:
  under normal conditions 8,0 %
  under extreme conditions 9,0 %

The RMS EVM per burst is measured under the duration of at least 200 bursts.

4.6.2.2 Origin Offset Suppression

The origin offset shall be measured over at least 200 bursts. For each burst a value shall be calculated using the formula for the origin offset suppression shown in annex G, but before taking the logarithm the average over the number of bursts shall be computed. Then this average shall be transferred to dB scale and the resulting origin offset suppression shall exceed 30 dB for MS and 35 dB for BTS under normal and extreme conditions.

4.6.2.3 Peak EVM

The peak value of EVM is the peak error deviation within a burst, measured at each symbol interval, averaged over at least 200 bursts to reflect the transient nature of the peak deviation. The bursts shall have a minimum distance in time of 7 idle timeslots between them. The peak EVM values are acquired during the useful part of the burst, excluding tail bits.

- The measured peak EVM values shall be $\le$ 30 % for MS and $\le$ 22 % for BTS under normal and extreme conditions. For BTS, the effect of any passive combining equipment is excluded.

4.6.2.4 95:th percentile

The 95:th percentile is the point where 95% of the individual EVM values, measured at each symbol interval, is below that point. That is, only 5% of the symbols are allowed to have an EVM exceeding the 95:th-percentile point. The EVM values are acquired during the useful part of the burst, excluding tail bits, over 200 bursts.

The measured 95:th-percentile value shall be $\le$ 15 % for MS and $\le$ 11 % for BTS under normal and extreme conditions. For BTS, the effect of any combining equipment is excluded.

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, or by non linear combining and amplification of multiple carriers.

4.7.1 Base transceiver station

An interfering CW signal shall be applied to the transmit antenna port, 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 or amplification of multiple carriers 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 3rd order intermodulation products fall into the receive band.

4.7.2.1 GSM 400, GSM 900, DCS 1800

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.

4.7.2.2 MXM 850 and MXM 1900

The following requirements apply to MXM 850 and MXM 1900 BTSs which include ANSI-136 [17] 30 kHz carriers, in addition to the 200 kHz carriers specified in the present document. All the following requirements relate to frequency offsets from the uppermost and lowermost carriers. The average value of intermodulation components for frequency offsets > 1,2 MHz to the edge of the relevant Tx band, shall not exceed:

(a) -60 dBc, measured in a 30 kHz bandwidth, relative to the average power of the 30 kHz channel carrier, measured in a 30 kHz bandwidth, using normal power averaging (per [17] Part 280), and

(b) -60 dBc, measured in a 200 kHz bandwidth, relative to the 200 kHz carrier average power, measured in a 300 kHz bandwidth and averaged over a timeslot.

In addition to the requirements of this section, the MXM 850 BTS and MXM 1900 BTS shall also comply with the applicable limits for spurious emissions established by the FCC rules for public mobile services [FCC Part 22, Subpart H] and FCC rules for wideband PCS services [14] respectively.

NOTE 1: In some areas, to avoid uncoordinated system impacts, it may be beneficial to use a more stringent value. -70 dBc rms is suggested.

NOTE 2: For testing reasons, a MXM 1900 normal BTS fulfilling the PCS 1900 normal BTS requirements or a MXM 850 normal BTS fulfilling GSM 850 normal BTS requirements in this subclause may be considered fulfilling the requirements for MXM 1900 normal BTS or MXM 850 normal BTS respectively.

4.7.2.3 GSM 850 and PCS 1900

All the following requirements relate to frequency offsets from the uppermost and lowermost carriers. For frequency offsets > 1,8 MHz to the edge of the relevant Tx band, measured in 300 kHz bandwidth the average value of intermodulation components over a timeslot shall not exceed -70 dBc relative to the per carrier power or -46 dBm, whichever is the higher. For offsets between 600 kHz and 1,8 MHz, the measurement technique and requirements are those specified in subclause 4.2.1, except for offsets between 1,2 MHz and 1,8 MHz, where the value of intermodulation components shall not exceed –70 dBc.

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

In regions where additional protection between uncoordinated systems is required by national regulatory agencies, the intermodulation components for frequency offsets > 1,2 MHz may be up to –60 dBc, if not violating the national regulation requirements. In this case the PCS 1900 BTS and GSM 850 shall also comply with the applicable limits for spurious emissions established by the FCC rules for wideband PCS services [14] and FCC rules for public mobile services [FCC Part 22, Subpart H] respectively, or similar national requirements with comparable limits and rules.

4.7.3 Void

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 $E = P + 20\log F_{(MHz)} + 77{,}2$):

assuming F = 460 MHz : E (dBµV/m) = P (dBm) + 130,5 for GSM 400;

assuming F = 859 MHz : E (dBµV/m) = P (dBm) + 135,9 for GSM 850;

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	PCS 1 900 & MXM 1900 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

Frequency band	Frequency range (MHz)	
	GSM 850 MS	GSM 850 & MXM 850 BTS
in-band	849 - 914	804 - 859
out-of-band (a)	0,1 - < 849	0,1 - < 804
out-of-band (b)	N/A	N/A
out-of band (c)	N/A	N/A
out-of band (d)	> 914- 12,750	> 859 - 12,750

Frequency band	Frequency range (MHz)			
	GSM 450		GSM 480	
	MS	BTS	MS	BTS
in-band	457,6 – 473,6	444,4 – 460,4	486,0 – 502,0	472,8 – 488,8
out-of-band (a)	0,1 - < 457,6	0,1 - < 444,4	0,1 - < 486,0	0,1 - < 472,8
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)	> 473,6 - 12,750	> 460,4 - 12,750	> 502,0 - 12,750	> 488,8 - 12,750

The reference sensitivity performance as specified in tables 1, 1a, 1b, 1c, 1d and 1e shall be met when the following signals are simultaneously input to the receiver:

- for all cases except GSM 850 normal BTS, MXM 850 normal BTS and MXM 1900 normal BTS, a useful signal, modulated with the relevant supported modulation (GMSK or 8-PSK), at frequency f_o, 3 dB above the reference sensitivity level or input level for reference performance, whichever applicable, as specified in subclause 6.2;
- for GSM 850 normal BTS, MXM 850 normal BTS and MXM 1900 normal BTS a useful signal, modulated with the relevant supported modulation (GMSK or 8-PSK), at frequency f_o, 1 dB above the reference sensitivity level or input level for reference performance, whichever applicable, 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. For GSM 850 normal BTS, MXM 850 normal BTS and MXM 1900 normal BTS at inband frequency offsets ≥ 3 000 kHz this signal is GMSK modulated by any 148-bit sequence of the 511-bit pseudo random bit sequence, defined in CCITT Recommendation O.153 fascicle IV.4,

with the following exceptions, called spurious response frequencies:

a) GSM 900 MS and BTS, GSM 850 MS and BTS, and MXM 850 BTS: in band, for a maximum of six occurrences (which if grouped shall not exceed three contiguous occurrences per group);

DCS 1 800, PCS 1 900 MS and BTS and MXM 1900 BTS: in band, for a maximum of twelve occurrences (which if grouped shall not exceed three contiguous occurrences per group);

GSM 400 MS and BTS: in band, for a maximum of three occurrences;

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).

NOTE: For testing reasons, a MXM 1900 normal BTS fulfilling the PCS 1900 normal BTS requirements in this paragraph may be considered fulfilling the requirements for MXM 1900 normal BTS.

Frequency band	**GSM 400, 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 ≤ $\|f-f_0\|$ < 800 kHz	75	-38	70	-43	87	-26	70	-43	78	-35
800 kHz ≤ $\|f-f_0\|$ < 1,6 MHz	80	-33	70	-43	97	-16	70	-43	88	-25
1,6 MHz ≤ $\|f-f_0\|$ < 3 MHz	90	-23	80	-33	97	-16	80	-33	88	-25
3 MHz ≤ $\|f-f_0\|$	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 450 small MS, in the band 450,4 MHz to 457,6 MHz	-5 dBm
for GSM 480 small MS, in the band 478,8 MHz to 486 MHz	-5 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

Frequency band	**GSM 850 MS**		**GSM 850 & MXM 850 BTS**		**MXM 1900 BTS**	
	dBµV (emf)	**dBm**	**dBµV (emf)**	**dBm**	**dBµV (emf)**	**dBm**
in-band						
600 kHz ≤ $\|f-f_0\|$ < 800 kHz	70	-43	76	-37	70	-43
800 kHz ≤ $\|f-f_0\|$ < 1,6 MHz	70	-43	78	-35	75	-38
1,6 MHz ≤ $\|f-f_0\|$ < 3 MHz	80	-33	80	-33	80	-33
3 MHz ≤ $\|f-f_0\|$	90	-23	80	-33	80	-33
out-of-band						
(a)	113	0	121	8	113	0
(b)	-	-	-	-	-	-
(c)	-	-	-	-	-	-
(d)	113	0	121	8	113	0

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, GSM 850 and MXM 850 micro and pico-BTS**				**DCS 1 800, PCS 1900 and MXM 1900 micro and pico-BTS**			
	M1 (dBm)	**M2 (dBm)**	**M3 (dBm)**	**P1 (dBm)**	**M1 (dBm)**	**M2 (dBm)**	**M3 (dBm)**	**P1 (dBm)**
in-band								
600 kHz ≤ $\|f\text{-}f_0\|$ < 800 kHz	-31	-26	-21	-34	-40	-35	-30	-41
800 kHz ≤ $\|f\text{-}f_0\|$ < 1,6 MHz	-21	-16	-11	-34	-30	-25	-20	-41
1,6 MHz ≤ $\|f\text{-}f_0\|$ < 3 MHz	-21	-16	-11	-26	-30	-25	-20	-31
3 MHz ≤ $\|f\text{-}f_0\|$	-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 tables 1, 1a, 1b, 1c, 1d and 1e shall be met when the following signals are simultaneously input to the receiver.

- A useful signal, modulated with the relevant supported modulation (GMSK or 8-PSK), at frequency f_o, 3 dB above the reference sensitivity level or input level for reference performance, whichever applicable, as specified in subclause 6.2.
- A single frequency (f), in the relevant receive band, $|f\text{-}f_o| > 6$ MHz, which is an integer multiple of 200 kHz, a GSM TDMA signal modulated in GMSK and by any 148-bit sequence of the 511-bit pseudo random bit sequence, defined in CCITT Recommendation O.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 400	-31	-31	**	**	**	**
GSM 900	-31	-31	-34	-29	-24	-21
GSM 850	-31	-31	-34	-29	-24	-21
MXM 850	-	-33	-34	-29	-24	-21
DCS 1 800	-29 / -31*	-35	-33	-28	-23	-26
PCS 1 900	-31	-35	-33	-28	-23	-26
MXM 1900	-	-35	-33	-28	-23	-26
NOTE 1: * 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. NOTE 2: ** These BTS types are not defined.						

5.3 Intermodulation characteristics

The reference sensitivity performance as specified in tables 1, 1a, 1b, 1c, 1d and 1e 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 or input level for reference performance, whichever applicable, 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 400 small MSs and GSM 900 small MSs and GSM 850 small MSs, DCS 1 800 and PCS 1 900 MS and DCS 1 800, PCS 1 900 and MXM 1900 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 GMSK modulating a signal at frequency f_2, and a level of 70 dBµV (emf) (i.e. -43 dBm):
    - for GSM 400 small MSs and GSM 900 small MSs and GSM 850 small MSs, DCS 1 800 and PCS 1 900 MS and DCS 1 800, PCS 1 900 and MXM 1900 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 O.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 GHz 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. The relevant propagation conditions appear in annex C.

6.1.1 GMSK modulation

Under the following propagation conditions and with an input level of 20 dB above the reference sensitivity level, the chip error rate, equivalent to the bit error rate of the non protected bits (e.g., TCH/FS class II or CS-4) shall have the following limits:

- static channel: BER ≤ 10^{-4};
- EQ50 channel: BER ≤ 3 %;

except for 3GPP TS 400, where the following limits applies:

- static channel: BER ≤ 10^{-4};
- EQ100 channel: BER ≤ 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 400, GSM 900, GSM 850 MS and GSM 400, GSM 900, GSM 850, MXM 850 BTS, -23 dBm for DCS 1 800, PCS 1 900 MS and DCS 1 800, PCS 1 900, MXM 1900 BTS.

For static conditions, a bit error rate of 10^{-3} shall also be maintained by the MS under frequency hopping conditions, for input levels on the C0 carrier of up to -15 dBm for GSM 400, GSM 900, and GSM 850, -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, GSM 850 and MXM 850, and -14 dBm for DCS 1 800, PCS 1 900 and MXM 1900.

6.1.2 8-PSK modulation

For static propagation conditions, the chip error rate, equivalent to the bit error rate of the uncoded data bits shall have the following limits for input levels specified below:

- BTS: BER ≤ 10^{-4} for levels ≥ -84 dBm;
- MS: BER ≤ 10^{-4} for levels ≥ -82 dBm.

This performance shall be maintained for normal BTS and MS, up to -40 dBm input level. The low level limit for other equipment shall be adjusted according to correction table in subclause 6.2.

NOTE 1: Uncoded data bits refer to the encrypted bits of a burst, extracted by the receiver without any signal processing improvement from encoding/decoding of the signal.

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

Furthermore, a bit error rate of 10^{-3} shall be maintained by MS and BTS for input levels up to -26 dBm.

For static conditions, a bit error rate of 10^{-3} shall also be maintained by the MS under frequency hopping conditions, for input levels on the C0 carrier of up to -26 dBm at 8-PSK, 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 -16 dBm for GSM 900; GSM 850 and MXM 850, and -17 dBm for DCS 1800, PCS 1900 and MXM 1900.

For micro-BTS, the maximum input level shall be adjusted according to the correction table for reference sensitivity level in subclause 6.2. In addition, for GSM 850, MXM 850 and GSM 900 the limits shall be reduced by 5 dB.

In addition, when the frequency of the input 8-PSK modulated signal is randomly offset, on a burst-by-burst basis, by the maximum frequency error specified in 3GPP TS 05.10 [7] (for MS the pico-BTS frequency error in subclause 5.1 applies, and for BTS the MS frequency error in subclause 6.1 applies), the performance shall fulfil the following limits for Static channel:

- for input levels specified below up to –40 dBm:
  - GSM 400, MXM 850, GSM 850 and GSM 900 normal BTS: BER $\leq 10^{-4}$ for levels $\geq$-84 dBm;
  - DCS 1800, PCS 1900 and MXM 1900 normal BTS: BER $\leq 10^{-4}$ for levels $\geq$-84 dBm;
  - GSM 400, GSM 850 and GSM 900 MS: BER $\leq 10^{-4}$ for levels $\geq$-82 dBm;
  - DCS 1800 and PCS 1900 MS: BER $\leq 10^{-3}$ for levels $\geq$–82 dBm.

For each burst, the sign of the frequency offset is chosen according to a 511-bit pseudo-random sequence, defined in ITU-T Recommendation O.153 [10]. This is also valid for consecutive timeslots in a multislot MS.

For other equipment the low signal level limit shall be adjusted according to correction table in subclause 6.2.

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 performance requirements for GSM 400 systems are as for GSM 900 in table 1, except that the GSM 400 MS speed is doubled from that of GSM 900, e.g. TU50 becomes TU100.

NOTE: For conformance testing purposes using requirements at double speed is considered sufficient to verify MS behaviour at realistic speeds. This applies for packet channels and reference interference performance as well.

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 400 MS

- for GSM 400 small MS	-102 dBm
- for other GSM 400 MS	-104 dBm

GSM 400 BTS

- for normal BTS	-104 dBm

GSM 900 MS

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

GSM 850 MS

- for GSM 850 small MS	-102 dBm
- for other GSM 850 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 class 1 or class 2 MS -102 dBm
- for other PCS 1 900 MS -104 dBm

GSM 900 BTS, GSM 850 BTS and MXM 850

- 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 and MXM 1900

- 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

* 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 Enhanced circuit-switched channels (ECSD), the minimum input signal level for which the reference performance shall be met is specified in table 1d and 1e, according to the modulation, type of channel and the propagation condition. The performance requirements for GSM 400 systems are as for GSM 900 in table 1d and 1e, except that the GSM 400 MS speed is doubled from that of GSM 900, e.g. TU50 becomes TU100.

The reference performance shall be:

- for data channels (E-TCH/F), transparent services (T) BER ≤ 0,1%
- for data channels (E-TCH/F), non-transparent services (NT)) BLER ≤ 10%
- for fast associated control channel (E-FACCH) FER ≤ 5%

where BLER refers to radio block (data block of 20 ms length, corresponding to 1368 coded bits, to be interleaved over a number of burst according to 05.03).

The levels are given for normal BTS and MS separately. For other equipment, the levels shall be corrected by the values below in the table for packet switched channels.

For packet switched channels, the minimum input signal level for which the reference performance shall be met is specified in table 1a for GMSK modulated input signals, and tables 1b and 1c for 8-PSK modulated input signals respectively, according to the type of channel and the propagation condition. The performance requirements for GSM 400 systems are as for GSM 900 in table 1a, 1b and 1c, except that the GSM 400 MS speed is doubled from that of GSM 900, e.g. TU50 becomes TU100. The levels are given for normal BTS for GMSK modulated signals. For 8-PSK modulated signals, the required levels are given for normal BTS and MS separately. The levels shall be corrected by the following values:

	MS, GMSK modulated signals	
-	for DCS 1 800 class 1 or class 2 MS	+2/+4 dB**
-	for DCS 1 800 class 3 MS	+2 dB
-	for GSM 400 small MS, GSM 900 small MS and GSM 850 small MS	+2 dB
-	for other GSM 400, GSM 900 MS and GSM 850 MS	0 dB
	for PCS 1900 class 1 or class 2 MS	+2 dB
	for other PCS 1900 MS	0 dB
	MS, 8-PSK modulated signals	
-	for GSM 400, GSM 900 and GSM 850 small MS	0 dB
-	for other GSM 400, GSM 900 and GSM 850 MS	-2 dB
-	for DCS 1 800 and PCS 1900 class 1 or class 2 MS	0 dB
-	for other DCS 1 800 and PCS 1900 MS	-2 dB
	BTS	
-	for normal BTS	0 dB
-	for GSM 900, GSM 850 and MXM 850 micro BTS M1	+7 dB
-	for GSM 900, GSM 850 and MXM 850 micro BTS M2	+12 dB
-	for GSM 900, GSM 850 and MXM 850 micro BTS M3	+17 dB
-	for GSM 900, GSM 850 and MXM 850 pico BTS P1	+16 dB
-	for DCS 1 800, PCS 1900 and MXM 1900 micro BTS M1	+2 dB
-	for DCS 1 800, PCS 1900 and MXM 1900 micro BTS M2	+7 dB
-	for DCS 1 800, PCS 1900 and MXM 1900 micro BTS M3	+12 dB
-	for DCS 1 800, PCS 1900 and MXM 1900 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 1a 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%

where BLER is the Block Error Rate, referring to all erroneously decoded data blocks including any headers, stealing flags, parity bits as well as any implicit information in the training sequence. For PDCH the BLER refers to RLC blocks, and hence there can be up to two block errors per 20ms radio block for EGPRS MCS7, MCS8 and MCS9. For USF, the BLER only refers to the USF value.

For 8-PSK modulated PDCH channels, the performance requirements for some coding schemes and propagation conditions are specified at higher BLER. Where applicable, the BLER value noted in table 1b and 1c applies.

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 reference sensitivity level 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 reference sensitivity level 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 GMSK signals in all cases. The reference sensitivity levels, specified above for circuit-switched, GMSK-modulated channels, apply to 8-PSK as well.

The requirements for micro-BTS for 8-PSK modulated input signals in the tables above, assume the same maximum output power in GMSK and 8-PSK. For other maximum output power levels, the sensitivity is adjusted accordingly.

The pico-BTS 900 MHz, 1800 MHz, 1900 MHz and 850 MHz 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 GSM 900, GSM 850, DCS 1 800, PCS 1900, MXM 850 and MXM 1900 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 and 1b for packet service) , for GMSK modulated signals, and 3 dB for 8-PSK modulated signals.

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 performance requirements for GSM 400 systems are as for GSM 900 in table 2, except that the GSM 400 MS speed is doubled from that of GSM 900, e.g. TU50 becomes TU100. 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 GMSK modulated channels, packet switched and ECSD, and for 8-PSK modulated channels, packet switched and ECSD, the minimum interference ratio for which the reference performance for cochannel interference (C/Ic) shall be met is specified in table 2a, 2d and 2e (GMSK), 2b and 2c, 2d and 2e (8-PSK) respectively, according to the type of channel, the propagation condition and type of equipment. The performance requirements for GSM 400 systems are as for GSM 900 in table 2a, 2b, 2c, 2d and 2e except that the GSM 400 MS speed is doubled from that of GSM 900, e.g. U50 becomes TU100. The reference performance is the same as defined in subclause 6.2. For equipment supporting 8-PSK, the requirements apply for both GMSK and 8-PSK modulated interfering signals. The corresponding interference ratio for adjacent channel interference shall be:

Modulation of wanted signal				GMSK	8-PSK
-	for adjacent (200 kHz) interference	C/Ia1	=	C/Ic - 18 dB	see table 2f, 2g, 2h and 2i
-	for adjacent (400 kHz) interference	C/Ia2	=	C/Ic - 50 dB	C/Ic –50 dB
-	for adjacent (600 kHz) interference	C/Ia3	=	C/Ic - 58 dB	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.

The values in tables 2f, 2g, 2h and 2i are also valid for GSM 400 with the exception that MS speed is doubled, e.g. TU50 becomes TU100.

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, GMSK modulated 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.

For ECSD channels and 8-PSK modulated packet-switched channels, the wanted input signal level shall be: - 93 dBm + Ir + Corr, where:

Ir = the interference ratio according to table 2b and 2c for packets switched channels and table 2d and 2e for ECSD
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 400 MS, a GSM 900 MS, a GSM 850, 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 RA500/250/130 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 GSM 900, GSM 850, DCS 1 800, PCS 1900, MXM 850 and MXM 1900 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, for GMSK modulated wanted signals, 4dB above the interference ratio specified above in this sub-clause (in combination with Table 2a for packet service). For 8-PSK modulated wanted signals, the interference ratio for this requirement is 4 dB above the interference ratio specified above in this sub-clause (in combination with Table 2b, 2c, 2d and 2e 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 850 & 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 and cochannel interference propagation conditions other than TI5 need not be tested. If, in order to ease adjacent channel measurements, 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, for GMSK modulated signals and 1 % for 8-PSK modulated signals. This requirement shall be met for all input levels up to –40 dBm for GMSK modulated signal, and up to -40 dBm for 8-PSK modulated signals.

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.

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 GSM 400, GSM 850 and 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 GSM 400, GSM 850 and 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%.

6.7 Incremental Redundancy Performance for EGPRS MS

Support for Incremental Redundancy reception is mandatory for all EGPRS capable MSs. In Incremental Redundancy RLC mode soft information from multiple, differently punctured, versions of an RLC data block may be used when decoding the RLC data block. This significantly increases the link performance.

An EGPRS capable MS shall under the conditions stated in the below table achieve a long-term throughput of 20 kbps per time slot (see note), measured between LLC and RLC/MAC layer.

Required throughput	20,0 kbps per timeslot
Propagation conditions	Static, input level -97,0 dBm
Modulation and Coding Scheme	MCS-9

Acknowledgements polling period	32 RLC data blocks
Roundtrip time	120 ms
Number of timeslots	Maximum capability of the MS
Transmit window size	Maximum for the MS timeslot capability

NOTE: This corresponds to an equivalent block error rate of approximately 0.66 using the prescribed MCS-9.

Table 1: Reference sensitivity performance

GSM 850 and 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 %

Continued

Table 1 (continued): Reference sensitivity performance

GSM 850 and GSM 900							
Type of Channel		**Propagation conditions**					
		Static	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**	**HT100 (no FH)**
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 %
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 %

Continued

Table 1 (continued): Reference sensitivity performance

GSM 850 and GSM 900							
Type of Channel		Propagation conditions					
		Static	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)	HT100 (no FH)
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 & PCS 1 900						
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 & PCS 1 900						
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 α 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 for GMSK modulated signals

GSM 900 and GSM 850						
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$^{1)}$	dBm	-104$^{(x)}$	-104	-104	-103	-103
PRACH/8 bits$^{1)}$	dBm	-104$^{(x)}$	-104	-104	-103	-103
GSM 900, GSM 850 and MXM 850						
Type of Channel		**Propagation conditions**				
		static	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**	**HT100 (no FH)**
PDTCH/MCS-1	dBm	-104$^{(x)}$	-102.5	-103	-103	-102
PDTCH/MCS-2	dBm	-104$^{(x)}$	-100,5	-101	-100,5	-100
PDTCH/MCS-3	dBm	-104$^{(x)}$	-96,5	-96,5	-92,5	-95,5
PDTCH/MCS-4	dBm	-101,5	-91	-91	*	*
USF/MCS-1 to 4	dBm	-104$^{(x)}$	-102.5	-104	-104$^{(x)}$	-102,5
PRACH/11 bits$^{2), 3)}$	dBm	-104$^{(x)}$	-104	-104	-103	-103
PRACH/8 bits$^{1)}$	dBm	-104$^{(x)}$	-104	-104	-103	-103
DCS 1 800 & PCS 1 900						
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$^{1)}$	dBm	-104$^{(x)}$	-104	-104	-103	-103
PRACH/8 bits$^{1)}$	dBm	-104$^{(x)}$	-104	-104	-103	-103
DCS 1800, PCS 1900 and MXM 1900						
Type of channel		**Propagation conditions**				
		static	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA130 (no FH)**	**HT100 (no FH)**
PDTCH/MCS-1	dBm	-104$^{(x)}$	-102,5	-103	-103	-101,5
PDTCH/MCS-2	dBm	-104$^{(x)}$	-100,5	-101	-100,5	-99,5
PDTCH/MCS-3	dBm	-104$^{(x)}$	-96,5	-96,5	-92,5	-94,5
PDTCH/MCS-4	dBm	-101.5	-90,5	-90,5	*	*
USF/MCS-1 to 4	dBm	-104$^{(x)}$	-104	-104	-104$^{(x)}$	-102,5
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 and PDTCH/MCS-x 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)

NOTE 5: Identification of the correct Training sequence is required. Cases identified by $^{1)}$ include one training sequence and cases identified by $^{2)}$ include 3 training sequences according to 3GPP TS 05.02. The specification marked by $^{3)}$ also applies to CPRACH.

Table 1b: Input signal level (for normal BTS) at reference performance for 8-PSK modulated signals

GSM 900, GSM 850 and MXM 850						
Type of channel		Propagation conditions				
		static	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)	HT100 (no FH)
PDTCH/MCS-5	dBm	-101	-96,5	-97	-96	-95
PDTCH/MCS-6	dBm	-99,5	-94	-94.5	-91	-91
PDTCH/MCS-7	dBm	-96	-89	-88.5	–87**	–86**
PDTCH/MCS-8	dBm	-93	-84	-84	*	-81,5**
PDTCH/MCS-9	dBm	-91,5	-80	-80	*	*
DCS 1 800, PCS 1900 and MXM 1900						
Type of channel		Propagation conditions				
		static	TU50 (no FH)	TU50 (ideal FH)	RA130 (no FH)	HT100 (no FH)
PDTCH/MCS-5	dBm	-101	-95,5	-97	-96	-93
PDTCH/MCS-6	dBm	-99,5	-94	-94	-91	–85,5
PDTCH/MCS-7	dBm	-96	-87	-86,5	-87**	*
PDTCH/MCS-8	dBm	-93	–86,5**	–86,5**	*	*
PDTCH/MCS-9	dBm	-91,5	-83**	-83**	*	*

Performance is specified at 30% BLER for those cases identified with mark **.

NOTE 1: 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 2: PDTCH for MCS-x can not meet the reference performance for some propagation conditions (*).

Table 1c: Input signal level (for MS) at reference performance for 8-PSK modulated signals

GSM 900 and GSM 850						
Type of channel		Propagation conditions				
		static	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)	HT100 (no FH)
PDTCH/MCS-5	dBm	-98	-93	-94	-93	-92
PDTCH/MCS-6	dBm	-96	-91	-91,5	-88	-89
PDTCH/MCS-7	dBm	-93	-84	-84	*	-83**
PDTCH/MCS-8	dBm	-90,5	-83**	-83**	*	*
PDTCH/MCS-9	dBm	-86	-78,5**	-78,5**	*	*
USF/MCS-5 to 9	dBm	-102[(x)]	-97,5	-99	-100	-99
DCS 1 800 and PCS 1900						
Type of channel		Propagation conditions				
		static	TU50 (no FH)	TU50 (ideal FH)	RA130 (no FH)	HT100 (no FH)
PDTCH/MCS-5	dBm	-98	-93,5	-93,5	-93	-89,5
PDTCH/MCS-6	dBm	-96	-91	-91	-88	-83,5
PDTCH/MCS-7	dBm	-93	-81,5	-80,5	*	*
PDTCH/MCS-8	dBm	-90,5	-80**	-80**	*	*
PDTCH/MCS-9	dBm	-86	*	*	*	*
USF/MCS-5 to 9	dBm	-102[(x)]	-99	-99	-100	-99

Performance is specified at 30% BLER for those cases identified with mark **.

NOTE 1: 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 2: PDTCH for MCS-x can not meet the reference performance for some propagation conditions (*).

NOTE 3: The complete conformance should not be restricted to the logical channels and channel models identified with (x).

Table 1d: Input signal level (for normal BTS) at reference performance for ECSD (GMSK and 8-PSK modulated signals)

GSM 900 and GSM 850						
Type of Channel		Propagation conditions				
		Static	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)	HT100 (no FH)
E-FACCH/F	dBm	-104(x)	-101	-102	-102	-98
E-TCH/F28.8 T	dBm	-99,5	-93,5	-95	-93,5	-94,5
E-TCH/F 32 T	dBm	-104	-97,5	-100	-100	-96,5
E-TCH/F28.8 NT	dBm	-100	-95,5	-96,5	-96,5	-96
E-TCH/F43.2 NT	dBm	-97	-91	-92	-89	-89,5
DCS 1 800 & PCS 1900						
Type of Channel		Propagation conditions				
		Static	TU50 (no FH)	TU50 (ideal FH)	RA130 (no FH)	HT100 (no FH)
E-FACCH/F	dBm	-104(x)	-102	-102	-102	-98
E-TCH/F28.8 T	dBm	-99,5	-94,5	-95	-92,5	-93
E-TCH/F 32 T	dBm	-104	-98,5	-100	-100	-97
E-TCH/F28.8 NT	dBm	-100	-96	-96,5	-96	-95
E-TCH/F43.2 NT	dBm	-97	-91,5	-91,5	-88,5	-86

NOTE 1: 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 2: The complete conformance should not be restricted to the logical channels and channel models identified with (x).

Table 1e: Input signal level (for MS) at reference performance for ECSD (GMSK and 8-PSK modulated signals)

GSM 850 and GSM 900						
Type of Channel		Propagation conditions				
		Static	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)	HT100 (no FH)
E-FACCH/F	dBm	-102(x)	-99	-100	-100	-96
E-TCH/F28.8 T	dBm	-97.5	-91.5	-93	-91.5	-90
E-TCH/F 32 T	dBm	-98.5	-93	-94	-94	-91.5
E-TCH/F28.8 NT	dBm	-98	-93.5	-94.5	-94.5	-92.5
E-TCH/F43.2 NT	dBm	-95	-89	-90	-87	-84.5
DCS 1 800 & PCS 1900						
Type of Channel		Propagation conditions				
		Static	TU50 (no FH)	TU50 (ideal FH)	RA130 (no FH)	HT100 (no FH)
E-FACCH/F	dBm	-102(x)	-100	-100	-100	-96
E-TCH/F28.8 T	dBm	-97.5	-92.5	-93	-90	-87.5
E-TCH/F 32 T	dBm	-98.5	-94	-94	-94	-87.5
E-TCH/F28.8 NT	dBm	-98	-94	-94.5	-93.5	-90.5
E-TCH/F43.2 NT	dBm	-95	-89.5	-89.5	-86.5	*

NOTE 1: 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 2: E-TCH/F for 43.2 NT can not meet the reference performance for some propagation conditions (*).
NOTE 3: The complete conformance should not be restricted to the logical channels and channel models identified with (x).

Table 2: Reference interference performance

GSM 850 and 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^{-4}	10^{-5}	10^{-5}
TCH/H2,4 (BER)	4 %	10^{-4}	$2\ 10^{-4}$	10^{-4}	10^{-4}
TCH/FS (FER)	21α %	3α %	6α %	3α %	3α %
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 %
(continued)					

Table 2 (continued): Reference interference performance

GSM 850 and GSM 900						
Type of Channel		Propagation conditions				
		TU3 (no FH)	TU3 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)
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 %
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 850 and 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 %	5,2 %	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 %
(continued)						

Table 2 (continued): Reference interference performance

GSM 850 and GSM 900					
Type of Channel	Propagation conditions				
	TU3 (no FH)	TU3 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)
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 %
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 %
(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)**
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}
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 %
(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/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 %
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 interference 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 interference 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 α 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 for GMSK modulated signals

Type of channel		TU3 (no FH)	TU3 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)
GSM 900 and GSM 850						
		Propagation conditions				
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 [1)]	dB	8	8	8	8	10
PRACH/8 bits [1)]	dB	8	8	8	8	9
GSM 850, MXM 850 and GSM 900						
Type of channel		**TU3 (no FH)**	**TU3 (ideal FH)**	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**
PDTCH/MCS-1	dB	13	9.5	10.5	9.5	10
PDTCH/MCS-2	dB	15	12	12.5	12	12
PDTCH/MCS-3	dB	16.5	16.5	17	17	19
PDTCH/MCS-4	dB	19	21.5	22	22	*
USF/MCS-1 to 4	dB	18	10	11	9.5	9.5
PRACH/11 bits [2), 3)]	dB	8	8	8	8	10
PRACH/8 bits [1)]	dB	8	8	8	8	9
DCS 1 800 & PCS 1 900						
Type of channel		**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 [1)]	dB	9	9	9	9	10
PRACH/8 bits [1)]	dB	8	8	8	8	9
DCS 1800, PCS 1 900 and MXM 1900						
Type of channel		**TU1,5 (no FH)**	**TU1,5 (ideal FH)**	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA130 (no FH)**
PDTCH/MCS-1	dB	13	9.5	10	9.5	10
PDTCH/MCS-2	dB	15	12	12	12	12
PDTCH/MCS-3	dB	16.5	16.5	17	18	19
PDTCH/MCS-4	dB	19	21.5	23	23	*
USF/MCS-1 to 4	dB	18	10	9.5	9.5	9.5
PRACH/11 bits [2), 3)]	dB	9	9	9	9	10
PRACH/8 bits [1)]	dB	8	8	8	8	9

Performance is specified at 30% BLER for those cases identified with mark **.

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 and PDTCH/MCS-x cannot meet the reference performance for some propagation conditions (*).

NOTE 4: Identification of the correct Training sequence is required. Cases identified by [1)] include one training sequence and cases identified by [2)] include 3 training sequences according to 3GPP TS 05.02. The specification identified by [3)] also applies to CPRACH.

Table 2b: Cochannel interference ratio (for normal BTS) at reference performance for 8-PSK modulated signals

GSM 900, GSM 850 and MXM 850						
Type of channel		Propagation conditions				
		TU3 (no FH)	TU3 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)
PDTCH/MCS-5	dB	18	14.5	15.5	14.5	16
PDTCH/MCS-6	dB	20	17	18	17.5	21
PDTCH/MCS-7	dB	23.5	23.5	24	24.5	26.5**
PDTCH/MCS-8	dB	28.5	29	30	30	*
PDTCH/MCS-9	dB	30	32	33	35	*
DCS 1 800. PCS 1900 and MXM 1900						
Type of channel		Propagation conditions				
		TU1,5 (no FH)	TU1,5 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA130 (no FH)
PDTCH/MCS-5	dB	18	14.5	15	15	16
PDTCH/MCS-6	dB	20	17	17.5	18	21
PDTCH/MCS-7	dB	23.5	23.5	26	26.5	27**
PDTCH/MCS-8	dB	28.5	29	25**	24.5**	*
PDTCH/MCS-9	dB	30	32	29**	29**	*

Performance is specified at 30% BLER for those cases identified with mark **.

NOTE 1: 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 perfomance requirements are given for information purposes and need not be tested.

NOTE 2: PDTCH for MCS-x can not meet the reference performance for some propagation conditions (*).

Table 2c: Cochannel interference ratio (for MS) at reference performance for 8-PSK modulated signals

GSM 850 and GSM 900						
Type of channel		Propagation conditions				
		TU3 (no FH)	TU3 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)
PDTCH/MCS-5	dB	19,5	14,5	15,5	14,5	16,5
PDTCH/MCS-6	dB	21,5	17	18	17,5	21
PDTCH/MCS-7	dB	26,5	23,5	25	24,5	*
PDTCH/MCS-8	dB	30,5	23,5**	25,5**	25,5**	*
PDTCH/MCS-9	dB	25,5**	28**	30,5**	30,5**	*
USF/MCS-5 to 9	dB	17	10,5	11,5	9	9
DCS 1 800 and PCS 1900						
Type of channel		Propagation conditions				
		TU1,5 (no FH)	TU1,5 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA130 (no FH)
PDTCH/MCS-5	dB	19,5	14,5	15	15,5	16,5
PDTCH/MCS-6	dB	21,5	17	18	18,5	21
PDTCH/MCS-7	dB	26,5	23,5	27,5	28	*
PDTCH/MCS-8	dB	30,5	23,5**	29,5**	29**	*
PDTCH/MCS-9	dB	25,5**	28**	*	*	*
USF/MCS-5 to 9	dB	17	10,5	10	9	9

Performance is specified at 30% BLER for those cases identified with mark **.

NOTE 1: 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 2: PDTCH for MCS-x can not meet the reference performance for some propagation conditions (*).

Table 2d: Cochannel interference ratio (for normal BTS) at reference performance for ECSD (GMSK and 8-PSK modulated signals)

GSM 900 and GSM 850						
Type of Channel		**Propagation conditions**				
		TU3 (no FH)	**TU3 (ideal FH)**	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**
E-FACCH/F	dB	17.5	11.5	12.5	11.5	11.5
E-TCH/F28.8 T	dB	27	15	17.5	15.5	16
E-TCH/F 32 T	dB	25.5	15.5	17	15.5	15.5
E-TCH/F28.8 NT	dB	20	13.5	14.5	13.5	13.5
E-TCH/F43.2 NT	dB	24	18.5	19.5	19	21.5
DCS 1 800 & PCS 1900						
Type of Channel		**Propagation conditions**				
		TU1,5 (no FH)	**TU1,5 (ideal FH)**	**TU50 (no FH)**	**TU50 ideal FH)**	**RA130 (no FH)**
E-FACCH/F	dB	17.5	11.5	11.5	11.5	11.5
E-TCH/F28.8 T	dB	27	15.5	16	16	17
E-TCH/F 32 T	dB	25.5	15.5	16	15.5	15.5
E-TCH/F28.8 NT	dB	20	13.5	14	14	14.5
E-TCH/F43.2 NT	dB	24	18.5	19.5	19.5	22
NOTE: 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.						

Table 2e: Cochannel interference ratio (for MS) at reference performance for ECSD (GMSK and 8-PSK modulated signals)

GSM 850 and GSM 900						
Type of Channel		**Propagation conditions**				
		TU3 (no FH)	**TU3 (ideal FH)**	**TU50 (no FH)**	**TU50 (ideal FH)**	**RA250 (no FH)**
E-FACCH/F	dB	17.5	11.5	12.5	11.5	11.5
E-TCH/F28.8 T	dB	28	15.5	18	16	16
E-TCH/F 32 T	dB	27.5	16	18	16	17.5
E-TCH/F28.8 NT	dB	20.5	14	15	14	14
E-TCH/F43.2 NT	dB	25	19	20	19.5	22
DCS 1 800 & PCS 1900						
Type of Channel		**Propagation conditions**				
		TU1,5 (no FH)	**TU1,5 (ideal FH)**	**TU50 (no FH)**	**TU50 ideal FH)**	**RA130 (no FH)**
E-FACCH/F	dB	17.5	11.5	11.5	11.5	11.5
E-TCH/F28.8 T	dB	28	15.5	16	16	17
E-TCH/F 32 T	dB	27.5	16	16.5	16,5	17.5
E-TCH/F28.8 NT	dB	20	13.5	14	14	14.5
E-TCH/F43.2 NT	dB	25	18.5	19.5	19.5	22
NOTE: 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.						

Table 2f: Adjacent channel interference ratio (for normal BTS) at reference performance for 8-PSK modulated signals

GSM 900, GSM 850 and MXM 850						
Type of channel		Propagation conditions				
		TU3 (no FH)	TU3 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)
PDTCH/MCS-5	dB	2.5	-2	-2	-2	1
PDTCH/MCS-6	dB	4.5	0.5	1	1	6.5
PDTCH/MCS-7	dB	8	8	8.5	8.5	13.5**
PDTCH/MCS-8	dB	10.5	12	9**	9.5**	*
PDTCH/MCS-9	dB	12	14	13.5**	13.5**	*
DCS 1 800, PCS 1900 and MXM 1900						
Type of channel		Propagation conditions				
		TU1,5 (no FH)	TU1,5 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA130 (no FH)
PDTCH/MCS-5	dB	2.5	-2	-2	-1.5	1
PDTCH/MCS-6	dB	4.5	0.5	1.5	1.5	6.5
PDTCH/MCS-7	dB	8	8	10.5	11	13.5**
PDTCH/MCS-8	dB	10.5	12	10**	9.5**	*
PDTCH/MCS-9	dB	12	14	16**	16**	*
NOTE 1: 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 2: PDTCH for MCS-x can not meet the reference performance for some propagation conditions (*).						

Table 2g: Adjacent channel interference ratio (for MS) at reference performance for 8-PSK modulated signals

GSM 850 and GSM 900						
Type of channel		Propagation conditions				
		TU3 (no FH)	TU3 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)
PDTCH/MCS-5	dB	2.5	-2	-1	-2	1
PDTCH/MCS-6	dB	5.5	0.5	2	1	6.5
PDTCH/MCS-7	dB	10.5	8	10	9	*
PDTCH/MCS-8	dB	15.5	9**	11**	10.5**	*
PDTCH/MCS-9	dB	10**	12.5**	17**	15.5**	*
USF/MCS-5 to 9	dB	-1	-8.5	-8	-9.5	-9
DCS 1 800 and PCS 1900						
Type of channel		Propagation conditions				
		TU1,5 (no FH)	TU1,5 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA130 (no FH)
PDTCH/MCS-5	dB	2.5	-2	-2	-1.5	1
PDTCH/MCS-6	dB	5.5	0.5	1.5	1.5	6.5
PDTCH/MCS-7	dB	10.5	8	12.5	12	*
PDTCH/MCS-8	dB	15.5	9**	16**	15.5**	*
PDTCH/MCS-9	dB	10**	12.5**	*	*	*
USF/MCS-5 to 9	dB	-1	-8.5	-9	-9.5	-9
Performance is specified at 30% BLER for those cases identified with mark **.						
NOTE 1: 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 2: PDTCH for MCS-x can not meet the reference performance for some propagation conditions (*).						

Table 2h: Adjacent channel interference (for normal BTS) ratio at reference performance for ECSD (8-PSK modulated signals)

Type of Channel		TU3 (no FH)	TU3 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)
GSM 900 and GSM 850						
		Propagation conditions				
E-TCH/F28.8 T	dB	10	-1	0.5	-1	2.5
E-TCH/F 32 T	dB	7.5	-4	-2.5	-4	-4
E-TCH/F28.8 NT	dB	3.5	-2.5	-1.5	-2.5	-0.5
E-TCH/F43.2 NT	dB	8	2.5	3.5	2.5	12
DCS 1 800 & PCS 1900						
Type of Channel		**TU1,5 (no FH)**	**TU1,5 (ideal FH)**	**TU50 (no FH)**	**TU50 ideal FH)**	**RA130 (no FH)**
E-TCH/F28.8 T	dB	10	-1	-0.5	-0.5	5
E-TCH/F 32 T	dB	7	-4	-3.5	-3.5	-4
E-TCH/F28.8 NT	dB	3.5	-2.5	-2	-2	0.5
E-TCH/F43.2 NT	dB	8	2.5	4	3.5	14

NOTE: 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.

Table 2i: Adjacent channel interference (for MS) ratio at reference performance for ECSD (8-PSK modulated signals)

Type of Channel		TU3 (no FH)	TU3 (ideal FH)	TU50 (no FH)	TU50 (ideal FH)	RA250 (no FH)
GSM 850 and GSM 900						
		Propagation conditions				
E-TCH/F28.8 T	dB	12.5	-0.5	1.5	0	4
E-TCH/F 32 T	dB	10	-1.5	0	-1.5	-1.5
E-TCH/F28.8 NT	dB	4.5	-2	-1	-2	1
E-TCH/F43.2 NT	dB	9.5	3.5	4.5	4	12.5
DCS 1 800 & PCS 1900						
Type of Channel		**TU1,5 (no FH)**	**TU1,5 (ideal FH)**	**TU50 (no FH)**	**TU50 ideal FH)**	**RA130 (no FH)**
E-TCH/F28.8 T	dB	12.5	-0.5	0.5	0.5	6.5
E-TCH/F 32 T	dB	10	-1.5	-1	-1	-1.5
E-TCH/F28.8 NT	dB	4.5	-2	-1.5	-1.5	2
E-TCH/F43.2 NT	dB	9.5	3.5	5	5	14

NOTE: 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.

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

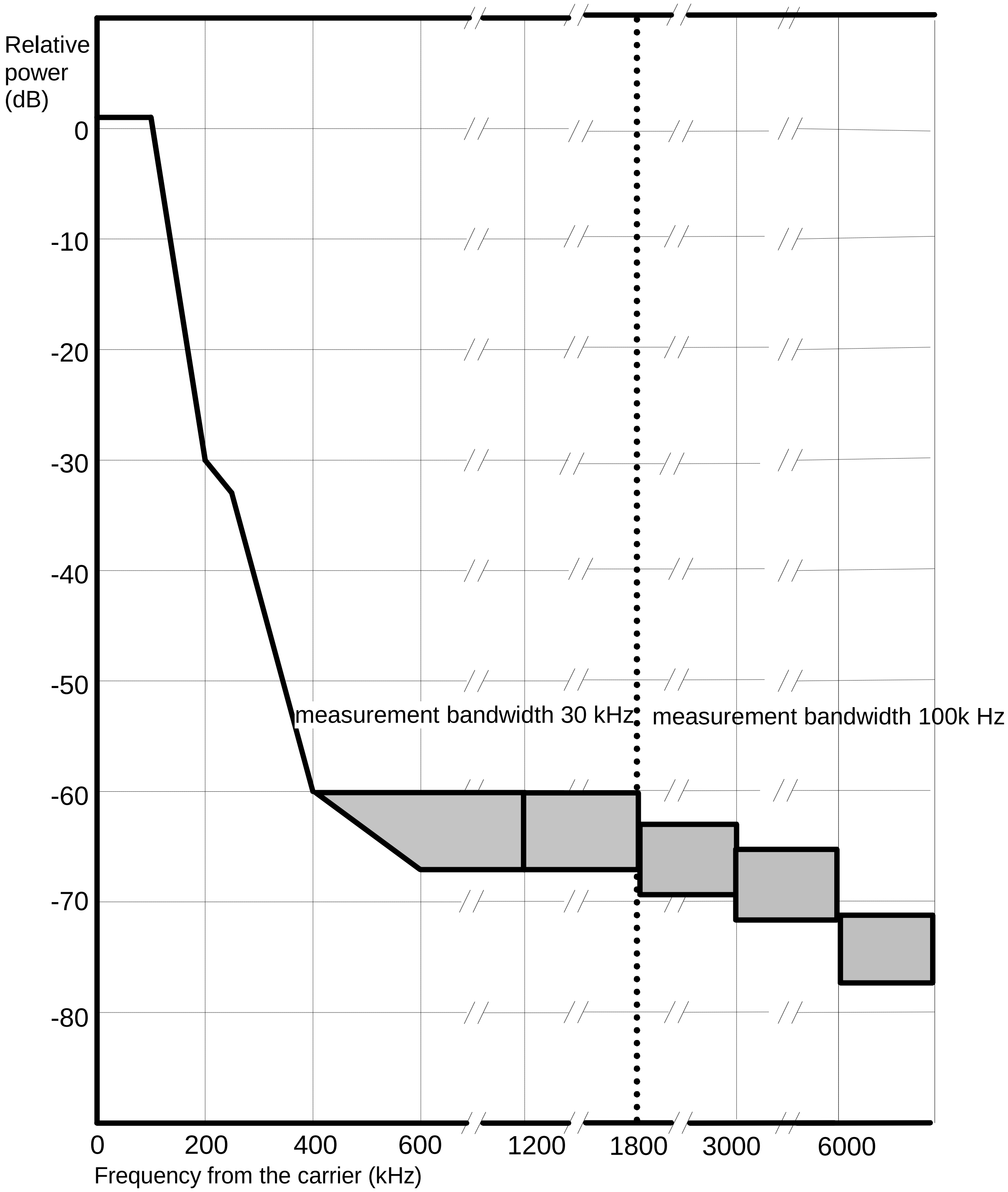

Figure A.1a: GSM 400, GSM 900 and GSM 850 MS spectrum due to GMSK modulation

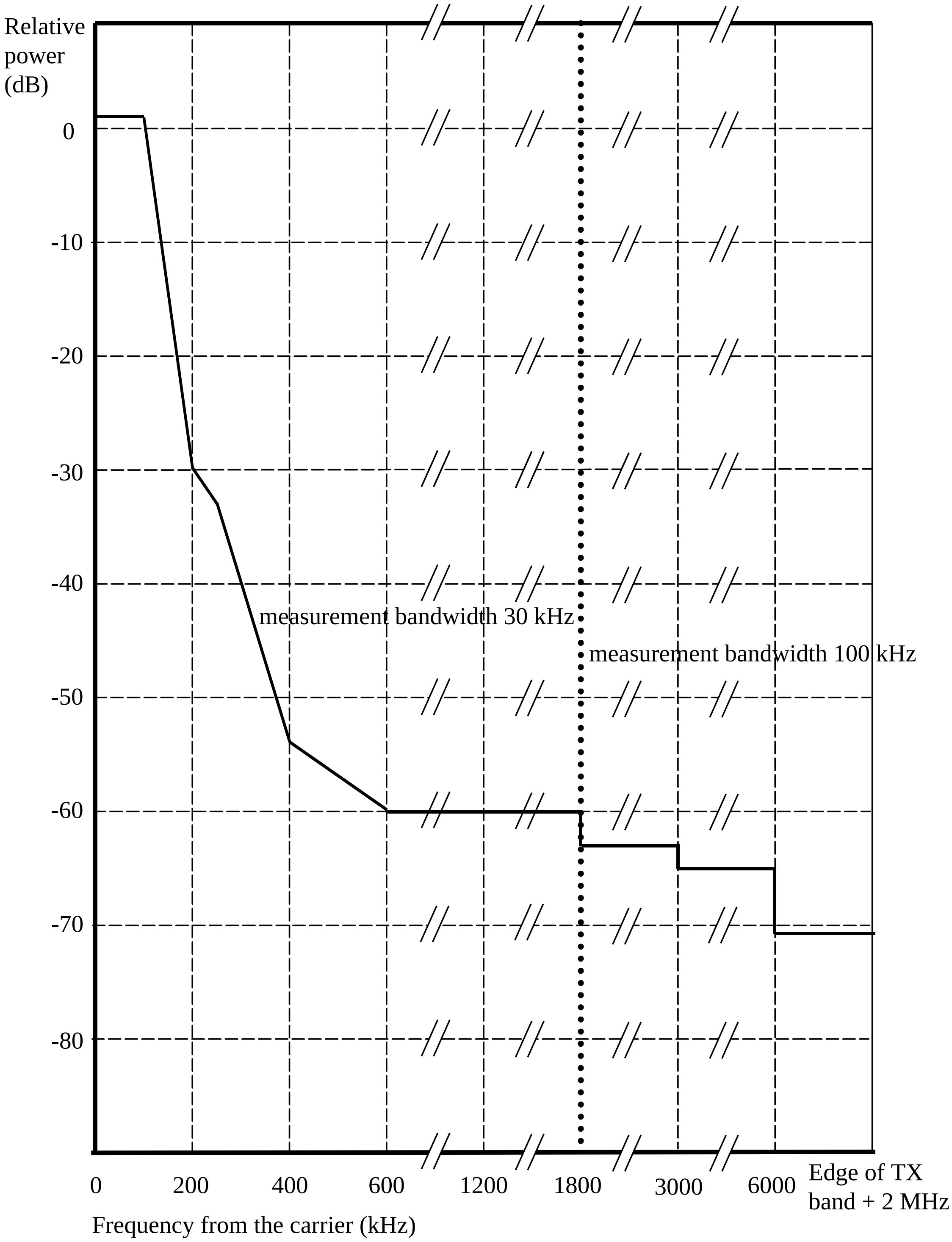

Figure A.1b: GSM 400, GSM 900 and GSM 850 MS spectrum due to 8-PSK modulation

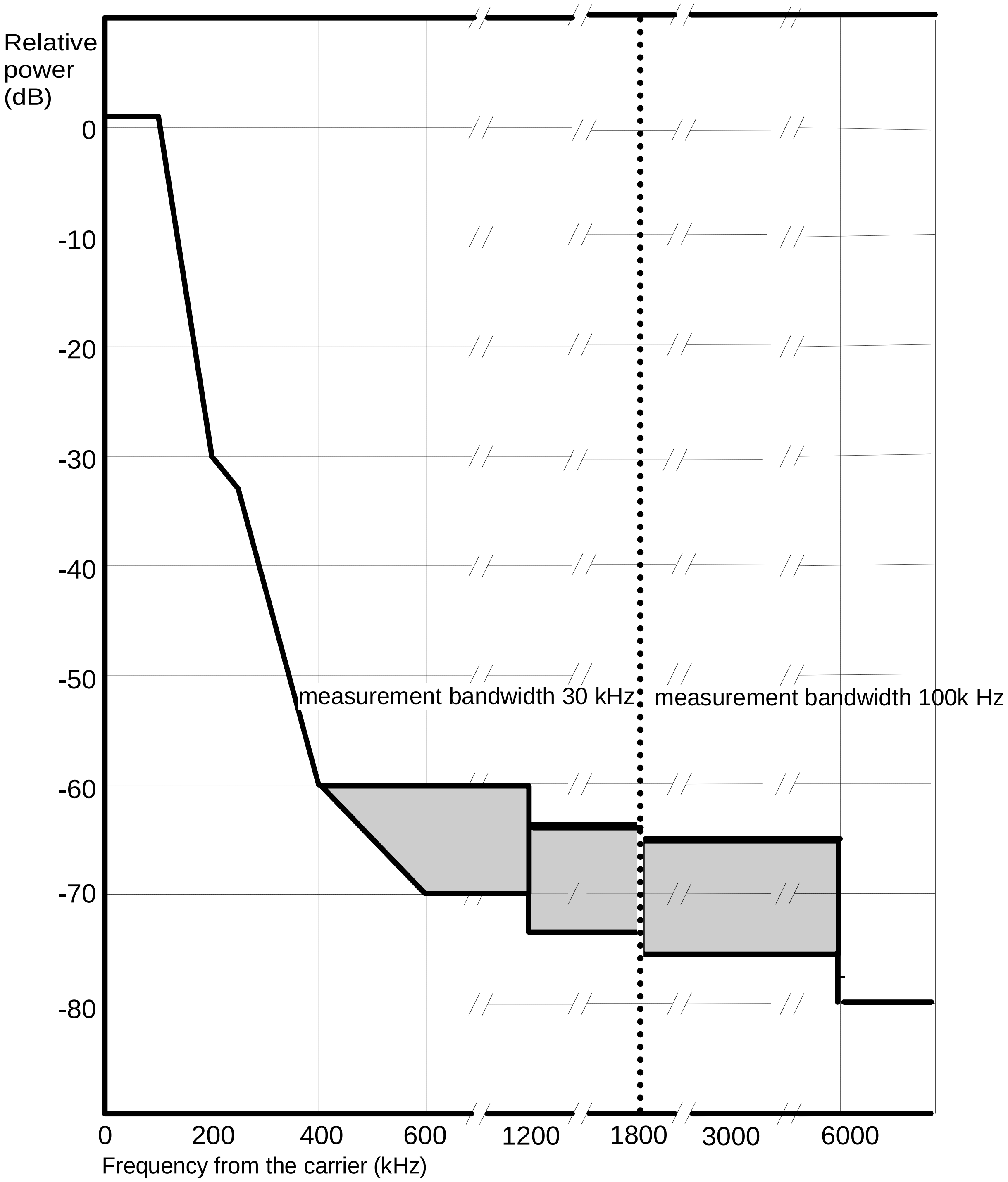

Figure A.2a: GSM 400, GSM 900, GSM 850, MXM 850, DCS 1800, PCS 1900 and MXM 1900 BTS spectrum due to GMSK modulation

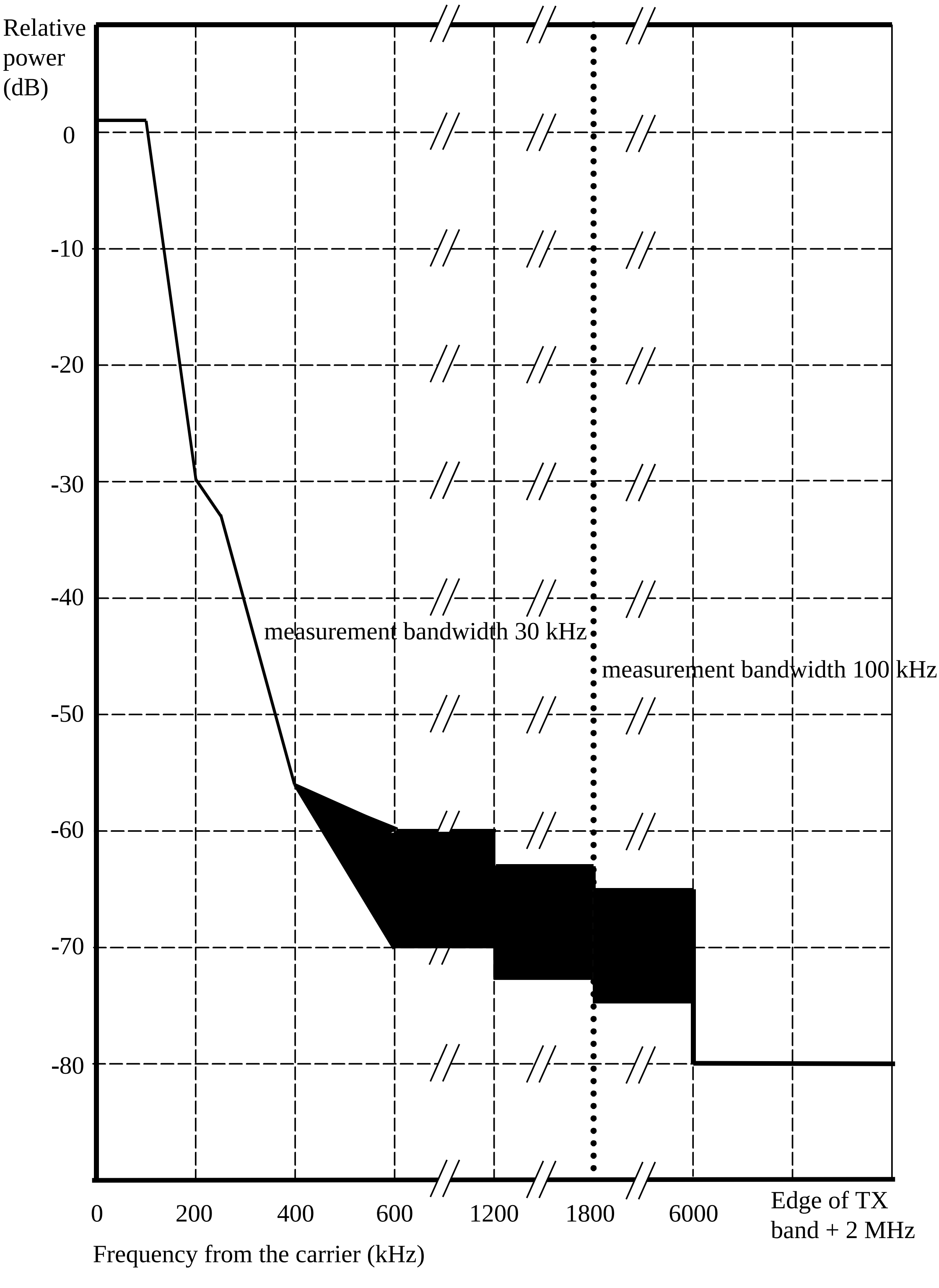

Figure A.2b: GSM 400, GSM 900, GSM 850, MXM 850, DCS 1800, PCS 1900 and MXM 1900 BTS spectrum due to 8-PSK modulation

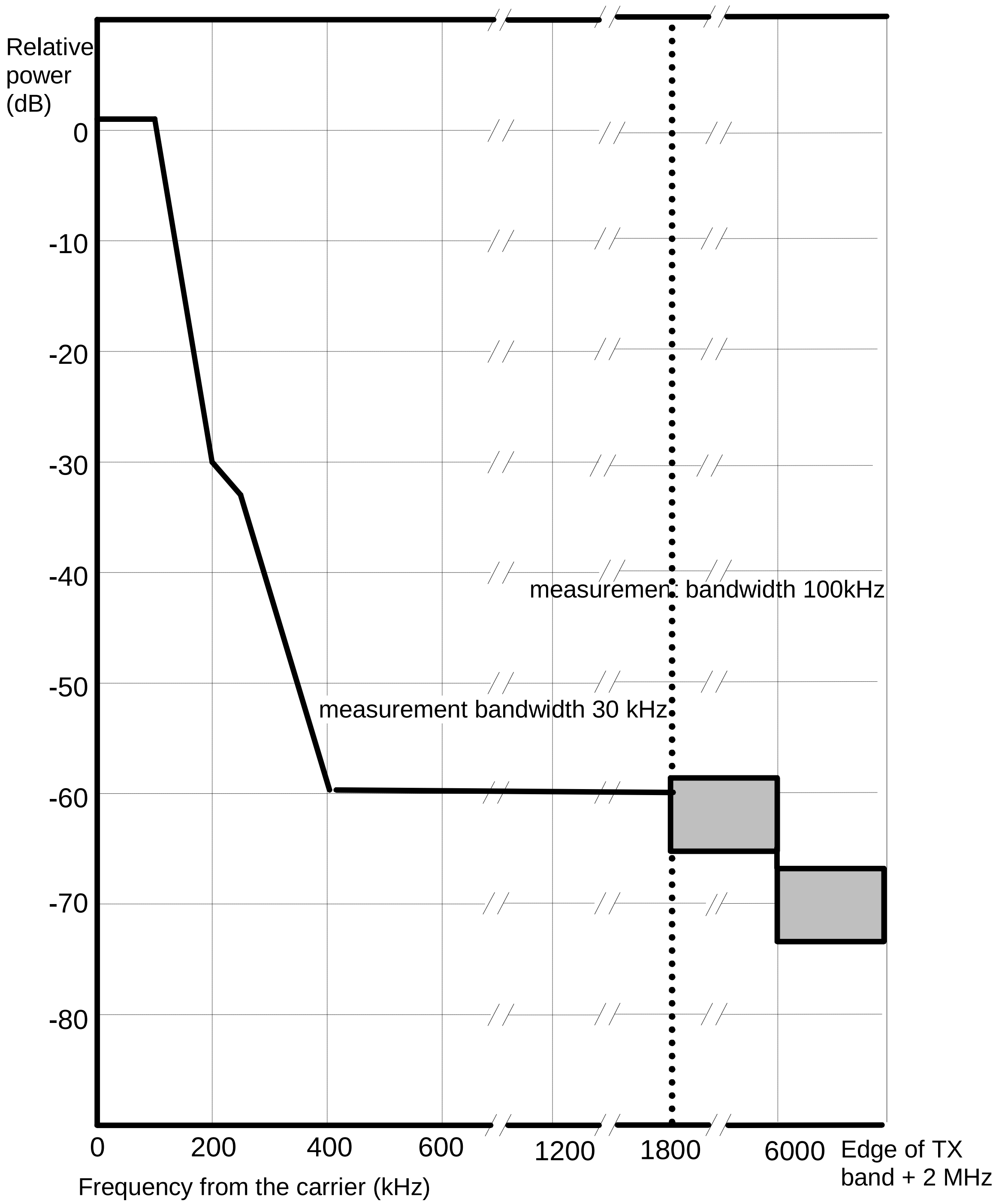

Figure A.3a: DCS 1 800 and PCS 1900 MS spectrum due to GMSK modulation

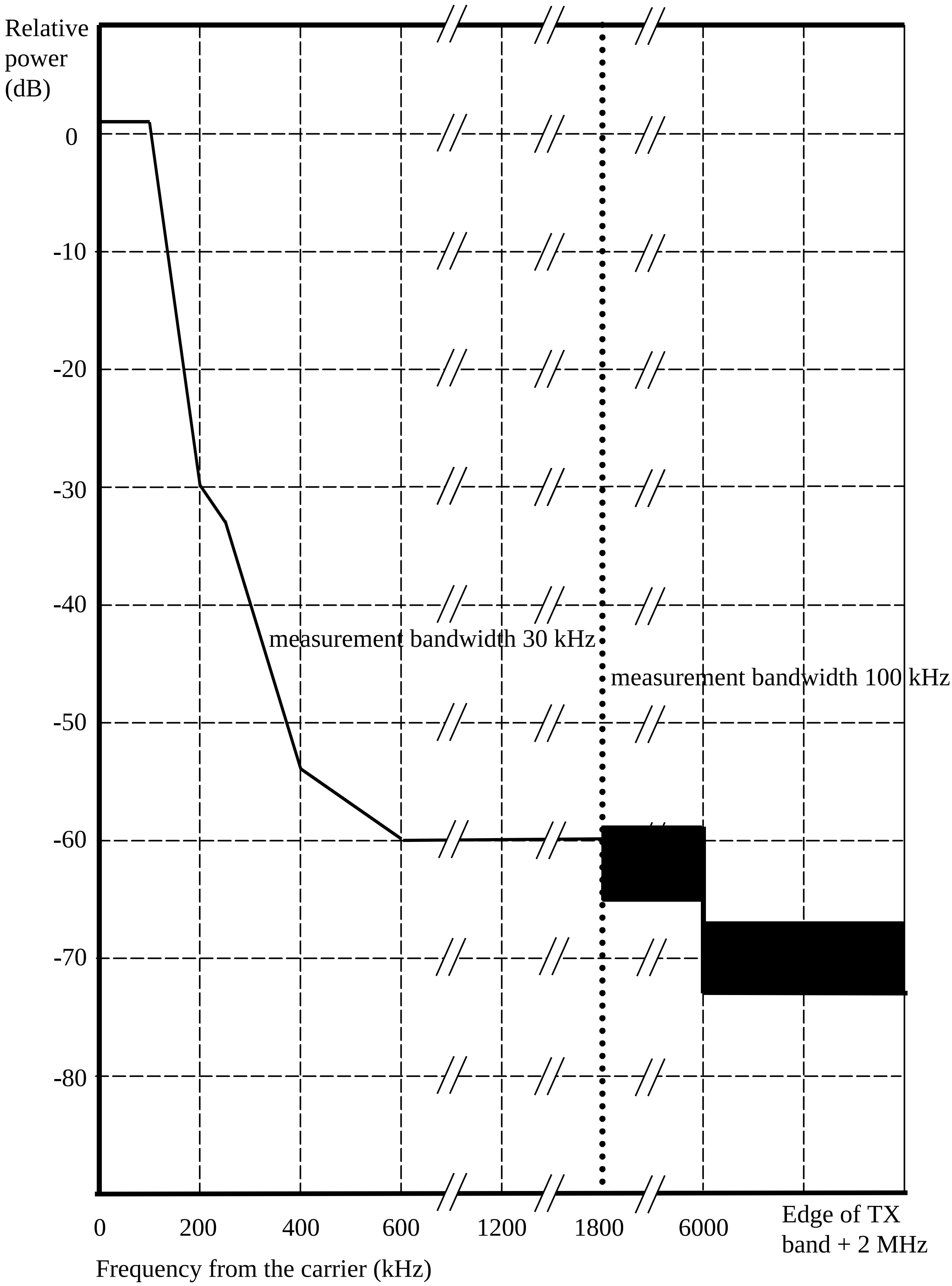

Figure A.3b: DCS 1 800 and PCS 1900 MS spectrum due to 8-PSK modulation

Annex B (normative): Transmitted power level versus time

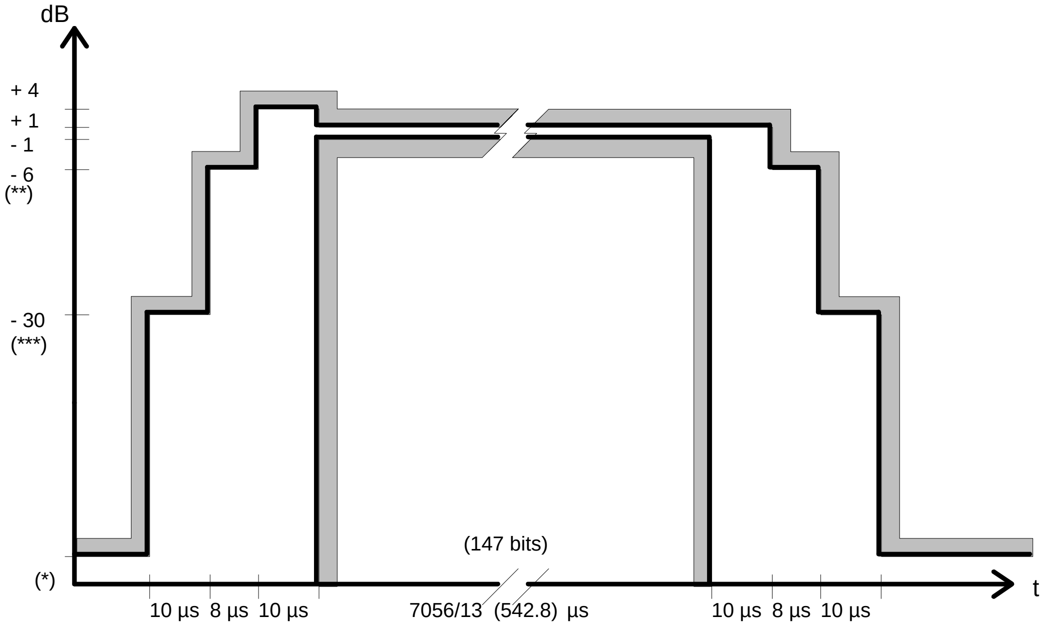

Figure B.1: Time mask for normal duration bursts (NB, FB, dB and SB) at GMSK modulation

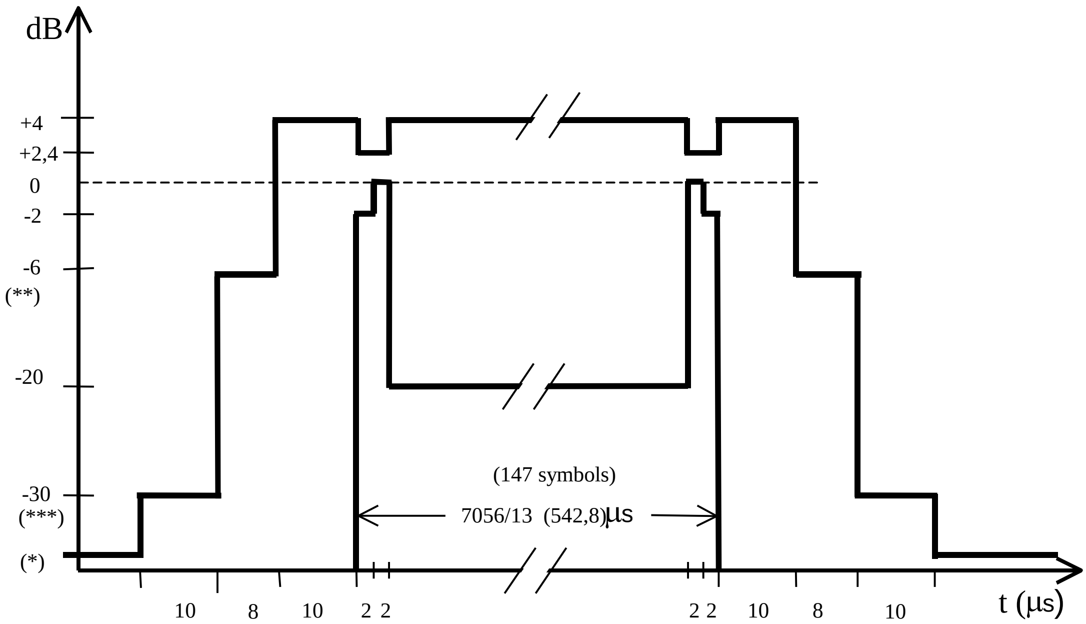

Figure B.2: Time mask for normal duration bursts (NB) at 8-PSK modulation

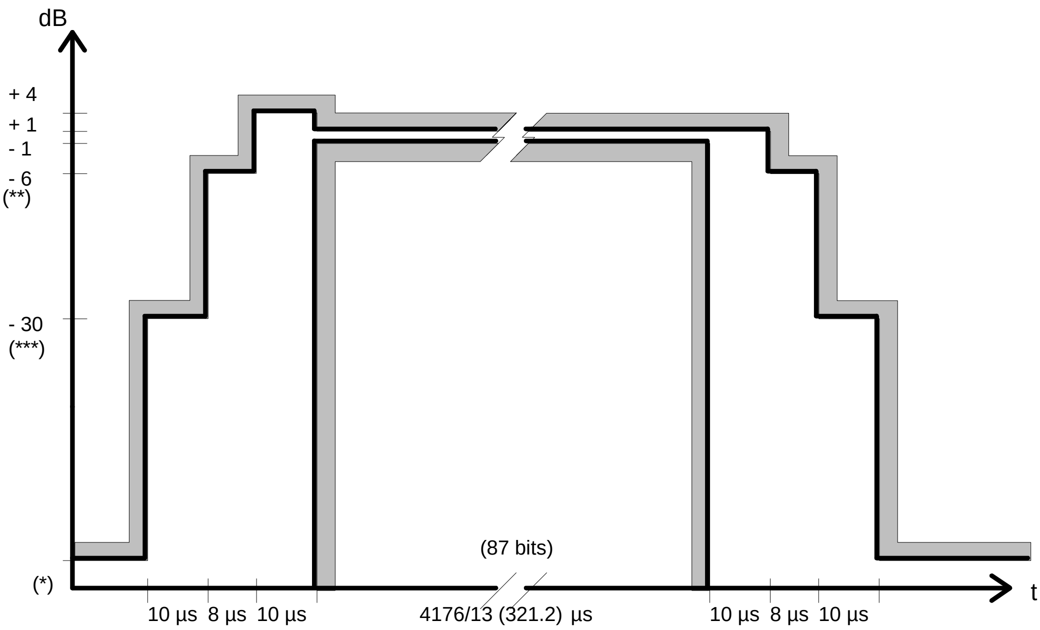

Figure B.3: Time mask for access bursts (AB)

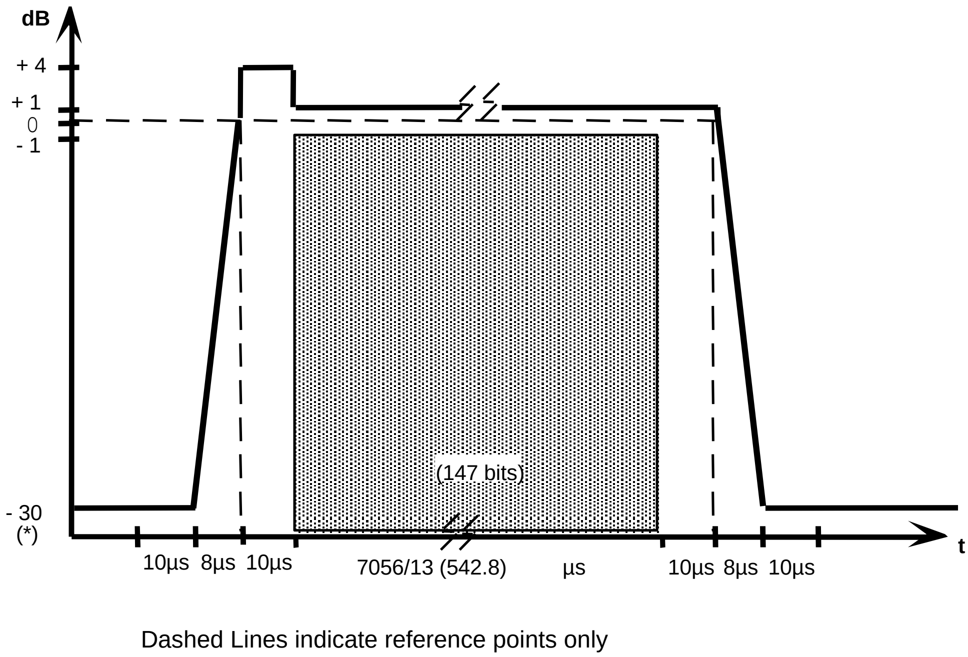

Figure B.4: PCS 1900 and MXM 1900 BTS Transmitter Time Mask at GMSK modulation

(*)	For GSM 400, GSM 850 and GSM 900 MS	:	see 4.5.2.
	For DCS 1 800 and PCS 1900 MS	:	-48 dBc or -48 dBm, whichever is the higher.
	For all BTS	:	no requirement below -30 dBc (see 4.5.1).
(**)	For GSM 400, GSM 900 and GSM 850 MS	:	-4 dBc for power control level 16; -2 dBc for power level 17; -1 dBc for power level controls levels 18 and 19.
	For DCS 1 800 MS		-4dBc for power control level 11, -2dBc for power level 12, -1dBc for power control levels 13,14 and 15
(***)	For GSM 400, GSM 900 and GSM 850 MS	:	-30 dBc or -17 dBm, whichever is the higher.
	For DCS 1 800 MS		-30dBc or -20dBm, whichever is the higher.

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:

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

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 λ (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 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 400, 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 and GSM 850)

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 400, 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 and GSM 850)

10 – 100 Hz: 3 m2/s3 (0.0132 g2/Hz)

100 – 500 Hz: -3dB/Octave

D.3 Environmental requirements for the BSS equipment

This clause applies to both GSM 400, 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 GSM 850, PCS 1 900, MXM 850, MXM 1900 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 400, 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, 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 outside the relevant BTS transmit band or MS transmit band	(offset from edge of the relevant transmit band)-	
	> 0 MHz	10 kHz
	≥ 2 MHz	30 kHz
	≥ 5 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 modulation accuracy

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.

E.5.1 Frequency error

This clause applies only to repeater systems using frequency shift.

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.

E.5.2 Modulation accuracy at GMSK modulation

This clause applies only to repeater systems using frequency shift.

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 in subclause 4.6 by 1.1 degrees RMS and by 4.5 degrees peak.

E.5.3 Modulation accuracy at 8-PSK modulation

This clause applies only to repeater systems supporting 8-PSK.

For a single repeater with no shift in frequency from input to output and operating at the nominal output power as specified by the manufacturer, the RMS EVM of the output RF signal for an ideal GSM 8-PSK input signal according to subclause 4.6, shall not exceed 8 %.

NOTE: Repeaters with higher RMS EVM value may be used in systems utilizing 8-PSK, if all other repeater requirements in this Annex are fulfilled. However, the system performance will be degraded.

For a complete repeater system using frequency shift and operating at the nominal output power as specified by the manufacturer, the RMS EVM of the output RF signal for an ideal GSM 8-PSK input signal according to subclause 4.6, shall not exceed 14.5 %. For a single repeater unit using frequency shift, operating at the nominal output power as specified by the manufacturer, the RMS EVM of the output RF signal for an ideal GSM 8-PSK input signal according to subclause 4.6, shall not exceed 12 %.

In addition the origin offset suppression according to Annex G shall not exceed –35 dBc.

Annex F (normative): Antenna Feeder Loss Compensator Characteristics (GSM 400, 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 400, GSM 900 and DCS 1 800 frequency bands. For GSM 900, the requirements apply to an AFLC intended for use with a GSM 400 and GSM 900 class 4 MS. For DCS 1 800, the requirements apply to an AFLC intended for use with a DCS 1 800 class 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 400 and 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 450,4 MHz to 457,6 MHz for a GSM 450 AFLC, at all frequencies in the transmit band 478,8 MHz to486 MHz for a GSM 480 AFLC, 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 multi band AFLC, which supports more than one, the requirements apply in any transmit bands implemented.

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 400, 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 400 and 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 400 and 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 an MS transmitting at +39 dBm for a GSM 900 AFLC and 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. ≥ 1,8 MHz ≥ 6,0 MHz	 30 kHz 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 - 1 GHz;
- 1 μW (-30 dBm) in the frequency band 1 - 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 - 960 MHz, the power measured in any 100 kHz band shall be no more than -79 dBm, in the band 925 - 935, 460.4 – 467.6 MHz and 488.8 – 496 MHz, shall be no more than -67 dBm and in the band 1 805 - 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 - 880 MHz, 915 - 1 000 MHz;
- 1,25 nW (-59 dBm) in the frequency band 880 - 915 MHz;

- 5 nW (-53 dBm) in the frequency band 1 710 - 1 785 MH;
- 20 nW (-47 dBm) in the frequency bands 1 000 - 1 710 MHz, 1 785 - 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 460.4 – 467.6 MHz for a GSM 450 AFLC, at all frequencies in the receive band 488.8 - 496 MHz for a GSM 480 AFLC, at all frequencies in the receive band 925 - 960 MHz for a GSM 900 AFLC, and at all frequencies in the receive band 1 805 - 1 880 MHz, for a DCS 1 800 AFLC. For a multi band AFLC, which supports more than one of the GSM and DCS bands, the requirements apply in all of the receive bands supported.

F.3.1 Gain

With a GSM input signal at any level in the range -102 dBm to -20 dBm for a GSM 400 and 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 400 and 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 power class 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 (normative): Calculation of Error Vector Magnitude

The Error Vector Magnitude (EVM) is computed at the symbol times in the useful part of the burst.
Let Y(t) be the complex signal produced by observing the real transmitter at instant t. R(t) is defined to be an ideal transmitted signal. The symbol timing phase of Y(t) is aligned with the ideal signal. The transmitter is modelled as:

$$Y(t) = C1\{R(t) + D(t) + C0\}W$$

where

$W = e^{\alpha + j\omega}$ accounts for both a frequency offset of "ω" radians per second phase rotation and an amplitude change of "α" nepers per second,

C0 is a constant origin offset representing carrier feedthrough,

C1 is a complex constant representing the arbitrary phase and output power of the transmitter and

D(t) is the residual complex error on signal R(t).

Y(t) is compensated in amplitude, frequency and phase by multiplying by the complex factor

$$W^{-t}/C1$$

After compensation, Y(t) is passed through the specified measurement filter to produce the signal

$$Z(k) = S(k) + E(k) + C0$$

where

S(k) is the ideal transmitter signal observed through the measurement filter.

$k = \text{floor}(t/T_s)$, where $T_s = 1/270.833\text{kHz}$ corresponding to the symbol times.

The error vector **E**(k)

$$E(k) = Z(k) - C0 - S(k)$$

is measured and calculated for each instant k.

The sum square vector error for each component is calculated over one burst. The relative RMS vector error is defined as:

$$\text{RMS EVM} = \sqrt{\sum_{k \in K} |E(k)|^2 \Big/ \sum_{k \in K} |S(k)|^2}$$ and shall not exceed the specified value.

The symbol vector error magnitude (EVM) at symbol k is defined as

$$EVM(k) = \sqrt{\frac{|E(k)|^2}{\frac{\sum_{k \in K} |S(k)|^2}{N}}} ,$$

where N is the number of elements in the set K. EVM(k) is the vector error length relative the root average energy of the useful part of the burst.

C0, C1 and W shall be chosen to minimise RMS EVM per burst and are then used to compute the individual vector errors E(k) on each symbol. The symbol timing phase of the samples used to compute the vector error should also be chosen to give the lowest value for the RMS EVM.

Origin offset suppression (in dB) is defined as

$$\text{OOS (dB)} = -10\log_{10}\left(\frac{|C_0|^2}{\frac{1}{N}\sum_{k\in K}|S(k)|^2}\right)$$

The minimum value of origin offset suppression is specified separately.

In the above equation, the errors shall be measured after a measurement receive filter at baseband. The specification is based on using the specified, windowed, raised-cosine, filter with roll-off 0.25 and single side-band bandwidth of 90 kHz as the measurement receive filter (see 4.6.2). Sufficient over-sampling is assumed (at least 4 times).

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.

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

Section H.2 and its subsections 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 section 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 Chapter 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 f_0, 9 dB above the reference sensitivity level as specified in Table H.1.1.
- A continuous static sine wave signal as described in Section 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 Section 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 Section 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 Section 5.3 of 3GPP TS 05.05.

H.1.2.4 Spurious emissions

The requirements for a BTS receiver as specified in section 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 clause specifies the required Time-of-Arrival (TOA) measurement accuracy of the LMU with and without interference and 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 Chapter 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 G.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. 70 μs) - 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 400, GSM 850, 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 section 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 clause, 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 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 Section 5.1 of 3GPP TS 05.05. For GSM 400 and GSM 900, the requirements for "other MS" shall be used. For GSM 850, DCS 1800 and PCS 1900, the requirements for "MS" shall be used.

The exceptions listed in Section 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 clause 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 400, GSM850, 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 clause 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 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 Chapter 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 section I.2.1. The input neighbour BCCH carrier signal shall be as defined in 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 below.

- 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 clause defines E-OTD measurement accuracy under multipath conditions. The test setup is as under 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	s29	A100		R99	7.1.0	8.0.0	Output level dynamic operation for EDGE
05.05	s29	A102		R99	7.1.0	8.0.0	Blocking requirements for EDGE MS and BTS receivers
05.05	s29	A103		R99	7.1.0	8.0.0	Power classes for EDGE mobile stations
05.05	s29	A104		R99	7.1.0	8.0.0	Modulation Accuracy for EDGE MS and BTS
05.05	s29	A105		R99	7.1.0	8.0.0	Spectrum Mask for EDGE MS and BTS
05.05	s29	A106		R99	7.1.0	8.0.0	High input level requirements for EDGE receivers
05.05	s29	A107		R99	7.1.0	8.0.0	Introduction of LCS – Requirements on Location Measurement Unit
05.05	s29	A108		R99	7.1.0	8.0.0	Output power for EDGE BTS
05.05	s29	A111		R99	7.1.0	8.0.0	GSM 400 systems introduced in 3GPP TS 05.05
05.05	s30	A114		R99	8.0.0	8.1.0	Output level Dynamic operation in EDGE
05.05	s30	A115		R99	8.0.0	8.1.0	EDGE blocking requirement for micro and pico-BTS
05.05	s30	A116		R99	8.0.0	8.1.0	850 MHz frequency band and channel arrangement
05.05	s30	A117		R99	8.0.0	8.1.0	EDGE 850 MHz and 1900 MHz mixed mode
05.05	s30	A118		R99	8.0.0	8.1.0	Frequency compensation requirements for EDGE receivers
05.05	s30	A119		R99	8.0.0	8.1.0	Modulation accuracy for EDGE MS and BTS
05.05	s30	A120		R99	8.0.0	8.1.0	AMR reference sensitivity and interference
05.05	s30	A124		R99	8.0.0	8.1.0	Introduction of RATSCCH for AMR
05.05	s30	A126		R99	8.0.0	8.1.0	8-PSK requirements for GSM 400
05.05	s30	A127		R99	8.0.0	8.1.0	PCS 1900 MHz intermodulation requirements
05.05	s30	A129		R99	8.0.0	8.1.0	Allowed power level between two consecutive active time slots
05.05	s30	A159		R99	8.0.0	8.1.0	GSM in the 400 MHz bands: editorial modification
05.05	s30b	A132		R99	8.1.0	8.2.0	EDGE blocking requirement for micro and pico-BTS
05.05	s30b	A133		R99	8.1.0	8.2.0	Spurious emission in RX- and TX-band in other frequency bands
05.05	S31	A101		R99	8.2.0	8.3.0	Transmitter/receiver performance for EDGE
05.05	S31	A134		R99	8.2.0	8.3.0	Measurement Filter for EDGE EVM
05.05	S31	A135		R99	8.2.0	8.3.0	Alignment of Measurement Filter reference
05.05	S31	A136		R99	8.2.0	8.3.0	Clarification of Intra BTS Intermodulation Attenuation requirements for MXM 850 and MXM 1900 BTS
05.05	S31	A137		R99	8.2.0	8.3.0	Clarification of Intra BTS Intermodulation Attenuation requirements for PCS 1900 BTS
05.05	S31	A138		R99	8.2.0	8.3.0	Definition of MS for Mixed-mode network
05.05	S31	A139		R99	8.2.0	8.3.0	Correction to Output level dynamic operation

SPEC	SMG#	CR	REV	PHASE	VERS	NEW_VERS	SUBJECT
05.05	S31	A141		R99	8.2.0	8.3.0	Nominal Error Rate performance for EDGE
05.05	S31	A142		R99	8.2.0	8.3.0	Corrections to receiver Characteristics for EDGE
05.05	S31	A143		R99	8.2.0	8.3.0	Spurious emission measurement bandwidths updated to include GSM 400 systems
05.05	S31	A144		R99	8.2.0	8.3.0	Harmonization of Transmitter/receiver performance requirements for PCS 1900
05.05	S31	A147		R99	8.2.0	8.3.0	Relaxation of C/I performance requirement for CS4
05.05	S31	A149		R99	8.2.0	8.3.0	EVM requirements for EDGE BTS transmitter with combining equipment
05.05	S31	A150		R99	8.2.0	8.3.0	Introduction of Incremental Redundancy Receiver Performance for MS
05.05	S31	A151		R99	8.2.0	8.3.0	Switching Transients for 8-PSK Modulation
05.05	S31	A237		R99	8.2.0	8.3.0	RF Requirements for TOA LMU
05.05	S31	A239		R99	8.2.0	8.3.0	Requirements on E-OTD LMU and E-OTD MS
05.05	S31b	A247		R99	8.3.0	8.4.0	Conforming requirements for LMUs containing a control mobile station
05.05	S31b	A154		R99	8.3.0	8.4.0	Completion of 3GPP TS 05.05 for EDGE and clean-up
05.05	S32	A157		R99	8.4.0	8.5.0	Removal of duplicated figures
05.05	S32	A160		R99	8.4.0	8.5.0	Alignment of spurious emissions GSM-3G (UTRA): BTS
05.05	S32	A161		R99	8.4.0	8.5.0	Alignment of spurious emissions GSM-3G (UTRA): MS
							September 2000 - TSG-GERAN#1
05.05	G01	A162		R99	8.5.0	8.6.0	Pico BTS Reference interference level clarification
05.05	G01	A163		R99	8.5.0	8.6.0	Alignment of spurious emissions GSM-3G(UTRA): BTS
05.05	G01	A164		R99	8.5.0	8.6.0	Alignment of spurious emissions GSM-3G(UTRA): MS
05.05	G01	A168	1	R99	8.5.0	8.6.0	Definition of "small MS"
05.05	G01	A172		R99	8.5.0	8.6.0	CR 05.05-A172 Correction on CS-4 performance requirements
05.05	G01	A173	1	R99	8.5.0	8.6.0	Clarification of BTS output power capability with 8-PSK
							November 2000 - TSG-GERAN#2
05.05	G02	A174	2	R99	8.6.0	8.7.0	NER requirements for EGPRS
05.05	G02	A175	1	R99	8.6.0	8.7.0	Tolerance of BTS output power levels
05.05	G02	A177		R99	8.6.0	8.7.0	Alignment of AM suppression requirements for PCS 1900 MS
05.05	G02	A178	2	R99	8.6.0	8.7.0	Testing of Blocking requirements for MXM 1900 BSS
05.05	G02	A179		R99	8.6.0	8.7.0	Testing of Intra BSS intermodulation attenation requirements for MXM 1900 BSS
					8.7.0	8.7.1	Front page layout correction
							January 2001 - TSG-GERAN#3
05.05	G03	A183		R99	8.7.1	8.8.0	Correction of Power vs Time mask for 8-PSK
05.05	G03	A184	1	R99	8.7.1	8.8.0	Definition of MXM systems missing
05.05	G03	A185		R99	8.7.1	8.8.0	Testing of Intra BSS intermodulation attenuation requirements for MXM 850 BSS
05.05	G03	A186	1	R99	8.7.1	8.8.0	Mixed-Mode Systems Intermodulation Attenuation
05.05	G03	A187		R99	8.7.1	8.8.0	Alignment of AM suppression requirements for MXM 1900 BTS with PCS 1900 BTS and MXM 850 BTS with GSM 850 BTS
05.05	G03	A188	1	R99	8.7.1	8.8.0	Interpretation of common DCS 1800 / PCS 1900 ARFCN numbers when transmitted on other bands

Change history							
Date	**TSG GERAN#**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2001-04	04	GP-010865	A189	1	Clarification of Origin Offset Suppression requirements	8.8.0	8.9.0
2001-04	04	GP-010863	A190	1	Corrections to facilitate the interpretation	8.8.0	8.9.0
2001-04	04	GP-010861	A191		Removal of requirements for Intermodulation between MS	8.8.0	8.9.0
2001-06	05	GP-011070	A192		Corrections for clarification regarding output power and blocking requirements	8.9.0	8.10.0
2001-08	06	GP-011908	A194	1	Incorrect references in sub-clause H.2.2.2	8.10.0	8.11.0
2001-08	06	GP-011535	A198		Corrections for clarification regarding GSM 850 MS and PCS 1900 MS requirements on spurious emissions	8.10.0	8.11.0
2001-08	06	GP-011942	A203		Alignment to 04.18 for the definition of the BAND_INDICATOR field	8.10.0	8.11.0
2002-04	09	GP-021156	A206	1	Correction of AMR FR inband performance requirement	8.11.0	8.12.0
2002-06	10	GP-021544	A210		Reference sensitivity and interference performance requirements for TCH/AFS and TCH/AHS	8.12.0	8.13.0
2002-06	10	GP-022029	A213		AMR AHS7.4 static channel performance correction	8.12.0	8.13.0
2002-08	11	GP-022818	A215	3	Relaxation of AMR-Inband, RATSCCH and SID_UPDATE	8.13.0	8.14.0
2003-04	14	GP-030864	A216		Correction of transmitted power level versus time	8.14.0	8.15.0
2003-08	16	GP-032097	A217	1	Introduction of mobile station multislot power classes	8.15.0	8.16.0
2004-11	22	GP-042860	A218	1	Maximum output power when the MS transmits on more slots than assigned for the uplink	8.16.0	8.17.0
2005-04	24	GP-051054	A219		Performance requirements for E-TCH/F32.0	8.17.0	8.18.0
2005-09	26	GP-052151	A249	1	Removal of RATSCCH Identification Requirement	8.18.0	8.19.0
2005-11	27	GP-052667	A248	2	Performance requirements for E-TCH/F32.0	8.19.0	8.20.0