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Digital cellular telecommunications system (Phase 2+) (GSM); Radio transmission and reception (GSM 05.05 version 6.7.1 Release 1997)

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Special Mobile Group (SMG).

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

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

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Version 6.x.y

where:

6 indicates release 1997 of GSM Phase 2+

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x the second digit is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

y the third digit is incremented when editorial only changes have been incorporated in the specification;

National transposition dates	
Date of adoption of the present document:	25 August 2000
Date of latest announcement of the present document (doa):	30 November 2000
Date of latest publication of new National Standard or endorsement of the present document (dop/e):	31 May 2001
Date of withdrawal of any conflicting National Standard (dow):	31 May 2001

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1 Scope

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

Requirements are defined for two categories of parameters:

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

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

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

In the present document some relaxations are introduced for GSM 900 MSs which fulfil the following conditions:

- pertain to power class 4 or 5 (see subclause 4.1.1);
- not designed to be vehicle mounted (see GSM 02.06).

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

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NOTE: In the present document, a handheld which can be connected to a car kit is not considered to be vehicle mounted.

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

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

1.1 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.
- For this Release 1997 document, references to GSM documents are for Release 1997 versions (version 6.x.y).

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

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

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

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

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

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

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

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

[9] GSM 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] ETS 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] ETS 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] GSM 04.14: "Digital cellular telecommunications system (Phase 2+); Individual equipment type requirements and interworking; Special conformance testing functions".

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1.2 Abbreviations

Abbreviations used in the present document are listed in GSM 01.04.

2 Frequency bands and channel arrangement

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

For Standard GSM 900 band, the system is required to operate in the following frequency band:

890 - 915 MHz: mobile transmit, base receive

935 - 960 MHz: base transmit, mobile receive

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

For Extended GSM 900 band, the system is required to operate in the following frequency band:

880 - 915 MHz: mobile transmit, base receive

925 - 960 MHz: base transmit, mobile receive

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

For Railways GSM 900 band, the system is required to operate in the following frequency band:

876 - 915 MHz: mobile transmit, base receive

921 - 960 MHz: base transmit, mobile receive

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iv) DCS 1 800 Band:

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

1 710 - 1 785 MHz: mobile transmit, base receive

1 805 - 1 880 MHz: base transmit, mobile receive

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

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

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

The carrier spacing is 200 kHz.

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

P-GSM 900	Fl(n) = 890 + 0.2*n	1 ≤ n ≤ 124	Fu(n) = Fl(n) + 45
E-GSM 900	Fl(n) = 890 + 0.2*n Fl(n) = 890 + 0.2*(n-1024)	0 ≤ n ≤ 124 975 ≤ n ≤ 1023	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

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Frequencies are in MHz.

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3 Reference configuration

The reference configuration for the radio subsystem is described in GSM 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.

4 Transmitter characteristics

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

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

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

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4.1 Output power

4.1.1 Mobile Station

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

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

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

The different power control levels needed for adaptive power control (see GSM 05.08) shall have the nominal output power as defined in the table below, starting from the power control level for the lowest nominal output power up to the power control level for the maximum nominal output power corresponding to the class of the particular MS as defined in the table above. Whenever a power control level commands the MS to use a nominal output power equal to or greater than the maximum nominal output power for the power class of the MS, the nominal output power transmitted shall be the maximum nominal output power for the MS class, and the tolerance of ±2 or 2.5 dB (see table above) shall apply.

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GSM 900

Power control level	Nominal Output power (dBm)	Tolerance (dB) for conditions	
		normal	extreme
0-2	39	±2	±2.5
3	37	±3	±4
4	35	±3	±4
5	33	±3	±4
6	31	±3	±4
7	29	±3	±4
8	27	±3	±4
9	25	±3	±4
10	23	±3	±4
11	21	±3	±4
12	19	±3	±4
13	17	±3	±4
14	15	±3	±4
15	13	±3	±4
16	11	±5	±6
17	9	±5	±6
18	7	±5	±6
19-31	5	±5	±6

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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 GSM 05.08.

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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.

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

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

4.1.2 Base station

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

GSM 900

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

DCS 1 800

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

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

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GSM 900 micro-BTS		DCS 1 800 micro-BTS	
TRX power class	**Maximum output power**	**TRX power class**	**Maximum output power**
M1	(> 19) - 24 dBm	M1	(> 27) - 32 dBm
M2	(> 14) - 19 dBm	M2	(> 22) - 27 dBm
M3	(> 9) - 14 dBm	M3	(> 17) - 22 dBm

The tolerance of the actual maximum output power of the BTS shall be ±2 dB under normal conditions and ±2.5 dB under extreme conditions. Settings shall be provided to allow the output power to be reduced from its maximum level in at least six steps of nominally 2 dB with an accuracy of ±1 dB to allow a fine adjustment of the coverage by the network operator. In addition, the actual absolute output power at each static RF power step (N) shall be 2*N dB below the absolute output power at static RF power step 0 with a tolerance of ±3 dB under normal conditions and ±4 dB under extreme conditions. The static RF power step 0 shall be the actual output power according to the TRX power class.

As an option the BSS can utilize downlink RF power control. In addition to the static RF power steps described above, the BSS may then utilize up to 15 steps of power control levels with a step size of 2 dB ±1.5 dB, in addition the actual absolute output power at each power control level (N) shall be 2*N dB below the absolute output power at power control level 0 with a tolerance of ±3 dB under normal conditions and ±4 dB under extreme conditions. The power control level 0 shall be the set output power according to the TRX power class and the six power settings defined above.

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

4.2 Output RF spectrum

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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.

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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 GSM 11.10 and 11.20. It is based on the "ringing effect" during the transients, and is a measurement in the time domain, at each point in frequency.

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

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

4.2.1 Spectrum due to the modulation and wide band noise

The output RF modulation spectrum is specified in the following tables. A mask representation of the present document is shown in annex A. The present document 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.

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

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

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a1) GSM 900 MS:

	100	200	250	400	≥ 600 <1800	≥ 1800 <3000	≥ 3000 <6000	≥ 6000
≥ 39	+0.5	-30	-33	-60	-66	-69	-71	-77
37	+0.5	-30	-33	-60	-64	-67	-69	-75
35	+0.5	-30	-33	-60	-62	-65	-67	-73
≤ 33	+0.5	-30	-33	-60	-60	-63	-65	-71

a2) GSM 900 normal BTS:

	100	200	250	400	≥ 600 < 1200	≥ 1200 < 1800	≥ 1800 < 6000	≥ 6000
≥ 43	+0.5	-30	-33	-60	-70	-73	-75	-80
41	+0.5	-30	-33	-60	-68	-71	-73	-80
39	+0.5	-30	-33	-60	-66	-69	-71	-80
37	+0.5	-30	-33	-60	-64	-67	-69	-80
35	+0.5	-30	-33	-60	-62	-65	-67	-80
≤ 33	+0.5	-30	-33	-60	-60	-63	-65	-80

a3) GSM 900 micro-BTS:

	100	200	250	400	≥ 600 < 1200	≥ 1200 < 1800	≥ 1800
≤ 33	+0.5	-30	-33	-60	-60	-63	-70

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b1) DCS 1 800 MS:

	100	200	250	400	≥ 600 < 1800	≥ 1800 < 6000	≥ 6000
≥ 36	+0.5	-30	-33	-60	-60	-71	-79
34	+0.5	-30	-33	-60	-60	-69	-77
32	+0.5	-30	-33	-60	-60	-67	-75
30	+0.5	-30	-33	-60	-60	-65	-73
28	+0.5	-30	-33	-60	-60	-63	-71
26	+0.5	-30	-33	-60	-60	-61	-69
≤ 24	+0.5	[tdb]	-33	-60	-60	-59	-67

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b2) DCS 1 800 normal BTS:

	100	200	250	400	≥ 600 < 1200	≥ 1200 < 1800	≥ 1800 < 6000	≥ 6000
≥ 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