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Digital cellular telecommunications system (Phase 2+) (GSM); Radio transmission and reception (GSM 05.05 version 7.3.1 Release 1998)

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European Standard (Telecommunications series)

Digital cellular telecommunications system (Phase 2+); Radio transmission and reception (GSM 05.05 version 7.3.1 Release 1998)

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GLOBAL SYSTEM FOR
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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 may be 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 re-submitted for formal approval procedures by ETSI with an identifying change of release date and an increase in version number as follows:

Version 7.x.y

where:

- 7 GSM Phase 2+ Release 1998, [SIST EN 300 910 V7.3.1:2003](https://standards.iteh.ai/catalog/standards/sist/fbcc333b-4b88-4382-99b2-e9e49d7b17a5/sist-en-300-910-v7-3-1-2003)
- x the second digit is incremented for changes of substance, 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:	1 September 2000
Date of latest announcement of the present document (doa):	31 December 2000
Date of latest publication of new National Standard or endorsement of the present document (dop/e):	30 June 2001
Date of withdrawal of any conflicting National Standard (dow):	30 June 2001

1 Scope

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

Requirements are defined for two categories of parameters:

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

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

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.

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 1998 document, references to GSM documents are for Release 1998 versions (version 7.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)".

- [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".
- [14] ANSI T1.610 "Generic Procedures for Supplementary Services", 1990-
<https://standards.iteh.ai/catalog/standards/sist/en-300-910-v7-3-1-2003>
- [15] GSM 03.52: "Digital cellular telecommunications system (Phase 2+); GSM Cordless Telephony System (CTS); Lower layers of the CTS radio interface; Stage 2".

1.2 Abbreviations

Abbreviations used in the present document are listed in 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

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

v) PCS 1 900 Band:

For PCS 1 900, the system is required to operate in the following band:

1850-1910 MHz: mobile transmit, base receive

1930-1990 MHz base transmit, mobile receive

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

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

Operators may implement networks which operate 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 $F_l(n)$ the frequency value of the carrier ARFCN n in the lower band, and $F_u(n)$ the corresponding frequency value in the upper band, we have:

P-GSM 900	$F_l(n) = 890 + 0.2 \cdot n$	$1 \leq n \leq 124$	$F_u(n) = F_l(n) + 45$
E-GSM 900	$F_l(n) = 890 + 0.2 \cdot n$ $F_l(n) = 890 + 0.2 \cdot (n-1024)$	$0 \leq n \leq 124$ $975 \leq n \leq 1023$	$F_u(n) = F_l(n) + 45$
R-GSM 900	$F_l(n) = 890 + 0.2 \cdot n$ $F_l(n) = 890 + 0.2 \cdot (n-1024)$	$0 \leq n \leq 124$ $955 \leq n \leq 1023$	$F_u(n) = F_l(n) + 45$
DCS 1 800	$F_l(n) = 1710.2 + 0.2 \cdot (n-512)$	$512 \leq n \leq 885$	$F_u(n) = F_l(n) + 95$
PCS 1 900	$F_l(n) = 1850.2 + .2 \cdot (n-512)$	$512 \leq n \leq 810$	$F_u(n) = F_l(n) + 80$

Frequencies are in MHz.

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.

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

4 Transmitter characteristics

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

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

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

4.1 Output power

4.1.1 Mobile Station

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

Power class	GSM 900 Nominal Maximum output power	DCS 1 800 Nominal Maximum output power	PCS 1 900 Nominal Maximum output power	Tolerance (dB) for conditions	
				normal	extreme
1	-----	1 W (30 dBm)	1 W (30 dBm)	±2	±2,5
2	8 W (39 dBm)	0,25 W (24 dBm)	0,25 W (24 dBm)	±2	±2,5
3	5 W (37 dBm)	4 W (36 dBm)	2 W (33 dBm)	±2	±2,5
4	2 W (33 dBm)			±2	±2,5
5	0,8 W (29 dBm)			±2	±2,5

NOTE: The lowest nominal output power for all classes of GSM 900 MS is 5 dBm and for all classes of DCS 1 800 and PCS 1 900 MS is 0 dBm.

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

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

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.

GSM 900

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

DCS 1 800

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

NOTE 1: For DCS 1 800, the power control levels 29, 30 and 31 are not used when transmitting the parameter MS_TXPWR_MAX_CCH on BCCH, for cross phase compatibility reasons. If levels greater than 30 dBm are required from the MS during a random access attempt, then these shall be decoded from parameters broadcast on the BCCH as described in GSM 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 $+2 \pm 1.5$ dB. Similarly, if the difference in output power actually transmitted by the MS between two power control levels where the difference in nominal output power indicates an decrease of 2 dB (taking into account the restrictions due to power class), shall be -2 ± 1.5 dB.

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

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

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

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

4.1.2 Base station

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

GSM 900

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

DCS 1 800 & PCS 1 900

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

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

GSM 900 micro and pico-BTS		DCS 1 800 & PCS 1 900 micro and pico-BTS	
TRX power class	Maximum output power	TRX power class	Maximum output power
Micro		Micro	
M1	(> 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

The tolerance of the actual maximum output power of the BTS shall be ± 2 dB under normal conditions and $\pm 2,5$ 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 $2 \cdot N$ 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 $2 \text{ dB} \pm 1,5 \text{ dB}$, in addition the actual absolute output power at each power control level (N) shall be $2 \cdot N$ 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.

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

SIST EN 300 910 V7.3.1:2003

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

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

4.2 Output RF spectrum

The specifications contained in this clause 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 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 clause.

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.