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Railway Telecommunications (RT);
GSM-R improved receiver parameters;
Part 1: Requirements for radio reception

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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Railway Telecommunications (RT).

The present document is part 1 of a multi-part deliverable covering the Railway Telecommunications (RT); GSM-R improved receiver parameters, as identified below:

Part 1: "Requirements for radio reception";

Part 2: "Radio conformance testing".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The present document defines the requirements for the receiver of professional mobile station (8 watts professional MS) belonging to the power classes 2/E1, (as described in clause 5.1) for the pan-European digital cellular telecommunication system R-GSM/ER-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 reception requirements for the professional MS.

The present document defines the Radio Frequency characteristics specific for the professional Mobile Station. The measurement methods are specified in TS 102 933-2 [5] and TS 100 607-1 [2].

Unless otherwise specified, the common rules of TS 100 607-1 [2] are applied.

MSs may operate on more than one of the frequency bands specified in clause 2. These MSs, defined in EN 300 919 [1], are referred to as "Multi band MSs" in the present document.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] ETSI EN 300 919: "Digital cellular telecommunications system (Phase 2+) (GSM); Types of Mobile Stations (MS) (GSM 02.06)".

[2] ETSI TS 100 607-1: "Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformance specification; Part 1: Conformance specification (3GPP 11.10-1 Release 1999)".

[3] CENELEC EN 50155: "Railway applications - Electronic equipment used on rolling stock".

[4] ETSI TS 100 910: "Digital cellular telecommunications system (Phase 2+); Radio transmission and reception (3GPP TS 05.05 Release 1999)".

[5] ETSI TS 102 933-2: "Railway Telecommunications (RT); GSM-R improved receiver parameters; Part 2: Radio conformance testing".

[6] UIC Project EIRENE (European Integrated Railway Radio Enhanced Network): "System Requirements Specification".

[7] ETSI TS 100 911: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control (3GPP TS 05.08)".

[8] ETSI TS 101 349: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control/Medium Access Control (RLC/MAC) protocol (3GPP TS 04.60)".

[9] Void.

[10] ETSI TS 136 141: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing (3GPP TS 36.141)".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TR 101 748: "Digital cellular telecommunications system (Phase 2+) (GSM); Abbreviations and acronyms (GSM 01.04)".

3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 101 748 [i.1] apply.

4 Frequency bands and channel arrangement

i) 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.

ii) Extended Railways GSM 900 Band, ER-GSM (includes Standard and Extended GSM 900 Band):

- for Railways GSM 900 band, the system is required to operate in the following frequency band:
  - 873 MHz to 915 MHz: mobile transmit, base receive;
  - 918 MHz to 960 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 a complete band, or the BTS capabilities may be restricted to a subset only, depending on the operators needs.

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:

Band	Frequency value of the carrier ARFCN in the lower band	Frequency channel number (ARFCN)	Frequency value of the carrier ARFCN in the upper band
R-GSM 900	Fl(n) = 890 + 0,2 × n Fl(n) = 890 + 0,2 × (n - 1 024)	0 ≤ n ≤ 124 955 ≤ n ≤ 974	Fu(n) = Fl(n) + 45
ER-GSM 900	Fl(n) = 890 + 0,2 × n Fl(n) = 890 + 0,2 × (n - 1 024)	0 ≤ n ≤ 124 940 ≤ n ≤ 974	Fu(n) = Fl(n) + 45

Frequencies are in MHz.

5 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.

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.

5.1 Output power

5.1.1 Mobile Station

The MS maximum output power and lowest power control level shall be, according to its class, as defined in tables 1 and 2 (see also EN 300 919 [1]).

For GMSK modulation:

Table 1

Power class	ER-GSM/R-GSM Nominal Maximum output	Tolerance (dB) for conditions	
	Power	Normal	Extreme
2	8 W (39 dBm)	±2	±2,5

For 8-PSK modulation (optional):

Table 2

Power class	ER-GSM/R-GSM Nominal Maximum output	ER-GSM/R-GSM Tolerance (dB) for conditions	
	Power	Normal	Extreme
E1	33 dBm	±2	±2,5

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.

The different power control levels needed for adaptive power control (see TS 100 911 [7]) shall have the nominal output power as defined in table 3, 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 tables 1 and 2. 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 tables 1 and 2) shall apply.

Table 3

ER-GSM/R-GSM			
Power control level	**Nominal Output power (dBm)**	**Tolerance (dB) for conditions**	
		Normal	**Extreme**
0 to 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 to 31	5	±5	±6
NOTE: If levels greater than 30 dBm are required from the MS during a random access attempt, then these are decoded from parameters broadcast on the BCCH as described in TS 100 911 [7].			

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: 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 R-GSM and power control levels 3 and 6 for class R-GSM.

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 TS 100 911 [7].

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.

Table 4

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 table 4.

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 dB to 2 dB.

In case the MS transmits on more uplink slots than assigned (e.g. due to a polling response, see TS 101 349 [8]), 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.

6 Receiver characteristics

In this clause, the requirements are given in terms of power levels at the antenna connector of the receiver assuming a 0 dBi gain antenna.

The following requirements are only applicable for ARFCN located within the R-GSM/ER-GSM band, i.e.:
955 to 973 for R-GSM MS and 940 to 973 for ER-GSM MS.

NOTE: Non static wanted signals and interfering signals in reality (e.g. non static, amplitude modulated, broadband signals) could be worse for the receiver performance than the required continuous wave signal. In order to be comparable to existing standards the continuous wave sine signal is used.

6.1 Blocking characteristics

The blocking characteristics of the receiver are specified separately for in-band and out-of-band performance as identified in tables 5 and 6.

Table 5

Frequency band	Frequency range (MHz) ER-GSM/R-GSM professional MS
in-band	915 to 925,6
out-of-band (a)	0,1 to < 915
out-of-band (b)	925,6 to 927
out-of-band (c)	927 to 960
out-of-band (d)	> 960 to 12 750

6.1.1 Blocking with CW interfering signals

The reference sensitivity performance as specified in TS 100 910 [4], tables 1, 1a, 1b, 1c, 1d and 1e shall be met when the following signals are simultaneously input to the receiver:

- for all cases a useful signal, modulated with the relevant supported modulation (GMSK or 8-PSK), at frequency f_0, at a level of -101 dBm;
- a continuous, static sine wave signal at a level as in table 6 and at a frequency (f) which is an integer multiple of 200 kHz.

With the following exceptions, called spurious response frequencies:

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

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

For spurious responses, the performance shall be met when the continuous sine wave signal (f) is set to a level of -40 dBm.

For the out of band emissions of the interfering signal, a maximum noise level of -113 dBm/200 kHz on the wanted ARFCN and its (bi)adjacent channels (968, 969, 971, 972) is to be considered.

Table 6

Frequency band	ER-GSM 900/R-GSM 900 professional MS (dBm)
in-band	
600 kHz ≤ $\|f-f_0\|$ < 800 kHz	-38
800 kHz ≤ $\|f-f_0\|$ < 1,6 MHz	-33
1,6 MHz ≤ $\|f-f_0\|$ < 5 MHz	-23
5 MHz ≤ $\|f-f_0\|$	-23
out-of-band	
(a)	0
(b)	-13
(c)	-10
(d)	0

The following exceptions to the level of the sine wave signal (f) in table 6 shall apply:

For professional MS R-GSM 900 and ER-GSM 900:	
in the band 880 MHz to 912 MHz	-5 dBm
in the band 912 MHz to 915 MHz	-12 dBm

6.1.2 Blocking with broadband interfering signals

The receiver performance as specified in TS 100 910 [4], tables 1, 1a, 1b, 1c, 1d and 1e shall be maintained in presence of the following interferers at the receiver antenna port.

Table 7

Wanted GSMR Signal Level on ARFCN 970 (dBm)	Interferer(s) Characteristics			Comment
Mobile Input Level (dBm/200 kHz)	ARFCN	Freq. (MHz)	Mobile Input Level (dBm/5 MHz)	
-101	3476	927,6	-13	LTE single interferer
	3476 & 3526	927,6 & 932,6	-13	LTE dual interferers

LTE interferer: as defined in clause 6.1.1.1: TM1.1 BW 5 MHz of TS 136 141 [10].

For the out of band emissions of the interfering signal, a maximum noise level of -113 dBm/200 kHz on the wanted ARFCN and its (bi)adjacent channels (968, 969, 971, 972) is to be considered.

7 Other requirements

RF characteristics which are not explicitly addressed in the present document shall be taken from TS 100 910 [4].

In addition, unless otherwise stated, the extended environmental requirements defined in the present document shall apply to specified equipment (see annex A).

Multi band MSs shall meet all requirements for each of the bands supported.

Annex A (normative): Environmental conditions

A.1 General

This normative annex specifies the environmental requirements for the professional MS according to the values specified within EN 50155 [3], within these limits the requirements of the GSM specifications shall be fulfilled.

A.2 Environmental requirements for the MSs

The requirements in this clause apply to professional MSs.

A.2.1 Temperature (R-GSM 900 and ER-GSM 900)

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

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

For extreme condition class T3 of EN 50155 [3] shall be applied.

Outside this temperature range the professional MS, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the professional MS exceed the transmitted levels as defined in TS 100 910 [4] for extreme operation.

A.2.2 Vibration (R-GSM 900 and ER-GSM 900)

The MS shall fulfil all the requirements according to EIRENE [6] System Requirement Specification.

Outside the specified frequency range the professional 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 TS 100 910 [4] for extreme operation.

Annex B (informative): Bibliography

- CENELEC EN 50125-1: "Railway applications - Environmental conditions for equipment".
- Recommendation ITU-T O.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate".

History

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