ATIS-0700019

ATIS Standard on -

RF MINIMUM PERFORMANCE OF WGPRS INDOOR BEARER

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ATIS-0700019, *RF Minimum Performance of WGPRS Indoor Bearer*

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ATIS Standard on

RF Minimum Performance of WGPRS Indoor Bearer

Alliance for Telecommunications Industry Solutions

Approved June 2015

Abstract

This document defines Radio Frequency (RF) characteristics for the Mobile Station (MS) and Base Station System (BSS). The BSS will contain either Base Transceiver Stations (BTS) or microcell base transceiver stations (micro-BTS). The precise measurement methods are specified in 3GPP TS 51.010-1 and 51.021.

Foreword

The Alliance for Telecommunication Industry Solutions (ATIS) serves the public through improved understanding between providers, customers, and manufacturers. The Wireless Technologies and Systems Committee (WTSC) develops and recommends standards and technical reports related to wireless and/or mobile services and systems, including service descriptions and wireless technologies. WTSC develops and recommends positions on related subjects under consideration in other North American, regional, and international standards bodies.

The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages. The word *may* denotes an optional capability that could augment the standard. The standard is fully functional without the incorporation of this optional capability.

Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, WTSC, 1200 G Street NW, Suite 500, Washington, DC 20005.

At the time of consensus on this document, WTSC, which was responsible for its development, had the following leadership:

M. Younge, WTSC Chair (T-Mobile)

D. Zelmer, WTSC Vice-Chair (AT&T)

J, Ragsdale, WTSC RAN Chair (Ericsson)

F. Khatibi, WTSC RAN Vice-Chair (Qualcomm)

The **Radio Access Network [RAN]** Subcommittee was responsible for the development of this document.

Table of Contents

Table of Figures

Table of Tables

ATIS Standard on –

RF Minimum Performance of WGPRS Indoor Bearer

1 Scope

This document defines the requirements for a Wideband General Packet Radio Service (WGPRS) High Speed (HS) Indoor transceiver

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 document defines RF characteristics for the MS and BSS. The BSS will contain either BTS or micro-BTS. The precise measurement methods are specified in 3GPP TS 51.010-1 and 51.021.

Unless otherwise stated, the requirements defined in this document apply to the full range of environmental conditions specified for the equipment.

MSs may operate on more than one of the frequency bands specified in section 2. These MSs are referred to as "Multi band MSs" in this document. Multi band MSs shall meet all requirements for each of the bands supported.

1.1 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid.

- 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 10 document, references to GSM documents are for Release 10 versions (version 10 3GPP TS.x.y).

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".[1]

[2] 3GPP TS 02.06: "Types of Mobile Stations (MS)".[1]

[3] 3GPP TS 43.064: "General Packet Radio Service (GPRS); GPRS Radio Interface Stage 2".[1]

[3a] 3GPP TS 43.071: "Location Services (LCS); Functional description – Stage 2".[1]

[4] 3GPP TS 45.001: "Physical layer on the radio path; General description".[1]

[1] This document is available from the Third Generation Partnership Project (3GPP) at < http://www.3gpp.org/specs/specs.htm >.

[5] 3GPP TS 45.004: "Modulation".[1]

[6] 3GPP TS 45.008: "Radio subsystem link control".[1]

[7] 3GPP TS 45.010: "Radio subsystem synchronization".[1]

[8] 3GPP TS 51.010-1: "Mobile Station (MS) conformance specification Part 1: Conformance Specification".[1]

[9] 3GPP TS 51.011: "Specification of the Subscriber Identity Module - Mobile Equipment (SIM - ME) interface".[1]

[10] ITU-T (formerly CCITT) Recommendation O.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate".[2]

[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".[3]

[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".[3]

[13] 3GPP TS 44.014: Individual equipment type requirements and interworking; Special conformance testing functions".[1]

[14] ATIS-1000610, *Generic Procedures for Supplementary Services*, 1990.[4]

[15] 3GPP TS 43.052: "GSM Cordless Telephony System (CTS); Phase 1; Lower layers of the CTS radio interface; Stage 2".[1]

[16] 3GPP TS 45.005, *Radio Transmission and Reception*

1.2 Abbreviations

Abbreviations used in this document are listed in 3GPP TR 21.905.

1.3 Acronyms

8-PSK	8-ary Phase Shift Keying
ARFCN	Absolute Radio-Frequency Channel Number
ATIS	Alliance for Telecommunications Industry Solutions
BLER	Block Error Rate
BSS	Base Station System
BTS	Base Transceiver Station
C/I	Carrier to Interference Ratio

[2] This document is available from the International Telecommunications Union. < http://www.itu.int/ITU-T/ >

[3] This document is available from the European Committee for Electrotechnical Standardization (CENELEC). < http://www.cenelec.eu/index.html >

[4] This document is available from the Alliance for Telecommunications Industry Solutions (ATIS) at < https://www.atis.org/docstore/product.aspx?id=27979 >.

CW	Continuous Wave
DMAC	Digital Mobile Attenuation Code
DRx	Discontinuous Reception
DTx	Discontinuous Transmission
ERP	Effective Radiated Power
FH	Frequency Hopping
GMSK	Gaussian Minimum Shift Keying
HS	High Speed
MAC	Mobile Attenuation Code
micro-BTS	microcell Base Transceiver Station
MS	Mobile Station
NER	Nominal Error Rates
O-QAM	Offset Quadrature Ampitude Modulation
PCS	8 PSK Coding Scheme
pico-BTS	picocell Base Transceiver Station
PL	Power Level
RF	Radio Frequency
SFH	Slow Frequency Hopping
VMAC	Voice Mobile Attenuation Code
WGPRS	Wideband General Packet Radio Service
WTSC	Wireless Technologies and Systems Committee

2 Frequency Bands & Channel Arrangement

i) 800 MHz Band:

For the 800 MHz band, the system is required to operate in the following frequency band:

824 - 849 MHz: mobile transmit, base receive.

869 - 894 MHz: base transmit, mobile receive.

ii) 1900 MHz Band:

For the 1900 MHz band, the system is required to operate in the following band:

1850-1910 MHz: mobile transmit, base receive.

1930-1990 MHz base transmit, mobile receive.

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

The carrier spacing is 1.6 MHz for the 1.6 MHz WGPRS HS Indoor bearer.

The channel number, expressed as ARFCN, identifying the center frequency in MHz is specified in 3GPP TS 45.005.

3 Reference Configuration

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 of small size and of low complexity 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 picocell Base Transceiver Station (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 section, 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 A).

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

4.1 Output Power

4.1.1 Mobile Station

4.1.1.1 800 MHz

The mean effective radiated power (ERP) of the mobile station is shown in the following table. The manufacturer should recommend the net power gain or loss of the antenna system to be installed with the mobile station such that the power measured at the transmitter output terminals can be directly related to the required ERP. (Typical antenna systems have 2.5 dB gain with respect to a half-wave dipole and 1.5 dB cable loss.) The station class indicated by the mobile station at the beginning of any call will be assumed by the system to be maintained throughout that call.

Table 4.1 – Mobile Station Nominal Power Levels

Mobile Station Power Level (PL)	Mobile Attenuation Code (MAC)	Nominal ERP(dBW) for Mobile Station Power Class (see Note 4)			
		I	II	III	IV
0	0000	6	2	- 2	-2
1	0001	2	2	- 2	-2
2	0010	- 2	- 2	- 2	-2
3	0011	- 6	- 6	- 6	-6
4	0100	-10	-10	-10	-10
5	0101	-14	-14	-14	-14
6	0110	-18	-18	-18	-18
7	0111	-22	-22	-22	-22
DIGITAL MODE ONLY					
8	1000	-22	-22	-22	-27±3dB
9	1001	-22	-22	-22	-32±4dB
10	1010	-22	-22	-22	-37±5dB

NOTE 1: The three least significant bits of MAC are used in the Voice Mobile Attenuation Code (VMAC) field. All four bits of MAC are used in the Digital Mobile Attenuation Code (DMAC) field.

NOTE 2: The output powers shown above shall be maintained within the range of +2 dB, -4 dB of nominal value for Power Levels 0 .. 7, and within +2 dB, -6 dB of the nominal value for Power Levels 8 .. 10 (see NOTE 3).

NOTE 3: The Nominal Output Power for levels 8, 9, and 10 are expressed as a range, rather than an absolute value. When the mobile station changes to one of these power levels, it shall insure that it stabilizes within the range centered around the target value for that level. For example, the target value for power level 8 in the 800 MHz operating band is -27dBW. The mobile station is considered to be within the requirement provided it stabilizes within 3dB of this target level. Once the mobile station has stabilized, the operating tolerance is applied to the specific value within the nominal range on which the mobile station stabilized.

NOTE 4: The Nominal ERP values in watts for power level 0 are:

Class	Power Level
I.	+6 dBW = 4.0 W
II.	+2 dBW = 1.6 W
III.	-2 dBW = 0.6 W
IV.	-2 dBW = 0.6 W

NOTE 5: Only Power Class IV is applicable to the Indoor.

Table 4.2 – Relative Step Accuracy vs. Power Level on a Single Channel

Mobile Station Power Class I, II, and III Levels (PL)	Mobile Station Power Class IV Levels (PL)	Step Between Successive Power Levels (dB)
0 .. 7	2 .. 7	4 ± 1
-	7 .. 10	4 ± 2

NOTE 1: The Power Class IV and Step Between Successive Power Levels columns indicate the dB reduction required when changing from the current power level to the next higher power level. Thus, the change from level 6 to level 7 utilizes the top row criteria; while the change from level 7 to level 8 uses the bottom row criteria.

4.1.1.2 1900 MHz

The mean ERP of the mobile station is shown in the table below. The manufacturer should recommend the net power gain or loss of the antenna system to be installed with the mobile station such that the power measured at the transmitter output terminals can be directly related to the required ERP (typical antenna systems have 2.5 dB gain with respect to a half-wave dipole and 1.5 dB cable loss). The station class indicated by the mobile station at the beginning of any call will be assumed by the system to be maintained throughout that call.

Table 4.3 – Mobile Station Nominal Power Levels

Mobile Station Power Level (PL)	Mobile Attenuation Code (MAC)	Nominal ERP(dBW) for Mobile Station Power Class (see Note 4)		
		II	III	IV
0	0000	0.0	•	-2
1	0001	0.0	•	-2
2	0010	-2	•	-2
3	0011	-6	•	-6
4	0100	-10	•	-10
5	0101	-14	•	-14
6	0110	-18	•	-18
7	0111	-22	•	-22
8	1000	-28±4dB	•	-28±4dB
9	1001	-33±5dB	•	-33±5dB
10	1010	-38±6dB	•	-38±6dB

NOTE 1: The three least significant bits of MAC are used in the VMAC field. All four bits of MAC are used in the DMAC field.

NOTE 2: The output powers shown above shall be maintained within the range of +2 dB, -4 dB of nominal value for Power Levels 0 .. 7, and within +2 dB, -6 dB of the nominal value for Power Levels 8 .. 10 (see Note 3).

NOTE 3: The Nominal Output Power for levels 8, 9, and 10 are expressed as a range, rather than an absolute value. When the mobile station changes to one of these power levels, it shall insure that it stabilizes within the range centered around the target value for that level. For example, the target value for power level 8 in the 1900 MHz operating band is -28dBW. The mobile station is considered to be within the requirement provided it stabilizes within 4dB of this target level. Once the mobile station has stabilized, the operating tolerance is applied to the specific value within the nominal range on which the mobile station stabilized.

NOTE 4: The Nominal ERP values in watts for power level 0 are:

Class	Power Level
II.	+0 dBW = 1.0 W
III.	Reserved
IV.	-2 dBW = 0.6 W

NOTE 5: Only Power Class IV is applicable to the Indoor.

Table 4.4 – Relative Step Accuracy vs. Power Level on a Single Channel

Mobile Station Power Class II Levels (PL)	Mobile Station Power Class IV Levels (PL)	Step Between Successive Power Levels (dB)
0 .. 7	2 .. 7	4 ± 1
-	7 .. 10	4 ± 2

When the mobile station changes from power level X to power level X+1, it shall satisfy the requirements for the Nominal Output Power for that level. Additionally, the mobile station shall satisfy the requirements identified for the Relative Step Accuracy going into the X+1 Power Level. Thus, the mobile station shall reduce its power such that it conforms to the Nominal level, with a reduction in power at least as great as the minimum specified by the Relative Step requirement.

4.1.2 Base Station

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.

Table 4.5 – Micro-BTS Maximum Output Power per Carrier

800 MHz micro and pico-BTS		1900 MHz 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 output power capability at 8-PSK modulation. For BTS supporting Offset Quadrature Ampitude Modulation (O-QAM), the manufacturer shall declare the output power capability at O-QAM modulation. The class of a micro-BTS or a pico-BTS is defined by the highest output power capability for either modulation and the output power shall not exceed the maximum output power of the corresponding class.

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

As an option the BSS can utilize downlink RF power control. In addition to the static RF power steps described above, the BSS may then utilize up to 15 steps of power control levels with a step size of 2 dB ±1.5 dB, in addition the actual absolute output power at each power control level (N) shall be 2*N dB

below the absolute output power at power control level 0 with a tolerance of ±3 dB under normal conditions and ±4 dB under extreme conditions. The power control level 0 shall be the set output power according to the TRX power class and the six power settings defined above.

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

4.1.2.1 Additional Requirements for 1900 MHz 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 Table 4.5. 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).

4.1.2.2 Additional Requirements for 800 MHz 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 Table 4.5. 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).

4.2 Output RF Spectrum

The specifications contained in this section 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; and
- 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 51.010-1 and 51.021. 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 section.

4.2.1 Spectrum Due to the Modulation & Wide Band Noise

The output RF modulation spectrum is specified in the following tables. 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) 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, in the format shown in the next table:

f_0	$f_0 \pm$ cw	$f_0 \pm$ 2cw	$f_0 \pm$ 3cw	$> f_0 \pm$ 3cw
dBm	dBc	dBc	dBc	dBc

NOTE 1: 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 45.050.

For the BTS, the power level is the "actual absolute output power" defined in section 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)800 MHz MS, Indoor mode 1.6 MHz bandwidth:

	1600	3200	4800	> 4800
≤ 28	-26	-45	-52	-60

a2) 800 MHz Indoor mode BTS 1.6 MHz bandwidth:

	1600	3200	4800	> 4800
≤ 20	-26	-45	-52	-60

b1) 1900 MHz MS Indoor mode 1.6 MHz bandwidth:

	1600	3200	4800	> 4800
≤ 33	-26	-45	-52	-52

b2) 1900 MHz BTS Indoor mode 1.6 MHz bandwidth:

	1600	3200	4800	≥ 4800
≤ 33	-26	-45	-52	-52

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

c) For MS:

Table 4.6 – Maximum Unwanted Emissions Levels

Frequency offset from the carrier	800 MHz	1900 MHz
< 600 kHz	-36 dBm	-36 dBm
≥ 600 kHz, < 1 800 kHz	-51 dBm	-56 dBm
≥ 1 800 kHz	-46 dBm	-51 dBm

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 4.1).

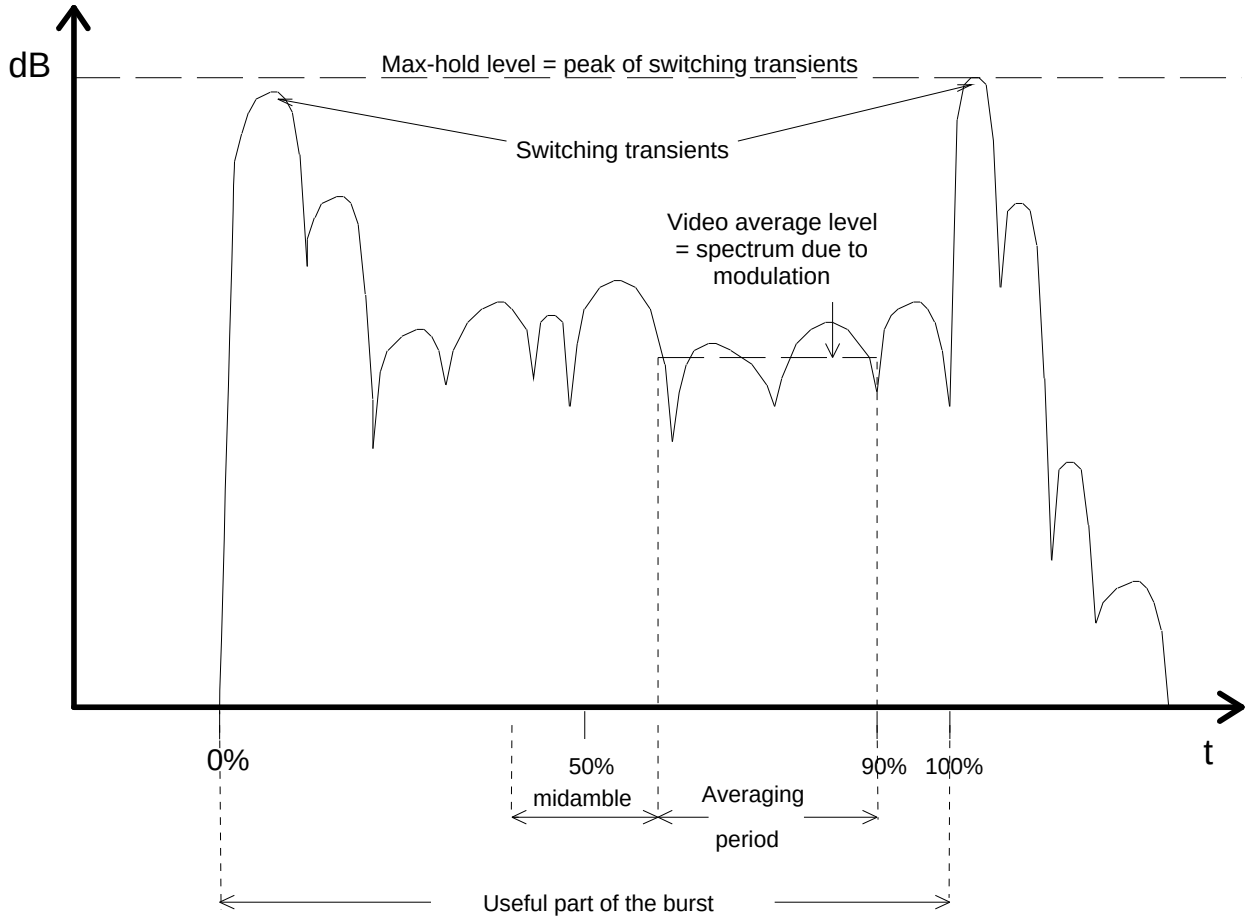


Figure 4.1 – Example of a time waveform due to a burst as seen in a 30 kHz filter offset from the carrier

Table 4.7 – Maximum Unwanted Emissions - MS

Power level	Maximum level measured		
Indoor	3200 kHz	4800 kHz	9600 kHz
≤ 28 dBm	-23 dBm	-26 dBm	-32 dBm

NOTE 1: 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 2: 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).

Table 4.8 – Maximum Unwanted Emissions - BTS

Frequency Band	Maximum level measured		
Indoor	3200 kHz	4800 kHz	6400 kHz
800 MHz	-57 dBc	-67 dBc	-74 dBc
1900 MHz	-50 dBc	-58 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 1: Some of the above requirements are different from those specified in section 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 1900 MHz BTS and 1900 MHz MS shall also comply with the applicable limits for spurious emissions established by the FCC rules for wideband PCS services [FCC Part 24].

In addition to the requirements of this section, the 800 MHz BTS and 800 MHz 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 section, 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 51.010-1 and 51.021. The frequency bands where these are actually measured may differ from one type to the other.

Table 4.9 – Measurement Conditions for In-Band

Band	Frequency offset	Measurement bandwidth
	(offset from carrier)	
relevant transmit	≥ 1.8 MHz	30 kHz
Band	≥ 6 MHz	100 kHz

Table 4.10 – Measurement Conditions Outside the Transmit Band

Band	Frequency offset	Measurement bandwidth
100 kHz - 50 MHz	-	10 kHz
50 MHz - 500 MHz	-	100 kHz
above 500 MHz outside the	(offset from edge of the	
relevant transmit band	relevant above band)	
	≥ 2 MHz	30 kHz
	≥ 5 MHz	100 kHz
	≥ 10 MHz	300 kHz
	≥ 20 MHz	1 MHz
	≥ 30 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 1: For radiated spurious emissions for MS with antenna connectors, and for all spurious emissions for MS with integral antennas, the specifications currently only apply to the frequency band 30 MHz to 4 GHz. The specification and method of measurement outside this band are under consideration.

4.3.2 Base Transceiver Station

The power measured in the conditions specified in Table 4.9 shall be no more than -36 dBm.

The power measured in the conditions specified in Table 4.10 shall be no more 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.

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 4.2.1, with a filter and video bandwidth of 100 kHz shall be no more than:

Table 4.11 – BTS Receive Band Spurious Emission Power Limits

	800 MHz (dBm)	1900 MHz(dBm)
Micro BTS M1	-91	-96
Micro BTS M2	-86	-91
Micro BTS M3	-81	-86
Pico BTS P1	-70	-80

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 800 MHz and 1900 MHz BTS are co-sited.

NOTE 1: Thus, for this case, assuming the coupling losses are as above, then the power measured in the conditions specified in section 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 800 MHz transmitter in the band 1850 - 1910 MHz and for 1900 MHz transmitter in the band 824 - 849 MHz.

In any case, the powers measured in the conditions specified in section 4.2.1, with a filter and video bandwidth of 100 kHz shall be no more than -47 dBm for an 800 MHz BTS in the band 1930 - 1990 MHz and -57 dBm for a 1900 MHz BTS in the band 869 - 894 MHz.

4.3.3 Mobile Station

Active Mode

The peak power measured in the conditions specified in Table 4.9, for a MS when allocated a channel, shall be no more than -36 dBm.

The peak power measured in the conditions specified in Table 4.10 for a MS, when allocated a channel, shall be no more than:

- -36 dBm in the frequency band 9 kHz - 1 GHz.
- -30 dBm in all other frequency bands 1 - 12.75 GHz.

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

- -79 dBm in the frequency band 869 - 894 MHz.
- -71 dBm in the frequency band 1930 -1990 MHz.

As exceptions up to five measurements with a level up to -36 dBm are permitted in each of the bands 869 - 894 MHz and 1930 - 1990 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 section 4.2.1.

Idle Mode

The 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 - 824 MHz, 849 - 1000 MHz.

- -59 dBm in the frequency bands 824 MHz - 849 MHz.
- -53 dBm in the frequency band 1850 - 1910 MHz.
- -47 dBm in all other frequency bands 1 - 12.75 GHz.

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

- -79 dBm in the frequency band 869 - 894 MHz.
- -71 dBm in the frequency band 1930 -1990 MHz.

A maximum of five exceptions with a level up to -36 dBm are permitted in the 869 - 894 MHz and 1930 - 1990 MHz bands for each ARFCN used in the measurements.

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

Sleep Mode

When a mobile is operating in sleep mode its emissions shall not exceed -117 dBm.

4.4 Radio Frequency Tolerance

The radio frequency tolerance for the base transceiver station and the MS is defined in 3GPP TS 45.010.

4.5 Output Level Dynamic Operation

NOTE 1: The term "any transmit band channel" is used here to mean any RF channel of 1.6 MHz centred on a multiple of 1.6 MHz 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 Discontinuous Transmission (DTx) applies. The output power relative to time when sending a burst is shown in Annex A. The reference level 0 dB corresponds to the output power level according to section 4. In the case where the bursts in two (or several) consecutive time slots are actually transmitted, at the same frequency, no requirements are specified to the power ramping in the guard times between the active time slots, and the template of Annex A shall be respected at the beginning and the end of the series of consecutive bursts. 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 2 MHz is assumed.

4.5.2 Mobile Station

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

The transmitted power level relative to time when sending a burst is shown in Annex A. The reference level 0 dB corresponds to the output power level according to section 4. In the case of Multislot Configurations where the bursts in two or more consecutive time slots are actually transmitted at the same frequency, no requirements are specified to the power ramping in the guard times between the active slots, and the template of Annex A shall be respected at the beginning and the end of the series of

consecutive bursts. The timing of the transmitted burst is specified in 3GPP TS 45.010. 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 800 MHz, 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 1900 MHz;
- In any transmit band channel.

A measurement bandwidth of at least 2 MHz is assumed.

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

4.6 Modulation Accuracy

4.6.1 Offset Quaternary Amplitude Modulation

Offset Quaternary Amplitude Modulation is defined in ATIS-0700361.

4.7 Intermodulation Attenuation

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

4.7.1 Base Transceiver Station

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

The intermodulation products shall meet the requirements in section 4.7.2.

4.7.2 Intra BTS Intermodulation Attenuation

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

All the following requirements relate to frequency offsets from the uppermost and lowermost carriers. The average value of intermodulation components over a timeslot, shall not exceed -60 dBc relative to the absolute, for frequency offsets >1.2 MHz measured in a 2 MHz bandwidth.

In addition to the requirements of this section, the 800 MHz BTS and 1900 MHz 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 8 PSK Coding Scheme (PCS) [FCC Part 24] respectively.

5 Receiver Characteristics

In this section, 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 = 859 MHz : E (dBµV/m) = P (dBm) + 135.9 for 800 MHz
assuming F = 1920 MHz : E (dBuV/m) = P (dBm) + 142.9 for 1900 MHz

Static propagation conditions are assumed in all cases, for both wanted and unwanted signals. For subsections 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.

Table 5.1 – Blocking Characteristics (1900 MHz)

Frequency band	Frequency range (MHz) 1900 MHz	
	MS	BTS
in-band	1910 - 2010	1830 - 1930
out-of-band (a)	0.1 - < 1830	0.1 - < 1830
out-of-band (b)	1830 - < 1910	N/A
out-of band (c)	> 2010 - 2070	N/A
out-of band (d)	> 2070 - 12,750	> 1930 - 12,750

Table 5.2 – Blocking Characteristics (800 MHz)

Frequency Band	Frequency range (MHz) 800 MHz	
	MS	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

The reference sensitivity performance as specified in table 6.1 shall be met when the following signals are simultaneously input to the receiver:

- A useful signal, modulated with the relevant supported modulation (O-QAM), at frequency f_o, 1 dB above the reference sensitivity level as specified in section 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 1.6 MHz.

With the following exceptions, called spurious response frequencies:

a) 800 MHz: in band, for a maximum of six occurrences (which if grouped shall not exceed three contiguous occurrences per group);

   1900 MHz: in band, for a maximum of twelve occurrences (which if grouped shall not exceed three contiguous occurrences per group);

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

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

Table 5.3 – Spurious Response for 800 MHz and 1900 MHz

Frequency Band	800 MHz				1900 MHz			
	MS		BTS		MS		BTS	
	dBµV (emf)	dBm	dBµV (emf)	dBm	dBµV (emf)	dBm	dBµV (emf)	dBm
Indoor 1.6 MHz bandwidth:								
4.8 MHz $\leq \lvert f-f_0 \rvert <$ 6.4 MHz	70	-43	62	-37	70	-43	62	-43
6.4 MHz $\leq \lvert f-f_0 \rvert <$ 12.8 MHz	70	-43	62	-35	70	-43	62	-38
12.8 MHz $\leq \lvert f-f_0 \rvert <$ 25.6 MHz	80	-33	70	-33	80	-33	72	-33
out-of-band								
(a)	113	0	121	8	113	0	113	0
(b)	-	-	-	-	101	-12	-	-
(c)	-	-	-	-	101	-12	-	-
(d)	113	0	121	8	113	0	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.

Table 5.4 – Blocking Characteristics of micro and pico-BTS Receivers

Frequency band and Modulation of useful signal	800 MHz micro and pico-BTS M1 (dBm)	M2 (dBm)	M3 (dBm)	P1 (dBm)	1900 MHz micro and pico-BTS M1 (dBm)	M2 (dBm)	M3 (dBm)	P1 (dBm)
in-band, Gaussian Minimum Shift Keying (GMSK)								
600 kHz $\leq \lvert f-f_0 \rvert <$ 800 kHz	-31	-26	-21	-34	-40	-35	-30	-41
800 kHz $\leq \lvert f-f_0 \rvert <$ 1.6 MHz	-21	-16	-11	-34	-30	-25	-20	-41
1.6 MHz $\leq \lvert f-f_0 \rvert <$ 3 MHz	-21	-16	-11	-26	-30	-25	-20	-31
3 MHz $\leq \lvert f-f_0 \rvert$	-21	-16	-11	-18	-30	-25	-20	-23

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

5.2 AM Suppression Characteristics

The reference sensitivity performance as specified in table 6.1 shall be met when the following signals are simultaneously input to the receiver.

- A useful signal at f_0, 3 dB above reference sensitivity level as specified in section 6.2.
- A single frequency (f), in the relevant receive band, $\lvert f-f_0 \rvert > 16$ MHz, which is an integer multiple of 1.6 MHz, a GSM TDMA signal modulated in GMSK and by any 148-bit sequence (O-QAM modulated signal, 144-bit sequence, Short burst at Indoor) of the 511-bit pseudo random bit sequence, defined in ITU-T Recommendation O.153, 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 1: When testing this requirement, a notch filter may be necessary to ensure that the co-channel performance of the receiver is not compromised.

	MS (dBm)	BTS (dBm)	Micro and pico-BTS M1 (dBm)	M2 (dBm)	M3 (dBm)	P1 (dBm)
800 MHz	-31	-35	-34	-29	-24	-21
1900 MHz	-29	-33	-33	-28	-23	-26

5.3 Intermodulation Characteristics

The reference sensitivity performance as specified in table 6.1 shall be met when the following signals are simultaneously input to the receiver:

- A useful signal at frequency f_0, 3 dB above the reference sensitivity level as specified in section 6.2;
- A continuous, static sine wave signal at frequency f_1 and a level of 70 dBµV (emf) (i.e., -43 dBm):

- For 1900 MHz MS and 1900 MHz BTS this value is relaxed to 64 dBµV (emf) (i.e., -49 dBm);
- Any 148-bits subsequence (O-QAM modulated signal, 144-bit sequence, Short burst at Indoor) of the 511-bits pseudo-random sequence, defined in ITU-T Recommendation O.153 modulating a signal at frequency f_2, and a level of 70 dBµV (emf) (i.e., -43 dBm):
- For 1900 MHz MS and 1900 MHz BTS this value is relaxed to 64 dBµV (emf) (i.e., -49 dBm);
- Such that $f_0 = 2f_1 - f_2$ and $|f_2-f_1| = 800$ kHz ($|f_2-f_1| = 6.4$ MHz).

NOTE 1: For sections 5.2 and 5.3 instead of any 148-bits subsequence of the 511-bits pseudo-random sequence, defined in ITU-T Recommendation O.153, 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 section 4.3.1, shall be no more than:

- 2 nW (-57 dBm) in the frequency band 9 kHz - 1 GHz; and
- 20 nW (-47 dBm) in the frequency band 1 - 12.75 GHz.

NOTE 1: 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 section 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 44.014.

This section aims at specifying the receiver performance, taking into account that transmitter errors must not occur, and that the transmitter shall be tested separately (see section 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 section 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.

6.1 Nominal Error Rates (NER)

This section describes the transmission requirements in terms of error rates in nominal conditions, i.e., without interference and with an input level of 20 dB above the reference sensitivity level.

6.1.1 O-QAM Modulation

Under the following propagation conditions, the chip error rate, equivalent to the bit error rate of the non protected bits shall have the following limits:

static channel: $BER \leq 10^{-4;}$

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

NOTE 1: This scenario may exist when BTS downlink power control and frequency hopping are used.

Furthermore, for static conditions, a bit error rate of 10^{-4} shall be maintained up to -26 dBm at O-QAM modulation for 800 MHz, and 1900 MHz.

For static conditions, a bit error rate of 10^{-4} shall also be maintained for input levels on the C0 carrier of up to -26 dBm at O-QAM modulation, with equal input levels on non C0 carriers, up to 30 dB less than on the C0 carrier.

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 6.1, according to the type of channel and the propagation condition.

The actual sensitivity level is defined as the input level for which this performance is met. The actual sensitivity level shall be less than a specified limit, called the reference sensitivity level. The reference sensitivity level at the indicated data service for the BTS and MS shall be:

Bearer	Environment	Speed (km/h)	Data Service	Error Rate	RF Level (dBm)
WGPRS HS Indoor	Indoor A	3	2 Mbit/s	10% BLER	-94

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

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

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

6.3 Reference Interference Level

In the following table the reference C/I, Block Error Rate (BLER) performance is defined for each of the channel conditions. 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. For 1.6 MHz bearers the reference interference ratio shall be, for BTS and all types of MS:

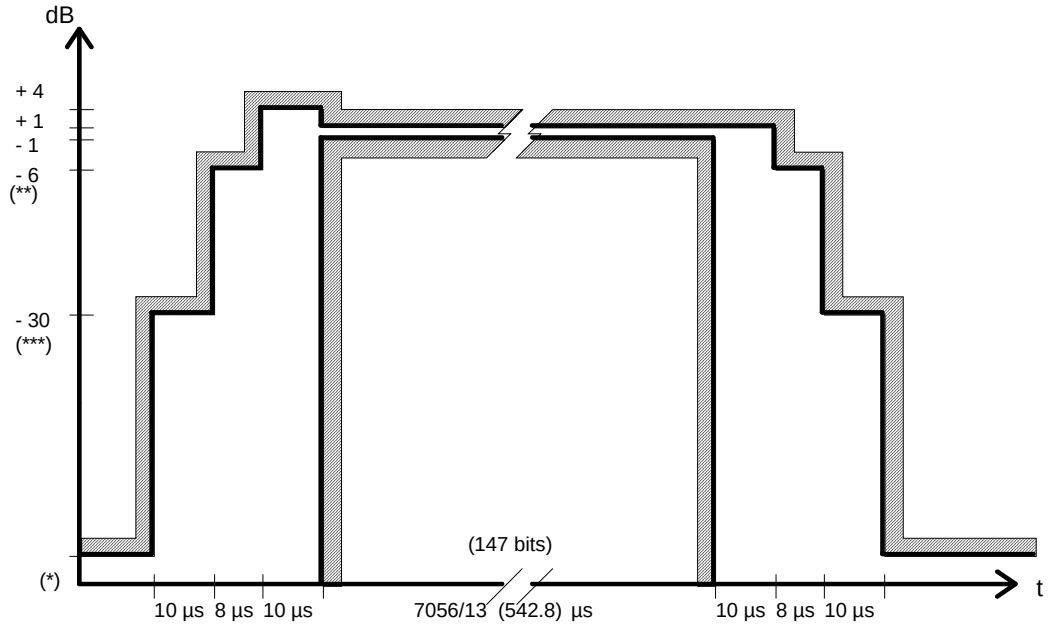
Table 6.1 – Input signal level and interference ratio for Indoor BTS at reference performance

800 and 1900 MHz					
Type of Channel				**Error Rate**	**Indoor B, Intereference Ratio [dB], (no FH)**
WMCS-1	Uplink	Short	B-O-QAM	10% BLER	11
		Long	B-O-QAM	10% BLER	11
	Downlink	Short	B-O-QAM	10% BLER	11
		Long	B-O-QAM	10% BLER	11
WMCS-2	Uplink	Short	B-O-QAM	10% BLER	17
		Long	B-O-QAM	10% BLER	17
	Downlink	Short	B-O-QAM	10% BLER	17
		Long	B-O-QAM	10% BLER	17
WMCS-3	Uplink	Short	Q-O-QAM	10% BLER	21
		Long	Q-O-QAM	10% BLER	21
	Downlink	Short	Q-O-QAM	10% BLER	21
		Long	Q-O-QAM	10% BLER	21
WMCS-4	Uplink	Short	Q-O-QAM	10% BLER	27
		Long	Q-O-QAM	10% BLER	27
	Downlink	Short	Q-O-QAM	10% BLER	27
		Long	Q-O-QAM	10% BLER	27
NOTE 1: WMCS performance for BLER=10%					

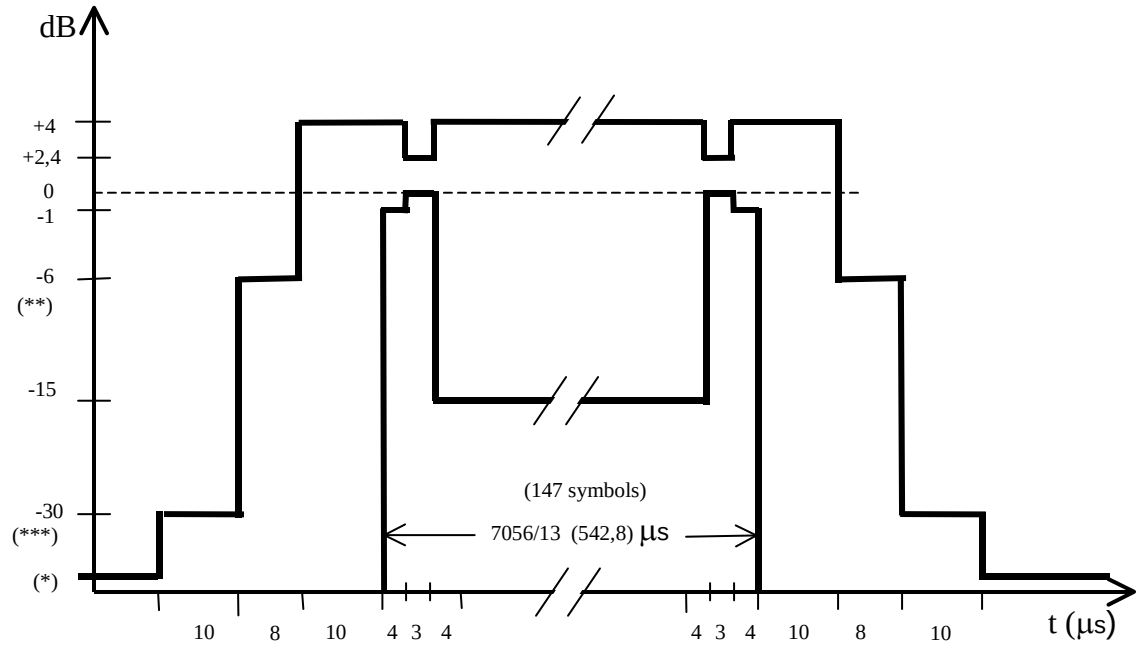
These specifications apply for a wanted signal input level of -70 dBm, and for a random, continuous, B-O-QAM-modulated 1.6 MHz interfering signal.

Annex A: Transmitted Power Level versus Time

(normative)



Time mask for normal duration bursts (NB, FB, dB and SB) at B-O-QAM modulation



Time mask for normal duration bursts (NB, FB, dB and SB) at Q-O-QAM modulation. For Indoor Long burst time scale shall be divided by 2. For Indoor Short burst time scale shall be divided by 8.