

# ETSI EN 300 609-4 V10.2.1 (2012-11)



**Global System for Mobile communications (GSM);  
Part 4: Harmonized EN for GSM Repeaters covering the  
essential requirements of article 3.2 of the R&TTE Directive**

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Reference

REN/MSG-0007

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Keywords

GSM, repeater

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## Foreword

This Harmonized European Standard (EN) has been produced by ETSI Technical Committee Mobile Standards Group (MSG).

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 98/34/EC [i.1] as amended by Directive 98/48/EC [i.7].

The title and reference to the present document are intended to be included in the publication in the Official Journal of the European Union of titles and references of Harmonized Standard under the Directive 1999/5/EC [i.2].

See article 5.1 of Directive 1999/5/EC [i.2] for information on presumption of conformity and Harmonised Standards or parts thereof the references of which have been published in the Official Journal of the European Union.

The requirements relevant to Directive 1999/5/EC [i.2] are summarized in annex A.

The present document is part 4 of a multi-part deliverable covering the Global System for Mobile communications (GSM), as identified below:

I-ETS 300 609-1: "Radio aspects (GSM 11.21 version 4.14.1)";

ETS 300 609-2: "Signalling aspects (GSM 11.23 version 4.9.1)";

ETS 300 609-3: "Transcoder aspects (GSM 11.24 version 4.3.1)";

**EN 300 609-4: "Harmonized EN for GSM Repeaters covering the essential requirements of article 3.2 of the R&TTE Directive".**

| <b>National transposition dates</b>  |                  |
|--|------------------|
| Date of adoption of this EN:   | 2 November 2012  |
| Date of latest announcement of this EN (doa):  | 28 February 2013 |
| Date of latest publication of new National Standard or endorsement of this EN (dop/e): | 31 August 2013   |
| Date of withdrawal of any conflicting National Standard (dow):                         | 31 August 2014   |

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## Introduction

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio and telecommunications terminal equipment within the scope of the R&TTE Directive [i.2]. The modular structure is shown in EG 201 399 [i.3].

# 1 Scope

The present document applies to the following radio equipment types:

- 1) Repeaters for GSM.

These radio equipment types are capable of operating in all or any part of the frequency bands given in table 1-1.

**Table 1-1: GSM Repeater frequency bands**

|          | <b>Direction of transmission</b> | <b>GSM Repeater relevant frequency bands</b> |
|----------|----------------------------------|--|
| P-GSM900 | Downlink                         | 935 MHz to 960 MHz                           |
|          | Uplink                           | 890 MHz to 915 MHz                           |
| E-GSM900 | Downlink                         | 925 MHz to 960 MHz                           |
|          | Uplink                           | 880 MHz to 915 MHz                           |
| R-GSM900 | Downlink                         | 921 MHz to 960 MHz                           |
|          | Uplink                           | 876 MHz to 915 MHz                           |
| DCS1800  | Downlink                         | 1 805 MHz to 1 880 MHz                       |
|          | Uplink                           | 1 710 MHz to 1 785 MHz                       |
| GSM450   | Downlink                         | 460,4 MHz to 467,6 MHz                       |
|          | Uplink                           | 450,4 MHz to 457,6 MHz                       |
| GSM480   | Downlink                         | 488,8 MHz to 496 MHz                         |
|          | Uplink                           | 478,8 MHz to 486 MHz                         |

NOTE 1: In some circumstances, for instance when an operator (or more than one operator who co-ordinate the use of repeaters), is not allocated a complete band as defined in table 1-1, it may be necessary to restrict the frequency range of operations of repeaters. In these circumstances, the test of "Gain outside pass band" in annex C may be used to verify the performance of the repeater.

NOTE 2: A repeater is designed to operate in one or several pass bands within the MS and BTS relevant transmit bands.

The present document covers requirements for GSM Repeaters for 3GPP Release 8, 9 and 10.

The present document is intended to cover the provisions of Directive 1999/5/EC [i.2] (R&TTE Directive), article 3.2, which states that "... radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communications and orbital resources so as to avoid harmful interference".

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the R&TTE Directive [i.2] may apply to equipment within the scope of the present document.

NOTE 3: A list of such ENs is included on the web site <http://www.newapproach.org>.

# 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] Void.
- [2] ETSI TS 151 026 (V10.3.0) (03/2012): "Digital cellular telecommunications system (Phase 2+); Base Station System (BSS) equipment specification; Part 4: Repeaters (3GPP TS 51.026 version 10.3.0 Release 10)".
- [3] ETSI TS 151 021 (V10.5.0) (07/2012): "Digital cellular telecommunications system (Phase 2+); Base Station System (BSS) equipment specification; Radio aspects (3GPP TS 51.021 version 10.5.0 Release 10)".
- [4] ITU-R Recommendation SM.329-11 (01/2011): "Unwanted emissions in the spurious domain".
- [5] ETSI TS 151 010-1 (V9.9.0) (05/2012): "Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformance specification; Part 1: Conformance specification (3GPP TS 51.010-1 version 9.9.0 Release 9)".
- [6] ETSI TS 145 004 (V10.0.0) (04/2011): "Digital cellular telecommunications system (Phase 2+); Modulation (3GPP TS 45.004 version 10.0.0 Release 10)".

## 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] Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.
- [i.2] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).
- [i.3] ETSI EG 201 399: "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of Harmonized Standards for application under the R&TTE Directive".
- [i.4] Void.
- [i.5] ETSI TR 100 028 (all parts) (V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [i.6] ETSI TS 145 005 (V10.4.0): "Digital cellular telecommunications system (Phase 2+); Radio Transmission and reception (3GPP TS 45.005 version 10.4.0 Release 10)".
- [i.7] Directive 98/48/EC of the European Parliament and of the Council of 20 July 1998 amending Directive 98/34/EC laying down a procedure for the provision of information in the field of technical standards and regulations.

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**broadband repeater:** repeater which is designed for operation on any combination of ARFCNs (up to a specified maximum number) within the relevant band of the repeater

**channelized repeater:** repeater which is designed for operation on a specified subset of ARFCNs within the operating band of the repeater

NOTE: The subset of ARFCNs may be determined during the manufacture of the repeater, or may be programmable.

**pass band:** frequency range that the Repeater operates in with operational configuration

NOTE 1: This frequency range can correspond to one or several consecutive nominal channels. If they are not consecutive each subset of channels have to be considered as an individual pass band.

NOTE 2: The Repeater can have one or several pass bands.

**relevant band:** frequency band of GSM Repeater declared by the manufacturer according to the designations in table 1-1

**repeater:** bi-directional Radio Frequency (RF) amplifier which can amplify and transmit a received Mobile Station (MS) signal in the GSM MS transmit band, simultaneously it can amplify and transmit a radiated or conducted received Base Transceiver Station (BTS) RF signal in the GSM BTS transmit band

**repeater system using frequency shift:** repeater system consisting of two different elements, a master unit close to the BTS and at least one remote unit close to the area to be covered

NOTE: The master unit amplifies the channels from the BTS and shifts them to different GSM channels. In the remote unit the shifted channels from the master unit will be transferred back to the original channels and amplified. This is valid for the downlink signals as well as for the uplink signals.

**Subchannel Power Imbalance Ratio on Downlink (SCPIR\_DL):** As defined in TS 145 004 [6], clause 6.

## 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

|          |  |
|----------|--|
| AQPSK    | Adaptive Quadrature Phase Shift Keying       |
| ARFCN    | Absolute Radio Frequency Channel Number      |
| BSS      | Base Station System                          |
| BTS      | Base Transceiver Station                     |
| CW       | Continuous Wave                              |
| DUT      | Device Under Test                            |
| EVM      | Error Vector Magnitude                       |
| GMSK     | Gaussian Minimum Shift Keying                |
| MS       | Mobile Station                               |
| PSK      | Phase Shift Keying                           |
| QAM      | Quadrature Amplitude Modulation              |
| QPSK     | Quadrature Phase Shift Keying                |
| RF       | Radio Frequency                              |
| RMS      | Root Mean Square                             |
| RSS      | Root Sum of the Squares                      |
| SCPIR_DL | Subchannel Power Imbalance Ratio on Downlink |

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## 4 Technical requirements specifications

### 4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be declared by the supplier. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the declared operational environmental profile.

For guidance on how a supplier can declare the environmental profile, see annex B.



## 4.2 Conformance requirements

### 4.2.1 Conducted spurious emissions

#### 4.2.1.1 Definition

This test measures the conducted spurious emissions at the antenna ports.

#### 4.2.1.2 Limit

This requirement applies to all antenna ports of the repeater, at maximum gain, and with the following input signals:

- without any RF input signal;
- with a continuous sinusoidal RF signal at a level which will result, when measured, in the maximum rated RF output power per channel, as declared by the manufacturer RF input signal.

The measured power shall not exceed:

- -36 dBm (250 nW) in the frequency band 9 kHz to 1 GHz;
- -30 dBm (1  $\mu$ W) in the frequency band 1 GHz to 12,75 GHz.

**Table 4.2.1.2-1: Measurement bandwidth for spurious emissions**

| Band  | Frequency offset<br>(offset from carrier)  | Measurement bandwidth                                    |
|---|--|--|
| In the relevant BTS transmit Band or MS transmit band | $\geq 100$ kHz   | 3 kHz  |
| 100 kHz to 50 MHz                                     | -  | 10 kHz   |
| 50 MHz to 500 MHz outside the relevant transmit band  | (offset from edge of the relevant transmit band)<br>$> 0$ MHz<br>$\geq 2$ MHz<br>$\geq 5$ MHz  | 10 kHz<br>30 kHz<br>100 kHz                              |
| Above 500 MHz outside the relevant transmit band      | (offset from edge of the relevant transmit band)<br>$> 0$ MHz<br>$\geq 2$ MHz<br>$\geq 5$ MHz<br>$\geq 10$ MHz<br>$\geq 20$ MHz<br>$\geq 30$ MHz | 10 kHz<br>30 kHz<br>100 kHz<br>300 kHz<br>1 MHz<br>3 MHz |

#### 4.2.1.3 Conformance

Conformance tests described in clause 5.3.1 shall be carried out.

### 4.2.2 Radiated spurious emissions

#### 4.2.2.1 Definition

This test measures the effective power of spurious emissions radiated by the cabinet and structure.

### 4.2.2.2 Limit

This requirement applies to all antenna ports of the repeater, at maximum gain, and with the following input signals:

- without any RF input signal;
- with a continuous sinusoidal RF signal at a level which will result, when measured, in the maximum rated RF output power per channel, as declared by the manufacturer RF input signal.

The effective radiated power shall not exceed:

- -36 dBm (250 nW) in the frequency band 30 MHz to 1 GHz;
- -30 dBm (1 $\mu$ W) in the frequency band 1 GHz to 12,75 GHz.

**Table 4.2.2.2-1: Measurement bandwidth for spurious emissions**

| Band  | Frequency offset<br>(offset from carrier)  | Measurement bandwidth                                    |
|---|--|--|
| In the relevant BTS transmit Band or MS transmit band | $\geq 100$ kHz   | 3 kHz  |
| 30 MHz to 50 MHz                                      | -  | 10 kHz   |
| 50 MHz to 500 MHz outside the relevant transmit band  | (offset from edge of the relevant transmit band)<br>$> 0$ MHz<br>$\geq 2$ MHz<br>$\geq 5$ MHz  | 10 kHz<br>30 kHz<br>100 kHz                              |
| Above 500 MHz outside the relevant transmit band      | (offset from edge of the relevant transmit band)<br>$> 0$ MHz<br>$\geq 2$ MHz<br>$\geq 5$ MHz<br>$\geq 10$ MHz<br>$\geq 20$ MHz<br>$\geq 30$ MHz | 10 kHz<br>30 kHz<br>100 kHz<br>300 kHz<br>1 MHz<br>3 MHz |

### 4.2.2.3 Conformance

Conformance tests described in clause 5.3.2 shall be carried out.

## 4.2.3 Intermodulation attenuation

### 4.2.3.1 Definition

To verify that the level of intermodulation products, generated in non-linear elements of the repeater, in the presence of two RF input signals, do not exceed the specified limits.

### 4.2.3.2 Limit

This requirement applies to all antenna ports of the repeater, at maximum gain, and with the following input signals:

- with a continuous sinusoidal RF signal at a level which will result, when measured, in the maximum rated RF output power per channel, as declared by the manufacturer RF input signal;
- with 10 dB increased continuous sinusoidal RF signals compared to the continuous sinusoidal RF signal at a level which will result, when measured, in the maximum rated RF output power per channel, as declared by the manufacturer RF input signal.

The maximum level of intermodulation product shall be not greater than:

- -36 dBm (250 nW) in the frequency band 9 kHz to 1 GHz;
- -30 dBm (1 μW) in the frequency band 1 GHz to 12,75 GHz.

#### 4.2.3.3 Conformance

Conformance tests described in clause 5.3.3 shall be carried out.

### 4.2.4 Out-of-band gain

#### 4.2.4.1 Definition

To test the net gain of the repeater outside the relevant MS or BTS transmit band.

This test shall also check the net gain at harmonic frequencies.

#### 4.2.4.2 Limit

This requirement applies to all antenna ports of the repeater, at maximum gain.

The net gain in both directions through the repeater shall be less than:

- 50 dB at 400 kHz offset and greater;
- 40 dB at 600 kHz offset and greater;
- 35 dB at 1 MHz offset and greater;
- 25 dB at 5 MHz offset and greater;

from the edges of the relevant MS or BTS transmit bands.

#### 4.2.4.3 Conformance

Conformance tests described in clause 5.3.4 shall be carried out.

### 4.2.5 Frequency error

#### 4.2.5.1 Definition

This clause applies only to repeater systems using frequency shift and describes the test of the frequency error.

#### 4.2.5.2 Limit

The average frequency error of the repeater system shall not exceed 0,1 ppm.

If tested, the average frequency error of a single repeater shall not exceed 0,05 ppm.

#### 4.2.5.3 Conformance

Conformance tests described in clause 5.3.5 shall be carried out.

## 4.2.6 Modulation accuracy at GMSK modulation

### 4.2.6.1 Definition

This clause applies only to repeater systems using frequency shift and describes the test of the phase error.

### 4.2.6.2 Limit

The phase error of a complete repeater system shall not exceed:

- 7° rms;
- 28° peak.

If tested, the phase error of a single repeater unit shall not exceed:

- 6,1° rms;
- 24,5° peak.

### 4.2.6.3 Conformance

Conformance tests described in clause 5.3.6 shall be carried out.

## 4.2.7 Modulation accuracy at 8-PSK, QPSK, 16-QAM, 32-QAM or AQPSK modulation

### 4.2.7.1 Definition

This clause applies only to repeater systems supporting 8-PSK, QPSK, 16-QAM, 32-QAM or AQPSK modulation and describes the test of the modulation accuracy.

### 4.2.7.2 Limit

For a repeater as defined in the first column of the table 4.2.7.2-1 the RMS EVM shall not exceed.

**Table 4.2.7.2-1: Modulation accuracy at 8-PSK, QPSK, 16-QAM, 32-QAM or AQPSK modulation**

|   |                          | Normal symbol rate  |       |        |        | Higher symbol rate |        |        |
|---|--------------------------|---------------------|-------|--------|--------|--------------------|--------|--------|
|   |                          | AQPSK<br>(see note) | 8-PSK | 16-QAM | 32-QAM | QPSK               | 16-QAM | 32-QAM |
| For a single repeater with no shift in frequency from input to output | under normal conditions  | 4,0 %               | 8,0 % | 4,0 %  | 4,0 %  | 8,0 %              | 4,0 %  | 4,0 %  |
| For a single repeater with no shift in frequency from input to output | under extreme conditions | 5,0 %               | 8,0 % | 5,0 %  | 5,0 %  | 8,0 %              | 5,0 %  | 5,0 %  |
| For a complete repeater system using frequency shift                  | under normal conditions  | 6,0 %               | 11 %  | 6,0 %  | 6,0 %  | 11 %               | 6,0 %  | 6,0 %  |
| For a complete repeater system using frequency shift                  | under extreme conditions | 7,0 %               | 11 %  | 7,0 %  | 7,0 %  | 11 %               | 7,0 %  | 7,0 %  |

NOTE: Only for Downlink, regardless of SCPIR\_DL value falling in the range defined in TS 145 004 [6], clause 6.2.

### 4.2.7.3 Conformance

Conformance tests described in clause 5.3.7 shall be carried out.

## 5 Testing for compliance with technical requirements

### 5.1 Environmental conditions for testing

Tests defined in the present document shall be carried out at representative points within the boundary limits of the declared operational environmental profile.

Where technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions (within the boundary limits of the declared operational environmental profile) to give confidence of compliance for the affected technical requirements.

### 5.2 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in the present document shall be as follows:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 5.2-1.

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated and shall correspond to an expansion factor (coverage factor)  $k = 1,96$  (which provides confidence levels of 95 % in the case where the distributions characterising the actual measurement uncertainties are normal (Gaussian)). Principles for the calculation of measurement uncertainty are contained in TR 100 028 [i.5], in particular in annex D of the TR 100 028-2 [i.5].

Table 5.2-1 is based on such expansion factors.

**Table 5.2-1: Maximum measurement uncertainty**

| Parameter  | Condition   | Uncertainty   |
|--|---|---|
| Conducted spurious emissions   | inside the BTS transmit band or MS transmit band  | ±1,5 dB   |
|  | in the receive band of the BSS  | ±3 dB   |
|  | elsewhere<br>$f \leq 2,2$ GHz   | ±1,5 dB   |
|  | $2,2$ GHz < $f \leq 4$ GHz<br>$f > 4$ GHz   | ±2,0 dB<br>±4,0 dB  |
| Radiated spurious emissions  | RF power  | ±6,0 dB   |
| Intermodulation attenuation  | Formula:<br>$\sqrt{(CW1\_level\_error)^2 + (2 \cdot CW2\_level\_error)^2 + (measurement\_error)^2}$<br>RSS: CW1 level error, 2 x CW2 level error, and measurement error<br>(using all errors = ±0,5 dB) | ±1,2 dB   |
| Out-of-band gain   | Calibration of test set-up shall be made without DUT in order to achieve the accuracy   | ±0,5 dB   |
| Frequency error  | Frequency   | ±10 Hz<br>(±5 Hz for GSM 400)   |
| Modulation accuracy at GMSK modulation                                 | Phase   | 1,5° rms;<br>5° peak  |
| Modulation accuracy at 8-PSK, QPSK, 16-QAM, 32-QAM or AQPSK modulation | EVM   | 2 % Stimulus<br>-(0,75 + 0,025 RMS_EVM) to<br>+(0,75 + 0,025 RMV_EVM) % RMS |

## 5.3 Essential radio test suites

### 5.3.1 Conducted spurious emissions

#### 5.3.1.1 Initial conditions

Test environment: normal, see TS 151 026 [2], clause 4.2.1.

- 1) One antenna port of the repeater shall be connected to a selective RF measurement device, for instance a spectrum analyser or a selective voltmeter, presenting to the repeater a load with an impedance of 50  $\Omega$ .

#### 5.3.1.2 Procedures

- 1) An average power measurement of spurious emissions shall be performed for frequency offsets from the carrier frequency greater than 600 kHz, with a measurement bandwidth according to table 4.2.2.2-1, without any RF input signal. The relevant input antenna port of the repeater shall be terminated with 50  $\Omega$ . An average detector on the selective RF measurement device shall be enabled.
- 2) An average power measurement of spurious emissions shall be performed for frequency offsets from the carrier frequency greater than 600 kHz, with a measurement bandwidth according to table 4.2.2.2-1, with an RF input signal. An average detector on the selective RF measurement device shall be enabled. The relevant antenna input port of the repeater shall be connected to an RF signal generator. A continuous sinusoidal RF signal shall be input at a level which will result, when measured, in the maximum rated RF output power per channel, as declared by the manufacturer. The RF input signal shall be set to the centre frequency of the repeaters pass band. In the case of a channelized repeater, the RF input signal shall be set to the centre of the supported ARFCN closest to the centre of the range of ARFCNs supported by the repeater.

The results obtained shall be compared to the limits in clause 4.2.1.2 in order to prove compliance.

### 5.3.2 Radiated spurious emissions

#### 5.3.2.1 Initial conditions

Test environment: normal, see TS 151 026 [2], clause 4.2.1.

- 1) A test site fulfilling the requirements of ITU-R Recommendation SM.329-11 [4] shall be used, except when it conflicts with the present document. The repeater shall be placed on a non-conducting support and shall be operated from a power source as recommended by the manufacturer via an RF filter, to prevent the power source or cable from influencing the result of the measurement.

#### 5.3.2.2 Procedures

- 1) The relevant output antenna port of the repeater shall be terminated with 50  $\Omega$ . The relevant antenna input port of the repeater shall be connected to a RF signal generator in such a way that the connection does not influence the result of the measurement. The RF input signal shall be set to the centre frequency of the repeaters pass band. A continuous sinusoidal RF signal shall be input at a level which will result, when measured, in the maximum rated output power per channel, as declared by the manufacturer.
- 2) An average RF power measurement shall be performed for frequency offsets from the carrier frequency greater than 600 kHz over the frequency range 30 MHz to 12,75 GHz, with a measurement bandwidth according to table 4.2.2.2-1. An average detector shall be enabled. The repeater shall be rotated through 360° in the horizontal plane and the test antenna shall be raised or lowered until the maximum spurious signal level is detected. The effective radiated power of each spurious component shall be determined by a substitution measurement.
- 3) The measurements shall be repeated with orthogonal polarization of the test antenna.
- 4) The measurements shall be repeated with no RF input signal, in this case the relevant antenna input port of the repeater shall be terminated with 50  $\Omega$ .

The results obtained shall be compared to the limits in clause 4.2.2.2 in order to prove compliance.

### 5.3.3 Intermodulation attenuation

#### 5.3.3.1 Initial conditions

Test environment: normal, see TS 151 026 [2], clause 4.2.1.

#### 5.3.3.2 Procedures

- 1) The repeater shall be set to maximum gain.
- 2) Two continuous sinusoidal RF signals shall be fed to the input antenna port of the repeater using a combining device. The frequencies of both RF signals shall be within the repeater's pass band. The spacing between both RF signals shall be the minimum possible spacing applied in a network, i.e. 600 kHz.

The level of both RF input signals shall be increased, until the maximum rated output power per channel, as declared by the manufacturer, is reached.

In case of a repeater only supporting one channel, one RF input signal shall be set to the operating frequency and the other RF input signal at an offset of 400 kHz to either side successively. In this case the input signal at the repeater's operating frequency shall be increased, until the maximum rated output power per channel, as declared by the manufacturer, is reached. The second signal shall be set to the same input level.

- 3) The level of the third order intermodulation products shall be measured by means of a selective measurement device presenting to the repeater a load with an impedance of 50  $\Omega$ .  
An average power measurement shall be performed using a bandwidth of 3 kHz. An average detector shall be enabled.

- 4) The test shall be repeated with both RF input signals increased by 10 dB each.

NOTE: In this case, the automatic gain (level) control may reduce the gain to a value less than maximum gain in order to keep the maximum rated output power per channel, as declared by the manufacturer.

- 5) The measurements shall apply to all antenna ports of the repeater.

The results obtained shall be compared to the limits in clause 4.2.3.2 in order to prove compliance.

### 5.3.4 Out-of-band gain

#### 5.3.4.1 Initial conditions

Test environment: normal, see TS 151 026 [2], clause 4.2.1.  
extreme temperature, see TS 151 026 [2], clause 4.2.3.

#### 5.3.4.2 Procedures

- 1) The repeater shall be set to maximum gain.

In case of a channel selective repeater, two of the channel selective modules shall be set to the lowermost and the uppermost ARFCN within the repeater's pass band.

- 2) A continuous sinusoidal RF signal shall be fed successively at frequency offsets Y from the edges of the relevant MS or BTS transmit frequency band into the relevant input port of the repeater.

The frequency offsets Y shall have the following values:

- 400 kHz;
- 600 kHz;

- 800 kHz;
- 1 MHz;
- 5 MHz;
- 10 MHz;
- 15 MHz;
- 20 MHz.

The power level of the RF input signal shall be at least 5 dB below the power level which would produce, when applied within the pass band, maximum rated output power, as declared by the manufacturer. This is to ensure that the equipment is operating in the linear output range.

- 3) The average output power in each case shall be measured and the net gain shall be recorded.
- 4) This shall be repeated with an RF input signal successively set to all harmonic frequencies of the repeaters pass band up to 12,75 GHz (i.e. multiples of the centre frequency of the repeaters pass band up to 12,75 GHz).
- 5) The measurements shall apply to all antenna ports of the repeater.

The results obtained shall be compared to the limits in clause 4.2.4.2 in order to prove compliance.

### 5.3.5 Frequency error

#### 5.3.5.1 Initial conditions

Test environment: normal, see TS 151 026 [2], clause 4.2.1.  
extreme temperature, see TS 151 026 [2], clause 4.2.3.

- 1) The repeater system shall be levelled according to the recommendations of the manufacturer. For the purpose of the frequency synchronisation of the repeater system it might be necessary to connect the system to a BTS or an equivalent test equipment like a mobile tester. In all cases an accurate frequency synchronisation source has to be used to synchronise the measurement setup.

#### 5.3.5.2 Procedures

- 1) The test of the repeater system shall be performed at the lowest and the highest ARFCN supported by the repeater system.

For the measurement of the frequency error a continuous, sinusoidal and synchronised RF signal shall be fed successively at a frequency of the relevant MS or BTS transmit frequency band into the relevant input port of the repeater.

The power level of the RF input signal shall be at least 5 dB below the power level which would produce, when applied within the pass band, maximum rated output power, as declared by the manufacturer. This is to ensure that the equipment is operating in the linear output range.

- 2) The average output frequency shall be measured with a frequency counter.
- 3) The frequency error of single elements within the repeater system such as master unit or remote unit may be measured as well.

The results obtained shall be compared to the limits in clause 4.2.5.2 in order to prove compliance.



## 5.3.6 Modulation accuracy at GMSK modulation

### 5.3.6.1 Initial conditions

Test environment: normal, see TS 151 026 [2], clause 4.2.1.  
extreme temperature, see TS 151 026 [2], clause 4.2.3.

- 1) The repeater system shall be levelled according to the recommendations of the manufacturer. For the purpose of the frequency synchronisation of the repeater system it might be necessary to connect the system to a BTS or an equivalent test equipment like a mobile tester. In all cases an accurate frequency synchronisation source has to be used to synchronise the measurement setup.
- 2) The GMSK signal source shall have a phase error below the following values:
  - 5° rms;
  - 20° peak.

### 5.3.6.2 Procedures

- 1) For the measurement of the phase error a continuous and synchronised GMSK signal modulated with a pseudo random bit sequence shall be fed successively at one frequency of the relevant MS or BTS transmit frequency band into the relevant input port of the repeater.  
  
The power level of the RF input signal shall be at least 5 dB below the power level which would produce, when applied within the pass band, maximum rated output power, as declared by the manufacturer. This is to ensure that the equipment is operating in the linear output range.
- 2) The phase trajectory shall be measured at the equivalent output of the repeater system and the calculation of the phase error shall be performed according to TS 151 010-1 [5] or TS 151 021 [3].

The results obtained shall be compared to the limits in clause 4.2.6.2 in order to prove compliance.

## 5.3.7 Modulation accuracy at 8-PSK, QPSK, 16-QAM, 32-QAM or AQPSK modulation

### 5.3.7.1 Initial conditions

Test environment: normal, see TS 151 026 [2], clause 4.2.1.  
extreme temperature, see TS 151 026 [2], clause 4.2.3.

- 1) The repeater system shall be levelled according to the recommendations of the manufacturer. For the purpose of the frequency synchronisation of the repeater system it might be necessary to connect the system to a BTS or an equivalent test equipment like a mobile tester. In all cases an accurate frequency synchronisation source has to be used to synchronise the measurement setup.

### 5.3.7.2 Procedures

- 1) For the measurement of the modulation accuracy a continuous and synchronised 8-PSK, QPSK, 16-QAM, 32-QAM or AQPSK signal modulated with a pseudo random bit sequence shall be fed successively at one frequency of the relevant MS or BTS transmit frequency band into the relevant input port of the repeater. For the AQPSK modulation the SCPIR\_DL is set at 0 dB.  
  
The power level of the RF input signal shall be at least 5 dB below the power level which would produce, when applied within the pass band, maximum rated output power, as declared by the manufacturer. This is to ensure that the equipment is operating in the linear output range.
- 2) The EVM shall be measured at the equivalent output of the repeater system and the calculation of the EVM shall be performed according to TS 151 021 [3].

The results obtained shall be compared to the limits in clause 4.2.7.2 in order to prove compliance.

## Annex A (normative): HS Requirements and conformance Test specifications Table (HS-RTT)

The HS Requirements and conformance Test specifications Table (HS-RTT) in table A.1 serves a number of purposes, as follows:

- it provides a statement of all the requirements in words and by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document(s);
- it provides a statement of all the test procedures corresponding to those requirements by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document(s);
- it qualifies each requirement to be either:
  - Unconditional: meaning that the requirement applies in all circumstances; or
  - Conditional: meaning that the requirement is dependent on the manufacturer having chosen to support optional functionality defined within the schedule;
- in the case of Conditional requirements, it associates the requirement with the particular optional service or functionality;
- it qualifies each test procedure to be either:
  - Essential: meaning that it is included with the Essential Radio Test Suite and therefore the requirement shall be demonstrated to be met in accordance with the referenced procedures;
  - Other: meaning that the test procedure is illustrative but other means of demonstrating compliance with the requirement are permitted.

**Table A.1: HS Requirements and conformance Test specifications Table (HS-RTT)**

| <b>Harmonized Standard EN 300 609-4</b>   |   |                             |                                   |   |                           |                             |
|---|---|-----------------------------|-----------------------------------|---|---------------------------|-----------------------------|
| The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive [i.2] |   |                             |                                   |   |                           |                             |
| <b>Requirement</b>  |   |                             | <b>Requirement Conditionality</b> |   | <b>Test Specification</b> |                             |
| <b>No</b>   | <b>Description</b>                      | <b>Reference: Clause No</b> | <b>U/C</b>                        | <b>Condition</b>                                | <b>E/O</b>                | <b>Reference: Clause No</b> |
| 1   | Conducted spurious emissions            | 4.2.1                       | U                                 |   | E                         | 5.3.1                       |
| 2   | Radiated spurious emission              | 4.2.2                       | U                                 |   | E                         | 5.3.2                       |
| 3   | Intermodulation attenuation             | 4.2.3                       | U                                 |   | E                         | 5.3.3                       |
| 4   | Out-of-band gain                        | 4.2.4                       | U                                 |   | E                         | 5.3.4                       |
| 5   | Frequency error                         | 4.2.5                       | C                                 | Only for Repeater systems using frequency shift | E                         | 5.3.5                       |
| 6   | Modulation accuracy at GMSK modulation  | 4.2.6                       | C                                 | Only for Repeater systems using frequency shift | E                         | 5.3.6                       |
| 7   | Modulation accuracy at 8-PSK modulation | 4.2.7                       | C                                 | Only for Repeater systems supporting 8-PSK      | E                         | 5.3.7                       |

### Key to columns:

#### Requirement:

**No** A unique identifier for one row of the table which may be used to identify a requirement or its test specification.

**Description** A textual reference to the requirement.

**Clause Number** Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

**Requirement Conditionality:**

**U/C** Indicates whether the requirement is to be *unconditionally* applicable (U) or is *conditional* upon the manufacturers claimed functionality of the equipment (C).

**Condition** Explains the conditions when the requirement shall or shall not be applicable for a technical requirement which is classified "conditional".

**Test Specification:**

**E/O** Indicates whether the test specification forms part of the Essential Radio Test Suite (E) or whether it is one of the Other Test Suite (O).

NOTE: All tests whether "E" or "O" are relevant to the requirements. Rows designated "E" collectively make up the Essential Radio Test Suite; those designated "O" make up the Other Test Suite; for those designated "X" there is no test specified corresponding to the requirement. The completion of all tests classified "E" as specified with satisfactory outcomes is a necessary condition for a presumption of conformity. Compliance with requirements associated with tests classified "O" or "X" is a necessary condition for presumption of conformity, although conformance with the requirement may be claimed by an equivalent test or by manufacturer's assertion supported by appropriate entries in the technical construction file.

**Clause Number** Identification of clause(s) defining the test specification in the present document unless another document is referenced explicitly. Where no test is specified (that is, where the previous field is "X") this field remains blank.

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## Annex B (informative): Environmental profile specification

The following environmental conditions may be declared by the supplier:

- barometric pressure: minimum and maximum;
- temperature: minimum and maximum;
- relative humidity: minimum and maximum;
- power supply: lower and upper voltage limit.

When operating outside the boundary limits of the declared operational environmental profile the equipment should not make ineffective use of the radio frequency spectrum so as to cause harmful interference.

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## Annex C (informative): Testing of gain for part band repeaters

### C.1 Rationale for this test

The normative provisions of the present document specify the out-of band gain relative to the edge of one of the GSM bands specified in clause 1. The purpose of this informative annex is to define a test method which may be used to measure the out-of-band gain for a repeater which is designed to operate only over part of one of these bands. This test may be used for acceptance testing or for regulatory purposes.

Agree the performance requirements prior to this test being performed, since TS 145 005 [i.6] does not specify the out-of-band gain requirements within a GSM band for such a repeater. Normally, the requirements for the uplink and downlink directions will be similar, but with the frequencies offset by 45 MHz or 95 MHz.

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### C.2 Gain outside pass band

#### C.2.1 Test purpose

To determine the net gain of the repeater outside its specified pass band (or bands), when this is less than a GSM band defined in clause 1 of the present document. Met always the out-of-band gain requirements of the present document, whether or not this test is also performed.

This test is not a normative requirement of the present document.

#### C.2.2 Test case

Set the repeater to maximum gain. In case of a channel selective repeater, two of the channel selective set the modules to the lowermost and the uppermost ARFCN within the repeaters pass band.

Feed a continuous sinusoidal RF signal successively at each specified frequency into the relevant input port of the repeater. Set the power level of the RF input signal to at least 5 dB below the power level which would produce, when applied within the specified pass band, maximum rated output power, as declared by the manufacturer. This is to ensure that the equipment is operating in the linear output range.

Measure the average output power in each case and record the net gain.

Apply the measurements to all antenna ports of the repeater.

Test environment: normal  
extreme temperature.

#### C.2.3 Conformance requirement

The requirement is met, if the gain through the repeater at each frequency specified to be measured is less than the specified value.

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Annex D (informative):  
Void

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## Annex E (informative): Bibliography

- Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC (text with EEA relevance (EMC Directive)).
- Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).
- ETSI TR 121 905 (V10.3.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Vocabulary for 3GPP Specifications (3GPP TR 21.905 version 10.3.0 Release 10)".

## History

| <b>Document history</b> |                |  |
|-------------------------|----------------|--|
| Edition 1               | January 1997   | Publication as ETS 300 609-4                         |
| Edition 2               | July 1998      | Publication as ETS 300 609-4                         |
| Edition 3               | October 1998   | Publication as ETS 300 609-4                         |
| Edition 4               | March 1999     | Publication as ETS 300 609-4                         |
| V8.0.2                  | October 2000   | Publication  |
| V9.2.1                  | October 2010   | Publication  |
| V10.1.1                 | January 2012   | Public Enquiry PE 20120517: 2012-01-18 to 2012-05-17 |
| V10.2.0                 | September 2012 | Vote V 20121102: 2012-09-03 to 2012-11-02            |
| V10.2.1                 | November 2012  | Publication  |