

Draft **ETSI EN 301 126-1** V2.1.0 (2025-04)



**Fixed Radio Systems;  
Conformance testing;  
Part 1: Point-to-point equipment -  
Definitions, general requirements and test procedures**

---

**Reference**

REN/ATTM-0462

---

**Keywords**

FWS, point-to-point, testing

**ETSI**

650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

---

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B  
Association à but non lucratif enregistrée à la  
Sous-Préfecture de Grasse (06) N° w061004871

---

**Important notice**

The present document can be downloaded from the  
[ETSI Search & Browse Standards](#) application.

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format on [ETSI deliver](#) repository.

Users should be aware that the present document may be revised or have its status changed,  
this information is available in the [Milestones listing](#).

If you find errors in the present document, please send your comments to  
the relevant service listed under [Committee Support Staff](#).

If you find a security vulnerability in the present document, please report it through our  
[Coordinated Vulnerability Disclosure \(CVD\)](#) program.

---

**Notice of disclaimer & limitation of liability**

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.  
In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

---

**Copyright Notification**

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2025.  
All rights reserved.

# Contents

Intellectual Property Rights .....	5
Foreword.....	5
Modal verbs terminology.....	6
Introduction .....	6
1 Scope .....	7
2 References .....	7
2.1 Normative references .....	7
2.2 Informative references.....	8
3 Definition of terms, symbols and abbreviations.....	9
3.1 Terms.....	9
3.2 Symbols.....	10
3.3 Abbreviations .....	10
4 Requirements related to DFRS equipment <i>conformance test</i> .....	11
4.0 Test procedure summary .....	11
4.1 General requirements .....	18
4.2 Requirements classification.....	18
4.2.1 DFRS classification .....	18
4.3 EUT test arrangement for <i>conformance test</i> .....	18
4.4 EUT environmental characteristics for <i>conformance test</i> .....	20
4.4.1 Test in the reference conditions .....	20
4.4.2 Test in the extreme conditions .....	20
4.5 DFRS test report.....	20
5 Test procedures for DFRS characteristics requirements .....	21
5.0 IEC standards reference.....	21
5.1 General characteristics .....	21
5.1.1 Equipment Configuration .....	21
5.2 Transmitter characteristics.....	22
5.2.1 Maximum output power and power environmental variation .....	22
5.2.2 Minimum output power .....	22
5.2.3 Automatic Transmit Power Control (ATPC).....	22
5.2.4 Remote Transmit Power Control (RTPC).....	23
5.2.5 Radio frequency stability .....	23
5.2.6 RF spectrum mask .....	24
5.2.7 Remote frequency control.....	25
5.2.8 Tx discrete CW components exceeding the Transmitter RF spectrum masks limits .....	25
5.2.9 Unwanted emissions in the Spurious domain (external).....	25
5.3 Receiver characteristics .....	26
5.3.1 Input level range .....	26
5.3.2 Receiver unwanted emissions in the spurious domain.....	27
5.3.3 System performance without diversity .....	27
5.3.3.1 BER as a function of Receiver input Signal Level (RSL).....	27
5.3.3.2 Co-channel interference sensitivity- external.....	28
5.3.3.2.0 Introduction .....	28
5.3.3.2.1 Method 1.....	28
5.3.3.2.3 Method 2.....	30
5.3.3.3 Adjacent (1 <sup>st</sup> or 2 <sup>nd</sup> ) channel interference sensitivity .....	31
5.3.3.3.0 Introduction .....	31
5.3.3.3.1 Method 1.....	32
5.3.3.3.2 Method 2.....	33
5.3.3.4 Blocking (CW spurious interference).....	34
5.3.3.5 Distortion sensitivity .....	35
5.3.4 System characteristics with diversity .....	37
5.3.4.1 BER performance.....	37

5.3.4.2	Interference sensitivity .....	37
5.3.4.3	Distortion sensitivity .....	37
<b>Annex A (informative):</b>	<b>Example of Test report template .....</b>	<b>38</b>
A.1	Test results .....	38
A.1.1	Summary of tests .....	38
A.1.2	General information about the tests .....	39
A.1.3	Test result forms .....	39
A.1.3.1	Transmitter characteristics .....	39
A.1.3.1.1	Transmitter power range .....	39
A.1.3.1.1.0	Generality .....	39
A.1.3.1.1.1	Maximum output power and power environmental variation .....	39
A.1.3.1.1.2	Minimum output power .....	40
A.1.3.1.2	Automatic transmit power control (ATPC) .....	41
A.1.3.1.3	Remote Transmit Power Control (RTPC) .....	41
A.1.3.1.4	Remote Frequency Control (RFC) .....	41
A.1.3.1.5	RF spectrum mask .....	41
A.1.3.1.6	Spectral lines at the symbol rate .....	43
A.1.3.1.7	Spurious emissions (Tx) - external .....	43
A.1.3.1.8	Tx radio frequency stability (short term) .....	45
A.1.3.2	Receiver characteristics .....	45
A.1.3.2.1	Input level range .....	45
A.1.3.2.2	Spurious emissions (Rx) - external .....	46
A.1.3.3	System performance without diversity .....	47
A.1.3.3.1	BER vs. Rx signal level .....	47
A.1.3.3.2	Interference sensitivity .....	49
A.1.3.3.2.1	Co-channel interference sensitivity - external and adjacent channel interference sensitivity .....	49
A.1.3.3.2.2	CW spurious interference .....	50
A.1.3.3.3	Distortion sensitivity .....	50
A.1.3.4	System performance with diversity .....	51
A.1.3.4.1	BER vs. Rx signal level .....	51
A.1.3.4.2	Interference sensitivity .....	53
A.1.3.4.2.1	Co-channel interference sensitivity .....	53
A.1.3.4.2.2	Adjacent channel interference sensitivity .....	53
A.1.3.4.3	Distortion sensitivity .....	53
A.2	Photographs of EUT .....	53
A.3	Test equipment used for tests .....	53
A.4	Additional information supplementary to the test report .....	54
<b>Annex B (informative):</b>	<b>Distortion sensitivity for diversity receivers .....</b>	<b>55</b>
<b>Annex C (informative):</b>	<b>Bibliography .....</b>	<b>56</b>
<b>Annex D (informative):</b>	<b>Change history .....</b>	<b>57</b>
History .....		58

---

# Intellectual Property Rights

## Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the [ETSI IPR online database](#).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

## Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

**DECT™**, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™**, **LTE™** and **5G™** logo are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

---

# Foreword

This draft European Standard (EN) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI EN Approval Procedure.

The present document is part 1 of a multi-part EN covering the Fixed Radio System; Conformance testing, as identified below:

- Part 1: "Point-to-point equipment - Definitions, general requirements and test procedures";**
- Part 2-1: "Point-to-Multipoint equipment - Definitions and general requirements";
- Part 2-2: "Point-to-Multipoint equipment - Test procedures for FDMA systems";
- Part 2-3: "Point-to-Multipoint equipment - Test procedures for TDMA systems";
- Part 2-4: "Point-to-Multipoint equipment - Test procedures for FH-CDMA systems";
- Part 2-5: "Point-to-Multipoint equipment - Test procedures for DS-CDMA systems";
- Part 2-6: "Point-to-Multipoint equipment; Test procedures for Multi Carrier Time Division Multiple Access (MC-TDMA) systems";
- Part 3-1: "Point-to-Point antennas - Definitions, general requirements and test procedures";
- Part 3-2: "Point-to-Multipoint antennas - Definitions, general requirements and test procedures".

<b>Proposed national transposition dates</b>	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

---

## Modal verbs terminology

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

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

---

## Introduction

The present document defines the *conformance test* requirements for radio specific parameters required directly by the radio equipment relevant standards ETSI EN 302 217-1 [8] and ETSI EN 302 217-2 [9]. Test methods, and test report format, for these parameters are also contained herein. It may be applied also for *conformance test* according other (international or national) *relevant standards* that might contain a number of similar requirements.

The main body of the present document contains definitions, general requirements and test procedures (see note) for *conformance test* of Digital Fixed Radio Systems (DFRS).

NOTE: It is assumed that where a clarification of a test procedure is needed, this should be described on the final page of the test report titled "Additional information supplementary to the test report".

---

# 1 Scope

The present document details standardized procedures for *conformance test* of radio interface parameters for Point to Point (PP) equipment used for Digital Fixed Radio Systems (DFRS). Three sets of procedures (for ER, OR and CP) are considered in the scope of the present document:

- Procedures for radio parameters relevant to *Essential Requirements* (ER) and *Optional Requirements* (OR), relevant to article 3.2 of Directive 2014/53/EU [i.1]. Requirements for these parameters are detailed in ETSI EN 302 217-2 [9].
- Procedures for *Complementary Requirements* (CP) that, even if not considered "essential" in the light of article 3.2 of Directive 2014/53/EU [i.1], are considered important for the operations of PP equipment. These parameters are detailed in clause 8 of ETSI EN 302 217-1 [8].

The present document is mainly intended to be applied in conjunction with the above equipment *relevant standards* and will enable commonality of test results, irrespective of the body carrying out the test.

However, the present document can be used also in conjunction with other DFRS *relevant standards* that would refer to the parameters and test methods hereby described.

The *conformance tests* described in the present document are those related to radio specific parameters required directly by the radio equipment *relevant standards* at antenna ports in conducted test methods. Conformance tests to other boundary standards (e.g. those for system input/output interfaces (i.e. set at X/X' interface, shown in figure 2, and related baseband process) are outside the scope of the present document.

Also, tests described in the present document are not applicable to radio equipment with *integral antenna* of *undetachable antenna* type requiring radiated test methods.

---

## 2 References

### 2.1 Normative 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 referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found in the [ETSI docbox](#).

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

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

- [1] [ETSI EN 300 019-1-3](#): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weatherprotected locations".
- [2] [ETSI EN 300 019-1-4](#): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weatherprotected locations".
- [3] [ETSI EN 300 019-2-3](#): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-3: Specification of environmental tests; Stationary use at weatherprotected locations".
- [4] [ETSI EN 300 019-2-4](#): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-4: Specification of environmental tests; Stationary use at non-weatherprotected locations".

- [5] [ETSI EN 300 019-2-0](#): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2: Specification of environmental tests; Sub-part 0: Introduction".
- [6] [ETSI EN 300 132-2](#): "Environmental Engineering (EE); Power supply interface at the input of Information and Communication Technology (ICT) equipment; Part 2: -48 V Direct Current (DC)".
- [7] [ETSI EN 300 132-1](#): "Environmental Engineering (EE); Power supply interface at the input to Information and Communication Technology (ICT) equipment; Part 1: Alternating Current (AC)".
- [8] [ETSI EN 302 217-1](#): "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 1: Overview, common characteristics and requirements not related to access to radio spectrum".
- [9] [ETSI EN 302 217-2](#): "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2: Digital systems operating in frequency bands from 1 GHz to 174,8 GHz; Harmonised Standard for access to radio spectrum".
- [10] [ETSI EN 301 126-3-1](#): "Fixed Radio Systems; Conformance testing; Part 3-1: Point-to-Point antennas; Definitions, general requirements and test procedures".

## 2.2 Informative 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 referenced document (including any amendments) applies.

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

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 2014/53/EU](#) of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.
- [i.2] Recommendation ITU-R F.746: "Radio-frequency channel arrangements for radio-relay systems".
- [i.3] Recommendation ITU-R F.1191: "Bandwidths and unwanted emissions of digital radio-relay systems".
- [i.4] Recommendation ITU-R SM.1539: "Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329".
- [i.5] ETSI EN 302 217-4: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 4: Antennas".
- [i.6] IEC 60835-1-2: "Methods of measurement for equipment used in digital microwave radio transmission systems; Part 1: Measurements common to terrestrial radio-relay systems and satellite earth stations; Section 2: Basic characteristics".
- [i.7] IEC 60835-1-4: "Methods of measurement for equipment used in digital microwave radio transmission systems; Part 1: Measurements common to terrestrial radio-relay systems and satellite earth stations; Section 4: Transmission performance".
- [i.8] IEC 60835-2-4: "Methods of measurement for equipment used in digital microwave radio transmission systems; Part 2-4: Measurements on terrestrial radio-relay systems – Transmitter/receiver including modulator/demodulator".



- [i.9] IEC 60835-2-7: "Methods of measurement for equipment used in digital microwave radio transmission systems; Part 2: Measurements on terrestrial radio-relay systems; Section 7: Diversity switching and combining equipment".
- [i.10] IEC 60835-2-8: "Methods of measurement for equipment used in digital microwave radio transmission systems; Part 2: Measurements on terrestrial radio-relay systems; Section 8: Adaptive equalizer".
- [i.11] IEC 60835-2-10: "Methods of measurement for equipment used in digital microwave radio transmission systems; Part 2: Measurements on terrestrial radio-relay systems; Section 10: Overall system performance".
- [i.12] IEC 60835-2-11: "Methods of measurement for equipment used in digital microwave radio transmission systems; Part 2: Measurements on terrestrial radio-relay systems; Section 11: Cross-polarization interference canceller".

---

## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

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

In the present document the "terms" defined in this clause, when used elsewhere, are given in "*italic*" font.

**Complementary Requirements (CR):** requirements not relevant to the *essential requirements*

**conformance test:** type testing process to verify to what extent the EUT conforms to the *relevant standard*

**Design Objectives: (DO):** regulatory and market aspects taken into account for the equipment design and/or operative performance to be guaranteed

NOTE: Information included in the *technical documentation*.

**Essential Requirements (ER):** basic set of parameters and functions which are necessary to meet any regulatory obligations related to the *relevant standard*

NOTE: In the scope of the present document, ER are those covered by article 3.2 of Directive 2014/53/EU [i.1]. Requirements covered by articles 3.1 and 3.3 of that Directive 2014/53/EU [i.1] are not in the scope of the present document.

**full conformance:** status of the Equipment Under Test (EUT) when it has successfully passed all the requirements of the *conformance test* process and therefore meets all the requirements of the *relevant standard* which the EUT refers to

**integral (integrated) antenna:** antenna which is indicated in the *technical documentation* as part of the radio equipment; it is not physically separable from the equipment

NOTE: Under this category different applications are possible, to which the following more detailed definitions apply:

- 1) **Detachable (integral) antenna:** even when equipment with integral antenna is concerned, the manufacturer's design might still permit, through specific procedure, to separate the antenna from the equipment at an internal antenna port, physically suitable for testing purpose. In such cases the assessment of the radio equipment and of the antenna against requirements of ETSI EN 302 217 parts 1 [8], 2 [9] and 4 [i.5] should be done separately with conducted test procedures.
- 2) **Undetachable (integral) antenna:** in this case the manufacturer's design does not permit the physical access to the antenna port; nevertheless, for the equipment in the scope of ETSI EN 302 217 parts 1 [8], 2 [9] and 4 [i.5], a "virtual" antenna port can be identified, according the indication in the *technical documentation*, where all requirements can be referenced. However, in this case only radiated test procedures (not in the scope of the present document) can be made.

**mandatory requirements:** requirement which the Equipment Under Test (EUT) has to meet

NOTE: To achieve *full conformance* to a *relevant standard* all its requirements are mandatory.

**manufacturer:** organization requesting the approval

**Optional Requirements (OR):** requirement whose feature is not mandatory (e.g. Automatic Transmit Power Control (ATPC), etc.)

NOTE: Once such an option has been implemented it becomes formally equivalent to an *essential requirement*.

**relevant standard:** standard (international or national) that provides the limits of the requirements for the equipment under test

**technical documentation:** See Articles 10 and 21 of Directive 2014/53/EU [i.1] (see note).

NOTE: It is assumed that when tests are performed based on a *relevant standard* not related to obligation of article 2 of that Directive, an equivalent documentation would also be provided before the test.

**type testing:** testing process (see note) for verifying *full conformance*

NOTE 1: A type test is to be carried out successfully in order to achieve *full conformance*; it implies that the EUT has met all the requirements (ER, CR and, if any, OR) of the *relevant standard* against which it has been tested.

NOTE 2: *Type testing* is when at least a representative sample of equipment is tested. The test result is considered to be applicable and representative for all other pieces of equipment manufactured identically.

## 3.2 Symbols

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

dB	decibel
dBc	decibels below the carrier power
dBm	decibel relative to 1 mW
$\delta f$	frequency variation with respect to a reference
$\delta P_{out}$	power output variation with respect to a reference

## 3.3 Abbreviations

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

AC	Alternating Current
ACAP	Adjacent Channel Alternated Polarization
ATPC	Automatic Transmit Power Control
BB	Baseband
BER	Bit Error Rate
BWe	evaluation BandWidth
C/I	Carrier to Interference
CC	Co-channel
CCDP	Co-Channel Dual Polarization
CR	Complementary Requirement
CS	Channel Spacing
CP	Complementary Requirement
CW	Continuous Wave
DFRS	Digital Fixed Radio Systems
DC	Direct Current
DO	Design Objectives
ER	Essential Requirement
Ext.	Extreme conditions
IF	Intermediate Frequency
EIRP	Equivalent Isotropically Radiated Power

EUT	Equipment Under Test
IFbw	Intermediate Frequency bandwidth

NOTE: Resolution bandwidth of a spectrum analyser.

ISDN	Integrated Services Digital Network
OR	Optional Requirement
PDH	Plesiochronous Digital Hierarchy
PP	Point to Point
Pout	Power output level of the Tx
RBER	Residual BER
Ref	Reference conditions
RF	Radio Frequency
RFC	Radio Frequency Channel
RSL	Received Signal Level
RTPC	Remote Transmit Power Control
RX	Receiver
SA	Spectrum Analyser
SDH	Synchronous Digital Hierarchy
TD	Technical Documentation
TP	Test Point
TR	Test Required
Tx	Transmitter
V	Vertical
XPIC	Cross-Polar Interference Canceller

---

## 4 Requirements related to DFRS equipment *conformance test*

### 4.0 Test procedure summary

Table 1 summarizes the DFRS requirements in the light of their test procedures, based on the following classification:

- All technical elements (*design objectives*, DO) reported in the *technical documentation*, related to the intended operation and the knowledge of the basic elements of the design.
- The list of functions and parameters which limits are included in ETSI EN 302 217-2 [9] (see note), relevant to *Essential Requirements* (ERs) in article 3.2 of Directive 2014/53/EU Radio Equipment [i.1] or *Optional Requirement* (OR), which, when optionally implemented in the design, are also considered as ER.
- The list of functions and parameters which limits may be included in ETSI EN 302 217-1 [8] (see note), as Complementary Requirements (CRs) that, while not affecting the ER are considered important for the correct function of the radio equipment itself.
- The test conditions (Ref or Ext) when test is required (TR). These are intended for a general, stand alone, use of the present document; however, when used for assessment of ER and OR parameters according ETSI EN 302 217-2 [9] (see note), the test conditions there described, if different, will prevail against those in the present document.

NOTE: Or any other DFRS *relevant standard* referencing the present document for test procedures of similar requirements.

Table 1: "Requirements" classification

Function or parameter description	ETSI EN 302 217 parts 1 [8] and [9]	Status for conformance			Requirement for conformance test (note 7)			Power supply conditions (note 5)		Climatic conditions for test		Limiting values	Test methods	
		ER or DO	CR	OR	TD	TR	TD + TR (note 1)	Ref	Ref + Ext	Ref.	Ref. + Ext.	(note 6)	Clause in present document	IEC 60835 series or other Reference Standards
<b>General information</b>														
Channel plan/operating frequency range		DO			X									Summary in Recommendation ITU-R F.746 [i.2]
Duplex frequency separation (MHz)		DO			X									Summary in Recommendation ITU-R F.746 [i.2]
Centre gap (MHz)		DO			X									Summary in Recommendation ITU-R F.746 [i.2]
Co-polar channel spacing (CS) (CCDP or ACAP)	Part 2	DO (note 2)			X							xx MHz		Summary in Recommendation ITU-R F.746 [i.2]
Innermost channel spacing (MHz)		DO			X									Summary in Recommendation ITU-R F.746 [i.2]
<b>Environmental profile</b>														
Environmental conditions	Part 2	DO (note 3)			X								4.4	ETSI EN 300 019-1-3 [1] ETSI EN 300 019-1-4 [2]
Weather protected locations	Part 2	DO (note 4)		X	X							(note 3)		ETSI EN 300 019-2-0 [5] ETSI EN 300 019-2-3 [3]
Non-weather protected locations	Part 2	DO (note 4)		X	X							(note 3)		ETSI EN 300 019-2-0 [5] ETSI EN 300 019-2-4 [4]

Function or parameter description	ETSI EN 302 217 parts 1 [8] and [9]	Status for conformance			Requirement for conformance test (note 7)			Power supply conditions (note 5)		Climatic conditions for test		Limiting values	Test methods	
		ER or DO	CR	OR	TD	TR	TD + TR (note 1)	Ref	Ref + Ext	Ref.	Ref. + Ext.	(note 6)	Clause in present document	IEC 60835 series or other Reference Standards
<b>Branching/feeder requirements</b>														
<b>Waveguide flanges (or other connectors)</b>	Part 1	DO	X		X									
<b>Return loss</b>	Part 1		X		X							[xx dB]		
<b>Intermodulation products</b>	Part 1		X		X							[xx dBm] within RX local band		
<b>Parameters for digital Systems</b>														
<b>Transmission capacity</b>	Part 2	ER (note 8)			X							xx Mbit/s		
<b>Baseband system loading</b>	Part 2	DO (note 9)												
<b>Transmitter characteristics</b>														
<b>Maximum power and EIRP (note 11)</b>	Part 2	ER					X		X		X (note 21)	≤xx dBm	5.2.1	IEC 60835-2-4 [i.8], clause 3.4
<b>Transmitter combined nominal output power and EIRP limits (note 10)</b>	Part 2	DO					X	X		X (note 21)		≤xx dBm (function of antenna gain)	5.2.1, 5.2.2	IEC 60835-2-4 [i.8], clause 3.4
<b>Transmitter output power environmental variation</b>	Part 2	ER					X		X		X	- xx <sub>1</sub> dB ≤ P <sub>out</sub> variance ≤ + xx <sub>2</sub> dB	5.2.1	IEC 60835-2-4 [i.8], clause 3.4
<b>Transmitter power and frequency control</b>	Part 2													
<b>Automatic Transmitter Power Control (ATPC)</b>	Part 2	DO		X			X	X		X		range: xx dB upper limit ≤xx dB.	5.2.1, 5.2.2	IEC 60835-2-4 [i.8], clause 3.4
<b>Remote Transmitter Power Control (RTPC)</b>	Part 2	DO		X			X	X		X		range: xx dB upper limit ≤xx dBm Spectrum mask respected	5.2.1, 5.2.2	IEC 60835-2-4 [i.8], clause 3.4 IEC 60835-2-4 [i.8], clause 3.3

Function or parameter description	ETSI EN 302 217 parts 1 [8] and [9]	Status for conformance			Requirement for conformance test (note 7)			Power supply conditions (note 5)		Climatic conditions for test		Limiting values	Test methods	
		ER or DO	CR	OR	TD	TR	TD + TR (note 1)	Ref	Ref + Ext	Ref.	Ref. + Ext.	(note 6)	Clause in present document	IEC 60835 series or other Reference Standards
Transmitter Remote Frequency Control (RFC)	Part 2	DO		X			X	X		X		Initial and final spectrum mask	5.2.7	IEC 60835-2-4 [i.8], clause 3.2
Transmitter emissions	Part 1 Part 2													
RF spectrum mask - normal channels	Part 2	ER					X		X		X	mask(s) of relevant standard (note 13)	5.2.6	IEC 60835-2-4 [i.8], clause 3.3
RF spectrum mask - innermost channels	Part 1	DO	X		X							mask(s) of relevant standard (note 13)	5.2.6 (up to SA sensitivity limit)	IEC 60835-2-4 [i.8], clause 3.3 (up to SA sensitivity limit)
Tx discrete CW components exceeding the Transmitter RF spectrum masks limits	Part 2	ER			X	X			X		X	≤xx dBm or Atten ≥xx dBc	5.2.8	IEC 60835-1-2 [i.6], clause 3
Tx unwanted emissions in the spurious domain	Part 2	ER				X		X		X		≤xx dBm in the frequency range	5.2.9	IEC 60835-1-2 [i.6], clause 3
Tx unwanted emissions - Internal	Part 1	DO	X		X (note 15)							≤xx dBm or Atten ≥xx dBc		
Tx emission limitations outside the allocated band	Part 2	ER (note 14)					X	X				≤xx dBm/IFbw and frequency range	Same as 5.2.9	IEC 60835-1-2 [i.6], clause 3
Tx Radio Frequency stability	Part 2	ER				X			X		X	± xx ppm (=δf/f <sub>o</sub> × 10 <sup>6</sup> )	5.2.5	IEC 60835-2-4 [i.8], clause 3.2
Receiver Characteristics														
Receiver maximum input level and input level range	Part 1		X			X		X		X		xx dBm or xx dB vs. BER threshold	5.3.1	IEC 60835-2-4 [i.8], clause 5.2

Function or parameter description	ETSI EN 302 217 parts 1 [8] and [9]	Status for conformance			Requirement for conformance test (note 7)			Power supply conditions (note 5)		Climatic conditions for test		Limiting values	Test methods	
		ER or DO	CR	OR	TD	TR	TD + TR (note 1)	Ref	Ref + Ext	Ref.	Ref. + Ext.	(note 6)	Clause in present document	IEC 60835 series or other Reference Standards
Receiver unwanted emissions in the spurious domain - External	Part 2	ER				X		X		X		≤xx dBm in the frequency range	5.3.2	IEC 60835-1-2 [i.6], clause 3
Rx unwanted emissions - Internal	Part 1		X (note 15)		X							≤xx dBm or Atten ≥xx dBc		
Receiver image rejection	Part 1		X		X							(note 16)		
Innermost channel selectivity	Part 1	DO	X		X							(note 16)		
System performance without diversity	Part 2													
BER vs. Rx signal level	Part 2	DO + ER (note 17)				X		X			X	BER ≤ limits at given RSL	5.3.3.1	IEC 60835-2-10 [i.11], clause 3.1
Equipment Residual BER (RBER)	Part 1		X		X		X	X		X		≤xx errors /period		IEC 60835-2-10 [i.11], clause 3.2
Rx selectivity and Rx distortion Sensitivity	Part 1 Part 2													
Co-channel interference sensitivity - External	Part 2	ER					X	X		X		BER less than limit at given min C/I ratio	5.3.3.2	IEC 60835-2-10 [i.11], clause 3.3
Co-channel interference sensitivity – Internal: For CCDP with XPIC (note 20)	Part 1		X			X				X		BER less than limit at given min C/I ratio	5.3.3.2	IEC 60835-2-10 [i.11], clause 3.3
Adjacent (1 <sup>st</sup> and 2 <sup>nd</sup> ) channel interference sensitivity	Part 2	DO + ER (note 18)				X (note 19)		X		X		BER less than limit at given min C/I ratio	5.3.3.3	IEC 60835-2-10 [i.11], clause 3.3
Blocking (CW spurious interference)	Part 2	ER				X		X		X		BER less than limit with given C/I ratio	5.3.3.4	IEC 60835-2-10 [i.11], clause 3.3
Multipath Distortion sensitivity	Part 1	DO			X			X		X		comply with limit at given BER	5.3.3.5	IEC 60835-2-4 [i.8], clause 5.3 IEC 60835-2-8 [i.10], clause 3

Function or parameter description	ETSI EN 302 217 parts 1 [8] and [9]	Status for conformance			Requirement for conformance test (note 7)			Power supply conditions (note 5)		Climatic conditions for test		Limiting values	Test methods	
		ER or DO	CR	OR	TD	TR	TD + TR (note 1)	Ref	Ref + Ext	Ref.	Ref. + Ext.	(note 6)	Clause in present document	IEC 60835 series or other Reference Standards
<b>System characteristics with diversity (note 12)</b>	Part 1													
<b>Differential delay compensation</b>	Part 1		X		X							xx ns		IEC 60835-2-7 [i.9], clause 3.3
<b>BER Performance</b>	Part 1		X			X		X			X	BER ≤ limits at given RSL	5.3.4.1	IEC 60835-2-7 [i.9], clause 4.2
<b>Co-channel interference sensitivity - External (note 22)</b>	Part 2	X				X		X		X		BER less than limit at given min C/I ratio	5.3.3.2	IEC 60835-2-10 [i.11], clause 3.3
<b>Co-channel interference sensitivity – Internal: For CCDP with XPIC (note 20) (note 22)</b>	Part 1		X		X							BER less than limit at given min C/I ratio	5.3.3.2	IEC 60835-2-11 [i.12], clause 3.1
<b>Adjacent channel interference sensitivity (note 22)</b>	Part 2	X				X		X		X		BER less than limit at given min C/I ratio	5.3.3.3	IEC 60835-2-10 [i.11], clause 3.3
<b>Multipath Distortion sensitivity (note 22)</b>	Part 1	DO			X			X		X		comply with limit at given BER	5.3.3.5	IEC 60835-2-4 [i.8], clause 5.3 IEC 60835-2-8 [i.10], clause 3

NOTE 1: Indication in the *Technical Documentation* (TD) is intended for appropriate selection from available options or for information necessary to carry out the test.

NOTE 2: The Channel Spacing(s), selected in the TD, is(are) a DO parameter on which basis a number of ER, OR and CR limits are defined in ETSI EN 302 217-1 [8] or in ETSI EN 302 217-2 [9].

NOTE 3: Alternative design defining the relevant extreme environmental conditions of the required tests.

NOTE 4: Selection from classes 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 in ETSI EN 300 019-1-3 [1] or from classes 4.1, 4.2, 4.3, 4.4 in ETSI EN 300 019-1-4 [2] or other climatic conditions foreseen by the *relevant standard*.

NOTE 5: When DC regulators from the secondary sources (i.e. from AC mains or conventional external battery supply) according ETSI EN 300 132-1 [7] (for AC) or ETSI EN 300 132-2 [6] (for DC) are integral to the radio equipment, test can be done at nominal input voltage level.

NOTE 6: "xx" notation represents the limits provided by the equipment/system *relevant standard*.

NOTE 7: Most CR (Complementary Requirements) tests are not considered in the present document; however, they might be present in some product standards; procedures are to be agreed by interested parties.

NOTE 8: The minimum transmission capacity(ies) and baseband parameters, selected in the TD are considered essential only for accessing the selected CS with the selected spectral efficiency class (see band specific annexes in ETSI EN 302 217-2 [9]).

NOTE 9: Selection of SDH, PDH, ISDN, Ethernet or other packet digital baseband interfaces. Relevant ITU-T or other standardized interfaces to be included in TD for choosing the reference base-band test signal for the assessment test.



Function or parameter description	ETSI EN 302 217 parts 1 [8] and [9]	Status for conformance			Requirement for conformance test (note 7)			Power supply conditions (note 5)		Climatic conditions for test		Limiting values	Test methods	
		ER or DO	CR	OR	TD	TR	TD + TR (note 1)	Ref	Ref + Ext	Ref.	Ref. + Ext.	(note 6)	Clause in present document	IEC 60835 series or other Reference Standards
<p>NOTE 10: When required in the equipment/system <i>relevant standard</i>.</p> <p>NOTE 11: With and without ATPC, if implemented.</p> <p>NOTE 12: When Diversity operation is provided.</p> <p>NOTE 13: Spectrum analyser resolution bandwidth defined by the <i>relevant standard</i>, see clause 5.2.6 of the present document.</p> <p>NOTE 14: ER if required by ETSI EN 302 217-2 [9] or other <i>relevant standard</i> under assessment.</p> <p>NOTE 15: Internal unwanted emission limits are lower than those of the external.</p> <p>NOTE 16: The technical documentation shall provide design data of the RF, IF and BB filters which cumulatively meet the required selectivity.</p> <p>NOTE 17: DO only for BER thresholds better guaranteed performance (in <i>technical documentation</i>) than minimum requirement in the <i>relevant standard</i>; ER to be tested according such better BER threshold.</p> <p>NOTE 18: DO only for 2<sup>nd</sup> adjacent sensitivity that has better guaranteed performance (in <i>technical documentation</i>) than minimum requirement (C/I performance equal to 1<sup>st</sup> adjacent) in the <i>relevant standard</i>. 2<sup>nd</sup> adjacent sensitivity test required only in such a case according to the C/I defined in <i>technical documentation</i>.</p> <p>NOTE 19: Degradation relative to BER thresholds defined according to note 17.</p> <p>NOTE 20: When XPIC is implemented.</p> <p>NOTE 21: When EIRP is to be tested, also the antenna gain has to be tested, at reference climatic conditions, according to the procedure in clause 6.3 of ETSI EN 301 126-3-1 [10] and added to the tested maximum power.</p> <p>NOTE 22: The two receivers of the diversity system separately compliant as single receivers. For XPIC operation it applies to the two couples of receivers as single XPIC operation.</p>														

## 4.1 General requirements

The present document is intended to cover the *conformance test* procedures of all the common parameters usually required by DFRS equipment *relevant standards*. Where, besides those in the equipment standard, a different parameter, which test method is not included in the present document, is desired, a suitable test method shall be agreed between the supplier, the test laboratory and the user requiring the test, prior to testing, and a description of the test method included in the Test Report.

Test methods from several parts of IEC 60835 series [i.6], [i.7], [i.8], [i.9], [i.10], [i.11], [i.12] are adopted, where applicable. Clear distinction is made between "*Essential Requirements*" (ERs) and "*Optional Requirements*" (ORs) which require the "*conformance test*" to a Harmonised Standard (HS) for regulatory purpose (e.g. an EU Directive) and "*Complementary Requirements*" (CRs) which fulfil the "*conformance test*" against a *relevant standard* for the equipment.

Distinction and allowance for information in the *technical documentation* on some parameters are also provided.

The manufacturer shall be considered responsible for any statement in the *technical description* and shall take necessary action to ensure that all equipment of the same type will conform to the Equipment Under Test (EUT) used for testing the respect of the requirements of the *relevant standard*.

Annex A contains an example of the test report template for the parameters listed in table 1.

## 4.2 Requirements classification

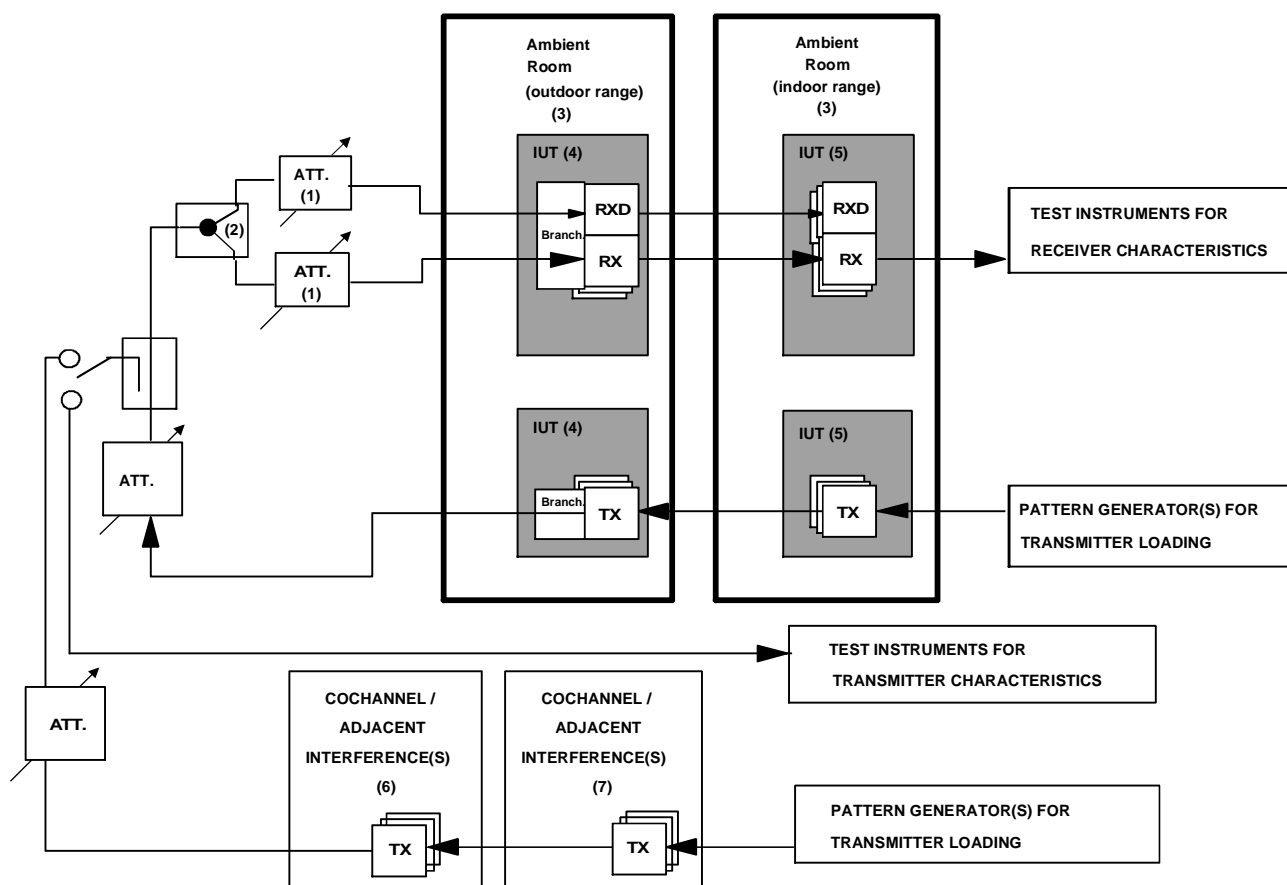
### 4.2.1 DFRS classification

In table 1 the generic clauses and parameters contained in ETSI EN 302 217-1 [8] and ETSI EN 302 217-2 [9] are classified, for *conformance test* purposes, in terms of the various categories defined in clause 3.1. Table 1 also provides for defining the climatic conditions applicable during testing of the parameters i.e. reference or extreme conditions.

## 4.3 EUT test arrangement for *conformance test*

General scheme for full indoor and split indoor/outdoor test arrangement is shown in figure 1 (e.g. EUT and climatic rooms with generic RF test bed for stand-alone transceiver requirements and interference sensitivity).

All the test configurations shown in the present document are typical/recommended.



- (1) for level balance
- (2) power splitter for space diversity option
- (3) two ambient ranges if applicable (for indoor/outdoor split units)
- (4) outdoor section of EUT (if applicable)
- (5) indoor section of EUT (if applicable)
- (6) outdoor sections of EUT (support for test)
- (7) indoor sections of EUT (support for test)

**Figure 1: Typical test set up**

Corresponding transmitter and receiver are tested at the same temperature. Transmitter and receiver are tested on the same link.

When a split indoor/outdoor EUT is being tested the climatic cycles of the two required ambient rooms will be produced with the rules stated in ETSI EN 300-019-2-0 [5], ETSI EN 300-019-2-3 [3] and ETSI EN 300-019-2-4 [4], in "tracking mode" (i.e. the same climatic boundary such as reference, lower or uppermost conditions, will be produced in both).

The EUT presented for *type approval test* shall be representative of production models and of a suitable conformation for the relevant test, i.e.:

- a) one transceiver (i.e. one transmitter and its corresponding receiver usually housed in two different hardware blocks) plus ancillary equipment for the *relevant standard* conformance;
- b) an additional transmitter for receiver interference sensitivity;
- c) at least two transceivers when CR for 1:1 or n:1 switching protection is to be included;
- d) an additional transceiver, as in a) above, for CR of systems which provide co-channel operation with XPIC (two Co-Channel (CC) transceivers in CC operation).

## 4.4 EUT environmental characteristics for *conformance test*

### 4.4.1 Test in the reference conditions

All *conformance* tests shall be carried out in environmental reference conditions. The result of the measurements under environmental reference conditions shall be taken to be reference performance. The reference performance will be used in comparison with representative measurements made at the climatic limits.

It is recognized that all requirements given in the *relevant standard* are relevant for all combinations of temperature and humidity of the chosen climatic class. However, some tests, as indicated in the ETSI EN 302 217-2 [9] (or other EUT *relevant standard*) or in table 1 and recorded in the *conformance test* report, may be carried out only in environmental reference conditions.

In all cases, when testing ER and OR according the ETSI EN 302 217-2 [9], that relevant standard provides a number of test conditions that shall prevail, if different, on those indicated in the present document.

The environmental reference condition is one of the possible existing combinations of temperature, humidity and air pressure falling within the limits given in table 2.

**Table 2**

temperature	+10°C to +35°C
relative humidity	10 % to 80 %
air pressure	8,6 x 10 <sup>4</sup> Pa to 1,06 x 10 <sup>5</sup> Pa

### 4.4.2 Test in the extreme conditions

*Conformance test* shall be carried out for temperature and humidity variation only; mechanical, chemical and biological environmental stress are outside the scope of the present document. ETSI EN 300 019-2-0 [5] climatic cycles procedure shall apply.

The EUT shall be tested under extreme conditions according to the required or the selected class of operation reported in ETSI EN 300 019-1-3 [1] or ETSI EN 300 019-1-4 [2] or any other foreseen by the *relevant standard*.

The extreme condition test shall be made under the procedures required by ETSI EN 300 019-2-0 [5] and ETSI EN 300 019-2-3 [3] or EN 300-019-2-4 [4].

The selection among the optional classes foreseen by the *relevant standard*, if any, will be made according to the *technical documentation*.

When non-ETSI EN 300 019-1-3 [1] or ETSI EN 300 019-1-4 [2] class is required by the *relevant standard* the test shall be carried out with procedures of the closest class in the ETSI EN 300 019-2-3 [3] or EN 300-019-2-4 [4], provided that the extreme limits are widened or reduced accordingly.

NOTE: Before testing at temperature extremes a period of stabilization is required (see ETSI EN 300 019-2-0 [5]).

## 4.5 DFRS test report

All test results shall be recorded by means of this test report format. Additional test details may be added to the test report where appropriate. Annex A contains an example of a test report template.

If a specific test parameter is not included in the standardized test report, the report should be used for guidance in producing the necessary addendum.

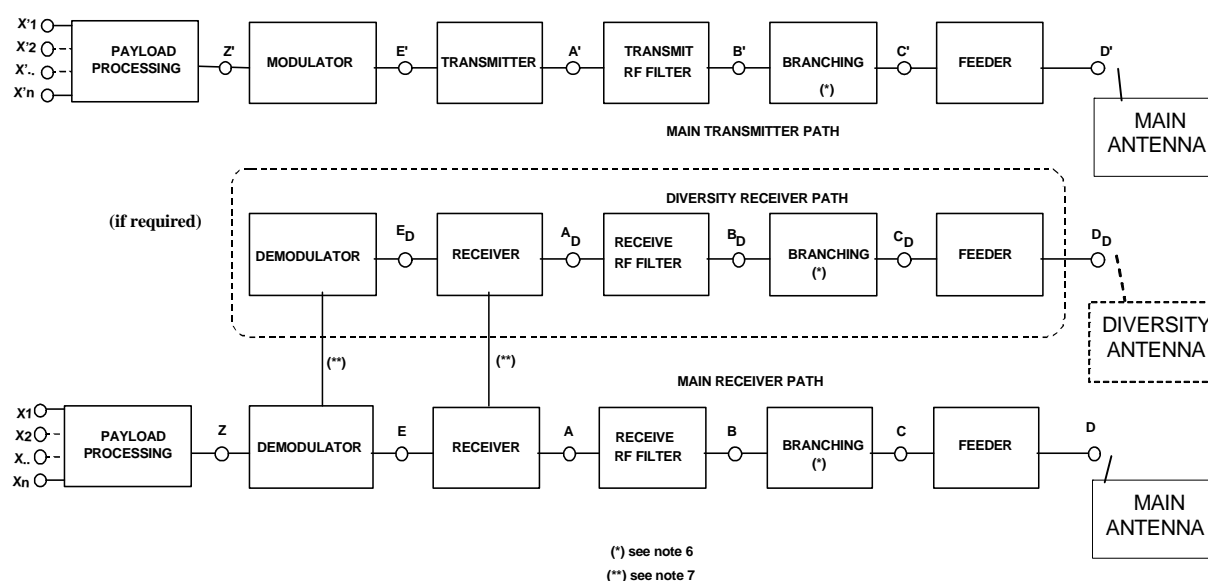
## 5 Test procedures for DFRS characteristics requirements

### 5.0 IEC standards reference

Where necessary, for better understanding of the application of test methods, in table 1 reference is made to the related part of IEC 60835 series [i.6], [i.7], [i.8], [i.9], [i.10], [i.11], [i.12] (Test methods).

### 5.1 General characteristics

#### 5.1.1 Equipment Configuration



NOTE 1: For the purpose of defining the measurement points, the branching network does not include a combiner.

NOTE 2: The points shown above are reference points only and do not mandate any physical implementation; points C and C', D and D' in general coincide.

NOTE 3: Points B, C, B' and C' may coincide when a simple duplexer is used.

NOTE 4: Points X1, X2, ... Xn and points X'1, X'2, ... X'n correspond to one or more digital or analogue signal input reference points. They are generically referred to as X and X'.

NOTE 5: The subdivision of "Payload processing" and the "Modulator/demodulator" blocks is functional and not physical. The first functionally contains the payload processing needed for building up the transport module (e.g. framing, multiplexing and or concentration), the latter functionally contains mo-demodulation, coding-decoding and service signals processing needed for transmission (e.g. error correction algorithms and service channels). Points Z and Z', that might not be physically available, represent the virtual points where the Radio Interface Capacity (RIC), referred in the provisions of annex D of ETSI EN 302 217-1 [8] and annex N of ETSI EN 302 217-2 [9], shall be defined.

NOTE 6: No filtering included.

NOTE 7: Alternative connection at RF, IF or Baseband level.

**Figure 2: System Block diagram**

## 5.2 Transmitter characteristics

### 5.2.1 Maximum output power and power environmental variation

**Objective:**

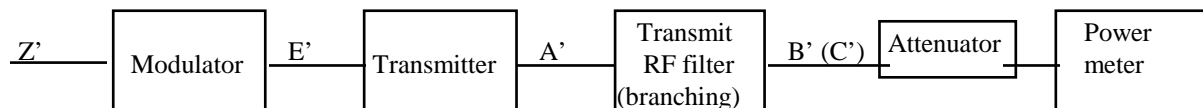
Verify that the maximum output average power measured at reference point B' or C' is within the maximum permitted by the regulations.

Verify that the nominal power, indicated in the *technical documentation*, remains within the (plus/minus) range given by the *relevant standard*.

**Test instruments:**

- 1) power meter;
- 2) power sensor.

**Test configuration:**



**Figure 3: Test configuration**

**Test procedure:**

With the transmitter power level set to maximum the average power output of the transmitter at point B'(C') is to be measured. Full account shall be taken of all losses between the test point and power meter.

### 5.2.2 Minimum output power

**Objective:**

Verify that the minimum output average power of equipment, fitted with power control circuitry, measured at reference point B' or C' is within the limit specified in the technical documentation.

**Test instruments:**

As for maximum power test.

**Test configuration:**

As for maximum power test.

**Test procedure:**

With the transmitter power level set to minimum the transmitter output at B' (C') is to be measured. Full account shall be taken of all losses between the test point and power meter.

### 5.2.3 Automatic Transmit Power Control (ATPC)

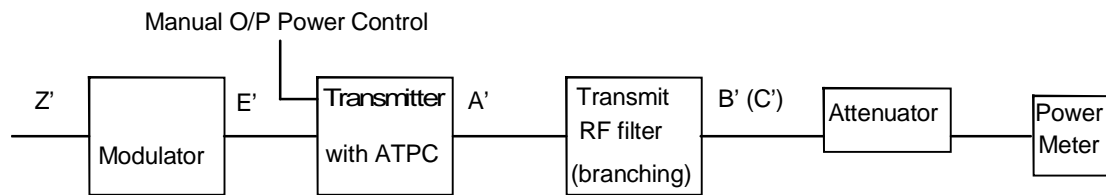
ATPC is an optional feature. However, when fitted, the minimum and maximum output average power levels shall be checked. In addition, satisfactory operation of the automatic facility shall be demonstrated according to the *technical documentation*.

**Objective:**

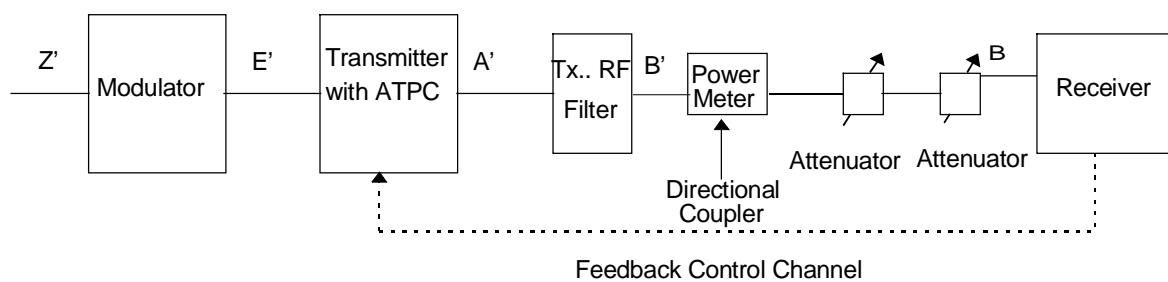
To verify the correct operation of the control loop i.e. when ATPC is implemented, that the transmitter output power can be manually set to the maximum and minimum level. In addition, the control loop is to be checked for satisfactory operation, i.e.: Tx output power is related to the input level at the far receiver.

**Test instruments:**

As for maximum power test.

**Test configuration (manual):**

**Figure 4: Test configuration (manual)**

**Test configuration (automatic ATPC loop):**

**Figure 5: Test configuration (automatic ATPC loop)**

**Test procedure:**

With the maximum transmitter output level selected the average power level at point B'(C') is to be measured. The test is to be repeated with minimum transmitter output power selected. All losses between point B'(C') and the power meter shall be taken into account.

All equipment fitted with automatic power control shall be checked for satisfactory closed loop operation. Attenuator B (see figure 5), initially set to produce the minimum transmitter output level is to be increased until the transmitter reaches its maximum output level. Throughout the transmitter's power range, the receiver input level is to be maintained within the limits stated in the *relevant standard* or in the *technical documentation*. The test is to be repeated to verify that the automatic power control performance, between maximum transmitter power and minimum transmitter power meets the *relevant standard* or within the performance limits as indicated in the *technical documentation*.

## 5.2.4 Remote Transmit Power Control (RTPC)

Where remote transmit power control is an available function (OR) it is to be checked (through the remote-control interface) and recorded during the transmitter output power test. The control range shall respect the indication of the *technical documentation*.

## 5.2.5 Radio frequency stability

**Objective:**

To verify the Tx output frequency is within the limits specified in the *relevant standard*. The method requires to use a frequency counter capable of measuring the centre frequency of a modulated signal. When this type of counter is not available and the EUT permits transmission of unmodulated (CW) carrier, the CW carrier is to be tested against the limit.

Unless specified in the *relevant standard*, frequency accuracy measurements are to be conducted at the lowest, mid-band and highest channel covered by the unit under test.

**Test instruments:**

- Frequency Counter.

**Test configuration:****Figure 6: Test configuration****Test procedure:**

The Tx is to be operated in the modulated or CW condition and frequency measurements conducted on the channel previously selected. The measured frequency is to be within the range stated in the *relevant standard*.

## 5.2.6 RF spectrum mask

The measurement shall be made with a suitable spectrum analyser connected to the transmitter port via a suitable attenuator.

Unless specified in the *relevant standard*, RF spectrum mask measurements are to be conducted at the lowest, mid-band and highest channel of the unit under test.

Where the *relevant standard* allows CW spectral lines at the symbol rate and at other frequency within the spectrum mask to exceed the spectrum mask limits, this relaxation has to be taken into consideration and their level recorded (see clause 5.2.8).

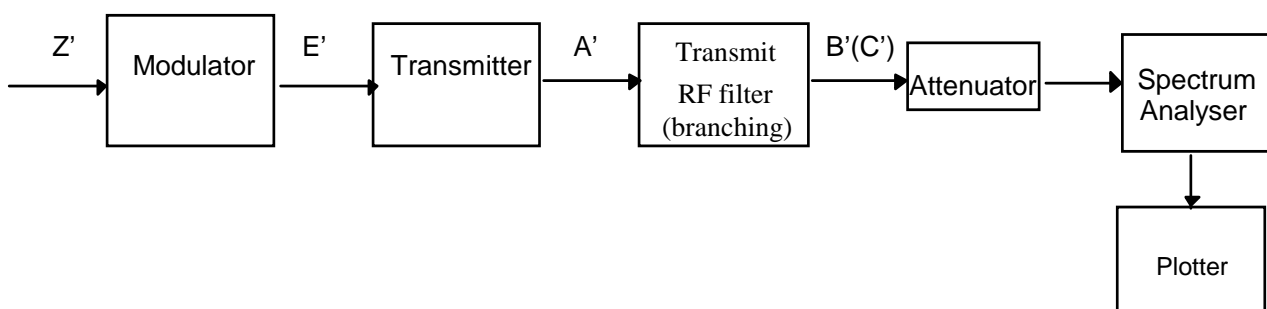
If more than one spectrum mask is available in the *relevant standard* then the appropriate mask should be recorded in the test report.

**Objective:**

To verify that the output frequency spectrum is within the specified limits of the *relevant standard*.

**Test instruments:**

- 1) spectrum analyser;
- 2) plotter or digital recorder.

**Test configuration:****Figure 7: Test configuration****Test procedure:**

The transmitter output port shall be connected to either a spectrum analyser via an attenuator or an artificial load with some means of monitoring the emissions with a spectrum analyser. The spectrum analyser shall have a variable persistence display or digital storage facility. The resolution bandwidth, frequency span, scan time and video filter settings of the spectrum analyser are to be set in accordance with the *relevant standard*.



With the transmitter modulated by a signal having the characteristics given in the *relevant standard*, the Tx power density shall be measured by the spectrum analyser and plotted. Unless specified in the *relevant standard*, transmitter spectral power density plots at the lowest, mid-band and highest channels, are to be recorded. In addition, plots shall be taken at the ambient temperature and environmental extremes and, unless specified in the *relevant standard*, at normal and extreme power supply voltages.

When the state-of-art spectrum analyser does not have enough dynamic range, with sufficient linearity, for verifying the lower mask floor level (see note), common practices for improving the dynamic range need to be used. Typical example is stop-band filter, with calibrated attenuation along the whole out of band mask span, centred to the modulated carrier frequency.

**NOTE:** Typically, this may happen in the higher frequency bands, when testing widest CS masks and/or when the SA set need to include down converters.

It should also be considered that, for the limitation in the highest accepted frequency of Spectrum Analysers (SAs), direct spectrum measurements might not be made without dedicated (and currently available on the SA instrument market) down-conversion accessories. In such cases the minimum sensitivity obtained might not be enough for spectrum mask assessment, due to limitation on the maximum input power to the down converter for acceptable distortion. However, it might be possible to use manufacturer's dedicated design down converter, assuming that they can be suitably calibrated with appropriate side instrumentation (e.g. with calibrated power meters currently available on the instrument market for the frequency range under consideration).

### 5.2.7 Remote frequency control

Remote frequency control is an optional feature. However, when fitted the function shall be tested during the frequency stability test (see clause 5.2.5) verifying any related requirement specified by the *relevant standard*.

### 5.2.8 Tx discrete CW components exceeding the Transmitter RF spectrum masks limits

#### **Objective:**

To verify that the power level of spectral lines at a distance from the channel centre frequency equal to the symbol rate and other CW spectral lines is less than x dBm or x dB below the average power level of the carrier or exceed the spectrum mask by less than xx dB.

The requirement of the *relevant standard* may be either an attenuation relative to the average carrier power or an absolute level.

See note in clause 5.2.6.

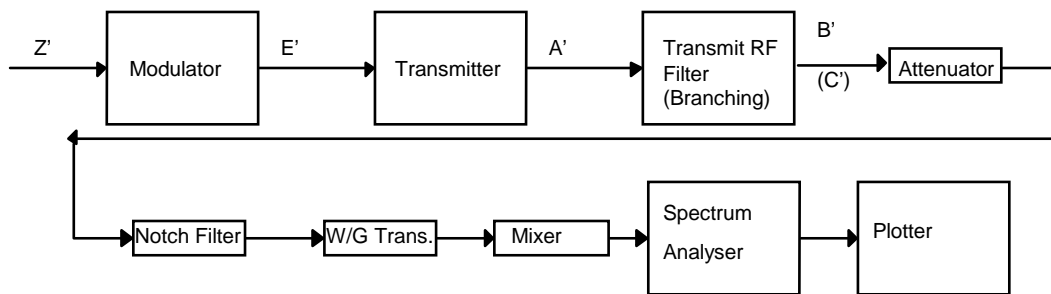
### 5.2.9 Unwanted emissions in the Spurious domain (external)

#### **Objective:**

To verify that any unwanted emissions generated by the transmitter are within the limits quoted in the *relevant standard*. For DFRS, unwanted emissions in the spurious domain are any emissions outside the bandwidth  $\pm(250\% \text{ CS})$ , or  $\pm(150\% \text{ CS} + 500 \text{ MHz})$  when  $\text{CS} > 500 \text{ MHz}$  (see Recommendation ITU-R F.1191 [i.3] and ITU-R Recommendation SM.1539 [i.4]). They include any type of emissions (e.g. harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products).

#### **Test instruments:**

- 1) spectrum analyser;
- 2) spectrum analyser mixer units - as required;
- 3) plotter or digital recorder.

**Test configuration:****Figure 8: Test configuration****Test procedure:**

The transmitter output port shall be connected to either a spectrum analyser via a suitable attenuator and/or notch filter to limit the power into the front end of the analyser. In some cases, where the upper frequency limit exceeds the basic operating range of the analyser, suitable waveguide transitions and mixer will be required. It is important that the circuit between the transmitter and the input to the mixer, or spectrum analyser, is characterized (calibrated) over the frequency range to be measured. These losses should be used to set the limit line of the analyser to a value which ensures that the specification criteria at point C' is not exceeded (see figure 8).

The transmitter is to be operated at the maximum output power indicated in the *technical documentation* and the level and frequency of all significant signals are to be measured and plotted throughout the frequency band quoted in the relevant specification. It is recommended that each scan be taken in 5 GHz steps below 21,2 GHz and 10 GHz steps above 21,2 GHz. However, unwanted emissions in the spurious domain close to the limit should be plotted over a restricted range which clearly demonstrates that the signal does not exceed the relevant limit.

NOTE 1: Where a specification states that the unwanted emissions in the spurious domain test is to be conducted with the equipment in the modulated condition, the resolution bandwidth of the spectrum analyser is to be set to the level quoted in the specification. The frequency span and scan rate of the analyser should be adjusted to maintain the noise floor below the limit line and maintain the spectrum analyser in the calibrated condition.

NOTE 2: Measurement of unwanted emissions in the spurious domain levels from equipment operating in the CW condition can be conducted with resolution bandwidth, frequency span and scan rates which maintain the spectrum analyser in the calibrated condition while keeping the difference between noise floor and limit line at about 10 dB.

The exclusion bandwidth across the nominal frequency shall be taken, as  $\pm(250\% \text{ CS})$ , or, when  $\text{CS} > 500 \text{ MHz}$ , as  $\pm(150\% \text{ CS} + 500 \text{ MHz})$ .

BWe shall be taken as 100 kHz for frequency below 1 GHz and 1 MHz above this limit.

However, if BWe are stated in the equipment *relevant standard* then these should be used.

The measurement shall be carried out with modulated carrier, provided that the level limits for noise like unwanted emissions in the spurious domain (e.g. harmonics and mixer image frequencies) were regarded as "maximum level in any elementary band equal to BWe".

## 5.3 Receiver characteristics

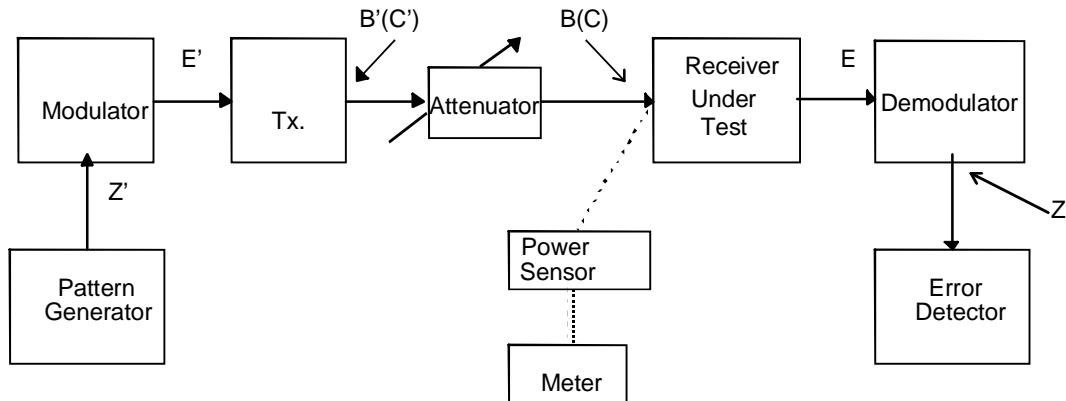
### 5.3.1 Input level range

**Objective:**

To verify that the receiver meets the Bit Error Rate (BER) criteria, given in the relevant specification, over a defined range of receiver input levels.

**Test instruments:**

- 1) power sensor and meter;
- 2) pattern generator/error detector.

**Test configuration:****Figure 9: Test configuration****Test procedure:**

Connect the pattern generator output to the BaseBand (BB) Tx input  $Z'$  and the error detector to the BB Rx output  $Z$ . Switch the transmitter to standby and adjust the variable attenuator to provide maximum attenuation. Disconnect the receiver under test. Connect the power meter, through a suitable power sensor, to point B(C) (see figure 9). Switch on the transmitter and adjust the attenuator to set the power to the upper limit for the input level range test. Switch the transmitter to standby and reconnect the receiver under test. Measure and record the BER for the upper range.

Increase the level of attenuation until the signal input level at the receiver causes BER equal to the lower limit quoted in the relevant specification, measure and record the BER at this level. The receiver input level range is the signal range between the upper and lower receiver input levels provided the BER is met.

### 5.3.2 Receiver unwanted emissions in the spurious domain

The same test method as described in clause 5.2.9 is applicable. Emission levels from a transmitter and receiver of duplex equipment using a common port are measured simultaneously and the test only needs to be conducted once.

**Objective:**

To verify that spurious emissions from the receiver are within the limits.

### 5.3.3 System performance without diversity

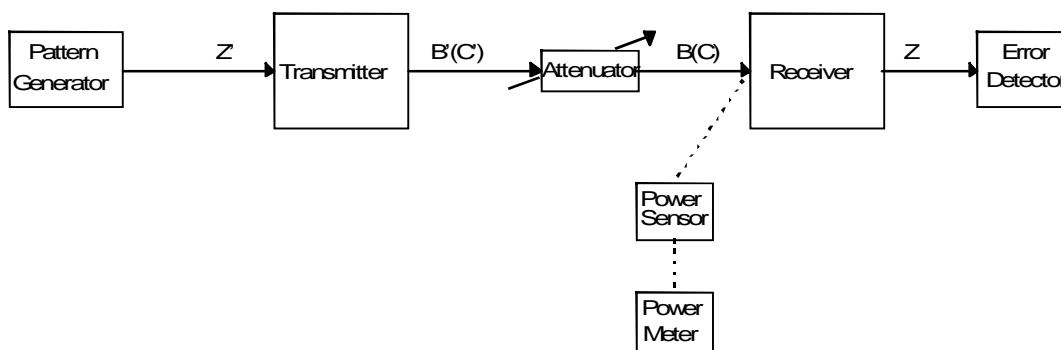
#### 5.3.3.1 BER as a function of Receiver input Signal Level (RSL)

**Objective:**

Received signal level versus BER thresholds are verified. This is typically measured at the three BER levels specified in the *relevant standard*.

**Test instruments:**

- 1) pattern generator/error detector;
- 2) power sensor and meter.

**Test configuration:****Figure 10: Test configuration****Test procedure:**

Connect the pattern generator output to the BB input of the Tx. Send the BB output signal of the Rx to the Error detector. Then take record of BER curve by varying the received field. Verify that the RSL, corresponding to the BER thresholds are within the specifications of the equipment *relevant standard*.

**5.3.3.2 Co-channel interference sensitivity- external****5.3.3.2.0 Introduction**

There are variations in some of the standards as to the measurement requirements for Co-channel Interference Sensitivity. The variations have been covered by providing Methods 1 and 2 (see note) for these tests. The test house should apply the approach stated in the equipment *relevant standard*.

NOTE: Method 2b) should be used when assessing conformity to ETSI EN 302 217-2 [9].

**5.3.3.2.1 Method 1****5.3.3.2.1.0 Generality****Objectives:**

To verify that the BER at point Z, of the receiver under test, remains below the relevant specification limit in the presence of an interfering like modulated signal on the same channel. The signal levels of the wanted and interfering signals at point B(C) shall be set at the levels given in the *relevant standard* specification.

**Test instruments:**

- 1) 2 bit pattern generators;
- 2) error detector;
- 3) power sensor and meter.

For this method 1 two alternative test configurations and test procedures are possible (1a and 1b)

#### 5.3.3.2.1.1a Test procedure 1a)

##### Test configuration 1a):

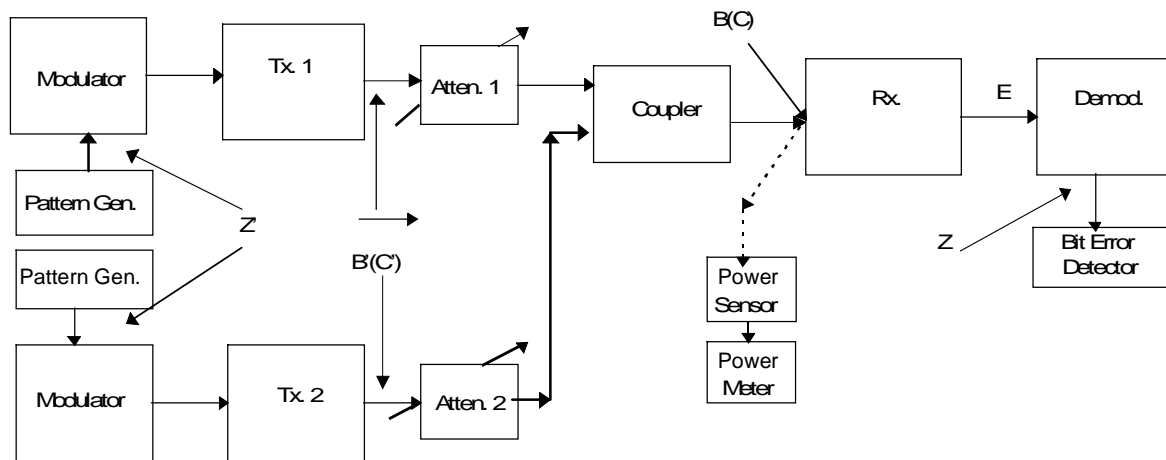


Figure 11: Test configuration 1a) and 2a)

##### Test procedure for test configuration 1a):

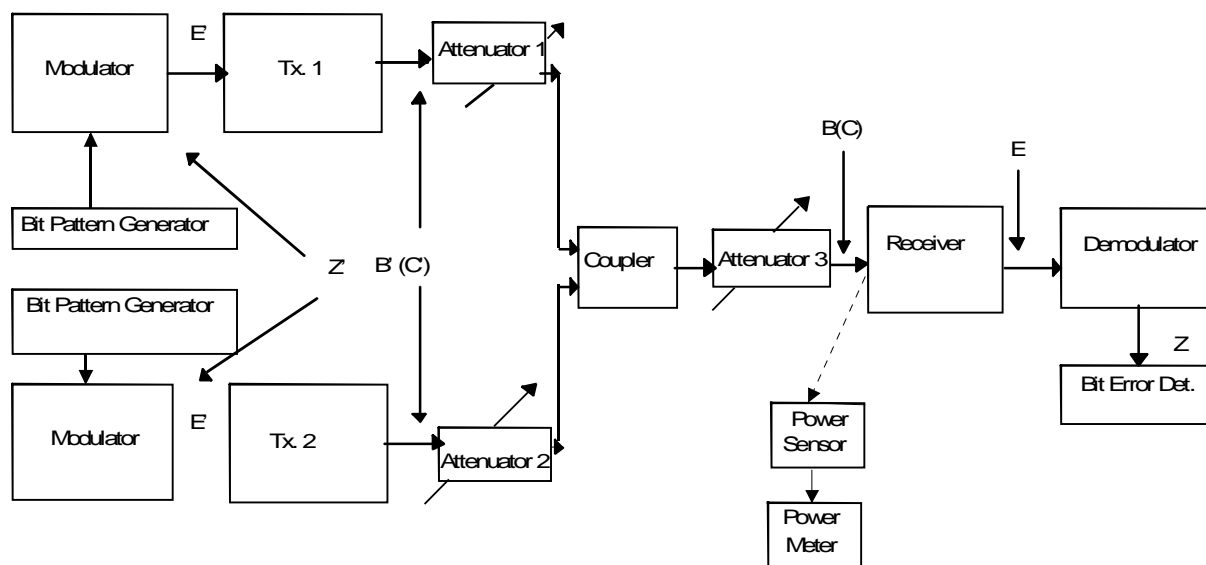
During this test both transmitters shall transmit on the same frequency and be modulated with different signals having the same characteristics. Switch the transmitters to standby and disconnect the waveguide or cable at point B(C) (see figure 11). Connect a suitable power sensor and meter. Switch on Tx 1 and adjust attenuator 1 to set the signal to a convenient level, say -30 dBm. Switch Tx 1 to standby and Tx 2 on. Adjust attenuator 2 to set the interfering signal to a level below the reference signal, measured previously, which is equal to the Carrier to Interference (C/I) ratio given in the *relevant standard* specification. Switch Tx 2 to standby.

Reconnect the receiver under test, switch on Tx 1 and increase attenuator 1 until the  $10^{-6}$  level required by the *relevant standard* is achieved. Increase attenuator 2 by the same amount attenuator 1 was increased (then, C/I remains constant as set before), switch on Tx 2 and record the BER for the C/I.

Decrease attenuator 2 until the receiver BER equals the limit quoted in the specification of the radio standard under assessment. Calculate and record the C/I ratio.

#### 5.3.3.2.1.1b Alternative test procedure 1b)

NOTE: This procedure uses an additional attenuator between the combiner and receiver to control the absolute wanted and unwanted signal levels into the receiver. The functions of attenuators 1 and 2 is to maintain the correct C/I ratio.

**Alternative Test configuration 1b):****Figure 12: Test configuration 1b) and 2b)****Test procedure for test configuration 1b):**

With the transmitters at standby set attenuators 1 and 2 to their maximum values and attenuator 3 to zero. Disconnect the waveguide or cable at point B(C) (see figure 12) and connect a suitable power sensor and meter. Switch on Tx 1 and reduce attenuator 1 to produce a suitable level, say -30 dBm. Record the measured level. Switch Tx 1 to standby and Tx 2 on. Reduce attenuator 2 to produce a signal below the level previously measured by an amount equal to the C/I ratio. Increase attenuator 3 to set the wanted receiver input level to that quoted in the specification of the radio standard under assessment.

With both transmitters on standby disconnect the power sensor and reconnect the receiver under test. Switch both transmitters on in the modulated condition and measure and record the receiver BER on the error detector.

Decrease attenuator 2 until the receiver BER equals the limit quoted in the specification of the radio standard under assessment. Calculate and record the wanted to unwanted ratio.

**5.3.3.2.3 Method 2****5.3.3.2.3.1 Generality**

Two similar and complementary objectives, test configurations and test procedures are covered by this method:

**Objectives:**

- a) To verify that the maximum C/I value for 1 dB and 3 dB degradation on  $10^{-6}$  and/or  $10^{-3}$  BER remains below the *relevant standard* specification limit in presence of an interfering like modulated signal on the same channel.
- b) To verify that the  $10^{-6}$  and/or  $10^{-3}$  BER is not exceeded at RSL 1 dB and 3 dB higher than the corresponding BER thresholds provided by the *relevant standard* specification in presence of an interfering like modulated signal on the same channel at C/I ratio also provided by the *relevant standard*.

**Test instruments:**

- 1) 2 pattern generators;
- 2) error detector;
- 3) power sensor and meter.

#### 5.3.3.2.3.2a Test procedure 2a)

##### Test configuration 2a):

See figure 11.

##### Test procedure for test configuration 2a):

During this test both transmitters shall transmit on the same channel and be modulated with signals that have the same characteristics and are uncorrelated. With the transmitters to standby set both attenuators to their maximum values.

Connect power meter at point B(C). Switch on Tx 1 and adjust attenuator 1 to set the wanted signal to the level required by the *relevant standard* for  $10^{-6}$  (or  $10^{-3}$ ). Decrease attenuator 1 by 1 dB (or 3 dB) and record its setting. Switch on the interferer and reduce attenuator 2 to achieve a BER of  $10^{-6}$  (or  $10^{-3}$ ) on the error detector. Switch both transmitters off and disconnect the waveguide, or cable, at point B(C) - see figure 10. Record the setting of attenuator 2 and connect the power sensor and meter to the waveguide or cable.

Switch Tx 1 on and reduce attenuator 1 to produce a wanted signal level within the calibrated range of the power meter. Record the power level and reduction in attenuation:

- Calculate  $\text{Power}_{\text{wanted signal}} = \text{Measured power level} - \text{change in attenuation}$ .
- Switch off Tx. 1, switch on Tx. 2 and repeat the procedure to calculate the  $\text{Power}_{\text{unwanted signal}}$ .

The maximum co-channel C/I value for 1 dB or 3 dB degradation on  $10^{-6}$  or  $10^{-3}$  is:

- $C/I = \text{Power}_{\text{wanted signal}} - \text{Power}_{\text{unwanted signal}}$

#### 5.3.3.2.3.2b Test procedure 2b)

##### Test configuration 2b):

See figure 12.

##### Test procedure for test configuration 2b):

During this test both transmitters shall transmit on the same channel and be modulated with signals that have the same characteristics and are uncorrelated. With the transmitters to standby set attenuators 1 and 2 to their maximum values and attenuator 3 at an attenuation  $> 3$  dB.

Connect power meter at point B(C). Switch on Tx 1 and adjust attenuator 1 to set the wanted signal to the level required by the *relevant standard* for  $10^{-6}$  (or  $10^{-3}$ ). Switch off Tx 1 and on Tx 2 and set with attenuator 2 the interference level for the C/I required by the *relevant standard*. Decrease attenuator 3 by 1 dB (or 3 dB). Switch both transmitters off and reconnect the waveguide, or cable, to the Rx at point B(C) - see figure 12. Switch on both the wanted Tx 1 and the interferer Tx 2 and verify that  $\text{BER} \leq 10^{-6}$  (or  $\text{BER} \leq 10^{-3}$ ) on the error detector.

### 5.3.3.3 Adjacent (1<sup>st</sup> or 2<sup>nd</sup>) channel interference sensitivity

#### 5.3.3.3.0 Introduction

There are variations in some of the *relevant standards* as to the measurement requirements for adjacent channel interference sensitivity. The variations have been covered by providing Method 1 and Method 2 options for these tests. The test house should apply the approach stated in the equipment *relevant standard*.

NOTE 1: In many cases the C/I ratio will be negative thus producing an interferer with a higher level than the wanted signal.

NOTE 2: Method 2b) should be used when assessing conformity to ETSI EN 302 217-2 [9].

### 5.3.3.3.1 Method 1

#### 5.3.3.3.1.0 Generality

For this method 1, two alternative test configurations and test procedures are possible (1a and 1b)

#### **Objective:**

To verify that the BER at point Z, of the receiver under test, remains below the relevant specification limit in the presence of an interfering like modulated signal on the adjacent channel. The signal levels of the wanted and interfering signals at point B(C) shall be set at the levels given in the *relevant standard* specification.

#### **Test instruments:**

Same as co-channel test.

#### 5.3.3.3.1.1a Test procedure 1a)

#### **Test configuration 1a):**

Same as co-channel test (see figure 11).

#### **Test procedure for test configuration 1a):**

During this test the interfering transmitter shall be modulated with signals having the same characteristics as the modulating signal of the wanted transmission and be tuned to an adjacent channel. Switch the transmitters to standby and disconnect the waveguide or cable at point B(C). Connect a suitable power sensor and meter. Switch on Tx 1 and adjust attenuator 1 to set the wanted signal at a convenient level, say -30 dBm. Switch Tx 1 to standby and Tx 2 on. Adjust attenuator 2 to set the interfering signal to a level above the reference signal, measured previously, which is equal to the C/I ratio given in the specification of the radio standard under assessment. Switch Tx 2 to standby.

Reconnect the receiver under test and increase both attenuators by equal amounts which ensure that the wanted and unwanted signal levels into the receiver are at their correct values. Switch on and modulate both transmitters. Record the receiver BER.

If desired, repeat the test with the interfering transmitter tuned to the other adjacent channel.

#### 5.3.3.3.1.1b Alternative test procedure 1b)

**NOTE:** This procedure uses an additional attenuator between the combiner and receiver to control the absolute wanted and unwanted signal levels into the receiver. The functions of attenuators 1 and 2 is to maintain the correct C/I ratio.

#### **Test configuration 1b):**

Same as Alternative 1b), Co-channel test (see figure 12).

#### **Test procedure for test configuration 1b):**

With the transmitters at standby set attenuators 1 and 2 to their maximum values and attenuator 3 to zero. Disconnect the waveguide or cable at point B(C) and connect a suitable power sensor and meter. Switch on Tx 1 and reduce attenuator 1 to produce a suitable level, say -30 dBm. Record the measured level. Switch Tx 1 to standby and Tx 2 on. Reduce attenuator 2 to produce a signal level above that previously measured, by an amount equal to the C/I ratio. Increase attenuator 3 to provide the receiver with an input equal to the specified receiver level.

With both transmitters on standby disconnect the power sensor and reconnect the receiver under test. Switch both transmitters on in the modulated condition and measure and record the receiver BER on the error detector.

Repeat the test with the interfering transmitter tuned to the other adjacent channel.



### 5.3.3.3.2 Method 2

#### 5.3.3.3.2.1 Generality

Two similar and complementary objectives, test configurations and test procedures are covered by this method.

#### Objective:

- a) To verify that the maximum C/I value for 1 dB and 3 dB degradation on  $10^{-6}$  and  $10^{-3}$  BER remains below the relevant specification limit in the presence of an interfering like modulated signal on the adjacent channel.
- b) To verify that the  $10^{-6}$  and/or  $10^{-3}$  BER is not exceeded at RSL 1 dB and 3 dB higher than the corresponding BER thresholds provided by the *relevant standard* specification in presence of an interfering like modulated signal on the 1<sup>st</sup> or 2<sup>nd</sup> adjacent channel at C/I ratio also provided by the *relevant standard*.

#### Test instruments:

- 1) 2 pattern generators;
- 2) error detector;
- 3) power sensor and meter.

#### 5.3.3.2.2.2a Test configuration 2a)

See figure 11.

#### Test procedure 2a):

During this test the interferer (Tx 2) shall transmit on one of the adjacent channels and be modulated with a signal having the same characteristics as the signal modulating the wanted transmitter. With both transmitters on standby set the attenuators to their maximum values.

Connect power meter at point B(C). Switch on Tx 1 and adjust attenuator 1 to set the wanted signal to the level required by the *relevant standard* for  $10^{-6}$  (or  $10^{-3}$ ). Decrease attenuator 1 by 1 dB (or 3 dB) and record its setting. Switch on the interfere and reduce attenuator 2 to achieve a BER of  $10^{-6}$  (or  $10^{-3}$ ) on the error detector. Switch both transmitters off and disconnect the waveguide, or cable, at point B(C) - see figure 10. Record the setting of attenuator 2 and connect the power sensor and meter to the waveguide or cable.

Switch Tx. 1 on and reduce attenuator 1 to produce a wanted signal level within the calibrated range of the power meter. Record the power level and reduction in attenuation:

- Calculate  $\text{Power}_{\text{wanted signal}} = \text{Measured power level} - \text{change in attenuation}$ .

Switch off Tx 1, switch on Tx 2 and repeat the procedure to calculate the  $\text{Power}_{\text{unwanted signal}}$ .

The maximum co-channel C/I value for 1 dB or 3 dB degradation on  $10^{-6}$  or  $10^{-3}$  is:

- $C/I = \text{Power}_{\text{wanted signal}} - \text{Power}_{\text{unwanted signal}}$

Repeat the test with the interferer on the other adjacent channel.

#### 5.3.3.2.2.2b Test configuration 2b)

See figure 12.

#### Test procedure 2b):

The test procedure is the same test procedure 2b) in clause 5.3.3.3.2b with the difference that the interfering Tx is not set co-channel to wanted signal, but set at 1<sup>st</sup> or 2<sup>nd</sup> adjacent channel.

### 5.3.3.4 Blocking (CW spurious interference)

There are variations in some of the standards (see note 1) as to the measurement requirements for:

**Objective a)** "generic blocking" (interference rejection capability) over a given frequency span.  
and

**Objective b)** for specific identification of worse "spurious response" at a number of single frequencies within that span.

The test house should apply the approach stated in the equipment *relevant standard*.

NOTE 1: Method a) should be used when assessing conformity to ETSI EN 302 217-2 [9].

#### Objective a) "generic blocking":

This test is designed to verify that the equipment receiver is capable to withstand a given fixed  $C/I$  (where  $I$  is a single CW emission higher than  $C$  level, i.e.  $C/I$  is negative value) with BER threshold degradation less than a given amount (e.g. 1 dB) indifferently placed within a given frequency span.

#### Objective b) "spurious response":

This test is designed to identify specific frequencies at which the receiver may have a spurious response e.g. image frequency, harmonic response of the receive filter, etc. The frequency range of the test should be in accordance with the relevant specification.

#### Test instruments a) and b):

- 1) pattern generator;
- 2) error detector;
- 3) signal generator;
- 4) power sensor and meter.

#### Test configuration a):

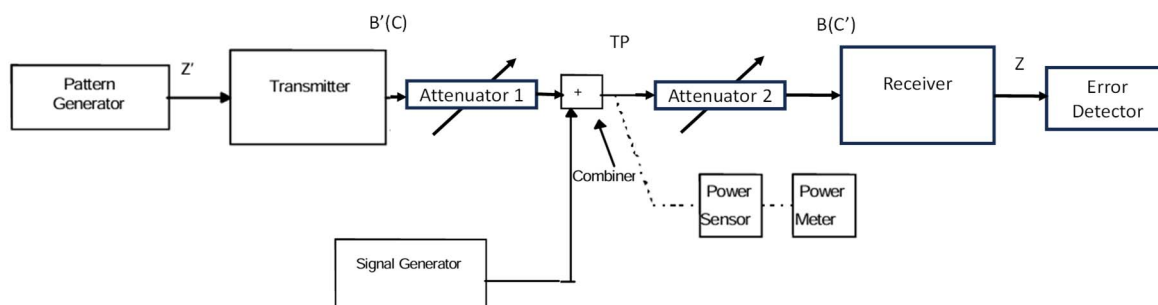


Figure 13a: Test configuration a) (see note 2)

#### Test configuration b):

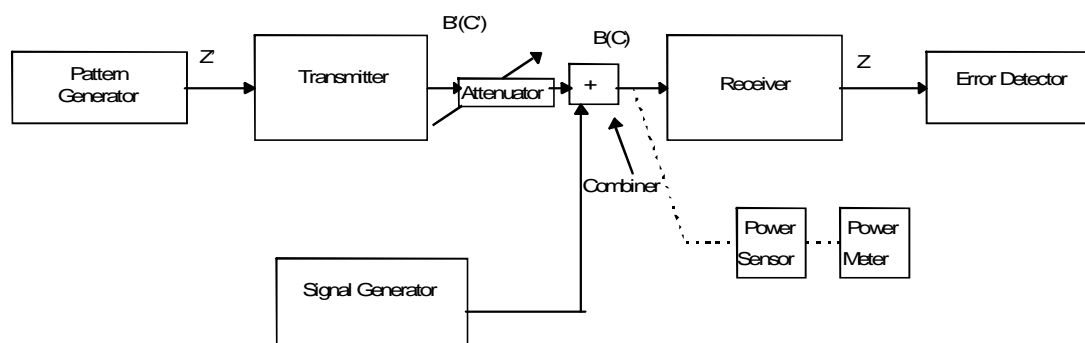


Figure 13b: Test configuration b) (see note 2)

NOTE 2: This test may require the use of low pass filters on the output of the signal generator to prevent harmonics of the signal generator falling into the receiver exclusion band.

**Test procedure a):**

Refer to figure 13a.

With the signal generator turned off, measure the transmitter output power at test point TP and, using attenuator 1, set the power at a level conveniently higher (e.g. 10 dB) than the RSL of BER threshold (e.g. for BER =  $10^{-6}$ ) required by the *relevant standard* (record this RSL level set). Turn off the transmitter and turn on the signal generator and set its regulated level, measured at same point TP, to be X dB above the transmitter power previously measured; where X = I/C ratio provided by the *relevant standard*.

With attenuator 2 reduce the power at point B(C) so that the wanted signal reaches a level of:

- RSL = [BER threshold limit (e.g. x dBm for BER =  $10^{-6}$ )] + [permitted maximum degradation (e.g. 1 dB as required by ETSI EN 302 217-2 [9])];
- with both values as required by the *relevant standard*.

Sweep (see note 3) the signal generator, at the calibrated level, through the frequency range, taking into account any exclusion band, as required in the *relevant standard*.

Check, for the whole sweep span required by the *relevant standard*, that BER  $\leq$  limit BER (e.g.  $10^{-6}$ ) provided as RSL threshold by the *relevant standard*.

**Test procedure b):**

Refer to figure 13b.

With the signal generator output turned off, measure the transmitter RF output power at point B(C) using a suitable power sensor, with a known level of attenuation. Replace the power sensor with the receiver under test and increase the level of attenuation until the level required by the *relevant standard* is measured. Record the BER for this receiver level (dBm) where applicable.

Switch off the transmitter, replace the receiver under test with a power sensor. Calibrate the signal generator across the frequency range required by the *relevant standard* at a level x dB above the level (dBm), where x is the required increase in level for the interfering CW signal.

Replace the power sensor with the receiver under test and confirm the BER level has not changed. Sweep (see note 3) the signal generator through the required frequency range at the calibrated level, taking into account any exclusion band stated in the *relevant standard*.

Any frequencies which cause the BER to exceed the level stated in the *relevant standard* shall be recorded. It is recommended that the calibration be rechecked at these frequencies.

NOTE 3: The use of a stepped signal generator is permitted provided that the step size is equal or less than the minimum value between 200 MHz and one third of the CS bandwidth of the receiver under test.

### 5.3.3.5 Distortion sensitivity

**Objective:**

The test is only applicable to certain (high capacity) systems.

This is a test of the equipment's immunity against propagation distortion. The results are given in the form of signatures.

**Test instruments:**

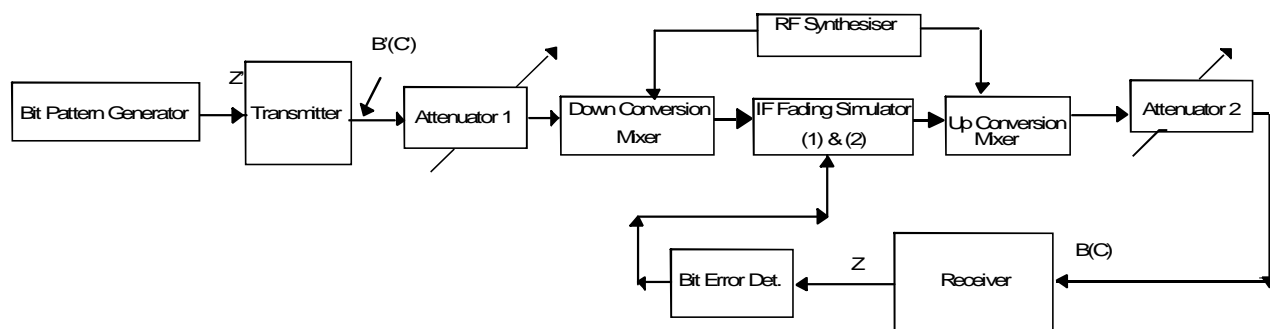
- 1) pattern generator;
- 2) error detector;
- 3) RF synthesizer;
- 4) IF fading simulator.

### Test configuration:

Two test configurations are considered.

#### Test configuration 1:

This test configuration may be used with all types of Rx implementation, and is particularly useful for test of Rx with direct demodulation.



- (1): IF fading simulator may include an error detector  
 (2): IF fading simulator frequency may be different from Rx. IF frequency  
 (3): RF branch may also be allowed between points B'(C) and B(C)

**Figure 14: Test configuration 1**

#### Test procedure for Test configuration 1:

- 1) connect the pattern generator output to the BB Tx input;
- 2) connect Tx RF output and RX RF input to the corresponding RF access points of the signature test bench;
- 3) connect the error detector at the BB RX output;
- 4) set the RF Synthesiser Frequency to channel nominal centre frequency + IF FADING SIMULATOR frequency.

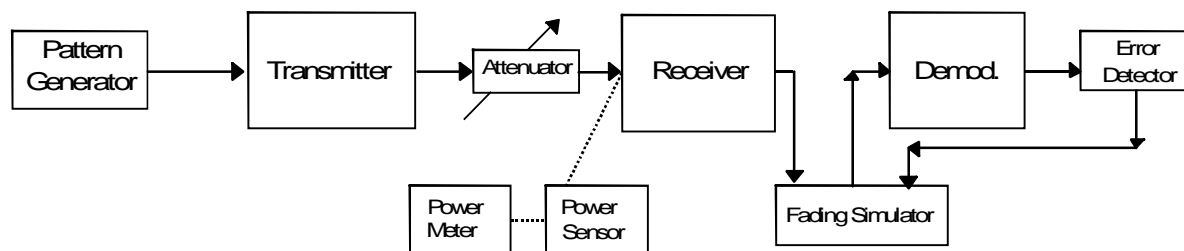
NOTE 1: If selectable, it is recommended that IF FADING SIMULATOR frequency be high.

NOTE 2: In some particular cases, the RF synthesiser frequency may be chosen as channel nominal centre frequency - IF FADING SIMULATOR frequency.

#### Test instruments:

- 1) pattern generator / error detector;
- 2) fading simulator.

#### Test configuration 2:



**Figure 15: Test configuration 2**

#### Test procedure for test configuration 2:

Connect the pattern generator output to the BB input of the Tx. Connect the fading simulator (delay 6,3 ns) between the Rx. IF amplifier and the demodulator input and measure the BER at the BB Rx output.

## 5.3.4 System characteristics with diversity

### 5.3.4.1 BER performance

Same test method can be use as described in clause 5.3.3.1. An improvement of the threshold shall be within the limits in the specification of the radio standard under assessment.

### 5.3.4.2 Interference sensitivity

For further study.

### 5.3.4.3 Distortion sensitivity

It is to be noted that no standard presently state requirements for distortion sensitivity in system with diversity (see note). This is mainly due to the difficulties to control the high number of parameters involved and the complexity of a suitable test set up. However, a practical and generic test set-up together with some possible measurements are reported in informative annex B.

NOTE: In such case it is generally assumed that both receivers fulfil their single distortion sensitivity (see clause 5.3.3.5).

## Annex A (informative): Example of Test report template

### A.1 Test results

#### A.1.1 Summary of tests

Parameter	C	NC	NT	NA	Reference to remark
Transmitter characteristics					
Transmitter power range					
Maximum output power					
Nominal power environmental variation					
Minimum output power					
Automatic Transmit Power Control (ATPC)					
Remote Transmit Power Control (RTPC)					
Remote Frequency Control (RFC)					
RF spectrum mask					
Discrete CW components					
Unwanted emissions in the Spurious domain, external					
Tx radio frequency stability					
Receiver characteristics					
Input level range					
Unwanted emissions in the Spurious domain					
System performance without diversity					
BER vs. Rx signal level					
Interference sensitivity					
Co-channel interference - external					
1 <sup>st</sup> and 2 <sup>nd</sup> adjacent channel interference					
Blocking (CW spurious interference)					
Distortion sensitivity					
System performance with diversity					
BER function of Rx signal level					
Interference sensitivity					
Distortion sensitivity					
NOTE:	C: The parameter is compliant with the requirements. NC: The parameter is not compliant with the requirements. NT: The parameter is not tested. NA: The test of this parameter is not applicable.				

## A.1.2 General information about the tests

General information about the tests should be given below.

<b>Name of laboratory performing the tests</b>	
<b>Test report reference number</b>	
<b>Relevant standard applied</b>	
<b>Dates of test (from - to)</b>	
<b>Name of manufacturer</b>	
<b>Manufacturer's type designation</b>	
<b>Type of equipment</b>	
<b>Equipment serial number(s)</b>	
<b>Module</b>	<b>Serial number</b>

## A.1.3 Test result forms

### A.1.3.1 Transmitter characteristics

#### A.1.3.1.1 Transmitter power range

##### A.1.3.1.1.0 Generality

The test is divided in two parts. The first one is maximum output power and the second one (if applicable) is minimum output power.

##### A.1.3.1.1.1 Maximum output power and power environmental variation

###### **Method of measurement:**

See clause 5.2.1.

###### **Results:**

Ambient temperature:     °C    Relative humidity:     %

Rated output power:     dBm.

Presentation example in following tables.

Test conditions		Transmitter power level (dBm)		
		RF channel low (GHz)	RF channel mid (GHz)	RF channel high (GHz)
T <sub>nom</sub> ( )	V <sub>nom</sub> ( )			
T <sub>min</sub> ( )	V <sub>min</sub> ( )			
	V <sub>max</sub> ( )			
T <sub>max</sub> ( )	V <sub>min</sub> ( )			
	V <sub>max</sub> ( )			
<b>Measurement uncertainty (dB)</b>				
NOTE: Use the number of columns that are required depending on how many frequency channels are to be tested.				

**Limits:**

<b>Maximum allowed power (dBm)</b>	
<b>Maximum nominal power environmental variation, all test conditions (dB)</b>	

<b>Test equipment used: (Item numbers)</b>	
--	--

## A.1.3.1.1.2 Minimum output power

**Method of measurement:**

See clause 5.2.2.

**Results:**

Ambient temperature: °C Relative humidity: %

Rated output power: dBm

Test conditions		Transmitter power level (dBm)		
		RF channel low (GHz)	RF channel mid (GHz)	RF channel high (GHz)
T <sub>nom</sub> ( )	V <sub>nom</sub> ( )			
T <sub>min</sub> ( )	V <sub>min</sub> ( )			
	V <sub>max</sub> ( )			
T <sub>max</sub> ( )	V <sub>min</sub> ( )			
	V <sub>max</sub> ( )			
<b>Measurement uncertainty (dB)</b>				
NOTE: Use the number of columns that are required depending on how many frequency channels are to be tested.				

**Limits:**

<b>Minimum output power (dBm)</b>	
<b>Minimum nominal power environmental variation, all test conditions (dB)</b>	

<b>Test equipment used: (Item numbers)</b>	
--	--



### A.1.3.1.2 Automatic transmit power control (ATPC)

#### Method of measurement:

See clause 5.2.3.

#### Results:

Ambient temperature: °C Relative humidity: %

Input voltage,  $V_{nom}$ : V

For results from Tx performance verification, the relevant sections for transmitter power range, RF spectrum mask, unwanted emissions in the spurious domain and output power stability should be used.

For the control loop performance, one of the directions should be tested only, and the results stated below.

Control loop performance		
	OK	Not OK
Power level control functionality: Minimum power level increasing to maximum power level (according to <i>technical documentation</i> ).		
Power level control functionality: Maximum power level decreasing to minimum power level (according to <i>technical documentation</i> ).		

Test equipment used: (Item numbers)	
-------------------------------------	--

### A.1.3.1.3 Remote Transmit Power Control (RTPC)

This measurement, if applicable, has been carried out under the "output power environmental variation" tests.	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not applicable <input type="checkbox"/>
---	------------------------------	-----------------------------	---

### A.1.3.1.4 Remote Frequency Control (RFC)

This measurement, if applicable, has been carried out under the "Radio Frequency stability" tests.	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not applicable <input type="checkbox"/>
--	------------------------------	-----------------------------	---

### A.1.3.1.5 RF spectrum mask

This clause is to be used for normal channels case or, if applicable, innermost channels case.

#### Method of measurement:

See clause 5.2.6.

#### Results:

The results should be represented by plots provided in the annex. Annex references should be stated below. An example of a diagram for providing a plot is shown in figure A.1 below.

NOTE: Use the number of tables that are required, depending on how many frequency channels are to be tested.

Ambient temperature: °C Relative humidity: %

Input voltage,  $V_{nom}$ : V

Test conditions		
Radio frequency channel (GHz)		Reference to plot in the annex
T <sub>nom</sub>	V <sub>nom</sub>	
T <sub>min</sub>	V <sub>min</sub>	
T <sub>max</sub>	V <sub>min</sub>	
T <sub>min</sub>	V <sub>max</sub>	
T <sub>max</sub>	V <sub>max</sub>	

Test conditions		
Radio frequency channel (GHz)		Reference to plot in the annex
T <sub>nom</sub>	V <sub>nom</sub>	
T <sub>min</sub>	V <sub>min</sub>	
T <sub>max</sub>	V <sub>min</sub>	
T <sub>min</sub>	V <sub>max</sub>	
T <sub>max</sub>	V <sub>max</sub>	

Test conditions		
Radio frequency channel (GHz)		Reference to plot in the annex
T <sub>nom</sub>	V <sub>nom</sub>	
T <sub>min</sub>	V <sub>min</sub>	
T <sub>max</sub>	V <sub>min</sub>	
T <sub>min</sub>	V <sub>max</sub>	
T <sub>max</sub>	V <sub>max</sub>	

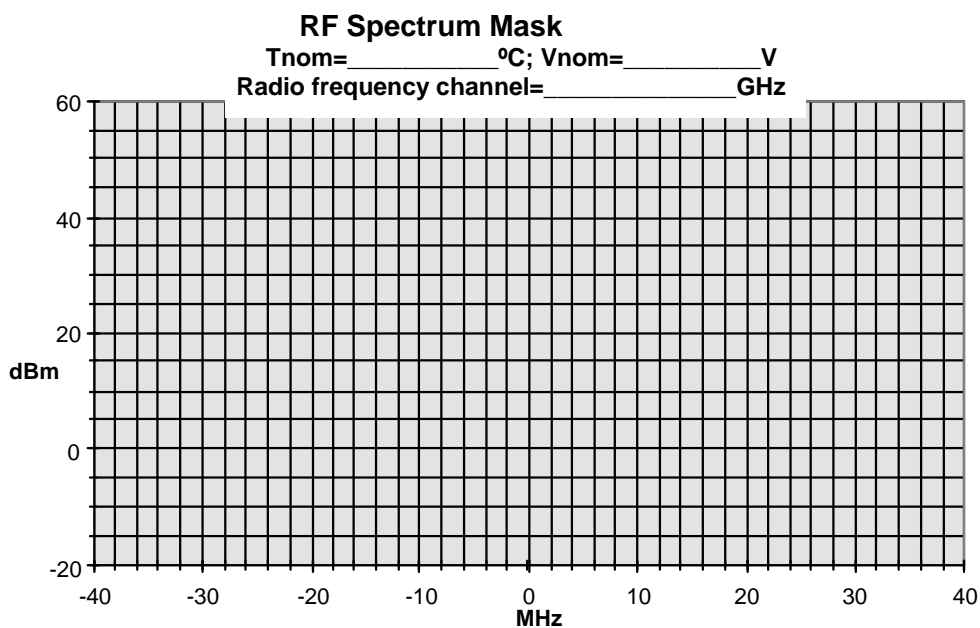


Figure A.1

Measurement uncertainty	
-------------------------	--

Test equipment used: (Item numbers)	
-------------------------------------	--

### A.1.3.1.6 Spectral lines at the symbol rate

#### Method of measurement:

See clause 5.2.8.

#### Results:

NOTE: Use the number of tables that are required, depending on how many frequency channels are to be tested.

The worst case of the measured values should be presented.

Ambient temperature: °C Relative humidity: %

Input voltage,  $V_{nom}$ : V

Radio frequency (GHz):		
Frequency offset from $f_c$ (MHz)	Power level of spectral lines (dBm / dB)	Limiting values (dBm / dBc)

Radio frequency (GHz):		
Frequency offset from $f_c$ (MHz)	Power level of spectral lines (dBm / dB)	Limiting values (dBm / dBc)

Radio frequency (GHz):		
Frequency offset from $f_c$ (MHz)	Power level of spectral lines (dBm / dB)	Limiting values (dBm / dBc)

Measurement uncertainty	
-------------------------	--

Test equipment used: (Item numbers)	
-------------------------------------	--

### A.1.3.1.7 Spurious emissions (Tx) - external

#### Method of measurement:

See clause 5.2.9.

#### Limits:

Limits are specified in the *relevant standard*.

#### Results:

The results should be presented by plots.

Annex references should be stated below. An example of a diagram for providing a plot is shown below.

NOTE: If the measurement for "spurious emissions (Tx) - external" and "spurious emissions (Rx) - external" can be carried out at the same time the results may be presented in the same plots. In that case only one of these clauses will be used and this fact be clearly declared in the test report.

Ambient temperature: °C Relative humidity: %

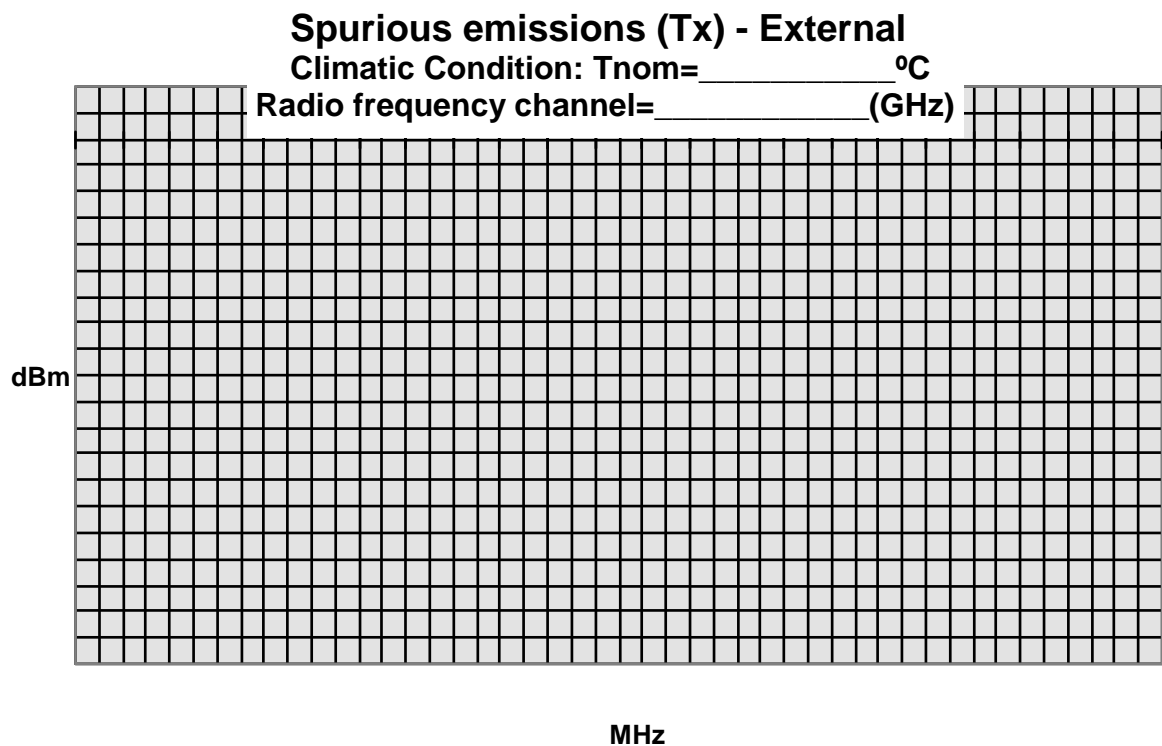
Input voltage,  $V_{nom}$ : V

Frequency (GHz) By plot range	Reference to plot in annex		
	RF channel low (GHz)	RF channel mid (GHz)	RF channel high (GHz)
Measurement uncertainty (dB)			

**Limits:**

Insert diagram showing spurious emissions(Tx) - external measurements

Example of diagram that can be used for presenting the measurements is shown in figure A.2.



**Figure A.2**

Test equipment used: (item numbers) \_\_\_\_\_

## A.1.3.1.8 Tx radio frequency stability (short term)

**Method of measurement:**

See clause 5.2.5.

**Results:**

Ambient temperature: °C Relative humidity: %

Test conditions		Frequency error (kHz / ppm)		
		RF channel low (GHz)	RF channel mid (GHz)	RF channel high (GHz)
T <sub>nom</sub> ( )	V <sub>min</sub> ( )			
	V <sub>nom</sub> ( )			
	V <sub>max</sub> ( )			
T <sub>min</sub> ( )	V <sub>min</sub> ( )			
	V <sub>max</sub> ( )			
T <sub>max</sub> ( )	V <sub>min</sub> ( )			
	V <sub>max</sub> ( )			
<b>Measurement Uncertainty (kHz / ppm)</b>				

**Limits:**

Limit (kHz / ppm)	
-------------------	--

Test equipment used: (item numbers)	
-------------------------------------	--

## A.1.3.2 Receiver characteristics

## A.1.3.2.1 Input level range

**Method of measurement:**

See clause 5.3.1.

**Results:**

Ambient temperature: °C Relative humidity: %

Input voltage, V<sub>nom</sub>: V

Test Conditions	RF channel low (GHz)	RF channel mid (GHz)	RF channel high (GHz)
Upper level (dBm) BER=			
Lower level (dBm) BER=			
NOTE: Use the number of columns that are required, depending on how many frequency channels are to be tested.			

**Limits:**

	Limit Level (dBm)	Limit BER
Upper level		
Lower level		

Measurement uncertainty	
-------------------------	--

Test equipment used: (Item numbers)	
-------------------------------------	--

### A.1.3.2.2 Spurious emissions (Rx) - external

#### Method of measurement:

See clause 5.3.2.

#### Limits:

Limits are specified in the *relevant standard*.

#### Results:

The results should be presented by plots.

Annex references should be stated below. An example of a diagram for providing a plot is shown below.

NOTE: If the measurement for "Spurious emissions (Tx) - external" and "Spurious emissions (Rx) - external" can be carried out at the same time the results may be presented in the same plots. In that case only one of these clauses will be used and this fact be clearly declared in the test report.

Ambient temperature:    °C    Relative humidity:    %

Input voltage,  $V_{nom}$ :    V

Frequency (GHz) By plot range	Reference to plot in annex		
	RF channel low (GHz)	RF channel mid (GHz)	RF channel high (GHz)
Measurement Uncertainty (dB)			

#### Limits:

Insert diagram showing spurious emissions(Rx) - external measurements

Example of diagram that can be used for presenting the measurements is presented in figure A.3.

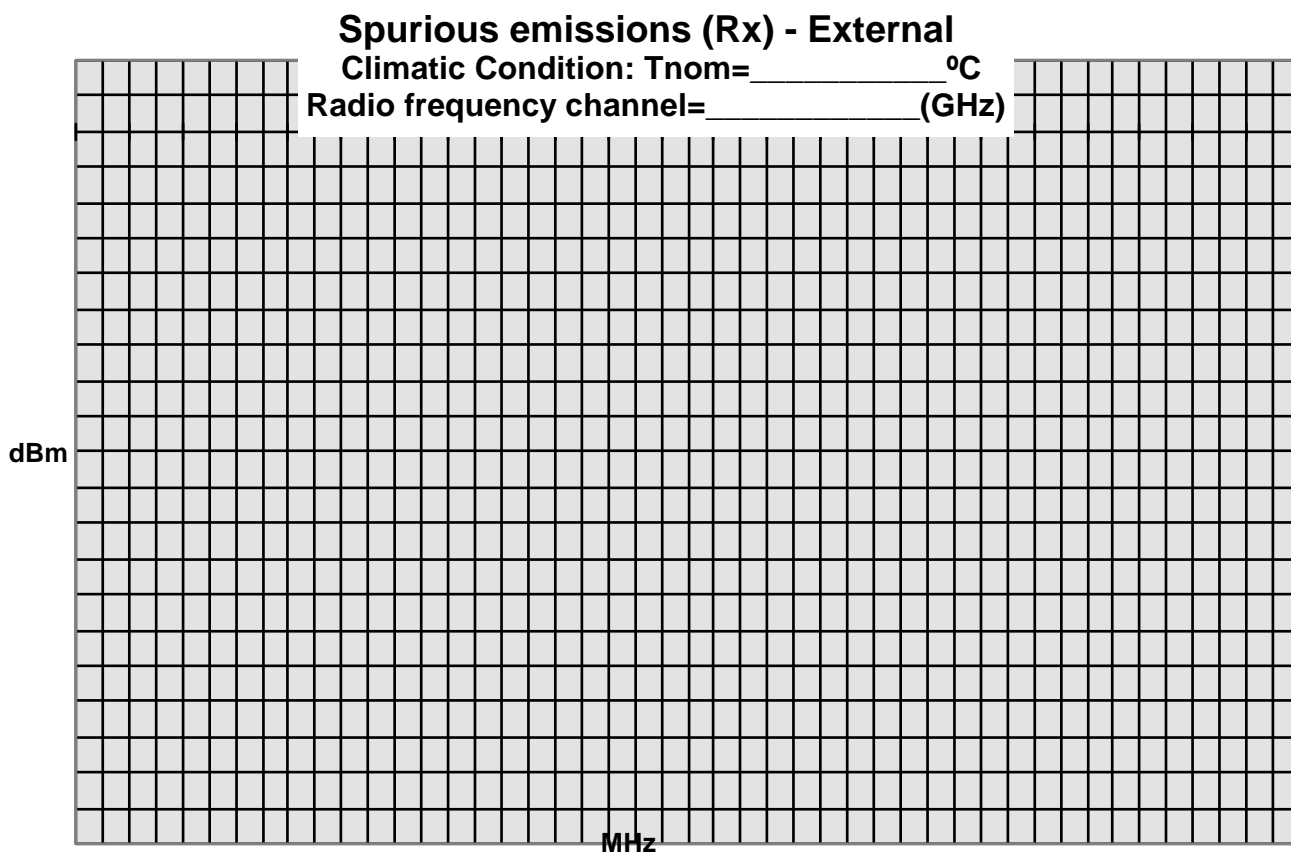


Figure A.3

Measurement uncertainty	
-------------------------	--

Test equipment used: (Item numbers)	
-------------------------------------	--

### A.1.3.3 System performance without diversity

#### A.1.3.3.1 BER vs. Rx signal level

**Method of measurement:**

See clause 5.3.3.1.

**Results:**

The results can be presented in table form.

The relevant test points (BER-values) according to the *relevant standard* should be declared together with the measured received signal level values. Only one frequency channel will normally be tested.

Ambient temperature:    °C    Relative humidity:    %

RF channel frequency:    GHz    Input voltage, V<sub>nom</sub>:    V

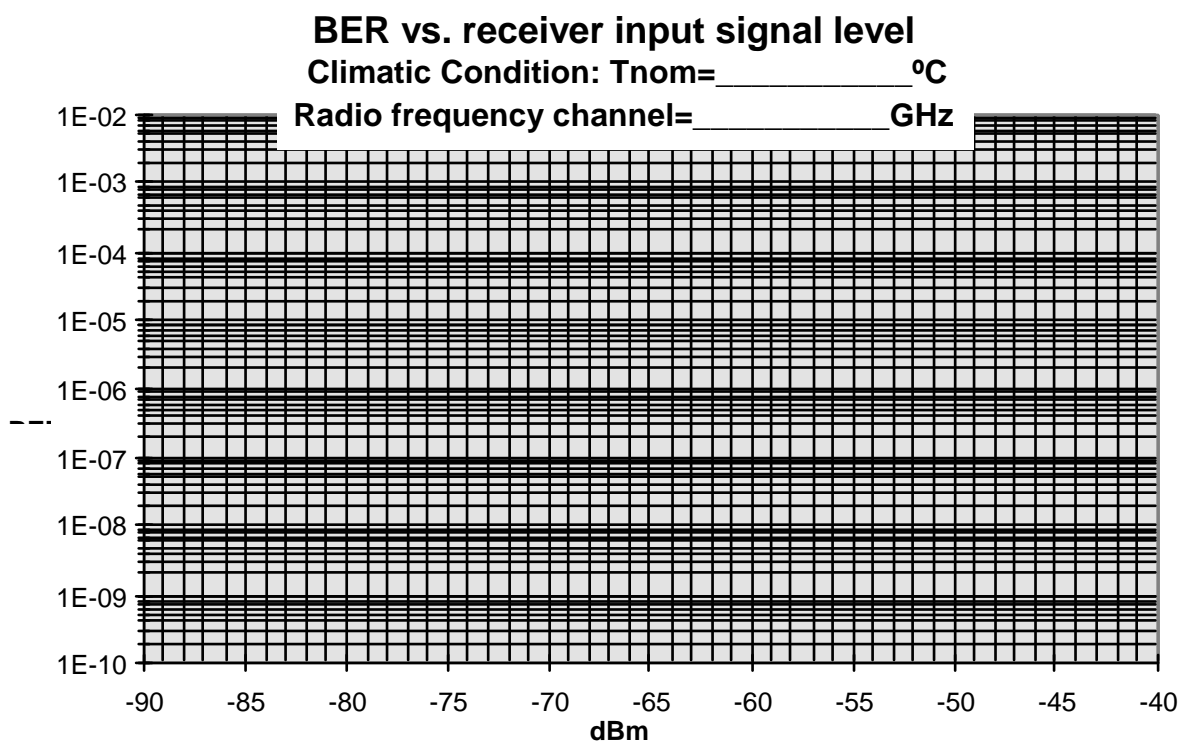
Climatic condition	T <sub>nom</sub> =	T <sub>min</sub> =	T <sub>max</sub> =
Received signal level (dBm) at BER=			
Received signal level (dBm) at BER=			
Received signal level (dBm) at BER=			

**Limits:**

	BER =	BER =	BER =
Limit level (dBm)			

Alternatively, plots may be used and in that case be supplied in the annex and referenced to in the table below.

Figure A.4 is an example of a diagram in which a plot can be presented.



**Figure A.4**

Ambient temperature: °C Relative humidity: %

RF channel frequency: GHz Input voltage, V<sub>nom</sub>: V

Test conditions	Reference to plot in the annex
T <sub>nom</sub> =	
T <sub>min</sub> =	
T <sub>max</sub> =	

<b>Measurement uncertainty</b>	
--------------------------------	--

<b>Test equipment used: (Item numbers)</b>	
--	--



A.1.3.3.2 Interference sensitivity

A.1.3.3.2.1 Co-channel interference sensitivity - external and adjacent channel interference sensitivity

**Method of measurement:**

See clauses 5.3.3.2 and 5.3.3.3.

**Results:**

The results should be presented in table form. Both the results from the co-channel interference and adjacent channel interference measurements should be presented. Two approaches exist and the one which conforms to the *relevant standard* should be used. Only one frequency channel will normally be tested.

**Method 1:**

State the maximum C/I (dB) values measured.

Ambient temperature: °C Relative humidity: %

RF channel frequency: GHz Input voltage,  $V_{nom}$ : V

Bit rate (Mbit/s)	Channel spacing (MHz)	Measured C/I resulting in a degradation from BER = $10^{-6}$ to BER = $10^{-5}$

**Limits:**

<b>C/I Limit (dB)</b>	
-----------------------	--

<b>Measurement uncertainty</b>	
--------------------------------	--

<b>Test equipment used: (Item numbers)</b>	
--	--

**Method 2:**

State the maximum C/I (dB) values measured.

Ambient temperature: °C Relative humidity: %

RF channel frequency: GHz Input voltage,  $V_{nom}$ : V

	RSL @ BER ⇒	RSL @ $10^{-3}$		RSL @ $10^{-6}$	
	Degradation ⇒	1 dB	3 dB	1 dB	3 dB
Bit rate (Mbit/s) ↓	Channel spacing (MHz) ↓				

**Limits:**

	1 dB 10 <sup>-3</sup>	3 dB 10 <sup>-3</sup>	1 dB 10 <sup>-6</sup>	3 dB 10 <sup>-6</sup>
<b>C/I Limit (dB)</b>				

## A.1.3.3.2.2 CW spurious interference

**Method of measurement:**

See clause 5.3.3.4.

**Results**

Maximum registered BER for any CW frequency (according to the measurement methods) should be presented in the table below. CW interferer frequency(ies) and level(s) at actual BER should be presented as well. Only one frequency channel will normally be tested.

Ambient temperature: °C Relative humidity: %

RF channel frequency: GHz Input voltage,  $V_{nom}$ : V

<b>CW spurious interference</b>			
<b>CW interferer frequency (MHz)</b>	<b>Minimum CW interferer level (dBm)</b>	<b>Measured BER</b>	<b>Measured C/I (dB)</b>

**Limits:**

<b>Limit BER at C/I (dB)</b>	<b>BER=</b>	<b>C/I=</b>
------------------------------	-------------	-------------

<b>Measurement uncertainty</b>	
--------------------------------	--

<b>Test equipment used: (Item numbers)</b>	
--	--

## A.1.3.3.3 Distortion sensitivity

**Method of measurement:**

See clause 5.3.3.5.

**Results:**

The measurement results should be presented in plots provided in the annex. References to the plots should be given in the table below. Only one frequency channel will normally be tested.

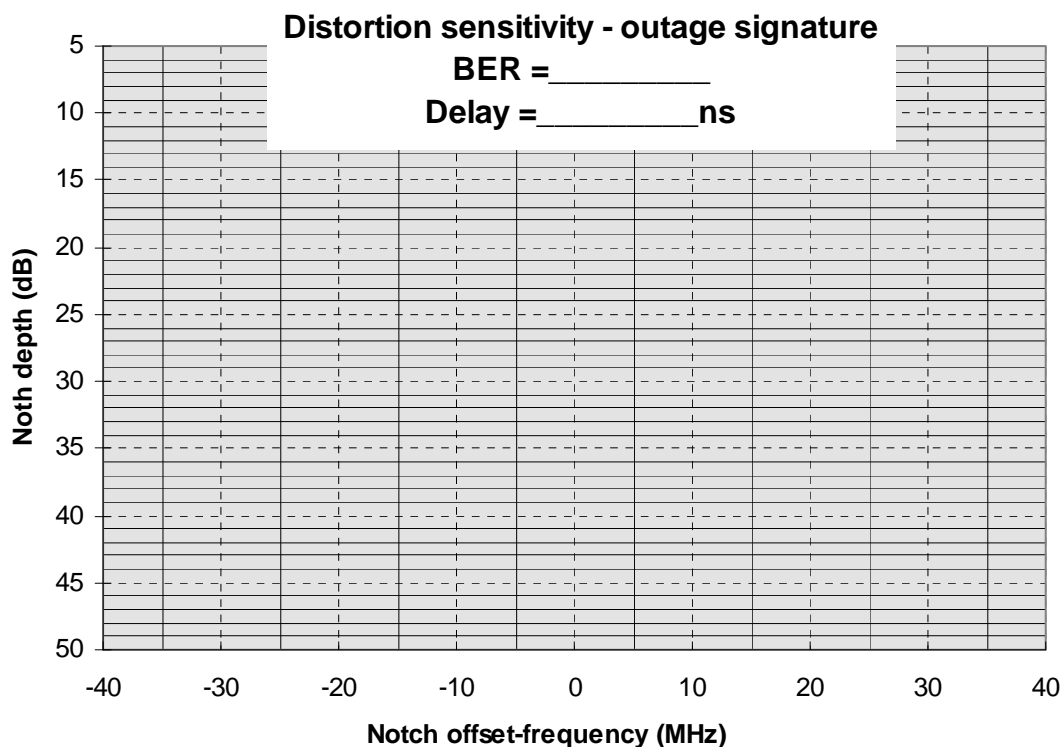
Both minimum phase and non-minimum phase signatures can be presented in the same diagram.

Ambient temperature: °C Relative humidity: %

RF channel frequency: GHz Input voltage,  $V_{nom}$ : V

<b>Test conditions</b>	<b>Reference to plot in the annex</b>
Outage signature	
Return signature	

Figure A.5 is an example of a diagram in which signature curves can be presented.



**Figure A.5**

Measurement uncertainty	
-------------------------	--

Test equipment used: (Item numbers)	
-------------------------------------	--

### A.1.3.4 System performance with diversity

#### A.1.3.4.1 BER vs. Rx signal level

NOTE: In this clause BER is the acronym for Bit Error Ratio.

**Method of measurement:**

See clause 5.3.4.1.

**Results:**

The results can be presented in table form.

The relevant test points (BER-values) according to the *relevant standard* should be declared together with the measured received signal level values. Only one direction (go or return) will normally be tested.

Ambient temperature:    °C    Relative humidity:    %

RF channel frequency:    GHz    Input voltage,  $V_{nom}$ :    V

Climatic condition	T <sub>nom</sub> =	T <sub>min</sub> =	T <sub>max</sub> =
Received signal level (dBm) at BER=			
Received signal level (dBm) at BER=			
Received signal level (dBm) at BER=			

Alternatively, plots may be used and in that case be supplied in the annex and referenced to in the table below.

Figure A.6 is an example of a diagram in which a plot can be presented.

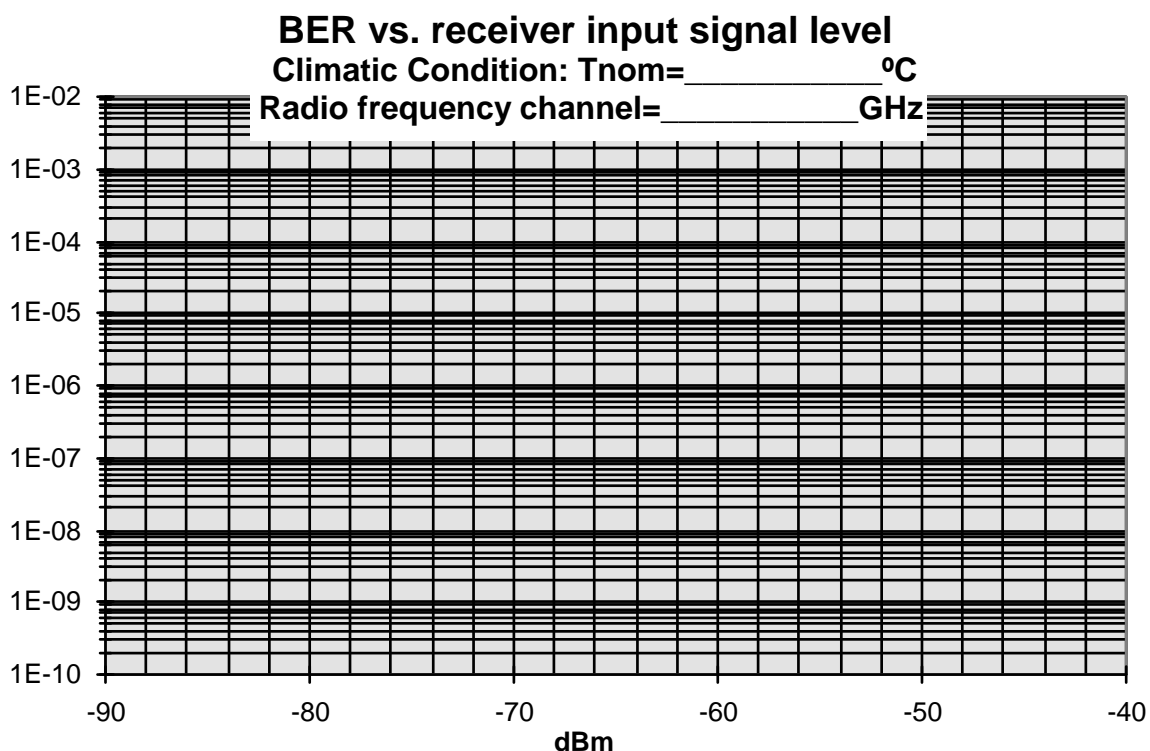


Figure A.6

Ambient temperature: \_\_\_\_\_ °C Relative humidity: \_\_\_\_\_ %

RF channel frequency: \_\_\_\_\_ GHz Input voltage, V<sub>nom</sub>: \_\_\_\_\_ V

Test conditions	Reference to plot in the annex
T <sub>nom</sub>	
T <sub>min</sub>	
T <sub>max</sub>	

**Limiting values:**

Enhanced input level limits for specified BER values:	
For IF or baseband combining systems	> 2,5 dB
For RF combining systems	> 1,5 dB
For baseband switch systems	no improvement

Measurement uncertainty	
-------------------------	--

Test equipment used: (Item numbers)	
-------------------------------------	--

#### A.1.3.4.2 Interference sensitivity

##### A.1.3.4.2.1 Co-channel interference sensitivity

See clause 5.3.4.2.

##### A.1.3.4.2.2 Adjacent channel interference sensitivity

See clause 5.3.4.2.

#### A.1.3.4.3 Distortion sensitivity

See clause 5.3.4.3.

---

## A.2 Photographs of EUT

Photographs of the equipment are to be provided as part of the test report.

As a minimum the photographs should be of:

- 1) assembly of units or parts;
- 2) front of unit (showing controls, labelling, etc.);
- 3) rear of unit (showing antenna connector, labelling, etc.).

If the label or identifying mark is affixed on a surface other than 2) or 3) above, a photograph of this should be provided.

The equipment (**only after type testing is completed**) should be opened and photographs of the internal construction should be made.

The photographs should be colour plate and of a size not less than 170 mm x 120 mm.

Each photograph should be clearly identified and mounted on a separate page.

---

## A.3 Test equipment used for tests

In the following table the test equipment used for the test should be listed by the test laboratory.

In each separate part of the test report the used test equipment should be stated. The instruments are then identified by a number which refers to the table below.

No.	Test equipment	Type	Manufacturer	Serial number	Calibration due date
01					
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

---

## A.4 Additional information supplementary to the test report

Remarks:

.....

.....

.....

.....

## Annex B (informative): Distortion sensitivity for diversity receivers

### Objective:

The test is applicable to systems which optionally use diversity combining techniques.

This test verifies the equipment immunity against propagation distortion, extending the concept of "signature" also to a radio receiver with diversity technique protection, for obtaining a so called "pseudo-signature".

The test set-up is suitable for equipment with IF interface at modulator output; however, it could be extended to RF level, provided that RF fading simulators are available.

The measurements should be made applying a two rays fading simulator at RF level for each of the two receiver inputs (main and diversity).

Some kind of simplification could be made according to the practical implementation of the diversity receiver.

### Test configuration:

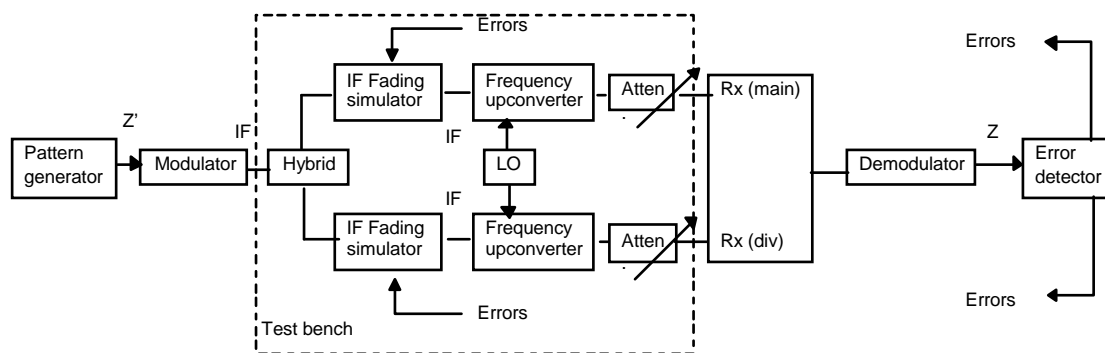


Figure B.1: Test configuration

### Test instruments:

- 1) pattern generator/error detector;
- 2) fading simulator.

### Test procedure:

Connect the pattern generator output to the BB Tx input. Control the two fading simulators (delay 6,3 ns) in order to produce the multipath distortion (a notch). Produce families of pseudo-signatures on the basis of errors detected at BB Rx output in the following condition:

- a) Control the fading simulator on the main Rx path in order to have flat condition (no distortion); control the fading simulator on the diversity Rx path in order to have a notch: vary the frequency of the notch (at 1 MHz step), increasing and decreasing its frequency in the modulated signal band; vary the depth of the notch(es) from 10 dB to 30 dB in 1 dB steps, with minimum and non-minimum phase condition. Control the attenuation of the variable attenuators, and repeat the measurements at different level of received signal.
- b) Interchange the situation, having a notch on the main Rx path and a flat condition on the diversity Rx path.
- c) Control the fading simulator on the main Rx path and on the diversity Rx path in order to have notches; vary the frequency of one notch (at 1 MHz step) increasing and decreasing frequency in the modulated signal band and keeping the second in a fixed position, and vary the depth of the notch(es) from 10 dB to 30 dB in 1 dB steps, with minimum and non-minimum phase condition. Control the attenuation of the variable attenuators and repeat the measurements at different level of received signal.

---

## Annex C (informative): Bibliography

- ETSI EN 301 390: "Fixed Radio Systems; Point-to-point and Multipoint Systems; Unwanted emissions in the spurious domain and receiver immunity limits at equipment/antenna port of Digital Fixed Radio Systems".
- [ERC/DEC\(97\)10 \(withdrawn 2004-03\)](#): "ERC Decision on the mutual recognition of conformity assessment procedures, including marking of radio equipment and radio terminal equipment".



## Annex D (informative): Change history

Date	Version	Information about changes
September 1999	1.1.2	First publication in support of " <i>type approval</i> " regime of " <i>mutual recognition, within CEPT, of the results of conformance tests on equipment carried out in individual CEPT countries</i> " according to ERC/DEC/(97)10 (see bibliography)
March 2025	2.2.1	Formal alignment of terminology (including deletion of Annex 1) to: <ul style="list-style-type: none"> <li>• the current EU regime provided by Directive 2014/53/EU [i.1],</li> <li>• the major use in conjunction to EN 302 217-2 [9].</li> <li>• improved description of interference tests.</li> </ul> Tests limited to "radio interfaces" removing references to EMC tests.

---

## History

<b>Document history</b>		
V1.1.2	September 1999	Publication
V2.1.0	April 2025	ENAP process AP 20250701: 2025-04-03 to 2025-07-02