Test Report
19-1-0137403T02a

Deutsche Akkreditierungsstelle
D-PL-12047-01-01
D-PL-12047-01-03
D-PL-12047-01-04

Number of pages:	38	**Date of Report:**	2020-Dec-04
Testing company:	CETECOM GmbH Im Teelbruch 116 45219 Essen Germany Tel. + 49 (0) 20 54 / 95 19-0 Fax: + 49 (0) 20 54 / 95 19-150	**Applicant:**	Bosch Healthcare Solutions GmbH
Test Object / Tested Device(s):	**System for quantitative measurement of fractional nitric oxide (FeNO) in human breath, Vivatmo pro (Base Station)**		
FCC ID:	2AVQ9VMPBS1	**IC:**	25928-VMPBS1
Testing has been carried out in accordance with:	**Title 47 CFR, Chapter I** **FCC Regulations, Subchapter A** §15.247 (DTS) **ISED-Regulations** RSS-Gen, Issue 5 RSS 247, Issue 2 Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
Tested Technology:	Bluetooth		
Test Results:	**☒ The EUT complies with the requirements in respect of all parameters subject to the test.** The test results relate only to devices specified in this document		

Signatures:

Digital unterschrieben von B.Sc. Mohamed Ahmed
DN: cn=B.Sc. Mohamed Ahmed, o=Cetecom GmbH, ou=RC/EMC, email=mohamed.ahmed@cetecom.com, c=DE
Datum: 2020.12.04 16:28:24 +01'00'

Dipl.-Ing. Niels Jeß	B.Sc. Mohamed Ahmed
Head of Compliance Testing	Test manager
Authorization of test report	Responsible of test report

Table of Contents

Table of Annex			
Annex No.	**Contents**	**Reference Description**	**Total Pages**
Annex 1	Test result diagrams	**CETECOM_TR19_1_0137403T02a_A1**	72
Annex 2	Internal photographs of EUT	**Please refer to external document provided by customer**	--
Annex 3	External photographs of EUT	**CETECOM_TR19_1_0137401T05a_A3**	6
Annex 4	Test set-up photographs	**CETECOM_TR19_1_0137401T05a_A4**	8
The listed attachments are separate documents.			

1 General information

1.1 Disclaimer and Notes

The test results of this test report relate exclusively to the test item specified in this test report as specified in chapter 2.7. CETECOM does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM.
The testing service provided by CETECOM has been rendered under the current "General Terms and Conditions for CETECOM".
CETECOM will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.
Under no circumstances does the CETECOM test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.
Under no circumstances does the CETECOM test report include or imply any product or service warranties from CETECOM, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CETECOM.
All rights and remedies regarding vendor's products and services for which CETECOM has prepared this test report shall be provided by the party offering such products or services and not by CETECOM.
In no case this test report can be considered as a Letter of Approval.

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at CETECOM.

Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

1.1. Summary of Test Results

The EUT integrates a Bluetooth transmitter. Other implemented wireless technologies were not considered within this test report.

Test case	Reference Clause FCC ☒	Reference Clause ISED ☒	Page	Remark	Result
Duty cycle	ANSI 63.10:2013	-	12	--	PASS
Emission Bandwidth 20 dB	§15.247 (a) (1)	RSS-247, Issue 2, § 5.1,a	15	--	PASS
Occupied Channel Bandwidth 99%	2.1049(h)	RSS-Gen, Issue 5, § 6.6	19	--	PASS
Carrier Frequency Separation	§15.247 (a) (1)	RSS-247, Issue 2, § 5.1,b	16	--	PASS
Number of Hopping Channels	§15.247 (a) (1) (iii)	RSS-247, Issue 2, § 5.1,d	17	--	PASS
Time of Occupancy	§15.247 (a) (1) (iii)	RSS-247, Issue 2, § 5.1,d	18	--	PASS
Peak output power (Sweep)	§15.247(b)(1)	RSS-247, Issue 2: 5.1 (b)	13	--	PASS
Transmitter Peak output power radiated	§15.247(b)(4)	RSS-247, Issue 2: 5.1 (b)	--	NP	--
Emissions in non-restricted frequency bands	§15.247(d)	RSS-247, § 5.5	20	--	PASS
Radiated Band-Edge emissions	§15.247(d)	RSS-247, § 5.5 RSS-Gen: Issue 5: §8.9 Table 5+6+7	30	--	PASS
Radiated field strength emissions below 30 MHz	§15.205(a) §15.209(a)	RSS-Gen: Issue 5 §8.9 Table 6	22	--	PASS
Radiated field strength emissions 30 MHz – 1 GHz	§15.209 §15.247(d)	RSS-Gen: Issue 5 §8.9 Table 5 RSS-247, § 5.5	26	--	PASS
Radiated field strength emissions above 1 GHz	§15.209(a) §15.247(d)	RSS-Gen: Issue 5: §8.9 Table 5+7 RSS-247, § 5.5	28	--	PASS
AC-Power Lines Conducted Emissions	§15.207	RSS-Gen Issue 5: § 8.8, Table 4	32	--	PASS

PASS	The EUT complies with the essential requirements in the standard.
FAILED	The EUT does not comply with the essential requirements in the standard.
NP	The test was not performed by the CETECOM Laboratory.
N/A	Not applicable

*The calculation of the measurement uncertainty shows compliance with the "maximum measurement uncertainties" of the tested standard and therefore for result evaluation the stated uncertainties will not be additionally added to the measured results.

1.2. Summary of Test Methods

Test case	Test method
Duty-Cycle	ANSI 63.10:2013, §11.6(b)
Emission Bandwidth 20 dB	ANSI C63.10:2013
Occupied Channel Bandwidth 99%	ANSI C63.10:2013, §6.9.3
Carrier Frequency Separation	ANSI C63.10:2013
Number of Hopping Channels	ANSI C63.10:2013
Time of Occupancy	ANSI C63.10:2013
Peak output power (Sweep)	ANSI 63.10:2013, §6.101
Power spectral density	ANSI C63.10:2013, §6.9.2, §11.8
Emissions in non-restricted frequency bands	ANSI C63.10:2013, §11.11, §6.10.5
Radiated Band-Edge emissions	ANSI C63.10-2013; “Marker-Delta method”, §6.10.5, §11.13
Transmitter Peak output power radiated	Result calculated with measured conducted RF-power value and stated/measured antenna gain for band of interest
Radiated field strength emissions below 30 MHz	ANSI C63.10-2013 §6.3, §6.4
Radiated field strength emissions 30 MHz- 1 GHz	ANSI C63.4-2014 §8.2.3, ANSI C63.10-2013 §6.3, § 6.5
Radiated field strength emissions above 1 GHz	ANSI C63.4-2014 §8.3, ANSI C63.10-2013 §6.3, § 6.6
AC-Power Lines Conducted Emissions	ANSI C63.4-2014 §7, ANSI C63.10-2013 § 6.2

And reference also to Test methods in KDB558074

2 Administrative Data

2.1 Identification of the Testing Laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing laboratory:	Dipl.-Ing. Ninovic Perez
Accreditation scope:	DAkkS Webpage
Test location:	CETECOM GmbH; Im Teelbruch 116; 45219 Essen - Kettwig

2.2 General limits for environmental conditions

Temperature:	22±2 °C
Relative. humidity:	45±15% rH

2.3 Test Laboratories sub-contracted

Company name:	--

2.4 Organizational Items

Order No.:	03
Responsible test manager:	M.Sc. Patrick Marzotko
Receipt of EUT:	2019-Nov-06
Date(s) of test:	2020-Aug-20 – 2020-Sep-30
Version of template:	14.3

2.5 Applicant's details

Applicant's name:	Bosch Healthcare Solutions GmbH
Address:	Stuttgarter Str. 130 71332 Waiblingen Baden-Württemberg Germany
Contact Person:	Markus Thürsam
Contact Person's Email:	Markus.Thuersam@de.bosch.com

2.6 Manufacturer's details

Manufacturer's name:	Bosch Healthcare Solutions GmbH
Address:	Please refer to applicant's details

2.7 EUT: Type, S/N etc. and short descriptions used in this test report

Short description*)	PMT Sample No.	EUT	Type	S/N	HW status	SW status
EUT 1	19-1-01374S27	Vivatmo pro (Base Station)	System for quantitative measurement of fractional nitric oxide (FeNO) in human breath	b827eb797911	F09G100168	1.4.0
EUT 2	19-1-01374S23	Vivatmo pro (Base Station)	System for quantitative measurement of fractional nitric oxide (FeNO) in human breath	b827eb336d24	F09G100168	1.4.0

*) EUT short description is used to simplify the identification of the EUT in this test report.

2.8 Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

Short description*)	PMT Sample No.	Auxiliary Equipment	Type	S/N	HW status	SW status
AE 1	19-1-01374S24_C01	Power Supply Vivatmo pro	UE36LCP-240150SPA	--	--	--
AE 2	--	CAT6, 1m	Ethernet Cable	--	--	--
AE 3	--	Laptop	DELL Latitude E6430	CTC522013	--	Windows 7
AE 4	--	SanDisk USB Stick	Cruzer Dial SDCZ57-016G	--	16GB	--
AE 5	--	SanDisk USB Stick	Cruzer Dial SDCZ57-016G	--	16GB	--

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

2.9 Connected cables

Short description*)	PMT Sample No.	Cable type	Connectors	Lenght
CAB 1	--	Ethernet Cable	--	1m

*) CAB short description is used to simplify the identification of the connected cables in this test report.

2.10 EUT set-ups

set-up no.*)	Combination of EUT and AE	Description
1	EUT 2 + AE 1 + AE 2 +(AE 3)** + AE 4 + AE 5	Used for Radiated measurements
2	EUT 1 + AE 1 + AE 2 + AE 3	Used for Conducted measurements

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

**) AE 3 was placed outside the Chamber after setting the Test mode

2.11 EUT operation modes

EUT operating mode no.*1)	Operating modes	Additional information
op. 1	Bluetooth BDR/EDR Modes* TX-Fixed Channel (Modulated)	The EUT was put to Fixed Channel (Modulated) Continuous transmissions mode. We refer to applicants information/papers for details about necessary commands.
op. 2	Bluetooth BDR/EDR Modes* Normal operating mode	The EUT was put into normal hopping mode. We refer to applicants information/papers for details about necessary commands.

*1) EUT operating mode no. is used to simplify the test report.

2.12 Test Software

For setting the right test mode a terminal tool **putty v0.74** saved on Laptop DELL Latitude E6430 CTC522013 was used to enter commands in the document provided by the customer, HCI commands for BT TX test.pdf

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Product name	Vivatmo pro (Base Station)		
Kind of product	System for quantitative measurement of fractional nitric oxide (FeNO) in human breath		
Firmware	☐ for normal use	☒ Special version for test execution	
	☒ AC Mains	single Line (L1/N) 120 V 60 Hz	
	☐ DC Mains	-	
	☐ Battery	-	
Operational conditions	T_{nom} = +23 °C	T_{min} = +5 °C	T_{max} = +40 °C
EUT sample type	**Production**		
Weight	1350 g		
Size	265 x 213 x 160 mm		
Interfaces/Ports	Ethernet, USB		
For further details refer Applicants Declaration & following technical documents			
For further details regarding radio parameters, please refer to Bluetooth Core Specification			

3.2 Detailed Technical data of Main EUT as Declared by Applicant

Frequency Band	2.4 GHz ISM Band (2400 MHz - 2483.5 MHz)
Number of Channels (USA/Canada -bands)	79
Nominal Channel Bandwidth	1 MHz
Type of Modulation | Data Rate	☒ GFSK **|** 1 Mbit / s ☒ 8DPSK **|** 3 Mbit / s
Other installed options	☒ b/g/n mode (not tested within this report) ☒ Bluetooth LE (not tested within this report)
Max. Conducted Output Power	GFSK: **10.3** dBm
	8DPSK: **9.1** dBm
EIRP Power (Calculated EIRP)	GFSK: **10.3** dBm + **1.5** dBi = **11.8** dBm
	8DPSK: **9.1** dBm+ **1.5** dBi = **10.6** dBm
Antenna Type(s)	Chip Antenna (declaredy by the customer, see datasheet)
Antenna Gain(s)	1.5 dBi
FCC label attached	No
Test firmware / software and storage location	terminal tool putty v0.74 saved on “C:\Users\InstallAdmin\Desktop” of Laptop DELL Latitude E6430 / CTC522013
For further details refer Applicants Declaration & following technical documents	

Description of Reference Document (supplied by applicant)	Version	Total Pages
AEL-A04 LTCC Antenna Data Sheet	**A2450M000000S007**	**9**
Dukumentation für Prüflinge für Cetecom 19-1-01374Q01	**3.0**	**18**

3.3 Modifications on Test sample

Additions/deviations or exclusions	--

4 Measurements

4.1 Duty-Cycle

Testing method:

The necessary duty-cycle correction factor is determined on nominal conditions on middle channel only. It is assumed that no noticeable changes occur when tested on other channels or climatic conditions.

EUT settings
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

A special firmware program is used for test purposes. In opposite to normal operating mode a higher duty-cycle is set in order to facilitate the measurements. This is maximized at the extent possible.

The necessary duty-cycle correction factor is determined on nominal conditions on one channel in each operable frequency-band. It is assumed that no noticeable changes occur when tested on other channels or climatic conditions. The Duty-Cycle was constant, means without variations.

Formula to calculate Duty-Cycle:

Duty cycle calculations: $x = {TX_{ON}}/{(TX_{ON} + TX_{OFF})}$	Duty cycle factor: DC=	Regarding power: $10 * log({1}/{x})$ dB Regarding field strength: $20 * log({1}/{x})$ dB

☒ The results were corrected in order to evaluate for worst-case result each time when average values are necessary for example average radiated emissions or similar
☒ No correction necessary: Duty-Cycle > 98%

4.1.1 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.1.2 Result

Mode	Channel	Duty-Cycle [%]	Duty-Cycle correction Power [dB]	Duty-Cycle correction Field Strength [dB]	Correction
Single, Non-Hopping 8PSK	0	100	--	--	Not Necessary
Single, Non-Hopping GFSK	39	100	--	--	Not Necessary
Single, Non-Hopping GFSK	78	100	--	--	Not Necessary

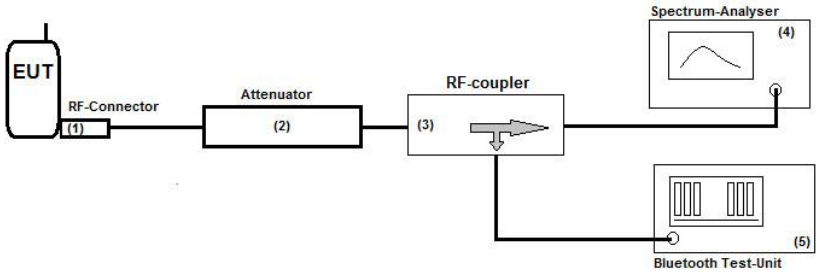
*) Mode not available

4.2 Peak output power (Sweep)

4.2.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then on the RF-coupler the coupled RF-path is connected to a Bluetooth test unit communication tester (5). The direct RF-path is connected to the spectrum – analyzer (4) for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Measurement is made using Rohde & Schwarz TS8997 test system.

EUT settings
Hopping mode was switched offso fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate

4.2.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.2.3 Limit

Frequency Range [MHz]	Limit [W]	Limit [dBm]	Detector	RBW / VBW [MHz]
2400 - 2483.5	1	30	MaxPeak	3 / 10

4.2.4 Result

Mode	Channel	Frequency [MHz]	Max Peak Power [dBm]	Result
Single, non-Hopping [GFSK]	0	2402	6.0	PASS
Single, non-Hopping [GFSK]	39	2441	8.9	PASS
Single, non-Hopping [GFSK]	78	2480	10.3	PASS
Single, non-Hopping [8PSK]	0	2402	4.2	PASS
Single, non-Hopping [8PSK]	39	2441	4.3	PASS
Single, non-Hopping [8PSK]	78	2480	4.3	PASS

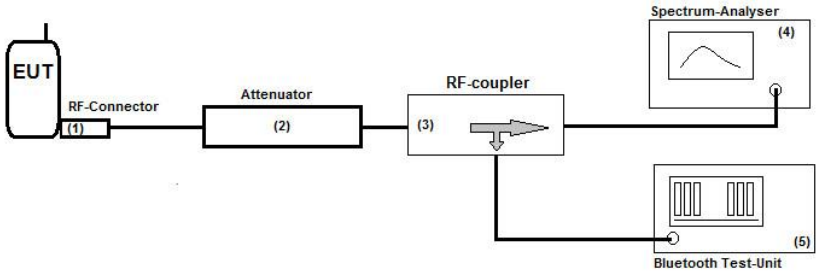
Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

4.3 Emission Bandwidth 20 dB

4.3.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then on the RF-coupler the coupled RF-path is connected to a Bluetooth test unit communication tester (5). The direct RF-path is connected to the spectrum – analyzer (4) for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Measurement is made using Rohde & Schwarz TS8997 test system.

EUT settings
For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

4.3.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.3.3 Limit

Limit [kHz]	Detector [MaxHold]	RBW / VBW [kHz]
--	MaxPeak	10 / 30

4.3.4 Result

Mode	Channel	Frequency [MHz]	20 dB bandwidth [MHz]	Result
Single, non-Hopping [GFSK]	0	2402	1.395000	PASS
Single, non-Hopping [GFSK]	39	2441	0.940000	PASS
Single, non-Hopping [GFSK]	78	2480	0.940000	PASS
Single, non-Hopping [GFSK]	0	2402	1.380000	PASS
Single, non-Hopping [GFSK]	39	2441	1.375000	PASS
Single, non-Hopping [GFSK]	78	2480	1.395000	PASS

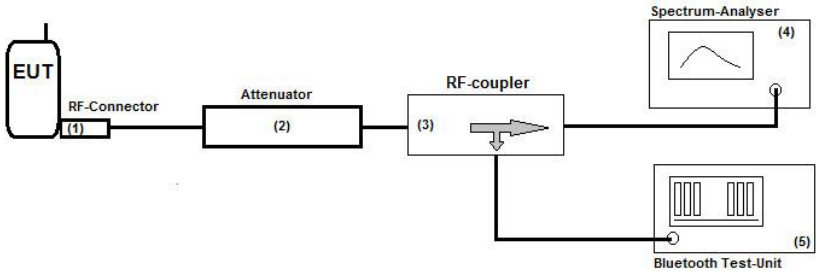
Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

4.4 Carrier Frequency Separation

4.4.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then on the RF-coupler the coupled RF-path is connected to a Bluetooth test unit communication tester (5). The direct RF-path is connected to the spectrum – analyzer (4) for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Measurement is made using Rohde & Schwarz TS8997 test system.

EUT settings
For FHSS-systems hopping mode was switched-on.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

4.4.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.4.3 Limit

Limit [MHz]	Detector [MaxHold]	RBW / VBW [kHz]
>= 0.025 or 2/3 of the 20 dB bandwidth	MaxPeak	300 / 300

4.4.4 Result

Mode	Channel	Frequency [MHz]	Frequency Separation [MHz]	Result
All Channels Hopping mode, GFSK	0	2402	0.980198	PASS
All Channels Hopping mode, GFSK	39	2441	0.980198	PASS
All Channels Hopping mode, GFSK	78	2480	1.009900	PASS

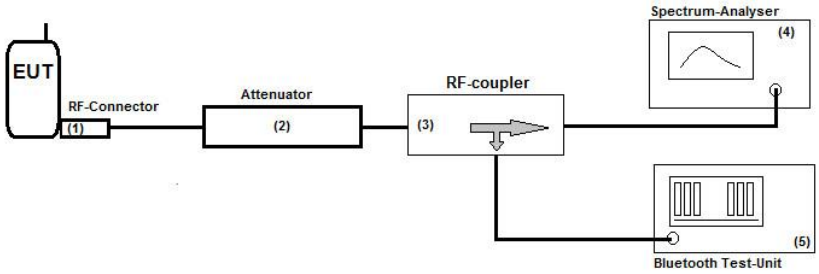
Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

4.5 Number of Hopping Channels

4.5.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then on the RF-coupler the coupled RF-path is connected to a Bluetooth test unit communication tester (5). The direct RF-path is connected to the spectrum – analyzer (4) for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Measurement is made using Rohde & Schwarz TS8997 test system.

EUT settings
For FHSS-systems hopping mode was switched-on.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

4.5.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.5.3 Limit

Limit [number]	Detector [MaxHold]	RBW / VBW [kHz]
15	MaxPeak	200 / 200

4.5.4 Result

Mode	Number of hopping channels	Result
All Channels Hopping mode, GFSK	79	PASS

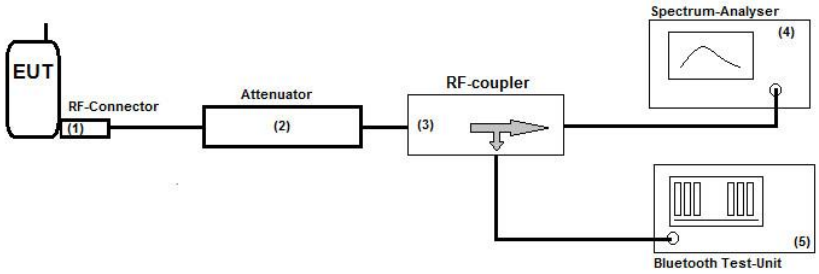
Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

4.6 Time of Occupancy

4.6.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then on the RF-coupler the coupled RF-path is connected to a Bluetooth test unit communication tester (5). The direct RF-path is connected to the spectrum – analyzer (4) for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Measurement is made using Rohde & Schwarz TS8997 test system.

EUT settings
For FHSS-systems hopping mode was switched-on.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

4.6.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.6.3 Limit

Limit [s]	Detector [MaxHold]	RBW / VBW [kHz]
<= 0.4	MaxPeak	200 / 200

4.6.4 Result

Mode	Transmission time [ms]	Time of occupancy [ms]	Result
All Channels Hopping mode, GFSK	0.141	90.24	PASS
All Channels Hopping mode, GFSK	0.140	29.82	PASS
All Channels Hopping mode, GFSK	0.141	18.05	PASS

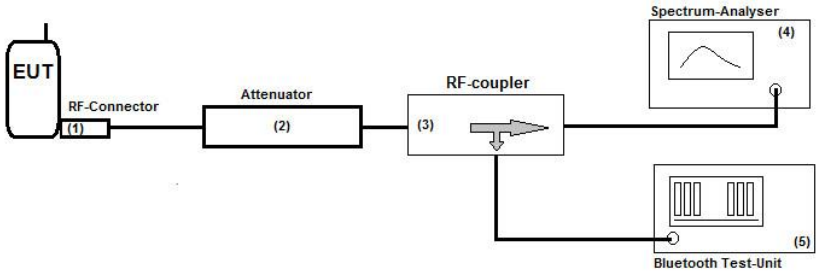
Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

4.7 Occupied Channel Bandwidth 99%

4.7.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then on the RF-coupler the coupled RF-path is connected to a Bluetooth test unit communication tester (5). The direct RF-path is connected to the spectrum – analyzer (4) for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Measurement is made using Rohde & Schwarz TS8997 test system.

EUT settings
For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

4.7.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.7.3 Limit

When the occupied bandwidth limit is not stated in the applicable reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

4.7.4 Result

Mode	Channel	Frequency [MHz]	99% Occupied bandwidth [MHz]
Single, non-Hopping [GFSK]	0	2402	1.240000
Single, non-Hopping [GFSK]	39	2441	0.925000
Single, non-Hopping [GFSK]	78	2480	0.925000
Single,non-Hopping [8PSK]	0	2402	1.230000
Single,non-Hopping [8PSK]	39	2441	1.235000
Single,non-Hopping [8PSK]	78	2480	1.250000

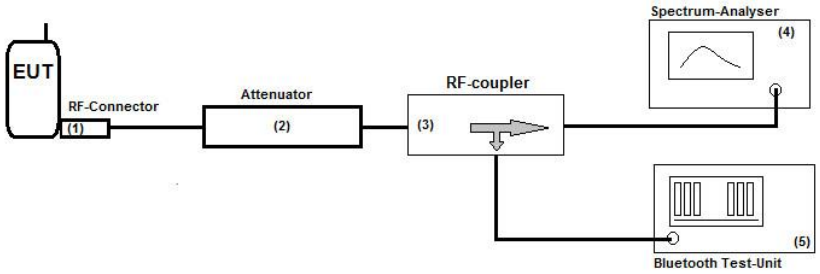
Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

4.8 Emissions in non-restricted frequency bands

4.8.1 Description of the general conducted test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then on the RF-coupler the coupled RF-path is connected to a Bluetooth test unit communication tester (5). The direct RF-path is connected to the spectrum – analyzer (4) for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Measurement is made using Rohde & Schwarz TS8997 test system.

The measurements were performed with the RBW set to 100 kHz & maximum carrier level was indicated with MAX-Hold positive peak detector using markers. Then a frequency line was set 20 or 30 dB below this measured maximum carrier level.

Then using RBW 100 kHz & spectrum analyzer span from 150 kHz to 25 GHz in three steps spurious emissions were measured with MAX-Hold positive peak detector.

The sweep time set as long as necessary to capture the full signal burst per hopping channel. The burst on-period is captured by setting appropriate markers in the rising and falling edges.

EUT settings
Fixed Channel Mode:
For FHSS-systems Hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked. e.g. data rates which EUT can operate.

Hopping Mode:
For FHSS-systems Hopping mode was switched- ON so emissions from hopping channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked. e.g. data rates which EUT can operate.

4.8.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.8.3 Limit

Frequency Range [MHz]	Limit [dBc]
0.15 – 25000	-20 / -30

4.8.4 Result

Maximum Level Peak [dBc]

Mode	Channel	Frequency [MHz]	Result
Single, non-Hopping [GFSK]	0	2402	PASS
Single, non-Hopping [GFSK]	39	2441	PASS
Single, non-Hopping [GFSK]	78	2480	PASS
Single, non-Hopping [8PSK]	0	2402	PASS
Single, non-Hopping [8PSK]	39	2441	PASS
Single, non-Hopping [8PSK]	78	2480	PASS

Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

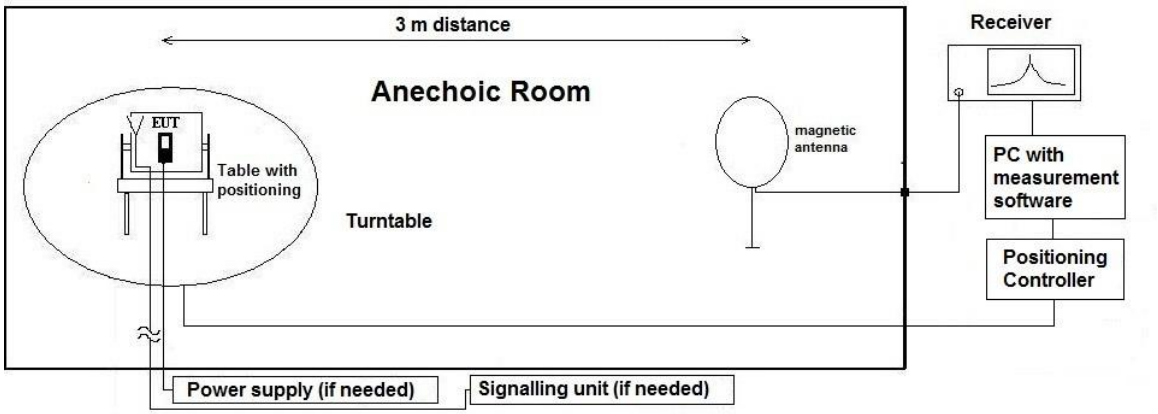
4.9 Radiated field strength emissions below 30 MHz

4.9.1 Description of the general test setup and methodology, see below example:

Evaluating the radiated field emissions are done first by an exploratory emission measurement and a final measurement for most critical frequencies determined.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter "General Limit - Radiated field strength emissions below 30 MHz". The tests are performed in the semi anechoic room recognized by the regulatory commission.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Exploratory, preliminary measurements
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (step 90°, range 0°to 360°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT), the emission spectrum was recorded.

The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by main-taining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position).

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$

$M = L_T - E_C$

AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
E_C = Electrical field – corrected value
E_R = Receiver reading
G_A = Gain of pre-amplifier (if used)
L_T = Limit
M = Margin

All units are dB-units, positive margin means value is below limit.

4.9.2 Measurement Location

Test site	120902 – SAC – Radiated Emission < 1GHz

Correction factors due to reduced meas. distance (f< 30 MHz):

The used correction factors when the measurement distance is reduced compared to regulatory measurement distance, are calculated according Extrapolation formulas valid for EUT's with maximum dimension of 0.625xLambda. Formula 2+3+4 as presented in ANSI C63.10, Chapter 6.4.4 are used for the calculations of proper extrapolation factors

Frequency -Range	f [kHz/MHz]	Lambda [m]	Far-Field Point [m]	Distance Limit accord. 15.209 [m]		1st Condition (dmeas< Dnear-field)	2'te Condition (Limit distance bigger dnear-field)	Distance Correction accord. Formula
	9.00E+03	33333.33	5305.17			fullfilled	not fullfilled	-80.00
	1.00E+04	30000.00	4774.65			fullfilled	not fullfilled	-80.00
	2.00E+04	15000.00	2387.33			fullfilled	not fullfilled	-80.00
	3.00E+04	10000.00	1591.55			fullfilled	not fullfilled	-80.00
	4.00E+04	7500.00	1193.66			fullfilled	not fullfilled	-80.00
	5.00E+04	6000.00	954.93			fullfilled	not fullfilled	-80.00
	6.00E+04	5000.00	795.78			fullfilled	not fullfilled	-80.00
	7.00E+04	4285.71	682.09			fullfilled	not fullfilled	-80.00
	8.00E+04	3750.00	596.83	**300**		fullfilled	not fullfilled	-80.00
	9.00E+04	3333.33	530.52			fullfilled	not fullfilled	-80.00
kHz	1.00E+05	3000.00	477.47			fullfilled	not fullfilled	-80.00
	1.25E+05	2400.00	381.97			fullfilled	not fullfilled	-80.00
	2.00E+05	1500.00	238.73			fullfilled	fullfilled	-78.02
	3.00E+05	1000.00	159.16			fullfilled	fullfilled	-74.49
	4.00E+05	750.00	119.37			fullfilled	fullfilled	-72.00
	4.90E+05	612.24	97.44			fullfilled	fullfilled	-70.23
	5.00E+05	600.00	95.49			fullfilled	not fullfilled	-40.00
	6.00E+05	500.00	79.58			fullfilled	not fullfilled	-40.00
	7.00E+05	428.57	68.21			fullfilled	not fullfilled	-40.00
	8.00E+05	375.00	59.68			fullfilled	not fullfilled	-40.00
	9.00E+05	333.33	53.05			fullfilled	not fullfilled	-40.00
	1.00	300.00	47.75			fullfilled	not fullfilled	-40.00
	1.59	188.50	**30.00**			fullfilled	not fullfilled	-40.00
	2.00	150.00	23.87			fullfilled	fullfilled	-38.02
	3.00	100.00	15.92			fullfilled	fullfilled	-34.49
	4.00	75.00	11.94			fullfilled	fullfilled	-32.00
	5.00	60.00	9.55			fullfilled	fullfilled	-30.06
	6.00	50.00	7.96			fullfilled	fullfilled	-28.47
	7.00	42.86	6.82			fullfilled	fullfilled	-27.13
	8.00	37.50	5.97			fullfilled	fullfilled	-25.97
	9.00	33.33	5.31			fullfilled	fullfilled	-24.95
	10.00	30.00	4.77	**30**		fullfilled	fullfilled	-24.04
	10.60	28.30	4.50			fullfilled	fullfilled	-23.53
MHz	11.00	27.27	4.34			fullfilled	fullfilled	-23.21
	12.00	25.00	3.98			fullfilled	fullfilled	-22.45
	13.56	22.12	3.52			fullfilled	fullfilled	-21.39
	15.00	20.00	3.18			fullfilled	fullfilled	-20.51
	15.92	18.85	**3.00**			fullfilled	fullfilled	-20.00
	17.00	17.65	2.81			not fullfilled	fullfilled	-20.00
	18.00	16.67	2.65			not fullfilled	fullfilled	-20.00
	20.00	15.00	2.39			not fullfilled	fullfilled	-20.00
	21.00	14.29	2.27			not fullfilled	fullfilled	-20.00
	23.00	13.04	2.08			not fullfilled	fullfilled	-20.00
	25.00	12.00	1.91			not fullfilled	fullfilled	-20.00
	27.00	11.11	1.77			not fullfilled	fullfilled	-20.00
	29.00	10.34	1.65			not fullfilled	fullfilled	-20.00
	30.00	10.00	1.59			not fullfilled	fullfilled	-20.00

4.9.3 Limit

Radiated emissions limits, (3 meters)					
Frequency Range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Distance [m]	Detector	RBW [kHz]
0.009 – 0.09	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	0.2
0.09 – 0.11	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Quasi peak	0.2
0.11 – 0.15	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	0.2
0.15 – 0.49	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	9
0.49 – 1.705	24000 / f [kHz]	87.6 – 20Log(f) (kHz)	30	Quasi peak	9
1.705 - 30	30	29.5	30	Quasi peak	9

*Remark: In Canada same limits apply, just unit reference is different

4.9.4 Result

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 0.009 – 30 MHz	Result
2.01a	Low	Single, non-Hopping [8PSK]	25.582 @ 19.751 MHz	Pass
2.01b	Low	Single, non-Hopping [8PSK]	25.258 @ 19.796 MHz	Pass
2.02a	Mid	Single, non-Hopping [GFSK]	25.294 @ 18.975 MHz	Pass
2.02b	Mid	Single, non-Hopping [GFSK]	20.211 @ 27.526 MHz	Pass
2.03a	High	Single, non-Hopping [GFSK]	19.685 @ 25.966 MHz	Pass
2.03b	High	Single, non-Hopping [GFSK]	19.807 @ 24.182 MHz	Pass

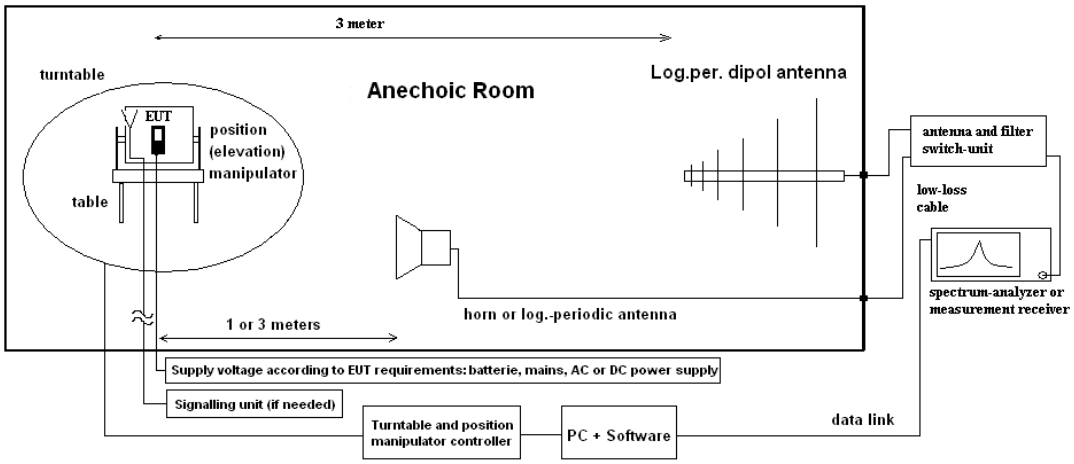
Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

4.10 Radiated field strength emissions 30 MHz – 1 GHz

4.10.1 Description of the general test setup and methodology, see below example:

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 16-1-4:2010 compliant semi anechoic room (SAR) and fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Exploratory, preliminary measurements
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc. either on 10m OATS or 3m semi-anechoic room.
First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height between 1 m and 4 m.
On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
E_C = Electrical field – corrected value
E_R = Receiver reading
G_A = Gain of pre-amplifier (if used)
L_T = Limit
M = Margin

All units are dB-units, positive margin means value is below limit.

4.10.2 Measurement Location

Test site	120902 – SAC – Radiated Emission < 1GHz

4.10.3 Limit

Radiated emissions limits, (3 meters)				
Frequency Range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector	RBW / VBW [kHz]
30 - 88	100	40.0	Quasi peak	100 / 300
88 - 216	150	43.5	Quasi peak	100 / 300
216 - 960	200	46.0	Quasi peak	100 / 300
960 - 1000	500	54.0	Quasi peak	100 / 300

4.10.4 Result

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 30 – 1000 MHz	Result
3.01a	Low	Single, non-Hopping [8PSK]	38.143 @ 432.00 MHz	Pass
3.01b	Low	Single, non-Hopping [8PSK]	38.797 @ 432.00 MHz	Pass
3.02a	Mid	Single, non-Hopping [GFSK]	38.291 @ 432.00 MHz	Pass
3.02b	Mid	Single, non-Hopping [GFSK]	38.291 @ 432.00 MHz	Pass
3.03a	High	Single, non-Hopping [GFSK]	38.090 @ 432.99 MHz	Pass
3.03b	High	Single, non-Hopping [GFSK]	37.290 @ 431.99 MHz	Pass

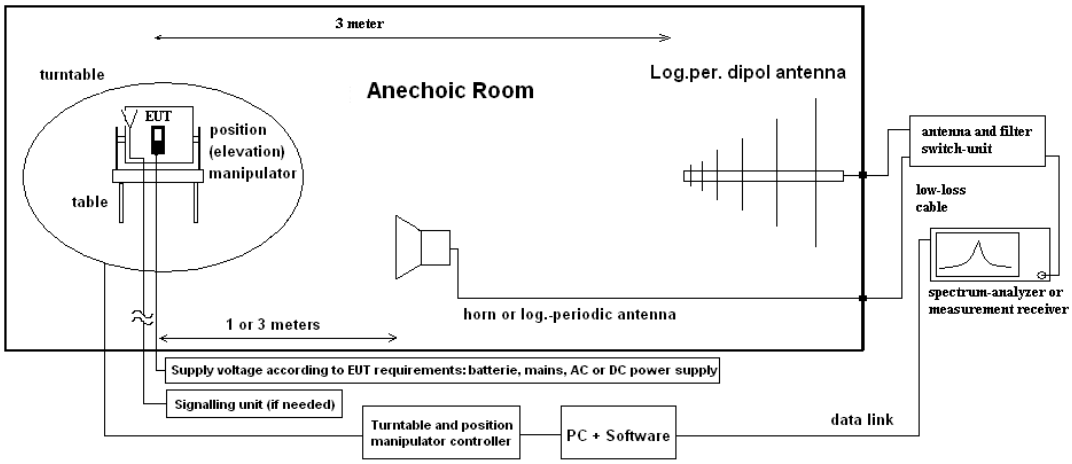
Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

4.11 Radiated field strength emissions above 1 GHz

4.11.1 Description of the general test setup and methodology, see below example:

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 18-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Exploratory, preliminary measurements

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies

Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis, the antenna height and tilting or three axis scan for portable/small equipment.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$E_C = E_R + A_F + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

E_C = Electrical field – corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
A_F = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
G_A = Gain of pre-amplifier (if used)

All units are dB-units, positive margin means value is below limit.

4.11.2 Measurement Location

Test site 1 – 18 GHz	120904 – FAC1 – Radiated Emissions
Test site 18 – 26.5 GHz	120907 – FAC2

4.11.3 Limit

Radiated emissions limits, (3 meters)				
Frequency Range [MHz]	**Limit [µV/m]**	**Limit [dBµV/m]**	**Detector**	**RBW / VBW [kHz]**
Above 1000	500	54	Average	1000 / 3000
Above 1000	5000	74	Peak	1000 / 3000

4.11.4 Result

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 1 – 18 GHz	Result
4.01a	Low	Single, non-Hopping [8PSK]	50.916 @ 17.243 GHz [AV]	Pass
4.02a	Mid	Single, non-Hopping [GFSK]	50.471 @ 17.332 GHz [AV]	Pass
4.03a	High	Single, non-Hopping [GFSK]	50.935 @ 17.236 GHz [AV]	Pass

Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

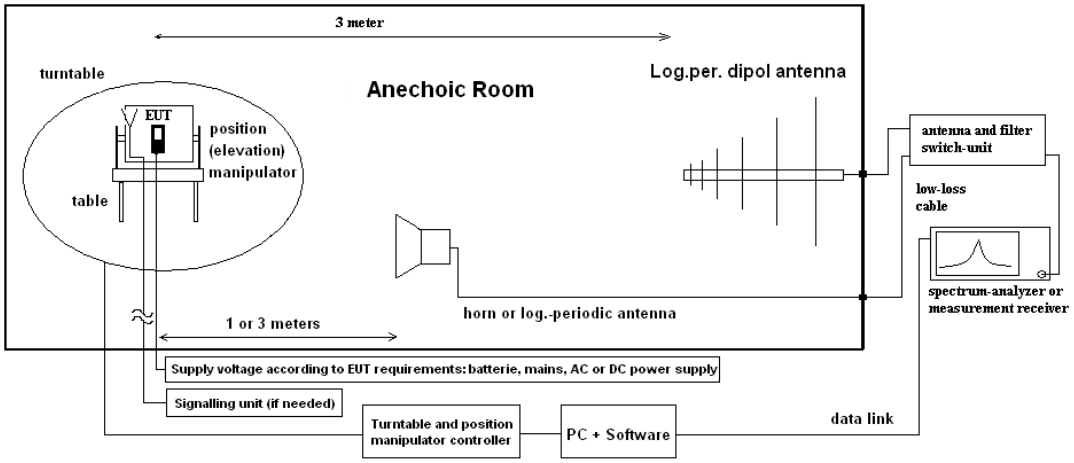
Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 18 – 26.5 GHz	Result
4.01b	Low	Single, non-Hopping [8PSK]	48.11 @ 25.225 GHz [AV]	Pass
4.02b	Mid	Single, non-Hopping [GFSK]	47.91 @ 25.202 GHz [AV]	Pass
4.03b	High	Single, non-Hopping [GFSK]	47.78 @ 25.569 GHz [AV]	Pass

Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

4.12 Radiated Band-Edge emissions

4.12.1 Description of the general test setup and methodology, see below example:

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

For uncritical results where a measurement resolution bandwidth of 1MHz can clearly show the compliance without influencing the results, a field strength measurement was performed to show compliance.

For critical results a Marker-Delta marker method was used for showing compliance to restricted bands.
The method consists of three independent steps:

1. Step: Prior to the measurement the fundamental radiated In-Band field strength was performed. The determined value is used as reference value.

2. Step: Second step consist of finding the relative attenuation between the fundamental emission and the maximum local out-of-band emission (within 2 MHz range around the band edge either on the band-edge directly or some modulation product if the level is greater than that on the band-edge) when measured with lower resolution bandwidth.

3. .Step: The delta value recorded in step 2 will be subtracted from value recorded in step 1, thus giving the required field strength at the band-edge. This value must fulfil the requirements for radiated spurious emissions in restricted bands in FCC §15.205 with the general limits of FCC §15.209

The EUT was instructed to send with maximum power (if adjustable) according to applicants instructions.

4.12.2 Measurement Location

Test site	120904 – FAC1 – Radiated Emissions

4.12.3 Limit

Frequency Range [MHz]	Pk Limit [dBc]	Avg Limit [dBc]	Avg Limit [dBµV/m]	Pk Limit [dBµV/m]	Detector	RBW / VBW [kHz]
Below 2390	-	-	54	74	Average / Peak	100 / 300
Above 2483.5	-	-	54	74	Average / Peak	1000 / 3000
2390 - 2400	-20	-	-	-	Peak	100 / 300
2390 - 2400	-	-30	-	-	Average	100 / 300

4.12.4 Result

Non-restricted bands near-by

Diagram	Channel	Mode	Peak [dBc]	Average [dBc]	Result
9.01	Low	Single, non-Hopping [8PSK]	42.345	47.739	PASS
9.03	Mid	Single, non-Hopping [GFSK]	42.296	42.187	PASS
9.07	All	All Channels Hopping mode	42.326	36.554	PASS

Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

Restricted bands near-by

Diagram	Channel	Mode	Peak [dBµV/m]	Average [dBµV/m]	Result
9.02	Low	Single, non-Hopping [8PSK]	58.839	46.529	PASS
9.04	Mid	Single, non-Hopping [GFSK]	58.051	46.449	PASS
9.08	All	All Channels Hopping mode	57.657	46.456	PASS

Remark: for more information and graphical plots see annex **CETECOM_TR19_1_0137403T02a_A1**

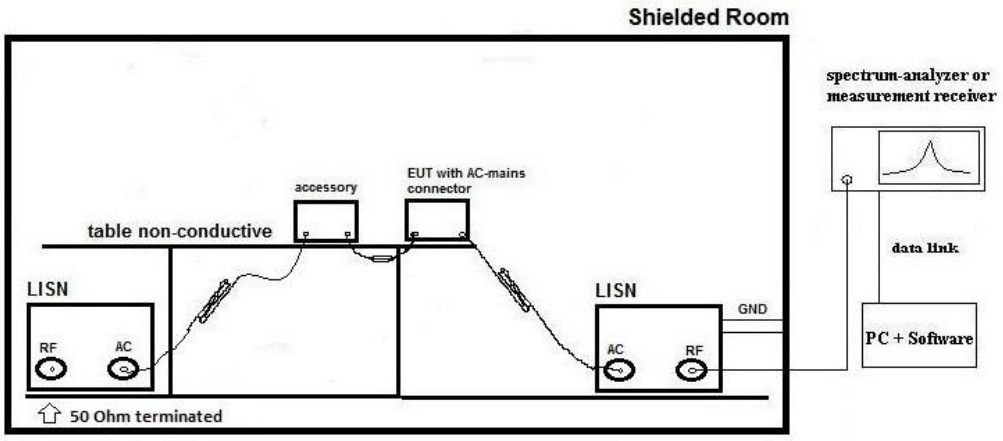
4.13 AC-Power Lines Conducted Emissions

4.13.1 Description of the general test setup and methodology, see below example:

The radio frequency voltage conducted back into the AC power line in the frequency range 150 kHz to 30 MHz has to be investigated.
Compliance should be tested by measuring the radio frequency voltage between each power line and ground at the power terminals in the stated frequency range.
A 50 Ohm / 50 µH line impedance stabilization network (LISN) is used coupling the interface to the measurement equipment.
The EUT power input leads are connected through the LISN to the AC-power source. The LISN enclosure is electrically connected to the ground plane. The measuring instrument is connected to the coaxial output of the LISN.

Tabletop devices were set-up on an 80 cm height above reference ground plane, floor standing equipment 10 cm raised above ground plane.
Measurements have been performed on each phase line and neutral line of the devices AC-power lines.
The EUT was power supplied with 120 V/60 Hz. The EUT was tested in the defined operating mode
and installed (connected) to accessory equipment according the general description of use given by the applicant.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Exploratory, preliminary measurements
As a first step, determines the worst-case phase line (neutral or phase) as well as the most critical operating mode of the equipment. A complete frequency-sweep with PK-Detector is performed on each current-carrying conductor.

Final measurement on critical frequencies
For power phases and critical frequencies (Margin to AV- or QP limit lower than 3 dB) as a second step includes measurements with receivers detector set to Quasi-Peak and Average.

Formula:

$V_C = V_R + C_L$ (1)
$M = L_T - V_C$ (2)

V_C = measured Voltage –corrected value
V_R = Receiver reading
C_L = Cable loss
M = Margin
L_T = Limit

All units are dB-units, positive margin means value is below limit.

4.13.2 Measurement Location

Test site	120919 – Conducted Emission

4.13.3 Limit

Frequency Range [MHz]	QUASI-Peak [dBµV]	AVERAGE [dBµV]
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

4.13.4 Result

Diagram	Mode	Power Line	Max [dBµV]	Detector	Result
1.01	BT 3Mbps ch low	N/L1	44.93	QP	Pass

Remark: see more in diagrams in separate document **CETECOM_TR19_1_0137403T02a_A1**

4.14 Results from external laboratory

None	-

4.15 Opinions and interpretations

None	-

4.16 List of abbreviations

None	-

5 Equipment lists

ID	Description	Manufacturer	SerNo	Cal due date
	120901 - SAC - Radiated Emission <1GHz			
20574	Biconilog Hybrid Antenna BTA-L	Frankonia GmbH	980026L	03.05.2022
20620	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH	100362	13.05.2021
20482	filter matrix Filter matrix SAR 1	CETECOM GmbH	-	
20885	Power Supply EA3632A	Agilent Technologies Deutschland GmbH	75305850	
20487	System CTC NSA-Verification SAR-EMI System EMI field (SAR) NSA	ETS-Lindgren Gmbh	-	23.03.2021
25038	Loop Antenna HFH2-Z2	Rohde & Schwarz Messgerätebau GmbH	879824/13	07.04.2022
	120904 - FAC1 - Radiated Emissions			
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	81650455	25.05.2022
20720	EMC32 [FAC]	Rohde & Schwarz Messgerätebau GmbH	V10.xx	
20489	EMI Test Receiver ESU40	Rohde & Schwarz Messgerätebau GmbH	1000-30	13.05.2021
20254	High Pass Filter 5HC 2600/12750-1.5KK (GSM1800/1900/DECT)	Trilithic	23042	
20868	High Pass Filter AFH-07000	AtlanTecRF	16071300004	
20291	High Pass Filter WHJ 2200-4EE (GSM 850/900)	Wainwright Instruments GmbH	14	
20020	Horn Antenna 3115 (Subst 1)	EMCO Elektronik GmbH	9107-3699	19.07.2021
20302	Horn Antenna BBHA9170 (Meas 1)	Schwarzbeck Mess-Elektronik OHG	155	15.04.2023
20549	Log.Per-Antenna HL025	Rohde & Schwarz Messgerätebau GmbH	1000060	31.07.2021
20512	Notch Filter WRCA 800/960-02/40-6EEK (GSM 850)	Wainwright Instruments GmbH	24	
20290	Notch Filter WRCA 901,9/903,1SS (GSM 900)	Wainwright Instruments GmbH	3RR	
20122	Notch Filter WRCB 1747/1748 (GSM 1800)	Wainwright Instruments GmbH	12	
20121	Notch Filter WRCB 1879,5/1880,5EE (GSM 1900)	Wainwright Instruments GmbH	15	
20448	Notch Filter WRCT 1850.0/2170.0-5/40-10SSK (WCDMA-FDD II)	Wainwright Instruments GmbH	5	
20066	Notch Filter WRCT 1900/2200-5/40-10EEK (WCDMA - FDDI)	Wainwright Instruments GmbH	5	
20449	Notch Filter WRCT 824.0/894.0-5/40-8SSK (WCDMA FDD V)	Wainwright Instruments GmbH	1	
20611	Power Supply E3632A	Agilent Technologies Deutschland GmbH	KR 75305854	
20338	Pre-Amplifier 100MHz - 26GHz JS4-00102600-38-5P	Miteq Inc.	838697	
20484	Pre-Amplifier 2,5GHz - 18GHz AMF-5D-02501800-25-10P	Miteq Inc.	1244554	
20287	Pre-Amplifier 25MHz - 4GHz AMF-2D-100M4G-35-10P	Miteq Inc.	379418	
20670	Radio Communication Tester CMU200	Rohde & Schwarz Messgerätebau GmbH	106833	16.06.2022
20690	Spectrum Analyzer FSU	Rohde & Schwarz Messgerätebau GmbH	100302/026	23.05.2021
20439	UltraLog-Antenna HL 562	Rohde & Schwarz Messgerätebau GmbH	100248	10.03.2023
20828	Netgear Nighthawk x4S	NETGEAR Ireland International Ltd	5K5188590067B	
20732	Signal- and Spectrum Analyzer FSW67	Rohde & Schwarz Messgerätebau GmbH	104023	27.05.2021
	120910 - Radio Laboratory 1 (TS 8997)			
20904	Climatic Chamber ClimeEvent C/1000/70a/5	Weiss Umwelttechnik GmbH	58226223240010	09.05.2021
20866	FSV3030 Signal Analyzer 30GHz	Rohde & Schwarz Messgerätebau GmbH	101247	10.09.2021
20805	Open Switch and control Platform OSP B157WX 40GHz 8Port Switch	Rohde & Schwarz Messgerätebau GmbH	101264	13.05.2021
20691	Open Switch and control Platform OSP120	Rohde & Schwarz Messgerätebau GmbH	101056	13.05.2021
20687	Signal Generator SMF 100A	Rohde & Schwarz Messgerätebau GmbH	102073	07.02.2021
20559	Vector Signal Generator SMU200A	Rohde & Schwarz Messgerätebau GmbH	103736	22.05.2021
20873	WTS-80 Schirmbox	CETECOM GmbH	P3101	

6 Measurement Uncertainty valid for conducted/radiated measurements

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved. For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it contribution to the overall uncertainty according its statistical distribution calculated.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%						Remarks
Conducted emissions (U_{CISPR})	-	9 kHz - 150 kHz 150 kHz - 30 MHz	4.0 dB 3.6 dB						-
Power Output radiated	-	30 MHz - 4 GHz	3.17 dB						Substitution method
Power Output conducted	-	Set-up No.	Cel-C1	Cel-C2	BT1	W1	W2	--	
		9 kHz - 12.75 GHz	N/A	0.60	0.7	0.25	N/A	--	-
		12.75 - 26.5 GHz	N/A	0.82	--	N/A	N/A	--	
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	0.70	N/A	0.69	--	N/A - not applicable
		2.8 GHz - 12.75 GHz	1.48	N/A	1.51	N/A	1.43	--	
		12.75 GHz – 18 GHz	1.81	N/A	1.83	N/A	1.77	--	
		18 GHz - 26.5 GHz	1.83	N/A	1.85	N/A	1.79	--	
Occupied bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			1.0 dB						Power
Emission bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
	-		See above: 0.70 dB						Power
Frequency stability	-	9 kHz - 20 GHz	0.0636 ppm						-
Radiated emissions Enclosure	-	150 kHz - 30 MHz	5.01dB						Magnetic field strength
		30 MHz - 1 GHz 1 GHz - 18 GHz 18-26.5 GHz	5.83 dB 4.91 dB 5.06 dB						Electrical Field strength

7 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2020-Dec-04
--	--	--
--	--	--

End Of Test Report