Test Report
19-1-0150502T11a

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

Number of pages:	24	**Date of Report:**	2020-Jul-22
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:**	MYNXG Product GmbH
Test Object / Tested Device(s):	**Sensor Device, SENSE MCE IBC**		
FCC ID: **Contains FCC ID:**	2ASE6SENSEMCEIBC ZMONL668AM00 2AC7Z-ESPWROOM32D	**IC:** **Contains IC:**	26095-SENSEMCEIBC 21374-NL668AM00 21098-ESPWROOM32D
Testing has been carried out in accordance with:	**Title 47 CFR, Chapter I** **FCC Regulations, Subchapter A** **Subpart C: §15.247 (DTS)** **RSS-247, Issue2 — Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices** Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
Tested Technology:	SRD (Short Range Device)		
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:

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Dipl.-Ing. Christian Lorenz	B.Sc. Mohamed Ahmed
Senior Test Manager	Test manager
Authorization of test report	Responsible of test report

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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.
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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

Test case	Reference Clause FCC ☒	Reference Clause ISED ☒	Page	Remark	Result
Duty cycle	ANSI 63.10:2013	-	-	-	N/A
Emission Bandwidth 6 dB	§15.247 (a) (2)	RSS-247, Issue 2, §5.2,a	11	-	PASSED
Occupied Channel Bandwidth 99%	2.1049(h)	RSS-Gen, Issue 5, §6.7	12	-	INFO ONLY
Carrier Frequency Separation	§15.247 (a) (1)	RSS-247, Issue 2, §5.1,b	-	-	N/A
Number of Hopping Channels	§15.247 (a) (1) (iii)	RSS-247, Issue 2, §5.1,d	-	-	N/A
Time of Occupancy	§15.247 (a) (1) (iii)	RSS-247, Issue 2, §5.1,d	-	-	N/A
Peak output power (Sweep)	§15.247(b)(3)	RSS-247, Issue 2: 5.4 (d)	10	-	PASSED
Transmitter Peak output power radiated	§15.247(b)(4)	RSS-247, Issue 2: 5.1 (b)	-	-	N/A
Emissions in non-restricted frequency bands	§15.247(d)	RSS-247, § 5.5	15	-	PASSED
Radiated Band-Edge emissions	§15.247(d)	RSS-247, §5.5 RSS-Gen: Issue 5: §8.9 Table 5+6+7	15	-	PASSED
Conducted power spectrum density	§15.205(e)	RSS-247, §5.2, b	13	-	PASSED
Radiated field strength emissions below 30 MHz	§15.205(a) §15.209(a)	RSS-Gen: Issue 5 §8.9 Table 6	-	-	N/A
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	17	-	PASSED
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	19	-	PASSED
AC-Power Lines Conducted Emissions	§15.207	RSS-Gen Issue 5: §8.8, Table 4	-	-	N/A

PASSED	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:	Volker Wittmann
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.:	HLDG-60000000719
Responsible for Test Report:	B. Sc. Mohamed Ahmed
Responsible test manager:	M.Sc. Guangcheng Huang
Receipt of EUT:	2020-Mar-17
Date(s) of test:	2019-Apr-02 – 2019-May-06
Version of template:	14.0

2.5 Applicant's details

Applicant's name:	MYNXG Product GmbH
Address:	Friedhofstrasse 72 DE-63263, Neu-Isenburg Germany
Contact Person:	Bernd Moeller
Contact Person's Email:	bernd.moeller@mynxg.com

2.6 Manufacturer's details

Manufacturer's name:	Please see applicant´s details
Address:	Please see 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	19-1-01505S100	SENSE MCE IBC	Sensor Device	41001200001200	2.2	0.0.25
EUT 2	19-1-01505S104	SENSE MCE IBC	Sensor Device	41001200001176	2.1	0.0.25

*) 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	19-1-01505S14	Fey Battery	Rechargeable Li ion battery	41001200001176	-	-
AE 2	19-1-01505S134	US companion device	MYNXG Sense MCO Machine	15130100001111	-	-
AE 3	19-1-01505S126	ACDC adapter	-	-	-	-
AE 4	19-1-01505S38	Laptop	Lenovo ThinkPad	IMEI: 013937006449977	-	-

*) 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	S/N	HW status	SW status
CAB 1	19-1-01505S125	Data communication	USB-RS232-CAN	-	-	-

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

2.10 Software

Short description*)	PMT Sample No.	Software	Type	S/N	HW status	SW status
SW 1	-	Python script	SRD test	-	-	-

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

2.11 EUT set-ups

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

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

Remark: The devices stated in the brackets are used only before the measurement for setting up the EUT test mode.

2.12 EUT operation modes

EUT operating mode no.*1)	Operating modes	Additional information
op. 1	TX CW	Continuous transmission without modulation for measurements like ERP and frequency error
op. 2	TX modulated	Continuous transmission with modulation for measurements like OBW, out of band emissions etc.
op. 3	RX	Continuously receiving

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

*2) Please refer to document “MYNXG_Certification_sense_mce_pa10.pdf” provided by applicant.

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Product name	SENSE MCE IBC		
Kind of product	Sensor Device		
Firmware	☐ for normal use	☒ Special version for test execution	
Power supply	☐ AC Mains	-	
	☐ DC Mains	- VDC via - Connector	
	☒ Battery	Lithium Ion battery	
Operational conditions	T_{nom} = 25 °C	T_{min} = -20 °C	T_{max} = +60 °C
	V_{nom} = 3.6 V	V_{min} = 2.7 V	V_{max} = 4.2 V
EUT sample type	**Pre-Production**		
Weight	-		
Size	-		
Interfaces/Ports	RF (SRD) interface		
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	902 – 928 MHz		
Number of Channels (USA/Canada -bands)	5 channels Ch1: 913 MHz Ch2: 914 MHz Ch3: 915 MHz Ch4: 916 MHz Ch5: 917 MHz		
Nominal Channel Bandwidth	526.8 kHz		
Type of Modulation | Data Rate	☐ GFSK | 100 kbit / s	☐ π/4 DQPSK | 2 Mbit / s	
	☐ 8DPSK | 3 Mbit / s	☒ LoRa |	
Other installed options	☒ a/n/ac mode (not tested within this report) ☒ b/g/n mode (not tested within this report) ☐ Bluetooth LE (not tested within this report) ☒ Wireless charging (not tested within this report) ☒ Cellular transceiver (2G/3G/4G/5G/GPS, not tested in this report)		
Max. Conducted Output Power (Measured RMS Power)	LoRa: max. 15.10 dBm + 0.5 dBi = 15.6 dBm (channel 1)		
EIRP Power (Calculated EIRP)	LoRa: 15.10 dBm + 0.5 dBi = 15.6 dBm		
Antenna Type(s)	Printed PCB Antenna		
Antenna Gain(s)	0.5 dBi		
FCC label attached	No		
Test firmware / software and storage location	\\cetecom.de\essen\CETECOMPMT\Archive\2019\19-1-01505\3_Documentation\02_Testing_Instruction\certification_sense_mce_0.0.5\control_scripts\0.0.5		
For further details refer Applicants Declaration & following technical documents			
Description of Reference Document (supplied by applicant)	**Version**	**Total Pages**	
MYNXG_Certification_sense_mce_pa10.pdf	**pa10**	**18**	

3.3 Modifications on Test sample

Additions/deviations or exclusions	--

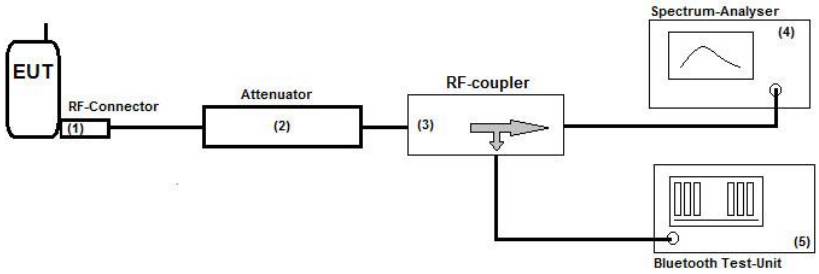
4 Measurements

4.1 Peak output power

4.1.1 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
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

4.1.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.1.3 Limit

Frequency Range [MHz]	Limit [W]	Limit [dBm]	Detector	RBW
902 - 928	1	30	MaxPeak	> EUT bandwidth

4.1.4 Result

Mode	Channel	Frequency [MHz]	Max Peak Power [dBm]	Result
TX continuous	F1	913	15.10	Passed
TX continuous	F3	915	13.86	Passed
TX continuous	F5	917	13.94	Passed

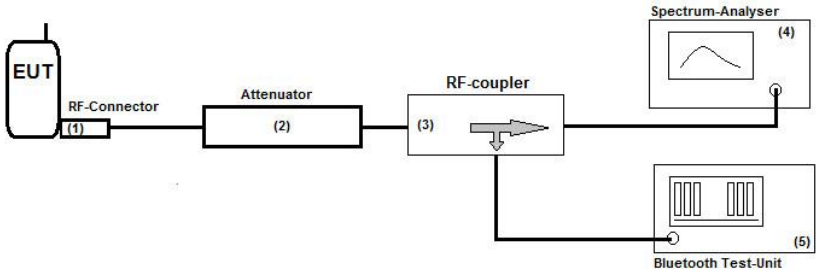
Remark: for more information and graphical plot see annex A1 **CETECOM_TR19_1_0150502T11a_A1**

4.2 Emission Bandwidth 6 dB

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
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.

4.2.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.2.3 Limit

Limit [kHz]	Detector [MaxHold]	RBW / VBW [kHz]
6 dB BW > 500 kHz	**MaxPeak**	**100 / 300**

4.2.4 Result

Mode	Channel	Frequency [MHz]	6 dB bandwidth [kHz]	Result
TX continuous	F1	913	536.0877	Passed
TX continuous	F3	915	538.4615	Passed
TX continuous	F5	917	536.8654	Passed

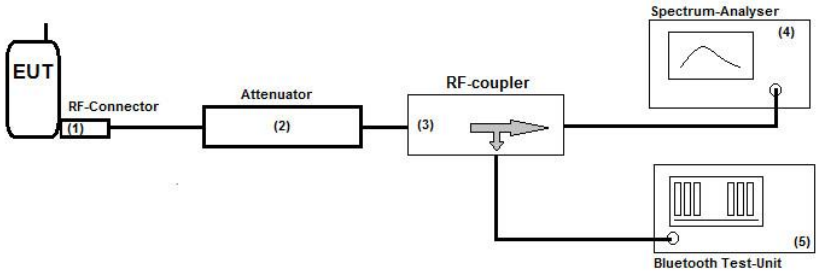
Remark: for more information and graphical plot see annex A1 **CETECOM_TR19_1_0150502T11a_A1**

4.3 Occupied Channel Bandwidth 99%

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
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

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.

4.3.4 Result

Mode	Channel	Frequency [MHz]	99% Occupied bandwidth [MHz]
TX continuous	F1	913	514.4231
TX continuous	F3	915	514.4231
TX continuous	F5	917	514.4231

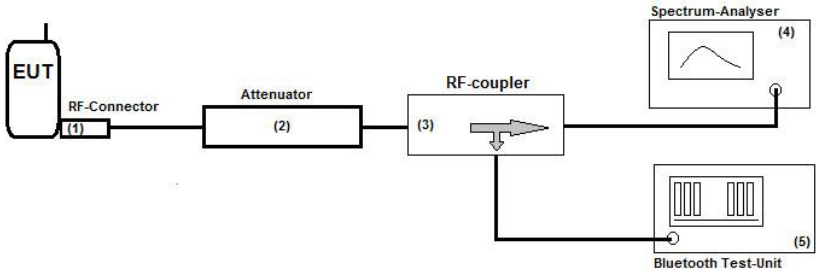
Remark: for more information and graphical plot see annex A1 **CETECOM_TR19_1_0150502T11a_A1**

4.4 Power spectral density

4.4.1 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.

4.4.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.4.3 Limit

Limit for conducted PSD
8 dBm in any 3 kHz band

4.4.4 Result

Maximum Level Peak [dBc]

Mode	Channel	Frequency [MHz]	Result
TX continuous	F1	913	Passed
TX continuous	F3	915	Passed
TX continuous	F5	917	Passed

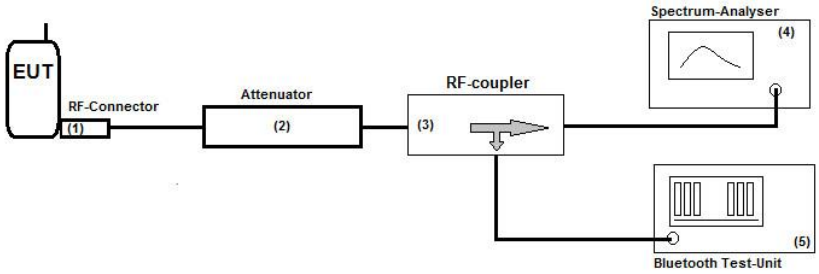
Remark: for more information and graphical plot see annex A1 **CETECOM_TR19_1_0150502T11a_A1**

4.5 Conducted spurious emissions

4.5.1 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.

4.5.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.5.3 Limit

Frequency Range [MHz]	Limit [dBc]
0.15 – 10000	**-20 / -30**

4.5.4 Result

Maximum Level Peak [dBc]

Diagram	Mode	Channel	Frequency [MHz]	Result
13-17	TX continuous	F1	913	Passed
18-22	TX continuous	F3	915	Passed
23-27	TX continuous	F5	917	Passed

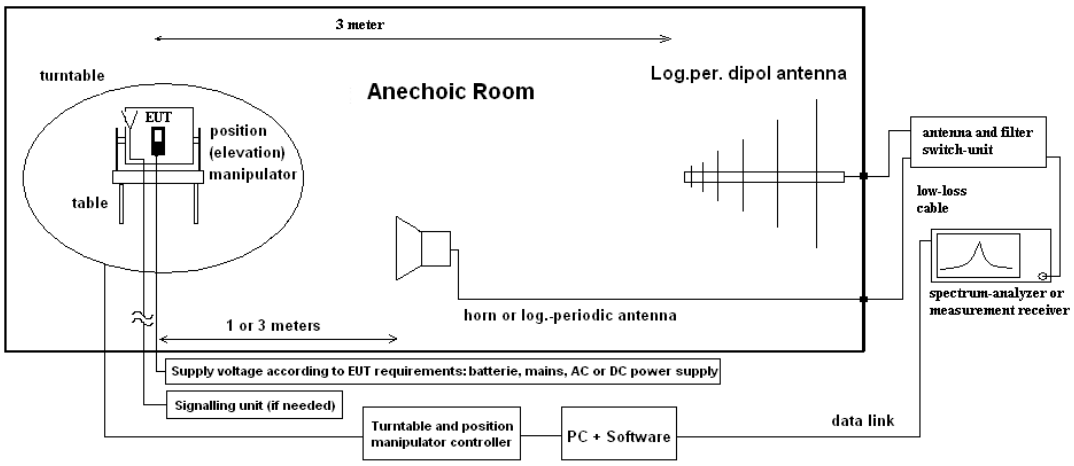
Remark: for more information and graphical plot see annex A1 **CETECOM_TR19_1_0150502T11a_A1**

4.6 Radiated field strength emissions 30 MHz – 1 GHz

4.6.1 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 it's 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.

4.6.2 Measurement Location

Test site	120901 – SAC – Radiated Emission <1 GHz

4.6.3 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

4.6.4 Result

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 30 – 1000 MHz	Result
3.01-3.02	F1	TX continuous	45.64	Passed
3.03-3.04	F5	TX continuous	44.69	Passed

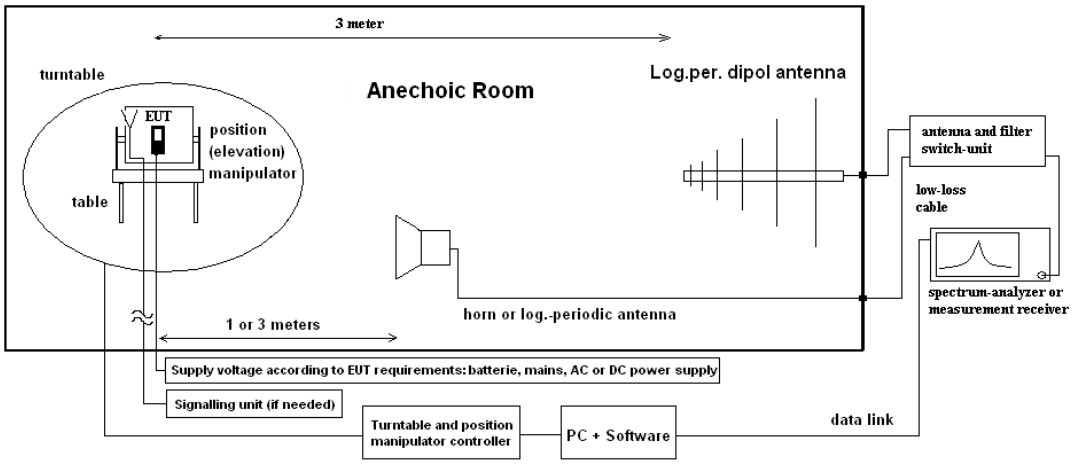
Remark: for more information and graphical plot see annex A1 **CETECOM_TR19_1_0150502T11a_A1**

4.7 Radiated field strength emissions above 1 GHz

4.7.1 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.

4.7.2 Measurement Location

Test site 1 – 18 GHz	120904 – FAC – Radiated emissions
Test site 18 – 26.5 GHz	120904 – FAC – Radiated emissions

4.7.3 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

4.7.4 Result

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 1 – 10 GHz	Result
8.01	F1	TX continuous	46.03 (PK) / 36.49 (AV)	Passed
8.01	F5	TX continuous	47.19 (PK) / 28.29 (AV)	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR19_1_0150502T11a_A1**

4.8 Results from external laboratory

None	-

4.9 Opinions and interpretations

None	-

5 Equipment lists

D	Description	Manufacturer	SerNo	Cal Date
	120901 - SAC - Radiated Emission <1GHz			
20574	Biconilog Hybrid Antenna BTA-L	Frankonia GmbH	980026L	03.05.2022
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	81650455	16.05.2020
20620	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH	100362	20.05.2020
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
	120904 - FAC1 - Radiated Emissions			
20720	EMC32 [FAC]	Rohde & Schwarz Messgerätebau GmbH	V10.xx	
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
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	
20262	Power Meter NRV-S	Rohde & Schwarz Messgerätebau GmbH	825770/0010	15.05.2020
20357	power sensor NRV-Z1	Rohde & Schwarz Messgerätebau GmbH	861761/002	21.05.2021
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	
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
	120910 - Radio Laboratory 1 (TS 8997)			
20866	FSV3030 Signal Analyzer 30GHz	Rohde & Schwarz Messgerätebau GmbH	101247	02.10.2020
20805	Open Switch and control Platform OSP B157WX 40GHz 8Port Switch	Rohde & Schwarz Messgerätebau GmbH	101264	03.05.2020
20691	Open Switch and control Platform OSP120	Rohde & Schwarz Messgerätebau GmbH	101056	29.05.2020
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	

Tools used in 'P1M1'

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.

Following table shows expectable uncertainties for each measurement type performed.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%						Remarks
Conducted emissions	-	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 GHz - 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 GHz -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-Jul-22
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End of Test Report