PARTIAL Test Report
18-1-0097201T22a-C02

D-PL-12047-01-01
D-PL-12047-01-03
D-PL-12047-01-04

Number of pages:	40	**Date of Report:**	2021-Sep-08
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:**	ACTIA NORDIC AB
Test Object / Tested Device(s):	**103360002, Telematics Device**		
FCC ID:	2AGKK103360002	**IC:**	20839-103360002
Testing has been carried out in accordance with:	**Title 47 CFR, Chapter I** **FCC Regulations, Subchapter A** Subpart E: §15.407 (DTS) Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
Tested Technology:	5 GHz W-LAN (IEEE 802.11)		
Test Results:	**☒ The EUT complies with the requirements in respect of selected parameters subject to the test.** The test results relate only to devices specified in this document The current version of the Test Report TR18-1-0097201T22a-C02 replaces the Test Report TR18-1-0097201T22a-C01 dated 2021-07-16. The replaced Test Report is herewith invalid.		

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Test Lab 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

The EUT integrates a 5 GHz W-LAN 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	--	--	13	NP 1)	
Minimum Emission Bandwidth 6 dB	2.1049(h), §15.407(e)	RSS-Gen, Issue 5, §6.7		NP 1)	
Emission Bandwidth 26 dB	2.1049(h)	RSS-Gen, Issue 5. §6.7		NP 1)	
Occupied Channel Bandwidth 99%	2.1049(h)	RSS-Gen, Issue 5, §6.7		NP1)	
Frequency stability	§ 2.1055 + §15.407(g)	RSS-Gen, Issue 5: § 6.11, 8.11		NP 1)	
RF output power	§15.407(a) (1)(2)(3)(4)	RSS-247, Issue 2 § 6.2.1.1 6.2.2.1 6.2.3.1 6.2.4.1	14		PASSED
Power spectral density	§15.407(a) (1)(2)(3)(5)	RSS-247, Issue 2 § 6.2.1.1 6.2.2.1 6.2.3.1 6.2.4.1		NP 1)	
Antenna gain information	§15.407(a) (1)(2)(3)	RSS-247, Issue 2 § 6.2.1.1 6.2.2.1 6.2.3.1 6.2.4.1		NP 1)	
Radiated Band-Edge emissions	§15.209, §15.205 §15.407(b)(1)(2)(3)(4)	RSS-247, Issue 2 § 6.2.1.2,6.2.2.2, 6.2.3.2, 6.2.4.2, RSS-Gen., Issue 5, §8.10, Table 7	30		PASSED
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5 §8.9 Table 6	18		PASSED
Radiated field strength emissions 30 MHz – 1 GHz	§15.205, §15.209 §15.407(6)(7)	RSS-Gen: Issue 5 §8.9 Table 5	23		PASSED
Radiated field strength emissions above 1 GHz	§15.407(6) §15.407(b)	RSS-Gen: Issue 5 §8.9 Table 5	26		PASSED
Transmit power control	§15.407 (h1)(h2)	RSS-247, Issue 2 §6.2.2.3 Additional requirements for antenna pattern radiation		NP 1)	
Dynamic frequency selection (DFS)	§15.407 (h1)	RSS-247. Issue 2, §6.2.1.1, §6.2.2.1		NP 1)	
Discontinuous transmissions + Device security	§15.407 (h2)	RSS-247, Issue 2 § 6.3		NP 1)	
AC-Power Lines Conducted Emissions	§15.407(i)	RSS-247, Issue 2 § 6.4 (a)(b)		NP 1)	

1.) For conducted tests see original reports from FCC ID no.

FCC ID: **XPYJODYW164-07A**

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.
NT	Not tested
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, §12.2(b)(2)
Emission Bandwidth 26 dB	ANSI C63.10:2013, §6.9.2, §11.8, §12.4.1
Occupied Channel Bandwidth 99%	ANSI C63.10:2013, §12.4.2
Frequency stability	ANSI C63.10:2013, §6.8.1, §6.8.2
RF output power	ANSI C63.10:2013, §12.3
Power spectral density	ANSI C63.10:2013, §12.5
Antenna gain information	ANSI C63.10:2013, §6.10.5, §6.10.6
Radiated Band-Edge emissions	ANSI C63.10-2013; “Marker-Delta method”, §6.10.4, §12.7.4.4
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, §12.7
Radiated field strength emissions above 1 GHz	ANSI C63.4-2014 §8.3, ANSI C63.10-2013 §6.3, § 6.6, §12.7
Transmit power control	ANSI C63.10:2013, §12.3
Dynamic frequency selection (DFS)	See TR reported
Discontinuous transmissions + Device security	See Applicant’s documentation
AC-Power Lines Conducted Emissions	ANSI C63.4-2014 §7, ANSI C63.10-2013 § 6.2

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.:	1
Responsible test manager:	M.Sc. Patrick Marzotko
Receipt of EUT:	2019-Nov-27
Date(s) of test:	2019-Dec-16 – 2020-Jun-19
Version of template:	14.0

2.5 Applicant's details

Applicant's name:	ACTIA Nordic AB, Sollentuna
Address:	Hammarbacken 4A, 3tr SE-19149 Sollentuna Schweden
Contact Person:	Salah Alazawi
Contact Person's Email:	salah.alazawi@actia.se

2.6 Manufacturer's details

Manufacturer's name:	See applicant's details
Address:	See applicant's details

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

Short description*)	PMT Sample No.	Model Name	Type	S/N	HW status	SW status
EUT A	Sample 20	103360002	Telematics Device	AN103350102B160	H1	1
EUT B	Sample 17	103360002	Telematics Device	AN103350102B162	H1	1

*) 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
AE1	Sample 10	Cable Harness	Power Cable	--	--	--
AE2	Sample 11	Fakra Cable	--	--	--	--
AE3	Sample 12	Fakra Cable	--	--	--	--
AE4	Sample 13	Fakra Cable	--	--	--	--
AE5	Sample 14	Fakra Cable	--	--	--	--
AE6	Sample 58	Cellular Antenna	CALEARO LTE Antenna	7680588	16MA800CP	--
AE7	Sample 59	Cellular Antenna	CALEARO LTE Antenna	7680588	16MA800CP	--
AE8	Sample 64	WLAN Antenna	CALEARO Wifi Antenna	7750162	16MA396CP	--
AE9	Sample 16	Cable	USB Cable	--	--	--
AE10	Sample 78	GNSS Antenna	CALEARO GNSS Antenna	7750161	16MA439CP	--
AE11	--	DELL Laptop	Latitude E6420	DPN:VVF52 A01	Intel core i5	Windows 7

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

2.9 Connected cables

Cable short description *)	Cable type	Connectors	Length
CAB 1	AE2–5 (Shielded)	FAKRA	2 m
CAB 2	AE9 (Shielded)	USB , RS232	2 m

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

2.10 Software

Short description*)	PMT Sample No.	Software	Type	S/N	HW status	SW status

*) 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
1	EUT A + AE1 + AE2 + AE3 + AE4 + AE5 + AE6 + AE7 + AE8 + AE9 + AE10 + (AE11)	Used for Radiated measurements. AE11 was used to setup the operating mode and was removed during measurements.
2	EUT B + AE1 + AE9 + AE11	Used for Conducted measurements

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

2.12 EUT operation modes

EUT operating mode no.*)	Operating modes	Additional information
op. 1	WLAN_TX-Mode	With help of special test firmware TX-mode was set-up. We refer to applicants information/papers for details about necessary commands.

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

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Product name	103360002	
Kind of product	Telematics Device	
Firmware	☐ for normal use	☒ Special version for test execution (ACU6 Certification 1.5.0.5)
	☐ AC Mains	-
	☒ DC Mains	**13.8** V DC
	☐ Battery	-
Operational conditions	T_{nom} = 23 °C	
EUT sample type	**Pre-Production**	
Weight	-	
Size	-	
Interfaces/Ports	-	
For further details refer Applicants Declaration & following technical documents		
For further details regarding radio parameters, please refer to IEEE802.11 Specification		

3.2 Detailed Technical data of Main EUT as Declared by Applicant

Frequency | Channel | B.W. (USA bands only)	U-NII 1: 5150-5250 MHz	☒ Ch 36 | 40 | 48	☒ BW 20 MHz
		☒ Ch. 38 | 46	☒ BW 40 MHz
		☒ Ch. 42	☒ BW 80 MHz
	U-NII 3: 5725 -5850 MHz	☒ Ch 149 | 157| 165	☒ BW 20 MHz
		☒ Ch 151 | 159	☒ BW 40 MHz
		☒ Ch. 155	☒ BW 80 MHz
802.11a – Mode OFDM Modulation | Data Rates	☒ BPSK | 6 Mbps / 9 Mbps ☒ QPSK | 12 Mbps / 18 Mbps ☒ 16-QAM | 24 Mbps / 36 Mbps ☒ 64-QAM | 48 Mbps / 54 Mbps		
802.11n – Mode OFDM Modulation | Data Rates	☒ HT20 (MCS0 – MCS7) | 7.2/14.4/21.7/28.9/43.3/57.8/65/72.2 Mbps		
	☒ HT40 (MCS0 – MCS7) | 15/30/45/60/90/120/135/150 Mbps		
802.11ac – Mode OFDM Modulation | Data Rates	☒ HT20 (MCS0 – MCS7) | 7.2/14.4/21.7/28.9/43.3/57.8/65/72.2 Mbps		
	☒ HT40 (MCS0 – MCS7) | 15/30/45/60/90/120/135/150 Mbps		
	☒ HT80 (MCS0 – MCS7) | 7.2/14.4/21.7/28.9/43.3/57.8/65/72.2 Mbps		
Other wireless options	☒ b/g/n mode (not tested within this report) ☒ Bluetooth LE (not tested within this report) ☒ Bluetooth EDR (not tested within this report) ☒ Cellular transceiver (2G/3G/4G/GPS, not tested in this report)		
MIMO	☐		

External Antenna **Max. Conducted Output Power (Measured RMS Power)** **And** **EiRP (Calculated EIRP = RMS + Gain – Path Loss)**	**Band**	**Mode**	**RMS [dBm]**	**EiRP [dBm]**
	U-NII 1	802.11a:	**11.95**	**9.10**
		802.11n40:	**9.55**	**6.60**
		802.11ac80:	**8.25**	**5.40**
	U-NII 3	802.11a:	**16.25**	**13.40**
		802.11n40:	**16.75**	**13.70**
		802.11ac80:	**14.25**	**11.40**
Antenna Type(s)	PCB Antenna			
Antenna Gain(s)	+3 dBi			
Path Loss	-2.55 dB – 3.3 dB = -5.85 dB			
Internal Antenna **Max. Conducted Output Power (Measured RMS Power)** **And** **EiRP (Calculated EIRP = RMS + Gain – Path Loss)**	**Band**	**Mode**	**RMS [dBm]**	**EiRP [dBm]**
	U-NII 1	802.11a:	**10.55**	**11.00**
		802.11n40:	**10.05**	**10.50**
		802.11ac80:	**8.05**	**8.50**
	U-NII 3	802.11a:	**16.95**	**17.40**
		802.11n40:	**17.45**	**17.90**
		802.11ac80:	**15.15**	**15.60**
Antenna Type(s)	PCB Antenna			
Antenna Gain(s)	+3 dBi			
Path Loss	-2.55 dB			
FCC label attached	☐ yes, ☒ no			
Test firmware / software and storage location	AE11			
For further details refer Applicants Declaration & following technical documents				
Description of Reference Document (supplied by applicant)		**Version**		**Total Pages**
ACU6 Technical Description 103360002 (US_CANADA)_0.2		**17-12-2019**		**14**

3.3 Worst case identification

WLAN mode	Data rate
802.11a	6 MBit
802.11n, 40MHz bandwidth	MCS0
802.11ac, 80MHz bandwidth	MCS0

3.4 Modifications on Test sample

Additions/deviations or exclusions	-

4 Measurements

4.1 Duty-Cycle

Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

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

Duty-Cycle [%]	Duty-Cycle correction Power [dB]	Duty-Cycle correction Field Strength [dB]
-	-	-

4.2 RF output power

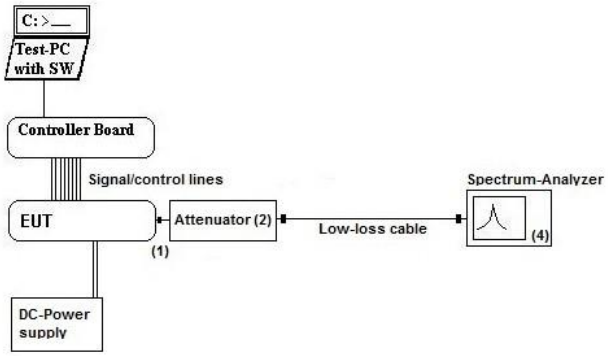
4.2.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to spectrum-analyzer (4) for RF-conducted measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings of the spectrum-analyzer.

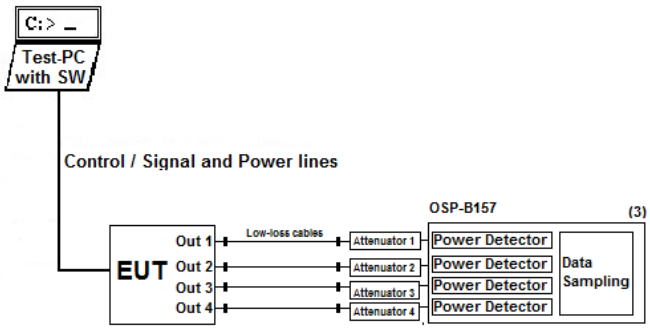
MIMO

The EUT use MIMO technology as it use multiple antennas for receive and transmit. The measurements are performed by using R&S TS8997 (Ref.No. 693) test system which is able to perform measurements simultaneously and time-synchronized on maximum 8 antenna conducted RF-ports. A common trigger ensures the sampling time is minimized so the total power represents a sampling value calculated for all 8-ports simultaneously for each time bin/frame. A high data sampling rate together with a wide band power measurement capability ensures that latest modulation schemes are correctly measured. Therefore testing method Subchapter E1 of KDB662911 is fulfilled. (measure-and-sum technique).

Schematic:



Schematic MIMO (if MIMO device):



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 7)

Measurement is made using Rohde & Schwarz TS8997 test system.

Test method	Maximum peak conducted output power(RBW = DTS-bandwidth of the signal)
SISO	☒
MIMO	☐ Summation of values from two antenna ports
Remarks	-

The measurement was performed in non-hopping transmission mode with the carrier set to lowest/middle and highest channel.

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

4.2.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.2.3 Limit

Frequency Range [MHz]	Application	FCC Limit [mW] / [dBm] ☒
5150-5250	Outdoor access point	1000 + antenna gain max. 6dBi + Elevation > 30° 21 dBm EIRP
5150-5250	Indoor Access Point	1000 + antenna gain max. 6dBi
5150-5250	Mobile & Portable client	250 (24) + antenna gain max. 6dBi
5150-5250	Vehicle	--
5150-5250	--	--
5250-5350	--	250 (24) or 11dBm+10log10(B)
5250-5350	Vehicle	--
5470-5725	--	250 (24) or 11dBm+10log10(B) + Antenna gain < 6dBi
5725-5850	--	1000 (30) If Antenna gain more 6dBi (-> reduction necessary)

4.2.4 Results

External Antenna

a-mode 20 MHz BW [6Mbps]

Mode	Power settings	DUT Frequency (MHz)	Gated RMS (dBm)	FCC Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
FCC External; 5180MHz	12	5180.000000	11.95	24.0	9.10	99.310	PASS
FCC External; 5200MHz	12	5200.000000	10.75	24.0	7.90	99.301	PASS
FCC External; 5220MHz	12	5220.000000	9.65	24.0	6.80	99.311	PASS
FCC External; 5240MHz	12	5240.000000	9.05	24.0	6.20	99.310	PASS
FCC External; 5745MHz	17	5745.000000	15.65	30.0	12.80	99.298	PASS
FCC External; 5765MHz	17	5765.000000	16.05	30.0	13.20	99.298	PASS
FCC External; 5785MHz	17	5785.000000	16.25	30.0	13.40	99.299	PASS
FCC External; 5805MHz	17	5805.000000	15.75	30.0	12.90	99.299	PASS
FCC External; 5825MHz	17	5825.000000	15.55	30.0	12.70	99.297	PASS

n-mode 40 MHz BW [MCS0]

Mode	Power settings	DUT Frequency (MHz)	Gated RMS (dBm)	FCC Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
FCC External; 5190MHz	10	5190.000000	9.45	24.0	6.60	98.498	PASS
FCC External; 5230MHz	13	5230.000000	8.35	24.0	5.50	98.474	PASS
FCC External; 5755MHz	17	5755.000000	16.55	30.0	13.70	98.490	PASS
FCC External; 5795MHz	17	5795.000000	16.75	30.0	13.90	98.490	PASS

ac-mode 80 MHz BW [MCS0]

Mode	Power settings	DUT Frequency (MHz)	Gated RMS (dBm)	FCC Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
FCC External; 5210MHz	10	5210.000000	8.25	24.0	5.40	97.021	PASS
FCC External; 5775MHz	15	5775.000000	14.25	30.0	11.40	96.928	PASS

Internal Antenna

a-mode 20 MHz BW [6Mbps]

Mode	Power settings	DUT Frequency (MHz)	Gated RMS (dBm)	FCC Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
FCC Internal; 5180MHz	12	5180.000000	10.55	24.0	11.00	99.298	PASS
FCC Internal; 5200MHz	12	5200.000000	10.35	24.0	10.80	99.299	PASS
FCC Internal; 5220MHz	12	5220.000000	9.75	24.0	10.20	99.303	PASS
FCC Internal; 5240MHz	12	5240.000000	8.65	24.0	9.10	99.301	PASS
FCC Internal; 5745MHz	17	5745.000000	16.45	30.0	16.90	99.299	PASS
FCC Internal; 5785MHz	17	5785.000000	16.95	30.0	17.40	99.299	PASS
FCC Internal; 5825MHz	17	5825.000000	16.05	30.0	16.50	99.296	PASS

n-mode 40 MHz BW [MCS0]

Mode	Power settings	DUT Frequency (MHz)	Gated RMS (dBm)	FCC Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
FCC Internal; 5190MHz	10	5190.000000	8.55	24.0	9.00	98.484	PASS
FCC Internal; 5230MHz	13	5230.000000	10.05	24.0	10.50	98.484	PASS
FCC Internal; 5755MHz	17	5755.000000	17.45	30.0	17.90	98.477	PASS
FCC Internal; 5795MHz	17	5795.000000	17.45	30.0	17.90	98.487	PASS

ac-mode 80 MHz BW [MCS0]

Mode	Power settings	DUT Frequency (MHz)	Gated RMS (dBm)	FCC Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
FCC Internal; 5210MHz	10	5210.000000	8.05	24.0	8.50	97.064	PASS
FCC Internal; 5775MHz	15	5775.000000	15.15	30.0	15.60	96.912	PASS

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

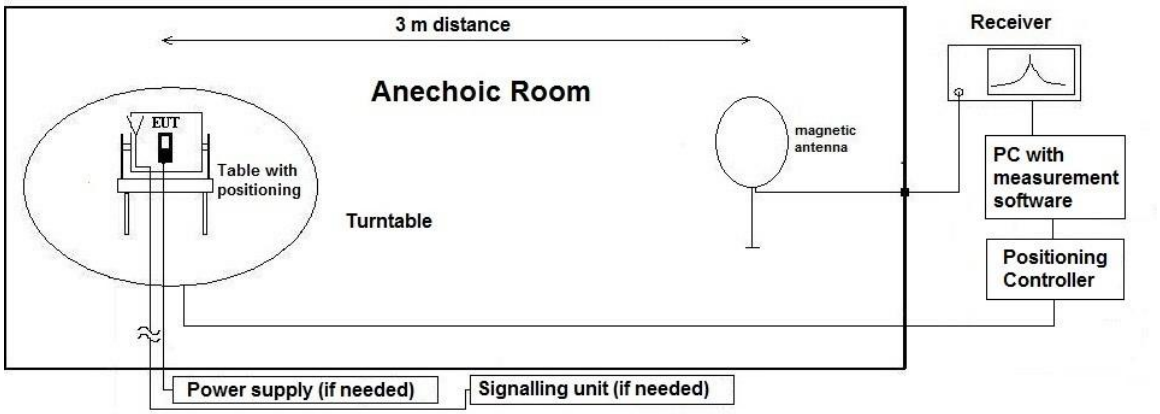
4.3 Radiated field strength emissions below 30 MHz

4.3.1 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 7)

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 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 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.

4.3.2 Measurement Location

Test site	120901 - 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)	2nd Condition (Limit distance bigger dnear-field)	Distance Correction accord. Formula
kHz	9.00E+03	33333.33	5305.17	300		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			fullfilled	not fullfilled	-80.00
	9.00E+04	3333.33	530.52			fullfilled	not fullfilled	-80.00
	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	30		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
MHz	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			fullfilled	fullfilled	-24.04
	10.60	28.30	4.50			fullfilled	fullfilled	-23.53
	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

4.3.3 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

4.3.4 Result

4.3.4.1 External Antenna

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 0.009 – 30 MHz	Result
2.01a	157	a-mode | 6MBps | ch157 | laying | PWR15	20.107 @ 21.842 MHz	Passed
2.01b	157	a-mode | 6MBps | ch157 | standing | PWR15	19.581 @ 22.426 MHz	Passed
2.02a	151	n-mode | MCS0 | ch151 | laying | PWR15	20.099 @ 23.038 MHz	Passed
2.02b	151	n-mode | HT40 | MCS0 | ch151 | standing | PWR15	20.287 @ 24.822 MHz	Passed
2.03a	155	ac-mode | VHT80 | MCS0 | ch155 | laying | PWR10	20.401 @ 25.698 MHz	Passed
2.03b	155	ac-mode | VHT80 | MCS0 | ch155 | standing | PWR10	19.416 @ 24.702 MHz	Passed
2.04a	36	a-mode | 6MBps | ch036 | laying | PWR15	18.334 @ 15.498 MHz	Passed
2.04b	36	a-mode | 6MBps | ch036 | standing | PWR15	19.548 @ 24.874 MHz	Passed
2.05a	38	n-mode | MCS0 | ch38 | laying | PWR15	No peaks found	Passed
2.05b	38	n-mode | MCS0 | ch038 | standing | PWR15	19.924 @ 22.66 MHz	Passed
2.06a	42	ac-mode | VHT80 | MCS0 | ch42 | laying | PWR10	20.208 @ 28.614 MHz	Passed
2.06b	42	ac-mode | VHT80 | MCS0 | ch42 | standing | PWR10	19.545 @ 24.714 MHz	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

4.3.4.2 Internal Antenna

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 0.009 – 30 MHz	Result
2.11a	157	a-mode | 6MBps | ch157 | laying | PWR15	18.006 @ 16.31 MHz	Passed
2.11b	157	a-mode | 6MBps | ch157 | standing | PWR15	19.412 @ 22.722 MHz	Passed
2.12a	151	n-mode | MCS0 | ch151 | laying | PWR15	17.705 @ 15.582 MHz	Passed
2.12b	151	n-mode | HT40 | MCS0 | ch151 | standing | PWR15	19.860 @ 20.178 MHz	Passed
2.13a	155	ac-mode | VHT80 | MCS0 | ch155 | laying | PWR10	19.644 @ 24.434 MHz	Passed
2.13b	155	ac-mode | VHT80 | MCS0 | ch155 | standing | PWR10	19.468 @ 20.098 MHz	Passed
2.14a	36	a-mode | 6MBps | ch036 | laying | PWR15	No peaks found	Passed
2.14b	36	a-mode | 6MBps | ch036 | standing | PWR15	19.823 @ 25.562 MHz	Passed
2.15a	38	n-mode | MCS0 | ch38 | laying | PWR15	20.978 @ 20.702 MHz	Passed
2.15b	38	n-mode | MCS0 | ch038 | standing | PWR15	20.232 @ 24.214 MHz	Passed
2.16a	42	ac-mode | VHT80 | MCS0 | ch42 | laying | PWR10	20.260 @ 27.498 MHz	Passed
2.16b	42	ac-mode | VHT80 | MCS0 | ch42 | standing | PWR10	19.799 @ 25.846 MHz	Passed

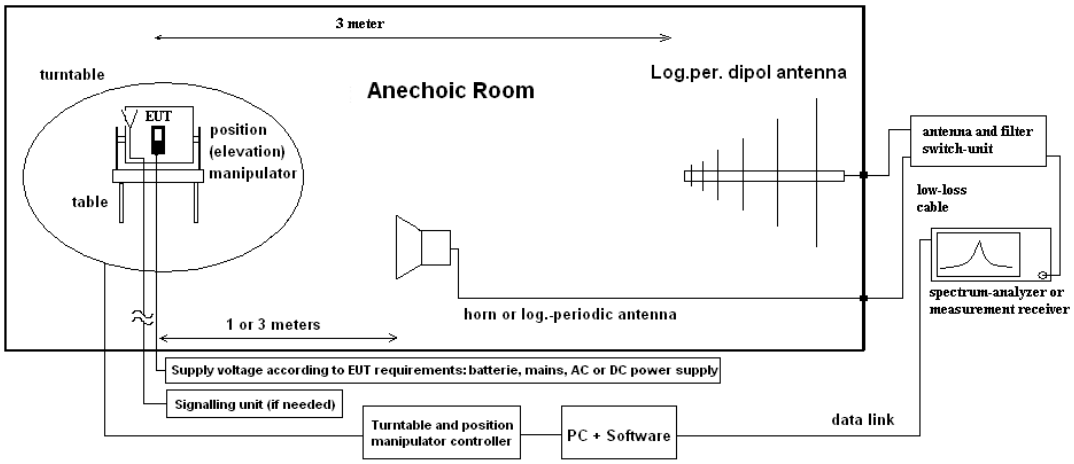
Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

4.4 Radiated field strength emissions 30 MHz – 1 GHz

4.4.1 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 7)

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 main-taining 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.

4.4.2 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

4.4.3 Result

4.4.3.1 External Antenna

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 30 – 1000 MHz	Result
3.01a	157	a-mode | 6MBps | ch157 | laying | PWR15	35,9 @ 794.768 MHz	Passed
3.01b	157	a-mode | 6MBps | ch157 | standing | PWR15	40,53 @ 794.756 MHz	Passed
3.02a	151	n-mode | MCS0 | ch151 | laying | PWR15	33,23 @ 794.712 MHz	Passed
3.02b	151	n-mode | HT40 | MCS0 | ch151 | standing | PWR15	39,95 @ 933.428 MHz	Passed
3.03a	155	ac-mode | VHT80 | MCS0 | ch155 | laying | PWR10	38,42 @ 928.400 MHz	Passed
3.03b	155	ac-mode | VHT80 | MCS0 | ch155 | standing | PWR10	36,48 @ 928.328 MHz	Passed
3.04a	36	a-mode | 6MBps | ch036 | standing | PWR15	36,42 @ 249.996 MHz	Passed
3.04b	36	a-mode | 6MBps | ch036 | laying | PWR15	40,32 @ 927.228 MHz	Passed
3.05a	38	n-mode | MCS0 | ch38 | laying | PWR15	33,54 @ 794.636 MHz	Passed
3.05b	38	n-mode | MCS0 | ch038 | standing | PWR15	40,68 @ 927.240 MHz	Passed

3.06a	42	ac-mode | VHT80 | MCS0 | ch42 | laying | PWR10	36,53 @ 928.380 MHz	Passed
3.06b	42	ac-mode | VHT80 | MCS0 | ch42 | standing | PWR10	36,87 @ 928.408 MHz	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

4.4.3.2 Internal Antenna

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 30 – 1000 MHz	Result
3.11a	157	a-mode | 6MBps | ch157 | standing | PWR15	41.86 @ 857.00 MHz	Passed
3.11b	157	a-mode | 6MBps | ch157 | laying | PWR15	46.24 @ 926.73 MHz	Passed
3.12a	151	n-mode | MCS0 | ch151 | laying | PWR15	42.41 @ 928.36 MHz	Passed
3.12b	151	n-mode | HT40 | MCS0 | ch151 | standing | PWR15	38.69 @ 794.67 MHz	Passed
3.13a	155	ac-mode | VHT80 | MCS0 | ch155 | laying | PWR10	35,88 @ 928.44 MHz	Passed
3.13b	155	ac-mode | VHT80 | MCS0 | ch155 | laying | PWR10	36,55 @ 928.45 MHz	Passed
3.14a	36	a-mode | 6MBps | ch036 | laying | PWR15	36,76 @ 794.31 MHz	Passed
3.14b	36	a-mode | 6MBps | ch036 | standing | PWR15	44,18 @ 928.33 MHz	Passed
3.15a	38	n-mode | MCS0 | ch38 | laying | PWR15	37,43 @ 249.99 MHz	Passed
3.15b	38	n-mode | MCS0 | ch038 | standing | PWR15	37,88 @ 37.88 MHz	Passed
3.16a	42	ac-mode | VHT80 | MCS0 | ch42 | standing | PWR10	33,9 @ 438.15 MHz	Passed
3.16b	42	ac-mode | VHT80 | MCS0 | ch42 | laying | PWR10	37,3 @ 928.33 MHz	Passed

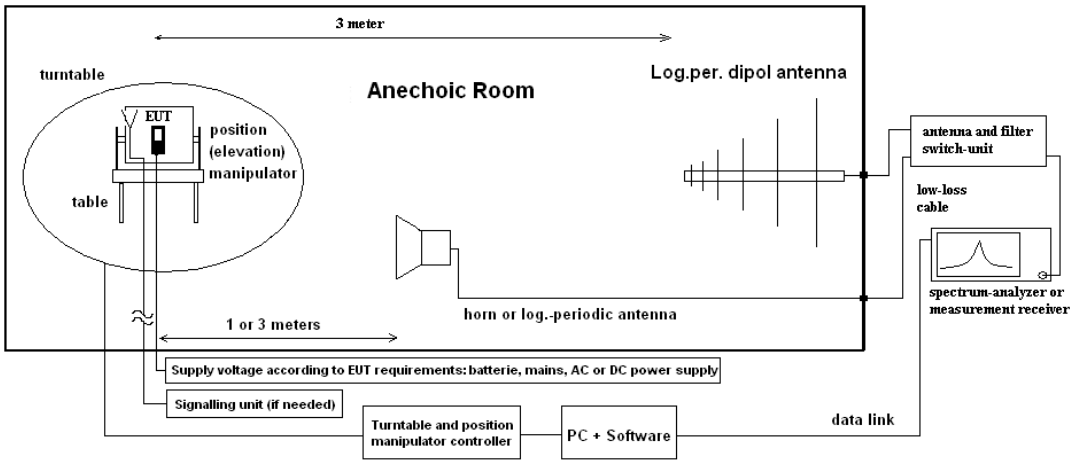
Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

4.5 Radiated field strength emissions above 1 GHz

4.5.1 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 7)

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 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 over 3-orthogonal axis and the height for EUT with large dimensions 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.

4.5.2 Measurement Location

Test site 1 – 16 GHz	120904 - FAC1 - Radiated Emissions
Test site 16 – 26.5 GHz	120904 - FAC1 - Radiated Emissions

4.5.3 Limit

Limit (3 meters)

Frequency Range [MHz]	AV Limit [µV/m]	AV Limit [dBµV/m]	Peak Limit [µV/m]	FCC Peak [dBµV/m] or [dBm/MHz] ☒
Above 1000	500	54	5000	74
5150 – 5250	--	--	--	-27 dBm eirp
5250 – 5350	--	--	--	-27 dBm eirp
5470 – 5725	--	--	--	-27 dBm eirp (-17 dBm/MHz eirp
5725 - 5850	--	--	--	Spectrum mask

4.5.4 Result

4.5.4.1 External Antenna

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 1 – 16GHz	Result
4.01a	157	a-mode | 6MBps | ch157 | laying | PWR15	No peaks found	Passed
4.01b	157	a-mode | 6MBps | ch157 | standing | PWR15	No peaks found	Passed
4.01c	157	a-mode | 6MBps | ch157 | laying | PWR15	No peaks found	Passed
4.01d	157	a-mode | 6MBps | ch157 | standing | PWR15	No peaks found	Passed
4.02a	151	n-mode | HT40 | MCS0 | ch151 | laying | PWR15	No peaks found	Passed
4.02b	151	n-mode | HT40 | MCS0 | ch151 | standing | PWR15	No peaks found	Passed
4.02c	151	n-mode | HT40 | MCS0 | ch151 | laying | PWR15	No peaks found	Passed
4.02d	151	n-mode | HT40 | MCS0 | ch151 | standing | PWR15	No peaks found	Passed
4.03a	155	ac-mode | VHT-80 | VHT-MCS0 | ch155| laying | PWR10	No peaks found	Passed
4.03b	155	ac-mode | VHT-80 | MCS0 | ch155 | standing | PWR10	No peaks found	Passed
4.03c	155	ac-mode | VHT-80 | MCS0 | ch155| laying | PWR 10	No peaks found	Passed
4.03d	155	ac-mode | VHT-80 | MCS0 | ch155| standing | PWR 10	No peaks found	Passed
4.04a	36	a-mode | 6MBps | ch036 | laying | PWR15	No peaks found	Passed
4.04b	36	a-mode | 6MBps | ch036 | standing | PWR15	No peaks found	Passed
4.04c	36	a-mode | 6MBps | ch036 | laying | PWR15	No peaks found	Passed
4.04d	36	a-mode | 6MBps | ch036 | standing | PWR15	No peaks found	Passed
4.05a	38	n-mode | HT40 | MCS0 | ch038 | laying | PWR15	No peaks found	Passed
4.05b	38	n-mode | HT40 | MCS0 | ch038 | Standing | PWR15	No peaks found	Passed
4.05c	38	n-mode | HT40 | MCS0 | ch038 | Laying | PWR15	No peaks found	Passed
4.05d	38	n-mode | HT40 | MCS0 | ch038 | Standing | PWR15	No peaks found	Passed
4.06a	42	ac-mode | VHT-80 | MCS0 | ch042 | laying | PWR10	No peaks found	Passed
4.06b	42	ac-mode | VHT-80 | MCS0 | ch042| standing | PWR 10	No peaks found	Passed
4.06c	42	ac-mode | VHT-80 | MCS0 | ch042 | laying | PWR10	No peaks found	Passed
4.06d	42	ac-mode | VHT-80 | MCS0 | ch042 | standing | PWR 10	No peaks found	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 16 – 26.5GHz	Result
4.01e	157	a-mode | 6MBps | ch157| PWR15	60.05 @ 39.96 GHz (Peak) 51.03 @ 39.99 GHz (Avg)	Passed
4.02e	151	n-mode | HT40 | MCS0 | ch151 | PWR15	59.44 @ 39.08 GHz (Peak) 50.52 @ 39.87 GHz (Avg)	Passed
4.03e	155	ac-mode | VHT-80 | MCS0 | ch042 | PWR 10	59.81 @ 39.52 GHz (Peak) 51.14 @ 39.68 GHz (Avg)	Passed
4.04e	36	a-mode | 6MBps | ch036 |PWR15	59.37 @ 39.66 GHz (Peak) 50.66 @ 39.90 GHz (Avg)	Passed
4.05e	38	n-mode | HT40 | MCS0 | ch38 | PWR15	59.53 @ 39.50 GHz (Peak) 50.78 @ 39.96 GHz (Avg)	Passed
4.06e	42	ac-mode | VHT-80 | MCS0 | ch042 | PWR 10	59.42 @ 39.50 GHz (Peak) 50.75 @ 39.95 GHz (Avg)	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

4.5.4.2 Internal Antenna

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 1 – 16GHz	Result
4.11a	157	a-mode | 6MBps | ch157 | laying | PWR15	No peaks found	Passed
4.11b	157	a-mode | 6MBps | ch157 | standing | PWR15	No peaks found	Passed
4.11c	157	a-mode | 6MBps | ch157 | laying | PWR15	No peaks found	Passed
4.11d	157	a-mode | 6MBps | ch157 | standing | PWR15	No peaks found	Passed
4.12a	151	n-mode | HT40 | MCS0 | ch151| laying | PWR15	No peaks found	Passed
4.12c	151	n-mode | HT40 | MCS0 | ch151| laying | PWR15	No peaks found	Passed
4.12c	151	n-mode | HT40 | MCS0 | ch151| laying | PWR15	No peaks found	Passed
4.12d	151	n-mode | HT40 | MCS0 | ch0151 | standing | PWR15	No peaks found	Passed
4.13a	155	ac-mode | VHT-80 | MCS0 | ch155| laying | PWR15	No peaks found	Passed
4.13b	155	ac-mode | VHT-80 | MCS0 | ch155 | standing | PWR15	No peaks found	Passed
4.13c	155	ac-mode | VHT-80 | MCS0 | ch155| laying | PWR15	No peaks found	Passed
4.13d	155	ac-mode | VHT-80 | MCS0 | ch151 | standing | PWR 15	No peaks found	Passed
4.14a	36	a-mode | 6MBps | ch036 | laying | PWR15	No peaks found	Passed
4.14b	36	a-mode | 6MBps | ch036 | standing | PWR15	No peaks found	Passed
4.14c	36	a-mode | 6MBps | ch036 | laying | PWR15	No peaks found	Passed
4.14d	36	a-mode | 6MBps | ch036 | standing | PWR15	No peaks found	Passed
4.15a	38	n-mode | HT40 | MCS0 | ch038| laying | PWR15	No peaks found	Passed
4.15b	38	n-mode | HT40 | MCS0 | ch151| laying | PWR15	No peaks found	Passed
4.15c	38	n-mode | HT40 | MCS0 | ch151| laying | PWR15	No peaks found	Passed
4.15d	38	n-mode | HT40 | MCS0 | ch0151 | standing | PWR15	No peaks found	Passed
4.16a	42	ac-mode | VHT-80 | MCS0 | ch42 | laying | PWR10	No peaks found	Passed
4.16b	42	ac-mode | VHT-80 | MCS0 | ch042| standing | PWR 10	No peaks found	Passed
4.16c	42	ac-mode | VHT-80 | MCS0 | ch42 | laying | PWR10	No peaks found	Passed
4.16d	42	ac-mode | VHT-80 | MCS0 | ch042 | standing | PWR 10	No peaks found	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

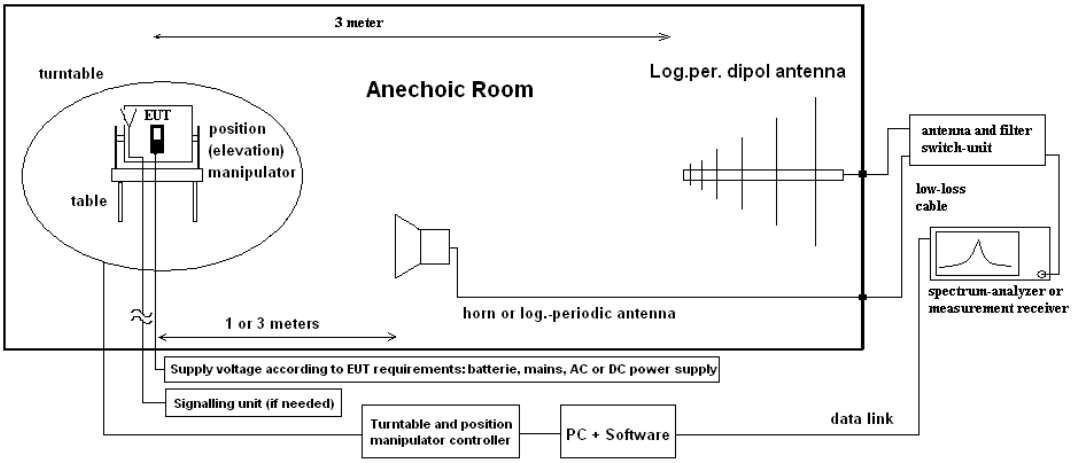
Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 16 – 26.5GHz	Result
4.11e	157	a-mode | 6MBps | ch157| PWR15	60.23 @ 39.53 GHz (Peak) 50.72 @ 39.51 GHz (Avg)	Passed
4.12e	151	n-mode | HT40 | MCS0 | ch151 | PWR15	59.72 @ 39.36 GHz (Peak) 50.94 @ 39.98 GHz (Avg)	Passed
4.13e	155	ac-mode | VHT-80 | MCS0 | ch042 | PWR 10	60.75 @ 39.91 GHz (Peak) 50.61 @ 39.99 GHz (Avg)	Passed
4.14e	36	a-mode | 6MBps | ch036 |PWR15	59.51 @ 39.91 GHz (Peak) 50.88 @ 39.90 GHz (Avg)	Passed
4.15e	38	n-mode | HT40 | MCS0 | ch38 | PWR15	59.42 @ 39.99 GHz (Peak) 50.68 @ 39.96 GHz (Avg)	Passed
4.16e	42	ac-mode | VHT-80 | MCS0 | ch042 | PWR 10	59.36 @ 39.58 GHz (Peak) 50.60 @ 39.99 GHz (Avg)	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

4.6 Band Edge

4.6.1 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 7)

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 is according ANSI C63.10:2013, Chapter 6.10.6 “Marker-Delta method”, 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.

4.6.2 Measurement Location

Test site	120904 - FAC1 - Radiated Emissions

4.6.3 Limit

Frequency Range [MHz]	Pk Limit [dBc]	Detector	RBW / VBW [kHz]
5150 – 5250	≤ 5.150 GHz: 54 dBuV/m (avg), 74 dBuV/m (pk)	Average / Peak	100 / 300
5250 – 5350	≥ 5.350 GHz: 54 dBuV/m (avg), 74 dBuV/m (pk)	Average / Peak	1000 / 3000
5470 – 5725	≤ 5.460 GHz: 54 dBuV/m (avg), 74 dBuV/m (pk) 5.460 – 5.470 GHz: -27 dBm/MHz (pk) equals 68.23 dBuV/m @ 3m	Average / Peak	1000 / 3000
5725 - 5850	All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge5	Peak	1000 / 3000

4.6.4 Result

4.6.4.1 External Antenna

Restricted bands near-by

Diagram	Channel	Mode	Peak [dBc]	Average [dBc]	Result
9.01a	36	a-mode | 6MBps | ch036 | laying | PWR 15	22.94	10.23	PASSED
9.01b	36	a-mode | 6MBps | ch036 | standing | PWR15	18.41	8.29	PASSED
9.03a	36	n-mode | MCS0 | ch036 | laying | PWR 15	20.03	10.11	PASSED
9.03b	36	n-mode | MCS0 | ch036 | standing | PWR 15	19.09	9.04	PASSED
9.05a	36	ac-mode | VHT-MCS0 | ch036 | laying | PWR 15	22.81	10.09	PASSED
9.05b	36	ac-mode | VHT-MCS0 | ch036 | standing | PWR 15	19.10	8.60	PASSED
9.07a	38	n-mode | MCS0 | ch038 | laying | PWR 15	18.60	6.50	PASSED
9.07b	38	n-mode | MCS0 | ch038 | standing | PWR 15	15.25	3.60	PASSED
9.09a	38	ac-mode | VHT-MCS0 | ch038 | laying | PWR 15	19.27	6.64	PASSED
9.09b	38	ac-mode | VHT-MCS0 | ch038 | standing | PWR 15	9.26	0.64	PASSED
9.11a	42	ac-mode | VHT-80 | MCS0 | ch042| laying | PWR 10	23.41	9.52	PASSED
9.11b	42	ac-mode | VHT-80 | MCS0 | ch042| standing | PWR 10	21.88	8.46	PASSED

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

Non-restricted bands near-by

Diagram	Channel	Mode	Peak [dBµV/m]	Average [dBµV/m]	Result
9.13a	149	a-mode | 6MBps | ch149 | laying | PWR 15	67.11	55.20	PASSED
9.13b	149	a-mode | 6MBps | ch149 | standing | PWR 15	71.77	58.84	PASSED
9.14a	165	n-mode | MCS0 | ch165 | laying | PWR 15	64.64	50.90	PASSED
9.14b	165	a-mode | 6MBps | ch165 | standing | PWR 15	68.44	53.86	PASSED
9.15a	149	n-mode | MCS0 | ch149 | laying | PWR 15	68.09	55.05	PASSED
9.15b	149	n-mode | MCS0 | ch149 | standing | PWR 15	75.82	59.11	PASSED
9.16a	165	n-mode | MCS0 | ch165 | laying | PWR 15	65.21	51.73	PASSED
9.16b	165	n-mode | MCS0 | ch165 | standing | PWR 15	70.35	55.21	PASSED
9.17a	149	ac-mode | VHT-MCS0 | ch149 | laying | PWR 15	67.71	54.16	PASSED
9.17b	149	ac-mode | VHT-MCS0 | ch149 | standing | PWR 15	73.55	59.22	PASSED
9.18a	165	ac-mode | VHT-MCS0 | ch165 | laying | PWR 15	65.40	51.81	PASSED
9.18b	165	ac-mode | VHT-MCS0 | ch165 | standing | PWR 15	67.30	54.92	PASSED
9.19a	151	n-mode | MCS0 | ch151 | laying | PWR 15	69.76	56.95	PASSED
9.19b	151	n-mode | MCS0 | ch151 | standing | PWR 15	75.95	60.67	PASSED
9.20a	159	n-mode | MCS0 | ch151 | laying | PWR 15	59.04	49.01	PASSED
9.20b	159	n-mode | MCS0 | ch151 | standing | PWR 15	62.39	51.35	PASSED
9.21a	151	ac-mode | VHT-MCS0 | ch151 | laying | PWR 15	67.74	56.08	PASSED
9.21b	151	ac-mode | VHT-MCS0 | ch151 | standing | PWR 15	72.06	60.29	PASSED
9.22a	159	ac-mode | VHT-MCS0 | ch159 | laying | PWR 15	60.73	49.55	PASSED
9.22b	159	ac-mode | VHT-MCS0 | ch159 | standing | PWR 15	62.48	51.42	PASSED
9.23a	155	ac-mode | VHT-80 || MCS0 | ch155| laying | PWR 15	65.85	56.41	PASSED
9.23b	155	ac-mode | VHT-80 | MCS0 | ch155 | standing | PWR15	68.46	56.55	PASSED
9.24a	155	ac-mode | VHT-80 |MCS0 | ch155| laying | PWR 15	61.32	51.38	PASSED
9.24b	155	ac-mode | VHT-80 | MCS0 | ch155 | standing | PWR15	63.78	52.84	PASSED

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

4.6.4.2 Internal Antenna

Restricted bands near-by

Diagram	Channel	Mode	Peak [dBc]	Average [dBc]	Result
9.31a	36	a-mode | 6MBps | ch036 | laying | PWR 15	22.06	9.61	PASSED
9.31b	36	a-mode | 6MBps | ch036 | standing | PWR 15	20.00	10.38	PASSED
9.33a	36	n-mode | MCS0 | ch036 | laying | PWR 15	21.83	10.14	PASSED
9.33b	36	n-mode | MCS0 | ch036 | standing | PWR 15	19.52	10.25	PASSED
9.35a	36	ac-mode | VHT-MCS0 | ch036 | laying | PWR 15	17.64	9.55	PASSED
9.35b	36	ac-mode | VHT-MCS0 | ch036 | standing | PWR 15	20.00	10.25	PASSED
9.37a	38	n-mode | MCS0 | ch038 | laying | PWR 15	18.38	6.20	PASSED
9.37b	38	n-mode | MCS0 | ch038 | standing | PWR 15	8.30	2.00	PASSED
9.39a	38	ac-mode | VHT-MCS0 | ch038 | laying | PWR 15	19.06	5.93	PASSED
9.39b	38	ac-mode | VHT-MCS0 | ch038 | standing| PWR 15	19.62	9.87	PASSED
9.41a	42	ac-mode | VHT-80 | MCS0 | ch042| laying | PWR 10 | low	24.43	10.53	PASSED
9.41b	42	ac-mode | VHT-80 | MCS0 | ch042| standing | PWR 10	23.49	9.51	PASSED

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

Non-restricted bands near-by

Diagram	Channel	Mode	Peak [dBµV/m]	Average [dBµV/m]	Result
9.43a	149	a-mode | 6MBps | ch149 | laying | PWR 15	67.17	54.58	PASSED
9.43b	149	a-mode | 6MBps | ch149 | standing | PWR 15	61.10	49.96	PASSED
9.44a	165	a-mode | 6MBps | ch165 | laying | PWR 15	66.16	52.25	PASSED
9.44b	165	a-mode | 6MBps | ch165 | standing | PWR 15	57.61	47.58	PASSED
9.45a	149	n-mode | MCS0 | ch149 | laying | PWR 15	67.85	55.13	PASSED
9.45b	149	n-mode | MCS0 | ch149 | standing | PWR 15	63.70	52.00	PASSED
9.46a	165	n-mode | MCS0 | ch165 | laying | PWR 15	64.62	51.30	PASSED
9.46b	165	n-mode | MCS0 | ch165 | standing | PWR 15	57.65	47.71	PASSED
9.47a	149	ac-mode | VHT-MCS0 | ch149 | laying | PWR 15	70.15	56.07	PASSED
9.47b	149	ac-mode | VHT-MCS0 | ch149 | standing | PWR 15	63.70	50.70	PASSED
9.48a	165	ac-mode | VHT-MCS0 | ch165 | laying | PWR 15	64.26	50.87	PASSED
9.48b	165	ac-mode | VHT-MCS0 | ch165 | standing | PWR 15	58.92	48.07	PASSED

9.49a	151	n-mode | MCS0 | ch151 | laying | PWR 15	70.69	56.83	PASSED
9.49b	151	n-mode | MCS0 | ch151 | standing | PWR 15	63.70	53.30	PASSED
9.50a	159	n-mode | MCS0 | ch159 | laying | PWR 15	59.38	49.00	PASSED
9.50b	159	n-mode | MCS0 | ch159 | standing | PWR 15	57.20	47.37	PASSED
9.51a	151	ac-mode | VHT-MCS0 | ch151 | laying | PWR 15	68.35	56.43	PASSED
9.51b	151	ac-mode | VHT-MCS0 | ch151 | standing | PWR 15	65.00	52.00	PASSED
9.52a	159	ac-mode | VHT-MCS0 | ch159 | laying | PWR 15	60.44	49.50	PASSED
9.52b	159	ac-mode | VHT-MCS0 | ch159 | standing | PWR 15	57.11	47.31	PASSED
9.53a	155	ac-mode | VHT-80 || MCS0 | ch155| laying | PWR 15	65.18	53.73	PASSED
9.53b	155	ac-mode | VHT-80 || MCS0 | ch155| standing | PWR 15	64.04	53.39	PASSED
9.54a	155	ac-mode | VHT-80 || MCS0 | ch155| laying | PWR 15	61.36	50.27	PASSED
9.54b	155	ac-mode | VHT-80 || MCS0 | ch155| standing | PWR 15	61.08	49.92	PASSED

Remark: for more information and graphical plot see annex A1 **CETECOM_TR18_1_0097201T22a_C02_A1**

4.7 Results from external laboratory

None	-

4.8 Opinions and interpretations

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	

ID	Description	Manufacturer	SerNo	Cal due date
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	02.10.2020
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})	CISPR 16-2-1	9 kHz - 150 kHz 150 kHz - 30 MHz	4.0 dB 3.6 dB						-
Radiated emissions Enclosure	CISPR 16-2-3	30 MHz - 1 GHz 1 GHz - 18 GHz	4.2 dB 5.1 dB						E-Field
Disturbance power	CISPR 16-2-2	30 MHz - 300 MHz	-						-
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 30 MHz - 1 GHz 1 GHz - 18 GHz 18 GHz – 26.5 GHz 26.5 GHz – 40 GHz	5.0 dB 4.2 dB 4.91 dB 5.06 dB 5.52 dB						Magnetic field E-field

7 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2020-07-30
C01	Added FCC ID and ISED ID below table Summary of test results	2021-07-16
C02	Updated Conducted output power values and EIRP values (p. 12, p. 16/17)	2021-09-08

End Of Test Report