

PARTIAL Test Report

20-1-0060701T51a



Number of pages: 25 **Date of Report:** 2021-Jun-02

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Applicant: VALEO Telematik und Akustik GmbH

Product: Telematic Device
Model: ATM-02-ROW-R1

FCC ID: QWY-ATM2-R-13 **IC:** --

Testing has been carried out in accordance with: Title 47 CFR, Chapter I
FCC Regulations, Subchapter B
Part 22 Subpart H, Part 27 Subpart C
Part 15, Subpart C, §15.209

Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".

Tested Technology: LTE (4G)

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

Signatures:

Dipl.-Ing. Niels Jeß
Head of Compliance Testing
Authorization of test report

Dipl.-Ing. Ninovic Perez
Senior Test manager
Responsible of test report

Table of Contents

Table of Annex.....	2
1.1 Disclaimer and Notes.....	3
1.2 Summary of Test Results	4
1.3 Summary of Test Methods	5
2.1 Identification of the Testing Laboratory	6
2.2 General limits for environmental conditions.....	6
2.3 Test Laboratories sub-contracted.....	6
2.4 Organizational Items	6
2.5 Applicant’s details	6
2.6 Manufacturer’s details	6
2.7 EUT: Type, S/N etc. and short descriptions used in this test report	7
2.8 Auxiliary Equipment (AE): Type, S/N etc. and short descriptions.....	7
2.9 Connected cables	7
2.10 Software.....	7
2.11 EUT set-ups	7
2.12 EUT operation modes.....	8
3.1 General Data of Main EUT as Declared by Applicant.....	9
3.2 Detailed Technical data of Main EUT as Declared by Applicant	10
3.3 Worst case identification.....	10
3.4 Modifications on Test sample.....	10
4.1 Conducted RF output power	11
4.2 Peak to Average ratio (PAPR)	13
4.3 Radiated field strength emissions below 30 MHz	14
4.4 Radiated spurious emissions	18
4.5 Radiated Band Edge.....	20
4.6 Results from external laboratory.....	22
4.7 Opinions and interpretations	22
4.8 List of abbreviations	22

Table of Annex			
Annex No.	Contents	Reference Description	Total Pages
Annex 1	Test result diagrams	CETECOM_TR20-1-0060701T51a_A1	17
Annex 2	Internal photographs of EUT	Not applicable	--
Annex 3	External photographs of EUT	CETECOM_TR20-1-0060701T51a_A3	8
Annex 4	Test set-up photographs	CETECOM_TR20-1-0060701T51a_A4	5
The listed attachments are separate documents.			

1 General information

1.1 Disclaimer and Notes

The test results of this test report relate exclusively to the test item specified in this test report as specified in chapter 2.7. CETECOM does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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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.

1.2 Summary of Test Results

Test case in LTE5 band	Reference Clause FCC <input checked="" type="checkbox"/>	Page	Remark	Result
AC-Power Lines Conducted Emissions	§15.207(a)	--	N/A	--
Conducted RF output power	§22.913(a)(5), §2.1046	12	--	PASSED
Radiated RF output power	§22.913, §2.1046(a)	--	calculated	PASSED
26dB Emission bandwidth	§22.917(b), §2.1049(h)	--	NP	See initial modules results
Occupied Channel Bandwidth 99%	§22.917(b), §2.1049(h)	--	NP	See initial modules results
Radiated Band Edge	§22.917(a)(b), §2.1053(a), §2.1057(a)	21	--	PASSED
Conducted RF Band Edge	§22.917(a)(b), §2.1051	--	--	See initial modules results
Peak to Average ratio (PAPR)	§22.913(a)(5), §2.1046	13	--	PASSED
Radiated field strength emissions below 30 MHz	§15.205, §15.209	17	--	PASSED
Spurious emissions at antenna terminals	§22.917(a)(b), §2.1051	--	--	See initial modules results
Radiated spurious emissions	§22.917(a)(b), §2.1053(a)	19	--	PASSED
Frequency stability, temperature variation	§22.355, §2.1055(a)(1)	--	NP	See initial modules results
Frequency stability, voltage variation	§22.355, §2.1055(a)(1)	--	NP	See initial modules results
Test case in LTE7 band	Reference Clause FCC	Page	Remark	Result
AC-Power Lines Conducted Emissions	§15.207(a)	--	N/A	--
Conducted RF output power	§27.50(h)(2), §2.1046	12	--	PASSED
Radiated RF output power	§27.50(d)(4) §2.1046(a)	--	calculated	PASSED
26dB Emission bandwidth	§27.53(h)(3) §2.202(a)	--	NP	See initial modules results
Occupied Channel Bandwidth 99%	§27.53(h)(3), §2.202(a)	--	NP	See initial modules results
Radiated Band Edge	§27.53(h), §2.1053(a) §2.1057(a)	21	--	PASSED
Conducted RF Band Edge	§27.53(l), §2.1051	--	--	See initial modules results
Peak to Average ratio (PAPR)	§27.50(h)(2), §2.1046	13	--	PASSED
Radiated field strength emissions below 30 MHz	§15.205, §15.209	17	--	PASSED
Spurious emissions at antenna terminals	§27.53(h), §2.1051	--	--	See initial modules results
Radiated spurious emissions	§27.53(l), §2.1053(a)	19	--	PASSED
Frequency stability, temperature variation	§27.54, §2.1055(a)(1)	--	NP	See initial modules results
Frequency stability, voltage variation	§27.54, §2.1055(a)(1)	--	NP	See initial modules results

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.

*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.

For initial modular report please refer to CETECOM_TR16-1-0050601T35a with FCC-ID QWY-V1233-0 dated 2017-08-30.

1.3 Summary of Test Methods

Test case	Test method
AC-Power Lines Conducted Emissions	ANSI C63.4-2014 § 7, ANSI C63.10-2013 § 6.2
Conducted RF output power	ANSI C63.26:2015, §5.2, KDB 971168 D01 v03r01
Radiated RF output power	ANSI C63.26:2015, §5.2.7, KDB 971168 D01 v03r01
Occupied Channel Bandwidth 99%	ANSI C63.26:2015, §5.4.4, KDB 971168 D01 v03r01
26dB Emission bandwidth	ANSI C63.26:2015, §5.4.3, KDB 971168 D01 v03r01
Modulation characteristics	ANSI C63.26:2015, §5.3
Radiated Band Edge	ANSI C63.26:2015, §5.5, KDB 971168 D01 v03r01
Conducted RF Band Edge	ANSI C63.26:2015, §5.7, KDB 971168 D01 v03r01
Peak to Average ratio (PAPR)	ANSI C63.26:2015, §5.2.6
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 C63.4-2014 §5.3, §8.2.1, §8.3.1.1+§8.3.2.1
Spurious emissions at antenna terminals	ANSI C63.26:2015, §5.7, KDB 971168 D01 v03r01
Radiated spurious emissions	ANSI C63.26:2015, §5.5, KDB 971168 D01 v03r01, ANSI C63.26.1:2018

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:	--
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2.4 Organizational Items

Responsible test manager:	Dipl.-Ing. Christian Lorenz
Receipt of EUT:	2020-Nov-05
Date(s) of test:	2021-Mar-10 – 2021-Apr-12
Version of template:	14.6

2.5 Applicant's details

Applicant's name:	VALEO Telematik und Akustik GmbH
Address:	Max-Planck-Str. 28-32 61381 Friedrichsdorf Germany
Contact Person:	Martin Fleckenstein
Contact Person's Email:	martin.fleckenstein@valeo.com

2.6 Manufacturer's details

Manufacturer's name:	VALEO Telematik und Akustik GmbH
Address:	Max-Planck-Str. 28-32 61381 Friedrichsdorf Germany

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

Short description*)	PMT Sample No.	Product	Model	Type	S/N	HW status	SW status
EUT 01	20-1-00607S223_C01	Telematic Device	ATM-02-ROW-R1	N/A	1140644	103.006.006	010.003.042
EUT 02	20-1-00607S17_C01	Automotive Antenna Roof-Pod	64177 / DA WAVE LOW 5G-ROW	N/A	0822	AI04	--

*) 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 01	20-1-00607S53_C01	Metal Plate	--	--	--	--
AE 02	21-1-00251S12_C01	EMV Testbox ATM-01 / ATM-02	--	S12	--	--
AE 03	20-1-00607S224_C01	EMC Switchbox	--	97	--	--
AE 04	20-1-00607S40_C01	Antenna	--	--	--	--

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

2.9 Connected cables

Short description*)	PMT Sample No.	Cable type	Connectors	Length
CAB 01	20-1-00607S125_C01	Cable Harness	N/A	< 3 m
CAB 02	20-1-00607S169_C01	Power Cable	N/A	< 3 m

*) 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 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 01 + EUT 02 + AE 01 + AE 02 + AE 03 + CAB 01 + CAB 02	Used for Radiated measurements
2	EUT 01 + AE 02 + AE 03 + AE 04 + CAB 01 + CAB 02	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
Operating mode 1	LTE FDD Band 5 Traffic	UE allocated channel 20525 (fc = 836.5.0MHz); Channel Bandwidth: 10MHz; # RB: 12; RB Pos: start 19; Modulation: QPSK
Operating mode 2	LTE FDD Band 7 Traffic	<p>Frequency / channel range: UL:2500 to 2569.90 MHz, DL: 2620 to 2689.90 MHz / Channel: UL: 20750 to 21449, DL: 2750 to 3449.</p> <p>A Communication link has been established between Wideband Radio Communication Tester CMW500 and EUT, Uplink Channel: 21100, Uplink frequency: 2535 MHz, RB:12, Start RB:19, BW:10 MHz, Downlink Frequency: 2655 MHz</p>

*) 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	Telematic device		
Kind of product	ATM-02-ROW-R1		
Firmware	<input checked="" type="checkbox"/> for normal use	<input type="checkbox"/> Special version for test execution	
	<input type="checkbox"/> AC Mains	-	
	<input checked="" type="checkbox"/> DC Mains	12 V DC via XX Connector	
	<input type="checkbox"/> Battery	-	
Operational conditions	T _{nom} =21 °C	T _{min} =-40 °C	T _{max} =90 °C
EUT sample type	Pre-Production		
Weight	268 g		
Size [LxWxH]	--		
Interfaces/Ports	--		
For further details refer Applicants Declaration & following technical documents <i>[Annex 1 Specification + add tech docs] 11_ATM-02_Test_setup_instruction</i> <i>[Annex 1 Specification + add tech docs] 01_ATM-02_Product specification sheet</i>			

3.2 Detailed Technical data of Main EUT as Declared by Applicant

TX Frequency range [MHz] and Number of channels	<input type="checkbox"/> LTE 2	1850 - 1910 (UL), 1930 - 1990 (DL)	UARFCN range 18600 - 19199
	<input type="checkbox"/> LTE 4	1710 - 1755 (UL), 2110 - 2155 (DL)	UARFCN range 19950 - 20399
	<input checked="" type="checkbox"/> LTE 5	824 - 849 (UL), 869 - 894 (DL)	UARFCN range 20400 - 20649
	<input checked="" type="checkbox"/> LTE 7	2505 - 2565 (UL), 2625 - 2685 (DL)	UARFCN range 20775 - 21350
	<input type="checkbox"/> LTE 12	699 - 716 (UL), 2625 - 2685 (DL)	UARFCN range 23010 - 23179
	<input type="checkbox"/> LTE 13	782 - 782 (UL), 751 - 751 (DL)	UARFCN range 23205 - 23230
	<input type="checkbox"/> LTE 17	704 - 716 (UL), 734 - 746 (DL)	UARFCN range 23755 - 23800
	<input type="checkbox"/> LTE 26	814 - 848.9 (UL), 859 - 893.9 (DL)	UARFCN range 26690 - 27039
	<input type="checkbox"/> LTE 28	708 - 743 (UL), 763 - 798 (DL)	UARFCN range 27225 - 27645
	<input type="checkbox"/> LTE 41	2501 - 2685 (UL), 2501 - 2685 (DL)	UARFCN range 39675 - 41490
Type of modulation	QPSK/16-QAM		
Data rates	Downlink Max -- kbps	Uplink Max -- kbps	
Emission designator	Nominal CBW	See initial certification of the module:	
	See modules report 16-1-0050601T34a for telematics row-module V1233-0		
Antenna Type	<input type="checkbox"/> Integrated <input type="checkbox"/> External, no RF- connector <input checked="" type="checkbox"/> External, separate RF-connector		
Antenna gain(s)	LTE band 2 -- dBi	LTE band 12: -- dBi	
	LTE band 4: -- dBi	LTE band 13: -- dBi	
	LTE band 5: -0.6 dBi	LTE band 17: -- dBi	
	LTE band 7: 5.0 dBi	LTE band 26: -- dBi	
	LTE band 41: -- dBi	LTE band 28: -- dBi	
FCC label attached	No		
Test firmware / software and storage location	EUT 01		
For further details refer Applicants Declaration & following technical documents			
Description of Reference Document (supplied by applicant)	Version	Total Pages	
Antenna data sheet (EUT2): Datasheet_WAVE_ROW_Low_9825130_04_20210125	2021-01-25	32	

3.3 Worst case identification

LTE mode	Configuration
LTE B05	5 MHz, ch 20425, 1 RB @ Low
LTE B07	10 MHz, ch 20800, 1 RB @ High

3.4 Modifications on Test sample

Additions/deviations or exclusions	--
---	----

4 Measurements

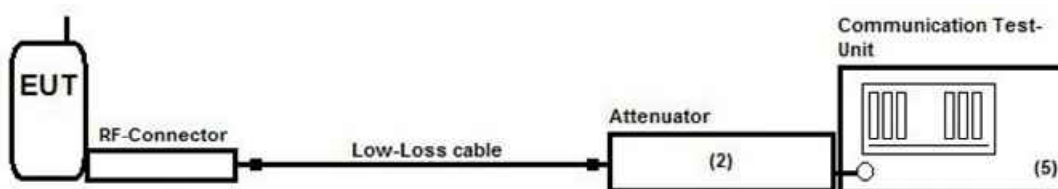
4.1 Conducted RF output power

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

Following modified test set-up apply for tests performed inside the climatic chamber (frequency stability) or conducted RF-carrier power-measurement. The EUT RF-Signal is directly connected over suitable RF-connector over low-loss cable and an attenuator (2) to the cellular radio communication test-unit. (5).

The measurements were performed with the integrated power measurement function of the communication test-unit. (5).

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 5)

EUT settings

The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band within the designated range within the allowed channel bandwidths. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance

4.1.2 Measurement Location

Test site	120911 - Radio Laboratory 2
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4.1.3 Limit

Operation band	Frequency Range [MHz]	FCC Limit [W] ☒
LTE5	824 - 849	7 ERP (38.5 dBm)
LTE7	2502.5 - 2567.5	2 EIRP (33 dBm)

4.1.4 Result

All values in dBm unit.

LTE Band 5			
QPSK		16-QAM	
Peak	RMS	Peak	RMS
25.20	21.45	25.05	21.21

LTE Band 7			
QPSK		16-QAM	
Peak	RMS	Peak	RMS
21.82	18.03	21.54	17.92

Remark:

1. for more information and graphical plot see annex A1 **CETECOM_TR20-1-0060701T51a_A1**

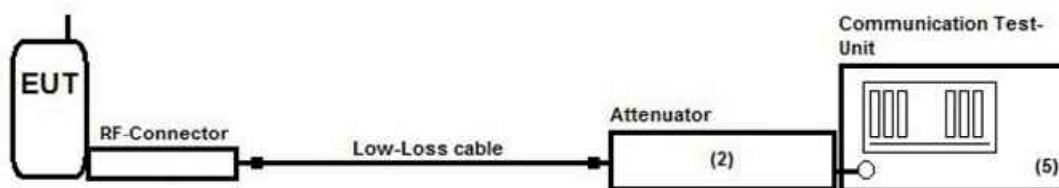
4.2 Peak to Average ratio (PAPR)

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

Following modified test set-up apply for tests performed inside the climatic chamber (frequency stability) or conducted RF-carrier power-measurement. The EUT RF-Signal is directly connected over suitable RF-connector over low-loss cable and an attenuator (2) to the cellular radio communication test-unit. (5).

The measurements were performed with the integrated power measurement function of the communication test-unit. (5).

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 5)

EUT settings

The EUT was set to highest transmit power condition.

4.2.2 Measurement Location

Test site	120911 - Radio Laboratory 2
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4.2.3 Limit

Peak to average power ratio [dB]
≤ 13

4.2.4 Result

Band	Mode	PAPR [dB]	Result
LTE Band 5	16-QAM	3.84	PASSED
LTE Band 7	QPSK	3.79	PASSED

Remark:

2. for more information and graphical plot see annex A1 **CETECOM_TR20-1-0060701T51a_A1**
3. difference from Peak to RMS stated.

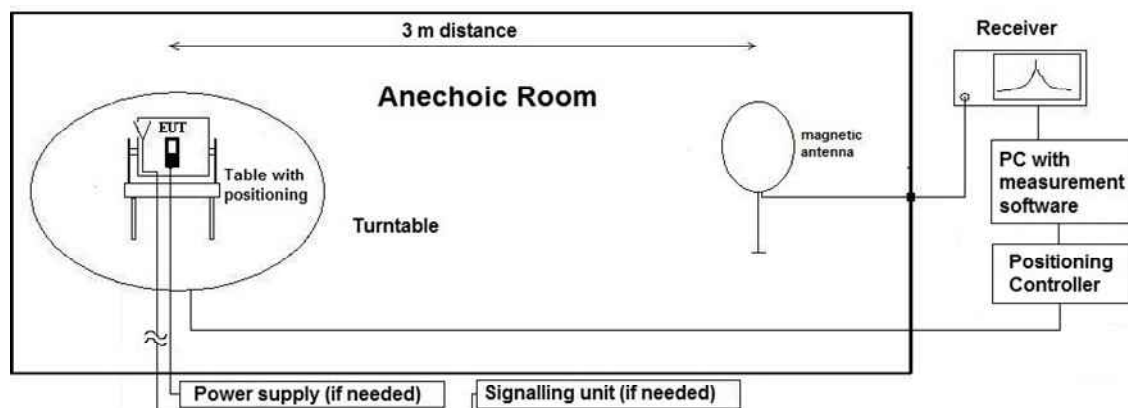
4.3 Radiated field strength emissions below 30 MHz

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 5)

Exploratory, preliminary measurements

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

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

Final measurement on critical frequencies

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

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

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

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

Formula:

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

$$M = L_T - E_C$$

AF = Antenna factor

C_L = Cable loss

D_F = Distance correction factor (if used)

E_C = Electrical field – corrected value

E_R = Receiver reading

G_A = Gain of pre-amplifier (if used)

L_T = Limit

M = Margin

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

4.3.2 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	33333.33	5305.17	300	fulfilled	not fulfilled	-80.00	
	10	30000.00	4774.65		fulfilled	not fulfilled	-80.00	
	20	15000.00	2387.33		fulfilled	not fulfilled	-80.00	
	30	10000.00	1591.55		fulfilled	not fulfilled	-80.00	
	40	7500.00	1193.66		fulfilled	not fulfilled	-80.00	
	50	6000.00	954.93		fulfilled	not fulfilled	-80.00	
	60	5000.00	795.78		fulfilled	not fulfilled	-80.00	
	70	4285.71	682.09		fulfilled	not fulfilled	-80.00	
	80	3750.00	596.83		fulfilled	not fulfilled	-80.00	
	90	3333.33	530.52		fulfilled	not fulfilled	-80.00	
	100	3000.00	477.47		fulfilled	not fulfilled	-80.00	
	125	2400.00	381.97		fulfilled	not fulfilled	-80.00	
	200	1500.00	238.73		fulfilled	fulfilled	-78.02	
	300	1000.00	159.16		fulfilled	fulfilled	-74.49	
	400	750.00	119.37		fulfilled	fulfilled	-72.00	
	490	612.24	97.44		fulfilled	fulfilled	-70.23	
	500	600.00	95.49		30	fulfilled	not fulfilled	-40.00
	600	500.00	79.58			fulfilled	not fulfilled	-40.00
700	428.57	68.21	fulfilled	not fulfilled		-40.00		
800	375.00	59.68	fulfilled	not fulfilled		-40.00		
900	333.33	53.05	fulfilled	not fulfilled		-40.00		
1.00	300.00	47.75	fulfilled	not fulfilled		-40.00		
1.59	188.50	30.00	fulfilled	not fulfilled		-40.00		
2.00	150.00	23.87	fulfilled	fulfilled		-38.02		
3.00	100.00	15.92	fulfilled	fulfilled		-34.49		
4.00	75.00	11.94	fulfilled	fulfilled		-32.00		
5.00	60.00	9.55	fulfilled	fulfilled		-30.06		
6.00	50.00	7.96	fulfilled	fulfilled		-28.47		
7.00	42.86	6.82	fulfilled	fulfilled		-27.13		
8.00	37.50	5.97	fulfilled	fulfilled		-25.97		
9.00	33.33	5.31	fulfilled	fulfilled		-24.95		
10.00	30.00	4.77	fulfilled	fulfilled		-24.04		
10.60	28.30	4.50	fulfilled	fulfilled		-23.53		
11.00	27.27	4.34	fulfilled	fulfilled		-23.21		
12.00	25.00	3.98	fulfilled	fulfilled	-22.45			
13.56	22.12	3.52	fulfilled	fulfilled	-21.39			
15.00	20.00	3.18	fulfilled	fulfilled	-20.51			
15.92	18.85	3.00	fulfilled	fulfilled	-20.00			
17.00	17.65	2.81	not fulfilled	fulfilled	-20.00			
18.00	16.67	2.65	not fulfilled	fulfilled	-20.00			
20.00	15.00	2.39	not fulfilled	fulfilled	-20.00			
21.00	14.29	2.27	not fulfilled	fulfilled	-20.00			
23.00	13.04	2.08	not fulfilled	fulfilled	-20.00			
25.00	12.00	1.91	not fulfilled	fulfilled	-20.00			
27.00	11.11	1.77	not fulfilled	fulfilled	-20.00			
29.00	10.34	1.65	not fulfilled	fulfilled	-20.00			
30.00	10.00	1.59	not fulfilled	fulfilled	-20.00			

4.3.3 Measurement Location

Test site	120901 - SAC - Radiated Emission <1GHz
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4.3.4 Limit

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

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

4.3.5 Result

Diagram	Band	Mode	Maximum Level [$\text{dB}\mu\text{V}/\text{m}$] Frequency Range 0.009 – 30 MHz	Result
2.01	LTE5	Operation mode 1	No peaks found	Passed
2.02	LTE7	Operation mode 2	No peaks found	Passed

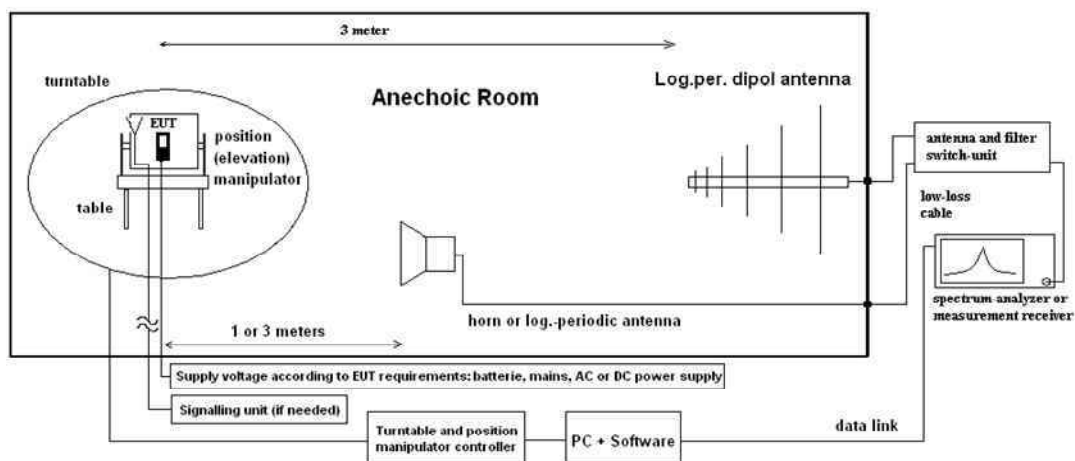
Remark: for more information and graphical plot see annex A1 [CETECOM_TR20-1-0060701T51a_A1](#)

4.4 Radiated spurious emissions

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 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 5)

Exploratory, preliminary measurements

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.50 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 45°) and the EUT itself on 3-orthogonal axis (the emission spectrum and it's 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.

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

The readings on the spectrum analyzer are corrected with conversion value between field strength and E(I)RP, so the readings shown are equivalent to ERP/EIRP values. Critical measurements near the limit are re-measured with a substitution method accord. ANSI/TIA/EIA 603 C/D

Formula:

$$P_{EIRP} = P_{MEAS} + C_L + FSL - G_{PreA} - G_{ANT} \quad (1)$$

P_{MEAS} = measured power at instrument

M = Margin

L_T = Limit

FSL = Free Space loss = Function(frequency, measurement distance)

$$M = L_T - P_{EIRP}$$

C_L = cable loss

G_{PreA} = Gain of pre-amplifier (if used)

G_{ANT} = Gain of antenna in [dBi]

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

4.4.2 Measurement Location

Test site	120904 - FAC1 - Radiated Emissions
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4.4.3 Limit

Operation band	Frequency Range [MHz]	Limit [dBm]	Detector [MaxHold]	RBW / VBW [MHz]
LTE5	30 - 8500	-13	Peak	3 / 3
LTE7	30 - 25700	-13	Peak	3 / 3

4.4.4 Result

Diagram	Band	Mode	30 to 1000 MHz	1 to 2.8 GHz	2.8 to 10 th Harmonics	Stop Freq [MHz]	Result
8.01	LTE5	LTE B5, BW 5MHz, ch, 20425, 1 RB @Low	No peaks found	No peaks found	No peaks found	9000	Passed
8.02a	LTE7	LTE B7, BW 10MHz, ch, 2800, 1 RB @High	No peaks found	No peaks found	No peaks found	2800	Passed
8.02b	LTE7	LTE B7, BW 10MHz, ch, 2800, 1 RB @High	No peaks found	No peaks found	-46.76	20000	Passed
8.02c	LTE7	LTE B7, BW 10MHz, ch, 2800, 1 RB @High	No peaks found	No peaks found	No peaks found	26000	Passed

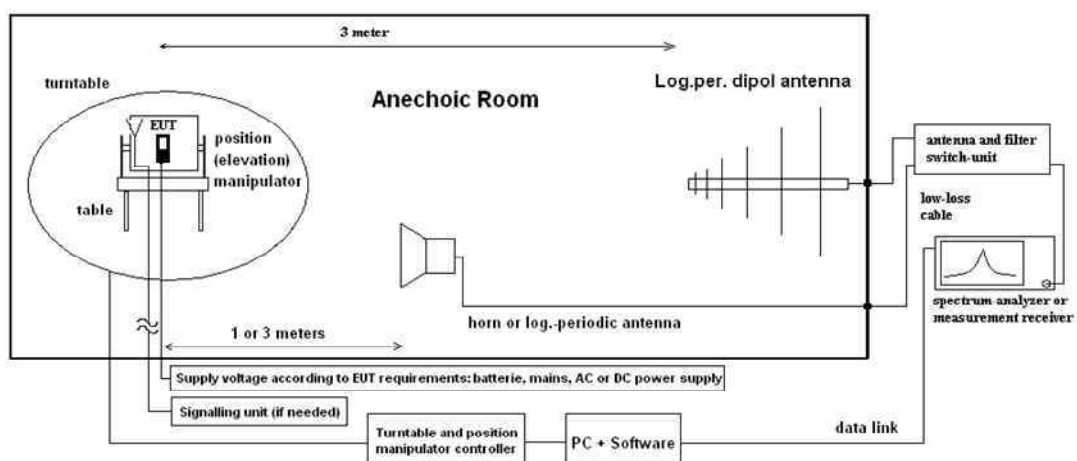
Remark: for more information and graphical plot see annex A1 **CETECOM_TR20-1-0060701T51a_A1**

4.5 Radiated Band Edge

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 16-1-4:2010 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 5)

See chapter Radiated Spurious Emission for Test method.

4.5.2 Measurement Location

Test site	120904 - FAC1 - Radiated Emissions
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4.5.3 Limit

Operation band	Frequency Range [MHz]	Limit [dBm]	Detector [MaxHold]	RBW / VBW [MHz]
LTE5	Below 824 and above 849	-13	Peak	0.02 / 0.2
LTE7	2496 - 2499	-10 (RBW = 1 MHz, VBW = 3 MHz)	Peak	0.03 / 0.3
	2499 – 2500	-10 (RBW = 500 kHz, VBW = 2 MHz)		
	2570 – 2571	-10 (RBW = 500 kHz, VBW = 2 MHz)		
	2571 – 2575	-10 (RBW = 1 MHz, VBW = 3 MHz)		

4.5.4 Result

Diagram	Band	Mode	Edge [Low / High]	Value [dBm]	Result
9.501	LTE5	LTE B5, BW 5MHz, ch, 20425, 1RB low	Low	No peaks found	Passed
9.502	LTE5	LTE B5, BW 5MHz, ch, 20425, RB 100%	Low	No peaks found	Passed
9.503	LTE5	LTE B5, BW 5MHz, ch, 20625, 1RB 100%	High	No peaks found	Passed
9.504	LTE5	LTE B5, BW 5MHz, ch, 20625, 1RB high	High	No peaks found	Passed
9.701	LTE7	LTE B7, BW 10MHz, ch, 2800, 1 RB @low	Low	No peaks found	Passed
9.702	LTE7	LTE B7, BW 10MHz, ch, 2800, 100% RB	Low	No peaks found	Passed
9.703	LTE7	LTE B7, BW 10MHz, ch, 21400, 1RB high	High	No peaks found	Passed
9.704	LTE7	LTE B7, BW 10MHz, ch, 21400, 100% RB	High	No peaks found	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR20-1-0060701T51a_A1**

4.6 Results from external laboratory

None	-
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4.7 Opinions and interpretations

None	-
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4.8 List of abbreviations

None	-
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5 Equipment lists

ID	Description	Manufacturer	SerNo	Cal due date
	120901 - SAC - Radiated Emission <1GHz			2025-Jul-21
20487	CETECOM Semi Anechoic Chamber < 1GHz	ETS-Lindgren GmbH	-	2025-Jul-15
20620	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH	100362	2021-May-13
25038	Loop Antenna HFH2-Z2	Rohde & Schwarz Messgerätebau GmbH	879824/13	2022-Apr-07
20885	Power Supply EA3632A	Agilent Technologies Deutschland GmbH	75305850	
	120904 - FAC1 - Radiated Emissions			
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	81650455	2022-May-25
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	2021-Jul-19
20302	Horn Antenna BBHA9170 (Meas 1)	Schwarzbeck Mess-Elektronik OHG	155	2023-Apr-15
20549	Log. Per. Antenna HL025	Rohde & Schwarz Messgerätebau GmbH	1000060	2021-Jul-31
20720	Measurement Software EMC32 [FAC]	Rohde & Schwarz Messgerätebau GmbH	V10.xx	
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	2022-Jun-16
20690	Spectrum Analyzer FSU	Rohde & Schwarz Messgerätebau GmbH	100302/026	2021-May-23

ID	Description	Manufacturer	SerNo	Cal due date
20439	Ultrabroadband-Antenna HL562	Rohde & Schwarz Messgerätebau GmbH	100248	2023-Mar-10
120911 - Radio Laboratory 2				
20457	DC-Power supply, 0-5A EA-3013 S	EA Elektro-Automatik GmbH & Co. KG	9624680	
20468	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	90090455	2021-May-16

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 its contribution to the overall uncertainty according its statistical distribution calculated.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%						Remarks
Conducted emissions (U _{CISPR})	-	9 kHz - 150 kHz	4.0 dB						-
		150 kHz - 30 MHz	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	5.83 dB						Electrical Field strength
		1 GHz - 18 GHz	4.91 dB						
		18-26.5 GHz	5.06 dB						

7 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2021-Jun-02
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End Of Test Report