

PARTIAL Test Report

20-1-0060701T55a-C1



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

Number of pages:	26	Date of Report:	2021-Jul-28
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:	VALEO Telematik und Akustik GmbH
Product:	Telematic Device		
Model:	ATM-02-US-R1		
FCC ID:	QWY-ATM2-R-11	IC:	6588A-ATM2R11
Testing has been carried out in accordance with:	Title 47 CFR, Chapter I FCC Regulations, Subchapter B Part 22 Subpart H, Part 24 Subpart E RSS-132, Issue 3; RSS-133, Issue 6 + Amendment RSS-Gen, Issue 5 Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
Tested Technology:	GSM		
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. Ninovic Perez Test Lab Manager Authorization of test report B.Sc. Al-Amin Hossain Test manager 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. CETECOM does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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

1.1. Summary of Test Results

Test case in GSM850 band	Reference Clause FCC ☒	Reference Clause ISCED ☒	Page	Remark	Result
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen Issue 5:§8.8	--	NP	--
Conducted RF output power	§2.1046(a)	RSS-132: 5.4 + SRSP 503 :5.1.3	13	--	PASSED
Radiated RF output power	§22.913(a)	4.4	--	Calculated	PASSED
Occupied Channel Bandwidth 99%	§22.917(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	NP	--
26dB Emission bandwidth	§22.917(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	NP	--
Radiated Band Edge	§2.1053(a), §2.1057(a)(1) §22.917(a)(b)	RSS-132, Issue 3: 5.5(i)(ii)	22	--	PASSED
Conducted RF Band Edge	§22.917(a)(b)(c)(d) §2.1051, §2.1057(a)(1)	RSS-132, Issue 3: 5.5(i)(ii)	--	NP	--
Peak to Average ratio (PAPR)	§2.1046(a)	RSS-132: 5.4 + SRSP 503 :5.1.3	14	Calculated	PASSED
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5:	18	--	PASSED
Spurious emissions at antenna terminals	§22.917(a)(b)(c)(d) §2.1051, §2.1057(a)(1)	RSS-132, Issue 3: 5.5(i)(ii)	--	NP	--
Radiated spurious emissions	§2.1053(a), §2.1057(a)(1) §22.917(a)(b)	RSS-132, Issue 3: 5.5(i)(ii)	20	--	PASSED
Frequency stability, temperature variation	§22.355, §2.1055(a)(1) (d)	RSS-Gen, Issue 5 RSS-132: 5.3	--	NP	--
Frequency stability, voltage variation	§22.355, §2.1055(a)(1) (d)	RSS-Gen, Issue 5 RSS-132: 5.3	--	NP	--
Test case in GSM1900 band	Reference Clause FCC	Reference Clause ISCED	Page	Remark	Result
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen Issue 5:§8.8	--	NP	--
Conducted RF output power	§2.1046(a)	RSS-133 4.1/6.4 + SRSP-510 :5.1.2	13	--	PASSED
Radiated RF output power	§24.232(b)	6.4	--	Calculated	PASSED
Occupied Channel Bandwidth 99%	§24.238(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	NP	--
26dB Emission bandwidth	§24.238(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	NP	--
Radiated Band Edge	§2.1053(a), §2.1057(a)(1) §24.238(a)(b)	RSS-133, Issue 6: 6.5.1(i)(ii)	22	--	PASSED
Conducted RF Band Edge	§24.238(a)(b)(c)(d) §2.1051, §2.1057(a)(1)	RSS-133, Issue 6: 6.5.1(i)(ii)	--	NP	--
Peak to Average ratio (PAPR)	§2.1046(a)	RSS-133 4.1/6.4 + SRSP-510 :5.1.2	14	Calculated	Passed
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5:	18	--	PASSED

Spurious emissions at antenna terminals	§24.238(a)(b)(c)(d) §2.1051, §2.1057(a)(1)	RSS-133, Issue 6: 6.5.1(i)(ii)	--	NP	--
Radiated spurious emissions	§2.1053(a), §2.1057(a)(1) §24.238(a)(b)	RSS-133, Issue 6: 6.5.1(i)(ii)	20	--	PASSED
Frequency stability, temperature variation	§24.235, §2.1055(a)(1) (d)	RSS-Gen, Issue 5 RSS-133: 6.3	--	NP	--
Frequency stability, voltage variation	§24.235, §2.1055(a)(1) (d)	RSS-Gen, Issue 5 RSS-133: 6.3	--	NP	--

Remarks:

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

FCC ID: **QWY-V1231-0**

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.

1.2. 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
Frequency stability, temperature variation	ANSI C63.26:2015, §5.6, KDB 971168 D01 v03r01
Frequency stability, voltage variation	ANSI C63.26:2015, §5.6, KDB 971168 D01 v03r01

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: FCC ISED
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:	B.Sc. Al-Amin Hossain
Responsible for test report:	M.Sc. Patrick Marzotko
Receipt of EUT:	2020-Nov-05
Date(s) of test:	2021-Jan-06 – 2021-Jan-12
Version of template:	14.5

2.5 Applicant's details

Applicant's name:	VALEO Telematik und Akustik GmbH
Address:	Max-Planck-Str. 28-32 61381 Friedrichsdorf Hessen 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	20-1-00607S215_C01	Telematic Device	ATM-02-US-R1	--	0000840212	103.006.006	010.003.001
EUT 02	20-1-00607S219_C01	Telematic Device	ATM-02-US-R1	--	0000860473	103.006.006	010.003.001

*) 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	20-1-00607S50_C01	Automotive Antenna Roof-Pod	34116 / DA WAVE LOW 5G US	13-08-20 0229	AI04	--
AE 02	20-1-00607S55_C01	Metal Plate	--	--	--	--
AE 03	21-1-00251S12_C01	EMV Testbox ATM-01 / ATM-02	--	S12	--	--
AE 04	20-1-00607S224_C01	EMC Switchbox	--	97	--	--
AE 05	20-1-00607S40_C01	Antenna	--	--	--	--
AE 06	20-1-00607S243_C01	Automotive Antenna Roof-Pod	34116 / DA WAVE LOW 5G US	26-03-21 0103	AI04	--
AE 07	20-1-00607S253_C01	Antenna Plastic Cover	Black Big	--	--	--
AE 08	20-1-00607S254_C01	Ground Plane	Partial car roof	--	--	--

*) 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	<1 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 + AE 01 + AE 02 + AE 03 + AE 04 + CAB 01 + CAB 02	Used for Radiated measurements.
2	EUT 02 + AE 03 + AE 04 + AE 06 + AE 07 + AE 08 + CAB 01 + CAB 02	Used for Radiated measurements (used for radiated spurious emissions)
3	EUT 01 + AE 03 + AE 04 + AE 05 + 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	GSM 850 Traffic	Frequency / channel range: UL: 824.20 to 848.80 MHz, DL: 869.20 to 993.80 MHz, Channel: UL: 128 to 251, DL: 128 to 251. A Communication link has been established between Radio Communication Tester CMU200 and EUT, Uplink Channel: 128, Uplink frequency: 824.20 MHz, Downlink Frequency: 869.20 MHz
Operating mode 2	GSM 1900 Traffic	Frequency / channel range: UL: 1850.20 to 1909.80 MHz, DL: 1930.20 to 1989.80 MHz, Channel: UL: 512 to 810, DL: 512 to 810. A Communication link has been established between Radio Communication Tester CMU200 and EUT, Uplink Channel: 512, Uplink frequency: 1850.20 MHz, Downlink Frequency: 1930.20 MHz

*) 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-US-R1		
Firmware	☐ for normal use	☒ Special version for test execution	
	☐ AC Mains	-	
	☒ DC Mains	12 V DC	
	☐ Battery	-	
Operational conditions	T _{nom} =21 °C	T _{min} =-40 °C	T _{max} =90 °C
EUT sample type	Production		
Weight	0.3 kg		
Size [LxWxH]	16x10x2 cm		
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	☒ GSM850	824 - 849 MHz (Uplink), 869-894 MHz (Downlink)
	☒ GSM1900	1850 - 1910 MHz (Uplink), 1930-1990 MHz (Downlink)
Number of channels	☒ GSM850	TCH range 128 - 251
	☒ GSM1900	TCH range 512 - 810
Type of modulation	GMSK	
Data rates	Downlink Max -- kbps	Uplink Max -- kbps
Emission designator	Nominal CBW	See initial certification of the module:
	See modules report 16-1-0050601T39a for telematics US-module	
Antenna Type	☐ Integrated	
	☐ External, no RF- connector	
	☒ External, separate RF-connector	
Antenna gain(s)	GSM850: max. -0.2 dBi GSM1900: max. 2.3 dBi	
FCC label attached	No	
Test firmware / software and storage location	EUT 01, EUT 02	
For further details refer Applicants Declaration & following technical documents		
Description of Reference Document (supplied by applicant)		Version
Datasheet_WAVE_US_LOW_9825131_02_20200302		2020-Mar-03
		Total Pages
		34

3.3 Worst case identification

GSM mode	Data rate
Conducted Power verification for GSM 850 has been performed and found the worst case	GSM 850, Channel: 128, Modulation: GMSK
Conducted Power verification for GSM 1900 has been performed and found the worst case	GSM 1900, Channel: 512, Modulation: GMSK

3.4 Modifications on Test sample

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

4 Measurements

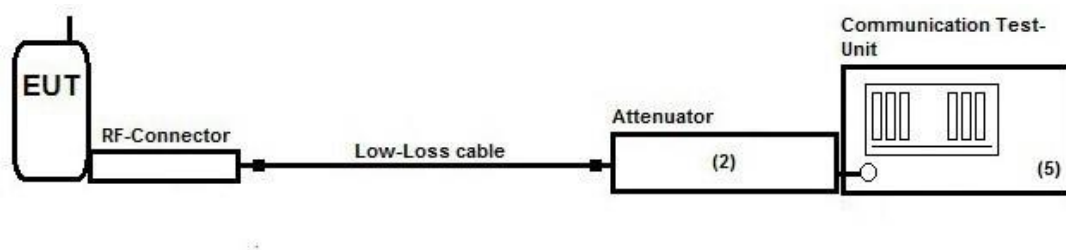
4.1 Conducted RF output power

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

Frequency Range [MHz]	Limit [W]	Limit [dBm]
824 – 849	7 ERP	38.5
1850 – 1910	2 EIRP	33

4.1.4 Result

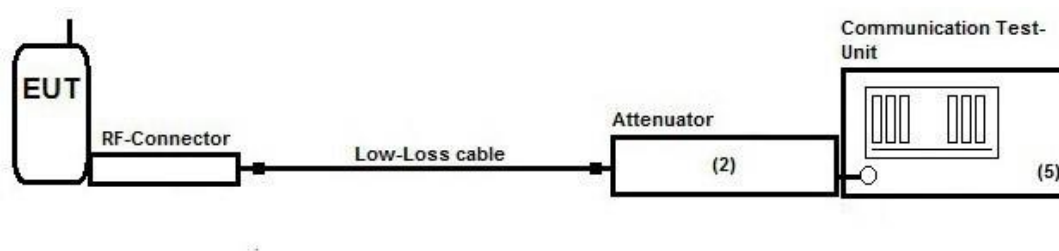
GSM/GPRS/E-GPRS mode										
GMSK-Modulation 850MHz Band	GPRS Mode 1 Slot					GMSK-Modulation 1900MHz Band	GPRS Mode, 1 Slot			
	ARFCN-Frequenc y [MHz]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]			ARFCN-Frequenc y [MHz]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]
Channel 128	824.2	29.80	29.50	0.30		Channel 512	1850.2	24.80	24.60	0.20
Channel 189	836.4	29.70	29.50	0.20		Channel 661	1880.0	24.60	24.40	0.20
Channel 251	848.8	29.70	29.50	0.20		Channel 810	1909.8	24.60	24.40	0.20
E-GPRS Mode 850MHz Band	EDGE/8P SK					E-GPRS Mode 1900MHz Band	EDGE			
	ARFCN-Frequenc y [MHz]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]			ARFCN-Frequenc y [MHz]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]
Channel 128	824.2	27.10	24.10	3.00		Channel 512	1850.2	23.70	20.50	3.20
Channel 189	836.4	27.20	24.00	3.20		Channel 661	1880.0	23.50	20.50	3.00
Channel 251	848.8	27.10	23.90	3.20		Channel 810	1909.8	23.60	20.60	3.00

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
GSM 850	1	0.3	Passed
GSM 1900	2	0.2	Passed
8PSK 850	1	3.2	Passed
8PSK 1900	2	3.2	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR20-1-0060701T55a_C1_A1**

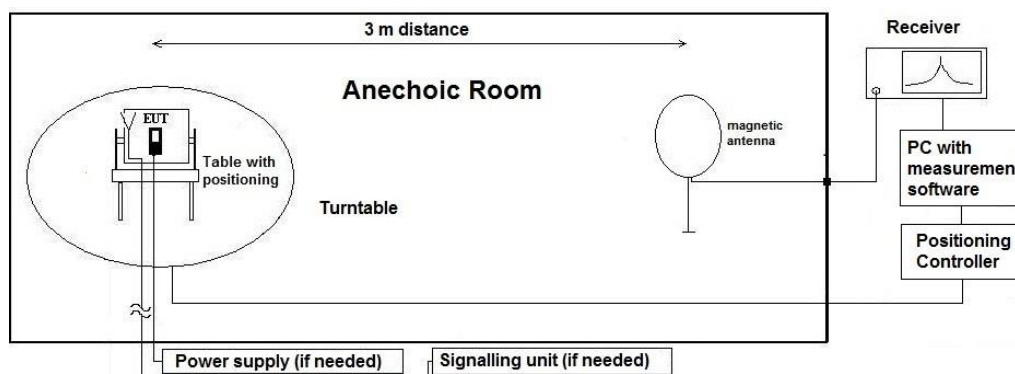
4.3 Radiated field strength emissions below 30 MHz

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 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 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 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 $0.625 \times \lambda$. 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
MHz	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	GSM850	1	No peaks found	Passed
2.02	GSM850	1	No peaks found	Passed
2.03	GSM1900	2	-21.57	Passed
2.04	GSM1900	2	19.59	Passed

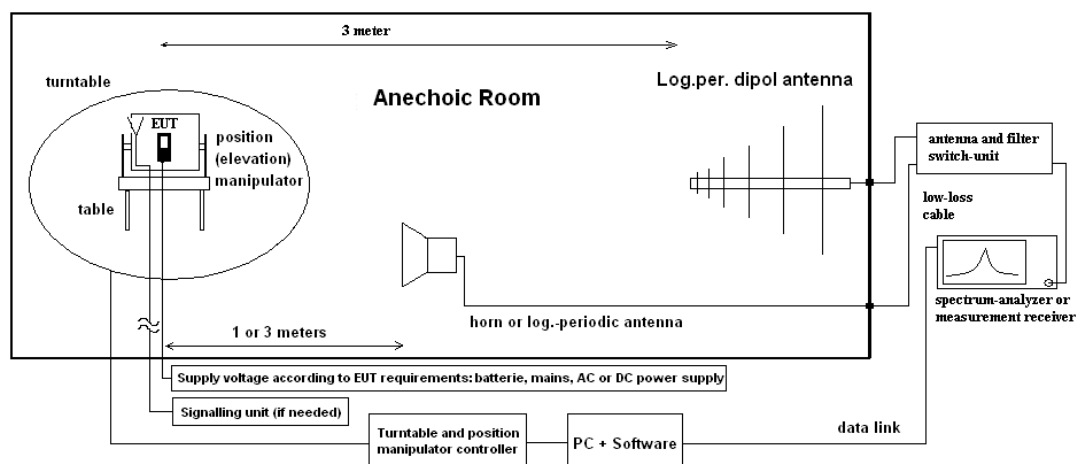
Remark: for more information and graphical plot see annex A1 **CETECOM_TR20-1-0060701T55a_C1_A1**

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:

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

$$EcE(I)RP = E_C - 95.2 \text{ dB}$$

$$M = L_T - EcE(I)RP$$

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)

$EcE(I)RP$ = Electrical field corrected for E(I)RP

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

Frequency Range [MHz]	Limit [dBm]	Detector [MaxHold]	RBW / VBW [MHz]
30 - 8500	-13	Peak	1 / 3
30 - 19100	-13	Peak	1 / 3

4.4.4 Result

Diagram	Band	Mode	30 to 1000 MHz	1 to 2.8 GHz	2.8 to 10 th Harmonics	Result
8.01	GSM850	1	No peaks found	-24.93	No peaks found	Passed
8.02	GSM850	1	No peaks found	No peaks found	-42.69	Passed
8.03	GSM1900	2	No peaks found	No peaks found	-39.79	Passed
8.03a	GSM1900	2	No peaks found	No peaks found	No peaks found	Passed
8.04	GSM1900	2	No peaks found	No peaks found	-42.61	Passed
8.04a	GSM1900	2	No peaks found	No peaks found	No peaks found	Passed

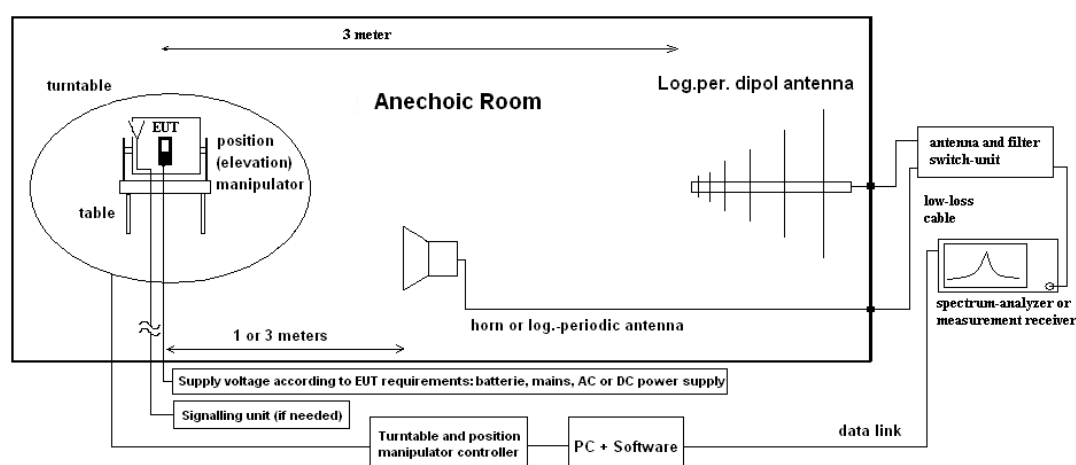
Remark: for more information and graphical plot see annex A1 CETECOM_TR20-1-0060701T55a_C1_A1

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

Frequency Range [MHz]	Limit [dBm]	Detector [MaxHold]	RBW / VBW [kHz]
Below 824 and above 849	-13	Peak	3 / 3
Below 1850 and above 1910	-13	Peak	3 / 3

4.5.4 Result

Diagram	Band	Mode	Edge [Low / High]	Value [dBm]	Result
9.01	GSM850	1	Low	No peaks found	Passed
9.02	GSM850	1	High	No peaks found	Passed
9.1900	GSM1900	2	Low	No peaks found	Passed
9.1901	GSM1900	2	High	No peaks found	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR20-1-0060701T55a_C1_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
20574	Biconilog Hybrid Antenna BTA-L	Frankonia GmbH	980026L	2022-May-03
20487	CETECOM Semi Anechoic Chamber < 1GHz	ETS-Lindgren GmbH	-	2025-Jul-15
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	81650455	2022-May-25
20620	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH	100362	2022-May-13
20482	filter matrix Filter matrix SAR 1	CETECOM GmbH	-	-
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				2022-Apr-30
20489	EMI Test Receiver ESU40	Rohde & Schwarz Messgerätebau GmbH	1000-30	2022-May-13
20254	High Pass Filter 5HC 2600/12750-1.5KK	Trilithic	23042	-
20868	High Pass Filter AFH-07000	AtlanTecRF	16071300004	-
20291	High Pass Filter WHJ 2200-4EE	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	-
20512	Notch Filter WRCA 800/960-02/40-6EEK (GSM 850)	Wainwright Instruments GmbH	24	-
20290	Notch Filter WRCA 901,9/903,1SS	Wainwright Instruments GmbH	3RR	-
20122	Notch Filter WRCB 1747/1748	Wainwright Instruments GmbH	12	-
20121	Notch Filter WRCB 1879,5/1880,5EE	Wainwright Instruments GmbH	15	-
20448	Notch Filter WRCT 1850.0/2170.0-5/40-10SSK	Wainwright Instruments GmbH	5	-

ID	Description	Manufacturer	SerNo	Cal due date
20066	Notch Filter WRCT 1900/2200-5/40-10EEK	Wainwright Instruments GmbH	5	-
20449	Notch Filter WRCT 824.0/894.0-5/40-8SSK	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	2022-Jun-16
20439	Ultrabroadband-Antenna HL562	Rohde & Schwarz Messgerätebau GmbH	100248	2023-Mar-10
20594	Radio Communication Tester CMW500	Rohde & Schwarz Messgerätebau GmbH	101757	2022-Mai-01
	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	2024-Jun-01
20431	Model 7405 Near-Field Probe Set	EMCO Elektronik GmbH	9305-2457	-
20690	Spectrum Analyzer FSU	Rohde & Schwarz Messgerätebau GmbH	100302/026	2023-May-23
20869	VT4002 Klimaschrank	Vötsch Industrietechnik GmbH, a schunk company	521/79152	-

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 150 kHz - 30 MHz	4.0 dB 3.6 dB							-
Power Output radiated	-	30 MHz - 4 GHz	3.17 dB							Substitution method
Power Output conducted	-	Set-up No.	Cel-C1	Cel-C2	BT1	W1	W2	--	-	
		9 kHz - 12.75 GHz	N/A	0.60	0.7	0.25	N/A	--		
		12.75 GHz - 26.5 GHz	N/A	0.82	--	N/A	N/A	--		
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	0.70	N/A	0.69	--	N/A - not applicable	
		2.8 GHz - 12.75 GHz	1.48	N/A	1.51	N/A	1.43	--		
		12.75 GHz – 18 GHz	1.81	N/A	1.83	N/A	1.77	--		
		18 GHz - 26.5 GHz	1.83	N/A	1.85	N/A	1.79	--		
Occupied bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)							Frequency error
			1.0 dB							Power
Emission bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)							Frequency error
	-		See above: 0.70 dB							Power
Frequency stability	-	9 kHz - 20 GHz	0.0636 ppm							-
Radiated emissions Enclosure	-	150 kHz - 30 MHz	5.01dB							Magnetic field strength
		30 MHz - 1 GHz	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-Jul-19
C1	Chapter 3.2, Antenna gain has been updated	2021-Jul-28
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End Of Test Report