PARTIAL Test Report
18-1-0173201T47a-C2

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

Number of pages:	23	**Date of Report:**	2020-Jan-05
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):	Telematics Device / 103250101		
FCC ID:	2AGKK103250101		
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, Part 27 Subpart C** 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		
	The current version of the Test Report CETECOM_TR18_1_0173201T47a_C3 replaces the Test Report CETECOM_TR18_1_0173201T47a_C2 dated 2020-Dec-21. The replaced test report is herewith invalid.		

Signatures:

Ninovic Perez
2021.01.07
12:56:42 +
01'00'

Digital unterschrieben von B.Sc. Mohamed Ahmed
DN: cn=B.Sc. Mohamed Ahmed, o=Cetecom GmbH, ou=RC/EMC, email=mohamed.ahmed@cetecom.com, c=DE
Datum: 2021.01.07 11:32:24 +01'00'

Dipl.-Ing. Ninovic Perez	B.Sc. Mohamed Ahmed
Test Lab Manager	Test manager
Authorization of test report	Responsible of test report

Table of Contents

Table of Annex			
Annex No.	**Contents**	**Reference Description**	**Total Pages**
Annex 1	Test result diagrams	**CETECOM_TR18_1_0173201T47a_C3_A1**	13
Annex 2	Internal photographs of EUT	**CETECOM_TR18_1_0173201T47a_C3_A2**	4
Annex 3	External photographs of EUT	**CETECOM_TR18_1_0173201T47a_C3_A3**	9
Annex 4	Test set-up photographs	**CETECOM_TR18_1_0173201T47a_C3_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. CETECOM does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM.
The testing service provided by CETECOM has been rendered under the current "General Terms and Conditions for CETECOM".
CETECOM will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.
Under no circumstances does the CETECOM test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.
Under no circumstances does the CETECOM test report include or imply any product or service warranties from CETECOM, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CETECOM.
All rights and remedies regarding vendor's products and services for which CETECOM has prepared this test report shall be provided by the party offering such products or services and not by CETECOM.
In no case this test report can be considered as a Letter of Approval.

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

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

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

1.1. Summary of Test Results

Test case in GSM850 band	Reference Clause FCC ☒	Reference Clause ISED ☐	Page	Remark	Result
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen Issue 5:§8.8	--	NA	--
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	--	NP	*1)
Occupied Channel Bandwidth 99%	§22.917(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	NP	*1)
26dB Emission bandwidth	§22.917(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	NP	*1)
Radiated Band Edge	§2.1053(a), §2.1057(a)(1) §22.917(a)(b)	RSS-132, Issue 3: 5.5(i)(ii)	20	--	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	*1)
Peak to Average ratio (PAPR)	§2.1046(a)	RSS-132: 5.4 + SRSP 503 :5.1.3	14	--	PASSED
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5:	17	--	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	*1)
Radiated spurious emissions	§2.1053(a), §2.1057(a)(1) §22.917(a)(b)	RSS-132, Issue 3: 5.5(i)(ii)	19	--	PASSED
Frequency stability, temperature variation	§22.355, §2.1055(a)(1)(d)	RSS-Gen, Issue 5 RSS-132: 5.3	--	NP	*1)
Frequency stability, voltage variation	§22.355, §2.1055(a)(1)(d)	RSS-Gen, Issue 5 RSS-132: 5.3	--	NP	*1)

*1) please refer to module test report no: **I20D00079-SRD26, FCC ID:QIPPLS62-W1**

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.

Test case in GSM1900 band	Reference Clause FCC	Reference Clause ISED	Page	Remark	Result
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen Issue 5:§8.8	--	NA	--
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	--	NP	*1)
Occupied Channel Bandwidth 99%	§24.238(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	NP	*1)
26dB Emission bandwidth	§24.238(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	NP	*1)
Radiated Band Edge	§2.1053(a), §2.1057(a)(1) §24.238(a)(b)	RSS-133, Issue 6: 6.5.1(i)(ii)	20		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	*1)
Peak to Average ratio (PAPR)	§2.1046(a)	RSS-133 4.1/6.4 + SRSP-510 :5.1.2	14		PASSED
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5:	17		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	*1)
Radiated spurious emissions	§2.1053(a), §2.1057(a)(1) §24.238(a)(b)	RSS-133, Issue 6: 6.5.1(i)(ii)	19		PASSED
Frequency stability, temperature variation	§24.235, §2.1055(a)(1)(d)	RSS-Gen, Issue 5 RSS-133: 6.3	--	NP	*1)
Frequency stability, voltage variation	§24.235, §2.1055(a)(1)(d)	RSS-Gen, Issue 5 RSS-133: 6.3	--	NP	*1)

*1) please refer to module test report no: **I20D00079-SRD26, FCC ID:QIPPLS62-W1**

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
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.:	IA4370
Responsible test manager:	B.Sc. Al-Amin Hossain
Receipt of EUT:	2019-Jun-13
Date(s) of test:	2019-Sep-17 – 2020-Jan-09
Version of template:	14.2

2.5 Applicant's details

Applicant's name:	Actia Nordic AB
Address:	Hammarbacken 4A, 3tr 191 49 Sollentuna Sweden
Contact Person:	Salah Alazawi
Contact Person's Email:	salah.alazawi@actia.se

2.6 Manufacturer's details

Manufacturer's name:	Same as Applicant's details.
Address:	Same as 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 01	18-1-01732S32_C01	103250101	Telematics Device	--	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
AE 01	18-1-01732S17_C01	Jinchang Electronic, GNSS+LTE Combination Antenna	1570718**)	--	--	--
AE 02	--	LAPTOP	DELL	CTC 522013	Intel core i5-3340M	Windows 7

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

**)157071x: This is the part number depending on cable length as stated below.

→0.2 m cable: 1570718, 1.05 m cable: 1570719, 1.7 m cable: 1570720, 3.5 m cable: 1570721,
4.3 m cable: 1570722, 5 m cable: 1570723

2.9 Connected cables

Short description*)	PMT Sample No.	Cable type	Connectors	Lenght
CAB 01	18-1-01732S06_C01	Cable Harness	--	< 3 meter
CAB 02	18-1-01732S89_C01	USB Cable	--	< 3 meter

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

2.10 Softwares

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 softwares in this test report.

2.11 EUT set-ups

set-up no.*)	Combination of EUT and AE	Description
set 01	EUT 01 + AE 01 + AE 02 + CAB 01 + CAB 02	➢ Used for Radiated measurements ➢ AE 02 has been used to activate the Cellular mode before start the measurements
set 02	EUT 01 + AE 02 + CAB 01 + CAB 02	➢ Used for Conducted measurements ➢ AE 02 has been used to activate the Cellular mode before start the measurements

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

*) AE 02 and a software(provided by Customer) has been used to activate the Cellular mode.

*) Please check chapter 3.2 for customer provided software information.

2.12 EUT operation modes

EUT operating mode no.*)	Operating modes	Additional information
1	GSM 850	GSM 850 (GPRS)Traffic ➢ Uplink Channel: 189, ➢ Uplink frequency: 836.40 MHz A Communication link has been established between Radio Communication Tester CMU200 and EUT
2	GSM 1900	GSM 1900 (GPRS)Traffic ➢ Uplink Channel:661, ➢ Uplink frequency:1880.0 MHz A Communication link has been established between Radio Communication Tester CMU200 and EUT

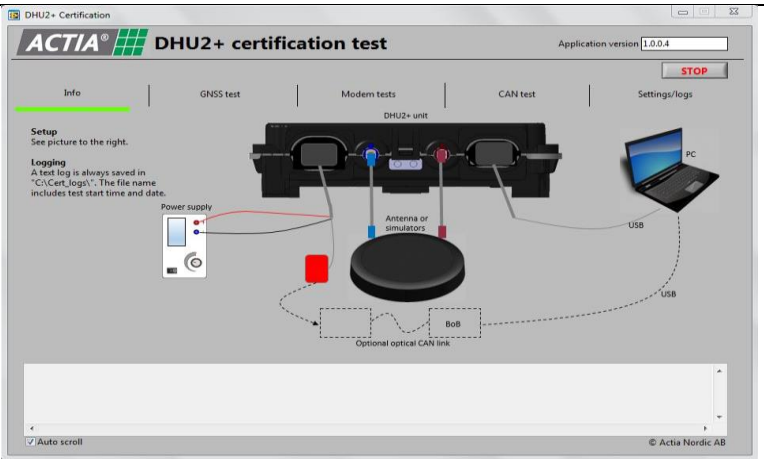
*) EUT operating mode no. is used to simplify the test report.

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Product name	103250101	
Kind of product	Telematics Device	
Firmware	☒ for normal use	☐ Special version for test execution
Power Supply	☐ AC Mains	--
	☒ DC Mains	**12** V DC
	☐ Battery	--
EUT sample type	Pre-Production	
Weight	please check the document “5586_40030_RFQ ACU-C Certification_1.0”	
Size	please check the document” ACU-C updated version for North America 20190321”	
Interfaces/Ports	please check the document” ACU-C updated version for North America 20190321”	
For further details refer Applicants Declaration & following technical documents ➢ ACU-C updated version for North America 20190321 ➢ 5586_40030_RFQ ACU-C Certification_1.0 ➢ 1032-501-01 User Manual_ver1.1 ➢ Product Information - Model 103250101		

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	
Emission designator	Nominal CBW	See initial certification of the module:
	--	**FCC ID:QIPPLS62-W1**
Antenna Type	☐ Integrated	
	☐ External, no RF- connector	
	☒ External, separate RF-connector	
Maximum antenna gain(s)	GSM850: **-0.44** dBi	
	GSM1900: **3.27** dBi	
Test firmware / software		

For further details refer Applicants Declaration & following technical documents

- ACU-C updated version for North America 20190321
- 5586_40030_RFQ ACU-C Certification_1.0
- 1032-501-01 User Manual_ver1.1
- Product Information - Model 103250101
- DHU2+ MPE Information Requirements – v3

3.3 Worst case identification

GSM mode	Worst Case
GSM 850	Channel: 189, Modulation: GMSK
GSM 1900	Channel: 661, Modulation: GMSK

Remarks:

- Worst case has been found from Conducted Power verification Measurements.

3.4 Modifications on Test sample

Additions/deviations or exclusions	--

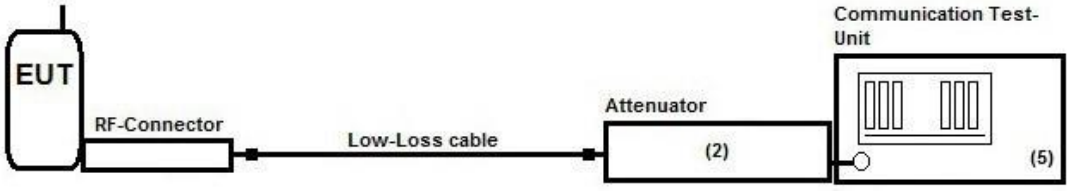
4 Measurements

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	Fula 1

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 850 MHz Band	GPRS Mode 1Slot					**GMSK-Modulation 1900 MHz Band**	GPRS Mode, 1 Slot			
	ARFCN-Frequency [MHz]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]			ARFCN-Frequency [MHz]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]
Channel 128	824.2	32.97	32.40	0.57		Channel 512	1850.2	29.61	29.36	0.25
Channel 189	**836.4**	**33.50**	**33.00**	**0.50**		**Channel 661**	**1880.0**	**29.96**	**29.80**	**0.16**
Channel 251	848.8	33.10	32.40	0.70		Channel 810	1909.8	29.56	29.29	0.27
E-GPRS Mode 850 MHz Band	**EDGE/8PSK**					**E-GPRS Mode 1900 MHz Band**	**EDGE**			
	ARFCN-Frequency [MHz]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]			ARFCN-Frequency [MHz]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]
Channel 128	824.2	29.53	26.42	3.11		Channel 512	1850.2	27.20	24.11	3.09
Channel 189	836.4	29.61	26.48	3.13		Channel 661	1880.0	27.31	24.51	2.80
Channel 251	848.8	29.73	26.56	3.17		Channel 810	1909.8	27.00	24.10	2.90

Conclusion conducted power verification:

All measured power values are below the values of the modular report I20D00079-SRD26 with FCC ID QIPPlS62-W1 dated 2020-08-10 => ERP/ EIRP calculation are based on values measured within this verification.

GSM/GPRS/E-GPRS mode												
GMSK-Modulation 850 MHz Band	GPRS Mode 1 Slot						**GMSK-Modulation 1900 MHz Band**	GPRS Mode, 1 Slot				
	ARFCN-Frequency [MHz]	Peak Power [dBm]	Antenna Gain [dBi]	Ext. Path Loss to antenna (external cables) [dB]	ERP [dBm]			ARFCN-Frequency [MHz]	Peak Power [dBm]	Antenna Gain [dBi]	Ext. Path Loss to antenna (external cables) [dB]	EIRP [dBm]
Channel 128	824.2	32.97	-1.78	1.88	27.16		Channel 512	1850.2	29.61	2.07	2.36	29.32
Channel 189	836.4	33.50	-1.28	1.88	28.19		Channel 661	1880.0	29.96	2.79	2.36	30.39
Channel 251	848.8	33.10	-0.44	1.88	28.63		Channel 810	1909.8	29.56	3.27	2.36	30.47
E-GPRS Mode 850 MHz Band	**EDGE/8PSK**						**E-GPRS Mode 1900 MHz Band**	**EDGE**				
	ARFCN-Frequency [MHz]	Peak Power [dBm]	Antenna Gain [dBi]	Ext. Path Loss to antenna (external cables) [dB]	ERP [dBm]			ARFCN-Frequency [MHz]	Peak Power [dBm]	Antenna Gain [dBi]	Ext. Path Loss to antenna (external cables) [dB]	EIRP [dBm]
Channel 128	824.2	29.53	-1.78	1.88	23.72		Channel 512	1850.2	27.20	2.07	2.36	26.91
Channel 189	836.4	29.61	-1.28	1.88	24.30		Channel 661	1880.0	27.31	2.79	2.36	27.74
Channel 251	848.8	29.73	-0.44	1.88	25.26		Channel 810	1909.8	27.00	3.27	2.36	27.91
ERP = EIRP -2.15							EIRP = Peak Power + Antenna Gain - Ext. Path Loss to antenna (external cables)					

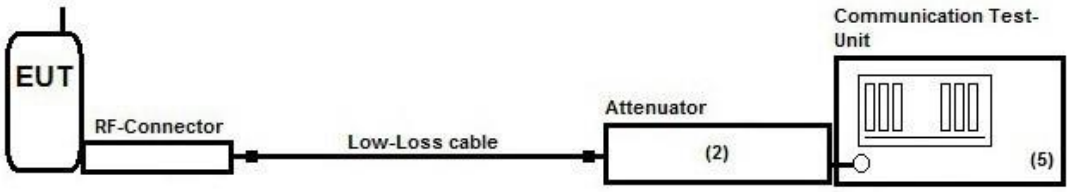
Band	Limit [W]	Limit [dBm]	Verdict
GSM 850	7 ERP	38.5	Passed
GSM 1900	2 EiRP	33	Passed

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	Fula 1

4.2.3 Limit

Peak to average power ratio [dB]
≤ 13

4.2.4 Result

Band	Operating Mode	PAPR [dB]	Result
GSM 850	1	0.50	Passed
GSM 1900	2	0.16	Passed

According KDB 971168D01 v03r01 two method are allowed.
☐ Chapter 5.7.2 Sub clause 5.2.3.4 of ANSI C63.26-2015 CCDF-Method (0.1% probability)
☒ Chapter 5.7.3: Sub clause 5.2.6 of ANSI C63.26-2015 [PAPR (dB)=$\mathbf{P}_{PK}$ (dBm or dBW) – $\mathbf{P}_{Avg}$ (dBm or dBW)]

Remark: for more informations see chapter 4.1.4

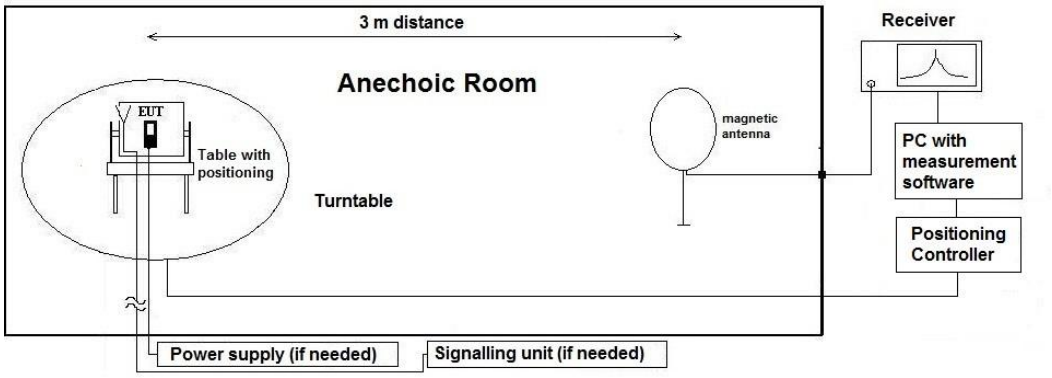
4.3 Radiated field strength emissions below 30 MHz

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 it's 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.

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

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

Frequency -Range	f [kHz/MHz]	Lambda [m]	Far-Field Point [m]	Distance Limit accord. 15.209 [m]		1st Condition (dmeas< Dnear-field)	2'te Condition (Limit distance bigger dnear-field)	Distance Correction accord. Formula
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

4.3.2 Measurement Location

Test site	Semi Anechoic Chamber

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

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

4.3.4 Result

Diagram	Band	Operating mode	Maximum Level [dBµV/m] Frequency Range 0.009 – 30 MHz	Result
2.01	GSM 850	1	No critical frequency found	Passed
2.02	GSM 850	1	No critical frequency found	Passed
2.03	GSM 1900	2	No critical frequency found	Passed
2.04	GSM 1900	2	No critical frequency found	Passed

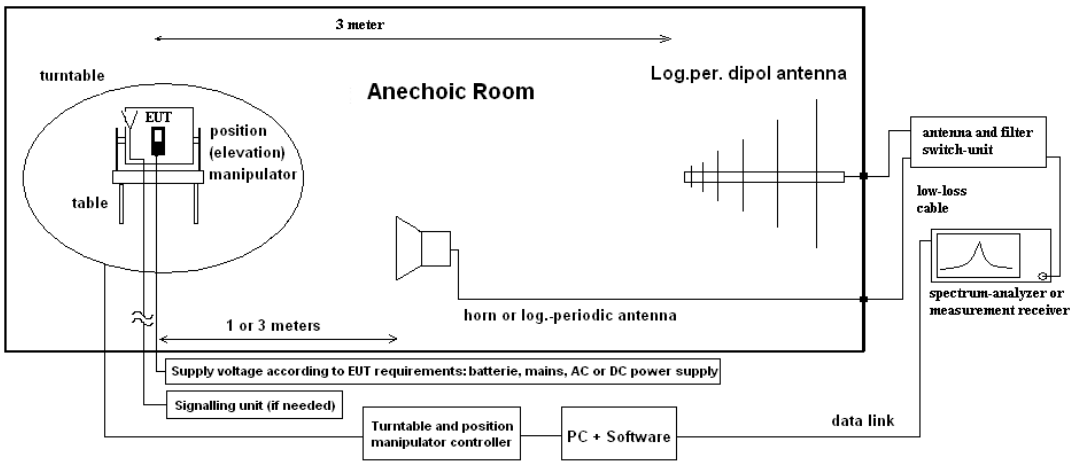
Remark: for more informations and graphical plot see annex A1

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:

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

$EcE(I)RP = Ec - 95.2\ dB$

$M = L_T - EcE(I)RP$

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	Fully Anechoic Chamber 1

4.4.3 Limit

Operation band	Frequency Range [MHz]	Limit [dBm]	Detector [MaxHold]	RBW / VBW [MHz]
GSM 850	30 - 9000	-13	Peak	0.1/0.3 (30-9000 MHz)
GSM 1900	30 - 20000	-13	Peak	0.1/0.3 (30-1000 MHz), 1 / 3 (30-20000 MHz)

4.4.4 Result

Diagram	Band	Operating Mode	30 to 1000 MHz	1 to 2.8 GHz	2.8 GHz to 10th Harmonics	Result
8.01a	GSM 850	1	No critical frequency found	No critical frequency found	--	Passed
8.01b	GSM 850	1	--	--	-30.7 dBm	Passed
8.02	GSM 1900	2	No critical frequency found	No critical frequency found	No critical frequency found	Passed

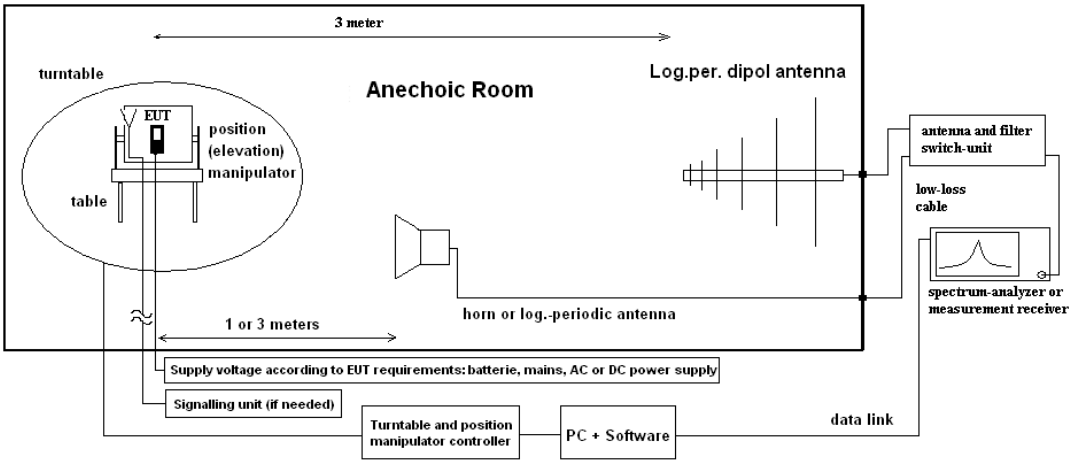
Remark: for more informations and graphical plot see annex A1

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 forTest method.

4.5.2 Measurement Location

Test site	Fully Anechoic Chamber 1

4.5.3 Limit

Frequency Range [MHz]	Limit [dBm]	Detector [MaxHold]	RBW / VBW [kHz]
Below 824 and above 849	-13	Peak	3 / 9
Below 1850 and above 1910	-13	Peak	3 / 9

4.5.4 Result

Diagram	Band	Mode	Edge [Low / High]	Value [dBm]	Result
9.1201	GSM 850	GSM 850_low_channel_128	Low	-19.516	Passed
9.1202	GSM 850	GSM 850_high_channel_251	High	-18.701	Passed
9.1203	GSM 1900	GSM 1900_low_channel_512	Low	-26.634	Passed
9.1204	GSM 1900	GSM 1900_high_channel_810	High	-25.021	Passed

Remark: for more informations and graphical plot see annex A1

4.6 Results from external laboratory

None	--

4.7 Opinions and interpretations

None	--

4.8 List of abbreviations

None	--

5 Equipment lists

ID	Description	Manufacturer	SerNo	Last cal date	Cal due date
120904 - FAC1 - Radiated Emissions					
20720	EMC32 [FAC]	Rohde & Schwarz Messgerätebau GmbH	V10.50.00	--	--
20254	High Pass Filter 5HC 2600/12750-1.5KK (GSM1800/1900/DECT)	Trilithic	23042	20.03.2020	20.03.2021
20868	High Pass Filter AFH-07000	AtlanTecRF	160713000004	20.03.2020	20.03.2021
20291	High Pass Filter WHJ 2200-4EE (GSM 850/900)	Wainwright Instruments GmbH	14	20.03.2020	20.03.2021
20020	Horn Antenna 3115 (Subst 1)	EMCO Elektronik GmbH	9107-3699	19.07.2018	19.07.2021
20549	Log.Per-Antenna HL025	Rohde & Schwarz Messgerätebau GmbH	1000060	31.07.2018	31.07.2021
20700	PC ctc662012 [FAC]	Dell Inc.	--	--	--
20338	Pre-Amplifier 100MHz - 26GHz JS4-00102600-38-5P	Miteq Inc.	838697	20.03.2020	20.03.2021
20484	Pre-Amplifier 2,5GHz - 18GHz AMF-5D-02501800-25-10P	Miteq Inc.	1244554	20.03.2020	20.03.2021
20287	Pre-Amplifier 25MHz - 4GHz AMF-2D-100M4G-35-10P	Miteq Inc.	379418	20.03.2020	20.03.2021
20690	Spectrum Analyzer FSU	Rohde & Schwarz Messgerätebau GmbH	100302/026	23.05.2019	23.05.2021
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	81650455	25.05.2020	25.05.2022
20885	Power Supply EA3632A	Agilent Technologies Deutschland GmbH	75305850	--	--
20670	Radio Communication Tester CMU200	Rohde & Schwarz Messgerätebau GmbH	106833	16.06.2020	16.06.2022
120901 - SAC - Radiated Emission <30MHz					
20620	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH	100362	13.05.2020	13.05.2021
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	81650455	25.05.2020	25.05.2022
25038	Loop Antenna HFH2-Z2	Rohde & Schwarz Messgerätebau GmbH	879824/13	07.04.2020	07.04.2022

6 Measurement Uncertainty valid for conducted/radiated measurements

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

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

7 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2020-Oct-29
C1	Calculated EIRP and ERP values added	2020-Nov-11
C2	Updated “Conducted RF output power” results, based on the updated antenna gain due to the internal loss between modem and antenna connector	2020-Dez-21
C3	Conclusion conducted power verification and clarification for ERP/ EIRP calculation added, last cal date added to equipment list	2020-Jan-05

End of Test Report