PARTIAL Test Report
22-1-0146701T003a

Number of pages:	17	**Date of Report:**	2023-Apr-03
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:**	Continental Advanced Antenna GmbH
Product: **Model:**	**RKE Module US** **RKE232E1** **A232 905 1101**		
Contains FCC ID:	2ACC7RKE232E1	**Contains IC:**	11980A-RKE232E1
Testing has been carried out in accordance with:	**FCC Regulations:** Title 47 CFR, Chapter I, Subchapter A, Subpart C: Part §15.231 **ISED Regulations:** RSS-210, Issue 10, Annex A.1 Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under “Test method and limit”.		
Tested Technology:	SRD		
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. Christian Lorenz Lab manager Authorization of test report		Timo Franke 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 2.7. 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 Attestation

I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All of the above requirements are met in accordance with enumerated standards.

1.3 Summary of Test Results

Test case	Reference in FCC ☒	Reference in ISED ☒	Page	Remark	Result
Radiated field strength emissions below 30 MHz	§15.205(a) §15.209(a)	GSS-Gen: Issue 5 Chapter 8.9 Table 6	--	See initial module report	NP
Radiated field strength emissions 30 MHz – 1 GHz (Inclusive fundamental field strength)	§15.231(b) §15.33 §15.35	RSS-210, Issue 10, A.1.2, Table A.1	9	From 2nd harmonic up	PASSED
Radiated field strength emissions above 1 GHz	§15.231(b) §15.33 §15.35	RSS-210, Issue 10, A.1.2, Table A.1	12	Till 6th harmonic	PASSED
Transmitter timing: 1. Deactivation of transmission 2. Periodic transmission	§15.231 (a)(1)(2)(3)	RSS-210, Issue 10 A.1.1	--	See initial module report	NP
20 dBc bandwidth	§15.231(c)	--	--	See initial module report	NP
99% bandwidth	§2.1049	RSS-210, Issue 10, §A.1.3 RSS-Gen, Issue 5, §6.7	--	See initial module report	NP

PASSED	The EUT complies with the essential requirements in the standard.
FAILED	The EUT does not comply with the essential requirements in the standard.
N/A	Test case does not apply to the test object.
NP	The test was not performed by the CETECOM Laboratory.

Decision Rule: CETECOM GmbH follows ILAC G8:2019 chapter 4.2.1 (Simple Acceptance Rule).

Remarks:

- Please check the module report "CETECOM_TR19-1-0173601T06_C1" for not performed Measurements by the CETECOM laboratory.

1.4 Summary of Test Methods

Test case	Test method
Radiated field strength emissions below 30 MHz	ANSI C63.10-2013, chapter §6.3, §6.4
Radiated field strength emissions 30 MHz – 1 GHz	ANSI C63.10-2013, chapter §6.3, §6.5
Radiated field strength emissions above 1 GHz	ANSI C63.10-2013, chapter §6.3, §6.6
20 dBc bandwidth, 99% bandwidth	ANSI C63.10-2013, chapter §6.3, §6.9

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**
IC Lab company No. / CAB ID:	3462D / DE0005
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

Responsible test manager:	Timo Franke
Receipt of EUT:	2023-Jan-31
Date(s) of test:	2023-Feb-02 to 2023-Feb-02
Version of template:	22.0901

2.5 Applicant's details

Applicant's name:	Continental Advanced Antenna GmbH
Address:	Bahnhofstraße 23 83022 Rosenheim Lower Saxony Germany
Contact Person:	Thomas Schuhbeck
Contact Person's Email:	Thomas.Schuhbeck@continental-corporation.com

2.6 Manufacturer's details

Manufacturer's name:	Continental Advanced Antenna, Sociedade Unipessoal Lda
Address:	Rua Professor Anton Kathrein 5000-082 Vila Real Portugal

2.7 Equipment under Test (EUT)

EUT No.*)	Sample No.	Product	Model	Type	SN	HW	SW
EUT 1	22-1-01467S15_C01	RKE Module US	RKE232E1 A232 905 1101	n/a	n/a	13620027B02V02	V11.31

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

2.8 Untested Variant (VAR)

VAR No.*)	Sample No.	Product	Model	Type	SN	HW	SW

*) The listed additional untested model variant(s) (VAR) is/are not object of evaluation of compliance. For further information please see Annex 5: Declaration of applicant of model differences.
If the table above does not show any other line than the headline, no untested variants are available.

2.9 Auxiliary Equipment (AE)

AE No.*)	Sample No.	Auxiliary Equipment	Model	SN	HW	SW
AE 1	22-1-01467S17_C01	Testbox RKE232	USA	180401C06	n/a	RKE223_V7.0
AE 2	22-1-01467S26_C01	Car	Mercedes Benz C192 AMG GT	n/a	n/a	n/a

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report. If the table above does not show any other line than the headline, no AE was used during testing nor was taken into account for evaluation

2.10 Connected cables (CAB)

CAB No.*)	Sample No.	Cable Type	Connectors / Details	Length
CAB 1	21-1-01653S43_C01	Cable for Testbox	Cable harness Testbox to Application sample	200 cm

*) CAB short description is used to simplify the identification of the connected cables in this test report. If the table above does not show any other line than the headline, no cable was used during testing nor was taken into account for evaluation

2.11 Software (SW)

SW No.*)	Sample No.	SW Name	Description	SW Status
SW 1	--	HTerm	Change Testbox power setting	0.8.5

*) SW short description is used to simplify the identification of the used software in this test report. If the table above does not show any other line than the headline, no SW was used during testing nor was taken into account for evaluation.

2.12 EUT set-ups

set-up no.*)	Combination of EUT and AE	Description
Set. 1	EUT 1 + AE 1 + AE 2 + CAB1 (+ SW 1)	Used for radiated measurements. SW 1 is just used to set testbox power level

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

2.13 EUT operation modes

EUT operating mode no.*)	Operating modes	Additional information
Op. 1	TX	Continuous modulated transmission Power value: 0x2E | Antenna 1 | Channel 2

*) 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

Firmware	☐ for normal use	☒ Special version for test execution	
Power supply	☐ AC Mains	--	
	☐ DC Mains	--	
	☒ Battery	Lead-Acid-Car battery via banana connector	
Operational conditions	T_{nom} =21 °C	T_{min} =-40 °C	T_{max} =+105 °C
EUT sample type	Production		
Weight	0.1		
Size [LxWxH]	12 cm x 2.5 cm x 1 cm		
Interfaces/Ports	2x MQS-connector		
For further details refer Applicants Declaration & following technical documents **181106_RKE-Box_Manual.pdf** **Description_Testbox_programming_detail.pptx**			

3.2 Modifications on Test sample

Additions/deviations or exclusions	--

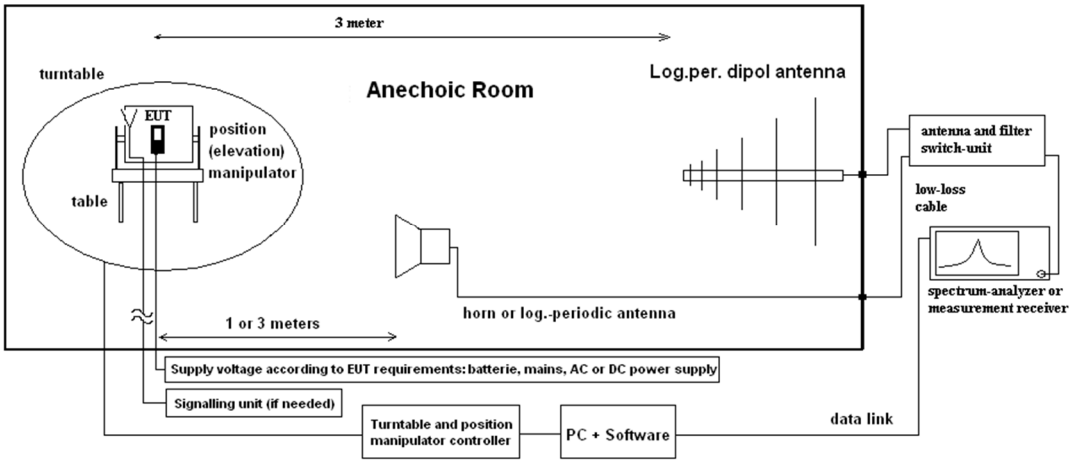
4 Measurements

4.1 Radiated field strength emissions 30 MHz – 1 GHz

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

Evaluating the field 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 NSA-compliant semi anechoic room (SAR) recognized by the regulatory commissions.

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 (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by main-taining the EUT's worst-case operation mode, cable position, etc. either on 10m OATS or 3m semi-anechoic room.
First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height between 1 m and 4 m.
On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out

Formula:

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

$M = L_T - E_C$ (2)

AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
E_C = Electrical field – corrected value
E_R = Receiver reading
G_A = Gain of pre-amplifier (if used)
L_T = Limit
M = Margin

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

4.1.2 Measurement Location

Test site	225911 - SAC5 - Radiated Emission <1GHz

4.1.3 Fundamental limits: FCC §15.231(b), RSS-210, Issue 10, Chapter A1.2

Frequency Range [MHz]	3 meters reference measurement		Spurious settings	
	Limit [µV/m]	Limit [dBµV/m]	Detector	RBW / VBW [kHz]
40.66-40.70 (Only USA)	2250	67.04	QP-Peak or AV	--/--
70-130	1250	61.93		--/--
130-174	1250 to 3750	61.93 to 71.48		--/--
174-260	3750	71.48		--/--
260-470	3750 to 12500	71.48 to 81.93		1000 / 3000
Above 470	12500	81.93		--/--
Above 1000	12500	81.93		--/--

4.1.4 Spurious emission limits: FCC §15.231(b), RSS-210, Issue 10, Chapter A1.2

Frequency Range [MHz]	3 meters reference measurement		Spurious settings	
	Limit [µV/m]	Limit [dBµV/m]	Detector	RBW / VBW [kHz]
40.66-40.70 (only USA)	225	47.04	QP-Peak or AV	100 / 300
70-130	125	41.93		100 / 300
130-174	125 to 375	41.93 to 51.48		100 / 300
174-260	375	51.48		100 / 300
260-470	375 to 1250	51.48 to 61.93		100 / 300
Above 470	1250	61.93		100 / 300
Above 1000	1250	61.93		1000/ 3000

4.1.5 Results for field strength of carrier

Diagram	Channel	Channel frequency	Op. Mode / Set-up no.	Maximum Level [dBµV/m]@3m	Limit: [dBµV/m]@3m	Result
--	1 - low	433.47 MHz	Op. 1 / Set. 1	73.15 AV	80.81 AV	PASSED
--	3 - middle	433.92 MHz	Op. 1 / Set. 1	75.32 AV	80.82 AV	PASSED
--	2 - high	434.37 MHz	Op. 1 / Set. 1	76.16 AV	80.84 AV	PASSED

Remarks:

1.) For more information and graphical plot refer to Test Report CETECOM_TR22_1_0146701T001a.
2.) power level setting: 0x2E, set on AE1
3.) RF-Path 1 used due higher power levels then RF Path 2 (pre-tested)
4.) Average value includes duty-cycle correction factor of -17.33 dB due timing of transmitter (modules certification)

4.1.6 Results for spurious emissions

Diagram	Channel	Mode/Set-up	Frequency Range 600 – 1000 MHz [dBµV/m]	Result
3.01	2	Op. 1 / Set. 1	35.15 (PK) @ 742.58 MHz	PASSED

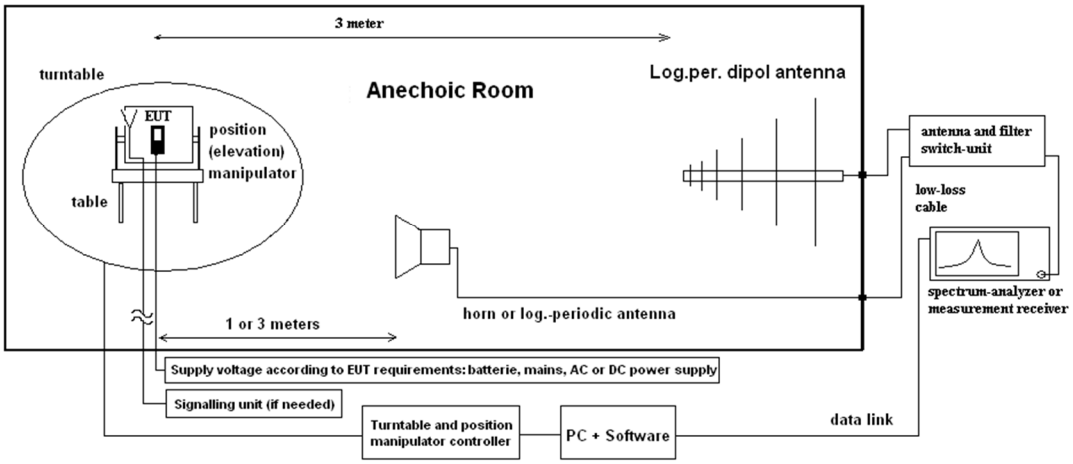
Remarks: for more information and graphical plot see annex A1 **CETECOM_TR22-1-0146701T003a_A1**

4.2 Radiated field strength emissions above 1 GHz

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

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 18-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

Schematic:



Testing method:

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

Exploratory, preliminary measurements
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

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

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

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions or three axis scan for portable/small equipment.

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

Formula:

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

$M = L_T - E_C$ (2)

E_C = Electrical field – corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
A_F = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
G_A = Gain of pre-amplifier (if used)

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

4.2.2 Measurement Location

Test site	225912 - SAC5 - Radiated Emission >1GHz

4.2.3 Spurious emission limits: FCC §15.231(b), RSS-210, Issue 10, Chapter A1.2

Frequency Range [MHz]	3 meters reference measurement		Spurious settings	
	Limit [µV/m]	Limit [dBµV/m]	Detector	RBW / VBW [kHz]
Above 1000	1250	61.93	QP-Peak or AV	1000/ 3000

4.2.4 Result

Diagram	Channel	Mode/Set-up	Maximum Level [dBµV/m] Frequency Range 1 – 2.7 GHz	Result
4.01	1	Op. 1 / Set. 1	44.07 (PK) @ 2.374 GHz [1)] 30.87 (AV) @ 1.485 GHz [1)]	PASSED

Remark:

1. noise level
2. for more information and graphical plot see annex A1 **CETECOM_TR22-1-0146701T003a_A1**

4.3 Equipment lists

ID	Description	Manufacturer	SerNo	CheckType	Last Check	Interval	Next Check
	225911 - SAC5 - Radiated Emission <1GHz			calchk	cal: 2016-Apr-05 chk: 2021-Jan-20	cal: 120M chk: 12M	cal: 2026-Apr-05 chk: 2022-Jan-20
25357	Ultrabroadband Antenna HL562E	Rohde & Schwarz Messgerätebau GmbH	100824	cal	cal: 2020-Oct-09	cal: 36M	cal: 2023-Oct-09
	225912 - SAC5 - Radiated Emission >1GHz			calchk	cal: 2016-May-04 chk: 2021-May-19	cal: 120M chk: 12M	cal: 2026-May-04 chk: 2022-May-19
25316	Multifunction AC/DC Power Source Netwave 20	EM TEST GmbH / Kamen	V1227113059	cal	cal: 2021-May-20	cal: 36M	cal: 2024-May-20
25348	Test Receiver ESR7	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101600	cal	cal: 2021-Aug-09	cal: 24M	cal: 2023-Aug-09
25352	Open Switch and control Platform OSP120	Rohde & Schwarz Messgerätebau GmbH	101542-rV	cpu			
25358	Semi Anechoic Chamber SAC5	Albatross Projects GmbH / Nattheim	P27281-016	cal	cal: 2022-Aug-12	cal: 10Y	cal: 2032-Aug-12
25360	Antenna Mast BAM 4.5-P	maturo GmbH / Pfreimd	BAM 4.5-P/091/17791115	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
25361	Controller NCD	maturo GmbH	NCD/202/17791115	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
25376	Measurement Software EMC32 [SAC5]	Rohde & Schwarz Messgerätebau GmbH	v10.60.10	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -

Tools used in 'P1M1'

4.3.1 Legend

Note / remarks	Interval of calibration & Verification
12M	12 months
24M	24 months
36M	36 months
10Y	10 Years

Abbreviation Check Type	Description
cnn	Calibration and verification not necessary
cal	Calibration
calchk	Calibration plus intermediate Verification
chk	Verification
cpu	Verification before usage

5 Results from external laboratory

None	-

6 Opinions and interpretations

None	-

7 List of abbreviations

None	-

8 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.

Issue No.	Measurement type	Reference	Frequency range of measurement		Calculated Uncertainty based on confidence level of 95.54%	Remarks
			Start [MHz]	Stop [MHz]		
1	Magnetic field strength	FCC15/18/22/ 24/27/90, ISED	0.009	30	4.86	Magnetic loop antenna, Pre-amp on
2	RF-Output power (eirp) Unwanted emissions (eirp) [dB]	FCC15/18 / ISED	30	100	4.57	without Pre-Amp
			30	100	4.91	with PreAmp
			100	1000	4.02	without Pre-Amp
			100	1000	4.26	with PreAmp
			1000	18000	4.36	without Pre-Amp
			1000	18000	5.23	with PreAmp
			18000	33000	4.92	Schwarzbeck BBHA9170 (#20302) Antenna set-up non-waveguide antenna)
			33000	50000	4.17	Set-up for Q-Band (WR-22), non-wave guide antenna
			40000	60000	4.69	Set-up U-Band (WR-19), non-waveguide antenna
			50000	75000	4.06	External Mixer set-up V-Band (WR-15)
			75000	110000	4.17	External Mixer set-up W-Band (WR-6)
			90000	140000	5.49	External Mixer set-up F-Band (WR-8)
			140000	225000	6.22	External Mixer set-up G-Band (WR-5)
			225000	325000	7.04	External Mixer set-up (WR-3)
			325000	500000	8.84	External Mixer set-up (WR-2.2)
3	Radiated Blocking [dB]	EN303883	1000	18000	2.85	Typical set-up with microwave generator and antenna, value for 7GHz calculated
			18000	33000	4.66	Typical set-up with microwave generator and antenna
			33000	50000	3.48	WR-22 set-up
			50000	75000	3.73	WR-15 set-up
			75000	110000	4.26	WR-6 set-up
4	Frequency Error / UWB+FMCW [kHz]	EN303883 FCC 15	40000	77000	276.19	calculated for 77 GHz (FMCW) carrier
			6000	7000	33.92	calculated for 6.5GHz UWB Ch.5
	Frequency Error / NFC [Hz]	FCC 15	11.00	14.00	20.76	calculated for 13.56MHz NFC carrier
5	TS 8997 conducted Parameters	FCC15/18 / ISED	30	6000	1.11	1. Power measurement with Fast-sampling-detector
			30	6000	1.20	2. Power measurement with Spectrum-Analyzer
			30	6000	1.20	3. Power Spectrum-Density measurement
			30	7500	1.20	4. Conducted Spurious emissions:
			0.009	30	2.56	5. Conducted Spurious emissions:
			2.4	2.48	1.95 ppm	6a. Bandwidth / 2-Marker Method for 2.4GHz ISM
			5.18	5.825	7.180 ppm	6b. Bandwidth / 2-Marker Method for 5GHz WLAN
			5.18	5.825	1.099 ppm	7 Frequency (Marker method) for 5GHz WLAN
			30	6000	0.11561µs	8 Medium-Utilization factor / Timing
			30	6000	1.85	9 Blocking-Level of companion device
			30	6000	1.62	9 Blocking Generator level
6	Conducted emissions	EN303883 FCC 15	0.009	30	3.57	

9 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2023-Apr-03
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End Of Test Report