

PARTIAL Test Report 21-1-0165302T05a



GmbH

Continental Advanced Antenna

17 Date of Report: 2022-Jul-15 Number of pages:

CETECOM GmbH Testing company:

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Product: RKE Module Base FCC

Model: **RKE223E1**

FCC ID: 2ACC7RKE223E1 IC: 11980A-RKE223E1

Testing has been carried out in accordance with: FCC Regulations: Title 47 CFR, Chapter I, Subchapter A, Subpart C: §15.231

ISED Regulations: RSS-210, Issue 10, Annex A

Deviations, modifications or clarifications (if any) to above mentioned documents are written

Applicant:

in each section under "Test method and limit".

SRD Tested Technology:

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

Dipl.-Ing. Christian Lorenz Test manager

Responsible of test report

Test Report 21-1-0165302T05a



1	G	eneral information	4
	1.1	Disclaimer and Notes	4
	1.1.	Summary of Test Results	5
	1.2.	Summary of Test Methods	5
2	Ad	dministrative Data	6
	2.1	Identification of the Testing Laboratory	6
	2.2	General limits for environmental conditions	6
	2.3	Test Laboratories sub-contracted	6
	2.4	Organizational Items	6
	2.5	Applicant's details	6
	2.6	Manufacturer's details	6
	2.7	EUT: Type, S/N etc. and short descriptions used in this test report	7
	2.8	Auxiliary Equipment (AE): Type, S/N etc. and short descriptions	7
	2.9	Connected cables	7
	2.10	Software	7
	2.11	EUT set-ups	7
	2.12	EUT operation modes	7
3	Ec	quipment under test (EUT)	8
	3.1	General Data of Main EUT as Declared by Applicant	8
	3.2	Modifications on Test sample	8
4	М	easurements	9
	4.1	Radiated field strength emissions <1 GHz	9
	4.2	Radiated field strength emissions >1 GHz	12
	4.3	Results from external laboratory	14
	4.4	Opinions and interpretations	14
	4.5	List of abbreviations	14
5	Ec	quipment lists	14
6	М	easurement Uncertainty valid for conducted/radiated measurements	16
7	Ve	ersions of test reports (change history)	17



	Table of Annex				
Annex No. Contents		Reference Description	Total Pages		
Annex 1	Test result diagrams	CETECOM_TR21-1-0165302T05a_A1	5		
Annex 2	Internal photographs of EUT	To be supplied by applicant			
Annex 3	External photographs of EUT	CETECOM_TR21-1-0165302T05a_A3	6		
Annex 4	Test set-up photographs	CETECOM_TR21-1-0165302T05a_A4	3		
The listed attachments are separate documents.					

CETECOM_TR 21-1-0165302T05a 3/17



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.

CETECOM_TR 21-1-0165302T05a 4/17



1.1. Summary of Test Results

Test case	Reference in FCC <mark>⊠</mark>	Reference in ISED ⊠	Page	Remark	Result
Radiated field strength emissions below 30 MHz	§15.205(a) §15.209(a)	RSS-Gen: Issue 5 §8.9 Table 6			NT
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, Table A.1	9	From 2 nd harmonic up	Passed
Radiated field strength emissions above 1 GHz	§15.231(b) §15.33 §15.35	RSS-210, Issue 10, §A.1, Table A.1	12	Till 6 th harmonic	Passed
Transmitter timing: 1. Deactivation of transmissions 2. Periodic transmissions	§15.231 (a)(1)(2)(3)	RSS-210, Issue 10, §A1.1(a)(b)(c)		Not tested See initial modules report 1)	NT
20dBc bandwidth	§15.231(c)	RSS-210, Issue 10, §A1.3 RSS-Gen, Issue 5, Chapter 6.7		Not tested See initial modules report ¹⁾	NT
99% bandwidth	§2.1049	RSS-Gen, Issue 5, Chapter 6.7		Not tested See initial modules report 1)	NT

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.

Remark1: Details can be found in initial test report for the module: CETECOM_TR18_1_0257101T93a_C2.

1.2. Summary of Test Methods

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

CETECOM_TR 21-1-0165302T05a 5 / 17

^{*}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.



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: Volker Briddigkeit

Accreditation scope: DAkkS Webpage

Test location: CETECOM GmbH; Mündelheimer Weg 35; 40472 Düsseldorf

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.: 21-1-01653OR02

Responsible test manager: Dipl.-Ing. Christian Lorenz

Receipt of EUT: 2022-Mar-24

Date(s) of test: 2022-Apr-01 – 2022-Apr-03

Version of template: 14.5

2.5 Applicant's details

Applicant's name: Continental Advanced Antenna GmbH

Address: Römerring 1 31137 Hildesheim

Germany

Contact Person: Mr. Thomas Schuhbeck

Contact Person's Email: Thomas.schuhbeck@continental.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

CETECOM_TR 21-1-0165302T05a 6/17



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

Short descrip tion*)	PMT Sample No.	Product	Model	Туре	S/N	HW status	SW status
EUT 01	21-1-01653S35_C01	RKE Module Base FCC	RKE223E1	Application sample	000131	13612160B08 V00	11.31

^{*)} 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 descrip tion*)	PMT Sample No.	Auxiliary Equipment	Туре	S/N	HW status	SW status
AE 01	21-1-01653S37_C01	Testbox	Testbox FCC (0x34hex)	180401B12		RKE223_V6.2
AE 02	21-1-01653S44_C01	Car	Mercedes Benz C-class sedan (W206)			

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

2.9 Connected cables

descrip	PMT Sample No.	Cable type	Connectors	Length
CAB 01	21-1-01653S43_C01	Cable for Testbox	Cable harness Testbox to Application sample	1.5m

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

2.10 Software

Short descrip tion*)	PMT Sample No.	Software	Туре	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
Set. 1	EUT 01 + AE 01 + AE 02 + CAB 01	Used for Radiated measurements. EUT application mode

^{*)} 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 m no.*)	Operating modes	Additional information
Op. 1	TX application	Continuous modulated carrier with help of AE1. Power value 0x2C 1) Antenna 2

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

Remark 1: initial power setting of 0x34 was changed to 0x2C for the final tests.

CETECOM_TR 21-1-0165302T05a 7 / 17



3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Product name	RKE223E1			
Kind of product	RKE Module BASE	FCC		
Firmware	\square for normal use		Special ver Speci	ersion for test execution
Power supply	☐ AC Mains	-		
	☑ DC Mains	12 V D	C	
	☐ Battery -			
Operational conditions	T _{nom} =21 °C	T _{min} =	- °C	T _{max} = °C
EUT sample type	Pre-Production			
Weight				
Size [LxWxH]				
Interfaces/Ports	See applicant's do	cument	S	
For further details refer Applicants Decla	ration & following	technica	al documents:	
181106_RKE-Box_Manual.pdf				
Description_Testbox_programming_detail.pptx				
SCN-Kodierung_MRA2_RKE223E1_J1.xls	SCN-Kodierung_MRA2_RKE223E1_J1.xlsx			

3.2 Modifications on Test sample

Additions/deviations or exclusions	

CETECOM_TR 21-1-0165302T05a 8/17



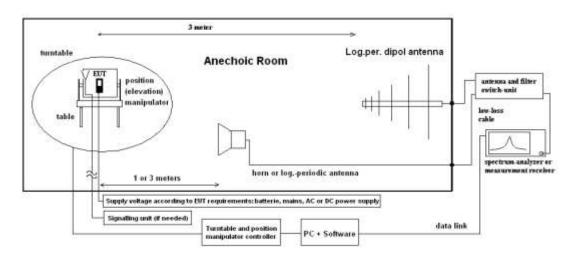
4 Measurements

4.1 Radiated field strength emissions <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.

CETECOM_TR 21-1-0165302T05a 9/17



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:

 $E_C = E_R + AF + C_L + D_F - G_A \quad \mbox{(1)} \label{eq:eccentric}$ $AF = \mbox{Antenna factor}$ $C_L = \mbox{Cable loss}$

 $M = L_T - E_C$ (2) $D_F = Distance correction factor (if used)$

 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]	Frequency Range [MHz] 3 meters reference measurement Limit [µV/m] Limit		Spurious settings	
			Detector	RBW / VBW
		[dBµV/m]		[kHz]
40.66-40.70	2250	67.04		/
(Only USA)				
70-130	1250	61.93	OD Daala an AM	/
130-174	1250 to 3750	61.93 to 71.48		/
174-260	3750	71.48	QP-Peak or AV	/
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	225	47.04		100 / 300
(only USA)				
70-130	125	41.93	QP-Peak or AV	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

CETECOM_TR 21-1-0165302T05a 10 / 17



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	75.88 AV	80.81 AV	Passed
	3 - middle	433.92 MHz	Op. 1	75.99 AV	80.82 AV	Passed
	2 - high	434.37 MHz	Op. 1	76.04 AV	80.84 AV	Passed

Remarks:

- 1.) For more information and graphical plot refer to Evaluation Report CETECOM_TR21-1-0165302T01a.
- 2.) power level setting: 0x2C, set on AE1
- 3.) RF-Path 2 used due higher power levels then RF Path 1 (pre-tested)
- 4.) Average value includes duty-cycle correction factor of -17.35 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
8.01a	2	Op. 1	37.113 *	Passed

Remark *: Noise level.

Remark 1: for more information and graphical plot see annex A1 CETECOM_TR21-1-0165302T05a_A1

Remark 2: Based on the basic homologation covered by the test report CETECOM_TR18_1_0257110T01b_C1, the tested frequency range of the spurious emissions is reduced. Thus the tested frequency range starts at 600 MHz.

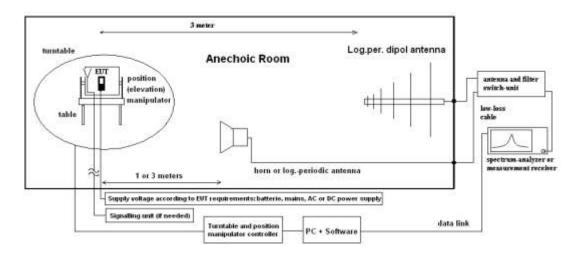


4.2 Radiated field strength emissions >1 GHz

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.

CETECOM_TR 21-1-0165302T05a 12 / 17



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:

 $E_C = E_R + A_F + C_L + D_F - G_A \quad \text{(1)} \\ E_C = \text{Electrical field} - \text{corrected value} \\ E_R = \text{Receiver reading} \\ M = L_T - E_C \quad \text{(2)} \\ M = \text{Margin} \\ L_T = \text{Limit} \\ A_F = \text{Antenna factor} \\ C_L = \text{Cable loss} \\ D_F = \text{Distance correction factor (if used)} \\ C_T = C_T + C_T$

 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	Detector	RBW / VBW
		[dBµV/m]		[kHz]
Above 1000	1250	61.93	PK / AV	1000/3000

4.2.4 Result

Diagram	Channel	Mode/Set-up	Maximum Level [dBμV/m] Frequency Range 1 – 5GHz	Result
8.01b	2	Op. 1	51.506* (PK) / 41.035* (AV)	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR21-1-0165302T05a_A1** Remark *: Noise level.

CETECOM_TR 21-1-0165302T05a 13 / 17



4.3 Results from external laboratory

None	-

4.4 Opinions and interpretations

None	-

4.5 List of abbreviations

None	-

5 Equipment lists

ID	Description	Manufacturer	SerNo	Cal due date
	225911 - SAC5 - Radiated Emission <1GHz			2026-Apr-05
25360	Antennenmast BAM 4.5-P	maturo GmbH	BAM 4.5- P/091/17791115	
25361	Controller NCD	maturo GmbH	NCD/202/17791115	
25348	EMI Test Receiver ESR7	Rohde & Schwarz Messgerätebau GmbH	101600	2023-Aug-09
25352	Open Switch and control Platform OSP120	Rohde & Schwarz Messgerätebau GmbH	101542-rV	
25358	Semi Anechoic Chamber SAC5	Albatross Projects GmbH	P27281-016	2026-Jun-30
25357	Ultrabroadband Antenna HL562E	Rohde & Schwarz Messgerätebau GmbH	100824	2023-Oct-09
	225912 - SAC5 - Radiated Emission >1GHz			2026-May-04
25360	Antennenmast BAM 4.5-P	maturo GmbH	BAM 4.5- P/091/17791115	
25361	Controller NCD	maturo GmbH	NCD/202/17791115	
25348	EMI Test Receiver ESR7	Rohde & Schwarz Messgerätebau GmbH	101600	2023-Aug-09
25352	Open Switch and control Platform OSP120	Rohde & Schwarz Messgerätebau GmbH	101542-rV	
25358	Semi Anechoic Chamber SAC5	Albatross Projects GmbH	P27281-016	30.06.2026

CETECOM_TR 21-1-0165302T05a 14/17

Test Report 21-1-0165302T05a



	225914 - SAC5 - Radiated Spurious Emission			2026-May-04
25374	Antennenmast CAM 4.0-P	maturo GmbH	CAM 4.0- P/239/2149.01	
25310	Double-Ridged Horn Antenna HF 907	Rohde & Schwarz Messgerätebau GmbH	100334	2024-Oct-03
25377	Low Noise Amplifier 10MHz - 12Ghz	B&Z Technologies	16095	
25378	Low Noise Amplifier 1Ghz - 18GHz	B&Z Technologies	16695-16511	
25372	Open Switch and control Platform OSP120	Rohde & Schwarz Messgerätebau GmbH	101833	
25348	EMI Test Receiver ESR7	Rohde & Schwarz Messgerätebau GmbH	101600	2023-Aug-09

CETECOM_TR 21-1-0165302T05a 15 / 17



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.

Issue No.	Measurement type	Reference	Frequency range of measurement Start [MHz] Stop [MHz]	Calculated Uncertainty based on confidence level of 95.54%	Remarks
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 30 100 100 1000 100 1000 100 18000 18000 33000 33000 50000 40000 75000 75000 110000 140000 225000 225000 325000 225000 350000	4.57 4.91 4.02 4.26 4.36 5.23 4.92 4.17 4.69 4.06 4.17 5.49 6.22 7.04 8.84	without Pre-Amp with PreAmp without Pre-Amp with PreAmp with PreAmp with PreAmp with PreAmp Schwarzbeck BBHA9170 (#20302) Antenna set-up non-waveguide antenna) Set-up Gr Q-Band (WR-19), non-waveguide antenna Set-up U-Band (WR-19), non-waveguide antenna External Mixer set-up V-Band (WR-15) External Mixer set-up W-Band (WR-6) External Mixer set-up W-Band (WR-8) External Mixer set-up G-Band (WR-8) External Mixer set-up G-Band (WR-8) External Mixer set-up (WR-3) External Mixer set-up (WR-2)
3	Radiated Blocking [dB]	EN303883	1000 18000 18000 33000 33000 50000 50000 75000 75000 110000	2.85 4.66 3.48 3.73 4.26	Typical set-up with microwave generator and antenna, value for 7GHz calculated Typical set-up with microwave generator and antenna WR-22 set-up WR-15 set-up WR-6 set-up
4	Frequency Error / UWB+FMCW [kHz]	EN303883 FCC 15	40000 77000 6000 7000	276.19 33.92	calculated for 77 GHz (FMCW) carrier 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 30 6000 30 6000 30 7500 0.009 30 2.4 2.48 5.18 5.825 5.18 5.825 30 6000 30 6000	1.11 1.20 1.20 1.20 1.20 2.56 1.95 ppm 7.180 ppm 1.099 ppm 0.11561µs 1.85 1.62	Power measurement with Fast-sampling-detector Power measurement with Spectrum-Analyzer Rower Spectrum-Density measurement Conducted Spurious emissions: Conducted Spurious emissions: Bandwidth / 2-Marker Method for 2.4GHz ISM Bandwidth / 2-Marker Method for 5GHz WLAN Frequency (Marker method) for 5GHz WLAN BMedium-Utilization factor / Timing Blocking-Level of companion device Blocking-Generator level
6	Conducted emissions	EN303883 FCC 15	0.009 30	3.57	

CETECOM_TR 21-1-0165302T05a 16 / 17



7 Versions of test reports (change history)

Version	Applied changes	Date of release
	Initial release	2022-Jul-15

End of Test Report