

Test Report

24-1-0023901T001-TR1-R01

Number of pages:	22	Date of Report:	2024-Sep-30
Testing company:	cetecom advanced GmbH Untertuerkheimer Str. 6-10 66117 Saarbruecken GERMANY	Applicant:	Infinite Play B.V.
Product:	Electronic Toy		
Model:	Picoo One		
FCC ID:	FCC ID: 2BEZJ-P1 Contains FCC ID: X8WBT840F	IC:	n/a
Testing has been carried out in accordance with:	CFR Title 47, Chapter I, Subchapter A Part 15 Radio frequency devices § 15.225 Operation within the band 13.110-14.010 MHz		
Tested Technology:	NFC 13.56MHz		
Test Results:	☒ The EUT complies with the requirements in respect of all parameters subject to the test. The test results relate only to devices specified in this document		
Signatures:	 Mr. Christoph Schneider Lab Manager Authorization of test report Mr. Christian Lorenz Lab Manager Responsible of test report		

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Annex 102	Internal photographs of EUT	To be supplied by applicant	--
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Annex 103	Test set-up photographs	24-1-0023901T001_TR1-A103-R01	4
The listed attachments are separate documents.			

1 General information

1.1 Disclaimer and Notes

The test results of this test report relate exclusively to the test item specified in this test report as specified in chapter 2.7. cetecom advanced 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

The EUT integrates **NFC** technology at 13.56MHz. Other implemented wireless technologies were not considered within this test report.

Test case	Reference Clause FCC ☒	Reference Clause ISED ☐	Page	Remark	Result
Radiated field strength emissions and emission mask	§15.225 (a)(b)(c)(d)	RSS-210, Issue 10, Annex B.6 (a)	10	1	PASSED
Radiated field strength emissions below 30 MHz	§15.209(a)	RSS-Gen: Issue 5 §8.9 Table 6	13	1	PASSED
Radiated field strength emissions 30 MHz – 1 GHz	§15.209	RSS-Gen: Issue 5 §8.9 Table 5	14	1	PASSED
Occupied Channel Bandwidth 99%	§2.202(a) §2.1049(h)	RSS-Gen Issue 5, §6.7	16	1	PASSED
Frequency stability	§2.1055 §15.225(e)	RSS-210, Issue 10, Annex B.6 (b)	17	2	PASSED
AC-Power Lines Conducted Emissions	§15.207	RSS-Gen Issue 5: §8.8 Table 4	--	3	3

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 advanced laboratory.

Decision Rule: cetecom advanced GmbH follows [ILAC G8:2019 chapter 4.2.1 \(Simple Acceptance Rule\)](#).

Remarks:

1. Please check annex **24-1-0023901T001a_TR1-A201-R01** for diagrams
2. Please check annex **24-1-0023901T001a_TR1-A202-R01** for diagrams
3. Please check annex **24-1-0023901T004a_TR1-R01** for tests and verdict

1.4 Summary of Test Methods

Test case	Test method
Radiated field strength emissions and emission mask	ANSI C63.10-2013
Radiated field strength emissions below 30 MHz	ANSI C63.10-2013 §6.3, §6.4
Radiated field strength emissions 30 MHz- 1 GHz	ANSI C63.4-2014 §8.2.3, ANSI C63.10-2013 §6.3, §6.5
Occupied Channel Bandwidth 99%	ANSI C63.10:2013, §6.9.3
Frequency stability tests	ANSI C63.10-2013 §6.8
AC-Power Lines Conducted Emissions	ANSI C63.4-2014 §7, ANSI C63.10-2013 §6.2

2 Administrative Data

2.1 Identification of the Testing Laboratory

Company name:	cetecom advanced GmbH
Address:	Untertuerkheimer Str. 6-10 66117 Saarbruecken Germany
Responsible for testing laboratory:	Dipl.-Ing. (FH) Andreas Luckenbill M.Sc.
Accreditation scope:	DAkkS Webpage: FCC ISED
IC Lab company No. / CAB ID:	3462D / DE0001
Test location 1:	Im Teelbruch 116; 45219 Essen
Test location 2:	--

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 testing manager:	Mr. Timo Franke
Receipt of EUT:	2024-Jun-13
Date(s) of test:	2024-July-10 to 2024-08-02
Version of template:	24.0301

2.5 Applicant's details

Applicant's name:	Infinite Play B.V.
Address:	Torenallee 20 5617 BC Eindhoven Netherlands
Contact Person:	Iris Soute
Contact Person's Email:	iris.soute@picoo.nl

2.6 Manufacturer's details

Manufacturer's name:	Infinite Play B.V.
Address:	Torenallee 20 5617 BC Eindhoven Niederlande

2.7 Equipment under Test (EUT)

EUT No. *)	Sample No.	Product	Model	Type	SN	HW	SW
1	24-1-00239S05_C01	Electronic toy	Picoo One	N/A	S05_C01	6	V2.20.2

*) 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
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*) 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	24-1-00239S15_C01	Picoo game RFID tag	PETG Card	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
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*) 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
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*) 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
1	EUT 1	Used for un-modulated measurements
1	EUT 1 + AE 1	Used for modulated measurements

*) 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	EUT intermittent transmission searching for counterpart
op. 2	TXRX	EUT intermittent communication to 13.56 MHz RFID tag AE 1. Modulated carrier

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

*2) Please refer to document xxx

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: <i>Putty</i> and specific commands under <i>help</i> available. Firmware: "p1-radio_test-81aec8e.hex"	
Power supply	☐ AC Mains	-	
	☐ DC Mains	-- V DC via -- Connector	
	☒ Battery 18650 cell	Lithium Ion battery	
Operational conditions	$T_{nom} = 20\text{ }^{\circ}\text{C}$	$T_{min} = -20\text{ }^{\circ}\text{C}$	$T_{max} = 50\text{ }^{\circ}\text{C}$
EUT sample type	Pre-Production		
Weight	0.150 kg		
Size [LxWxH]	14.5 cm x 5.0 cm x 5.0 cm		
Interfaces/Ports	Charging port / USB-C		
For further details refer Applicants Declaration & following technical documents			

3.2 Detailed Technical data of Main EUT as Declared by Applicant

Main function	Electronic toy	
Type	Picoo One	
Frequency range and channels (US/Canada -bands)	13.553 -13.567 MHz	
Type of modulation (packet types)	ASK	
Occupied bandwidth	1.3261 MHz	
Number of channels	1 nominal channel at 13.56MHz	
Antenna Type	☒ Integrated ☐ External, no RF- connector ☐ External, separate RF-connector	
Antenna Gain	--	
FCC label attached	No	
Test firmware / software and storage location	EUT1 (MCU)	
For further details refer Applicants Declaration & following technical documents		
Description of Reference Document (supplied by applicant)	Version	Total Pages
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3.3 Modifications on Test sample

Additions/deviations or exclusions	--
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4 Measurements

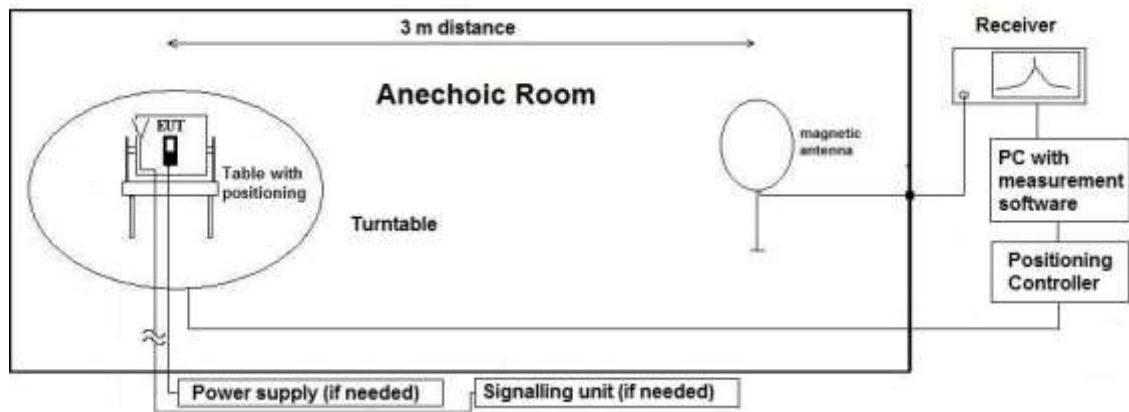
4.1 Radiated field strength emissions below 30 MHz

4.1.1 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.

4.1.2 Sample calculation

Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss	Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
19.83	18.9	-70.75	0.18	--	-51.67	-31.83	30 to 3 m correction used according ANSI C63.10-2013

Remark: This calculation is based on an example value at 458 kHz

4.1.3 Measurement Location

Test site	120901
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4.1.4 Correction factors due to reduced meas. distance (f < 30 MHz):

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

Frequency Range	f [kHz/MHz]	Lambda [m]	Far-Field Point [m]	Distance Limit accord. 15.209 [m]	1st Condition (dmeas < Dnear-field)	2nd Condition (Limit distance bigger dnear-field)	Distance Correction accord. Formula
kHz	9	33333.33	5305.17	300	fulfilled	not fulfilled	-80.00
	10	30000.00	4774.65		fulfilled	not fulfilled	-80.00
	20	15000.00	2387.33		fulfilled	not fulfilled	-80.00
	30	10000.00	1591.55		fulfilled	not fulfilled	-80.00
	40	7500.00	1193.66		fulfilled	not fulfilled	-80.00
	50	6000.00	954.93		fulfilled	not fulfilled	-80.00
	60	5000.00	795.78		fulfilled	not fulfilled	-80.00
	70	4285.71	682.09		fulfilled	not fulfilled	-80.00
	80	3750.00	596.83		fulfilled	not fulfilled	-80.00
	90	3333.33	530.52		fulfilled	not fulfilled	-80.00
	100	3000.00	477.47		fulfilled	not fulfilled	-80.00
	125	2400.00	381.97		fulfilled	not fulfilled	-80.00
	200	1500.00	238.73		fulfilled	fulfilled	-78.02
	300	1000.00	159.16		fulfilled	fulfilled	-74.49
	400	750.00	119.37		fulfilled	fulfilled	-72.00
	490	612.24	97.44		fulfilled	fulfilled	-70.23
	500	600.00	95.49	30	fulfilled	not fulfilled	-40.00
	600	500.00	79.58		fulfilled	not fulfilled	-40.00
	700	428.57	68.21		fulfilled	not fulfilled	-40.00
	800	375.00	59.68		fulfilled	not fulfilled	-40.00
	900	333.33	53.05		fulfilled	not fulfilled	-40.00
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

4.1.5 Limit §15.209

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

4.1.6 Result carrier field strength emission mask §15.225 (a)(b)(c) (13.56MHz nominal)

Diagram no.	Channel	Op.Mode	Maximum measured level: [dBμV/m]	Limit within 13.553 -13.567MHz band: [dBμV/m]	Result
2.01	nominal	1	22.68	84	Passed
2.02	nominal	2	21.93	84	Passed
2.03	nominal	1	35.36	84	Passed
2.04	nominal	2	30.56	84	Passed

Remark: for more information and graphical plot see annex A201

4.1.7 Result – spurious emissions §15.225(d)

Diagram no,	Channel	Op. Mode	Maximum Level [dBμV/m] Frequency Range 0.009 – 30 MHz	Result
2.05a	nominal	1	≤ 20	Passed
2.05b	nominal	1	≤ 20	Passed
2.06a	nominal	2	≤ 20	Passed
2.06b	nominal	2	≤ 20	Passed

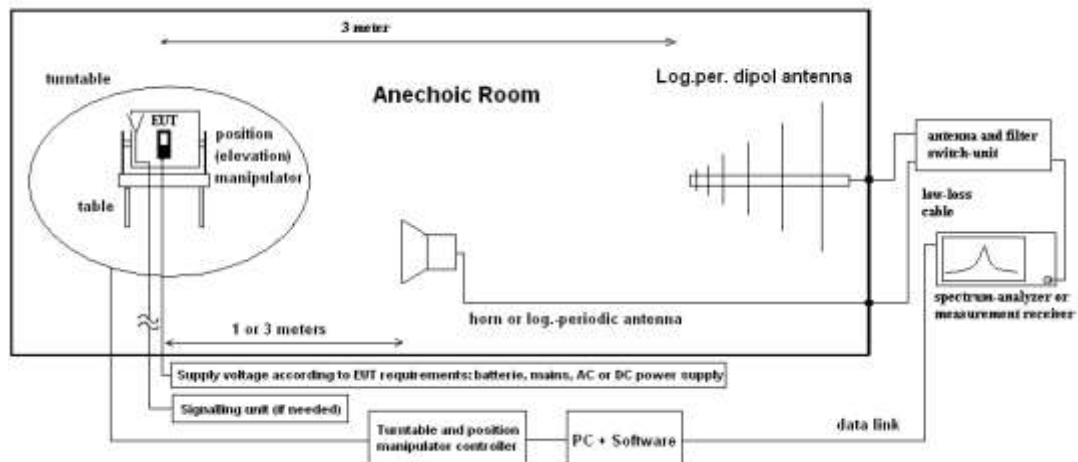
Remark: for more information and graphical plot see annex A201

4.2 Radiated field strength emissions 30 MHz – 1 GHz

4.2.1 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:

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

$$M = L_T - E_C \quad (2)$$

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.

4.2.2 Sample calculation

Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss	Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
32.7	22.25	--	3.1	--	25.35	58.05	--

Remark: This calculation is based on an example value at 800.4 MHz

4.2.3 Measurement Location

Test site	120901 - SAC3 - Radiated Emission <1GHz
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4.2.4 Limit

Frequency Range [MHz]	☒ (3 meters)		Detector	RBW / VBW [kHz]
	Limit [μV/m]	Limit [dBμV/m]		
30 - 88	100	40.0	Quasi peak	100 / 300
88 - 216	150	43.5	Quasi peak	100 / 300
216 - 960	200	46.0	Quasi peak	100 / 300
Above 960MHz	500	54.0	Quasi peak	100 / 300

4.2.5 Result

Diagram	Set-up	Mode	Maximum Level [dBμV/m] Frequency Range 30 – 1000 MHz	Result
3.01a	1	1 (laying)	32.30	Passed
3.01a	1	1 (standing)	34.56	Passed
3.02a	2	2 (standing)	27.93@40.67MHz	Passed
3.02b	2	2 (laying)	33.49@40.68MHz	Passed

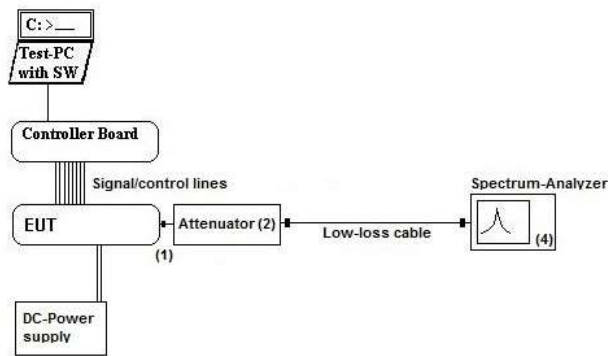
Remark: for more information and graphical plot see annex A201

4.3 Occupied Channel Bandwidth 99%

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

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to spectrum-analyzer (4) for RF-conducted measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings of the spectrum-analyzer.

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)

Settings of measurement equipment can be seen on diagram enclosed in annex A201

4.3.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)
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4.3.3 Limit

When the occupied bandwidth limit is not stated in the applicable reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

4.3.4 Result

Mode	Channel	Frequency [MHz]	99% Occupied bandwidth [MHz]
2	nominal	13.56	1.655032

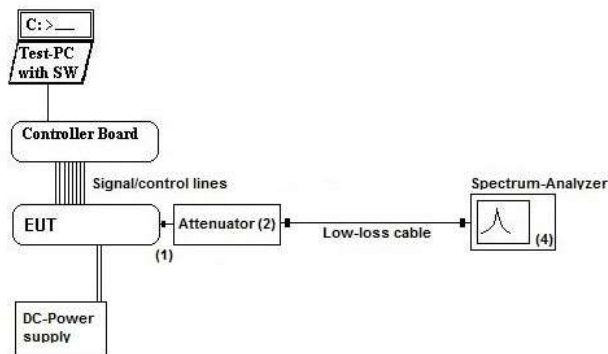
Remark: for more information and graphical plot see annex A201

4.4 Frequency stability/tolerance

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

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to spectrum-analyzer (4) for RF-conducted measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings of the spectrum-analyzer.

Schematic:



Testing method:

Frequency stability was measured for operating mode 2 under nominal and extreme conditions with a spectrum-analyzer. The frequency of the markers set on the un-modulated carrier, was compared for all measurements related to an reference measurement under nominal test conditions.

4.4.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)
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4.4.3 Limit

Test limit §15.225(e)
The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+ 50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery

4.4.4 Spectrum-Analyzer Settings

Span	5kHz
Resolution Bandwidth (RBW)	10Hz
Video Bandwidth (VBW)	10Hz
Sweep time	7980ms
Detector	Peak detector
Sweep mode	Single sweep, MAX-HOLD

4.4.5 Result for temperature range

Nominal conditions Reference measurement					
(DC Laboratory power supply) Tnom = 20°C	Measured Reference frequency [MHz]	13.560107	Limit-> 100 ppm:	1356.0107	Hz

Extreme conditions								
Temperature	Frequency deviation of the EUT	Frequency measured	Values for Frequency Error			Abs. Maximum Value	Absolute Maximum value	Verdict
			[Hz]	[%]	[ppm]			
Tmax=50°C	f0	13.5600260	-81.0000000	-0.000597	-5.97	5.97	5.97	Passed
T=40°C	f0	13.5600470	-60.0000000	-0.000442	-4.42	4.42		
T=30°C	f0	13.5600790	-28.0000000	-0.000206	-2.06	2.06		
T=10°C	f0	13.5601570	50.0000000	0.000369	3.69	3.69		
T=0°C	f0	13.5601730	66.0000000	0.000487	4.87	4.87		
T=-10°C	f0	13.5601670	60.0000000	0.000442	4.42	4.42		
T=-20°C	f0	13.5601370	30.0000000	0.000221	2.21	2.21		

4.4.6 Result for voltage range

Nominal condition					
Vnom = 3.6 V Tnom = 20°C	13.56010700	MHz	Limit-> 100ppm:	1356.0107	Hz
			f _{MIN}	13.55875099	MHz
			f _{MAX}	13.56146301	MHz

Extreme conditions					
Voltage	Frequency measured	Values for Frequency Error			
[V]	[MHz]	[Hz]	[%]	[ppm]	
V _{MAX} 4.14	13.5601090	2	0.000015	0.15	
V _{NOM} 3.60	13.5601070	0	0.000000	0.00	
V _{MIN} 3.06	13.5601080	1	0.000007	0.07	

4.5 Equipment lists

ID	Description	Manufacturer	SerNo	CheckType	Last Check	Interval	Next Check
	120901 - SAC3 - Radiated Emission <1GHz			calchk	cal: 2015-Jul-21 chk: 2021-Jul-27	cal: 10Y chk: 12M	cal: 2025-Jul-21 chk: 2022-Jul-27
20442	Semi Anechoic Chamber SAC3	ETS-Lindgren GmbH / Taufkirchen	without	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20482	Filter Matrix SAC3	cetecom advanced GmbH / Essen	without	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20574	Biconilog Hybrid Antenna BTA-L	Frankonia GmbH / Heideck	980026L	cal	cal: 2022-Jun-15	cal: 36M	cal: 2025-Jun-15
20620	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100362	cal	cal: 2024-May-15	cal: 12M	cal: 2025-May-15
20885	Power Supply EA3632A	Agilent Technologies Deutschland GmbH	75305850	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
	120904 - FAC1 - Radiated Emissions			chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20287	Pre-Amplifier 25MHz - 4GHz AMF-2D-100M4G-35-10P	Miteq Inc.	379418	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH / Glotttetal	81650455	cal	cal: 2024-May-13	cal: 24M	cal: 2026-May-13
20489	Test Receiver ESU40	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100030	cal	cal: 2024-May-15	cal: 12M	cal: 2025-May-15
20549	Log. Per. Antenna HL025	Rohde & Schwarz Messgerätebau GmbH	1000060	calchk	cal: 2021-Aug-18	cal: 36M chk: 12M	cal: 2024-Aug-18
20558	Fully Anechoic Chamber 1	ETS-Lindgren GmbH / Taufkirchen	-	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20608	Ultrabroadband-Antenna HL562	Rohde & Schwarz Messgerätebau GmbH / Memmingen	830547/009	cal	cal: 2023-Jul-04	cal: 36M	cal: 2026-Jul-04
20611	Power Supply E3632A	Agilent Technologies Deutschland GmbH	KR 75305854	cpu			
20690	Spectrum Analyzer FSU26	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100302/026	cal	cal: 2023-May-25	cal: 24M	cal: 2025-May-25
20720	Measurement Software EMC32 [FAC]	Rohde & Schwarz Messgerätebau GmbH	V10.xx	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20883	Open Switch and control Platform OSP-B20052 Satellite	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101432	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20884	Open Switch and control Platform OSP320	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101391	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22

Tools used in 'P1M1'

4.5.1 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	-
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6 Opinions and interpretations

None	-
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7 List of abbreviations

None	-
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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 its 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	EN ,FCC, JP, IC	0.009	30	4.86	Magnetic loop antenna, Pre-Amp on
2	RF-Output Power (EIRP) Unwanted emissions (EIRP) [dB]	EN, FCC, JP, IC	30	100	4.57	without Pre-Amp
			30	100	4.91	with Pre-Amp
			100	1000	4.02	without Pre-Amp
			100	1000	4.26	with Pre-Amp
			1000	18000	4.36	without Pre-Amp
			1000	18000	5.23	with Pre-Amp
			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]	EN	1000	18000	2.85	Typical set-up with microwave generator and antenna, value for 7 GHz 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]	EN, FCC, JP, ISED	40000	77000	276.19	calculated for 77 GHz (FMCW) carrier
	Frequency Error / NFC [Hz]	EN, FCC, JP, ISED	6000	7000	33.92	calculated for 6.5 GHz UWB Ch.5
			11.00	14.00	20.76	calculated for 13.56 MHz 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 2.4 GHz ISM
			5.18	5.825	7.180 ppm	6b. Bandwidth / 2-Marker Method for 5 GHz WLAN
			5.18	5.825	1.099 ppm	7. Frequency (Marker method) for 5 GHz WLAN
			30	6000	0.11561 µs	8. Medium-Utilization factor / Timing
			30	6000	1.85	9a. Blocking-Level of companion device
			30	6000	1.62	9b. Blocking Generator level
6	Conducted Emissions	EN, FCC	0.009	30	3.57	general EMI-measurements on AC/DC ports

9 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2024-Sep-30
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End Of Test Report