

Test Report

23-1-0014801T032_TR1-R03

Number of pages:	27	Date of Report:	2025-Apr-07
Testing company:	cetecom advanced GmbH Untertuerkheimer Str. 6-10 66117 Saarbruecken GERMANY	Applicant:	VALEO Telematik und Akustik GmbH
Product:	Antenna and Remote Telematics Integrated System		
Model:	ARTEMIS-NAR-01		
FCC ID:	QWY-ARTEMIS-NAR01	IC:	6588A-ARTEMISNAR1
		PMN:	ARTEMIS-NAR-01
		HVIN:	ARTEMIS-NAR-01
		FVIN:	E20 R550
Testing has been carried out in accordance with:	<p>FCC Regulations: Title 47 CFR, Chapter I, Subchapter A, Subpart C: §15.231</p> <p>ISED Regulations: RSS-210, Issue 11 RSS-Gen, Issue 5</p> <p>Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".</p>		
Tested Technology:	SRD		
Test Results:	<p><input checked="" type="checkbox"/> The EUT complies with the requirements in respect of all parameters subject to the test.</p> <p>The test results relate only to devices specified in this document</p> <p>The current version of Test Report 23-1-0014801T032_TR1-R03 replaces the test report 23-1-0014801T032_TR1-R02 dated 2024-Oct-17. The replaced test report is herewith invalid.</p>		
Signatures:			

B.Eng. Martin Nunier
Supervisor Radio Services
Authorization of test report

Christian Lorenz
Lab Manager
Responsible of test report

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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.

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 advanced.

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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 SRD RKE technology. 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 below 30 MHz	§15.205(a) §15.209(a)	RSS-Gen: Issue 5 §8.9 Table 6 §8.10 Table 7	11	--	PASSED
Radiated field strength emissions 30 MHz – 1 GHz	§15.209(a) §15.205(a) §15.231(b)	RSS-Gen: Issue 5; §8.9 Table 5 §8.10 Table 7 RSS-210: Issue 11 Annex A.1.3 Table A1	15	--	PASSED
Radiated field strength emissions above 1 GHz	§15.209(a) §15.231(b)	RSS-Gen: Issue 5: §8.9 Table 5 §8.10 Table 7 RSS-210: Issue 11 Annex A.1.3 Table A1	18	--	PASSED
Transmitter timing	§15.231(a)(2)	RSS-210: Issue 11: Annex A.1.2	20	--	PASSED
Emission Bandwidth 20 dB	§15.231(c)	RSS-Gen, Issue 5: §6.7	21	--	PASSED
Occupied Channel Bandwidth 99%	2.1049(h)	RSS-Gen, Issue 5: §6.7 RSS-210, Issue 11: Annex A.1.4	22	--	PASSED

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 \(Simple Acceptance Rule\)](#).

1.4 Summary of Test Methods

Test case	Test method
Emission Bandwidth 20 dB	ANSI C63.10:2020
Occupied Channel Bandwidth 99%	ANSI C63.10:2020, §6.9.3
Emissions in non-restricted frequency bands	ANSI C63.10:2020, §11.11, §6.10.5
Radiated field strength emissions below 30 MHz	ANSI C63.10-2020 §6.3, §6.4
Radiated field strength emissions 30 MHz- 1 GHz	ANSI C63.4-2014 §8.2.3, ANSI C63.10-2020 §6.3, § 6.5
Radiated field strength emissions above 1 GHz	ANSI C63.4-2014 §8.3, ANSI C63.10-2020 §6.3, § 6.6
AC-Power Lines Conducted Emissions	ANSI C63.4-2014 §7, ANSI C63.10-2020 § 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:	Timo Franke
Receipt of EUT:	2023-Sep-13
Date(s) of test:	2024-Jun-14 to 2024-Apr-18
Version of template:	24.0301

2.5 Applicant's details

Applicant's name:	VALEO Telematik und Akustik GmbH
Address:	Max-Planck-Str. 28-32 61381 Friedrichsdorf Hesse Germany
Contact Person:	Martin Fleckenstein
Contact Person's Email:	martin.fleckenstein@valeo.com

2.6 Manufacturer's details

Manufacturer's name:	VALEO Telematik und Akustik GmbH
Address:	Max-Planck-Str. 28-32 61381 Friedrichsdorf Deutschland

2.7 Equipment under Test (EUT)

EUT No.*)	Sample No.	Product	Model	Type	SN	HW	SW
EUT 1	23-1-00148S178_C01	Antenna and Remote Telematics Integrated System	ARTEMIS-NAR-01	-	AT10NAFH 240000000 51	D4	E20 R550
EUT2	--	Car vehicle	FIN: W1KFJ1DB3S J0001	FIN: W1KFJ1DB 3SJ0001	174-1368	--	--
	--	Remote Keyless Entry Transceiver	ARTEMIS-NAR-01	--	--	24-23-1	24-17-09

*) 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	23-1-00148S58_C01	Car roof	N/A	N/A	N/A	N/A
AE 2	23-1-00148S59_C01	EMC Load Box	N/A	N/A	N/A	N/A
AE 3	23-1-00148S95_C01	DDS Signal generator	JDS6600	N/A	N/A	N/A
AE 4	23-1-00148S97_C01	Power supply	N/A	N/A	N/A	N/A
AE 5	--	EIS/KG	ECU	0000178558723 00212012201	23-32-1	25-07-04
AE 6	--	Vehicle Key	MS7	#1	--	--

*) 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

1) AE 5 to AE6 are provided by MERCEDES BENZ AG and are part of SET. 3. This was a separate setup due to the confidentiality and safety to open/close doors of a vehicle.

*) 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	23-1-00148S111_C01	Cable harness	-	100 cm
CAB 2	23-1-00148S152_C01	RKE LIN Cable	-	50 cm
CAB 3	23-1-00148S30_C01	Cable harness Power	-	100 cm
CAB 4	23-1-00148S70_C01	Cable	SMA / U.FL	15 cm
CAB 5	23-1-00148S163_C01	Cable	Simplified RKE and Power cable	50 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 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 + AE 1 + AE 2 + AE 3 + CAB 4 + CAB 5	Used for radiated measurements
2	EUT 1 + AE 3 + AE 4 + CAB 1 + CAB 2 + CAB 3 + CAB 4	Used for conducted measurements
3	EUT 2 + AE 5 + AE 6	EUT-unit build inside car vehicle. (Tested as final configuration)

*) 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.*1)	Operating modes	Additional information
Op. 1	TX	EUT is triggered by AE 3 to transmit a continuous carrier at middle frequency 433.92 MHz on antenna 1 or antenna 2.
Op. 2	Normal mode	Automatic transmitter de-activation, scenario1
Op. 3	Normal mode	Engine start, scenario2

*1) 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	<input type="checkbox"/> for normal use	<input checked="" type="checkbox"/> Special version for test execution		
Power supply	<input type="checkbox"/> AC Mains	-		
	<input checked="" type="checkbox"/> DC Mains	12 V DC		
	<input type="checkbox"/> Battery	-		
Operational conditions	$T_{\text{nom}} = 21 \text{ }^{\circ}\text{C}$	$T_{\text{min}} = -40 \text{ }^{\circ}\text{C}$ $T_{\text{max}} = +110 \text{ }^{\circ}\text{C}$		
EUT sample type	Pre-Production			
Weight	0.860 kg			
Size [LxWxH]	61.0 cm x 11.0 cm x 4.5 cm			
Interfaces/Ports	2x Fakra, 2x MQS, 1x MateNet			
For further details refer Applicants Declaration & following technical documents				
For further details regarding radio parameters: --				

3.2 Detailed Technical data of Main EUT as Declared by Applicant

Frequency Band	433 MHz	
Number of Channels (USA/Canada -bands)	3	433.47 MHz
		433.92 MHz
		434.37 MHz
Nominal Channel Bandwidth	165 kHz	
Type of Modulation Data Rate	GFSK	
Other installed options	<input checked="" type="checkbox"/> None	
Max. Conducted Output Power	+9 dBm	
Antenna Type	n/a	
Antenna Gain	-10 dBi	
FCC label attached	Yes	
Test firmware / software and storage location	EUT	
For further details refer Applicants Declaration & following technical documents		
Description of Reference Document (supplied by applicant)		Version
ARTEMIS_Tune-up-information		Rev. 1.2
		23

3.3 Modifications on Test sample

Additions/deviations or exclusions	--
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4 Measurements

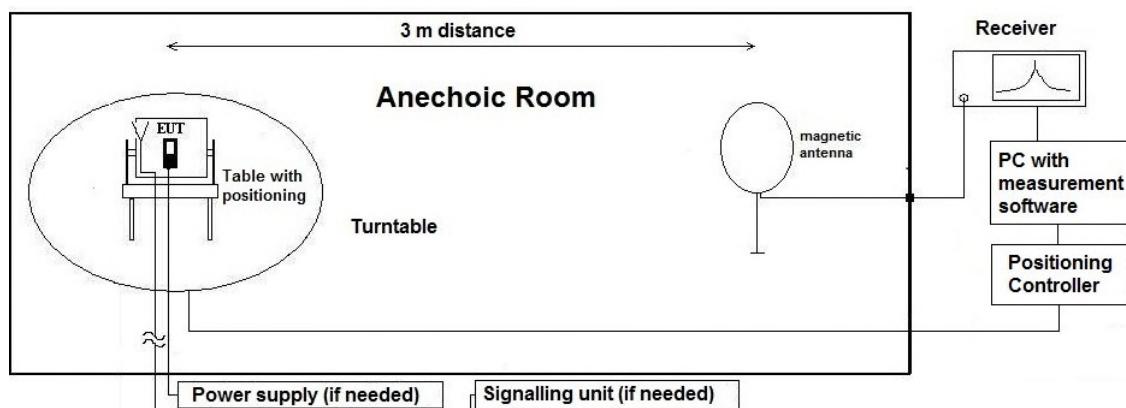
4.1 Radiated field strength emissions below 30 MHz

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:

$$E_C = E_R + AF + C_L + D_F - G_A$$

AF = Antenna factor

$$M = L_T - E_C$$

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	120901 - SAC - Radiated Emission <1GHz
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4.1.3 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	fullfilled	not fullfilled	-80.00
	10	30000.00	4774.65		fullfilled	not fullfilled	-80.00
	20	15000.00	2387.33		fullfilled	not fullfilled	-80.00
	30	10000.00	1591.55		fullfilled	not fullfilled	-80.00
	40	7500.00	1193.66		fullfilled	not fullfilled	-80.00
	50	6000.00	954.93		fullfilled	not fullfilled	-80.00
	60	5000.00	795.78		fullfilled	not fullfilled	-80.00
	70	4285.71	682.09		fullfilled	not fullfilled	-80.00
	80	3750.00	596.83		fullfilled	not fullfilled	-80.00
	90	3333.33	530.52		fullfilled	not fullfilled	-80.00
	100	3000.00	477.47		fullfilled	not fullfilled	-80.00
	125	2400.00	381.97		fullfilled	not fullfilled	-80.00
	200	1500.00	238.73		fullfilled	fullfilled	-78.02
	300	1000.00	159.16		fullfilled	fullfilled	-74.49
	400	750.00	119.37		fullfilled	fullfilled	-72.00
	490	612.24	97.44		fullfilled	fullfilled	-70.23
	500	600.00	95.49		fullfilled	not fullfilled	-40.00
	600	500.00	79.58		fullfilled	not fullfilled	-40.00
	700	428.57	68.21		fullfilled	not fullfilled	-40.00
	800	375.00	59.68		fullfilled	not fullfilled	-40.00
	900	333.33	53.05		fullfilled	not fullfilled	-40.00
MHz	1.00	300.00	47.75	30	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

4.1.4 Limit

Radiated emissions limits (3 meters)					
Frequency Range [MHz]	Limit [μ V/m]	Limit [$\text{dB}\mu\text{V}/\text{m}$]	Distance [m]	Detector	RBW [kHz]
0.009 – 0.09	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	0.2
0.09 – 0.11	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Quasi peak	0.2
0.11 – 0.15	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	0.2
0.15 – 0.49	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	9
0.49 – 1.705	24000 / f [kHz]	87.6 – 20Log(f) (kHz)	30	Quasi peak	9
1.705 – 30	30	29.5	30	Quasi peak	9

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

4.1.5 Result

Diagram	Channel	Mode	Maximum Level [$\text{dB}\mu\text{V}/\text{m}$] Frequency Range 0.009 – 30 MHz	Result
2.01a	Mid	Op. 1 Ant 1	No peaks < 6 dB margin found	PASSED
2.01b	Mid	Op. 1 Ant 1	No peaks < 6 dB margin found	PASSED
2.02a	Mid	Op. 1 Ant 2	No peaks < 6 dB margin found	PASSED
2.02b	Mid	Op. 1 Ant 2	No peaks < 6 dB margin found	PASSED

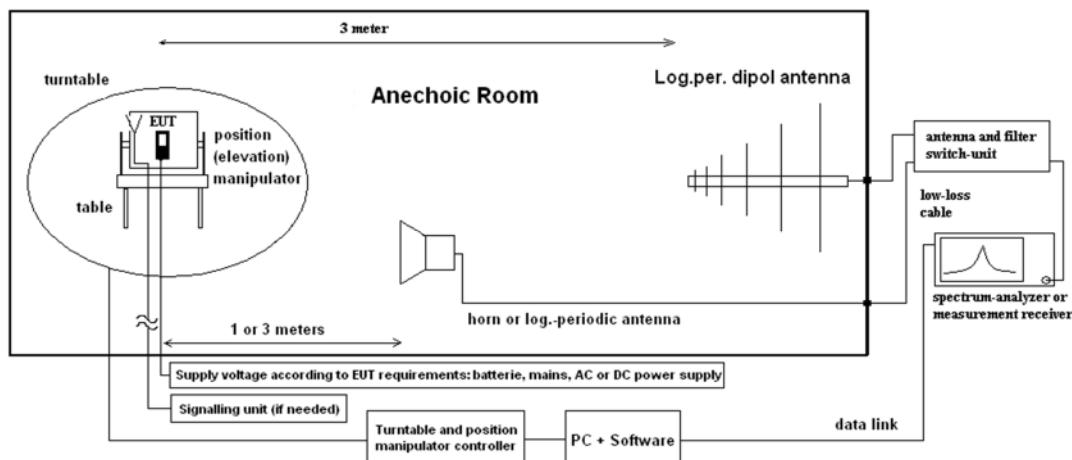
Remark: for more information and graphical plot see annex 201

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 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 semi anechoic room (SAR) and 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 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 maintaining 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:

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

AF = Antenna factor

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

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 Measurement Location

Test site	120901 - SAC - Radiated Emission <1GHz
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4.2.3 Limit

Fundamental radiated emissions limits (3 meters)				
Frequency Range [MHz]	Limit [μV/m]	Limit [dBμV/m]	Detector	RBW / VBW [kHz]
30 – 70	Not allowed ²⁾	Not allowed ²⁾	Average / CISPR quasi-peak	100 / 300
40.66 - 40.70 ¹⁾	2250	67.04	Average / CISPR quasi-peak	100 / 300
70 – 130	1250	61.93	Average / CISPR quasi-peak	100 / 300
130 – 174	1250 – 3750	61.93 – 71.48	Average / CISPR quasi-peak	100 / 300
174 – 260	3750	71.48	Average / CISPR quasi-peak	100 / 300
260 – 470	3.750 – 12500	71.48 – 81.93	Average / CISPR quasi-peak	100 / 300
Above 470	12500	81.93	Average / CISPR quasi-peak	100 / 300

Spurious radiated emissions limits (3 meters)				
Frequency Range [MHz]	Limit [μV/m]	Limit [dBμV/m]	Detector	RBW / VBW [kHz]
30 – 70	100	40.0	Average / CISPR quasi-peak	100 / 300
40.66 - 40.70 ¹⁾	225	47.04	Average / CISPR quasi-peak	100 / 300
70 – 130	125	41.93	Average / CISPR quasi-peak	100 / 300
130 – 174	125 – 375	41.93 – 51.48	Average / CISPR quasi-peak	100 / 300
174 – 260	375	51.48	Average / CISPR quasi-peak	100 / 300
260 – 470	375 – 1250	51.48 – 61.93	Average / CISPR quasi-peak	100 / 300
Above 470	1250	61.93	Average / CISPR quasi-peak	100 / 300

Remark 1): only USA

Remark 2): no operation, except frequency band mentioned in Remark 1, allowed

4.2.4 Result

Fundamental emissions

Diagram	Channel	Mode	Maximum Level (PK) [dB μ V/m]	Maximum Level (AV / QP) [dB μ V/m] *	Limit at 433.92 MHz (Linear interpolation)	Result
3.01	Mid	Op. 1 Ant 1	96.46	79.25	80.83	PASSED
3.02	Mid	Op. 1 Ant 2	95.86	78.66	80.83	PASSED

Remark

- 1.) Worst-case duty cycle correction PK-AV applied of 17.2dB, see chapter 1.4 of annex 201 for calculations of value
- 2.) for more information and graphical plots, see annex 201

Spurious emissions

Diagram	Channel	Mode	Maximum Level (PK) [dB μ V/m]	Result
3.01	Mid	Op. 1 Ant 1	41.57 @ 934.83 MHz	PASSED
3.02	Mid	Op. 1 Ant 2	39.70 @ 934.83 MHz	PASSED

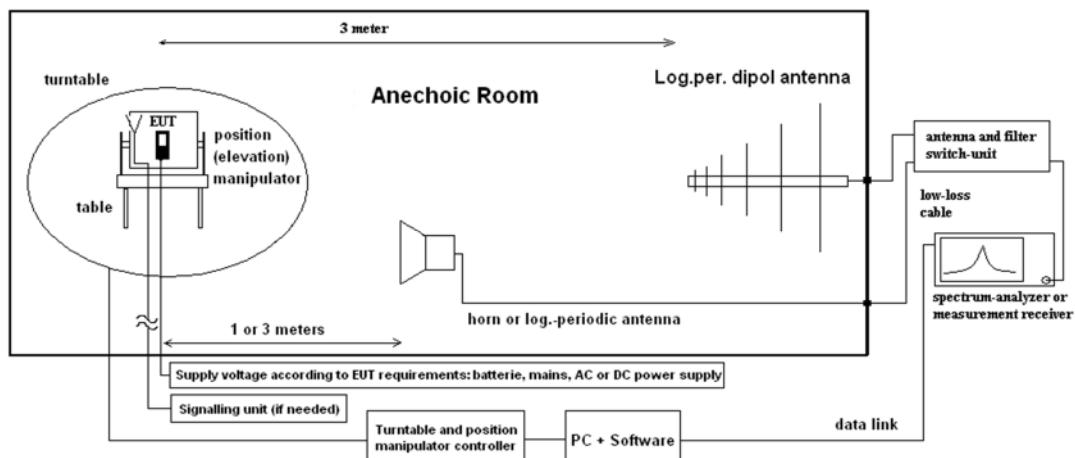
Remark: for more information and graphical plots, see annex 201

4.3 Radiated field strength emissions above 1 GHz

4.3.1 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 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 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:

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

E_C = Electrical field – corrected value

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

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.

4.3.2 Measurement Location

Test site 1 – 10 GHz	120904 - FAC1 - Radiated Emissions
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4.3.3 Limit

Radiated emissions limits (3 meters)				
Frequency Range [MHz]	Limit [μ V/m]	Limit [dB μ V/m]	Detector	RBW / VBW [kHz]
Above 1000	1.250	61.93	Average	1000 / 3000
Above 1000	12.500	81.93	Peak	1000 / 3000

4.3.4 Result

Diagram	Channel	Mode	Maximum Level [dB μ V/m] Frequency Range 1 – 10 GHz	Result
4.01a	Mid	Op. 1 Ant 1 / lying	No peaks < 6 dB margin found	PASSED
4.01b	Mid	Op. 1 Ant 1 / standing	No peaks < 6 dB margin found	PASSED
4.02a	Mid	Op. 1 Ant 2 / lying	No peaks < 6 dB margin found	PASSED
4.02b	Mid	Op. 1 Ant 2 / standing	No peaks < 6 dB margin found	PASSED

Remark: for more information and graphical plots, see annex 201

4.1 Transmitter timing

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

A radiated measurement was performed on set-up no.3 in order to capture emissions of the EUT2.

Testing method:

The measurement is made according to relevant reference clauses:

(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Spectrum-Analyzer set to ZERO-SPAN settings with high RBW of 3MHz to capture all EUT emissions on one of the available channels of 433.47MHz/433.92MHz/434.37MHz. A sweep time suitable for tests was chosen and the RAW files captured.

EUT settings

The EUT is set to normal operating mode.

4.1.2 Measurement Location

Test site	Laboratory area SAC1
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4.1.3 Limit

- (1) A manually operated transmitter shall automatically cease transmission within not more than 5 seconds.
- (2) A automatically activated transmitter shall cease transmission within 5 seconds after activation.
- (3) Periodic transmissions at regular predetermined intervals are not permitted. Polling, supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed as long the total transmission time does not exceed 2s/hour.
- (4) During emergencies involving fire, security, and safety of life, may operate during the pendency of the alarm condition.
- (5) Transmission of set-up information for security systems may exceed the transmission duration limits, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically

4.1.4 Result

Activation of transmitter	Applicable Limit	Result
<input type="checkbox"/> manual activated transmitter <input checked="" type="checkbox"/> automatic activated transmitter	<input type="checkbox"/> (1) <input checked="" type="checkbox"/> (2) <input type="checkbox"/> (3) <input type="checkbox"/> (4) <input type="checkbox"/> (5)	PASSED

Remark: for more information and graphical plot TID005, see annex 201

4.2 Emission Bandwidth 20 dB

4.2.1 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. The direct RF-path is connected to the spectrum – analyzer for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Testing method:

The measurement is made according to relevant reference clauses:

(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

EUT settings

EUT is set to modulated continuous transmission mode.

4.2.2 Measurement Location

Test site	120910 - Radio Laboratory 2
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4.2.3 Limit

Frequency [MHz]	Limit	Detector [MaxHold]	RBW [kHz]	VBW [kHz]
70 < f_c < 900	0.25% of f_c	MaxPeak		
> 900	0.5% of f_c	MaxPeak	1% to 5% of OBW	3x RBW

Remark: RBW shall be between 1% and 5% of f_c

4.2.4 Result

Diagram	Channel	Mode	Frequency [MHz]	20 dB bandwidth [kHz]	Result
D001_01	Mid	Op. 1 Ant 1	433.893	49.35	PASSED
D002_01	Mid	Op. 1 Ant 2	433.893	48.15	PASSED

Remark: for more information and graphical plots, see annex 201.

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. The direct RF-path is connected to the spectrum – analyzer for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

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

EUT is set to modulated continuous transmission mode.

4.3.2 Measurement Location

Test site	120910 - Radio Laboratory 2
-----------	-----------------------------

4.3.3 Limit

Frequency	Limit	Detector [MaxHold]	RBW [kHz]	VBW [kHz]
70 MHz < f_c < 900 MHz	0.25% of f_c	MaxPeak	1% to 5% of OBW	3x RBW
> 900 MHz	0.5% of f_c	MaxPeak		

4.3.4 Result

Diagram	Channel	Mode	Frequency [MHz]	99% OBW [kHz]	Result
D001_02	Mid	Op. 1 Ant 1	433.895	56.156	PASSED
D002_02	Mid	Op. 1 Ant 2	433.895	56.684	PASSED

Remark: for more information and graphical plots, see annex 201.

4.4 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
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH / Glottental	81650455	cal	cal: 2024-May-13	cal: 24M	cal: 2026-May-13
20442	Semi Anechoic Chamber	ETS-Lindgren GmbH / Taufkirchen	without	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20482	filter matrix Filter matrix SAR 1	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	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: -
25038	Loop Antenna HFH2-22	Rohde & Schwarz Messgerätebau GmbH / Memmingen	879824/13	cal	cal: 2022-Jul-04	cal: 24M	cal: 2024-Jul-04
	120904 - FAC1 - Radiated Emissions			chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20020	Horn Antenna 3115 (Subst 1)	EMCO Elektronik GmbH	9107-3699	calchk	cal: 2021-Aug-17 chk: 2013-Apr-20	cal: 36M chk: 12M	cal: 2024-Aug-17
20066	Notch Filter WRCT 1900/2200-5/40-10EEK	Wainwright Instruments GmbH	5	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20121	Notch Filter WRCB 1879,5/1880,5EE	Wainwright Instruments GmbH	15	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20122	Notch Filter WRCB 1747/1748	Wainwright Instruments GmbH / Andechs	12	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20254	High Pass Filter 5HC 2600/12750-1.5KK	Trilithic	23042	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
20290	Notch Filter WRCA 901,9/903,15S	Wainwright Instruments GmbH	3RR	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20291	High Pass Filter WHJ 2200-4EE	Wainwright Instruments GmbH	14	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20338	Pre-Amplifier 100MHz - 26GHz JS4-00102600-38-5P	Miteq Inc.	838697	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20448	Notch Filter WRCT 1850,0/2170,0-5/40-10SSK	Wainwright Instruments GmbH	5	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20449	Notch Filter WRCT 824,0/894,0-5/40-8SSK	Wainwright Instruments GmbH	1	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20484	Pre-Amplifier 2,5GHz - 18GHz AMF-5D-02501800-25-10P	Miteq Inc.	1244554	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20489	Test Receiver ESU40	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100030	cal	cal: 2024-May-15	cal: 12M	cal: 2025-May-15
20512	Notch Filter WRCA 800/960-02/40-6EEK (GSM 850)	Wainwright Instruments GmbH	24	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
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 FSU	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: -
20868	High Pass Filter AFH-07000	AtlanTecRF	16071300004	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20883	Open Switch and control Platform OSP-B200S2	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
	120910 - Radio Laboratory 1 (TS 8997)			chk	chk: 2023-Jul-10	chk: 12M	chk: 2024-Jul-10
20559	Vector Signal Generator SMU200A	Rohde & Schwarz Messgerätebau GmbH / Memmingen	103736	cal	cal: 2023-May-25	cal: 24M	cal: 2025-May-25
20691	Open Switch and control Platform OSP157W 8 Port Plus	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100950	cal	cal: 2023-Jun-30	cal: 36M	cal: 2026-Jun-30
20805	Open Switch and control Platform OSP B157WX 40GHz 8Port Switch	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101264	cal	cal: 2023-May-26	cal: 36M	cal: 2026-May-26
20866	Signal Analyzer FSV3030	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101247	cal	cal: 2023-Jun-14	cal: 12M	cal: 2024-Jun-14
20871	NRP-Z81	Rohde & Schwarz Messgerätebau GmbH / Memmingen	104631	cal	cal: 2024-May-15	cal: 12M	cal: 2025-May-15
20872	NRX Power Meter	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101831	cal	cal: 2024-May-14	cal: 24M	cal: 2026-May-14
20904	Climatic Chamber ClimeEvent C/1000/70a/5	Weiss Umwelttechnik GmbH / Reiskirchen-Lindenstruth	58226223240010	cal	cal: 2022-Nov-29	cal: 24M	cal: 2024-Nov-29
20927	Signal Generator SMF 100A	Rohde & Schwarz Messgerätebau GmbH / Memmingen	102109	cal	cal: 2022-May-19	cal: 36M	cal: 2025-May-19
20732	Signal- and Spectrum Analyzer FSW67	Rohde & Schwarz Messgerätebau GmbH / Memmingen	104023	cal	Cal: 2024-Jul-30	Cal: 12M	Cal: 2025-Jul-30

Tools used in 'P1M1'

4.4.1 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 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-waveguide 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)
			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
3	Radiated Blocking [dB]	EN	33000	50000	3.48	WR-22 set-up
			50000	75000	3.73	WR-15 set-up
			75000	110000	4.26	WR-6 set-up
			40000	77000	276.19	calculated for 77 GHz (FMCW) carrier
			6000	7000	33.92	calculated for 6.5 GHz UWB Ch.5
4	Frequency Error / UWB+FMCW [kHz]	EN, FCC, JP, ISED	11.00	14.00	20.76	calculated for 13.56 MHz NFC carrier
	Frequency Error / NFC [Hz]	EN, FCC, JP, ISED	30	6000	1.11	1. Power measurement with Fast-sampling-detector
5	TS 8997 Conducted Parameters	FCC15/18 / ISED	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 μ s	8. Medium-Utilization factor / Timing
			30	6000	1.85	9a. Blocking-Level of companion device
			30	6000	1.62	9b. Blocking Generator level
			0.009	30	3.57	general EMI-measurements on AC/DC ports
			0.009	30	3.57	

9 Versions of test reports (change history)

Version	Applied changes	Date of release
R01	Initial release	2024-Jun-27
R02	PMN, HVIN and FVIN for ISED edit Change to RSS-210 Issue 11 Some formatting and organizational changes	2024-Oct-17
R03	Re-calculation of duty-cycle on latest diagrams (set-up3)	2024-April-07

End Of Test Report