

PARTIAL Test Report

24-1-0039801T013_TR2-R01

Number of pages:	27	Date of Report:	2024-Nov-04
Testing company:	cetecom advanced GmbH Untertuerkheimer Str. 6-10 66117 Saarbruecken GERMANY	Applicant:	Lufthansa Technik AG
Product:	Small Aircraft Cabin Management and Inflight Entertainment System (SAC)		
Model:	SAC0522		
FCC ID:	2BKRFSA0522001001		
Testing has been carried out in accordance with:	FCC Regulations Title 47 CFR, Chapter I, Subchapter A, Part 15 Subpart E Unlicensed National Information Infrastructure Devices § 15.407 General technical requirements		
Tested Technology:	5 GHz W-LAN (IEEE 802.11)		
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:	 B.Eng. Martin Nunier Supervisor Radio Services Authorization of test report Salih Öztan Testing 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.

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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 a 5 GHz W-LAN transmitter. Other implemented wireless technologies were not considered within this test report.

Test case	Reference Clause FCC ☒	Page	Remark	Result
Duty Cycle	--	--	--	NP
Minimum Emission Bandwidth 6 dB	2.1049(h) §15.407(e)	--	--	NP
Emission Bandwidth 26 dB	2.1049(h)	--	--	NP
Occupied Channel Bandwidth 99%	2.1049(h)	--	--	NP
Frequency stability	§2.1055 §15.407(g)	--	--	NP
RF output power	§15.407(a) (1)(2)(3)(4)		--	NP
Power spectral density	§15.407(a) (1)(2)(3)(5)	--	--	NP
Antenna gain information	§15.407(a) (1)(2)(3)	--	--	NP
Radiated Band-Edge emissions	§15.209 §15.205 §15.407(b)(1)(2)(3)(4)	22	--	PASSED
Radiated field strength emissions below 30 MHz	§15.205 §15.209	14	--	PASSED
Radiated field strength emissions 30 MHz – 1 GHz	§15.205 §15.209 §15.407(6)(7)	16	--	PASSED
Radiated field strength emissions above 1 GHz	§15.407(6) §15.407(b)	19	--	PASSED
Transmit power control	§15.407 (h1)(h2)	--	--	NP
Dynamic frequency selection (DFS)	§15.407(h1)	--	--	NP
Discontinuous transmissions + Device security	§15.407(h2)	--	--	NP
AC-Power Lines Conducted Emissions	§15.407(i)	--	--	N/A

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:

- Please check the module report "MDE_UBLOX_2030_FCC_02_rev02_SIGNED" for not performed measurements by the cetecom advanced laboratory.

1.4 Summary of Test Methods

Test case	Test method
Duty Cycle	ANSI C63.10:2013, §12.2(b)(2)
Emission Bandwidth 26 dB	ANSI C63.10:2013, §6.9.2, §11.8, §12.4.1
Occupied Channel Bandwidth 99%	ANSI C63.10:2013, §12.4.2
Frequency stability	ANSI C63.10:2013, §6.8.1, §6.8.2
RF output power	ANSI C63.10:2013, §12.3
Power spectral density	ANSI C63.10:2013, §12.5
Antenna gain information	ANSI C63.10:2013, §6.10.5, §6.10.6
Radiated Band-Edge emissions	ANSI C63.10-2013; "Marker-Delta method", §6.10.4, §12.7.4.4
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, §12.7
Radiated field strength emissions above 1 GHz	ANSI C63.4-2014 §8.3, ANSI C63.10-2013 §6.3, § 6.6, §12.7
Transmit power control	ANSI C63.10:2013, §12.3
Dynamic frequency selection (DFS)	See TR reported
Discontinuous transmissions + Device security	See Applicant's documentation
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:	cetekom 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
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:	Salih Öztan
Receipt of EUT:	2024-Aug-06
Date(s) of test:	2024-Sep-03 to 2024-Sep-27
Version of template:	24.0301

2.5 Applicant's details

Applicant's name:	Lufthansa Technik AG
Address:	Weg beim Jäger 193 22335 Hamburg Hamburg Germany
Contact Person:	Clemens Zumegen
Contact Person's Email:	clemens.zumegen@lht.dlh.de

2.6 Manufacturer's details

Manufacturer's name:	Lufthansa Technik AG
Address:	Weg beim Jäger 193 22335 Hamburg Germany

2.7 Equipment under Test (EUT)

EUT No.*)	Sample No.	Product	Model	Type	SN	HW	SW
EUT 1	24-1-00398S02_C01	Small Aircraft Cabin Management and Inflight Entertainment System (SAC)	SAC0522	MOD0	Q000040	SAC0522-001-001	SCDP1-01-A-RC01

*) 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	24-1-00398S03_C01	WiFi Antenna	WIFI ANTENNA MIMO	N/A	N/A	N/A
AE 2	24-1-00398S06_C01	Socket	N/A	N/A	N/A	N/A
AE 3	24-1-00398S07_C01	Termination Network	N/A	N/A	N/A	N/A

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

2.10 Connected cables (CAB)

CAB No.*)	Sample No.	Cable Type	Connectors / Details	Length
CAB 1	24-1-00398S04_C01	Network cable	--	200 cm
CAB 2	24-1-00398S05_C01	Power Cable	--	< 300 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
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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 + AE 1 + AE 2 + AE 3 + CAB 1 + CAB 2	Used for radiated 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	RLAN_TX-Mode	With help of special test firmware TX-mode was set-up. We refer to applicants information/papers for details about necessary commands.

*) 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

Typical use	☐ portable	☒ fixed indoor	☐ fixed outdoor	☐ vehicular
Firmware	☐ for normal use	☒ Special version for test execution		
Power supply	☐ AC Mains	-		
	☒ DC Mains	28 V DC		
	☐ Battery	-		
Operational conditions	T _{nom} = +21 °C	T _{min} = N/A	T _{max} = N/A	
EUT sample type	Pre-Production			
Weight	2.130 kg			
Size [LxWxH]	28.0 cm x 18.0 cm x 7.0 cm			
Interfaces/Ports	USB, TNC			
For further details refer Applicants Declaration & following technical documents				
For further details regarding radio parameters, please refer to IEEE802.11 Specification				

3.2 Detailed Technical data of Main EUT as Declared by Applicant

Frequency Channel B.W. (USA bands only)	U-NII 1: 5150-5250 MHz	☒ Ch 36 40 48	☒ BW 20 MHz
		☒ Ch. 38 46	☒ BW 40 MHz
		☐ Ch. 42	☐ BW 80 MHz
	U-NII2A: 5250-5350 MHz	☐ Ch 52 56 64	☐ BW 20 MHz
		☐ Ch. 54 62	☐ BW 40 MHz
		☐ Ch. 58	☐ BW 80 MHz
	U-NII 2C: 5470-5725 MHz	☐ Ch 100 108 116	☐ BW 20 MHz
		☐ Ch 120 124 128 (USA only)	
		☐ Ch 132 136 140	
		☐ Ch 102 110 118 126 134 (Ch 118 126 USA only)	☐ BW 40 MHz
		☐ Ch. 106 122 (Ch 122 USA only)	☐ BW 80 MHz
	U-NII 3: 5725 -5850 MHz	☐ Ch 149 157 165	☐ BW 20 MHz
		☐ Ch 151 159	☐ BW 40 MHz
		☐ Ch. 155	☐ BW 80 MHz
802.11a – Mode OFDM Modulation Data Rates	☒ BPSK 6 Mbps / 9 Mbps ☒ QPSK 12 Mbps / 18 Mbps ☒ 16-QAM 24 Mbps / 36 Mbps ☒ 64-QAM 48 Mbps / 54 Mbps		
802.11n – Mode OFDM Modulation Data Rates	☒ HT20 (MCS0 – MCS7) 7.2/14.4/21.7/28.9/43.3/57.8/65/72.2 Mbps		
	☒ HT40 (MCS0 – MCS7) 15/30/45/60/90/120/135/150 Mbps		
802.11ac – Mode OFDM Modulation Data Rates	☒ HT20 (MCS0 – MCS7) 7.2/14.4/21.7/28.9/43.3/57.8/65/72.2 Mbps		
	☒ HT40 (MCS0 – MCS7) 15/30/45/60/90/120/135/150 Mbps		
	☐ HT80 (MCS0 – MCS7) 7.2/14.4/21.7/28.9/43.3/57.8/65/72.2 Mbps		
Other wireless options	☒ a/n/ac mode		
	☒ b/g/n mode		
	☐ Bluetooth LE (not tested within this report)		
	☒ Bluetooth EDR (not tested within this report)		
MIMO	☒		

Max. Conducted Output Power (Measured RMS Power) And EiRP (Calculated EiRP = RMS + Gain)	Band	Mode	RMS [dBm]	EiRP [dBm]
	U-NII 1	802.11a:	18.10	23.20
		802.11n40:	17.10	22.20
		802.11n20-MIMO:	18.30	23.40
802.11n40-MIMO:		18.20	23.30	
Antenna Type(s)	external antenna			
Antenna Gain(s)	WLAN 5 GHz 5.1 dBi			
FCC label attached	No			
Test firmware / software and storage location	EUT 1			
For further details refer Applicants Declaration & following technical documents				
Description of Reference Document (supplied by applicant)		Version		Total Pages
--		--		--

3.3 Worst case identification

WLAN mode	Data rate
a-mode	6Mbps
n40-mode	MCS0
n20-MIMO	MCS8
n40-MIMO	MCS8

3.4 Modifications on Test sample

Additions/deviations or exclusions	--
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4 Measurements

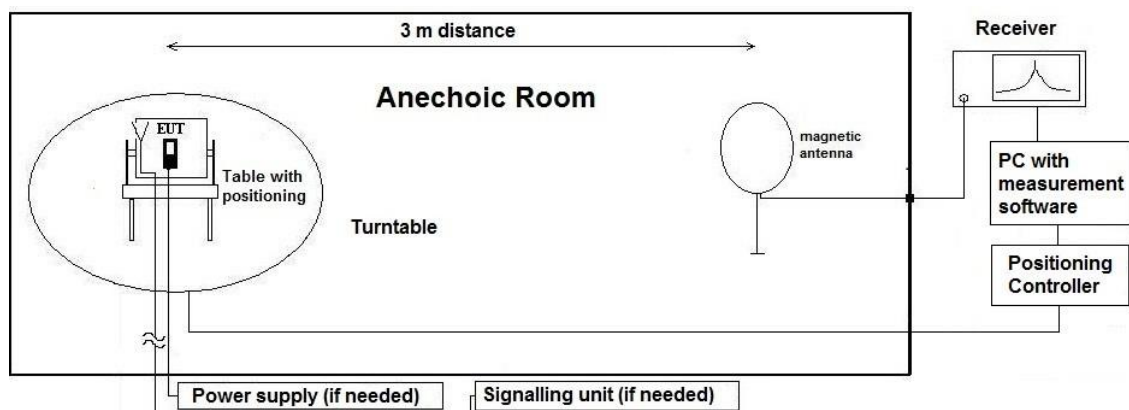
4.1 Radiated field strength emissions below 30 MHz

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 7)

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 - SAC3 - Radiated Emission <1GHz
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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	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

4.1.5 Limit

Radiated emissions limits (3 meters)					
Frequency Range [MHz]	Limit [$\mu\text{V}/\text{m}$]	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

4.1.6 Result

Diagram	Channel	Mode	Maximum Level [$\text{dB}\mu\text{V}/\text{m}$] Frequency Range 0.009 – 30 MHz	Result
2.01	36	a-mode 6Mbps ch36 lying	No peaks found	Passed
2.02	36	a-mode 6Mbps ch36 standing	No peaks found	Passed
2.03	40	a-mode 6Mbps ch40	No peaks found	Passed
2.04	48	a-mode 6Mbps ch48	No peaks found	Passed
2.05	38	n-mode HT40 MCS0 ch38	No peaks found	Passed
2.06	46	n-mode HT40 MCS0 ch46	No peaks found	Passed
2.07	36	n-MIMO HT20 MCS8 ch36	No peaks found	Passed
2.08	40	n-MIMO HT20 MCS8 ch40	No peaks found	Passed
2.09	48	n-MIMO HT20 MCS8 ch48	No peaks found	Passed
2.10	38	n-MIMO HT40 MCS8 ch38	No peaks found	Passed
2.11	46	n-MIMO HT40 MCS8 ch46	No peaks found	Passed

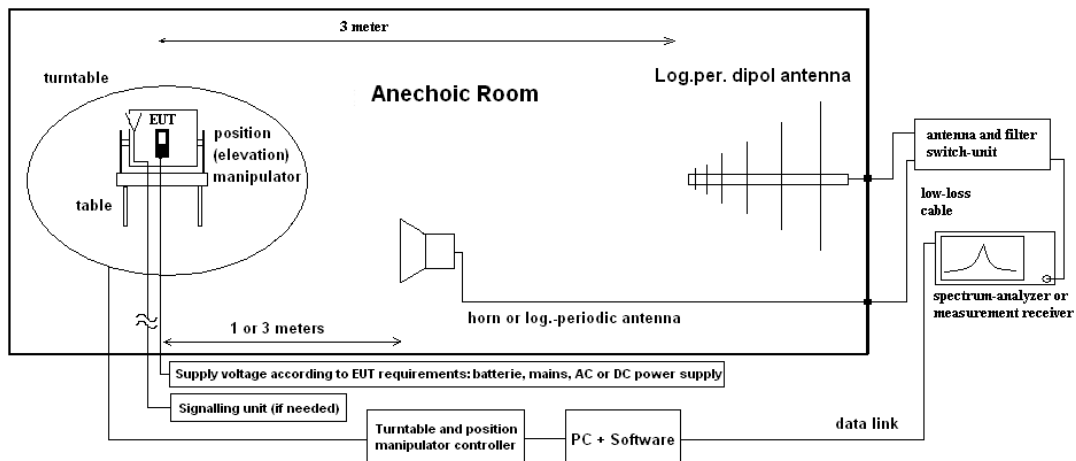
Remark: for more information and graphical plot see annex A1 **24-1-0039801T013_TR2-A201-R01**

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 7)

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 Limit

Radiated emissions limits (3 meters)				
Frequency Range [MHz]	Limit [μV/m]	Limit [dBμV/m]	Detector	RBW / VBW [kHz]
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
960 - 1000	500	54.0	Quasi peak	100 / 300

4.2.4 Result

Diagram	Channel	Mode	Maximum Level [dBμV/m] Frequency Range 30 – 1000 MHz	Result
3.01	36	a-mode 6Mbps ch36 lying	27.90 @74.55MHz	Passed
3.02	36	a-mode 6Mbps ch36 standing	31.84 @213.99MHz	Passed
3.03	40	a-mode 6Mbps ch40	32.86 @412.83MHz	Passed
3.04	48	a-mode 6Mbps ch48	32.70 @75.23MHz	Passed
3.05	38	n-mode HT40 MCS0 ch38	32.52 @74.49MHz	Passed
3.06	46	n-mode HT40 MCS0 ch46	32.84 @74.88MHz	Passed
3.07	36	n-MIMO HT20 MCS8 ch36	No peaks found	Passed
3.08	40	n-MIMO HT20 MCS8 ch40	32.51 @74.28MHz	Passed
3.09	48	n-MIMO HT20 MCS8 ch48	32.55 @74.35MHz	Passed
3.10	38	n-MIMO HT40 MCS8 ch38	32.08 @75.19MHz	Passed
3.11	46	n-MIMO HT40 MCS8 ch46	32.25 @74.35MHz	Passed

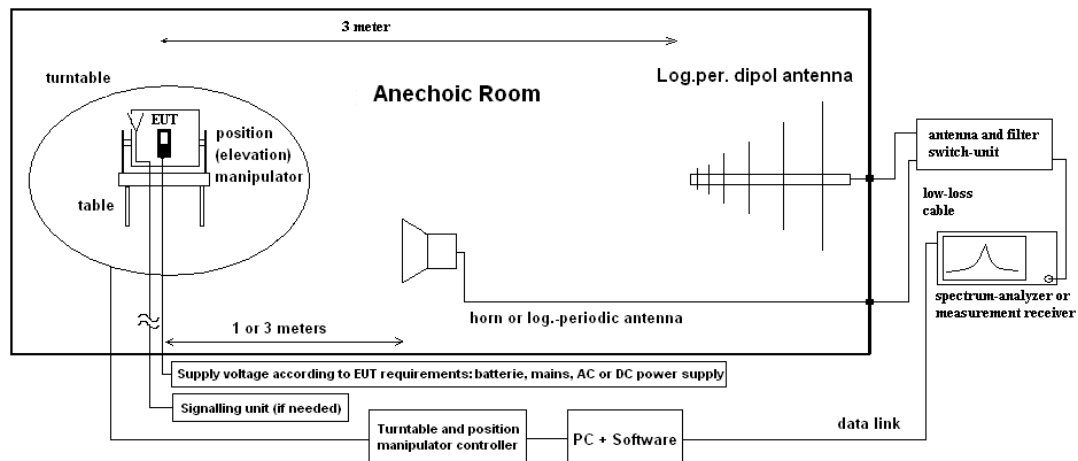
Remark: for more information and graphical plot see annex A1 **24-1-0039801T013_TR2-A201-R01**

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 7)

Exploratory, preliminary measurements

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.

The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies

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

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

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

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

Formula:

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

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

E_C = Electrical field – corrected value

E_R = Receiver reading

M = Margin

L_T = Limit

A_F = Antenna factor

C_L = Cable loss

D_F = Distance correction factor (if used)

G_A = Gain of pre-amplifier (if used)

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

4.3.2 Sample calculation

Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss + Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
29.37	41.20	--	24.28	16.92	46.3	CableLoss and PreAmp data in one data correction file

Remark: This calculation is based on an example value at 10 GHz

4.3.3 Measurement Location

Test site 1 – 18 GHz	120904 - FAC1 - Radiated Emissions
Test site 18 – 26.5 GHz	120907 - FAC2 - Radiated Emissions

4.3.4 Limit

Limit (3 meters)

Frequency Range [MHz]	AV Limit [μV/m]	AV Limit [dBμV/m]	Peak Limit [μV/m]	FCC Peak [dBμV/m] or [dBm/MHz] ☒
Above 1000	500	54	5000	74
5150 – 5250	--	--	--	-27dBm eirp
5250 – 5350	--	--	--	-27dBm eirp
5470 – 5725	--	--	--	-27dBm eirp (-17dBm/MHz eirp
5725 - 5850	--	--	--	Spectrum mask
--	--	--	--	--
--	--	--	--	--

4.3.5 Result

Diagram	Channel	Mode	Maximum Level [dBμV/m] Frequency Range 1 – 7GHz	Maximum Level [dBμV/m] Frequency Range 7 – 18GHz	Result
4.01	36	a-mode 6Mbps ch36	No peaks found	--	Passed
4.02	40	a-mode 6Mbps ch40	No peaks found	--	Passed
4.03	48	a-mode 6Mbps ch48	No peaks found	--	Passed
4.04	38	n-mode HT40 MCS0 ch38	No peaks found	--	Passed
4.05	46	n-mode HT40 MCS0 ch46	No peaks found	--	Passed
4.06	36	n-MIMO HT20 MCS8 ch36	No peaks found	--	Passed
4.07	40	n-MIMO HT20 MCS8 ch40	No peaks found	--	Passed
4.08	48	n-MIMO HT20 MCS8 ch48	No peaks found	--	Passed
4.09	38	n-MIMO HT40 MCS8 ch38	No peaks found	--	Passed
4.10	46	n-MIMO HT40 MCS8 ch46	No peaks found	--	Passed
4.11	36	a-mode 6Mbps ch36	--	No peaks found	Passed
4.12	40	a-mode 6Mbps ch40	--	No peaks found	Passed
4.13	48	a-mode 6Mbps ch48	--	No peaks found	Passed
4.14	38	n-mode HT40 MCS0 ch38	--	No peaks found	Passed
4.15	46	n-mode HT40 MCS0 ch46	--	No peaks found	Passed
4.16	36	n-MIMO HT20 MCS8 ch36	--	No peaks found	Passed
4.17	40	n-MIMO HT20 MCS8 ch40	--	No peaks found	Passed
4.18	48	n-MIMO HT20 MCS8 ch48	--	No peaks found	Passed
4.19	38	n-MIMO HT40 MCS8 ch38	--	No peaks found	Passed
4.20	46	n-MIMO HT40 MCS8 ch46	--	No peaks found	Passed

Remark: for more information and graphical plot see annex A1 **24-1-0039801T013_TR2-A201-R01**

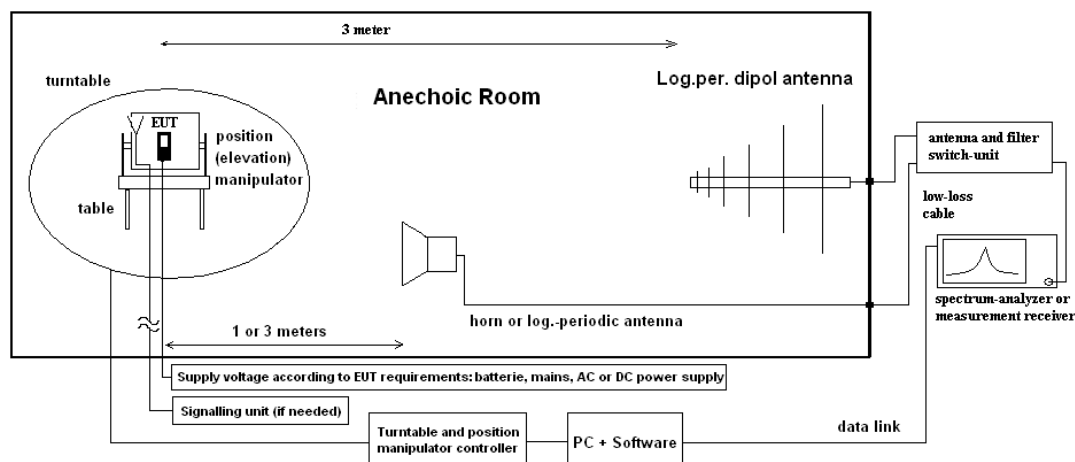
Diagram	Channel	Mode	Maximum Level [dB μ V/m] Frequency Range 18 – 26.5 GHz	Result
4.21	36	a-mode 6Mbps ch36	49.45 @39.04GHz	Passed
4.22	36	a-mode 6Mbps ch36	49.59 @38.60GHz	Passed
4.23	40	a-mode 6Mbps ch40	49.40 @39.04GHz	Passed
4.24	40	a-mode 6Mbps ch40	49.53 @39.05GHz	Passed
4.25	48	a-mode 6Mbps ch48	49.36 @39.05GHz	Passed
4.26	48	a-mode 6Mbps ch48	49.23 @39.02GHz	Passed
4.27	38	n-mode HT40 MCS0 ch38	49.27 @39.14GHz	Passed
4.28	38	n-mode HT40 MCS0 ch38	49.17 @39.14GHz	Passed
4.29	46	n-mode HT40 MCS0 ch46	49.22 @39.03GHz	Passed
4.30	46	n-mode HT40 MCS0 ch46	49.37 @39.06GHz	Passed
4.31	36	n-MIMO HT20 MCS8 ch36	49.35 @39.04GHz	Passed
4.32	36	n-MIMO HT20 MCS8 ch36	49.31 @39.06GHz	Passed
4.33	40	n-MIMO HT20 MCS8 ch40	47.47 @37.73GHz	Passed
4.34	40	n-MIMO HT20 MCS8 ch40	49.27 @39.04GHz	Passed
4.35	48	n-MIMO HT20 MCS8 ch48	49.43 @39.03GHz	Passed
4.36	48	n-MIMO HT20 MCS8 ch48	49.38 @39.06GHz	Passed
4.37	38	n-MIMO HT40 MCS8 ch38	49.39 @39.06GHz	Passed
4.38	38	n-MIMO HT40 MCS8 ch38	49.35 @39.04GHz	Passed
4.39	46	n-MIMO HT40 MCS8 ch46	49.38 @39.08GHz	Passed
4.40	46	n-MIMO HT40 MCS8 ch46	49.18 @39.02GHz	Passed

Remark: for more information and graphical plot see annex A1 **24-1-0039801T013_TR2-A201-R01**

4.4 Band Edge

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

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 7)

For uncritical results where a measurement resolution bandwidth of 1MHz can clearly show the compliance without influencing the results, a field strength measurement was performed to show compliance.

For critical results a Marker-Delta marker method was used for showing compliance to restricted bands. The method is according ANSI C63.10:2013, Chapter 6.10.6 "Marker-Delta method", the method consists of three independent steps:

1. Step: Prior to the measurement the fundamental radiated In-Band field strength was performed. The determined value is used as reference value.
2. Step: Second step consist of finding the relative attenuation between the fundamental emission and the maximum local out-of-band emission (within 2 MHz range around the band edge either on the band-edge directly or some modulation product if the level is greater than that on the band-edge) when measured with lower resolution bandwidth.
3. .Step: The delta value recorded in step 2 will be subtracted from value recorded in step 1, thus giving the required field strength at the band-edge. This value must fulfil the requirements for radiated spurious emissions in restricted bands in FCC §15.205 with the general limits of FCC §15.209

The EUT was instructed to send with maximum power (if adjustable) according to applicants instructions.

4.4.2 Measurement Location

Test site	120904 - FAC1 - Radiated Emissions
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4.4.3 Limit

Frequency Range [MHz]	Pk Limit [dBc]	Detector	RBW / VBW [kHz]
5150 – 5250	≤ 5.150 GHz: 54 dBuV/m (avg), 74 dBuV/m (pk)	Average / Peak	1000 / 3000
5250 – 5350	≥ 5.350 GHz: 54 dBuV/m (avg), 74 dBuV/m (pk)	Average / Peak	1000 / 3000
5470 – 5725	≤ 5.460 GHz: 54 dBuV/m (avg), 74 dBuV/m (pk) 5.460 – 5.470 GHz: -27 dBm/MHz (pk) equals 68.23 dBuV/m @ 3m	Average / Peak	1000 / 3000
5725 - 5850	All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge5	Peak	1000 / 3000

4.4.4 Result

Non-restricted bands near-by

Diagram	Channel	Mode	Peak [dBc]	Average [dBc]	Result
9.01	36	a-mode 6Mbps	24.553	28.480	Passed
9.02	36	n-mode HT20 MCS0	23.016	26.513	Passed
9.03	36	n-MIMO HT20 MCS8	23.985	26.276	Passed
9.04	38	n-mode HT40 MCS0	20.080	22.686	Passed
9.05	38	n-MIMO HT40 MCS8	20.947	22.326	Passed
9.11	36	ac-mode VHT20 MCS0	21.405	24.047	Passed
9.12	38	ac-mode VHT40 MCS0	19.206	21.241	Passed
9.15	36	ac-MIMO VHT20 MCS0	28.812	28.971	Passed
9.16	38	ac-MIMO VHT40 MCS0	19.564	23.807	Passed

Remark: for more information and graphical plot see annex A1 **24-1-0039801T013_TR2-A201-R01**

Restricted bands near-by

Diagram	Channel	Mode	Peak [dBμV/m]	Average [dBμV/m]	Result
9.01	36	a-mode 6Mbps	56.238	43.994	Passed
9.02	36	n-mode HT20 MCS0	56.447	43.990	Passed
9.03	36	n-MIMO HT20 MCS8	56.485	44.200	Passed
9.04	38	n-mode HT40 MCS0	56.110	44.001	Passed
9.05	38	n-MIMO HT40 MCS8	55.900	44.013	Passed
9.11	36	ac-mode VHT20 MCS0	55.900	44.200	Passed
9.12	38	ac-mode VHT40 MCS0	55.881	44.009	Passed
9.15	36	ac-MIMO VHT20 MCS0	55.718	43.999	Passed
9.16	38	ac-MIMO VHT40 MCS0	56.322	44.013	Passed
9.06	48	a-mode 6Mbps	50.691	40.421	Passed
9.07	48	n-mode HT20 MCS0	51.494	40.225	Passed
9.08	48	n-MIMO HT20 MCS8	51.528	40.407	Passed
9.09	46	n-mode HT40 MCS0	50.510	40.389	Passed
9.10	46	n-MIMO HT40 MCS8	51.054	40.362	Passed
9.19	48	ac-mode VHT20 MCS0	50.008	40.229	Passed
9.20	46	ac-mode VHT40 MCS0	50.200	40.234	Passed
9.23	48	ac-MIMO VHT20 MCS0	50.512	40.200	Passed
9.24	46	ac-MIMO VHT40 MCS0	50.306	40.133	Passed

Remark: for more information and graphical plot see annex A1 **24-1-0039801T013_TR2-A201-R01**

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	cetekom 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
20020	Double-Ridged Waveguide Horn Antenna 3115 (Subst 1)	EMCO Elektronik GmbH / Gilching	9107-3699	calchk	cal: 2024-Sep-11 chk: 2013-Apr-20	cal: 36M chk: 12M	cal: 2027-Sep-11
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-3S-10P	Miteq Inc.	379418	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20290	Notch Filter WRCA 901,9/903,1SS	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 JS4-00102600-38-5P	Miteq Inc.	838697	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH / Glottertal	81650455	cal	cal: 2024-May-13	cal: 24M	cal: 2026-May-13
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
20558	Fully Anechoic Chamber 1	ETS-Lindgren GmbH / Taufkirchen	without	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: -
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 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
	120907 - FAC2 - Radiated Emissions			chk	chk: 2024-Mar-15	chk: 12M	chk: 2025-Mar-15
20005	AC - LISN 50 Ohm/50µH ESH2-Z5	Rohde & Schwarz Messgerätebau GmbH / Memmingen	861741/005	cal	cal: 2024-May-16	cal: 12M	cal: 2025-May-16
20133	Double-Ridged Waveguide Horn Antenna 3115 (Meas 1)	EMCO Elektronik GmbH / Gilching	9012-3629	cal	cal: 2023-May-22	cal: 36M	cal: 2026-May-22
20302	Horn Antenna BBHA9170 (Meas 1)	Schwarzbeck Mess-Elektronik OHG / Schönaun	155	cpu	chk: 2020-Apr-15	chk: 12M	
20412	Fully Anechoic Chamber 2	ETS-Lindgren GmbH / Taufkirchen	without	chk	chk: 2024-Mar-15	chk: 12M	chk: 2025-Mar-15
20729	FS-Z140	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101004	cal	cal: 2023-Jun-16	cal: 36M	cal: 2026-Jun-16
20730	FS-Z110	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101468	cal	cal: 2023-Jun-02	cal: 36M	cal: 2026-Jun-02
20731	FS-Z75	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101022	cal	cal: 2022-May-18	cal: 36M	cal: 2025-May-18
20733	Harmonic Mixer FS-Z220	RPG-Radiometer Physics GmbH / Meckenheim	101009	cal	cal: 2024-May-24	cal: 36M	cal: 2027-May-24
20734	Harmonic Mixer FS-Z325	RPG-Radiometer Physics GmbH / Meckenheim	101005	cal	cal: 2024-May-24	cal: 36M	cal: 2027-May-24
20765	Pickett-Potter Horn Antenna FH-PP 40-60	RPG-Radiometer Physics GmbH / Meckenheim	010001	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20767	Pickett-Potter Horn Antenna FH-PP 140-220	RPG-Radiometer Physics GmbH / Meckenheim	010011	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20811	Horn Antenna ASY-SGH-124-SMA	Antenna Systems Solutions S.L. / Santander	29F14182337	cal	cal: 2021-Oct-20	cal: 36M	cal: 2024-Oct-20
20812	Pickett-Potter Horn Antenna FH-PP-325	RPG-Radiometer Physics GmbH / Meckenheim	10024	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20813	Pickett-Potter Horn Antenna FH-PP 075	RPG-Radiometer Physics GmbH / Meckenheim	10006	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20

ID	Description	Manufacturer	SerNo	CheckType	Last Check	Interval	Next Check
20814	Pickett-Potter Horn Antenna FH-PP 140	RPG-Radiometer Physics GmbH / Meckenheim	10008	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20815	Pickett-Potter Horn Antenna FH-PP 110	RPG-Radiometer Physics GmbH / Meckenheim	10014	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20816	SGH Antenna SGH-26-WR10	Anteral S.L.	1144	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20817	Waveguide Rectangular Horn Antenna SAR-2309-22-S2	ERAVANT / Torrance	13254-01	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20836	1-18 GHz Amplifier	Wright Technologies, Inc., Inc. / Roseville	0001	chk		chk: 36M	
20907	Waveguide WR-15 attenuator STA-30-15-M2	SAGE Millimeter Inc.	13256-01	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20908	Waveguide WR 10 attenuator STA-30-10-M2	SAGE Millimeter Inc.	13256-01	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20909	Waveguide Horn Antenna PE9881-24	Pasternack Enterprises, Inc.	37/2016	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20910	Frequency Multiplier 936VF-10/385	MI-Wave, Millimeter Wave Products Inc.	142	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20911	Frequency Multiplier 938WF-10/387	MI-Wave, Millimeter Wave Products Inc.	141	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20913	Phase Amplitude Stable Cable Assembly DC-40GHz	RF-Lambda Europe GmbH	AC19040001	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
25457	DRG Horn Antenna SAS-574	A.H. Systems, Inc. / Chatsworth	383	cal	cal: 2022-Mar-28	cal: 36M	cal: 2025-Mar-28

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
R01	Initial release	2024-Nov-04
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End Of Test Report