TEST REPORT
No.: 2-0023-11-1-7c

According to:
FCC Regulations
Part 15.107 & 15.109
Part 15.109 & 15.209
Part 15.247

for

Research In Motion Limited

Smartphone REA71UW in Bluetooth®-Mode
FCC-ID: L6AREA70UW
IC-ID: 2503A-REA70UW

Laboratory Accreditation and Listings			
DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01	Reg. No.: 736496 MRA US-EU 0003	Industry Canada Reg. No.: 3462D-1 Reg. No.: 3462D-2 Reg. No.: 3462D-3	Voluntary Controls for Electromagnetic Emissions Reg. No.: R-2665, R-2666 C-2914, T-1967, G-301
Wi Fi ALLIANCE AUTHORIZED RF LABORATORY	CTIA Authorized Test Lab LAB CODE 20011130-00		
accredited according to DIN EN ISO/IEC 17025			

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1. Summary of test results

The test results apply exclusively to the test samples as presented in chapter 3.1. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests.

The presented EUT is a mobile phone with integrated Bluetooth® transmitter and integral antenna. For Bluetooth® technology below described tests show compliance, other implemented wireless technologies were not considered within this test report.

Following tests have been performed to show compliance with applicable FCC Part 2 and Part 15 rules of the FCC CFR 47 (10-1-10 Edition) and Industry Canada RSS-210, Issue 8 and RSS-Gen, Issue 3 regulations.

1.1. TESTS OVERVIEW USA FCC and Canada IC Standards (RSS)

TEST CASES	PORT	REFERENCES & LIMITS			EUT set-up	EUT operating mode	Result
		FCC Standard	RSS Section	TEST LIMIT			
TX-Mode							
20dB Bandwidth	Antenna terminal (conducted)	§15.247(a)(1)	RSS-210 Issue 8: A8.1 (a)(b)	At least 25kHz or 2/3 of 20dB bandwidth	2	1	Passed
Channel carrier frequency separation					2	2	
99% occuppied bandwidth	Antenna terminal (conducted)	--	RSS-210 Issue 8: Chapter 4.6.1	99% Power bandwidth	2	1	Passed
Channel use, average channel use, input bandwidth and synchronization between signals	--	§15.247(a)(1)	RSS-210 Issue 8: A8.1	See specification	--	--	Not performed remark 1
Channel average occupancy time and number of channels	Antenna terminal (conducted)	§15.247(a)(1)(iii)	RSS-210 Issue 8: A8.1(d)	0.4 seconds	2	2	Passed
Transmitter Peak output power	Antenna terminal (conducted)	§15.247(b)(1)	RSS-210 Issue 8: A8.4 (2)	< 0.125mW	2	1	Passed
Transmitter frequency stability	Antenna terminal (conducted)	--	RSS-Gen., Chapter 4.7	Operation within designated operational band	2	1	Passed
Transmitter Peak Output power radiated	Cabinet (radiated)	§15.247(b)(4)	RSS-210 Issue 8:A8.4 (4)	< 0.125mW (EIRP) for antenna with directional gain less 6dBi	1	1	Passed
Out-Of-Band RF-emissions Band-Edge emissions	Antenna terminal (conducted)	§15.247 (d)	RSS-210 Issue 8: A8.5	20 dBc & Emissions in restricted bands must meet the general field-strength radiated limits	2	1	Passed

General field strength emissions + restricted bands	Cabinet + Interconnecting cables (radiated)	§15.247 (d) §15.205 §15.209	RSS-210 Issue 8, Chapter 2.5 RSS-Gen: Issue 3: §7.2.5 Table 5+6	Emissions in restricted bands must meet the general field-strength radiated limits	1	1	Passed
AC-Power Lines Conducted Emissions	AC-Power lines	§15.207	RSS-Gen, Issue 3: Chapter 7.2.4, Table 4	FCC §15.107 class B limits §15.207 limits IC: Table 4, Chapter 7.2.4	4	1+4	Passed

Remark: 1.) See applicants declaration for compliance

RX Mode							
RECEIVER Radiated emissions	Cabinet + Interconnecting cables (radiated)	§15.109 §15.33 §15.35	RSS-Gen, Issue 3: Chapter 6.1	FCC 15.109 class B limits IC-limits: Table 1, Chapter 6	3	3+4	Passed

Remark: *.) Please find applicants separate declaration for detailed information of the implementation of this requirement.

Due to customer request no EUT photographs should be inside of this test report.

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 requirements as shown in above table are met in accordance with enumerated standards.

W. Richter

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Dipl.-Ing. W. Richter
Responsible for test section

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Dipl.-Ing. B. Taslica
Responsible for test report

2. Administrative Data

2.1. Identification of the testing laboratory

Company name: Address:	CETECOM GmbH Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing laboratory:	Dipl.-Ing. W. Richter
Deputy:	Dipl.-Ing. J. Schmitt
Laboratory accreditations/Listings:	DAkkS-Registration No. D-PL-12047-01-01 FCC-Registration No.: 736496, MRA US-EU 0003 IC-Registration No. 3462D-1, 3462D-2, 3462D-3 VCCI Reg. No. R-2665, R-2666, C-2914, T-1967, G-301

2.2. Test location

2.2.1. Test laboratory "CTC"

Company name:	see chapter 2.1. Identification of the testing laboratory

2.3. Organizational items

Order No.:	E200023001
Responsible for test report and project leader:	Dipl.-Ing. B. Taslica
Receipt of EUT:	2011-08-29
Date(s) of test:	2011-08-29 to 2011-09-30
Date of report:	2011-11-07
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Version of template: 11.05	

2.4. Applicant's details

Applicant's name:	Research In Motion Limited
Address:	440 Phillip Street N2L 5R9 Waterloo ON CANADA
Contact person:	Mr. Masud Attayi

2.5. Manufacturer's details

Manufacturer's name:	Research In Motion Limited
Address:	440 Phillip Street N2L 3W8 Waterloo ON CANADA

3. Equipment under test (EUT)

3.1. Additional declaration and description of main EUT

Main function	Mobile phone with integrated Bluetooth® Transceiver		
Type	REA71UW		
Frequency range (US/Canada -bands)	2402 MHz (Channel 0) to 2480 MHz (Channel 78)		
Type of modulation	DH1/DH3/DH5 – GFSK 2DH1/2DH3/2DH5 – Pi/4 DQPSK 3DH1/3DH3/3DH5 – 8DPSK		
Number of channels (USA/Canada -bands)	0 to 78		
Antenna Type	Integrated		
Antenna Gain	Max. -0.55/ 0.01/ -1.39 dBi Peak gain according applicants information in 2402MHz/ 2441MHz/ 2480MHz bands		
MAX Field strength (radiated):	98.4 dBµV/m@3m distance and 2480 MHz		
FCC-ID	L6AREA70UW		
IC-ID	2503-REA70UW		
Installed option	☒ additional wireless technologies: GSM/UMTS/W-LAN/NFC/GPS ☒ battery charging option over separated AC charger		
Special EMI components	--		
Power supply	Li-Io. Battery: range from 3.6V (V_{min}) to 4.2 V (V_{max})		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering

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

Short description*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	Smartphone	REA71UW	004401138459314	CER-41251-001 rev. 2	v7.0.0.368 PL: 9.32.0.13 Bundle: 1755
EUT B	Smartphone	REA71UW	004402241090202	CER-41251-001 rev. 1	v7.0.0.368 PL: 9.32.0.13 Bundle: 1755
EUT C	Smartphone	REA71UW	004402241090749	CER-41251-001 rev. 1	v7.0.0.368 PL: 9.32.0.13 Bundle: 1755
EUT D	Premium Stereo Headset	HDW-15766-005	--	--	--
EUT E	Cobra Fixed Blade (Flextronics)	HDW-24481-001	--	rev. 1	--
EUT F	USB (1.2m)	HDW-28109-003	--	--	--
EUT G	Li-Ion Battery (1230mAh)	BAT-30615-006	--	JM1	--

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

3.3. Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

AE short description *)	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 1	Dummy battery	For EUT B	--	--	--

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

3.4. EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
Set. 1	EUT A + EUT G	Used for RF radiated measurements (TX Mode).
Set. 2	EUT B + AE 1	Used for RF conducted measurements.
Set. 3	EUT A + EUT D + EUT E + EUT F+ EUT G	Used for RF radiated measurements (RX Mode).
Set. 4	EUT C + EUT D + EUT E + EUT F+ EUT G	Used for AC-mains emission measurement.

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

3.5. EUT operating modes

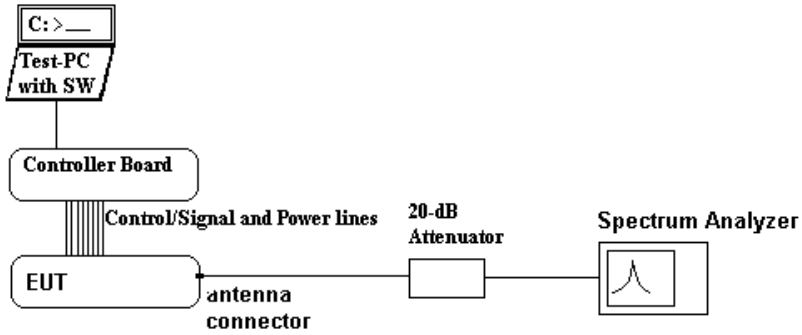
EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	TX-Test Mode	With help of a special firmware software a continuous traffic mode could be establish with help of a Bluetooth base simulator (R&S CBT32). The modulation and packet type will be special mentioned in the results.
op. 2	TX-Mode (hopping on)	Hopping mode was activated with help of a Bluetooth base simulator. (R&S CBT32).
op. 3	RX-Mode	With help of a special firmware software an receiver mode could be establish with help of a Bluetooth base simulator (R&S CBT32).
op. 4	Battery charging	A empty battery was charged during the tests.

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

4. DESCRIPTION OF TEST SET-UP's

4.1. Test Set-up for conducted measurements

EUT's RF-signal is first attenuated by 20dB before it is feed to the spectrum analyzer. Customers RF-adapters are used in case of no suitable RF-Adapters are mounted on the EUT. The specific attenuation losses for the RF-signal path is determined within a path-loss calibration and the measurement readings corrected therefore. The Test-PC as shown above was not necessary for this project.



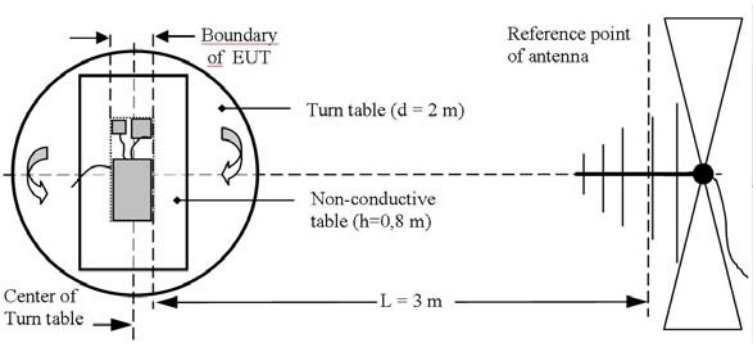
Schematic: Test set-up 3: conducted for RF-tests

4.2. Test set-up for radiated measurements

Please see below description and schematic for radiated measurements used set-up.

MEASUREMENT METHOD (30 MHz<f <1 GHz):

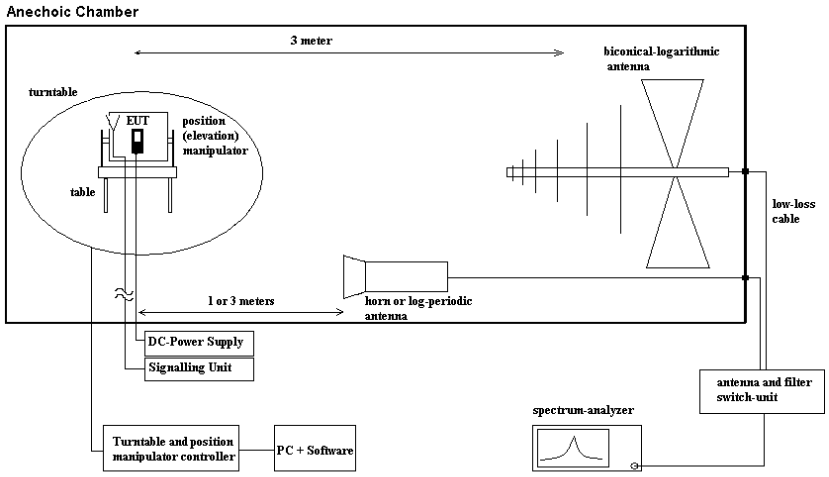
A EMI analyzer together with a broadband antenna was used in order to identify the emissions from the EUT by positioning the antenna close to the EUT surfaces. The interconnecting cables and equipment position were varied in order to maximize the emissions. Then most critical frequencies are recorded for further investigations. Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's operating mode, cable position, etc. The EUT was placed on a non-conductive support of 0.8 m height. By rotating the turntable angle 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) and the measurement antenna height from 1 meter to 4 meters, the maximized emissions are recorded. The measurements are performed for both polarizations of the measuring antenna: horizontal and vertical.



MEASUREMENT METHOD (1 GHz<f <26.5 GHz):

The EUT and accessories are placed on a non-conducting tipping table of 0.8 meter height (semi-anechoic chamber) or 1.55m height (fully-anechoic chamber) which is situated in the middle of the turntable. The turntable can rotate the device under test 360 degree, the tipping table can rotate the device from laid to standing position. This way the device under test can be rotated in all three orthogonal planes in order to maximize the detected emissions. The turn- and tipping table are controlled by a controller unit. All positions manipulations are software controlled from a operator PC.
The measurements are performed for both receiving antenna polarisations: vertical and horizontal.

Up to 18 GHz a measurement distance of 3 meters is used, above 18 GHz the distance is 1 meter. A biconical-logarithmic antenna up to 1 GHz and a logarithmic-periodic ant. for frequencies above 1 GHz up to 26.5 GHz is used. For frequencies above 26.5 GHz a horn antenna is used, pls. compare the equipment list for more details.



The EUT is powered either by a external DC-supply with nominal voltage or a AC/DC power supply as accessory. The communication signalling (if necessary for operation) is performed from outside the chamber with a communication test simulator (CMU200 from Rohde&Schwarz) and a signalling antenna place near the EUT.

Schematic: radiated measurements test set-up

5. Measurements

5.1. Conducted emissions on AC-Power lines

TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter 2.2.1)		☐ Please see Chapter 2.2.2		☐ Please see Chapter 2.2.3	
test site	☐ 333 EMI field	☒ 348 EMI cond.				
receiver	☐ 001 ESS	☒ 377 ESCS 30				
LISN	☒ 005 ESH2-Z5	☐ 007 ESH3-Z6	☐ 300 ESH3-Z5 & 50Ω used for AE		☐ no LISN for AE	
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU			
line voltage	☐ 230 V 50 Hz via public mains		☒060 110 V 60 Hz via PAS 5000			

STANDARDS AND LIMITS: PART 15, SUBPART B, §15.107, §15.207, CANADA: RSS-Gen, ANSI C63.4:2009

Frequency [MHz]	Conducted limit Class B [dBµV]	
	QUASI-Peak	AVERAGE
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50
Remark: * decreases with the logarithm of the frequency		

TEST CONDITION AND MEASUREMENT PROCEDURES TEST SET-UP

link to test system (if used):	☒ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top (40 cm distance to reference ground plane (wall)		☐ floor standing EUT stands isolated on reference ground plane (floor)
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
EMI-Receiver (Analyzer) Settings	Span/Range: 150 kHz to 30 MHz RBW: 9 kHz Detector/Mode: Max PEAK-hold, repetitive scan for preliminary testing Quasi-Peak Detector and Average-Detector for final measurement according ANSI 63.4, CISPR 16		

Devices which can be connected to the public AC-power network, should be tested against the radio frequency voltage conducted back into the AC-power line in the frequency range 150kHz to 30 MHz. Compliance should be tested by measuring the radio frequency voltage between each power line and ground at the power terminals in the stated frequency range.
A 50Ohm/50µH line impedance stabilization network (LISN) is used therefore. The EUT power input leads are connected through the LISN to the AC-power source. The LISN enclosure is electrically connected to the GND-plane. The measuring instrument is connected to the coaxial output of the LISN.
Tabletop devices were set-up on a 80 cm height over reference ground plane, floor standing equipment 10 cm raised above ground plane.
Measurements have been performed on each phase line and neutral line of the devices AC-power lines. The EUT was power supplied with 110 V/60Hz.
The EUT was tested in the defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.
Preliminary testing as a first step, determines the worst-case phase line (neutral or phase) as well as the most critical amplitude by changing the operating mode. A complete frequency-sweep is performed with PK-Detector.
Final testing for power phases and critical frequencies (Margin to AV- or QP limit lower than 3dB) as a second step includes measurements either on discrete frequency components with receivers detector set to Quasi-Peak and Average per frequency component or a complete frequency sweep with corresponding detector.

RESULTS

EUT Type and S/N or EUT set-up no.		EUT set-up 4			
EUT operating mode		EUT operating mode 1+ 4			
Diagram No.	Command or EUT operating mode or operating mode no.	Detector (Peak, CISPR AV, CISPR QP)	Power line (L1, L2, L3, N)	Additional (scan-) information (e.g. Pre-test Fast scan, Maxhold, Final measurement)	Result (passed / failed /final measurem . necessary)
1.1	EUT operating mode 1	Peak, AV,QP	L1, N	The Diagram shows PK/AV detector measurements on L1 and N with maxhold mode. Final measurement QP and AV was carried out on at least one frequency (please see diagram)	passed

Remarks: The diagram contains the maximum values from L 1 + N

Margin to Limit for verdict: $M = L_T - R_R + C_{Loss}$

Abbreviations used:
- R_R : Receiver readings in dBµV
- C_{Loss}: cable loss
- L_T : Limit in dBµV

VERDICT

Summary of measurement results for conducted emissions on AC-Power lines: Passed

5.2. Radiated field strength emissions below 30 MHz

TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☒ 441 EMI SAR	☐ 487 SAR NSA	☐ 347 Radio.lab.		☐	☐
receiver	☐ 377 ESCS30	☒ 001 ESS	☐	☐	☐	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
antenna	☐ 574 BTA-L	☐ 133 EMCO3115	☐ 302 BBHA9170	☐ 289 CBL 6141	☒ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU			
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 378 RadiSense	
DC power	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
line voltage	☐ 230 V 50 Hz via public mains		☒060 110 V 60 Hz via PAS 5000			

STANDARDS AND LIMITS: CFR 47, §15.205, §15.209, RSS-Gen, ANSI C63.10:2009,

Frequency [MHz]	Field strength [µV/m]	Field strength [dBuV/m]	Measurement distance [meters]	Remarks
0.009 – 0.490	2400/f (kHz)	67.6 – 20Log(f) (kHz)	300	Correction factor used due to measurement distance of 3m
0.490 – 1.705	24000/f (kHz)	87.6 – 20 Log(f) (kHz)	30	Correction factor used due to measurement distance of 3m
1.705 – 30	30	29.54	30	Correction factor used due to measurement distance of 3m
Remark: * decreases with the logarithm of the frequency				

TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	☒ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top		☐ floor standing
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
EMI-Receiver (Analyzer) Settings	Span/Range: 9kHz to 150kHz; 150 kHz to 30 MHz RBW/VBW: 200Hz/auto; 10 kHz/ auto (ANSI63.10/CISPR#16) Detector/ Mode: PEAK, TRACE max-hold mode, repetitive scan for exploratory measurements Quasi-Peak, for final measurement on critical frequencies (f<1GHz)		

GENERAL MEASUREMENT PROCEDURES:

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2009

The **Equipment under Test** (EUT) was set-up to defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

The measurement loop antenna was situated in 3m distance to the EUT. Between EUT and measurement antenna absorbers are covering the GND-Plane. With these absorbers the chamber fulfills CIPR16-1-4 site VSWR-criteria. Radiated magnetic emission measurements were made with the antenna situated in 1 meter height. 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 EUT itself either over 3-orthogonal axes (no defined usage position) or 2-orthogonal axis (defined usage position) by the position manipulator.

According the standard the compliance should be checked in 30m and 300m measurement distance. Therefore a additional extrapolation factor was used in order to normalize the measurement data. The frequency dependent extrapolation factor used for this reduced measurement distance, can be found in the chapter annexes.

MEASUREMENT RESULTS

Packet type: DH5

Channel Low=0

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency (kHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_3.11	9..150	< -56.0	10.0	0.2	1	--	0°..360°	--	> 20dB	See diagram
	150..30000	< 18.0	10.0	10.0	1	--		--	> 11.54	29.54

Remark: *.) see also plots enclosed in annex A1

Channel middle=39

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency (kHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_3.12	9..150	< -56.0	10.0	0.2	1	--	0°..360°	--	> 20dB	See diagram
	150..30000	< 18.0	10.0	10.0	1	--		--	> 11.54	29.54

Remark: *.) see also plots enclosed in annex A1

Channel high=78

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency (kHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_3.13	9..150	< -56.0	10.0	0.2	1	--	0°..360°	--	> 20dB	See diagram
	150..30000	< 18.0	10.0	10.0	1	--		--	> 11.54	29.54

Remark: *.) see also plots enclosed in annex A1

Packet type: 2DH5

Channel Low=0

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency (kHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_3.14	9..150	< -56.0	10.0	0.2	1	--	0°..360°	--1	> 20dB	See diagram
	150..30000	< 18.0	10.0	10.0	1	--		--	> 11.54	29.54

Remark: *.) see also plots enclosed in annex A1

Channel middle=39

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency (kHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_3.15	9..150	< -57.0	10.0	0.2	1	--	0°..360°	--	> 20dB	See diagram
	150..30000	< 19.0	10.0	10.0	1	--		--	> 10.54	29.54

Remark: *.) see also plots enclosed in annex A1

Channel middle=78

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency (kHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_3.16	9..150	< -56.0	10.0	0.2	1	--	0°..360°	--	> 20dB	See diagram
	150..30000	< 19.0	10.0	10.0	1	--		--	> 10.54	29.54

Remark: *.) see also plots enclosed in annex A1

Packet type: 3DH5

Channel Low=0

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency (kHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_3.17	9..150	< -56.0	10.0	0.2	1	--	0°..360°	--1	> 20dB	See diagram
	150..30000	< 18.0	10.0	10.0	1	--		--	> 11.54	29.54

Remark: *.) see also plots enclosed in annex A1

Channel middle=39

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency (kHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_3.18	9..150	< -60.0	10.0	0.2	1	--	0°..360°	--	> 20dB	See diagram
	150..30000	< 17.0	10.0	10.0	1	--		--	> 12.54	29.54

Remark: *.) see also plots enclosed in annex A1

Channel middle=78

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency (kHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_3.19	9..150	< -58.0	10.0	0.2	1	--	0°..360°	--	> 20dB	See diagram
	150..30000	< 18.0	10.0	10.0	1	--		--	> 11.54	29.54

Remark: *.) see also plots enclosed in annex A1

Margin to Limit:

$$M = L_T - R_R + C_F + D_F$$
$$= L_T - R_R + \left(AF_{ANTENNA} + Cable_{LOSS}\right) + D_F$$

Remark: positive margin means passed result

Abbreviations used:

- R_R : Receiver readings in dBµV/m
- C_F: Transducer in dB = AF (antenna factor) + CL (cable loss)
- D_F : distance correction factor (if different measurement distance used than specified in the standard
- L_T : Limit in dBµV/m

VERDICT: Summary of measurement results for radiated frequencies below 30 MHz - passed

5.3. Radiated field strength emissions, 30 MHz - 1 GHz

TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☒ 441 EMI SAR	☒ 487 SAR NSA				
receiver	☒ 377 ESCS30	☒ 001 ESS	☐			
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK			
antenna	☐ 574 BTA-L	☐ 133 EMCO3115	☐ 302 BBHA9170	☐ 289 CBL 6141	☐ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU			
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☒ 482 Filter Matrix		
DC power	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 110 V 60 Hz via PAS 5000			

STANDARDS AND LIMITS: CFR 47, PART 15B, §15.209, RSS-Gen, ANSI C63.10:2009, ANSI 63.4:2009

Frequency [MHz]	Radiated emission limits, Class B, 3 meters	
	QUASI-Peak [microvolts/meter]	QUASI-Peak [dBµV/m]
30-88	100	40
88-216	150	43,5
216-960	200	46,0
above 960	500	54,0

TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	☒ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top 0.8m height		☐ floor standing
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
EMI-Receiver (Analyzer) Settings	Span/Range: 30 MHz to 1 GHz RBW/VBW: 120 kHz / (auto) Detector/ Mode: PEAK, TRACE max-hold mode, repetitive scan Quasi-Peak, for final measurement for critical measurements		

The ***Equipment under Test*** (EUT) set-up to defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

RESTRICTED BANDS OF OPERATION, §15.205

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	--
13.36-13.41	--	--	--

Remark: only spurious emissions are allowed within these frequency bands not exceeding the limits per §15.209

GENERAL MEASUREMENT PROCEDURES:
The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.4: 2009 (RX mode) or ANSI63.10:2009 (TX mode).

5.3.1. Radiated emissions below 1GHz, TX-Mode according FCC §15.209, RSS-Gen, RSS-210

Channel Low (Channel 0)

Set-up No.		1								
Operating Mode		1								
Diagram no./ Packet type*	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_2.01/ DH5	30..1000	< 42.5 1.)	0.1	120.0	1..4	H&V	0°..360°	--	> 6dB	See diagramm
c_2.04/ 2DH5	30..1000	< 42.5 1.)	0.1	120.0	1..4	H&V	0°..360°	--	> 6dB	See diagramm
c_2.07/ 3DH5	30..1000	< 42.5 1.)	0.1	120.0	1..4	H&V	0°..360°	--	> 6dB	See diagramm

Remark: *.) see also plots enclosed in annex A1
1.) Noise level, no peaks found

Channel middle (Channel 39)

Set-up No.		1								
Operating Mode		1								
Diagram no./ Packet type*	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_2.02/ DH5	30..1000	< 42.5 1.)	0.1	120.0	1..4	H&V	0°..360°	--	> 6dB	See diagramm
c_2.05/ 2DH5	30..1000	< 42.5 1.)	0.1	120.0	1..4	H&V	0°..360°	--	> 6dB	See diagramm
c_2.08/ 3DH5	30..1000	< 42.5 1.)	0.1	120.0	1..4	H&V	0°..360°	--	> 6dB	See diagramm

Remark: *.) see also plots enclosed in annex A1
1.) Noise level, no peaks found

Channel high (Channel 78)

Set-up No.		1								
Operating Mode		1								
Diagram no./ Packet type	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_2.03/ DH5	30..1000	< 42.5 1.)	0.1	120.0	1..4	H&V	0°..360°	--	> 6dB	See diagramm
c_2.06/ 2DH5	30..1000	< 42.5 1.)	0.1	120.0	1..4	H&V	0°..360°	--	> 6dB	See diagramm
c_2.09/ 3DH5	30..1000	< 42.5 1.)	0.1	120.0	1..4	H&V	0°..360°	--	> 6dB	See diagramm

Remark: 1.) see also plots enclosed in annex A1

5.3.2. Radiated emissions, below 1GHz, RX-Mode according FCC §15.109 class B, RSS-Gen

Channel Middle (Channel 39)

Set-up No.		3								
Operating Mode		3								
Diagram no.	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
c_2.10	30..1000	38.15 (PK)	1000	100	1..4	H/V	0°..360°	--	+ 7.85	See diagram

Remark: 1.) see also plot enclosed in annex A1

Margin to Limit:

$$M = L_T - R_R + C_F + D_F$$
$$= L_T - R_R + (AF_{ANTENNA} + Cable_{LOSS}) + D_F$$

Remark: positive margin means passed result

Abbreviations used:

- R_R : Receiver readings in dBµV/m
- CF: Transducer in dB = AF (antenna factor) + CL (cable loss)
- D_F : distance correction factor (if different measurement distance used than specified in the standard
- L_T : Limit in dBµV/m

VERDICT

Summary of measurement results for radiated emissions above 30 MHz and below 1 GHz : Passed

5.4. Radiated emissions, above 1GHz

TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test site	☐ 441 EMI SAR	☐ 348 EMI cond.	☒ 443 EMI FAR	☐ 347 Radio.lab.	☐ 337 OATS	☐
equipment	☐ 331 HC 4055	☐	☐	☐	☐	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☒ 489 ESU	☐	☐
antenna meas	☐ 574 BTA-L	☐ 289 CBL 6141	☒ 608 HL 562	☒ 549 HL025	☐ 302 BBHA9170	☐ 477 GPS
antenna meas	☐ 123 HUF-Z2	☐ 132 HUF-Z3	☐ 030 HFH-Z2	☐	☐	☐
antenna subst	☐ 071 HUF-Z2	☐ 020 EMCO3115	☐ 063 LP 3146	☐ 303 BBHA9170	☐	☐
power meter	☐ 009 NRV	☐ 010 URV5-Z2	☐ 011 URV5-Z2	☐	☐	☐
signalgener.	☐ 008 SMG	☐ 140 SMHU	☐ 263 SMP04	☐	☐	☐
power meter	☐ 262 NRV-S	☐ 266 NRV-Z31	☐ 265 NRV-Z33	☐ 261 NRV-Z55	☐ 356 NRV-Z1	☐
multimeter	☐ 341 Fluke 112	☐	☐	☐	☐	☐
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU			
DCpower	☐ 086 LNG50-10	☐ 087 EA3013	☐ 354 NGPE 40	☐ 349 car battery	☐ 350 Car battery	☐
line voltage	☐ 230 V 50 Hz via public mains		☒060 110 V 60 Hz via PAS 5000			

STANDARDS AND LIMITS: CFR 47, §15.109 (CLASS B), §15.209, RSS-Gen, RSS-210, ANSI C63.4:2009 ODER 63.10:2009

Frequency [MHz]	Radiated emission limits, 3 meters measurement distance			
	AV [microvolts/meter]	AV [dBµV/m]	Peak [microvolts/meter]	Peak [dBµV/m]
above 1GHz	500	54.0	5000	74.0

TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	☐ air link	☐ cable connection	☐
EUT-grounding	☐ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top 1.5m height		☐ floor standing
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
Spectrum-Analyzer settings	Span/Frequency range :	1..26 GHz +single frequencies determined in step 1	
	RBW/VBW:	1 MHz / 3 MHz	
	Detector/ Mode:	Peak, MAX-hold, repetitive scan for exploratory measurement	
		PEAK/ AVERAGE, for final measurement for critical frequencies	
	Antenna Polarisation	Horizontal / Vertical	

GENERAL MEASUREMENT PROCEDURES:

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.4: 2009 (RX) oder ANSI 63.10:2009 (TX)

The ***Equipment under Test*** (EUT) was placed on a non-conductive positioning table of 0.8 or 1.5 meter height depending from the frequency range. The measuring distance was set to 3 meter for frequencies up to 18GHz and 1 meter above 18GHz.
The EUT was set-up to defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

1. **Step exploratory measurement**: see above description as in the frequency range lower 1GHz.
2. **Step Final Measurement(1 GHz<f <26 GHz)**: On the Worst-Case EUT configuration, frequency components with a margin lower than 6 dB to the limits, will be re-measured by maintaining the EUT's operating mode, cable position, etc.. For find the worst-case emission, the turntable was changed in the range 0 to 360 degree and the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurements are performed for both polarizations of the measuring antenna: horizontal and vertical.

5.4.1. Radiated emissions above 1GHz, TX-Mode according FCC §15.209, RSS-Gen, RSS-210

Channel low=0

Set-up No.:		1		
Operating Mode:		1		
Diagram no./ Packet type	Frequency (GHz)	Bandwidth (kHz)	Level (dBm)	Verdict
8.01a/ DH5	1 – 2.8	1000	Please see diagrams in annex A1	Passed
8.01b/ DH5	2.8 - 18			Passed
8.04a/ 2DH5	1 – 2.8			Passed
8.04b/ 2DH5	2.8 - 18			Passed
8.07a/ 3DH5	1 – 2.8			Passed
8.07b/ 3DH5	2.8 - 18			Passed

Remarks: 1.) Bluetooth carrier on diagrams with letter ‘a’
2.) letter ‘c’ measurements from 18 to 26 GHz performed as exploratory measurements, no peaks found

Channel middle=39

Set-up No.:		1		
Operating Mode:		1		
Diagram no./ Packet type	Frequency (GHz)	Bandwidth (kHz)	Level (dBm)	Verdict
8.02a/ DH5	1 – 2.8	1000	Please see diagrams in annex A1	Passed
8.02b/ DH5	2.8 - 18			Passed
8.05a/ 2DH5	1 – 2.8			Passed
8.05b/ 2DH5	2.8 - 18			Passed
8.08a/ 3DH5	1 – 2.8			Passed
8.08b/ 3DH5	2.8 - 18			Passed

Remarks: 1.) Bluetooth carrier on diagrams with letter ‘a’
2.) letter ‘c’ measurements from 18 to 26 GHz performed as exploratory measurements, no peaks found

Channel middle=78

Set-up No.:		1		
Operating Mode:		1		
Diagram no./ Packet type	Frequency (GHz)	Bandwidth (kHz)	Level (dBm)	Verdict
8.03a/ DH5	1 – 2.8	1000	Please see diagrams in annex A1	Passed
8.03b/ DH5	2.8 - 18			Passed
8.06a/ 2DH5	1 – 2.8			Passed
8.06b/ 2DH5	2.8 - 18			Passed
8.09a/ 3DH5	1 – 2.8			Passed
8.09b/ 3DH5	2.8 - 18			Passed

Remarks: 1.) Bluetooth carrier on diagrams with letter 'a'
2.) letter 'c' measurements from 18 to26 GHz performed as exploratory measurements, no peaks found

5.4.2. Radiated emissions, above 1GHz, RX-Mode according FCC §15.109 class B, RSS-Gen

Channel middle=39

Set-up No.:		3		
Operating Mode:		3		
Diagram no./ Packet type	Frequency (GHz)	Bandwidth (kHz)	Level (dBm)	Verdict
2.03/ 3DH5	1 – 2.8	1000	Please see diagrams in annex A1 (no peaks found)	Passed
2.04/ 3DH5	2.8 - 18			Passed

Remark: --

Margin to Limit:

$$M = L_T - R_R + C_F + D_F$$
$$= L_T - R_R + \left(AF_{ANTENNA} + Cable_{LOSS}\right) + D_F$$

Remark: positive margin means passed result

Abbreviations used:

- R_R : Receiver readings in dBµV/m
- CF: Transducer in dB = AF (antenna factor) + CL (cable loss)
- D_F : distance correction factor (if different measurement distance used than specified in the standard
- L_T : Limit in dBµV/m

5.5. 20-dB and 99% occupied bandwidth

TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☒ 347 Radio.lab.	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ 489 ESU	☐	☐
otherwise	☒613 20dB Attenuator			☒ cable K4	

REFERENCES: §15.247(a)(1), RSS-210: A8.1(b)

(1) *Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.*

(2) *DSSS Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.*

EUT SETTINGS:

For FHHS-systems hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

MEASUREMENT METHOD:

The measurement was performed with the RBW set to 100kHz. The span was set to cover the complete carrier. Three carrier frequencies (low/middle/high) were used for showing the compliance with this requirement. A DELTA Marker method was set to measure the bandwidth compared to the highest In-Band power. The operating modes have been varied (e.g. data rate, modulation scheme, etc.). If applicable the hopping-mode is switched off.

Also the **99% emission bandwidth** was measured. Two markers are placed on frequency points such that left to lower f-marker and right to higher f-marker only 1% of the TX-power is contained. Between the markers, 99% of the power is laying. The RBW value is readjusted and the measurement repeated until the RBW/EBW ratio is around 1%.

SPECTRUM-ANALYZER SETTINGS:

Span	Set as to fully display the emissions and at least 20dB below the PEAK level
Resolution Bandwidth (RBW)	Set to approx 1% of the emission width
Video Bandwidth (VBW)	3 times the resolution bandwidth
Sweep time	Coupled and low enough to have no gaps within power envelope
Detector	Sample (if bin-width: Span/no. of frequency points SA < 0.5*RBW SA otherwise Peak detector)
Sweep mode	Repetitive Mode, MAX-HOLD

The bandwidth 20dB as well as 99% was checked for different channel and modulations, full results in tabular format can be found in annex a1. Here only an extract about the maximum results can be found.

RESULTS:

Set-up no.:	2
Op. Mode:	1
T_{NOM} = 21°C V_{NOM} = 3.7V	**Max. 20 dB Bandwidth [MHz]**
Low channel = 0 (2402 MHz), 2DH5	1.317
Middle channel = 39 (2442 MHz), 2DH5 & 3DH5	1.317
High channel = 78 (2480 MHz), 3DH5	1.320

Remark: see diagrams in separate document A1

Value was measured for each modulation of the maximum 20dB bandwidth.

Set-up no.:	2
Op. Mode:	1
T_{NOM} = 21°C V_{NOM} = 3.7V	**Max. 99% Emission Bandwidth [MHz]**
DH5: Low channel= 0	0.853
2DH5: High channel= 78	1.196
3DH5: High channel =78	1.212

Remark: see diagrams in separate document A1

FINAL VERDICT: Passed

5.6. Channel carrier frequency separation for FHSS-systems

TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☒ 347 Radio.lab.	☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ 489 ESU	☐	☐	☐
spectr. analys.	☐ 381 380 FSBS	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
otherwise	☒613 20dB Attenuator			☒ cable K4		

REFERENCES: §15.247(a)(1), RSS-210:A8.1(b)

(1) *FHHS Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.*

(2) *DSSS Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.*

MEASUREMENT METHOD

The measurement to prove this requirement was performed with a low RBW of 100kHz, peak detector and trace Hold-Max function in order to resolve each frequency carrier separately.

The span of the frequency analyzer was set to cover the carrier investigated as well as its neighbour channels. A frequency DELTA Marker method was set to measure the frequency separation between the channels.

RESULTS

Set-up No. 2 Op. Mode 2	**CHANNEL SEPARATION**
T_{NOM} =21.2°C, V_{NOM} =3.7V	Measured around middle channel (2441 MHz)
Measured Result	1 MHz
Applicants declared value	1 MHz according BT-core spec.

LIMIT

Either:

1. 25 kHz or 20dB BW

Or

2. 25kHz and 2/3of BW if Power<125mW

VERDICT: Passed

5.7. Requirements on channel use, average channel use, input bw and synchronization btw. signals for FHSS

REQUIREMENT:
The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies.

RESULT:
The above requirement is implemented in the firmware of the device. Please find applicants separate declaration for detailed information.

REQUIREMENT:
Each frequency must be used equally on the average by each transmitter.

RESULT:
The above requirement is implemented in the firmware of the device. Please find applicants separate declaration for detailed information.

REQUIREMENT:
The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and ..

RESULT:
Please find applicants separate declaration for detailed information.

REQUIREMENT:
The system receivers shall shift frequencies in synchronization with the transmitted signals.

RESULT:
The synchronization requirement is implemented in the firmware of the device – Please find applicants separate declaration for detailed information.

5.8. Specification for hopping channel numbers and time of occupancy for FHSS-systems

5.8.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☒ 347 Radio.lab.	☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ 489 ESU	☐	☐	☐
spectr. analys.	☐ 489 ESU	☐ 120 FSEM	☐ 264 FSEK	☐ 489 ESU	☐	☐
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☒613 20dB Attenuator			☒ cable K4		

REFERENCE: §15.247(A)(1)(III) AND RSS-210, A8.1(d)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

METHOD FOR MEASUREMENT OF THE CHANNEL NUMBERS:

The measurement was performed with spectrum analyzer's RBW set to 500kHz. The device was set to work within the defined specification with frequency hopping mode set on. The spectrum-analyzer was set to MAX-Hold positive peak detector mode. After a trace stabilization period the trace is recorded and the number of channels counted.

RESULTS

SET-UP NO. 2 OP. MODE 1	NUMBER OF CHANNELS
T_{NOM} =21.2°C V_{NOM} = 3.7 V	79

Remark: see diagrams enclosed in the separate annex A1, for better accuracy reading the sweep was splitted in two separated sweeps.

METHOD FOR MEASURING THE OCCUPANCY TIME:

The measurement was performed with a spectrum analyzer set to ZERO span. The device was set to work within the defined specification with frequency hopping mode on. The spectrum-analyzer was set the MAX-Hold positive peak detector mode. The sweep time set as long as necessary to capture the full signal burst per hopping channel. The burst on-period is captured by setting appropriate markers in the rising and falling edges.

RESULTS

SET-UP NO. 2 OP. MODE 2	OCCUPANCY TIME PER TRANSMISSION [ms]		
	DH1 modulation	DH3 modulation	3DH5 modulation
T_{NOM} =21.2°C, V_{NOM} = 3.7V	0.3807	1.6432	2.8857

Remarks: diagrams can be found in separate annex A1

Calculations

Formula for calculating the dwell time (pseudo-hopping sequence over all channels assumed):

Average Dwell Time: $$Timeslot\ \ length \cdot \frac{Hop\ \ rate}{number\ \ of\ \ hopping\ \ channels} \cdot time\ \ period$$

For Bluetooth® following is valid:

The maximum staying time of 0.4 seconds within a 31.6 second period in data mode is constant for Bluetooth® devices and independent from the packet type. For longer packet types the hopping data rate is reduced according the packet type length in order to comply with this requirement.

DH1/2DH1/3DH1 Paket type: Hop rate 1600 1/s (basic hop rate)
DH3/2DH3/3DH3 Packet type: Hop rate 1600 1/s /3 = approx. 533.33 1/s
DH5/2DH5/3DH5 Paket type: Hop rate 1600 1/s /5 = approx. 320 1/s

On one channel **per one second**:

DH1/2DH1/3DH1 Paket types: 1600 1/s /79 channels: 20.25 transmissions; per 31.6 seconds period = approx 640 transmissions

DH3/2DH3/3DH3 Packet types: 533.33 1/s /79 channels: 6.75 transmissions; per 31.6 seconds period = approx. 214 transmissions

DH5/2DH5/3DH5 Paket types: 320 1/s /79 channels: 4.05 transmissions; per 31.6seconds period = approx. 128 transmissions

Measured pulse width for **different** packet types/modulations (see annex A1 for diagrams):

DH1/DH3/DH5: 380.76 us – total time per 31.6 seconds period => 380.76 us*640 transmissions=243.69 ms
DH3/2DH3/3DH3: 1.6432 ms - total time per 31.6seconds period => 1.6432 ms*214 transmissions=351.64 ms
DH5/2DH5/3DH5: 2.8857 ms –total time per 31.6 seconds period=> 2.8857 ms * 128 transmissions =369.37 ms

VERDICT: Pass < 400 msec.

FINAL VERDICT: Passed

5.9. Transmitter frequency stability

Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☒ 347 Radio.lab.	☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ 489 ESU	☐	☐	☐
spectr. analys.	☐ 489 ESU	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☒ 498 NGPE 40
otherwise	☒613 20dB Attenuator			☒ cable K4		

ReferenceS: RSS-Gen, chapter 4.7
„Frequency stability is a measure of frequency drift due to temperature and supply voltage variations with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage. Unless specified otherwise in the RSS that is applicable to the device, the reference temperature for transmitters is +20°C“

EUT SETTINGS:
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
EUT was sending an unmodulated carrier according applicants instructions.
A dummy battery was used together with a external power supply. The supply voltage delivered to the EUT was also changed within the real Li-Ion battery low and maximum voltage limits.

Measurement method:

First the frequency deviation at room temperature (20°C) was recorded. All other records at different temperatures are referenced to this 20°C value.

After reaching the desired temperature a sufficient time was waited before recording the measurement values. A modulated carrier was established and spectrum analyzers build in frequency counter used. All values are compared to the nominal deviation at 20° as recorded before and the relative deviation calculated.

Frequency Error [ppm]			
Set-up no.: 2 Op-Mode: 1	Low channel = 0 (2402 MHz), DH5	Middle channel = 39 (2441 MHz), 2DH5	High channel = 78 (2480 MHz), 3DH5
Modulated carrier (CW)	-4.871 ppm	-4.506 ppm	-4.798 ppm
Limit	Within operation band 2.4GHz to 2.4835GHz		

Remark: Above results are maximum values among all data, pls. compare separate annex A1 for other details

Verdict: Passed

5.10. Transmitter peak output power conducted

TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☒ 443 System CTC-FAR-EMI-		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☒ 347 Radio.lab.	☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ 489 ESU	☐	☐	☐
spectr. analys.	☐ 489 ESU	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☒613 20dB Attenuator			☒ cable K4		

REFERENCE: §15.247(B)(1) AND RSS-210: A8.4 (2)

The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(1) For frequency hopping systems (FHHS) operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.
(3) For systems using digital modulation (DSSS) in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

ANTENNA CHARACTERISTICS:

☒ Directional Gain < 6 dBi (measured: difference between measured conducted and radiated eirp. power)
☐ Directional Gain > 6 dBi (measured / applicant's declaration) -> conducted power reduction necessary

EUT SETTINGS:

For FHHS-systems hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

MEASUREMENT METHOD:

The measurement was performed in non-hopping transmission mode with the carrier set to lowest/middle and highest channel. The power was also checked for different data rates, modulation scheme or packet types if applicable.

SETTINGS ON SPECTRUM-ANALYZER:

Center Frequency	Nominal channel frequency
Span	150 MHz
Resolution Bandwidth (RBW)	3 MHz > 20dB-Bandwidth of the signal
Video Bandwidth (VBW)	3 times the resolution bandwidth = 10MHz
Sweep time	coupled
Detector	Peak, Max hold mode
Sweep Mode	Repetitive mode

5.10.1. **CONDUCTED MEASUREMENT: MAX. PEAK POWER**

- Maximum declared antenna gain [isotropical]:
  Max. -0.55(2402MHz)/ 0.01(2441MHz)/ -1.39(2480MHz) dBi Peak gain according applicants information.
- External Path Loss: 21.2 dB
- Power was checked for different channel and modulations, full results in tabular format can be found in annex A1
- The below-mentioned results are an extract about the maximum levels.

RESULTS

3DH5 MODULATION

MAX. PEAK POWER (conducted)			
Set-up no.: 2 Op-Mode: 1	Low channel = 0 (2402 MHz)	Middle channel = 39 (2442 MHz)	High channel = 78 (2482 MHz)
Measured Peak power [dBm]	8.17	8.93	8.91
Antenna gain [dBi]	-0.55	0.01	-1.39
Resulting Peak Power	7.62 dBm	8.94 dBm	7.52 dBm
Limit	0.125 Watt (21dBm)		

Remark: see separate document A1 for full results

FINAL VERDICT: Passed

5.11. Radiated measurement: max. E.i.r.p power

Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test site	☐ 441 EMI SAR	☐ 348 EMI cond.	☒ 443 EMI FAR	☐ 347 Radio.lab.	☐ 337 OATS	☐
equipment	☐ 331 HC 4055	☐	☐	☐	☐	☐
Spectr. analys.	☐ 489 ESU	☐ 120 FSEM	☐ 264 FSEK	☒ 489 ESU	☐	☐
antenna meas	☐ 549 HL025	☐ 289 CBL 6141	☐ 439 HL 562	☒ 133 EMCO3115	☐ 302 BBHA9170	☐ 477 GPS
antenna subst	☐ 071 HUF-Z2	☐ 020 EMCO3115	☐ 063 LP 3146	☐ 303 BBHA9170	☐	☐
power meter	☐ 009 NRV	☐ 010 URV5-Z2	☐ 011 URV5-Z2	☐	☐	☐
Signalgener.	☐ 008 SMG	☐ 140 SMHU	☐ 263 SMP04	☐	☐	☐
power meter	☐ 262 NRV-S	☐ 266 NRV-Z31	☐ 265 NRV-Z33	☐ 261 NRV-Z55	☐ 356 NRV-Z1	☐
DCpower	☐ 086 LNG50-10	☐ 087 EA3013	☐ 354 NGPE 40	☐ 349 car battery	☐ 350 Car battery	☐

EUT SETTINGS:
For FHHS-systems hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

Alternative measurement method: a field strength measurement was performed in 3m distance to the EUT. General measurement procedures as shown in chapter 5.3 applies therefore. Using transformation formula between field strength and e.i.r.p. power as shown in ANSI63.10: 2009, chapter 7.8.2 is used for conversion. In addition a bandwidth correction factor applied: 10*log(20dB BW/RBW=1MHz)

MAX. FIELD STRENGTH MEASURED IN 3m DISTANCE

DH5-MODULATION

Maximum Radiated field strength@3m distance			
Set-up no.: 1 Op. Mode: 1	Low channel = 0 (2402 MHz)	Middle channel = 39 (2441 MHz)	High channel = 78 (2480 MHz)
Determined field strength [dBuV/m] in 3m distance with RBW=1MHz	94.9 (PK) 93.92 (AV)	98.4 (PK) 95.5 (AV)	98.4 (PK) 94.7 (AV)
Value in dBm using conversion formula and assumed numeric Gain=1: $E=\sqrt{\left(\frac{30*P*G}{d^2}\right)}$	-0.33 dBm (PK)	2.68 dBm (PK)	3.08 dBm (PK)
Bandwidth correction factor[1.)]	0	0	0
e.i.r.p. power [dBm] assumed 0dBi gain	-0.33	2.68	3.08
Actual declared gain of antenna by applicant [dBi]	-0.55	0.01	-1.39
Final Result e.i.r.p. [dBm]:	-0.88	**2.69**	1.69

Remark: 1.) see 20dB BW results before

2DH5-MODULATION

Maximum Radiated field strength@3m distance			
Set-up no.: 1 Op. Mode: 1	Low channel = 0 (2402 MHz)	Middle channel = 39 (2441 MHz)	High channel = 78 (2480 MHz)
Determined field strength [dBuV/m] in 3m distance with RBW=1MHz	96.5 (PK) 92.9 (AV)	92.9 (PK) 88.7 (AV)	94.9 (PK) 90.5 (AV)
Value in dBm using conversion formula and assumed numeric Gain=1: $E=\sqrt{\left(\frac{30*P*G}{d^2}\right)}$	1.27 dBm (PK)	-2.33 dBm (PK)	-0.33 dBm (PK)
Bandwidth correction factor[1.)]	1.20	1.20	1.20
e.i.r.p. power [dBm] assumed 0dBi gain	2.47	-1.13	0.87
Actual declared gain of antenna by applicant [dBi]	-0.55	0.01	-1.39
Final Result e.i.r.p. [dBm]:	**1.92**	-1.12	-0.52

Remark: 1.) see 20dB BW results before

3DH5-MODULATION

Maximum Radiated field strength@3m distance			
Set-up no.: 1 Op. Mode: 1	Low channel = 0 (2402 MHz)	Middle channel = 39 (2441 MHz)	High channel = 78 (2480 MHz)
Determined field strength [dBuV/m] in 3m distance with RBW=1MHz	96.3 (PK) 89.5 (AV)	95.9 (PK) 89.1 (AV)	95.7 (PK) 88.8 (AV)
Value in dBm using conversion formula and assumed numeric Gain=1: $E=\sqrt{\left(\frac{30*P*G}{d^2}\right)}$	1.07 dBm (PK)	0.67 dBm (PK)	0.47 dBm (PK)
Bandwidth correction factor[1.)]	1.18	1.20	1.14
e.i.r.p. power [dBm] assumed 0dBi gain	2.25	1.87	1.61
Actual declared gain of antenna by applicant [dBi]	-0.55	0.01	-1.39
Final Result e.i.r.p. [dBm]:	1.70	**1.88**	0.22

Remark: 1.) see 20dB BW results before

FINAL VERDICT: Passed, Maximum value: 2.69 dBm (antenna gain < 6 dBi)

5.12. 20dBc conducted emission FCC 15.247, RSS-210

TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☒ 347 Radio.lab.	☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ 489 ESU	☐	☐	☐
spectr. analys.	☐ 489 ESU	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☒530 10dB Attenuator			☒ cable K15		

REFERENCES: §15.247, §15.205, RSS-210: A8.5

(d) *In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.*

EUT SETTINGS:

For FHHS-systems hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.

MEASUREMENT METHOD:

The frequency spectrum was investigated for **conducted/radiated** spurious emissions values lower than 20dB related to the RF-carrier power value. Three carrier frequencies (low/middle/high channel) were used for showing the compliance with this requirement. The detector were chosen according §15.209(d). The video bandwidth (VBW) was chosen 10 times the resolution bandwidth (RBW). The frequency scan was up to 10 times the highest channel frequency within the operational mode. The spectrum-analyzer was set to MAX-PEAK Detector, MAX-Hold Mode.

For FHHS-systems hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.

DH5-Modulation

Set-up no.: 2 Op. Mode: 1	**Test: 20 dBc Spurious emissions conducted**					
Frequency Range	Low channel =0 (2402 MHz) Level Reference (In-Band) = 7.23 dBm Limit = -12.77 dBm		Middle channel = 39 (2441 MHz) Level Reference (In-Band) = 7.72 dBm Limit = -12.28 dBm		High channel = 78 (2480 MHz) Level Reference (In-Band) = 8.41dBm Limit= -11.59 dBm	
	Level [dBm]	Margin to limit [dB]	Level [dBm]	Margin to limit [dB]	Level [dBm]	Margin to limit [dB]
0.15 .. 1000 MHz	See diagrams	>20	See diagrams	>20	See diagrams	>20
1 GHz .. 2.8 GHz						
2.8GHz .. 18 GHz						
18..25GHz						
Band-Edge (no hopping)	55.25 dBc	35.25	--		56.32 dBc	36.32
Band-Edge (Hopping mode)	50.89 dBc	30.89	--		56.40 dBc	36.40

Remark: see diagrams in separate document A1.
The limit on the diagrams is 20dB under the reference level measured In-Band for each channel.

2DH5-Modulation

Set-up no.: 2 Op. Mode: 1	**Test: 20 dBc Spurious emissions conducte**					
Frequency Range	Low channel =0 (2402 MHz) Level Reference (In-Band) = 4.06 dBm Limit = -15.94 dBm		Middle channel = 39 (2441 MHz) Level Reference (In-Band) = 6.05 dBm Limit = -13.95 dBm		High channel = 78 (2480 MHz) Level Reference (In-Band) = 6.39dBm Limit= -13.61 dBm	
	Level [dBm]	Margin to limit [dB]	Level [dBm]	Margin to limit [dB]	Level [dBm]	Margin to limit [dB]
0.15 .. 1000 MHz	See diagrams	>18	See diagrams	>18	See diagrams	>19
1 GHz .. 2.8 GHz						
2.8GHz .. 18 GHz						
18..25GHz						
Band-Edge (no hopping)	48.11 dBc	28.11	--		51.52 dBc	31.52
Band-Edge (Hopping mode)	55.21 dBc	35.21	--		53.71 dBc	53.71

Remark: see diagrams in separate document A1.
The limit on the diagrams is 20dB under the reference level measured In-Band for each channel.

3DH5-Modulation

Set-up no.: 2 Op. Mode: 1	**Test: 20 dBc Spurious emissions conducted**					
Frequency Range	Low channel =0 (2402 MHz) Level Reference (In-Band) = 4.60 dBm Limit = -15.40 dBm		Middle channel = 39 (2441 MHz) Level Reference (In-Band) = 5.47 dBm Limit = -14.53 dBm		High channel = 78 (2480 MHz) Level Reference (In-Band) = 6.33dBm Limit= -13.67 dBm	
	Level [dBm]	Margin to limit [dB]	Level [dBm]	Margin to limit [dB]	Level [dBm]	Margin to limit [dB]
0.15 .. 1000 MHz	See diagrams	>18	See diagrams	>17	See diagrams	>18
1 GHz .. 2.8 GHz						
2.8GHz .. 18 GHz						
18..25GHz						
Band-Edge (no hopping)	48.06 dBc	28.06	--		50.69 dBc	30.69
Band-Edge (Hopping m.)	49.54 dBc	20.54	--		55.74 dBc	25.74

Remark: see diagrams in separate document A1.
The limit on the diagrams is 20dB under the reference level measured In-Band for each channel.

FINAL VERDICT: Passed

5.13. Radiated Band-Edge compliance measurements, FCC 15.247, RSS-210

TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☒ 443 System CTC-FAR-EMI-		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☒ 347 Radio.lab.	☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ 489 ESU	☐	☐	☐
spectr. analys.	☐ 489 ESU	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☒530 10dB Attenuator			☒ cable K15		

MEASUREMENT METHOD:
A Delta marker method was used for showing compliance to restricted bands according §15.205. The method is according Public Notice "Marker-Delta method", Extract from DA00-705. 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 §15.205 with the general limits of §15.209.

EUT SETTINGS:
For frequency-hopping systems (FHHS) the measurement is done in hopping mode on and off and with different modulation to find worst-case.
For DTS systems the measurement was performed with different modulation, e.g. data rates to find worst-case.

RESULTS

DH5-Modulation

Set-up: 1 Op. Mode: 1						
T_{NOM} = 21°C, V_{NOM} = 3.7V	Fundamental field strength-radiated [dBµV/m]	Delta Marker Value[1)] [dB]	Subtratcion: Fund. Field strength – Delta value [dBc]	Value at Band-Edge [dBµV/m]	Limit	Verdict
Channel Low	94.9 (PK) 93.92 (AV)	47.69	47.21 (PK) 46.23 (AV)	--	>20dBc	Passed
Channel High	98.4 (PK)	53.82	--	44.58	74 dBµV/m	Passed
	94.7 (AV)		--	40.88	54 dBµV/m	Passed

Remark: 1) Value of the highest peak subtracted from lowest peak of band-edge (radiated).

RESULTS

2DH5-Modulation

Set-up: 1 Op. Mode: 1						
T_{NOM} = 21°C, V_{NOM} = 3.7V	Fundamental field strength-radiated [dBµV/m]	Delta Marker Value[1)] [dB]	Subtratcion: Fund. Field strength – Delta value [dBc]	Value at Band-Edge [dBµV/m]	Limit	Verdict
Channel Low	96.5 (PK) 92.9 (AV)	47.2	49.3 (PK) 45.7 (AV)	--	>20dBc	Passed
Channel High	94.9 (PK)	50.62	--	44.28	74 dBµV/m	Passed
	90.5 (AV)		--	39.88	54 dBµV/m	Passed

Remark: 1) Value of the highest peak subtracted from lowest peak of band-edge (radiated).

3DH5-Modulation

Set-up: 1 Op. Mode: 1						
T_{NOM} = 21°C, V_{NOM} = 3.7V	Fundamental field strength-radiated [dBµV/m]	Delta Marker Value[1)] [dB]	Subtratcion: Fund. Field strength – Delta value [dBc]	Value at Band-Edge [dBµV/m]	Limit	Verdict
Channel Low	96.3 (PK) 89.5 (AV)	44.34	47.21 (PK) 46.23 (AV)	--	>20dBc	Passed
Channel High	95.7 (PK)	47.29	--	48.41	74 dBµV/m	Passed
	88.8 (AV)		--	41.51	54 dBµV/m	Passed

Remark: 1) Value of the highest peak subtracted from lowest peak of band-edge (radiated).

Used Transducer factors (f < 30 MHz)

1	2	3	4	5	6
					=2+3+4+5
Frequency	**Antenna factor**	**Corection factor**		**Cable loss**	**Transducer factor**
		300m to 3m	**30m to 3m**		
kHz	**dB µV/m**	**dB**	**dB**	**dB**	**dB µV/m**
9.0	20.0	-116.7		0.0	-96.7
10.6	20.0	-116.7		0.0	-96.7
12.6	20.0	-116.7		0.0	-96.7
14.8	20.0	-116.7		0.0	-96.7
17.5	20.0	-116.6		0.0	-96.6
20.7	20.0	-116.6		0.0	-96.6
24.4	20.0	-116.6		0.0	-96.6
28.9	20.0	-116.6		0.0	-96.6
34.1	20.0	-116.5		0.0	-96.5
40.3	20.0	-116.4		0.0	-96.4
47.6	20.0	-116.3		0.0	-96.3
56.2	20.0	-116.2		0.0	-96.2
66.4	20.0	-116.0		0.0	-96.0
78.4	20.0	-115.8		0.0	-95.8
92.7	20.0	-115.4		0.0	-95.4
109.4	20.0	-115.0		0.0	-95.0
129.3	20.0	-114.5		0.0	-94.5
152.7	20.0	-113.9		0.0	-93.9
180.4	20.0	-113.1		0.0	-93.1
213.1	20.0	-112.2		0.0	-92.2
251.7	20.0	-111.3		0.0	-91.3
297.3	20.0	-108.3		0.0	-88.3
351.2	20.0	-105.2		0.0	-85.2
414.8	20.0	-102.1		0.0	-82.1
490.0	20.0	-99.1		0.0	-79.1
490.0	20.0		-56.4	0.1	-36.3
582.0	20.0		-56.2	0.1	-36.1
690.0	20.0		-56.0	0.2	-35.8
820.0	20.0		-55.7	0.2	-35.5
973.0	20.0		-55.4	0.2	-35.2
1,155.0	20.0		-54.9	0.3	-34.6
1,371.0	20.0		-54.4	0.3	-34.1
1,627.0	20.0		-53.7	0.3	-33.4
1,931.0	20.0		-52.9	0.4	-32.5
2,292.0	20.0		-52.0	0.4	-31.6
2,721.0	20.0		-49.8	0.5	-29.3
3,230.0	20.0		-46.6	0.5	-26.1
3,834.0	20.0		-43.3	0.6	-22.7
4,551.0	20.0		-40.1	0.6	-19.5
5,402.0	20.0		-36.8	0.7	-16.1
6,412.0	20.0		-33.5	0.7	-12.8
7,612.0	20.0		-30.3	0.8	-9.5
9,035.0	20.0		-27.0	0.8	-6.2
10,725.0	20.0		-23.9	0.9	-3.0
12,730.0	20.0		-21.2	0.9	-0.3
15,111.0	20.0		-19.3	1.0	1.7
17,937.0	20.0		-18.4	1.0	2.6
21,292.0	20.0		-18.2	1.1	2.9
25,274.0	20.0		-18.3	1.1	2.8
30,000.0	20.0		-18.4	1.2	2.8