T E S T R E P O R T
No.: 2-20810461-13-1c

According to:
FCC Regulations
Part 15C, Part 15.407
Part 15.207, Part 15.209

IC-Regulations
RSS-Gen Issue 3,
RSS-210 Issue 8

for

Sony Mobile Communications AB

Tablet PC
Model name: SGP311 (Type TS-0000-BV)
in
WLAN a, n (HT20 & HT40) Modes (5.2/ 5.3/ 5.6 GHz)

FCC-ID: PY7TS-0000
IC-ID: 4170B-TS0000

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			

CETECOM GmbH
Laboratory Radio Communications & Electromagnetic Compatibility
Im Teelbruch 116 • 45219 Essen • Germany
Registered in Essen, Germany, Reg. No.: HRB Essen 8984
Tel.: + 49 (0) 20 54 / 95 19-954 • Fax: + 49 (0) 20 54 / 95 19-964
E-mail: info@cetecom.com • Internet: www.cetecom.com

Table of contents

Table of annex

	Total pages
ANNEX 1: Internal EUT Photographs	6
ANNEX 2: External EUT Photographs	7
ANNEX 3: Test set up's Photographs	4
ANNEX 4: Measurement Diagrams	111

The listed attachments are an integral part of this report.

1. Summary of test results

The test results apply exclusively to the test samples as presented in this Report. 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 Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies. The presented device integrates an IEEE802.11a/n WLAN transmitter in the 5,150 – 5,750 GHz frequency range. Other implemented wireless technologies were not considered within this test report.

Following test cases have been performed to show compliance with valid Part 15.207/15.209/15.407 of the FCC CFR 47 Rules, Edition 1st October 2012 and IC RSS-210 Issue 8/RSS-Gen Issue 3 standards.

1.1. Tests overview US Goverment (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							
AC-Power Lines Conducted Emissions	AC-Power lines	§15.207	RSS-Gen, Issue 3: Chapter 7.2.4, Table 4	§15.207 limits IC: Table 4, Chapter 7.2.4	1	1	Passed
field strength <30 MHz radiated	Cabinet +Intercon-necting cables	§15.209(a)	RSS-Gen: 4.11	2400/F(kHz) µV/m 24000/F(kHz) µV/m 30 µV/m	2	1	Passed
General field strength emissions + restricted bands (30 MHz to 40 GHz)	Cabinet + Inter-connecting cables (radiated)	§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 (Peak+AV)	2+3+4	1	Passed
Out-of-band emission limits		§15.407(b)(1)(2)(3)(4)	RSS-210 Issue 8, Chapter A9.2 (1)(2)(3)(4)	Outside Bands: -27dBm/MHz e.i.r.p. or max. 10MHz near operating-band: -17dBm/MHz e.i.r.p.			
26 dB emission bandwidth(=B)	Antenna terminal (conducted)	§15.407(a)(1)(2)(3)	--	--	5	1	No pass & fail criteria
99% occupied bandwidth (=B)	Antenna terminal (conducted)	--	RSS-Gen Issue 3: Chapter 4.6.1	99% Power bandwidth	5	1	No pass & fail criteria

TX-Mode							
Transmitter Peak output power	Cabinet (radiated+ conducted)	§15.407(a) (1)(2)(3)	RSS-210 Issue 8: A9.2 (1)(2)(3)(4)	Lesser of: 50mW(FCC)/200mW (RSS) or 4dBm+10log$_{10}$(B) (U-NII 1: 5.15-5.25 GHz) Lesser of: 250mW or 11dBm+10log$_{10}$(B) (U-NII 2+ext.: 5.25-5.35 GHz + 5.47-5.725 GHz) Lesser of: 1W or 17dBm+10log$_{10}$(B) (U-NII 3: 5.725-5.825 GHz)[1)]	5	1	Passed[1)]
Peak Power spectral density	Antenna terminal (conducted)	§15.407(a)(5)	RSS-210 Issue 8: A9.2 (1)(2)	U-NII 1: ≤ 4(FCC) dBm/ MHz ≤ 10(RSS)dBm/ MHz U-NII 2+ext.: ≤ 11 dBm/ MHz	5	1	Passed
Ratio between Peak-Average on power envelope (Peak excursion)	Antenna terminal (conducted)	§15.407(a)(6)	--	< 13 dB across any 1MHz	5	1	Passed
Duty cycle	Antenna terminal (conducted)	U-NII Part 15	--	--	5	1	No pass & fail criteria
RX Mode							
RECEIVER Radiated emissions	Cabinet + Inter-connecting 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	2)	2)	Passed[2)]
AC-Power Lines Conducted Emissions	AC-Power lines	§15.107	RSS-Gen, Issue 3: Chapter 7.2.4, Table 4	§15.107 limits IC: Table 4, Chapter 7.2.4	2)	2)	Passed[2)]

General remark: KDB789033 D01 v01r02 (9-26-2012) guidelines for compliance testing for U-NII devices used.
1.) It concerns U-NII 3 frequency band , pls. refer test report no.' 2-20810461-13-1ab' acc. Part15.247/RSS-210
2.) It concerns RX Mode, please refer test report no. '2-20810461-13-1d' according Part15B/ICES-003

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.

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

CETECOM GmbH
Im Teelbruch 116
45219 Essen
Tel.: + 49 (0) 20 54 / 95 19 - 0
Fax: + 49 (0) 20 54 / 95 19 - 997

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

2. Administrative Data

2.1. Identification of the testing laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing laboratory:	Dipl.-Ing. W. Richter
Deputy:	Dipl.-Ing. N. Jeß

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

Responsible for test report and project leader:	Dipl.-Ing. B. Taslica
Receipt of EUT:	2013-01-28
Date(s) of test:	Jan. 2013 – March 2013 (see diagrams)
Date of report:	2013-03-12
---	---
Version of template: 12.08 Taslica	

2.4. Applicant's details

Applicant's name:	Sony Mobile Communications AB
Address:	Nya Vattentornet 22188 LUND SWEDEN
Contact person:	Mr. Håkan Sjöberg

2.5. Manufacturer's details

Manufacturer's name:	please see Applicant's details
Address:	please see Applicant's details

3. Equipment under test (EUT)

3.1. Technical data of main EUT declared by applicant

Main function used for testing	Tablet with integrated IEEE 802.11a/n W-LAN Transceiver		
Type	TS-0000-BV		
Frequency range and channels (US/Canada -bands) ***Note:*** *some channels (5600-5650MHz) are not available for US/Canada or indoor-only allowed*	U-NII 1: 5150 – 5350 MHz: 36, 38, 40, 44, 46, 48, 52, 56, 60, 62, 64 U-NII 2+ext.: 5470 – 5725 MHz: 100, 102, 104,108, 110, 112, 116, 132, 134, 136, 140 U-NII 3: 5725 – 5825 MHz: 151, 159 (tested acc. FCC 15.247/RSS-210)		
Type of modulation (packet types)	See chapter 3.6		
Antenna Type	☒ Integrated ☐ External, no RF- connector ☐ External, separate RF-connector		
Antenna Gain	Max. antenna gain 2.8 dBi (PK) at 5GHz (acc. applicant‘s information antenna data sheet)		
Transmitter spurious radiated: (worst case)	37.58 dBµV/m@3m distance on channel 102 (135 Mbps) at 654.56 MHz		
FCC-ID	PY7TS-0000		
IC-ID	4170B-TS0000		
Installed options (not tested within this test report)	☐ GSM 850 and GSM 1900 Bands ☒ WLAN b&g-Modes ☒ RFID, Bluetooth® ☒ FM Radio ☒ GPS		
Power supply	☒ Internal battery Li-Ion		
Special EMI components	--		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
Firmware	☐ for normal use		☒ Special version for test execution
FCC label attached	☐ yes	☒ no	

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

Short descrip-tion*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	Tablet PC[1)]	TS-0000-BV	CB5A1N1KVK	AP1	ATPV:1267-7120, s_atp_pollux_ windy_0_0_32 _3_g_wlan
EUT B	Tablet PC[1)]	TS-0000-BV	CB5A1N1KWT	AP1	
EUT C	Tablet PC[1)]	TS-0000-BV	CB5A1N1KP1	AP1	
EUT D	Tablet PC[1)]	TS-0000-BV	CB5A1N1KYJ	AP1	

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

Remark: 1) Model name is SGP311 with 16 GB (tested) and second variant model name SGP312 as 32 GB.

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

AE short descrip-tion *)	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 1	Korak EU charger EP 880	AC-0400	#22469	AP	-
AE 2	USB to micro USB Cable	AI-0401 (1.5 m length)	#22683	SP1	-
AE 3	Korak JP charger EP 880	AC-0400-JP	#23621	AP	-
AE 4	Notebook Dell	Latitude D2120	CTC#7	--	Windows 7 + Special Firmware SW

*) 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[1)]	Remarks
Set. 1	EUT A + AE 2 + AE 3	Set-up for EMI-AC Power lines measurement
Set. 2	EUT A + AE 1 + AE 2	Set-up for radiated EMI measurements with accessories (9 kHz – 18 GHz)
Set. 3	EUT B + AE 1 + AE 2	Set-up for radiated EMI measurements with accessories (1 – 7 GHz)
Set. 4	EUT C + AE 1 + AE 2	Set-up for radiated EMI measurements with accessories (18 – 40 GHz)
Set. 5	EUT D + AE2	Set-up for conducted measurements

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.
Remark: 1) The internal battery of EUT discharges itself several times. Therefore were used several set-up's.

3.5. EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	WLAN Continuous TX-Mode	The EUT was put to continuous transmissions mode with help of a special firmware software on Laptop (AE 4). The modulation and Bit rate used will be special mentioned in the results. According measurement results of output power conducted selected this as reference for other measurements the highest output power related to the data rate except radiated field-strength measurements. For this issue were selected data rates highest, lowest and middle (alternating).

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

3.6. IEEE 802.11 Overview: Modulation and Data Rates

The modulations and data rates defined for 802.11 a/b/g/n transmitters are identified in the table below. Also it shows which operational mode is possible for the device under test (EUT) according applicant's information.

802.11**a**-Mode (OFDM system)		
Brutto data rate [Mbps]	Modulation type of subcarriers	Supported by EUT
6	BPSK	YES
9		
12	QPSK	YES
18		
24	16-QAM	YES
36		
48	64-QAM	YES
54		

Remark: 52 sub-carriers which can be modulated at different data-rates.

802.11**n**-Mode (OFDM)		
Brutto data rate [Mbps]	Modulation type	Supported by EUT
6.5/13/19.5/26/39/52/58.5/65 Mbps	HT20 (MCS0..MCS7)	Yes
14.444/28.889/43.333/57.778/86.667/ 115.556/130/144.444 Mbps	HT20 (MCS8..MCS15)	No
13.5/27/40.5/54/81/108/121.5/135 Mbps	HT40 (MCS0..MCS7)	Yes (only low and middle channels available)
30/60/90/120/180/240/270/300 Mbps	HT40 (MCS8..MCS15)	No

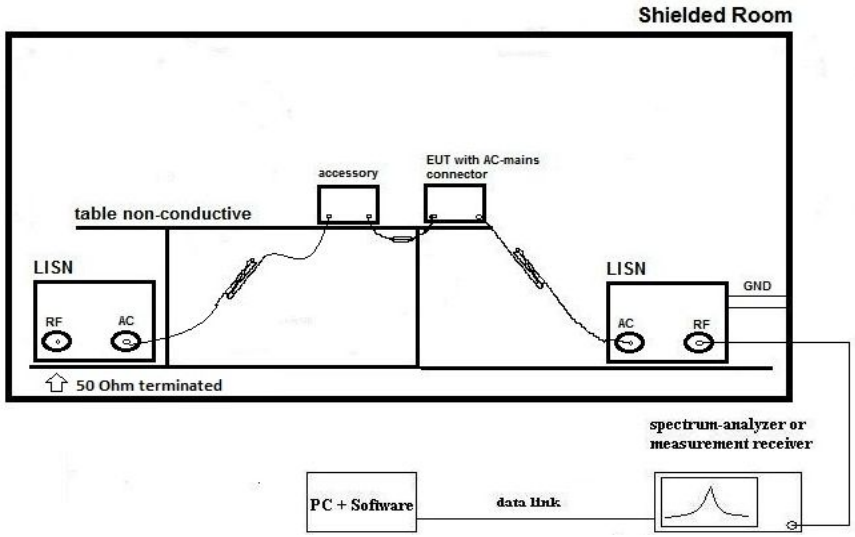
4. Description of test system set-up's

4.1. Test system set-up for AC power-line conducted emission measurements

Specification: ANSI C63.4-2009 chapter 7, ANSI C63.10-2009 chapter 6.2

General Description: The radio frequency voltage conducted back into the AC power line in the frequency range 150 kHz to 30 MHz has to be investigated. 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 50 Ohm / 50 µH line impedance stabilization network (LISN) is used coupling the interface to the measurement equipment. The EUT power input leads are connected through the LISN to the AC-power source. The LISN enclosure is electrically connected to the ground plane. The measuring instrument is connected to the coaxial output of the LISN.
Tabletop devices were set-up on a 80 cm height above 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 120 V/60 Hz. 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.

Schematic:



Only schematic view, we refer to figure 6, 7 and 8 of ANSI C63.4-2009 for more details.

Testing method: **Exploratory, preliminary measurements** as a first step, determines the worst-case phase line (neutral or phase) as well as the most critical operating mode of the equipment. A complete frequency-sweep with PK-Detector is performed on each current-carrying conductor.

Final testing for power phases and critical frequencies (Margin to AV- or QP limit lower than 3 dB) as a second step includes measurements with receivers detector set to Quasi-Peak and Average.

Formula:

$V_C = V_R + C_L$ (1)
$M = L_T - V_C$ (2)

V_C = measured Voltage –corrected value
V_R = Receiver reading
C_L = Cable loss
M = Margin
L_T = Limit

Values are in dB, positive margin means value is below limit.

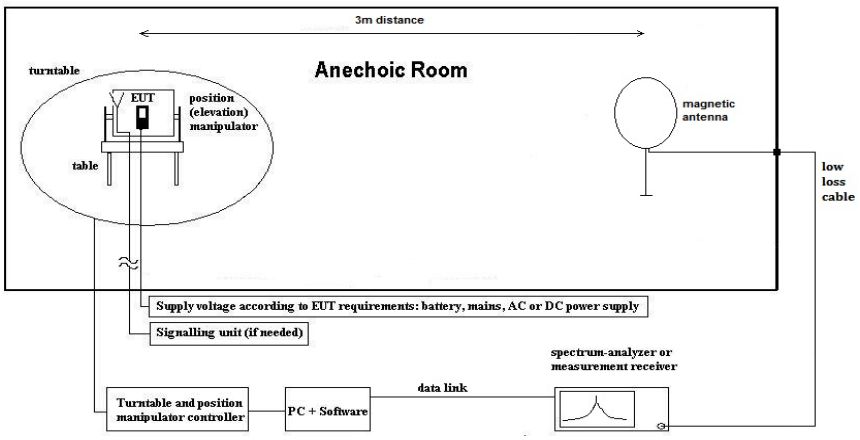
4.2. Test system set-up for radiated magnetic field measurements below 30 MHz

Specification: ANSI C63.4-2009 chapter 8.2.1, ANSI C63.10-2009 chapter 6.4

General Description: Evaluating the radiated field emissions to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies.

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 commissions.

Schematic:



Testing method:

Exploratory, preliminary measure-ment
The EUT and it's 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 and it's characteristics was recorded with an EMI-receiver, broadband loop antenna and software.
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 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 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
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.

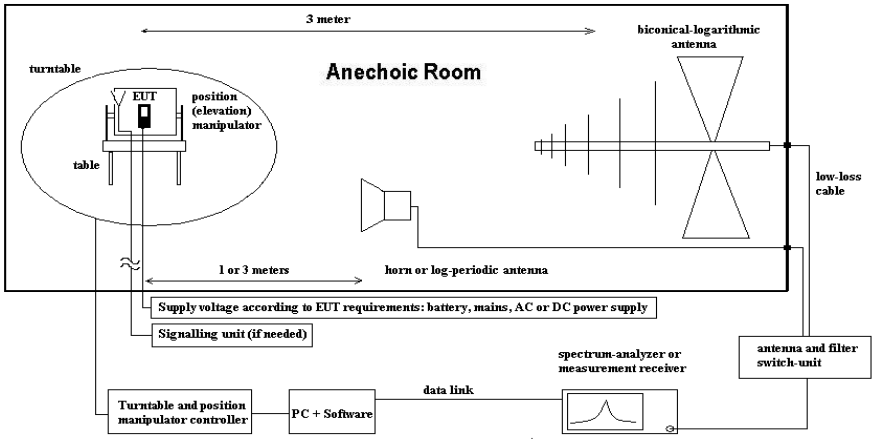
Distance correction: Reference for applied correction (extrapolating) factors:
IEEC Transaction EMC, Vol. 47, No. 3 , Aug. 2005, Journal Paper
"*Extrapolating Near-field emissions of low frequency loop transmitters*".

4.3. Test system set-up for electric field measurement in the range 30 MHz to 1 GHz

Specification: ANSI C63.4-2009 chapter 8, ANSI C63.10-2009 chapter 6.5

General Description: Evaluating the field emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a NSA-compliant semi anechoic room (SAR) recognized by the regulatory commissions.

Schematic:



Testing method:

Exploratory, preliminary measurements
The EUT and it's 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 it's characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

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

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

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself 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

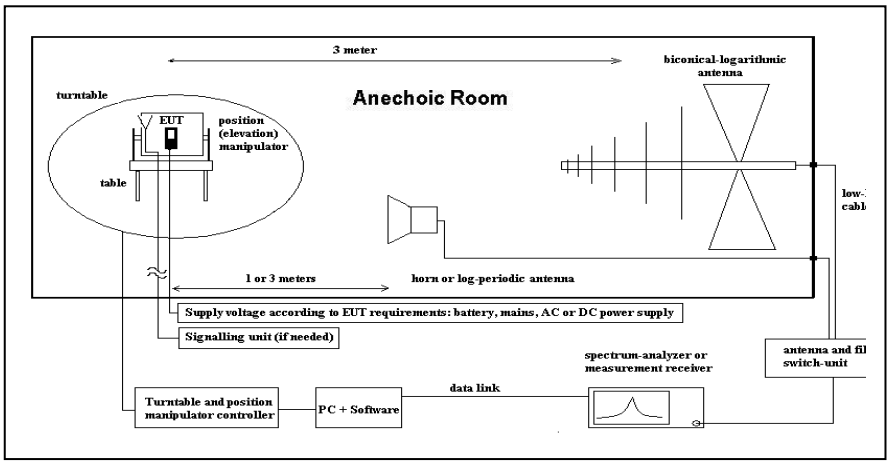
All units are dB-units, positive margin means value is below limit.

4.4. Test system set-up for electric field measurement above 1 GHz

Specification: ANSI C63.4-2009 chapter 8, ANSI C63.10-2009 chapter 6.6

General Description: Evaluating the field emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 16-4 compliant fully anechoic room (FAR) recognized by the regulatory commissions. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 1 meter above 18 GHz. Logarithmic periodic antenna is used for frequency range 1 GHz to 18 GHz, above 18 GHz a horn antenna is used. The antennas are set to fixed antenna height of 1.55 m and the EUT aligned within 3 dB cone of radiation pattern.

Schematic:



Testing method:

Exploratory, preliminary measurements
The EUT and it's 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 45°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and it's characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

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

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

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height is fixed to 1.55 m.

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

Formula:

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

$M = L_T - E_C$ (2)

E_C = Electrical field – corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
AF = 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.
For measurement above 18 GHz used distance correction factor -9.54 dB

5. Measurements

5.1. General Limit - Conducted emissions on AC-Power lines

5.1.1. Test location and 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	☐ 489 ESU 40	☐ 620 ESU 26		
LISN	☒ 005 ESH2-Z5	☐ 007 ESH3-Z6	☐ 300 ESH3-Z5 & 50Ω used for AE		☐ no LISN for AE	
signalling	☐ 371 CBT32	☐ 436 CMU	☐ 547 CMU	☐ 594 CMW		
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 120 V 60 Hz via PAS 5000			

5.1.2. Requirements

FCC		Part 15, Subpart B, §15.207	
IC		RSS-Gen., § 7.2.4	
ANSI		C63.10-2009	
Limit	Frequency [MHz]	QUASI-Peak [dBµV]	AVERAGE [dBµV]
	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			

5.1.3. Test condition and test set-up

link to signalling 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 or Analyzer settings	Scan data	☒ 9 – 150 kHz, RBW = 200 Hz, Step = 61 Hz ☒ 150 kHz – 30 MHz RBW = 9 kHz, Step = 4 kHz ☐ other:		
	Scan-Mode Pre-measurement Final measurement	6 dB EMI-Receiver Mode Peak detector, Repetitive-Scan, max-hold, sweep-time 50 µs per frequency point Average & Quasi-peak detector at critical frequencies		
General measurement procedures		Please see chapter "Test system set-up for AC power line conducted emissions measurements"		

5.1.4. Measurement results

The results are presented below in summary form only. The EUT performed on middle channel. If critical peaks found (Margin <10 dB) the lowest and highest channels will be performing too.

EUT Type and S/N or EUT set-up no.		EUT set-up 1			
Diagram No.	EUT operating mode no. or commend	Used Detector	Power line	Additional (scan-) information or remarks	Result
1.01_...	EUT operating mode 1	☒ Peak ☒ CAV ☒ QP	L1/ N	WLAN_a_Mode (due to uncritical measurement result (Margin>15 dB) no further operating mode tested)	passed

Remarks: For more information please see the diagrams at annex 4.

5.2. General Limit - Radiated field strength emissions below 30 MHz

5.2.1. 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	☐ 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			

5.2.2. Standards and Limits: CFR 47, §15.205, §15.209, RSS-Gen

Frequency [MHz]	Field strength [µV/m]	[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				

5.2.3.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: between potential equalisation connector (EUT) and GND with a lab wire 1,2 m)
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)		

5.2.4.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 on page 16.

5.2.5.Measurement Results

WLAN -Modes

Set-up No.		2								
Operating Mode		1								
Diagram no.	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
2.05 (a-Mode)	Same settings (see below)	See diagram		Same settings (see below)				Same settings (see below)	See diagram	
2.06 (n (HT40)-Mode)										
2.04 (n (HT20)-Mode)	0.009 to 0.150	-56.2	10	0.2	100	--	0°..360°	300 to 3m	>20	See dia-gram
	0.150 to 0.5	~ -25		10				300 to 3m	>20	
	0.5 to 30	~ 17.5		10				300 to 3m 30 to 3m	>12.04	29.54

Remark: Please see the measured channels as diagrams at annex 4.

General remarks: Due to uncritical measurements of WLAN will be showing only the middle channel of each mode otherwise by any critical emission, will be performing also the highest and lowest channels.

5.2.6.Verdict: Summary of all WLAN measurement results for radiated frequencies below 30 MHz – Passed

5.2.7. Correction factors due to reduced meas. distance (f< 30 MHz)

The used correction factors when the measurement distance is reduced, are taken from IEEC Transaction EMC, Vol 47, No.3, Aug. 2005, Journal Paper *"EXTRAPOLATING NEAR-FIELD EMISSIONS OF LOW-FREQUENCY LOOP TRANSMITTERS"*.

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

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

5.3.1. Requirements Test location and 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	☐ 489 ESU 40	☐ 620 ESU 26		
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	☐ 594 CMW		
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			

5.3.2. Requirements/Limits for non-restricted bands (outside operational bands)

FCC		☒ Part 15 Subpart C, §15.407(b)(1)(2)(3)(4)	
IC		RSS-210, Issue 8, A9.2(1)(2)(3)(4)	
ANSI		☒ C63.10-2009 for TX-mode	
KDB Guidance no.		☒ 789033 D01 General UNII test procedures v01r02': G(1)(3)(4)	
	Operating frequency band [MHz]	EIRP – limit for outside operating frequency band	
		Peak [dBm] 30 MHz to 40 GHz	Peak [dBµV/m][1.)] 30 MHz to 40 GHz@3m
	5.15 – 5.25 GHz	-27.0	68.2
	5.25 – 5.35 GHz	-27.0	68.2
	5.47 – 5.725 GHz	-27.0	68.2
	5.725 – 5.825 GHz	-27.0 (10 MHz greater above/below band edge) -17.0 (within 10 MHz offset to band-edge)	68.2 (10 MHz greater above/below band edge) 78.2 (within 10 MHz offset to band-edge)

Remark: 1.) Conversion formula between EIRP and field strength: E[dBµV/m]=EIRP[dBm]+95.2dB for measurement distance of 3m. (Guidance no. 789033 D01 General UNII test procedures v01r02)
2.) for practical reasons for measurements below 1 GHz only the stricter limit of §15.209 is visible.

5.3.3. Requirements/Limits for restricted bands (§15.205):

FCC		☒ Part 15 Subpart B, §15.109, class B ☒ Part 15 Subpart C, §15.209 @ frequencies defined in §15.205	
IC		RSS-Gen., Issue 3	
ANSI		☒ C63.4-2009 for RX-Mode ☒ C63.10-2009 for TX-mode	
Limit	Frequency [MHz]	Radiated emissions limits, 3 meters	
		QUASI Peak [µV/m]	QUASI-Peak [dBµV/m]
	30 - 88	100	40.0
	88 - 216	150	43.5
	216 - 960	200	46.0
	above 960	500	54.0

5.3.4. 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	37.5-38.25	1645.5-1646.5	9.3-9.5
6.215-6.218	73-74.6	1660-1710	10.6-12.7
6.26775-6.26825	74.8-75.2	1718.8-1722.2	13.25-13.4
6.31175-6.31225	108-121.94	2200-2300	14.47-14.5
8.291-8.294	123-138	2310-2390	15.35-16.2
8.362-8.366	149.9-150.05	2483.5-2500	17.7-21.4
8.37625-8.38675	156.52475-156.52525	2690-2900	22.01-23.12
8.41425-8.41475	156.7-156.9	3260-3267	23.6-24.0
12.29-12.293	162.0125-167.17	3332-3339	31.2-31.8
12.51975-12.52025	167.72-173.2	3345.8-3358	36.43-36.5
12.57675-12.57725	240-285	3600-4400	--
13.36-13.41	322-335.4	--	--
Remark: only spurious emissions are allowed within these frequency bands not exceeding the limits per §15.209			

5.3.5. 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	Scan frequency range:	☒ 30 – 1000 MHz ☐ other:		
	Scan-Mode	☒ 6dB EMI-Receiver Mode ☐ 3dB spectrum analyser mode		
	Detector	Peak / Quasi-peak		
	RBW/VBW	100 kHz/300 kHz		
	Mode:	Repetitive-Scan, max-hold		
	Scan step	80 kHz		
	Sweep-Time	Coupled – calibrated display if continuous TX-signal otherwise adapted to EUT's individual duty-cycle		
General measurement procedures		Please see chapter "Test system set-up for electric field radiated measurements in the range 30 MHz to 1000 MHz"		

5.3.6. MEASUREMENT RESULTS: TX-MODE

The results are presented below in summary form only. For more information please see diagrams.

Table of measurement results:

Diagram no.	Carrier channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Channel no.	Channel frequency					PK	AV	QP	
3.04-1_...	36	5180 MHz	30 to. 1000 MHz	2	1	No peaks are visible within 6 dB margin to the limit (WLAN a, n(HT20) & n(HT40) modes)	☒	☐	☐	passed
3.04-2_...	40	5240 MHz					☒	☐	☐	passed
3.04-3_...	48	5320 MHz					☒	☐	☐	passed
3.05-1_...	52	5260 MHz					☒	☐	☐	passed
3.05-2_...	56	5280 MHz					☒	☐	☒	passed
3.05-3_...	64	5320 MHz					☒	☐	☐	passed
3.06-1_...	102	5540 MHz					☒	☐	☒	passed
3.06-2_...	110	5550 MHz					☒	☐	☐	passed
3.06-3_...	134	5670 MHz					☒	☐	☐	passed

Remark: --

5.4. General Limit - Radiated emissions, above 1 GHz

5.4.1. Test location and 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 40	☐	☐
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	☐594 CMW		
DCpower	☐086 LNG50-10	☐087 EA3013	☐354 NGPE 40	☐349 car battery	☐350 Car battery	☐
line voltage	☐ 230 V 50 Hz via public mains		☒060 120 V 60 Hz via PAS 5000			

5.4.2. Requirements/Limits for non-restricted bands (outside operational bands)

FCC		☒ Part 15 Subpart C, §15.407(b)(1)(2)(3)(4)	
IC		RSS-210, Issue 8, A9.2(1)(2)(3)(4)	
ANSI		☒ C63.10-2009 for TX-mode	
KDB Guidance no.		☒ 789033 D01 General UNII test procedures v01r02': G(1)(3)(5)(6)	
	Operating frequency band [MHz]	EIRP – limit for outside operating frequency band	
		Peak [dBm] 30 MHz to 40 GHz	Peak [dBµV/m][1.] 30 MHz to 40 GHz@3m
	5.15 – 5.25 GHz	-27.0	68.2
	5.25 – 5.35 GHz	-27.0	68.2
	5.47 – 5.725 GHz	-27.0	68.2
	5.725 – 5.825 GHz	-27.0 (10 MHz greater above/below band edge) -17.0 (within 10 MHz offset to band-edge)	68.2 (10 MHz greater above/below band edge) 78.2 (within 10 MHz offset to band-edge)

Remark: 1.) Conversion formula between EIRP and field strength: E[dBµV/m]=EIRP[dBm]+95.2dB for measurement distance of 3m. (Guidance no. 789033 D01 General UNII test procedures v01r02)

5.4.3. Requirements/Limits for restricted bands

FCC	☒ Part 15 Subpart B, §15.109 class B ☒ Part 15 subpart C, §15.209			
IC	RSS-Gen., Issue 3			
ANSI	☒ C63.4: 2009 ☒ C63.10: 2009			
Frequency [MHz]	Limits @ 3m			
	AV [µV/m]	AV [dBµV/m]	Peak [µV/m]	Peak [dBµV/m]
above 1 GHz	500	54.0	5000	74.0

5.4.3.1. 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	Scan frequency range: Scan-Mode Detector RBW/VBW Trace-Mode: Sweep-Time	☒ 1 – 18 GHz ☐ 18 – 25 GHz ☒ 18 – 40 GHz ☐ other: ☐ 6 dB EMI-Receiver Mode ☒ 3 dB Spectrum analyser Mode Peak and Average for restricted bands, Peak for non-restricted bands 1 MHz / 3 MHz Max-hold Coupled – calibrated display if CW signal otherwise adapted to EUT's individual duty-cycle (>98%)		
General measurement procedures		Please see chapter "Test system set-up for radiated electric field measurements above 1 GHz" It is used also the distance correction factor for measurements above 18 GHz (3 m to 1 m)		

5.4.4. Measurement Results TX-Mode

Table of measurement results:

Diagram no.	Carrier channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Channel no.	Channel frequency					PK	AV	QP	
4.04a-1_...	36	5180 MHz	1 to 7GHz	2	1	No critical peaks are detected except external interferer at 1,8 GHz. (WLAN a, n(HT20) & n(HT40) modes)	☒	☒	☐	passed
4.04a-2_...	40	5240 MHz					☒	☒	☐	passed
4.04a-3_...	48	5320 MHz					☒	☒	☐	passed
4.05a-1_...	52	5260 MHz					☒	☒	☐	passed
4.05a-2_...	56	5280 MHz					☒	☒	☐	passed
4.05a-3_...	64	5320 MHz					☒	☒	☐	passed
4.06a-1_...	102	5540 MHz		3			☒	☒	☐	passed
4.06a-2_...	110	5550 MHz					☒	☒	☐	passed
4.06a-2_...	134	5670 MHz					☒	☒	☐	passed

Remark: Peak above limit from wanted TX traffic channel are visible and peak at 1,8 GHz, not relevant for results.

Table of measurement results:

Diagram no.	Carrier channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Channel no.	Channel frequency					PK	AV	QP	
4.04b-1_...	36	5180 MHz	7 to 18 GHz	2	1	No peaks are visible within 10 dB margin to the limit. (WLAN a, n(HT20) & n(HT40) modes)	☒	☒	☐	passed
4.04b-2_...	40	5240 MHz					☒	☒	☐	passed
4.04b-3_...	48	5320 MHz					☒	☒	☐	passed
4.05b-1_...	52	5260 MHz					☒	☒	☐	passed
4.05b-2_...	56	5280 MHz					☒	☒	☐	passed
4.05b-3_...	64	5320 MHz					☒	☒	☐	passed
4.06b-1_...	102	5540 MHz					☒	☒	☐	passed
4.06b-2_...	110	5550 MHz					☒	☒	☐	passed
4.06b-3_...	134	5670 MHz					☒	☒	☐	passed

Remark: --

Table of measurement results:

Diagram no.	Carrier channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Channel no.	Channel frequency					PK	AV	QP	
4.04-1_...	36	5180 MHz	18 to 40 GHz	4	1	No peaks are visible within 19 dB margin to the limit. (WLAN a, n(HT20) & n(HT40) modes)	☒	☒	☐	passed
4.04-2_...	40	5240 MHz					☒	☒	☐	passed
4.04-3_...	48	5320 MHz					☒	☒	☐	passed
4.05-1_...	52	5260 MHz					☒	☒	☐	passed
4.05-2_...	56	5280 MHz					☒	☒	☐	passed
4.05-3_...	64	5320 MHz					☒	☒	☐	passed
4.06-1_...	102	5540 MHz					☒	☒	☐	passed
4.06-2_...	110	5550 MHz					☒	☒	☐	passed
4.06-3_...	134	5670 MHz					☒	☒	☐	passed

Remark: --

5.5. General Limit - Band-edge compliance measurements

5.5.1. 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 20 dB Attenuator			☒ cable K4		

5.5.2. References

Reference: §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.*

Reference:

FCC		☒ Part 15 Subpart C, §15.407(b)(1)(2)(3)(4)	
IC		RSS-210, Issue 8, A9.2(1)(2)(3)(4)	
ANSI		☒ C63.10-2009 for TX-mode	
KDB Guidance no.		☒ 789033 D01 General UNII test procedures v01r02': G(2)(c)(d), G(3)(d)	
	Operating frequency band [MHz]	EIRP – limit for outside operating frequency band	
		Peak [dBm] 30 MHz to 40 GHz	Peak [dBµV/m][1.)] 30 MHz to 40 GHz@3m
	5.15 – 5.25 GHz	-27.0	68.2
	5.25 – 5.35 GHz	-27.0	68.2
	5.47 – 5.725 GHz	-27.0	68.2
	5.725 – 5.825 GHz	-27.0 (10 MHz greater above/below band edge) -17.0 (within 10 MHz offset to band-edge)	68.2 (10 MHz greater above/below band edge) 78.2 (within 10 MHz offset to band-edge)

Remark: 1.) Conversion formula between EIRP and field strength used (Please read measurement method).

5.5.3. 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/ANSI C63.10:2009. 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.

Alternative as specified in 15.407 (b) was also checked the peak emission and used acc. guidance 789033 the chapter 2(d)(iii). Finally, the strictly method was used.

The formula EIRP[dBm] = E [dBµV/m] - 95.2 for radiated measurements, which used field strength at 3 meters to convert the value in dBm.

5.5.4. EUT settings:

The EUT was instructed to send with maximum power (if adjustable) according to applicants instructions and which was detected at output power measurements and selected for this tests. For sending with continuous mode a special firmware was used.

5.5.5. RESULTS

5.5.5.1. RESULTS for a-Mode

Set-up: 2 Op. Mode: 1								
T_{NOM} = 21°C, V_{NOM} = 3.7 V	Channel/ data rate	Fundamental field strength-radiated	Delta Marker Value (PK_h – PK_l)	Value at Band-Edge				Verdict
Diagram no.				§15.209	Limit	§15.407	Limit	
		[dBµV/m]	[dBc]	[dBµV/m]		[dBm/MHz]		
9.11_...	36/ 48 Mbps	101.2 (Peak)	43.04	58.16 (PK)	74	34.1(PK)	-27	Passed
		92.2 (AV)		49.16 (AV)	54	--	--	

Remark: see also diagrams enclosed

Set-up: 2 Op. Mode: 1								
T_{NOM} = 21°C, V_{NOM} = 3.7 V	Channel/ data rate	Fundamental field strength-radiated	Delta Marker Value (PK_h – PK_l)	Value at Band-Edge				Verdict
Diagram no.				§15.209	Limit	§15.407	Limit	
		[dBµV/m]	[dBc]	[dBµV/m]		[dBm/MHz]		
9.12_...	36/ 6 Mbps	103.8 (Peak)	45.38	58.42 (PK)	74	-32.70 (PK)	-27	Passed
		94.4 (AV)		49.02 (AV)	54	--	-27	

Remark: see also diagrams enclosed

Set-up: 2 Op. Mode: 1								
T_{NOM} = 21°C, V_{NOM} = 3.7 V	Channel/ data rate	Fundamental field strength-radiated	Delta Marker Value (PK_h – PK_l)	Value at Band-Edge				Verdict
Diagram no.				§15.209	Limit	§15.407	Limit	
		[dBµV/m]	[dBc]	[dBµV/m]		[dBm/MHz]		
9.15_...	64/ 65 Mbps	102.5 (Peak)	48.85	53.65 (PK)	74	-40.12 (PK)	-27	Passed
		90.4 (AV)		41.55 (AV)	54	--	--	

Remark: see also diagrams enclosed

Set-up: 2 Op. Mode: 1								
T_{NOM} = 21°C, V_{NOM} = 3.7 V	Channel/ data rate	Fundamental field strength-radiated	Delta Marker Value (PK_h – PK_l)	Value at Band-Edge				Verdict
Diagram no.				§15.209	Limit	§15.407	Limit	
		[dBµV/m]	[dBc]	[dBµV/m]		[dBm/MHz]		
9.16_...	100/ 6 Mbps	91.23 (Peak)	45.46	45.77 (PK)	74	-45.41 (PK)	-27	Passed
		74.79 (AV)		29.33 (AV)	54	--	--	

Set-up: 2 Op. Mode: 1								
T_{NOM} = 21°C, V_{NOM} = 3.7 V	Channel/ data rate	Fundamental field strength-radiated	Delta Marker Value (PK_h – PK_l)	Value at Band-Edge				Verdict
Diagram no.				§15.209	Limit	§15.407	Limit	
		[dBµV/m]	[dBc]	[dBµV/m]		[dBm/MHz]		
9.17_...	140/ 26 Mbps	99.8 (Peak)	42.6	57.2 (PK)	74	-38.0 (PK)	-27	Passed
		89.2 (AV)		46.60 (AV)	54	--	--	

Remark: see also diagrams enclosed

5.5.5.2. RESULTS for n(HT40)-Mode

Set-up: 2 Op. Mode: 1								
T_{NOM} = 21°C, V_{NOM} = 3.7 V	Channel/ data rate	Fundamental field strength-radiated	Delta Marker Value (PK_h – PK_l)	Value at Band-Edge				Verdict
Diagram no.				§15.209	Limit	§15.407	Limit	
		[dBµV/m]	[dBc]	[dBµV/m]		[dBm/MHz]		
9.18_...	38/ 6.5 Mbps	100.0 (Peak)	--	--	--	-28.5 (PK)	-27	Passed
		89.9 (AV)	--	--	--	--	--	

Remark: see also diagrams enclosed

Set-up: 2 Op. Mode: 1								
T_{NOM} = 21°C, V_{NOM} = 3.7 V	Channel/ data rate	Fundamental field strength- radiated	Delta Marker Value (PK_h – PK_l)	Value at Band-Edge				Verdict
Diagram no.				§15.209	Limit	§15.407	Limit	
		[dBµV/m]	[dBc]	[dBµV/m]		[dBm/MHz]		
9.19_...	46/ 135 Mbps	98.84 (Peak)	--	--	--	LB: -45.14 (PK) RB:-43.2 (PK)	-27	Passed
		86.9 (AV)	--	--	--	---	--	

Remark: see also diagrams enclosed

Set-up: 2 Op. Mode: 1								
T_{NOM} = 21°C, V_{NOM} = 3.7 V	Channel/ data rate	Fundamental field strength- radiated	Delta Marker Value (PK_h – PK_l)	Value at Band-Edge				Verdict
Diagram no.				§15.209	Limit	§15.407	Limit	
		[dBµV/m]	[dBc]	[dBµV/m]		[dBm/MHz]		
9.20_...	102/ 135 Mbps	95.7 (Peak)	-	-	--	-42.70 (PK)	-27	Passed
		81.8 (AV)	-	--	--	---	--	

Set-up: 2 Op. Mode: 1								
T_{NOM} = 21°C, V_{NOM} = 3.7 V	Channel/ data rate	Fundamental field strength- radiated	Delta Marker Value (PK_h – PK_l)	Value at Band-Edge				Verdict
Diagram no.				§15.209	Limit	§15.407	Limit	
		[dBµV/m]	[dBc]	[dBµV/m]		[dBm/MHz]		
9.21_...	134/ 135 Mbps	95.7 (Peak)	-	--	--	-44.74 (PK)	-27	Passed
		83.5 (AV)	--	--	--	--	--	

Remark: see also diagrams enclosed

Set-up: 2 Op. Mode: 1								
T_{NOM} = 21°C, V_{NOM} = 3.7 V	Channel/ data rate	Fundamental field strength- radiated	Delta Marker Value (PK_h – PK_l)	Value at Band-Edge				Verdict
Diagram no.				§15.209	Limit	§15.407	Limit	
		[dBµV/m]	[dBc]	[dBµV/m]		[dBm/MHz]		
9.22_...	38/ 135 Mbps	101.2 (Peak)	35.90	65.30 (PK)	74	--	---	Passed
		89.7 (AV)		53.80 (AV)	54	--	---	

Remark: see also diagrams enclosed

5.6 RF Parameter - 26 dB and 99% occupied Bandwidth

5.6.1 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	☐
spectr. analys.	☐ 584 FSU	☒ 120 FSEM	☐ 264 FSEK	☒ 489 ESU	☐	☐
attenuator	☒ 530 10 dB	☐	☐	☐	☐	☐
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU			
DCpower	☐ 463 Power source	☐ 087 EA3013	☒ 354 NGPE 40	☐ 086 LNG50-10	☐	☐
line voltage	☐ 230 V 50 Hz via public mains		☐060 120 V 60 Hz via PAS 5000			

5.6.2 Test condition and measurement test set-up

link to test system (if used):	☐ air link	☒ cable connection	☐
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%

5.6.3 References of occupied and emission bandwidth

FCC	☒ Part 15 Subpart C, §15.407(b)(1)(2)(3)
IC	RSS-Gen, Issue 3, chapter 4.6.1
ANSI	☒ C63.10-2009 for TX-mode
KDB Guidance no.	☒ 789033 D01 General UNII test procedures v01r02': D
Limits	--

5.6.4 EUT Settings:

The EUT was instructed to send with different power/ data rates (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

5.6.5 Measurement method:

The measurement was performed with the RBW set to approximately 1% of the emission bandwidth. The span was set to cover the complete carrier. Three carrier frequencies 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 for **26 dB bandwidth** (e.g. data rate, modulation scheme, etc.).

Also the **99% occupied 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%. The operating modes have been taken the maximum data rates, which had been found out at the output power conducted measurements.

5.6.6 Spectrum-Analyzer Settings:

Span	Set as to fully display the emissions and at least 26 dB below the PEAK level
Resolution Bandwidth (RBW)	Set to approx 1%
Video Bandwidth (VBW)	3 times the resolution bandwidth
Sweep time	Coupled and low enough to have no gaps within power envelope
Detector	PK (26 dB BW)/Sample (99% OBW)
Sweep mode	Repetitive Mode, MAX-HOLD

5.6.7 Results:

The results mentioned-below shows only the highest value of each modulation. Please refer at annex 4 all plots.

Set-up no.:			5
Op. Mode:			1
T_{NOM} = 21.4°C V_{NOM} = 3.7V			**26 dB Bandwidth (=B) [MHz]**
Diagram no.'s	34.- 01/03 (a-Mode)	Channels =40/56 (5200/5280 MHz)	22.74
	34.13 (n(20)-Mode)	channel = 40 (5200 MHz)	23.08
	34.29 (n(40)-Mode)	channel = 110 (5550 MHz)	40.14

Remark: See extract of diagrams in separate document A4.

Set-up no.:			5
Op. Mode:			1
T_{NOM} = 21.7°C V_{NOM} = 3.7V			**99% Occupied Bandwidth (=B) [MHz]**
Diagram no.	35.10 (a-Mode)	Channels =56 (5280 MHz)	17.26
	35.12-14 (n(20)-Mode)	channel = 40/56/112 (5200/5280/5560 MHz)	18.03
	35.15/17 (n(40)-Mode)	channel = 38/110 (5190/5550 MHz)	36.30

Remark: See extract of diagrams in separate document A4.

5.7 RF-Parameter - Transmitter Peak output power (conducted and radiated)

5.7.1 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 40	☐ 620 ESU 26	☐	☐
spectr. analys.	☐ 215 FSU	☐ 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 10 dB Attenuator			☒ cable K5		

5.7.2 Reference:

FCC	☒ Part 15 Subpart C, §15.407(a)(1)(2)(3)
IC	☒ RSS-210Issue 8: A9.2 (1)(2)(3)(4)
ANSI	☒ C63.10-2009 for TX-mode
KDB Guidance no.	☒ 789033 D01 General UNII test procedures v01r02': C(3) (e) Method SA-2 Alternative
Limits (For the band 5600–5650 MHz, no operation is permitted)	Lesser of: FCC: 50mW or 4dBm+10log$_{10}$(B) IC: 200mW or 10dBm+10log$_{10}$(B) (U-NII 1: 5.15-5.25 GHz) Lesser of: 250mW or 11dBm+10log$_{10}$(B) (U-NII 2+ extension: 5.25-5.35 GHz + 5.47-5.725 GHz)

Remark: EUT has a duty cycle < 98% and measured acc. guidance no. 789903 thee chapter B(2)(b))

5.7.3 Antenna characteristics:

According §15.407(a)(1)(2):

☒ 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

5.7.4 EUT settings:

For OFDM-systems were 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.

5.7.5 Measurement method:

The measurement was performed in OFDM transmission mode with the carrier selected of each available U-NII band area. The power was also checked for different data rates, modulation scheme or packet types if applicable.

5.7.6 Settings on Spectrum-Analyzer:

Center Frequency	Nominal channel frequency
Span	40/80 MHz
Resolution Bandwidth (RBW)	1 MHz
Video Bandwidth (VBW)	3 MHz
Sweep time	60 s
Detector	RMS, Max hold mode
Sweep Mode	Repetitive mode

5.7.8 Conducted power measurement and EIRP calculation

- Maximum declared antenna according customer has a peak gain [isotropical]: 2.8 dBi at 5 GHz
- Duty cycle and correction factor (please refer at annex 4, chpt. 9):

OFDM/a-Mode 75,67 % => 1.21 dB
OFDM/n(HT20)-Mode 74,52 % => 1.28 dB
OFDM/n(HT40)-Mode 79,23 % => 1.01 dB

Results

	MAX. OUTPUT POWER (conducted and EIRP)			
Set-up no.: 5 & Op-Mode: 1	Diagram no.'s	30.78	30.81	30.93
	Channel	channel = 40 (a-Mode/ 48 Mbps, 5200 MHz)	channel = 40 (n20-Mode/ 6.5 Mbps, 5200 MHz)	channel = 38 (n40-Mode/13.5 Mbps, 5190 MHz)
	(10 dB Attenuator + Cable attenuation excluded)[1)] Average Power -conducted- [dBm]	9.34	8.96	10.29
	Duty cycle corr. factor [dB]	1.21	1.28	1.01
	Resulting average Power (calculated) -conducted- [dBm]	10.55	10.24	**11.30**
	Max. Ant. gain [dBi]	2.8		
	Max. EIRP Resulting (calculated)	13.35 dBm 21.63 mW	13.04 dBm 20.14 mW	**14.10 dBm 25.70 mW**
Limits -conducted- (taken lesser one acc. FCC)		17.00 dBm (50.00 mW)	17.00 dBm (50.00 mW)	17.00 dBm (50.00 mW)
Limits –EIRP- (+ 6 dBi antenna gain)		23 dBm	23 dBm	23 dBm

Remark: 1) The highest results were taken directly from the spectrum analyzer display, the path loss and attenuators were included as reference level offset (TDF) in the spectrum analyzer. Please refer the diagrams at annex 4.

General remark: This measurement are performed to select for other measurements the highest output power related to the data rate except radiated field-strength measurements. For this issue were selected data rates highest, lowest and middle (alternating).

5.7.9 Final verdict: Passed

5.8 RF Parameter – Peak Power Spectral Density (PPSD)

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.	☐ 215 FSU	☐ 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		

5.8.2 References

FCC	☒ Part 15 Subpart C, §15.407(a)(1)(2)(5)
IC	☒ RSS-210Issue 8: A9.2 (1)(2)
ANSI	☒ C63.10-2009 for TX-mode
KDB Guidance no.	☒ 789033 D01 General UNII test procedures v01r02': E
Limits [dBm/MHz]	FCC: U-NII 1:≤ 4 dBm in any 1 MHz band IC: U-NII 1:≤ 10 dBm in any 1 MHz band, U-NII 2+ext.:≤ 11 dBm in any 1 MHz band U-NII 3: ≤ 17 dBm in any 1 MHz band (tested acc. FCC 15.247&RSS-210)*

Remark: *) Please refer test report no. '2-20810461-13-1ab'

5.8.3 EUT settings:

For OFDM-systems were three different channels measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions
And which observed at the measurements for output power conducted.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

5.8.4 Measurement Method:

A frequency sweep around nominal carrier frequency is performed over the complete power envelope. The maximum peak is located and the frequency recorded. With the nominal frequency set to the determined frequency in the step before, a new frequency sweep is performed with a resolution bandwidth of 1 MHz. The measured value is corrected due to external measuring set-up and the resulting value is compared with the standard requirement.

The results mentioned-below shows only the highest value of each modulation. Please refer at annex 4 all plots.

5.8.5 Results

Set-up no.: 5 & Op. Mode: 1	**Peak Power Spectral Density (PPSD)**			
	Diagram no.'s	3.18	3.21	3.25
	Channel	channel = 40 (a-Mode/ 48 Mbps, 5200 MHz)	channel = 40 (n20-Mode/ 6.5 Mbps, 5200 MHz)	channel = 38 (n40-Mode/ 13.5 Mbps, 5190 MHz)
	Measured Level [dBm/MHz]	-1.82	-2.44	-4.13
	Ext. Path loss [dB]+ 10 dB Attenuator+ Cable attenuation	--(Incl. as TDF)*)		
	Duty cycle corr. factor [dB]	1.21	1.28	1.01
	Resulting max. Peak Power spectral density (PPSD) [dBm/MHz]	-0.61	-1.16	-3.12
Limit acc. FCC (worst-case)		≤ 4 dBm/MHz		

Remark: *)The highest results were taken directly from the spectrum analyzer display, the path loss and attenuators were included as transducer factor in the spectrum analyzer. Please refer the plots at annex 4 .

5.8.6 Final verdict: Passed

5.9 RF Parameter - Peak excursion

5.9.1 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.	☐ 215 FSU	☐ 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		

5.9.2 References

FCC	☒ Part 15 Subpart C, §15.407(a)(6)
IC	☐ --
ANSI	☒ C63.10-2009 for TX-mode
KDB Guidance no.	☒ 789033 D01 General UNII test procedures v01r02': F
Limit	≤ 13 dB

5.9.3 EUT settings:
For OFDM-systems were three different channels measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked and selected the highest one according values of output power measurement and data rates which EUT can operate.

5.9.4 Measurement Method:
A frequency sweep around nominal carrier frequency is performed over the complete power envelope of the signal with PEAK detector, MAX hold mode. The maximum peak is located and the frequency recorded. With the nominal frequency set to the determined frequency in the step before, a new frequency sweep is performed with a resolution bandwidth of 1 MHz. The measured value is corrected due to external measuring set-up and the resulting value is compared with the standard requirement. Finally calculated the difference between average (PPSD) to peak-max-hold spectrum of Peak excursion measurement.

The results mentioned-below shows only the highest value of each modulation. Please refer at annex 4 all plots.

5.9.5 Results

	Peak excursion			
Set-up no.: 5 & Op. Mode: 1	Diagram no.	41.01	41.05	41.08
	Channel	channel 40 (5200 MHz, a-Mode)	channel = 56 (5280 MHz, n20-Mode)	channel = 54 (5270 MHz, n40-Mode)
	Measured Level PK [dBm/MHz]	10.42	9.56	6.20
	PPSD (RMS) [dBm/MHz]	-0.61	-1.39	-4.96
	Resulting of max. ratio PK to PPSD [dB]	11.03	10.95	**11.16**
Limit		Difference < 13 dB		

Remark: The results were taken directly from the spectrum analyzer display, the path loss and attenuators were included as transducer factor in the spectrum analyzer. Please refer the diagrams at annex 4.

5.9.6. Final verdcict: Passed

5.10 Measurement uncertainties

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved.
For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it's contribution to the overall uncertainty according it's statistical distribution calculated.

Following table shows expectable uncertainties for each measurement type performed.

RF-Measurement	Frequency range	Calculated uncertainty based on a confidence level of 95%	Remarks:
Power Output conducted	9 kHz .. 20 GHz	1.0 dB	--
Power Output radiated	30 MHz .. 4 GHz	3.17 dB	Substitution method
Conducted emissions on antenna ports	9 kHz .. 20 GHz	1.0 dB	--
Radiated emissions enclosure	150 kHz .. 30 MHz	5.0 dB	Magnetic field
	30 MHz .. 1 GHz	4.2 dB	E-Field
	1 GHz .. 20 GHz	3.17 dB	Substitution method
Occupied bandwidth	9 kHz .. 4 GHz	0.1272 ppm (Delta Marker)	Frequency error
		1.0 dB	Power
Emission bandwidth	9 kHz .. 4 GHz	0.1272 ppm (Delta Marker)	Frequency error
		1.0 dB	Power
Frequency stability	9 kHz .. 20 GHz	0.0636 ppm	--
Conducted emissions on AC-mains port (U_{CISPR})	9 kHz .. 150 kHz	4.0 dB	--
	150 kHz .. 30 MHz	3.6 dB	

Table: measurement uncertainties, valid for conducted/radiated measurements

6. Abbreviations used in this report

The abbreviations	
ANSI	American National Standards Institute
AV or AVG	Average detector
CAV	Average detector
EIRP	Equivalent isotropically radiated power, determined within a separate measurement
EGPRS	Enhanced General Packet Radio Service
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
IC	Industry Canada
n.a.	not applicable
Op-Mode	Operating mode of the equipment
PK	Peak
RBW	resolution bandwidth
RF	Radio frequency
RSS	Radio Standards Specification, Dokuments from Industry Canada
Rx	Receiver
TCH	Traffic channel
Tx	Transmitter
QP	Quasi peak detector
VBW	Video bandwidth
ERP	Effective radiated power

7. Accreditation details of CETECOM's laboratories and test sites

Ref.-No.	Accreditation Certificate	Valid for laboratory area or test site	Accreditation Body
-	D-PL-12047-01-01	All laboratories and test sites of CETECOM GmbH, Essen	DAkkS, Deutsche Akkreditierungsstelle GmbH
337 487 558 348 348	736496	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem.	FCC, Federal Communications Commission Laboratory Division, USA (MRA US-EU 0003)
337 487 550 558	3462D-1 3462D-2 3462D-2 3462D-3	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR)	IC, Industry Canada Certification and Engineering Bureau
337 487 550 348 348	R-2665 R-2666 G-301 C-2914 T-1967	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem.	VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan
OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room			

8. Instruments and Ancillary

8.1. Used equipment "CTC"

The "Ref.-No" in the left column of the following tables allows the clear identification of the laboratory equipment.

8.1.1. Test software and firmware of equipment

Ref.-No.	Equipment	Type	Serial-No.	Version of Firmware or Software during the test
001	EMI Test Receiver	ESS	825132/017	Firm.= 1.21 , OTP=2.0, GRA=2.0
012	Signal Generator (EMS-cond.)	SMY 01	839069/027	Firm.= V 2.02
013	Power Meter (EMS cond.)	NRVD	839111/003	Firm.= V 1.51
017	Digital Radiocommunication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99
053	Audio Analyzer	UPA3	860612/022	Firm. V 4.3
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	Firm.= V 3.1DHG
140	Signal Generator	SMHU	831314/006	Firm.= 3.21
261	Thermal Power Sensor	NRV-Z55	825083/0008	EPROM-Datum 02.12.04, SE EE 1 B
262	Power Meter	NRV-S	825770/0010	Firm.= 2.6
263	Signal Generator	SMP 04	826190/0007	Firm.=3.21
264	Spectrum Analyzer	FSEK 30	826939/005	Bios=2.1, Analyzer= 3.20
295	Racal Digital Radio Test Set	6103	1572	UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02
298	Univ. Radio Communication Tester	CMU 200	832221/091	R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used
323	Digital Radiocommunication Tester	CMD 55	825878/0034	Firm.= 3.52 .22.01.99
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	TSI 1.53
335	CTC-EMS-Conducted	System EMS Conducted	-	EMC 32 V 8.52
340	Digital Radiocommunication Tester	CMD 55	849709/037	Firm.= 3.52 .22.01.99
355	Power Meter	URV 5	891310/027	Firm.= 1.31
365	10V Insertion Unit 50 Ohm	URV5-Z2	100880	Eprom Data = 31.03.08
366	Ultra Compact Simulator	UCS 500 M4	V0531100594	Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10
371	Bluetooth Tester	CBT32	100153	CBT V5,30+ SW-Option K55, K57
377	EMI Test Receiver	ESCS 30	100160	Firm.= 2.30, OTP= 02.01, GRA= 02.36
378	Broadband RF Field Monitor	RadiSense III	03D00013SNO-08	Firm.= V.03D13
383	Signal Generator	SME 03	842 828 /034	Firm.= 4.61
389	Digital Multimeter	Keithley 2000	0583926	Firm. = A13 (Mainboard) A02 (Display)
392	Radio Communication Tester	MT8820A	6K00000788	Firm.= 4.50 #005, IPL=4.01#001,OS=4.02#001, GSM=4.41#013, W-CDMA= 4.54#004, scenario= 4.52#002
436	Univ. Radio Communication Tester	CMU 200	103083	R&S Test Firmware Base=5.14, Mess-Software= GSM:5.14 WCDMA:5.14 (current Testsoftw. F. all band
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR)	-	EMC 32 Version 8.52
442	CTC-SAR-EMS	System EMS field (SAR)	-	EMC 32 Version 8.40
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	Spuri 7.2.5 or EMC 32 Ver. 8.53
444	CTC-FAR-EMS field	System-EMS-Field (FAR)	-	EMC 32 Version 8.40
460	Univ. Radio Communication Tester	CMU 200	108901	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used,
489	EMI Test Receiver	ESU40	1000-30	Firmware=4.43 SP3, Bios=V5.1-16-3, Spec. =01.00
491	ESD Simulator dito	ESD dito	dito307022	V 2.30
524	Voltage Drop Simulator	VDS 200	0196-16	Software Nr: 000037 Version V4.20a01
526	Burst Generator	EFT 200 A	0496-06	Software Nr. 000034 Version V2.32
527	Micro Pulse Generator	MPG 200 B	0496-05	Software-Nr. 000030 Version V2.43
528	Load Dump Simulator	LD 200B	0496-06	Software-Nr. 000031 Version V2.35a01
546	Univ. Radio Communication Tester	CMU 200	106436	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used
547	Univ. Radio Communication Tester	CMU 200	835390/014	R&S Test Firmware Base=V5.1403 (current Testsoftw., f. all band used, GSM = 5.14 WCDMA: = 5.14
584	Spectrum Analyzer	FSU 8	100248	2.82_SP3
594	Wideband Radio Communication Tester	CMW500	101757	Firmware Base=2.0.20.9, LTE=2.0.20.8. CDMA= 2.0.10
597	Univ. Radio Communication Tester	CMU 200	100347	R&S Test Firmware Base=5.01, GSM=5.02 WCDMA= not installed, Mainboard= µP1=V.850
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Firmware Bios 3.40 , Analyzer 3.40 Sp 2
620	EMI Test Receiver	ESU 26	100362	4.43_SP3
642	Wideband Radio Communication Tester	CMW 500	126089	

8.1.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
001	EMI Test Receiver	ESS	825132/017	Rohde & Schwarz	12 M	-	31.03.2013
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	24/12 M	-	31.03.2014
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	24/12 M	-	31.03.2014
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	31.03.2013
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	31.03.2013
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.03.2013
021	Loop Antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	31.03.2015
030	Loop Antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	31.03.2015
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	31.03.2013
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	pre-m	1a	
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-10EEK	5	Wainwright GmbH	12 M	1g	30.06.2013
086	DC - power supply, 0 -10 A	LNG 50-10	-	Heinzinger Electronic	pre-m	2	
087	DC - power supply, 0 -5 A	EA-3013 S	-	Elektro Automatik	pre-m	2	
090	Helmholtz coil: 2x10 coils in series	-	-	RWTÜV	-	4	
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba	-	4	
099	passive voltage probe	ESH2-Z3	299.7810.52	Rohde & Schwarz	36 M	-	31.03.2015
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	31.03.2015
110	USB-LWL-Converter	OLS-1	-	Ing. Büro Scheiba	-	4	
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	BOCONSULT	36 M	-	31.03.2013
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO	12 M	-	31.03.2014
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO	36 M	-	31.03.2015
140	Signal Generator	SMHU	831314/006	Rohde & Schwarz	24 M	-	31.03.2014
248	attenuator	SMA 6dB 2W	-	Radiall	pre-m	2	
249	attenuator	SMA 10dB 10W	-	Radiall	pre-m	2	
252	attenuator	N 6dB 12W	-	Radiall	pre-m	2	
256	attenuator	SMA 3dB 2W	-	Radiall	pre-m	2	
257	hybrid	4031C	04491	Narda	pre-m	2	
260	hybrid coupler	4032C	11342	Narda	pre-m	2	
261	Thermal Power Sensor	NRV-Z55	825083/0008	Rohde & Schwarz	24 M	-	31.03.2014
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	31.03.2014
263	Signal Generator	SMP 04	826190/0007	Rohde & Schwarz	36 M	-	31.03.2013
264	Spectrum Analyzer	FSEK 30	826939/005	Rohde & Schwarz	12 M	-	31.03.2013
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	31.03.2014
266	peak power sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	31.03.2014
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH	pre-m	2	
270	termination	1418 N	BB6935	Weinschel	pre-m	2	
271	termination	1418 N	BE6384	Weinschel	pre-m	2	
272	attenuator (20 dB) 50 W	Model 47	BF6239	Weinschel	pre-m	2	
273	attenuator (10 dB) 100 W	Model 48	BF9229	Weinschel	pre-m	2	
274	attenuator (10 dB) 50 W	Model 47 (10 dB) 50 W	BG0321	Weinschel	pre-m	2	
275	DC-Block	Model 7003 (N)	C5129	Weinschel	pre-m	2	
276	DC-Block	Model 7006 (SMA)	C7061	Weinschel	pre-m	2	
279	power divider	1515 (SMA)	LH855	Weinschel	pre-m	2	
287	pre-amplifier 25MHz - 4GHz	AMF-2D-100M4G-35-10P	379418	Miteq	12 M	1c	30.06.2013
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	1c	30.06.2013
298	Univ. Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	pre-m	3	
300	AC LISN (50 Ohm/50µH, 1-phase)	ESH3-Z5	892 239/020	Rohde & Schwarz	24/12 M	-	31.03.2014
301	attenuator (20 dB) 50W, 18GHz	47-20-33	AW0272	Lucas Weinschel	pre-m	2	
302	horn antenna 40 GHz (Meas 1)	BBHA9170	155	Schwarzbeck	36 M	-	31.03.2014
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	31.03.2014
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	Heraeus Vötsch	24 M	-	30.11.2013
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	31.03.2014
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	31.03.2013
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	
354	DC - Power Supply 40A	NGPE 40/40	448	Rohde & Schwarz	pre-m	2	
355	Power Meter	URV 5	891310/027	Rohde & Schwarz	24 M	-	31.03.2014
356	power sensor	NRV-Z1	882322/014	Rohde & Schwarz	24 M	-	31.03.2013
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	31.03.2013
371	Bluetooth Tester	CBT32	100153	R&S	12 M	-	31.03.2013
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	24/12 M	-	31.03.2014
376	Horn Antenna 6 GHz	BBHA9120 E	BBHA 9120 E 179	Schwarzbeck	12 M	-	31.03.2013
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	31.03.2013
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	31.03.2013
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	31.03.2013
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	31.03.2013
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR) Cable	-	CETECOM	12 M	5	31.10.2013

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	30.06.2013
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-	5	Wainwright Instruments GmbH	12 M	1c	30.06.2013
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-8SSK	1	Wainwright	12 M	1c	30.06.2013
454	Oscilloscope	HM 205-3	9210 P 29661	Hameg	-	4	
456	DC-Power supply 0-5 A	EA 3013 S	207810	Elektro Automatik	pre-m	2	
459	DC -Power supply 0-5 A , 0-32 V	EA-PS 2032-50	910722	Elektro Automatik	pre-m	2	
460	Univ. Radio Communication Tester	CMU 200	108901	Rohde & Schwarz	12 M	-	31.03.2013
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	31.03.2014
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	24 M	-	31.03.2014
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	24 M	-	31.03.2014
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
480	power meter (Fula)	NRVS	838392/031	Rohde & Schwarz	24 M	-	31.03.2013
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Brl)	-	1d	
484	pre-amplifier 2,5 - 18 GHz	AMF-5D-02501800-25-10P	1244554	Miteq	12 M	-	30.06.2013
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	30.09.2013
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	31.03.2013
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-	SN 5	Wainwright	pre-m	2	
512	notch filter GSM 850	WRCA 800/960-02/40-6EEK	SN 24	Wainwrght	12 M	1c	30.06.2013
517	relais switch matrix	HF Relais Box Keithley	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	31.03.2013
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel	pre-m	2	
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-	pre-m	2	
546	Univ. Radio Communication Tester	CMU 200	106436	R&S	12 M	-	31.03.2013
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	31.03.2013
548	Digital-Barometer	GBP 2300	without	Greisinger GmbH	36 M	-	30.06.2015
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.03.2015
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainwright	12 M	1c	30.06.2013
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	31.07.2013
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	30.03.2013
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	12 M	-	31.03.2013
594	Wideband Radio Communication Tester	CMW500	101757	Rohde & Schwarz	24 M	-	31.03.2014
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	12 M	-	31.03.2013
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Rohde & Schwarz	24 M	-	13.01.2014
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	31.03.2013
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	12.01.2014
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	12.01.2014
608	UltraLog-Antenna	HL 562	830547/009	Rohde & Schwarz	36/12 M	-	31.03.2014
611	DC power supply	E3632A	KR 75305854	Agilent	pre-m	2	
612	DC power supply	E3632A	MY 40001321	Agilent	pre-m	2	
613	Attenuator	R416120000 20dB 10W	Lot. 9828	Radiall	pre-m	2	
616	Digitalmultimeter	Fluke 177	88900339	Fluke	24 M	-	31.03.2014
617	Power Splitter/Combiner	ZFSC-2-2-S+	S F987001108	Mini Circuits	-	2	
618	Power Splitter/Combiner	50PD-634	600994	JFW Industries USA	-	2	
619	Power Splitter/Combiner	50PD-634	600995	JFW Industries, USA	-	3	
620	EMI Test Receiver	ESU 26	100362	Rohde-Schwarz	12 M	-	01.01.2014
621	Step Attenuator 0-139 dB	RSP	100017	Rohde & Schwarz	pre-m	2	
625	Generic Test Load USB	Generic Test Load USB	-	CETECOM	-	2	
627	data logger	OPUS 1	201.0999.9302.6.4.1.43	G. Lufft GmbH	24 M	-	30.05.2014
634	Spectrum Analyzer	FSM (HF-Unit)	826188/010	Rohde & Schwarz	pre-m	2	
636	Wärmebildkamera	Ti32	Ti32-12060213, Tele	Fluke Corporation	24 M	-	31.07.2014
637	High Speed HDMI with Ethernet 1m	HDMI cable with Ethernet 1m	-	KogiLink	-	2	
638	HDMI Kabel with Ethernet 1,5 m flach	HDMI cable with Ethernet	-	Reichelt	-	2	
640	HDMI cable 2m rund	HDMI cable 2m rund	-	Reichelt	-	2	
641	HDMI cable with Ethernet	Certified HDMI cable with	-	PureLink	-	2	
642	Wideband Radio Communication Tester	CMW 500	126089	Rohde&Schwarz	24 M	-	31.03.2014

8.1.3. Legend

Note / remarks		Calibrated during system calibration:
	1a	System CTC-SAR-EMS (Ref.-No. 442)
	1b	System-CTC-EMS-Conducted (Ref.-No. 335)
	1c	System CTC-FAR-EMI-RSE (Ref.-No . 443)
	1d	System CTC-SAR-EMI (Ref.-No . 441)
	1e	System CTC-OATS (EMI radiated) (Ref.-No. 337)
	1 f	System CTC-CTIA-OTA (Ref.-No . 420)
	1 g	System CTC-FAR-EMS (Ref.-No . 444)
	2	Calibration or equipment check immediately before measurement
	3	Regulatory maintained equipment for functional check or support purpose
	4	Ancillary equipment without calibration e.g. mechanical equipment or monitoring equipment
	5	Test System

Interval of calibration	12 M	12 month
	24 M	24 month
	36 M	36 month
	24/12 M	Calibration every 24 months, between this every 12 months internal validation
	36/12 M	Calibration every 36 months, between this every 12 months internal validation
	Pre-m	Check before starting the measurement
	-	Without calibration