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

According to:
FCC Regulations
Part 15.209, 15.207,
Part 15.247

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, b, g, n (HT20 & HT40) Modes (2.4/ 5.8 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			

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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 presented Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies with WLAN technology and operating frequency ranges at 2.412 to 2.462 GHz and 5.725 to 5.850 GHz according to IEEE802.11 a/b/g/n.
Other implemented wireless technologies were not considered within this test report.

Following test cases have been performed to show compliance with valid Part 15.207/15.209/15.247 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 opera-ting 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	FCC §15.107 class B limits §15.207 limits IC: Table 4, Chapter 7.2.4	1	2	passed
6 dB bandwidth	Antenna terminal (conducted)	§15.247(a)(2)	RSS-210 Issue 8: A8.2 (a) RSS-Gen Issue 3: Chapter 4.6.2	≥ 500 kHz for DTS systems	5	1	passed
99% occupied bandwidth	Antenna terminal (conducted)	--	RSS-Gen Issue 3: Chapter 4.6.1	99% Power bandwidth	5	1	No pass & fail criteria
Transmitter Peak output power	Antenna terminal (conducted)	§15.247(b)(3)	RSS-210 Issue 8: A8.4 (4)	1 Watt Peak	5	1	passed
Transmitter Peak output power radiated	Cabinet (radiated)	§15.247(b)(4)	RSS-210 Issue 8:A8.4 (4)	< 4 Watt (EIRP) for antenna with directional gain less 6dBi	5	1	passed
Out-Of-Band RF- emissions Band-Edge emissions	Antenna terminal (conducted)	§15.247 (d)	RSS-210 Issue 8: A8.5	20 dBc	5	1	passed
Power spectral density	Antenna terminal (conducted)	§15.247(e)	RSS-210 Issue 8: A8.2 (b)	8dBm in any 3 kHz band	5	1	passed
Duty-Cycle	Antenna terminal (conducted)	--	--	--	5	1	No pass & fail criteria
General field strength emissions + restricted bands	Cabinet + Inter-connecting 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	2+3+4	1	passed

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	1)	1)	Passed[1)]

General remark: KDB558074 D01 DTS Meas Guidance v02 (10/04/2012) for operating under §15.247.
1.) 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

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45219 Essen
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.....
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:	2013-03-14
---	---
Version of template: 12.11 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	Tablet with integrated IEEE 802.11a/b/g/n W-LAN Transceiver		
Type	TS-0000-BV		
Frequency range (US/Canada -bands)	2412 MHz (Channel 1) to 2462 MHz (Channel 11), U-NII/ISM: 5725 to 5850 MHz (Channels 149 – 165)		
Type of modulation	See chapter 3.2		
Number of channels (USA/Canada -bands)	1 to 11 149 to 165		
Antenna Type	☒ Integrated ☐ External, no RF- connector ☐ External, separate RF-connector		
Antenna Gain	Max. 1.9 dBi gain according applicants information in 2.4 GHz band		
Transmitter spurious radiated: (worst case)	36.88 dBµV/m@3m distance on channel 1 (1 Mbps) at 641.56 MHz		
FCC-ID	PY7TS-0000		
IC	4170B-TS0000		
Installed options	☐ GSM 850 and GSM 1900 Bands ☐ W-CDMA Band II and Band V ☒ RFID, Bluetooth® ☒ FM Radio ☒ GPS		
Power supply	☒ Internal battery Li-Io, range 3.3V to 4.1V ☒ over AC/DC adapter: 120V/60 Hz ☒ DC power only: nominal 3.7 V		
Special EMI components	--		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
FCC label attached	☐ yes	☒ no	

3.2. 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**b**-Mode (DSSS System)		
Data rate [MBps]	Modulation type	Supported by EUT
1	DBPSK (Differential binary phase shift keying)	YES
2	DQPSK (Differential quadrature phase shift keying)	YES
5.5 / 11	CCK/PBCC (8-chip complementary code keying)	YES
22	ERP-PBCC (Packet binary convolutional coding)	NO

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

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

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

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

3.3. 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	Tablet PC[1)]	Type TS-0000-BV	CB5A1N1KVK	AP1	ATPV:1267-7120, s_atp_pollux_windy_0_0_32_3_g_wlan
EUT B	Tablet PC[1)]	Type TS-0000-BV	CB5A1N1KWT	AP1	
EUT C	Tablet PC[1)]	Type TS-0000-BV	CB5A1N1KP1	AP1	
EUT D	Tablet PC[1)]	Type TS-0000-BV	CB5A1N1KYJ	AP1	
EUT E	Tablet PC[1)]	Type TS-0000-BV	CB5A1NL15	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.

3.4. 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	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	Head-Set PHF	AG-0500	#226167	AP1.1	-
AE 4	D-Link Access-Point	DAP-2553	CTC#1	--	--
AE 5	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.

3.5. EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
Set. 1	EUT E + AE1 + AE 2 + AE 3 + AE 4	Set-up for EMI-AC Power lines measurement
Set. 2	EUT A + AE 1 + AE 2	Set-up for radiated EMI measurements with accessories (30 MHz – 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: The internal battery of EUT discharges itself several times. Therefore were used several set-up's

3.6. 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 5). 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).
op. 2	WLAN TX Traffic link	A traffic link as slave was established to an master access-point. The settings were set from the web-control page of the access-point.

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

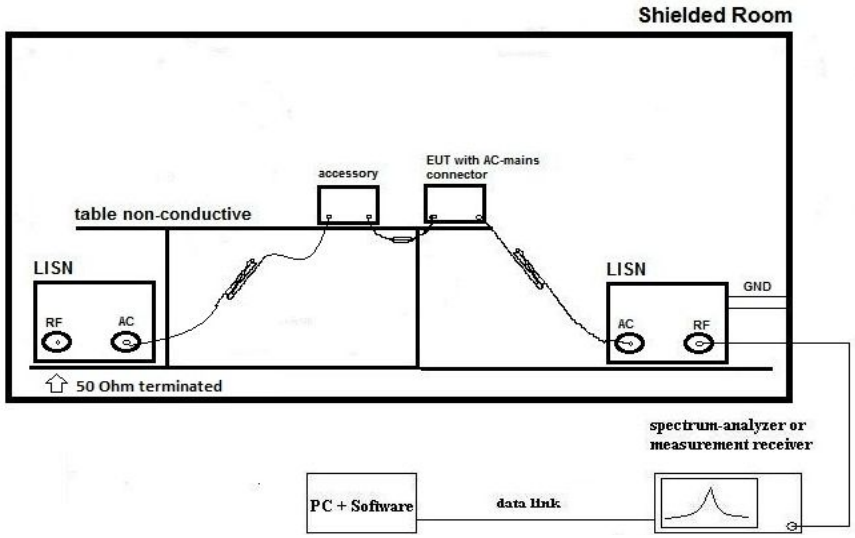
4. Description of test system set-up's

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.

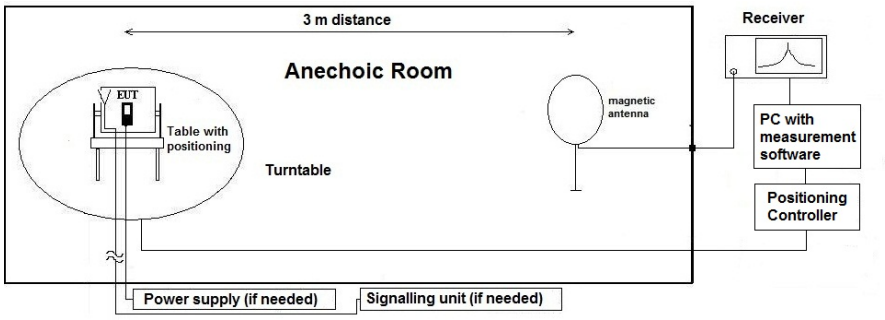
4.2. Test system set-up for radiated magnetic field measurements below 30 MHz

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

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

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter "General Limit - Radiated field strength emissions below 30 MHz". The tests are performed in the semi anechoic room recognized by the regulatory commission.

Schematic:



Testing method:

Exploratory, preliminary measurement
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 was recorded. The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

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

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

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

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

Formula:

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

$M = L_T - E_C$

AF =Antenna factor
C_L = Cable loss
D_F= Distance correction factor
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.

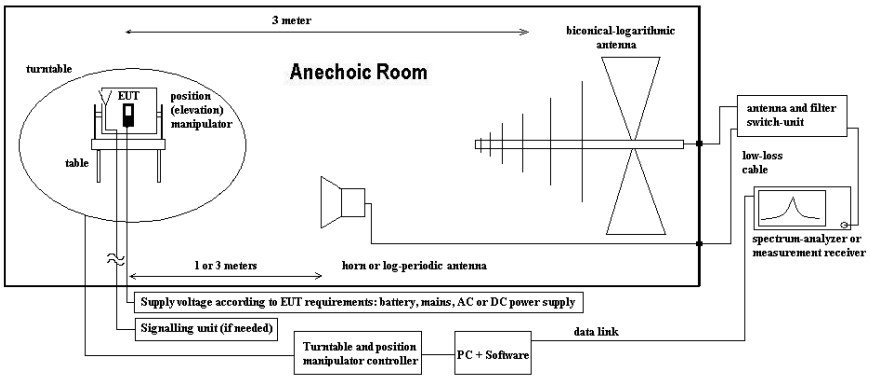
Distance correction: Reference for applied correction (extrapolating) factors:
IEEC Transaction EMC, Vol. 47, No. 3 , Aug. 2005, Journal Paper
"*Extrapolating Near-field emissions of low frequency loop transmitters*".

4.3. Test system set-up for radiated electric field measurement 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:

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

$M = L_T - E_C$ (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

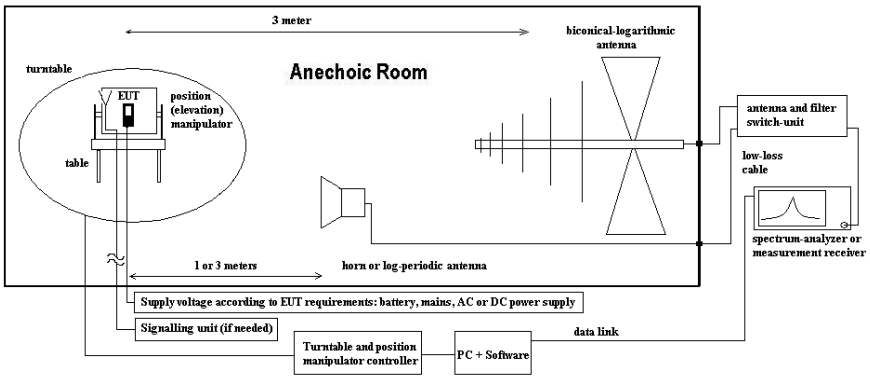
All units are dB-units, positive margin means value is below limit.

4.4. Test system set-up for radiated 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)

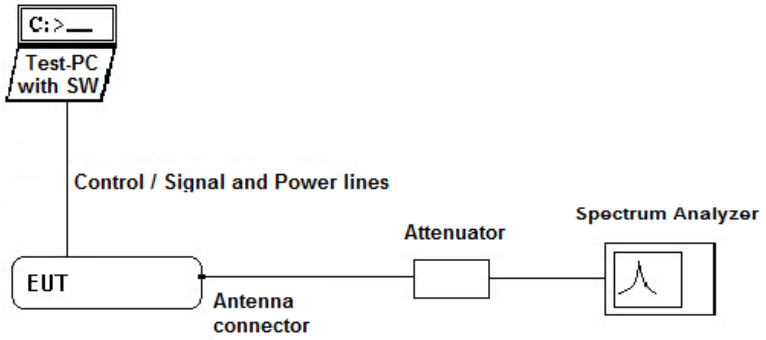
All units are dB-units, positive margin means value is below limit.
For measurement above 18 GHz used distance correction factor -9.54 dB

4.5. Test system set-up for conducted RF-measurement at antenna port

Specification: ANSI C63.10-2009

General Description: In order to avoid overload, the EUT's RF-signal is first attenuated before it is connected to the spectrum – analyzer. The specific attenuation is determined prior to the measurement within a set-up calibration. The value is taken into account by correcting the measurement readings on the spectrum-analyzer either by a transducer factor (TDF) or an relative offset to reference level.

Schematic:



Testing method: According to ANSI C63.10-2009 for each individual test, see details in each chapter.

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 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 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:		
EMI-Receiver or Analyzer settings – 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 performed 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 2	☒ Peak ☒ CAV ☒ QP	L1/ N	WLAN_g_Mode (due to uncritical measurement result (Margin>15 dB) no further operating mode tested)	passed

Remarks: For more information please see the diagrams at annex4.

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

5.2.1. 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	☒ 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	☐ 594 CMW		
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		☒ 060 120 V 60 Hz via PAS 5000			

5.2.2. Requirements

FCC	Part 15, Subpart C, §15.205 & §15.209			
IC	RSS-Gen., Issue 3			
ANSI	C63.10-2009			
Frequency [MHz]	Field strength limit [µV/m]	[dBµV/m]	Distance [m]	Remarks
0.009 – 0.490	2400/f (kHz)	67.6 – 20Log(f) (kHz)	300	Correction factor used due to measurement distance of 3 m
0.490 – 1.705	24000/f (kHz)	87.6 – 20Log(f) (kHz)	30	Correction factor used due to measurement distance of 3 m
1.705 – 30	30	29.5	30	Correction factor used due to measurement distance of 3 m

5.2.3. Test condition and test set-up

link to signalling system (if used):		☐ air link	☐ cable connection	☒ none
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 or Analyzer Settings	Scan data	☒ 9 – 150 kHz RBW/VBW = 200 Hz Scan step = 80 Hz ☒ 150 kHz – 30 MHz RBW/VBW = 9 kHz Scan step = 4 kHz ☐ other:		
	Scan-Mode Detector Mode: Sweep-Time	☒ 6 dB EMI-Receiver Mode ☐ 3dB Spectrum analyser Mode Peak (pre-measurement) and Quasi-PK/Average (final if applicable) Repetitive-Scan, max-hold Coupled – calibrated display if continuous signal otherwise adapted to EUT's individual transmission duty-cycle		
General measurement procedures		Please see chapter "Test system set-up radiated magnetic field measurements below 30 MHz"		

5.2.4. Measurement Results

Table of measurement results:

Diagram No.	Carrier Channel Range	Carrier Channel No.	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector PK	AV	QP	Result
02.01 (b-Mode)	Middle	6	9 kHz-30 MHz	2	1	No critical peaks detected	☒	☐	☐	passed
02.02 (g-Mode)	Middle	6	9 kHz-30 MHz				☒	☐	☐	passed
02.03 (n(20)-Mode)	Middle	6	9 kHz-30 MHz				☒	☐	☐	passed
02.07 (n(40)-Mode)	Middle	157	9 kHz-30 MHz				☒	☐	☐	passed

Remark: For more information please see the diagrams at annex4.

General remark: 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.

5.2.5. 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. 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		☒ 060 120 V 60 Hz via PAS 5000			

5.3.2. Requirements/Limits

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 ☒ C63.10-2009	
KDB Guidance no.		☒ 558074 D01 DTS Meas Guidance v02 (04-10-2012) for operating under §15.247: chapters 10.2 and 10.2.3	
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	49.0

Remark: 1.) Conversion formula between EIRP and field strength: E[dBµV/m]=EIRP[dBm]-95.2 for measurement distance of 3m (Guidance no. 558074 D01 DTS Meas Guidance v02)
2.) For practical reasons for measurements below 1 GHz only the stricter limit of §15.209 is visible.

5.3.3. 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			

5.3.4. Test condition and measurement test set-up

link to test system (if used):		☐ air link	☐ cable connection	☒ none
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	☒ 6 dB EMI-Receiver Mode ☐ 3 dB 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 measurement in the range 30 MHz to 1 GHz"		

5.3.5. MEASUREMENT RESULTS

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

Table of measurement results:

Dia-gram no.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
03.01_1	Low	1	30 MHz – 1 GHz	2	1	b-Mode	☒	☐	☒	passed
03.01_2	Middle	6				"	☒	☐	☒	passed
03.01_3	High	11				"	☒	☐	☐	passed
03.02_1	Low	1				g-Mode	☒	☐	☐	passed
03.02_2	Middle	6				"	☒	☐	☒	passed
03.02_3	High	11				"	☒	☐	☐	passed
03.03_1	Low	1				n(HT20)-Mode	☒	☐	☐	passed
03.03_2	Middle	6				"	☒	☐	☐	passed
03.03_3	High	11				"	☒	☐	☐	passed
03.06_1	Low	151				n(HT40)-Mode	☒	☐	☒	passed
03.06_2	Middle	159				"	☒	☐	☐	passed
--	High	--	--	--	--	N.A. for n(HT40)-Mode	☐	☐	☐	--

Remark: N.A. = Not Available according applicant

5.4. General Limit - Radiated field strength emissions, above 1 GHz

5.4.1. Test location and equipment FAR

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 40	☐	☐
antenna meas	☐ 574 BTA-L	☐ 289 CBL 6141	☒ 608 HL 562	☒ 549 HL025	☐ 302 BBHA9170	☐ 477 GPS
multimeter	☒ 341 Fluke 112	☐	☐	☐	☐	☐
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 120 V 60 Hz via PAS 5000			

5.4.2. Requirements/Limits

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 ☒ C63.10-2009			
KDB Guidance no.	☒ 558074 D01 DTS Meas Guidance v02 (04-10-2012) for operating under §15.247: chapters 10.2 and 10.2.3			
Frequency [MHz]	Limits, 3 meters			
	AV [µV/m]	AV [dBµV/m]	Peak [µV/m]	Peak [dBµV/m]
above 1 GHz	500	54.0	5000	74.0

5.4.3. 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
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:	☒ 1 – 18 GHz ☒ 18 – 25 GHz ☒ 18 – 40 GHz ☐ other:	
	Scan-Mode	☐ 6 dB EMI-Receiver Mode ☒ 3 dB Spectrum analyser Mode	
	Detector	Peak and Average	
	RBW/VBW	1 MHz / 3 MHz	
	Mode:	Repetitive-Scan, max-hold	
	Scan step	400 kHz	
	Sweep-Time	Coupled – calibrated display if CW signal otherwise adapted to EUT's individual duty-cycle	
General measurement procedures		Please see chapter "Test system set-up for radiated electric field measurements above 1 GHz"	

5.4.4. Measurement Results

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

Diagram no.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
04.01-1	Low	1	1-18 GHz	2	1	b-Mode	☒	☒	☐	passed
04.01-2	Middle	6				"	☒	☒	☐	passed
04.01-3	High	11				"	☒	☒	☐	passed
04.02-1	Low	1				g-Mode	☒	☒	☐	passed
04.02-2	Middle	6				"	☒	☒	☐	passed
04.02-3	High	11				"	☒	☒	☐	passed
04.03-1	Low	1				n(HT20)-Mode	☒	☒	☐	passed
04.03-2	Middle	6				"	☒	☒	☐	passed
04.03-3	High	11				"	☒	☒	☐	passed
04.07a-1	Low	151	1-7 GHz	3		n(HT40)-Mode	☒	☒	☐	passed
04.07a-2	High	159	1-7 GHz			"	☒	☒	☐	passed
04.07b-1	Low	151	7-18 GHz	2		"	☒	☒	☐	passed
04.07b-2	Middle	159	7-18 GHz			"	☒	☒	☐	passed
--	High	--	--	--	--	N.A. for n(HT40)-Mode	☐	☐	☐	--
04.01-4	Low	1	18-25 GHz	4	1	b-Mode	☒	☒	☐	passed
04.02-4	Middle	6				g-Mode	☒	☒	☐	passed
04.03-4	High	11				n(HT20)-Mode	☒	☒	☐	passed
04.07-2	Middle	159				n(HT40)-Mode	☒	☒	☐	passed
04.07-3	Low	151				"	☒	☒	☐	passed
--	High	--	--	--	--	N.A. for n(HT40)-Mode	☐	☐	☐	--

Remark: N.A. = Not available according applicant

5.5. RF-Parameter - Radiated 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)		☐ 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	☐ 371 CBT32			☐ cable K4	☐ cable K5	

5.5.2. Requirements

FCC	☒ §15.205 (a) ☒ §15.209 (a) ☒ §15.247 (d)
IC	☒ RSS-Gen, Issue 3, §7.2.2
KDB Guidance	☒ 558074 D01 DTS Meas Guidance v02 (04-10-2012) for operating under §15.247: chapter 10.2.5

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 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.

5.5.4. EUT settings

The EUT was instructed to send with maximum power according to measurements of max. conducted power.

5.5.5. Measurements results:

Set-up: 2 Op. Mode: 1							
Tnom= 21°C Vnom= 3.7 V		Delta Marker Value	Fundamental field strength-radiated	Subtraction: Fund. field strength – Delta value	Value at Band-Edge	Limit	Result
Diagram No.	Channel No.	[dB]	[dBµV/m]	[dBc]	[dBµV/m]		
9.01_...	Low 1 (b-Mode)	99.03 (PK_h) -51.37(PK_l) = 47.66	104.3 (PK) 96.0 (AV)	104.3(PK) - 47.66 = 56.64	--	>20dBc	passed
9.02_...	High 11 (b-Mode)	95.04 (PK_h) -43.22(PK_l) = 51.81	105.4 (PK) 96.6 (AV)	104.3(PK) -51.81 = >	53.59(PK)	74 dBµV/m	passed
				96.0 (AV) -51.81 =>	44.79(AV)	54 dBµV/m	passed
9.03_...	Low 1 (g-Mode)	97.04 (PK_h) -60.98 (PK_l) = 36.06	104.2 (PK) 93.6 (AV	104.2(PK)-36.06= 68.14	--	>20dBc	passed

Set-up: 2 Op. Mode: 1							
Tnom= 21°C Vnom= 3.7 V		Delta Marker Value	Fundamental field strength-radiated	Subtraction: Fund. field strength – Delta value	Value at Band-Edge	Limit	Result
Diagram No.	Channel No.	[dB]	[dBµV/m]	[dBc]	[dBµV/m]		
9.04_...	High 11 (g-Mode)	92.5 (PK_h) -45.24 (PK_l) =47.26	104.4 (PK) 93.1 (AV)	104.4 (PK)-47.26=> 93.1 (AV) -47.26 =>	57.14 45.84	74 dBµV/m 54 dBµV/m	passed
9.05_...	Low 1 (n-Mode)	95.01 (PK_h) -57.80 (PK_l) =37.21	104.4 (PK) 93.1 (AV)	104.4 (PK)-37.21=> 93.1 (AV) -37.21 =>	65.69 53.19	74 dBµV/m 54 dBµV/m	passed
9.06_...	High 11 (n-Mode)	93.31 (PK_h) -46.60 (PK_l) =46.71	102.7 (PK) 91.5 (AV)	102.7 (PK)-46.71=> 91.5 (AV) -46.71 =>	55.99 44.79	74 dBµV/m 54 dBµV/m	passed
9.07_...	Low 149 (n(20)-Mode)	95.31 (PK_h) -58.93(PK_l) = 36.38	105.4 (PK) 93.2 (AV)	105.4(PK) - 36.38 = 69.02	--	>20dBc	passed
9.08_...	High 165 (n(20)-Mode)	92.89 (PK_h) -48.92(PK_l) = 43.91	101.5 (PK) 88.6 (AV)	101.5(PK) - 43.91 = 57.59	--	>20dBc	passed
9.09_...	Low 151 (n(40)-Mode)	91.82 (PK_h) -59.11(PK_l) = 32.71	101.7 (PK) 90.8 (AV)	101.7(PK) - 32.71 = 68.99	--	>20dBc	passed
9.10_...	Middle 159 (n(40)-Mode)	91.94 (PK_h) -59.8 (PK_l) = 32.14	99.2 (PK) 87.8 (AV)	99.2 (PK) - 32.14 = 67.06	--	>20dBc	passed

5.5.6. Final Test results: Passed

5.6. RF-Parameter - 6 dB Bandwidth and 99% occupied Bandwith

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		☐ 060 110 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. Reference

FCC	☒ §15.247(a) (2)
IC	☒ RSS-210:A8.2
ANSI	☐ -
KDB Guidance no.	☒ 558074 D01 DTS Meas Guidance v02 (04-10-2012) for operating under §15.247: chapters 2.0 &7.0

5.6.4. EUT Settings:

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.

5.6.5. Measurement method:

The measurement was performed with the RBW set to 100 kHz. 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 max. TX-power data rate 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%.

5.6.6. Spectrum-Analyzer Settings:

Span	Set as to fully display the emissions and at least 6 dB 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	PK (6 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.

6dB Bandwidth:

Set-up no.: 5 Op. Mode: 1	**6dB Bandwidth [MHz]**		
T_{NOM} =21°C, V_{NOM} = 3.7V	Low channel = 1 (2412 MHz)	Middle channel = 6 (2437 MHz)	High channel = 11 (2462 MHz)
Maximum value for CCK/PBCC Modulation (b-Mode)	**9.35 (2Mbps)**	1)	1)
Maximum value for BPSK Modulation (g-mode)	1)	**16.53 (54Mbps)**	**16.53 (12Mbps)**
Maximum value for OFDM Modulation (n-Mode)	1)	**17.83 (65Mbps)**	1)
	Low channel = 149 (5745 MHz)	Middle channel = 157 (5785 MHz)	High channel = 165 (5825 MHz)
Maximum value for OFDM Modulation (a-Mode)	1)	**16.52 (9 Mbps)**	1)
Maximum value for OFDM Modulation (n(HT20)-Mode)	**17.74 (26/52/65 Mbps)**	**17.74 (26/52/65 Mbps)**	**17.74 (19.5/39/58.5 Mbps)**
	Low channel = 151 (5755 MHz)	Middle channel = 159 (5795 MHz)	
Maximum value for OFDM Modulation (n(HT40)--Mode)	**36.14 (54 Mbps)**	**36.88 (121.5 Mbps)**	N.A.

Remark: 1.) Please see extract of plots and results for different modulation types(Data rates) in separate document at annex4.

Conclusion: 6 dB bandwidth is bigger than 500 kHz so tests according Part 15.247 should apply for this wireless technology.

99% Occupied bandwidth:

Set-up no.: 5 Op. Mode: 1	**Max. 99% Bandwidth[1)] [MHz]**		
T_{NOM} =21°C, V_{NOM} = 3.7V	Low channel = 1 (2412 MHz)	Middle channel = 6 (2437 MHz)	High channel = 11 (2462 MHz)
Maximum value for CCK/PBCC Modul.11Mbps	**12.93**	N.R.(not required)	1)
Maximum value for BPSK Modulation 24Mbps	**17.02**	N.R.	1)
Maximum value for n-Mode 26Mbps	**18.17**	N.R.	1)
	Low channel = 149 (5745 MHz)	Middle channel = 157 (5785 MHz)	High channel = 165 (5825 MHz)
Maximum value for OFDM Modul. (a-Mode) 12Mbps	1)	N.R.	**17.16**
Maximum value for OFDM Modulation(n(HT20)-Mode) (52/19.5 Mbps)	**18.03**	N.R.	**18.03**
	Low channel = 151 (5755 MHz)	Middle channel = 159 (5795 MHz)	
Maximum value for OFDM Modulation(n(HT40)-Mode) 108 Mbps	**36.28**	N.R.	N.A.(not available)

Remark: 1.) maximum 99% occupied bandwidth values are presented. Please see all plots at annex 4.

5.7. RF-Parameter - RF Power Conducted and Radiated (EIRP)

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	☒ 347 Radio.lab.		☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ 489 ESU 40	☐	☐	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☒ 489 ESU 40	☐	☐
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	☐ 463 HP3245A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☒ 498 NGPE 40
otherwise	☐ 331 HC 4055	☐ 248 6 dB Attenuator	☐ 529 Power divider	☒ - cable OTA20		
	☒513 10dB Attenuator		☒ K 4 Cable kit			
line voltage	☐ 230 V 50 Hz via public mains		☐ 60 120 V 60 Hz via PAS 5000			

5.7.1.1. Reference

FCC	☒ §15.247(b) (3)
IC	☒ RSS-210: A8.5
ANSI	☐ -
KDB Guidance	☒ 558074 D01 DTS Meas Guidance v02 (04-10-2012) for operating under §15.247: chpt. 5.0, 6.0 & 8.1.2
Remark	*For systems using digital modulation 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.*

5.7.2. 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

5.7.3. EUT Settings:

For DTS-systems mode were fixed on three different channels, if 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.

5.7.4. 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.

The band/channel power measurement function with the band limits to DTS bandwidth edges of spectrum analyzer werea used.

5.7.5. Settings on Spectrum-Analyzer:

Center Frequency	Nominal channel frequency
Span	Set as to fully display to see complete the carrier
Resolution Bandwidth (RBW)	1 MHz
VBW	≥ 3x RBW
Sweep time	coupled
Detector	Peak, Max hold mode
Sweep Mode	Repetitive mode (allow trace to fully stabilize)

5.7.6. Results

- Maximum declared antenna gain of applicant [isotropical]: 1.9 dBi at 2.4 GHz
- Maximum declared antenna gain of applicant [isotropical]: 2.8 dBi at 5 GHz
- External Path Loss: 11.0 dB -> set as correction in spectrum-analyzer

Different modulation types and data rates were tested in order to find the maximum peak conducted output power. **Enclosed are only the maximum values for each modulation format:**

MAX PEAK POWER (conducted) [dBm]			
Set-up no: 5 Op-Mode: 1	Low channel = 1 1 Mbit (2412 MHz)	Middle channel = 6 1 Mbit (2437 MHz)	High channel = 11 5.5 Mbit (2462 MHz)
IEEE 802.11 b-Mode:	**18.02**	16.58	16.91
data rate	18 Mbit	36 Mbit	48 Mbit
IEEE 802.11 g-Mode:	**20.29**	18.86	19.61
data rate	26	65	58.5
IEEE 802.11 n-mode:	**19.48**	17.56	18.59
	Low channel = 149 (5745 MHz)	Middle channel = 157 (5785 MHz)	High channel = 165 (5825 MHz)
data rate	36	54	48
IEEE 802.11 a-Mode:	15.92	**16.69**	16.30
data rate	52	65	19.5
IEEE 802.11 n(20)-Mode:	16.92	**17.08**	16.41
	Low Ch 151= 5755 MHz	Middle Ch 159= 5795 MHz	--
data rate	108	121.5	
IEEE 802.11 n(40)-mode:	**15.33**	15.18	--
Limit (conducted)	1 Watt (30dBm) Peak		
Limit EIRP	1 Watt (30dBm) Peak + max. 6 dBi antenna gain		

Remark: 1.) at this place only each maximum power reported

Test Result: Maximum power **conducted** value off all modulation is g-Mode=> **20.29 dBm Peak (106.91 mW)**
2.4 GHz ISM: Maximum EIRP value off all modulation as calculated for g-Mode=> 20.29 dBm + 1.9 dBi (PK)
5.8 GHz UN-II/ISM:Maximum EIRP value off all mod. calculated for n(20)-Mode=> 17.08 dBm + 2.8 dBi (PK)

Maximum EIRP = 22.19 dBm PK (165.58 mW) at 2.4 GHz ISM Band
Maximum EIRP = 19.88 dBm PK (97.27 mW) at 5.8 GHz UN-II/ISM Band

Final verdict: Passed

5.8. RF Parameter - 20dBc Emission specification

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

FCC	☒ §15.247(d)
IC	☒ RSS-210: A8.5
ANSI	☐ -
KDB Guidance no.	☒ 558074 D01 DTS Meas Guidance v02 (04-10-2012) for operating under §15.247: chpt. 10
Remark	*For systems using digital modulation 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.*

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

5.8.4. Measurement method:
The frequency spectrum was investigated for **conducted** spurious emissions values lower than 20 dB 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 3 times to 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 DTS-systems were three different channels measured.
The EUT was instructed to send with maximum power (if adjustable) related to the data rates according applicants instructions.

5.8.5. Results

b-Mode

Set-up no.: 5 Op. mode: 1	**RF-Conducted test: 20 dBc spurious emissions**					
Frequency Range	Low channel =1 (2412 MHz) Level Reference (In-Band) = 3.48 dBm		Middle channel = 6 (2437 MHz) Level Reference (In-Band) = 2.46 dBm		High channel = 11 (2462 MHz) Level Reference (In-Band) = 4.54 dBm	
	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]
0.150 to 25000 MHz	--	No remarkable peaks found Margin>19 dB to limit -16.52 dBm	--	No remarkable peaks found Margin>19 dB to limit -17.54 dBm	--	No remarkable peaks found Margin>19 dB to limit -15.46 dBm

g-Mode

Set-up no.: 5 Op. mode: 1	**RF-Conducted test: 20 dBc spurious emissions**					
Frequency Range	Low channel =1 (2412 MHz) Level Reference (In-Band) = 0.50 dBm		Middle channel = 6 (2437 MHz) Level Reference (In-Band) = -1.03 dBm		High channel = 11 (2462 MHz) Level Reference (In-Band) = 0.16 dBm	
	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]
0.150 to 25000 MHz	--	No remarkable peaks found Margin>15 dB to limit -19.50 dBm	--	No remarkable peaks found Margin>14 dB to limit -21.03 dBm	--	No remarkable peaks found Margin>15 dB to limit -19.84 dBm

n-Mode

Set-up no.: 5 Op. mode: 1	**RF-Conducted test: 20 dBc spurious emissions**					
Frequency Range	Low channel =1 (2412 MHz) Level Reference (In-Band) = -0.75 dBm		Middle channel = 6 (2437 MHz) Level Reference (In-Band) = -2.09 dBm		High channel = 11 (2462 MHz) Level Reference (In-Band) = -1.27 dBm	
	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]
0.150 to 25000 MHz	--	No remarkable peaks found Margin>13 dB to limit -21.75 dBm	--	No remarkable peaks found Margin>12 dB to limit -22.09 dBm	--	No remarkable peaks found Margin>14 dB to limit -21.27 dBm

a-Mode

Set-up no.: 5 Op. mode: 1	**RF-Conducted test: 20 dBc spurious emissions**					
Frequency Range	Low channel =149 (5750 MHz) Level Reference (In-Band) = -3.20 dBm		Middle channel = 157 (5780 MHz) Level Reference (In-Band) = -4.02 dBm		High channel = 165 (5825 MHz) Level Reference (In-Band) = -3.74 dBm	
	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]
0.150 to 25000 MHz	--	No remarkable peaks found Margin>8 dB to limit -23.20 dBm	--	No remarkable peaks found Margin>5 dB to limit -24.02 dBm	--	No remarkable peaks found Margin>6 dB to limit -23.74 dBm

n(HT20)-Mode

Set-up no.: 5 Op. mode: 1	**RF-Conducted test: 20 dBc spurious emissions**					
Frequency Range	Low channel =149 (5750 MHz) Level Reference (In-Band) = -3.36 dBm		Middle channel = 157 (5780 MHz) Level Reference (In-Band) = -3.32 dBm		High channel = 165 (5825 MHz) Level Reference (In-Band) = -4.34 dBm	
	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]
0.150 to 25000 MHz	--	No remarkable peaks found Margin>6 dB to limit -23.36 dBm	--	No remarkable peaks found Margin>7 dB to limit -23.32 dBm	--	No remarkable peaks found Margin>5 dB to limit -24.34 dBm

n(HT40)-Mode

Set-up no.: 5 Op. mode: 1	**RF-Conducted test: 20 dBc spurious emissions**					
Frequency Range	Low channel =151 (5755 MHz) Level Reference (In-Band) = -13.86 dBm		Middle channel = 159 (5795 MHz) Level Reference (In-Band) = -15.57 dBm		High channel	
	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]
0.150 to 40000 MHz	--	No remarkable peaks found Margin>10 dB to limit -33.86 dBm	--	No remarkable peaks found Margin>10 dB to limit -35.57 dBm	N.A.	N.A.

General remark: The limit on the diagrams is 20 dB under the reference level measured In-Band for each channel. Please refer the plots at annex 4.

5.8.6. Final verdict: Passed

5.9. RF-Parameter - Power Spectral Density

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.	☐ 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 K4		

5.9.2. REFERENCES: §15.247(E), RSS-210:A8.3

FCC	☒ §15.247 (e)
IC	☒ RSS-210 Issue 8, A8.2(b)
KDB Guidance	☒ 558074 D01 DTS Meas Guidance v02 (04-10-2012) for operating under §15.247: chapter 9.0 (opt.9.1)
Remarks	***(e)*** *For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.*

5.9.3. EUT SETTINGS:
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, exactly only maximum data rates which found out at power conducted measurements, 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 required resolution bandwidth of 3 kHz.
The method is as shown in ANSI63.10:2009, chapter 6.11.2.3
The measured value is corrected due to external measuring set-up path-loss and the resulting value is compared with the standard requirement.

5.9.5. RESULTS

Set-up no.: 5 Op. Mode: 1	**POWER SPECTRAL DENSITY**		
	Low channel	Middle channel	High channel
Measured Level b-Mode [dBm/3 kHz]	**-14.33**	1)	1)
Measured Level g-Mode [dBm/3 kHz]	**-16.99**		
Measured Level n-Mode [dBm/3 kHz]	**-18.69**		
Measured Level a-Mode UN-II/ISM [dBm/3 kHz]	**-21.42**		
Measured Level n20-Mode UN-II/ISM [dBm/3 kHz]	1)		**-18.80**
Measured Level n40-Mode UN-II/ISM [dBm/3 kHz]	**-22.14**		1)
Correction factor [dB] (Path loss+cable attenuation) included	11.0 (set as correction factor in SA-> readings = final result)		
Limit	< 8dBm/3 kHz		

Remark: 1) Please see diagrams for details on frequency in separate annex A4

5.9.6. Final verdict: 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 , AVG, 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	Setup V03.26, Test programm component V02.12.01

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	-	30.11.2014
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
644	Amplifierer	ZX60-2534M+	SN865701299	Mini-Circuits	-	-	
645	Power Amplifier	CBA 230M-080	T44236	TESEQ	-	1g	

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