

TEST REPORT
No.: 2-20797620g/11

According to:
FCC Regulations
Part 15 B & Part 15.249(a)(c)(d)(e)
IC Regulations
RSS-Gen, Issue 3
RSS-210: Issue 8

for
Sony Ericsson Mobile Communications AB
Mobile phone AAD-3880110-BV

FCC-ID: PY7A3880110
IC: 4170B-A3880110

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

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

The presented EUT is a mobile phone with integrated ANT+ wireless technology and integral antenna. Other wireless technologies were not considered within this test report.

Following tests have been performed to show compliance with applicable FCC Part 2 and Part 15 rules of the FCC CFR 47 (2010-1-09 Edition) and Industry Canada RSS-210, Issue 8 and RSS-Gen, Issue 3 regulations.

1.1. TESTS OVERVIEW 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							
6dB bandwidth	Antenna terminal (conducted)	§15.247(a)(2)	RSS-210 Issue 8: A8.2 (a)	≥ 500 kHz for DTS systems	1	2	For information only
99% occupied bandwidth & Emission Bandwidth (26dBc)	Antenna terminal (conducted)	--	RSS-210 Issue 8: Chapter 4.6.1	99% Power bandwidth	1	2	For information only
Carrier field strength	Cabinet (radiated)	§15.249(a)	RSS-210 Issue 8:A2.9(a)	50mV/m	1	2	Passed
Field strength of harmonics	Cabinet + Interconnecting cables (radiated)	§15.247 (d) §15.205 §15.209	RSS-210 Issue 8:A2.9(a)	0.5mV/m	1	2	Passed
General field strength emissions + restricted bands			RSS-210 Issue 8, A2.9(b) RSS-Gen: Issue 3: §7.2.5 Table 5+6	Emissions in restricted bands must meet the general field-strength radiated limits	1	2	Passed
AC-Power Lines Conducted Emissions	AC-Power lines	§15.207	RSS-Gen, Issue 3: Chapter 7.2.4, Table 4	FCC §15.107 class B limits §15.207 limits IC: Table 4, Chapter 7.2.4	--	--	Not performed Remark 1

RX Mode							
AC-Power Lines Conducted Emissions	AC-Power lines (conducted)	§15.107	RSS-Gen, Issue 3: Chapter 7.2.4	FCC §15.107 class B limits §15.207 limits IC: Table 2, Chapter 7.2.2	--	--	Not performed Remark 1
RECEIVER Radiated emissions	Cabinet + Interconnecting cables (radiated)	§15.109 §15.33 §15.35	RSS-Gen, Issue 3: Chapter 6.1	FCC 15.109 class B limits IC-limits: Table 2, Chapter 6	1	1	Passed

Remark: 1.) in accordance with applicant's statement and information, covered by Bluetooth® test mode (same carrier generating chip), see other test report



.....
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.....
Dipl.-Ing. C. Lorenz
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. J. Schmitt
Laboratory accreditations/Listings:	DAkKS-Registration No. D-PL-12047-01-01 FCC-Registration No.: 736496, MRA US-EU 0003 IC-Registration No. 3462D-1, 3462D-2 VCCI Reg. No. R-2665, R-2666, C-2914, T-1967, G-301

2.2. Test location

2.2.1. Test laboratory "CTC"

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

Order No.:	20797620
Responsible for test report and project leader:	Dipl.-Ing. C. Lorenz
Receipt of EUT:	2011-04-08
Date(s) of test:	2011-06-22 to 2011-06-27
Date of report:	2011-07-06

Version of template:	11.05 _All.Dotm

2.4. Applicant's details

Applicant's name:	Sony Ericsson Mobile Communications AB
Address:	Nya Vattentornet 221-88 Lund Sweden
Contact person:	Mr. Anders Nordlöf

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. Additional declaration and description of main EUT

Main function	Mobile phone with integrated ANT+ Transceiver		
Type	AAD-3880110-BV		
Frequency range (US/Canada -bands)	2402 MHz (Channel 0) to 2480 MHz (Channel 78) Channel spacing 1 MHz		
Type of modulation	GFSK with modulation Index 0.32		
Number of channels (USA/Canada -bands)	0 to 78		
Data rate	1 MBps		
Antenna Type	<input checked="" type="checkbox"/> Integrated <input type="checkbox"/> External, no RF- connector <input type="checkbox"/> External, separate RF-connector		
Antenna Gain	Max. -1.0 dBi gain according applicants information in 2.4 GHz band		
MAX Field strength (radiated):	PK: 100.8 dB μ V/m@3m distance on nominal 2412 MHz AV: 74.9 dB μ V/m		
FCC-ID	PY7A3880110		
IC	4170B-A3880110		
Installed option	<input checked="" type="checkbox"/> additional wireless technologies: GSM/UMTS/Bluetooth/WiFi <input checked="" type="checkbox"/> battery charging option over separated AC charger <input checked="" type="checkbox"/> GPS		
Power supply	Li-Io. Battery: range from 3.5 V (V_{min}) to 4.1 V (V_{max})		
Special EMI components	--		
EUT sample type	<input type="checkbox"/> Production	<input checked="" type="checkbox"/> Pre-Production	<input type="checkbox"/> Engineering

3.1. 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	Mobile phone	AAD-3880110-BV	IMEI: 00440214- 239780 (CB5A1CHYCC)	AP1	R1A034
EUT B	Battery Li-io	CBA-0002025	012028PTPCL H	11W01	--

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

3.2. 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	USB cable	EC700	#19321	--	--
AE 2	Notebook	Dell D610	CTC#4	--	Windows XP + Special firmware program

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

3.3. EUT set-ups

EUT set-up no. *)	Combination of EUT and AE	Remarks
Set. 1	EUT A + EUT B + (AE1 + AE2)	AE1 and AE2 disconnected after succesfull set-up of necessary operating mode

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

3.4. Configuration of cables used for testing

Cable number	Item	Type	S/N serial number	HW hardware status	Cable length
Cable 1	--	--	--	--	--

Remarks: no cable used

3.5. EUT operating modes

EUT operating mode no. *)	Description of operating modes	Additional information
op. 1	RX-Mode	With help of special test firmware and command, RX-mode was set-up.
op. 2	TX-Mode	With help of special test firmware and command a <u>continuous</u> traffic mode could be established. Duty Cycle of maximum 5%.

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

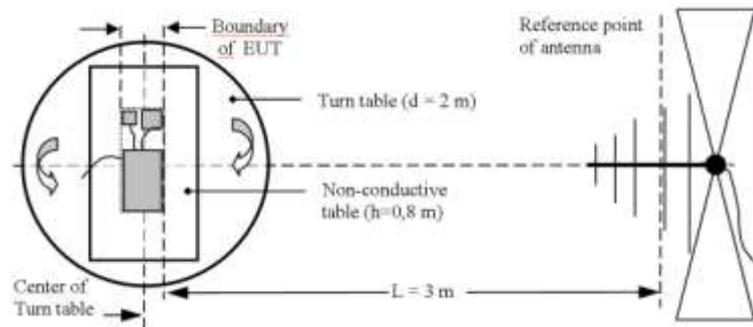
4. DESCRIPTION OF TEST SET-UP'S

4.1. Test set-up for radiated measurements

Pls. see above description and schematic for radiated measurements used set-up.

MEASUREMENT METHOD (30 MHz <math>f < 1\text{ GHz}</math>):

A EMI analyzer together with a broadband antenna was used in order to identify the emissions from the EUT by positioning the antenna close to the EUT surfaces. The interconnecting cables and equipment position were varied in order to maximize the emissions. Then most critical frequencies are recorded for further investigations. Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's operating mode, cable position, etc. The EUT was placed on a non-conductive support of 0.8 m



height. By rotating the turntable angle in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position) and the measurement antenna height from 1 meter to 4 meters, the maximized emissions are recorded. The measurements are performed for both polarizations of the measuring antenna: horizontal and vertical.

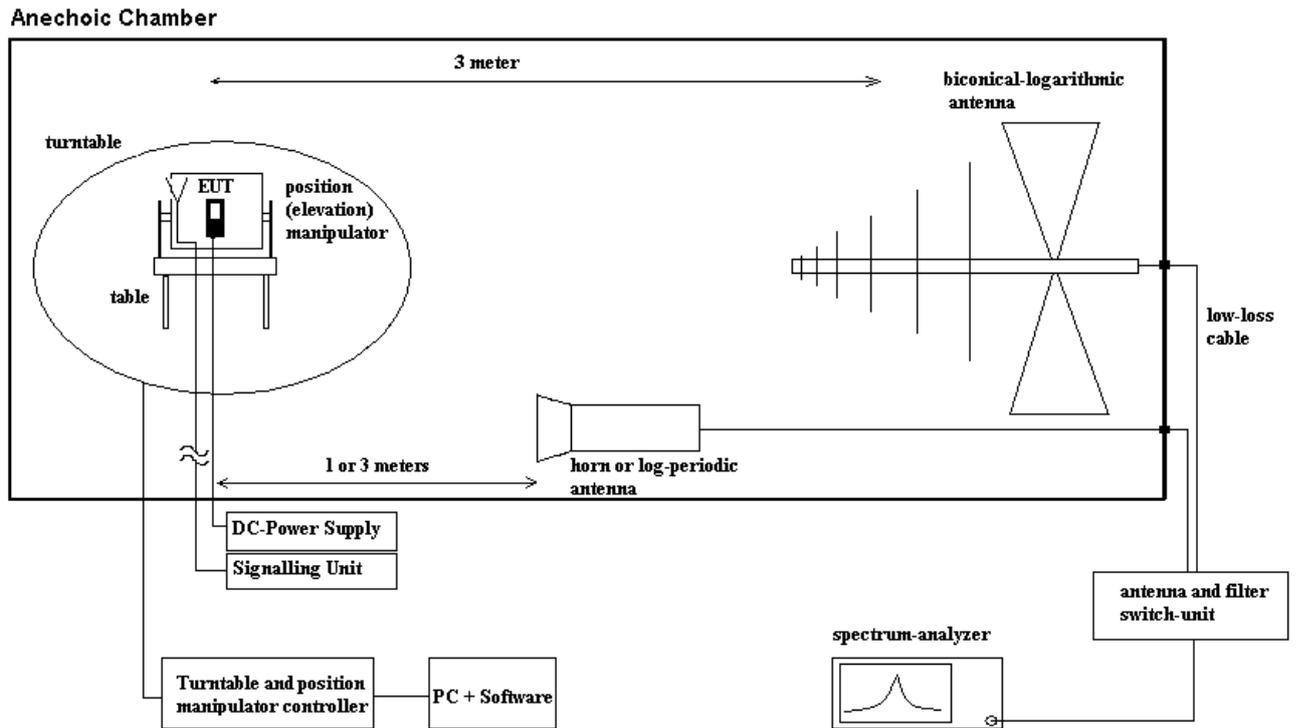
MEASUREMENT METHOD (1 GHz <math>f < 26.5\text{ GHz}</math>):

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

The measurements are performed for both receiving antenna polarisations: vertical and horizontal.

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

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



Schematic: radiated measurements test set-up

5. Measurements

5.1. Radiated field strength emissions below 30 MHz

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

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input type="checkbox"/> Please see Chapter. 2.2.2	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input checked="" type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 337 OATS
receiver	<input type="checkbox"/> 377 ESCS30	<input checked="" type="checkbox"/> 001 ESS	<input type="checkbox"/> 347 Radio.lab.
spectr. analys.	<input type="checkbox"/> 584 FSU	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK
antenna	<input type="checkbox"/> 574 BTA-L	<input type="checkbox"/> 133 EMCO3115	<input type="checkbox"/> 302 BBHA9170
signaling	<input type="checkbox"/> 298 CMU	<input type="checkbox"/> 460 CMU	<input type="checkbox"/> 295 RACAL
otherwise	<input type="checkbox"/> 400 FTC40x15E	<input type="checkbox"/> 401 FTC40x15E	<input type="checkbox"/> 110 USB LWL
DC power	<input type="checkbox"/> 456 EA 3013A	<input type="checkbox"/> 457 EA 3013A	<input type="checkbox"/> 459 EA 2032-50
line voltage	<input type="checkbox"/> 230 V 50 Hz via public mains	<input type="checkbox"/> 060 110 V 60 Hz via PAS 5000	<input type="checkbox"/> 289 CBL 6141
			<input checked="" type="checkbox"/> 030 HFH-Z2
			<input type="checkbox"/> 477 GPS
			<input type="checkbox"/> 392 MT8820A
			<input type="checkbox"/> 482 Filter Matrix
			<input type="checkbox"/> 378 RadiSense
			<input type="checkbox"/> 494 AG6632A
			<input type="checkbox"/> 498 NGPE 40

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

Frequency [MHz]	Field strength		Measurement distance [meters]	Remarks
	[μ V/m]	[dBuV/m]		
0.009 – 0.490	2400/f (kHz)	67.6 – 20Log(f) (kHz)	300	Correction factor used due to measurement distance of 3m
0.490 – 1.705	24000/f (kHz)	87.6 – 20 Log(f) (kHz)	30	Correction factor used due to measurement distance of 3m
1.705 – 30	30	29.54	30	Correction factor used due to measurement distance of 3m

Remark: * decreases with the logarithm of the frequency

TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	<input type="checkbox"/> air link	<input type="checkbox"/> cable connection	<input type="checkbox"/>
EUT-grounding	<input type="checkbox"/> none	<input type="checkbox"/> with power supply	<input type="checkbox"/> additional connection
Equipment set up	<input checked="" type="checkbox"/> table top		<input type="checkbox"/> floor standing
Climatic conditions	Temperature: (18.9°C)		Rel. humidity: (57)%
EMI-Receiver (Analyzer) Settings	Span/Range: 9 kHz to 150 kHz; 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<1 GHz)		

GENERAL MEASUREMENT PROCEDURES:

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

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

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

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

MEASUREMENT RESULTS

Set-up No.		1								
Operating Mode		2								
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)
G_3.01	19.82	14.95	10.0	10.0	100.0	--	0°..360°	--	> 14.59	29.54
G_3.02	25.44	15.13	10.0	10.0	100.0	--	0°..360°	--	>14.41	29.54
G_3.03	17.08	14.58	10.0	10.0	100.0	--	0°..360°	--	>14.96	29.54

Remark: 1.) diagrams shows PK detector measurements
 *.) see also plots enclosed in annex A1

<p>Margin to Limit:</p> $M = L_T - R_R + C_F + D_F$ $= L_T - R_R + AF_{ANTENNA} + Cable_{LOSS} + D_F$ <p>Remark: positive margin means passed result</p>	<p>Abbreviations used:</p> <ul style="list-style-type: none"> • R_R : Receiver readings in dBμV/m • C_F: Transducer in dB = AF (antenna factor) + CL (cable loss) • D_F: distance correction factor (if different measurement distance used than specified in the standard) • L_T : Limit in dBμV/m
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VERDICT: Summary of measurement results for radiated frequencies below 30 MHz - passed

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

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

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input type="checkbox"/> Please see Chapter. 2.2.2	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input checked="" type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 337 OATS <input type="checkbox"/> 347 Radio.lab.
receiver	<input type="checkbox"/> 377 ESCS30	<input checked="" type="checkbox"/> 001 ESS	<input type="checkbox"/> <input type="checkbox"/>
spectr. analys.	<input type="checkbox"/> 584 FSU	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK <input type="checkbox"/>
antenna	<input checked="" type="checkbox"/> 574 BTA-L	<input type="checkbox"/> 133 EMCO3115	<input type="checkbox"/> 302 BBHA9170 <input type="checkbox"/> 289 CBL 6141 <input type="checkbox"/> 030 HFH-Z2 <input type="checkbox"/> 477 GPS
signaling	<input type="checkbox"/> 298 CMU	<input type="checkbox"/> 460 CMU	<input type="checkbox"/> 295 RACAL <input type="checkbox"/> 392 MT8820A
otherwise	<input type="checkbox"/> 400 FTC40x15E	<input type="checkbox"/> 401 FTC40x15E	<input type="checkbox"/> 110 USB LWL <input checked="" type="checkbox"/> 482 Filter Matrix <input type="checkbox"/> 378 RadiSense
DC power	<input type="checkbox"/> 456 EA 3013A	<input type="checkbox"/> 457 EA 3013A	<input type="checkbox"/> 459 EA 2032-50 <input type="checkbox"/> 268 EA- 3050 <input type="checkbox"/> 494 AG6632A <input type="checkbox"/> 498 NGPE
line voltage	<input type="checkbox"/> 230 V 50 Hz via public mains		<input type="checkbox"/> 060 110 V 60 Hz via PAS 5000

STANDARDS AND LIMITS: CFR 47, PART §15.249(a), RSS-Gen, ANSI C63.10:2009, (a) The field strength of the emissions from the intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency [MHz]	Field strength of fundamental		Field strength of harmonics	
	[mV/m]	[dBµV/m]	[µV/m]	[dBµV/m]
902-928	50	94.0	500	54.0
2400-2483.5	50	94.0	500	54.0
5725-5875	50	94.0	500	54.0
24.0-24.25 GHz	250	108.0	2500	68.0

(c) field strength limits are specified at a distance of 3meters

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(e) for frequency above 1000 MHz, the field strength limits in paragraph (a) .. are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits above by more than 20dB under any condition of modulation.

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

Frequency [MHz]	Radiated emission limits3 meters	
	QUASI-Peak [microvolts/meter]	QUASI-Peak [dBµV/m]
30-88	100	40
88-216	150	43,5
216-960	200	46,0
above 960	500	54,0

TEST CONDITION AND MEASUREMENT TEST SET-UP

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

RESTRICTED BANDS OF OPERATION, §15.205

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

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

GENERAL MEASUREMENT PROCEDURES:

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.4: 2009 or ANSI63.10:2009.

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

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

Pls. see description in chapter 4.1

5.2.1. MEASUREMENT RESULTS TX-MODE (§15.249)**Channel Low (Channel 0)**

Set-up No.		1								
Operating Mode		2								
Diagram no.	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C _F)	Margin (dB) (M)	Limit (dBµV /m) (L _T)
G_2.07	995.68	41.68	10.0	100.0	1..4m	H/V	0°..360°	--	12.32	54.0

Remark: *) see also plots enclosed in annex A1

Channel middle (Channel 39)

Set-up No.		1								
Operating Mode		2								
Diagram no.	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C _F)	Margin (dB) (M)	Limit (dBµV /m) (L _T)
G_2.08	840.32	40.94	10.0	100.0	1..4m	H/V	0°..360°	--	>20	--

Remark: *) see also plots enclosed in annex A1

Channel high (Channel 78)

Set-up No.		1								
Operating Mode		2								
Diagram no.	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C _F)	Margin (dB) (M)	Limit (dBµV /m) (L _T)
G_2.09	986.72	42.02	10.0	100.0	1..4m	H/V	0°..360°	--	11.98	54.0

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

5.2.2. MEASUREMENT RESULTS RX-MODE (§15.109, CLASS B)

Channel middle(RX Ch.39)

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (m)	Polarity	Turntable position (deg)	Corr. (dB) (C _F)	Margin (dB) (M)	Limit (dBµV /m) (L _T)
G_2.10	935.68	40.92 (PK)	10.0	100.0	1..4m	H/V	0°..360°	--	>5	46.0

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

<p>Margin to Limit:</p> $M = L_T - R_R + C_F + D_F$ $= L_T - R_R + AF_{ANTENNA} + Cable_{LOSS} + D_F$ <p>Remark: positive margin means passed result</p>	<p>Abbreviations used:</p> <ul style="list-style-type: none"> • R_R : Receiver readings in dBµV/m • C_F: Transducer in dB = AF (antenna factor) + CL (cable loss) • D_F: distance correction factor (if different measurement distance used than specified in the standard) • L_T : Limit in dBµV/m
---	--

VERDICT

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

5.3. Radiated emissions, above 1 GHz

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

test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 348 EMI cond.	<input checked="" type="checkbox"/> 443 EMI FAR	<input type="checkbox"/> 347 Radio.lab.	<input type="checkbox"/> 337 OATS	<input type="checkbox"/>
equipment	<input type="checkbox"/> 331 HC 4055	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
spectr. analys.	<input type="checkbox"/> 584 FSU	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK	<input checked="" type="checkbox"/> 489 ESU	<input type="checkbox"/>	<input type="checkbox"/>
antenna meas	<input type="checkbox"/> 574 BTA-L	<input type="checkbox"/> 289 CBL 6141	<input type="checkbox"/> 439 HL 562	<input checked="" type="checkbox"/> 549 HL025	<input type="checkbox"/> 302 BBHA9170	<input type="checkbox"/> 477 GPS
antenna meas	<input type="checkbox"/> 123 HUF-Z2	<input type="checkbox"/> 132 HUF-Z3	<input type="checkbox"/> 030 HFH-Z2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
antenna subst	<input type="checkbox"/> 071 HUF-Z2	<input type="checkbox"/> 020 EMCO3115	<input type="checkbox"/> 063 LP 3146	<input type="checkbox"/> 303 BBHA9170	<input type="checkbox"/>	<input type="checkbox"/>
power meter	<input type="checkbox"/> 009 NRV	<input type="checkbox"/> 010 URV5-Z2	<input type="checkbox"/> 011 URV5-Z2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
signalgener.	<input type="checkbox"/> 008 SMG	<input type="checkbox"/> 140 SMHU	<input type="checkbox"/> 263 SMP04	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
power meter	<input type="checkbox"/> 262 NRV-S	<input type="checkbox"/> 266 NRV-Z31	<input type="checkbox"/> 265 NRV-Z33	<input type="checkbox"/> 261 NRV-Z55	<input type="checkbox"/> 356 NRV-Z1	<input type="checkbox"/>
multimeter	<input type="checkbox"/> 341 Fluke 112	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
signaling	<input type="checkbox"/> 298 CMU	<input type="checkbox"/> 460 CMU	<input type="checkbox"/> 295 RACAL	<input type="checkbox"/> 392 MT8820A		
DCpower	<input type="checkbox"/> 086 LNG50-10	<input type="checkbox"/> 087 EA3013	<input type="checkbox"/> 354 NGPE 40	<input type="checkbox"/> 349 car battery	<input type="checkbox"/> 350 Car battery	<input type="checkbox"/>
line voltage	<input type="checkbox"/> 230 V 50 Hz via public mains		<input type="checkbox"/> 060 110 V 60 Hz via PAS 5000			

STANDARDS AND LIMITS: CFR 47, PART §15.249(a), RSS-Gen, ANSI C63.10:2009(a) *The field strength of the emissions from the intentional radiators operated within these frequency bands shall comply with the following:*

Fundamental frequency [MHz]	Field strength of fundamental		Field strength of harmonics	
	[mV/m]	[dBµV/m]	[µV/m]	[dBµV/m]
902-928	50	94.0	500	54.0
2400-2483.5	50	94.0	500	54.0
5725-5875	50	94.0	500	54.0
24.0-24.25 GHz	250	108.0	2500	68.0

(c) *field strength limits are specified at a distance of 3meters*

(d) *Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.*

(e) *for frequency above 1000 MHz, the field strength limits in paragraph (a) .. are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits above by more than 20dB under any condition of modulation.*

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

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

TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	<input type="checkbox"/> air link	<input type="checkbox"/> cable connection	<input type="checkbox"/>
EUT-grounding	<input type="checkbox"/> none	<input type="checkbox"/> with power supply	<input type="checkbox"/> additional connection
Equipment set up	<input checked="" type="checkbox"/> table top 1.5m height		<input type="checkbox"/> floor standing
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
Spectrum-Analyzer settings	Span/Frequency range : 1..18 GHz +single frequencies determined in step 1 RBW/VBW: 1 MHz / 3 MHz Detector/ Mode: Peak, MAX-hold, repetitive scan for exploratory measurement PEAK/ AVERAGE, for final measurement for critical frequencies Antenna Polarisation Horizontal / Vertical		

GENERAL MEASUREMENT PROCEDURES:

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.4: 2009 for RX-mode and ANSI 63.10:2009 for TX-mode.

The *Equipment under Test* (EUT) was placed on a non-conductive positioning table of 0.8 or 1.5 meter height depending from the frequency range. The measuring distance was set to 3 meter for frequencies up to 18 GHz and 1 meter above 18 GHz.

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

For RX-measurements following is valid regarding the frequency range of measurements:

For the upper frequency measurement range, it was assumed that the highest frequency generated in the device is same as the highest operable TX-frequency in ANT mode (2480 MHz). For practical reasons the upper frequency limit was set to 12.75 GHz

- 1. **Step exploratory measurement:** see above description as in the frequency range lower 1 GHz.
- 2. **Step Final Measurement(1 GHz < f < 18 GHz):** On the Worst-Case EUT configuration, frequency components with a margin lower than 6 dB to the limits, will be re-measured by maintaining the EUT's operating mode, cable position, etc.. For find the worst-case emission, the turntable was changed in the range 0 to 360 degree and the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurements are performed for both polarizations of the measuring antenna: horizontal and vertical.

5.3.1. CARRIER FIELD STRENGTH ACCORD. §15.249(a):

Maximum Radiated field strength @ 3m distance			
Set-up no.: 1 Op. Mode: 2	Low channel = 0 (2402 MHz)	Middle channel = 39 (2441 MHz)	High channel = 78 (2480 MHz)
Determined field strength [dBuV/m] in 3m distance with RBW=1 MHz	97.1 (PK) 68.4 (AV)	100.8 (PK) 74.9 (AV)	97.5 (PK) 72.0 (AV)

Remark: standard refer to an carrier limit of 94 dBuV/m AVERAGE and 114 dBuV/m PEAK value.

5.3.2. MEASUREMENT OF SPURIOUS EMISSIONS TX-MODE (§15.209):

Channel low (Ch 0)

Set-up No.:		1								
Operating Mode:		2								
Diagram no.	Frequency (MHz)	MaxPeak (dB μ V/m)	Meas . Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C _F)	Margin (dB) (M)	Limit (dB μ V/m) (L _T)
G_2.01	PK-detector									
	2282.0	<60.26	10.0	1000	100	H/V	0°..360°	--	>13.74	74.0
	AV-detector									
	2752.5	<48.29	10.0	1000	100	H/V	0°..360°	--	5.71	54.0

Remark: 1.) diagrams shows PK/AV detector measurements see also plots enclosed in annex A1

Set-up No.:		1								
Operating Mode:		2								
Diagram no.	Frequency (MHz)	MaxPeak (dB μ V/m)	Meas . Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C _F)	Margin (dB) (M)	Limit (dB μ V/m) (L _T)
G_2.04	PK-detector									
	17800.5	64.46	10.0	1000	100	H/V	0°..360°	--	>9.5	74.0
	AV-detector									
	17849.5	50.77	10.0	1000	100	H/V	0°..360°	--	>3.23	54.0
G_2.04a	24786.8	<40.45	Exploratory measurement only							

Remark: 1.) diagrams shows PK/AV detector measurements see also plots enclosed in annex A1

2.) no peaks detected (harmonic or spurious), noise level of measurement set-up

3.) measurements from 18 to 25 GHz performed as exploratory measurements only, due to noise level

Channel middle (Ch 39)

Set-up No.:		1								
Operating Mode:		2								
Diagram no.	Frequency (MHz)	MaxPeak (dB μ V/m)	Meas . Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C _F)	Margin (dB) (M)	Limit (dB μ V/m) (L _T)
G_2.02	PK-detector									
	2764.5	<61.76	10.0	1000	100	H/V	0°..360°	--	>12.24	74.0
	AV-detector									
	2757.5	<48.30	10.0	1000	100	H/V	0°..360°	--	> 5.7	54.0

Remark: 1.) diagrams shows PK/AV detector measurements see also plots enclosed in annex A1

Set-up No.:		1								
Operating Mode:		2								
Diagram no.	Frequency (MHz)	MaxPeak (dB μ V/m)	Meas . Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C _F)	Margin (dB) (M)	Limit (dB μ V/m) (L _T)
G_2.05	PK-detector									
	14479.5	< 65.0	10.0	1000	100	H/V	0°..360°	--	>9.0	74.0
	AV-detector									
	17991.5	51.09	10.0	1000	100	H/V	0°..360°	--	>3.9	54.0
G_2.05a	18852.5	<40.27	Exploratory measurement only							

Remark: 1.) diagrams shows PK/AV detector measurements see also plots enclosed in annex A1

2.) no peaks detected (harmonic or spurious), noise level of measurement set-up

3.) measurements from 18 to25 GHz performed as exploratory measurements only, due to noise level

Channel middle (Ch 78)

Set-up No.:		1								
Operating Mode:		2								
Diagram no.	Frequency (MHz)	MaxPeak (dB μ V/m)	Meas . Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C _F)	Margin (dB) (M)	Limit (dB μ V/m) (L _T)
G_2.03	PK-detector									
	2753.5	<61.67	10.0	1000	100	H/V	0°..360°	--	>12.33	74.0
	AV-detector									
	2747.5	<48.17	10.0	1000	100	H/V	0°..360°	--	> 5.83	54.0

Remark: 1.) diagrams shows PK/AV detector measurements see also plots enclosed in annex A1

Set-up No.:		1								
Operating Mode:		2								
Diagram no.	Frequency (MHz)	MaxPeak (dB μ V/m)	Meas . Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C _F)	Margin (dB) (M)	Limit (dB μ V/m) (L _T)
G_2.06	PK-detector									
	15691.0	< 61.55	10.0	1000	100	H/V	0°..360°	--	>12.54	74.0
	2800 .. 18000	< 65.0	10.0	1000	100	H/V	0°..360°		> 9.0	
	AV-detector									
	17932.5	< 50.88	10.0	1000	100	H/V	0°..360°	--	>3.12	54.0
G_2.06a	24181.08	<40.69	Exploratory measurement only							

Remark: 1.) diagrams shows PK/AV detector measurements, see also plots enclosed in annex A1

2.) no peaks detected (harmonic or spurious), noise level of measurement set-up

3.) measurements from 18 to25 GHz performed as exploratory measurements only, due to noise level

5.3.3. MEASUREMENT OF SPURIOUS EMISSIONS RX-MODE (§15.109, CLASS B)

Channel middle (RX Ch 39)

Set-up No.:		1								
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 (dBµ V/m) (L _T)
G_2.50	PK-detector									
	2591.6	<45.93	10.0	1000	100	H/V	0°..360°	--	>28.07	74.0
	AV-detector									
	2756.0	<32.63	10.0	1000	100	H/V	0°..360°	--	> 21.37	54.0

Remark: 1.) diagrams shows PK/AV detector measurements, see also plots enclosed in annex A1

Set-up No.:		1								
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 (dBµ V/m) (L _T)
G_2.51	PK-detector									
	12207.5	< 56.37	10.0	1000	100	H/V	0°..360°	--	>17.63	74.0
	AV-detector									
	12624.0	< 42.69	10.0	1000	100	H/V	0°..360°	--	>11.31	54.0

Remark: 1.) diagrams shows PK/AV detector measurements, see also plots enclosed in annex A1

<p>Margin to Limit:</p> $M = L_T - R_R + C_F + D_F$ $= L_T - R_R + AF_{ANTENNA} + Cable_{LOSS} + D_F$ <p>Remark: positive margin means passed result</p>	<p>Abbreviations used:</p> <ul style="list-style-type: none"> • R_R : Receiver readings in dBµV/m • C_F: Transducer in dB = AF (antenna factor) + CL (cable loss) • D_F: distance correction factor (if different measurement distance used than specified in the standard) • L_T : Limit in dBµV/m
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VERDICT

Summary of measurement results for radiated emissions above 1 GHz : Passed

5.4. 6-dB Bandwidth

FCC 15.247, RSS-210

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

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input type="checkbox"/> Please see Chapter. 2.2.2	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 337 OATS
receiver	<input type="checkbox"/> 377 ESCS30	<input type="checkbox"/> 001 ESS	<input checked="" type="checkbox"/> 489 ESU
otherwise	<input type="checkbox"/> 530 10dB Attenuator	<input checked="" type="checkbox"/> 347 Radio.lab.	<input type="checkbox"/> 431 Near field probe
		<input type="checkbox"/> cable K15	

REFERENCES: §15.247(a)(1), RSS-210

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

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

EUT SETTINGS:

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

MEASUREMENT METHOD:

The measurement was performed with the RBW set to 50 kHz. The span was set to cover the complete carrier. A DELTA Marker method was set to measure the bandwidth compared to the highest peak within power envelope. The operating modes have been varied (e.g. data rate, modulation scheme, etc.), if applicable

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

SPECTRUM-ANALYZER SETTINGS:

Span	Set as to fully display the emissions and approximate 30dB below the PEAK level
Resolution Bandwidth (RBW)	Set to approx 3% to 5% of the emission width
Video Bandwidth (VBW)	Minimum 3 times the resolution bandwidth
Sweep time	Coupled and low enough to have no gaps within power envelope
Detector	Sample (if bin width: Span/no. of frequency points SA < 0.5*RBW SA otherwise Peak detector)
Sweep mode	Repetitive Mode, MAX-HOLD

RESULTS:

Set-up no.: 1 Op. Mode: 1	6 dB Bandwidth [MHz]		
T _{NOM} = 21°C V _{NOM} = 4.1V	Low channel = 0 (2402 MHz)	Middle channel = 39 (2442 MHz)	High channel = 78 (2480 MHz)
Value	435.8974 kHz	Remark 2	Remark 2

Remark:

- 1.) see diagrams in separate document A1
- 2.) test and result of one frequency is conclusive enough for judgement of the applicability of correct standard

Conclusion: 6dB bandwidth smaller than 500 kHz so tests according Part 15.249 should apply for this wireless technology.

Set-up no.: 1 Op. Mode: 1	99% EMISSION BANDWIDTH [MHz]		
T _{NOM} = 21°C V _{NOM} = 4.1V	Low channel = 0 (2402 MHz)	Middle channel = 39 (2442 MHz)	High channel = 78 (2480 MHz)
Value	Remark 2	864.4 kHz	Remark 2

Remark:

- 1.) see diagrams in separate document A1
- 2.) one frequency is conclusive enough for applicability of standards, 99% bandwidth for information only tested

VERDICT: As 6dB bandwidth is smaller than 500 kHz standard Part 15.249(a) apply.

5.5. Band-Edge compliance measurements,

FCC 15.205/15.209, RSS-210

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

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input checked="" type="checkbox"/> 443 System CTC-FAR-EMI-	<input type="checkbox"/> Please see Chapter. 2.2.3			
test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 337 OATS	<input checked="" type="checkbox"/> 347 Radio.lab.	<input type="checkbox"/>	<input type="checkbox"/>
receiver	<input type="checkbox"/> 377 ESCS30	<input type="checkbox"/> 001 ESS	<input checked="" type="checkbox"/> 489 ESU	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
antenna meas	<input type="checkbox"/> 574 BTA-L	<input type="checkbox"/> 289 CBL 6141	<input type="checkbox"/> 439 HL 562	<input checked="" type="checkbox"/> 549 HL025	<input type="checkbox"/>	<input type="checkbox"/>
spectr. analys.	<input type="checkbox"/> 489 ESU	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
power supply	<input type="checkbox"/> 456 EA 3013A	<input type="checkbox"/> 457 EA 3013A	<input type="checkbox"/> 459 EA 2032-50	<input type="checkbox"/> 268 EA- 3050	<input type="checkbox"/> 494 AG6632A	<input type="checkbox"/> 498 NGPE 40
otherwise	<input type="checkbox"/> 530 10dB Attenuator			<input type="checkbox"/> cable K15		

MEASUREMENT METHOD:

A Delta marker method was used for showing compliance to restricted bands according §15.205. The method is according Public Notice “Marker-Delta method”, Extract from DA00-705. The method consists of three independent steps:

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

EUT SETTINGS:

For frequency-hopping systems (FHSS) the measurement is done in hopping mode on and off and with different modulation to find worst-case.

For DTS systems the measurement was performed with different modulation, e.g. data rates to find worst-case.

RESULTS

Set-up: 1				
Op. Mode: 2				
$T_{NOM} = 21^{\circ}C$, $V_{NOM} = 4.1V$	Fundamental field strength-radiated [dB μ V/m]	Delta Marker Value [dB]	Value at Band-Edge [dB μ V/m]	Verdict
Channel Low	97.1 PK	> 44.06 (>20dB)	53.04 (PK)	Passed
Channel High	97.5 PK 72.0 AV	51.39	46.11 (PK)	Passed

VERDICT: pass

5.6. 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.

Measurement	Frequency range	Calculated uncertainty based on a confidence level of 95%	Remarks:
RF-Power Output conducted	9 kHz .. 20 GHz	1.0 dB	--
RF-Power Output radiated	30 MHz .. 4 GHz	3.17 dB	Substitution method
Conducted RF-emissions on antenna ports	9 kHz .. 20 GHz	1.0 dB	--
Radiated RF-emissions enclosure	150 kHz .. 30 MHz	5.0 dB	Magnetic field
	30 MHz .. 1 GHz	4.2 dB	E-Field
	1 GHz .. 18 GHz	4.8 dB	E-Field
	1 GHz .. 20 GHz	3.17 dB	Substitution method
Occupied bandwidth	9 kHz .. 4 GHz	0.1272 ppm (Delta Marker method)	Frequency error
		1 dB	Power
Emission bandwidth	9 kHz .. 4 GHz	0.1272 ppm (Delta Marker method)	Frequency error
		1 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. Instruments and Ancillary

6.1. Used equipment “CTC”

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

6.1.1. 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	System-CTC-EMS-Conducted	System EMS Conducted	-	EMC 32 V 8.40
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
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
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR) Cable	-	EMC 32 Version 8.40
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. 8.40
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	Univ. 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

6.1.2. 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	-	31.03.2012
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	24/12 M	-	31.03.2012
007	DC - LISN (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	24/12 M	-	31.03.2012
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	-	31.03.2013
030	Loop Antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	31.03.2012
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	31.03.2013
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	1c	30.06.2012
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	-	31.03.2012
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	31.03.2012
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	-	31.03.2012
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO	12 M	-	31.03.2012
140	Signal Generator	SMHU	831314/006	Rohde & Schwarz	24 M	-	31.03.2012
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	24/12 M	-	31.03.2012
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	31.03.2012
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	-	31.03.2014
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	31.03.2012
266	peak power sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	31.03.2012
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH	pre-m	2	
268	AC/DC power supply	EA 3050-A	9823636	Elektro Automatik	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	30.06.2012
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	1c	30.06.2012
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	-	31.03.2012
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	-	30.11.2012
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	31.03.2012
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	-	31.03.2012
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
373	V-Network 5µH/50 Ohm	ESH3-Z6	100535	Rohde & Schwarz	24/12 M	-	31.03.2012
376	Horn Antenna 6 GHz	BBHA9120 E	BBHA 9120 E 179	Schwarzbeck	12 M	-	31.03.2012
377	Emi Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	31.03.2012
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	31.03.2013
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	31.03.2012
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR) Cable	-	CETECOM	12 M	5	31.08.2011
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-	-	ETS-	12 M	5	30.06.2012

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
		RSE		Lindgren/CETECOM			
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-10SSK	5	Wainwright Instruments GmbH	12 M	1c	30.06.2012
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-8SSK	1	Wainwright	12 M	1c	30.06.2012
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	-	31.03.2012
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	31.03.2012
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	24 M	-	31.03.2012
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	24 M	-	31.03.2012
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	-	30.07.2012
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren/CETECOM	12 M	-	30.09.2011
489	Emi Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	31.03.2012
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-60/10SS	SN 5	Wainwright	pre-m	2	
512	notch filter GSM 850	WRCA 800/960-02/40-6EEK	SN 24	Wainwright	12 M	1c	30.06.2012
517	relais switch matrix	HF Relais Box Keithley System	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	
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	31.03.2012
548	Digital-Barometer	GBP 2300	without	Greisinger GmbH	36/12 M	-	31.03.2012
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.03.2012
552	high pass filter 2,8-18GHz	WHKX 2,8/18G-10SS	4	Wainwright	12 M	1c	30.07.2012
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	31.08.2011
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	30.03.2013
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	12 M	-	31.03.2012
594	Univ. Radio Communication Tester	CMW500	101757	Rohde & Schwarz	24 M	-	31.03.2012
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	12 M	-	31.03.2012
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Rohde & Schwarz	24 M	-	13.01.2013
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	-	12.01.2013
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	12.01.2013
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	

6.1.3. 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

