

TEST REPORT

No.: 2-20798191b/11

According to:
FCC Regulations
 Part 15.107, 15.207, Part 15.225,1 5.209
IC Regulations
 RSS-Gen Issue 3, RSS-310, Issue 2

for
 Sony Ericsson Mobile Communications AB
 Mobile Phone AAD-3880112-BV

FCC-ID: PY7A3880112-BV
 IC: 4170B-A3880112

Laboratory Accreditation and Listings			
 D-PL-12047-01-01	 Reg. No.: 736496 MRA US-EU 0003	 Industry Canada Reg. No.: 3462D-1 3462D-2	 Reg. No.: R-2665, R-2666 C-2914, T-1967 G-301
 CTIA Authorized Test Lab LAB CODE 20011130-00		 WIFI ALLIANCE AUTHORIZED RF LABORATORY	
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 device under test incorporates an NFC-Transceiver working at 13.56MHz nominal frequency. Other wireless technologies were 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-Gen, Issue 3 & RSS-310, Issue 2 regulations.

1.1. TESTS OVERVIEW FCC Part 15 and Canada IC Standards (RSS-Gen)

TEST CASES	PORT	REFERENCES & LIMITS			EUT set-up	EUT operating mode	Result
		FCC Standard	RSS Section	TEST LIMIT			
TX-Mode							
FIELD STRENGTH (radiated in 30m measurement distance) & EMISSION MASK	Cabinet	§2.1046 §15.225(a)(b)(c)(d)	RSS-310, Issue 2, Chapter 3.4.2 (c)	FCC Part 15.225 IC: Table 2+3	1	1	Passed
99% OCCUPIED BANDWIDTH	Antenna coupling (radiated)	§2.202 §2.1049	RSS Gen, Issue 3, Chapter 4.6.1	99% Power	--	--	Not performed -> Spectrum Mask fulfilled
SPURIOUS EMISSIONS (radiated)	Cabinet + Interconnecting cables (radiated)	§15.209(a)	RSS-Gen, Issue 3: Chapter 4.11 Chapter 7.2.5, Table 5+6 RSS-310: Issue 2, Table 2+3	2400/F(kHz) µV/m 24000/F(kHz) µV/m 30 µV/m	1	1	Passed
FREQUENCY STABILITY	Antenna coupling (radiated)	§2.1055 §15.225(e)	RSS-Gen, Issue 3, Chapter 4.7+7.2.6	FCC: ±100ppm IC: within Band	1	1	Passed
AC-Power Lines Conducted Emissions	AC-Power lines	§15.207	RSS-Gen, Issue 3: Chapter 7.2.4	FCC §15.207 limits IC: Table 4, Chapter 7.2.4	2	1+3	Passed

RX Mode							
AC-Power Lines Conducted Emissions	AC-Power lines	§15.107 §15.207	RSS-Gen, Issue 3: Chapter 7.2.4	FCC §15.107 class B limits §15.207 limits IC: Table 2, Chapter 7.2.4	2	2+3	Passed
RECEIVER Radiated emissions	Cabinet + Interconnecting cables (radiated)	§15.109 §15.33 §15.35	RSS-Gen, Issue 3: Chapter 7.2.5	FCC 15.109 class B limits IC-limits: Table 2, Chapter 6.1 & Table 5	1	2	Passed

Remark: --

ATTESTATION:

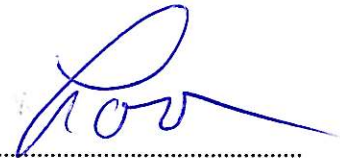
I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All requirements as shown in above table are met in accordance with enumerated standards.



.....
Dipl.-Ing. W. Richter
Responsible for testsection



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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 Registration 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.:	207 98191
Responsible for test report and project leader:	Dipl.-Ing. C. Lorenz
Receipt of EUT:	2011-04-04
Date(s) of test:	2011-04-04 to 2011-04-26
Date of report:	2011-05-03

Version of template:	11.01 _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 NFC Transceiver		
Type	AAD-3880112-BV		
Frequency range (US/Canada -bands)	13.553 -13.567 MHz		
Type of modulation	10% 2-ASK (Amplitude Shift Keying)		
Number of channels (USA/Canada -bands)	1 nominal channel at 13.56MHz		
Antenna Type	☒ Integrated ☐ External, no RF- connector ☐ External, separate RF-connector		
Antenna Gain	no information/not known		
Maximum field strength	30.4 dBuA/m at 30m (QP-detector)		
FCC-ID	PY7A3880112-BV		
IC	4170B-A3880112		
Installed option	☒ additional wireless technologies: GSM/UMTS/Bluetooth/Wifi ☒ battery charging option over separated AC/DC adapter ☒ GPS		
Power supply	Li-Io. Battery: range from 3.5V (V_{min}) to 4.1 V (V_{max})		
Special EMI components	--		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering

3.2. Configuration of cables used for testing

Cable number	Item	Type	S/N serial number	HW hardware status	Cable length
Cable 1	USB cable	EC700	#19321	--	1.2m

Remark:--

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	Mobile Phone	AAD-3880112-BV	IMEI: 004402142499 122 (#19771)	AP1.1	private
EUT B	AC Adapter	CAA-0002016-BV	#19318	EP800	--
EUT C	Battery Li-Io 3.7V BA750	CBA-0002024	000103SWBB CC	10W27	--
EUT D	USB cable	EC700	#19321	--	--

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

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	--	--	--	--	--

*) 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 A + EUT C	Integrated battery: radiated tests
Set. 2	EUT A + EUT B + EUT C + EUT D	Used for conducted tests on AC-mains and also radiated during RX-mode

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

3.6. EUT operating modes

EUT operating mode no. *)	Description of operating modes	Additional information
op. 1	NFC TX operating	Use of special test software for continuous TX mode, maximum output level. Baud-Rate: 424kbps, Cycle Time up to 100.000, normal and extreme test conditions
op. 2	NFC Stand-by/ RX-mode	Transmitter is set to RX-mode (no transmission), phone in stand-by mode, normal test conditions
op. 3	Charging battery	Charging standard battery. This operating mode is combined with other op. modes.

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

4. Measurements

4.1. Conducted emissions on AC-Power lines

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

test location							☒ CETECOM Essen (Chapter 2.2.1)	☐ Please see Chapter 2.2.2		☐ Please see Chapter 2.2.3			
test site		☐ 333 EMI field		☒ 348 EMI cond.		☐ 334 EMS-field		☐ 335 EMS cond		☐ 347 Radio.lab.		☐ 337 OATS	
receiver		☒ 001 ESS		☐ 377 ESCS 30		☐		☐		☐		☐	
LISN		☒ 005 ESH2-Z5		☐ 007 ESH3-Z6		☐ 300 ESH3-Z5 & 50Ω used for AE				☐ no LISN for AE		☐	
signaling		☐ 017 CMD 65		☐ 323 CMD 55		☐ 340 CMD 55							
signaling		☐ 298 CMU		☐ 460 CMU		☐ 295 RACAL		☐ 392 MT8820A					

STANDARDS AND LIMITS: PART 15, SUBPART B, §15.107 CLASS B, §15.207, CANADA: RSS-Gen, RSS-310, ANSI C63.4:2009

Frequency [MHz]	Conducted limit [dBμV]: 15.107 Class B and 15.207		Conducted limit [dBμV] 15.107 Class A	
	QUASI-Peak	AVERAGE	QUASI-Peak	AVERAGE
0.15 – 0.5	66 to 56*	56 to 46*	79	66
0.5 – 5	56	46	73	60
5 – 30	60	50	73	60

Remark: * decreases with the logarithm of the frequency

TEST CONDITION AND MEASUREMENT PROCEDURES TEST SET-UP

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

Devices which can be connected to the public AC-power network, should be tested against the radio frequency voltage conducted back into the AC-power line in the frequency range 150kHz to 30 MHz. Compliance should be tested by measuring the radio frequency voltage between each power line and ground at the power terminals in the stated frequency range.

A 500hm/50μH line impedance stabilization network (LISN) is used therefore. The EUT power input leads are connected through the LISN to the AC-power source. The LISN enclosure is electrically connected to the GND-plane. The measuring instrument is connected to the coaxial output of the LISN.

Tabletop devices were set-up on a 80 cm height over reference ground plane, floor standing equipment 10 cm raised above ground plane.

Measurements have been performed on each phase line and neutral line of the devices AC-power lines. The EUT was power supplied with 110 V/60Hz.

The EUT was tested in the defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant. The tests have been performed with a empty battery on the beginning of the tests.

Preliminary testing as a first step, determines the worst-case phase line (neutral or phase) as well as the most critical amplitude by changing the operating mode. A complete frequency-sweep is performed with PK-Detector.

Final testing for power phases and critical frequencies (Margin to AV- or QP limit lower than 3dB) as a second step includes measurements either on discrete frequency components with receivers detector set to Quasi-Peak and Average per frequency component or a complete sweep with corresponding detector.

MEASUREMENT RESULTS

EUT Type and S/N or EUT set-up no.		EUT set-up 2			
Diagram No.	Command or EUT operating mode or operating mode no.	Detector (Peak, AV, QP)	Power line (L1, L2, L3, N)	Additional (scan-) information (e.g. Pre-test Fast scan, Maxhold, Final measurement)	Result (passed / failed /final measurement . necessary)
b_1.01	EUT operating mode 1+3 (TX-Mode)	Peak, AV, QP	L1, N	The Diagram shows PK/AV detector measurements on L1 and N with max-hold mode. Final measurement QP and AV was carried out on at least one frequency (please see diagram)	passed
b_1.02	EUT operating mode 2+3 (RX-Mode)	Peak, AV, QP	L1, N	The Diagram shows PK/AV detector measurements on L1 and N with max-hold mode. Final measurement QP and AV was carried out on at least one frequency (please see diagram)	passed

Remarks: The diagram contains the maximum values from L 1 + N, pls. see annex A1

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

Abbreviations used:

- R_R : Receiver readings in dB μ V
- C_{Loss} : cable loss
- L_T : Limit in dB μ V

VERDICT

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

4.2. Radiated field strength emission mask at 13.110-14.010MHz

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

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	☐	☐	☐	☐	
spectr. analys.	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐	☐	
antenna	☐ 048 EMCO3143	☐ 133 EMCO3115	☐ 302 BBHA9170	☐ 289 CBL 6141	☒ 030 HFH-Z2	☐	
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40	
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 477 GPS	☐	

STANDARDS AND LIMITS: CFR 47, §15.225(a)(b)(c)(d), RSS-310

Frequency [MHz]	Field strength		Measurement distance [meters]	Remarks
	[μV/m]	[dBuV/m]		
13.553 -13.567 (allocated band)	15.848	84.00	30	Correction factor used due to measurement distance of 3m
13.410-13.710	334	50.47	30	
13.110-14.010	106	40.50	30	
Outside band 13.110-14.010	30	29.5	30	

TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	☐ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top	☐	☐ floor standing
Climatic conditions	Temperature: (23,6°C)		Rel. humidity: (31)%
EMI-Receiver (Analyzer) Settings	Span/Range: 9kHz to 150kHz; 150 kHz to 30 MHz RBW/VBW: 200Hz/auto; 10 kHz/ auto (ANSI63.10/CISPR#16) Detector/ Mode: PEAK, TRACE max-hold mode, repetitive scan for exploratory measurements Quasi-Peak, for final measurement on critical frequencies (f<1GHz)		

GENERAL MEASUREMENT PROCEDURES:

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

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

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

According the standard the compliance should be checked in 30m 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 9.

MEASUREMENT RESULTS: CARRIER FIELD STRENGTH (EMISSION MASK)

Set-up No.	1									
Operating Mode	1									
Diagram no.	Frequency	MaxPeak	Meas. Time	Bandwidth	Antenna height	Polarity	Turntable position	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
	(kHz)	(dBμV/m)	(ms)	(kHz)	(cm)		(deg)	(C _F)	(M)	(L _T)
b_3.00	13.560000	30.4	1000	10.00	100	--	203.0	0.4	53.60	84.00 (QP)

Remark: *.) see diagrams enclosed in annex A1 for details

MEASUREMENT RESULTS: RADIATED FIELD STRENGTH (SPURIOUS)

Set-up No.	1									
Operating Mode	1									
Diagram no.	Frequency	MaxPeak	Meas. Time	Bandwidth	Antenna height	Polarity	Turntable position	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
	(kHz)	(dBμV/m)	(ms)	(kHz)	(cm)		(deg)	(C _F)	(M)	(L _T)
b_3.01 ^{1.)}	560	-22.12	10	10	100	--	0..360°	--	>20dB	32.64
	10675.0	10.45	10	10	100	--	0..360°	--	19.09 dB	29.54
	28240	14.64	10	10	100	--	0..360°	--	14.09 dB	

Remark: *.) see diagrams enclosed in annex A1 for details

- 1.) Carrier at 13.56MHz on diagram, excluded from limit line
- 2.) Spurious between 17kHz to 53kHz due to external interferer

Margin to Limit: $M = L_T - R_R + C_F + D_F$ $= L_T - R_R + AF_{ANTENNA} + Cable_{LOSS} + D_F$ Remark: positive margin means passed result	Abbreviations used: • R_R : Receiver readings in dBμV/m • 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: Limits according §15.225(a)(b)(c) - passed

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

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

test location	☒ CETECOM Essen (Chapter. 2.2.1)	☐ Please see Chapter. 2.2.2	☐ Please see Chapter. 2.2.3
test site	☒ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS
receiver	☒ 377 ESCS30	☒ 001 ESS	☐ 347 Radio.lab.
spectr. analys.	☐ 381 380 FSBS	☐ 120 FSEM	☐ 264 FSEK
antenna	☒ 048 EMCO3143	☐ 133 EMCO3115	☐ 302 BBHA9170
signaling	☐ 298 CMU	☐ 460 CMU	☒ 392 MT8820A
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☒ 482 Filter Matrix

STANDARDS AND LIMITS: CFR 47, PART 15B, §15.209, RSS-Gen, RSS-310, ANSI C63.10:2009, ANSI 63.4:2009

Frequency [MHz]	Radiated emission limits, §15.109 Class B, 3 meters	
	QUASI-Peak [microvolts/meter]	QUASI-Peak [dBµV/m]
30-88	100	40
88-216	150	43.5
216-960	200	46.0
above 960	500	54.0 AV 74. PK

TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	☐ air link	☐ cable connection	☐
EUT-grounding	☐ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top 0.8m height	☐ floor standing	
Climatic conditions	Temperature: (23,6°C) Rel. humidity: (31)%		
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

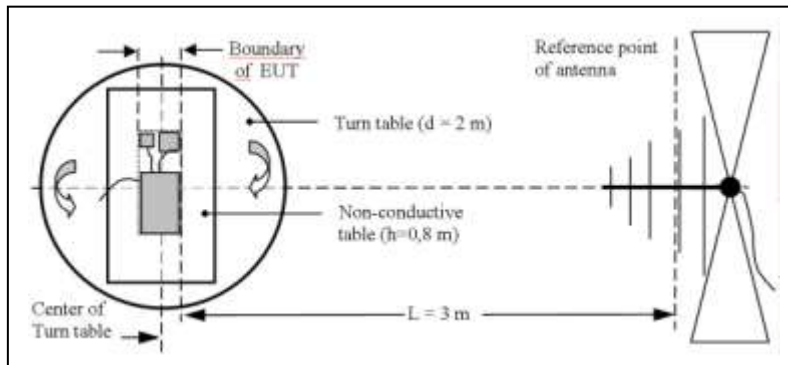
GENERAL MEASUREMENT PROCEDURES:

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.4: 2009 for the RX-Mode and ANSI63.10:2009 for the TX-mode.

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):

An 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 RESULTS TX-MODE

Remark: All emissions (restricted and other bands) are under general limits of FCC Part 15.109, class B or §15.209

Nominal channel=13.56MHz

Set-up No.		1								
Operating Mode		1								
Diagram no.	Frequency	MaxPeak	Meas. Time	Bandwidth	Antenna height	Polarity	Turntable position	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
	(MHz)	(dBμV/m)	(ms)	(kHz)	(cm)		(deg)	(C _F)	(M)	(L _T)
b_2.01	681.690000	25.2	1000	120.000	100.0	H	238.0	23.3	20.80	46.00 **

Remark: *.) see diagrams enclosed in annex A1 for details

**.) not restricted band

MEASUREMENT RESULTS RX-MODE

Set-up No.		2								
Operating Mode		2								
Diagram no.	Frequency	MaxPeak	Meas. Time	Bandwidth	Antenna height	Polarity	Turntable position	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
	(MHz)	(dBμV/m)	(ms)	(kHz)	(cm)		(deg)	(C _F)	(M)	(L _T)
b_2.24	48.32	24.2	1000	120.0	100.0	V	345.0	13.8	15.8	40.0
	155.14	9.3	1000	120.0	342.0	V	238.0	9.0	34.2	43.5
	895.03	29.9	1000	120.0	277.0	V	23.0	26.5	16.1	46.0

Remark: *.) see diagrams enclosed in annex A1 for details

Margin to Limit: $M = L_T - R_R + C_F + D_F$ $= L_T - R_R + \Delta F_{ANTENNA} + Cable_{LOSS} + D_F$ Remark: positive margin means passed result	Abbreviations used: • R_R : Receiver readings in dBμV/m • CF: Transducer in dB = AF (antenna factor) + CL (cable loss) • D_F : distance correction factor (if different measurement distance used than specified in the standard) • L_T : Limit in dBμV/m
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VERDICT

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

4.4. Frequency error(tolerance)

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	☐	☐	☐	☐
spectr. analys.	☐ 489 ESU40	☒ 584 FSU8	☐	☐	☐	☐
antenna	☐ 048 EMCO3143	☐ 133 EMCO3115	☐ 302 BBHA9170	☐ 289 CBL 6141	☐ 030 HFH-Z2	☒ 431 Model 7405
signaling	☐ 298 CMU	☐ 460 CMU	☐ 295 RACAL	☐ 392 MT8820A	☐	☐
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 477 GPS	☐

Standards and Limits: CFR 47, §15.225(e), ANSI 63.10: 2009

Frequency [MHz]	Frequency tolerance			Remarks
	[%]	[ppm]	[Hz]	
13.553 -13.567	±0.01	±100	±1356.7	Carrier should lie within designated bands under all extreme conditions regarding temperature&voltages

Test condition and measurement test set-up

link to test system (if used):	☐ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection: between potential equalisation connector (EUT) and GND with a lab wire 1,2 m)
Equipment set up	☒ table top	☐ floor standing	
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
EMI-Receiver (Analyzer) Settings	Span/Range: 9kHz to 150kHz; 150 kHz to 30 MHz RBW/VBW: 200Hz/auto; 10 kHz/ auto (ANSI63.10/CISPR#16) Detector/ Mode: PEAK, TRACE max-hold mode, repetitive scan for exploratory measurements		

REFERENCES

FCC: §15.225(e)

IC: RSS-210:A2.6

TEST SET-UP

A sniffer antenna acts like a coupling antenna for measuring the fundamental frequency. This is placed at about 20cm away from the equipment. Also connecting cables at the equipment are avoided on the extent possible in order not to degrade the resonance frequency of the equipment and integral antenna.

EQUIPMENT SETTINGS

The measurements is made on nominal carrier frequency within operational band.

TEST METHOD

If the equipment is capable of producing an un-modulated carrier then a trace with max-hold function was recorded. The maximum peak within the span was found, then the frequency deviation was recorded with the build-in frequency counter within the spectrum-analyzer ESU40. The maximum resolution was chosen which ESU40 can deliver.

The frequency deviation was recorded at switching on point of the equipment and on 2 minutes, 5minutes and 10 minutes after at in accordance with ANSI 63.10: 2009, Chapter 6.8

All measurements data are enclosed in annex measurements. Here only maximum frequency error is reported.

4.4.1. Frequency shift of carrier against voltage range at constant nominal temperature of 20° Celsius

- 1.) determine the carrier frequency for the lowest and highest channel at room temperature and nominal voltage [20°C] after a long run of the device equipment (EUT). This frequency is taken as reference for all other measured frequencies.
- 2.) loaded batteries with specified voltage are prepared and used in the equipment specified range of the battery and equipment declared voltage.

Results

Set.up 1, Op. Mode 1

Nominal conditions

Vnom = 4.1 V (full battery)
Tnom = 21°C

Reference frequency
[MHz]

13,5600409

Limit-> 100ppm:

1356,00409

Hz

Extreme conditions

Voltage [V]	measured frequency [MHz]				max. Values for Frequency Error		
	on start up	2 minutes after	5 minutes after	10 minutes after	[Hz]	[%]	[ppm]
Vmax= 4,1	13,56007300	13,56006800	13,5600627	13,5600553	-32,1000000	-0,000237	-2,37
4,0	13,56007360	13,56006790	13,56006390	13,56005850	-32,7000000	-0,000241	-2,41
3,9	13,56006990	13,56006530	13,56006050	13,56005410	-29,0000000	-0,000214	-2,14
3,8	13,56006490	13,56006000	13,56005670	13,56005460	-24,0000000	-0,000177	-1,77
3,7	13,56006420	13,56005930	13,56005520	13,56005060	-23,3000000	-0,000172	-1,72
3,6	13,56005990	13,56005710	13,56005390	--	-19,0000000	-0,000140	-1,40
Vmin= 3,5	13,56004950	--	--	--	-8,6000000	-0,000123	-0,63

Remark: not all time requirements could be fulfilled due to low performance of the battery on low temperatures.

4.4.2. Frequency shift of carrier against temperature at constant power supply voltage

- 1.) Use a full loaded battery for tests according this chapter
- 2.) determine the carrier frequency at room temperature and nominal voltage [20°C] after a long run of the device equipment (EUT). This frequency is taken as reference for all other measured frequencies.
- 3.) Perform the carrier frequencies measurements in 10°C increments from 50°C down to -20°C as required by the standards. The stabilization period was about 1 hour after thermal reach of the required temperature.

Results

Set. Up. 1/ Op. Mode 1

Nominal conditions

Vnom = 4.1 V (full battery)
Tnom = 21°C

Reference frequency [MHz] **13,5600409** Limit-> 100ppm: **1356,00409** Hz

Extreme conditions

Temperature	Measurement period after power-up the EUT	Frequency measured	Values for Frequency Error		
			[Hz]	[Hz]	[ppm]
Tmax=50°C	on StartUp	13,5599725	-68,4000000	-0,000504	-5,04
	2 Minutes	13,5599679	-73,0000000	-0,000538	-5,38
	5 Minutes	13,5599622	-78,7000000	-0,000580	-5,80
	10 Minutes	13,5599584	-82,5000000	-0,000608	-6,08
T=40°C	on StartUp	13,5600065	-34,4000000	-0,000254	-2,54
	2 Minutes	13,5600017	-39,2000000	-0,000289	-2,89
	5 Minutes	13,5599927	-48,2000000	-0,000355	-3,55
	10 Minutes	13,5599859	-55,0000000	-0,000406	-4,06
T=30°C	on StartUp	13,5600537	12,8000000	0,000094	0,94
	2 Minutes	13,5600476	6,7000000	0,000049	0,49
	5 Minutes	13,5600415	0,6000000	0,000004	0,04
	10 Minutes	13,5600368	-4,1000000	-0,000030	-0,30
T=20°C	= Reference frequency				
T=10°C	on StartUp	13,5601380	97,1000000	0,000716	7,16
	2 Minutes	13,5601337	92,8000000	0,000684	6,84
	5 Minutes	13,5601303	89,4000000	0,000659	6,59
	10 Minutes	13,5601270	86,1000000	0,000635	6,35
T=0°C	StartUp	13,5601609	120,0000000	0,000885	8,85
	2 Minutes	13,5601588	117,9000000	0,000869	8,69
	5 Minutes	13,5601572	116,3000000	0,000858	8,58
	10 Minutes	13,5601559	115,0000000	0,000848	8,48
T=-10°C	StartUp	13,5601647	123,8000000	0,000913	9,13
	2 Minutes	13,560166	125,1000000	0,000923	9,23
	5 Minutes	13,5601666	125,7000000	0,000927	9,27
	10 Minutes	13,5601669	126,0000000	0,000929	9,29

T=-20°C	StartUp	13,5601685	127,6000000	0,000941	9,41
	2 Minutes	13,5601686	127,7000000	0,000942	9,42
	5 Minutes	13,5601673	126,4000000	0,000932	9,32
	10 Minutes	13,5601605	119,6000000	0,000882	8,82

Remark: reference frequency and worst-case Frequency error can be found in annex A1 as plot, yellow is worst-case.

VERDICT: Limits according §15.225(e) + within assigned band limits - passed

4.5. 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 .. 18GHz	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

5. Instruments and Ancillary

5.1. Used equipment “CTC”

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

5.1.1. 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	Communication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT Firmware D2.87
053	audio analyzer	UPA3	860612/022	Firm. V 4.3
119	RT harmonics analyser/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,
298	Univ. Radio Communication Tester	CMU 200	832221/091	R&S Test Firmware =3.53 /3.54 (current Testsoftw. f.
323	Communication Tester	CMD 055	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	-	EMS-K1 Immunity Test-Software 1.20SR10
340	Univ. Communication 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,
441	System CTC-SAR-EMI Cable Loss	System EMI field (SAR)	-	EMC 32 Version 8.40
442	System CTC-SAR-EMS	System EMS field (SAR)	-	EMC 32 Version 8.40
443	System CTC-FAR-EMI-Spuri	System CTC-FAR-EMI-	-	Spuri 7.2.5
444	System CTC FAR-EMS	System EMS-Field (FAR)	-	EMS-K1 Immunity-Software 1.20SR10
460	Univ. Radio Communication Tester	CMU 200	108901	R&S Test Firmware Base=5.14/Messsoftware=
489	emi test receiver	ESU40	1000-30	Firmware=4.43 SP3, Bios=V5.1-16-3,
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
547	Univ. Radio Kommunikation Tester	CMU 200	835390/014	R&S Test Firmware Base=V5.1403 (current Testsoftw.
584	Spectrum Analyzer	FSU 8	100248	2.82 SP3
594	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 /Messsoftware=
598	Spectrum Analyser	FSEM 30 (Reserve)	831259/013	Firmware Bios 3.40 , Analyzer 3.40 Sp 2

5.1.2. 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
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
031	absorbing clamp	MDS-21	863325/015	Rohde & Schwarz	36 M	-	31.03.2012
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	31.03.2013
051	VHF-current probe 20-300 MHz	ESV-Z1	872421	Rohde & Schwarz	36 M	-	31.03.2012
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
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
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO	12 M	-	31.03.2012
261	thermal power sensor	NRV-Z55	825083/0008	Rohde & Schwarz	24/12 M	-	31.03.2012
264	spectrum analyzer	FSEK 30	826939/005	Rohde & Schwarz	12 M	-	31.03.2014
268	AC/DC power supply	EA 3050-A	9823636	-	pre-m	2	
298	Univ. Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	pre-m	-	
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
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
400	ferrite tube (>15 dB, EN 55022)	FTC 40 X 15 E	5559	Lüthi	36 M	-	31.03.2012
401	ferrite tube (>15 dB, EN 55022)	FTC 40 X 15 E	5560	Lüthi	36 M	-	31.03.2012
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
489	emi test receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	31.03.2012
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
598	Spectrum Analyser	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
608	UltraLog-Antenna	HL 562	830547/009	Rohde & Schwarz	36/12 M	-	31.03.2014

5.1.3. 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-spurious emission (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

