

Inter**Lab**[®]

Final Report on

Bittium Tough Mobile

FCC ID V27SD-41

IC: 3282B-SD41

Report Reference: MDE_ELEKT_1502_FCCi
according to FCC Part 90 Subpart R

Date: October 29, 2015

Test Laboratory:

7layers GmbH
Borsigstraße 11
40880 Ratingen
Germany



Note:

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

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Dr. Harald Ansorge

Registergericht registered in:
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USt-IdNr VAT No.:
DE203159652
TAX No. 147/5869/0385
A Bureau Veritas Group Company

1 Administrative Data

1.1 Project Data

Project Responsible: Imad Hjije
Date Of Test Report: 2015/10/29
Date of first test: 2015/06/22
Date of last test: 2015/10/23

1.2 Applicant Data

Company Name: Bittium Wireless Ltd.

Street: Tutkijantie 8
City: 90570 Oulu
Country: Finland

Contact Person: Mr. Jyrki Juvani

Function: Specialist, Test Management
Department: Wireless Solutions
Phone: +358 40 344 5781
E-Mail: Jyrki.Juvani@bittium.com

1.3 Test Laboratory Data

The following list shows all places and laboratories involved for test result generation:

7 layers DE

Company Name : 7layers GmbH
Street : Borsigstrasse 11
City : 40880 Ratingen
Country : Germany
Contact Person : Mr. Michael Albert
Phone : +49 2102 749 201
Fax : +49 2102 749 444
E Mail : Michael.Albert@7Layers.com

Laboratory Details

Lab ID	Identification	Responsible	Accreditation Info
Lab 1	Radiated Emissions	Mr. Marco Kullik Mr. Robert Machulec	DAkKS-Registration no. D-PL-12140-01-01
Lab 2	Radio Lab	Mr. Dobrin Dobrinov Mr. Daniel Gall	DAkKS-Registration no. D-PL-12140-01-01

1.4 Signature of the Testing Responsible


Imad Hjije
responsible for tests performed in: Lab 1, Lab 2

1.5 Signature of the Accreditation Responsible

 [B. RETKA]

Accreditation scope responsible person
responsible for Lab 1, Lab 2

2 Test Object Data

2.1 General OUT Description

The following section lists all OUTs (Object's Under Test) involved during testing.

OUT: Bittium Tough Mobile
FCC ID: V27SD-41
IC: 3282B-SD41

Manufacturer:

Company Name:

See applicant data:

Contact Person:

-

Parameter List:

Parameter name

Value

2.2 Detailed Description of OUT Samples

Sample : aa01

<i>OUT Identifier</i>	Bittium Tough Mobile		
	FCC ID: V27SD-41		
	IC: 3282B-SD41		
<i>Sample Description</i>	Radiated Sample		
<i>Serial No.</i>	K0251300425		
<i>HW Status</i>	0302		
<i>SW Status</i>	2.6.0		
<i>Low Voltage</i>	3.6 V	<i>Low Temp.</i>	-30 °C
<i>High Voltage</i>	4.2 V	<i>High Temp.</i>	+55 °C
<i>Nominal Voltage</i>	3.8 V	<i>Normal Temp.</i>	23 °C

Sample : ae01

<i>OUT Identifier</i>	Bittium Tough Mobile		
	FCC ID: V27SD-41		
	IC: 3282B-SD41		
<i>Sample Description</i>	Conducted Sample		
<i>Serial No.</i>	K0251300433		
<i>HW Status</i>	0302		
<i>SW Status</i>	2.6.0		
<i>Low Voltage</i>	3.6 V	<i>Low Temp.</i>	-30 °C
<i>High Voltage</i>	4.2 V	<i>High Temp.</i>	+55 °C
<i>Nominal Voltage</i>	3.8 V	<i>Normal Temp.</i>	23 °C

Sample : af01

<i>OUT Identifier</i>	Bittium Tough Mobile		
	FCC ID: V27SD-41		
	IC: 3282B-SD41		
<i>Sample Description</i>	Conducted Sample		
<i>Serial No.</i>	K0251300436		
<i>HW Status</i>	0302		
<i>SW Status</i>	2.6.0		
<i>Low Voltage</i>	3.6 V	<i>Low Temp.</i>	-30 °C
<i>High Voltage</i>	4.2 V	<i>High Temp.</i>	+55 °C
<i>Nominal Voltage</i>	3.8 V	<i>Normal Temp.</i>	23 °C

2.3 OUT Features

Features for OUT: Bittium Tough Mobile
FCC ID: V27SD-41
IC: 3282B-SD41

<i>Designation</i>	<i>Description</i>	<i>Allowed Values</i>	<i>Supported Value(s)</i>
Features for scope: FCC_v2			
AC	The OUT is powered by or connected to AC Mains		
BT	EUT supports Bluetooth data rate of 1 Mbps with GFSK modulation in the band 2400 MHz - 2483.5 MHz		
BTLE	Support of Bluetooth Low Energy		
DC	The OUT is powered by or connected to DC		
EDGE850	EUT supports EDGE in the band 824 MHz - 849 MHz		
EDGE1900	EUT supports EDGE in the band 1850 MHz - 1910 MHz		
EDR2	EUT supports Bluetooth using data rate of 2 Mbps with PI/4 DQPSK modulation in the band 2400 MHz - 2483.5 MHz		
EDR3	EUT supports Bluetooth using data rate of 3 Mbps with 8DPSK modulation in the band 2400 MHz - 2483.5 MHz		
eFDD2	Supported bandwidth: 1.4, 3, 5, 10, 15 and 20 MHz		
eFDD4	Supported bandwidth: 1.4, 3, 5, 10, 15 and 20 MHz		
eFDD5	Supported bandwidth: 1.4, 3, 5 and 10 MHz		
eFDD13	Supported bandwidth: 5 and 10 MHz		
eFDD14	Supported bandwidth: 5 and 10 MHz		
eFDD17	Supported bandwidth: 5 and 10 MHz		
FDD2	EUT supports UMTS FDD2 in the band 1850 MHz - 1910 MHz		
FDD5	EUT supports UMTS FDD5 in the band 824 MHz - 849 MHz		
GSM850	EUT supports GSM850 band 824MHz - 849MHz		
HSDPA-FDD2	EUT supports UMTS FDD2 HSDPA in the band 1850 MHz - 1910 MHz		
HSDPA-FDD4	EUT supports UMTS FDD4 HSDPA in the band 1710 MHz - 1755 MHz		
HSDPA-FDD5	EUT supports UMTS FDD5 HSDPA in the band 824 MHz - 849 MHz		
HSUPA-FDD2	EUT supports UMTS FDD2 HSUPA in the band 1850 MHz - 1910 MHz		
HSUPA-FDD4	EUT supports UMTS FDD4 HSUPA in the band 1710 MHz - 1755 MHz		
HSUPA-FDD5	EUT supports UMTS FDD5 HSUPA in the band 824 MHz - 849 MHz		
Iant	Integral Antenna: permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment		
PCS1900	EUT supports PCS1900 band 1850MHz - 1910MHz		
TantC	temporary antenna connector, which may be only built-in for testing, designed as an example part of the equipment		
Wa1	EUT supports WLAN in mode a in the band 5150 MHz - 5250 MHz		
Wa2	EUT supports WLAN in mode a in the band 5250 MHz - 5350 MHz		

Features for OUT: Bittium Tough Mobile
FCC ID: V27SD-41
IC: 3282B-SD41

<i>Designation</i>	<i>Description</i>	<i>Allowed Values</i>	<i>Supported Value(s)</i>
Wa3	EUT supports WLAN in mode a in the band 5470 MHz - 5725 MHz		
Wa4	EUT supports WLAN in mode a in the band 5725 MHz - 5825 MHz		
Wa5	EUT supports WLAN in mode a in the band 5725 MHz - 5875 MHz		
Wa10	EUT supports WLAN in mode a in the band 5650 MHz - 5700 MHz		
Wn	EUT supports WLAN in mode n in the band 2400 MHz - 2483.5 MHz		

2.4 Setups used for Testing

For each setup a relation is given to determine if and which samples and auxiliary equipment is used. The left side list all OUT samples and the right side lists all auxiliary equipment for the given setup.

<i>Setup No.</i>	<i>List of OUT samples</i>	<i>List of auxiliary equipment</i>
<i>Sample No.</i>	<i>Sample Description</i>	<i>AE No.</i> <i>AE Description</i>
S01_AA01		
Sample: aa01	Radiated Sample	
S01_AE01		
Sample: ae01	Conducted Sample	
S01_AF01		
Sample: af01	Conducted Sample	

3 Results

3.1 General

Documentation of tested devices:

Available at the test laboratory.

Interpretation of the test results:

The results of the inspection are described on the following pages, where 'Conformity' or 'Passed' means that the certification criteria were verified and that the tested device is conform to the applied standard.

In cases where 'Declaration' is printed, the required documents are available in the manufacturers product documentation.

In cases where 'not applicable' is printed, the test case requirements are not relevant to the specific equipment implementation.

Note:

1. All tests are performed under environmental conditions within the requirements of the specifications. Environmental conditions are available at the laboratory.

2. This report covers only LTE band 14. Other Bands and technologies are reported separately.

3.2 List of the Applicable Body

(Body for Scope: FCC_v2)

<i>Designation</i>	<i>Description</i>
FCC47CFRChIPART90PRIVATE LAND MOBILE RADIO SERVICES	Subpart I - General Technical Standards & Subpart S - Regulations Governing Licensing and Use of Frequencies

3.3 List of Test Specification

<i>Test Specification:</i>	FCC part 90
<i>Version</i>	10-1-13 Edition
<i>Title:</i>	PART 90 - GENERAL RULES AND REGULATIONS

3.4 Summary

Test Case Identifier / Name Test (condition)	Result	Date of Test	Lab Ref.	Setup
90.1 Maximum Channel Power, §2.1046, §90.205&90.635				
90.1; RF Power Output Summary §2.1046, §90.542	Passed	2015/08/26	Lab 2	S01_AF01
90.2 Occupied Bandwidth, §2.1049, §90.209				
90.2; Emission and Occupied Bandwidth Summary §2.1049	Passed	2015/07/19	Lab 2	S01_AE01
90.3 Band Edges Compliance, §2.1051, §90.691				
90.3; Band edge compliance summary §2.1053, §90.543	Passed	2015/07/19	Lab 2	S01_AE01
90.4 Spurious Emissions at Antenna Terminal, §2.1051, §90.210&§90.669				
90.4; Spurious emissions at antenna terminals summary §2.1051, §90.543	Passed	2015/07/17	Lab 2	S01_AE01
90.5 Radiated Spurious Emission, §2.1055, §90.210				
90.5; Frequency Band = eFDD14, Mode = QPSK 5MHz, Channel = 23305, Frequency = 790.5MHz, Method = radiated	Passed	2015/10/23	Lab 1	S01_AA01
90.5; Frequency Band = eFDD14, Mode = QPSK 5MHz, Channel = 23330, Frequency = 793MHz, Method = radiated	Passed	2015/06/22	Lab 1	S01_AA01
90.5; Frequency Band = eFDD14, Mode = QPSK 5MHz, Channel = 23355, Frequency = 795.5MHz, Method = radiated	Passed	2015/06/22	Lab 1	S01_AA01
90.6 Frequency Stability, §2.1055, §90.230				
90.6; Frequency Band = eFDD14, Mode = QPSK, mid Channel = 23330, Frequency = 793MHz, Method = conducted	Passed	2015/08/09	Lab 2	S01_AE01
90.7 Peak-to-Average Ratio §2.1046				
90.7; Peak-to-Average Ratio Summary §2.1046	Passed	2015/08/05	Lab 2	S01_AE01

3.5 Detailed Results

3.5.1 90.1 Maximum Channel Power, §2.1046, §90.205&90.635

Test: 90.1; RF Power Output Summary §2.1046, §90.542

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_AF01
<i>Date of Test:</i>	2015/08/26 17:06
<i>Body:</i>	FCC47CFRChIPART90PRIVATE LAND MOBILE RADIO SERVICES
<i>Test Specification:</i>	FCC part 90

Detailed Results:

Test Band	Bandwidth	Channel	Modulation	RB	RMS Conducted Power (dBm)	FCC ERP limit (dBm)	Verdict
eFDD14	5	23305	QPSK	RB 1	23.50	34.77	Passed
				RB 12	22.10	34.77	Passed
				RB 25	22.00	34.77	Passed
			16QAM	RB 1	22.40	34.77	Passed
				RB 25	21.00	34.77	Passed
		23330	QPSK	RB 1	23.20	34.77	Passed
				RB 12	22.10	34.77	Passed
				RB 25	22.10	34.77	Passed
			16QAM	RB 1	22.50	34.77	Passed
				RB 25	21.20	34.77	Passed
		23355	QPSK	RB 1	23.20	34.77	Passed
				RB 12	22.10	34.77	Passed
				RB 25	22.00	34.77	Passed
			16QAM	RB 1	22.30	34.77	Passed
				RB 25	21.00	34.77	Passed
	10	23330	QPSK	RB 1	23.40	34.77	Passed
				RB 50	22.00	34.77	Passed
			16QAM	RB 1	22.40	34.77	Passed
				RB 50	21.10	34.77	Passed



Marker 1 [T1]

RBW 100 kHz

RF Att 30 dB

Ref Lvl

21.22 dBm

VBW 300 kHz

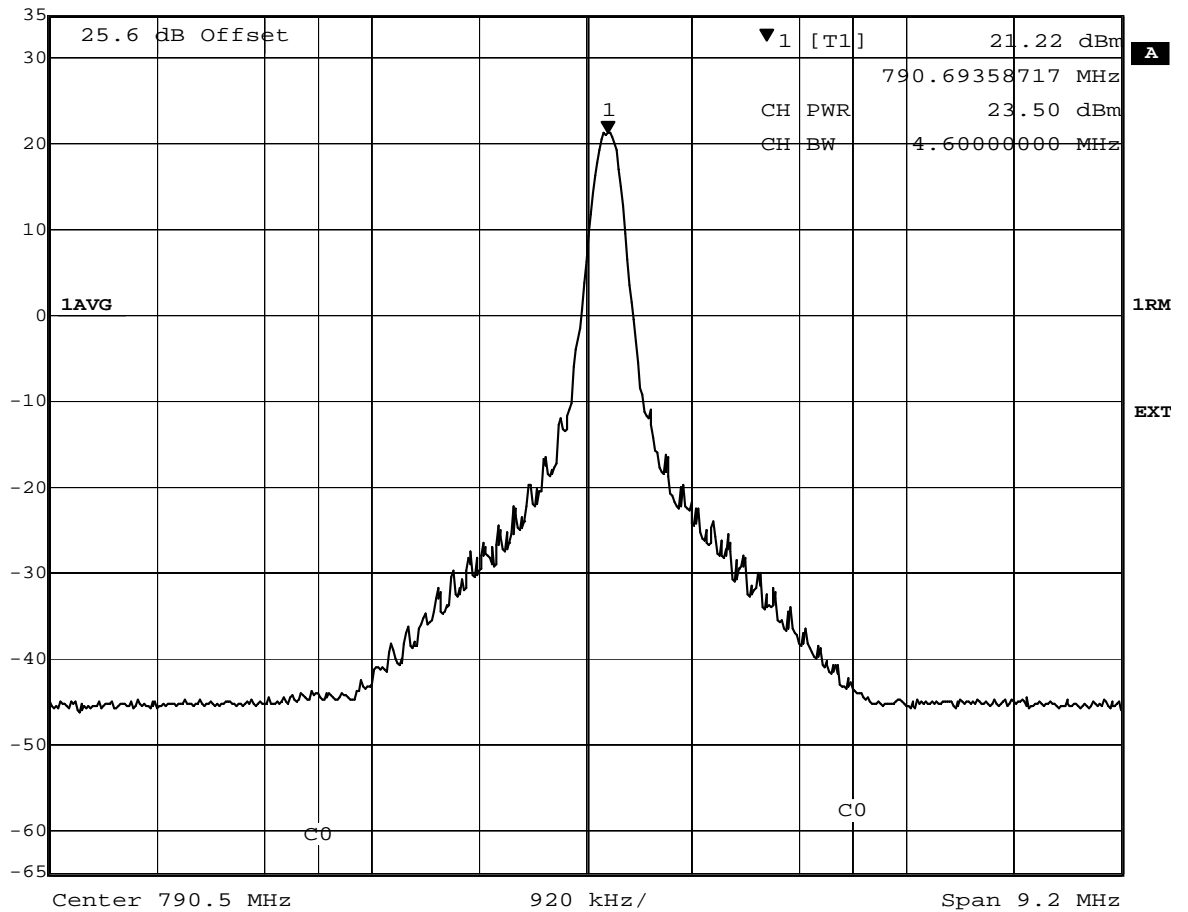
35 dBm

790.69358717 MHz

SWT 5 ms

Unit

dBm



Date: 26.AUG.2015 18:01:47

3.5.2 90.2 Occupied Bandwidth, §2.1049, §90.209

Test: 90.2: Emission and Occupied Bandwidth Summary §2.1049

Result: Passed

Setup No.: S01_AE01

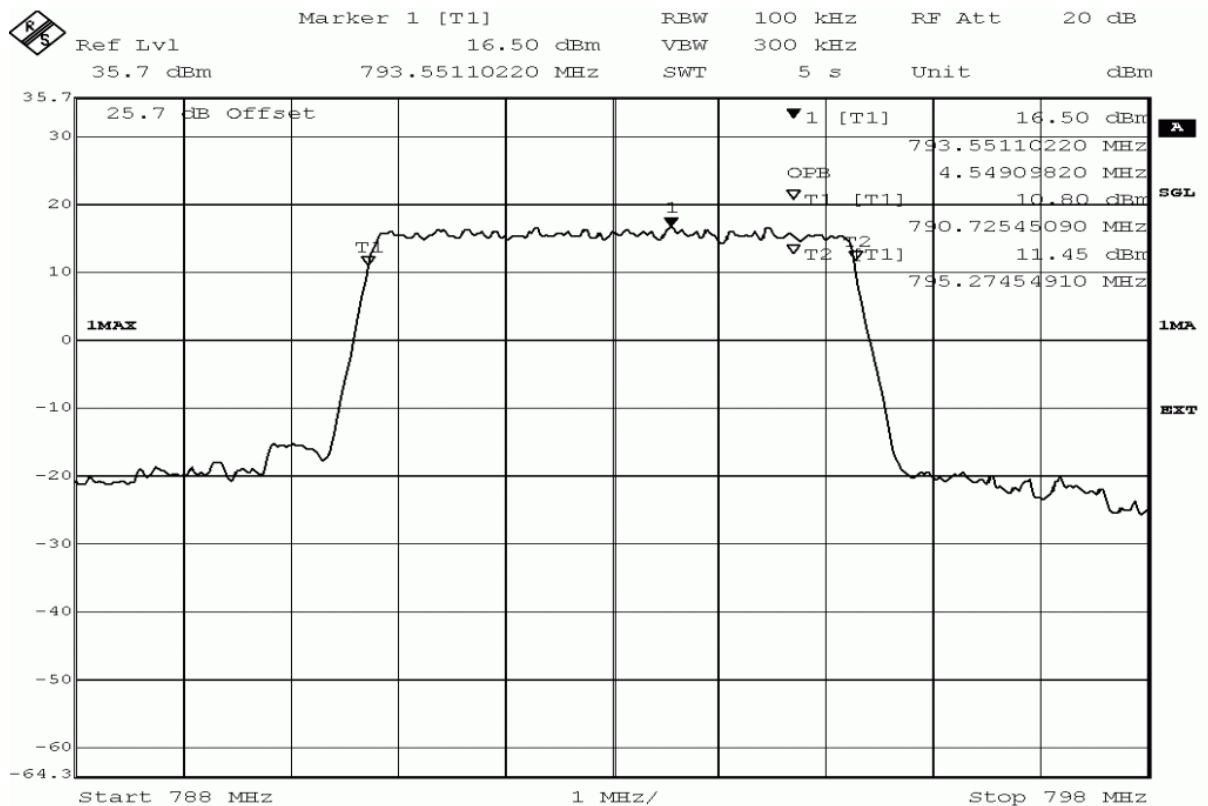
Date of Test: 2015/07/19 17:11

Body: FCC47CFRChIPART90PRIVATE LAND MOBILE RADIO SERVICES

Test Specification: FCC part 90

Detailed Results:

LTE Band 14							
Channel BW: 5MHz				Channel BW: 10 MHz			
Channel	Frequency (MHz)	99% BW (MHz)		Channel	Frequency (MHz)	99% BW (MHz)	
		QPSK	16QAM			QPSK	16QAM
23305	790.5	4.5	4.5	-	-	-	-
23330	793.0	4.5	4.5	23330	793.0	9.1	9.1
23355	795.5	4.5	4.5	-	-	-	-



Title: bandwidth measurement

Comment A: DE1132001, eFDD14 QPSK 5 MHz, occupied bandwidth (99%), channel 23330 (793.0MHz)

Date: 19.JUL.2015 09:09:59

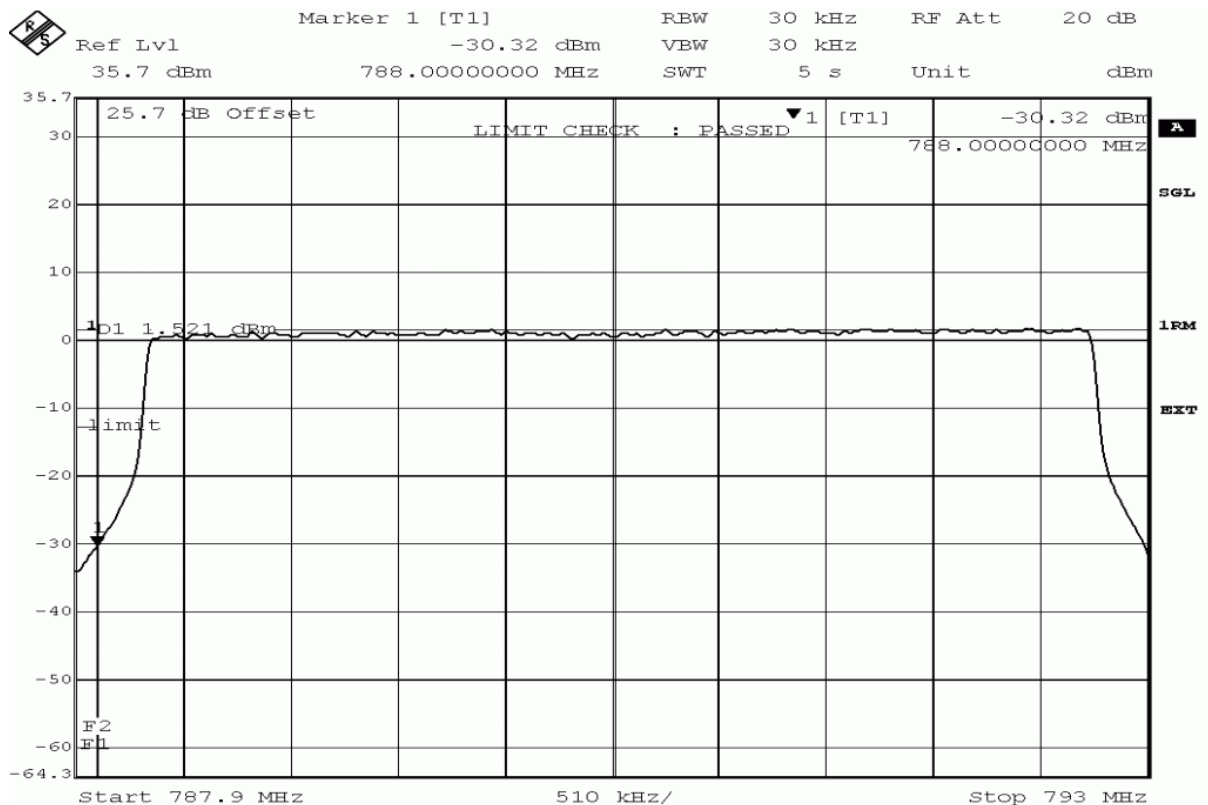
3.5.3 90.3 Band Edges Compliance, §2.1051, §90691

Test: 90.3: Band edge compliance summary §2.1053, §90.543

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_AE01
<i>Date of Test:</i>	2015/07/19 17:15
<i>Body:</i>	FCC47CFRChIPART90PRIVATE LAND MOBILE RADIO SERVICES
<i>Test Specification:</i>	FCC part 90

Detailed Results:

Modulation	Resource Blocks / Offset	Channel	Detector	Frequency (MHz)	Peak Value (dBm)	Limit (dBm)	Verdict
QPSK	25 / 0	23305	Average	777	-31.91	-13	Passed
			RMS		-30.32	-13	Passed
	25 / Max	23355	Average	787	-32.36	-13	Passed
			RMS		-31.24	-13	Passed
16QAM	25 / 0	23305	Average	777	-33.02	-13	Passed
			RMS		-31.24	-13	Passed
	25 / Max	23355	Average	787	-33.84	-13	Passed
			RMS		-31.91	-13	Passed
QPSK	50 / 0	23330	Average	777	-32.26	-13	Passed
	RMS		-30.62		-13	Passed	
16QAM	50 / 0		Average	787	-33.42	-13	Passed
			RMS		-31.91	-13	Passed



Title: band edge compliance measurement
Comment A: DE1132001, eFDD14 QPSK 5 MHz, band edge compliance,
channel 23305 (790.5MHz)
Date: 19.JUL.2015 09:47:33

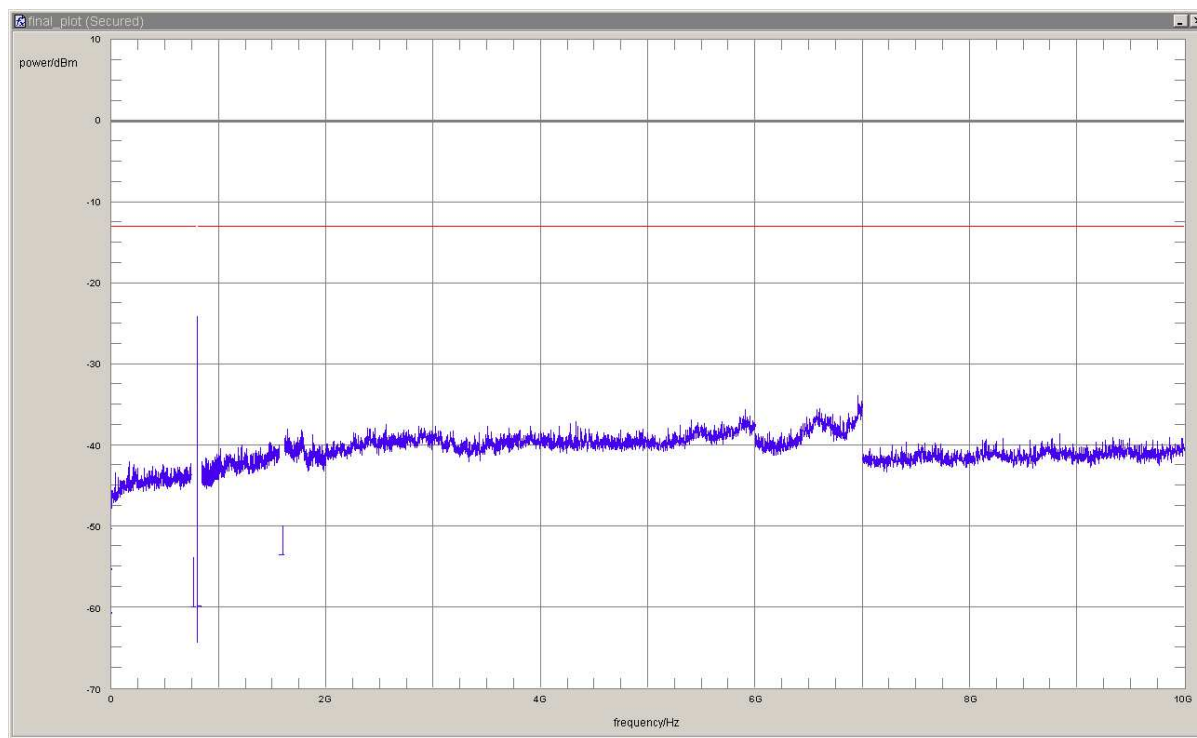
3.5.4 90.4 Spurious Emissions at Antenna Terminal, §2.1051, §90.210&§90.669

Test: 90.4: Spurious emissions at antenna terminals summary §2.1051, §90.543

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_AE01
<i>Date of Test:</i>	2015/07/17 17:22
<i>Body:</i>	FCC47CFRChIPART90PRIVATE LAND MOBILE RADIO SERVICES
<i>Test Specification:</i>	FCC part 90

Detailed Results:

Band / Band-width	Modulation	Channel	Detector	Trace	Resolution Band-width (kHz)	Frequency (MHz)	Highest Value (dBm)	Margin to Limit /dB	Limit /dBm	Verdict
eFDD14 / 5MHz	QPSK	23305	rms	maxhold	100	786.2	-32.7	19.7	-13	Passed
		23305	rms	maxhold	100	787.9	-26.3	13.3	-13	Passed
		23305	rms	maxhold	30	788.0	-22.5	9.5	-13	Passed
		23330	rms	maxhold	100	-	-	-	-13	Passed
		23355	rms	maxhold	30	798.0	-24.1	11.1	-13	Passed
		23355	rms	maxhold	100	798.1	-24.5	11.5	-13	Passed
		23355	rms	maxhold	10	799.6	-47.9	12.9	-35	Passed
		23355	rms	maxhold	10	799.8	-40.9	5.9	-35	Passed
		23355	rms	maxhold	10	801.8	-53.9	18.9	-35	Passed
		23355	rms	maxhold	10	801.8	-53.9	18.9	-35	Passed
		23355	rms	maxhold	10	801.8	-53.9	18.9	-35	Passed
		23355	rms	maxhold	10	802.0	-47.9	12.9	-35	Passed
		23355	rms	maxhold	10	802.2	-53.9	18.9	-35	Passed
		23355	rms	maxhold	10	802.2	-53.9	18.9	-35	Passed



3.5.5 90.5 Radiated Spurious Emission, §2.1055, §90.210

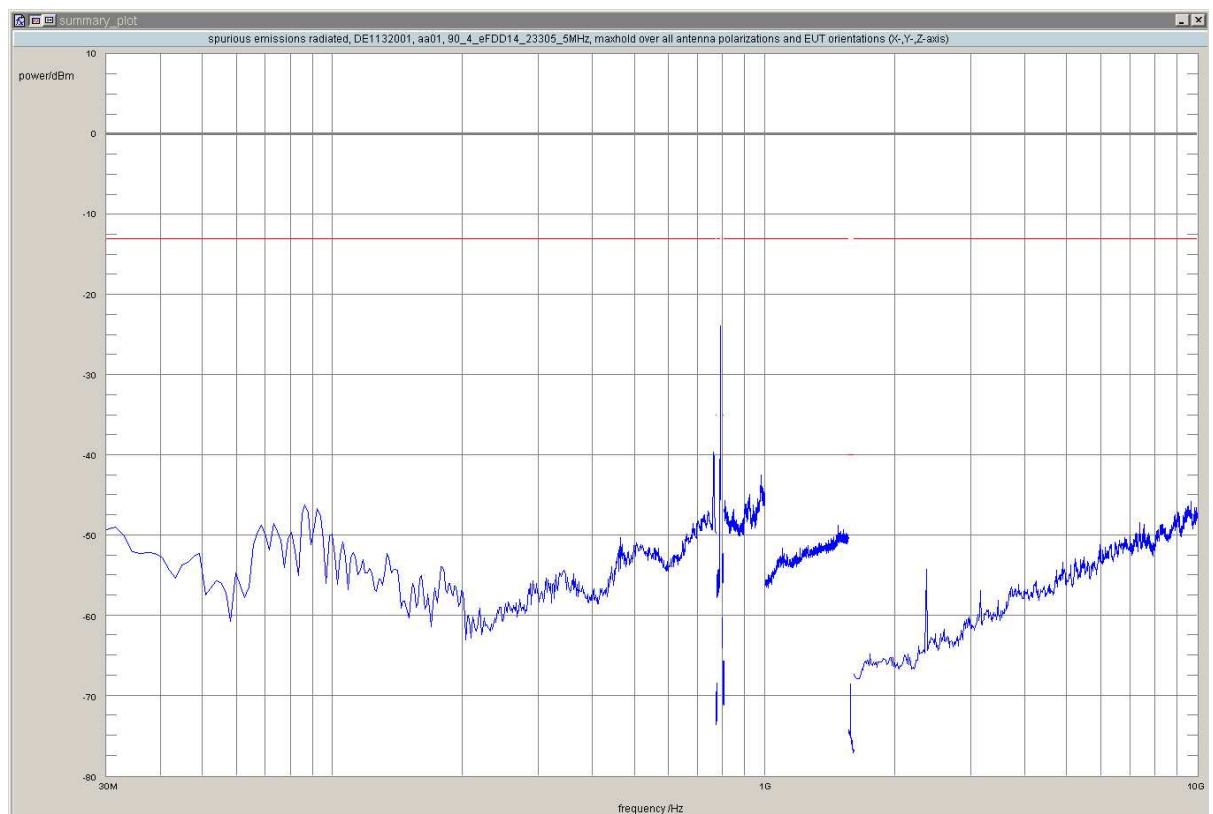
Test: 90.5; Frequency Band = eFDD14, Mode = QPSK 5MHz, Channel = 23305, Frequency = 790.5MHz, Method = radiated

Result: Passed
Setup No.: S01_AA01
Date of Test: 2015/10/23 17:30
Body: FCC47CFRChIPART90PRIVATE LAND MOBILE RADIO SERVICES
Test Specification: FCC part 90

Detailed Results:

detector	trace	resolution bandwidth /kHz	frequency /MHz	peak value /dBm	limit /dBm	margin to limit /dB	azimuth /°	antenna polarization	EUT orientation	verdict
peak	maxhold	100	787.90	-23.82	-13.00	10.82	-180.0	horizontal	horizontal	passed

no further values have been found with a margin of less than 20 dB



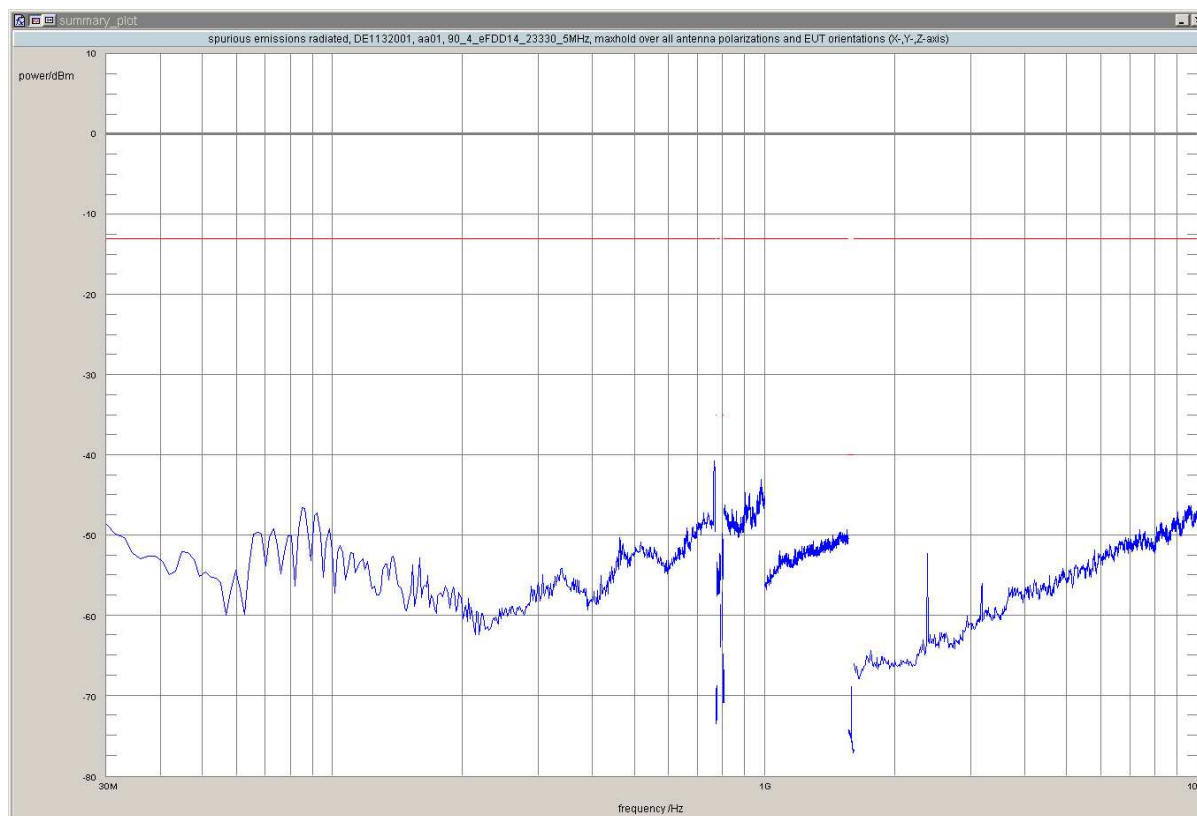
Test: 90.5; Frequency Band = eFDD14, Mode = QPSK 5MHz, Channel = 23330, Frequency = 793MHz, Method = radiated

Result: Passed
Setup No.: S01_AA01
Date of Test: 2015/06/22 17:32
Body: FCC47CFRChIPART90PRIVATE LAND MOBILE RADIO SERVICES
Test Specification: FCC part 90

Detailed Results:

detector	trace	resolution bandwidth /kHz	frequency /MHz	peak value /dBm	limit /dBm	margin to limit /dB	azimuth /°	antenna polarization	EUT orientation	verdict
peak	maxhold	1000	764.6	-40.75	-13.00	27.75	0.0	vertical	vertical	passed

no further values have been found with a margin of less than 20 dB



Test: 90.5; Frequency Band = eFDD14, Mode = QPSK 5MHz, Channel = 23355, Frequency = 795.5MHz, Method = radiated

Result: Passed

Setup No.: S01_AA01

Date of Test: 2015/06/22 17:33

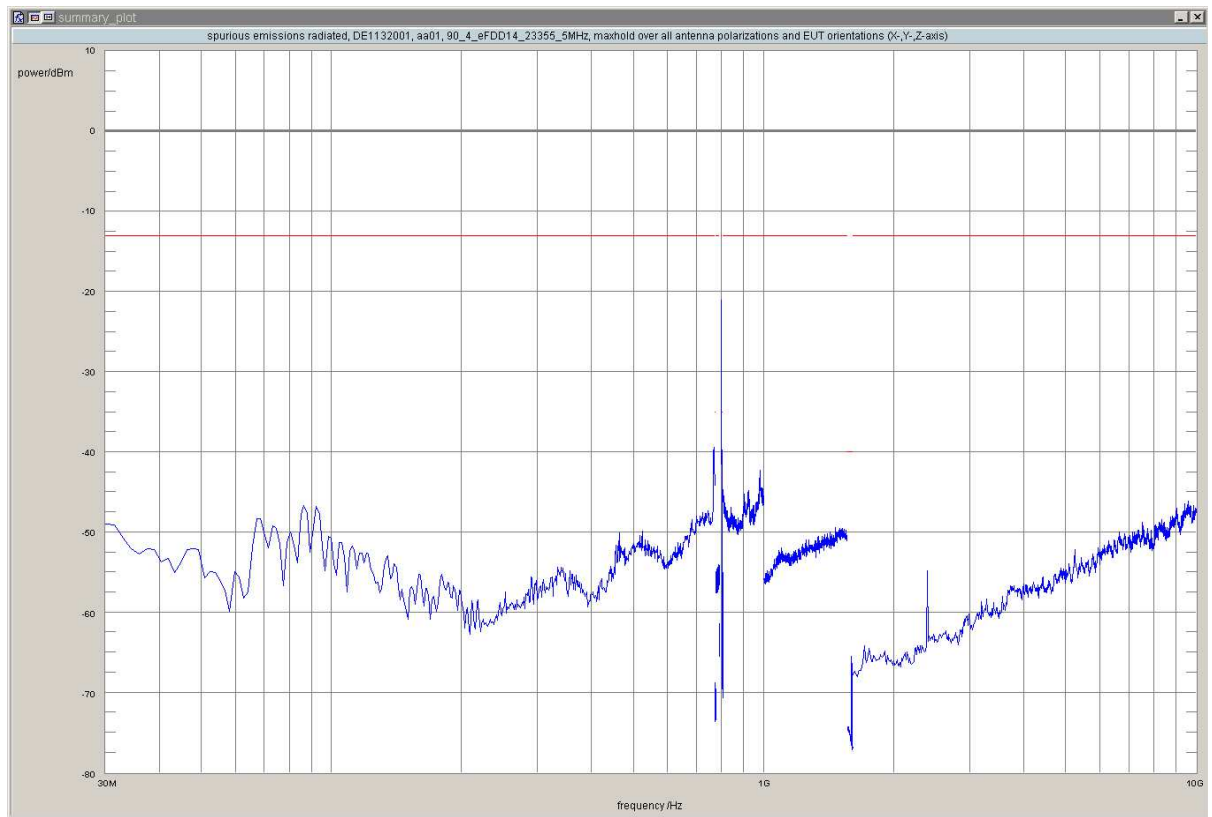
Body: FCC47CFRChIPART90PRIVATE LAND MOBILE RADIO SERVICES

Test Specification: FCC part 90

Detailed Results:

detector	trace	resolution bandwidth /kHz	frequency /MHz	peak value /dBm	limit /dBm	margin to limit /dB	azimuth /°	antenna polarization	EUT orientation	verdict
peak	maxhold	100	798.10	-21.06	-13.00	8.06	-180.0	horizontal	horizontal	passed
peak	maxhold	10	799.806	-54.44	-35.00	19.44	90.0	vertical	vertical	passed
peak	maxhold	10	799.842	-46.14	-35.00	11.14	-180.0	horizontal	vertical	passed
peak	maxhold	10	799.854	-43.11	-35.00	8.11	90.0	horizontal	vertical	passed
peak	maxhold	10	801.934	-54.24	-35.00	19.24	0.0	horizontal	vertical	passed
peak	maxhold	10	801.994	-46.35	-35.00	11.35	-180.0	horizontal	horizontal	passed
peak	maxhold	10	802.006	-47.84	-35.00	12.84	-180.0	vertical	vertical	passed
peak	maxhold	10	802.018	-46.21	-35.00	11.21	90.0	horizontal	vertical	passed
peak	maxhold	10	802.030	-48.25	-35.00	13.25	-180.0	horizontal	vertical	passed

no further values have been found with a margin of less than 20 dB



3.5.6 90.6 Frequency Stability, §2.1055, §90.230

Test: 90.6; Frequency Band = eFDD14, Mode = QPSK, mid Channel = 23330, Frequency = 793MHz, Method = conducted

Result: Passed
Setup No.: S01_AE01
Date of Test: 2015/08/09 17:21
Body: FCC47CFRChIPART90PRIVATE LAND MOBILE RADIO SERVICES
Test Specification: FCC part 90

Detailed Results:

Voltage	Temp (°C)	LTE eFDD14				
		Modulation	Frequency (MHz)	Frequency Error (Hz)	Deviation (ppm)	Limit (Hz)
100%	-30	QPSK	793	-3	-0.00378	1983
	-20	QPSK	793	7	0.008827	1983
	-10	QPSK	793	10	0.01261	1983
	0	QPSK	793	-3	-0.00378	1983
	10	QPSK	793	-4	-0.00504	1983
	20	QPSK	793	-10	-0.01261	1983
	30	QPSK	793	-5	-0.00631	1983
	40	QPSK	793	6	0.007566	1983
	50	QPSK	793	-6	-0.00757	1983
Low	20	QPSK	793	-11	-0.01387	1983
High	20	QPSK	793	-22	-0.02774	1983

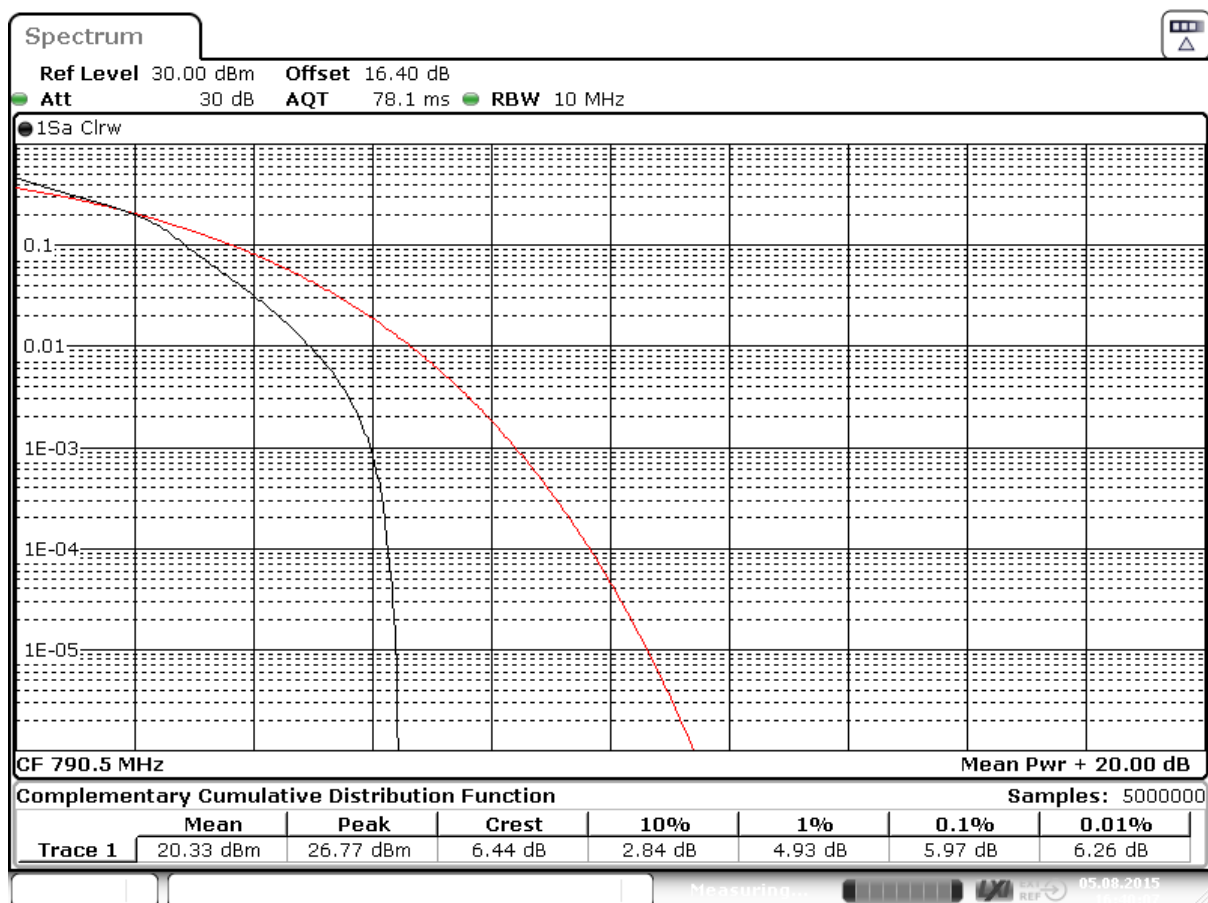
3.5.7 90.7 Peak-to-Average Ratio §2.1046

Test: 90.7: Peak-to-Average Ratio Summary §2.1046

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_AE01
<i>Date of Test:</i>	2015/08/05 17:19
<i>Body:</i>	FCC47CFRChIPART90PRIVATE LAND MOBILE RADIO SERVICES
<i>Test Specification:</i>	FCC part 90

Detailed Results:

Band	Bandwidth / Resource Blocks	Channel	Modulation	Peak to Average Value (dB)	Limit (dB)	Verdict
eFDD14	5 MHz / 25 RB	23305	QPSK	5.13	13	Passed
		23330		5.04	13	Passed
		23355		5.16	13	Passed
		23305	16-QAM	5.97	13	Passed
		23330		5.86	13	Passed
		23355		5.91	13	Passed



Date: 5.AUG.2015 16:40:07

4 Test Equipment Details

4.1 List of Used Test Equipment

The calibration, hardware and software states are shown for the testing period.

Test Equipment Anechoic Chamber

Lab ID:	Lab 1		
Manufacturer:	Frankonia		
Description:	Anechoic Chamber for radiated testing		
Type:	10.58x6.38x6.00 m ³		
	<i>Calibration Details</i>	<i>Last Execution</i>	<i>Next Exec.</i>
	NSA (FCC)	2014/01/09	2017/01/09

Single Devices for Anechoic Chamber

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m ³	none	Frankonia
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	FCC listing 96716 3m Part15/18		2014/01/09 2017/01/08
Controller Maturo	MCU	961208	Maturo GmbH
EMC camera	CE-CAM/1	-	CE-SYS
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1		Siemens&Matsushita
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID: Lab 1
Description: Equipment for emission measurements
Serial Number: see single devices

Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	Type	Serial Number	Manufacturer
Antenna mast	AM 4.0	AM4.0/180/11920 513	Maturo GmbH
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck Mess-Elektronik OHG
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck Mess-Elektronik OHG
Broadband Amplifier 1 GHz - 4 GHz	AFS4-01000400-1Q-10P-4	-	Miteq
Broadband Amplifier 18 GHz - 26 GHz	JS4-18002600-32-5P	849785	Miteq
Broadband Amplifier 30 MHz - 18 GHz	JS4-00101800-35-5P	896037	Miteq
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01-2	Kabel Kusch
Cable "ESI to Horn Antenna"	SucoFlex	W18.02-2+W38.02-2	HUBER+SUHNER
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG
<i>Calibration Details</i>			<i>Last Execution Next Exec.</i>
Standard Calibration			2012/06/26 2015/06/25
Standard Calibration			2015/06/23 2018/06/22
Double-ridged horn	HF 907	102444	Rohde & Schwarz GmbH & Co. KG
<i>Calibration Details</i>			<i>Last Execution Next Exec.</i>
Standard Calibration			2015/05/11 2018/05/10
Double-ridged horn-duplicated 2015-07-15 10:47:55	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
High Pass Filter	5HC3500/18000-1.2-KK	200035008	Trilithic
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright
Horn Antenna Schwarzbeck 15-26.5 GHz BBHA 9170	BBHA 9170	BBHA9170262	Schwarzbeck Mess-Elektronik OHG
Log.-per. Antenna	HL 562 Ultralog	100609	Rohde & Schwarz GmbH & Co. KG
<i>Calibration Details</i>			<i>Last Execution Next Exec.</i>
Standard Calibration			2012/12/18 2015/12/17
Log.-per. Antenna (upgraded)	HL 562 Ultralog new biconicals	830547/003	Rohde & Schwarz GmbH & Co. KG
<i>Calibration Details</i>			<i>Last Execution Next Exec.</i>
Standard Calibration			2015/06/30 2018/06/29
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG
<i>Calibration Details</i>			<i>Last Execution Next Exec.</i>

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
	DKD Calibration		2014/11/27 2017/11/27
Standard Gain / Pyramidal Horn Antenna 26.5 GHz	3160-09	00083069	EMCO Elektronik GmbH
Standard Gain / Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5- 10kg/024/379070 9	Maturo GmbH

Test Equipment Auxiliary Test Equipment

Lab ID:	Lab 1, Lab 2
Manufacturer:	see single devices
Description:	Single Devices for various Test Equipment
Type:	various
Serial Number:	none

Single Devices for Auxiliary Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
		<i>Calibration Details</i>	<i>Last Execution Next Exec.</i>
		Customized calibration	2013/12/04 2015/12/03
Digital Multimeter 13 (Clamp Meter)	Fluke 325	31270091WS	FLUKE
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Signal Analyzer	FSV30	103005	Rohde & Schwarz GmbH & Co. KG
		<i>Calibration Details</i>	<i>Last Execution Next Exec.</i>
		Standard	2014/02/10 2016/02/09
Spectrum Analyser	FSU26	200418	Rohde & Schwarz GmbH & Co.KG
		<i>Calibration Details</i>	<i>Last Execution Next Exec.</i>
		Standard calibration	2014/07/29 2015/07/28
Spectrum Analyzer	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
		<i>Calibration Details</i>	<i>Last Execution Next Exec.</i>
		DKD calibration	2015/06/23 2018/06/22
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

Test Equipment Digital Signalling Devices

Lab ID: Lab 1, Lab 2
Description: Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	Type	Serial Number	Manufacturer
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Standard calibration		2014/01/27 2016/01/26
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	DKD calibration		2014/12/02 2017/12/01
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG
	<i>HW/SW Status</i>		<i>Date of Start Date of End</i>
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 ---		2007/07/16
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	DKD calibration		2014/12/03 2017/12/02
	<i>HW/SW Status</i>		<i>Date of Start Date of End</i>
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 ---		2007/01/02
	SW: K62, K69		2008/11/03
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG

Test Equipment Emission measurement devices

Lab ID: Lab 1
Description: Equipment for emission measurements
Serial Number: see single devices

Single Devices for Emission measurement devices

Single Device Name	Type	Serial Number	Manufacturer
EMI Receiver / Spectrum Analyzer	ESR 7	101424	Rohde & Schwarz
	Calibration Details		Last Execution Next Exec.
	Initial Factory Calibration		2014/11/13 2016/11/12
Personal Computer	Dell	30304832059	Dell
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		Last Execution Next Exec.
	Standard calibration		2015/05/11 2016/05/10
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		Last Execution Next Exec.
	Standard calibration		2015/05/11 2016/05/10
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		Last Execution Next Exec.
	Standard Calibration		2014/06/24 2017/06/23
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		Last Execution Next Exec.
	Standard Calibration		2014/01/07 2016/01/31
	HW/SW Status		Date of Start Date of End
	Firmware-Update 4.34.4 from 3.45 during calibration		2009/12/03
Spectrum Analyzer	FSW 43	103779	Rohde & Schwarz
	Calibration Details		Last Execution Next Exec.
	Initial Factory Calibration		2014/11/17 2016/11/16

Test Equipment Multimeter 03

Lab ID: Lab 1, Lab 2
Description: Fluke 177
Serial Number: 86670383

Single Devices for Multimeter 03

Single Device Name	Type	Serial Number	Manufacturer
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
	Calibration Details		Last Execution Next Exec.
	Customized calibration		2013/12/04 2015/12/03

Test Equipment Radio Lab Test Equipment

Lab ID: Lab 2
Description: Radio Lab Test Equipment

Single Devices for Radio Lab Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
Broadband Power Divider SMA	WA1515	A856	Weinschel Associates
Coax Attenuator 10dB SMA 2W	4T-10	F9401	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3702	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3711	Weinschel Associates
Coax Cable Huber&Suhner	Sucotest 2,0m		Huber&Suhner
Coax Cable Rosenberger Micro Coax FA210A0010003030 SMA/SMA 1,0m	FA210A0010003030	54491-2	Rosenberger Micro-Coax
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG
		<i>Calibration Details</i>	<i>Last Execution Next Exec.</i>
		Standard calibration	2015/05/11 2016/05/10
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG
Rubidium Frequency Standard	Datum, Model: MFS	5489/001	Datum-Beverly
		<i>Calibration Details</i>	<i>Last Execution Next Exec.</i>
		Standard calibration	2014/07/03 2015/06/24
		Standard calibration	2015/06/25 2016/06/24
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
		<i>Calibration Details</i>	<i>Last Execution Next Exec.</i>
		Standard calibration	2015/05/11 2016/05/10
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG
		<i>Calibration Details</i>	<i>Last Execution Next Exec.</i>
		Standard calibration	2014/12/02 2017/12/01
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG
		<i>Calibration Details</i>	<i>Last Execution Next Exec.</i>
		Standard calibration	2013/05/06 2016/05/05

Test Equipment T/A Logger 13

Lab ID: Lab 1, Lab 2
Description: Lufft Opus10 TPR
Type: Opus10 TPR
Serial Number: 13936

Single Devices for T/A Logger 13

Single Device Name	Type	Serial Number	Manufacturer
ThermoAirpressure Datalogger 13 (Environ)	Opus10 TPR (8253.00)	13936	Lufft Mess- und Regeltechnik GmbH
Calibration Details		Last Execution	Next Exec.
Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 03

Lab ID: Lab 2
Description: Lufft Opus10
Serial Number: 7482

Single Devices for T/H Logger 03

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro Datalogger 03 (Environ)	Opus10 THI (8152.00)	7482	Lufft Mess- und Regeltechnik GmbH
Calibration Details		Last Execution	Next Exec.
Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 12

Lab ID: Lab 1
Description: Lufft Opus10
Serial Number: 12482

Single Devices for T/H Logger 12

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro Datalogger 12 (Environ)	Opus10 THI (8152.00)	12482	Lufft Mess- und Regeltechnik GmbH
Calibration Details		Last Execution	Next Exec.
Customized calibration		2015/03/10	2017/03/09

Test Equipment Temperature Chamber 05

Lab ID: Lab 2
Manufacturer: see single devices
Description: Temperature Chamber VT4002
Type: Vötsch
Serial Number: see single devices

Single Devices for Temperature Chamber 05

Single Device Name	Type	Serial Number	Manufacturer
Temperature Chamber Vötsch 05	VT 4002	58566080550010	Vötsch
Calibration Details		Last Execution	Next Exec.
Customized calibration		2014/03/11	2016/03/10

5 Annex

5.1 Additional Information for Report

Summary of Test Results

The EUT complied with all performed tests as listed in the summary section of this report.

Technical Report Summary

Type of Authorization :

Certification for a CDMA2000 cellular radiotelephone device

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations.
The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

- § 2.1046 Measurement required: RF power output
- § 2.1049 Measurement required: Occupied bandwidth
- § 2.1051 Measurement required: Band Edge Compliance
- § 2.1051 Measurement required: Spurious emissions at antenna terminals
- § 2.1053 Measurement required: Field strength of spurious radiation
- § 2.1055 Measurement required: Frequency stability
- § 2.1057 Frequency spectrum to be investigated

Part 90, Subpart I - General Technical Standards & Subpart S - Regulations Governing Licensing and Use of Frequencies in the 806–824, 851–869, 896–901, and 935–940 MHz Bands

- § 90.205/90.635 Maximum Channel Power
- § 90.209 Occupied Bandwidth
- § 90.691 Band Edge Compliance
- § 90.210/90.669 Spurious Emissions At Antenna Terminal
- § 90.210 Radiated Spurious Emissions
- § 90.213 Frequency stability

additional documents

ANSI TIA-603-C-2004

Description of Methods of Measurements

Maximum Channel Power

Standard: FCC Part 90, Subpart I & S

The test was performed according to: FCC §2.1046

Test Description (conducted measurement procedure)

- 1) The EUT was coupled to a Spectrum Analyser and a Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".
 - 2) The total insertion losses for signal path 1 and signal path 2 were measured. The values were used to correct the readings from the Spectrum Analyser and the Digital Communication Tester.
 - 3) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
- Important Settings:
- Channel (Frequency): please refer to the detailed results
- 4) The transmitted power of the EUT was recorded by using a CMW500.

Test Description (radiated measurement procedure)

- 1) The EUT was placed inside an anechoic chamber. Refer to chapter "Setup Drawings". The EUT was coupled to a Digital Communication Tester which was located outside the chamber via a small signalling antenna.
 - 2) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
- Important Settings:
- Output Power: Maximum
 - Channel: please refer to the detailed results
- 3) A substitution procedure is used so that the readings from the spectrum analyser are corrected and represent directly the equivalent radiated power (related to a $\lambda/2$ dipole).
 - 4) The output power was measured in both vertical and horizontal antenna polarisation during the call is established on the lowest channel, mid channel and on the highest channel. To find the worst case power all orientations (X, Y, Z) of the EUT have been measured.
 - 5) The test procedure according to TIA-603-C-2004 has been considered.

Test Requirements / Limits

§2.1046 Measurements Required: RF Power Output

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the output terminals when this test is made shall be stated.

§90.205 Power and antenna height limits

(k) (...) Power and height limitations are specified in § 90.635

§90.635 Limitations on power and antenna height

(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw)

Emission and Occupied Bandwidth

Standard: FCC Part 90, Subpart I & S

The test was performed according to: FCC §2.1049

Test Description

- 1) The EUT was coupled to a Spectrum Analyser and a Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".
 - 2) The total insertion losses for signal path 1 and signal path 2 were measured. The values were used to correct the readings from the Spectrum Analyser and the Digital Communication Tester.
 - 3) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
- Important Settings:
- Output Power: Maximum
 - Channel: please refer to the detailed results
- 4) Important Analyser Settings:
 - Resolution Bandwidth: >1% of the manufacturer's stated occupied bandwidth
 - 5) The maximum spectral level of the modulated signal was recorded as the reference.
 - 6) The emission bandwidth is measured as follows:
the two furthest frequencies above and below the frequency of the maximum reference level where the spectrum is -26 dB down have to be found.
 - 7) The occupied bandwidth (99% Bandwidth) is measured as follows:
the occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5 percent of the total mean power.

Test Requirements / Limits

§ 2.1049 Measurements required: Occupied bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions (as applicable):

(h) Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

Band Edge Compliance

Standard: FCC Part 90, Subpart I & S

The test was performed according to: FCC §90.691

Test Description

- 1) The EUT was coupled to a Spectrum Analyser and a Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".
 - 2) The total insertion losses for signal path 1 and signal path 2 were measured. The values were used to correct the readings from the Spectrum Analyser and the Digital Communication Tester.
 - 3) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
- Important Settings:
- Output Power: Maximum
 - Channel: please refer to the detailed results
- 4) Important Analyser Settings:
- Resolution Bandwidth = Video Bandwidth: >1% of the manufacturer's stated occupied bandwidth

Test Requirements / Limits

§ 90.691 Emission mask requirements for EA-based systems

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

Spurious Emissions At Antenna Terminal

Standard: FCC Part 90, Subpart I & S

The test was performed according to FCC §2.1051

Test Description

- 1) The EUT was coupled to a Spectrum Analyser and a Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".
 - 2) The total insertion losses for signal path 1 and signal path 2 were measured. The values were used to correct the readings from the Spectrum Analyser and the Digital Communication Tester.
 - 3) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
- Important Settings:

- Output Power: Maximum
- Channel: please refer to the detailed results
- 4) Important Analyser Settings
 - [Resolution Bandwidth]:
 - a) [$\geq 1\%$ of wanted signal bandwidth] in the Span of 1 MHz directly below and above the Band,
 - b) otherwise [1 MHz]
 - c) [reduced resolution bandwidth] in case the curve of the analyser IF-Filter or the wanted EUT signal leads to an exceeding of the limit, in this case a correction factor was used
 - Sweep Time: depending on the transmitting signal, the span and the resolution bandwidth
- 5) The spurious emissions peaks were measured in the frequency range from 9 kHz to 20 GHz (up to the 10th harmonic) during the call was established

Test Requirements / Limits

§ 2.1051 Spurious emissions at antenna terminals

The radio frequency voltage or power generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in Sec. 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 2.1057 Frequency spectrum to be investigated.

- (a) In all of the measurements set forth in Secs. 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:
 - (1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
 - (b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.
 - (c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.
 - (d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

§ 90.691 Emission mask requirements for EA-based systems

- (2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10\log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

For reporting only spurious emission levels reaching to the 20dB margin to limit were noted.

Radiated Spurious Emissions

Standard: FCC Part 90, Subpart I & S

The test was performed according to: FCC §2.1053

Test Description

- 1) The EUT was placed inside an anechoic chamber. Refer to chapter "Setup Drawings". The EUT was coupled to a Digital Communication Tester which was located outside the chamber via a small signalling antenna.
 - 2) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
- Important Settings:
- Output Power: Maximum
 - Channel: please refer to the detailed results
- 3) A pre-calibration procedure is used so that the readings from the spectrum analyser are corrected and

represent directly the equivalent radiated power (related to a $\lambda/2$ dipole).

4) All spurious radiation measurements were made with spectrum analyser and the appropriate calibrated antennas for the frequency range of 30 MHz to 20 GHz (up to the 10th harmonic of the transmit frequency). The frequency range from 9 kHz to 30 MHz has been examined during the conducted spurious emission measurements.

5) Important Analyser Settings

- [Resolution Bandwidth / Video Bandwidth]:

a) [3 kHz / 10 kHz] in the Span of 1 MHz directly below and above the Band,

b) [10 kHz / 30 kHz] in case the curve of the analyser IF-Filter leads to an exceeding of the limit, in this case a worst case correction factor of 20 dB (1 MHz \rightarrow 10 kHz) was used

c) [1 MHz / 3 MHz] otherwise

- Sweep Time: depending on the transmitting signal, the span and the resolution bandwidth

6) The spurious emissions peaks were measured in both vertical and horizontal antenna polarisation during the call is established on the lowest channel, mid channel and on the highest channel. To find the worst case peaks all orientations (X, Y, Z) of the EUT have been measured.

7) After this initial test, a final test according to TIA-603-C 2.2.12 Unwanted Emissions is performed on signals which are identified as being close to the limit. For any emissions found to be within 10 dB of the limit, a specific signal substitution measurement is performed at the frequency of the emission to determine the exact e.i.r.p. value.

Test Requirements / Limits

§ 2.1053 Measurements required: Field strength of spurious radiation.

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of Sec. 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(2) All equipment operating on frequencies higher than 25 MHz.

§ 2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in Secs. 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

§ 90.210 Radiated Spurious Emissions

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

This is calculated to be -13 dBm (effective radiated power) which corresponds to 84.6 dB μ V/m (field strength) in a distance of 3 m.

For reporting only spurious emission levels reaching to the 20dB margin to limit were noted.

Standard: FCC Part 90, Subpart I & S

The test was performed according to FCC §2.1055

Test Description

- 1) The EUT was placed inside a temperature chamber.
 - 2) The EUT was coupled to a Digital Communication Tester. Refer to chapter "Setup Drawings".
 - 3) The climatic chamber was cycled down/up to a certain temperature, starting with the EUT minimum temperature.
 - 4) After the temperature was stabilized the EUT was switched on and a call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
- Important Settings:
- Output Power: Maximum
 - Mid Channel
- 5) The frequency error of the EUT was recorded by using an internal measurement function of the Digital Communication Tester immediately after the call was established, five minutes after the call was established and ten minutes after the call was established.
 - 6) This measurement procedure was performed for temperature variation from -30°C to +50°C in increments of 10°C, if not otherwise stated in the detailed results.
- When the EUT did not operate at certain temperature levels, these measurements were left out.

Test Requirements / Limits

§2.1055 Measurements required: Frequency stability

- (a) The frequency stability shall be measured with variation of ambient temperature as follows:
- (1) From -30° to +50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
 - (b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.
 - (d) The frequency stability shall be measured with variation of primary supply voltage as follows:
 - (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
 - (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
 - (3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

§ 90.213 Frequency stability

According table "MINIMUM FREQUENCY STABILITY" Mobile stations, working in the frequency range 809 - 824 MHz, with an output power < 2 watts, must be within a frequency tolerance of 2.5 ppm.

Peak-to-Average Ratio

Standard: FCC §2.1049

The test was performed according to KDB 971168 v02r01 – Section 5.7.1

Test Description

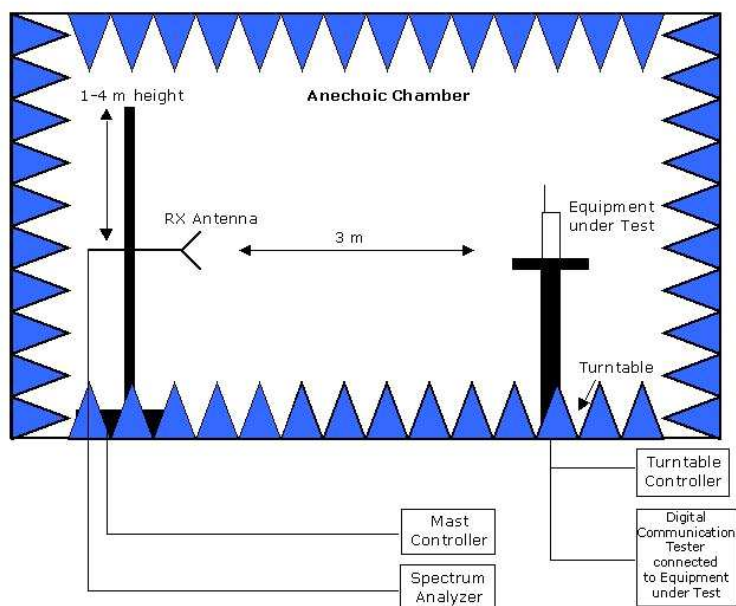
A peak to average ratio measurement is performed at the conducted port of the EUT.

The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

Test Settings

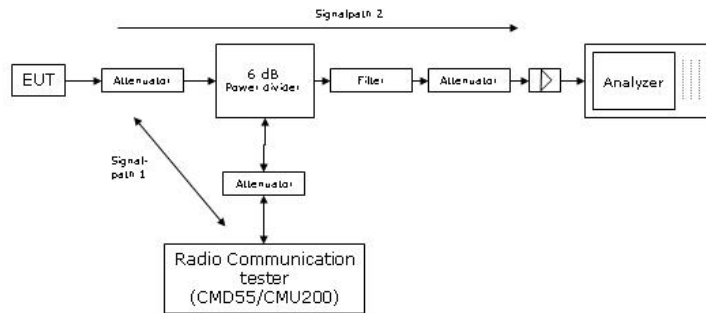
1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW > Emission bandwidth of signal
4. The signal analyser was set to collect at least one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analysed.

Setup Drawings



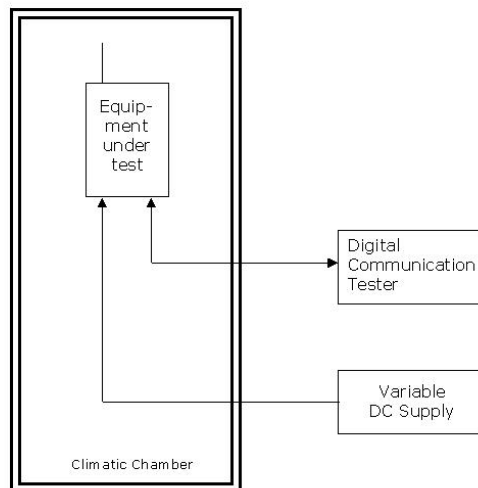
Remark: Depending on the frequency range suitable antenna types, attenuators or preamplifiers are used.

Principle set-up for radiated measurements



Remark: Depending on the frequency range suitable attenuators and/or filters and/or amplifiers are used.

Principle set-up for conducted measurements under nominal conditions



Principle set-up for tests under extreme test conditions

Measurement Uncertainties

FCC Part 22, 24, 27, 90
IC RSS-132, RSS-133, RSS-139

Test Case	Parameter	Uncertainty
RF Power Output	Power	± 2.2 dB
Frequency Stability	Frequency	± 25 Hz
Spurious Emissions at antenna terminal	Power	± 2.2 dB
Field strength of spurious radiation	Power	± 4.5 dB
Emission and Occupied Bandwidth	Power Frequency	± 2.9 dB GSM: ± 10.6 kHz UMTS, LTE: ± 120.0 kHz
Band Edge Compliance	Power Frequency	± 2.9 dB GSM: ± 14.6 kHz UMTS, LTE: ± 68.0 kHz

FCC Part 15b
IC ICES-003

Test Case	Parameter	Uncertainty
AC Power Line	Power	± 3.4 dB
Field Strength of spurious radiation	Power+	± 5.5 dB

FCC Part 15c, 15e
IC RSS-210, IC RSS-247

Test Case	Parameter	Uncertainty
AC Power Line	Power	± 3.4 dB
Field Strength of spurious radiation	Power	± 5.5 dB
6 dB / 26 dB / 99% Bandwidth	Power Frequency	± 2.9 dB ± 11.2 kHz
Conducted Output Power		± 2.2 dB
Spurious Emissions at antenna terminal	Power	± 2.2 dB
Band Edge Compliance	Power Frequency	± 2.2 dB ± 11.2 kHz
Frequency Stability	Frequency	± 25 Hz
Power Spectral Density	Power	± 2.2 dB

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