InterLab®

Final Report on

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

Report Reference:	MDE_ELEKT_1502_FCCd According to: FCC 47 CFR Ch.1 Part 15 Subpart B, Class B
Date:	October 21, 2015

Test Laboratory:
7layers GmbH
Borsigstraße 11
40880 Ratingen
Germany

DAkkS
Deutsche
Akkreditierungsstelle
D-PL-12140-01-01

1 Administrative Data

1.1 Project Data

Project Responsible:	Imad Hjije
Date Of Test Report:	2015/10/21
Date of first test:	2015/07/09
Date of last test:	2015/09/07

1.2 Applicant Data

Company Name: Bittium Wireless Ltd.

Street:	Tutkijantie 8
City:	90570 Oulu
Country:	Finnland

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:

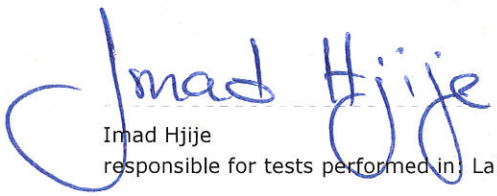
7 layers DE

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	Conducted Emissions	Mr. Andreas Petz Mr. Wolfgang Richter	DAkkS-Registration no. D-PL-12140-01-01
Lab 2	Radiated Emissions	Mr. Marco Kullik Mr. Robert Machulec	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 [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*
Parameter for Scope FCC_v2:	
AC Power Supply	120 (V)
DC Power Supply	3.8 (V)

2.2 Detailed Description of OUT Samples

Sample : ah01

OUT Identifier	Bittium Tough Mobile FCC ID: V27SD-41 IC: 3282B-SD41		
Sample Description	Radiated Sample		
Serial No.	K0251300430		
HW Status	0302		
SW Status	2.6.0		
Nominal Voltage	3.8 V	*Normal Temp.*	23 °C

2.3 OUT Features

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

Designation	*Description*	*Allowed Values*	*Supported Value(s)*
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			
eFDD4			
eFDD5			
eFDD13			
eFDD17			
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		
Wa3	EUT supports WLAN in mode a in the band 5470 MHz - 5725 MHz		

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

Designation	*Description*	*Allowed Values*	*Supported Value(s)*
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 - 5850 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 Auxiliary Equipment

AE No.	*Type Designation*	*Serial No.*	*HW Status*	*SW Status*	*Description*
AE AUX3	3700034, 3.8 V, 2420 mAh	3520001			Battery from Celltech
AE AUX2	AK-300116-010-S				USB cable from ASSMANN
AE AUX6	CHERRY RS 6000 USB ON	G 0000273 2P28			Keyboard
AE AUX4	Fujitsu Lifebook Eseries E781	DSCK013817	2012-03	Win7 Prof. Engl.	Laptop
AE AUX5	Fujitsu Ltd. SED100P2-19.0	07Y17323A	2007.11		Laptop Power Supply
AE AUX1	KSA29B0500200D5	P0315			AC adapter (Seanen Electronics)
AE AUX8	LG L17MB-P	412WAPL0U560			TFT Monitor
AE AUX7	Logitech M-BT58	HC60915A2XC			Mouse

2.5 Operating Mode(s)

Ref.-No.	*Description*
1	The product is powered via Laptop and has Data transfer with it
2	The product is powered via AC/DC adapter

2.6 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.

Setup No.	*List of OUT samples*		*List of auxiliary equipment*	
	Sample No.	*Sample Description*	*AE No.*	*AE Description*
Setup_ACDC				
	Sample: ah01	Radiated Sample	AE AUX3	Battery from Celltech
			AE AUX2	USB cable from ASSMANN
			AE AUX1	AC adapter (Seanen Electronics)
Setup_Comp.				
	Sample: ah01	Radiated Sample	AE AUX6	Keyboard
			AE AUX4	Laptop
			AE AUX5	Laptop Power Supply
			AE AUX8	TFT Monitor
			AE AUX7	Mouse

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. This report contains the abbreviated information content pertaining to services rendered. Supporting documentation not included herein is maintained and available at the laboratory.

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

3.2 List of the Applicable Body

(Body for Scope: FCC_v2)

Designation	*Description*
FCC47CFRChIPART15bRADIO FREQUENCY DEVICES	Part 15, Subpart B - Unintentional Radiators

3.3 List of Test Specification

Test Specification:	**FCC part 2 and 15**
Version	10-1-13 Edition
Title:	PART 2 - GENERAL RULES AND REGULATIONS PART 15 - RADIO FREQUENCY DEVICES

3.4 Summary

Test Case Identifier / Name *Test (condition)*	*Result*	*Date of Test*	*Lab Ref.*	*Setup*
15b.1 Conducted Emissions (AC Power Line) §15.107				
15b.1; Mode = Generating a high power consumption	Passed	2015/07/27	Lab 1	Setup_ACDC
	operating mode: 2			
	Passed	2015/07/27	Lab 1	Setup_Comp.
	operating mode: 1			
15b.2 Spurious Radiated Emissions §15.109				
15b.2; Mode = Generating a high power consumption	Passed	2015/09/07	Lab 2	Setup_ACDC
	operating mode: 2			
	Passed	2015/07/09	Lab 2	Setup_Comp.
	operating mode: 1			

3.5 Detailed Results

3.5.1 15b.1 Conducted Emissions (AC Power Line) §15.107

Test1: 15b.1; Mode = Generating a high power consumption

Result:	Passed
Setup No.:	Setup_Comp.
Date of Test:	2015/07/27 17:39
Body:	FCC47CFRChIPART15bRADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

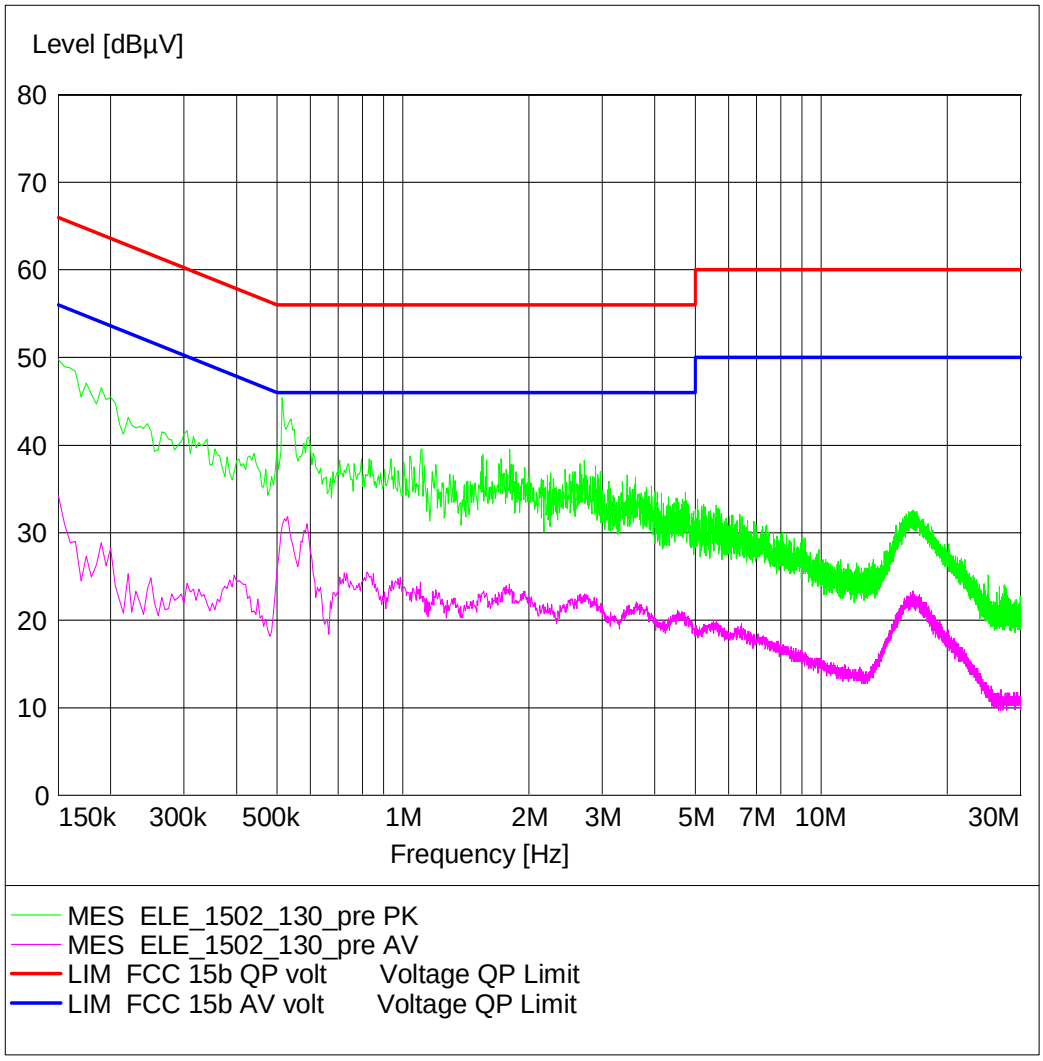
Detailed Results:

AC MAINS CONDUCTED

```
EUT:                 (DE1132001ah01)
Manufacturer:        Bittium
Operating Condition: WLAN TX on 2437 MHz, USB data transfer,b-mode,USB 1Mbps, 19 dBm, 120V/60Hz
Test Site:           7 layers Ratingen
Operator:            Mit
Test Specification:  ANSI C63.4; FCC 15.107 / 15.207, Class B
Comment:             AC-Adapter
Start of Test:       27.07.2015 / 10:04:33
```

SCAN TABLE: "FCC Voltage"

Short Description:			FCC Voltage			
Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak Average	20.0 ms	9 kHz	ESH3-Z5



Test1: 15b.1; Mode = Generating a high power consumption

Result:	Passed
Setup No.:	Setup_ACDC
Date of Test:	2015/07/27 17:40
Body:	FCC47CFRChIPART15bRADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

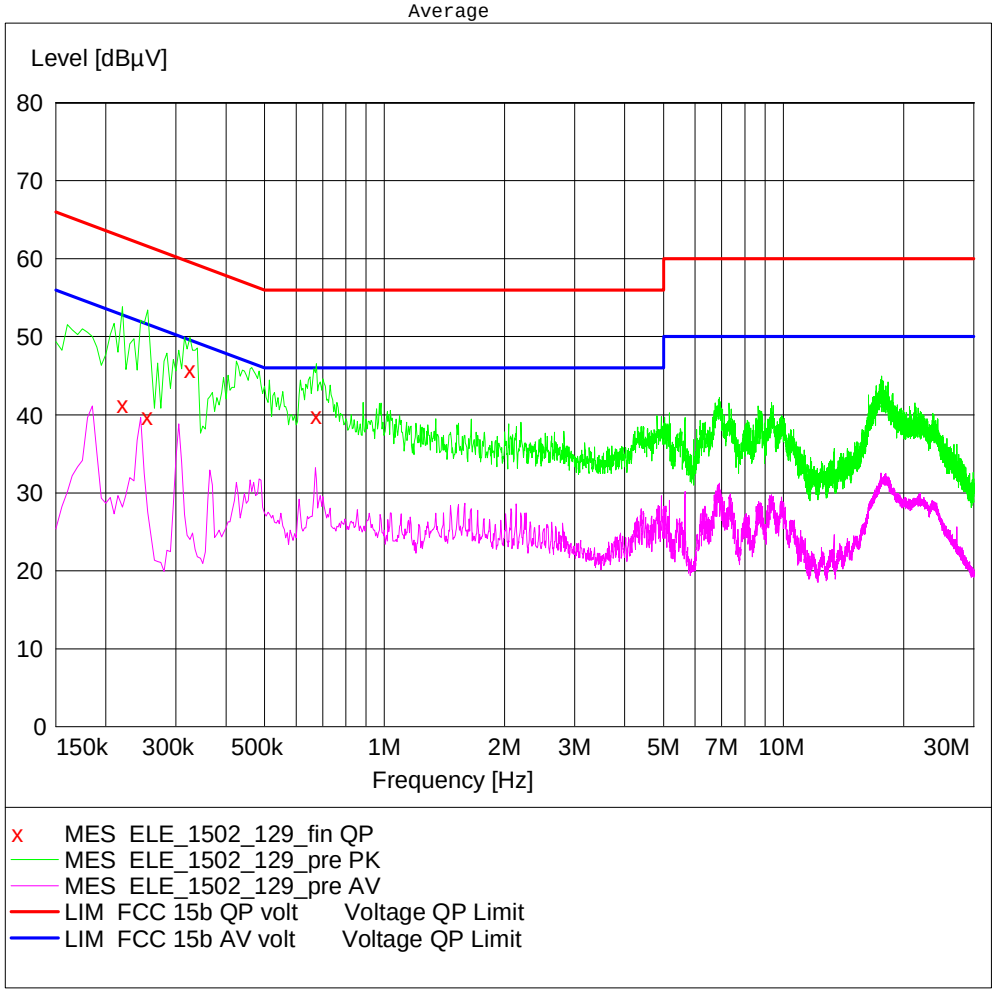
Detailed Results:

AC MAINS CONDUCTED

```
EUT:                 (DE1132001ah01)
Manufacturer:        Elektrobit
Operating Condition: BT TX on 2441 MHz, 1-DH1, USB-charging, 120V/60Hz
Test Site:           7 layers Ratingen
Operator:            Mit
Test Specification:  ANSI C63.4; FCC 15.107 / 15.207, Class B
Comment:             computer peripheral
Start of Test:       27.07.2015 / 09:44:43
```

SCAN TABLE: "FCC Voltage"

Short Description:			FCC Voltage			
Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak Average	20.0 ms	9 kHz	ESH3-Z5



MEASUREMENT RESULT: "ELE_1502_129_fin QP"

27.07.2015 09:50

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.220000	41.30	10.1	63	21.6	N	GND
0.255000	39.70	10.1	62	21.9	L1	GND
0.325000	45.70	10.1	60	13.9	L1	GND
0.675000	40.00	10.1	56	16.0	L1	GND

3.5.2 15b.2 Spurious Radiated Emissions §15.109

Test1: 15b.2; Mode = Generating a high power consumption

Result:	Passed
Setup No.:	Setup_Comp.
Date of Test:	2015/07/09 17:28
Body:	FCC47CFRChIPART15bRADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

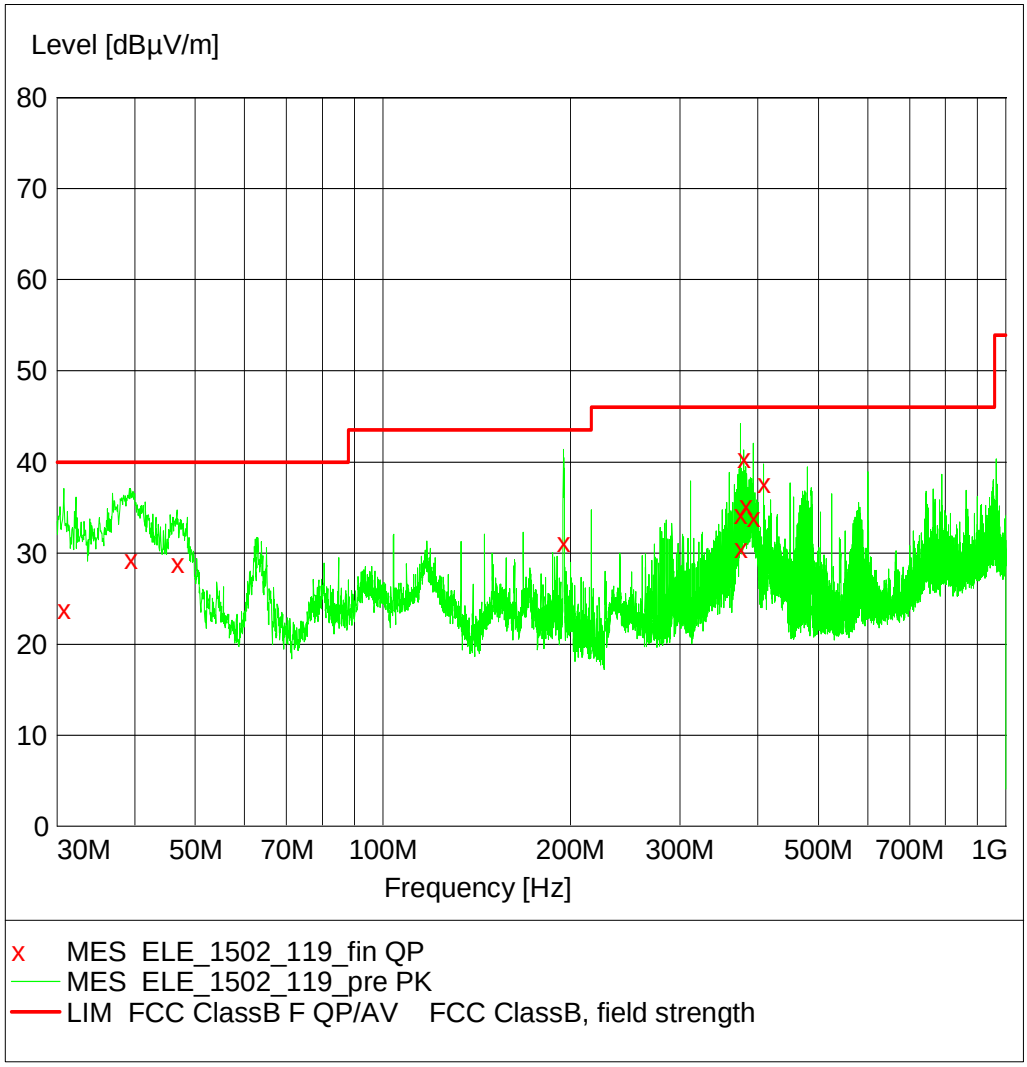
Detailed Results:

EMI RADIATED TEST

```
EUT:                 (DE1132001ah01)
Manufacturer:        Elektrobit
Operating Condition: BT TX on 2441 MHz, 1-DH1, computer peripheral; 120V/60Hz
Test Site:           7 layers, Ratingen
Operator:            ASO
Test Specification:  FCC Part 15 B Class B
Comment:             Horizontal EUT position, Horizontal+Vertical antenna polaris
Start of Test:       09.07.2015 / 19:09:52
```

SCAN TABLE: "FCC part 15 b"

```
Short Description:            FCC part 15 b
Start      Stop       Step       Detector  Meas.     IF      Transducer
Frequency  Frequency  Width                Time      Bandw.
30.0 MHz   1.0 GHz    60.0 kHz   MaxPeak   1.0 ms    120 kHz HL562
```



MEASUREMENT RESULT: "ELE_1502_119_fin QP"

09.07.2015 20:07

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Polarisation
30.720000	23.80	20.3	40.0	16.2	275.0	292.00	VERTICAL
39.360000	29.40	15.5	40.0	10.6	190.0	168.00	VERTICAL
46.740000	28.90	10.5	40.0	11.1	107.0	243.00	VERTICAL
194.760000	31.20	10.0	43.5	12.3	100.0	157.00	VERTICAL
374.160000	34.30	15.3	46.0	11.7	105.0	338.00	HORIZONTAL
375.000000	30.60	15.3	46.0	15.4	125.0	359.00	HORIZONTAL
379.200000	40.40	15.3	46.0	5.6	100.0	338.00	HORIZONTAL
382.380000	35.30	15.4	46.0	10.7	125.0	292.00	HORIZONTAL
393.000000	33.90	15.7	46.0	12.1	100.0	338.00	HORIZONTAL
408.000000	37.60	15.9	46.0	8.4	100.0	94.00	HORIZONTAL

Test2: 15b.2; Mode = Generating a high power consumption

Result:	Passed
Setup No.:	Setup_ACDC
Date of Test:	2015/09/07 17:35
Body:	FCC47CFRChIPART15bRADIO FREQUENCY DEVICES
Test Specification:	FCC part 2 and 15

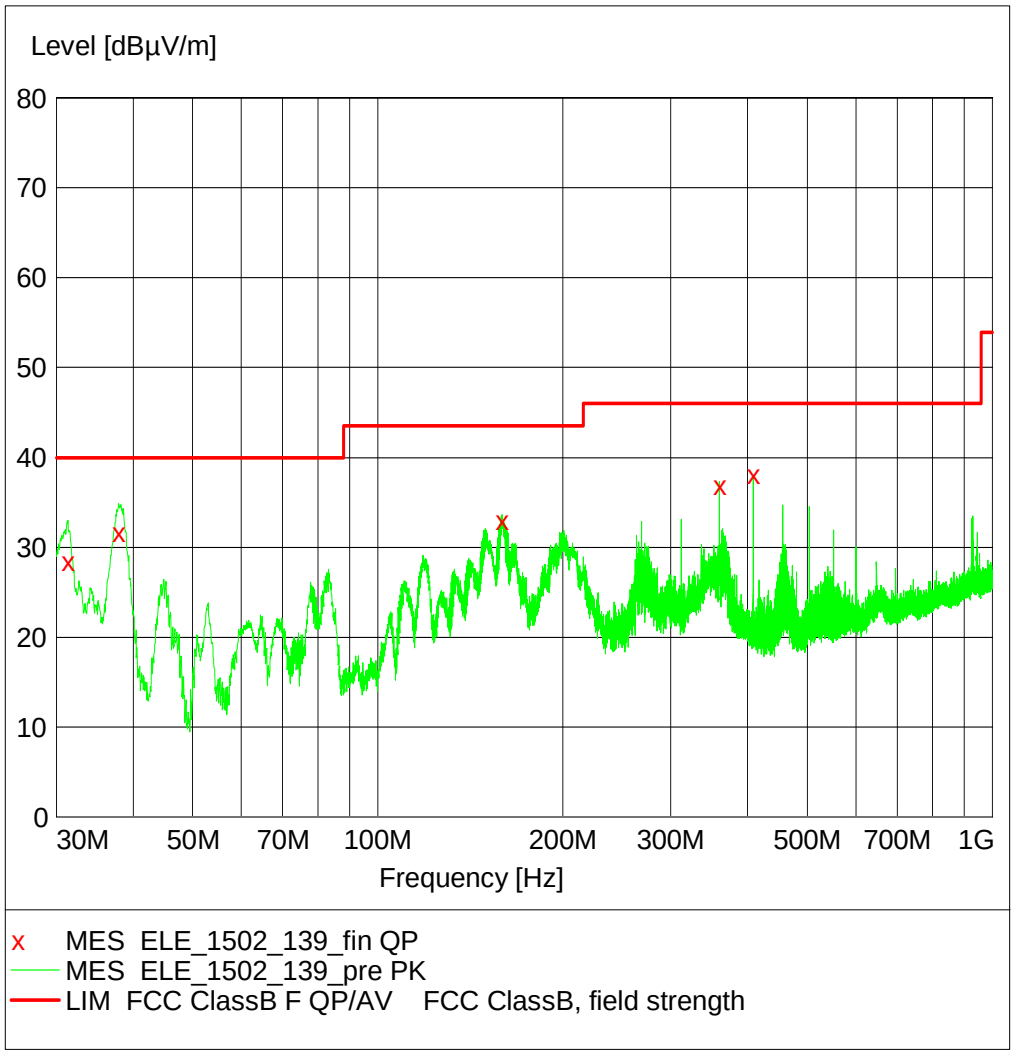
Detailed Results:

EMI RADIATED TEST

```
EUT:                (DE1132001ah01)
Manufacturer:       Elektrobit
Operating Condition: WLAN TX on 2437 MHz, b-mode, 1 Mbps, NFC TX on 13.56 MHz,
                    AC/DC Adapter, 120V/60Hz, EUT charging
Test Site:          7 layers, Ratingen
Operator:           URO
Test Specification: FCC Part 15 B Class B
Comment:            Horizontal EUT position, Horizontal+Vertical antenna polarisation
Start of Test:      07.09.2015 / 14:30:31
```

SCAN TABLE: "FCC part 15 b"

```
  Short Description:            FCC part 15 b
  Start      Stop       Step       Detector  Meas.     IF      Transducer
  Frequency  Frequency  Width                Time      Bandw.
  30.0 MHz   1.0 GHz    60.0 kHz   MaxPeak   1.0 ms    120 kHz HL562
```



MEASUREMENT RESULT: "ELE_1502_139_fin QP"

07.09.2015 15:12

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Polarisation
31.320000	28.40	19.6	40.0	11.6	100.0	223.00	VERTICAL
37.920000	31.70	16.2	40.0	8.3	102.0	247.00	VERTICAL
159.300000	33.00	9.4	43.5	10.5	100.0	67.00	VERTICAL
360.000000	36.90	13.9	46.0	9.1	103.0	112.00	HORIZONTAL
408.000000	38.10	15.0	46.0	7.9	101.0	112.00	HORIZONTAL

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 2**
Manufacturer:	Frankonia
Description:	Anechoic Chamber for radiated testing
Type:	10.58x6.38x6.00 m³

Calibration Details	*Last Execution*	*Next Exec.*
NSA (FCC)	2014/01/09	2017/01/09

Single Devices for Anechoic Chamber

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m³	none	Frankonia
	Calibration Details		*Last Execution* *Next Exec.*
	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 Conducted emissions

Lab ID:	**Lab 1**
Manufacturer:	Rohde & Schwarz GmbH & Co.KG
Description:	EMI Conducted Auxiliary Equipment

Single Devices for Auxiliary Equipment for Conducted emissions

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber&Suhner	
Impedance Stabilization Network	ISN T800	36159	Teseq GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2014/02/06	2016/02/28
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ENY41	100002	Rohde & Schwarz GmbH & Co. KG	
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ST08	36292	Teseq GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2014/01/10	2016/01/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN T8-Cat6	32187	Teseq GmbH	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2014/01/08	2016/01/31
One-Line V-Network	ESH 3-Z6	100489	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	standard calibration		2014/06/18	2017/11/30
One-Line V-Network	ESH 3-Z6	100570	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2013/11/25	2016/11/24
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	DAkkS Calibration		2015/03/30	2017/03/31
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	DAkks Calibration		2015/03/30	2017/03/31

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID:	**Lab 2**
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	AM4.0/180/11920513	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
	Calibration Details		*Last Execution* *Next Exec.*
	Standard Calibration		2015/06/23 2018/06/22
Double-ridged horn	HF 907	102444	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	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
	Calibration Details		*Last Execution* *Next Exec.*
	Standard Calibration		2012/12/18 2015/12/17
Log.-per. Antenna (upgraded)	HL 562 Ultralog new biconicals	830547/003	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard Calibration		2015/06/30 2018/06/29
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
	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/024/3790709	Maturo GmbH	

Test Equipment Auxiliary Test Equipment

Lab ID:	**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.
	Calibration Details		*Last Execution* *Next Exec.*
	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 Transformatorenwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Signal Analyzer	FSV30	103005	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard		2014/02/10 2016/02/09
Spectrum Analyser	FSU26	200418	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2014/07/29 2015/07/28
Spectrum Analyzer	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	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
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2014/01/27 2016/01/26
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	DKD calibration		2014/12/02 2017/12/01
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG
	HW/SW Status		*Date of Start* *Date of End*
	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
	Calibration Details		*Last Execution* *Next Exec.*
	DKD calibration		2014/12/03 2017/12/02
	HW/SW Status		*Date of Start* *Date of End*
	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, Lab 2**
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 Harmonic & Flicker measurement system and AC Source

Lab ID:	**Lab 1**
Manufacturer:	Spitzenberger & Spieß GmbH & Co. KG
Description:	EN61000-3-2&3 test system,source for magnetic field EN61000-4-8
Type:	PHE 1200/B Spitzenberger&Spies
Serial Number:	B6280

Single Devices for Harmonic & Flicker measurement system and AC Source

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Amplifier with integrated variable Oscillator	EP 1200/B, NA/B1	B6278	Spitzenberger & Spieß GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2015/07/23	2018/07/30
Flickermeter / Harmonic Analyzer	B10	M70579	Spitzenberger & Spieß GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2015/07/23	2018/07/30
Line impedance simulation system	1-pase 16A	B6279	Spitzenberger & Spieß GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2015/07/22	2018/07/30

Test Equipment Multimeter 03

Lab ID:	**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 Shielded Room 02

Lab ID:	**Lab 1**
Manufacturer:	Frankonia
Description:	Shielded Room for conducted testing
Type:	12 qm
Serial Number:	none

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 02

Lab ID:	**Lab 1**
Description:	Lufft Opus10
Serial Number:	7489

Single Devices for T/H Logger 02

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoHygro Datalogger 02 (Environ)	Opus10 THI (8152.00)	7489	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 2**
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

5 Annex

5.1 Additional Information for Report

Test Description

Conducted emissions (AC power line)

Standard FCC Part 15 Subpart B

The test was performed according to: ANSI C 63.4, 2009

Test Description
The test set-up was made in accordance to the general provisions of ANSI C 63.4-2009.
The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was connected to a 50 µH || 50 Ohm Line Impedance Stabilization Network (LISN), which meets the requirements of ANSI C63.4–2009, Annex B, in the frequency range of the measurements. The LISN's unused connections were terminated with 50 Ohm loads.
AC Power supply voltage for EUT: 120 V 60 Hz (if not stated within the measurement plot and/or test result).

The measurement procedure consists of two steps. It is implemented into the EMI test software ES-K1 from R&S.

Step 1: Preliminary scan
Intention of this step is, to determine the conducted EMI-profile of the EUT.
EMI receiver settings:
- Detector: Peak - Maxhold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF–Bandwidth: 9 kHz
- Measuring time / Frequency step: 20 ms
- Measurement on phase + neutral lines of the power cords

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2: Final measurement
Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.
EMI receiver settings:
- Detector: Quasi-Peak
- IF - Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:
1) Neutral lead - reference ground (PE grounded)
2) Phase lead - reference ground (PE grounded)
3) Neutral lead - reference ground (PE floating)
4) Phase lead - reference ground (PE floating)

The highest value is reported.

Test Requirements / Limits

If not stated within the measurement plot and/or test result, class B limits are applied.

FCC Part 15, Subpart B, §15.107, Class B Limit

Frequency Range (MHz)	QP Limit (dBµV)	AV Limit (dBµV)
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

FCC Part 15, Subpart B, §15.107, Class A Limit

Frequency Range (MHz)	QP Limit (dBµV)	AV Limit (dBµV)
0.15 - 0.5	79	66
0.5 – 30	73	60

Used conversion factor: Limit (dBµV) = 20 log (Limit (µV)/1µV).

NOTES:
A missing result table in the corresponding test report section means, that no final measurement was performed because no relevant frequencies (peaks) were found in the preliminary scan.
The chosen operating mode is selected as representative mode to generate "worst-case" conditions, i.e. high power consumption.

Spurious radiated emissions

Standard FCC Part 15, Subpart B

The test was performed according to: ANSI C 63.4, 2009

Test Description
Measurement below 1 GHz:
The test set-up was made in accordance to the general provisions of ANSI C 63.4-2009.
The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.
The test was performed at the distance of 3 m between the EUT and the receiving antenna. The measurement procedure is implemented into the EMI test software ES-K1 from R&S. The radiated emissions measurements were made in a typical installation configuration. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is performed at 2 axes. A pre-check is also performed while the EUT is powered from both AC and DC (battery) power in order to find the worst-case operating condition. AC Power supply voltage for EUT: 120 V 60 Hz (if not stated within the measurement plot and/or test result).

Step 1: Preliminary scan (test to identify the highest amplitudes relative to the limit)
Intention of this step is, to determine the radiated EMI-profile of the EUT.
Settings for step 1:
- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 µs
- Turntable angle range: –180° to +180°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarization: Horizontal + Vertical

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2:
A further measurement will be performed on the frequencies determined in step 1. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.
Settings for step 2:
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: –180° to +180°
- Turntable step size: 45°
- Height variation range: 1 – 4 m
- Height variation step size: 0.5 m
- Polarizations: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):
- Frequency
- Azimuth value (of turntable)

- Antenna height
The last two values have now the following accuracy:
- Azimuth value (of turntable): 45°
- Antenna height: 0.5 m

Step 3: final measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will be slowly varied by +/- 22.5° around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by +/- 25 cm around the antenna height determined. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100ms
- Turntable angle range: –22.5° to +22.5° around the determined value
- Height variation range: -0.25 m to +0.25 m around the determined value

Step 4: Final measurement (with QP detector)
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: Quasi-Peak(< 1GHz)
- Measured frequencies: in step 3 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

Measurement above 1 GHz:
The following modifications apply to the measurement procedure for the frequency range above 1 GHz:
The measurement distance was reduced to 1 m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements, inverse-linear-distance-squared for the power density measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18–25 GHz) are used, the steps 2-4 as described before, are omitted. Step 1 was performed at one height of the receiving antenna only.
Detector: Peak, Average (simultaneously)
RBW = VBW = 1 MHz; above 7 GHz 100 kHz

Test Requirements / Limits

If not stated within the measurement plot and/or test result, class B limits are applied.

FCC Part 15, Subpart B, §15.109, Radiated Emission Limits

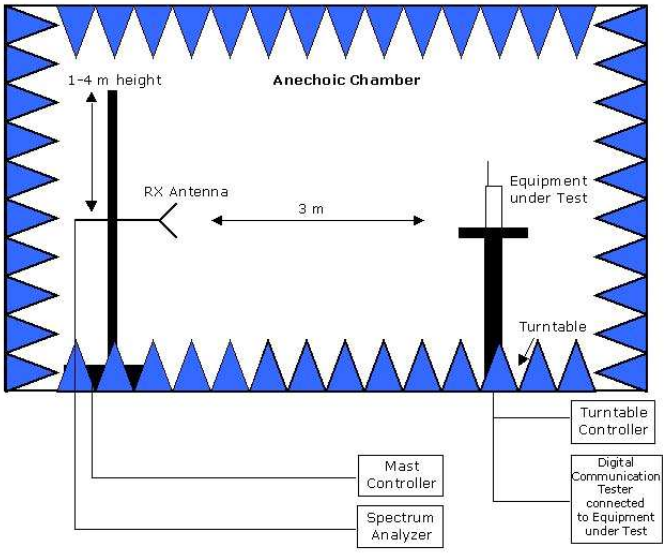
Frequency Range (MHz)	Class B Limit (dBµV/m)
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0

Frequency Range (MHz)	Class A Limit (dBµV/m) / @ 3 m!
30 - 88	49.5
88 - 216	54.0
216 - 960	56.9
above 960	60.0

§15.35(b)
..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....
Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

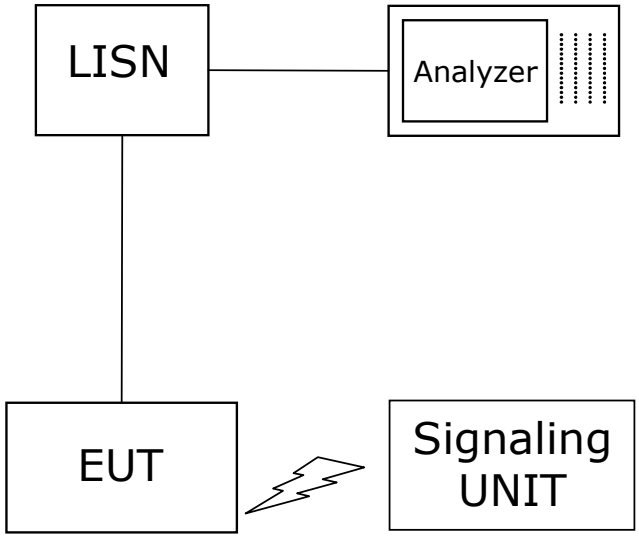
NOTE: A missing result table in the corresponding test report section means, that no final measurement was performed because no relevant frequencies (peaks) were found in the preliminary scan.

Setup Drawings



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

Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting ground plane.



Setup in the shielded room for conducted measurements at AC mains port

November, 2014

To Whom This May Concern

Correlation of measurement requirements for Information Technology Equipment (ITE) / Digital Circuits from FCC and IC

Information Technology Equipment (ITE) / Radio Apparatus Containing Digital Circuits

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§15.107	ICES-003 Issue 5: 6.1
Spurious Radiated Emissions	§15.109	ICES-003 Issue 5: 6.2

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

6 Index