InterLab®

FCC Measurement/Technical Report on

WLAN transceiver
Bittium Tough Mobile

FCC ID: V27SD-41
IC: 3282B-SD41

Report Reference: MDE_ELEKT_1502_FCCb_rev2

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

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

Table of Contents

0 Applied Standards and Test Summary

0.1 Applied Standards

Type of Authorization
Certification for an Intentional Radiator (Digital Device / Spread Spectrum).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (10-1-13 Edition) and 15 (10-1-13 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

Part 15, Subpart E – Unlicensed National Information Infrastructure Devices

§ 15.403 Definitions

§ 15.407 General technical requirements

Note:
The tests were selected and performed with reference to the FCC Public Notice "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D02 General U-NII Test Procedures v01, 2014-06-06".

ANSI C63.10 is applied.

FCC ET Docket No. 13-49, FIRST REPORT AND ORDER, April 1, 2014 ("new rules") is applied.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.3 Measurement Summary / Signatures.

0.2 FCC-IC Correlation Table

Correlation of measurement requirements for UNII / LE-LAN (e.g. WLAN 5 GHz) equipment

UNII equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 4: 8.8
Occupied bandwidth	§ 15.403 (i) (26 dB) / § 15.407 (e) (6 dB)	RSS-247 Issue 1: 6.2.1 (1), 6.2.2 (1), 6.2.3 (1) (99%) RSS-247 Issue 1: 6.2.4 (1) (6 dB)
Maximum conducted output power	§ 15.407 (a) (1),(2),(3),(4)	RSS-247 Issue 1: : 6.2.1 (1), 6.2.2 (1), 6.2.3 (1), 6.2.4 (1)
Maximum power spectral density	§ 15.407 (a) (1),(2),(3),(5)	RSS-247 Issue 1: : 6.2.1 (1), 6.2.2 (1), 6.2.3 (1), 6.2.4 (1)
Transmitter undesirable emissions; General Field Strength Limits, Restricted Bands	15.407 (b) § 15.209 (a)	RSS-Gen Issue 4: 6.13/8.9/8.10; RSS-247 Issue 1: : 6.2.1 (2), 6.2.2 (2), 6.2.3 (2), 6.2.4 (2)
Frequency stability	§ 15.407 (g)	RSS-Gen Issue 4: 6.11/8.11
Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS)	§ 15.407 (h)	RSS-247 Issue 1: 6.2.2 (1), 6.2.3 (1), 6.3
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 4: 8.3
Receiver spurious emissions	–	-

0.3 Measurement Summary / Signatures

FCC Part 15, Subpart C		**§ 15.207**	
Conducted emissions (AC power line)			
The measurement was performed according to ANSI C63.4			
OP-Mode	**Setup**	**Port**	**Final Result**
a-Mode, CH 36, 20 MHz	Setup_03	AC Port (power line)	passed

FCC Part 15, Subpart E		**§ 15.403 (i), 15.407 (e)**	
26 / 6 dB Emission bandwidth / 99 % occupied bandwidth			
The measurement was performed according to FCC § 15.31			
OP-Mode	**Setup**	**Port**	**Final Result**
a-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	performed
a-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	performed
a-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	performed
a-Mode, CH 52, 20 MHz	Setup_01	Temp.ant.connector	performed
a-Mode, CH 56, 20 MHz	Setup_01	Temp.ant.connector	performed
a-Mode, CH 64, 20 MHz	Setup_01	Temp.ant.connector	performed
a-Mode, CH 100, 20 MHz	Setup_01	Temp.ant.connector	performed
a-Mode, CH 116, 20 MHz	Setup_01	Temp.ant.connector	performed
a-Mode, CH 140, 20 MHz	Setup_01	Temp.ant.connector	performed
a-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed
a-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed
a-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed
n-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 52, 20 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 56, 20 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 64, 20 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 100, 20 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 116, 20 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 140, 20 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed
n-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed
n-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed
n-Mode, CH 38, 40 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 46, 40 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 54, 40 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 62, 40 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 102, 40 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 110, 40 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 134, 40 MHz	Setup_01	Temp.ant.connector	performed
n-Mode, CH 151, 40 MHz	Setup_01	Temp.ant.connector	passed
n-Mode, CH 159, 40 MHz	Setup_01	Temp.ant.connector	passed
ac-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 52, 20 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 56, 20 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 64, 20 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 100, 20 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 116, 20 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 140, 20 MHz	Setup_01	Temp.ant.connector	performed

ac-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed
ac-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed
ac-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed
ac-Mode, CH 38, 40 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 46, 40 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 54, 40 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 62, 40 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 102, 40 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 110, 40 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 134, 40 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 151, 40 MHz	Setup_01	Temp.ant.connector	passed
ac-Mode, CH 159, 40 MHz	Setup_01	Temp.ant.connector	passed
ac-Mode, CH 42, 80 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 58, 80 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 106, 80 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 122, 80 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 134, 80 MHz	Setup_01	Temp.ant.connector	performed
ac-Mode, CH 159, 80 MHz	Setup_01	Temp.ant.connector	passed

FCC Part 15, Subpart E **§ 15.407 (a)(1,2,3,4)**

Maximum Conducted Output Power

The measurement was performed according to FCC § 15.31

OP-Mode	Setup	Port	Final Result FCC	IC
a-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 52, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 56, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 64, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 100, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 116, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 140, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 52, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 56, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 64, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 100, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 116, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 140, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 38, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 46, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 54, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 62, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 102, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 110, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 134, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 151, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 159, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 52, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 56, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 64, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 100, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 116, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 140, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 38, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 46, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 54, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 62, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 102, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 110, 40 MHz	Setup_01	Temp.ant.connector	passed	passed

ac-Mode, CH 134, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 151, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 159, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 42, 80 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 58, 80 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 106, 80 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 122, 80 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 134, 80 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 159, 80 MHz	Setup_01	Temp.ant.connector	passed	passed

FCC Part 15, Subpart E **§ 15.407 (a)(1,2,3,5)**

Maximum Power Spectral Density

The measurement was performed according to FCC § 15.31

OP-Mode	Setup	Port	Final Result FCC	IC
a-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 52, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 56, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 64, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 100, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 116, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 140, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 52, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 56, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 64, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 100, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 116, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 140, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 38, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 46, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 54, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 62, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 102, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 110, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 134, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 151, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 159, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 52, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 56, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 64, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 100, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 116, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 140, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 38, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 46, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 54, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 62, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 102, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 110, 40 MHz	Setup_01	Temp.ant.connector	passed	passed

ac-Mode, CH 134, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 151, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 159, 40 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 42, 80 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 58, 80 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 106, 80 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 122, 80 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 134, 80 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 159, 80 MHz	Setup_01	Temp.ant.connector	passed	passed

FCC Part 15, Subpart E **§ 15.407 (g)**

Frequency Stability

The measurement was performed according to FCC § 15.31

OP-Mode	Setup	Port	Final Result
n-Mode, CH 52, 20 MHz	Setup_01	Temp.ant.connector	N/P

FCC Part 15, Subpart C & E	§ 15.205, § 15.209 § 15.407 (b)(1,2,3,4,5,6)			
Undesirable Emissions, General Field Strength Limits; Restricted Bands and Radiated Emission Limits The measurement was performed according to ANSI C63.4			**Final Result**	
OP-Mode	**Setup**	**Port**	**FCC**	**IC**
a-Mode, CH 36, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 44, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 48, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 52, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 56, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 64, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 100, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 116, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 140, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 149, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 157, 20 MHz	Setup_02	Enclosure	passed	passed
a-Mode, CH 165, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 36, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 44, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 48, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 52, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 56, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 64, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 100, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 116, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 140, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 149, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 157, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 165, 20 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 38, 40 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 46, 40 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 54, 40 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 62, 40 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 102, 40 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 110, 40 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 134, 40 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 151, 40 MHz	Setup_02	Enclosure	passed	passed
n-Mode, CH 159, 40 MHz	Setup_02	Enclosure	passed	passed

FCC Part 15, Subpart E	§ 15.407 (h)		
Dynamic Frequency selection The measurement was performed according to FCC § 15.31			**Final Result**
OP-Mode	**Setup**	**Port**	**FCC**
–	–	–	N/P

N/P Not performed

Responsible for Accreditation Scope: MARCO KULLIK 2015.12.01 16:00:37 +01'00'

Responsible for Test Report: DANIEL GALL 2015.12.01 15:49:14 +01'00'

Revision History

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2015-10-23	--	invalid
rev1	2015-11-12	Corrected KDB reference in testcase "Maximum conducted output power"	invalid
rev2	2015-12-01	Corrected KDB reference in testcase "Maximum Power Spectral Density"	valid

1 Administrative Data

1.1 Testing Laboratory

Company Name:	7layers GmbH
Address	Borsigstr. 11 40880 Ratingen Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number: 96716 .
This facility has been fully described in a report submitted to the IC and accepted under the registration number: Site# 3699A-1
The test facility is also accredited by the following accreditation organisation:

Laboratory accreditation no.:	DAkkS D-PL-12140-01-01
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Thomas Hoell Dipl.-Ing Andreas Petz Dipl.-Ing Marco Kullik
Report Template Version:	2014-11-24

1.2 Project Data

Responsible for testing and report:	Dipl.-Ing. Daniel Gall
Employees who performed the tests:	documented internally at 7layers
Date of Test(s):	2015-06-04 to 2015-09-01
Date of Report:	2015-12-01

1.3 Applicant Data

Company Name:	Bittium Wireless Ltd.
Address:	Tutkijantie 8 90590, Oulu Finland
Contact Person:	Mr. Jyrki Juvani

1.4 Manufacturer Data

Company Name:	Please see applicant data
Address:	
Contact Person:	

2 Test object Data

2.1 General EUT Description

Equipment under Test:	IEEE 802.11a/b/g/n/ac WLAN transceiver (5 GHz)
Type Designation:	Bittium Tough Mobile
Kind of Device: (optional)	
Voltage Type:	DC (internal Battery); AC Adapter for charging
Voltage Level:	DC 3.8 V; AC 120V / 60Hz
Tested Modulation Type:	DBPSK; OFDM:BPSK; OFDM:64-QAM

General product description:

The EUT is a tough Mobile Phone supporting
GSM 850/900/1800/1900,
UMTS/WCDMA FDD I, II, IV, VIII
LTE FDD 2, 3, 4, 5, 7, 13, 14, 17, 20
WLAN 802.11 a, b, g, n, ac
Bluetooth (BDR, EDR, LE (4.0))
GPS & GLONASS
NFC 13.56 MHz

The WLAN Transceiver is operating in the 5 GHz band using Direct Sequence Spread Spectrum (DSSS) Modulation and Orthogonal Frequency Division Multiplexing (OFDM).

Specific product description for the EUT:

The EUT is a dual band WLAN (802.11 2.4 GHz b/g/n and 5 GHz a/n/ac) and Bluetooth module with one joint antenna connector for WLAN and Bluetooth, but simultaneous transmission is not possible and is managed by the module. In IEEE 802.11n mode it supports 20 MHz and 40 MHz bandwidth channels (both with MCS7), providing 72.2 Mbit/s, and 150 Mbit/s transfer data rates respectively. In IEEE 802.11ac it supports additional the 80 MHz bandwidth.
The WLAN (Wireless Local Area Network) transceiver is operating in the 5 GHz band in the range 5.15 – 5.25 GHz, 5.25 – 5.35 GHz, 5.47 – 5.725 GHz and 5.725 – 5.850 GHz.

The object of this test report is the WLAN transceiver, it was tested at 20 MHz, 40 MHz and 80 MHz channel bandwidth.

The EUT provides the following ports:

Ports
Enclosure
AC Port
USB (DC and Data) Port
Audio Port

The main components of the EUT are listed and described in chapter 2.2

2.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status
EUT A (Code: DE1132001ae01)	WLAN transceiver	Tough Mobile	K0251300433	0302	Android Version 5.1.1
Remark: EUT A is equipped with a temporary antenna connector.					
EUT B (Code: DE1132001ah01)	WLAN transceiver	Tough Mobile	K02513004	0302	Android Version 5.1.1
Remark: EUT B is equipped with a dual-band integral antenna with antenna gain = -3.5 dBi at 2.4 – 2.5 GHz frequency range and 1.0 dBi for UNII SB1, 2.0 dBi for UNII SB2A / SB2 and 2.5 dBi for UNII SB2C /SB3 in 4.9 – 5.9 GHz frequency range.					

NOTE: The short description is used to simplify the identification of the EUT in this test report.

2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status
ANC1	Battery from Celltech	Model: 3700034	3520001	–	–

2.4 Auxiliary Equipment

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status
AUX1	AC Adapter from Seanen Electronics Co. LTD	KSA29B0500200D5	P0315	–	–
AUX2	Headset/Earphone from Foster	HS2-1.1	3520001	-	-
AUX3	USB cable from ASSMANN	AK-300116-010-S	-	-	-

2.5 EUT Setups

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup	Combination of EUTs	Description and Rationale
Setup_01	EUT B + ANC1 + AUX1	setup for conducted radio measurements
Setup_02	EUT A + ANC1 + AUX1 to AUX3	setup for radiated measurements
Setup_03	EUT B + ANC1 +AUX1 to AUX3	setup for conducted emissions (AC power line) measurements

2.6 Operating Modes

This chapter describes the operating modes of the EUTs used for testing.

2.6.1 Test Channels

UNII-Subband 1 5150 - 5250 MHz			UNII-Subband 2A 5250 - 5350 MHz			UNII-Subband 2C 5470 - 5725 MHz			UNII-Subband 3 5725 - 5850 MHz			Nom. BW
Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top	20 MHz
36	44	48	52	56	64	100	116	140	149	157	165	Ch.-No.
5180	5220	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825	MHz

Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top	40 MHz
38	-	46	54	-	62	102	110	134	151	-	159	Ch.-No.
5190	-	5230	5270	-	5310	5510	5550	5670	5755	-	5795	MHz

Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top	80 MHz
-	42	-	-	58	-	106	122	134	-	159	-	Ch.-No.
-	5210	-	-	5290	-	5530	5610	5670	-	5795	-	MHz

2.6.2 Datarates and Duty Cycles

Datarate	Duty Cycle
WLAN a-Mode; 20 MHz; 6 Mbit/s	0.94
WLAN n-Mode; 20 MHz; 65 Mbit/s - MCS7, 800ns GI	0.63
WLAN n-Mode; 40 MHz; 135 Mbit/s - MCS7, 800ns GI	0.91
WLAN ac-Mode; 20 MHz; 6,5 Mbit/s - MCS0, 800ns GI	0.51
WLAN ac-Mode; 40 MHz; 180Mbit/s - MCS9, 800ns GI	0.48
WLAN ac-Mode; 80 MHz; 29,3Mbit/s - MCS0,800ns GI	0.72

2.7 Special software used for testing

An Android-Application was used with the option to switch on a local WLAN transmitter with different settings for modulation type, data rate, channel bandwidth and output power level.

2.8 Product labelling

2.8.1 FCC ID label

Please refer to the documentation of the applicant.

2.8.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

3 Test Results

3.1 Conducted emissions (AC power line)

Standard FCC Part 15 Subpart C & E

The test was performed according to: ANSI C 63.4

3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4
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 powered from 50µH || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.

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.

3.1.2 Test Requirements / Limits

FCC Part 15, Subpart E, §15407 (b)(6) and Subpart C, §15.207

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

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

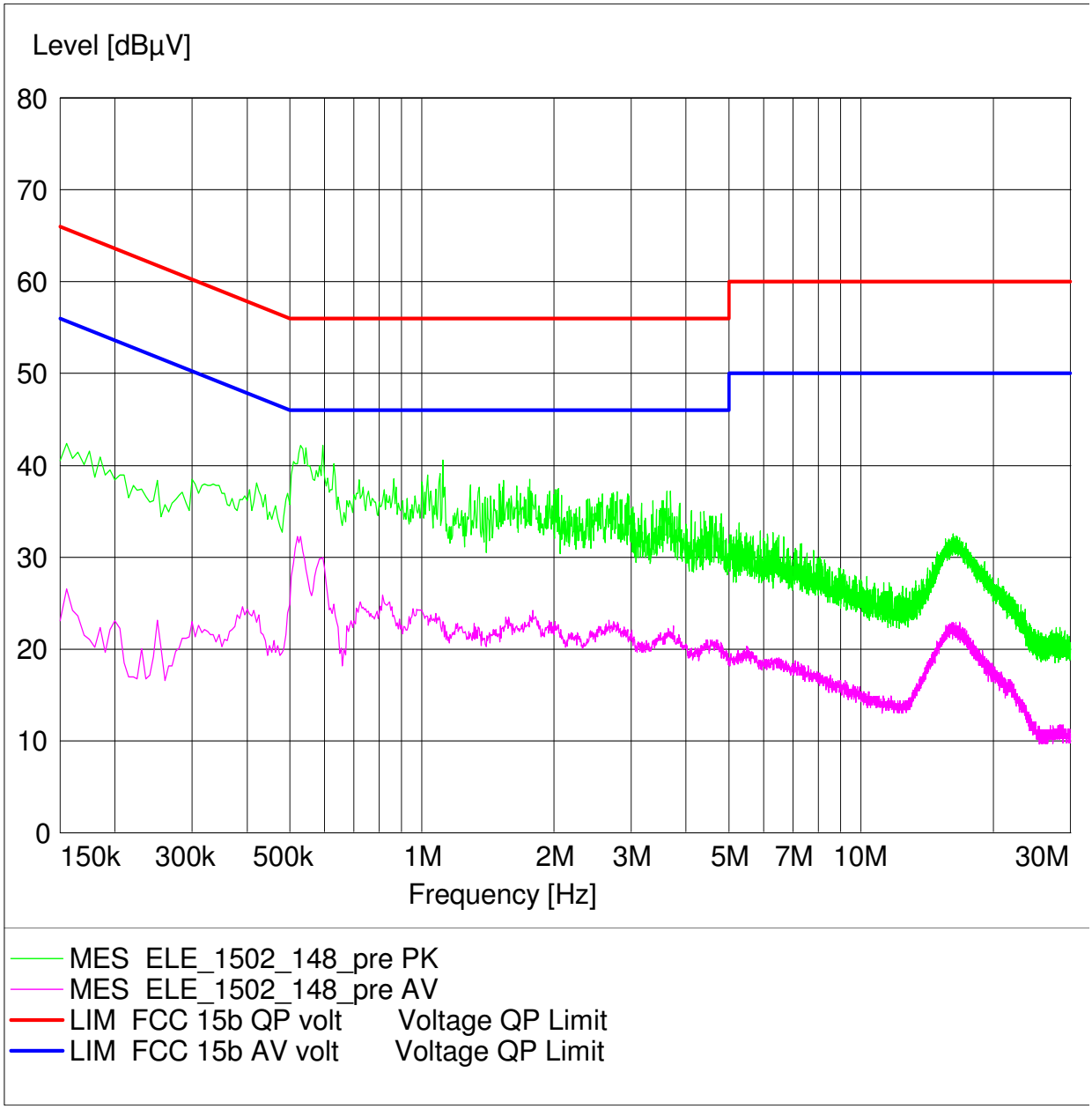
3.1.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1009 hPa
Humidity: 40 %

Power line	Frequency MHz	Measured value QP dBµV	Measured value AV dBµV	QP Limit dBµV	AV Limit dBµV	Margin QP dB	Margin AV dB
N	–	–	–	–	–	–	–
L	–	–	–	–	–	–	–

Remark: No final measurement was performed because no frequencies (peaks) were found within the offset for acceptance analysis during the preliminary scan.
Please see next sub-clause for the measurement plot. Mode a, 6 Mbit/s. The chosen operating mode is selected as representative mode to generate "worst-case" conditions, i.e. high power consumption.
The EUT is operated at 4.2 V DC while supplied by AUX3 which is connected to AC Mains at 120 V / 60 Hz.

3.1.4 Measurement Plot (showing the highest value, "worst case")



WLAN TX on 5180 MHz, a-mode, 6Mbps, charging

3.2 26 / 6 dB Emission bandwidth / 99 % occupied bandwidth

Standard FCC Part 15, Subpart E

The test was performed according to: FCC §15.31

3.2.1 Test Description

The Equipment Under Test (EUT) was setup in a shielded room to perform the occupied bandwidth measurements.
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.
The results recorded were measured with the modulation which produce the worst-case (widest) emission bandwidth (26 / 6 dB and 99%).

The EUT was connected to spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:
1) 26 bandwidth, sub-bands 1, 2A and 2C:
- Resolution Bandwidth (RBW): initially approx. 1 % of nominal emission bandwidth
- Video Bandwidth (VBW): > RBW
- re-adjust RBW close to 1 % of measured bandwidth and repeat the measurement
2) 6 dB bandwidth, sub-band 3:
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): ≥ 3 times the RBW
1+2) 26 / 6 dB bandwidth:
- Detector: Peak
- Trace: Maxhold
- Sweeps: ≥ 200
- Sweeptime: at least coupled
3) 99% occupied bandwidth:
- Span: 1.5 to 5 times the occupied bandwidth
- Resolution Bandwidth (RBW): approx. ≥ 1 % of the span, but not below
- Video Bandwidth (VBW): ≥ 3 times the RBW
- Detector: Sample
- Trace: Maxhold
- Sweeps: ≥ 200
- Sweeptime: at least coupled

3.2.2 Test Requirements / Limits

FCC Part 15, Subpart E, §15.403 (i)
There exist no applicable limits for the U-NII subbands 1, 2A and 2C. The test was performed to determine the limits for the "Maximum Conducted Output Power" test case. Therefore no result was applied.

FCC Part 15, Subpart E, §15.407 (e)
Within the 5.725-5.850 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

3.2.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 40 %

1) 26 dB bandwidth

WLAN a-Mode; 20 MHz; 6 Mbit/s			
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**26 dB Bandwidth [MHz]**
1	36	5180	23.618
	44	5220	22.692
	48	5240	23.039
2A	52	5260	23.965
	56	5280	23.560
	64	5320	22.865
2C	100	5500	22.750
	116	5580	23.329
	140	5700	25.007
3	149	5745	26.570
	157	5785	25.933
	165	5825	27.496

WLAN n-Mode; 20 MHz; 65 Mbit/s - MCS7, 800ns GI			
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**26 dB Bandwidth [MHz]**
1	36	5180	22.460
	44	5220	22.460
	48	5240	22.518
2A	52	5260	22.229
	56	5280	22.402
	64	5320	22.229
2C	100	5500	22.634
	116	5580	22.808
	140	5700	23.329
3	149	5745	23.329
	157	5785	23.444
	165	5825	24.255

(tables continues on next page)

WLAN n-Mode; 40 MHz; 135 Mbit/s - MCS7, 800ns GI			
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**26 dB Bandwidth [MHz]**
1	38	5190	44.320
	46	5230	44.107
2A	54	5270	44.427
	62	5310	45.547
2C	102	5510	43.680
	110	5550	43.840
	134	5670	44.107
3	151	5755	45.387
	159	5795	44.480

WLAN ac-Mode; 20 MHz; 6,5 Mbit/s - MCS0, 800ns GI			
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**26 dB Bandwidth [MHz]**
1	36	5180	21.823
	44	5220	21.881
	48	5240	22.171
2A	52	5260	21.881
	56	5280	21.997
	64	5320	21.939
2C	100	5500	21.881
	116	5580	21.823
	140	5700	21.939
3	149	5745	21.997
	157	5785	21.997
	165	5825	22.055

WLAN ac-Mode; 40 MHz; 180Mbit/s - MCS9, 800ns GI			
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**26 dB Bandwidth [MHz]**
1	38	5190	48.538
	46	5230	48.509
2A	54	5270	48.567
	62	5310	48.509
2C	102	5510	48.538
	110	5550	48.559
	134	5670	48.538
3	151	5755	48.539
	159	5795	48.568

(tables continues on next page)

WLAN ac-Mode; 80 MHz; 29,3Mbit/s - MCS0,800ns GI			
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**26 dB Bandwidth [MHz]**
1	42	5210	84.653
2A	58	5290	85.400
2C	106	5530	84.747
	122	5610	84.420
	134	5670	84.700
3	159	5795	84.747

2) 6 dB bandwidth (UNII-band 3 only)

WLAN a-Mode; 20 MHz; 6 Mbit/s					
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**6 dB Bandwidth [MHz]**	**Limit [MHz]**	**Margin [MHz]**
3	149	5745	16.411	0.500	15.911
	157	5785	16.455	0.500	15.955
	165	5825	16.454	0.500	15.954

WLAN n-Mode; 20 MHz; 65 Mbit/s - MCS7, 800ns GI					
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**6 dB Bandwidth [MHz]**	**Limit [MHz]**	**Margin [MHz]**
3	149	5745	17.757	0.500	17.257
	157	5785	17.844	0.500	17.344
	165	5825	17.800	0.500	17.300

WLAN n-Mode; 40 MHz; 135 Mbit/s - MCS7, 800ns GI					
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**6 dB Bandwidth [MHz]**	**Limit [MHz]**	**Margin [MHz]**
3	151	5755	36.471	0.500	35.971
	159	5795	36.584	0.500	36.084

3) 99% bandwidth

WLAN a-Mode; 20 MHz; 6 Mbit/s				
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**99 % Bandwidth [MHz]**	**Upper 99% point Ch 48 [MHz]**
1	36	5180	18.162	
	44	5220	18.017	
	48	5240	17.945	5248.97
2A	52	5260	18.090	
	56	5280	18.018	
	64	5320	17.945	
2C	100	5500	17.873	
	116	5580	18.017	
	140	5700	18.234	
3	149	5745	18.524	
	157	5785	18.234	
	165	5825	18.379	

WLAN n-Mode; 20 MHz; 65 Mbit/s - MCS7, 800ns GI				
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**99 % Bandwidth [MHz]**	**Upper 99% point Ch 48 [MHz]**
1	36	5180	18.452	
	44	5220	18.234	
	48	5240	18.379	5249.19
2A	52	5260	18.379	
	56	5280	18.451	
	64	5320	18.379	
2C	100	5500	18.452	
	116	5580	18.379	
	140	5700	18.524	
3	149	5745	18.524	
	157	5785	18.596	
	165	5825	18.524	

WLAN n-Mode; 40 MHz; 135 Mbit/s - MCS7, 800ns GI				
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**99 % Bandwidth [MHz]**	**Upper 99% point Ch 46 [MHz]**
1	38	5190	36.469	
	46	5230	36.614	5248.16
2A	54	5270	36.614	
	62	5310	36.614	
2C	102	5510	36.614	
	110	5550	36.758	
	134	5670	36.614	
3	151	5755	36.469	
	159	5795	36.758	

(tables continues on next page)

WLAN ac-Mode; 20 MHz; 6,5 Mbit/s - MCS0, 800ns GI				
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**99% dB Bandwidth [MHz]**	**Upper 99% point Ch 48 [MHz]**
1	36	5180	18.669	
	44	5220	18.669	
	48	5240	18.669	5249.33
2A	52	5260	18.669	
	56	5280	18.669	
	64	5320	18.741	
2C	100	5500	18.669	
	116	5580	18.669	
	140	5700	18.741	
3	149	5745	18.741	
	157	5785	18.741	
	165	5825	18.813	

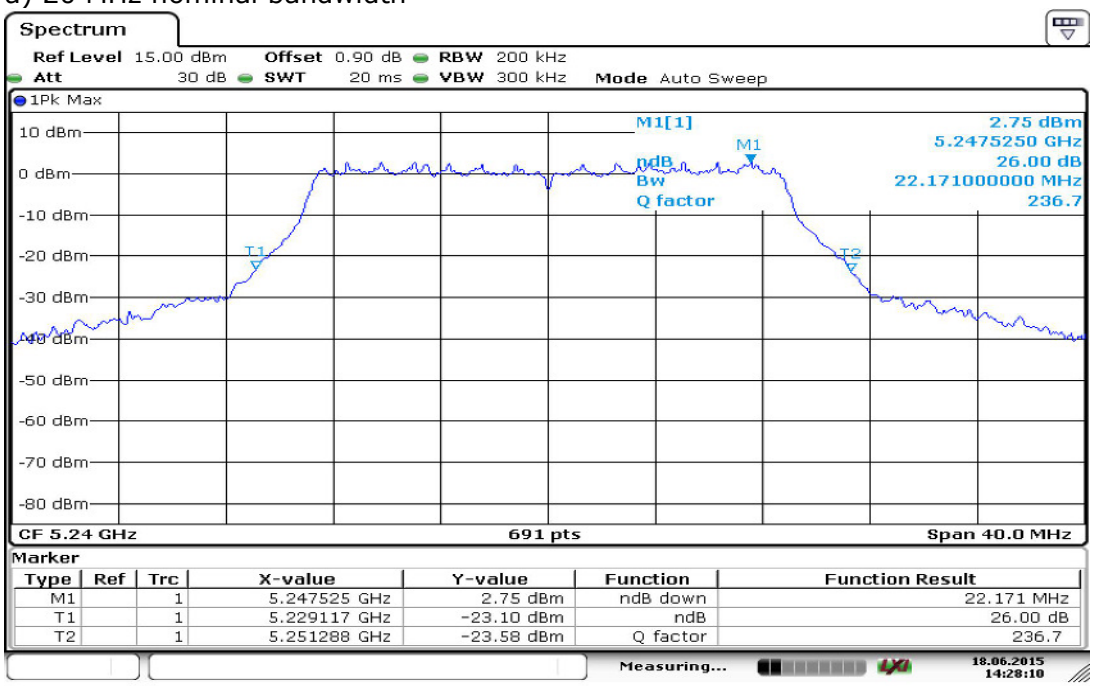
WLAN ac-Mode; 40 MHz; 180Mbit/s - MCS9, 800ns GI				
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**99 % Bandwidth [MHz]**	**Upper 99% point Ch 46 [MHz]**
1	38	5190	36.469	
	46	5230	36.397	5248.16
2A	54	5270	36.397	
	62	5310	36.397	
2C	102	5510	36.397	
	110	5550	36.397	
	134	5670	36.397	
3	151	5755	36.397	
	159	5795	36.397	

WLAN ac-Mode; 80 MHz; 29,3Mbit/s - MCS0,800ns GI				
UNII-Subband	**Channel No.**	**Frequency [MHz]**	**99 % Bandwidth [MHz]**	**Upper 99% point Ch 42 [MHz]**
1	42	5210	75.253	5247.48
2A	58	5290	74.964	
2C	106	5530	75.543	
	122	5610	75.543	
	134	5670	75.253	
3	159	5795	75.253	

3.2.4 Measurement Plot (showing the highest value, "worst case")

1) 26 dB bandwidth

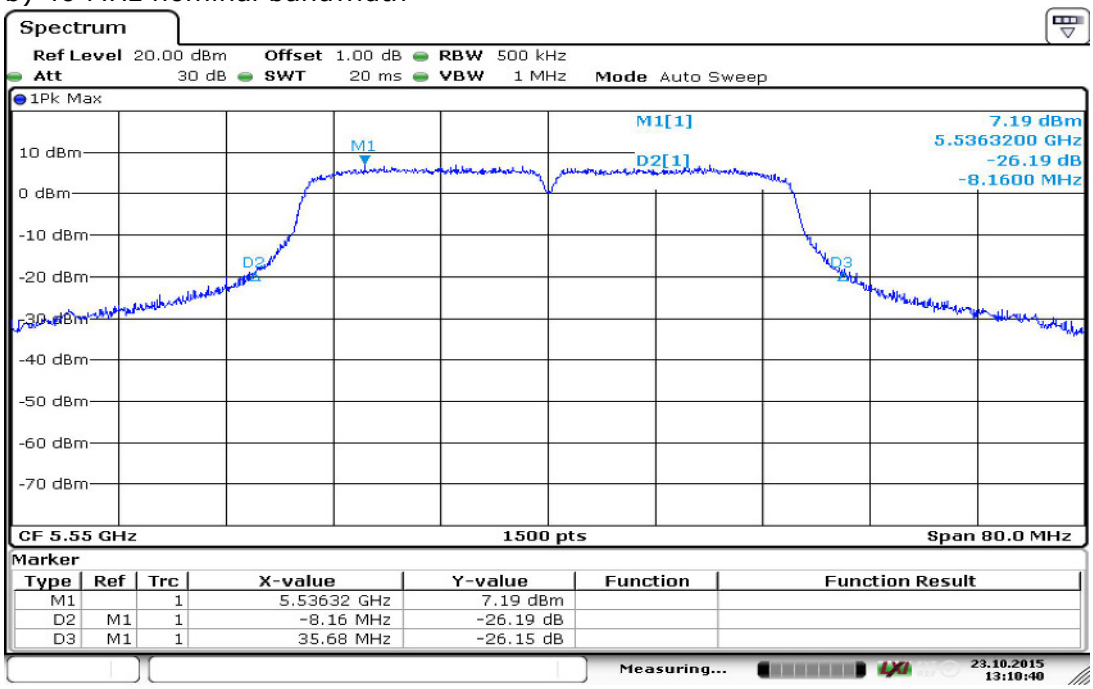
a) 20 MHz nominal bandwidth



Date: 18.JUN.2015 14:28:10

mode ac, 20MHz, 6.5Mbit/s, channel 48

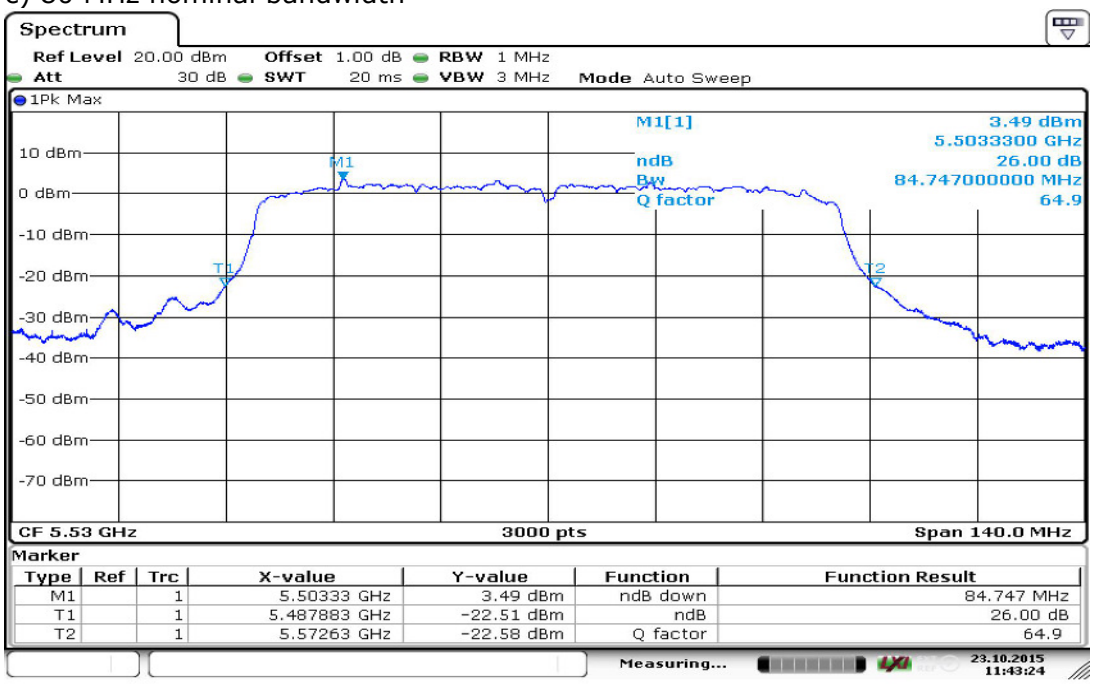
b) 40 MHz nominal bandwidth



Date: 23.OCT.2015 13:10:40

mode n, 40MHz, 135Mbit/s, channel 110

c) 80 MHz nominal bandwidth

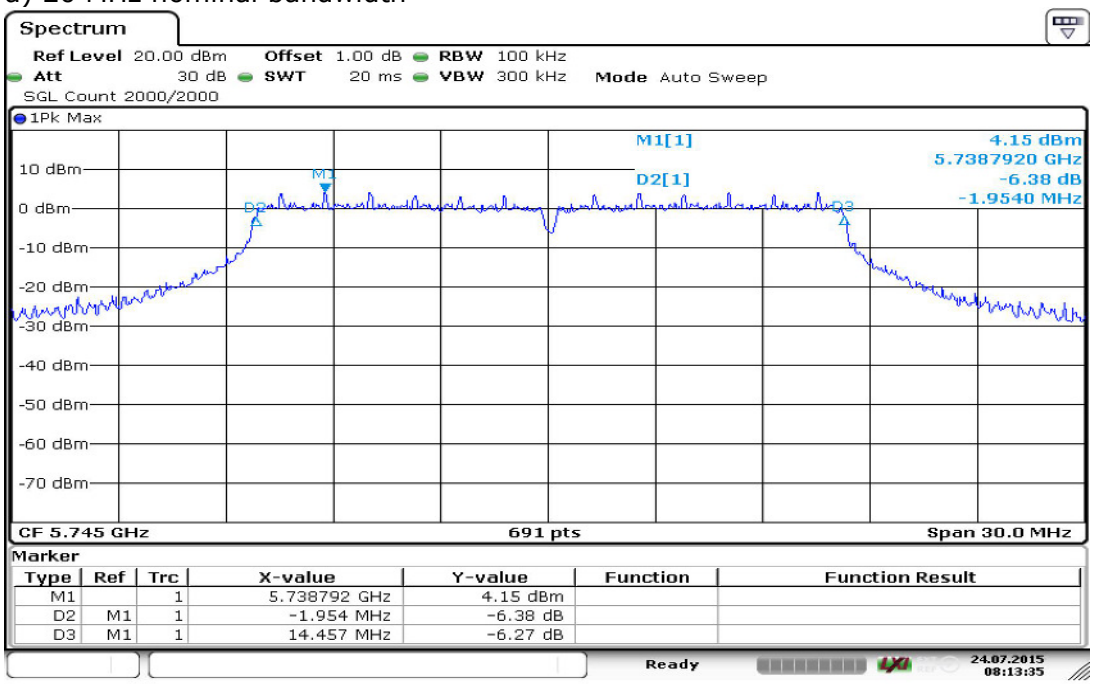


Date: 23.OCT.2015 11:43:23

mode ac, 80MHz, 29.3Mbit/s, channel 106

2) 6 dB bandwidth

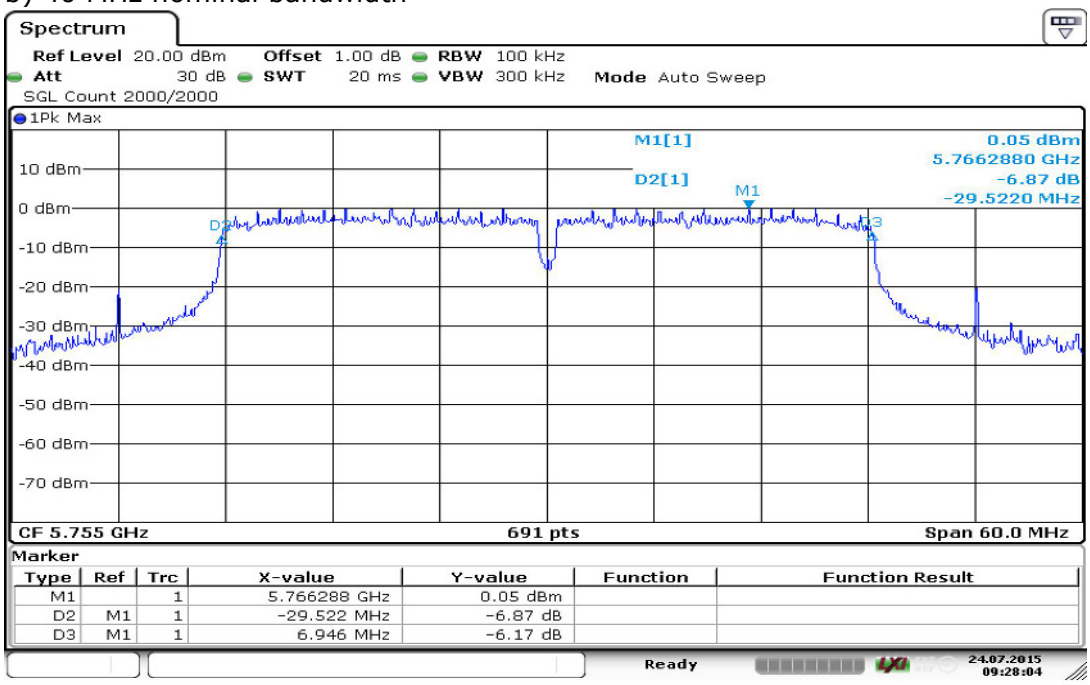
a) 20 MHz nominal bandwidth



Date: 24.JUL.2015 08:13:35

mode a, 20MHz, 6Mbit/s, channel 149

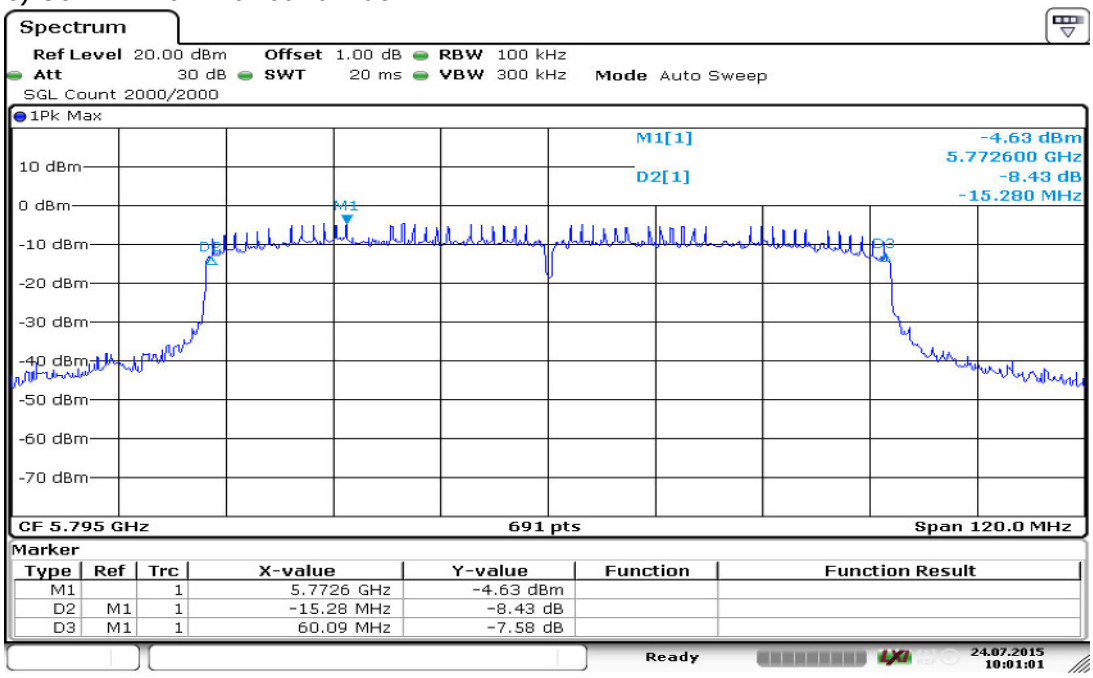
b) 40 MHz nominal bandwidth



Date: 24.JUL.2015 09:28:04

mode n, 40MHz, 135Mbit/s, channel 151

c) 80 MHz nominal bandwidth

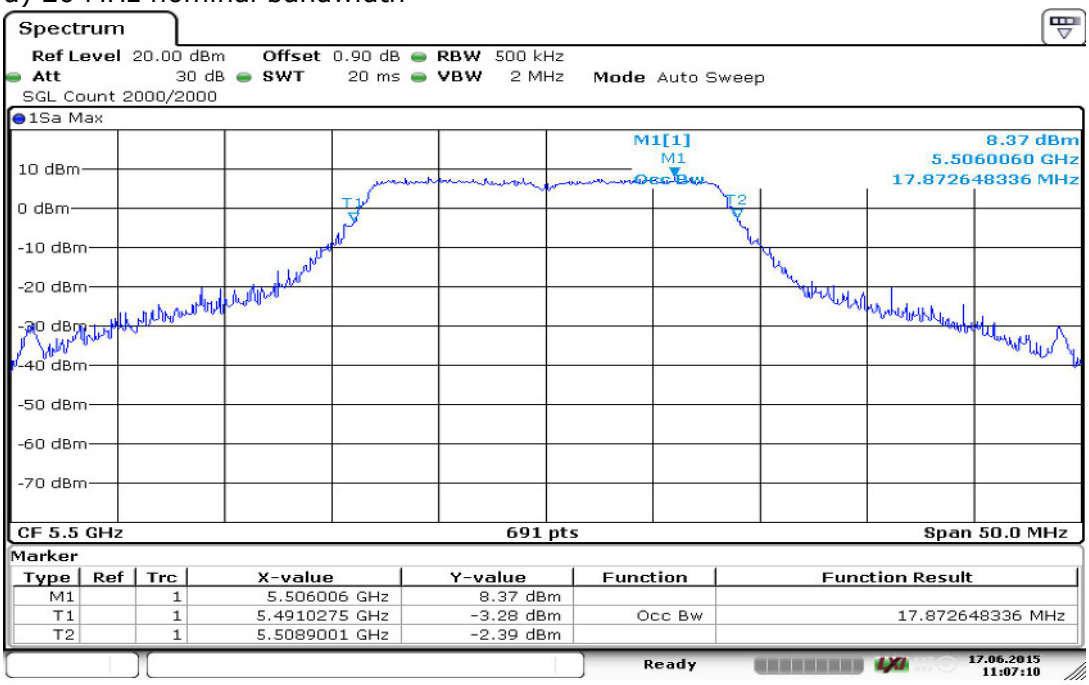


Date: 24.JUL.2015 10:01:01

Mode ac, 80MHz, 29.3Mbit/s, channel 159

3) 99% bandwidth

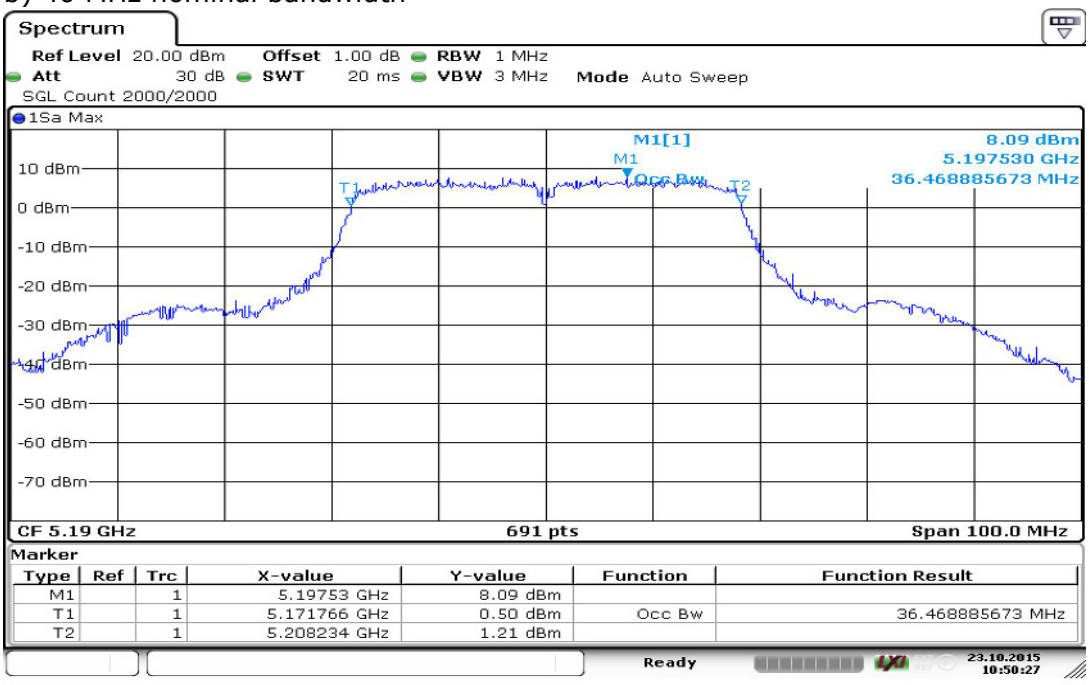
a) 20 MHz nominal bandwidth



Date: 17.JUN.2015 11:07:10

mode a, 20MHz, 6 Mbit/s, channel 100

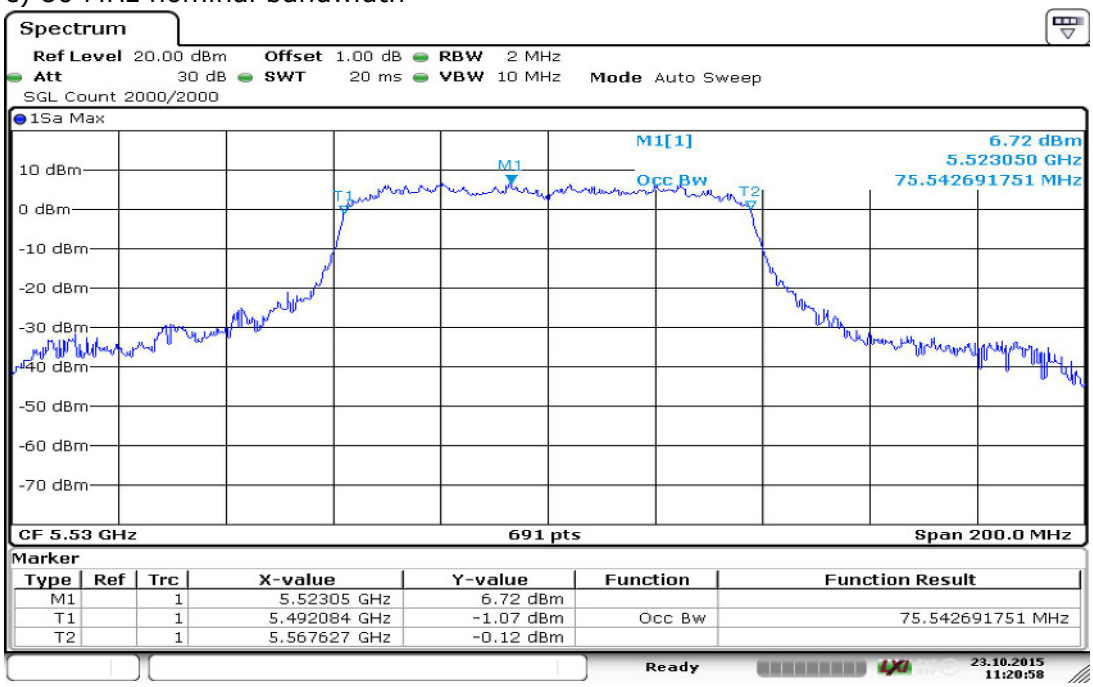
b) 40 MHz nominal bandwidth



Date: 23.OCT.2015 10:50:27

mode n, 40MHz, 135Mbit/s, channel 38

c) 80 MHz nominal bandwidth



Date: 23.OCT.2015 11:20:59

mode ac, 80MHz, 29.3Mbit/s, channel 106

3.3 Maximum conducted output power

Standard FCC Part 15, Subpart E

The test was performed according to: FCC §15.31

3.3.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the output power measurements. The results recorded were measured with the modulation which produces the worst-case (highest) output power. The EUT was connected to spectrum analyser via a short coax cable with a known loss.

Analyser settings:
- Resolution Bandwidth (RBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Detector: RMS
- Trace: Average, RMS power averaging mode
- Sweeps: 100
- Sweeptime: coupled
- Trigger: gated mode

Note:
The analyser settings are according FCC Public Note "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D02 General U-NII Test Procedures v01, 2014-06-06", method **SA-1**.

3.3.2 Test Requirements / Limits

A) FCC
For systems using digital modulation techniques in the 5.15 – 5.25 GHz bands:
§15.407 (a) (1)
Limit: 50 mW (17 dBm) or 4 dBm + 10 log (26 dB bandwidth/MHz) whatever is the lesser.
FCC ET Docket No. 13-49, FIRST REPORT AND ORDER, April 1, 2014 ("new rules"):
§15.407 (a) (1) (i): Outdoor access point:
Limit: 1 W (30 dBm) provided the maximum antenna gain does not exceed 6 dBi.
The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).
§15.407 (a) (1) (ii): Indoor access point:
Limit: 1 W (30 dBm) provided the maximum antenna gain does not exceed 6 dBi.
§15.407 (a) (1) (iv): Mobile and portable client devices:
Limit: 250 mW (24 dBm) provided the maximum antenna gain does not exceed 6 dBi.

For systems using digital modulation techniques in the 5.25 – 5.35 GHz and 5.47 – 5.725 GHz bands:
§15.407 (a) (2)
Limit: 250 mW (24 dBm) or 11 dBm + 10 log (26 dB bandwidth/MHz) whatever is the lesser.

For systems using digital modulation techniques in the 5.725 – 5.850 GHz bands:
§15.407 (a) (3)
Limit: 1 W (30 dBm) or 17 dBm + 10 log (26 dB bandwidth/MHz) whatever is the lesser.

FCC ET Docket No. 13-49, FIRST REPORT AND ORDER, April 1, 2014 (“new rules”):
§15.407 (a) (3):
Limit: 1 W (30 dBm).

§15.407 (a) (4):
The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

B) IC
Different frequency bands and limits apply, as compared to the FCC requirements.

RSS-247, 6.2 (1), Band 5150-5250 MHz, indoor operation only:
Limit (e.i.r.p.): 200 mW (23 dBm) or 10 + 10 log10 B [dBm], whichever power is less.
B is the 99% emission bandwidth in MHz.

RSS-247, 6.2 (2), Band 5250-5350 MHz:
Limits:
Maximum conducted Power: 250 mW (24 dBm) or 11 + 10 log10 B [dBm], whichever power is less.
e.i.r.p.: 1.0 W (30 dBm) or 17 + 10 log10 B [dBm], whichever power is less.

Note: For EUTs operating at a higher e.i.r.p. than 200 mW (23 dBm), compliance with the e.i.r.p. elevation mask is required.

RSS-247, 6.2 (3), Bands 5470-5600 MHz and 5650-5725 MHz:
Limits:
Maximum conducted Power: 250 mW (24 dBm) or 11 + 10 log10 B [dBm], whichever power is less.
e.i.r.p.: 1.0 W (30 dBm) or 17 + 10 log10 B [dBm], whichever power is less.

RSS-247, 6.2 (4), Band 5725-5825 MHz:
Limits:
Maximum conducted Power: 1W (30 dBm) or 17 + 10 log10 B [dBm], whichever power is less.
e.i.r.p.: 4.0 W (36 dBm) or 23 + 10 log10 B [dBm], whichever power is less.

All frequency bands: B is the 99% emission bandwidth in MHz.

3.3.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 40 %

WLAN a-Mode; 20 MHz; 6 Mbit/s					FCC		IC				
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]	
1	36	5180	15.0	16.0	30.0	15.0	N/A		22.6	6.6	1)
	44	5220	14.9	15.9	30.0	15.1	N/A		22.6	6.6	1)
	48	5240	14.9	15.9	30.0	15.1	N/A		22.5	6.6	1)
2A	52	5260	14.9	15.9	24.0	9.1	23.6	8.7	29.6	13.7	1)
	56	5280	14.7	15.7	24.0	9.3	23.6	8.8	29.6	13.8	1)
	64	5320	14.7	15.7	24.0	9.3	23.5	8.8	29.5	13.8	1)
2C	100	5500	15.0	16.0	24.0	9.0	23.5	8.5	29.5	13.5	
	116	5580	15.1	16.1	24.0	8.9	23.6	8.5	29.6	13.5	
	140	5700	15.6	16.6	24.0	8.4	23.6	8.0	29.6	13.0	
3	149	5745	15.3	16.3	30.0	14.7	29.7	14.4	35.7	19.4	
	157	5785	15.4	16.4	30.0	14.6	29.6	14.2	35.6	19.2	
	165	5825	15.2	16.2	30.0	14.8	29.6	14.4	35.6	19.4	

WLAN n-Mode; 20 MHz; 65 Mbit/s - MCS7, 800ns GI					FCC		IC				
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]	
1	36	5180	14.9	15.9	30.0	15.2	N/A		22.7	6.8	1)
	44	5220	14.8	15.8	30.0	15.2	N/A		22.6	6.8	1)
	48	5240	14.7	15.7	30.0	15.3	N/A		22.6	7.0	1)
2A	52	5260	14.8	15.8	24.0	9.3	23.6	8.9	29.6	13.9	1)
	56	5280	14.5	15.5	24.0	9.5	23.7	9.1	29.7	14.1	1)
	64	5320	14.6	15.6	24.0	9.4	23.6	9.1	29.6	14.1	1)
2C	100	5500	15.0	16.0	24.0	9.0	23.7	8.7	29.7	13.7	
	116	5580	15.2	16.2	24.0	8.8	23.6	8.5	29.6	13.5	
	140	5700	15.6	16.6	24.0	8.4	23.7	8.0	29.7	13.0	
3	149	5745	15.2	16.2	30.0	14.8	29.7	14.5	35.7	19.5	
	157	5785	15.5	16.5	30.0	14.6	29.7	14.2	35.7	19.2	
	165	5825	15.2	16.2	30.0	14.8	29.7	14.5	35.7	19.5	

(tables continues on next page)

WLAN n-Mode; 40 MHz; 135 Mbit/s - MCS7, 800ns GI					FCC		IC				
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]	
1	38	5190	13.9	14.9	30.0	16.1	N/A		23.0	8.1	1)
	46	5230	13.7	14.7	30.0	16.3	N/A		23.0	8.3	1)
2A	54	5270	13.6	14.6	24.0	10.4	24.0	10.4	30.0	15.4	1)
	62	5310	13.7	14.7	24.0	10.3	24.0	10.3	30.0	15.3	1)
2C	102	5510	14.1	15.1	24.0	9.9	24.0	9.9	30.0	14.9	
	110	5550	14.2	15.2	24.0	9.8	24.0	9.8	30.0	14.8	
	134	5670	14.5	15.5	24.0	9.5	24.0	9.5	30.0	14.5	
3	151	5755	14.5	15.5	30.0	15.5	30.0	15.5	36.0	20.5	
	159	5795	14.5	15.5	30.0	15.5	30.0	15.5	36.0	20.5	

WLAN ac-Mode; 20 MHz; 6,5 Mbit/s - MCS0, 800ns GI					FCC		IC				
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]	
1	36	5180	12.7	12.7	30.0	17.3	N/A		22.7	10.0	1)
	44	5220	12.7	12.7	30.0	17.3	N/A		22.7	10.0	1)
	48	5240	13.0	13.0	30.0	17.0	N/A		22.7	9.7	1)
2A	52	5260	12.9	12.9	24.0	11.1	23.7	10.8	29.7	16.8	1)
	56	5280	12.9	12.9	24.0	11.1	23.7	10.8	29.7	16.8	1)
	64	5320	12.8	12.8	24.0	11.2	23.7	11.0	29.7	17.0	1)
2C	100	5500	13.1	13.1	24.0	10.9	23.7	10.6	29.7	16.6	
	116	5580	13.3	13.3	24.0	10.7	23.7	10.4	29.7	16.4	
	140	5700	13.6	13.6	24.0	10.4	23.7	10.1	29.7	16.1	
3	149	5745	13.5	13.5	30.0	16.5	29.7	16.3	35.7	22.3	
	157	5785	13.4	13.4	30.0	16.6	29.7	16.3	35.7	22.3	
	165	5825	13.3	13.3	30.0	16.7	29.7	16.5	35.7	22.5	

WLAN ac-Mode; 40 MHz; 180Mbit/s - MCS9, 800ns GI					FCC		IC				
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]	
1	38	5190	11.9	11.9	30.0	18.1	N/A		23.0	11.1	1)
	46	5230	11.8	11.8	30.0	18.2	N/A		23.0	11.2	1)
2A	54	5270	11.9	11.9	24.0	12.2	24.0	12.2	30.0	18.2	1)
	62	5310	11.7	11.7	24.0	12.3	24.0	12.3	30.0	18.3	1)
2C	102	5510	12.3	12.3	24.0	11.7	24.0	11.7	30.0	17.7	
	110	5550	12.2	12.2	24.0	11.8	24.0	11.8	30.0	17.8	
	134	5670	12.4	12.4	24.0	11.6	24.0	11.6	30.0	17.6	
3	151	5755	12.4	12.4	30.0	17.6	30.0	17.6	36.0	23.6	
	159	5795	12.6	12.6	30.0	17.5	30.0	17.5	36.0	23.5	

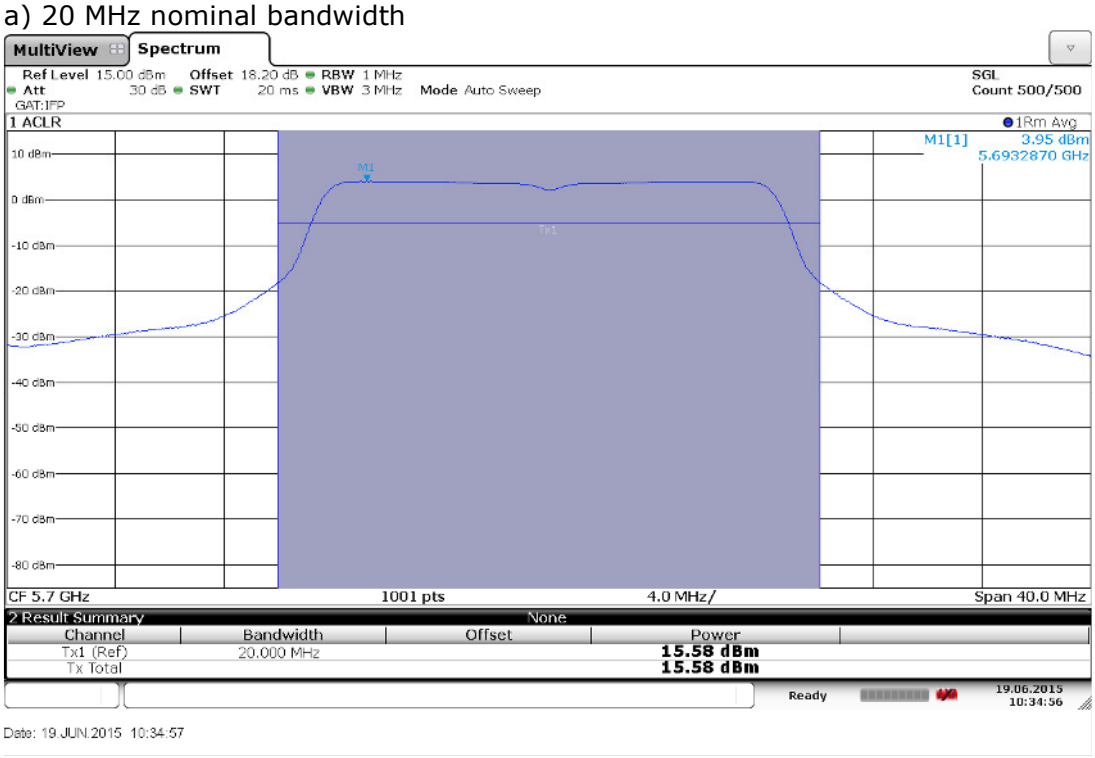
(tables continues on next page)

WLAN ac-Mode; 80 MHz; 29,3Mbit/s - MCS0,800ns GI					FCC		IC				
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]	
1	42	5210	10.9	10.9	30.0	19.1	N/A		23.0	12.1	1)
2A	58	5290	10.8	10.8	24.0	13.2	24.0	13.2	30.0	19.2	1)
2C	106	5530	11.5	11.5	24.0	12.5	24.0	12.5	30.0	18.5	
	122	5610	11.7	11.7	24.0	12.3	24.0	12.3	30.0	18.3	
	134	5670	11.6	11.6	24.0	12.4	24.0	12.4	30.0	18.4	
3	159	5795	12.1	12.1	30.0	18.0	30.0	18.0	36.0	24.0	

1) = no additional limit applies related to the elevation.

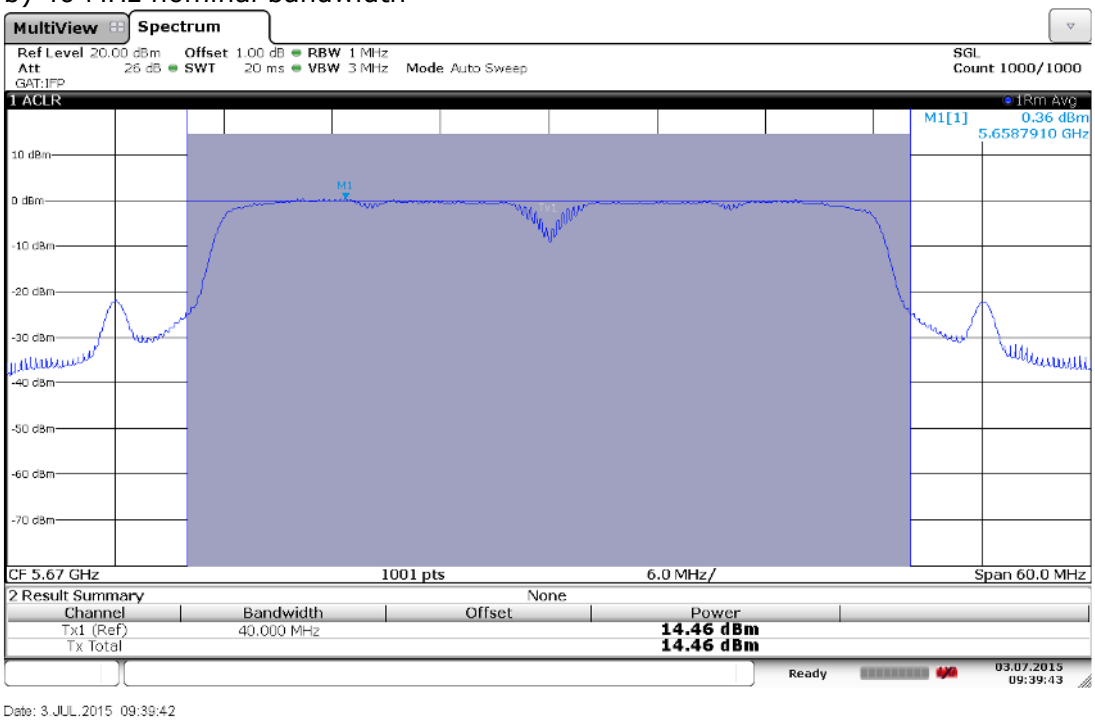
3.3.4 Measurement Plot (showing the highest value, "worst case")

a) 20 MHz nominal bandwidth



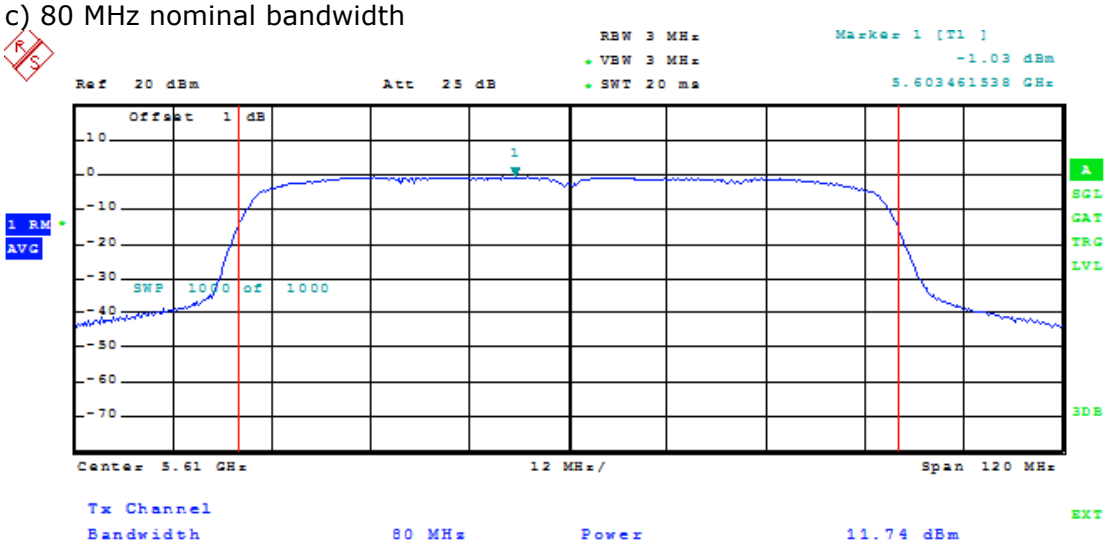
mode a, 20MHz, 6Mbit/s, channel 140

b) 40 MHz nominal bandwidth



mode n, 40MHz, 135Mbit/s, channel 134

c) 80 MHz nominal bandwidth



mode ac, 80MHz, 29.3Mbit/s, channel 122

3.4 Maximum Power Spectral Density

Standard FCC Part 15, Subpart E

The test was performed according to: FCC §15.31

3.4.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the Maximum Power Spectral Density measurements.
The results recorded were measured with the modulation which produces the worst-case (highest) output power.

The EUT was connected to spectrum analyser via a short coax cable with a known loss.

Analyser settings:
- Resolution Bandwidth (RBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Detector: RMS
- Trace: Average, RMS power averaging mode
- Sweeps: 100
- Sweeptime: coupled
- Marker: Peak
- Trigger: gated mode

Note:
The analyser settings are according FCC Public Note "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D02 General U-NII Test Procedures v01, 2014-06-06", method **SA-1.**

3.4.2 Test Requirements / Limits

A) FCC

FCC Part 15, Subpart E, §15.407 (a) (1)
For systems using digital modulation techniques in the 5.15 – 5.25 GHz bands:
(i) and (ii), outdoor and indoor access points: Limit: 17 dBm/MHz.
(iv), mobile and portable client devices: Limit: 11 dBm/MHz.

FCC Part 15, Subpart E, §15.407 (a) (2)
For systems using digital modulation techniques in the 5.25 – 5.35 GHz and 5.47 – 5.725 GHz bands:
Limit: 11 dBm/MHz.

FCC Part 15, Subpart E, §15.407 (a) (3)
For systems using digital modulation techniques in the 5.725 – 5.850 GHz bands:
Limit: 30 dBm/500 kHz.

Note: The limit will be also fulfilled when measuring at any bandwidth greater than 500 kHz. This applies to signals where the maximum conducted output power was measured at a bandwidth exceeding 500 kHz and which fulfil that limit of 30 dBm.

B) IC
Different frequency bands and limits apply, as compared to the FCC requirements.

RSS-247, 6.2 (1), Band 5150-5250 MHz, indoor operation only:
Limit (e.i.r.p.): 10 dBm/MHz.

RSS-247, 6.2 (2), Band 5250-5350 MHz:
Limit: 11 dBm/MHz.

RSS-247, 6.2 (3), Bands 5470-5600 MHz and 5650-5725 MHz:
Limit: 11 dBm/MHz.

RSS-247, 6.2 (4), Band 5725-5825 MHz:
Limit: 17 dBm/MHz.

3.4.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 40 %

WLAN a-Mode; 20 MHz; 6 Mbit/s								
UNII-Sub-band	Ch. No.	Freq. [MHz]	MPSD [dBm/ MHz]	FCC Limit [dBm]	Margin [dB]	IC Limit [dBm]	Margin [dB]	IC EIRP MPSD
1	36	5180	3.4	11.0	7.6	10.0	5.6	4.4
	44	5220	3.3	11.0	7.7	10.0	5.7	4.3
	48	5240	3.3	11.0	7.7	10.0	5.7	4.3
2A	52	5260	3.2	11.0	7.8	11.0	7.8	unit:
	56	5280	3.1	11.0	7.9	11.0	7.9	dBm/
	64	5320	3.8	11.0	7.2	11.0	7.2	MHz
2C	100	5500	3.4	11.0	7.6	11.0	7.6	
	116	5580	3.5	11.0	7.5	11.0	7.5	
	140	5700	4.0	11.0	7.1	11.0	7.1	
3	149	5745	3.7	30.0	26.4	17.0	13.4	
	157	5785	3.8	30.0	26.2	17.0	13.2	
	165	5825	3.6	30.0	26.4	17.0	13.4	

WLAN n-Mode; 20 MHz; 65 Mbit/s - MCS7, 800ns GI								
UNII-Sub-band	Ch. No.	Freq. [MHz]	MPSD [dBm/ MHz]	FCC Limit [dBm]	Margin [dB]	IC Limit [dBm]	Margin [dB]	IC EIRP MPSD
1	36	5180	3.1	11.0	7.9	10.0	5.9	4.1
	44	5220	3.0	11.0	8.0	10.0	6.0	4.0
	48	5240	2.9	11.0	8.1	10.0	6.1	3.9
2A	52	5260	3.0	11.0	8.1	11.0	8.1	unit:
	56	5280	2.7	11.0	8.3	11.0	8.3	dBm/
	64	5320	2.8	11.0	8.2	11.0	8.2	MHz
2C	100	5500	3.2	11.0	7.8	11.0	7.8	
	116	5580	3.5	11.0	7.6	11.0	7.6	
	140	5700	3.9	11.0	7.1	11.0	7.1	
3	149	5745	3.5	30.0	26.5	17.0	13.5	
	157	5785	3.7	30.0	26.3	17.0	13.3	
	165	5825	3.4	30.0	26.6	17.0	13.6	

(tables continues on next page)

WLAN n-Mode; 40 MHz; 135 Mbit/s - MCS7, 800ns GI								
UNII-Sub-band	**Ch. No.**	**Freq. [MHz]**	**MPSD [dBm/ MHz]**	**FCC Limit [dBm]**	**Margin [dB]**	**IC Limit [dBm]**	**Margin [dB]**	**IC EIRP MPSD**
1	38	5190	-0.3	11.0	11.3	10.0	9.3	0.7
	46	5230	-0.4	11.0	11.4	10.0	9.4	0.6
2A	54	5270	-0.6	11.0	11.6	11.0	11.6	unit:
	62	5310	-0.4	11.0	11.4	11.0	11.4	dBm/
2C	102	5510	0.0	11.0	11.0	11.0	11.0	MHz
	110	5550	0.1	11.0	10.9	11.0	10.9	
	134	5670	0.4	11.0	10.6	11.0	10.6	
3	151	5755	0.6	30.0	29.5	17.0	16.5	
	159	5795	0.3	30.0	29.7	17.0	16.7	

WLAN ac-Mode; 20 MHz; 6,5 Mbit/s - MCS0, 800ns GI								
UNII-Sub-band	**Ch. No.**	**Freq. [MHz]**	**MPSD [dBm/ MHz]**	**FCC Limit [dBm]**	**Margin [dB]**	**IC Limit [dBm]**	**Margin [dB]**	**IC EIRP MPSD**
1	36	5180	0.9	11.0	10.1	10.0	9.1	0.9
	44	5220	0.9	11.0	10.1	10.0	9.1	0.9
	48	5240	1.1	11.0	9.9	10.0	8.9	1.1
2A	52	5260	1.0	11.0	10.0	11.0	10.0	unit:
	56	5280	1.0	11.0	10.0	11.0	10.0	dBm/
	64	5320	0.9	11.0	10.1	11.0	10.1	MHz
2C	100	5500	1.3	11.0	9.7	11.0	9.7	
	116	5580	1.5	11.0	9.5	11.0	9.5	
	140	5700	1.7	11.0	9.3	11.0	9.3	
3	149	5745	1.6	30.0	28.4	17.0	15.4	
	157	5785	1.6	30.0	28.4	17.0	15.4	
	165	5825	1.4	30.0	28.6	17.0	15.6	

WLAN ac-Mode; 40 MHz; 180Mbit/s - MCS9, 800ns GI								
UNII-Sub-band	**Ch. No.**	**Freq. [MHz]**	**MPSD [dBm/ MHz]**	**FCC Limit [dBm]**	**Margin [dB]**	**IC Limit [dBm]**	**Margin [dB]**	**IC EIRP MPSD**
1	38	5190	-2.3	11.0	13.3	10.0	12.3	-2.3
	46	5230	-2.3	11.0	13.3	10.0	12.3	-2.3
2A	54	5270	-2.2	11.0	13.2	11.0	13.2	unit:
	62	5310	-2.3	11.0	13.3	11.0	13.3	dBm/
2C	102	5510	-1.8	11.0	12.8	11.0	12.8	MHz
	110	5550	-1.9	11.0	12.9	11.0	12.9	
	134	5670	-1.7	11.0	12.7	11.0	12.7	
3	151	5755	-1.5	30.0	31.5	17.0	18.5	
	159	5795	1.5	30.0	28.5	17.0	15.5	

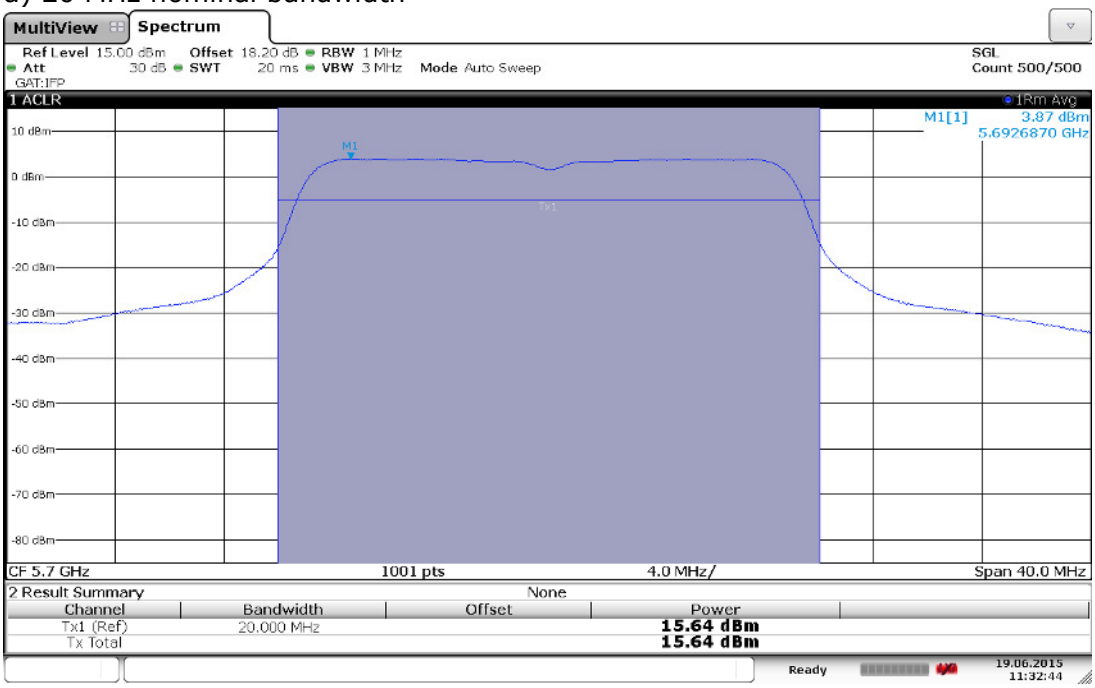
(tables continues on next page)

WLAN ac-Mode; 80 MHz; 29,3Mbit/s - MCS0,800ns GI								
UNII-Sub-band	**Ch. No.**	**Freq. [MHz]**	**MPSD [dBm/ MHz]**	**FCC Limit [dBm]**	**Margin [dB]**	**IC Limit [dBm]**	**Margin [dB]**	**IC EIRP MPSD**
1	42	5210	-2.0	11.0	13.0	10.0	12.0	-2.0
2A	58	5290	-1.9	11.0	12.9	11.0	12.9	unit:
2C	106	5530	-1.4	11.0	12.4	11.0	12.4	MHz
	122	5610	-1.0	11.0	12.0	11.0	12.0	
	134	5670	-0.9	11.0	11.9	11.0	11.9	
3	159	5795	-0.8	30.0	30.8	17.0	17.8	

Note: MPSD for subband 3 is measured at 1 MHz bandwidth.

3.4.4 Measurement Plot (showing the highest value, "worst case")

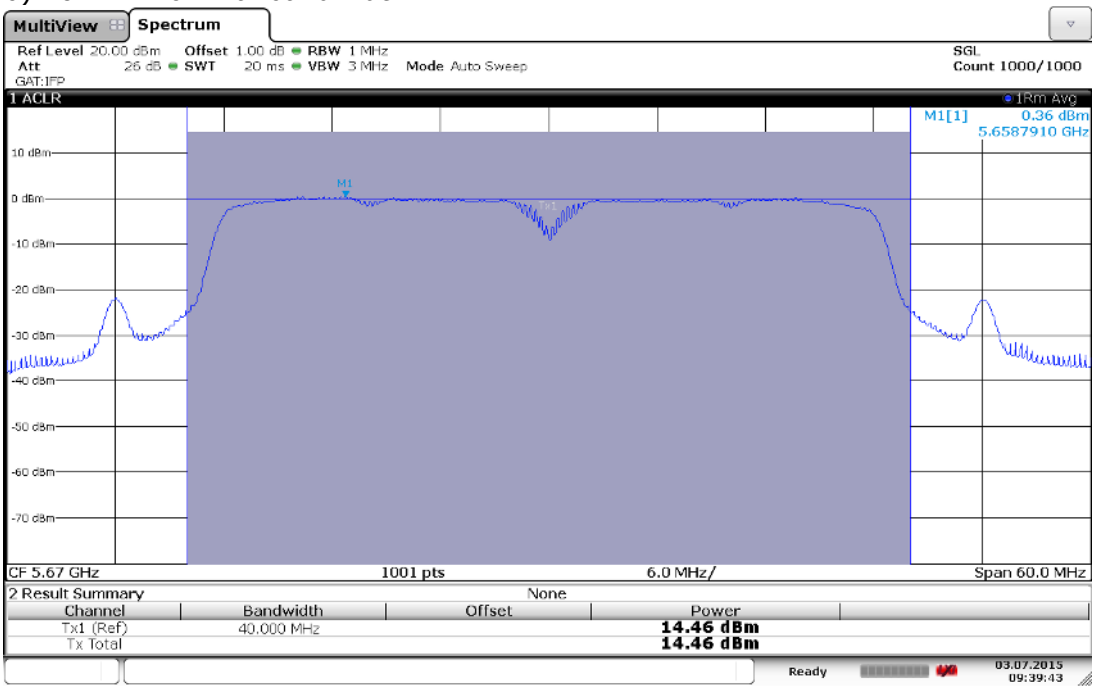
a) 20 MHz nominal bandwidth



Date: 19.JUN.2015 11:32:44

mode n, 20MHz, 65Mbit/s, channel 140

b) 40 MHz nominal bandwidth



Date: 3.JUL.2015 09:39:42

mode n, 40MHz, 135Mbit/s, channel 134

3.5 Frequency Stability

Standard FCC Part 15, Subpart E

3.5.1 Test Description

The Equipment Under Test (EUT) was set up in an temperature chamber to perform the frequency stability test.
The results recorded, were measured while the EUT is transmitting a CW signal on the required frequency.

The EUT was connected to spectrum analyser via a short coax cable with a known loss.

Analyser settings:
- Frequency Counter activated, Resolution 1 Hz

3.5.2 Test Requirements / Limits

FCC Part 15, Subpart E, § 15.407 (g)

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

IC, RSS-Gen, 8.11:

If the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required provided that the occupied bandwidth of the licence-exempt radio apparatus lies entirely outside the restricted bands and the prohibited TV bands of 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz.

3.5.3 Test Protocol

Temperature: TT °C
Air Pressure: PPPP hPa
Humidity: HH %

Test was not performed.

3.6 Undesirable Emissions / General Field Strength Limits; Restricted Band and Radiated Emission Limits, Band Edge

Standard FCC Part 15, Subpart C & E

The test was performed according to: ANSI C 63.4

3.6.1 Test Description

The radiated emissions measurements were made in a typical installation configuration. The measurement procedure is implemented into the EMI test software ES-K1 from R&S.

1. Measurement up to 30 MHz
The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.
The Loop antenna HFH2-Z2 is used.
Step 1: pre measurement
- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 - 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF–Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.
Step 2: final measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.
- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 200 Hz - 10 kHz
- Measuring time / Frequency step: 100 ms

2. Measurement above 30 MHz and up to 1 GHz
Step 1: Preliminary scan
Preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- 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
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: second measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.
- 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
- Polarisation: 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: 100 ms
- 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
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

Measurement above 1 GHz
The following modifications apply to the measurement procedure for the frequency range above 1 GHz:
The Equipment Under Test (EUT) was set up on a non-conductive support at 1.4 m height in the fully-anechoic chamber. 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 reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 15 GHz) and a horn antenna (15-26 GHz) are used, the steps 2-4 are omitted. Step 1 was performed with one height of the receiving antenna only.
EMI receiver settings:
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

For the data rate in mode n the test is performed as worst-case-check in order to verify that emissions have a comparable level as found at modes b and g. Typically, the measurement is performed in the frequency range 1 to 15 GHz but it depends on the emissions found during the test for the modes b and g. Please refer to the results for the used frequency range.

In the frequency range 26 – 40 GHz the measurement was performed conducted.

3.6.2 Test Requirements / Limits

A) FCC

FCC Part 15 Subpart E , §15.407 (b)(1)
For transmitters operating in the 5150–5250 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E , §15.407 (b)(2)
For transmitters operating in the 5250–5350 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E , §15.407 (b)(3)
For transmitters operating in the 5470–5725 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5470–5725 MHz.

FCC Part 15 Subpart E , §15.407 (b)(4)
For transmitters operating in the 5725–5850 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5715–5860 MHz and additionally
Limit: –17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5850–5860 MHz.

B) IC
Different frequency bands and limits apply, as compared to the FCC requirements.

RSS-247, 6.2 (1), Emissions outside the band 5150-5250 MHz, indoor operation only:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz. However, any unwanted emissions that fall into the band 5250-5350 MHz must be 26 dBc, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth, above 5.25 GHz.

RSS-247, 6.2 (2), Emissions outside the band 5250-5350 MHz:
Limit: –27 dBm/MHz EIRP outside of the band 5250–5350 MHz.

RSS-247, 6.2 (3), Emissions outside the bands 5470-5600 MHz and 5650-5725 MHz:
Limit: –27 dBm/MHz EIRP outside of the band 5470–5725 MHz.
Note: No operation is permitted for the frequency range 5600–5650 MHz.

RSS-247, 6.2 (4), Emissions outside the band 5725-5825 MHz:
Limit: –27 dBm/MHz EIRP outside of the band 5715–5835 MHz and additionally
Limit: –17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5825–5835 MHz.

C) FCC & IC

FCC Part 15 Subpart E , §15.405 and §15.407 (b)(6,7)
Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. The provisions of §§ 15.203 and 15.205 are included.

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)		Calculated Limits(dBµV/m @10m)	Limits(dBµV/m @10m)
0.009 – 0.49	2400/F(kHz)	300	10	(48.5 – 13.8) + 59.1 dB	107.6 – 72.9
0.49 – 1.705	24000/F(kHz)	30	10	(33.8 – 23.0) + 19.1 dB	52.9 – 42.1
1.705 – 30	30	30	10	29.5 + 19.1 dB	48.6

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
30 – 88	100	3	40.0
88 – 216	150	3	43.5
216 – 960	200	3	46.0
above 960	500	3	54.0

§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)
Limit (dBµV/m) = EIRP [dBm] – 20 log (d [m]) + 104.8
where d is the measurement distance

3.6.3 Test Protocol

Limit types:
RB – Emissions falls into a "Restricted Band" according FCC §§15.205 and 15.209
UE – "Undesirable Emission Limit" according FCC §15.407
BE-RB – Band Edge Limit basing on "Restricted Band Limits"
BE-RB – Band Edge Limit basing on "Undesirable Emission Limit"

Temperature: 24–29 °C
Air Pressure: 1000–1016 hPa
Humidity: 33–49 %

3.6.3.1 Radiated spurious and undesired emissions

WLAN a-Mode; 20 MHz; 6 Mbit/s				Applied duty cycle correction (AV) [dB]: 0.3			
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]
36	5180	10360.5	49.3	PEAK	1000	68.0	18.7
44	5220	37.4	30.0	QP	120	40.0	10.0
44	5220	358.4	40.7	QP	120	46.0	5.3
44	5220	360.6	44.5	QP	120	46.0	1.5
44	5220	361.6	43.5	QP	120	46.0	2.5
44	5220	363.2	39.4	QP	120	46.0	6.6
44	5220	364.8	41.6	QP	120	46.0	4.4
44	5220	456.0	36.7	QP	120	46.0	9.3
44	5220	457.6	40.0	QP	120	46.0	6.0
44	5220	887.9	39.5	QP	120	46.0	6.5
44	5220	5273.5	49.9	PEAK	1000	68.0	18.1
44	5220	10440.5	51.0	PEAK	1000	68.0	17.0
52	5260	5207.5	50.5	PEAK	1000	68.0	17.5
52	5260	10520.5	48.7	PEAK	1000	68.0	19.3
100	5500	5448.0	54.2	PEAK	1000	74.0	19.8
100	5500	5448.0	43.0	AV	1000	54.0	11.0
116	5580	11160.5	56.1	PEAK	1000	74.0	17.9
116	5580	11160.5	44.8	AV	1000	54.0	9.2
116	5580	11162.5	57.7	PEAK	1000	74.0	16.3
116	5580	11162.5	43.9	AV	1000	54.0	10.1
140	5700	11391.5	54.3	PEAK	1000	74.0	19.7
140	5700	11391.5	38.9	AV	1000	54.0	15.1
140	5700	11404.0	54.0	PEAK	1000	74.0	20.0
140	5700	11404.0	40.1	AV	1000	54.0	13.9
140	5700	14995.0	53.1	PEAK	1000	68.0	15.0
149	5745	14974.5	52.5	PEAK	1000	68.0	15.5
157	5785	5590.0	53.2	PEAK	1000	68.0	14.8
157	5785	14990.0	53.0	PEAK	1000	68.0	15.0
165	5825	14978.5	52.4	PEAK	1000	68.0	15.6

(tables continues on next page)

WLAN n-Mode; 20 MHz; 65 Mbit/s - MCS7, 800ns GI				Applied duty cycle correction (AV) [dB]: 2.0			
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]
36	5180	10363.5	58.9	PEAK	1000	68.0	9.1
44	5220	5272.5	48.9	PEAK	1000	68.0	19.1
44	5220	10440.5	58.7	PEAK	1000	68.0	9.3
52	5260	5208.5	50.4	PEAK	1000	68.0	17.6
56	5280	5228.5	49.9	PEAK	1000	68.0	18.1
64	5320	5372.0	53.2	PEAK	1000	74.0	20.8
64	5320	5372.0	40.1	AV	1000	54.0	13.9
64	5320	5507.5	50.0	PEAK	1000	68.0	18.0
64	5320	10640.5	46.0	PEAK	1000	74.0	28.0
64	5320	10640.5	38.9	AV	1000	54.0	15.1
100	5500	5306.5	50.4	PEAK	1000	68.0	17.6
100	5500	5448.0	54.6	PEAK	1000	74.0	19.4
100	5500	5448.0	41.5	AV	1000	54.0	12.5
100	5500	11000.5	47.5	PEAK	1000	74.0	26.5
100	5500	11000.5	35.7	AV	1000	54.0	18.3
116	5580	5394.0	51.2	PEAK	1000	74.0	22.8
116	5580	5394.0	36.5	AV	1000	54.0	17.5
116	5580	11159.5	50.5	PEAK	1000	74.0	23.5
116	5580	11159.5	35.1	AV	1000	54.0	18.9
140	5700	5725.5	67.9	PEAK	1000	68.0	0.1
140	5700	11400.5	50.5	PEAK	1000	74.0	23.5
140	5700	11400.5	36.0	AV	1000	54.0	18.0
149	5745	5551.0	51.7	PEAK	1000	68.0	16.3
149	5745	11490.5	47.2	PEAK	1000	74.0	26.8
149	5745	11490.5	35.9	AV	1000	54.0	18.1
157	5785	5591.5	53.8	PEAK	1000	68.0	14.2
165	5825	5631.5	55.6	PEAK	1000	68.0	12.4
165	5825	11650.5	45.7	PEAK	1000	74.0	28.3
165	5825	11650.5	34.2	AV	1000	54.0	19.8

(tables continues on next page)

WLAN n-Mode; 40 MHz; MCS 0				Applied duty cycle correction (AV) [dB]: 2.9			
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]
38	5190	5143.0	61.1	PEAK	1000	74.0	12.9
38	5190	5143.0	42.9	AV	1000	54.0	11.1
38	5190	5149.0	62.6	PEAK	1000	74.0	11.4
38	5190	5149.0	47.5	AV	1000	54.0	6.5
62	5310	5352.0	64.5	PEAK	1000	74.0	9.5
62	5310	5352.0	47.1	AV	1000	54.0	6.9
151	5755	5711.5	61.9	PEAK	1000	68.0	6.1
151	5755	11509.0	45.8	PEAK	1000	74.0	28.2
151	5755	11510.5	39.9	AV	1000	54.0	14.1
159	5795	11590.5	45.1	PEAK	1000	68.0	22.9
159	5795	11590.5	39.4	AV	1000	68.0	28.6

Note: No (further) spurious emissions in the range 20 dB below the limit found.
The results of the pre-test with peak detector have been similar for all four transmit frequencies in the frequency range 30–1000 MHz and independent from the transmit frequency. Therefore the final test applying the QP-(quasi-peak-)detector was performed only for one transmit frequency.

The tests for mode a and n (40MHz) have been performed in the frequency range 30–26500 MHz, for mode n (20MHz) in the range 1-15 GHz in order to check i.e. for harmonics in respect to the measured conducted output power and because at pre-measurements no significant spurious emissions have been found outside this frequency range.
In the ranges 30-1000 MHz and 18-26.5 GHz setup_03 was tested, otherwise setup_02.

3.6.3.2 Band Edge

WLAN a-Mode; 20 MHz; 6 Mbit/s					Applied duty cycle correction (AV) [dB]: 0.3			
UNII-Sub-band	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]
1	36	5180	5150.0	51.3	PEAK	1000	74.0	22.7
	36	5180	5150.0	38.1	AV	1000	54.0	15.9
2A	64	5320	5350.0	49.8	PEAK	1000	74.0	24.2
	64	5320	5350.0	37.1	AV	1000	54.0	16.9
2C	100	5500	5460.0	48.6	PEAK	1000	74.0	25.4
	100	5500	5460.0	48.9	AV	1000	54.0	5.1
	100	5500	5470.0	54.4	PEAK	1000	68.0	13.6
	140	5700	5725.0	64.1	PEAK	1000	68.0	3.9
	140	5700	5725.5	65.4	PEAK	1000	68.0	2.6
3	149	5745	5725.0	76.8	PEAK	1000	78.0	1.2
	165	5825	5850.0	60.8	PEAK	1000	78.0	17.3

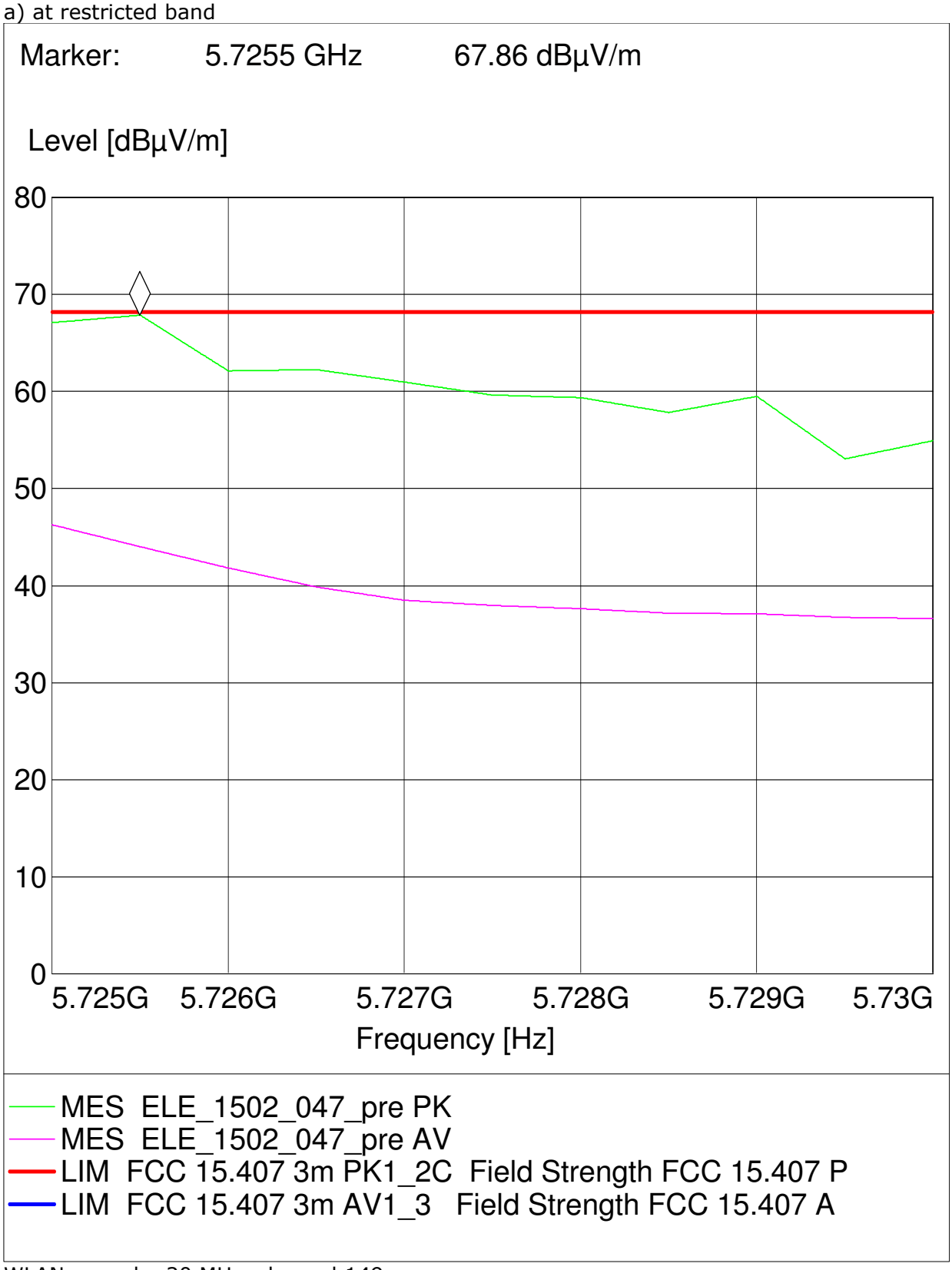
WLAN n-Mode; 20 MHz; MCS 7					Applied duty cycle correction (AV) [dB]: 2.0			
UNII-Sub-band	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]
1	36	5180	5150.0	44.3	PEAK	1000	74.0	29.7
	36	5180	5150.0	34.1	AV	1000	54.0	19.9
2A	64	5320	5350.0	51.7	PEAK	1000	74.0	22.3
	64	5320	5350.0	36.0	AV	1000	54.0	18.0
2C	100	5500	5470.0	54.7	PEAK	1000	68.0	13.3
	140	5700	5725.0	67.1	PEAK	1000	68.0	0.9
3	149	5745	5725.0	75.0	PEAK	1000	78.0	3.0
	165	5825	5850.0	62.0	PEAK	1000	78.0	16.0

WLAN n-Mode; 40 MHz; MCS 0				Applied duty cycle correction (AV) [dB]:				2.9
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type
38	5190	5143.0	61.1	PEAK	1000	74.0	12.9	RB
38	5190	5143.0	42.9	AV	1000	54.0	11.1	RB
38	5190	5149.0	62.6	PEAK	1000	74.0	11.4	RB
38	5190	5149.0	47.5	AV	1000	54.0	6.5	RB
62	5310	5352.0	64.5	PEAK	1000	74.0	9.5	RB
62	5310	5352.0	47.1	AV	1000	54.0	6.9	RB
151	5755	5711.5	61.9	PEAK	1000	68.0	6.1	UE
151	5755	11509.0	45.8	PEAK	1000	74.0	28.2	RB
151	5755	11510.5	39.9	AV	1000	54.0	14.1	RB
159	5795	11590.5	45.1	PEAK	1000	68.0	22.9	UE
159	5795	11590.5	39.4	AV	1000	68.0	28.6	UE

Note: Tests at the Band Edges are implicitly performed together with the undesired emission tests, which are performed as radiated test. The measurements are performed up to the band edges using the bandwidth specified for the undesired emissions.
If this test is passed, no additional test especially at the band edges will be performed, e.g. applying a reduced bandwidth or carrying out tests using the marker-delta method. Otherwise, the results will be reported in this sub-clause.
Band Edge tests are always performed and reported when the band directly adjacent to a Restricted Band.
Spurious emissions in the range 20 dB below the limit need not to be reported.

3.6.4 Measurement Plot Band Edge (showing the highest value, "worst case")

a) at restricted band



WLAN n-mode, 20 MHz, channel 149

4 Measurement Uncertainties

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

5 Test Equipment

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

Test Equipment Anechoic Chamber

Lab ID:	**Lab 3**		
Manufacturer:	Frankonia		
Description:	Anechoic Chamber for radiated testing		
Type:	10.58x6.38x6.00 m³		
	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 FCC listing 96716 3m Part15/18	none	Frankonia 2014/01/09	2017/01/08
Controller Innco 2000	CO 2000	CO2000/328/12470 406/L	Innco innovative constructions GmbH	
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*	
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.	
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber&Suhner	
Impedance Stabilization Network	ISN T800	36159	Teseq GmbH	
	Calibration Details		*Last Execution*	*Next Execution*
	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 Execution*
	Standard calibration		2014/01/10	2016/01/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN T8-Cat6	32187	Teseq GmbH	

Single Devices for Auxiliary Equipment for Conducted emissions (continued)

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
	Calibration Details		*Last Execution*	*Next Execution*
	Standard Calibration		2014/01/08	2016/01/31
One-Line V-Network	ESH 3-Z6	100489	Rohde & Schwarz GmbH & Co. KG	
	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 Execution*
	Standard Calibration		2013/11/25	2016/11/24
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG	
	DAkkS Calibration		2015/03/30	2017/03/31
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz GmbH & Co. KG	
	DAkks Calibration		2015/03/30	2017/03/31

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID:	**Lab 3**
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	
Antenna mast	AS 620 P	620/37	HD 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	
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02-2	Rosenberger Micro-Coax	
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG	
	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	
	Calibration Details		*Last Execution*	*Next Execution*
	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	
Dreheinheit	DE 325		HD GmbH	
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 Execution*
	Standard Calibration		2012/12/18	2015/12/17
Log.-per. Antenna (upgraded)	HL 562 Ultralog new biconicals	830547/003	Rohde & Schwarz GmbH & Co. KG	
	Standard Calibration		2015/06/30	2018/06/29

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG
	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 3, Lab 4**
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*
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.
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 Execution*
	Customized calibration		2013/12/04 2015/12/03
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 Execution*
	Standard		2014/02/10 2016/02/09
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
	Standard		2012/06/13 2015/06/12
	DKD calibration		2015/06/23 2018/06/22
Spectrum Analyser	FSU26	200418	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2014/07/29 2015/07/28
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

Test Equipment Digital Signalling Devices

Lab ID:	**Lab 1, Lab 3, Lab 4**
Description:	Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Bluetooth Signalling Unit CBT	CBT	100589	Rohde & Schwarz GmbH & Co. KG	
	Standart calibration		2015/01/21	2018/01/19
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2014/01/27	2016/01/26
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG	
	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	
	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 3**
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 Analyser	ESR 7	101424	Rohde & Schwarz	
	Calibration Details		*Last Execution*	*Next Execution*
	Initial Factory Calibration		2014/11/13	2016/11/12
Personal Computer	Dell	30304832059	Dell	
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2015/05/11	2016/05/10
Power Sensor	NRV-Z1	836219/005	Rohde & Schwarz GmbH & Co. KG	
Powermeter	NRVS	836333/064	Rohde & Schwarz GmbH & Co. KG	
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2015/05/11	2016/05/10
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG	
	Standard Calibration		2014/06/24	2017/06/23
Spectrum Analyser	FSW 43	103779	Rohde & Schwarz	
	Calibration Details		*Last Execution*	*Next Execution*
	Initial Factory Calibration		2014/11/17	2016/11/16
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG	
	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	

Test Equipment Multimeter 03

Lab ID:	**Lab 3, Lab 4**
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 Execution*
	Customized calibration		2013/12/04	2015/12/03

Test Equipment Radio Lab Test Equipment

Lab ID: **Lab 4**
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	
	Standard calibration		2015/05/11	2016/05/10
Power Sensor	NRV-Z1	836219/005	Rohde & Schwarz GmbH & Co. KG	
Powermeter	NRVS	836333/064	Rohde & Schwarz GmbH & Co. KG	
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG	
Rubidium Frequency Standard	Datum, Model: MFS	5489/001	Datum-Beverly	
	Standard calibration		2014/07/03	2015/07/02
	Standard Calibration		2015/06/25	2016/06/24
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2015/05/11	2016/05/10
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2014/12/02	2017/12/01
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Execution*
	Standard calibration		2013/05/06	2016/05/05
Spectrum Analyser	FSIQ26	840061/005	Rohde & Schwarz GmbH & Co. KG	
	Calibration after reparation		2015/04/02	2017/04/01
Vector Signal Generator	SMIQ 03B	837747/020	Rohde & Schwarz GmbH & Co. KG	

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 3, Lab 4**
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	
	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	
	Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 03

Lab ID:	**Lab 4**
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	
	Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 12

Lab ID:	**Lab 3**
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	
	Customized calibration		2015/03/10	2017/03/09

Test Equipment Temperature Chamber 05

Lab ID:	**Lab 4**
Manufacturer:	see single devices
Description:	Temperature Chamber VT4002
Type:	Vötsch
Serial Number:	see single devices

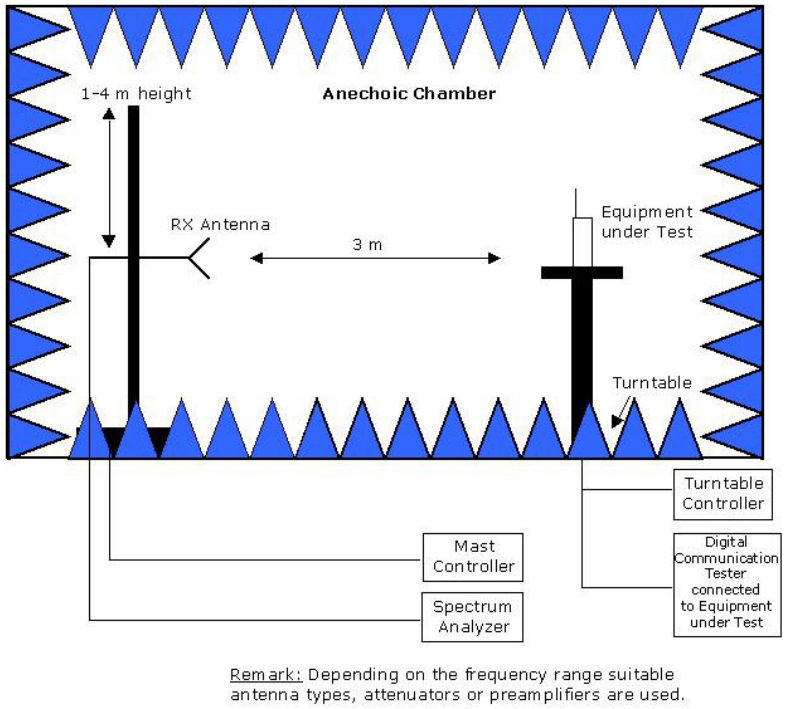
Single Devices for Temperature Chamber 05

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Temperature Chamber Vötsch 05	VT 4002	58566080550010	Vötsch	
	Customized calibration		2014/03/11	2016/03/10

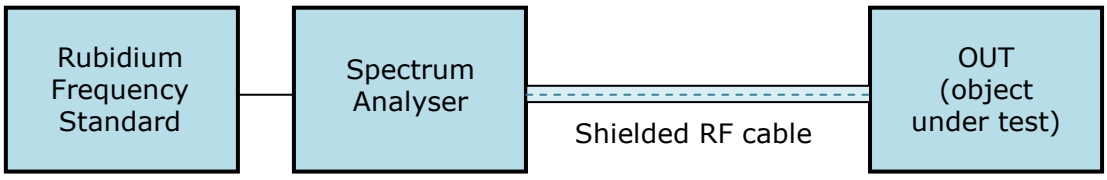
6 Photo Report

Please refer to external report.

7 Setup Drawings



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



Drawing 2: Setup for conducted radio tests.