

FCC Measurement/Technical Report on

TQ-Systems Modul No. 1 Mini RF-TX Q1049

FCC ID: 2ABQT-Q1049

Report Reference: MDE_SRI_1401_FCCb_rev2

Test Laboratory:

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Note:

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

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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 and 15 (10-1-14 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”.

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

ANSI C63.10-2013 is applied.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary / Signatures.

0.2 Measurement Summary / Signatures

FCC Part 15, Subpart C

§ 15.207

Conducted emissions (AC power line)

The measurement was performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
video, CH 48, 20 MHz	Setup_02	AC Port (power line)	passed

FCC Part 15, Subpart E

§ 15.403 (i), 15.407 (e)

26 / 6 dB Emission bandwidth

The measurement was performed according to FCC § 15.31

OP-Mode	Setup	Port	Final Result
video, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed
video, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed
video, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed
video, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed
video, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed
video, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed
video, CH 38, 40 MHz	Setup_01	Temp.ant.connector	passed
video, CH 46, 40 MHz	Setup_01	Temp.ant.connector	passed
video, CH 151, 40 MHz	Setup_01	Temp.ant.connector	passed
video, CH 161, 40 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
video, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 38, 40 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 46, 40 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 151, 40 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 161, 40 MHz	Setup_01	Temp.ant.connector	passed	N/P

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
video, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 38, 40 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 46, 40 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 151, 40 MHz	Setup_01	Temp.ant.connector	passed	N/P
video, CH 161, 40 MHz	Setup_01	Temp.ant.connector	passed	N/P

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/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 C63.10

OP-Mode	Setup	Port	Final Result	
			FCC	IC
video, CH 38, 40 MHz	Setup_01	Enclosure	passed	N/P
video, CH 46, 40 MHz	Setup_01	Enclosure	passed*	N/P
video, CH 151, 40 MHz	Setup_01	Enclosure	passed*	N/P
video, CH 161, 40 MHz	Setup_01	Enclosure	passed*	N/P
video, CH 36, 20 MHz	Setup_01	Enclosure	passed*	N/P
video, CH 149, 20 MHz	Setup_01	Enclosure	passed*	N/P
video, CH 165, 20 MHz	Setup_01	Enclosure	passed*	N/P

FCC Part 15, Subpart E

§ 15.407 (h)

Dynamic Frequency selection

The measurement was performed according to FCC § 15.31

OP-Mode	Setup	Port	Final Result	
			FCC	IC
—	—	—	N/P	N/P

N/A Not applicable

N/P Not performed

* Tests not performed over the complete frequency range, for details please refer to the test protocols.

Revision History

Report version control			
Version	Release date	Change Description	Version validity
initial	2015-03-20	-	invalid
rev1	2016-05-02	Test results of sub-bands 2A and 2C removed, which are not supported by this device, worst-case results adapted accordingly; update to CFR 47 Rules 10-1-14 Edition; correction of FCC-ID: from 2ABTQ... to 2ABQT; administrative changes; further change in clause: 3.5.3	invalid
rev2	2016-05-24	Updated measurement results for radiated emissions in the range of 26-40 GHz	valid

Responsible for
Accreditation Scope:

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for Test Report:

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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 .

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. Andreas Petz
Employees who performed the tests: documented internally at 7Layers
Date of Test(s): 2014-08-28 to 2016-05-24
Date of Report: 2016-05-24

1.3 Applicant Data

Company Name: TQ-Systems Durach GmbH
Address: Johann-Georg-Halske-Strasse 1
87471 Durach
Germany
Contact Person: Mr. Bernd Wein

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:	Wireless HD-Video-Transmitter (5 GHz)
Type Designation:	Modul No. 1 Mini RF-TX Q1049
Kind of Device: (optional)	Module supporting this technology: 5 GHz high performance RLAN equipment that is intended to operate in the frequency ranges 5150 to 5250 MHz and 5725 to 5850 MHz, transceiver (5 GHz)
Voltage Type:	DC
Voltage Level:	5.0 V
Tested Modulation Type:	OFDM: 16-QAM

General product description:

The Transceiver is operating in the 5 GHz band using Orthogonal Frequency Division Multiplexing (OFDM).

Specific product description for the EUT:

The EUT is a module which enables video transmission in the 5 GHz bands. It is using bi-directional communication with a proprietary modulation scheme and supports 20 MHz and 40 MHz bandwidth channels.

The transceiver is operating in the 5 GHz band in the ranges 5.15 – 5.25 GHz, and 5.725 – 5.850 GHz.

In transmit direction for the video signal, 2 TX transmit chains are operating with symmetrical power distribution (MIMO), while the receiver operates with 1 RX receive chain in order to receive control commands.

The EUT is supplied with power via a standard USB port.

The object of this test report is the video transceiver, it was tested at 20 and 40 MHz channel bandwidth. For the tests a synthetic video signal (OFDM) is provided as test mode, both transmit chains are always active and the duty cycle (linear) is 0.96 at 20 MHz bandwidth and 1.0 at 40 MHz (in this test mode).

The EUT provides the following ports:

Ports

Enclosure

Data / DC port (system connector to ANC1)

5 GHz Antenna (2x UFL connector)

HDMI (at ANC1)

USB / DC power (at ANC1)

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: DE1059000ab01)	Wireless HD-Video-Transmitter	Modul No. 1 Mini RF-TX Q1049	SRI14242337 12	Q1049-X100-3	3.x.28.1
Remark: EUT A is equipped with integral antennas (1x TX, 1x TX/RX, each gain = 2.0 dBi) and each has a test antenna connector (the antenna is then deactivated) to perform conducted tests.					

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	TX Board with HDMI connector for Video-transmission	SRI, M.mini_HDMI-TX Q1048-M-2	SRI1424233639	Q1048-M-2	3.103.60

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	Laboratory Power Supply	Conrad PS 303 A	–	–	–
AUX2	AC/DC adapter USB, 100-240VAC, 5VDC	Goobay Model-No.: 43749	–	–	–
AUX3	HDMI cable	Schwaiger HDMIV15 031 high end	– (P/N: 4004005150506)	–	–

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 A + ANC1 + AUX1 + AUX3	setup for radiated and conducted measurements
Setup_02	EUT A + ANC1 + AUX2 + 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							149	157	165	Ch.-No.
5180	5220	5240							5745	5785	5825	MHz

Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top	40 MHz
38	-	46							151	-	161	Ch.-No.
5190	-	5230							5755	-	5805	MHz

2.6.2 Data rates

variable, not specified (the OUT is a video modem and the data rate depends on the video signal)

2.7 Special software used for testing

A tool which is called "AppCom" (version 4.4.0.7) is used to set the EUT into the desired test modes. From the software, PRBS script files provided by the applicant, are used to control directly the EUT via a RS-232 port fastened at ANC1. A software tool "Debug View" is used to check the correct execution of the commands (at the software layer).

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 63.10

3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.10. 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 50 μ H || 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 & Average
- 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 & Average
- 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).

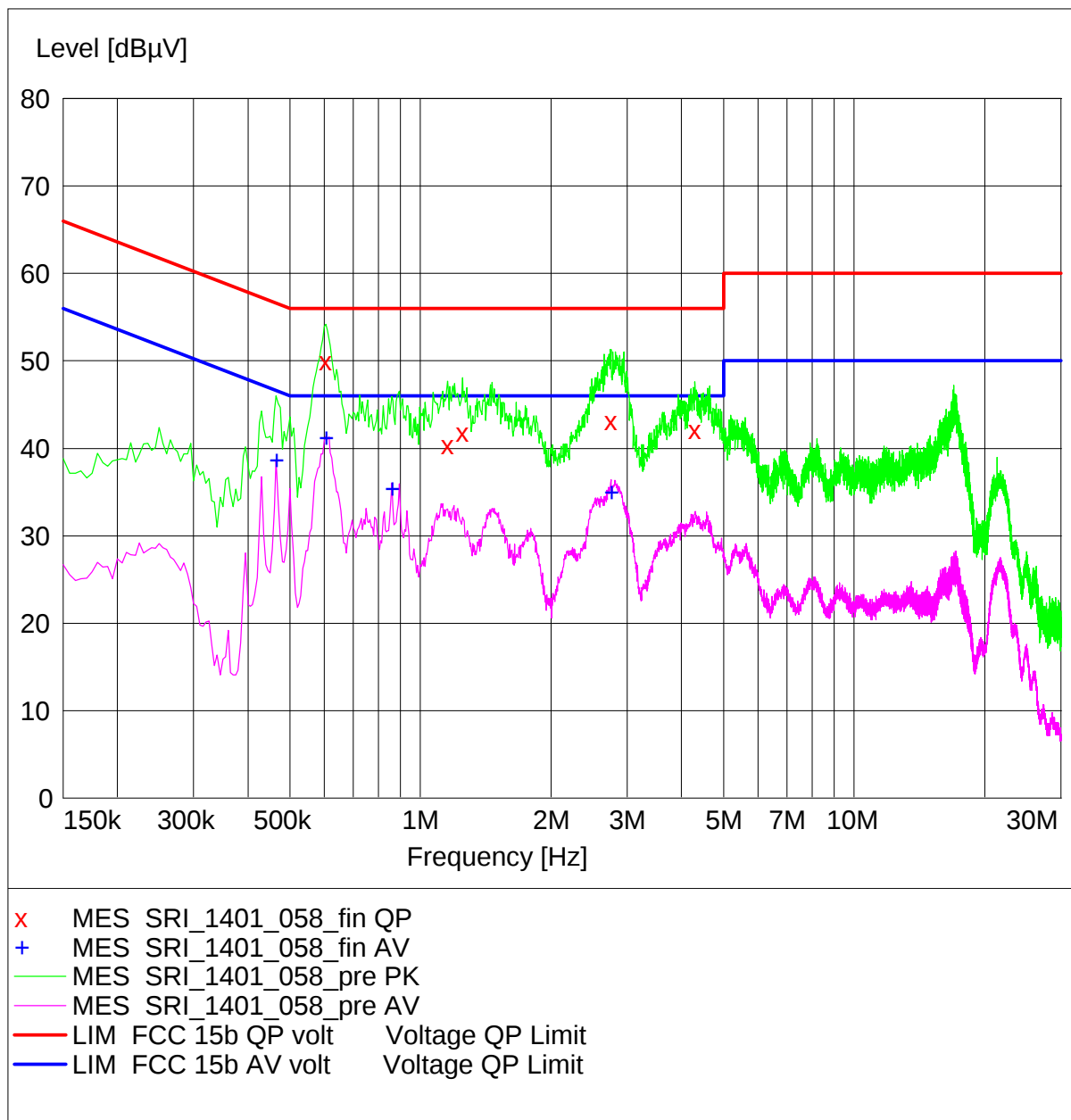
3.1.3 Test Protocol

Temperature: 26 °C
Air Pressure: 1010 hPa
Humidity: 31 %

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	0.465	–	38.6	–	46.7	–	8.1
N, L	0.605	50.0	41.2	56.0	46.0	6.0	4.8
N, L	0.860	–	35.4	–	46.0	–	10.6
N, L	1.155	40.4	–	56.0	–	15.6	–
N, L	1.250	41.8	–	56.0	–	14.2	–
N, L	2.750	43.2	35.0	56.0	46.0	12.8	11.0
N, L	4.295	42.2	–	56.0	–	13.8	–

Remark: Please see next sub-clause for the measurement plot.
The chosen operating mode is selected as representative mode to generate “worst-case” conditions, i.e. high power consumption.
The EUT is operated at 5 V DC while supplied by AUX2 which is connected to AC Mains at 120 V / 60 Hz.

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



3.2 26 / 6 dB Emission 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).

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
- readjust 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: 25 °C
Air Pressure: 1018 hPa
Humidity: 46 %

1) 26 dB bandwidth

Video-Mode; 20 MHz			
UNII-Subband	Channel No.	Frequency [MHz]	26 dB Bandwidth [MHz]
1	36	5180	19.219
	44	5220	19.045
	48	5240	19.103
2A	52	5260	NA
	56	5280	NA
	64	5320	NA
2C	100	5500	NA
	120	5600	NA
	140	5700	NA
3	149	5745	19.161
	157	5785	19.161
	165	5825	19.334

Video-Mode; 40 MHz			
1	38	5190	38.900
	46	5230	38.900
2A	54	5270	NA
	62	5310	NA
2C	102	5510	NA
	118	5590	NA
	134	5670	NA
3	151	5755	40.550
	159	5795	39.768

Maximum [MHz]:	20 MHz:	19.334	40 MHz:	40.550
Minimum [MHz]:		19.045		38.900

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

Video-Mode; 20 MHz					
UNII-Subband	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin [MHz]
3	149	5745	17.062	0.500	16.562
	157	5785	17.062	0.500	16.562
	165	5825	17.366	0.500	16.866

Video-Mode; 40 MHz					
UNII-Subband	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin [MHz]
3	151	5755	36.817	0.500	36.317
	159	5795	36.931	0.500	36.431

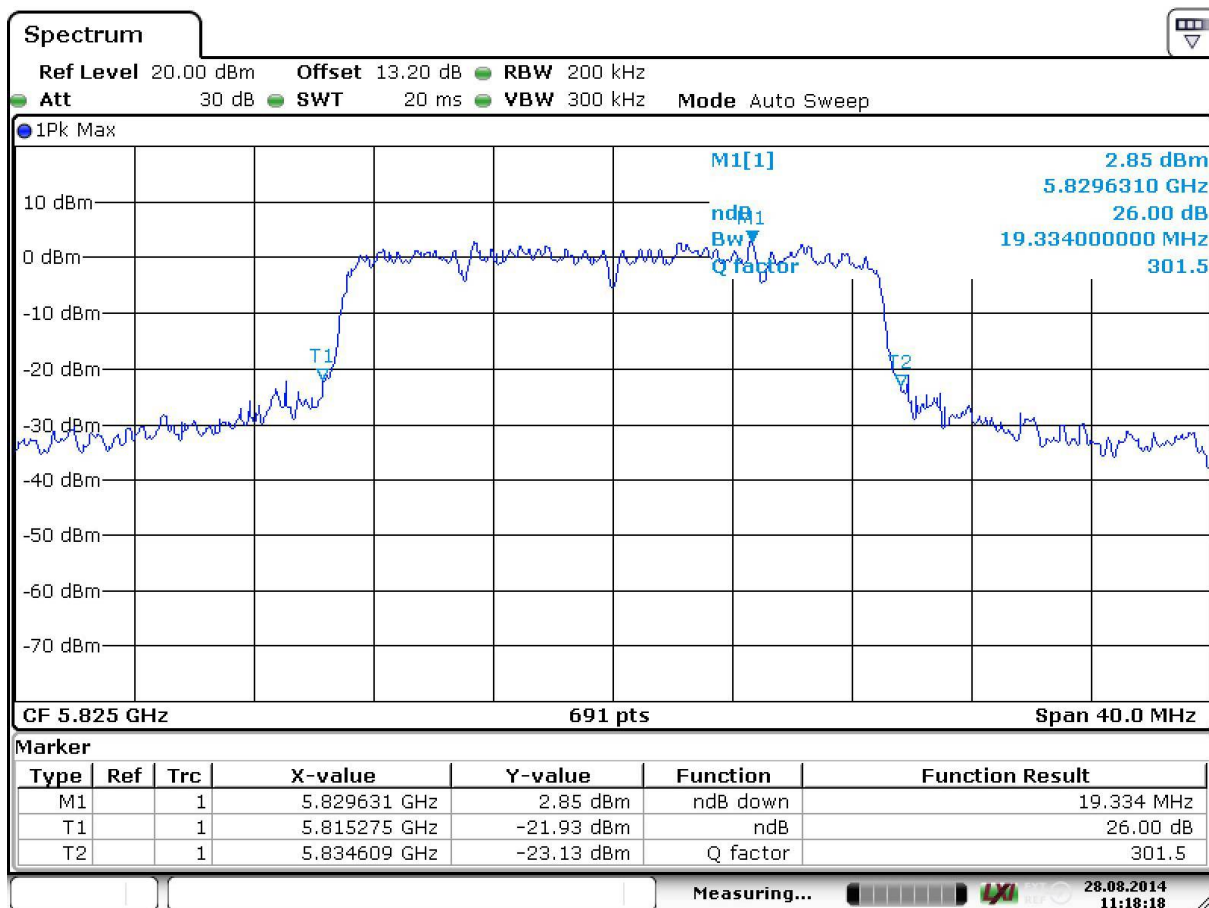
3) 99% bandwidth

(not tested)

3.2.4 Measurement Plots (showing the highest value, “worst case”)

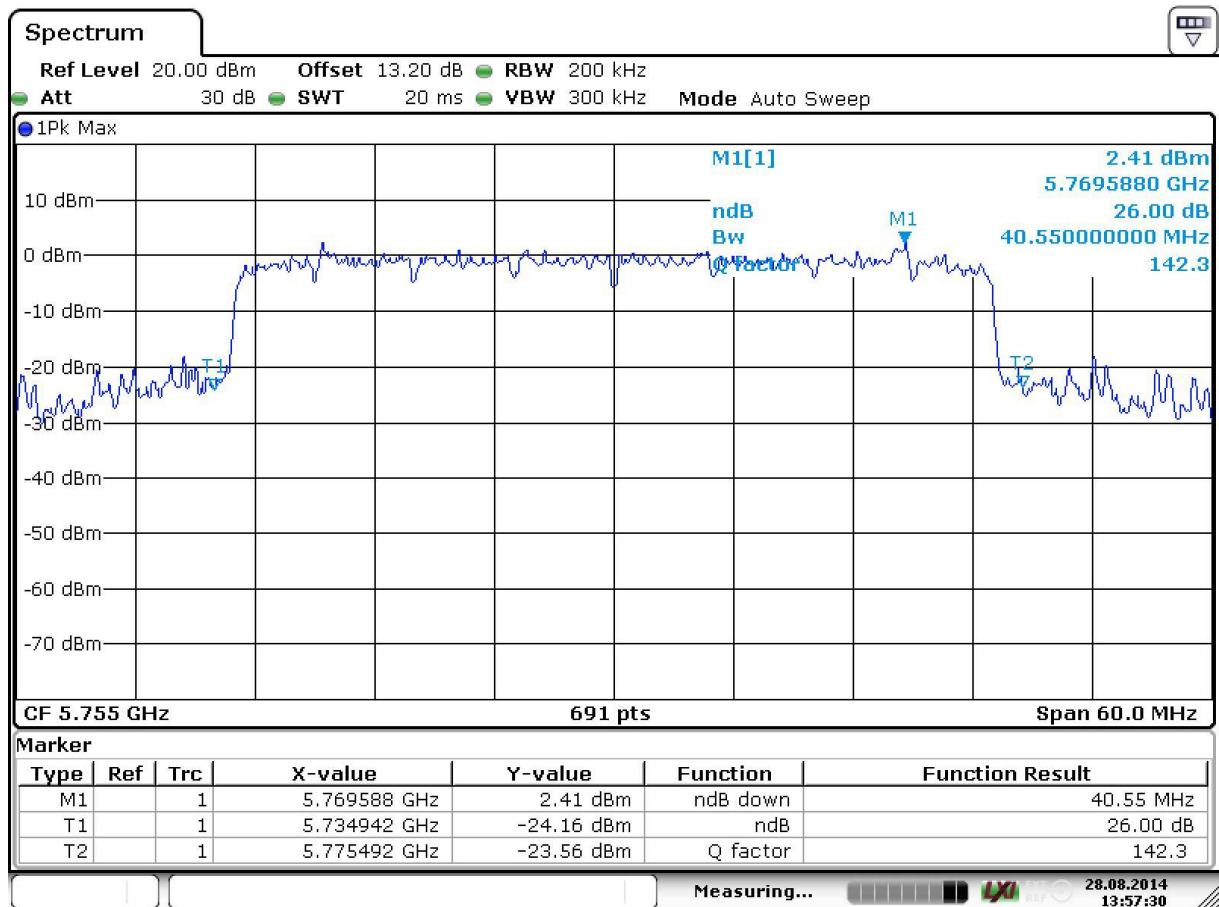
1) 26 dB bandwidth (showing the highest value, “worst case”)

a) 20 MHz nominal bandwidth



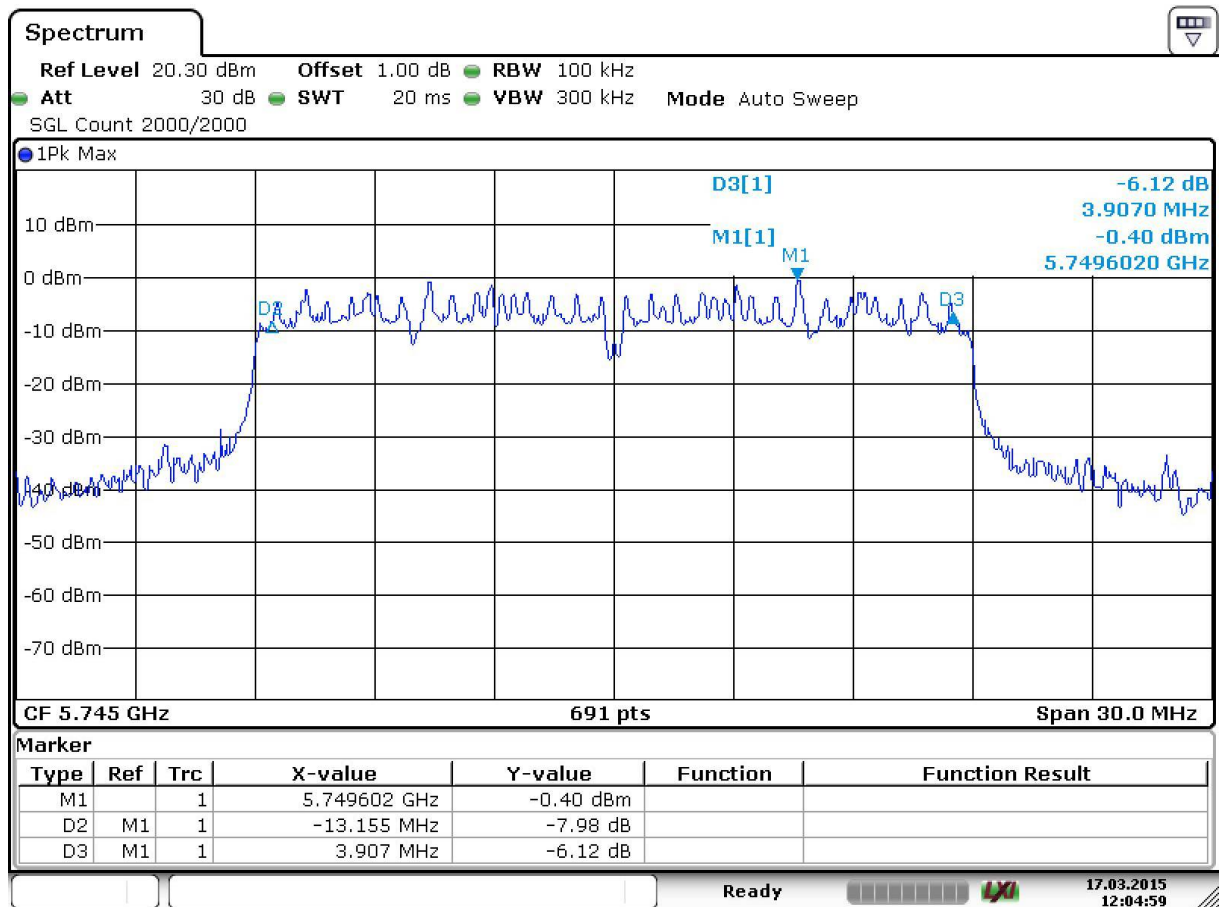
Date: 28.AUG.2014 11:18:18

b) 40 MHz nominal bandwidth



Date: 28.AUG.2014 13:57:30

2) 6 dB bandwidth (showing the lowest value, “worst case”)



Date: 17.MAR.2015 12:04:59

3) 99% bandwidth (showing the highest value, “worst case”)

not tested

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
- Sweep time: 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 D01 General UNII Test Procedures v01r03, 2013-4-08", 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 $4 \text{ dBm} + 10 \log (26 \text{ dB bandwidth/MHz})$ 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 $11 \text{ dBm} + 10 \log (26 \text{ dB bandwidth/MHz})$ 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 $17 \text{ dBm} + 10 \log (26 \text{ dB bandwidth/MHz})$ 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.

3.3.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1019 hPa
Humidity: 44 %

Video-Mode; 20 MHz			FCC				TX1	TX2
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	ANT1	ANT2
1	36	5180	9.3	11.3	30.0	20.7	6.3	6.2
	44	5220	9.4	11.4	30.0	20.6	6.5	6.2
	48	5240	9.4	11.4	30.0	20.6	6.5	6.3
2A	52	5260	NA	NA	NA	NA	NA	NA
	56	5280	NA	NA	NA	NA	NA	NA
	64	5320	NA	NA	NA	NA	NA	NA
2C	100	5500	NA	NA	NA	NA	NA	NA
	120	5600	NA	NA	NA	NA	NA	NA
	140	5700	NA	NA	NA	NA	NA	NA
3	149	5745	10.0	12.0	30.0	20.0	6.9	7.1
	157	5785	10.3	12.3	30.0	19.7	7.5	7.0
	165	5825	10.1	12.1	30.0	19.9	7.5	6.6

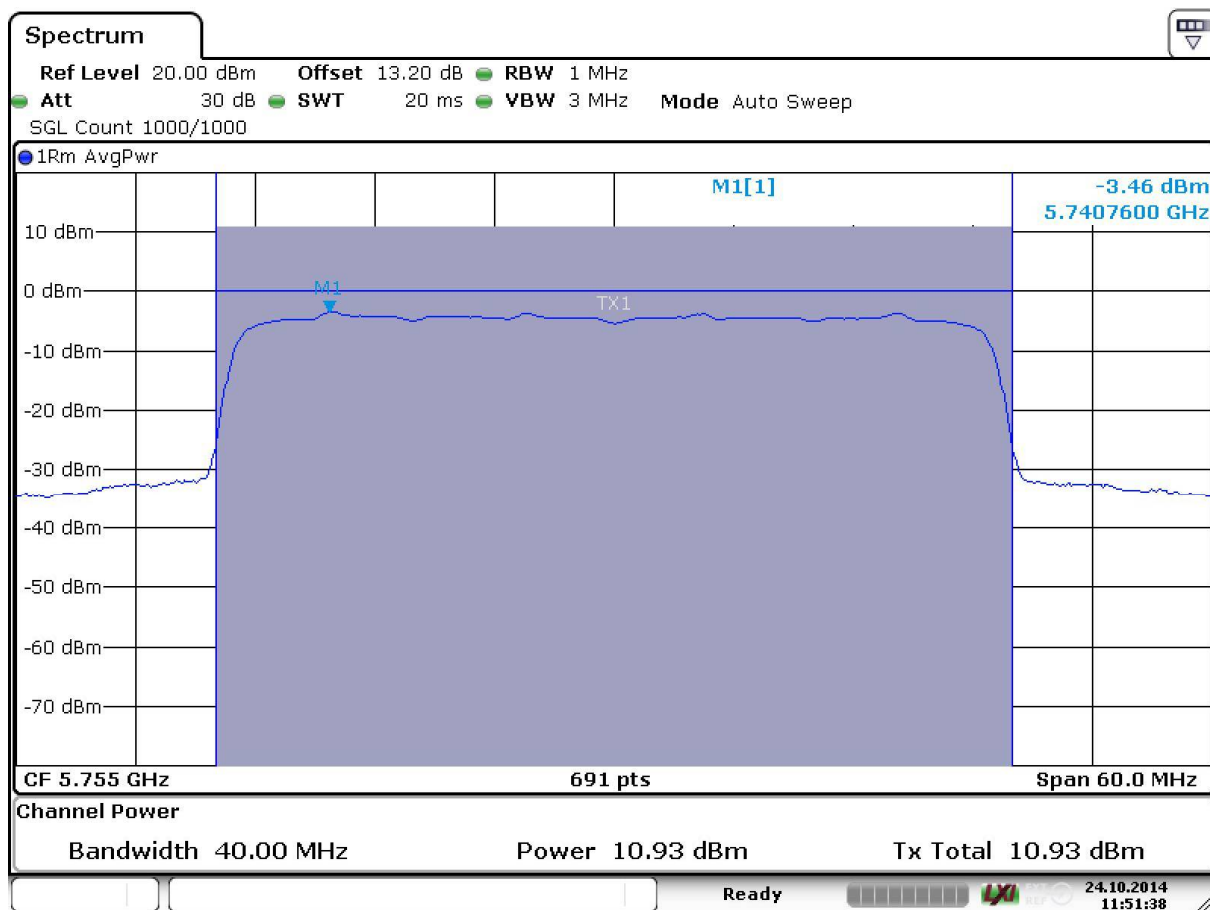
Video-Mode; 40 MHz					FCC		TX1	TX2
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	ANT1	ANT2
1	38	5190	13.2	15.2	30.0	16.8	10.3	10.0
	46	5230	13.0	15.0	30.0	17.0	10.2	9.7
2A	54	5270	NA	NA	NA	NA	NA	NA
	62	5310	NA	NA	NA	NA	NA	NA
2C	102	5510	NA	NA	NA	NA	NA	NA
	118	5590	NA	NA	NA	NA	NA	NA
	134	5670	NA	NA	NA	NA	NA	NA
3	151	5755	13.6	15.6	30.0	16.4	10.9	10.2
	159	5795	13.3	15.3	30.0	16.7	10.7	9.9

Maximum [dBm]:	20 MHz:	10.3	40 MHz:	13.6	(conducted)
Maximum [dBm]:	20 MHz:	12.3	40 MHz:	15.6	(EIRP)

- 1) = no additional limit applies related to the elevation.
2) = check to comply with FCC limit for elevation > 30° !
3) = check to comply with IC elevation mask requirement !

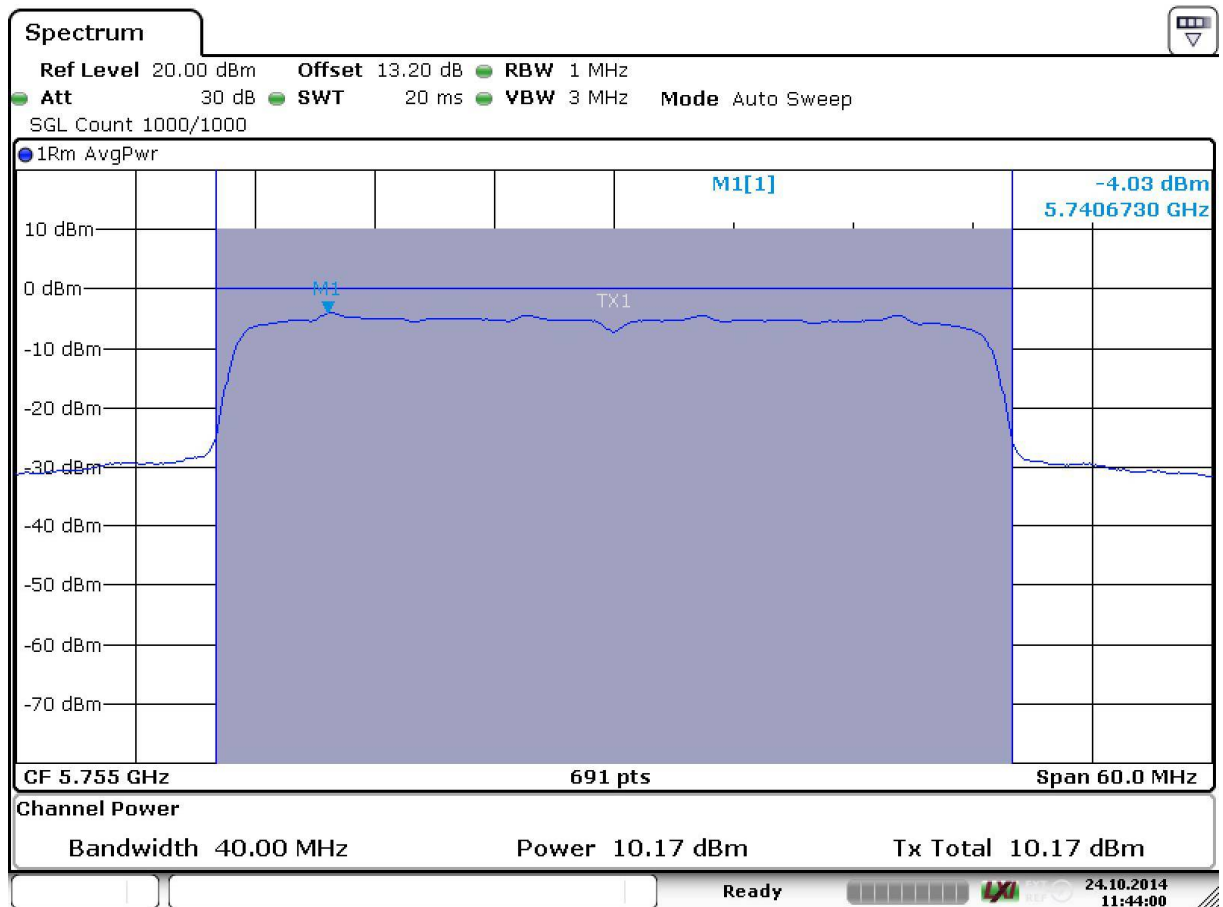
3.3.4 Measurement Plot (showing the highest value, “worst case”)

1) TX-chain #1



Date: 24.OCT.2014 11:51:38

2) TX-chain #2



Date: 24.OCT.2014 11:44:00

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
- Sweeps: 100
- Sweep time: coupled
- Marker: Peak

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 D01 General UNII Test Procedures, 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.

3.4.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1019 hPa
Humidity: 44 %

Video-Mode; 20 MHz						TX1	TX2
UNII-Sub-band	Ch. No.	Freq. [MHz]	MPSD [dBm/MHz]	FCC Limit [dBm]	Margin [dB]	ANT1	ANT2
1	36	5180	-0.8	17.0	17.8	-3.8	-3.8
	44	5220	-0.7	17.0	17.7	-3.6	-3.8
	48	5240	-0.7	17.0	17.7	-3.7	-3.7
2A	NA	NA	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA	NA	NA
2C	NA	NA	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA	NA	NA
3	149	5745	0.0	30.0	30.0	-3.2	-2.9
	157	5785	0.2	30.0	29.8	-2.6	-3.0
	165	5825	0.1	30.0	29.9	-2.5	-3.4

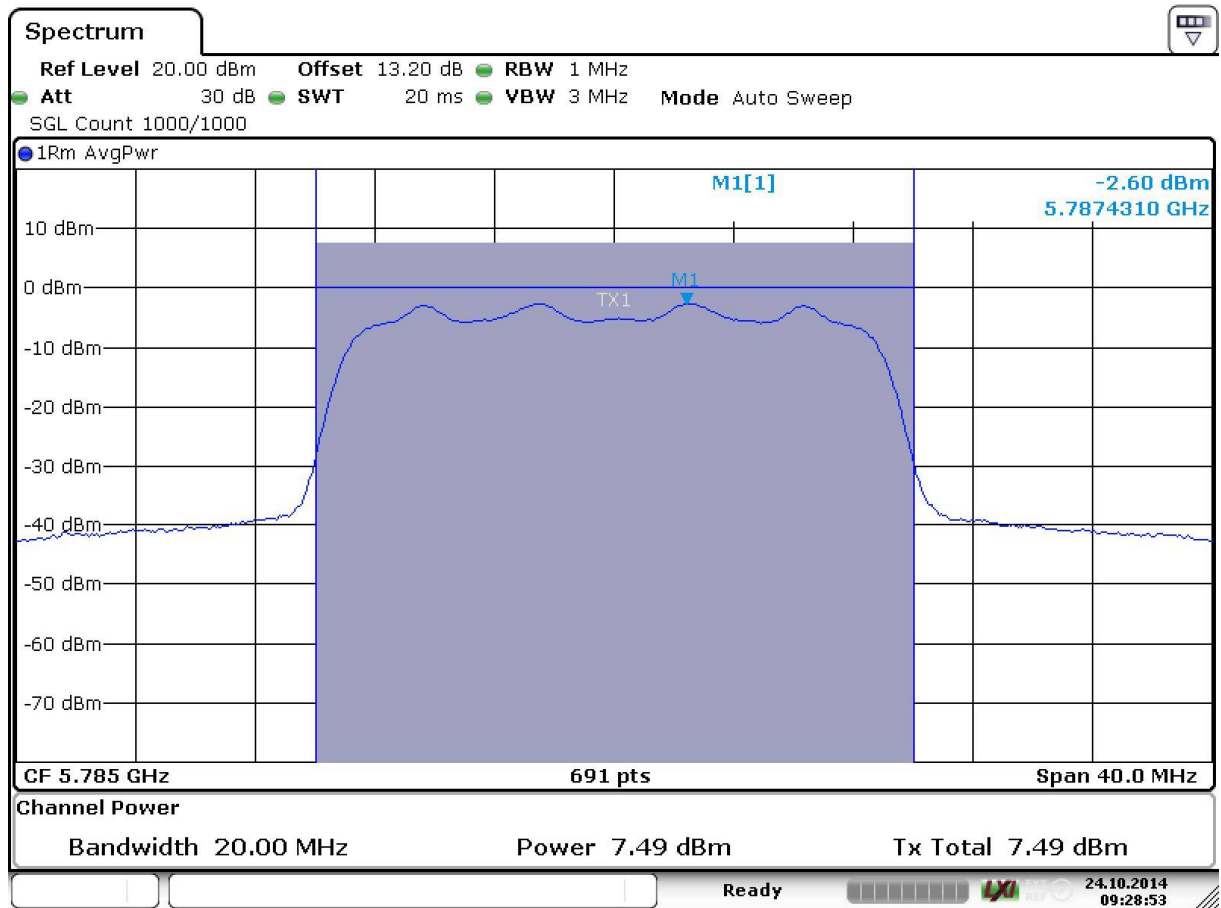
Video-Mode; 40 MHz						TX1	TX2
UNII-Sub-band	Ch. No.	Freq. [MHz]	MPSD [dBm/MHz]	FCC Limit [dBm]	Margin [dB]	ANT1	ANT2
1	38	5190	-1.2	17.0	18.2	-4.2	-4.3
	46	5230	-1.4	17.0	18.4	-4.3	-4.6
2A	NA	NA	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA	NA	NA
2C	NA	NA	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA	NA	NA
3	151	5755	-0.7	30.0	30.7	-3.5	-4.0
	159	5795	-1.1	30.0	31.1	-3.8	-4.5

Maximum [dBm/MHz]:	20 MHz:	0.2	40 MHz:	-0.7
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Note: MPSD for subband 3 is measured at 1 MHz bandwidth.

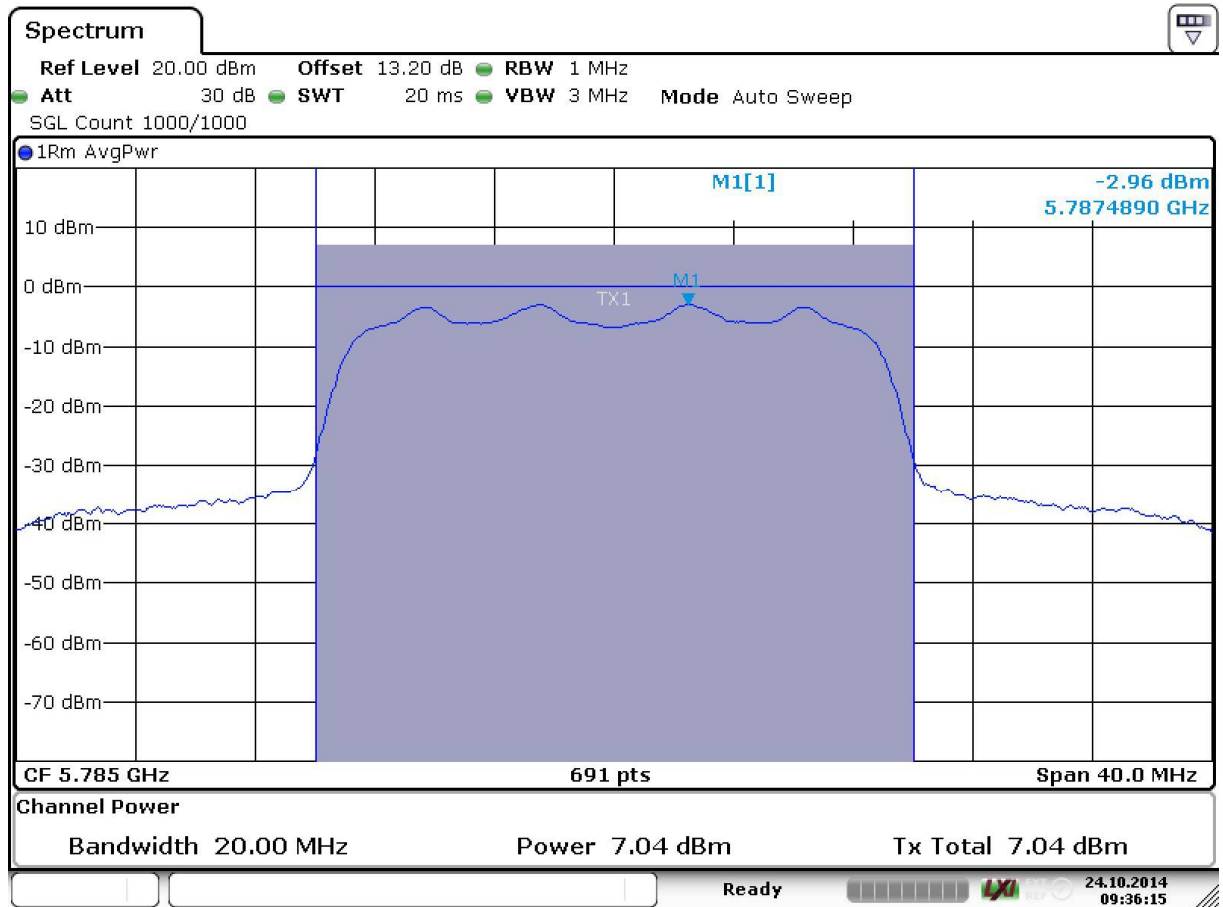
3.4.4 Measurement Plot (showing the highest value, “worst case”)

1) TX-chain #1



Date: 24.OCT.2014 09:28:54

2) TX-chain #2



Date: 24.OCT.2014 09:36:15

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.

3.5.3 Test Protocol

Test was not performed.

The manufacturer declares that the fundamental emissions of the device stay within the U-NII 1 and U-NII-3 bands.

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 63.10

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 μ s
- 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 $\pm 22.5^{\circ}$ 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 $+22.5^{\circ}$ 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), a horn antenna (15-26 GHz) and a Standard Gain Horn Antenna (26-40 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.

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.

C) FCC

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: $\text{Limit (dB}\mu\text{V/m)} = 20 \log (\text{Limit } (\mu\text{V/m})/1\mu\text{V/m})$
 $\text{Limit (dB}\mu\text{V/m)} = \text{EIRP [dBm]} - 20 \log (d [\text{m}]) + 104.8$
 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: 23–26 °C

Air Pressure: 1000–1021 hPa

Humidity: 34–47 %

3.6.3.1 Radiated spurious and undesired emissions

Video-Mode; 40 MHz				Applied duty cycle correction (AV) [dB]: 0.0				
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin [dB]	Limit Type
38	5190	10400.0	62.9	PEAK	1000	68.0	5.1	UE
38	5190	15553.5	66.0	PEAK	1000	74.0	8.0	RB
38	5190	15562.5	45.9	AV	1000	54.0	8.1	RB
38	5190	20760.5	44.2	PEAK	1000	74.0	29.8	RB
38	5190	20760.5	38.4	AV	1000	54.0	15.6	RB
46	5230	10449.0	61.4	PEAK	1000	68.0	6.6	UE
46	5230	15669.0	57.7	PEAK	1000	74.0	16.3	RB
46	5230	15691.5	35.8	AV	1000	54.0	18.2	RB
46	5230	20920.5	45.1	PEAK	1000	74.0	28.9	RB
46	5230	20920.5	40.8	AV	1000	54.0	13.2	RB

table is continued on next page

151	5755	5710.0	68.0	PEAK	1000	68.0	0.0	UE
151	5755	5721.0	72.0	PEAK	1000	78.0	6.0	UE
151	5755	11508.0	57.1	PEAK	1000	74.0	16.9	RB
151	5755	11510.0	47.7	AV	1000	54.0	6.3	RB
151	5755	17237.0	59.8	PEAK	1000	68.0	8.2	UE
151	5755	23024.0	52.5	PEAK	1000	74.0	21.6	RB
151	5755	23020.0	40.3	AV	1000	54.0	13.7	RB

159	5795	5829.5	73.7	PEAK	1000	78.0	4.3	BE
159	5795	11569.6	59.5	PEAK	1000	74.0	14.5	RB
159	5795	11590.0	46.3	AV	1000	54.0	7.7	RB
159	5795	17421.0	58.9	PEAK	1000	68.0	9.1	UE
159	5795	23226.0	51.0	PEAK	1000	68.0	17.0	RB
159	5795	23180.5	37.8	AV	1000	54.0	16.2	RB

Note: No (further) spurious emissions in the range 20 dB below the limit found.
The tests for mode a have been performed in the frequency range 0.009–40000 MHz for channel 38, in the range 30–40000 MHz for channel 159, in the range 1-26 GHz for the remaining channels.

3.6.3.2 Band Edge

Video-Mode; 20 MHz					Applied duty cycle correction (AV) [dB]: 0.2				
UNII-Sub-band	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detector	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type
1	36	5180	5150.0	45.9	PEAK	1000	74.0	28.1	BE-RB
	36	5180	5150.0	31.7	AV	1000	54.0	22.3	BE-RB
2A	64	5320	5350.0	NA	NA	NA	NA	NA	NA
	64	5320	5350.0	NA	NA	NA	NA	NA	NA
2C	100	5500	5460.0	NA	NA	NA	NA	NA	NA
	100	5500	5460.0	NA	NA	NA	NA	NA	NA
3	165	5825	5850.0	64.3	PEAK	1000	78.0	13.7	BE-UE

Video-Mode; 40 MHz					Applied duty cycle correction (AV) [dB]: 0.0				
UNII-Sub-band	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detector	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type
1	38	5190	5150.0	60.9	PEAK	1000	74.0	13.1	BE-RB
	38	5190	5150.0	45.1	AV	1000	54.0	8.9	BE-RB
2A	62	5310	5350.0	NA	NA	NA	NA	NA	NA
	62	5310	5350.0	NA	NA	NA	NA	NA	NA
2C	102	5510	5460.0	NA	NA	NA	NA	NA	NA
	134	5670	5725.0	NA	NA	NA	NA	NA	NA
3	151	5755	5725.0	70.4	PEAK	1000	78.0	7.6	BE-UE
	159	5795	5850.0	53.6	PEAK	1000	78.0	24.4	BE-UE

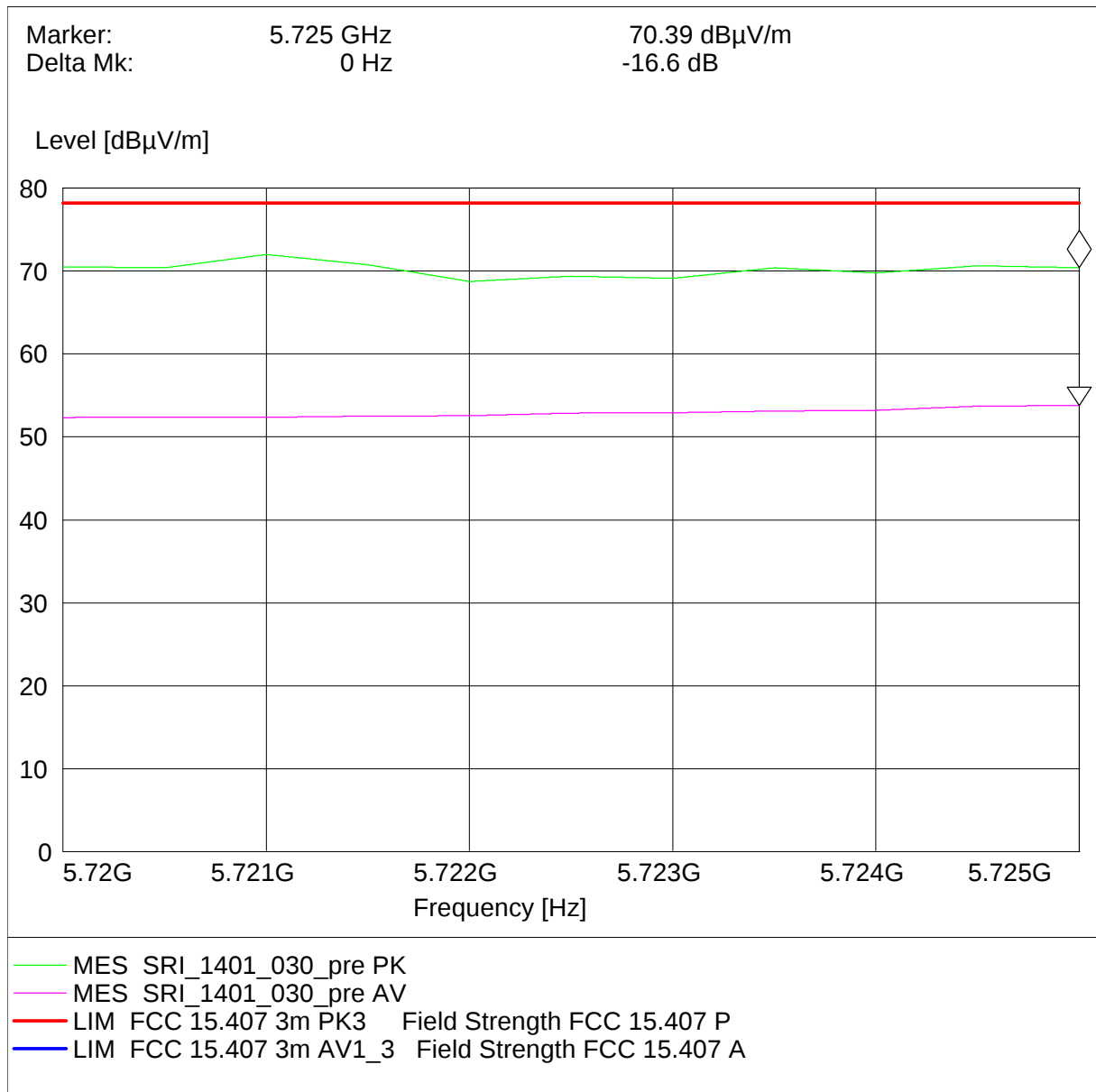
Note: Tests at the Band Edges are implicitly performed together with the undesired emission tests, which are performed as radiated test. The measurements are performed up to the band edges using the bandwidth specified for the undesired emissions.

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”)



4 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 m ³		
	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 m ³ FCC listing 96716 3m Part15/18	none	Frankonia 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
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard Calibration	2014/02/06 2016/02/28
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ENY41	100002	Rohde & Schwarz GmbH & Co. KG
		Standard calibration	2013/03/01 2015/03/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ST08	36292	Teseq GmbH
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard calibration	2014/01/10 2016/01/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN T8-Cat6	32187	Teseq GmbH
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard Calibration	2014/01/08 2016/01/31

Single Devices for Auxiliary Equipment for Conducted emissions (continued)

Single Device Name	Type	Serial Number	Manufacturer	
One-Line V-Network	ESH 3-Z6	100489	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	standard calibration		2014/06/18	2017/11/30
One-Line V-Network	ESH 3-Z6	100570	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration		2013/11/25	2016/11/24
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standart Calibration		2013/03/01	2015/02/28
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration		2013/03/01	2015/02/28

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
Antenna mast	AS 620 P	620/37	HD GmbH
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck
Biconical dipole	VUBA 9117 Standard Calibration	9117-108	Schwarzbeck 2012/01/18 2015/01/17
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq
Broadband Amplifier 30MHz-18GHz	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"	UFB311A+UFB293C	W18.02-2+W38.02-2	Rosenberger Micro-Coax
Double-ridged horn	HF 906 Standard Calibration	357357/001	Rohde & Schwarz GmbH & Co. KG 2012/05/18 2015/05/17
Double-ridged horn	HF 906 Standard Calibration	357357/002	Rohde & Schwarz GmbH & Co. KG 2012/06/26 2015/06/25
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright
Horn Antenna Schwarzbeck 15-26 GHz BBHA 9170	BBHA 9170	BBHA9170262	
Log.-per. Antenna	HL 562 Ultralog Calibration Details Standard Calibration	100609	Rohde & Schwarz GmbH & Co. KG Last Execution 2012/12/18 Next Exec. 2015/12/17
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG
Loop Antenna	HFH2-Z2 Calibration Details DKD Calibration Standard calibration	829324/006	Rohde & Schwarz GmbH & Co. KG Last Execution 2014/11/27 Next Exec. 2017/11/27 2011/10/27 2014/10/26
Standard Gain / Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	Type	Serial Number	Manufacturer
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, Lab 3
Manufacturer:	see single devices
Description:	Single Devices for various Test Equipment
Type:	various
Serial Number:	none

Single Devices for Auxiliary Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
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
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard			2014/02/10 2016/02/09
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard			2012/06/13 2015/06/12
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 2, Lab 3

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	
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2011/11/24	2014/11/23
	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	
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2011/11/28	2014/11/27
	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		2007/07/16	
	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			
Universal Radio Communication Tester	Firmware: µP1 8v50 02.05.06 ---			
	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2011/12/07	2014/12/06
	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		2007/01/02	
	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 ---			
	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 ESR 7 Analyser		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	
	Standard calibration		2014/05/13	2015/05/12
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2014/05/13	2015/05/12
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 Exec.
	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 12

Lab ID: Lab 5
Description: Ex-Tech 520
Serial Number: 05157876

Single Devices for Multimeter 12

Single Device Name	Type	Serial Number	Manufacturer	
Digital Multimeter 12 (Multimeter)	EX520	05157876	Extech Instruments Corp.	
	Calibration Details		Last Execution	Next Exec.
	Customized calibration		2013/12/04	2015/12/03

Test Equipment Radio Lab Test Equipment

Lab ID: Lab 3
Description: Radio Lab Test Equipment

Single Devices for Radio Lab Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
Broadband Power DividerWA1515 SMA		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		2014/05/13 2015/05/12
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
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2014/05/13 2015/05/12
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		Last Execution Next Exec.
	Standard calibration		2014/12/02 2017/12/01
	Standard calibration		2011/11/25 2014/11/24
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		Last Execution Next Exec.
	Standard calibration		2013/05/06 2016/05/05
Spectrum Analyser	FSIQ26	840061/005	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		Last Execution Next Exec.
	Standard Calibration		2013/02/12 2015/02/11

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 Shielded Room 07

Lab ID: Lab 5
Description: Shielded Room 4m x 6m

Test Equipment T/A Logger 13

Lab ID: Lab 1, Lab 2, Lab 3
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		2013/02/07	2015/02/26
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 DataloggerOpus10 THI (8152.00) 02 (Environ)	Opus10 THI (8152.00)	7489	Lufft Mess- und Regeltechnik GmbH
Calibration Details		Last Execution	Next Exec.
Customized calibration		2013/02/07	2015/02/26
Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 03

Lab ID: Lab 3
Description: Lufft Opus10
Serial Number: 7482

Single Devices for T/H Logger 03

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 03 (Environ)	Opus10 THI (8152.00)	7482	Lufft Mess- und Regeltechnik GmbH
Calibration Details		Last Execution	Next Exec.
Customized calibration		2013/02/07	2015/02/26
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 DataloggerOpus10 THI (8152.00) 12 (Environ)		12482	Lufft Mess- und Regeltechnik GmbH
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Customized calibration			2013/01/07 2015/03/09
Customized calibration			2015/03/10 2017/03/09

Test Equipment T/H Logger 15

Lab ID: Lab 5
Description: Lufft Opus10
Serial Number: 13985

Single Devices for T/H Logger 15

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 15 (Environ)		13985	Lufft Mess- und Regeltechnik GmbH
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Customized calibration			2013/01/07 2015/03/09
Customized calibration			2015/03/10 2017/03/09

Test Equipment Temperature Chamber 01

Lab ID: Lab 5
Manufacturer: see single devices
Description: Temperature Chamber KWP 120/70
Type: Weiss
Serial Number: see single devices

Single Devices for Temperature Chamber 01

Single Device Name	Type	Serial Number	Manufacturer
Temperature Chamber Weiss 01	KWP 120/70	59226012190010	Weiss Umwelttechnik GmbH
Customized calibration			2014/03/12 2016/03/11

Test Equipment Temperature Chamber 05

Lab ID: Lab 3
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

Test Equipment WLAN RF Test Solution

Lab ID: Lab 5
Manufacturer: 7 layers AG
Description: Regulatory WLAN RF Tests
Type: WLAN RF
Serial Number: 001

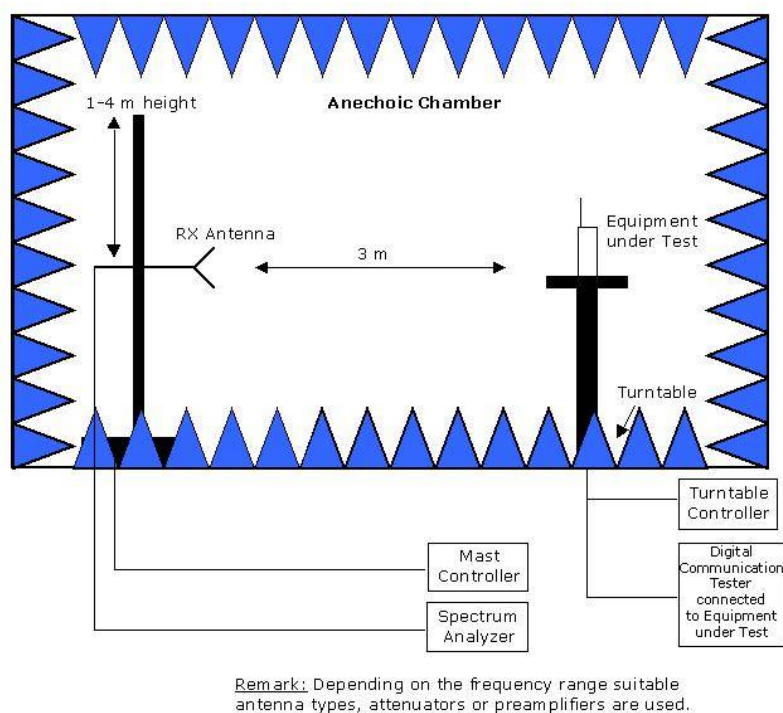
Single Devices for WLAN RF Test Solution

Single Device Name	Type	Serial Number	Manufacturer	
Arbitrary Waveform Generator	TGA12101	284482		
Power Meter NRVD	NRVD Standard calibration	832025/059	2014/08/29	2015/08/28
Power Sensor NRV Z1 A	PROBE Standard calibration	832279/013	2014/08/28	2015/08/27
Power Supply	NGSM 32/10 Standard calibration	2725	2013/06/20	2015/06/19
Rubidium Frequency Normal MFS	Datum MFS Standard calibration	002	Datum GmbH	2014/08/29 2015/08/28
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG	
Spectrum Analyser	FSU26 Standard Calibration Standard Calibration HW/SW Status	100136	Rohde & Schwarz GmbH & Co.KG 2014/01/06 2015/02/01 2015/02/02 2016/02/01 Date of Start Date of End	
	FSU FW Update to v4.61 SP3, K5 v4.60 and K73 v4.61		2011/12/05	
Spectrum Analyser	FSU3 Standard calibration HW/SW Status	200046	Rohde & Schwarz GmbH & Co.KG 2014/07/01 2015/06/30 Date of Start Date of End	
	Firmware Version 4.51 SP1 Option FS-K72 4.50 SP1 Option FS-K73 4.50 SP1		2011/12/07	
TOCT Switching Unit	Switching Unit	040107	7 layers, Inc.	
Vector Signal Generator SMIQ03B	SMIQ03B Standard calibration	832870/017	2013/06/21	2016/06/20

5 Photo Report

Please refer to external report.

6 Setup Drawings



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