



TEST REPORT

Test Report No. : UL-RPT-RP-11836203-216FCC

Manufacturer : Harman Becker Automotive System GmbH
Model No. : AUS4 Standard
Technology : WLAN
Test Standard(s) : FCC Parts 15.209(a) & 15.247

1. This test report shall not be reproduced in full or partial, without the written approval of UL International Germany GmbH.
2. The results in this report apply only to the sample tested.
3. The test results in this report are traceable to the national or international standards.
4. Test Report Version 1.3 – Supersede Version 1.2
5. Result of the tested sample: **PASS**

Prepared by: Abdoufataou, Salifou
Title: Laboratory Engineer
Date: 26.02.2018

Approved by: Jakob, Reschke
Title: Test Engineer
Date: 28.11.2018



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The tests reported herein have been performed in
accordance with its' terms of accreditation.

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1. Customer Information

Company Name:	Harman Becker Automotive System GmbH
Company Address:	Becker-Görling-str.16, 67307- Karlsbad, Germany
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Contact Phone No.:	+49 7248715407 / +49 7248713382

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.247
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.209
Site Registration:	22511-1

Applied Standards

Location

Location of Testing:	UL International Germany GmbH Hedelfinger Str. 61 70327 Stuttgart Germany
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Date information

Order Date:	23 June 2017
EUT arrived:	03 May 2017
Test Dates:	29 August 2017 to 27 November 2018
EUT returned:	-/-

2.2. Summary of Test Results

Clause	Measurement	Complied	Did not comply	Not performed	Not applicable
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	☒	☐	☐	☐
Part 15.35(c)	Transmitter Duty Cycle	☒	☐	☐	☐
Part 15.247(e)	Transmitter Power Spectral Density	☒	☐	☐	☐
Part 15.247(b)(3)	Transmitter Maximum (Average) Output Power	☒	☐	☐	☐
Part 15.247(d) & 15.209(a)	Transmitter Radiated Emissions	☒	☐	☐	☐
Part 15.247(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	☒	☐	☐	☐

Note:

Device is an in car/vehicle device. No connection to AC mains. Due to this fact Part 15.207 is not applicable (AC conducted measurements)

2.3. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	KDB 558074 D01 DTS Meas Guidance v04
Title:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	SCANIA
Model Name or Number:	AUS4 STANDARD
Test Sample Serial Number:	A562CT0H2540810 (<i>Radiated sample</i>)
Hardware Version Number:	C3
Software Version Number:	SCANIA_J6_R32.0.0_16313A
FCC ID:	T8GAUS4STD

Brand Name:	SCANIA
Model Name or Number:	AUS4 STANDARD
Test Sample Serial Number:	A562CY0H2540806 (<i>Conducted sample with RF port</i>)
Hardware Version Number:	C3
Software Version Number:	SCANIA_J6_R32.0.0_16313A
FCC ID:	T8GAUS4STD

3.2. Description of EUT

The equipment under test was a head unit with WLAN capability.

Device is mounted in a car/vehicle and powered over the car battery. No AC mains supply/connection possible.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Technology Tested:	WLAN (IEEE 802.11b,g) / Digital Transmission System	
Type of Unit:	Transceiver	
Modulation Type:	DBPSK, DQPSK, BPSK, QPSK, QPSK, 16QAM & 64QAM	
Data Rates:	802.11b	1, 2, 5.5 & 11 Mbps
	802.11g	6, 9, 12, 18, 24, 36, 48 & 54 Mbps
Power Supply Requirement(s):	Nominal	12 VDC
Maximum Conducted Output Power:	10.03 dBm	
Declared Antenna Gain:	4.5 dBi	
Channel Spacing:	20 MHz	
Transmit Frequency Range:	2412 MHz to 2472 MHz	
Transmit Channels Tested:	Channel Number	Channel Frequency (MHz)
	1	2412
	7	2442
	13	2472

3.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Laptop PC with software application Tera Term	Lenovo	20F1-001YGE	MP-16X71T 16/11
2	Power supply wires (Length 2 metres)	Not marked or stated	Not marked or stated	Not marked or stated
3	Edge connector	HARMAN BECKER	45/16 MOS	Not marked or stated
4	USB-Adapter	BECKER	40/16 MOS	Not marked or stated
5	USB cable (Length 2 metres)	Not marked or stated	Not marked or stated	Not marked or stated
6	Laboratory Power Supply	Conrad Electronic Germany	PS -2403D	Not marked or stated
7	2 USB	Kingston	DTR3.0 G2	Not marked or stated

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):

- ☒ Continuously transmitting with a modulated carrier at maximum power on the bottom, middle and top channels as required using the supported data rates/modulation types.

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- Controlled using a terminal application on the laptop PC along with instructions provided by the customer. The document was called "How to configure named MAN-Scania-Testsetup_170116 v06.pdf" dated 16/01/17.
- The application was used to enable a continuous transmission mode and to select the test channels, data rates and modulation schemes and power settings as required.
- The customer declared the following data rates to be used for all measurements as:
 - 802.11b – 1, 2, 5.5 & 11 Mbps
 - 802.11g – 6, 9, 12, 18, 24, 36, 48 & 54 Mbps
- All supported modes and channel widths were initially investigated on one channel. The modes that produced the highest power and widest bandwidth for all bands were:
 - o Highest power
 - 802.11b –DQPSK / 5.5 Mbps
 - 802.11g –BPSK / 9 Mbps
 - o Highest power spectral density
 - 802.11b –DQPSK / 5.5 Mbps
 - 802.11g –BPSK / 9 Mbps
 - o Widest bandwidth
 - 802.11b – DBPSK / 5.5 Mbps
 - 802.11g – BPSK / 9 Mbps
- Transmitter spurious emissions were performed with the EUT transmitting with a data rate of 9 Mbps. This was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and, as this mode emits the highest output power level, it was deemed to be the worst case.
- The conducted sample with serial number A562CY0H2540806 was used for minimum 6 dB bandwidth, maximum output power and power spectral density tests.
- The radiated sample with serial number A562CT0H2540810 was used for all other tests.
- Software EMC32 V10.1.0

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 6 *Measurement Uncertainty* for details.

In accordance with DAkkS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2. Test Results

5.2.1. Transmitter Minimum 6 dB Bandwidth

Test Summary:

Test Engineer:	Abdoufataou Salifou	Test Date:	04 October 2017
Test Sample Serial Number:	A562CY0H2540806 (Conducted sample with RF port)		
Test Site Identification	SR 9		

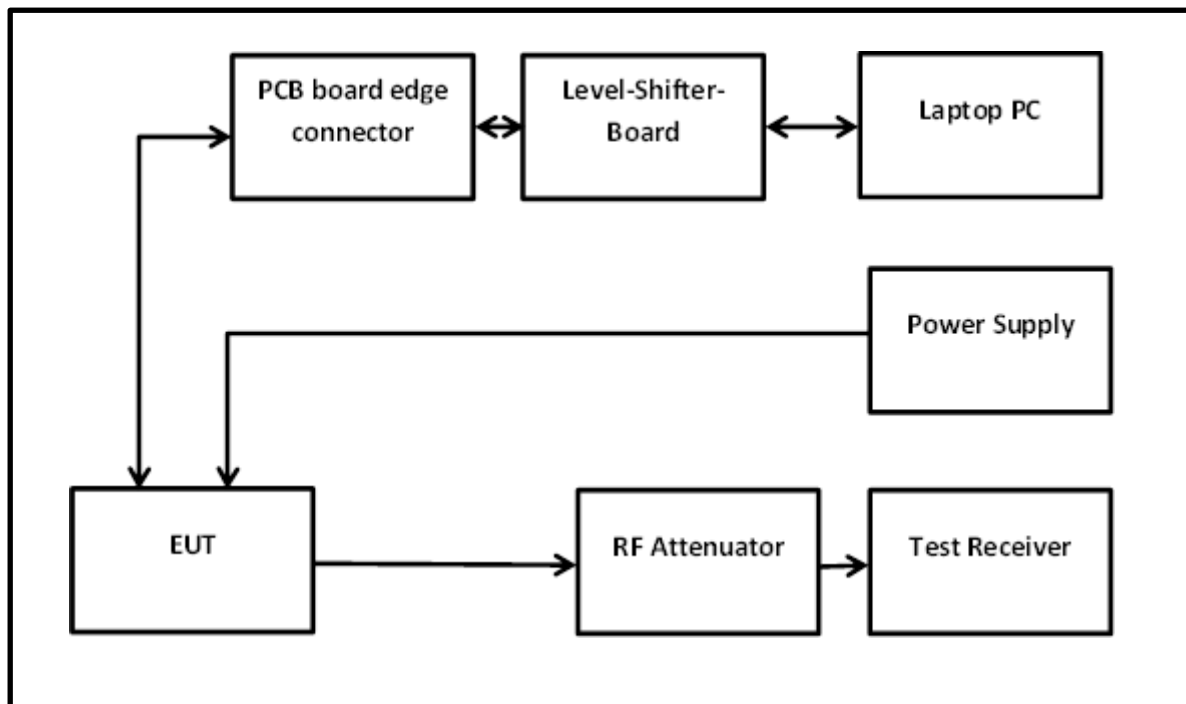
FCC Reference:	Part 15.247(a)(2)
Test Method Used:	FCC KDB 558074 Section 8.1

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	42

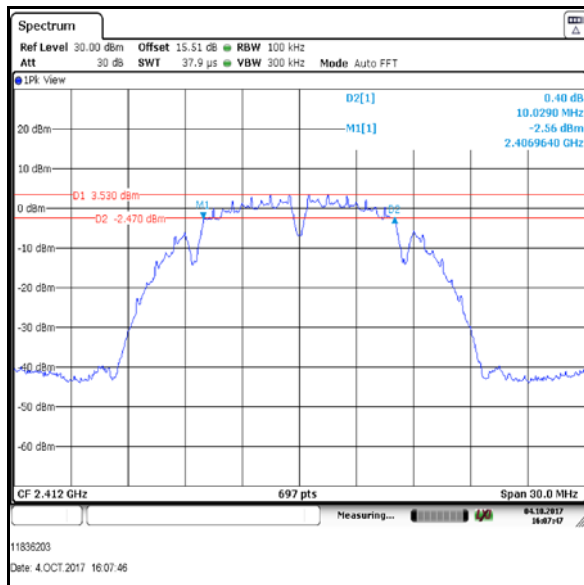
Note(s):

- The customer declared the following data rates to be used for all measurements as:
 - 802.11b – 1, 2, 5.5, 11 Mbps
 - 802.11g – 6, 9, 12, 18, 24, 36, 48, 54 Mbps
- All configurations supported by the EUT were investigated on one channel in accordance with KDB 558074 Section 8.1 Option 1 measurement procedure. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 30 MHz. The DTS bandwidth was measured at 6 dB down from the peak of the signal. The data rates that produced the narrowest bandwidth and therefore deemed worst case were:
 - 802.11b – DBPSK / 1 Mbps
 - 802.11g – BPSK / 6 Mbps
- Final measurements were performed using the above configurations on the bottom, middle and top channels in accordance with KDB 558074 Section 8.1 Option 1 measurement procedure.
- Plots for all data rates are archived on the Company server and available for inspection upon request.
- The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

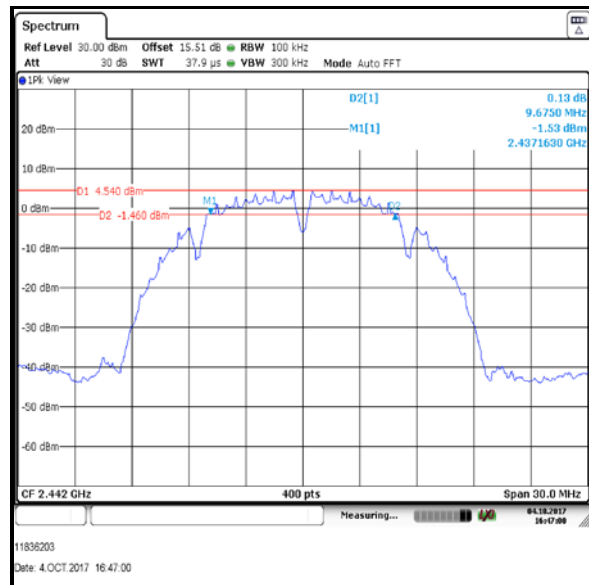
Transmitter Minimum 6 dB Bandwidth continued**Test setup:**

Transmitter Minimum 6 dB Bandwidth continued**Results: 802.11b / DBPSK / 1 Mbps**

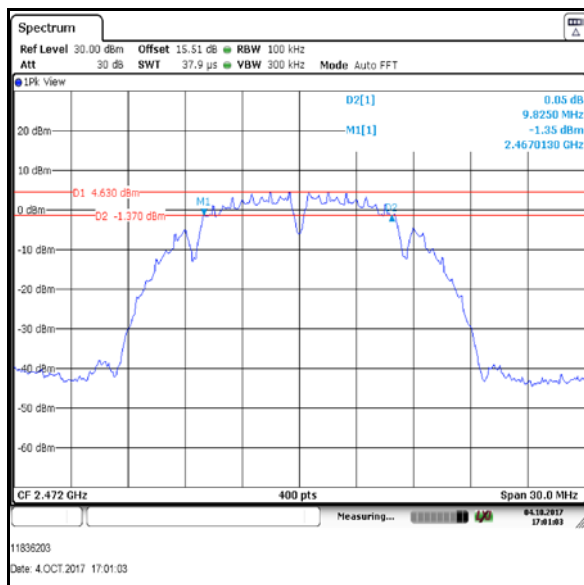
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	10029.000	≥500	9529.000	Complied
Middle	9675.000	≥500	9175.000	Complied
Top	9825.000	≥500	9325.000	Complied



Bottom Channel



Middle Channel

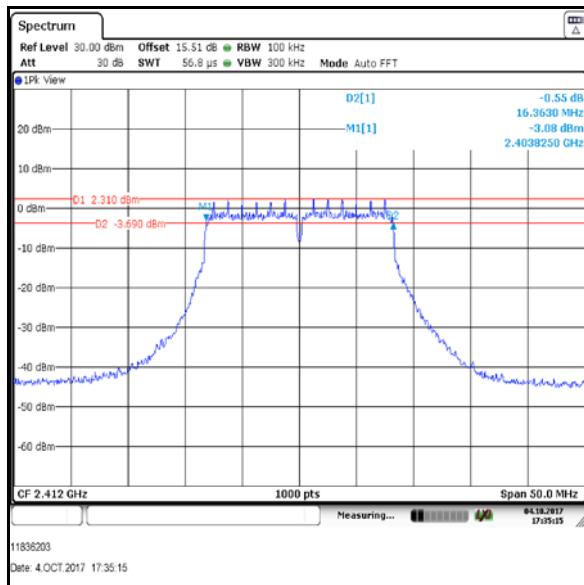
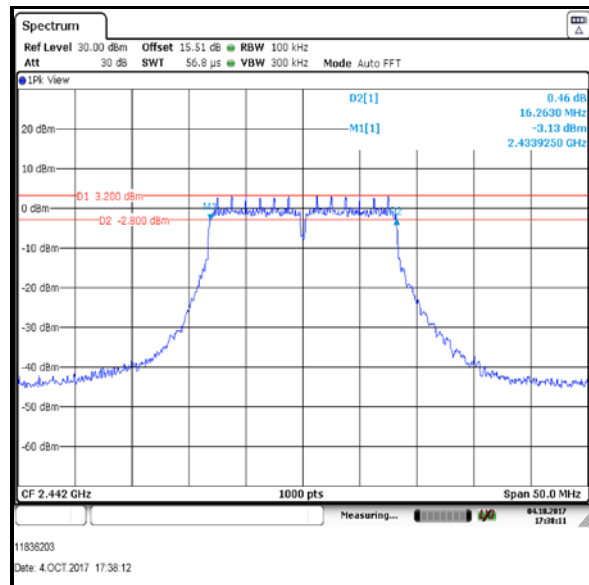
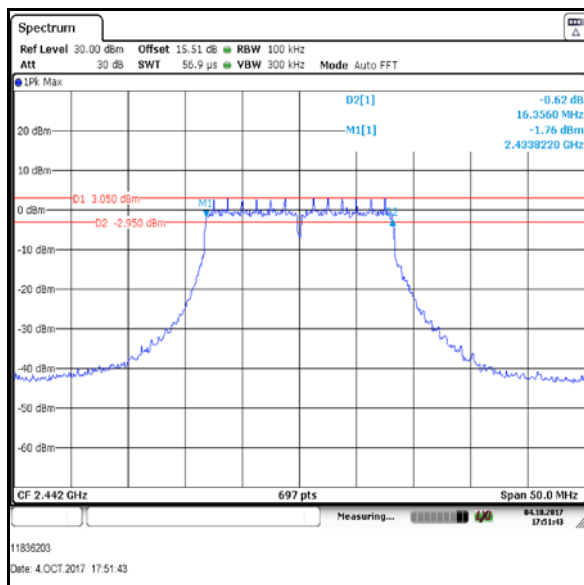


Top Channel

Result: Pass

Transmitter Minimum 6 dB Bandwidth continued**Results: 802.11g / BPSK / 6 Mbps**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	16363.000	≥500	15863.000	Complied
Middle	16263.000	≥500	15763.000	Complied
Top	16356.000	≥500	15856.000	Complied

**Bottom Channel****Middle Channel****Top Channel****Result: Pass**

5.2.2. Transmitter Duty Cycle**Test Summary:**

Test Engineer:	Abdoufataou Salifou	Test Date:	26 September 2017
Test Sample Serial Number:	A562CY0H2540806 (<i>Conducted sample with RF port</i>)		

FCC Reference:	Part 15.35(c)
Test Method Used:	FCC KDB 558074 Section 6.0

Environmental Conditions:

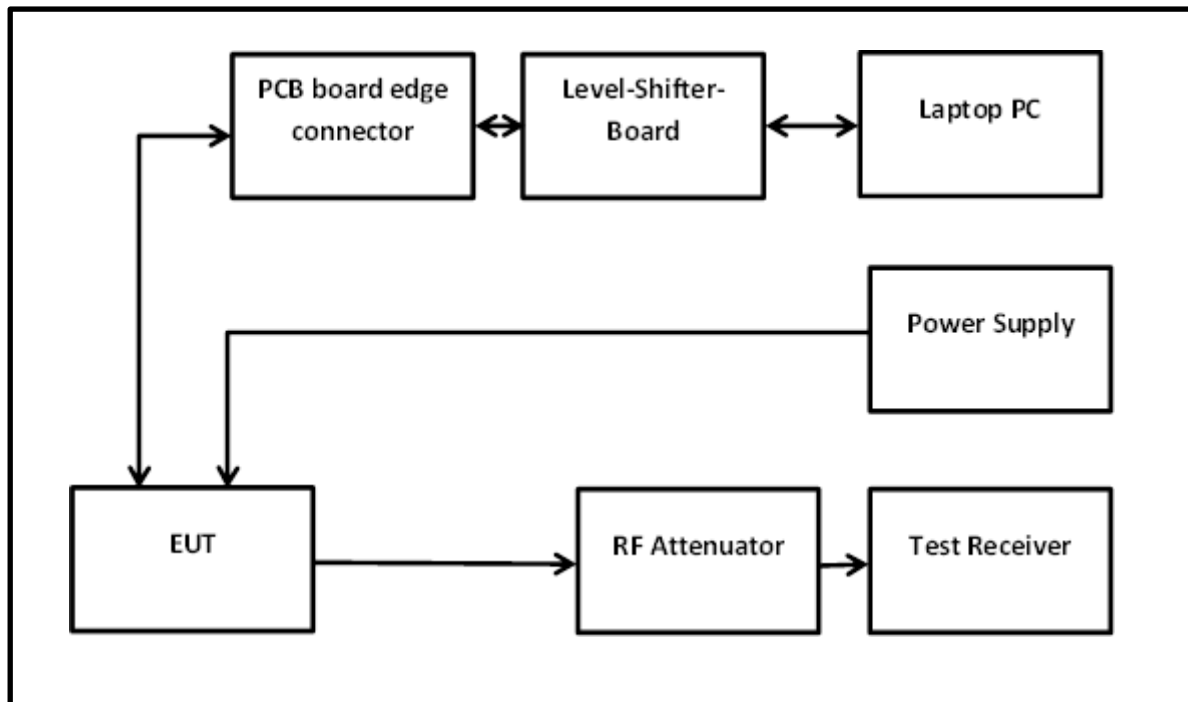
Temperature (°C):	24
Relative Humidity (%):	44

Note(s):

1. In order to assist with the determination of the average level of fundamental and spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

$$10 \log (1 / (\text{On Time} / [\text{Period or } 100 \text{ ms whichever is the lesser}])).$$

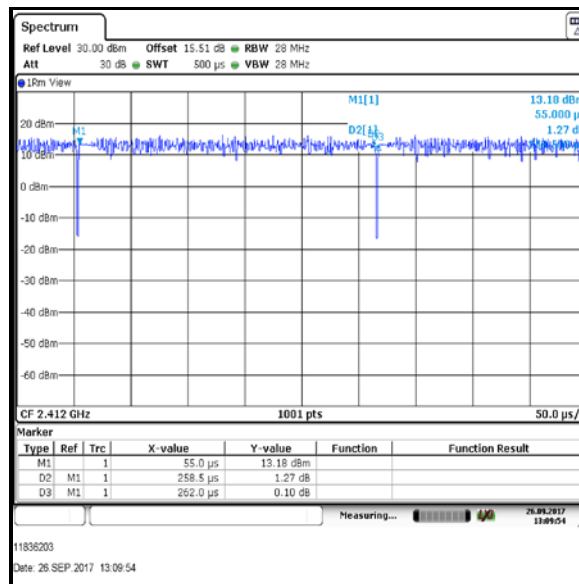
$$802.11g / 9 \text{ Mbps duty cycle: } 10 \log (1 / (258.5 \mu\text{s} / 262.0 \mu\text{s})) = 0.1 \text{ dB}$$

Test setup:

Transmitter Duty Cycle (continued)**Results: 802.11g / 9 Mbps**

Pulse Duration (μ s)	Duty Cycle (dB)
258.5	0.1

Period (μ s)
262.0

**TX on time**

5.2.3. Transmitter Power Spectral Density**Test Summary:**

Test Engineer:	Abdoufataou Salifou	Test Date:	04 October 2017
Test Sample Serial Number:	A562CY0H2540806 (<i>Conducted sample with RF port</i>)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(e)
Test Method Used:	FCC KDB 558074 Sections 10.3 &10.5

Environmental Conditions:

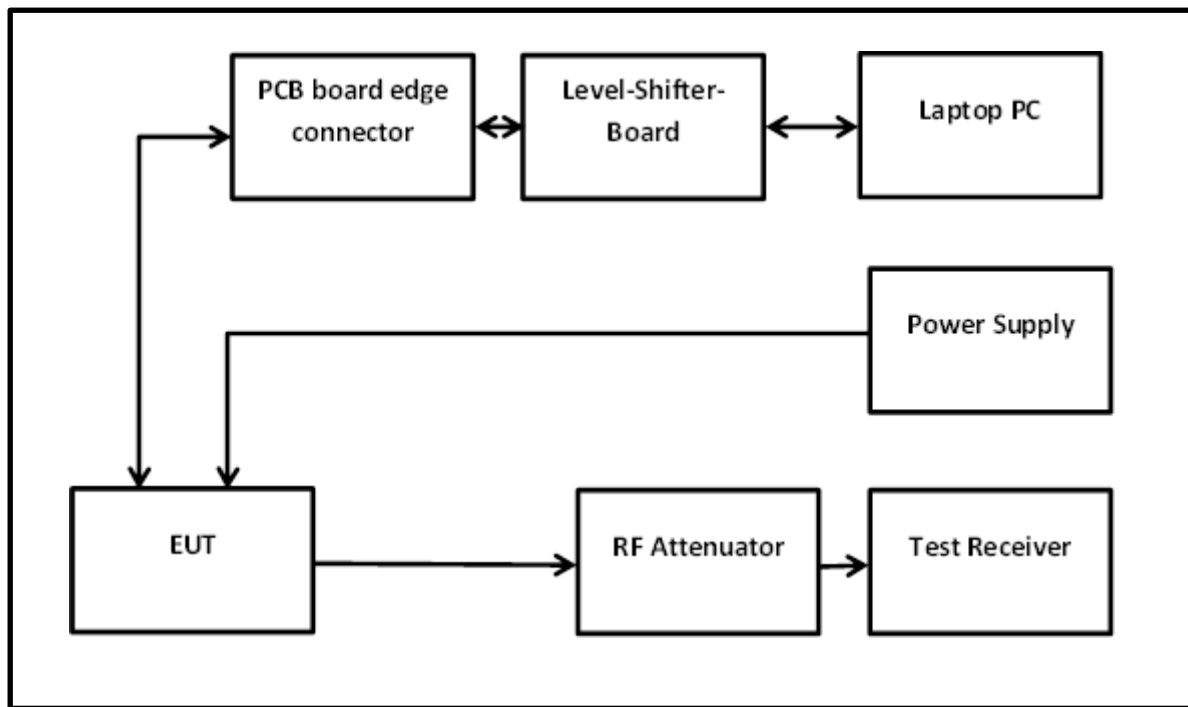
Temperature (°C):	23
Relative Humidity (%):	42

Settings of the Instrument

RBW/VBW	100 KHz / 300 KHz
Span	1.5 * OBW
Sweep time	Auto
Detector	RMS

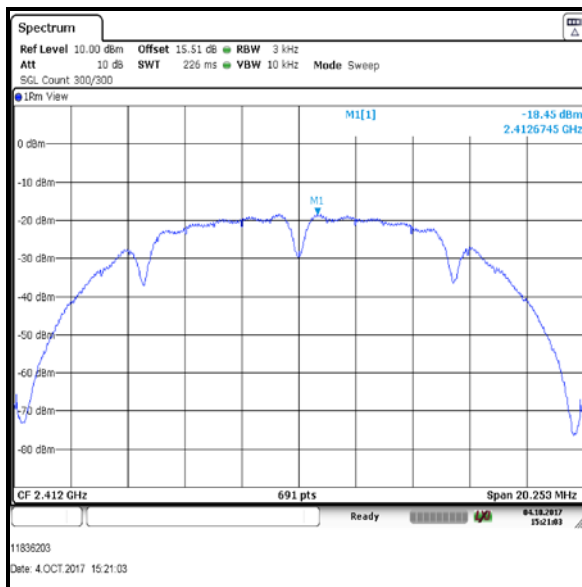
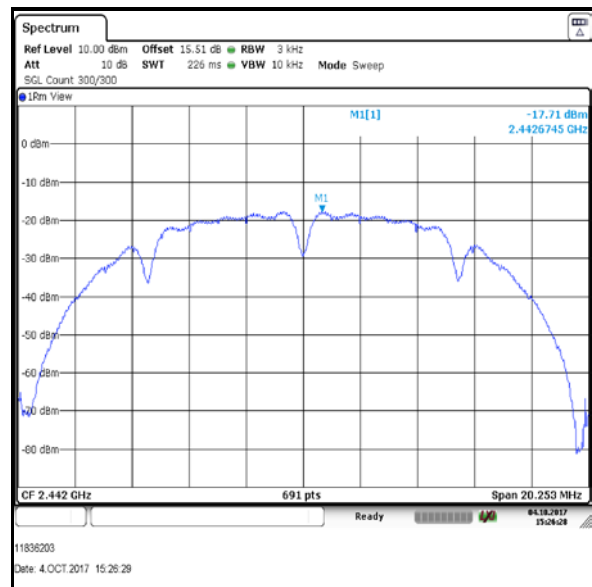
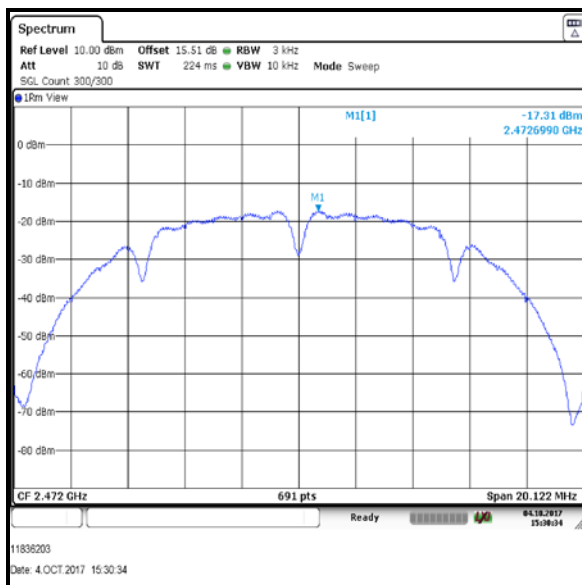
Note(s):

1. All configurations supported by the EUT were investigated on one channel in accordance with KDB 558074 Section 10.6 measurement procedure AVGPDS-2 Alternative. The data rates that produced the highest power and therefore deemed worst case were::
 - o 802.11b – DQPSK / 5.5 Mbps
 - o 802.11g – BPSK / 9 Mbps
2. Final measurements were performed using the above configurations on the bottom, middle and top channels.
3. For 802.11b and 802.11g the EUT transmits only from one antenna port, therefore conducted measurements were performed on that port.
4. For 802.11b, the EUT was transmitting at 100% duty cycle and testing was performed in accordance with KDB 558074 Section 10.3 Method AVGPDS-1. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. An RMS detector was used and sweep time set manually to perform trace averaging over 300 traces. The span was set to 1.5 times the 99% occupied emission bandwidth. The highest peak of the measured signal was recorded.
5. For 802.11g, the EUT was transmitting at <98% duty cycle and testing was performed in accordance with KDB 558074 Section 10.5 Method AVGPDS-2. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. An RMS detector was used and sweep time set manually to perform trace averaging over 300 traces. The span was set to 1.5 times the 99% occupied emission bandwidth. The highest peak of the measured signal was recorded. The calculated duty cycle in section 5.2.3 was added to the measured average power spectral density in order to compute the average power spectral density during the actual transmission time.
6. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

Transmitter Power Spectral Density (Continued)**Test setup:**

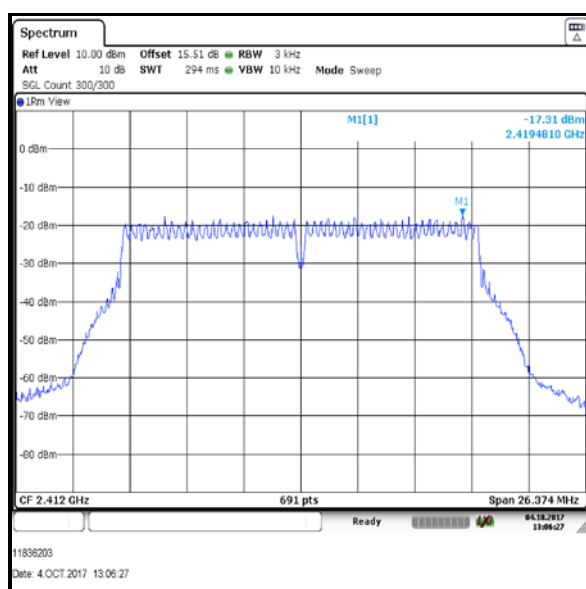
Transmitter Power Spectral Density (Continued)**Results: 802.11b / DQPSK / 5.5 Mbps**

Channel	Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-18.5	8.0	26.5	Complied
Middle	-17.7	8.0	25.7	Complied
Top	-17.3	8.0	25.3	Complied

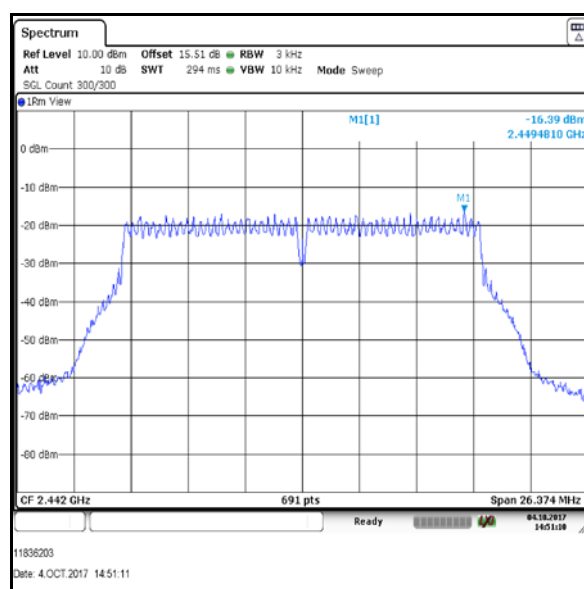
**Bottom Channel****Middle Channel****Top Channel****Result: Pass**

Transmitter Power Spectral Density (Continued)**Results: 802.11g / BPSK / 9 Mbps**

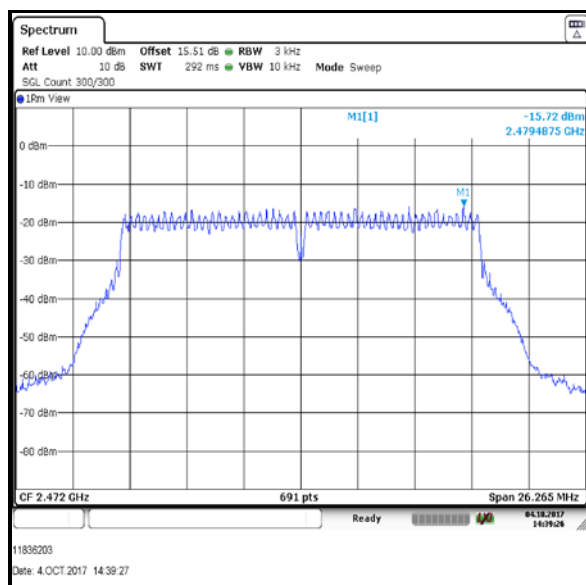
Channel	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-17.3	0.1	-17.2	8.0	25.2	Complied
Middle	-16.4	0.1	-16.3	8.0	24.3	Complied
Top	-15.7	0.1	-15.6	8.0	23.6	Complied



Bottom Channel



Middle Channel



Top Channel

Result: Pass

5.2.4. Transmitter Maximum (Average) Output Power**Test Summary:**

Test Engineer:	Segun Adeniji	Test Date:	27 November 2018
Test Sample Serial Number:	A562CY0H2540806 (<i>Conducted sample with RF port</i>)		
Test Site Identification	SR 9		

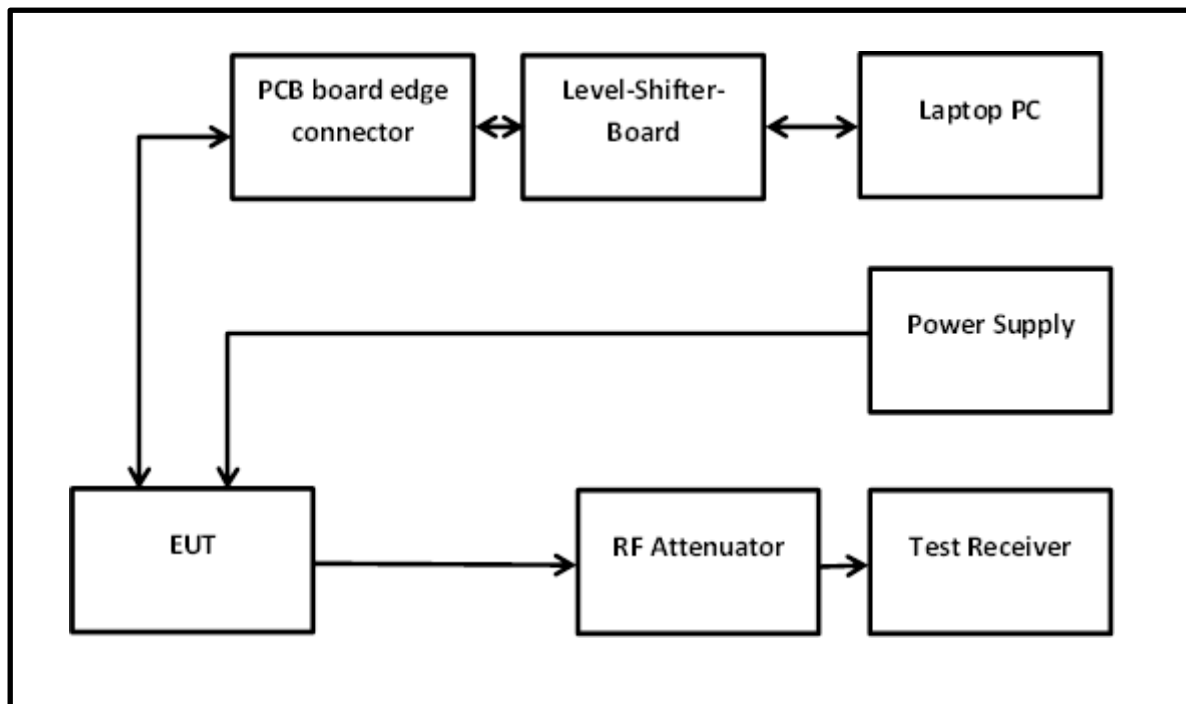
FCC Reference:	Part 15.247(b)(3)
Test Method Used:	FCC KDB 558074 Sections 9.2.2.2 & 9.2.2.4

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	42

Note(s):

- The customer declared the following data rates to be used for all measurements as:
 - 802.11b – 1, 2, 5.5, 11Mbps
 - 802.11g – 6, 9, 12, 18, 24, 36, 48, 54Mbps
- Final measurements were performed using the above configurations on the bottom, middle and top channels. The power has been integrated over the 99% emission bandwidth. Plots for the occupied bandwidth are archived on the company server and available for inspection upon request.
- For 802.11b, the EUT was transmitting at 100% duty cycle and testing was performed in accordance with KDB 558074 Section 9.2.2.2 Method AVGSA-1. The signal analyser's integration function was used to integrate across the 99% occupied bandwidth. The signal analyser resolution bandwidth was set to 200 kHz and video bandwidth 1 MHz. An RMS detector was used and sweep time set manually to perform trace averaging over 300 traces. The span was set to 1.5 times the 99% occupied emission bandwidth.
- For 802.11g, the EUT was transmitting at >98% duty cycle and testing was performed in accordance with KDB 558074 Section 9.2.2.4 Method AVGSA-2. The signal analyser's integration function was used to integrate across the 99% occupied bandwidth. The signal analyser resolution bandwidth was set to 500 kHz and video bandwidth 2 MHz. An RMS detector was used and sweep time set manually to perform trace averaging over 300 traces. The span was set to 1.5 times the 99% occupied emission bandwidth. The calculated duty cycle in section 5.2.2 was added to the measured power in order to compute the average power during the actual transmission time.
- The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

Transmitter Maximum (Average) Output Power (continued)**Test setup:**

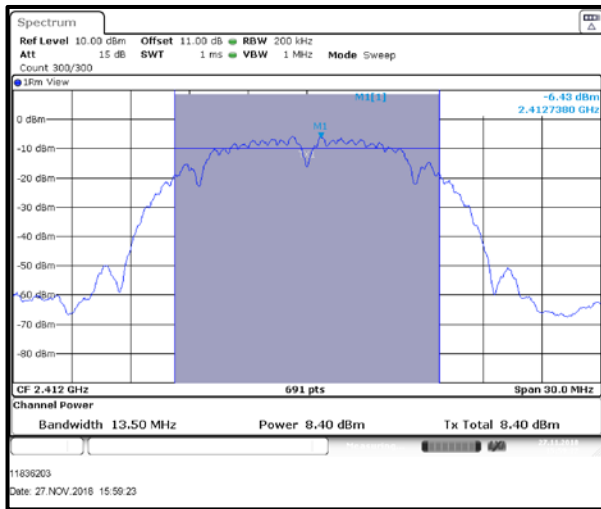
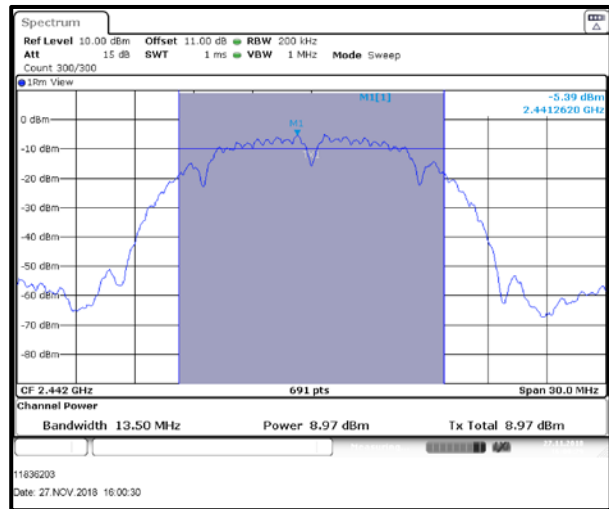
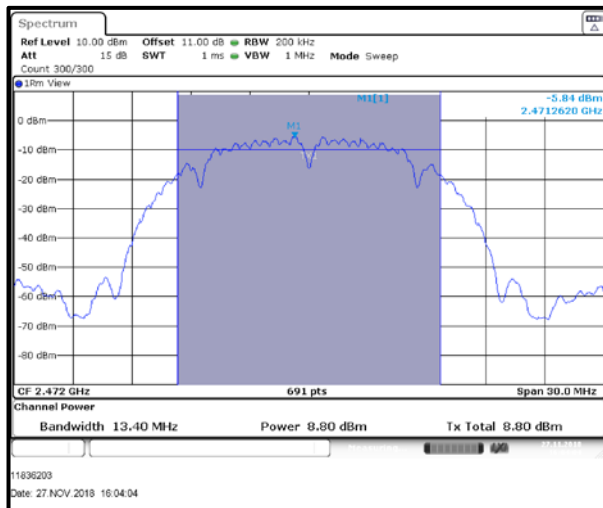
Transmitter Maximum (Average) Output Power (continued)**Results: 802.11b / 20 MHz / 5.5 Mbps****Conducted Peak Limit Comparison**

Channel	Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	8.40	30.0	21.60	Complied
Middle	8.97	30.0	21.03	Complied
Top	8.80	30.0	21.20	Complied

De Facto EIRP Limit Comparison

Channel	Conducted Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	8.40	4.5	12.90	36.0	23.10	Complied
Middle	8.97	4.5	13.47	36.0	22.53	Complied
Top	8.80	4.5	13.30	36.0	22.70	Complied

Result: Pass

Transmitter Maximum (Average) Output Power (continued)**Results: 802.11b / DQPSK / 5.5 Mbps****Bottom Channel****Middle Channel****Top Channel**

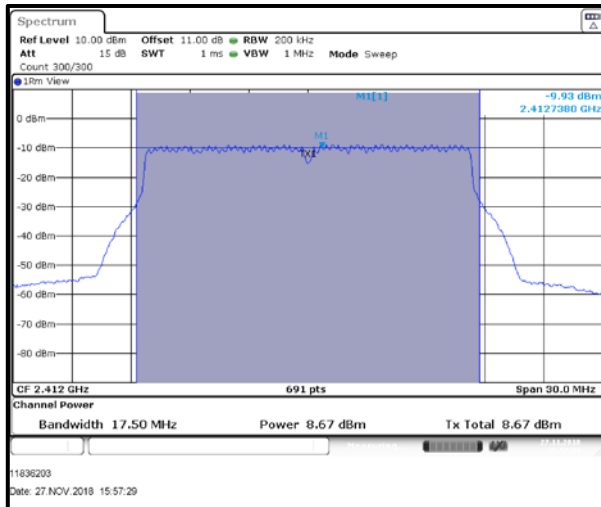
Transmitter Maximum (Average) Output Power (continued)**Results: 802.11g / BPSK / 9 Mbps****Conducted Peak Limit Comparison**

Channel	Conducted Power (dBm)	Duty Cycle Correction (dB)	Corrected Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	8.67	0.1	8.77	30.0	21.23	Complied
Middle	9.93	0.1	10.03	30.0	19.97	Complied
Top	8.80	0.1	8.90	30.0	21.10	Complied

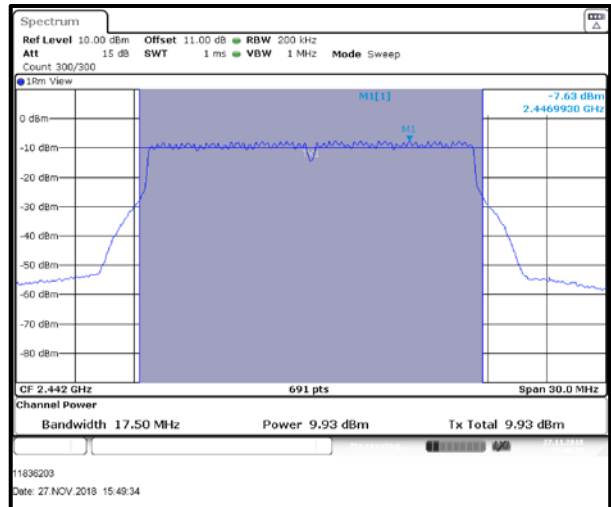
De Facto EIRP Limit Comparison

Channel	Corrected Conducted Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	8.77	4.5	13.27	36.0	22.73	Complied
Middle	10.03	4.5	14.53	36.0	21.47	Complied
Top	8.90	4.5	13.40	36.0	22.60	Complied

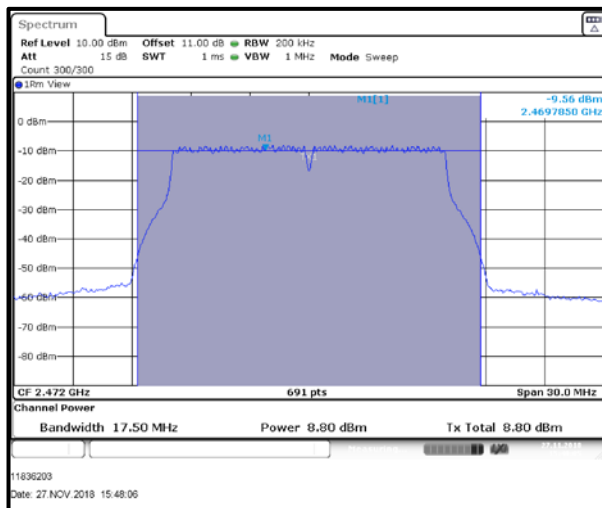
Result: Pass

Transmitter Maximum (Average) Output Power (continued)**Results: 802.11g / BPSK / 9 Mbps**

Bottom Channel



Middle Channel



Top Channel

5.2.5. Transmitter Radiated Emissions**Test Summary:**

Test Engineer:	Abdoufataou Salifou	Test Date:	30 August 2017 10 October 2017
Test Sample Serial Number:	A562CT0H2540810 (<i>Radiated sample</i>)		
Test Site Identification	SR 1/2		

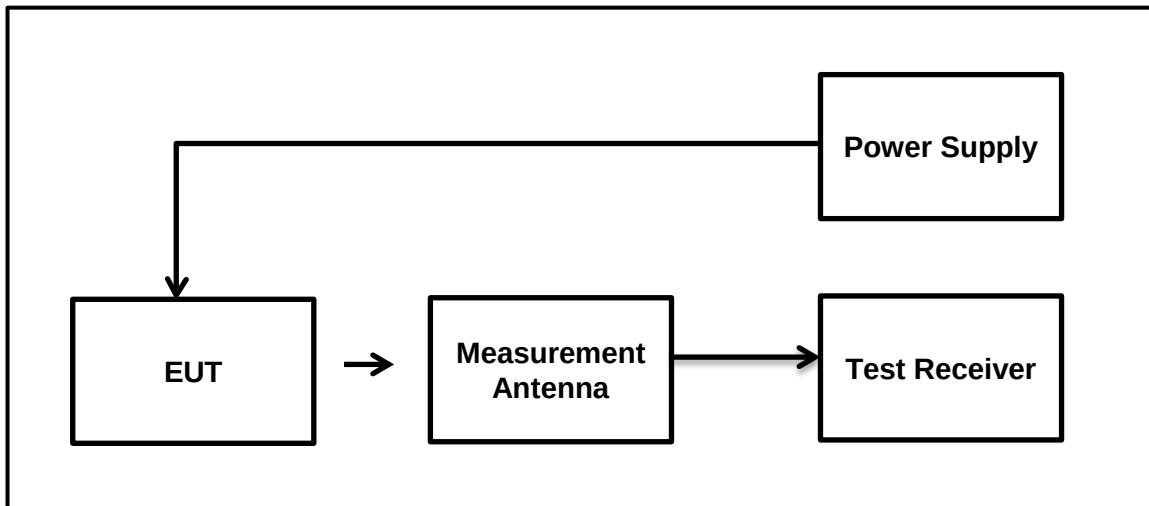
FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.5
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	47

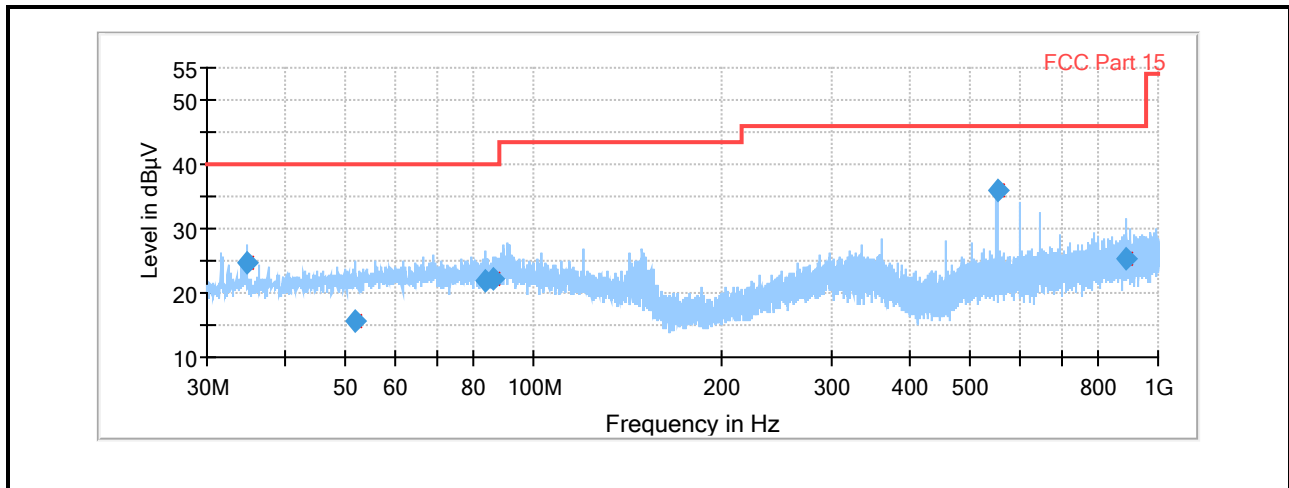
Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the middle channel only.
3. All emissions shown on the pre-scan plots were investigated and found to be ambient, or >20 dB below the applicable limit or below the measurement system noise floor. Therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
4. Measurements below 1 GHz were performed in a semi-anechoic chamber at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
5. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.

Transmitter Radiated Emissions (continued)**Test setup for radiated measurements:****Semi-anechoic chamber**

Transmitter Radiated Emissions (continued)**Results: Middle Channel / 802.11g / BPSK / 9 Mbps**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
552.000	Vertical	35.8	46	10.2	Complied



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

Result: Pass

Test Summary:

Test Engineer:	Abdoufataou Salifou	Test Date:	30 August 2017 10 October 2017
Test Sample Serial Number:	A562CT0H2540810 (<i>Radiated sample</i>)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.6
Frequency Range	1 GHz to 25 GHz

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	47

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak noise floor readings of the measuring receiver were recorded as shown in the tables below.
3. The emission shown approximately on the 1 GHz to 4 GHz plot is the EUT fundamental.
4. *In accordance with ANSI C63.10 Section 6.6.4.3 (Note 1), if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
5. Pre-scans above 1 GHz were performed in a semi anechoic chamber with absorber on the floor at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
6. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. The sweep time was set to auto.

Transmitter Radiated Emissions (continued)**Results: Peak / Bottom Channel**

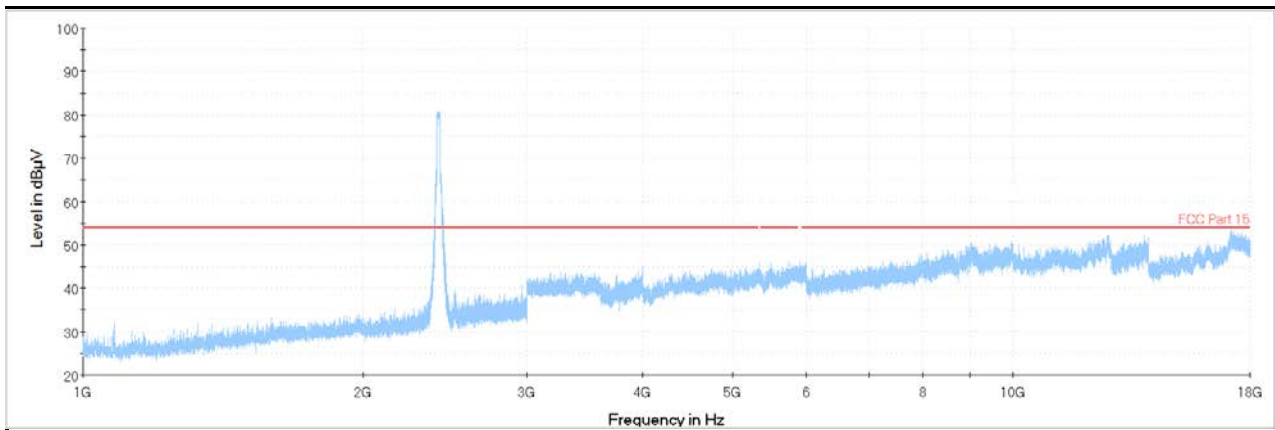
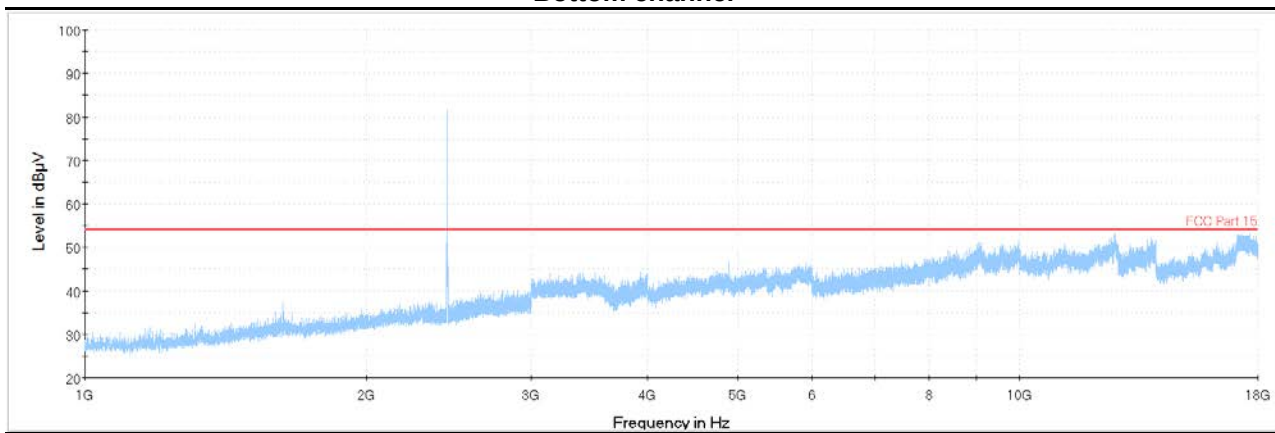
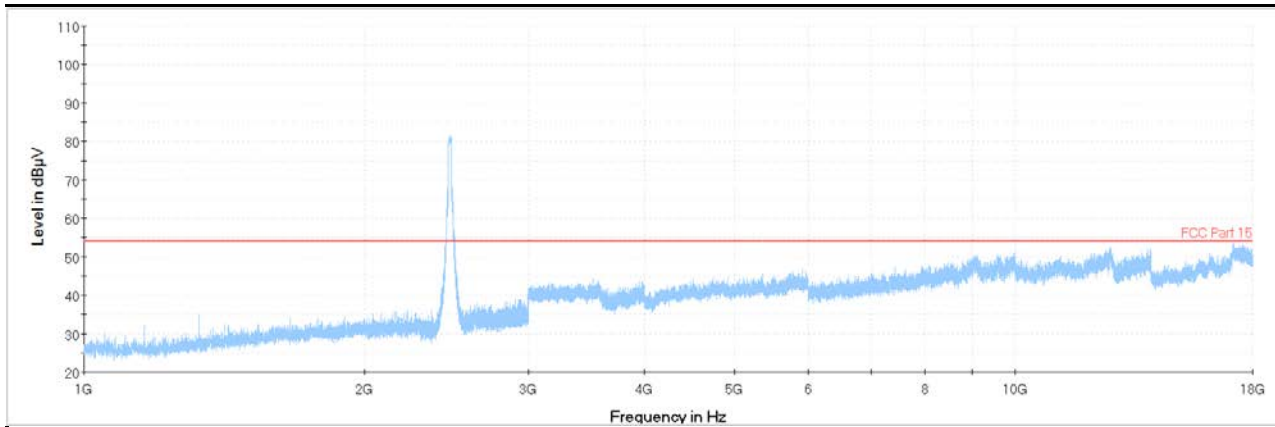
Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
9956.000	Vertical	49.8	54.0	4.2	Complied
17183.333	Vertical	51.8	54.0	2.2	Complied

Results: Peak / Middle Channel

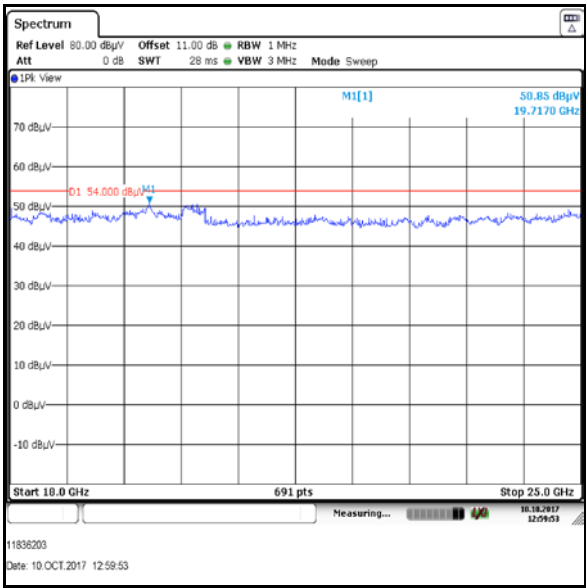
Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
9997.333	Horizontal	49.9	54.0	4.1	Complied
12650.541	Vertical	50.9	54.0	3.1	Complied

Results: Peak / Top Channel

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
9996.666	Horizontal	48.2	54.0	5.8	Complied
12660.166	Vertical	50.7	54.0	3.3	Complied

Transmitter Radiated Emissions (continued)**Bottom channel****Middle channel****Top channel**

Transmitter Radiated Emissions (continued)



From 18 GHz to 25 GHz

Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

Result: Pass

5.2.6. Transmitter Band Edge Radiated Emissions**Test Summary:**

Test Engineer:	Abdoufataou Salifou	Test Date:	26 September 2017 and 12 October 2017
Test Sample Serial Number:	A562CT0H2540810 (<i>Radiated sample</i>)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10 Section 6.10 & FCC KDB 558074 Sections 11 & 12

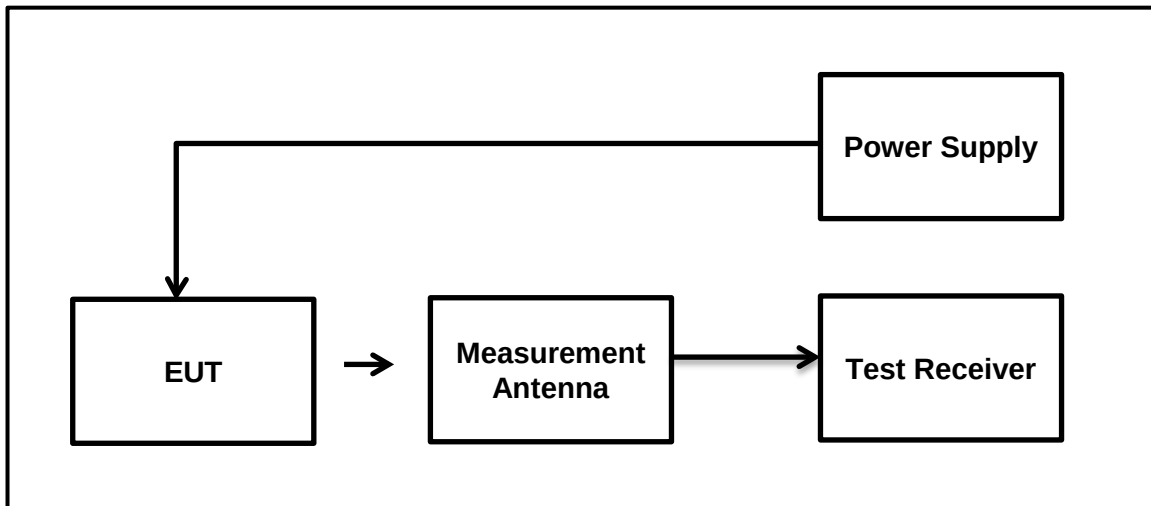
Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	34

Note(s):

- The customer declared the following data rates to be used for all measurements as:
 - 802.11b – 1, 2, 5.5, 11Mbps
 - 802.11g – 6, 9, 12, 18, 24, 36, 48, 54 Mbps

Final measurements were performed with the above configurations.
- The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
- The maximum conducted peak output power was previously measured. In accordance with FCC KDB 558074 Section 11.1(b), the lower band edge measurement should be performed with a peak detector and the -30 dBc limit applied.
- As the lower band edge falls within a non-restricted band, only peak measurements are required. In accordance with FCC KDB 558074 Section 11.1, the test method in Section 11.3 was followed: the test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. As the maximum conducted (average) output power was measured using an RMS detector in accordance with FCC KDB 558074 Section 9.2.2.4 an out-of-band limit line was placed 30 dB (FCC KDB 558074 Section 11.1(b)) below the peak level. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent non-restricted band of operation (where a higher level emission was present). Marker frequencies and levels were recorded.
- As the upper band edge falls within a restricted band both peak and average measurements were recorded by placing a marker at the edge of the band. For peak measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. For average measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. An average detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent restricted band of operation (where a higher level emission was present). Marker frequencies and levels were recorded.
- The restricted band plot for 2310 MHz to 2390 MHz can be found under the results for 802.11g / 9 Mbps as this mode had the highest output power and was therefore deemed worst case.

Transmitter Band Edge Radiated Emissions (continued)**Test setup for Transmitter Band Edge Radiated Emissions:****Semi-anechoic chamber**

Transmitter Band Edge Radiated Emissions (continued)**Results: 802.11b / DQPSK / 5.5 Mbps****Results: Lower Band Edge**

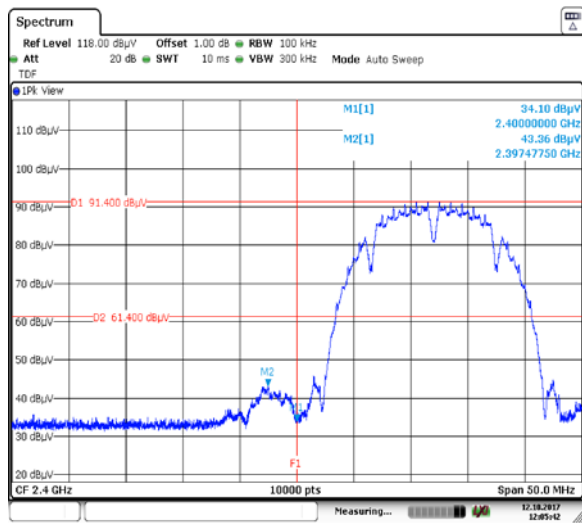
Frequency (MHz)	Level (dB μ V/m)	-30 dBc Limit (dB μ V/m)	Margin (dB)	Result
2397.478	43.4	61.4	18.0	Complied
2400.0	34.1	61.4	27.3	Complied

Results: Upper Band Edge / Restricted Band / Peak

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	48.6	74.0	25.4	Complied
2486.593	48.7	74.0	25.3	Complied

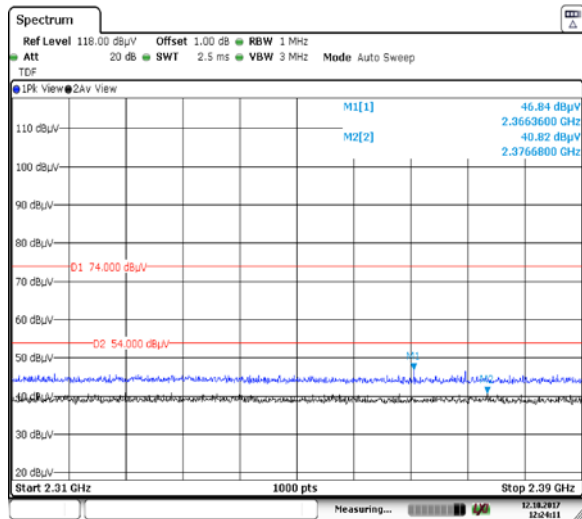
Results: Upper Band Edge / Restricted Band / Average

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	37.5	54.0	16.5	Complied
2486.673	39.3	54.0	14.7	Complied

Transmitter Band Edge Radiated Emissions (continued)**Results: 802.11b / DQPSK / 5.5 Mbps**

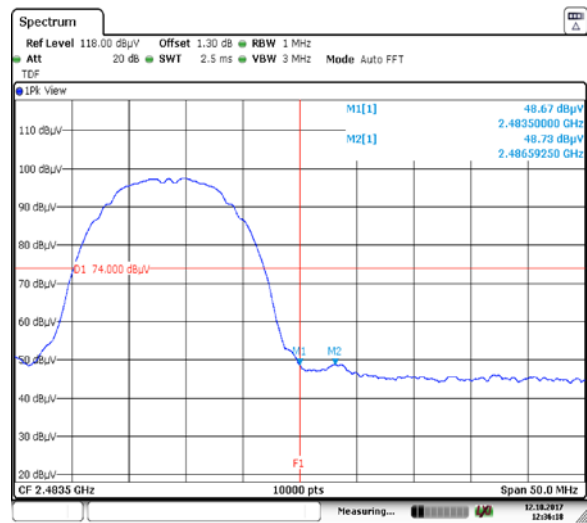
11836203

Date: 12.OCT.2017 12:05:43

Lower Band Edge Peak Measurement

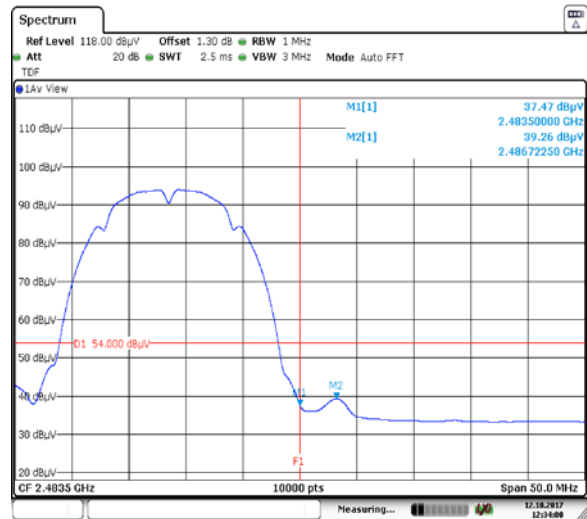
11836203

Date: 12.OCT.2017 12:24:11

2310 MHz to 2390 MHz Restricted Band Plot

11836203

Date: 12.OCT.2017 12:36:19

Upper Band Edge Peak Measurement

11836203

Date: 12.OCT.2017 12:34:01

Upper Band Edge Average Measurement

Transmitter Band Edge Radiated Emissions continued**Results: 802.11g / BPSK / 9 Mbps****Results: Lower Band Edge**

Frequency (MHz)	Level (dB μ V/m)	-30 dBc Limit (dB μ V/m)	Margin (dB)	Result
2399.679	63.1	67.6	4.5	Complied
2400	59.5	67.6	8.1	Complied

Results: Upper Band Edge / Restricted Band / Peak

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	72.2	74.0	1.8	Complied
2483.806	73.1	74.0	0.9	Complied

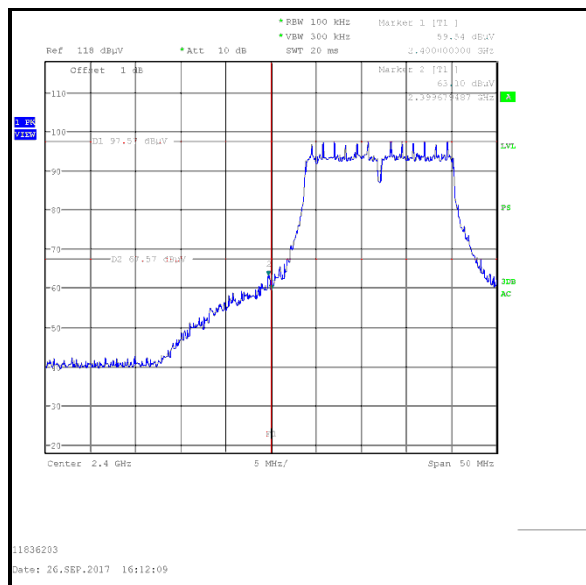
Results: Upper Band Edge / Restricted Band / Average

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	45.3	54.0	8.7	Complied

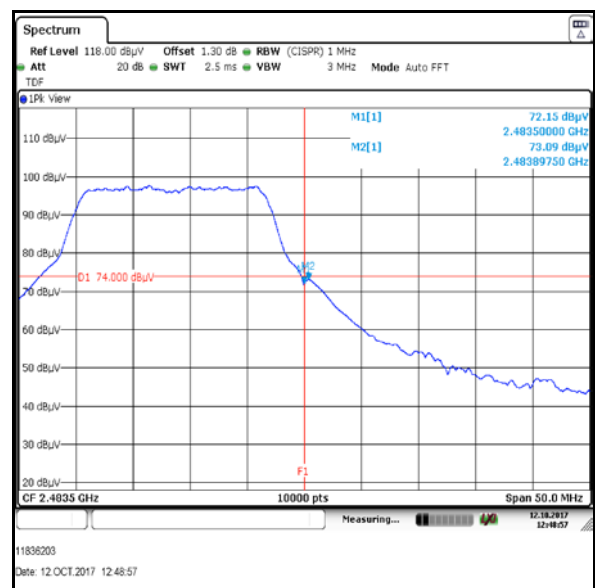
Result: Pass

Transmitter Band Edge Radiated Emissions continued

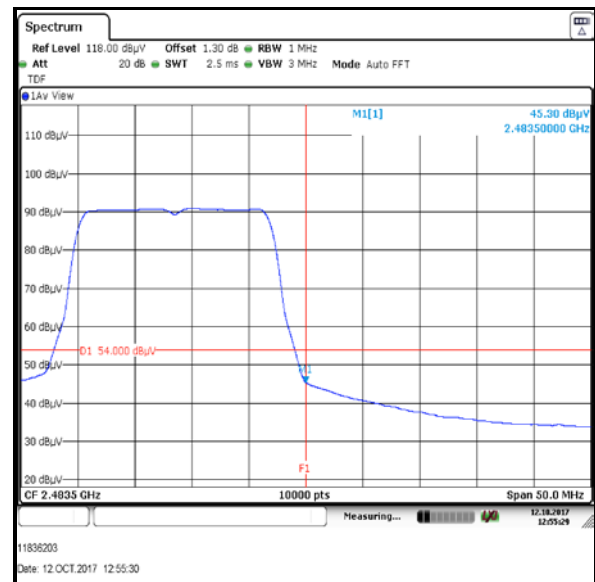
Results: 802.11g / BPSK / 9 Mbps



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Upper Band Edge Average Measurement

6. Measurement Uncertainty

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document "approximately" is interpreted as meaning "effectively" or "for most practical purposes".

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Conducted Maximum Peak Output Power	2.4 GHz to 2.4835 GHz	95%	±0.59 dB
Spectral Power Density	2.4 GHz to 2.4835 GHz	95%	±2.53 dB
Minimum 6 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±0.89 %
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±2.53 dB
Radiated Spurious Emissions	1 GHz to 25 GHz	95%	±2.53 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

7. Used equipment

Test site: SR 1/2

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
103	EMCO	Antenna, Horn	3115	9008/3485	7/20/2016	36
104	EMCO	Antenna, Horn	3115	9008/3486	7/20/2016	36
156	Rohde & Schwarz	V-Network	ESH3-Z6	843864/004	7/12/2017	12
350	Rohde & Schwarz	Receiver, EMI Test	ESIB7	836697/014	7/13/2017	12
377	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 0118-1A	025294B	7/11/2017	12
383	Rohde & Schwarz	Antenna, Rod	HFH2-Z1	890151/11	7/14/2017	24
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	055929	7/12/2017	12
424	EMCO	Antenna, Horn	EMCO 3116	00046537	7/28/2016	24
425	Agilent	Generator, CW Signal	E8247C	MY43320849	7/19/2016	24
426	Agilent	Spectrum Analyzer	E4446A	US44020316	7/20/2016	24
460	Deisl	Turntable	DT 4250 S		n/a	n/a
465	Schwarzbeck	Antenna, Trilog Broadband	VULB 9168	9168-240	8/8/2016	36
474	Agilent	Analyzer, ENA Network	E5071C	MY46100912	7/20/2016	24
495	Rohde & Schwarz	Antenna, Log. - Periodical	HL050	100296	7/20/2016	24
496	Rohde & Schwarz	Antenna, log. - periodical	HL050	100297	7/20/2016	24
497	Schwarzbeck	Antenna, Biconical	VHBB 9124	423	7/7/2016	36
499	Schwarzbeck	Antenna, log.-per	VUSLP 9111	317	8/2/2016	36
587	Maturo	antenna mast, tilting	TAM 4.0-E	011/7180311	n/a	n/a
588	Maturo	Controller	NCD	029/7180311	n/a	n/a
591	Rohde & Schwarz	Receiver	ESU 40	100244/040	7/12/2017	12
607	Schwarzbeck	Antenna broadband horn antenna	BBHA 9170	9170-561	7/28/2016	24
608	Rohde & Schwarz	Switch Matrix	OSP 120	101227	4/8/2014	60
363	Wainwright	Notch Filter GSM900	WW-NF9	100002	Lab verification	n/a
611	Wainwright Instruments	Band Reject Filter DL LTE	WRCGV8-	1	Lab verification	n/a
612	Wainwright Instruments	Band Reject Filter UL LTE	WRCGV8-	1	Lab verification	n/a
613	Wainwright Instruments	Band Reject Filter WLAN/ BT	WRCTF12-	1	Lab verification	n/a
614	Wainwright Instruments	Highpass Filter 3GHz	WHKX10-	1	Lab verification	n/a
615	Wainwright Instruments	Highpass Filter 1GHz	WHKX12-	3	Lab verification	n/a
620	Bonn Elektronik	pre-amplifier	BLNA 0110-01N	1510111	7/12/2017	24
624	Wainwright	6 GHz high-pass filter	WHKX10-5850-6500-18000-40SS	5	9/6/2016	60
628	Maturo	Antenna mast	CAM 4.0-P	224/19590716	n/a	n/a
629	Maturo	Kippeinrichtung	KE 2.5-R-M	MAT002	n/a	n/a

Test site: SR 9

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
472	Rohde & Schwarz	Generator, Vektorsignal	SMU200A	102409	7/11/2017	12
592	Rohde & Schwarz	Wideband Radio Communication tester	CMW 500	119593	8/15/2017	12
622	Rohde & Schwarz	Step Attenuator	RSC	101904	7/13/2017	12
625	Schwarzbeck	Antenna, H-field	HFSL 7101	109	Verification - only relative measurements	n/a
626	Rohde & Schwarz	Bluetooth Tester	CBT	100481	Signaling Only	24
634	Rohde & Schwarz	Wireless Devices Test System	TS8997		7/11/2017	12
635	Rohde & Schwarz	Signal generator	SMB100A	179875	7/11/2017	12
636	Rohde & Schwarz	switching unit	OSP120	101698	7/14/2017	12
637	Rohde & Schwarz	Spectrum Analyzer	FSV40	101587	7/11/2017	12
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	55929	7/21/2016	24
451	Rohde & Schwarz	Power Meter, Dual Channel	NRVD	101190	7/19/2016	12
427	Rohde & Schwarz	Probe, Power Sensor	NRV-Z5	1019	7/19/2016	12
195	SPS	Power Supply	TOE8842-24	51455	Verified by Multimeter	12
216	Agilent	Multimeter	34401A	US36017458	5/20/2015	24

Test site: SR 9 (for power re-measurements)

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
637	Rohde & Schwarz	Spectrum Analyzer	FSV40	101587	7/11/2018	12

8. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
1.1	7	3.1	FCC ID changed
1.2	5,21	2.1, 5.2.4	Test Dates Corrected
	27,34	5.2.5, 5.2.6	Test Dates Corrected
1.3	21-26	5.2.4	Output Power re-measured

--- END OF REPORT ---