Nemko Korea Co., Ltd.

155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, 449-852 KOREA, REPUBLIC OF

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FCC EVALUATION REPORT FOR CERTIFICATION

Applicant :

Healcerion Co., Ltd
72, Digital-ro 26-gil, Guro-gu, Seoul, Korea
Attn. : Mr. Jaeyeob Jung

Dates of Issue : July 22, 2015
Test Report No. : NK-14-R-181
Test Site : Nemko Korea Co., Ltd.

FCC ID	**2ADXVSWM300**
Brand Name	**Healcerion Co., Ltd**
Contact Person	**Healcerion Co., Ltd** **72, Digital-ro 26-gil, Guro-gu, Seoul, Korea** **Attn. : Mr. Jaeyeob Jung** **Telephone No. : +82-10-2023-8171**

Applied Standard:	FCC 47 CFR Part 15C
Classification:	Digital Transmission System
EUT Type:	Wifi module

The device bearing the brand name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2009. The client should not use it to claim product endorsement by TAF or any government agencies. The test results in the report only apply to the tested sample.
I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

July 22, 2015

Tested By : Seungyong Shin
Engineer

Deokha Ryu July 22. 2015

Reviewed By : Deokha Ryu
Technical Manager

TABLE OF CONTENTS

1. SCOPE

Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15

Responsible Party : **Contact Person :**	Healcerion Co., Ltd Mr. Jaeyeob Jung
Manufacturer :	Healcerion Co., Ltd 72, Digital-ro 26-gil, Guro-gu, Seoul, Korea

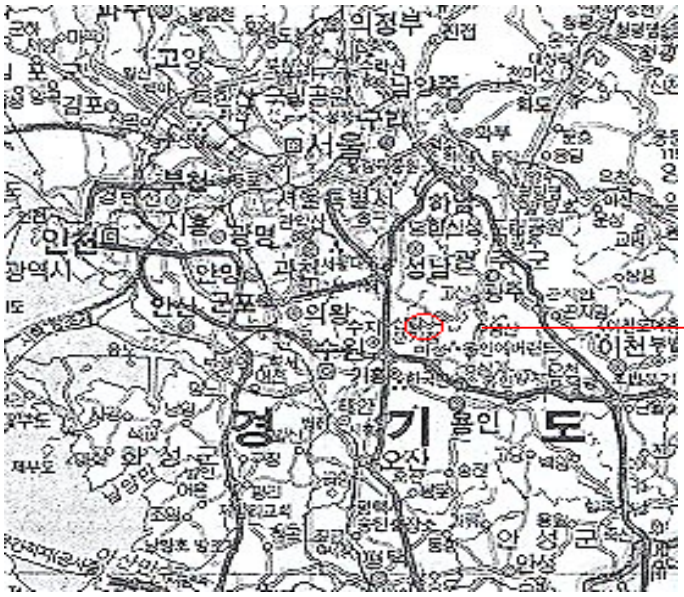
- FCC ID: 2ADXVSWM300
- Model: SWM-300
- Brand Name: Healcerion Co., Ltd
- EUT Type: Wifi module
- Classification: Digital Transmission System
- Applied Standard: FCC 47 CFR Part 15 subpart C
- Test Procedure(s): ANSI C63.4-2009, ANSI C63.10 and FCC guidance of Guidance 558074 D01 DTS Meas. Guidance v03r02
- Dates of Test: Sep 17, 2014 ~ Nov 29, 2014
- Place of Tests: Nemko Korea Co., Ltd.

2. INTRODUCTION

2.1 Test facility

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2009), the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2009) was used in determining radiated and conducted emissions emanating from **Healcerion Co., Ltd** FCC ID : 2ADXVSWM300.

These measurement tests were conducted at ***Nemko Korea Co., Ltd. EMC Laboratory*** .
The site address 155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 449-852 KOREA, REPULIC OF.
The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 km (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 km (18miles) south-southeast from central Seoul.
It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.
The detailed description of the measurement facility was found to be in compliance with the requirements of §2.948 according to ANSI C63.4-2009.



Nemko Korea Co., Ltd.
EMC Lab.
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Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. EMC Lab. and Incheon Airport.

2.2 Accreditation and listing

Accreditation type		Accreditation number
FC	CAB Accreditation for DOC	Designation No. KR0026
KOLAS	KOLAS Accredited Lab. (Korea Laboratory Accreditation Scheme)	Registration No. 155
Industry Canada	Canada IC Registered site	Site No. 2040E
VCCI	VCCI registration site(RE/CE/Telecom CE)	Member No. 2118
IECEE CB SCHEME	EMC CBTL	-
KC	KCC(RRL)Designated Lab.	Registration No. KR0026

3. TEST CONDITIONS & EUT INFORMATION

3.1 Operation During Test

The EUT is the SISO transceiver supporting the 802.11 g/n(20,40MHz) mode.
The Laptop were used to control the EUT continuously (duty cycle > 98%) to transmit the wanted TX channel by the TeraTerm program which manufacturer supported. The Laptop was removed after controlling the EUT to transmit the wanted signal. The EUT was tested at the lowest channel, middle channel and the highest channel with the maximum output power in accordance with the manufacturer's specifications. The worst data were recorded in the report.

The EUT was programmed with the following output power setting that was used during testing:

Test frequency		2412 MHz	2437 MHz	2462 MHz
802.11g	Power Level	13	13	13
802.11n(HT20)	Power Level	13	13	13
Test frequency		2422 MHz	2437 MHz	2452 MHz
802.11n(HT40)	Power Level	13	13	13

3.1.1 Table of test channels and modes

Test Items	Mode	Data rate (Mbps)	Test Channel (CH)
Radiated Emissions	802.11n	MCS0	6
6 dB Bandwidth	802.11g	6	1/6/11
	802.11n(HT20)	MCS0	1/6/11
	802.11n(HT40)	MCS0	3/6/9
Peak Output Power	802.11g	6 Mbps ~ 54 Mbps	1/6/11
	802.11n(HT20)	MCS0 ~ MCS7	1/6/11
	802.11n(HT40)	MCS0 ~ MCS7	3/6/9
Peak Power Spectral Density	802.11g	6	1/6/11
	802.11n(HT20)	MCS0	1/6/11
	802.11n(HT40)	MCS0	3/6/9
Conducted Spurious Emission	802.11g	6	1/6/11
	802.11n(HT20)	MCS0	1/6/11
	802.11n(HT40)	MCS0	3/6/9
Radiated Spurious Emission, Band edge Emission	802.11g	6	1/6/11
	802.11n(HT20)	MCS0	1/6/11
	802.11n(HT40)	MCS0	3/6/9

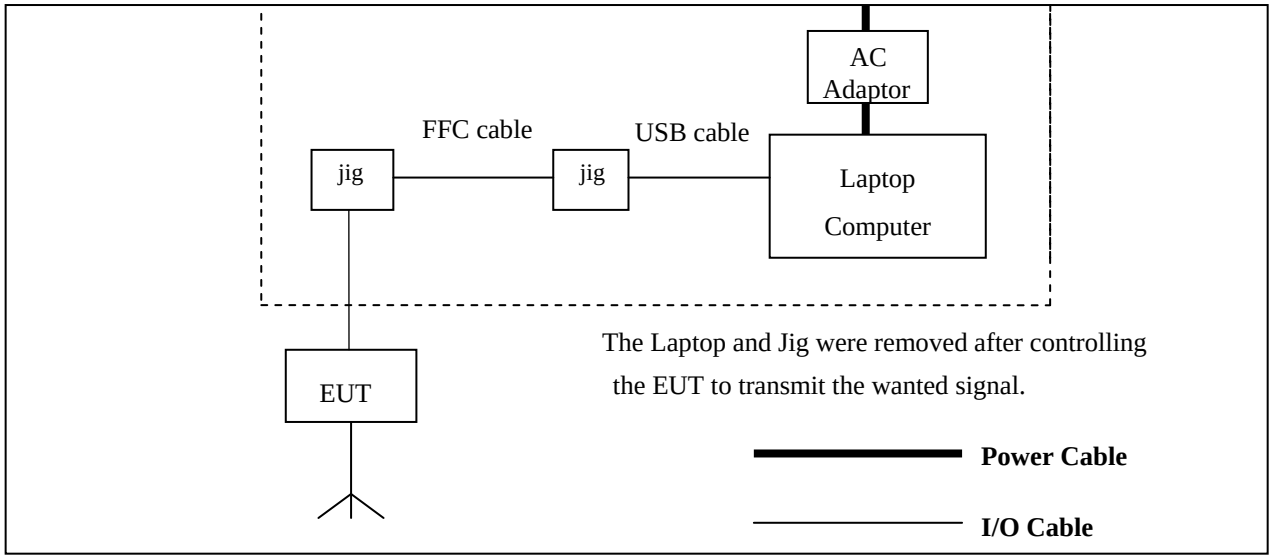
3.1.2 Antenna TX mode information:

Frequency band	Mode	Antenna TX mode	Support MIMO
2.4 GHz	802.11g,n(20,40MHz)	■ 1TX, □ 2TX	□ Yes, ■ No

3.2 Support Equipment

EUT	Healcerion Co., Ltd Model: SWM-300 0.5 m Removable USB cable	FCC ID: 2ADXVSWM300 S/N: N/A
Laptop Computer	DELL Model : PP20L	FCC ID: E2KWM3945ABG S/N : N/A
AC/DC Adapter	DELL Model : AC-PA-10 1.5 m unshielded power cable	FCC DOC S/N : N/A

3.3 Setup Drawing



3.4 EUT Information

The EUT is the **Healcerion Co., Ltd FCC ID : 2ADXVSWM300**

Specifications:

Category	Wifi module
Model Name	SWM-300
Brand Name	SAMSUNG
Frequency of Operation	802.11g/n(HT20) : 2412 MHz ~ 2462 MHz 802.11n(HT40) : 2422 MHz ~ 2452 MHz
Maximum Conducted Output Power	802.11g : 9.77 dBm 802.11n (HT20) : 9.90 dBm 802.11n (HT40) : 9.84 dBm
Channels	802.11g,n(HT20) : 11 CH, 802.11n(HT40) : 7CH
Antenna Gain (peak)	3.0 dBi
Antenna Setup	1TX / 1RX
Modulations	OFDM(BPSK,QPSK,16QAM,64QAM) for 802.11g,n
Temperature Range	-20 ℃ ~ +50 ℃
Voltage	3.3 Vdc
Dimensions (H x W x D)	20 mm x 25 mm x 1 mm
Weight	1 g
H/W Status	1.0A
S/W Status	1.0A
Remarks	-

4. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	FCC Paragraph No.	Result	Remark
Conducted Emission	15.207	N/A	Battery operation
Radiated Emission	15.209	Complies	
6 dB Bandwidth	15.247(a)(2)	Complies	
Maximum conducted output power	15.247(b)(3)	Complies	
Power Spectral Density	15.247(e)	Complies	
Conducted Spurious Emission	15.247(d)	Complies	
Radiated Spurious Emission	15.247(d)	Complies	
Maximum Permissible Exposure	1.1307(b)	Complies	

5. RECOMMENDATION/CONCLUSION

The data collected shows that the Healcerion **WiFi module FCC ID: 2ADXVSEM300** is in compliance with Part 15.247 of the FCC rule.

6. ANTENNA REQUIREMENTS

§15.203 of the FCC Rules part 15 Subpart C

: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The antenna of the **Healcerion WiFi module FCC ID: 2ADXVSEM300** is **external antenna** that is connected with a unique coupling to the module. It complies with the requirement of §15.203.

7. DESCRIPTION OF TESTS

7.1 Conducted Emissions

The Line conducted emission test facility is located inside a 4 x 7 x 2.5 meter shielded enclosure. It is manufactured by EM engineering. The shielding effectiveness of the shielded room is in accordance with MIL-STD-285 or NSA 65-6. A 1 m x 1.5 m wooden table 0.8 m height is placed 0.4 m away from the vertical wall and 1.5 m away from the side of wall of the shielded room Rohde & Schwarz (ESH3-Z5) and (ESH2-Z5) of the 50 ohm/50 μH Line Impedance Stabilization Network (LISN) are bonded to the shielded room. The EUT is powered from the Rohde & Schwarz LISN (ESH3-Z5) and the support equipment is powered from the Rohde & Schwarz LISN (ESH2-Z5). Power to the LISNs are filtered by high-current high insertion loss Power line filters. The purpose of filter is to attenuate ambient signal interference and this filter is also bonded to shielded enclosure. All electrical cables are shielded by tinned copper zipper tubing with inner diameter of 1 / 2 ".

If DC power device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the LISNs, All interconnecting cables more than 1 meter were shortened by non inductive bundling (serpentinefashion) to a 1 meter length.

Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT.

The spectrum was scanned from 150 kHz to 30 MHz with 200 msec sweep time.

The frequency producing the maximum level was re-examined using the EMI test receiver.

(Rohde & Schwarz ESCS30). The detector functions were set to CISPR quasi-peak mode & average mode. The bandwidth of receiver was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission.

Each emission was maximized by; switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; whichever determined the worst case emission.

Each EME reported was calibrated using the R&S signal generator.

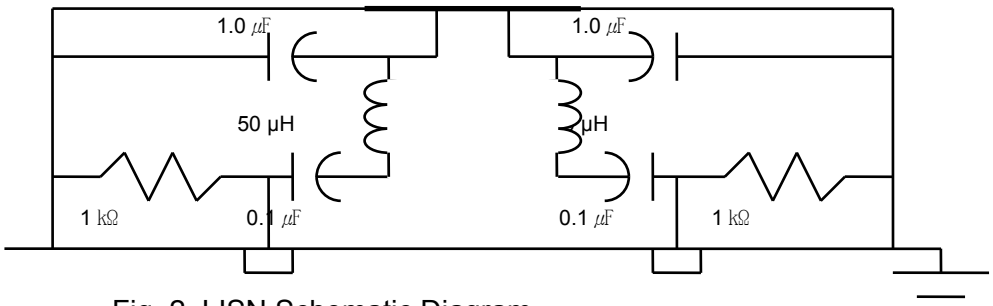


Fig. 2. LISN Schematic Diagram

7.2 Radiated Emissions

The measurement was performed at the test site that is specified in accordance with ANSI C63.4-2009 and ANCI C63.10-2009.

The spurious emission was scanned from 9 kHz to 30 MHz using Loop Antenna(Rohde&Schwarz, HFH2-Z2) and 30 to 1000 MHz using Trilog broadband test antenna(Schwarzbeck, VULB 9163). Above 1 GHz, Horn antenna (Schwarzbeck BBHA 9120D: up to 18 GHz, Q-par Angus QSH20S20 : 18 to 26.5 GHz, QSH22K20: up to 40 GHz) was used.

The test equipment was placed on turntable with 0.8 m above ground. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The EUT, cable, wire arrangement and mode of operation that has the highest amplitude relative to the limit was selected. Then, the turn table was rotated from 0˚ to 360˚ and an antenna mast was moved from 1 m to 4 m height to maximize the suspected highest amplitude signal. The final maximized level was recorded.

At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection.

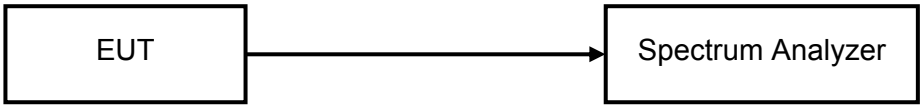
At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in KDB “558074D01 DTS Meas Guidance v03r02” in section 12.2.4 and 12.2.5.1. Peak emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Trace mode = max hold. Average emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = RMS, Trace averaging in power averaging (RMS) mode over a minimum of 100 traces, If continuous transmission of the EUT couldn’t be achieved and duty cycle was constant, a correction factor (10 log (1 / x)) was added to the measurement result.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	3

Radiated Emissions Limits per 47 CFR 15.209(a)

7.3 6 dB Bandwidth

Test Setup

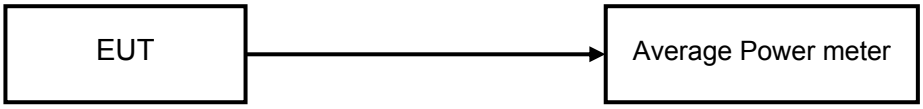


Test Procedure

EUTs 6 dB bandwidth is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.
The spectrum analyzer setting is as follows.
RBW = 100 kHz
VBW ≥ 3 x RBW
Detector = Peak
Trace mode = max hold
Sweep = auto couple
Allow the trace to stabilize.
The bandwidth measurement function on the spectrum analyzer is used to measure the 6 dB bandwidth.

7.4 Maximum Conducted (average) Output Power

Test Setup

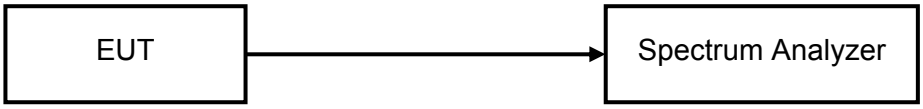


Test Procedure

EUTs Maximum Conducted (average) Output Power is measured at low, middle, high channels with an Average Power meter connected to the antenna terminal while the EUTs operating at its maximum power control level.

7.5 Power Spectral Density

Test Setup

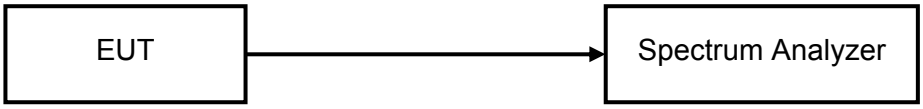


Test Procedure

EUTs Power Spectral Density is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.
The spectrum analyzer setting is as follows.
Center frequency = DTS channel center frequency
Span = At least 1.5 times the OBW
RBW to : 3 kHz ≤ RBW ≤ 100 kHz
VBW ≥ 3 x RBW
Detector = power averaging (RMS)
Ensure that the number of measurement points = sweep ≥ span/RBW
Sweep time = auto couple
Trace mode = averaging(RMS) mode
Allow the trace over a minimum of 100 traces.
The peak search function on the spectrum analyzer is used to determine the maximum amplitude level within the fundamental OBW bandwidth.

7.6 Conducted Spurious Emissions

Test Setup



Test Procedure

EUTs Conducted spurious emissions are measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.
The spectrum analyzer setting is as follows.

1) Reference Level
RBW = 100 kHz
VBW ≥ 3 x RBW
Span = At least 1.5 times the DTS channel bandwidth
Detector = peak
Sweep time = auto couple
Trace mode = max hold
Allow the trace to stabilize.
The peak search function on the spectrum analyzer is used to determine the maximum PSD level.

2) Emission level measurement
RBW = 100 kHz
VBW ≥ 3 x RBW
Set the center frequency and span to encompass frequency range to be measured
Detector = peak
Sweep time = auto couple
Trace mode = max hold
Allow the trace to stabilize.
The amplitude of all unwanted emissions outside of the authorized frequency band is confirmed that it is attenuated by at least the minimum requirements specified.

8. TEST DATA

8.1 Radiated Emissions

FCC §15.209

2.4 GHz band

Frequency (MHz)	Reading (dBμV/m)	Pol* (H/V)	Antenna Heights (cm)	Turntable Angles (°)	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
308.00	57.40	H	100	292	-20.4	37.0	46.0	9.0
528.00	49.70	H	183	245	-14.3	35.4	46.0	10.6
660.02	48.90	H	130	308	-12.1	36.8	46.0	9.2
836.02	45.80	H	100	44	-10.2	35.6	46.0	10.4
880.01	44.60	H	100	183	-9.5	35.1	46.0	10.9
924.00	47.40	H	100	234	-9.2	38.2	46.0	7.8

Radiated Measurements at 3meters

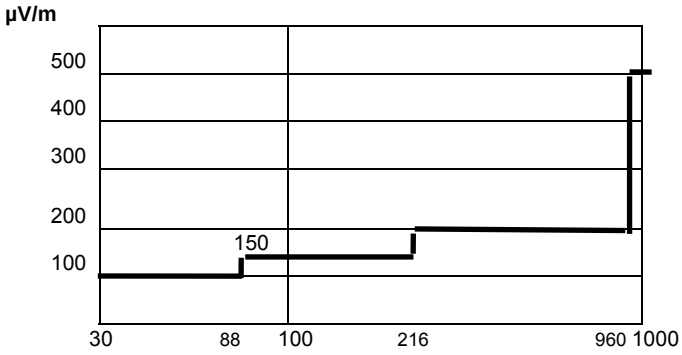


Fig. 3. Limits at 3 meters

Note(s):

1. All modes were measured and the worst-case emission was reported.

2 The radiated limits are shown on Figure 3.

Above 1 GHz the limit is 500 μV/m.

*3. *Pol. H = Horizontal, V = Vertical*

*4. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*

5. Measurements using CISPR quasi-peak mode.

6. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.

7. The limit is on the FCC Part section 15.209(a).

8.2 6 dB Modulated Bandwidth

FCC §15.247(a)(2)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11g mode

Channel	Frequency(MHz)	Result(MHz)	Limit (MHz)
Low	2412	16.65	0.5
Middle	2437	16.46	0.5
High	2462	16.63	0.5

802.11n (HT20) mode

Channel	Frequency(MHz)	Result(MHz)	Limit (MHz)
Low	2412	17.91	0.5
Middle	2437	17.91	0.5
High	2462	17.90	0.5

802.11n (HT40) mode

Channel	Frequency(MHz)	Result(MHz)	Limit (MHz)
Low	2422	36.48	0.5
Middle	2437	36.43	0.5
High	2452	36.66	0.5

PLOTS OF EMISSIONS

802.11g mode

6 dB Bandwidth, Lowest Channel (2412 MHz)

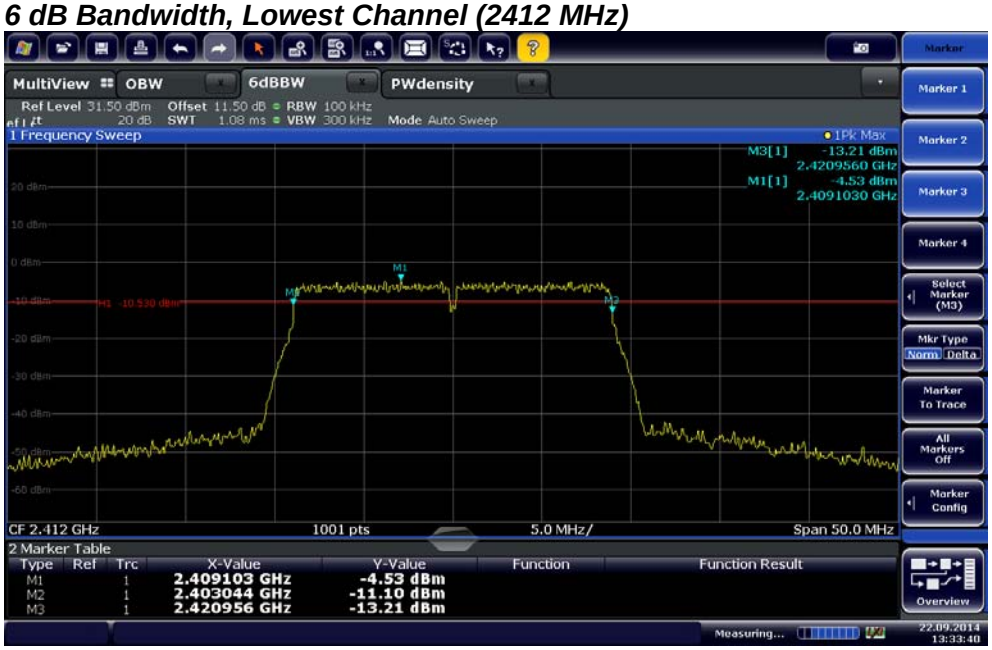
6 dB Bandwidth, Middle Channel (2437 MHz)

PLOTS OF EMISSIONS

6 dB Bandwidth, Highest Channel (2462 MHz)

802.11n (HT20) mode

6 dB Bandwidth, Lowest Channel (2412 MHz)



PLOTS OF EMISSIONS

6 dB Bandwidth, Middle Channel (2437 MHz)

6 dB Bandwidth, Highest Channel (2462 MHz)

PLOTS OF EMISSIONS

802.11n (HT40) mode

6 dB Bandwidth, Lowest Channel (2422 MHz)

6 dB Bandwidth, Middle Channel (2437 MHz)

PLOTS OF EMISSIONS

6 dB Bandwidth, Highest Channel (2452 MHz)

8.3 Maximum conducted (average) output power

FCC §15.247(b)(3)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11g

Frequency (MHz)	Data rate (Mbps)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
2412	6	9.50	30.00	20.50
	9	9.50	30.00	20.50
	12	9.51	30.00	20.49
	18	9.55	30.00	20.45
	24	9.44	30.00	20.56
	36	9.32	30.00	20.68
	48	9.39	30.00	20.61
	54	9.31	30.00	20.69
2437	6	9.69	30.00	20.31
	9	9.34	30.00	20.66
	12	9.30	30.00	20.70
	18	9.34	30.00	20.66
	24	9.27	30.00	20.73
	36	9.22	30.00	20.78
	48	9.27	30.00	20.73
	54	9.26	30.00	20.74
2462	6	9.45	30.00	20.55
	9	9.41	30.00	20.59
	12	9.45	30.00	20.55
	18	9.77	30.00	20.23
	24	9.69	30.00	20.31
	36	9.61	30.00	20.39
	48	9.66	30.00	20.34
	54	9.64	30.00	20.36

802.11n (HT20)

Frequency (MHz)	Data rate (Mbps)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
2412	MCS0	9.90	30.00	20.10
	MCS1	9.68	30.00	20.32
	MCS2	9.63	30.00	20.37
	MCS3	9.61	30.00	20.39
	MCS4	9.73	30.00	20.27
	MCS5	9.81	30.00	20.19
	MCS6	9.81	30.00	20.19
	MCS7	9.62	30.00	20.38
2437	MCS0	9.38	30.00	20.62
	MCS1	9.46	30.00	20.54
	MCS2	9.35	30.00	20.65
	MCS3	9.39	30.00	20.61
	MCS4	9.44	30.00	20.56
	MCS5	9.46	30.00	20.54
	MCS6	9.45	30.00	20.55
	MCS7	9.41	30.00	20.59
2462	MCS0	9.46	30.00	20.54
	MCS1	9.47	30.00	20.53
	MCS2	9.42	30.00	20.58
	MCS3	9.52	30.00	20.48
	MCS4	9.51	30.00	20.49
	MCS5	9.50	30.00	20.50
	MCS6	9.46	30.00	20.54
	MCS7	9.54	30.00	20.46

802.11n (HT40)

Frequency (MHz)	Data rate (Mbps)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
2422	MCS0	9.57	30.00	20.43
	MCS1	9.61	30.00	20.39
	MCS2	9.49	30.00	20.51
	MCS3	9.58	30.00	20.42
	MCS4	9.51	30.00	20.49
	MCS5	9.50	30.00	20.50
	MCS6	9.56	30.00	20.44
	MCS7	9.52	30.00	20.48
2437	MCS0	9.29	30.00	20.71
	MCS1	9.31	30.00	20.69
	MCS2	9.40	30.00	20.60
	MCS3	9.28	30.00	20.72
	MCS4	9.34	30.00	20.66
	MCS5	9.31	30.00	20.69
	MCS6	9.33	30.00	20.67
	MCS7	9.27	30.00	20.73
2452	MCS0	9.84	30.00	20.16
	MCS1	9.81	30.00	20.19
	MCS2	9.75	30.00	20.25
	MCS3	9.71	30.00	20.29
	MCS4	9.68	30.00	20.32
	MCS5	9.63	30.00	20.37
	MCS6	9.67	30.00	20.33
	MCS7	9.62	30.00	20.38

Note(s):

The following equation was used for spectrum offset:

Power Meter offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)

8.6 Power Spectral Density

FCC §15.247(e)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11g

Channel	Frequency(MHz)	Result(dBm)	Limit (dBm)
Low	2412	-10.79	8.0
Middle	2437	-11.51	8.0
High	2462	-11.48	8.0

802.11n (HT20)

Channel	Frequency(MHz)	Result(dBm)	Limit (dBm)
Low	2412	-11.44	8.0
Middle	2437	-12.32	8.0
High	2462	-11.66	8.0

802.11n (HT40)

Channel	Frequency(MHz)	Result(dBm)	Limit (dBm)
Low	2422	-14.16	8.0
Middle	2437	-14.91	8.0
High	2452	-14.85	8.0

Note(s):

The following equation was used for spectrum offset:

Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)

PLOT OF TEST DATA

802.11g mode

Maiximum Power Spectral Density, Lowest Channel (2412 MHz)

Maiximum Power Spectral Density, Middle Channel (2437 MHz)

PLOT OF TEST DATA

Maiximum Power Spectral Density, Highest Channel (2462 MHz)

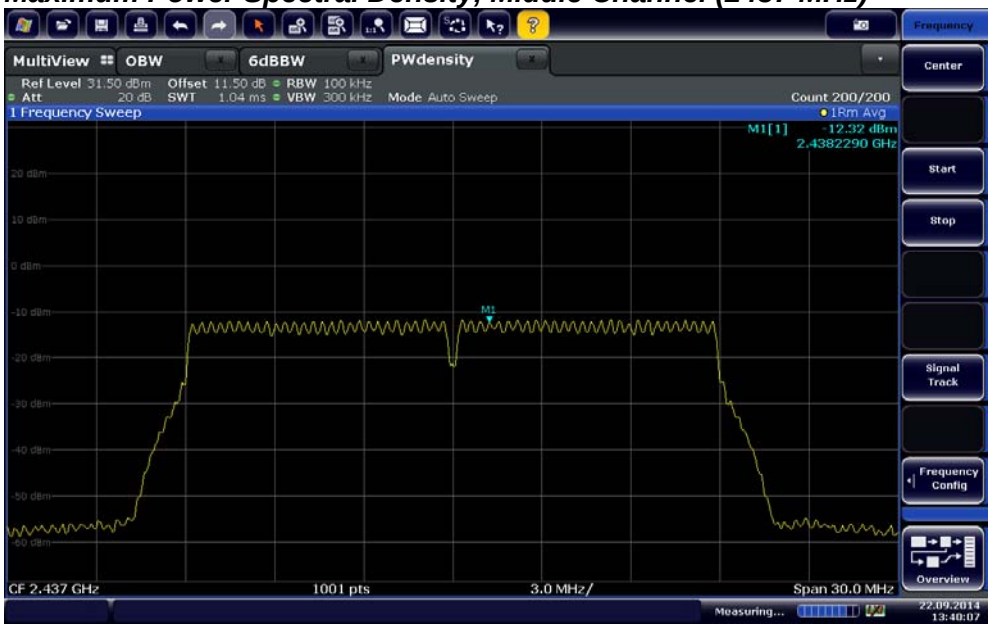
802.11n (HT20) mode

Maximum Power Spectral Density, Lowest Channel (2412 MHz)

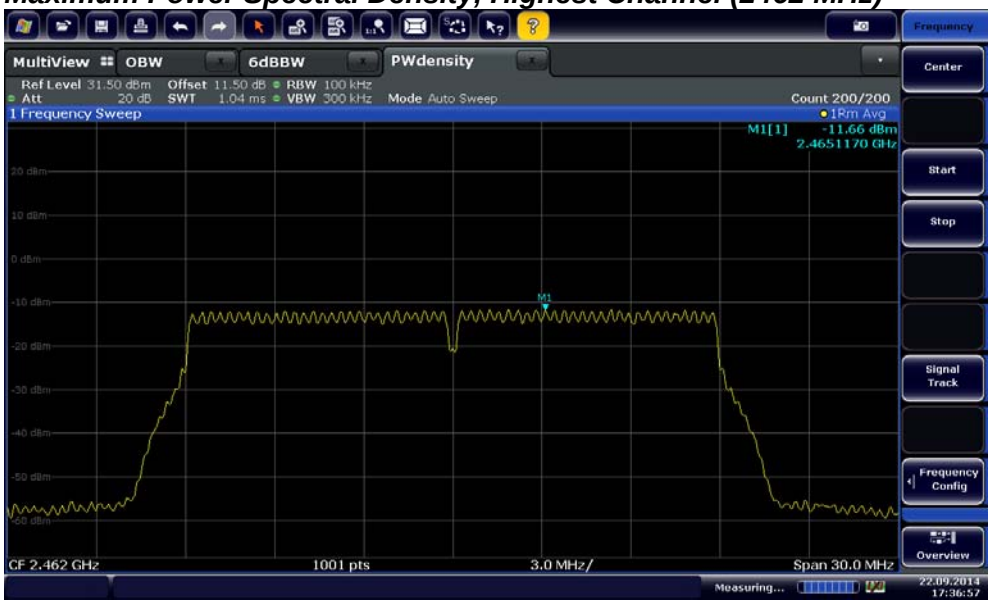
PLOT OF TEST DATA

802.11n (HT20) mode

Maximum Power Spectral Density, Middle Channel (2437 MHz)



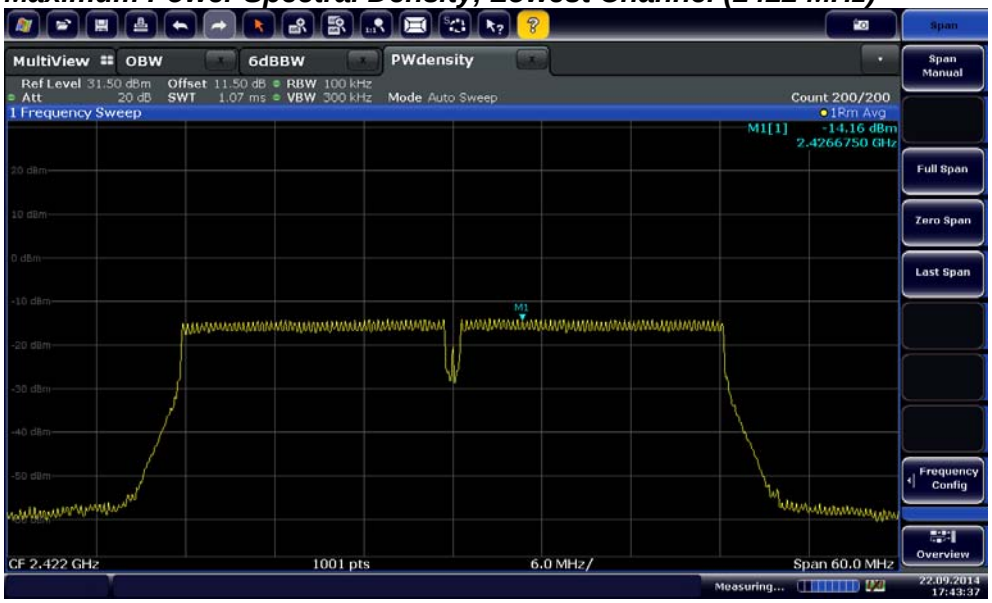
Maximum Power Spectral Density, Highest Channel (2462 MHz)



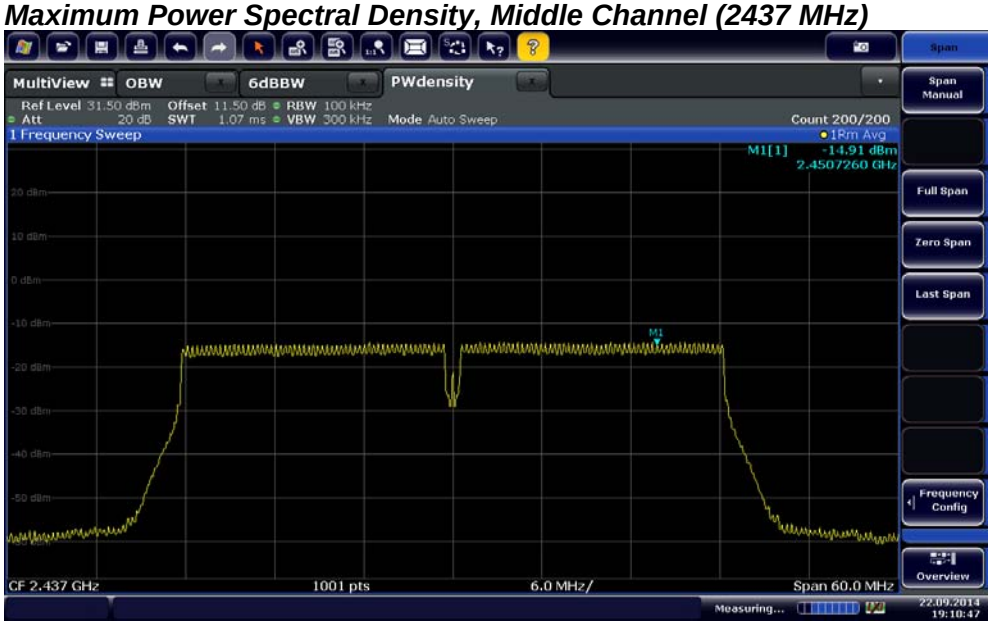
PLOT OF TEST DATA

802.11n (HT40) mode

Maximum Power Spectral Density, Lowest Channel (2422 MHz)

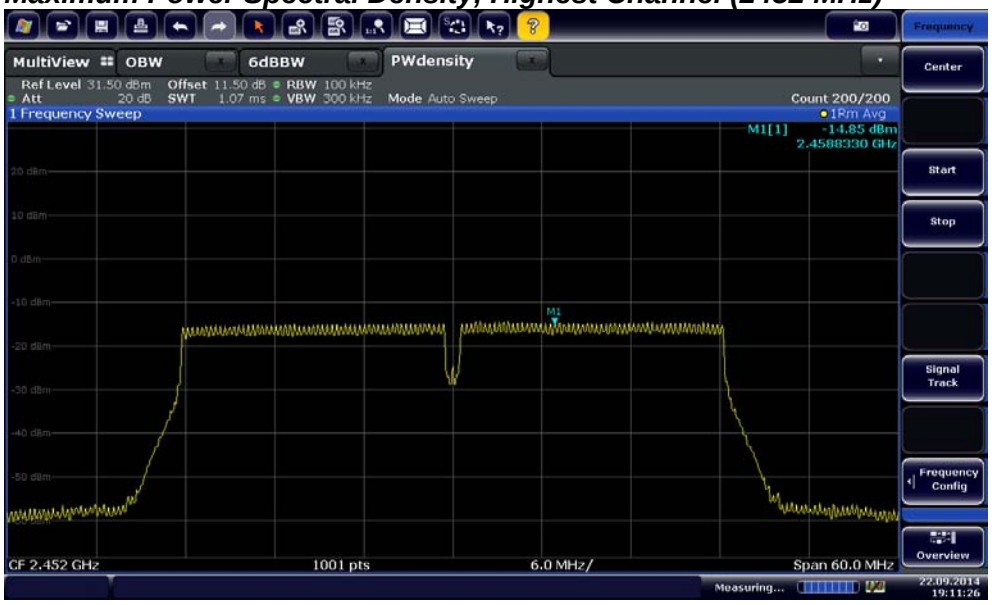


Maximum Power Spectral Density, Middle Channel (2437 MHz)



PLOT OF TEST DATA

Maximum Power Spectral Density, Highest Channel (2452 MHz)



8.7 Conducted Spurious Emissions

FCC §15.247(d)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11g mode

Channel	Frequency (MHz)	Reference Level (dBm)	Conducted Spurious Emissions (dBc)	Limit (dBc)
Low	2412	-4.60	More than 30 dBc	30
Middle	2437	-4.56	More than 30 dBc	30
High	2462	-5.15	More than 30 dBc	30

802.11n (HT20) mode

Channel	Frequency (MHz)	Reference Level (dBm)	Conducted Spurious Emissions (dBc)	Limit (dBc)
Low	2412	-2.89	More than 30 dBc	30
Middle	2437	-2.86	More than 30 dBc	30
High	2462	-3.68	More than 30 dBc	30

802.11n (HT40) mode

Channel	Frequency (MHz)	Reference Level (dBm)	Conducted Spurious Emissions (dBc)	Limit (dBc)
Low	2422	-5.70	More than 30 dBc	30
Middle	2437	-7.51	More than 30 dBc	30
High	2452	-7.92	More than 30 dBc	30

Notes:

1. *The cable and attenuator loss from 30 MHz to 25 GHz was reflected in spectrum analyzer with correction factor for the spurious emissions test.*
2. *The display line shown in the following plots indicates the limit at 30 dB below the fundamental emission level measured in a 100 kHz bandwidth.*
3. *For plots showing conducted spurious emissions near the limit, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.*
4. *For the following out of band conducted spurious emissions plots, the EUT was investigated in all available data rates for 802.11g,n(HT20,40) modes. The worst case spurious emissions were found while transmitting in 802.11n(HT40) mode at MCS0 and are shown in the plots below.*
5. *During the test, the sweep point was set 8001 for the conducted spurious emissions test and 1001 for the Band Edge test.*

PLOT OF TEST DATA

802.11n (HT40) mode

Conducted Spurious Emissions, (2422 MHz), MCS0 data rate

Conducted Spurious Emissions, (2437 MHz), MCS0 data rate

PLOT OF TEST DATA

Conducted Spurious Emissions, (2452 MHz), MCS0 data rate

802.11g mode

Band Edge, Lowest Channel (2412 MHz)

PLOT OF TEST DATA

Band Edge, Highest Channel(2462 MHz)

802.11n (HT20) mode

Band Edge, Lowest Channel (2412 MHz)

PLOT OF TEST DATA

Band Edge, Highest Channel(2462 MHz)

802.11n (HT40) mode

Band Edge, Lowest Channel (2422 MHz)

PLOT OF TEST DATA

Band Edge, Highest Channel(2452 MHz)

8.8 Radiated Spurious Emissions

FCC §15.247(d)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11 g mode

Lowest Channel

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1012.00	39.00	H	Av	-5.40	-	33.60	54.00	20.40
1099.75	38.40	H	Av	-5.00	-	33.40	54.00	20.60
1187.75	36.30	H	Av	-4.70	-	31.60	54.00	22.40
2390.00	47.60	H	Pk	-0.30	-	47.30	74.00	26.70
2390.00	35.70	H	Av	-0.30	-	35.40	54.00	18.60
4823.13	30.10	H	Av	9.70	-	39.80	54.00	14.20
5055.00	40.30	V	Pk	10.60	-	50.90	74.00	23.10

Middle Channel

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1011.75	40.10	H	Av	-5.40	-	34.70	54.00	19.30
1188.00	36.50	H	Av	-4.70	-	31.80	54.00	22.20
2220.50	44.10	V	Pk	-0.70	-	43.40	74.00	30.60
2387.75	32.50	H	Av	-0.30	-	32.20	54.00	21.80
2484.75	43.50	H	Pk	0.10	-	43.60	74.00	30.40
2491.75	33.30	H	Av	0.10	-	33.40	54.00	20.60
4946.88	40.90	V	Pk	10.20	-	51.10	74.00	22.90
4947.50	29.70	V	Av	10.20	-	39.90	54.00	14.10

TEST DATA

Highest Channel

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1012.00	57.20	H	Pk	-5.40	-	51.80	74.00	22.20
1011.75	55.60	H	Av	-5.40	-	50.20	54.00	3.80
1099.75	54.60	H	Pk	-5.00	-	49.60	74.00	24.40
1099.75	52.50	H	Av	-5.00	-	47.50	54.00	6.50
2483.50	55.00	H	Pk	0.10	-	55.10	74.00	18.90
2483.50	42.80	H	Av	0.10	-	42.90	54.00	11.10
2484.00	57.30	H	Pk	0.10	-	57.40	74.00	16.60
2483.75	42.80	H	Av	0.10	-	42.90	54.00	11.10
4920.00	41.80	H	Pk	10.10	-	51.90	74.00	22.10
4926.25	31.00	H	Av	10.10	-	41.10	54.00	12.90

Note(s):

*1. *Pol. H = Horizontal V = Vertical*

*2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*

*3. ***DCF (Duty Cycle Correction Factor) = 10 log(1/x), x = On-time/(On-time + Off-time)*

4. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.

5. Peak emissions were measured using RBW = 1 MHz, VBW = 1 MHz, Detector = Peak

6. For average measurements, "12.2.5.1 Average Power Measurement Procedures" at "558074 D01 DTS Meas Guidance v03r02" was used.

7. The spectrum was measured from 9 kHz to 10th harmonic and the worst-case emissions were reported. No significant emissions were found beyond the 2nd harmonic for this device.

TEST DATA

802.11n (HT20) mode

Lowest Channel

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1011.75	46.00	H	Pk	-5.40	-	40.60	74.00	33.40
1011.75	39.80	H	Av	-5.40	-	34.40	54.00	19.60
1100.00	37.60	H	Av	-5.00	-	32.60	54.00	21.40
1188.00	36.20	H	Av	-4.70	-	31.50	54.00	22.50
2388.75	34.50	H	Av	-0.30	-	34.20	54.00	19.80
2389.50	46.60	H	Pk	-0.30	-	46.30	74.00	27.70
2390.00	47.20	H	Pk	-0.30	-	46.90	74.00	27.10
2390.00	35.20	H	Av	-0.30	-	34.90	54.00	19.10
4941.25	41.50	V	Pk	10.20	-	51.70	74.00	22.30
5065.63	29.40	V	Av	10.60	-	40.00	54.00	14.00

Middle Channel

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1012.00	39.20	H	Av	-5.10	-	34.10	54.00	19.90
2489.50	49.10	V	Pk	-0.80	-	48.30	74.00	25.70
2490.50	23.90	H	Av	9.60	-	33.50	54.00	20.50
4950.00	30.10	H	Av	9.60	-	39.70	54.00	14.30
5045.63	41.30	H	Pk	9.60	-	50.90	74.00	23.10

TEST DATA

Highest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1011.75	41.80	H	Av	-5.40	-	36.40	54.00	17.60
1012.00	47.80	H	Pk	-5.40	-	42.40	74.00	31.60
1099.75	37.80	H	Av	-5.00	-	32.80	54.00	21.20
1188.00	36.70	H	Av	-4.70	-	32.00	54.00	22.00
1200.00	35.80	H	Av	-4.60	-	31.20	54.00	22.80
2312.00	43.70	V	Pk	-0.50	-	43.20	74.00	30.80
2483.50	39.30	H	Av	0.10	-	39.40	54.00	14.60
2484.25	53.50	H	Pk	0.10	-	53.60	74.00	20.40
4958.13	41.20	H	Pk	10.20	-	51.40	74.00	22.60
5100.63	30.40	H	Av	10.50	-	40.90	54.00	13.10

Note(s):

*1. *Pol. H = Horizontal V = Vertical*

*2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*

*3. ***DCF (Duty Cycle Correction Factor) = 10 log(1/x), x = On-time/(On-time + Off-time)*

4. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.

5. Peak emissions were measured using RBW = 1 MHz, VBW = 1 MHz, Detector = Peak

6. For average measurements, "12.2.5.1 Average Power Measurement Procedures" at "558074 D01 DTS Meas Guidance v03r02" was used.

7. The spectrum was measured from 9 kHz to 10th harmonic and the worst-case emissions were reported. No significant emissions were found beyond the 2nd harmonic for this device.

TEST DATA

802.11n (HT40) mode

Lowest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1187.75	46.30	H	Pk	-4.70	-	50.00	74.00	24.00
1188.00	37.70	H	Av	-4.70	-	48.40	54.00	5.60
2389.25	46.90	V	Pk	-0.30	-	61.20	74.00	12.80
2388.75	38.40	V	Av	-0.30	-	45.40	54.00	8.60
2390.00	45.30	V	Pk	-0.30	-	56.40	74.00	17.60
2390.00	36.20	V	Av	-0.30	-	45.40	54.00	8.60
4846.88	36.20	H	Av	9.70	-	40.40	54.00	13.60
4991.25	36.20	H	Pk	10.30	-	51.70	74.00	22.30
5100.63	36.20	H	Av	10.50	-	40.30	54.00	13.70

Middle Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1011.75	37.40	V	Av	-5.40	-	32.00	54.00	22.00
1099.75	35.40	H	Av	-5.00	-	30.40	54.00	23.60
2348.75	43.10	V	Pk	-0.30	-	42.80	74.00	31.20
2388.75	32.20	H	Av	-0.30	-	31.90	54.00	22.10
4874.98	29.90	H	Av	9.80	-	39.70	54.00	14.30
5088.13	40.60	H	Pk	10.50	-	51.10	74.00	22.90

Highest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1012.00	37.20	V	Av	-5.40	-	31.80	54.00	22.20
1099.75	37.70	V	Av	-5.00	-	32.70	54.00	21.30
2384.25	44.50	V	Pk	-0.30	-	44.20	74.00	29.80
2483.50	45.00	V	Av	0.10	-	45.10	54.00	8.90
2488.00	59.40	V	Pk	0.10	-	59.50	74.00	14.50
4949.38	40.80	H	Pk	10.20	-	51.00	74.00	23.00
5100.63	29.60	H	Av	10.50	-	40.10	54.00	13.90

TEST DATA

Note(s):

1. *Pol. H = Horizontal V = Vertical
2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
3. ***DCF (Duty Cycle Correction Factor) = 10 log(1/x), x = On-time/(On-time + Off-time)
4. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.
5. Peak emissions were measured using RBW = 1 MHz, VBW = 1 MHz, Detector = Peak
6. For average measurements, "12.2.5.1 Average Power Measurement Procedures" at "558074 D01 DTS Meas Guidance v03r02" was used.
7. The spectrum was measured from 9 kHz to 10th harmonic and the worst-case emissions were reported. No significant emissions were found beyond the 2nd harmonic for this device.

8.9 Radiated Band Edge

FCC §15.247(d)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11g mode

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.00	53.70	H	Peak	0.10	-	53.80	74.00	20.20
2390.00	43.11	H	Average	0.10	-	43.21	54.00	10.79
2483.50	58.90	H	Peak	0.60	-	59.50	74.00	14.50
2483.50	44.47	H	Average	0.60	-	45.07	54.00	8.93
2485.21	69.50	H	Peak	0.60	-	70.10	74.00	3.90
2485.21	40.75	H	Average	0.60	-	41.35	54.00	12.65

802.11n (HT20) mode

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.00	58.80	H	Peak	0.10	-	58.90	74.00	15.10
2390.00	43.24	H	Average	0.10	-	43.34	54.00	10.66
2483.50	61.00	H	Peak	0.60	-	61.60	74.00	12.40
2483.50	47.22	H	Average	0.60	-	47.82	54.00	6.18
2483.99	67.70	H	Peak	0.60	-	68.30	74.00	5.70
2483.99	44.27	H	Average	0.60	-	44.87	54.00	9.13
2485.87	67.20	H	Peak	0.60	-	67.80	74.00	6.20
2485.87	42.48	H	Average	0.60	-	43.08	54.00	10.92

TEST DATA

802.11n (HT40) mode

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.00	58.10	H	Peak	0.10	-	58.20	74.00	15.80
2390.00	47.44	H	Average	0.10	-	47.54	54.00	6.46
2483.50	63.90	H	Peak	0.60	-	64.50	74.00	9.50
2483.50	46.46	H	Average	0.60	-	47.06	54.00	6.94

Note(s):

*1. *Pol. H = Horizontal V = Vertical*

*2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*

*3. ***Duty Factor = 10 log (1/x), where x is the duty cycle measured in clause 7.7*

4. Measurement of the radiated emissions is performed in vertical and horizontal polarizations. The worst data were recorded

5. For peak measurements, the resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz.

6. For average measurements, "12.2.5.1 Average Power Measurement Procedures" at "558074 D01 DTS Meas Guidance v03r02" was used.

9. TEST EQUIPMENT

No.	Instrument	Manufacturer	Model	Serial No.	Calibration Date	Calibration Interval
1	*Test Receiver	R & S	ESU 40	100202	Apr. 01 2015	1 year
2	Test Receiver	R & S	ESCS 30	100302	Oct. 06 2014	1 year
3	*Amplifier	R & S	SCU 01	10030	Apr. 01 2015	1 year
4	*Amplifier	Sonoma Instrument	310N	291916	Jul. 17 2014	1 year
5	*Amplifier	R & S	SCU18	10065	Apr. 01 2015	1 year
6	*Amplifier	R & S	SCU26	10011	Jul. 08 2014	1 year
7	Amplifier	R & S	SCU40	10008	Jul. 08 2014	1 year
8	*Pre Amplifier	HP	8449B	3008A00107	Jan. 09 2015	1 year
9	Spectrum Analyzer	Agilent	E4440A	MY44303257	Jul. 16 2014	1 year
10	*Spectrum Analyzer	R & S	FSW43	100732	Apr. 07 2015	1 year
11	*Spectrum Analyzer	R & S	FSP40	100361	Jul. 16 2014	1 year
12	*Loop Antenna	R & S	HFH2-Z2	100279	Feb. 13 2014	2 year
13	*Wideband Power Sensor	R & S	NRP-Z81	100634	Jul. 17 2014	1 year
14	*Biconical Log Antenna	ARA	LPB-2520/A	1180	Apr. 17 2014	2 year
15	*Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-508	Sep. 01 2014	2 year
16	*Horn Antenna	Q-par Angus	QSH20S20	8179	Apr. 30 2015	2 year
17	Horn Antenna	Q-par Angus	QSH22K20	8180	Apr. 30 2015	2 year
18	*Trilog-Broadband Antenna	SCHWARZBECK	VULB 9163	9163-423	Jun. 13 2013	2 year
19	Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-257	Apr. 17 2014	2 year
20	LISN	R & S	ESH3-Z5	833874/006	Oct. 06 2014	1 year
21	LISN	R & S	ESH2-Z5	100227	Apr. 01 2015	1 year
22	*Position Controller	DAEIL EMC	N/A	N/A	N/A	N/A
23	*Turn Table	DAEIL EMC	N/A	N/A	N/A	N/A
24	*Antenna Mast	DAEIL EMC	N/A	N/A	N/A	N/A
25	*Shielded Room	EM Eng.	N/A	N/A	N/A	N/A
26	*Position Controller	INNCO	CO2000	1480406/L	N/A	N/A
27	*Turn Table	INNCO	DS1200S	N/A	N/A	N/A
28	*Antenna Mast	INNCO	MA4000	N/A	N/A	N/A
29	*Anechoic Chamber	Seo-Young EMC	N/A	N/A	N/A	N/A
30	*Shielded Room	Seo-Young EMC	N/A	N/A	N/A	N/A
31	*Open Switch And Control Unit	R & S	OSP-120	100015	N/A	N/A

Note(s)

1. ** Test equipment used during the test.*

10. ACCURACY OF MEASUREMENT

The Measurement Uncertainties stated were calculated in accordance with the requirements of measurement uncertainty contained in CISPR 16-4-2 with the confidence level of 95%

1. Conducted Uncertainty Calculation

Source of Uncertainty	Xi	Uncertainty of Xi		Coverage factor k	u(Xi) (dB)	Ci	Ci u(Xi) (dB)
		Value (dB)	Probability Distribution				
Receiver reading	RI	± 0.1	normal 1	1.000	0.1	1	0.1
Attenuation AMN-Receiver	LC	± 0.08	normal 2	2.000	0.04	1	0.04
AMN Voltage division factor	LAMN	± 0.8	normal 2	2.000	0.4	1	0.4
Sine wave voltage	dVSW	± 2.00	normal 2	2.000	1.00	1	1.00
Pulse amplitude response	dVPA	± 1.50	rectangular	1.732	0.87	1	0.87
Pulse repetition rate response	dVPR	± 1.50	rectangular	1.732	0.87	1	0.87
Noise floor proximity	dVNF	± 0.00	-	-	0.00	1	0.00
AMN Impedance	dZ	± 1.80	triangular	2.449	0.73	1	0.73
ⓐ Mismatch	M	+ 0.70	U-Shaped	1.414	0.49	1	0.49
ⓑ Mismatch	M	- 0.80	U-Shaped	1.414	- 0.56	1	- 0.56
Measurement System Repeatability	RS	0.05	normal 1	1.000	0.05	1	0.05
Remark	ⓐ: AMN-Receiver Mismatch : + ⓑ: AMN-Receiver Mismatch : -						
Combined Standard Uncertainty	Normal			± 1.88			
Expended Uncertainty U	Normal (k = 2)			± 3.76			

10. ACCURACY OF MEASUREMENT

2. Radiation Uncertainty Calculation

Source of Uncertainty	Xi	Uncertainty of Xi		Coverage factor k	u(Xi) (dB)	Ci	Ci u(Xi) (dB)
		Value (dB)	Probability Distribution				
Measurement System Repeatability	**RS**	0.34	normal 1	1.00	0.34	1	0.34
Receiver reading	**Ri**	± 0.02	normal 2	2.00	0.01	1	0.01
Sine wave voltage	**dVsw**	± 0.17	normal 2	2.00	0.09	1	0.09
Pulse amplitude response	**dVpa**	± 0.92	normal 2	2.00	0.46	1	0.46
Pulse repetition rate response	**dVpr**	± 0.35	normal 2	2.00	0.18	1	0.18
Noise floor proximity	**dVnf**	± 0.50	normal 2	2.00	0.25	1	0.25
Antenna Factor Calibration	**AF**	± 2.00	rectangular	$\sqrt{3}$	1.15	1	1.15
Cable Loss	**CL**	± 1.00	normal 2	2.00	0.50	1	0.50
Antenna Directivity	**AD**	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.00
Antenna Factor Height Dependence	**AH**	± 2.00	rectangular	$\sqrt{3}$	1.15	1	1.15
Antenna Phase Centre Variation	**AP**	± 0.20	rectangular	$\sqrt{3}$	0.12	1	0.12
Antenna Factor Frequency Interpolation	**Ai**	± 0.25	rectangular	$\sqrt{3}$	0.14	1	0.14
Site Imperfections	**Si**	± 4.00	triangular	$\sqrt{6}$	1.63	1	1.63
Measurement Distance Variation	**DV**	± 0.60	rectangular	$\sqrt{3}$	0.35	1	0.35
Antenna Balance	**Dbal**	± 0.90	rectangular	$\sqrt{3}$	0.52	1	0.52
Cross Polarisation	**DCross**	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.18
Mismatch	**M**	+ 0.98 - 1.11	U-Shaped	$\sqrt{2}$	0.74	1	0.74
EUT Volume Diameter	**Vd**	0.33	normal 1	1.00	0.33	1	0.11
Remark							
Combined Standard Uncertainty	Normal						
Expended Uncertainty U	Normal (k = 2)						