

Test report No.: KES-RF-15T0093 Page (1) of (68)

TEST REPORT

Part 15 Subpart C 15.247

Equipment under testWiFi ModuleModel nameSWL-Q93TDerivative ModelSWL-CQ93FCC IDNLMSWLQ93TApplicantHanwha Techwin Co., Ltd.ManufacturerHanwha Techwin Co., Ltd.Date of test(s)2015.11.16 ~ 2015.12.15Date of issue2015.12.17

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Test and report completed by :	Report approval by :	
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Test report No .: KES-RF-15T0093 Page (2) of (68)

Revision history

Revision	Date of issue Test report No.		Description
-	2015.12.17	KES-RF-15T0093	Initial



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Test report No .: KES-RF-15T0093 Page (3) of (68)

TABLE OF CONTENTS

1.	General ir	nformation	4
	1.1.	EUT description	4
	1.2.	Frequency/channel operations	4
	1.3	Information about derivative model	
	1.4	Directional antenna gain for MIMO	5
2.	Summary	of tests	5
3.		S	
	3.1.	Radiated restricted band and emissions	8
	3.2.	Conducted spurious emissions & band edge	18
	3.3.	6 dB bandwidth	37
	3.4.	Peak output power	49
	3.5.	Power spectral density	
	3.6.	AC conducted emission	
Apr	endix A.	Measurement equipment	66
		Test setup photo	



1.	General	information	

Applicant:	Hanwha Techwin Co., Ltd.						
Applicant address:	1204, Changwon-daero, Seongsan-gu, Changwon-si						
	Gyeongsangnam-do, South Korea						
Test site:	KES Co., Ltd.						
Test site address:	C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea						
	473-29, Gayeo-ro, Yeoju-si, Gyeonggi-do, 12658, Korea						
FCC rule part(s):	15.247						
Test device serial No .:	Production Pre-production Engineering						
Application purpose:	Original grant Class I permissive change Class II permissive change						

1.1. EUT description

Equipment under test	WiFi Module
	$2 412 \text{ MHz} \sim 2 462 \text{ MHz}(802.11b/g/n_HT20)$
	5 745 MHz ~ 5 825 MHz(802.11a/n_HT20), 5 755 MHz ~ 5 795 MHz(802.11n_HT40)
Frequency range	5 180 MHz ~ 5 240 MHz(802.11a/n_HT20), 5 190 MHz ~ 5 230 MHz(802.11n_HT40)
	5 260 MHz ~ 5 320 MHz(802.11a/n_HT20), 5 270 MHz ~ 5 310 MHz(802.11n_HT40)
	5 500 MHz ~ 5 700 MHz(802.11a/n_HT20), 5 510 MHz ~ 5 670 MHz(802.11n_HT40)
Model:	SWL-Q93T(Basic), SWL-CQ93(Derivative model)
Modulation technique	DSSS, OFDM
	2 412 MHz ~ 2 462 MHz(802.11 b/g/n_HT20) : 11ch
	5 745 MHz ~ 5 825 MHz(802.11a/n_HT20) : 5ch
	5 755 MHz ~ 5 795 MHz(802.11n_HT40) : 2ch
	5 180 MHz ~ 5 240 MHz(802.11a/n_HT20) : 4ch
Number of channels	5 190 MHz ~ 5 230 MHz(802.11n_HT40) : 2ch
runnoer of channels	$5\ 260\ \text{MHz} \sim 5\ 320\ \text{MHz}(802.11a/n_HT20): 4ch$
	$5\ 270\ \text{MHz} \sim 5\ 310\ \text{MHz}(802.11n_HT40)$: 2ch
	5 500 MHz ~ 5 700 MHz(802.11a/n_HT20) : 11ch
	5 510 MHz ~ 5 670 MHz(802.11n_HT40) : 5ch
Antenna specification	Antenna type: FIPA Antenna
Power source	DC 5 V

1.2. Frequency/channel operations

Ch.	Frequency (Mb)	Mode
1	2 412	11b/g/n_HT20
· · ·	-	-
6	2 437	11b/g/n_HT20
	-	-
11	2 462	11b/g/n_HT20

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1.3 Information about derivative model

This is to notify that SWL-CQ93 are same Hardware, Software and components.

1.4 Directional antenna gain for MIMO

Model : SWL-CQ93 (Airlink)

ANT1 Gain (dBi)	ANT2 Gain (dBi)	Total Gain (dBi)	Note		
-2.69	-2.22	1.78	For 2.4 GHz		
Ant Cain $-10.1_{0.0}[10G1/20]$	$\pm 10G^{2/20} \pm \pm 10G^{N/20} \frac{1}{N}$				

-Ant Gain = $10 \log[10^{G1/20} + 10^{G2/20} + ... + 10^{GN/20}]^2 / N_{ANT}$

2. Summary of tes

Reference	Test description	Test results
15.205, 15.209	Radiated restricted band and emission	Pass
15.207(d)	Conducted band edge and out of band emissions	Pass
15.247(a)(2)	6 dB bandwidth	Pass
15.247(b)(3)	Peak output power	Pass
15.247(e)	Power spectral density	Pass
15.207	AC conducted emissions	Pass

Test procedures;

The EUT was tested per the guidance of ANSI C63.10-2009 was used to reference the appropriate EUT setup for radiated spurious emissions testing, the guidance provided in KDB 558074_v03r03 and KDB 662911 D01 v02r01 were used in the measurement of the EUT.



Pre-scanned maximum output power

Preliminary tests were performed in different data rate as below table and the highest power data rates(802.11b, 802.11g, 802.11n_HT20) were chosen for full test in the following section to demonstrate compliance to the FCC limit line.

Antenna 0

802.11b

channel	Detector	Conducted power(dB m)						
	Detector mode	Data rate(Mbps)						
		1	2	5.5	11			
Low		<u>13.45</u>	13.31	13.03	12.69			
Middle	Peak	<u>12.82</u>	12.81	12.76	12.44			
High		<mark>12.86</mark>	12.85	12.79	12.12			

802.11g

channel	Detector mode	Conducted power(dB m)								
			Data rate(Mbps)							
		6	9	12	18	24	36	48	54	
Low		<u>11.64</u>	11.33	10.71	10.56	10.53	10.47	10.30	10.03	
Middle	Peak	<mark>12.59</mark>	12.22	12.11	12.10	12.09	12.05	12.00	11.99	
High		<mark>12.51</mark>	12.41	12.19	12.14	12.13	12.12	12.10	11.93	

802.11n(HT20)

Test mode	Detector	Conducted power(dB m)								
	Detector mode		Data rate(Mbps)							
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
Low		<u>13.09</u>	13.00	12.71	12.55	12.33	12.17	12.01	11.96	
Middle	Peak	<u>12.68</u>	12.58	12.25	12.19	12.17	11.92	11.81	11.75	
High		12.40	12.37	12.23	12.13	12.04	11.98	11.97	11.80	



Antenna 1

802.11b

	Detector	Conducted power(dB m)					
channel	Detector	Data rate(Mbps)					
	mode	1	2	5.5	11		
Low		<u>13.45</u>	13.31	13.03	12.69		
Middle	Peak	<u>12.82</u>	12.81	12.76	12.44		
High	-	<u>12.86</u>	12.85	12.79	12.12		

802.11g

	Detector			C	onducted j	power(dB i	m)			
channel	Detector		Data rate(Mbps)							
	mode	6	9	12	18	24	36	48	54	
Low		<u>13.14</u>	12.73	12.67	12.50	12.50	12.50	12.26	12.14	
Middle	Peak	<u>12.24</u>	12.04	11.97	11.89	11.86	11.71	11.56	11.25	
High		<mark>11.91</mark>	11.65	11.43	11.38	11.28	11.23	11.16	11.15	

802.11n(HT20)

	Detector			C	onducted j	power(dB	m)		
Test mode	Detector	Data rate(Mbps)							
	mode	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
Low		<u>12.66</u>	12.63	12.55	12.49	12.48	12.34	12.21	11.90
Middle	Peak	<u>12.34</u>	12.16	12.05	11.95	11.85	11.76	11.62	11.45
High		<u>12.18</u>	11.74	11.53	11.52	11.51	11.49	11.33	11.23

Antenna 0 + Antenna 1

802.11n(HT20)

Test mode	Detector			С	onducted j	power(dB i	m)		
	Detector	Data rate(Mbps)							
	mode	MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15
Low		<mark>15.89</mark>	15.83	15.64	15.53	15.42	15.27	15.12	14.97
Middle	Peak	<u>15.52</u>	15.39	15.16	15.08	15.02	14.85	14.73	14.61
High		<u>15.30</u>	15.08	14.90	14.85	14.79	14.75	14.67	14.53

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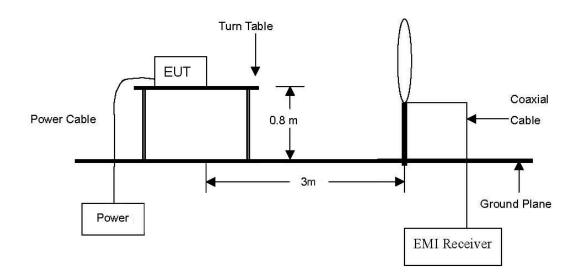


3. Test results

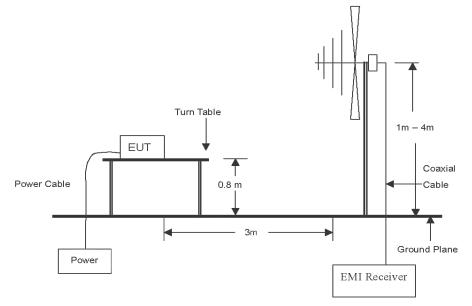
3.1. Radiated restricted band and emissions

Test setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 Mz to 1 Gz emissions.



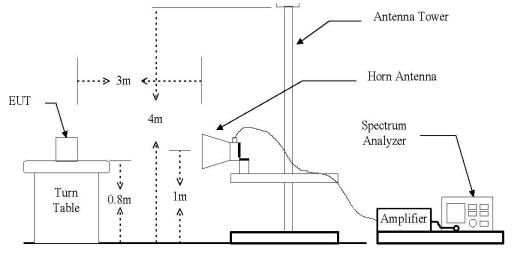
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Test report No.: KES-RF-15T0093 Page (9) of (68)

The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 24 GHz emissions.





Test procedure

Radiated emissions from the EUT were measured according to the dictates in section 11.0 & 12.0 of KDB 558074_v03r03 and ANSI C63.4-2009

- 1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site or open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2. During performing radiated emission below 10thz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference receiving antenna.
- 3. The antenna is a broadband antenna, and its height is varied from 1 meter to 4 meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 5. The test receiver system was set to peak detect function and specified bandwidth with maximum hold mode.
- 6. If the emission level of the EUT in peak mode was 10 dBlower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have10 dB margin would be retested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Note.

All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

1. Average Field Strength Measurements per Section 12.2.5.1

Analyzer center frequency was set to the frequency of the radiated spurious emission of interest. Set RBW = 1 Mtz. Set VBW = 3 Mtz (\geq 3 x RBW). Set detector = power average(RMS). Set sweep time = auto. Trace (RMS) averaging was performed over at least 100 traces.

2. Peak Field Strength Measurements per Section 12.2.4

Analyzer center frequency was set to the frequency of the radiated spurious emission of interest. Set RBW = 1 MHz. Set VBW = 3 MHz ($\geq 3 \times RBW$). Set detector = Peak. Set sweep time = auto. Trace mode = max hold. Allow sweeps to continue until the trace stabilizes.



Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (Mb)	Distance (Meters)	Radiated (µV/m)
$0.009 \sim 0.490$	300	2 400 / F(kHz)
0.490 ~ 1.705	30	24 000 / F(kHz)
1.705 ~ 30.0	30	30
30~88	3	100**
88~216	3	150**
216~960	3	200**
Above 960	3	500

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands $54 \sim 72$ Mb, $76 \sim 88$ Mb, $174 \sim 216$ Mb or $470 \sim 806$ Mb. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.



Test results (Below 30 Mz)

Mode:	802.11 n_HT20(MIMO)
Transfer rate:	6 Mbps
Distance of measurement:	3 meter
Operating frequency:	2 412 M₂ (Worst case)
Channel:	01

Frequency (Mb)	Level (dBµV)	Ant. Pol.	Correction factors (dB/m)	F _d (dB)	Field strength (dBµV/m)	Limit (dBµN/m)	Margin (dB)
No signal detected							

Test results (Below 1 000 Mz)

Mode:	802.11 n_HT20(MIMO)
Transfer rate:	6 Mbps
Distance of measurement:	3 meter
Operating frequency:	2 412 Mz (Worst case)
Channel:	01

Radiated	emissions	Ant.	Correctio	Correction factors		Liı	mit
Frequency (Mbz)	Reading (dBµN)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dBµV/m)	Limit (dBµV/m)	Margin (dB)
100.810	27.68	Н	8.93	0.79	37.40	43.52	6.12
144.460	20.95	V	12.88	0.92	34.75	43.52	8.77
173.560	24.30	V	11.75	1.09	37.14	43.52	6.38
214.300	24.36	Н	10.67	1.32	36.35	43.52	7.17
240.490	24.53	Н	11.63	1.37	37.53	46.02	8.49
264.740	20.12	Н	12.52	1.46	34.10	46.02	11.92
346.220	21.04	Н	14.86	1.65	37.55	46.02	8.47
451.950	17.45	Н	17.23	2.01	36.69	46.02	9.33

Note.

- 1. All spurious emission at channels are almost the same below 1 GHz, so that <u>low channel</u> was chosen at representative in final test.
- 2. Actual = Reading + Ant. factor + Cable loss
- 3. Detector mode: Quasi peak
- 4. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.



Test results (Above 1 000 Mz)

-Antenna port 0

Mode:	802.11b
Transfer rate:	1 Mbps
Operating frequency:	2 412 MHz

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2397.21	61.84	Peak	Н	-0.91	60.93	74.00	13.07
2398.69	45.35	Avg	Н	-0.90	44.45	54.00	9.55
2397.21	52.55	Peak	V	-0.91	51.64	74.00	22.36
2398.69	40.67	Avg	V	-0.90	39.77	54.00	14.23

Mode:	802.11b
Transfer rate:	1 Mbps
Operating frequency:	2 437 MHz

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dB ₄ N/m)	Limit (dBµV/m)	Margin (dB)
Emission levels are not reported much lower than the limits by over 20 dB							

Mode:	802.11b
Transfer rate:	1 Mbps
Operating frequency:	2 462 MHz

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2484.37	49.00	Peak	Н	-0.44	48.56	74.00	25.44
2483.86	48.24	Peak	V	-0.45	47.79	74.00	26.21



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Mode:	802.11g	
Transfer rate:	6 Mbps	
Operating frequency:	2 412 MHz	

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2399.68	72.80	Peak	Н	-0.90	71.90	74.00	2.10
2399.90	42.31	Avg	Н	-0.90	41.41	54.00	12.59
2399.36	67.41	Peak	V	-0.90	66.51	74.00	7.49
2399.90	36.12	Avg	V	-0.90	35.22	54.00	18.78

Mode:	802.11g
Transfer rate:	6 Mbps
Operating frequency:	2 437 MHz

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4884.00	36.00	Peak	Н	8.64	44.64	74.00	29.36

802.11g

Transfer rate: Operating frequency: 6 Mbps 2 462 MHz

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dB#V/m)	Limit (dBµV/m)	Margin (dB)
2485.74	58.12	Peak	Н	-0.44	57.68	74.00	16.32
2483.55	31.62	Avg	Н	-0.45	31.17	54.00	22.83
2484.37	57.40	Peak	V	-0.44	56.96	74.00	17.04
2483.55	29.63	Avg	V	-0.45	29.18	54.00	24.82



-Antenna port 1

802.11b
1 Mbps
2 412 MHz

Frequency (Mb)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2397.61	62.57	Peak	Н	-0.91	61.66	74.00	12.34
2398.14	51.63	Avg	Н	-0.91	50.72	54.00	3.28
2397.93	58.34	Peak	V	-0.91	57.43	74.00	16.57
2398.14	46.33	Avg	V	-0.91	45.42	54.00	8.58
4829.00	38.84	Peak	Н	8.25	47.09	74.00	26.91

Mode:	802.11b
Transfer rate:	1 Mbps
Operating frequency:	2 437 MHz

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4884.00	37.76	Peak	Н	8.64	46.40	74.00	27.60

Mode:	802.11b
Transfer rate:	1 Mbps
Operating frequency:	2 462 MHz

Frequency (Mb)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2484.59	58.56	Peak	Н	-0.44	58.12	74.00	15.88
2483.55	35.71	Avg	Н	-0.45	35.26	54.00	18.74
2484.73	57.89	Peak	V	-0.44	57.45	74.00	16.55
2483.55	36.15	Avg	V	-0.45	35.70	54.00	18.30
4924.00	39.13	Peak	Н	8.93	48.06	74.00	25.94



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Mode:	802.11g
Transfer rate:	6 Mbps
Operating frequency:	2 412 MHz

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2399.84	71.78	Peak	Н	-0.90	70.88	74.00	3.12
2399.68	42.21	Avg	Н	-0.90	41.31	54.00	12.69
2399.84	69.99	Peak	V	-0.90	69.09	74.00	4.91
2399.79	46.12	Avg	V	-0.90	45.22	54.00	8.78

Mode:	802.11g
Transfer rate:	6 Mbps
Operating frequency:	2 437 MHz

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Emission levels are not reported much lower than the limits by over 20 dB							

Mode:	802.11g
Transfer rate:	6 Mbps
Operating frequency:	2 462 MHz

6 Mbp	DS
2 462	MHz

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2484.15	57.33	Peak	Н	-0.45	56.88	74.00	17.12
2483.55	35.65	Avg	Н	-0.45	35.20	54.00	18.80
2487.41	58.38	Peak	V	-0.43	57.95	74.00	16.05
2483.56	35.42	Avg	V	-0.45	34.97	54.00	19.03



Antenna 0 + Antenna 1

Mode:	802.11n (HT20)
Transfer rate:	MCS8
Operating frequency:	2 412 MHz

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2399.04	72.10	Peak	Н	-0.90	71.20	74.00	2.80
2399.68	47.42	Avg	Н	-0.90	46.52	54.00	7.48
2399.68	69.59	Peak	V	-0.90	68.69	74.00	5.31
2399.68	44.20	Avg	V	-0.90	43.30	54.00	10.70

Mode:

802.11n (HT20)

Transfer rate:

MCS8 2 437 Mbz

Frequency (Mb)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	En	nission levels are	not reported muc	h lower than the l	imits by over 20	dB	

Mode:

802.11n (HT20)

MCS8

2 462 MHz

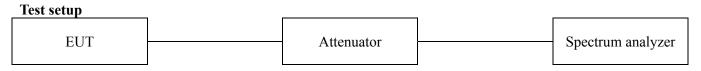
Transfer rate:

Operating frequency:

Frequency (Mz)	Level (dBµV)	Detect	Ant. Pol.	Correction factors (dB/m)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2484.15	58.37	Peak	Н	-0.45	57.92	74.00	16.08
2483.61	36.75	Avg	Н	-0.45	36.30	54.00	17.70
2484.59	57.44	Peak	V	-0.44	57.00	74.00	17.00
2483.55	35.56	Avg	V	-0.45	35.11	54.00	18.89



3.2. Conducted spurious emissions & band edge



Test procedure

All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

Per the guidance of KDB 558074_v03r03, section 11.2&11.3,
1. Use the following spectrum analyzer setting Center frequency: Low and high channel.
Set the span to encompass frequency range to be measured.
Set the RBW = 100 kHz.
Set the VBW = 300 kHz (≥3x RBW).
Detector = peak.
Sweep time = auto couple.
Trace mode= max hold.
Allow trace to fully stabilize.
Use the peak market function to determine the maximum PSD level.

2. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

Limit

According to 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section 15.205(a), must also comply the radiated emission limits specified in section 15.209(a) (see section 15.205(c))



Test results for conducted spurious emission

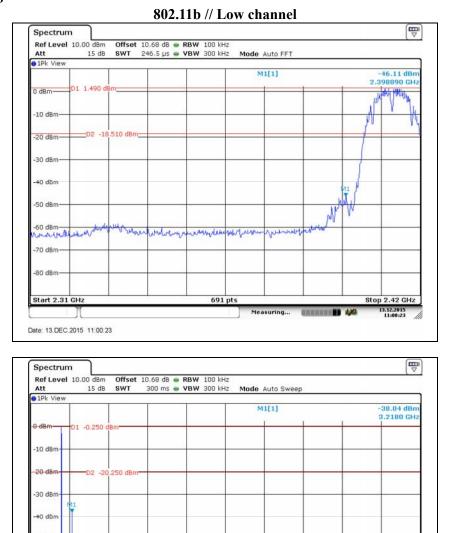
-50 dB

-70 dBm

Start 30.0 MHz

Date: 13.DEC.2015 11:01:30

-Antenna port 0



with

moran

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Apple

Seal.

unan

Stop 30.0 GHz

13.12.2015 11:01:30

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691 pt

uplander M

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802.11b // Middle channel

N/A

1Pk View		_	-						
					M	1[1]			40.89 dBm 3.2610 GHz
0 dBm	D1 -0.410	dBm				-			
-10 dBm-									
-20 d8m	D2 -2	0.410 dBm				-			
-30 dBm-	-								
-40 dBm	M1								
-50 dBm			-						
-60 dBm	housedate	m	- Louis hi Piri	hanne with	unthink	mentioner	wheelain	merchan	montenet
-70 dBm—		W/NW/M							
-80 dBm—									
Start 30.	0 MHz	0	32	691	pts			Stop	30.0 GHz



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802.11b // High channel

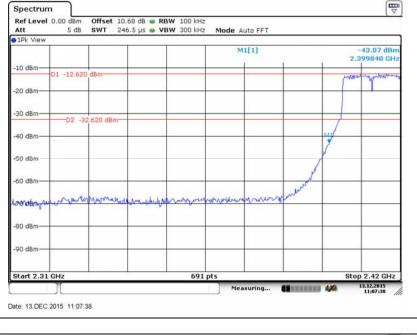


	00 ms 👜 VBW 300 kHz	Mode Auto Sweep		
1Pk View		2010/02/01		
		M1[1]		-43.29 dBm 3.2610 GHz
0 dBm D1 0.760 dBm				0.2010 012
-10 dBm-				- 1
-20 dBm				-
-30 dBm-				
-40 dBm				
-50 dBm-				
-60 dBm	whenter	with when were	where there we do no with a	at may the Marches
-70 dBm	March of Parline Contract of			
-80 dBm				
Start 30.0 MHz	691 p	its	St	top 30.0 GHz



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802.11g // Low channel



1Pk View					
0.57.22			M1[1]		-38.24 dBm 3.2180 GHz
-10 dBm-01 -13.490 dBm-					-
-20 dBm-					
-30 dBm-	10 m				
-40 dBm					
50 dBm					
-60 dBm					
-70 dBm Autoutur Mart	we power has	introver on the market	montentrochurant	Mundopped	- Muberle
-80 dBm					
-90 dBm					
Start 30.0 MHz	1.1	691 pts		Sto	p 30.0 GHz



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802.11g // Middle channel

N/A

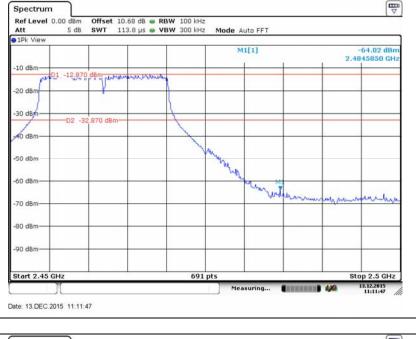
Att 5	dB SWT 300	ms 💿 VBW	300 KHZ Mode	Auto Sweep		
TPK VIEW				M1[1]		-41.32 dBm 3.2610 GHz
-10 dBm	3.130 dBm					+
-20 dBm						-
-30 dBm	2 -33.130 dBm					
-40 dBm						
-50 dBm						
-60 dBm						+
-70 dBm - Warter	hursday	manum	manuarter	monument	hortenantiatude	Mumum
-80 dBm				+ +		
90 dBm						
Start 30.0 MHz			691 pts		Sto	p 30.0 GHz

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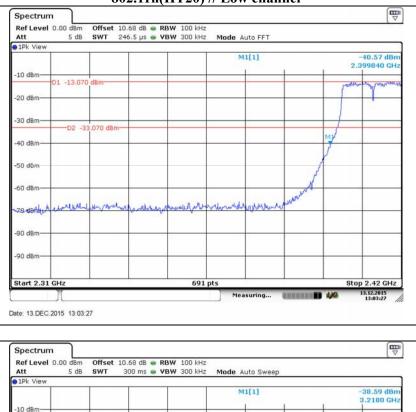
802.11g // High channel



Att 1Pk View	5 dB SWT	300 ms 🥃 VI	SW 300 KHZ	Mode Auto Sweep		
IFK VIEW				M1[1]		-44.13 dBm 3.2610 GHz
-10 dBm01	-12.650 dBm	_				
-20 dBm-						
-30 dBm-	-D2 -32.650 dBr	n				
-40 dBm						
-50 dßm						
-60 dBm						
-70 dem	understand	marchand	munome	manne	watching	nothershould
-80 dBm						
-90 dBm						
Start 30.0 MH	z		691 pts	2.6		Stop 30.0 GHz 13.12.2015



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01 -13.20

-D2 -33

.200 dBm

warmen when a show the

-20 dBr -30 dBr

-40 dB -50 dB

70 dBm

-80 dBm -90 dBm

Start 30.0 MH

Date: 13.DEC.2015 13:04:04

802.11n(HT20) // Low channel

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W-Musham

691 pts

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Measuring...

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None

Stop 30.0 GHz

3.12.2015

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802.11n(HT20) // Middle channel

N/A ₽ Spectrum
 Ref Level
 0.00 dBm
 Offset
 10.68 dB
 RBW
 100 kHz

 Att
 5 dB
 SWT
 300 ms
 VBW
 300 kHz
 Mode Auto Sweep 1Pk Viev -41.56 dBn 3.2610 GH M1[1] -10 dBm 01 -13.410 -20 dBr -30 dBr -D2 -33.410 dBm 40 dB -50 dq 60 inthe M. Rurd ha where Munth -80 dB 90 dBm Stop 30.0 GHz Start 30.0 MH 691 pts 3.12.2015 13:05:07 Measuring... Date: 13.DEC.2015 13:05:07



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802.11n(HT20) // High channel

Att 5 dB			iode Auto Sweep	
1Pk View			2012/01	
			M1[1]	-44.40 dB 3.2610 GF
-10 dBm-		_		
D1 -13.1	20 dBm			
-20 dBm-				
-30 dBm	33.120 dBm			
	55.120 dbm			
-40 dBm				
-50 dβm				
-50 0011				
-60 dBm-	-			
-70 dam	Frence	1	647 I . H	a ka
walks for the	hand	munition	Neuradurahanak	and a superior and the superior and the
-80 dBm				
-90 dBm				
Start 30.0 MHz	12 N	691 pts	20 - 20 - 20 - 20 - 20 - 20 - 20 - 20 -	Stop 30.0 GH

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Test report No.: KES-RF-15T0093 Page (28) of (68)

-Antenna port 1

802.11b // Low channel



		м	1[1]		-49.05 dBm 1.6130 GHz
0 dBm 01 0.430 dBm					
-10 dBm-					
-20 dBm-D2 -19.570 dB	m				
-30 dBm-					
-40 dDm M1 -50 dBm-					
-60 dam Hubmenussel of the	بالمولية والاستعال المراقعات	human	transtable before and the	Nendehendeur	a persident and a second
-80 dBm					
Start 30.0 MHz		691 pts	suring	Sto	p 30.0 GHz 13.12.2015 13:08:56

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802.11b // Middle channel

 N/A

 Spectrum
 Image: Constraint of the second second

inner

Measuring...

691 pts

Stop 30.0 GHz

BB 420

3.12.2015 13:12:01

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-044

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-50 dBr

-60 dBm

-70 dBm -80 dBm

Start 30.0 MHz

Date: 13.DEC.2015 13:12:00



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802.11b // High channel

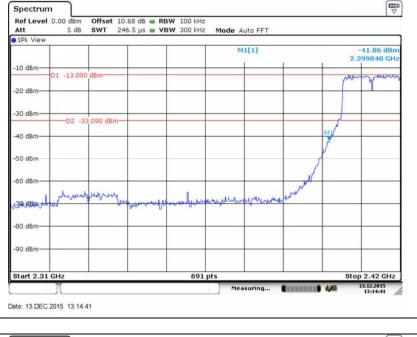


Att	15 dB	SWT	300 ms 🖷	VBW 300 kH	iz Mode	Auto Sweep			
1Pk View				-					
					M	1[1]			48.05 dBm 1.6560 GHz
0.dBm	D1 -0.650	dBm							
-10 dBm-			-					i	
-20 dBm	D2 -20	0.650 dBm							
-30 dBm									
-40 dBm									
-50 dBm									
-60 d8m	under	phat h	under al	unuhar	manun	howard	mobilitions	nuchan	WHOMAN
-70 dBm		Conduction	, , , , , , , , , , , , , , , , , , ,						
-80 dBm									
Start 30.0	MHz			691	pts			Stop	30.0 GHz



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802.11g // Low channel



1Pk View							
				M1[1]			1.40 dBn 6130 GH
-10 dBm	13.450 dBm			-	_		
-20 dBm-							
-30 dBm-	D2 -33.450 dBm-						
-40 dBm-	D2 -35.450 06m						
50 dem					_		
60 d8m					_		
peter the	month			When a la ma	halananan	المعالم الم	n Maria mal
-80 dBm	ann	norman	wwwwww			a moto a sada	
90 dBm					_		
Start 30.0 MHz			691 pt	5		Stop :	30.0 GHz



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802.11g // Middle channel

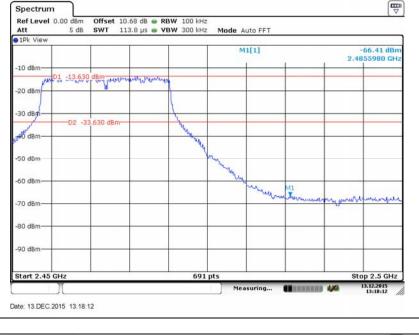
N/A

Att 5 dB SWT 30 1Pk View	1 ms 👜 VBW 300 kHz	Mode Auto Sweep		
		M1[1]		-51.22 dBm 1.6130 GHz
-10 dBm				
-20 dBm-	10			-
-30 dBm-				
-40 dBm				
-50 dem				
-60 d8m-				
Poldsm				
BO dBm	www.walawith	al Mananda Jaha	nonthematic	Warner
-90 dBm				
Start 30.0 MHz	691	pts	Sto	op 30.0 GHz



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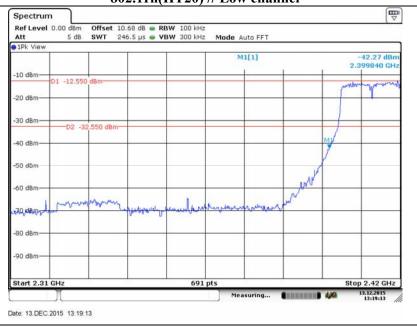
802.11g // High channel



Att 5 dB	Offset 10.68 dB . F SWT 300 ms .		Auto Sweep	
1Pk View	1	1		
10 dBm-		Ň	11[1]	-50.93 dBm 1.6560 GHz
D1 -14.34	0 dBm			
20 dBm				
30 dBm-				
40 dBm-	14.340 dBm			
50 dam				
50 dBm-				
Helen Allumia	mindenter	un und for the	manumenter and and	munutuh
80 dBm	· · · · · · · · · · · · · · · · · · ·			
90 dBm				
tart 30.0 MHz		691 pts	NY SY	Stop 30.0 GHz



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	.68 dB 👄 RBW 100 kH 800 ms 👄 VBW 300 kH			
1Pk View		M1[1]		54 45 dB-
		MILI		-51.45 dBr 1.6130 GH
-10 dBm			+ +	-
-20 dBm-				
30 dBm				
D2 -33.920 dBm				
40 dBm				
MI				
50 dem				
-60 d8m-				
and the				
70/2Bm Hu whowhy		1.40.000	1 A 16	te and the
	unununun	an our and	when when the second	accommence
80 dBm				
90 dBm				
20 0011				
Start 30.0 MHz	691	pts		Stop 30.0 GHz
NC NC NC NC	0,7,7	Measuring	11 444	13.12.2015

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802.11n(HT20) // Middle channel

N/A ₽ Spectrum
 Ref Level
 0.00 dBm
 Offset
 10.68 dB
 RBW
 100 kHz

 Att
 5 dB
 SWT
 47.9 ms
 VBW
 300 kHz
 Mode Auto Sweep • 1Pk View 51.32 dBn 252.9 MH M1[1] -10 dBm D1 -13.860 -20 dBr -30 dB -D2 -33.860 dBm 40 dB -50 de 60 d and manager and with dela man Later and ML 34 greener 80 de 90 dBn Start 0.0 Hz Stop 4.788 GHz 691 pts 13:20:17 Measuring. Date: 13.DEC.2015 13:20:17

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802.11n(HT20) // High channel

	1.18 dBm 6130 GHz
-10 dBm D1 -13.690 dBm	
-20 dBm -30 dBm -D2 -33,690 dBm	
-20 dBm -30 dBm -02 -33,690 dBm	
D2 -33,690 dBm	
-50 M1	
-60 dBm	
19th Mundan and man man man man man and a second and as second and a second and as second and a second and an	NAME
-80 dBm-	
-90 dBm	



3.3. 6 dB bandwidth



Test procedure

KDB 558074_v03r03 – section 8.1 option 1 or section 8.2 option 2.

Option 1:

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth(VBW) $\geq 3 \times RBW$.
- c) Detector = peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Option 2:

The automatic bandwidth measurement capability of an instrument may be employed using the X bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, $VBW \ge 3 \times RBW$, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

Limit

According to \$15.247(a)(2), systems using digital modulation techniques may operate $902 \sim 928$ Mb, $2400 \sim 2483.5$ Mb, and $5725 \sim 5850$ Mb bands. The minimum 6 dB bandwidth shall be at least 500 kb.



Test results

Antenna port	Operation mode	Frequency(Mz)	6 dB bandwidth(Mb)	Limit(婚友)
		2 412	10.12	
	802.11b	2 437	10.12	
		2 462	10.12	
		2 412	16.54	
0	802.11g	2 437	16.59	
		2 462	16.59	
		2 412	17.84	
	802.11n (HT20)	2 437	17.84	
	(11120)	2 462	17.84	0.5
		2 412	10.12	0.5
	802.11b	2 437	10.12	
		2 462	10.12	
		2 412	16.59	
1	802.11g	2 437	16.59	
		2 462	16.59	
		2 412	17.80	
	802.11n (HT20)	2 437	17.84	
	(11120)	2 462	17.80	

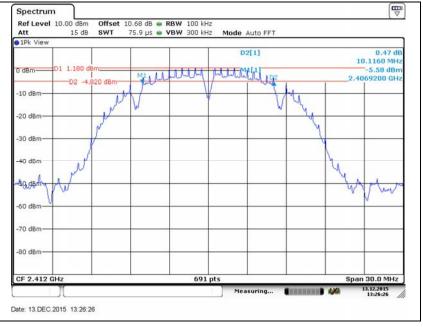


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Test report No.: KES-RF-15T0093 Page (39) of (68)

- Antenna port 0

802.11b // Low channel



Ref Level 10 Att	15 dB			RBW 100 kH VBW 300 kH		uto FFT			
1Pk View									
					D2	[1]			0.32 dB 10.1160 MHz
0 dBm D1	1.350 d	Bm;			a La Long	[1]		_	-5.25 dBm
	-D2 -4	650 dBm-	Might	filled	Martin	Jul 192		2.4	319200 GHz
-10 dBm						1	Le .		
10 000		N	M		ř I	11	N.		
-20 dBm		1	W			W	Y.		
20 Obin		N					N.		
-30 dBm	_								
-oo abiii									
-40 dBm	p/							4	
	N							4.	
So dem 4	1			_				Y	1 MMar
1P	UN							1	V. Y
-60 dBm			-						·
0.6420000.02									
-70 dBm									
-80 dBm	_			-					
CF 2.437 GH	2			691	pts			Spa	in 30.0 MHz
	r					uring		100	13.12.2015 13:27:43

802.11b // Middle channel

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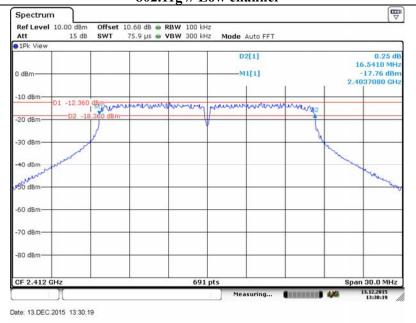


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802.11b // High channel



802.11g // Low channel

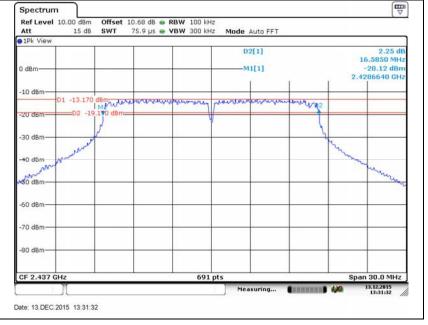


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802.11g // Middle channel



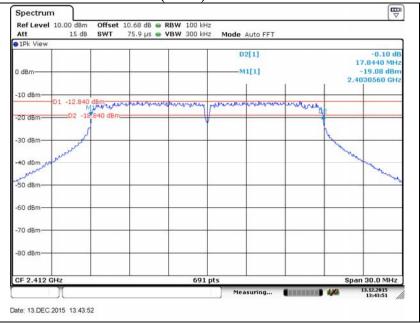
Spectrum Ref Level 10.00 dBm Att 15 dB Mode Auto FFT 1Pk Viev D2[1] -2.15 d 16.5850 MHz -18.03 dBm 2.4537080 GHz M1[1] 0 dBn -10 dBm D1 -13.190 d8 mentionentering D2 -1 2U dBr dB -30 dBr 40 dBn BU dBm--60 dBm -70 dBn -80 dBm 691 pts Span 30.0 MHz CF 2.462 GH 13.12.2015 13:32:21 Measuring... •••••••••••••••• Date: 13.DEC.2015 13:32:21

802.11g // High channel

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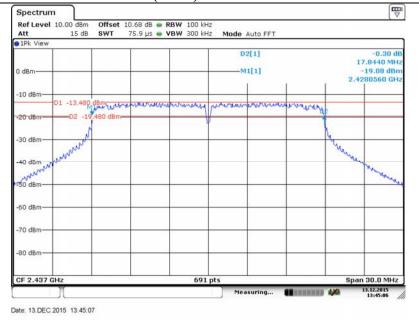


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802.11n(HT20) // Low channel

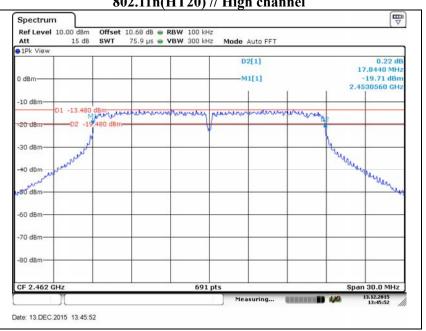
802.11n(HT20) // Middle channel





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Test report No .: KES-RF-15T0093 Page (43) of (68)



802.11n(HT20) // High channel



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Test report No.: KES-RF-15T0093 Page (44) of (68)

- Antenna port 1

802.11b // Low channel



Ref Level 10.0 Att	15 dB SWT	t 10.68 dB 👄 R 75.9 μs 👄 V		Mode Auto FFT			
1Pk View				Den Karder			
				D2[1]		10	0.39 dB
0 dBm D1	1.000 dBm=		01.11.0	Jun Millinge			-5.61 dBm
	-D2 -5.000 dBm	Michel	www.way	www.ululululog2	1	2.43	19200 GHz
-10 dBm		MI			vi.	10	-
	1	VV	T	V	2		
-20 dBm	P				4		
	M				Y		
-30 dBm	V						
10.10	1						
-40 dBm	ľ					1	
No challen .	N					Y	
and N	1					Un	when
-60 dBm	1					51	V
-70 dBm							
-80 dBm			-				
CF 2.437 GHz			691 pts		-	Span	30.0 MHz
T T			1	Measuring			13.12.2015 13:48:20

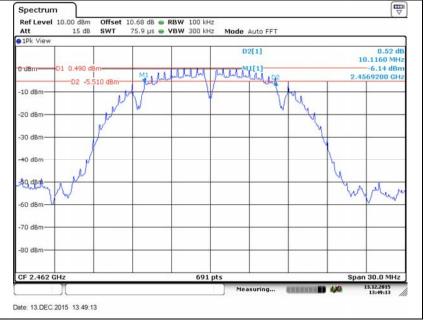
802.11b // Middle channel

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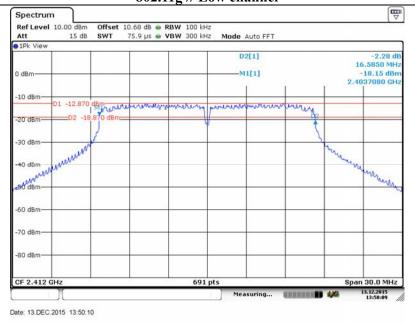


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802.11b // High channel



802.11g // Low channel

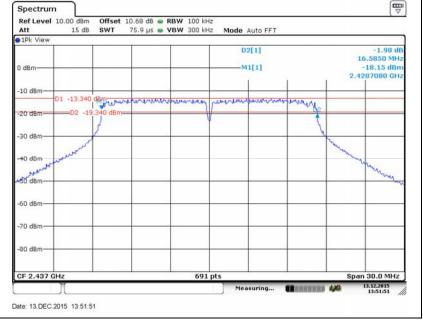


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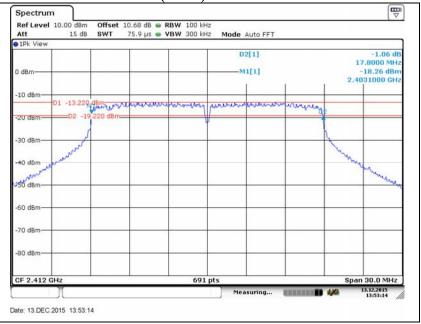
Spectrum Ref Level 10.00 dBm Att 15 dB Mode Auto FFT 1Pk Viev D2[1] -2.25 dl 16.5850 MHz -18.54 dBm 2.4537080 GHz M1[1] 0 dBn -10 dBm D1 -13.590 dBm unumuny Julianu 02 -19 20 d8 -30 dBn 40 dBm mary 50 de -60 dBn -70 dBn -80 dBm 691 pts Span 30.0 MHz CF 2.462 GH 13.12.2015 13:52:30 Measuring... OTHER DESIGNATION. Date: 13.DEC.2015 13:52:30

802.11g // High channel

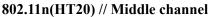
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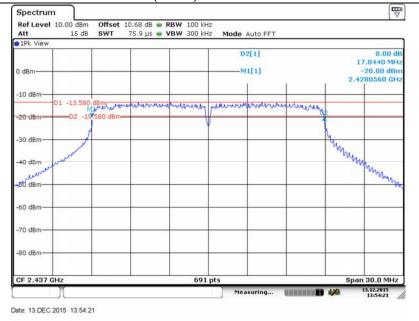


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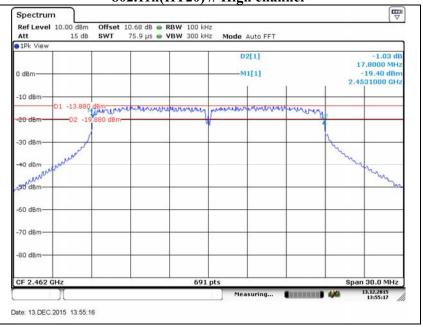
802.11n(HT20) // Low channel







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802.11n(HT20) // High channel



3.4. Peak output power

Test setup	_		_	
EUT		Attenuator		Wideband Power Sensor(with PC)

Test procedure

All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

KDB 558074 v03r03 - section 9.1.2

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

Limit

According to §15.247(b)(3), For systems using digital modulation in the 902~928 Mb, 2 400~2 483.5 Mb, and 5 725~5 850 Mb bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted out-put power. Maximum Conducted Out-put Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to \$15.247(b)(4), The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmit-ting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



Test results

Operation mode	Frequency(Mb)	С	onducted power (dBm))	Limit(dBm)
Operation mode	Ant0		Ant1	Ant0 + Ant1	
	2 412	13.45	13.50	-	
802.11b	2 437	12.82	12.66	-	
	2 462	12.86	12.32	-	
	2 412	11.64	13.14	-	
802.11g	2 437	12.59	12.24	-	30
	2 462	12.51	11.91	-	
	2 412	13.09	12.66	15.89	
802.11n(HT20)	2 437	12.68	12.34	15.52	
	2 462	12.40	12.18	15.30	

Ant Gain = $10 \log[10^{G1/20} + 10^{G2/20} + ... + 10^{GN/20}]^2 / N_{ANT} = 1.78 \text{ dBi} < 6 \text{ dBI}$, so no need to reduce the limit



3.5. Power spectral density

Test setup

EUT	Attenuator	Spectrum analyzer

Test procedure

KDB 558074_v03r03- section 10.2

Measurement procedure

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS channel bandwidth.
- c) Set the RBW to: 3 kHz \leq RBW \leq 100 kHz
- d) Set the VBW \geq 3 \times RBW.
- e) Detector = power averaging (RMS) or sample detector(when RMS not available).
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
- i) Use the peak marker function to determine the maximum amplitude level.
- j) If measured value exceeds limit, reduce RBW(no less than 3 kHz) and repeat.

Limit

According to 15.247, For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.



Test results

One section mode	Energy on av (MIr)		Measured PSD(dBm))	I :m:t(dDm)
Operation mode	Frequency(Mz)	Ant0	Ant1	Ant0 + Ant1	Limit(dBm)
	2 412	-12.69	-12.46	-	
802.11b	2 437	-13.32	-12.78	-	
	2 462	-12.30	-12.92	-	
	2 412	-22.04	-22.62	-	
802.11g	2 437	-22.71	-22.81	-	8
	2 462	-22.66	-22.85	-	
	2 412	-23.42	-23.66	-20.53	
802.11n(HT20)	2 437	-22.46	-23.47	-19.93	
	2 462	-23.35	-24.36	-20.82	

Ant Gain = $10 \log[10^{G1/20} + 10^{G2/20} + ... + 10^{GN/20}]^2 / N_{ANT} = 1.78 \text{ dBi} < 6 \text{ dBI}$, so no need to reduce the limit



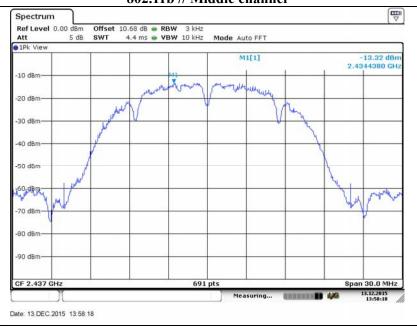
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Test report No.: KES-RF-15T0093 Page (53) of (68)

-Antenna port 0

802.11b // Low channel





802.11b // Middle channel

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802.11g // Low channel



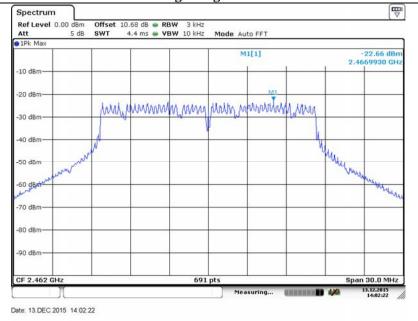


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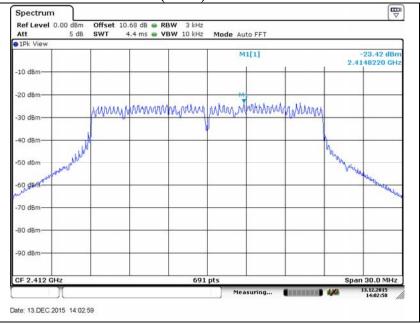




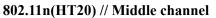


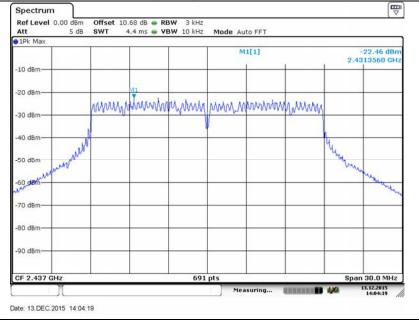


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802.11n(HT20) // Low channel





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802.11n(HT20) // High channel



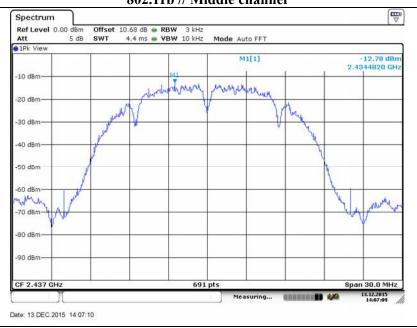
KES Co., Ltd. C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea Tel: +82-31-425-6200 / Fax: +82-31-424-0450 www.kes.co.kr

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-Antenna port 1

802.11b // Low channel





802.11b // Middle channel

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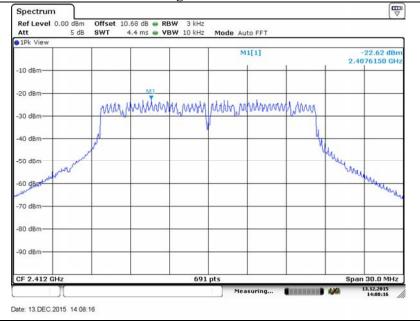


C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea Tel: +82-31-425-6200 / Fax: +82-31-424-0450 www.kes.co.kr Test report No.: KES-RF-15T0093 Page (59) of (68)





802.11g // Low channel

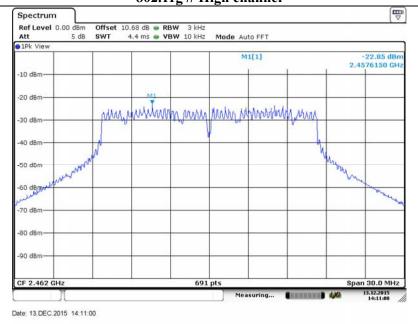




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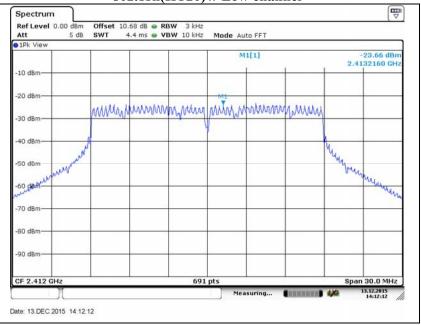


802.11g // High channel

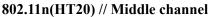
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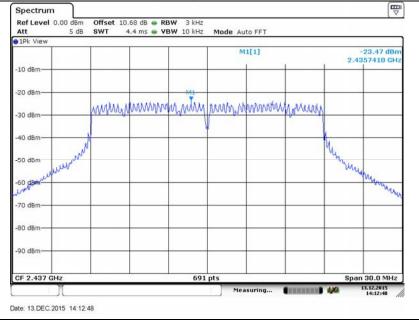


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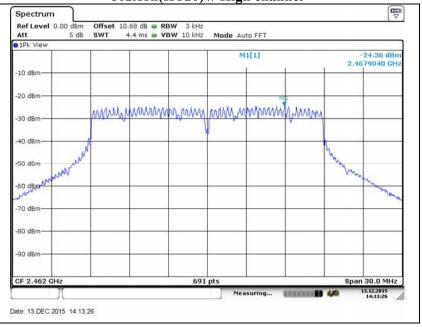
802.11n(HT20) // Low channel







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802.11n(HT20) // High channel



3.6. AC conducted emission

Frequency range of measurement 150 kHz to 30 MHz

Instrument settings

IF Band Width: 9 kHz

Test procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m. Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (407)	Conducted limit (dBµV/m)				
Frequency of Emission (Mz)	Quasi-peak	Average			
0.15 - 0.50	66 - 56*	56 - 46*			
0.50 - 5.00	56	46			
5.00 - 30.0	60	50			

Note.

a) Decreases with the logarithm of the frequency.

b) All AC Conducted emission at channels are almost the same, so that <u>802.11b High channel</u> was chosen at representative in final test.

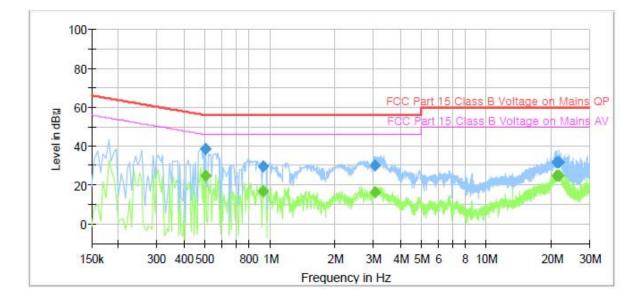


Test results – TX_H

Test Report

Common Information

Test Description: Model No.: Mode Operator Name: Conducted Emission SWL-Q93T TX KES



Final_Result

Frequency (MHz)	QuasiPeak (dB#V)	CAverage (dB#V)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.505000		25.07	46.00	20.93	1000.0	9.000	L1	9.7
0.505000	38.78		56.00	17.22	1000.0	9.000	L1	9.7
0.930000		16.88	46.00	29.12	1000.0	9.000	L1	9.7
0.930000	29.79		56.00	26.21	1000.0	9.000	L1	9.7
3.060000		16.18	46.00	29.82	1000.0	9.000	L1	9.8
3.060000	30.10		56.00	25.90	1000.0	9.000	L1	9.8
21.080000	6442	25.07	50.00	24.93	1000.0	9.000	L1	10.2
21.080000	31.85		60.00	28.15	1000.0	9.000	L1	10.2
21.595000		25.14	50.00	24.86	1000.0	9.000	L1	10.2
21.595000	31.80		60.00	28.20	1000.0	9.000	L1	10.2

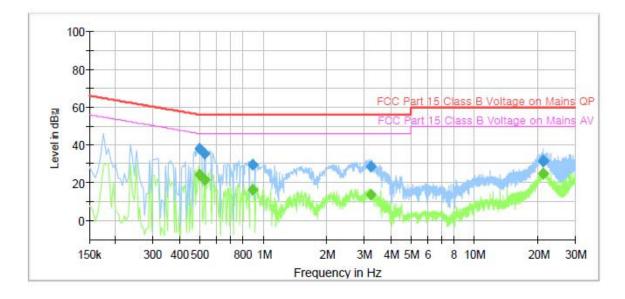


Test results – TX_N

Test Report

Common Information

Test Description: Model No.: Mode Operator Name: Conducted Emission SWL-Q93T TX KES



Final_Result

Frequency (MHz)	QuasiPeak (dB#V)	CAverage (dB ₄ N)	Limit (dBpV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.500000		24.49	46.00	21.51	1000.0	9.000	N	9.7
0.500000	37.92		56.00	18.08	1000.0	9.000	N	9.7
0.525000		21.94	46.00	24.06	1000.0	9.000	N	9.7
0.525000	35.73		56.00	20.27	1000.0	9.000	N	9.7
0.890000		16.33	46.00	29.67	1000.0	9.000	N	9.7
0.890000	29.71		56.00	26.29	1000.0	9.000	N	9.7
3.225000		13.83	46.00	32.17	1000.0	9.000	N	9.8
3.225000	28.38	S)	56.00	27.62	1000.0	9.000	N	9.8
21.170000		25.03	50.00	24.97	1000.0	9.000	N	10.0
21.170000	31.89		60.00	28.11	1000.0	9.000	N	10.0
21.235000		24.68	50.00	25.32	1000.0	9.000	N	10.0
21.235000	31.37		60.00	28.63	1000.0	9.000	N	10.0



Appendix A. Measu	irement equipm	ent		~	~
Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV40	101002	1 year	2016.07.25
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2016.01.23
Attenuator	KEYSIGHT	8493C	82506	1 year	2016.04.02
Power Meter	Anritsu	ML2495A	1438001	1 year	2016.01.22
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2016.01.26
Loop Antenna	R&S	HFH2-Z2.335.4711.52	826532	2 years	2017.03.03
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-461	2 years	2017.04.03
Horn Antenna	A.H. SYSTEMS	SAS-571	414	2 years	2017.02.09
Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170550	2 years	2017.04.30
High Pass Filter	Wainwright Instrument	WHJS3000-10TT	1	1 year	2016.07.24
Low Pass Filter	Wainwright Instrument	WLK1.0/18G-10T	1	1 year	2016.07.24
Preamplifier	SCHWARZBECK	BBV-9718	9718-246	1 year	2016.10.23
Broadband Amplifier	SCHWARZBECK	BBV-9721	PS9721-003	1 year	2016.04.03
EMI Test Receiver	R & S	ESR3	101781	1 year	2016.05.06
EMI Test Receiver	R & S	ESR3	101783	1 year	2016.05.06
LISN	R & S	ENV216	101137	1 year	2016.02.10

Appendix A. Measurement equipment

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook Computer	Samsung Electronics Co., Ltd.	RV518	HTK991NC600207R
Mouse	Moneual	MSU0846	0910020101086E