

TEST REPORT

of

FCC Part 15 Subpart C §15.247

FCC ID: A3LNFA455

Equipment Under Test : SAMSUNG NOTEBOOK
Model Name : NFA455 (Host PC : NP500R5H)
Applicant : Samsung Electronics Co., Ltd.
Manufacturer : Samsung Electronics Co., Ltd.
Date of Test(s) : 2015.05.28 ~ 2015.06.02
Date of Issue : 2015.06.02

In the configuration tested, the EUT complied with the standards specified above.

Tested By:



Jinhyoung Cho

Date:

2015.06.02

Approved By:



Hyunchae You

Date:

2015.06.02

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 435-837

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

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1.2. Details of Applicant

Applicant : Samsung Electronics Co., Ltd.

Address : 129, Samsung-Ro, Yeongtong-Gu, Suwon-Si, Gyeonggi-Do, Korea

Contact Person : Seo, Bum-Hee

Phone No. : +82 31 8062 4313

1.3. Description of EUT

Kind of Product	SAMSUNG NOTEBOOK
Model Name	NFA455 (Host PC : NP500R5H)
Frequency Range	2 402 MHz ~ 2 480 MHz (BT, LE), 2 412 MHz ~ 2 462 MHz (11b/g/n_HT20), 2 422 MHz ~ 2 452 MHz (11n_HT40), 5 745 MHz ~ 5 805 MHz (11a/n_HT20, 11ac_VHT20), 5 755 MHz ~ 5 795 MHz (11n_HT40, 11ac_VHT40), 5 775 MHz (11ac_VHT80), 5 180 MHz ~ 5 240 MHz (11a/n_HT20 – Non DFS, 11ac_VHT20 – Non DFS), 5 190 MHz ~ 5 230 MHz (11n_HT40 – Non DFS, 11ac_VHT40 – Non DFS), 5 210 MHz (11ac_VHT80 – Non DFS), 5 260 MHz ~ 5 320 MHz (11a/n_HT20 – DFS, 11ac_VHT20 – DFS), 5 270 MHz ~ 5 310 MHz (11n_HT40 – DFS, 11ac_VHT40 – DFS), 5 290 MHz (11ac_VHT80 – DFS), 5 500 MHz ~ 5 700 MHz (11a/n_HT20 – DFS, 11ac_VHT20 – DFS), 5 510 MHz ~ 5 670 MHz (11n_HT40 – DFS, 11ac_VHT40 – DFS), 5 530 MHz ~ 5 690 MHz (11ac_VHT80 – DFS)
Modulation Technique	DSSS, OFDM, GFSK, $\pi/4$ DQPSK, 8DPSK
Number of Channels	11 channel (11b/g/n_HT20), 7 channel (11n_HT40), 4 channel (11a/n_HT20, 11ac_VHT20), 2 channel (11n_HT40, 11ac_VHT40), 1 channel (11ac_VHT80), 4 channel (11a/n_HT20–Non DFS, 11ac_VHT20–Non DFS), 2 channel (11n_HT40 – Non DFS, 11ac_VHT40–Non DFS), 1 channel (11ac_VHT80–Non DFS), 12 channel (11a/n_HT20 – DFS, 11ac_VHT20 – DFS), 5 channel (11n_HT40 – DFS, 11ac_VHT40 – DFS), 3 channel (11ac_VHT80 – DFS), 79 channel (BT, LE), 40 channel (LE)
Antenna Type	Internal type

1.4. Declaration by the manufacturer

- Adaptive Frequency Hopping is supported and use at least 20 channels
- WLAN & BT do not transmit simultaneously

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1.5. Information about the FHSS characteristics:

1.5.1. Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

1.5.2. Equal Hopping Frequency Use

The channels of this system will be used equally over the long-term distribution of the hopsets.

1.5.3. Example of a 79 hopping sequence in data mode:

02, 05, 31, 24, 20, 10, 43, 36, 30, 23, 40, 06, 21, 50, 44, 09, 71, 78, 01, 13, 73, 07, 70, 72, 35, 62, 42, 11, 41, 08, 16, 29, 60, 15, 34, 61, 58, 04, 67, 12, 22, 53, 57, 18, 27, 76, 39, 32, 17, 77, 52, 33, 56, 46, 37, 47, 64, 49, 45, 38, 69, 14, 51, 26, 79, 19, 28, 65, 75, 54, 48, 03, 25, 66, 05, 16, 68, 74, 59, 63, 55

1.5.4. System Receiver Input Bandwidth

Each channel bandwidth is 1 MHz.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

1.5.5. Equipment Description

15.247(a)(1) that the rx input bandwidths shift frequencies in synchronization with the transmitted

15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

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1.6. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	R&S	SMBV100A	255834	Jun. 25, 2014	Annual	Jun. 25, 2015
Signal Generator	R&S	SMR40	100272	Jul. 18, 2014	Annual	Jul. 18, 2015
Spectrum Analyzer	Agilent	N9030A	US53120526	Jul. 17, 2014	Annual	Jul. 17, 2015
High Pass Filter	Wainwright	WHK3.0/18G-10SS	344	Jun. 10, 2014	Annual	Jun. 10, 2015
High Pass Filter	Wainwright	WHNX7.5/26.5G-6SS	15	Jul. 02, 2014	Annual	Jul. 02, 2015
Low Pass Filter	Mini circuits	NLP-1200+	V8979400903-2	Mar. 12, 2015	Annual	Mar. 12, 2016
Power Sensor	R&S	NRP-Z81	100669	Mar. 12, 2015	Annual	Mar. 12, 2016
Preamplifier	H.P.	8447F	2944A03909	Aug. 27, 2014	Annual	Aug. 27, 2015
Preamplifier	R&S	SCU-18	10117	Apr. 10, 2015	Annual	Apr. 10, 2016
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	May 07, 2015	Annual	May 07, 2016
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	396	Jun. 07, 2013	Biennial	Jun. 07, 2015
Loop Antenna	SCHWARZBECK MESSELEKTRONIK	FMZB 1519	1519-039	Jul. 09, 2013	Biennial	Jul. 09, 2015
Horn Antenna	R&S	HF906	100326	Dec. 10, 2013	Biennial	Dec. 10, 2015
Horn Antenna	SCHWARZBECK MESSELEKTRONIK	BBHA 9170	BBHA9170431	May 15, 2014	Biennial	May 15, 2016
Antenna Master	INN-CO	MM4000	N/A	N.C.R.	N/A	N.C.R.
Turn Table	INN-CO	DS 1200S	N/A	N.C.R.	N/A	N.C.R.
Test Receiver	R&S	ESU26	100109	Mar. 03, 2015	Annual	Mar. 03, 2016
Anechoic Chamber	SY Corporation	L x W x H (9.6 m x 6.4 m x 6.6 m)	N/A	N.C.R.	N/A	N.C.R.

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1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD:FCC Part15 subpart C § 15.247		
Section	Test Item	Result
15.205(a) 15.209 15.247(d)	Transmitter Radiated Spurious Emissions	Complied

1.8. Sample calculation

Where relevant, the following sample calculation is provided:

1.8.1. Radiation test

Field strength level (dB μ V/m) = Measured level (dB μ V) + Antenna factor (dB) + Cable loss (dB) – amplifier gain (dB)

1.9. Test report revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL008784	2015.06.02	Initial

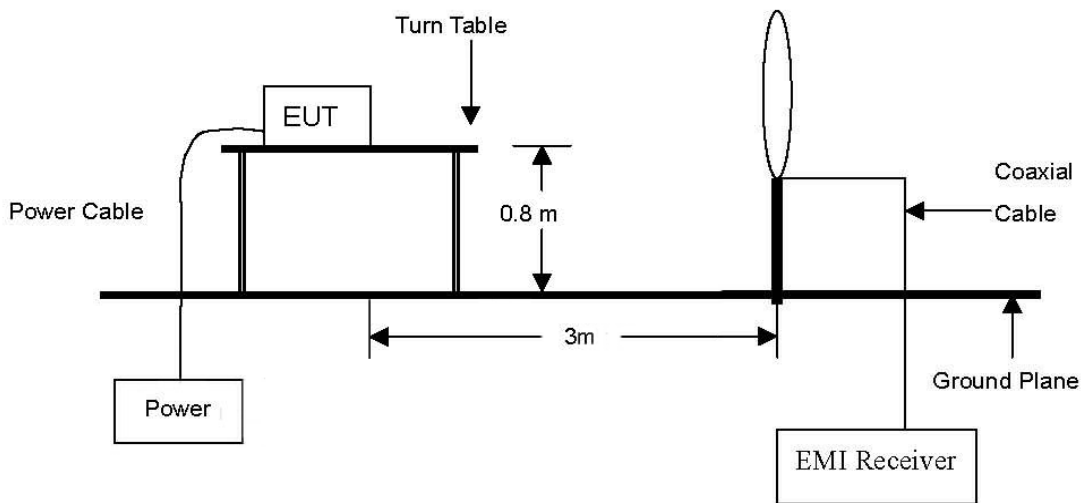
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2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

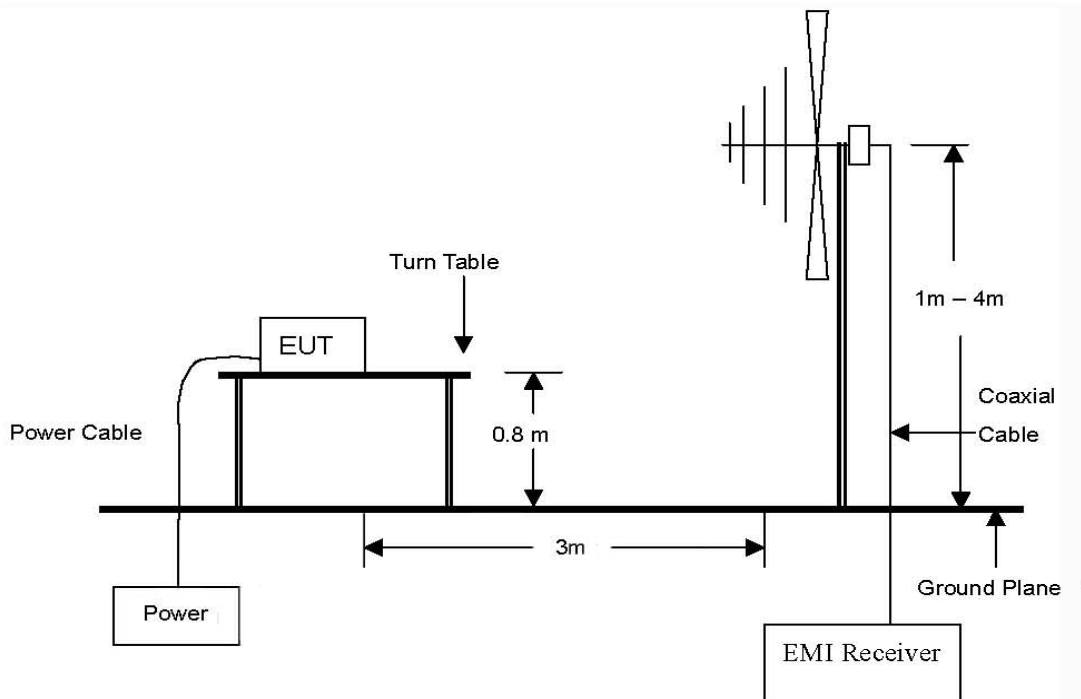
2.1. Test Setup

2.1.1. Transmitter Radiated Spurious Emissions

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

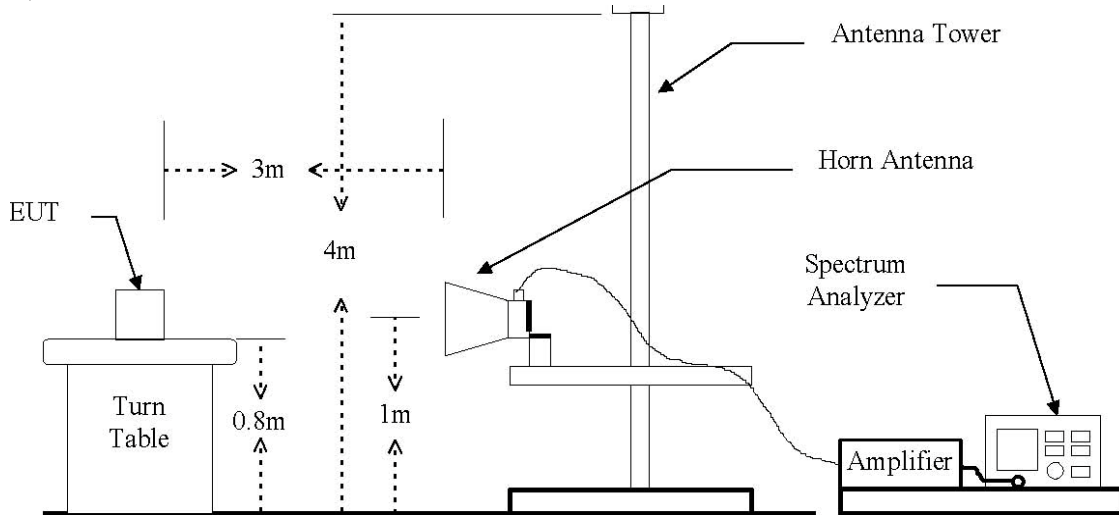


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



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The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 GHz to the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.



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2.2. 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 fall 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))

According to § 15.209(a), Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Frequency (MHz)	Distance (Meters)	Field Strength (dB μ V/m)	Field Strength (μ V/m)
0.009 – 0.490	300	20 log (2400/F(kHz))	2400/F(kHz)
0.490 – 1.705	30	20 log (24000/F(kHz))	24000/F(kHz)
1.705 – 30.0	30	29.54	30
30 - 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

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2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of DA 00-705 and ANSI C63.4-2003

2.3.1. Test Procedures for Radiated Spurious Emissions

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. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, 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 one meter to four 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 dB lower 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 have 10 dB margin would be re-tested 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. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $1/T_{on}$ Hz (T_{on} = On-time of the Pulsed emission) for Average detection (AV) at frequency above 1 GHz.
VBW = 350 Hz $\geq 1/T_{on}$ Hz, pulse width in seconds (T_{on} = 2.89 ms). Refer to the DH5, 3DH5 of Time of Occupancy (Dwell Time) test item.
4. When Average result is different from peak result over 20 dB (over-averaging), According to 15.35 (c), as a "duty cycle correction factor", pulse averaging with 20 log(duty cycle) has to be used.
5. Test orthogonal plan of EUT is X-axis during radiation test.

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2.4. Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

2.4.1. Spurious Radiated Emission

The frequency spectrum from 9 kHz to 1 000 MHz was investigated. All reading values are applied for peak values per frequency band.

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
52.96	32.96	Peak	V	14.06	-26.52	20.50	40.00	19.50
459.51	33.00	Peak	H	17.78	-24.28	26.50	46.00	19.50
611.23	32.62	Peak	V	19.74	-24.06	28.30	46.00	17.70
Above 700.00	Not detected	-	-	-	-	-	-	-

Remark:

1. All spurious emissions at channels are almost the same below 1 GHz
2. Reported spurious emissions are in **GFSK / DH5 / Low channel** as worst case among other modes.
3. According to § 15.31(o), Emission levels are not reported much lower than the limits by over 20 dB.
4. Radiated spurious emission measurement as below
(Actual = Reading + Antenna Factor + Amp + CL)

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2.4.2. Spurious Radiated Emission

The frequency spectrum above 1 000 MHz was investigated. All reading values are peak and average values.

Operating Mode: GFSK(1 Mbps)

A. Low Channel (2 402 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 310.00	23.41	Peak	H	27.77	6.48	57.66	74.00	16.34
*2 310.00	15.25	Average	H	27.77	6.48	49.50	54.00	4.50
*2 322.72	27.51	Peak	H	27.90	6.34	61.75	74.00	12.25
*2 322.72	15.86	Average	H	27.90	6.34	50.10	54.00	3.90
*2 390.00	24.32	Peak	H	28.08	6.47	58.87	74.00	15.13
*2 390.00	15.53	Average	H	28.08	6.47	50.08	54.00	3.92

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-

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C. High Channel (2 480 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 483.50	25.64	Peak	H	28.17	6.65	60.46	74.00	13.54
*2 483.50	16.18	Average	H	28.17	6.65	51.00	54.00	3.00
*2 489.16	27.56	Peak	H	28.23	6.73	62.52	74.00	11.48
*2 489.16	16.32	Average	H	28.23	6.73	51.28	54.00	2.72
*2 500.00	25.76	Peak	H	28.31	6.88	60.95	74.00	13.05
*2 500.00	16.07	Average	H	28.31	6.88	51.26	54.00	2.74

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-

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Operating Mode: 8DPSK(3 Mbps)

A. Low Channel (2 402 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 310.00	24.44	Peak	H	27.77	6.48	58.69	74.00	15.31
*2 310.00	15.31	Average	H	27.77	6.48	49.56	54.00	4.44
*2 347.04	26.82	Peak	H	28.04	6.52	61.38	74.00	12.62
*2 347.04	15.94	Average	H	28.04	6.52	50.50	54.00	3.50
*2 390.00	24.90	Peak	H	28.08	6.47	59.45	74.00	14.55
*2 390.00	15.54	Average	H	28.08	6.47	50.09	54.00	3.91

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-

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C. High Channel (2 480 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 483.50	25.04	Peak	H	28.17	6.65	59.86	74.00	14.14
*2 483.50	16.16	Average	H	28.17	6.65	50.98	54.00	3.02
*2 483.60	27.39	Peak	H	28.17	6.65	62.21	74.00	11.79
*2 483.60	16.26	Average	H	28.17	6.65	51.08	54.00	2.92
*2 500.00	25.35	Peak	H	28.31	6.88	60.54	74.00	13.46
*2 500.00	16.02	Average	H	28.31	6.88	51.21	54.00	2.79

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-

Remarks:

1. "*" means the restricted band.
2. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
3. According to § 15.31(o), Emission levels are not reported much lower than the limits by over 20 dB.
4. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
5. Actual = Reading + AF + AMP + CL

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