

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:



Hyunchoe 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>.

Telephone : +82 31 688 0901

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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) |
| Antenna Type | Internal type |

1.4. Declaration by the manufacturer

- WLAN & LE do not transmit simultaneously

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1.5. 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 |
| Attenuator | MCLI | FAS-23-20 | 23834 | Jun. 20, 2014 | Annual | Jun. 20, 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 |
| Test Receiver | R&S | ESU26 | 100109 | Mar. 03, 2015 | Annual | Mar. 03, 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. |
| 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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1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

| APPLIED STANDARD: FCC Part15 Subpart C § 15.247 | | |
|-------------------------------------------------|-----------------------------------------|----------|
| Standard section | Test Item(s) | Result |
| 15.205 15.209 15.247(d) | Transmitter Radiated Spurious Emissions | Complied |

1.7. Test Procedure(s)

The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003) and the guidance provided in KDB 558074_v03r02 were used in the measurement of the DUT.

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 (dB)

1.9. Test report revision

| Revision | Report number | Date of Issue | Description |
|----------|----------------------|---------------|-------------|
| 0 | F690501/RF-RTL008785 | 2015.06.02 | Initial |

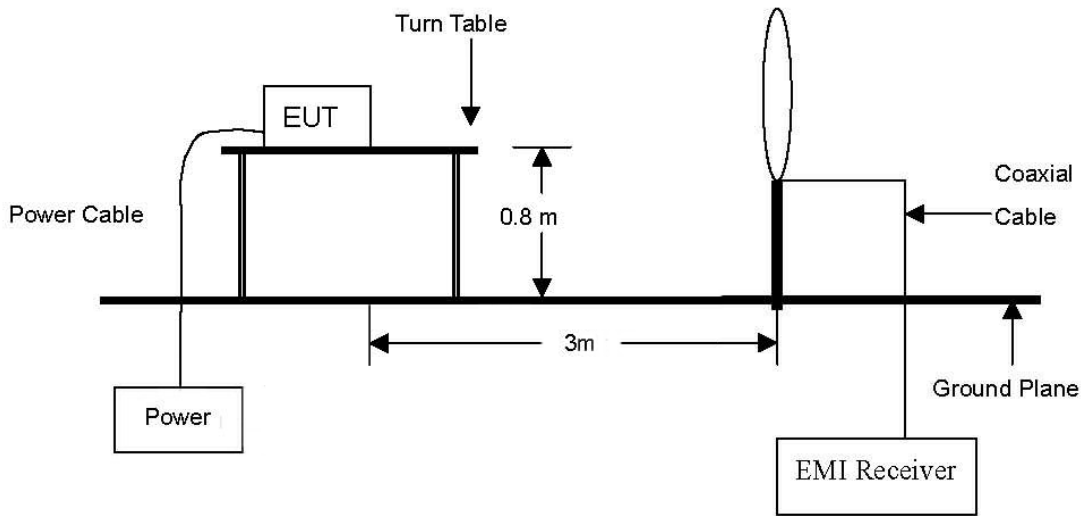
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2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

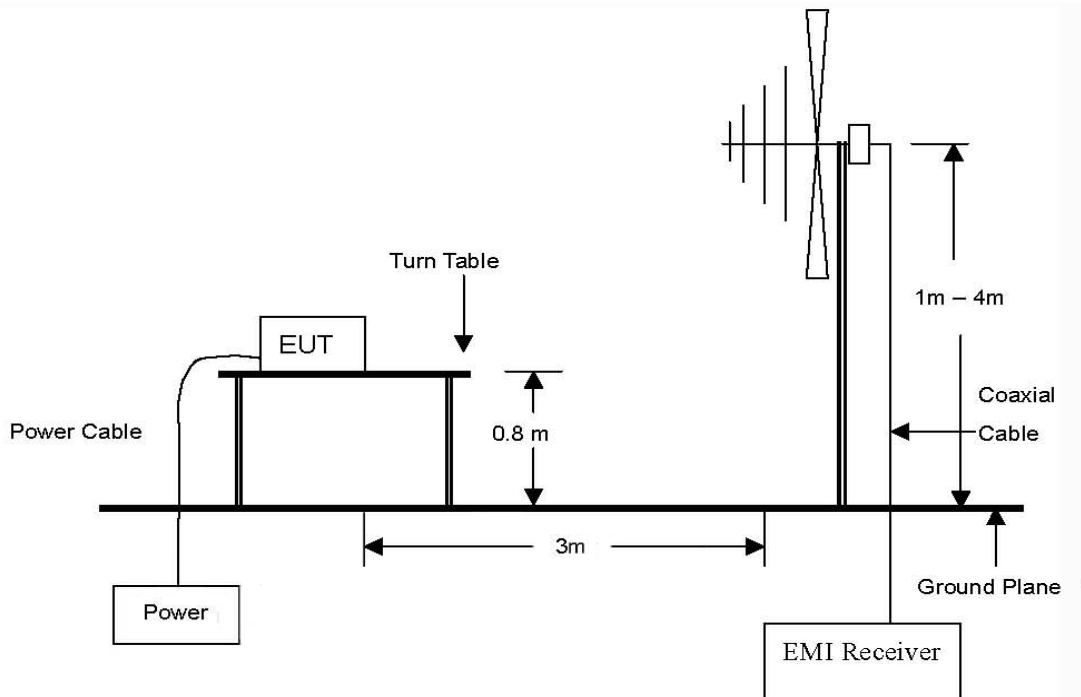
2.1. Test Setup

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 kHz to 30 MHz Emissions.

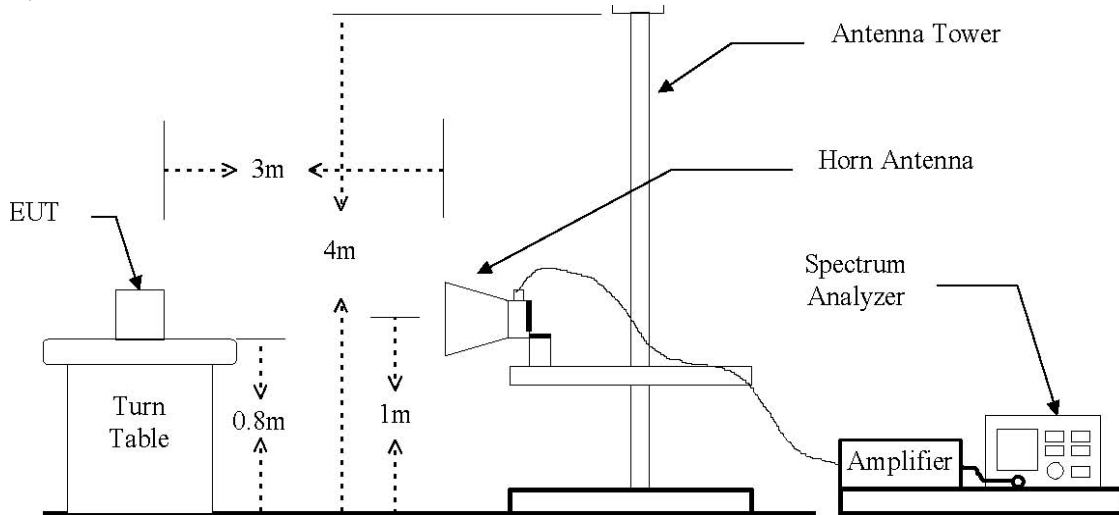


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



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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 form 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 (2 400/F(kHz)) | 2 400/F(kHz) |
| 0.490 – 1.705 | 30 | 20 log (24 000/F(kHz)) | 24 000/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 in section 11.0 & 12.0 of KDB 558074_v03r02 and ANSI C63.4 2003.

2.3.1. Test Procedures for emission below 30 MHz

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. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from above 30 MHz

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 bi-log antenna, a horn 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.

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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. Unwanted Emissions into Non-Restricted Frequency Bands

- The Reference Level Measurement refer to section 11.2

Set analyzer center frequency to DTS channel center frequency, SPAN ≥ 1.5 times the DTS bandwidth, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold.

- Unwanted Emissions Level Measurement refer to section 11.3

Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold.

2. Unwanted Emissions into Restricted Frequency Bands

- Peak Power measurement procedure refer to section 12.2.4

Set RBW = as specified in Table 1, VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = auto, Trace = Max hold.

Table 1- RBW as a function of frequency

| Frequency | RBW |
|----------------|---------------|
| 9 – 150 kHz | 200 – 300 Hz |
| 0.15 – 30 MHz | 9 – 10 kHz |
| 30 – 1 000 MHz | 100 – 120 kHz |
| >1 000 MHz | 1 MHz |

- Average Power measurements procedure refer to section 12.2.5.2

Set RBW = 1 MHz, VBW $\geq 3 \times$ RBW, Detector = RMS, if span/(# of points in sweep) \leq (RBW/2).

Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied then the detector mode shall be set to peak,

Averaging type = power(i.e., RMS). Sweep time = auto, Perform a trace average of at least 100 traces.

If duty cycle < 98 percent, a correction factor shall be added to the measurement results.

- Averaging (RMS) mode was used above the correction factor is $10 \log (1/x)$, where x is the duty cycle.

3. To get a maximum emission level from the EUT, the EUT is manipulated through three orthogonal planes. Worst 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. Radiated Spurious Emission

The frequency spectrum from 9 MHz 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 (dBμV) | Detect Mode | Pol. | AF (dB/m) | AMP + CL (dB) | Actual (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
| 89.05 | 38.19 | Peak | V | 11.46 | -26.05 | 23.60 | 43.50 | 19.90 |
| 101.90 | 39.86 | Peak | H | 14.36 | -25.82 | 28.40 | 43.50 | 15.10 |
| 212.52 | 44.21 | Peak | H | 11.94 | -24.65 | 31.50 | 43.50 | 12.00 |
| 212.52 | 41.71 | Peak | V | 12.24 | -24.65 | 29.30 | 43.50 | 14.20 |
| 452.15 | 37.60 | Peak | H | 17.65 | -24.35 | 30.90 | 46.00 | 15.10 |
| 992.64 | 33.76 | Peak | V | 24.28 | -21.94 | 36.10 | 54.00 | 17.90 |

Remark:

1. Spurious emissions for all channels and modes were investigated and almost the same below 1 GHz.
2. Reported spurious emissions are in **Middle 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) | Duty factor (dB) | Actual (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) |
| *2 310.00 | 23.73 | Peak | H | 27.77 | 6.48 | - | 57.98 | 74.00 | 16.02 |
| *2 310.00 | 14.16 | Average | H | 27.77 | 6.48 | 1.95 | 50.36 | 54.00 | 3.64 |
| *2 377.52 | 27.37 | Peak | H | 28.16 | 6.54 | - | 62.07 | 74.00 | 11.93 |
| *2 377.52 | 15.83 | Average | H | 28.16 | 6.54 | 1.95 | 52.48 | 54.00 | 1.52 |
| *2 390.00 | 25.97 | Peak | H | 28.08 | 6.47 | - | 60.52 | 74.00 | 13.48 |
| *2 390.00 | 14.56 | Average | H | 28.08 | 6.47 | 1.95 | 51.06 | 54.00 | 2.94 |

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

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B. Middle Channel (2 440 MHz)

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

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) | Duty factor (dB) | Actual (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) |
| *2 483.50 | 24.41 | Peak | H | 28.17 | 6.65 | - | 59.23 | 74.00 | 14.77 |
| *2 483.50 | 15.52 | Average | H | 28.17 | 6.65 | 1.95 | 52.29 | 54.00 | 1.71 |
| *2 496.33 | 27.25 | Peak | H | 28.28 | 6.83 | - | 62.36 | 74.00 | 11.64 |
| *2 496.33 | 15.44 | Average | H | 28.28 | 6.83 | 1.95 | 52.50 | 54.00 | 1.50 |
| *2 500.00 | 25.09 | Peak | H | 28.31 | 6.88 | - | 60.28 | 74.00 | 13.72 |
| *2 500.00 | 15.12 | Average | H | 28.31 | 6.88 | 1.95 | 52.26 | 54.00 | 1.74 |

| Radiated Emissions | | | Ant | Correction Factors | | | Total | FCC Limit | |
|--------------------|----------------------|-------------|------|--------------------|--------------|------------------|-----------------------|----------------------|-------------|
| Frequency (MHz) | Reading (dB μ V) | Detect Mode | Pol. | AF (dB/m) | AMP+ CL (dB) | Duty factor (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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