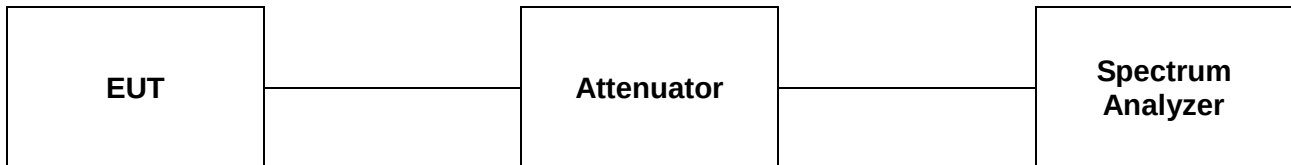


## 5. Power Spectral Density

### 5.1. Test Setup



### 5.2. Limit

#### 5.2.1 FCC

According to §15.247(e), 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.

#### 5.2.2 IC

According to RSS-247 Issue 2, 5.2(b), the transmitter power spectral density conducted from the transmitter 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 section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

### 5.3. Test Procedure

The measurements are recorded using the PKPSD measurement procedure in section 11.10.2 of ANSI C63.10-2013.

- This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 x DTS bandwidth.
3. Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
4. Set the VBW  $\geq 3 \times \text{RBW}$ .
5. Detector = Peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

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A4(210 mm x 297 mm)

## 5.4. Test Results

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

| Operation Mode      | Data Rate | Channel | Frequency (MHz) | Measured PSD (dB m) |         | Maximum Limit (dB m) |
|---------------------|-----------|---------|-----------------|---------------------|---------|----------------------|
|                     |           |         |                 | DC 5 V              | DC 12 V |                      |
| DSSS (802.11b)      | 11 Mbps   | Low     | 2 412           | 7.10                | 7.01    | 8                    |
|                     |           | Middle  | 2 437           | 6.76                | 6.47    |                      |
|                     |           | High    | 2 462           | 4.86                | 5.13    |                      |
| OFDM (802.11g)      | 12 Mbps   | Low     | 2 412           | -12.25              | -12.37  |                      |
|                     |           | Middle  | 2 437           | -12.77              | -11.89  |                      |
|                     |           | High    | 2 462           | -12.72              | -12.88  |                      |
| OFDM (802.11n_HT20) | MCS1      | Low     | 2 412           | -13.50              | -13.10  |                      |
|                     |           | Middle  | 2 437           | -12.84              | -13.07  |                      |
|                     |           | High    | 2 462           | -14.23              | -13.66  |                      |
| OFDM (802.11n_HT40) | MCS2      | Low     | 2 422           | -16.04              | -18.19  |                      |
|                     |           | Middle  | 2 437           | -14.97              | -15.49  |                      |
|                     |           | High    | 2 452           | -14.78              | -14.86  |                      |

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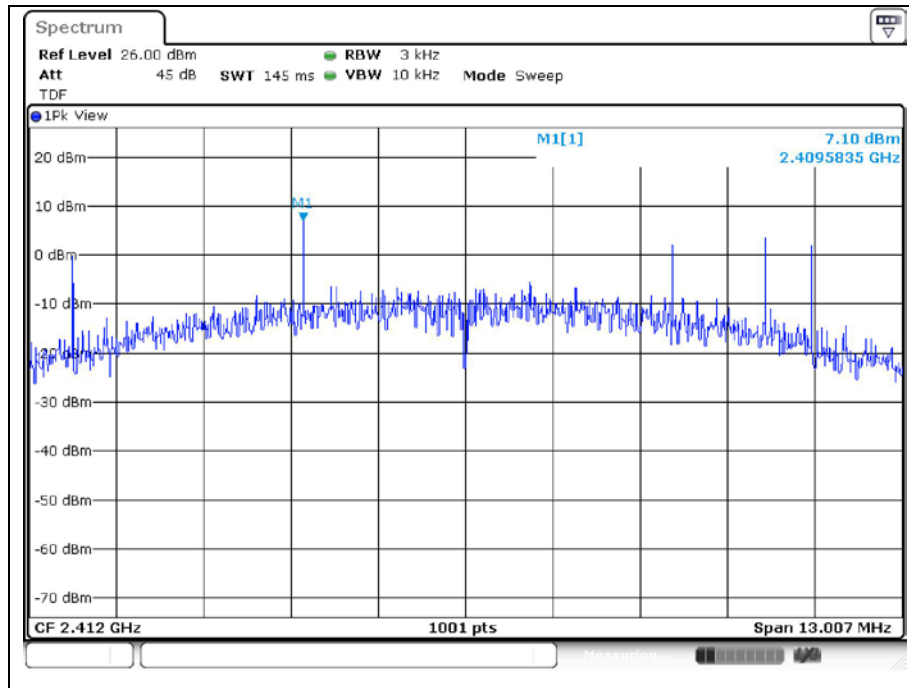
A4(210 mm x 297 mm)

## - Test plots

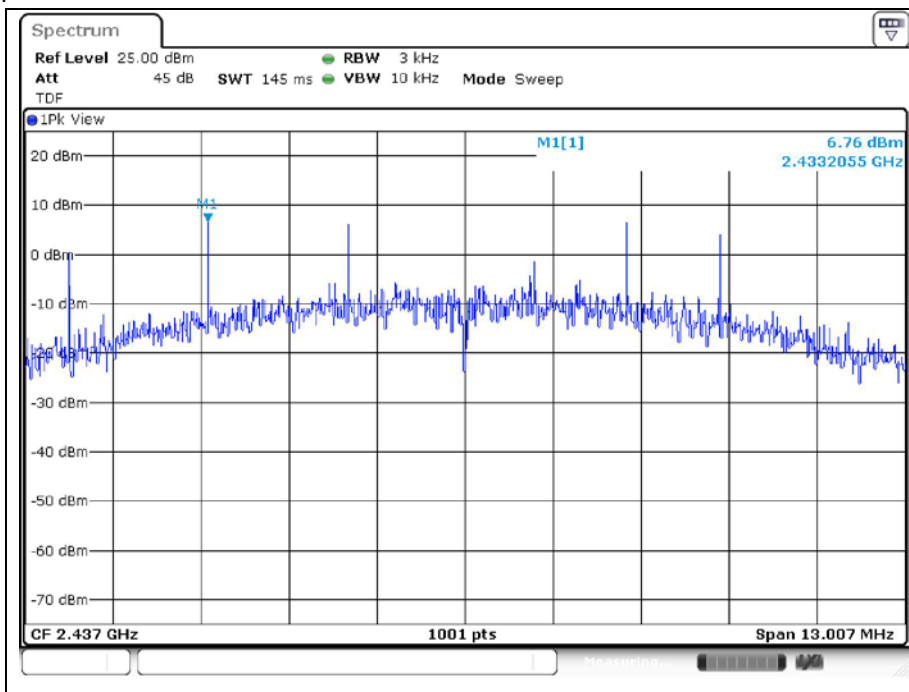
Test Condition: DC 5 V

DSSS: 802.11b

Low Channel



Middle Channel



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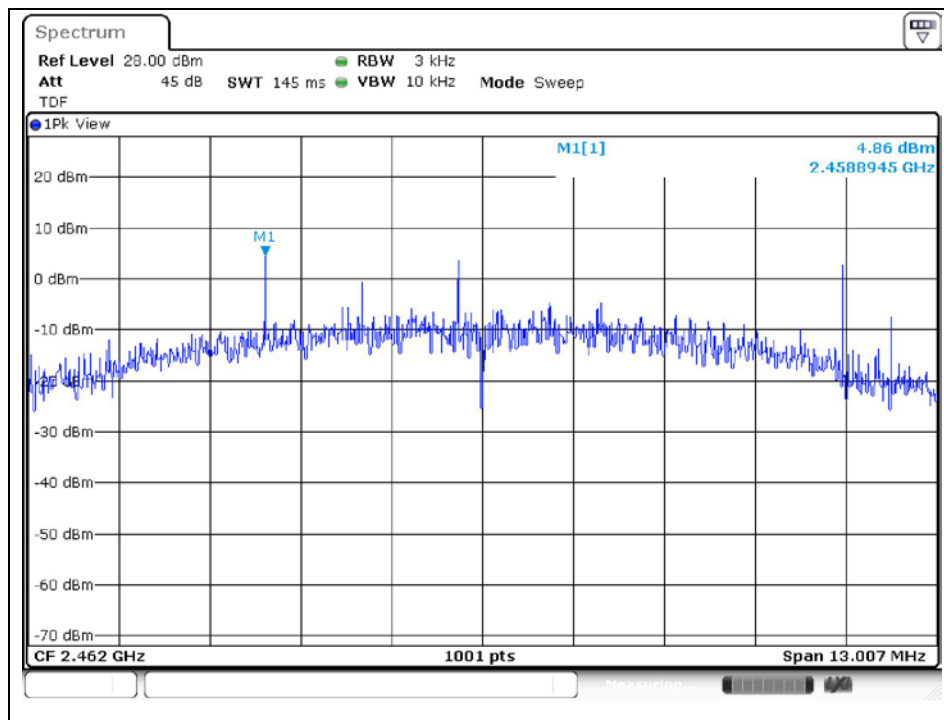
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

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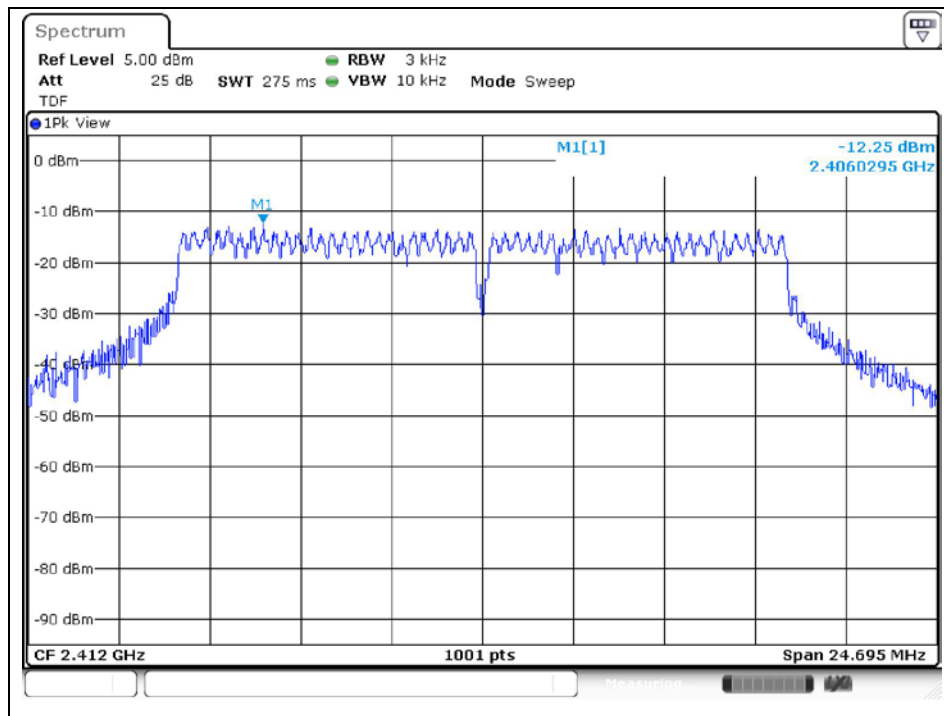
A4(210 mm x 297 mm)

## High Channel



## OFDM: 802.11g

### Low Channel



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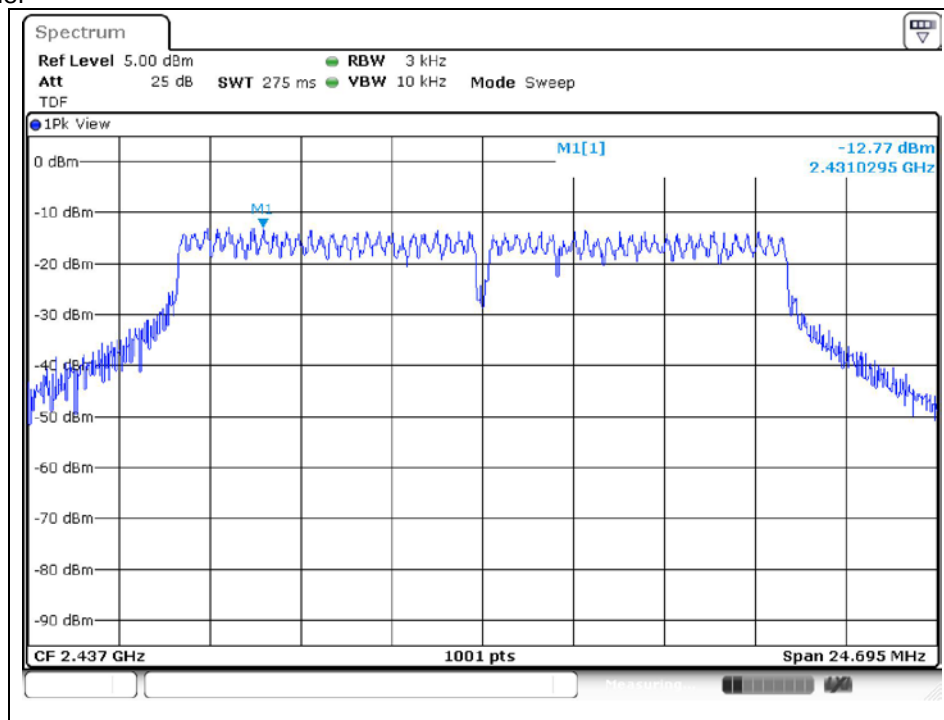
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2019.04.24)(1)

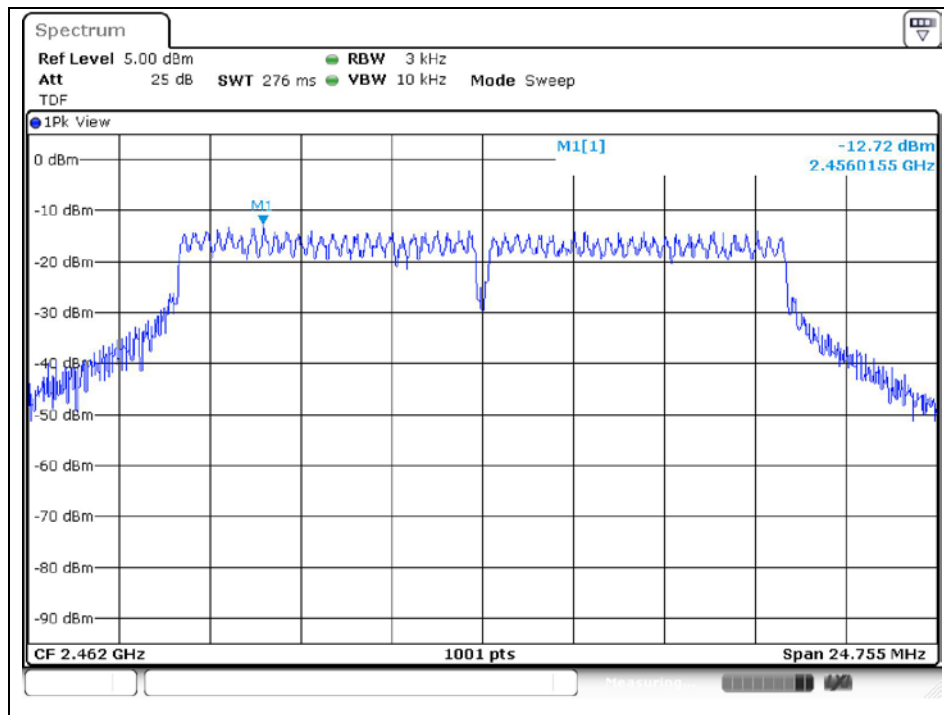
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A4(210 mm x 297 mm)

## Middle Channel



## High Channel



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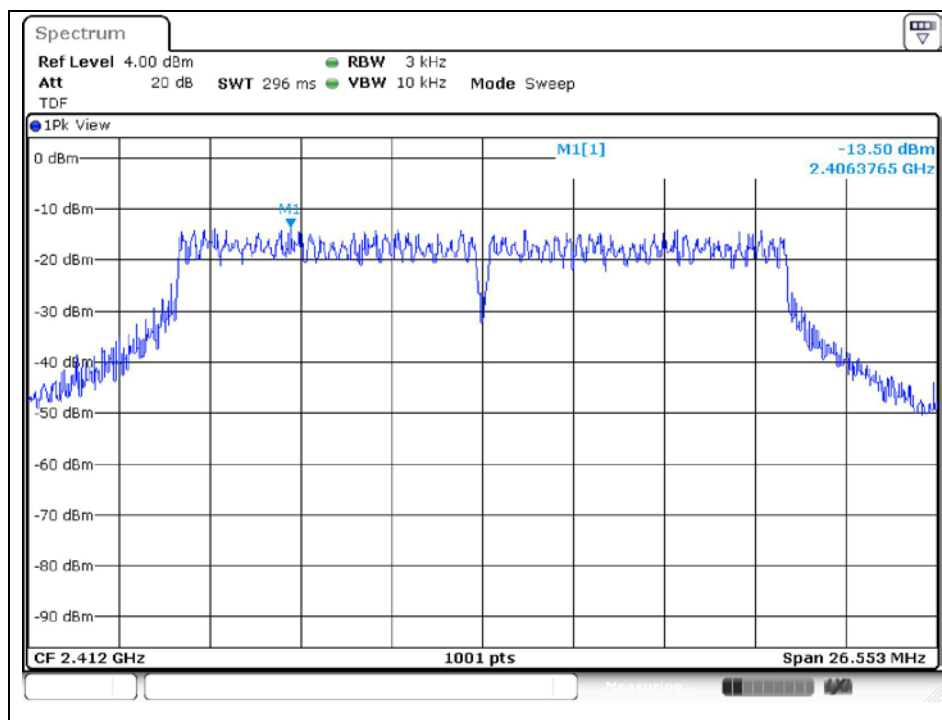
RTT5041-19(2019.04.24)(1)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

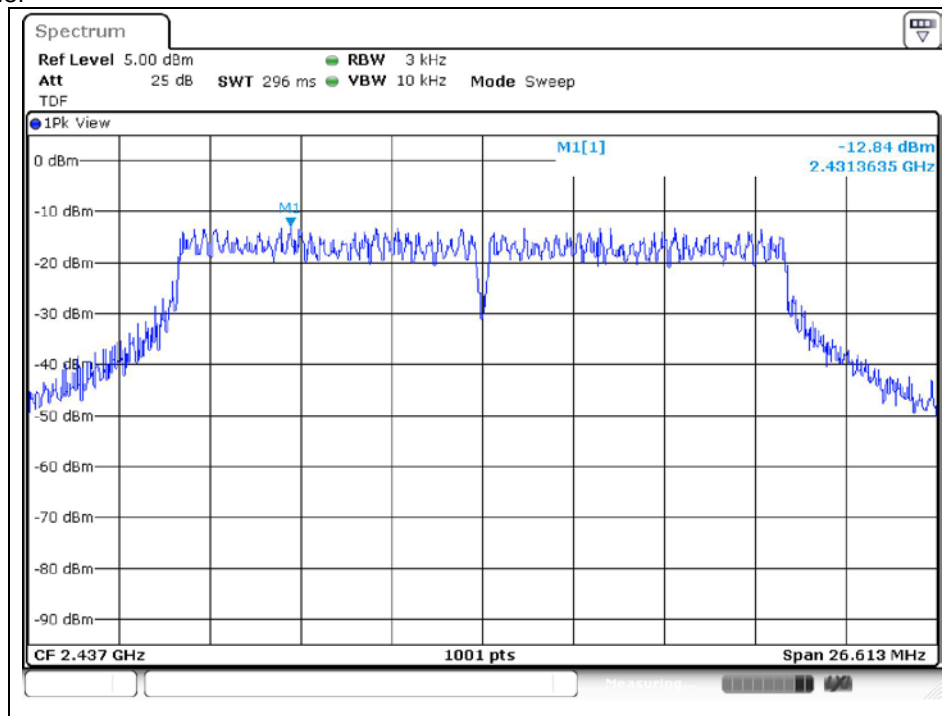
A4(210 mm x 297 mm)

## OFDM: 802.11n\_HT20

### Low Channel



### Middle Channel



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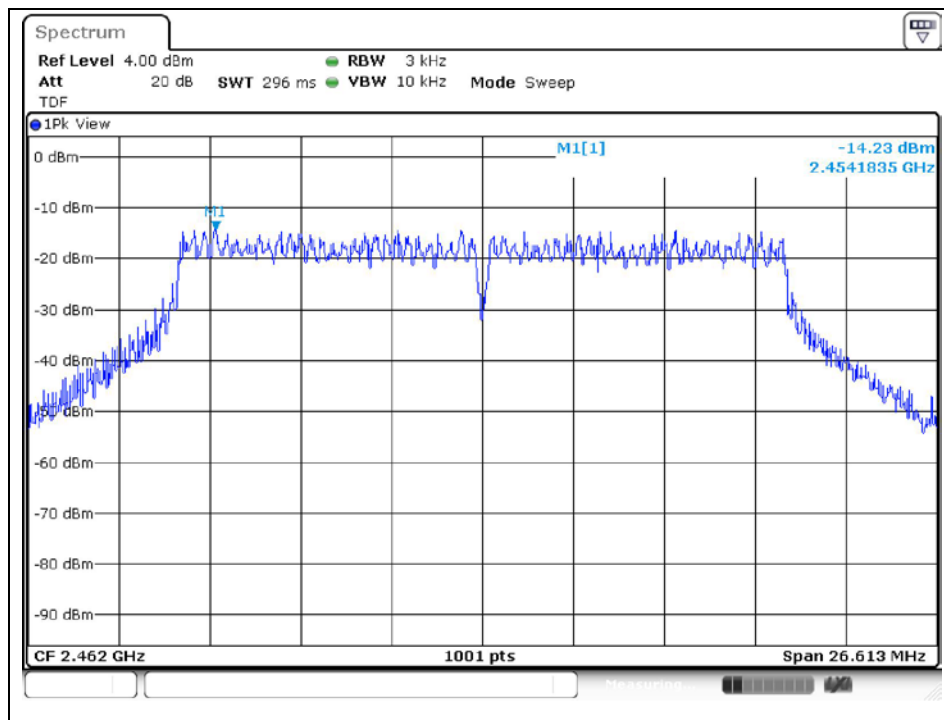
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

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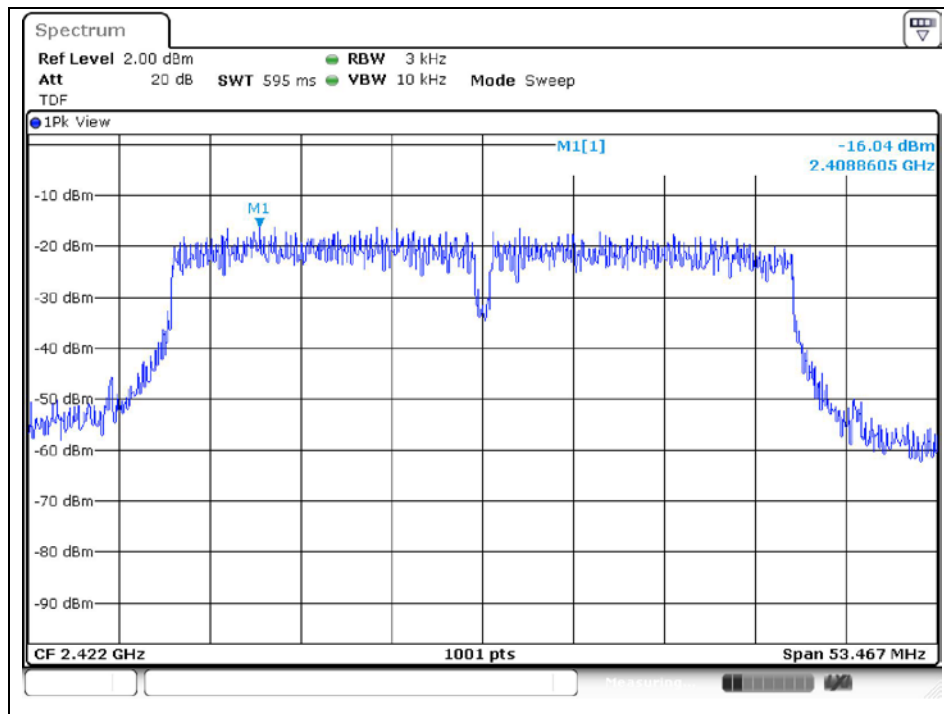
A4(210 mm x 297 mm)

## High Channel



## OFDM: 802.11n\_HT40

### Low Channel



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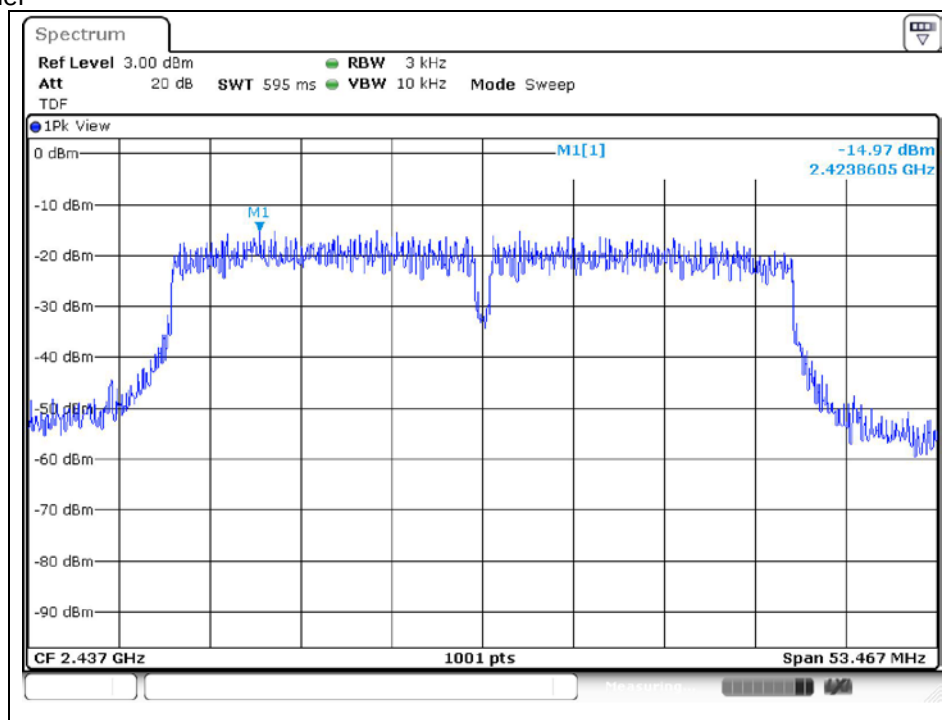
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2019.04.24)(1)

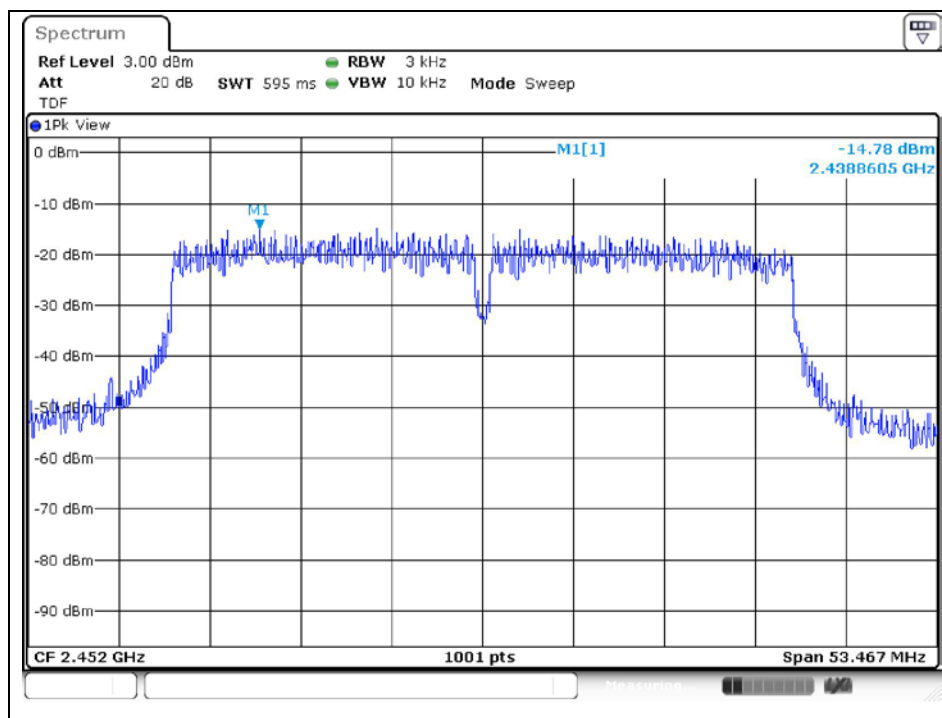
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A4(210 mm x 297 mm)

## Middle Channel



## High Channel



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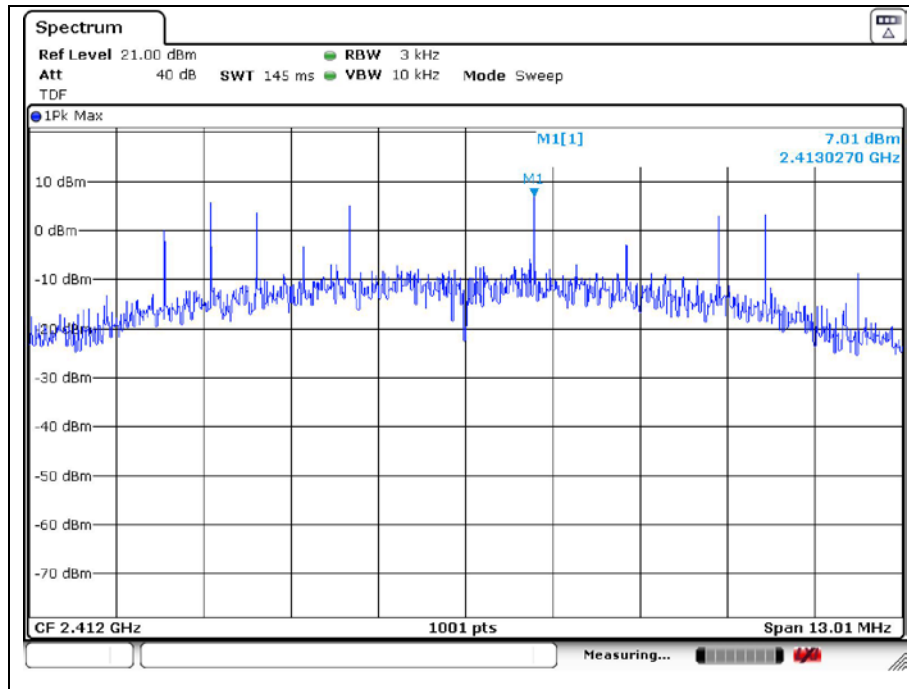
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

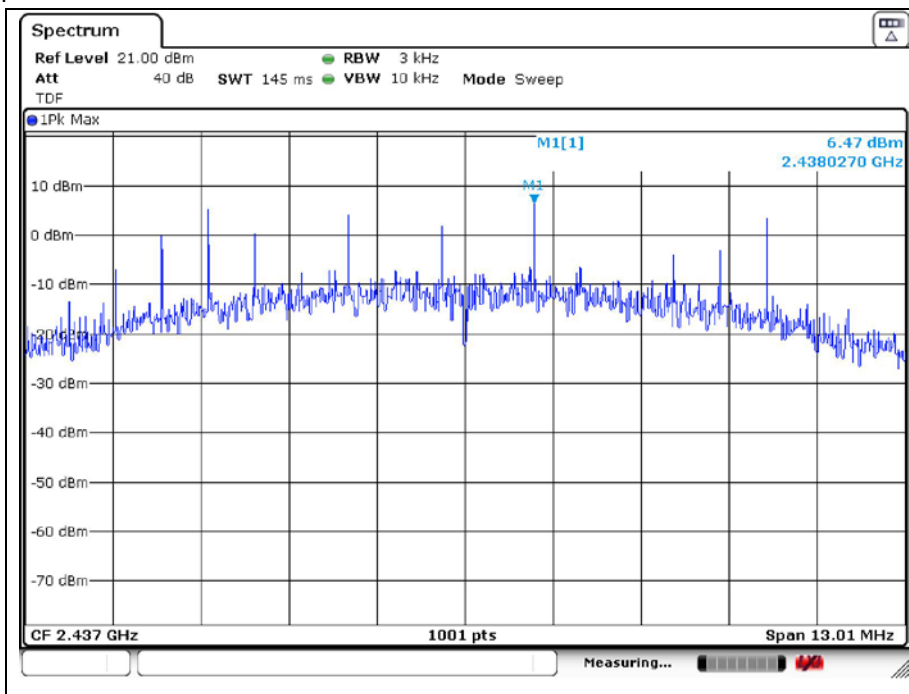
Test Condition: DC 12 V

DSSS: 802.11b

Low Channel



Middle Channel



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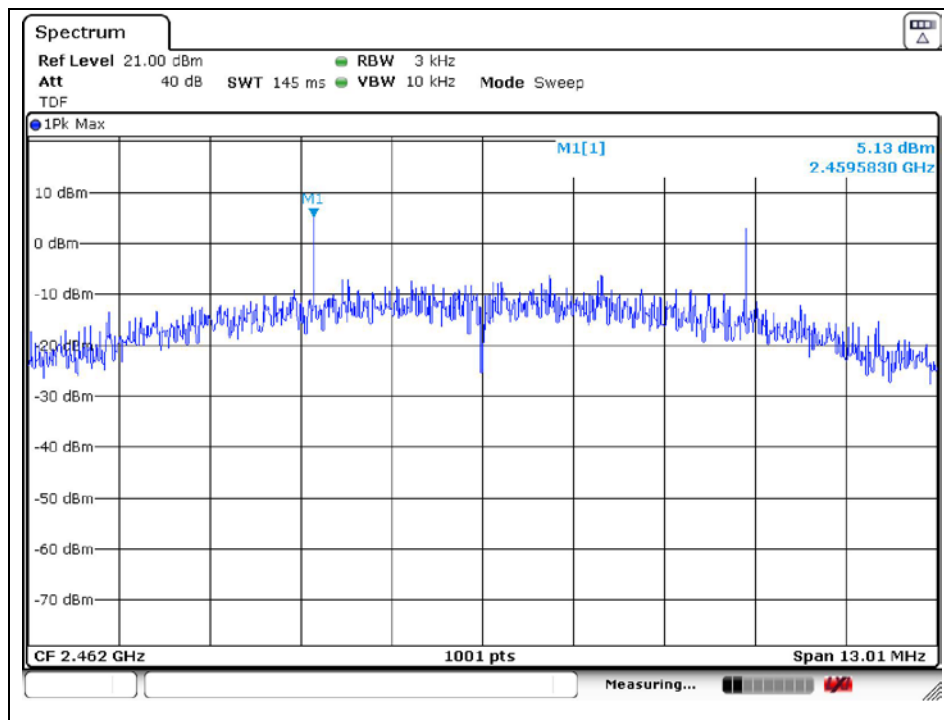
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

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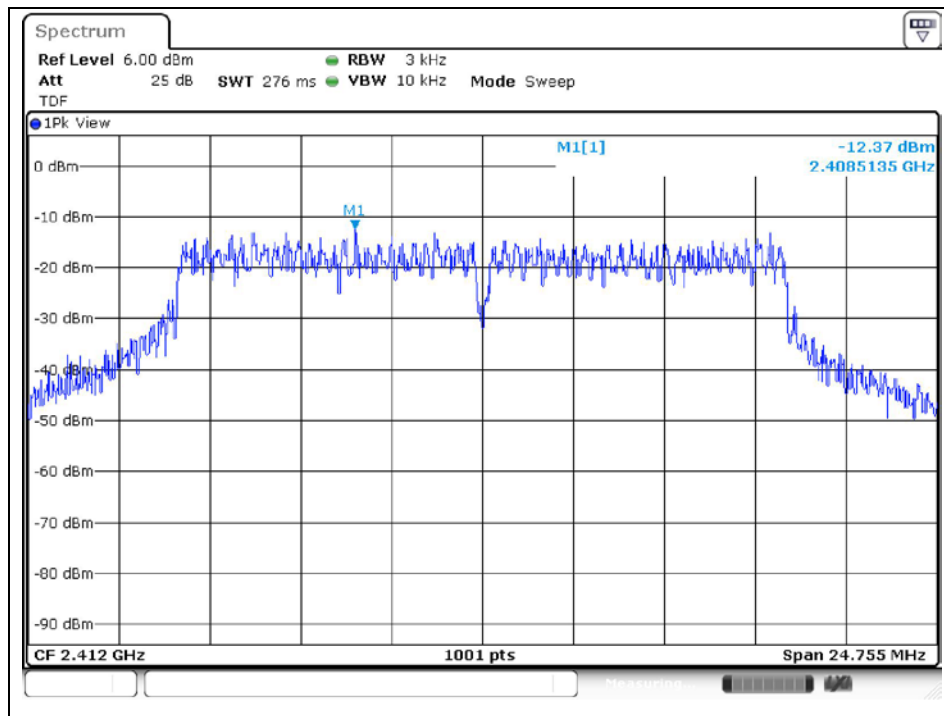
A4(210 mm x 297 mm)

## High Channel



## OFDM: 802.11g

### Low Channel



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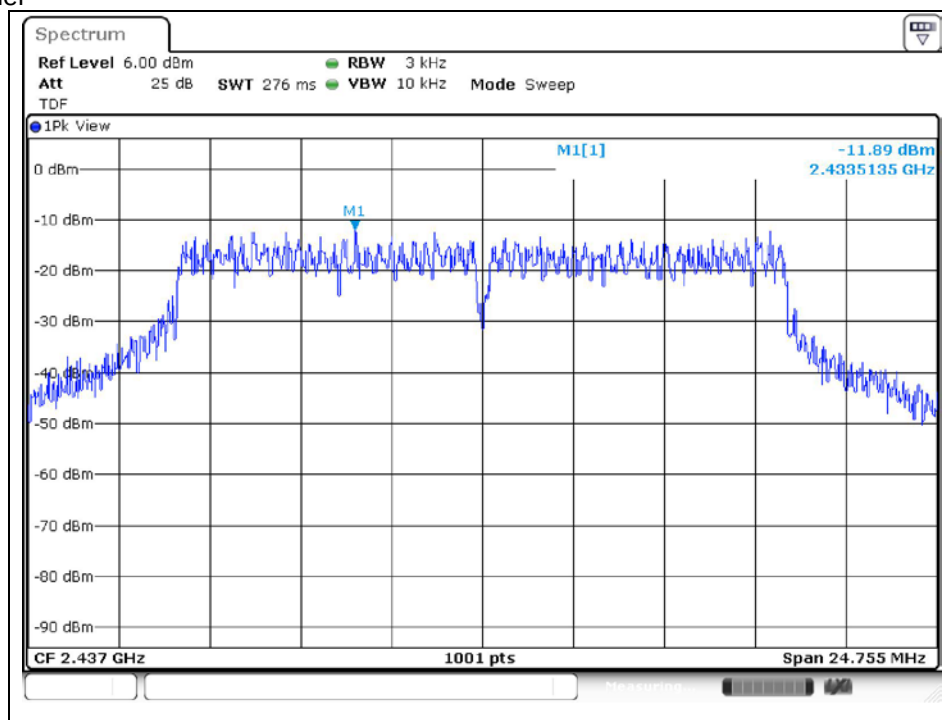
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RTT5041-19(2019.04.24)(1)

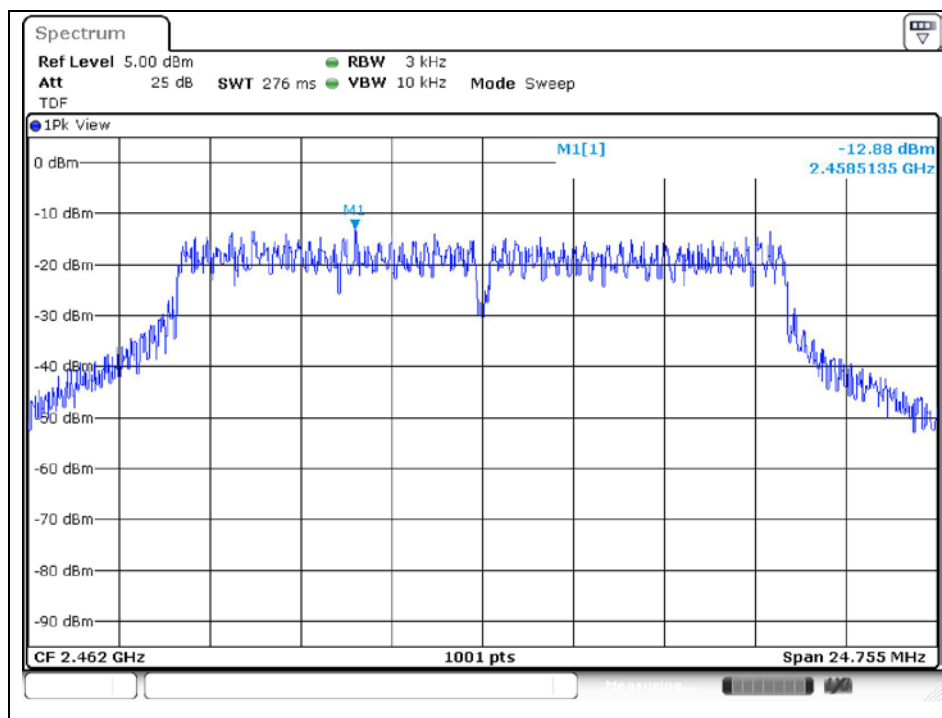
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A4(210 mm x 297 mm)

## Middle Channel



## High Channel



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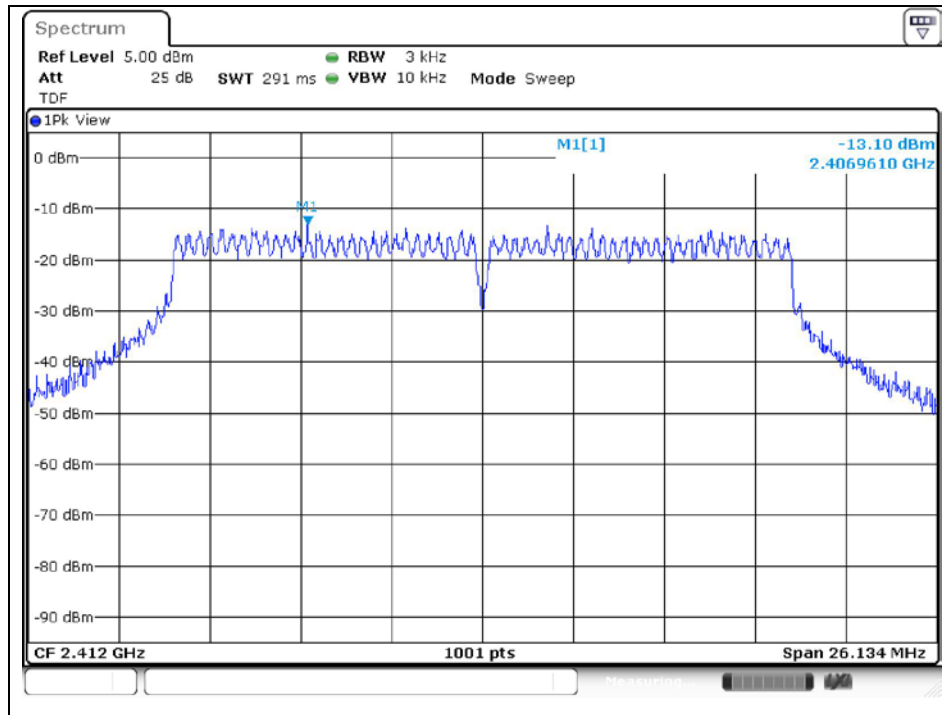
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Tel. +82 31 428 5700 / Fax. +82 31 427 2370

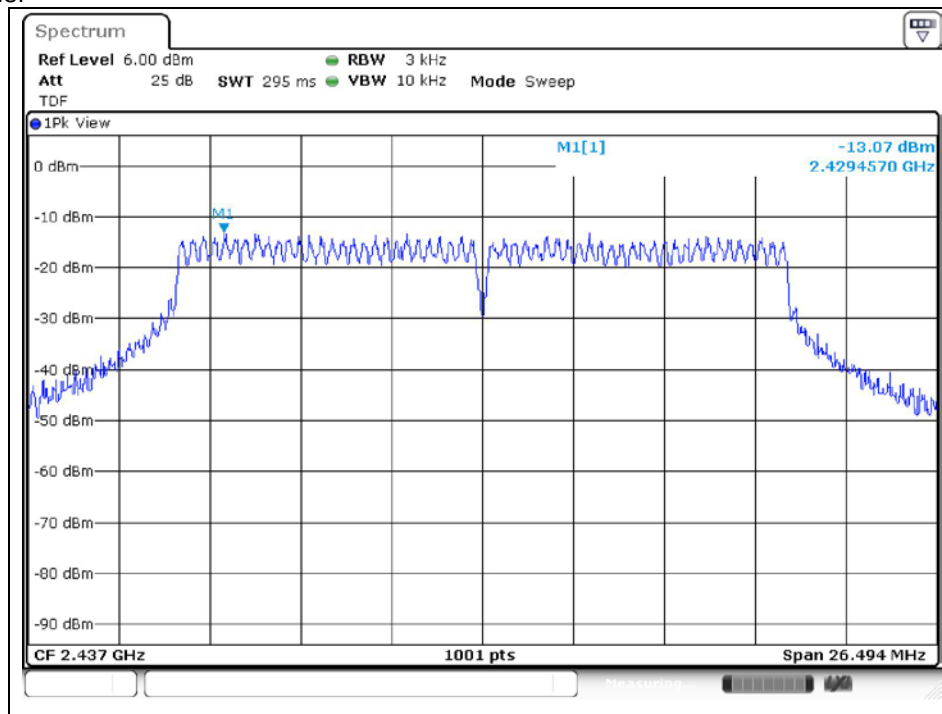
A4(210 mm x 297 mm)

## OFDM: 802.11n\_HT20

### Low Channel



### Middle Channel



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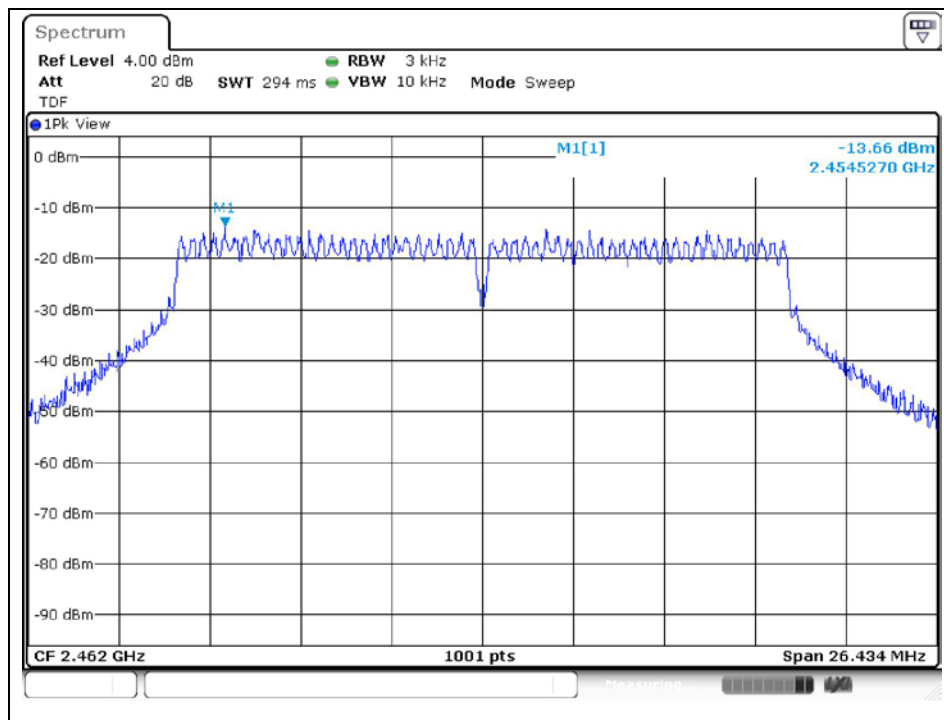
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

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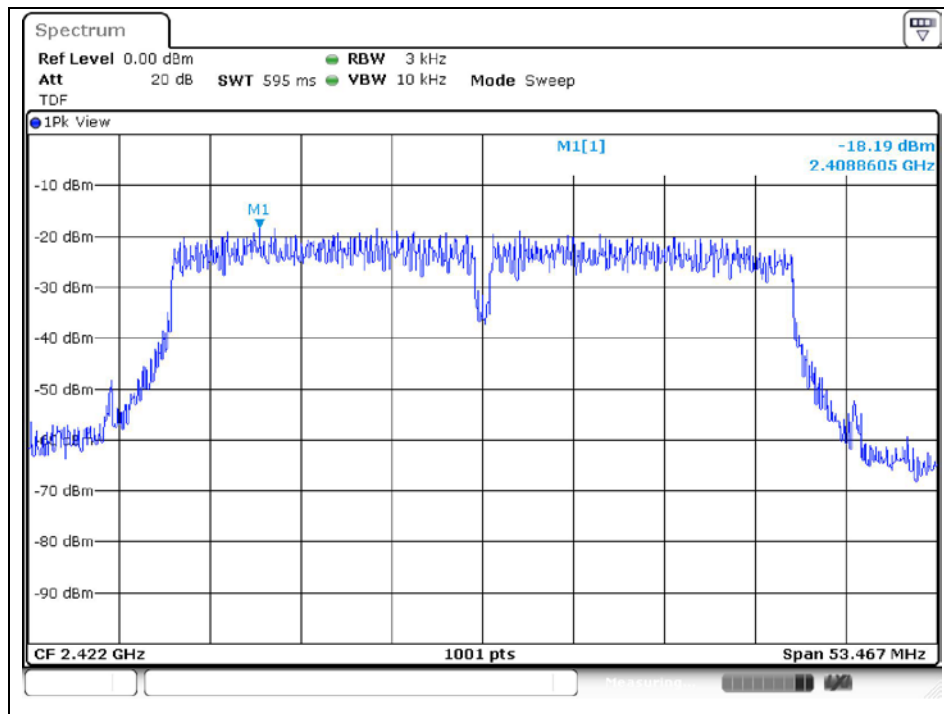
A4(210 mm x 297 mm)

## High Channel



## OFDM: 802.11n\_HT40

### Low Channel



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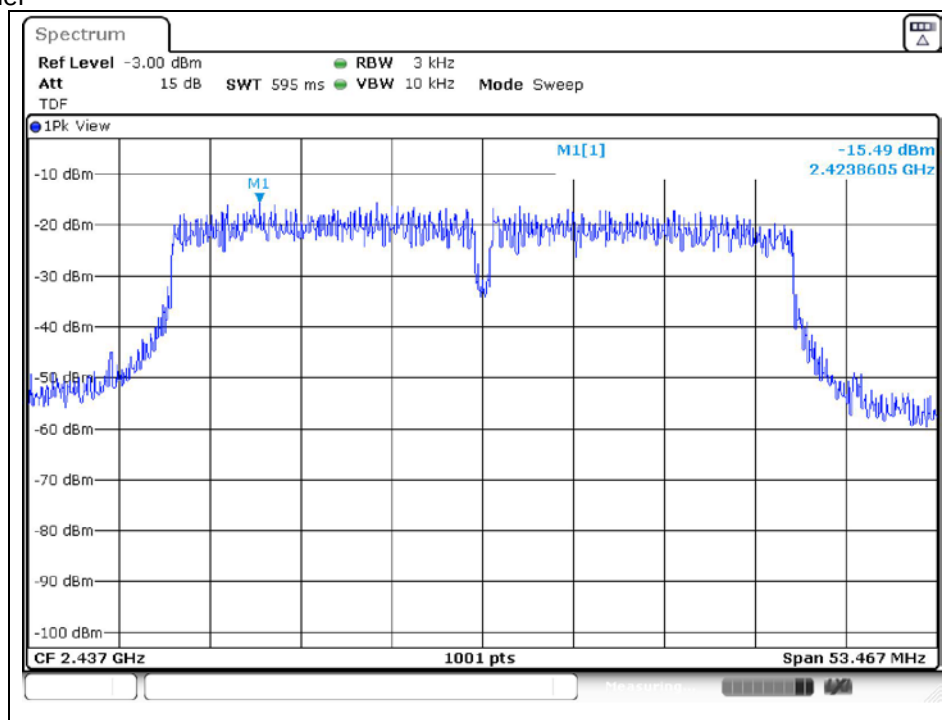
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

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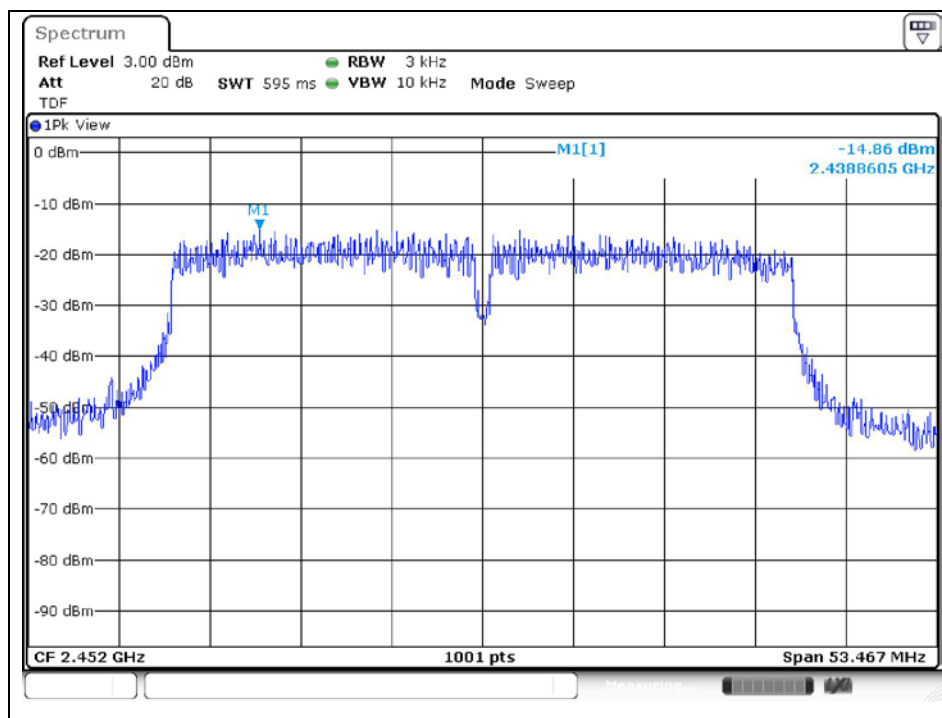
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A4(210 mm x 297 mm)

## Middle Channel



## High Channel



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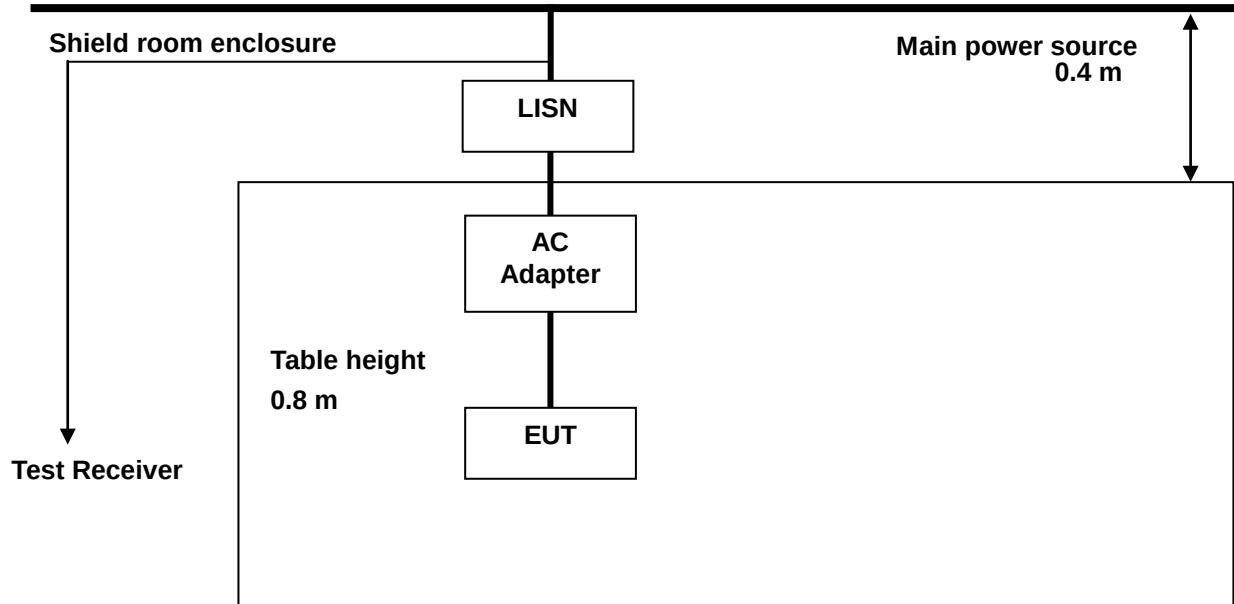
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A4(210 mm x 297 mm)

## 6. Transmitter AC Power Line Conducted Emission

### 6.1. Test Setup



### 6.2. Limit

#### 6.2.1 FCC

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 50  $\mu$  H /50 ohms line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency of emission<br>(MHz) | Conducted limit<br>(dB $\mu$ V) |           |
|--------------------------------|---------------------------------|-----------|
|                                | Quasi-peak                      | Average   |
| 0.15-0.5                       | 66 to 56*                       | 56 to 46* |
| 0.5-5                          | 56                              | 46        |
| 5-30                           | 60                              | 50        |

\* Decreases with the logarithm of the frequency.

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A4(210 mm x 297 mm)

### 6.2.2 IC

RSS-Gen Issue 5, 8.8, Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50  $\mu$  H / 50  $\Omega$  line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

**Table 4 - AC power-line conducted emissions limits**

| Frequency<br>(MHz) | Conducted limit<br>(dB $\mu$ V) |           |
|--------------------|---------------------------------|-----------|
|                    | Quasi-peak                      | Average** |
| 0.15-0.5           | 66 to 56*                       | 56 to 46* |
| 0.5-5              | 56                              | 46        |
| 5-30               | 60                              | 50        |

**Note 1:** The level decreases linearly with the logarithm of the frequency.

For an EUT with a permanent or detachable antenna operating between 150 kHz and 30 MHz, the AC power-line conducted emissions must be measured using the following configurations:

- Perform the AC power-line conducted emissions test with the antenna connected to determine compliance with the limits of table 4 outside the transmitter's fundamental emission band.
- Retest with a dummy load instead of the antenna to determine compliance with the limits of table 4 within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network that simulates the antenna in the fundamental frequency band.

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### 6.3. Test Procedures

AC conducted emissions from the EUT were measured according to the dictates of ANSI C63.10:2013

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

---

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A4(210 mm × 297 mm)

## 6.4. Test Results

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Ambient temperature : (23 ± 1) °C  
Relative humidity : 47 % R.H.  
  
Frequency range : 0.15 MHz - 30 MHz  
Measured Bandwidth : 9 kHz

**Test Condition: DC 5 V**

| FREQ.<br>(MHz) | LEVEL (dBμV) |         | LINE | LIMIT (dBμV) |         | MARGIN (dB) |         |
|----------------|--------------|---------|------|--------------|---------|-------------|---------|
|                | Q-Peak       | Average |      | Q-Peak       | Average | Q-Peak      | Average |
| 0.15           | 56.90        | 31.10   | N    | 66.00        | 56.00   | 9.10        | 24.90   |
| 0.21           | 47.70        | 31.30   | N    | 63.21        | 53.21   | 15.51       | 21.91   |
| 2.09           | 30.00        | 24.20   | N    | 56.00        | 46.00   | 26.00       | 21.80   |
| 5.79           | 26.60        | 20.30   | N    | 60.00        | 50.00   | 33.40       | 29.70   |
| 8.01           | 23.70        | 18.00   | N    | 60.00        | 50.00   | 36.30       | 32.00   |
| 15.51          | 26.30        | 19.50   | N    | 60.00        | 50.00   | 33.70       | 30.50   |
| 0.16           | 59.60        | 39.00   | H    | 65.46        | 55.46   | 5.86        | 16.46   |
| 0.57           | 35.50        | 32.80   | H    | 56.00        | 46.00   | 20.50       | 13.20   |
| 1.35           | 33.70        | 24.40   | H    | 56.00        | 46.00   | 22.30       | 21.60   |
| 1.70           | 34.80        | 27.90   | H    | 56.00        | 46.00   | 21.20       | 18.10   |
| 9.37           | 27.20        | 22.30   | H    | 60.00        | 50.00   | 32.80       | 27.70   |
| 15.49          | 26.50        | 19.30   | H    | 60.00        | 50.00   | 33.50       | 30.70   |

### Remark;

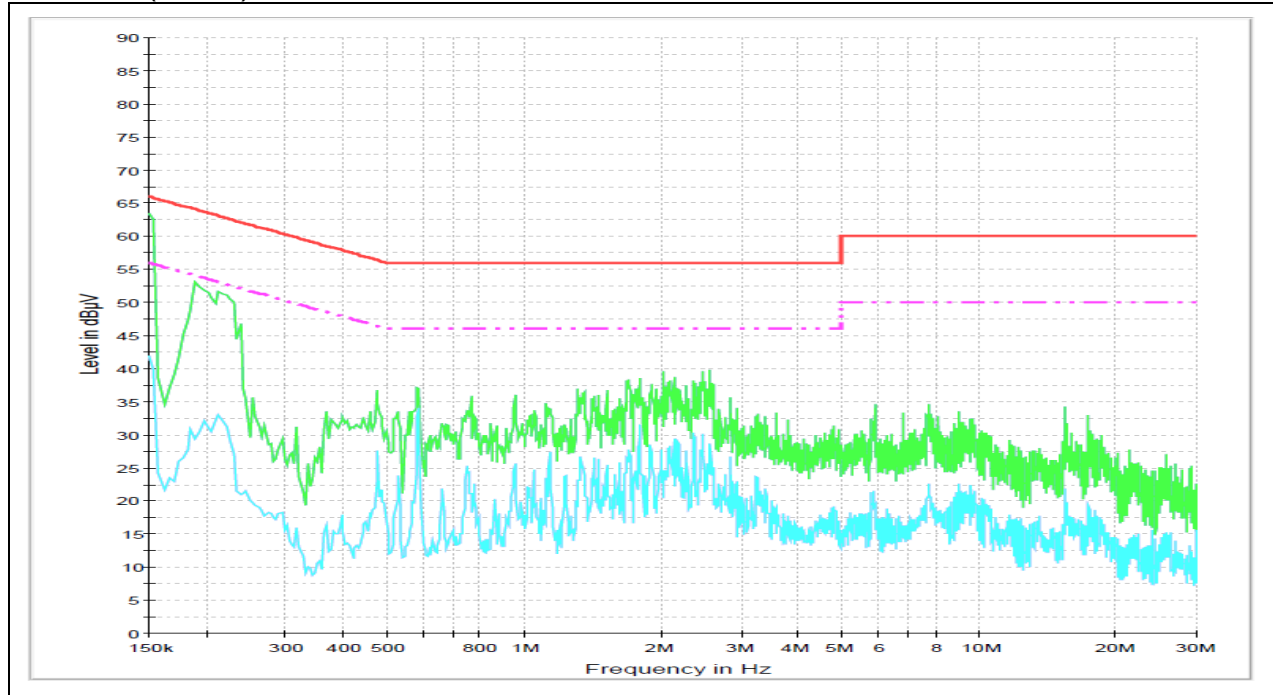
- Line ( H ): Hot, Line ( N ): Neutral.
- All modes of operation were investigated and the worst-case emissions were reported using **11g / 12 Mbps / Middle channel.**
- The limit for Class B device(s) from 150 kHz to 30 MHz are specified in Section of the Title 47 CFR.
- Traces shown in plot were made by using a peak detector and average detector.
- Deviations to the Specifications: None.

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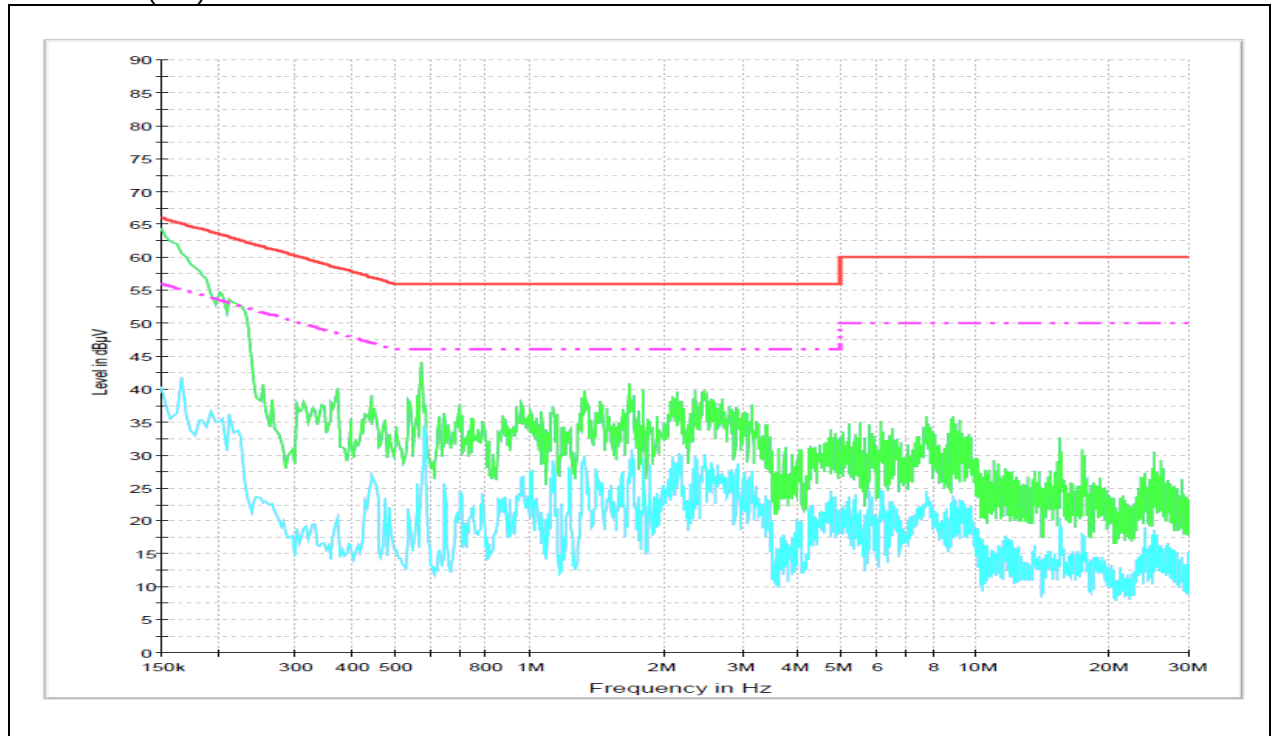
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## -Test plots

Test mode: (Neutral)



Test mode: (Hot)



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A4(210 mm x 297 mm)

**Test Condition: DC 12 V**

| FREQ.<br>(MHz) | LEVEL (dB $\mu$ V) |         | LINE | LIMIT (dB $\mu$ V) |         | MARGIN (dB) |         |
|----------------|--------------------|---------|------|--------------------|---------|-------------|---------|
|                | Q-Peak             | Average |      | Q-Peak             | Average | Q-Peak      | Average |
| 0.17           | 57.60              | 35.90   | N    | 64.96              | 54.96   | 7.36        | 19.06   |
| 0.72           | 32.30              | 23.50   | N    | 56.00              | 46.00   | 23.70       | 22.50   |
| 1.45           | 30.70              | 24.80   | N    | 56.00              | 46.00   | 25.30       | 21.20   |
| 2.17           | 33.10              | 26.90   | N    | 56.00              | 46.00   | 22.90       | 19.10   |
| 9.72           | 31.90              | 23.90   | N    | 60.00              | 50.00   | 28.10       | 26.10   |
| 17.45          | 23.60              | 16.80   | N    | 60.00              | 50.00   | 36.40       | 33.20   |
| 0.17           | 56.70              | 34.30   | H    | 64.96              | 54.96   | 8.26        | 20.66   |
| 0.57           | 32.20              | 28.10   | H    | 56.00              | 46.00   | 23.80       | 17.90   |
| 1.74           | 31.60              | 23.00   | H    | 56.00              | 46.00   | 24.40       | 23.00   |
| 2.49           | 32.90              | 25.30   | H    | 56.00              | 46.00   | 23.10       | 20.70   |
| 7.80           | 27.80              | 22.70   | H    | 60.00              | 50.00   | 32.20       | 27.30   |
| 17.42          | 25.20              | 17.90   | H    | 60.00              | 50.00   | 34.80       | 32.10   |

**Remark;**

- Line ( H ): Hot, Line ( N ): Neutral.
- All modes of operation were investigated and the worst-case emissions were reported using **11g / 12 Mbps / Middle channel.**
- The limit for Class B device(s) from 150 kHz to 30 MHz are specified in Section of the Title 47 CFR.
- Traces shown in plot were made by using a peak detector and average detector.
- Deviations to the Specifications: None.

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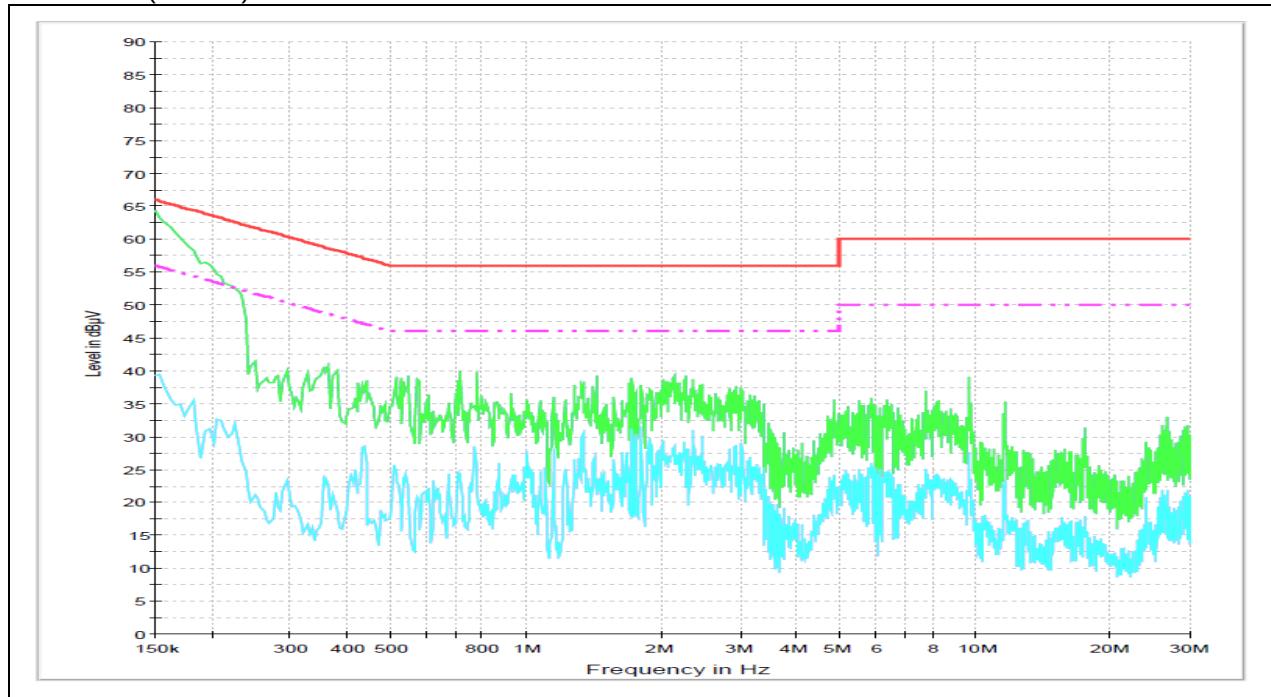
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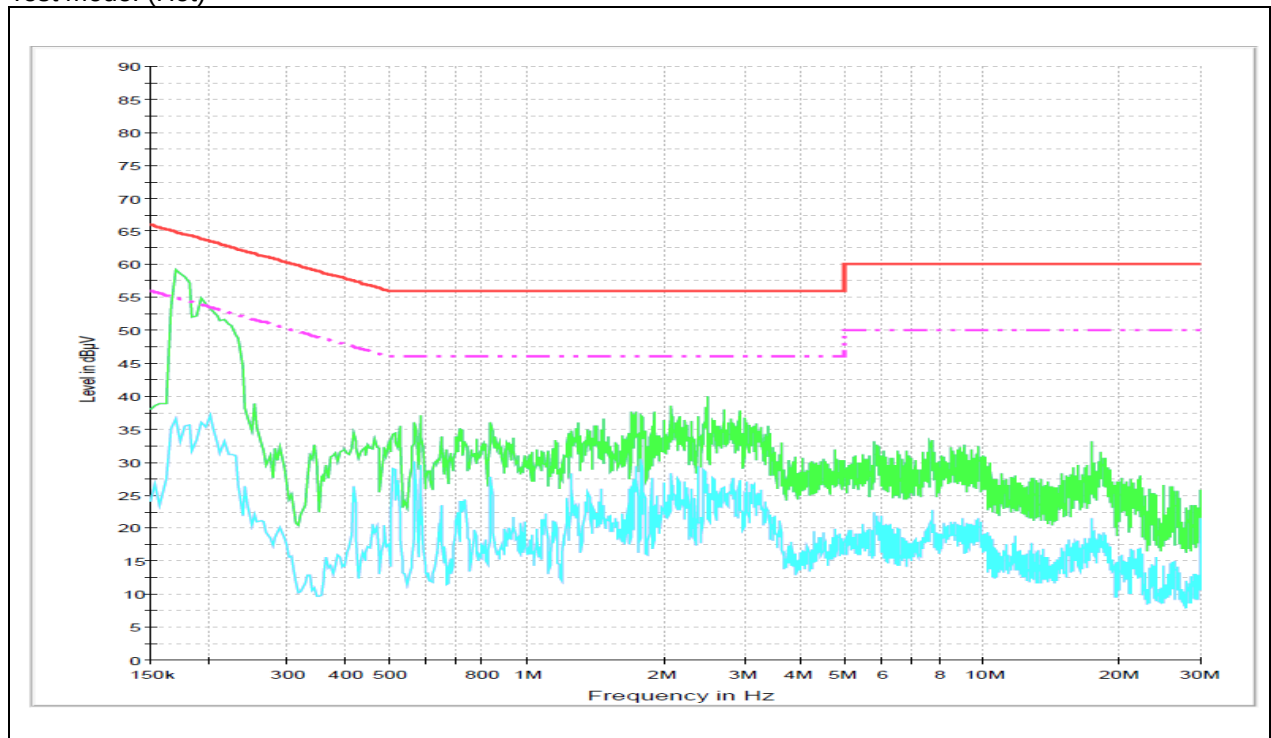
A4(210 mm x 297 mm)

## -Test plots

Test mode: (Neutral)



Test mode: (Hot)



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A4(210 mm x 297 mm)

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## 7. Antenna Requirement

### 7.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §15.203, 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. And according to FCC 47 CFR Section §15.247(b) if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

### 7.2. Antenna Connected Construction

Antenna used in this product is PCB Pattern antenna with gain of 3.56 dBi.

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### - End of the Test Report -

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