

# TEST REPORT

## Part 15 Subpart C 15.247

**Equipment under test** WiFi Module

**Model name** SWL-Q93T

**Derivative Model** SWL-CQ93

**FCC ID** NLMSWLQ93T

**Applicant** Hanwha Techwin Co., Ltd.

**Manufacturer** Hanwha Techwin Co., Ltd.

**Date of test(s)** 2015.11.16 ~ 2015.12.15

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**Issued to**

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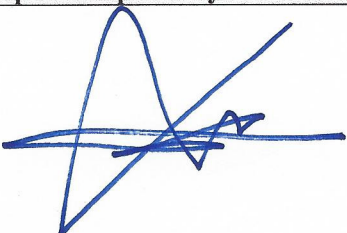
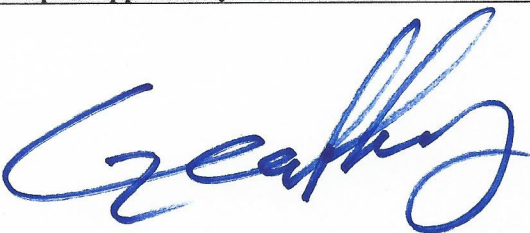
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| Test and report completed by :                                                      | Report approval by :                                                                 |
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| Kwon-se Kim / Test engineer                                                         | Jeff Do / Technical manager                                                          |



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### Revision history

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



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## 1. General information

Applicant: Hanwha Techwin Co., Ltd.  
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473-29, Gayeo-ro, Yeuju-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  
Frequency range 2 412 MHz ~ 2 462 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)  
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  
Number of channels 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  
5 190 MHz ~ 5 230 MHz(802.11n\_HT40) : 2ch  
5 260 MHz ~ 5 320 MHz(802.11a/n\_HT20) : 4ch  
5 270 MHz ~ 5 310 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 (MHz) | Mode         |
|-----|-----------------|--------------|
| 1   | 2 412           | 11b/g/n_HT20 |
| .   | .               | .            |
| 6   | 2 437           | 11b/g/n_HT20 |
| .   | .               | .            |
| 11  | 2 462           | 11b/g/n_HT20 |

### 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 |

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

## 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 mode | Conducted power(dB m) |       |       |       |
|---------|---------------|-----------------------|-------|-------|-------|
|         |               | Data rate(Mbps)       |       |       |       |
|         |               | 1                     | 2     | 5.5   | 11    |
| Low     | Peak          | 13.45                 | 13.31 | 13.03 | 12.69 |
| Middle  |               | 12.82                 | 12.81 | 12.76 | 12.44 |
| High    |               | 12.86                 | 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     | Peak          | 11.64                 | 11.33 | 10.71 | 10.56 | 10.53 | 10.47 | 10.30 | 10.03 |
| Middle  |               | 12.59                 | 12.22 | 12.11 | 12.10 | 12.09 | 12.05 | 12.00 | 11.99 |
| High    |               | 12.51                 | 12.41 | 12.19 | 12.14 | 12.13 | 12.12 | 12.10 | 11.93 |

#### 802.11n(HT20)

| Test mode | Detector mode | Conducted power(dB m) |       |       |       |       |       |       |       |
|-----------|---------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|           |               | Data rate(Mbps)       |       |       |       |       |       |       |       |
|           |               | MCS0                  | MCS1  | MCS2  | MCS3  | MCS4  | MCS5  | MCS6  | MCS7  |
| Low       | Peak          | 13.09                 | 13.00 | 12.71 | 12.55 | 12.33 | 12.17 | 12.01 | 11.96 |
| Middle    |               | 12.68                 | 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

| channel | Detector mode | Conducted power(dB m) |       |       |       |
|---------|---------------|-----------------------|-------|-------|-------|
|         |               | Data rate(Mbps)       |       |       |       |
|         |               | 1                     | 2     | 5.5   | 11    |
| Low     | Peak          | 13.45                 | 13.31 | 13.03 | 12.69 |
| Middle  |               | 12.82                 | 12.81 | 12.76 | 12.44 |
| High    |               | 12.86                 | 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     | Peak          | 13.14                 | 12.73 | 12.67 | 12.50 | 12.50 | 12.50 | 12.26 | 12.14 |
| Middle  |               | 12.24                 | 12.04 | 11.97 | 11.89 | 11.86 | 11.71 | 11.56 | 11.25 |
| High    |               | 11.91                 | 11.65 | 11.43 | 11.38 | 11.28 | 11.23 | 11.16 | 11.15 |

### 802.11n(HT20)

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

## Antenna 0 +Antenna 1

### 802.11n(HT20)

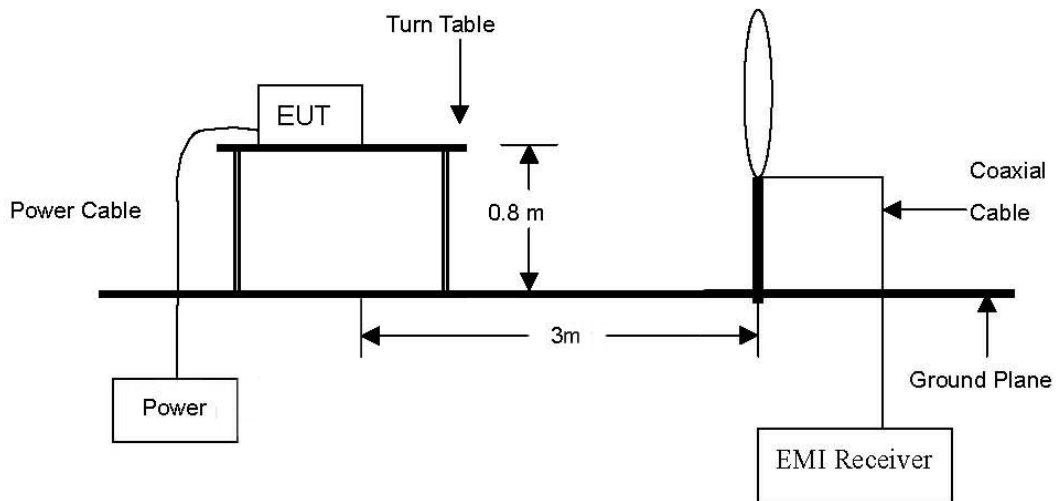
| Test mode | Detector mode | Conducted power(dB m) |       |       |       |       |       |       |       |
|-----------|---------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|           |               | Data rate(Mbps)       |       |       |       |       |       |       |       |
|           |               | MCS8                  | MCS9  | MCS10 | MCS11 | MCS12 | MCS13 | MCS14 | MCS15 |
| Low       | Peak          | 15.89                 | 15.83 | 15.64 | 15.53 | 15.42 | 15.27 | 15.12 | 14.97 |
| Middle    |               | 15.52                 | 15.39 | 15.16 | 15.08 | 15.02 | 14.85 | 14.73 | 14.61 |
| High      |               | 15.30                 | 15.08 | 14.90 | 14.85 | 14.79 | 14.75 | 14.67 | 14.53 |

### 3. Test results

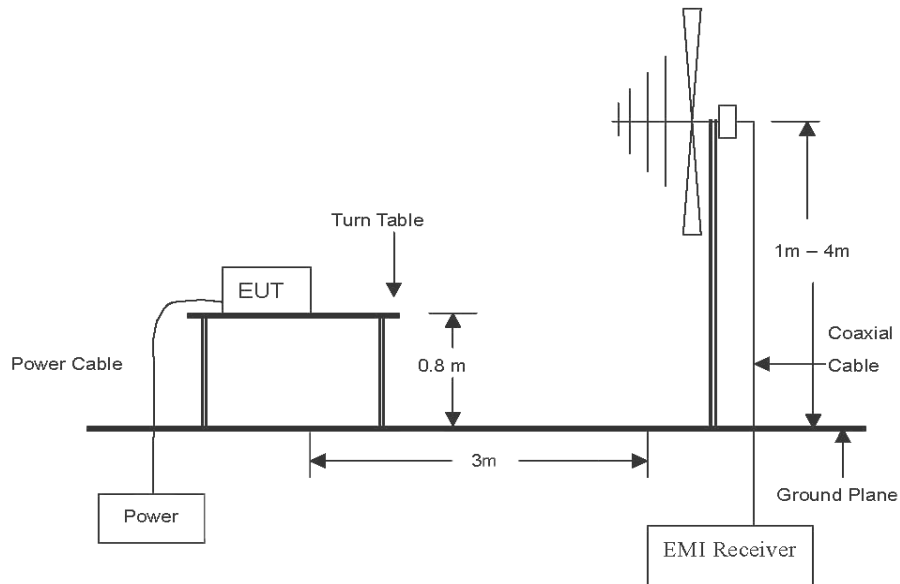
#### 3.1. Radiated restricted band and emissions

##### Test setup

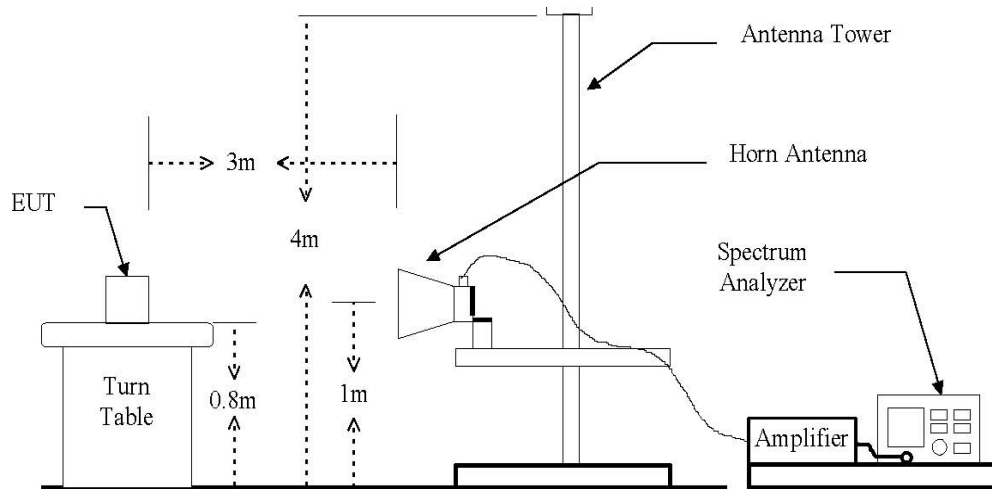
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



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



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 1GHz, 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 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 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 MHz.

Set VBW = 3 MHz ( $\geq 3 \times \text{RBW}$ ).

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 ( $\geq 3 \times \text{RBW}$ ).

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 (MHz) | Distance (Meters) | Radiated ( $\mu\text{V/m}$ ) |
|-----------------|-------------------|------------------------------|
| 0.009 ~ 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 ~ 72 MHz, 76 ~ 88 MHz, 174 ~ 216 MHz or 470 ~ 806 MHz. 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 MHz)

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

| Frequency (MHz)    | Level (dBμV) | Ant. Pol. | Correction factors (dB/m) | F <sub>d</sub> (dB) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|--------------------|--------------|-----------|---------------------------|---------------------|-------------------------|----------------|-------------|
| No signal detected |              |           |                           |                     |                         |                |             |

### Test results (Below 1 000 MHz)

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

| Radiated emissions |                | Ant. | Correction factors |                 | Total           | Limit          |             |
|--------------------|----------------|------|--------------------|-----------------|-----------------|----------------|-------------|
| Frequency (MHz)    | Reading (dBμV) | Pol. | Ant. factor (dB/m) | Cable loss (dB) | Actual (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
| 100.810            | 27.68          | H    | 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          | H    | 10.67              | 1.32            | 36.35           | 43.52          | 7.17        |
| 240.490            | 24.53          | H    | 11.63              | 1.37            | 37.53           | 46.02          | 8.49        |
| 264.740            | 20.12          | H    | 12.52              | 1.46            | 34.10           | 46.02          | 11.92       |
| 346.220            | 21.04          | H    | 14.86              | 1.65            | 37.55           | 46.02          | 8.47        |
| 451.950            | 17.45          | H    | 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 low channel 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 MHz)

#### -Antenna port 0

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

| Frequency (MHz) | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|--------|-----------|---------------------------|-------------------------|----------------|-------------|
| 2397.21         | 61.84        | Peak   | H         | -0.91                     | 60.93                   | 74.00          | 13.07       |
| 2398.69         | 45.35        | Avg    | H         | -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 (MHz)                                                           | 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: 802.11b  
Transfer rate: 1 Mbps  
Operating frequency: 2 462 MHz

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

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

| Frequency (MHz) | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|--------|-----------|---------------------------|-------------------------|----------------|-------------|
| 2399.68         | 72.80        | Peak   | H         | -0.90                     | 71.90                   | 74.00          | 2.10        |
| 2399.90         | 42.31        | Avg    | H         | -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 (MHz) | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|--------|-----------|---------------------------|-------------------------|----------------|-------------|
| 4884.00         | 36.00        | Peak   | H         | 8.64                      | 44.64                   | 74.00          | 29.36       |

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

| Frequency (MHz) | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|--------|-----------|---------------------------|-------------------------|----------------|-------------|
| 2485.74         | 58.12        | Peak   | H         | -0.44                     | 57.68                   | 74.00          | 16.32       |
| 2483.55         | 31.62        | Avg    | H         | -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

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

| Frequency (MHz) | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|--------|-----------|---------------------------|-------------------------|----------------|-------------|
| 2397.61         | 62.57        | Peak   | H         | -0.91                     | 61.66                   | 74.00          | 12.34       |
| 2398.14         | 51.63        | Avg    | H         | -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   | H         | 8.25                      | 47.09                   | 74.00          | 26.91       |

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

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

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

| Frequency (MHz) | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|--------|-----------|---------------------------|-------------------------|----------------|-------------|
| 2484.59         | 58.56        | Peak   | H         | -0.44                     | 58.12                   | 74.00          | 15.88       |
| 2483.55         | 35.71        | Avg    | H         | -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   | H         | 8.93                      | 48.06                   | 74.00          | 25.94       |



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

| Frequency (MHz) | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|--------|-----------|---------------------------|-------------------------|----------------|-------------|
| 2399.84         | 71.78        | Peak   | H         | -0.90                     | 70.88                   | 74.00          | 3.12        |
| 2399.68         | 42.21        | Avg    | H         | -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 (MHz)                                                           | 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

| Frequency (MHz) | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|--------|-----------|---------------------------|-------------------------|----------------|-------------|
| 2484.15         | 57.33        | Peak   | H         | -0.45                     | 56.88                   | 74.00          | 17.12       |
| 2483.55         | 35.65        | Avg    | H         | -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 (MHz) | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|--------|-----------|---------------------------|-------------------------|----------------|-------------|
| 2399.04         | 72.10        | Peak   | H         | -0.90                     | 71.20                   | 74.00          | 2.80        |
| 2399.68         | 47.42        | Avg    | H         | -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  
Operating frequency: 2 437 MHz

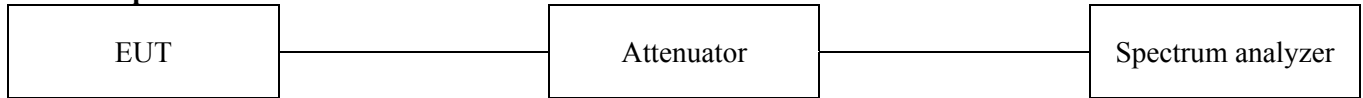
| Frequency (MHz)                                                           | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---------------------------------------------------------------------------|--------------|--------|-----------|---------------------------|------------------------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

Mode: 802.11n (HT20)  
Transfer rate: MCS8  
Operating frequency: 2 462 MHz

| Frequency (MHz) | Level (dBμV) | Detect | Ant. Pol. | Correction factors (dB/m) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|--------|-----------|---------------------------|-------------------------|----------------|-------------|
| 2484.15         | 58.37        | Peak   | H         | -0.45                     | 57.92                   | 74.00          | 16.08       |
| 2483.61         | 36.75        | Avg    | H         | -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 setup



#### 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 ( $\geq 3 \times$  RBW).

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker 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.

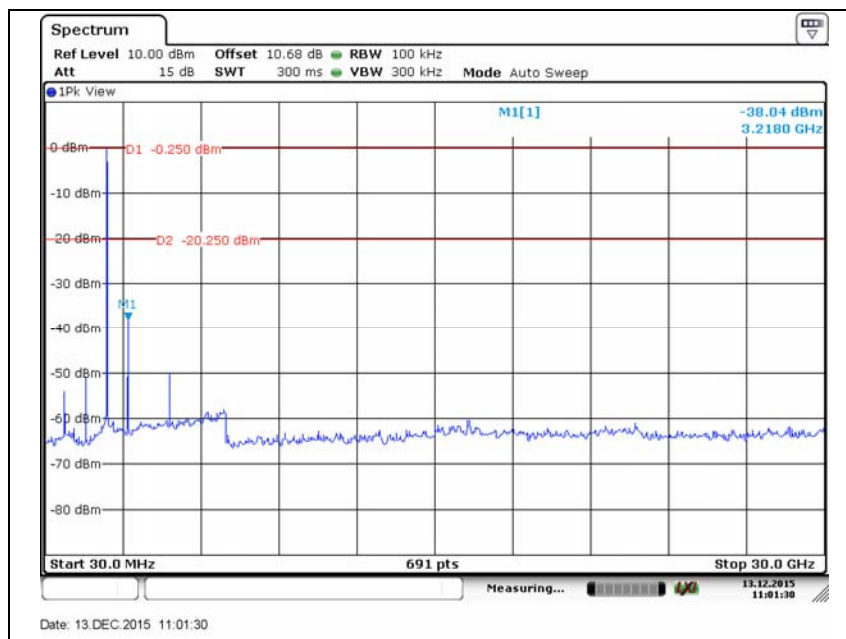
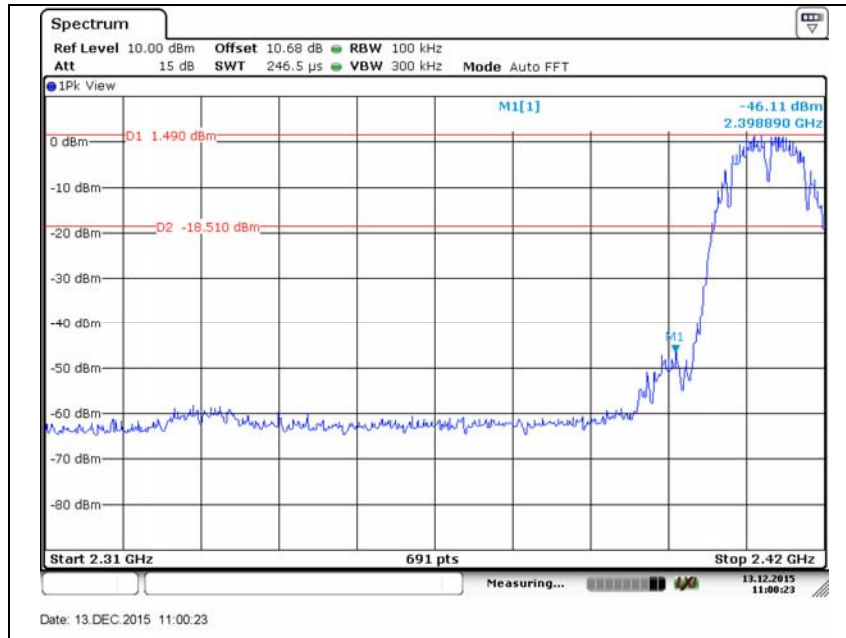
#### Limit

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 defined 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

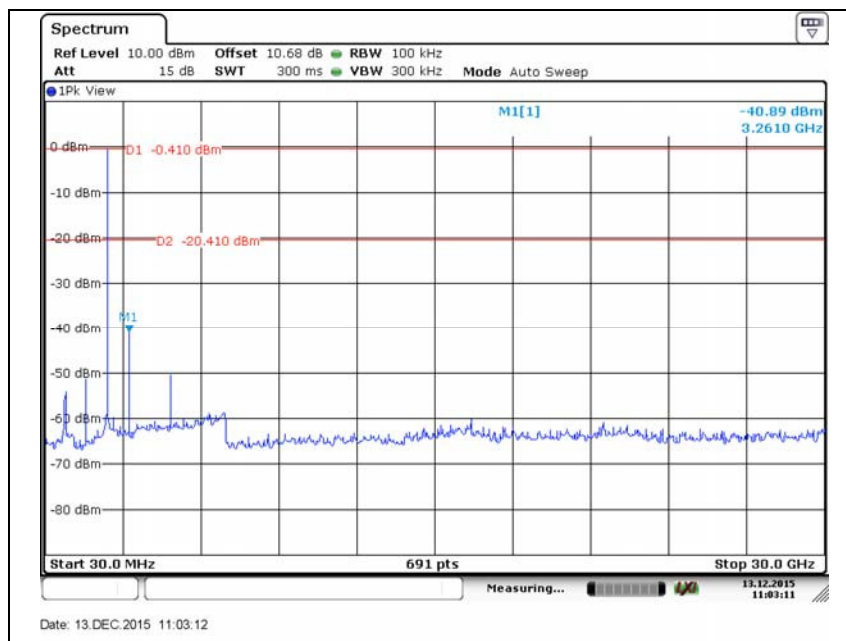
### -Antenna port 0

#### 802.11b // Low channel

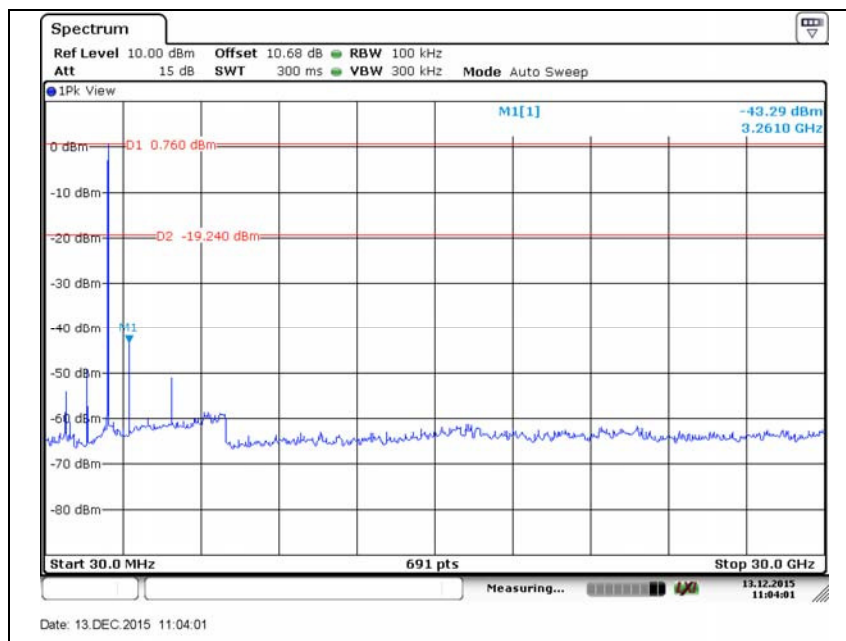
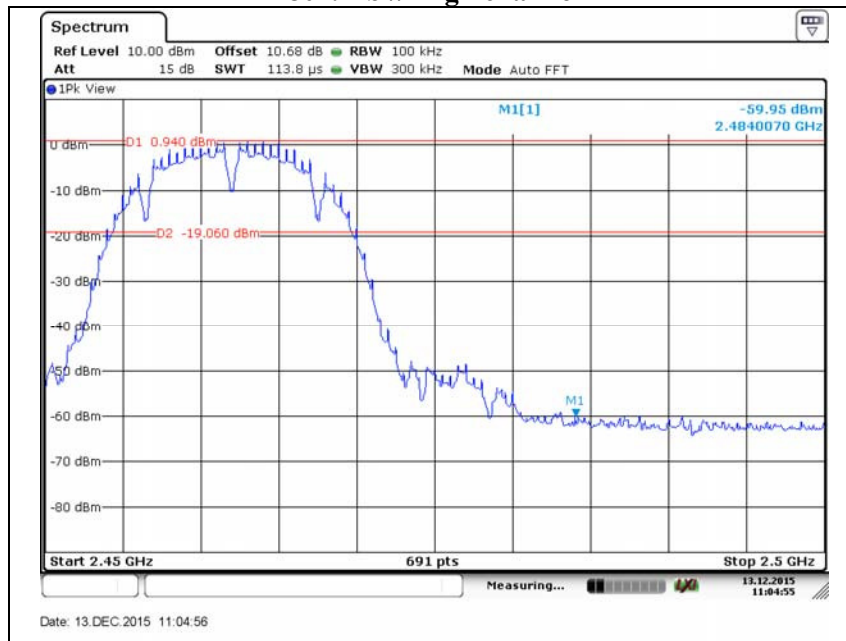


### 802.11b // Middle channel

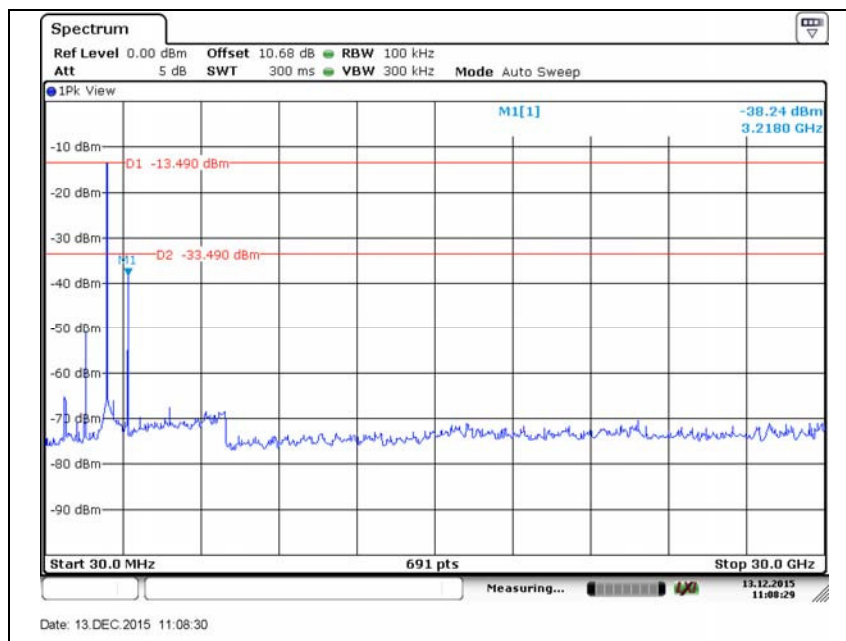
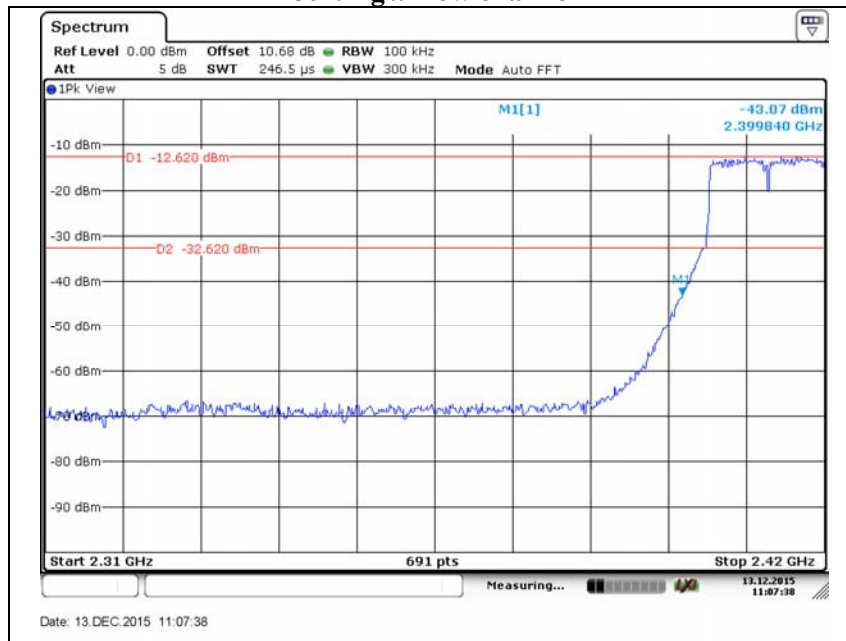
N/A



### 802.11b // High channel

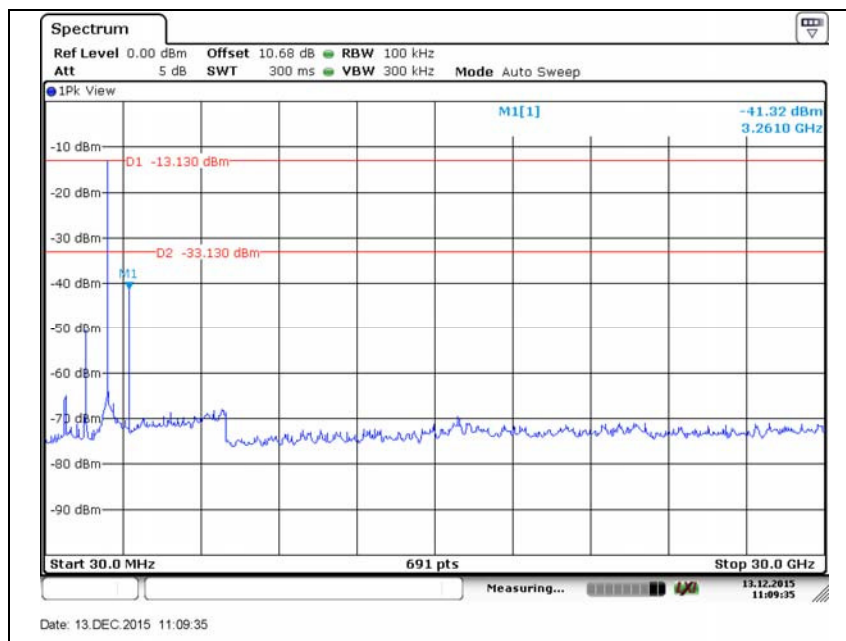


### 802.11g // Low channel

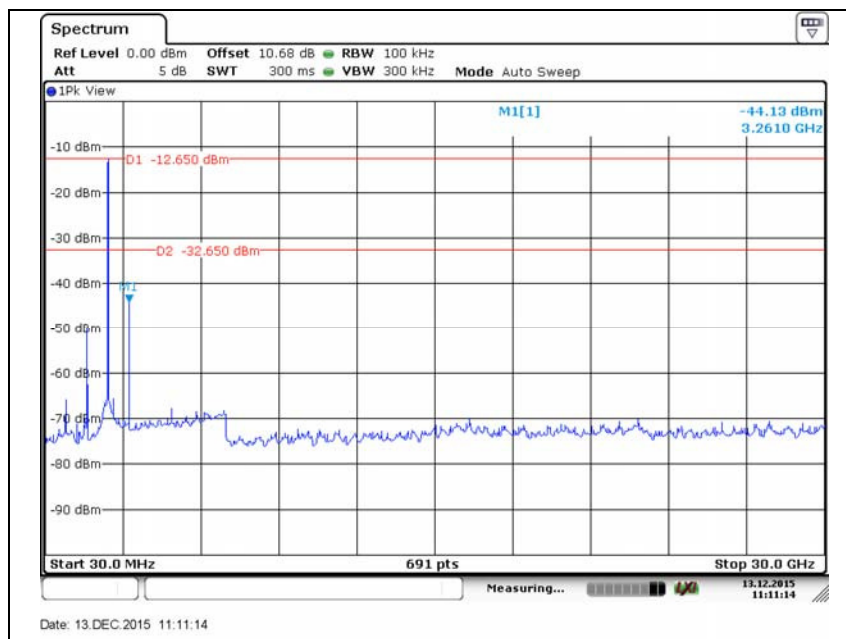
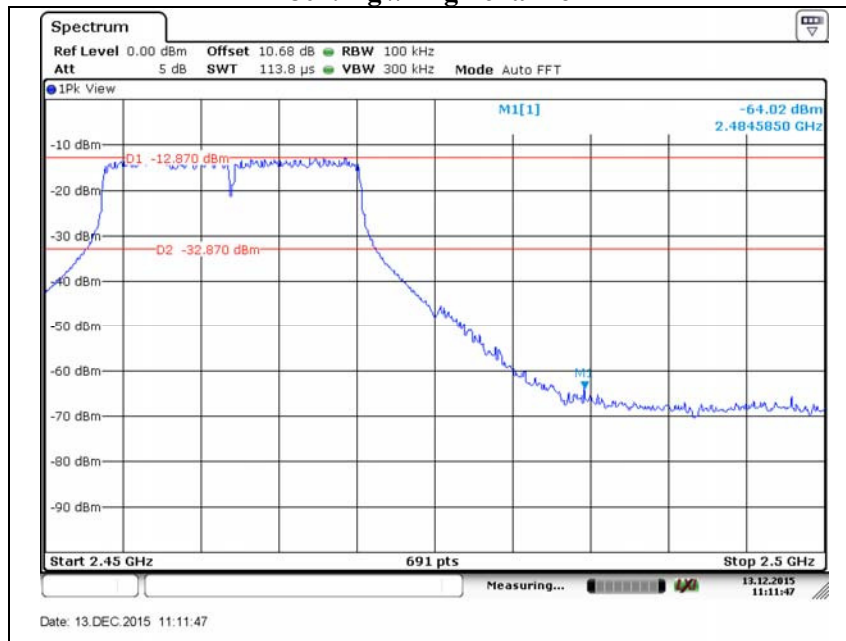


### 802.11g // Middle channel

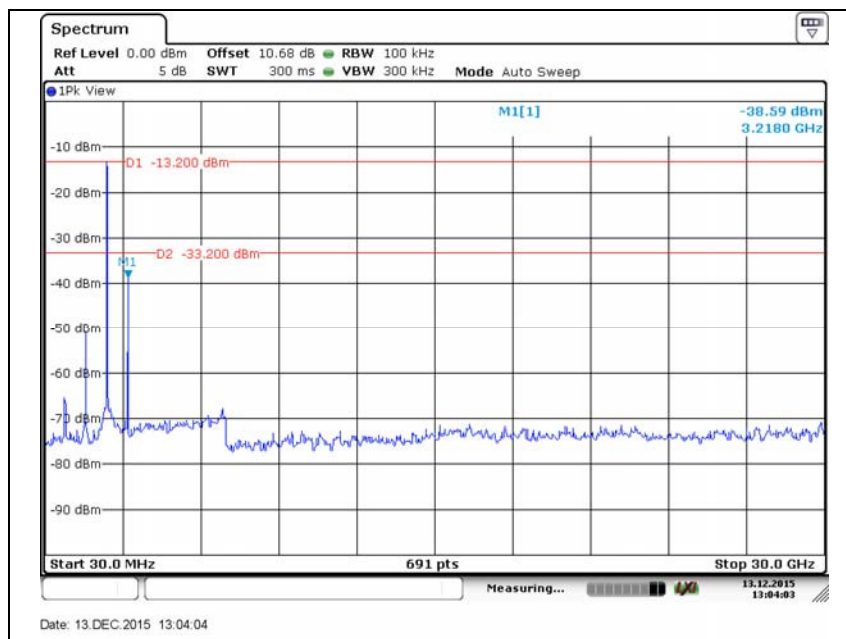
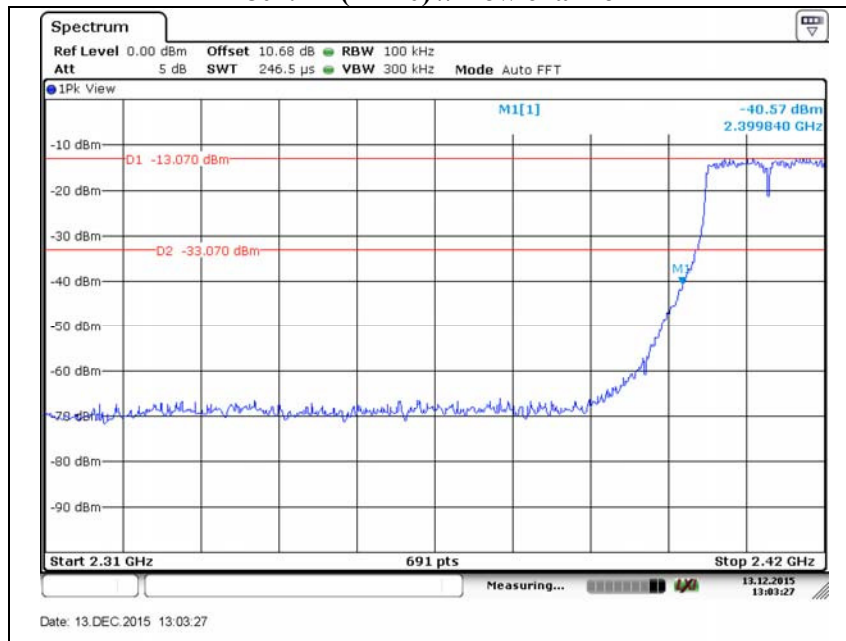
N/A



### 802.11g // High channel

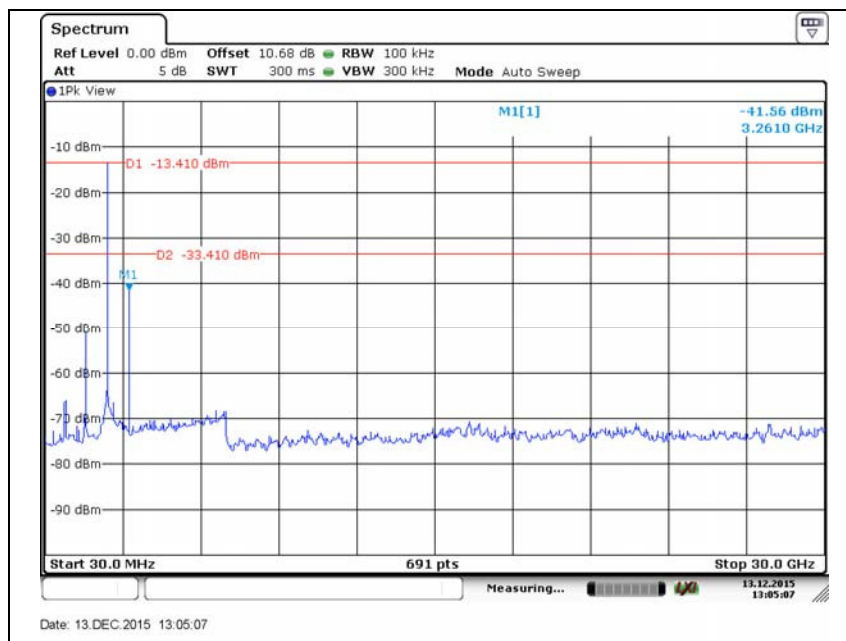


### 802.11n(HT20) // Low channel

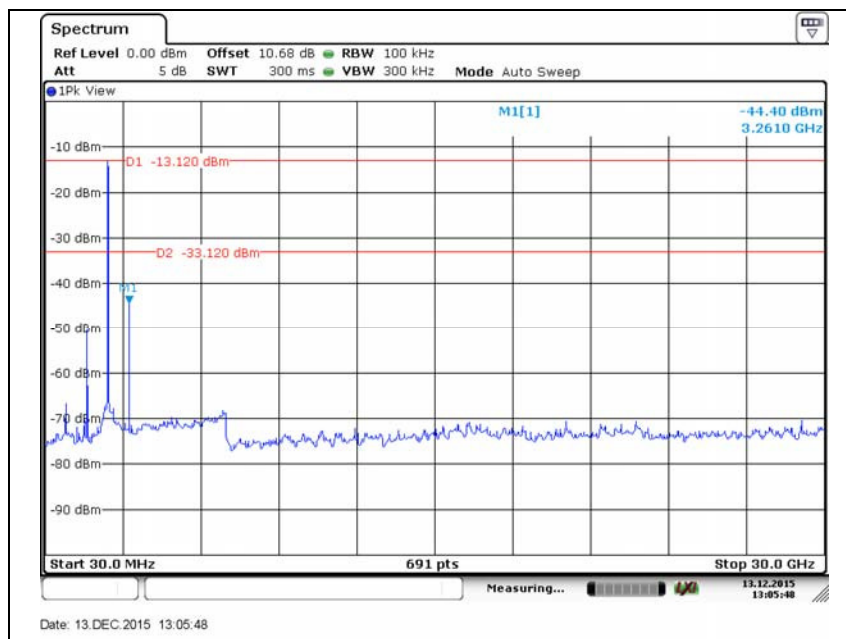
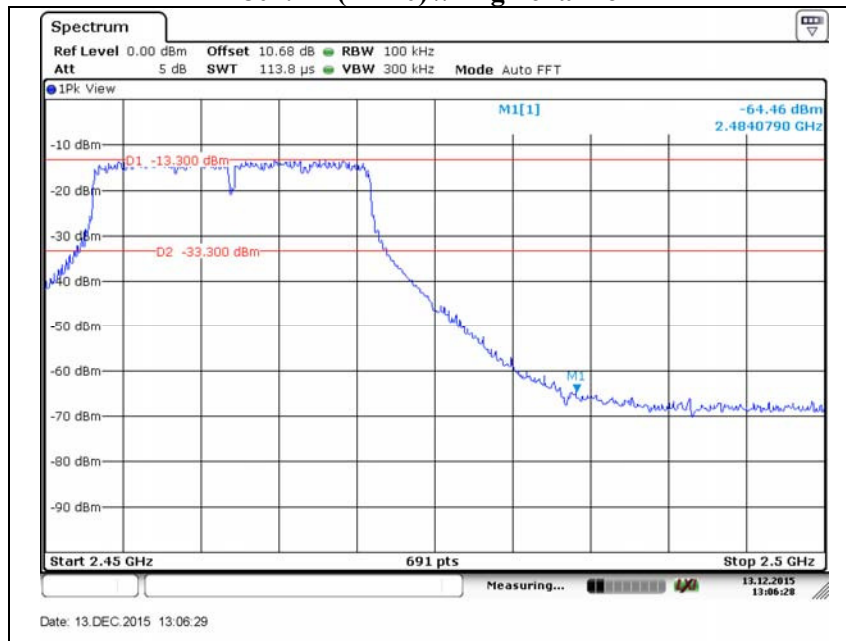


### 802.11n(HT20) // Middle channel

N/A

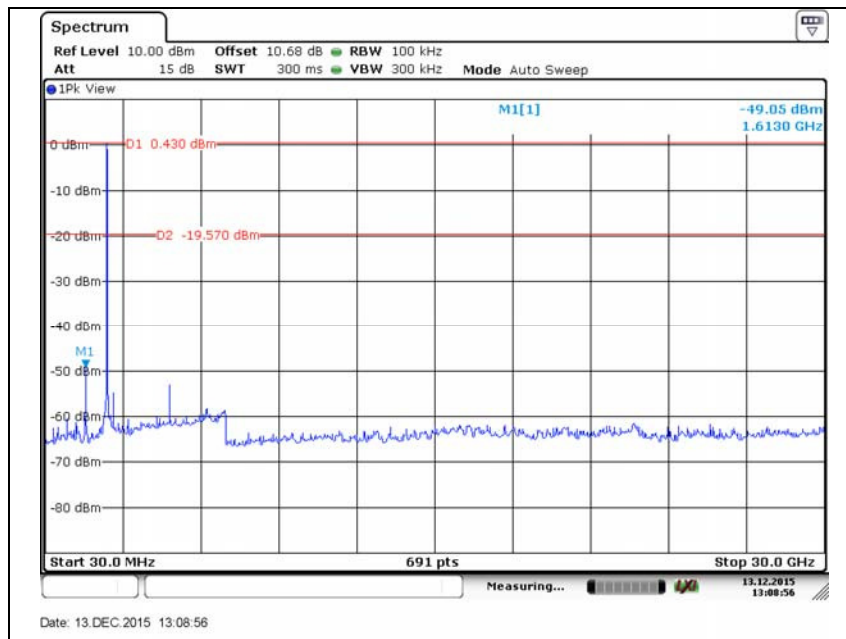
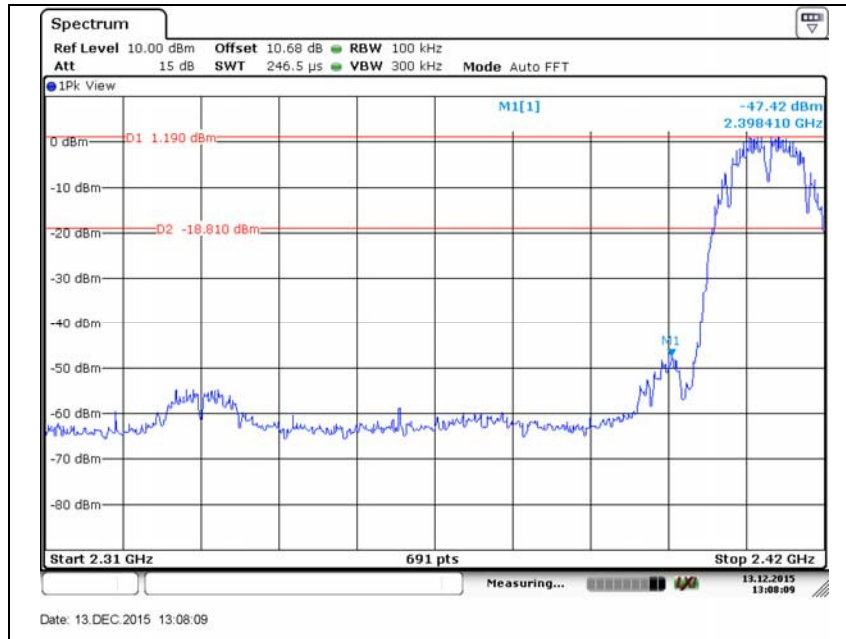


### 802.11n(HT20) // High channel



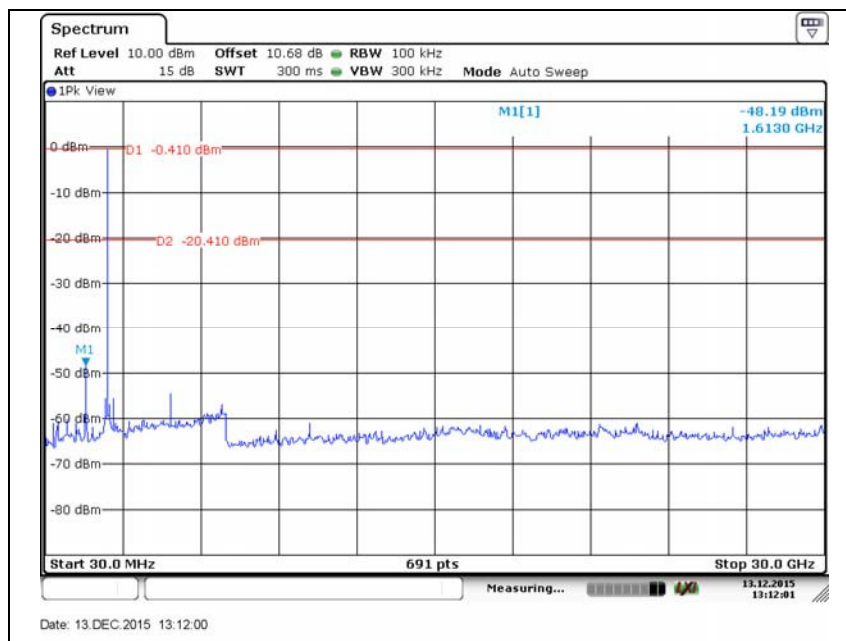
**-Antenna port 1**

**802.11b // Low channel**

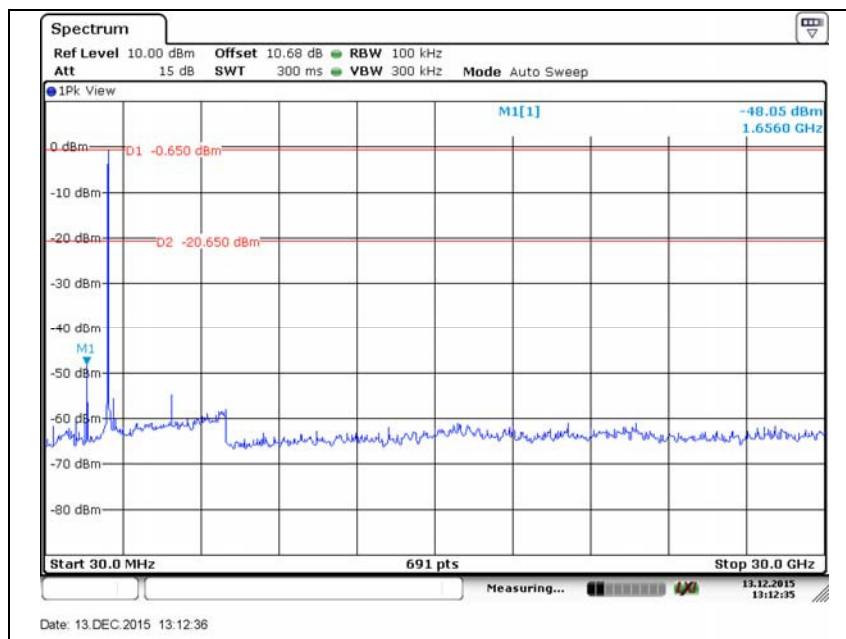
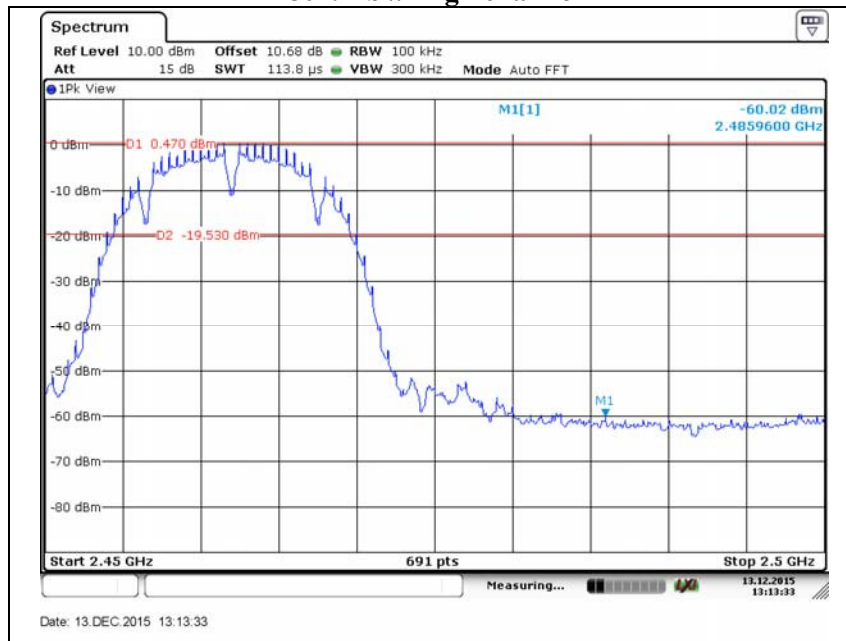


### 802.11b // Middle channel

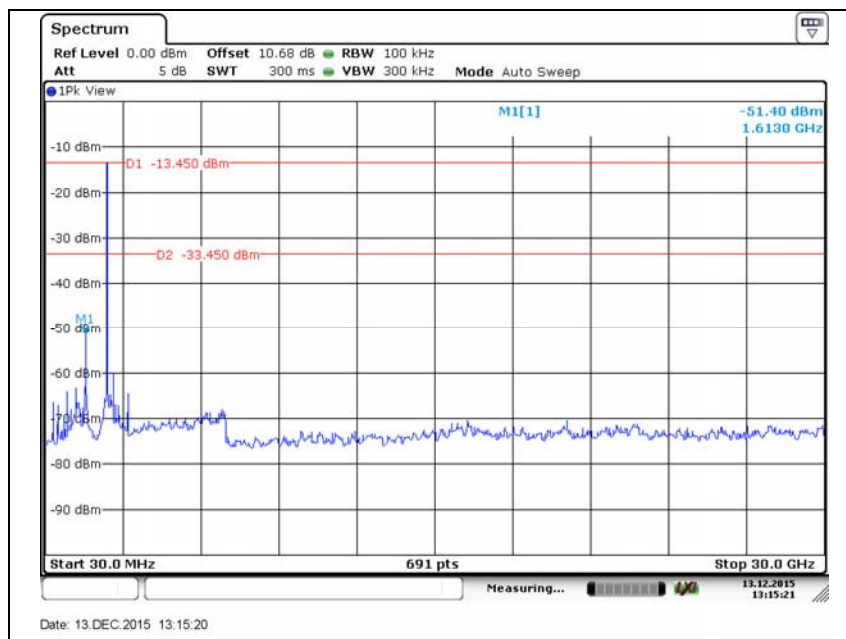
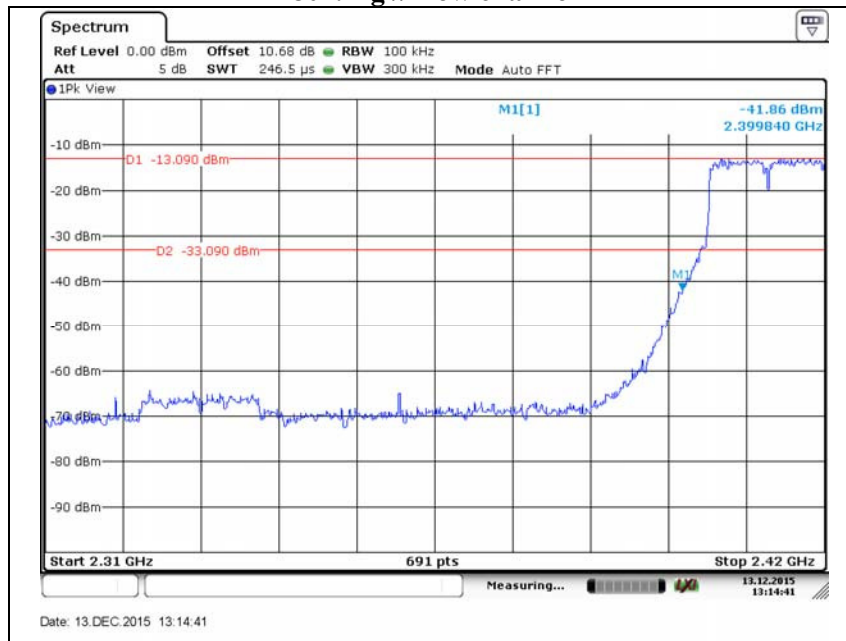
N/A



### 802.11b // High channel

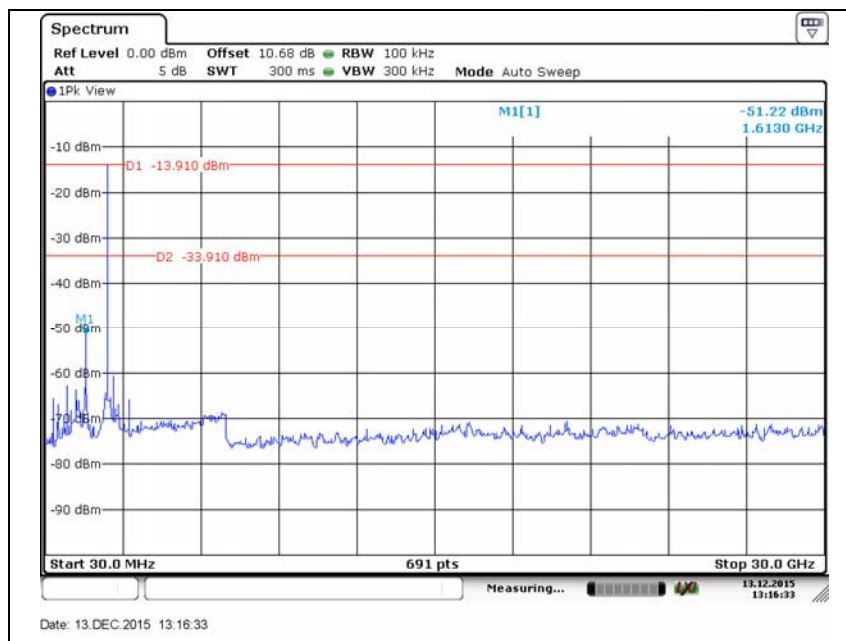


### 802.11g // Low channel

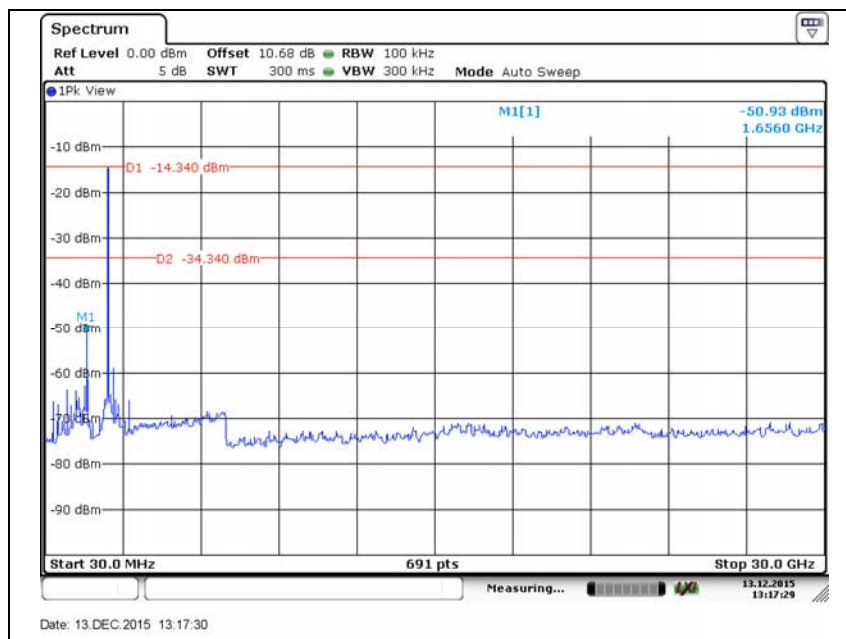
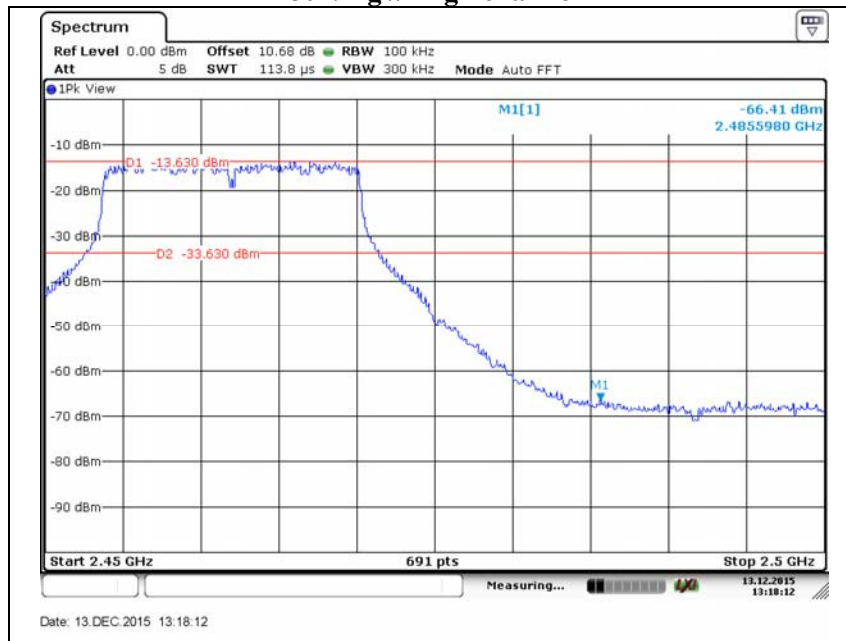


### 802.11g // Middle channel

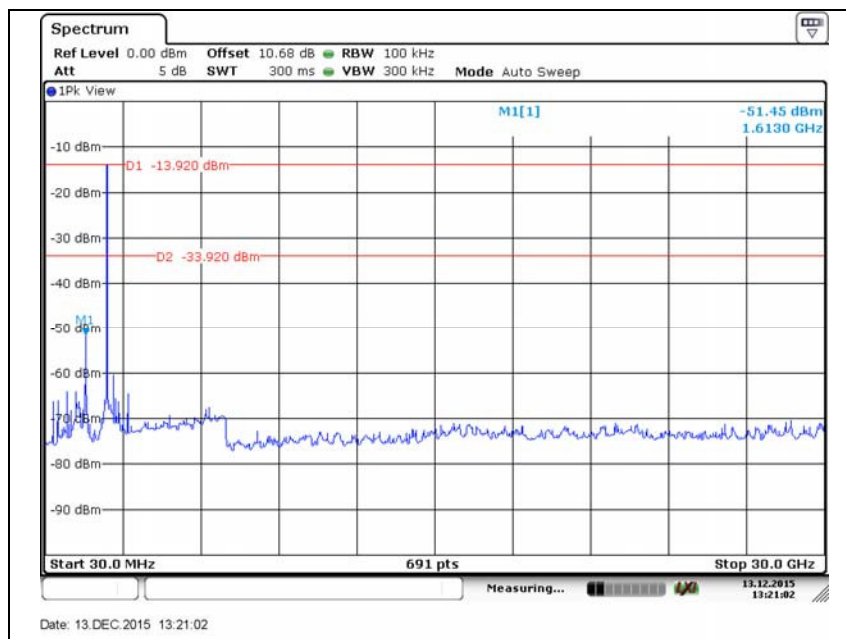
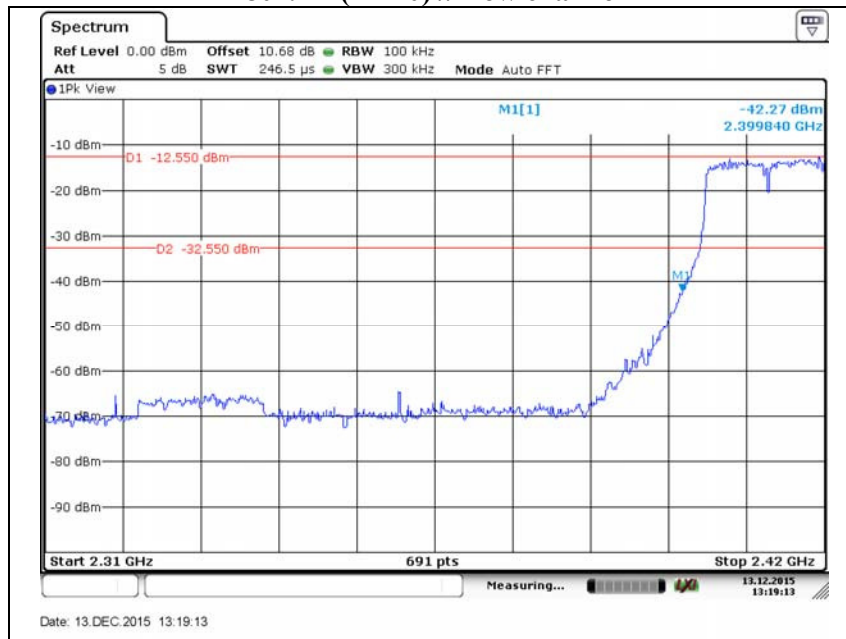
N/A



### 802.11g // High channel

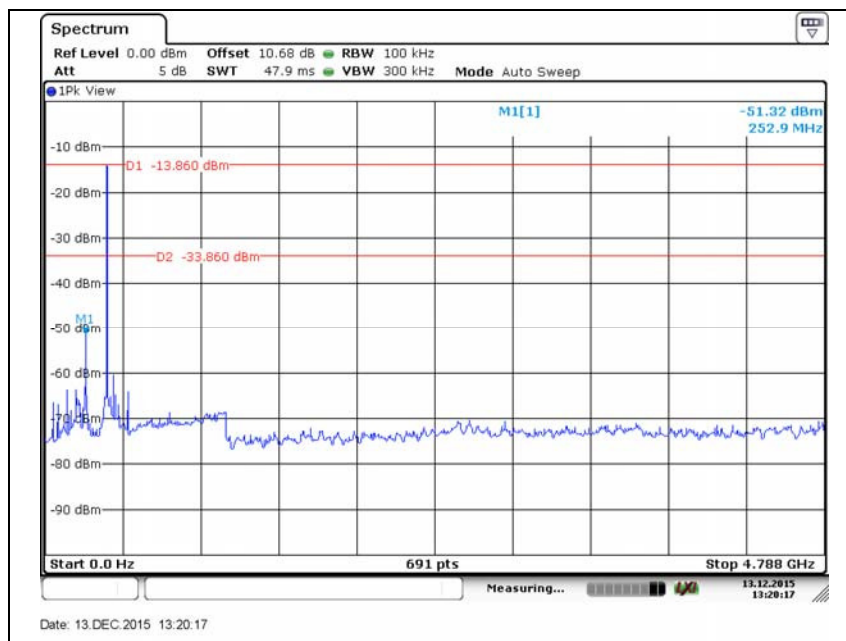


### 802.11n(HT20) // Low channel

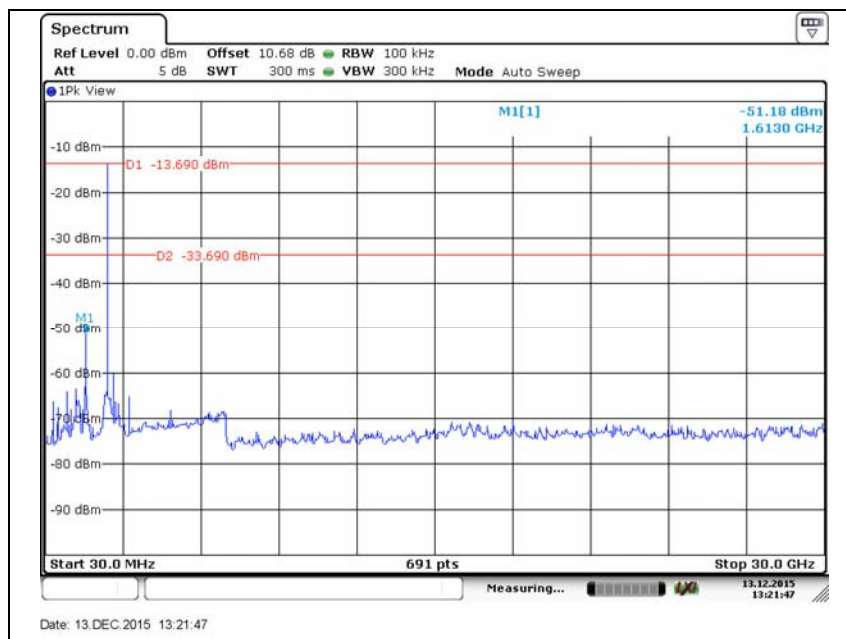
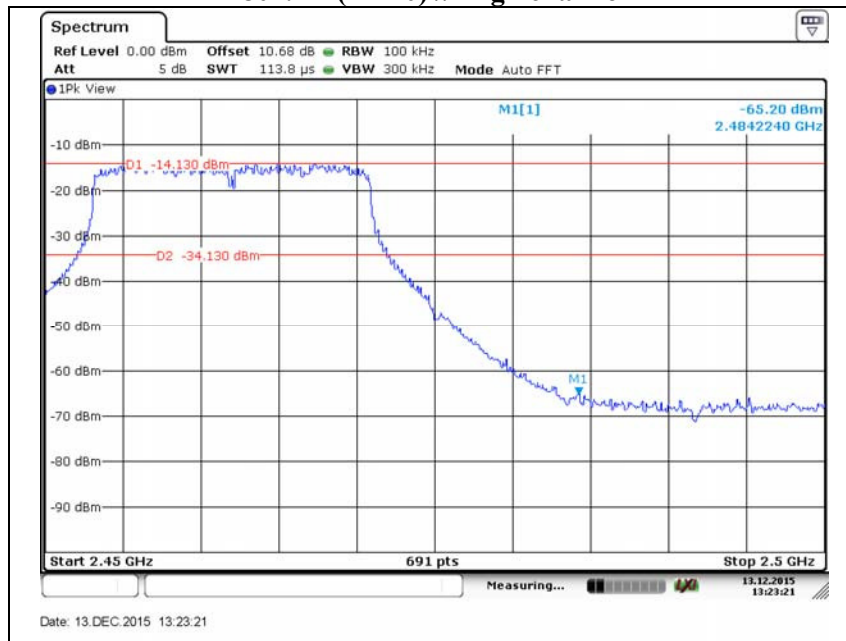


### 802.11n(HT20) // Middle channel

N/A

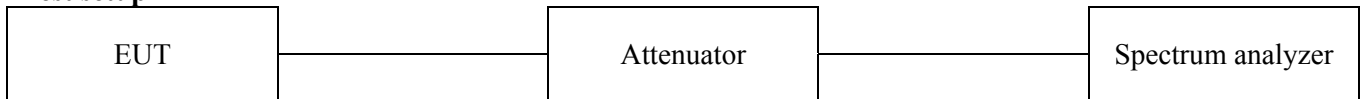


### 802.11n(HT20) // High channel



### 3.3. 6 dB bandwidth

#### Test setup



#### Test procedure

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

#### Option 1:

- Set RBW = 100 kHz.
- Set the video bandwidth(VBW)  $\geq 3 \times$  RBW.
- Detector = peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- 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  $\geq 3 \times$  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  $\geq 6$  dB.

#### Limit

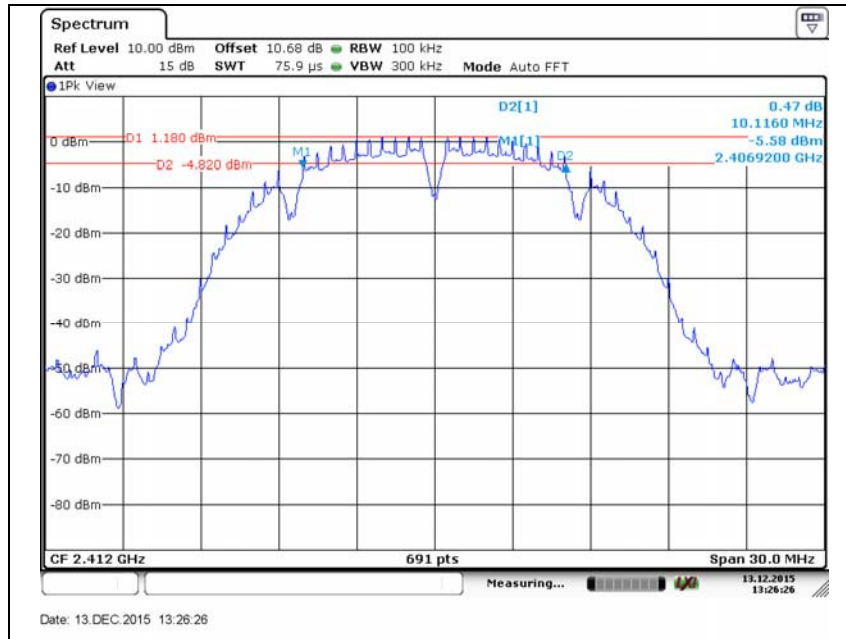
According to §15.247(a)(2), systems using digital modulation techniques may operate 902 ~ 928 MHz, 2 400 ~ 2 483.5 MHz, and 5 725 ~ 5 850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### Test results

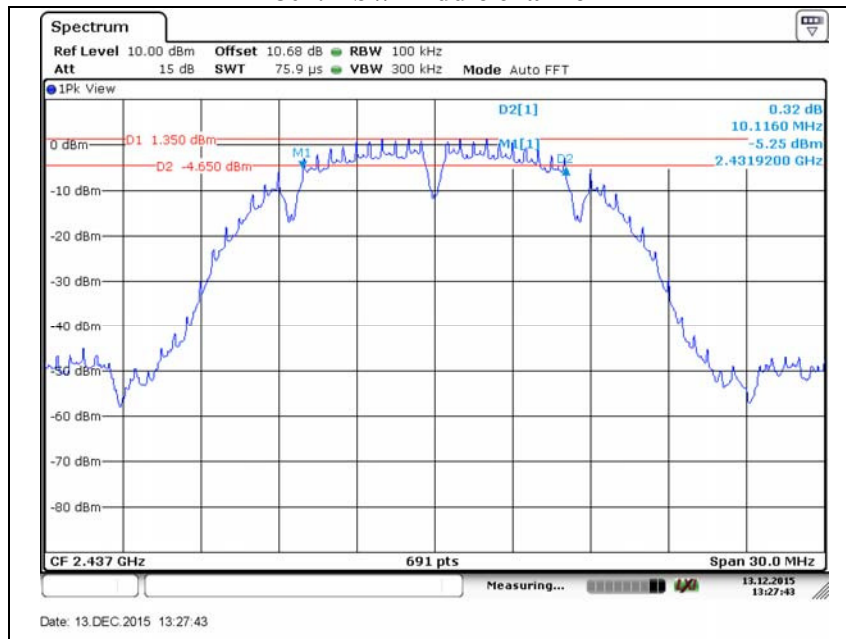
| Antenna port | Operation mode    | Frequency(MHz) | 6 dB bandwidth(MHz) | Limit(MHz) |
|--------------|-------------------|----------------|---------------------|------------|
| 0            | 802.11b           | 2 412          | 10.12               | 0.5        |
|              |                   | 2 437          | 10.12               |            |
|              |                   | 2 462          | 10.12               |            |
|              | 802.11g           | 2 412          | 16.54               |            |
|              |                   | 2 437          | 16.59               |            |
|              |                   | 2 462          | 16.59               |            |
|              | 802.11n<br>(HT20) | 2 412          | 17.84               |            |
|              |                   | 2 437          | 17.84               |            |
|              |                   | 2 462          | 17.84               |            |
| 1            | 802.11b           | 2 412          | 10.12               |            |
|              |                   | 2 437          | 10.12               |            |
|              |                   | 2 462          | 10.12               |            |
|              | 802.11g           | 2 412          | 16.59               |            |
|              |                   | 2 437          | 16.59               |            |
|              |                   | 2 462          | 16.59               |            |
|              | 802.11n<br>(HT20) | 2 412          | 17.80               |            |
|              |                   | 2 437          | 17.84               |            |
|              |                   | 2 462          | 17.80               |            |

- Antenna port 0

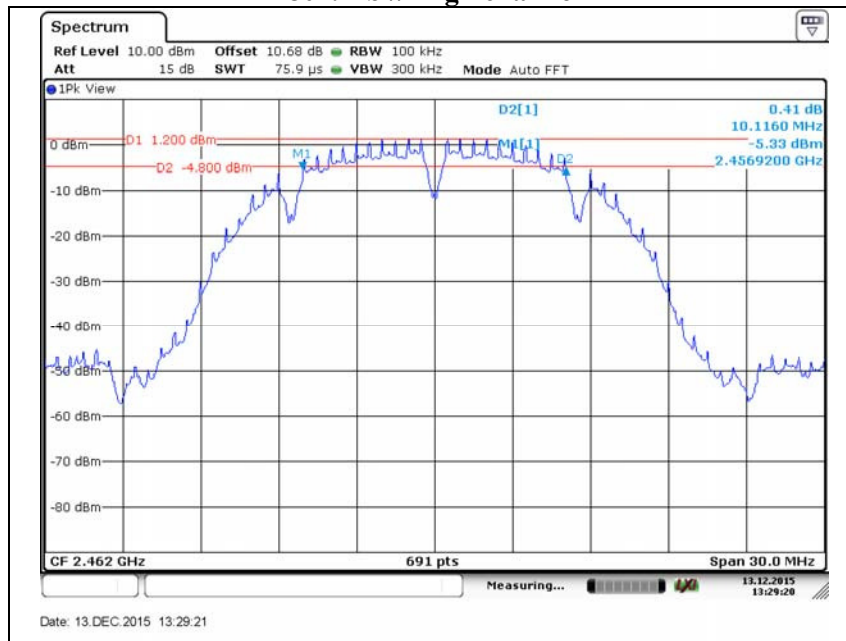
**802.11b // Low channel**



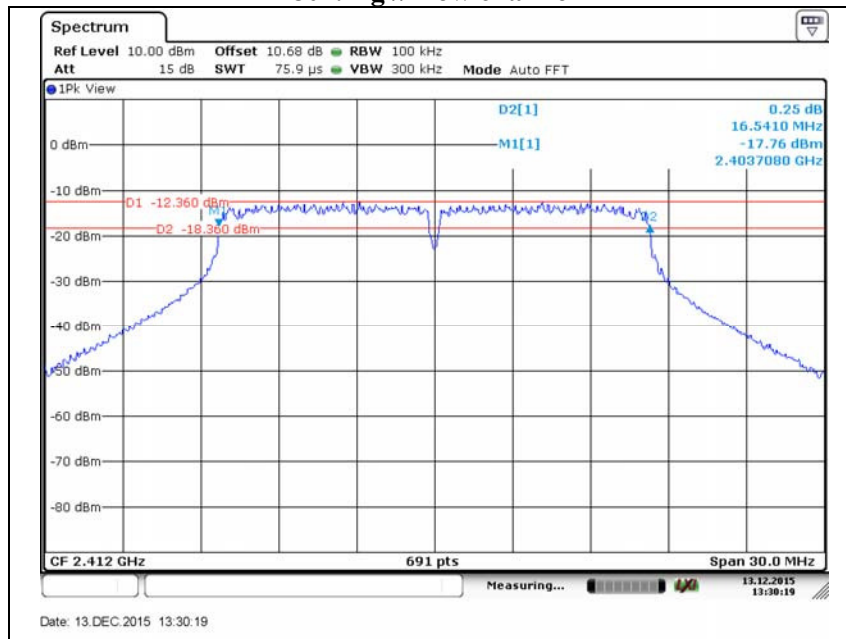
**802.11b // Middle channel**



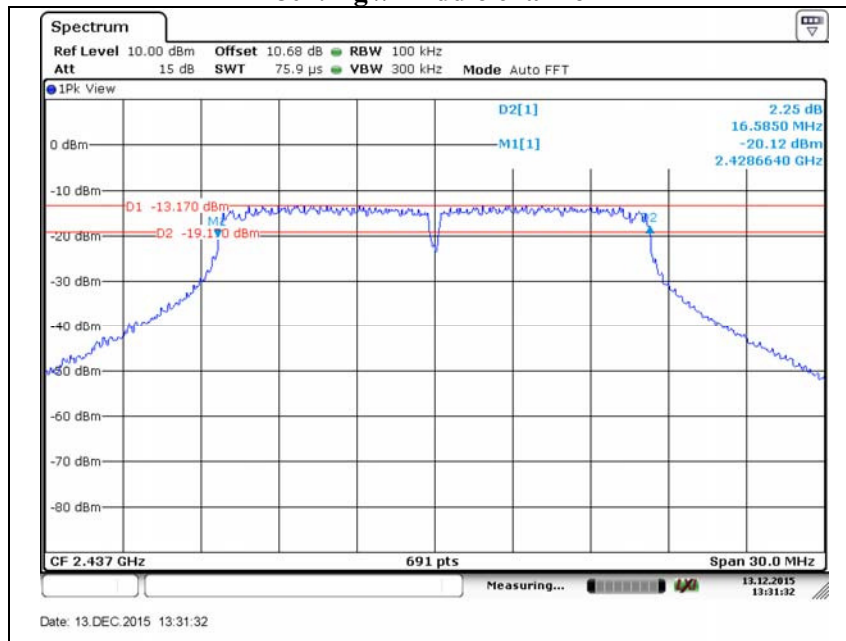
### 802.11b // High channel



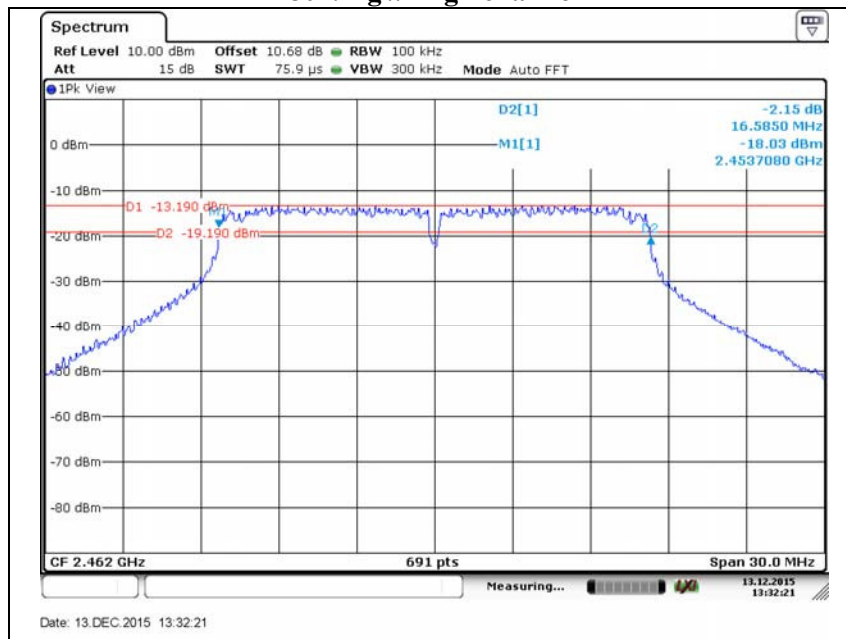
### 802.11g // Low channel



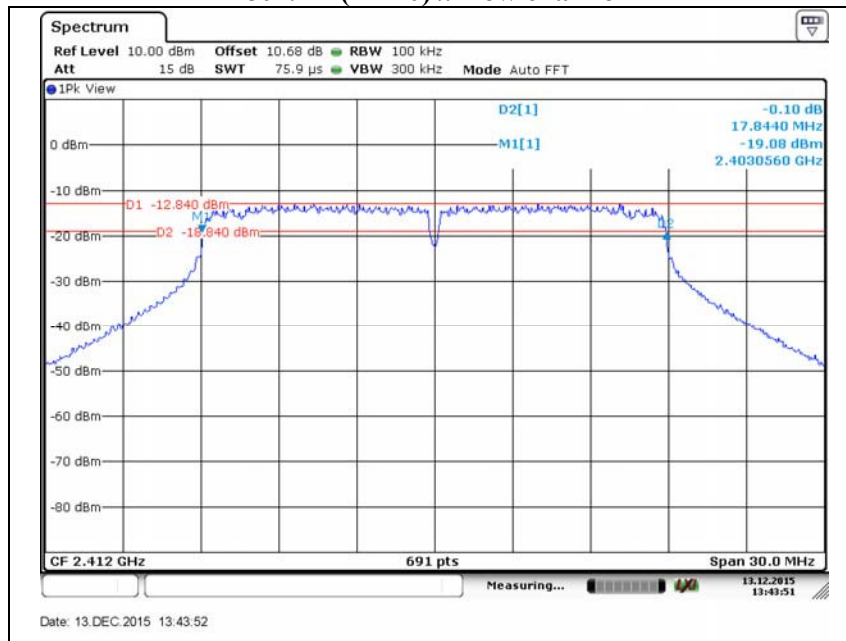
### 802.11g // Middle channel



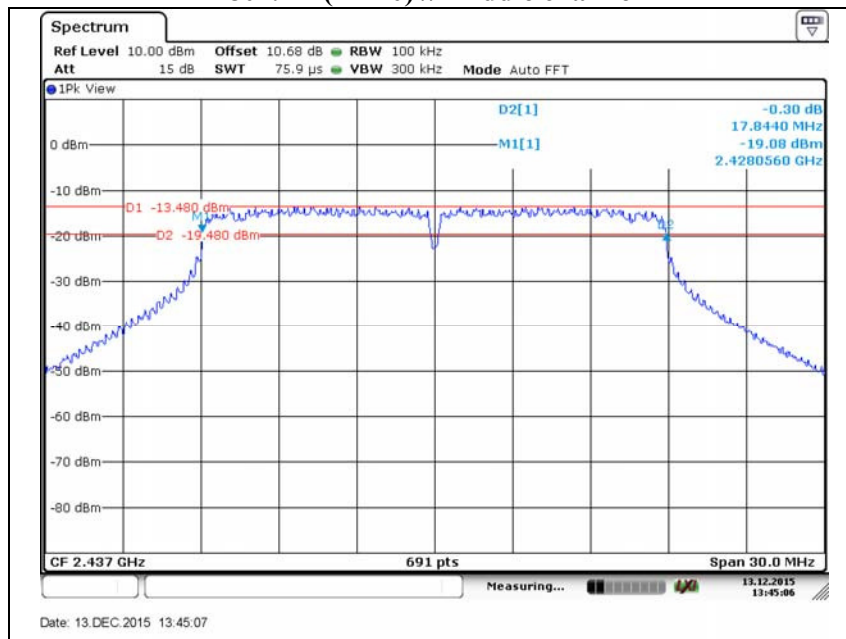
### 802.11g // High channel



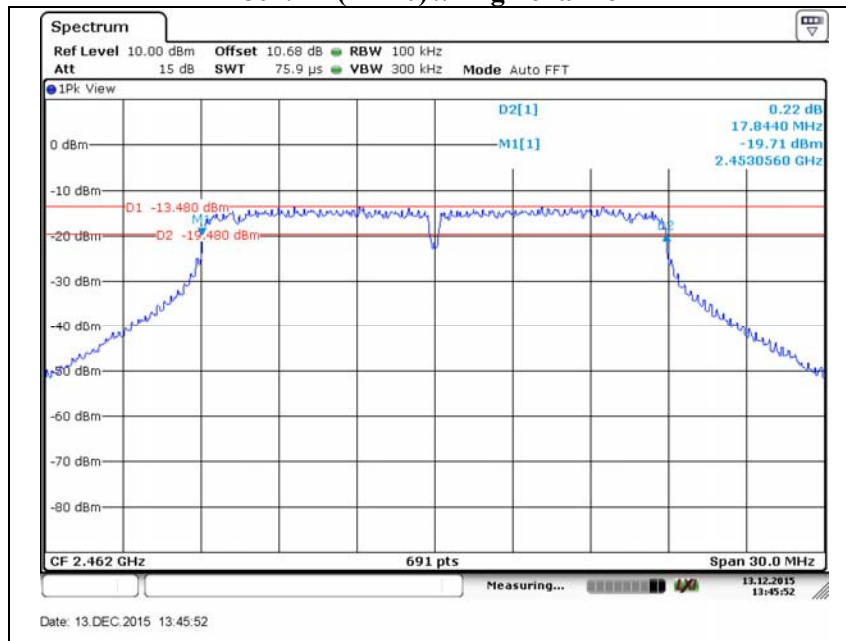
### 802.11n(HT20) // Low channel



### 802.11n(HT20) // Middle channel



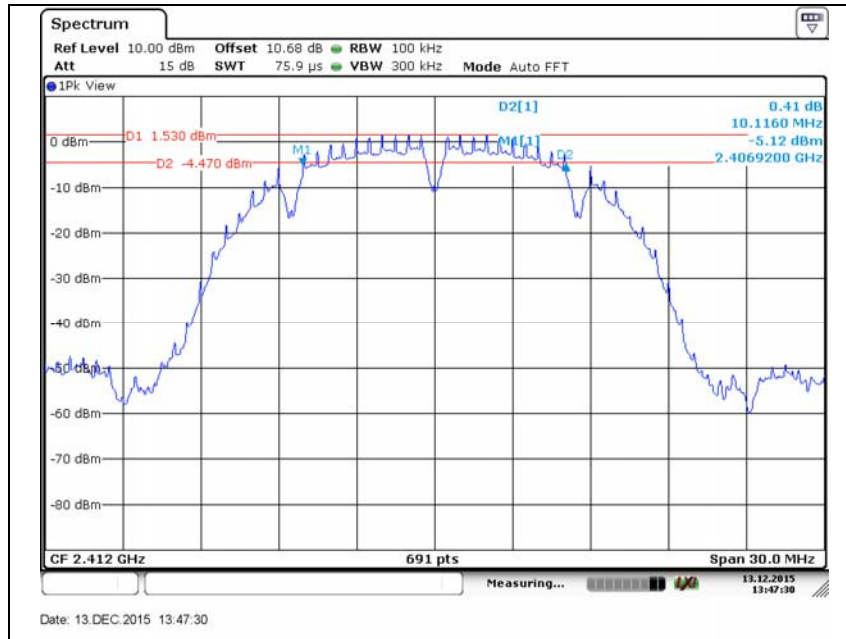
### 802.11n(HT20) // High channel



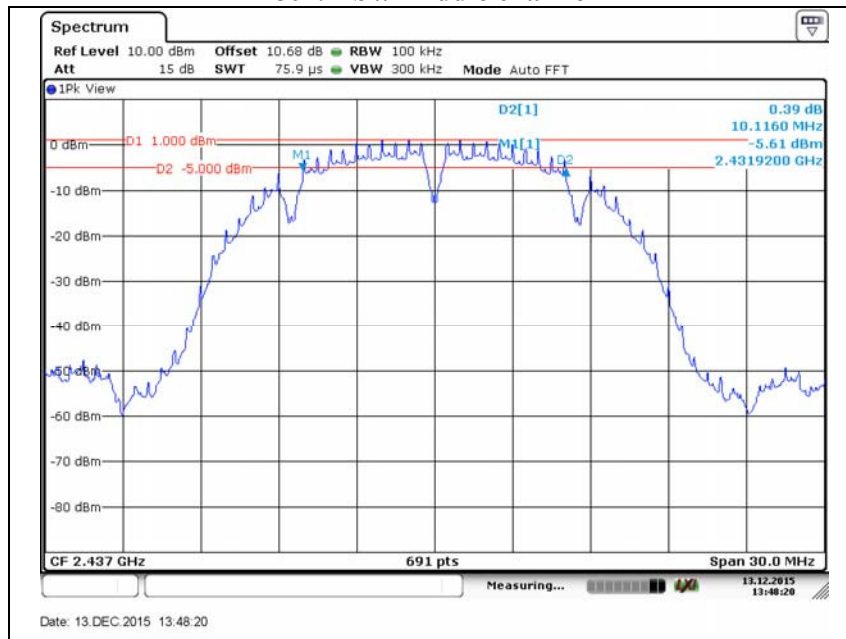
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The test results in the report only apply to the tested sample.

- Antenna port 1

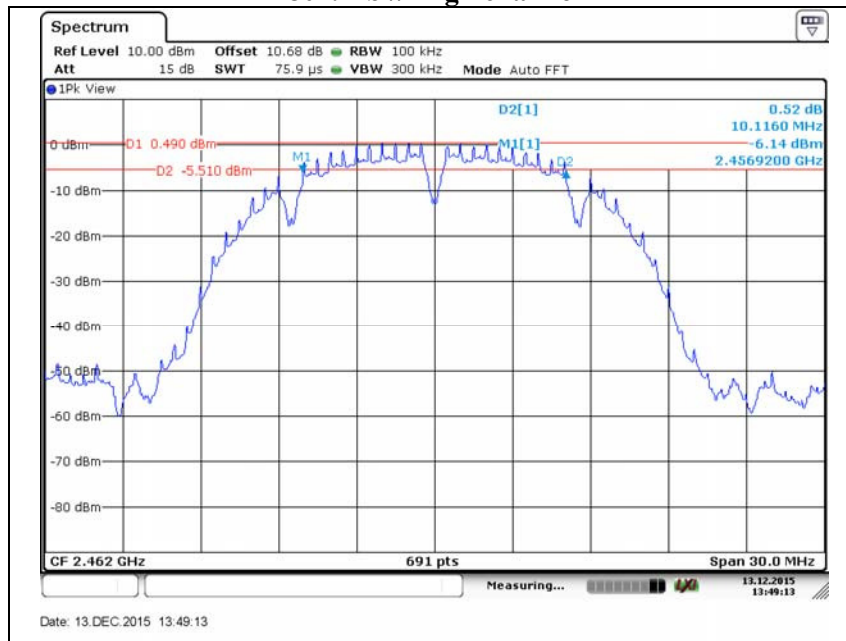
**802.11b // Low channel**



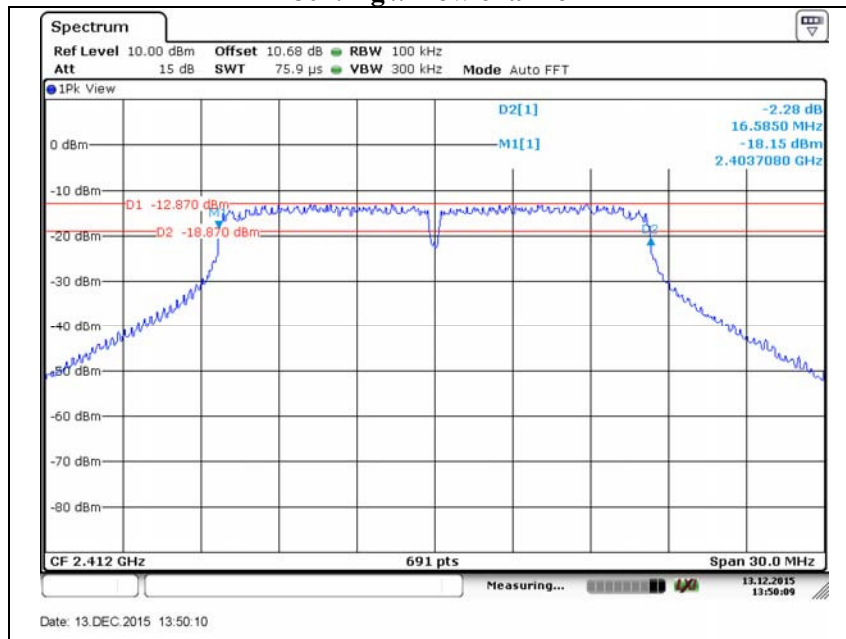
**802.11b // Middle channel**



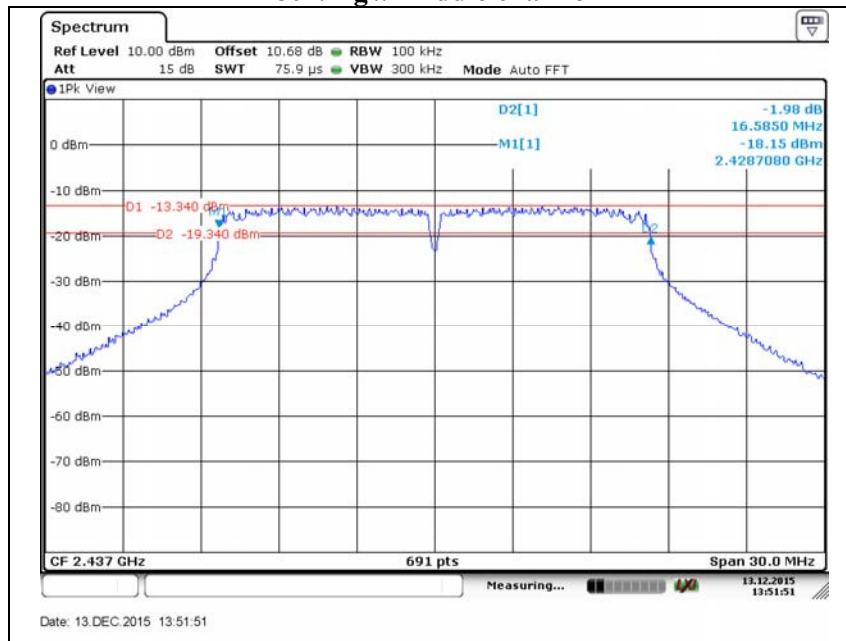
### 802.11b // High channel



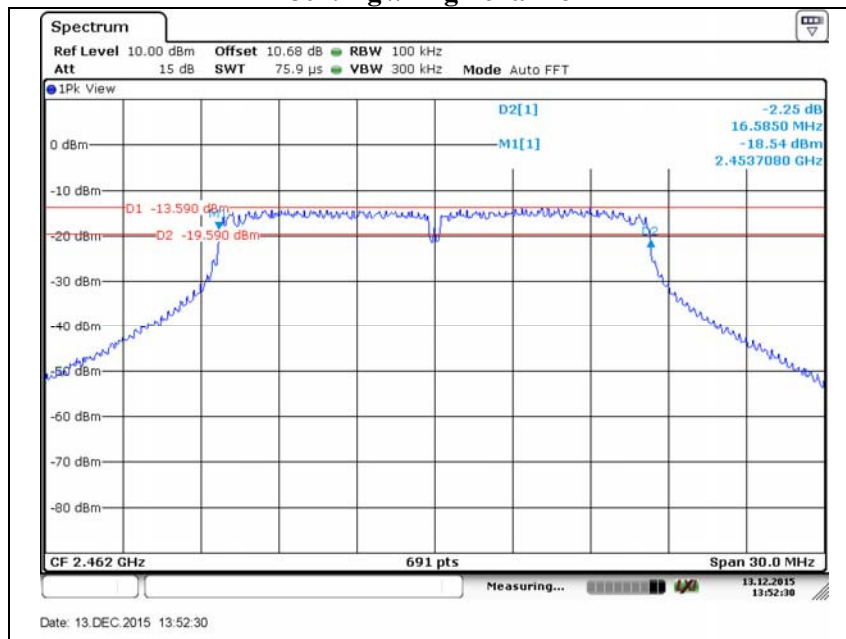
### 802.11g // Low channel



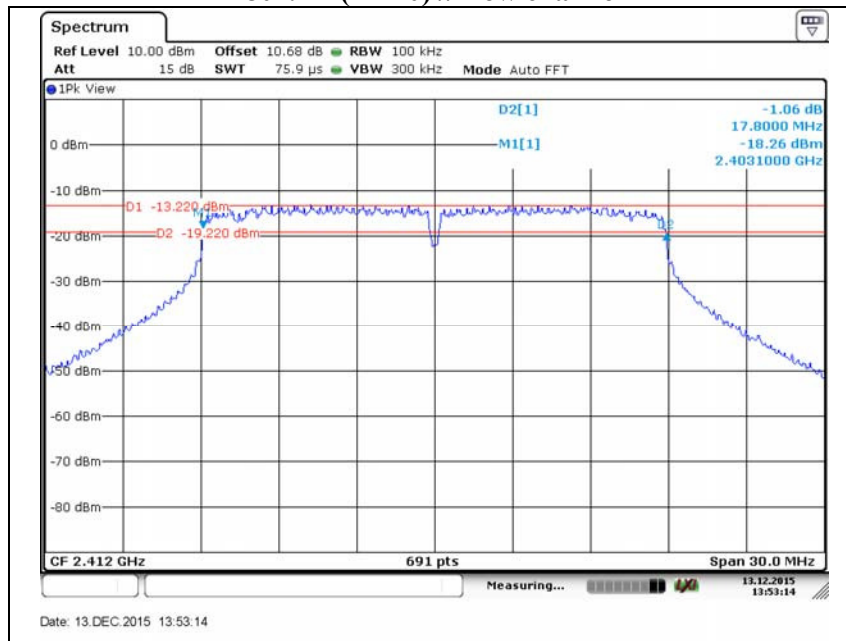
### 802.11g // Middle channel



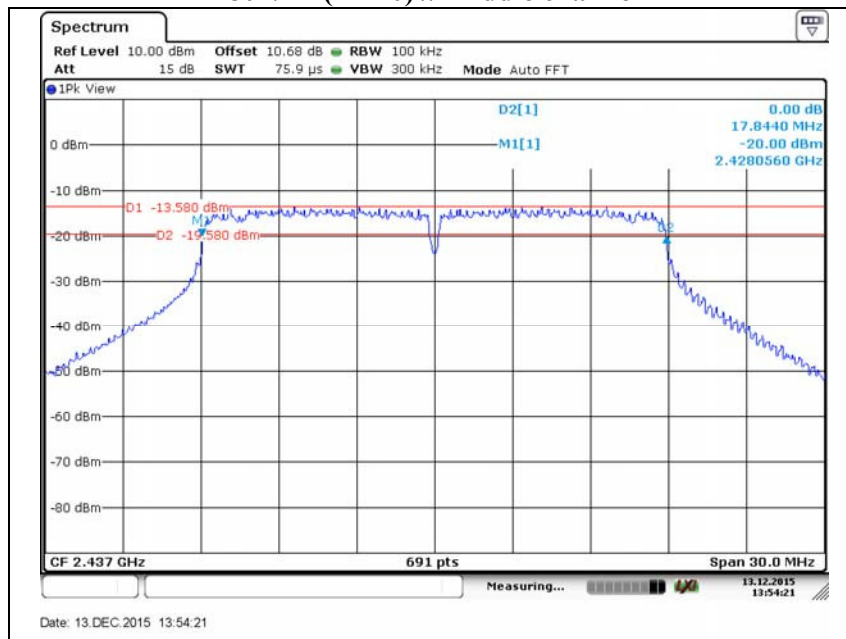
### 802.11g // High channel



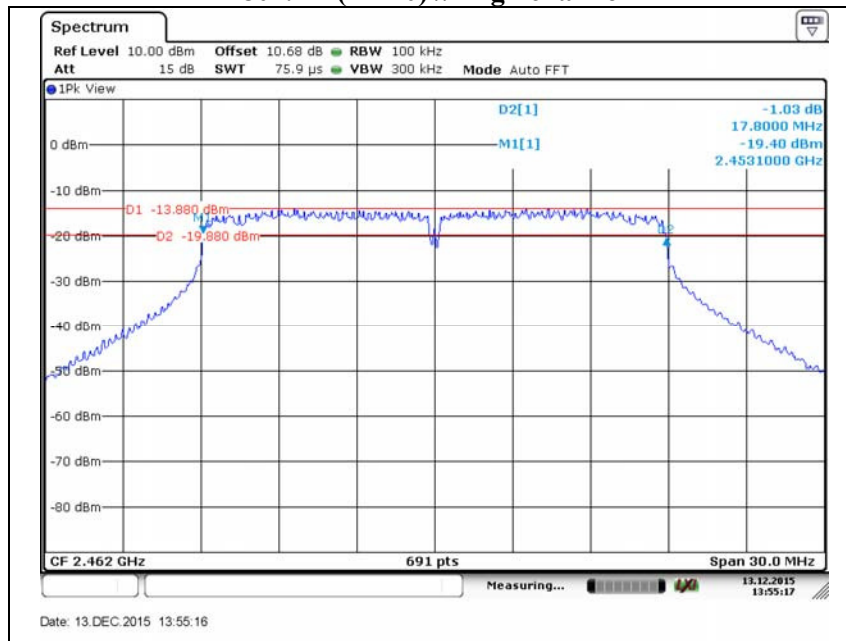
### 802.11n(HT20) // Low channel



### 802.11n(HT20) // Middle channel

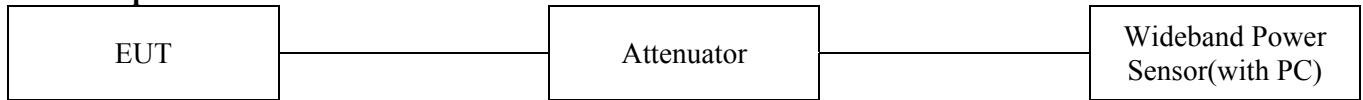


### 802.11n(HT20) // High channel



### 3.4. Peak output power

#### Test setup



#### 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 MHz, 2 400~2 483.5 MHz, and 5 725~5 850 MHz 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 transmitting 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.

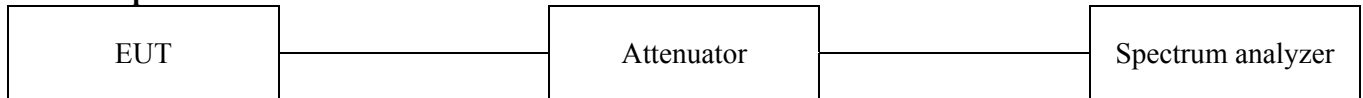
### Test results

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

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

### 3.5. Power spectral density

#### Test setup



#### Test procedure

KDB 558074\_v03r03– section 10.2

#### Measurement procedure

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS channel bandwidth.
- Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- Set the VBW  $\geq 3 \times \text{RBW}$ .
- Detector = power averaging (RMS) or sample detector(when RMS not available).
- Sweep time = auto couple.
- Trace mode = max hold.
- Employ trace averaging (RMS) mode over a minimum of 100 traces.
- Use the peak marker function to determine the maximum amplitude level.
- 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.

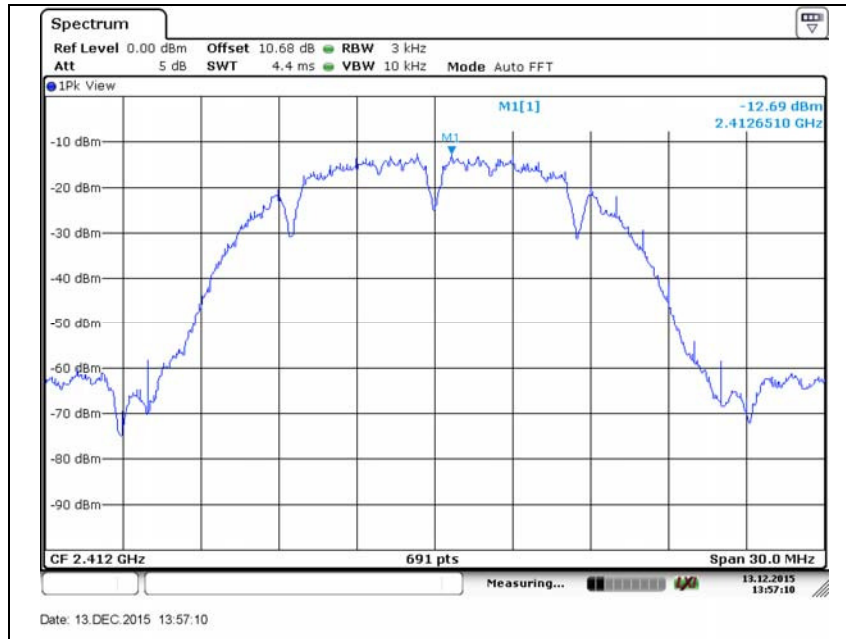
### Test results

| Operation mode | Frequency(MHz) | Measured PSD(dBm) |        |             | Limit(dBm) |
|----------------|----------------|-------------------|--------|-------------|------------|
|                |                | Ant0              | Ant1   | Ant0 + Ant1 |            |
| 802.11b        | 2 412          | -12.69            | -12.46 | -           | 8          |
|                | 2 437          | -13.32            | -12.78 | -           |            |
|                | 2 462          | -12.30            | -12.92 | -           |            |
| 802.11g        | 2 412          | -22.04            | -22.62 | -           |            |
|                | 2 437          | -22.71            | -22.81 | -           |            |
|                | 2 462          | -22.66            | -22.85 | -           |            |
| 802.11n(HT20)  | 2 412          | -23.42            | -23.66 | -20.53      |            |
|                | 2 437          | -22.46            | -23.47 | -19.93      |            |
|                | 2 462          | -23.35            | -24.36 | -20.82      |            |

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

**-Antenna port 0**

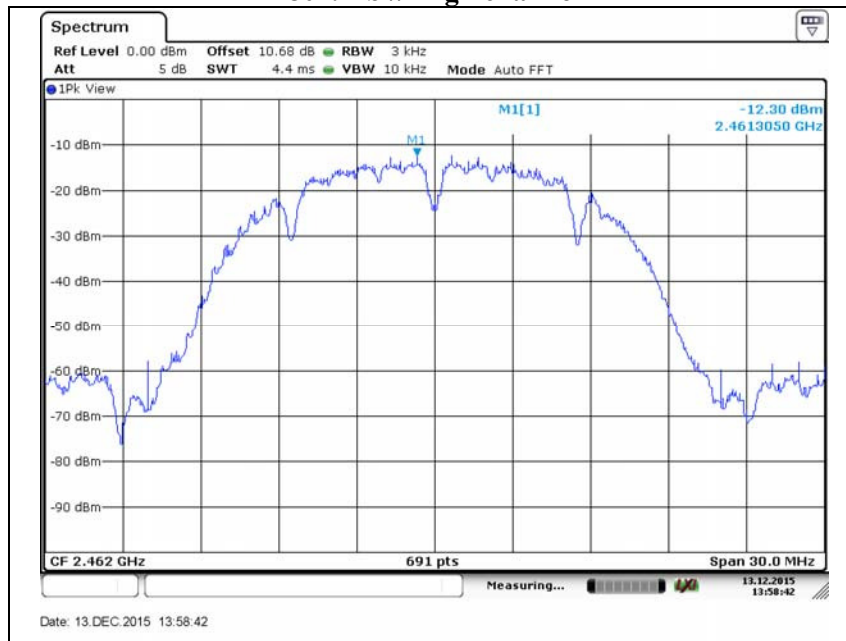
**802.11b // Low channel**



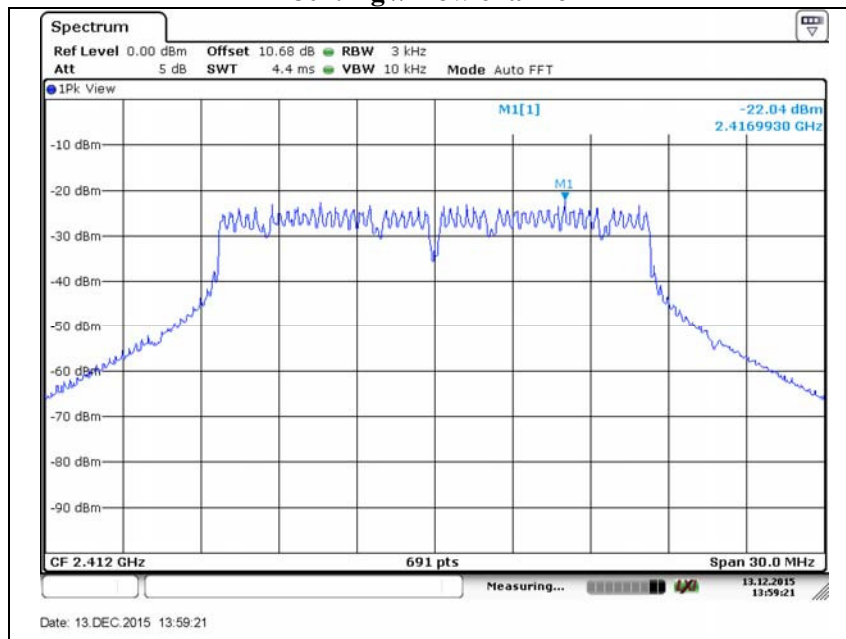
**802.11b // Middle channel**



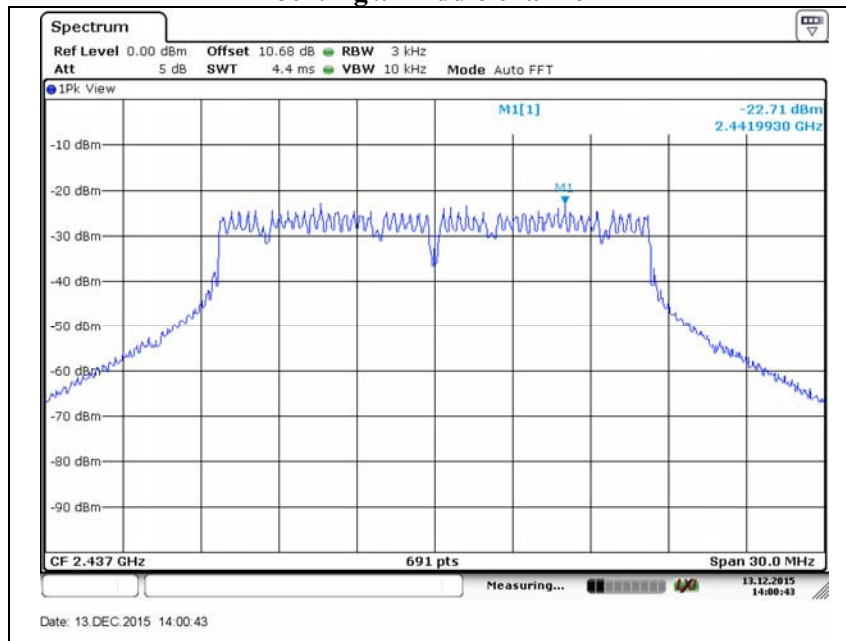
### 802.11b // High channel



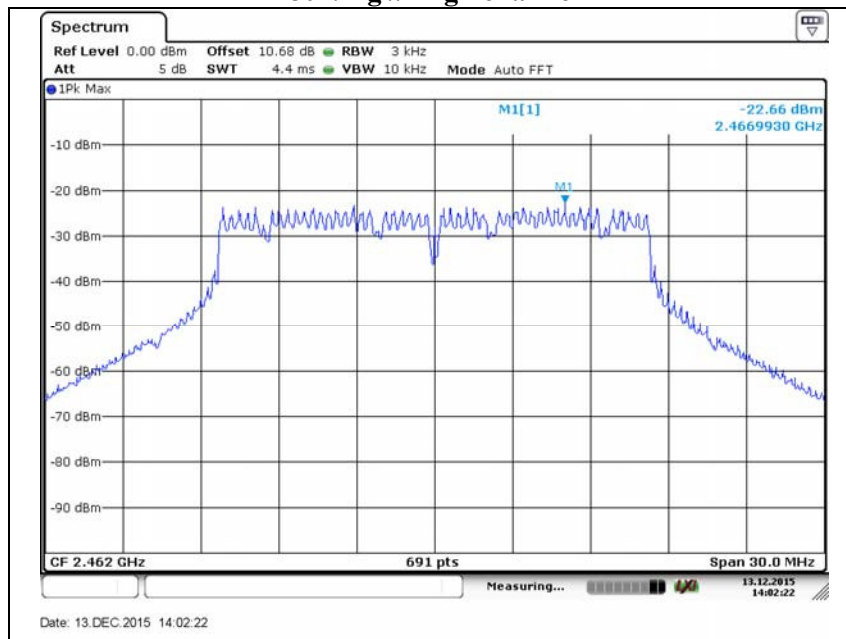
### 802.11g // Low channel



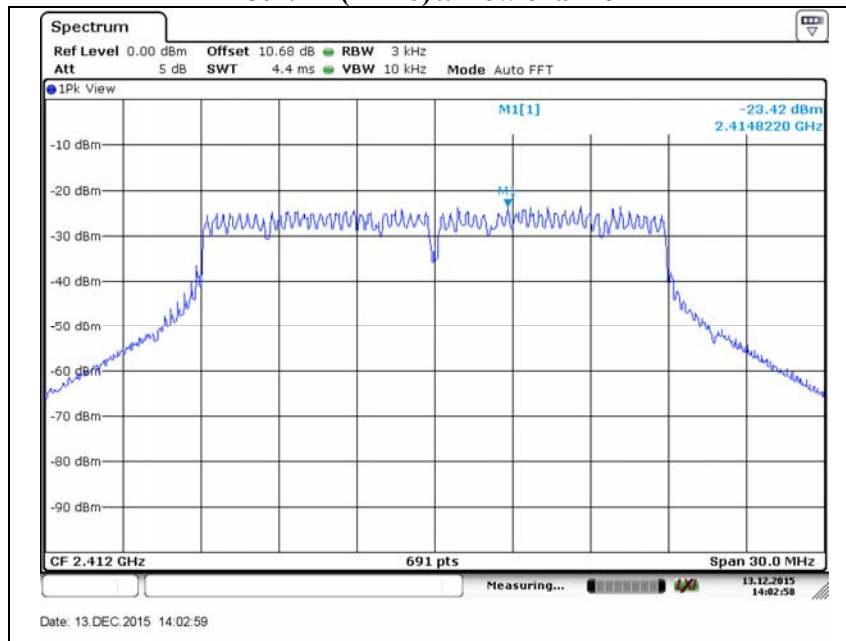
### 802.11g // Middle channel



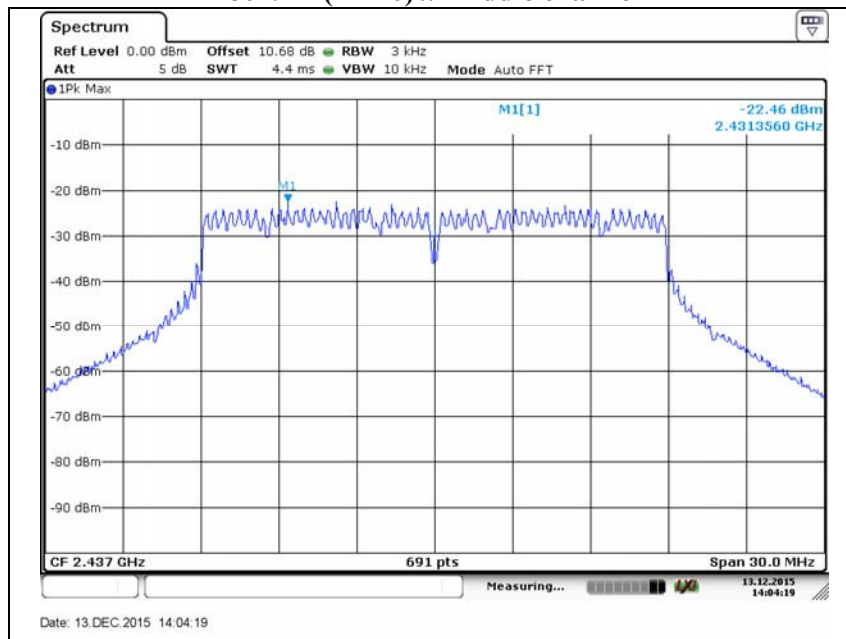
### 802.11g // High channel



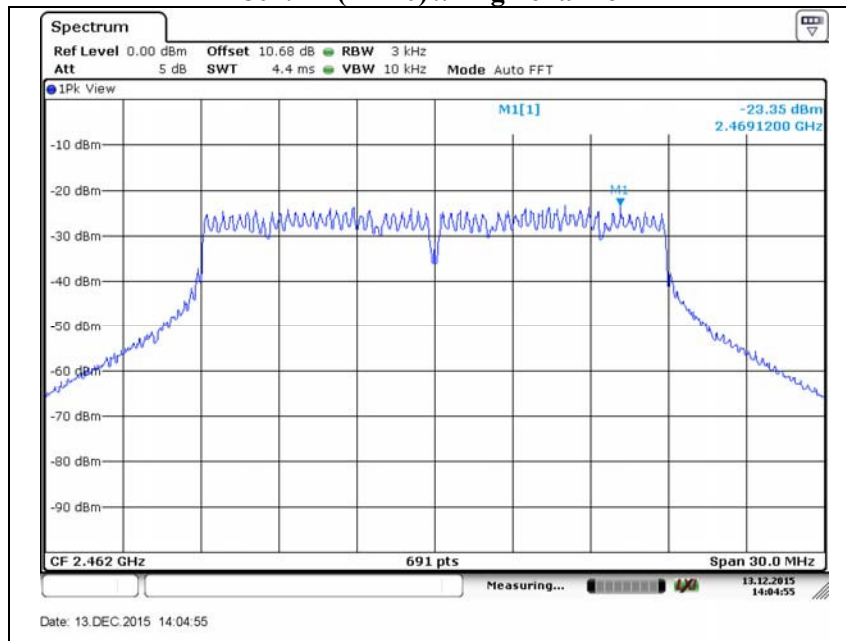
### 802.11n(HT20) // Low channel



### 802.11n(HT20) // Middle channel

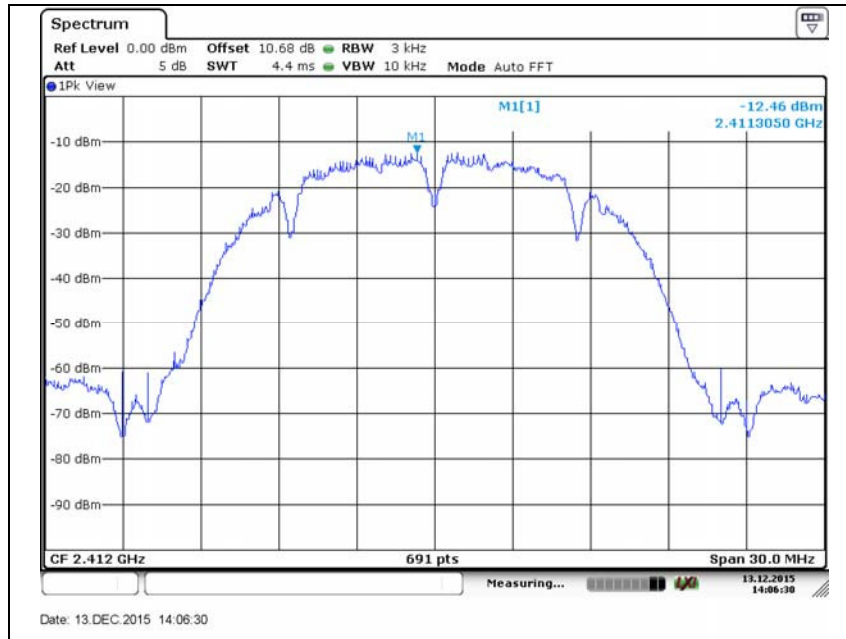


### 802.11n(HT20) // High channel

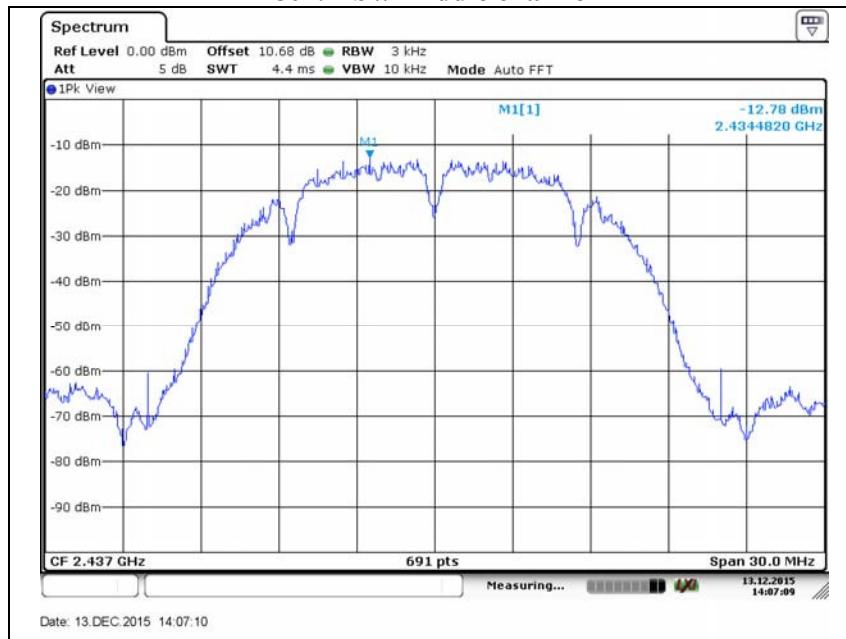


**-Antenna port 1**

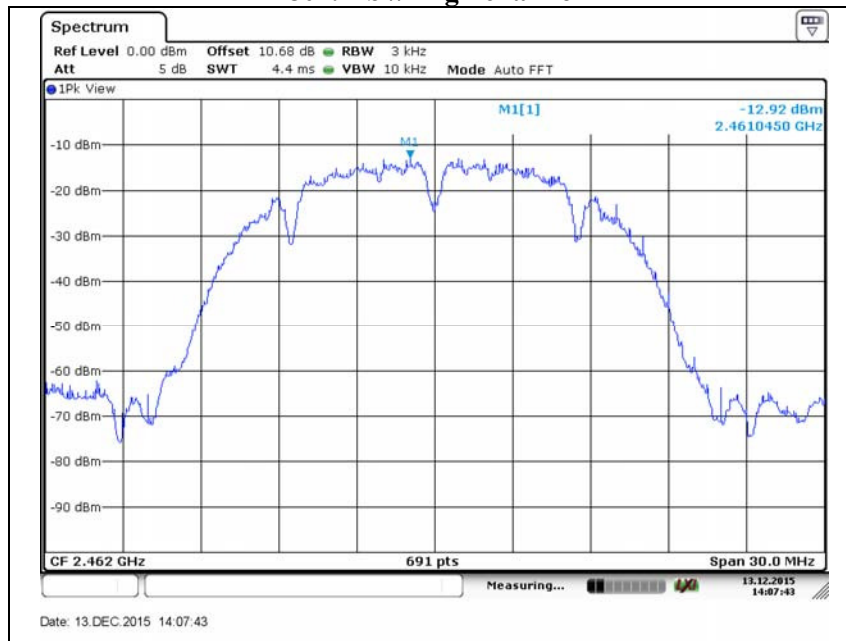
**802.11b // Low channel**



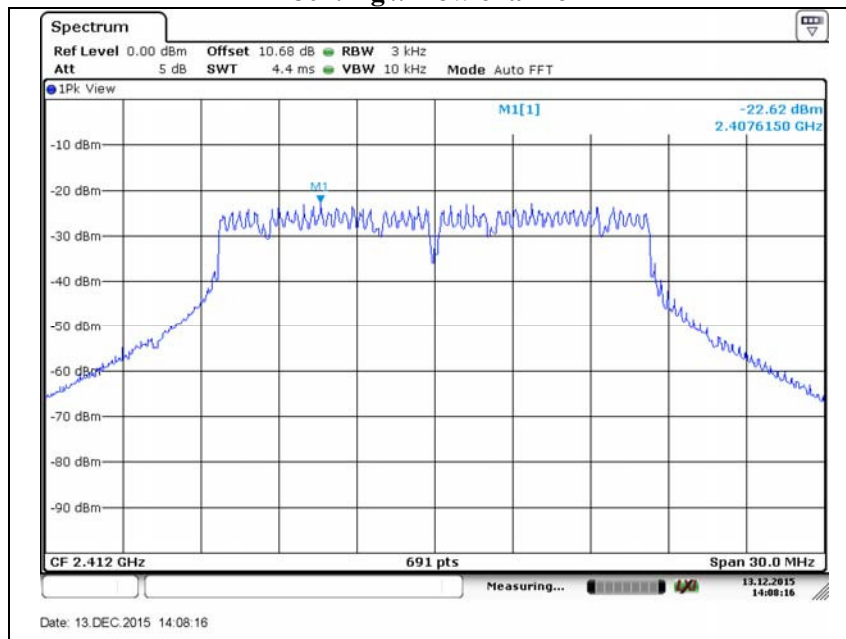
**802.11b // Middle channel**



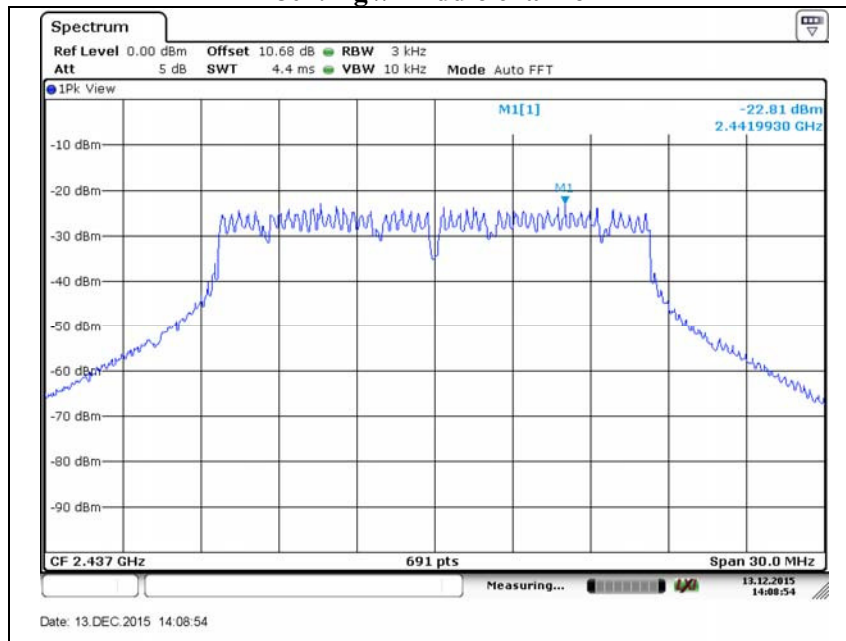
### 802.11b // High channel



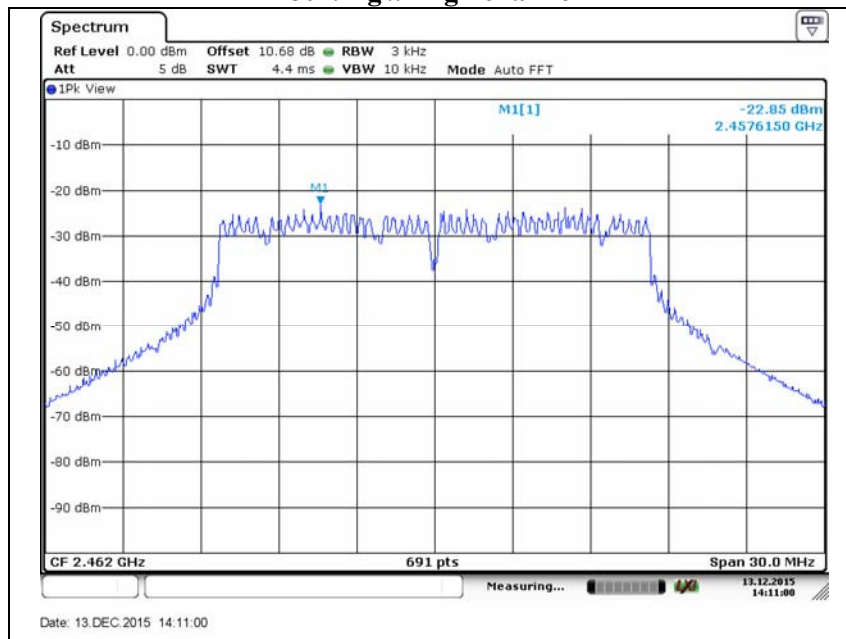
### 802.11g // Low channel



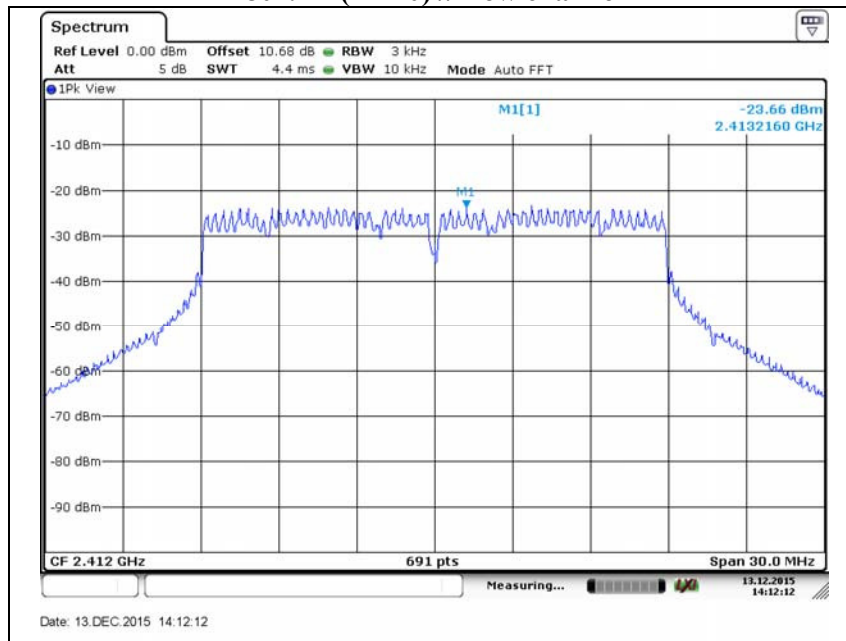
### 802.11g // Middle channel



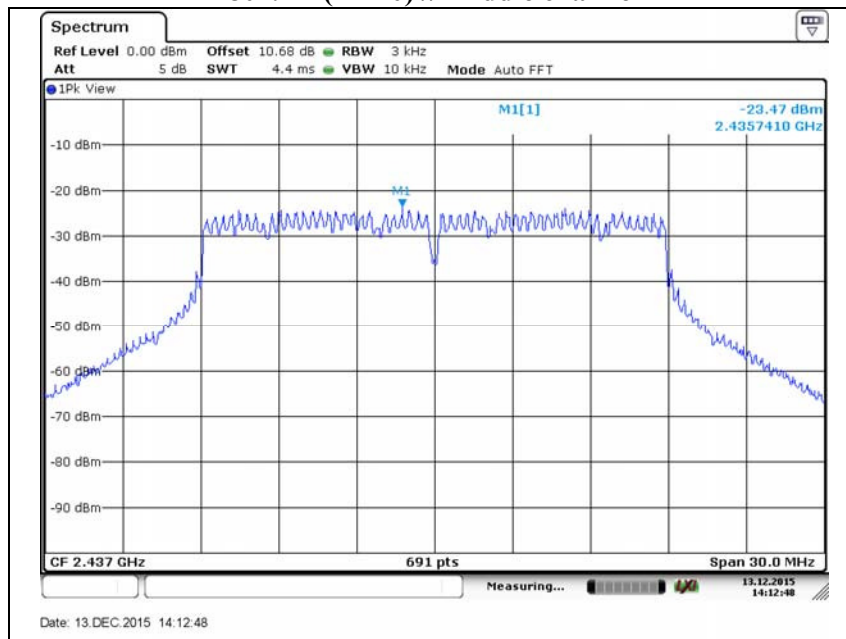
### 802.11g // High channel



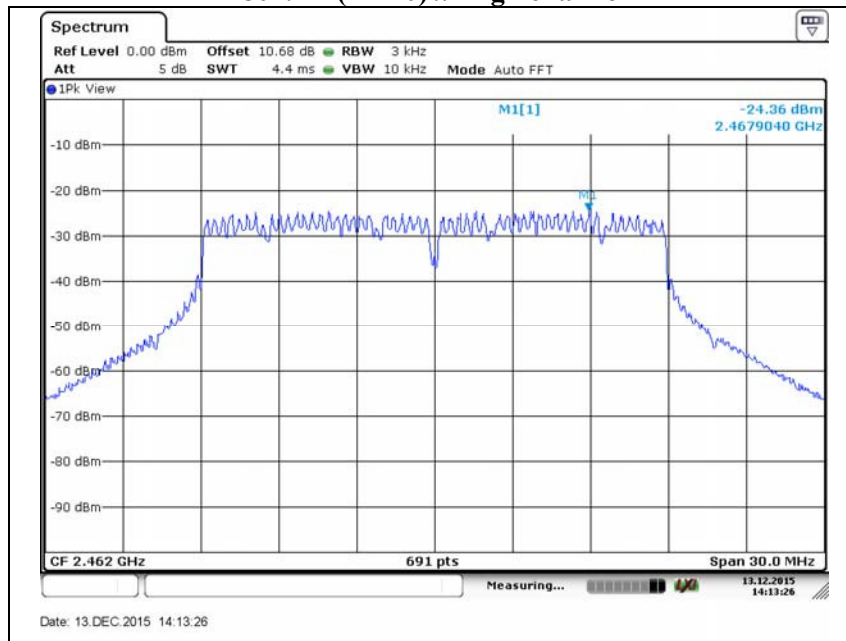
### 802.11n(HT20) // Low channel



### 802.11n(HT20) // Middle channel



### 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 (MHz) | Conducted limit (dBμV/m) |          |
|-----------------------------|--------------------------|----------|
|                             | Quasi-peak               | Average  |
| 0.15 – 0.50                 | 66 - 56*                 | 56 - 46* |
| 0.50 – 5.00                 | 56                       | 46       |
| 5.00 – 30.0                 | 60                       | 50       |

#### Note.

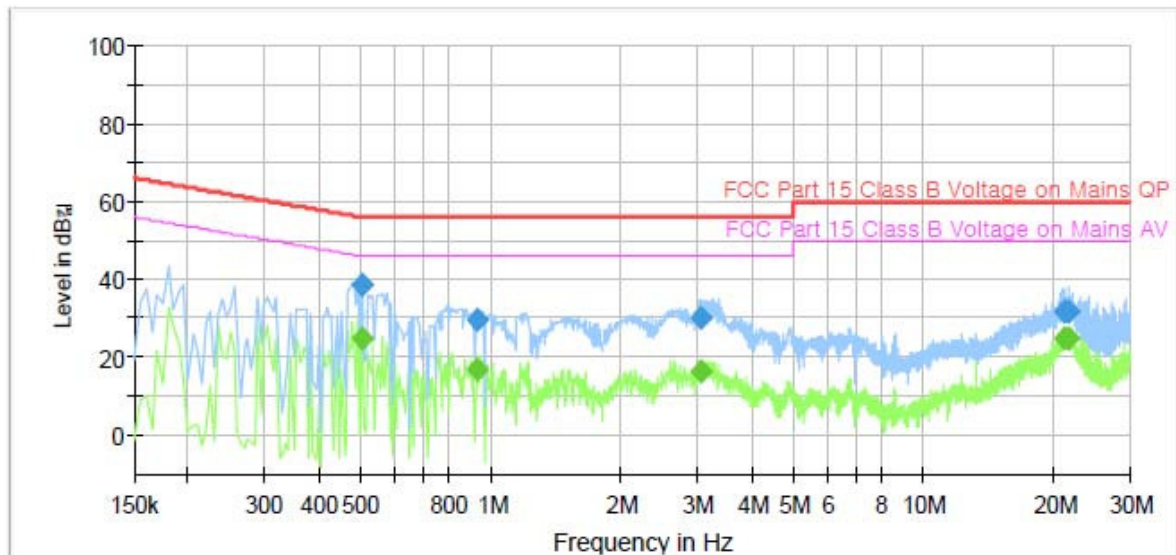
- Decreases with the logarithm of the frequency.
- All AC Conducted emission at channels are almost the same, so that 802.11b High channel was chosen at representative in final test.

## Test results – TX\_H

# Test Report

## Common Information

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



## Final Result

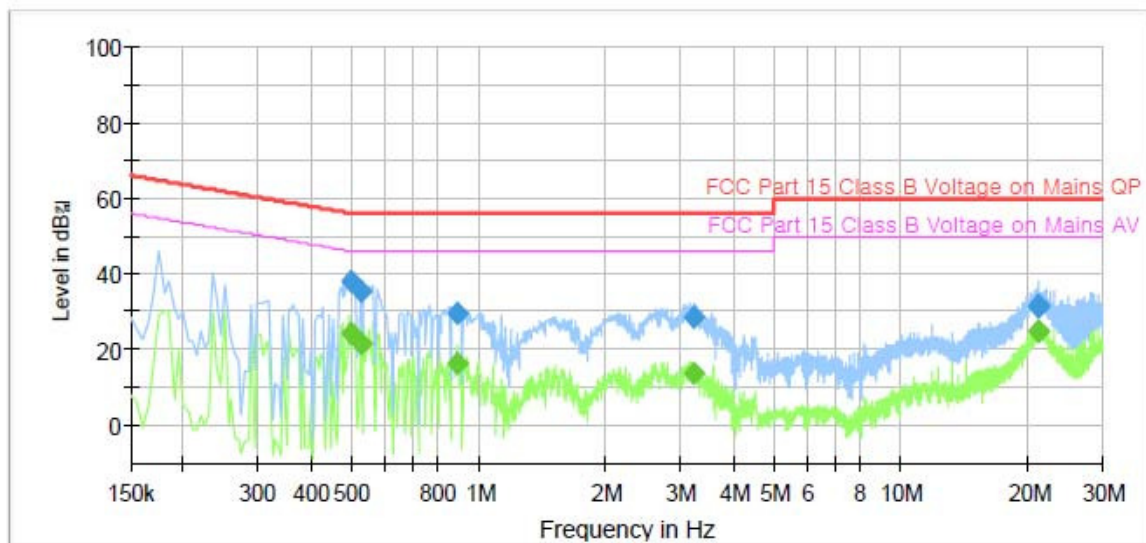
| Frequency (MHz) | QuasiPeak (dBμV) | CAverage (dBμV) | Limit (dBμV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|-----------------|-----------------|------|------------|
| 0.505000        | ---              | 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       | ---              | 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: | Conducted Emission |
| Model No.:        | SWL-Q93T           |
| Mode              | TX                 |
| Operator Name:    | KES                |



## Final Result

| Frequency (MHz) | QuasiPeak (dBμV) | CAverage (dBμV) | Limit (dBμV) | 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            | ---             | 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. Measurement equipment

| 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       |

## Peripheral devices

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