

# TEST REPORT

## Part 15 Subpart C 15.247

**Equipment under test** Outdoor, Battery-Powered Camera

**Model name** SNW-R0130BW

**FCC ID** NLMSNWR0130BW

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

**Manufacturer** Hanwha Techwin(Tianjin) Co., Ltd

**Date of test(s)** 2017.02.09 ~ 2017.02.21

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**Issued to**

**Hanwha Techwin Co., Ltd.**

1204, Changwon-daero, Seongsan-gu Changwon-si,

Gyeongsangnam-do, South Korea

Tel: +82-70-7147-8361/ Fax: +82-31-8108-3717

**Issued by**



**KES Co., Ltd.**

C-3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,

Gyeonggi-do, Korea

473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea

Tel: +82-31-425-6200 / Fax: +82-31-424-0450

| Test and report completed by :  | Report approval by :   |
|---|--|
|  |  |
| Hyeon-su Jang<br>Test engineer  | Jeff Do<br>Technical manager   |



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**Revision history**

| <b>Revision</b> | <b>Date of issue</b> | <b>Test report No.</b> | <b>Description</b> |
|-----------------|----------------------|------------------------|--------------------|
| -               | 2017.02.22           | KES-RF-17T0020         | Initial            |

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## 1. General information

Applicant: Hanwha Techwin Co., Ltd.  
Applicant address: 1204, Changwon-daero, Seongsan-gu, Changwon-si  
Gyeongsangnam-do, South Korea  
Test site: KES Co., Ltd.  
Test site address: C-3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, Korea  
473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea  
FCC rule part(s): 15.247  
FCC ID: NLMSNWR0130BW  
Test device serial No.:  Production  Pre-production  Engineering

### 1.1. EUT description

Equipment under test Outdoor, Battery-Powered Camera  
Frequency range 2412 MHz ~ 2462 MHz(11b/g/n\_HT20)  
920.6 MHz ~ 922.0 MHz  
Modulation technique DSSS, OFDM, FSK  
Number of channels 2412 MHz ~ 2462 MHz(11b/g/n\_HT20): 11ch  
920.6 MHz ~ 922.0 MHz: 8ch  
Antenna type 2.4GHz Single module: PCB antenna,  
900MHz module : Chip antenna  
Antenna gain 2.4GHz Single module: 1.2 dBi  
900MHz module : -1.7 dBi  
Power source DC 6.0 V (Lithium Battery)

### 1.2. Test configuration

The **Hanwha Techwin Co., Ltd. Outdoor, Battery-Powered Camera FCC ID: NLMSNWR0130BW** was tested per the guidance of KDB 558074 D01 v03r05. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing.

### 1.3. Device modifications

N/A

### 1.4. Information about derivative model

N/A



### 1.5. Frequency/channel operations

| Ch. | Frequency (MHz) | Mode             |
|-----|-----------------|------------------|
| 01  | 2412            | 802.11b/g/n_HT20 |
| ⋮   | ⋮               | ⋮                |
| 06  | 2437            | 802.11b/g/n_HT20 |
| ⋮   | ⋮               | ⋮                |
| 11  | 2462            | 802.11b/g/n_HT20 |

### 1.6. Worst case data rate

1. Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.
2. Worst-case data rates were:  
802.11b: **1 Mbps**  
802.11g: **6 Mbps**  
802.11n\_HT20: **MCS0**

### 1.7. Accessory information

| Applicant | Equipment | Manufacturer | Model | Power source |
|-----------|-----------|--------------|-------|--------------|
| -         | -         | -            | -     | -            |



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C-3701, 40, Simin-daero 365beon-gil,  
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**2. Summary of tests**

| Reference     | Parameter                                 | Test results |
|---------------|---|--------------|
| 15.247(a)(2)  | 6 dB bandwidth                            | Pass         |
| 15.247(b)(3)  | Peak output power                         | Pass         |
| 15.247(e)     | Power spectral density                    | Pass         |
| 15.205 15.209 | Radiated restricted band and emission     | Pass         |
| 15.247(d)     | Conducted spurious emission and band edge | Pass         |

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### 3. Test results

#### 3.1. 6 dB bandwidth

##### Test procedure

KDB 558074 D01 v03r05 – Section 8.1 or 8.2

Used test method is section 8.1.

##### Section 8.1

1. RBW = 100 kHz.
2. VBW  $\geq 3 \times$  RBW.
3. Detector = peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize
7. 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.

##### Section 8.2

The automatic bandwidth measurement capability of an instrument may be employed using the X dB 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.



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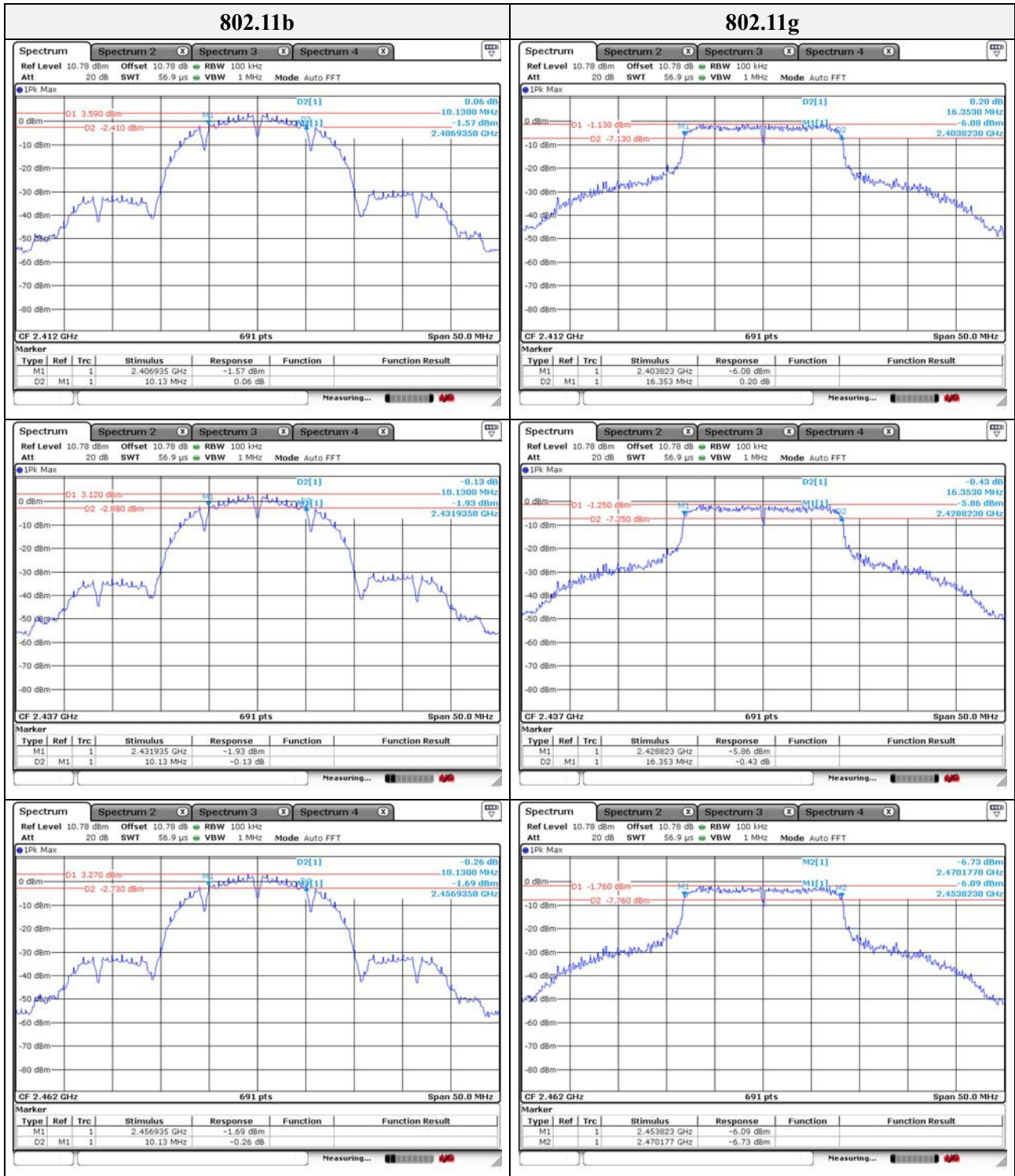
**Test results**

| <b>6 dB bandwidth of 20 MHz bandwidth</b> |                |                |                |                   |
|---|----------------|----------------|----------------|-------------------|
| <b>Measured 6 dB bandwidth(MHz)</b>       |                |                |                | <b>Limit(MHz)</b> |
| <b>Frequency(MHz)</b>                     | <b>802.11b</b> | <b>802.11g</b> | <b>802.11n</b> |                   |
| 2412                                      | 10.13          | 16.35          | 16.93          | 0.5               |
| 2437                                      | 10.13          | 16.35          | 16.79          |                   |
| 2462                                      | 10.13          | 16.35          | 16.79          |                   |

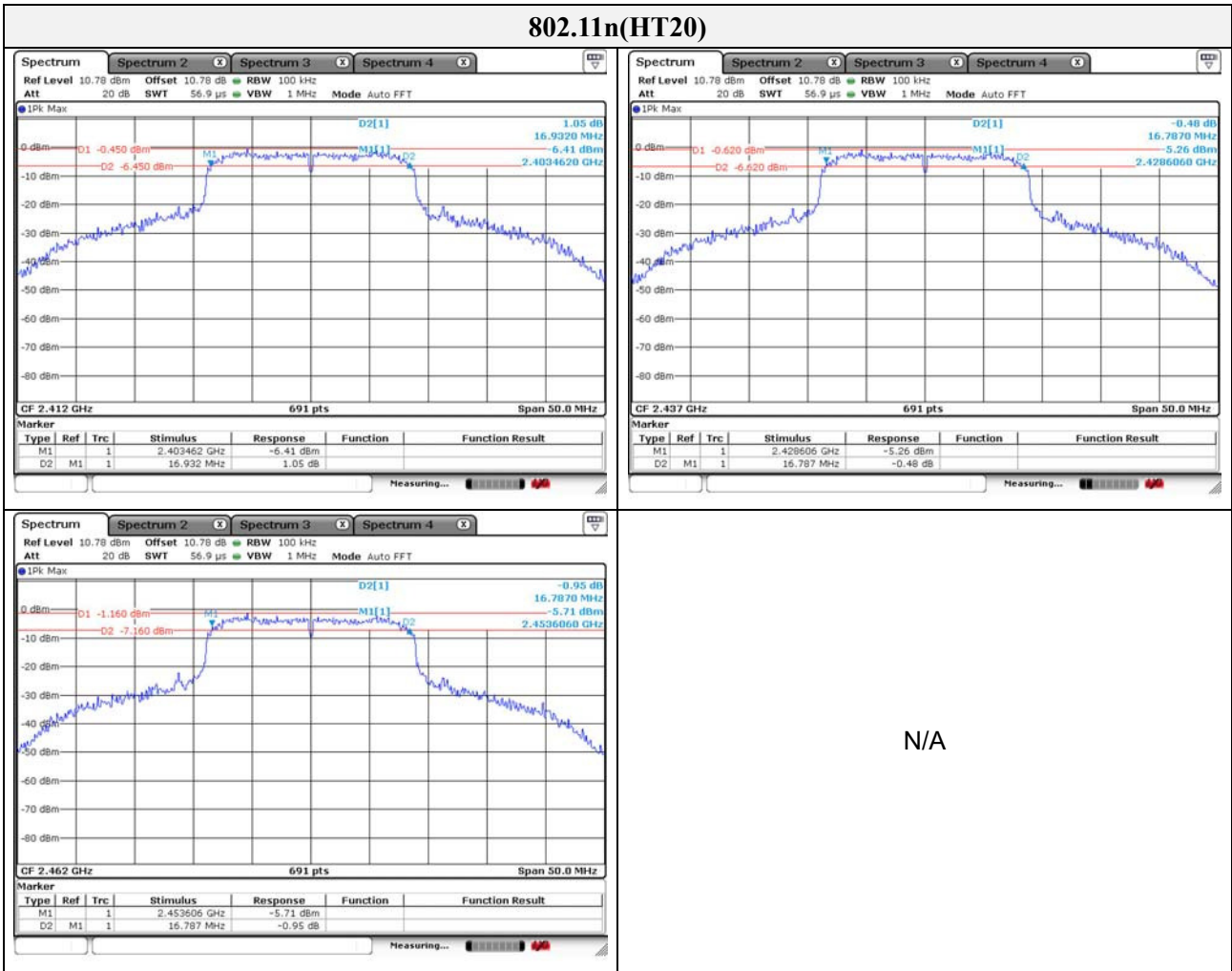
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### 3.2. Output power

#### Test procedure

KDB 558074 D01 v03r05 – section 9.1.1 or 9.1.2

Used test method is section 9.1.2.

#### Section 9.1.1

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

1. Set the RBW  $\geq$  DTS bandwidth.
2. Set VBW  $\geq 3 \times$  RBW.
3. Set span  $\geq 3 \times$  RBW
4. Sweep time = auto couple
5. Detector = peak
6. Trace mode = max hold
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level

#### 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**

| <b>Measured output power (dBm)</b> |                 |                |                 |                |                 |                |
|------------------------------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|
| <b>Mode</b>                        | <b>2412 MHz</b> |                | <b>2437 MHz</b> |                | <b>2462 MHz</b> |                |
|                                    | <b>Peak</b>     | <b>Average</b> | <b>Peak</b>     | <b>Average</b> | <b>Peak</b>     | <b>Average</b> |
| 11b                                | 16.74           | 14.39          | 16.37           | 13.99          | 15.83           | 13.43          |
| 11g                                | 19.19           | 12.45          | 18.78           | 11.86          | 18.40           | 11.26          |
| 11n_HT 20                          | 18.92           | 12.54          | 18.46           | 11.39          | 18.07           | 11.12          |

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### 3.3. Power spectral density

#### Test procedure

KDB 558074 D01 v03r05– section 10.2

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW :  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
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.
10. If measured value exceeds limit, reduce RBW(no less than 3 kHz) and repeat.

#### Limit

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.



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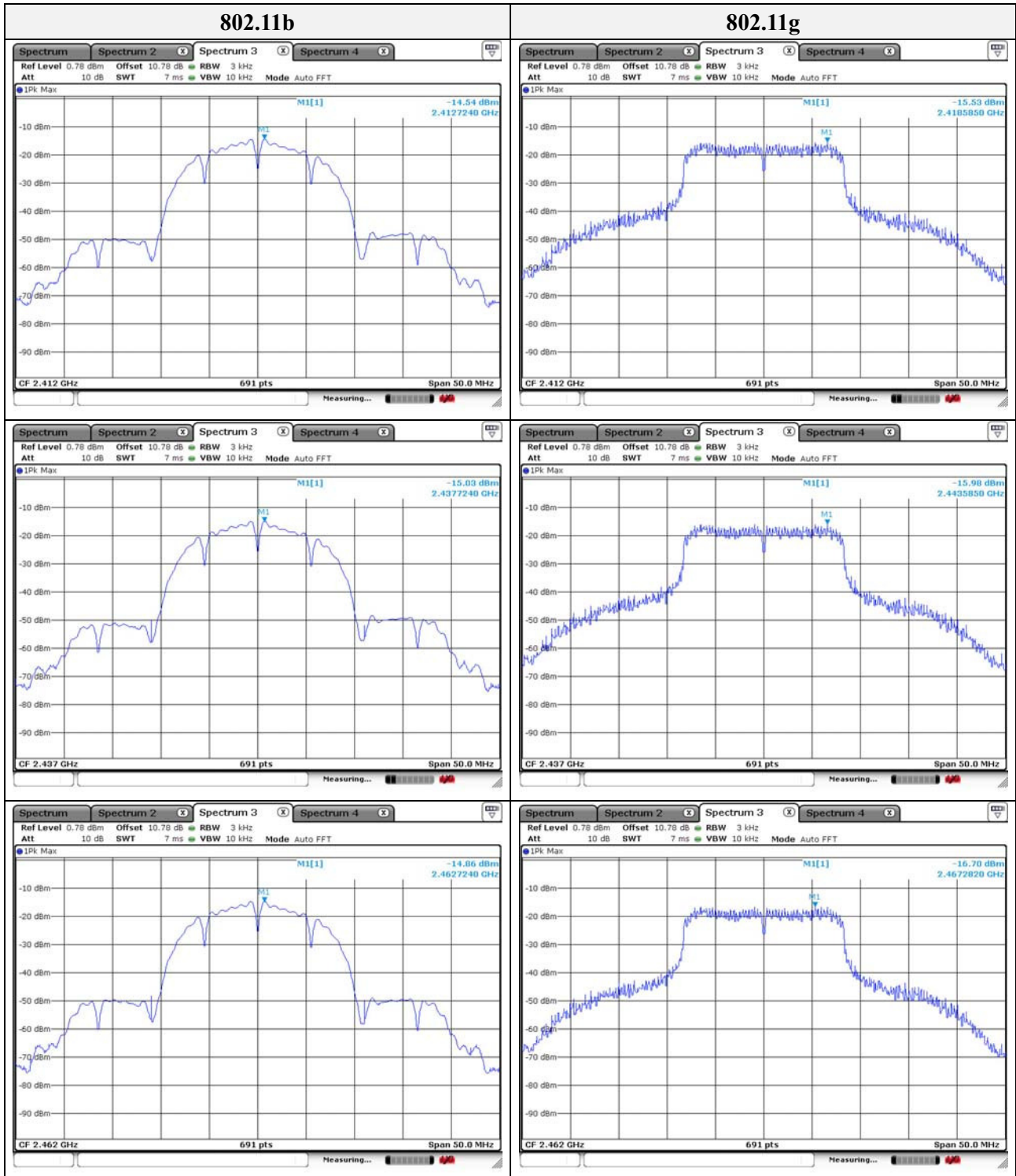
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**Test results**

| <b>PSD of 20 MHz bandwidth</b> |                |                |                |                   |
|--------------------------------|----------------|----------------|----------------|-------------------|
| <b>Measured PDS(dBm)</b>       |                |                |                | <b>Limit(dBm)</b> |
| <b>Frequency(MHz)</b>          | <b>802.11b</b> | <b>802.11g</b> | <b>802.11n</b> |                   |
| 2412                           | -14.54         | -15.53         | -14.79         | 8                 |
| 2437                           | -15.03         | -15.98         | -15.08         |                   |
| 2462                           | -14.86         | -16.70         | -15.56         |                   |

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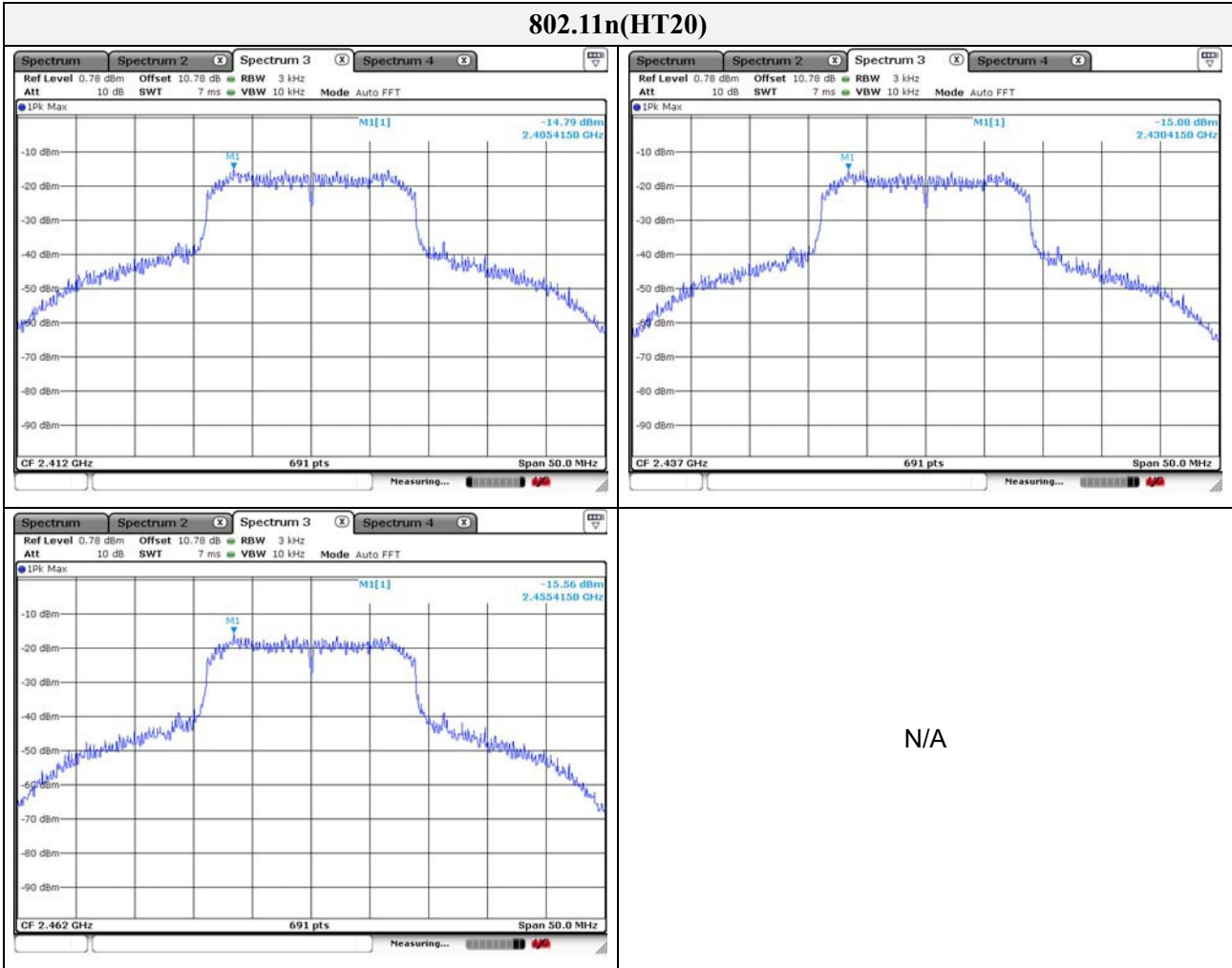


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**802.11n(HT20)**



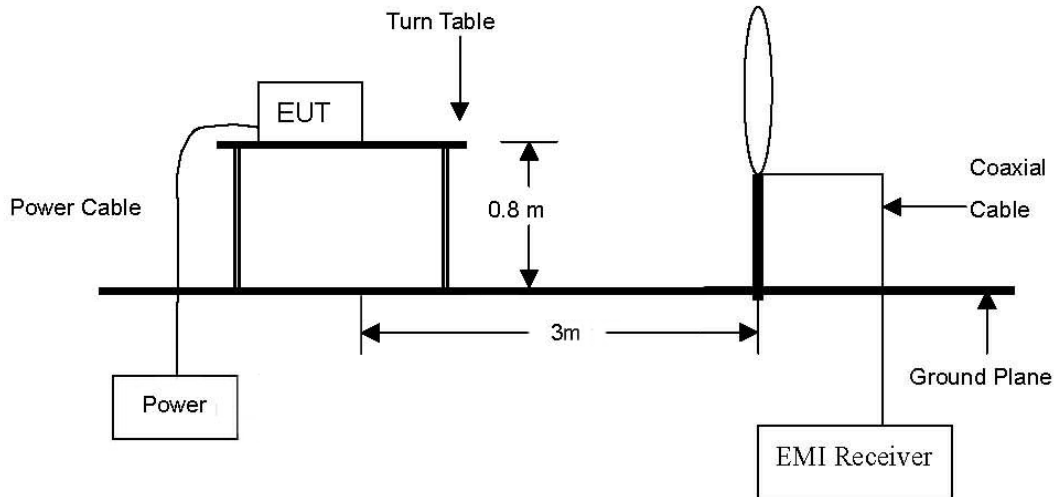
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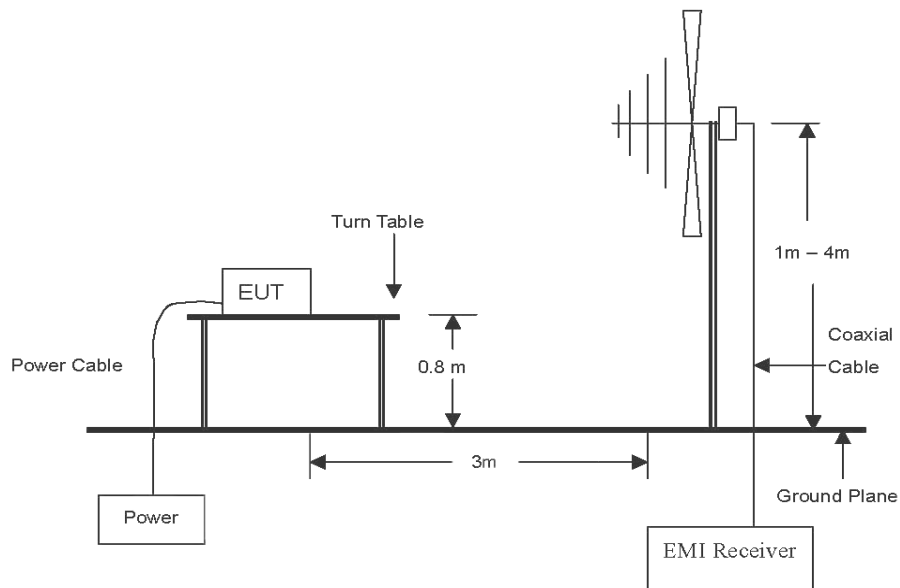
### 3.4. Radiated restricted band and emissions

#### Test setup

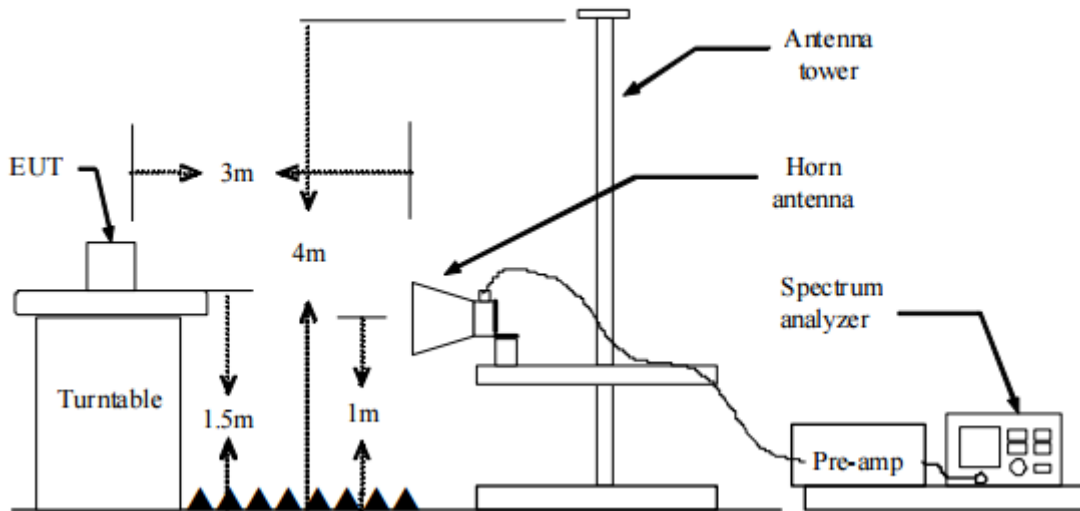
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



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 the tenth harmonic of the highest fundamental frequency or to 40 GHz emissions, whichever is lower.



#### Test procedure 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.

#### Test procedure above 30 MHz

1. Spectrum analyzer settings for  $f < 1$  GHz:
  - ① Span = wide enough to fully capture the emission being measured
  - ② RBW = 100 kHz
  - ③ VBW  $\geq$  RBW
  - ④ Detector = quasi peak
  - ⑤ Sweep time = auto
  - ⑥ Trace = max hold
2. Spectrum analyzer settings for  $f \geq 1$  GHz: Peak
  - ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
  - ② RBW = 1 MHz
  - ③ VBW  $\geq$  3 MHz
  - ④ Detector = peak
  - ⑤ Sweep time = auto
  - ⑥ Trace = max hold
  - ⑦ Trace was allowed to stabilize

3. Spectrum analyzer settings for  $f \geq 1$  GHz: Average

- ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- ② RBW = 1 MHz
- ③ VBW  $\geq 3 \times$  RBW
- ④ 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.
- ⑤ Averaging type = power(i.e., RMS)
  - 1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
  - 2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
- ⑥ Sweep = auto
- ⑦ Trace = max hold
- ⑧ Perform a trace average of at least 100 traces.
- ⑨ A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
  - 1) If power averaging (RMS) mode was used in step ⑤, then the applicable correction factor is  $10 \log(1/x)$ , where x is the duty cycle.
  - 2) If linear voltage averaging mode was used in step ⑤, then the applicable correction factor is  $20 \log(1/x)$ , where x is the duty cycle.
  - 3) If a specific emission is demonstrated to be continuous ( $\geq 98$  percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

**Note.**

1.  $f < 30$  MHz, extrapolation factor of 40 dB/decade of distance.  $F_d = 40 \log(D_m/D_s)$   
 $f \geq 30$  MHz, extrapolation factor of 20 dB/decade of distance.  $F_d = 20 \log(D_m/D_s)$   
Where:  
 $F_d$  = Distance factor in dB  
 $D_m$  = Measurement distance in meters  
 $D_s$  = Specification distance in meters
3. CF(Correction factors(dB)) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB) + or  $F_d$ (dB)
4. Field strength(dB $\mu$ V/m) = Level(dB $\mu$ V) + CF (dB) + or DCF(dB)
5. Margin(dB) = Limit(dB $\mu$ V/m) - Field strength(dB $\mu$ V/m)
6. Emissions below 18 GHz were measured at a 3 meter test distance while emissions above 18 GHz were measured at a 1 meter test distance with the application of a distance correction factor.
7. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z, it was determined that **X orientation** was worst-case orientation; therefore, all final radiated testing was performed with the EUT in **X orientation**.
8. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.



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Dongan-gu, Anyang-si, Gyeonggi-do, Korea  
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**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 ( $\mu V/m$ ) |
|-----------------|-------------------|------------------------|
| 0.009 ~ 0.490   | 300               | 2400/F(kHz)            |
| 0.490 ~ 1.705   | 30                | 24000/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.

### Duty cycle

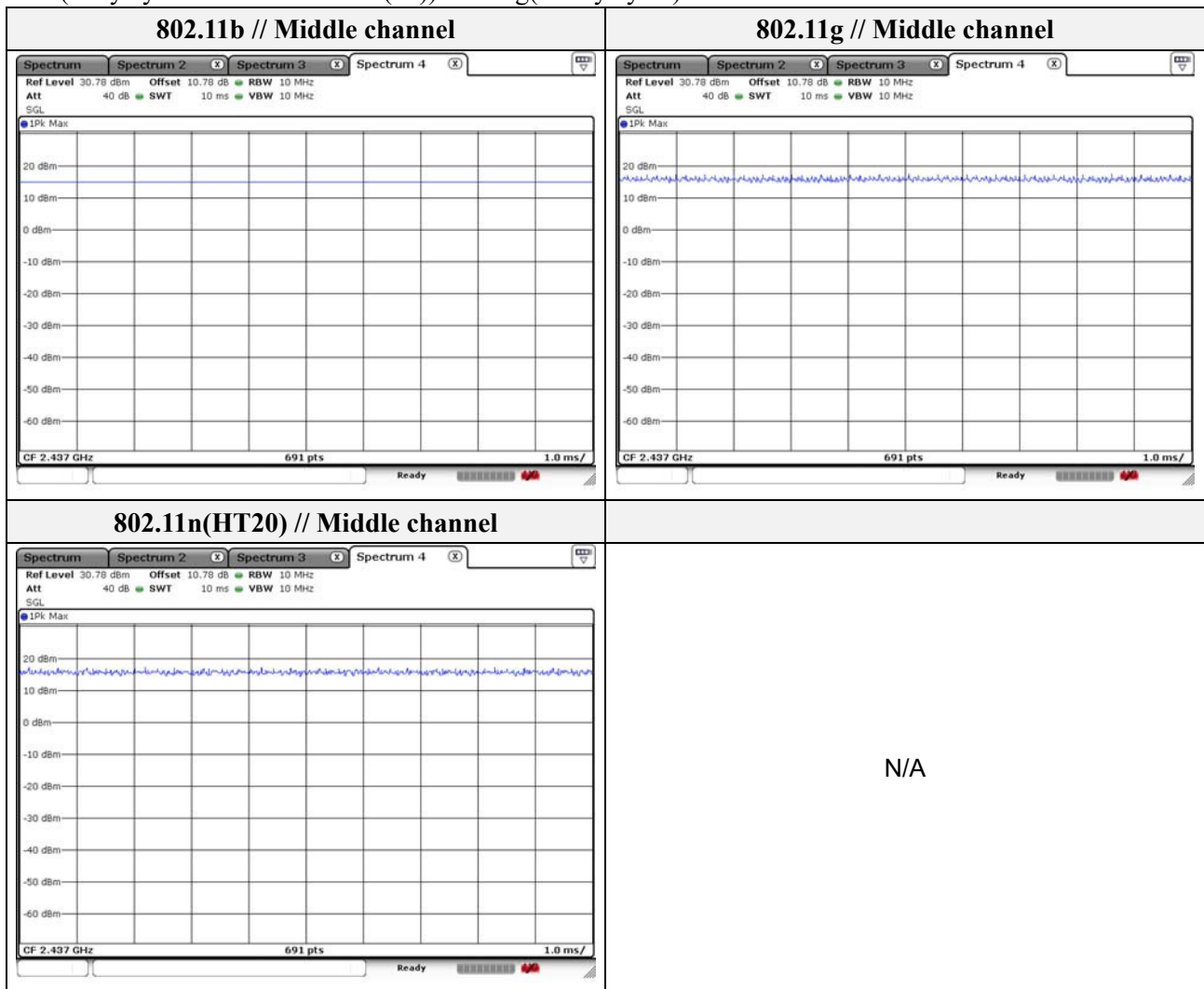
Regarding to KDB 558074 D01\_v03r05, 6.0, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below.

Set RBW  $\geq$  OBW if possible; otherwise, set RBW to the largest available value. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are  $> 50/T$  and the number of sweep points across duration T exceeds 100.

| Test mode     | T <sub>on</sub> time (ms) | Period (ms) | Duty cycle (Linear) | Duty cycle (%) | Duty cycle correction factor (dB) |
|---------------|---------------------------|-------------|---------------------|----------------|-----------------------------------|
| 802.11b       | 10.00                     | 10.00       | 1                   | 100            | 0                                 |
| 802.11g       | 10.00                     | 10.00       | 1                   | 100            | 0                                 |
| 802.11n(HT20) | 10.00                     | 10.00       | 1                   | 100            | 0                                 |

Duty cycle (Linear) = T<sub>on</sub> time/Period

DCF(Duty cycle correction factor (dB)) = 10log(1/duty cycle)



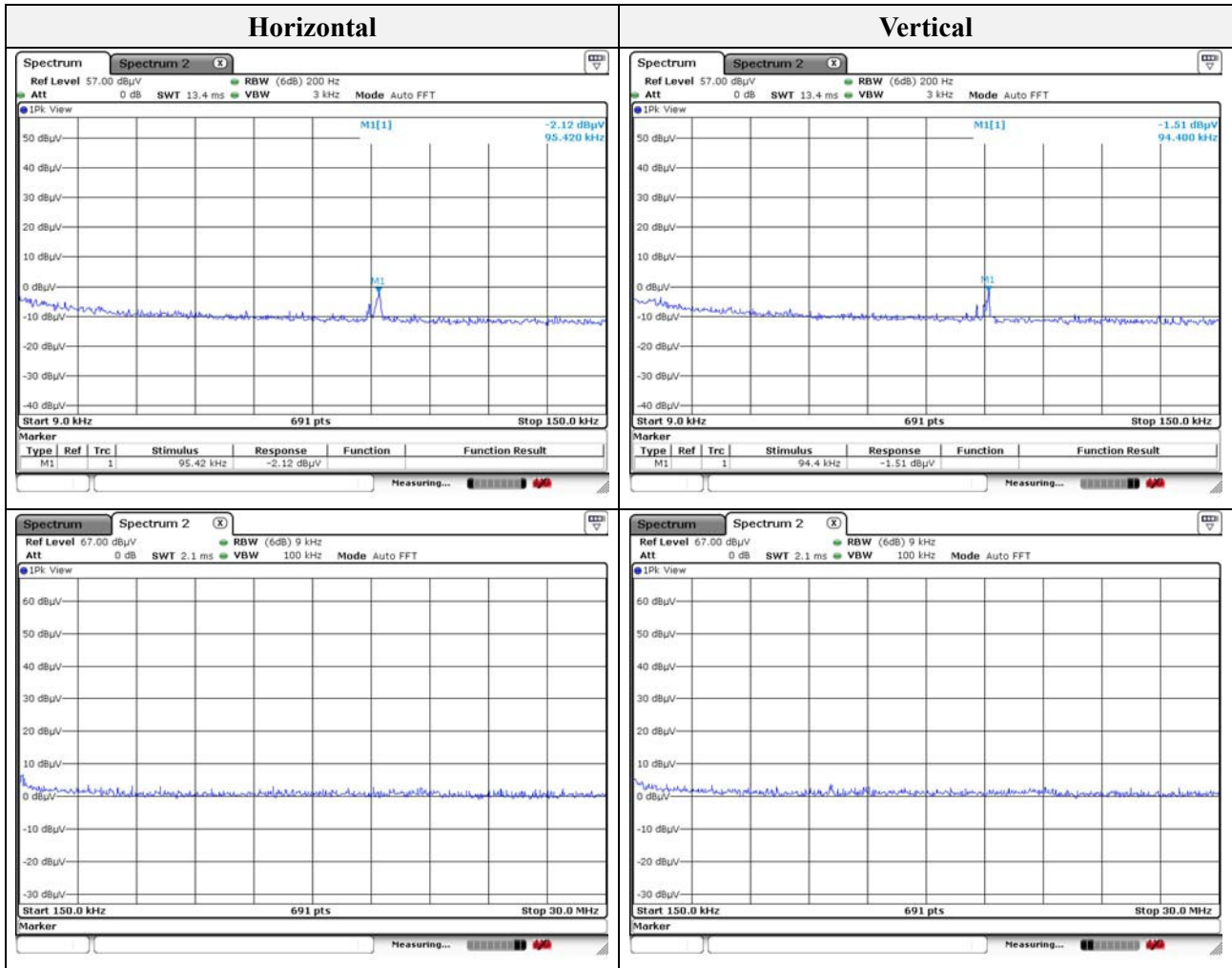
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**Test results (Below 30 MHz)**

Mode: 802.11b  
 Distance of measurement: 3 meter  
 Channel: 01 (Worst case)

| Frequency<br>(MHz)  | Level<br>(dB $\mu$ V) | Ant. Pol.<br>(H/V) | CF<br>(dB) | F <sub>d</sub><br>(dB) | Field strength<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Margin<br>(dB) |
|---|-----------------------|--------------------|------------|------------------------|----------------------------------|-------------------------|----------------|
| No spurious emissions were detected within 20 dB of the limit |                       |                    |            |                        |                                  |                         |                |

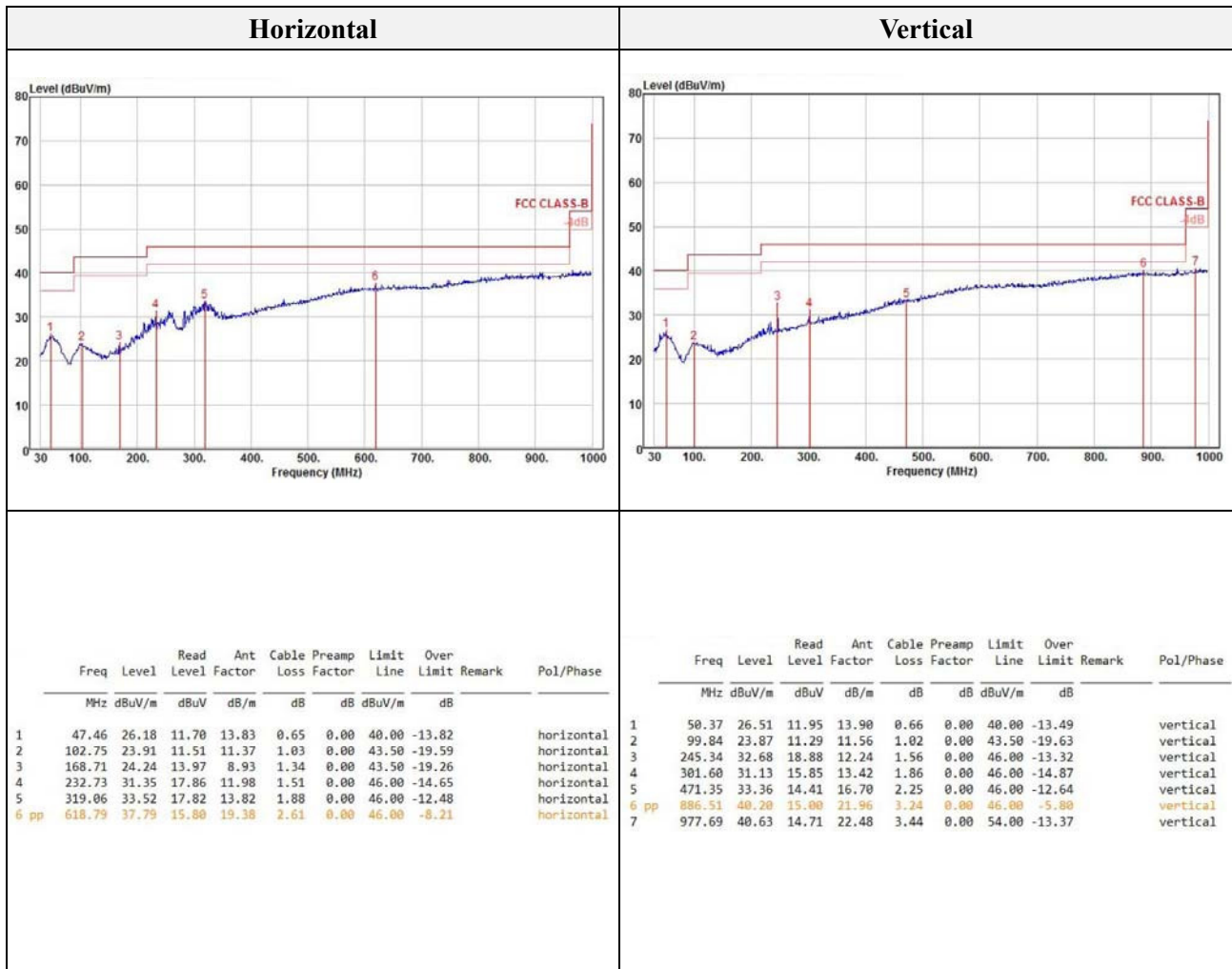


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**Test results (Below 1 000 MHz) – Worst case**

Mode: 802.11b  
 Distance of measurement: 3 meter  
 Channel: 01 (Worst case)



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**Test results (Above 1 000 MHz)**

Mode: 802.11b  
Distance of measurement: 3 meter  
Channel: 01

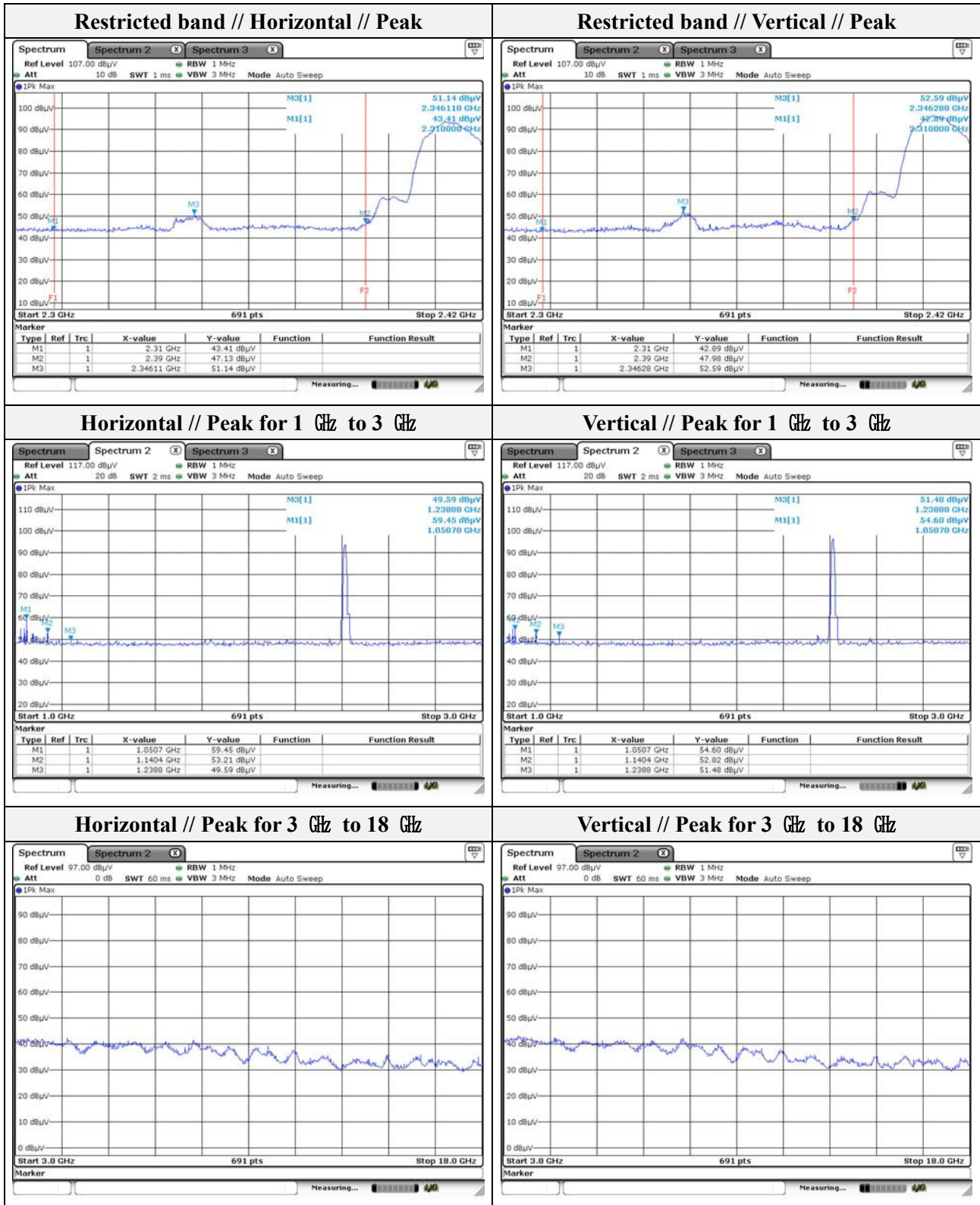
**- Spurious**

| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 1050.70         | 59.45              | Peak        | H               | -9.30   | -        | 50.15                         | 74.00                | 23.85       |
| 1140.40         | 53.21              | Peak        | H               | -9.04   | -        | 44.17                         | 74.00                | 29.83       |
| 1238.80         | 49.59              | Peak        | H               | -8.78   | -        | 40.81                         | 74.00                | 33.19       |
| 1050.70         | 54.60              | Peak        | V               | -9.30   | -        | 45.30                         | 74.00                | 28.70       |
| 1140.40         | 52.82              | Peak        | V               | -9.04   | -        | 43.78                         | 74.00                | 30.22       |
| 1238.80         | 51.48              | Peak        | V               | -8.78   | -        | 42.70                         | 74.00                | 31.30       |

**- Band edge**

| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 2346.11         | 51.14              | Peak        | H               | -2.49   | -        | 48.65                         | 74.00                | 25.35       |
| 2346.28         | 52.59              | Peak        | V               | -2.49   | -        | 50.10                         | 74.00                | 23.90       |





Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

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Dongan-gu, Anyang-si, Gyeonggi-do, Korea  
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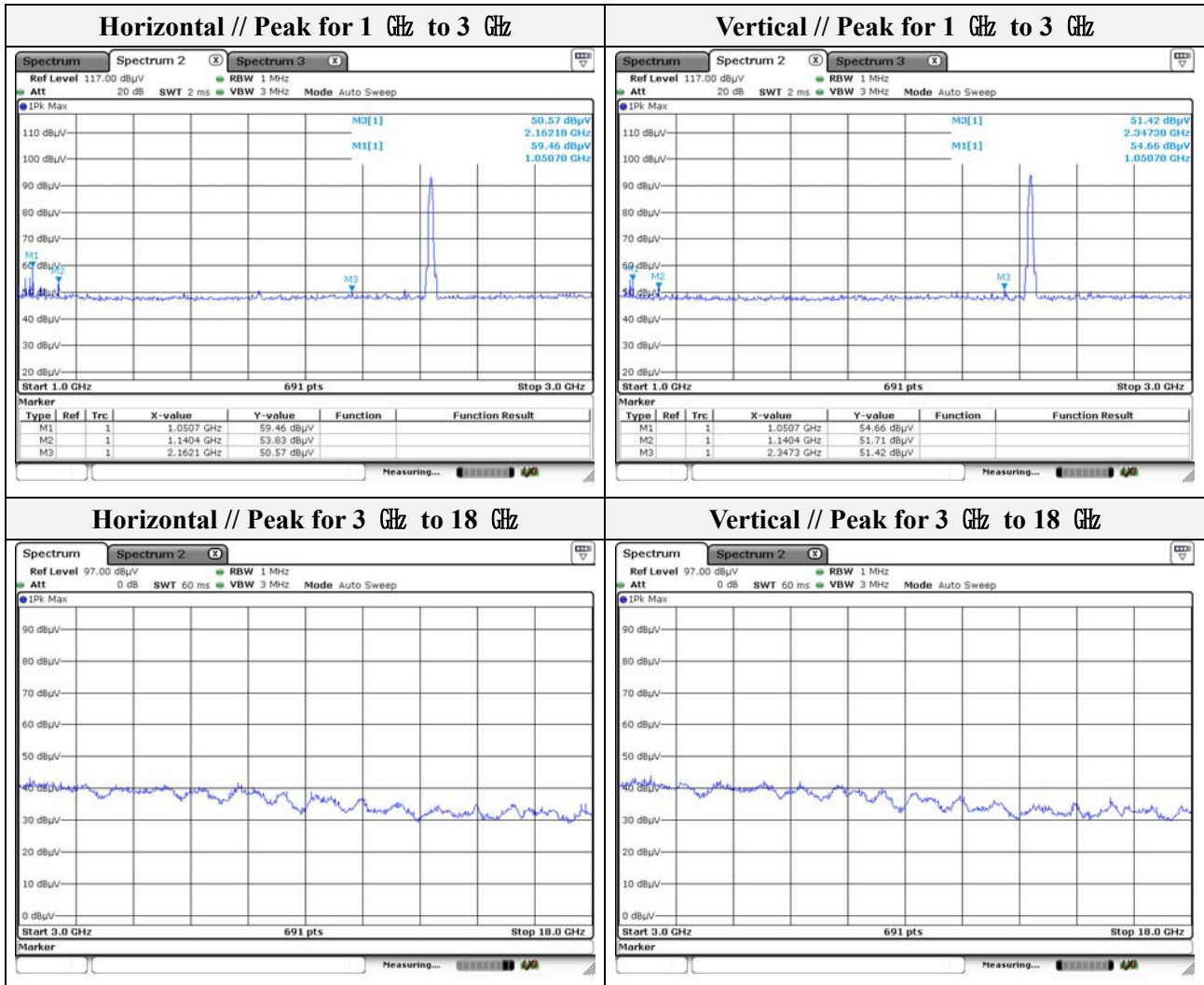
Test report No.:  
KES-RF-17T0020  
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Mode: 802.11b  
Distance of measurement: 3 meter  
Channel: 06

- **Spurious**

| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 1050.70         | 59.46              | Peak        | H               | -9.30   | -        | 50.16                         | 74.00                | 23.84       |
| 1140.40         | 53.83              | Peak        | H               | -9.04   | -        | 44.79                         | 74.00                | 29.21       |
| 2162.10         | 50.57              | Peak        | H               | -3.43   | -        | 47.14                         | 74.00                | 26.86       |
| 1050.70         | 54.66              | Peak        | V               | -9.30   | -        | 45.36                         | 74.00                | 28.64       |
| 1140.40         | 51.71              | Peak        | V               | -9.04   | -        | 42.67                         | 74.00                | 31.33       |
| 2347.30         | 51.42              | Peak        | V               | -2.48   | -        | 48.94                         | 74.00                | 25.06       |

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Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

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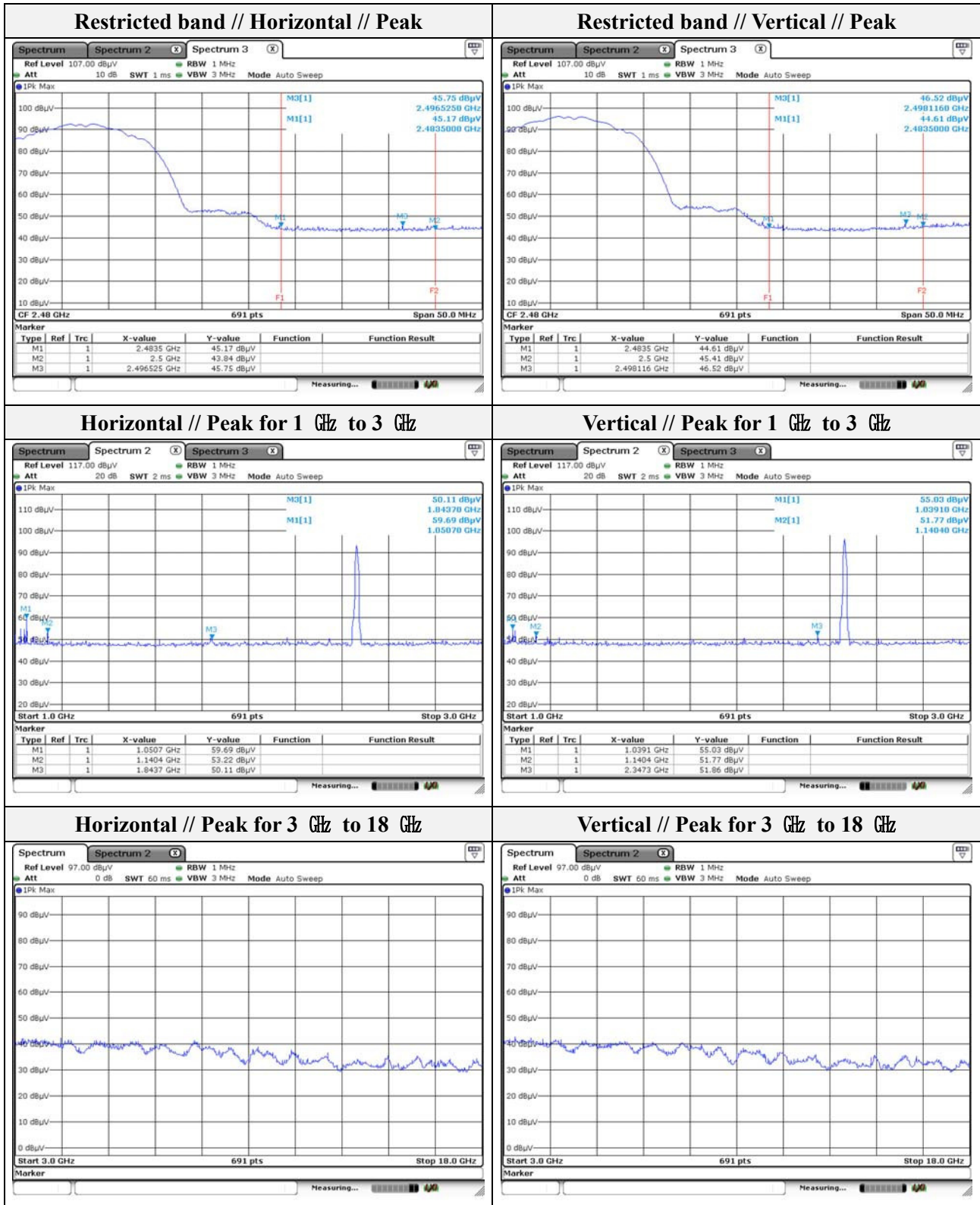
Mode: 802.11b  
Distance of measurement: 3 meter  
Channel: 11

- **Spurious**

| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 1050.70         | 59.69              | Peak        | H               | -9.30   | -        | 50.39                         | 74.00                | 23.61       |
| 1140.40         | 53.22              | Peak        | H               | -9.04   | -        | 44.18                         | 74.00                | 29.82       |
| 1843.70         | 50.11              | Peak        | H               | -5.45   | -        | 44.66                         | 74.00                | 29.34       |
| 1039.10         | 55.03              | Peak        | V               | -9.33   | -        | 45.70                         | 74.00                | 28.30       |
| 1140.40         | 51.77              | Peak        | V               | -9.04   | -        | 42.73                         | 74.00                | 31.27       |
| 2347.30         | 51.86              | Peak        | V               | -2.48   | -        | 49.38                         | 74.00                | 24.62       |

- **Band edge**

| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 2496.53         | 45.75              | Peak        | H               | -1.73   | -        | 44.02                         | 74.00                | 29.98       |
| 2498.12         | 46.52              | Peak        | V               | -1.72   | -        | 44.80                         | 74.00                | 29.20       |



Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

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Test report No.:  
KES-RF-17T0020  
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Mode: 802.11g  
Distance of measurement: 3 meter  
Channel: 01

**- Spurious**

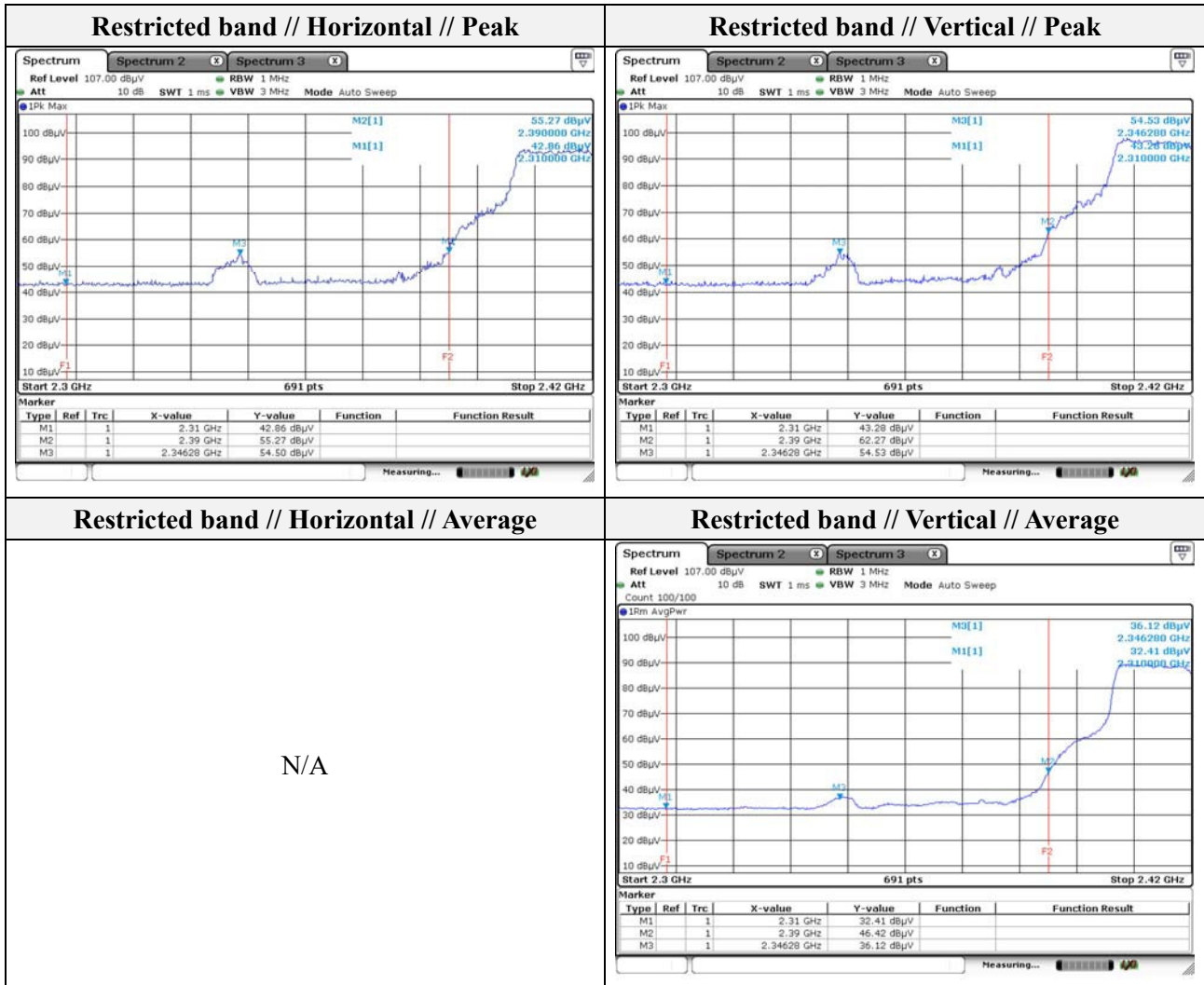
| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 1050.70         | 60.29              | Peak        | H               | -9.30   | -        | 50.99                         | 74.00                | 23.01       |
| 1140.40         | 53.64              | Peak        | H               | -9.04   | -        | 44.60                         | 74.00                | 29.40       |
| 1050.70         | 54.62              | Peak        | V               | -9.30   | -        | 45.32                         | 74.00                | 28.68       |
| 1140.40         | 52.30              | Peak        | V               | -9.04   | -        | 43.26                         | 74.00                | 30.74       |
| 2347.30         | 52.51              | Peak        | V               | -2.48   | -        | 50.03                         | 74.00                | 23.97       |

**- Band edge**

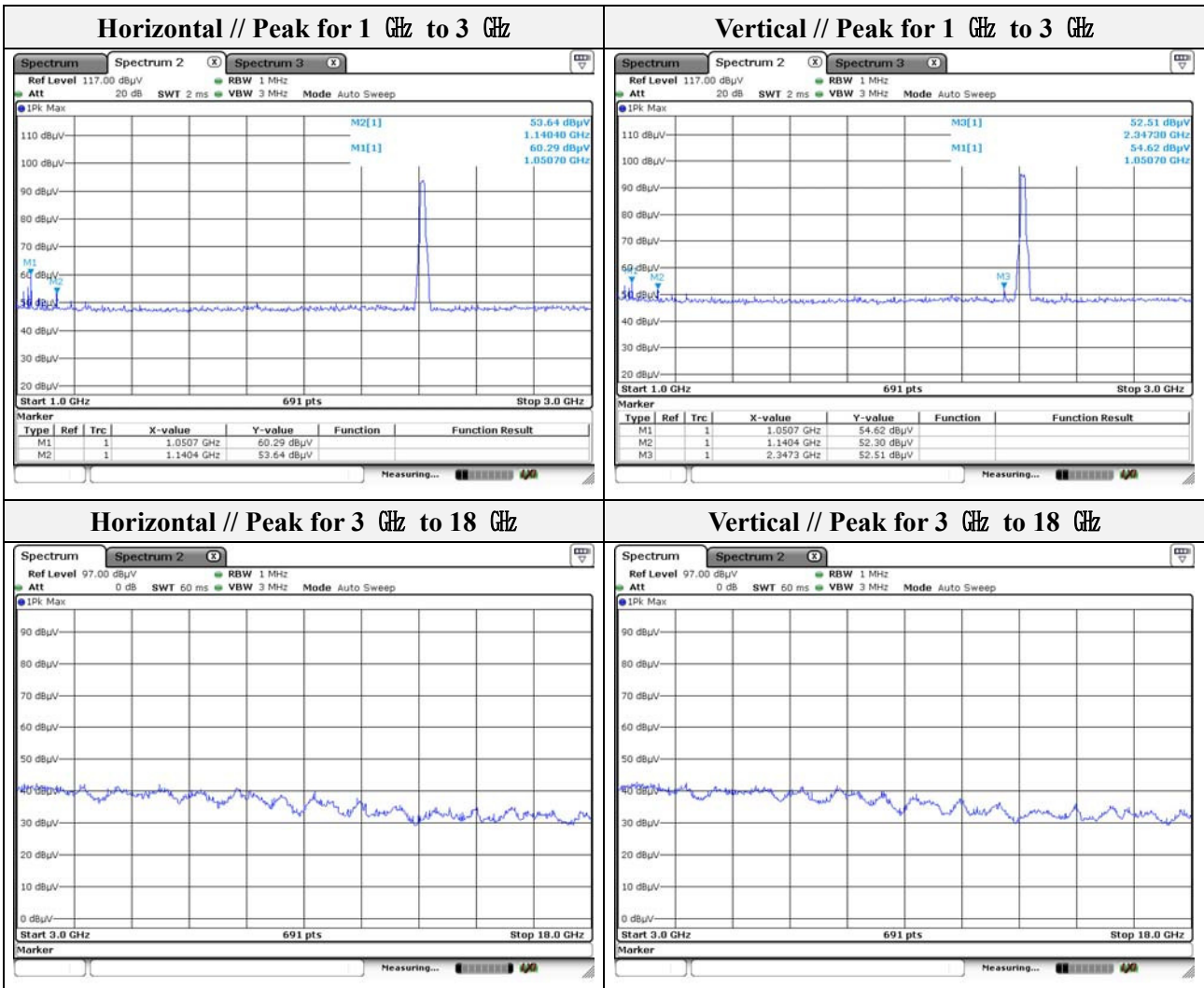
| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 2390.00         | 55.27              | Peak        | H               | -2.26   | -        | 53.01                         | 74.00                | 20.99       |
| 2390.00         | 62.27              | Peak        | V               | -2.26   | -        | 60.01                         | 74.00                | 13.99       |
| 2390.00         | 46.42              | Average     | V               | -2.26   | -        | 44.16                         | 54.00                | 9.84        |

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Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.





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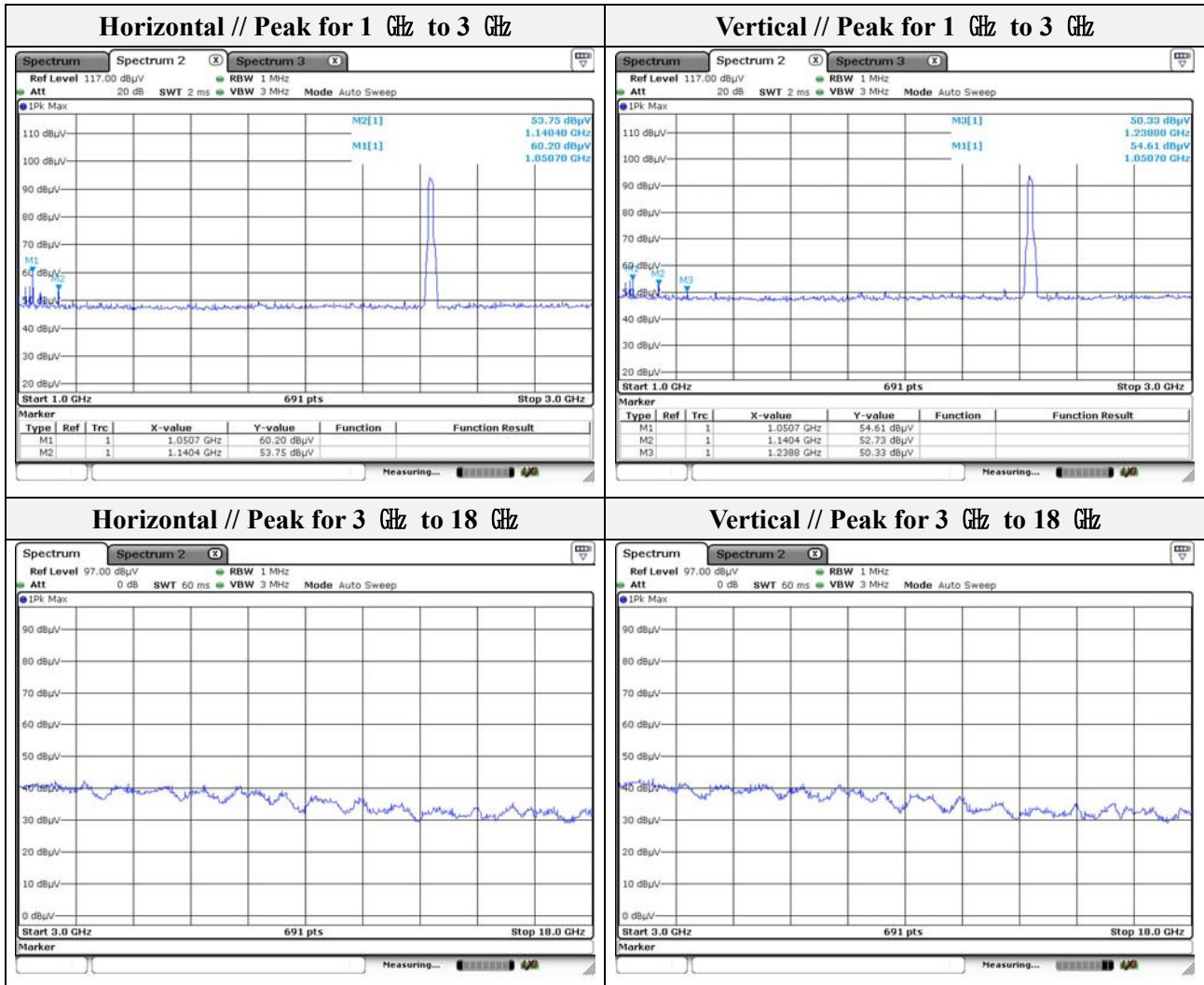
Test report No.:  
KES-RF-17T0020  
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Mode: 802.11g  
Distance of measurement: 3 meter  
Channel: 06

- **Spurious**

| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 1050.70         | 60.20              | Peak        | H               | -9.30   | -        | 50.90                         | 74.00                | 23.10       |
| 1140.40         | 53.75              | Peak        | H               | -9.04   | -        | 44.71                         | 74.00                | 29.29       |
| 1050.70         | 54.61              | Peak        | V               | -9.30   | -        | 45.31                         | 74.00                | 28.69       |
| 1140.40         | 52.73              | Peak        | V               | -9.04   | -        | 43.69                         | 74.00                | 30.31       |
| 1238.80         | 50.33              | Peak        | V               | -8.78   | -        | 41.55                         | 74.00                | 32.45       |

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Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.



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Dongan-gu, Anyang-si, Gyeonggi-do, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
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Test report No.:  
KES-RF-17T0020  
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Mode: 802.11g  
Distance of measurement: 3 meter  
Channel: 11

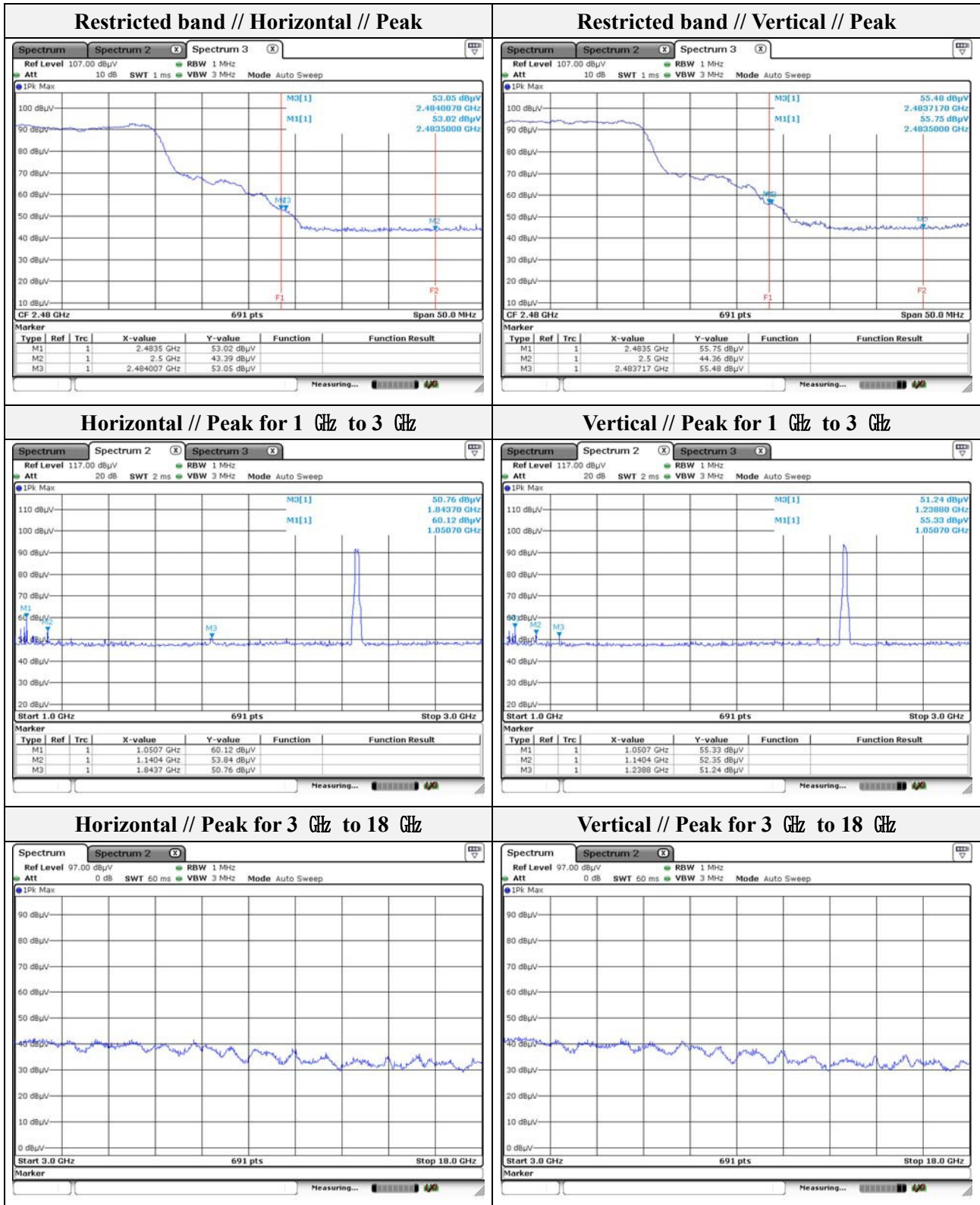
**- Spurious**

| Frequency (MHz) | Level (dBμV) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|-------------|-----------------|---------|----------|-------------------------|----------------|-------------|
| 1050.70         | 60.12        | Peak        | H               | -9.30   | -        | 50.82                   | 74.00          | 23.18       |
| 1140.40         | 53.84        | Peak        | H               | -9.04   | -        | 44.80                   | 74.00          | 29.20       |
| 1843.70         | 50.76        | Peak        | H               | -5.45   | -        | 45.31                   | 74.00          | 28.69       |
| 1050.70         | 55.33        | Peak        | V               | -9.30   | -        | 46.03                   | 74.00          | 27.97       |
| 1140.40         | 52.35        | Peak        | V               | -9.04   | -        | 43.31                   | 74.00          | 30.69       |
| 1238.80         | 51.24        | Peak        | V               | -8.78   | -        | 42.46                   | 74.00          | 31.54       |

**- Band edge**

| Frequency (MHz) | Level (dBμV) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|-----------------|--------------|-------------|-----------------|---------|----------|-------------------------|----------------|-------------|
| 2484.01         | 53.05        | Peak        | H               | -1.79   | -        | 51.26                   | 74.00          | 22.74       |
| 2483.50         | 55.75        | Peak        | V               | -1.79   | -        | 53.96                   | 74.00          | 20.04       |

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Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

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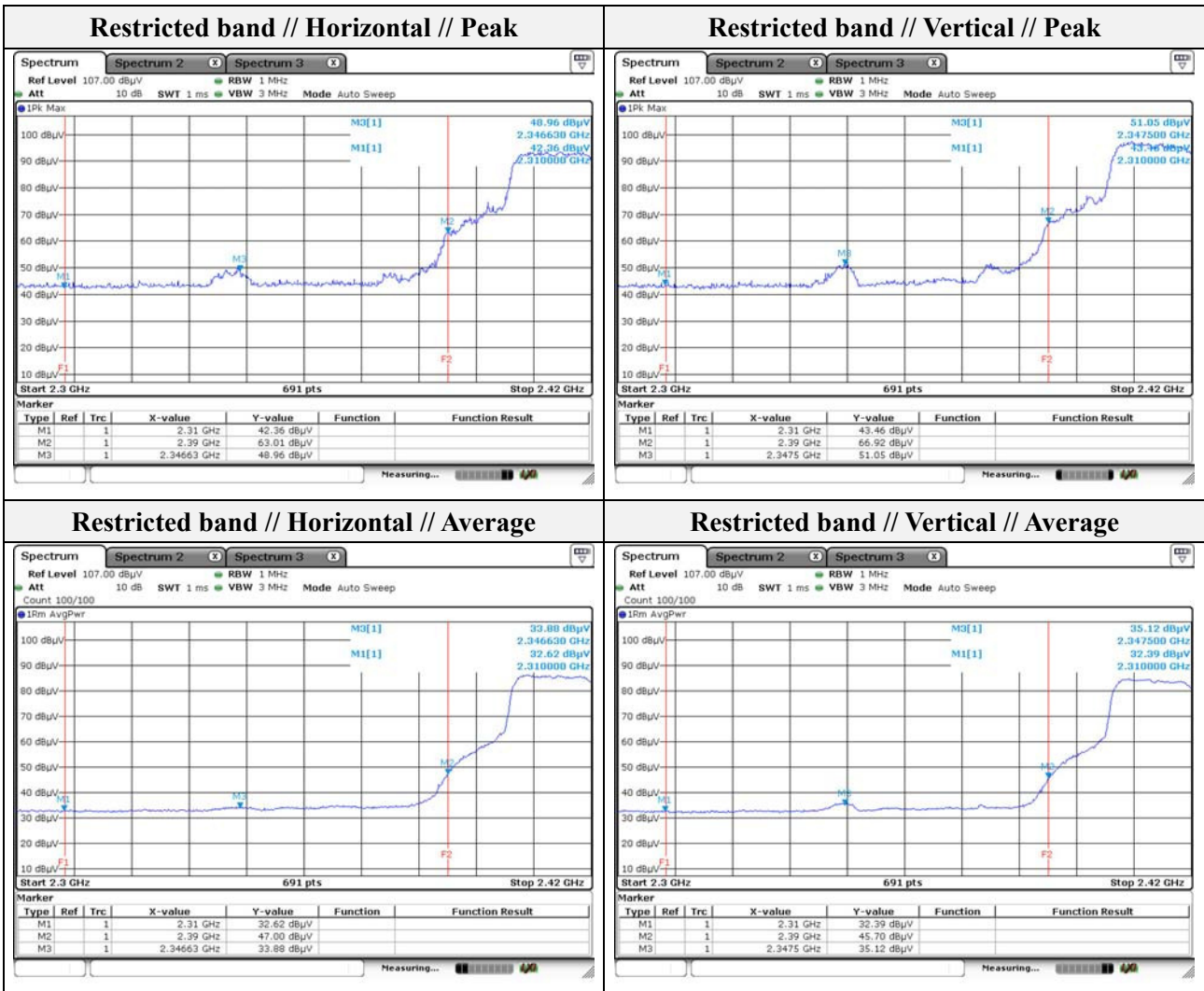
Mode: 802.11n(HT20)  
Distance of measurement: 3 meter  
Channel: 01

- **Spurious**

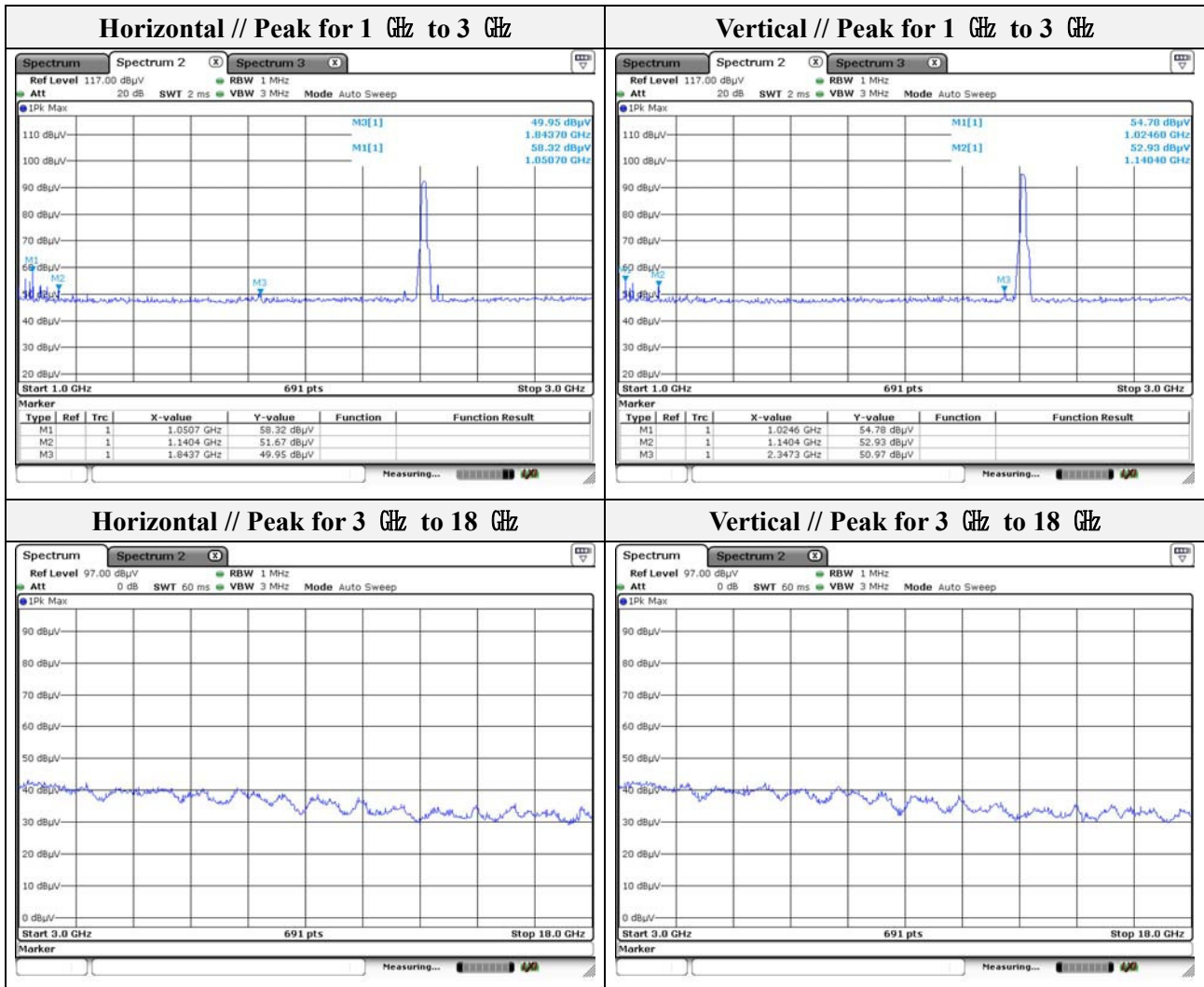
| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 1050.70         | 58.32              | Peak        | H               | -9.30   | -        | 49.02                         | 74.00                | 24.98       |
| 1140.40         | 51.67              | Peak        | H               | -9.04   | -        | 42.63                         | 74.00                | 31.37       |
| 1843.70         | 49.95              | Peak        | H               | -5.45   | -        | 44.50                         | 74.00                | 29.50       |
| 1024.60         | 54.78              | Peak        | V               | -9.37   | -        | 45.41                         | 74.00                | 28.59       |
| 1140.40         | 52.93              | Peak        | V               | -9.04   | -        | 43.89                         | 74.00                | 30.11       |
| 2347.30         | 50.97              | Peak        | V               | -2.48   | -        | 48.49                         | 74.00                | 25.51       |

- **Band edge**

| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 2390.00         | 63.01              | Peak        | H               | -2.26   | -        | 60.75                         | 74.00                | 13.25       |
| 2390.00         | 47.00              | Average     | H               | -2.26   | -        | 44.74                         | 54.00                | 9.26        |
| 2390.00         | 66.92              | Peak        | V               | -2.26   | -        | 64.66                         | 74.00                | 9.34        |
| 2390.00         | 45.70              | Average     | V               | -2.26   | -        | 43.44                         | 54.00                | 10.56       |



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Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.



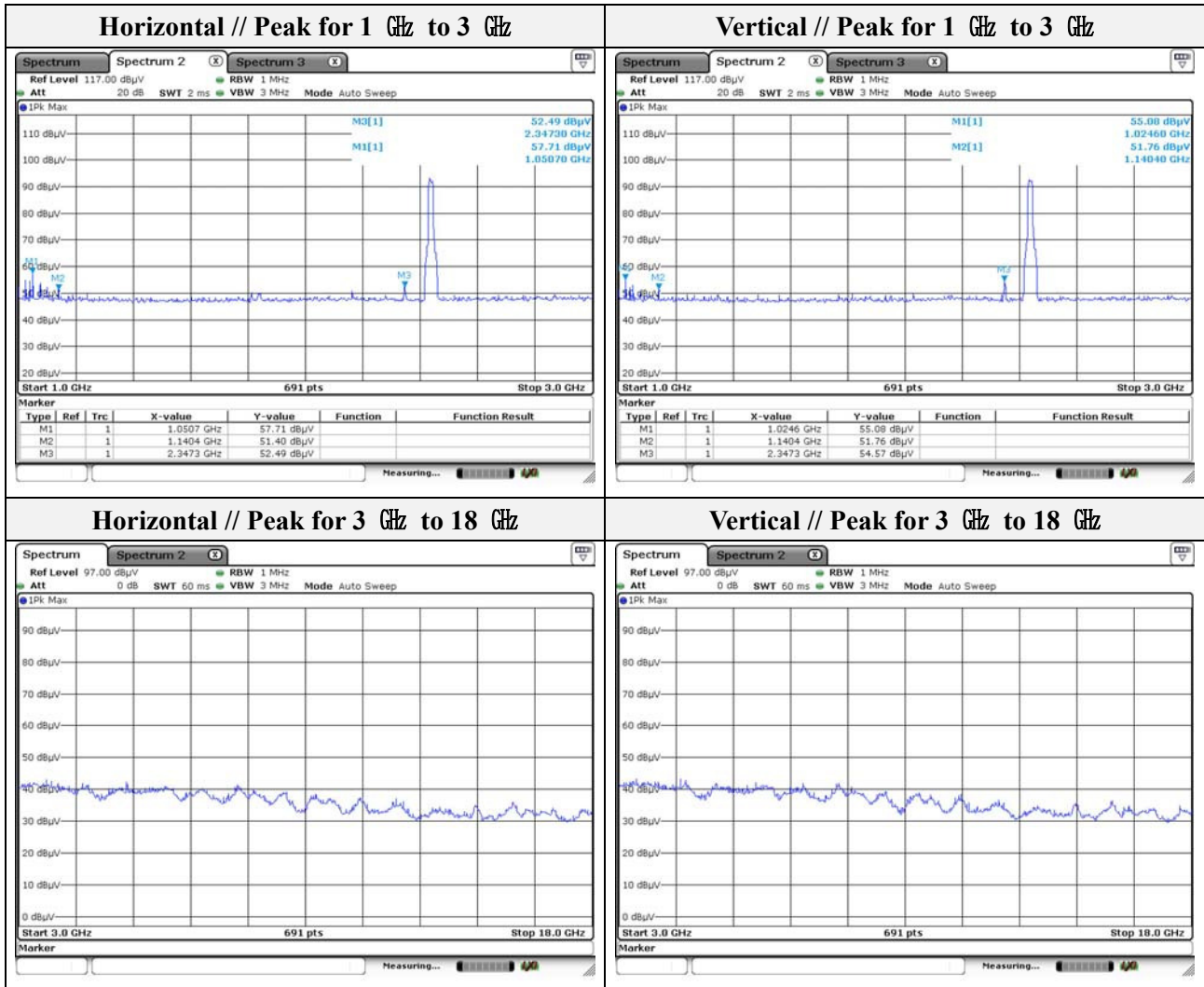


Mode: 802.11n(HT20)  
Distance of measurement: 3 meter  
Channel: 06

- **Spurious**

| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 1050.70         | 57.71              | Peak        | H               | -9.30   | -        | 48.41                         | 74.00                | 25.59       |
| 1140.40         | 51.40              | Peak        | H               | -9.04   | -        | 42.36                         | 74.00                | 31.64       |
| 2347.30         | 52.49              | Peak        | H               | -2.48   | -        | 50.01                         | 74.00                | 23.99       |
| 1024.60         | 55.08              | Peak        | V               | -9.37   | -        | 45.71                         | 74.00                | 28.29       |
| 1140.40         | 51.76              | Peak        | V               | -9.04   | -        | 42.72                         | 74.00                | 31.28       |
| 2347.30         | 54.57              | Peak        | V               | -2.48   | -        | 52.09                         | 74.00                | 21.91       |





Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

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Dongan-gu, Anyang-si, Gyeonggi-do, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
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Mode: 802.11n(HT20)  
Distance of measurement: 3 meter  
Channel: 11

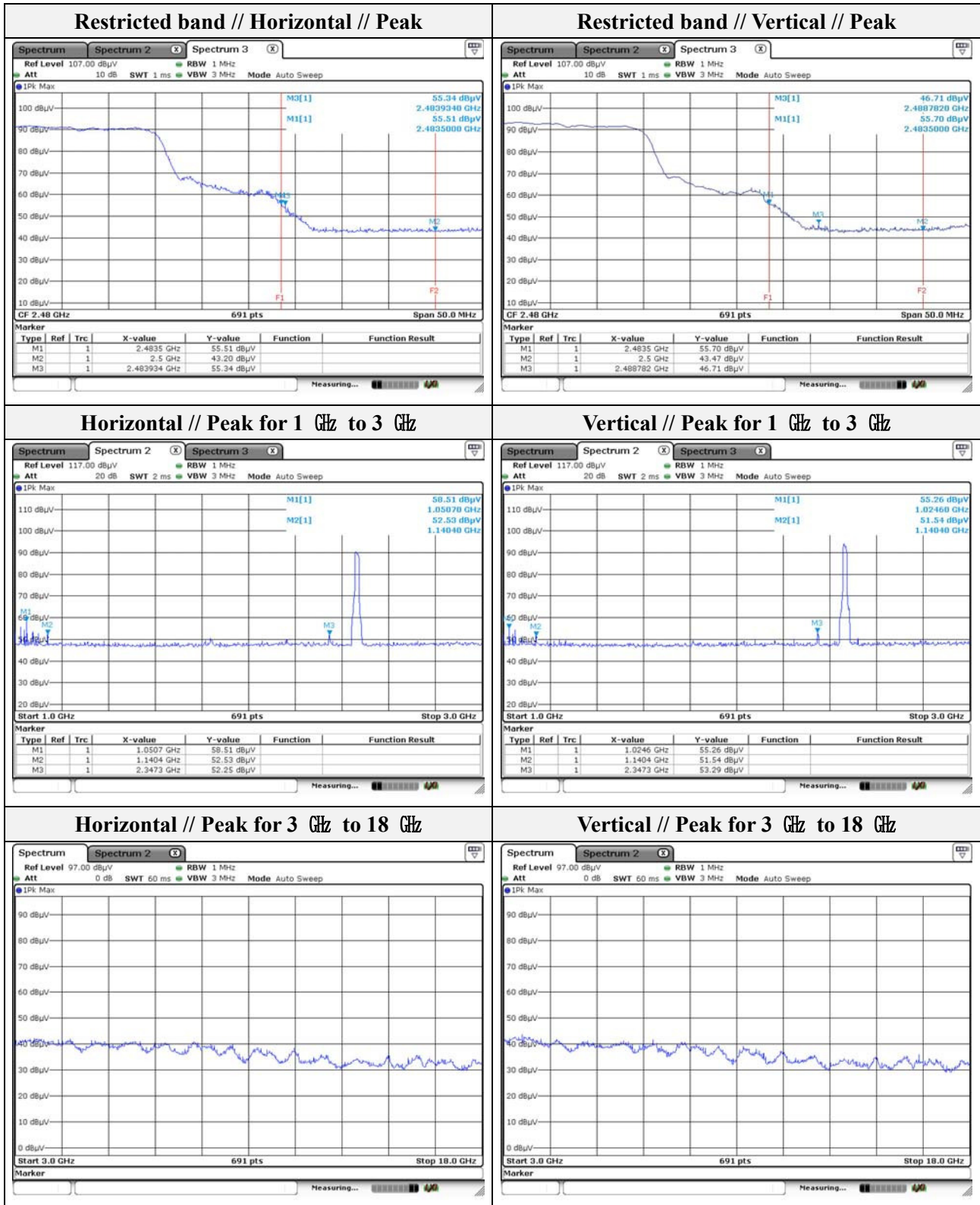
**- Spurious**

| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 1050.70         | 58.51              | Peak        | H               | -9.30   | -        | 49.21                         | 74.00                | 24.79       |
| 1140.40         | 52.53              | Peak        | H               | -9.04   | -        | 43.49                         | 74.00                | 30.51       |
| 2347.30         | 52.25              | Peak        | H               | -2.48   | -        | 49.77                         | 74.00                | 24.23       |
| 1024.60         | 55.26              | Peak        | V               | -9.37   | -        | 45.89                         | 74.00                | 28.11       |
| 1140.40         | 51.54              | Peak        | V               | -9.04   | -        | 42.50                         | 74.00                | 31.50       |
| 2347.30         | 53.29              | Peak        | V               | -2.48   | -        | 50.81                         | 74.00                | 23.19       |

**- Band edge**

| Frequency (MHz) | Level (dB $\mu$ V) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|--------------------|-------------|-----------------|---------|----------|-------------------------------|----------------------|-------------|
| 2483.50         | 55.51              | Peak        | H               | -1.79   | -        | 53.72                         | 74.00                | 20.28       |
| 2483.50         | 55.70              | Peak        | V               | -1.79   | -        | 53.91                         | 74.00                | 20.09       |

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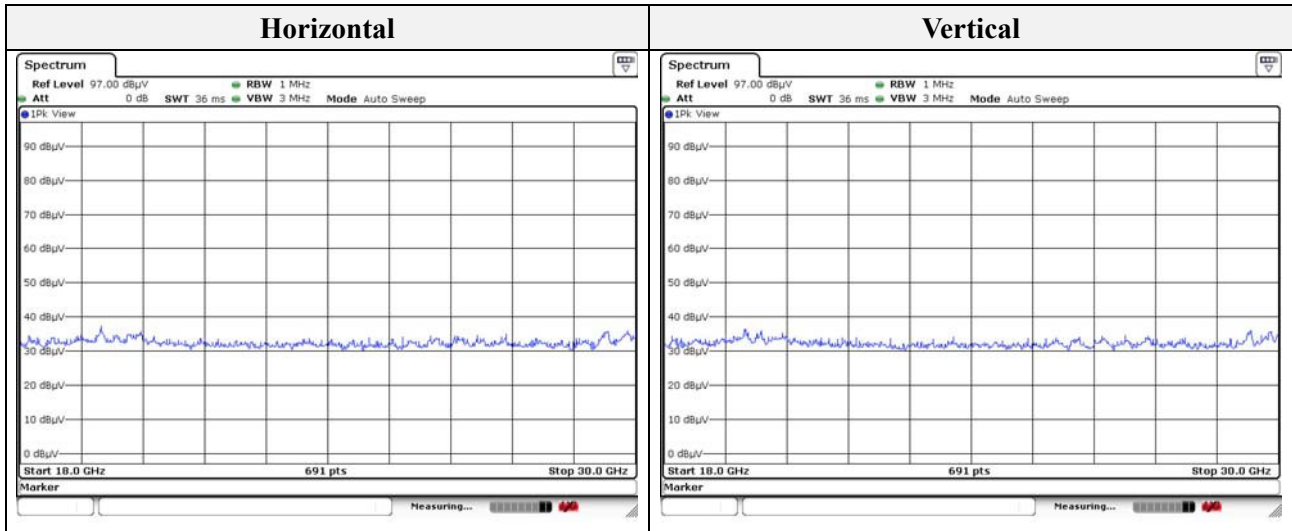
Note.

1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

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**Test results (18 GHz to 30 GHz) – Worst case**

Mode: 802.11b  
Distance of measurement: 3 meter  
Channel: 01 (Worst case)



Note.

1. No spurious emission were detected above 18 GHz.

### 3.5 Conducted spurious emissions & band edge

#### Test procedure

##### Band edge

KDB 558074 D01 v03r05 – Section 11.3

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100 kHz
4. VBW = 300 kHz
5. Detector = Peak
6. Number of sweep points  $\geq 2 \times \text{Span/RBW}$
7. Trace mode = max hold
8. Sweep time = auto
9. The trace was allowed to stabilize

##### Out of band emissions

KDB 558074 D01 v03r05 – Section 11.3

1. Start frequency was set to 30 MHz and stop frequency was set to 25 GHz for 2.4 GHz frequencies and 40 GHz for 5 GHz frequencies
2. RBW = 100 kHz
3. VBW = 300 kHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

#### Limit

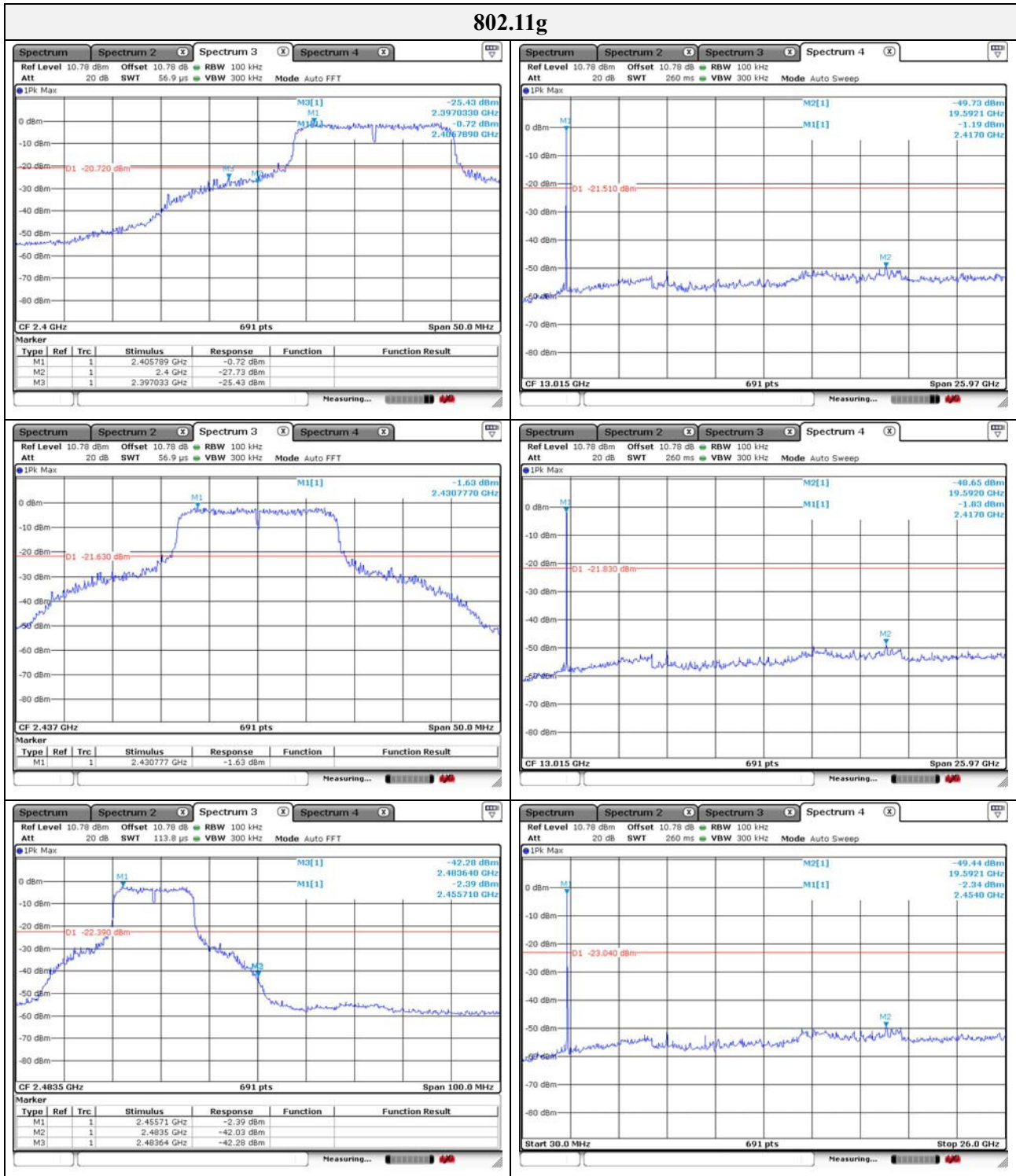
According to 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within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

## Test results

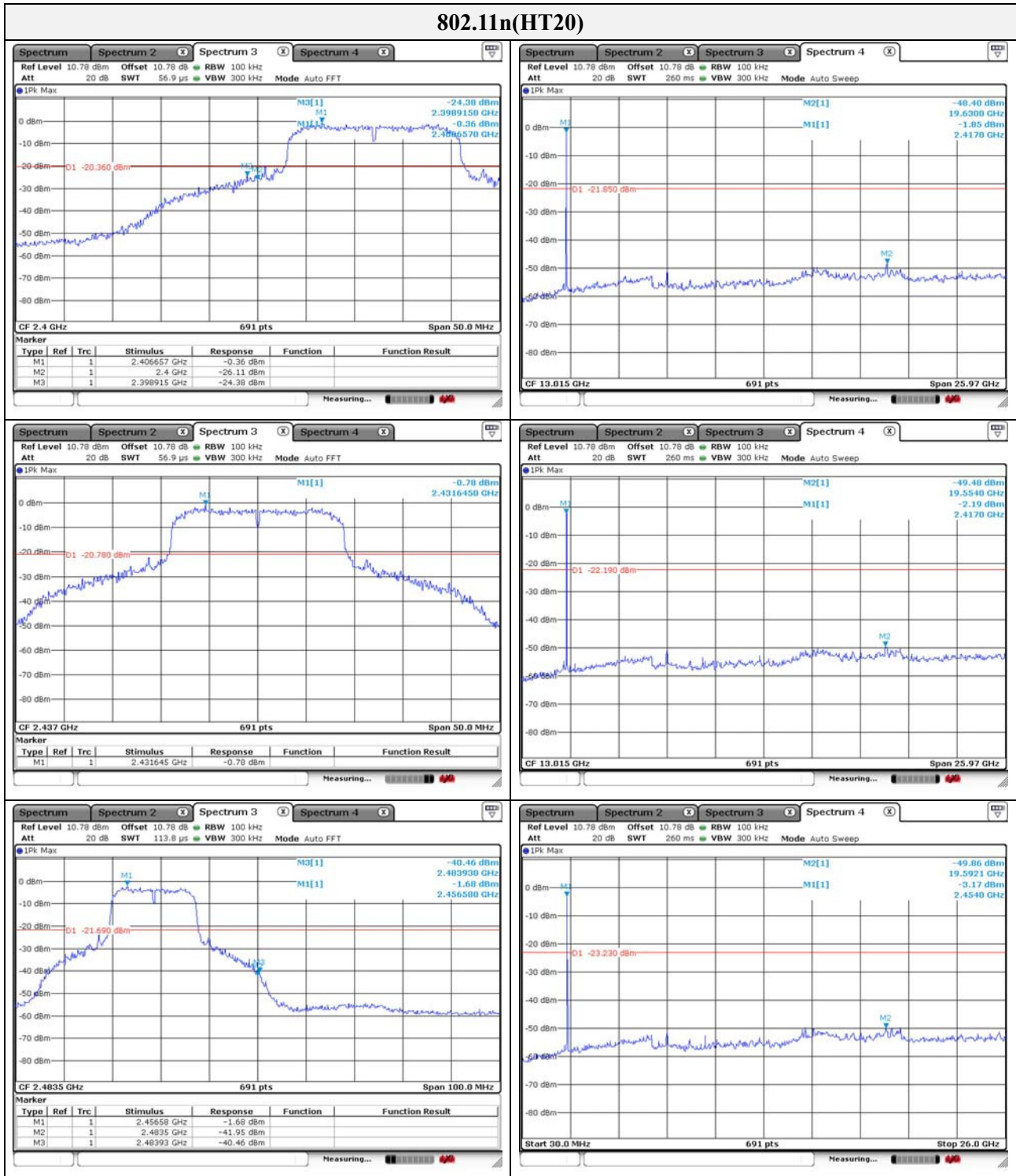


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## Appendix A. Measurement equipment

| Equipment                           | Manufacturer          | Model                | Serial No.  | Calibration interval | Calibration due. |
|-------------------------------------|-----------------------|----------------------|-------------|----------------------|------------------|
| Spectrum Analyzer                   | R&S                   | FSV30                | 100736      | 1 year               | 2017.07.06       |
| Spectrum Analyzer                   | R&S                   | FSV40                | 101002      | 1 year               | 2017.07.06       |
| 8360B Series Swept Signal Generator | HP                    | 83630B               | 3844A00786  | 1 year               | 2018.01.23       |
| Power Meter                         | Anritsu               | ML2495A              | 1438001     | 1 year               | 2018.01.23       |
| Pluse Power Sensor                  | Anritsu               | MA2411B              | 1339205     | 1 year               | 2018.01.23       |
| Attenuator                          | Keysight              | 8493C                | 82506       | 1 year               | 2018.01.23       |
| Loop Antenna                        | R&S                   | HFH2-Z2.335.4711.52  | 826532      | 2 years              | 2017.03.03       |
| Trilog-broadband antenna            | SCHWARZBECK           | VULB 9163            | 9168-713    | 2 years              | 2017.05.15       |
| Horn Antenna                        | E/L                   | 3117                 | 135889      | 2 years              | 2018.10.25       |
| Horn Antenna                        | SCHWARZBECK           | BBHA9170             | BBHA9170550 | 2 years              | 2017.04.30       |
| High Pass Filter                    | WAINWRIGHT INSTRUMENT | WHJS3000-10TT        | 1           | 1 year               | 2017.07.04       |
| Low Pass Filter                     | WEINSCHEL             | WLK1.0/18G-10TT      | 1           | 1 year               | 2017.07.04       |
| Preamplifier                        | HP                    | 8449B                | 3008A00538  | 1 year               | 2017.07.05       |
| Preamplifier                        | SCHWARZBECK           | BBV-9718             | 9718-246    | 1 year               | 2017.10.14       |
| EMI Test Receiver                   | R&S                   | ESR3                 | 101781      | 1 year               | 2017.05.03       |
| EMI Test Receiver                   | R&S                   | ESU26                | 100552      | 1 year               | 2017.04.24       |
| EMI Test Receiver                   | R&S                   | ESR3                 | 101783      | 1 year               | 2017.05.03       |
| Pulse Limiter                       | R&S                   | ESH3-Z2 0357.8810.54 | 101914      | 1 year               | 2017.12.13       |
| LISN                                | R&S                   | ENV216               | 101137      | 1 year               | 2018.02.03       |

## Peripheral devices

| Device            | Manufacturer                  | Model No. | Serial No.      |
|-------------------|-------------------------------|-----------|-----------------|
| Notebook Computer | Samsung Electronics Co., Ltd. | NP-QX411L | HJV993BB905283V |
| Test Board        | N/A                           | N/A       | N/A             |