



# TEST REPORT



Report No. : KES-RF250350

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**KES Co., Ltd.**

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## ■ IC TEST REPORT

### 1. Client

- Name : SJIT Co.,Ltd
- Address : 54-11, Dongtanhana 1-gil, Hwaseong-si, Gyeonggi-do, South Korea

### 2. Sample Description

- Product item : Ultra-Low power & Long-range Wireless LAN Module
- Model name : WHM200A
- Manufacturer etc. : SJIT Co.,Ltd

3. Date of test : 2025.05.30 ~ 2025.06.12

4. Location of Test :  Permanent Testing Lab       On Site Testing  
○ Adress : 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea

5. Test method used : RSS-247 (Issue 3), RSS-Gen (Issue 5)

6. Test result : PASS

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

This laboratory is not accredited for the test results marked \*.

This test report is not related to KOLAS accreditation.

Affirmation	Tested by	Technical Manager
	Name : Gu-Bong, Kang (Signature)	Name : Yeong-Jun Cho (Signature)

2025. 06. 30.

**KES Co., Ltd.**

**Accredited by KOLAS, Republic of KOREA**



## REPORT REVISION HISTORY

Date	Test Report No.	Revision History
2025.06.30	KES-RF250350	Initial

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### Use of uncertainty of measurement for decisions on conformity (decision rule):

- No decision rule is specified by the standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty("simple acceptance" decision rule, previously known as "accuracy method").
- Other (to be specified, for example when required by the standard or client)



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## 1. General information

Applicant: SJIT Co.,Ltd  
Applicant address: 54-11, Dongtanhana 1-gil, Hwaseong-si, Gyeonggi-do, South Korea  
Test site: KES Co., Ltd.  
Test site address:  #3002, #3503, #3701, 40, Simin-daero365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Republic of Korea  
 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea  
Test Facility ISED Registration No.: 23298  
IC rule part(s): RSS-247 (Issue 3), RSS-Gen (Issue 5)  
IC Number: 32019-WHM200A  
Test device serial No.:  Production  Pre-production  Engineering

### 1.1. EUT description

Equipment under test Ultra-Low power & Long-range Wireless LAN Module  
Frequency range 802.11ah\_1 MHz Bandwidth : 903.5 MHz ~ 926.5 MHz  
802.11ah\_2 MHz Bandwidth : 905.0 MHz ~ 925.0 MHz  
802.11ah\_4 MHz Bandwidth : 906.0 MHz ~ 922.0 MHz  
Model WHM200A  
Modulation technique OFDM  
Number of channels 802.11ah\_1 MHz Bandwidth : 903.5 MHz ~ 926.5 MHz : 24 ch  
802.11ah\_2 MHz Bandwidth : 905.0 MHz ~ 925.0 MHz : 11 ch  
802.11ah\_4 MHz Bandwidth : 906.0 MHz ~ 922.0 MHz : 5 ch  
Antenna specification PCB Pattern Antenna((SJANT-PCB-900-01) // Peak gain: 3.03 dBi  
Dipole Antenna(STDPA201354SMB900) // Peak gain: 3.0 dBi  
Dipole Antenna(STDPA131909IBS900) // Peak gain: 2.5 dBi  
Power source DC 3.3 V  
H/W version REV06  
S/W version Ver. 2.0  
Serial number WAJJK2001

### 1.2. Test configuration

The SJIT Co.,Ltd // Ultra-Low power & Long-range Wireless LAN Module // WHM200AC // IC Number : 32019-WHM200A was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

ISED RSS-247 Issue 3 and RSS-Gen Issue 5  
KDB 558074 D01 v05 r02  
ANSI C63.10-2013

**1.3. Information about derivative model**

N/A

**1.4. Accessory information**

Equipment	Manufacturer	Model	Serial No.	Power source
-	-	-	-	-

**1.5. Device modifications**

N/A

**1.6. Sample calculation**

Where relevant, the following sample calculation is provided

For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 1.10 + 20 = 21.10 \text{ (dB)}\end{aligned}$$

For Radiation test :

Field strength level ( $\text{dB}\mu\text{V}/\text{m}$ ) = Measured level ( $\text{dB}\mu\text{V}$ ) + Antenna factor (dB) + Cable loss (dB) – Amplifier gain (dB)**1.7. Measurement Uncertainty**

Test Item	Uncertainty	
Uncertainty for Conduction emission test	2.22 dB ( SHIELD ROOM #6 )	
Uncertainty for Radiation emission test (include Fundamental emission)	Below 1 GHz	4.04 dB ( SAC #6 )
	Above 1 GHz	5.32 dB ( SAC #5 )
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$ .		



### 1.8. Frequency/channel operations

Ch.	Frequency (MHz)	Mode
01	903.5	802.11ah_ 1 MHz bandwidth
:	:	:
13	915.5	802.11ah_ 1 MHz bandwidth
:	:	:
24	926.5	802.11ah_ 1 MHz bandwidth

Ch.	Frequency (MHz)	Mode
01	905.0	802.11ah_ 2 MHz bandwidth
:	:	:
06	915.0	802.11ah_ 2 MHz bandwidth
:	:	:
11	925.0	802.11ah_ 2 MHz bandwidth

Ch.	Frequency (MHz)	Mode
01	906.0	802.11ah_ 4 MHz bandwidth
:	:	:
03	914.0	802.11ah_ 4 MHz bandwidth
:	:	:
05	922.0	802.11ah_ 4 MHz bandwidth



## 2. Summary of tests

Section in RSS-247 & Gen	Test description	Test results
RSS-Gen 6.7	99% Occupied Bandwidth	Pass
RSS-247 5.2(a)	6 dB bandwidth	Pass
RSS-247 5.4(d)	Output power	Pass
RSS-247 5.2(b)	Power spectral density	Pass
RSS-247 5.5 RSS-Gen 8.9,8,10	Radiated restricted band and emission	Pass
RSS-247 5.5	Conducted spurious emission and band edge	Pass
RSS-Gen 8.8	AC Conducted emissions	Pass
-	Antenna Requirement	Pass

\*N/T: Not Tested

**Note:**

1. By applicant's request, This test is performed with condition below :  
Power setting - 802.11ah\_1 MHz bandwidth : 19  
- 802.11ah\_2 MHz bandwidth : 19  
- 802.11ah\_4 MHz bandwidth : 19
2. This EUT is a product that can optionally use 1 of 3 antennas, and the PCB pattern antenna with the highest gain value among the 3 antennas was tested during the radiated test.



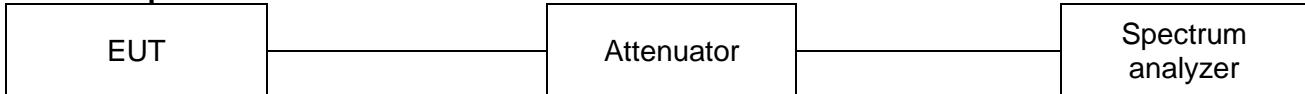
### 3. Test results

#### 3.1. 99% Occupied Bandwidth

##### Test procedure

ANSI C63.10-2013 clause 6.9.2 and 6.9.3

##### Test setup



##### Test setting

Span = The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

RBW = The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW

VBW = shall be approximately three times the RBW

Sweep = auto

Detector function = Peak

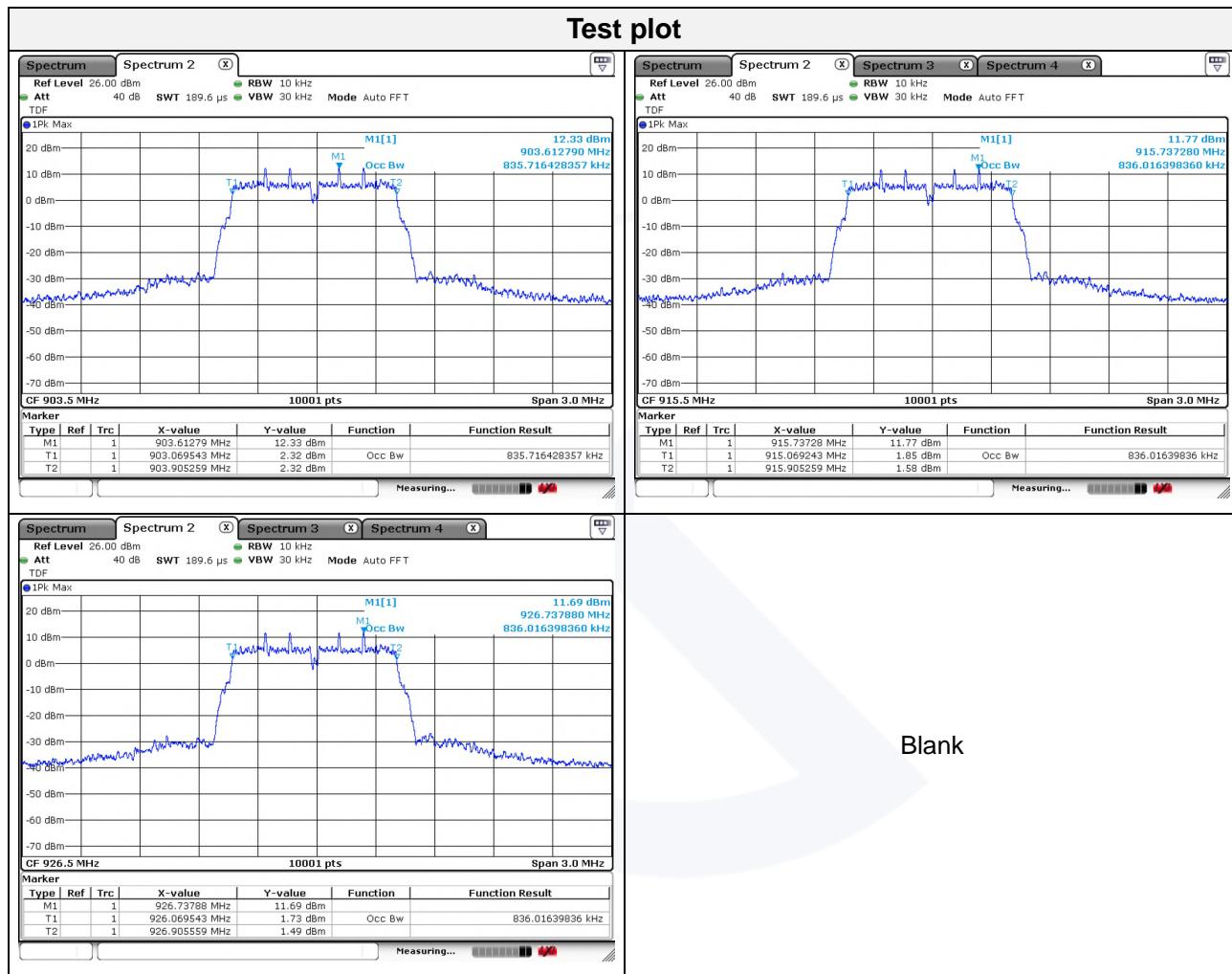
Trace = Max hold

##### Limit

None; for reporting purpose only.

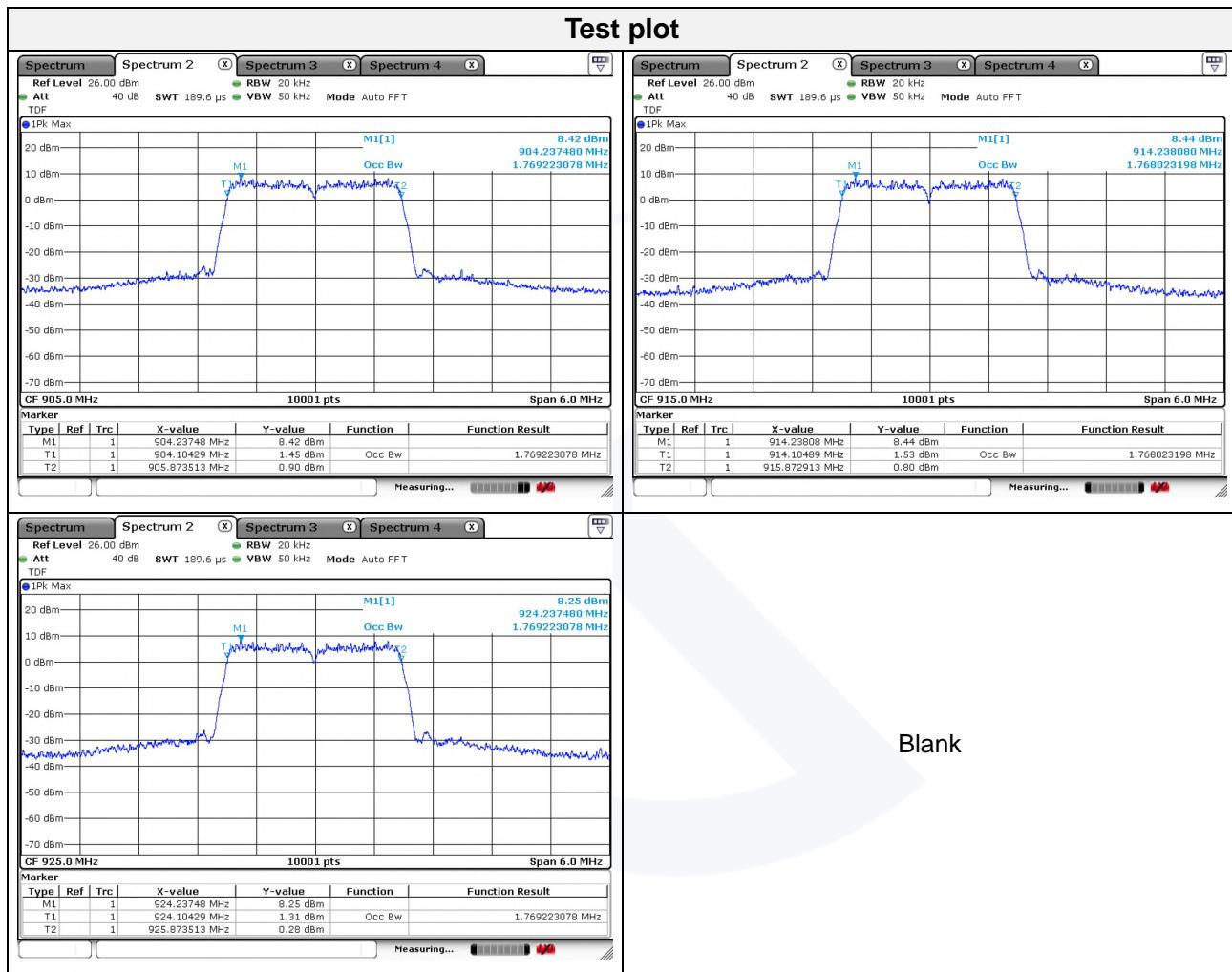
**Mode : 802.11ah 1 MHz bandwidth**

Frequency(MHz)	99% occupied bandwidth(MHz)	Limit(MHz)
903.5	0.84	
915.5	0.84	-
926.5	0.84	



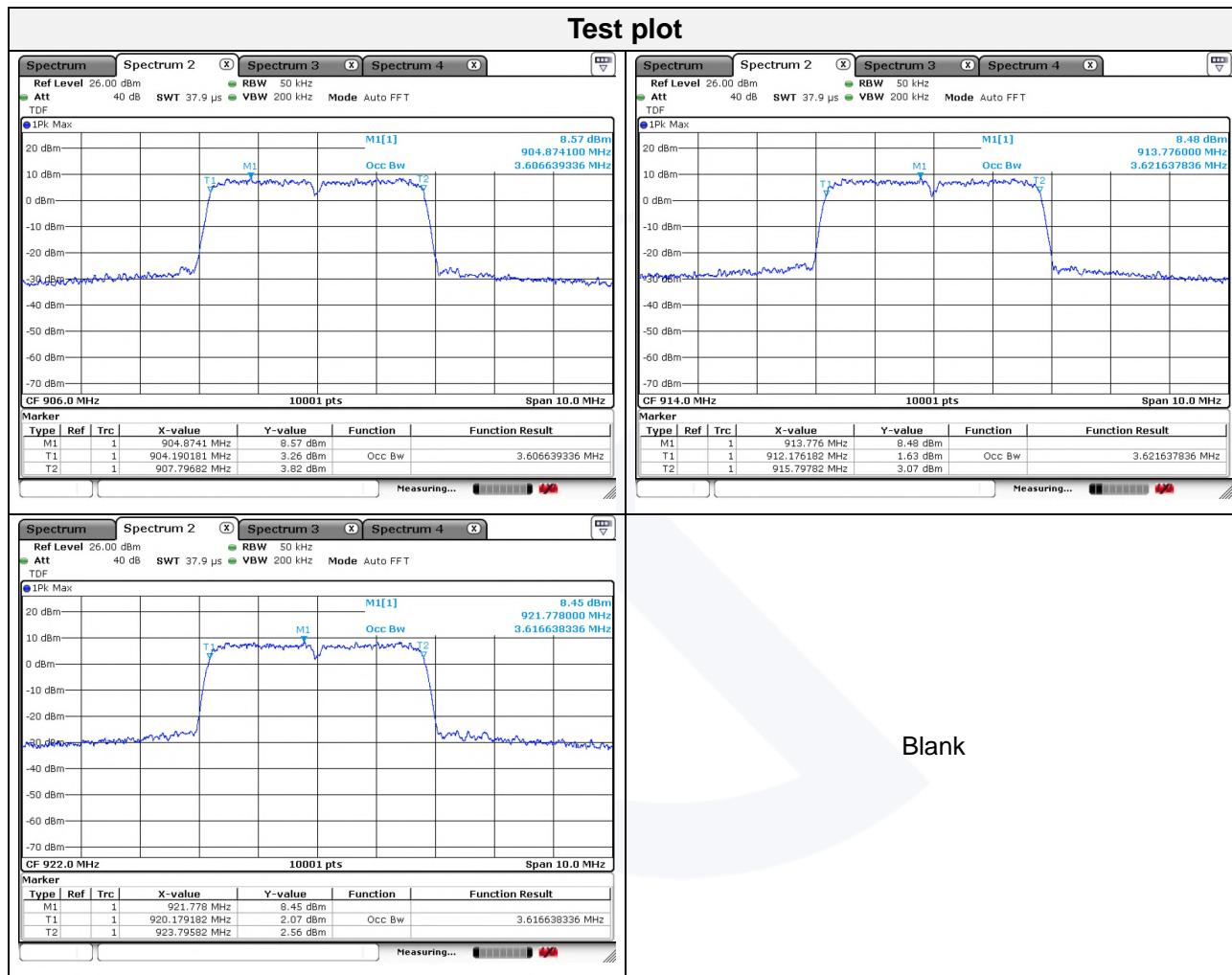
**Mode : 802.11ah 2 MHz bandwidth**

Frequency(MHz)	99% occupied bandwidth(MHz)	Limit(MHz)
905.0	1.77	
915.0	1.77	-
925.0	1.77	



**Mode : 802.11ah 4 MHz bandwidth**

Frequency(MHz)	99% occupied bandwidth(MHz)	Limit(MHz)
906.0	3.61	-
914.0	3.62	
922.0	3.62	



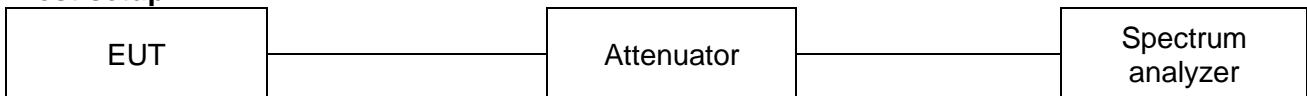


### 3.2. 6 dB bandwidth

#### Test procedure

ANSI C63.10-2013 - Section 11.8.2

#### Test setup



#### ANSI C63.10-2013 - Section 11.8.2

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

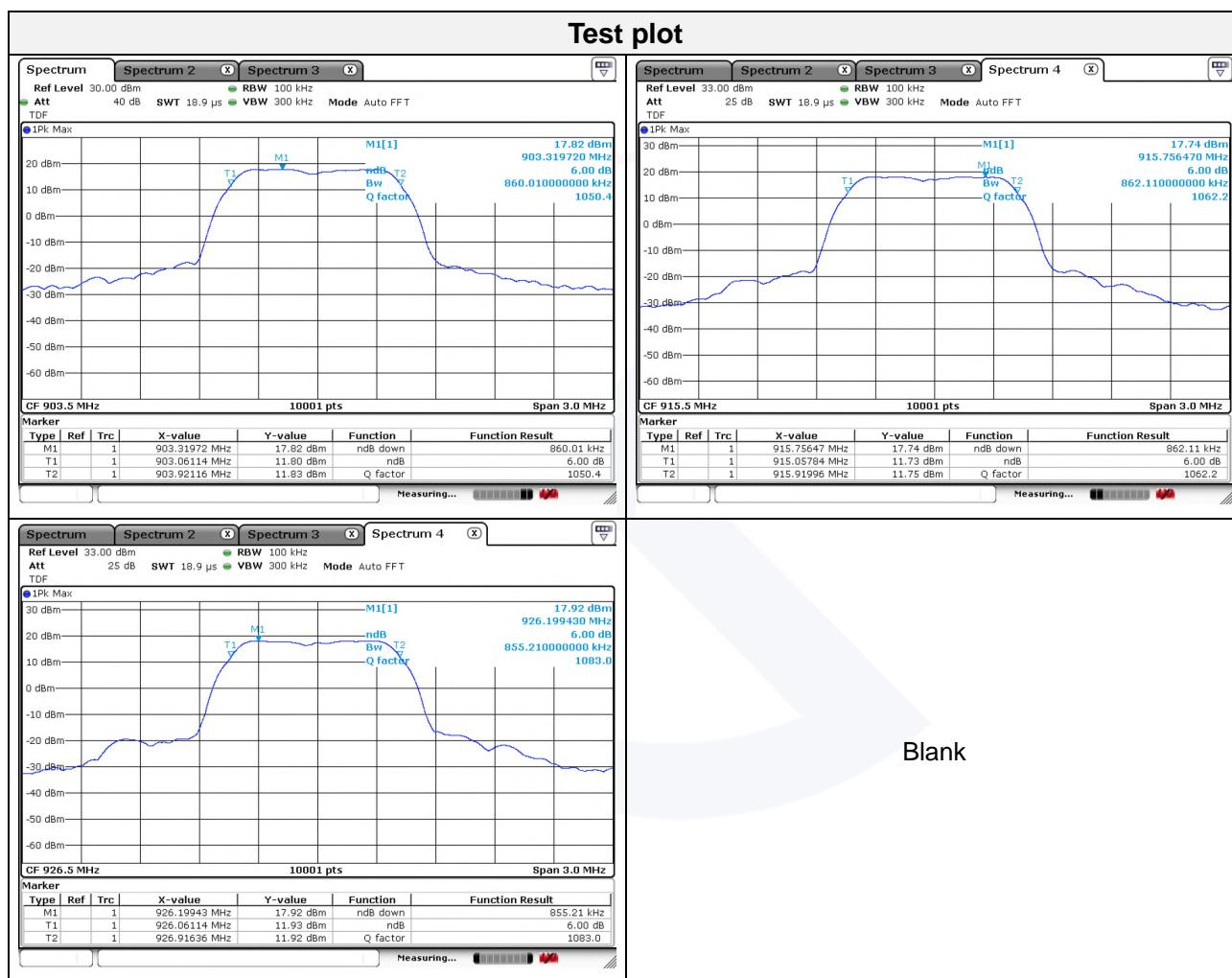
According to RSS-247 5.2(a), The minimum 6 dB bandwidth shall be 500 kHz.



## Test results

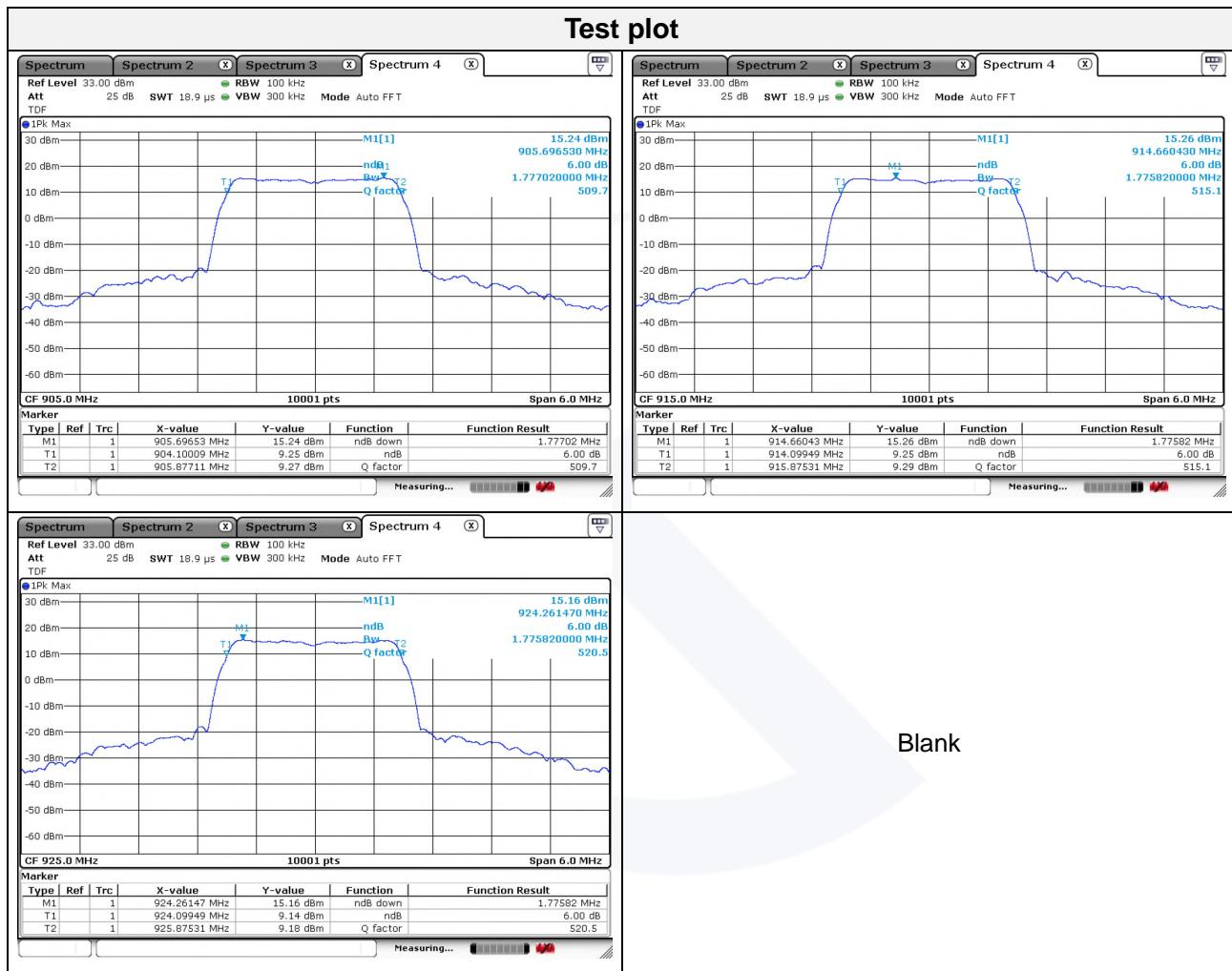
### Mode : 802.11ah 1 MHz bandwidth

Frequency(MHz)	6 dB bandwidth(MHz)	Limit(MHz)
903.5	0.86	$\geq 0.500$
915.5	0.86	
926.5	0.86	



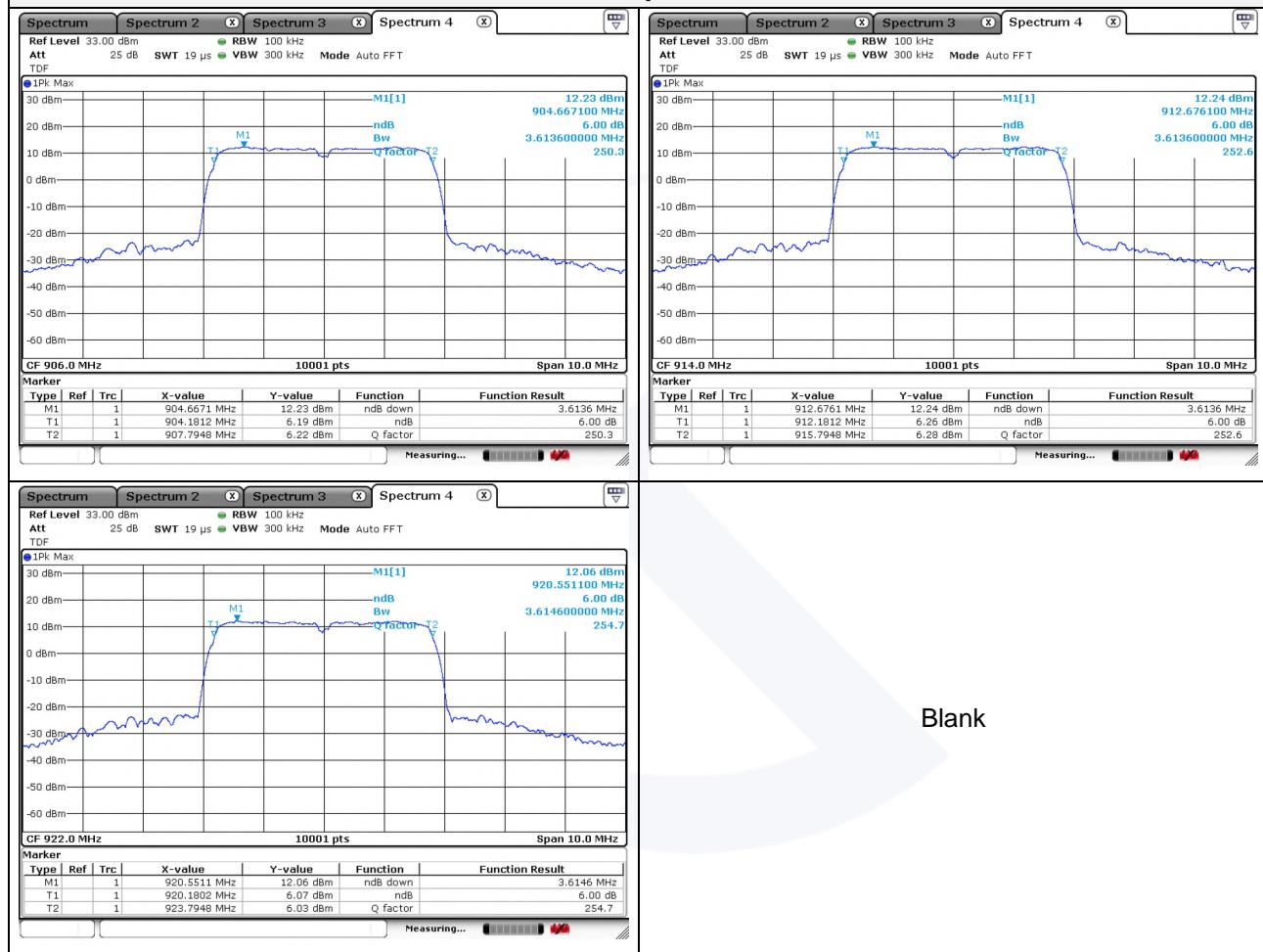
**Mode : 802.11ah 2 MHz bandwidth**

Frequency(MHz)	6 dB bandwidth(MHz)	Limit(MHz)
905.0	1.78	$\geq 0.500$
915.0	1.78	
925.0	1.78	



**Mode : 802.11ah 4 MHz bandwidth**

Frequency(MHz)	6 dB bandwidth(MHz)	Limit(MHz)
906.0	3.61	$\geq 0.500$
914.0	3.61	
922.0	3.61	

**Test plot**

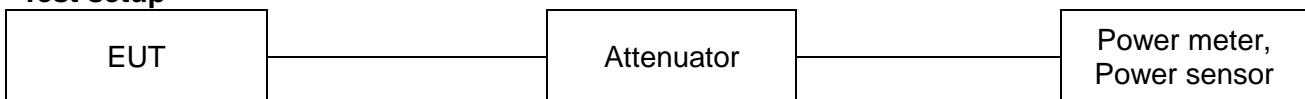


### 3.3. Output power

#### Test procedure

ANSI C63.10-2013 - Section 11.9.1.3 and 11.9.2.3.2

#### Test setup



#### ANSI C63.10-2013 - Section 11.9.1.3

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 use a fast-responding diode detector.

#### ANSI C63.10-2013 - Section 11.9.2.3.2

Alternatively, measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

#### Limit

According to RSS-247 5.4(d), For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2 400-2 483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

**Test results**

Mode	903.5 MHz		915.5 MHz		926.5 MHz		Limit (dBm)
	Average (dBm)	Peak (dBm)	Average (dBm)	Peak (dBm)	Average (dBm)	Peak (dBm)	
802.11ah 1 MHz bandwidth	18.39	28.07	18.65	28.32	18.43	28.16	30.00

Mode	905.0 MHz		915.0 MHz		925.0 MHz		Limit (dBm)
	Average (dBm)	Peak (dBm)	Average (dBm)	Peak (dBm)	Average (dBm)	Peak (dBm)	
802.11ah 2 MHz bandwidth	18.77	29.47	18.76	29.46	18.64	29.43	30.00

Mode	906.0 MHz		914.0 MHz		922.0 MHz		Limit (dBm)
	Average (dBm)	Peak (dBm)	Average (dBm)	Peak (dBm)	Average (dBm)	Peak (dBm)	
802.11ah 4 MHz bandwidth	18.64	28.82	18.55	28.85	18.54	28.93	30.00

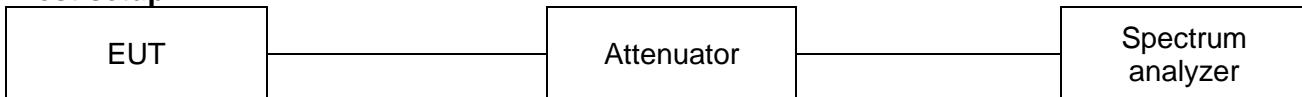


### 3.4. Power spectral density

#### Test procedure

ANSI C63.10-2013 - Section 11.10.2

#### Test setup



#### Section 10.2 & ANSI C63.10-2013 - Section 11.10.2

- a. Set analyzer center frequency to DTS channel center frequency.
- b. Set the span to 1.5 times the DTS bandwidth.
- c. Set the RBW to  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- d. Set the VBW  $\geq [3 \times \text{RBW}]$ .
- e. Detector = peak.
- f. Sweep time = auto couple.
- g. Trace mode = max hold.
- h. Allow trace to fully stabilize.
- i. Use the peak marker function to determine the maximum amplitude level within the RBW.
- j. If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

#### Limit

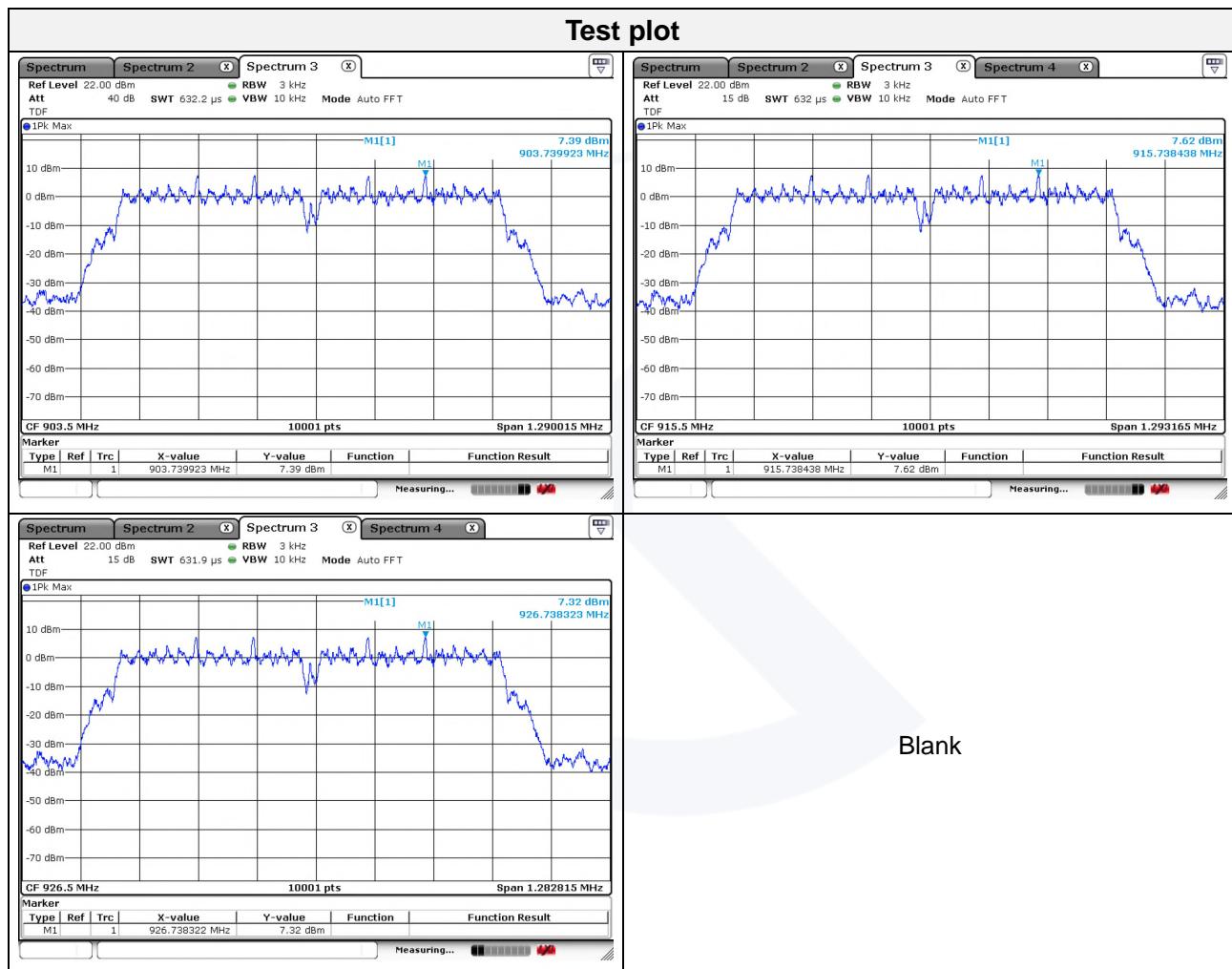
According to RSS-247 5.2(b), The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).



## Results

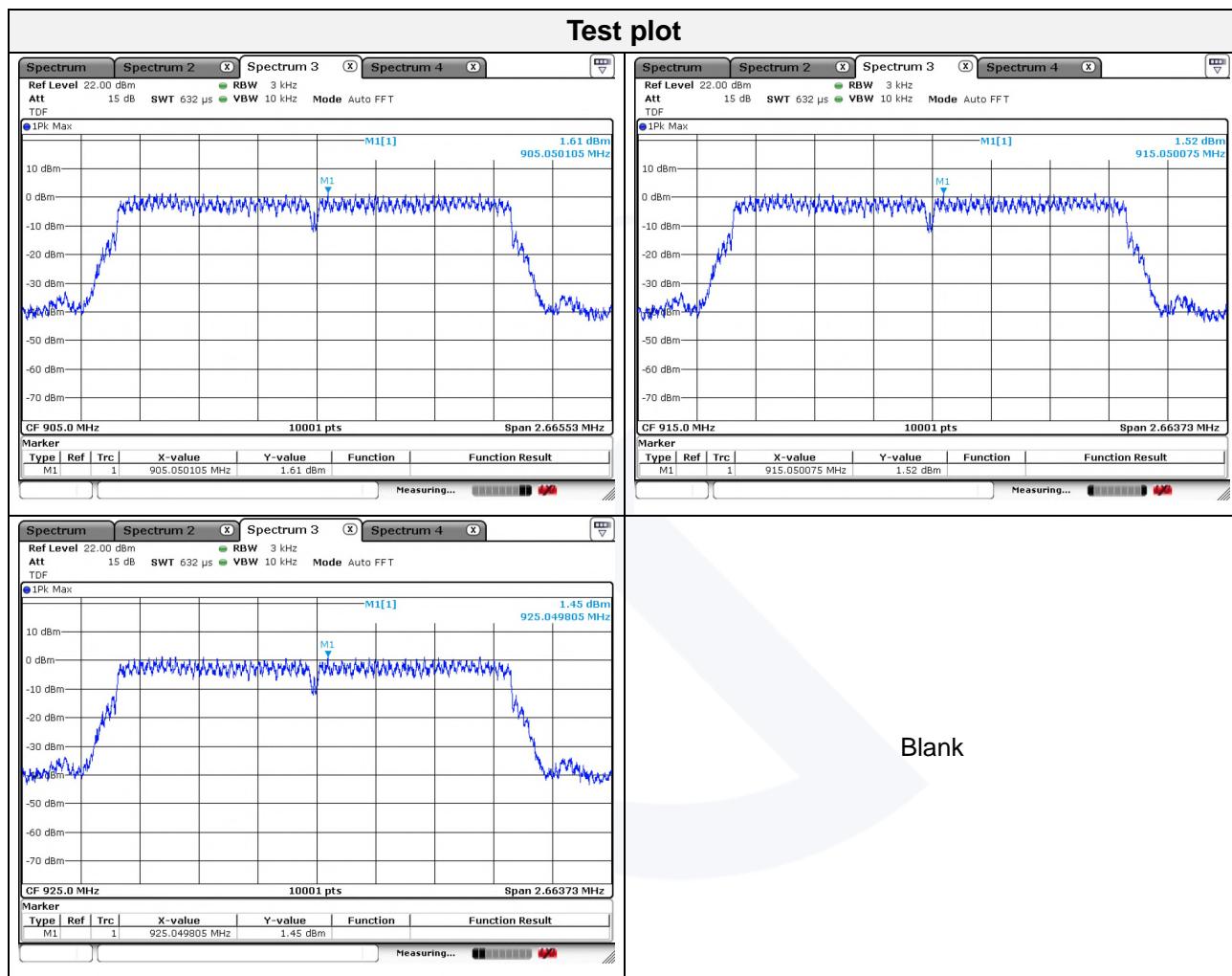
### Mode : 802.11ah 1 MHz bandwidth

Frequency(MHz)	PSD (dBm/3 kHz)	Limit(dBm/3 kHz)
903.5	7.39	$\leq 8$
915.5	7.62	
926.5	7.32	



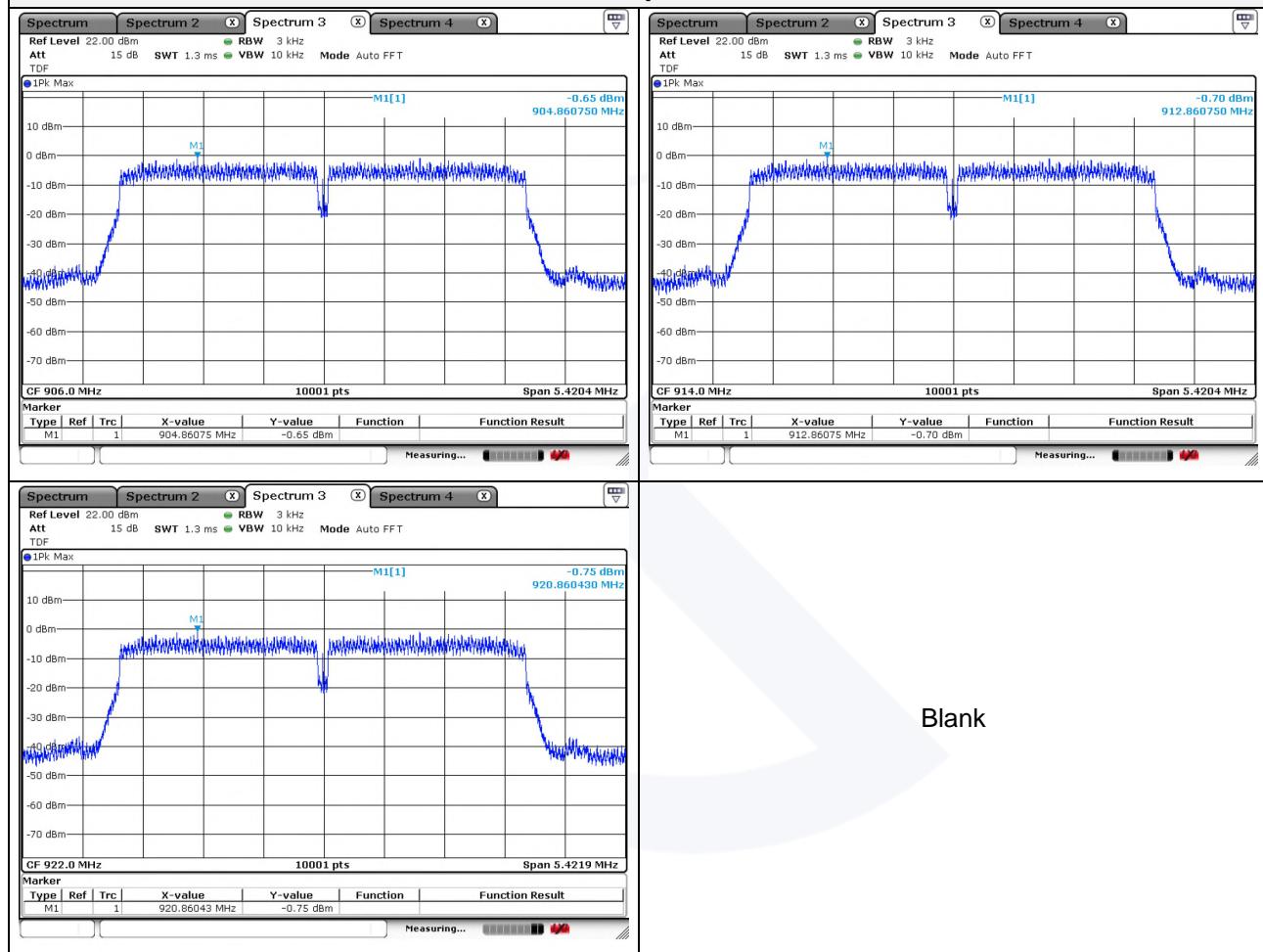
**Mode : 802.11ah 2 MHz bandwidth**

Frequency(MHz)	PSD (dBm/3 kHz)	Limit(dBm/3 kHz)
905.0	1.61	$\leq 8$
915.0	1.52	
925.0	1.45	



**Mode : 802.11ah 4 MHz bandwidth**

Frequency(MHz)	PSD (dBm/3 kHz)	Limit(dBm/3 kHz)
906.0	-0.65	$\leq 8$
914.0	-0.70	
922.0	-0.75	

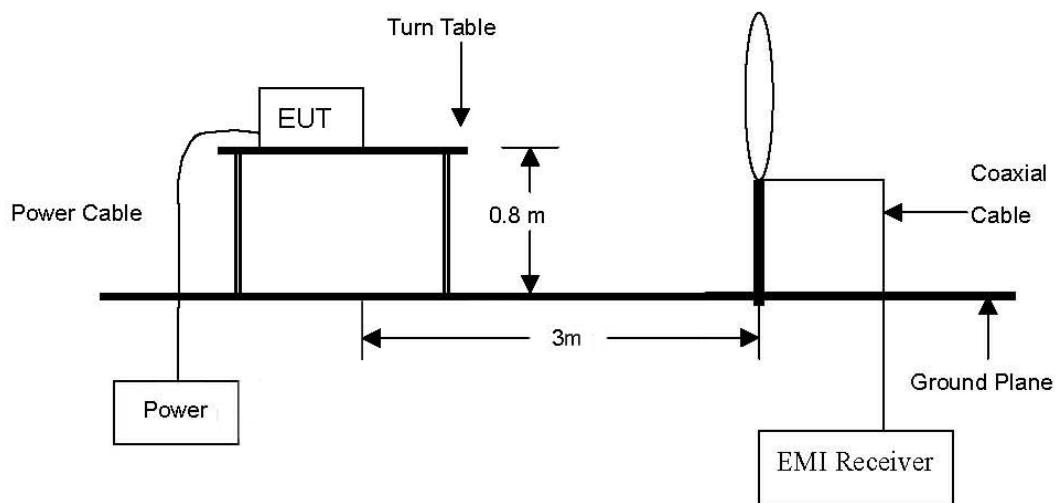
**Test plot**



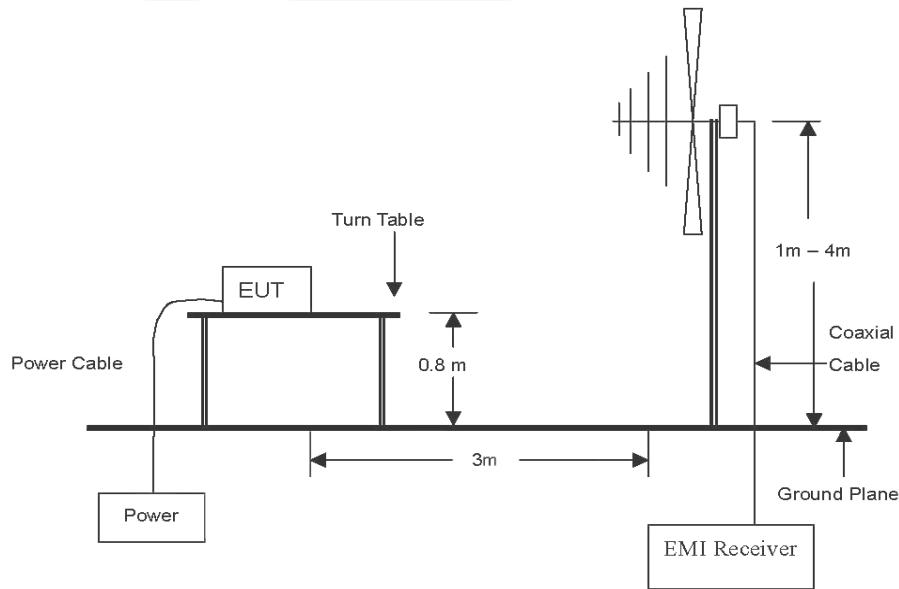
### 3.5. Radiated restricted band and emissions

#### 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.

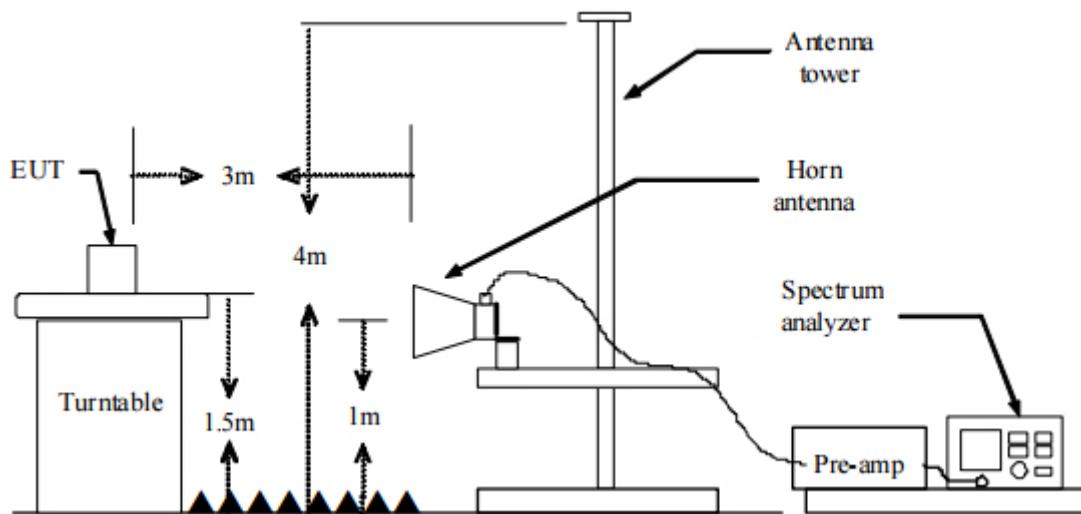


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.





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

Radiated emissions from the EUT were measured according to the dictates in section 11.11 & 11.12 of ANSI C63.10-2013.

#### 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, ground parallel and perpendicular of the antenna are set to make the measurement. It was determined that parallel was worst-case orientation; therefore, all final radiated testing was performed with the EUT in parallel.
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. The EUT was placed on the top of a rotating table 0.8 meters above the ground for 30 MHz-1 GHz and 1.5 meters for above 1 GHz at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The antenna is a bi-log antenna, a horn antenna ,and its height are varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. 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.
4. The test receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
5. 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

6. Spectrum analyzer settings for  $f \geq 1 \text{ GHz}$ : Peak

- ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- ② RBW = 1 MHz
- ③ VBW  $\geq 3 \text{ MHz}$
- ④ Detector = peak
- ⑤ Sweep time = auto
- ⑥ Trace = max hold
- ⑦ Trace was allowed to stabilize

7. Spectrum analyzer settings for  $f \geq 1 \text{ GHz}$ : Average

- ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- ② RBW = 1 MHz
- ③ VBW  $\geq 3 \times \text{RBW}$
- ④ Detector = RMS, if span/(# of points in sweep)  $\leq (\text{RBW}/2)$ . 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.  $f < 30 \text{ MHz}$ , extrapolation factor of 40 dB/decade of distance.  $F_d = 40\log(D_m/D_s)$   
 $f \geq 30 \text{ MHz}$ , 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
2. Field strength(dB $\mu$ V/m) = Level(dB $\mu$ V) + CF (dB) + or DCF(dB)
3. Margin(dB) = Limit(dB $\mu$ V/m) – Field strength(dB $\mu$ V/m)
4. 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.
5. 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.
6. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
7. According to exploratory test no any obvious emission were detected from 9 kHz to 30 MHz. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

**Limit**

According to RSS-Gen, Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits :

Frequency (MHz)	Distance (Meters)	Radiated ( $\mu$ V/m)
0.009 ~ 0.490	300	2 400 / $F(\text{kHz})$
0.490 ~ 1.705	30	24 000 / $F(\text{kHz})$
1.705 ~ 30.0	30	30
30 ~ 88	3	100
88 ~ 216	3	150
216 ~ 960	3	200
Above 960*	3	500

\* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

**Note:** Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.



## Duty cycle

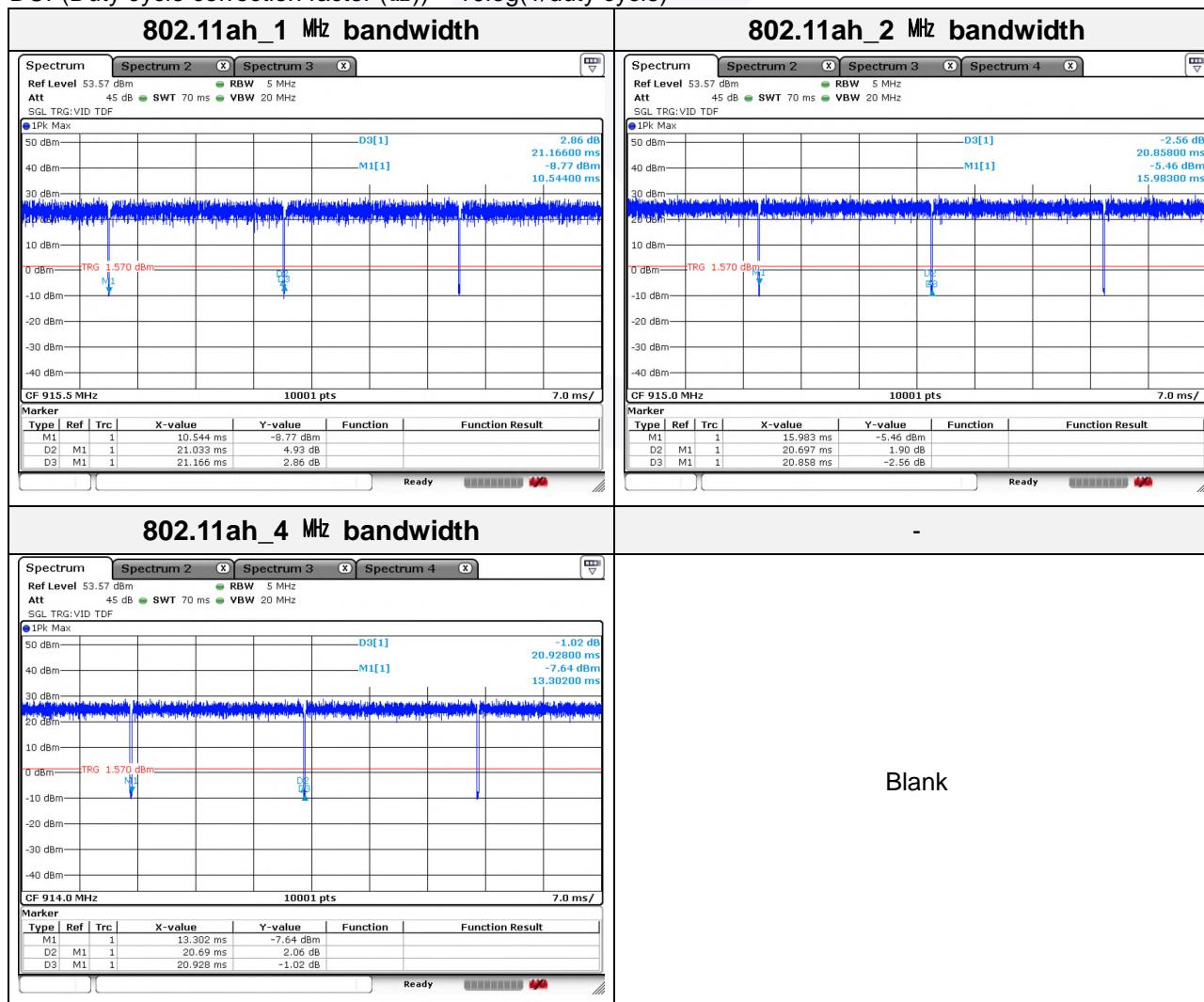
Regarding to KDB 558074 D01\_v05 r02, 6. Measurements of duty cycle and transmission duration shall be performed using one of the following techniques:

- A diode detector and an oscilloscope that together have sufficiently short response time to permit accurate measurements of the on- and off-times of the transmitted signal.
- The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on- and off-times of the transmitted signal.

Mode	T <sub>on</sub> time (ms)	Period (ms)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (dB)
802.11ah_1 MHz bandwidth	21.033	21.166	0.99	99.37	-
802.11ah_2 MHz bandwidth	20.697	20.853	0.99	99.25	-
802.11ah_4 MHz bandwidth	20.690	20.928	0.99	98.86	-

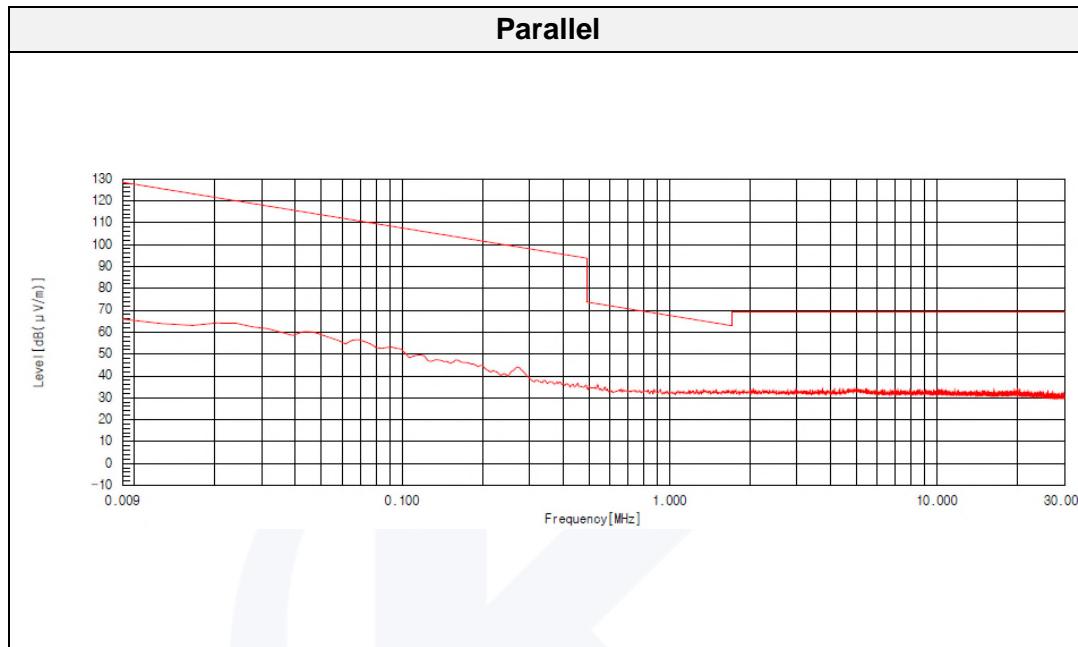
Duty cycle (Linear) = T<sub>on</sub> time/Period

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



**Test results (Below 30 MHz)**

Mode: 802.11ah\_2 MHz bandwidth (Worst case)  
Distance of measurement: 3 meter  
Channel: 01 (Worst case)

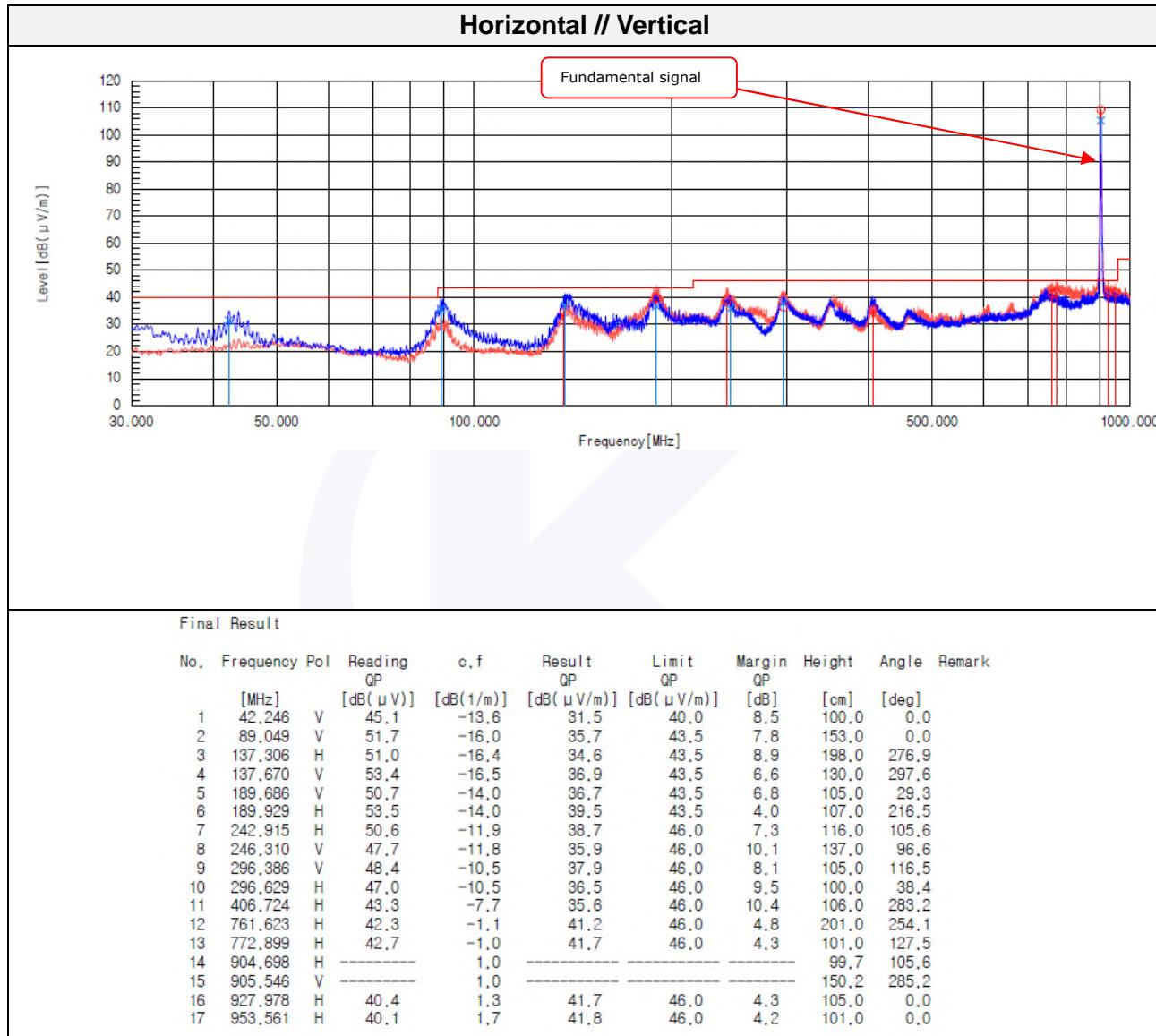


Note.

1. No spurious emission were detected under 30 MHz.

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

Mode: 802.11ah\_2 MHz bandwidth (Worst case)  
Distance of measurement: 3 meter  
Channel: 01 (Worst case)

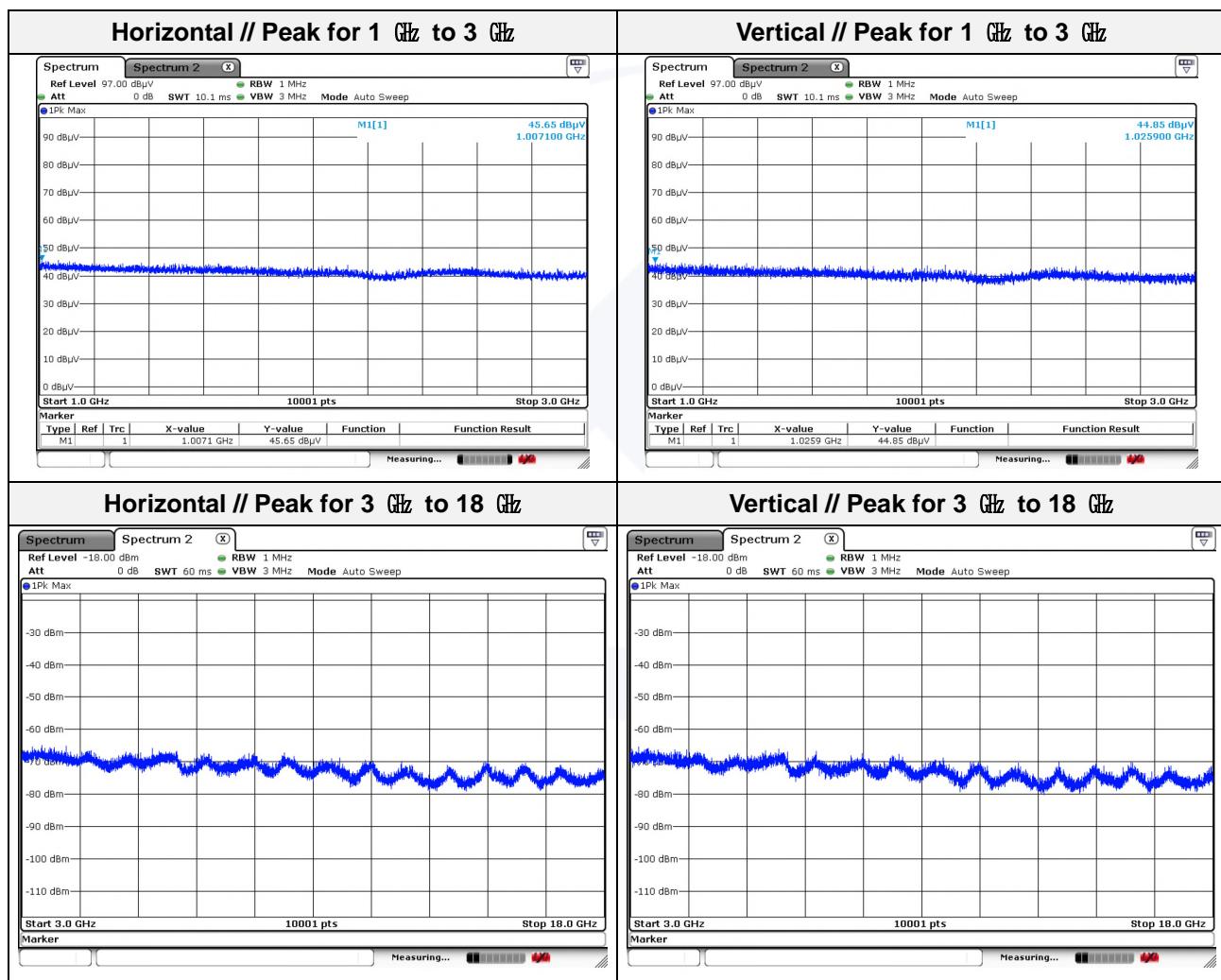


**Test results (Above 1 000 MHz)**

Mode: 802.11ah\_1 MHz bandwidth  
 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 $\mu$ W/m)	Limit (dB $\mu$ W/m)	Margin (dB)
1 007.10	45.65	Peak	H	-9.23	-	36.42	74.00	37.58
1 025.90	44.85	Peak	V	-9.11	-	35.74	74.00	38.26



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.



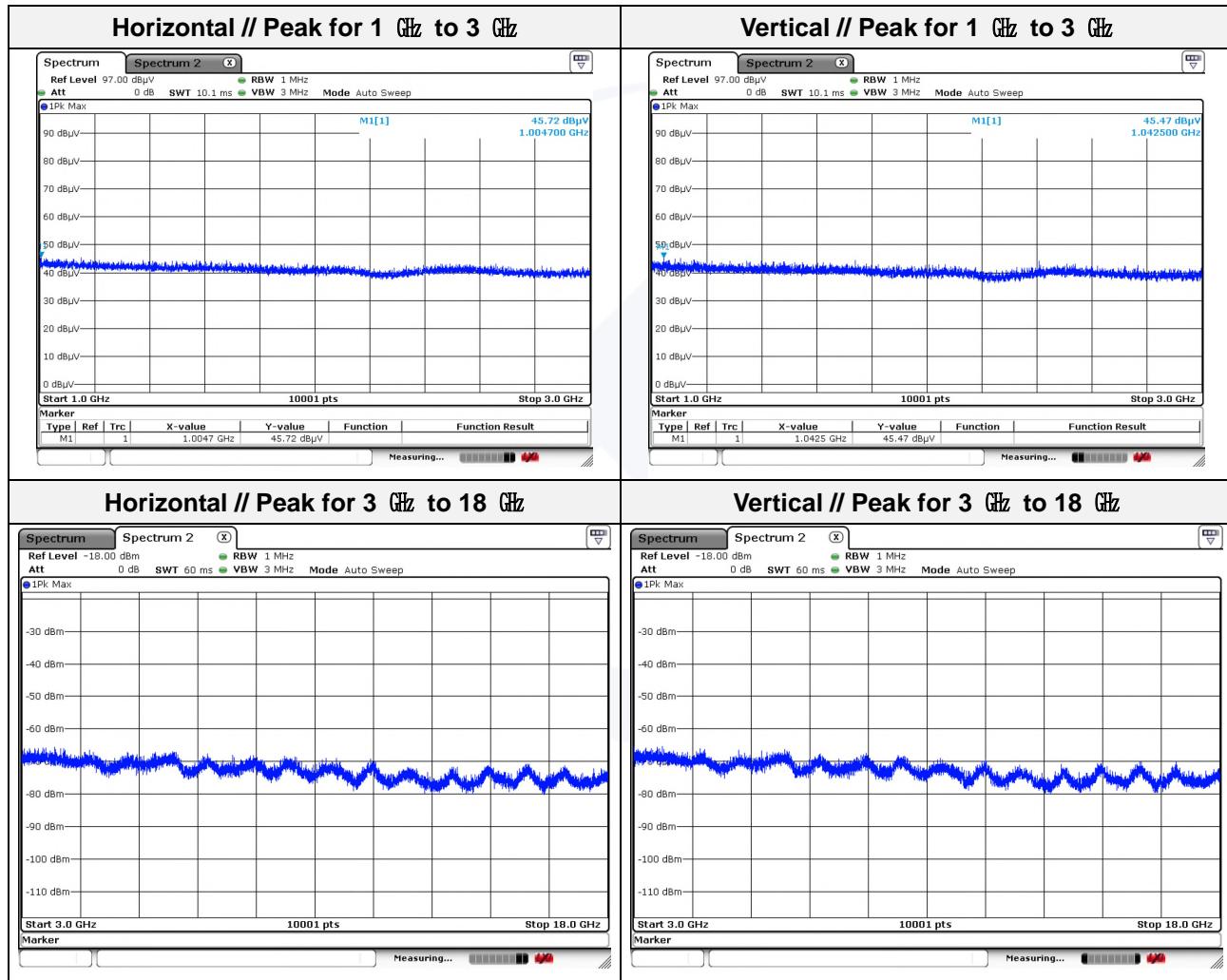
Mode: 802.11ah\_1 MHz bandwidth

Distance of measurement: 3 meter

Channel: 13

### - Spurious

Frequency (MHz)	Level (dB $\mu$ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
1 004.70	45.72	Peak	H	-9.25	-	36.47	74.00	37.53
1 042.50	45.47	Peak	V	-9.01	-	36.46	74.00	37.54



### 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.



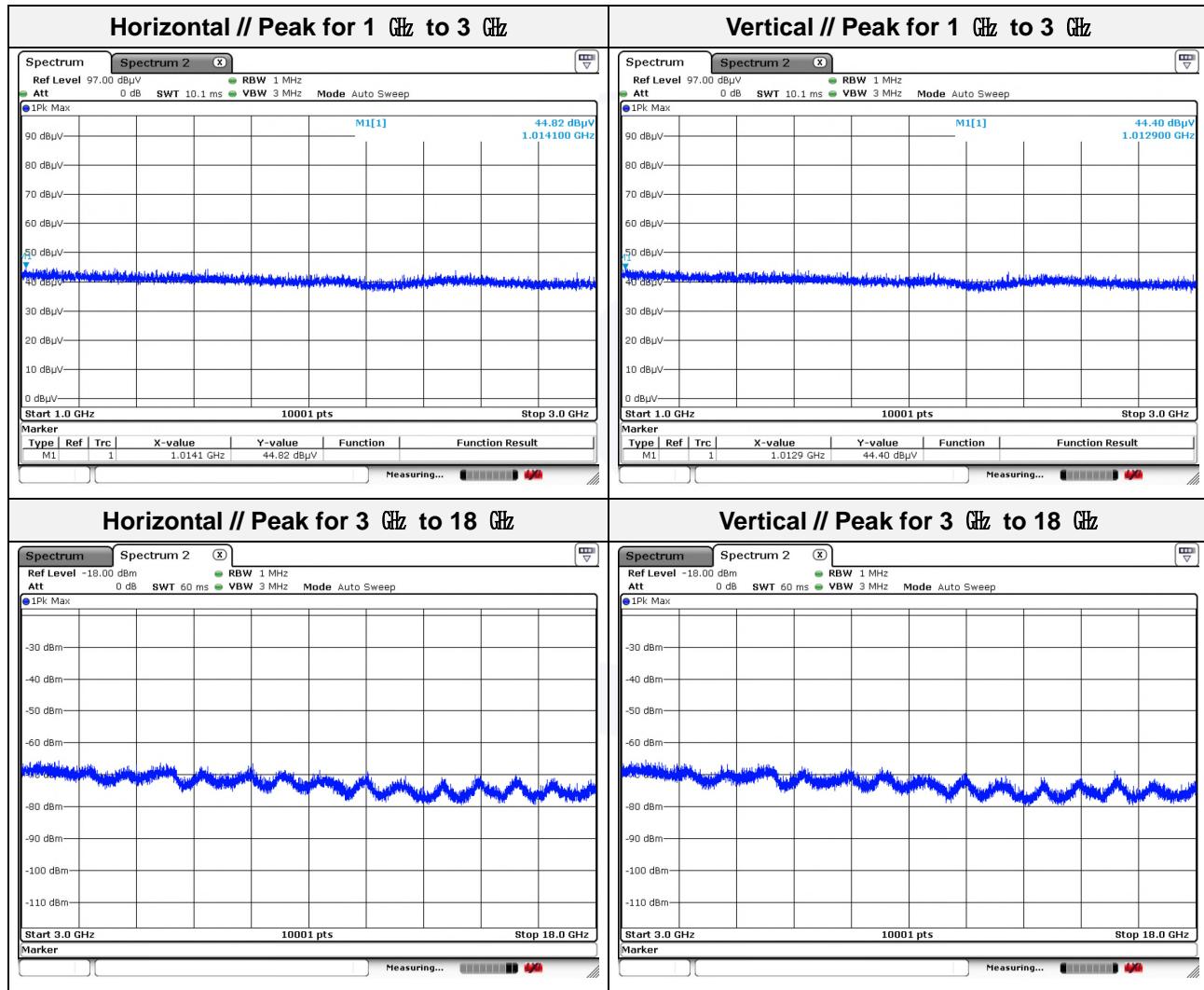
Mode: 802.11ah\_1 MHz bandwidth

Distance of measurement: 3 meter

Channel: 24

### - Spurious

Frequency (MHz)	Level (dB $\mu$ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
1 014.10	44.82	Peak	H	-9.19	-	35.63	74.00	38.37
1 012.90	44.40	Peak	V	-9.20	-	35.20	74.00	38.80



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.



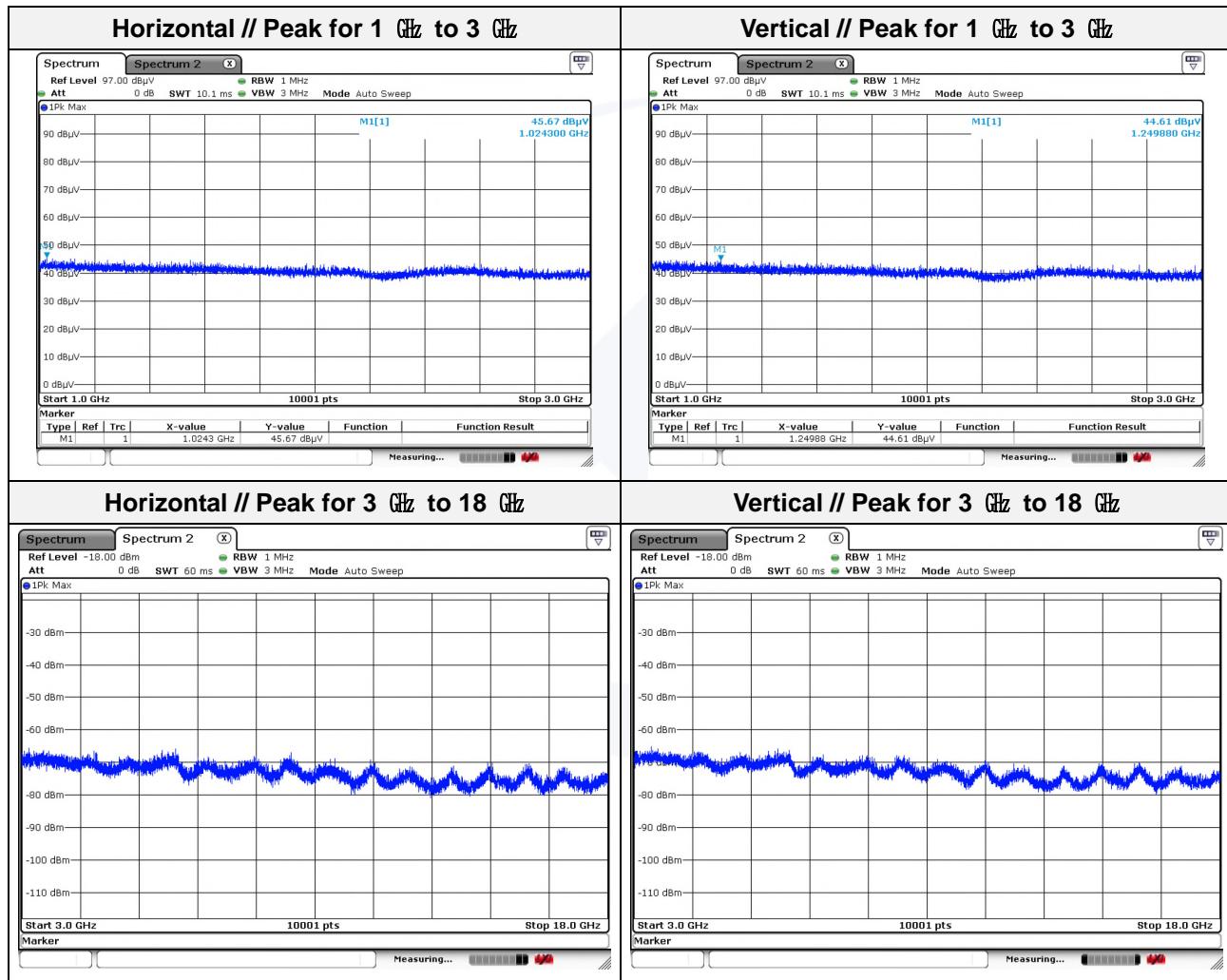
Mode: 802.11ah\_2 MHz bandwidth

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)
1 024.30	45.67	Peak	H	-9.12	-	36.55	74.00	37.45
1 249.88	44.61	Peak	V	-7.65	-	36.96	74.00	37.04



#### 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.



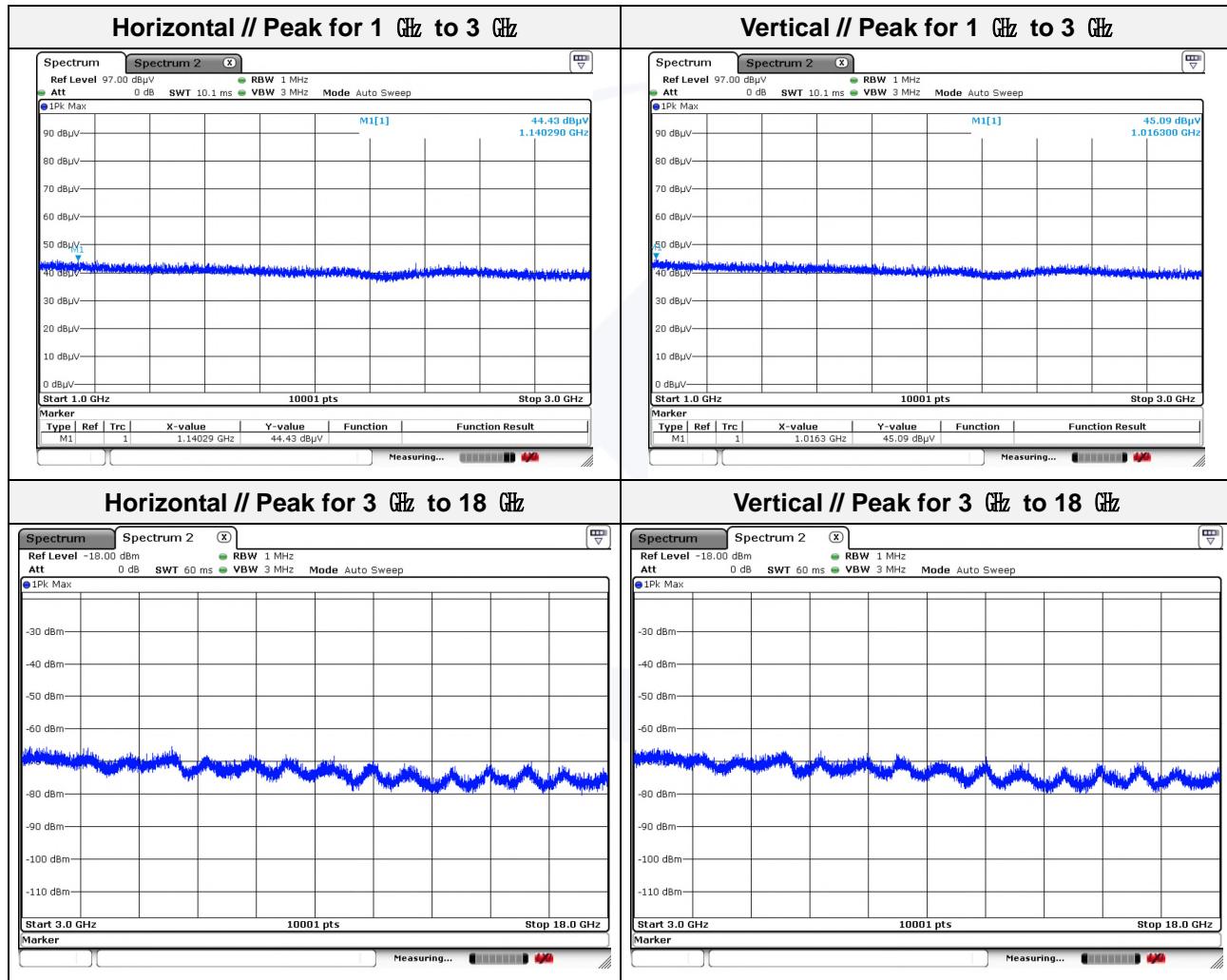
Mode: 802.11ah\_2 MHz bandwidth

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 $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
1 016.30	45.09	Peak	V	-9.17	-	35.92	74.00	38.08
1 140.29	44.43	Peak	H	-8.38	-	36.05	74.00	37.95



### Note.

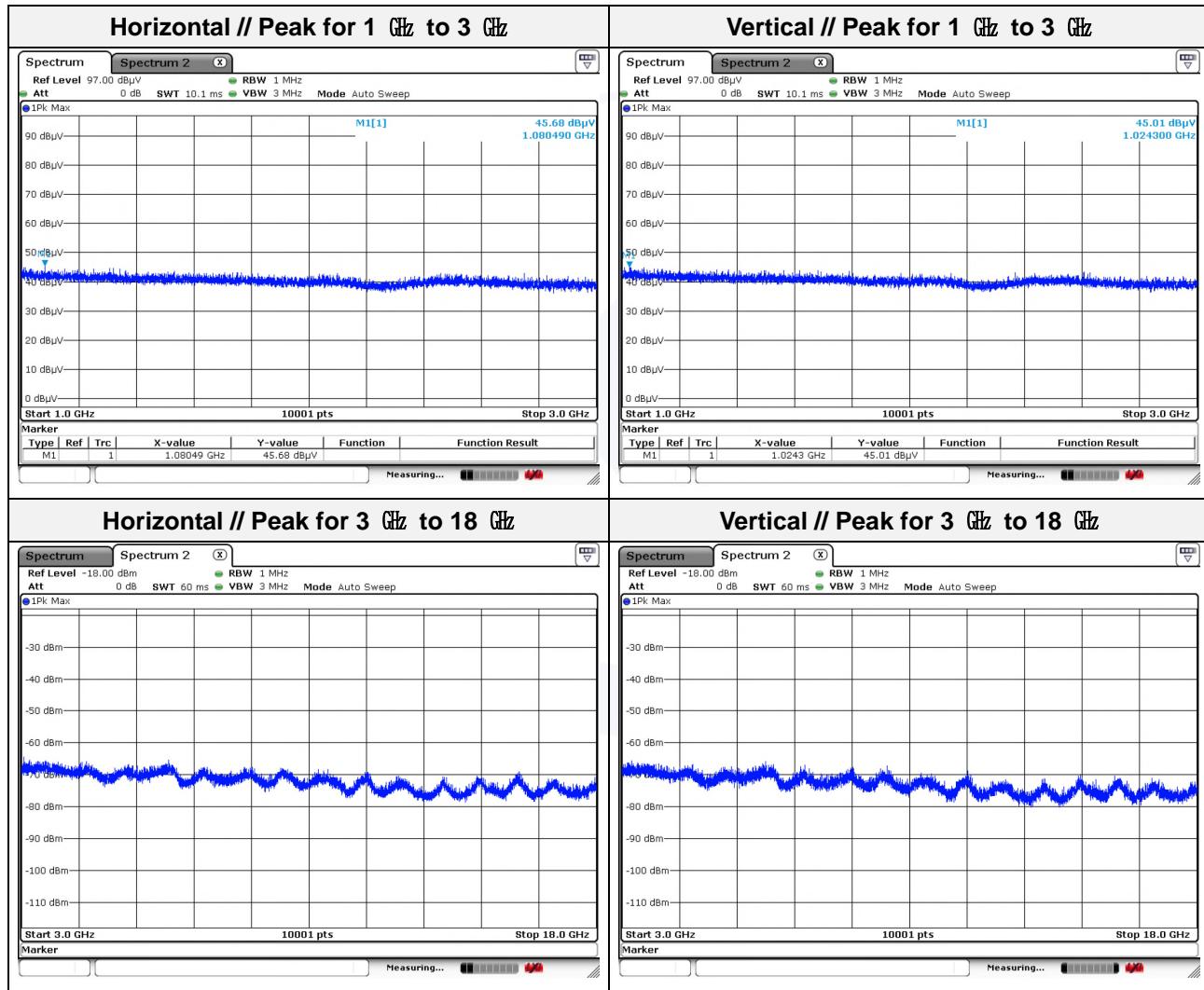
1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.



Mode: 802.11ah\_2 MHz bandwidth  
 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 $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
1 024.30	45.01	Peak	V	-9.12	-	35.89	74.00	38.11
1 080.49	45.68	Peak	H	-8.76	-	36.92	74.00	37.08



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.



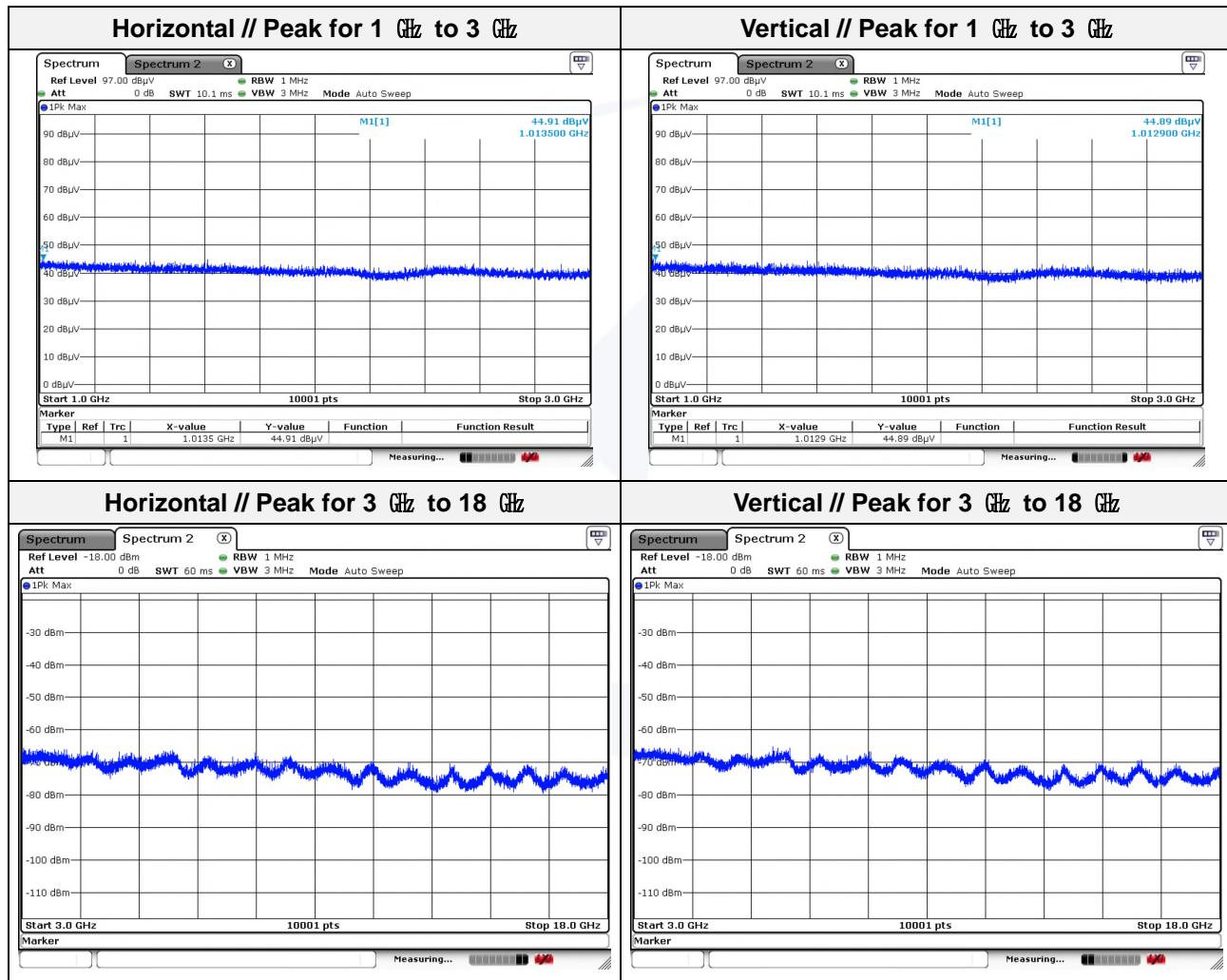
Mode: 802.11ah\_4 MHz bandwidth

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)
1 012.90	44.89	Peak	V	-9.20	-	35.69	74.00	38.31
1 013.50	44.91	Peak	H	-9.19	-	35.72	74.00	38.28



Note.

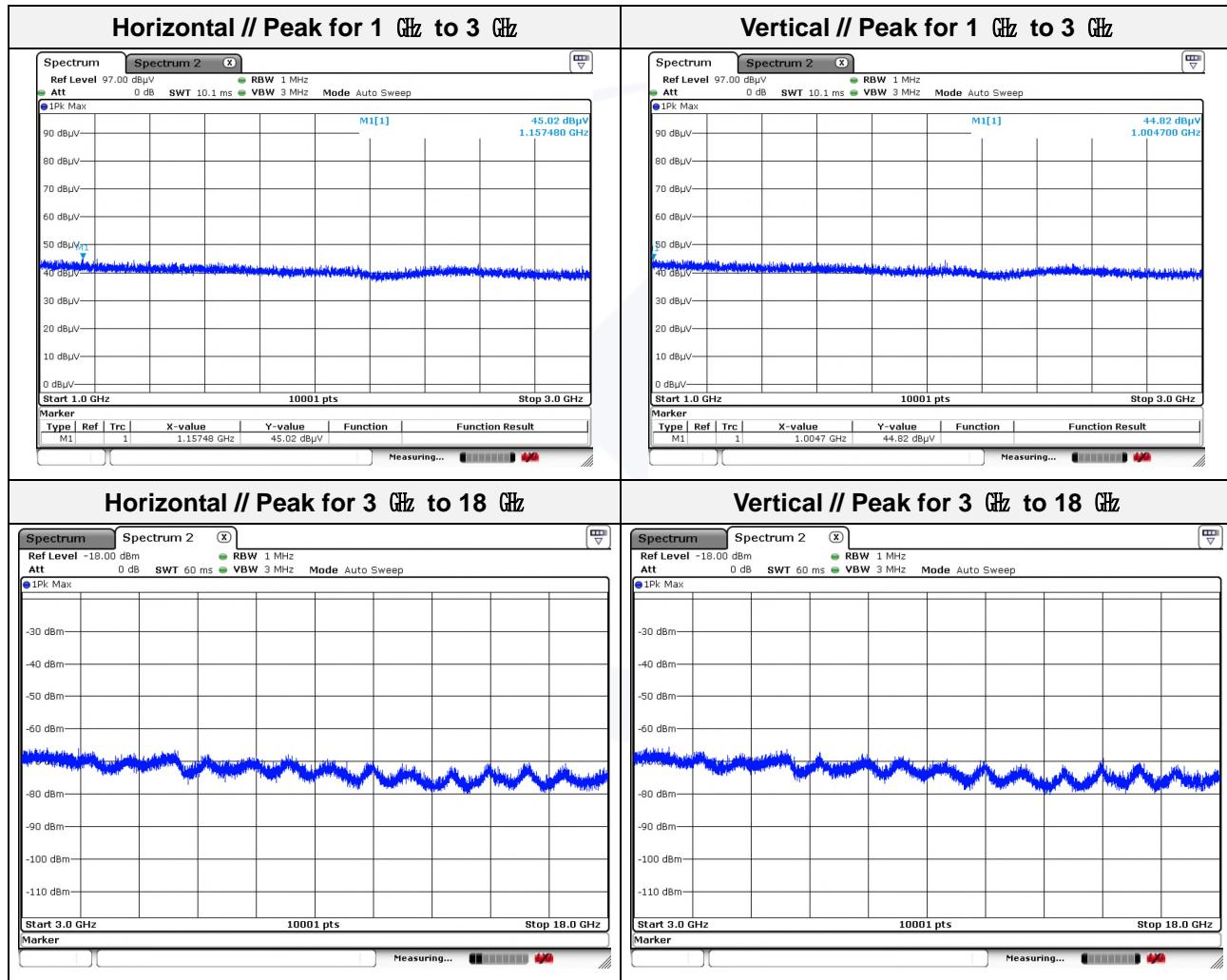
1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.



Mode: 802.11ah\_4 MHz bandwidth  
 Distance of measurement: 3 meter  
 Channel: 03

#### - Spurious

Frequency (MHz)	Level (dB $\mu$ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
1 004.70	44.82	Peak	V	-9.25	-	35.57	74.00	38.43
1 157.48	45.02	Peak	H	-8.27	-	36.75	74.00	37.25



#### Note.

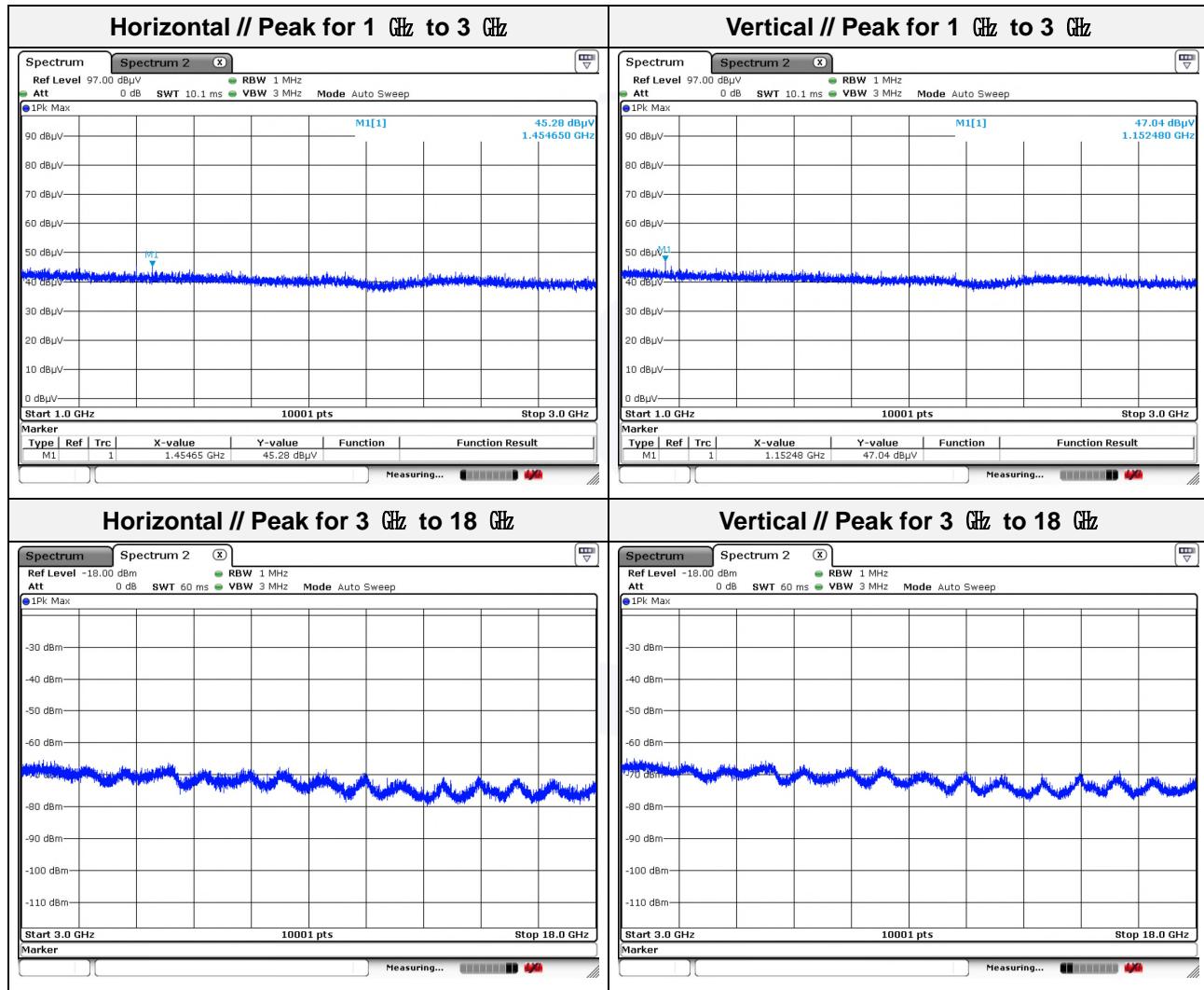
1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.



Mode: 802.11ah\_4 MHz bandwidth  
 Distance of measurement: 3 meter  
 Channel: 05

### - Spurious

Frequency (MHz)	Level (dB $\mu$ V)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
1 152.48	47.04	Peak	V	-8.30	-	38.74	74.00	35.26
1 454.65	45.28	Peak	H	-6.25	-	39.03	74.00	34.97



Note.

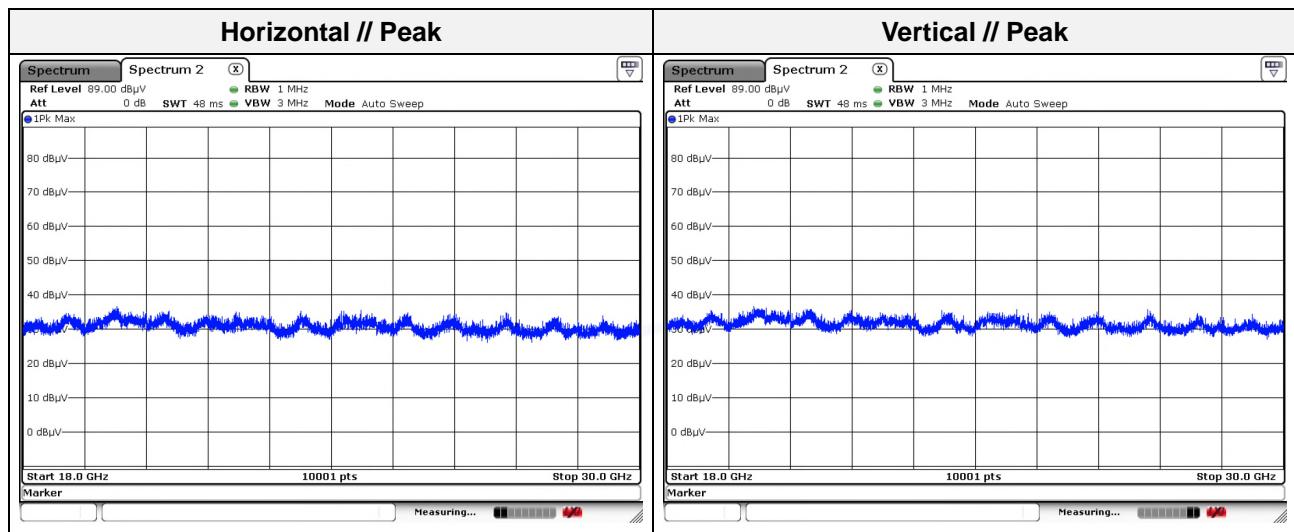
1. No spurious emission were detected above 3 GHz.
2. Average test would be performed if the peak result were greater than the average limit.

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

Mode: 802.11ah\_1 MHz bandwidth (Worst case)

Distance of measurement: 3 meter

Channel: 01 (Worst case)



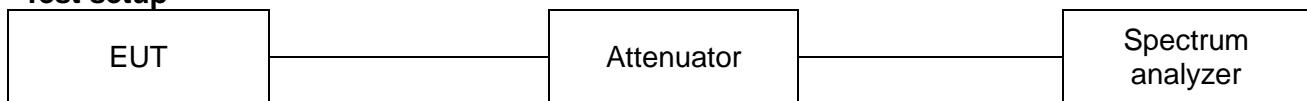
Note.

1. No spurious emission were detected above 18 GHz.



### 3.6. Conducted spurious emissions & band edge

#### Test setup



#### Test procedure

##### Band edge

ANSI C63.10-2013 - Section 11.11

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. Set the RBW = 100 kHz
4. Set the VBW = [3 × RBW].
5. Detector = Peak
6. Sweep time = auto
7. Trace mode = max hold
8. Allow trace to fully stabilize.

##### Out of band emissions

ANSI C63.10-2013 - Section 11.11

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. Set the RBW = 100 kHz
3. Set the VBW = [3 × RBW].
4. Detector = Peak
5. Sweep time = auto
6. Trace mode = max hold
7. Allow trace to fully stabilize.

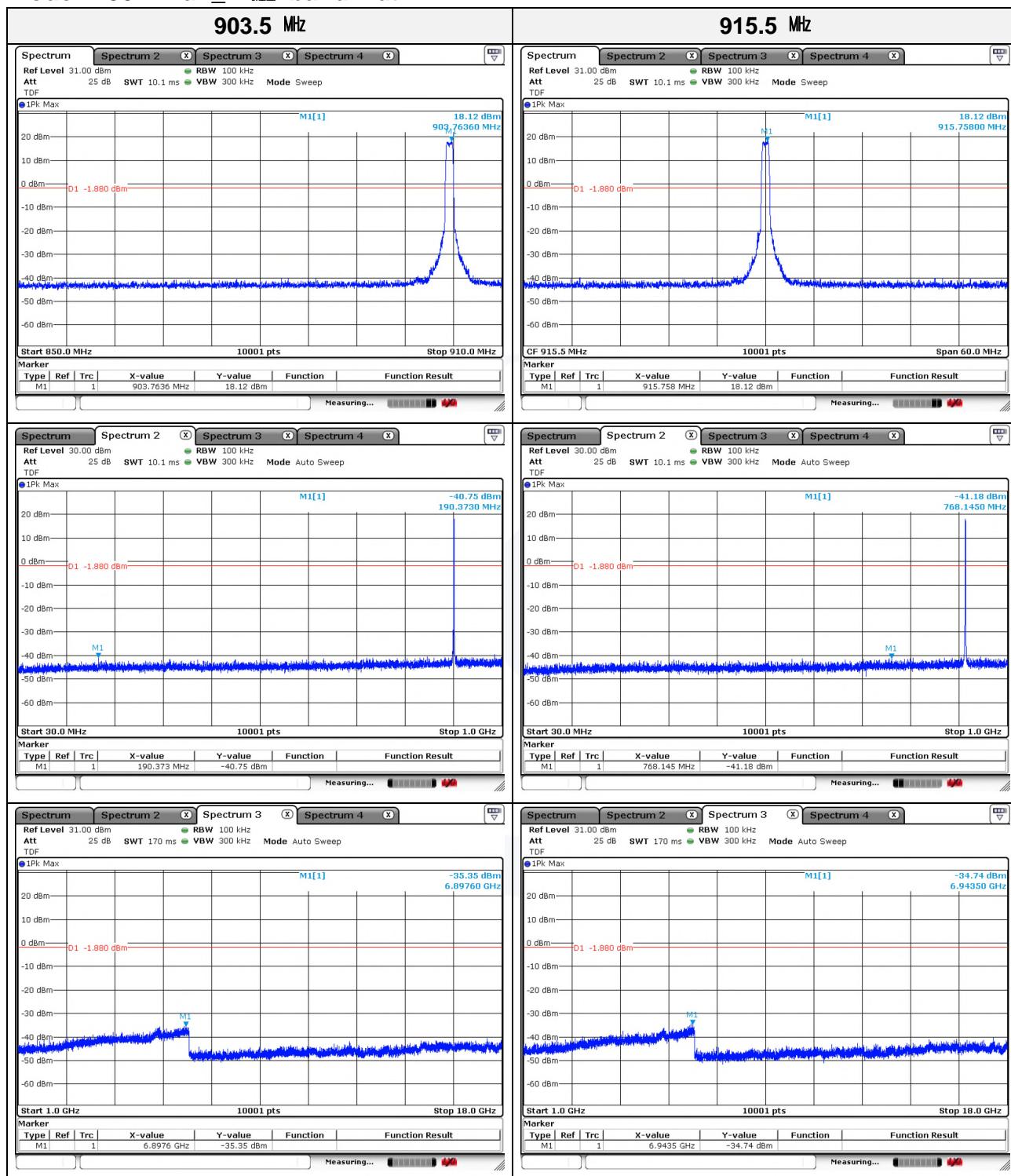
#### Limit

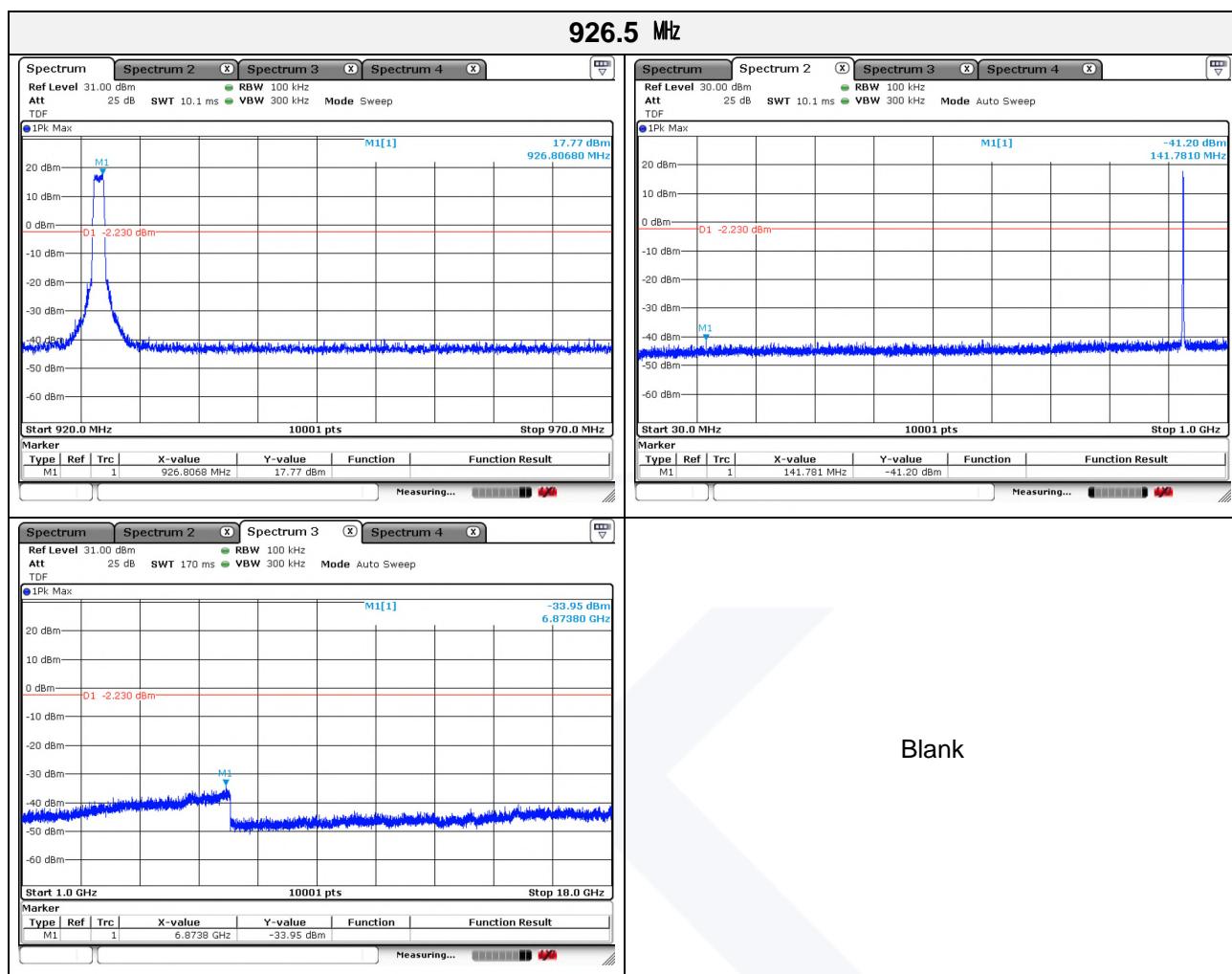
According to RSS-247 5.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.



## Test results

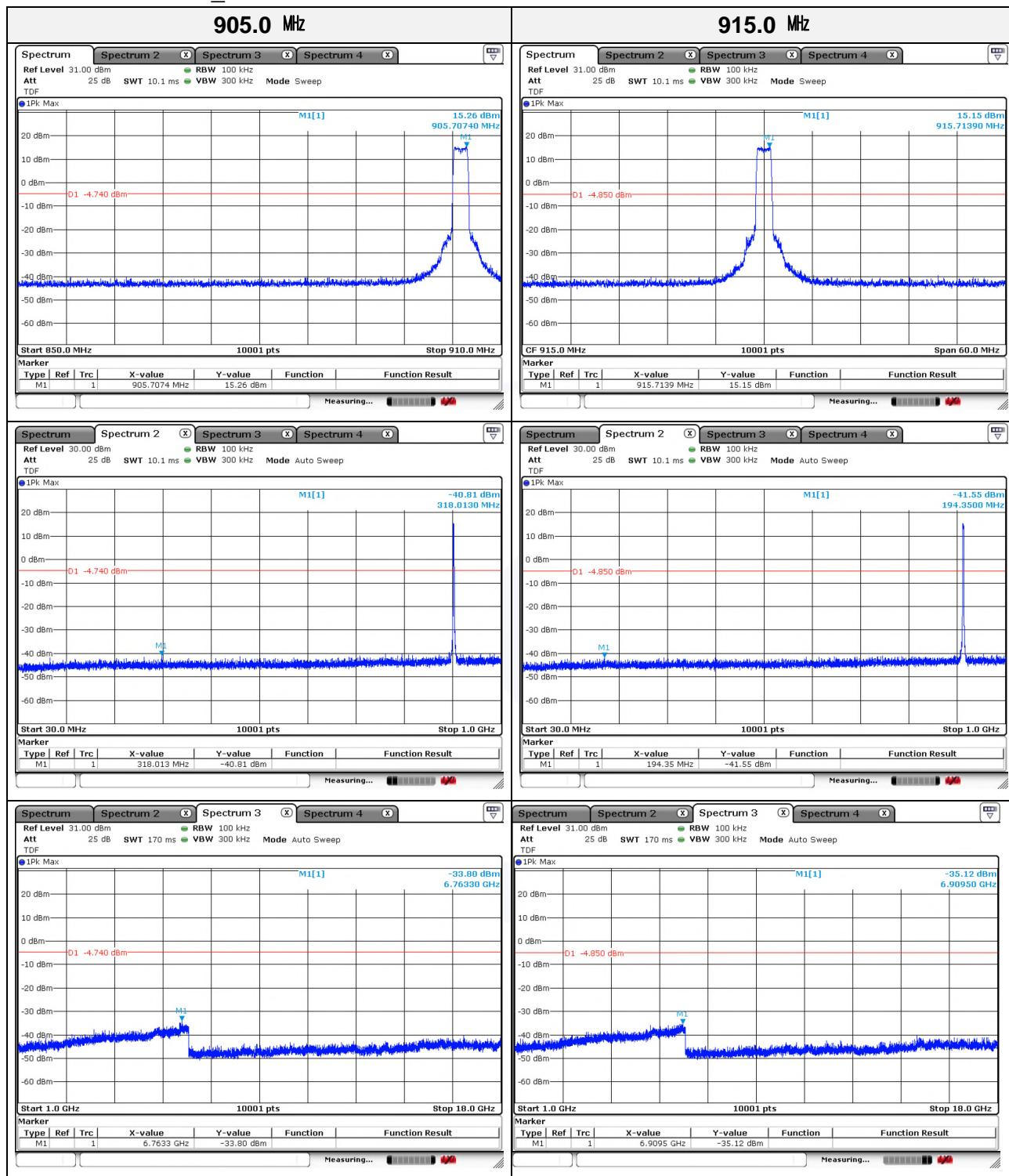
### Mode : 802.11ah\_1 MHz bandwidth

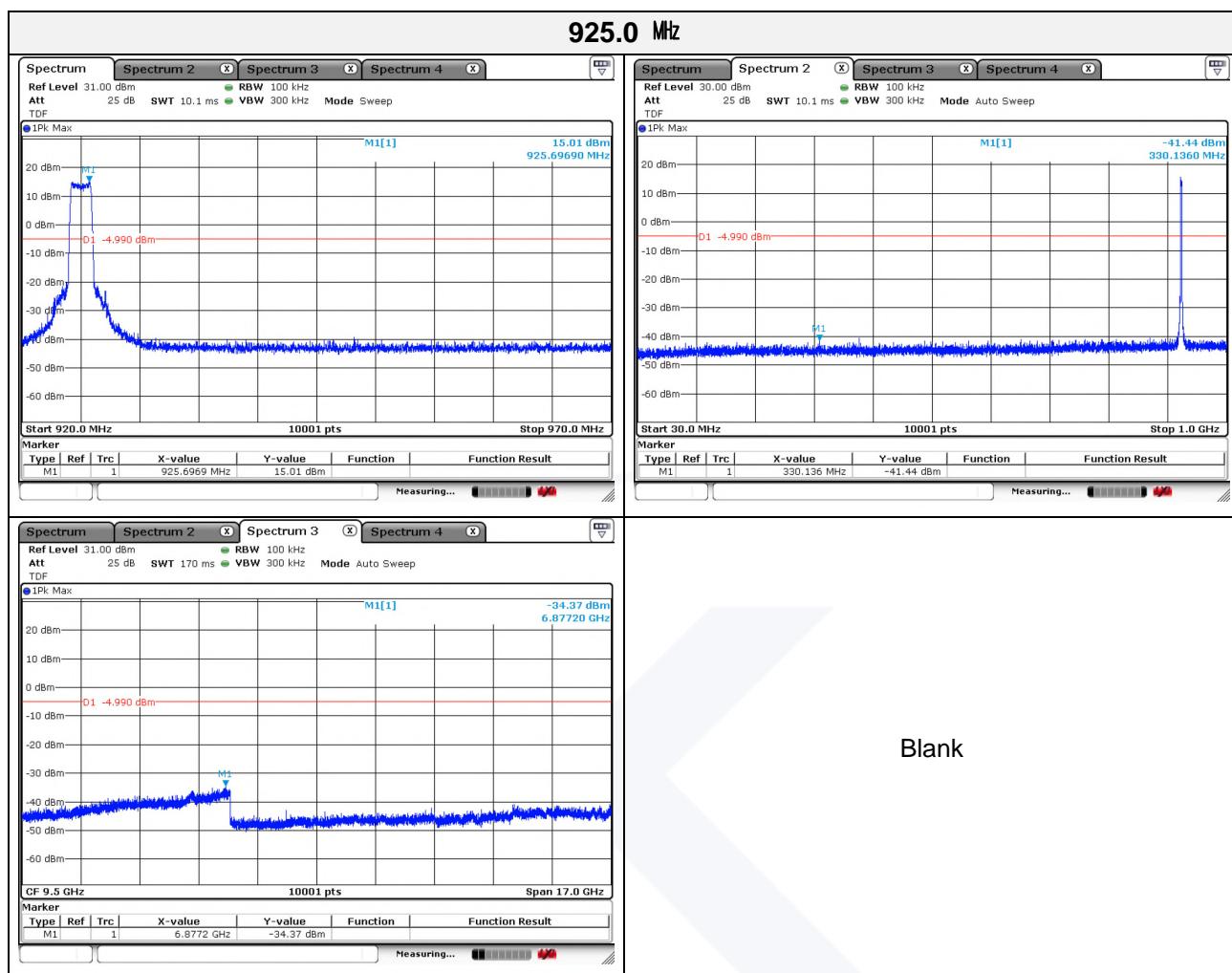






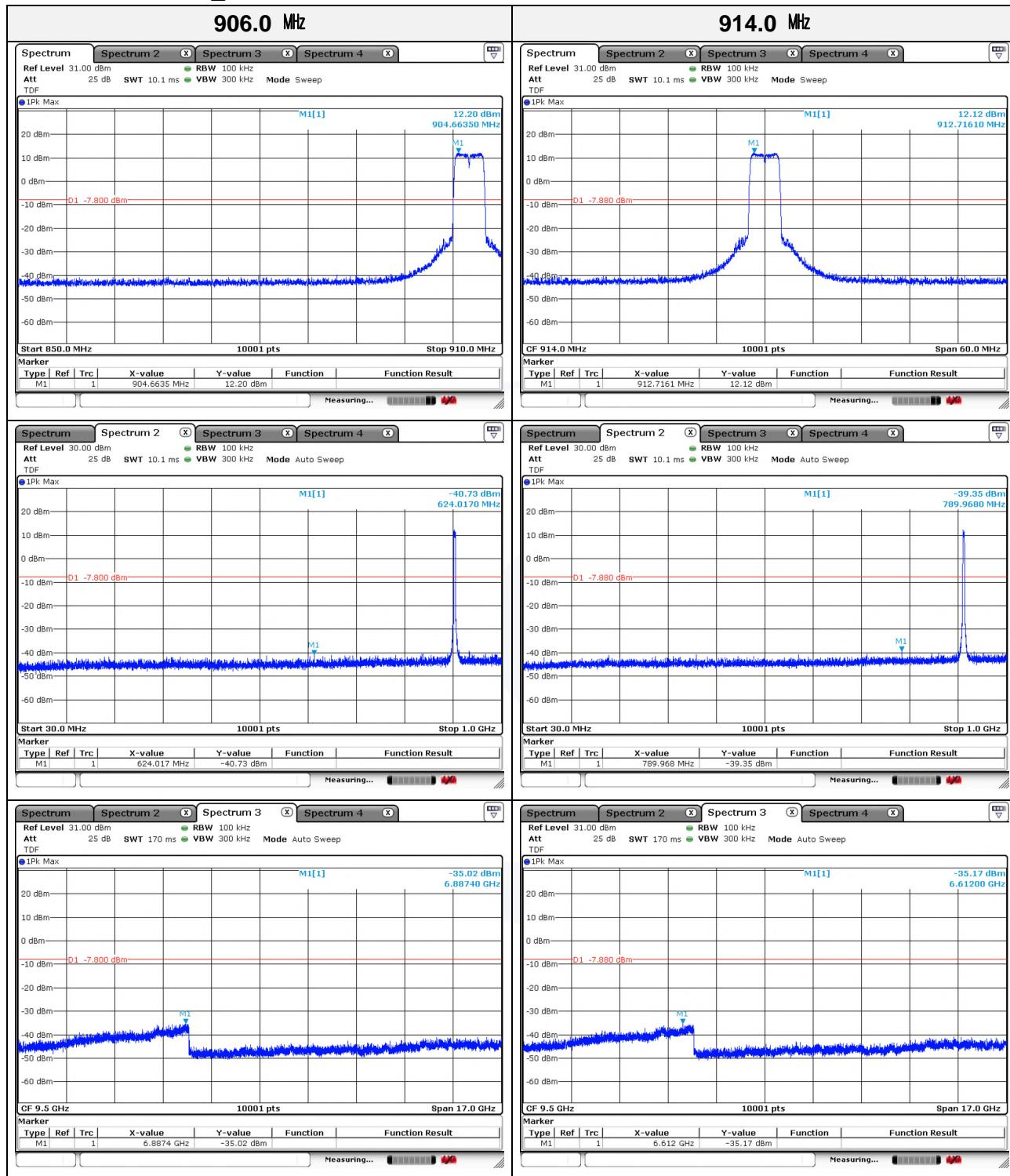
## Mode : 802.11ah\_2 MHz bandwidth

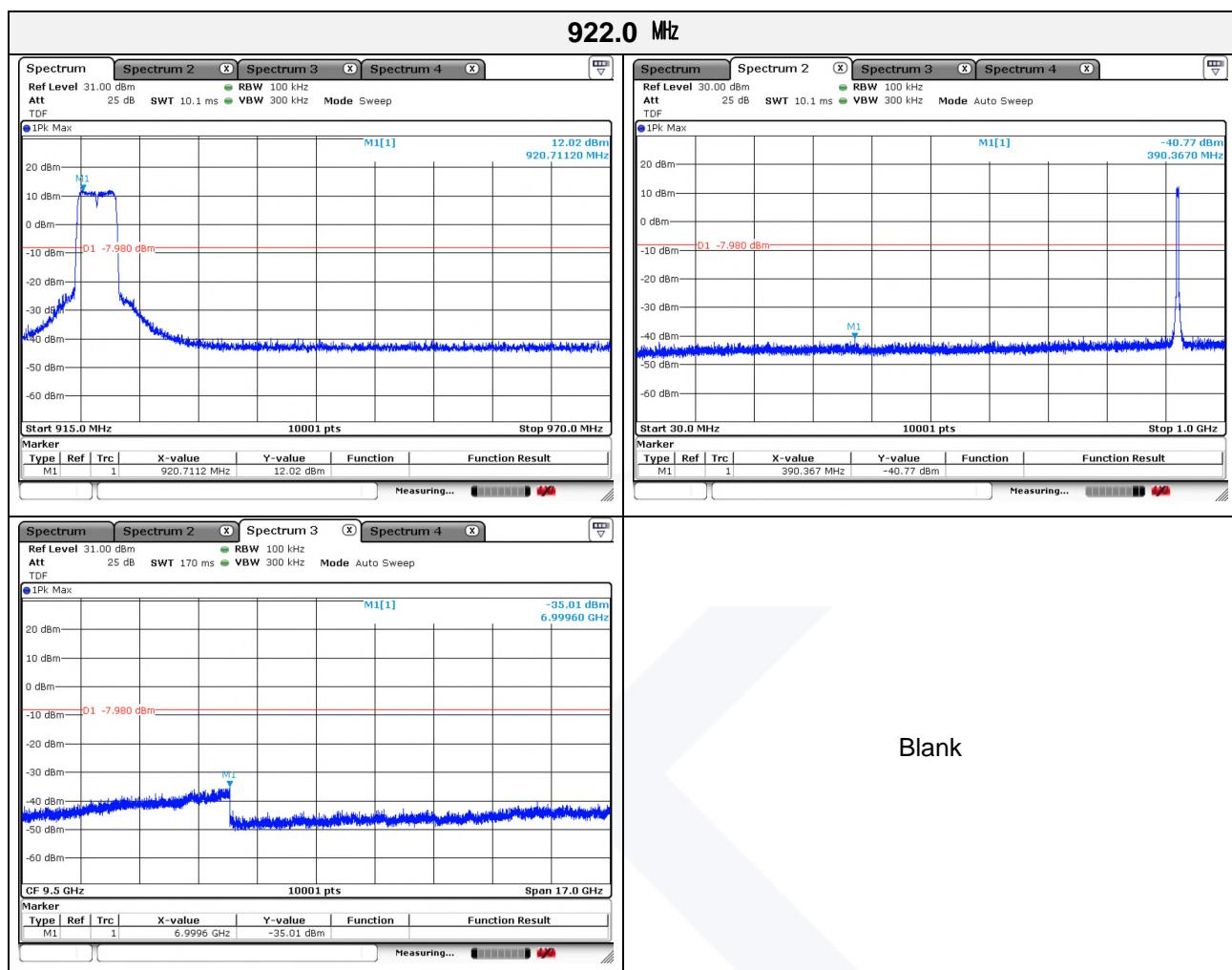






## Mode : 802.11ah\_4 MHz bandwidth







### 3.7. AC conducted emissions

#### Limit

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

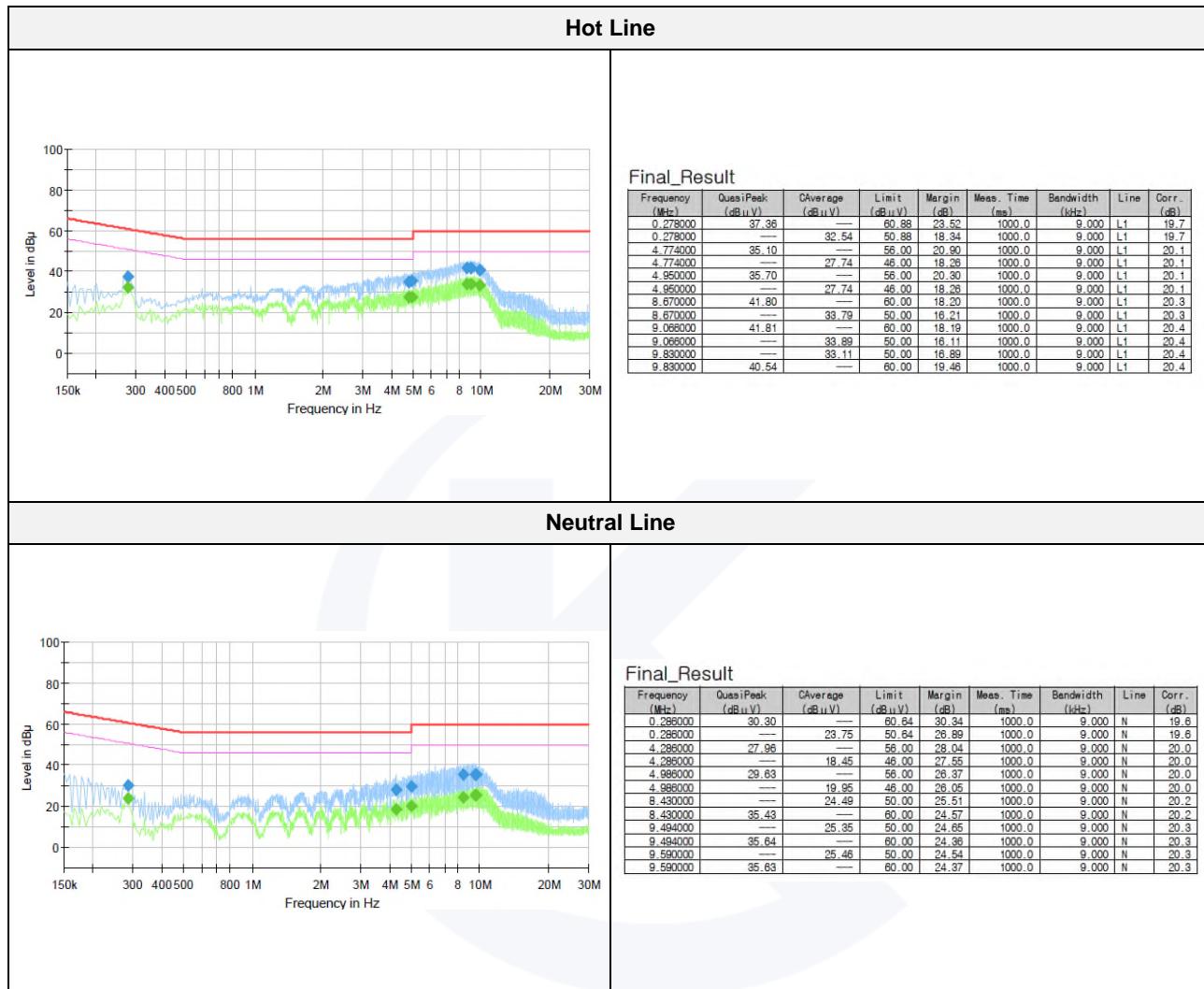
For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at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

Frequency of Emission (MHz)	Conducted limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

**Test results**

Mode: 802.11ah\_2 MHz bandwidth (Worst case)

Channel: 01 (Worst case)





### 3.8. Antenna Requirement

According to 15.207(a), An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.



## Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV40	101725	1 year	2026.06.10
SIGNAL GENERATOR	KEYSIGHT	N5182B	MY59100115	1 year	2026.04.16
SIGNAL GENERATOR	Anritsu	68369B	002118	1 year	2026.04.21
Power Meter	Anritsu	ML2495A	1438001	1 year	2026.04.16
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2026.04.16
Attenuator	Mini-Circuits	BW-S10-2W263+	3	1 year	2026.01.09
LOOP ANTENNA	TESEQ	HLA6121	66547	2 years	2026.01.22
TRILOG-BROADBAND ANTENNA	Schwarzbeck	VULB 9163	714	2 years	2026.04.19
Attenuator	HUBER+SHHNER	6806.17.A	NONE	1 year	2026.02.13
ATTENUATOR	HP	8491B	23094	1 year	2026.02.13
BAND REJECT FILTER	K&L	3TNF-500/1000-N/N	399	1 year	2026.06.09
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA 9170550	1 year	2026.01.13
Amplifier	SONOMA INSTRUMENT	310N	401123	1 year	2026.02.13
PREAMPLIFIER	HP	8449B	3008A00538	1 year	2026.04.30
BROADBAND AMPLIFIER	SCHWARZBECK	BBV9721	PS9721-003	1 year	2026.01.09
DC POWER SUPPLY	AGILENT	6632B	MY43004090	1 year	2026.06.12
EMI Test Receiver	R&S	ESU26	100551	1 year	2026.02.13
EMI Test Receiver	R&S	ESU26	100552	1 year	2026.02.13
EMI Test Receiver	R&S	ESR3	101783	1 year	2025.11.06
PULSE LIMITER	R&S	ESH2-Z2	101915	1 year	2025.11.06
LISN	R&S	ENV216	101786	1 year	2026.01.09
Cable	-	-	#5	1 year	2025.11.01
Cable (SR #6)	RG 400	-	-	0.5 year	2025.07.25
Cable (SAC #5)	SUCOFLEX106	HUBER_SUHNER	-	0.5 year	2025.07.25
	SUCOFLEX106	HUBER_SUHNER	-		
	LH21D/2xSMA	OSI Cable	-		
Cable (SAC #6)	TCLH21D-SMSM-2.5M 0222	OSI Cable	-	0.5 year	2025.07.25
	TCLH21D-NMNM-10.0M 0222	OSI Cable	-		
	TCLH21D-SMSM-7.0M 0222	OSI Cable	-		

\* Statement of Traceability: KES Co., Ltd. attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

## Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook computer	LG Electronics Inc.,	LGS53	306QCZP560949
Test Jig Board	N/A	N/A	N/A

**The End.**

KES-QP16-F01(00-23-01-01)

KES Co., Ltd.

The authenticity of this test report can be found on the verification page of our website ([www.kes.co.kr](http://www.kes.co.kr)).