

# EST REPORT

## Part 15 Subpart C 15.247

**Equipment under test** Instant Dock Printer

**Model name** PD460

**Derivative name** PD450, PD460A, PD460B, PD460BT,  
PD450BT

**FCC ID** PO5PD460A

**Applicant** Prinics Co.Ltd

**Manufacturer** Prinics Co.Ltd

**Date of test(s)** 2020.06.03 ~ 2020.06.10

**Date of issue** 2020.06.16

**Issued to**



**Prinics Co.Ltd**

228-92, Saneop-ro 155beon-gil,  
Gwonseon-gu, Suwon-si, Gyeonggi-do, 16648, Korea  
Tel: +82-31-293-5991 / Fax: +82-31-293-5994

**Issued by**

**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,  
Gyeonggi-do, 14057, 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 :
	
Jun-Su Jeong Test engineer	Young-Jin, Lee Technical manager



---

### Revision history

Revision	Date of issue	Test report No.	Description
-	2020.06.16	KES-RF-20T0096	Initial

## TABLE OF CONTENTS

1.	General information.....	4
1.1.	EUT description .....	4
1.2.	Test configuration.....	5
1.3.	Device modifications.....	5
1.4.	Frequency/channel operations.....	5
1.5.	Accessory information.....	5
1.6.	Software and Firmware description.....	5
1.7.	Information about derivative model .....	6
1.8.	Measurement results explanation example .....	6
1.9.	Measurement Uncertainty .....	6
2.	Summary of tests .....	7
3.	Test results .....	8
3.1.	20 dB bandwidth .....	8
3.2.	Output power.....	12
3.3.	Carrier frequency separation .....	16
3.4.	Number of hopping frequency.....	18
3.5.	Time of occupancy .....	20
3.6.	Radiated restricted band and emissions.....	24
3.7.	Conducted band edge and out of band emissions .....	45
3.8.	AC conducted emissions .....	50
Appendix A.	Measurement equipment .....	52
Appendix B.	Test setup photo.....	53

## 1. General information

Applicant: Prinics Co.Ltd  
Applicant address: 228-92, Saneop-ro 155beon-gil,  
Gwonseon-gu, Suwon-si, Gyeonggi-do, 16648, Korea  
Test site: KES Co., Ltd.  
Test site address: 3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,  
Gyeonggi-do, 14057, Korea  
473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea  
Test Facility FCC Accreditation Designation No.: KR0100, Registration No.: 444148  
FCC rule part(s): 15.247  
FCC ID: PO5PD460A  
Test device serial No.: ☒ Production ☐ Pre-production ☐ Engineering

### 1.1. EUT description

Equipment under test Instant Dock Printer  
Frequency range 2 402 Mhz ~ 2 480 Mhz (BDR/EDR)  
Model PD460  
Derivative name PD450, PD460A, PD460B, PD460BT, PD450BT  
Modulation technique GFSK,  $\pi/4$ DQPSK, 8DPSK  
Number of channels 79 ch  
Antenna specification Antenna type : PCB antenna, Peak gain : -0.37 dBi  
Power source DC 24.0 V (Adapter)

15.247(a)(1) that the rx input bandwidths shift frequencies in synchronization with the transmitted signals.

15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate it channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

### **Pseudorandom frequency hopping sequence**

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

### **Equal hopping frequency use**

The channels of this system will be used equally over the long-term distribution of the hopsets.

### **System receiver input bandwidth**

Each channel bandwidth is 1 MHz.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

## **1.2. Test configuration**

The **Prinics Co.Ltd PD460 FCC ID: PO5PD460A** was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Part 15.247  
KDB 558074 D01 v05 r02  
ANSI C63.10-2013

## **1.3. Device modifications**

N/A

## **1.4. Frequency/channel operations**

Ch.	Frequency (MHz)	Rate(Mbps)
00	2402	1,2,3
.	.	.
39	2441	1,2,3
.	.	.
78	2480	1,2,3

## **1.5. Accessory information**

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



## **1.6. Software and Firmware description**

The software and firmware installed in the EUT is version 3.0.

## 1.7. Information about derivative model

- PD460B, PD460BT, PD450BT

The difference between basic model and derivative is the presence USB docking, the other circuit diagram and software are fundamentally the same. Please refer to the figure below for details.

Basic model	Derivative model
	

- PD450, PD460A

The circuit diagram and software of the basic model and derivative are fundamentally the same. It is for model management purpose per business partner.

## 1.8. Measurement results explanation example

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.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 0.68 + 10 = 10.68\end{aligned}$$

## 1.9. Measurement Uncertainty

Test Item		Uncertainty
Uncertainty for Conduction emission test		2.62 dB
Uncertainty for Radiation emission test (include Fundamental emission)	9kHz - 30MHz	4.54 dB
	30MHz - 1GHz	4.36 dB
	Above 1GHz - 30GHz	5.00 dB
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.		



## 2. Summary of tests

Reference	Test description	Test results
15.247(a)(1)(iii)	20 dB bandwidth	Pass
15.247(b)(1)	Output power	Pass
15.247(a)(1)	Channel separation	Pass
15.247(a)(1)(iii)	Number of channels	Pass
15.247(a)(1)(iii)	Time of occupancy	Pass
15.205, 15.209	Radiated restricted band and emission	Pass
15.207(d)	Conducted band edge and out of band emissions	Pass
15.207(a)	AC conducted emissions	Pass

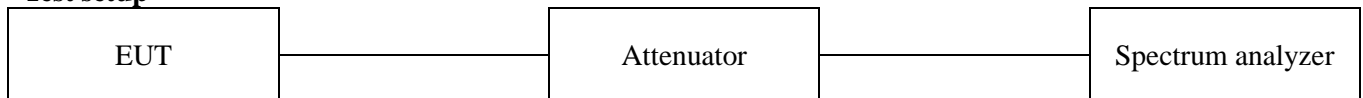
### **3. Test results**

#### **3.1. 20 dB bandwidth**

##### **Test procedure**

ANSI C63.10-2013 clause 6.9.2 and 6.9.3

##### **Test setup**



##### **Test setting**

1. Span = The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 2.0 times and 5.0 times the OBW.
2. RBW = The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW.
3. VBW = Shall be approximately three times the RBW.
4. Sweep = auto
5. Detector function = peak
6. Trace mode = max hold

##### **Limit**

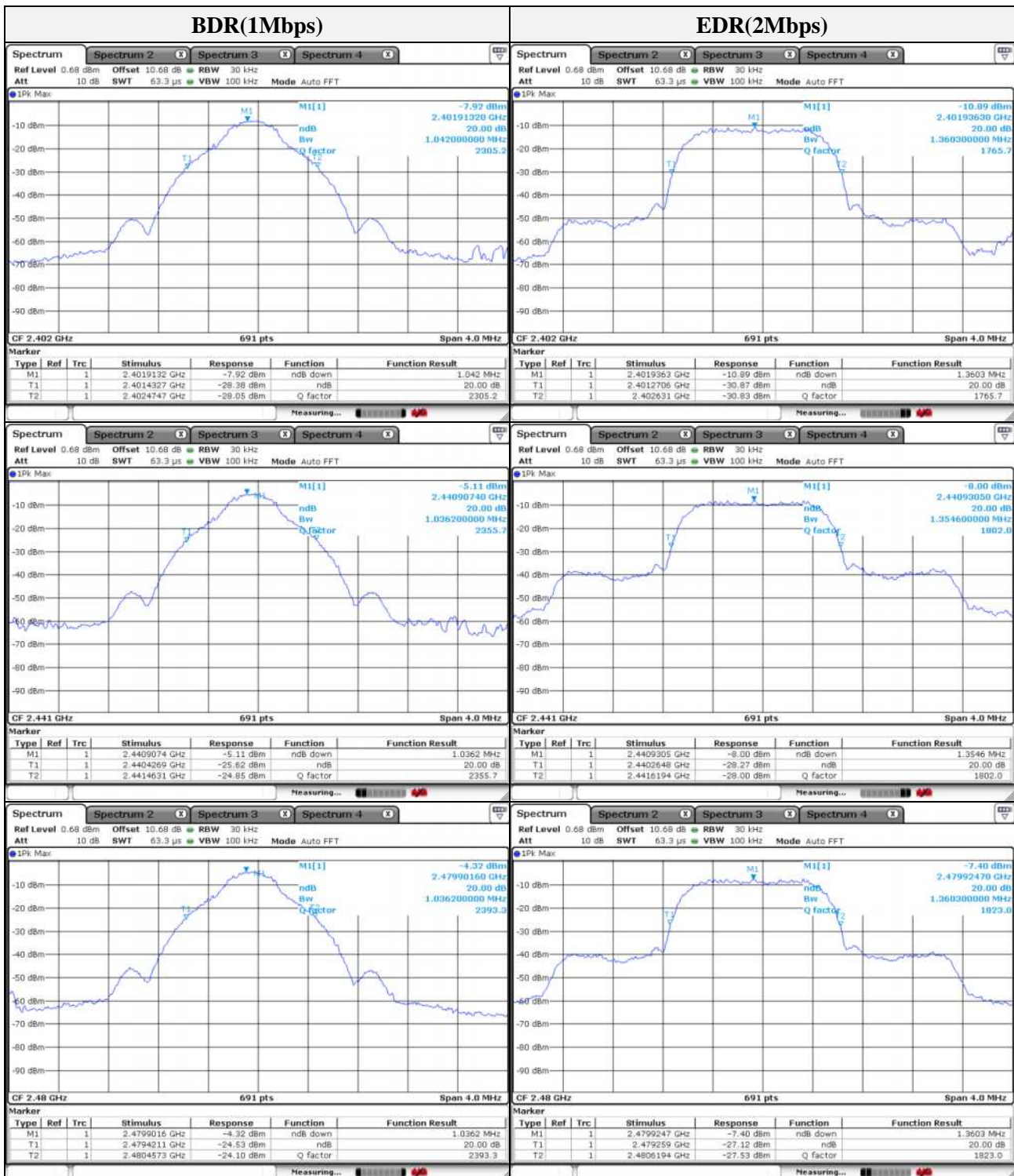
Not applicable

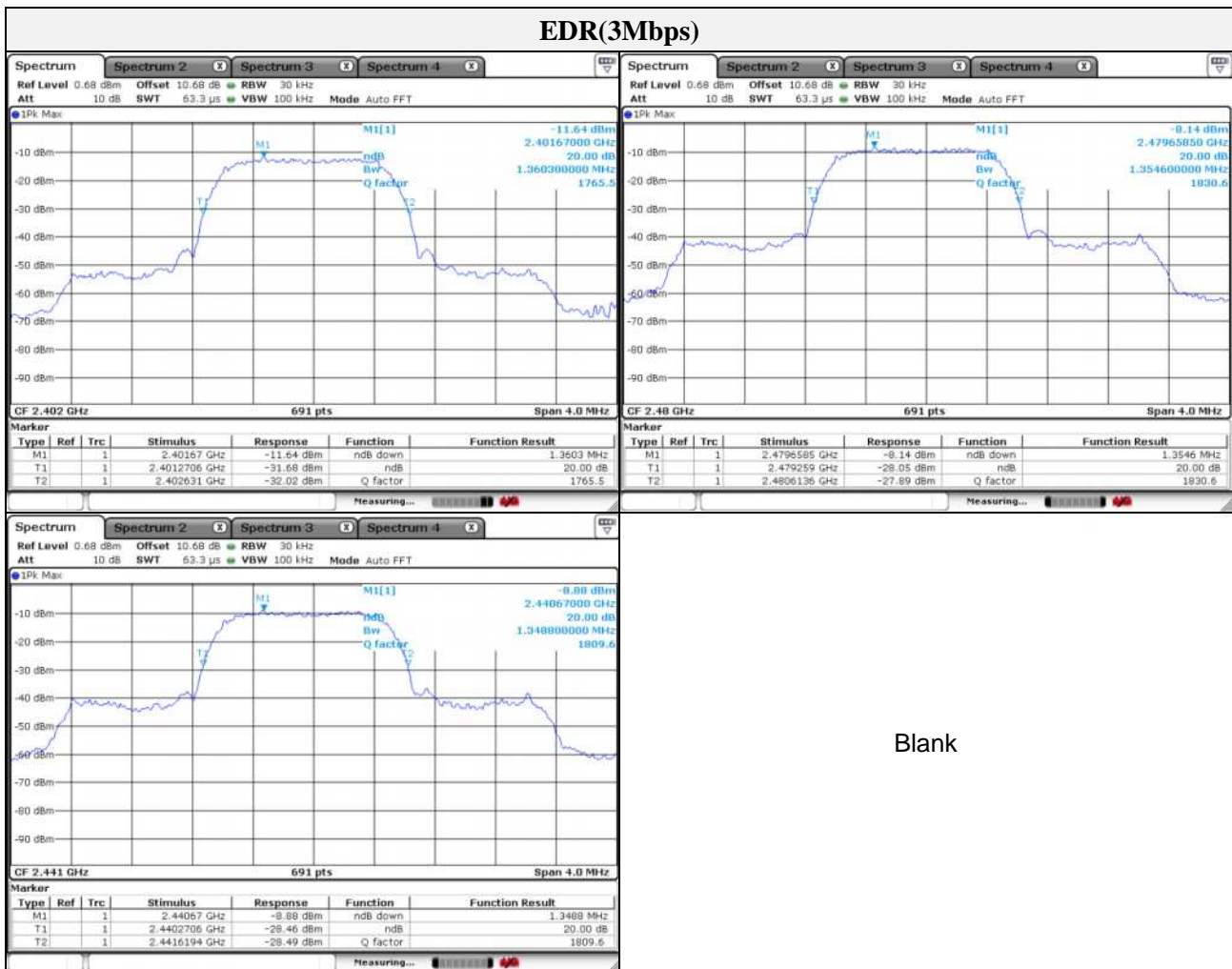




### Test results

Frequency(MHz)	Channel no.	Data rate(Mbps)	Measured bandwidth(MHz)
2 402	00	1	1.042
2 441	39		1.036
2 480	78		1.036
2 402	00	2	1.360
2 441	39		1.355
2 480	78		1.360
2 402	00	3	1.360
2 441	39		1.349
2 480	78		1.355



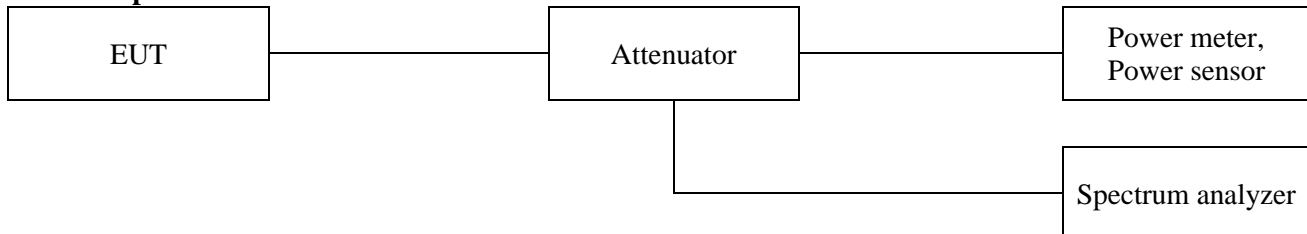


### 3.2. Output power

#### Test procedure

ANSI C63.10-2013 - Section 7.8.5

#### Test setup



#### Test setting

1. Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
2. RBW > the 20 dB bandwidth of the emission being measured
3. VBW  $\geq$  RBW
4. Sweep = Auto
5. Detector function = Peak
6. Trace = Max hold

#### Limit

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

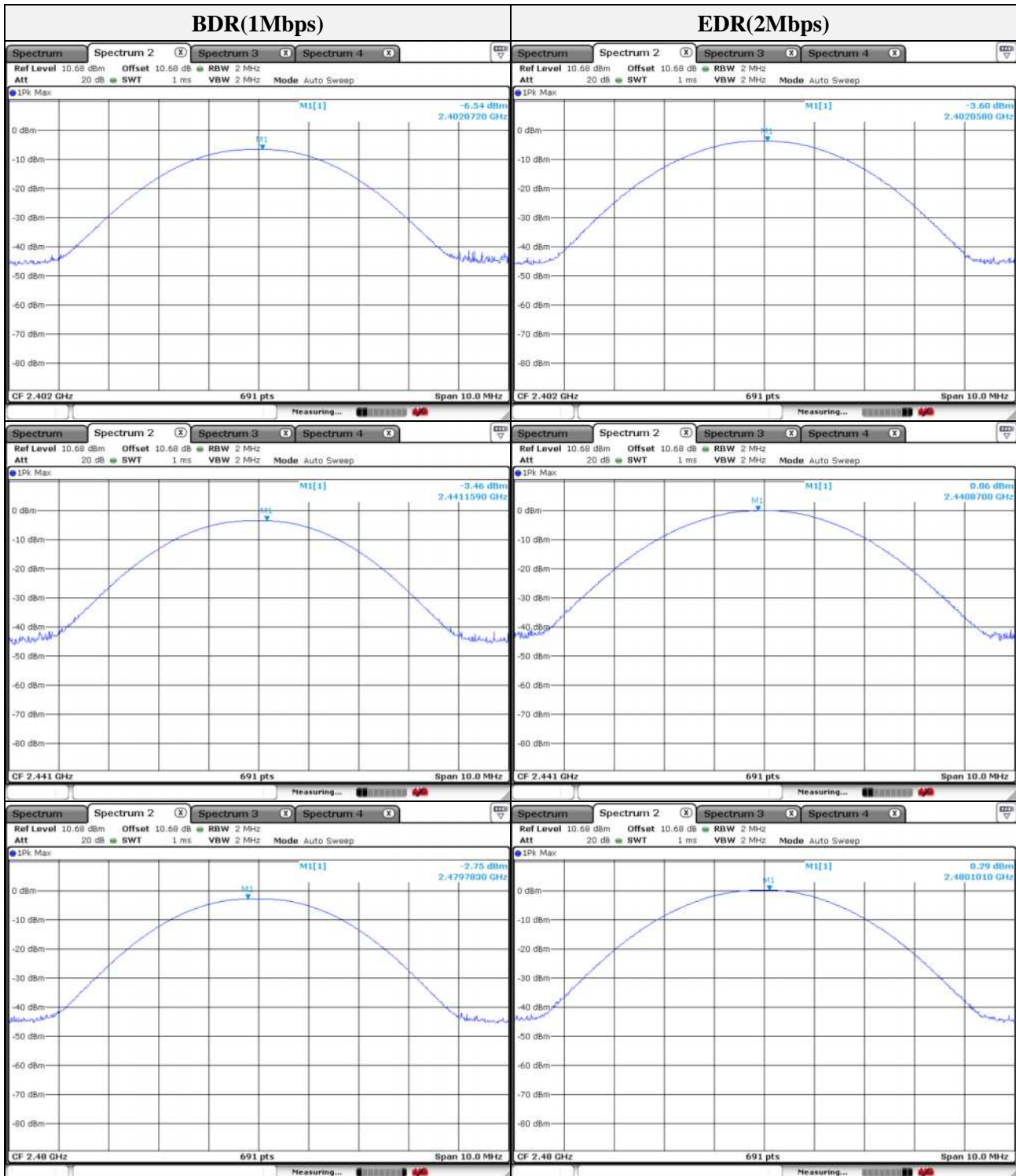
According to §15.247(b)(1), For frequency hopping systems operating in the 2 400 ~ 2 483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 ~ 5 805 MHz band: 1 Watt.

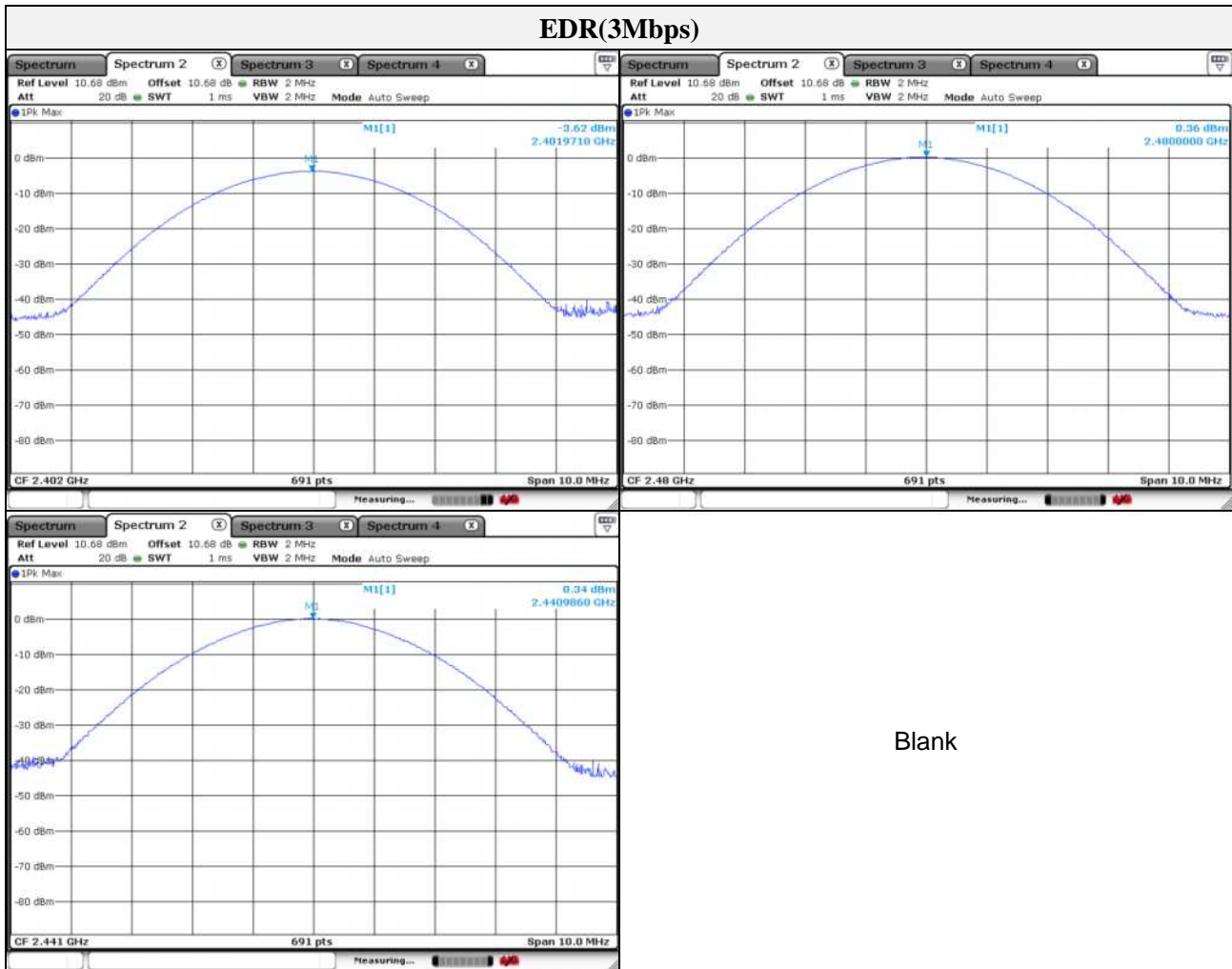
### Test results

Frequency(MHz)	Channel no.	Data rate(Mbps)	Peak Power (dBm)	Average Power (dBm) <sup>Note1</sup>	Power Limit (dBm)
2 402	00	1	-6.54	-7.05	20.97
2 441	39		-3.46	-4.09	20.97
2 480	78		-2.75	-3.40	20.97
2 402	00	2	-3.60	-6.95	20.97
2 441	39		0.06	-3.80	20.97
2 480	78		0.29	-3.30	20.97
2 402	00	3	-3.62	-7.48	20.97
2 441	39		0.34	-4.57	20.97
2 480	78		0.36	-3.79	20.97

### Note.

1. The average power was tested using an average power meter.





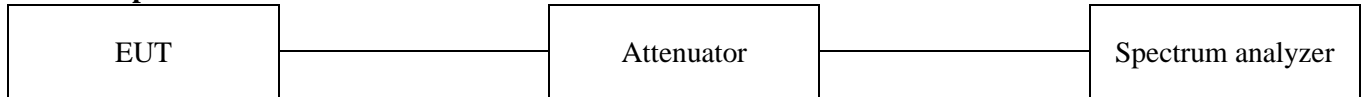


### 3.3. Carrier frequency separation

#### Test procedure

ANSI C63.10-2013 - Section 7.8.2

#### Test setup



#### Test Setting

1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
2. Span = wide enough to capture the peaks of two adjacent channels
3. Resolution (or IF) Bandwidth (RBW) = Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
4. Video (or Average) Bandwidth (VBW)  $\geq$  RBW
5. Sweep = auto
6. Detector function = peak
7. Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

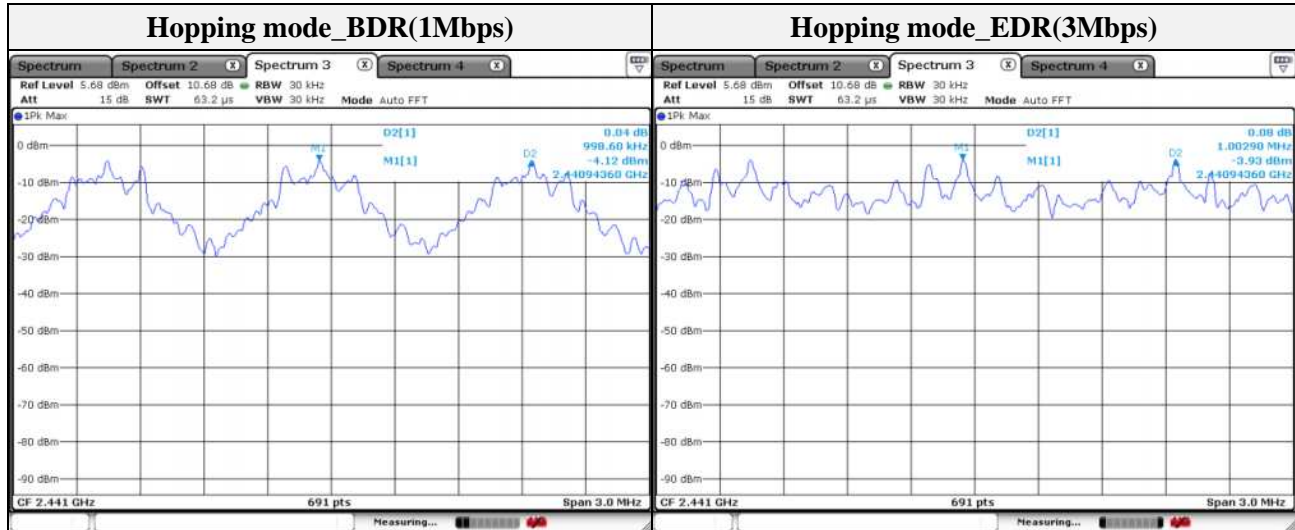
#### Limit

According to 15.247(a)(1), frequency hopping system operating in 2 400 ~ 2 483.5 MHz. Band may have hopping channel carrier frequencies that are separated by 25 kHz or two-third of 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.



## Test results

Frequency(MHz)	Channel no.	Data rate(Mbps)	Channel Separation (MHz)
2 441	39	1	0.999
2 441	39	3	1.003

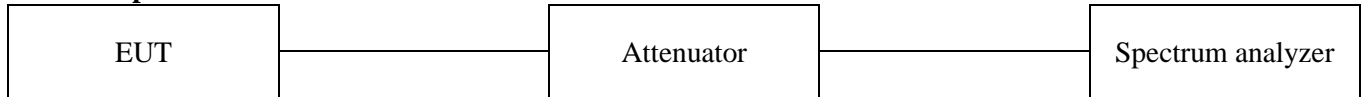


### 3.4. Number of hopping frequency

#### Test procedure

ANSI C63.10-2013 - Section 7.8.3

#### Test setup



#### Test setting

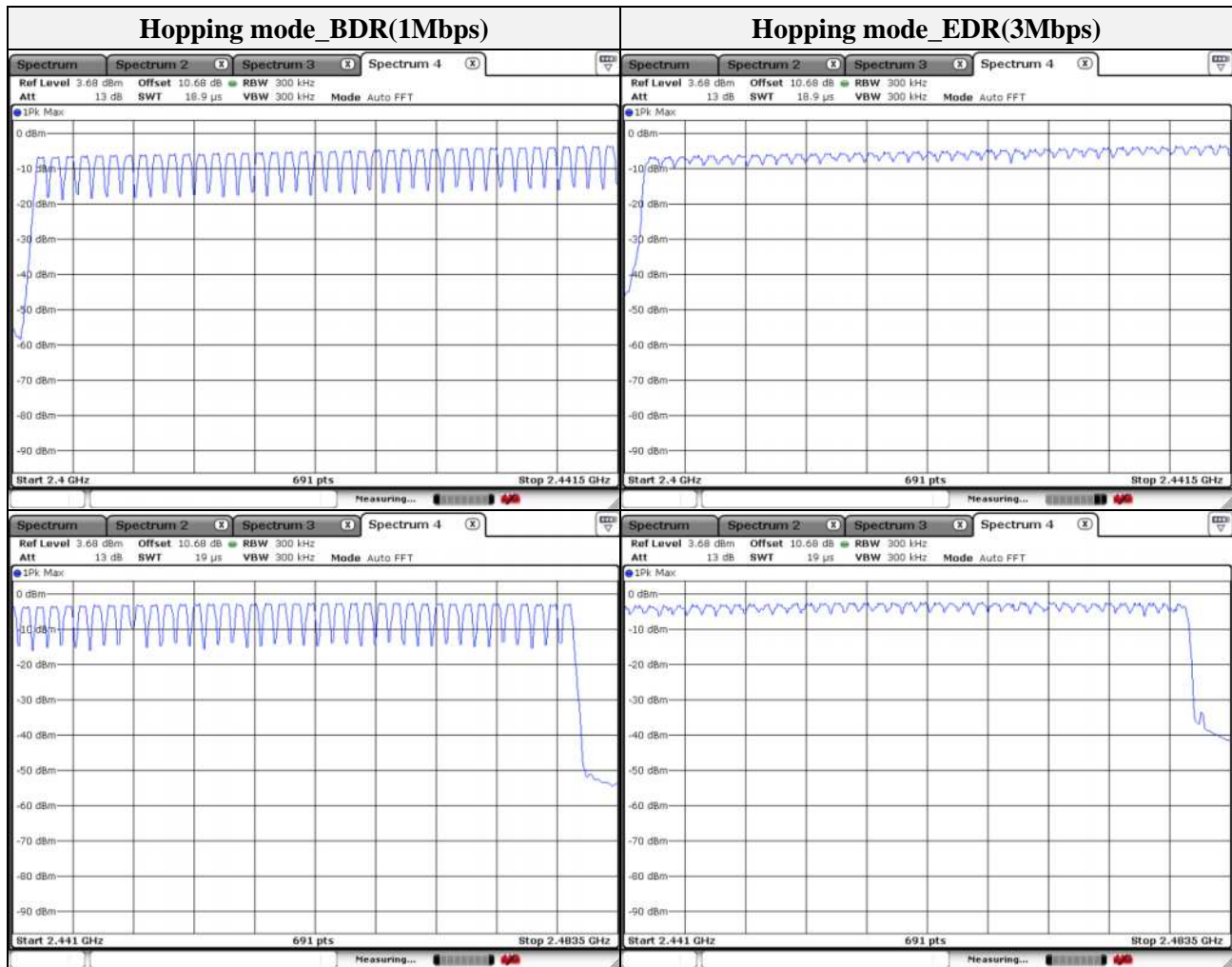
1. The EUT must have its hopping function enabled.
2. Frequency range: 2 400 MHz ~ 2 441.5 MHz, 2 441.5 MHz ~ 2 483.5 MHz
3. Span = the frequency band of operation
4. RBW = To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
5. VBW  $\geq$  RBW
6. Sweep = auto
7. Detector function = peak
8. Trace = max hold

Allow the trace to stabilize. It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

#### Limit

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 MHz bands shall use at least 15 hopping frequencies.

## Test results

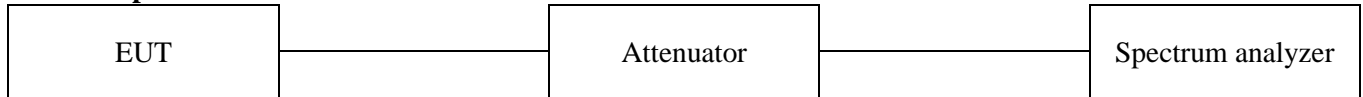


### 3.5. Time of occupancy

#### Test procedure

ANSI C63.10-2013 - Section 7.8.4

#### Test setup



#### Test setting

1. The EUT must have its hopping function enabled.
2. Span = zero span, centered on a hopping channel
4. RBW = 1 MHz
5. VBW = 1 MHz ( $\geq$  RBW)
6. Sweep = as necessary to capture the entire dwell time per hopping channel
7. Detector function = peak
8. Trace = max hold

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

#### Limit

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 MHz band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 31.6 second period.

$$\text{A period time} = 0.4(\text{s}) \times 79 = 31.6(\text{s})$$

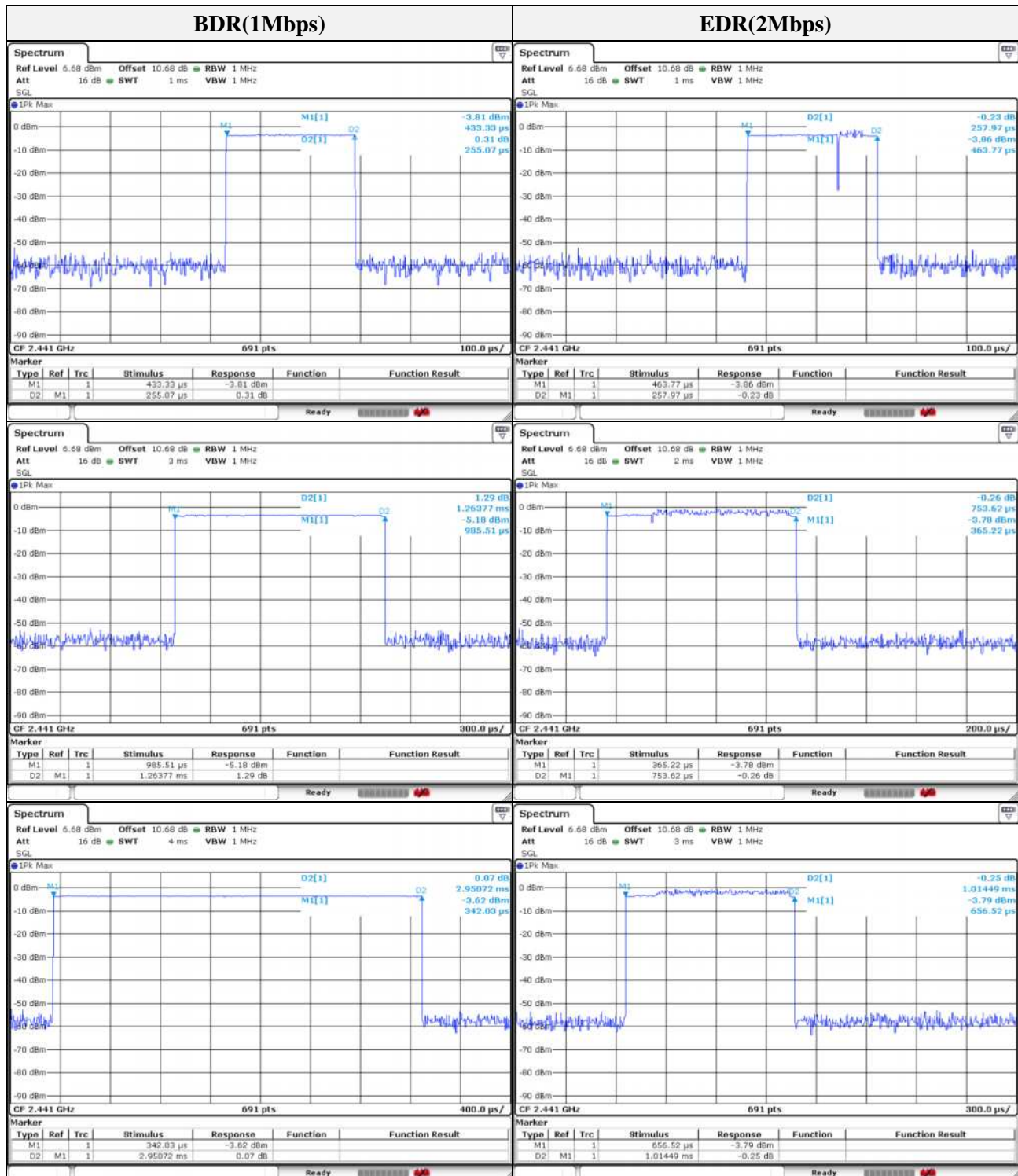
$$\begin{aligned} &\text{Time of occupancy on the TX channel in 31.6 sec} \\ &= \text{time domain slot length} \times (\text{hop rate} \div \text{number of hop per channel}) \times 31.6 \end{aligned}$$

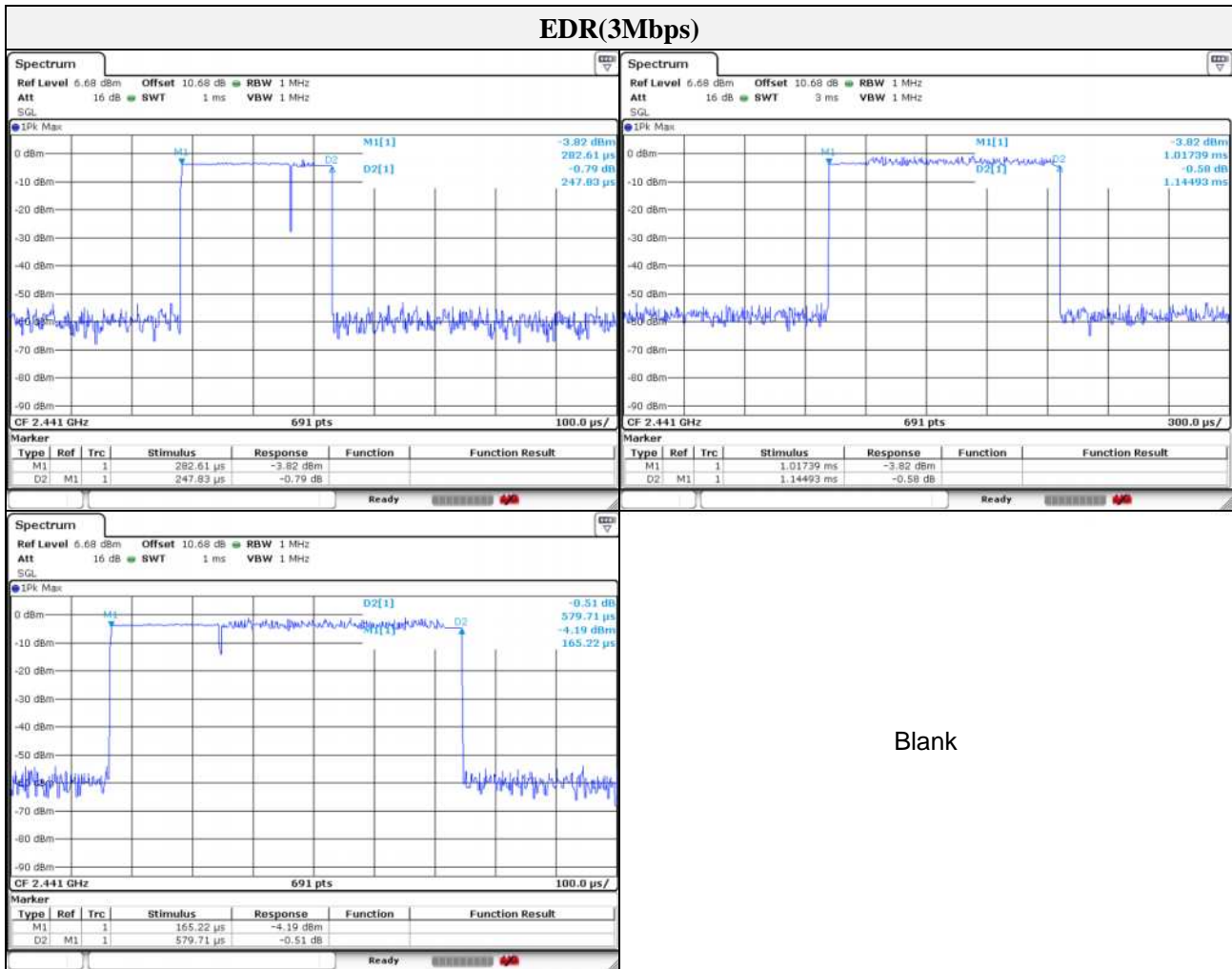
### Test results

Packet type	Frequency (MHz)	Dwell time (ms)	Time of occupancy on the Tx channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx channel in 31.6 sec (ms)
DH1	2 441	0.255	81.60	400
DH3	2 441	1.264	202.24	400
DH5	2 441	2.951	314.77	400
2-DH1	2 441	0.258	82.56	400
2-DH3	2 441	0.754	120.64	400
2-DH5	2 441	1.014	108.16	400
3-DH1	2 441	0.248	79.36	400
3-DH3	2 441	0.580	92.80	400
3-DH5	2 441	1.145	122.13	400

### Note:

DH1: Dwell time (ms)  $\times [(1\ 600 \div 2) \div 79] \times 31.6(s) = 81.60\ (ms)$   
 DH3: Dwell time (ms)  $\times [(1\ 600 \div 4) \div 79] \times 31.6(s) = 202.24\ (ms)$   
 DH5: Dwell time (ms)  $\times [(1\ 600 \div 6) \div 79] \times 31.6(s) = 314.77\ (ms)$   
 2-DH1: Dwell time (ms)  $\times [(1\ 600 \div 2) \div 79] \times 31.6(s) = 82.56\ (ms)$   
 2-DH3: Dwell time (ms)  $\times [(1\ 600 \div 4) \div 79] \times 31.6(s) = 120.64\ (ms)$   
 2-DH5: Dwell time (ms)  $\times [(1\ 600 \div 6) \div 79] \times 31.6(s) = 108.16\ (ms)$   
 3-DH1: Dwell time (ms)  $\times [(1\ 600 \div 2) \div 79] \times 31.6(s) = 79.36\ (ms)$   
 3-DH3: Dwell time (ms)  $\times [(1\ 600 \div 4) \div 79] \times 31.6(s) = 92.80\ (ms)$   
 3-DH5: Dwell time (ms)  $\times [(1\ 600 \div 6) \div 79] \times 31.6(s) = 122.13\ (ms)$





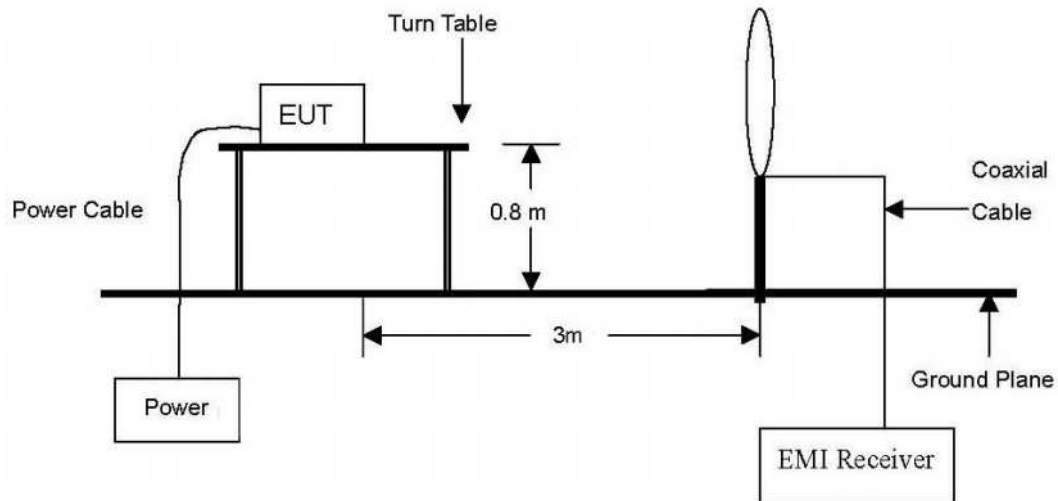
Blank



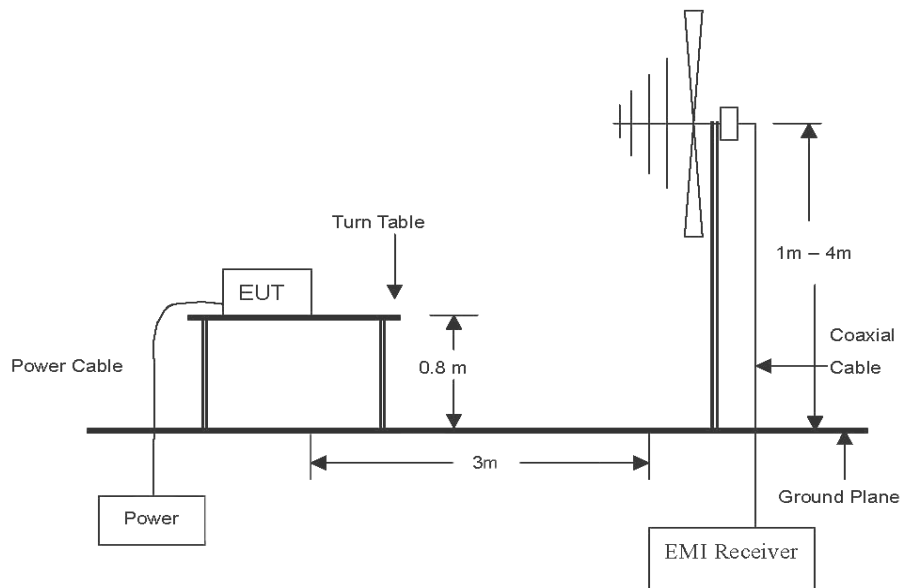
### 3.6. Radiated restricted band and emissions

#### 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.

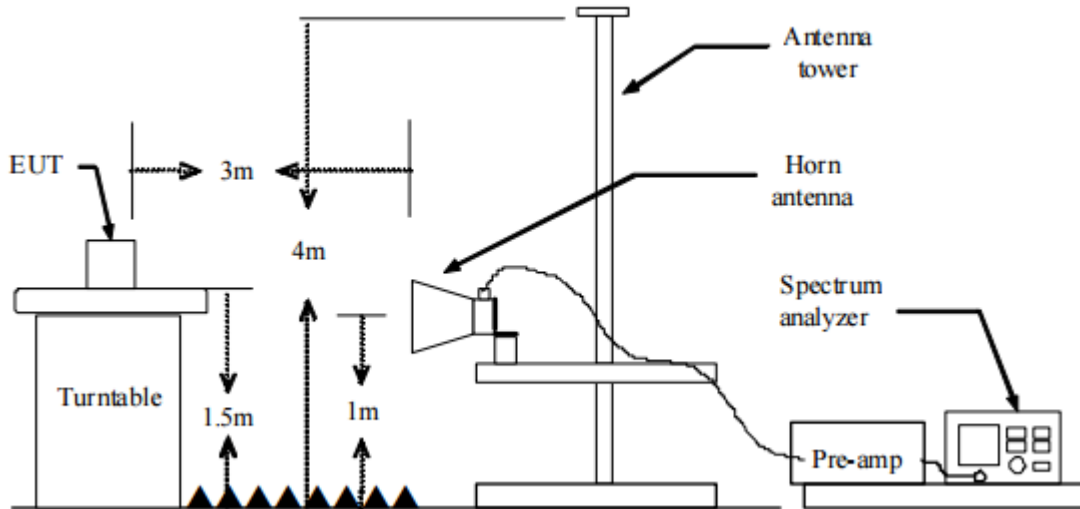


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.





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

1. The EUT is placed on a turntable, which is 0.8 m (below 1 GHz) and 1.5 m (above 1 GHz) ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. Spectrum analyzer settings for  $f < 1$  GHz:
  - Span = wide enough to fully capture the emission being measured
  - RBW = 100 kHz
  - VBW  $\geq$  RBW
  - Sweep = auto
  - Detector function = quasi peak
  - Trace = max hold
8. Spectrum analyzer settings for  $f \geq 1$  GHz: Peak
  - Span = wide enough to fully capture the emission being measured
  - RBW = 1 MHz
  - VBW  $\geq$  RBW
  - Sweep = auto
  - Detector function = peak
  - Trace = max hold
9. Spectrum analyzer settings for  $f \geq 1$  GHz: Average
  - Average value of pulsed emissions.
  - Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determined from the peak field strength after correcting for the worst-case duty cycle as described in 7.5 in ANSI 63.10-2013 & Procedure 9(b) in the KDB 558074 v05r02.
10. Duty Cycle Correction Factor (79 channel hopping)
  - a. Time to cycle through all channels =  $\Delta t = \tau[\text{ms}] \times 79$  channels = **233.129** ms, where  $\tau$  = pulse width
  - b.  $100 \text{ ms} / \Delta t[\text{ms}] = H \rightarrow$  Round up to next highest integer,  $H' = 1$
  - c. Worst Case Dwell Time =  $\tau[\text{ms}] \times H' = \mathbf{2.951}$  ms
  - d. Duty Cycle Correction =  $20\log(\text{Worst Case Dwell Time} / 100\text{ms}) \text{ dB} = \mathbf{-30.60}$  dB
11. Both 2Mbps & 3Mbps data rate were investigated. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

**Note:**

1. The spectrum is measured from 9 kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1 GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20 dB of the respective limits were not reported.
2. The loop antenna was investigated with three polarizations, and horizontal and vertical polarizations were reported as the worst case.
3. According to 15.35 (c), as a “duty cycle correction factor”, pulse averaging with  $20 \log(\text{duty cycle})$  has to be used.  
Duty cycle correction factor =  $20 \log(\text{dwell time}/100 \text{ ms})$
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. Average test would be performed if the peak result were greater than the average limit.
6. Field strength(dBμV/m) = Level(dBμV) + Correction factors(dB/m) + Cable loss(dB) + or  $F_d(\text{dB})$
7. Correction factors(dB/m) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB)
8. Margin(dB) = Limit(dBμV/m) - Field strength(dBμV/m)
9. 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.
10. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
11. 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 test site, adequate comparison measurements were confirmed against 30 m open field test 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.
12.  $f < 30 \text{ MHz}$ , 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

### Limit

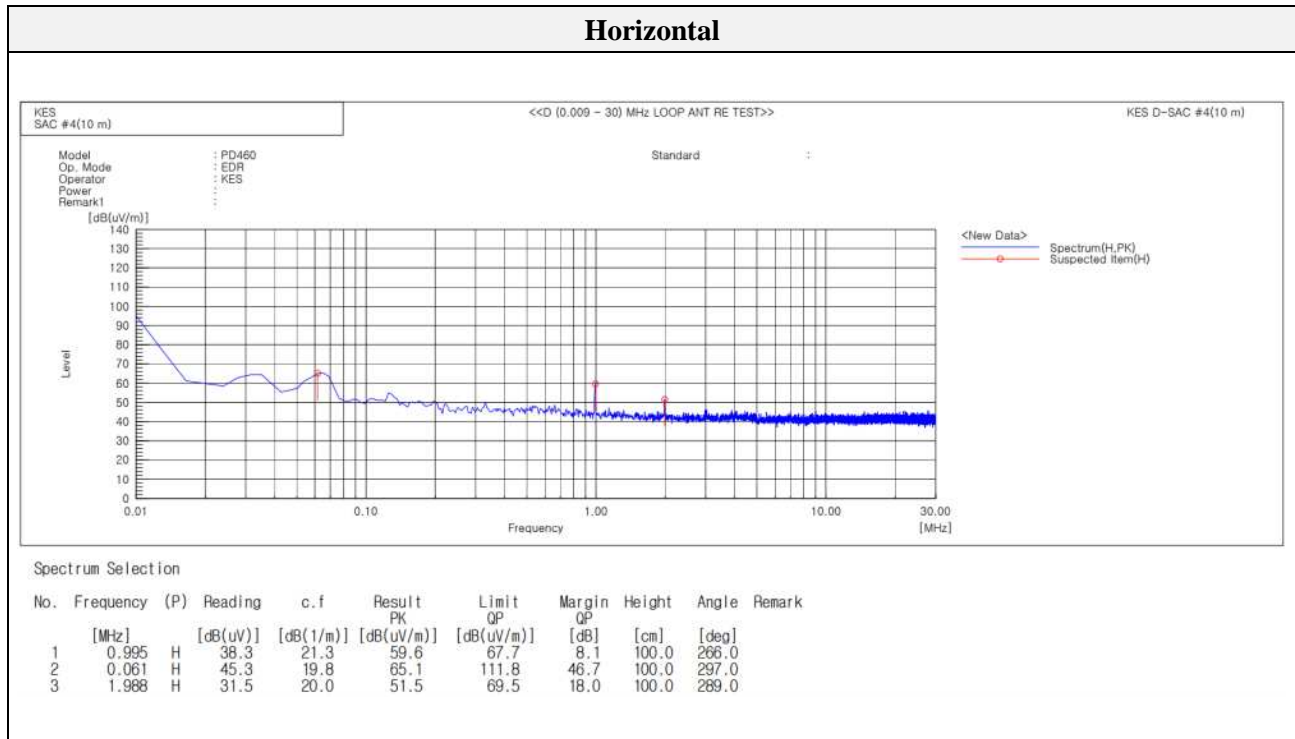
According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

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: EDR  
 Transfer rate: 3 Mbps  
 Distance of measurement: 3 meter  
 Channel: 78(Worst case)

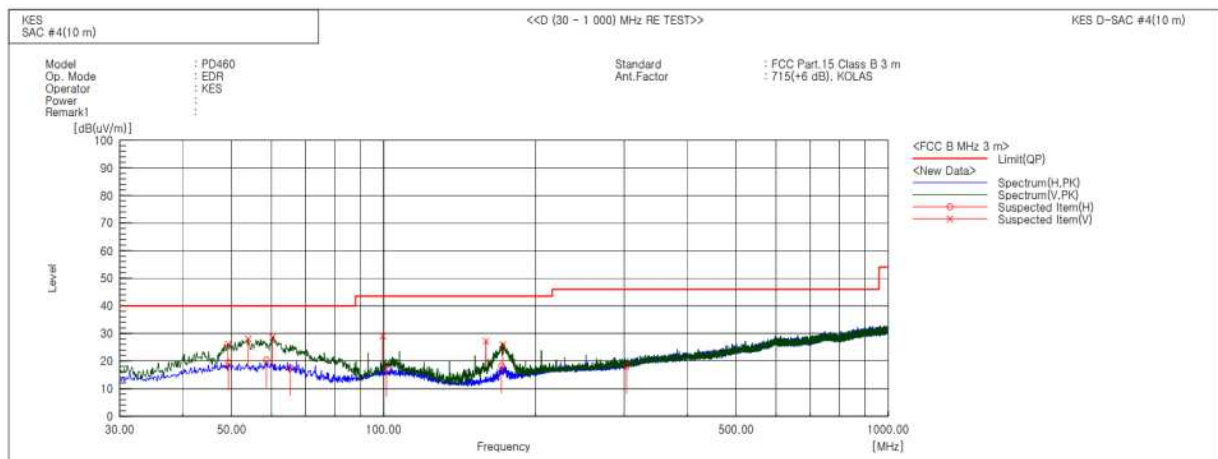




### Test results (Below 1 000 MHz) – Worst case

Mode: EDR  
Transfer rate: 3 Mbps  
Distance of measurement: 3 meter  
Channel: 78(Worst case)

#### Horizontal // Vertical



#### Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	49.279	H	41.3	-21.9	19.4	40.0	20.6	250.0	279.0	
2	58.615	H	43.1	-22.8	20.3	40.0	19.7	100.0	122.0	
3	65.284	H	41.7	-24.2	17.5	40.0	22.5	100.0	176.0	
4	101.416	H	40.2	-23.2	17.0	43.5	26.5	250.0	124.0	
5	171.256	H	43.6	-25.3	18.3	43.5	25.2	250.0	315.0	
6	303.298	H	38.0	-19.8	18.2	46.0	27.8	250.0	81.0	
7	49.158	V	48.1	-21.9	26.2	40.0	13.8	100.0	254.0	
8	53.886	V	50.2	-22.2	28.0	40.0	12.0	100.0	223.0	
9	60.191	V	51.6	-23.1	28.5	40.0	11.5	100.0	263.0	
10	99.719	V	52.2	-23.2	29.0	43.5	14.5	100.0	164.0	
11	159.495	V	53.2	-26.0	27.2	43.5	16.3	100.0	176.0	
12	172.348	V	51.2	-25.3	25.9	43.5	17.6	100.0	338.0	

This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.

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

The authenticity of the test report, contact shchoi@kes.co.kr



### Test results (Above 1 000 MHz)

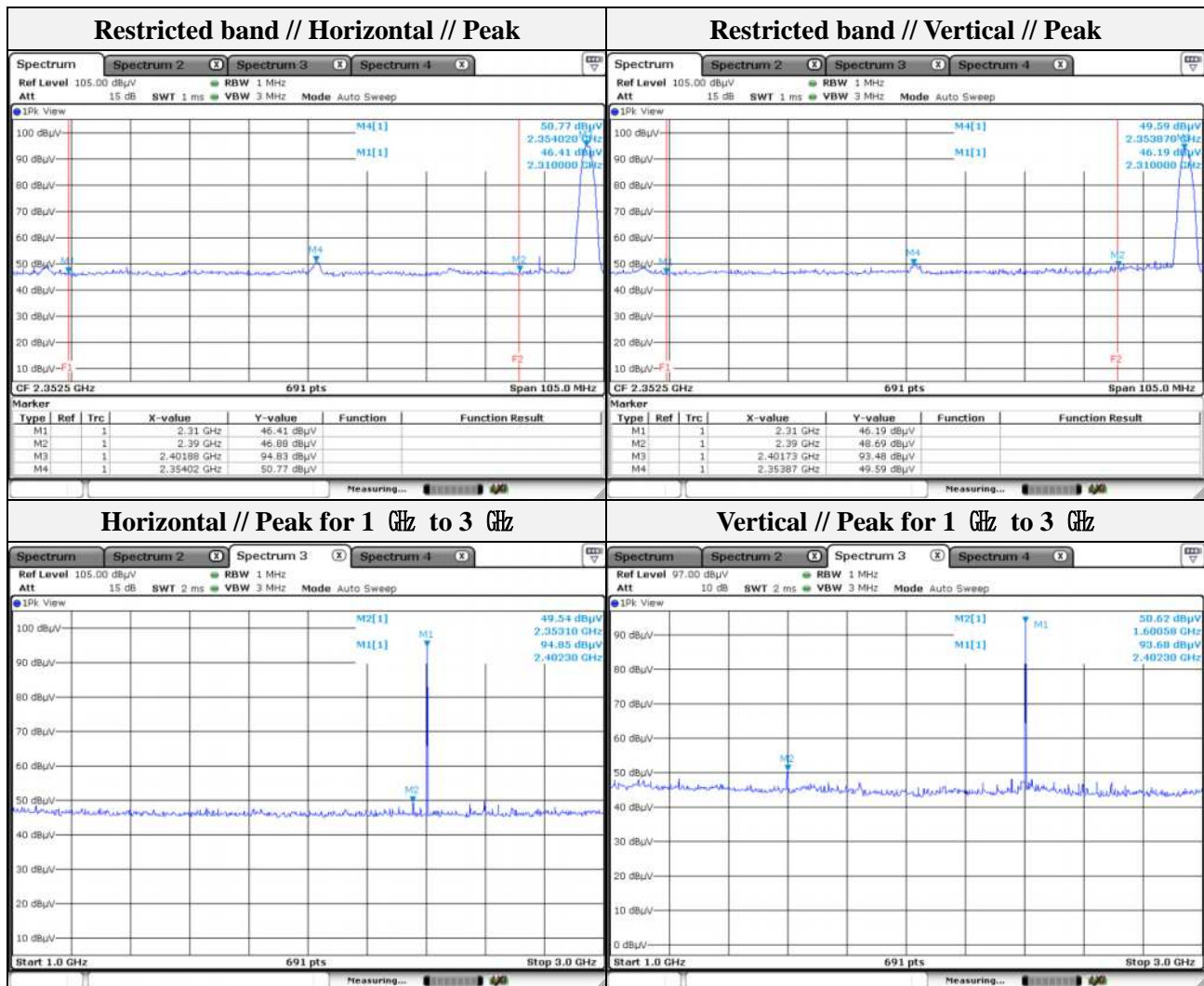
Mode: BDR  
Transfer rate: 1 Mbps  
Distance of measurement: 3 meter  
Channel: 00

#### - Spurious

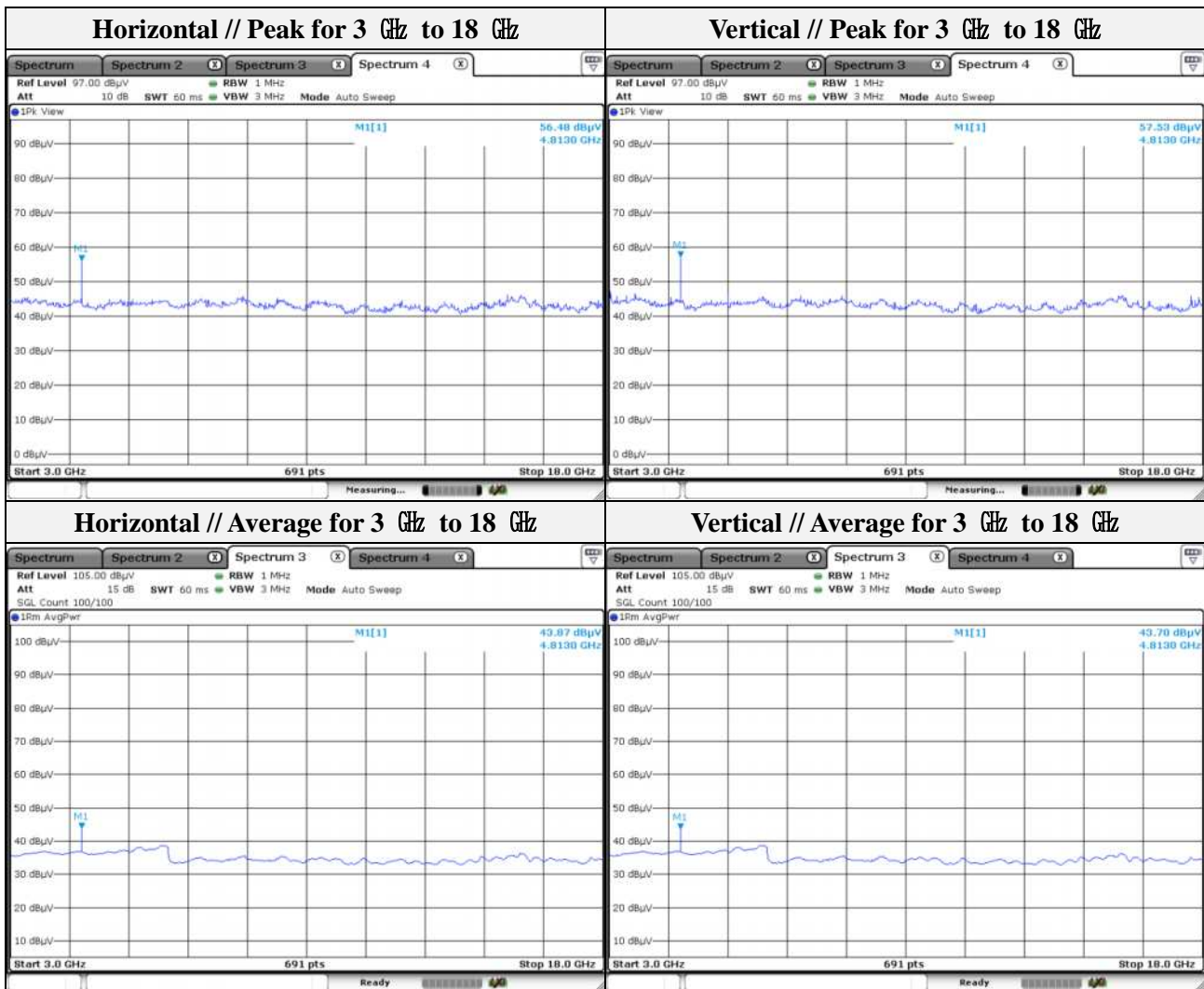
Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 353.10	49.54	Peak	H	-0.20	-	49.34	74.00	24.66
4 813.00	56.48	Peak	H	7.06	-	63.54	74.00	10.46
4 813.00	43.87	Average	H	7.06	-30.60	20.33	54.00	33.67
1 600.58	50.62	Peak	V	-4.75	-	45.87	74.00	28.13
4 813.00	57.53	Peak	V	7.06	-	64.59	74.00	9.41
4 813.00	43.70	Average	V	7.06	-30.60	20.16	54.00	33.84

#### - 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)
2 354.02	50.77	Peak	H	-0.20	-	50.57	74.00	23.43
2 353.87	49.59	Peak	V	-0.20	-	49.39	74.00	24.61







**Note.**

1. Average test would be performed if the peak result were greater than the average limit.

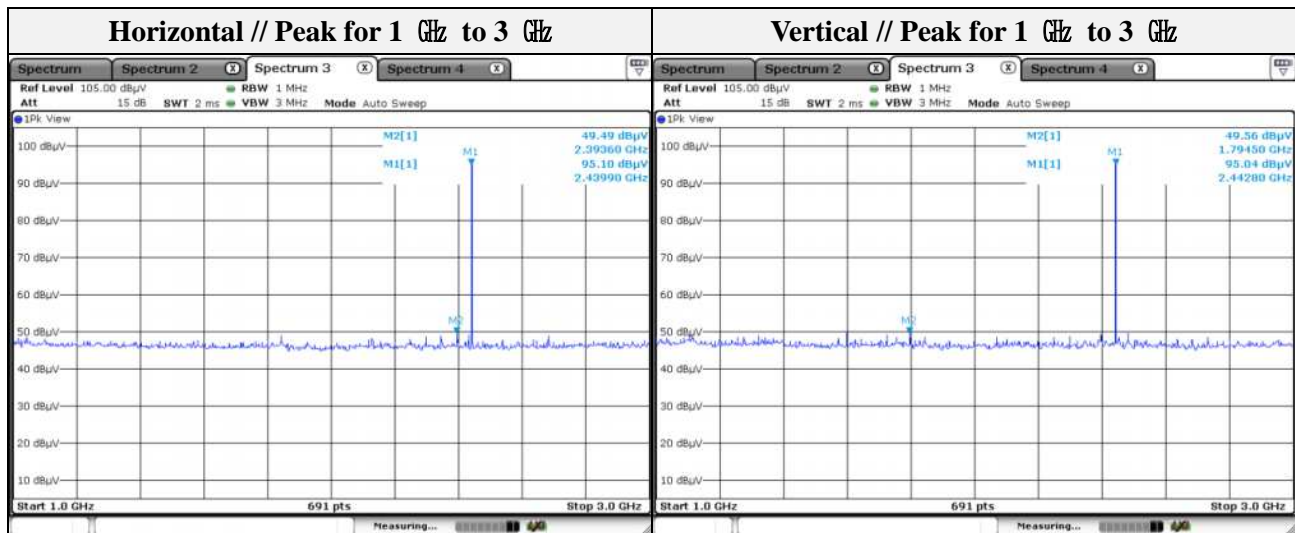
**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

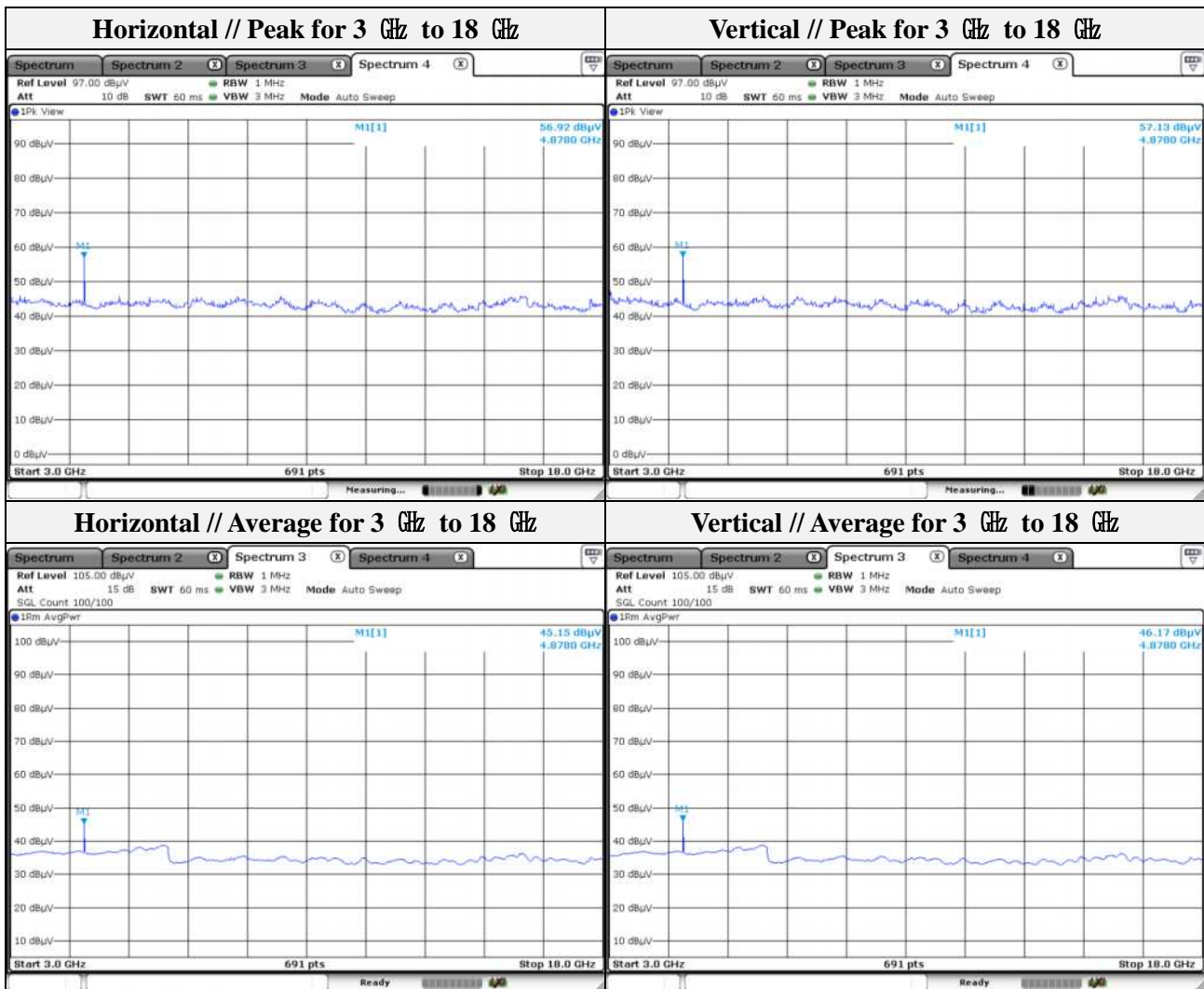
Report No.:  
KES-RF-20T0096  
Page (34 ) of (53)

Mode: BDR  
Transfer rate: 1 Mbps  
Distance of measurement: 3 meter  
Channel: 39

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 393.60	49.49	Peak	H	-0.13	-	49.36	74.00	24.64
4 878.00	56.92	Peak	H	7.54	-	64.46	74.00	9.54
4 878.00	45.15	Average	H	7.54	-30.60	22.09	54.00	31.91
1 794.50	49.56	Peak	V	-2.87	-	46.69	74.00	27.31
4 878.00	57.13	Peak	V	7.54	-	64.67	74.00	9.33
4 878.00	46.17	Average	V	7.54	-30.60	23.11	54.00	30.89



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr



**Note.**

1. Average test would be performed if the peak result were greater than the average limit.

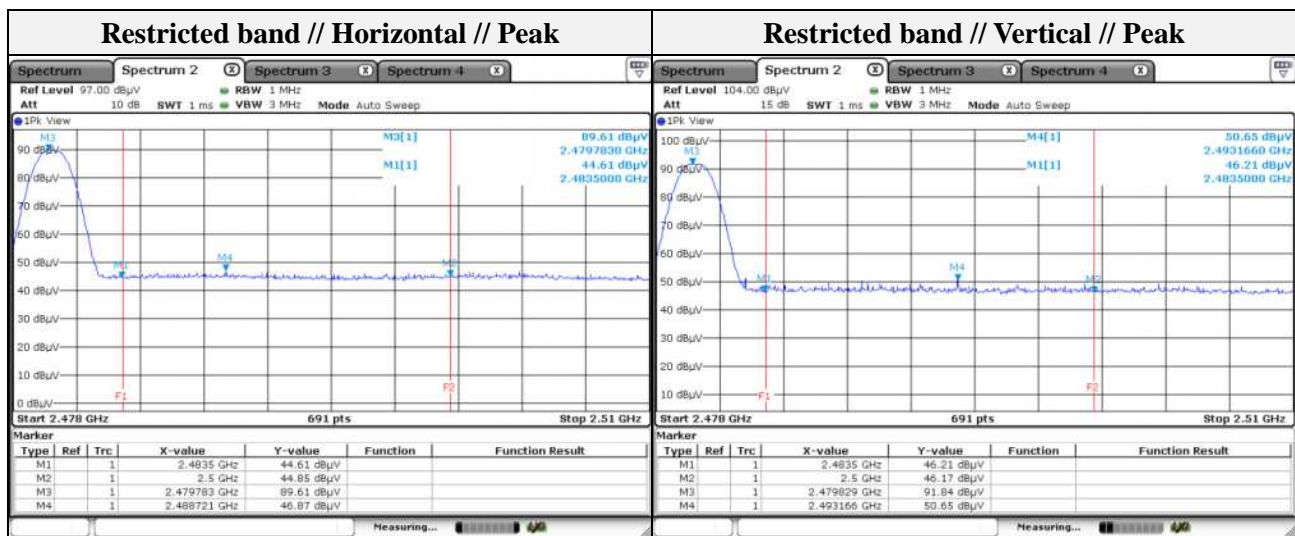
Mode:	BDR
Transfer rate:	1 Mbps
Distance of measurement:	3 meter
Channel:	78

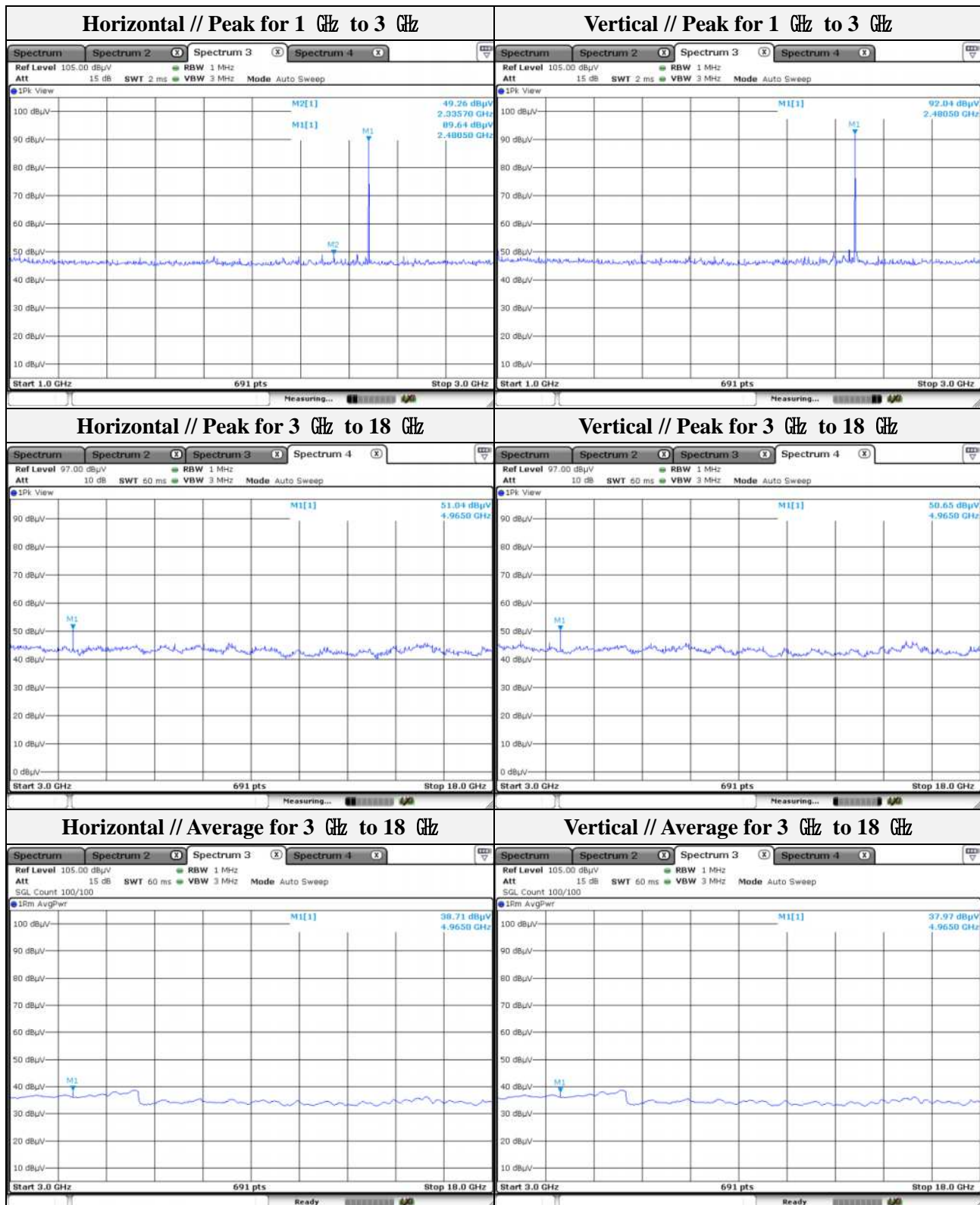
#### - Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 335.70	49.26	Peak	H	-0.24	-	49.02	74.00	24.98
4 965.00	51.04	Peak	H	8.18	-	59.22	74.00	14.78
4 965.00	38.71	Average	H	8.18	-30.60	16.29	54.00	37.71
4 965.00	50.65	Peak	V	8.18	-	58.83	74.00	15.17
4 965.00	37.97	Average	V	8.18	-30.60	15.55	54.00	38.45

#### - 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)
2 488.72	46.87	Peak	H	0.08	-	46.95	74.00	27.05
2 493.17	50.65	Peak	V	0.09	-	50.74	74.00	23.26





**Note.**

1. Average test would be performed if the peak result were greater than the average limit.



**KES Co., Ltd.**

3701, 40, Simin-daero 365beon-gil,  
Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  
Tel: +82-31-425-6200 / Fax: +82-31-424-0450  
www.kes.co.kr

Report No.:

KES-RF-20T0096

Page (38 ) of (53)

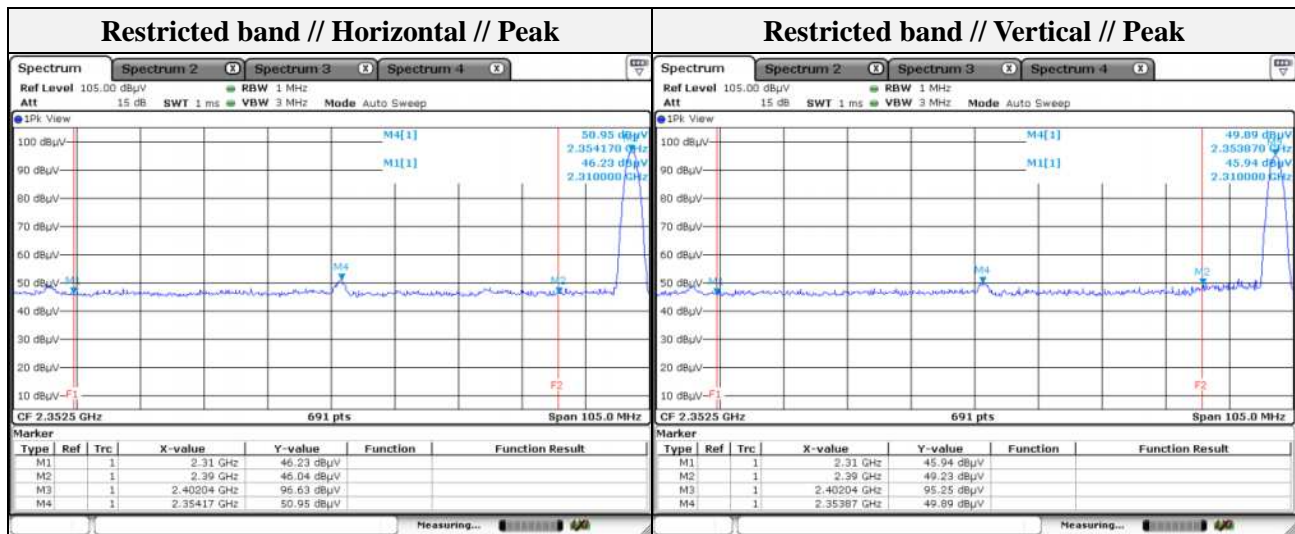
Mode:	EDR
Transfer rate:	3 Mbps(Worst case)
Distance of measurement:	3 meter
Channel:	00

**- Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 353.10	50.34	Peak	H	-0.20	-	50.14	74.00	23.86
4 813.00	58.29	Peak	H	7.06	-	65.35	74.00	8.65
4 813.00	43.25	Average	H	7.06	-30.60	19.71	54.00	34.29
4 813.00	58.87	Peak	V	7.06	-	65.93	74.00	8.07
4 813.00	43.26	Average	V	7.06	-30.60	19.72	54.00	34.28

**- Band edge**

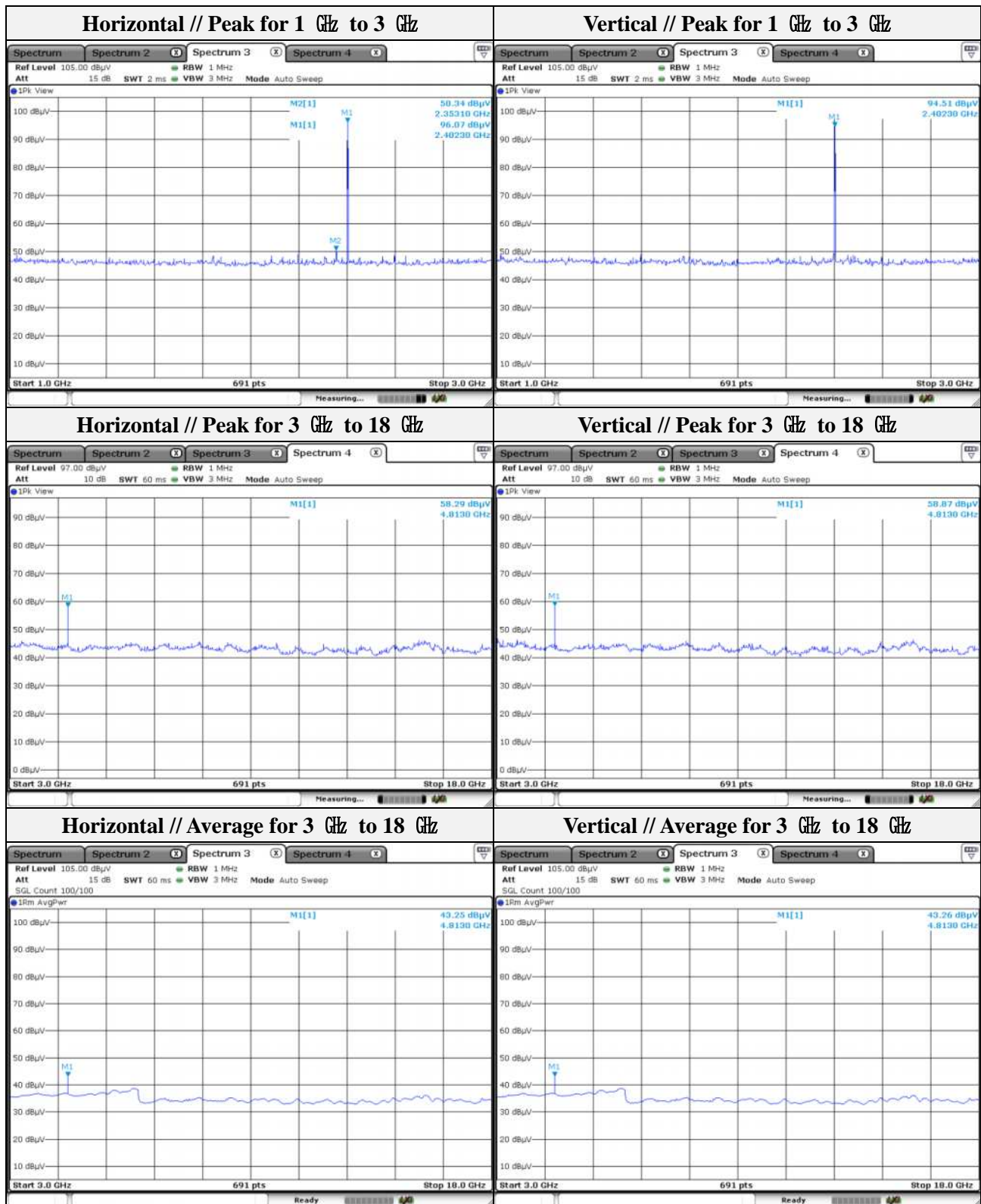
Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 354.17	50.95	Peak	H	-0.20	-	50.75	74.00	23.25
2 353.87	49.89	Peak	V	-0.20	-	49.69	74.00	24.31



This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.

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

The authenticity of the test report, contact shchoi@kes.co.kr



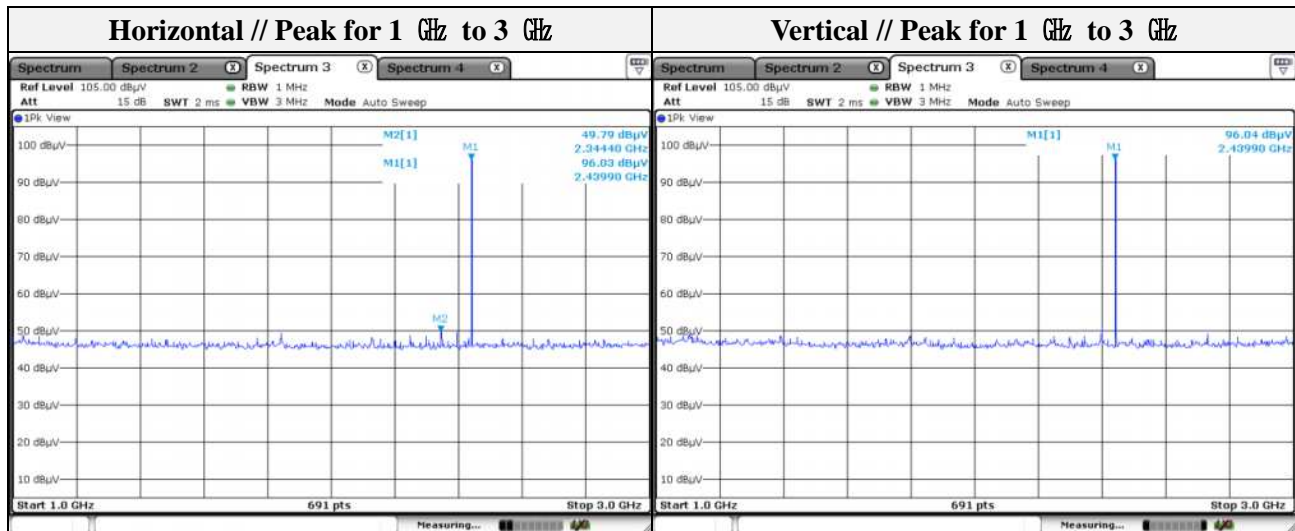
**Note.**

1. Average test would be performed if the peak result were greater than the average limit.

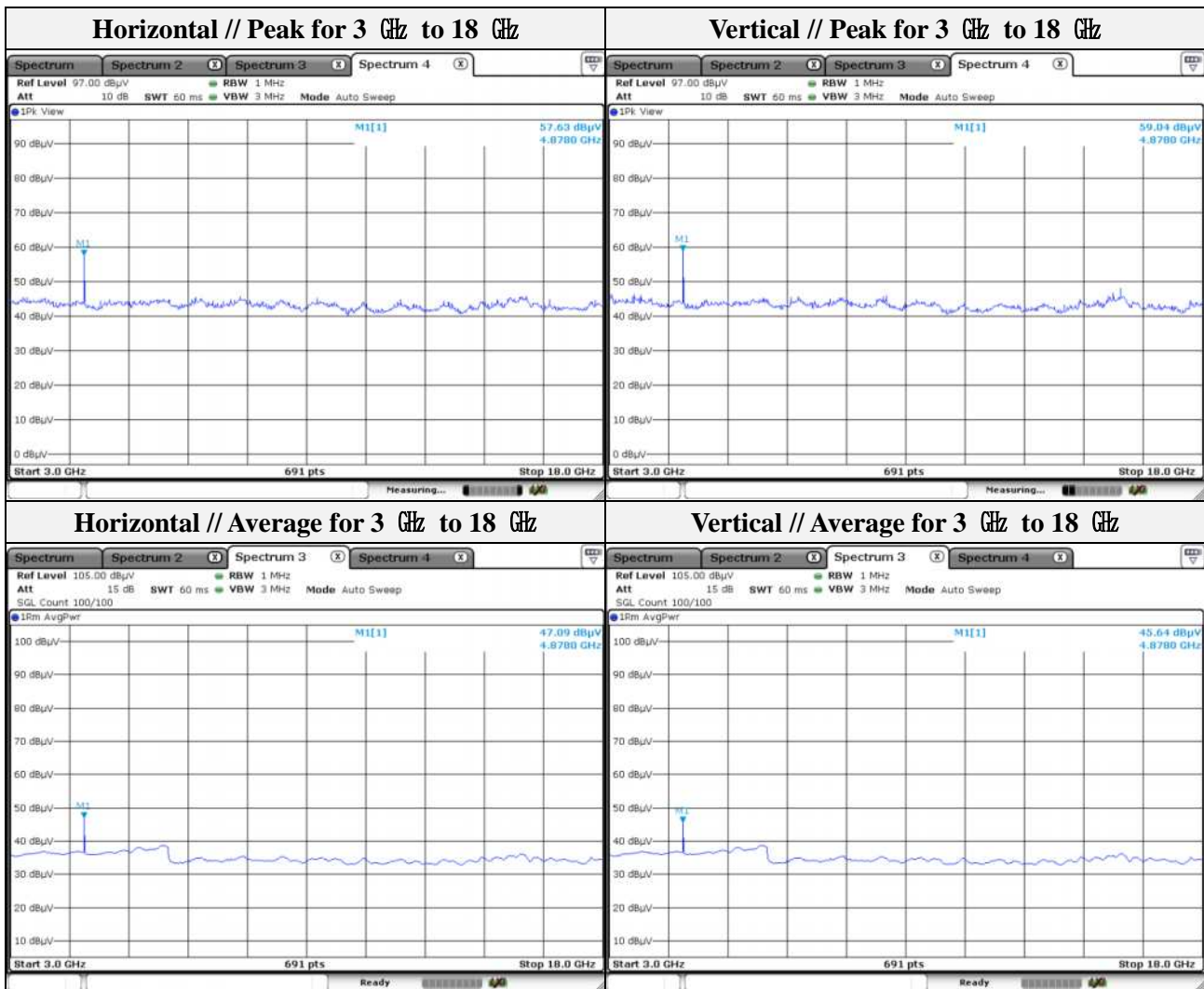
Mode: EDR  
Transfer rate: 3 Mbps(Worst case)  
Distance of measurement: 3 meter  
Channel: 39

- Spurious

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 344.40	49.79	Peak	H	-0.22	-	49.57	74.00	24.43
4 878.00	57.63	Peak	H	7.54	-	65.17	74.00	8.83
4 878.00	47.09	Average	H	7.54	-30.60	24.03	54.00	29.97
4 878.00	59.04	Peak	V	7.54	-	66.58	74.00	7.42
4 878.00	45.64	Average	V	7.54	-30.60	22.58	54.00	31.42







**Note.**

1. Average test would be performed if the peak result were greater than the average limit.

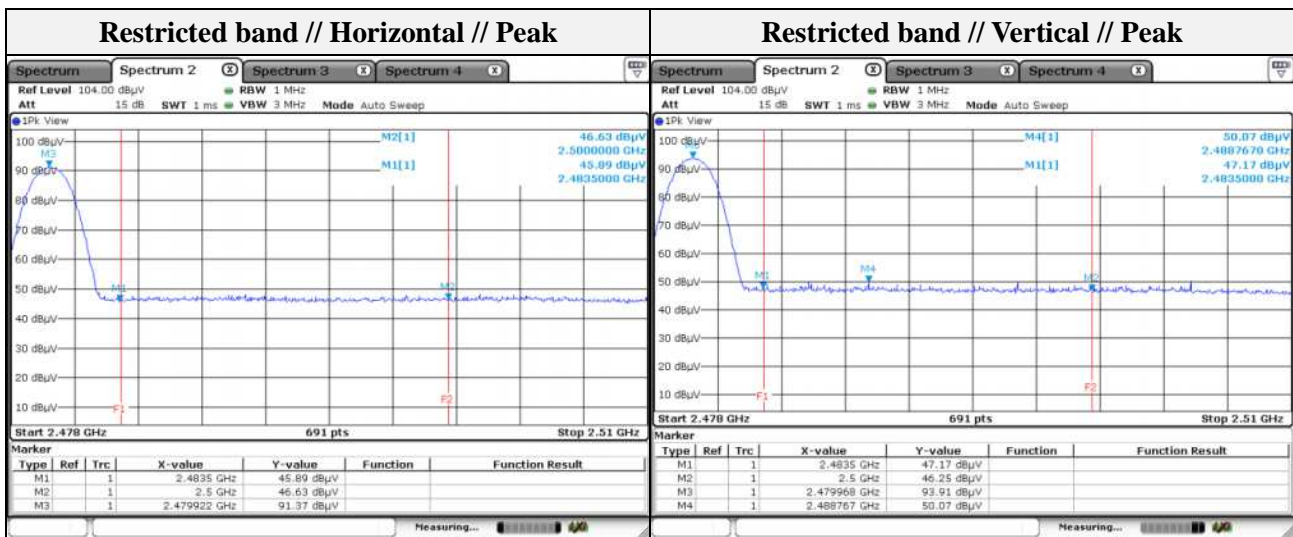
Mode:	EDR
Transfer rate:	3 Mbps(Worst case)
Distance of measurement:	3 meter
Channel:	78

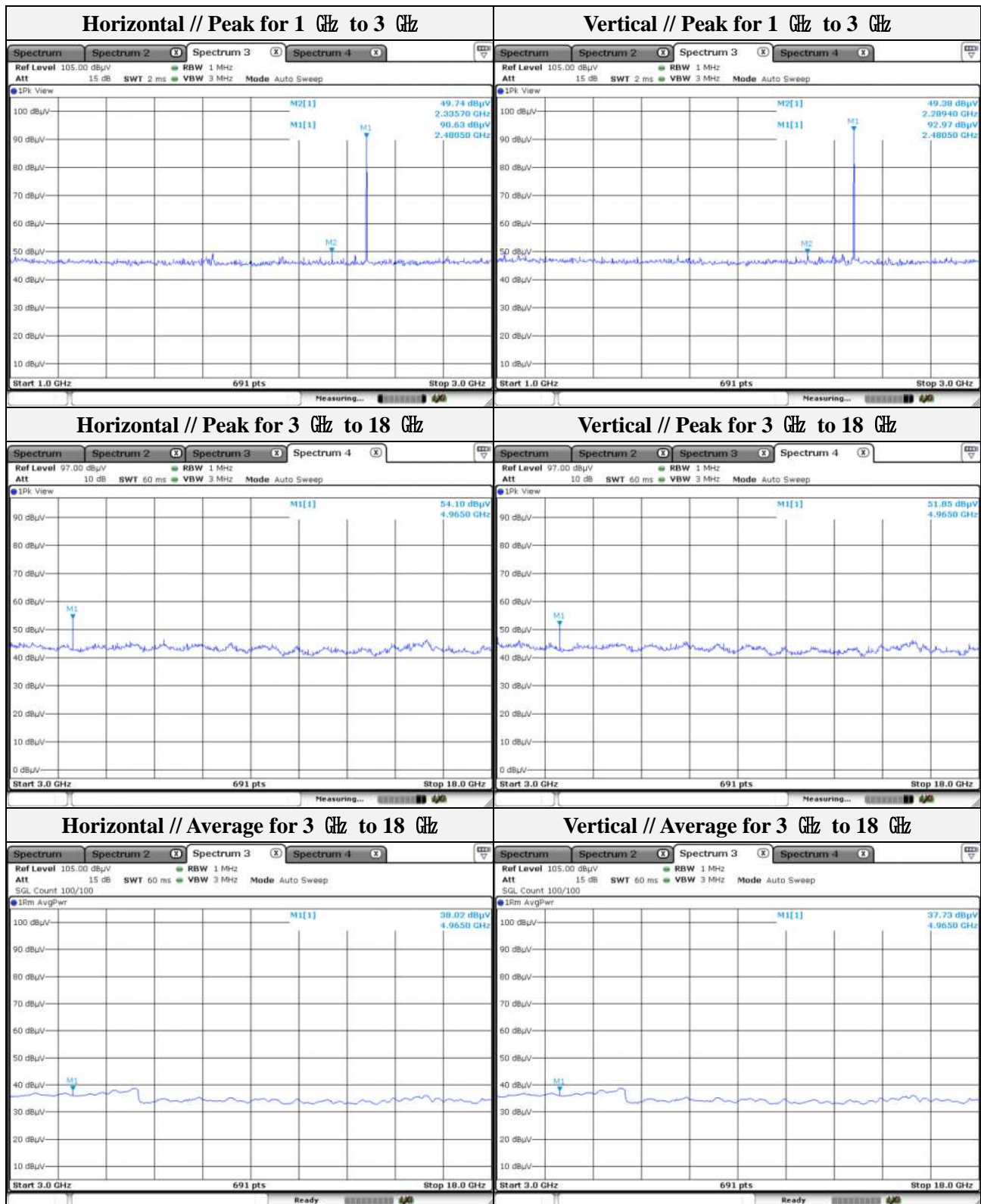
**- Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 335.70	49.74	Peak	H	-0.24	-	49.50	74.00	24.50
4 965.00	54.10	Peak	H	8.18	-	62.28	74.00	11.72
4 965.00	38.02	Average	H	8.18	-30.60	15.60	54.00	38.40
2 289.40	49.38	Peak	V	-0.33	-	49.05	74.00	24.95
4 965.00	51.85	Peak	V	8.18	-	60.03	74.00	13.97
4 954.00	37.73	Average	V	8.10	-30.60	15.31	54.00	38.69

**- 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)
2 488.77	50.07	Peak	V	0.08	-	50.15	74.00	23.85



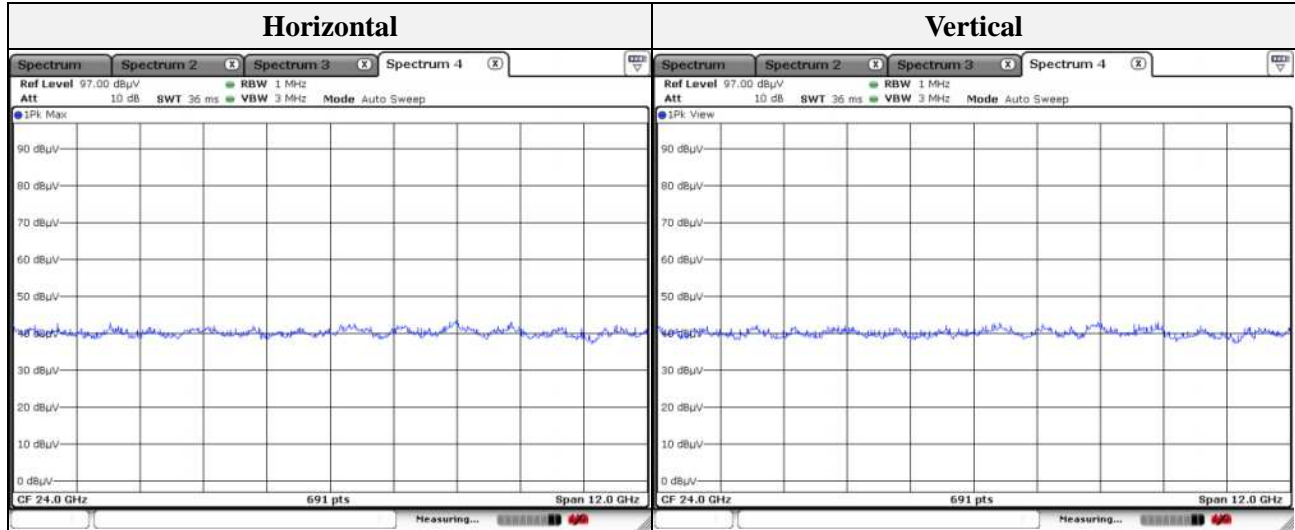


**Note.**

1. 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: BDR  
 Transfer rate: 1 Mbps  
 Distance of measurement: 3 meter  
 Channel: 78(Worst case)



### Note.

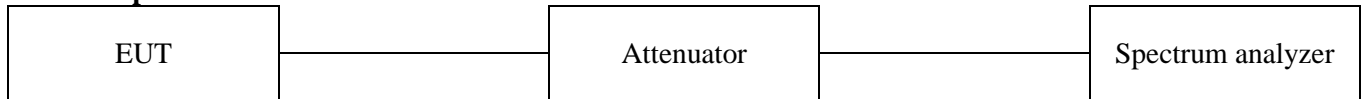
1. No spurious emission were detected above 18 GHz.

### 3.7. Conducted band edge and out of band emissions

#### Test procedure

ANSI C63.10-2013 - Section 7.8.4 and 7.8.8

#### Test setup



#### Test setting

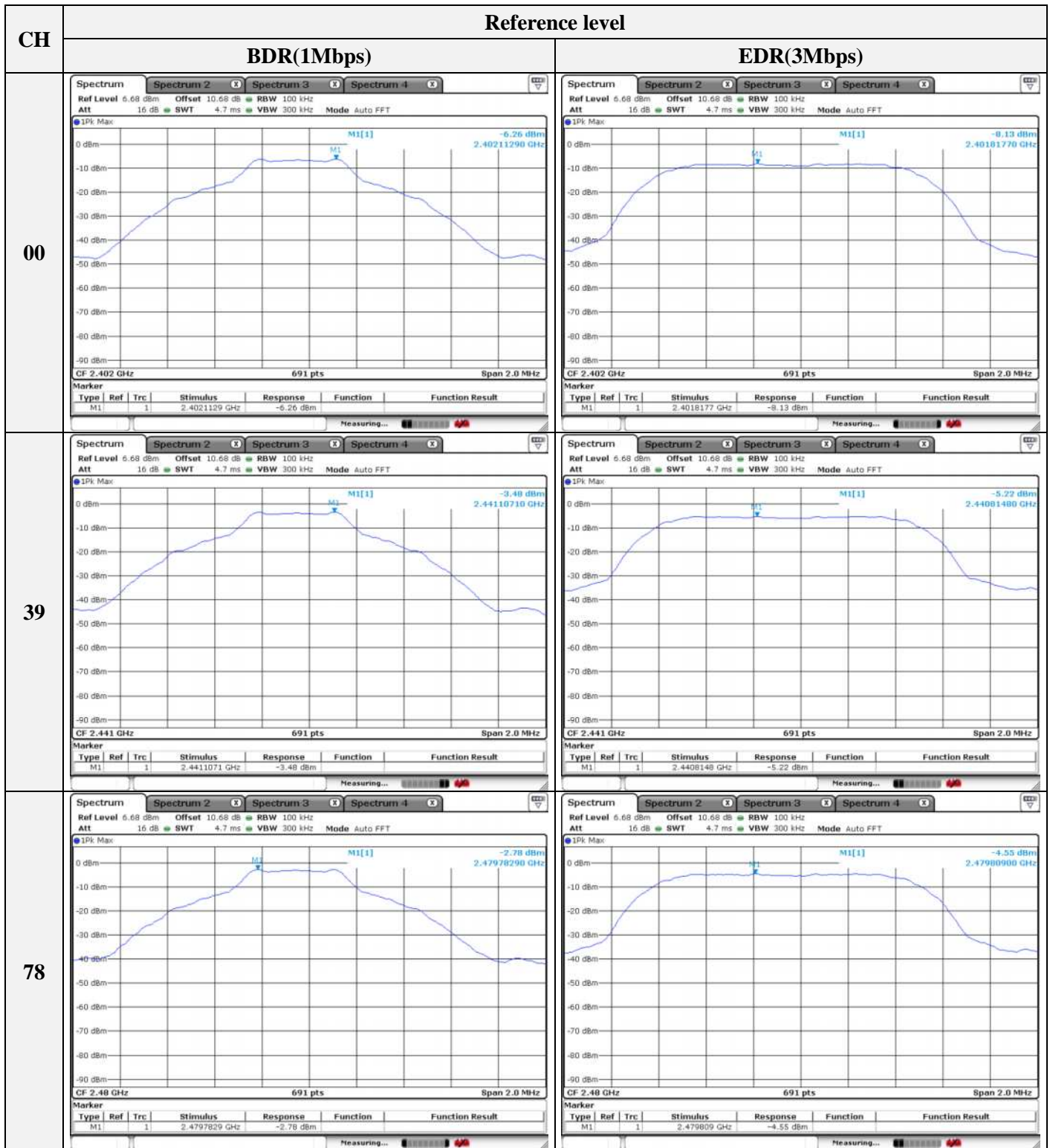
1. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions(e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
2. RBW = 100 kHz
3. VBW  $\geq$  300 kHz
4. Detector = Peak
5. Number of sweep points  $\geq 2 \times \text{Span/RBW}$
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

#### Limit

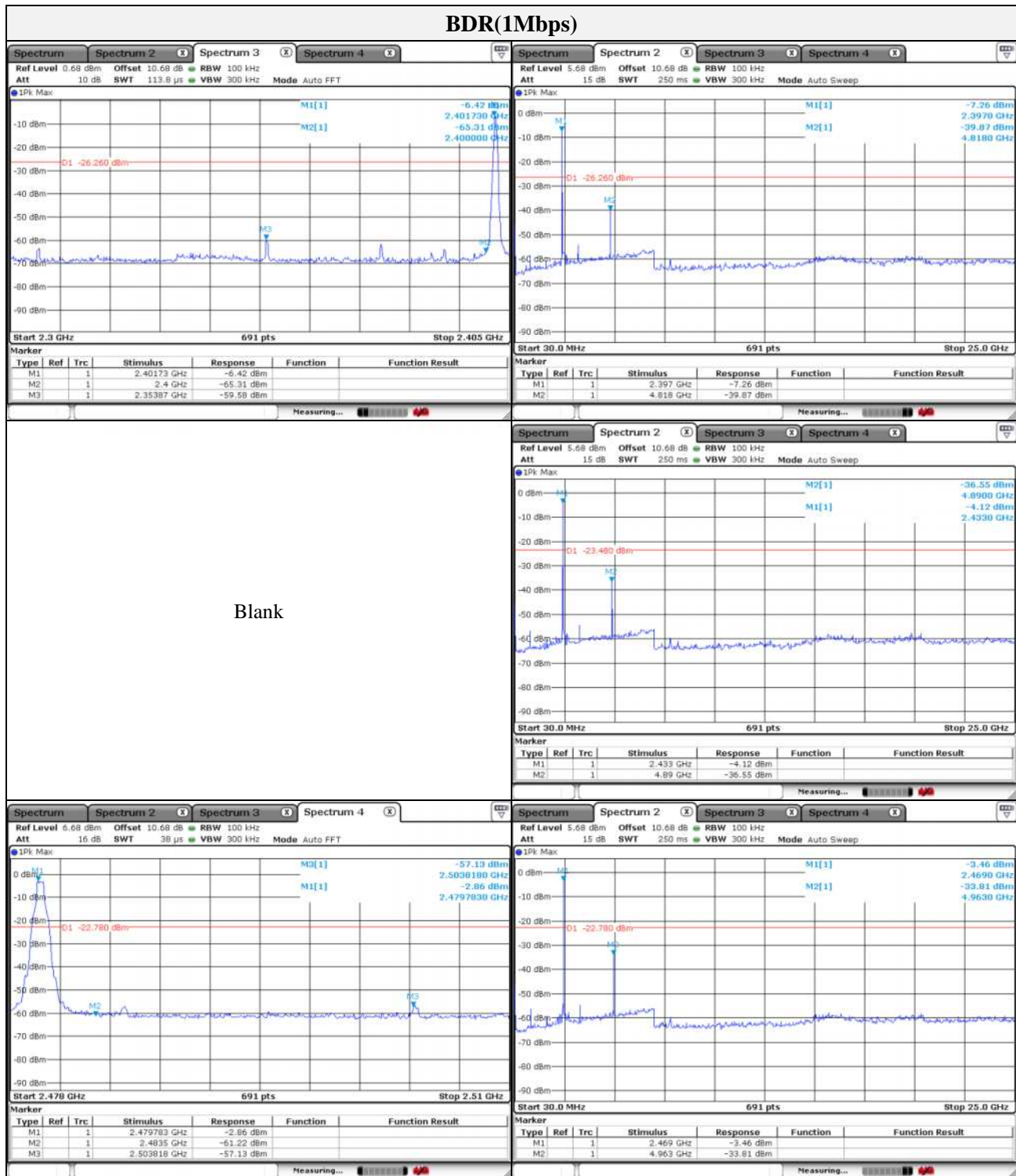
According to 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within 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))

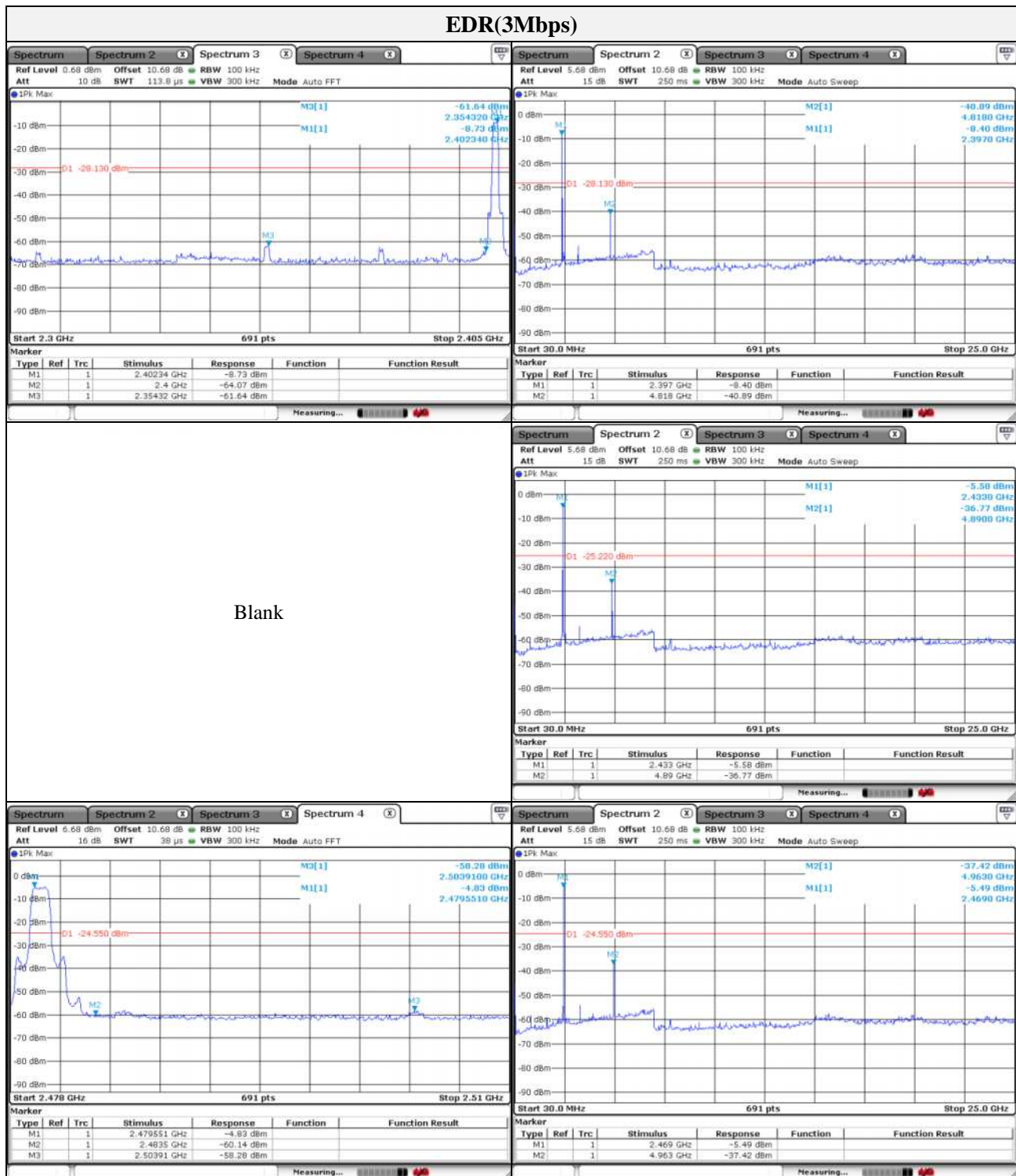


## Test results



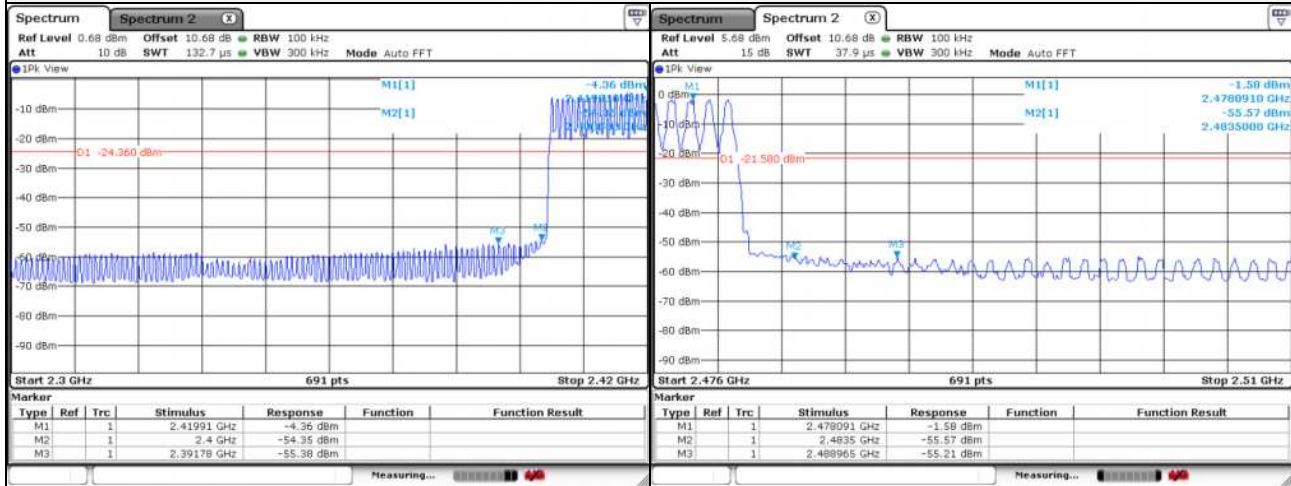
This report shall not be reproduced except in full, without the written approval of KES Co., Ltd.  
The results shown in this test report refer only to the sample(s) tested unless otherwise stated.  
The authenticity of the test report, contact shchoi@kes.co.kr



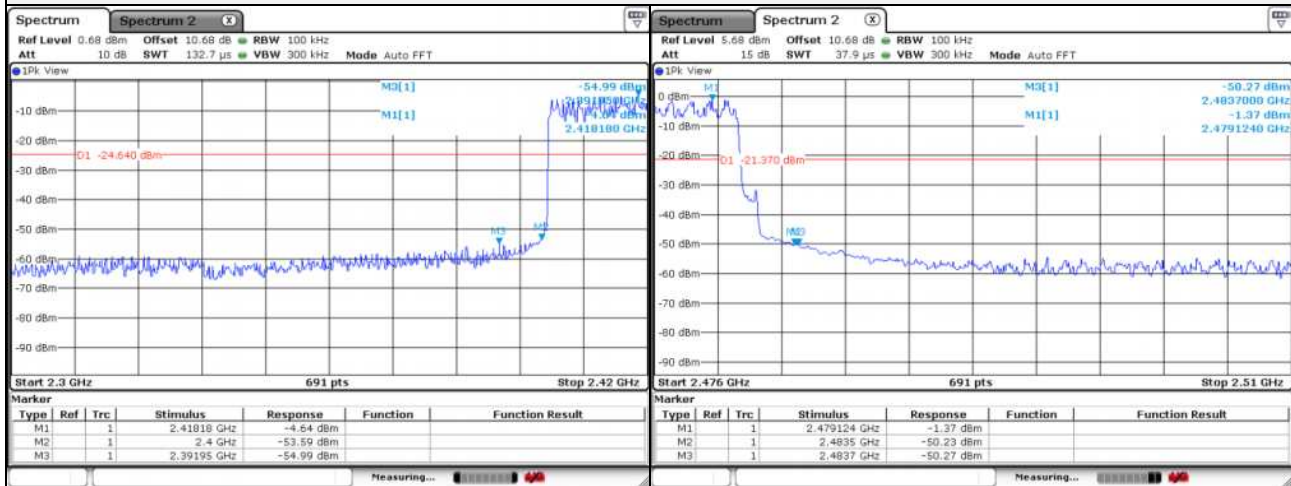




### Hopping mode\_BDR(1Mbps)

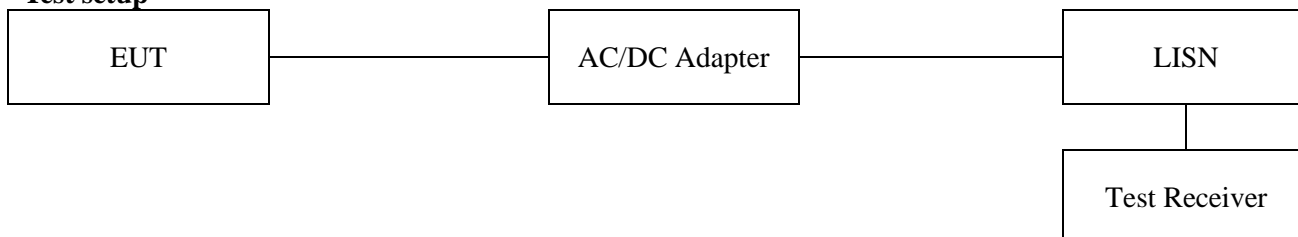


### Hopping mode\_EDR(3Mbps)



### 3.8. AC conducted emissions

#### Test setup



#### 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.

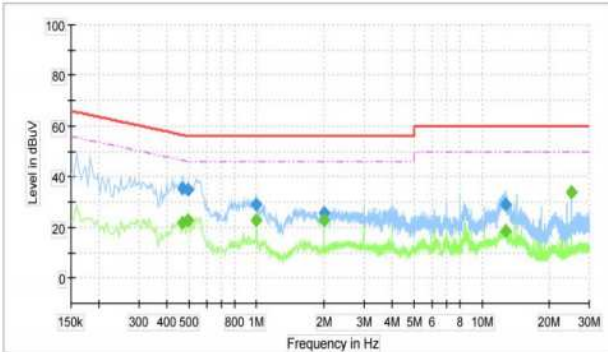
Frequency of Emission (MHz)	Conducted limit (dBμV/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

#### Note:

1. All AC line conducted spurious emission are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and the appropriate frequencies. All data rates and modes were investigated for conducted spurious emission. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.
3. Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).

## Test results

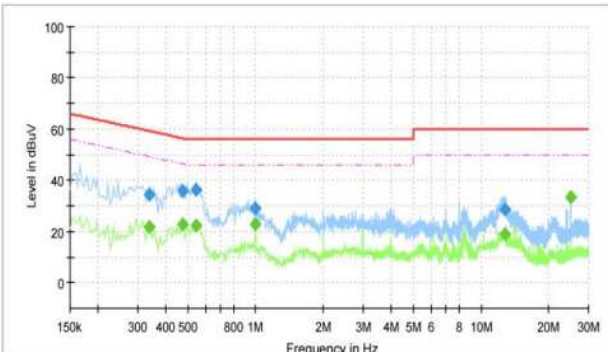
Hot Line



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	Average (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.470000	35.57	---	56.51	20.94	1000.0	9.000	L1	19.7
0.470000	---	21.98	46.51	24.53	1000.0	9.000	L1	19.7
0.494000	34.71	---	56.10	21.39	1000.0	9.000	L1	19.7
0.494000	---	22.96	46.10	23.14	1000.0	9.000	L1	19.7
0.994000	29.32	---	56.00	26.68	1000.0	9.000	L1	19.7
0.994000	---	22.83	46.00	23.17	1000.0	9.000	L1	19.7
1.990000	25.47	---	56.00	30.53	1000.0	9.000	L1	19.8
1.990000	---	22.70	46.00	23.30	1000.0	9.000	L1	19.8
12.738000	28.97	---	60.00	31.03	1000.0	9.000	L1	20.5
12.738000	---	18.70	50.00	31.30	1000.0	9.000	L1	20.5
24.998000	---	33.89	50.00	16.11	1000.0	9.000	L1	21.2
24.998000	34.01	---	60.00	25.99	1000.0	9.000	L1	21.2

Neutral Line



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	Average (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.338000	34.25	---	59.25	25.00	1000.0	9.000	N	19.7
0.338000	---	21.93	49.25	27.32	1000.0	9.000	N	19.7
0.474000	---	23.03	46.44	23.41	1000.0	9.000	N	19.7
0.474000	36.06	---	56.44	20.38	1000.0	9.000	N	19.7
0.542000	---	22.26	46.00	23.74	1000.0	9.000	N	19.7
0.542000	36.36	---	56.00	19.64	1000.0	9.000	N	19.7
0.994000	28.99	---	56.00	27.01	1000.0	9.000	N	19.7
0.994000	---	22.95	46.00	23.05	1000.0	9.000	N	19.7
12.738000	28.53	---	60.00	31.47	1000.0	9.000	N	20.6
12.738000	---	18.73	50.00	31.27	1000.0	9.000	N	20.6
24.998000	33.62	---	60.00	26.38	1000.0	9.000	N	21.3
24.998000	---	33.49	50.00	16.51	1000.0	9.000	N	21.3

### Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV40	101002	1 year	2020.06.24
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2021.01.15
AC POWER SOURCE ANALYZER	HP	6813A	3729A00754	1 year	2021.01.15
Power Meter	Anritsu	ML2495A	1438001	1 year	2021.01.14
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2021.01.14
Attenuator	KEYSIGHT	8493C	82506	1 year	2021.01.14
Loop Antenna	Schwarzbeck	FMZB1513	225	2 years	2021.02.15
Trilog-broadband antenna	SCHWARZBECK	VULB 9163	715	2 years	2020.09.20
Horn Antenna	A.H	SAS-571	414	2 years	2021.02.11
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA 9170550	2 years	2021.02.19
Preamplifier	R&S	SCU01	100603	1 year	2020.11.25
Preamplifier	AGILENT	8449B	3008A01742	1 year	2021.01.02
EMI Test Receiver	R&S	ESU26	100551	1 year	2021.04.01
EMI TEST RECEIVER	R & S	ESR3	101781	1 year	2021.01.10

### Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook computer	LG Electronics Inc.,	LGS53	306QCZP560949