

FCC Test Report

FCC ID : 2ACAHAC01
Equipment : AudioClip
Model No. : AC1A, AC1B
(Please refer to section 1.1.1 for more details)
Applicant : SBO Hearing A/S
Address : Kongebakken 9 DK-2765 Smørum, Denmark
Standard : 47 CFR FCC Part 15.247
Received Date : Sep. 04, 2017
Tested Date : Sep. 07 ~ Sep. 18, 2017

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:



Along Chen / Assistant Manager

Approved by:



Gary Chang / Manager



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Release Record

Report No.	Version	Description	Issued Date
FR790403AC-1	Rev. 01	Initial issue	Oct. 16, 2017
FR790403AC-1	Rev. 02	Modified frequency of section 1.1.6	Oct. 25, 2017

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV]: 0.564MHz 33.22 (Margin -12.78dB) - AV	Pass
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 2483.50MHz 44.67 (Margin -9.33dB) - AV	Pass
15.247(d)	Band Edge	Meet the requirement of limit	Pass
15.247(b)(1)	Conducted Output Power	Power [dBm]: 10.74	Pass
15.247(a)(1)(iii)	Number of Hopping Channels	Meet the requirement of limit	Pass
15.247(a)(1)	Hopping Channel Separation	Meet the requirement of limit	Pass
15.247(a)(1)(iii)	Dwell Time	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

1 General Description

1.1 Information

1.1.1 Product Details

The following models are provided to this EUT.

Model Name	Product Name	Description
AC1A	AudioClip	For different housing design.
AC1B		

1.1.2 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	Modulation Mode	Ch. Frequency (MHz)	Channel Number	Data Rate
2400-2483.5	FHSS	2404-2476	0-35 [36]	2 Mbps
Note 1: Modulation is 2FSK. Note 2: HW version: 8 / SW version: Luna1.1.0				

1.1.3 Antenna Details

Ant. No.	Type	Gain (dBi)	Connector	Remark
1	Inverted-F	5.8	---	---

1.1.4 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	5Vdc from adapter 5Vdc from host 3.7Vec from battery
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1.1.5 Accessories

Accessories		
No.	Equipment	Description
1	AC adapter	Brand: PHIHONG Model: AM05A-050A Power Rating: I/P: 100-240Vac, 50/60Hz, 0.2A O/P: 5Vdc, 1A Power Line: 1.8m non-shielded cable without core
2	Battery	Brand: SYNERGY Model: AHB451730PC Power Rating: Rating: 3.7Vdc, 200mAh
3	USB cable	1m shielded cable without core

1.1.6 Channel List

Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2404	9	2422	18	2442	27	2460
1	2406	10	2424	19	2444	28	2462
2	2408	11	2428	20	2446	29	2464
3	2410	12	2430	21	2448	30	2466
4	2412	13	2432	22	2450	31	2468
5	2414	14	2434	23	2452	32	2470
6	2416	15	2436	24	2454	33	2472
7	2418	16	2438	25	2456	34	2474
8	2420	17	2440	26	2458	35	2476

1.1.7 Test Tool and Duty Cycle

Test Tool	NebulaDeveloper, Version: 3.2.0.0
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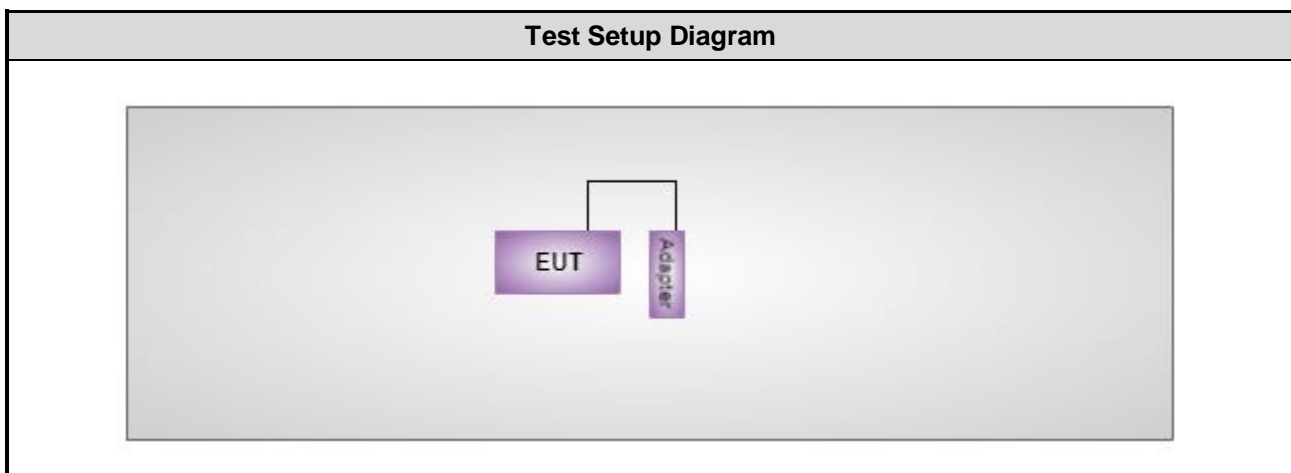
1.1.8 Power Setting

Modulation Mode	Test Frequency (MHz)		
	2404	2440	2476
FHSS/2Mbps	Default	Default	Default

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Signal cable / Length (m)
1	Notebook	DELL	Latitude E6430	DoC	---

1.3 Test Setup Chart



Note: The support notebook was disconnected from EUT and removed from test table when EUT is set to transmit continuously.

1.4 The Equipment List

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101657	Dec. 21, 2016	Dec. 20, 2017
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 08, 2016	Nov. 07, 2017
RF Cable-CON	EMC	EMCCFD300-BM-B M-6000	50821	Dec. 20, 2016	Dec. 19, 2017
Measurement Software	AUDIX	e3	6.120210k	NA	NA

Note: Calibration Interval of instruments listed above is one year.

Test Item	Radiated Emission				
Test Site	966 chamber 3 / (03CH03-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	ROHDE&SCHWARZ	FSV40	101486	Nov. 15, 2016	Nov. 14, 2017
Receiver	Agilent	N9038A	MY53290044	Oct. 06, 2016	Oct. 05, 2017
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-685	Apr. 28, 2017	Apr. 27, 2018
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1206	Feb. 09, 2017	Feb. 08, 2018
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Oct. 25, 2016	Oct. 24, 2017
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 10, 2016	Nov. 09, 2017
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Dec. 09, 2016	Dec. 08, 2017
Preamplifier	EMC	EMC02325	980187	Sep. 04, 2017	Sep. 03, 2018
Preamplifier	Agilent	83017A	MY53270014	Aug. 21, 2017	Aug. 20, 2018
Preamplifier	EMC	EMC184045B	980192	Aug. 22, 2017	Aug. 21, 2018
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22620/4	Feb. 04, 2017	Feb. 03, 2018
RF cable-8M	HUBER+SUHNER	SUCOFLEX104	MY22600/4	Feb. 04, 2017	Feb. 03, 2018
RF cable-1M	HUBER+SUHNER	SUCOFLEX104	MY22624/4	Feb. 04, 2017	Feb. 03, 2018
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800 -001	Feb. 04, 2017	Feb. 03, 2018
LF cable-3M	EMC	EMC8D-NM-NM-300 0	131103	Feb. 04, 2017	Feb. 03, 2018
LF cable-13M	EMC	EMC8D-NM-NM-130 00	131104	Feb. 04, 2017	Feb. 03, 2018
Measurement Software	AUDIX	e3	6.120210g	NA	NA

Note: Calibration Interval of instruments listed above is one year.

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101063	Mar. 15, 2017	Mar. 14, 2018
Power Meter	Anritsu	ML2495A	1241002	Oct. 06, 2016	Oct. 05, 2017
Power Sensor	Anritsu	MA2411B	1207366	Oct. 06, 2016	Oct. 05, 2017
DC POWER SOURCE	GW INSTRUK	GPC-6030D	EM892433	Oct. 20, 2016	Oct. 19, 2017
AC POWER SOURCE	APC	AFC-500W	F312060012	Oct. 28, 2016	Oct. 27, 2017
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247

ANSI C63.10-2013

1.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor ($k=2$))

Measurement Uncertainty	
Parameters	Uncertainty
Bandwidth	± 34.134 Hz
Conducted power	± 0.808 dB
Power density	± 0.463 dB
Conducted emission	± 2.670 dB
AC conducted emission	± 2.90 dB
Radiated emission ≤ 1 GHz	± 3.66 dB
Radiated emission > 1 GHz	± 5.37 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	23°C / 57%	Alex Huang
Radiated Emissions	03CH03-WS	24-25°C / 64-65%	Aska Huang Brand Wu
RF Conducted	TH01-WS	25°C / 65%	Felix Sung

- FCC Designation No.: TW0009
- FCC site registration No.: 207696
- IC site registration No.: 10807C-1

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate (Mbps)	Test Configuration
Conducted Emissions	FHSS	2476	2Mbps	---
Radiated Emissions ≤ 1GHz	FHSS	2476	2Mbps	---
Radiated Emissions > 1GHz	FHSS	2404, 2440, 2476	2Mbps	---
Conducted Output Power	FHSS	2404, 2440, 2476	2Mbps	---
Number of Hopping Channels	FHSS	2404~2476	2Mbps	---
Hopping Channel Separation 20dB and Occupied bandwidth	FHSS	2404, 2440, 2476	2Mbps	---
Dwell Time	FHSS	2440	2Mbps	---

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Z-plane** results were found as the worst case and were shown in this report.
2. S/N of test samples are as below
000016098300J2305570011
000016098300J2305570023
000016098300J2304263002
3. Two models AC1A and AC1B had been covered during the pretest. The worst model is **AC1B**, and only its data was record in this test report.

3 Transmitter Test Results

3.1 Conducted Emissions

3.1.1 Limit of Conducted Emissions

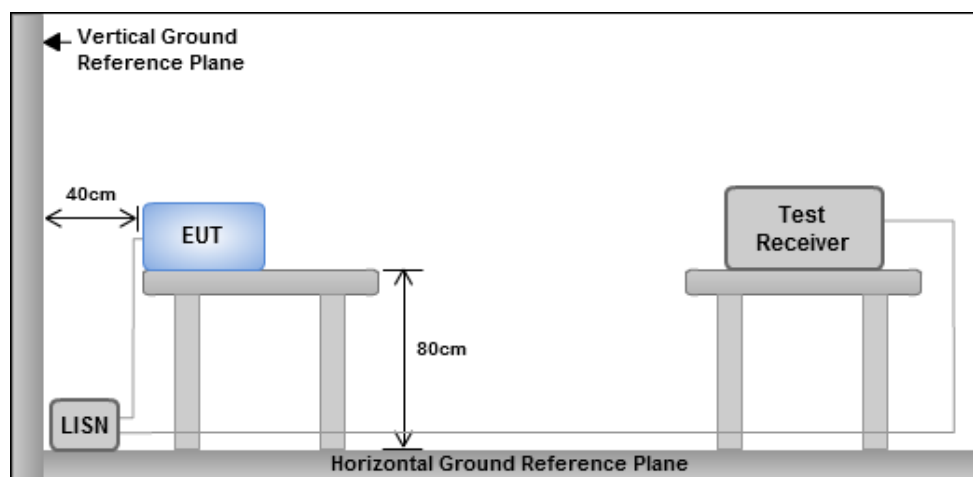
Conducted Emissions Limit		
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: * Decreases with the logarithm of the frequency.

3.1.2 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V/60Hz

3.1.3 Test Setup

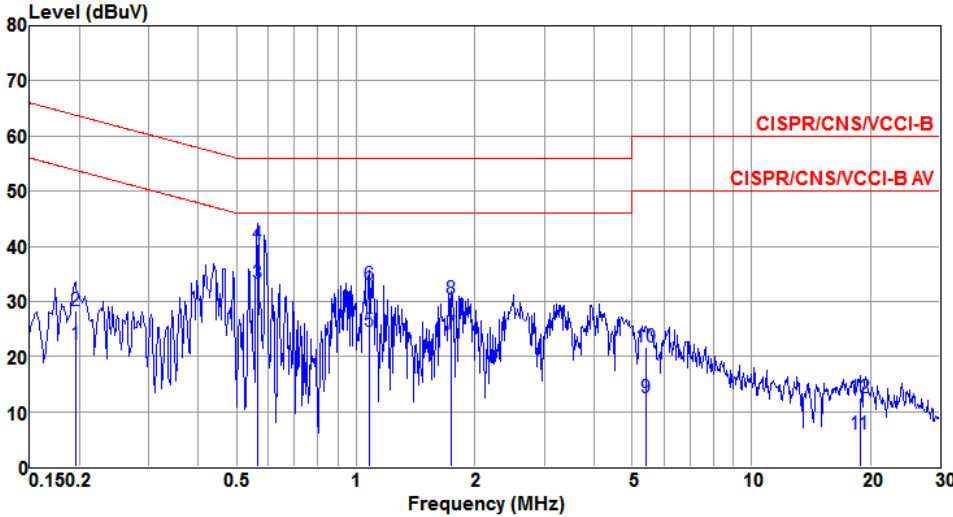


Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.1.4 Test Result of Conducted Emissions

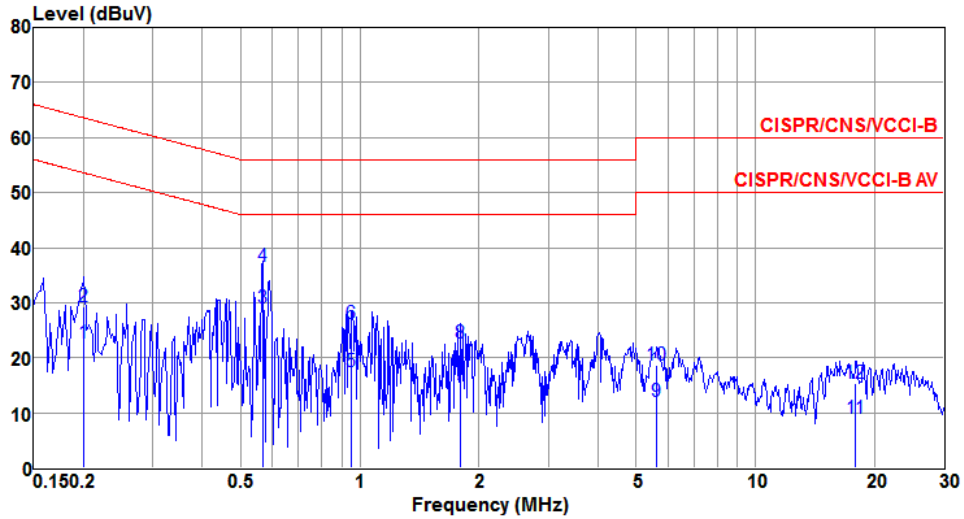
Modulation Mode	FHSS	Test Freq. (MHz)	2476
Power Phase	Line		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.195	22.27	53.80	-31.53	21.84	0.39	0.04	Average
2	0.195	28.25	63.80	-35.55	27.82	0.39	0.04	QP
3	0.564	33.22	46.00	-12.78	32.84	0.34	0.04	Average
4	0.564	40.25	56.00	-15.75	39.87	0.34	0.04	QP
5	1.082	24.50	46.00	-21.50	24.12	0.34	0.04	Average
6	1.082	32.93	56.00	-23.07	32.55	0.34	0.04	QP
7	1.744	24.09	46.00	-21.91	23.62	0.43	0.04	Average
8	1.744	30.45	56.00	-25.55	29.98	0.43	0.04	QP
9	5.419	12.50	50.00	-37.50	11.57	0.75	0.18	Average
10	5.419	21.62	60.00	-38.38	20.69	0.75	0.18	QP
11	18.820	5.96	50.00	-44.04	5.21	0.50	0.25	Average
12	18.820	12.53	60.00	-47.47	11.78	0.50	0.25	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 Note 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Modulation Mode	FHSS	Test Freq. (MHz)	2476
Power Phase	Neutral		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.201	22.72	53.58	-30.86	22.34	0.34	0.04	Average
2	0.201	29.28	63.58	-34.30	28.90	0.34	0.04	QP
3@	0.567	29.04	46.00	-16.96	28.63	0.37	0.04	Average
4	0.567	36.50	56.00	-19.50	36.09	0.37	0.04	QP
5	0.953	17.55	46.00	-28.45	17.15	0.36	0.04	Average
6	0.953	26.10	56.00	-29.90	25.70	0.36	0.04	QP
7	1.800	15.13	46.00	-30.87	14.64	0.45	0.04	Average
8	1.800	22.69	56.00	-33.31	22.20	0.45	0.04	QP
9	5.623	12.01	50.00	-37.99	11.23	0.60	0.18	Average
10	5.623	18.66	60.00	-41.34	17.88	0.60	0.18	QP
11	17.944	8.89	50.00	-41.11	8.22	0.42	0.25	Average
12	17.944	15.42	60.00	-44.58	14.75	0.42	0.25	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

3.2 Radiated Emission

3.2.1 Limit of Emissions in Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.2.2 Test Procedures

1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

1. Radiated emission below 1GHz
120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission
2. Radiated emission above 1GHz / Peak value
RBW=1MHz, VBW=3MHz and Peak detector
Radiated emission above 1GHz / Average value for harmonics
The average value is: Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from following formula:

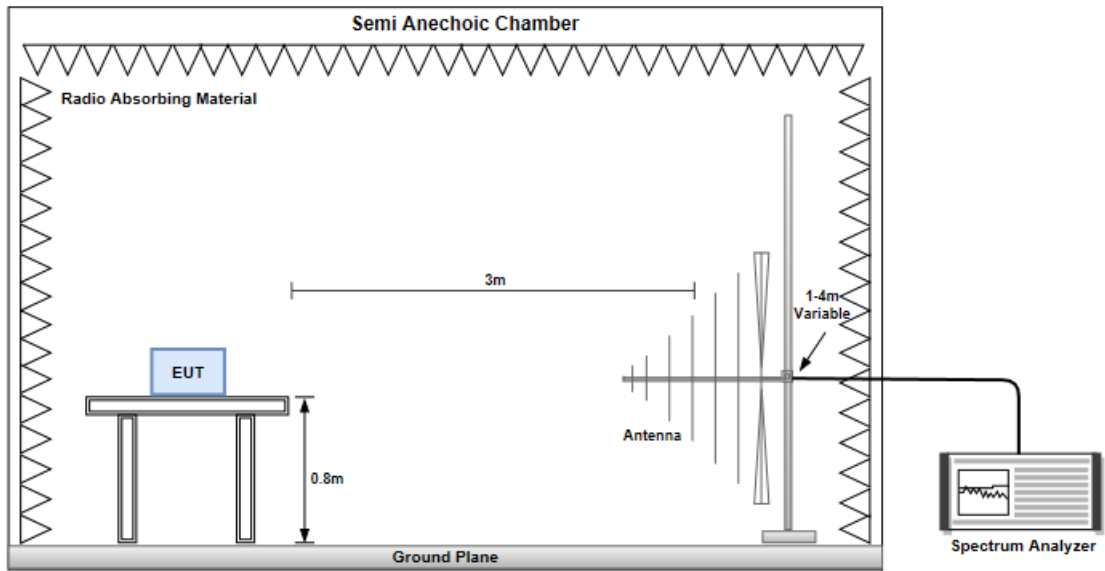
3.
$$20\log(\text{Duty cycle}) = 20\log \frac{4 * 0.48696 \text{ ms}}{100 \text{ ms}} = -34.21\text{dB}$$

Please see page 25 for plotted duty

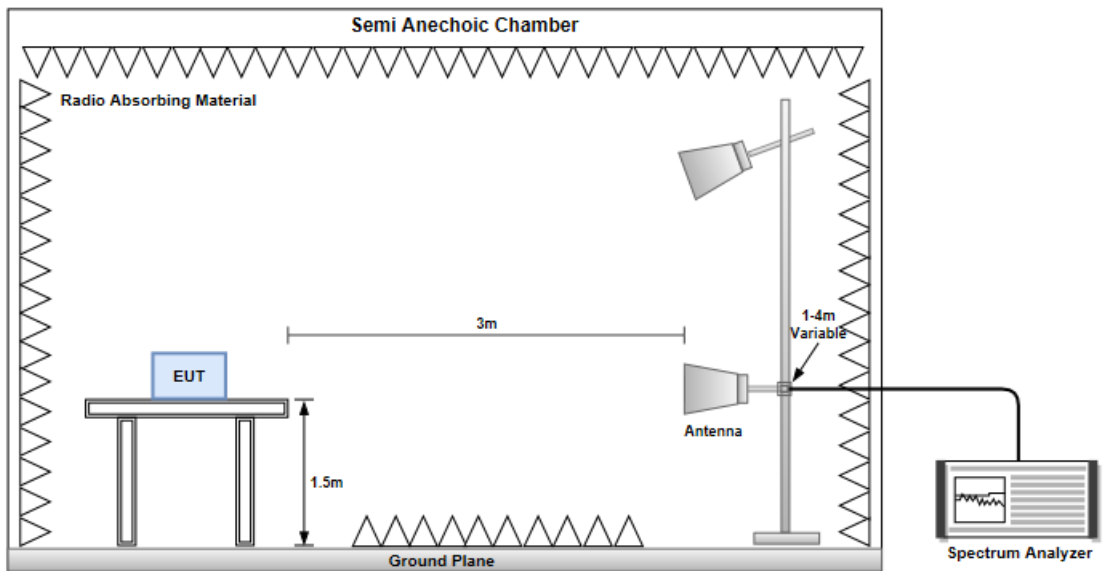
4. Radiated emission above 1GHz / Average value for other emissions
RBW=1MHz, VBW=10Hz and Peak detector

3.2.3 Test Setup

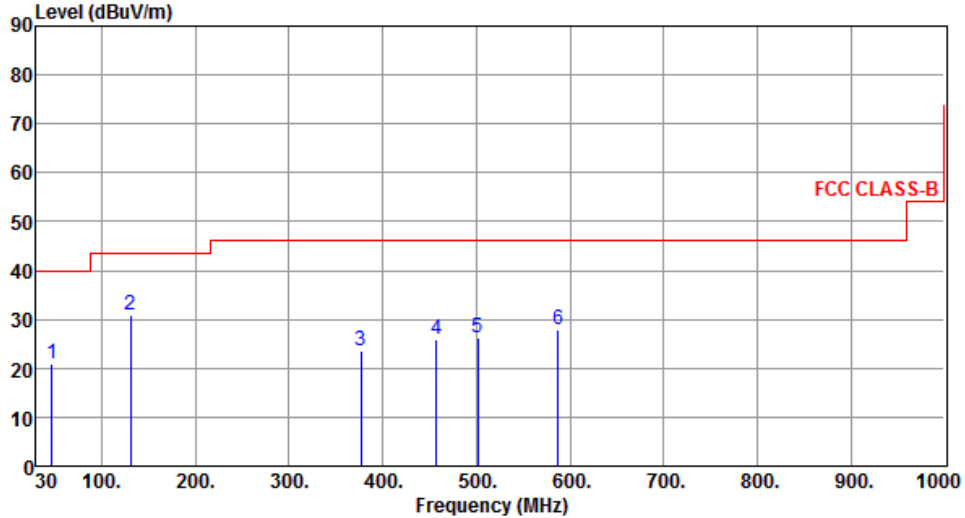
Radiated Emissions below 1 GHz



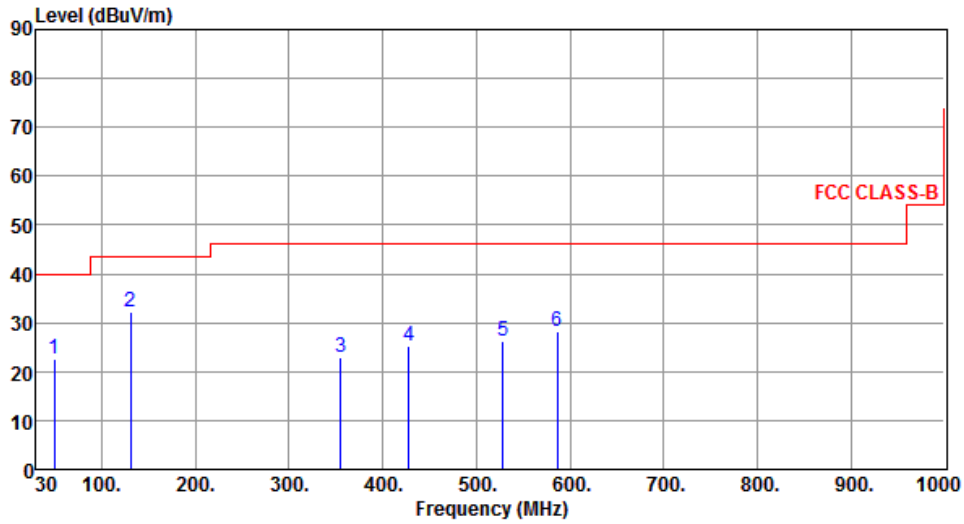
Radiated Emissions above 1 GHz



3.2.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation	FHSS		Test Freq. (MHz)	2476					
Polarization	Horizontal								
 <p>The graph plots Level (dBuV/m) on the y-axis (0 to 90) against Frequency (MHz) on the x-axis (30 to 1000). A red line represents the FCC CLASS-B limit, which is 40 dBuV/m from 30 to 100 MHz, 45 dBuV/m from 100 to 1000 MHz, and 55 dBuV/m from 1000 to 10000 MHz. Six blue vertical lines represent emission peaks at 46.49, 130.88, 377.26, 457.77, 501.42, and 587.75 MHz, labeled 1 through 6 respectively.</p>									
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	46.49	20.92	40.00	-19.08	29.23	-8.31	Peak	---	---
2	130.88	30.88	43.50	-12.62	40.75	-9.87	Peak	---	---
3	377.26	23.61	46.00	-22.39	29.58	-5.97	Peak	---	---
4	457.77	25.86	46.00	-20.14	29.81	-3.95	Peak	---	---
5	501.42	26.15	46.00	-19.85	29.47	-3.32	Peak	---	---
6	587.75	27.81	46.00	-18.19	29.14	-1.33	Peak	---	---
<p>Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m). Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.</p>									

Modulation	FHSS	Test Freq. (MHz)	2476
Polarization	Vertical		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	49.40	22.47	40.00	-17.53	30.64	-8.17	Peak	---	---
2	130.88	32.19	43.50	-11.31	42.06	-9.87	Peak	---	---
3	354.95	22.81	46.00	-23.19	29.43	-6.62	Peak	---	---
4	427.70	25.18	46.00	-20.82	29.79	-4.61	Peak	---	---
5	528.58	26.33	46.00	-19.67	29.10	-2.77	Peak	---	---
6	586.78	28.21	46.00	-17.79	29.56	-1.35	Peak	---	---

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

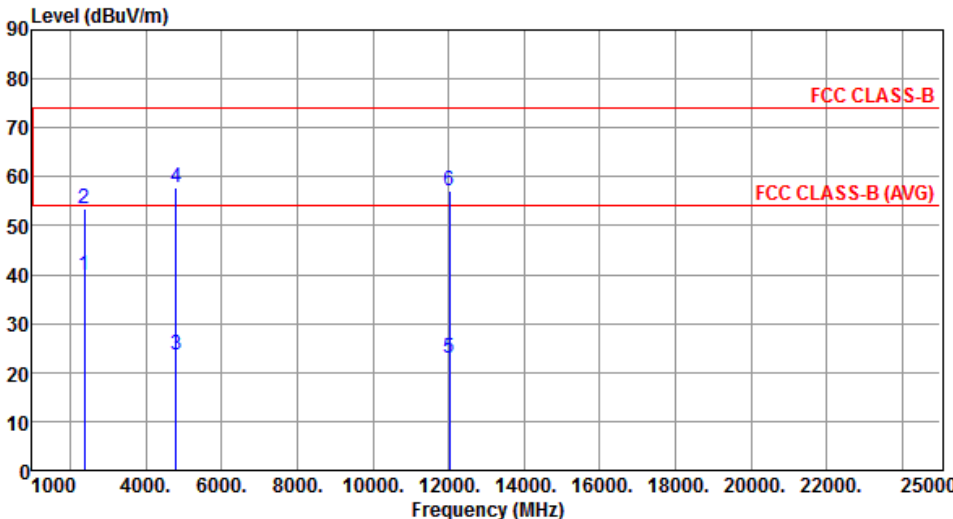
*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.2.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)

Modulation	FHSS		Test Freq. (MHz)	2404	
Polarization	Horizontal				

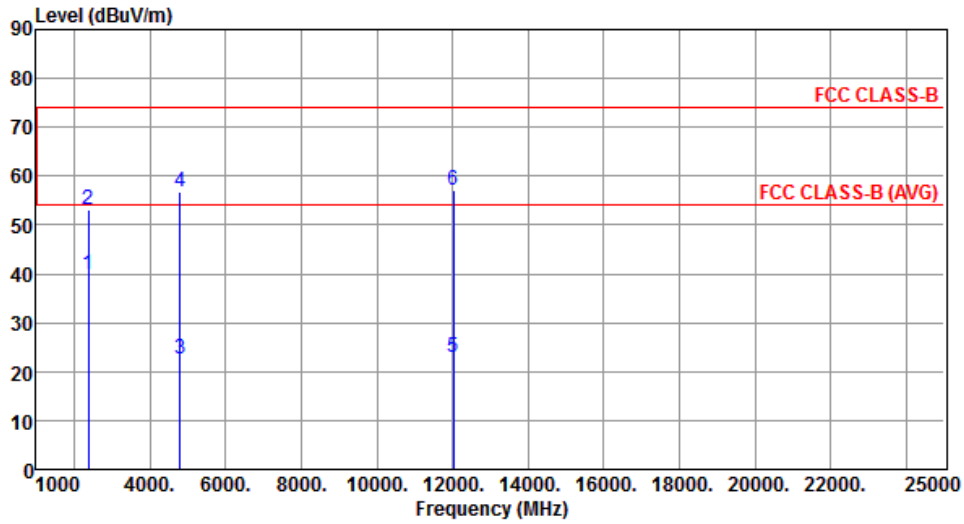


The graph plots Level (dBuV/m) on the y-axis (0 to 90) against Frequency (MHz) on the x-axis (1000 to 25000). Two horizontal red lines represent FCC CLASS-B (at ~75 dBuV/m) and FCC CLASS-B (AVG) (at ~55 dBuV/m). Six vertical blue lines represent measurement points labeled 1 through 6. Point 1 is at 2390 MHz (level ~42), point 2 at 2390 MHz (level ~53), point 3 at 4808 MHz (level ~24), point 4 at 4808 MHz (level ~58), point 5 at 12020 MHz (level ~23), and point 6 at 12020 MHz (level ~57).

	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	39.90	54.00	-14.10	41.87	-1.97	Average	236	179
2	2390.00	53.32	74.00	-20.68	55.29	-1.97	Peak	236	179
3	4808.00	23.50	54.00	-30.50	18.87	4.63	Average	235	21
4	4808.00	57.71	74.00	-16.29	53.08	4.63	Peak	235	21
5	12020.00	22.93	54.00	-31.07	9.04	13.89	Average	238	29
6	12020.00	57.14	74.00	-16.86	43.25	13.89	Peak	238	29

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	FHSS	Test Freq. (MHz)	2404
Polarization	Vertical		



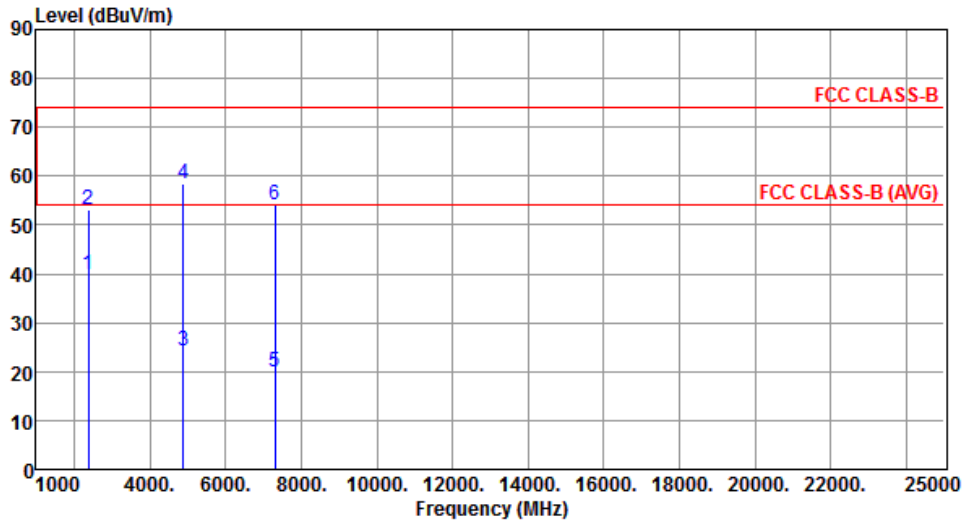
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	39.82	54.00	-14.18	41.79	-1.97	Average	235	246
2	2390.00	53.28	74.00	-20.72	55.25	-1.97	Peak	235	246
3	4808.00	22.61	54.00	-31.39	17.98	4.63	Average	211	209
4	4808.00	56.82	74.00	-17.18	52.19	4.63	Peak	211	209
5	12020.00	22.81	54.00	-31.19	8.92	13.89	Average	208	211
6	12020.00	57.02	74.00	-16.98	43.13	13.89	Peak	208	211

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	FHSS	Test Freq. (MHz)	2440
Polarization	Horizontal		



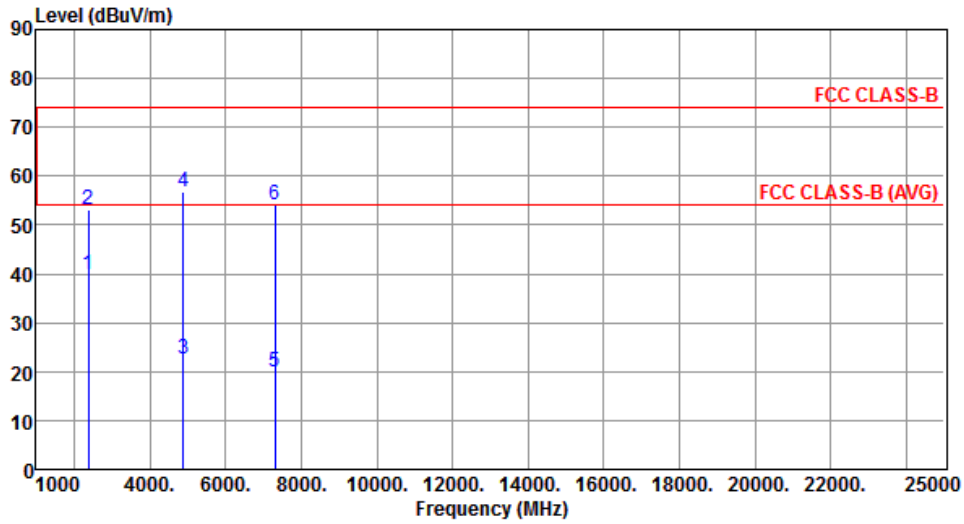
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	39.78	54.00	-14.22	41.75	-1.97	Average	236	179
2	2390.00	53.16	74.00	-20.84	55.13	-1.97	Peak	236	179
3	4880.00	24.25	54.00	-29.75	19.47	4.78	Average	233	32
4	4880.00	58.46	74.00	-15.54	53.68	4.78	Peak	233	32
5	7320.00	19.99	54.00	-34.01	10.65	9.34	Average	235	26
6	7320.00	54.20	74.00	-19.80	44.86	9.34	Peak	235	26

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	FHSS	Test Freq. (MHz)	2440
Polarization	Vertical		



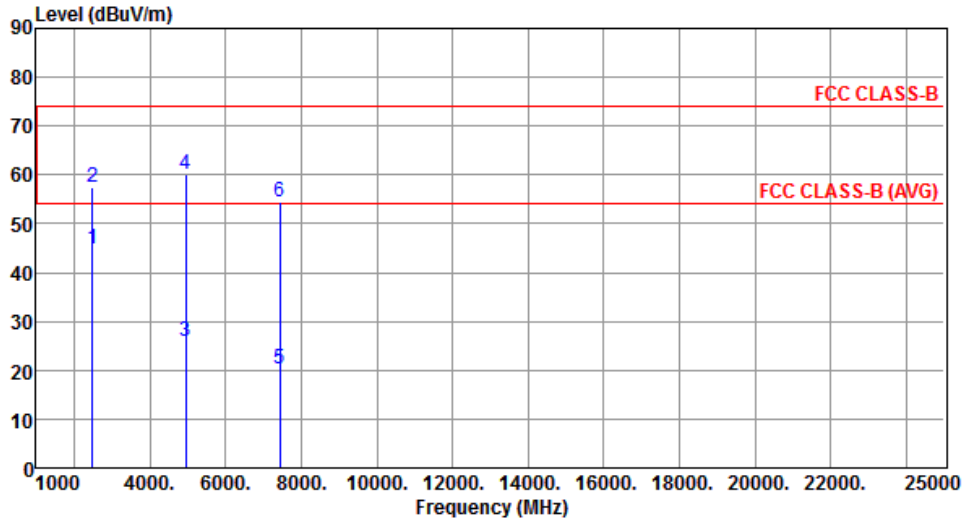
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	39.79	54.00	-14.21	41.76	-1.97	Average	238	241
2	2390.00	53.25	74.00	-20.75	55.22	-1.97	Peak	238	241
3	4880.00	22.74	54.00	-31.26	17.96	4.78	Average	210	204
4	4880.00	56.95	74.00	-17.05	52.17	4.78	Peak	210	204
5	7320.00	19.87	54.00	-34.13	10.53	9.34	Average	203	196
6	7320.00	54.08	74.00	-19.92	44.74	9.34	Peak	203	196

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	FHSS	Test Freq. (MHz)	2476
Polarization	Horizontal		



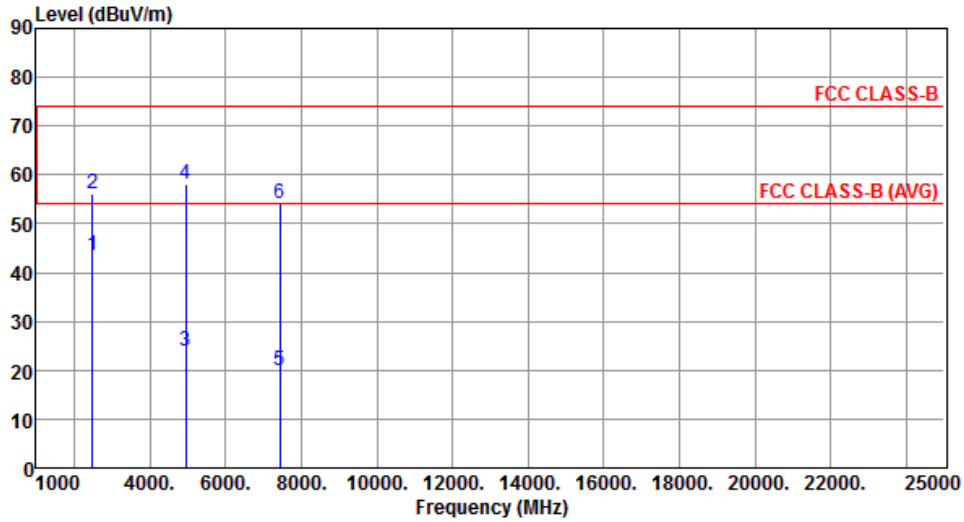
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	44.67	54.00	-9.33	46.29	-1.62	Average	223	183
2	2483.50	57.49	74.00	-16.51	59.11	-1.62	Peak	223	183
3	4952.00	25.94	54.00	-28.06	21.02	4.92	Average	230	28
4	4952.00	60.15	74.00	-13.85	55.23	4.92	Peak	230	28
5	7428.00	20.18	54.00	-33.82	10.52	9.66	Average	231	26
6	7428.00	54.39	74.00	-19.61	44.73	9.66	Peak	231	26

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	FHSS	Test Freq. (MHz)	2476
Polarization	Vertical		

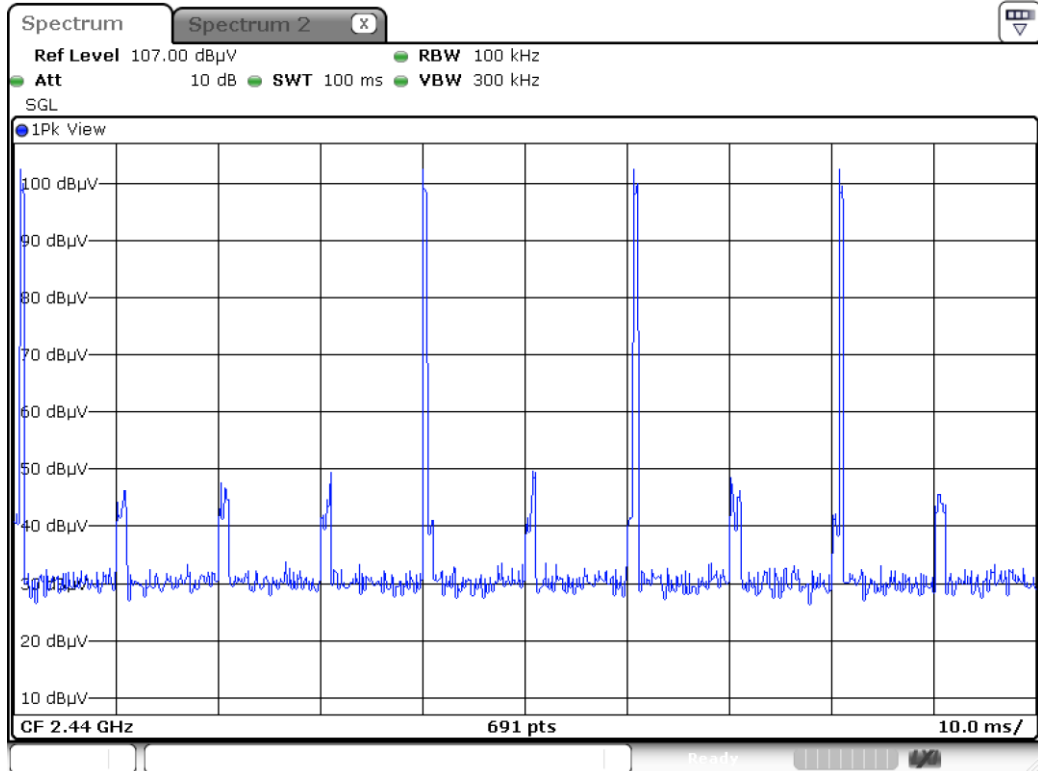
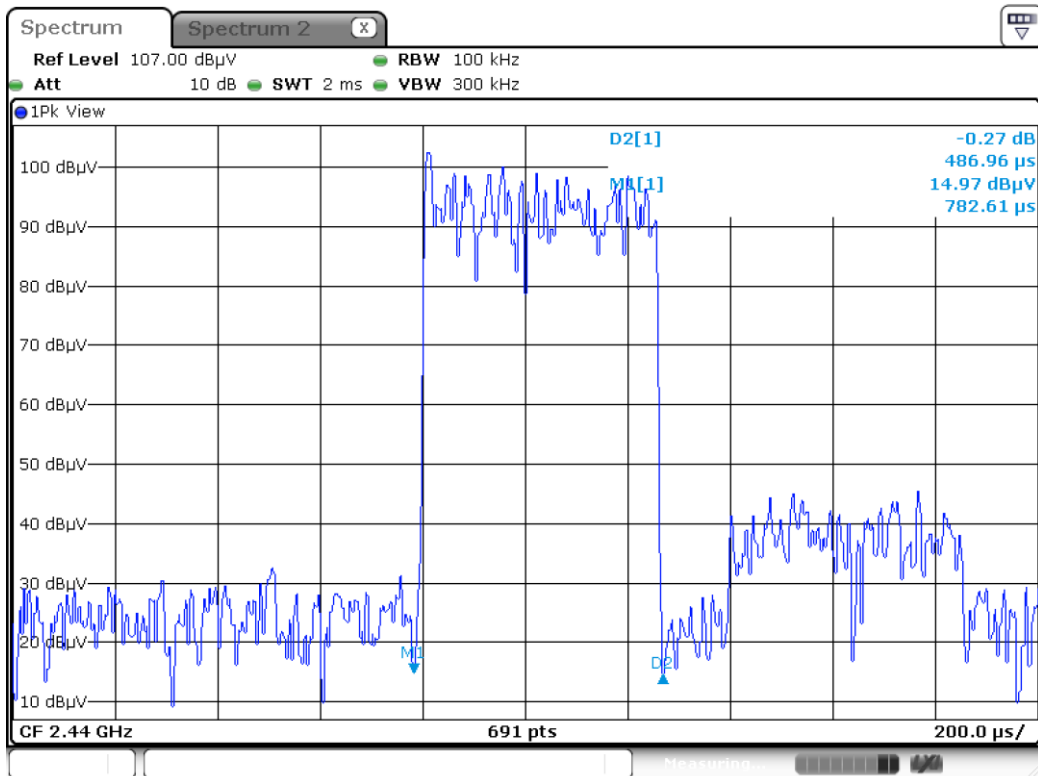


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	43.52	54.00	-10.48	45.14	-1.62	Average	236	243
2	2483.50	56.28	74.00	-17.72	57.90	-1.62	Peak	236	243
3	4952.00	24.00	54.00	-30.00	19.08	4.92	Average	211	209
4	4952.00	58.21	74.00	-15.79	53.29	4.92	Peak	211	209
5	7428.00	20.01	54.00	-33.99	10.35	9.66	Average	203	191
6	7428.00	54.22	74.00	-19.78	44.56	9.66	Peak	203	191

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).



$$20\log(\text{Duty cycle}) = 20\log\left(\frac{4 \times 0.48696 \text{ ms}}{100 \text{ ms}}\right) = -34.21\text{dB}$$

3.3 Unwanted Emissions into Non-Restricted Frequency Bands

3.3.1 Limit of Unwanted Emissions into Non-Restricted Frequency Bands

The peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

3.3.2 Test Procedures

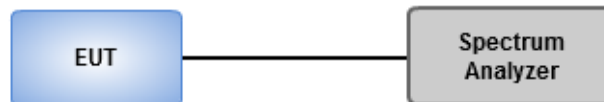
Reference Level Measurement

1. Set the RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
2. Set Sweep time = auto couple, Trace mode = max hold.
3. Allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

Unwanted Emissions Level Measurement

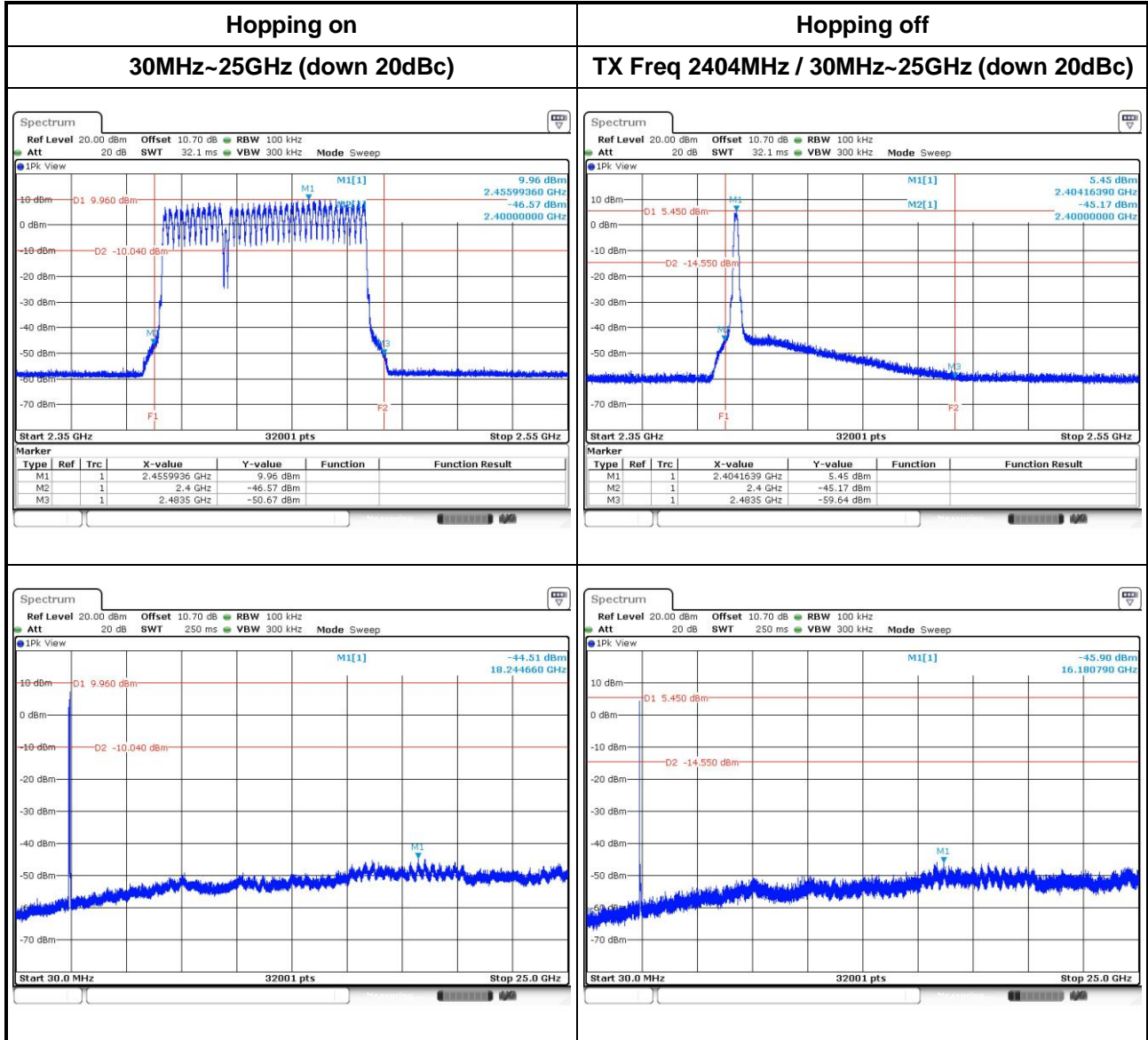
1. Set RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
2. Trace Mode = max hold, Sweep = auto couple.
3. Allow the trace to stabilize.
4. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

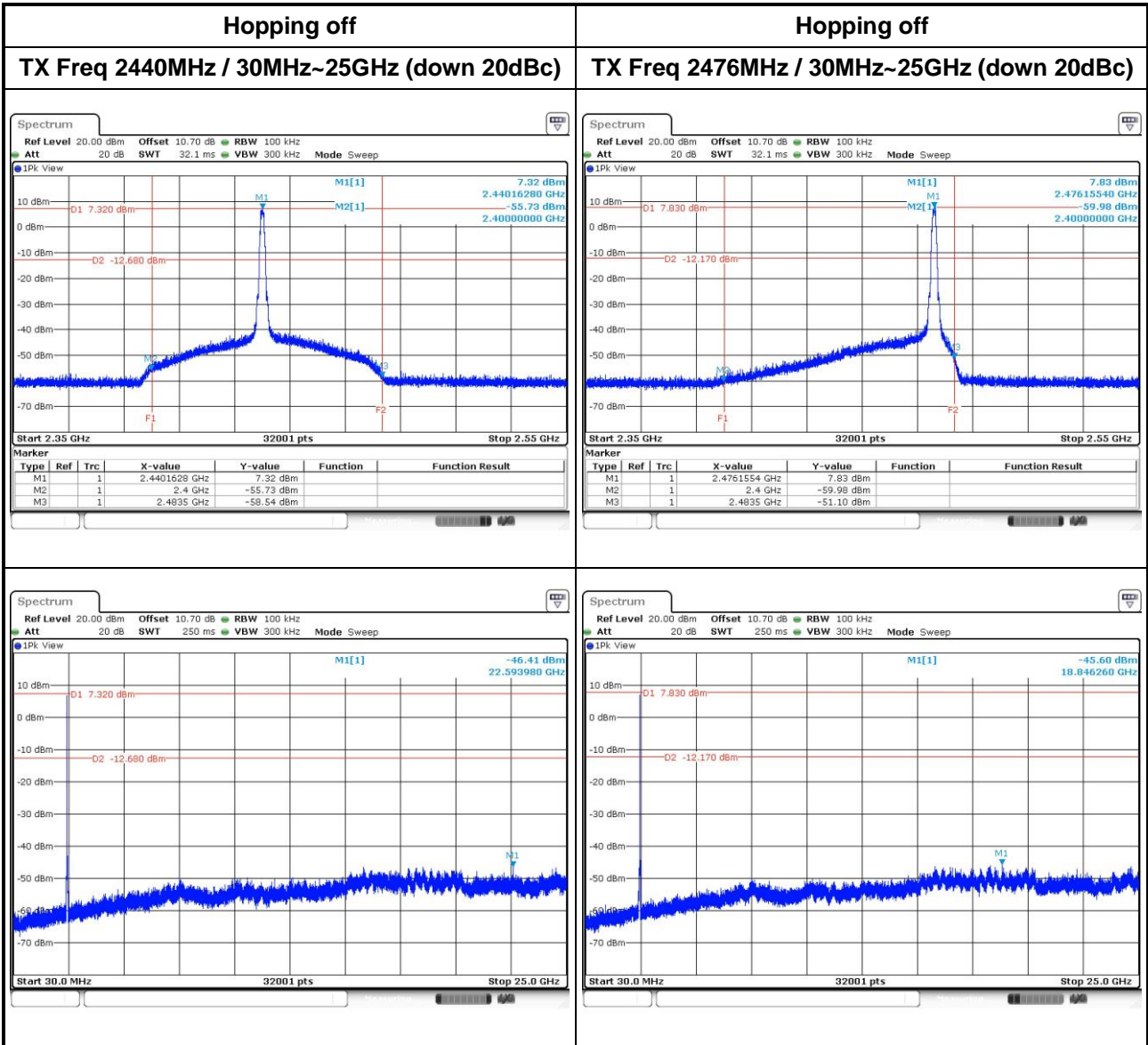
3.3.3 Test Setup



3.3.4 Unwanted Emissions into Non-Restricted Frequency Bands

FHSS





3.4 Conducted Output Power

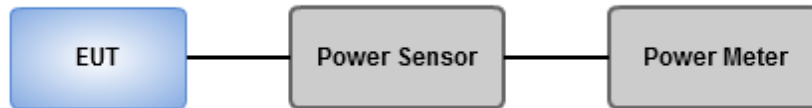
3.4.1 Limit of Conducted Output Power

- 1 Watt
For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band.
- 0.125 Watt
For all other frequency hopping systems in the 2400–2483.5 MHz band.
- 0.125 Watt
For Frequency hopping systems operating in the 2400–2483.5 MHz band have hopping channel carrier frequencies that are separated by two-thirds of the 20 dB bandwidth of the hopping channel.

3.4.2 Test Procedures

1. A wideband power meter is used for power measurement. Bandwidth of power sensor and meter is 50MHz
2. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power

3.4.3 Test Setup



3.4.4 Test Result of Conducted Output Power

Modulation Mode	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Limit (mW)
FHSS	2404	6.49	8.12	125
FHSS	2440	9.82	9.92	125
FHSS	2476	11.86	10.74	125

Modulation Mode	Freq. (MHz)	AV Output Power (mW)	AV Output Power (dBm)
FHSS	2404	6.03	7.80
FHSS	2440	9.53	9.79
FHSS	2476	11.27	10.52

Note: Average power is for reference only.

3.5 Number of Hopping Frequency

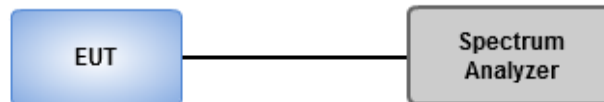
3.5.1 Limit of Number of Hopping Frequency

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

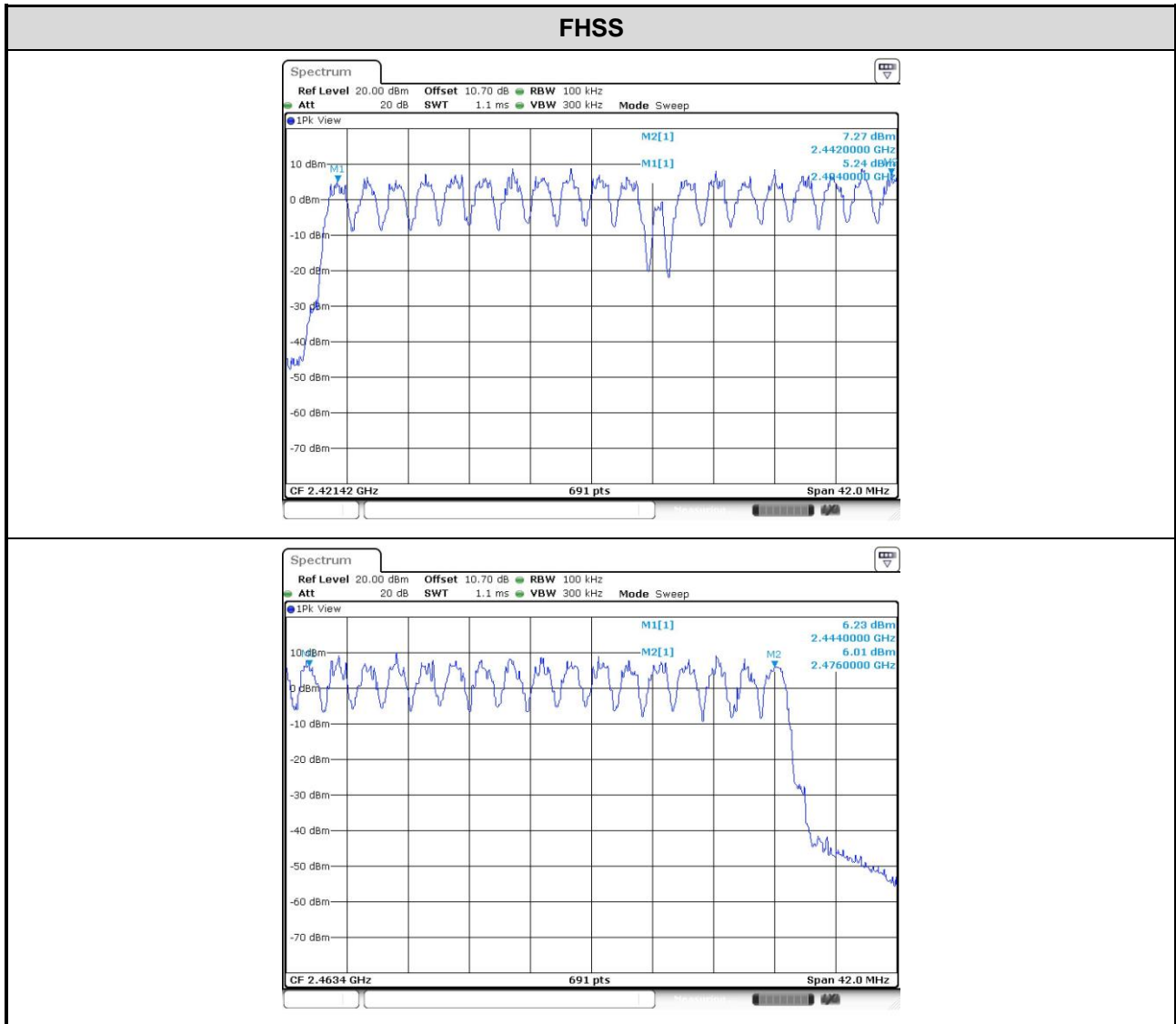
3.5.2 Test Procedures

1. Set RBW = 100kHz, VBW = 300kHz, Sweep time = Auto, Detector = Peak Trace max hold.
2. Allow trace to stabilize.

3.5.3 Test Setup



3.5.4 Test Result of Number of Hopping Frequency



3.6 20dB and Occupied Bandwidth

3.6.1 Test Procedures

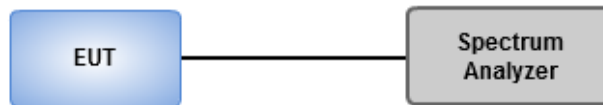
20dB Bandwidth

1. Set RBW=30kHz, VBW=100kHz, Sweep time = Auto, Detector=Peak, Trace max hold
2. Allow trace to stabilize
3. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

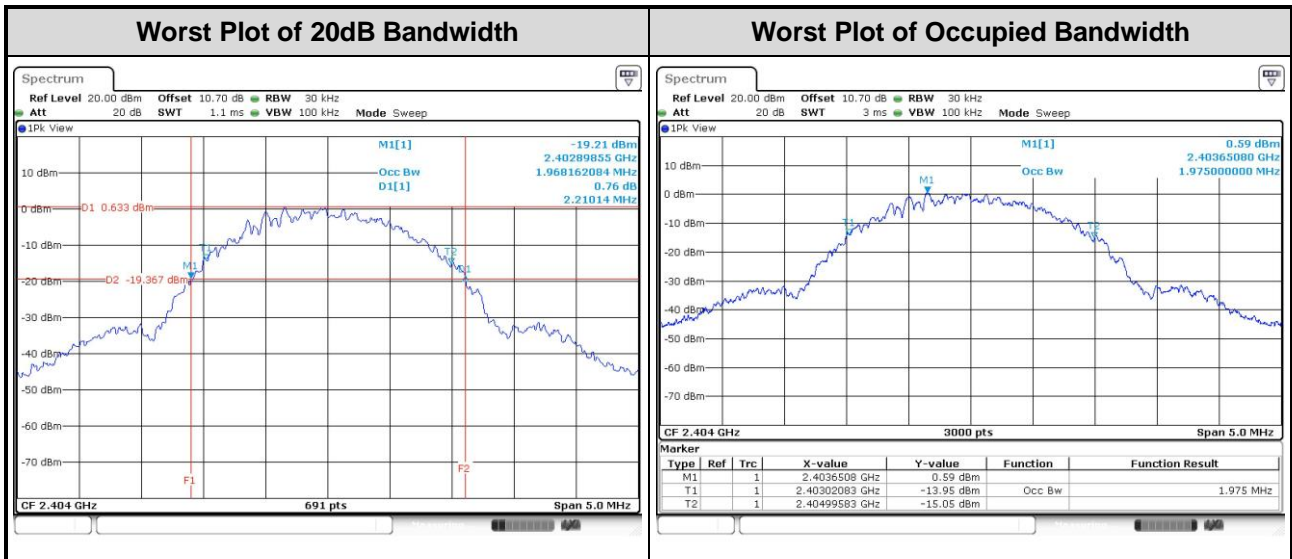
1. Set RBW=30kHz, VBW=100kHz, Sweep time = Auto, Detector=Sample, Trace max hold
2. Allow trace to stabilize
3. Use Occupied bandwidth function of spectrum analyzer to measuring 99% occupied bandwidth

3.6.2 Test Setup



3.6.3 Test result of 20dB and Occupied Bandwidth

Modulation Mode	Freq. (MHz)	20dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
FHSS	2404	2.210	1.975
FHSS	2440	2.210	1.970
FHSS	2476	2.210	1.960



3.7 Channel Separation

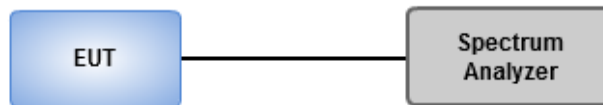
3.7.1 Limit of Channel Separation

- 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.
- Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

3.7.2 Test Procedures

1. Set RBW=100kHz, VBW=300kHz, Sweep time = Auto, Detector=Peak Trace max hold
2. Allow trace to stabilize
3. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The EUT shall show compliance with the appropriate regulatory limit

3.7.3 Test Setup



3.8 Number of Dwell Time

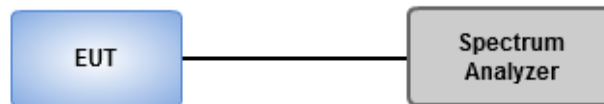
3.8.1 Limit of Dwell time

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

3.8.2 Test Procedures

1. Set RBW=100kHz,VBW=300kHz,Sweep time =1ms / 1s, Detector=Peak, Span=0Hz,Trace max hold
2. Enable gating and trigger function of spectrum analyzer to measure burst on time.

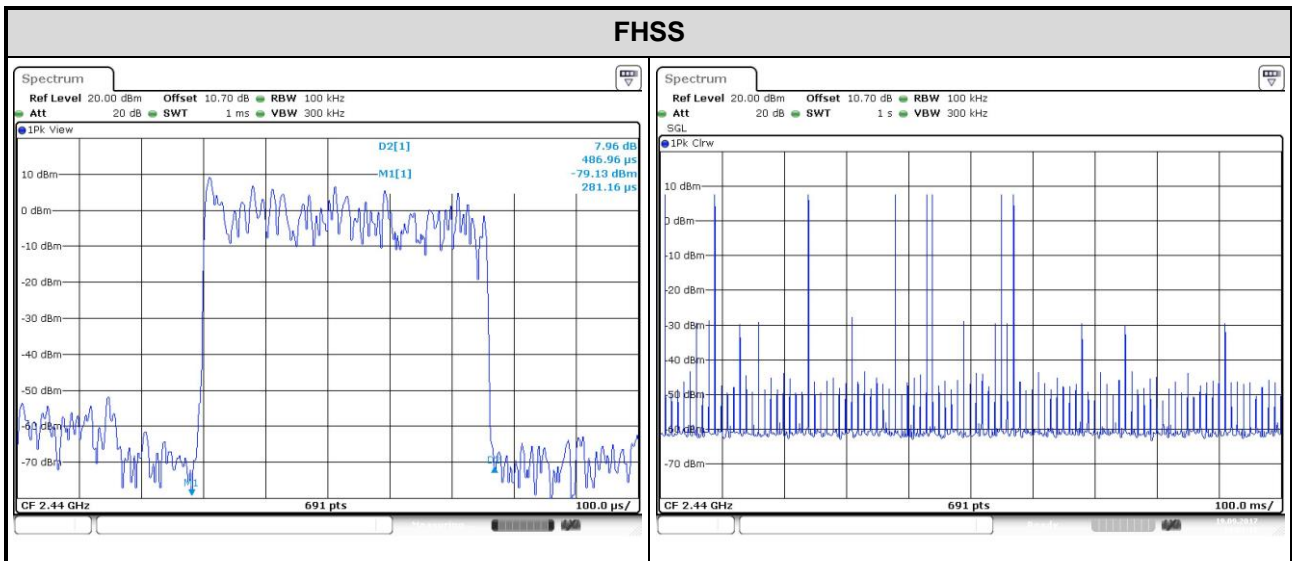
3.8.3 Test Setup



3.8.4 Test Result of Dwell Time

Modulation Mode	Freq. (MHz)	Length of Transmission Time (msec)	Number of Transmission in a 14.4 (36 Hopping*0.4)	Result (s)	Limit (s)
2FSK-DH1	2440	0.48696	115.2	0.056	0.4

Note: $115.2 = 8 \text{ pulse/1second} * 14.4$



4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

Linkou

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Kou District, New Taipei City,
Taiwan, R.O.C.

Kwei Shan

Tel: 886-3-271-8666

No. 3-1, Lane 6, Wen San 3rd St.,
Kwei Shan District, Tao Yuan City
333, Taiwan, R.O.C.

Kwei Shan Site II

Tel: 886-3-271-8640

No. 14-1, Lane 19, Wen San 3rd
St., Kwei Shan District, Tao Yuan
City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information.

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==END==