TEST REPORT

Test Report Number:	N2203R-0996-1
Project Number:	A2022-03330
Applicant:	ATID CO., Ltd
Address of Applicant:	#1402, 83, Gasan Digital 1-Ro, Geumcheon-Gu, Seoul, South Korea 08589
Manufacturer and Country	ATID CO., Ltd
Address of Manufacturer/Factory:	#1402, 83, Gasan Digital 1-Ro, Geumcheon-Gu, Seoul, South Korea 08589

Equipment Under Test (EUT)

Product Name:	UHF RFID Reader
Model No.:	ATS200

■ **FCC ID** : VUJ-ATS200 □ **IC**

Applicable standards:	FCC CFR Title 47 Part 15 Subpart C (15.247) ANSI C63.10-2020 KDB 558074 D01
Date of Test:	Mar. 7, 2022 to Mar. 28, 2022
Date of report issued:	Mar. 29, 2022
Test Result:	Compliance *

Prepared By: ***Date:*** Mar. 29. 2022

Project Engineer

Check By: ***Date:*** Mar. 29. 2022

Reviewer

REPORT REVISION HISTORY

Date	Revision	Page No
Mar. 28. 2022	Originally Issued	-
Mar. 29. 2022	Correction of the applicant's address	1

Contents

1. General Information

1.1 General Description of EUT

Product Name	UHF RFID Reader
Model Name	ATS200
Variant Model Name	RP200
FCC ID	VUJ-ATS200
Operation Frequency	UHF RFID : 902.75 MHz ~ 927.25 MHz Bluetooth(BDR/EDR/Low Energy) : 2402 MHz ~ 2480 MHz
Number of Channel	UHF RFID : 50 Bluetooth(BDR/EDR) : 79 Bluetooth(Low Energy) : 40
Antenna Specification	UHF RFID : Circularly Polarized Antenna Bluetooth(BDR/EDR/Low Energy) : Multilayer Chip Antenna
Antenna Gain	UHF RFID : 1.82 dBi Bluetooth(BDR/EDR/Low Energy) : 0.5 dBi
Power supply	3.7 V (Internal rechargeable Li-ion Battery)

1.2 EUT Test Frequency

The EUT was operated in the engineering mode to fix Tx frequency that was for the purpose of the test measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level.

The test was performed at low, middle and high channel and the selected channel as shown in the chart below:

RFID

Channel	Frequency [MHz]
Lowest channel	902.75
Middle channel	914.75
Highest channel	927.25

Bluetooth(BDR/EDR)

Channel	Frequency [MHz]
Lowest channel	2 402
Middle channel	2 441
Highest channel	2 480

Bluetooth(Low Energy)

Channel	Frequency [MHz]
Lowest channel	2 402
Middle channel	2 442
Highest channel	2 480

1.3 Test Condition

	Normal voltage
DC Power	3.7

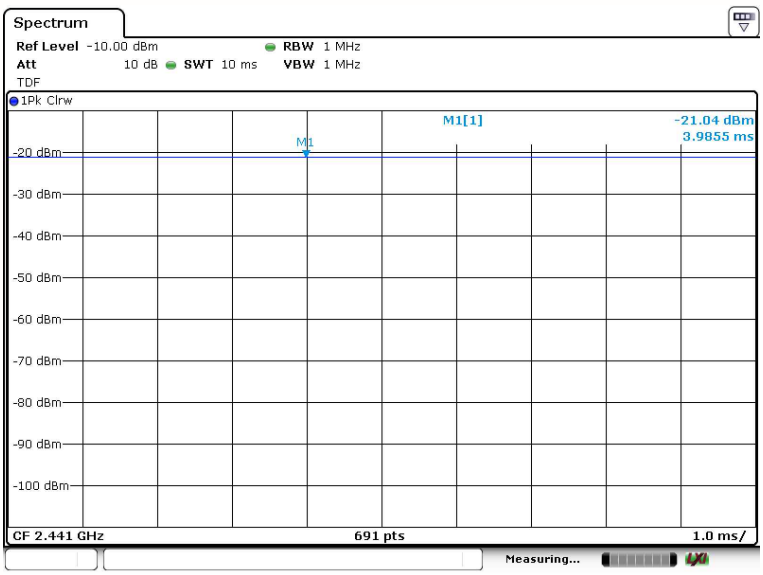
1.4 Duty Cycle

Mode	Ton (ms)	Ton+off (ms)	Duty Cycle[1)] (%)	Duty Factor[2)] (dB)
Bluetooth(BDR)	-	-	100	0
Bluetooth(EDR)	-	-	100	0

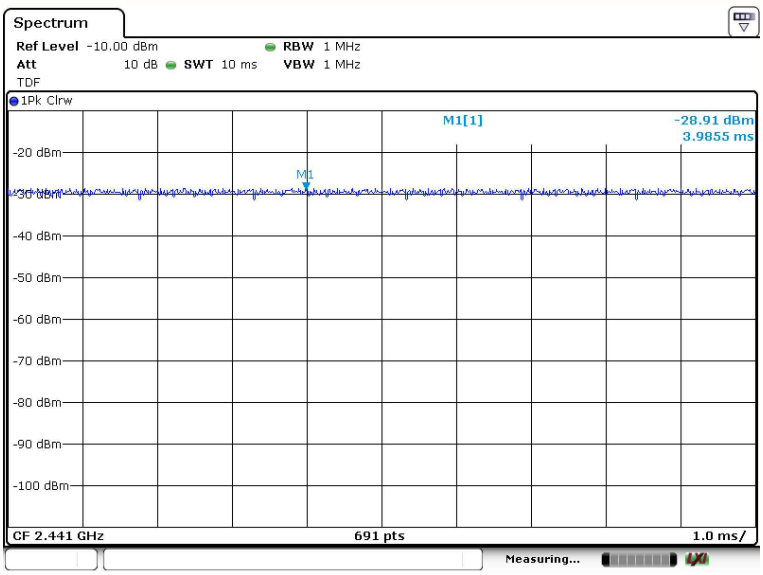
Note[1)] : Duty Cycle = (Ton/Ton+off)*100
Note[2)] : Duty Factor = 10*log(1/Duty cycle)

Test plots

Bluetooth BDR	Test channel:	Highest(2 480 MHz)



Bluetooth EDR	Test channel:	Highest(2 480 MHz)



1.5 Test Perfomed

RRA Designation No.: KR0157

KOLAS Accreditation No. : KT511

Laboratory		NTREE Co., Ltd.
1st laboratory Address	:	228-60, Saneop-ro 155beon-gil, Gwonseon-gu, Suwon-si, Gyeionggi-do, 16648, KOREA
Telephone	:	+82-31-893-0999
Facsimile	:	+82-31-297-0444
2nd laboratory Address	:	30, Pajangcheon-ro 44beon-gil, Jangan-gu, Suwon-si, Gyeonggi-do, 16204, KOREA
Telephone	:	+82-31-893-1000
Facsimile	:	+82-31-893-0111

SITE MAP

1st laboratory

2nd laboratory

* The test was performed at 1st laboratory.

1.6 Test Instruments List

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Due date (mm-dd-yy)
1	Signal Analyzer	ROHDE & SCHWARZ	FSVA40	101501	11-01-22
2	DC Power Supply	AGILENT	6632B	MY43004016	03-10-23
3	DC Power Supply	TOYOTECH	DP30-05CF	17050049	07-15-22
4	Signal Generator	ROHDE & SCHWARZ	SMB100A	177568	03-10-23
5	Vector Signal Generator	ROHDE & SCHWARZ	SMBV100A	260354	03-10-23
6	Power Sensor	ROHDE & SCHWARZ	NRP-Z85	101554	11-02-22
7	Tri-Log Antenna	ROHDE & SCHWARZ	VULB9168	9168-578	10-05-22
8	LOOP ANTENNA	ROHDE & SCHWARZ	FMZB1519	1519-046	05-18-22
9	EMI Test Receiver	ROHDE & SCHWARZ	ESR7	101302	10-03-23
10	Attenuator	AEROFLEX	40AH2W-10	203130	03-11-23
11	Horn Antenna	Schwarzbeck	BBHA 9120D	02083	10-18-22
12	Horn Antenna	Schwarzbeck	BBHA 9170	573	03-22-23
13	Amplifier	TESTEK	TK-PA1840H	140003	03-11-23
14	Amplifier	TESTEK	TK-PA18H	160006-L	03-11-23
15	Amplifier	TESTEK	TK-PA6S	120018	11-02-22
16	Band Reject Filter	CHENGDU MICROWAVE	WT-A1205-R12	WT160105001	03-11-23
17	Two-Line V-Network(MAIN)	ROHDE & SCHWARZ	ENV216	102177	03-10-23

1.7 Summary of tests

FCC Rules	Description of Test Item	Test Result
§15.247(b)(1)	RF Output Power	Pass
§15.247(a)(1)(iii)	Number of Hopping Frequency	Pass
§15.247(a)(1)	Carrier Frequency Separation	Pass
§15.247(a)(1)(i)	Time of Occupancy (Dwell time)	Pass
§15.247(a)	20dB Bandwidth	Pass
§2.1051, §15.247(d)	Conducted Spurious Emissions and Band Edge	Pass
§15.247(d), §15.205, §15.209	Radiated Spurious Emissions and Restricted Bands	Pass
§15.207(a)	AC Power Line Conducted Emission	Pass
§15.203	Antenna Requirement	Pass

1.8 Measurement uncertainty

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR100028-1 [2] and shall correspond to an expansion factor (coverage factor) *k*=1.96 or *k*=2 (which provide confidence levels of respectively 95% and 95.5% in the case where the distributions characterizing the actual measurement uncertainties are normal.

Parameter	Uncertainty
Transmitter output power (Conducted)	± 1.3 dB
AC Conducted emission	± 2.0 dB
Radiated spurious emission (Below 1 GHz)	± 4.8 dB
Radiated spurious emission (Above 1 GHz)	± 5.0 dB

1.9 Information of Variant Model

Model Name	Information
ATS200	- Basic Model
RP200	- Same to Basic Model - Only Color is different(Case Black)

2. Test results

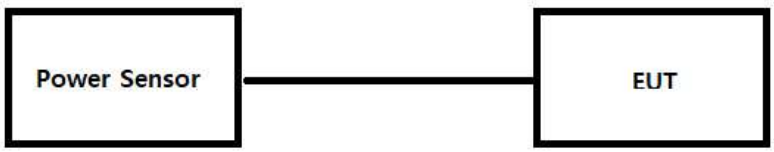
2.1 Maximum Peak Output Power

2.1.1 Limit

The maximum peak output power of the intentional radiator shall not exceed the following:

1. According to ∮15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band. Employing at least 75 non-overlapping hopping channels: 0.125Watt.
2. According to ∮15.247(b)(4), the conducted output power limit specified in paragraph(b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph(c) of this section, is transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs(b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi

2.1.2 Test configuration



2.1.3 Test procedure

1. PKPM1 Peak power meter method of KDB558074 D01v05r02
   The maximum conducted output powers were measured using a broadband peak RF power meter which has greater video bandwidth than DUT's DTS bandwidth and utilize a fast-responding diode detector.
2. Method AVGPM-G (Measurement using a gated RF average power meter) of KDB558074 D01v05r02 The average conducted output powers were measured 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. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

Note: The measure-and-sum technique is used for test mode with multiple transmitting.

2.1.4 Test Result

Measurement Data

Test mode	Channel	Conducted output power (dBm)	
		Average	Peak
Bluetooth BDR	Lowest(2 402 MHz)	9.83	12.80
	Middle(2 441 MHz)	10.16	12.54
	Highest(2 480 MHz)	10.39	12.74
Limit (dBm)		20.97	
Limit (mW)		125	
Result		Pass	

Test mode	Channel	Conducted output power (dBm)	
		Average	Peak
Bluetooth EDR(2M)	Lowest(2 402 MHz)	7.15	12.33
	Middle(2 441 MHz)	7.46	12.60
	Highest(2 480 MHz)	7.80	12.74
Limit (dBm)		20.97	
Limit (mW)		125	
Result		Pass	

Test mode	Channel	Conducted output power (dBm)	
		Average	Peak
Bluetooth EDR(3M)	Lowest(2 402 MHz)	7.09	12.29
	Middle(2 441 MHz)	7.40	12.62
	Highest(2 480 MHz)	7.52	12.85
Limit (dBm)		20.97	
Limit (mW)		125	
Result		Pass	

Note 1: Conducted output power (dBm) = Attenuator loss + Cable loss + Duty cycle factor

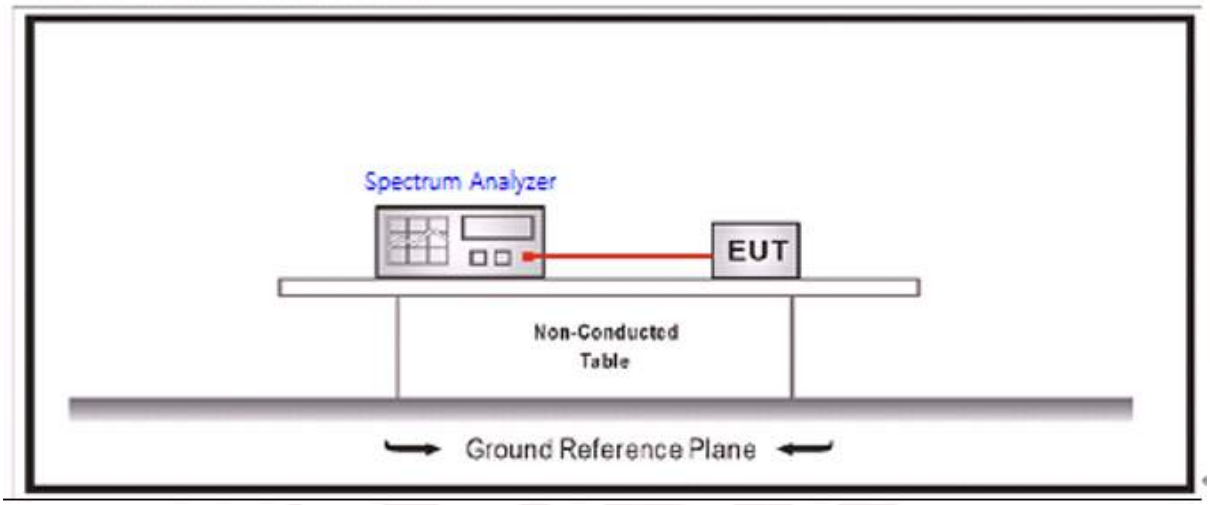
2.2 20 dB Bandwidth

2.2.1 Limit

Not Applicable (Occupied Bandwidth-relative measurement procedure)

2.2.2 Test Configuration

RF Conducted Measurement:



2.2.3 Test Procedure

According to ANSI 63.10-2020 Section 6.9.2 and 6.9.3

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

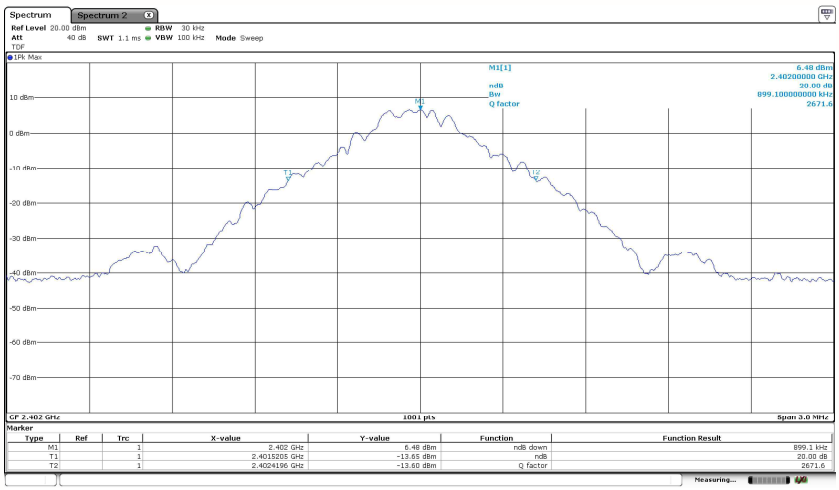
2.2.4 Test Result

Measurement Data

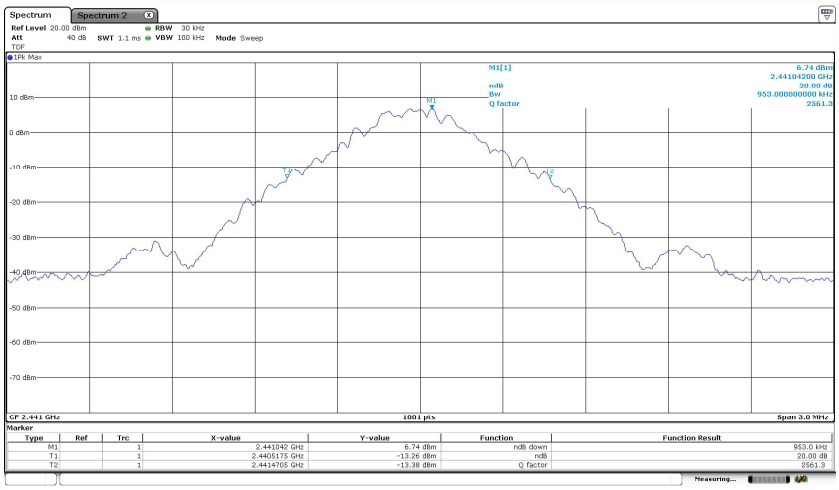
Test mode	Channel	20 dB bandwidth (MHz)	Limit (kHz)
BDR	Lowest	0.899	N/A
	Middle	0.953	
	Highest	0.953	
EDR(2M)	Lowest	1.373	
	Middle	1.376	
	Highest	1.379	
EDR(3M)	Lowest	1.361	
	Middle	1.361	
	Highest	1.358	

20 dB bandwidth test plot as follows:

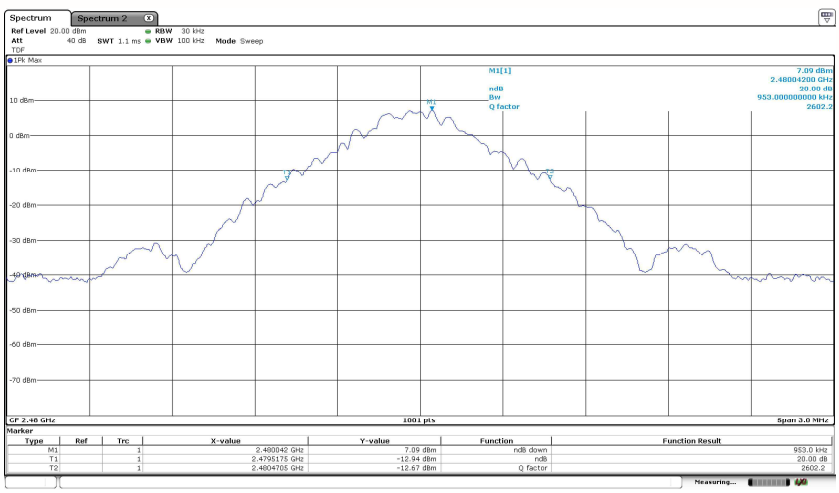
BDR	Test channel:	Lowest



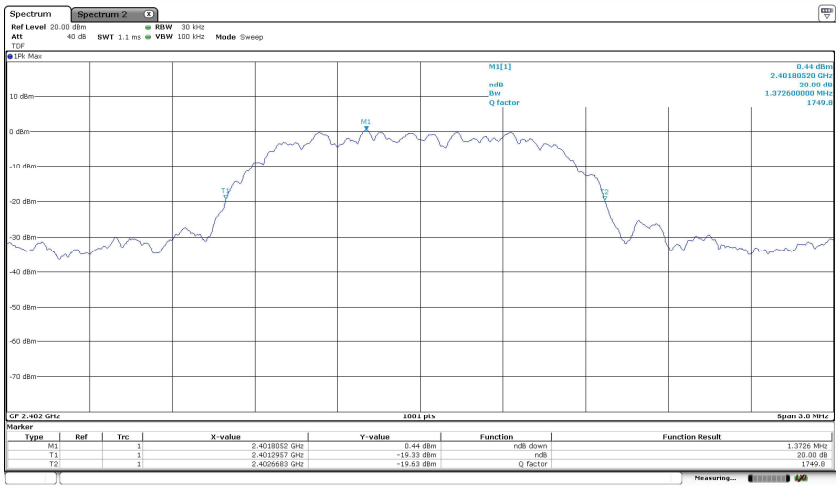
BDR	Test channel:	Middle



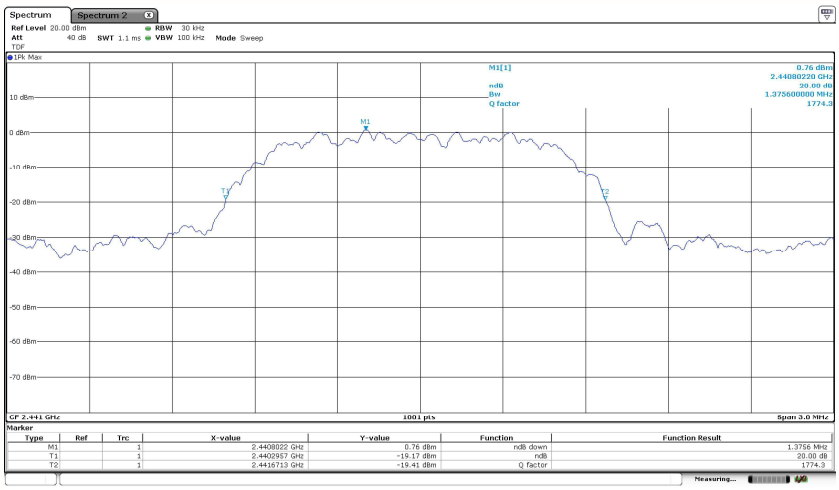
BDR	Test channel:	Highest



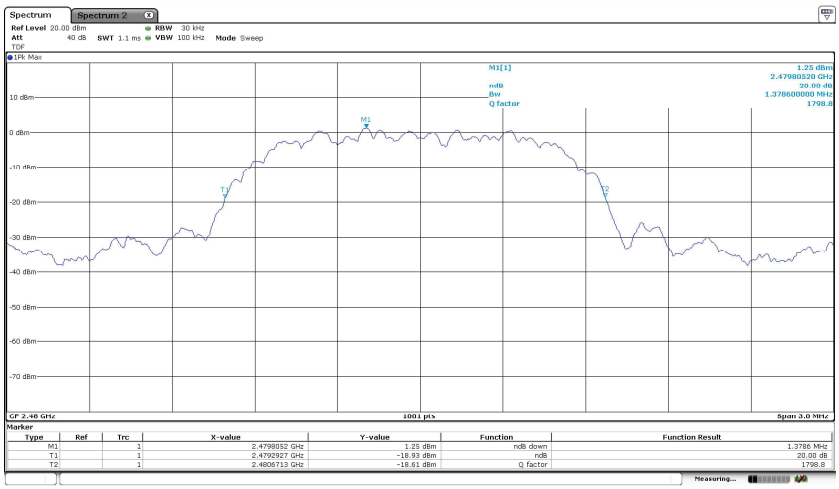
EDR(2M)	Test channel:	Lowest



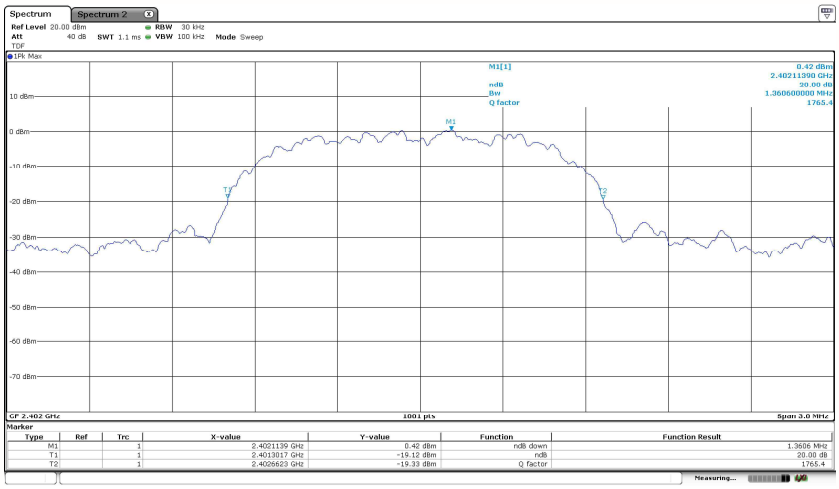
EDR(2M)	Test channel:	Middle



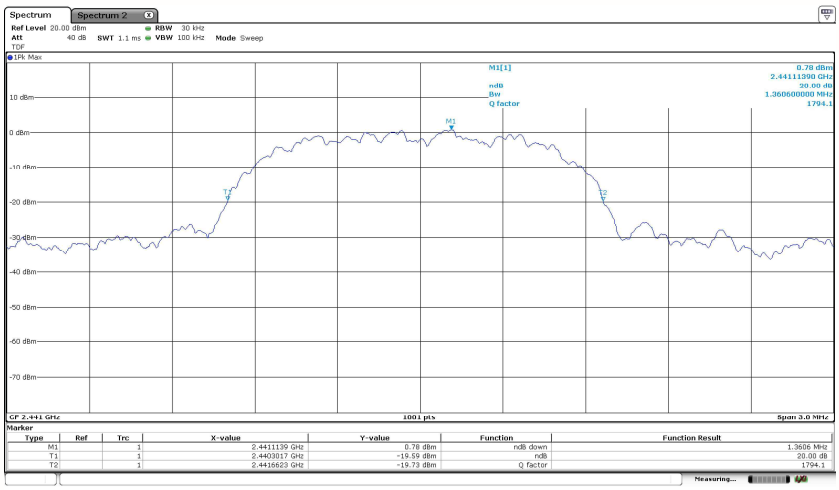
EDR(2M)	Test channel:	Highest



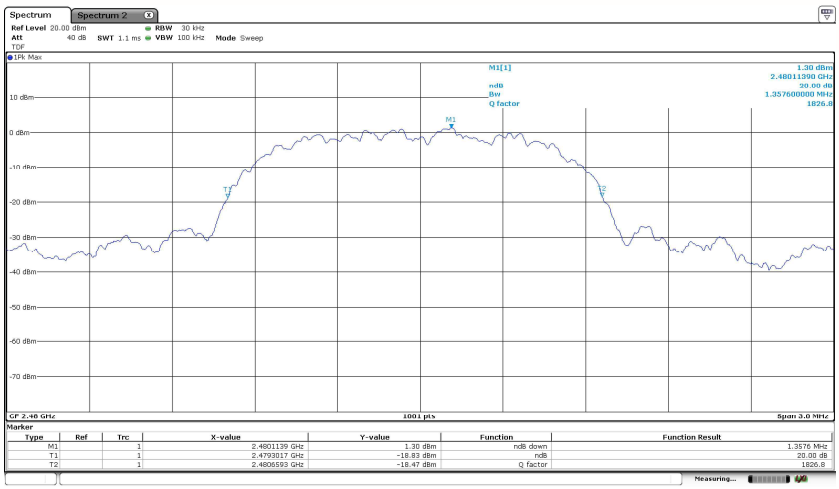
EDR(3M)	Test channel:	Lowest



EDR(3M)	Test channel:	Middle



EDR(3M)	Test channel:	Highest



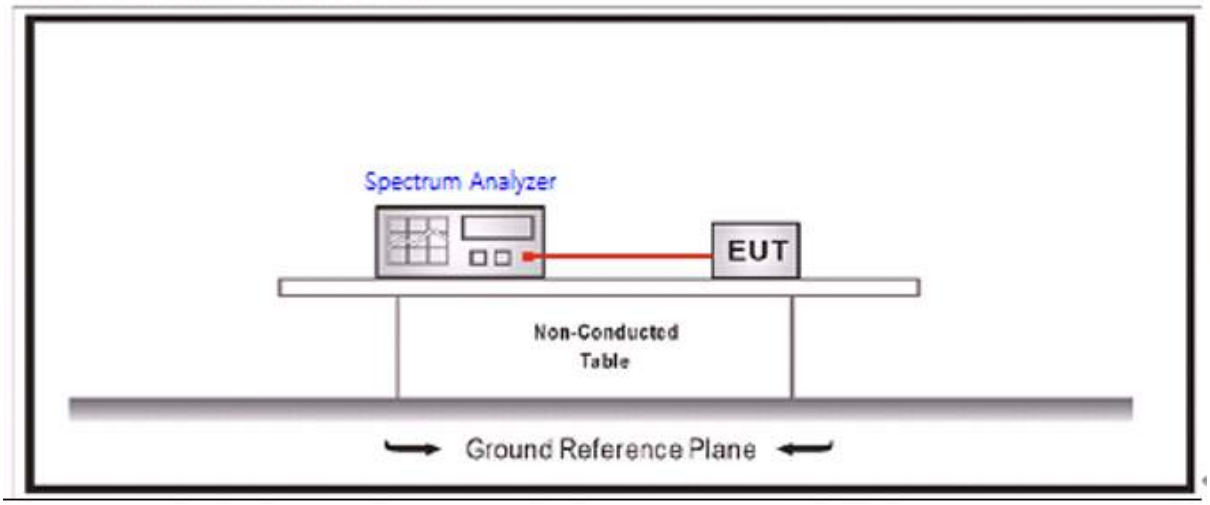
2.3 Carrier Frequency Separation

2.3.1 Limit

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

2.3.2 Test Configuration

RF Conducted Measurement:



2.3.3 Test Procedure

According to ANSI 63.10-2020 Section 7.8.2

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
a) Span: Wide enough to capture the peaks of two adjacent channels.
b) 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.
c) Video (or average) bandwidth VBW ≥ RBW .
d) Sweep: No faster than coupled (auto) time.
e) Detector function: Peak.
f) Trace: tvfax-hold.
g) Allow the trace to stabilize.

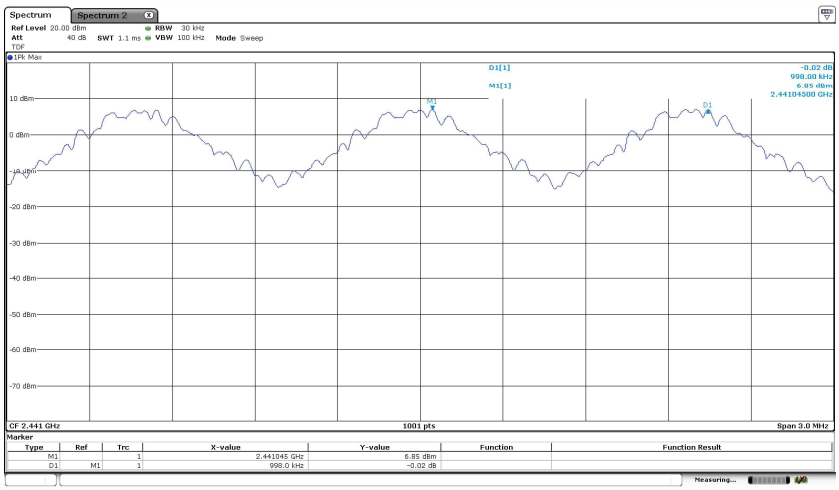
2.3.4 Test Result

Measurement Data

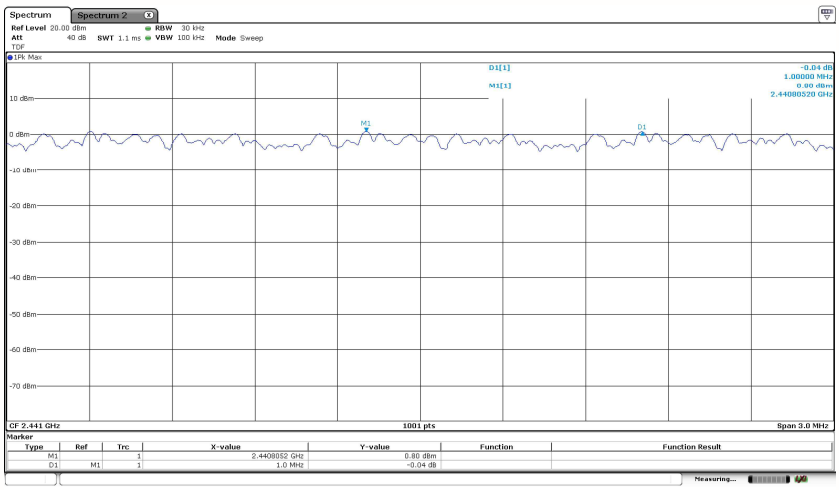
Test mode	Channel No.	Channel Separation (kHz)	Limit (kHz)
BDR	39	998	635.3
EDR(2M)	39	1000	919.3
EDR(3M)	39	1003	907.3
Test Result	**Pass**		

Channel Separation test plot as follows:

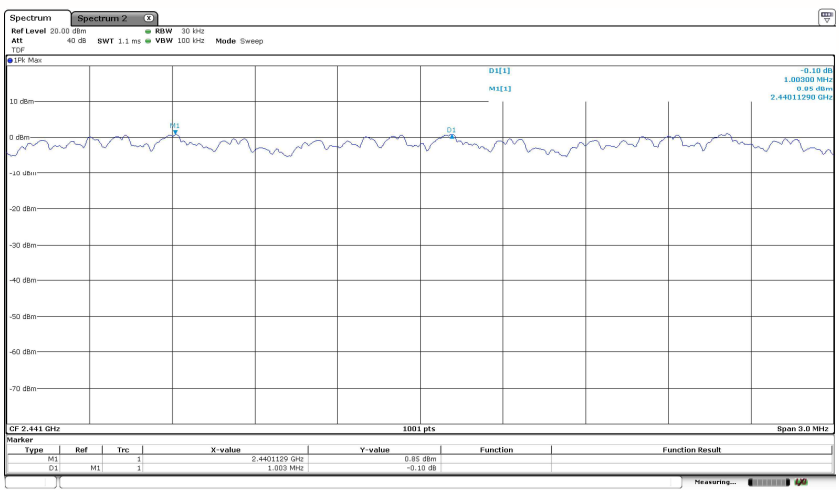
BDR	Test channel:	Middle



EDR(2M)	Test channel:	Middle



EDR(3M)	Test channel:	Middle



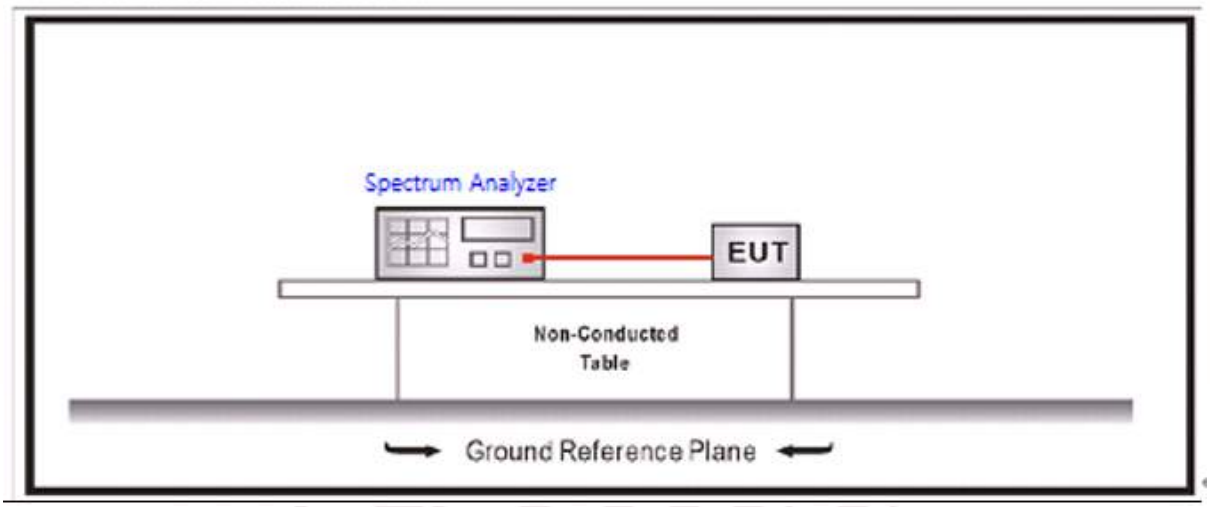
2.4 Number of Hopping Frequency

2.4.1 Limit

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

2.4.2 Test Configuration

RF Conducted Measurement:



2.4.3 Test Procedure

According to ANSI 63.10-2020 Section 7.8.3
The EUT shall have its hopping function enabled.
Use the following spectrum analyzer settings:

a) Span: The frequency band of operation. Depending on the number of channels the device supports, it could be necessary to divide the frequency range of operation across multiplespans, to allow the individual channels to be clearly seen.
b) 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.
c) VBW ≥ RBW
d) Sweep: No faster than coupled (auto) time.
e) Detector function: Peak.
f) Trace: max-hold.
g) Allow the trace to stabilize.

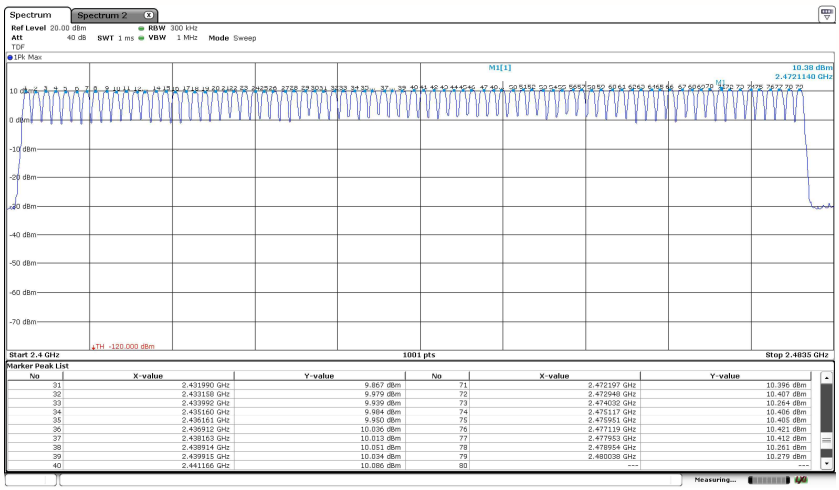
2.4.4 Test Result

Measurement Data

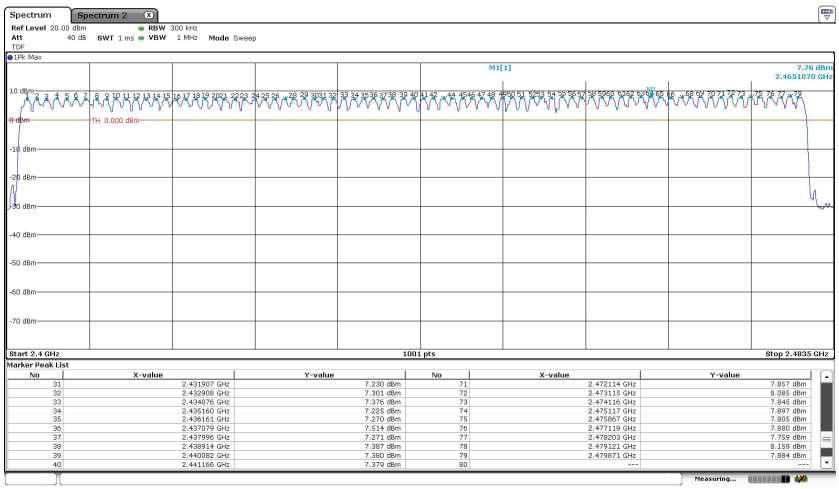
Test mode	Number of Hopping Frequency	Limit
BDR	79	15
EDR(2M)	79	
EDR(3M)	79	
Test Result	**Pass**	

Number of Hopping Frequency test plot as follows:

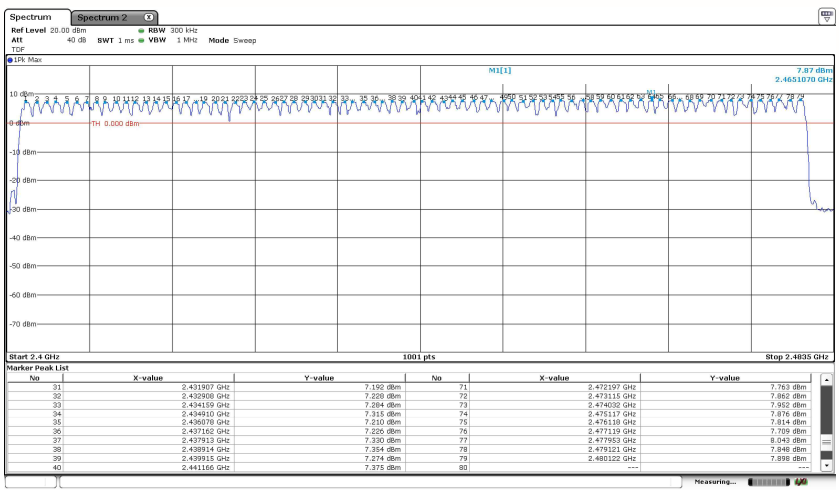
BDR	Test Mode:	Hopping



EDR(2M)	Test Mode:	Hopping



EDR(3M)	Test Mode:	Hopping



2.5 Time of Occupancy

2.5.1 Limit

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

A period time = 0.4(s) × 79 = 31.6(s)

Time of occupancy on the TX channel in 31.6 sec
= time domain slot length × (hop rate ÷ number of hop per channel) × 31.6

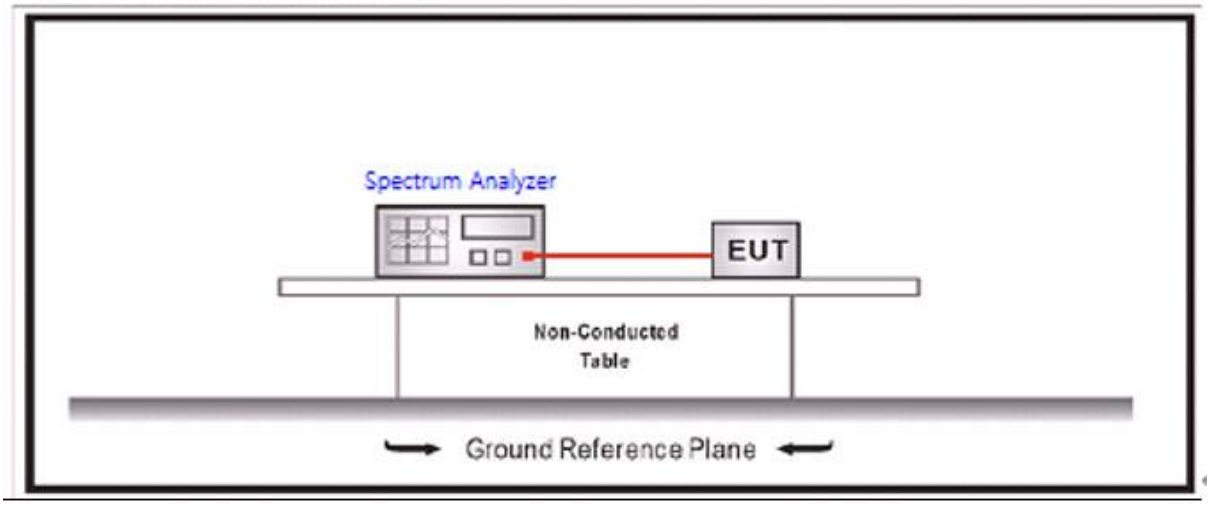
• Adaptive Frequency Hopping

A period time = 0.4(s) × 20 = 8.0(s)

Time of occupancy on the TX channel in 8.0 sec
= time domain slot length × (hop rate ÷ number of hop per channel) × 8.0

2.5.2 Test Configuration

RF Conducted Measurement:



2.5.3 Test Procedure

According to ANSI 63.10-2020 Section 7.8.4

a) Span: Zero span, centered on a hopping channel.
b) RBW shall be ≤ channel spacing and where possible RBW should be set >> I / T, where T is the expected transmission time per hop.
c) Sweep time: Set so that the start of the first transmission and end of the last transmission for the hop are clearly captured. Setting the sweep time to be slightly longer than the hopping period per channel (hopping period = I/hopping rate) should achieve this.
d) use a video trigger, where possible with a trigger delay, so that the start of the transmission is clearly observed. The trigger level might need adjustment to reduce the chance of triggering when the system hops on an adjacent channel.
e) Detector function: Peak.
t) Trace: Clear-write, single sweep.
g) Place markers at the start of the first transmission on the channel and at the end of the last transmission. The dwell time per hop is the time between these two markers.

2.5.4 Test Result

Measurement Data

Test mode	Packet Type	Dwell Time(ms)	Time of Occupancy on the Tx Channel (ms)	Limit (ms)
BDR	DH1	0.385	123.20	400
	DH3	1.639	262.24	
	DH5	2.891	308.37	
EDR(2M)	2-DH1	0.389	124.48	
	2-DH3	1.640	262.40	
	2-DH5	2.888	308.05	
EDR(3M)	3-DH1	0.389	124.48	
	3-DH3	1.637	261.92	
	3-DH5	2.889	308.16	
Test Result	**Pass**			

Note:

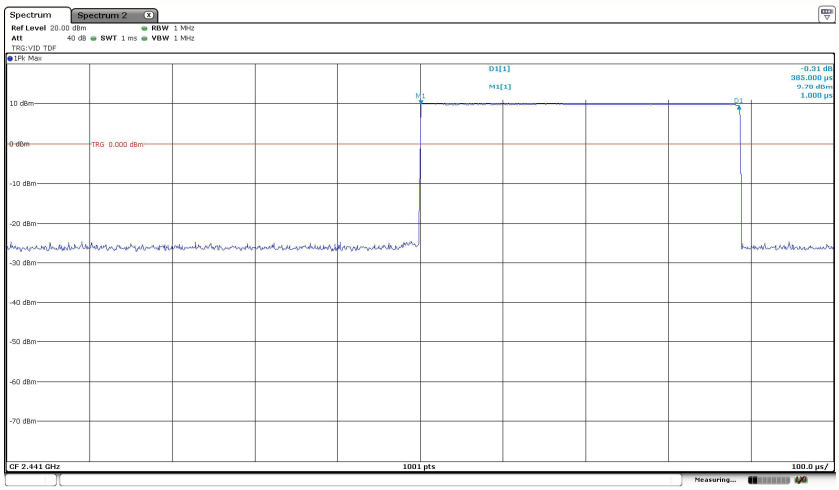
1. Normal Mode
DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 79] × 31.6(s) = 123.20 (ms)
DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 79] × 31.6(s) = 262.24 (ms)
DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 79] × 31.6(s) = 308.37 (ms)
2-DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 79] × 31.6(s) = 124.48 (ms)
2-DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 79] × 31.6(s) = 262.40 (ms)
2-DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 79] × 31.6(s) = 308.05 (ms)
3-DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 79] × 31.6(s) = 124.48 (ms)
3-DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 79] × 31.6(s) = 261.92 (ms)
3-DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 79] × 31.6(s) = 308.16 (ms)

2. AFH Mode
DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 20] × 8.0(s) = 123.20 (ms)
DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 20] × 8.0(s) = 262.24 (ms)
DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 20] × 8.0(s) = 308.37 (ms)
2-DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 20] × 8.0(s) = 124.48 (ms)
2-DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 20] × 8.0(s) = 262.40 (ms)
2-DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 20] × 8.0(s) = 308.05 (ms)
3-DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 20] × 8.0(s) = 124.48 (ms)
3-DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 20] × 8.0(s) = 261.92 (ms)
3-DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 20] × 8.0(s) = 308.16 (ms)

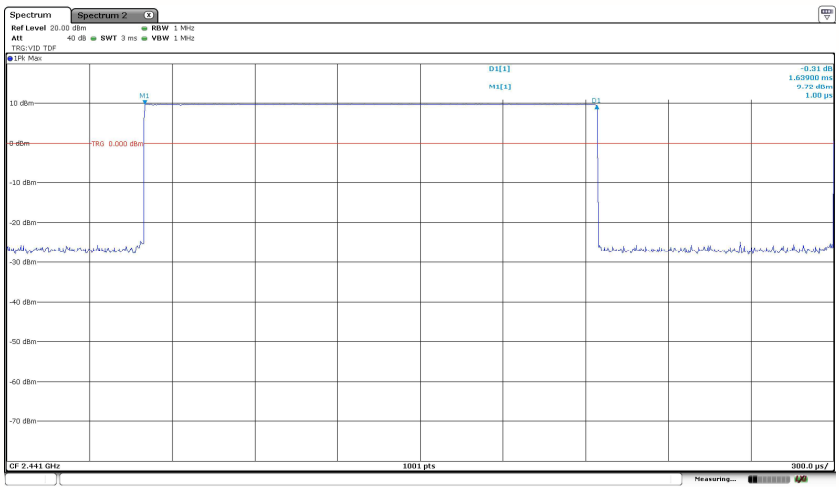
3. The dwell time was investigated with normal and AFH mode. And the dwell time of each mode is almost the same. So only data plot in normal mode is reported.

Time of Occupancy test plot as follows:

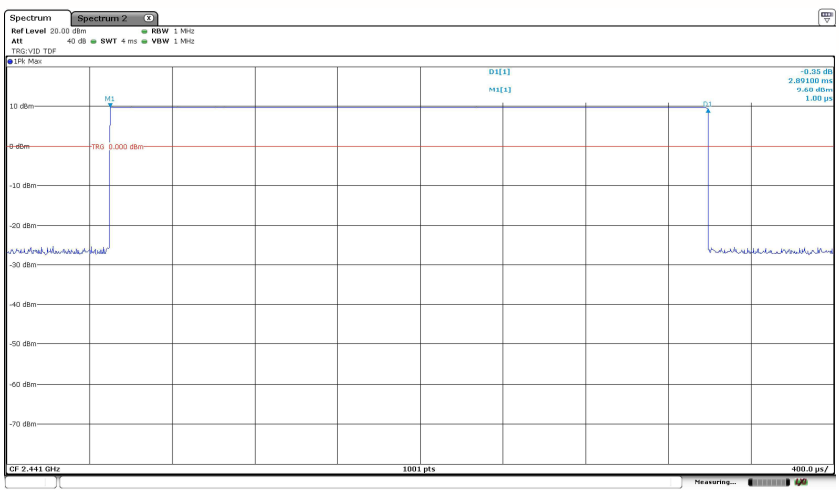
BDR	Test Mode:	DH1



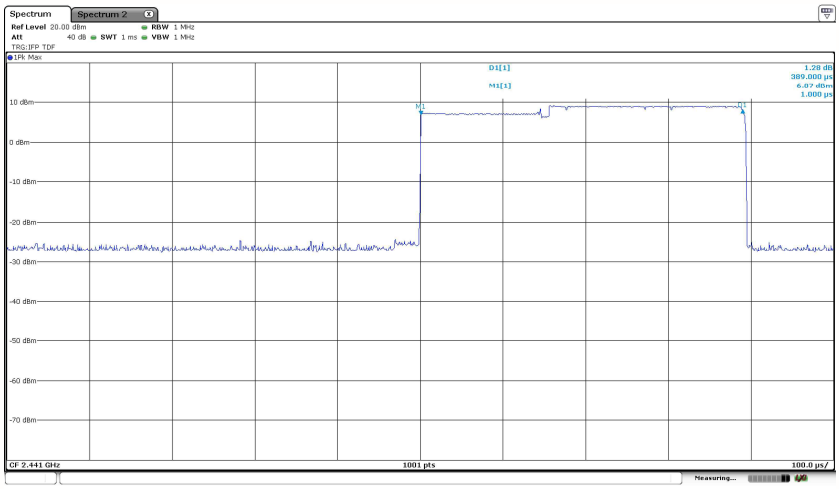
BDR	Test Mode:	DH3



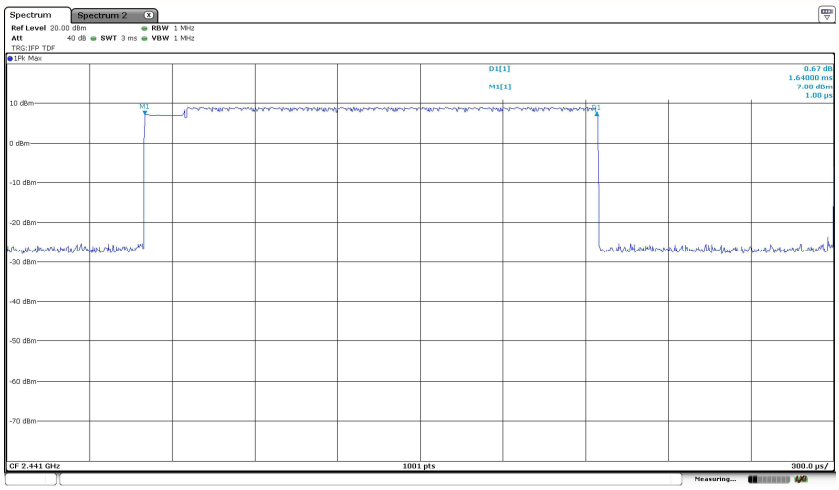
BDR	Test Mode:	DH5



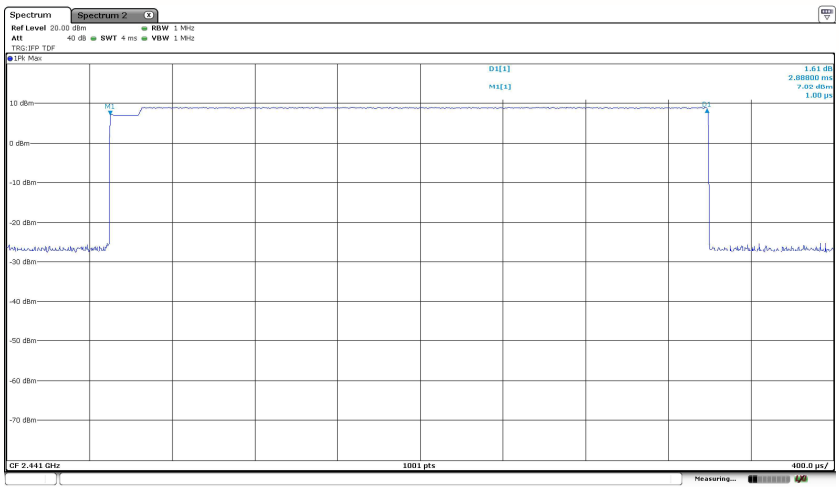
EDR(2M)	Test Mode:	2-DH1



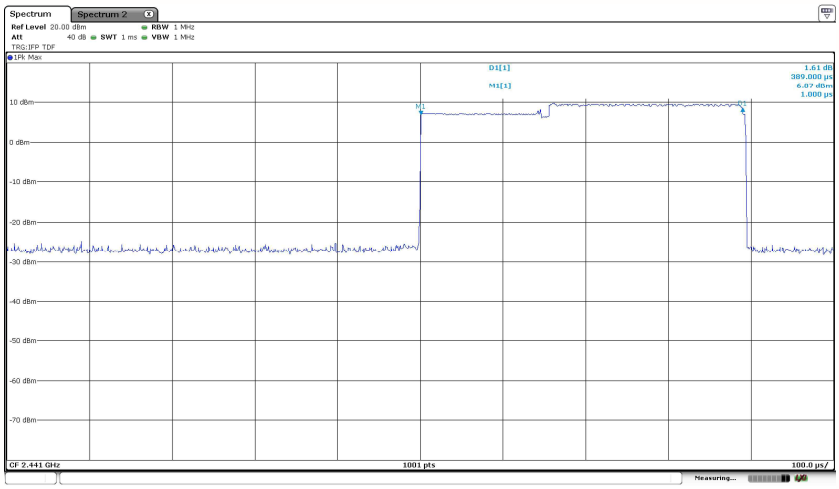
EDR(2M)	Test Mode:	2-DH3



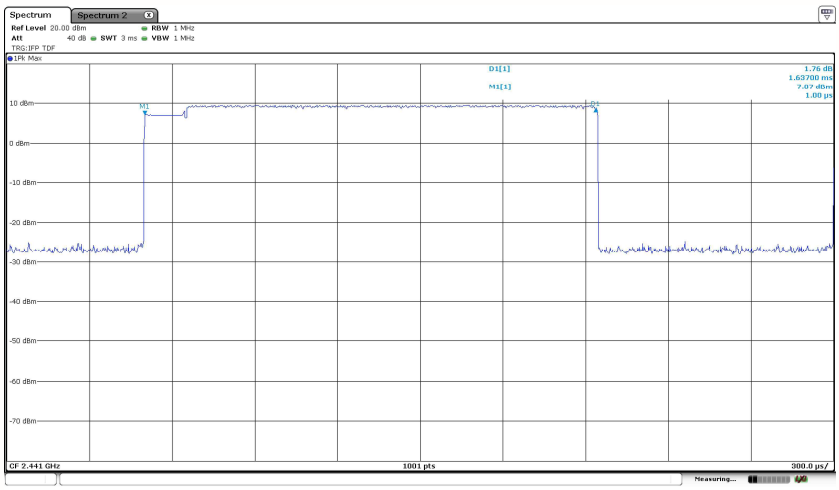
EDR(2M)	Test Mode:	2-DH5



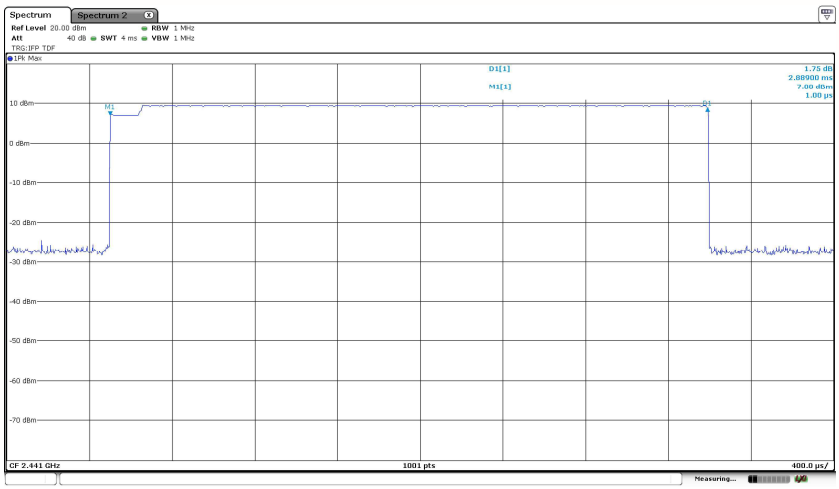
EDR(3M)	Test Mode:	3-DH1



EDR(3M)	Test Mode:	3-DH3



EDR(3M)	Test Mode:	3-DH5

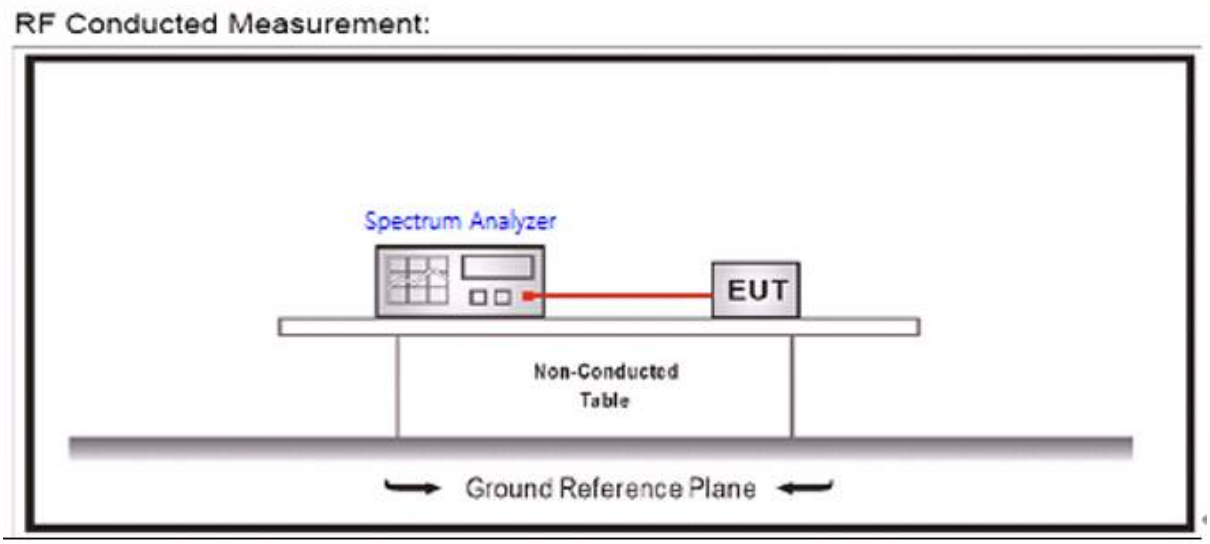


2.6 Conducted Emissions and Band Edge

2.6.1 Requirement

According to 15.247(d) and RSS-247 5.5, 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 base on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of thes section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in 15.209(a) is not required.

2.6.2 Test configuration



2.6.3 Test Procedure

The transmitter output is connected to a spectrum analyzer with RBW = 100 kHz, VBW = 300 kHz, peak detector, and max hold. Measurements utilizing these settings are made of the in-band reference level, bandedge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

2.6.4 Test Result

Test mode	Channel	Max. Out of band Emission	Carrier level	Calculated -20dBc limit
BDR	Lowest	-32.67	8.73	-11.27
	Middle	-32.42	9.19	-10.81
	Highest	-32.30	9.16	-10.84
EDR(2M)	Lowest	-33.03	4.43	-15.57
	Middle	-32.71	4.49	-15.51
	Highest	-33.19	5.23	-14.77
EDR(3M)	Lowest	-33.39	4.39	-15.61
	Middle	-32.26	5.01	-14.99
	Highest	-33.00	5.32	-14.68
Hopping(1M)	-	-33.66	9.16	-10.84
Hopping(2M)	-	-33.28	6.52	-13.48
Hopping(3M)	-	-33.00	6.53	-13.47