Test Report

Product Name	Communication Control Unit
Model No.	IMWW
FCC ID.	IPH-04484

Applicant	Garmin International Inc.
Address	1200 East 151st. Street Olathe KS 66062 United States Of America (Excluding The States Of Alaska

Date of Receipt	Sep. 06, 2022
Issued Date	Nov. 01, 2022
Report No.	2290126R-RFUSBT2V01-A
Report Version	V1.0

Testing Laboratory
3023

The test results relate only to the samples tested.
The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.
This report must not be used to claim product endorsement by TAF or any agency of the government.
The test report shall not be reproduced without the written approval of DEKRA Testing and Certification Co., Ltd.
Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

Test Report

Product Name	Communication Control Unit
Applicant	Garmin International Inc.
Address	1200 East 151st. Street Olathe KS 66062 United States Of America (Excluding The States Of Alaska
Manufacturer	Garmin Corporation
Model No.	IMWW
FCC ID.	IPH-04484
EUT Rated Voltage	DC 9-16V
EUT Test Voltage	AC 120V / 50Hz
Trade Name	GARMIN
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C ANSI C63.4: 2014, ANSI C63.10: 2013
Test Result	Complied

Documented By : April Chen

(Senior Project Specialist / April Chen)

Tested By : Bill Lin

(Senior Engineer / Bill Lin)

Approved By : Alan Chen

(Senior Engineer / Alan Chen)

TABLE OF CONTENTS

Revision History

Report No.	Version	Description	Issued Date
2290126R-RFUSBT2V01-A	V1.0	Initial issue of report.	Nov. 01, 2022

1. General Information

1.1. EUT Description

Product Name	Communication Control Unit
Trade Name	GARMIN
Model No.	IMWW
FCC ID.	IPH-04484
Frequency Range	2402 – 2480 MHz
Channel Number	Bluetooth V3.0, V2.1+EDR: 79
Type of Modulation	Bluetooth V3.0, V2.1+EDR: GFSK(1 Mbps) / π /4DQPSK(2 Mbps) / 8DPSK(3 Mbps)
Antenna Type	Chip
Channel Control	Auto
Antenna Gain	Refer to the Antenna List

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	INPAQ	VGAP-CLA-AS-A1	Chip	1.46 dBi for 2400 MHz

Note: The antenna of EUT conforms to FCC 15.203.

Center Frequency of Each Channel:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	01	2403	02	2404	03	2405
04	2406	05	2407	06	2408	07	2409
08	2410	09	2411	10	2412	11	2413
12	2414	13	2415	14	2416	15	2417
16	2418	17	2419	18	2420	19	2421
20	2422	21	2423	22	2424	23	2425
24	2426	25	2427	26	2428	27	2429
28	2430	29	2431	30	2432	31	2433
32	2434	33	2435	34	2436	35	2437
36	2438	37	2439	38	2440	39	2441
40	2442	41	2443	42	2444	43	2445
44	2446	45	2447	46	2448	47	2449
48	2450	49	2451	50	2452	51	2453
52	2454	53	2455	54	2456	55	2457
56	2458	57	2459	58	2460	59	2461
60	2462	61	2463	62	2464	63	2465
64	2466	65	2467	66	2468	67	2469
68	2470	69	2471	70	2472	71	2473
72	2474	73	2475	74	2476	75	2477
76	2478	77	2479	78	2480		

Note:

1. The EUT is a Bluetooth Headset with built-in Bluetooth (4.2 and V3.0, V2.1+EDR) transceiver, this report for Bluetooth V3.0, V2.1+EDR.
2. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.
3. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test
4. DEKRA has evaluated each test mode. Only the worst case is shown in the report.
5. These tests were conducted on a sample for the purpose of demonstrating compliance of transmitter with Part 15 Subpart C Paragraph 15.247 for spread spectrum devices.
6. The test mode is based on the Bluetooth technology, while testing 1Mbps, 2Mbps and 3Mbps, the worst case is 1Mbps and 3Mbps, and only worse case data is recorded in this report.

Test Mode	Mode 1	Transmit - 1 Mbps
		Transmit - 3 Mbps

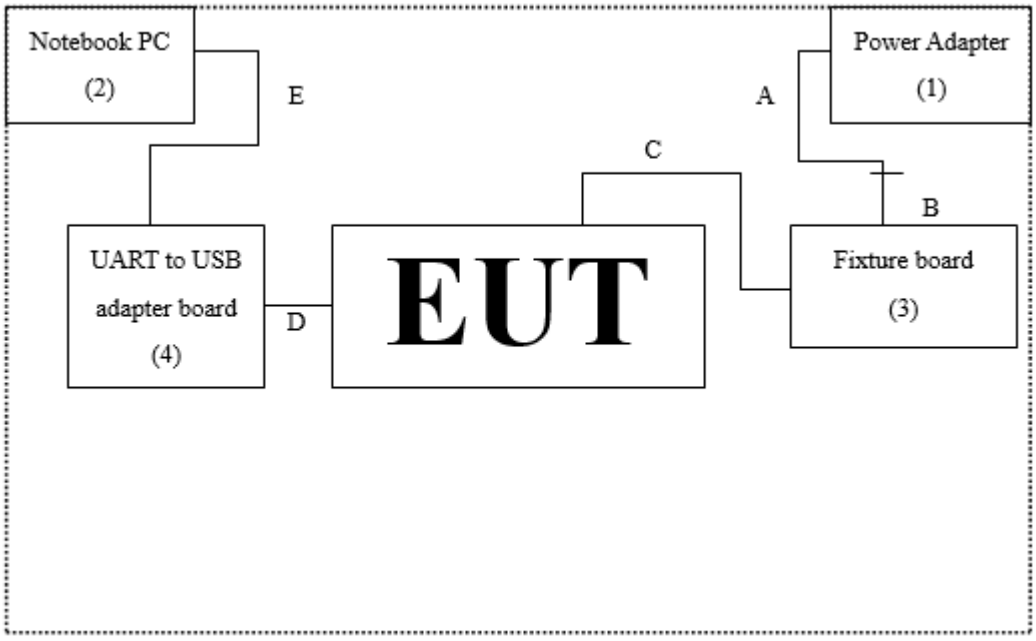
1.2. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	Power Adapter	PHIHONG	PSAC24A-120L6	N/A	N/A
2	Notebook PC	ASUS	P5430U	G8NXCV07J11032C	N/A
3	Fixture board	GARMIN	105-04151-00 VER 2	N/A	N/A
4	UART to USB adapter board	GARMIN	EPCB-0000721 GARMIN V3	N/A	N/A

Signal Cable Type		Signal cable Description
A	Power Cable	Non-Shielded, 1.5m
B	Fixture board Cable	Non-Shielded, 0.1m
C	Signal Cable	Non-Shielded, 0.4m
D	UART adapter cable	Non-Shielded, 0.4m
E	USB A to mini-B cable	Shielded, 0.5m

1.3. Configuration of Tested System



1.4. EUT Exercise Software

1. Setup the EUT as shown in Section 1.3.
2. Execute software “CyBluetool Ver.0.1.97.1” on the Notebook PC.
3. Configure the test mode, the test channel, and the data rate.
4. Press “OK” to start the continuous Transmit.
5. Verify that the EUT works properly.

1.5. Test Facility

Ambient conditions in the laboratory:

Performed Item	Items	Required	Actual
Conducted Emission	Temperature (°C)	10~40 ℃	24.5 ℃
	Humidity (%RH)	10~90 %	56.2 %
Radiated Emission	Temperature (°C)	10~40 ℃	23.4 ℃
	Humidity (%RH)	10~90 %	59.5 %
Conductive	Temperature (°C)	10~40 ℃	24.0 ℃
	Humidity (%RH)	10~90 %	56.0 %

USA : FCC Registration Number: TW0033

Canada : CAB Identifier Number: TW3023 / Company Number: 26930

Site Description : Accredited by TAF
Accredited Number: 3023

Test Laboratory : DEKRA Testing and Certification Co., Ltd
Address : No. 5-22, Ruishukeng Linkou District, New Taipei City, 24451, Taiwan
Performed Location : No. 26, Huaya 1st Rd., Guishan Dist.,Taoyuan City 333411, Taiwan, R.O.C.
Phone Number : +886-3-275-7255
Fax Number : +886-3-327-8031
Email Address : info.tw@dekra.com
Website : http://www.dekra.com.tw

1.6. List of Test Equipment

For Conduction Measurements /HY-SR01

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
V	EMI Test Receiver	R&S	ESR7	101601	2022/06/23	2023/06/22
V	Two-Line V-Network	R&S	ENV216	101306	2022/05/23	2023/05/22
V	Two-Line V-Network	R&S	ENV216	101307	2022/05/04	2023/05/03
V	Coaxial Cable	SUHNER	RG400_BNC	RF001	2022/05/24	2023/05/23

Note:
1. All equipments are calibrated every one year.
2. The test instruments marked with "V" are used to measure the final test results.
3. Test Software Version : E3 210616 dekra V9.

For Conducted Measurements /HY-SR02

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
V	Spectrum Analyzer	R&S	FSV40	101149	2022/10/03	2023/03/24
V	Peak Power Analyzer	KEYSIGHT	8990B	MY51000410	2022/08/06	2023/08/05
V	Wideband Power Sensor	KEYSIGHT	N1923A	MY56080003	2022/08/05	2023/08/04
V	Wideband Power Sensor	KEYSIGHT	N1923A	MY56080004	2022/08/05	2023/08/04

Note:
1. All equipments are calibrated every one year.
2. The test instruments marked with "V" are used to measure the final test results.
3. Test Software Version : RF Conducted Test Tools R3 V3.0.1.19.

For Radiated Measurements /HY-CB03

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
	Loop Antenna	AMETEK	HLA6121	49611	2022/03/18	2023/03/17
V	Bi-Log Antenna	SCHWARZBECK	VULB9168	9168-675	2021/08/11	2023/08/10
V	Horn Antenna	RF SPIN	DRH18-E	210503A18ES	2022/06/08	2023/06/07
V	Horn Antenna	Com-Power	AH-840	101100	2021/10/04	2023/10/03
V	Pre-Amplifier	SGH	0301-9	20211007-11	2022/02/22	2023/02/21
V	Pre-Amplifier	EMCI	EMC051835SE	980632	2021/09/07	2022/09/06
V	Pre-Amplifier	EMCI	EMC05820SE	980285	2021/12/16	2022/12/15
	Pre-Amplifier	EMCI	EMC184045SE	980369	2022/05/12	2023/05/11
	Coaxial Cable	EMCI	EMC102-KM-KM-600	1160314		
	Coaxial Cable	EMCI	EMC102-KM-KM-7000	170242		
V	Filter	MICRO TRONICS	BRM50702	G251	2021/09/16	2022/09/15
	Filter	MICRO TRONICS	BRM50716	G188	2021/09/16	2022/09/15
V	EMI Test Receiver	R&S	ESR	102793	2021/12/15	2022/12/14
V	Spectrum Analyzer	R&S	FSV3044	101114	2022/02/11	2023/02/10
V	Coaxial Cable	SGH	HA800	GD20110223-2	2022/01/05	2023/01/04
	Coaxial Cable	SGH	HA800	GD20110222-4		
	Coaxial Cable	SGH	SGH18	2021005-2		
	Coaxial Cable	SGH	SGH18	202108-5		

Note:
1. Bi-Log Antenna and Horn Antenna(AH-840) is calibrated every two years, the other equipments are calibrated every one year.
2. The test instruments marked with "V" are used to measure the final test results.
3. Test Software Version : E3 210616 dekra V9.

1.7. Uncertainty

Uncertainties have been calculated according to the DEKRA internal document.

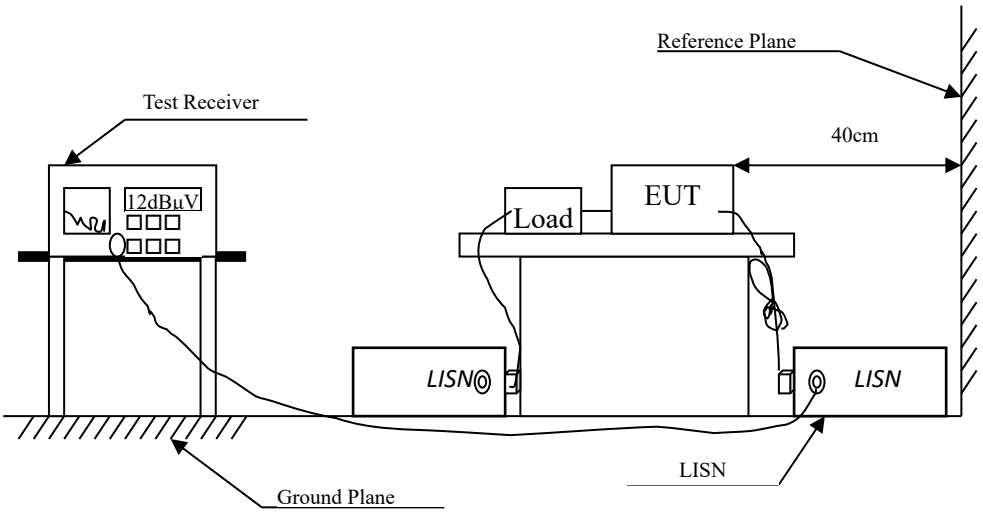
The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

Test item	**Uncertainty**	
Conducted Emission	±3.42 dB	
Peak Power Output	±0.89 dB	
Radiated Emission	Under 1GHz ±4.05 dB	Under 1GHz ±4.05 dB
RF Antenna Conducted Test	±2.06 dB	
Band Edge	Under 1GHz ±4.05 dB	Under 1GHz ±4.05 dB
Channel Number	±1544.74 Hz	
Channel Separation	N/A	
Dwell Time	±2.31 ms	
Occupied Bandwidth	±1544.74 Hz	
Duty Cycle	±2.31 ms	

2. Conducted Emission

2.1. Test Setup



2.2. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dBµV) Limit		
Frequency MHz	Limits	
	QP	AV
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

Remarks: In the above table, the tighter limit applies at the band edges.

2.3. Test Procedure

The EUT and Peripherals are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs.)

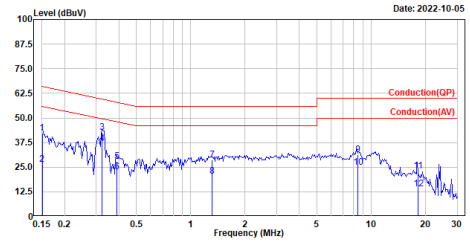
Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15 MHz to 30 MHz using a receiver bandwidth of 9 kHz.

The EUT setup and the test procedure are according to ANSI C63.4, 2014 to comply with the requirements of FCC 47CFR Subpart C.

2.4. Test Result of Conducted Emission

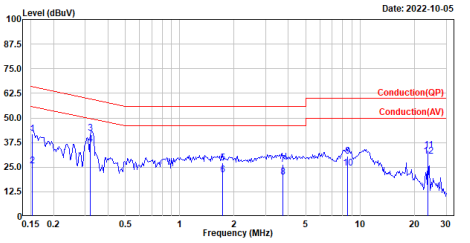
Site :HY-SR01
Condition :Line
Mode :BT3M_2441MHz_TX
test by :Daniel



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	0.150	42.20	65.97	-23.77	32.52	9.68	QP
2	0.150	26.56	55.97	-29.41	16.88	9.68	Average
3	0.321	42.71	59.67	-16.96	33.04	9.67	QP
4	0.321	37.05	49.67	-12.62	27.38	9.67	Average
5	0.390	28.02	58.06	-30.04	18.34	9.68	QP
6	0.390	22.64	48.06	-25.42	12.96	9.68	Average
7	1.319	28.66	56.00	-27.34	18.91	9.75	QP
8	1.319	20.52	46.00	-25.48	10.77	9.75	Average
9	8.466	31.28	60.00	-28.72	20.47	10.81	QP
10	8.466	24.99	50.00	-25.01	14.18	10.81	Average
11	18.155	23.18	60.00	-36.82	12.46	10.72	QP
12	18.155	14.14	50.00	-35.86	3.42	10.72	Average

Note:
1. Level = Read Level + Factor
2. Factor = LISN insertion loss + Cable loss
3. Over Limit = Level - Limit Line

Site :HY-SR01
Condition :Neutral
Mode :BT3M_2441MHz_TX
test by :Daniel

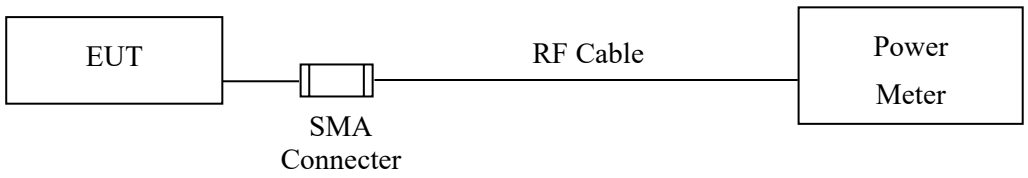


No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	0.152	41.96	65.87	-23.91	32.30	9.66	QP
2	0.152	25.84	55.87	-30.03	16.18	9.66	Average
3	0.321	42.12	59.67	-17.55	32.47	9.65	QP
4	0.321	36.64	49.67	-13.03	26.99	9.65	Average
5	1.737	27.30	56.00	-28.70	17.52	9.78	QP
6	1.737	21.21	46.00	-24.79	11.43	9.78	Average
7	3.742	26.35	56.00	-29.65	15.96	10.39	QP
8	3.742	19.98	46.00	-26.02	9.59	10.39	Average
9	8.511	30.49	60.00	-29.51	19.69	10.80	QP
10	8.511	24.48	50.00	-25.52	13.68	10.80	Average
11	23.781	33.61	60.00	-26.39	22.90	10.71	QP
12	23.781	30.64	50.00	-19.36	19.93	10.71	Average

Note:
1. Level = Read Level + Factor
2. Factor = LISN insertion loss + Cable loss
3. Over Limit = Level - Limit Line

3. Peak Power Output

3.1. Test Setup



3.2. Limit

The maximum peak power shall be less 1Watt.

3.3. Test Procedure

Tested according to FHSS test procedure of KDB 558074 section 9 (b for compliance to FCC 47CFR 15.247 requirements.

3.4. Test Result of Peak Power Output

Product : Communication Control Unit
Test Item : Peak Power Output
Test Mode : Transmit - 1 Mbps
Test Date : 2022/10/03

Channel No.	Frequency (MHz)	Measurement (dBm)	Required Limit	Result
00	2402	1.25	1 Watt= 30 dBm	Pass
39	2441	1.20	1 Watt= 30 dBm	Pass
78	2480	1.16	1 Watt= 30 dBm	Pass

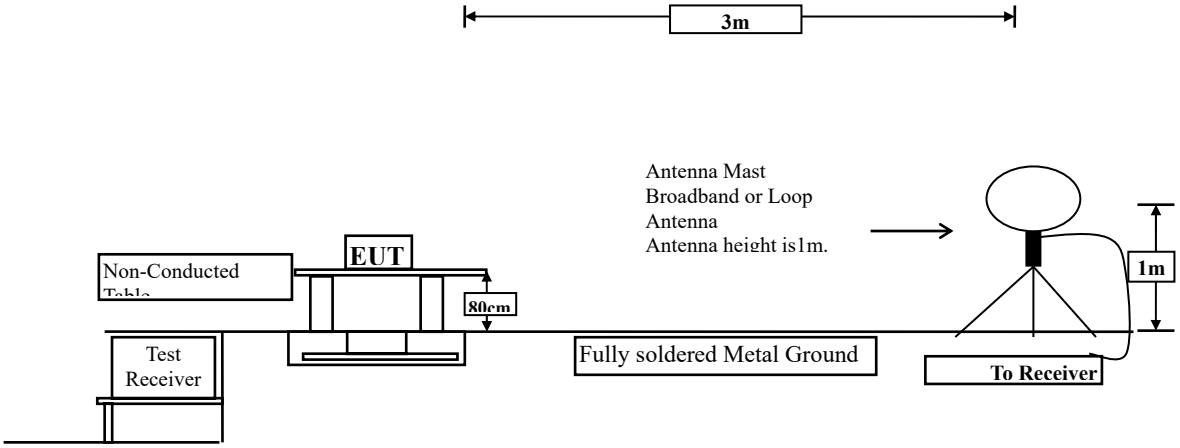
Product : Communication Control Unit
Test Item : Peak Power Output
Test Mode : Transmit - 3 Mbps
Test Date : 2022/10/03

Channel No.	Frequency (MHz)	Measurement (dBm)	Required Limit	Result
00	2402	1.29	1 Watt= 30 dBm	Pass
39	2441	1.47	1 Watt= 30 dBm	Pass
78	2480	1.39	1 Watt= 30 dBm	Pass

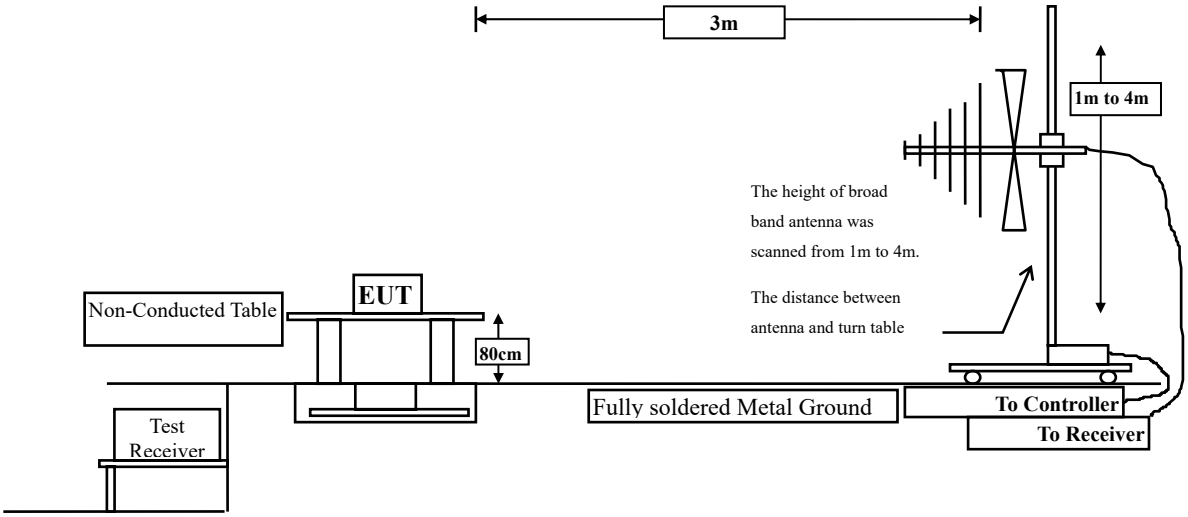
4. Radiated Emission

4.1. Test Setup

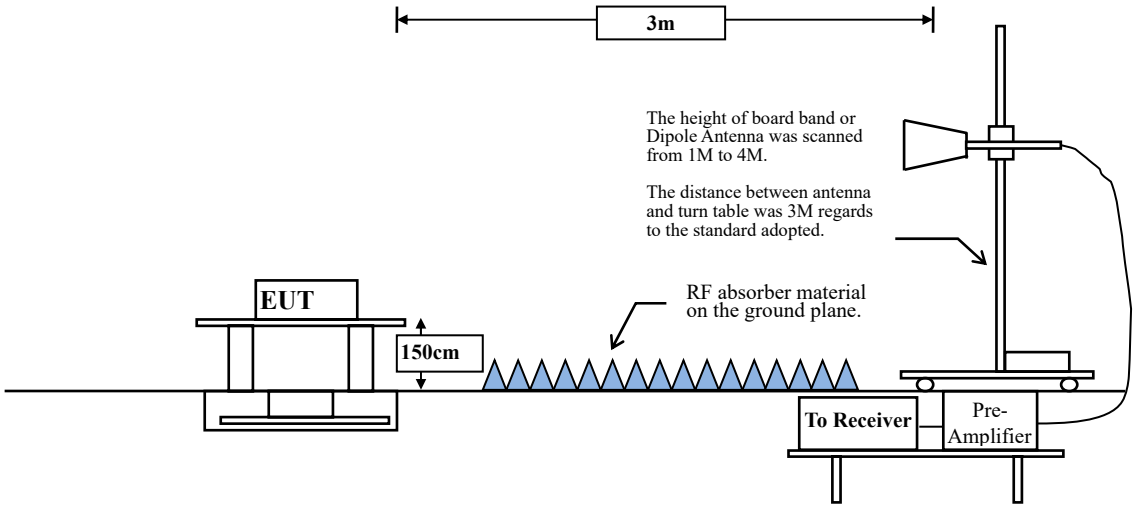
Radiated Emission Under 30MHz



Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



4.2. Limits

➢ **General Radiated Emission Limits**

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209 Limits		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks:

1. RF Voltage (dBμV) = 20 log RF Voltage (uV)
2. In the Above Table, the tighter limit applies at the band edges.
3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

4.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested compliance to FCC 47CFR 15.247 requirements.

Measuring the frequency range below 1 GHz, the EUT is placed on a turn table which is 0.8 meter above ground, when measuring the frequency range above 1 GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

The turn table is rotated 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2013 on radiated measurement.

The resolution bandwidth below 30 MHz setting on the field strength meter is 9 kHz and 30 MHz~1 GHz is 120 kHz and above 1 GHz is 1 MHz.

Radiated emission measurements below 30 MHz are made using Loop Antenna and 30 MHz~1 GHz are made using broadband Bilog antenna and above 1 GHz are made using Horn Antennas.

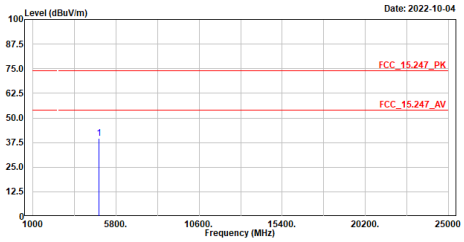
The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.

The measurement frequency range form 9 kHz - 10th Harmonic of fundamental was investigated.

4.4. Test Result of Radiated Emission

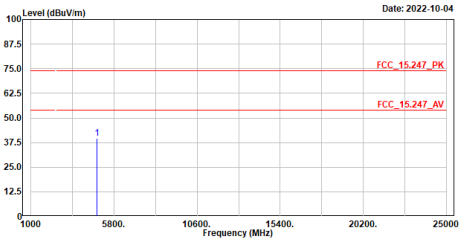
Site :HY-CB03
Condition :3m ,HORIZONTAL
Mode :TX_bt1M_2402MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4804.000	39.46	74.00	-34.54	54.10	-14.64	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

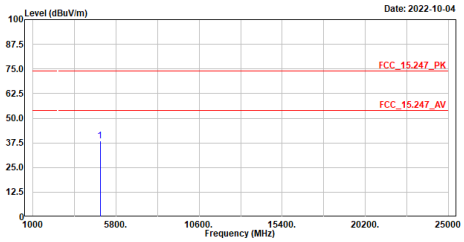
Site :HY-CB03
Condition :3m ,VERTICAL
Mode :TX_bt1M_2402MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4804.000	39.69	74.00	-34.31	54.33	-14.64	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

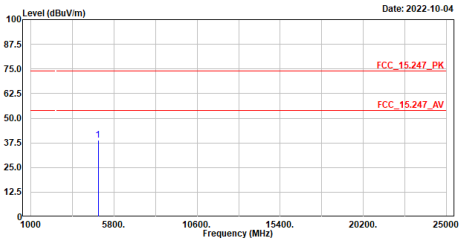
Site :HY-CB03
Condition :3m ,HORIZONTAL
Mode :TX_bt1M_2441MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4882.000	38.66	74.00	-35.34	53.00	-14.34	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

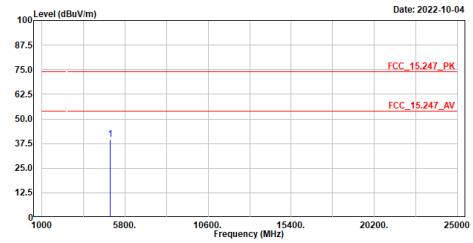
Site :HY-CB03
Condition :3m ,VERTICAL
Mode :TX_bt1M_2441MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4882.000	39.00	74.00	-35.00	53.34	-14.34	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

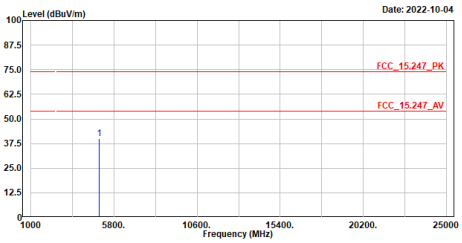
Site :HY-CB03
Condition :3m ,HORIZONTAL
Mode :TX_bt1M_2480MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4960.000	39.48	74.00	-34.52	53.44	-13.96	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

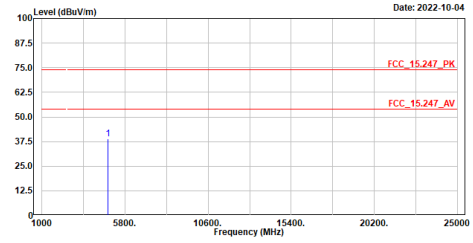
Site :HY-CB03
Condition :3m ,VERTICAL
Mode :TX_bt1M_2480MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4960.000	40.15	74.00	-33.85	54.11	-13.96	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

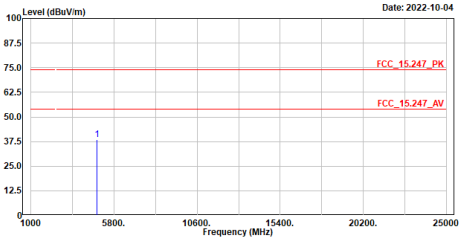
Site :HY-CB03
Condition :3m ,HORIZONTAL
Mode :TX_bt3M_2402MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4804.000	38.72	74.00	-35.28	53.36	-14.64	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

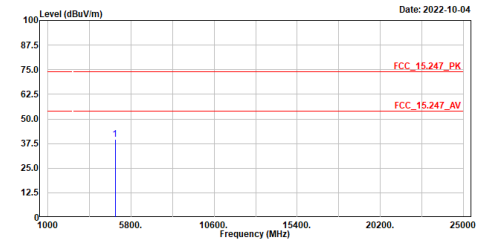
Site :HY-CB03
Condition :3m ,VERTICAL
Mode :TX_bt3M_2402MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4804.000	38.64	74.00	-35.36	53.28	-14.64	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

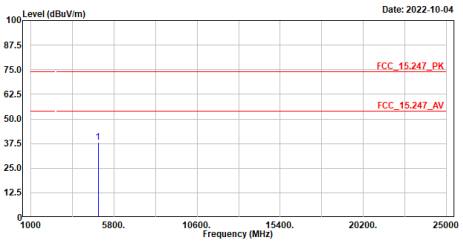
Site :HY-CB03
Condition :3m ,HORIZONTAL
Mode :TX_bt3M_2441MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4882.000	39.64	74.00	-34.36	53.98	-14.34	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

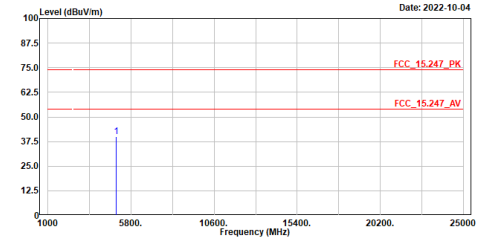
Site :HY-CB03
Condition :3m ,VERTICAL
Mode :TX_bt3M_2441MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4882.000	37.95	74.00	-36.05	52.29	-14.34	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

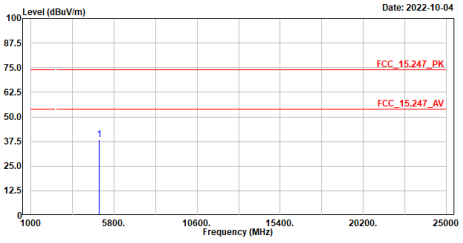
Site :HY-CB03
Condition :3m ,HORIZONTAL
Mode :TX_bt3M_2480MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4960.000	39.88	74.00	-34.12	53.84	-13.96	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

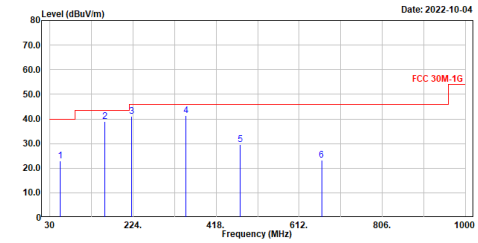
Site :HY-CB03
Condition :3m ,VERTICAL
Mode :TX_bt3M_2480MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4960.000	38.47	74.00	-35.53	52.43	-13.96	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

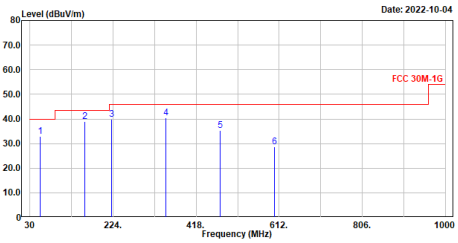
Site :HY-CB03
Condition :3m ,HORIZONTAL
Mode :TX_bt3M_2441MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	53.280	23.01	40.00	-16.99	47.36	-24.35	QP
2	158.040	38.91	43.50	-4.59	63.20	-24.29	QP
3	221.090	40.98	46.00	-5.02	67.99	-27.01	QP
4	347.190	41.44	46.00	-4.56	64.09	-22.65	QP
5	474.260	29.54	46.00	-16.46	48.83	-19.29	QP
6	664.380	23.37	46.00	-22.63	38.98	-15.61	QP

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

Site :HY-CB03
Condition :3m ,VERTICAL
Mode :TX_bt3M_2441MHz
Test BY :Jing Chang

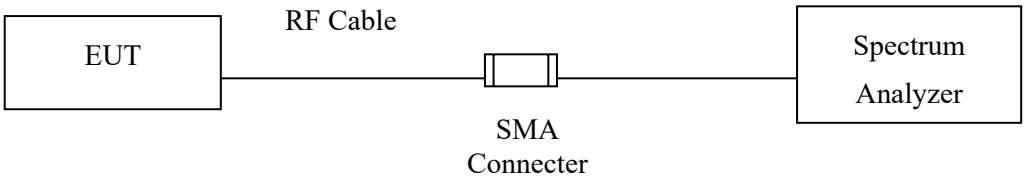


No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	53.280	32.82	40.00	-7.18	57.17	-24.35	QP
2	158.040	39.06	43.50	-4.44	63.35	-24.29	QP
3	221.090	39.70	46.00	-6.30	66.71	-27.01	QP
4	348.160	40.53	46.00	-5.47	63.18	-22.65	QP
5	474.260	35.29	46.00	-10.71	54.58	-19.29	QP
6	601.330	28.68	46.00	-17.32	44.95	-16.27	QP

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

5. RF Antenna Conducted Test

5.1. Test Setup



5.2. Limits

According to FCC Section 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 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, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

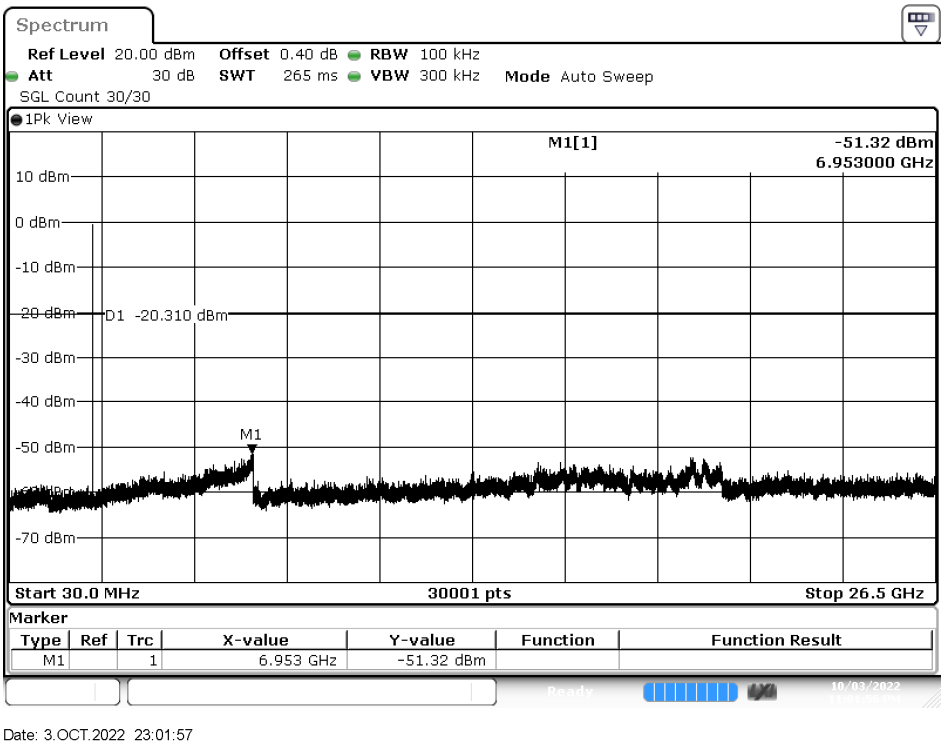
5.3. Test Procedure

Tested according to FHSS test procedure of KDB558074 section 9 b) for compliance to FCC 47CFR 15.247 requirements.

5.4. Test Result of RF Antenna Conducted Test

Product	:	Communication Control Unit
Test Item	:	RF Antenna Conducted Test
Test Mode	:	Transmit - 1 Mbps
Test Date	:	2022/10/03

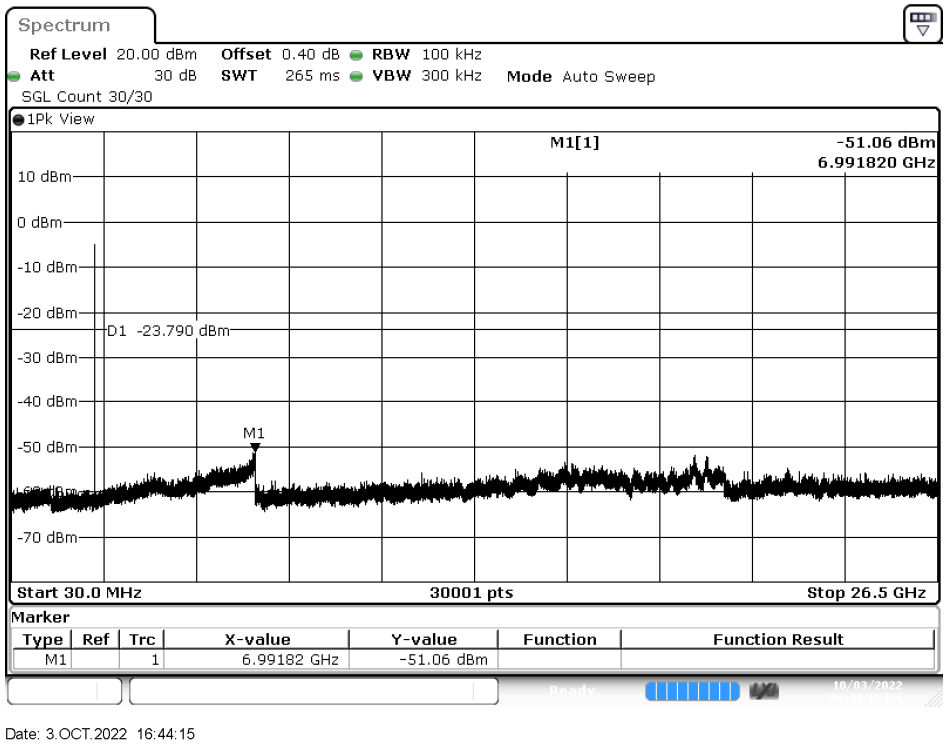
Figure Channel 00:



Note: The above test pattern is synthesized by multiple of the frequency range.

Product	:	Communication Control Unit
Test Item	:	RF Antenna Conducted Test
Test Mode	:	Transmit - 3 Mbps
Test Date	:	2022/10/03

Figure Channel 00:



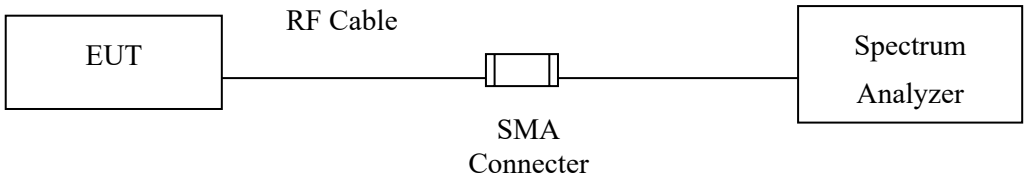
Date: 3.OCT.2022 16:44:15

Note: The above test pattern is synthesized by multiple of the frequency range.

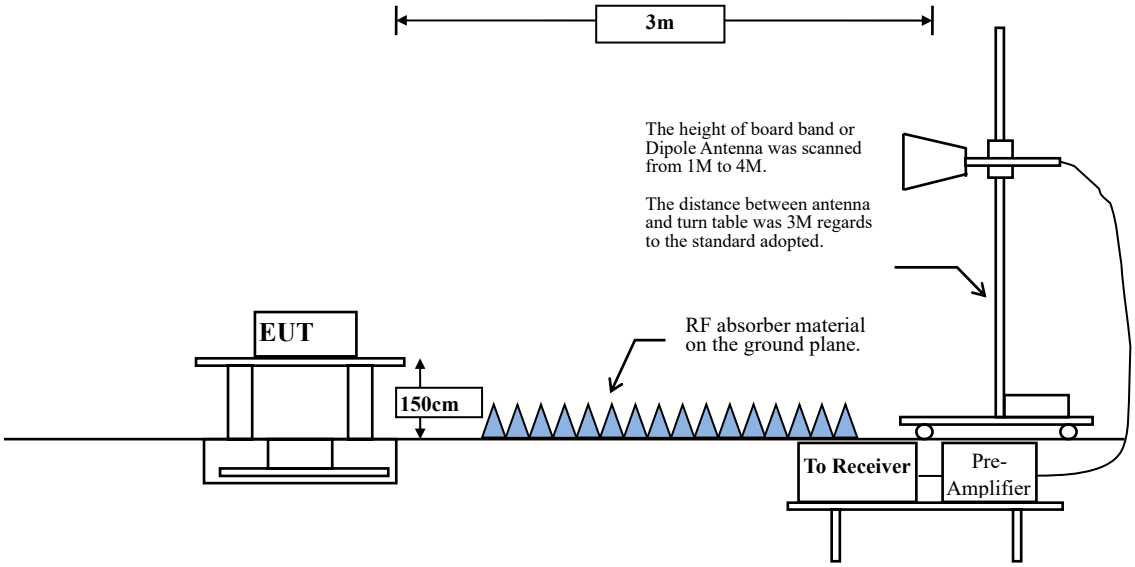
6. Band Edge

6.1. Test Setup

RF Conducted Measurement



RF Radiated Measurement:



6.2. Limit

According to FCC Section 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 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, 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 emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

6.3. Test Procedure

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

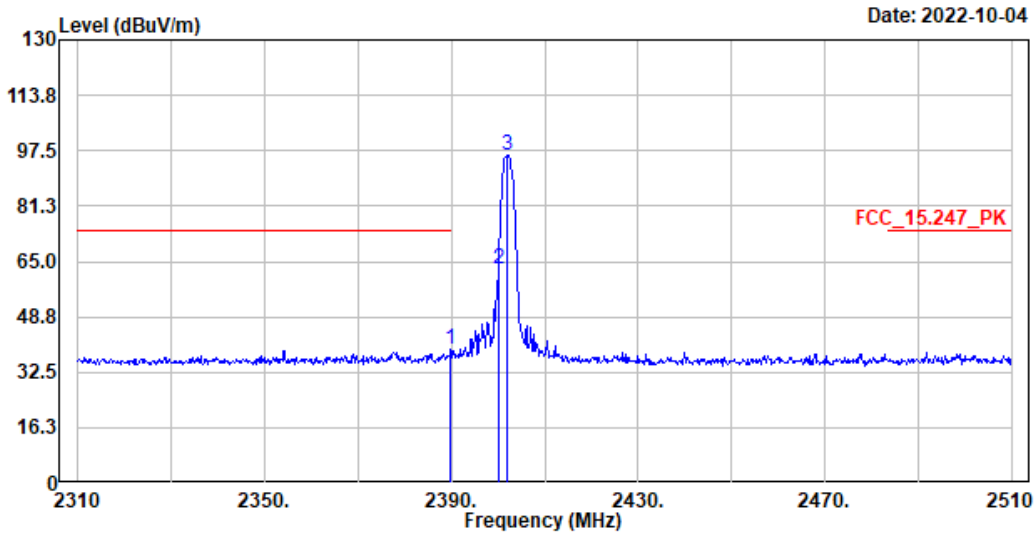
The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.

The bandwidth setting below 1 GHz and above 1 GHz on the field strength meter is 120 kHz and 1MHz, respectively.

6.4. Test Result of Band Edge

```
Site       :HY-CB03
Condition  :3m    ,Horizontal
Mode       :TX_bt1M_2402MHz
Test BY    :Ashton Chiu
```



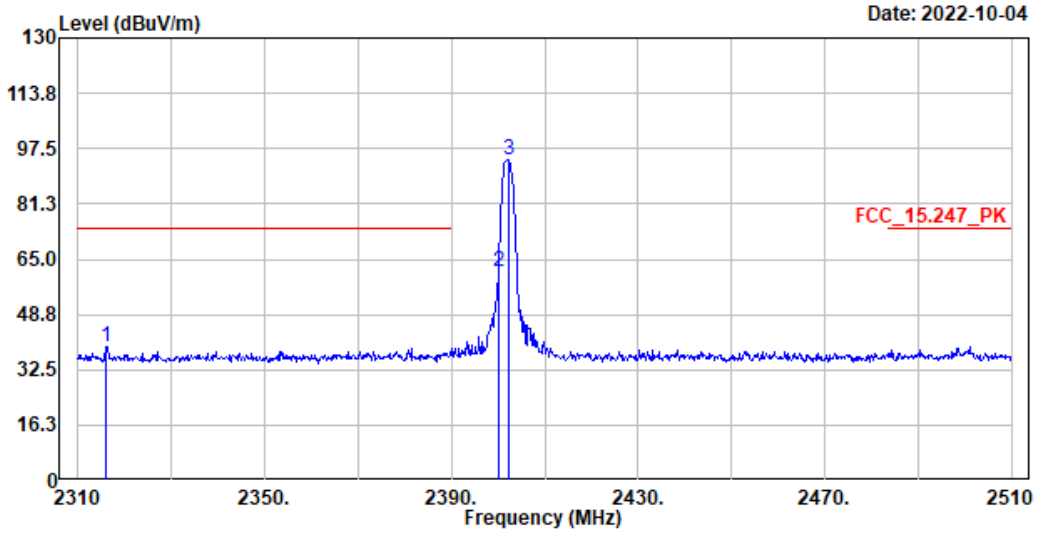
No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2389.800	39.06	74.00	-34.94	32.52	6.54	Peak
2	2400.000	62.71	------	------	56.18	6.53	Peak
3	2402.000	96.21	------	------	89.68	6.53	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

Horizontal -Average Detector:

Frequency (MHz)	Peak Measurement (dBµV/m)	Duty Cycle Factor (dB)	Measurement Level (dBµV/m)	Margin (dB)	Limit (dBµV/m)
2389.8	39.06	-24.437	14.623	-39.377	54.000
2400	62.71	-24.437	38.273	--	--
2402	96.21	-24.437	71.773	--	--

Site :HY-CB03
Condition :3m ,Vertical
Mode :TX_bt1M_2402MHz
Test BY :Ashton Chiu



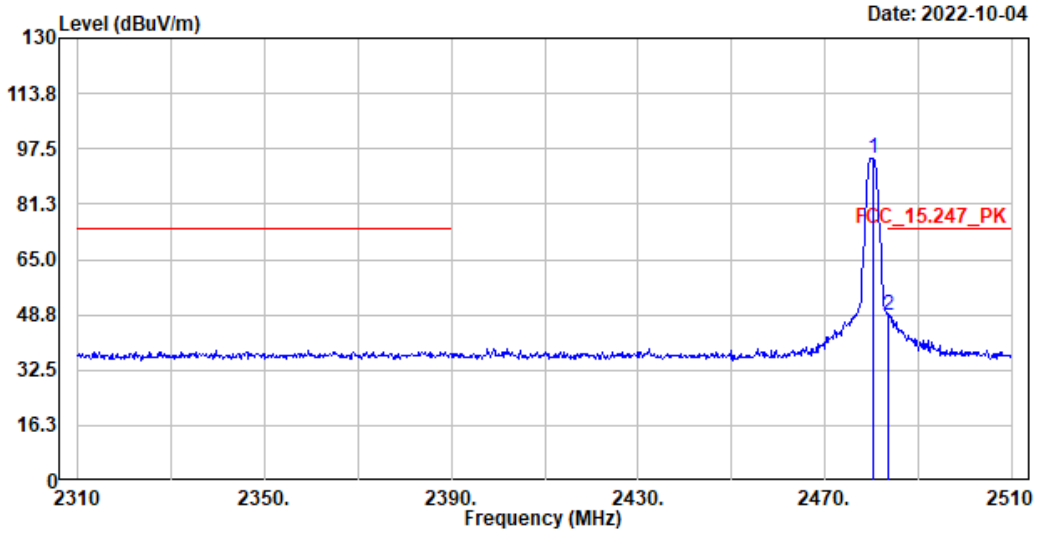
No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2316.200	39.02	74.00	-34.98	32.43	6.59	Peak
2	2400.000	61.13	------	------	54.60	6.53	Peak
3	2402.200	94.12	------	------	87.59	6.53	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

Vertical -Average Detector:

Frequency (MHz)	Peak Measurement (dBµV/m)	Duty Cycle Factor (dB)	Measurement Level (dBµV/m)	Margin (dB)	Limit (dBµV/m)
2316.2	39.02	-24.437	14.583	-39.417	54.000
2400	61.13	-24.437	36.693	--	--
2402.2	94.12	-24.437	69.683	--	--

Site :HY-CB03
Condition :3m ,Horizontal
Mode :TX_bt1M_2480MHz
Test BY :Ashton Chiu



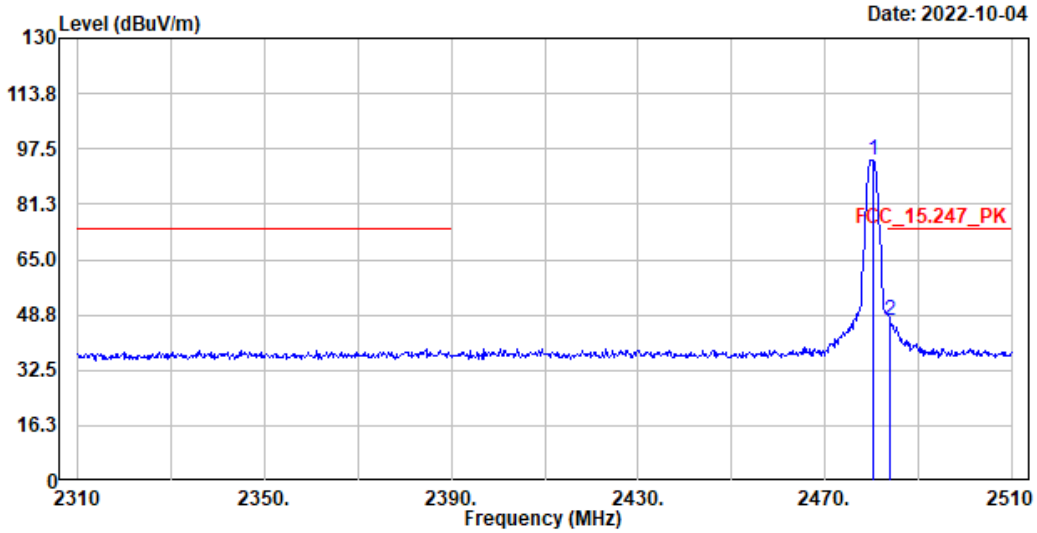
No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2480.200	94.88	------	------	88.35	6.53	Peak
2	2483.500	48.54	74.00	-25.46	42.00	6.54	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

Horizontal -Average Detector:

Frequency (MHz)	Peak Measurement (dBμV/m)	Duty Cycle Factor (dB)	Measurement Level (dBμV/m)	Margin (dB)	Limit (dBμV/m)
2480.2	94.88	-24.437	70.443	--	--
2483.5	48.54	-24.437	24.103	-29.897	54.000

Site :HY-CB03
Condition :3m ,Vertical
Mode :TX_bt1M_2480MHz
Test BY :Ashton Chiu



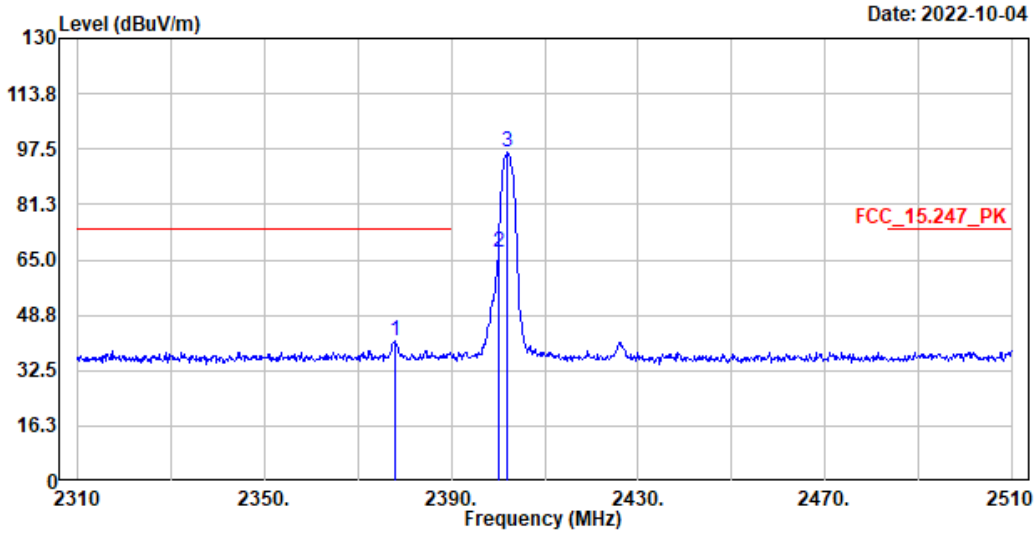
No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2480.200	94.02	------	------	87.49	6.53	Peak
2	2484.000	46.96	74.00	-27.04	40.42	6.54	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

Vertical -Average Detector:

Frequency (MHz)	Peak Measurement (dBµV/m)	Duty Cycle Factor (dB)	Measurement Level (dBµV/m)	Margin (dB)	Limit (dBµV/m)
2480.2	94.02	-24.437	69.583	--	--
2484	46.96	-24.437	22.523	-31.477	54.000

Site :HY-CB03
Condition :3m ,Horizontal
Mode :TX_bt3M_2402MHz
Test BY :Jing Chang



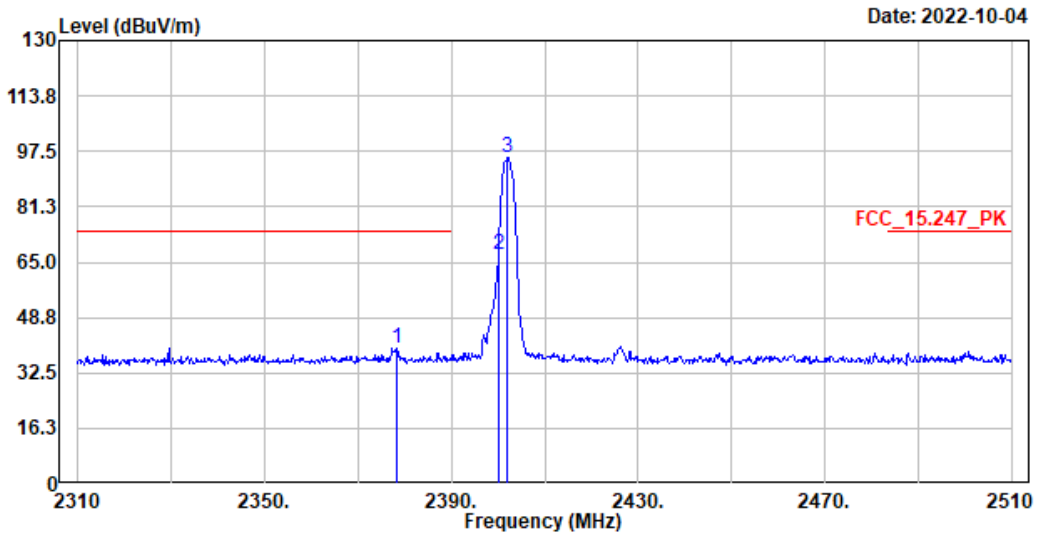
No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2377.800	41.09	74.00	-32.91	34.55	6.54	Peak
2	2400.000	67.28	------	------	60.75	6.53	Peak
3	2402.000	96.46	------	------	89.93	6.53	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

Horizontal -Average Detector:

Frequency (MHz)	Peak Measurement (dBμV/m)	Duty Cycle Factor (dB)	Measurement Level (dBμV/m)	Margin (dB)	Limit (dBμV/m)
2377.8	41.09	-24.731	16.359	-37.641	54.000
2400	67.28	-24.731	42.549	--	--
2402	96.46	-24.731	71.729	--	--

Site :HY-CB03
Condition :3m ,Vertical
Mode :TX_bt3M_2402MHz
Test BY :Jing Chang



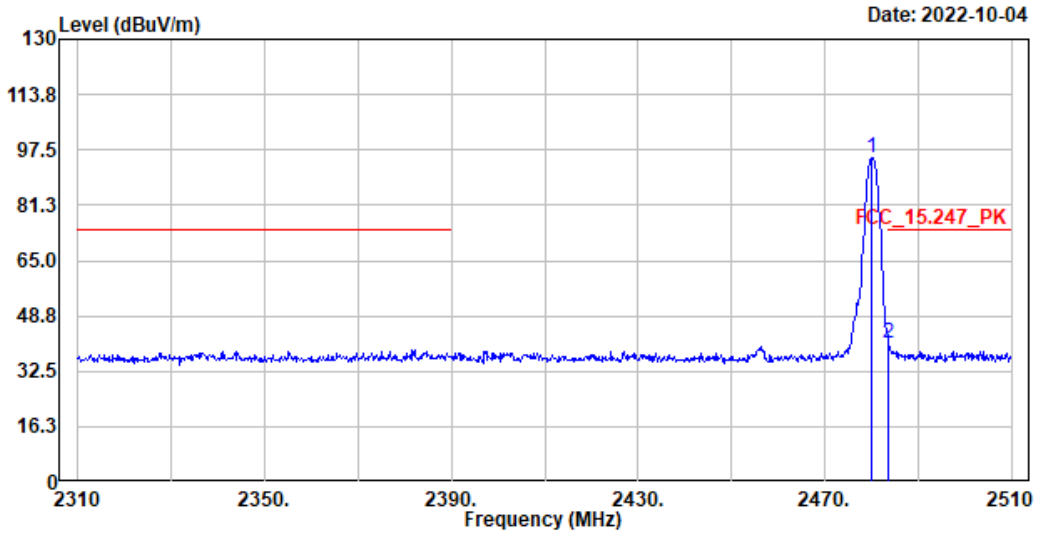
No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2378.400	39.94	74.00	-34.06	33.40	6.54	Peak
2	2400.000	67.35	------	------	60.82	6.53	Peak
3	2402.000	95.83	------	------	89.30	6.53	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

Vertical -Average Detector:

Frequency (MHz)	Peak Measurement (dBµV/m)	Duty Cycle Factor (dB)	Measurement Level (dBµV/m)	Margin (dB)	Limit (dBµV/m)
2378.4	39.94	-24.731	15.209	-38.791	54.000
2400	67.35	-24.731	42.619	--	--
2402	95.83	-24.731	71.099	--	--

Site :HY-CB03
Condition :3m ,Horizontal
Mode :TX_bt3M_2480MHz
Test BY :Jing Chang



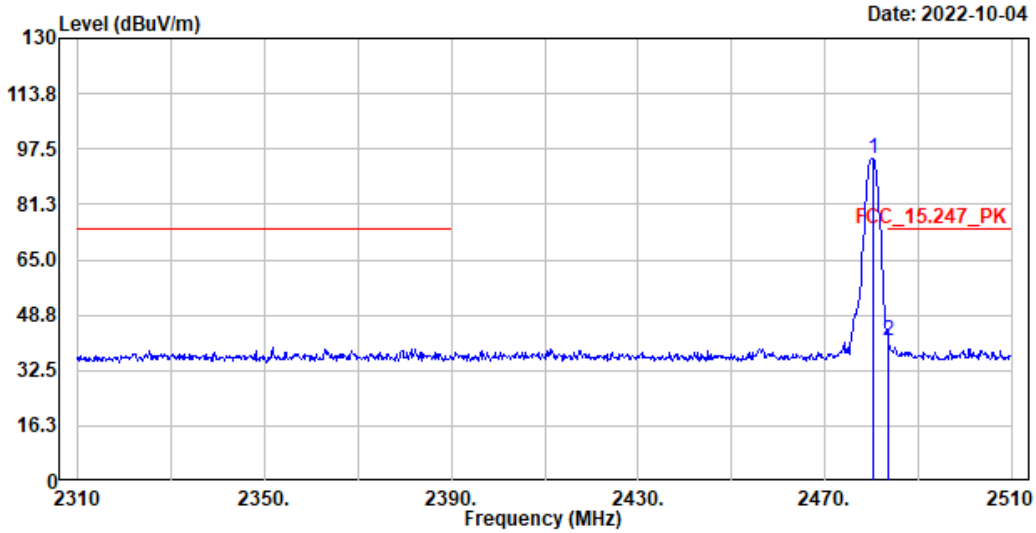
No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2480.000	95.03	------	------	88.50	6.53	Peak
2	2483.600	40.64	74.00	-33.36	34.10	6.54	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

Horizontal -Average Detector:

Frequency (MHz)	Peak Measurement (dBμV/m)	Duty Cycle Factor (dB)	Measurement Level (dBμV/m)	Margin (dB)	Limit (dBμV/m)
2480	95.03	-24.731	70.299	--	--
2483.6	40.64	-24.731	15.909	-38.091	54.000

Site :HY-CB03
Condition :3m ,Vertical
Mode :TX_bt3M_2480MHz
Test BY :Jing Chang



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2480.200	94.85	------	------	88.32	6.53	Peak
2	2483.600	41.16	74.00	-32.84	34.62	6.54	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission levels of other frequencies are very lower than the limit and not show in test report.

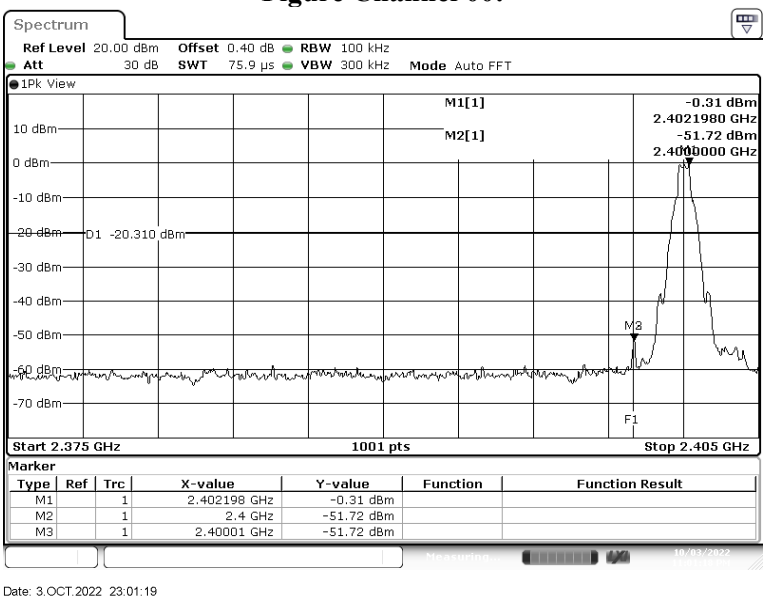
Vertical -Average Detector:

Frequency (MHz)	Peak Measurement (dBμV/m)	Duty Cycle Factor (dB)	Measurement Level (dBμV/m)	Margin (dB)	Limit (dBμV/m)
2480	101.26	-24.731	76.529	--	--
2483.6	43.79	-24.731	19.059	-34.941	54.000

Product : Communication Control Unit
Test Item : Band Edge
Test Mode : Transmit - 1 Mbps(Hopping off)
Test Date : 2022/10/03

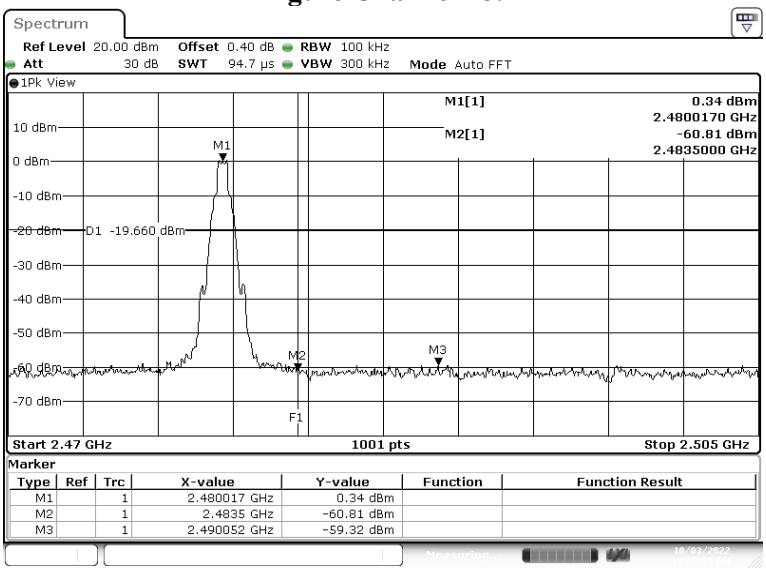
Measurement Level Δ (dB)	Result
> 20	PASS

Figure Channel 00:



Date: 3.OCT.2022 23:01:19

Figure Channel 78:

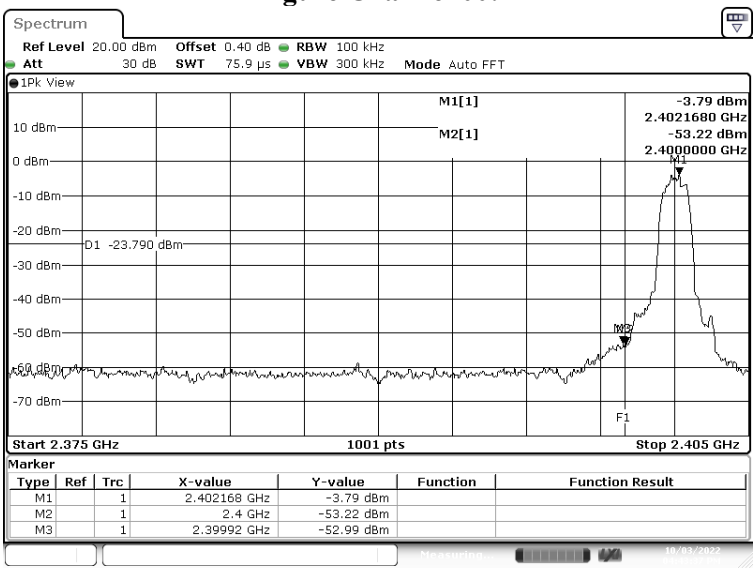


Date: 3.OCT.2022 23:06:38

Product : Communication Control Unit
Test Item : Band Edge
Test Mode : Transmit - 3 Mbps (Hopping off)
Test Date : 2022/10/03

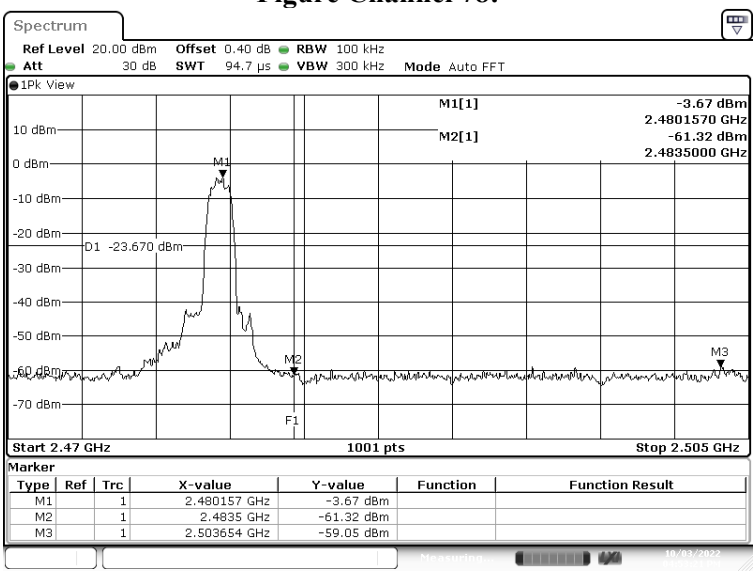
Measurement Level Δ (dB)	Result
> 20	PASS

Figure Channel 00:



Date: 3.OCT.2022 16:43:38

Figure Channel 78:

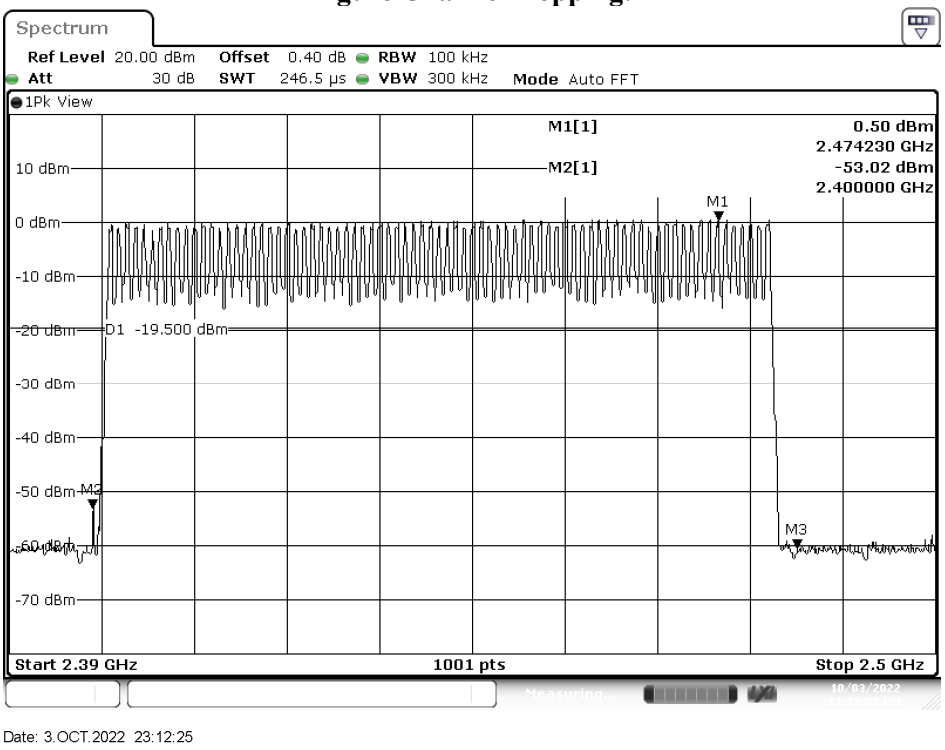


Date: 3.OCT.2022 16:53:22

Product : Communication Control Unit
Test Item : Band Edge
Test Mode : Transmit - 1 Mbps(Hopping on)
Test Date : 2022/10/03

Measurement Level Δ (dB)	Result
> 20	PASS

Figure Channel Hopping:

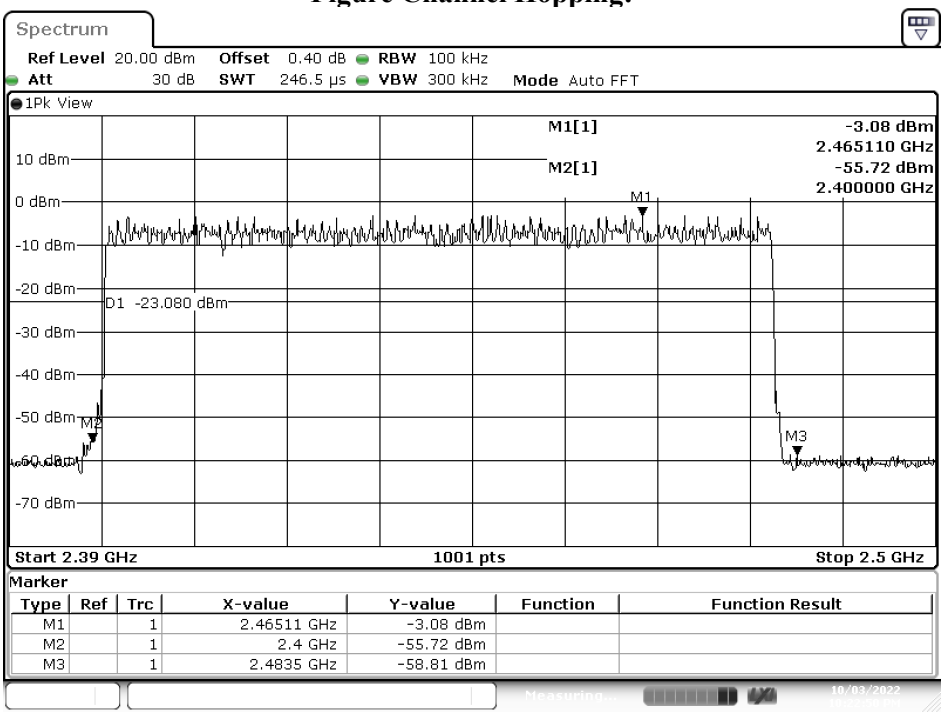


Date: 3.OCT.2022 23:12:25

Product : Communication Control Unit
Test Item : Band Edge
Test Mode : Transmit - 3 Mbps (Hopping on)
Test Date : 2022/10/03

Measurement Level Δ (dB)	Result
> 20	PASS

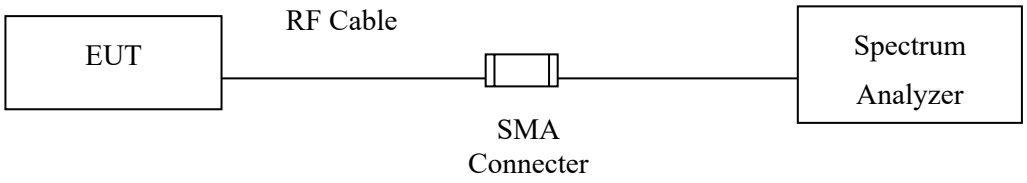
Figure Channel Hopping:



Date: 3.OCT.2022 22:22:50

7. Channel Number

7.1. Test Setup



7.2. Limit

Frequency hopping systems operating in the 2400-2483.5 MHz bands shall use at least 75 hopping frequencies.

7.3. Test Procedure

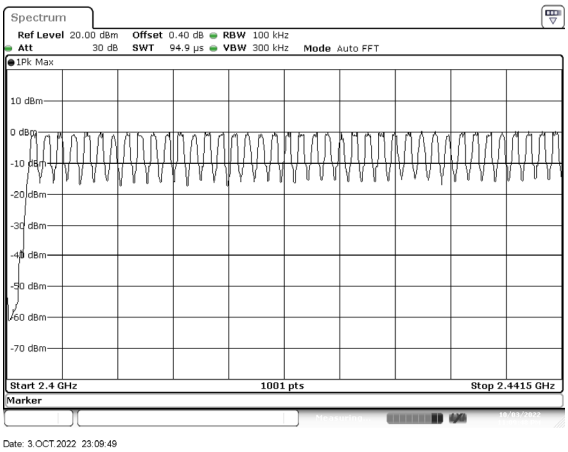
Tested according to FHSS test procedure of KDB558074 section 9 (b for compliance to FCC 47CFR 15.247 requirements.

7.4. Test Result of Channel Number

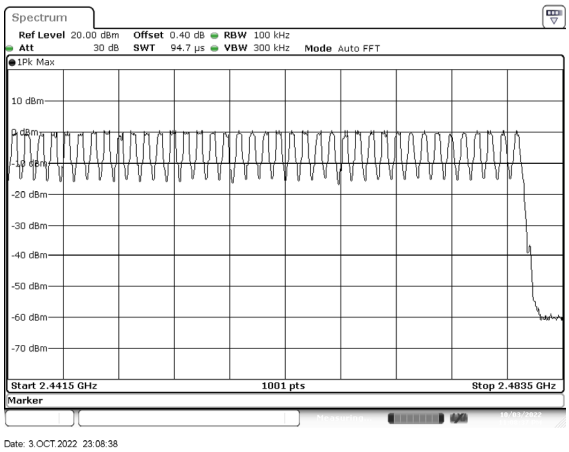
Product : Communication Control Unit
Test Item : Channel Number
Test Mode : Transmit - 1 Mbps
Test Date : 2022/10/03

Frequency Range (MHz)	Measurement (Hopping Channel)	Required Limit (Hopping Channel)	Result
2402 ~ 2480	79	>75	Pass

2402 MHz



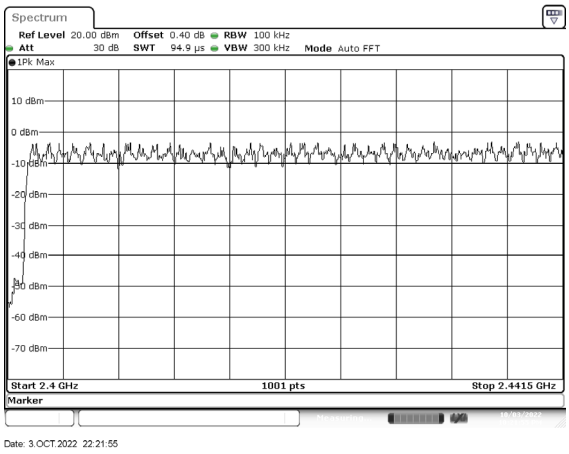
2480 MHz



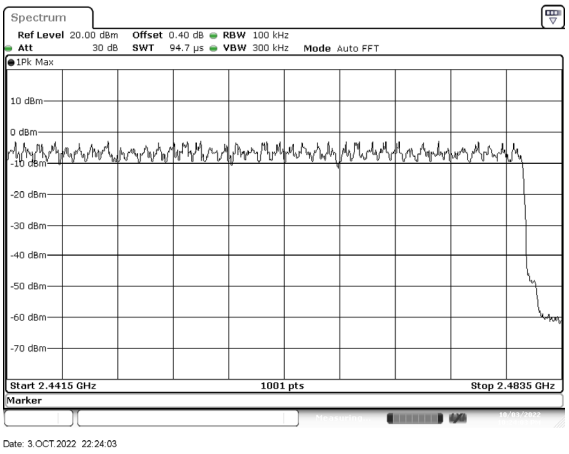
Product : Communication Control Unit
Test Item : Channel Number
Test Mode : Transmit - 3 Mbps
Test Date : 2022/10/03

Frequency Range (MHz)	Measurement (Hopping Channel)	Required Limit (Hopping Channel)	Result
2402 ~ 2480	79	>75	Pass

2402 MHz

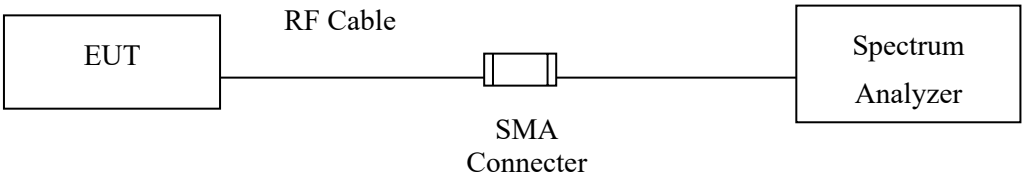


2480 MHz



8. Channel Separation

8.1. Test Setup



8.2. Limit

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.

8.3. Test Procedure

Tested according to FHSS test procedure of KDB558074 section 9 (b for compliance to FCC 47CFR 15.247 requirements.

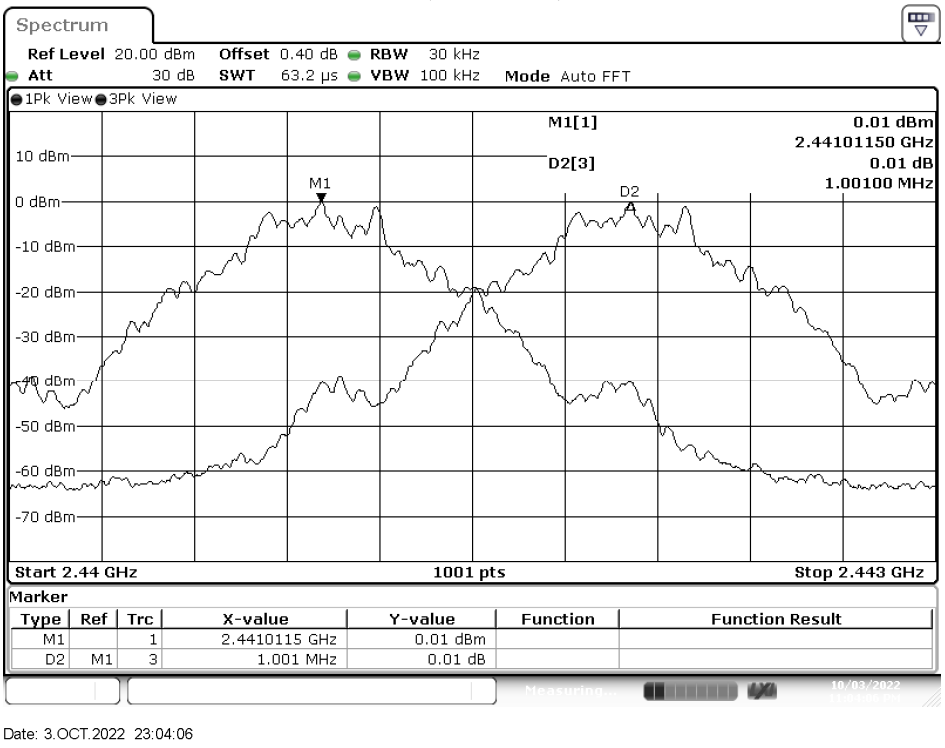
8.4. Test Result of Channel Separation

Product : Communication Control Unit
Test Item : Channel Separation
Test Mode : Transmit - 1 Mbps
Test Date : 2022/10/03

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Limit (kHz)	Limit of (2/3)*20dB Bandwidth (kHz)	Result
00	2402	998	>25 kHz	671.3	Pass
39	2441	1001	>25 kHz	675.3	Pass
78	2480	998	>25 kHz	677.3	Pass

Note: The 20dB Bandwidth is refer to section 10.

Channel 00 (2441 MHz)

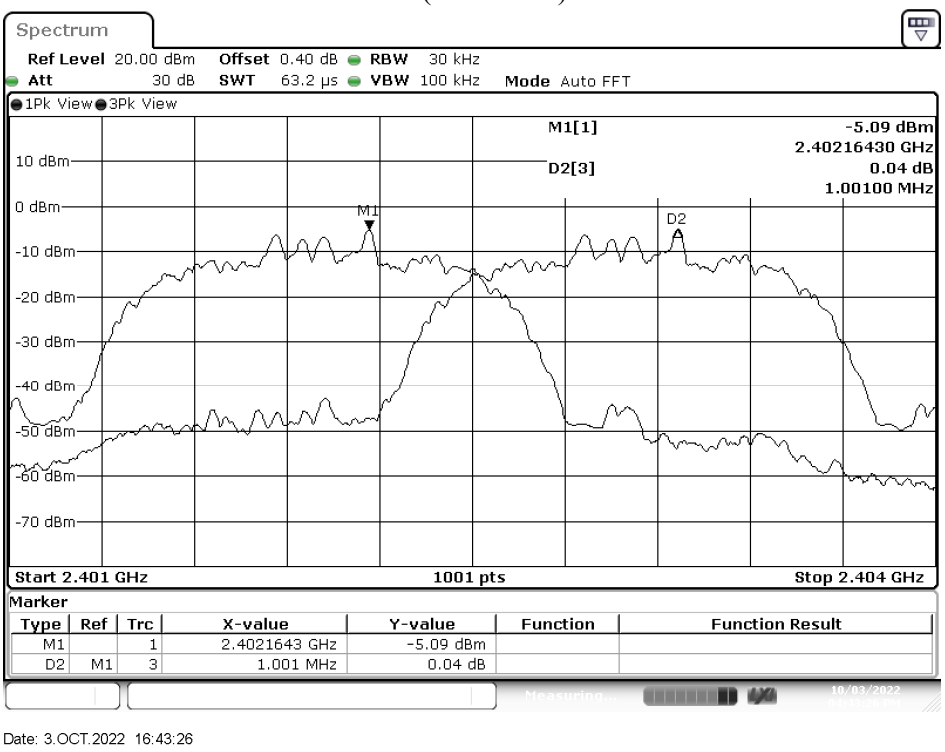


Product : Communication Control Unit
Test Item : Channel Separation
Test Mode : Transmit - 3 Mbps
Test Date : 2022/10/03

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Limit (kHz)	Limit of (2/3)*20dB Bandwidth (kHz)	Result
00	2402	1001	>25 kHz	867.1	Pass
39	2441	998	>25 kHz	867.1	Pass
78	2480	1001	>25 kHz	869.1	Pass

Note: The 20dB Bandwidth is refer to section 10.

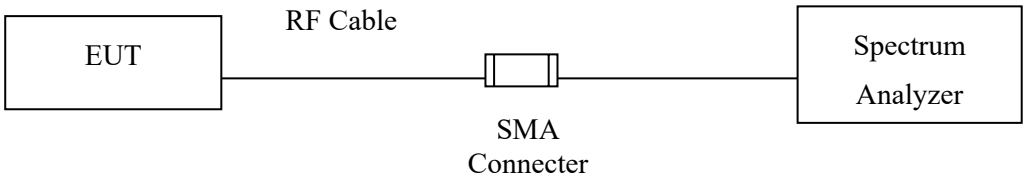
Channel 00 (2402 MHz)



Date: 3.OCT.2022 16:43:26

9. Dwell Time

9.1. Test Setup



9.2. Limit

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.

9.3. Test Procedure

Tested according to FHSS test procedure of KDB558074 section 9 (b for compliance to FCC 47CFR 15.247 requirements.

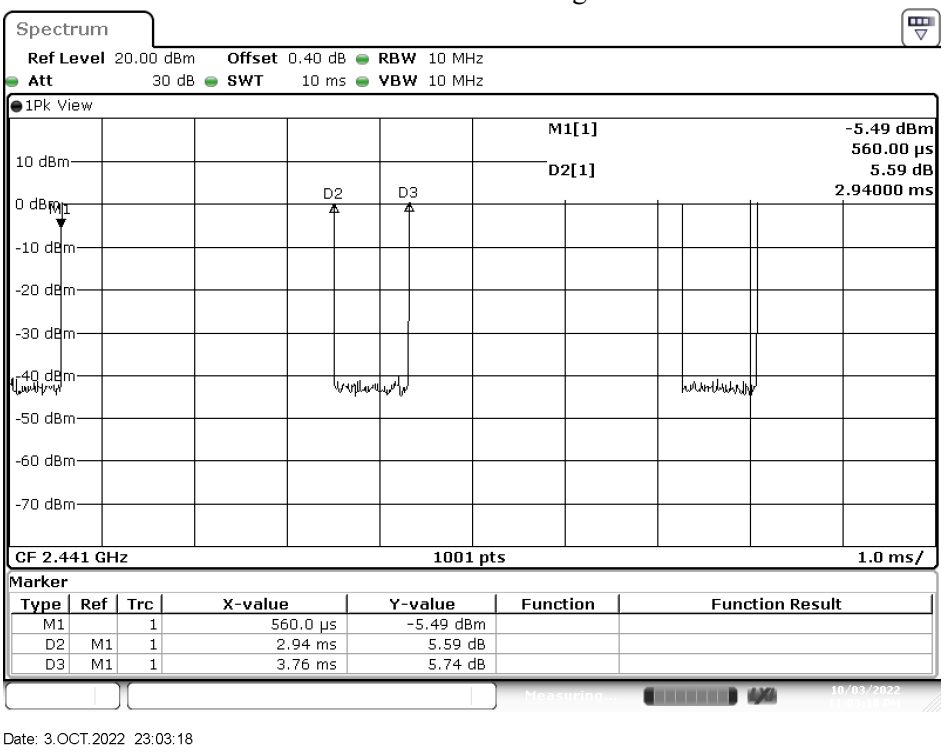
9.4. Test Result of Dwell Time

Product : Communication Control Unit
Test Item : Dwell Time
Test Mode : Transmit - 1 Mbps (Channel 00,39,78)
Test Date : 2022/10/03

Frequency (MHz)	Time slot length (ms)	Period (sec)	(calculation)	Dwell Time (ms)	Limit (ms)	Result
2402	2.930	31.6	Time(sec)*(266.67/79)*31.6	312.537	400	Pass
2441	2.940	31.6	Time(sec)*(266.67/79)*31.6	313.604	400	Pass
2480	2.940	31.6	Time(sec)*(266.67/79)*31.6	313.604	400	Pass

Note: Dwell time =Time slot length* calculation

CH 00 Time slot length

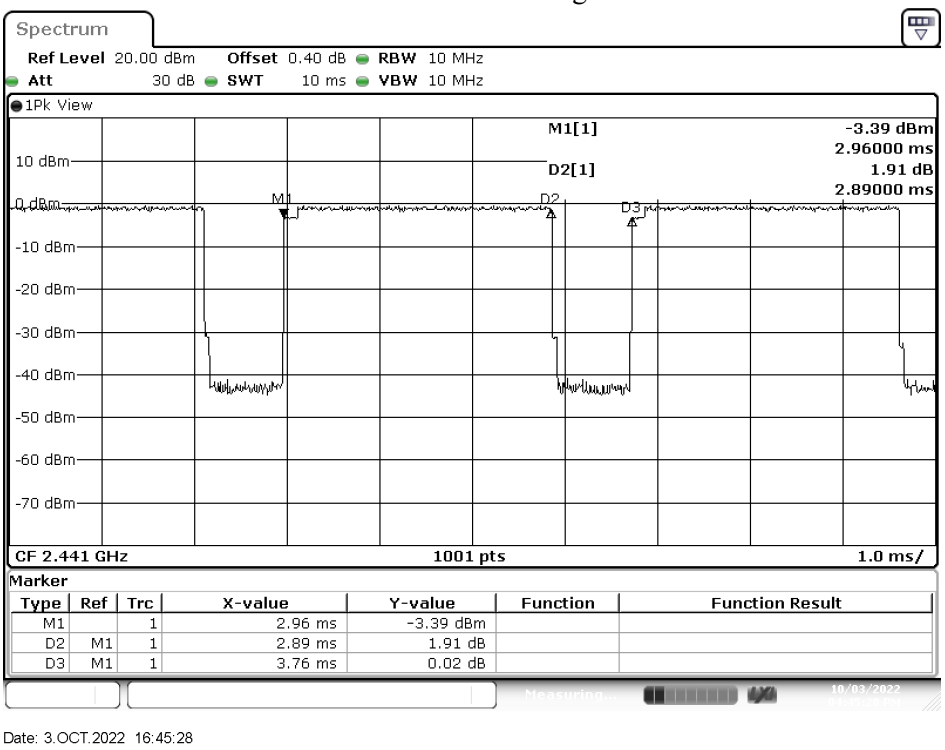


Product : Communication Control Unit
Test Item : Dwell Time
Test Mode : Transmit - 3 Mbps (Channel 00,39,78)
Test Date : 2022/10/03

Frequency (MHz)	Time slot length (ms)	Period (sec)	(calculation)	Dwell Time (ms)	Limit (ms)	Result
2402	2.890	31.6	Time(sec)*(266.67/79)*31.6	308.271	400	Pass
2441	2.890	31.6	Time(sec)*(266.67/79)*31.6	308.271	400	Pass
2480	2.880	31.6	Time(sec)*(266.67/79)*31.6	307.204	400	Pass

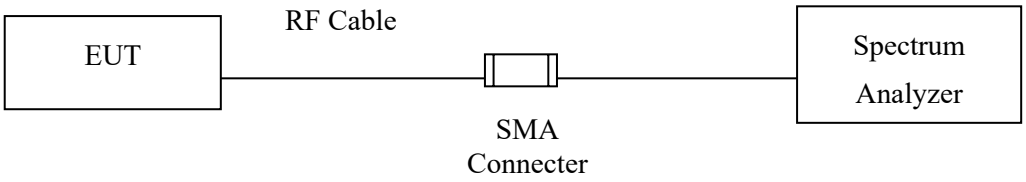
Note: Dwell time =Time slot length* calculation

CH 00 Time slot length



10. Occupied Bandwidth

10.1. Test Setup



10.2. Limits

N/A

10.3. Test Procedure

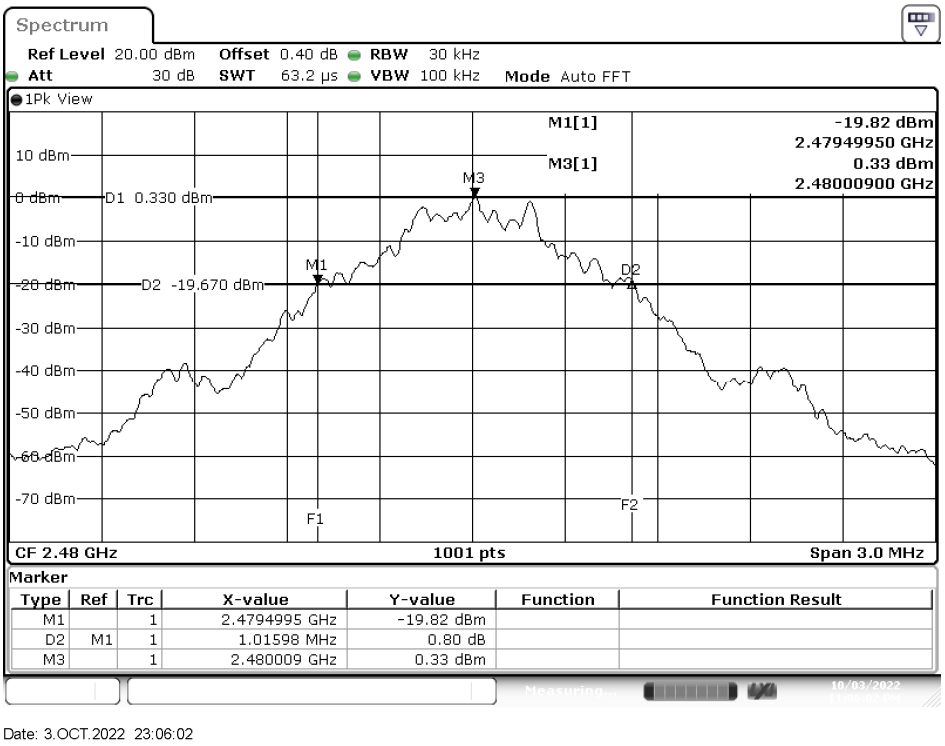
Tested according to FHSS test procedure of KDB558074 section 9 (b for compliance to FCC 47CFR 15.247 requirements.

10.4. Test Result of Occupied Bandwidth

Product : Communication Control Unit
Test Item : Occupied Bandwidth Data
Test Mode : Transmit - 1 Mbps
Test Date : 2022/10/03

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
00	2402	1007	--	NA
39	2441	1013	--	NA
78	2480	1016	--	NA

Figure Channel 78:

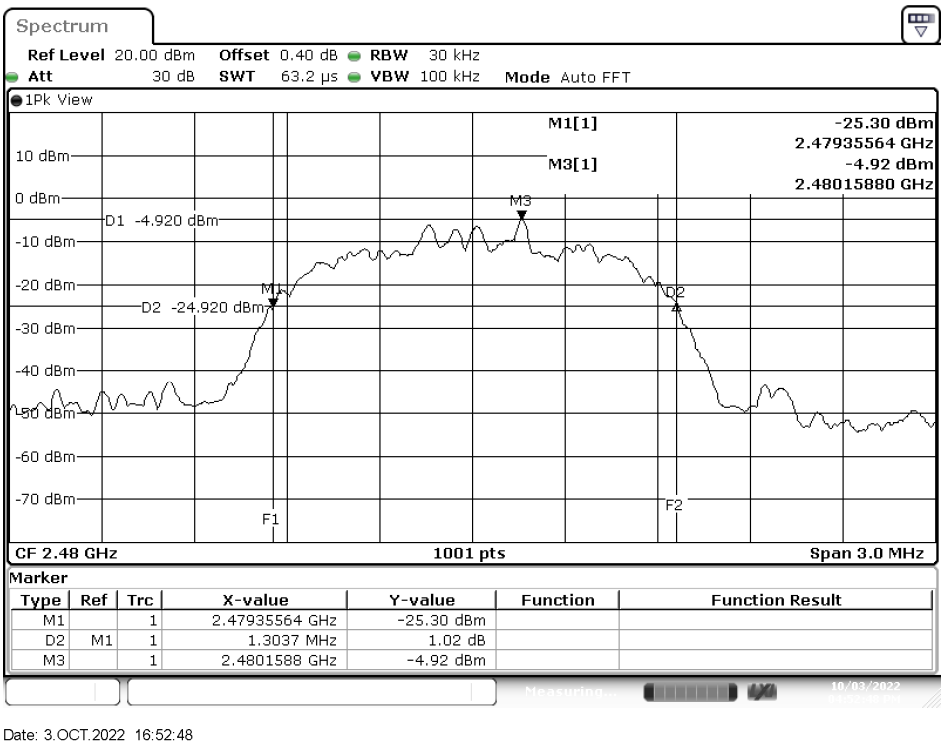


Date: 3.OCT.2022 23:06:02

Product : Communication Control Unit
Test Item : Occupied Bandwidth Data
Test Mode : Transmit - 3 Mbps
Test Date : 2022/10/03

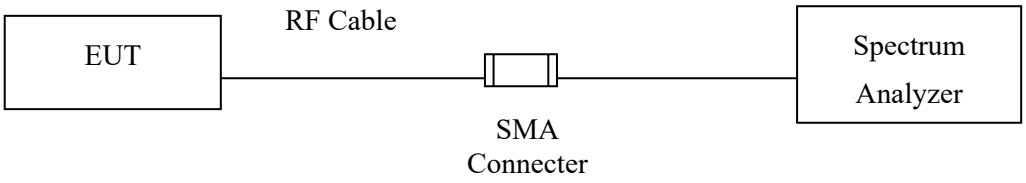
Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
00	2402	1301	--	NA
39	2441	1301	--	NA
78	2480	1304	--	NA

Figure Channel 78:



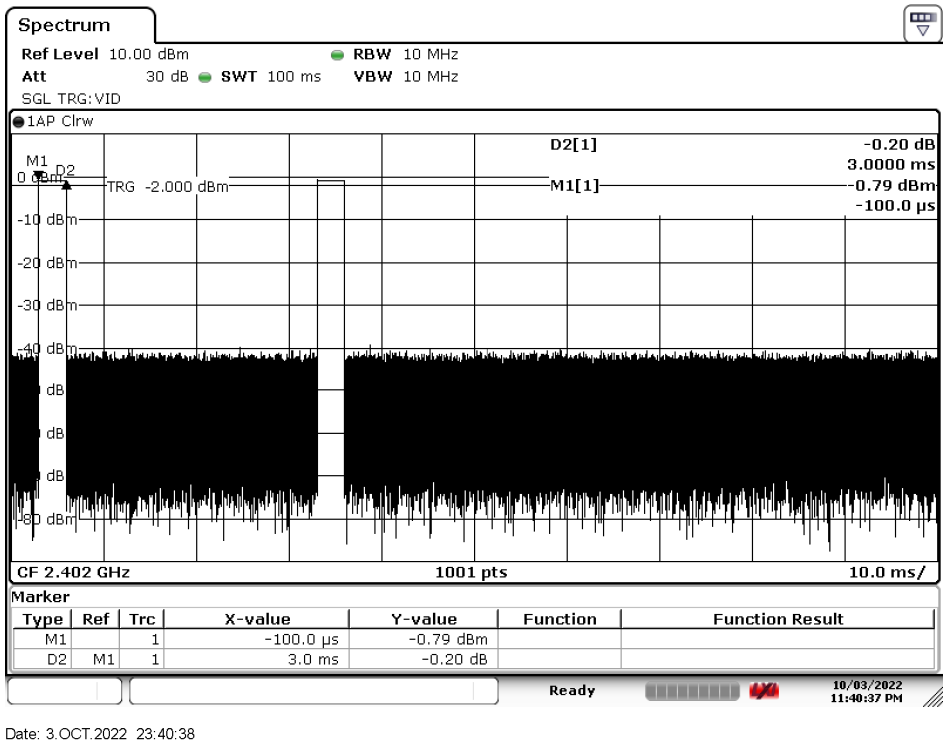
11. Duty Cycle

11.1. Test Setup



11.2. Test Result of Duty Cycle

Product : Communication Control Unit
Test Item : Duty Cycle Data
Test Mode : Transmit - 1 Mbps



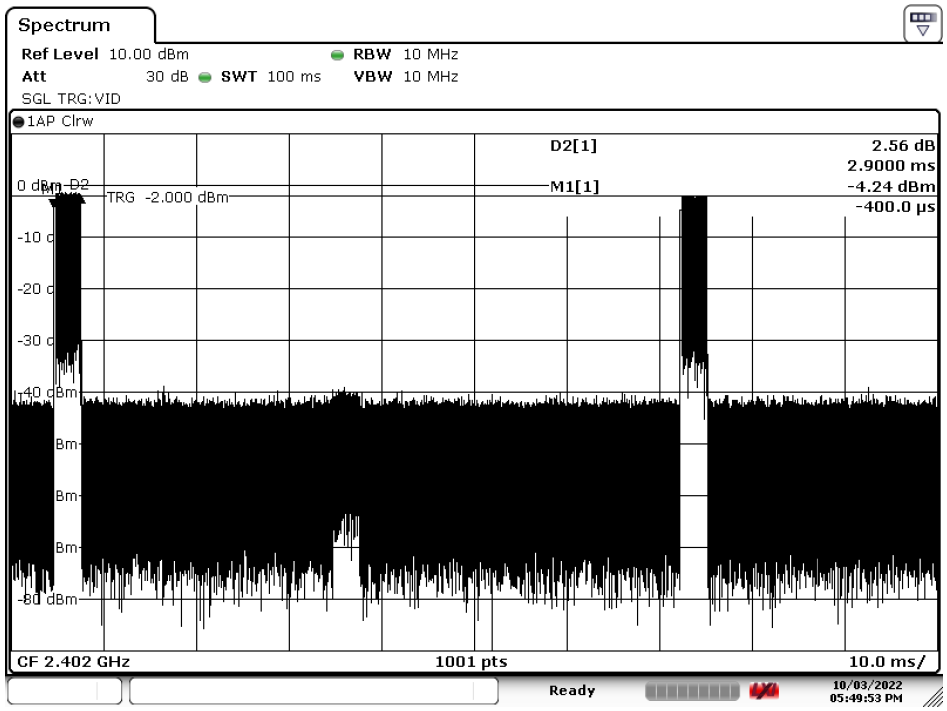
Time on of 100ms= 6ms

Duty Cycle=6ms / 100msec=0.06

Duty Cycle correction factor= 20 LOG 0.06= -24.437 dB

Duty Cycle correction factor	**-24.437**	**dB**

Product : Communication Control Unit
Test Item : Duty Cycle Data
Test Mode : Transmit - 3 Mbps



Date: 3.OCT.2022 17:49:54

Time on of 100ms= 5.8ms

Duty Cycle=5.8ms / 100msec=0.058

Duty Cycle correction factor= 20 LOG 0.058= -24.731 dB

Duty Cycle correction factor	**-24.731**	**dB**

12. EMI Reduction Method During Compliance Testing

No modification was made during testing.