



FCC TEST REPORT

FCC ID: 2A2IL-G88

Product Name	:	WIRELESS EARBUDS
Model Name	:	G88,G03 Pro,G20,G30,G58,G88X,X2,X3,X7,X8
Brand Name	:	N/A
Report No.	:	PTC22123003801E-FC01
Sample ID	:	PTC22123003801E-1#
Prepared for		
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Prepared by		
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1TEST RESULT CERTIFICATION

Applicant's name : shenzhen Koseli Technology.,Ltd.
Address : 4F,Block 1,Tumao Industrial Park,Hebei Industrial Zone,South Rd
Dalang,Longhua,Shenzhen,China
Manufacture's name : shenzhen Koseli Technology.,Ltd.
Address : 4F,Block 1,Tumao Industrial Park,Hebei Industrial Zone,South Rd
Dalang,Longhua,Shenzhen,China
Product name : WIRELESS EARBUDS
Model name : G88,G03 Pro,G20,G30,G58,G88X,X2,X3,X7,X8
Standards : FCC CFR47 Part 15 Section 15.247
Test procedure : ANSI C63.10:2013
Test Date : Jan.29, 2023 to Jan. 31, 2023
Date of Issue : Feb. 01, 2023
Test Result : Pass

This device described above has been tested by PTC, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Test Engineer:

A handwritten signature in black ink that reads "Simon Pu".

Simon Pu / Engineer

Technical Manager:

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Ronnie Liu / Manager



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2 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Conducted spurious Emission and Band edge	15.247(d) 15.205(a)	PASS
Conduct Emission	15.207	PASS
20dB Bandwidth	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Antenna Requirement	15.203	PASS



Report No.:PTC22123003801E-FC01

3 TEST FACILITY

Precise Testing & Certification Co., Ltd

Address: Building 1, No. 6, Tongxin Road, Dongcheng Street, Dongguan, Guangdong, China

A2LA Certificate No.: 4408.01

FCC Registration Number: 790290

FCC Designation Number: CN1219

IC Registration Number: 12191A

CAB identifier: CN0080



4 General Information

4.1 General Description of E.U.T.

Product Name	:	WIRELESS EARBUDS
Model Name	:	G88,G03 Pro,G20,G30,G58,G88X,X2,X3,X7,X8
Bluetooth Version	:	BT 5.3
Operating frequency	:	2402-2480MHz
Numbers of Channel	:	79 channels
Antenna Type	:	Chip Antenna
Antenna Gain	:	1.32dBi
Type of Modulation	:	GFSK, $\pi/4$ -DQPSK
Power	:	DC 3.7V lion battery
Hardware Version	:	V1.0
Software Version	:	V1.0



4.2 Test Mode

The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonics of the highest fundamental frequency or to 40 GHz, whichever is lower).

The EUT has been tested under TX operating condition.

This EUT is a FHSS system, were conducted to determine the final configuration from all possible combinations. We use software control the EUT, Let EUT hopping on and transmit with highest power, all the modes GFSK, $\pi/4$ -DQPSK have been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.



Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	1	2403	2	2404	3	2405
4	2406	5	2407	6	2408	7	2409
8	2410	9	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	-	-

Channel	Frequency(MHz)
0	2402
39	2441
78	2480



5 Equipment During Test

5.1 Equipments List

RF Conducted Test

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
MXG Signal Analyzer	Agilent	N9020A	MY56070279	10Hz-30GHz	Aug21,2023
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	Aug21,2023
Antenna Connector	Florida RF Labs	N/A	RF01#	N/A	Aug21,2023
Scope	Tektronix	TDS3032B	B014131	300MHz BW; 2 way scope	Aug21,2023
DC power	eTOMENS	eTM-1560	--	15V 60A	Aug21,2023
Power Meter	Anritsu	ML2495A	0949003	300MHz-40GHz	Aug21,2023
Power Sensor	Anritsu	MA2411B	0917017	300MHz-40GHz	Aug21,2023

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

Radiated Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Aug21,2023
Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	Aug21,2023
Bilog Antenna	SCHWARZBECK	VULB9160	9160-3355	25MHz-2GHz	Aug21,2023
Preamplifier (low frequency)	SCHWARZBECK	BBV 9475	9745-0013	1MHz-1GHz	Aug21,2023
Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	Aug21,2023
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-40GHz	Aug21,2023
Horn Antenna	SCHWARZBECK	9120D	9120D-1246	1GHz-18GHz	Aug21,2023
High NOISE AMPLIFIER	ZHINAN	ZN3380C	15002	10KHz-18GHz	Aug21,2023
Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	Aug21,2023
Spectrum Analyzer	Rohde&Schwarz	FSVR40	101003	10Hz-40GHz	Aug21,2023



Horn Antenna	SCHWARZBECK	BBHA9170	01066	15GHZ-40GHZ	Aug21,2023
Preamplifier	SCHWARZBECK	BBV-9721	81	18GHZ-40GHZ	Aug21,2023
Test S/W	Tonscend	JS32-RE/4.0.0.0			

Conducted Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Aug21,2023
Artificial Mains Network	Rohde&Schwarz	L2-16B	000WX31025	9KHz-300MHz	Aug21,2023
Artificial Mains Network	Rohde&Schwarz	ENV216	102453	9KHz-300MHz	Aug21,2023
Test S/W	Tonscend	JS32-CE/4.0.0.3			



5.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	±1.0dB
Power Spectral Density, conducted	±2.2dB
Radio Frequency	± 1 x 10 ⁻⁶
Bandwidth	± 1.5 x 10 ⁻⁶
Time	±2%
Duty Cycle	±2%
Temperature	±1°C
Humidity	±5%
DC and low frequency voltages	±3%
Conducted Emissions (150kHz~30MHz)	±3.64dB
Radiated Emission(9KHz~30MHz)	±2.54dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	



5.3 Description of Support Units

Equipment	Model No.	Series No.
adapter	MDY-10-EX	---

6 Conducted Emission

Test Requirement:	:	FCC CFR 47 Part 15 Section 15.207
Test Method:	:	ANSI C63.10:2013
Test Result:	:	PASS
Frequency Range:	:	150kHz to 30MHz
Class/Severity:	:	Class B
Detector:	:	Peak for pre-scan (9kHz Resolution Bandwidth)

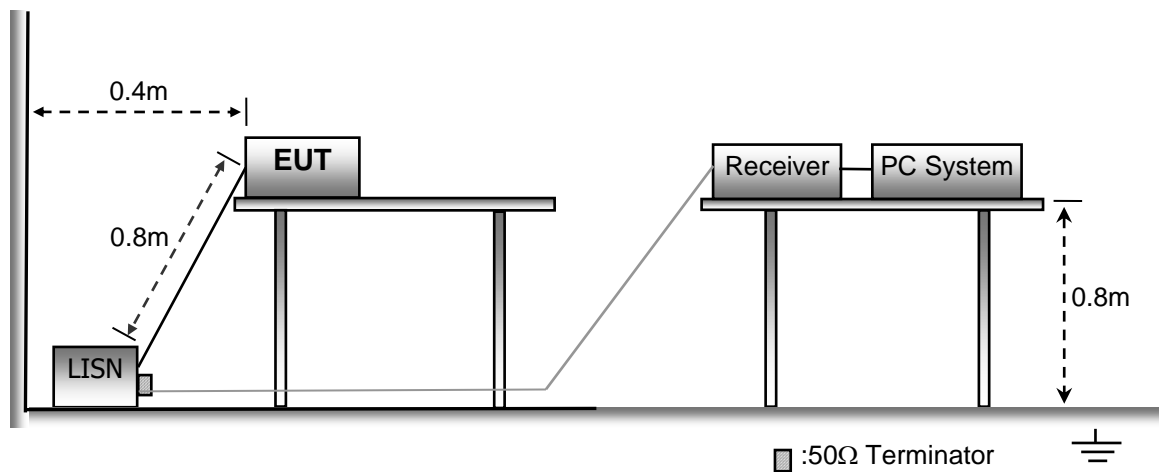
6.1 E.U.T. Operation

Operating Environment :

Temperature:	:	25.5 °C
Humidity:	:	51 % RH
Atmospheric Pressure:	:	101.2kPa

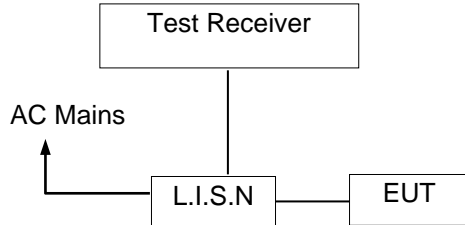
6.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10: 2013





6.3 Test SET-UP (Block Diagram of Configuration)



6.4 Measurement Procedure:

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

6.5 Conducted Emission Limit

Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

6.6 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

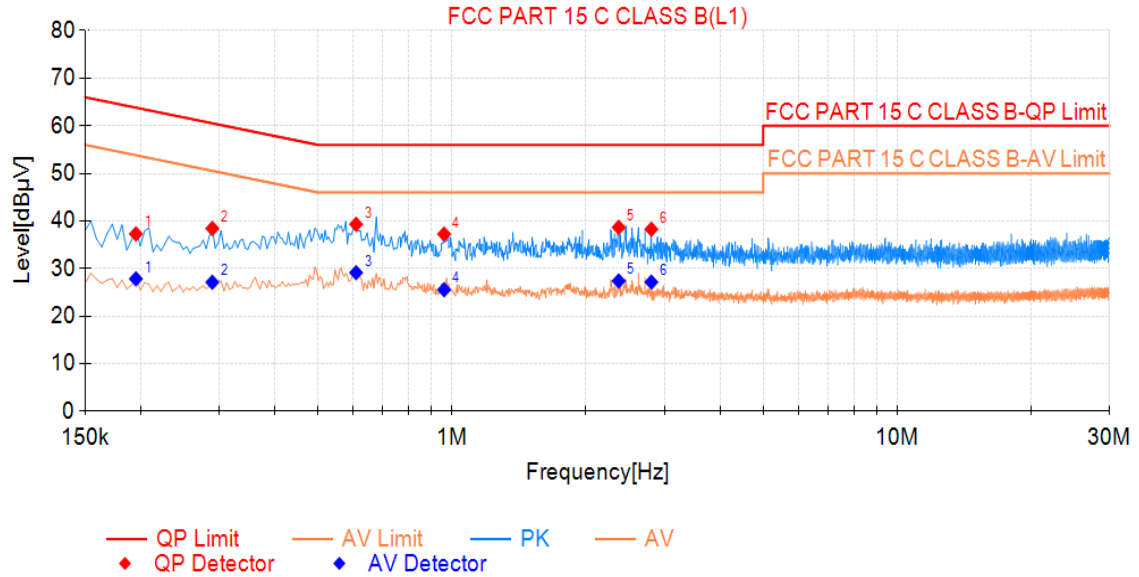
6.7 Conducted Emission Test Result

Pass.

EUT is Charging mode. All the modulation modes were tested with both AC230V 50Hz and AC120V 60Hz, the data of the worst mode (AC 120V/60Hz) are recorded in the following pages and the others modulation methods do not exceed the limits.



Line -120V/60Hz:

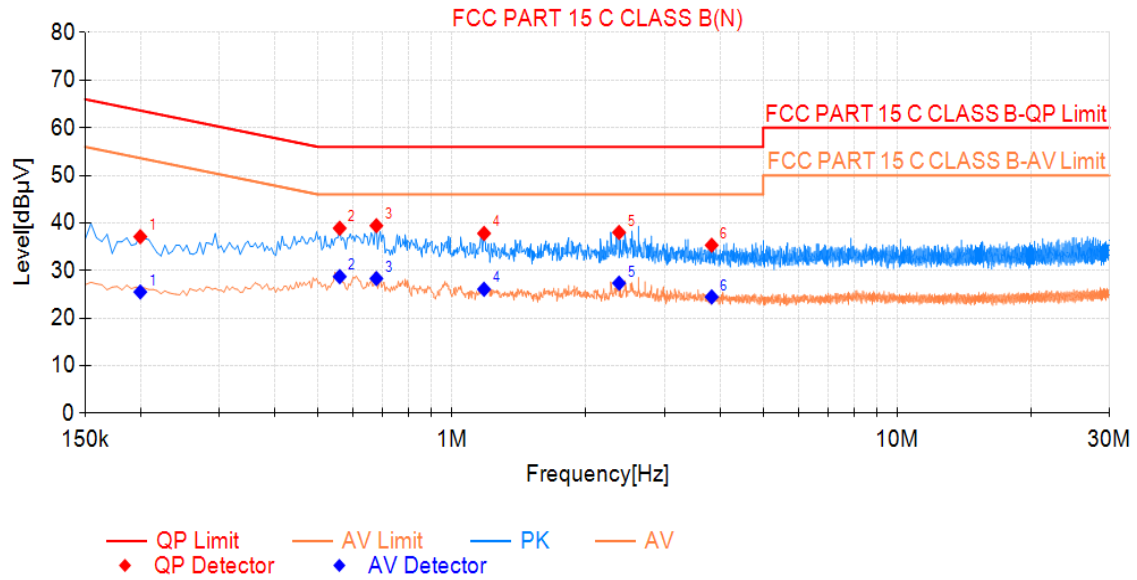


Final Data List								
NO.	Freq. [MHz]	QP Value	QP Limit	QP Margin	AV Value	AV Limit	AV Margin	Verdict
1	0.195	37.28	63.82	26.54	27.84	53.82	25.98	PASS
2	0.290	38.43	60.54	22.11	27.13	50.54	23.41	PASS
3	0.609	39.32	56.00	16.68	29.15	46.00	16.85	PASS
4	0.960	37.26	56.00	18.74	25.55	46.00	20.45	PASS
5	2.369	38.68	56.00	17.32	27.40	46.00	18.60	PASS
6	2.805	38.27	56.00	17.73	27.16	46.00	18.84	PASS

Note: Value= Reading Value+ Cable Loss-Factor



Neutral -120V/60Hz:



Final Data List								
NO.	Freq. [MHz]	QP Value	QP Limit	QP Margin	AV Value	AV Limit	AV Margin	Verdict
1	0.200	37.13	63.63	26.50	25.51	53.63	28.12	PASS
2	0.560	38.90	56.00	17.10	28.74	46.00	17.26	PASS
3	0.677	39.44	56.00	16.56	28.32	46.00	17.68	PASS
4	1.181	37.81	56.00	18.19	26.07	46.00	19.93	PASS
5	2.373	38.01	56.00	17.99	27.36	46.00	18.64	PASS
6	3.831	35.34	56.00	20.66	24.46	46.00	21.54	PASS

Note: Value= Reading Value+ Cable Loss-Factor



7 Radiated Spurious Emissions

Test Requirement : FCC CFR47 Part 15 Section 15.209 & 15.247
 Test Method : ANSI C63.10:2013
 Test Result : PASS
 Measurement Distance : 3m
 Limit : See the follow table

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

7.1 EUT Operation

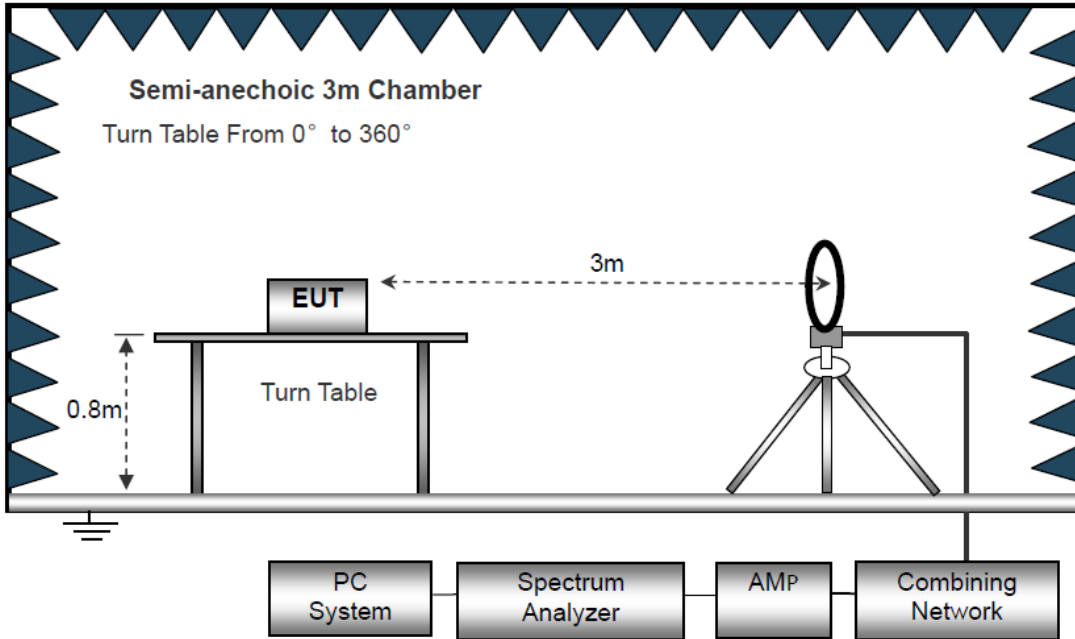
Operating Environment :

Temperature : 23.5 °C
 Humidity : 51.1 % RH
 Atmospheric Pressure : 101.2kPa

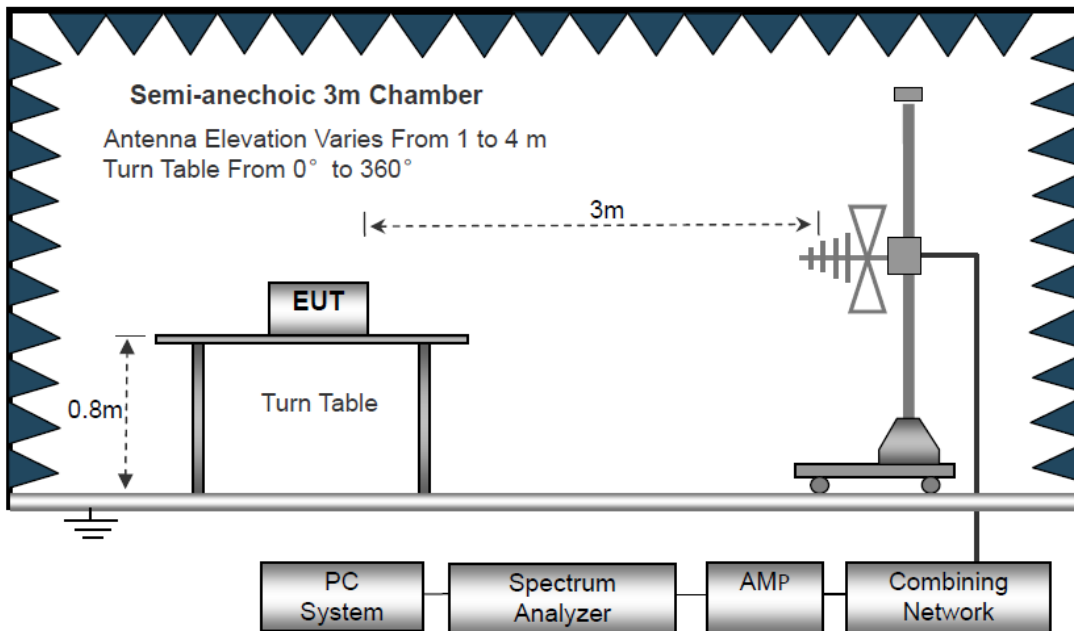
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

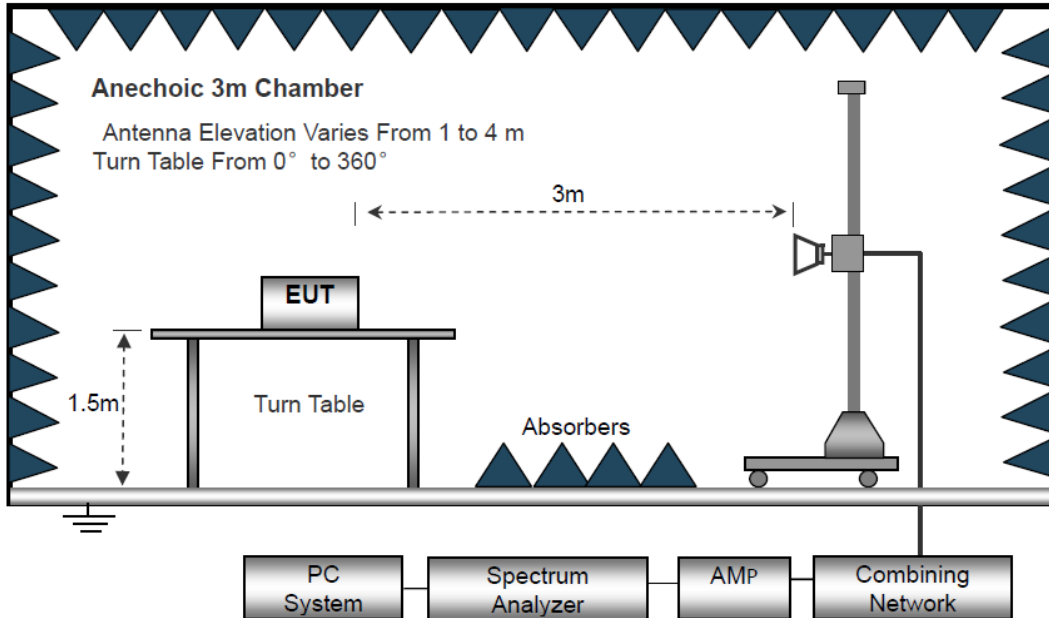
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP



7.4 Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.
2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
7. Test Procedure of measurement (For Above 1GHz):
 - 1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
 - 2) Change the antenna polarization and repeat 1) with vertical polarization.
 - 3) Make a hardcopy of the spectrum.
 - 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
 - 5) Change the analyser mode to Clear/ Write and found the cone of emission.
 - 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
 - 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
 - 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.
7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.



7.5 Summary of Test Results

Test Frequency: 9KHz-30MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	>20

Note:

The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Distance extrapolation factor = $40\log(\text{Specific distance/ test distance})$ (dB);
Limit line=Specific limits(dBuV) + distance extrapolation factor.

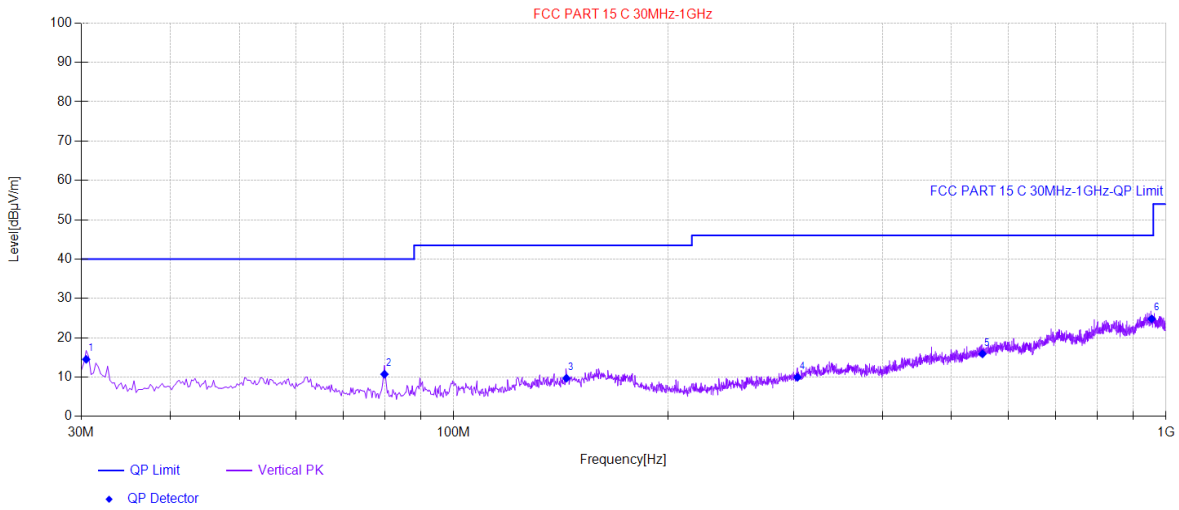
Test Frequency: 30MHz ~ 1GHz

Please refer to the following test plots:

All the modulation modes were tested the data of the worst mode (AC 120V/60Hz, GFSK TX 2402MHz) are recorded in the following pages and the others modulation methods do not exceed the limits.



Test plot for Vertical: GFSK(2402MHz)

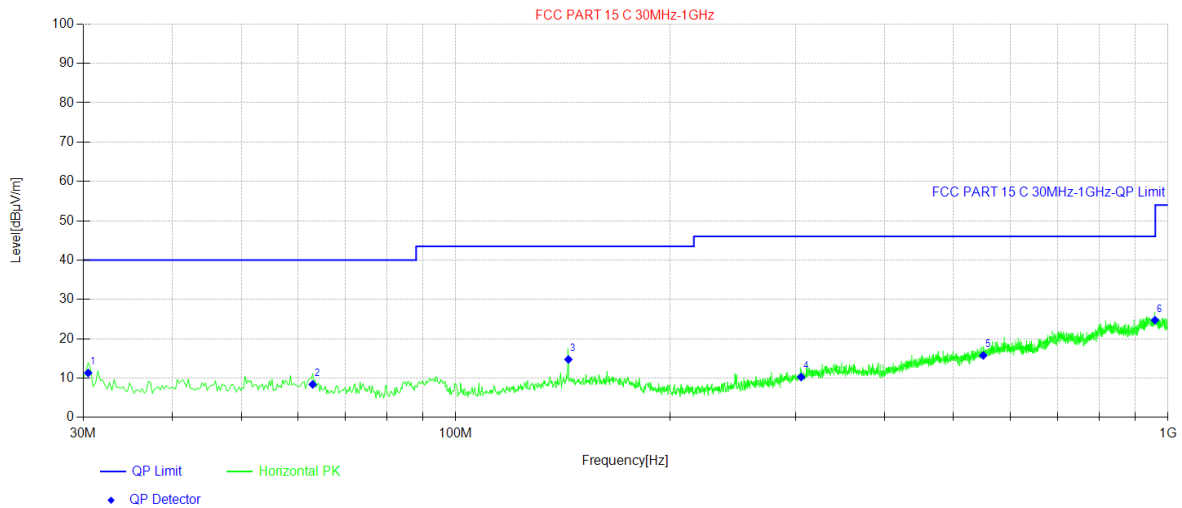


Final Data List[QP]							
NO.	Freq. [MHz]	QP Reading [dBµV/m]	Factor [dB]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	Polarity
1	30.49	32.84	-18.32	14.52	40.00	25.48	Vertical
2	79.96	31.97	-21.23	10.74	40.00	29.26	Vertical
3	143.98	26.18	-16.46	9.72	43.50	33.78	Vertical
4	303.78	25.29	-15.34	9.95	46.00	36.05	Vertical
5	552.59	25.27	-9.35	15.92	46.00	30.08	Vertical
6	954.41	26.94	-2.14	24.80	46.00	21.20	Vertical

Remark: Emission Level = Reading + Cable Loss + ANT Factor - AMP Factor



Test plot for Horizontal: GFSK(2402MHz)



Final Data List[QP]							
NO.	Freq. [MHz]	QP Reading [dBµV/m]	Factor [dB]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	Polarity
1	30.49	29.65	-18.32	11.33	40.00	28.67	Horizontal
2	62.98	26.65	-18.25	8.40	40.00	31.60	Horizontal
3	143.98	31.21	-16.46	14.75	43.50	28.75	Horizontal
4	305.48	25.57	-15.29	10.28	46.00	35.72	Horizontal
5	550.41	25.14	-9.37	15.77	46.00	30.23	Horizontal
6	958.78	26.79	-2.06	24.73	46.00	21.27	Horizontal

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor



Test Frequency 1GHz-25GHz

Low Channel (2402MHz) Worst case GFSK

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4824	28.14	AV	V	8.13	8.26	7.46	37.07	54	-16.93
4824	29.35	AV	H	8.13	8.26	7.46	38.28	54	-15.72
4824	32.66	PK	V	8.13	8.26	7.46	41.59	74	-32.41
4824	35.28	PK	H	8.13	8.26	7.46	44.21	74	-29.79
15447	27.46	AV	V	9.14	9.57	8.62	37.55	54	-16.45
15447	28.28	AV	H	9.14	9.57	8.62	38.37	54	-15.63
15447	30.49	PK	V	9.14	9.57	8.62	40.58	74	-33.42
15447	32.58	PK	H	9.14	9.57	8.62	42.67	74	-31.33

Middle Channel (2441MHz) Worst case π/4-DQPSK

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4882	26.43	AV	V	8.24	9.47	11.05	33.09	54	-20.91
4882	28.15	AV	H	8.24	9.47	11.05	34.81	54	-19.19
4882	30.26	PK	V	8.24	9.47	11.05	36.92	74	-37.08
4882	32.19	PK	H	8.24	9.47	11.05	38.85	74	-35.15
15483	28.49	AV	V	9.33	10.46	11.48	36.8	54	-17.2
15483	29.35	AV	H	9.33	10.46	11.48	37.66	54	-16.34
15483	31.45	PK	V	9.33	10.46	11.48	39.76	74	-34.24
15483	32.87	PK	H	9.33	10.46	11.48	41.18	74	-32.82

High Channel (2480MHz) Worst case GFSK

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4960	25.46	AV	V	8.26	8.37	9.46	32.63	54	-21.37
4960	27.35	AV	H	8.26	8.37	9.46	34.52	54	-19.48
4960	30.15	PK	V	8.26	8.37	9.46	37.32	74	-36.68
4960	32.59	PK	H	8.26	8.37	9.46	39.76	74	-34.24
15386	28.43	AV	V	9.44	9.04	11.26	35.65	54	-18.35
15386	29.61	AV	H	9.44	9.04	11.26	36.83	54	-17.17
15386	31.48	PK	V	9.44	9.04	11.26	38.7	74	-35.3
15386	33.68	PK	H	9.44	9.04	11.26	40.9	74	-33.1

Note: 1. The testing has been conformed to 10*2480MHz=24800MHz.



- 2. All other emissions more than 30dB below the limit.
- 3. Factor = Antenna Factor + Cable Loss – Pre-amplifier.
 Emission Level = Reading + Factor
 Margin=Emission Level-Limit

Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

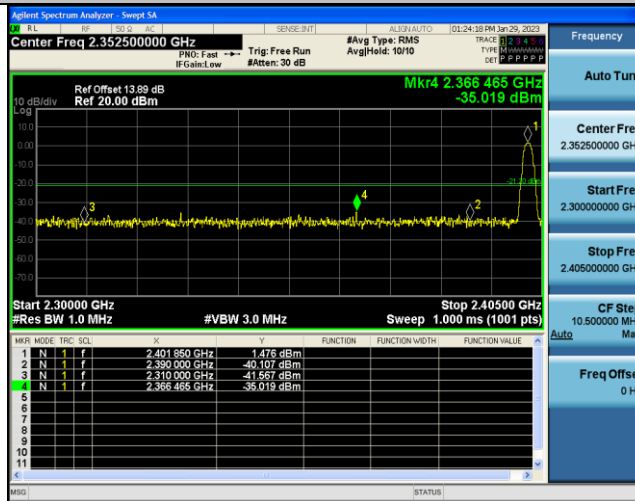
TestMode	Antenna	Channel	Frequency[MHz]	Detector	Freq [MHz]	Result [dBm]	Limit [dBm]	Result [dBuV/m]	Limit [dBuV/m]	Verdict
DH5	Ant1	Low	2402	Peak	2390.000	-40.11	≤-21.20	55.09	≤74	PASS
DH5	Ant1	Low	2402	Peak	2310.000	-41.57	≤-21.20	53.63	≤74	PASS
DH5	Ant1	Low	2402	Peak	2366.465	-35.02	≤-21.20	60.18	≤74	PASS
DH5	Ant1	Low	2402	AV	2390.000	-45.23	≤-41.20	49.97	≤54	PASS
DH5	Ant1	Low	2402	AV	2310.000	-45.82	≤-41.20	49.38	≤54	PASS
DH5	Ant1	Low	2402	AV	2383.160	-44.96	≤-41.20	50.24	≤54	PASS
DH5	Ant1	High	2480	Peak	2483.500	-40.78	≤-21.20	54.42	≤74	PASS
DH5	Ant1	High	2480	Peak	2500.000	-38.66	≤-21.20	56.54	≤74	PASS
DH5	Ant1	High	2480	Peak	2498.000	-36.61	≤-21.20	58.59	≤74	PASS
DH5	Ant1	High	2480	AV	2483.500	-45.47	≤-41.20	49.73	≤54	PASS
DH5	Ant1	High	2480	AV	2500.000	-45.22	≤-41.20	49.98	≤54	PASS
DH5	Ant1	High	2480	AV	2496.960	-45	≤-41.20	50.20	≤54	PASS
2DH5	Ant1	Low	2402	Peak	2390.000	-39.95	≤-21.20	55.25	≤74	PASS
2DH5	Ant1	Low	2402	Peak	2310.000	-39.67	≤-21.20	55.53	≤74	PASS
2DH5	Ant1	Low	2402	Peak	2382.005	-35.96	≤-21.20	59.24	≤74	PASS
2DH5	Ant1	Low	2402	AV	2390.000	-45.31	≤-41.20	49.89	≤54	PASS
2DH5	Ant1	Low	2402	AV	2310.000	-45.73	≤-41.20	49.47	≤54	PASS
2DH5	Ant1	Low	2402	AV	2383.055	-44.89	≤-41.20	50.31	≤54	PASS
2DH5	Ant1	High	2480	Peak	2483.500	-40.25	≤-21.20	54.95	≤74	PASS
2DH5	Ant1	High	2480	Peak	2500.000	-41.46	≤-21.20	53.74	≤74	PASS
2DH5	Ant1	High	2480	Peak	2495.200	-35.91	≤-21.20	59.29	≤74	PASS
2DH5	Ant1	High	2480	AV	2483.500	-45.47	≤-41.20	49.73	≤54	PASS
2DH5	Ant1	High	2480	AV	2500.000	-45.23	≤-41.20	49.97	≤54	PASS
2DH5	Ant1	High	2480	AV	2497.520	-44.97	≤-41.20	50.23	≤54	PASS
DH5	Ant1	Low	Hop_2402	Peak	2390.000	-37.29	≤-21.20	57.91	≤74	PASS
DH5	Ant1	Low	Hop_2402	Peak	2310.000	-37.05	≤-21.20	58.15	≤74	PASS
DH5	Ant1	Low	Hop_2402	Peak	2377.385	-35.11	≤-21.20	60.09	≤74	PASS
DH5	Ant1	High	Hop_2480	Peak	2483.500	-36.37	≤-21.20	58.83	≤74	PASS
DH5	Ant1	High	Hop_2480	Peak	2500.000	-38.42	≤-21.20	56.78	≤74	PASS
DH5	Ant1	High	Hop_2480	Peak	2496.400	-34.97	≤-21.20	60.23	≤74	PASS
2DH5	Ant1	Low	Hop_2402	Peak	2390.000	-36.38	≤-21.20	58.82	≤74	PASS
2DH5	Ant1	Low	Hop_2402	Peak	2310.000	-37.45	≤-21.20	57.75	≤74	PASS
2DH5	Ant1	Low	Hop_2402	Peak	2336.540	-35.54	≤-21.20	59.66	≤74	PASS
2DH5	Ant1	High	Hop_2480	Peak	2483.500	-38.01	≤-21.20	57.19	≤74	PASS
2DH5	Ant1	High	Hop_2480	Peak	2500.000	-38.06	≤-21.20	57.14	≤74	PASS
2DH5	Ant1	High	Hop_2480	Peak	2492.720	-35.51	≤-21.20	59.69	≤74	PASS

Note:

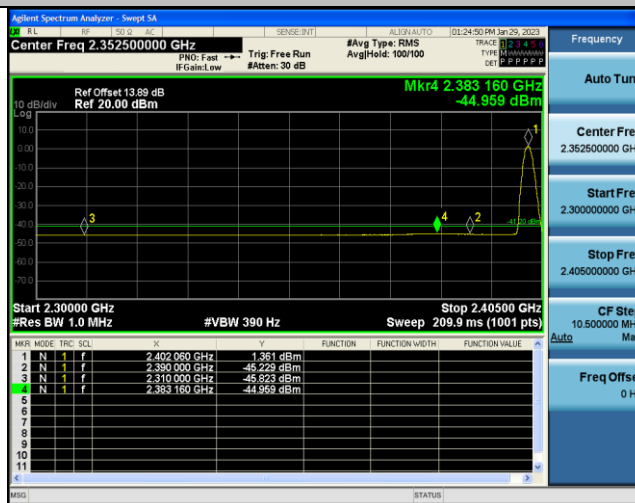


1. The Antenna Gain is compensated in the graph.
2. The limit in dBm for average detector is conversion from 54dBuV/m, according to 15.209(a). The limit in dBm for peak detector is 20dB above the limit of average detector in dBm.

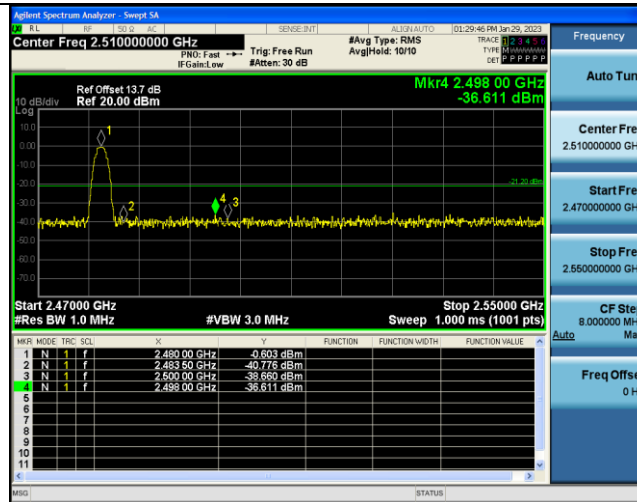
DH5-Ant1-Low-2402-Peak-2390.000



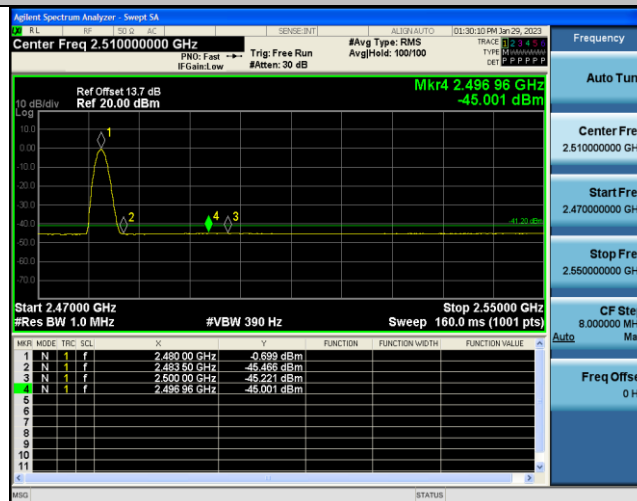
DH5-Ant1-Low-2402-AV-2390.000



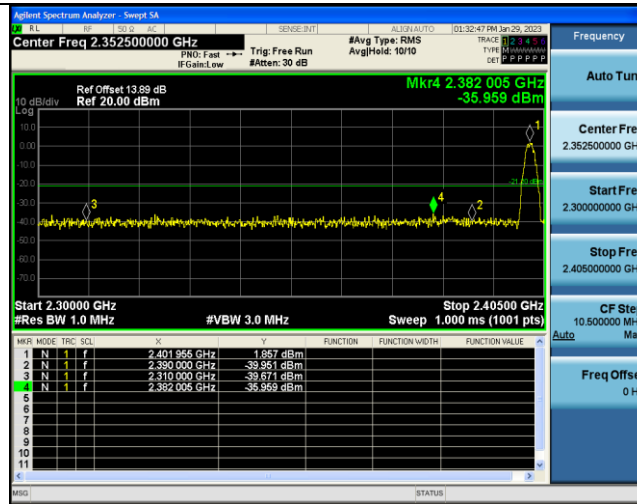
DH5-Ant1-High-2480-Peak-2483.500



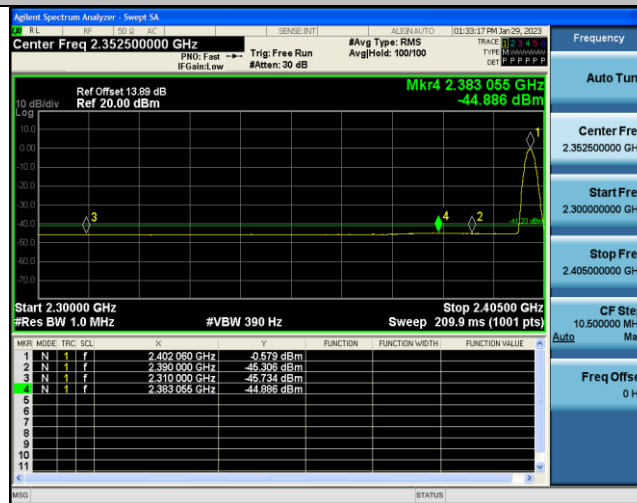
DH5-Ant1-High-2480-AV-2483.500



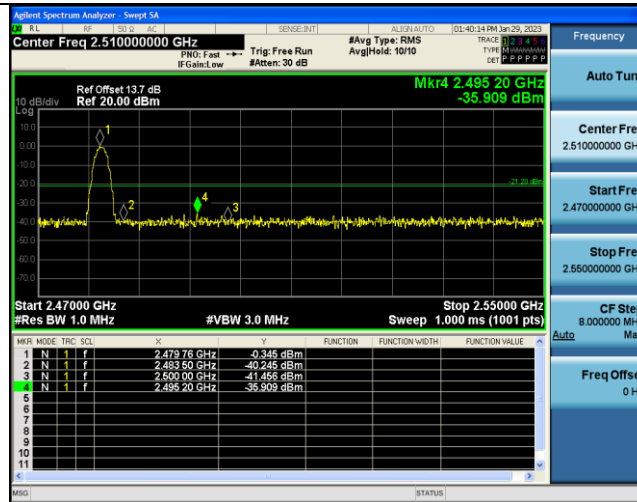
2DH5-Ant1-Low-2402-Peak-2390.000



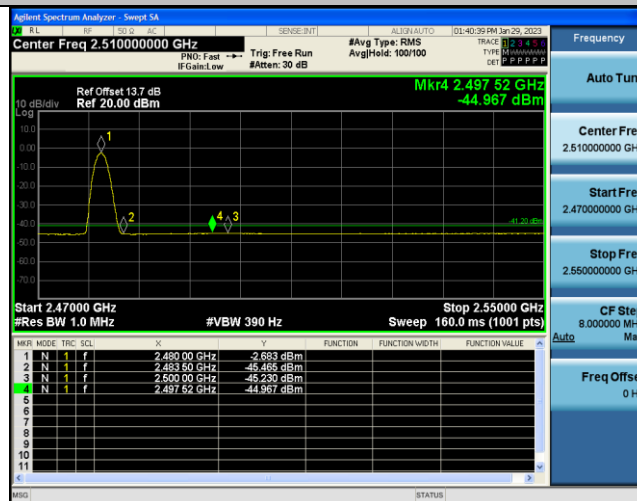
2DH5-Ant1-Low-2402-AV-2390.000



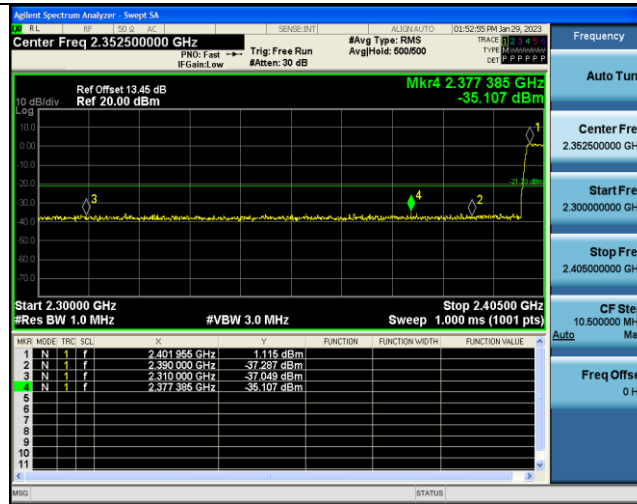
2DH5-Ant1-High-2480-Peak-2483.500



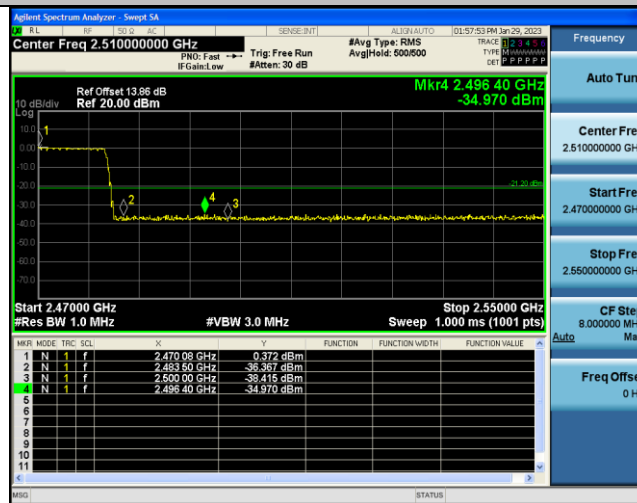
2DH5-Ant1-High-2480-AV-2483.500



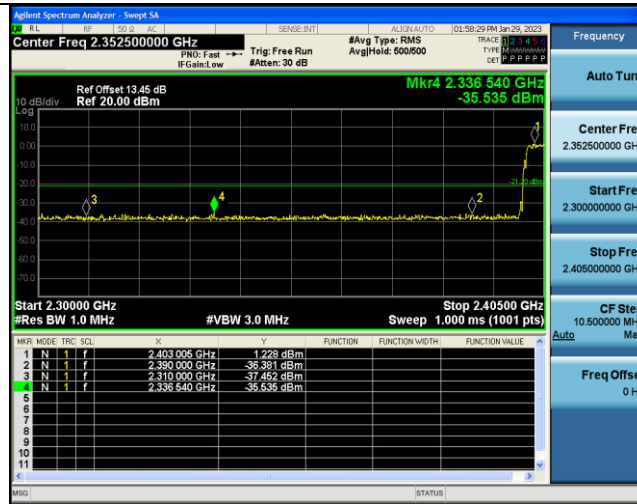
DH5-Ant1-Low-Hop_2402-Peak-2390.000



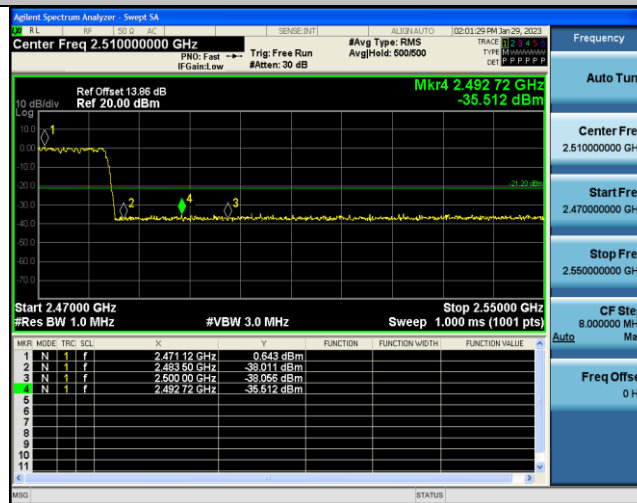
DH5-Ant1-High-Hop_2480-Peak-2483.500



2DH5-Ant1-Low-Hop_2402-Peak-2390.000



2DH5-Ant1-High-Hop_2480-Peak-2483.500



8 CONDUCTED BAND EDGE EMISSION

8.1 REQUIREMENT

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

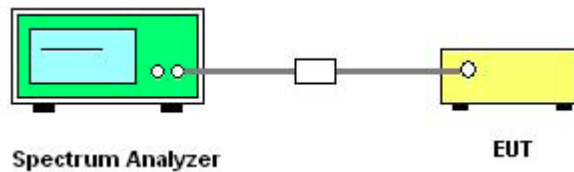
8.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2300 – 2403 MHz Upper Band Edge: 2479 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

8.3 TEST SETUP



1. The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100KHz. The video bandwidth is set to 300KHz.

2. The spectrum from 30MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

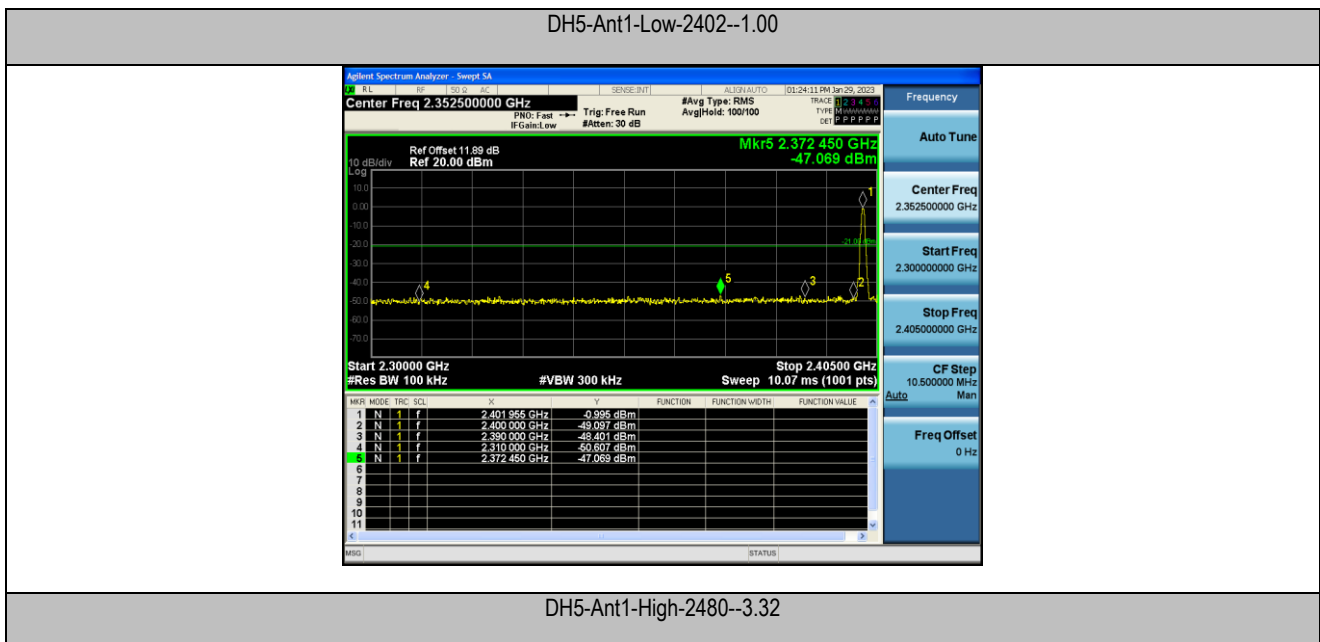


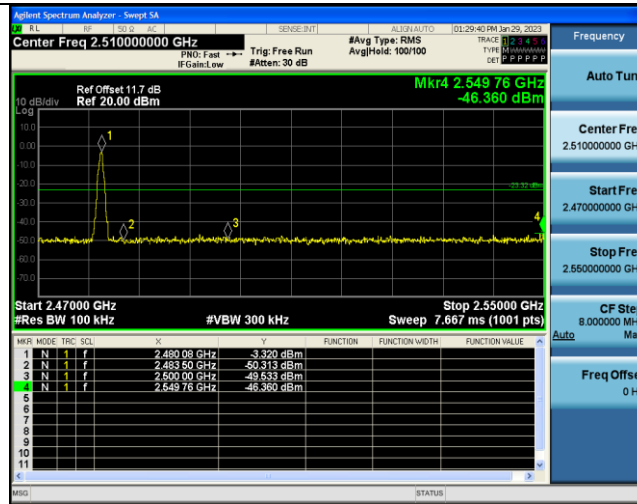
8.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

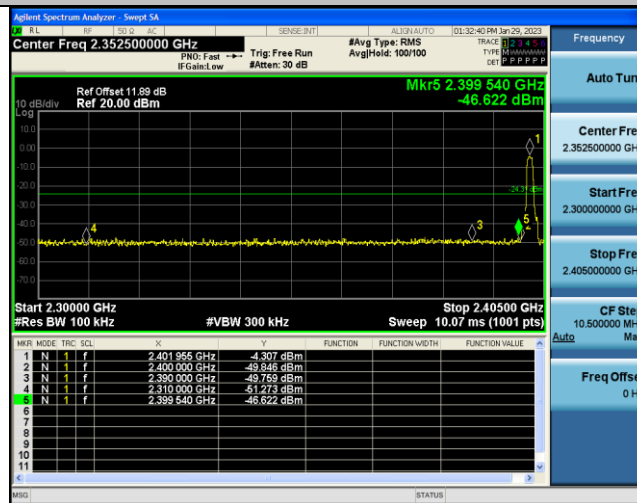
8.5 TEST RESULTS

TestMode	Antenna	ChName	Frequency[MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	Low	2402	-1.00	-47.07	≤-21	PASS
DH5	Ant1	High	2480	-3.32	-46.36	≤-23.32	PASS
2DH5	Ant1	Low	2402	-4.31	-46.62	≤-24.31	PASS
2DH5	Ant1	High	2480	-2.74	-47.12	≤-22.74	PASS
DH5	Ant1	Low	Hop_2402	-1.82	-46.77	≤-21.82	PASS
DH5	Ant1	High	Hop_2480	-2.36	-46.55	≤-22.36	PASS
2DH5	Ant1	Low	Hop_2402	-4.10	-45.74	≤-24.1	PASS
2DH5	Ant1	High	Hop_2480	-2.22	-45.48	≤-22.22	PASS

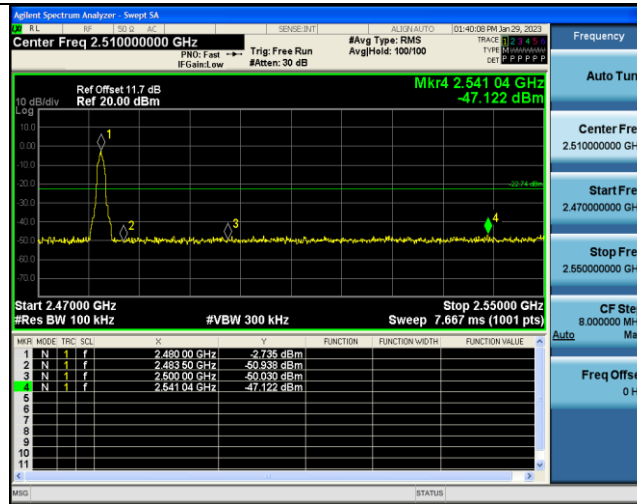




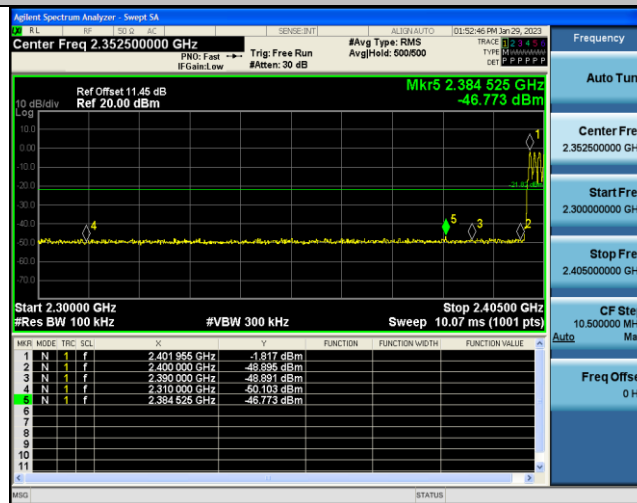
2DH5-Ant1-Low-2402--4.31



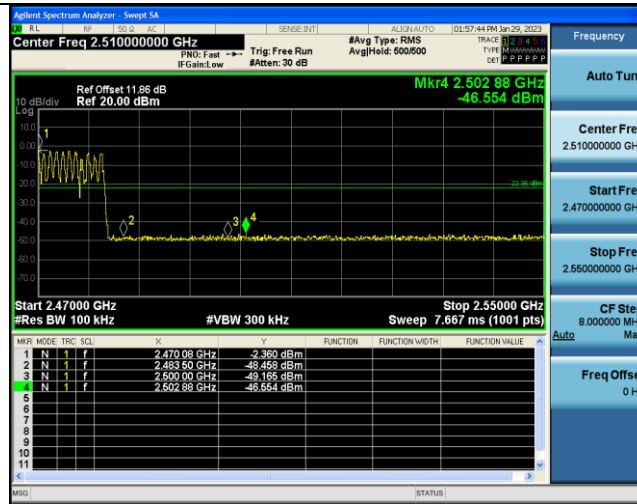
2DH5-Ant1-High-2480--2.74



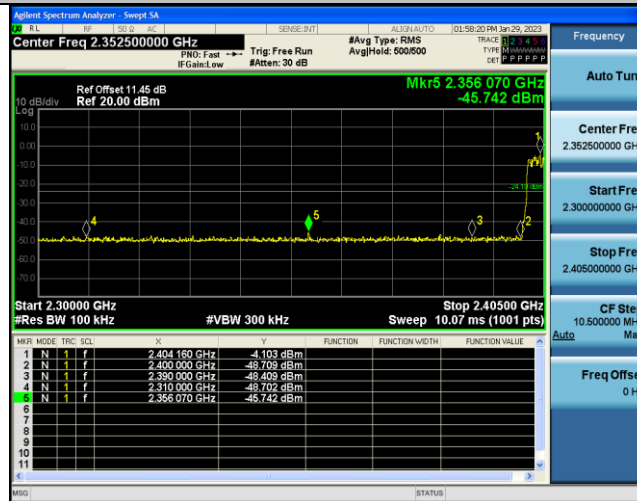
DH5-Ant1-Low-Hop_2402--1.82



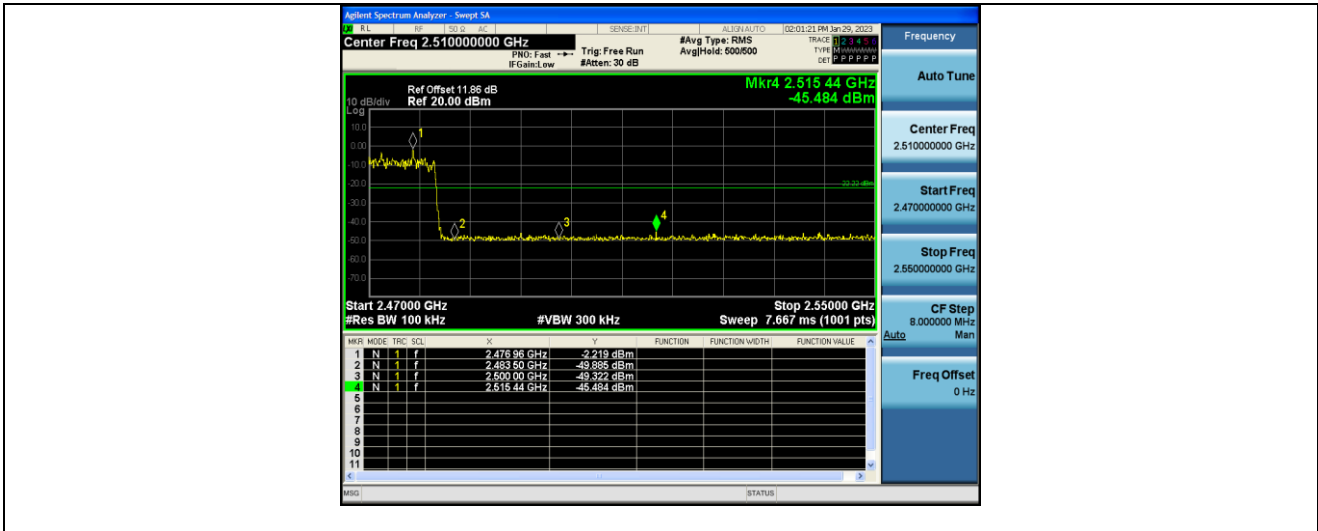
DH5-Ant1-High-Hop_2480--2.36



2DH5-Ant1-Low-Hop_2402--4.10



2DH5-Ant1-High-Hop_2480--2.22



For Conduct spurious emissions

TestMode	Antenna	Frequency[MHz]	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	0~Reference	-1.10	-1.10	---	PASS
DH5	Ant1	2402	30~1000	-1.10	-57.14	≤-21.1	PASS
DH5	Ant1	2402	1000~26500	-1.10	-41.35	≤-21.1	PASS
DH5	Ant1	2441	0~Reference	-1.80	-1.80	---	PASS
DH5	Ant1	2441	30~1000	-1.80	-57.06	≤-21.8	PASS
DH5	Ant1	2441	1000~26500	-1.80	-40.8	≤-21.8	PASS
DH5	Ant1	2480	0~Reference	-3.44	-3.44	---	PASS
DH5	Ant1	2480	30~1000	-3.44	-57.45	≤-23.44	PASS
DH5	Ant1	2480	1000~26500	-3.44	-40.17	≤-23.44	PASS
2DH5	Ant1	2402	0~Reference	-0.81	-0.81	---	PASS
2DH5	Ant1	2402	30~1000	-0.81	-56.64	≤-20.81	PASS
2DH5	Ant1	2402	1000~26500	-0.81	-42.72	≤-20.81	PASS
2DH5	Ant1	2441	0~Reference	-1.71	-1.71	---	PASS
2DH5	Ant1	2441	30~1000	-1.71	-53.85	≤-21.71	PASS

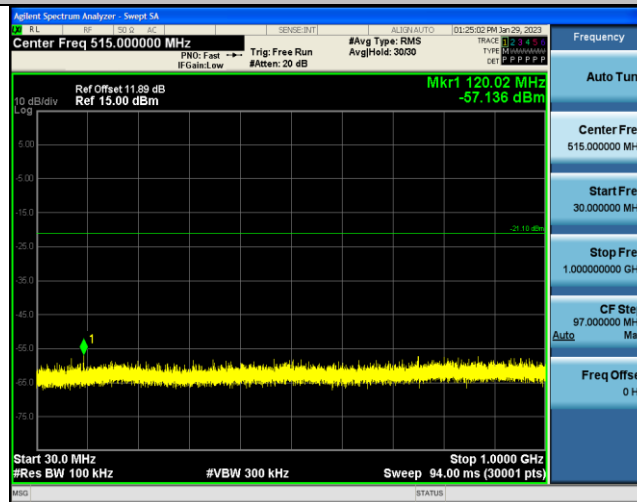


2DH5	Ant1	2441	1000~26500	-1.71	-41.65	≤-21.71	PASS
2DH5	Ant1	2480	0~Reference	-2.65	-2.65	---	PASS
2DH5	Ant1	2480	30~1000	-2.65	-46.05	≤-22.65	PASS
2DH5	Ant1	2480	1000~26500	-2.65	-41.99	≤-22.65	PASS

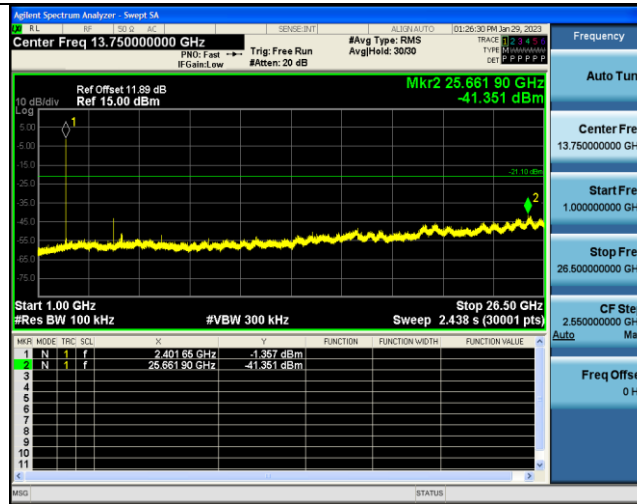
DH5-Ant1-2402-0~Reference--1.10



DH5-Ant1-2402-30~1000--1.10



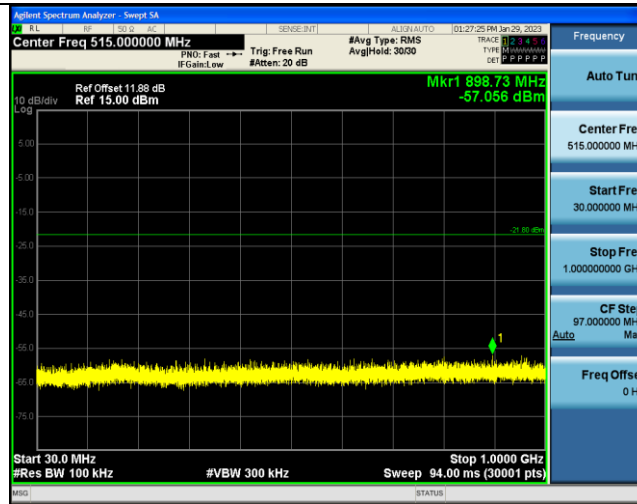
DH5-Ant1-2402-1000~26500--1.10



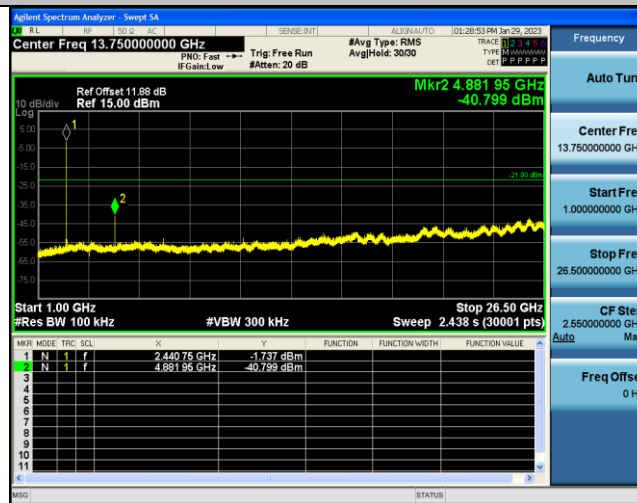
DH5-Ant1-2441-0~Reference--1.80



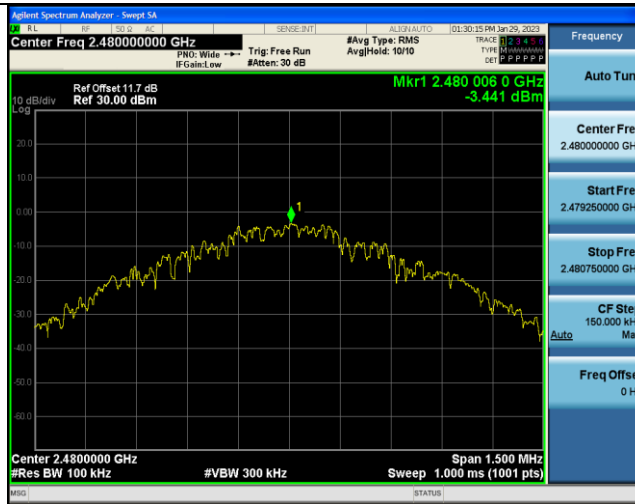
DH5-Ant1-2441-30~1000--1.80



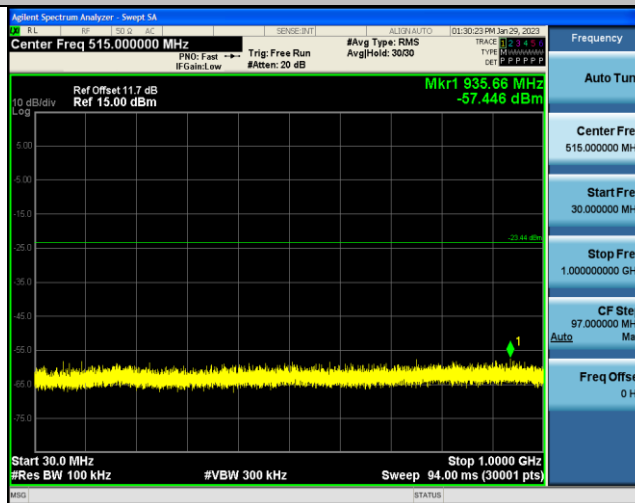
DH5-Ant1-2441-1000~26500--1.80



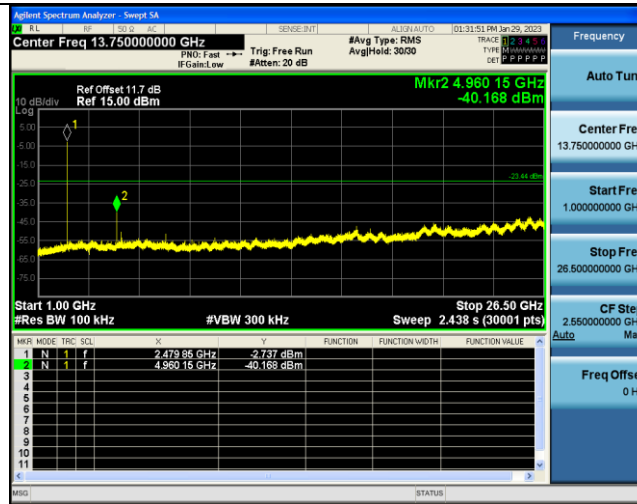
DH5-Ant1-2480-0~Reference--3.44



DH5-Ant1-2480-30~1000--3.44



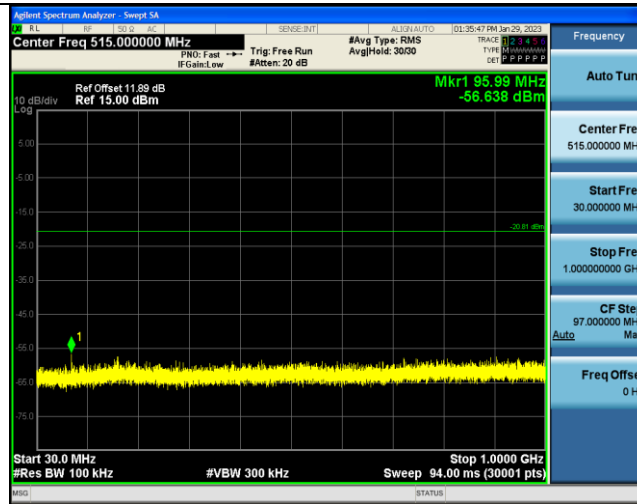
DH5-Ant1-2480-1000~26500--3.44



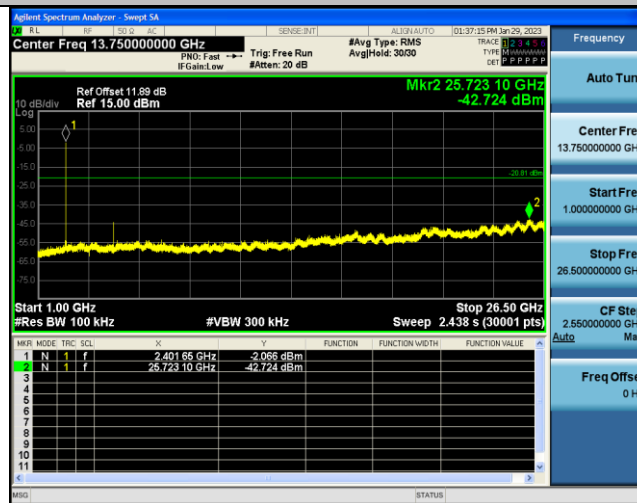
2DH5-Ant1-2402-0~Reference--0.81



2DH5-Ant1-2402-30~1000--0.81



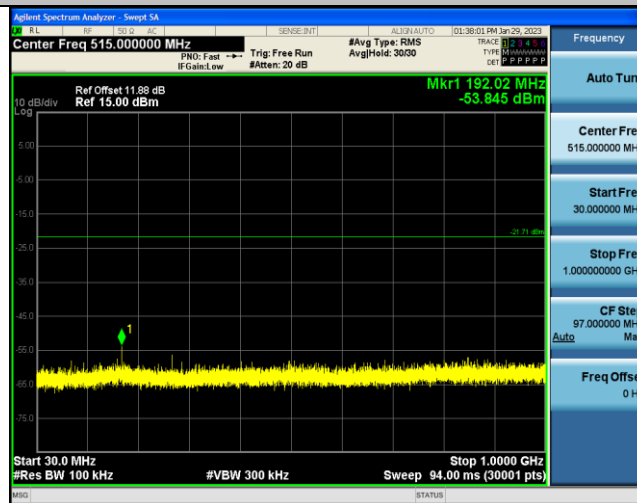
2DH5-Ant1-2402-1000-26500-0.81



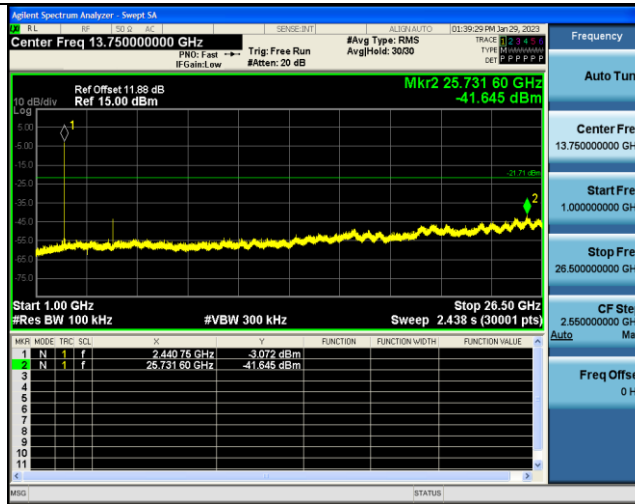
2DH5-Ant1-2441-0-Reference--1.71



2DH5-Ant1-2441-30~1000--1.71



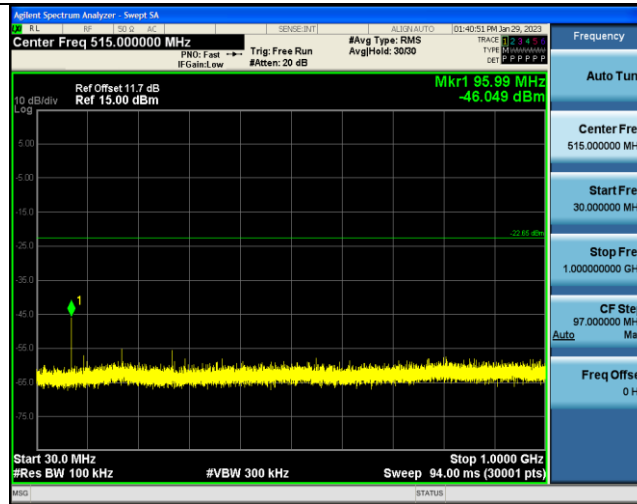
2DH5-Ant1-2441-1000~26500--1.71



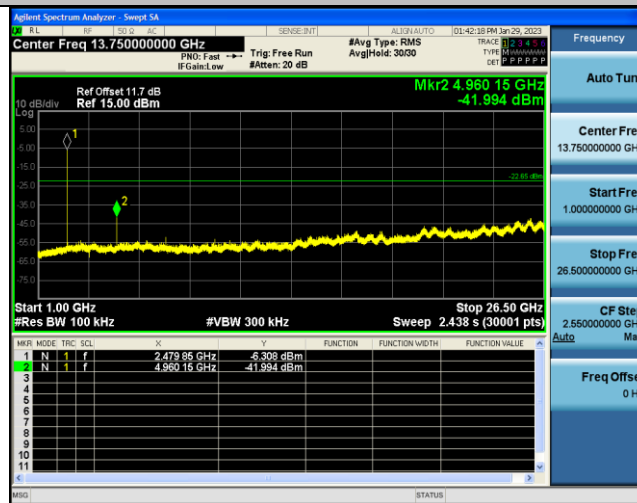
2DH5-Ant1-2480-0~Reference--2.65



2DH5-Ant1-2480-30~1000--2.65



2DH5-Ant1-2480-1000-26500--2.65

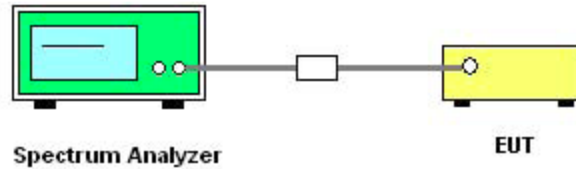


9 20 dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

9.1 Test Procedure



1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW =100kHz, VBW = 100kHz

9.2 Test Result

TestMode	Antenna	Frequency[MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	1.041	2401.475	2402.516	---	---
DH5	Ant1	2441	1.047	2440.475	2441.522	---	---
DH5	Ant1	2480	1.050	2479.475	2480.525	---	---
2DH5	Ant1	2402	1.302	2401.346	2402.648	---	---
2DH5	Ant1	2441	1.425	2440.283	2441.708	---	---
2DH5	Ant1	2480	1.344	2479.325	2480.669	---	---

DH5-Ant1-2402



DH5-Ant1-2441



DH5-Ant1-2480



2DH5-Ant1-2402



2DH5-Ant1-2441



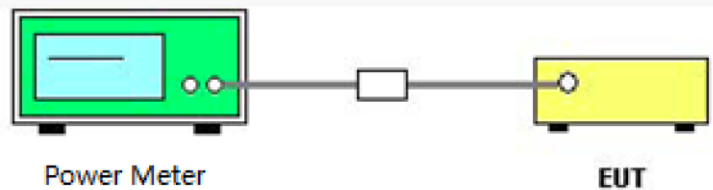
2DH5-Ant1-2480



10 Maximum Peak Output Power

Test Requirement : FCC CFR47 Part 15 Section 15.247
 Test Method : ANSI C63.10:2013
 Test Limit : Regulation 15.247 (b)(1), 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: 1 watt (30dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
 Refer to the result “Number of Hopping Frequency” of this document. The 0.125watts (20.97 dBm) limit applies.

10.1 Test Procedure



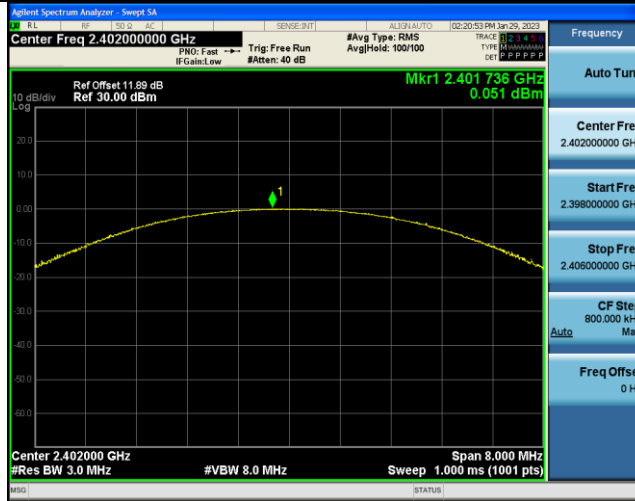
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the power meter.
2. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

10.2 Test Result

Test Mode	Antenna	Frequency[MHz]	Conducted Peak Power[dBm]	Conducted Limit[dBm]	Verdict
DH5	Ant1	2402	0.05	≤20.97	PASS
DH5	Ant1	2441	-0.39	≤20.97	PASS
DH5	Ant1	2480	-1.73	≤20.97	PASS
2DH5	Ant1	2402	0.49	≤20.97	PASS
2DH5	Ant1	2441	0.07	≤20.97	PASS
2DH5	Ant1	2480	-1.23	≤20.97	PASS



DH5-Ant1-2402



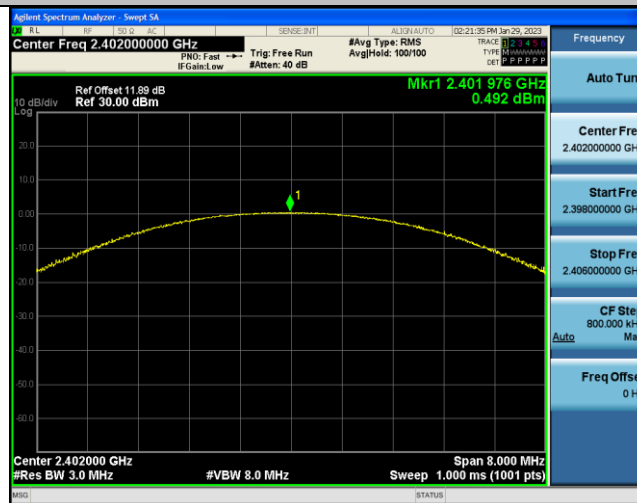
DH5-Ant1-2441



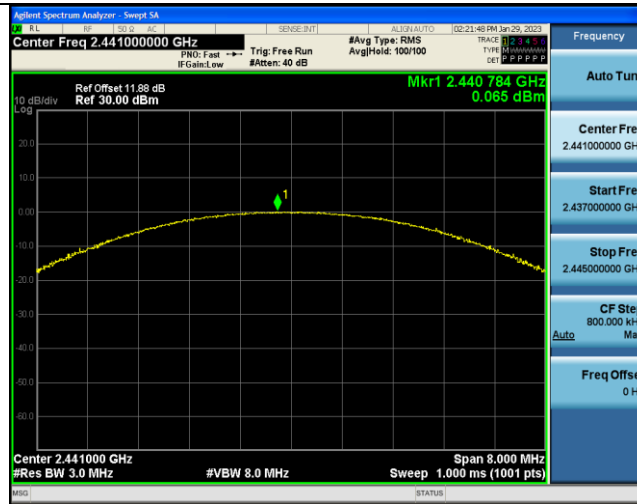
DH5-Ant1-2480



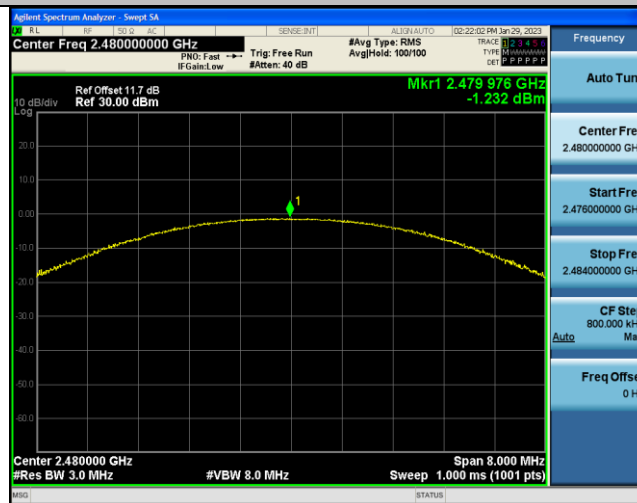
2DH5-Ant1-2402



2DH5-Ant1-2441



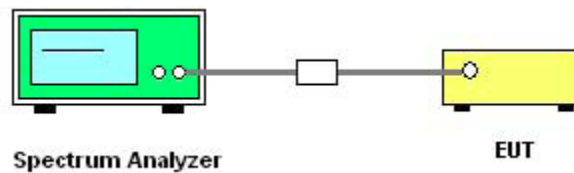
2DH5-Ant1-2480



11 Hopping Channel Separation

Test Requirement	: FCC CFR47 Part 15 Section 15.247
Test Method	: ANSI C63.10:2013
Test Limit	: Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5MHz 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, provided the systems operate with an output power no greater than 1W.
Test Mode	: Hopping

11.1 Test Procedure



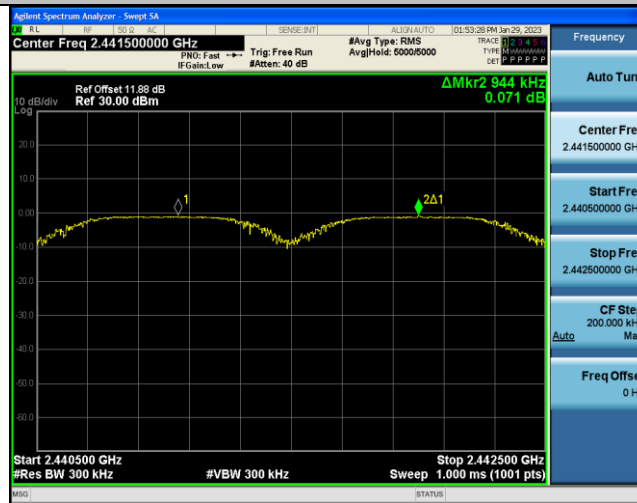
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30KHz. VBW = 100KHz, Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.



11.2 Test Result

TestMode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	0.944	≥0.704	PASS
2DH5	Ant1	Hop	0.986	≥0.950	PASS

DH5-Ant1-Hop



2DH5-Ant1-Hop

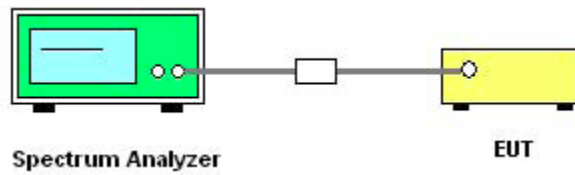




12 Number of Hopping Frequency

Test Requirement : FCC CFR47 Part 15 Section 15.247
 Test Method : ANSI C63.10:2013
 Test Limit : Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
 Test Mode : Hopping(GFSK)

12.1 Test Procedure

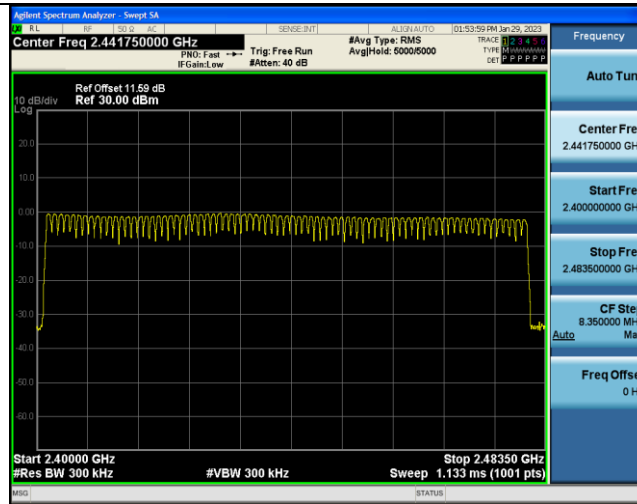


1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100KHz. VBW = 300KHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.483GHz. Sweep=auto;

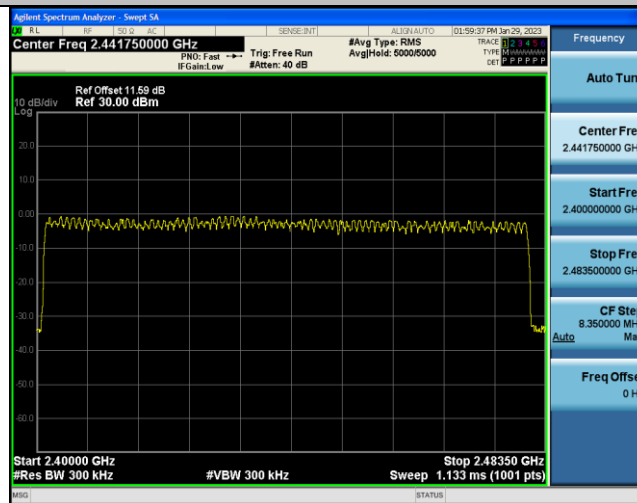
12.2 Test Result

TestMode	Antenna	Frequency[MHz]	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS
2DH5	Ant1	Hop	79	≥15	PASS

DH5-Ant1-Hop



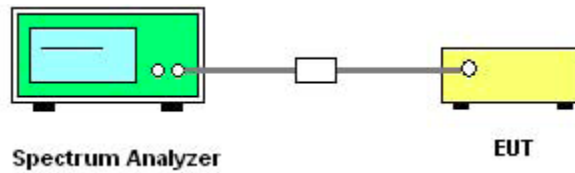
2DH5-Ant1-Hop



13 Dwell Time

- Test Requirement : FCC CFR47 Part 15 Section 15.247
- Test Method : ANSI C63.10:2013
- Test Limit : Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. 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.
- Test Mode : The worst case(GFSK) was recorded

13.1 Test Procedure



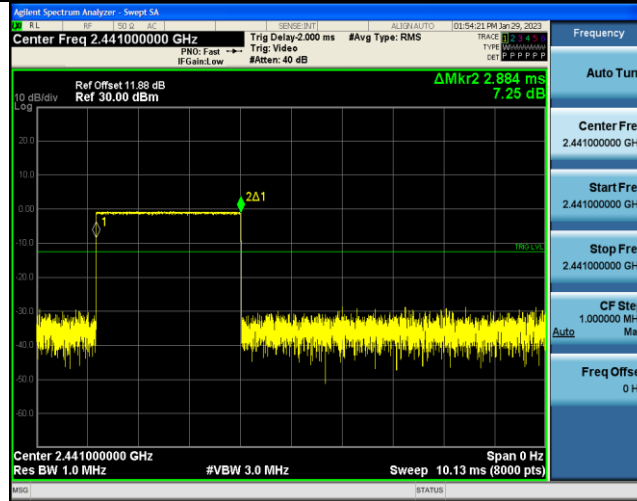
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 3MHz.Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

13.2 Test Result

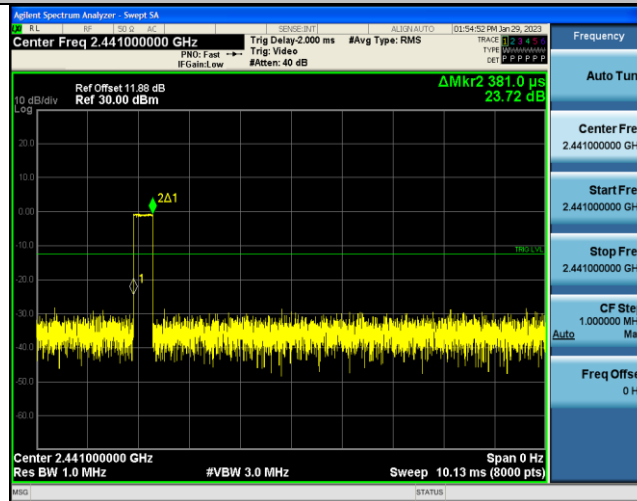
TestMode	Antenna	Frequency[MHz]	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH5	Ant1	Hop	2.884	106.67	0.308	≤0.4	PASS
DH1	Ant1	Hop	0.381	320	0.122	≤0.4	PASS
DH3	Ant1	Hop	1.635	160	0.262	≤0.4	PASS
2DH5	Ant1	Hop	2.889	106.67	0.308	≤0.4	PASS
2DH1	Ant1	Hop	0.390	320	0.125	≤0.4	PASS
2DH3	Ant1	Hop	1.643	160	0.263	≤0.4	PASS



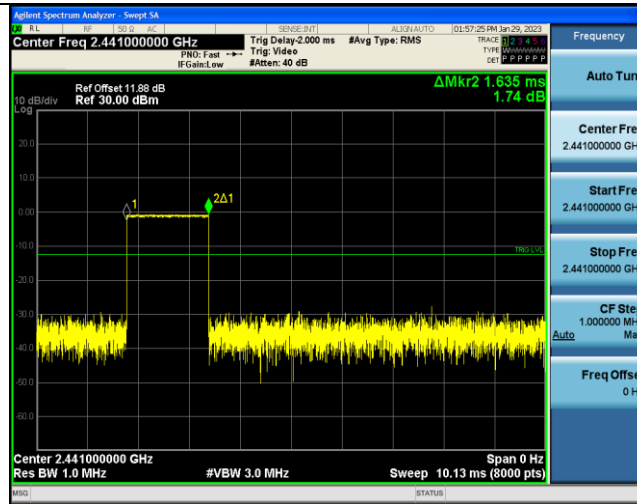
DH5-Ant1-Hop-2.884-106.67



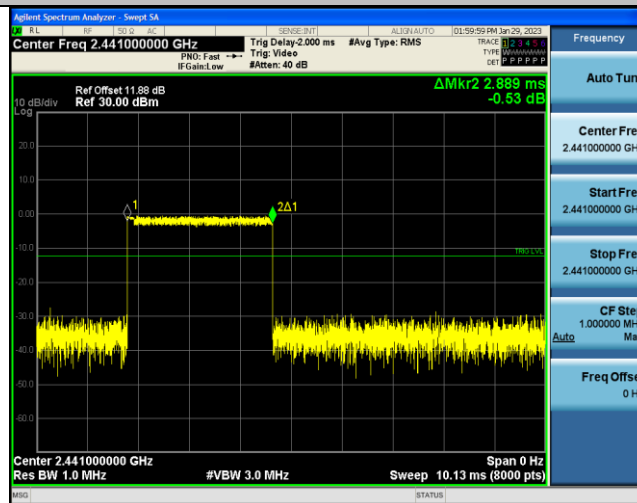
DH1-Ant1-Hop-0.381-320



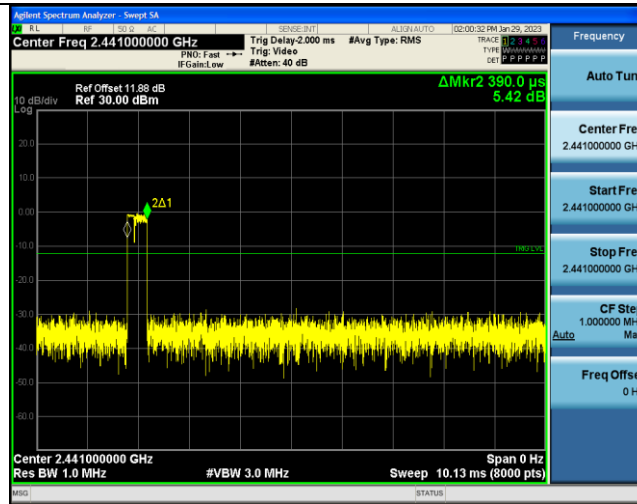
DH3-Ant1-Hop-1.635-160



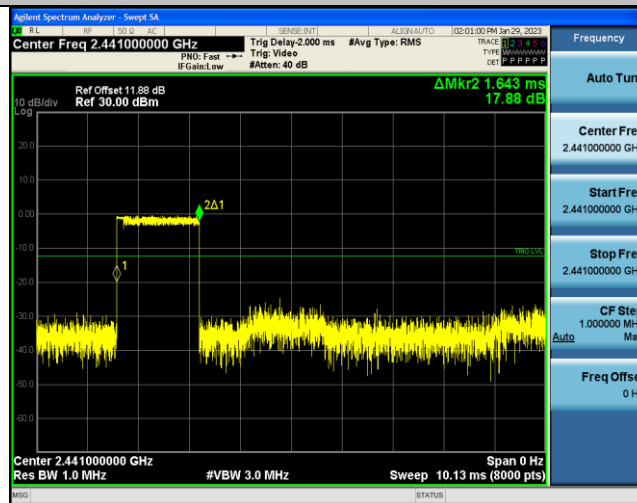
2DH5-Ant1-Hop-2.889-106.67



2DH1-Ant1-Hop-0.390-320



2DH3-Ant1-Hop-1.643-160





14 Antenna Requirement

14.1 Antenna Requirement

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

14.2 Result

The EUT'S antenna, permanent attached antenna, is Internal PCB Antenna. The antenna's gain is 1.32dBi and meets the requirement.



15 TEST PHOTOS

Conducted Emissions



Radiated Spurious Emissions
Test Frequency From 30MHz-1000MHz





Test frequency above 1GHz





Report No.:PTC22123003801E-FC01

16 EUT PHOTOS

Please reference file "Exe photos" and "Int photos".

*****THE END REPORT*****