TCT 通测检测
TESTING CENTRE TECHNOLOGY

TEST REPORT

FCC ID. ..... :	2AZ8F-M70	
Test Report No..... :	TCT201208E007	
Date of issue..... :	Jun. 23, 2021	
Testing laboratory ..... :	SHENZHEN TONGCE TESTING LAB	
Testing location/ address:	TCT Testing Industrial Park Fuqiao 5th Industrial Zone, Fuhai Street, Bao'an District Shenzhen, Guangdong, 518103, People's Republic of China	
Applicant's name..... :	Shenzhen JINGMAI Trade CO., Limited	
Address..... :	B-103, HonShengYuan Industrial Park, NO.339 of BuLong Road, BanTian, LongGang Dist, ShenZhen, GuangDong, China	
Manufacturer's name ... :	Shenzhen Gennuo Technology Co.LTD	
Address..... :	6th Floor, East and West District, Tianrun Intelligent Innovation Industrial Park, No. 23 Jiuwei 1st Road, Xixiang, Baoan, Shenzhen, China	
Standard(s) ..... :	FCC CFR Title 47 Part 15 Subpart C Section 15.247 FCC KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10:2013	
Test item description ..... :	Tablet PC	
Trade Mark ..... :	JEEMAK	
Model/Type reference..... :	M70, Q86, Q863, F86, F101, F863, Q101, L133P, L102, M710	
Rating(s)..... :	Refer to EUT description of page 3	
Date of receipt of test item ..... :	Dec. 08, 2020	
Date (s) of performance of test..... :	See dates for each test case	
Tested by (+signature) ... :	Brews Xu	Brews Xu
Check by (+signature).... :	Beryl Zhao	Beryl zhao
Approved by (+signature):	Tomsin	Tomsin

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1. General Product Information

1.1. EUT description

Test item description .....:	Tablet PC
Model/Type reference.....:	M70
Sample Number.....:	TCT201208E007-0101
Bluetooth Version .....:	V2.1+EDR
Operation Frequency .....:	2402MHz~2480MHz
Transfer Rate .....:	1/2/3 Mbits/s
Number of Channel .....:	79
Modulation Type .....:	GFSK, π/4-DQPSK, 8DPSK
Modulation Technology .....:	FHSS
Antenna Type.....:	Internal Antenna
Antenna Gain.....:	1.5dBi
Rating(s).....:	Adapter Information: MODEL: RSF-DY080-0502000USU INPUT: AC 100-240V, 50/60Hz, 0.3A OUTPUT: DC 5V, 2A Rechargeable Li-ion Battery DC 3.7V
Remark.....:	/

Note: The antenna gain listed in this report is provided by applicant, and the test laboratory is not responsible for this parameter.

1.2. Model(s) list

No.	Model No.	Tested with
1	M70	☒
Other models	Q86, Q863, F86, F101, F863, Q101, L133P, L102, M710	☐
Note: M70 is tested model, other models are derivative models. The models are identical in circuit and PCB layout, only different on the model names. So the test data of M70 can represent the remaining models.		

1.3. Operation Frequency

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	20	2422MHz	40	2442MHz	60	2462MHz
1	2403MHz	21	2423MHz	41	2443MHz	61	2463MHz
…	…	…	…	…	…	…	…
10	2412MHz	30	2432MHz	50	2452MHz	70	2472MHz
11	2413MHz	31	2433MHz	51	2453MHz	71	2473MHz
…	…	…	…	…	…	…	…
18	2420MHz	38	2440MHz	58	2460MHz	78	2480MHz
19	2421MHz	39	2441MHz	59	2461MHz	-	
Remark: Channel 0, 39 &78 have been tested for GFSK, π/4-DQPSK, 8DPSK modulation mode.							

2. Test Result Summary

Requirement	CFR 47 Section	Result
Antenna Requirement	§15.203/§15.247 (c)	PASS
AC Power Line Conducted Emission	§15.207	PASS
Conducted Peak Output Power	§15.247 (b)(1)	PASS
20dB Occupied Bandwidth	§15.247 (a)(1)	PASS
Carrier Frequencies Separation	§15.247 (a)(1)	PASS
Hopping Channel Number	§15.247 (a)(1)	PASS
Dwell Time	§15.247 (a)(1)	PASS
Radiated Emission	§15.205/§15.209	PASS
Band Edge	§15.247(d)	PASS

Note:

1. *PASS: Test item meets the requirement.*
2. *Fail: Test item does not meet the requirement.*
3. *N/A: Test case does not apply to the test object.*
4. *The test result judgment is decided by the limit of test standard.*

3. General Information

3.1. Test environment and mode

Operating Environment:		
Condition	Conducted Emission	Radiated Emission
Temperature:	25.0 °C	25.0 °C
Humidity:	55 % RH	55 % RH
Atmospheric Pressure:	1010 mbar	1010 mbar
Test Software:		
Software Information:	ADB command	
Power Level:	7	
Test Mode:		
Engineering mode:	Keep the EUT in continuous transmitting by select channel and modulations with Fully-charged battery	
The sample was placed 0.8m & 1.5m for the measurement below & above 1GHz above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case(Z axis) are shown in Test Results of the following pages. DH1 DH3 DH5 all have been tested , only worse case DH1 is reported.		

3.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
/	/	/	/	/

Note:

1. *All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
2. *Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*
3. *For conducted measurements (Output Power, 20dB Occupied Bandwidth, Carrier Frequencies Separation, Hopping Channel Number, Dwell Time, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.*

4. Facilities and Accreditations

4.1. Facilities

The test facility is recognized, certified, or accredited by the following organizations:

- FCC - Registration No.: 645098
  SHENZHEN TONGCE TESTING LAB
  Designation Number: CN1205
  The testing lab has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.
- IC - Registration No.: 10668A-1
  SHENZHEN TONGCE TESTING LAB
  CAB identifier: CN0031
  The testing lab has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing.

4.2. Location

SHENZHEN TONGCE TESTING LAB
Address: TCT Testing Industrial Park Fuqiao 5th Industrial Zone, Fuhai Street, Bao'an District Shenzhen, Guangdong, 518103, People's Republic of China
TEL: +86-755-27673339

4.3. Measurement Uncertainty

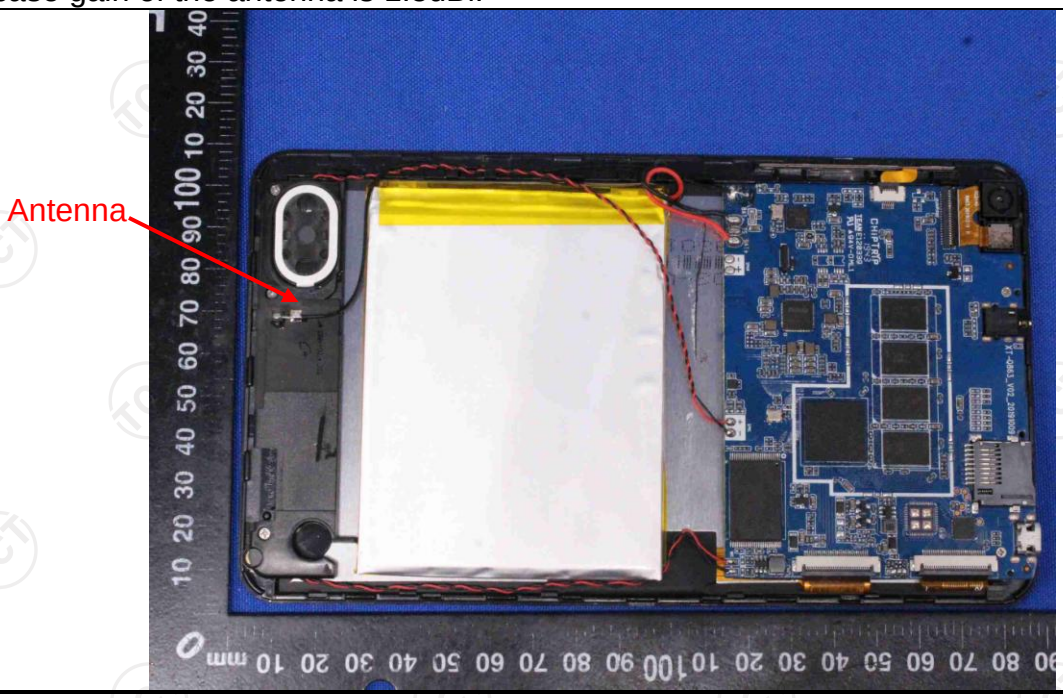
The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	MU
1	Conducted Emission	± 3.10 dB
2	RF power, conducted	± 0.12 dB
3	Spurious emissions, conducted	± 0.11 dB
4	All emissions, radiated(<1 GHz)	± 4.56 dB
5	All emissions, radiated(1 GHz - 18 GHz)	± 4.22 dB
6	All emissions, radiated(18 GHz- 40 GHz)	± 4.36 dB

5. Test Results and Measurement Data

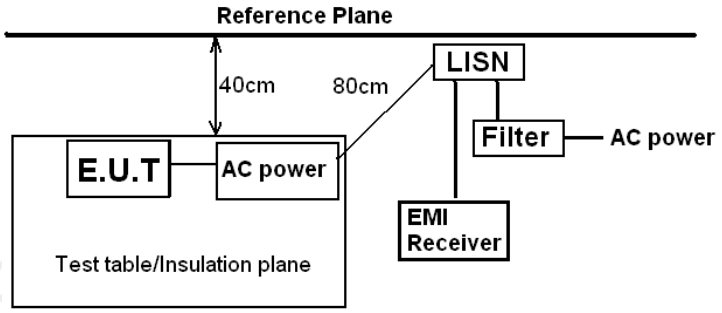
5.1. Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
15.203 requirement: 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.	
E.U.T Antenna:	
The Bluetooth antenna is internal antenna which permanently attached, and the best case gain of the antenna is 1.5dBi.	



5.2. Conducted Emission

5.2.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.207
Test Method:	ANSI C63.10:2013
Frequency Range:	150 kHz to 30 MHz
Receiver setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto
Limits:	Frequency range (MHz) / Limit (dBuV): Quasi-peak / Average 0.15-0.5: 66 to 56* / 56 to 46* 0.5-5: 56 / 46 5-30: 60 / 50
Test Setup:	 *Remark:* *E.U.T: Equipment Under Test* *LISN: Line Impedence Stabilization Network* *Test table height=0.8m*
Test Mode:	Refer to item 4.1
Test Procedure:	1. The E.U.T is connected to an adapter through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. 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). 3. 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 of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement.
Test Result:	PASS

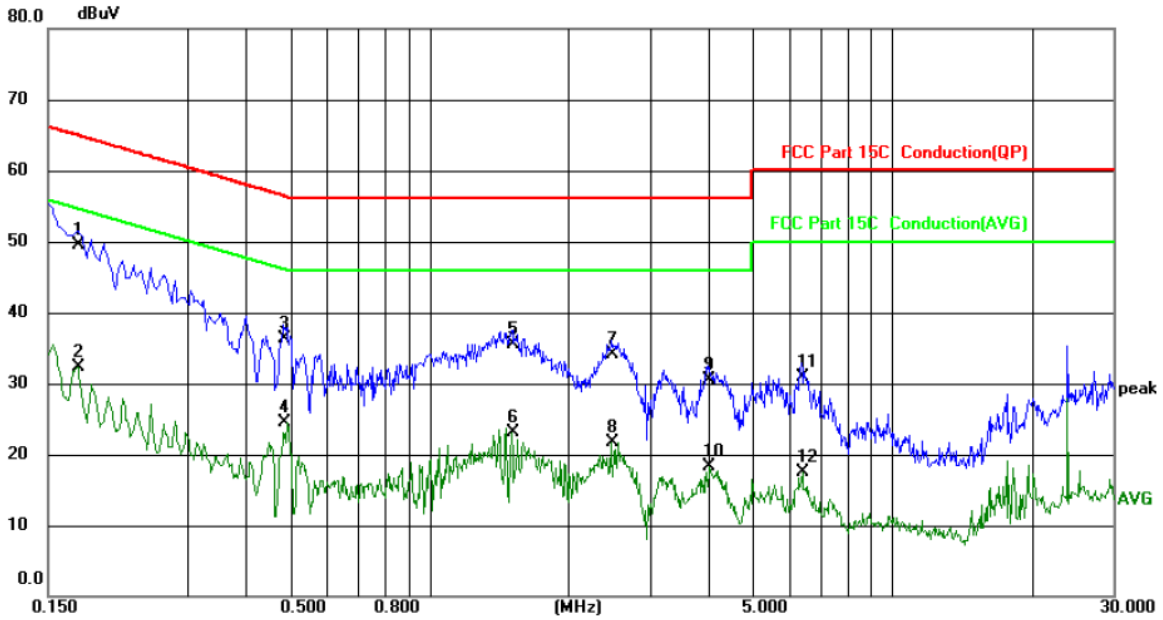
5.2.2. Test Instruments

Conducted Emission Shielding Room Test Site (843)				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Test Receiver	R&S	ESCI3	100898	Jul. 27, 2021
LISN-2	Schwarzbeck	NSLK 8126	8126453	Sep. 11, 2021
Line-5	TCT	CE-05	N/A	Sep. 02, 2021
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

5.2.3. Test data

Please refer to following diagram for individual

Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



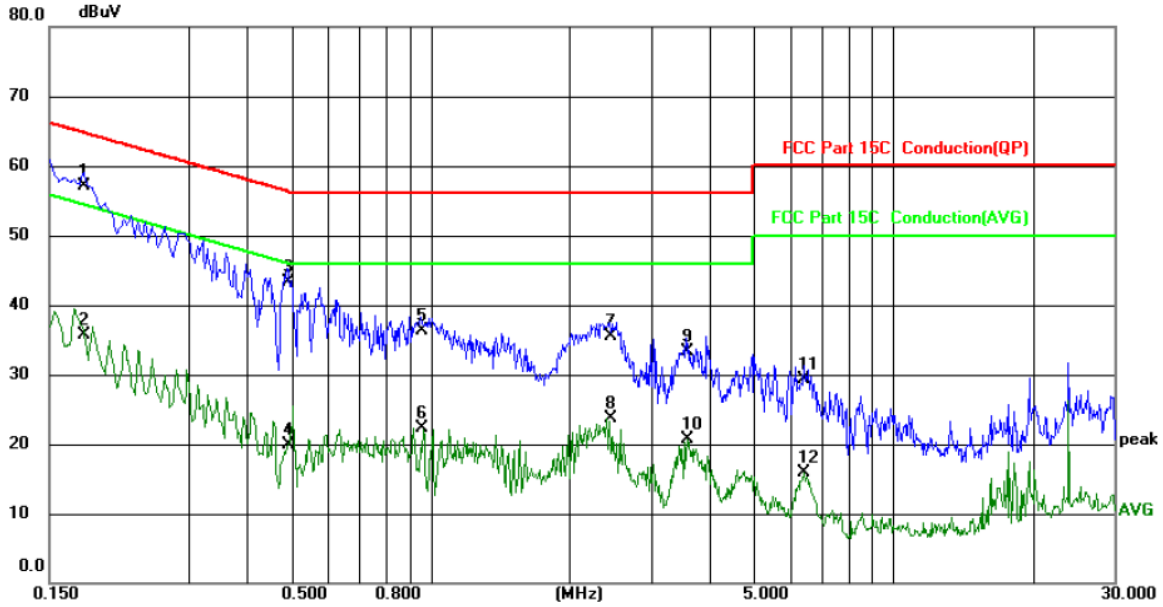
Site	Phase: *L1*	Temperature:	25 (C)
Limit: FCC Part 15C Conduction(QP)	Power: AC120V/60Hz	Humidity:	55 %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1740	39.49	10.10	49.59	64.77	-15.18	QP	
2		0.1740	22.30	10.10	32.40	54.77	-22.37	AVG	
3		0.4860	26.13	10.14	36.27	56.24	-19.97	QP	
4		0.4860	14.39	10.14	24.53	46.24	-21.71	AVG	
5		1.5140	25.22	10.21	35.43	56.00	-20.57	QP	
6		1.5140	12.82	10.21	23.03	46.00	-22.97	AVG	
7		2.4739	23.78	10.28	34.06	56.00	-21.94	QP	
8		2.4739	11.45	10.28	21.73	46.00	-24.27	AVG	
9		3.9980	20.16	10.36	30.52	56.00	-25.48	QP	
10		3.9980	8.03	10.36	18.39	46.00	-27.61	AVG	
11		6.3580	20.52	10.46	30.98	60.00	-29.02	QP	
12		6.3580	6.97	10.46	17.43	50.00	-32.57	AVG	

Note:

Freq. = Emission frequency in MHz
Reading level (dBµV) = Receiver reading
Corr. Factor (dB) = LISN factor + Cable loss
Measurement (dBµV) = Reading level (dBµV) + Corr. Factor (dB)
Limit (dBµV) = Limit stated in standard
Margin (dB) = Measurement (dBµV) – Limits (dBµV)
Q.P. =Quasi-Peak
AVG =average
** is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.*

Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)



Site		Phase:	N	Temperature:	25 (C)
Limit: FCC Part 15C Conduction(QP)		Power:	AC120V/60Hz	Humidity:	55 %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1780	47.07	10.10	57.17	64.58	-7.41	QP	
2		0.1780	25.63	10.10	35.73	54.58	-18.85	AVG	
3		0.4900	33.24	10.14	43.38	56.17	-12.79	QP	
4		0.4900	9.72	10.14	19.86	46.17	-26.31	AVG	
5		0.9540	26.10	10.17	36.27	56.00	-19.73	QP	
6		0.9540	12.08	10.17	22.25	46.00	-23.75	AVG	
7		2.4420	25.29	10.28	35.57	56.00	-20.43	QP	
8		2.4420	13.46	10.28	23.74	46.00	-22.26	AVG	
9		3.5740	23.00	10.33	33.33	56.00	-22.67	QP	
10		3.5740	10.29	10.33	20.62	46.00	-25.38	AVG	
11		6.4140	18.81	10.46	29.27	60.00	-30.73	QP	
12		6.4140	5.41	10.46	15.87	50.00	-34.13	AVG	

Note1:

Freq. = Emission frequency in MHz

Reading level (dBµV) = Receiver reading

Corr. Factor (dB) = LISN factor + Cable loss

Measurement (dBµV) = Reading level (dBµV) + Corr. Factor (dB)

Limit (dBµV) = Limit stated in standard

Margin (dB) = Measurement (dBµV) – Limits (dBµV)

Q.P. =Quasi-Peak AVG =average

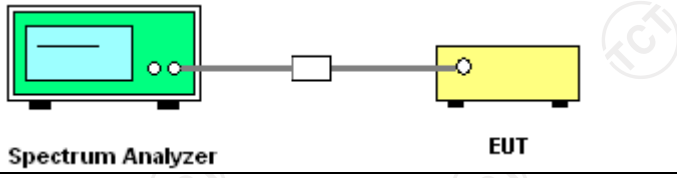
** is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.*

Note2:

Measurements were conducted in all three channels (high, middle, low) and three modulation (GFSK, Pi/4 DQPSK, 8DPSK), and the worst case Mode (Middle channel and 8DPSK) was submitted only.

5.3. Conducted Output Power

5.3.1. Test Specification

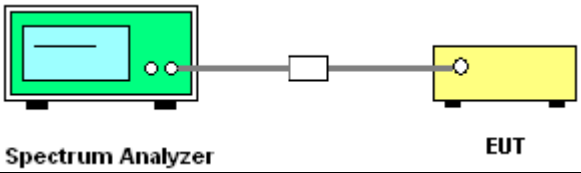
Test Requirement:	FCC Part15 C Section 15.247 (b)(1)
Test Method:	KDB 558074 D01 v05r02
Limit:	Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts.
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	Use the following spectrum analyzer settings: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.
Test Result:	PASS

5.3.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Sep. 11, 2021
4 Ch. Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	N/A	Sep. 02, 2021
Combiner Box	Ascentest	AT890-RFB	N/A	Sep. 02, 2021

5.4. 20dB Occupy Bandwidth

5.4.1. Test Specification

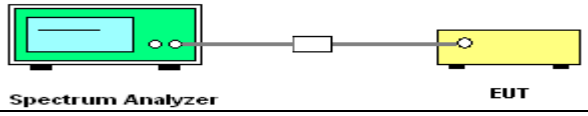
Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	KDB 558074 D01 v05r02
Limit:	N/A
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel; 1%≤RBW≤5% of the 20 dB bandwidth; VBW≥3RBW; Sweep = auto; Detector function = peak; Trace = max hold. 4. Measure and record the results in the test report.
Test Result:	PASS

5.4.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Sep. 11, 2021
4 Ch. Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	N/A	Sep. 02, 2021
Combiner Box	Ascentest	AT890-RFB	N/A	Sep. 02, 2021

5.5. Carrier Frequencies Separation

5.5.1. Test Specification

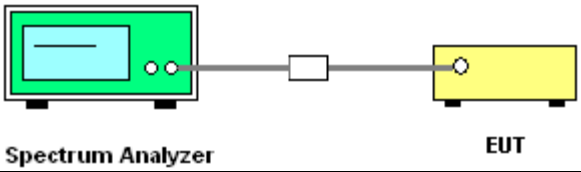
Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	KDB 558074 D01 v05r02
Limit:	Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.
Test Setup:	
Test Mode:	Hopping mode
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Enable the EUT hopping function. 4. Use the following spectrum analyzer settings: Span = wide enough to capture the peaks of two adjacent channels; RBW is set to approximately 30% of the channel spacing, adjust as necessary to best identify the center of each individual channel; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold. 5. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Record the value in report.
Test Result:	PASS

5.5.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Sep. 11, 2021
4 Ch. Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	N/A	Sep. 02, 2021
Combiner Box	Ascentest	AT890-RFB	N/A	Sep. 02, 2021

5.6. Hopping Channel Number

5.6.1. Test Specification

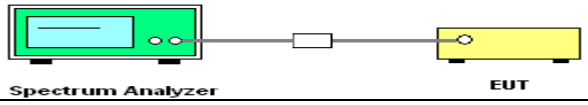
Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	KDB 558074 D01 v05r02
Limit:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Setup:	
Test Mode:	Hopping mode
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Enable the EUT hopping function. 4. Use the following spectrum analyzer settings: Span = the frequency band of operation; set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold. 5. The number of hopping frequency used is defined as the number of total channel. 6. Record the measurement data in report.
Test Result:	PASS

5.6.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Sep. 11, 2021
4 Ch. Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	N/A	Sep. 02, 2021
Combiner Box	Ascentest	AT890-RFB	N/A	Sep. 02, 2021

5.7. Dwell Time

5.7.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	KDB 558074 D01 v05r02
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.
Test Setup:	
Test Mode:	Hopping mode
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Enable the EUT hopping function. 4. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel; VBW≥RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold. 5. Measure and record the results in the test report.
Test Result:	PASS

5.7.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Sep. 11, 2021
4 Ch. Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	N/A	Sep. 02, 2021
Combiner Box	Ascentest	AT890-RFB	N/A	Sep. 02, 2021

5.8. Pseudorandom Frequency Hopping Sequence

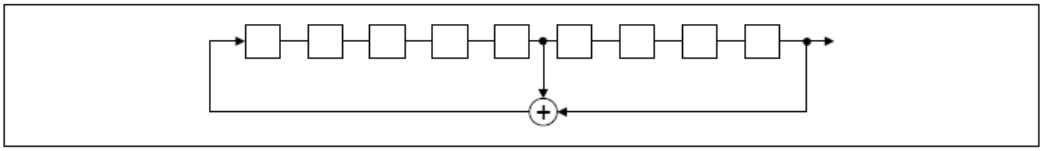
Test Requirement:	FCC Part15 C Section 15.247 (a)(1) requirement:

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 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence

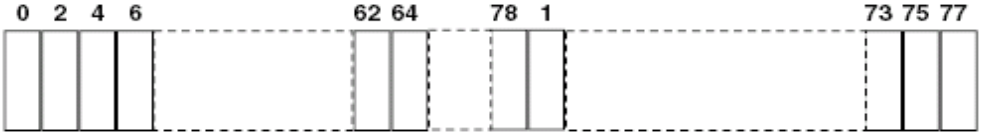
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones; i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence: 2^9 -1 = 511 bits
- Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

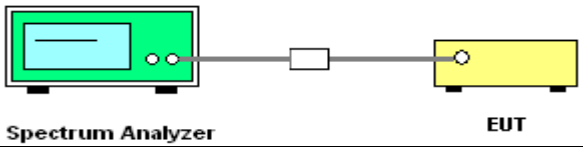
An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.
The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

5.9. Conducted Band Edge Measurement

5.9.1. Test Specification

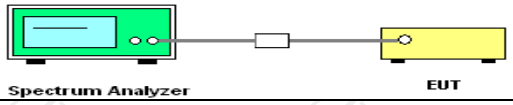
Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB 558074 D01 v05r02
Limit:	In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. Set to the maximum power setting and enable the EUT transmit continuously. 2. Set RBW = 100 kHz (≥1% span=10MHz), VBW = 300 kHz (≥RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used. 3. Enable hopping function of the EUT and then repeat step 2 and 3. 4. Measure and record the results in the test report.
Test Result:	PASS

5.9.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Sep. 11, 2021
4 Ch. Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	N/A	Sep. 02, 2021
Combiner Box	Ascentest	AT890-RFB	N/A	Sep. 02, 2021

5.10. Conducted Spurious Emission Measurement

5.10.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB 558074 D01 v05r02
Limit:	In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. 4. Measure and record the results in the test report. 5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
Test Result:	PASS

5.10.2. Test Instruments

Name	Manufacturer	Model No.	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100619	Sep. 11, 2021
4 Ch. Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	N/A	Sep. 02, 2021
Combiner Box	Ascentest	AT890-RFB	N/A	Sep. 02, 2021

5.11. Radiated Spurious Emission Measurement

5.11.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.209
Test Method:	ANSI C63.10:2013
Frequency Range:	9 kHz to 25 GHz
Measurement Distance:	3 m
Antenna Polarization:	Horizontal & Vertical

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
150kHz-30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak Value
Above 1GHz	Peak	1MHz	3MHz	Peak Value
	Peak	1MHz	10Hz	Average Value

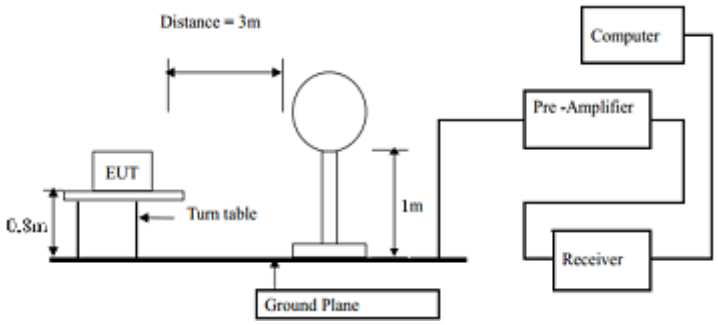
Limit:

Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)
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

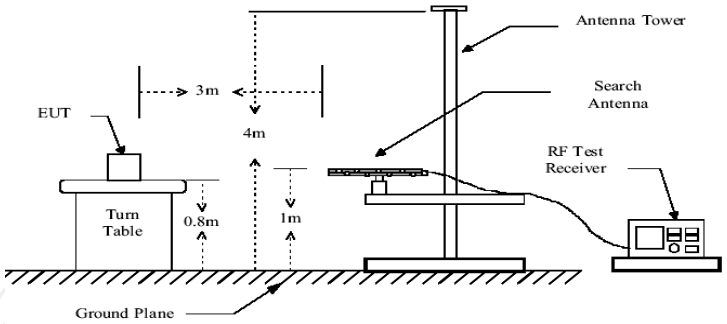
Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)	Detector
Above 1GHz	500	3	Average
	5000	3	Peak

Test setup:

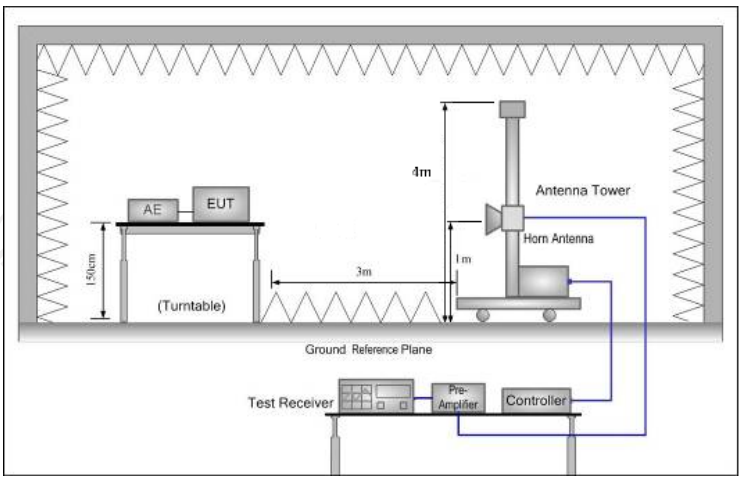
For radiated emissions below 30MHz



30MHz to 1GHz



Above 1GHz



Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10:2013 Measurement Guidelines. 2. For the radiated emission test below 1GHz: The EUT was placed on a turntable with 0.8 meter above ground. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) 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. For the radiated emission test above 1GHz: Place the measurement antenna on a turntable with 1.5 meter above ground, which is away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission

	and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Use the following spectrum analyzer settings: (1) Span shall wide enough to fully capture the emission being measured; (2) Set RBW=120 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak (3) For average measurement: use duty cycle correction factor method per 15.35(c). Duty cycle = On time/100 milliseconds On time =N1*L1+N2*L2+...+Nn-1*LNn-1+Nn*Ln Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc. Average Emission Level = Peak Emission Level + 20*log(Duty cycle) Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
Test results:	PASS

5.11.2. Test Instruments

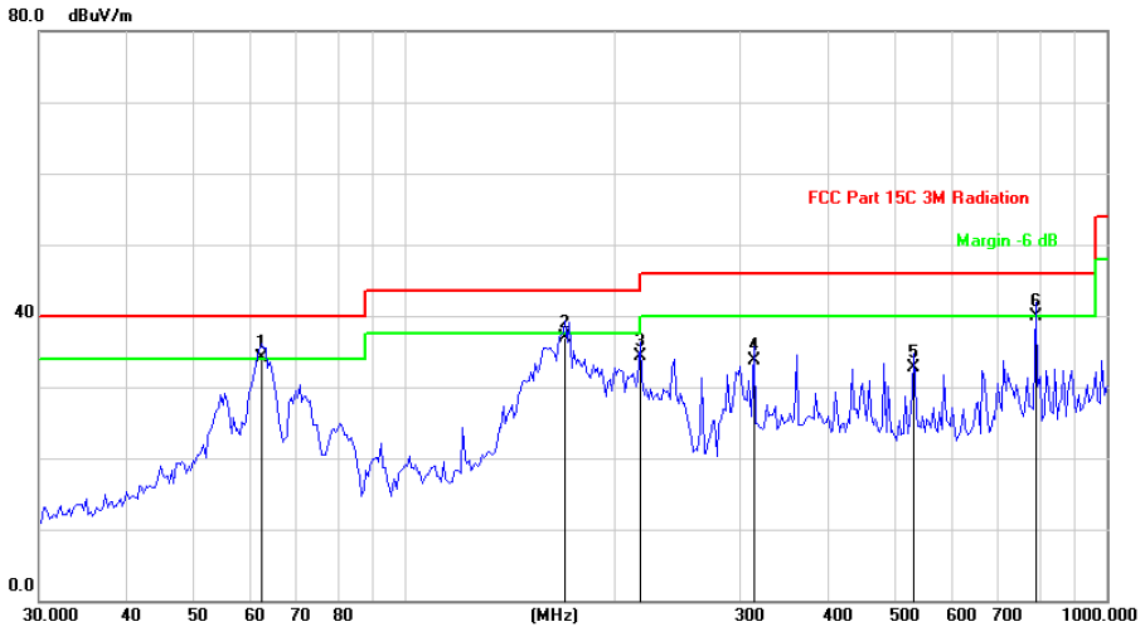
Radiated Emission Test Site (966)				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Test Receiver	ROHDE&SCHWARZ	ESIB7	100197	Jul. 27, 2021
Spectrum Analyzer	ROHDE&SCHWARZ	FSQ40	200061	Sep. 11, 2021
Pre-amplifier	EM Electronics Corporation CO.,LTD	EM30265	07032613	Sep. 02, 2021
Pre-amplifier	HP	8447D	2727A05017	Sep. 02, 2021
Loop antenna	ZHINAN	ZN30900A	12024	Sep. 05, 2022
Broadband Antenna	Schwarzbeck	VULB9163	340	Sep. 04, 2022
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Sep. 04, 2022
Horn Antenna	A-INFO	LB-180400-KF	J211020657	Sep. 04, 2022
Antenna Mast	Keleto	RE-AM	N/A	N/A
Line-4	TCT	RE-high-04	N/A	Sep. 02, 2021
Line-8	TCT	RE-01	N/A	Jul. 27, 2021
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

5.11.3. Test Data

Please refer to following diagram for individual

Below 1GHz

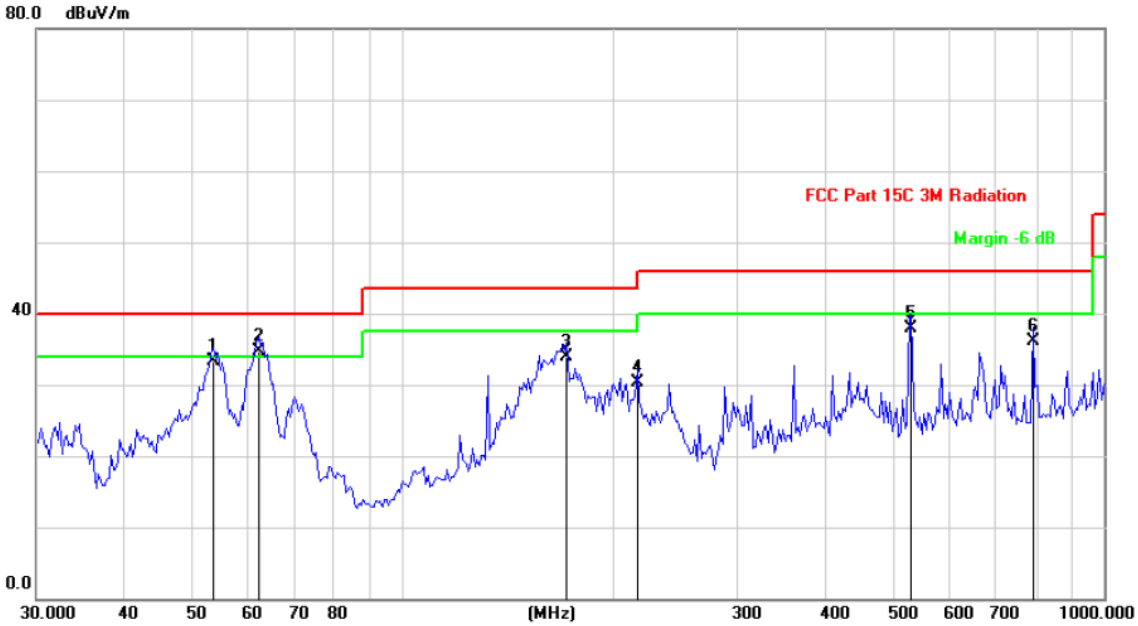
Horizontal:



Site	Polarization: *Horizontal*	Temperature: 25	
Limit: FCC Part 15C 3M Radiation	Power:	Humidity: 55 %	

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	*	62.3038	48.42	-14.35	34.07	40.00	-5.93	QP
2		168.9970	51.60	-14.64	36.96	43.50	-6.54	QP
3		216.1197	47.56	-13.17	34.39	46.00	-11.61	QP
4		313.6482	43.89	-10.18	33.71	46.00	-12.29	QP
5		531.2910	40.61	-7.95	32.66	46.00	-13.34	QP
6		793.0281	45.27	-5.32	39.95	46.00	-6.05	QP

Vertical:



Site	Polarization: *Vertical*	Temperature:	25
Limit: FCC Part 15C 3M Radiation	Power:	Humidity:	55 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		53.7559	45.93	-12.70	33.23	40.00	-6.77	QP
2	*	62.3038	48.96	-14.35	34.61	40.00	-5.39	QP
3		171.3890	48.35	-14.54	33.81	43.50	-9.69	QP
4		216.1197	43.39	-13.17	30.22	46.00	-15.78	QP
5		531.2910	45.81	-7.95	37.86	46.00	-8.14	QP
6		793.0281	41.41	-5.32	36.09	46.00	-9.91	QP

Note: *1.The low frequency, which started from 9KHz~30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.*

2. Measurements were conducted in all three channels (high, middle, low) and three modulation (GFSK, Pi/4 DQPSK, 8DPSK) and the worst case Mode (Middle channel and 8DPSK) was submitted only.

3. Freq. = Emission frequency in MHz

Measurement (dBµV/m) = Reading level (dBµV) + Corr. Factor (dB)

Correction Factor= Antenna Factor + Cable loss – Pre-amplifier

Limit (dBµV/m) = Limit stated in standard

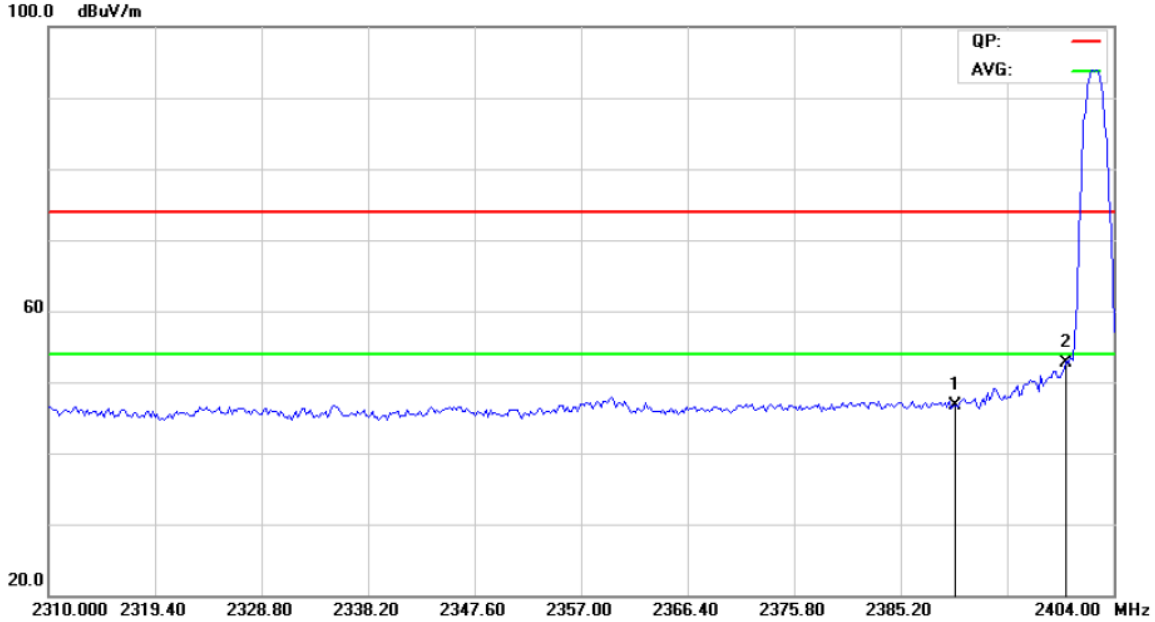
Over (dB) = Measurement (dBµV/m) – Limits (dBµV/m)

** is meaning the worst frequency has been tested in the test frequency range.*

Test Result of Radiated Spurious at Band edges

Lowest channel 2402:

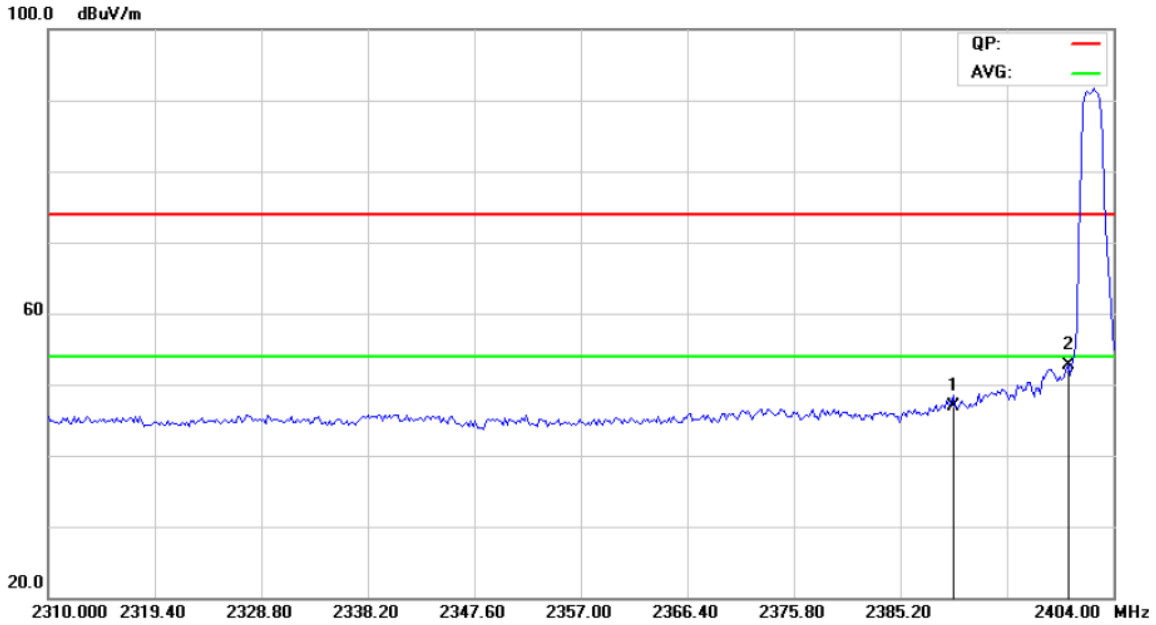
Horizontal:



Site	Polarization: *Horizontal*	Temperature:	25 (C)
Limit: FCC part 15 (PK)	Power: AC 120V/60Hz	Humidity:	55 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2390.000	59.92	-13.15	46.77	74.00	-27.23	peak
2	*	2400.000	65.92	-13.12	52.80	74.00	-21.20	peak

Vertical:

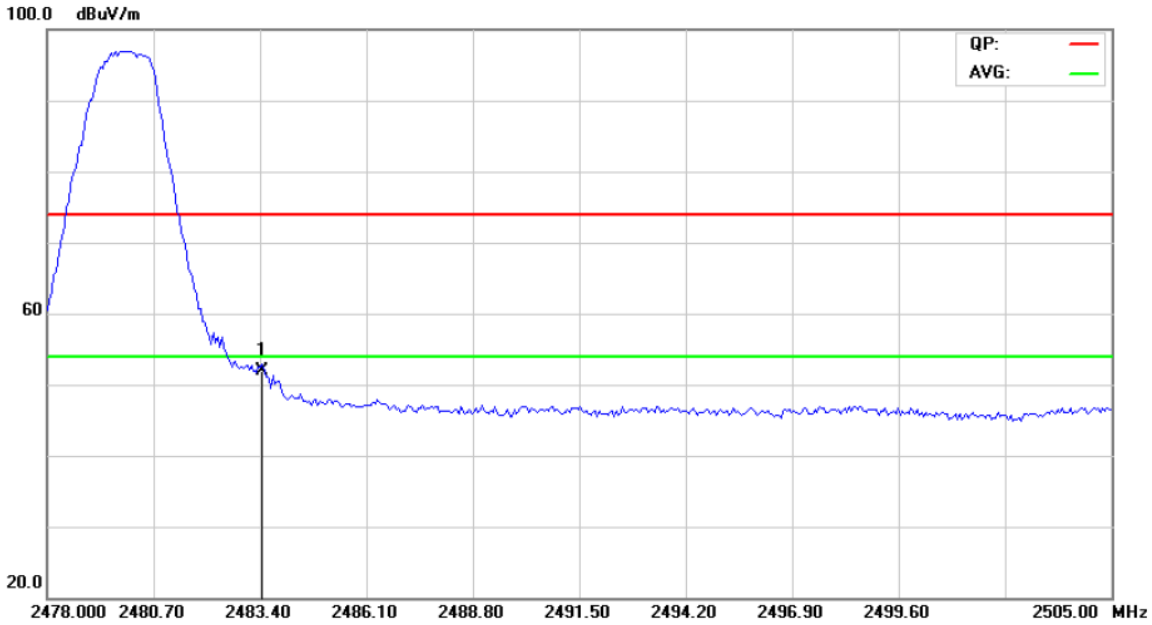


Site	Polarization: *Vertical*	Temperature:	25 (C)
Limit: FCC part 15 (PK)	Power: AC 120V/60Hz	Humidity:	55 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2390.000	60.04	-13.15	46.89	74.00	-27.11	peak
2	*	2400.000	65.81	-13.12	52.69	74.00	-21.31	peak

Highest channel 2480:

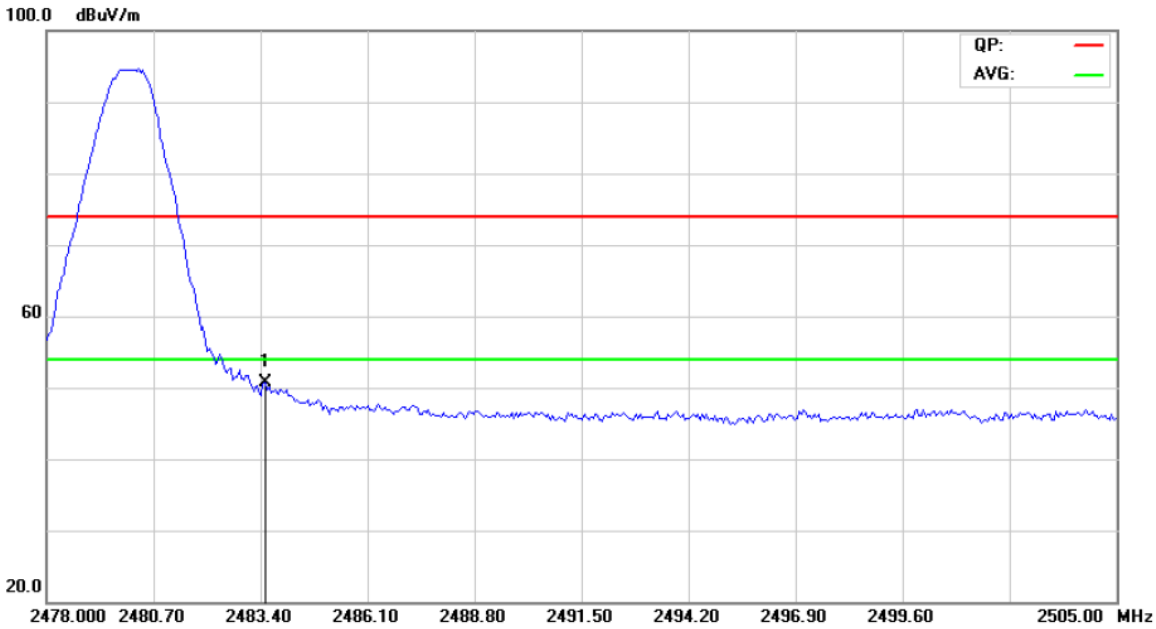
Horizontal:



Site	Polarization: *Horizontal*	Temperature:	25 (C)
Limit: FCC part 15 (PK)	Power: AC 120V/60Hz	Humidity:	55 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	*	2483.500	64.69	-12.84	51.85	74.00	-22.15	peak

Vertical:



Site	Polarization: *Vertical*	Temperature:	25 (C)
Limit: FCC part 15 (PK)	Power: AC 120V/60Hz	Humidity:	55 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	*	2483.500	63.53	-12.84	50.69	74.00	-23.31	peak

Note: *Measurements were conducted in all three modulation (GFSK, Pi/4 DQPSK, 8DPSK), and the worst case Mode (8DPSK) was submitted only.*

Above 1GHz

Modulation Type: 8DPSK									
Low channel: 2402 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBuV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4804	H	44.36	---	0.66	45.02	---	74	54	-8.98
7206	H	34.71	---	9.50	44.21	---	74	54	-9.79
---	H	---	---	---	---	---	---	---	---
4804	V	44.93	---	0.66	45.59	---	74	54	-8.41
7206	V	35.45	---	9.50	44.95	---	74	54	-9.05
---	V	---	---	---	---	---	---	---	---

Middle channel: 2441 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4882	H	44.07	---	0.99	45.06	---	74	54	-8.94
7323	H	34.63	---	9.87	44.50	---	74	54	-9.50
---	H	---	---	---	---	---	---	---	---
4882	V	42.82	---	0.99	43.81	---	74	54	-10.19
7323	V	33.57	---	9.87	43.44	---	74	54	-10.56
---	V	---	---	---	---	----	---	---	---

High channel: 2480 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4960	H	44.60	---	1.33	45.93	---	74	54	-8.07
7440	H	36.18	---	10.22	46.40	---	74	54	-7.60
---	H	---	---	---	---	---	---	---	---
4960	V	46.96	---	1.33	48.29	---	74	54	-5.71
7440	V	36.42	---	10.22	46.64	---	74	54	-7.36
---	V	---	---	---	---	---	---	---	---

Note:

1. *Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss – Pre-amplifier*
2. *Margin (dB) = Emission Level (Peak) (dBμV/m)-Average limit (dBμV/m)*
3. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
4. *Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency.*
5. *Data of measurement shown "---"in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.*
6. *Measurements were conducted in all three modulation (GFSK, Pi/4 DQPSK, 8DPSK), and the worst case Mode (8DPSK) was submitted only.*
7. *All the restriction bands are compliance with the limit of 15.209.*

Appendix A: Test Result of Conducted Test

20dB Emission Bandwidth

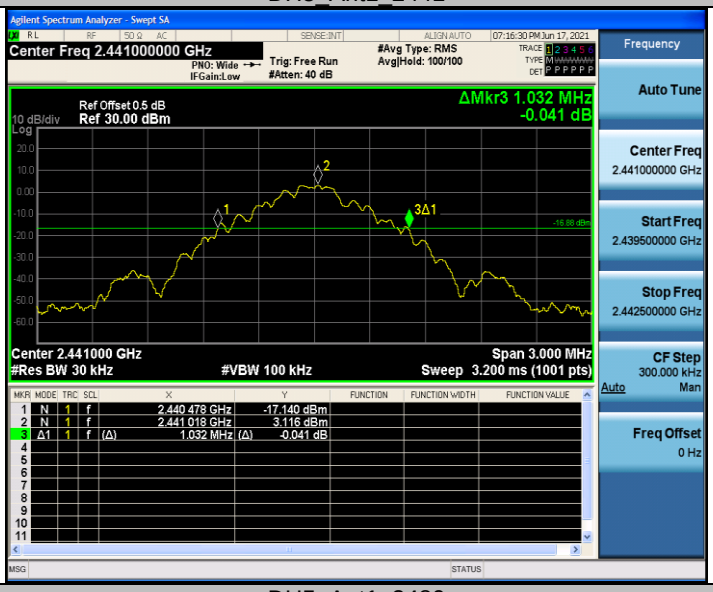
Test Result

Test Mode	Antenna	Channel	20db EBW [MHz]	FL [MHz]	FH [MHz]	Limit [MHz]	Verdict
DH5	Ant1	2402	1.035	2401.487	2402.522	---	PASS
		2441	1.032	2440.478	2441.510	---	PASS
		2480	1.035	2479.466	2480.501	---	PASS
2DH5	Ant1	2402	1.344	2401.322	2402.666	---	PASS
		2441	1.347	2440.310	2441.657	---	PASS
		2480	1.350	2479.301	2480.651	---	PASS
3DH5	Ant1	2402	1.296	2401.340	2402.636	---	PASS
		2441	1.296	2440.328	2441.624	---	PASS
		2480	1.299	2479.319	2480.618	---	PASS

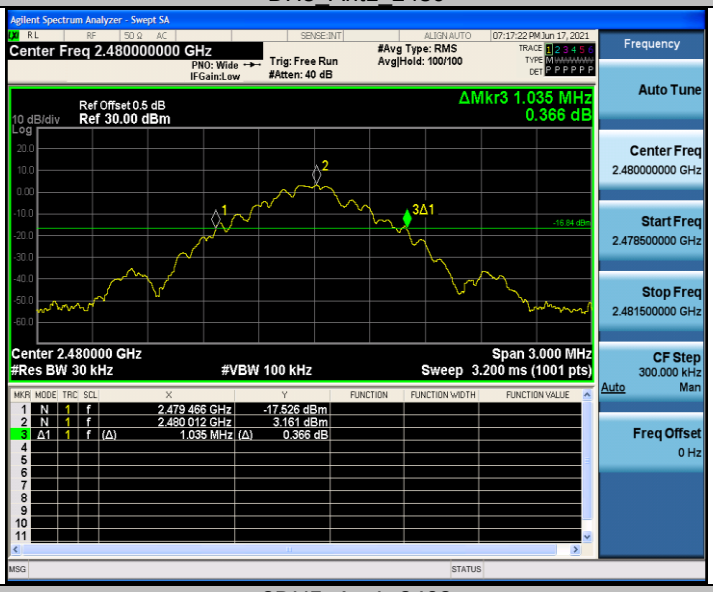
Test Graphs

DH5_Ant1_2402

DH5_Ant1_2441



DH5_Ant1_2480



2DH5_Ant1_2402

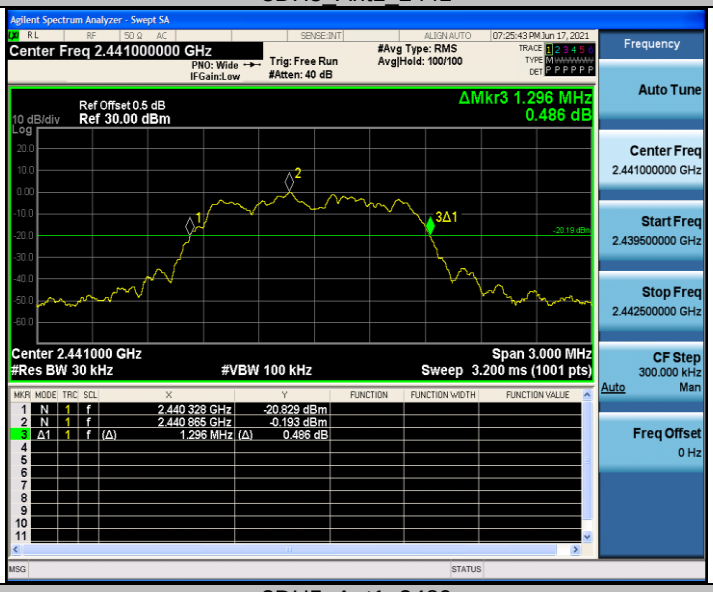
2DH5_Ant1_2441

2DH5_Ant1_2480

3DH5_Ant1_2402

Hotline: 400-6611-140 Tel: 86-755-27673339 Fax: 86-755-27673332 http://www.tct-lab.com

3DH5_Ant1_2441



3DH5_Ant1_2480

Hotline: 400-6611-140 Tel: 86-755-27673339 Fax: 86-755-27673332 http://www.tct-lab.com

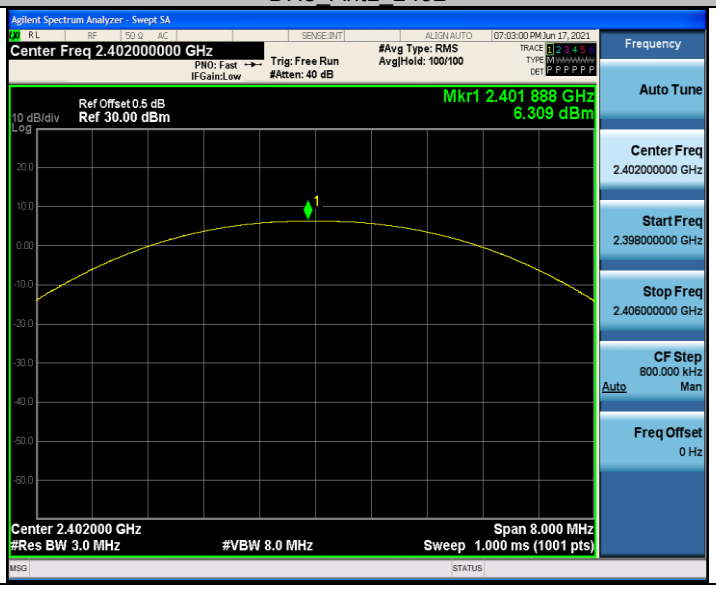
Maximum conducted output power

Test Result

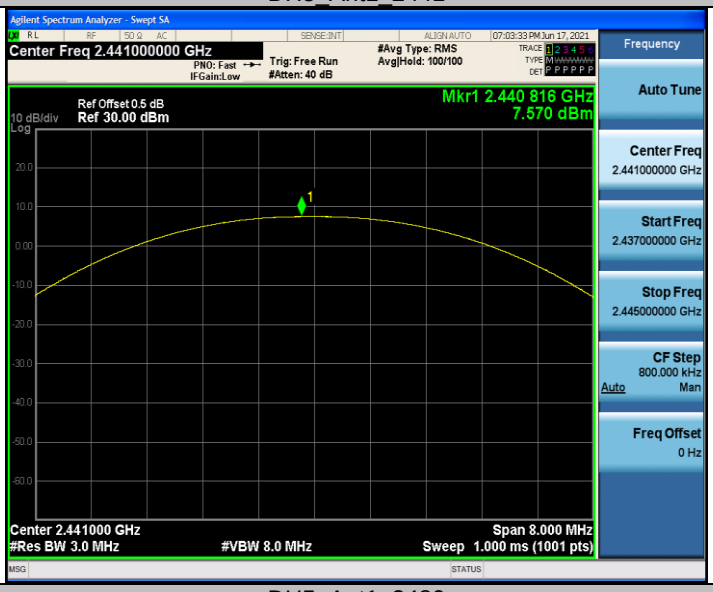
Test Mode	Antenna	Channel	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	6.31	<=20.97	PASS
		2441	7.57	<=20.97	PASS
		2480	7.71	<=20.97	PASS
2DH5	Ant1	2402	7.46	<=20.97	PASS
		2441	8.79	<=20.97	PASS
		2480	8.94	<=20.97	PASS
3DH5	Ant1	2402	7.82	<=20.97	PASS
		2441	8.98	<=20.97	PASS
		2480	8.97	<=20.97	PASS

Test Graphs

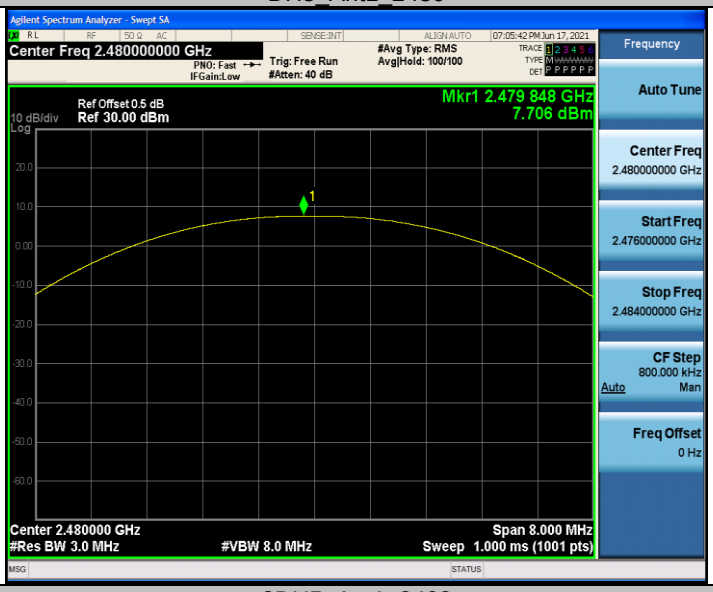
DH5_Ant1_2402



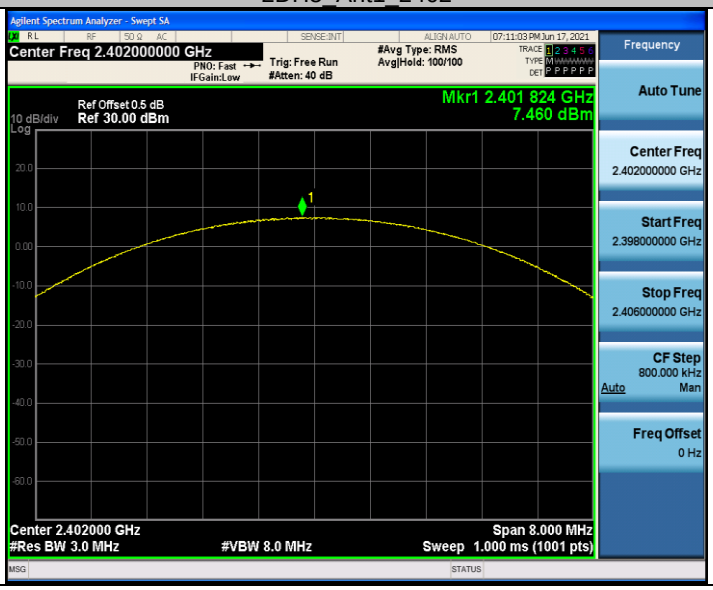
DH5_Ant1_2441



DH5_Ant1_2480



2DH5_Ant1_2402



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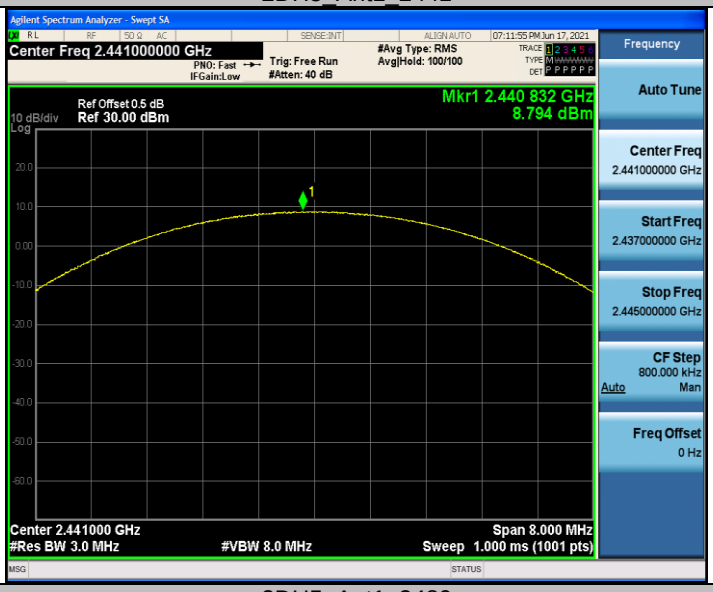
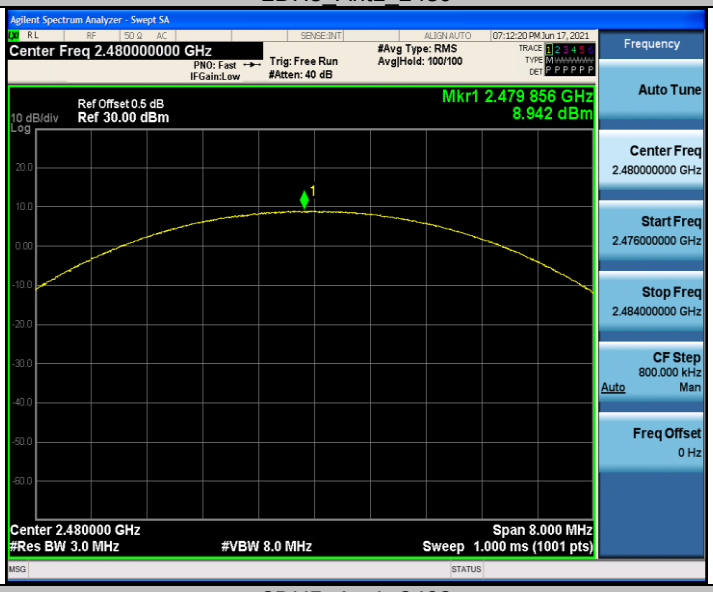
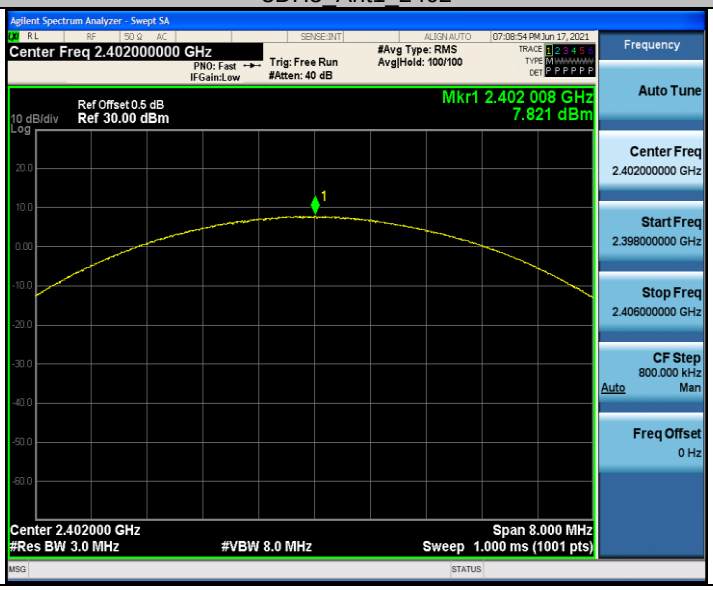
2DH5_Ant1_2441



2DH5_Ant1_2480



3DH5_Ant1_2402



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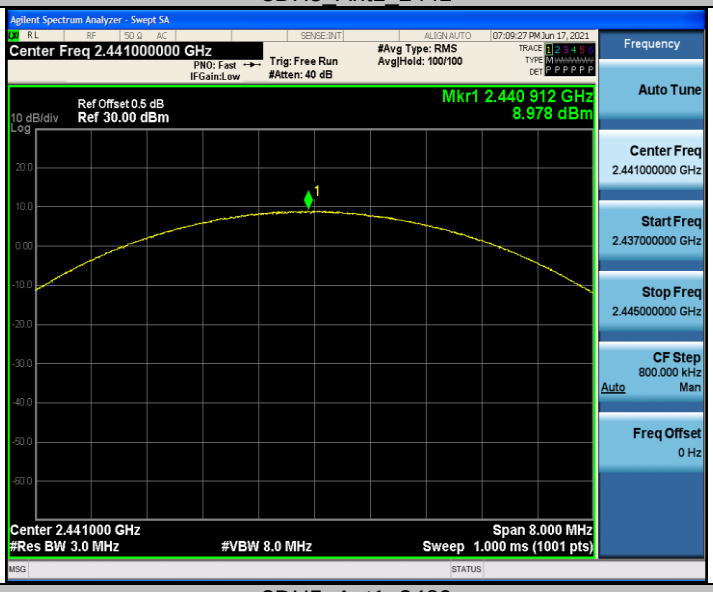
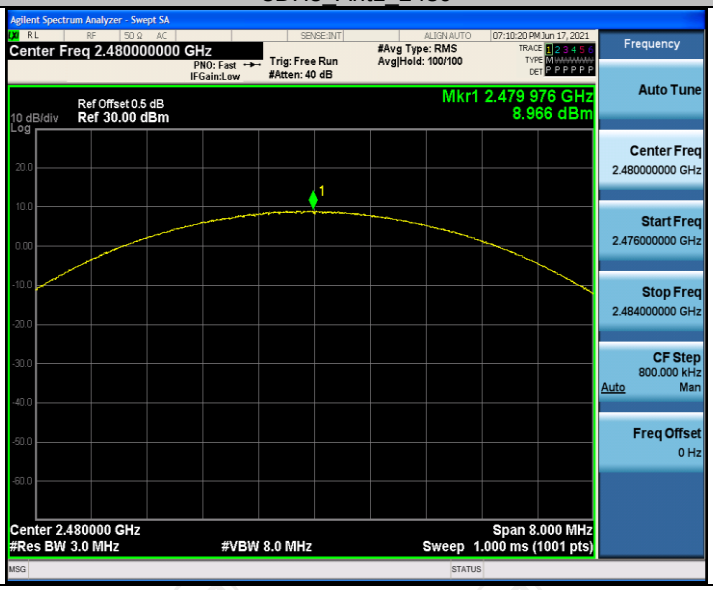
3DH5_Ant1_2441



3DH5_Ant1_2480



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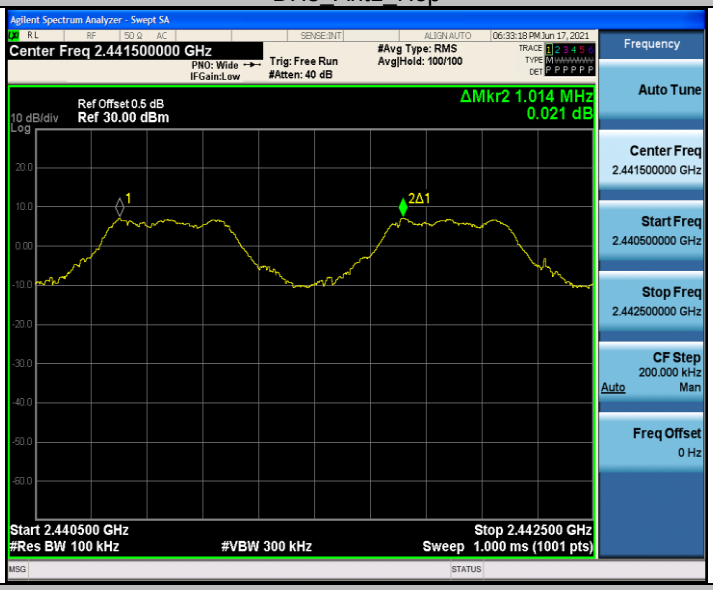
Carrier frequency separation

Test Result

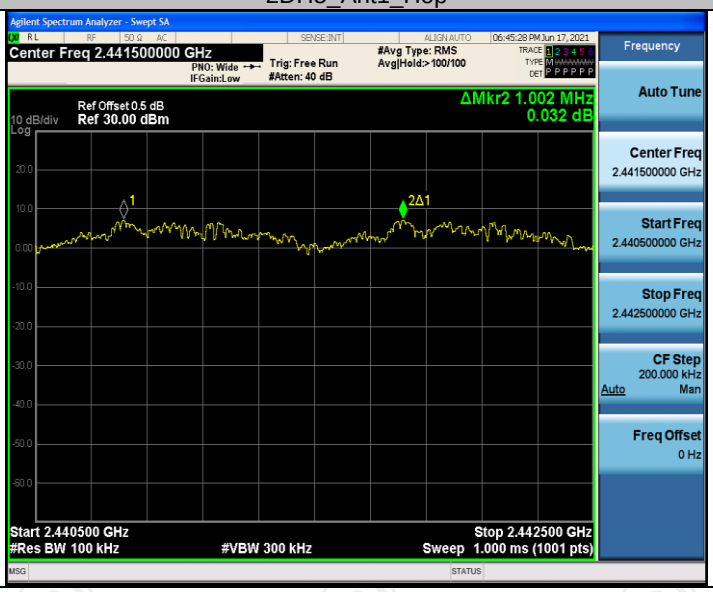
Test Mode	Antenna	Channel	Result [MHz]	Limit [MHz]	Verdict
DH5	Ant1	Hop	1.014	>=0.728	PASS
2DH5	Ant1	Hop	1.002	>=0.912	PASS
3DH5	Ant1	Hop	1.008	>=0.864	PASS

Test Graphs

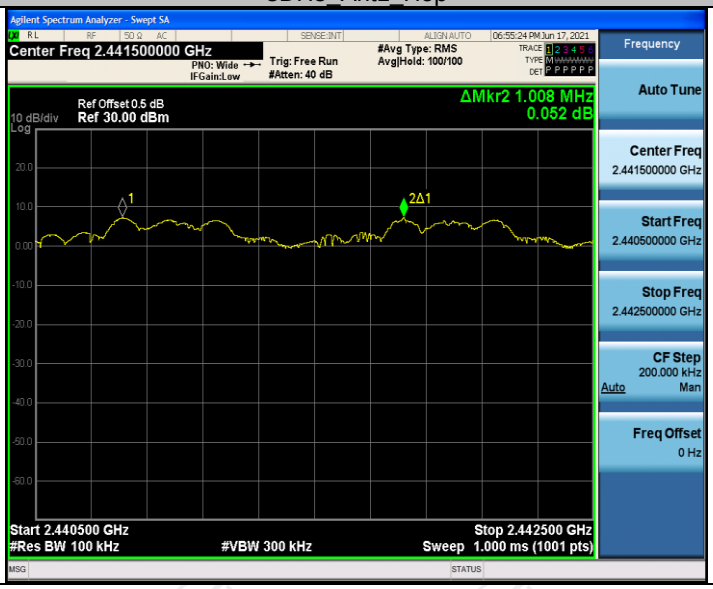
DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop



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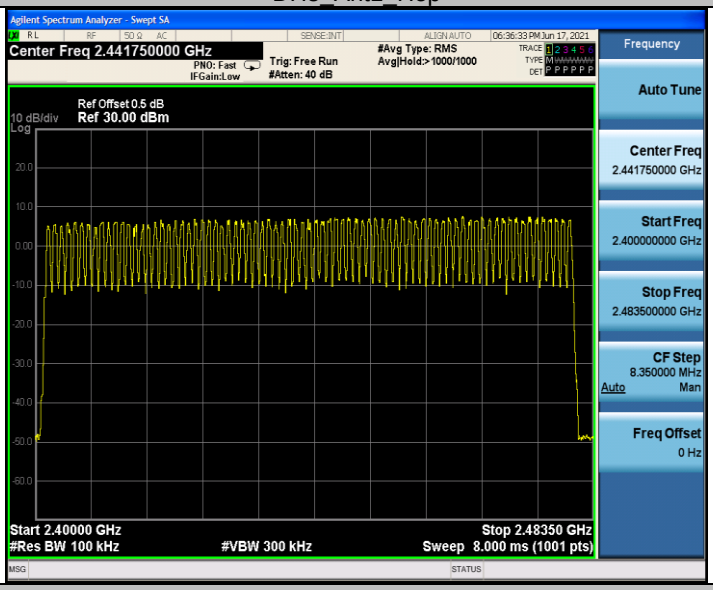
Number of hopping channels

Test Result

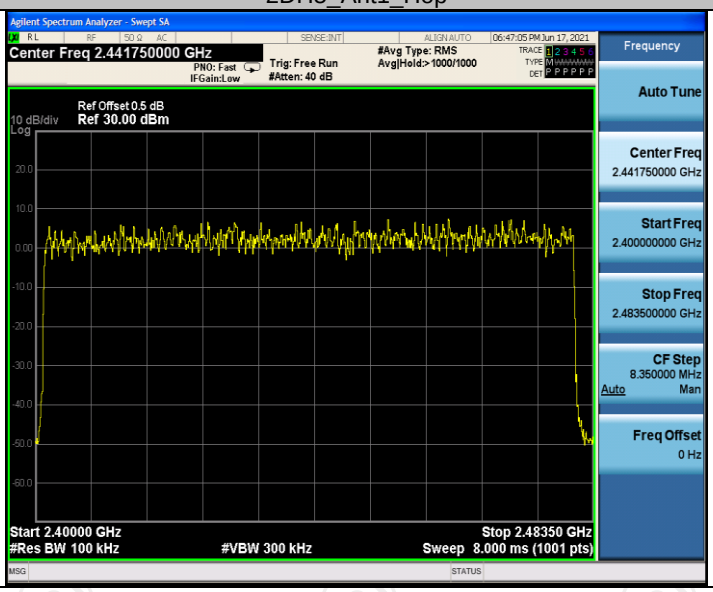
Test Mode	Antenna	Channel	Result [Num]	Limit [Num]	Verdict
DH5	Ant1	Hop	79	>=15	PASS
2DH5	Ant1	Hop	79	>=15	PASS
3DH5	Ant1	Hop	79	>=15	PASS

Test Graphs

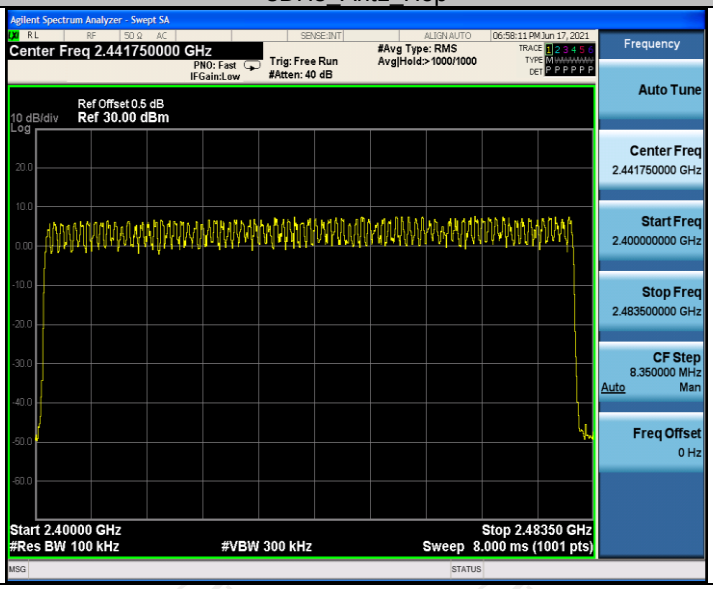
DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop



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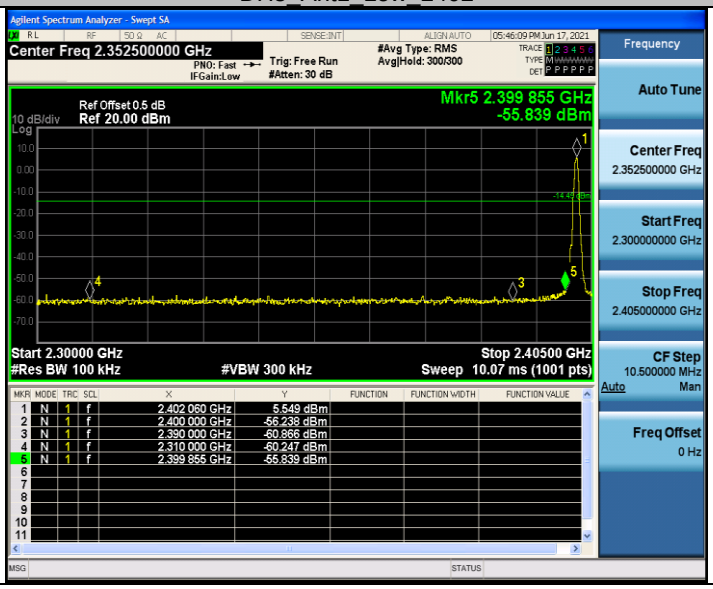
Band edge measurements

Test Result

Test Mode	Antenna	Ch Name	Channel	Ref Level [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	Low	2402	5.55	-55.84	<=-14.45	PASS
		High	2480	6.83	-55.11	<=-13.17	PASS
		Low	Hop_2402	6.13	-57.81	-13.87	PASS
		High	Hop_2480	6.96	-57.63	-13.04	PASS
2DH5	Ant1	Low	2402	2.71	-48.13	<=-17.29	PASS
		High	2480	4.12	-55.72	<=-15.88	PASS
		Low	Hop_2402	3.69	-58.34	-16.31	PASS
		High	Hop_2480	4.54	-57.29	-15.46	PASS
3DH5	Ant1	Low	2402	2.77	-48.57	<=-17.23	PASS
		High	2480	4.15	-53.62	<=-15.85	PASS
		Low	Hop_2402	2.17	-57.67	-17.83	PASS
		High	Hop_2480	6.37	-56.78	-13.63	PASS

Test Graphs

DH5_Ant1_Low_2402



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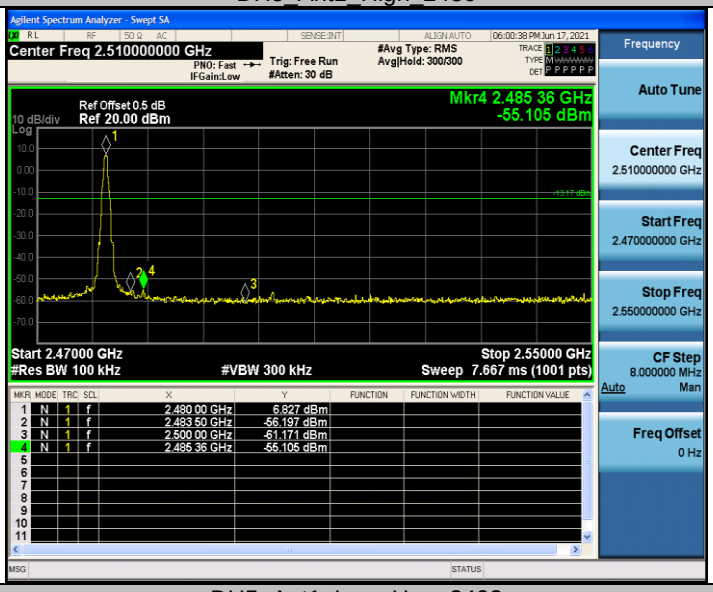
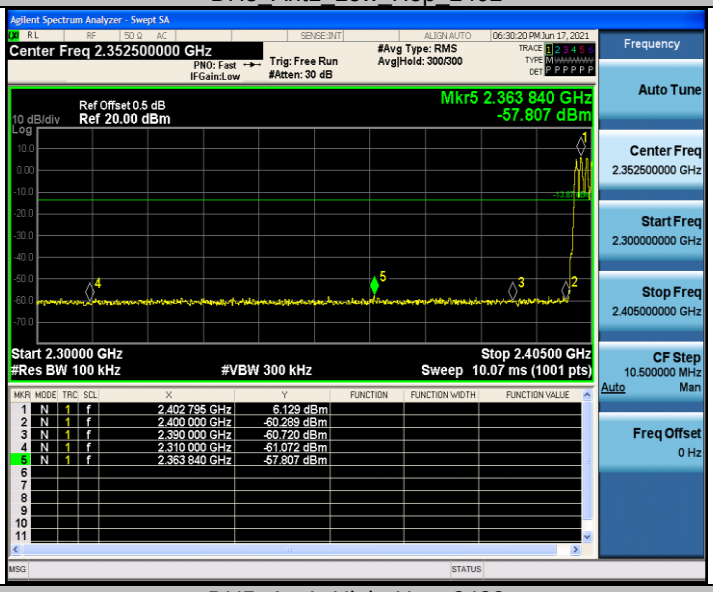
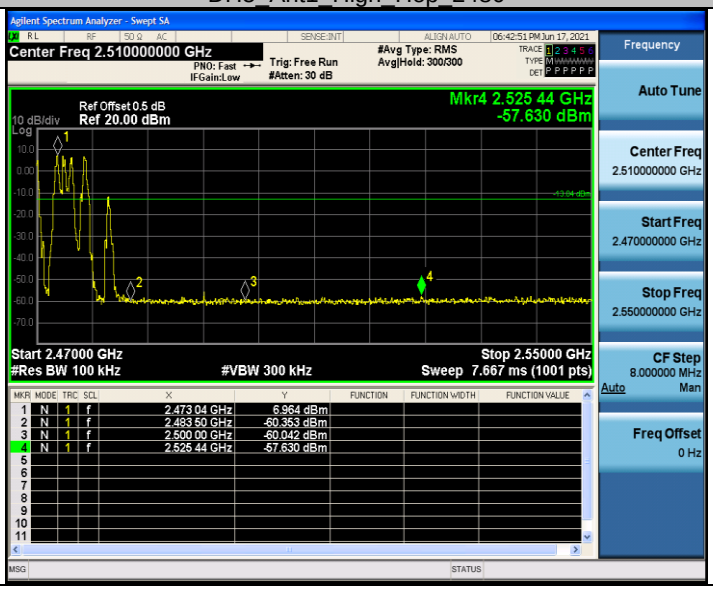
DH5_Ant1_High_2480



DH5_Ant1_Low_Hop_2402



DH5_Ant1_High_Hop_2480



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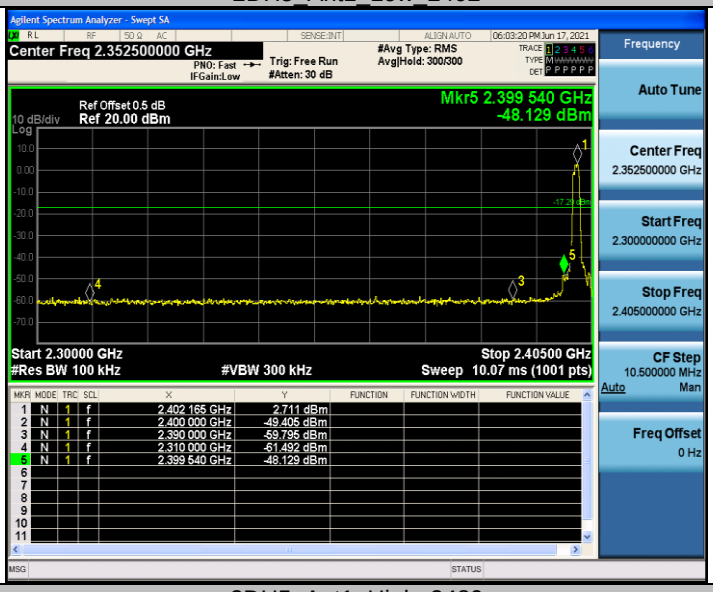
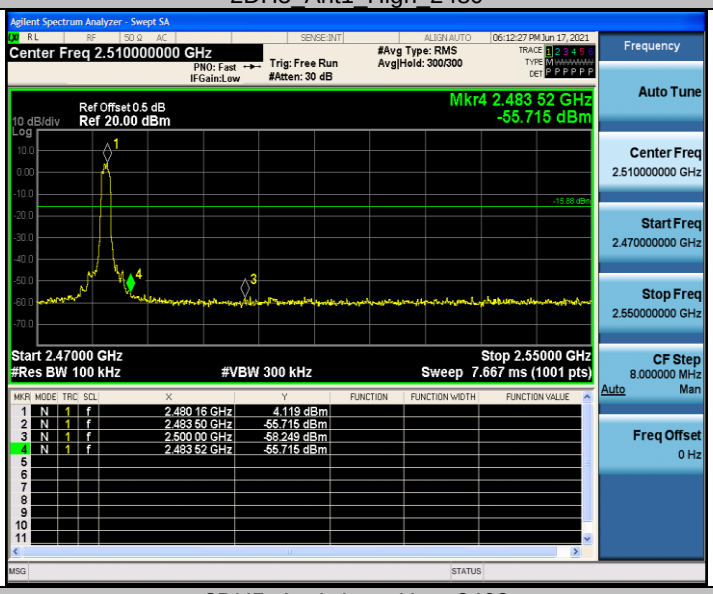
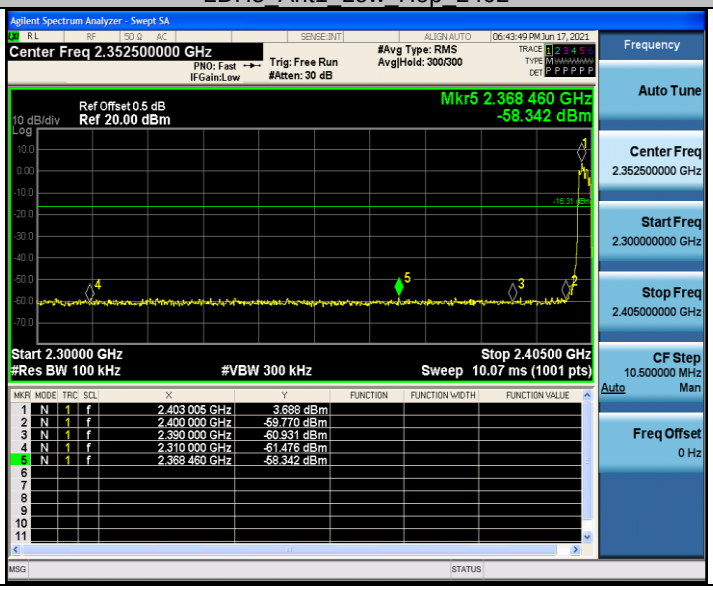
2DH5_Ant1_Low_2402



2DH5_Ant1_High_2480



2DH5_Ant1_Low_Hop_2402



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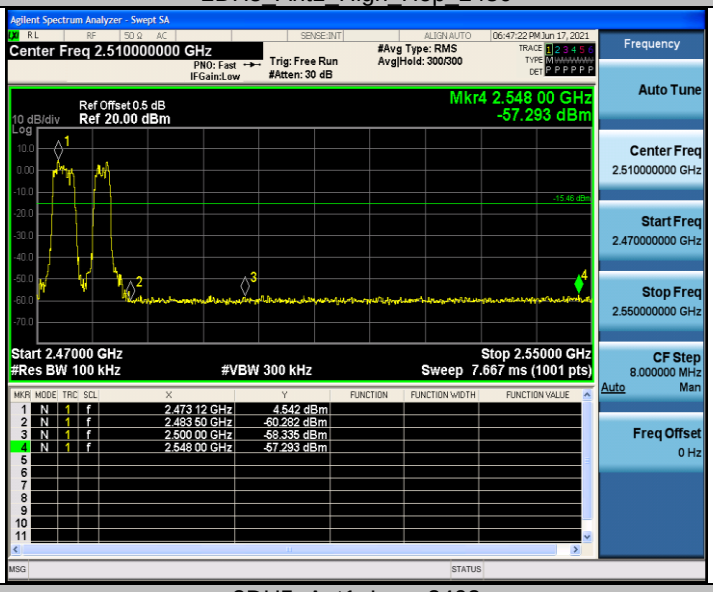
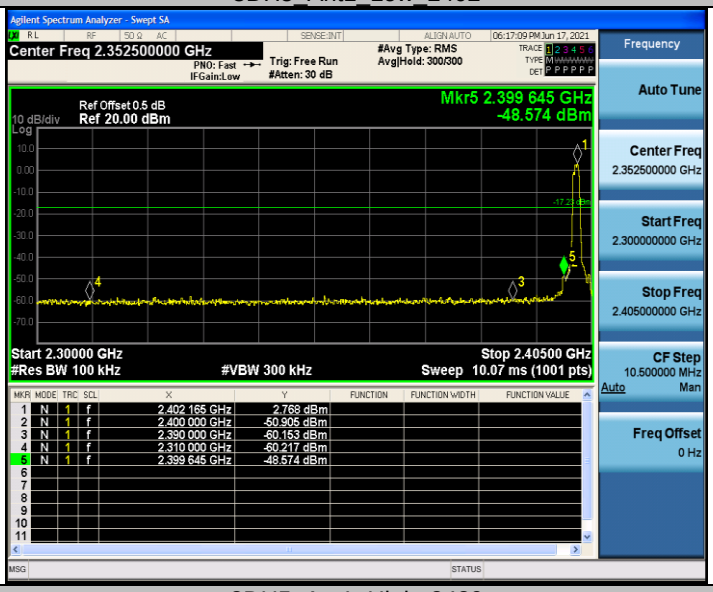
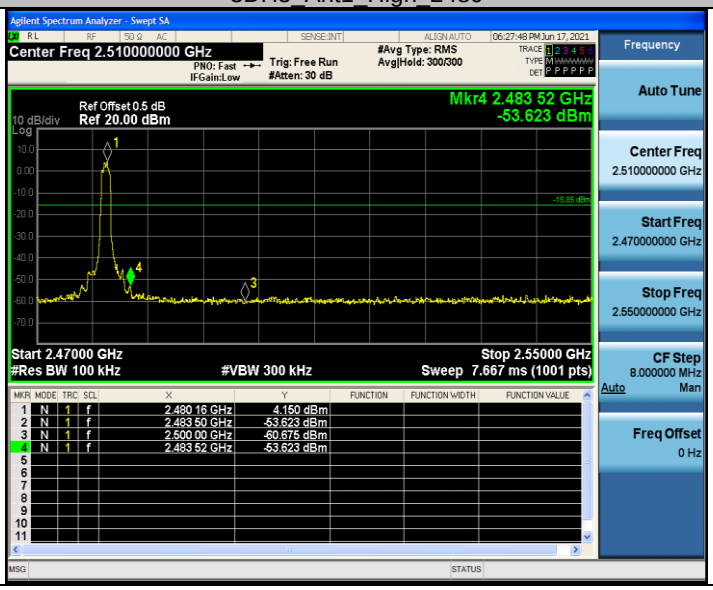
2DH5_Ant1_High_Hop_2480



3DH5_Ant1_Low_2402



3DH5_Ant1_High_2480



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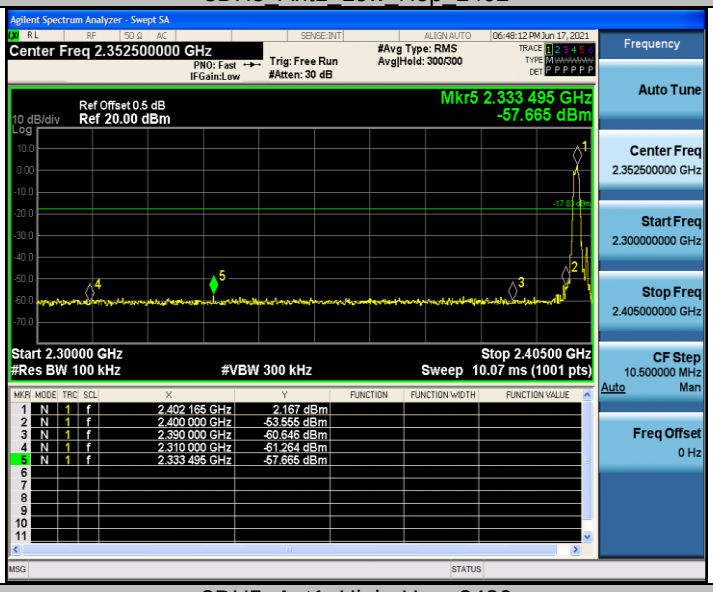
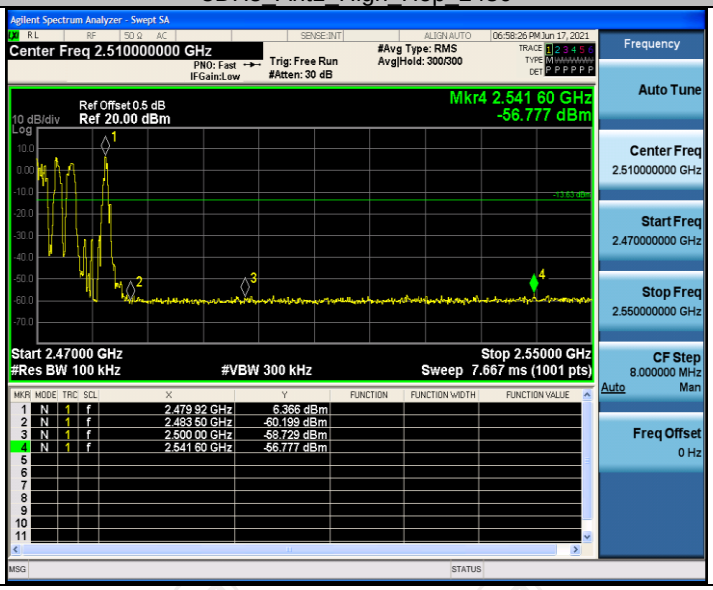
3DH5_Ant1_Low_Hop_2402



3DH5_Ant1_High_Hop_2480



Conducted Spurious Emission

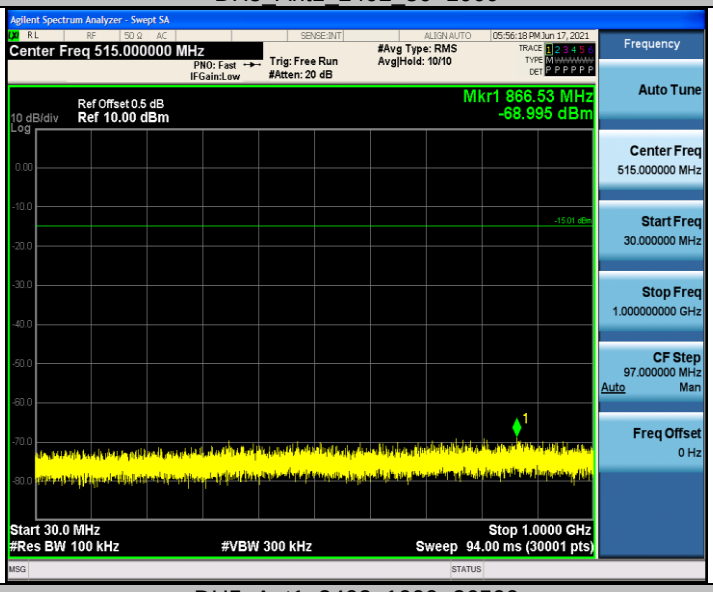
Test Result

Test Mode	Antenna	Channel	Freq Range [MHz]	Ref Level [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	Reference	4.99	4.99	---	PASS
			30~1000	30~1000	-68.995	<=-15.007	PASS
			1000~26500	1000~26500	-43.268	<=-15.007	PASS
		2441	Reference	6.20	6.20	---	PASS
			30~1000	30~1000	-67.926	<=-13.796	PASS
			1000~26500	1000~26500	-42.304	<=-13.796	PASS
		2480	Reference	6.39	6.39	---	PASS
			30~1000	30~1000	-68.901	<=-13.614	PASS
			1000~26500	1000~26500	-41.509	<=-13.614	PASS
2DH5	Ant1	2402	Reference	2.33	2.33	---	PASS
			30~1000	30~1000	-68.87	<=-17.675	PASS
			1000~26500	1000~26500	-43.134	<=-17.675	PASS
		2441	Reference	3.51	3.51	---	PASS
			30~1000	30~1000	-69.266	<=-16.49	PASS
			1000~26500	1000~26500	-43.593	<=-16.49	PASS
		2480	Reference	3.68	3.68	---	PASS
			30~1000	30~1000	-68.767	<=-16.317	PASS
			1000~26500	1000~26500	-43.036	<=-16.317	PASS
3DH5	Ant1	2402	Reference	2.29	2.29	---	PASS
			30~1000	30~1000	-67.997	<=-17.706	PASS
			1000~26500	1000~26500	-43.476	<=-17.706	PASS
		2441	Reference	3.54	3.54	---	PASS
			30~1000	30~1000	-68.723	<=-16.459	PASS
			1000~26500	1000~26500	-42.083	<=-16.459	PASS
		2480	Reference	3.75	3.75	---	PASS
			30~1000	30~1000	-68.445	<=-16.254	PASS
			1000~26500	1000~26500	-43.02	<=-16.254	PASS

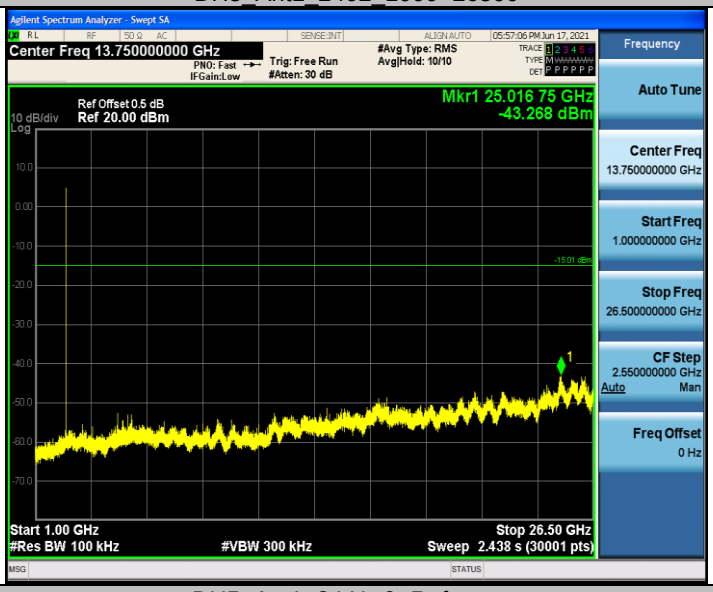
Test Graphs

DH5_Ant1_2402_0~Reference

DH5_Ant1_2402_30~1000



DH5_Ant1_2402_1000~26500



DH5_Ant1_2441_0~Reference