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TEST REPORT

FCC ID: 2ACXH-T11

Product: Wireless Headphones

Model No.: T11

Additional Model No.: N/A

Trade Mark: N/A

Report No.: WSCT-A2LA-R&E210400001A

Issued Date: 29 April 2021

Issued for:

Applicant: ASKA ELECTRONICS CO.,LIMITED

Address: ROOM A 11/F HO LEE COMMERCIAL BUILDING
38-44 D' AGUILAR STREET CENTRAL HK

Issued By:

WORLD STANDARDIZATION CERTIFICATION & TESTING GROUP (SHENZHEN)
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Note: In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with A2LA's ENERGY STAR ® Accreditation Program requirements 1) accreditation is granted to this laboratory to perform the following tests: EMC, electromagnetic compatibility, telecommunications and Energy Star.



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1. GENERAL INFORMATION

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Product:	Wireless Headphones
Model No.:	T11
Additional Model:	N/A
Applicant:	ASKA ELECTRONICS CO.,LIMITED
Address:	ROOM A 11/F HO LEE COMMERCIAL BUILDING 38-44 D' AGUILAR STREET CENTRAL HK
Manufacturer:	ASKA ELECTRONICS CO.,LIMITED
Address:	ROOM A 11/F HO LEE COMMERCIAL BUILDING 38-44 D' AGUILAR STREET CENTRAL HK
Data of receipt	Apr. 15, 2021
Date of Test:	Mar. 30, 2021 ~ Apr. 13, 2021
Applicable Standards:	FCC Rules and Regulations Part 15 Subpart C Section 15.247, ANSI C63.10: 2013

The above equipment has been tested by World Standardization Certification & Testing Group (Shenzhen) Co., Ltd. And found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Tested By: Jim HanCheck By: Sol Qin

(Jim Han)

(Sol Qin)

Approved By: Wang FengbingDate: 29 April 2021

(Wang Fengbing)

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1.1 GENERAL DESCRIPTION OF EUT

Software version:	N/A
Charging Battery Information:	Model: ZM0802424 Nominal Voltage: 3.7V Nominal Capacity: 500mAh/1.850Wh Charging Limit Voltage: 4.7V
Two Headphones Battery Information:	Model: N/A Nominal Voltage: 3.7V Nominal Capacity: 60mAh/0.222Wh Charging Limit Voltage: 4.7V
Operating Frequency	BT: 2402~2480MHz
Channels	79 Channels for BR+EDR
Channel Spacing	1MHz for BR+EDR
Modulation Type	GFSK, Pi/4 QPSK, 8DPSK for BR+EDR
Power Source	DC 5V from Adapter
Version	210324018
Antenna Type:	FPC antenna
Antenna gain:	2dBi

Note: N/A stands for no applicable.

1.2 CARRIER FREQUENCY OF CHANNELS

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





17	2419	38	2440	59	2461		For Question, Please Contact with WSCT www.wsct-cert.com
18	2420	39	2441	60	2462		
19	2421	40	2442	61	2463		
20	2422	41	2443	62	2464		



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1.3 FACILITIES AND ACCREDITATIONS

All measurement facilities used to collect the measurement data are located at **Building A-B, Baoshi Science & Technology Park, Baoshi Road, Bao'an District, Shenzhen, Guangdong, China** of the **WORLD STANDARDIZATION CERTIFICATION & TESTING GROUP (SHENZHEN) CO., LTD.**

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

Certificate Number: 5768.01

1.3.1 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

USA A2LA (The certificate registration number is NVLAP LAB CODE:0030725345)

China CNAS (The certificated registration number is L3732)

Copies of granted accreditation certificates are available for downloading from our web site,
<http://www.wsct-cert.com>



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**1.3.2 TEST DESCRIPTION****1.3.2.1 MEASUREMENT UNCERTAINTY**

The reported uncertainty of measurement $y \pm U$ · 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	Uncertainty
1	Conducted Emission Test	$\pm 3.2\text{dB}$
2	RF power,conducted	$\pm 0.16\text{dB}$
3	Spurious emissions,conducted	$\pm 0.21\text{dB}$
4	All emissions, radiated(<1G)	$\pm 4.7\text{dB}$
5	All emissions, radiated(>1G)	$\pm 4.7\text{dB}$
6	Temperature	$\pm 0.5^\circ\text{C}$
7	Humidity	$\pm 2\%$





1.4 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Modulation type	Mode
GFSK(1Mbps)	
$\pi/4$ DQPSK(2Mbps)	Mode 1、Mode 2、Mode 3
8DPSK(3Mbps)	
Normal Hopping	Mode 4

Pretest Mode	Description
Mode 1	CH00:2402MHz
Mode 2	CH39:2441MHz
Mode 3	CH78:2480MHz

For Conducted Emission	
Final Test Mode	Description
GFSK(1Mbps)	Mode 1、Mode 2、Mode 3
$\pi/4$ DQPSK(2Mbps)	Mode 1、Mode 2、Mode 3
8DPSK(3Mbps)	Mode 1、Mode 2、Mode 3
Normal Hopping	Mode 4

For Radiated Emission	
Final Test Mode	Description
GFSK(1Mbps)	Mode 1、Mode 2、Mode 3
$\pi/4$ DQPSK(2Mbps)	Mode 1、Mode 2、Mode 3
8DPSK(3Mbps)	Mode 1、Mode 2、Mode 3
Normal Hopping	Mode 4

Note:

- (1) The measurements are performed at the highest, middle, lowest available channels.
- (2) The data rate was set in 1Mbps, 2Mbps, 3Mbps for radiated emission due to the highest RF output
- (3) Record the worst case of each test item in this report.





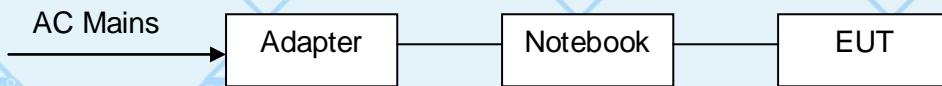
1.5 TABLE OF PARAMETERS OF TEXT SOFTWARE SETTING

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of FHSS

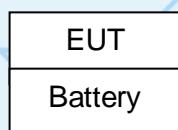
Test software Version	Airoha.Tool.Kit		
Frequency	2402 MHz	2441 MHz	2480 MHz
Parameters(1Mbps)	DEF	DEF	DEF
Parameters(2Mbps)	DEF	DEF	DEF
Parameters(3Mbps)	DEF	DEF	DEF

1.4.1 CONFIGURATION OF SYSTEM UNDER TEST

Operation of EUT during Conducted testing



Operation of EUT during Radiation testing



(EUT: Wireless Headphones)





1.6 DESCRIPTION OF SUPPORT UNITS(CONDUCTED MODE)

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.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
1	Adapter	/	JDA0301800130WUS	/	/
2	Notebook	/	Lenovo G475	/	/

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.
- (3) "YES" is means "shielded" "with core"; "NO" is means "unshielded" "without core".





2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part15 (15.247) , Subpart C			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	PASS	
15.247(a)(1)	Hopping Channel Separation	PASS	
15.247(b)(1)	Peak Output Power	PASS	
15.209	Radiated Spurious Emission	PASS	
15.247(a)(1)(iii)	Number of Hopping Frequency	PASS	
15.247(a)(1)(iii)	Dwell Time	PASS	
15.247(a)(1)	Bandwidth	PASS	
15.247(d)	Conducted Bandege Measurement	PASS	
15.205	Band Edge Emission	PASS	
15.247(d)	Spurious RF Conducted Emission	PASS	
15.203	Antenna Requirement	PASS	

NOTE:

(1)" N/A" denotes test is not applicable in this test report.
 (2)The manufacture declare the equipment comply with the all the technical requirements in 15.247(g). 15.247(h).

The equipment are not required to employ all available hopping channels during each transmission. it can be presented with a continuous data (or information) stream. the equipment can recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels.





3. MEASUREMENT INSTRUMENTS

NAME OF EQUIPMENT	MANUFACTURER	MODEL	SERIAL NUMBER	Calibration Date	Calibration Due.
EMI Test Receiver	R&S	ESCI	100005	2020-11-05	2021-11-04
LISN	AFJ	LS16	16010222119	2020-11-05	2021-11-04
LISN(EUT)	Mestec	AN3016	04/10040	2020-11-05	2021-11-04
MXG Signal Analyzer	Keysight	N9020A	MY56070279	2020-11-05	2021-11-04
Coaxial cable	Megalon	LMR400	N/A	2020-11-05	2021-11-04
GPIB cable	Megalon	GPIB	N/A	2020-11-05	2021-11-04
Spectrum Analyzer	R&S	FSU	100114	2020-11-05	2021-11-04
Pre Amplifier	H.P.	HP8447E	2945A02715	2020-11-05	2021-11-04
Pre-Amplifier	CDSI	PAP-1G18-38	--	2020-11-05	2021-11-04
Bi-log Antenna	SUNOL Sciences	JB3	A021907	2020-11-05	2021-11-04
9*6*6 Anechoic	--	--	--	2020-11-05	2021-11-04
Horn Antenna	COMPLIANCE ENGINEERING	CE18000	--	2020-11-05	2021-11-04
Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-631	2020-11-05	2021-11-04
Cable	TIME MICROWAVE	LMR-400	N-TYPE04	2020-11-05	2021-11-04
System-Controller	CCS	N/A	N/A	N.C.R	N.C.R
Turn Table	CCS	N/A	N/A	N.C.R	N.C.R
Antenna Tower	CCS	N/A	N/A	N.C.R	N.C.R
RF cable	Murata	MXHQ87WA3000	--	2020-11-05	2021-11-04
Loop Antenna	EMCO	6502	00042960	2020-11-05	2021-11-04
Horn Antenna	SCHWARZBECK	BBHA 9170	1123	2020-11-05	2021-11-04
Power meter	Anritsu	ML2487A	6K00003613	2020-11-05	2021-11-04
Power sensor	Anritsu	MX248XD	--	2020-11-05	2021-11-04





4. EMC EMISSION TEST

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 POWER LINE CONDUCTED EMISSION Limits (Frequency Range 150KHz-30MHz)

FREQUENCY (MHz)	Conducted limit (dB μ V)		Conducted limit (dB μ V)
	Quasi-peak	Quasi-peak	
0.15 -0.5	66 - 56 *	56 - 46 *	FCC
0.50 -5.0	56.00	46.00	FCC
5.0 -30.0	60.00	50.00	FCC

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz





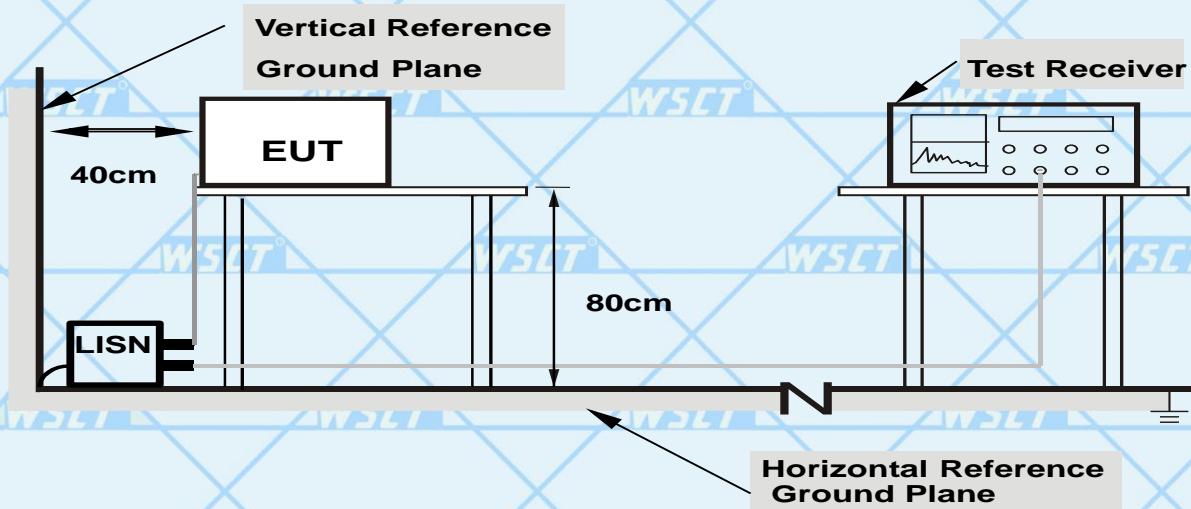
4.1.2 TEST PROCEDURE

- The EUT was placed 0.4 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN at least 80 cm from nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.1.3 DEVIATION FROM TEST STANDARD

No deviation

4.1.4 TEST SETUP



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

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

4.1.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

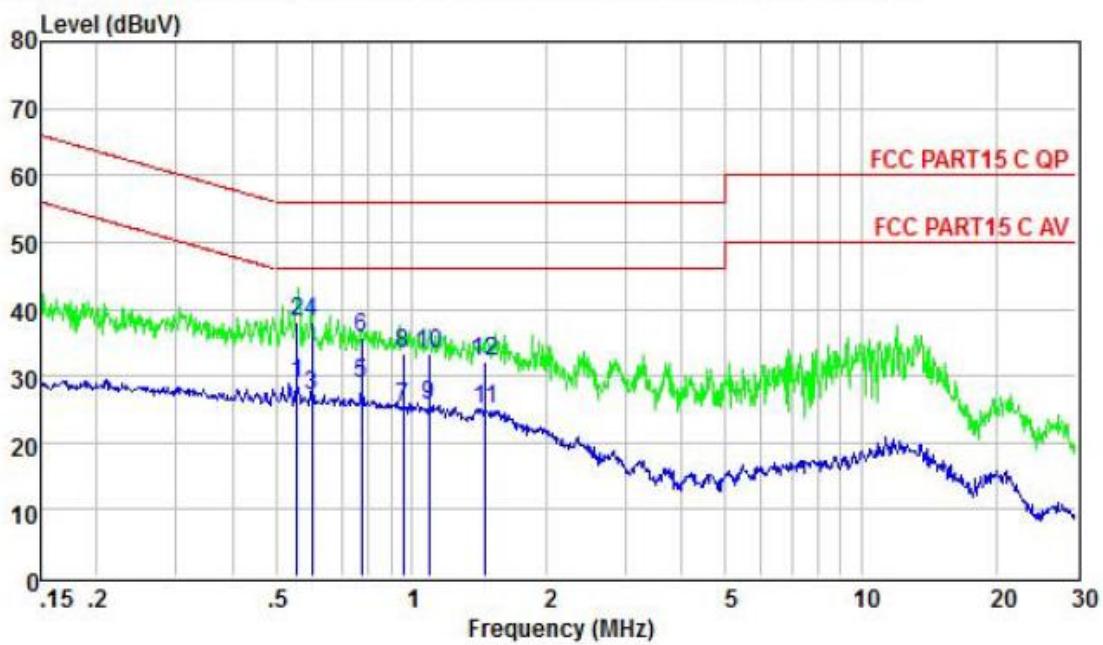




4.1.6 TEST RESULTS

Temperature	24.9 °C	Relative Humidity	56%
Pressure	1015hPa	Voltage	AC120V/60Hz
Test Mode	Mode 3 with $\pi/4$ DQPSK modulation	Test Results	Pass

L:



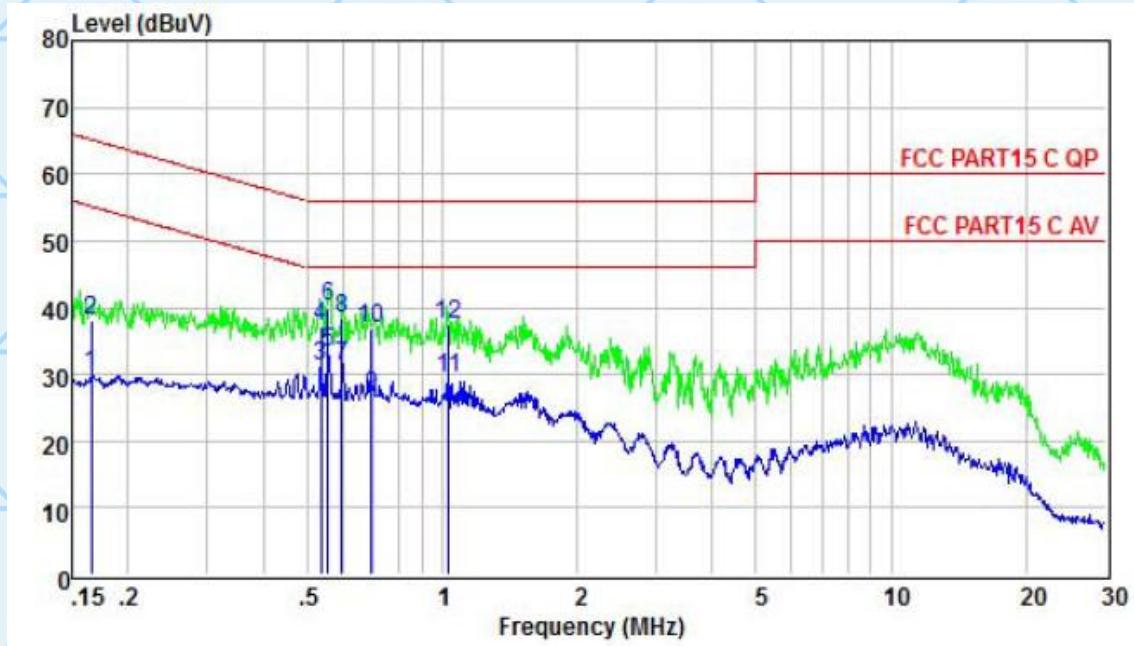
Freq	Level	Cable	Limit	Over	Remark
		Loss	Line	Limit	

	MHz	dBuV	dB	dBuV	dB	
1	0.56	28.80	0.01	46.00	-17.20	Average
2	0.56	38.03	0.01	56.00	-17.97	QP
3	0.60	27.05	0.01	46.00	-18.95	Average
4	0.60	38.03	0.01	56.00	-17.97	QP
5	0.78	28.73	0.01	46.00	-17.27	Average
6	0.78	35.57	0.01	56.00	-20.43	QP
7	0.96	25.32	0.01	46.00	-20.68	Average
8	0.96	33.24	0.01	56.00	-22.76	QP
9	1.09	25.72	0.01	46.00	-20.28	Average
10	1.09	33.27	0.01	56.00	-22.73	QP
11	1.46	24.84	0.01	46.00	-21.16	Average
12	1.46	32.24	0.01	56.00	-23.76	QP





N:



Freq	Level	Cable	Limit	Over	Remark
		Loss	Line	Limit	
		MHz	dBuV	dB	
1	0.17	29.92	0.01	55.16	-25.24 Average
2	0.17	38.20	0.01	65.16	-26.96 QP
3	0.54	31.26	0.01	46.00	-14.74 Average
4	0.54	37.26	0.01	56.00	-18.74 QP
5	0.56	33.17	0.01	46.00	-12.83 Average
6	0.56	40.00	0.01	56.00	-16.00 QP
7	0.60	31.19	0.01	46.00	-14.81 Average
8	0.60	38.36	0.01	56.00	-17.64 QP
9	0.70	26.65	0.01	46.00	-19.35 Average
10	0.70	37.03	0.01	56.00	-18.97 QP
11	1.03	29.31	0.01	46.00	-16.69 Average
12	1.03	37.60	0.01	56.00	-18.40 QP

Note: 1. All the modes have been investigated, only the worst result of $\pi/4$ DQPSK mode 3 is presented in this report.

2. Over=Reading Level+ Correct Factor - Limit.





4.2 RADIATED EMISSION MEASUREMENT

4.2.1 Radiated Emission Limits (Frequency Range 9kHz-1000MHz)

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Limit (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

- (1) The limit for radiated test was performed according to FCC PART 15C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

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





4.2.2 TEST PROCEDURE

- a. The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- b. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The height of the equipment or of the substitution antenna shall be 0.8 m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

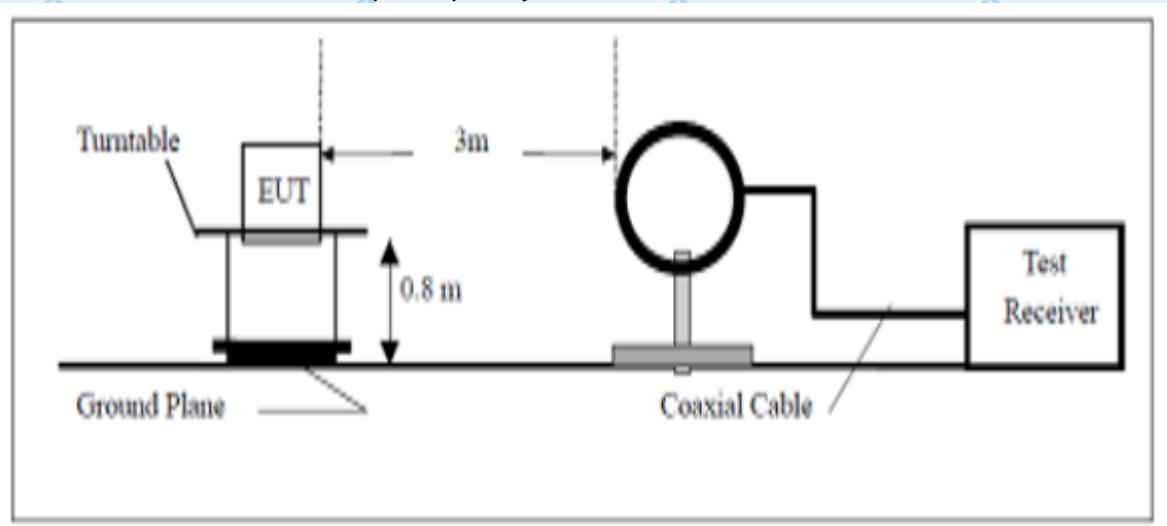
**Both horizontal and vertical antenna polarities were tested
and performed pretest to three orthogonal axis. The worst case emissions were reported**

4.2.3 DEVIATION FROM TEST STANDARD

No deviation

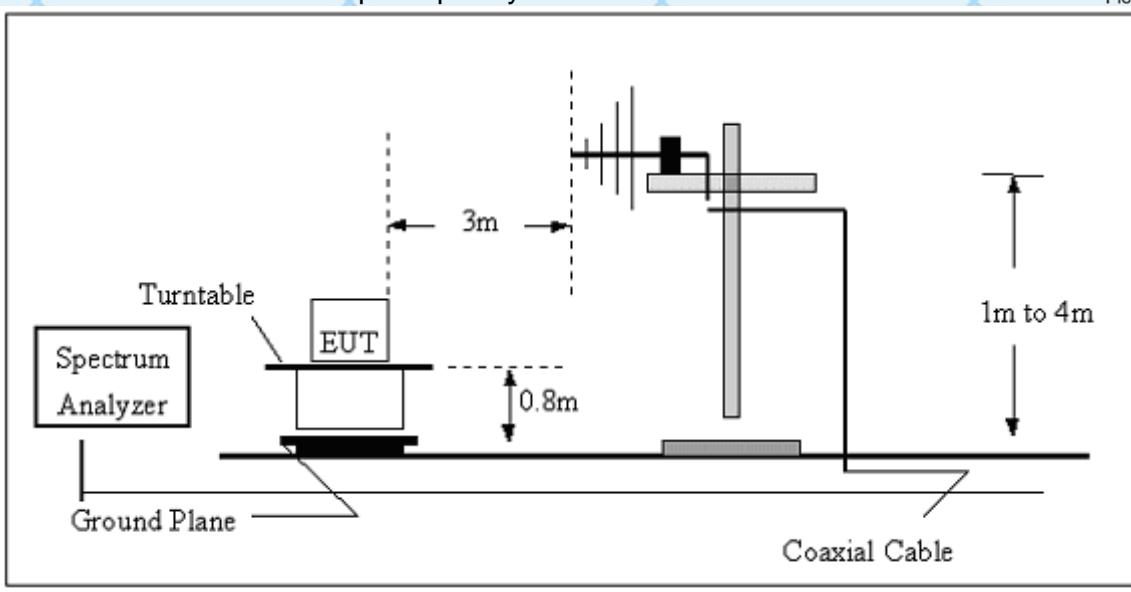
4.2.4 TEST SETUP

(A) Radiated Emission Test-Up Frequency Below 30MHz



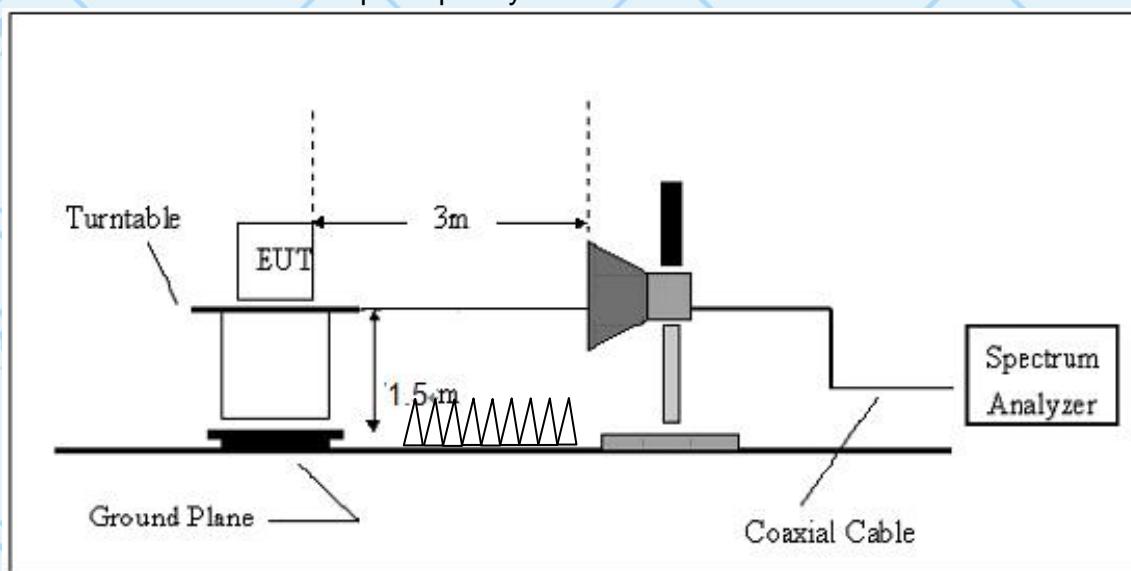


(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



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(C) Radiated Emission Test-Up Frequency Above 1GHz



4.2.5 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.





4.2.5.1 RESULTS (Below 30 MHz)

Test Mode	All Mode	Polarization	Horizontal / Vertical
Temperature	24.8 °C	Relative Humidity	56%
Pressure	1015 hPa		

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	P
--	--	--	--	P

NOTE:

No result in this part for margin above 20dB.

Distance extrapolation factor = $40 \log(\text{specific distance}/\text{test distance})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

All the x/y/z orientation has been investigated, and only worst case is presented in this report.

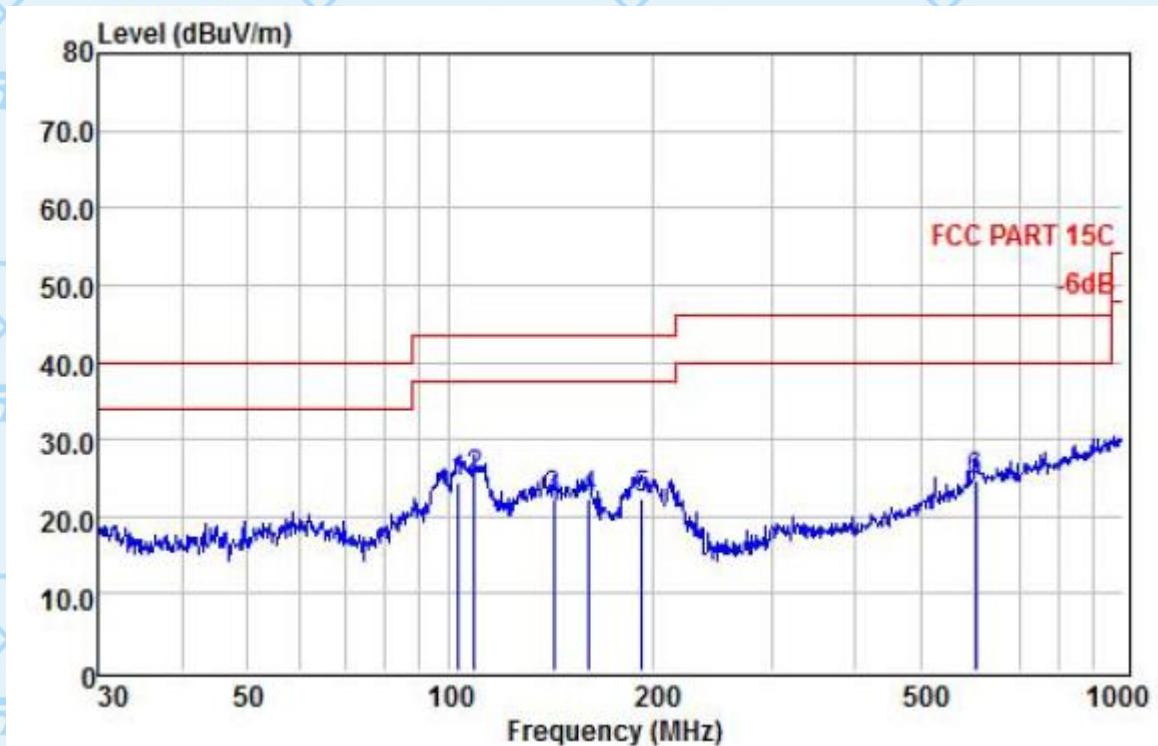




4.2.5.2 TEST RESULTS (Between 30M – 1000 MHz)

Temperature	24.8 °C	Relative Humidity	56%
Pressure	1015hPa	Voltage	DC 3.7V
Test Mode	Mode 3 with $\pi/4$ DQPSK modulation		

H:

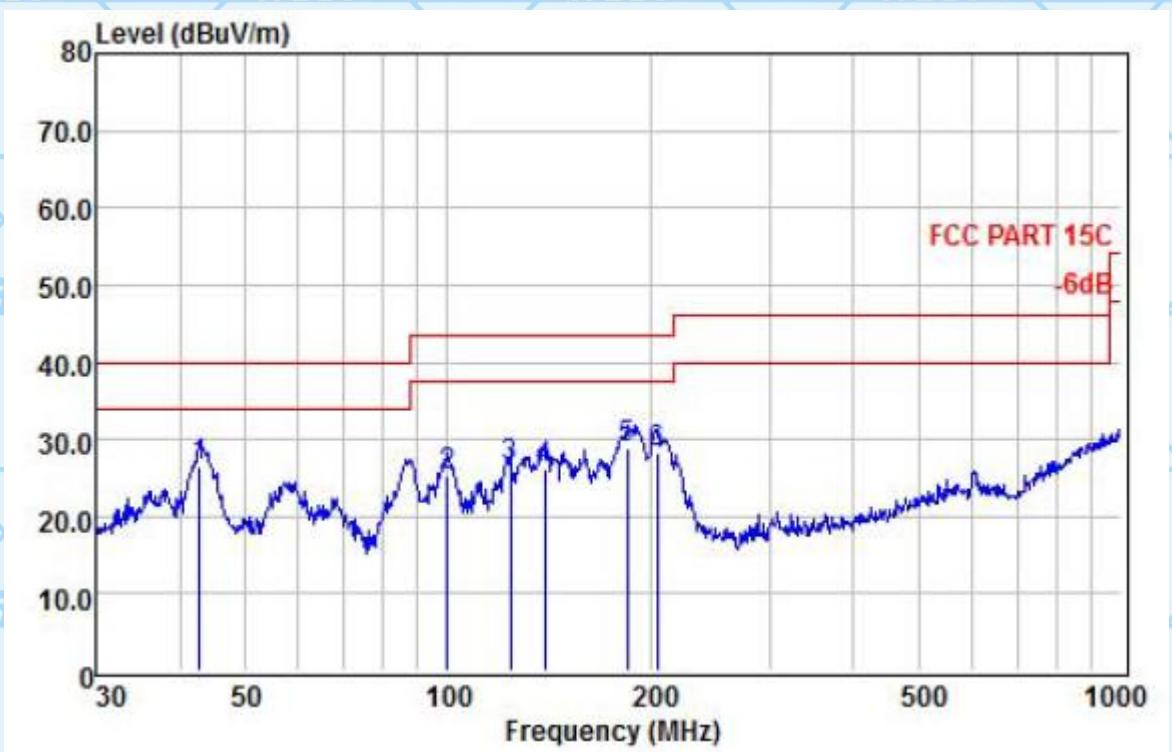


Freq	ReadAntenna		Cable		Limit	Over	Remark
	Level	Factor	Loss	Level			
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB
1	103.08	12.84	11.39	0.18	24.41	43.50	-19.09 QP
2	108.65	13.16	11.71	0.19	25.06	43.50	-18.44 QP
3	142.82	6.81	15.28	0.23	22.32	43.50	-21.18 QP
4	160.91	6.49	15.52	0.23	22.24	43.50	-21.26 QP
5	193.09	10.17	11.83	0.29	22.29	43.50	-21.21 QP
6	603.54	4.91	18.61	1.14	24.66	46.00	-21.34 QP





V:



Freq	Read	Antenna	Cable	Limit	Over	Remark	
	Line	Level	Loss	Level	Line		
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB
1	42.75	12.99	13.35	0.13	26.47	40.00	-13.53 QP
2	99.88	13.85	11.20	0.17	25.22	43.50	-18.28 QP
3	123.70	13.46	12.89	0.21	26.56	43.50	-16.94 QP
4	139.36	10.91	15.13	0.23	26.27	43.50	-17.23 QP
5	185.14	16.16	12.35	0.26	28.77	43.50	-14.73 QP
6	204.24	16.51	11.42	0.33	28.26	43.50	-15.24 QP

Note: 1. All the modes have been investigated, only the worst result of 8DPSK mode 3 is presented in this report.
 2. Over=Reading Level+ Correct Factor - Limit.



4.2.5.3 TEST RESULTS(1GHz to 25GHz) $\pi/4$ DQPSK Worst Case

Pressure	1015 hPa	Test Mode	TX/Mode 1(2402MHz)
Temperature	24.8 °C	Relative Humidity	56%
Polarization:	Horizontal		

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
2402	109.51	-5.84	103.67	114.00	-10.33	PK
2402	84.53	-5.84	78.69	94.00	-15.31	AV
4804	64.27	-3.64	60.63	74.00	-13.37	PK
4804	52.49	-3.64	48.85	54.00	-5.15	AV
7206	63.24	-0.95	62.29	74.00	-11.71	PK
7206	48.26	-0.95	47.31	54.00	-6.69	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit

Pressure	1015 hPa	Test Mode	TX/Mode 1(2402MHz)
Temperature	24.8 °C	Relative Humidity	56%
Polarization:	Vertical		

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
2402	111.41	-5.84	105.57	114.00	-8.43	PK
2402	81.75	-5.84	75.91	94.00	-18.09	AV
4804	60.37	-3.64	56.73	74.00	-17.27	PK
4804	51.36	-3.64	47.72	54.00	-6.28	AV
7206	56.39	-0.95	55.44	74.00	-18.56	PK
7206	47.53	-0.95	46.58	54.00	-7.42	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit

Pressure	1015 hPa	Test Mode	TX/Mode 2(2441MHz)
Temperature	24.8 °C	Relative Humidity	56%
Polarization:	Horizontal		

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
2441	112.15	-5.84	106.31	114.00	-7.69	PK
2441	82.35	-5.84	76.51	94.00	-17.49	AV
4882	62.28	-3.64	58.64	74.00	-15.36	PK
4882	52.54	-3.64	48.90	54.00	-5.10	AV
7323	56.47	-0.95	55.52	74.00	-18.48	PK
7323	47.15	-0.95	46.20	54.00	-7.80	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit





Pressure	1015 hPa	Test Mode	TX/Mode 2(2441MHz)
Temperature	24.8 °C	Relative Humidity	56%
Polarization:	Vertical		

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
2441	112.55	-5.71	106.84	114.00	-7.16	PK
2441	82.49	-5.71	76.78	94.00	-17.22	AV
4882	61.37	-3.51	57.86	74.00	-16.14	PK
4882	50.24	-3.51	46.73	54.00	-7.27	AV
7323	56.26	-0.82	55.44	74.00	-18.56	PK
7323	46.74	-0.82	45.92	54.00	-8.08	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit

Pressure	1015 hPa	Test Mode	TX/Mode 3(2480MHz)
Temperature	24.8 °C	Relative Humidity	56%
Polarization:	Horizontal		

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
2480	109.36	-5.84	103.52	114.00	-10.48	PK
2480	83.46	-5.84	77.62	94.00	-16.38	AV
4960	62.43	-3.64	58.79	74.00	-15.21	PK
4960	49.21	-3.64	45.57	54.00	-8.43	AV
7440	62.15	-0.95	61.2	74.00	-12.8	PK
7440	48.36	-0.95	47.41	54.00	-6.59	AV

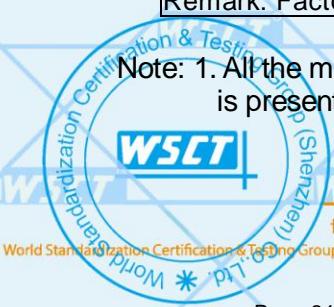
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit

Pressure	1015 hPa	Test Mode	TX/Mode 3(2480MHz)
Temperature	24.8 °C	Relative Humidity	56%
Polarization:	Vertical		

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
2480	107.46	-5.84	101.62	114.00	-12.38	PK
2480	82.35	-5.84	76.51	94.00	-17.49	AV
4960	61.42	-3.64	57.78	74.00	-16.22	PK
4960	52.36	-3.64	48.72	54.00	-5.28	AV
7440	61.24	-0.95	60.29	74.00	-13.71	PK
7440	48.69	-0.95	47.74	54.00	-6.26	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit

Note: 1. All the modes have been investigated, only the worst result of π/4 DQPSK is presented in this report.





Remark:

- (1) Measuring frequencies from 1 GHz to the 25 GHz.
- (2) "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency.
- (3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (4) Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
- (6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
- (7) All modes of operation were investigated and the worst-case emissions are reported.





4.2.5.4 TEST RESULTS (Restricted Bands Requirements)

Test result for $\pi/4$ DQPSK Mode:

Polarization	Horizontal	Test Mode	TX /Mode1(2402MHz)
Temperature	24.8 °C	Relative Humidity	56%
Pressure	1015 hPa		

Frequency (MHz)	Reading Result (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
2310	53.42	-5.81	47.61	74.00	-26.39	PK
2310	/	-5.81	/	54.00	/	AV
2390	53.38	-5.84	47.54	74.00	-26.46	PK
2390	/	-5.84	/	54.00	/	AV
2400	53.23	-5.84	47.39	74.00	-26.61	PK
2400	/	-5.84	/	54.00	/	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Polarization	Vertical	Test Mode	TX /Mode1(2402MHz)
Temperature	24.8 °C	Relative Humidity	56%
Pressure	1015 hPa		

Frequency (MHz)	Reading Result (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
2310	52.27	-5.81	46.46	74.00	-27.54	PK
2310	/	-5.81	/	54.00	/	AV
2390	53.19	-5.81	47.38	74.00	-26.62	PK
2390	/	-5.84	/	54.00	/	AV
2400	53.26	-5.84	47.42	74.00	-26.58	PK
2400	/	-5.84	/	54.00	/	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.



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Polarization	Horizontal	Test Mode	TX /Mode 3(2480MHz)
Temperature	24.8 °C	Relative Humidity	56%
Pressure	1015 hPa		

Frequency (MHz)	Reading Result (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
2483.5	53.57	-5.65	47.92	74.00	-26.08	PK
2483.5	/	-5.65	/	54.00	/	AV
2500	53.28	-5.72	47.56	74.00	-26.44	PK
2500	/	-5.72	/	54.00	/	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Polarization	Vertical	Test Mode	TX /Mode 3(2480MHz)
Temperature	24.8 °C	Relative Humidity	56%
Pressure	1015 hPa		

Frequency (MHz)	Reading Result (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
2483.5	52.44	-5.65	46.79	74.00	-27.21	PK
2483.5	/	-5.65	/	54.00	/	AV
2500	53.25	-5.72	47.53	74.00	-26.47	PK
2500	/	-5.72	/	54.00	/	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Note: 1. All the modes have been investigated, only the worst result of $\pi/4$ DQPSK is presented in this report.





5. NUMBER OF HOPPING CHANNEL

5.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (a)(1)(iii)	Number of Hopping Channel	≥15	2400-2483.5	PASS

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating Frequency Range
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.1.1 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting: RBW= 1MHz, VBW=3MHz, Sweep time = Auto.

5.1.2 DEVIATION FROM STANDARD

No deviation.

5.1.3 TEST SETUP



5.1.4 EUT OPERATION CONDITIONS

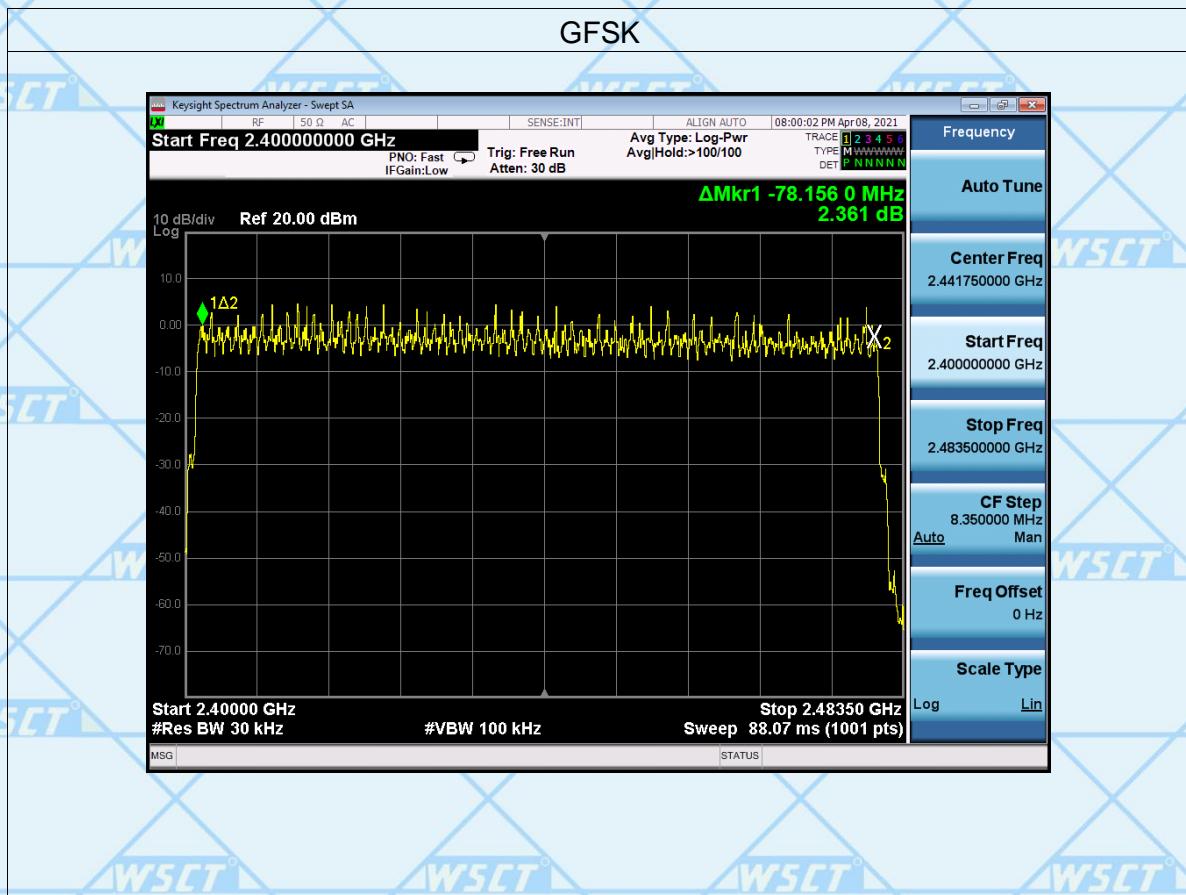
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.





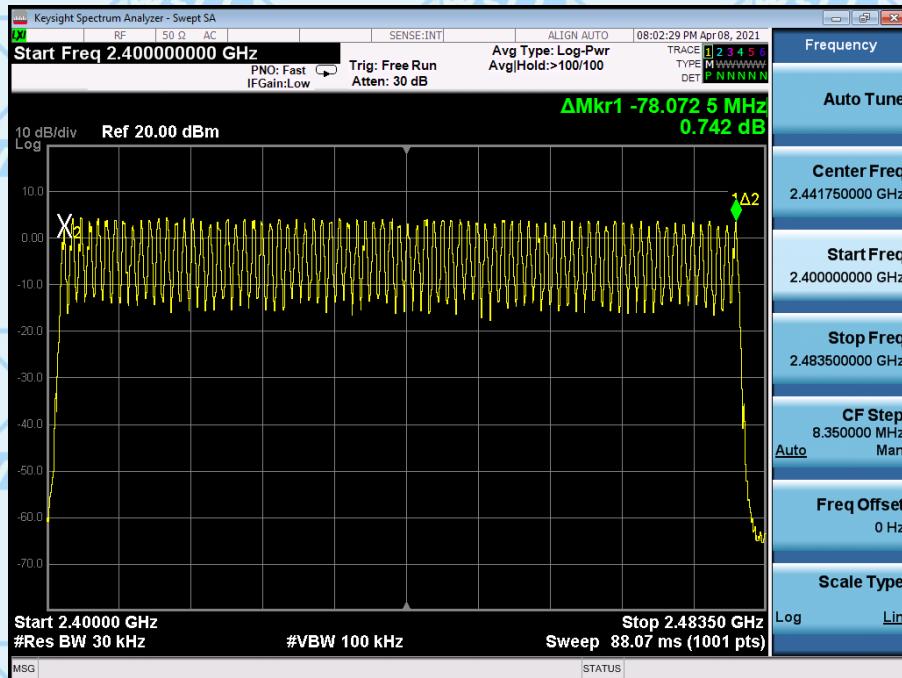
5.2 TEST RESULTS

Mode	Hopping channel numbers	Limit	Result
GFSK, P/4-DQPSK, 8DPSK	79	15	PASS

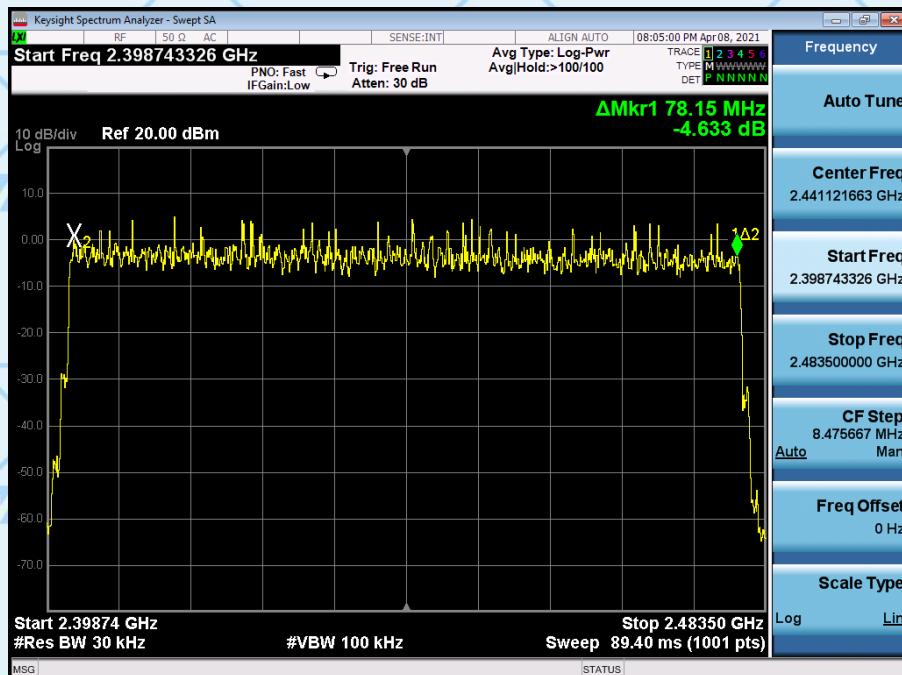




P/4-DQPSK



8DPSK





6. AVERAGE TIME OF OCCUPANCY

6.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (a)(1)(iii)	Average Time of Occupancy	0.4sec	2400-2483.5	PASS

6.1.2 TEST PROCEDURE

- The EUT test port was connected to the spectrum analyzer with RF cable and antenna connector.
- Set RBW of spectrum analyzer to 1MHz and VBW to 3MHz.
- Use a video trigger with the trigger level set to enable triggering only on full pulses.
- Sweep Time is more than once pulse time.
- Set the center frequency on any frequency would be measure and set the frequency span to zero span.
- Measure the maximum time duration of one single pulse.
- Set the EUT for 1DH5, 2DH5 and 3DH5 packet transmitting.
- Measure the maximum time duration of one single pulse.
- Dwell time = Pulse time*(1600/6/79)*31.6S

6.1.3 DEVIATION FROM STANDARD

No deviation.

6.1.4 TEST SETUP



6.1.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

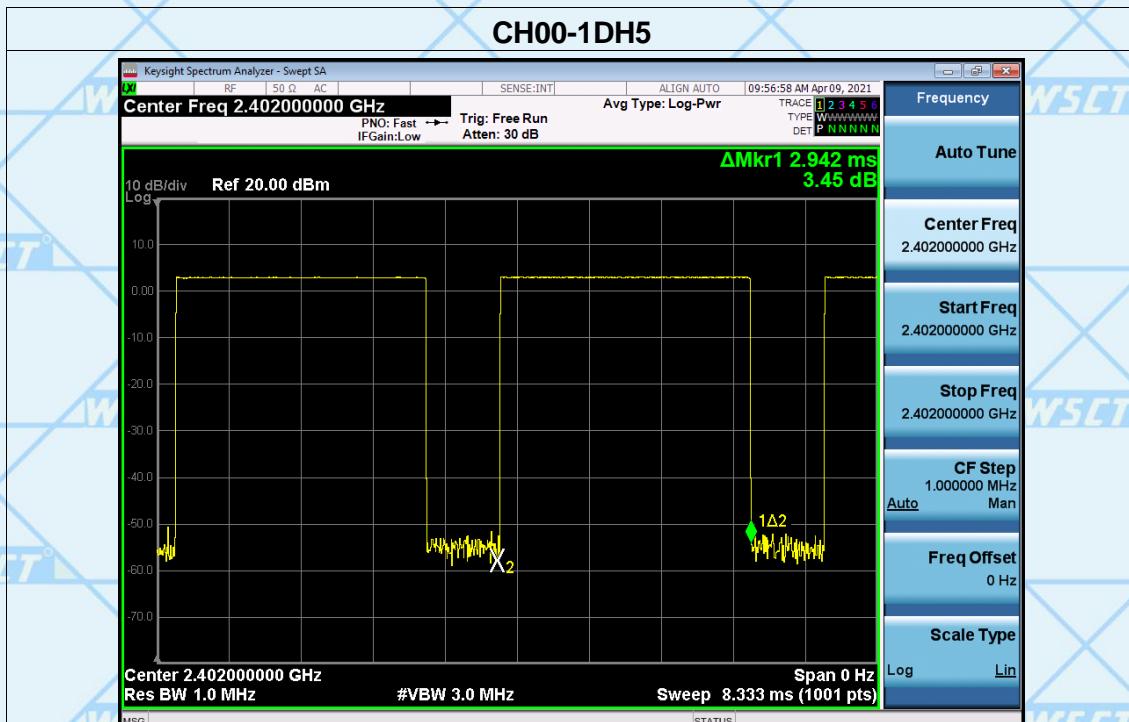




6.2 TEST RESULTS

Pressure	1012 hPa	Test Mode	1DH5-1Mbps
Temperature	25°C	Relative Humidity	60%

Data Packet	Frequency	Pulse time(ms)	Dwell Time(S)	Limits (S)	Result
1DH5	2402MHz	2.942	0.314	0.4	PASS
1DH5	2441MHz	2.917	0.311	0.4	PASS
1DH5	2480MHz	2.933	0.313	0.4	PASS

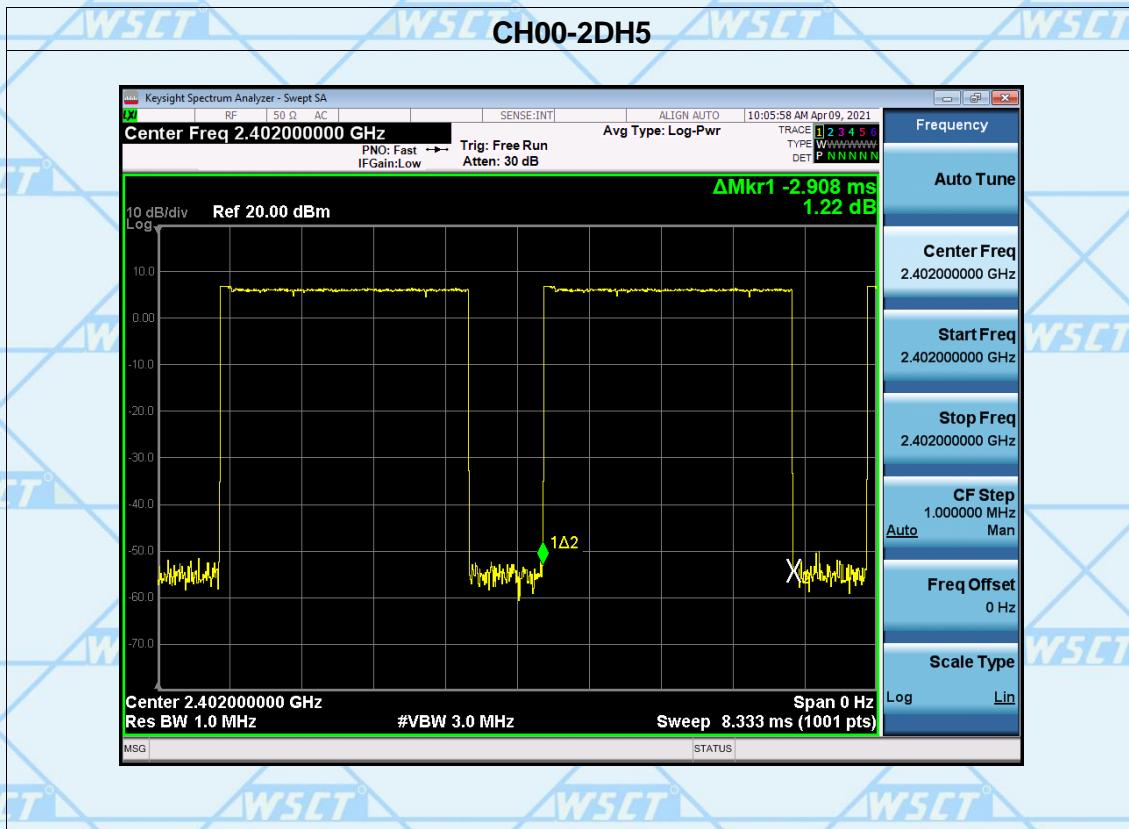






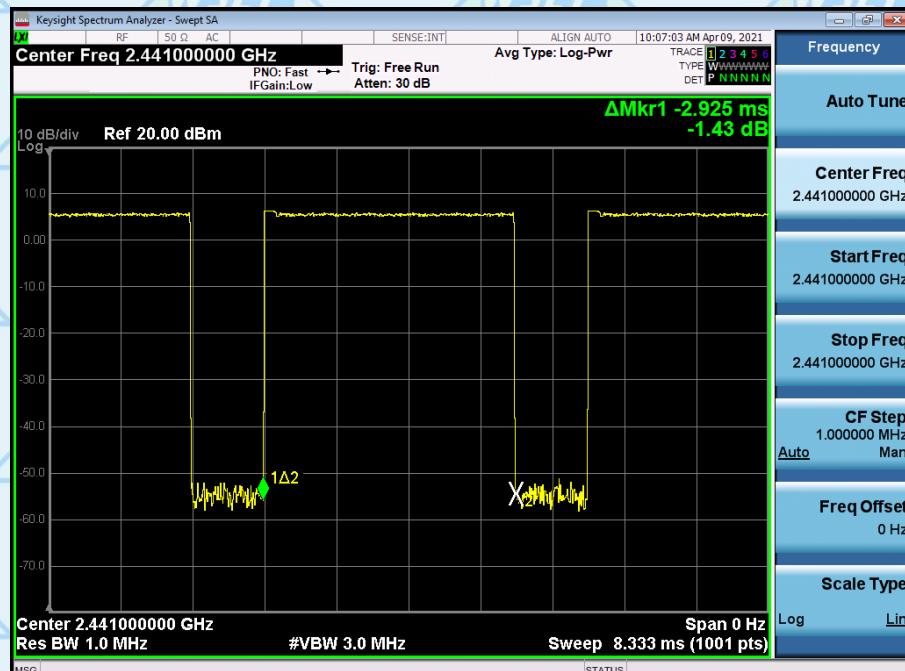
Pressure	1012 hPa	Test Mode	2DH5-2Mbps
Temperature	25°C	Relative Humidity	60%

Data Packet	Frequency	Pulse time(ms)	Dwell Time(S)	Limits (S)	Result
2DH5	2402MHz	2.908	0.310	0.4	PASS
2DH5	2441MHz	2.925	0.312	0.4	PASS
2DH5	2480MHz	2.933	0.313	0.4	PASS





CH39-2DH5



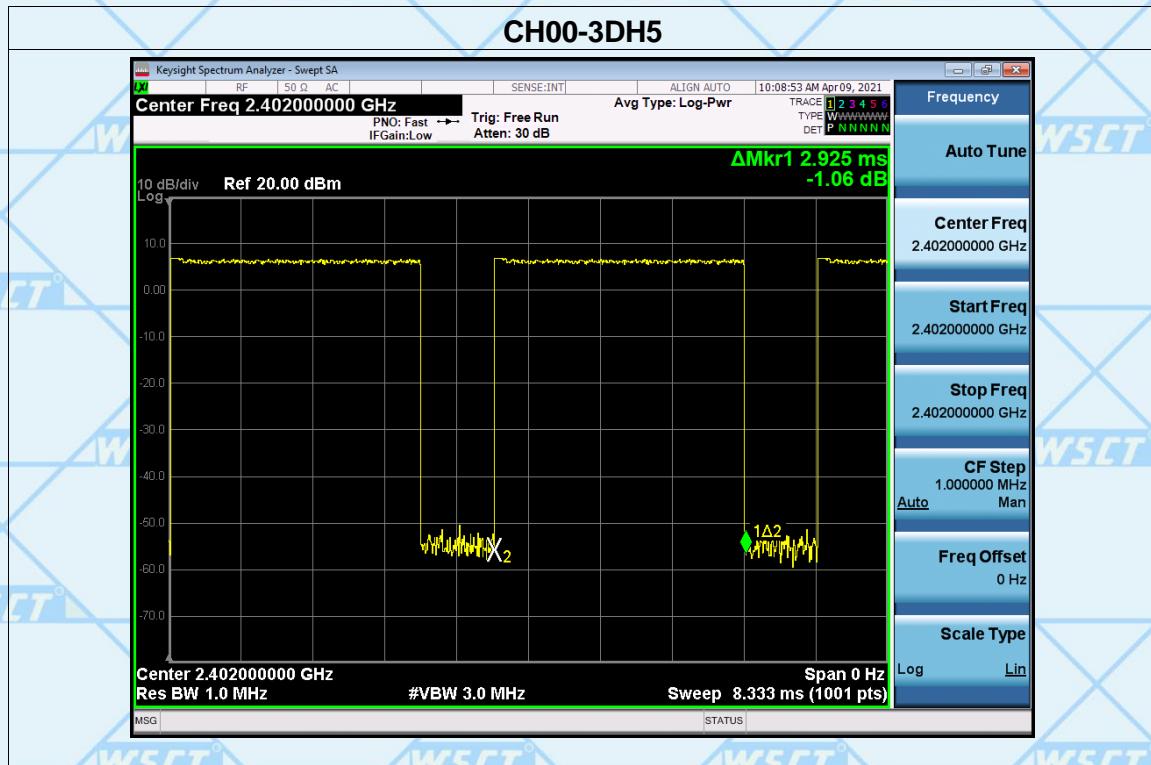
CH78-2DH5





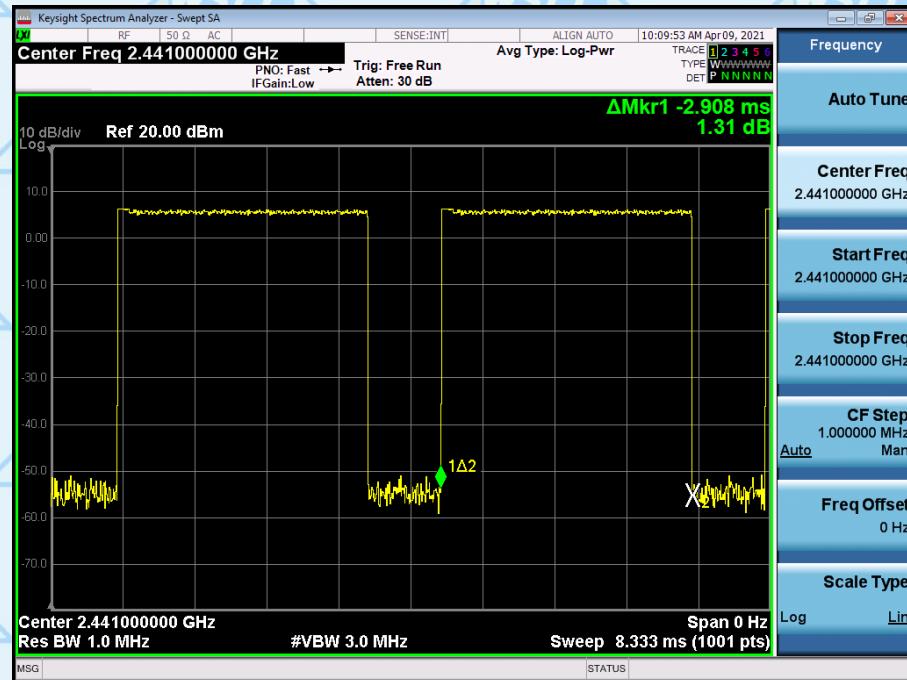
Pressure	1012 hPa	Test Mode	3DH5-3Mbps
Temperature	25°C	Relative Humidity	60%

Data Packet	Frequency	Pulse time(ms)	Dwell Time(S)	Limits (S)	Result
3DH5	2402MHz	2.925	0.313	0.4	PASS
3DH5	2441MHz	2.908	0.313	0.4	PASS
3DH5	2480MHz	2.933	0.313	0.4	PASS

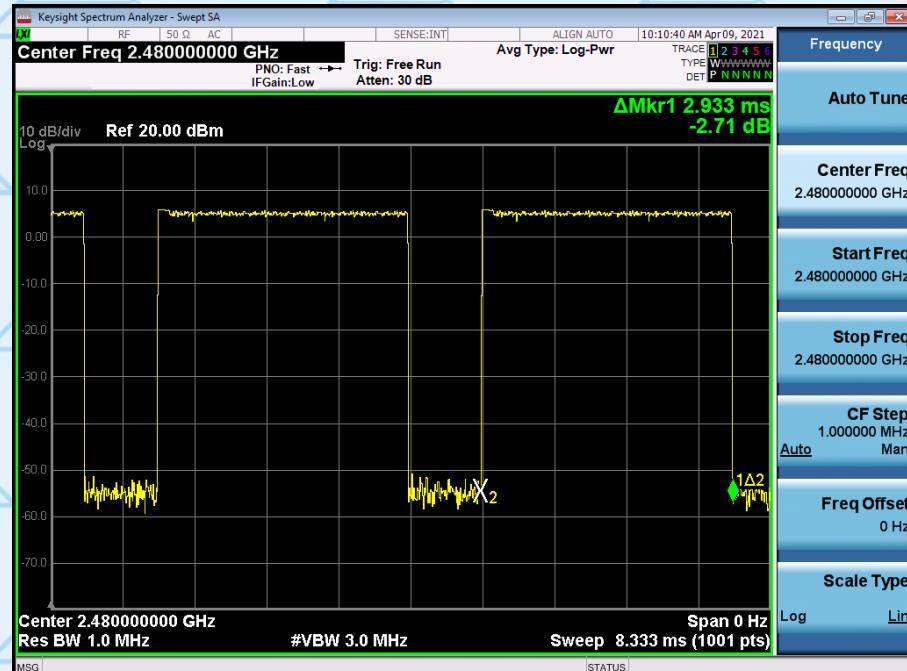




CH39-3DH5



CH78-3DH5





7. HOPPING CHANNEL SEPARATION MEASUREMENT

7.1 APPLIED PROCEDURES / 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.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RB	Resolution (or IF) Bandwidth (RBW) $\geq 1\%$ of the span
VB	Video (or Average) Bandwidth (VBW) \geq RBW
Detector	Peak
Trace	Max hold
Sweep Time	Auto

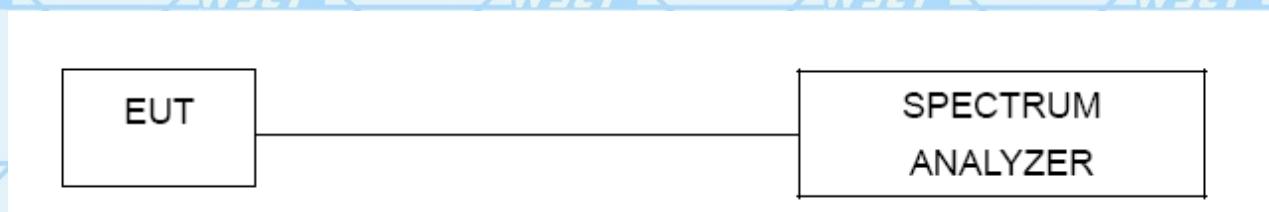
7.1.2 TEST PROCEDURE

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = wide enough to capture the peaks of two adjacent channels; Resolution (or IF) Bandwidth (RBW) $\geq 1\%$ of the span; Video (or Average) Bandwidth (VBW) \geq RBW; Sweep = auto; Detector function = peak; Trace = max hold
3. Measure the separation between the peaks of the adjacent channels using the marker-delta function.
4. Repeat above procedures until all frequencies measured were complete.

7.1.3 DEVIATION FROM STANDARD

No deviation.

7.1.4 TEST SETUP



7.1.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.





7.2 TEST RESULTS

Pressure	1012 hPa	Test Mode	CH00 / CH39 /CH78 (1Mbps)
Temperature	25°C	Relative Humidity	60%
Test Result	Pass		

Channel number	Channel frequency (MHz)	Separation Read value (KHz)	Separation limit (KHz)
00	2402	1010	618
39	2441	1006	618
78	2480	996	618





CH39 -1Mbps



CH78 -1Mbps

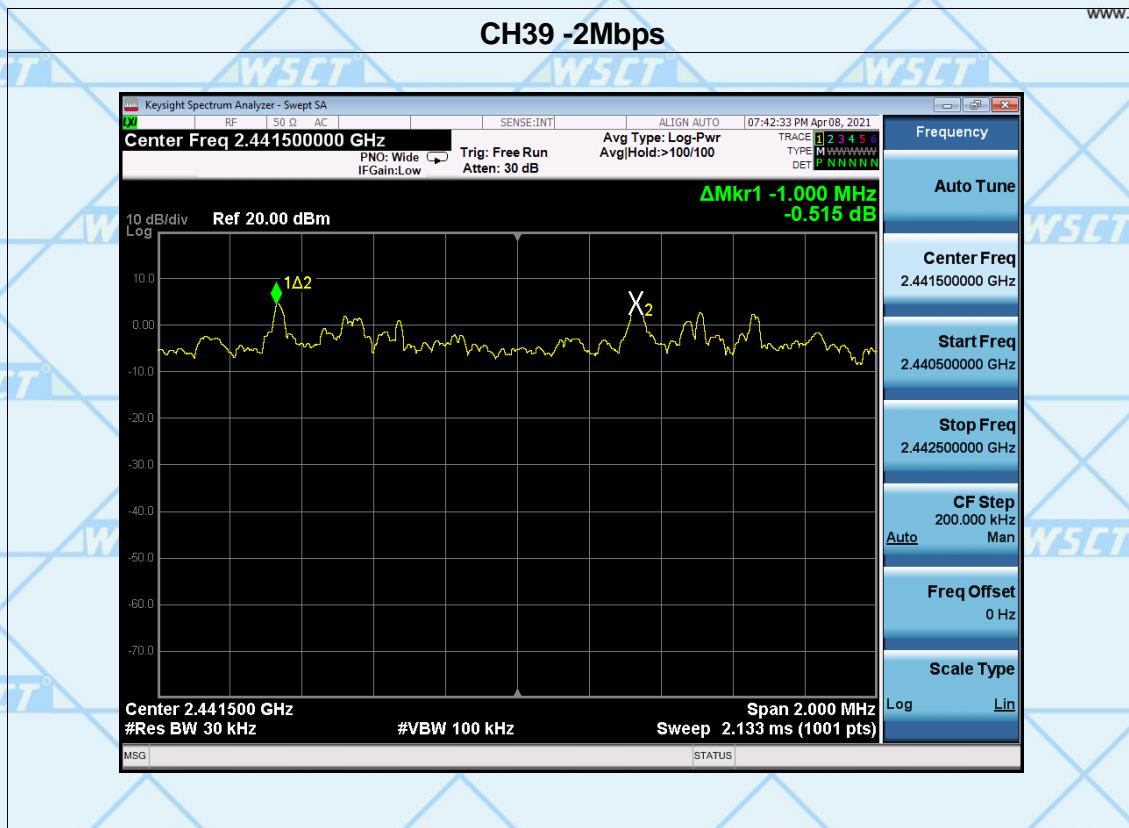




Pressure	1012 hPa	Test Mode	CH00 / CH39 /CH78 (2Mbps)
Temperature	25°C	Relative Humidity	60%
Test Result	Pass		

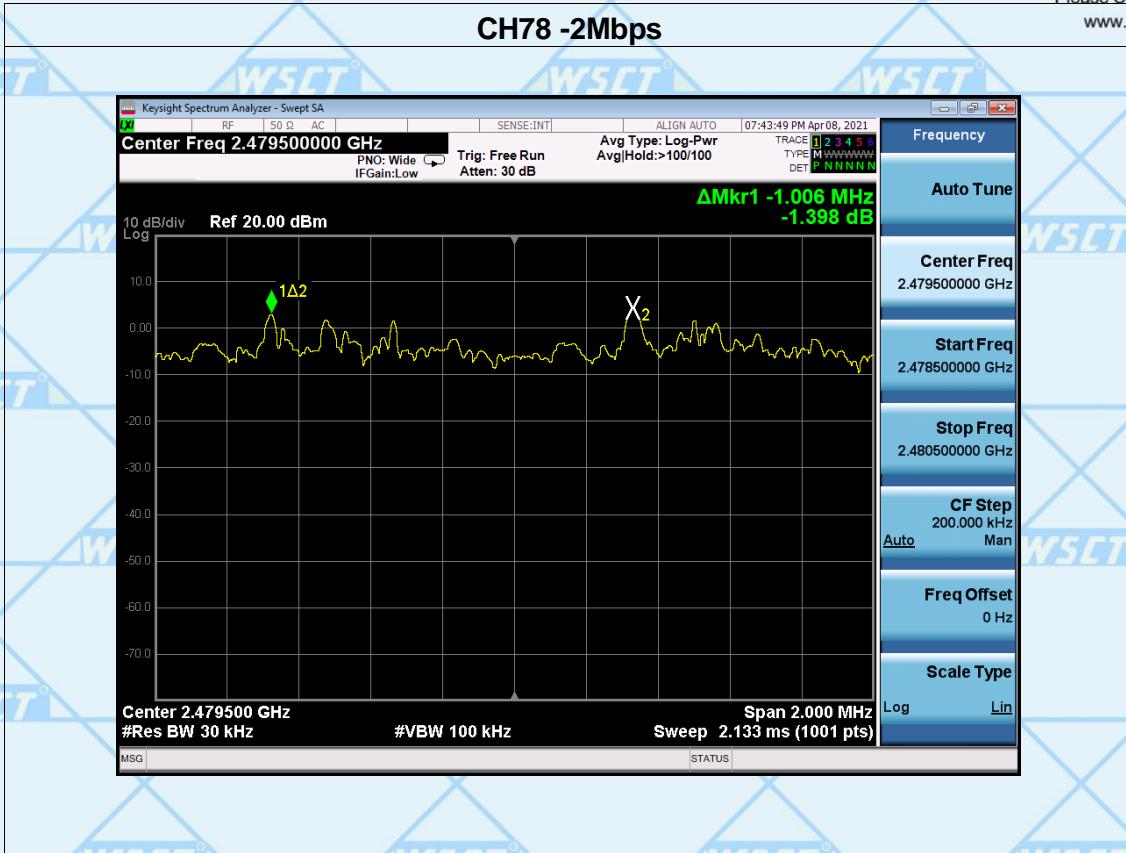
Channel number	Channel frequency (MHz)	Separation Read value (KHz)	Separation limit (KHz)
00	2402	1006	823
39	2441	1000	667
78	2480	1006	671







CH78 -2Mbps

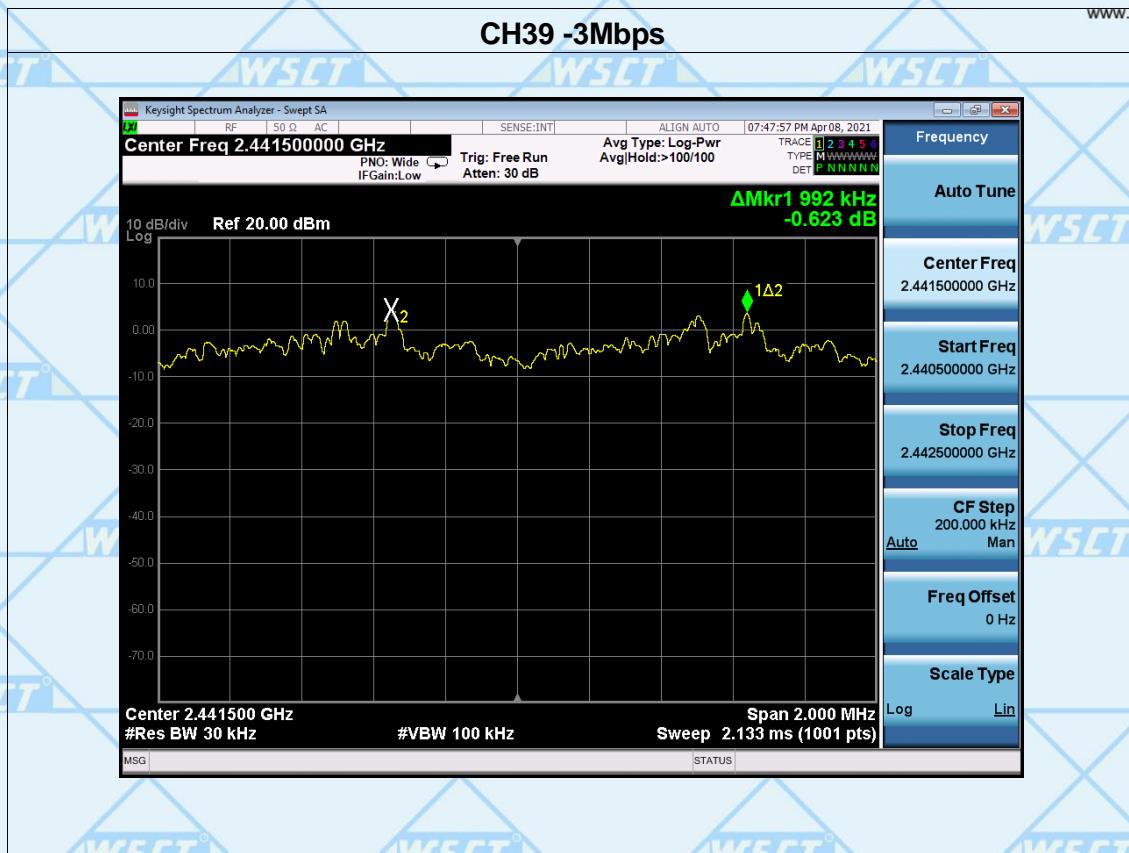




Pressure	1012 hPa	Test Mode	CH00 / CH39 /CH78 (3Mbps)
Temperature	25°C	Relative Humidity	60%
Test Result	Pass		

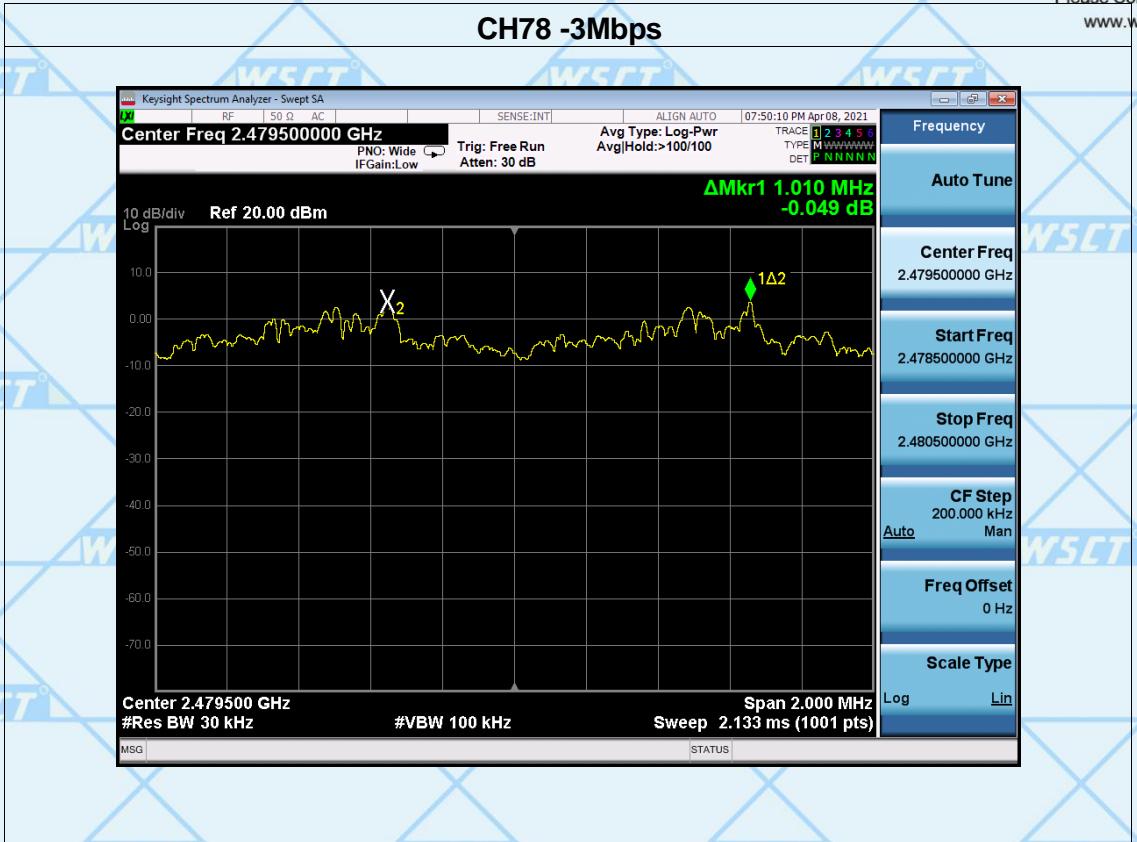
Channel number	Channel frequency (MHz)	Separation Read value (KHz)	Separation limit (KHz)
00	2402	996	820
39	2441	992	818
78	2480	1010	818







CH78 -3Mbps





8. BANDWIDTH TEST

8.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (a)(1)	Bandwidth	(20dB bandwidth)	2400-2483.5	PASS

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RB	30kHz
VB	100 kHz
Detector	Peak
Trace	Max hold
Sweep Time	Auto

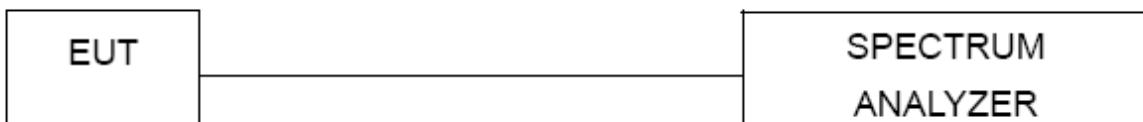
8.1.2 TEST PROCEDURE

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: VBW =30kHz, RBW=100kHz, Sweep = auto Detector function = peak ,Trace = max hold
3. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
4. Repeat above procedures until all frequencies measured were complete.

8.1.3 DEVIATION FROM STANDARD

No deviation.

8.1.4 TEST SETUP



8.1.5 EUT OPERATION CONDITIONS

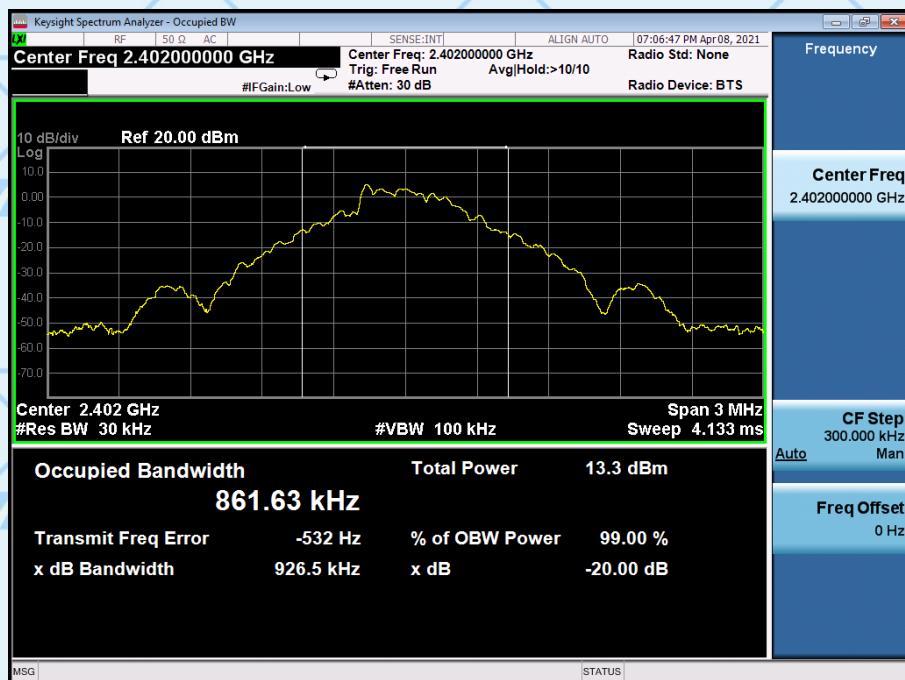
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.



Pressure	1012 hPa	Test Mode	CH00/CH39/C78(1Mbps)
Temperature	25°C	Relative Humidity	60%

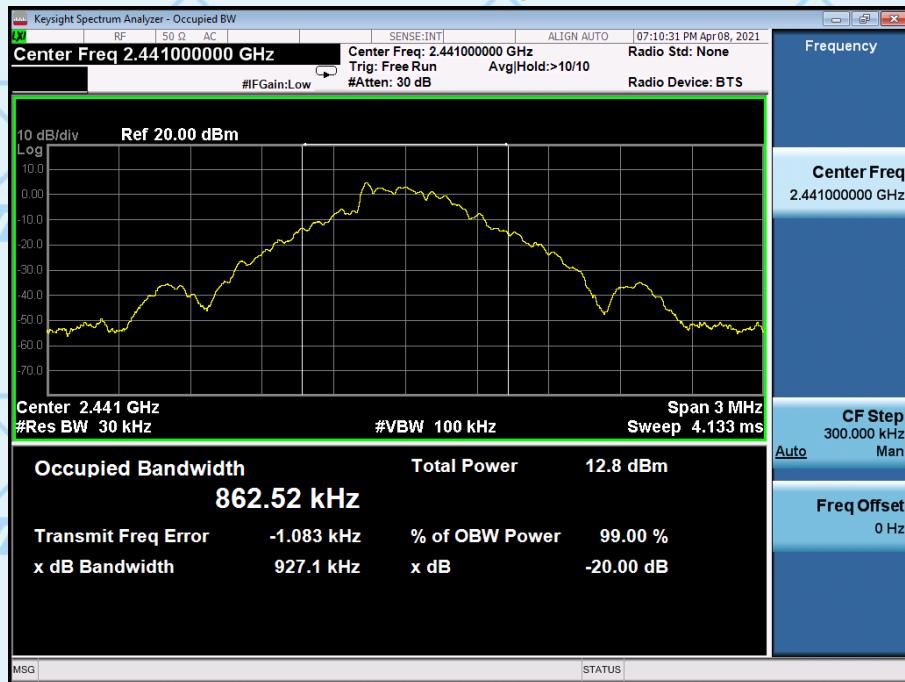
Frequency	20dB Bandwidth (kHz)	Result
2402 MHz	926.5	PASS
2441 MHz	927.1	PASS
2480 MHz	927.1	PASS

CH00 -1Mbps

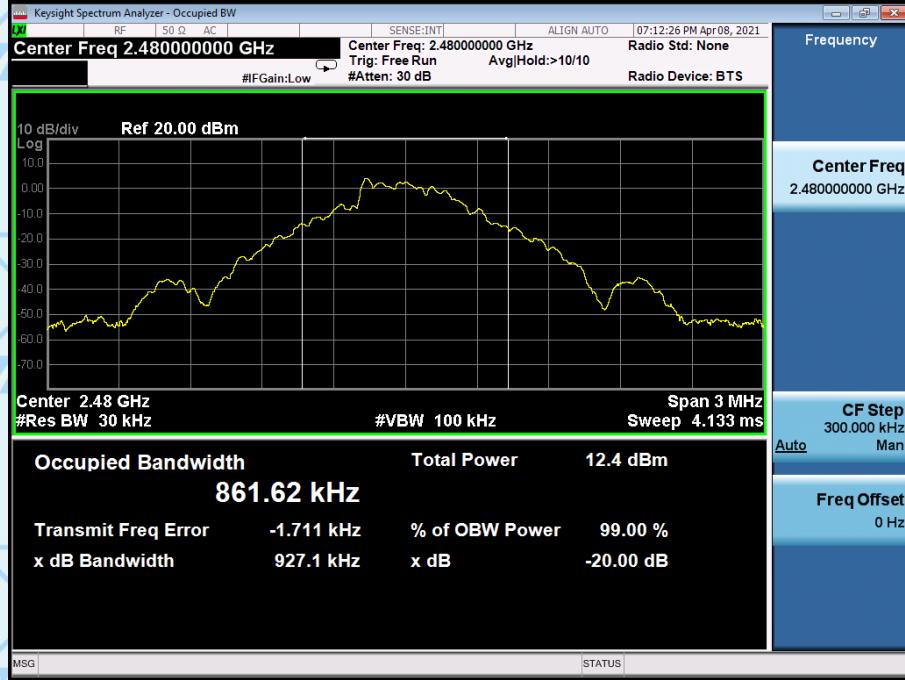




CH39 -1Mbps



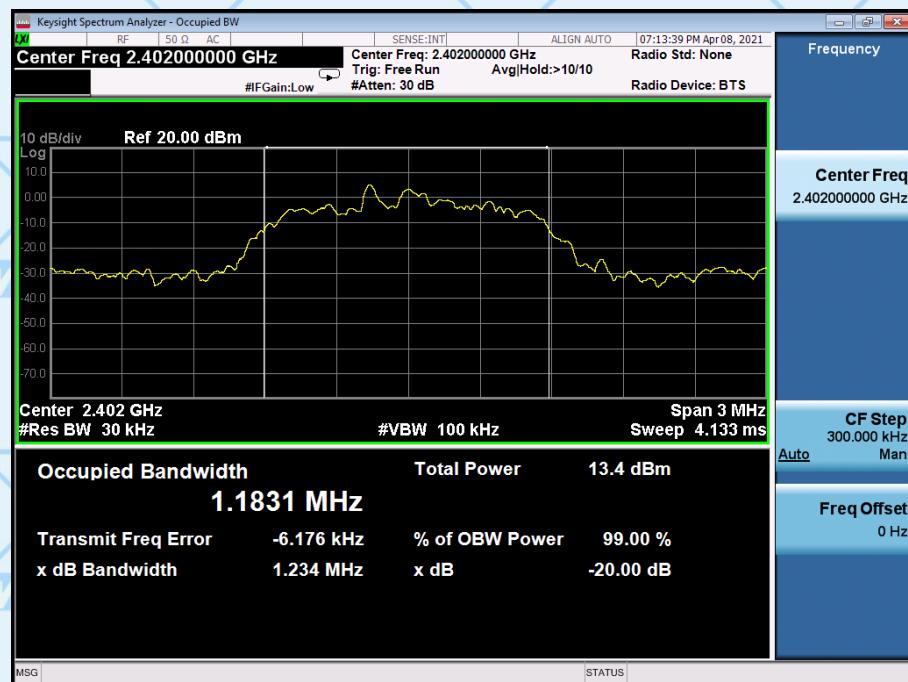
CH78 -1Mbps





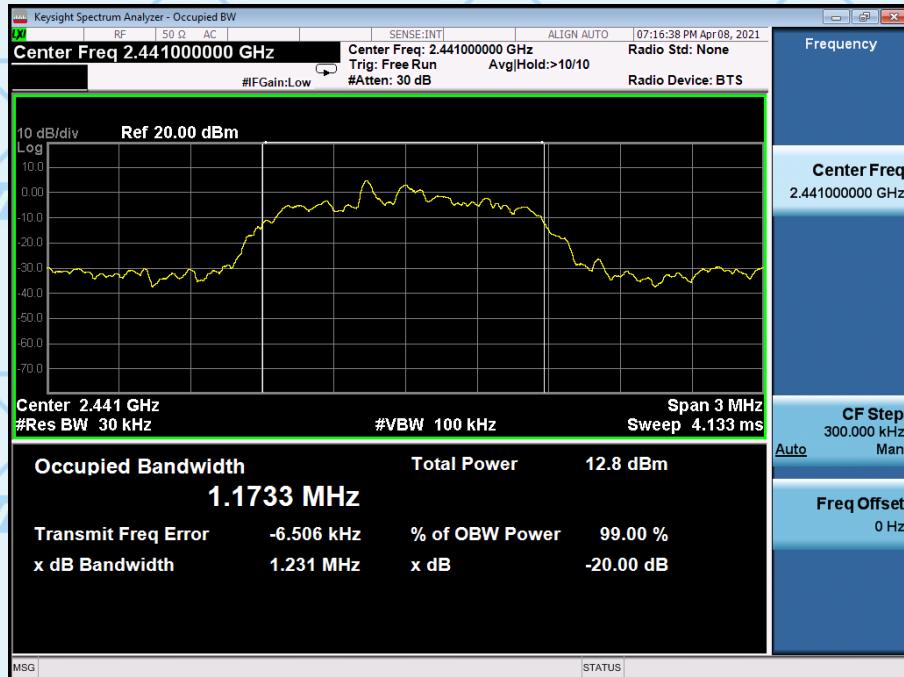
Pressure	1012 hPa	Test Mode	CH00/CH39/C78(2Mbps)
Temperature	25°C	Relative Humidity	60%

Frequency	20dB Bandwidth (kHz)	Result
2402 MHz	1234	PASS
2441 MHz	1231	PASS
2480 MHz	1230	PASS

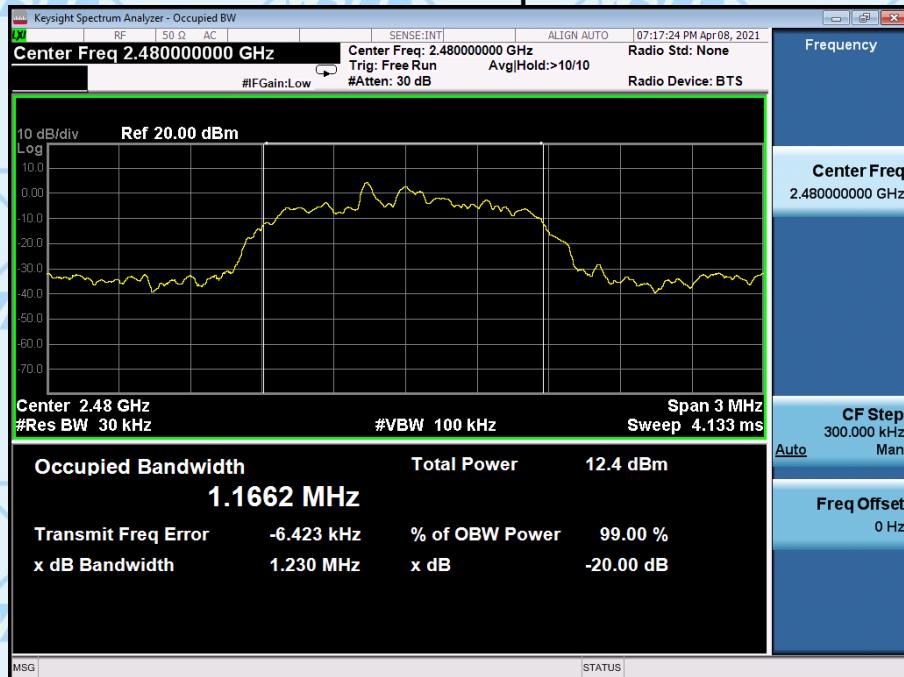




CH39 -2Mbps



CH78 -2Mbps

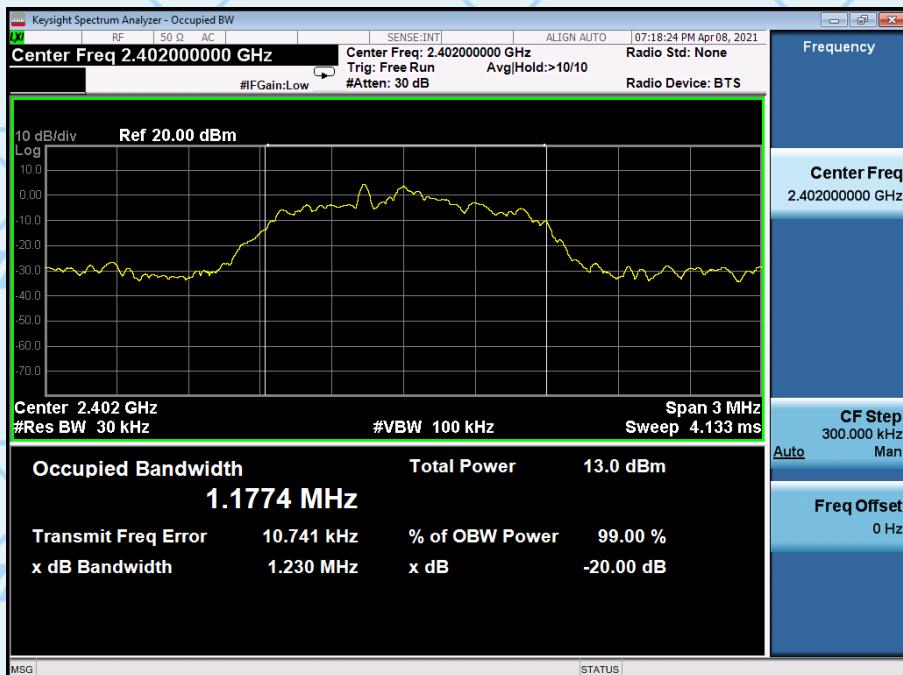




Pressure	1012 hPa	Test Mode	CH00/CH39/C78(3Mbps)
Temperature	25°C	Relative Humidity	60%

Frequency	20dB Bandwidth (kHz)	Result
2402 MHz	1230	PASS
2441 MHz	1227	PASS
2480 MHz	1227	PASS

CH00 -3Mbps

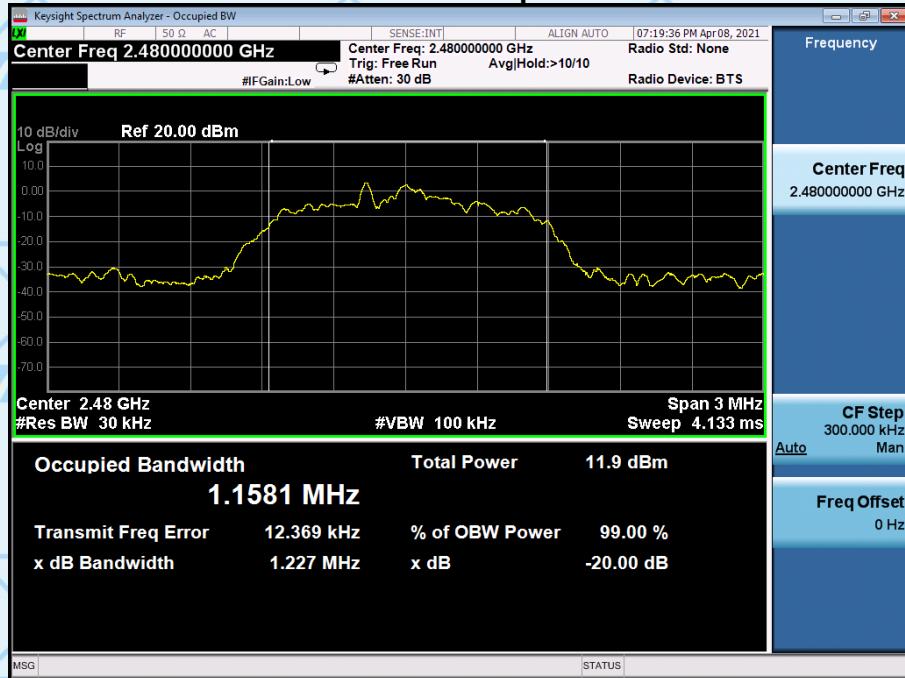




CH39 -3Mbps



CH78 -3Mbps





9. PEAK OUTPUT POWER TEST

9.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (b)(i)	Peak Output Power	1W for 1Mbps 0.125W for 2/3Mbps	2400-2483.5	PASS

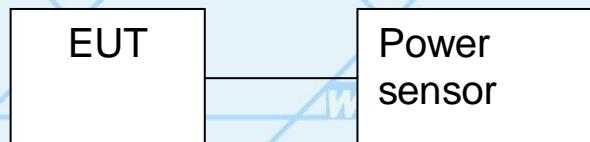
9.1.2 TEST PROCEDURE

EUT was directly connected to the power sensor for testing.

9.1.3 DEVIATION FROM STANDARD

No deviation.

9.1.4 TEST SETUP



9.1.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.





9.2 TEST RESULTS

Pressure	1012 hPa	Test Mode	CH00/ CH39 /CH78 (1M/2M/3Mbps)
Temperature	25°C	Relative Humidity	60%

Test Channel	Frequency (MHz)	Peak Output Power (dBm)	LIMIT(dBm)	Result
1Mbps				
CH00	2402	1.83	30	Pass
CH39	2441	1.78	30	Pass
CH78	2480	1.63	30	Pass
2Mbps				
CH00	2402	2.59	20.97	Pass
CH39	2441	2.53	20.97	Pass
CH78	2480	2.92	20.97	Pass
3Mbps				
CH00	2402	2.68	20.97	Pass
CH39	2441	2.73	20.97	Pass
CH78	2480	2.33	20.97	Pass

Note: π/4 DQPSK Worst Case







10. CONDUCTED BANDEGE MEASUREMENT

10.1 TEST SETUP



10.2 TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as TX operation and connect directly to the spectrum analyzer.
3. Based on FCC Part15 C Section 15.247: RBW=100KHz, VBW=300KHz.
4. Set detected by the spectrum analyzer with peak detector.

10.3 LIMIT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20dB.

10.4 TEST RESULT

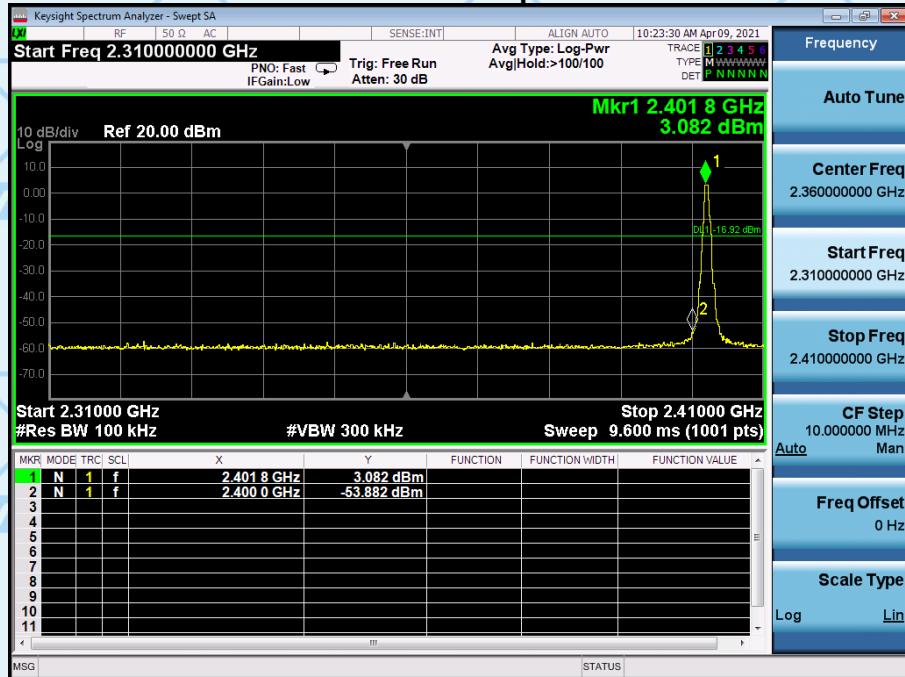
PASS

Modulation		Frequency Band	Delta Peak to band emission (dBc)	> Limit (dBc)	Result
GFSK (1Mbps)	Non-hopping	Left Band	56.96	20	Pass
		Right Band	60.55	20	Pass
	hopping	Left Band	60.70	20	Pass
		Right Band	60.29	20	Pass
$\pi/4$ DQPS K (2Mbps)	Non-hopping	Left Band	59.27	20	Pass
		Right Band	61.00	20	Pass
	hopping	Left Band	59.27	20	Pass
		Right Band	60.64	20	Pass
8DPSK (3Mbps)	Non-hopping	Left Band	57.90	20	Pass
		Right Band	60.51	20	Pass
	hopping	Left Band	61.73	20	Pass
		Right Band	61.33	20	Pass

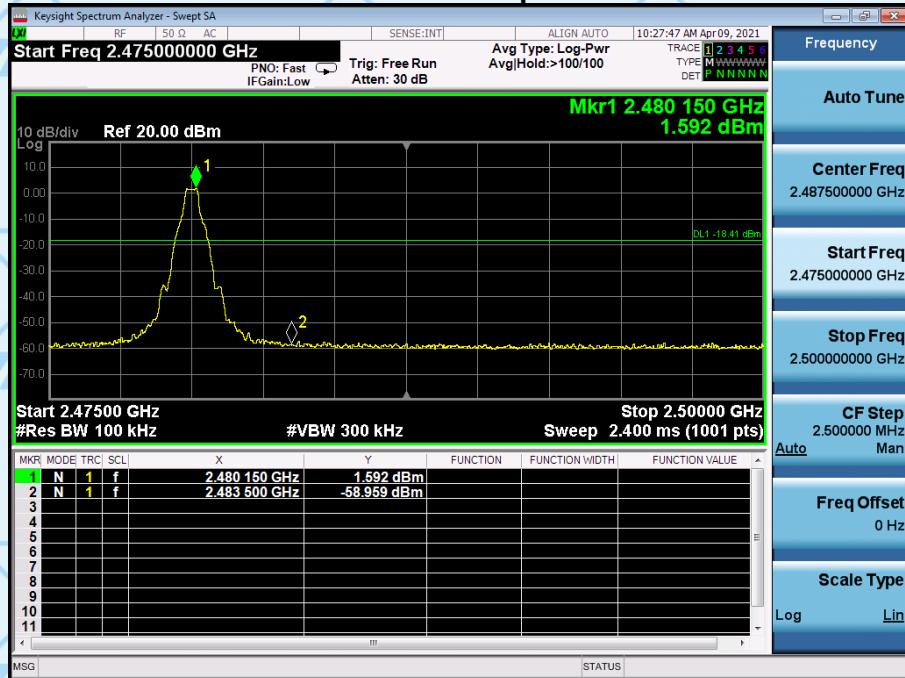




CH00 -1Mbps

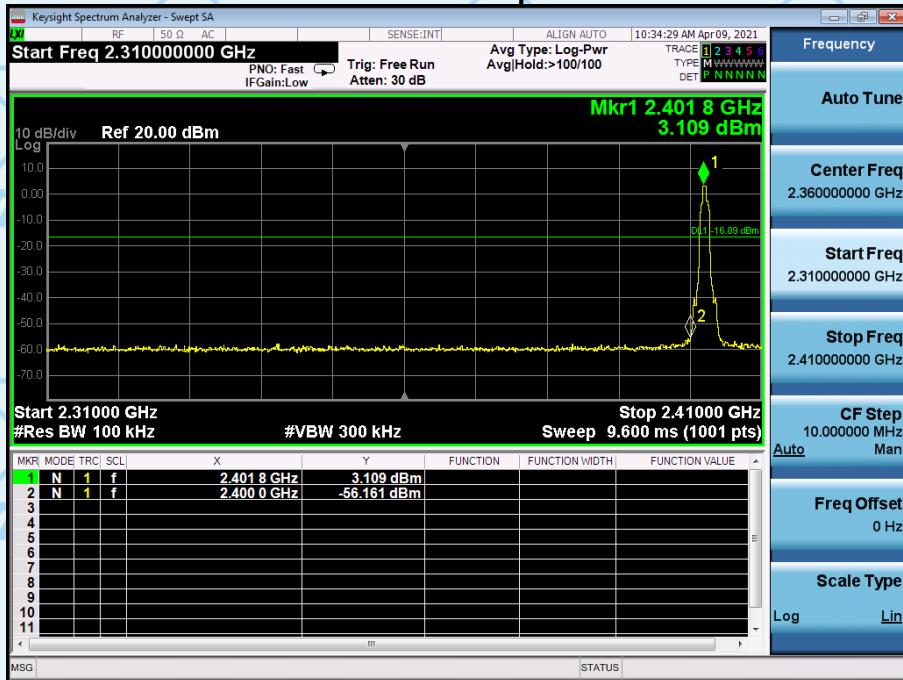


CH78 -1Mbps

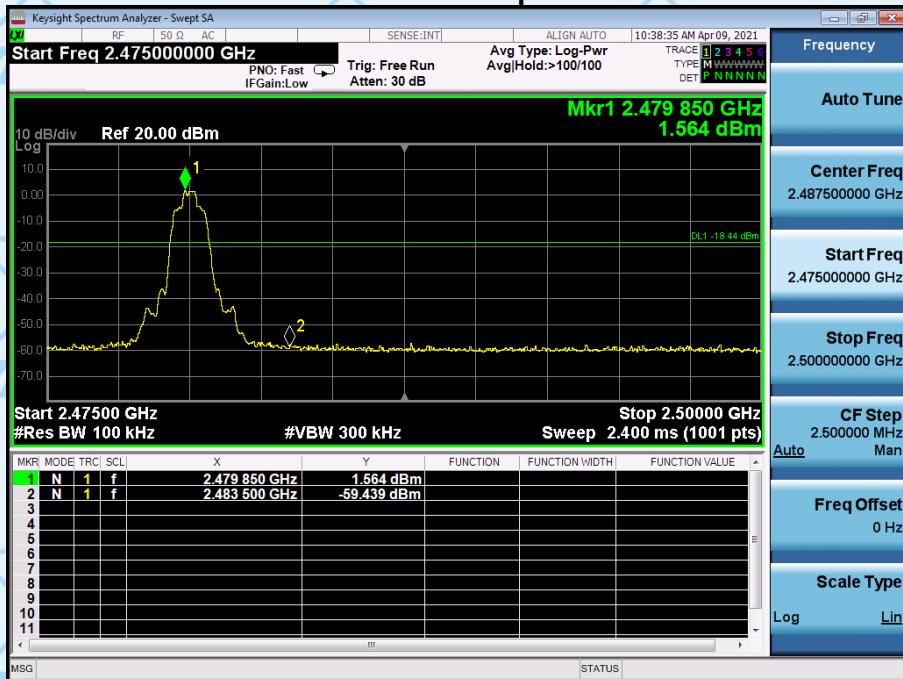




CH00 -2Mbps

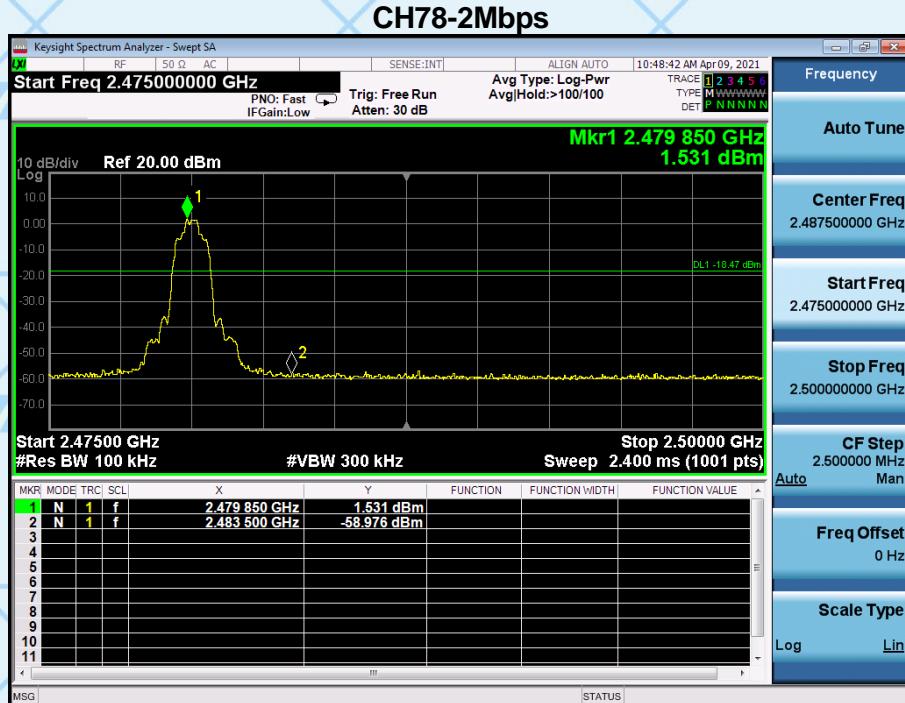
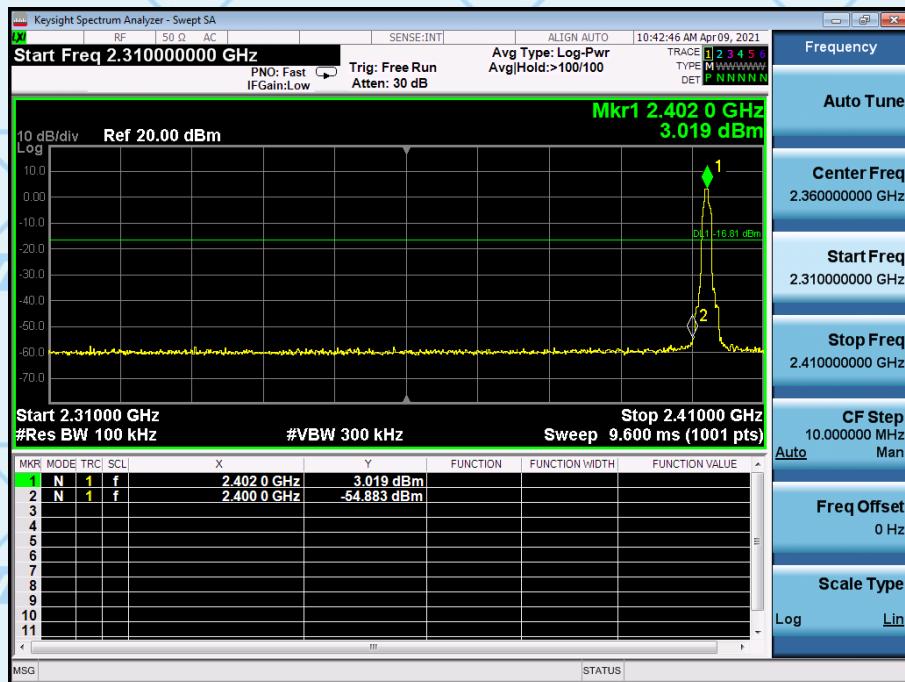


CH78 -2Mbps



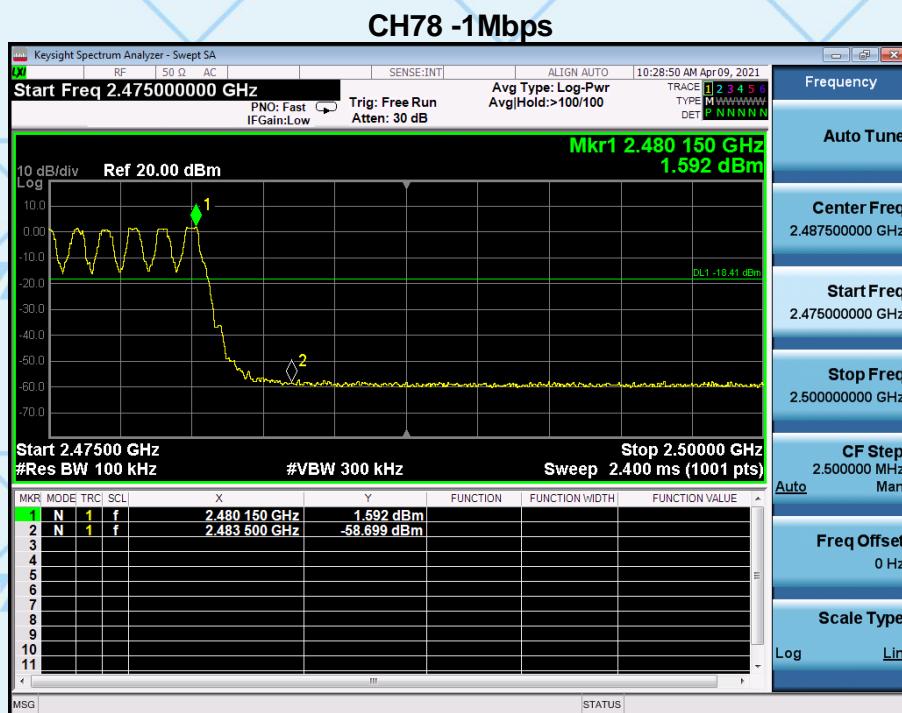
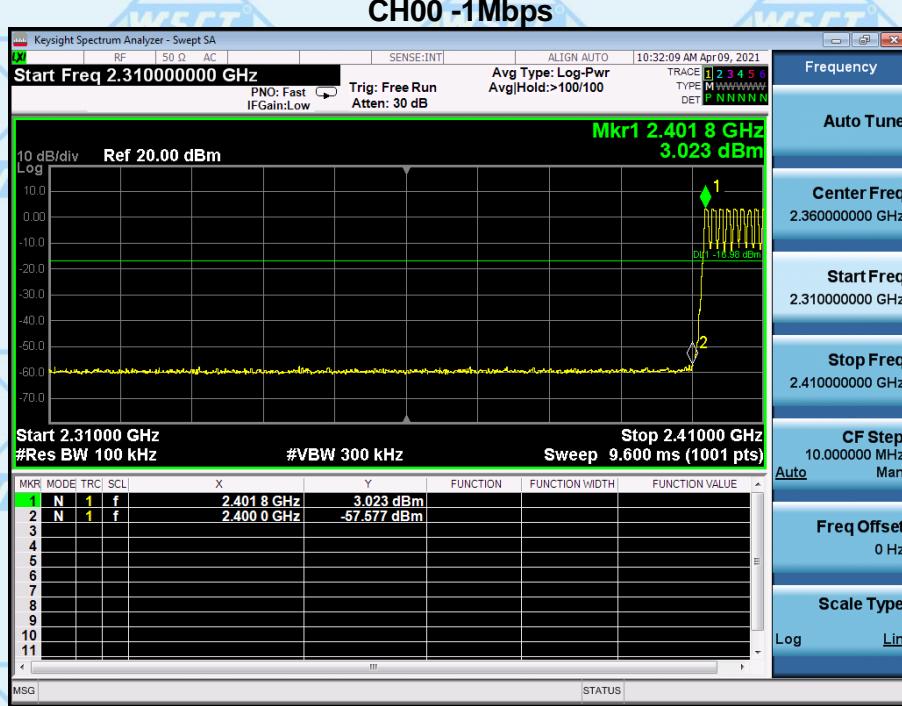
CH00 -3Mbps

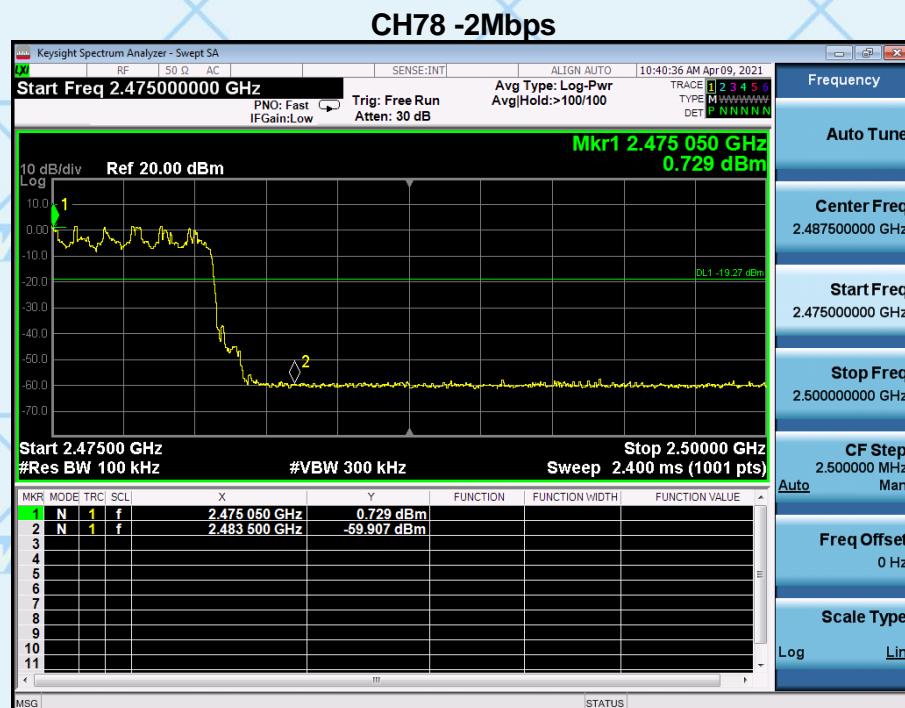
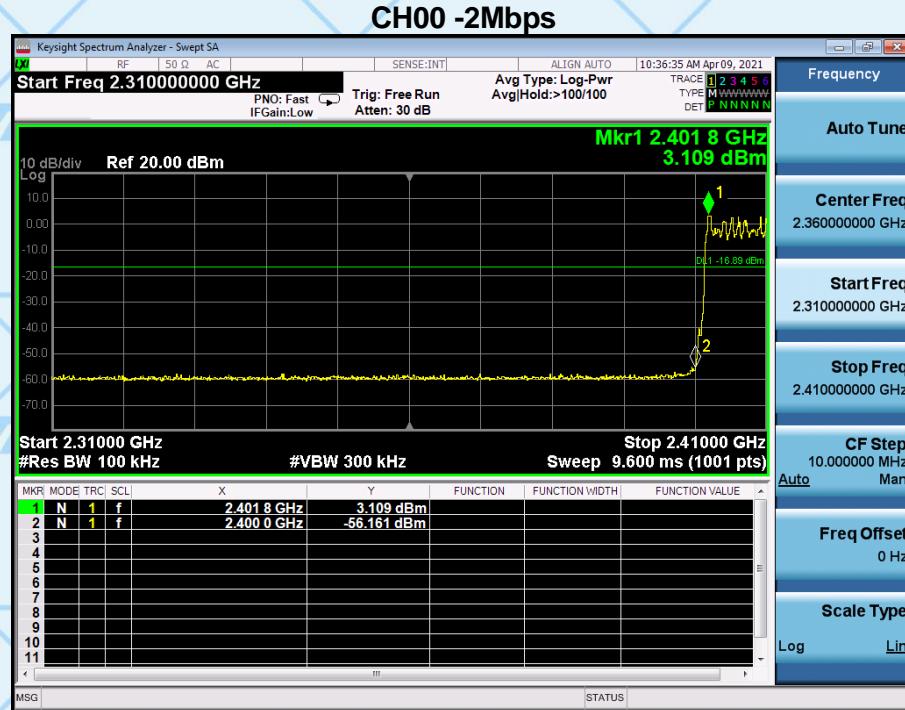






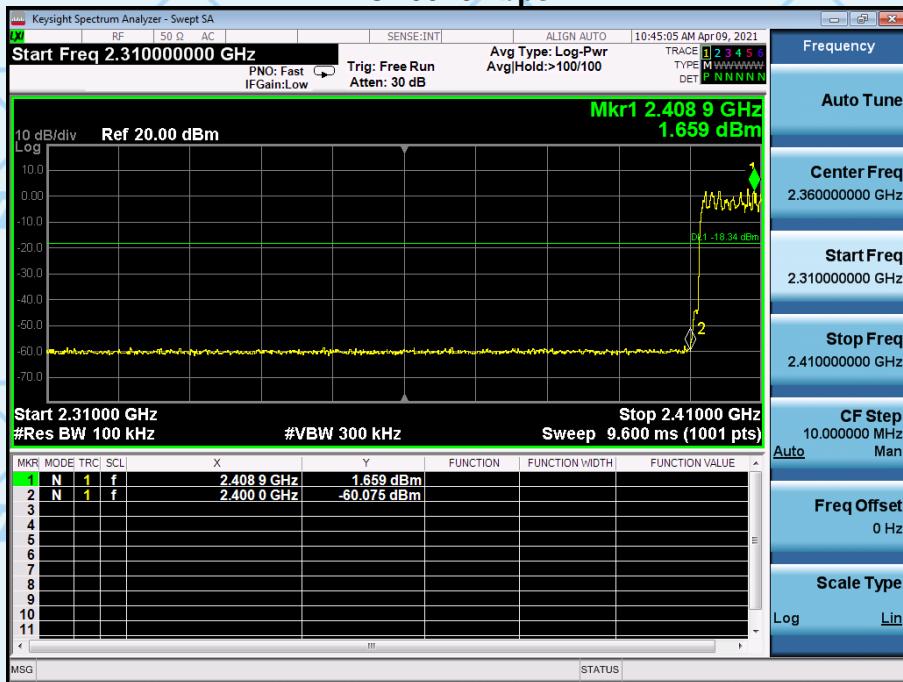
Hopping



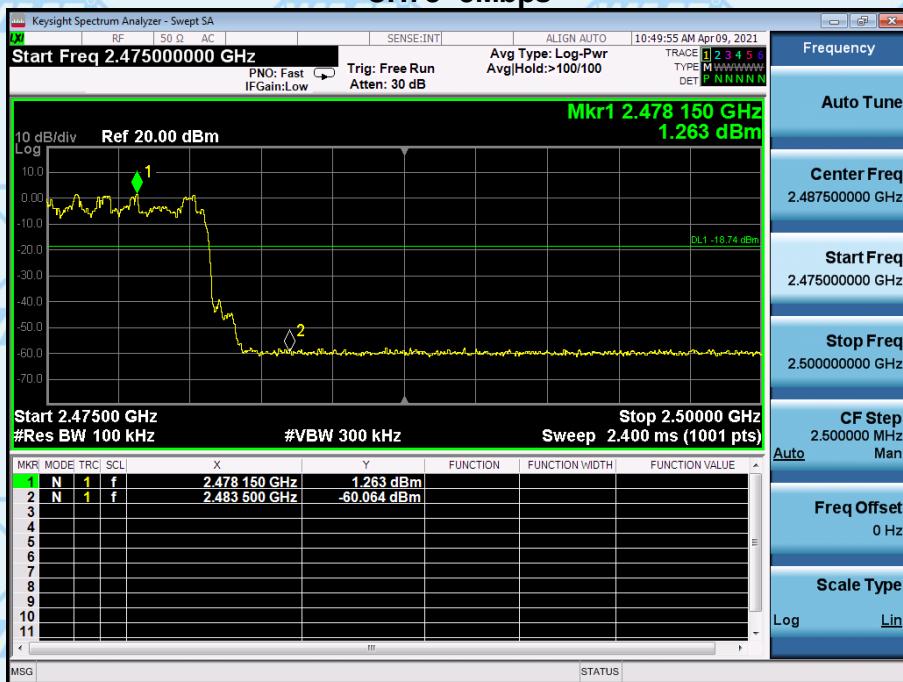




CH00 -3Mbps



CH78 -3Mbps





11. SPURIOUS RF CONDUCTED EMISSION

11.1 TEST LIMIT

1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.
3. For below 30MHz, For 9KHz-150kHz, 150K-10MHz, We use the RBW 1KHz, 10KHz, So the limit need to calculated by "10lg(BW1/BW2)". for example For 9KHz-150kHz, RBW 1KHz, The Limit= the highest emission level-20-10log(100/1)= the highest emission level-40.

11.2 TEST PROCEDURE

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013, For 9KHz-150kHz, Set RBW=1kHz and VBW= 3KHz; For 150KHz-10MHz, Set RBW=10kHz and VBW= 30KHz; For 10MHz-25GHz, Set RBW=100kHz and VBW= 300KHz in order to measure the peak field strength, and mwasure frequeney range from 9KHz to 25GHz.

11.3 TESTSETUP

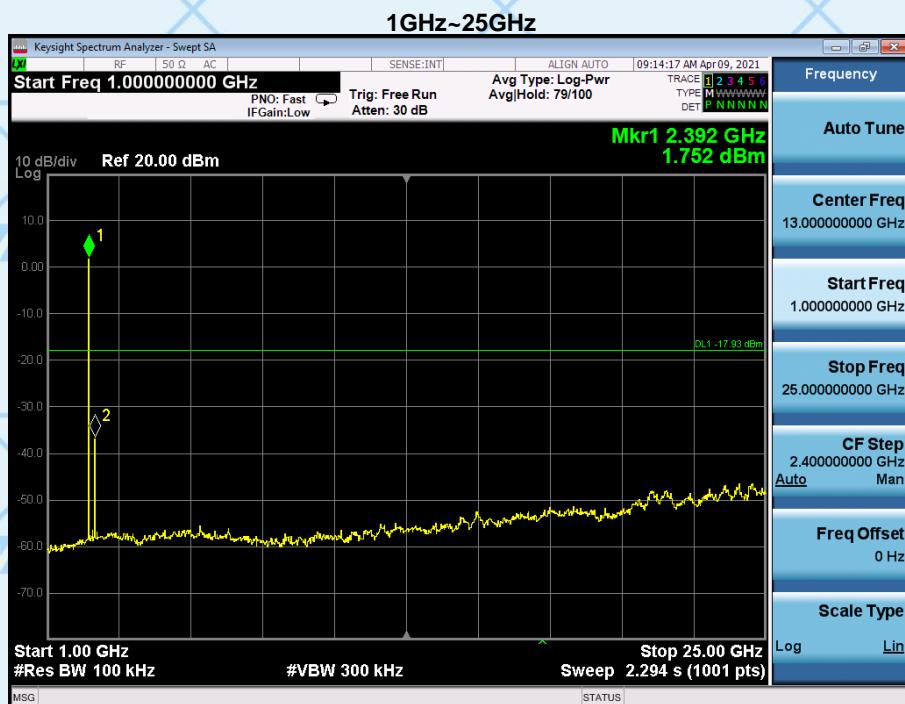
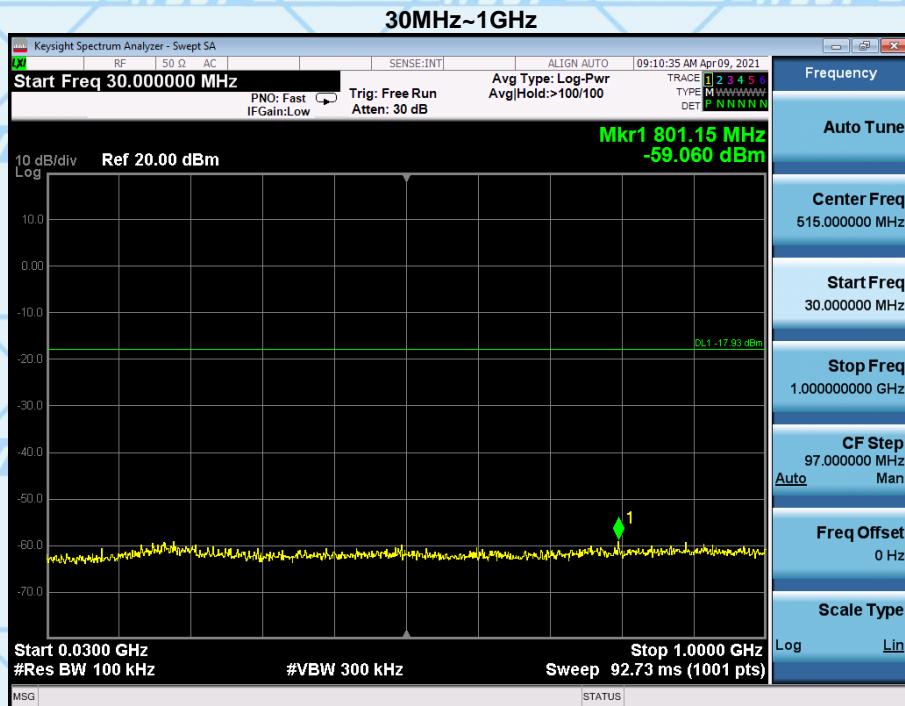


11.4 TEST RESULT

PASS

Remark: All modes of GFSK, $\pi/4$ DQPSK, 8DPSK were tested, only the worst result of GFSK was reported as below:



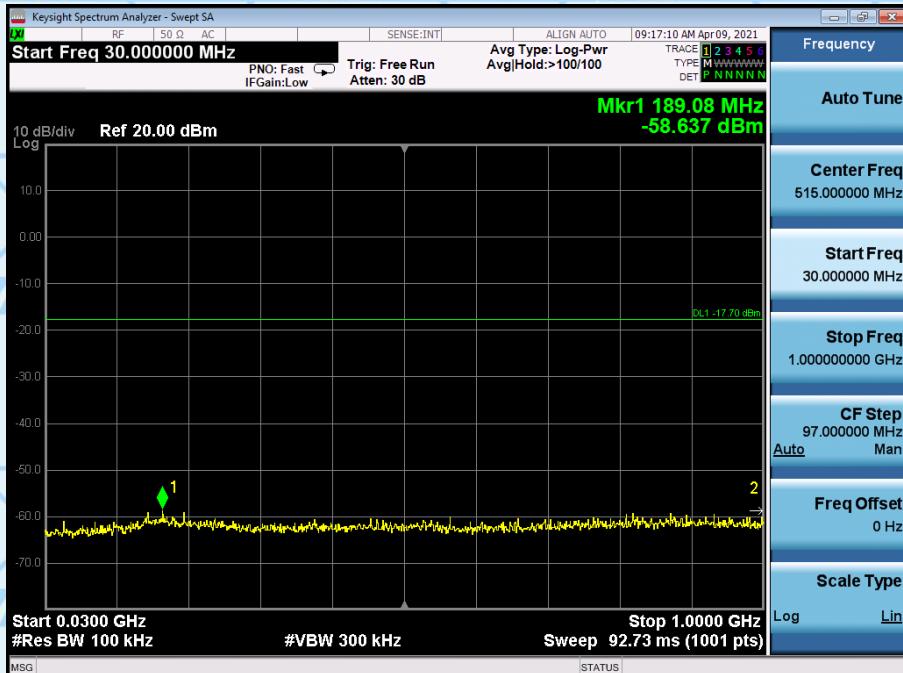


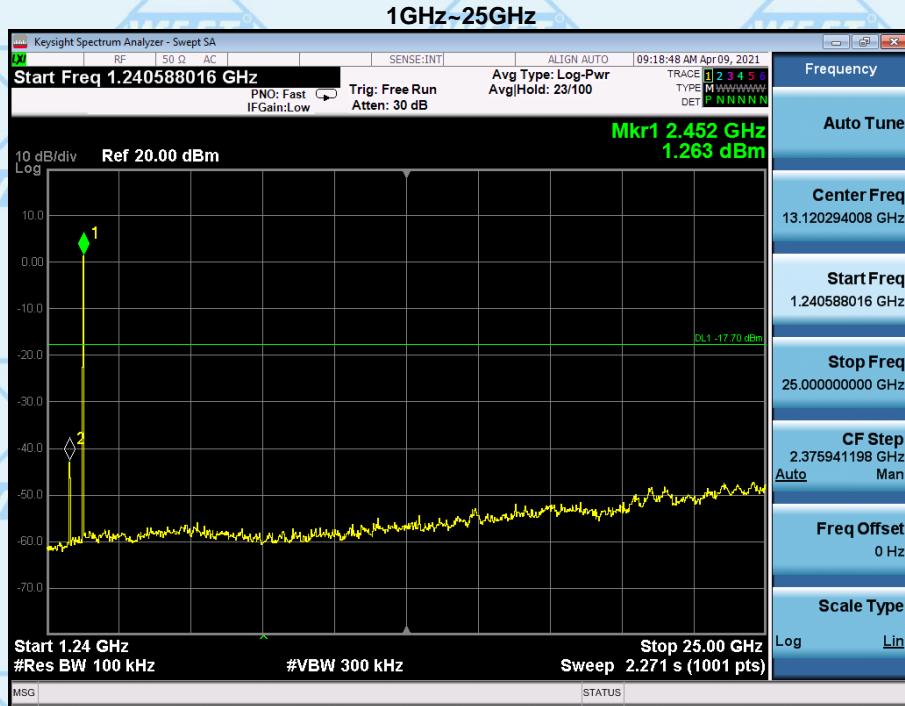


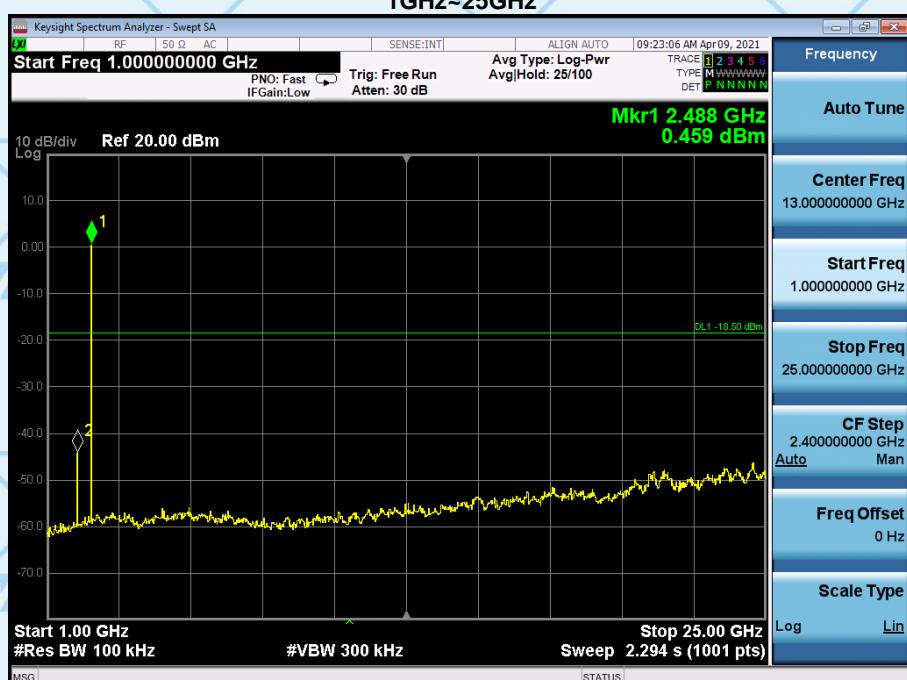
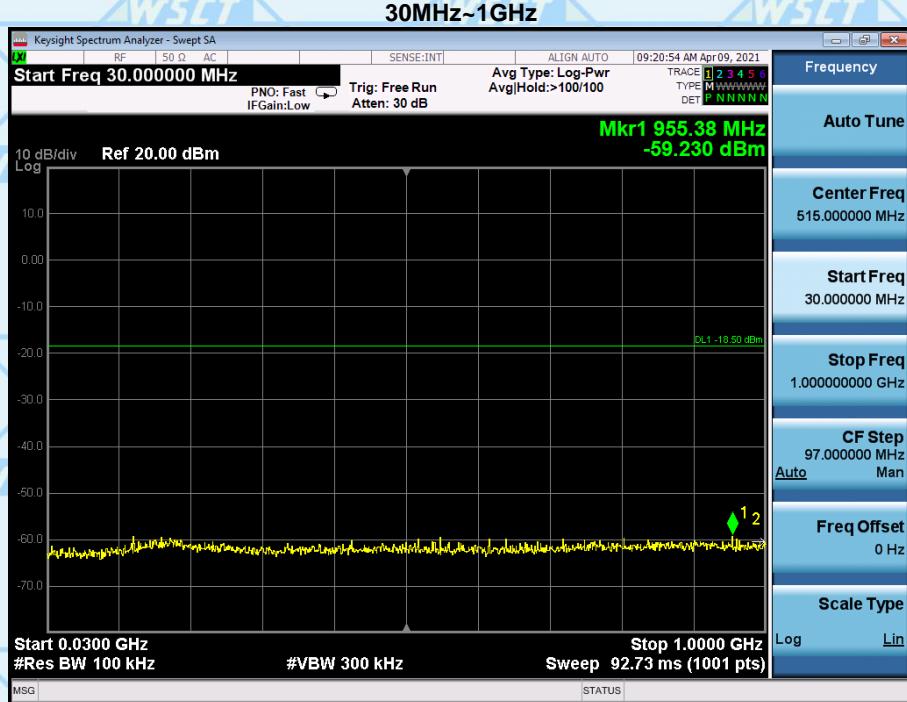
CH39: 2441MHz



30MHz~1GHz









12. ANTENNA APPLICATION

12.1 ANTENNA REQUIREMENT

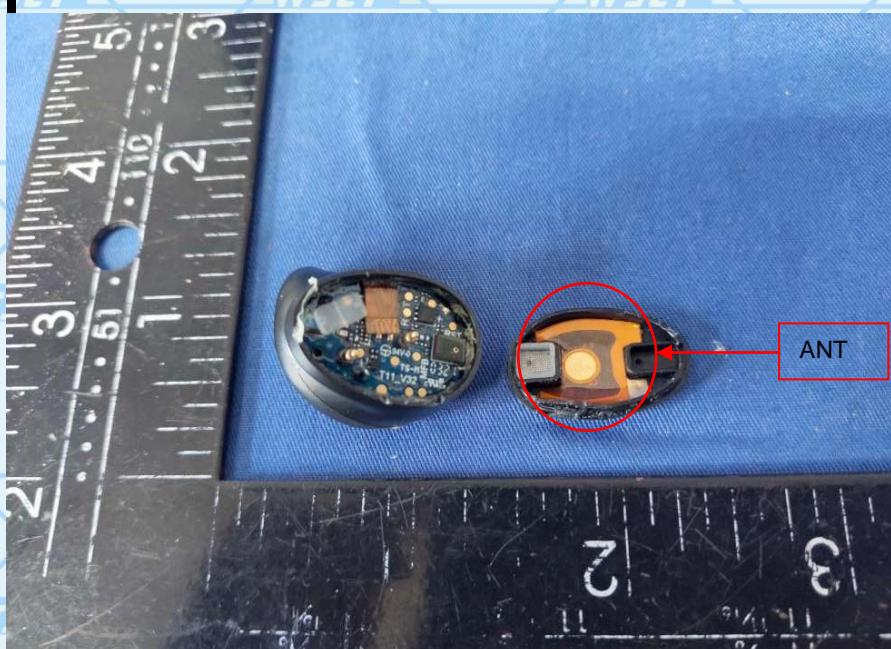
The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247

FCC part 15C section 15.247 requirements: Systems operating in the 2402-2480MHz band that are used exclusively for fixed.

12.2 Result

The EUT's antenna FPC Antenna, The antenna's gain is 2dBi and meets the requirement.

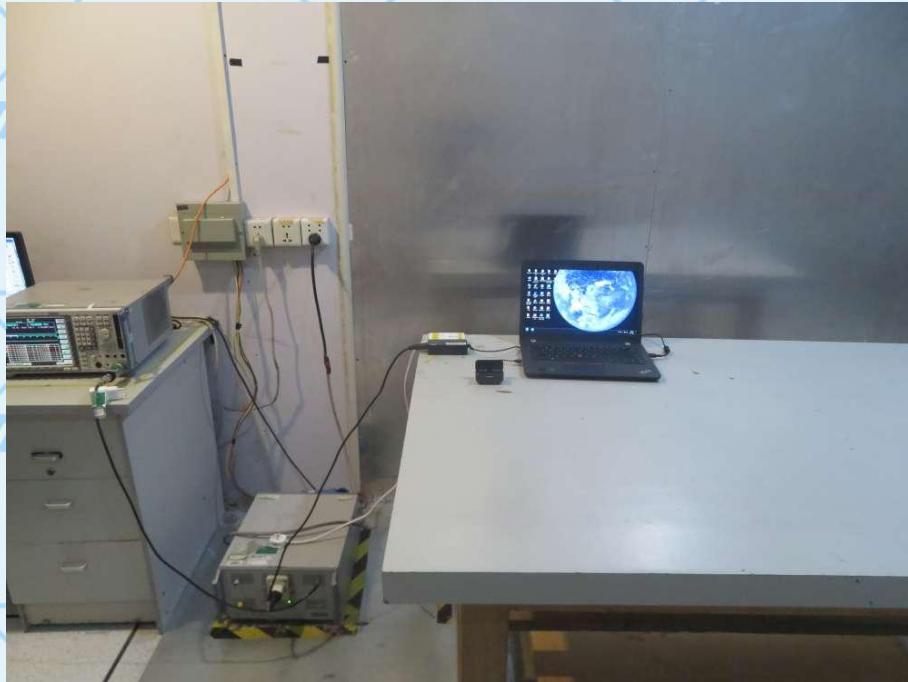
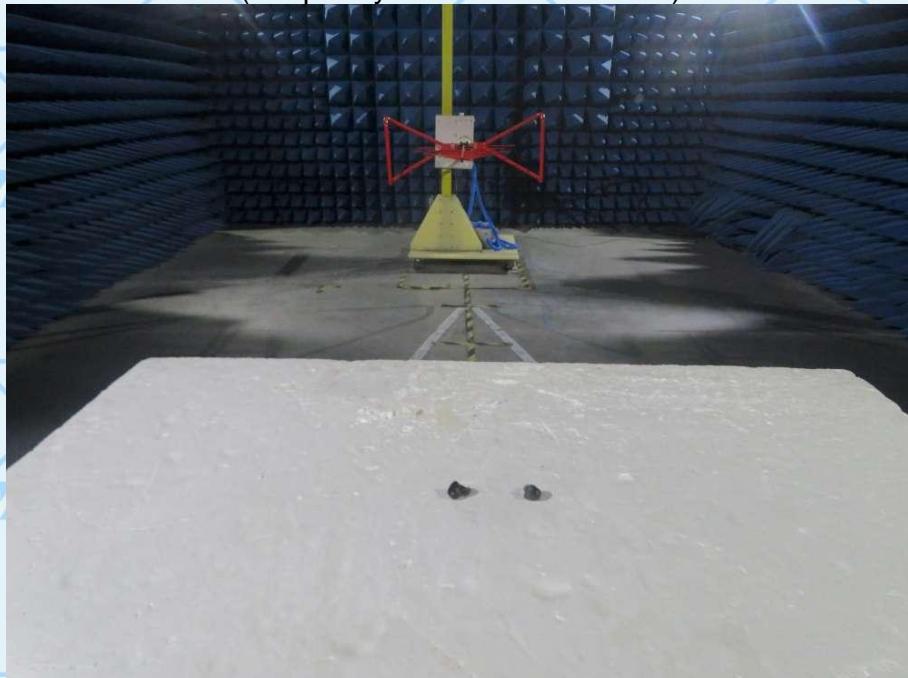
Internal photograph of EUT





13. TEST SETUP PHOTOGRAPHS

CONDUCTED EMISSION TEST

RADIATED EMISSION TEST
(Frequency from 30MHz to 1GHz)

RADIATED EMISSION TEST
(Frequency above 1GHz)