



FCC TEST REPORT

FCC ID:2BKJN-ONCE81

Report Number..... : ZKT-240827L10563E-1

Date of Test..... : July 26, 2024 to Aug. 21, 2024

Date of issue..... : Aug. 21, 2024

Test Result..... : PASS

Testing Laboratory..... : Shenzhen ZKT Technology Co., Ltd.

Address : 1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen, China

Applicant's name : Anhui Haiqing Information Technology Co.,Ltd.

Address : Room 938, Floor 9, Building B2, Phase I, Zhongan Chuanggu Science and Technology Park, No. 900 Wangjiang West Road, High-tech Zone, Hefei City, Anhui Province ,China

Manufacturer's name : Anhui Haiqing Information Technology Co.,Ltd.

Address : Room 938, Floor 9, Building B2, Phase I, Zhongan Chuanggu Science and Technology Park, No. 900 Wangjiang West Road, High-tech Zone, Hefei City, Anhui Province ,China

Test specification:

Standard..... : FCC CFR Title 47 Part 15 Subpart C Section 15.247

Test procedure..... : KDB558074 D01 15.247 Meas Guidance v05r02

Non-standard test method : N/A

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

This report shall not be reproduced except in full, without the written approval of ZKT, this document may be altered or revised by ZKT, personal only, and shall be noted in the revision of the document.

Product name..... : THUNDERBOT KEYBOARD

Trademark : THUNDERBOT

Model/Type reference..... : ONCE81, ONCE81 FIRE SWITCH, ONCE81 FC SWITCH, ONCE81 SD, ONCE81 GL, ONCE81 ES, ONCE81 PT

Model Difference..... : ONCE81 is tested model, other models are derivative models .The models are identical in circuit, only different on the model names. So the test data of ONCE81 can represent the remaining models.

Ratings..... : Input: DC 3.7V or DC 3.7V powered by battery



Testing procedure and testing location:

Testing Laboratory.....: **Shenzhen ZKT Technology Co., Ltd.**

Address.....: 1/F, No. 101, Building B, No. 6, Tangwei Community
Industrial Avenue, Fuhai Street, Bao'an District,
Shenzhen, China

Tested by (name + signature).....:

Jim Liu

Jim Liu

Reviewer (name + signature).....:

Tom Zou

Tom Zou

Approved (name + signature).....:

Lake Xie

Lake Xie



Table of Contents

	Page
1. VERSION	5
2. SUMMARY OF TEST RESULTS	6
2.1 TEST FACILITY	7
2.2 MEASUREMENT UNCERTAINTY	7
3. GENERAL INFORMATION	8
3.1 GENERAL DESCRIPTION OF EUT	8
3.2 DESCRIPTION OF TEST MODES	10
3.3 TEST SETUP CONFIGURATION	10
CONDUCTED EMISSION	10
3.4 DESCRIPTION OF SUPPORT UNITS(CONDUCTED MODE)	11
3.5EQUIPMENTS LIST FOR ALL TEST ITEMS	12
4. EMC EMISSION TEST	14
4.1 CONDUCTED EMISSION MEASUREMENT	14
4.1.1 POWER LINE CONDUCTED EMISSION Limits	14
4.1.2 TEST PROCEDURE	14
4.1.3 DEVIATION FROM TEST STANDARD	14
4.1.4 TEST SETUP	15
4.1.5 EUT OPERATING CONDITIONS	15
4.2 RADIATED EMISSION MEASUREMENT	18
4.2.1 RADIATED EMISSION LIMITS	18
4.2.2 TEST PROCEDURE	18
4.2.3 DEVIATION FROM TEST STANDARD	19
4.2.4 TEST SETUP	19
4.2.5 EUT OPERATING CONDITIONS	20
4.2.6 TEST RESULTS	20
1GHZ~25GHZ	23
5. RADIATED BAND EMISSIONMEASUREMENT	25
5.1 TEST REQUIREMENT:	25
5.2 TEST PROCEDURE	25
5.3 DEVIATION FROM TEST STANDARD	25
5.4 TEST SETUP	26
5.5 EUT OPERATING CONDITIONS	26
5.6 TEST RESULT	27
6. POWER SPECTRAL DENSITY TEST	28
6.1 APPLIED PROCEDURES / LIMIT	28
6.2 TEST PROCEDURE	28
6.3 DEVIATION FROM STANDARD	28



6.4 TEST SETUP	28
6.5 EUT OPERATION CONDITIONS	29
6.6 TEST RESULT	29
7. CHANNEL BANDWIDTH	30
7.1 APPLIED PROCEDURES / LIMIT	30
7.2 TEST PROCEDURE	30
7.3 DEVIATION FROM STANDARD	30
7.4 TEST SETUP	30
7.5 EUT OPERATION CONDITIONS	30
7.6 TEST RESULT	31
8. PEAK OUTPUT POWER TEST	32
8.1 APPLIED PROCEDURES/LIMIT	32
8.2 TEST PROCEDURE	32
8.3 DEVIATION FROM STANDARD	32
8.4 TEST SETUP	32
8.5 EUT OPERATION CONDITIONS	32
8.6 TEST RESULT	32
9. CONDUCTED BAND EDGE AND SPURIOUS EMISSION	33
9.1 APPLICABLE STANDARD	33
9.2 TEST PROCEDURE	33
9.3 DEVIATION FROM STANDARD	33
9.4 TEST SETUP	33
9.5 EUT OPERATION CONDITIONS	33
9.6 TEST RESULTS	33
10. ANTENNA REQUIREMENT	34
11. APPENDIX A	35
11.1 DUTY CYCLE	35
11.2 MAXIMUM AVERAGE CONDUCTED OUTPUT POWER	37
11.3 MAXIMUM PEAK CONDUCTED OUTPUT POWER	39
11.4 -6DB BANDWIDTH	41
11.5 OCCUPIED CHANNEL BANDWIDTH	43
11.6 MAXIMUM POWER SPECTRAL DENSITY LEVEL	45
11.7 BAND EDGE	47
11.8 CONDUCTED RF SPURIOUS EMISSION	49
12. TEST SETUP PHOTO	52
13. EUT CONSTRUCTIONAL DETAILS	52



1. VERSION

Report No.	Version	Description	Approved
ZKT-240827L10563E-1	Rev.01	Initial issue of report	Aug. 21, 2024



2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part15 (15.247) , Subpart C			
Standard Section	Test Item	Result	Remark
FCC part 15.203/15.247 (b)(4)	Antenna requirement	PASS	
FCC part 15.207	AC Power Line Conducted Emission	PASS	
FCC part 15.247 (b)(3)	Conducted Output Power	PASS	
FCC part 15.247 (a)(2)	Channel Bandwidth	PASS	
FCC part 15.247 (e)	Power Spectral Density	PASS	
FCC part 15.247(d)	Band Edge	PASS	
FCC part 15.205/15.209	Spurious Emission	PASS	

NOTE:

(1) "N/A" denotes test is not applicable in this Test Report



2.1 TEST FACILITY

Shenzhen ZKT Technology Co., Ltd.

Add. : 1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen, China

FCC Test Firm Registration Number: 692225

Designation Number: CN1299

IC Registered No.: 27033

2.2 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	$\pm 1.38\text{dB}$
2	RF conducted power	$\pm 0.16\text{dB}$
3	Conducted spurious emissions	$\pm 0.21\text{dB}$
4	All radiated emissions (9k-30MHz)	$\pm 4.68\text{dB}$
5	All radiated emissions (<1G)	$\pm 4.68\text{dB}$
6	All radiated emissions (>1G)	$\pm 4.89\text{dB}$
7	Temperature	$\pm 0.5^{\circ}\text{C}$
8	Humidity	$\pm 2\%$
9	Occupied Bandwidth	$\pm 4.96\%$



3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Product Name:	THUNDERBOT KEYBOARD
Test Model No.:	ONCE81
Hardware Version:	V1.0
Software Version:	V1.0
Sample(s) Status:	Engineer sample
Operation Frequency:	2402MHz~2479MHz
Channel Numbers:	78
Channel Separation:	1MHz
Modulation Type:	GFSK
Antenna Type:	PCB Antenna
Antenna gain:	1.58dBi



Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402MHz	21	2422MHz	41	2442MHz	61	2462MHz
2	2403MHz	22	2423MHz	42	2443MHz	62	2463MHz
3	2404MHz	23	2424MHz	43	2444MHz	63	2464MHz
4	2405MHz	24	2425MHz	44	2445MHz	64	2465MHz
5	2406MHz	25	2426MHz	45	2446MHz	65	2466MHz
6	2407MHz	26	2427MHz	46	2447MHz	66	2467MHz
7	2408MHz	27	2428MHz	47	2448MHz	67	2468MHz
8	2409MHz	28	2429MHz	48	2449MHz	68	2469MHz
9	2410MHz	29	2430MHz	49	2450MHz	69	2470MHz
10	2411MHz	30	2431MHz	50	2451MHz	70	2471MHz
11	2412MHz	31	2432MHz	51	2452MHz	71	2472MHz
12	2413MHz	32	2433MHz	52	2453MHz	72	2473MHz
13	2414MHz	33	2434MHz	53	2454MHz	73	2474MHz
14	2415MHz	34	2435MHz	54	2455MHz	74	2475MHz
15	2416MHz	35	2436MHz	55	2456MHz	75	2476MHz
16	2417MHz	36	2437MHz	56	2457MHz	76	2477MHz
17	2418MHz	37	2438MHz	57	2458MHz	77	2478MHz
18	2419MHz	38	2439MHz	58	2459MHz	78	2479MHz
19	2420MHz	39	2440MHz	59	2460MHz		
20	2421MHz	40	2441MHz	60	2461MHz		

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The lowest channel	2402MHz
The middle channel	2440MHz
The Highest channel	2479MHz

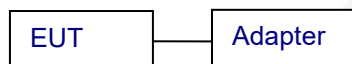


3.2 DESCRIPTION OF TEST MODES

Transmitting mode	Keep the EUT in continuously transmitting mode
Remark: EUT use new battery during the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.	

3.3 TEST SETUP CONFIGURATION

Conducted Emission



Radiated Emission





3.4 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
E-1	Adapter	N/A	HW-059200CHQ	N/A	AE

Item	Shielded Type	Ferrite Core	Length	Note

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.



3.5EQUIPMENTS LIST FOR ALL TEST ITEMS

Radiation Test equipment

Item	Equipment	Manufacturer	Type No.	Serial No.	Firmware Version	Last calibration	Calibrated until
1	Spectrum Analyzer (9kHz-26.5GHz)	KEYSIGHT	9020A	MY55370835	A.17.05	Nov. 02, 2023	Nov. 01, 2024
2	Spectrum Analyzer (10kHz-39.9GHz)	R&S	FSV40-N	100363	1.71 SP2	Nov. 02, 2023	Nov. 01, 2024
3	EMI Test Receiver (9kHz-7GHz)	R&S	ESCI7	100969	4.32	Nov. 02, 2023	Nov. 01, 2024
4	Bilog Antenna (30MHz-1500MHz)	Schwarzbeck	VULB9168	N/A	N/A	Nov. 13, 2023	Nov. 12, 2024
5	Horn Antenna (1GHz-18GHz)	Agilent	AH-118	071145	N/A	Nov. 13, 2023	Nov. 12, 2024
6	Horn Antenna (15GHz-40GHz)	A.H.System	SAS-574	588	N/A	Nov. 13, 2023	Nov. 12, 2024
7	Loop Antenna	TESEQ	HLA6121	58357	N/A	Nov. 16, 2023	Nov. 15, 2024
8	Amplifier (30-1000MHz)	EM Electronics	EM330 Amplifier	60747	N/A	Nov. 02, 2023	Nov. 01, 2024
9	Amplifier (1GHz-26.5GHz)	HuiPu	8449B	3008A00315	N/A	Nov. 02, 2023	Nov. 01, 2024
10	Amplifier (500MHz-40GHz)	QuanJuDa	DLE-161	097	N/A	Nov. 02, 2023	Nov. 01, 2024
11	Test Cable	N/A	R-01	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
12	Test Cable	N/A	R-02	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
13	Test Cable	N/A	R-03	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
14	Test Cable	N/A	RF-01	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
15	Test Cable	N/A	RF-02	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
16	Test Cable	N/A	RF-03	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
17	ESG Signal Generator	Agilent	E4421B	N/A	B.03.84	Nov. 02, 2023	Nov. 01, 2024
18	Signal Generator	Agilent	N5182A	N/A	A.01.87	Nov. 02, 2023	Nov. 01, 2024
19	Magnetic Field Probe Tester	Narda	ELT-400	0-0344	N/A	Nov. 16, 2023	Nov. 15, 2024
20	Wideband Radio Communication Test	R&S	CMW500	106504	V 3.7.22	Nov. 02, 2023	Nov. 01, 2024
21	MWRF Power Meter Test system	MW	MW100-RF CB	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
22	D.C. Power Supply	LongWei	TPR-6405D	N/A	N/A	\	\
23	EMC Software	Frad	EZ-EMC	Ver.EMC-CO N 3A1.1	N/A	\	\
24	RF Software	MW	MTS8310	V2.0.0.0	N/A	\	\
25	Turntable	MF	MF-7802BS	N/A	N/A	\	\
26	Antenna tower	MF	MF-7802BS	N/A	N/A	\	\



Conduction Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Firmware Version	Last calibration	Calibrated until
1	LISN	R&S	ENV216	101471	N/A	Nov. 14, 2023	Nov. 13, 2024
2	LISN	CYBERTEK	EM5040A	E1850400149	N/A	Nov. 02, 2023	Nov. 01, 2024
3	Test Cable	N/A	C-01	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
4	Test Cable	N/A	C-02	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
5	Test Cable	N/A	C-03	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
6	EMI Test Receiver	R&S	ESCI3	101393	4.42 SP3	Nov. 02, 2023	Nov. 01, 2024
7	Triple-Loop Antenna	N/A	RF300	N/A	N/A	Nov. 02, 2023	Nov. 01, 2024
8	Absorbing Clamp	DZ	ZN23201	15034	N/A	Nov. 07, 2023	Nov. 06, 2024
9	EMC Software	Frad	EZ-EMC	Ver.EMC-CON 3A1.1	N/A	\	\



4. EMC EMISSION TEST

4.1 CONDUCTED EMISSION MEASUREMENT

Test Requirement:	FCC Part15 C Section 15.207
Test Method:	ANSI C63.10:2013
Test Frequency Range:	150KHz to 30MHz
Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto

4.1.1 POWER LINE CONDUCTED EMISSION Limits

FREQUENCY (MHz)	Limit (dBuV)		Standard
	Quasi-peak	Average	
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) *Decreases with the logarithm of the frequency.

4.1.2 TEST PROCEDURE

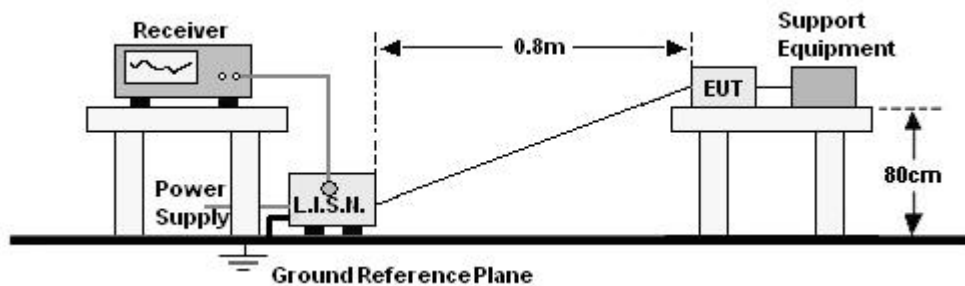
- The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- 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



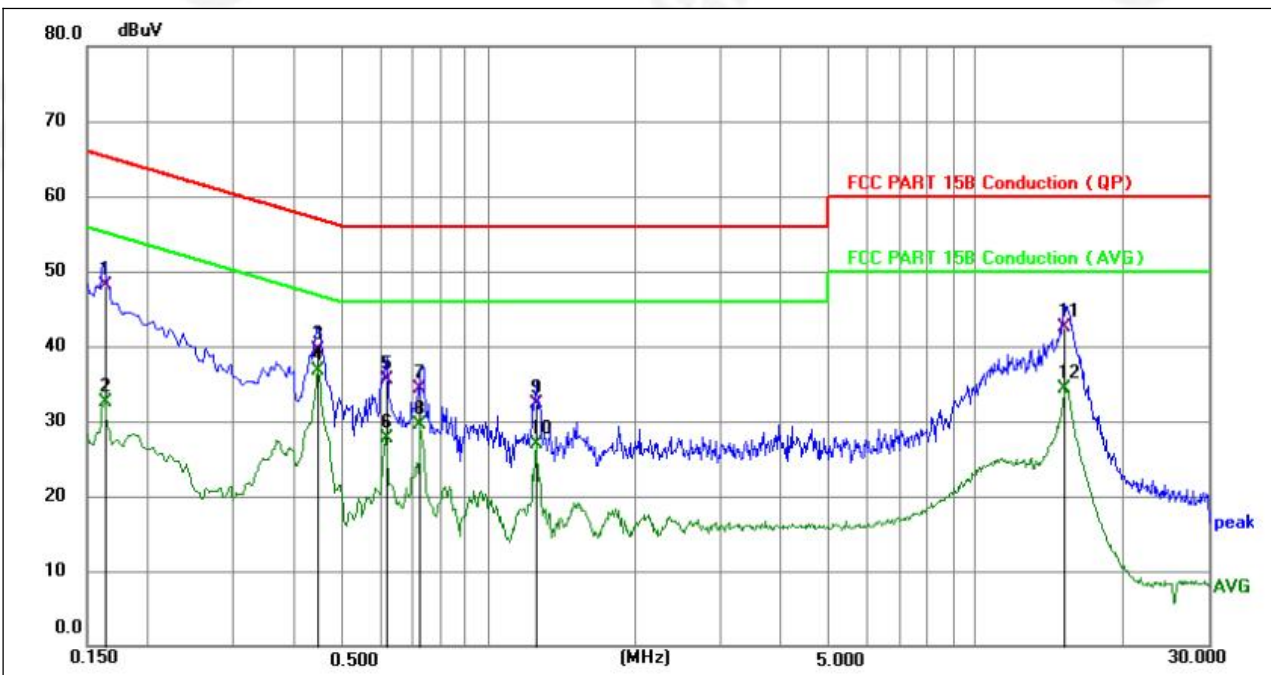
4.1.5 EUT OPERATING CONDITIONS

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 result

Temperature:	24.3℃	Relative Humidity :	50%
Pressure:	101kPa	Phase :	L
Test Voltage:	AC 120V/60Hz		



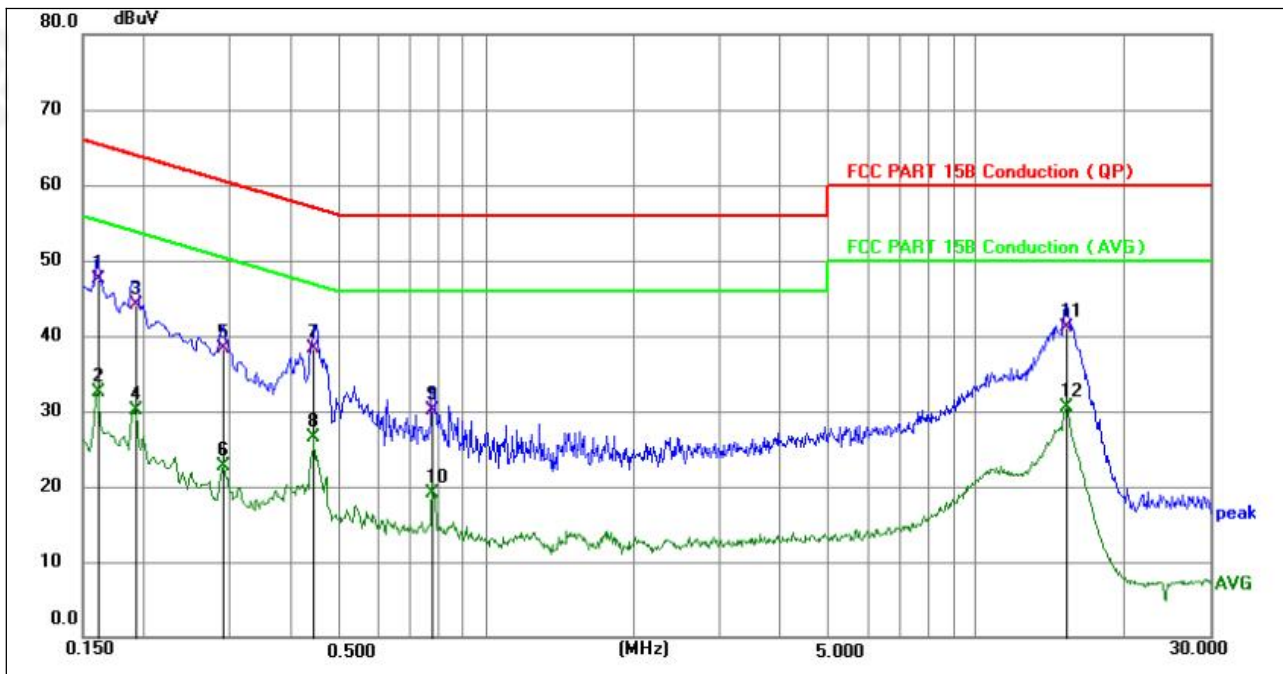
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1632	38.20	9.90	48.10	65.30	-17.20	QP	P	
2	0.1632	22.51	9.90	32.41	55.30	-22.89	AVG	P	
3	0.4470	29.50	10.00	39.50	56.93	-17.43	QP	P	
4 *	0.4470	26.75	10.00	36.75	46.93	-10.18	AVG	P	
5	0.6180	25.57	10.03	35.60	56.00	-20.40	QP	P	
6	0.6180	17.65	10.03	27.68	46.00	-18.32	AVG	P	
7	0.7304	24.26	10.04	34.30	56.00	-21.70	QP	P	
8	0.7304	19.49	10.04	29.53	46.00	-16.47	AVG	P	
9	1.2570	22.34	10.06	32.40	56.00	-23.60	QP	P	
10	1.2570	16.90	10.06	26.96	46.00	-19.04	AVG	P	
11	15.2025	32.40	10.10	42.50	60.00	-17.50	QP	P	
12	15.2025	24.11	10.10	34.21	50.00	-15.79	AVG	P	

Notes:

- 1.An initial pre-scan was performed on the line and neutral lines with peak detector.
- 2.Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
- 3.Measurement Level = Reading level + Correct Factor
- 4.The test data shows only the worst case GFSK mode (Middle Channel:2440MHz).



Temperature:	24.3℃	Relative Humidity :	50%
Pressure:	101kPa	Phase :	N
Test Voltage:	AC 120V/60Hz		



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1 *	0.1615	37.61	9.89	47.50	65.39	-17.89	QP	P	
2	0.1615	22.52	9.89	32.41	55.39	-22.98	AVG	P	
3	0.1922	34.29	9.91	44.20	63.94	-19.74	QP	P	
4	0.1922	20.14	9.91	30.05	53.94	-23.89	AVG	P	
5	0.2893	28.35	9.95	38.30	60.54	-22.24	QP	P	
6	0.2893	12.81	9.95	22.76	50.54	-27.78	AVG	P	
7	0.4425	28.40	10.00	38.40	57.01	-18.61	QP	P	
8	0.4425	16.59	10.00	26.59	47.01	-20.42	AVG	P	
9	0.7752	20.16	10.04	30.20	56.00	-25.80	QP	P	
10	0.7752	9.04	10.04	19.08	46.00	-26.92	AVG	P	
11	15.3420	31.10	10.10	41.20	60.00	-18.80	QP	P	
12	15.3420	20.48	10.10	30.58	50.00	-19.42	AVG	P	

Notes:

- 1.An initial pre-scan was performed on the line and neutral lines with peak detector.
- 2.Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
- 3.Measurement Level = Reading level + Correct Factor
- 4.The test data shows only the worst case GFSK mode (Middle Channel:2440MHz).



4.2 RADIATED EMISSION MEASUREMENT

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	9kHz to 25GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average

4.2.1 RADIATED EMISSION LIMITS

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

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).

4.2.2 TEST PROCEDURE

Below 1GHz test procedure as below:

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of variable-height antenna tower.



- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dBmargin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Above 1GHz test procedure as below:

- g. Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).
- h. Test the EUT in the lowest channel ,the middle channel ,the Highest channel

Note:

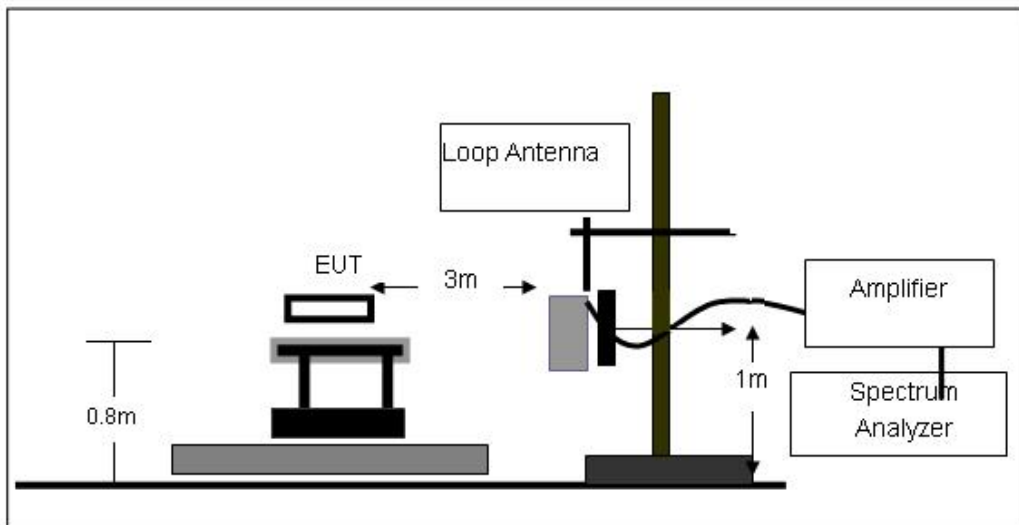
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

4.2.3 DEVIATION FROM TEST STANDARD

No deviation

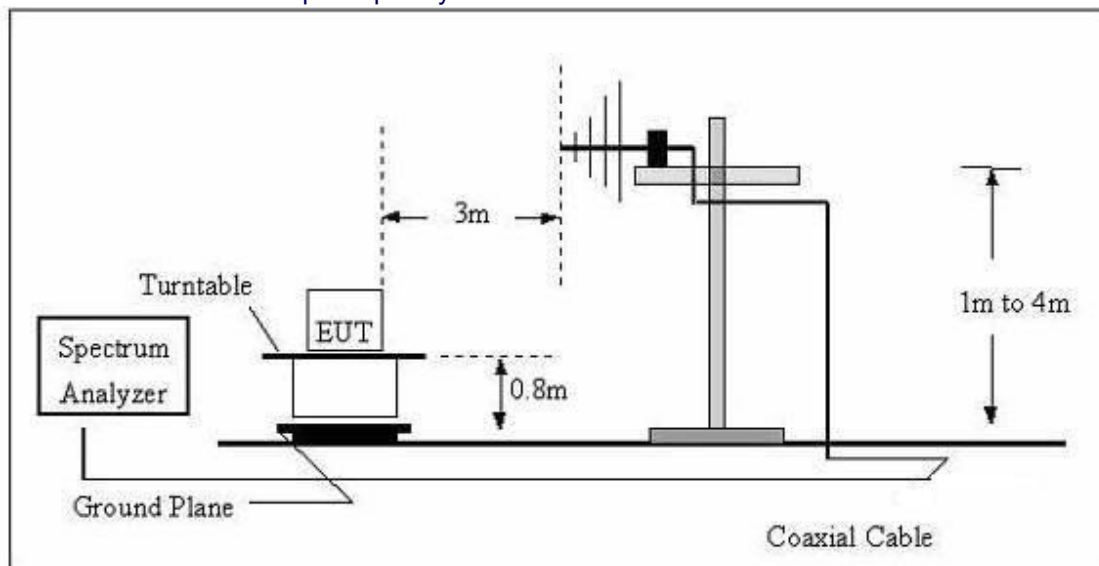
4.2.4 TEST SETUP

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

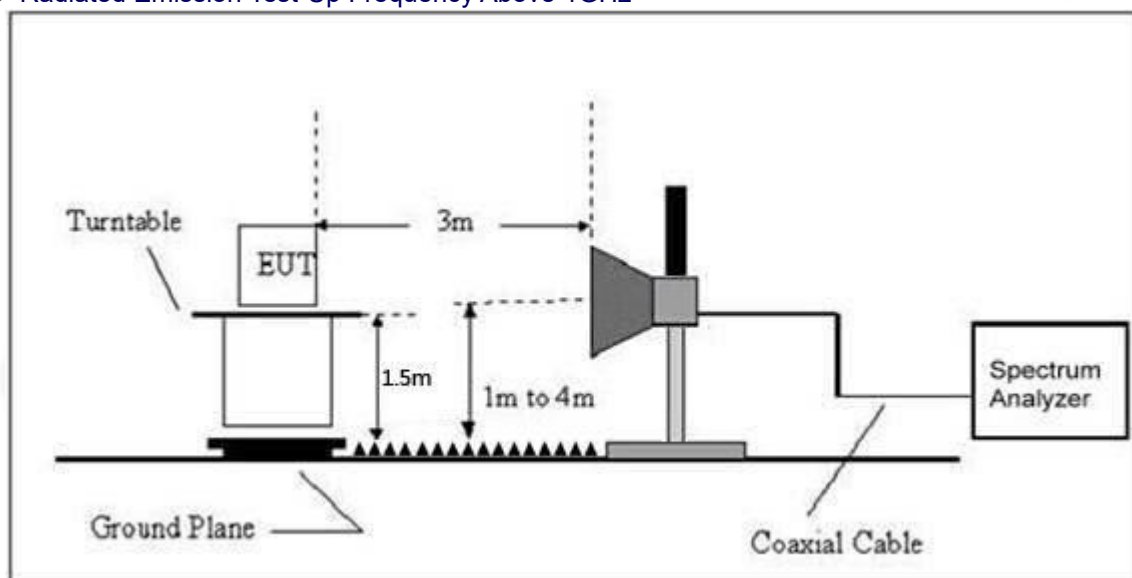




(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(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.

4.2.6 TEST RESULTS

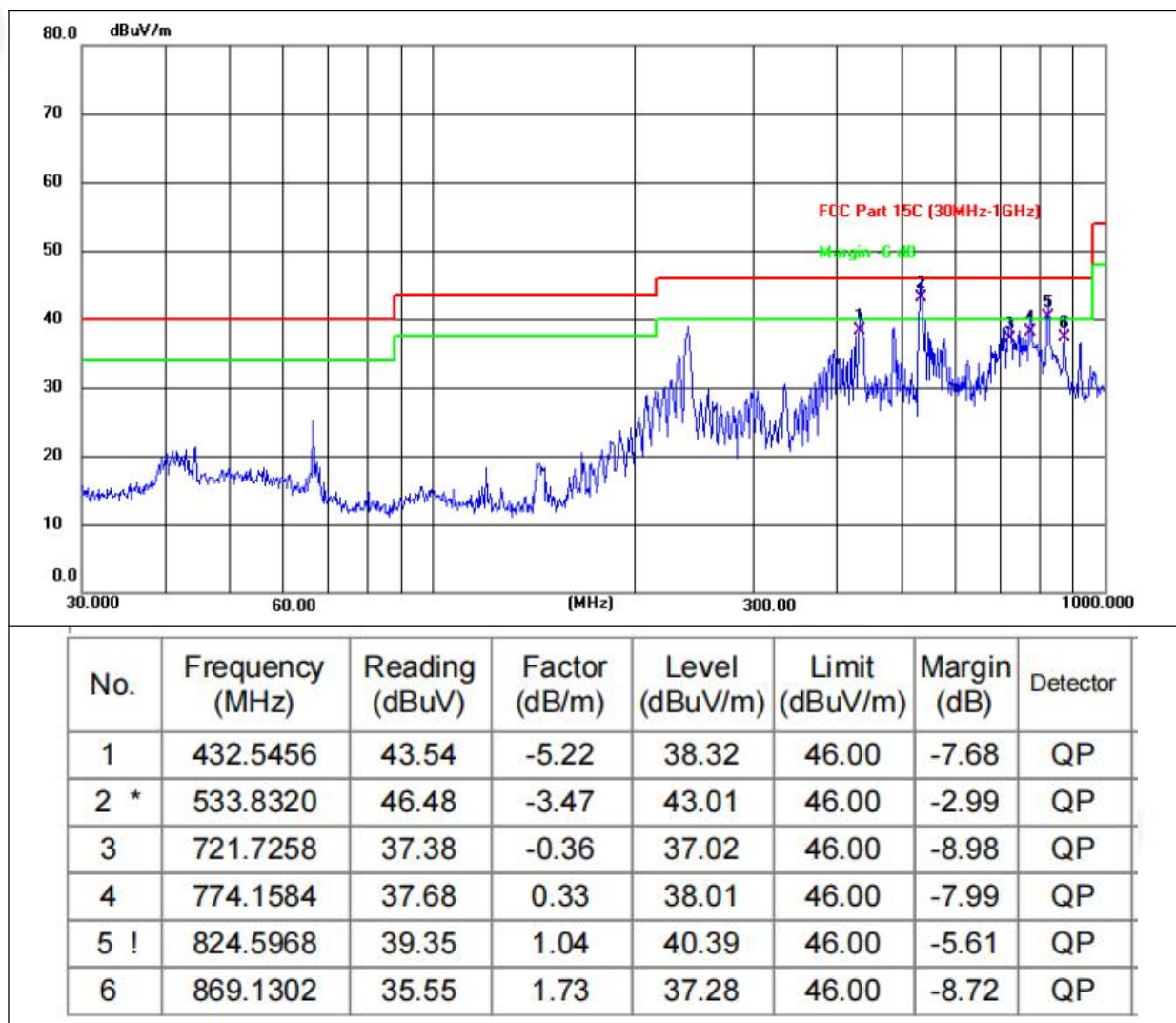
Between 9KHz – 30MHz

The emission from 9 kHz to 30MHz was pre-tested and found the result was 20dB lower than the limit, and according to 15.31(o) & RSS-Gen 6.13, the test result no need to reported.



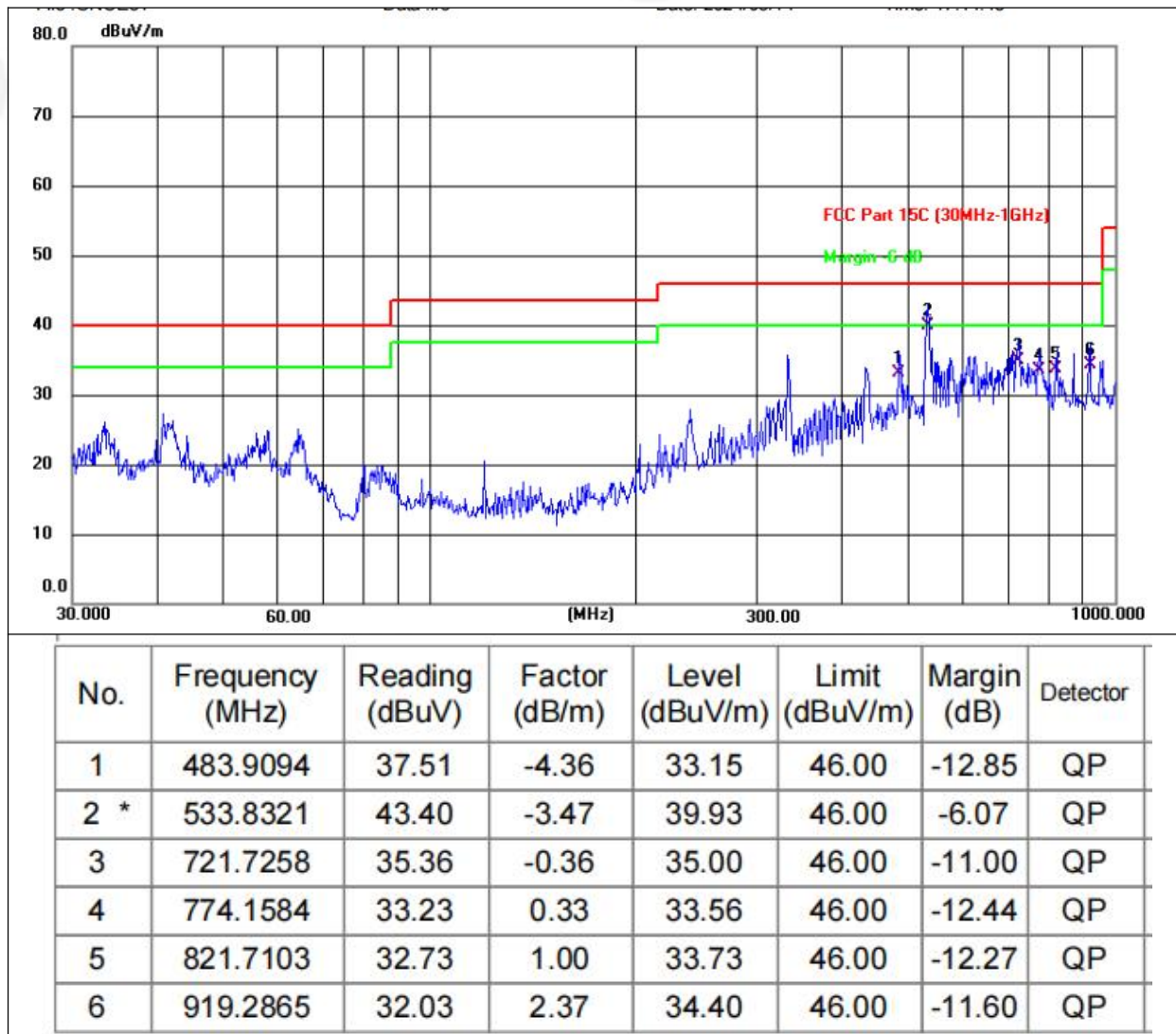
Between 30MHz – 1GHz

Temperature :	25.1℃	Relative Humidity :	50%
Pressure :	101kPa	Polarization :	Horizontal
Test Voltage :	DC 3.7V		





Temperature :	25.1℃	Relative Humidity :	50%
Pressure :	101kPa	Polarization :	Vertical
Test Voltage :	DC 3.7V		



Remarks:

- 1.Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
- 2.The emission levels of other frequencies are very lower than the limit and not show in test report.
- 3.The test data shows only the worst case GFSK mode (Middle Channel:2440MHz).



1GHz~25GHz

Polar (H/V)	Frequency	Meter Reading	Pre-ampli fier	Cable Loss	Antenna Factor	Emission Level	Limits	Margin	Detector Type
	(MHz)	(dBuV)	(dB)	(dB)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Low Channel:2402MHz									
V	4804.00	58.92	30.55	5.77	24.66	58.8	74	-15.2	Pk
V	4804.00	44.17	30.55	5.77	24.66	44.05	54	-9.95	AV
V	7206.00	56	30.33	6.32	24.55	56.54	74	-17.46	Pk
V	7206.00	41.84	30.33	6.32	24.55	42.38	54	-11.62	AV
V	9608.00	59.72	30.55	5.77	24.66	59.6	74	-14.4	Pk
V	9608.00	41.75	30.55	5.77	24.66	41.63	54	-12.37	AV
V	12010.00	59.95	30.33	6.32	24.55	60.49	74	-13.51	Pk
V	12010.00	43.16	30.33	6.32	24.55	43.7	54	-10.3	AV
H	4804.00	55.12	30.55	5.77	24.66	55	74	-19	Pk
H	4804.00	41.07	30.55	5.77	24.66	40.95	54	-13.05	AV
H	7206.00	58.44	30.33	6.32	24.55	58.98	74	-15.02	Pk
H	7206.00	41.65	30.33	6.32	24.55	42.19	54	-11.81	AV
H	9608.00	57.07	30.55	5.77	24.66	56.95	74	-17.05	Pk
H	9608.00	41.55	30.55	5.77	24.66	41.43	54	-12.57	AV
H	12010.00	59.17	30.33	6.32	24.55	59.71	74	-14.29	Pk
H	12010.00	41.5	30.33	6.32	24.55	42.04	54	-11.96	AV

Polar (H/V)	Frequency	Meter Reading	Pre-ampli fier	Cable Loss	Antenna Factor	Emission Level	Limits	Margin	Detector Type
	(MHz)	(dBuV)	(dB)	(dB)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Middle Channel:2440MHz									
V	4880.00	55.74	30.55	5.77	24.66	55.62	74	-18.38	Pk
V	4880.00	41.05	30.55	5.77	24.66	40.93	54	-13.07	AV
V	7320.00	57.32	30.33	6.32	24.55	57.86	74	-16.14	Pk
V	7320.00	44	30.33	6.32	24.55	44.54	54	-9.46	AV
V	9760.00	58.33	30.55	5.77	24.66	58.21	74	-15.79	Pk
V	9760.00	43.96	30.55	5.77	24.66	43.84	54	-10.16	AV
V	12200.00	55.69	30.33	6.32	24.55	56.23	74	-17.77	Pk
V	12200.00	42.78	30.33	6.32	24.55	43.32	54	-10.68	AV
H	4880.00	58.28	30.55	5.77	24.66	58.16	74	-15.84	Pk
H	4880.00	42.11	30.55	5.77	24.66	41.99	54	-12.01	AV
H	7320.00	59.54	30.33	6.32	24.55	60.08	74	-13.92	Pk
H	7320.00	42.36	30.33	6.32	24.55	42.9	54	-11.1	AV
H	9760.00	59.16	30.55	5.77	24.66	59.04	74	-14.96	Pk
H	9760.00	41.4	30.55	5.77	24.66	41.28	54	-12.72	AV
H	12200.00	58.05	30.33	6.32	24.55	58.59	74	-15.41	Pk
H	12200.00	42.89	30.33	6.32	24.55	43.43	54	-10.57	AV



Page 21 of 62

Polar (H/V)	Frequency	Meter Reading	Pre-ampli fier	Cable Loss	Antenna Factor	Emission Level	Limits	Margin	Detector Type
	(MHz)	(dBuV)	(dB)	(dB)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
High Channel:2479MHz									
V	4958.00	57.91	30.55	5.77	24.66	57.79	74	-16.21	Pk
V	4958.00	41.49	30.55	5.77	24.66	41.37	54	-12.63	AV
V	7437.00	56.29	30.33	6.32	24.55	56.83	74	-17.17	Pk
V	7437.00	42.43	30.33	6.32	24.55	42.97	54	-11.03	AV
V	9916.00	59.94	30.55	5.77	24.66	59.82	74	-14.18	Pk
V	9916.00	41.43	30.55	5.77	24.66	41.31	54	-12.69	AV
V	12395.00	56.62	30.33	6.32	24.55	57.16	74	-16.84	Pk
V	12395.00	41.89	30.33	6.32	24.55	42.43	54	-11.57	AV
H	4958.00	58.05	30.55	5.77	24.66	57.93	74	-16.07	Pk
H	4958.00	41.85	30.55	5.77	24.66	41.73	54	-12.27	AV
H	7437.00	57.54	30.33	6.32	24.55	58.08	74	-15.92	Pk
H	7437.00	42.28	30.33	6.32	24.55	42.82	54	-11.18	AV
H	9916.00	59.6	30.55	5.77	24.66	59.48	74	-14.52	Pk
H	9916.00	43.91	30.55	5.77	24.66	43.79	54	-10.21	AV
H	12395.00	57.4	30.33	6.32	24.55	57.94	74	-16.06	Pk
H	12395.00	41.51	30.33	6.32	24.55	42.05	54	-11.95	AV

Remark:

1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier,
Margin= Emission Level - Limit

2. If peak below the average limit, the average emission was no test.

3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.



5. RADIATED BAND EMISSION MEASUREMENT

5.1 TEST REQUIREMENT:

Test Requirement:	FCC Part15 C Section 15.209 and 15.205				
Test Method:	ANSI C63.10: 2013				
Test Frequency Range:	All of the restrict bands were tested, only the worst band's (2310MHz to 2500MHz) data was showed.				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	Above	Peak	1MHz	3MHz	Peak
	1GHz	Average	1MHz	3MHz	Average

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Class B (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).

5.2 TEST PROCEDURE

Above 1GHz test procedure as below:

1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dBmargin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
7. Test the EUT in the lowest channel, the Highest channel

Note:

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

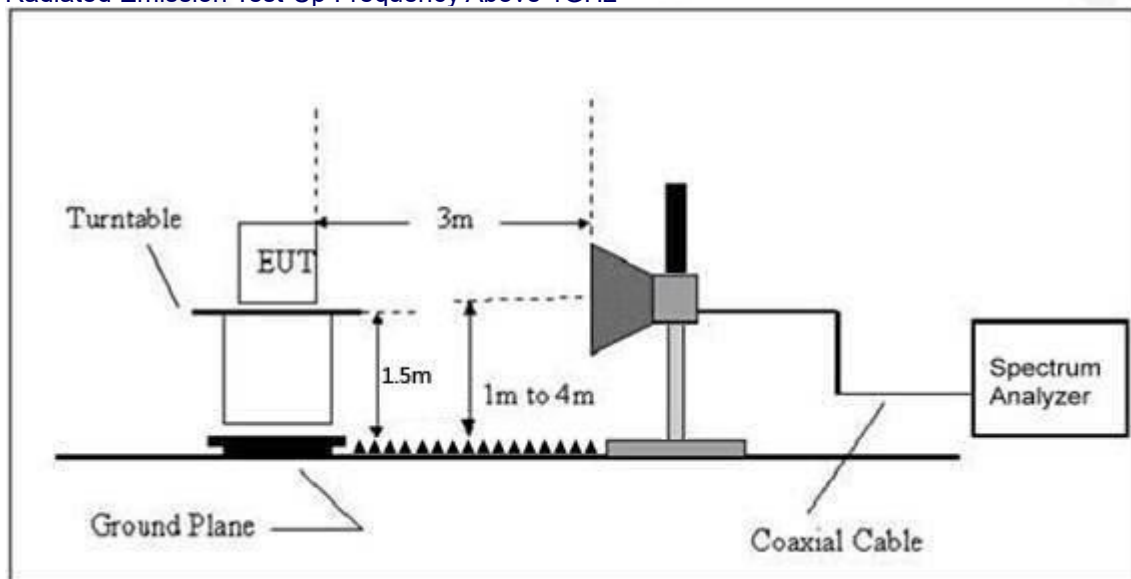
5.3 DEVIATION FROM TEST STANDARD

No deviation



5.4 TEST SETUP

Radiated Emission Test-Up Frequency Above 1GHz



5.5 EUT OPERATING CONDITIONS

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



5.6 TEST RESULT

	Polar (H/V)	Frequenc y (MHz)	Meter Reading (dBuV)	Pre- amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB/m)	Emission level (dBuV/m)	Limit (dBuV /m)	Margi n (dB)	Detec tor Type	Result
GFSK	Low Channel: 2402MHz										
	H	2390.00	61.03	30.22	4.85	23.98	59.64	74.00	-14.36	PK	PASS
	H	2390.00	47.32	30.22	4.85	23.98	45.93	54.00	-8.07	AV	PASS
	H	2400.00	59.57	30.22	4.85	23.98	58.18	74.00	-15.82	PK	PASS
	H	2400.00	46.01	30.22	4.85	23.98	44.62	54.00	-9.38	AV	PASS
	V	2390.00	60.66	30.22	4.85	23.98	59.27	74.00	-14.73	PK	PASS
	V	2390.00	46.58	30.22	4.85	23.98	45.19	54.00	-8.81	AV	PASS
	V	2400.00	62.74	30.22	4.85	23.98	61.35	74.00	-12.65	PK	PASS
	V	2400.00	46.30	30.22	4.85	23.98	44.91	54.00	-9.09	AV	PASS
	High Channel: 2479MHz										
	H	2483.50	59.17	30.22	4.85	23.98	57.78	74.00	-16.22	PK	PASS
	H	2483.50	47.95	30.22	4.85	23.98	46.56	54.00	-7.44	AV	PASS
	H	2500.00	59.10	30.22	4.85	23.98	57.71	74.00	-16.29	PK	PASS
	H	2500.00	48.35	30.22	4.85	23.98	46.96	54.00	-7.04	AV	PASS
	V	2483.50	62.12	30.22	4.85	23.98	60.73	74.00	-13.27	PK	PASS
	V	2483.50	46.65	30.22	4.85	23.98	45.26	54.00	-8.74	AV	PASS
	V	2500.00	61.99	30.22	4.85	23.98	60.60	74.00	-13.40	PK	PASS
	V	2500.00	48.69	30.22	4.85	23.98	47.30	54.00	-6.70	AV	PASS
Remark: 1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier, Margin= Emission Level - Limit											



6. POWER SPECTRAL DENSITY TEST

Test Requirement:	FCC Part15 C Section 15.247 (e)
Test Method:	KDB558074 D0115.247 Meas Guidancev05r02

6.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247	Power Spectral Density	8dBm/3kHz	2400-2483.5	PASS

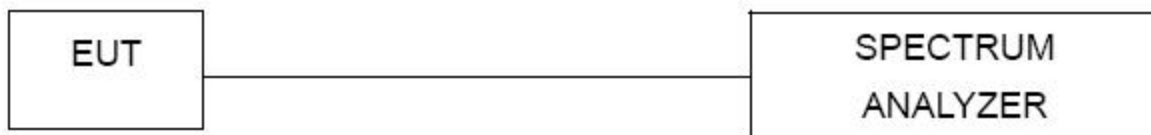
6.2 TEST PROCEDURE

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: $3\text{ kHz} \leq \text{RBW} \leq 100\text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.3 DEVIATION FROM STANDARD

No deviation.

6.4 TEST SETUP





6.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.1 Unless otherwise a special operating condition is specified in the follows during the testing.

6.6 TEST RESULT

Temperature :	25.9℃	Relative Humidity :	52%
Pressure :	101kPa	Test Voltage :	DC 3.7V

Please refer to APPENDIX A



7. CHANNEL BANDWIDTH

Test Requirement:	FCC Part15 C Section 15.247 (a)(2)
Test Method:	KDB558074 D0115.247 Meas Guidancev05r02

7.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	$\geq 500\text{KHz}$ (6dB bandwidth)	2400-2483.5	PASS

7.2 TEST PROCEDURE

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

7.3 DEVIATION FROM STANDARD

No deviation.

7.4 TEST SETUP



7.5 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.



7.6 TEST RESULT

Temperature :	25.8℃	Relative Humidity :	52%
Pressure :	101kPa	Test Voltage :	DC 3.7V
Test Mode :	TX Mode		

Please refer to APPENDIX A



8. PEAK OUTPUT POWER TEST

Test Requirement:	FCC Part15 C Section 15.247 (b)(3)
Test Method:	KDB558074 D0115.247 Meas Guidancev05r02

8.1 APPLIED PROCEDURES/LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Peak Output Power	1 watt or 30dBm	2400-2483.5	PASS

8.2 TEST PROCEDURE

- a. The EUT was directly connected to the Power Analyzer

8.3 DEVIATION FROM STANDARD

No deviation.

8.4 TEST SETUP



8.5 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.

8.6 TEST RESULT

Temperature :	25.3°C	Relative Humidity :	55%
Pressure :	101kPa	Test Voltage :	DC 3.7V

Please refer to APPENDIX A



9. CONDUCTED BAND EDGE AND SPURIOUS EMISSION

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB558074 D0115.247 Meas Guidancev05r02

9.1 APPLICABLE STANDARD

in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in§15.205(a), must also comply with the radiated emission limits specified in15.209(a).

9.2 TEST PROCEDURE

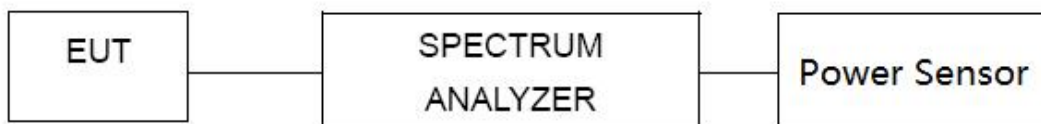
Using the following spectrum analyzer setting:

- A) Set the RBW = 100KHz.
- B) Set the VBW = 300KHz.
- C) Sweep time = auto couple.
- D) Detector function = peak.
- E) Trace mode = max hold.
- F) Allow trace to fully stabilize.

9.3 DEVIATION FROM STANDARD

No deviation.

9.4 TEST SETUP



9.5 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.

9.6 TEST RESULTS

Please refer to APPENDIX A



10. ANTENNA REQUIREMENT

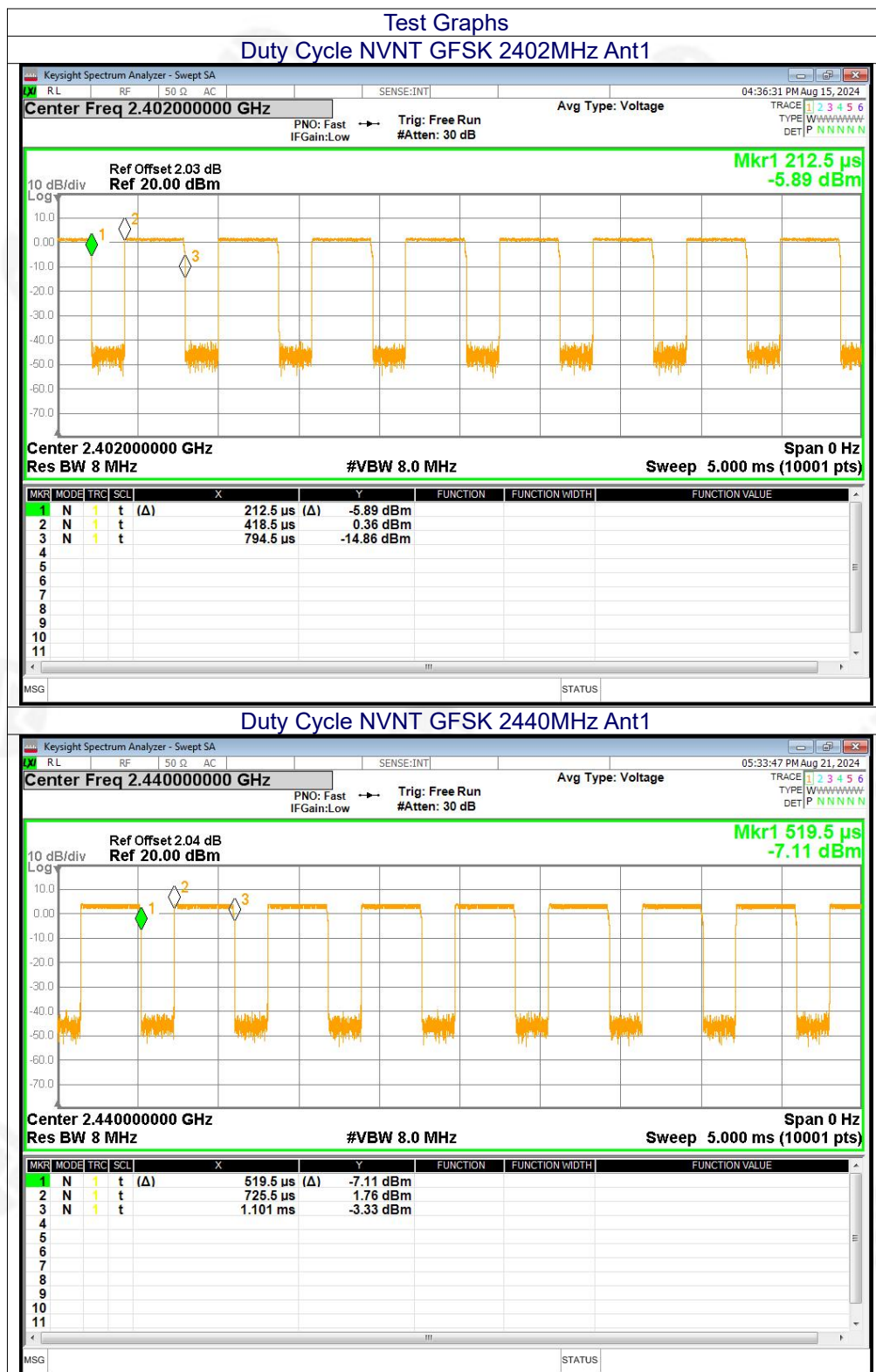
Standard requirement:	FCC Part15 C Section 15.203 /247(b)(4)
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a 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(b) (4) requirement: (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.	
EUT Antenna: The antenna is PCB Antenna, the best case gain of the antenna is 1.58dBi, reference to the appendix II for details	

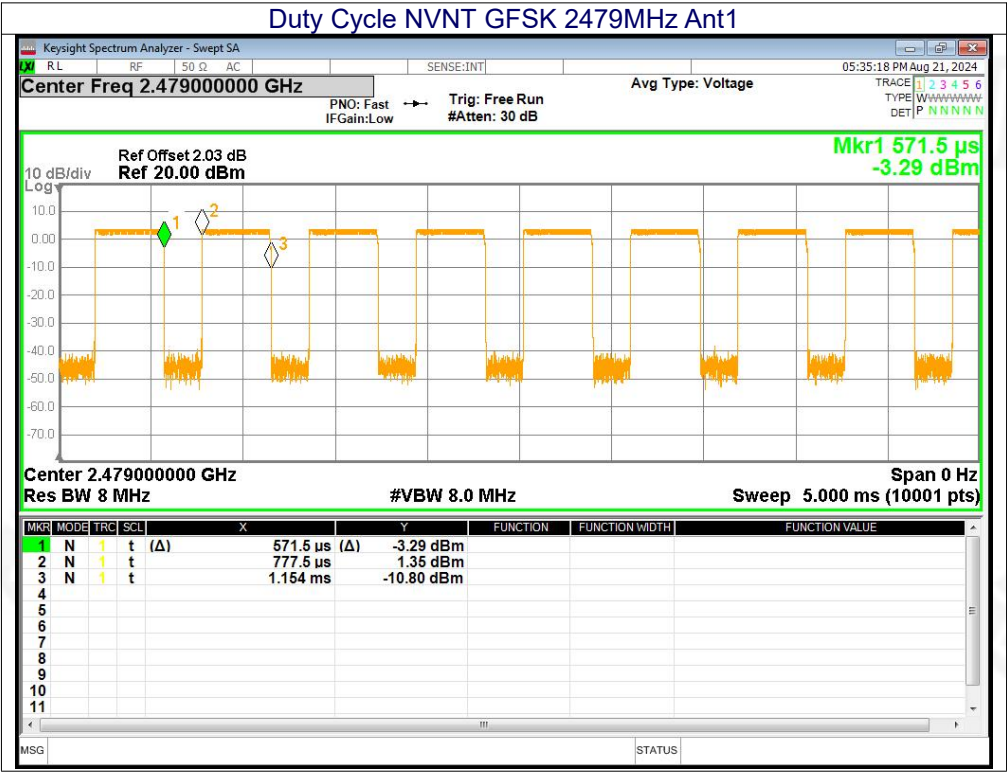


11. APPENDIX A

11.1 DUTY CYCLE

Condition	Mode	Frequency (MHz)	Antenna	Duty Cycle (%)	Correction Factor (dB)	1/T (kHz)
NVNT	GFSK	2402	Ant1	64.6	1.9	2.66
NVNT	GFSK	2440	Ant1	64.57	1.9	2.66
NVNT	GFSK	2479	Ant1	64.6	1.9	2.66

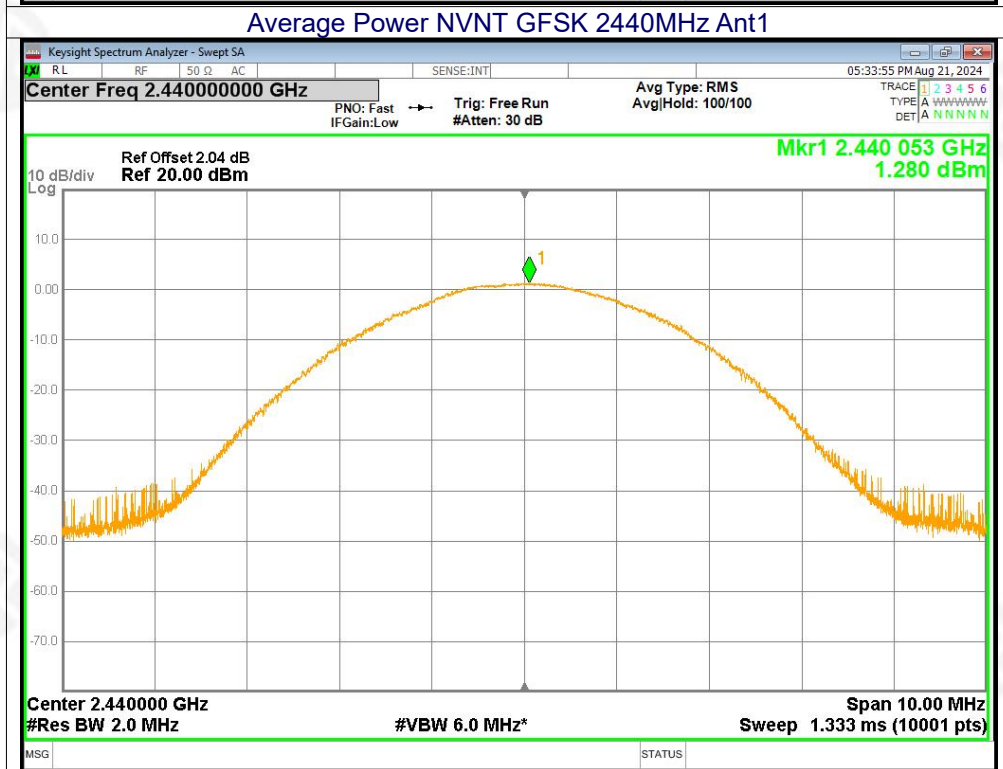
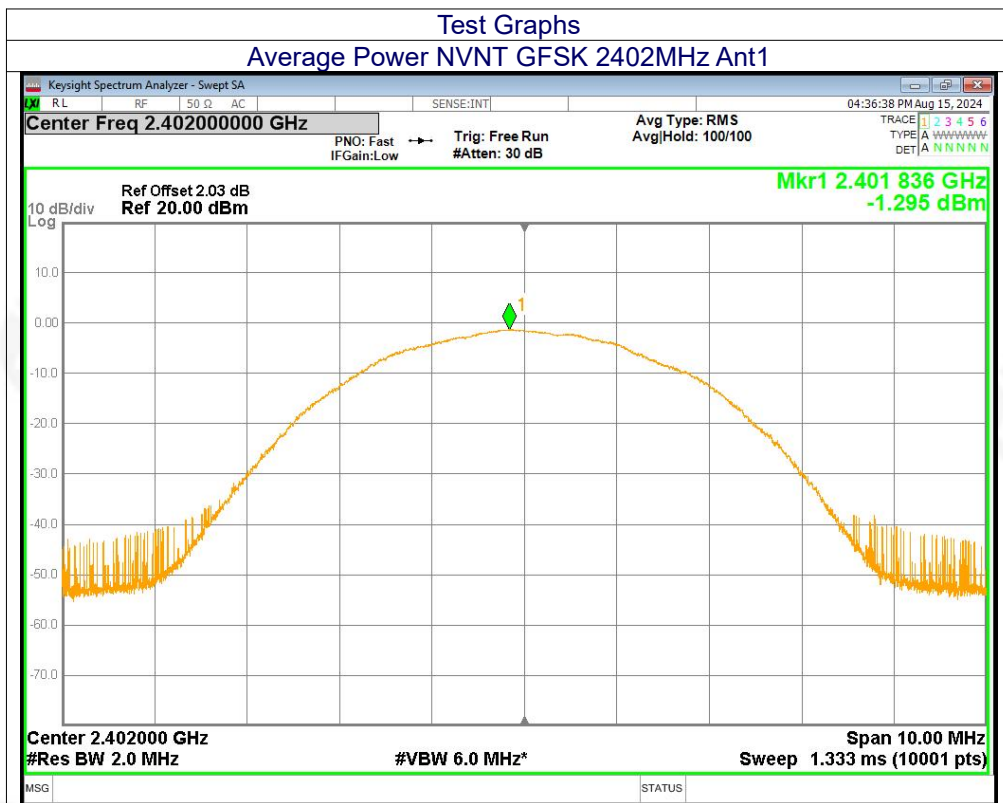




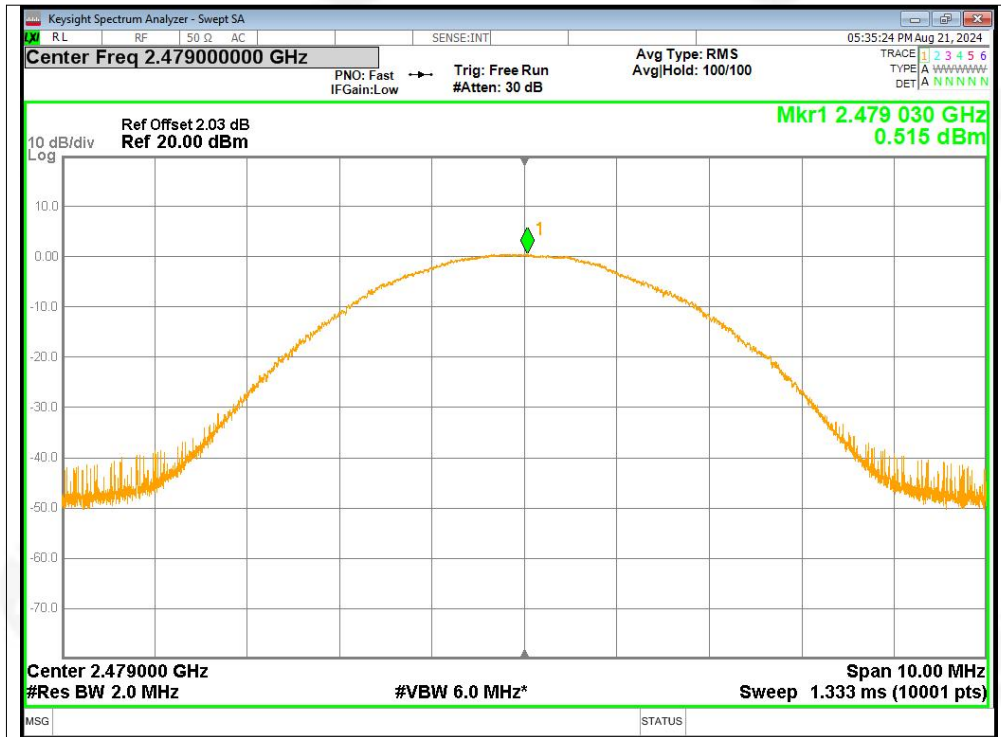


11.2 MAXIMUM AVERAGE CONDUCTED OUTPUT POWER

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	GFSK	2402	Ant1	-1.3	1.9	0.6	30	Pass
NVNT	GFSK	2440	Ant1	1.28	1.9	3.18	30	Pass
NVNT	GFSK	2479	Ant1	0.52	1.9	2.42	30	Pass



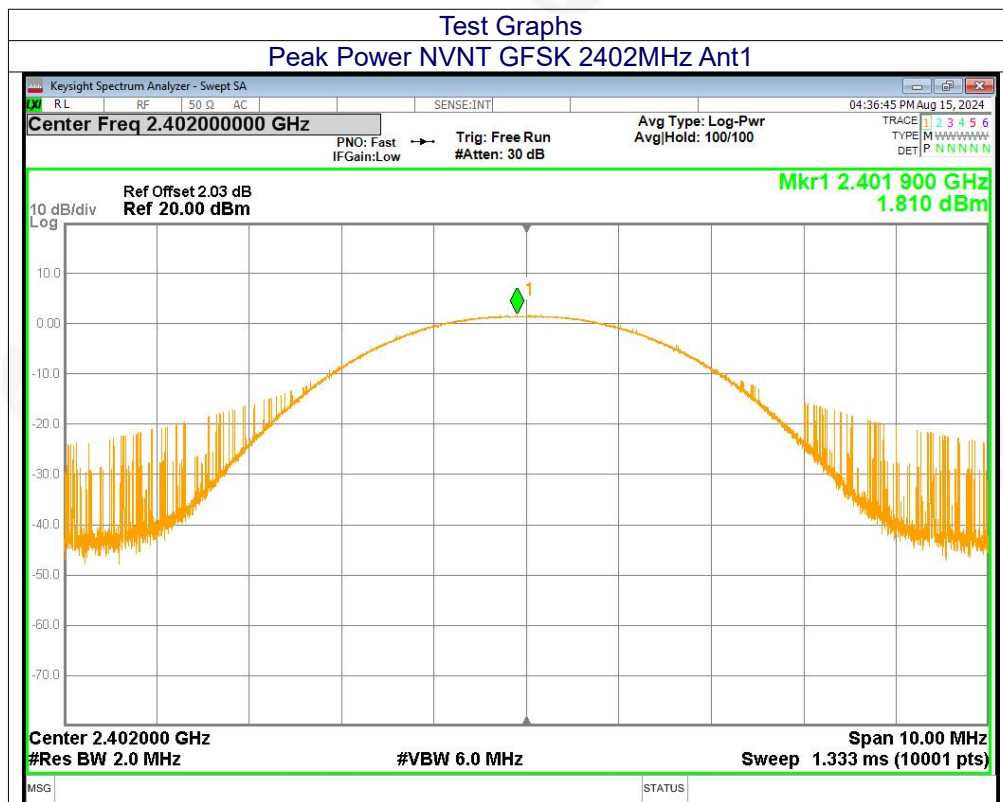
Average Power NVNT GFSK 2479MHz Ant1

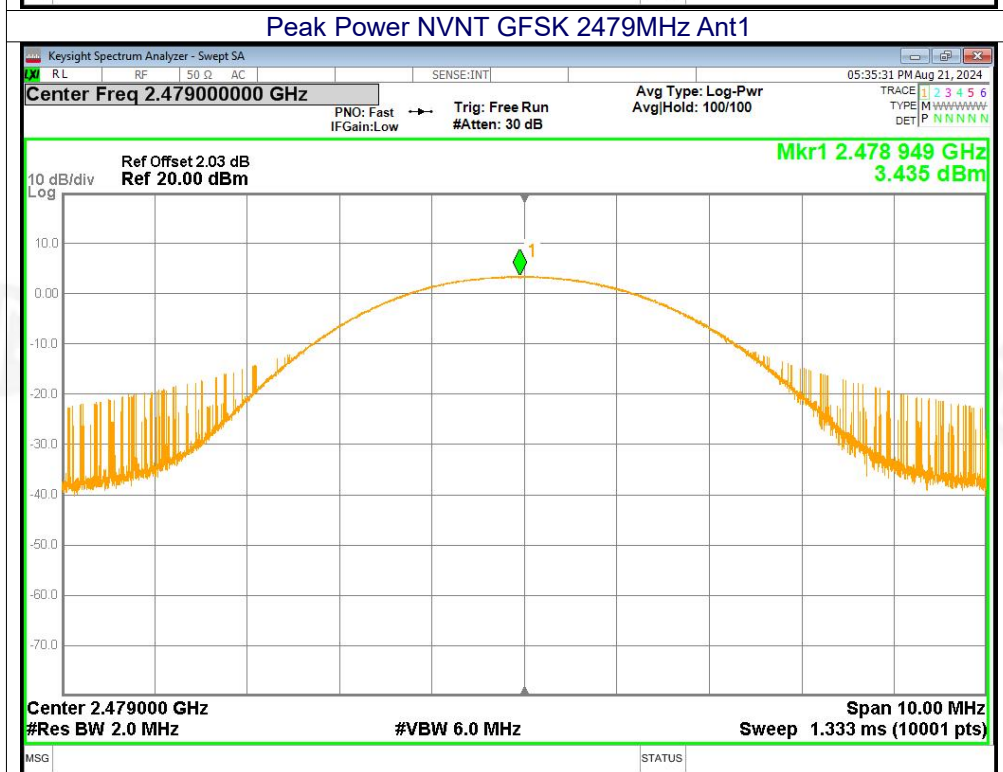
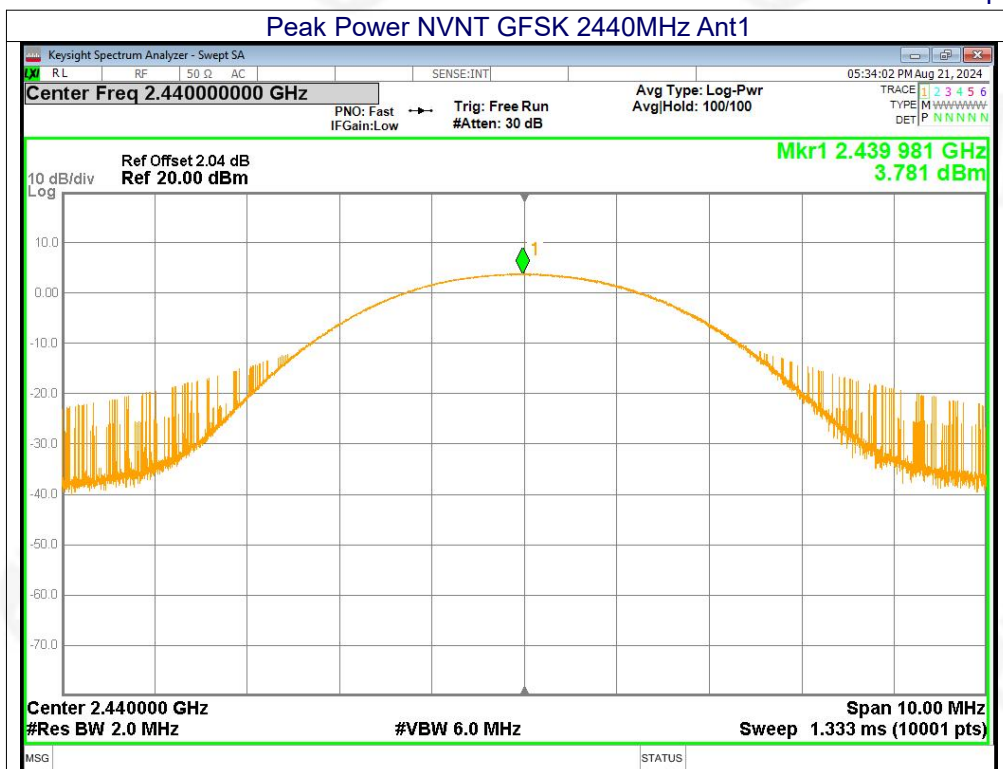




11.3 MAXIMUM PEAK CONDUCTED OUTPUT POWER

Condition	Mode	Frequency (MHz)	Antenna	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	GFSK	2402	Ant1	1.81	30	Pass
NVNT	GFSK	2440	Ant1	3.78	30	Pass
NVNT	GFSK	2479	Ant1	3.44	30	Pass





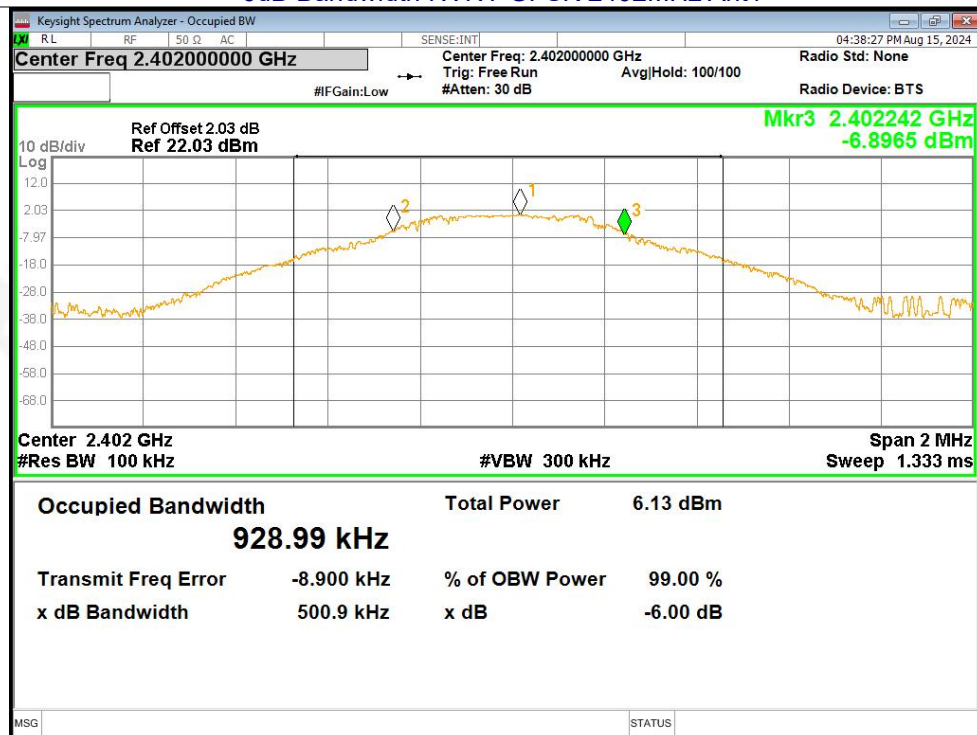


11.4 -6DB BANDWIDTH

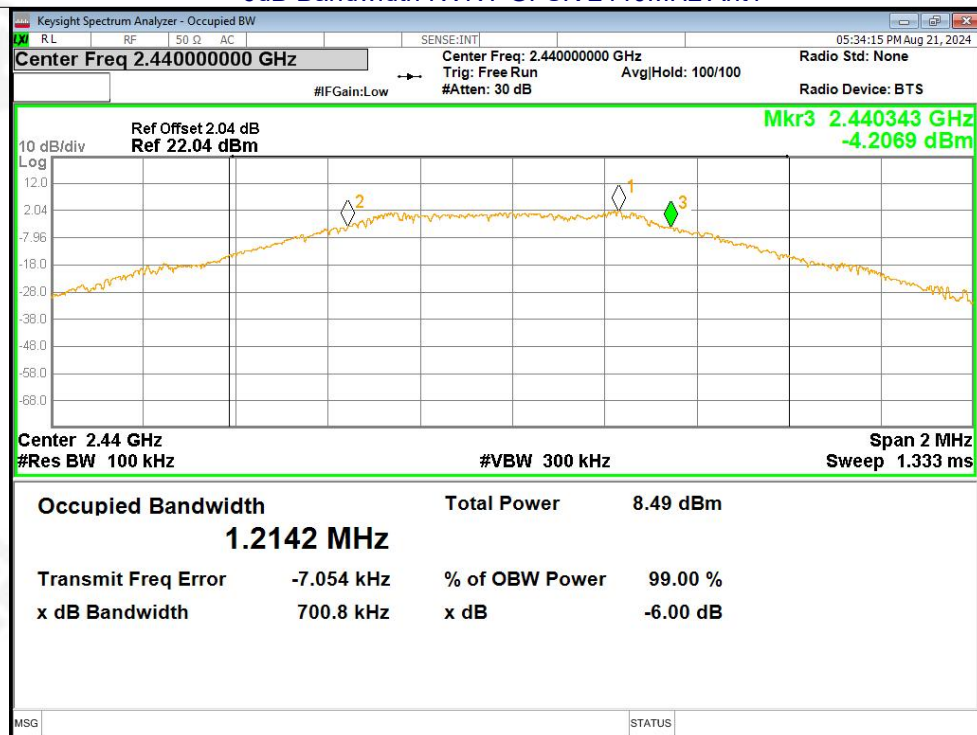
Condition	Mode	Frequency (MHz)	Antenna	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
NVNT	GFSK	2402	Ant1	0.501	0.5	Pass
NVNT	GFSK	2440	Ant1	0.701	0.5	Pass
NVNT	GFSK	2479	Ant1	0.716	0.5	Pass

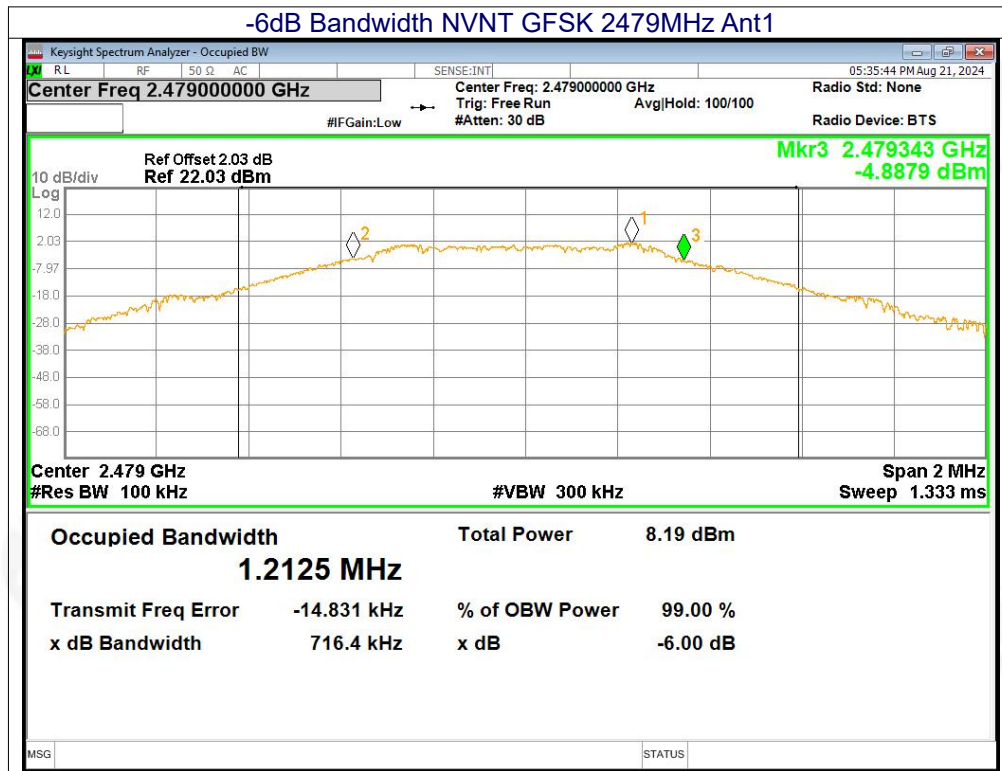
Test Graphs

-6dB Bandwidth NVNT GFSK 2402MHz Ant1



-6dB Bandwidth NVNT GFSK 2440MHz Ant1

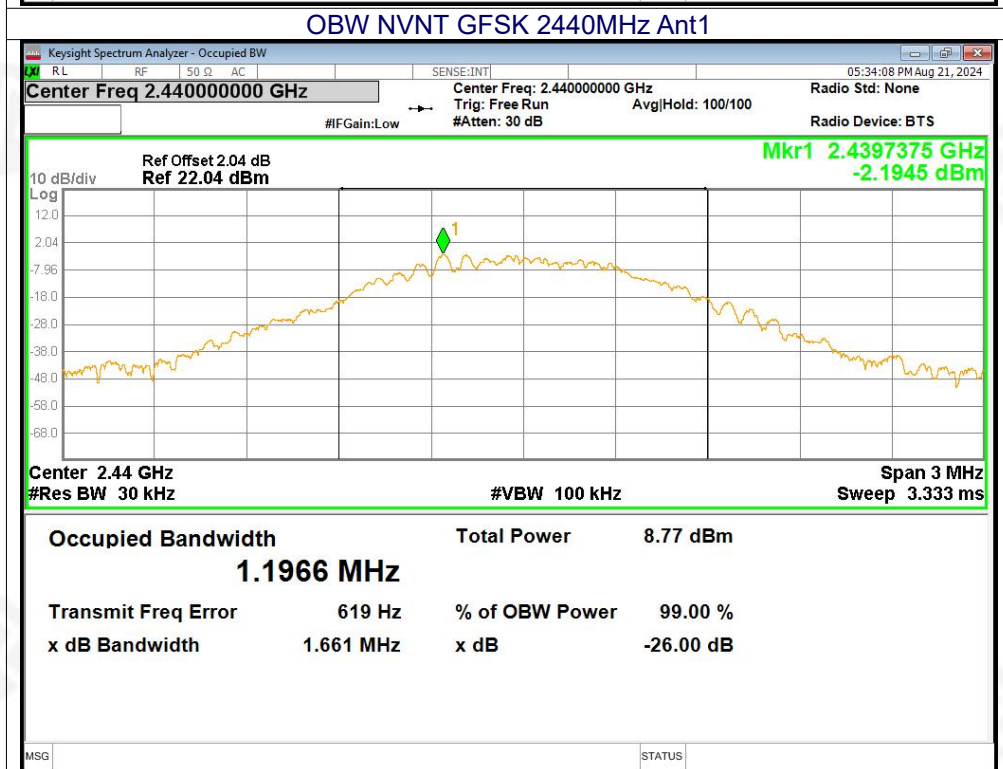
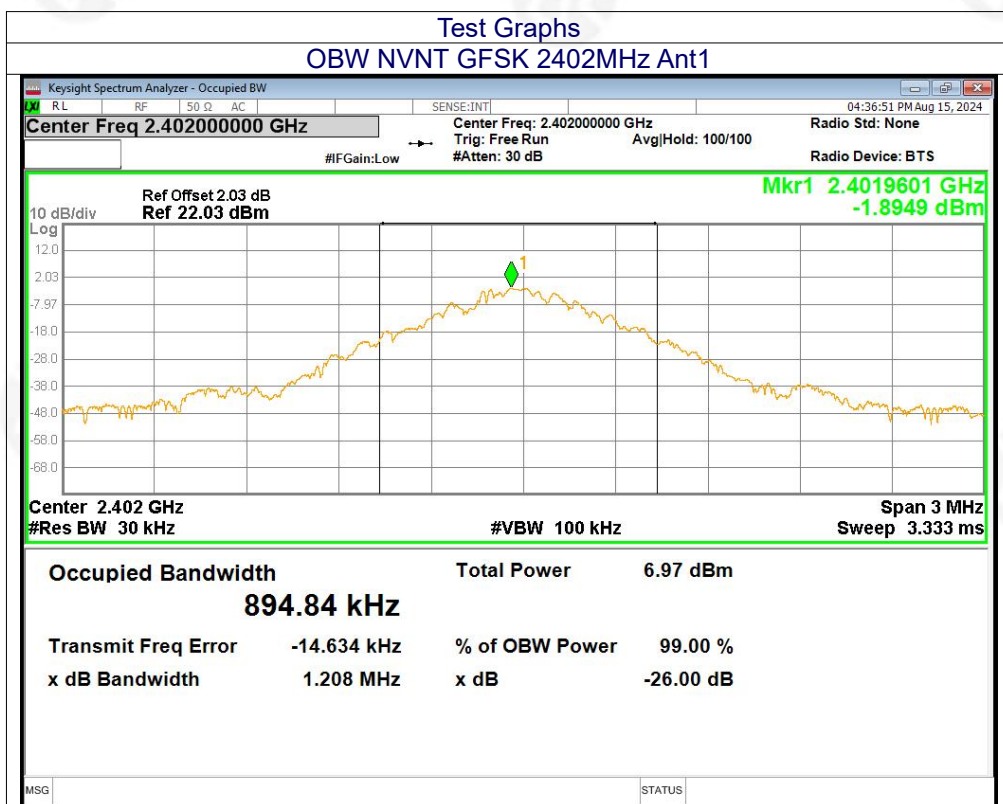


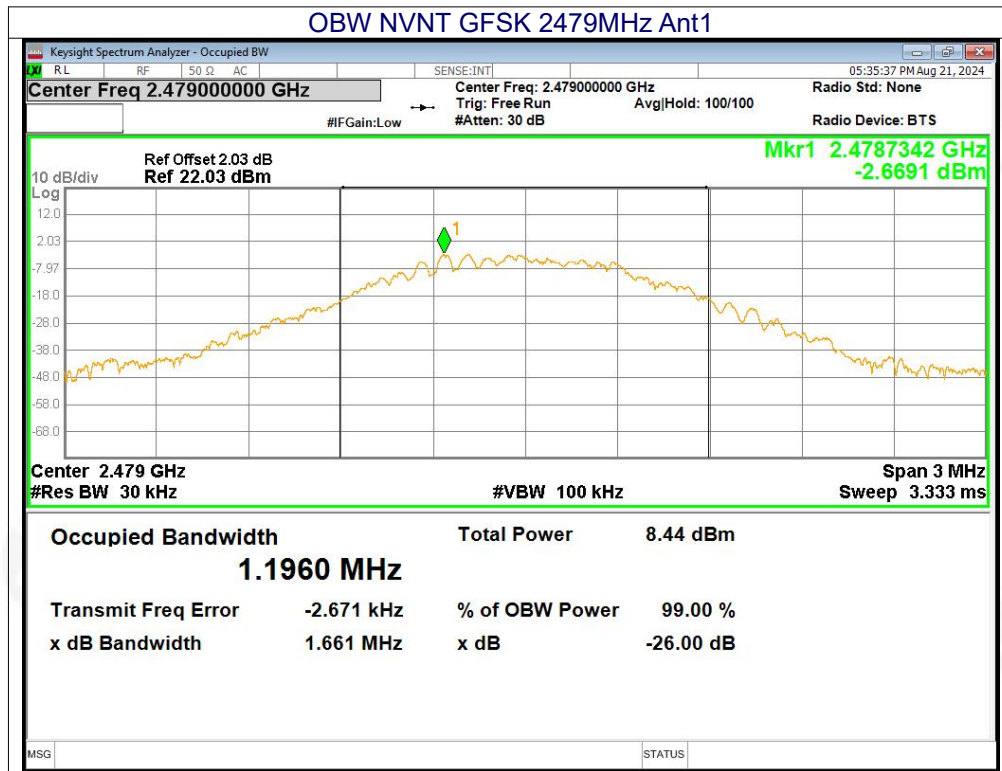




11.5 OCCUPIED CHANNEL BANDWIDTH

Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)
NVNT	GFSK	2402	Ant1	0.895
NVNT	GFSK	2440	Ant1	1.197
NVNT	GFSK	2479	Ant1	1.196





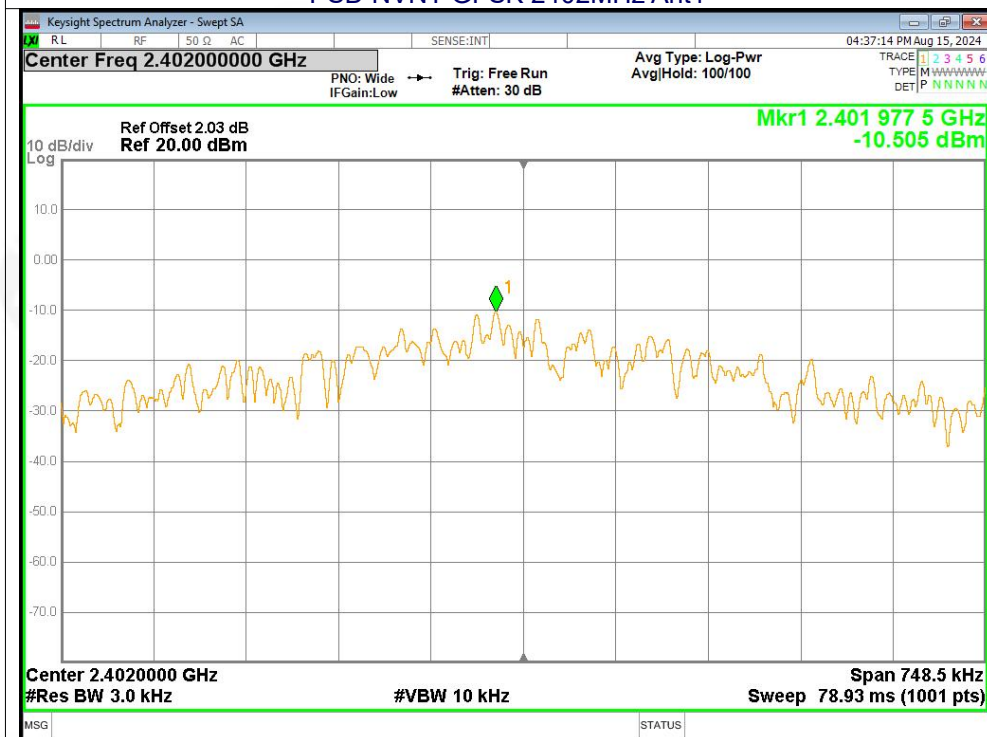


11.6 MAXIMUM POWER SPECTRAL DENSITY LEVEL

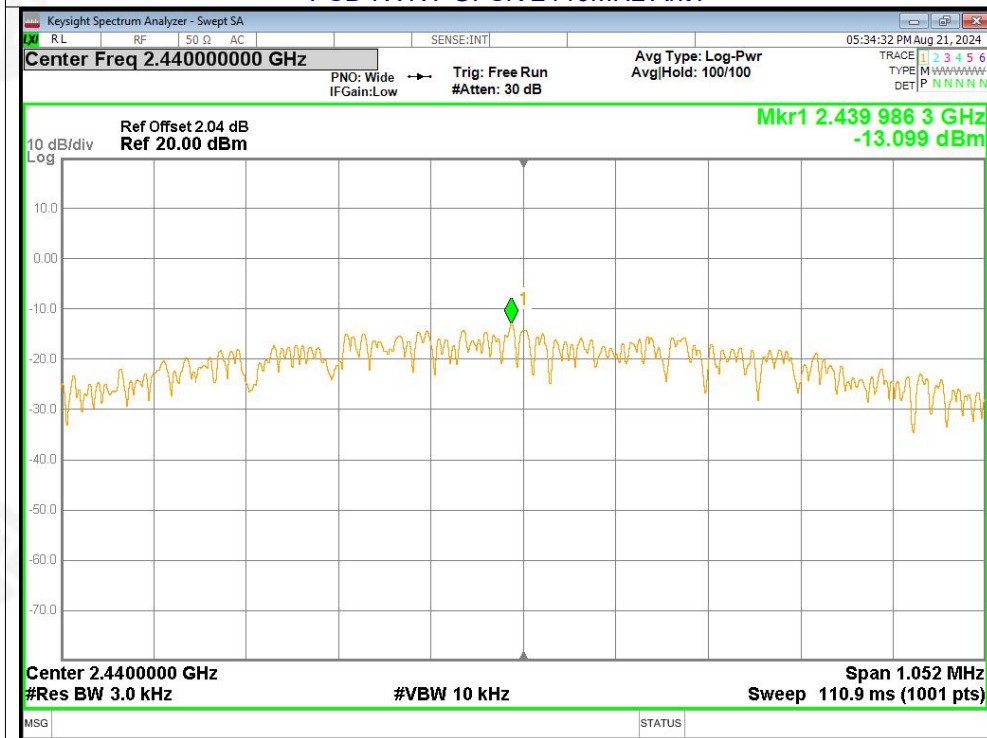
Condition	Mode	Frequency (MHz)	Antenna	Conducted PSD (dBm/3kHz)	Duty Factor (dB)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
NVNT	GFSK	2402	Ant1	-10.51	1.9	-8.61	8	Pass
NVNT	GFSK	2440	Ant1	-13.1	1.9	-11.2	8	Pass
NVNT	GFSK	2479	Ant1	-13.61	1.9	-11.71	8	Pass

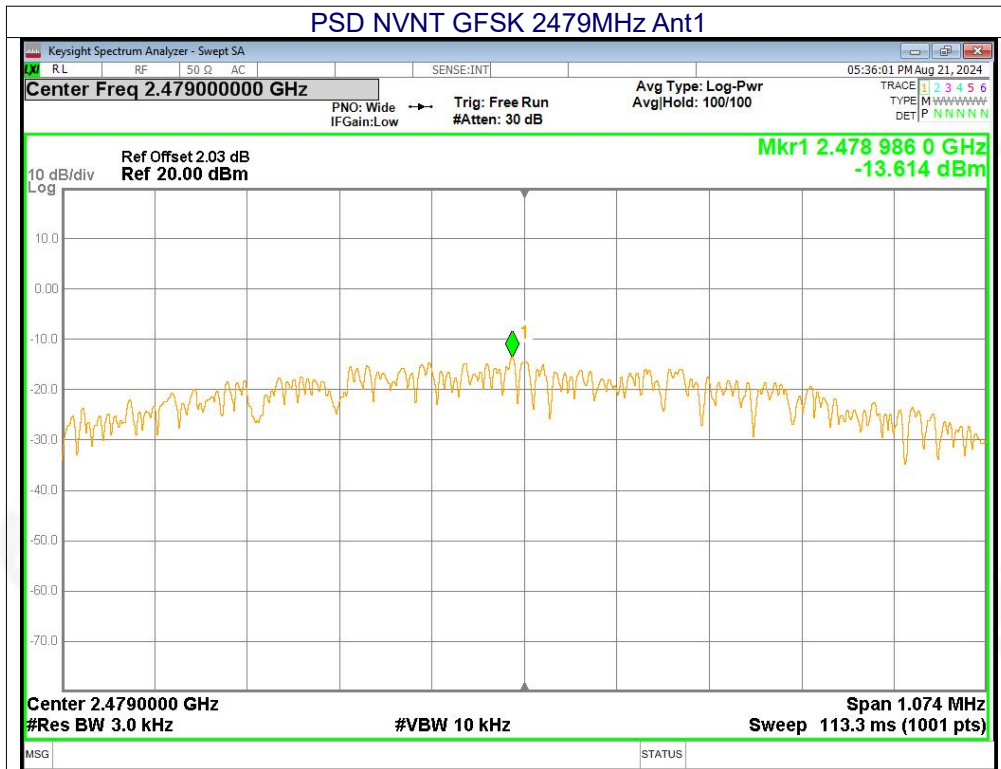
Test Graphs

PSD NVNT GFSK 2402MHz Ant1



PSD NVNT GFSK 2440MHz Ant1





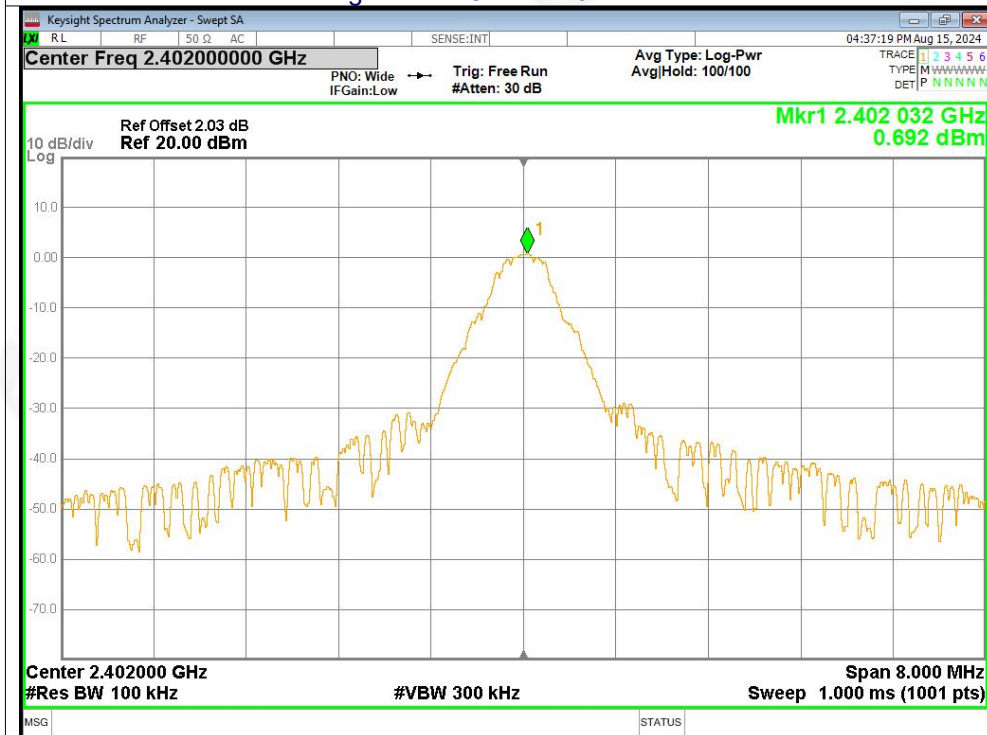


11.7 BAND EDGE

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	GFSK	2402	Ant1	-40.13	-20	Pass
NVNT	GFSK	2479	Ant1	-48.01	-20	Pass

Test Graphs

Band Edge NVNT GFSK 2402MHz Ant1 Ref

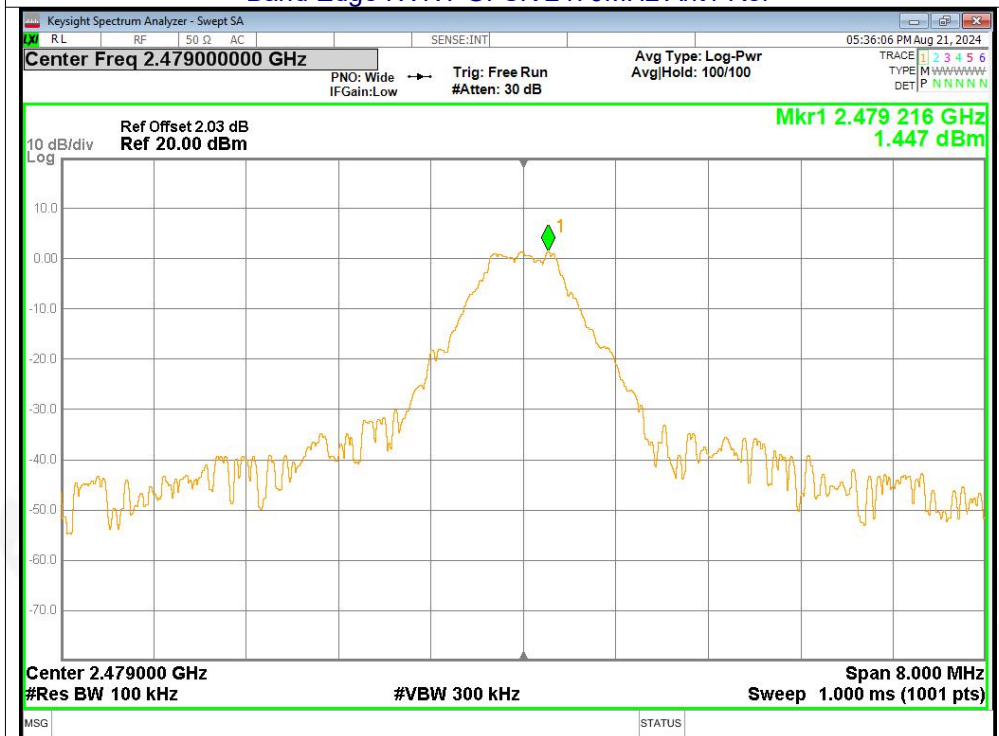


Band Edge NVNT GFSK 2402MHz Ant1 Emission

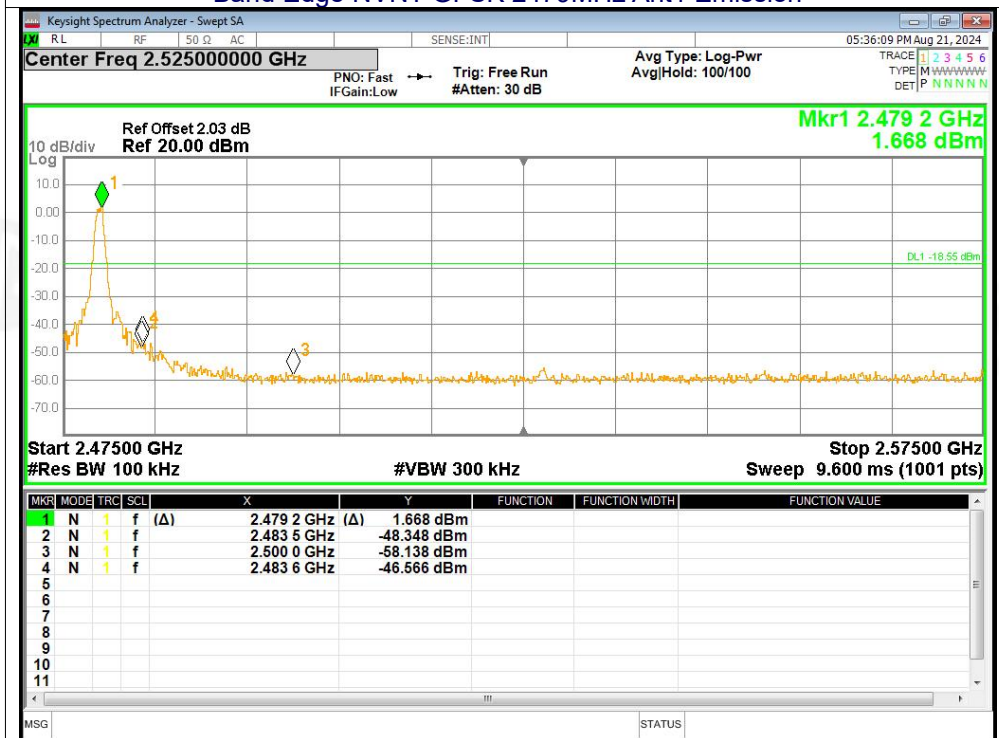




Band Edge NVNT GFSK 2479MHz Ant1 Ref



Band Edge NVNT GFSK 2479MHz Ant1 Emission



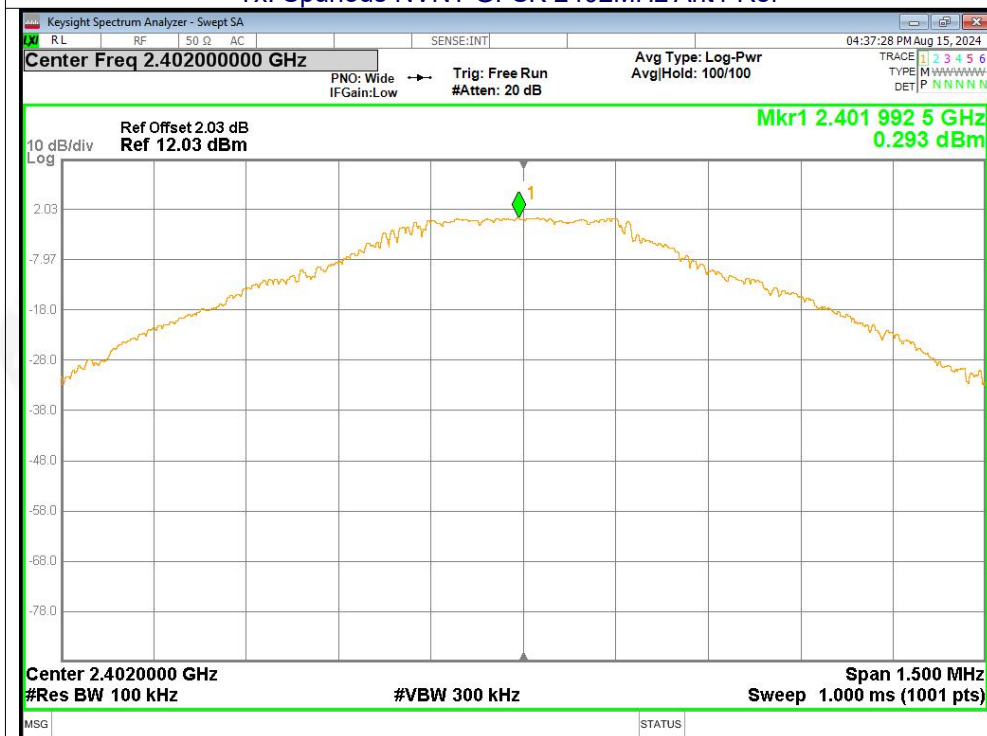


11.8 CONDUCTED RF SPURIOUS EMISSION

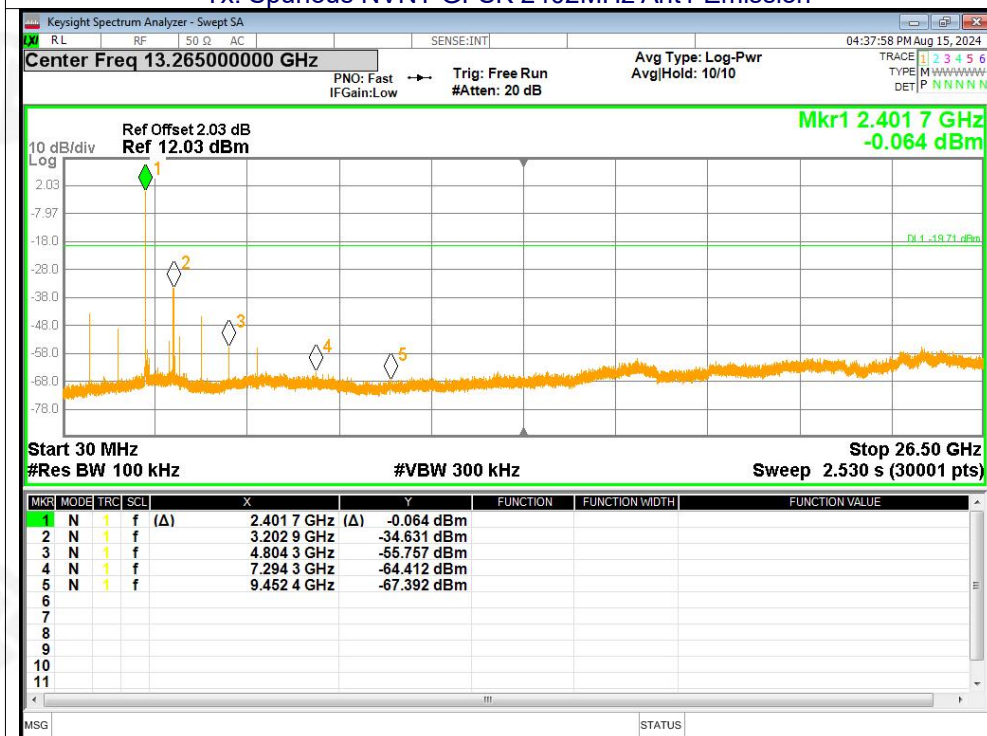
Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	GFSK	2402	Ant1	-34.92	-20	Pass
NVNT	GFSK	2440	Ant1	-38.5	-20	Pass
NVNT	GFSK	2479	Ant1	-39.73	-20	Pass

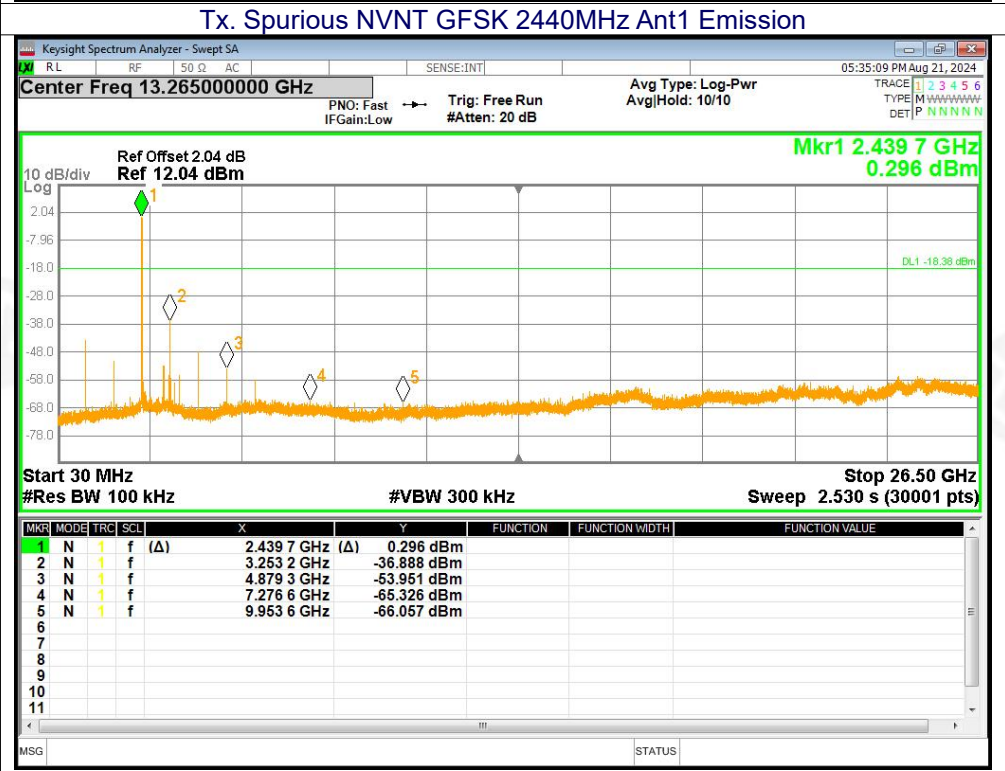
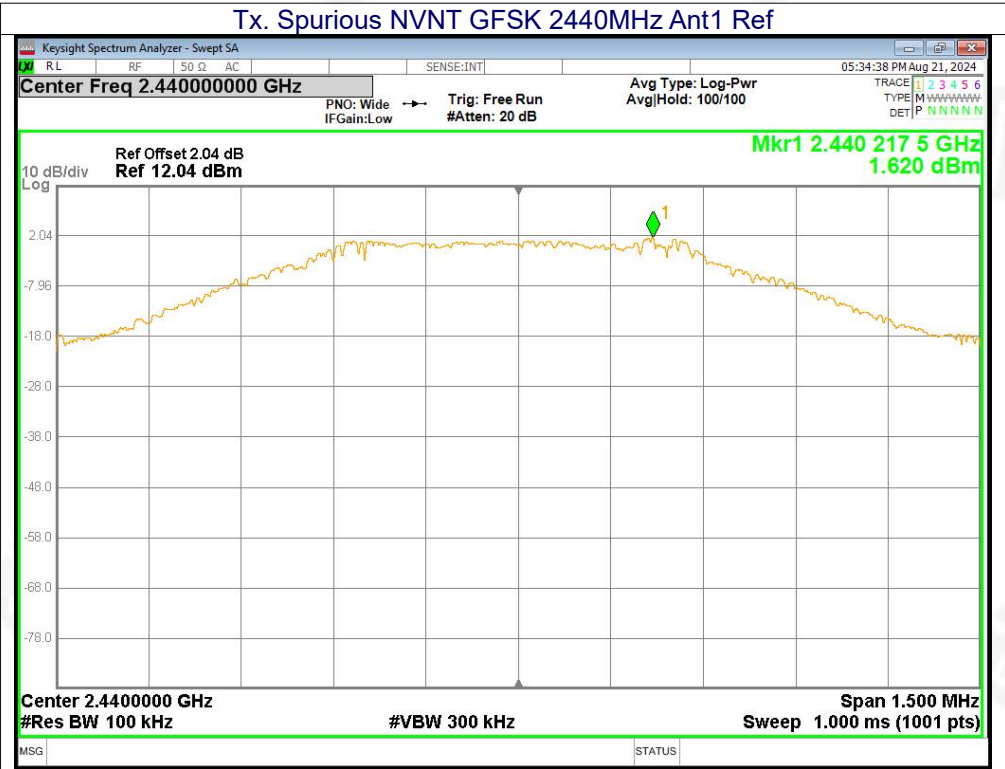
Test Graphs

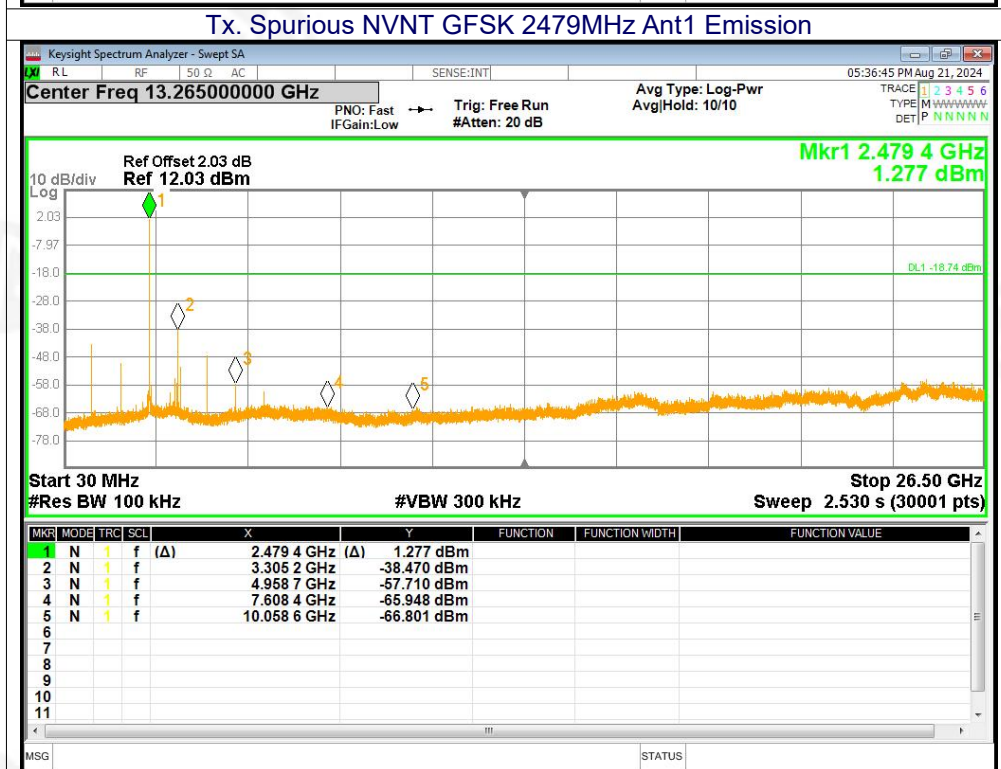
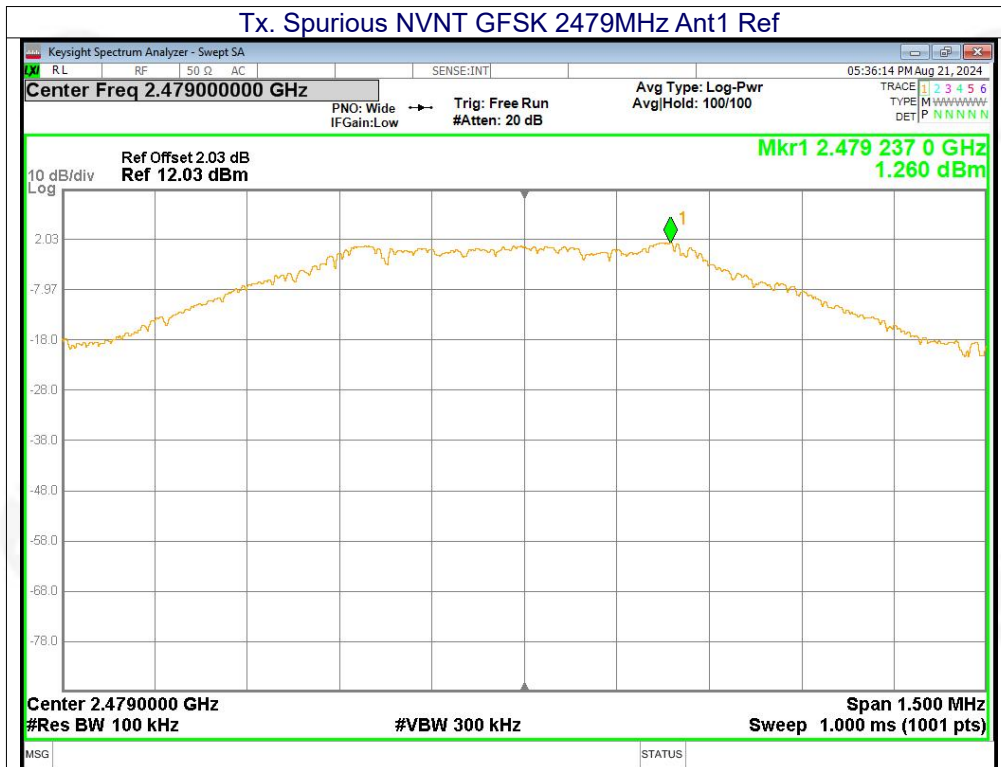
Tx. Spurious NVNT GFSK 2402MHz Ant1 Ref



Tx. Spurious NVNT GFSK 2402MHz Ant1 Emission









12. TEST SETUP PHOTO

Reference to the appendix I for details.

13. EUT CONSTRUCTIONAL DETAILS

Reference to the appendix II for details.

***** END OF REPORT *****