

TEST REPORT

Reference No...... : WTF22D04074006W003
FCC ID : BRWSPMR20500
Applicant..... : Horizon Hobby, LLC.
Address..... : 2904 Research Rd., Champaign, IL, 61822 United States
Manufacturer : Horizon Hobby, LLC.
Address..... : 2904 Research Rd., Champaign, IL, 61822 United States
Product..... : NX20 20 Channel Transmitter
Model(s) : SPMR20500, SPMR205001(alternate stickconfig),
SPMR20500EU (EU only version), SPMR20500 Regular US,
SPMR20500EU EU Version
Standards..... : FCC 47CFR Part15 Subpart C §15.247
Date of Receipt sample : 2022-04-20
Date of Test : 2022-04-20 to 2022-07-18
Date of Issue..... : 2022-08-30
Test Result..... : Pass

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

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3 Revision History

Test Report No.	Date of Receipt Sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTF22D04074006W003	2022-04-20	2022-04-20 to 2022-07-18	2022-08-30	Original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product: NX20 20 Channel Transmitter

Model(s): SPMR20500, SPMR205001(alternate stickconfig), SPMR20500EU (EU only version), SPMR20500 Regular US, SPMR20500EU EU Version

Model Description: Only the model names are different for different market requirement. The test sample's model name is SPMR20500.

Hardware Version: Rev K

Software Version: 1.0

4.2 Details of E.U.T.

Operation Frequency: 2402-2478MHz

2.4G Transmitter Module: 2.4G PLANO

Max. RF output power: 2.4G (ANT 1): 24.19dBm
2.4G (ANT 2): 24.21dBm

Modulation Technology: GFSK

Antenna installation: internal permanent antenna

Antenna Gain: 0dBi

Ratings: Cylindrical Li-Ion Battery 3.7V 1S 3P 10500mAh 38.85Wh

4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	1	2404	2	2407	3	2411
4	2414	5	2417	6	2420	7	2424
8	2427	9	2430	10	2433	11	2437
12	2440	13	2446	14	2450	15	2456
16	2459	17	2463	18	2466	19	2469
20	2473	21	2476	22	2478	/	/

4.4 Test Facility

The test facility has a test site registered with the following organizations:

ISED CAB identifier: CN0013. Test Firm Registration No.: 7760A.

Waltek Testing Group Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files.

Registration number 7760A, October 15, 2016.

FCC Designation No.: CN1201. Test Firm Registration No.: 523476.

Waltek Testing Group Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration number 523476, September 10, 2019.

4.5 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test Lab: N/A

Lab address: N/A

Test items: N/A

4.6 Abnormalities from Standard Conditions

None.

4.7 Test Mode

Table 2 Tests Carried Out Under FCC part 15.247

Test Items	Mode	Channel	TX/RX
Maximum Peak Output Power	GFSK	0/12/22	TX
Power Spectral Density	GFSK	0/12/22	TX
6dB Bandwidth	GFSK	0/12/22	TX
Band Edge	GFSK	0/12/22	TX
Transmitter Spurious Emissions	GFSK	0/12/22	TX

Note: Parameters set by test software during channel & power tests, the software provided by the customer was used to set the operating channels as well as the output power level. The RF output power set is the power expected by the manufacturer and is going to be fixed on the firmware of the final product.

5 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.247(d) 15.205(a) 15.209(a)	PASS
Conducted Spurious Emissions	15.247(d)	PASS
Conducted Emissions	15.207(a)	PASS
6dB Bandwidth	15.247(a)(2)	PASS
Maximum Peak Output Power	15.247(b)(3), (4)	PASS
Power Spectral Density	15.247(e)	PASS
Band Edge	15.247(d)	PASS
Antenna Requirement	15.203	PASS
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	PASS

6 Equipment Used during Test

6.1 Equipments List

Conducted Emissions Test Site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date	Valid
1	EMI Test Receiver	R&S	ESCI	100947	2021-07-26	2022-07-25
2	LISN	R&S	ENV216	101215	2021-07-26	2022-07-25
3	Cable	Top	TYPE16(3.5M)	-	2021-07-26	2022-07-25
Conducted Emissions Test Site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date	Valid
1	EMI Test Receiver	R&S	ESCI	101155	2021-07-26	2022-07-25
2	LISN	SCHWARZBECK	NSLK 8128	8128-289	2021-07-26	2022-07-25
3	Limiter	York	MTS-IMP-136	261115-001-0024	2021-07-26	2022-07-25
4	Cable	LARGE	RF300	-	2021-07-26	2022-07-25
3m Semi-anechoic Chamber for Radiation Emissions Test site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date	Valid
1	Spectrum Analyzer	R&S	FSP30	100091	2021-04-26 2022-04-28	2022-04-25 2023-04-27
2	Amplifier	Agilent	8447D	2944A10178	2021-04-26 2022-04-28	2022-04-25 2023-04-27
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	2021-08-23	2022-08-22
4	Coaxial Cable	Top	TYPE16(13M)	-	2021-04-26 2022-04-28	2022-04-25 2023-04-27
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	2021-04-30 2022-04-29	2022-04-29 2023-04-28
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	2021-07-30	2022-07-29
7	Broadband Preamplifier	COMPLIANCE	PAP-1G18	2004	2021-07-26	2022-07-25
8	Coaxial Cable	ZT26-NJ-NJ-8M/FA	1GHz-18GHz	NA	2021-04-26 2022-04-28	2022-04-25 2023-04-27
3m Semi-anechoic Chamber for Radiation Emissions Test site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date	Valid
1	Test Receiver	R&S	ESCI	101296	2021-04-26 2022-04-28	2022-04-25 2023-04-27
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2021-04-26 2022-04-28	2022-04-25 2023-04-27
3	Active Loop Antenna	Com-Power Corp.	AL-130R	10160007	2022-05-05	2023-05-04
4	Amplifier	ANRITSU	MH648A	M43381	2021-04-26 2022-04-28	2022-04-25 2023-04-27
5	Cable	HUBER+SUHNER	CBL2	525178	2021-04-26	2022-04-25

					2022-04-28	2023-04-27
RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date	Valid
1.	EMC Analyzer (9k~26.5GHz)	Agilent	E7405A	MY45114943	2021-04-26 2022-04-28	2022-04-25 2023-04-27
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	2021-04-26 2022-04-28	2022-04-25 2023-04-27
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	2021-04-26 2022-04-28	2022-04-25 2023-04-27
4.	Humidity Chamber	GF	GTH-225-40-1P	IAA061213	2021-04-26 2022-04-28	2022-04-25 2023-04-27

6.2 Description of Support Units

Equipment	Manufacturer	Model No.	Series No.
/	/	/	/

6.3 Measurement Uncertainty

Parameter	Uncertainty
Conducted Emission	± 3.64dB (AC mains 150KHz~30MHz)
Radiated Spurious Emissions	± 5.08dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)
Radio Frequency	± 1 x 10 ⁻⁷ Hz
RF Power	± 0.42 dB
RF Power Density	± 0.7dB
Conducted Spurious Emissions	± 2.76 dB (9kHz~26500MHz)
Confidence interval: 95%. Confidence factor: k=2	

6.4 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R. China.

7 Duty Cycle

ANT 1

Type of Modulation	On time ms	Period ms	Duty Cycle linear	Duty Cycle %	Duty Cycle Factor(dB)	Average Factor(dB)
GFSK	2.7200	22.0000	0.12	12.36	9.08	-18.16

ANT 2

Type of Modulation	On time ms	Period ms	Duty Cycle linear	Duty Cycle %	Duty Cycle Factor(dB)	Average Factor(dB)
GFSK	2.7200	21.8400	0.12	12.45	9.05	-18.09

Remark:

Duty cycle=On Time/period;

Duty cycle factor= $10 \cdot \log(1/\text{Duty cycle})$;

Average factor= $20 \log_{10} \text{Duty cycle}$

8 Conducted Emission

Test Requirement: FCC CFR 47 Part 15 Section 15.207
Test Method: ANSI C63.10:2013
Test Result: PASS
Frequency Range: 150kHz to 30MHz
Class/Severity: Class B
Limit:

Frequency (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46
0.5 to 5	56	46
5 to 30	60	50

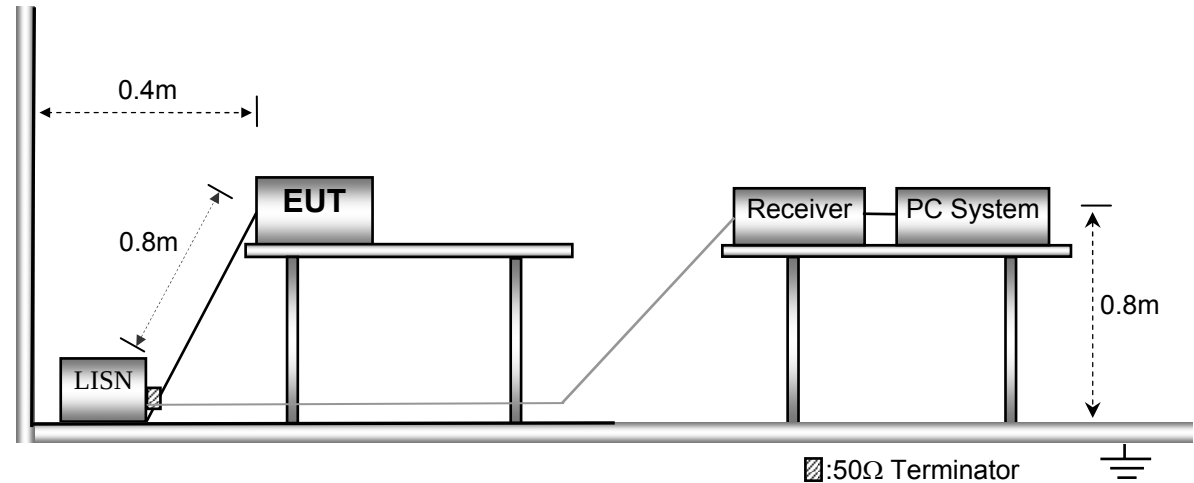
8.1 E.U.T. Operation

Operating Environment :
Temperature: 21.5 °C
Humidity: 51.9 % RH
Atmospheric Pressure: 101.2kPa
EUT Operation :

The test was performed in TX transmitting mode, the worst data were shown in the report.

8.2 EUT Setup

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



8.3 Measurement Description

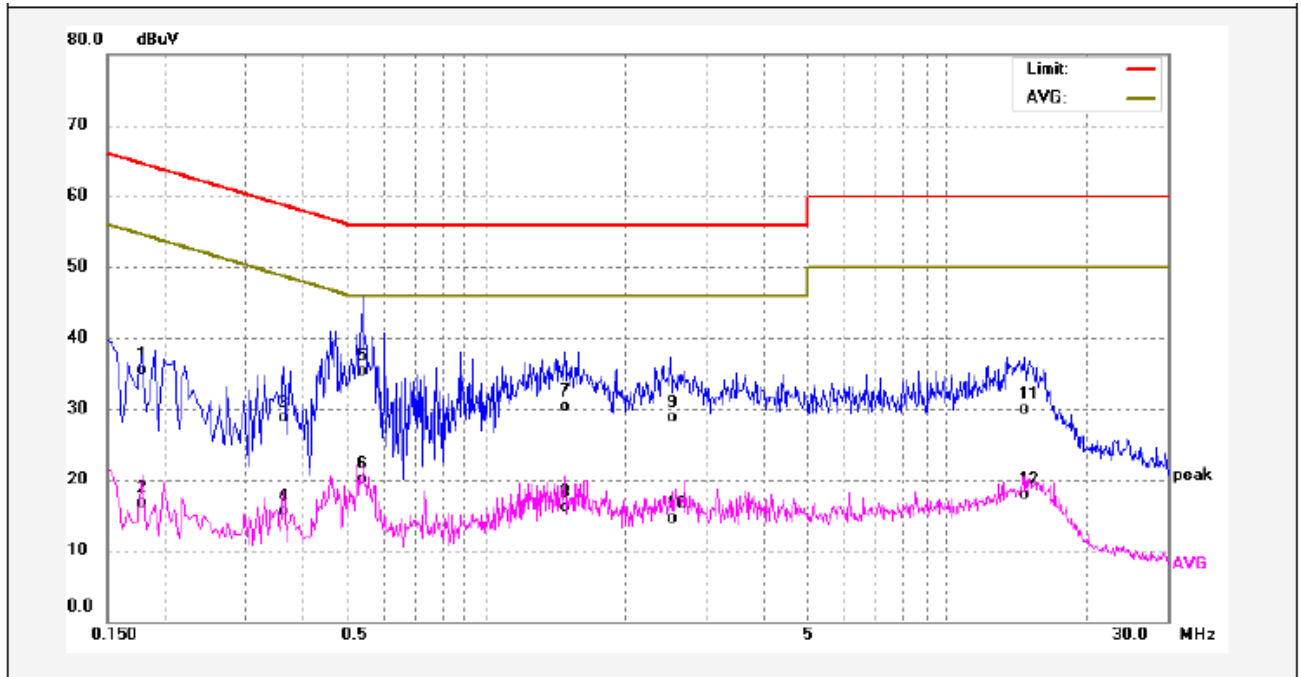
The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

8.4 Conducted Emission Test Result

An initial pre-scan was performed on the live and neutral lines.

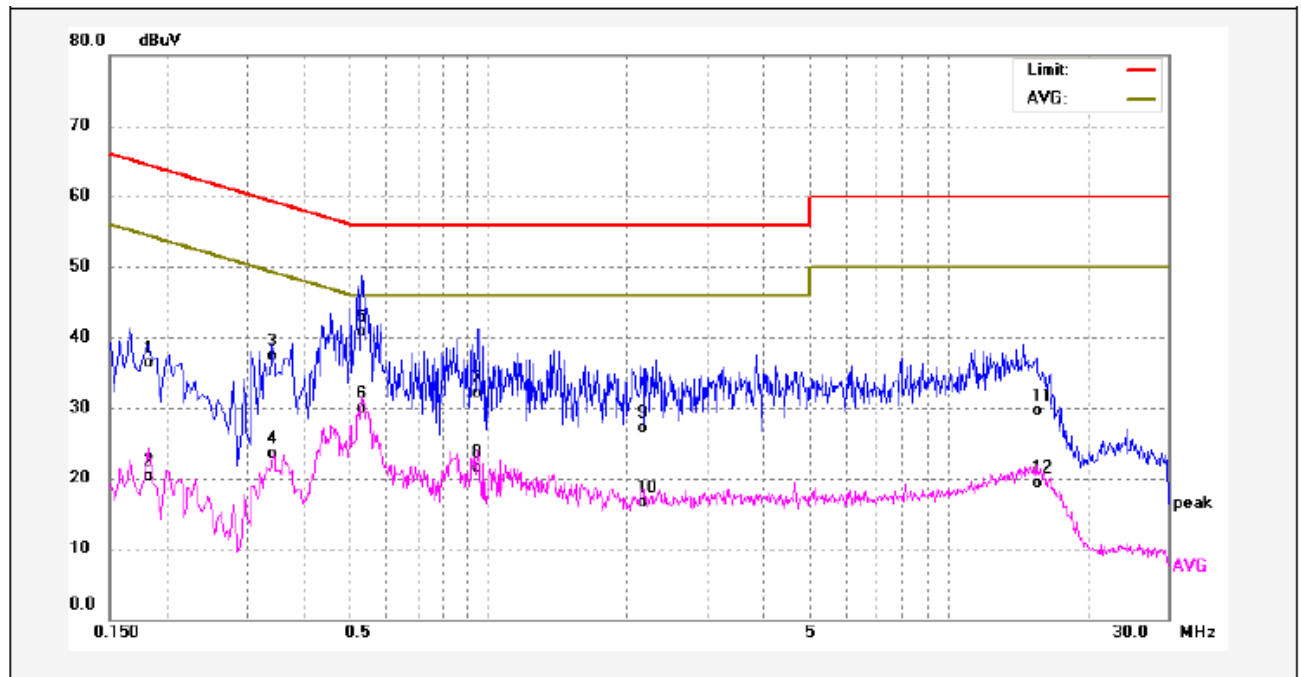
Worst Mode: GFSK mode (low channel)

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1780	23.61	11.98	35.59	64.57	-28.98	QP	
2	0.1780	4.74	11.98	16.72	54.57	-37.85	AVG	
3	0.3620	16.92	11.74	28.66	58.68	-30.02	QP	
4	0.3620	3.72	11.74	15.46	48.68	-33.22	AVG	
5	0.5380	23.51	11.78	35.29	56.00	-20.71	QP	
6	0.5380	8.32	11.78	20.10	46.00	-25.90	AVG	
7	1.4740	18.43	11.90	30.33	56.00	-25.67	QP	
8	1.4740	4.26	11.90	16.16	46.00	-29.84	AVG	
9	2.5059	16.76	12.00	28.76	56.00	-27.24	QP	
10	2.5059	2.41	12.00	14.41	46.00	-31.59	AVG	
11	14.6380	18.11	11.82	29.93	60.00	-30.07	QP	
12	14.6380	6.08	11.82	17.90	50.00	-32.10	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1819	24.80	11.41	36.21	64.39	-28.18	QP	
2	0.1819	8.94	11.41	20.35	54.39	-34.04	AVG	
3	0.3379	26.05	11.22	37.27	59.25	-21.98	QP	
4	0.3379	12.32	11.22	23.54	49.25	-25.71	AVG	
5	0.5299	29.56	11.16	40.72	56.00	-15.28	QP	
6	0.5299	18.76	11.16	29.92	46.00	-16.08	AVG	
7	0.9460	20.88	11.30	32.18	56.00	-23.82	QP	
8	0.9460	10.18	11.30	21.48	46.00	-24.52	AVG	
9	2.1340	15.84	11.32	27.16	56.00	-28.84	QP	
10	2.1340	5.24	11.32	16.56	46.00	-29.44	AVG	
11	15.6300	18.10	11.47	29.57	60.00	-30.43	QP	
12	15.6300	7.92	11.47	19.39	50.00	-30.61	AVG	

9 Radiated Emissions

Test Requirement: FCC 47CFR Part 15 Section 15.209 & 15.247

Test Method: KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019;
ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

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

9.1 EUT Operation

Operating Environment:

Temperature: 23.5 °C

Humidity: 52.1 % RH

Atmospheric Pressure: 101.2kPa

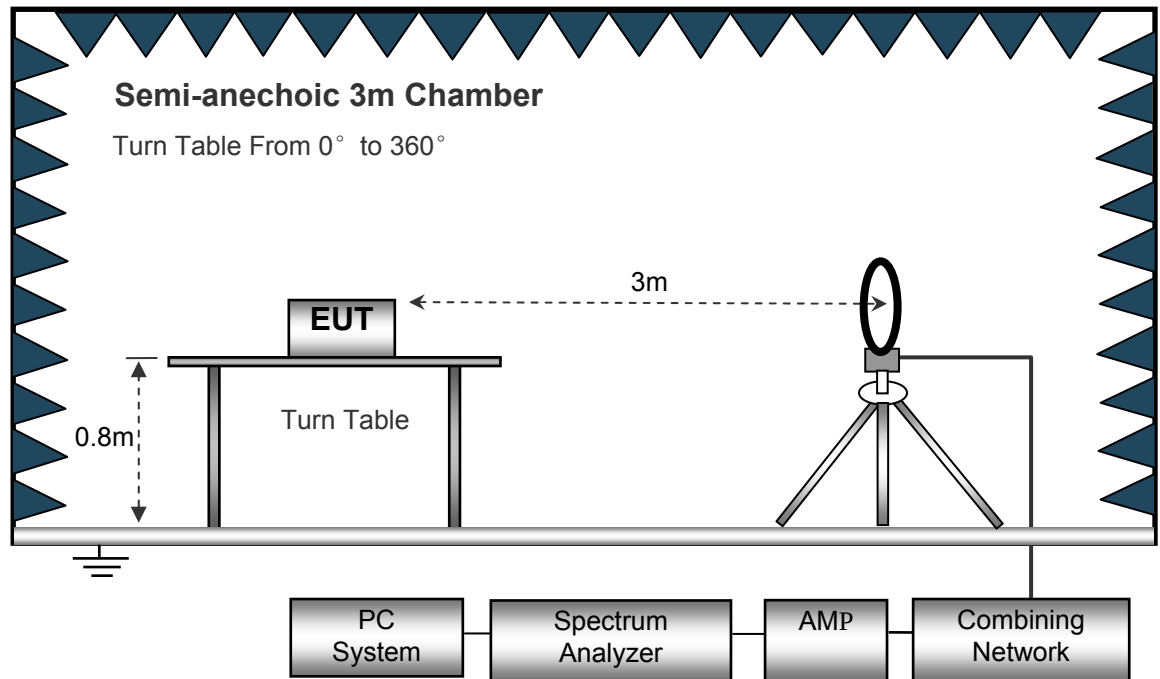
EUT Operation:

The test was performed in TX transmitting mode, the test data were shown in the report.

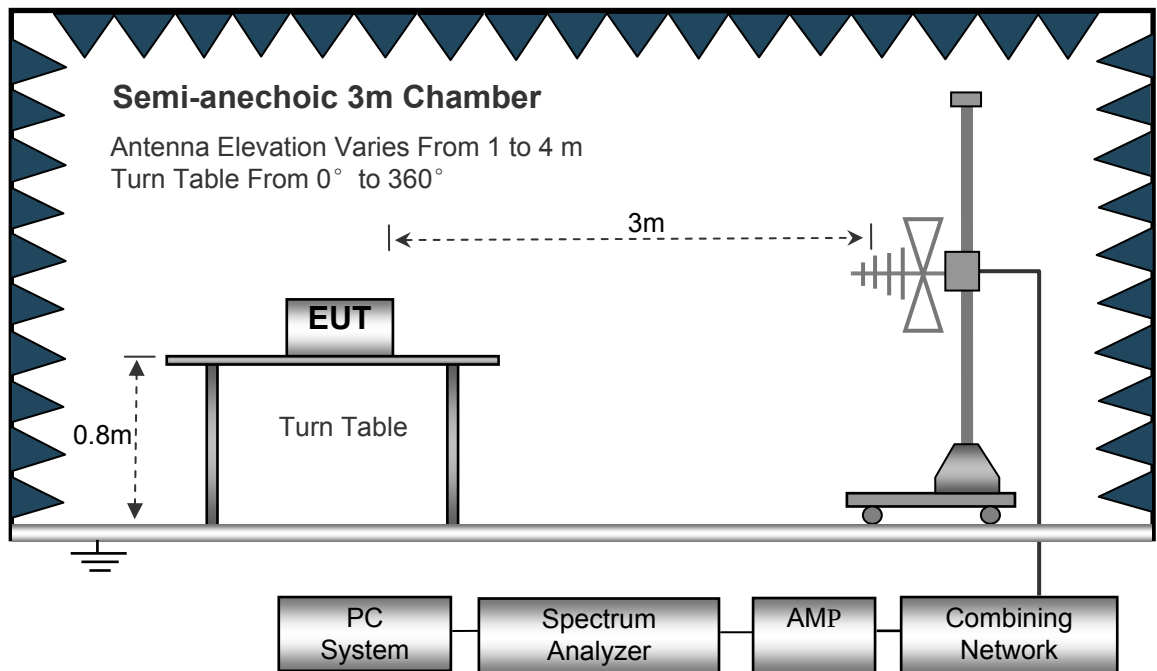
9.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10.

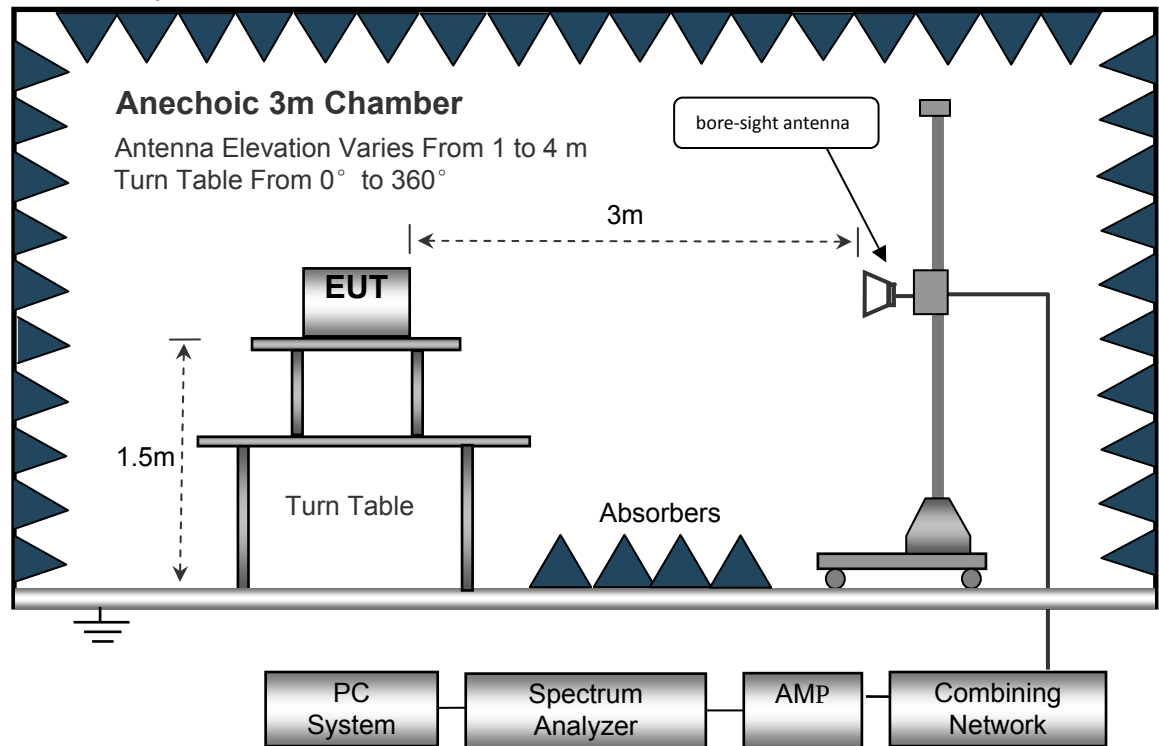
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



9.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed Auto
IF Bandwidth..... 10kHz
Video Bandwidth..... 10kHz
Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed Auto
Detector PK
Resolution Bandwidth..... 100kHz
Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed Auto
Detector PK
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 3MHz
Detector Ave.
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 10Hz

9.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are performed in X,Y and Z axis positioning(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand),the worst condition was tested putting the eut in Z axis,so the worst data were shown as follow.
8. A 2.4GHz high –pass filter is used during radiated emissions above 1GHz measurement.

9.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

9.6 Summary of Test Results

Test Frequency: 9KHz~26MHz

Remark: only the worst data (ANT1 GFSK modulation Low channel mode) were recorded.

Frequency	Measurement results dB μ V @3m	Detector PK/QP	Correct factor dB/m	Extrapolation factor dB	Measurement results (calculated) dB μ V/m @30m	Limits dB μ V/m @30m	Margin dB
(MHz)	Measurement results	Detector	Correct factor	Extrapolation factor	Measurement results (calculated)	Limits	Margin
6.021	25.35	QP	21.84	40.00	7.19	29.54	-22.35
15.731	25.42	QP	21.35	40.00	6.77	29.54	-22.77
25.680	24.59	QP	20.67	40.00	5.26	29.54	-24.28

Test Frequency : 26MHz ~ 30MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency : 30MHz ~ 18GHz

Remark: only the worst data (ANT1)were recorded.

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Low Channel 2402MHz									
269.33	37.27	QP	213	1.1	H	-13.35	23.92	46.00	-22.08
269.33	38.94	QP	29	1.6	V	-13.35	25.59	46.00	-20.41
4804.00	43.46	PK	219	1.6	V	-1.06	42.40	74.00	-31.60
4804.00	40.33	Ave	219	1.6	V	-1.06	39.27	54.00	-14.73
7206.00	47.05	PK	98	1.3	H	1.33	48.38	74.00	-25.62
7206.00	36.35	Ave	98	1.3	H	1.33	37.68	54.00	-16.32
2346.47	45.75	PK	230	1.8	V	-13.19	32.56	74.00	-41.44
2346.47	39.95	Ave	230	1.8	V	-13.19	26.76	54.00	-27.24
2373.95	43.33	PK	92	1.2	H	-13.14	30.19	74.00	-43.81
2373.95	38.13	Ave	92	1.2	H	-13.14	24.99	54.00	-29.01
2498.01	42.45	PK	205	1.4	V	-13.08	29.37	74.00	-44.63
2498.01	37.67	Ave	205	1.4	V	-13.08	24.59	54.00	-29.41

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dB μ V)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
GFSK Middle Channel 2440MHz									
269.33	37.29	QP	343	1.2	H	-13.35	23.94	46.00	-22.06
269.33	40.05	QP	192	1.3	V	-13.35	26.70	46.00	-19.30
4880.00	43.46	PK	193	1.2	V	-0.62	42.84	74.00	-31.16
4880.00	39.01	Ave	193	1.2	V	-0.62	38.39	54.00	-15.61
7320.00	46.67	PK	82	1.2	H	2.21	48.88	74.00	-25.12
7320.00	37.30	Ave	82	1.2	H	2.21	39.51	54.00	-14.49
2315.93	45.60	PK	176	1.2	V	-13.19	32.41	74.00	-41.59
2315.93	37.50	Ave	176	1.2	V	-13.19	24.31	54.00	-29.69
2367.99	42.76	PK	90	1.2	H	-13.14	29.62	74.00	-44.38
2367.99	36.97	Ave	90	1.2	H	-13.14	23.83	54.00	-30.17
2496.85	42.69	PK	246	1.8	V	-13.08	29.61	74.00	-44.39
2496.85	36.17	Ave	246	1.8	V	-13.08	23.09	54.00	-30.91

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dB μ V)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
GFSK High Channel 2478MHz									
269.33	36.67	QP	261	1.1	H	-13.35	23.32	46.00	-22.68
269.33	38.46	QP	161	1.5	V	-13.35	25.11	46.00	-20.89
4960.00	44.01	PK	210	1.1	V	-0.24	43.77	74.00	-30.23
4960.00	38.59	Ave	210	1.1	V	-0.24	38.35	54.00	-15.65
7440.00	46.37	PK	355	1.6	H	2.84	49.21	74.00	-24.79
7440.00	36.29	Ave	355	1.6	H	2.84	39.13	54.00	-14.87
2326.45	45.23	PK	197	1.4	V	-13.19	32.04	74.00	-41.96
2326.45	39.96	Ave	197	1.4	V	-13.19	26.77	54.00	-27.23
2358.70	43.93	PK	276	1.4	H	-13.14	30.79	74.00	-43.21
2358.70	36.47	Ave	276	1.4	H	-13.14	23.33	54.00	-30.67
2484.96	42.87	PK	149	1.3	V	-13.08	29.79	74.00	-44.21
2484.96	36.18	Ave	149	1.3	V	-13.08	23.10	54.00	-30.90

10 Conducted Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019;
ANSI C63.10:2013

Test Result: PASS

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 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer:
 - a) Set instrument center frequency to DTS channel center frequency.
 - b) Set the span to _ 1.5 times the DTS bandwidth.
 - c) Set the RBW = 100 kHz.
 - d) Set the VBW _ [3 × RBW].
 - e) Detector = peak.
 - f) Sweep time = auto couple.
 - g) Trace mode = max hold.
 - h) Allow trace to fully stabilize.
 - i) Use the peak marker function to determine the maximum PSD level.

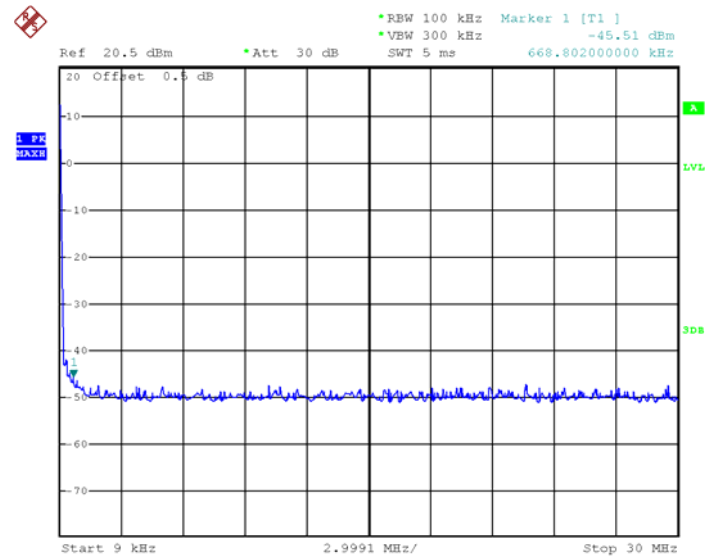
Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

10.2 Test Result

9KHz – 30MHz

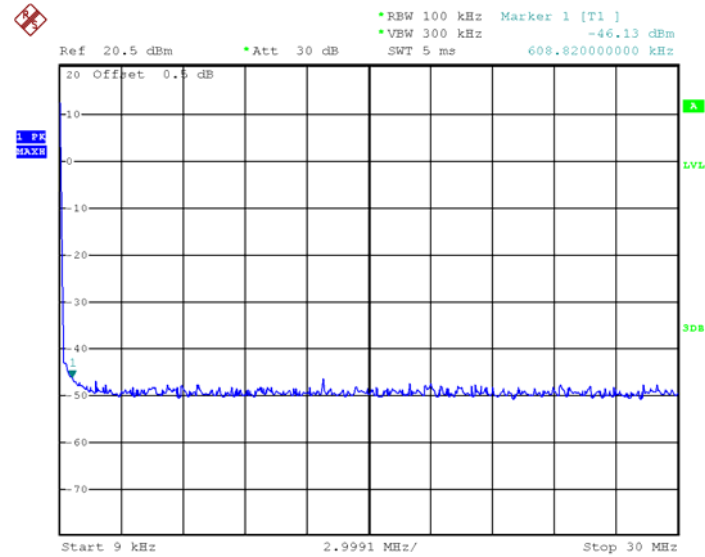
GFSK (ANT 1)

Low Channel

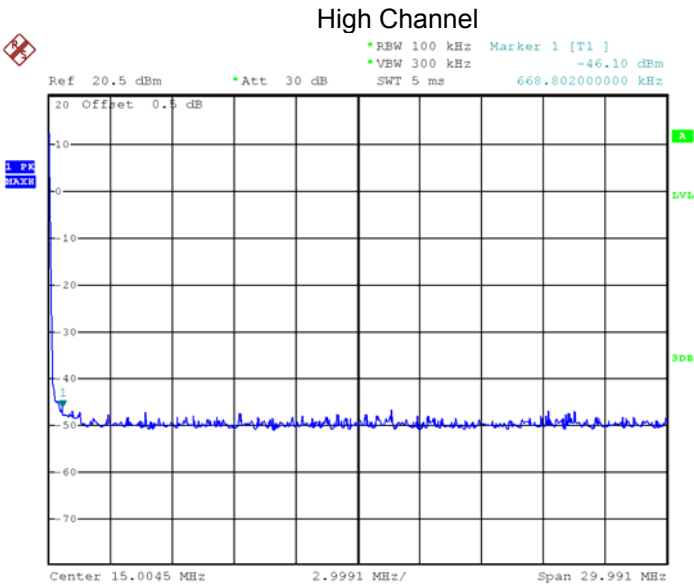


Date: 31.MAY.2022 14:34:00

Middle Channel

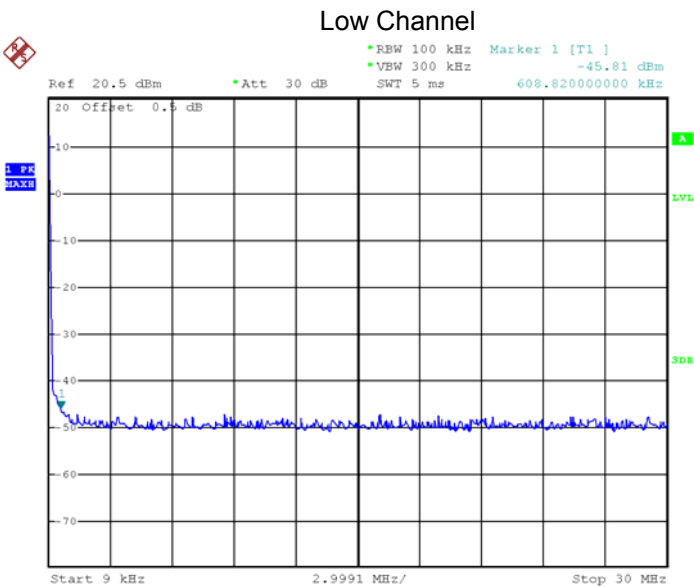


Date: 31.MAY.2022 14:34:27

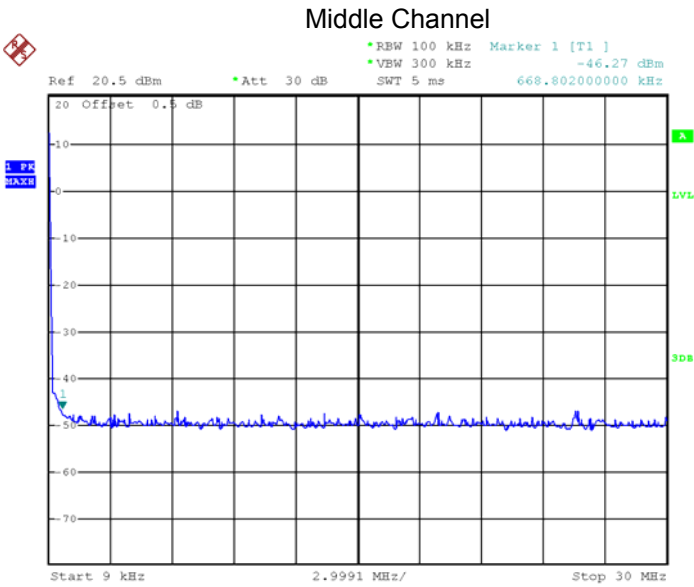


Date: 31.MAY.2022 14:35:36

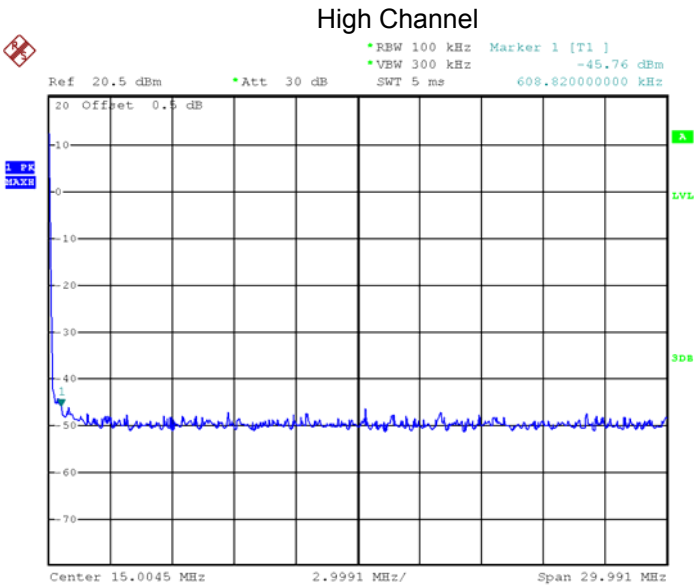
GFSK (ANT 2)



Date: 31.MAY.2022 14:33:43

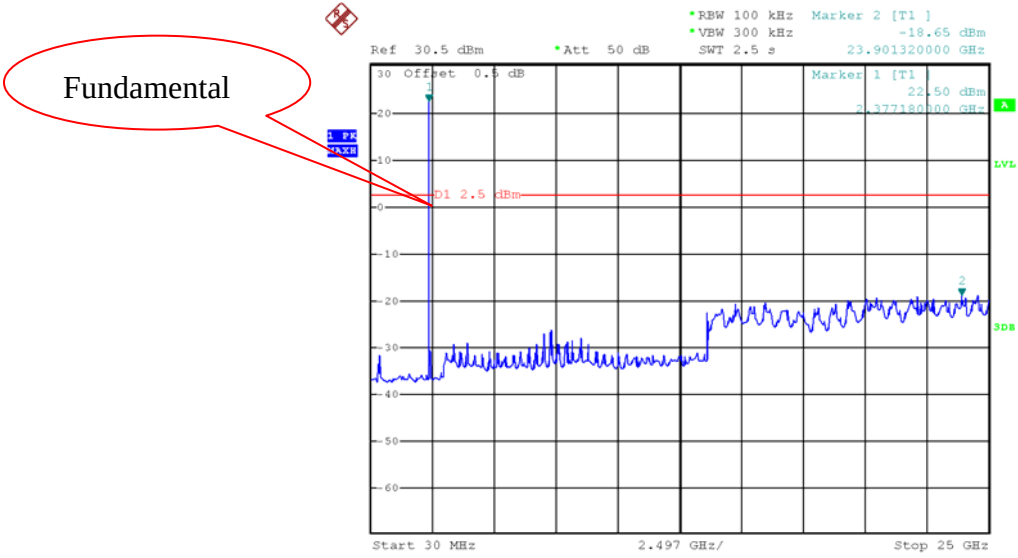


Date: 31.MAY.2022 14:34:52



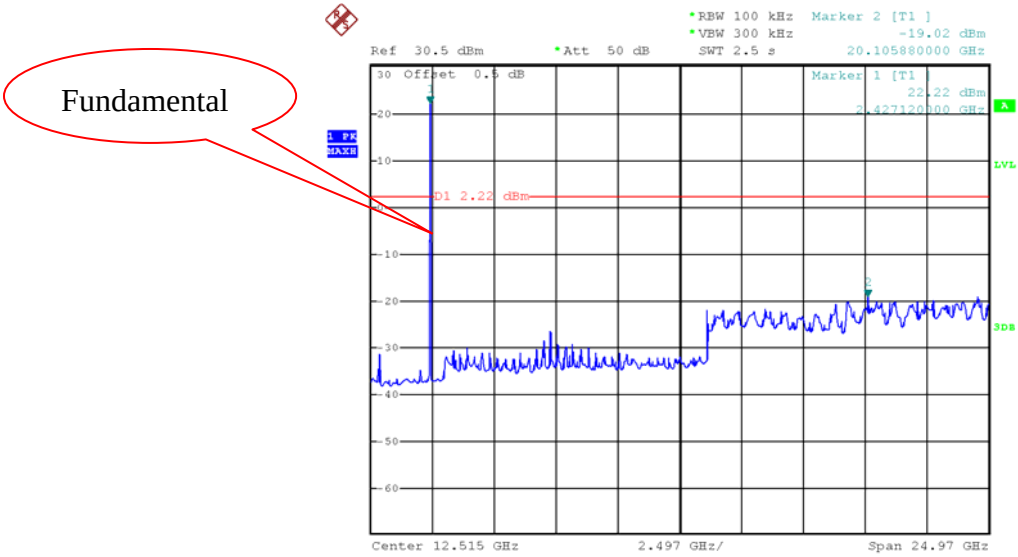
Date: 31.MAY.2022 14:35:14

Above 30MHz
GFSK (ANT 1)
Low Channel

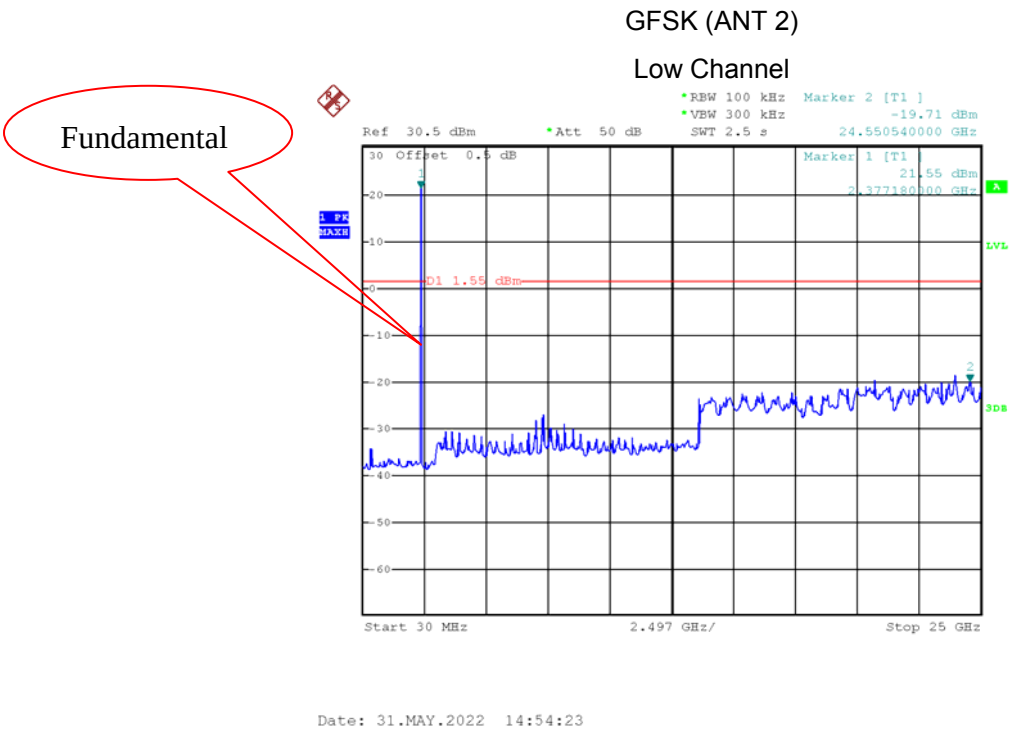
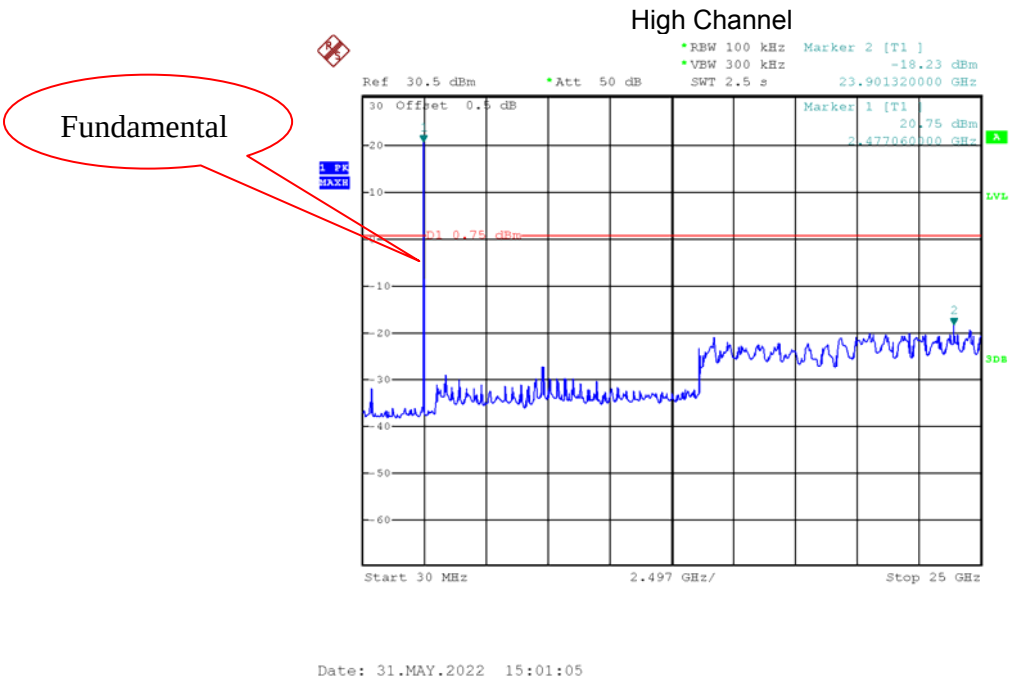


Date: 31.MAY.2022 14:53:49

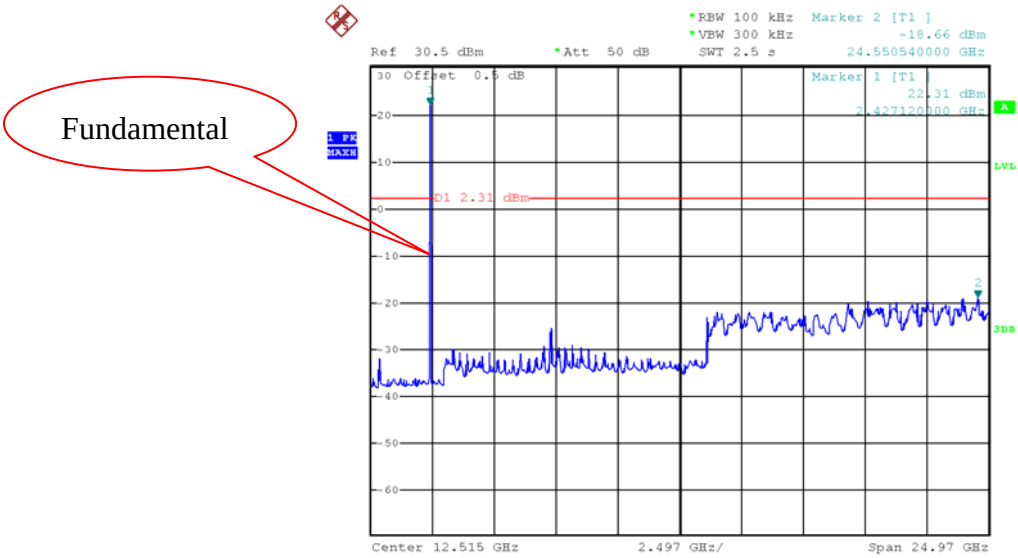
Middle Channel



Date: 31.MAY.2022 14:48:51

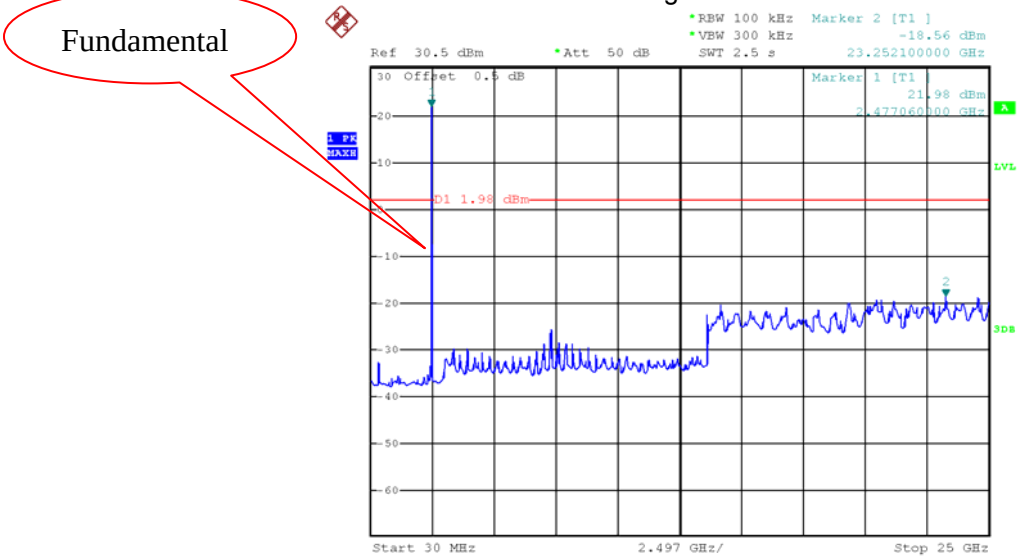


Middle Channel



Date: 31.MAY.2022 14:42:59

High Channel



Date: 31.MAY.2022 15:00:13

11 Band Edge Measurement

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019

Regulation 15.247 (d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or 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 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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 in §15.209(a) (see §15.205(c)).

Test Mode: Transmitting

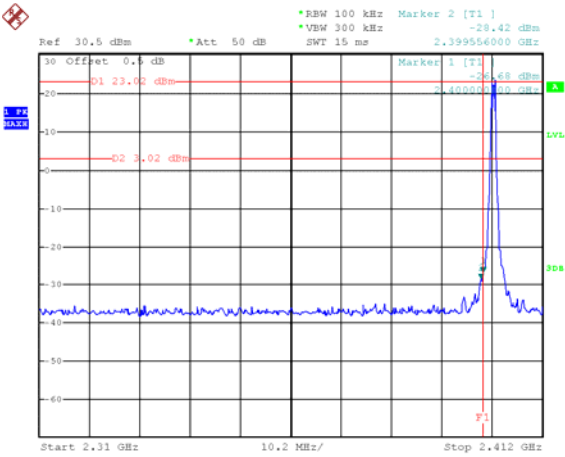
11.1 Test Produce

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

11.2 Test Result

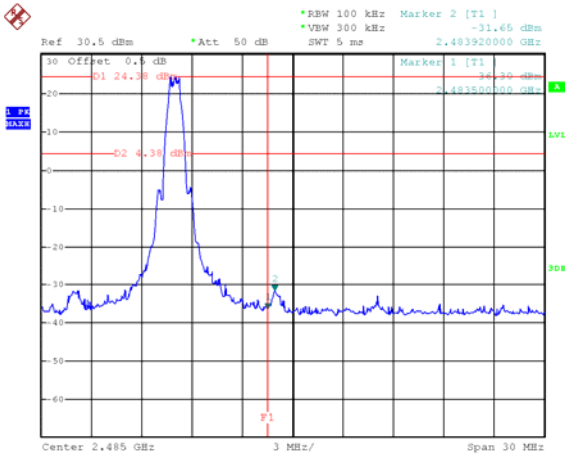
Test result plots shown as follows:

GFSK(ANT 1): Band edge-left side



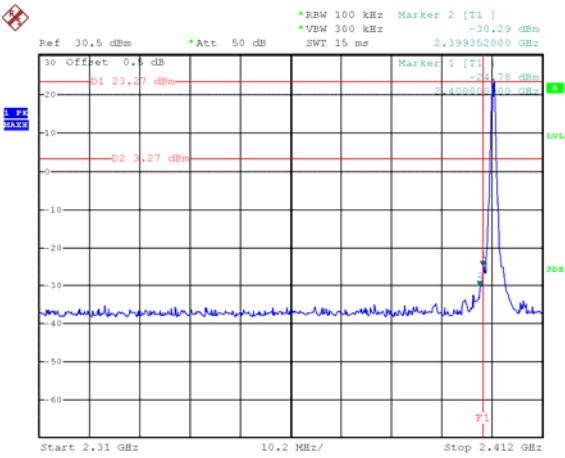
Date: 31.MAY.2022 12:48:03

GFSK(ANT 1): Band edge-right side



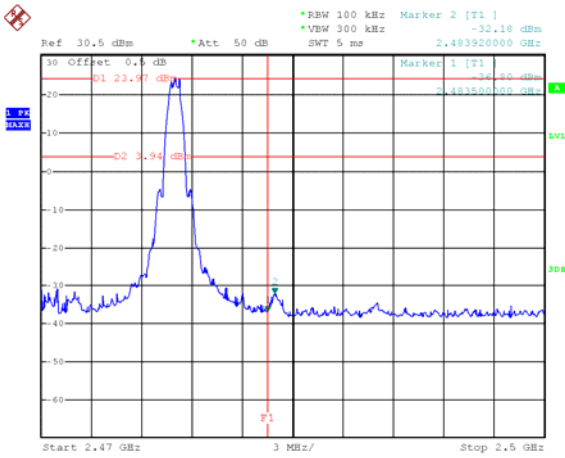
Date: 31.MAY.2022 14:30:42

GFSK(ANT 2): Band edge-left side



Date: 31.MAY.2022 12:46:48

GFSK(ANT 2): Band edge-right side



Date: 31.MAY.2022 14:32:01

12 6 dB Bandwidth and 99% Bandwidth Measurement

Test Requirement: FCC 47CFR Part 15 Section 15.247
 Test Method: ANSI C63.10:2013
 KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
 Test Limit: §15.247(a)(2)
 Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
 Test Mode: Transmitting

12.1 Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. 6dB Bandwidth Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz
 99% Bandwidth Set the spectrum analyzer: 1~5% of the OBW, VBW = 3 times the RBW

12.2 Test Result:

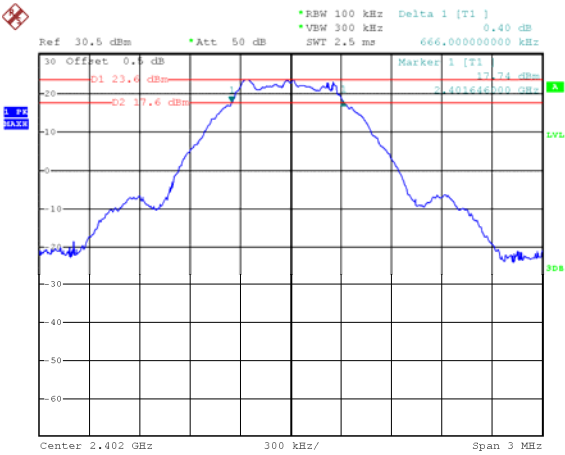
Operation mode	Test Channel	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
GFSK(ANT 1)	Channel 0	0.666	1.026
	Channel 12	0.696	1.032
	Channel 22	0.672	1.068
GFSK(ANT 2)	Channel 0	0.672	1.038
	Channel 12	0.690	1.026
	Channel 22	0.666	1.056

Test result plot:

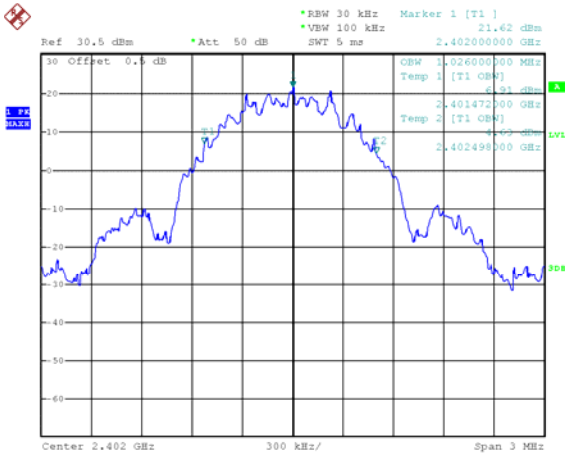
6 dB Bandwidth

99% Bandwidth

GFSK(ANT 1): channel 0



Date: 31.MAY.2022 11:59:05

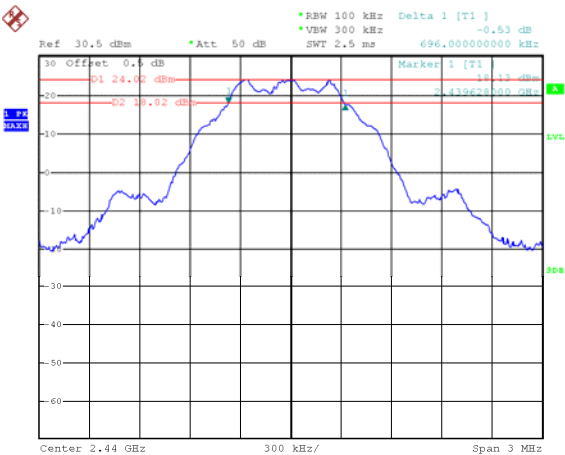


Date: 30.MAY.2022 15:27:17

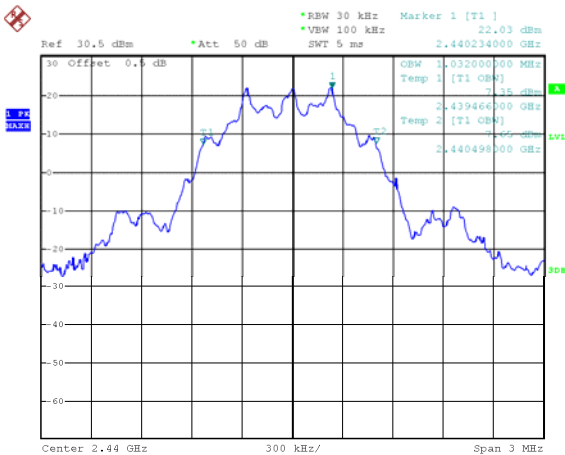
6 dB Bandwidth

99% Bandwidth

GFSK(ANT 1): channel 12



Date: 31.MAY.2022 11:56:20

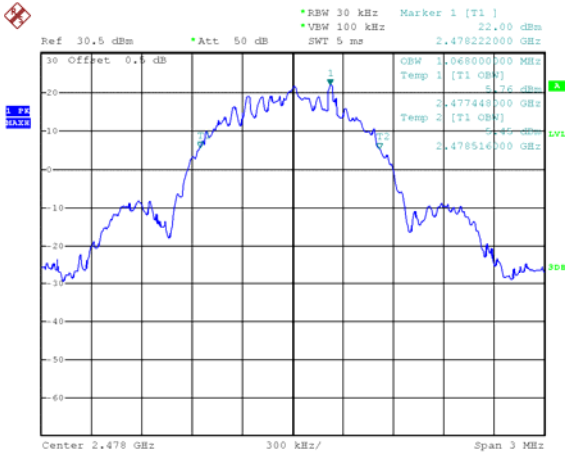
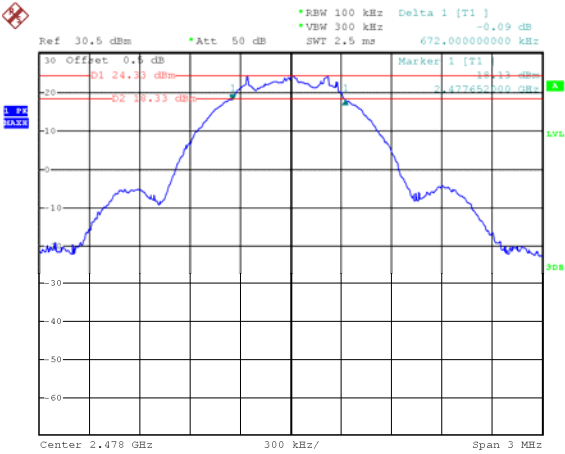


Date: 30.MAY.2022 15:10:32

6 dB Bandwidth

99% Bandwidth

GFSK(ANT 1): channel 22



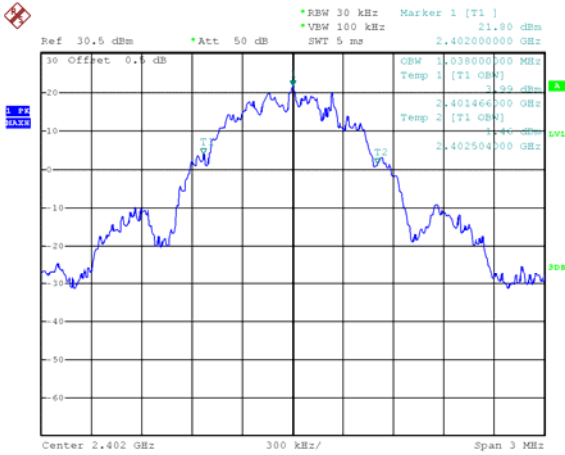
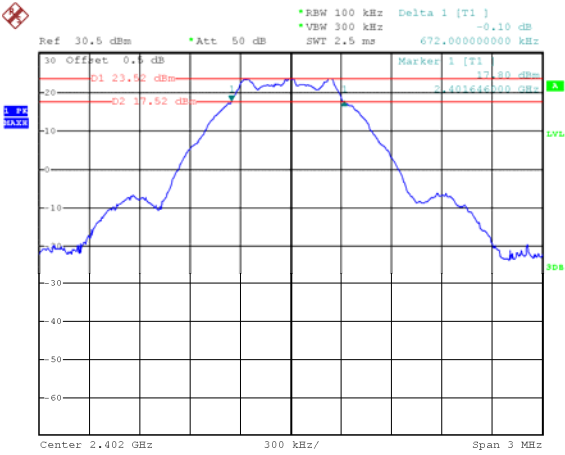
Date: 31.MAY.2022 12:00:12

Date: 30.MAY.2022 15:08:45

6 dB Bandwidth

99% Bandwidth

GFSK(ANT 2): channel 0



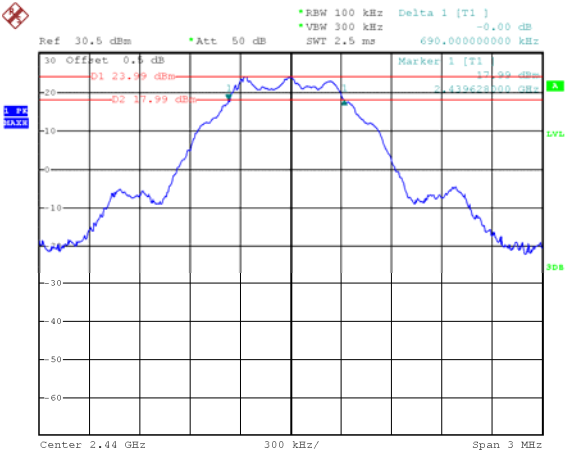
Date: 31.MAY.2022 11:58:25

Date: 30.MAY.2022 15:25:02

6 dB Bandwidth

99% Bandwidth

GFSK(ANT 2): channel 12



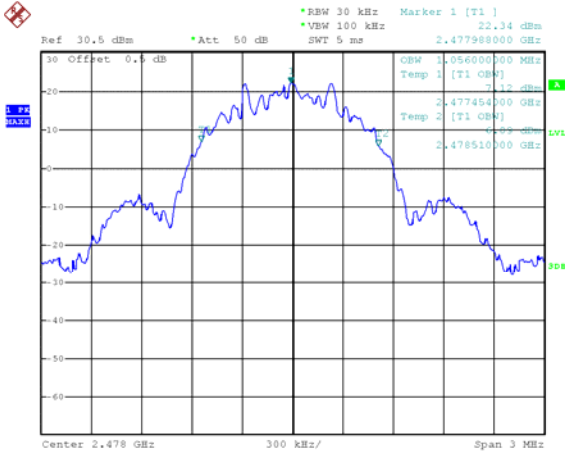
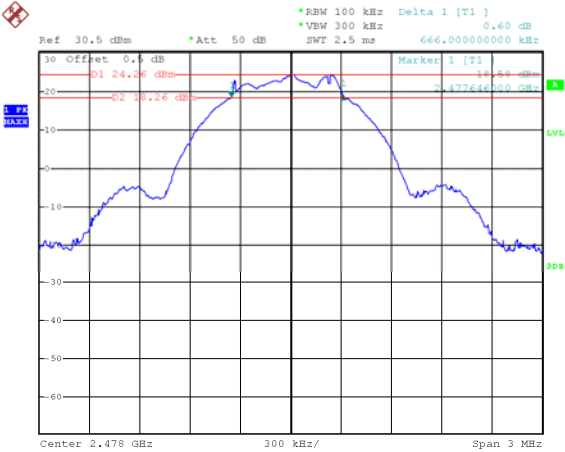
Date: 31.MAY.2022 11:57:06

Date: 30.MAY.2022 15:11:28

6 dB Bandwidth

99% Bandwidth

GFSK(ANT 2): channel 22



Date: 31.MAY.2022 12:01:27

Date: 30.MAY.2022 15:08:09

13 Maximum Peak conducted Output Power

Test Requirement:	FCC 47CFR Part 15 Section 15.247
Test Method:	ANSI C63.10:2013 KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
Test Limit:	§15.247(b) The maximum peak conducted output power of the intentional radiator shall not exceed 1W.
Test Mode:	Transmitting

13.1 Test Procedure:

According to KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019

Section 8.3.1.1 RBW $\geq$ DTS bandwidth

Subclause 11.9.1.1 of ANSI C63.10 is applicable.

Section 8.3.1.2 Integrated band power method

For measuring the output power of a device transmitting a wide-band noise-like signal where the peak power amplitude is a statistical parameter, the preferred methodology is to use an integrated average power measurement, as described in 8.3.2. The peak integrated band power method of 11.9.1 in ANSI C63.10 is not applicable.

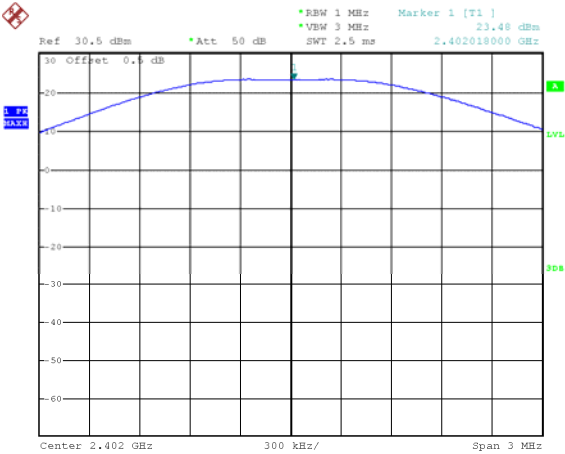
Subclause 11.9.2 of ANSI C63.10 is applicable.

13.2 Test Result:

Operation mode	Channel Frequency (MHz)	Maximum Peak Output Power (dBm)	Limit
GFSK(ANT 1)	Low-2402	23.48	1W/30dBm
	Middle-2440	23.86	1W/30dBm
	High-2478	24.19	1W/30dBm
GFSK(ANT 2)	Low-2402	23.43	1W/30dBm
	Middle-2440	23.85	1W/30dBm
	High-2478	24.21	1W/30dBm

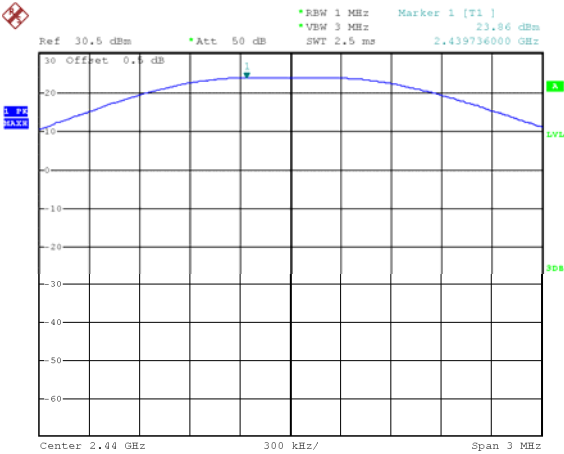
Test Plot:

GFSK(ANT 1): channel 0



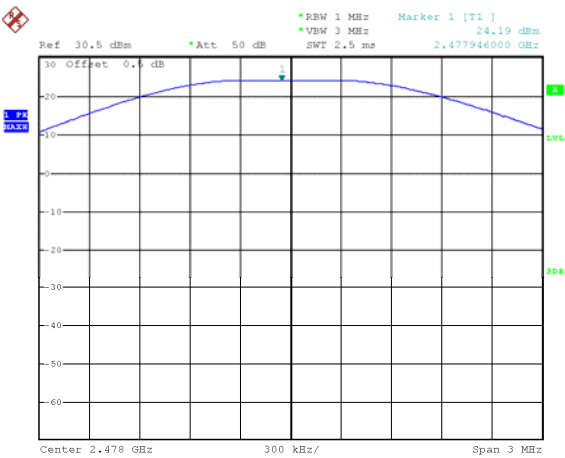
Date: 31.MAY.2022 12:05:37

GFSK(ANT 1): channel 12



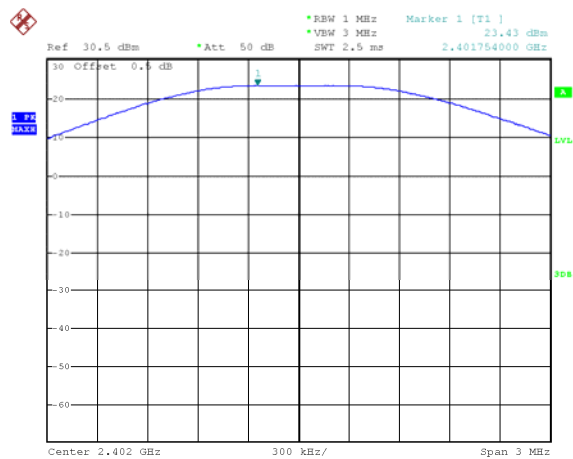
Date: 31.MAY.2022 12:06:54

GFSK(ANT 1): channel 22



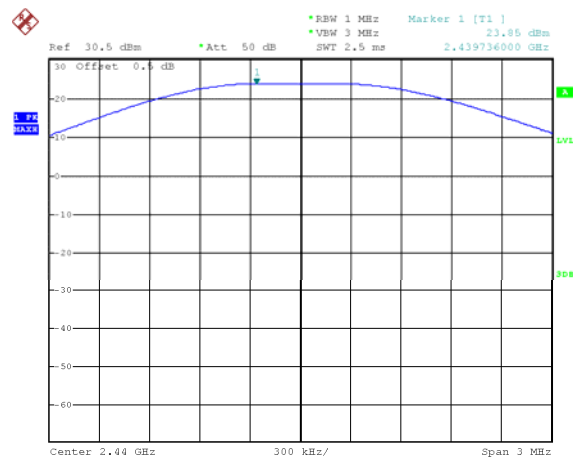
Date: 31.MAY.2022 12:07:25

GFSK(ANT 2): channel 0



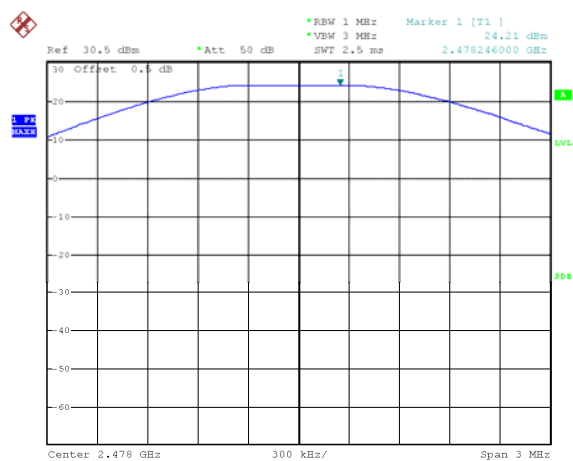
Date: 31.MAY.2022 12:05:59

GFSK(ANT 2): channel 12



Date: 31.MAY.2022 12:06:33

GFSK(ANT 2): channel 22



Date: 31.MAY.2022 12:07:44

14 Power Spectral density

Test Requirement:	FCC 47CFR Part 15 Section 15.247
Test Method:	ANSI C63.10:2013 KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
Test Limit:	§15.247(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.
Test Mode:	Transmitting

14.1 Test Procedure:

According to KDB 558074 D01 15.247 Meas Guidance v05r02 April 2, 2019 section 8.4

Subclause 11.10 of ANSI C63.10 is applicable.

Choose the test procedure according to the product type

Peak PSD

Subclause 11.10.2 of ANSI C63.10 is applicable.

AVG PSD

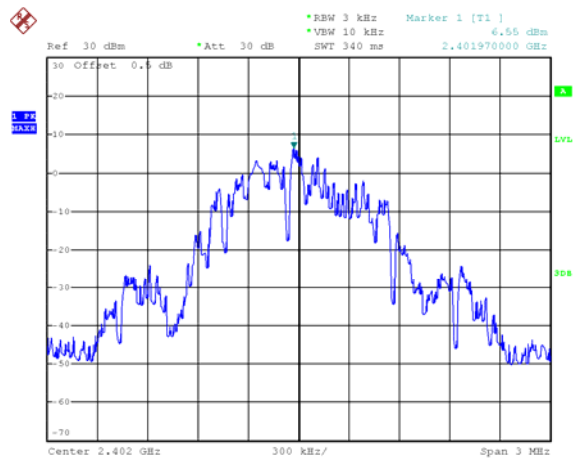
Subclause 11.10.3/4/5/6/7/8 of ANSI C63.10 is applicable.

14.2 Test Result:

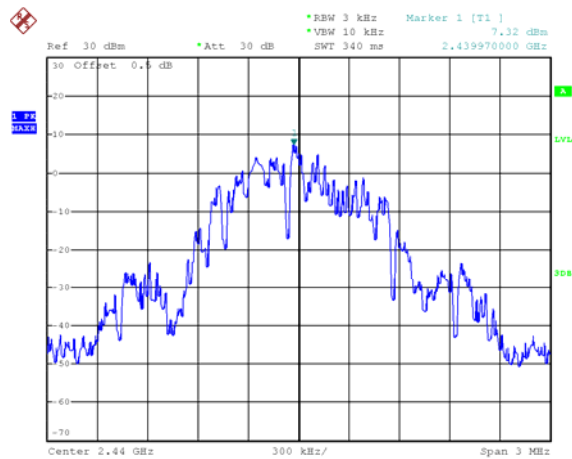
Operation mode	Channel Frequency (MHz)	Power Spectral (dBm per 3kHz)	Limit
GFSK(ANT 1)	Low-2402	6.55	8dBm per 3kHz
	Middle-2440	7.32	8dBm per 3kHz
	High-2478	6.59	8dBm per 3kHz
GFSK(ANT 2)	Low-2402	6.42	8dBm per 3kHz
	Middle-2440	7.09	8dBm per 3kHz
	High-2478	6.87	8dBm per 3kHz

Test Plot:

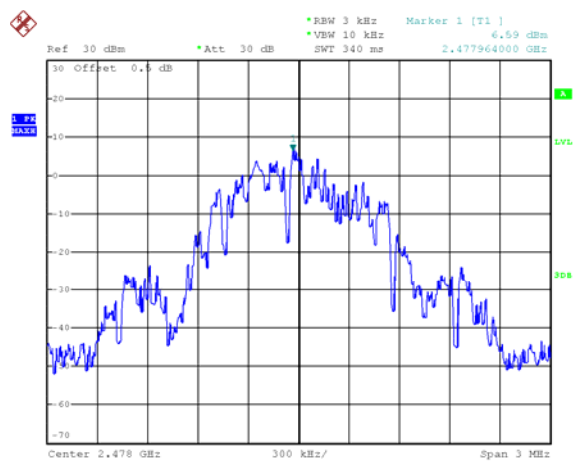
GFSK(ANT 1): channel 0



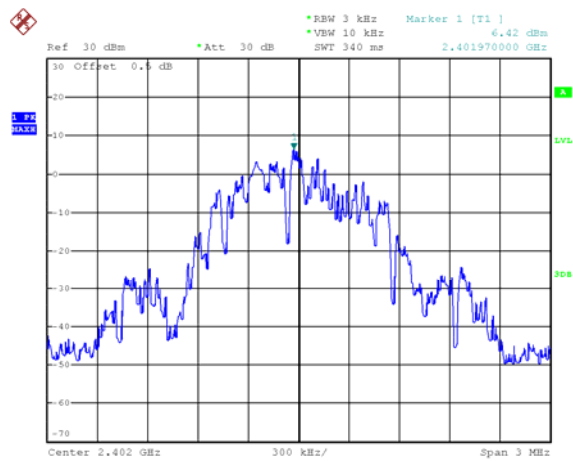
GFSK(ANT 1): channel 12



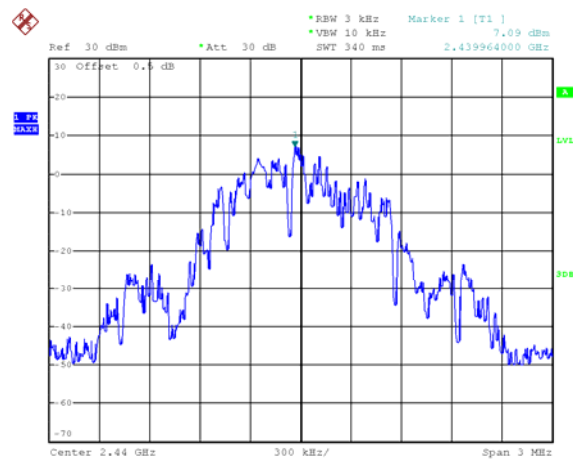
GFSK(ANT 1): channel 22



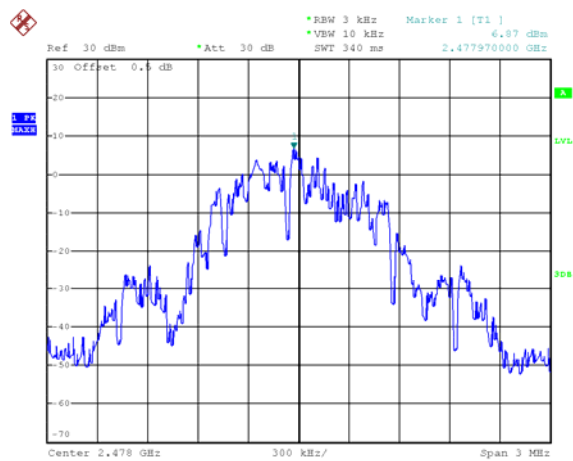
GFSK(ANT 2): channel 0



GFSK(ANT 2): channel 12



GFSK ANT 2): channel 22



15 Antenna Requirement

According to the FCC Part 15 Paragraph 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. This product has an internal permanent antenna fulfil the requirement of this section.

Note: Please refer to EUT photos for more details.

16 RF Exposure

Note: Please refer to SAR Test Report: WTF22X04076577W.

17 Photographs of test setup and EUT.

Note: Please refer to appendix: Appendix- SPMR20500-Photos.

=====End of Report=====