



FCC TEST REPORT

FCC ID: RSB-SP770

Product Name	:	Amplifier Speaker
Model Name	:	SP770/BK-358D/BK-001D/BK-002D/BK-003D
Brand Name	:	SYLVANIA, BOOK
Report No.	:	PTC19051605202E-FC01
Prepared for		
BK Pride Electronics Co.,Ltd.		
Book Digital Industry Park Meilin District,Dalingshan Town,Dongguan City,Guangdong Province		
Prepared by		
Dongguan Precise Testing & Certification Corp., Ltd.		
Building D, Baoding Technology Park, Guangming Road 2, Guangming Community, Dongcheng District, Dongguan, Guangdong, China		



Report No.: PTC19051605202E-FC01

1TEST RESULT CERTIFICATION

Applicant's name	:	BK Pride Electronics Co.,Ltd.
Address	:	Book Digital Industry Park Meilin District,Dalingshan Town,Dongguan City,Guangdong Province
Manufacture's name	:	BK Pride Electronics Co.,Ltd.
Address	:	Book Digital Industry Park Meilin District,Dalingshan Town,Dongguan City,Guangdong Province
Product name	:	Amplifier Speaker
Model name	:	SP770/BK-358D/BK-001D/BK-002D/BK-003D
Standards	:	FCC CFR47 Part 15 Section 15.247
Test procedure	:	ANSI C63.10:2013
Test Date	:	May 30, 2019 to June 25, 2019
Date of Issue	:	June 26, 2019
Test Result	:	Pass

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

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

Test Engineer:

Leo Yang / Engineer

Technical Manager:

Chris Du / Manager



Contents

Page

1 TEST RESULT CERTIFICATION.....	2
2 TEST SUMMARY.....	5
3 TEST FACILITY.....	6
4 GENERAL INFORMATION.....	7
4.1 GENERAL DESCRIPTION OF E.U.T.....	7
4.2 TEST MODE.....	8
4.3 ACCESSORIES OF EUT.....	10
4.4 ASSISTANT EQUIPMENT USED FOR TEST.....	11
4.5 DEVIATIONS OF TEST STANDARD.....	12
4.6 TEST ENVIRONMENT CONDITIONS.....	13
5 EQUIPMENT DURING TEST.....	14
5.1 EQUIPMENTS LIST.....	14
5.2 MEASUREMENT UNCERTAINTY.....	16
6 CONDUCTED EMISSION.....	17
6.1 E.U.T. OPERATION.....	17
6.2 EUT SETUP.....	17
6.3 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION).....	18
6.4 MEASUREMENT PROCEDURE.....	18
6.5 CONDUCTED EMISSION LIMIT.....	18
6.6 MEASUREMENT DESCRIPTION.....	18
6.7 CONDUCTED EMISSION TEST RESULT.....	18
7 RADIATED SPURIOUS EMISSIONS.....	21
7.1 EUT OPERATION.....	21
7.2 TEST SETUP.....	22
7.3 SPECTRUM ANALYZER SETUP.....	23
7.4 TEST PROCEDURE.....	24
7.5 SUMMARY OF TEST RESULTS.....	25
8 BAND EDGE COMPLIANCE (RADIATED METHOD)BLOCK DIAGRAM OF TEST SETUP.....	30
8.1 LIMIT.....	30
8.2 TEST PROCEDURE.....	30
8.3 TEST RESULT.....	31
9 CONDUCTED BAND EDGE EMISSION.....	33
9.1 REQUIREMENT.....	33
9.2 TEST PROCEDURE.....	33
9.3 TEST SETUP.....	33
9.4 EUT OPERATION CONDITIONS.....	34
9.5 TEST RESULTS.....	34
10 20 DB BANDWIDTH MEASUREMENT.....	39
10.1 TEST PROCEDURE.....	39
10.2 TEST RESULT.....	39
11 MAXIMUM PEAK OUTPUT POWER.....	43
11.1 TEST PROCEDURE.....	43
11.2 TEST RESULT.....	43
12 HOPPING CHANNEL SEPARATION.....	47
12.1 TEST PROCEDURE.....	47
12.2 TEST RESULT.....	47
13 NUMBER OF HOPPING FREQUENCY.....	49
13.1 TEST PROCEDURE.....	49
13.2 TEST RESULT.....	49



Report No.: PTC19051605202E-FC01

14 DWELL TIME	51
14.1 TEST PROCEDURE	51
14.2 TEST RESULT	51
15 ANTENNA REQUIREMENT	58
15.1 ANTENNA REQUIREMENT	58
15.2 RESULT	58



Report No.: PTC19051605202E-FC01

2 Test Summary

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



Report No.: PTC19051605202E-FC01

3 TEST FACILITY

Dongguan Precise Testing & Certification Corp., Ltd.

Address: Building D, Baoding Technology Park, Guangming Road2, Dongcheng District, Dongguan,
Guangdong, China

FCC Registration Number: 790290

A2LA Certificate No.: 4408.01

IC Registration Number: 12191A-1



Report No.: PTC19051605202E-FC01

4 General Information

4.1 General Description of E.U.T.

Product Name	:	Amplifier Speaker
Model Name	:	SP770/BK-358D/BK-001D/BK-002D/BK-003D
Difference of model number	:	All models are identical except the model number, therefore the test performed on the model SP770.
Power supply	:	DC 15V/2.4A input via adapter AC 120V 60Hz (adapter model:RS-AE024J00)
Bluetooth Version	:	BT 4.2+EDR
Operating frequency	:	2402MHz-2480MHz
Numbers of Channel	:	79 channels
Operation frequency	:	2402MHz -2480MHz
Modulation	:	GFSK, $\pi/4$ -DQPSK
Data rate	:	1Mbps, 2Mbps
Antenna Type	:	Integral PCB antenna, maximum PK gain: -0.68dBi
Sample Type	:	Series production



4.2 Test Mode

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

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

The EUT has been tested under TX operating condition.

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

Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	1	2403	2	2404	3	2405
4	2406	5	2407	6	2408	7	2409
8	2410	9	2411	10	2412	11	2413
12	2414	13	2415	14	2416	15	2417
16	2418	17	2419	18	2420	19	2421
20	2422	21	2423	22	2424	23	2425
24	2426	25	2427	26	2428	27	2429
28	2430	29	2431	30	2432	31	2433
32	2434	33	2435	34	2436	35	2437
36	2438	37	2439	38	2440	39	2441
40	2442	41	2443	42	2444	43	2445
44	2446	45	2447	46	2448	47	2449
48	2450	49	2451	50	2452	51	2453
52	2454	53	2455	54	2456	55	2457
56	2458	57	2459	58	2460	59	2461
60	2462	61	2463	62	2464	63	2465
64	2466	65	2467	66	2468	67	2469
68	2470	69	2471	70	2472	71	2473
72	2474	73	2475	74	2476	75	2477
76	2478	77	2479	78	2480	-	-

Tested mode, channel, information		
Mode	Channel	Frequency (MHz)
GFSK hopping on Tx mode	CH0 to CH78	2402 to 2480



Report No.: PTC19051605202E-FC01

$\pi/4$ -DQPSK hopping on Tx mode	CH0 to CH78	2402 to 2480
GFSK hopping off Tx mode	CH0	2402
	CH39	2441
	CH78	2480
$\pi/4$ -DQPSK hopping off Tx mode	CH0	2402
	CH39	2441
	CH78	2480



Report No.: PTC19051605202E-FC01

4.3 Accessories of EUT

Description of Accessories	Manufacturer	Model number	Serial No.	Other
AC ADAPTER	Shenzhen Jinhusheng Power Technology Co.,Ltd	RS-AE024J00	N/A	Length: 1.5m



Report No.: PTC19051605202E-FC01

4.4 Assistant equipment used for test

Assistant equipment	Manufacturer	Model number	EMC Compliance	SN
Notebook	DELL	Latitude D610	FCC DOC	00045-534-136-300
Battery	N/A	N/A	N/A	N/A



Report No.: PTC19051605202E-FC01

4.5 Deviations of test standard

No Deviation.



Report No.: PTC19051605202E-FC01

4.6 Test environment conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature range:	21-25°C
Humidity range:	40-75%
Pressure range:	86-106kPa



Report No.: PTC19051605202E-FC01

5 Equipment During Test

5.1 Equipments List

RF Conducted Test

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
MXG Signal Analyzer	Agilent	N9020A	MY56070279	10Hz-30GHz	Sep.19, 2019
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	Sep.19, 2019
Antenna Connector	Florida RF Labs	N/A	RF01#	N/A	Sep.19, 2019

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

Radiated Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Sep.19, 2019
Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	Sep.19, 2019
Bilog Antenna	SCHWARZBECK	VULB9160	9160-3355	25MHz-2GHz	Sep.19, 2019
Preamplifier (low frequency)	SCHWARZBECK	BBV 9475	9745-0013	1MHz-1GHz	Sep.19, 2019
Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	Sep.19, 2019
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-40GHz	Sep.19, 2019
Horn Antenna	SCHWARZBECK	9120D	9120D-1246	1GHz-18GHz	Sep.19, 2019
Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	Sep.19, 2019
Horn Antenna	SCHWARZBECK	BBHA 9170	9170-181	14GHz-40GHz	Sep.25, 2019
Amplifier	SCHWARZBECK	BBV 9721	9721-205	18GHz-40GHz	Sep.19, 2019
Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	Sep.19, 2019
RF Cable	R&S	R204	R21X	1GHz-40GHz	Sep.19, 2019

Conducted Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Sep.19, 2019



Report No.: PTC19051605202E-FC01

Artificial Mains Network	Rohde&Schwarz	L2-16B	000WX31025	9KHz-300MHz	Sep.19, 2019
Artificial Mains Network	Rohde&Schwarz	ENV216	101342	9KHz-300MHz	Sep.19, 2019



Report No.: PTC19051605202E-FC01

5.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	$\pm 1.0\text{dB}$
Power Spectral Density, conducted	$\pm 2.2\text{dB}$
Radio Frequency	$\pm 1 \times 10^{-6}$
Bandwidth	$\pm 1.5 \times 10^{-6}$
Time	$\pm 2\%$
Duty Cycle	$\pm 2\%$
Temperature	$\pm 1^\circ\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 3\%$
Conducted Emissions (150kHz~30MHz)	$\pm 3.64\text{dB}$
Radiated Emission(30MHz~1GHz)	$\pm 5.03\text{dB}$
Radiated Emission(1GHz~25GHz)	$\pm 4.74\text{dB}$
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	



6 Conducted Emission

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

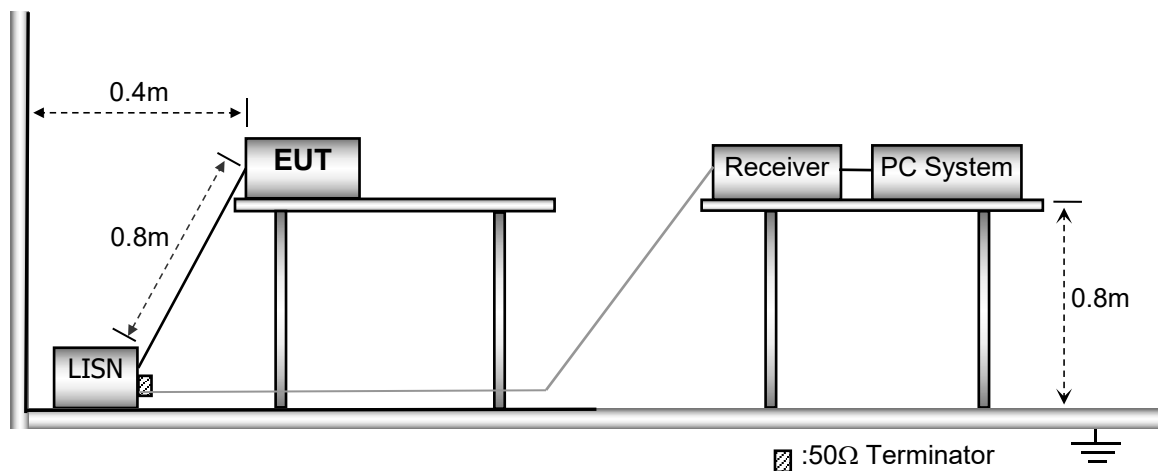
6.1 E.U.T. Operation

Operating Environment :

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

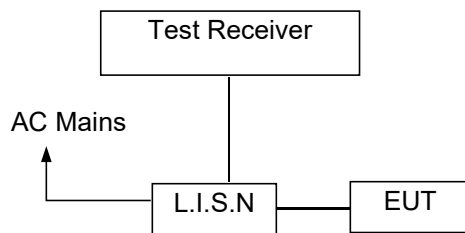
6.2 EUT Setup

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





6.3 Test SET-UP (Block Diagram of Configuration)



6.4 Measurement Procedure:

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

6.5 Conducted Emission Limit

Conducted Emission

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

Note:

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

6.6 Measurement Description

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

6.7 Conducted Emission Test Result

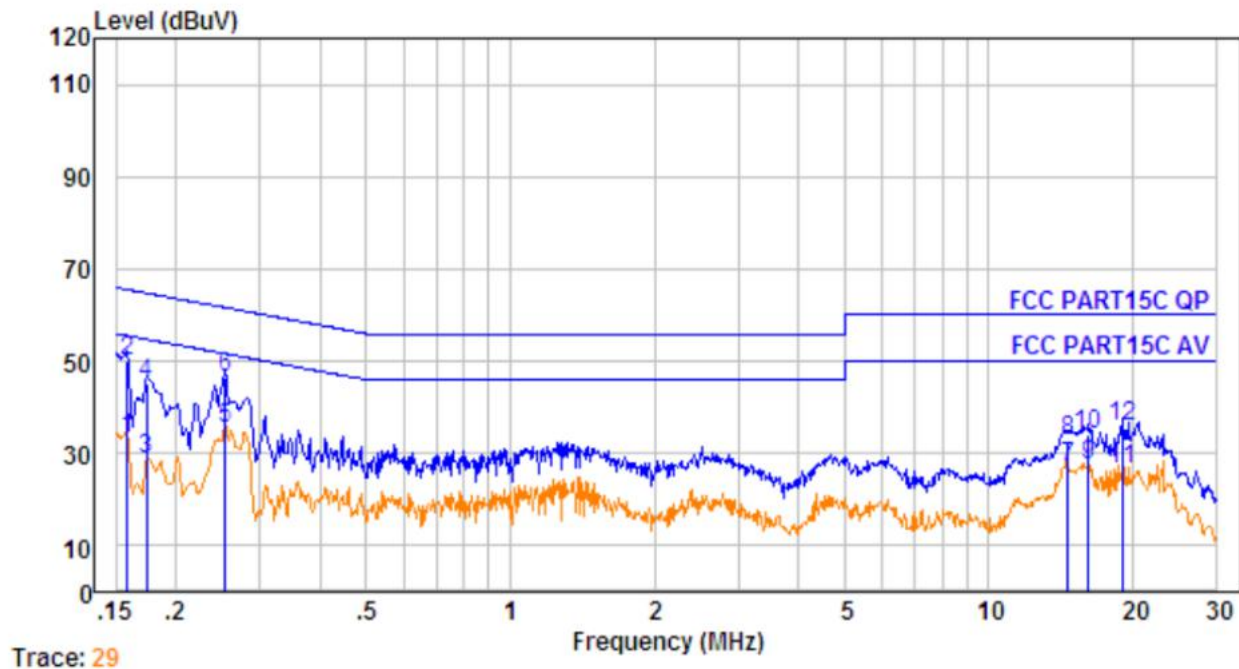
Pass.

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



Report No.: PTC19051605202E-FC01

Line -120V/60Hz:

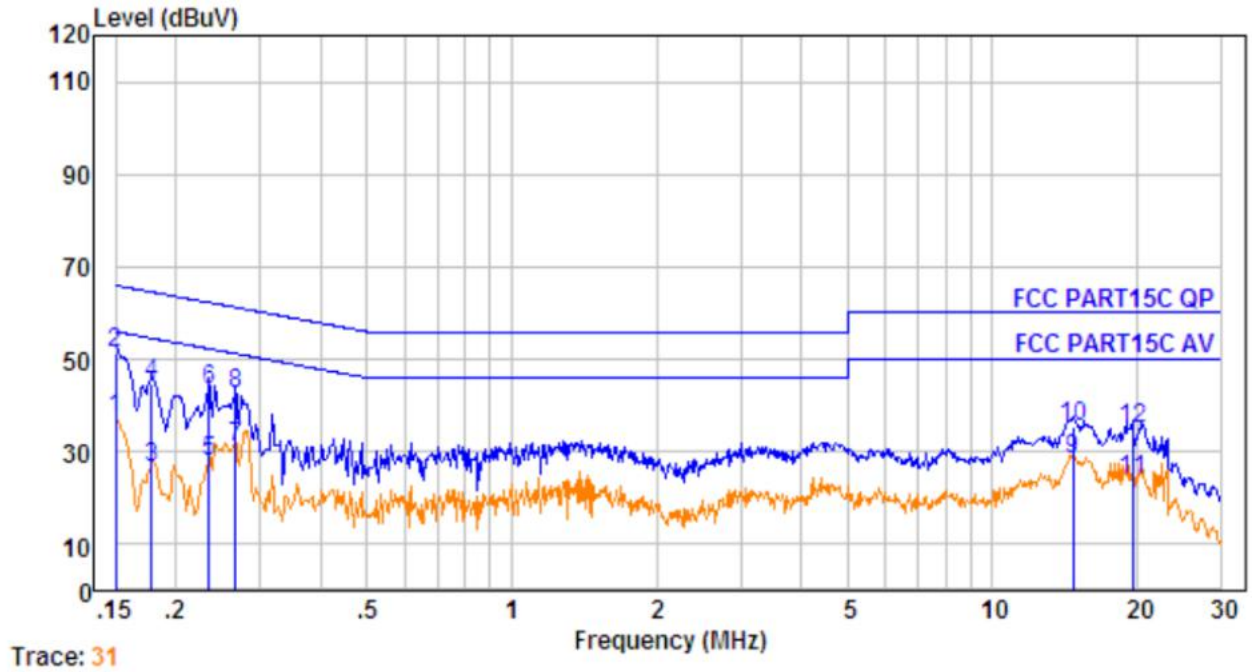


No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	0.158	0.22	9.51	23.47	33.20	55.56	-22.36	Average
2.	0.158	0.22	9.51	40.40	50.13	65.56	-15.43	QP
3.	0.174	0.24	9.54	19.01	28.79	54.77	-25.98	Average
4.	0.174	0.24	9.54	35.42	45.20	64.77	-19.57	QP
5.	0.253	0.33	9.64	25.46	35.43	51.64	-16.21	Average
6.	0.253	0.33	9.64	36.41	46.38	61.64	-15.26	QP
7.	14.672	0.56	10.01	16.63	27.20	50.00	-22.80	Average
8.	14.672	0.56	10.01	22.42	32.99	60.00	-27.01	QP
9.	16.140	0.52	9.97	16.98	27.47	50.00	-22.53	Average
10.	16.140	0.52	9.97	23.44	33.93	60.00	-26.07	QP
11.	19.021	0.42	9.87	16.41	26.70	50.00	-23.30	Average
12.	19.021	0.42	9.87	25.51	35.80	60.00	-24.20	QP



Report No.: PTC19051605202E-FC01

Neutral -120V/60Hz:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBUV	Emission Level dBUV	Limit dBUV	Over Limit dB	Remark
1.	0.150	0.21	9.53	27.43	37.17	56.00	-18.83	Average
2.	0.150	0.21	9.53	41.63	51.37	66.00	-14.63	QP
3.	0.178	0.25	9.58	16.90	26.73	54.59	-27.86	Average
4.	0.178	0.25	9.58	34.84	44.67	64.59	-19.92	QP
5.	0.234	0.31	9.65	17.97	27.93	52.30	-24.37	Average
6.	0.234	0.31	9.65	33.42	43.38	62.30	-18.92	QP
7.	0.266	0.34	9.68	21.08	31.10	51.25	-20.15	Average
8.	0.266	0.34	9.68	32.41	42.43	61.25	-18.82	QP
9.	14.750	0.56	10.08	17.78	28.42	50.00	-21.58	Average
10.	14.750	0.56	10.08	24.64	35.28	60.00	-24.72	QP
11.	19.532	0.40	9.97	13.50	23.87	50.00	-26.13	Average
12.	19.532	0.40	9.97	24.65	35.02	60.00	-24.98	QP



Report No.: PTC19051605202E-FC01

7 Radiated Spurious Emissions

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

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

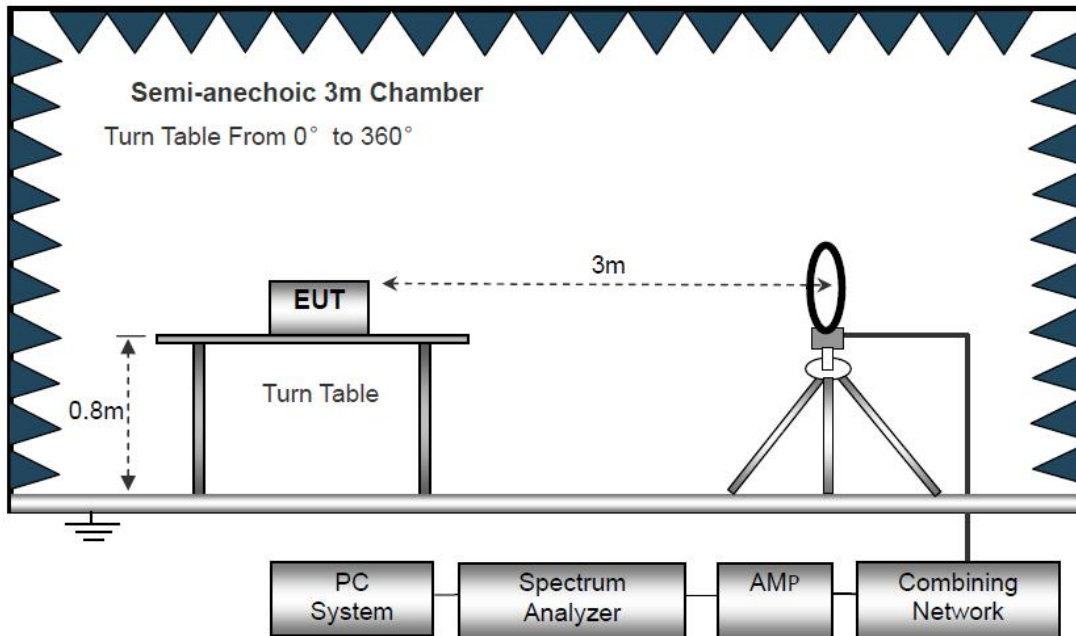
7.1 EUT Operation

Operating Environment :

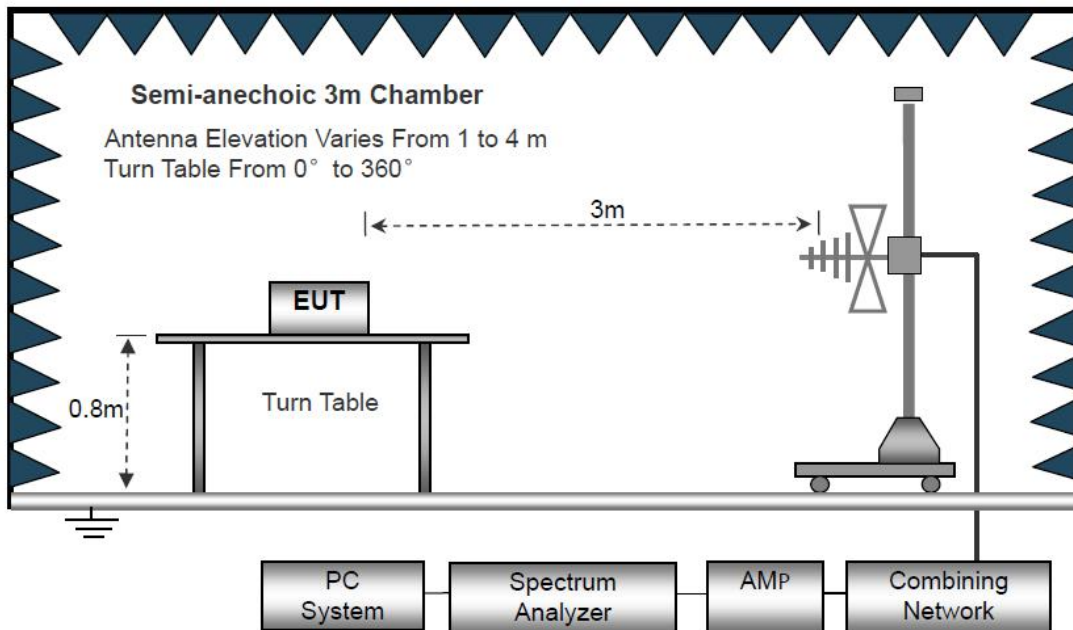
Temperature : 23.5 °C
Humidity : 51.1 % RH
Atmospheric Pressure : 101.2kPa

7.2 Test Setup

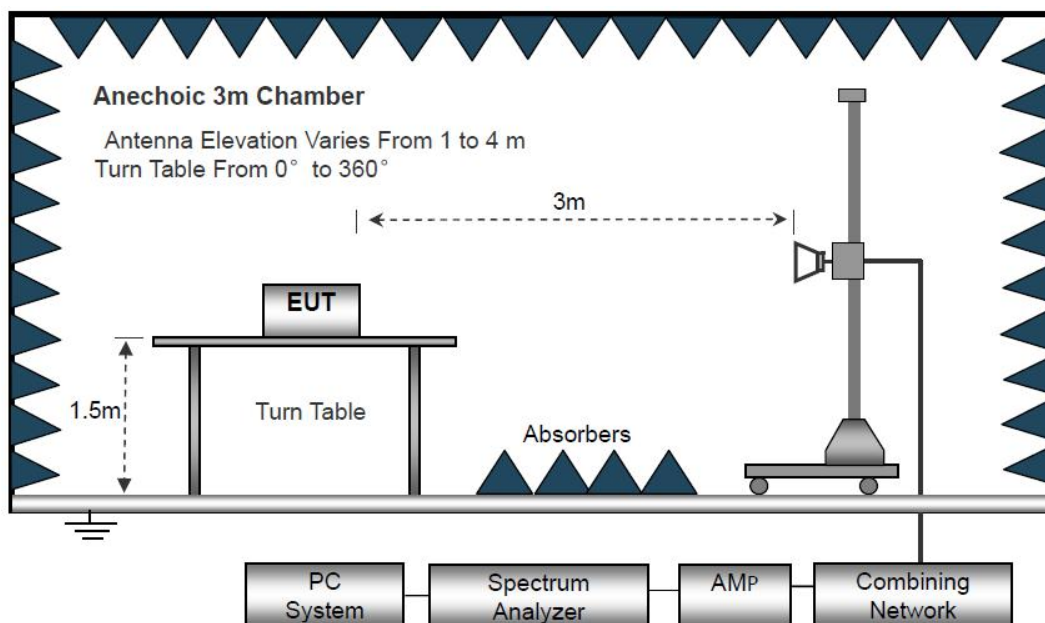
The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

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

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



7.4 Test Procedure

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



7.5 Summary of Test Results

PASS. (See below detailed test result)

All the emissions except fundamental emission from 9 kHz to 25GHz were comply with 15.209 limits.

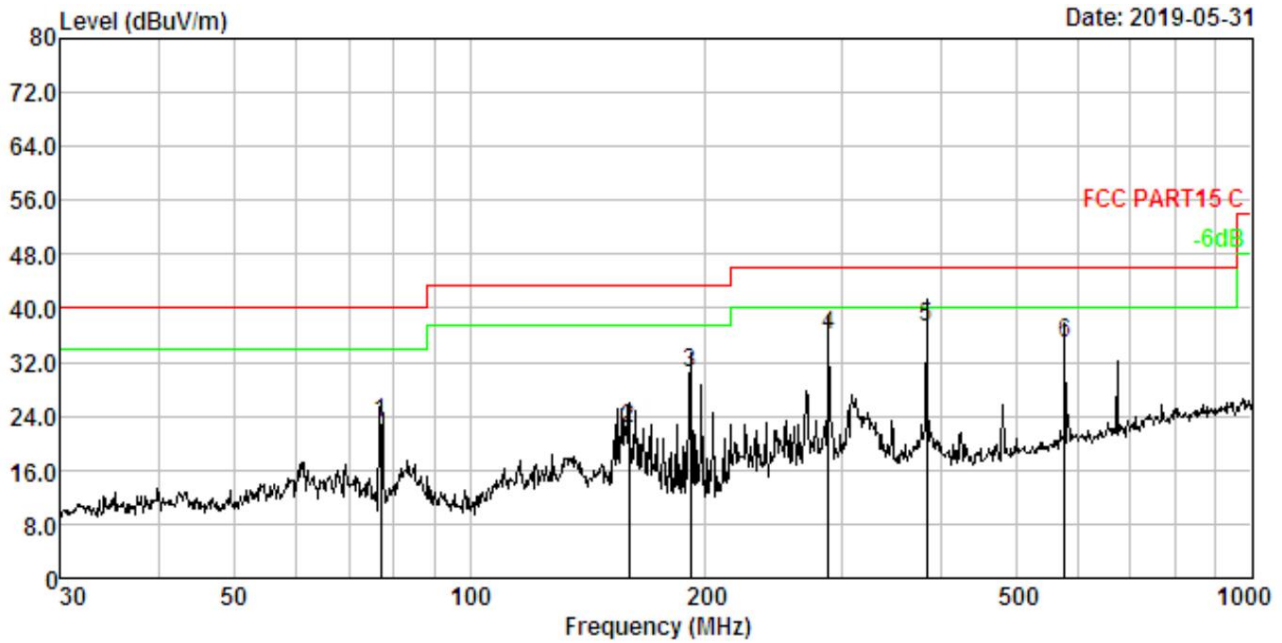
Note1: According exploratory test no any obvious emission was detected from 9kHz to 30MHz and 18GHz to 25GHz.

Note2: For emissions below 1GHz, according exploratory explorer test, when change Tx mode and channel, have no distinct influence on emissions level, so for emissions below 1GHz, the final test was only performed with EUT working in $\pi/4$ -DQPSK, Tx 2480MHz mode.

Note3: For emissions above 1GHz. If peak results comply with AV limit, AV Result is deemed to comply with AV limit.



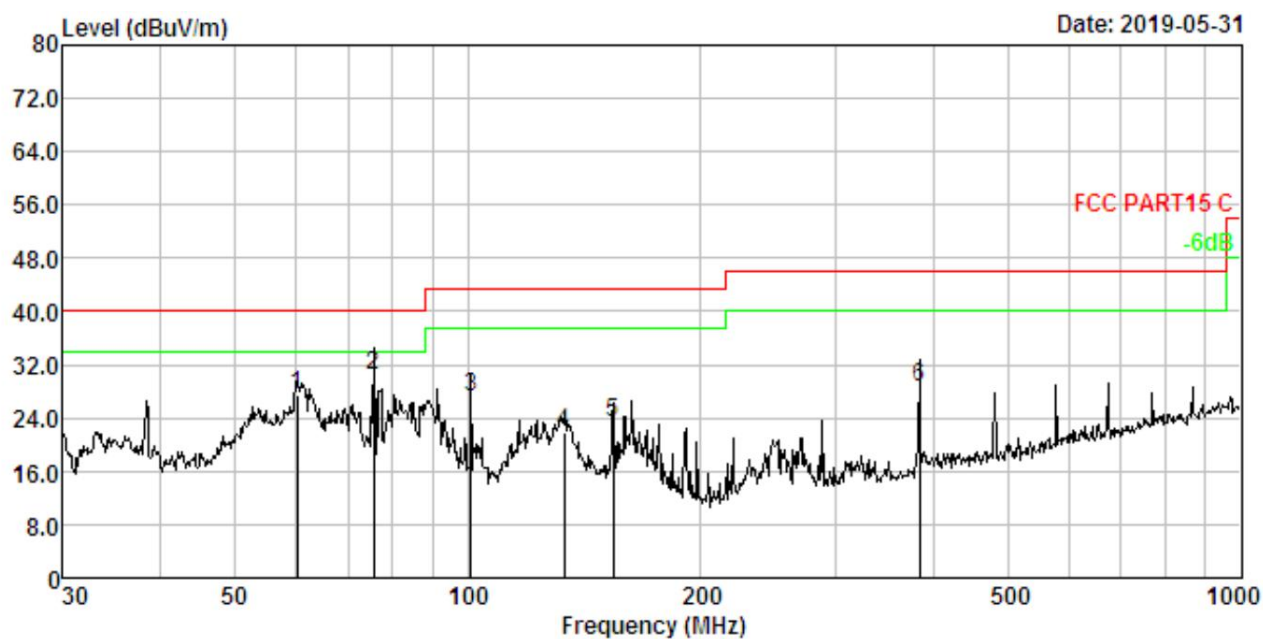
Test plot for Horizontal: GFSK(2402MHz)



No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamp Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	77.051	2.82	9.41	41.01	30.30	22.94	40.00	-17.06	QP
2.	159.784	4.08	13.88	34.60	30.55	22.01	43.50	-21.49	QP
3.	191.745	4.39	10.97	45.65	30.62	30.39	43.50	-13.11	QP
4.	287.990	5.09	12.96	48.75	30.76	36.04	46.00	-9.96	QP
5.	383.932	5.58	14.97	47.64	30.86	37.33	46.00	-8.67	QP
6.	576.644	6.28	18.55	41.08	31.00	34.91	46.00	-11.09	QP



Test plot for Vertical: GFSK(2402MHz)



No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamp Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	60.280	2.40	12.15	43.06	30.21	27.40	40.00	-12.60	QP
2.	75.711	2.79	9.71	48.20	30.29	30.41	40.00	-9.59	QP
3.	100.934	3.29	10.32	44.05	30.39	27.27	43.50	-16.23	QP
4.	133.151	3.76	12.87	35.76	30.49	21.90	43.50	-21.60	QP
5.	154.279	4.02	13.89	35.83	30.54	23.20	43.50	-20.30	QP
6.	383.932	5.58	14.97	38.95	30.86	28.64	46.00	-17.36	QP



Report No.: PTC19051605202E-FC01

Radiated Emission test (above 1GHz)

Freq. (MHz)	Read level (dBμV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBμV/m)	Limit (dBμV/ m)	Margin (dB)	Detector type	Polarization
Tx mode 2402MHz									
4808.00	52.58	34.69	43.92	7.39	50.74	74.00	-23.26	Peak	HORIZONTAL
7358.00	48.36	36.94	43.61	8.65	50.34	74.00	-23.66	Peak	HORIZONTAL
9551.00	47.70	37.75	44.27	10.66	51.84	74.00	-22.16	Peak	HORIZONTAL
12101.00	44.70	38.88	44.13	11.01	50.46	74.00	-23.54	Peak	HORIZONTAL
13512.00	44.23	39.80	44.48	11.87	51.42	74.00	-22.58	Peak	HORIZONTAL
14855.00	42.45	41.57	44.30	12.80	52.52	74.00	-21.48	Peak	HORIZONTAL
4808.00	51.14	34.69	43.92	7.39	49.30	74.00	-24.70	Peak	VERTICAL
7392.00	47.55	36.96	43.62	8.68	49.57	74.00	-24.43	Peak	VERTICAL
9500.00	46.43	37.70	44.25	10.63	50.51	74.00	-23.49	Peak	VERTICAL
11540.00	45.52	38.62	44.17	11.01	50.98	74.00	-23.02	Peak	VERTICAL
13019.00	45.27	39.32	44.35	11.37	51.61	74.00	-22.39	Peak	VERTICAL
14345.00	43.66	41.03	44.48	12.54	52.75	74.00	-21.25	Peak	VERTICAL
Tx mode 2441MHz									
4910.00	48.86	34.86	43.85	7.49	47.36	74.00	-26.64	Peak	HORIZONTAL
7358.00	47.79	36.94	43.61	8.65	49.77	74.00	-24.23	Peak	HORIZONTAL
9568.00	46.49	37.77	44.27	10.67	50.66	74.00	-23.34	Peak	HORIZONTAL
12050.00	44.55	38.89	44.11	10.99	50.32	74.00	-23.68	Peak	HORIZONTAL
13444.00	44.19	39.74	44.46	11.80	51.27	74.00	-22.73	Peak	HORIZONTAL
15025.00	42.47	41.65	44.24	12.89	52.77	74.00	-21.23	Peak	HORIZONTAL
4876.00	50.74	34.80	43.87	7.46	49.13	74.00	-24.87	Peak	VERTICAL
7205.00	48.27	36.88	43.56	8.51	50.10	74.00	-23.90	Peak	VERTICAL



Report No.: PTC19051605202E-FC01

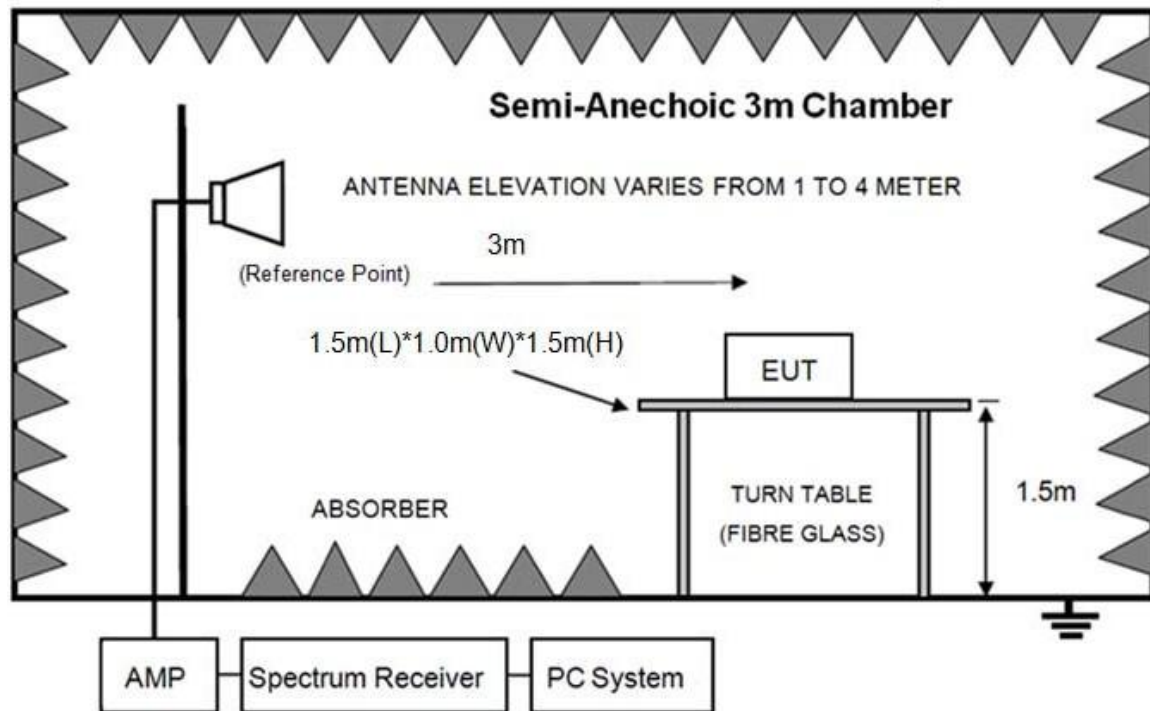
9534.00	45.99	37.73	44.26	10.65	50.11	74.00	-23.89	Peak	VERTICAL
11523.00	44.69	38.61	44.17	11.01	50.14	74.00	-23.86	Peak	VERTICAL
13121.00	45.37	39.42	44.38	11.47	51.88	74.00	-22.12	Peak	VERTICAL
14685.00	43.08	41.54	44.36	12.71	52.97	74.00	-21.03	Peak	VERTICAL
Tx mode 2480MHz									
4910.00	49.07	34.86	43.85	7.49	47.57	74.00	-26.43	Peak	HORIZONTAL
7953.00	47.72	37.18	43.79	9.19	50.30	74.00	-23.70	Peak	HORIZONTAL
9772.00	46.19	37.97	44.33	10.77	50.60	74.00	-23.40	Peak	HORIZONTAL
12101.00	44.46	38.88	44.13	11.01	50.22	74.00	-23.78	Peak	HORIZONTAL
13631.00	44.76	39.85	44.51	11.99	52.09	74.00	-21.91	Peak	HORIZONTAL
14413.00	43.08	41.24	44.46	12.57	52.43	74.00	-21.57	Peak	HORIZONTAL
4961.00	49.48	34.94	43.82	7.54	48.14	74.00	-25.86	Peak	VERTICAL
7953.00	47.35	37.18	43.79	9.19	49.93	74.00	-24.07	Peak	VERTICAL
9602.00	46.05	37.80	44.28	10.68	50.25	74.00	-23.75	Peak	VERTICAL
11829.00	44.35	38.80	44.13	10.99	50.01	74.00	-23.99	Peak	VERTICAL
13121.00	45.21	39.42	44.38	11.47	51.72	74.00	-22.28	Peak	VERTICAL
14583.00	42.90	41.52	44.40	12.66	52.68	74.00	-21.32	Peak	VERTICAL
Result: Pass									

Note: 1.30MHz~25GHz: (Scan with GFSK, $\pi/4$ -DQPSK, worse case is $\pi/4$ -DQPSK Mode)

2. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.

3: For emissions above 1GHz. If peak results comply with AV limit,
AV Result is deemed to comply with AV limit.

8 Band Edge Compliance (radiated method)Block diagram of test setup



8.1 Limit

All restriction band should comply with 15.209, other emission should be at least 20dB below the fundamental.

8.2 Test Procedure

Same with clause 10.3 except change investigated frequency range from 2310MHz to 2415MHz and 2475MHz to 2500MHz.

Remark: All restriction band have been tested, and only the worst case is shown in report.



8.3 Test result

PASS. (See below detailed test result)

Remark: hopping on and hopping off mode all have been test, hopping off mode is worst and reported only.

GFSK 2402MHz

Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/ m)	Over Limit (dB)	Detector	Polarization
1	2369.59	56.76	26.93	44.32	5.09	44.46	74.00	-29.54	Peak	HORIZONTAL
2	2390.00	54.13	27.00	44.32	5.11	41.92	74.00	-32.08	Peak	HORIZONTAL

Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/ m)	Over Limit (dB)	Detector	Polarization
1	2371.90	57.96	26.94	44.32	5.09	45.67	74.00	-28.33	Peak	VERTICAL
2	2390.00	54.69	27.00	44.32	5.11	42.48	74.00	-31.52	Peak	VERTICAL

GFSK 2480MHz

Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/ m)	Over Limit (dB)	Detector	Polarization
1	2483.50	54.98	27.34	44.32	5.21	43.21	74.00	-30.79	Peak	HORIZONTAL
2	2487.55	54.38	27.36	44.32	5.22	42.64	74.00	-31.36	Peak	HORIZONTAL

Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/ m)	Over Limit (dB)	Detector	Polarization
1	2483.50	56.87	27.34	44.32	5.21	45.10	74.00	-28.90	Peak	VERTICAL
2	2484.85	56.78	27.35	44.32	5.21	45.02	74.00	-28.98	Peak	VERTICAL



Report No.: PTC19051605202E-FC01

$\pi/4$ -DQPSK

Item (Mark)	Freq. (MHz)	Read Level (dB μ V)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Result Level (dB μ V/m)	Limit Line (dB μ V/m)	Over Limit (dB)	Detector	Polarization
1	2374.30	56.43	26.95	44.32	5.09	44.15	74.00	-29.85	Peak	HORIZONTAL
2	2390.00	55.10	27.00	44.32	5.11	42.89	74.00	-31.11	Peak	HORIZONTAL

Item (Mark)	Freq. (MHz)	Read Level (dB μ V)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Result Level (dB μ V/m)	Limit Line (dB μ V/m)	Over Limit (dB)	Detector	Polarization
1	2368.50	57.11	26.93	44.32	5.09	44.81	74.00	-29.19	Peak	VERTICAL
2	2390.00	53.37	27.00	44.32	5.11	41.16	74.00	-32.84	Peak	VERTICAL

Item (Mark)	Freq. (MHz)	Read Level (dB μ V)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Result Level (dB μ V/m)	Limit Line (dB μ V/m)	Over Limit (dB)	Detector	Polarization
1	2483.50	53.51	27.34	44.32	5.21	41.74	74.00	-32.26	Peak	HORIZONTAL
2	2491.10	54.57	27.37	44.32	5.22	42.84	74.00	-31.16	Peak	HORIZONTAL

Item (Mark)	Freq. (MHz)	Read Level (dB μ V)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss dB	Result Level (dB μ V/m)	Limit Line (dB μ V/m)	Over Limit (dB)	Detector	Polarization
1	2483.50	56.64	27.34	44.32	5.21	44.87	74.00	-29.13	Peak	VERTICAL
2	2487.70	54.93	27.36	44.32	5.22	43.19	74.00	-30.81	Peak	VERTICAL

9 CONDUCTED BAND EDGE EMISSION

9.1 REQUIREMENT

According to FCC section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

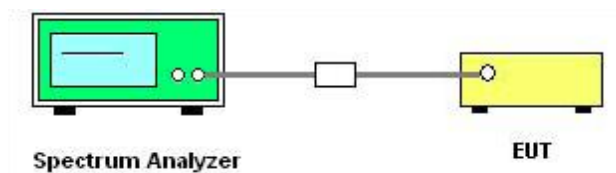
9.2 TEST PROCEDURE

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

For Band edge

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

9.3 TEST SETUP



1. The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100KHz. The video bandwidth is set to 300KHz.
2. The spectrum from 30MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

9.4 EUT OPERATION CONDITIONS

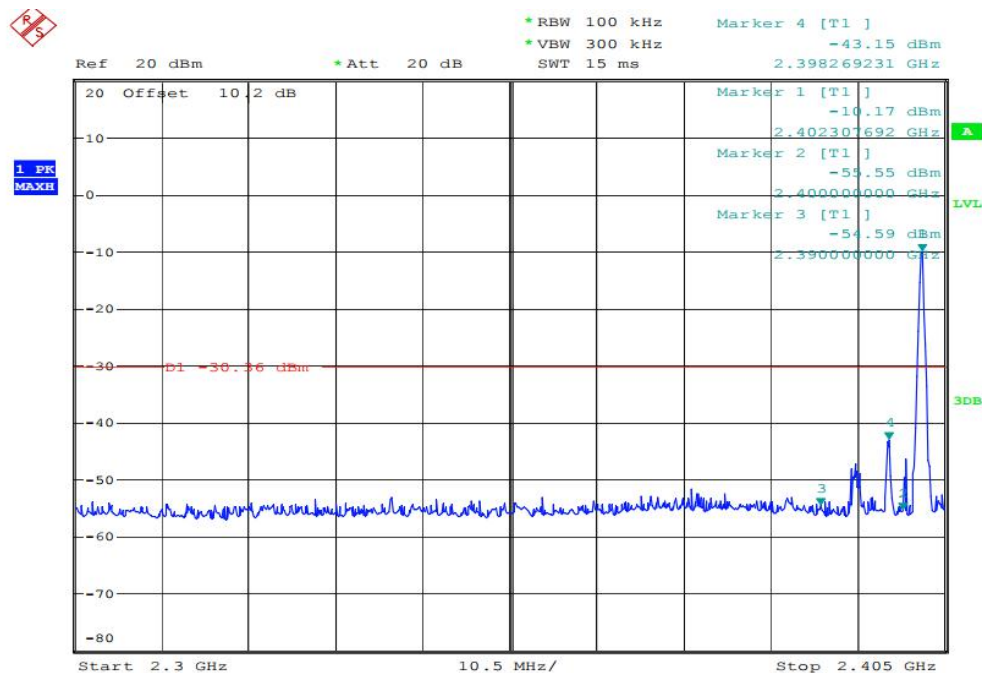
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

9.5 TEST RESULTS

Mode	Freq (MHz)	Conclusion
GFSK	Hopping off 2402	PASS
	Hopping off 2480	PASS
	Hopping on	PASS
$\pi/4$ -DQPSK	Hopping off 2402	PASS
	Hopping off 2480	PASS
	Hopping on	PASS

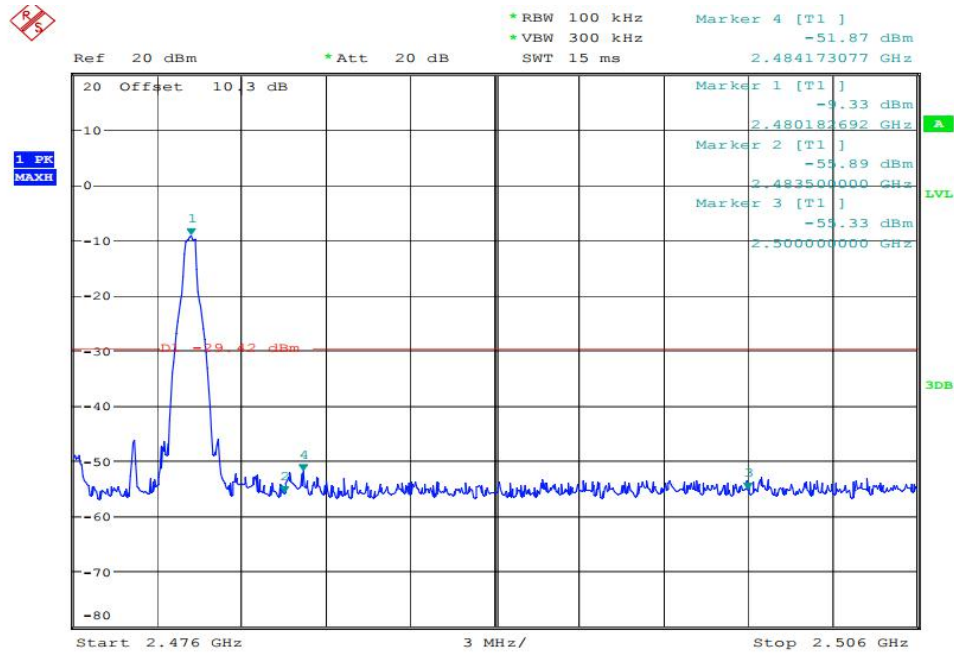
For Non-Hopping Mode:

GFSK

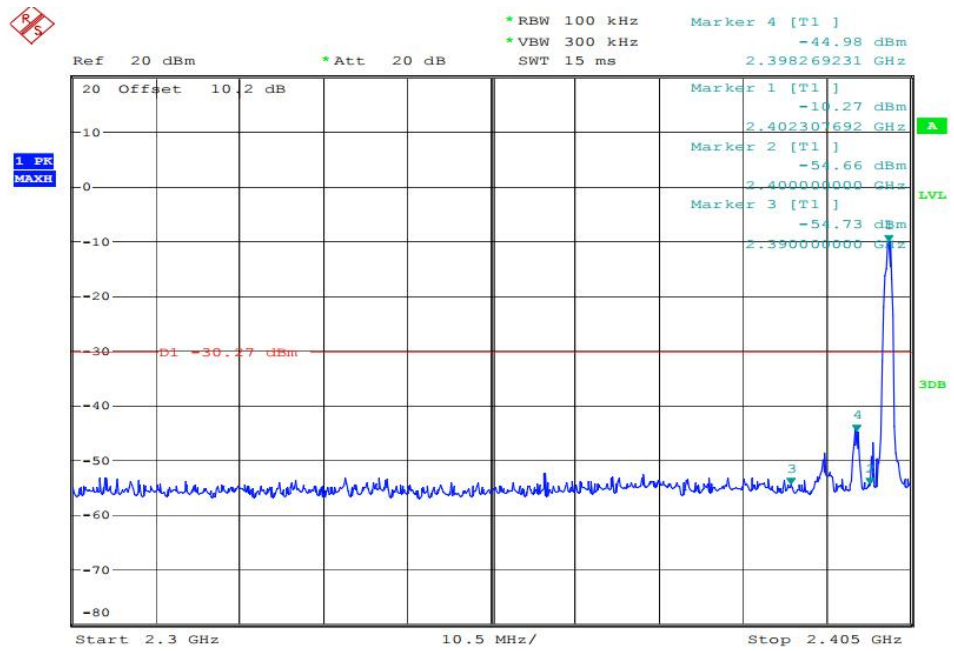




Report No.: PTC19051605202E-FC01

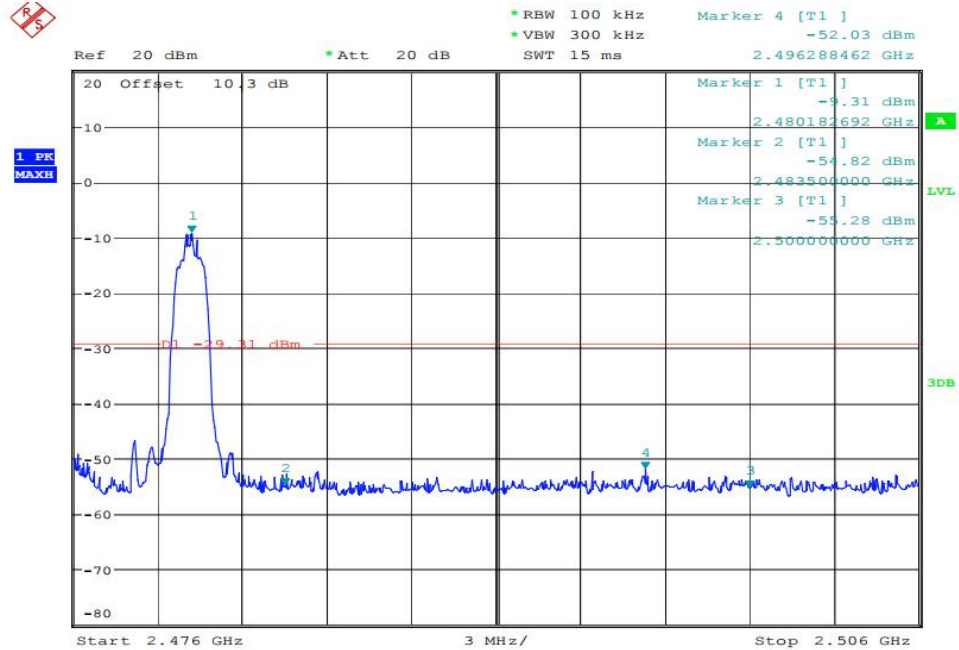


$\pi/4$ -DQPSK



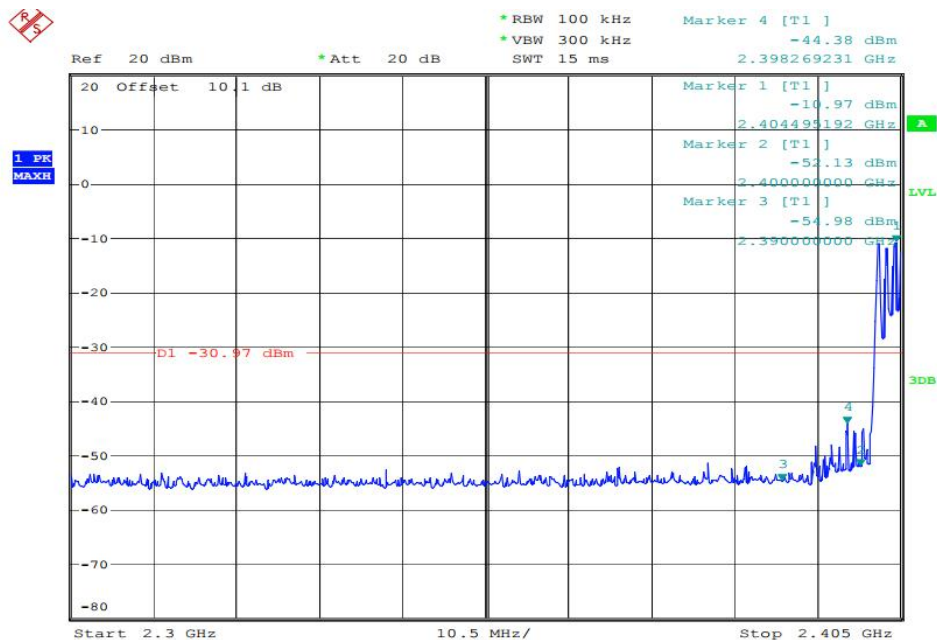


Report No.: PTC19051605202E-FC01



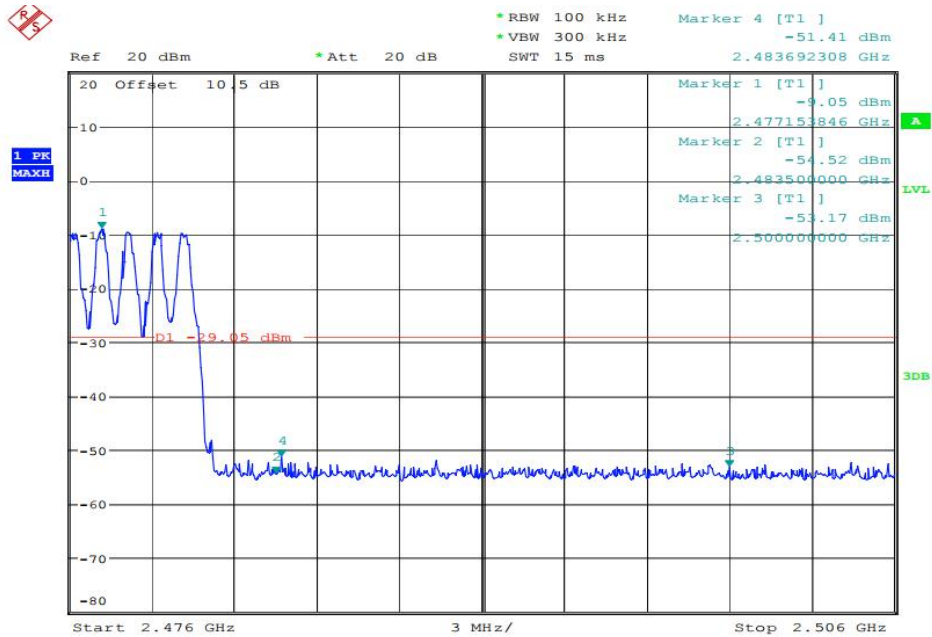
For Hopping Mode:

GFSK

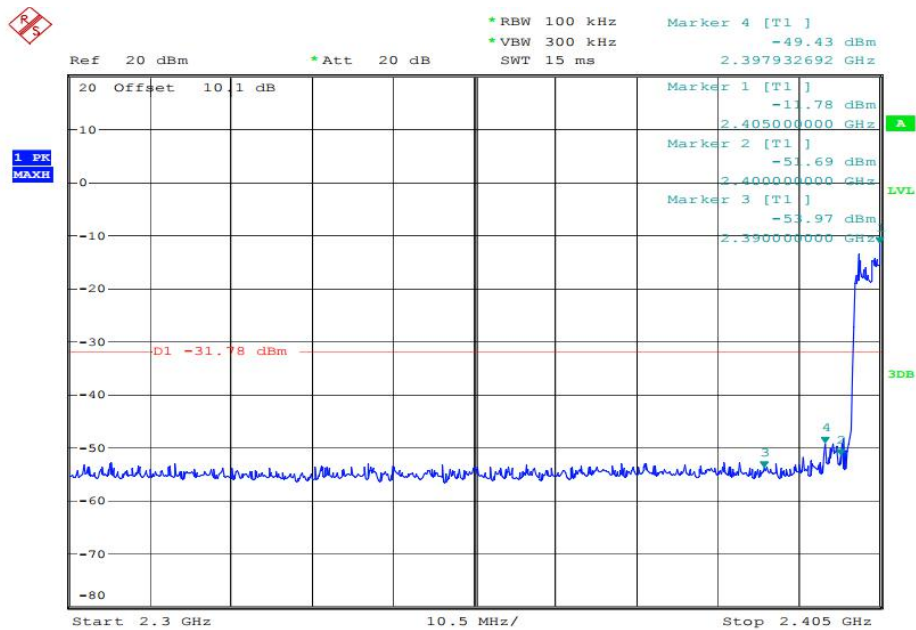




Report No.: PTC19051605202E-FC01

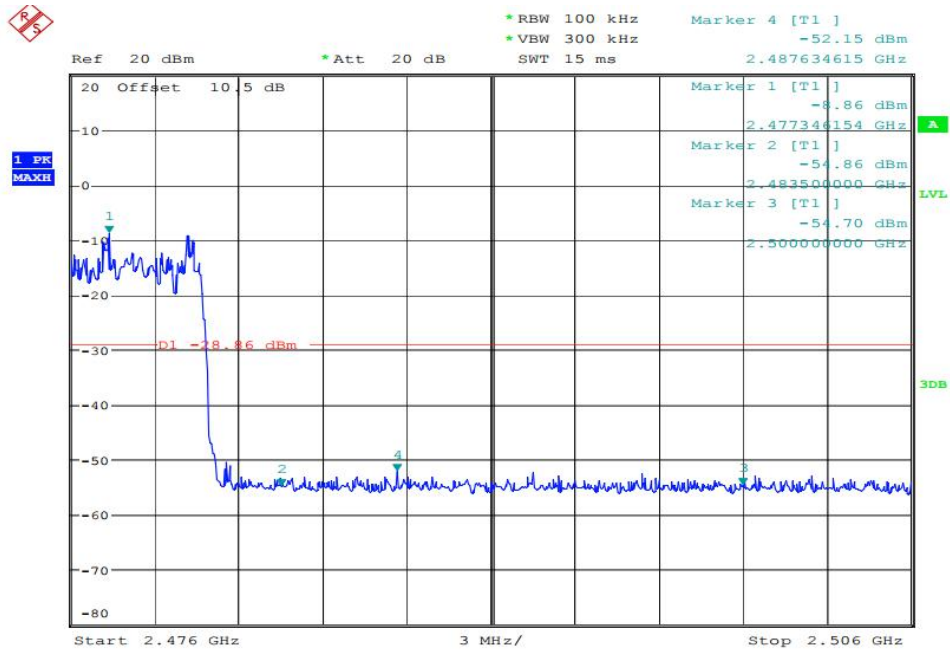


$\pi/4$ -DQPSK





Report No.: PTC19051605202E-FC01





10 20 dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Limits : Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

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: RBW =100kHz, VBW = 100kHz

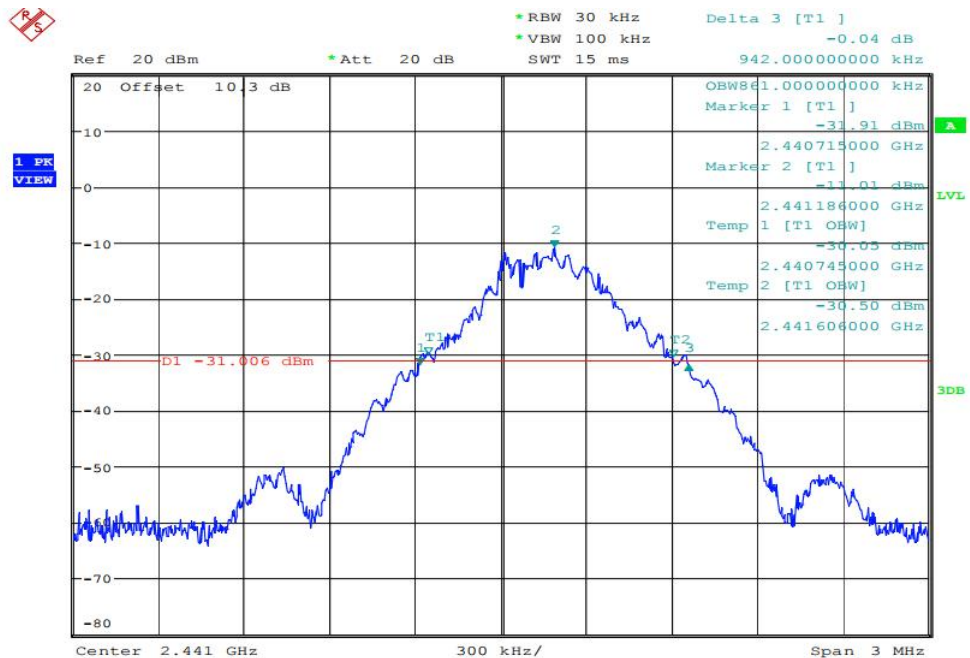
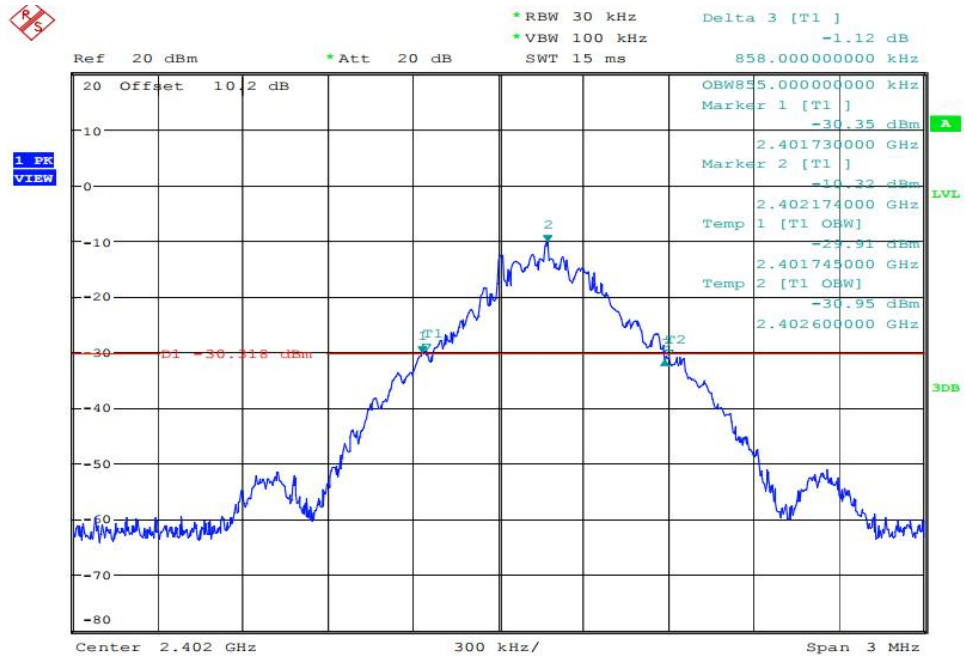
10.2 Test Result

Mode	Freq. (MHz)	20dB bandwidth Result (MHz)	Conclusion
GFSK	2402	0.858	PASS
	2441	0.942	PASS
	2480	0.948	PASS
$\pi/4$ -DQPSK	2402	1.221	PASS
	2441	1.203	PASS
	2480	1.224	PASS



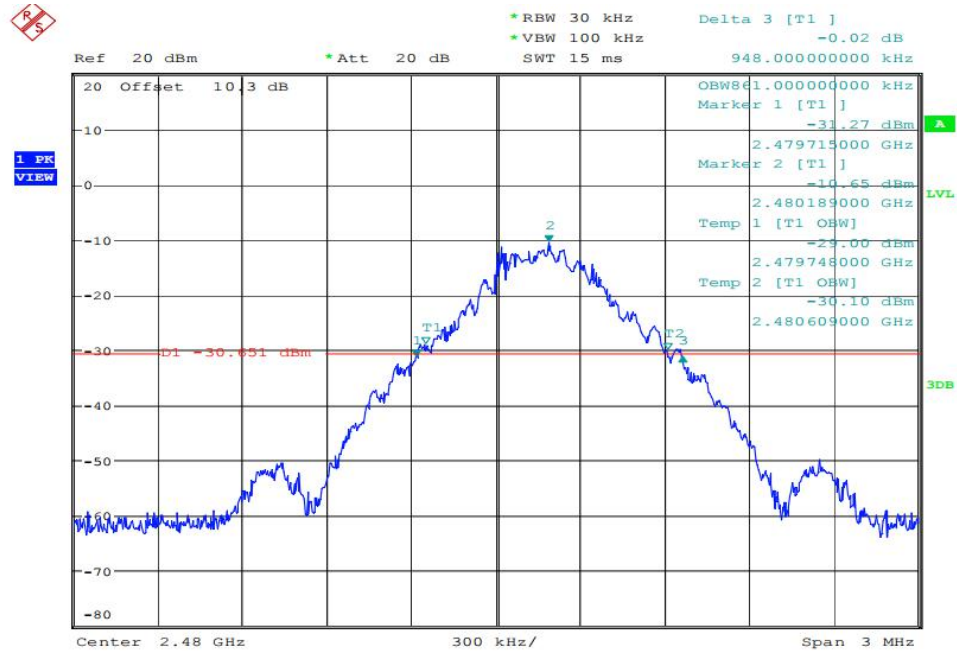
Report No.: PTC19051605202E-FC01

Test Mode: CH00 / CH39 / CH78 (GFSK Mode)

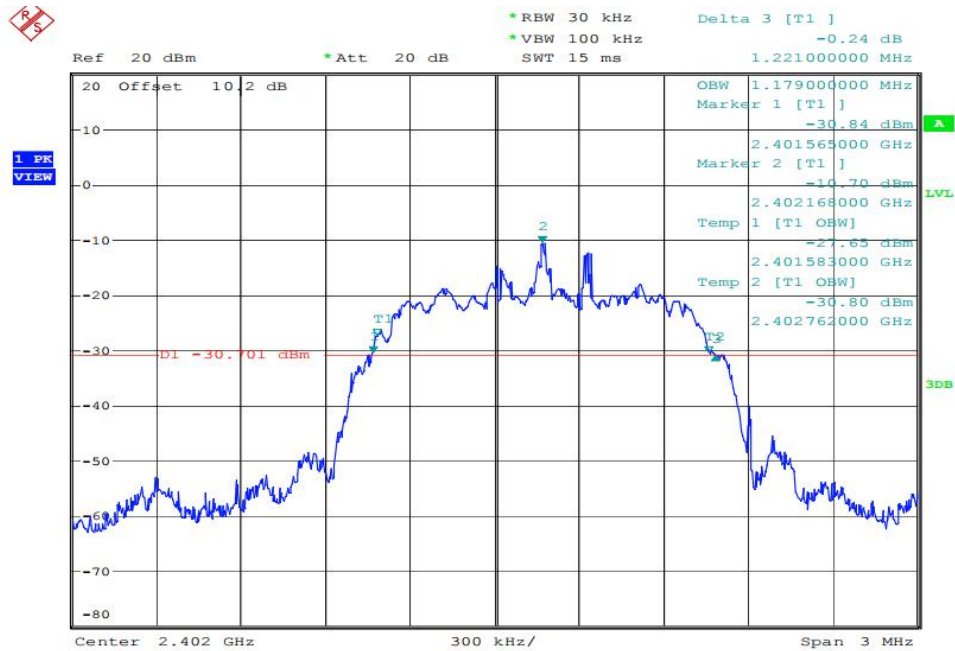




Report No.: PTC19051605202E-FC01

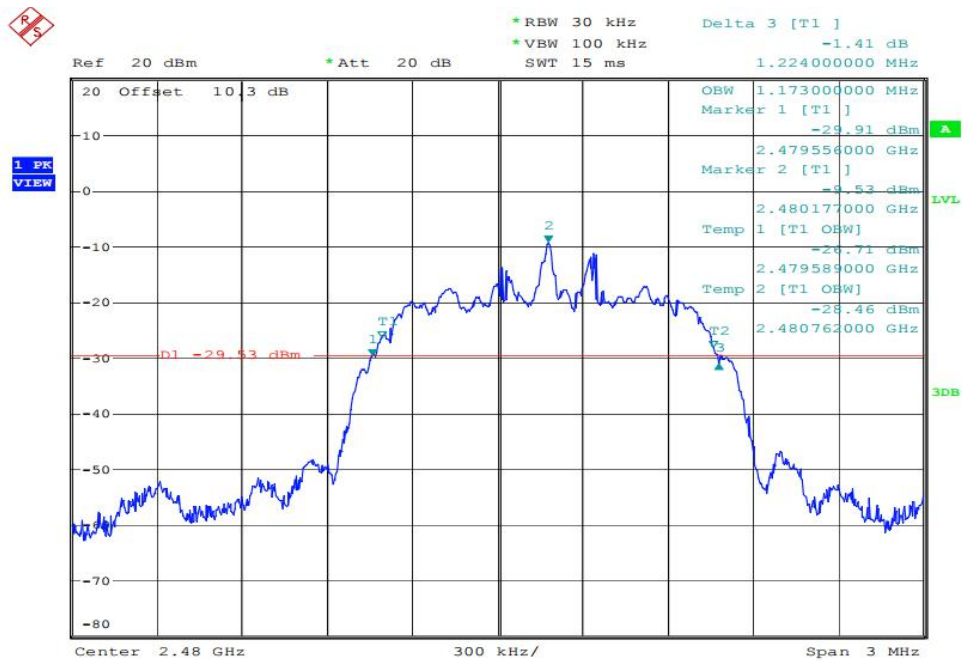
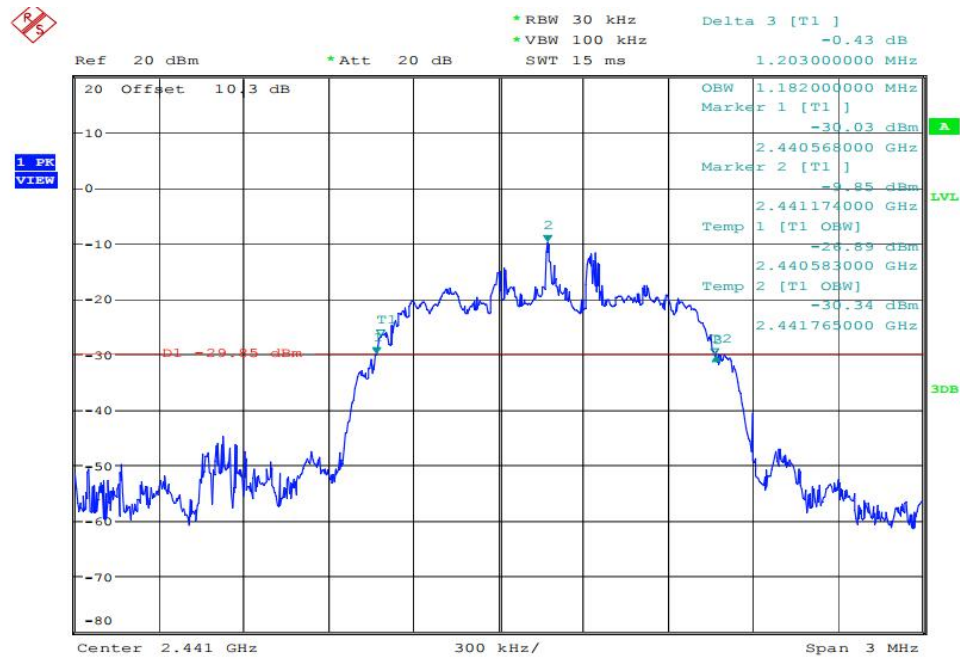


Test Mode: CH00 / CH39 / CH78 ($\pi/4$ -DQPSK Mode)





Report No.: PTC19051605202E-FC01





11 Maximum Peak Output Power

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Test Limit : Regulation 15.247 (b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt (30dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Refer to the result "Number of Hopping Frequency" of this document. The 0.125watts (20.97 dBm) limit applies.

11.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyser: RBW = 3.0 MHz. VBW = 3.0 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

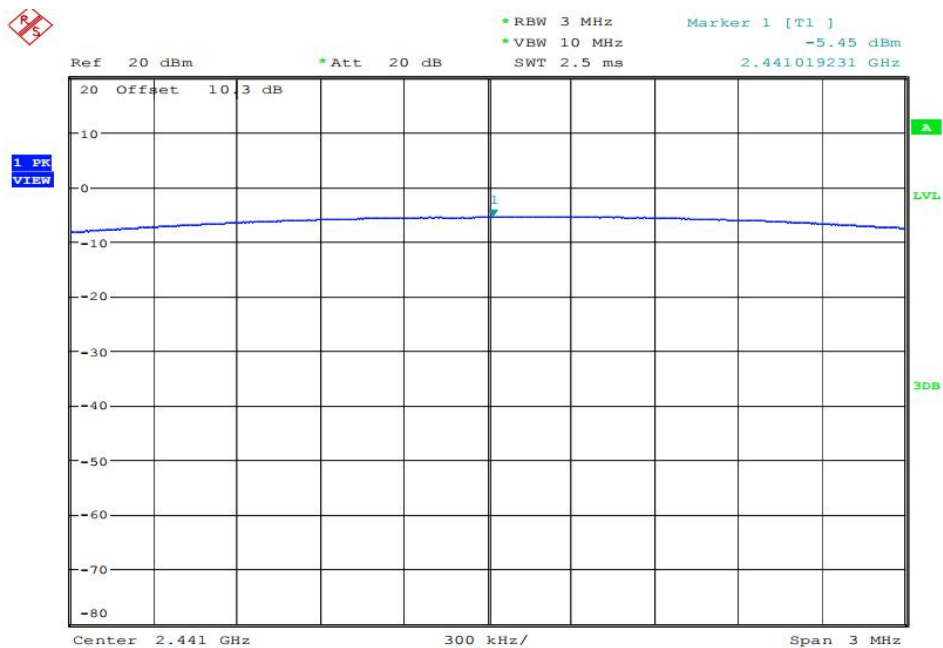
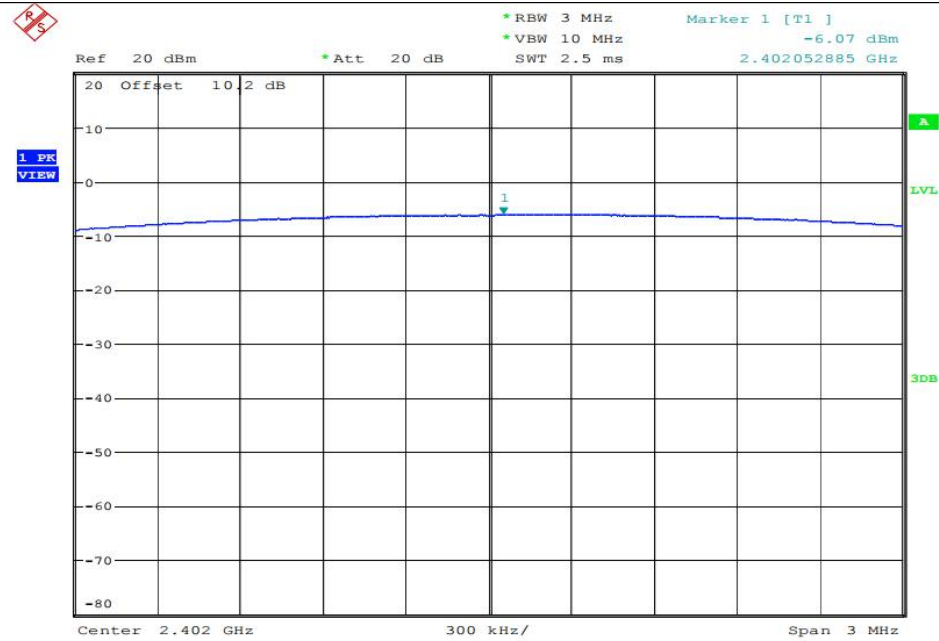
11.2 Test Result

Mode	Freq (MHz)	Result (dBm)	Limit (dBm)	Conclusion
GFSK	2402	-6.07	21	PASS
	2441	-5.45	21	PASS
	2480	-5.19	21	PASS
$\pi/4$ -DQPSK	2402	-5.01	21	PASS
	2441	-4.34	21	PASS
	2480	-4.13	21	PASS

GFSK

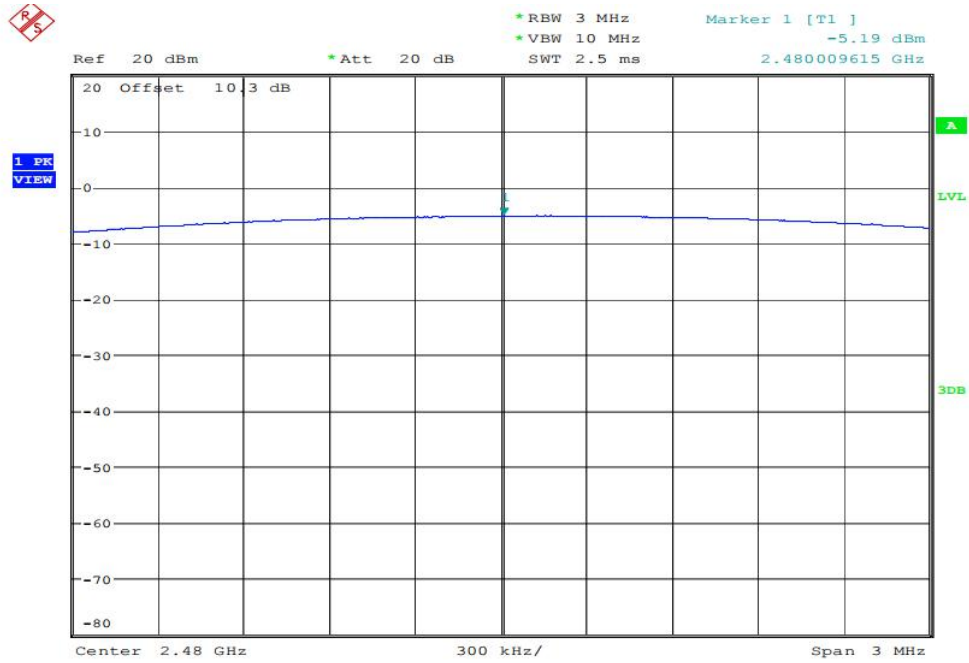


Report No.: PTC19051605202E-FC01

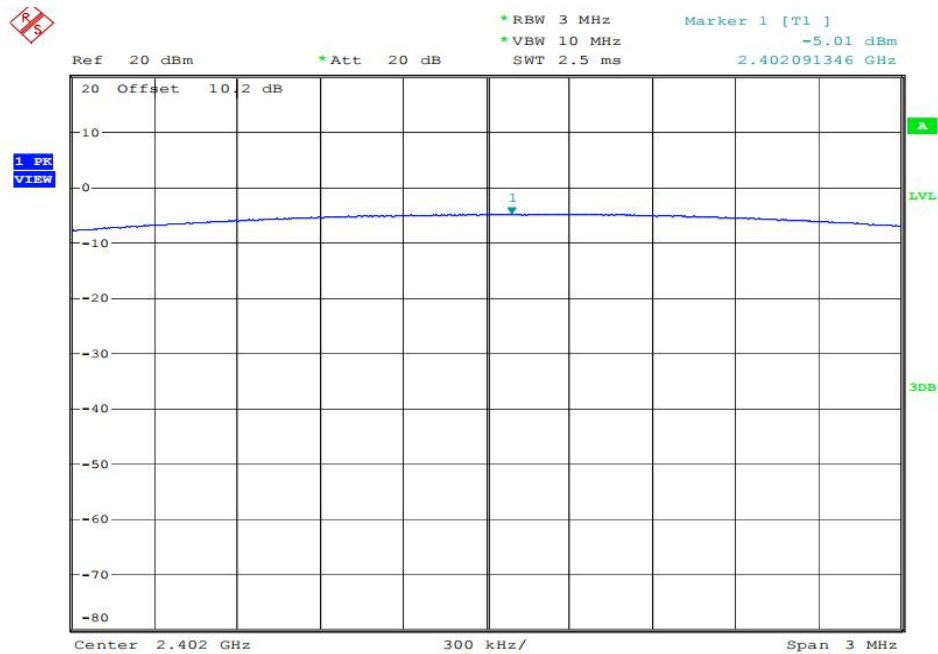




Report No.: PTC19051605202E-FC01

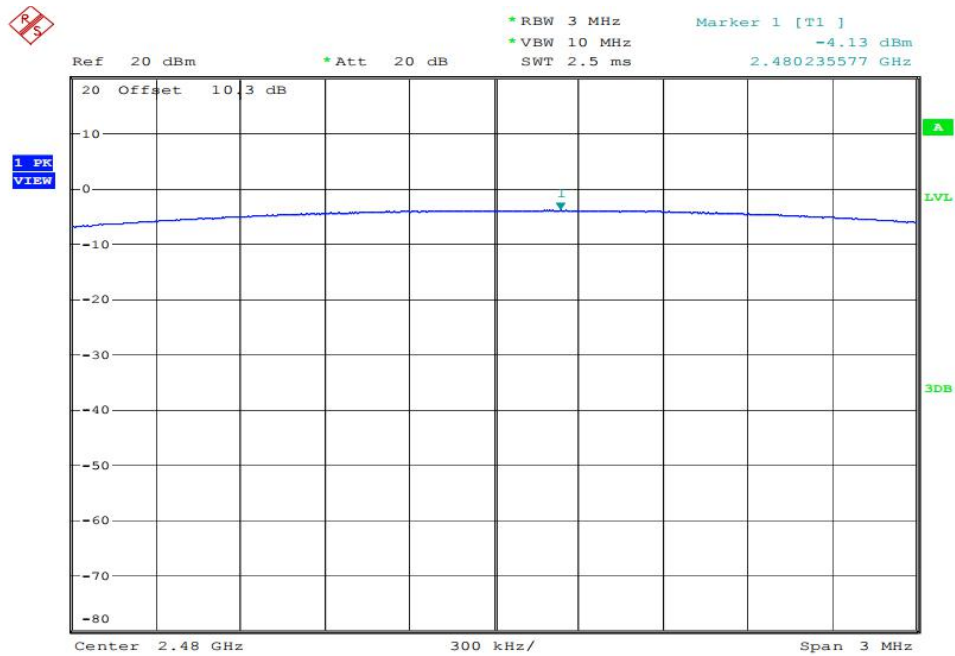
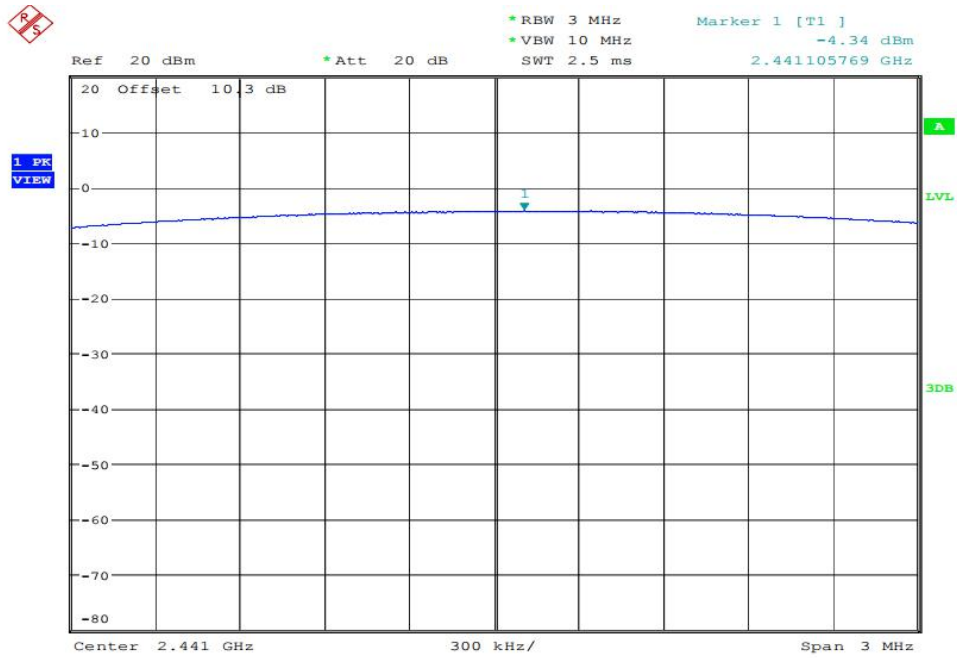


$\pi/4$ -DQPSK





Report No.: PTC19051605202E-FC01





12 Hopping Channel Separation

Test Requirement	: FCC CFR47 Part 15 Section 15.247
Test Method	: ANSI C63.10:2013
Test Limit	: Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
Test Mode	: Hopping

12.1 Test Procedure

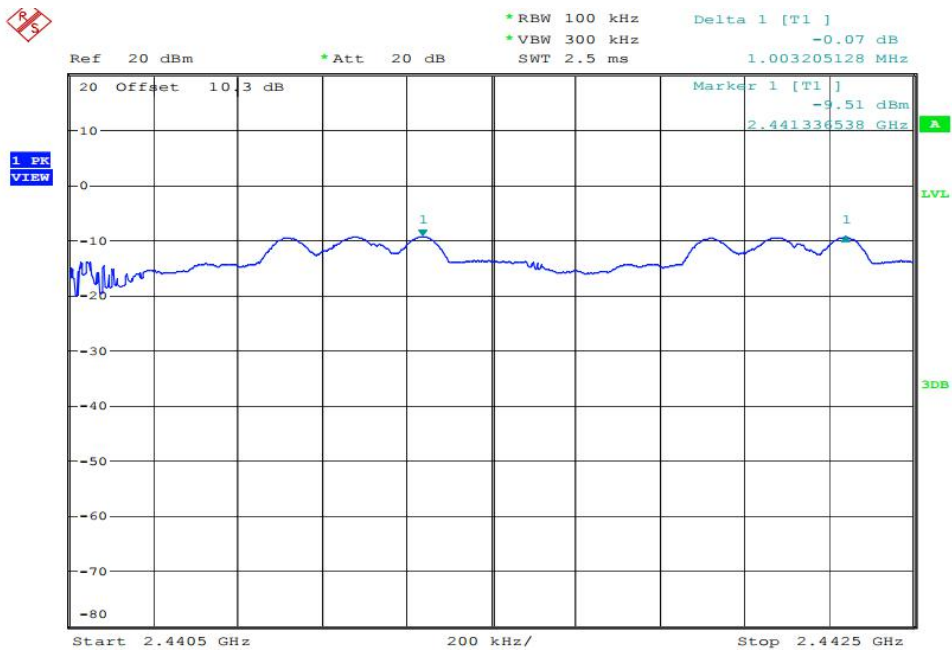
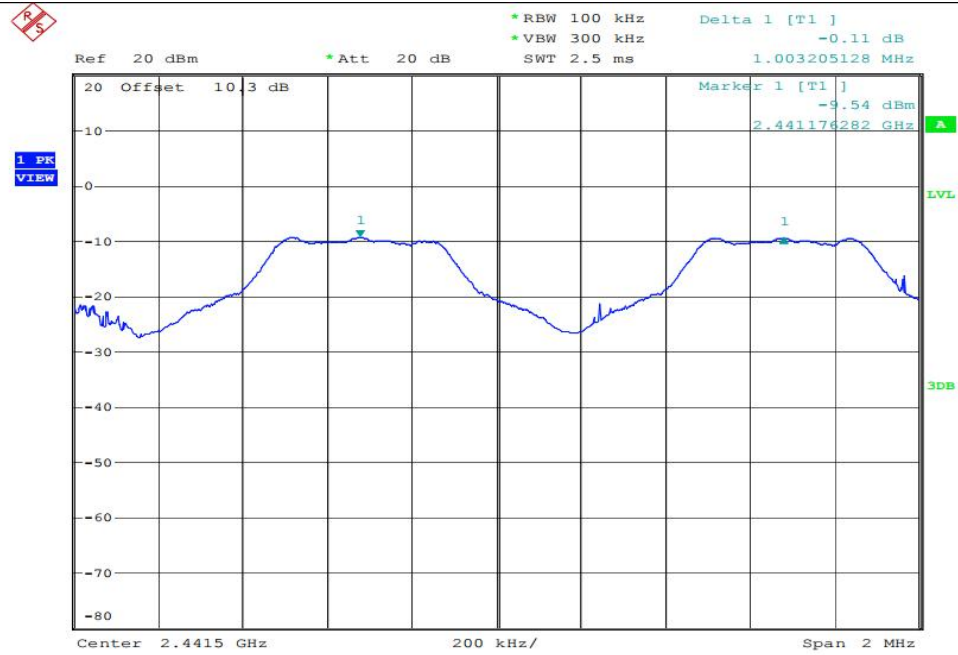
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100KHz. VBW = 300KHz, Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

12.2 Test Result

Mode	Channel separation (MHz)	20dB bandwidth (MHz) (worse case)	Limit (MHz) 2/3 of 20dB bandwidth	Conclusion
GFSK	1.003	0.948	≥ 0.632	PASS
$\pi/4$ -DQPSK	1.003	1.224	≥ 0.816	PASS



Report No.: PTC19051605202E-FC01





13 Number of Hopping Frequency

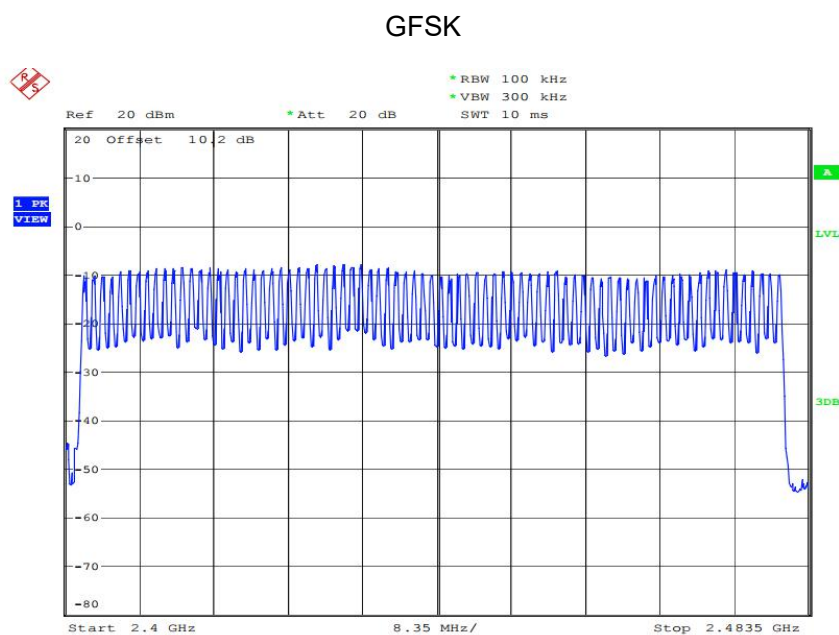
Test Requirement : FCC CFR47 Part 15 Section 15.247
Test Method : ANSI C63.10:2013
Test Limit : Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode : Hopping(GFSK)

13.1 Test Procedure

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

13.2 Test Result

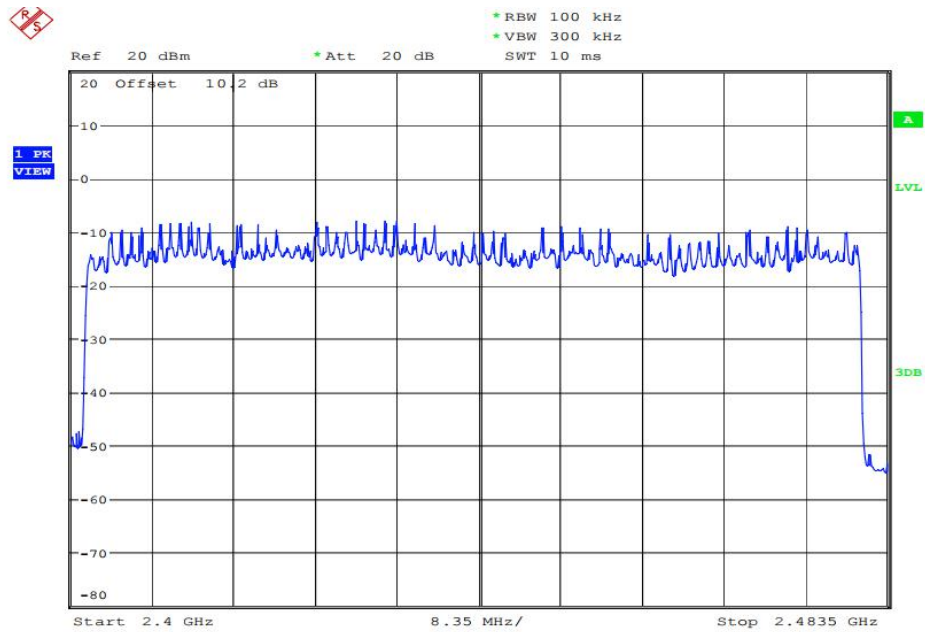
Mode	Number of hopping channel	Limit	Conclusion
GFSK	79	>15	PASS
$\pi/4$ -DQPSK	79	>15	PASS





Report No.: PTC19051605202E-FC01

$\pi/4$ -DQPSK





14 Dwell Time

Test Requirement	: FCC CFR47 Part 15 Section 15.247
Test Method	: ANSI C63.10:2013
Test Limit	: Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.
Test Mode	: The worst case(GFSK) was recorded

14.1 Test Procedure

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

14.2 Test Result

Mode	Dwell time (s)	Pulse's on time (ms)	Total hops	Limit	Conclusion
DH1	0.128	0.41	314	<400ms	PASS
DH3	0.258	1.66	155	<400ms	PASS
DH5	0.271	2.91	93	<400ms	PASS
2-DH1	0.130	0.42	312	<400ms	PASS
2-DH3	0.266	1.67	159	<400ms	PASS
2-DH5	0.321	2.92	110	<400ms	PASS

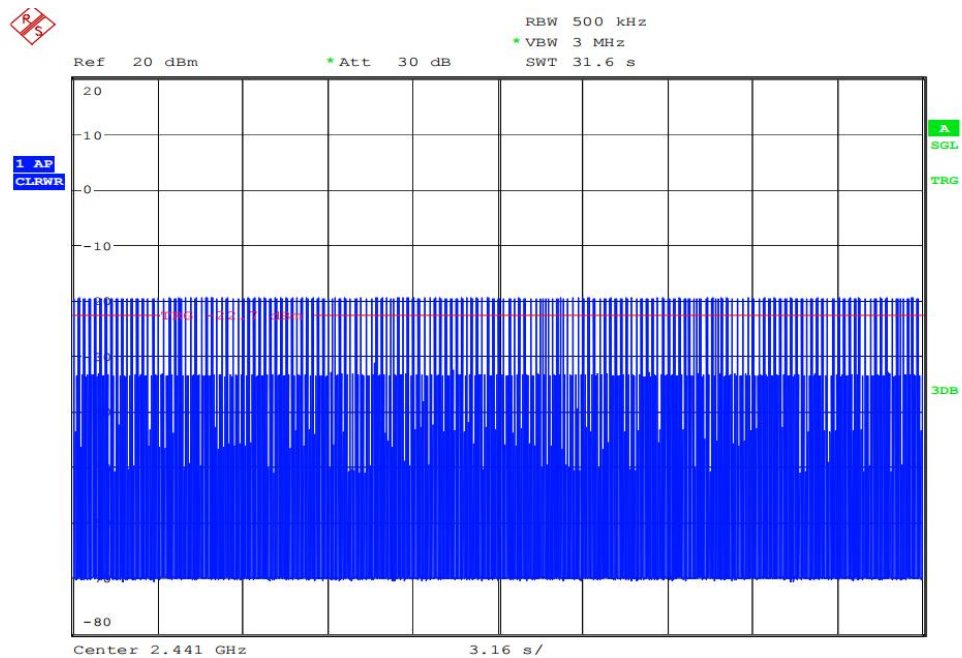
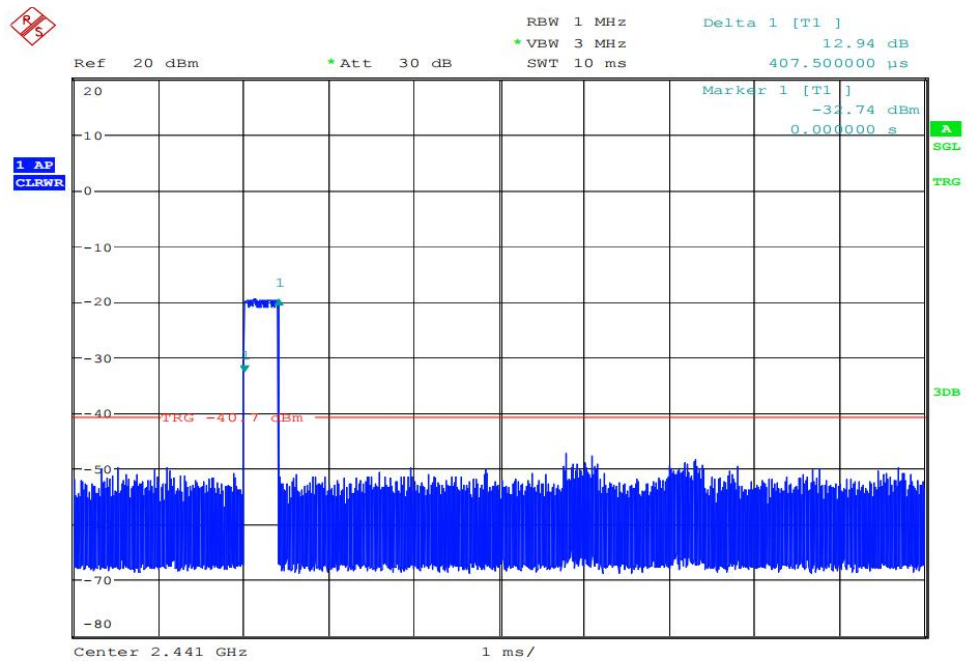
Note: Dwell time = total hops *pulse's on time.



Report No.: PTC19051605202E-FC01

GFSK

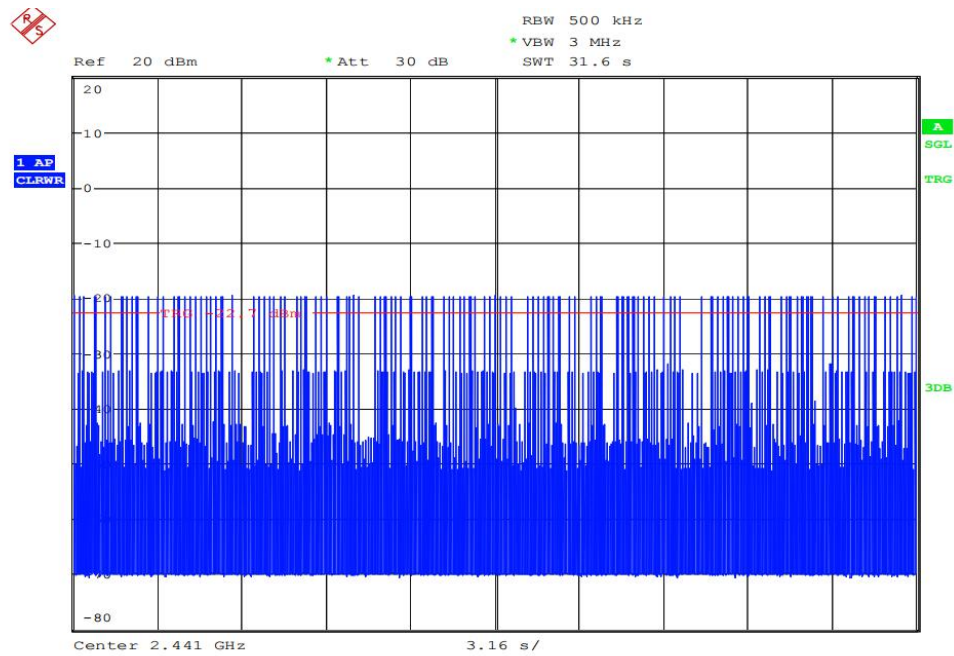
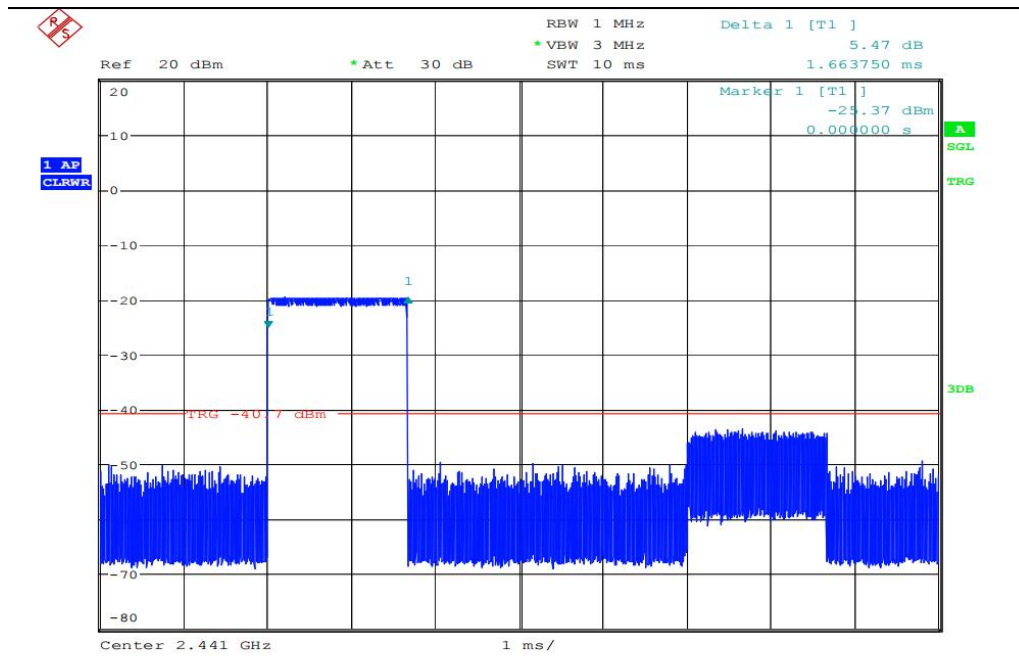
DH1





Report No.: PTC19051605202E-FC01

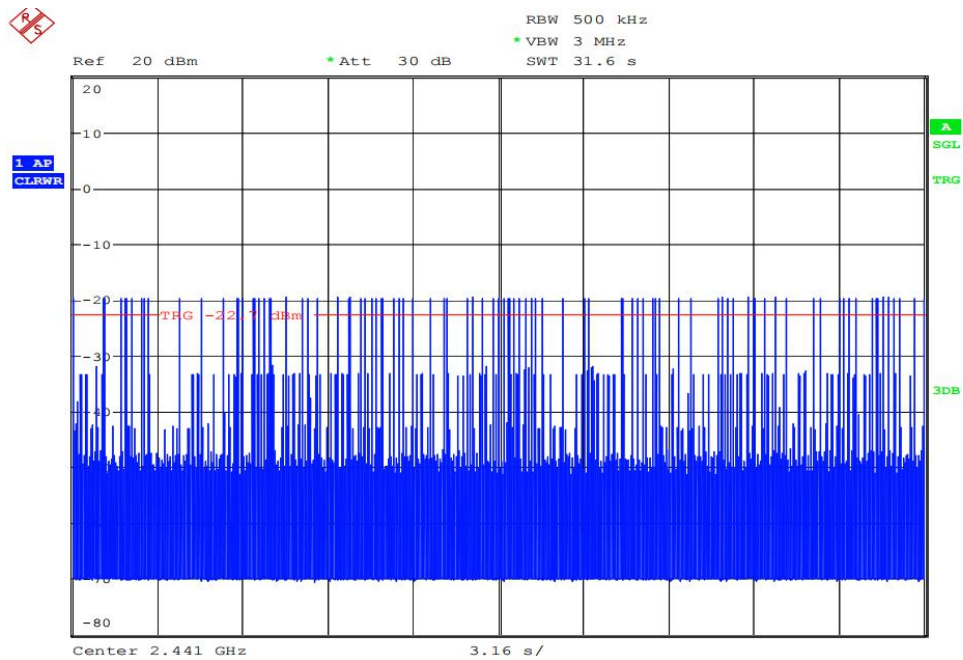
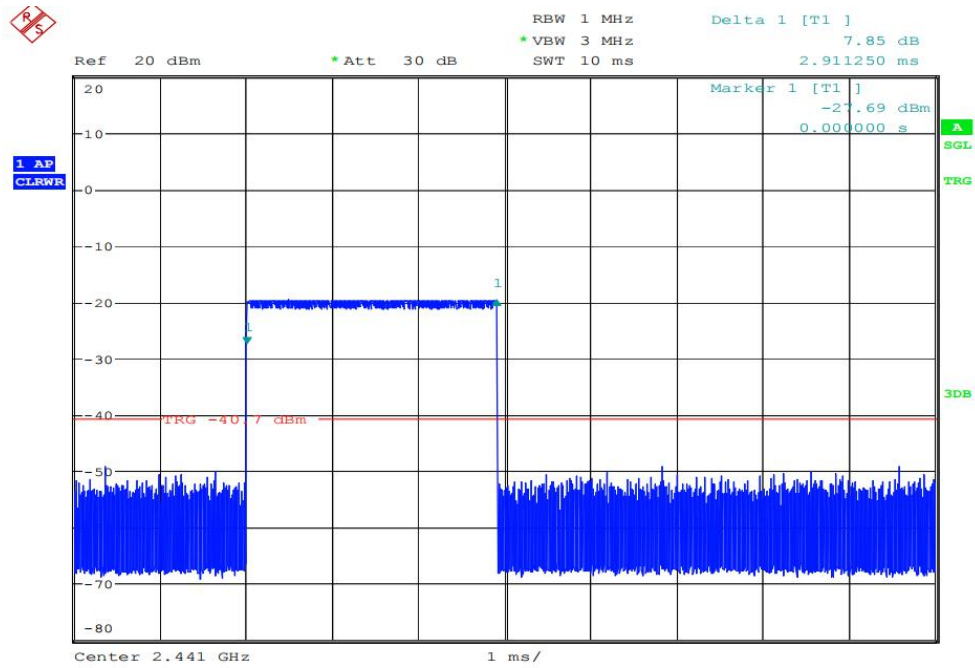
DH3





Report No.: PTC19051605202E-FC01

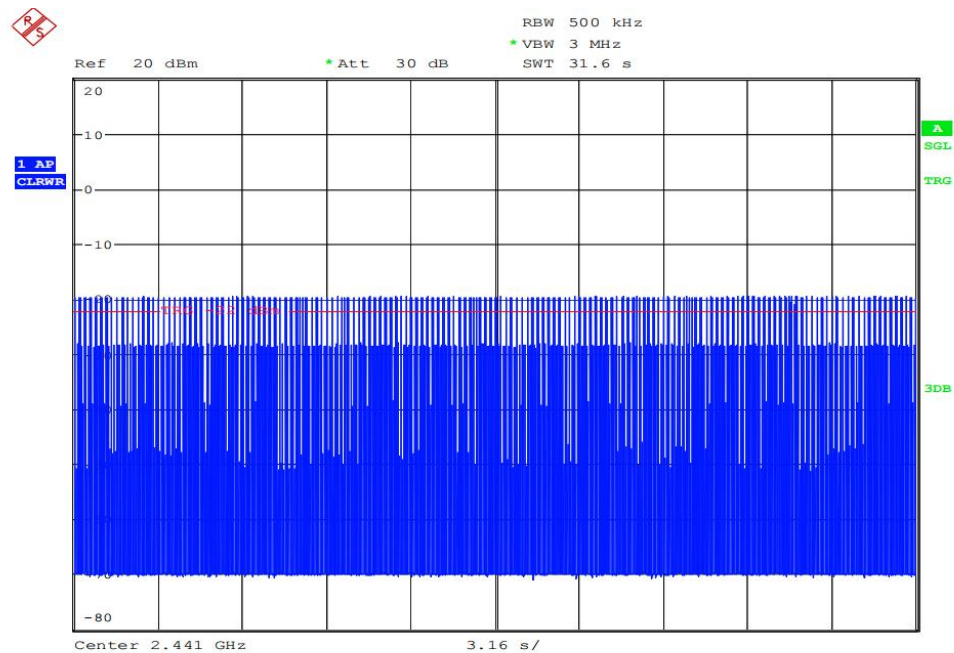
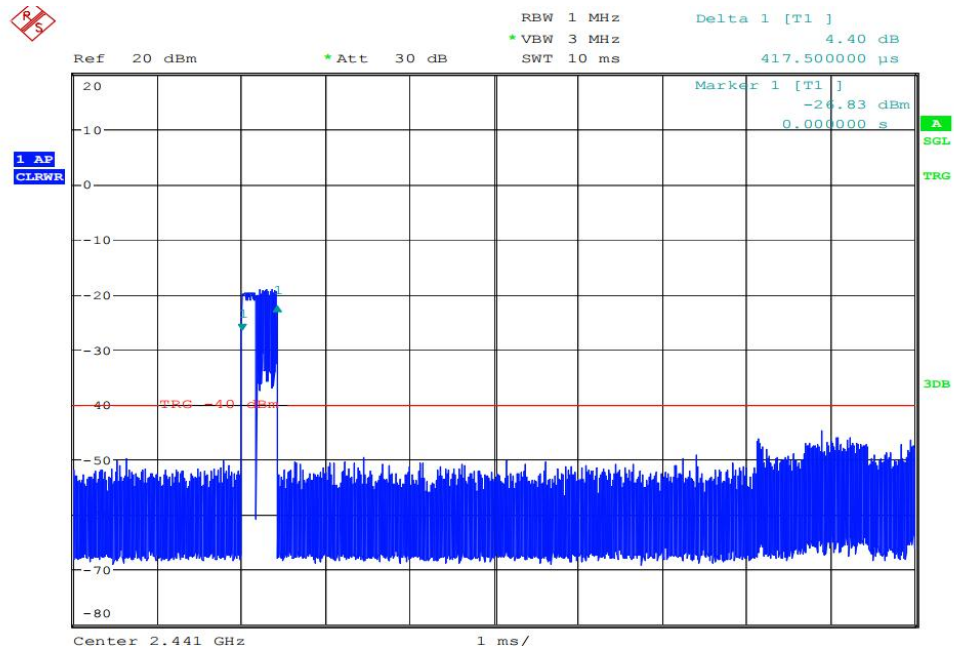
DH5





$\pi/4$ -DQPSK

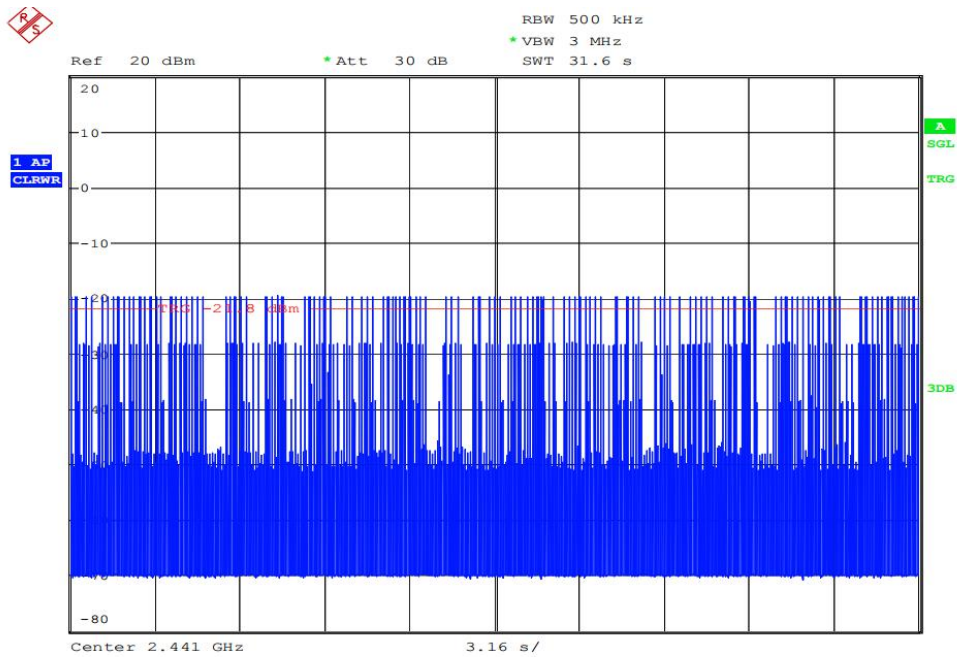
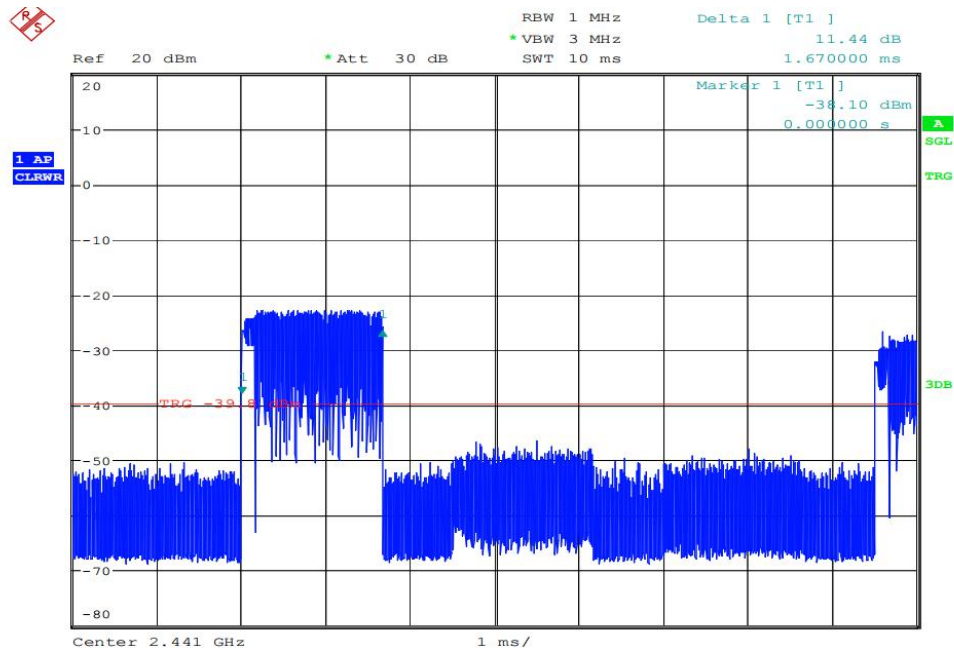
DH1





Report No.: PTC19051605202E-FC01

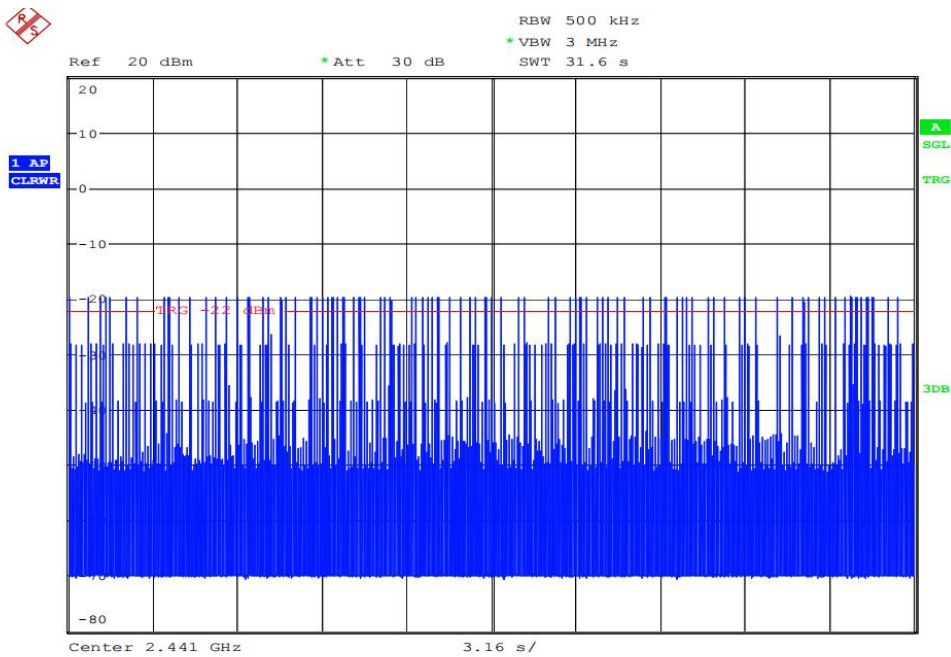
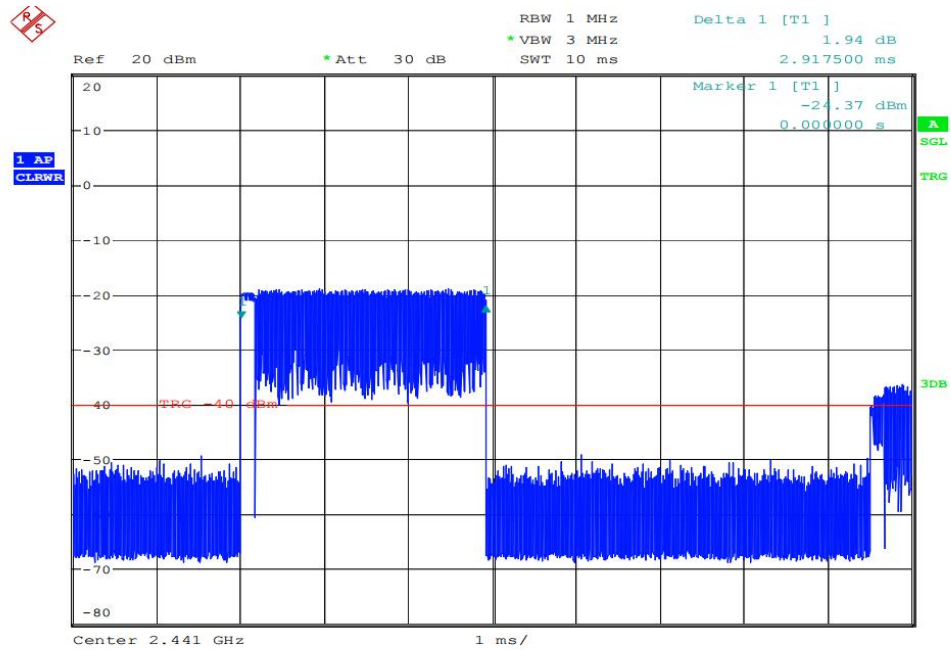
DH3





Report No.: PTC19051605202E-FC01

DH5





15 Antenna Requirement

15.1 Antenna Requirement

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

15.2 Result

The EUT'S antenna, permanent attached antenna, is Internal PCB Antenna. The antenna's gain is -0.68dBi and meets the requirement.

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