NCC Test Report

Product Description	:	**Bluetooth headset**
Model No.	:	**SCBT13**
Brand Name	:	**EPOS | SENNHEISER**
Applicant	:	**Sennheiser Communications A/S**
Address	:	**Industriparken 27, Ballerup 2750, Denmark**
Standard	:	**LP0002 Section 3.10.1 (2018-01-10)**
Received Date	:	**May 29, 2019**
Tested Date	:	**Dec. 07 ~ Dec. 08, 2015 (for original test)** **Jun. 05 ~ Jul. 12, 2019 (for new test)**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by: **Approved by:**

Along Chen / Assistant Manager **Gary Chang / Manager**

Testing Laboratory 2732

Table of Contents

1 GENERAL DESCRIPTION 5

1.1 Information 5
1.2 Local Support Equipment List 9
1.3 Test Setup Chart 9
1.4 The Equipment List 10
1.5 Test Standards 13
1.6 Deviation from Test Standard and Measurement Procedure 13
1.7 Measurement Uncertainty 13

2 TEST CONFIGURATION 14

2.1 Testing Condition 14
2.2 The Worst Test Modes and Channel Details 15

3 TRANSMITTER TEST RESULTS 16

3.1 Conducted Emissions 16
3.2 Unwanted Emissions into Restricted Frequency Bands 19
3.3 Unwanted Emissions into Non-Restricted Frequency Bands 35
3.4 Conducted Output Power 40
3.5 Number of Hopping Frequency 43
3.6 20dB and Occupied Bandwidth 45
3.7 Channel Separation 47
3.8 Number of Dwell Time 49

4 RECEIVER TEST RESULTS 52

4.1 Conducted Emissions 52
4.2 Unwanted Emissions into Restricted Frequency Bands 55

5 TEST LABORATORY INFORMATION 61

Release Record

Report No.	Version	Description	Issued Date
TR5D0103-03AD	Rev. 01	Initial issue	Mar. 20, 2020
TR5D0103-03AD	Rev. 02	Adding battery brand and model name information.	Mar. 31, 2020

Summary of Test Results

NCC Rules	Test Items	Measured	Result
2.3	Conducted Emissions	[dBuV]: 0.153MHz 49.63 (Margin -16.19dB) - QP	Pass
3.10.1(5) 2.8	Radiated Emissions	[dBuV/m at 3m]: 311.30MHz 36.80 (Margin -9.20dB) - PK	Pass
3.10.1(5)	Band Edge	Meet the requirement of limit	Pass
3.10.1.2(1)(B)	Conducted Output Power	Power [dBm]: 5.2	Pass
3.10.1.6(1)(A)	Number of Hopping Channels	Meet the requirement of limit	Pass
3.10.1.6(1)(A)	Hopping Channel Separation	Meet the requirement of limit	Pass
3.10.1(6.1)	Dwell Time	Meet the requirement of limit	Pass
3.10.1(4)	Antenna Requirement	Meet the requirement of limit	Pass

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

This report is issued as a supplementary report to the original project no. TR5D0103-02AD. The modification is concerned with following item:

✧ Applicant / Model / Product name changed .

Due to no impact on tests, all data remain unchanged..

1.1.1 Product Details

The following models are provided to this EUT.

Brand name	Model name	Product name	Product description
EPOS | SENNHEISER	SCBT13	ADAPT 660	Bluetooth headset

1.1.2 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	**Bluetooth Mode**	**Ch. Frequency (MHz)**	**Channel Number**	**Data Rate**
2400-2483.5	BR	2402-2480	0-78 [79]	1 Mbps
2400-2483.5	EDR	2402-2480	0-78 [79]	2 Mbps
2400-2483.5	EDR	2402-2480	0-78 [79]	3 Mbps
Note 1: Bluetooth BR uses a GFSK. Note 2: Bluetooth EDR uses a combination of π/4-DQPSK and 8DPSK.				

1.1.3 Antenna Details

Ant. No.	Type	Gain (dBi)	Connector	Remark
1	Inverted F	4.2	N/A	---

1.1.4 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.7Vdc from battery

1.1.5 Accessories

Accessories		
No.	**Equipment**	**Description**
1	USB cable	廠牌:SENNHEISER 型號: USB CHARGING CABLE 1200MM, BLACK 線長:1.28m, shielded cable without core.
2	Audio cable	廠牌: SENNHEISER 型號: Audio cable 3.5 to 2.5 mm jack 線長:1.45m, non-shielded without core
3	Battery	廠牌: Synergy 型號: AHB413645PCT 額定電源: 3.7V, 730mAh

1.1.6 Channel List

Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461	---	---

1.1.7 Test Tool and Duty Cycle

Test Tool	BlueTest3, Version: 2.5.0.93

1.1.8 Power Setting

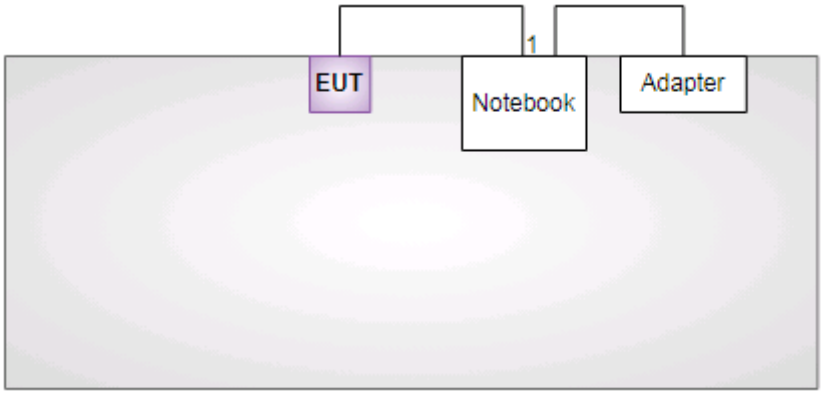
Modulation Mode	Test Frequency (MHz)		
	2402	**2441**	**2480**
GFSK/1Mbps	4	4	4
8DPSK/3Mbps	4	4	4

1.2 Local Support Equipment List

Support Equipment List					
No.	**Equipment**	**Brand**	**Model**	**FCC ID**	**Remarks**
1	Notebook	DELL	Latitude E5420	DoC	

1.3 Test Setup Chart

Test Setup Diagram (Charging with Notebook)



No.	Signal cable / Length (m)
1	USB, 1.28m shielded without core

1.4 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber 2 / (03CH02-WS)				
Test date	Dec. 07 ~ Dec. 08, 2015				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101499	Dec. 31, 2014	Dec. 30, 2015
Receiver	R&S	ESR3	101657	Jan. 15, 2015	Jan. 14, 2016
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-523	Nov. 09, 2015	Nov. 08, 2016
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1095	Oct. 07, 2015	Oct. 06, 2016
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 04, 2015	Nov. 03, 2016
Loop Antenna	R&S	HFH2-Z2	11900	Nov. 16, 2015	Nov. 15, 2016
Preamplifier	Burgeon	BPA-530	100218	Nov. 03, 2015	Nov. 02, 2016
Preamplifier	Agilent	83017A	MY39501309	Sep. 22, 2015	Sep. 21, 2016
Preamplifier	EMC	EMC184045B	980192	Sep. 01, 2015	Aug. 31, 2016
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16140/4	Dec. 16, 2014	Dec. 15, 2015
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Dec. 16, 2014	Dec. 15, 2015
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16015/4	Dec. 16, 2014	Dec. 15, 2015
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Dec. 16, 2014	Dec. 15, 2015
LF cable 10M	EMCC	CFD400-E	CFD400-001	Jun. 17, 2015	Jun. 16, 2016
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Test date	Dec. 07 ~ Dec. 08, 2015				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101063	Feb. 03, 2015	Feb. 02, 2016
Power Meter	Anritsu	ML2495A	1241002	Sep. 21, 2015	Sep. 20, 2016
Power Sensor	Anritsu	MA2411B	1207366	Sep. 21, 2015	Sep. 20, 2016
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Test date	Jun. 05 ~ Jun. 13, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101657	Jan. 08, 2019	Jan. 07, 2020
LISN	R&S	ENV216	101579	Mar. 08, 2019	Mar. 07, 2020
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Nov. 29, 2018	Nov. 28, 2019
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 23, 2018	Oct. 23, 2019
50 ohm terminal (Support Unit)	NA	50	04	May 28, 2019	May 27, 2020
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Test date	Jun. 05 ~ Jun. 13, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101498	Dec. 27, 2018	Dec. 26, 2019
Receiver	R&S	ESR3	101658	Dec. 11, 2018	Dec. 10, 2019
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jul. 18, 2018	Jul. 17, 2019
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 18, 2018	Dec. 17, 2019
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 15, 2018	Nov. 14, 2019
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 09, 2018	Nov. 08, 2019
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 08, 2018	Oct. 07, 2019
Preamplifier	EMC	EMC02325	980225	Jul. 20, 2018	Jul. 19, 2019
Preamplifier	Agilent	83017A	MY39501308	Oct. 04, 2018	Oct. 03, 2019
Preamplifier	EMC	EMC184045B	980192	Aug. 09, 2018	Aug. 08, 2019
RF Cable	EMC	EMC104-SM-SM-8000	181106	Oct. 08, 2018	Oct. 07, 2019
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Oct. 08, 2018	Oct. 07, 2019
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Oct. 08, 2018	Oct. 07, 2019
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160502	Oct. 08, 2018	Oct. 07, 2019
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 08, 2018	Oct. 07, 2019
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Oct. 08, 2018	Oct. 07, 2019
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Test date	Jul. 12, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101063	Apr. 17, 2019	Apr. 16, 2020
Power Meter	Anritsu	ML2495A	1241002	Oct. 09, 2018	Oct. 08, 2019
Power Sensor	Anritsu	MA2411B	1207366	Oct. 09, 2018	Oct. 08, 2019
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

LP0002 Section 3.10.1 (2018-01-10)
ANSI C63.10-2013
FCC KDB 558074 D01 15.247 Meas Guidance v05r02

1.6 Deviation from Test Standard and Measurement Procedure

None

1.7 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty	
Parameters	**Uncertainty**
Bandwidth	±34.134 Hz
Conducted power	±0.808 dB
Power density	±0.463 dB
Conducted emission	±2.670 dB
AC conducted emission	±2.92 dB
Radiated emission ≤ 1GHz	±3.41 dB
Radiated emission > 1GHz	±4.59 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	20°C / 56%	Peter Lin
Radiated Emissions ≤ 1GHz	03CH01-WS	26°C / 62%	Akun Chung
Radiated Emissions > 1GHz	03CH02-WS	21°C / 67%	Morgan Chen
RF Conducted	TH01-WS	23°C / 65%	Alex Huang

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- ISED#: 10807A
- CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate (Mbps)	Mode	Test Configuration
Conducted Emissions	GFSK	2480	1Mbps	TX	---
Radiated Emissions ≤ 1GHz	GFSK	2480	1Mbps	TX	---
Radiated Emissions > 1GHz	GFSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480	1Mbps 3Mbps	TX	---
Conducted Output Power	GFSK π/4 QDPSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480 2402, 2441, 2480	1Mbps 2Mbps 3Mbps	TX	---
Number of Hopping Channels	GFSK 8DPSK	2402~2480 2402~2480	1Mbps 3Mbps	TX	---
Hopping Channel Separation	GFSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480	1Mbps 3Mbps	TX	---
Dwell Time	GFSK 8DPSK	2402 2402	1Mbps 3Mbps	TX	---

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **X-plane** results were found as the worst case and were shown in this report.
2. Two test configurations (charging with notebook & charging with adapter) had been covered during the pretest, and found that **charging with notebook** was the worst case and was selected for final test.

Test item	Mode	Test Frequency (MHz)	Data Rate (Mbps)	Mode	Test Configuration
Conducted Emissions	GFSK	2480	1Mbps	RX	---
Radiated Emissions	GFSK	2480	1Mbps	RX	---

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **X-plane** results were found as the worst case and were shown in this report.
2. Two test configurations (charging with notebook & charging with adapter) had been covered during the pretest, and found that **charging with notebook** was the worst case and was selected for final test.

3 Transmitter Test Results

3.1 Conducted Emissions

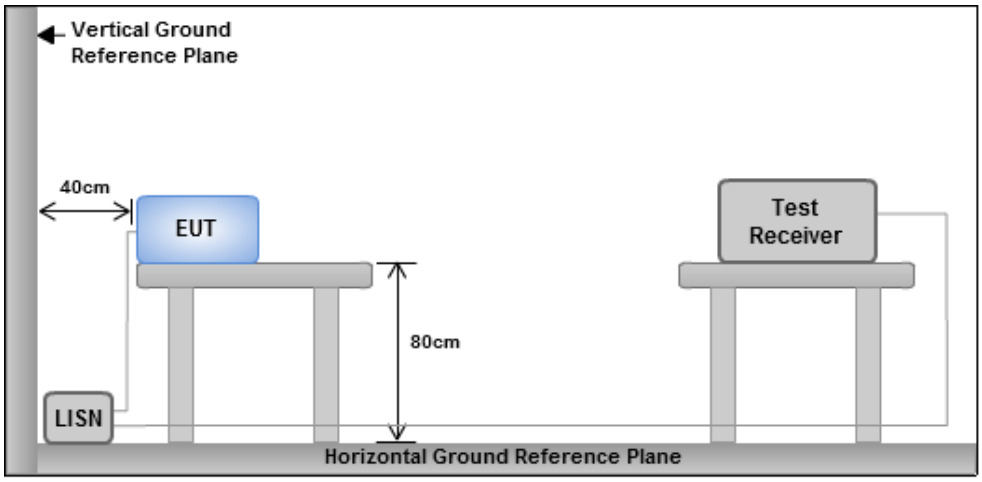
3.1.1 Limit of Conducted Emissions

Conducted Emissions Limit		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarithm of the frequency.		

3.1.2 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V/60Hz

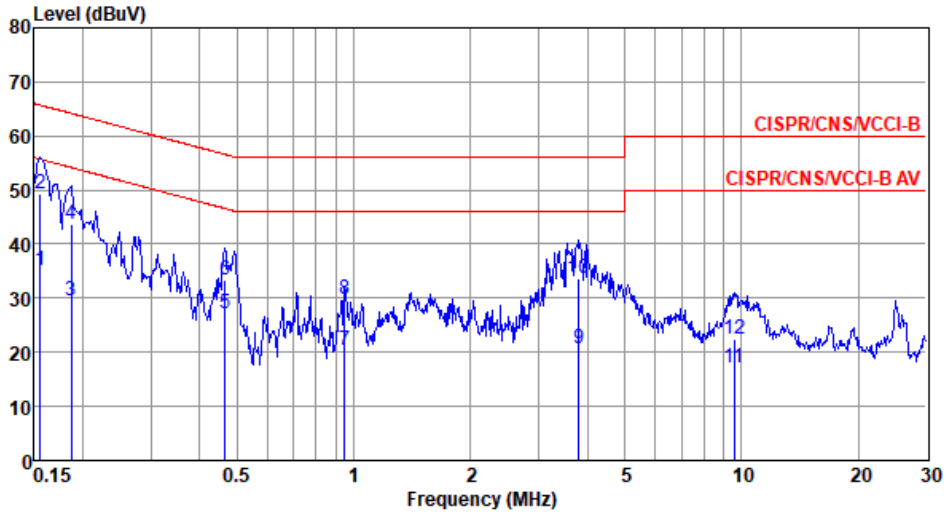
3.1.3 Test Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.1.4 Test Result of Conducted Emissions

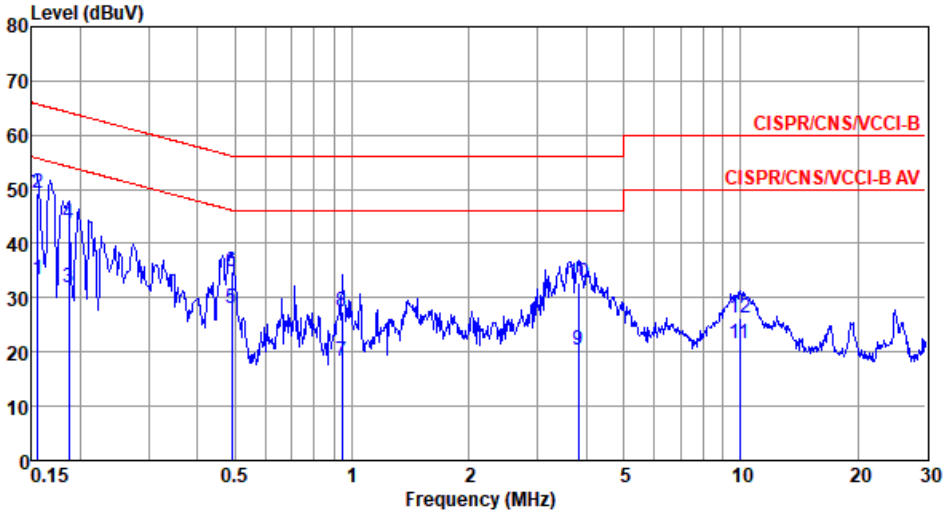
Modulation Mode	GFSK	Test Freq. (MHz)	2480
Power Phase	Line		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.156	35.07	55.69	-20.62	25.49	9.53	0.05	Average
2*	0.156	49.23	65.69	-16.46	39.65	9.53	0.05	QP
3	0.186	29.48	54.20	-24.72	19.87	9.54	0.07	Average
4	0.186	43.60	64.20	-20.60	33.99	9.54	0.07	QP
5	0.466	27.03	46.58	-19.55	17.37	9.58	0.08	Average
6	0.466	33.49	56.58	-23.09	23.83	9.58	0.08	QP
7	0.948	20.33	46.00	-25.67	10.63	9.60	0.10	Average
8	0.948	29.85	56.00	-26.15	20.15	9.60	0.10	QP
9	3.799	20.78	46.00	-25.22	10.90	9.61	0.27	Average
10	3.799	33.57	56.00	-22.43	23.69	9.61	0.27	QP
11	9.552	16.99	50.00	-33.01	6.91	9.65	0.43	Average
12	9.552	22.55	60.00	-37.45	12.47	9.65	0.43	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Modulation Mode	GFSK	Test Freq. (MHz)	2480
Power Phase	Neutral		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.156	33.39	55.69	-22.30	23.77	9.57	0.05	Average
2*	0.156	49.17	65.69	-16.52	39.55	9.57	0.05	QP
3	0.186	31.84	54.20	-22.36	22.19	9.58	0.07	Average
4	0.186	43.64	64.20	-20.56	33.99	9.58	0.07	QP
5	0.491	27.90	46.14	-18.24	18.20	9.62	0.08	Average
6	0.491	34.90	56.14	-21.24	25.20	9.62	0.08	QP
7	0.943	18.37	46.00	-27.63	8.63	9.64	0.10	Average
8	0.943	27.52	56.00	-28.48	17.78	9.64	0.10	QP
9	3.820	20.42	46.00	-25.58	10.49	9.66	0.27	Average
10	3.820	32.72	56.00	-23.28	22.79	9.66	0.27	QP
11	9.966	21.69	50.00	-28.31	11.54	9.71	0.44	Average
12	9.966	26.26	60.00	-33.74	16.11	9.71	0.44	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

3.2 Unwanted Emissions into Restricted Frequency Bands

3.2.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit
Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.2.2 Test Procedures

1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

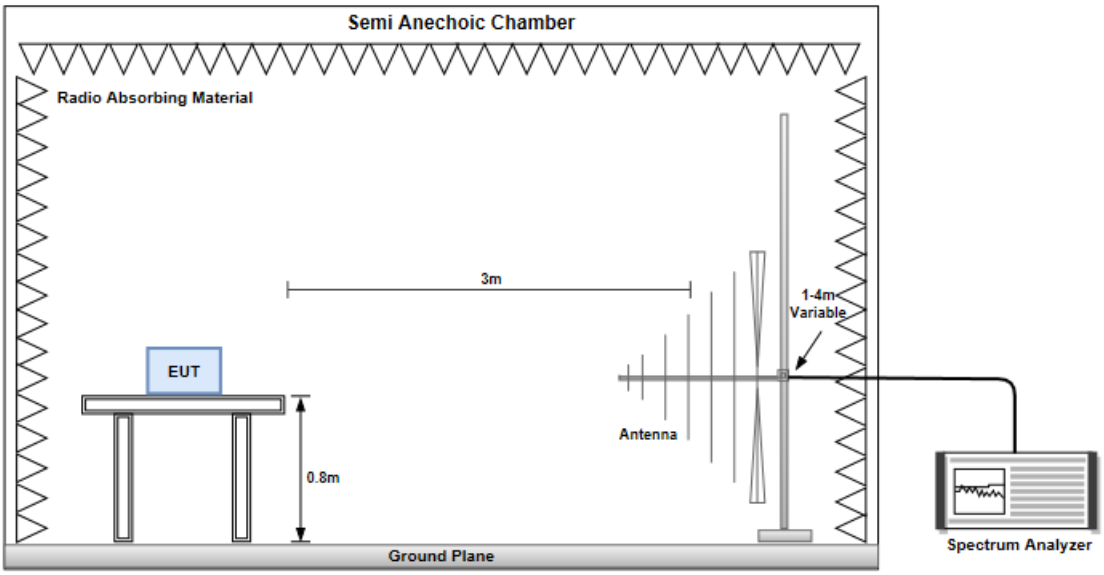
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. Radiated emission above 1GHz / Peak value
   RBW=1MHz, VBW=3MHz and Peak detector
3. Radiated emission above 1GHz / Average value for harmonics
   The average value is: Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from following formula for DH5 packet type which has worst duty factor:

$$20\log(\text{Duty cycle}) = 20\log\frac{1s / 1600 * 5}{100\ ms} = -30.1dB$$

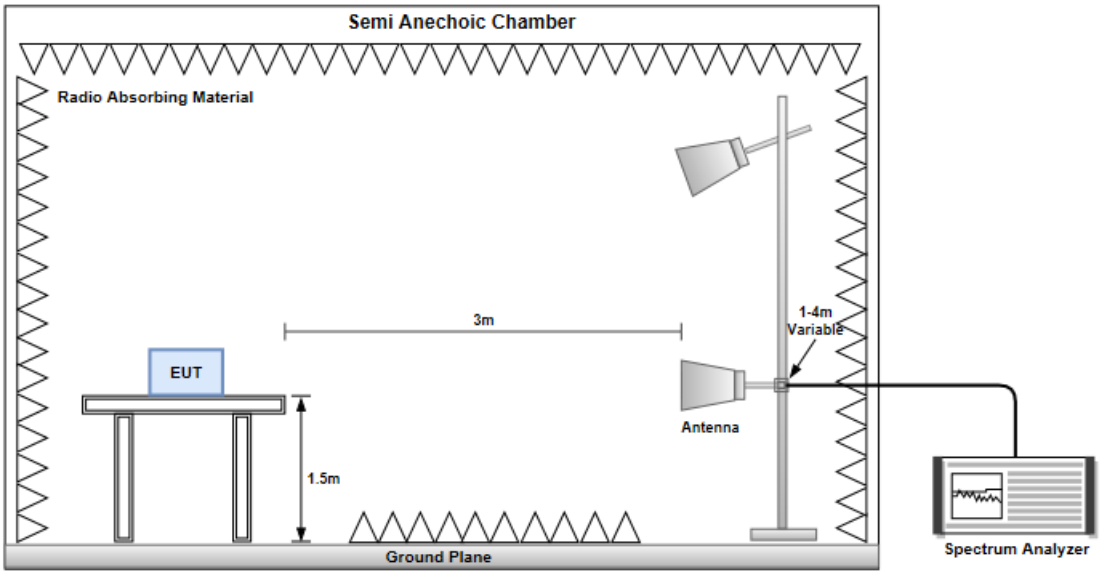
4. Radiated emission above 1GHz / Average value for other emissions
   RBW=1MHz, VBW=1/T and Peak detector

3.2.3 Test Setup

Radiated Emissions below 1 GHz

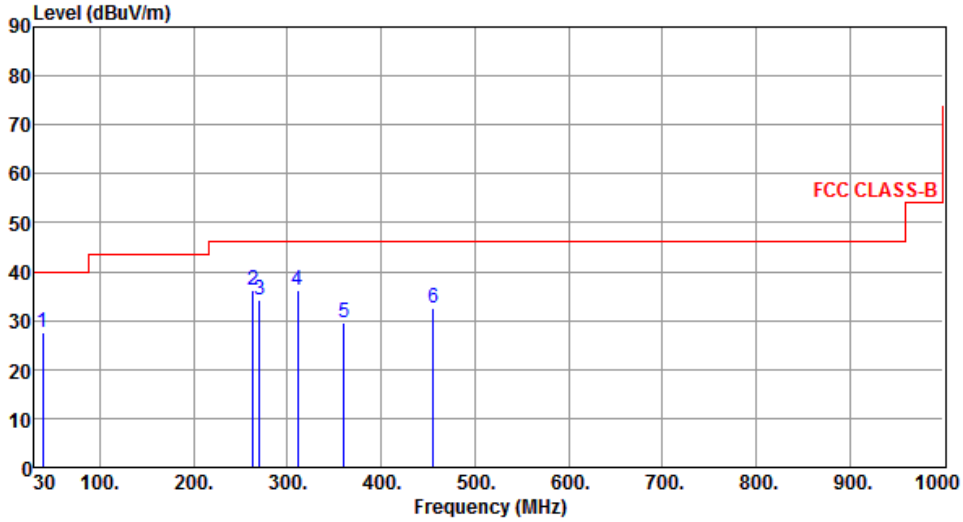


Radiated Emissions above 1 GHz



3.2.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

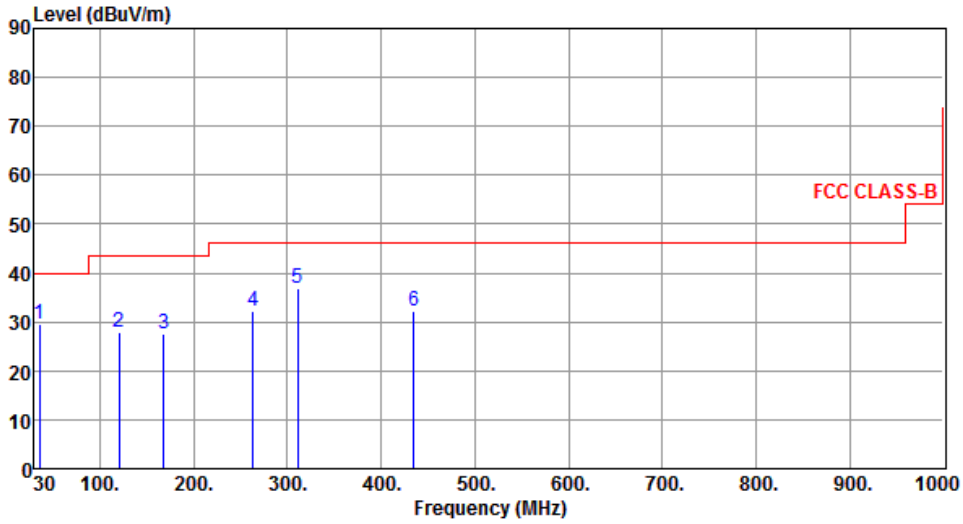
Modulation	GFSK	**Test Freq. (MHz)**	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	38.73	27.58	40.00	-12.42	35.84	-8.26	Peak	---	---
2	263.77	36.18	46.00	-9.82	45.05	-8.87	Peak	---	---
3	270.56	34.36	46.00	-11.64	42.92	-8.56	Peak	---	---
4	311.30	36.20	46.00	-9.80	43.72	-7.52	Peak	---	---
5	360.77	29.53	46.00	-16.47	35.63	-6.10	Peak	---	---
6	455.83	32.38	46.00	-13.62	36.15	-3.77	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		

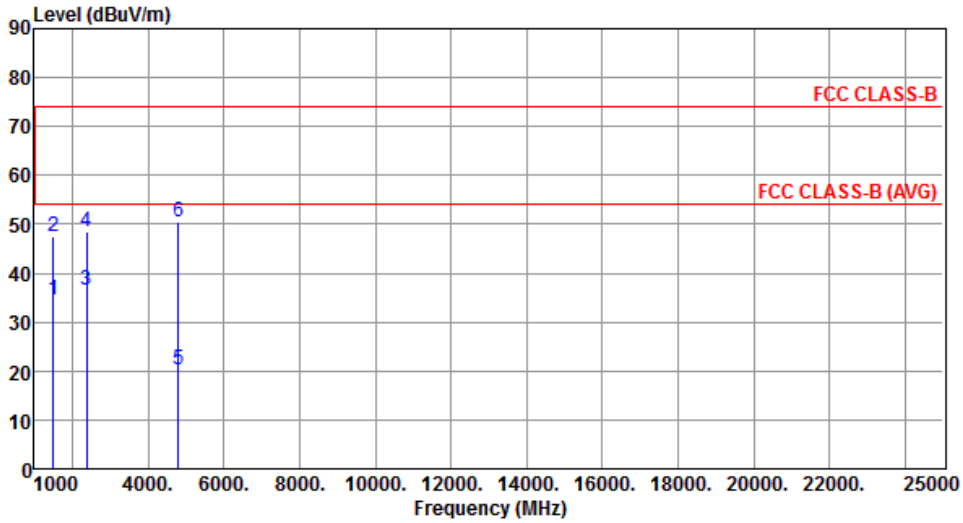


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	35.82	29.41	40.00	-10.59	37.98	-8.57	Peak	---	---
2	120.21	27.85	43.50	-15.65	38.45	-10.60	Peak	---	---
3	167.74	27.66	43.50	-15.84	36.07	-8.41	Peak	---	---
4	263.77	32.12	46.00	-13.88	40.99	-8.87	Peak	---	---
5	311.30	36.80	46.00	-9.20	44.32	-7.52	Peak	---	---
6	434.49	32.26	46.00	-13.74	36.52	-4.26	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.2.5 Transmitter Radiated Unwanted Emissions (Above 1GHz) for GFSK

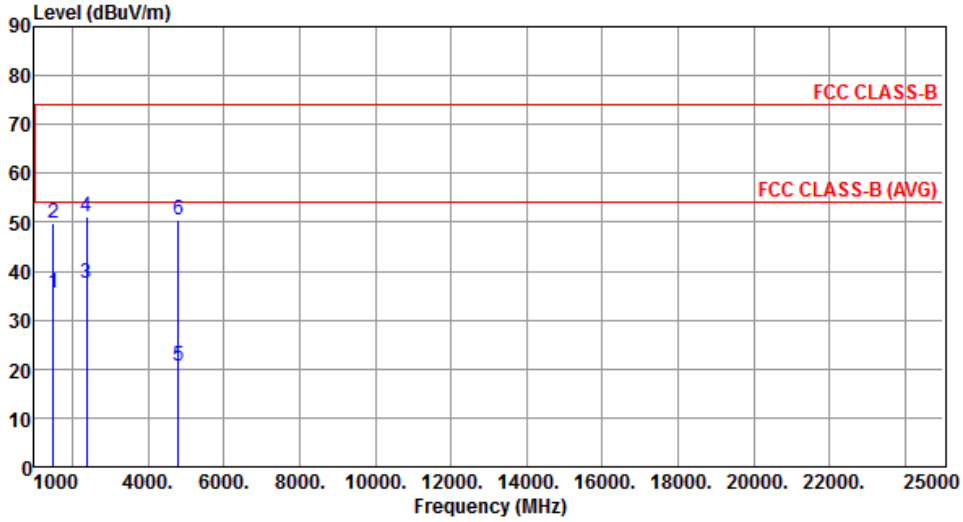
Modulation	GFSK	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1500.00	34.55	54.00	-19.45	40.14	-5.59	Average	167	159
2	1500.00	47.53	74.00	-26.47	53.12	-5.59	Peak	167	159
3	2390.00	36.49	54.00	-17.51	39.19	-2.70	Average	149	154
4	2390.00	48.55	74.00	-25.45	51.25	-2.70	Peak	149	154
5	4804.00	20.23	54.00	-33.77	15.30	4.93	Average	167	9
6	4804.00	50.33	74.00	-23.67	45.40	4.93	Peak	167	9

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

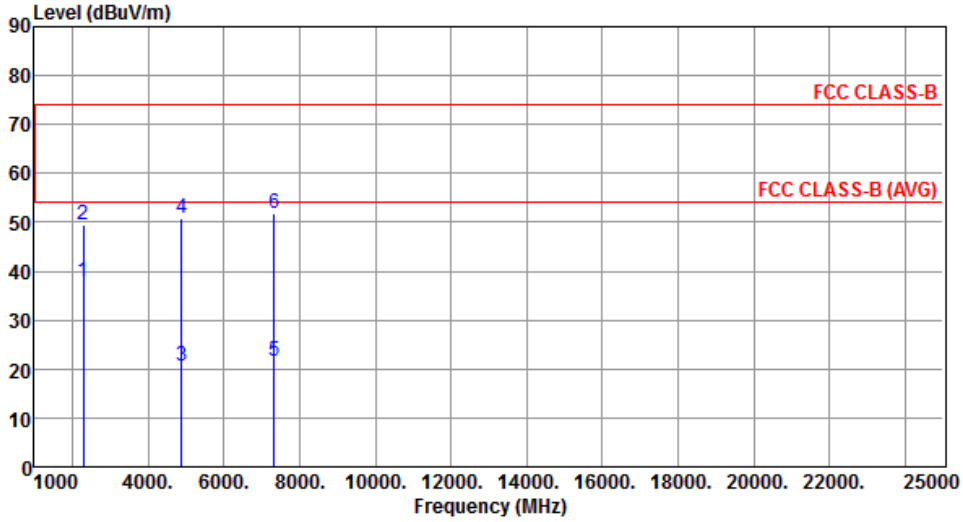
Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1500.00	35.69	54.00	-18.31	41.28	-5.59	Average	205	158
2	1500.00	49.78	74.00	-24.22	55.37	-5.59	Peak	205	158
3	2390.00	37.42	54.00	-16.58	40.12	-2.70	Average	167	279
4	2390.00	51.28	74.00	-22.72	53.98	-2.70	Peak	167	279
5	4804.00	20.45	54.00	-33.55	15.52	4.93	Average	188	88
6	4804.00	50.55	74.00	-23.45	45.62	4.93	Peak	188	88

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

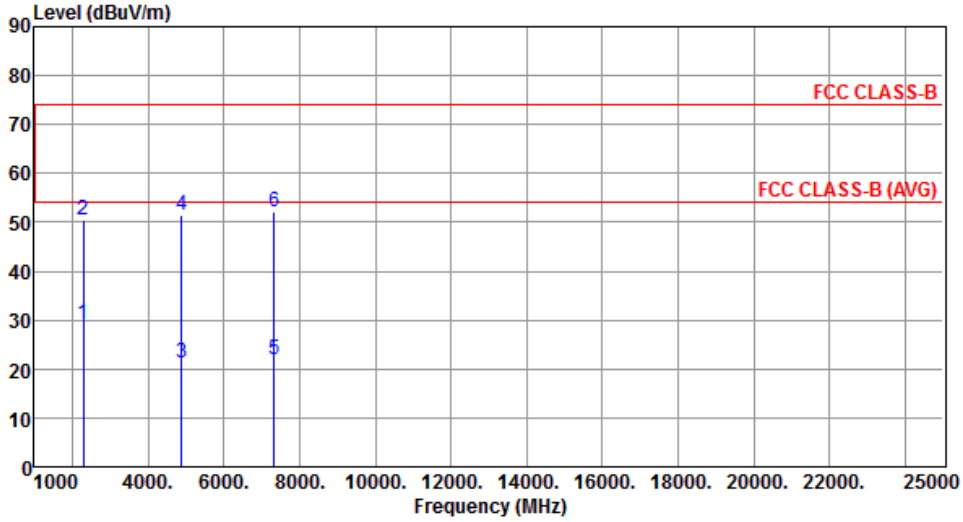
Modulation	GFSK	Test Freq. (MHz)	2441
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2284.00	37.95	54.00	-16.05	41.04	-3.09	Average	140	153
2	2284.00	49.56	74.00	-24.44	52.65	-3.09	Peak	140	153
3	4882.00	20.67	54.00	-33.33	15.57	5.10	Average	174	39
4	4882.00	50.77	74.00	-23.23	45.67	5.10	Peak	174	39
5	7323.00	21.58	54.00	-32.42	11.67	9.91	Average	161	233
6	7323.00	51.68	74.00	-22.32	41.77	9.91	Peak	161	233

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

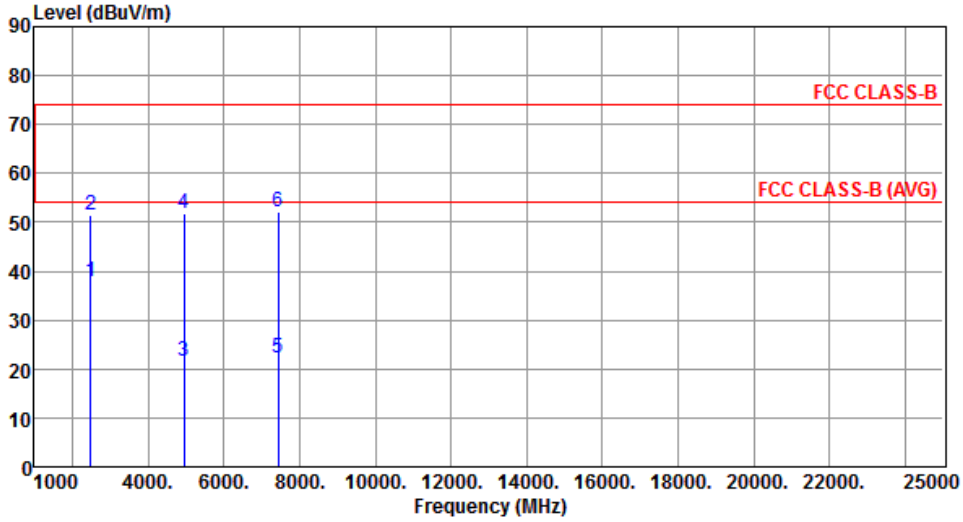
Modulation	GFSK	Test Freq. (MHz)	2441
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2284.00	29.06	54.00	-24.94	32.15	-3.09	Average	167	276
2	2284.00	50.58	74.00	-23.42	53.67	-3.09	Peak	167	276
3	4882.00	21.25	54.00	-32.75	16.15	5.10	Average	200	89
4	4882.00	51.35	74.00	-22.65	46.25	5.10	Peak	200	89
5	7323.00	21.95	54.00	-32.05	12.04	9.91	Average	173	189
6	7323.00	52.05	74.00	-21.95	42.14	9.91	Peak	173	189

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

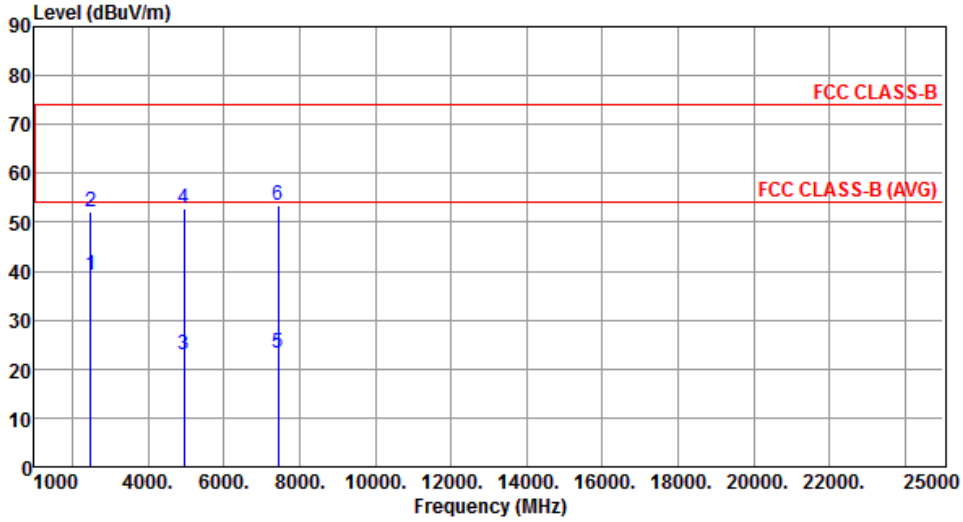
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	37.77	54.00	-16.23	40.14	-2.37	Average	142	154
2	2483.50	51.32	74.00	-22.68	53.69	-2.37	Peak	142	154
3	4960.00	21.55	54.00	-32.45	16.28	5.27	Average	175	25
4	4960.00	51.65	74.00	-22.35	46.38	5.27	Peak	175	25
5	7440.00	22.17	54.00	-31.83	12.03	10.14	Average	160	320
6	7440.00	52.27	74.00	-21.73	42.13	10.14	Peak	160	320

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		

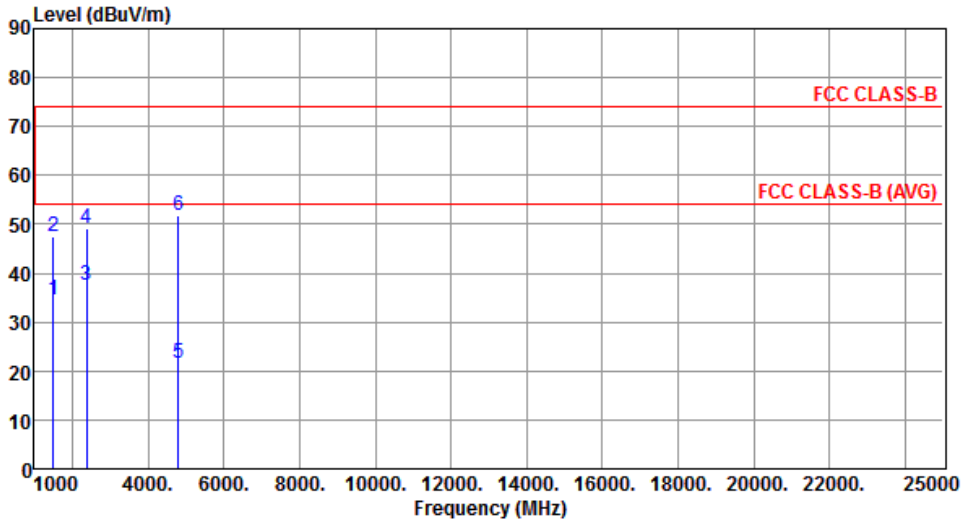


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	39.07	54.00	-14.93	41.44	-2.37	Average	160	280
2	2483.50	52.25	74.00	-21.75	54.62	-2.37	Peak	160	280
3	4960.00	22.82	54.00	-31.18	17.55	5.27	Average	183	52
4	4960.00	52.92	74.00	-21.08	47.65	5.27	Peak	183	52
5	7440.00	23.25	54.00	-30.75	13.11	10.14	Average	213	169
6	7440.00	53.35	74.00	-20.65	43.21	10.14	Peak	213	169

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.2.6 Transmitter Radiated Unwanted Emissions (Above 1GHz) for 8DPSK

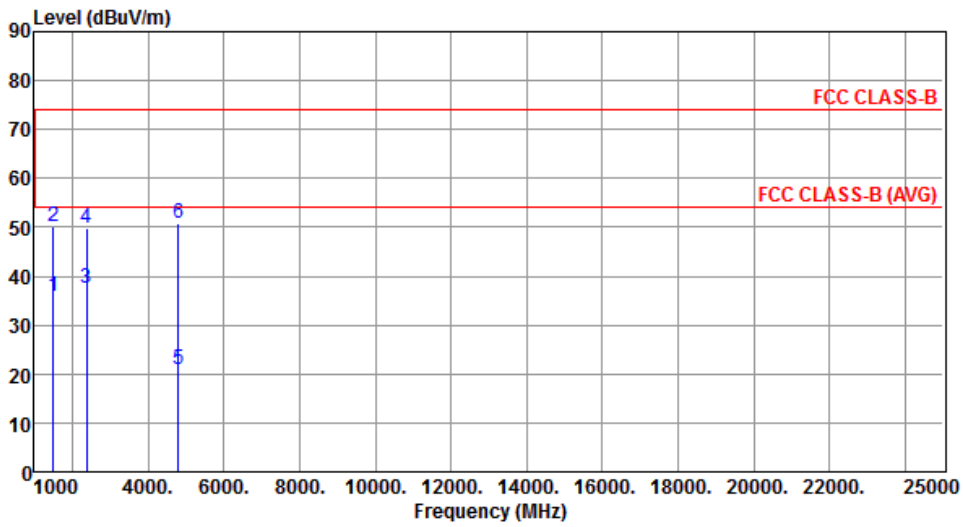
Modulation	8DPSK	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1500.00	34.67	54.00	-19.33	40.26	-5.59	Average	170	154
2	1500.00	47.65	74.00	-26.35	53.24	-5.59	Peak	170	154
3	2390.00	37.42	54.00	-16.58	40.12	-2.70	Average	139	122
4	2390.00	49.15	74.00	-24.85	51.85	-2.70	Peak	139	122
5	4804.00	21.55	54.00	-32.45	16.62	4.93	Average	159	325
6	4804.00	51.65	74.00	-22.35	46.72	4.93	Peak	159	325

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

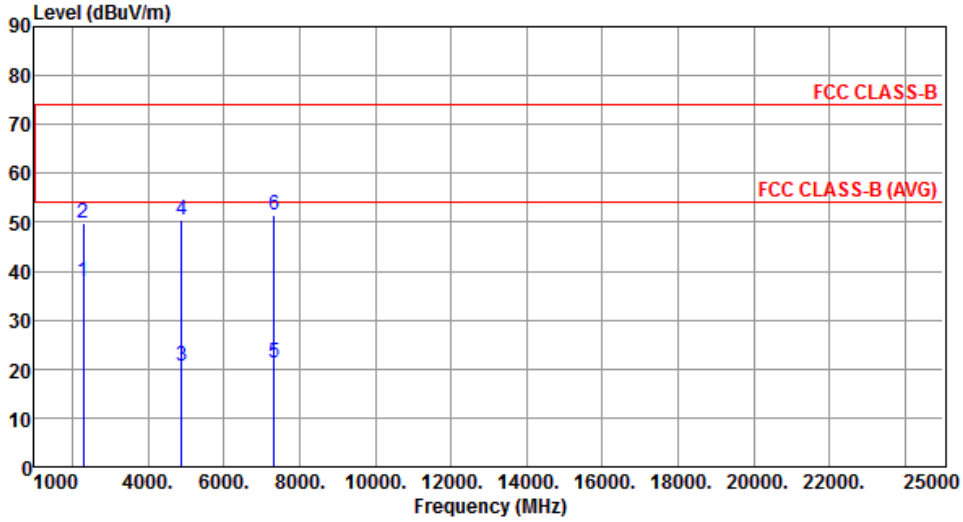
Modulation	8DPSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1500.00	35.71	54.00	-18.29	41.30	-5.59	Average	176	151
2	1500.00	50.06	74.00	-23.94	55.65	-5.59	Peak	176	151
3	2390.00	37.66	54.00	-16.34	40.36	-2.70	Average	164	282
4	2390.00	49.69	74.00	-24.31	52.39	-2.70	Peak	164	282
5	4804.00	20.85	54.00	-33.15	15.92	4.93	Average	185	51
6	4804.00	50.95	74.00	-23.05	46.02	4.93	Peak	185	51

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

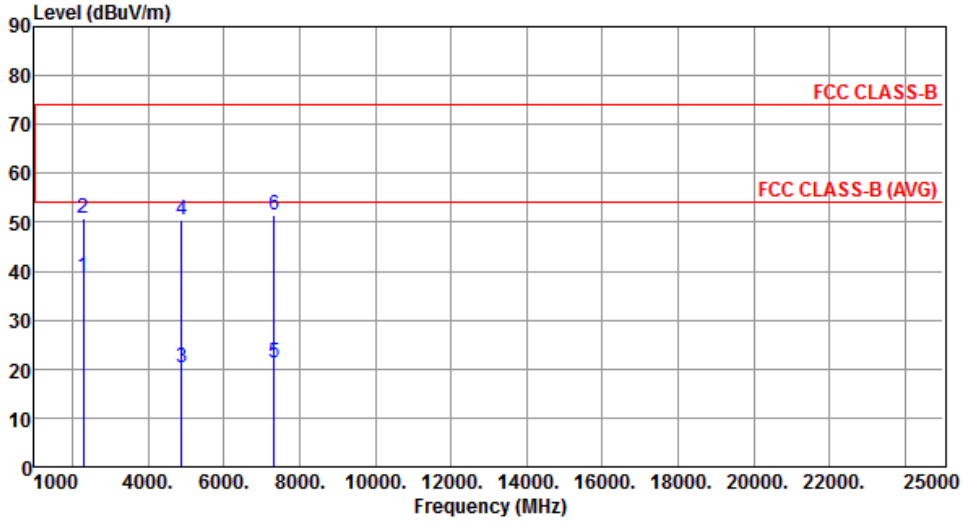
Modulation	8DPSK	Test Freq. (MHz)	2441
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2284.00	37.91	54.00	-16.09	41.00	-3.09	Average	137	142
2	2284.00	49.69	74.00	-24.31	52.78	-3.09	Peak	137	142
3	4882.00	20.51	54.00	-33.49	15.41	5.10	Average	159	305
4	4882.00	50.61	74.00	-23.39	45.51	5.10	Peak	159	305
5	7323.00	21.41	54.00	-32.59	11.50	9.91	Average	171	350
6	7323.00	51.51	74.00	-22.49	41.60	9.91	Peak	171	350

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

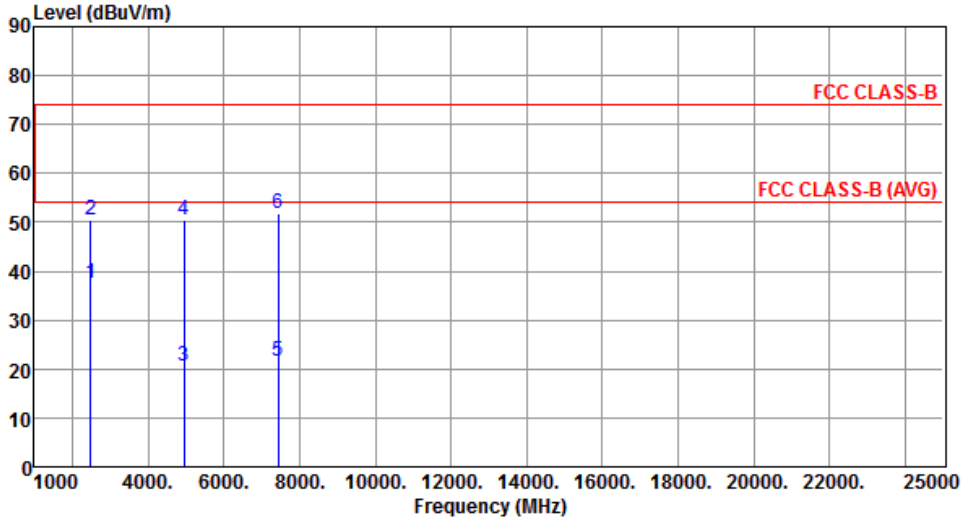
Modulation	8DPSK	Test Freq. (MHz)	2441
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2284.00	38.98	54.00	-15.02	42.07	-3.09	Average	165	279
2	2284.00	50.74	74.00	-23.26	53.83	-3.09	Peak	165	279
3	4882.00	20.22	54.00	-33.78	15.12	5.10	Average	183	229
4	4882.00	50.32	74.00	-23.68	45.22	5.10	Peak	183	229
5	7323.00	21.39	54.00	-32.61	11.48	9.91	Average	198	198
6	7323.00	51.49	74.00	-22.51	41.58	9.91	Peak	198	198

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

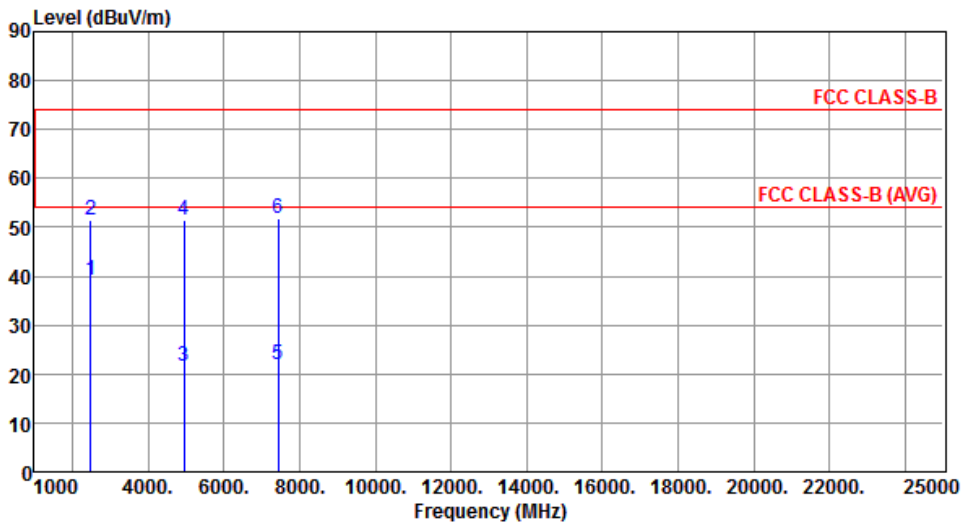
Modulation	8DPSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	37.64	54.00	-16.36	40.01	-2.37	Average	145	155
2	2483.50	50.42	74.00	-23.58	52.79	-2.37	Peak	145	155
3	4960.00	20.52	54.00	-33.48	15.25	5.27	Average	158	358
4	4960.00	50.62	74.00	-23.38	45.35	5.27	Peak	158	358
5	7440.00	21.69	54.00	-32.31	11.55	10.14	Average	163	320
6	7440.00	51.79	74.00	-22.21	41.65	10.14	Peak	163	320

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	8DPSK	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	39.02	54.00	-14.98	41.39	-2.37	Average	174	276
2	2483.50	51.33	74.00	-22.67	53.70	-2.37	Peak	174	276
3	4960.00	21.43	54.00	-32.57	16.16	5.27	Average	195	34
4	4960.00	51.53	74.00	-22.47	46.26	5.27	Peak	195	34
5	7440.00	21.76	54.00	-32.24	11.62	10.14	Average	200	189
6	7440.00	51.86	74.00	-22.14	41.72	10.14	Peak	200	189

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.3 Unwanted Emissions into Non-Restricted Frequency Bands

3.3.1 Limit of Unwanted Emissions into Non-Restricted Frequency Bands

The peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

3.3.2 Test Procedures

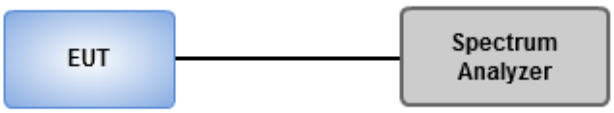
Reference Level Measurement

1. Set the RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
2. Set Sweep time = auto couple, Trace mode = max hold.
3. Allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

Unwanted Emissions Level Measurement

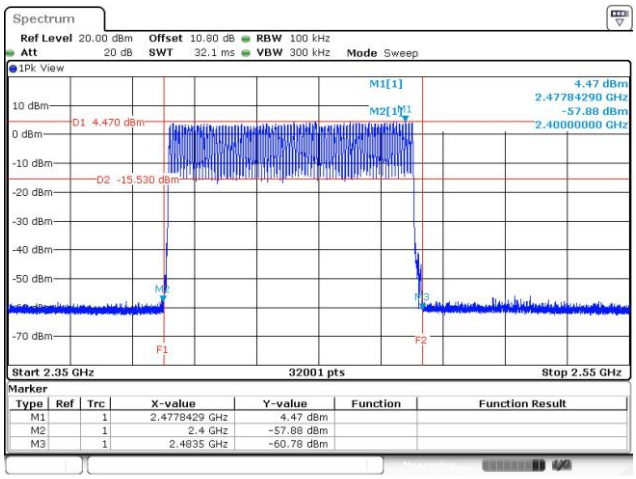
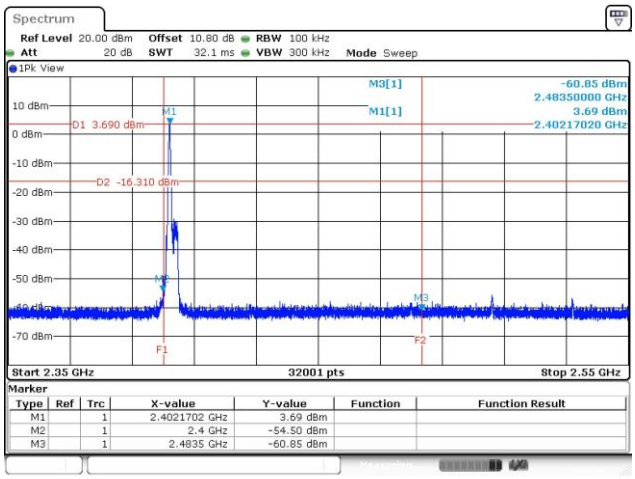
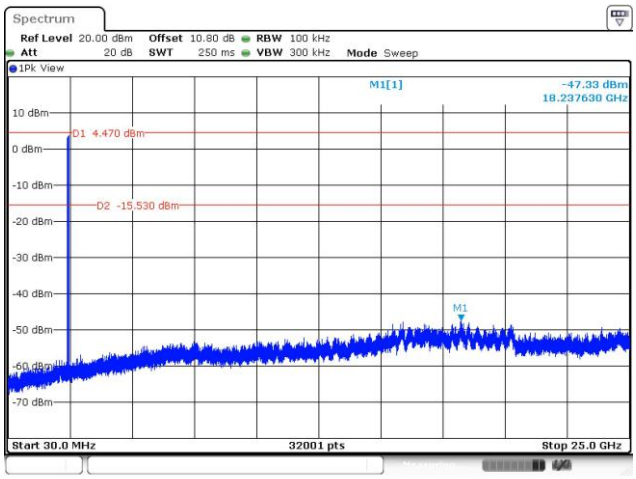
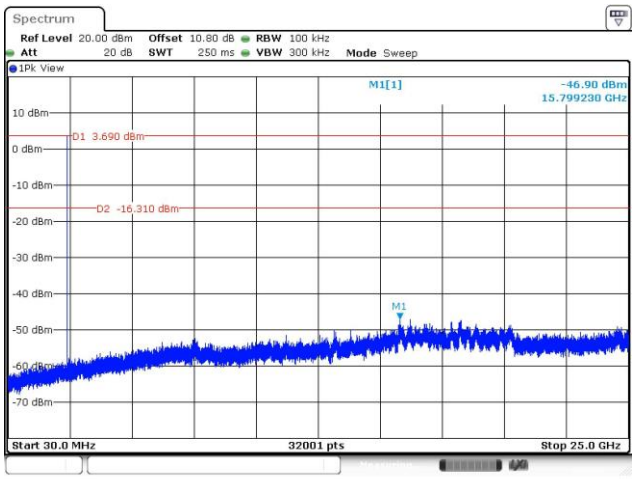
1. Set RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
2. Trace Mode = max hold, Sweep = auto couple.
3. Allow the trace to stabilize.
4. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

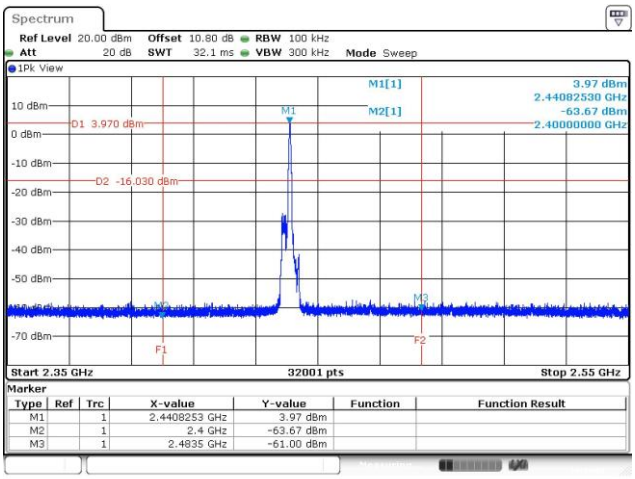
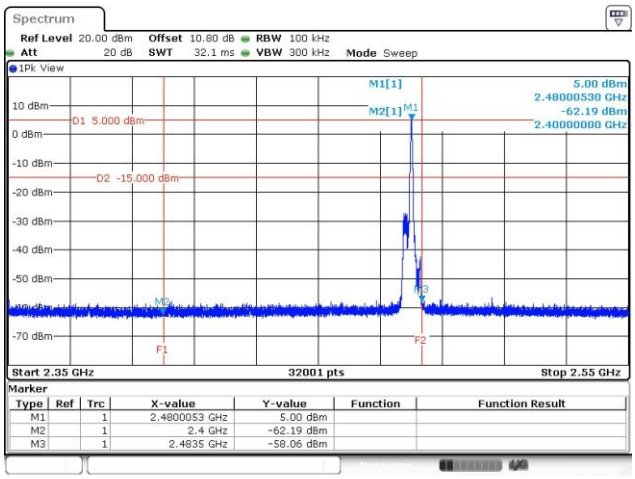
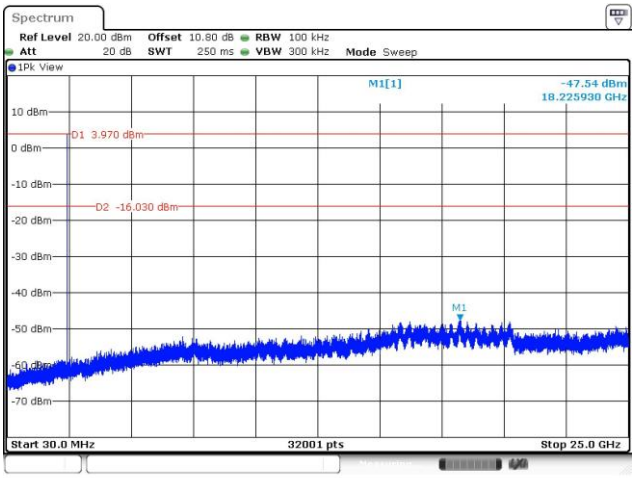
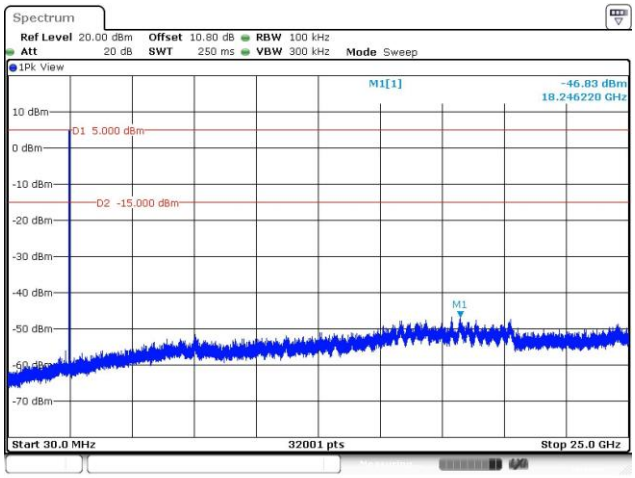
3.3.3 Test Setup



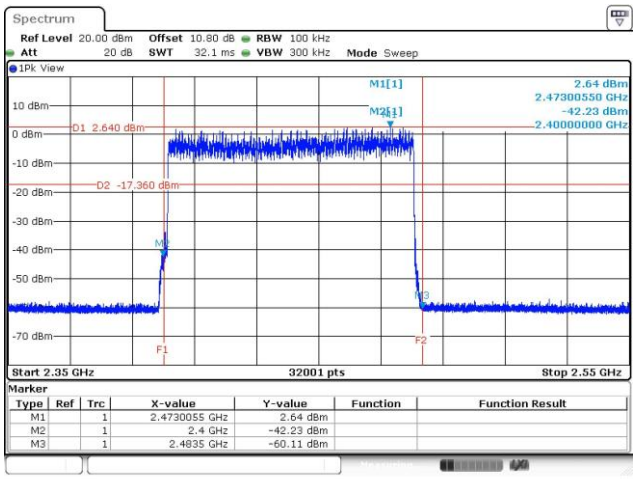
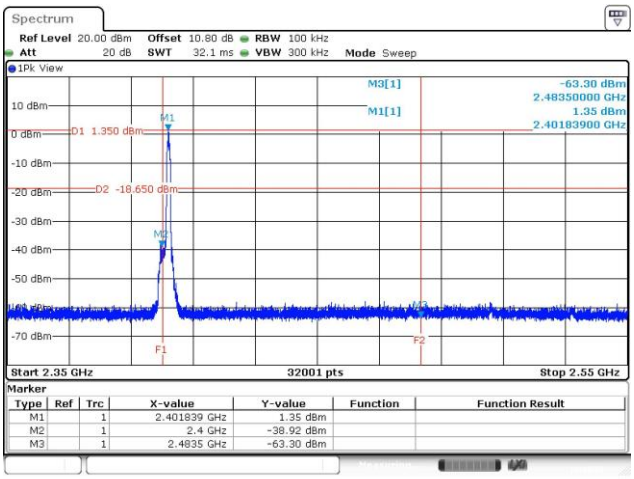
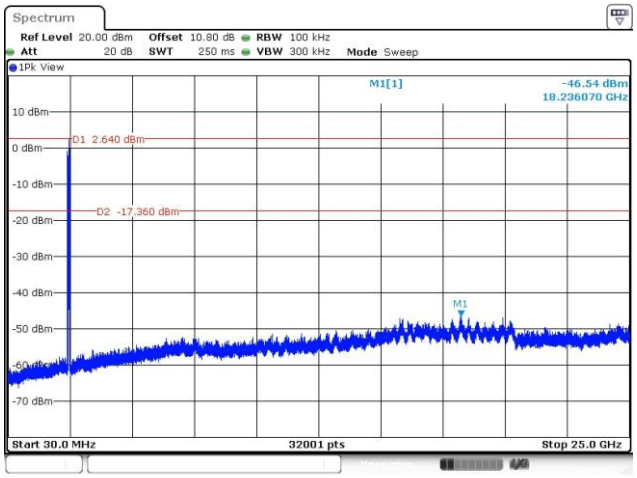
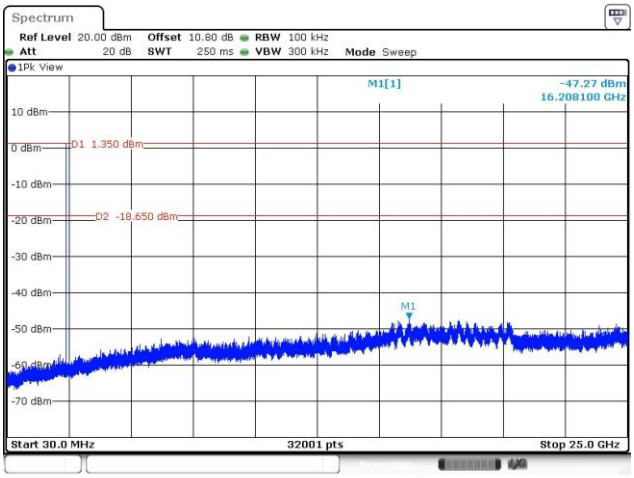
3.3.4 Unwanted Emissions into Non-Restricted Frequency Bands

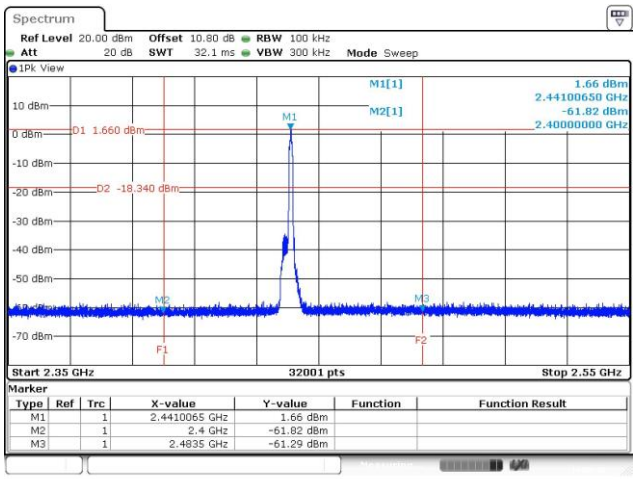
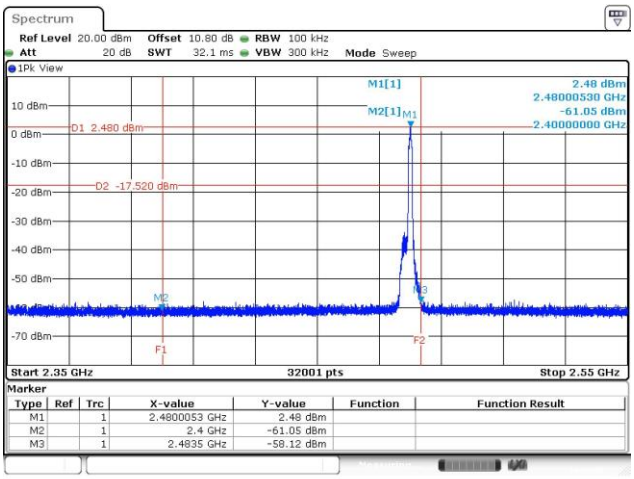
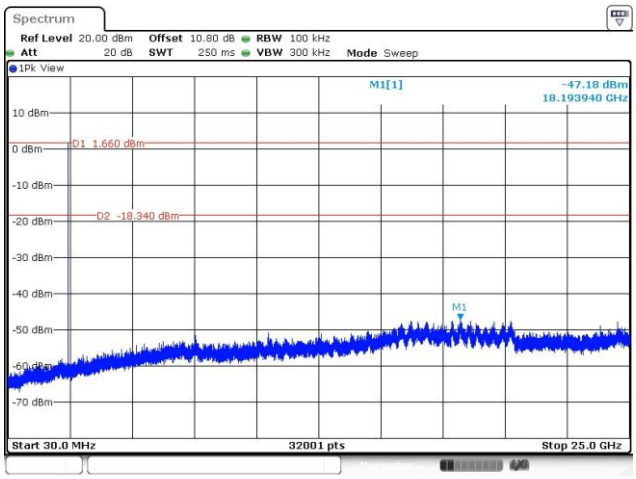
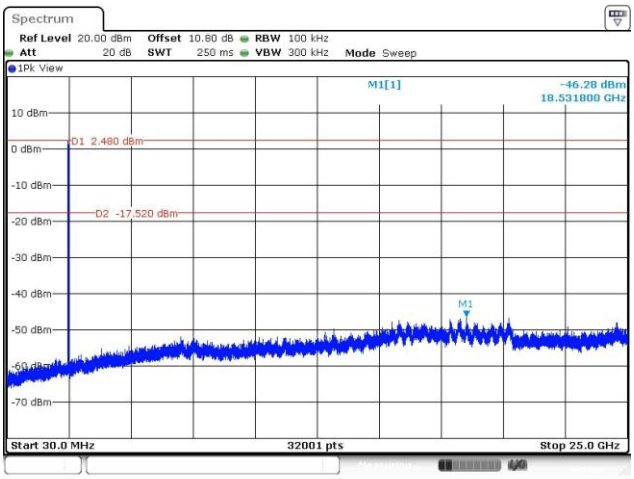
GFSK

Hopping on	Hopping off
30MHz~25GHz (down 20dBc)	**TX Freq 2402MHz / 30MHz~25GHz (down 20dBc)**
	
	

Hopping off	Hopping off
TX Freq 2441MHz / 30MHz~25GHz (down 20dBc)	**TX Freq 2480MHz / 30MHz~25GHz (down 20dBc)**
	
	

8DPSK

Hopping on	Hopping off
30MHz~25GHz (down 20dBc)	**TX Freq 2402MHz / 30MHz~25GHz (down 20dBc)**
	
	

Hopping off	Hopping off
TX Freq 2441MHz / 30MHz~25GHz (down 20dBc)	**TX Freq 2480MHz / 30MHz~25GHz (down 20dBc)**
	
	

3.4 Conducted Output Power

3.4.1 Limit of Conducted Output Power

☐ 1 Watt
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.

☒ 0.125 Watt
For all other frequency hopping systems in the 2400–2483.5 MHz band.

☐ 0.125 Watt
For Frequency hopping systems operating in the 2400–2483.5 MHz band have hopping channel carrier frequencies that are separated by two-thirds of the 20 dB bandwidth of the hopping channel.

3.4.2 Test Procedures

1. A wideband power meter is used for power measurement. Bandwidth of power senor and meter is 50MHz
2 If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power

3.4.3 Test Setup

3.4.4 Test Result of Conducted Output Power

Modulation Mode	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Limit (mW)
GFSK	2402	2.35	3.71	125
GFSK	2441	2.81	4.48	125
GFSK	2480	3.31	**5.20**	125
π/4 DQPSK	2402	1.91	2.81	125
π/4 DQPSK	2441	2.14	3.30	125
π/4 DQPSK	2480	2.60	4.15	125
8DPSK	2402	2.07	3.17	125
8DPSK	2441	2.38	3.77	125
8DPSK	2480	2.85	4.55	125

Modulation Mode	Freq. (MHz)	AV Output Power (mW)	AV Output Power (dBm)
GFSK	2402	2.10	3.22
GFSK	2441	2.48	3.95
GFSK	2480	2.94	4.69
π/4 DQPSK	2402	1.09	0.38
π/4 DQPSK	2441	1.22	0.85
π/4 DQPSK	2480	1.49	1.72
8DPSK	2402	1.10	0.40
8DPSK	2441	1.22	0.87
8DPSK	2480	1.49	1.74

Note: Average power is for reference only.

3.4.5 Verification and Comparison of Conducted Output Power

Modulation Mode	Freq. (MHz)	Peak Output Power (dBm)		Difference (dB)	Limit (dB)
		Original device	Variant device		
GFSK	2402	3.71	2.43	1.28	+ / - 2 dB
GFSK	2441	4.48	4.12	0.36	+ / - 2 dB
GFSK	2480	**5.20**	4.01	1.19	+ / - 2 dB
π/4 DQPSK	2402	2.81	1.46	1.35	+ / - 2 dB
π/4 DQPSK	2441	3.30	3.06	0.24	+ / - 2 dB
π/4 DQPSK	2480	4.15	2.93	1.22	+ / - 2 dB
8DPSK	2402	3.17	2.06	1.11	+ / - 2 dB
8DPSK	2441	3.77	3.74	0.03	+ / - 2 dB
8DPSK	2480	4.55	3.38	1.17	+ / - 2 dB

Modulation Mode	Freq. (MHz)	Average Output Power (dBm)		Difference (dB)	Limit (dB)
		Original device	Variant device		
GFSK	2402	3.22	1.98	1.24	+ / - 2 dB
GFSK	2441	3.95	3.78	0.17	+ / - 2 dB
GFSK	2480	4.69	3.58	1.11	+ / - 2 dB
π/4 DQPSK	2402	0.38	-1.15	1.53	+ / - 2 dB
π/4 DQPSK	2441	0.85	0.46	0.39	+ / - 2 dB
π/4 DQPSK	2480	1.72	0.34	1.38	+ / - 2 dB
8DPSK	2402	0.40	-1.17	1.57	+ / - 2 dB
8DPSK	2441	0.87	0.49	0.38	+ / - 2 dB
8DPSK	2480	1.74	0.35	1.39	+ / - 2 dB

3.5 Number of Hopping Frequency

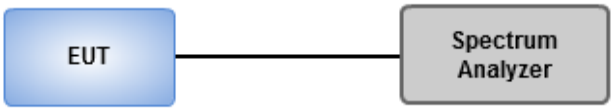
3.5.1 Limit of Number of Hopping Frequency

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

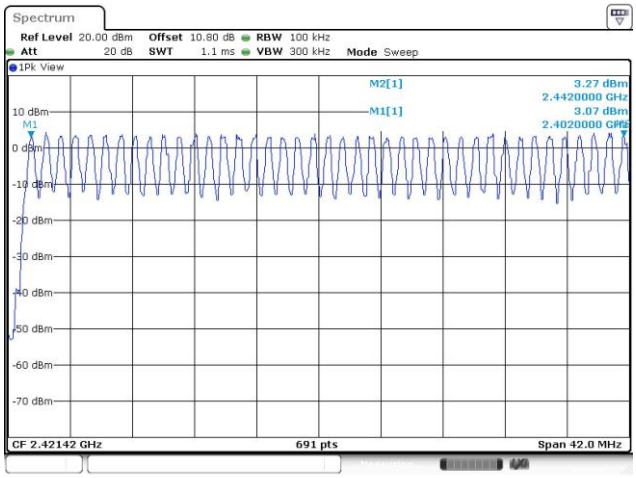
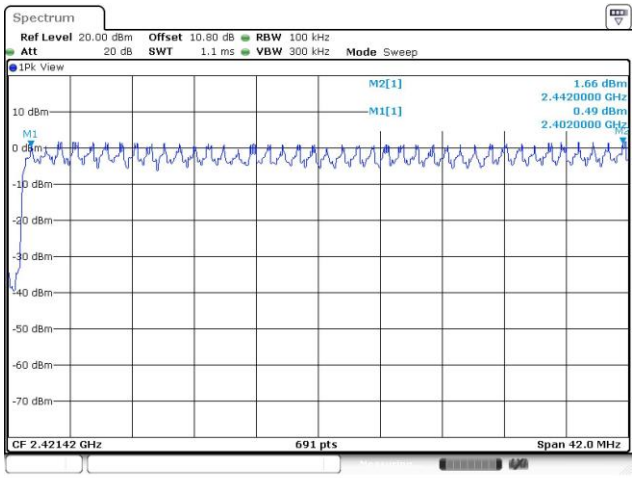
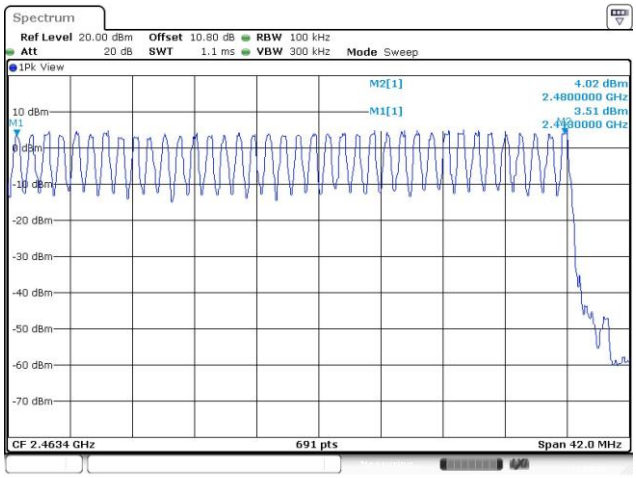
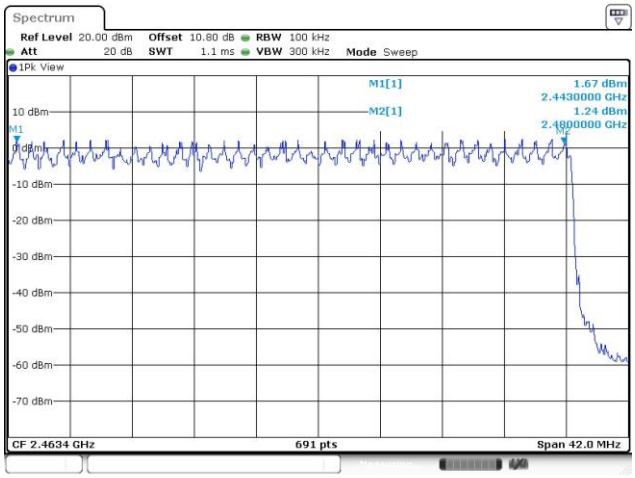
3.5.2 Test Procedures

1. Set RBW = 100kHz, VBW = 300kHz, Sweep time = Auto, Detector = Peak Trace max hold.
2 Allow trace to stabilize.

3.5.3 Test Setup



3.5.4 Test Result of Number of Hopping Frequency

GFSK	8DPSK
	
	

3.6 20dB and Occupied Bandwidth

3.6.1 Test Procedures

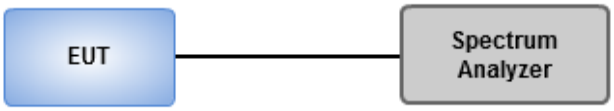
20dB Bandwidth

1. Set RBW=30kHz, VBW=100kHz,Sweep time = Auto, Detector=Peak, Trace max hold
2 Allow trace to stabilize
3 Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

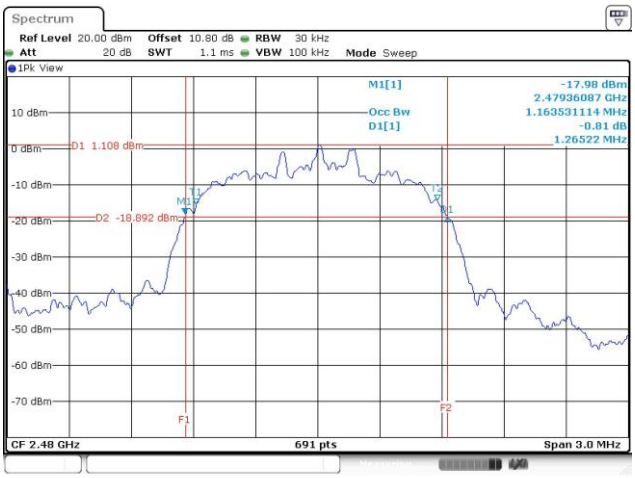
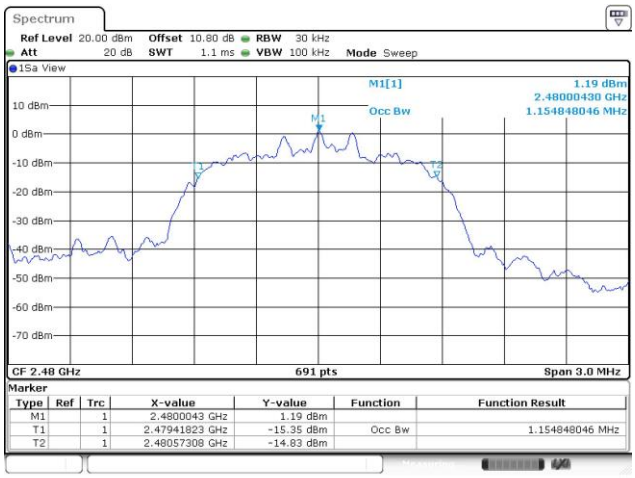
1. Set RBW=30kHz, VBW=100kHz,Sweep time = Auto, Detector=Sample, Trace max hold
2 Allow trace to stabilize
3. Use Occupied bandwidth function of spectrum analyzer to measuring 99% occupied bandwidth

3.6.2 Test Setup



3.6.3 Test result of 20dB and Occupied Bandwidth

Modulation Mode	Freq. (MHz)	20dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
GFSK	2402	0.939	0.868
GFSK	2441	0.948	0.860
GFSK	2480	0.939	0.864
8DPSK	2402	1.252	1.155
8DPSK	2441	1.257	1.155
8DPSK	2480	1.265	1.155

Worst Plot of 20dB Bandwidth	Worst Plot of Occupied Bandwidth
	

3.7 Channel Separation

3.7.1 Limit of Channel Separation

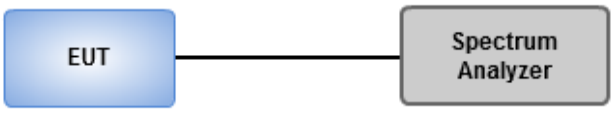
☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

☒ Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

3.7.2 Test Procedures

1. Set RBW=100kHz, VBW=300kHz,Sweep time = Auto, Detector=Peak Trace max hold
2 Allow trace to stabilize
3 Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The EUT shall show compliance with the appropriate regulatory limit

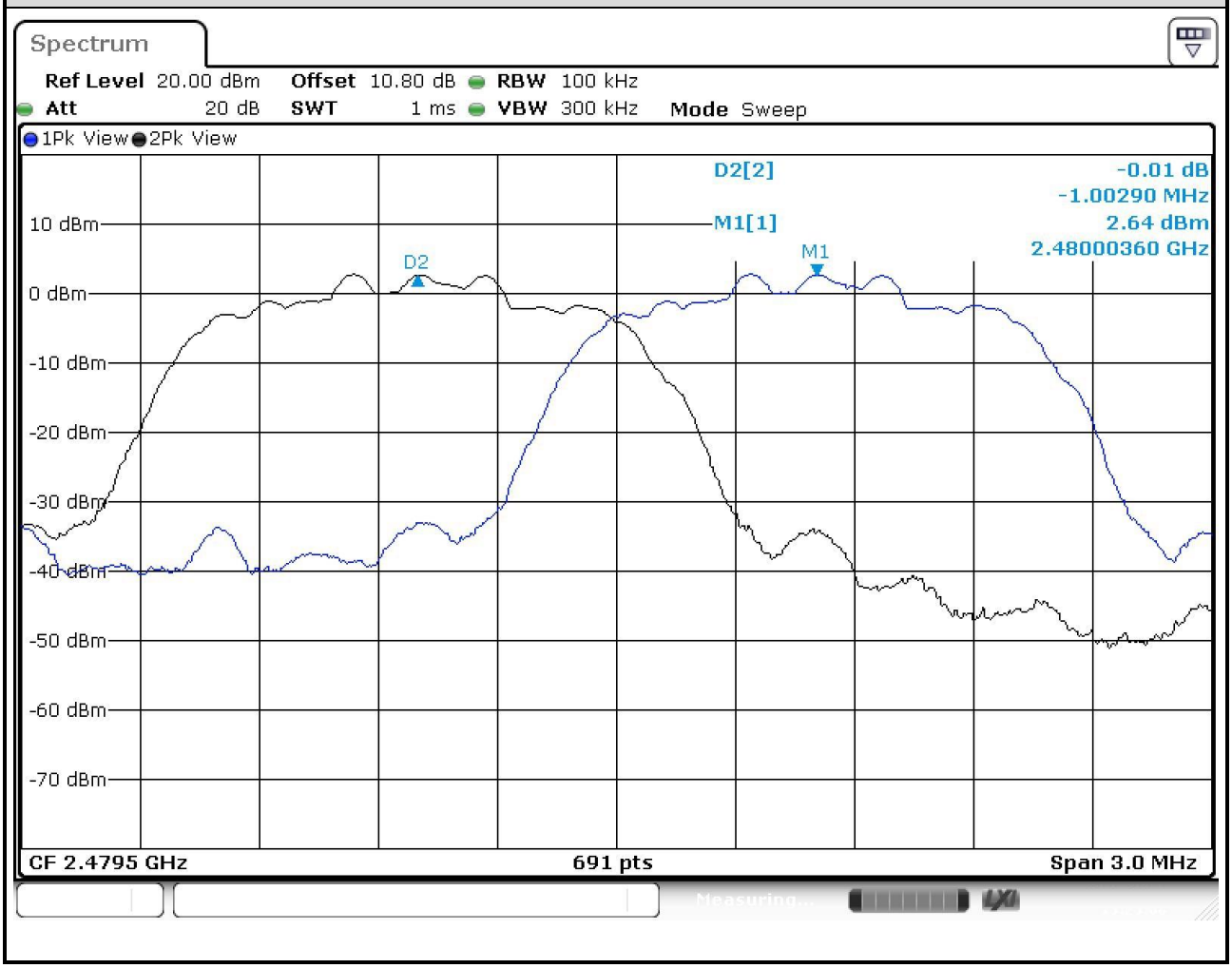
3.7.3 Test Setup



3.7.4 Test result of Channel Separation

Modulation Mode	Freq. (MHz)	Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)
GFSK	2402	1.003	0.939	0.626
GFSK	2441	1.003	0.948	0.632
GFSK	2480	1.003	0.939	0.626
8DPSK	2402	1.003	1.252	0.835
8DPSK	2441	1.003	1.257	0.838
8DPSK	2480	1.003	1.265	0.843

Worst Plot



3.8 Number of Dwell Time

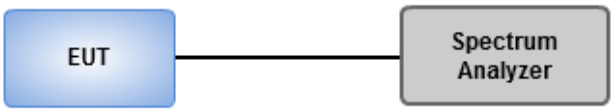
3.8.1 Limit of Dwell time

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.

3.8.2 Test Procedures

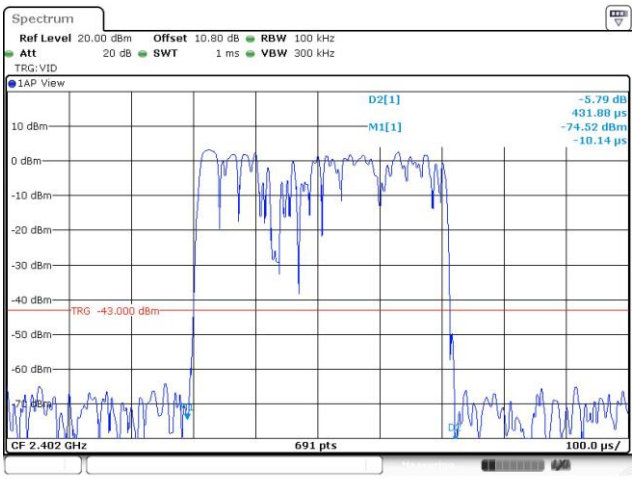
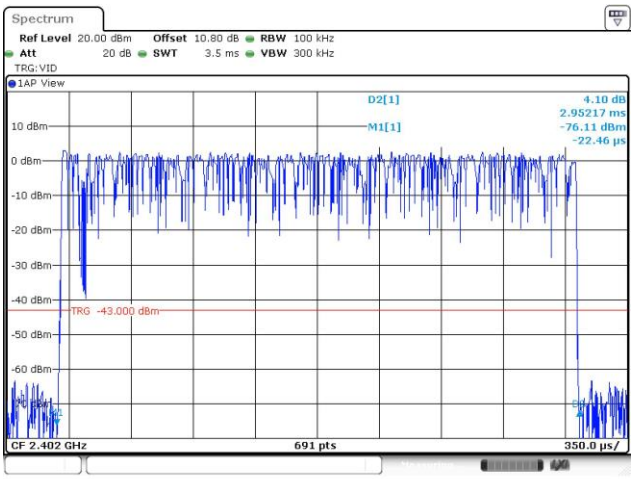
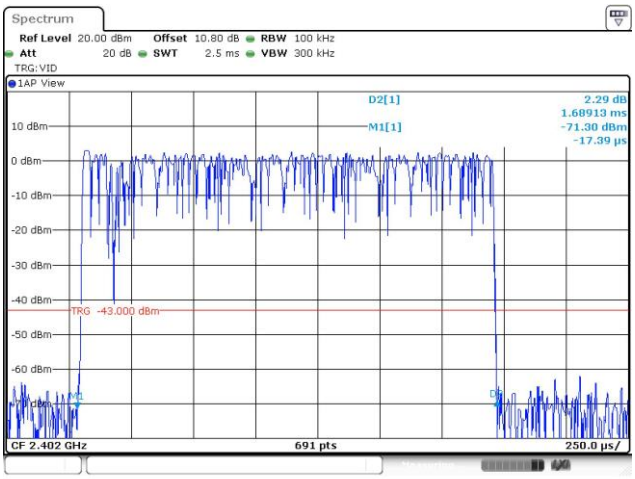
1. Set RBW=100kHz,VBW=300kHz,Sweep time = 500us(DH1),2ms(DH3),4ms(DH5), Detector=Peak, Span=0Hz,Trace max hold
2 Enable gating and trigger function of spectrum analyzer to measure burst on time.
3. The DH1 packet can cover a single time slot. A maximum length packet has duration of 1 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 1/1600 seconds, or 0.625ms. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.
4. The DH3 packet can cover up to 3 time slots. A maximum length packet has duration of 3 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 3/1600 seconds, or 1.875ms. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.
5 The DH5 packet can cover up to 5 time slots. Operate DH5 at maximum dwell time and maximum duty cycle. A maximum length packet has duration of 5 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 5/1600 seconds, or 3.125ms. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds

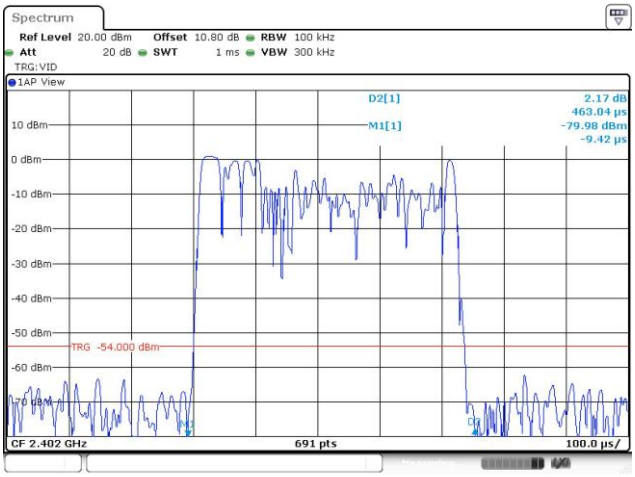
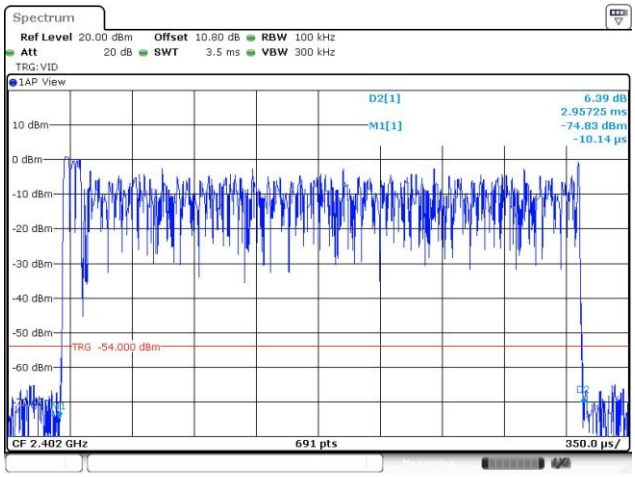
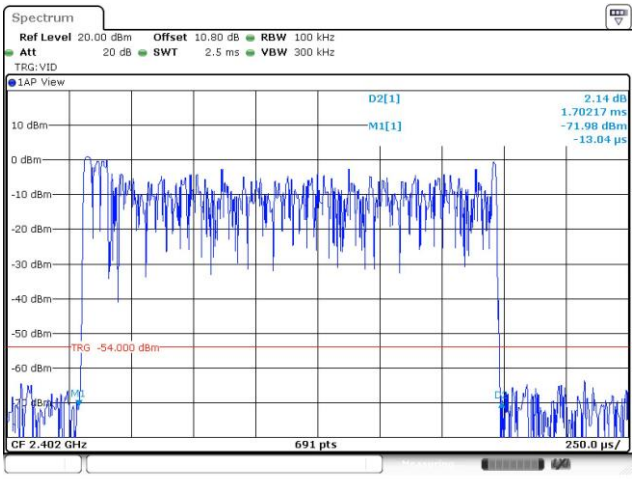
3.8.3 Test Setup



3.8.4 Test Result of Dwell Time

Modulation Mode	Freq. (MHz)	Length of Transmission Time (msec)	Number of Transmission in a 31.6 (79 Hopping*0.4)	Result (s)	Limit (s)
GFSK-DH1	2402	0.43188	320	0.138	0.4
GFSK-DH3	2402	1.68913	160	0.270	0.4
GFSK-DH5	2402	2.95217	106.6	0.315	0.4
8DPSK-DH1	2402	0.46304	320	0.148	0.4
8DPSK-DH3	2402	1.70217	160	0.272	0.4
8DPSK-DH5	2402	2.95725	106.6	0.315	0.4

GFSK	
DH1	**DH5**
	
DH3	**--**
	--

8DPSK	
3DH1	**3DH5**
	
3DH3	**--**
	--

4 Receiver Test Results

4.1 Conducted Emissions

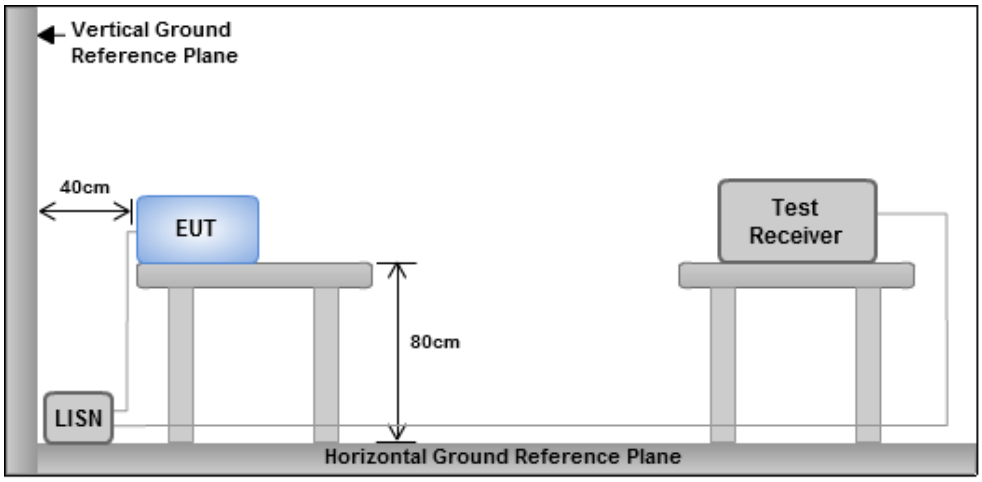
4.1.1 Limit of Conducted Emissions

Conducted Emissions Limit		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarithm of the frequency.		

4.1.2 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V / 60Hz.

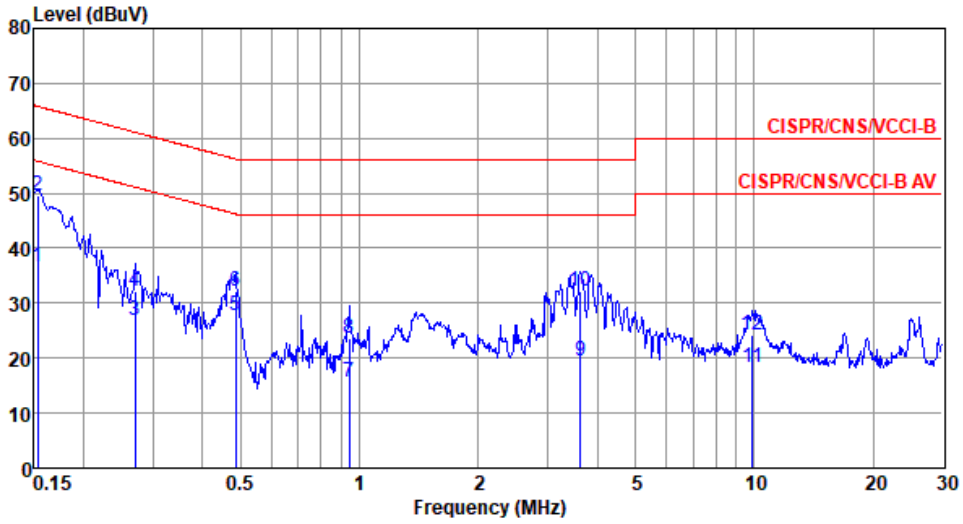
4.1.3 Test Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

4.1.4 Test Result of Conducted Emissions

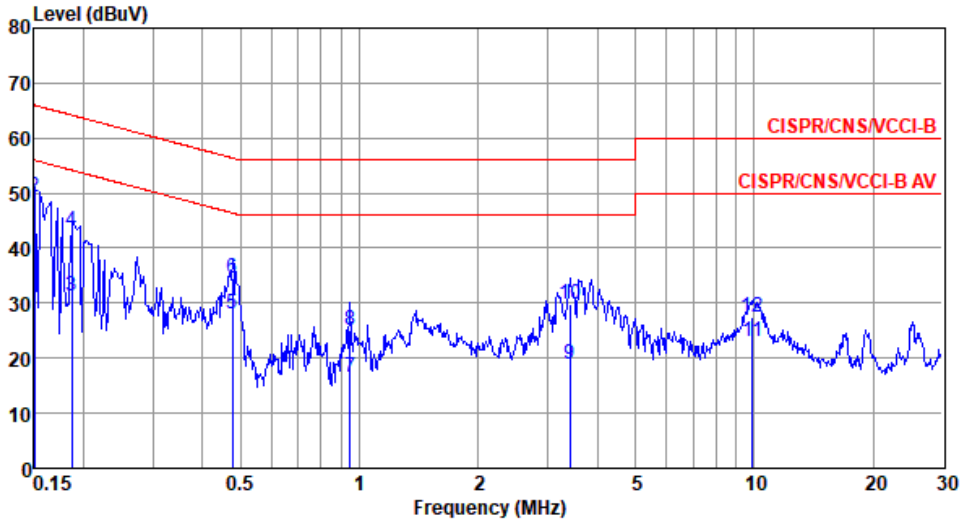
Modulation Mode	GFSK	Test Freq. (MHz)	2480
Power Phase	Line		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.153	36.61	55.82	-19.21	27.03	9.53	0.05	Average
2*	0.153	49.63	65.82	-16.19	40.05	9.53	0.05	QP
3	0.270	26.74	51.12	-24.38	17.12	9.55	0.07	Average
4	0.270	32.05	61.12	-29.07	22.43	9.55	0.07	QP
5	0.486	27.83	46.23	-18.40	18.17	9.58	0.08	Average
6	0.486	32.18	56.23	-24.05	22.52	9.58	0.08	QP
7	0.943	15.51	46.00	-30.49	5.81	9.60	0.10	Average
8	0.943	23.64	56.00	-32.36	13.94	9.60	0.10	QP
9	3.623	19.45	46.00	-26.55	9.58	9.61	0.26	Average
10	3.623	32.04	56.00	-23.96	22.17	9.61	0.26	QP
11	9.913	18.43	50.00	-31.57	8.34	9.65	0.44	Average
12	9.913	24.28	60.00	-35.72	14.19	9.65	0.44	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Modulation Mode	GFSK	Test Freq. (MHz)	2480
Power Phase	Neutral		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.150	35.73	56.00	-20.27	26.11	9.57	0.05	Average
2*	0.150	49.43	66.00	-16.57	39.81	9.57	0.05	QP
3	0.186	31.34	54.20	-22.86	21.69	9.58	0.07	Average
4	0.186	43.09	64.20	-21.11	33.44	9.58	0.07	QP
5	0.476	28.01	46.41	-18.40	18.31	9.62	0.08	Average
6	0.476	34.50	56.41	-21.91	24.80	9.62	0.08	QP
7	0.948	16.40	46.00	-29.60	6.66	9.64	0.10	Average
8	0.948	25.17	56.00	-30.83	15.43	9.64	0.10	QP
9	3.417	18.84	46.00	-27.16	8.93	9.66	0.25	Average
10	3.417	29.94	56.00	-26.06	20.03	9.66	0.25	QP
11	9.913	23.01	50.00	-26.99	12.86	9.71	0.44	Average
12	9.913	27.40	60.00	-32.60	17.25	9.71	0.44	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

4.2 Unwanted Emissions into Restricted Frequency Bands

4.2.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit
Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

4.2.2 Test Procedures

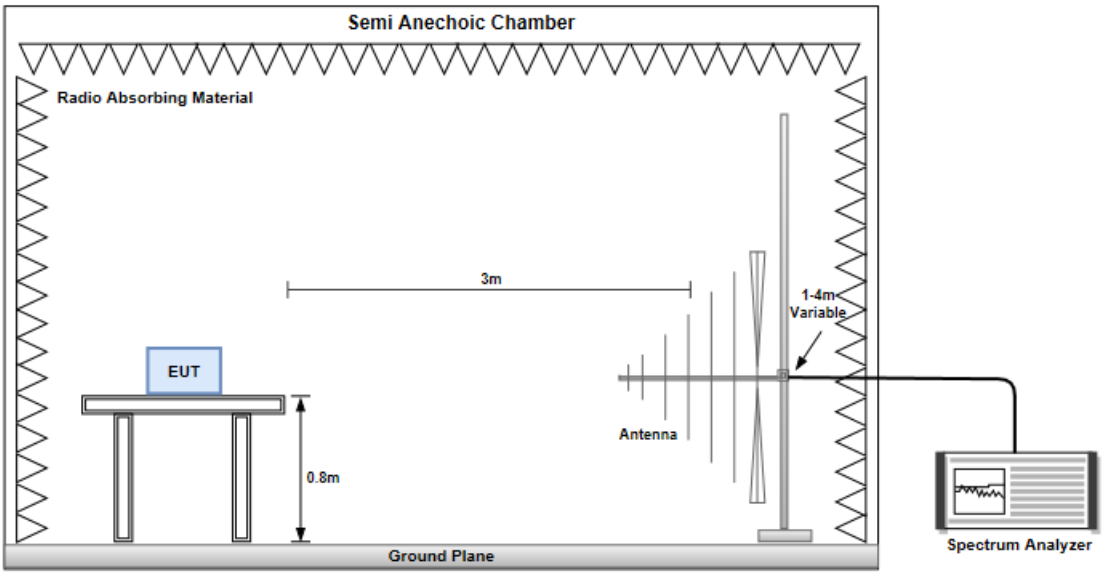
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

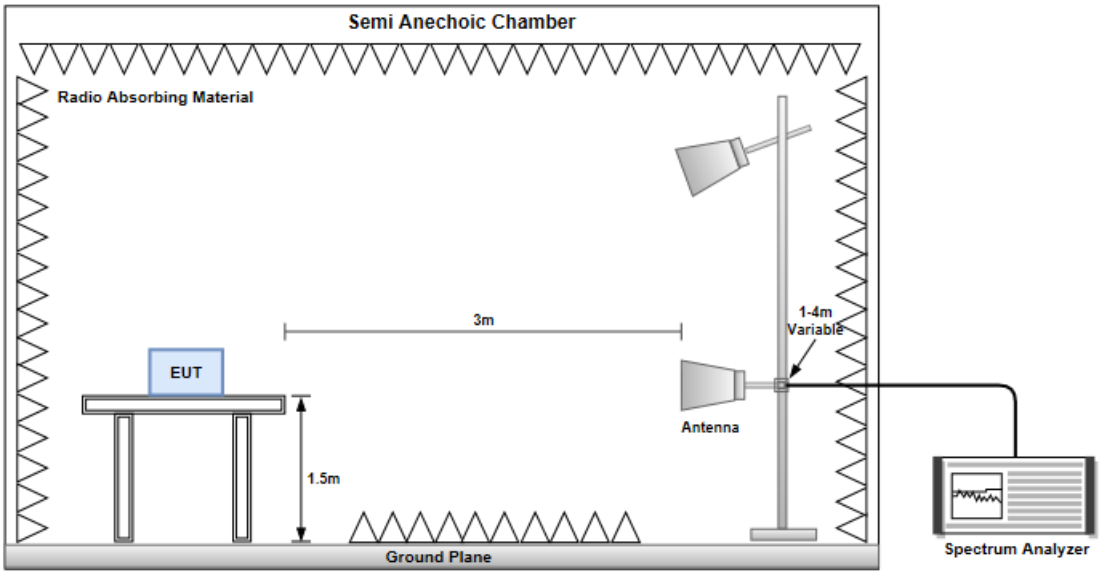
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=3MHz and RMS detector is for average measured value of radiated emission above 1GHz.

4.2.3 Test Setup

Radiated Emissions below 1 GHz

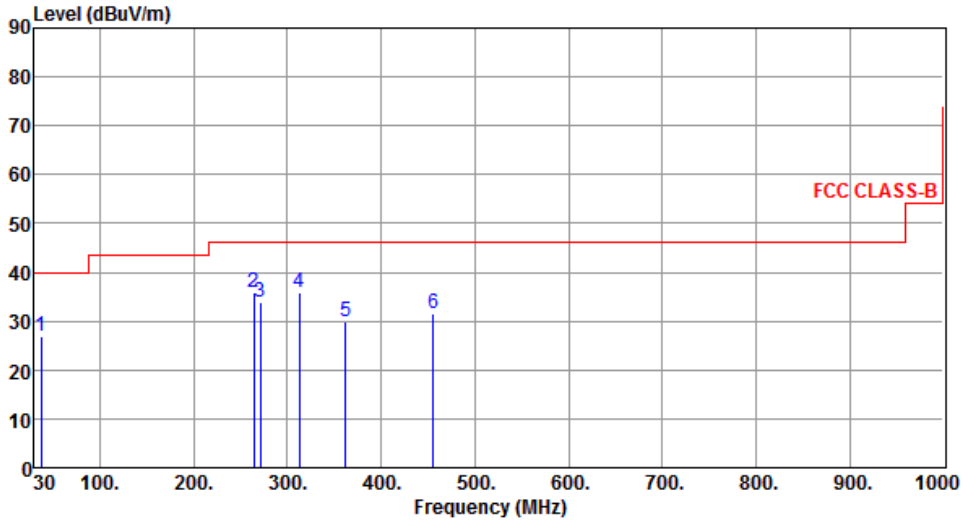


Radiated Emissions above 1 GHz



4.2.4 Receiver Radiated Unwanted Emissions

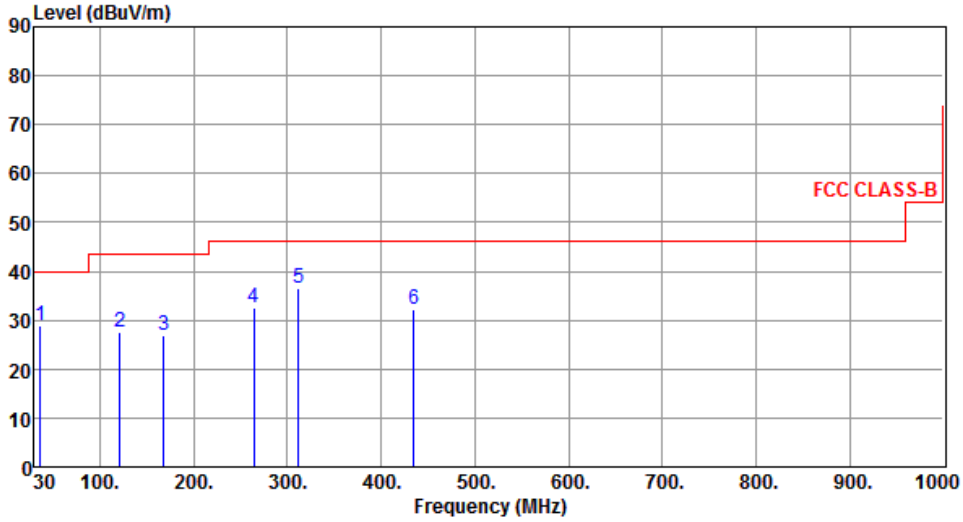
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	37.52	26.85	40.00	-13.15	35.28	-8.43	Peak	---	---
2	264.58	35.88	46.00	-10.12	44.71	-8.83	Peak	---	---
3	270.89	34.00	46.00	-12.00	42.54	-8.54	Peak	---	---
4	312.58	35.89	46.00	-10.11	43.35	-7.46	Peak	---	---
5	361.85	29.88	46.00	-16.12	35.93	-6.05	Peak	---	---
6	455.25	31.47	46.00	-14.53	35.25	-3.78	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		

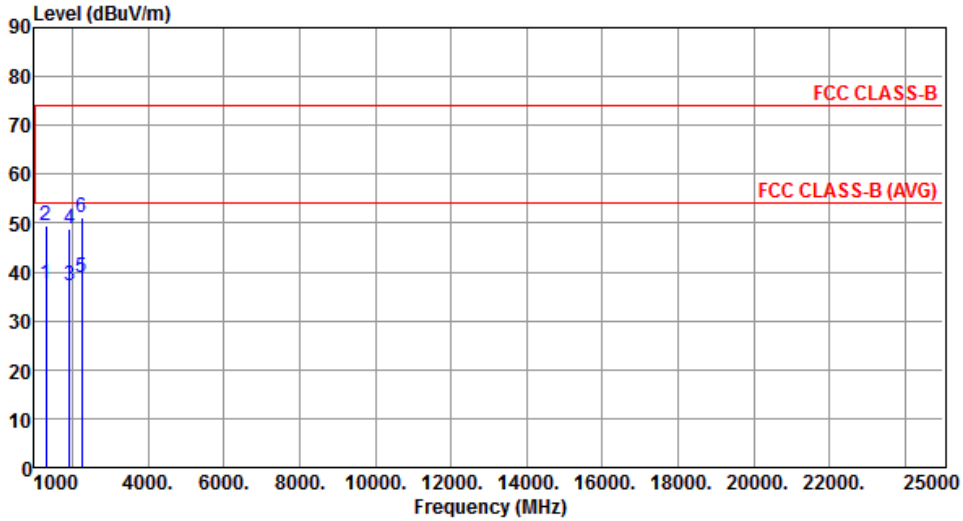


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	36.54	28.88	40.00	-11.12	37.42	-8.54	Peak	---	---
2	121.25	27.54	43.50	-15.96	38.03	-10.49	Peak	---	---
3	167.74	27.00	43.50	-16.50	35.41	-8.41	Peak	---	---
4	264.58	32.50	46.00	-13.50	41.33	-8.83	Peak	---	---
5	311.58	36.44	46.00	-9.56	43.95	-7.51	Peak	---	---
6	434.88	32.17	46.00	-13.83	36.43	-4.26	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

4.2.5 Receiver Radiated Unwanted Emissions (Above 1GHz)

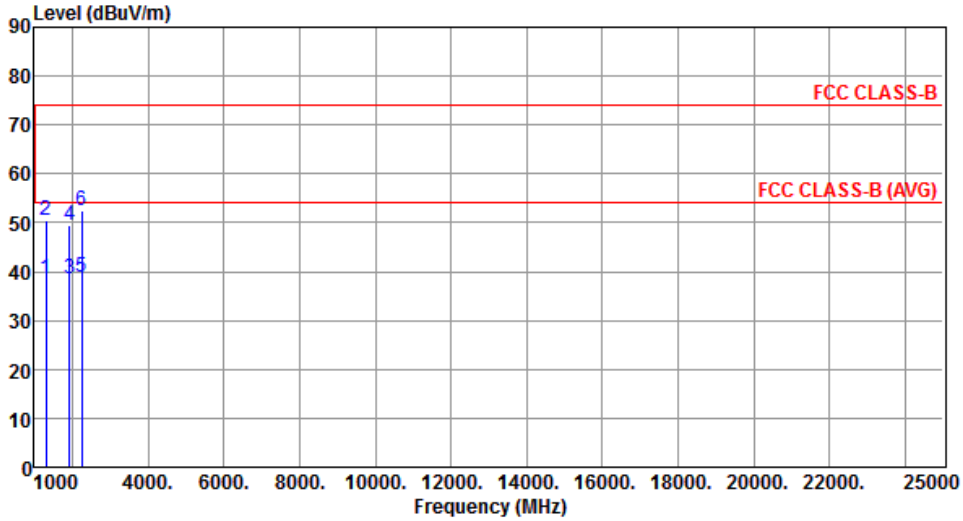
Modulation	GFSK	**Test Freq. (MHz)**	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1300.00	37.51	54.00	-16.49	44.42	-6.91	Average	330	220
2	1300.00	49.57	74.00	-24.43	56.48	-6.91	Peak	330	220
3	1937.00	37.11	54.00	-16.89	41.52	-4.41	Average	150	177
4	1937.00	48.96	74.00	-25.04	53.37	-4.41	Peak	150	177
5	2241.00	38.85	54.00	-15.15	42.10	-3.25	Average	200	302
6	2241.00	51.29	74.00	-22.71	54.54	-3.25	Peak	200	302

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1300.00	38.36	54.00	-15.64	45.27	-6.91	Average	196	205
2	1300.00	50.57	74.00	-23.43	57.48	-6.91	Peak	196	205
3	1937.00	38.42	54.00	-15.58	42.83	-4.41	Average	205	183
4	1937.00	49.36	74.00	-24.64	53.77	-4.41	Peak	205	183
5	2241.00	39.02	54.00	-14.98	42.27	-3.25	Average	228	357
6	2241.00	52.58	74.00	-21.42	55.83	-3.25	Peak	228	357

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

5 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information.

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