

FCC TEST REPORT

Applicant Name : PANDA INTERNATIONAL Co., Ltd.
Brand Name : N/A
Applicant Address : 171, Gasan digital 1-ro, Geumcheon-gu, Seoul, Republic of Korea
FCC ID : 2AX8G-SNP-W8
Products Name : Bluetooth Speaker
Model No. : SNP-W8
Variant Model No. : N/A
Products Manufacturer : SHENZHEN YAYUSI ELECTRONIC TECHNOLOGY CO.,LTD
Test Standard : FCC CFR 47 Part 15 Subpart C
Test Method : KDB 558074 D01 v05 and ANSI C63.10:2013
Test Result : PASS
Dates of Test : November 4, 2020 to November 6, 2020
Date of Issue : November 19, 2020
Test Laboratory : Korea Standard Testlab
FCC Registration No. : 829397

Tested by



Seung-ho Baek
Test Engineer

Approved by



Su-wook Chae
Technical Manager

TABLE OF CONTENTS

1. APPLICANT & MANUFACTURER & TEST LABORATORY INFORMATION	4
1.1. APPLICANT INFORMATION	4
1.2. MANUFACTURER INFORMATION	4
1.3. TEST LABORATORY INFORMATION	4
2. EQUIPMENT UNDER TEST(EUT) INFORMATION	5
2.1. GENERAL INFORMATION	5
2.2. ADDITIONAL INFORMATION	5
2.3. TEST FREQUENCY	5
2.4. WORST-CASE	6
2.5. MODE OF OPERATION DURING THE TEST	6
2.6. MODIFICATIONS OF EUT	6
2.7. INFORMATION ABOUT THE FHSS CHARACTERISTICS	7
3. MAXIMUM PERMISSIBLE EXPOSURE	8
3.1. RF EXPOSURE CALCULATION	8
3.2. RESULT	8
4. TEST SUMMARY	9
4.1. TEST STANDARDS AND RESULTS	9
4.2. PURPOSE OF THE TEST	9
4.3. TEST METHODOLOGY	9
4.4. CONFIGURATION OF TEST SYSTEM	9
4.5. ANTENNA REQUIREMENT	10
5. USED EQUIPMENT ON TEST	11
6. PEAK OUTPUT POWER	12
6.1. MEASUREMENT PROCEDURE	12
6.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)	12
6.3. LIMITS AND MEASUREMENT RESULT	13
7. 20DB BANDWIDTH	17
7.1. MEASUREMENT PROCEDURE	17
7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)	17
7.3. LIMITS AND MEASUREMENT RESULT	18

8. CONDUCTED SPURIOUS EMISSION	22
8.1. MEASUREMENT PROCEDURE	22
8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)	22
8.3. MEASUREMENT EQUIPMENT USED	22
8.4. LIMITS AND MEASUREMENT RESULT	22
9. RADIATED EMISSION	39
9.1. MEASUREMENT PROCEDURE	39
9.2. TEST SET-UP	41
9.3. LIMITS AND MEASUREMENT RESULT	42
9.4. TEST RESULT	42
10. NUMBER OF HOPPING FREQUENCY	46
10.1. MEASUREMENT PROCEDURE	46
10.2. TEST SET-UP(BLOCK DIAGRAM OF CONFIGURATION)	46
10.3. MEASUREMENT EQUIPMENT USED	46
10.4. LIMITS AND MEASUREMENT RESULT	46
11. TIME OF OCCUPANCY (DWELL TIME)	47
11.1. MEASUREMENT PROCEDURE	47
11.2. TEST SET-UP(BLOCK DIAGRAM OF CONFIGURATION)	47
11.3. MEASUREMENT EQUIPMENT USED	47
11.4. LIMITS AND MEASUREMENT RESULT	47
12. FREQUENCY SEPARATION	51
12.1. MEASUREMENT PROCEDURE	51
12.2. TEST SET-UP(BLOCK DIAGRAM OF CONFIGURATION)	51
12.3. MEASUREMENT EQUIPMENT USED	51
12.4. LIMITS AND MEASUREMENT RESULT	51
13. FCC LINE CONDUCTED EMISSION TEST	52
13.1. LIMITS OF LINE CONDUCTED EMISSION TEST	52
13.2. BLOCK DIAGRAM OF LINE CONDUCTED EMISSION TEST	52
13.3. PRELIMINARY PROCEDURE OF LINE CONDUCTED EMISSION TEST	53
13.4. FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST	53
13.5. TEST RESULT OF LINE CONDUCTED EMISSION TEST	54

1. APPLICANT & MANUFACTURER & TEST LABORATORY INFORMATION**1.1 APPLICANT INFORMATION**

Applicant	PANDA INTERNATIONAL Co., Ltd.
Address	171, Gasan digital 1-ro, Geumcheon-gu, Seoul, Republic of Korea
Contact Person	WoonCheong Baek
Telephone No.	+82-70-5158-8011
Fax No.	-
E-mail	sunny@soundpanda.co.kr

1.2 MANUFACTURER INFORMATION

Manufacturer	SHENZHEN YAYUSI ELECTRONIC TECHNOLOGY CO.,LTD
Address	Yayusi Industry Park, 22#, 2th Rd Tangkeng, Tangkeng Community, Pingshan New Dist, Shenzhen

1.3 TEST LABORATORY INFORMATION

Conducted tests were performed at	
Laboratory	Korea Standard Testlab
Address	#107-27, Jangdeokdong-gil, Namyang-eup, Hwaseong-si, Gyeonggi-do, Korea
Telephone No.	+82-31-356-7333
Fax No.	+82-31-356-7303
RRA No.	KR0155

2. EQUIPMENT UNDER TEST(EUT) INFORMATION

2.1 GENERAL INFORMATION

Brand Name	-	
Model Name	SNP-W8	
Additional Model Name	-	
Hardware Version	1.0	
Software Version	AppoTech RF Control Kit V4.2.18	
Power Supply	DC 3.7V by battery or DC 5V by adapter	
EUT Firmware Version	1.0	
Target Power	Bluetooth BDR	-6.03 dBm(Max)
	Bluetooth EDR	-6.68 dBm(Max)
EUT Serial Number	Test 2	

2.2 ADDITIONAL INFORMATION

Equipment Class	DSS-Part 15 Spread Spectrum Transmitter / Frequency hopping systems (FHS)
Device Type	Stand-alone
Operating Frequency	2 402 MHz ~ 2 480 MHz
RF Output Power	-6.03 dBm
Number of Channel	79
Modulation Type	GFSK / $\pi/4$ -DQPSK / 8DPSK
Antenna Type	PCB Pattern Antenna
Antenna Gain	1.9 dBi
Antenna Operating Mode	Single Antenna Equipment with only one antenna

2.3 TEST FREQUENCY

Test Frequency	Test frequency (MHz)		
	Lowest frequency	Middle frequency	High frequency
GFSK	2 402	2 441	2 480
$\pi/4$ -DQPSK	2 402	2 441	2 480
8DPSK	2 402	2 441	2 480

2.4 WORST-CASE

BDR	DH5(GFSK)
EDR	3-DH5(8DPSK)

Note: The power measurement has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

2.5 MODE OF OPERATION DURING THE TEST

- The EUT is continuous transmission mode during the test with set at Low Channel, Middle Channel, and High Channel. To get a maximum radiated emission levels from the EUT, the EUT was moved throughout the XY, YZ, XZ planes.

2.6 MODIFICATIONS OF EUT

- None

2.7 INFORMATION ABOUT THE FHSS CHARACTERISTICS

2.7.1 Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

2.7.2 Equal Hopping Frequency Use

The channels of this system will be used equally over the long-term distribution of the hopsets.

2.7.3 Example of a 79 hopping sequence in data mode

02, 05, 31, 24, 20, 10, 43, 36, 30, 23, 40, 06, 21, 50, 44, 09, 71, 78, 01, 13, 73, 07, 70, 72, 35, 62, 42, 11, 41, 08, 16, 29, 60, 15, 34, 61, 58, 04, 67, 12, 22, 53, 57, 18, 27, 76, 39, 32, 17, 77, 52, 33, 56, 46, 37, 47, 64, 49, 45, 38, 69, 14, 51, 26, 79, 19, 28, 65, 75, 54, 48, 03, 25, 66, 05, 16, 68, 74, 59, 63, 55

2.7.4 System Receiver Input Bandwidth

Each channel bandwidth is 1 MHz.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

2.7.5 Equipment Description

15.247(a)(1) that the rx input bandwidths shift frequencies in synchronization with the transmitted signals.

15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

3. MAXIMUM PERMISSIBLE EXPOSURE

3.1 RF EXPOSURE CALCULATION

According to the FCC rule §1.1310 and RSS-102 issue 5, the limit for General Population/Uncontrolled exposure is 1 mW/cm² for the device operating 1 500 MHz ~ 100 000

Kind of EUT	NCT OFFICIAL FANLIGHT
Operating Frequency Band	2 402 MHz ~ 2 480 MHz
Max. Output Power	-6.03 dBm
Exposure Evaluation Applied	N/A

3.2 RESULT

According to the procedure, KDB 447498 D01, the standalone SAR test exclusion threshold is

$$[(\text{Max. Power of channel, including tune-up tolerance, mW}) / (\text{Min. test separation distance, mm})] \times [\sqrt{f(\text{GHz})}] < 3$$

$$= (0.28/5) \times \sqrt{2.402} = 1.55$$

Conclusion: The SAR test exclusion threshold is less than 3, so the device meets the RF Exposure Requirement and excluded SAR Test.

Operating Mode	Frequency (MHz)	Target Power W / tolerance	Max tune up power		Separation distance (mm)	RF exposure
		(dBm)	(dBm)	(mW)		
BDR	2 402	-6.03±0.5	-5.53	0.28	5	1.55

4. TEST SUMMARY

4.1 TEST STANDARDS AND RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
15.247 (b)(1)	Peak Output Power	Compliant
15.247 (a)(1)	20 dB Bandwidth	Compliant
15.247 (d)	Conducted Spurious Emission	Compliant
15.209	Radiated Emission	Compliant
15.247 (a)(1)(iii)	Number of Hopping Frequency	Compliant
15.247 (a)(1)(iii)	Time of Occupancy	Compliant
15.247 (a)(1)	Frequency Separation	Compliant
15.207	Conducted Emission	Compliant

4.2 PURPOSE OF THE TEST

- To determine whether the equipment under test fulfills the requirements of the standards stated in FCC Part 15 Subpart C Section 15.247

4.3 TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013.

Radiated testing was performed at a distance of 3 m from EUT to the antenna.

4.4 CONFIGURATION OF TEST SYSTEM

4.4.1 Radiated emission test

Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 m Semi Anechoic Chamber. The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

4.4.2 Conducted emission test

The EUT was connected to LISN. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

4.5 ANTENNA REQUIREMENT

According to §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.

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.5.1 Result: Pass

The transmitter has a PCB Pattern Antenna. The directional gain of the antenna is 1.9 dBi.

5. USED EQUIPMENT ON TEST

No.	Test Equipment	Manufacturer	Model No.	Serial No.	Next Cal. Data
1	Spectrum Analyzer	Agilent	E4440A	MY45304715	2021.10.08
2	Test Receiver	ROHDE & SCHWARZ	ESPI	101014	2021.02.21
3	LISN	ROHDE & SCHWARZ	ENV216	101732	2021.02.21
4	Test Receiver	ROHDE & SCHWARZ	ESI	838786/014	2021.02.21
5	Bi-log Antenna	SCHWARZBECK	VULB9163	760	2021.04.09
6	Low Noise Amplifier	Testek	TK-PA06S	190018-L	2021.05.21
7	Preamplifier	HP	8449B	3008A00224	2021.05.20
8	Horn Antenna	Schwarzbeck	BBHA 9120D	9120D-1281	2021.05.08
9	Horn Antenna	Celluteq	CE1220-K20	180298010002	2021.07.01
10	Attenuator	태성정밀	SMA-2	-	2021.05.20

6. PEAK OUTPUT POWER

6.1 MEASUREMENT PROCEDURE

For peak power test:

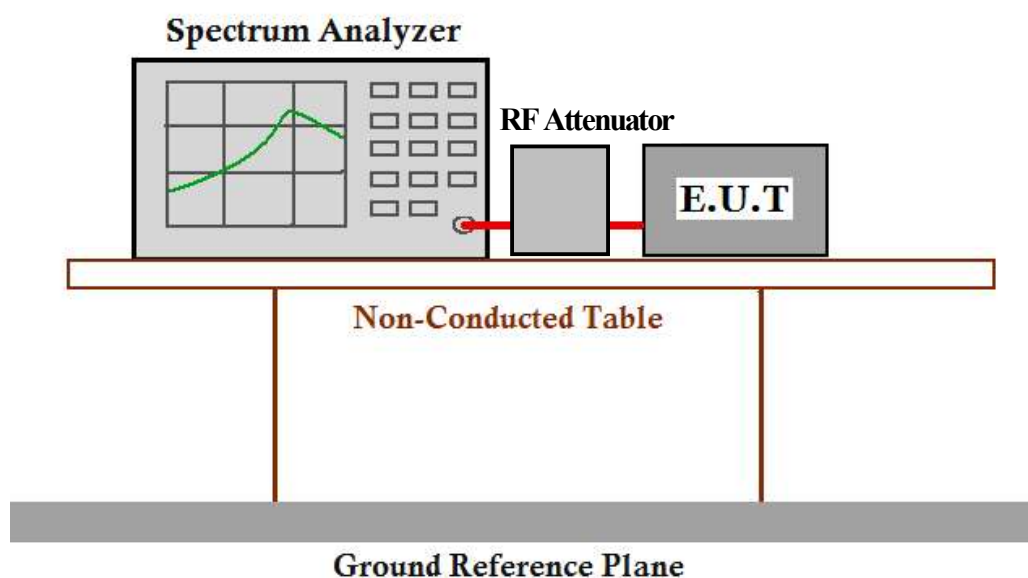
1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
3. RBW > 20 dB bandwidth of the emission being measured.
4. VBW $\geq$ RBW.
5. Sweep: Auto.
6. Detector function: Peak.
7. Trace: Max hold.

Allow trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.

The indicated level is the peak output power, after any corrections for external attenuators and cables.

6.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

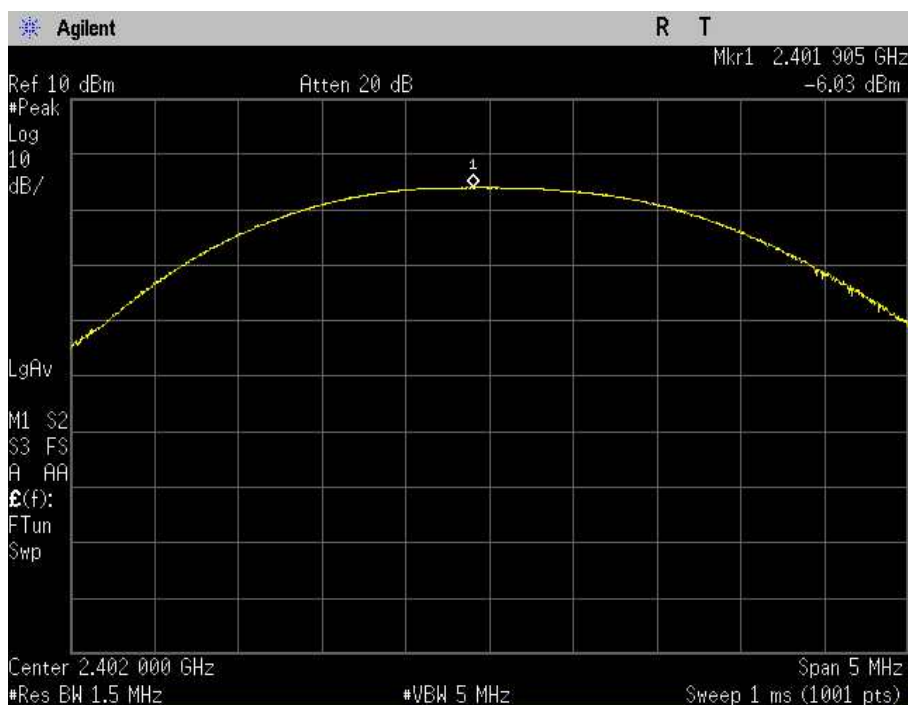
PEAK POWER TEST SETUP



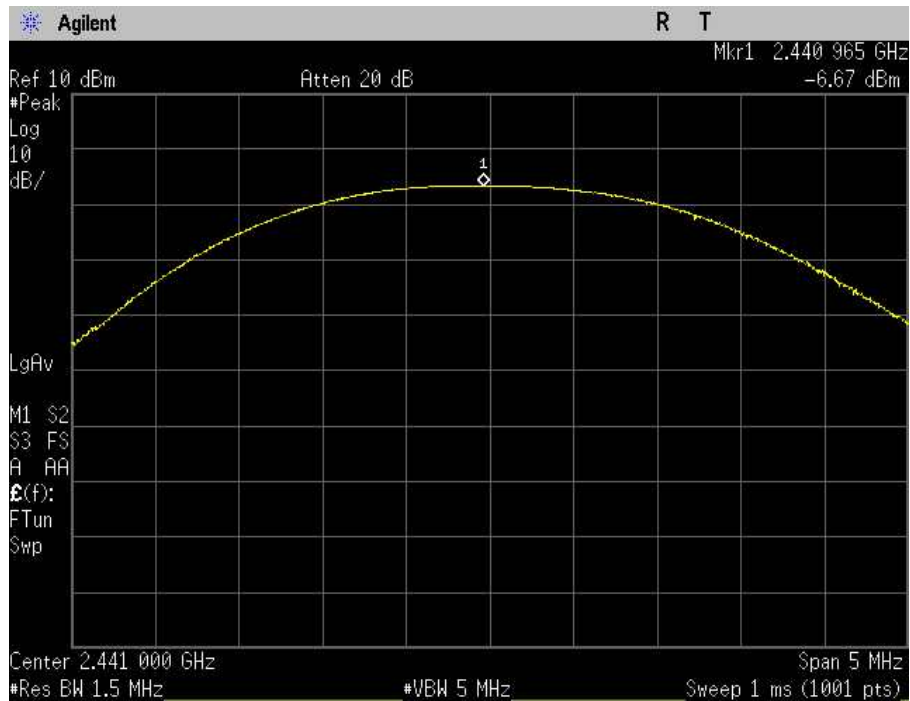
6.3 LIMITS AND MEASUREMENT RESULT

PEAK OUTPUT POWER MEASUREMENT RESULT FOR GFSK MODULATION			
Frequency (GHz)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
2 402	-6.03	30	PASS
2 441	-6.67	30	PASS
2 480	-7.20	30	PASS

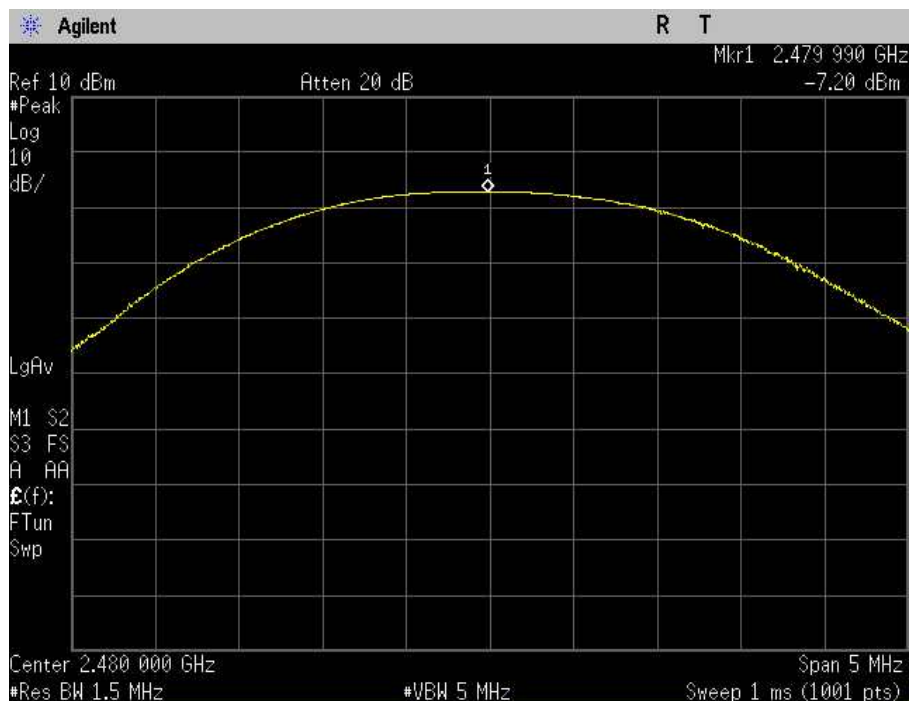
Low CH



Mid CH

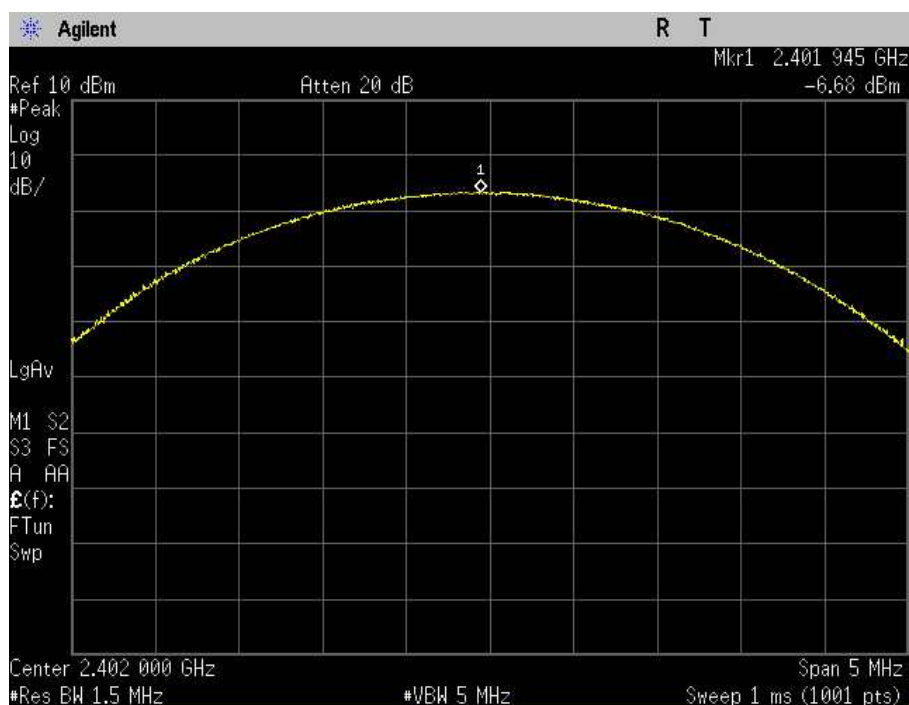


High CH

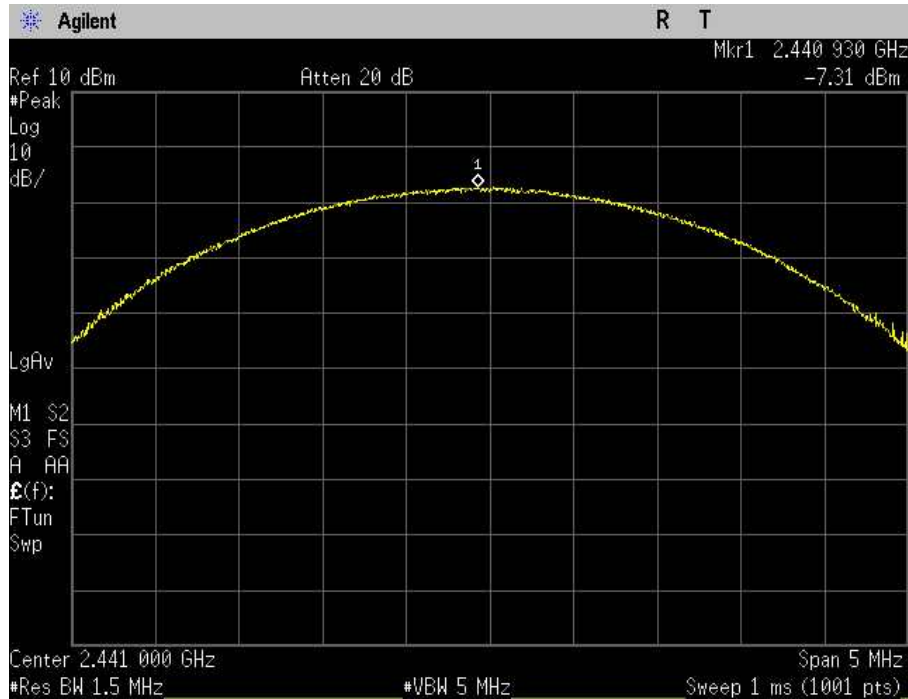


PEAK OUTPUT POWER MEASUREMENT RESULT FOR 8DPSK MODULATION			
Frequency (GHz)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
2 402	-6.68	21	Pass
2 441	-7.31	21	Pass
2 480	-7.80	21	Pass

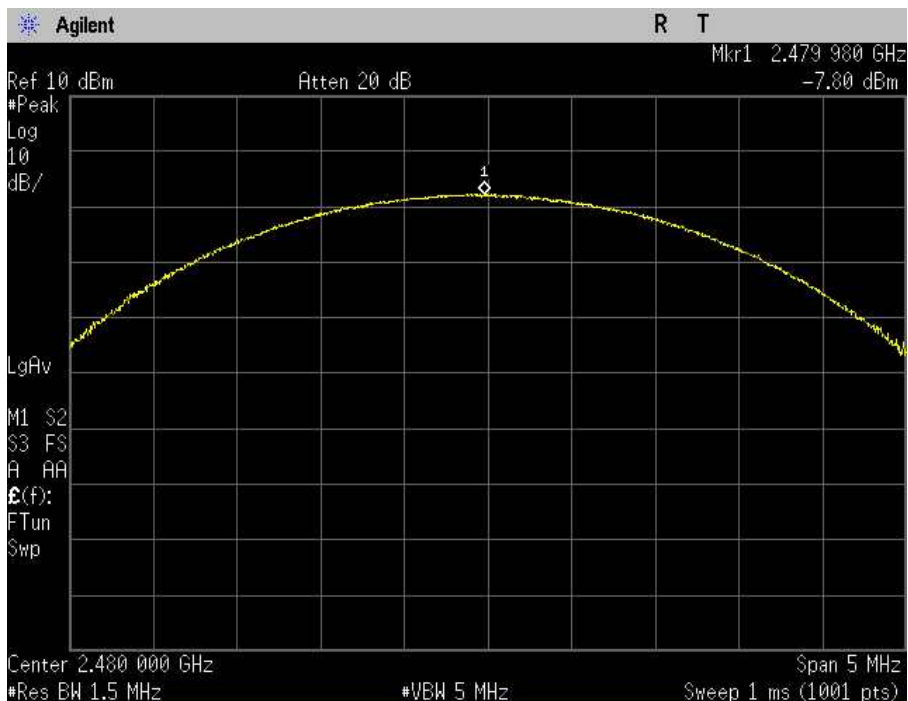
Low CH



Mid CH



High CH

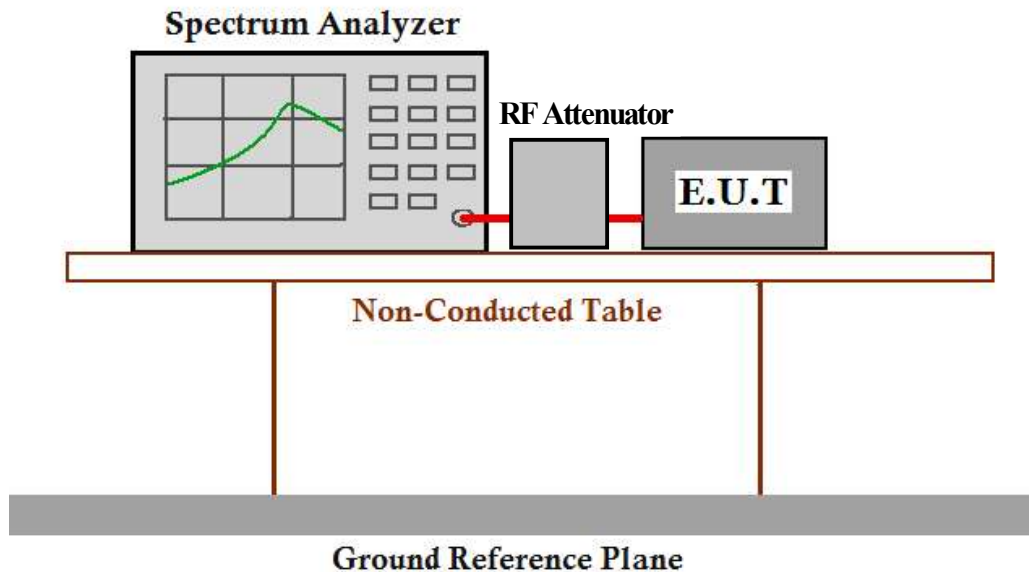


7. 20DB BANDWIDTH

7.1 MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel
The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

7.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)



7.3 LIMITS AND MEASUREMENT RESULTS

MEASUREMENT RESULT FOR GFSK MODULATION			
Applicable Limits	Measurement Result		
	Test Data (MHz)		Criteria
N/A	Low Channel	1.038	PASS
	Middle Channel	1.004	PASS
	High Channel	1.047	PASS

Low CH



Mid CH

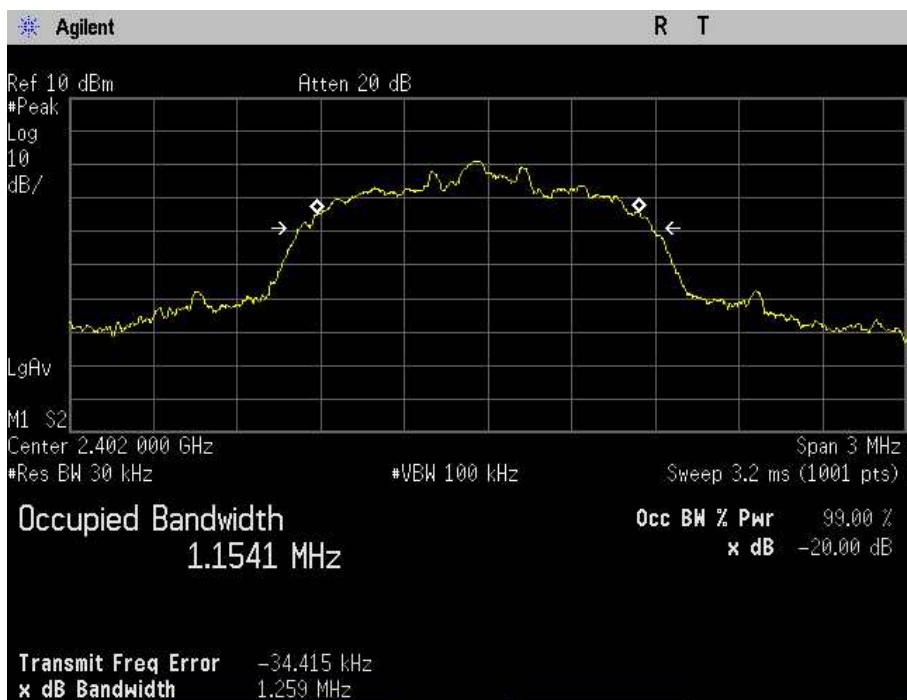


High CH

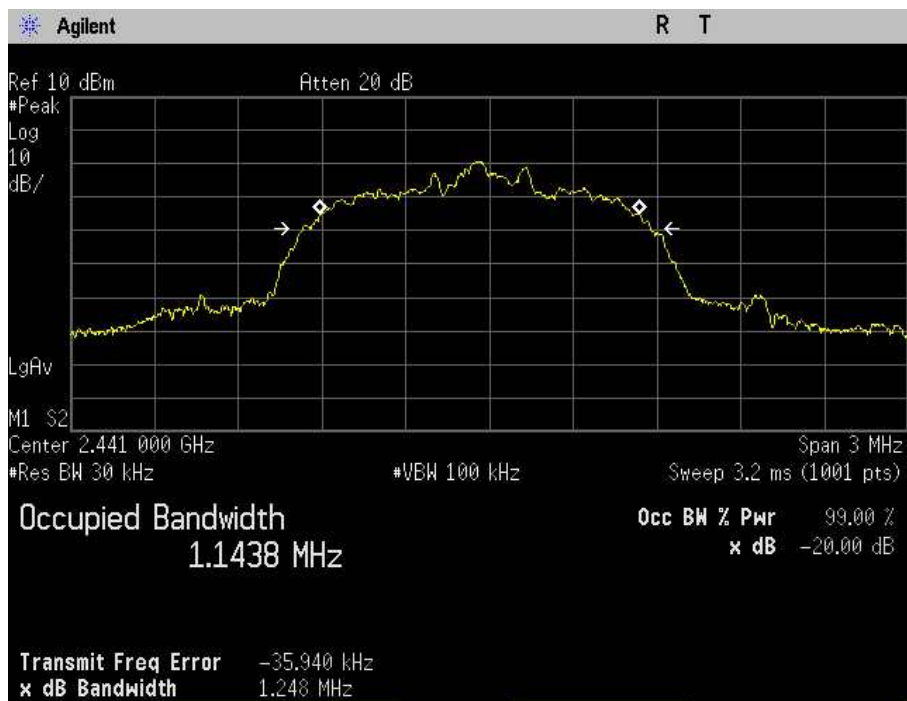


MEASUREMENT RESULT FOR 8DPSK MODULATION			
Applicable Limits	Measurement Result		
	Test Data (MHz)		Criteria
N/A	Low Channel	1.259	PASS
	Middle Channel	1.248	PASS
	High Channel	1.264	PASS

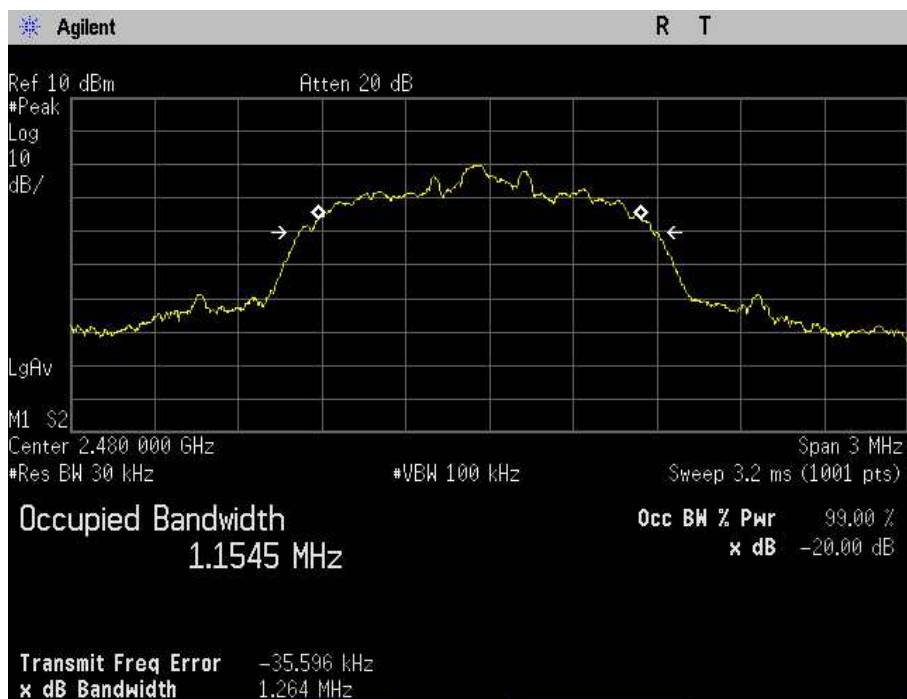
Low CH



Mid CH



High CH



8. CONDUCTED SPURIOUS EMISSION

8.1 MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set the Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
RBW = 100 kHz; VBW= 300 kHz; Sweep = auto; Detector function = peak.
4. Set SPA Trace 1 Max hold, then View.

8.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 8.2

8.3 MEASUREMENT EQUIPMENT USED

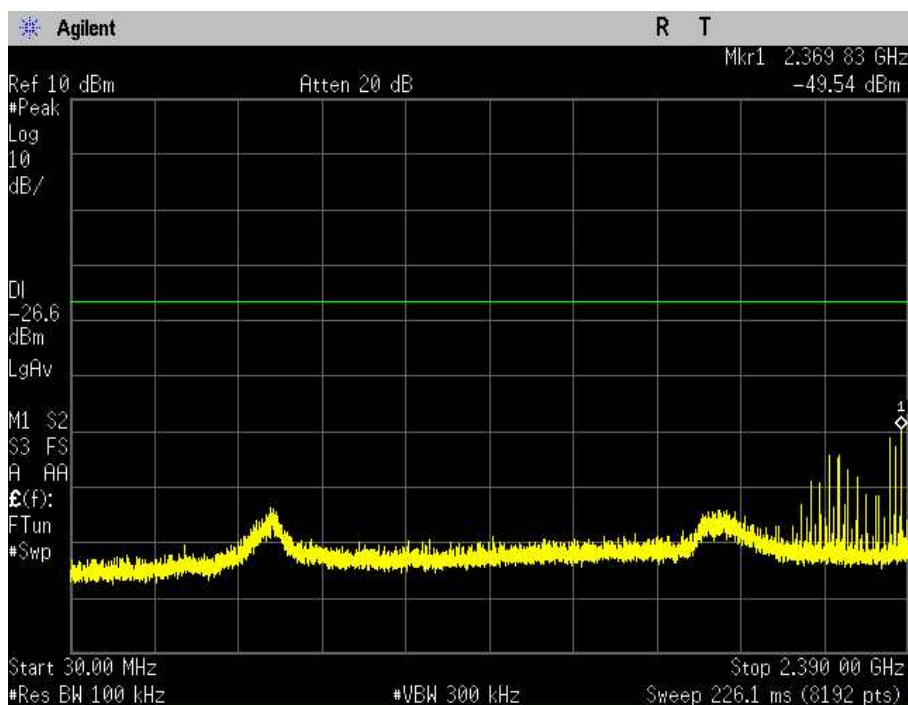
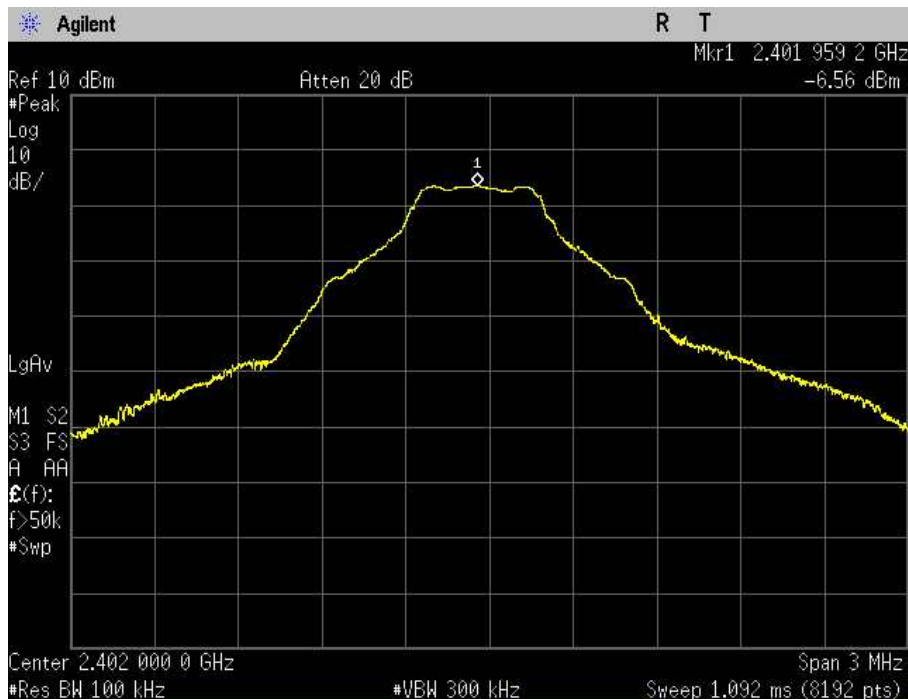
The same as described in section 6

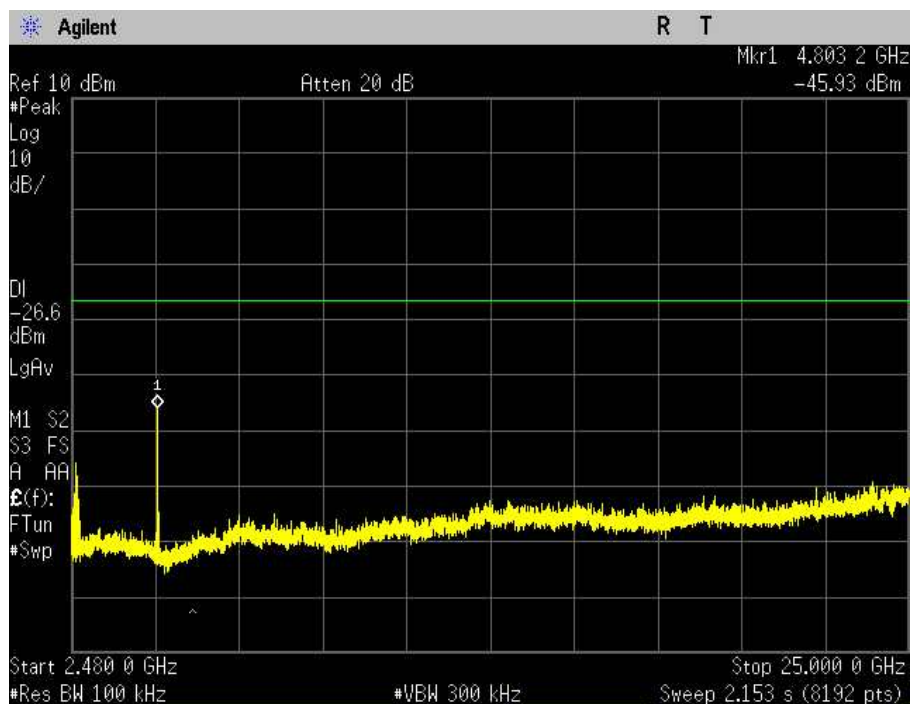
8.4 LIMITS AND MEASUREMENT RESULT

LIMITS AND MEASUREMENT RESULT		
Applicable Limits	Measurement Result	
	Test Data	Criteria
In any 100 kHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. In addition, radiation emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in§15.209(a))	At least -20dBc than the limit Specified on the BOTTOM Channel	PASS
	At least -20dBc than the limit Specified on the TOP Channel	PASS

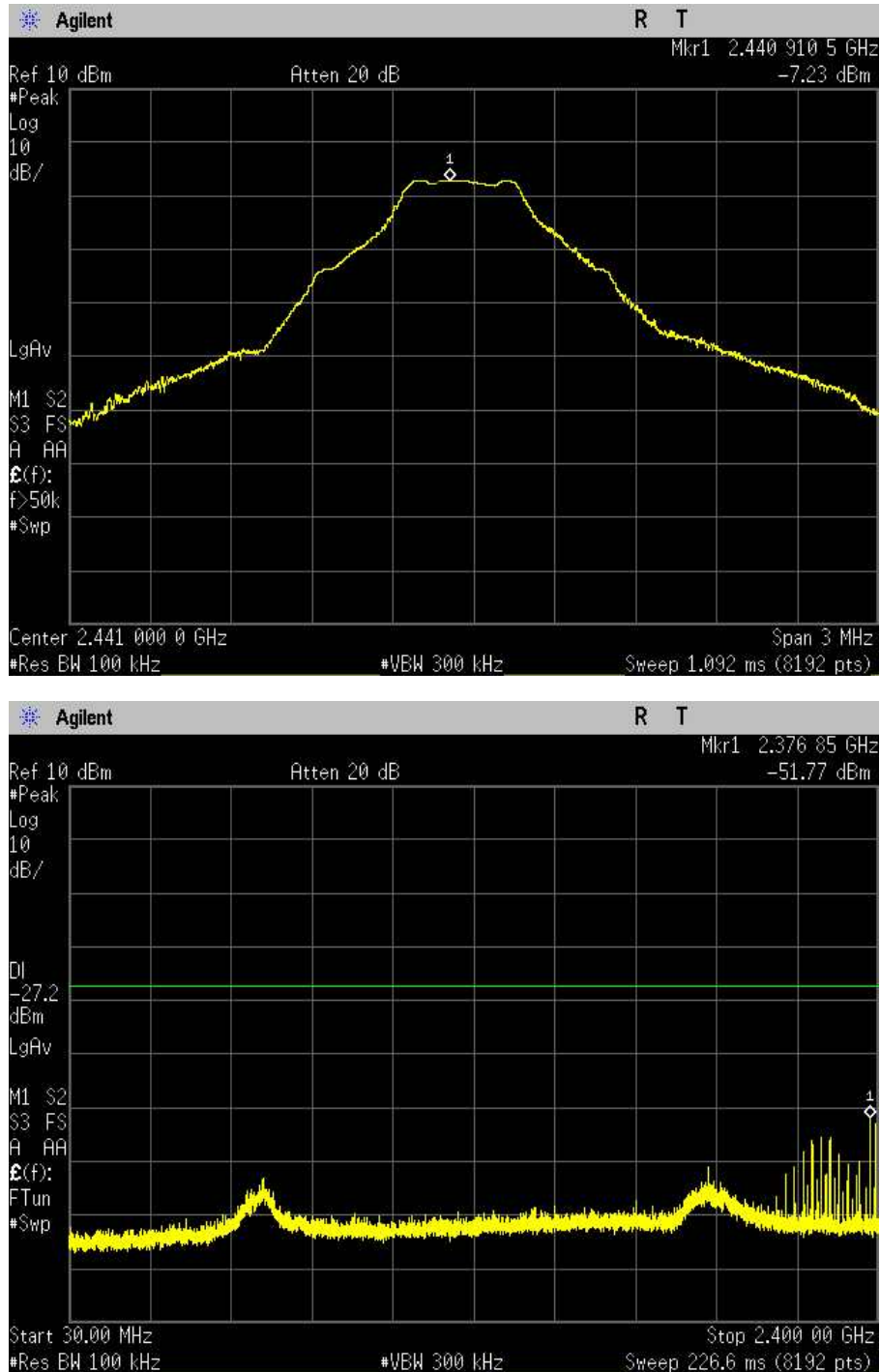
TEST RESULT FOR ENTIRE FREQUENCY RANGE

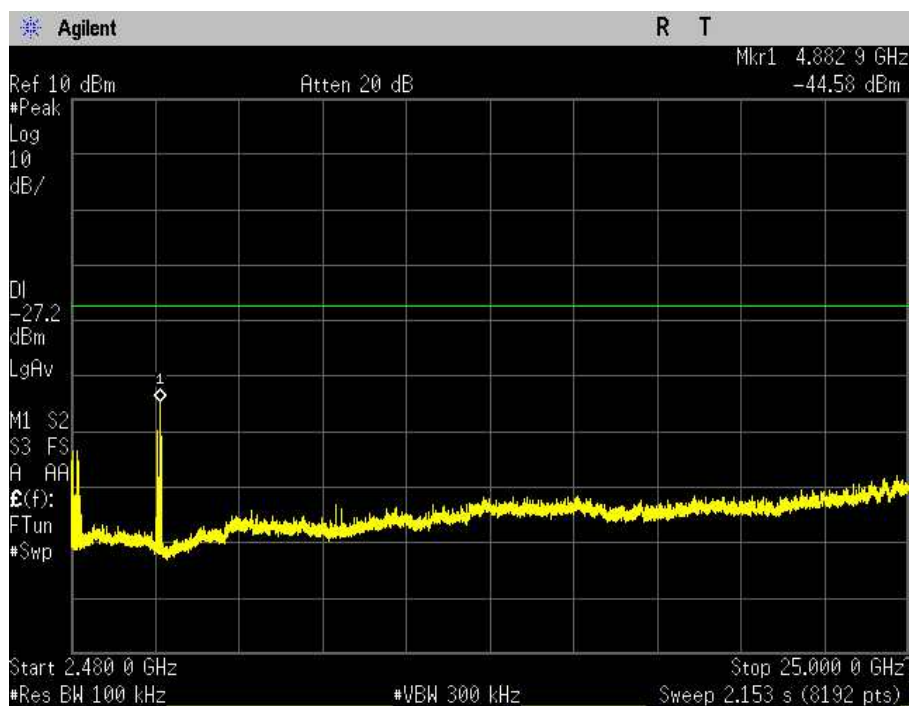
TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE OF GFSK MODULATION IN LOW CHANNEL



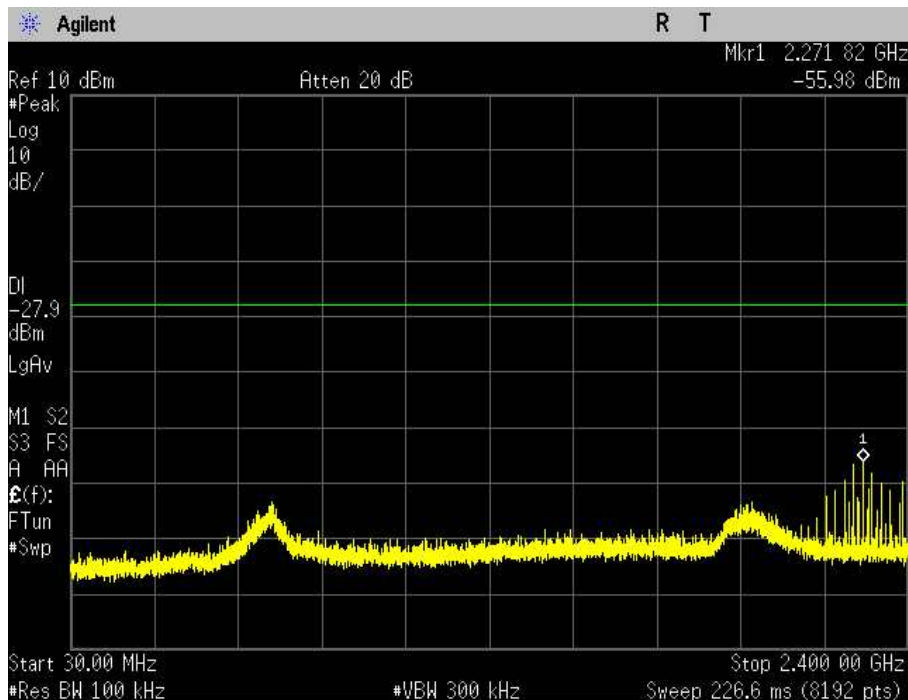
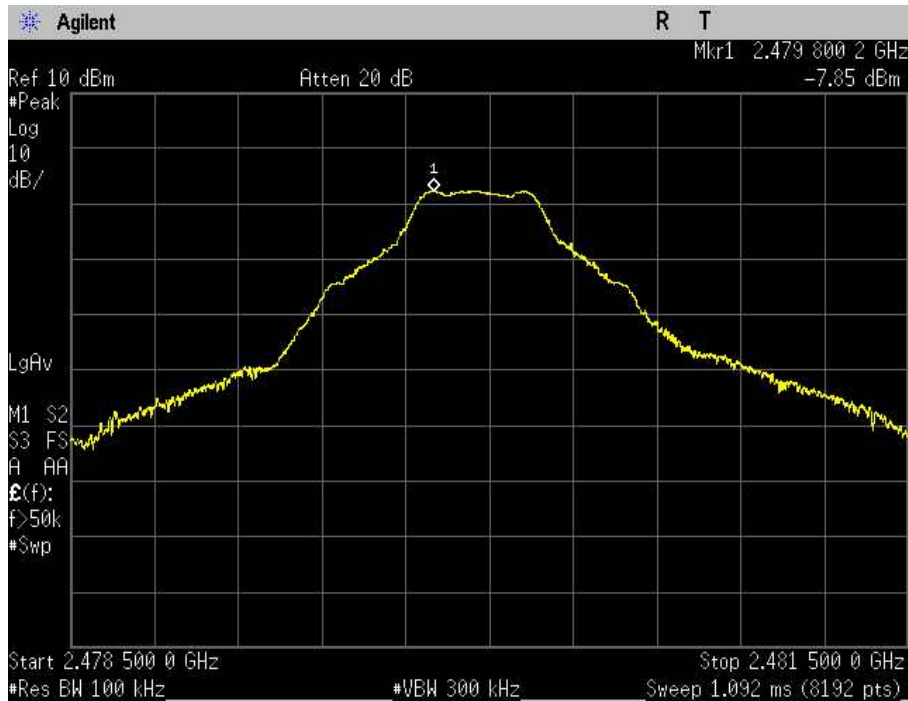


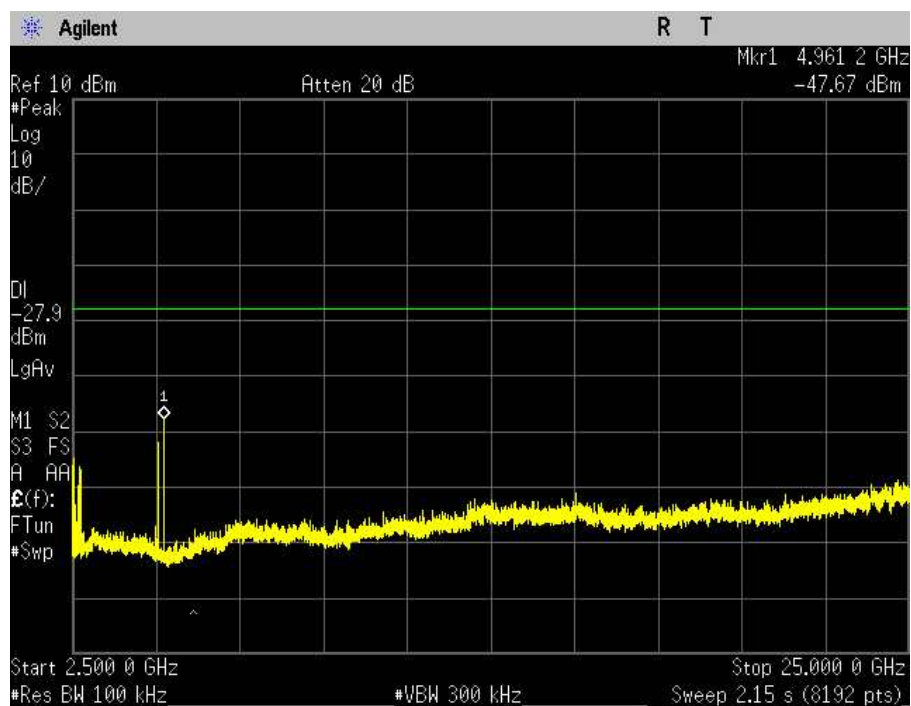
TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE
OF GFSK MODULATION IN MIDDLE CHANNEL



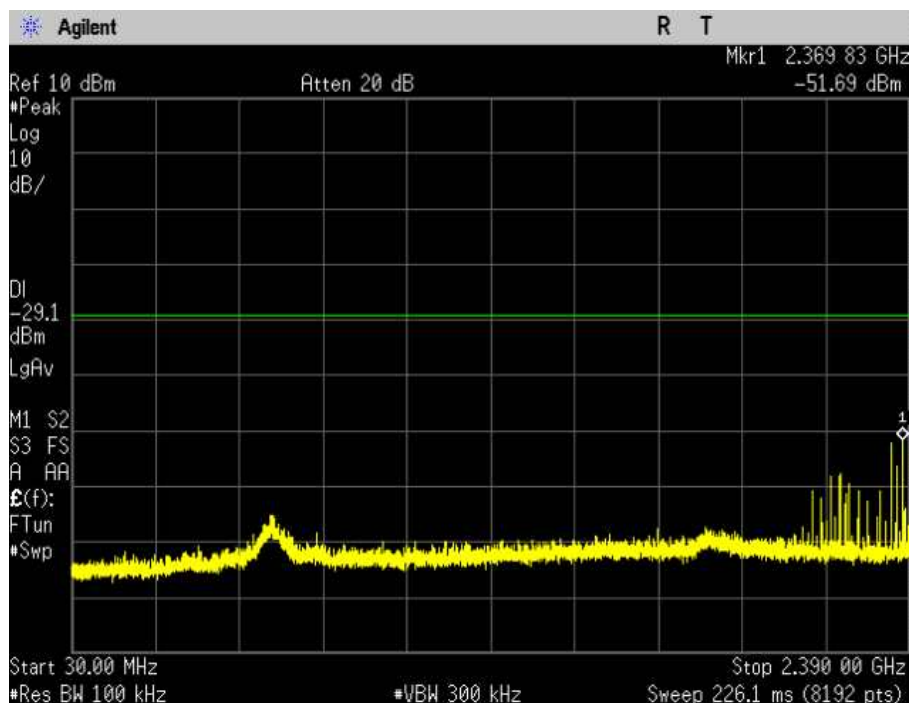
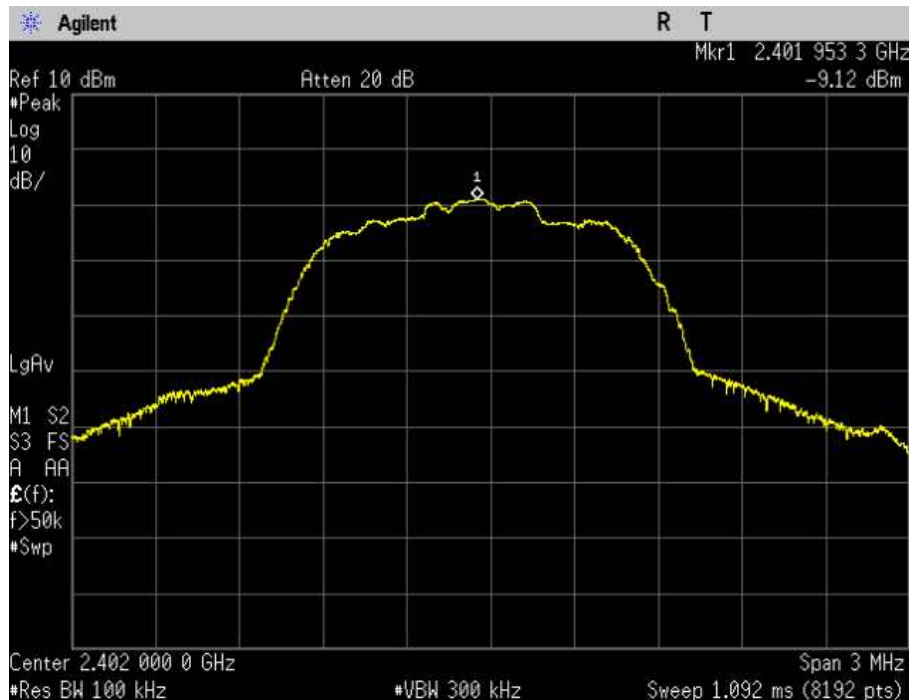


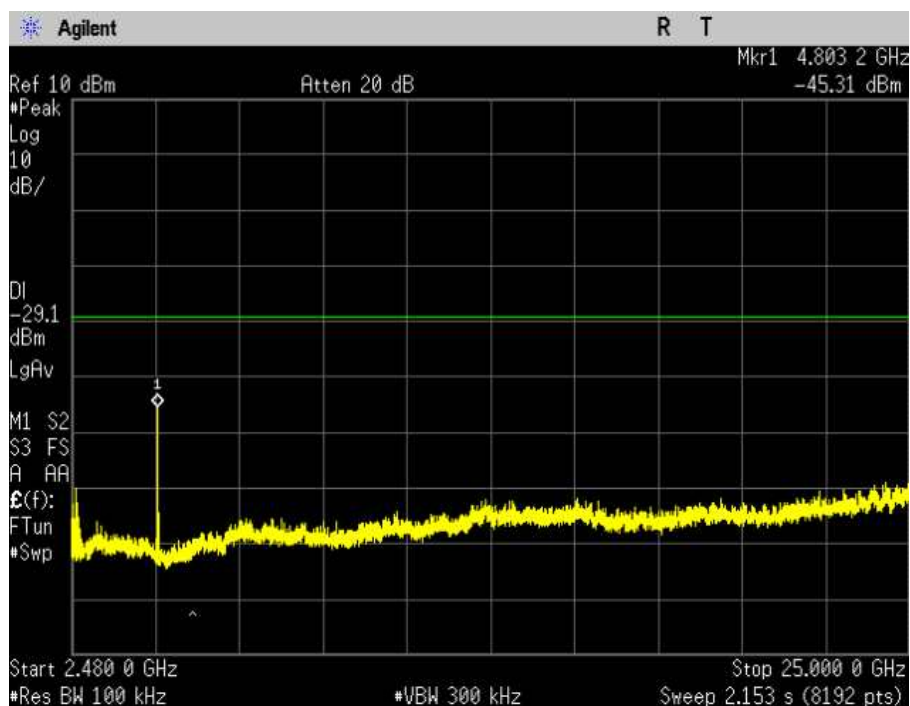
TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE
OF GFSK MODULATION IN HIGH CHANNEL



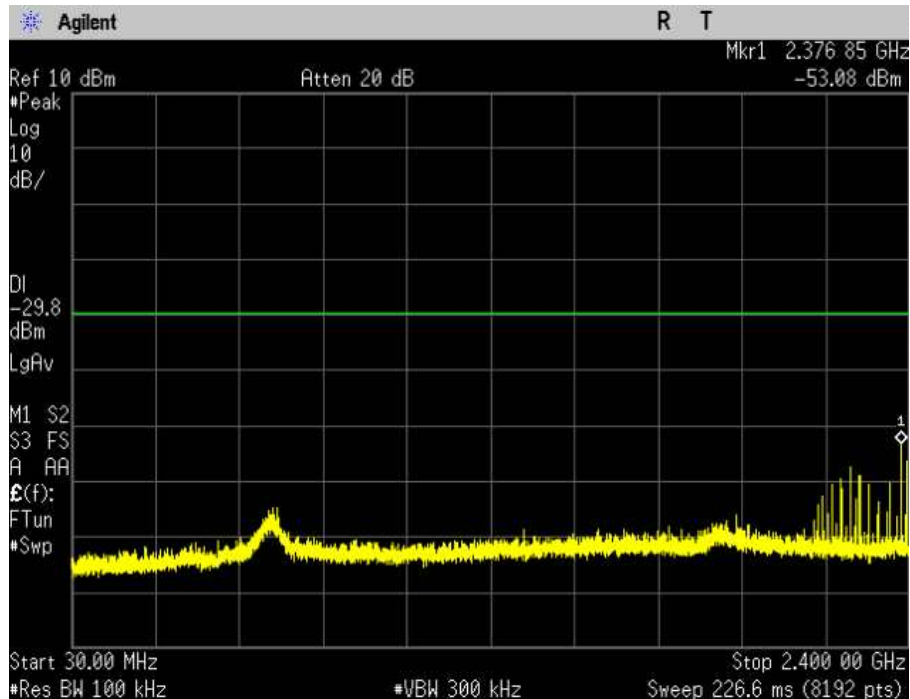
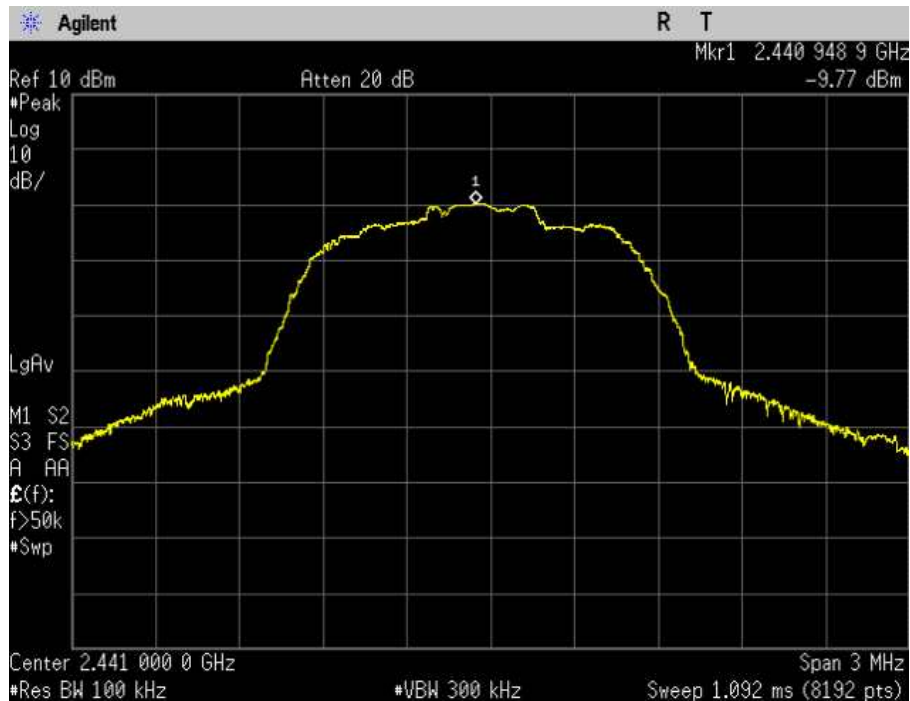


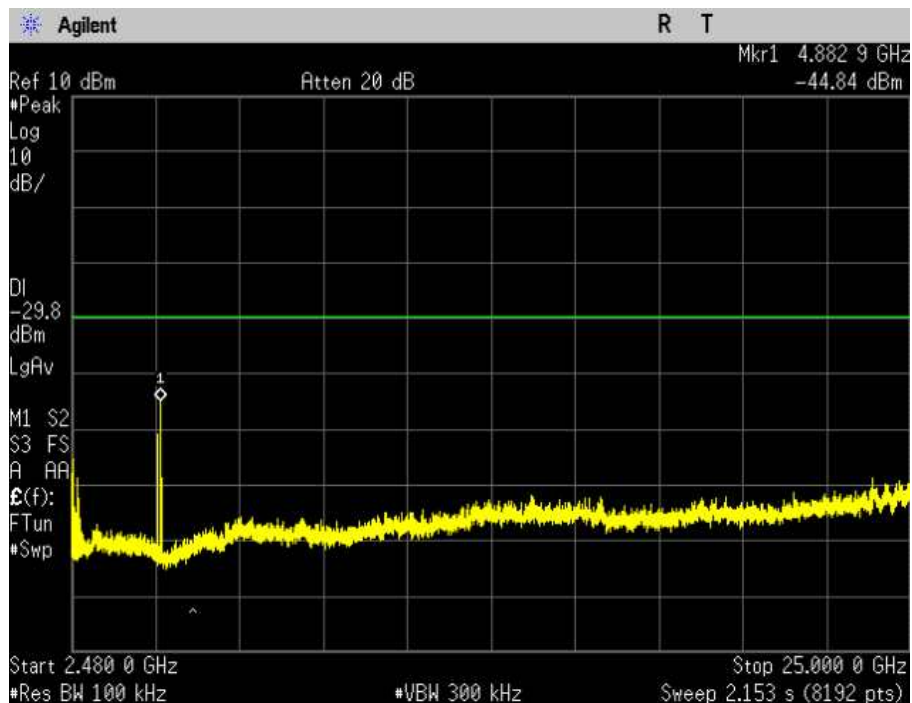
TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE
OF 8DPSK MODULATION IN LOW CHANNEL



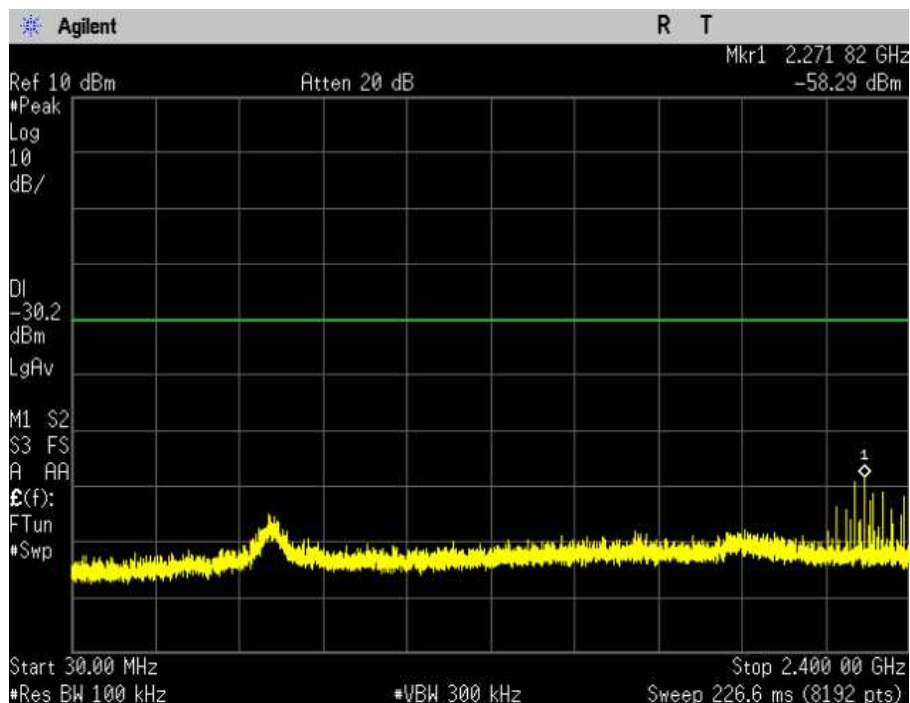
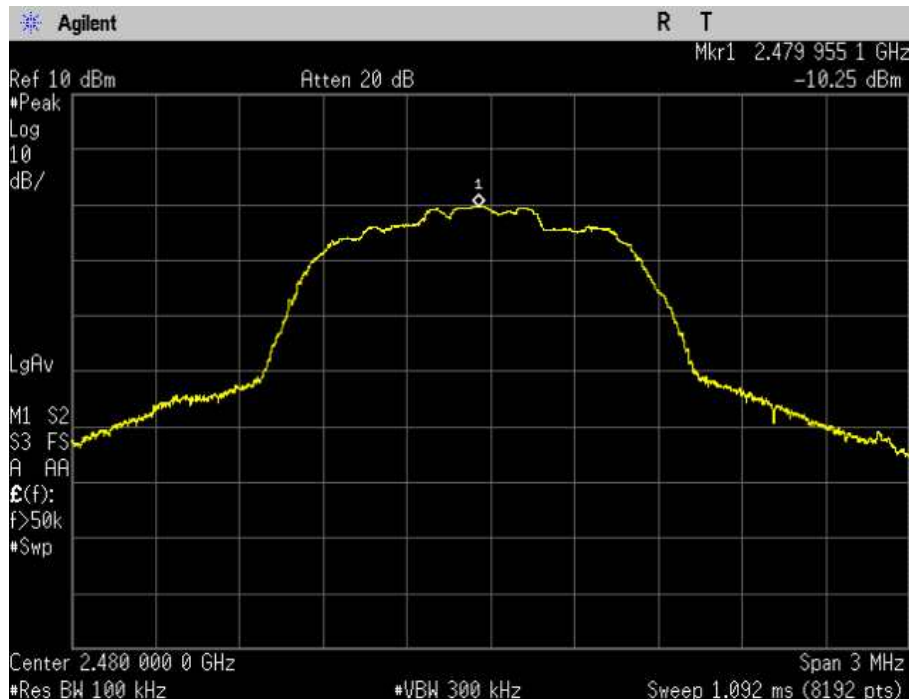


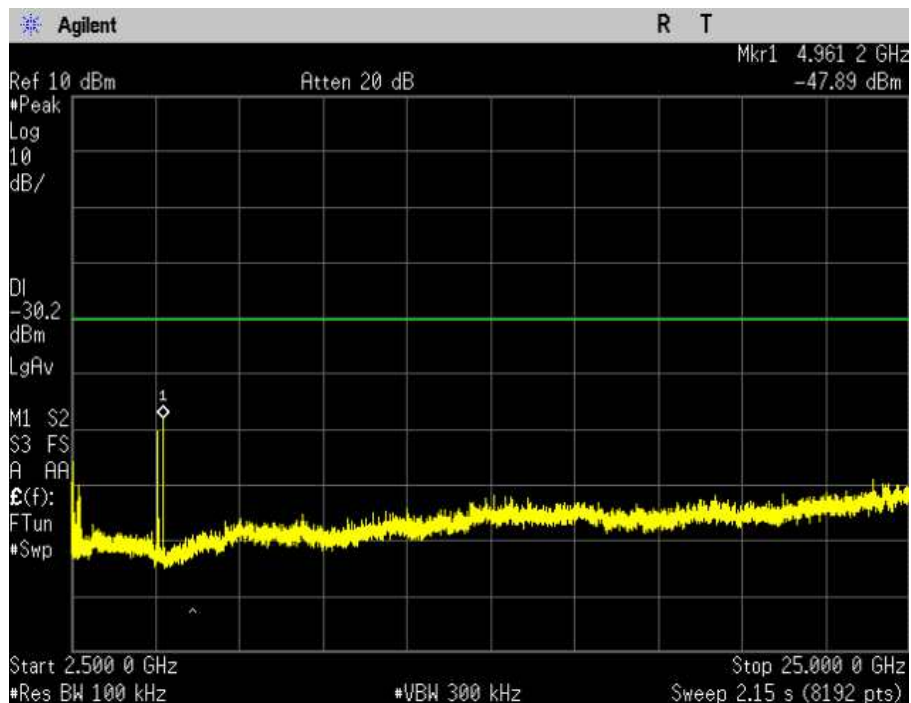
TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE
OF 8DPSK MODULATION IN MIDDLE CHANNEL





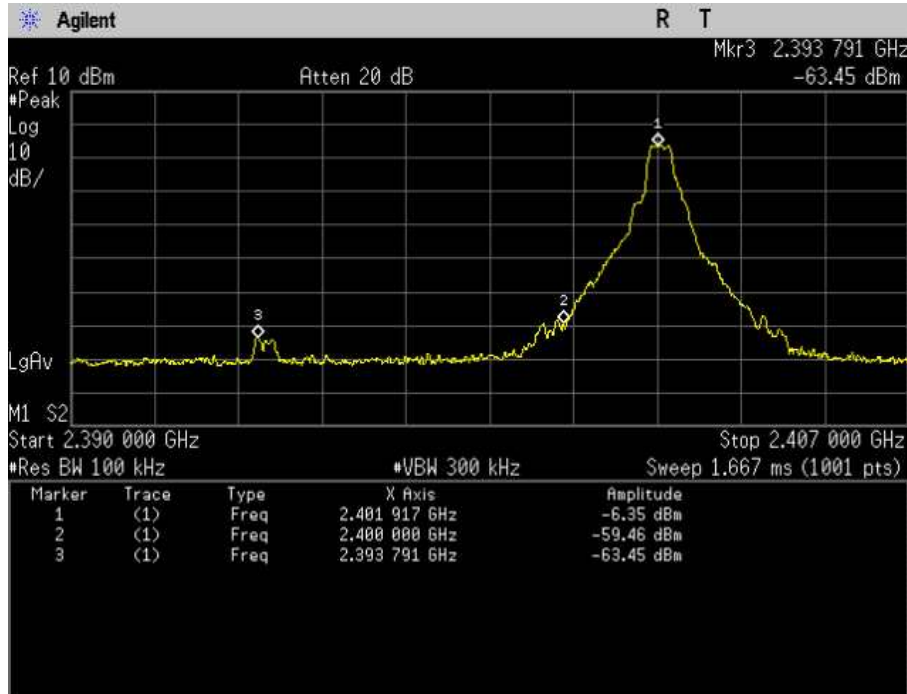
TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE
OF 8DPSK MODULATION IN HIGH CHANNEL



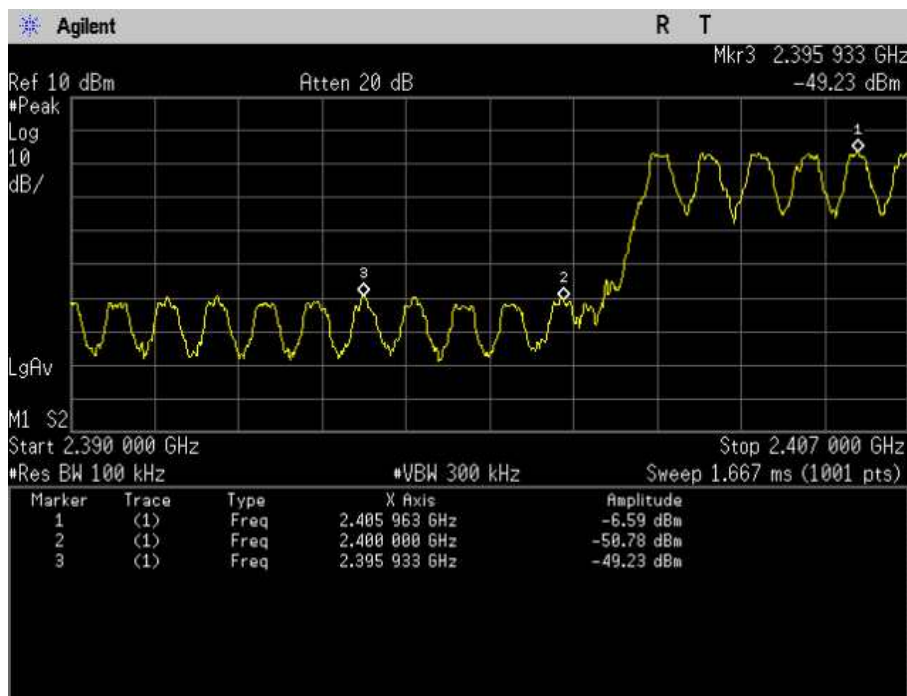


TEST RESULT FOR BAND EDGE
GFSK MODULATION IN LOW CHANNEL

Hopping off

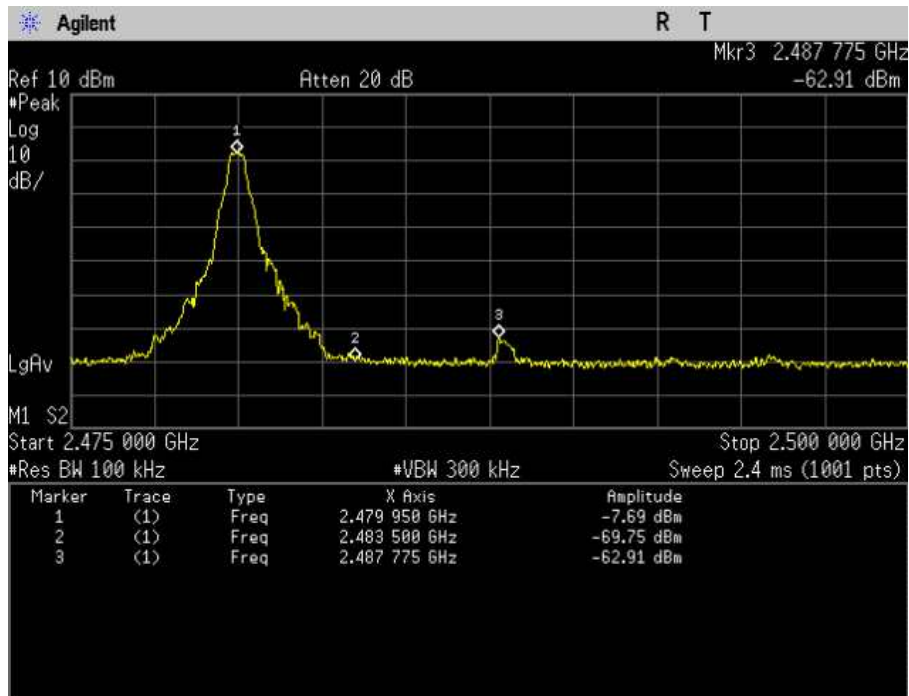


Hopping on

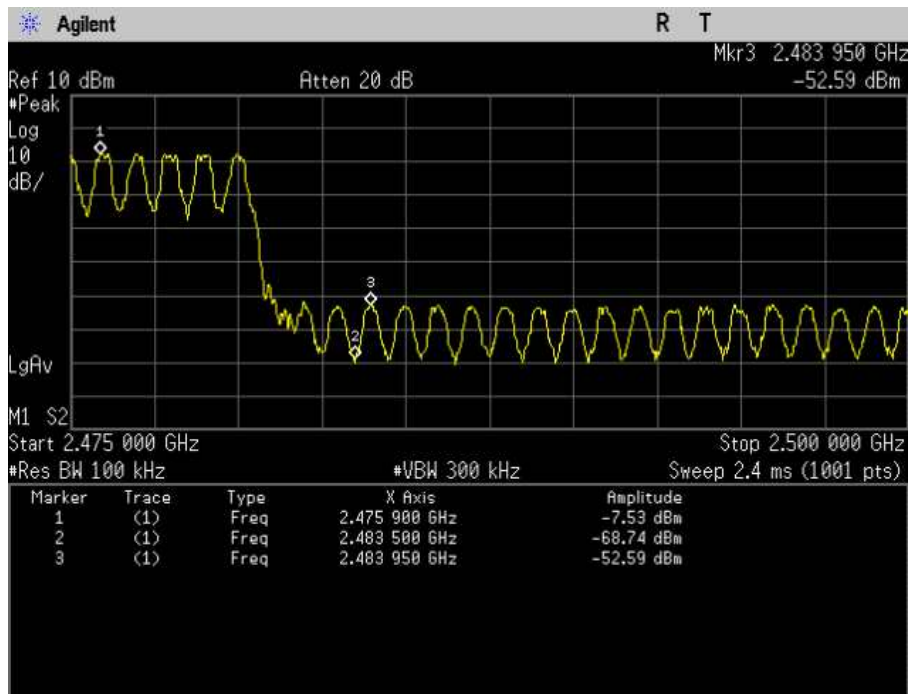


GFSK MODULATION IN HIGH CHANNEL

Hopping off

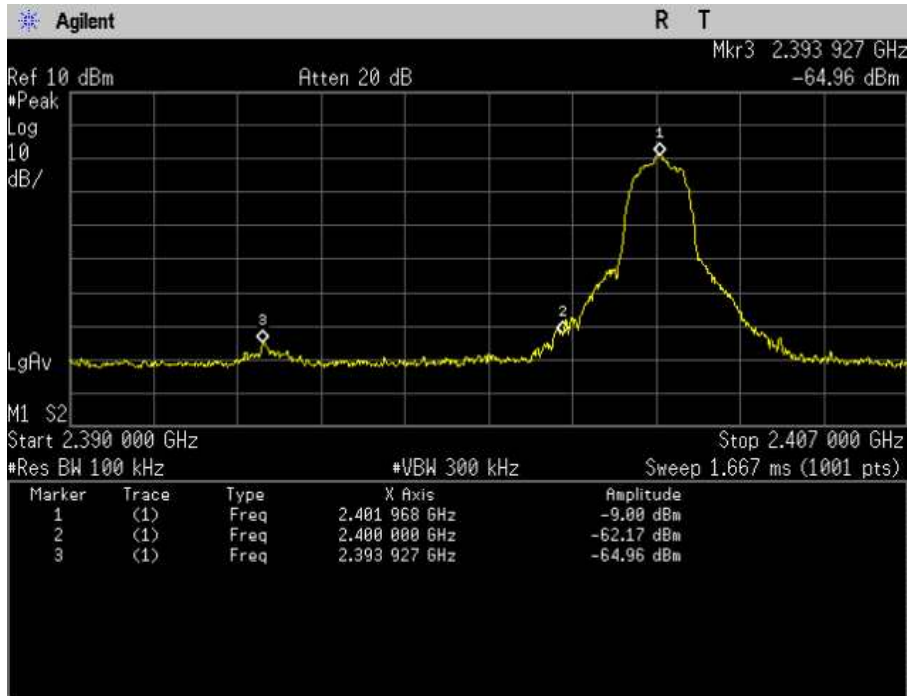


Hopping on

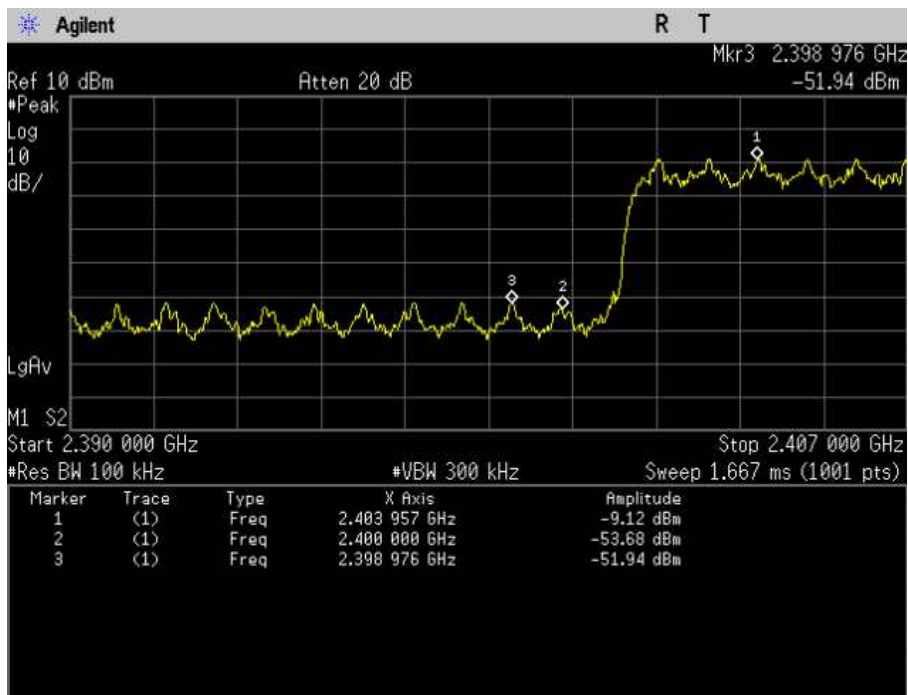


8-DPSK MODULATION IN LOW CHANNEL

Hopping off

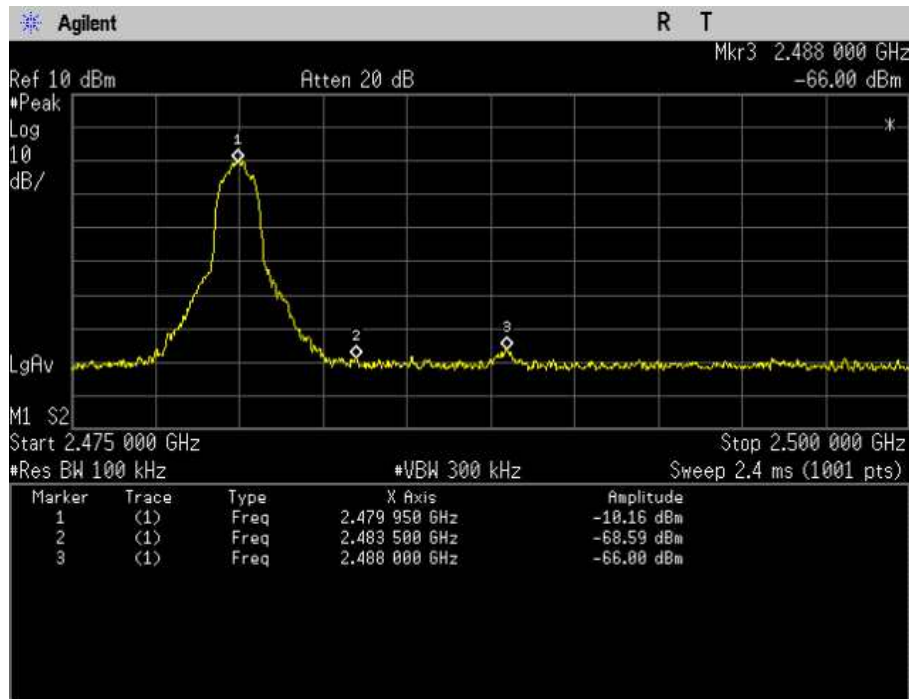


Hopping on

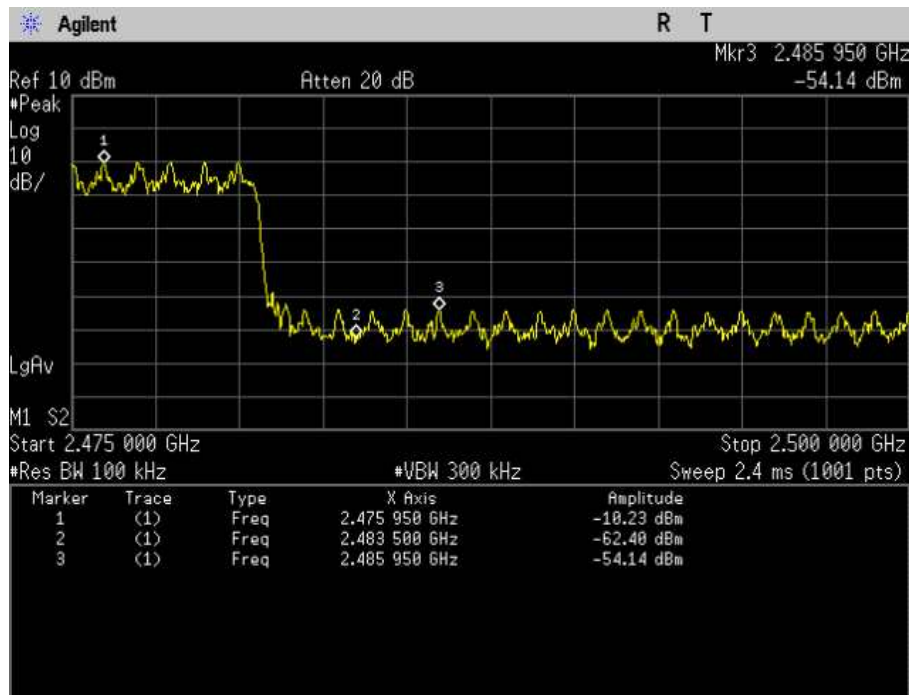


8-DPSK MODULATION IN HIGH CHANNEL

Hopping off



Hopping on



9. RADIATED EMISSION

9.1 MEASUREMENT PROCEDURE

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

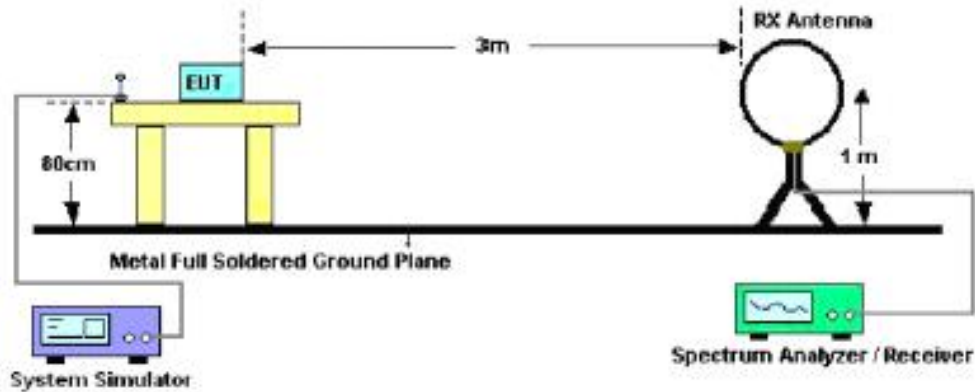
The following table is the setting of receiver.

Spectrum Parameter	Setting
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
Start ~Stop Frequency	1GHz~26.5GHz 1MHz/3MHz for Peak, 1MHz/3MHz for Average

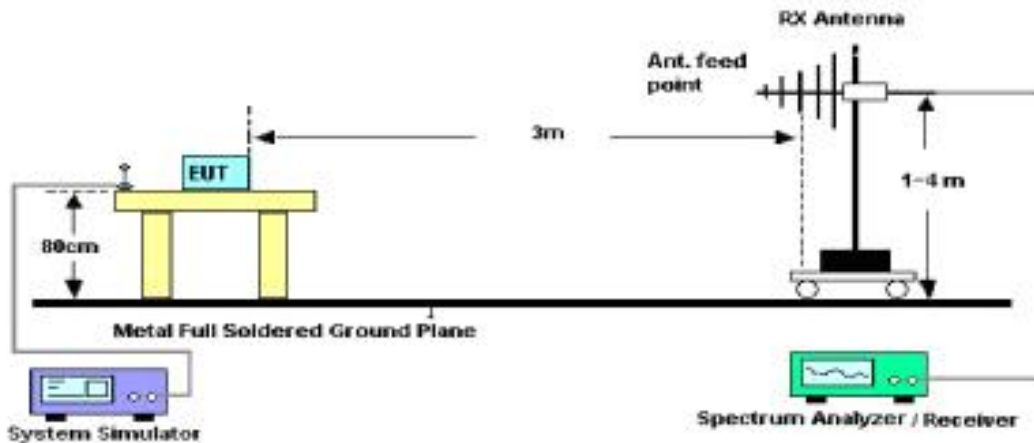
Receiver Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP

9.2 TEST SETUP

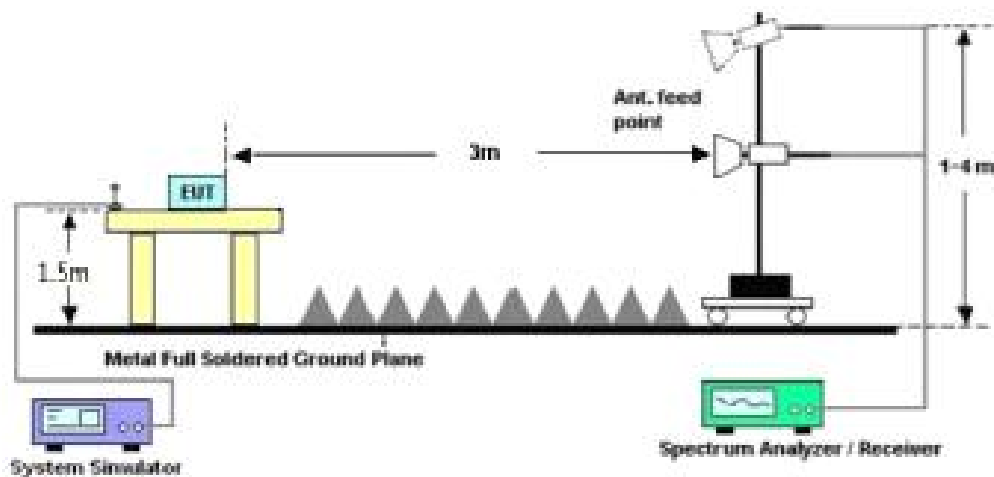
RADIATED EMISSION TEST SETUP BELOW 30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



9.3 LIMITS AND MEASUREMENT RESULT

15.209 Limit in the below table has to be followed

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

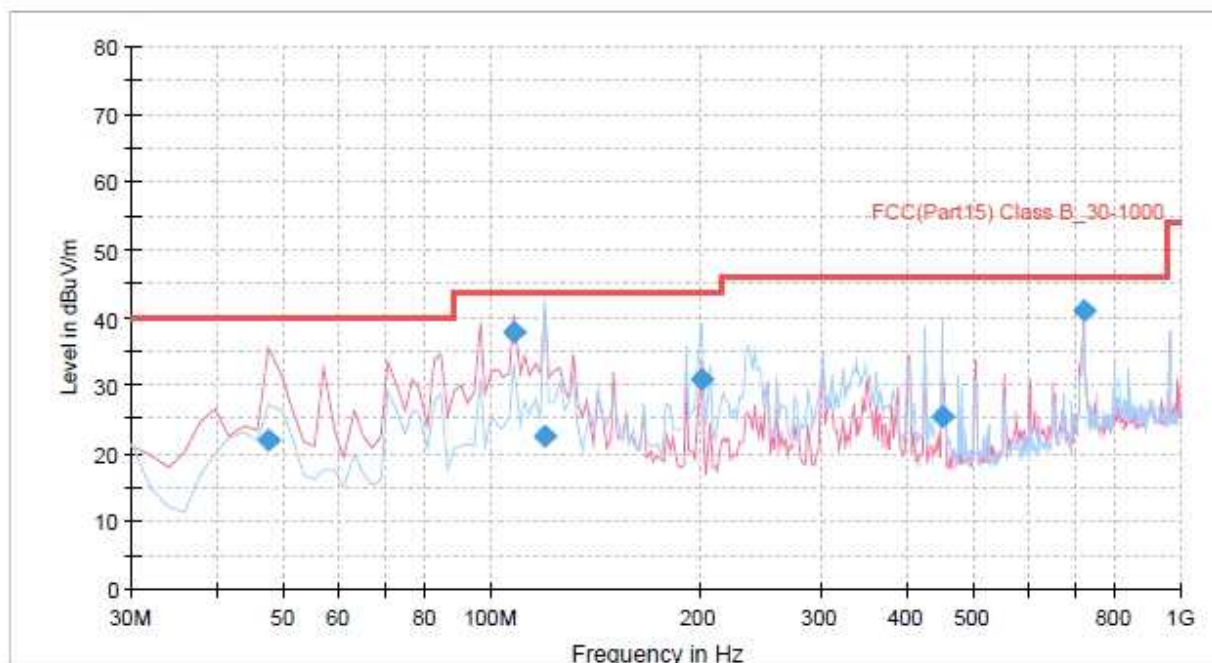
9.4 TEST RESULT

RADIATED EMISSION BELOW 30MHz

The amplitude of spurious emissions from 9kHz to 30MHz which are attenuated more than 20 dB below the permissible value need not be reported.

RADIATED EMISSION BELOW 1GHz

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
47.494990	22.07	40.00	17.93	1000.0	120.000	103.0	V	289.0
107.755511	37.85	43.50	5.65	1000.0	120.000	100.0	V	81.0
119.418838	22.39	43.50	21.11	1000.0	120.000	136.0	H	230.0
201.062124	30.94	43.50	12.56	1000.0	120.000	203.0	H	44.0
449.879760	25.31	46.00	20.69	1000.0	120.000	264.0	H	202.0
720.080160	41.09	46.00	4.91	1000.0	120.000	101.0	V	206.0

RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Over= Measurement -Limit.

2. All test modes had been pre-tested. The worst case and recorded in the report.

RADIATED EMISSION ABOVE 1GHz
BDR (GFSK)

Frequency (MHz)	MaxPeak (dBuV/m)	CAverage (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1579.158317	49.00	-	74.00	25.00	1000.0	1000.0	140.0	V
1579.158317	-	36.54	54.00	17.46	1000.0	1000.0	140.0	V
1919.839679	58.55	-	74.00	15.45	1000.0	1000.0	245.0	H
1919.839679	-	50.82	54.00	3.18	1000.0	1000.0	245.0	H
4849.699399	63.03	-	74.00	10.97	1000.0	1000.0	125.0	H
4849.699399	-	47.25	54.00	6.75	1000.0	1000.0	125.0	H
5462.925852	61.47	-	74.00	12.53	1000.0	1000.0	150.0	V
5462.925852	-	47.62	54.00	6.38	1000.0	1000.0	150.0	V
5871.743487	61.84	-	74.00	12.16	1000.0	1000.0	288.0	V
5871.743487	-	46.12	54.00	7.88	1000.0	1000.0	288.0	V
6484.969940	63.49	-	74.00	10.51	1000.0	1000.0	248.0	H
6484.969940	-	48.76	54.00	5.24	1000.0	1000.0	248.0	H

EDR (8DFSK)

Frequency (MHz)	MaxPeak (dBuV/m)	CAverage (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1579.158317	-	34.90	54.00	19.10	1000.0	1000.0	300.0	V
1579.158317	48.06	-	74.00	25.94	1000.0	1000.0	300.0	V
1919.839679	57.34	-	74.00	16.66	1000.0	1000.0	247.0	H
1919.839679	-	49.90	54.00	4.10	1000.0	1000.0	247.0	H
3827.655311	-	45.63	54.00	8.37	1000.0	1000.0	410.0	H
3827.655311	57.82	-	74.00	16.18	1000.0	1000.0	410.0	H
4849.699399	-	46.36	54.00	7.64	1000.0	1000.0	150.0	H
4849.699399	61.26	-	74.00	12.74	1000.0	1000.0	150.0	H
6655.310621	61.02	-	74.00	12.98	1000.0	1000.0	370.0	V
6655.310621	-	47.27	54.00	6.73	1000.0	1000.0	370.0	V
8222.444890	-	46.25	54.00	7.75	1000.0	1000.0	248.0	V
8222.444890	58.70	-	74.00	15.30	1000.0	1000.0	248.0	V

RESULT: PASS

Note:

The amplitude of other spurious emissions from 1G to 25 GHz which are attenuated more than 20 dB below the permissible value need not be reported.

Factor = Antenna Factor + Cable loss - Amplifier gain, Margin = Level - Limit.

The "Factor" value can be calculated automatically by software of measurement system.

All test modes had been tested. The 8DFSK modulation is the worst case and recorded in the report.9.

NUMBER OF HOPPING FREQUENCY

10.1 MEASUREMENT PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
2. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3. VBW $\geq$ RBW. Sweep: Auto. Detector function: Peak. Trace: Max hold.
4. Allow the trace to stabilize.

10.2 TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

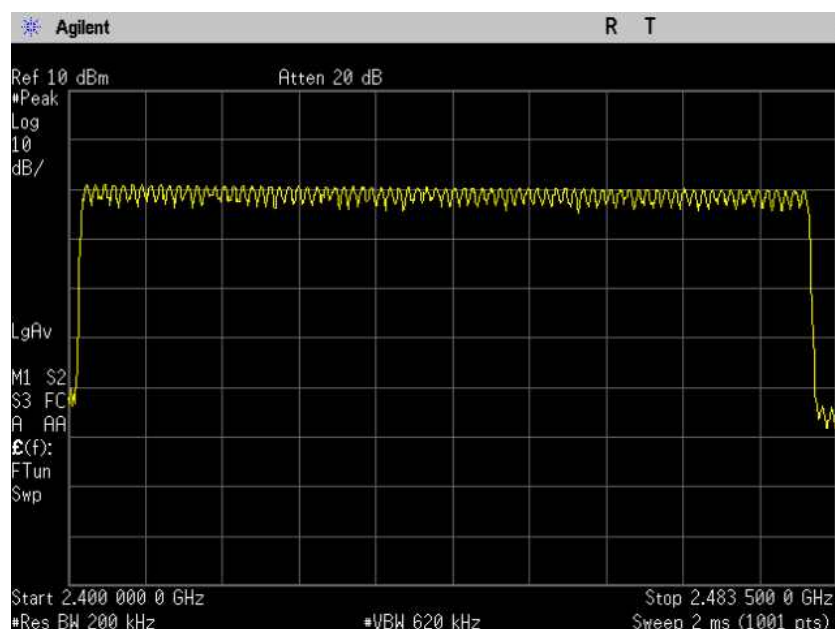
10.3 MEASUREMENT EQUIPMENT USED

The same as described in section 6

10.4 LIMITS AND MEASUREMENT RESULT

TOTAL NO. OF HOPPING CHANNEL	LIMIT (NO. OF CH)	MEASUREMENT (NO. OF CH)	RESULT
	≥ 15	79	PASS

TEST PLOT FOR NO. OF TOTAL CHANNELS



11. TIME OF OCCUPANCY (DWEELL TIME)

11.1 MEASUREMENT PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: Zero span, centered on a hopping channel.
2. RBW shall be $\leq$ channel spacing and where possible RBW should be set $\gg 1/T$, where T is the expected dwell time per channel.
3. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
4. Detector function: Peak. Trace: Max hold.
5. Use the marker-delta function to determine the transmit time per hop.
6. Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:
(Number of hops in the period specified in the requirements) =
(number of hops on spectrum analyzer) $\times$ (period specified in the requirements / analyzer sweep time)
7. The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements.

11.2 TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

11.3 MEASUREMENT EQUIPMENT USED

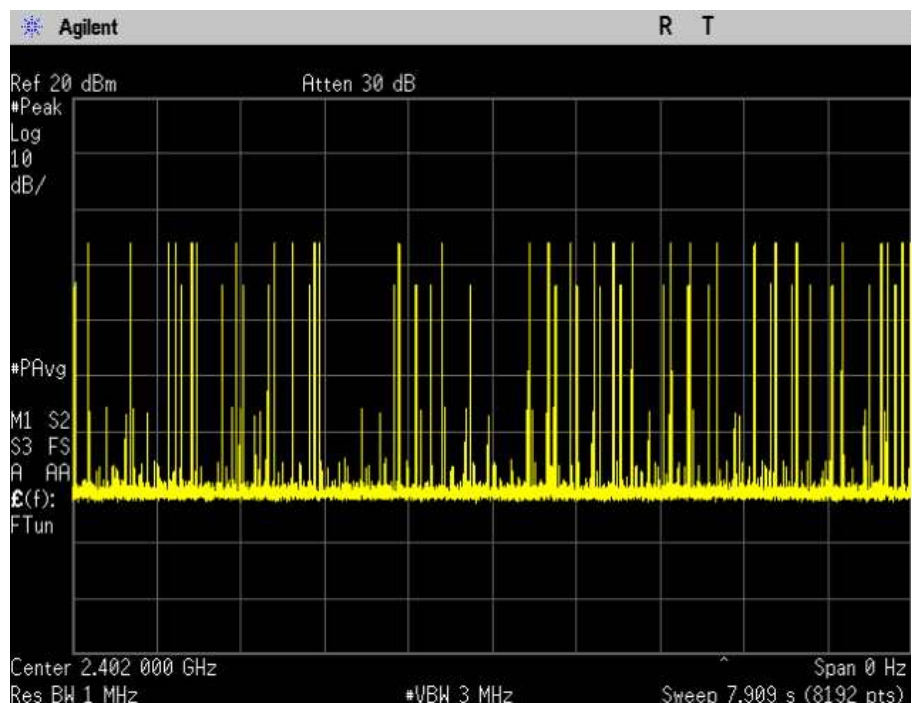
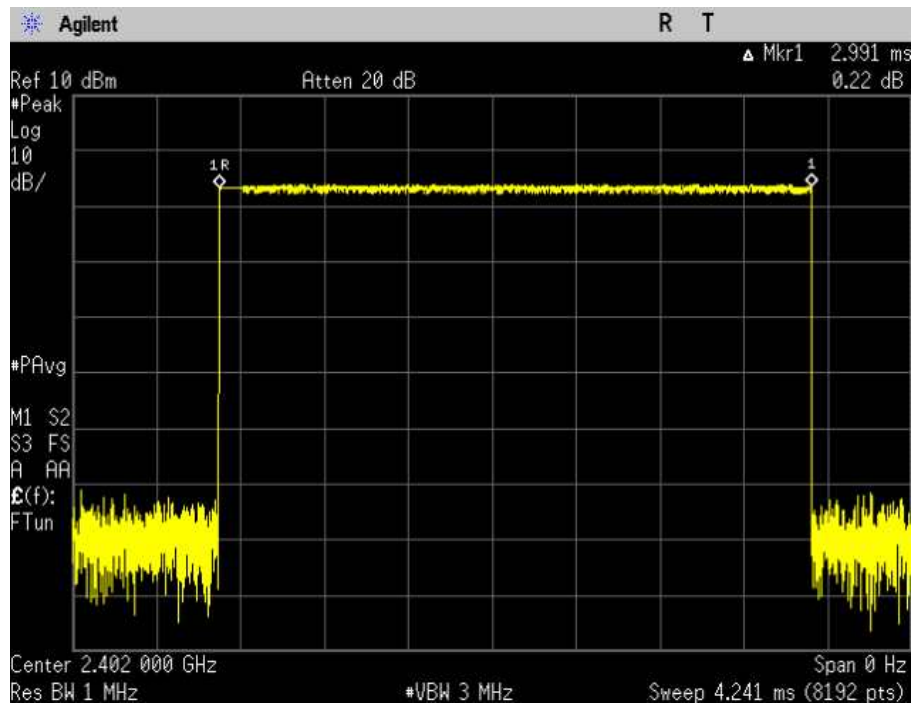
The same as described in section 6

11.4 LIMITS AND MEASUREMENT RESULT

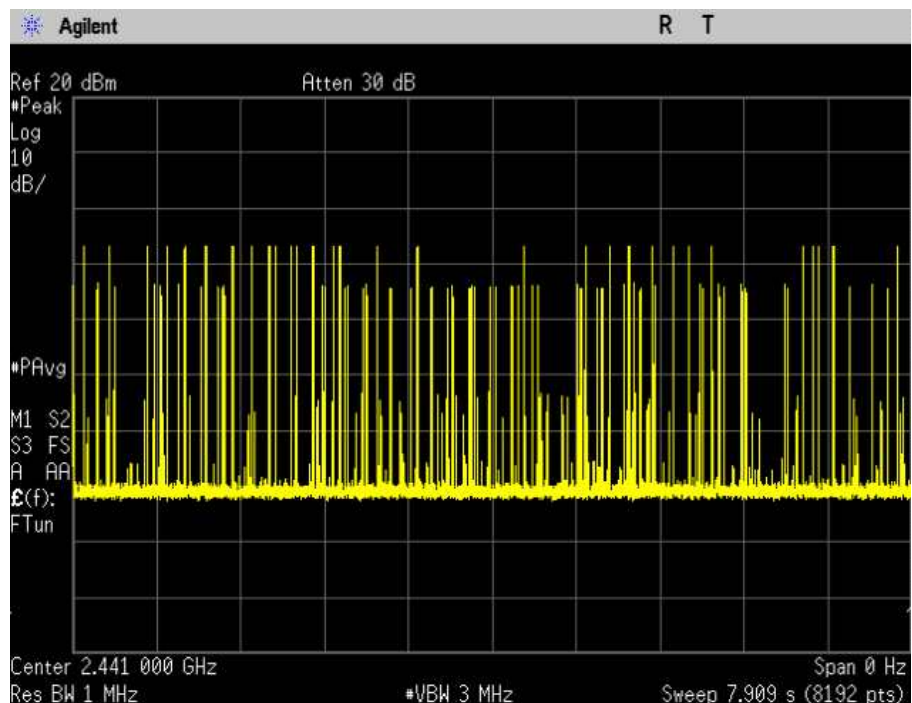
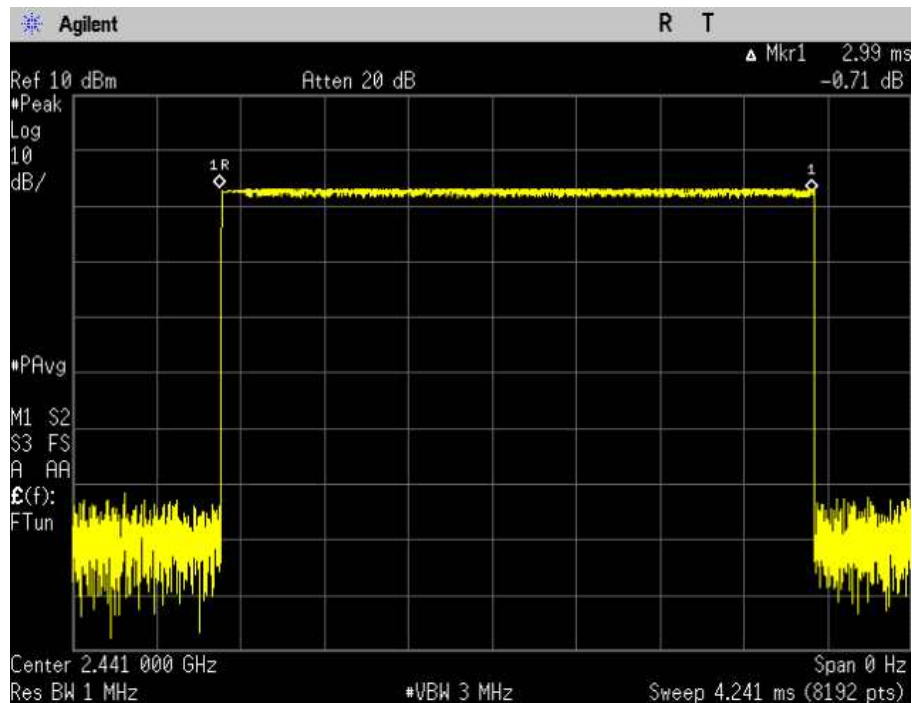
Channel	Time of Pulse for DH5 (ms)	Number of hops in the period specified in the requirements	Sweep Time (ms)	Limit (ms)
Low	2.991	30*4	358.920	400
Middle	2.990	30*4	358.800	400
High	2.992	29*4	347.072	400

Note: The GFSK modulation is the worst case and recorded in the report.

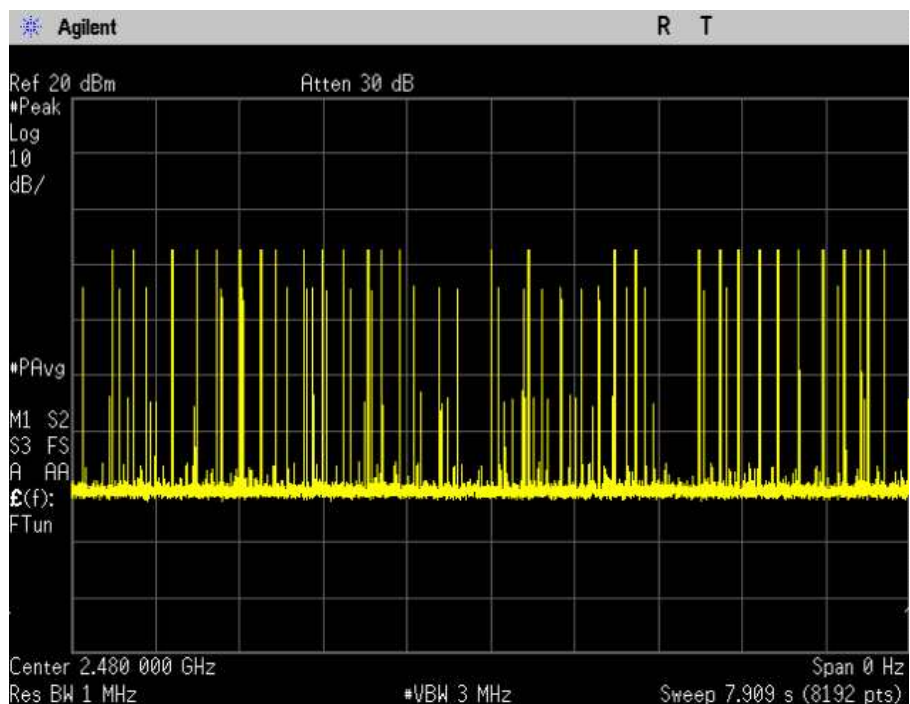
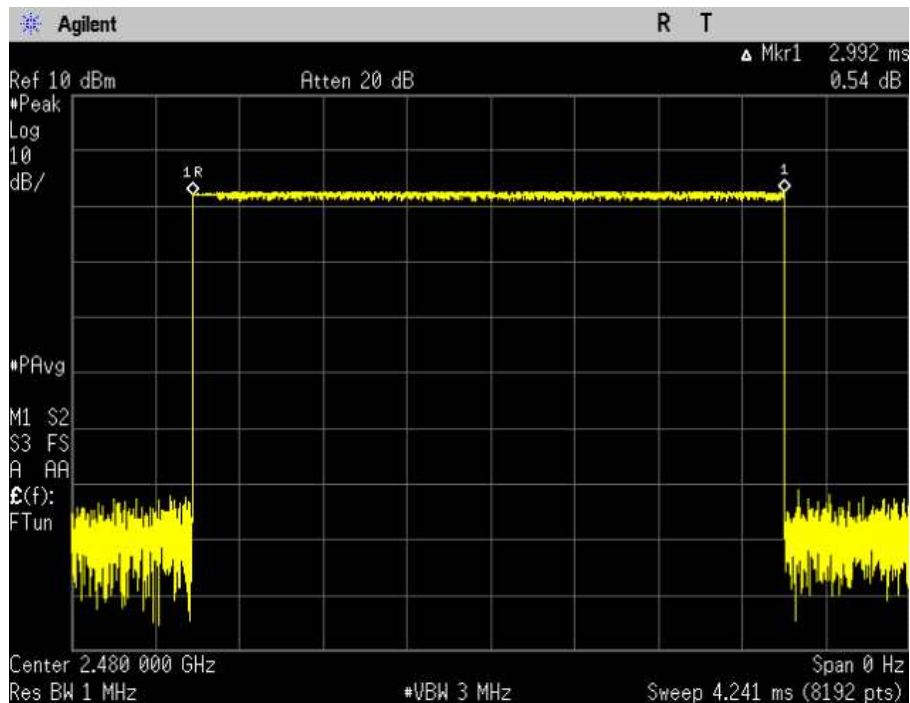
TEST PLOT OF LOW CHANNEL



TEST PLOT OF MIDDLE CHANNEL



TEST PLOT OF HIGH CHANNEL



12. FREQUENCY SEPARATION

12.1 MEASUREMENT PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: Wide enough to capture the peaks of two adjacent channels.
2. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
3. Video (or average) bandwidth (VBW) $\geq$ RBW.
4. Sweep: Auto. e) Detector function: Peak. f) Trace: Max hold. g) Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

12.2 TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 6.2

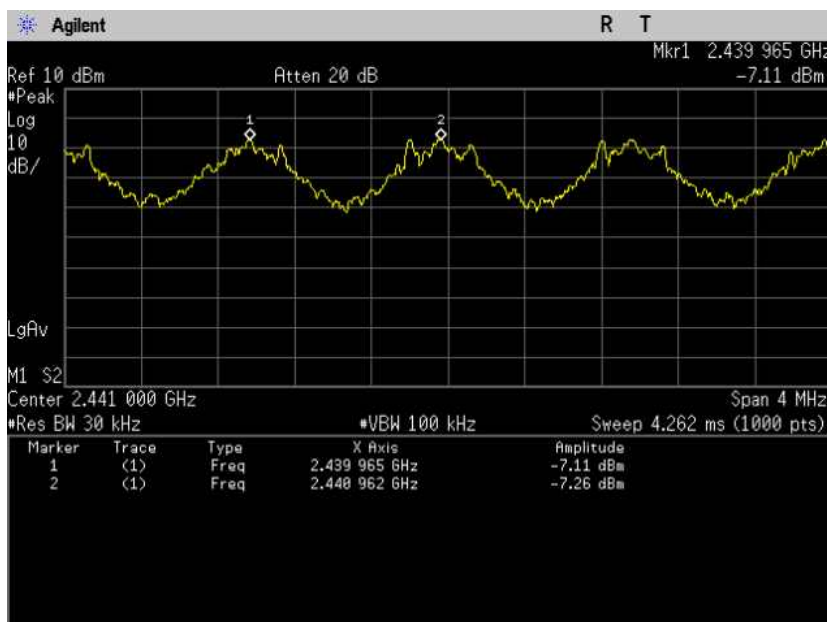
12.3 MEASUREMENT EQUIPMENT USED

The same as described in section 6.3

12.4 LIMITS AND MEASUREMENT RESULT

CHANNEL	CHANNEL SEPARATION	LIMIT	RESULT
	MHz		
CH38-CH39	0.997	$\geq 2/3 * 20\text{DB BW}$	PASS

TEST PLOT FOR FREQUENCY SEPARATION



Note: The GFSK modulation is the worst case and recorded in the report.

13. FCC LINE CONDUCTED EMISSION TEST

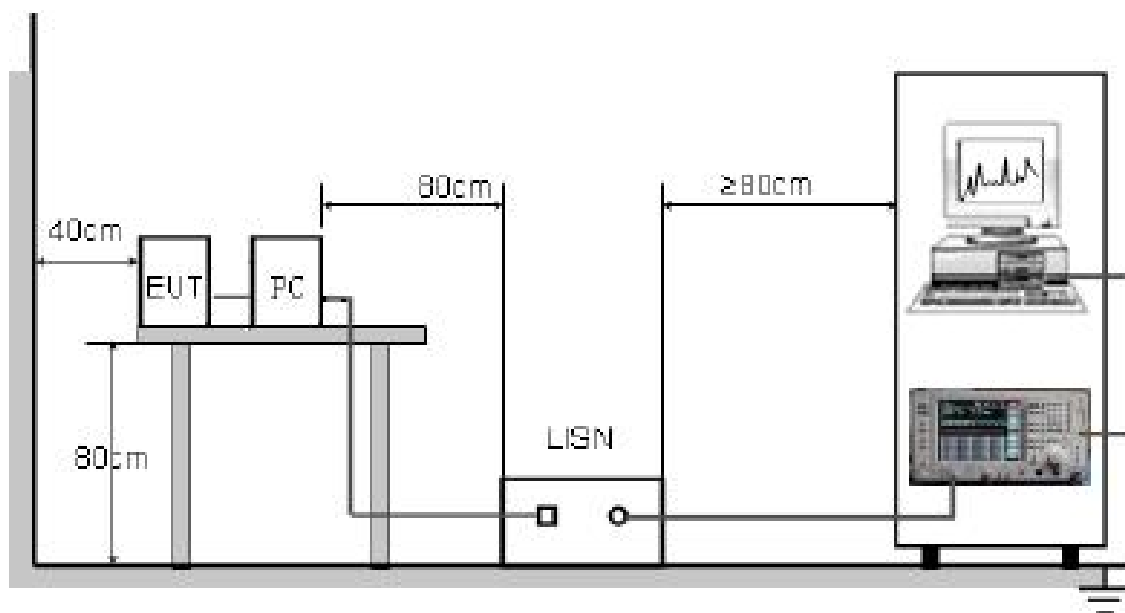
13.1 LIMITS OF LINE CONDUCTED EMISSION TEST

Frequency	Maximum RF Line Voltage	
	Q.P. (dB μ V)	Average (dB μ V)
150kHz~500kHz	66-56	56-46
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Note:

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

13.2 BLOCK DIAGRAM OF LINE CONDUCTED EMISSION TEST



13.3 PRELIMINARY PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
2. Support equipment, if needed, was placed as per ANSI C63.10.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
4. All support equipment received AC120V/60Hz power from a LISN, if any.
5. The EUT received DC 3.7V power from control board which received AC120V/60Hz power from a LISN.
6. The test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.
9. The test mode(s) were scanned during the preliminary test.

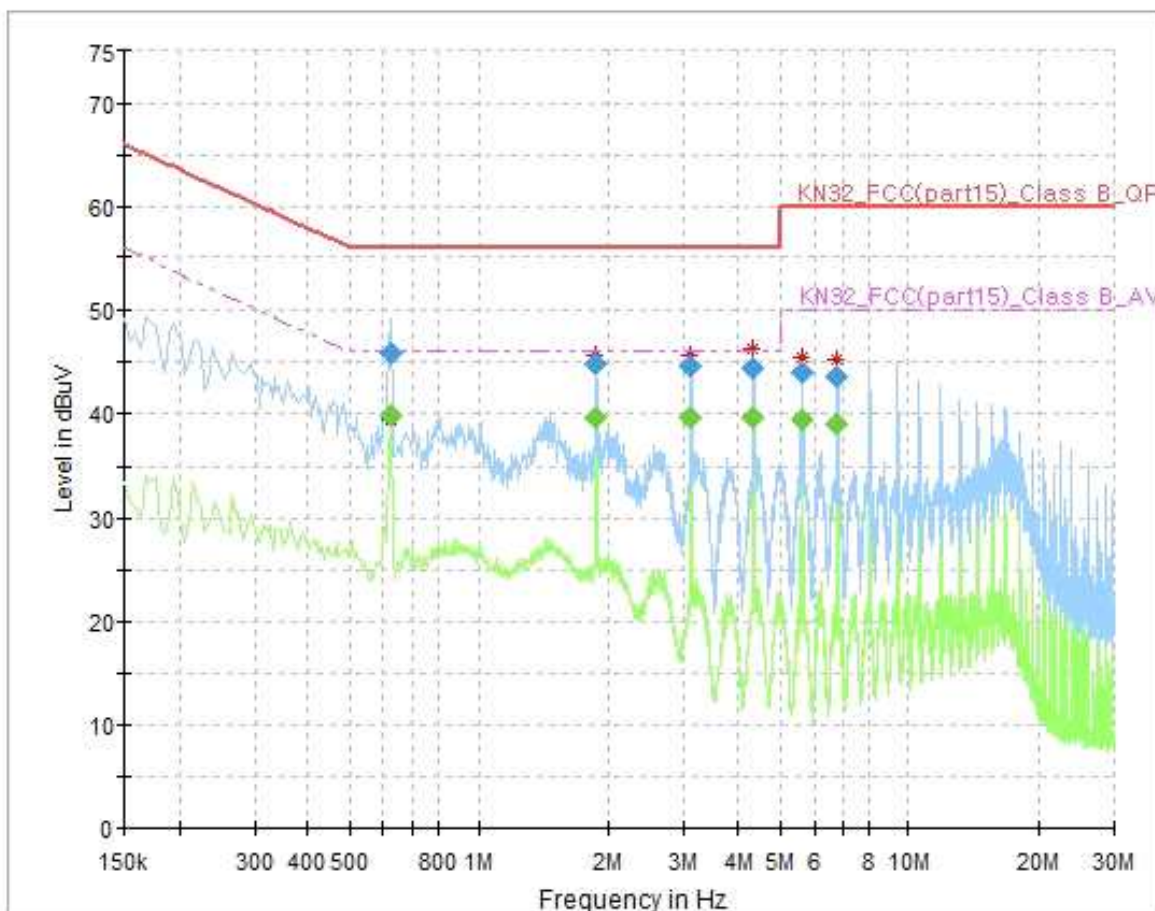
Then, the EUT configuration and cable configuration of the above highest emission level were recorded for reference of final testing.

13.4 FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less -2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
3. The test data of the worst case condition(s) was reported on the Summary Data page.

13.5 TEST RESULT OF LINE CONDUCTED EMISSION TEST

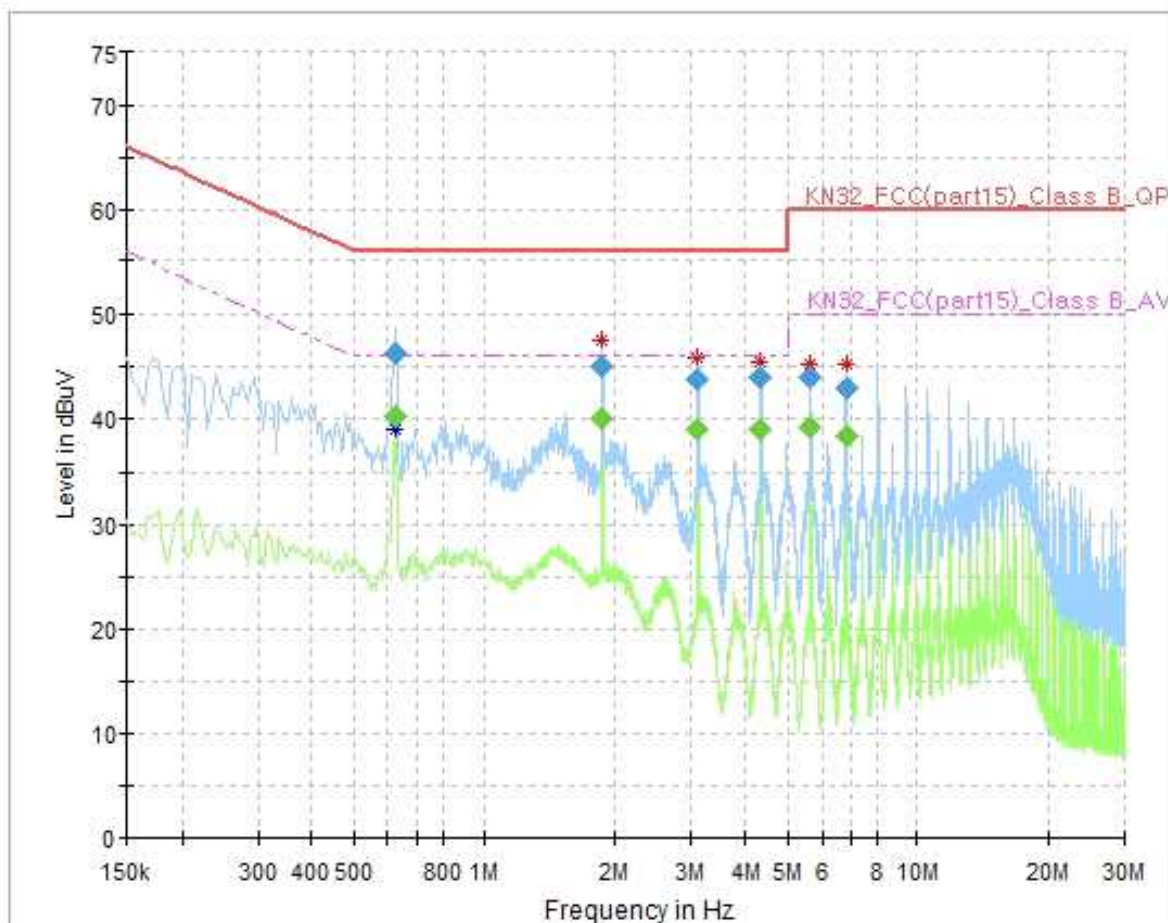
Line Conducted Emission Test Line 1-L



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Corr. (dB)	Comment
0.622500	---	39.79	46.00	6.21	L1	9.9	
0.622500	45.89	---	56.00	10.11	L1	9.9	
1.864500	---	39.65	46.00	6.35	L1	9.7	
1.864500	44.76	---	56.00	11.24	L1	9.7	
3.106500	---	39.64	46.00	6.36	L1	9.7	
3.106500	44.61	---	56.00	11.39	L1	9.7	
4.348500	---	39.56	46.00	6.44	L1	9.7	
4.348500	44.43	---	56.00	11.57	L1	9.7	
5.590500	---	39.28	50.00	10.72	L1	9.7	
5.590500	44.03	---	60.00	15.97	L1	9.7	
6.832500	---	38.90	50.00	11.10	L1	9.8	
6.832500	43.60	---	60.00	16.40	L1	9.8	

Line Conducted Emission Test Line 2-N



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Corr. (dB)	Comment
0.622500	---	40.18	46.00	5.82	N	9.8	
0.622500	46.23	---	56.00	9.77	N	9.8	
1.864500	---	40.04	46.00	5.96	N	9.7	
1.864500	45.04	---	56.00	10.96	N	9.7	
3.106500	---	38.87	46.00	7.13	N	9.7	
3.106500	43.83	---	56.00	12.17	N	9.7	
4.353000	---	39.07	46.00	6.93	N	9.7	
4.353000	43.95	---	56.00	12.05	N	9.7	
5.595000	---	39.23	50.00	10.77	N	9.7	
5.595000	44.04	---	60.00	15.96	N	9.7	
6.837000	---	38.32	50.00	11.68	N	9.7	
6.837000	42.90	---	60.00	17.10	N	9.7	