

Nemko Korea CO., Ltd.

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FCC EVALUATION REPORT FOR CERTIFICATION

Applicant :

Samsung Electronics Co., Ltd.
Monitor Division, R&D Dept, 416,
Maetan3-Dong, Youngtong-Gu,
Suwon-Shi, Kyunggi-Do, Korea.
(Post code : 442-742)

Dates of Issue : January 30 , 2007

Test Report No. : NK2HR010

Test Site : Nemko Korea Co., Ltd.

EMC site, Korea

Attn. : Mr. Chang-Seub,Eum

FCC ID

A3LBT

Brand Name

SAMSUNG

Contact Person

Samsung Electronics Co., Ltd.
Monitor Division, R&D Dept, 416, Youngtong-Gu,
Suwon-Shi, Kyunggi-Do, Korea, 442-742.
Mr. Chang-Seub, Eum
Telephone No. : +82-31-277-2635

Applied Standard:

FCC 47 CFR Part 15, Subpart C : 2004

Classification :

FCC Class B Device

EUT Type:

Bluetooth Module

The device bearing the brand name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2003.

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.



Tested By : Minchul Shin
Engineer



Reviewed By : H.H. Kim
Manager & Chief Engineer

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SCOPE

Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15.

Responsible Party :	Samsung Electronics Co., Ltd.
Contact Person :	Mr. Chang-Seub, Eum
Manufacturer :	Samsung Electronics Co., Ltd. Monitor Division, R&D Dept, 416 Maetan-3Dong, Youngtong-Gu, Suwon Kyungki-Do, 442-742 KOREA

- FCC ID: A3LBT
- Model: BT
- Brand Name: SAMSUNG
- EUT Type: Bluetooth Module
- Classification: FCC Class B
- Applied Standard: FCC 47 CFR Part 15, Subpart C
- Test Procedure(s): ANSI C63.4 (2003)
- Dates of Test: Jan 17, 2007 ~ Jan 29, 2007
- Place of Tests: Nemko Korea Co., Ltd. EMC Site
- Test Report No.: NK2HR010

INTRODUCTION

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C63.4-2003) was used in determining radiated and conducted emissions emanating from **Samsung Electronics Co., Ltd.**

FCC ID : **A3LBT**

These measurement tests were conducted at **Nemko Korea Co., Ltd. EMC Laboratory**.

The site address is 300-2, Osan-Ri, Mohyun-Myun, Yongin-City, Kyungki-Do, KOREA.

The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 kilo-meters (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 kilometers (18miles) south-southeast from central Seoul.

It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.

The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 2003.



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Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. EMC Lab. and Incheon Airport.

TEST CONDITIONS & EUT INFORMATION

Operating During Test

The EUT was Controlled and monitored by CSR Bluetest testing program which manufacturer supported through USB cable with Notebook computer.

The EUT was supplied from the DC power supply according to the manufacturer's request.

The test was performed at the Lowest, Middle, Highest channel.

For the Maximum Peak output power, Carrier Frequency separation, 20 dB Bandwidth, Band Edge tests were tested with both GFSK and 8DPSK modulation.

For the Radiation test was tested with GFSK modulation mode which was the worst case.

Support Equipment

Blue Tooth Module (EUT)	Samsung Electronics Co., Ltd. FCC ID: A3LBT 0.5m Unshielded DC power cable	S/N: N/A
DC Power Supply	Unicorn Co., Ltd. Model : UP-100DT	S/N: 9668IP
Notebook Computer	Samsung Electronics Model: SP15 Adaptor : Samsung Electronics Model : AD-8019 1.8m unshielded AC cable, 0.8m unshielded DC cable with ferrite core at DC jack end.	S/N: F77191FW300356 S/N: N/A
PS/2 Mouse	CHIC TECHNOLOGY CORP. Model : SMOP5000WX 1.5m Unshielded Din cable	S/N: 3110042811
Printer	H.P. Model : C6429A 1.0m shielded USB cable 1.8m unshielded AC power cable	S/N: N/A

TEST CONDITIONS & EUT INFORMATION

EUT Information

RF Frequency	2402 ~ 2480 MHz
Channel Number	79
Modulation	GFSK, QPSK, 8DPSK
RF output power	Maximum of 3.52 dBm (EIRP)
Power	DC 3.3 V
Size(with stand)	43(width) X 14(length) X 4(height) mm
Weight	2 g

SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	Paragraph No.	Result	Remark
Conducted Emission	15.107	Complies	
Radiated Emission	15.109	Complies	
20dB Bandwidth and Carrier Frequency Separation	15.247(a)	Complies	
Transmitter Average Time of Occupancy	15.247(a)	Complies	
Peak Power Output	15.247(b)	Complies	
Conducted Spurious Emission	15.247(d)	Complies	
Radiated Spurious Emission	15.247(d)	Complies	
Number of Hopping capability	15.247(g)	Complies	
Maximum Permissible Exposure	15.247(b)	Complies	

RECOMMENDATION/CONCLUSION

The data collected shows that the **Samsung Electronics Co., Ltd.**

FCC ID : **A3LBT, Bluetooth module.**

The highest emission observed was at **0.15 MHz** for conducted emissions with a

Average margin of **9.6 dB**, at **4.804 GHz** for radiated emissions with a margin of **7.52 dB**.

SAMPLE CALCULATION

$$\text{dB } \mu V = 20 \log_{10} (\mu V/m)$$

$$\mu V = 10^{(\text{dB } \mu V/20)}$$

EX. 1.

@57.7 MHz

Class B limit = 100 $\mu V/m$ = 40.0 dB $\mu V/m$

Reading = 19.1 dB μV (calibrated level)

Antenna factor + Cable Loss + Amplifier Gain = 10.12 dB

Total = 29.22 dB $\mu V/m$

Margin = 40.0 – 29.22 = 10.78

10.78 dB below the limit

DESCRIPTION OF TESTS

Conducted Emissions

The Line conducted emission test facility is located inside a 4 X 7 X 2.5 meter shielded enclosure. It is manufactured by EM engineering. The shielding effectiveness of the shielded room is in accordance with MIL-STD-285 or NSA 65-6.

A 1m X 1.5m wooden table 0.8m height is placed 0.4m away from the vertical wall and 1.5m away from the side of wall of the shielded room Rohde & Schwarz (ESH3-Z5) and Kyoritsu (KNW-407) of the 50ohm/50uH Line Impedance Stabilization Network(LISN) are bonded to the shielded room. The EUT is powered from the Rohde & Schwarz LISN and the support equipment is powered from the Kyoritsu LISN. Power to the LISN s are filtered by high-current high insertion loss Power line filters. The purpose of filter is to attenuate ambient signal interference and this filter is also bonded to shielded enclosure. All electrical cables are shielded by tinned copper zipper tubing with inner diameter of 1/2".

If DC power device, power will be derived from the source power supply it normally will be powered from

and this supply lines will be connected to the LISNs, All interconnecting cables more than 1 meter were shortened by non inductive bundling (serpentine fashion) to a 1 meter length.

Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT.

The spectrum was scanned from 150 kHz to 30 MHz with 20 msec sweep time.

The frequency producing the maximum level was re-examined using the EMI test receiver. (Rohde & Schwarz ESCS30).

The detector function were set to CISPR quasi-peak mode & average mode.

The bandwidth of receiver was set to 9KHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission.

Each emission was maximized by; switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; which ever determined the worst case emission.

Each EME reported was calibrated using the R&S signal generator.

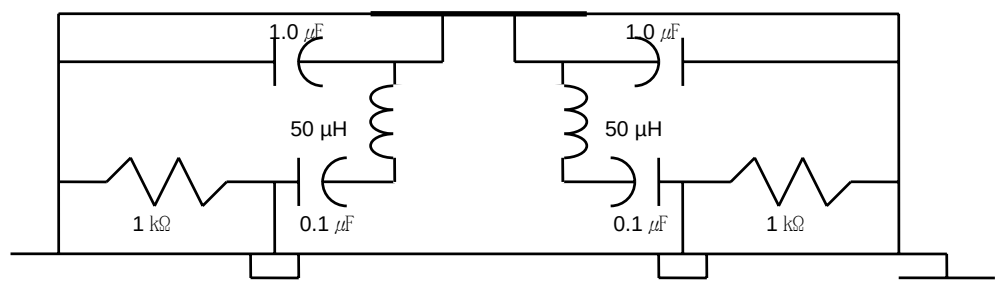


Fig. 2. LISN Schematic Diagram

DESCRIPTION OF TESTS

Radiated Emissions

Preliminary measurement were made indoors at 3 meter using broad band antennas, broadband amplifier, and spectrum analyzer to determine the frequency producing the maximum EME. Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The Technology configuration, clock speed, mode of operation or video resolution, turntable azimuth with respect to the antenna was note for each frequency found. The spectrum was scanned from 27 to 1000 MHz using Bi-conical log Antenna(ARA, LPB-2520/A). Above 1 GHz, Doppels Teg Horn antenna (EMCO, DAA-37121:upto 1~18 GHz) was used. Final Measurements were made outdoors at 3 or 10 m test range using Logbicon Super Antenna (Schwarzbeck, VULB9166) or Doppels Teg Horn antenna.(EMCO, DAA-37121) The test equipment was placed on a wooden table. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

Each frequency found during pre-scan measurements was reexamined and investigated using EMI test receiver.(ESCS30) The detector function was set to CISPR peak mode or quasi-peak mode or average mode and the band-width of the receiver was set to 120 kHz or 1MHz depending on the frequency or type of signal. The half wave dipole antenna was tuned to the frequency found during preliminary radiated measurements. The EUT support equipment and interconnecting cables were re configured to the setup producing the maximum emission for the frequency and were placed on top of a 0.8 m high non- metallic 1.0 X 1.5 meter table. The EUT, support equipment and interconnecting cables were re-arranged and manipulated to maximize each EME emission. The turn table containing the Technology was rotated; the antenna height was varied 1 to 4meter and stopped at the azimuth or height producing the maximum emission Each emission was maximized by : switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; which ever determined the worst case emission.

Each EME reported was calibrated using the R/S signal generator.

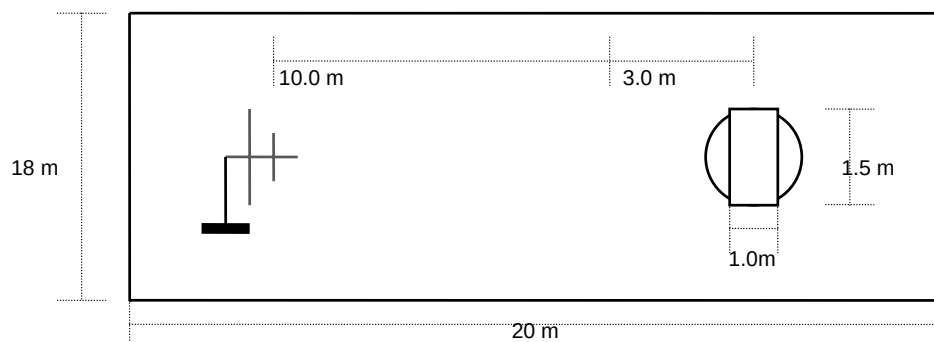
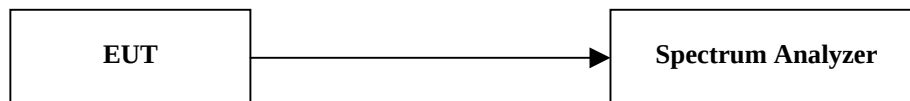


Fig. 2. Dimensions of Outdoor Test Site

DESCRIPTION OF TESTS

20 dB Bandwidth and Carrier Frequency Separation

Test Setup



Test Procedure

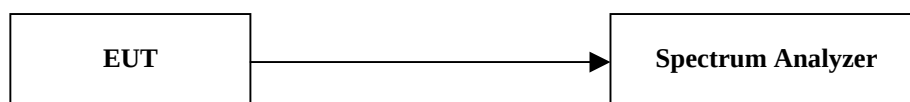
The transmitter is set to the Low , Middle, High channels is connected to the spectrum analyzer. The RBW of spectrum analyzer is set to 10 kHz and VBW is set to the 100 kHz. The sweep time is coupled.

The spectrum analyzer is set for peak detected and Max hold scan mode.

When Carrier Frequency separation is tested, Frequency hopping is set.

Transmitter Average Time of Occupancy

Test Setup



Test Procedure

The transmitter output is connected to a spectrum analyzer. The span is set to zero, centered on a single, selected hopping channel.

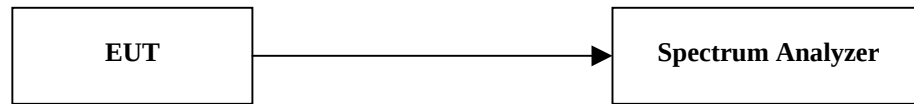
The width of a single pulse is measured in a fast scan. The number of pulses is measured in 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channel x 0.4 second) is equal to 10 x number of pulses in 3.16 second x pulse width.

DESCRIPTION OF TESTS

Number of Hopping Channels

Test Setup



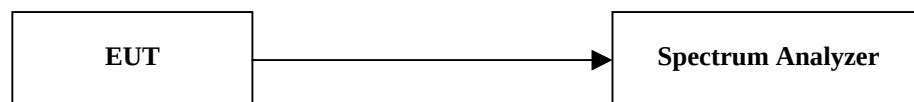
Test Procedure

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, In either a single sweep or in multiple continuous sweeps. The RBW is set to 1% of the span.

The spectrum analyzer is set to Max Hold.

Maximum Peak Output Power

Test Setup



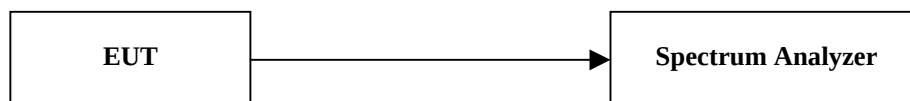
Test Procedure

The transmitter is set to the Low , Middle, High channels is connected to the spectrum analyzer. The RBW of spectrum analyzer is set to 3 MHz and VBW is set to the 3 MHz. The sweep time is coupled.

DESCRIPTION OF TESTS

Conducted Spurious Emission

Test Setup



Test Procedure

The transmitter is connected to the spectrum analyzer.

The RBW of spectrum analyzer is set to 100 kHz and VBW is set to the 100 kHz.

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the Lowest, Middle and highest channels.

TEST DATA

Conducted Emissions - 15.107

FCC ID : A3LBT

Frequency (MHz)	Level(dB μ V)		Line	Limit(dB μ V)		Margin(dB)	
	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.15	35.6	18.1	N	66.0	56.0	30.4	37.9
6.89	37.3	33.6	N	60.0	50.0	22.7	16.4
7.43	36.8	32.1	N	60.0	50.0	23.2	17.9
8.10	37.5	33.0	N	60.0	50.0	22.5	17.0
15.18	41.1	40.4	N	60.0	50.0	18.9	9.6
20.86	37.1	31.3	N	60.0	50.0	22.9	18.7

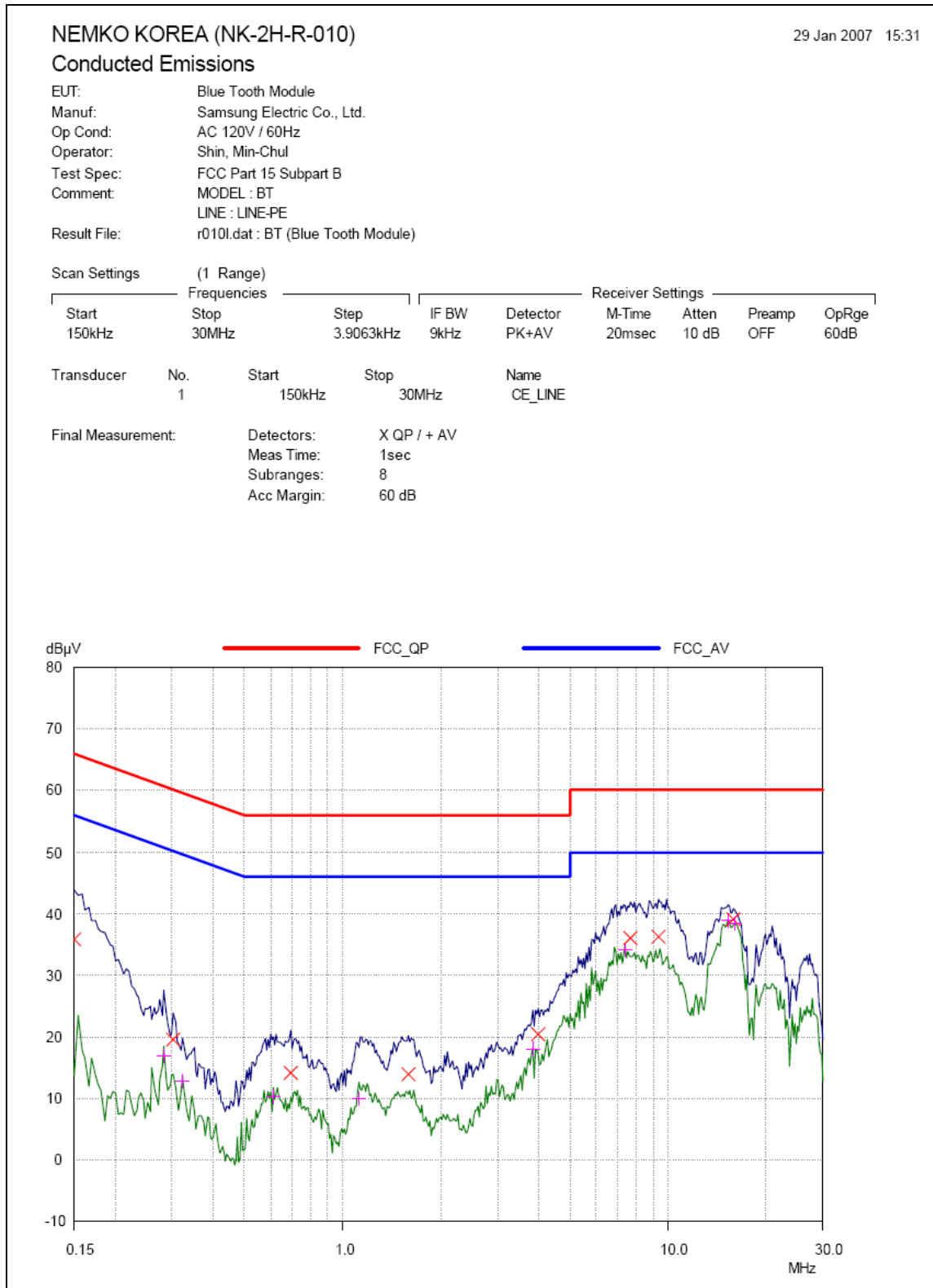
Table 1. Line Conducted Emissions Tabulated Data

NOTES:

1. Measurements using CISPR quasi-peak mode & average mode.
2. All modes of operation were investigated and the worst -case emission are reported. See attached Plots.
3. LINE : L =Line , N = Neutral
4. The limit is on the FCC Part section 15.107(a).

PLOTS OF EMISSIONS

● **Conducted Emission at the Mains port (Line)**



PLOTS OF EMISSIONS

● **Conducted Emission at the Mains port (Neutral)**



TEST DATA

Radiated Emissions - 15.109

FCC ID : A3LBT

Frequency (MHz)	Reading (dB μ V/m)	Pol* (H/V)	AF+CL+Amp (dB)**	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
45.00	46.3	H	-17.0	29.3	40.0	10.7
48.00	47.3	H	-17.5	29.8	40.0	10.2
130.50	41.0	V	-12.4	28.6	43.5	14.9
143.97	38.7	H	-11.0	27.7	43.5	15.8
391.52	42.0	V	-8.1	33.9	46.0	12.1
423.90	38.6	V	-7.1	31.5	46.0	14.5

Table 3. Radiated Measurements at 3meters

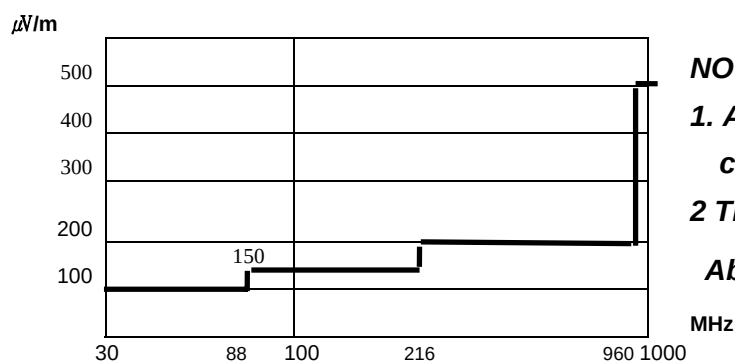


Fig. 1. Limits at 3 meters

NOTES:

1. All modes were measured and the worst-case emission was reported.

2 The radiated limits are shown on Figure 1.

Above 1GHz the limit is 500 μ V/m.

NOTES:

1. *Pol. H =Horizontal, V=Vertical

2. **AF+CL+Amp. = Antenna Factor + Cable Loss + Amplifier.

3. Measurements using CISPR quasi-peak mode.

4. The limit is on the FCC Part section 15.109(a).

5. GFSK modulation mode is the worst condition. The test is measured at the GFSK mode.

TEST DATA

20 dB Modulated Bandwidth - 15.247(a)

FCC ID : A3LBT

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result:

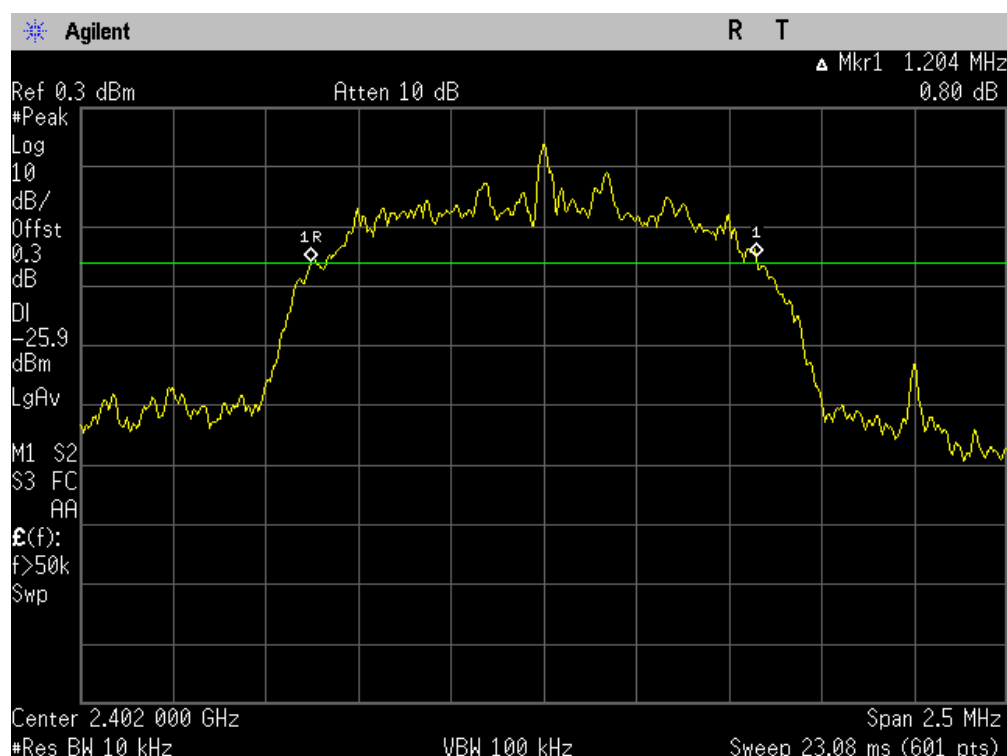
Modulation Mode	Frequency(MHz)	Result(KHz)	Limit(KHz)
GFSK	2402	875	Non specified
GFSK	2441	871	Non specified
GFSK	2480	879	Non specified
8DPSK	2402	1204	Non specified
8DPSK	2441	1204	Non specified
8DPSK	2480	1200	Non specified

PLOTS OF EMISSIONS

20 dB Bandwidth, Lowest Channel (2402 MHz, GFSK Mode)



20 dB Bandwidth, Lowest Channel (2402 MHz, 8DPSK Mode)

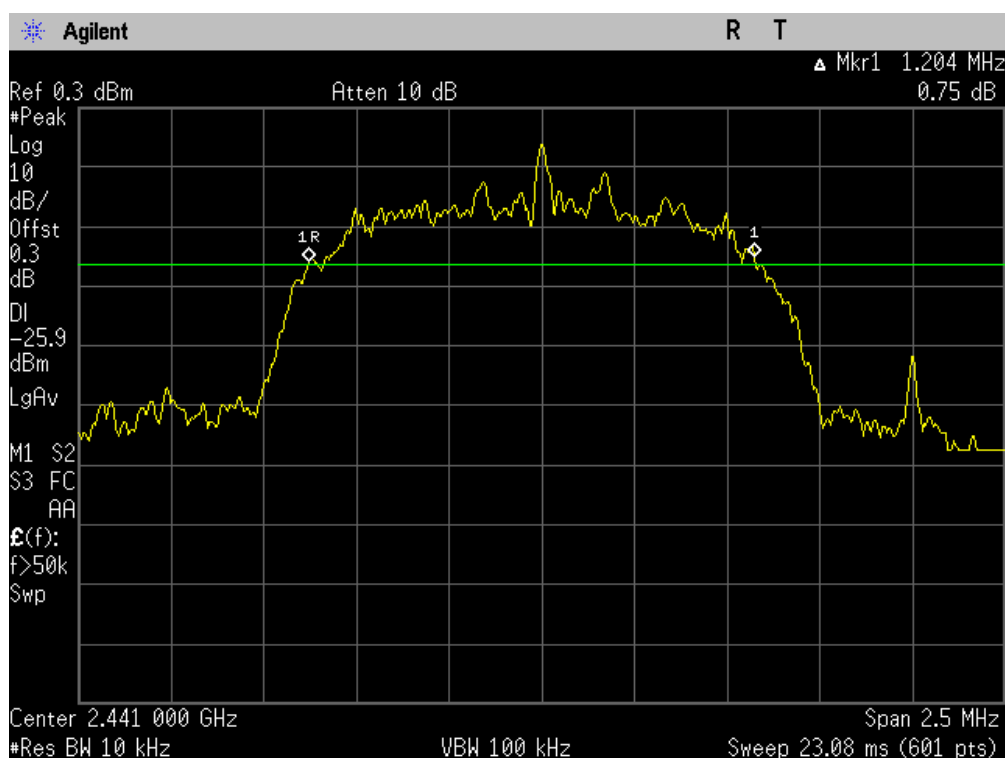


PLOTS OF EMISSIONS

20 dB Bandwidth, Middle Channel (2441 MHz, GFSK Mode)

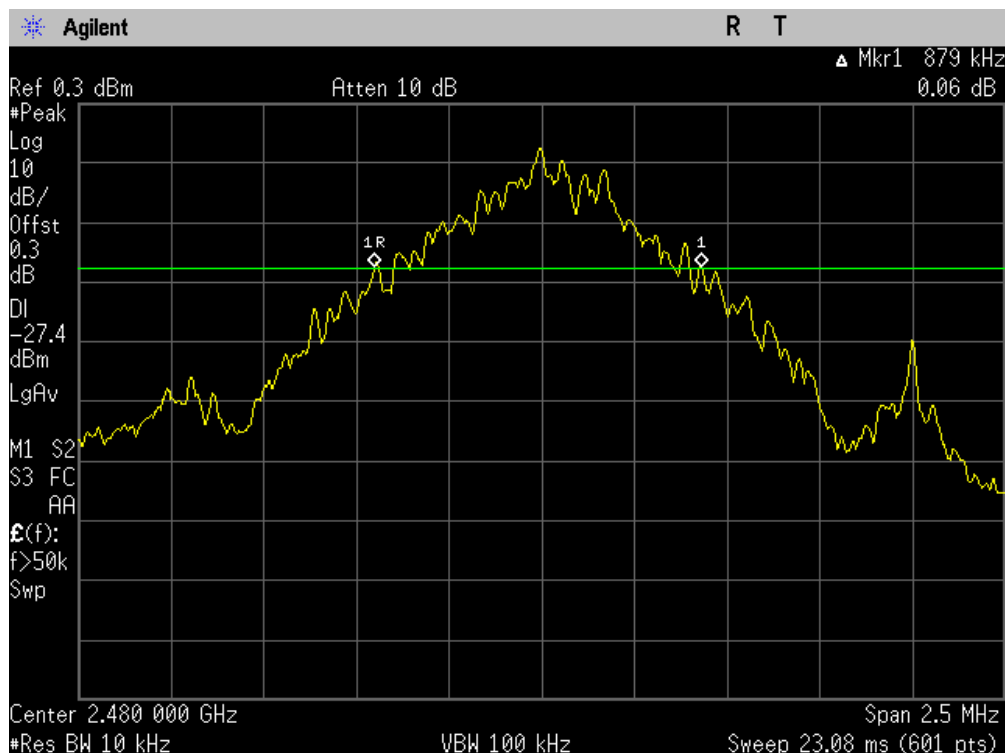


20 dB Bandwidth, Middle Channel (2441 MHz, 8DPSK Mode)

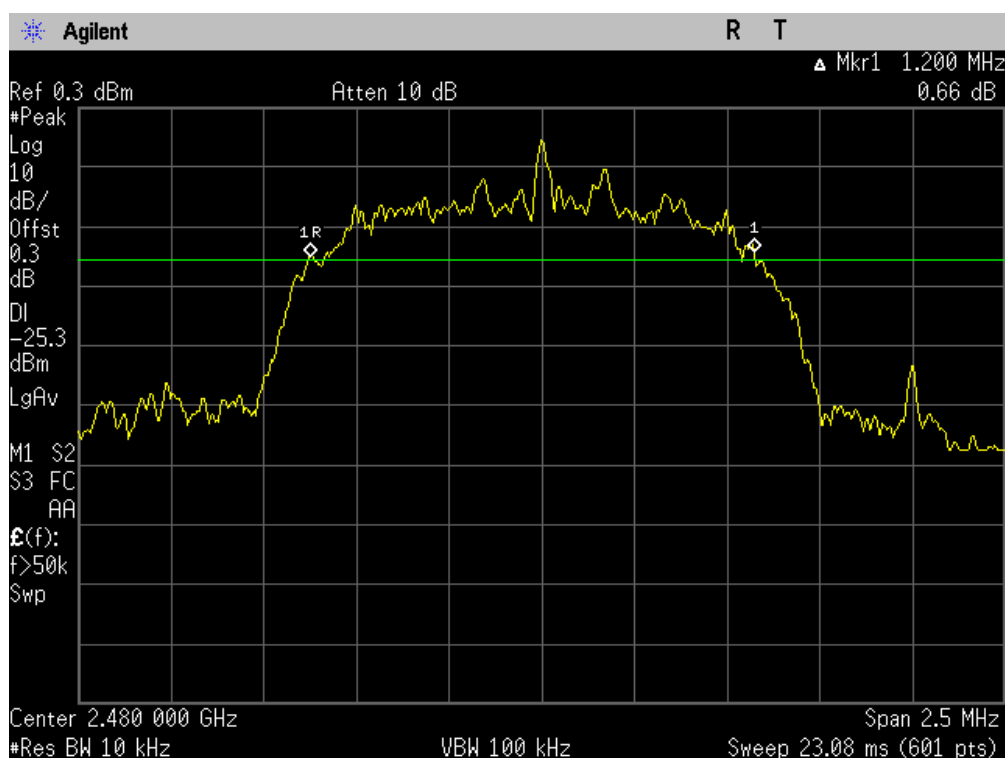


PLOTS OF EMISSIONS

20 dB Bandwidth, Highest Channel (2480 MHz, GFSK Mode)



20 dB Bandwidth, Highest Channel (2480 MHz, 8DPSK Mode)



TEST DATA

Carrier Frequency Separation - 15.247(a)

FCC ID : A3LBT

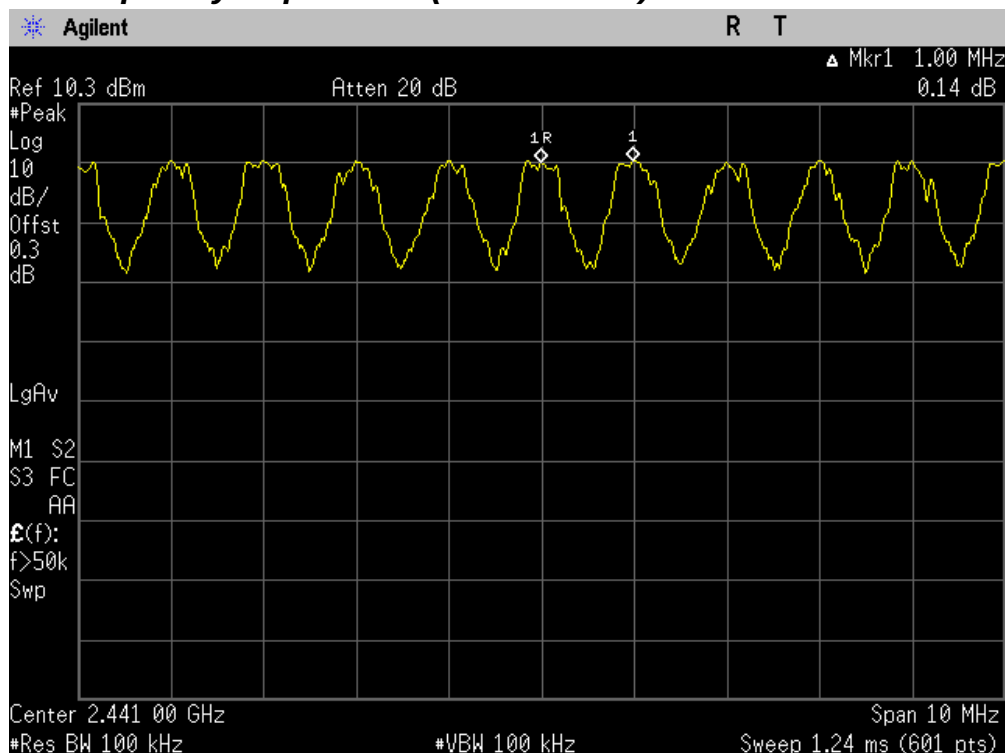
Test Mode : Set to Hopping mode

Result:

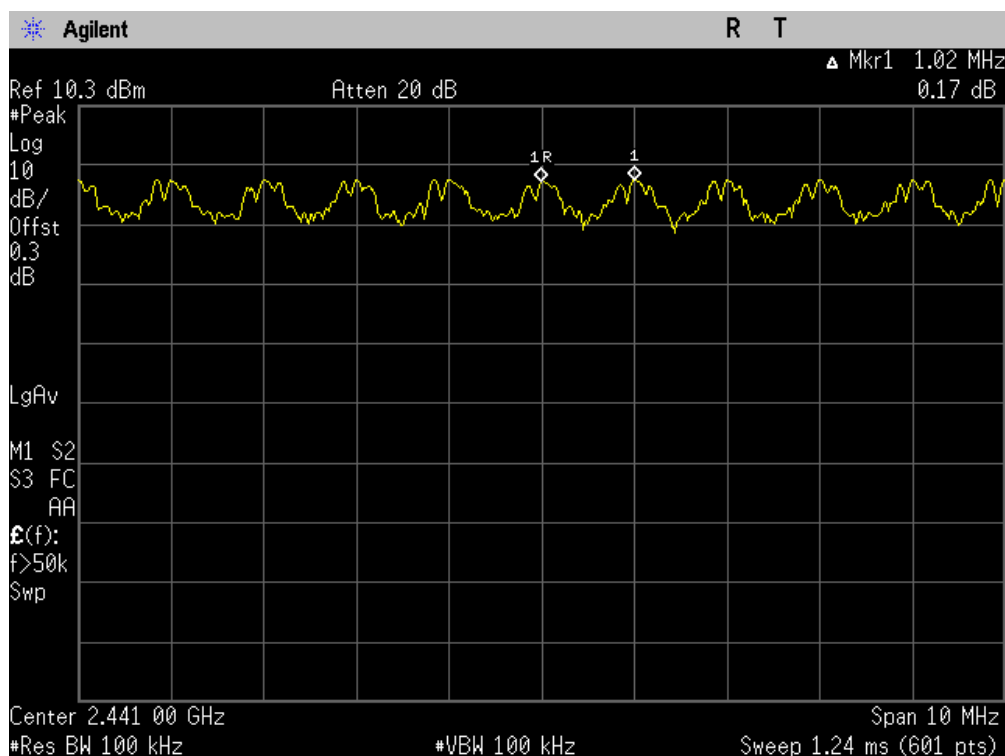
Modulation Mode	Carrier Frequency Separation (kHz)	Limit (2/3 of 20dB Bandwidth) (kHz)	Margin (kHz)
GFSK	1000.0	586.0	414.0
8DPSK	1020.0	802.7	217.3

PLOTS OF EMISSIONS

Carrier Frequency Separation (GFSK Mode)



Carrier Frequency Separation (8DPSK Mode)



TEST DATA

Transmitter Average Time of Occupancy – 15.247(a)

FCC ID : A3LBT

Test Mode : Set to Hopping mode

Result:

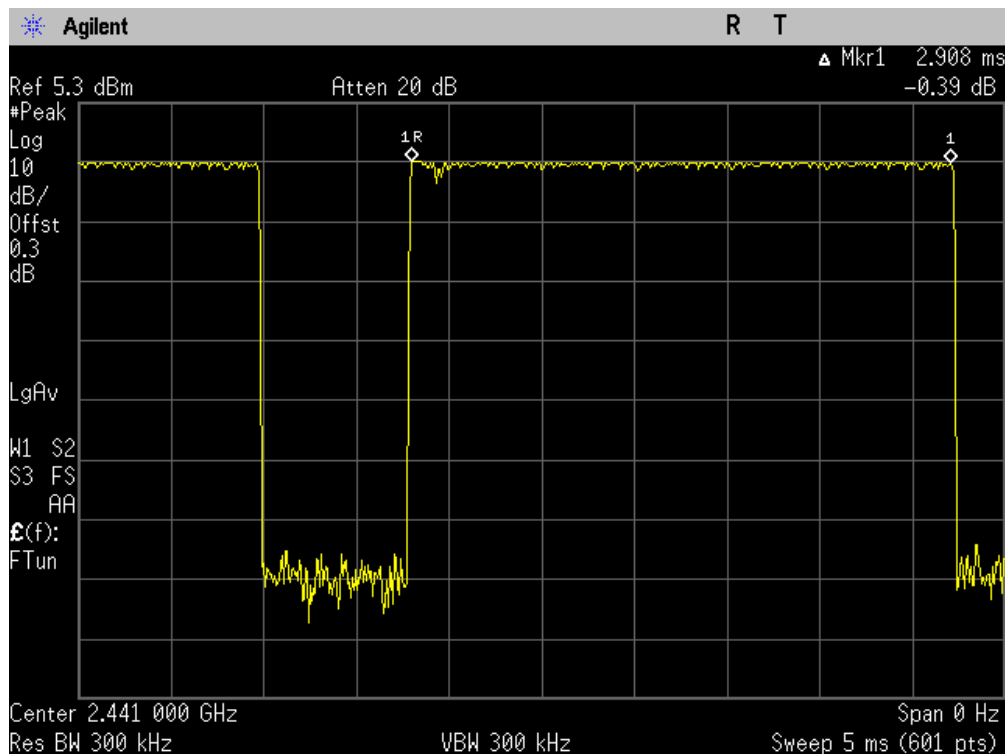
Modulation Mode	Pulse width (μ s)	Number of 3.16 second	¹⁾ Average time of Occupancy(s)	Margin (s)
GFSK	2908	10	0.29080	0.10200
8DPSK	2925	11	0.32175	0.07825

Notes:

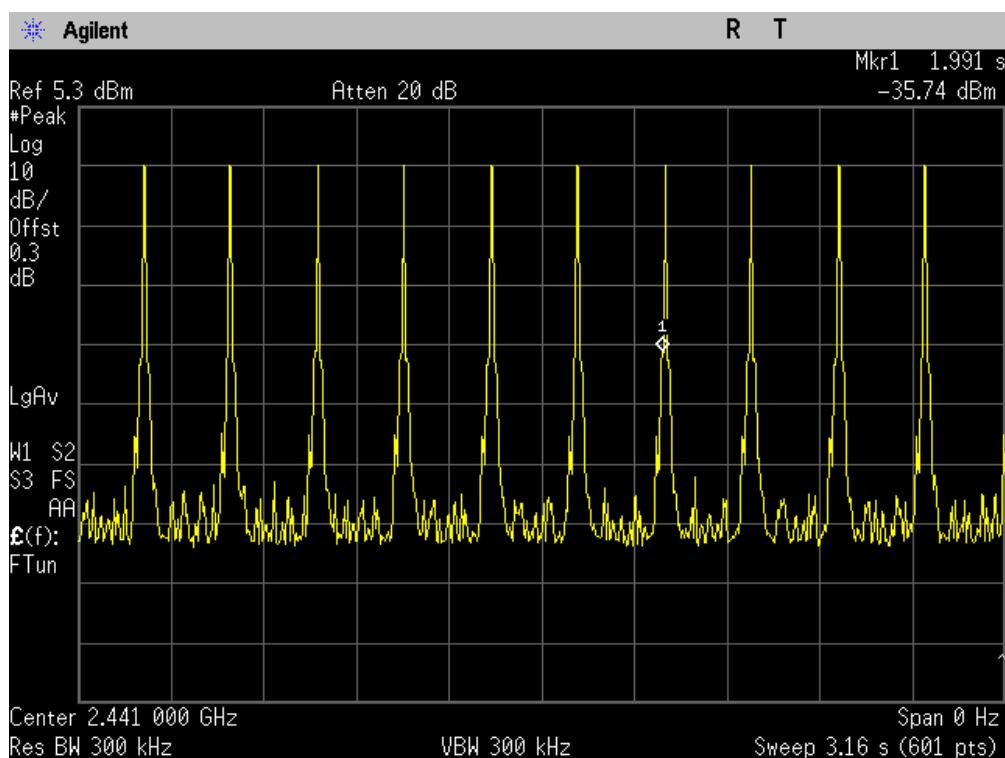
¹⁾ Average time of Occupancy = pulse width x Number of 3.16 sec x 10

PLOT OF TEST DATA

One pluse Width (GFSK Mode)

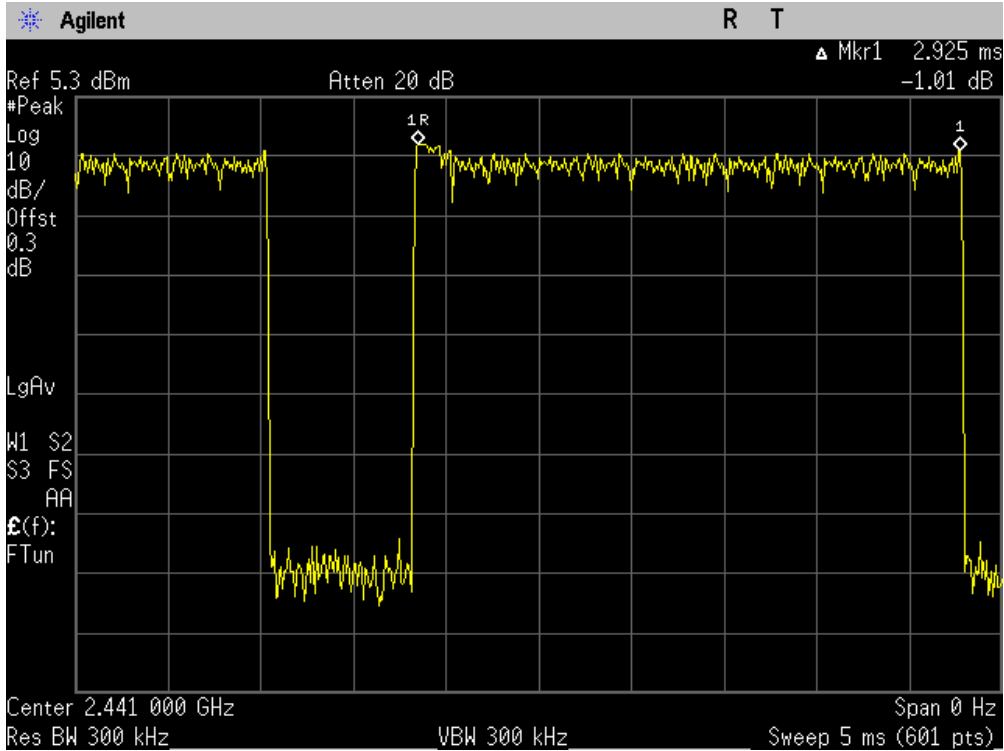


Number of pulses in 3.16 second period (GFSK Mode)

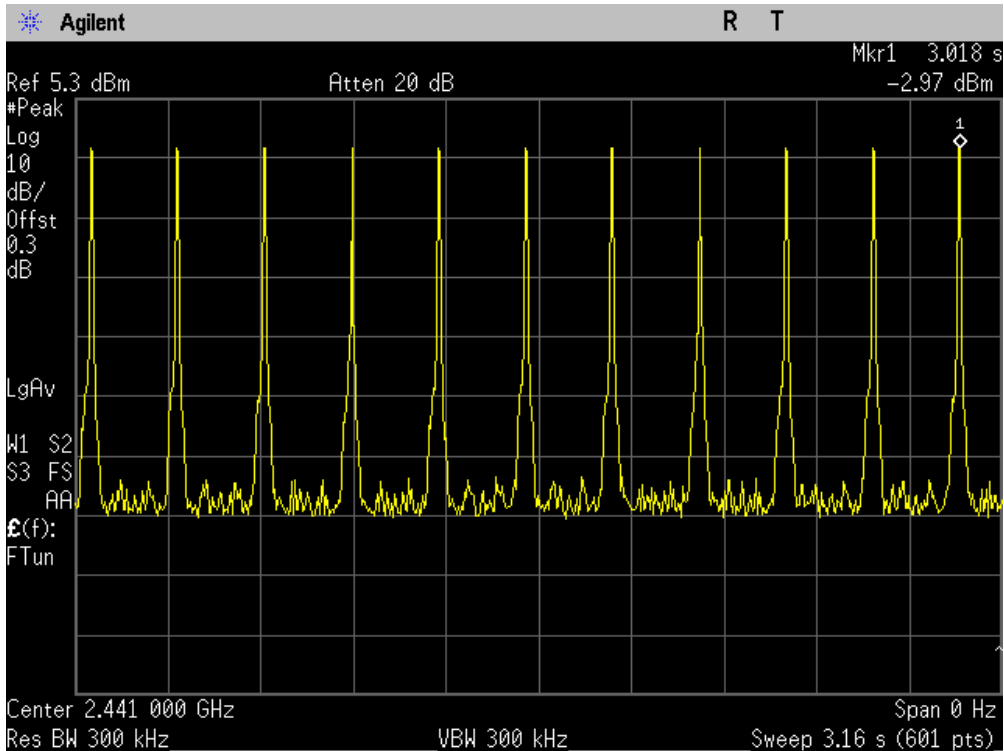


PLOT OF TEST DATA

One pluse Width (8DPSK Mode)



Number of pulses in 3.16 second period (8DPSK Mode)



TEST DATA

Number of Hopping Channels – 15.247(g)

FCC ID : A3LBT

Test Mode : Set to Hopping mode

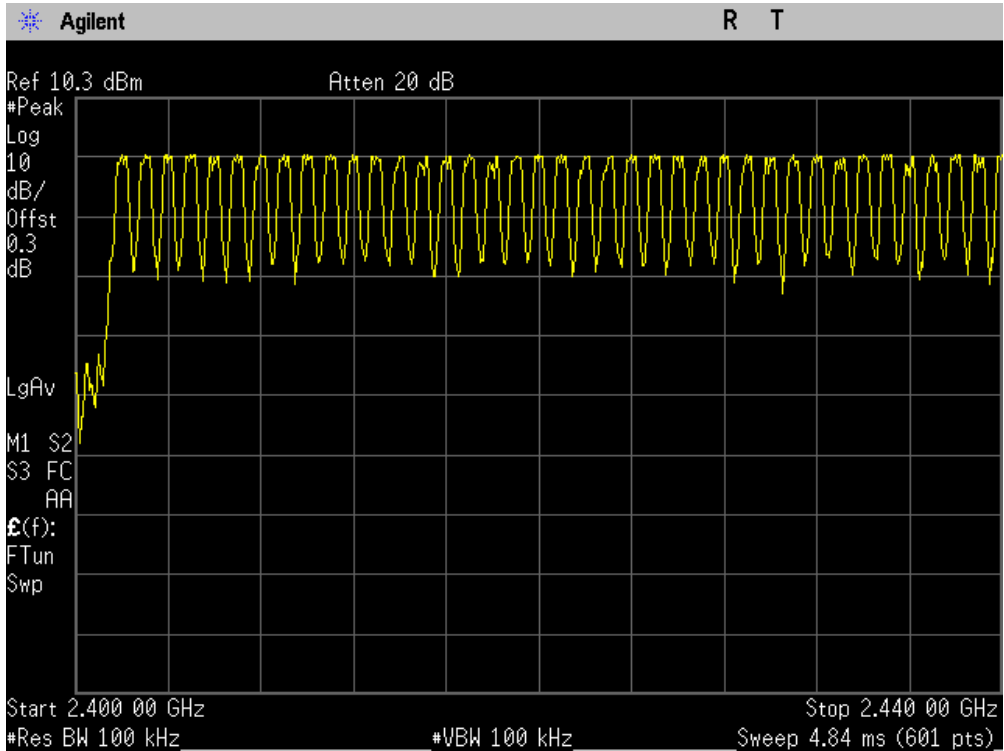
Result:

Total Hopping Channels = 38 + 41 = 79

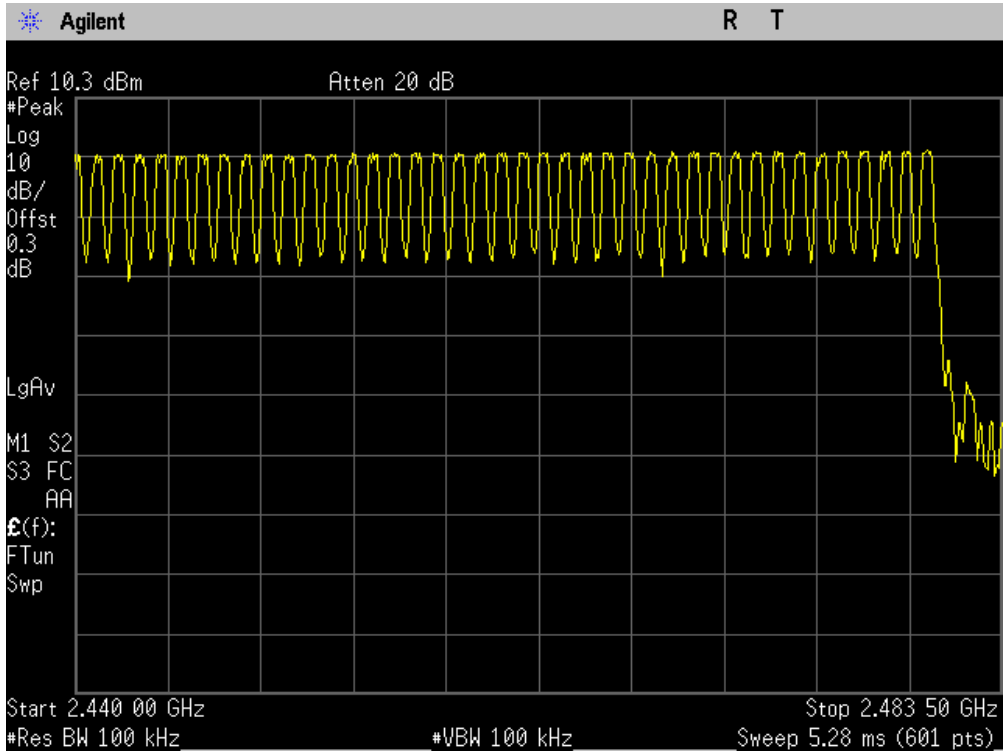
The EUT meets the specifications of Section 15.247(a)(1)(iii) for Number of Hopping Channels.

PLOT OF TEST DATA

Top half of Authorized band



Bottom half of Authorized band



TEST DATA

Peak Power Output – 15.247(b)

FCC ID : A3LBT

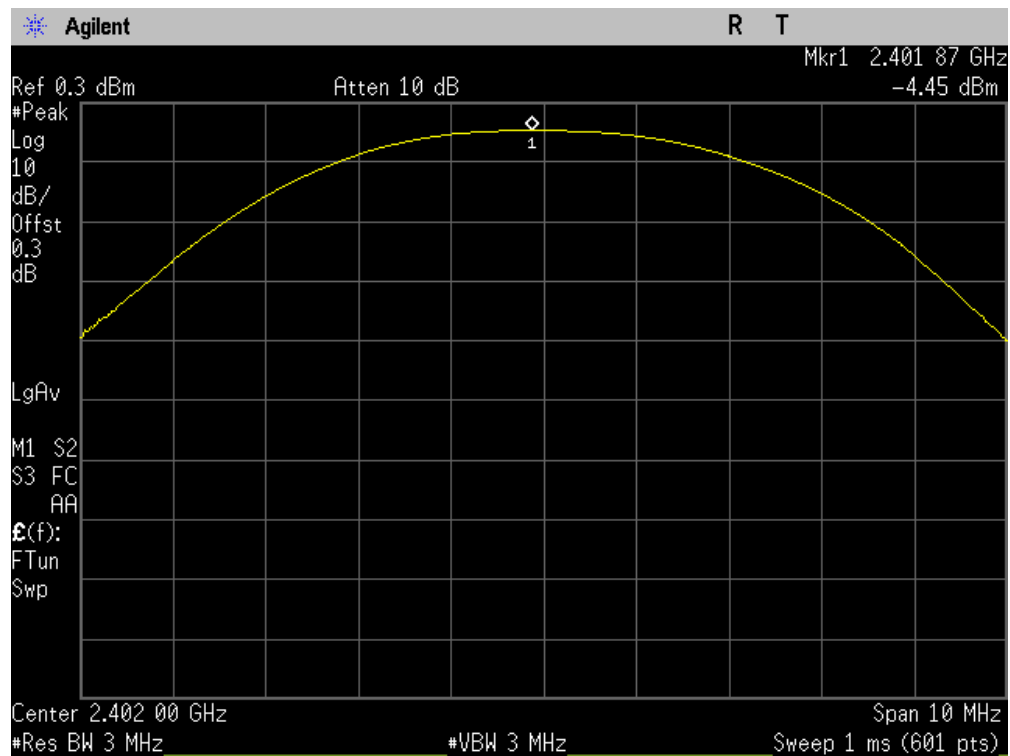
Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result:

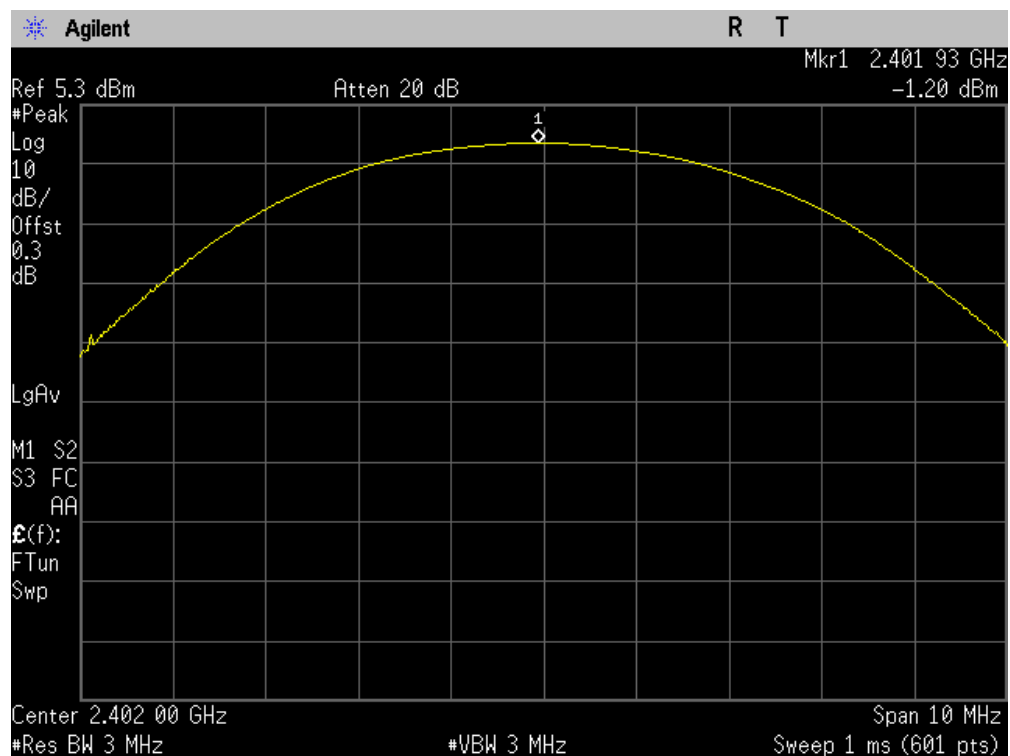
Modulation Mode	Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)
GFSK	2402	-4.45	4.21	-0.24	0.95
GFSK	2441	-4.51	4.21	-0.30	0.93
GFSK	2480	-4.01	4.21	0.20	1.05
8DPSK	2402	-1.20	4.21	3.01	2.00
8DPSK	2441	-1.25	4.21	2.96	1.98
8DPSK	2480	-0.69	4.21	3.52	2.25

PLOT OF TEST DATA

Output Power, Lowest Channel (2402 MHz, GFSK Mode)

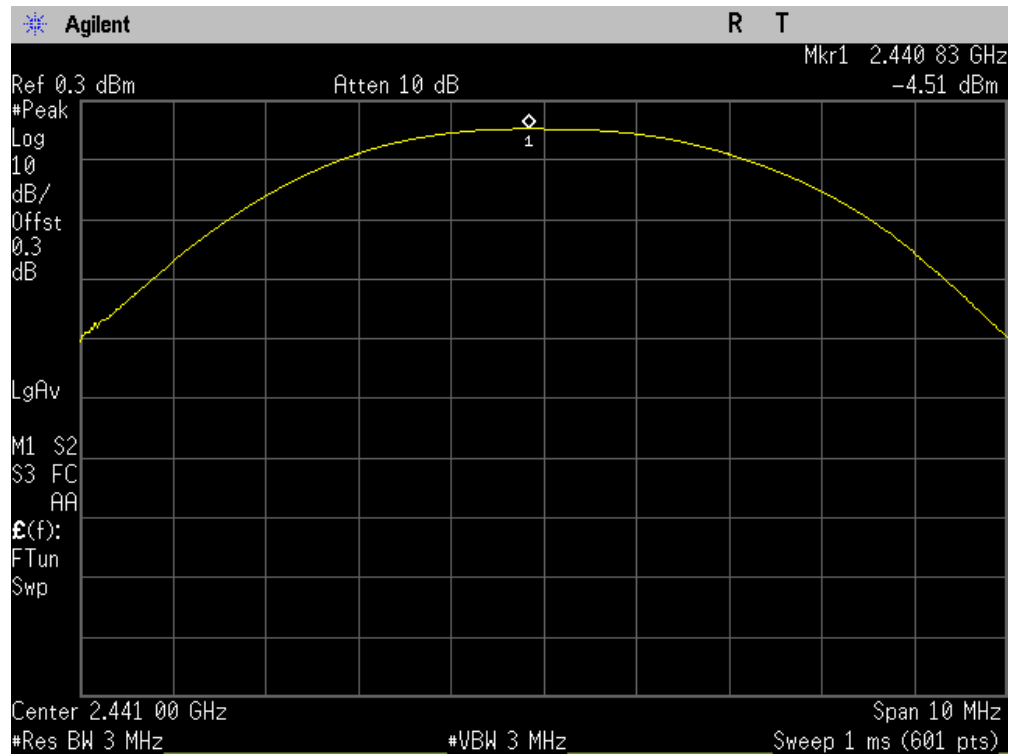


Output Power, Lowest Channel (2402 MHz, 8DPSK Mode)

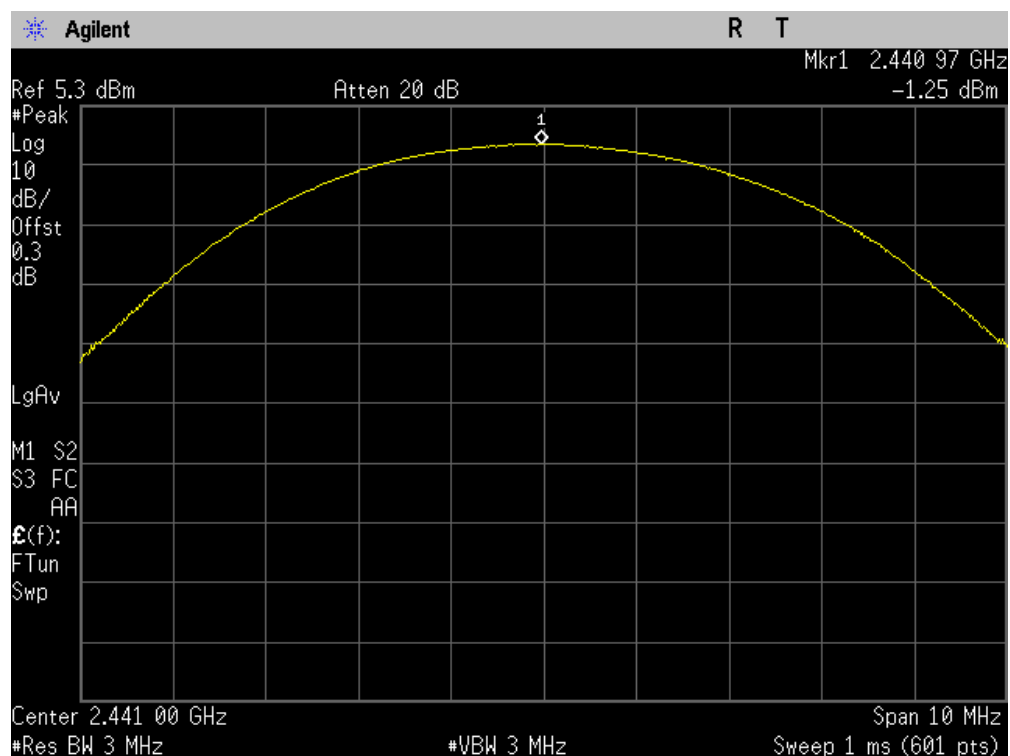


PLOT OF TEST DATA

Output Power, Middle Channel (2441 MHz, GFSK Mode)

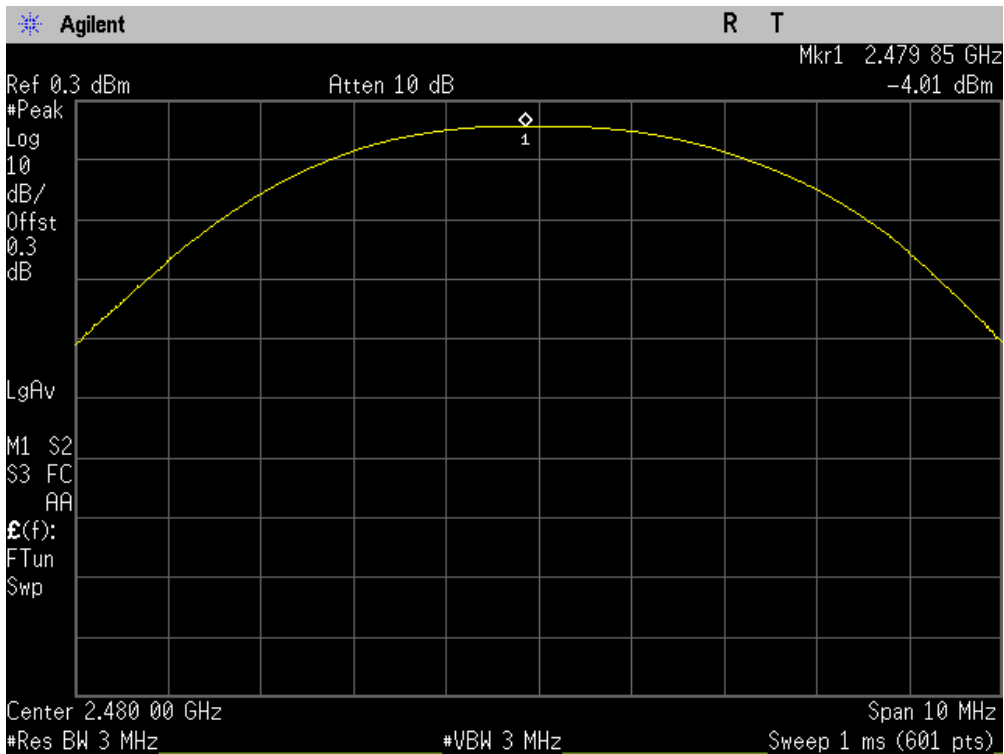


Output Power, Middle Channel (2441 MHz, 8DPSK Mode)

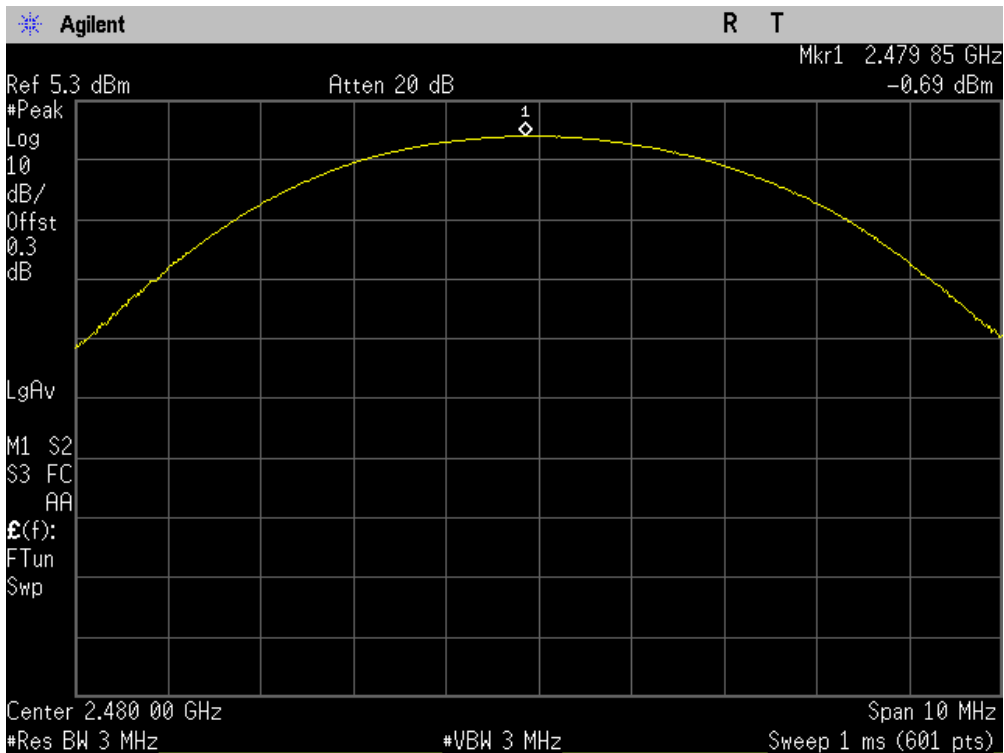


PLOT OF TEST DATA

Output Power, Highest Channel (2480 MHz, GFSK Mode)



Output Power, Highest Channel (2480 MHz, 8DPSK Mode)



TEST DATA

Conducted Spurious Emission – 15.247(d)

FCC ID : A3LBT

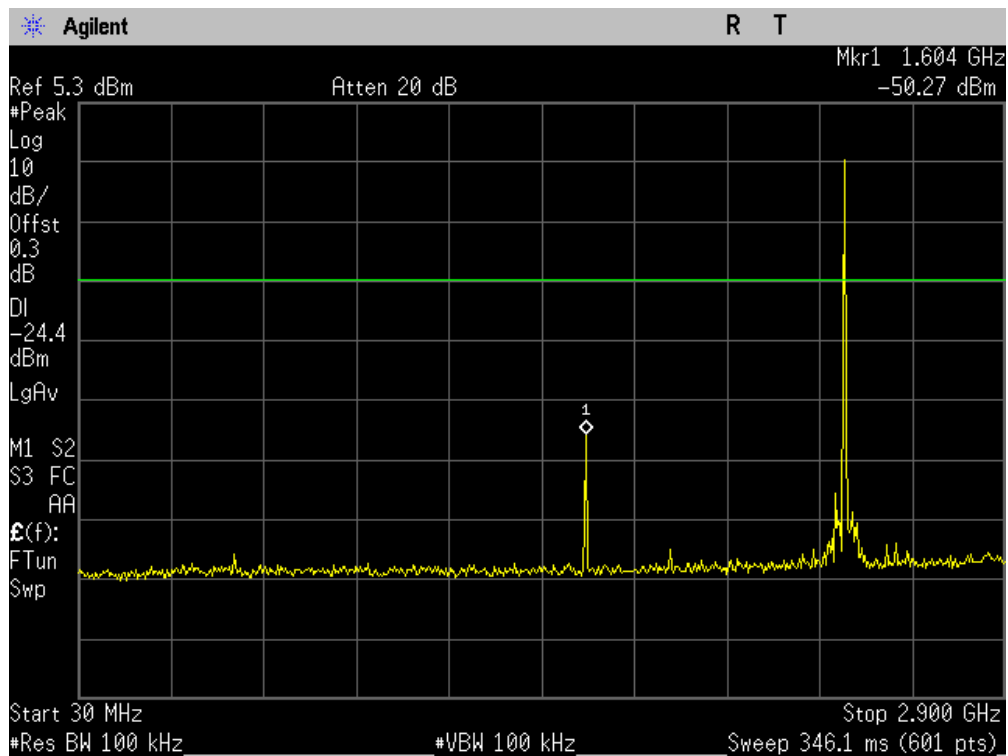
Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result:

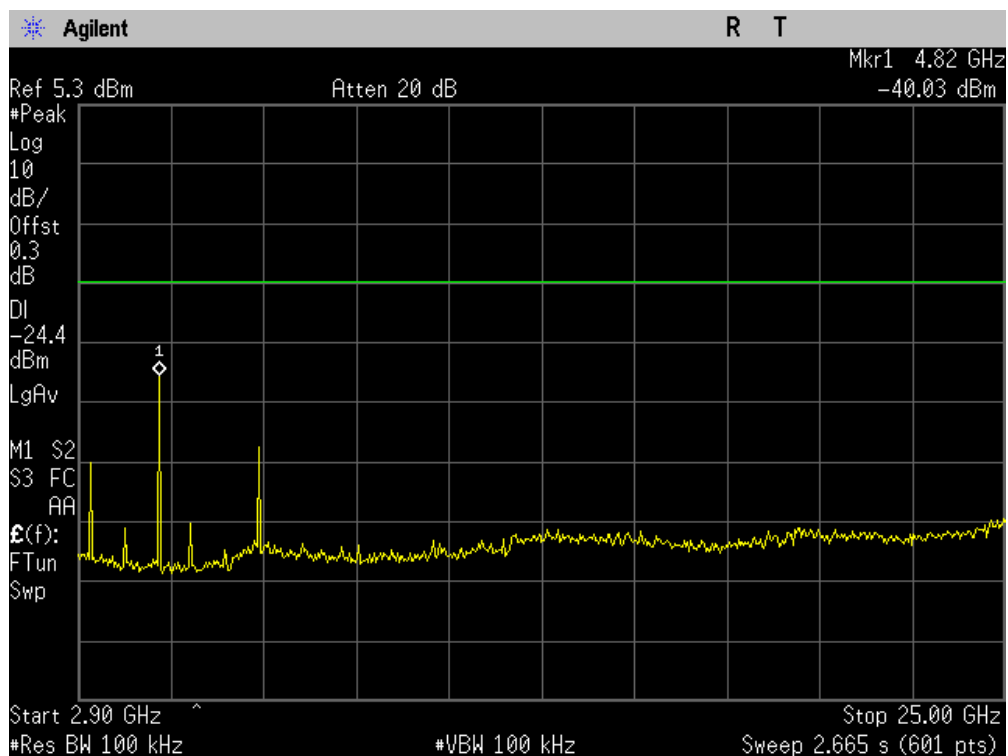
Modulation Mode	Frequency(MHz)	Result(dBc)	Limit(dBc)
GFSK	2402	More than 40 dBc	20
GFSK	2441	More than 40 dBc	20
GFSK	2480	More than 40 dBc	20
8DPSK	2402	More than 40 dBc	20
8DPSK	2441	More than 40 dBc	20
8DPSK	2480	More than 40 dBc	20

PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 2.9 GHz(2402 MHz, GFSK Mode)

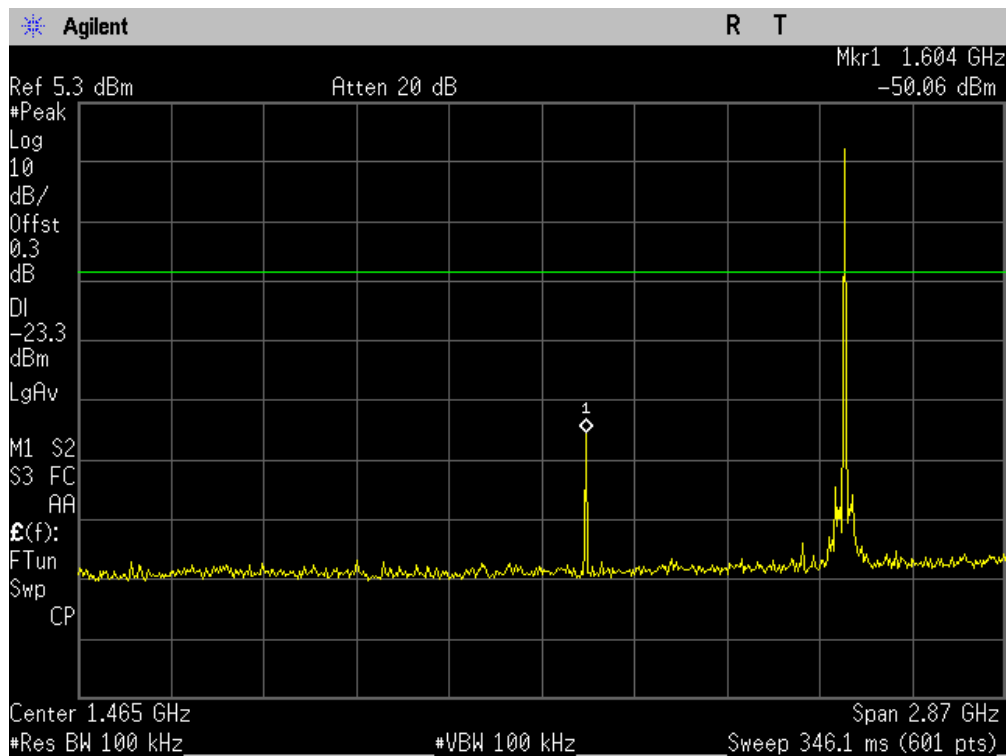


Conducted Spurious Emissions, 2.9 GHz ~ 25 GHz(2402 MHz, GFSK Mode)

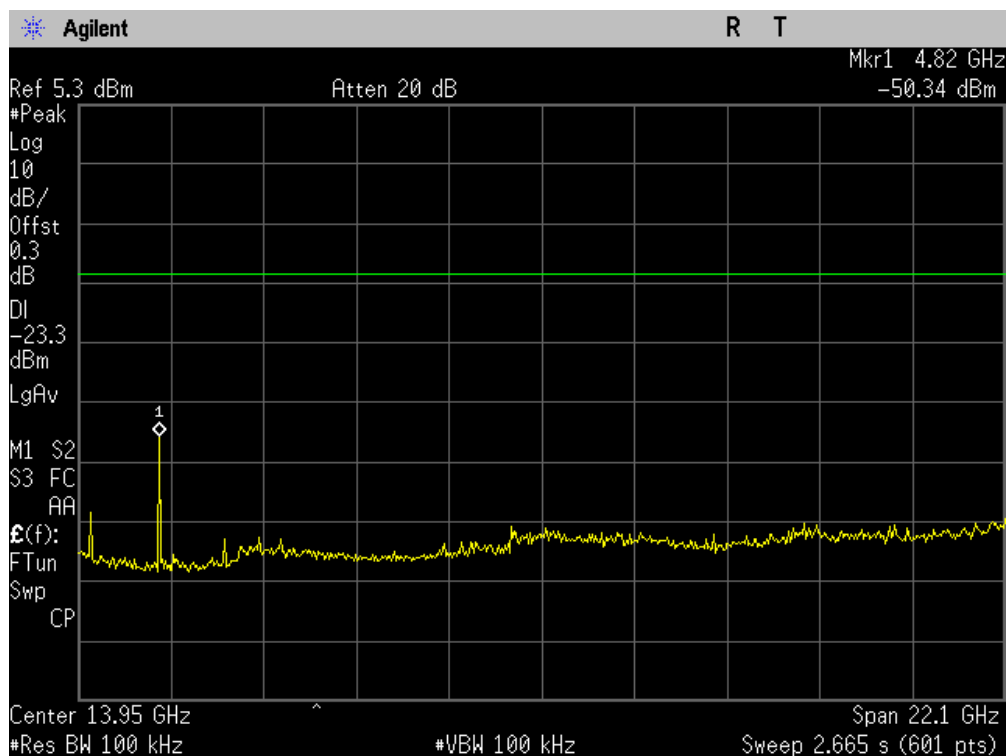


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 2.9 GHz(2402 MHz, 8DPSK Mode)

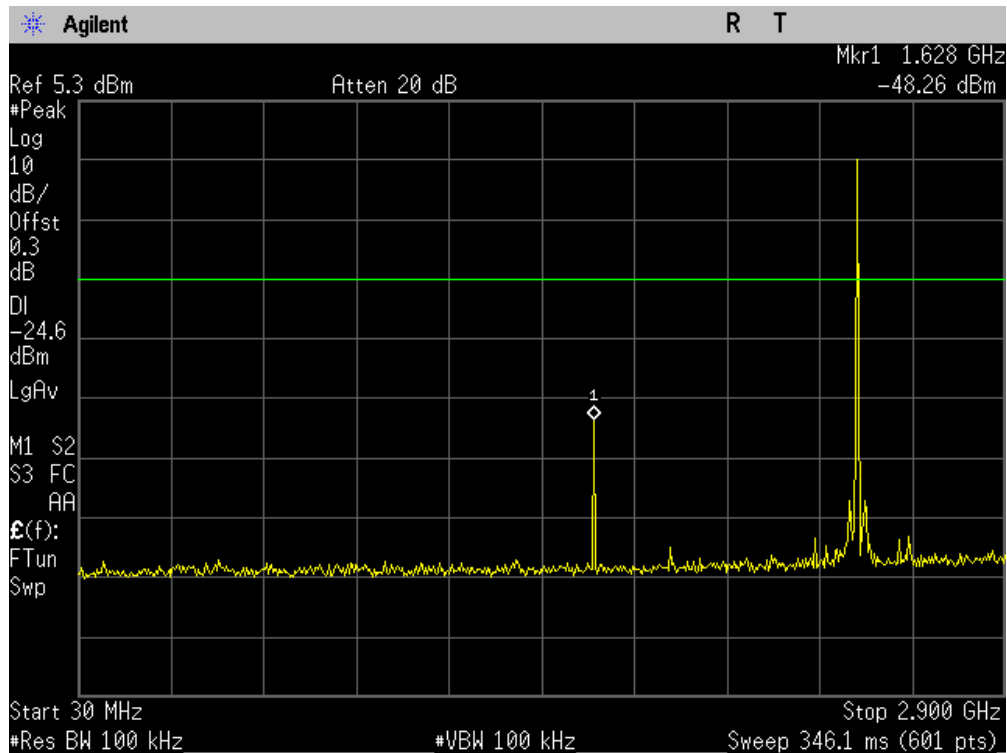


Conducted Spurious Emissions, 2.9 GHz ~ 25 GHz(2402 MHz, 8DPSK Mode)

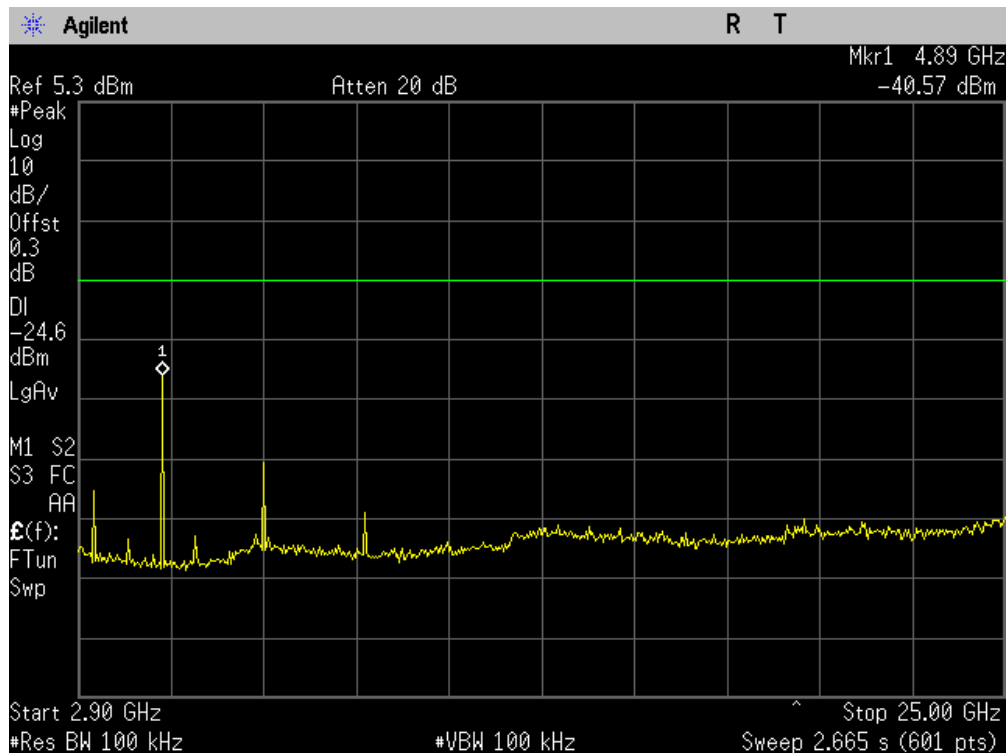


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 2.9 GHz(2441 MHz, GPSK Mode)

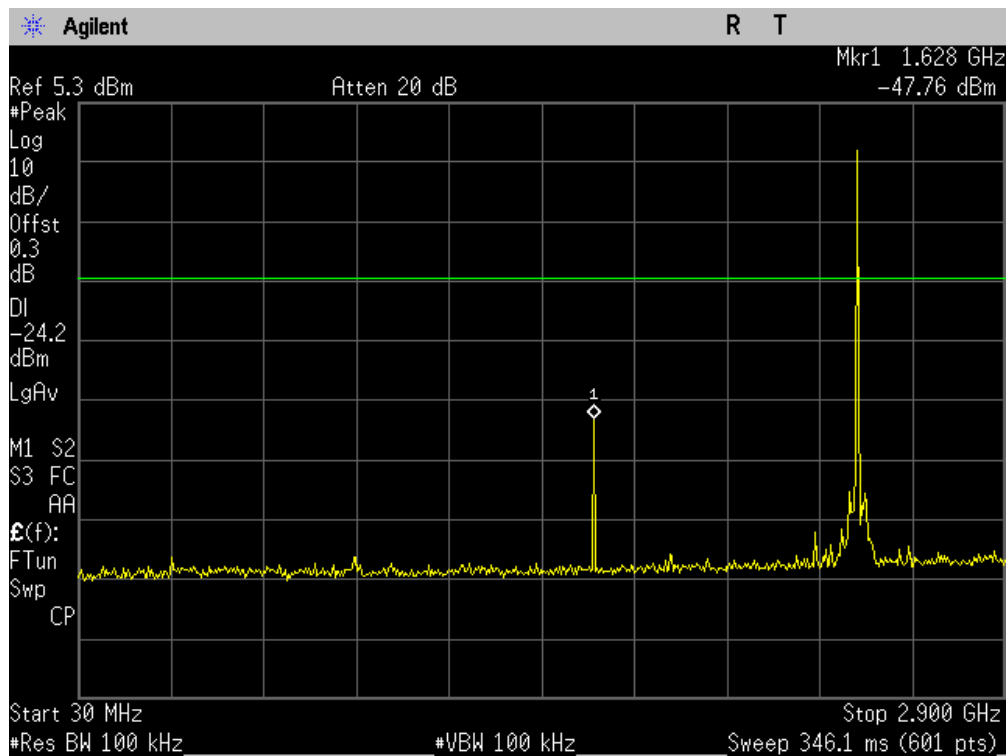


Conducted Spurious Emissions, 2.9 GHz ~ 25 GHz(2441 MHz, GPSK Mode)

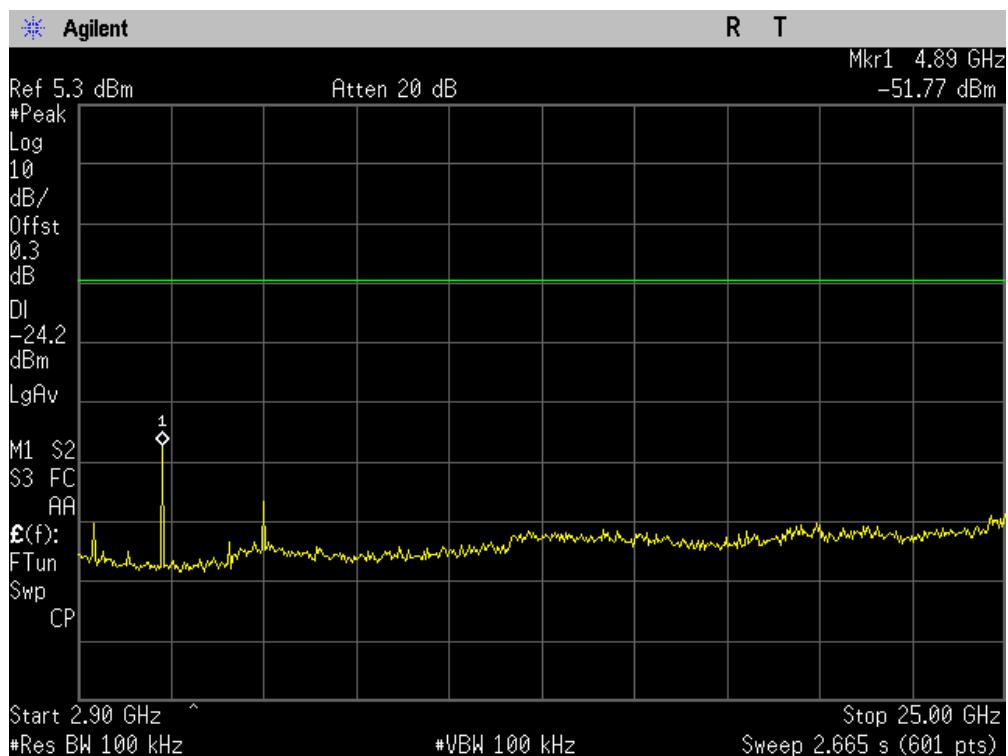


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 2.9 GHz(2441 MHz, 8DPSK Mode)

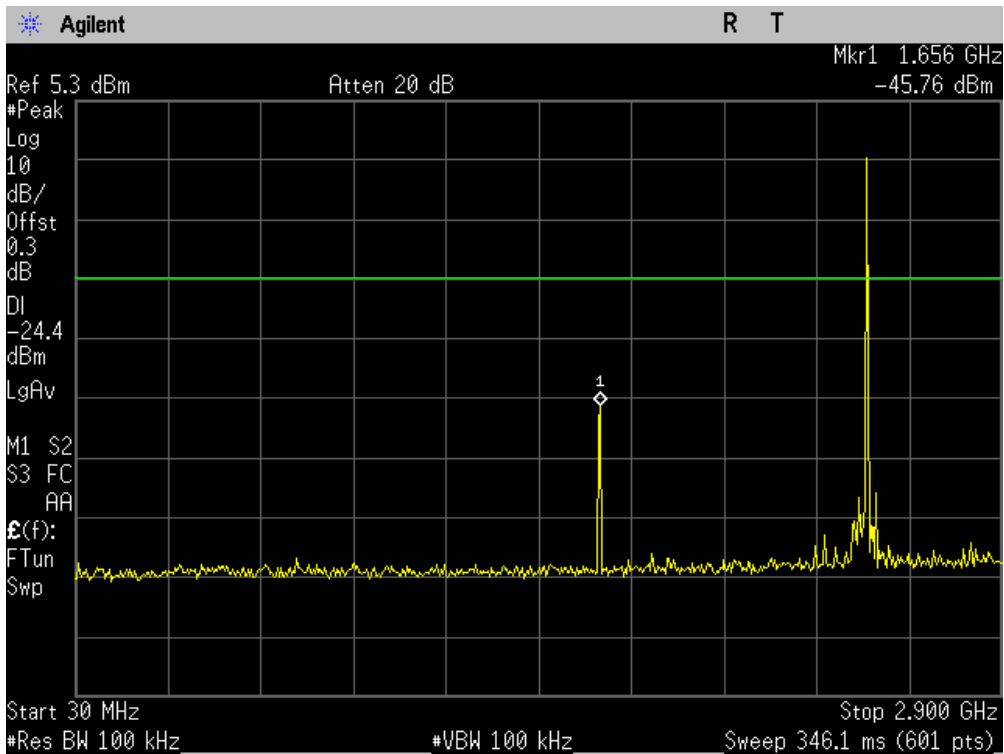


Conducted Spurious Emissions, 2.9 GHz ~ 25 GHz(2441 MHz, 8DPSK Mode)

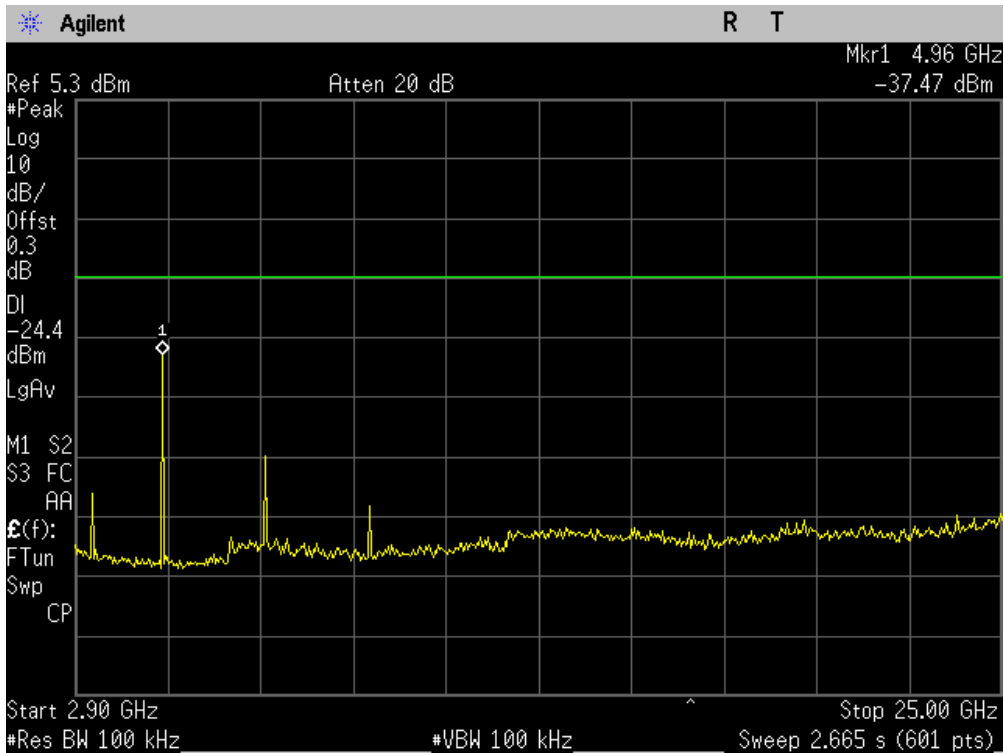


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 2.9 GHz(2480 MHz, GPSK Mode)

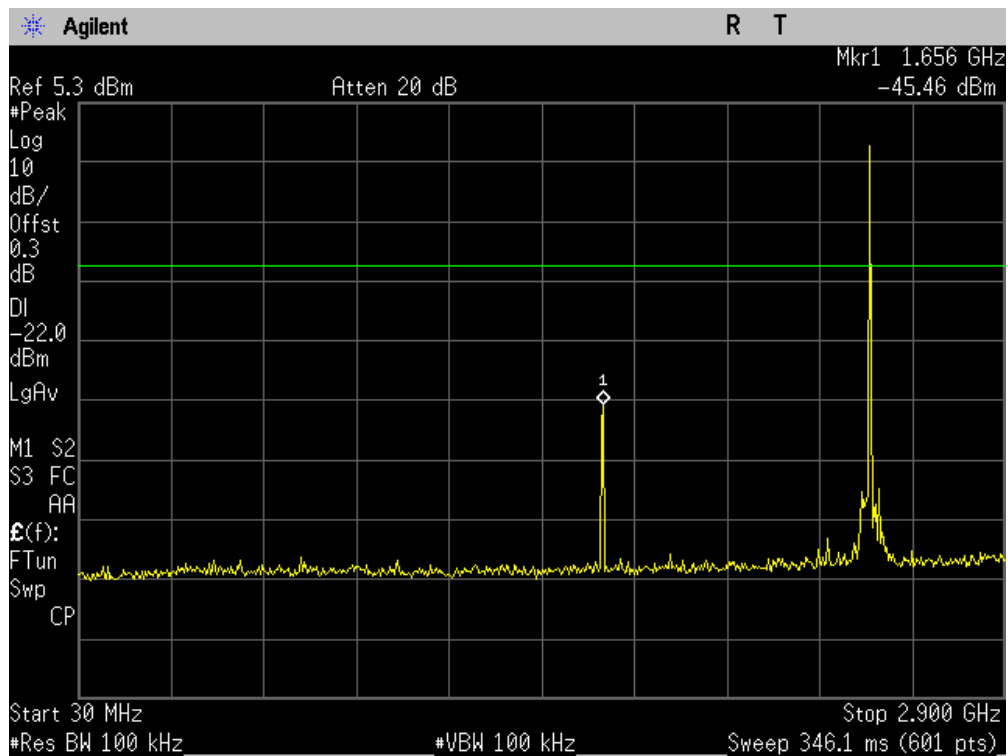


Conducted Spurious Emissions, 2.9 GHz ~ 25 GHz(2480 MHz, GPSK Mode)

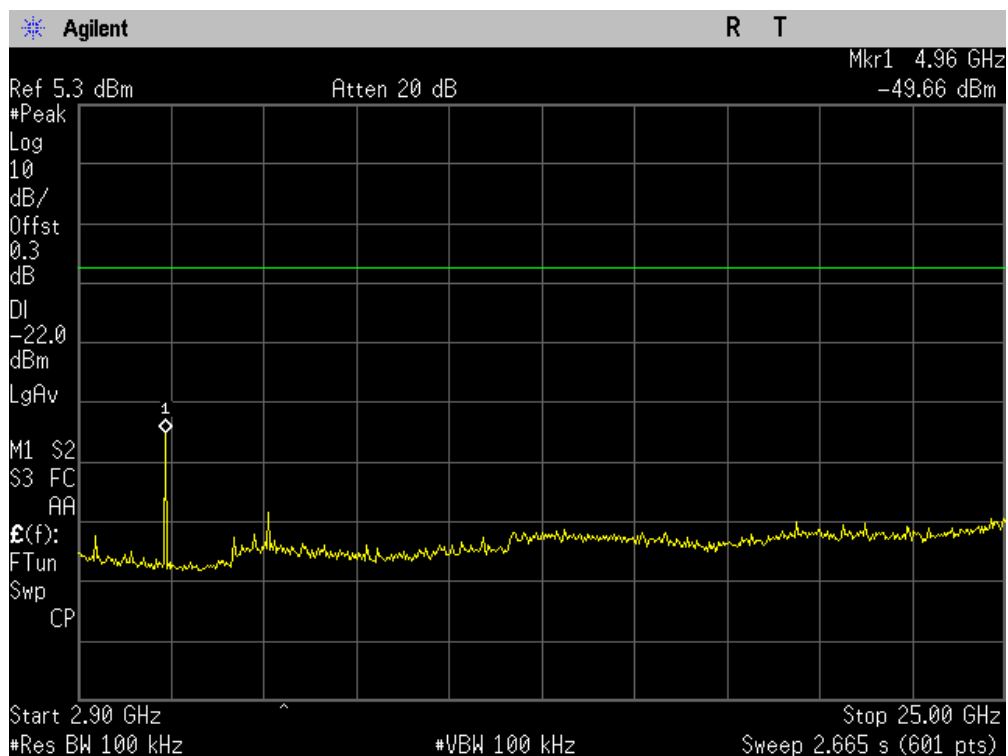


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 2.9 GHz(2480 MHz, 8DPSK Mode)

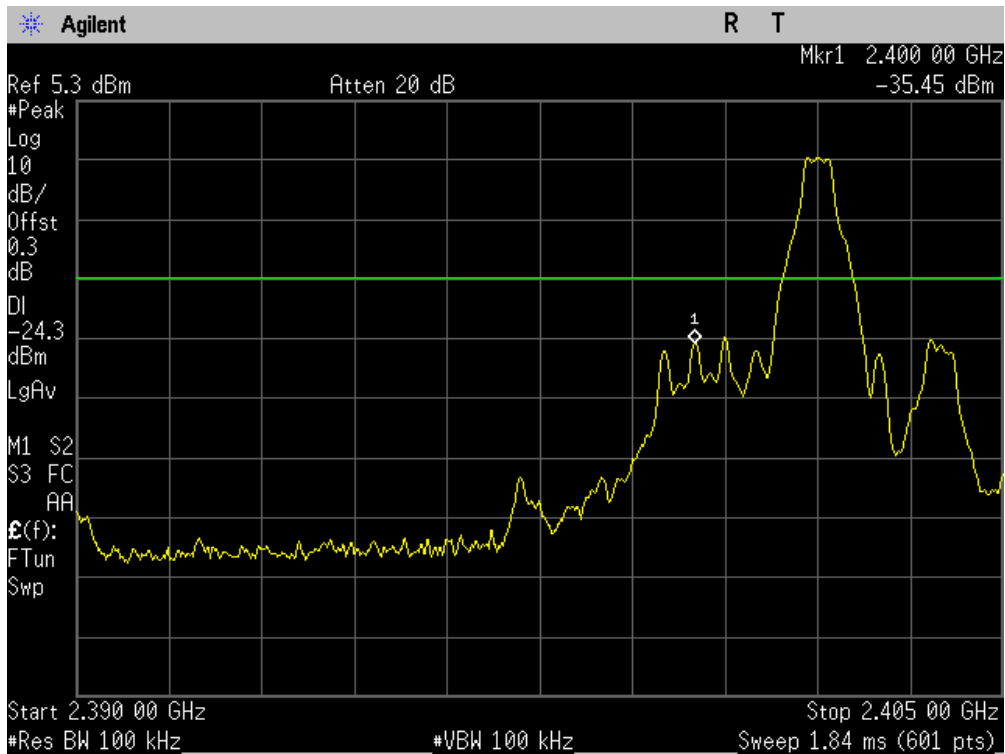


Conducted Spurious Emissions, 2.9 GHz ~ 25 GHz(2480 MHz, 8DPSK Mode)

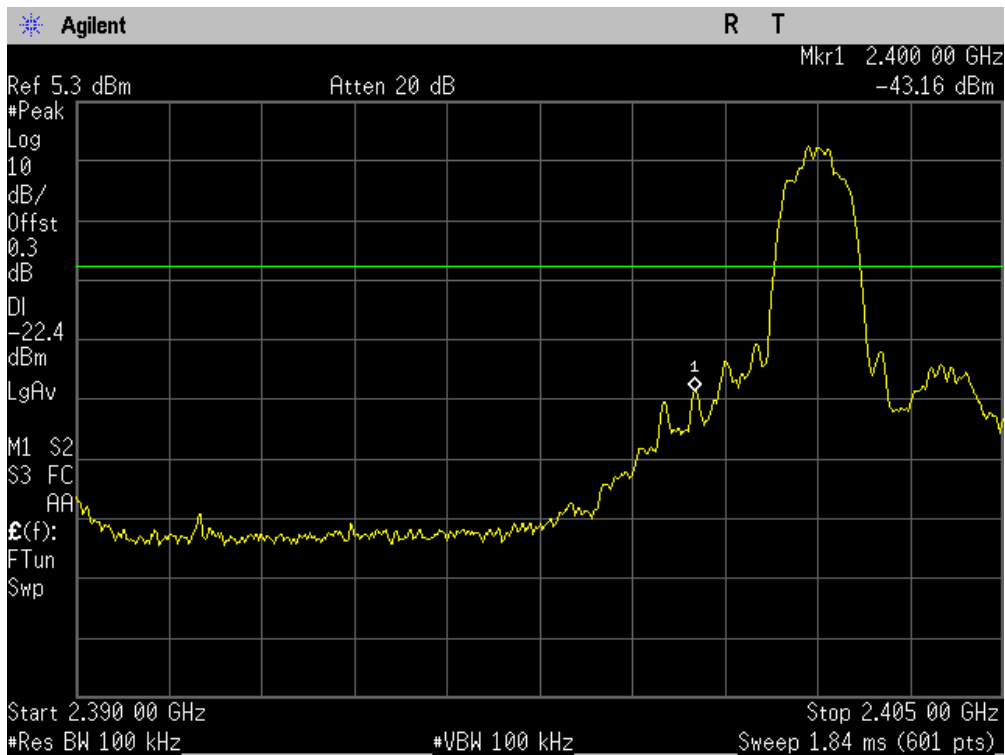


PLOT OF TEST DATA

Band Edge , Lowest Channel(2402 MHz, GFSK Mode)

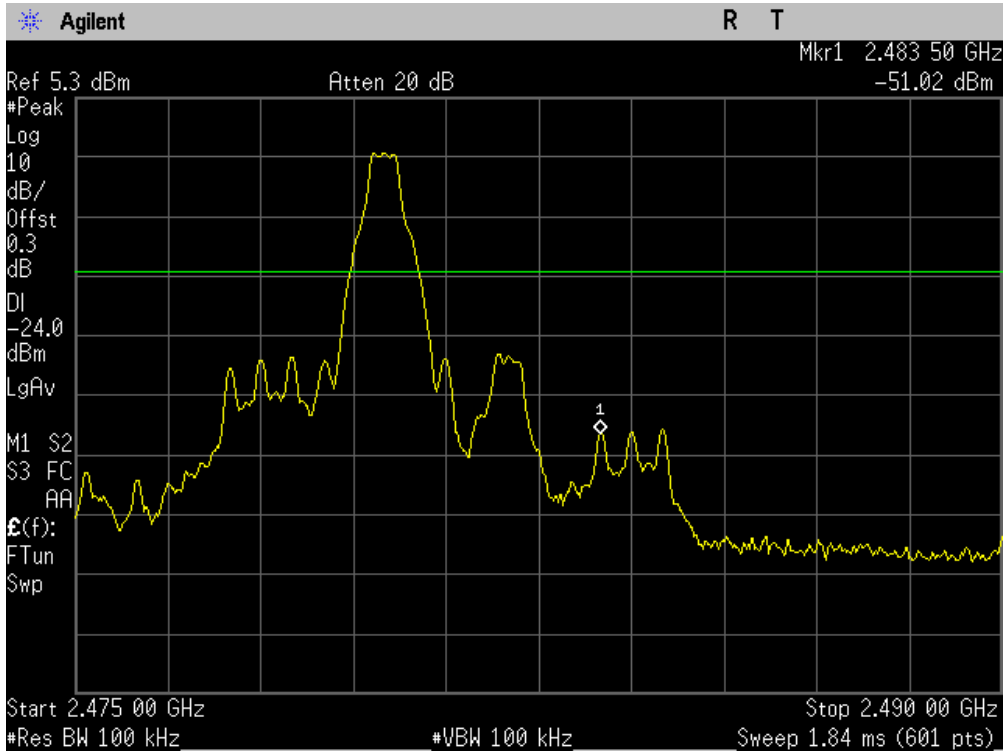


Band Edge , Lowest Channel(2402 MHz, 8DPSK Mode)

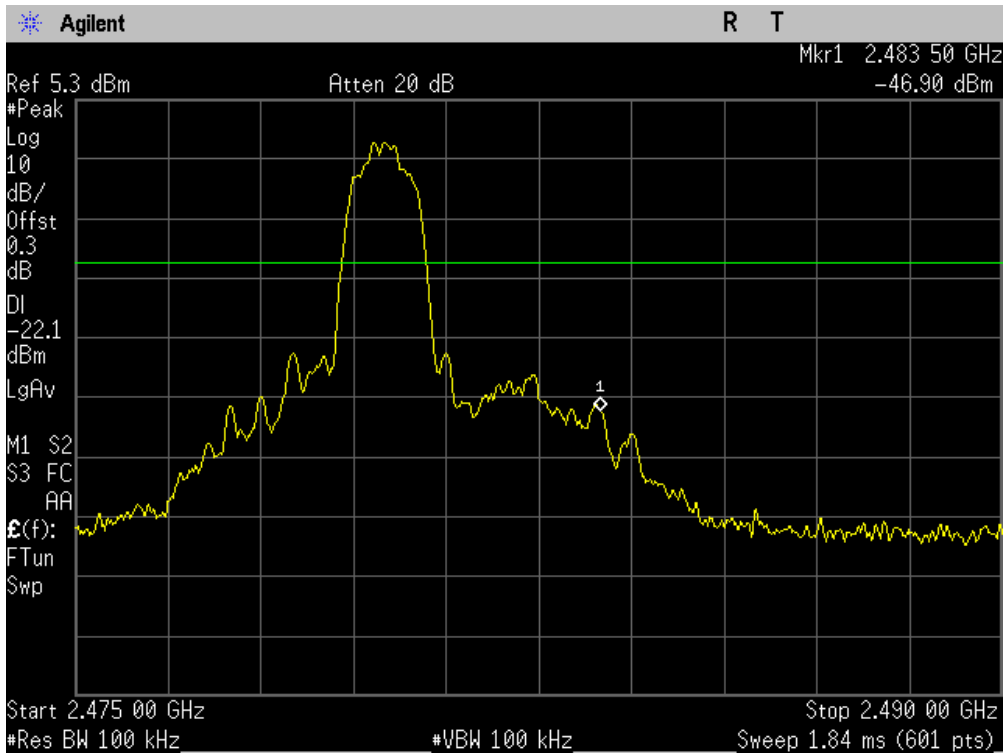


PLOT OF TEST DATA

Band Edge , Highest Channel(2480 MHz, GFSK Mode)



Band Edge , Highest Channel(2480 MHz, 8DPSK Mode)



TEST DATA

Radiated Spurious Emission – 15.247(d)

FCC ID : A3LBT

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result:

Lowest Channel

Frequency (MHz)	Reading (dB μV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dB μV /m)	Limit (dB μV /m)	Margin (dB)
4804	53.79	H	peak	9.95	63.7	74.0	10.26
4804	34.81	H	average	9.95	44.8	54.0	9.24
4804	53.92	V	peak	10.22	64.1	74.0	9.86
4804	36.26	V	average	10.22	46.5	54.0	7.52
7206	40.12	H	peak	10.48	50.6	74.0	23.40
7206	28.51	H	average	9.95	38.5	54.0	15.54
7206	41.38	V	peak	10.22	51.6	74.0	22.40
7206	28.99	V	average	10.22	39.2	54.0	14.79

Middle Channel

Frequency (MHz)	Reading (dB μV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dB μV /m)	Limit (dB μV /m)	Margin (dB)
4882	56.71	H	peak	4.96	61.7	74.0	12.33
4882	35.74	H	average	4.96	40.7	54.0	13.30
4882	55.93	V	peak	4.96	60.9	74.0	13.11
4882	35.95	V	average	4.96	40.9	54.0	13.09
7323	39.34	H	peak	11.96	51.3	74.0	22.70
7323	27.70	H	average	11.96	39.7	54.0	14.34
7323	39.95	V	peak	11.96	51.9	74.0	22.09
7323	28.27	V	average	11.96	40.2	54.0	13.77

TEST DATA

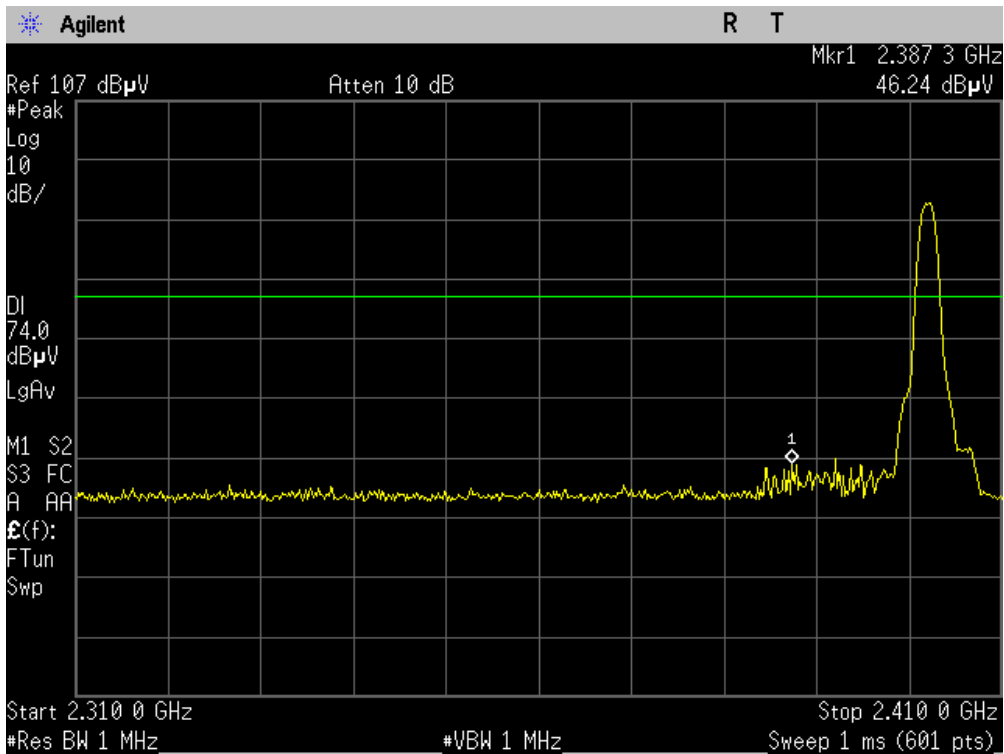
Highest Channel

Frequency (MHz)	Reading (dB μ V)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
4960	58.13	H	peak	4.59	62.7	74.0	11.28
4960	36.16	H	average	4.59	40.8	54.0	13.25
4960	58.31	V	peak	4.59	62.9	74.0	11.10
4960	37.21	V	average	4.59	41.8	54.0	12.20
7440	39.76	H	peak	11.90	51.7	74.0	22.34
7440	28.70	H	average	11.90	40.6	54.0	13.40
7440	39.86	V	peak	11.90	51.8	74.0	22.24
7440	28.16	V	average	11.90	40.1	54.0	13.94

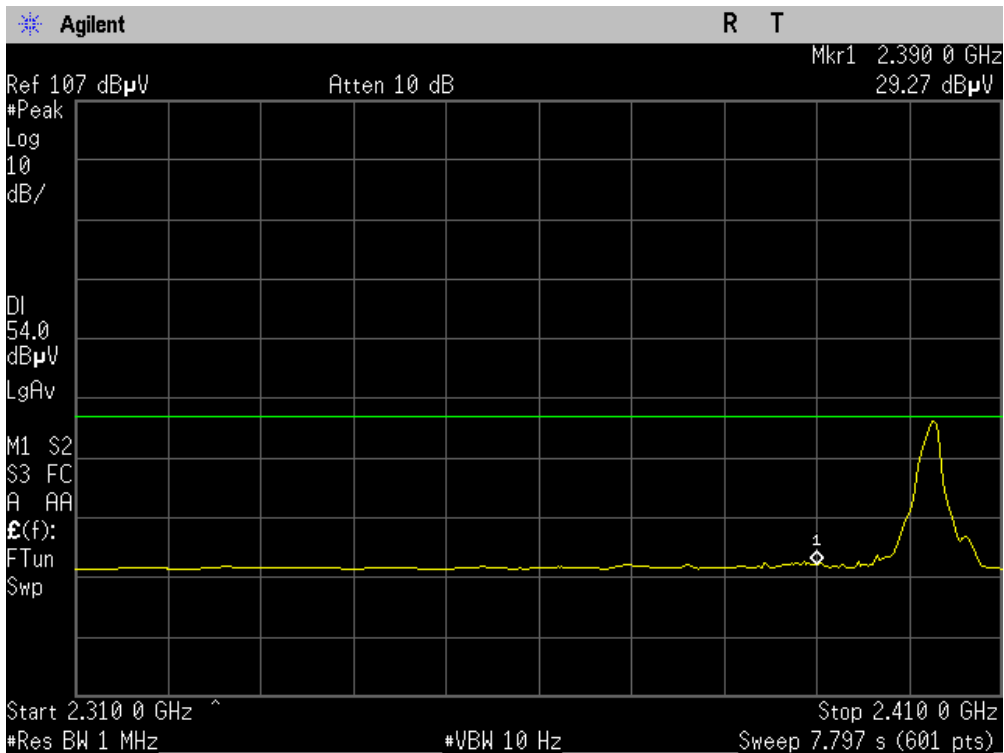
1. *Pol. H =Horizontal V=Vertical
2. **AF+CL+Amp. = Antenna Factor + Cable Loss + Amplifier.
3. Other spurious are under 20 dB below Fundamental.
4. GFSK modulation mode is the worst condition. All test are measured at the GFSK mode.

PLOT OF TEST DATA

Restricted Band Spurious Emissions, Lowest channel(Horizontal, Peak)

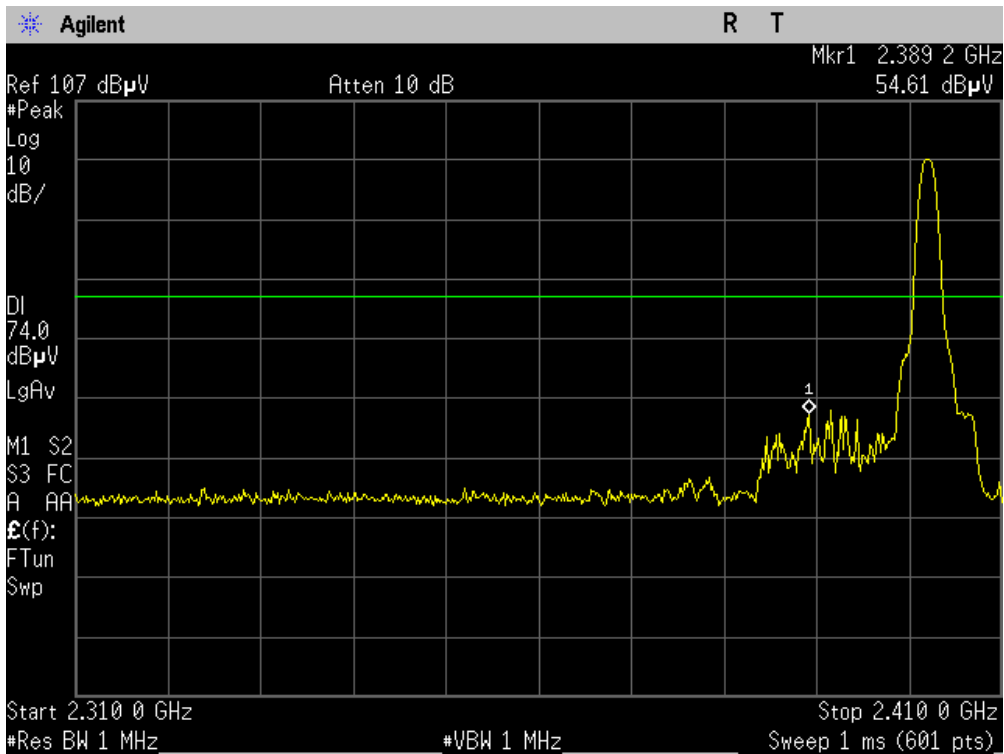


Restricted Band Spurious Emissions, Lowest channel(Horizontal, Average)

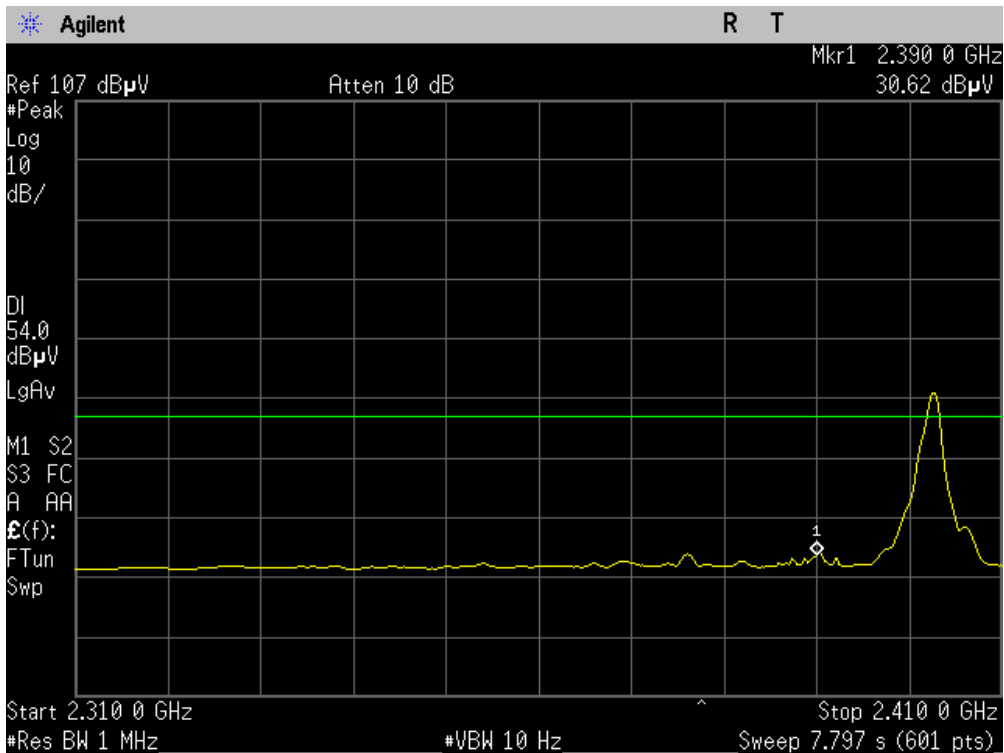


PLOT OF TEST DATA

Restricted Band Spurious Emissions, Lowest channel(Vertical, Peak)

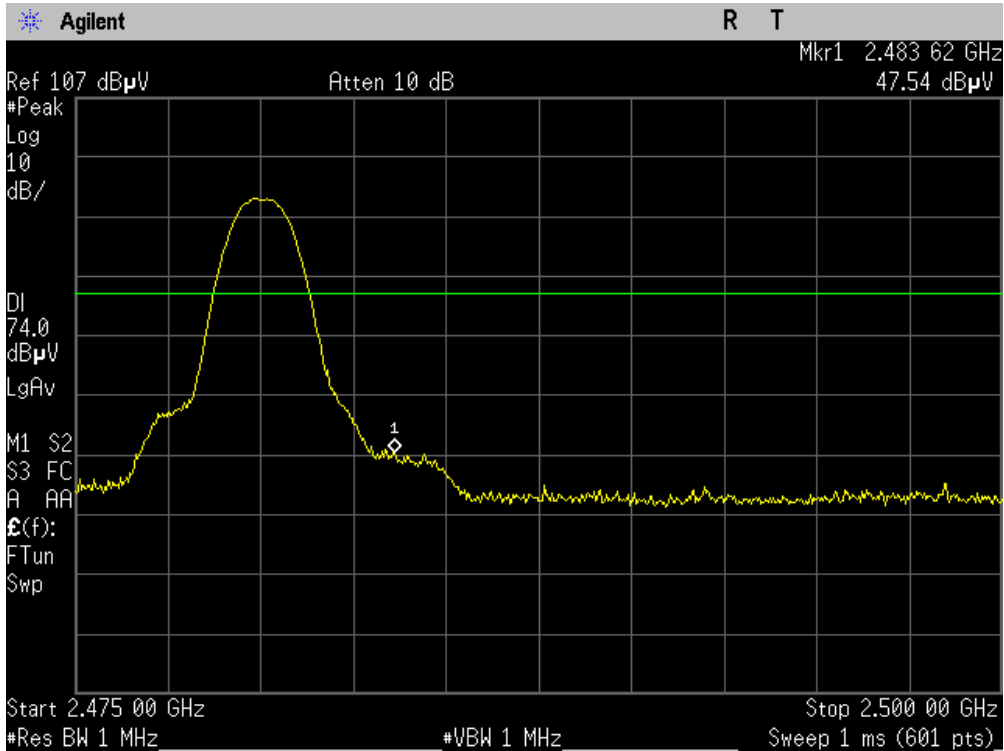


Restricted Band Spurious Emissions, Lowest channel(Vertical, Average)

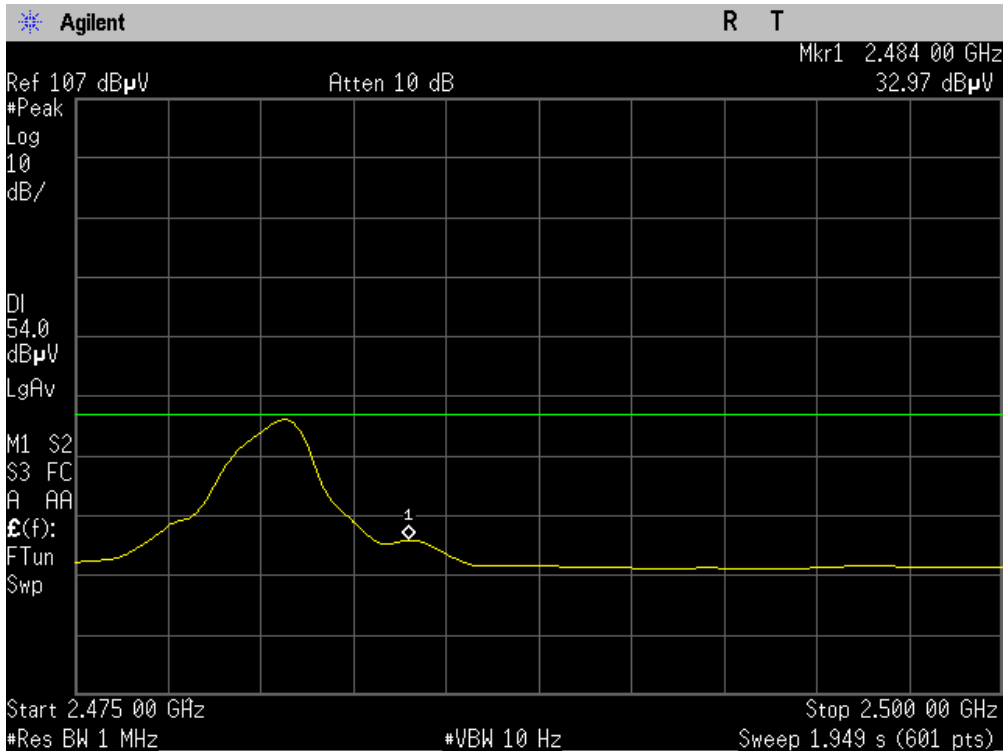


PLOT OF TEST DATA

Restricted Band Spurious Emissions, Highest channel(Horizontal, Peak)

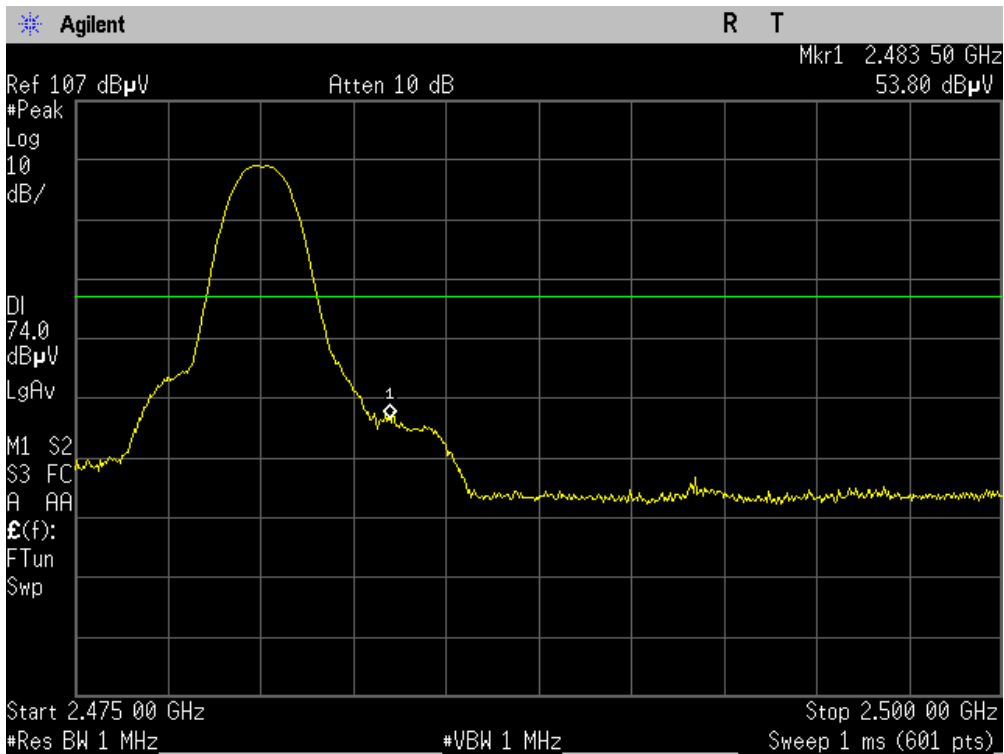


Restricted Band Spurious Emissions, Highest channel(Horizontal, Average)

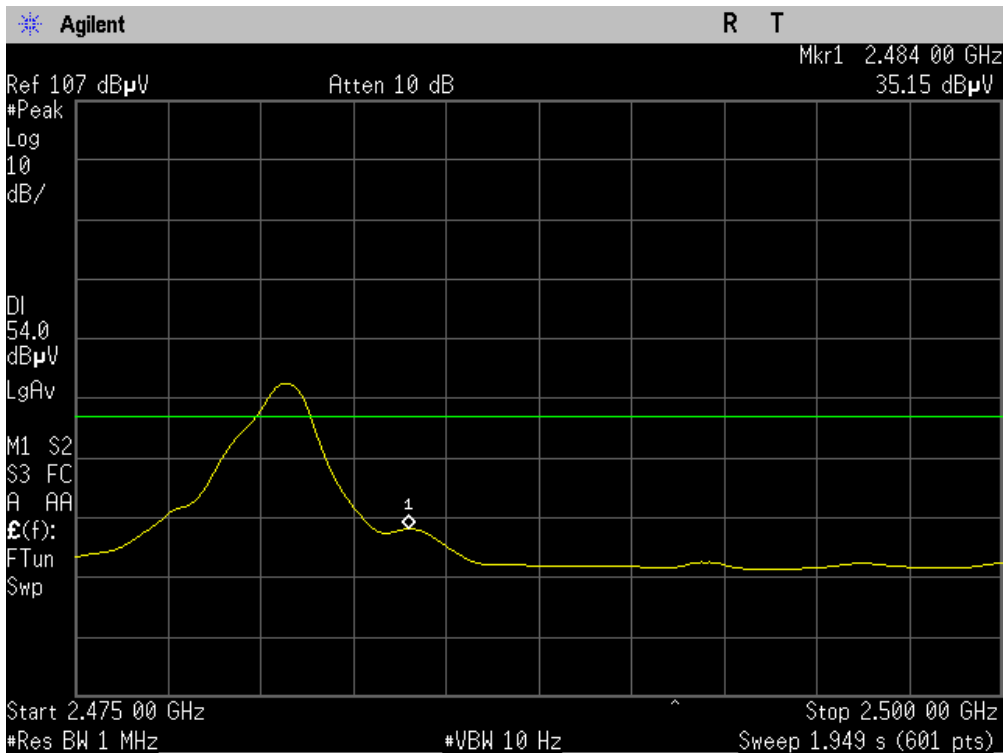


PLOT OF TEST DATA

Restricted Band Spurious Emissions, Highest channel(Vertical, Peak)



Restricted Band Spurious Emissions, Highest channel(Vertical, Average)



TEST DATA

Maximum Permissible Exposure

RF Exposure Limit

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the Environmental of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

Limits for Maximum Permissible Exposure (MPE)

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (Minutes)
(A) Limits for occupational / Contral Exposure				
30 - 300	61.4	0.163	1	6
300 - 1500	...	...	F/300	6
1500 - 100000	...	...	5	6
(B) Limits for General Population / Uncontrolled Exposure				
30 - 300	27.5	0.073	0.2	30
300 - 1500	...	...	F/1500	30
1500 - 100000	...	...	1	30

F = Frequency (MHz)

Fries formula

Fries transmission formula : $P_d = (P_{out} * G) / (4 * \pi * r^2)$

$$r = \sqrt{((P_{out} * G) / 4 * \pi * P_d)}$$

Where

P_d = Power density in mW/cm²

P_{out} = Output power to antenna in mW

G = Gain of antenna in linear scale

π = 3.1416

r = Distance between observation point center of the radiator in cm

P_d is the limit of MPE, 1 mW/cm². If we know the Maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

TEST DATA

Test Result

The maximum antenna gain is 4.21 dBi or 2.64(Numeric)

Output power into antenna and RF Exposure Distance

Modulation Mode	Frequency (MHz)	Output Power to Antenna (mW)	Antenna Gain (Numeric)	RF Exposure Distance (Cm)
GFSK	2402	0.36	2.64	0.27
GFSK	2441	0.35	2.64	0.27
GFSK	2480	0.40	2.64	0.29
8DPSK	2402	0.76	2.64	0.40
8DPSK	2441	0.75	2.64	0.40
8DPSK	2480	0.85	2.64	0.42

MPE Safe Distance =0.42 cm

ACCURACY OF MEASUREMENT

The Measurement Uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 with the confidence level of 95%

1. Radiation Uncertainty Calculation

Contribution	Probability Distribution	Uncertainty(+/-dB)
Antenna Factor	Normal (k=2)	± 0.5
Cable Loss	Normal (k=2)	± 0.04
Receiver Specification	Rectangular	± 2.0
Antenna directivity	Rectangular	± 1.0
Antenna Factor variation with Height		
Antenna Phase Center Variation		
Antenna Factor Frequency Interpolation		
Measurement Distance Variation		
Site Imperfections	Rectangular	± 2.0
Mismatch:Receiver VRC $r_i=0.3$ Antenna VRC $r_R=0.1(B_i)0.4(L_p)$ Uncertainty Limits $20\log(1+/-r_i r_R)$	U-Shaped	$+ 0.25 / - 0.26$
System Repeatibility	Std.deviation	± 0.05
Repeatability of EUT	-	-
Combined Standard Uncertainty	Normal	± 1.77
Expended Uncertainty U	Normal (k=2)	± 3.5

2. Conducted Uncertainty Calculation

Contribution	Probability Distribution	Uncertainty(+/-dB)
Receiver Specification	Normal (k=2)	± 2.0
LISN coupling spec.	Normal (k=2)	± 0.4
Cable and input attenuator cal.	Rectangular	± 0.4
Mismatch:Receiver VRC $r_i=0.3$ LISN vrc $r_g=0.1$ Uncertainty Limits $20\log(1+/-r_i r_R)$	U-Shaped	± 0.26
System Repeatibility	Std.deviation	± 0.68
Repeatability of EUT	-	-
Combined Standard Uncertainty	Normal	± 1.18
Expended Uncertainty U	Normal (k=2)	± 2.4

TEST EQUIPMENT

No.	Instrument	Manufacturer	Model	Calibration Date	Calibration Interval
1	*Test Receiver	R & S	ESCS 30	2006.08	1 year
2	*Test Receiver	R & S	ESCS 30	2006.12	1 year
3	*Amplifier	HP	8447F	2006.08	1 year
4	*Amplifier	HP	8447F	2006.10	1 year
5	*Amplifier	HP	8449F	2006.03	1 year
6	*Spectrum Analyzer	HP	8568B	2006.10	1 year
7	*Spectrum Analyzer	Agilent	E4440A	2006.11	1 year
8	Spectrum Analyzer	HP	8593E	2006.12	1 year
9	*Biconical Antenna Log	ARA	LPB-2520/A	2006.05	1 year
10	*DC Power Supply	HP	6574A	2006.08	1 year
11	*Horn Antenna	Schwarzbeck	BBHA 9120D	2006.10	1 year
12	*Signal Generator	Anritsu	68245B	2006.12	1 year
13	*Signal Generater	HP	E4436B	2006.12	1 year
14	*LISN	R & S	ESH3-Z5	2006.11	1 year
15	*LISN	Kyoritsu	KNW-407	2006.03	1 year
16	*Position Controller	EM Eng.	N/A	N/A	N/A
17	*Turn Table	EM Eng.	N/A	N/A	N/A
18	*Antenna Mast	EM Eng.	N/A	N/A	N/A
19	*Anechoic Chamber	EM Eng.	N/A	N/A	N/A
20	*Shielded Room	EM Eng.	N/A	N/A	N/A
21	*DC Power Supply	UNICON	UP-100DT	2006.12	1 year

*) Test equipment used during the test