TEST REPORT

Applicant:	WOW Technologies (Singapore) Pte Ltd
Address of Applicant:	62 Burn Road #06-01 TSH Centre Singapore
Manufacturer:	WOW Technologies (Singapore) Pte Ltd
Address of Manufacturer:	62 Burn Road #06-01 TSH Centre Singapore
Product name:	TOWER SPEAKERS
Model:	TOWER SPEAKERS, TW-22
Rating(s):	Input: 120 Vac, 60 Hz
Trademark:	NAKAMICHI (For model TOWER SPEAKERS), HAIYA (For model TW-22)
Standards:	FCC Part 15.247 :2016
FCC ID:	2AGB6TWSPK
Date of Receipt:	2016-07-27
Date of Test:	2016-07-27~2016-08-04
Date of Issue:	2016-08-05
Test Result	**Pass***

* In the configuration tested, the test item complied with the standards specified above.

Authorized for issue by:

Test by:			***Reviewed by:***		
Aug.05, 2016	Eleven Liang Project Engineer	Eleven Liang	Aug.05, 2016	Pauler Li Project Manager	Pauler Li
Date	*Name/Position*	*Signature*	*Date*	*Name/Position*	*Signature*

Possible test case verdicts:	
test case does not apply to the test object ..:	N/A
test object does meet the requirement .....:	P (Pass)
test object does not meet the requirement ..:	F (Fail)

Testing Laboratory information:

Testing Laboratory Name ..... :	I-Test Laboratory
Address.....:	1-2 floor, South Block, Building A2 , No 3 Keyan Lu, Science City, Guangzhou, Guangdong Province, P.R. China
Testing location :	Same as above
Tel :	0086-20-32209330
Fax :	0086-20-62824387
E-mail :	itl@i-testlab.com

General remarks:

The test results presented in this report relate only to the object tested.

The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.

This report would be invalid test report without all the signatures of testing technician and approver.

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

General product information:

The models TOWER SPEAKERS and TW-22 are identical to each other except for model designation. All tests were performed on the model TOWER SPEAKERS as representative.

1 Test Summary

Test	Test Requirement	Test method	Result
Antenna Requirement	FCC PART 15 C section 15.247 (c) and Section 15.203	FCC PART 15 C section 15.247 (c) and Section 15.203	PASS
Occupied Bandwidth (99% and -20dB)	FCC PART 15 C section 15.247 (a)(1);	ANSI C63.10:2013 Clause 6.9	PASS
Carrier Frequencies Separated	FCC PART 15 C section 15.247(a)(1);	ANSI C63.10:2013	PASS
Hopping Channel Number	FCC PART 15 C section 15.247(a)(1)(iii)	ANSI C63.10:2013	PASS
Dwell Time	FCC PART 15 C section 15.247(a)(1)(iii);	ANSI C63.10:2013	PASS
Maximum Peak Output Power	FCC PART 15 C section 15.247(b)(1);	ANSI C63.10:2013 Clause 6.10	PASS
Conducted Spurious Emission (30 MHz to 25 GHz)	FCC PART 15 C section 15.247(d);	ANSI C63.10:2013 Clause 6.7	PASS
Radiated Spurious Emission (9 kHz to 25 GHz)	FCC PART 15 C section 15.247(d);	ANSI C63.10:2013 Clause 6.4,6.5 and 6.6	PASS
Band Edges Measurement	FCC PART 15 C section 15.247 (d) &15.205	ANSI C63.10:2013 Clause 6.9	PASS
Conducted Emissions at Mains Terminals	FCC PART 15 C section 15.207;	ANSI C63.10:2013 Clause 6.2	PASS

Remark:

N/A: not applicable. Refer to the relative section for the details.
EUT: In this whole report EUT means Equipment Under Test.
Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
RF: In this whole report RF means Radio Frequency.
ANSI C63.10:2013 the detail version is ANSI C63.10:2013 in the whole report.

2 Contents

3 General Information

3.1 Client Information

Applicant:	WOW Technologies (Singapore) Pte Ltd
Address of Applicant:	62 Burn Road #06-01 TSH Centre Singapore

3.2 General Description of E.U.T.

Name:	TOWER SPEAKERS
Model No.:	TOWER SPEAKERS
Trade Mark:	NAKAMICHI
Operating Frequency:	2402 MHz to 2480 MHz for Bluetooth.
Channels:	79 channels with 1MHz step for Bluetooth
Bluetooth Version:	3.0
Modulation Technique:	Frequency Hopping Spread Spectrum (FHSS)
Type of Modulation	GFSK, (π/4) DQPSK, 8DPSK for Bluetooth
Dwell time	Per channel is less than 0.4s.
Antenna Type	PCB Antenna
Antenna gain:	0dBi max
Function:	Bluetooth speaker

3.3 Details of E.U.T.

EUT Power Supply:	AC for power supply Input: 120 Vac, 60 Hz
Test mode:	The program used to control the EUT for staying in continuous transmitting and receiving mode is programmed. Channel lowest (2402MHz), middle (2441MHz) and highest (2480MHz) are chosen for Bluetooth full testing. Normal mode: the Bluetooth has been tested on the Modulation of GFSK; EDR mode: the Bluetooth has been tested on the Modulation of (π/4)DQPSK and 8DPSK, compliance test and record the worst case on (π/4)DQPSK and 8DPSK
Power cord:	1.5m*2 AC power cord

3.4 Description of Support Units

The EUT has been tested as an independent unit for fixed frequency by testing lab.

3.5 Test Location

All tests were performed at:

I-Test Laboratory

1-2 floor, South Block, Building A2 , No 3 Keyan Lu, Science City, Guangzhou, Guangdong Province, P.R. China

0086-20-32209330

itl@i-testlab.com

No tests were sub-contracted.

3.6 Deviation from Standards

Biconical and log periodic antennas were used instead of dipole antennas.

3.7 Abnormalities from Standard Conditions

None.

3.8 Other Information Requested by the Customer

None.

3.9 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **CNAS(Lab code:L4957)**
- **FCC (Registration No.:935596)**
- **IC (Registration NO.:8368A)**

3.10 Measurement Uncertainty

The below measurement uncertainties given below are based on a 95% confidence level (base on a coverage factor (k=2).)

Parameter	Uncertainty
Radio frequency	$\pm 1.06 \times 10^{-7}$
total RF power, conducted	1.37 dB
RF power density , conducted	2.89 dB
All emissions, radiated	±3.35 dB
Temperature	±0.23 °C
Humidity	±0.3 %
DC and low frequency voltages	±0.3 %

4 Instruments Used during Test

No.	Test Equipment	Manufacturer	Model	Serial No.	Last Cal.	Cal. Due
ITL-114	Spectrum Analyzer	Agilent	N9010A	MY51250936	2016/01/25	2017/01/25
ITL-154	EMI test receiver 9kHz to 26.5GHz	R&S	ESR26	101257	2016/01/05	2017/01/05
ITL-116	Pre Amplifier	HP	8447F	3113A05905	2016/01/25	2017/01/25
ITL-117	Wideband Amplifier Super Ultra	Mini-circuits	ZVA-183-S+	469101134	2016/01/25	2017/01/25
ITL-105	Biconilog Antenna	ETS•Lindgren	3142D	00108096	2015/01/24	2018/01/24
ITL-110	Horn Antenna	A-INFOMW	JXTXLB-10180-N	J2031090612133	2015/01/24	2018/01/24
ITL-102	EMI Test receiver	R&S	ESCI	100910	2016/06/17	2017/06/17
ITL-103	Two-line v-network	R&S	ENV216	100120	2016/06/17	2017/06/17
ITL-115	50Ω Coaxial Cable	Mini-circuits	CBL	C001	2016/06/17	2017/06/17
ITL-100	Semi-Anechoic chamber	ETS•Lindgren	FACT3 2.0	CT09015	2014/06/17	2017/06/17
ITL-145	Loop Antenna	ZHINAN	ZN30900A	002489	2016/01/25	2017/01/25
ITL-146	Horn Antenna	Schwarzbeck	BBHA 9170	B09806543	2016/06/17	2017/06/17
ITL-101	Shielded Room	ETS•Lindgren	8*4*3	CT09010	2015/03/09	2018/03/09

5 Test Results

5.1 E.U.T. test conditions

Test Voltage: Input: AC 120V, 60 Hz

Temperature: 20.0 -25.0 °C

Humidity: 38-50 % RH

Atmospheric Pressure: 1000 -1010 mbar

Test frequencies and frequency range: According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

According to the 15.33 (a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

Number of fundamental frequencies to be tested in EUT transmit band

Frequency range in which	Number of	Location in frequency range
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

Frequency range of radiated emission measurements

Lowest frequency generated	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz,
At or above 10 GHz to below	5th harmonic of highest fundamental frequency or to 100 GHz,
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz,

EUT channels and frequencies list for bluetooth:

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

Test frequencies are the lowest channel: 0 channel(2402 MHz), middle channel: 39 channel(2441 MHz) and highest channel: 78 channel(2480 MHz)

5.2 Antenna equirement

Standard requirement

15.203 requirement:

For intentional device. 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.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz bands that are used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna

The antenna is a PCB antenna and no consideration of replacement. The best case gain of the antenna is 0dBi.

Test result: The unit does meet the FCC requirements.

5.3 Occupied Bandwidth

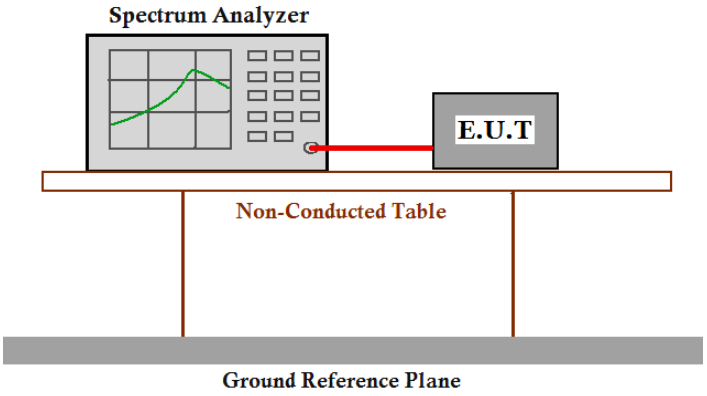
Test Requirement: FCC Part 15 C section 15.247

(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 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, provided the systems operate with an output power no greater than 125 mW.

Test Method: ANSI C63.10: Clause 6.9 & DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest, middle and highest channel with different data package. Compliance test in normal mode (DH5), EDR mode (2DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: Span = approximately 2 to 3 times the 20dB bandwidth, centring on a hopping channel;
3. Set the spectrum analyzer: RBW >= 1% of the 20dB bandwidth VBW >= RBW. Sweep = auto; Detector Function = Peak. Trace = Max Hold.
4. Mark the peak frequency and -20dB points bandwidth.

Test result (-20dB bandwidth), For bluetooth

Normal mode:

Test Channel	Bandwidth(MHz)	2/3 bandwidth(MHz)
Lowest	1.12	0.747
Middle	1.12	0.747
Highest	1.12	0.747

EDR mode (2DH5):

Test Channel	Bandwidth(MHz)	2/3 bandwidth(MHz)
Lowest	1.38	0.920
Middle	1.37	0.913
Highest	1.38	0.920

EDR mode (3DH5):

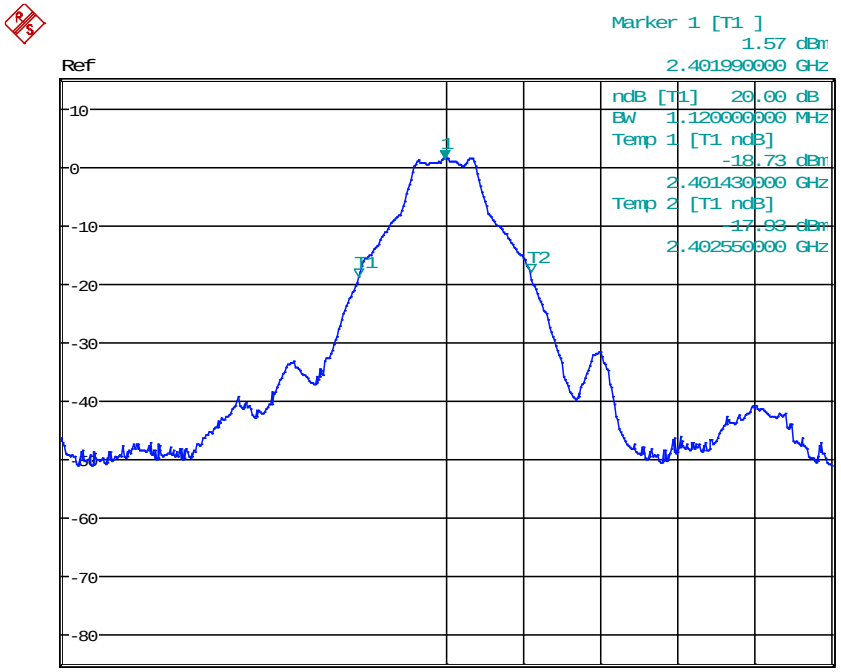
Test Channel	Bandwidth(MHz)	2/3 bandwidth(MHz)
Lowest	1.38	0.920
Middle	1.39	0.927
Highest	1.39	0.927

For bluetooth

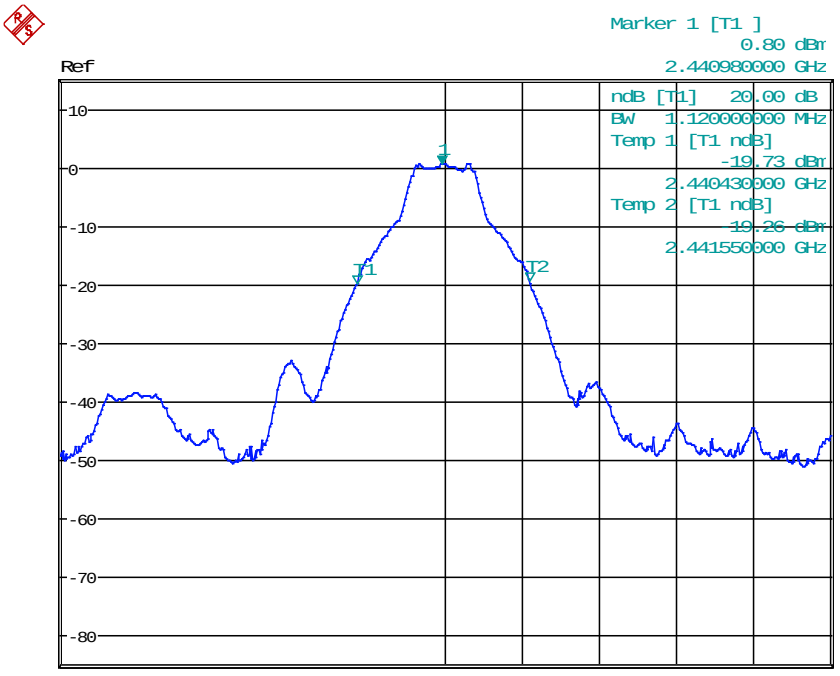
Result plot as follows:

DH5:

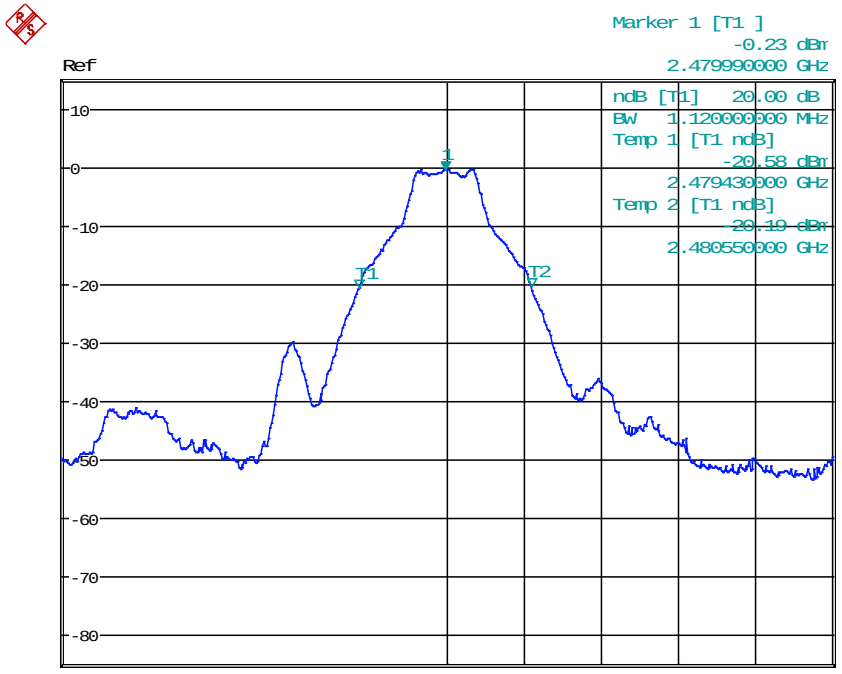
Lowest Channel:



Middle Channel:

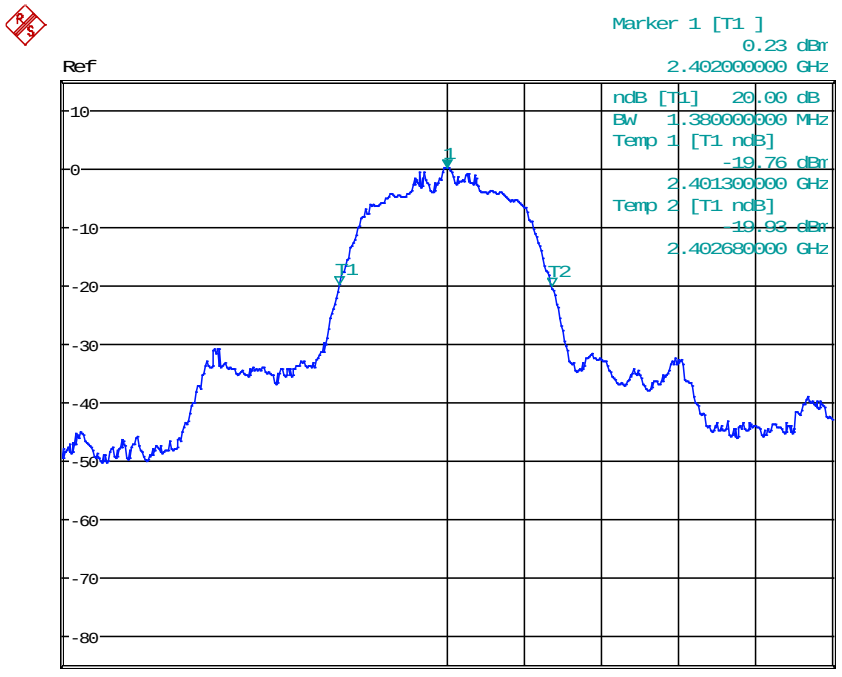


Highest Channel:

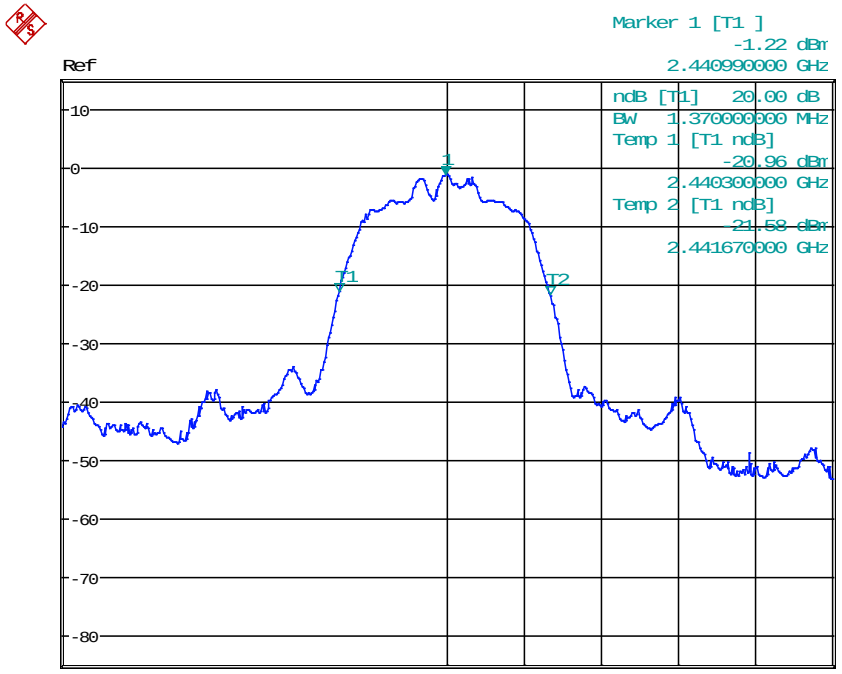


2DH5:

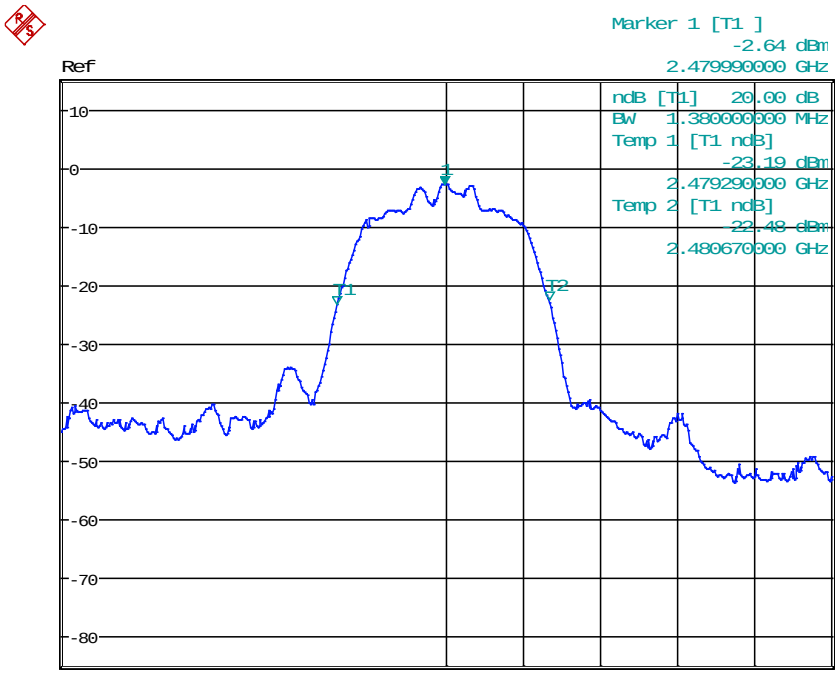
Lowest channel:



Middle channel:

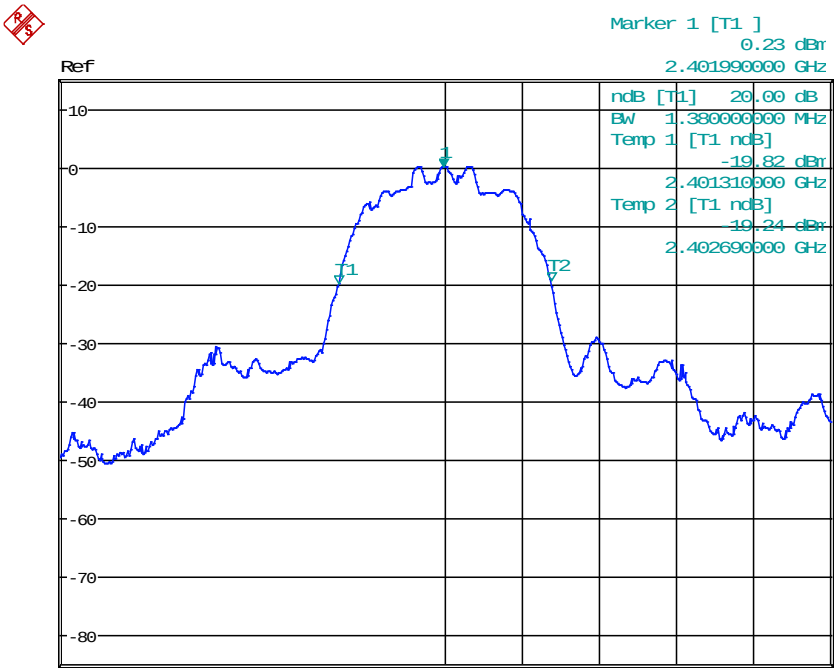


Highest channel:

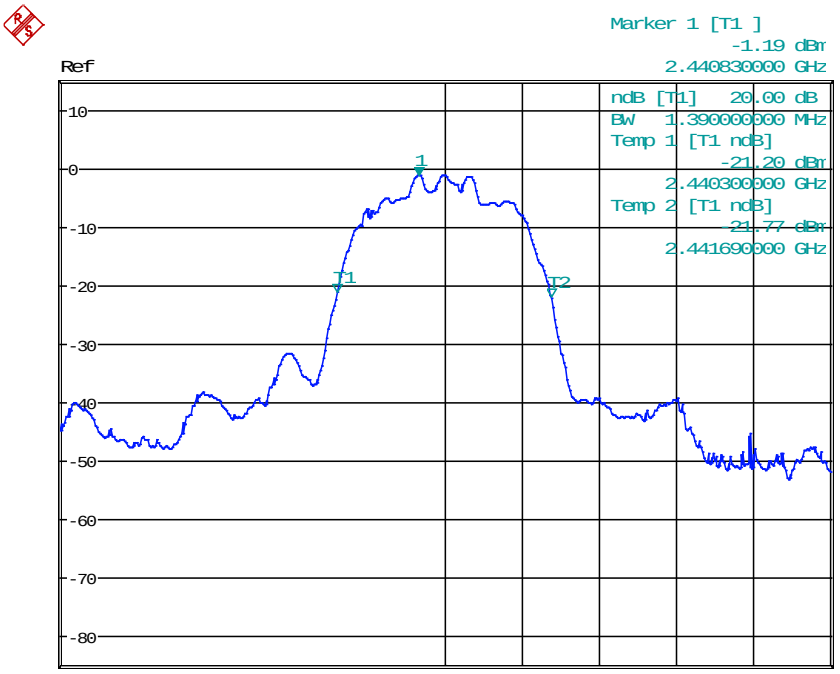


3DH5:

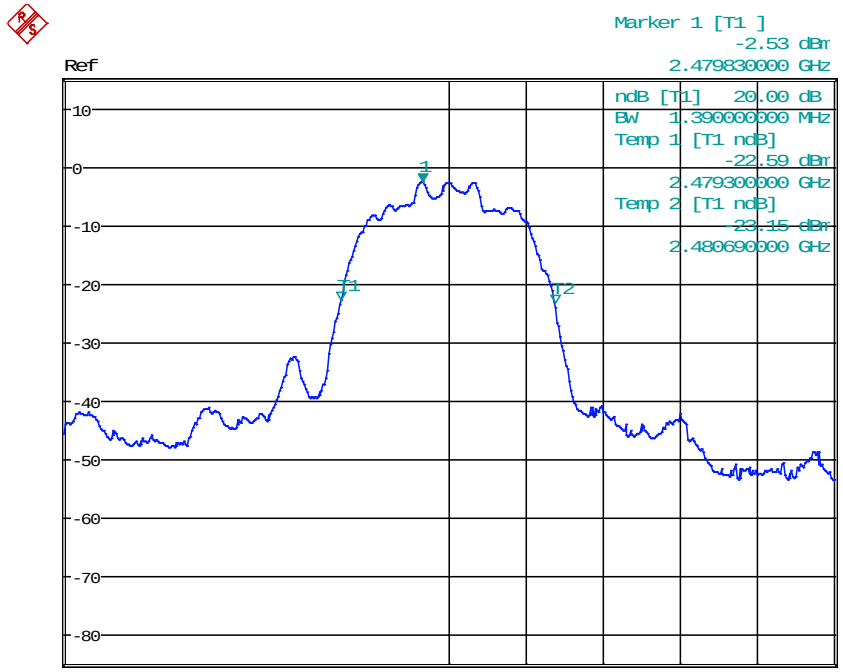
Lowest channel:



Middle channel:



Highest channel:



5.4 Carrier Frequencies Separated

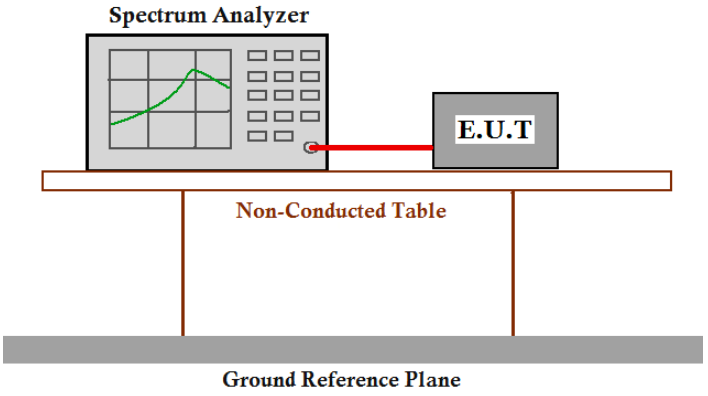
Test Requirement: FCC Part 15 C section 15.247

(a),(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 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, provided the systems operate with an output power no greater than 125 mW.

Test Method: DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest, middle and highest channel with different data package. Compliance test in normal mode (DH5), EDR mode (2DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

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

Test result:

For Bluetooth

DH5

Test Channel	Carrier Frequencies Separated	Pass/Fail
Lower Channels (channel 0 and channel 1)	1.00 MHz	Pass
Middle Channels (channel 39 and channel 40)	1.00 MHz	Pass
Upper Channels (channel 77 and channel 78)	1.00 MHz	Pass
Remark: The limit is maximum two-thirds of the 20 dB bandwidth: 0.747 MHz		

2DH5

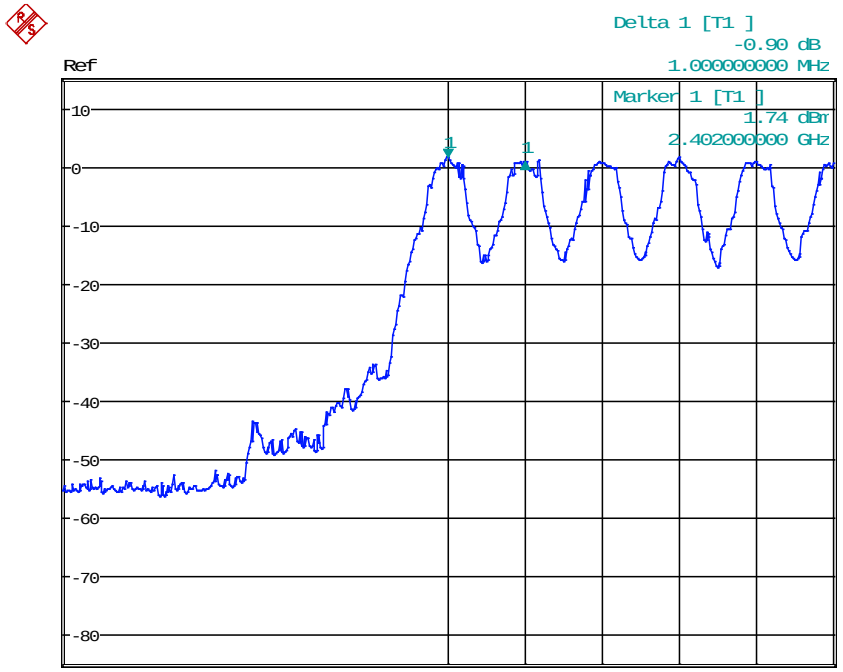
Test Channel	Carrier Frequencies Separated	Pass/Fail
Lower Channels (channel 0 and channel 1)	1.00 MHz	Pass
Middle Channels (channel 39 and channel 40)	1.00 MHz	Pass
Upper Channels (channel 77 and channel 78)	1.00 MHz	Pass
Remark: The limit is maximum two-thirds of the 20 dB bandwidth: 0.920 MHz		

3DH5

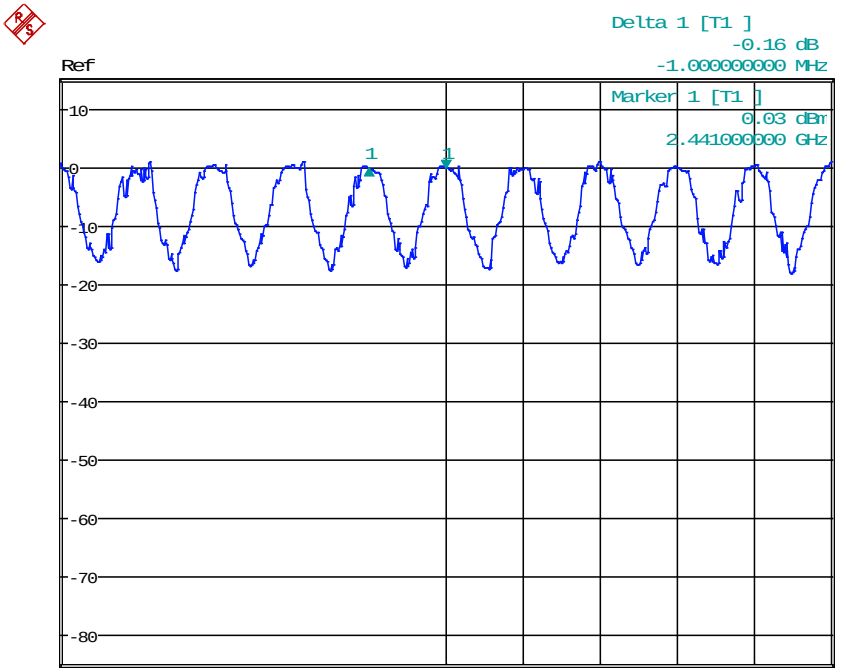
Test Channel	Carrier Frequencies Separated	Pass/Fail
Lower Channels (channel 0 and channel 1)	1.00 MHz	Pass
Middle Channels (channel 39 and channel 40)	1.00 MHz	Pass
Upper Channels (channel 77 and channel 78)	1.00 MHz	Pass
Remark: The limit is maximum two-thirds of the 20 dB bandwidth: 0.927 MHz		

For buletooth
Carrier Frequencies Separated plot:
DH5

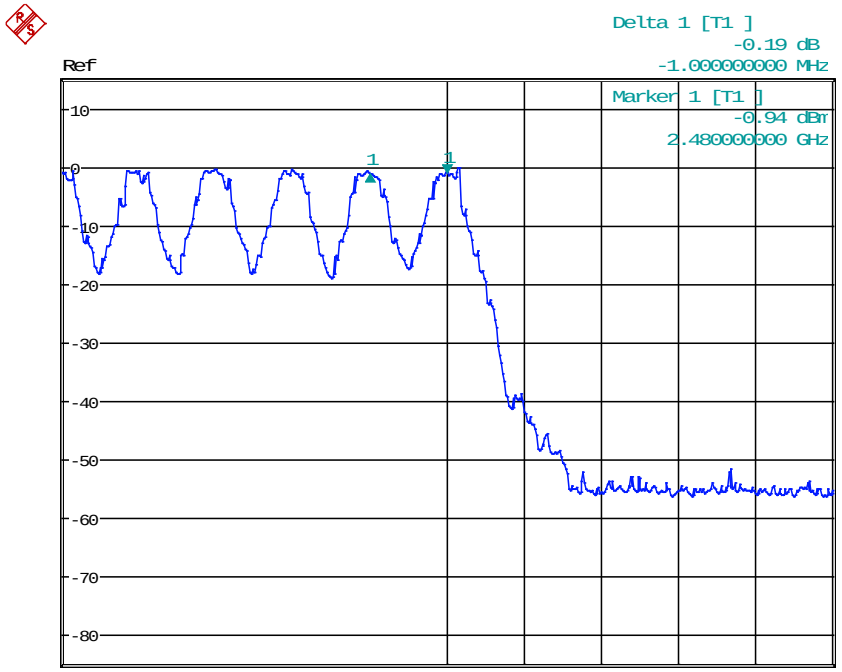
1. Lowest Channels:



2. Middle Channels:



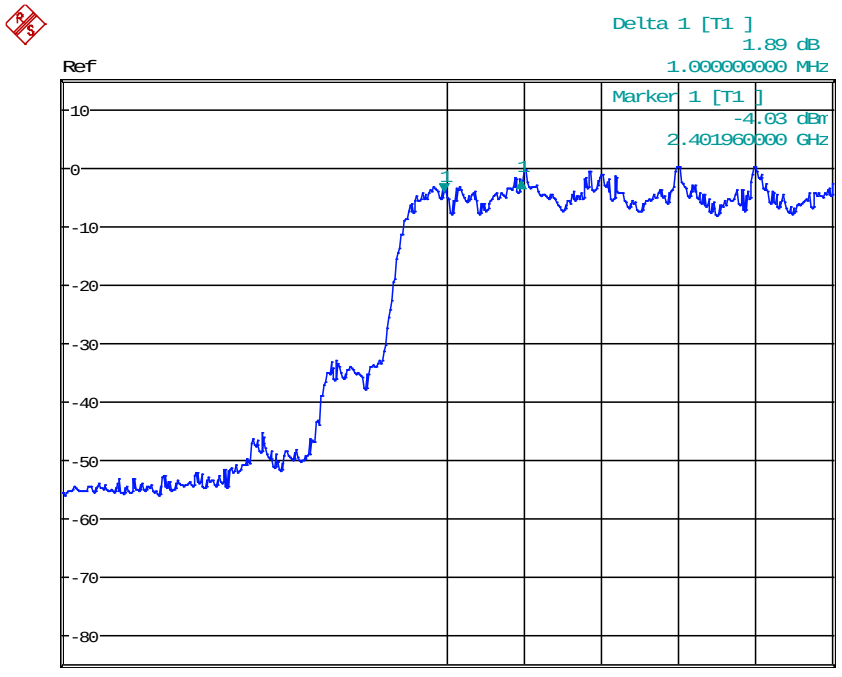
3. Highest Channels



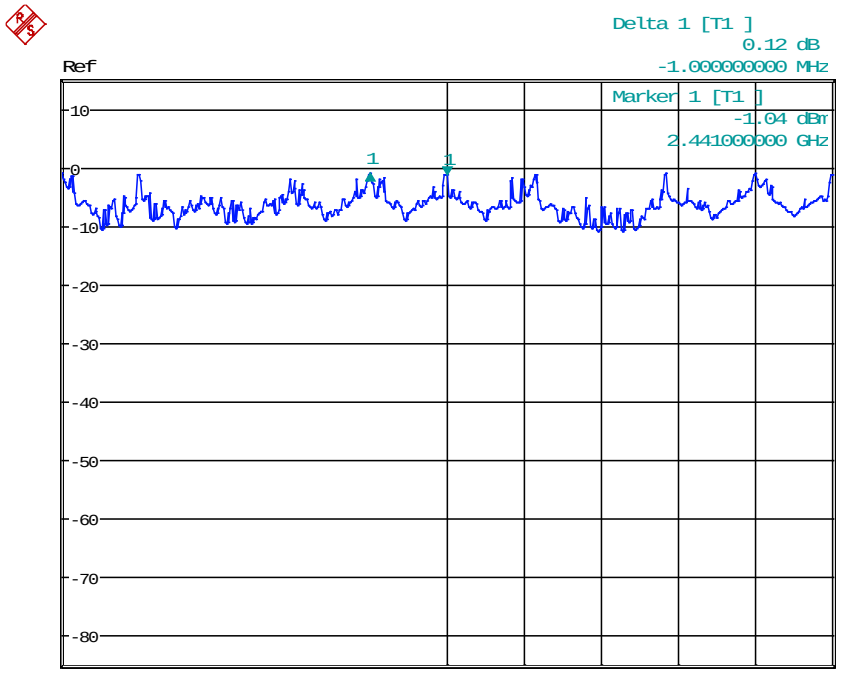
2DH5

1. Lowest Channels:

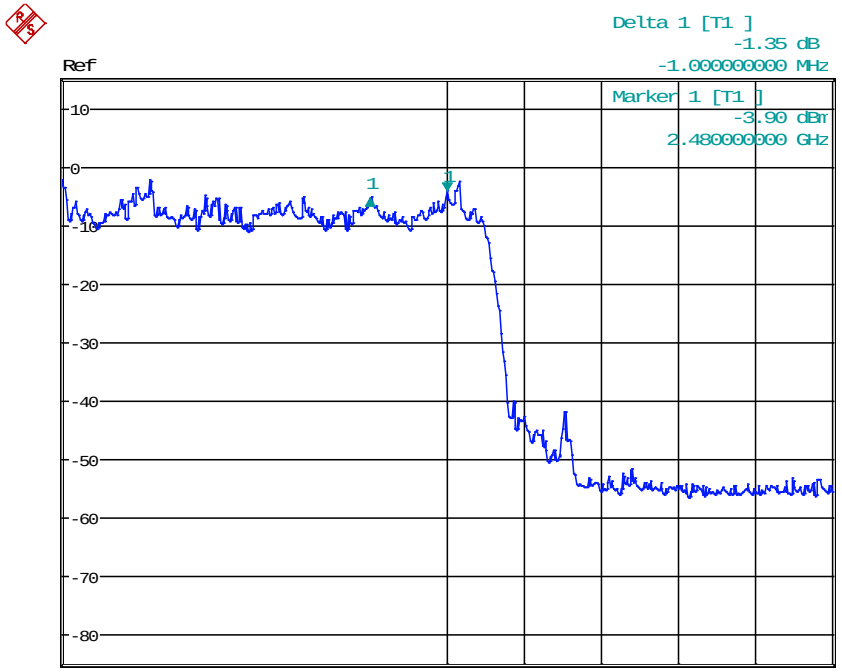
..



2. Middle Channels:

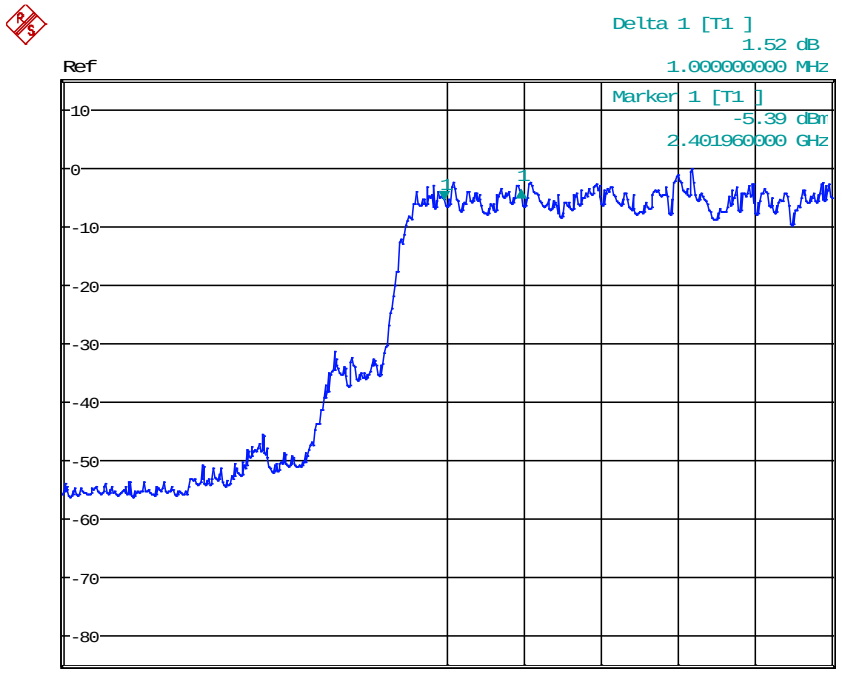


3. Highest Channels

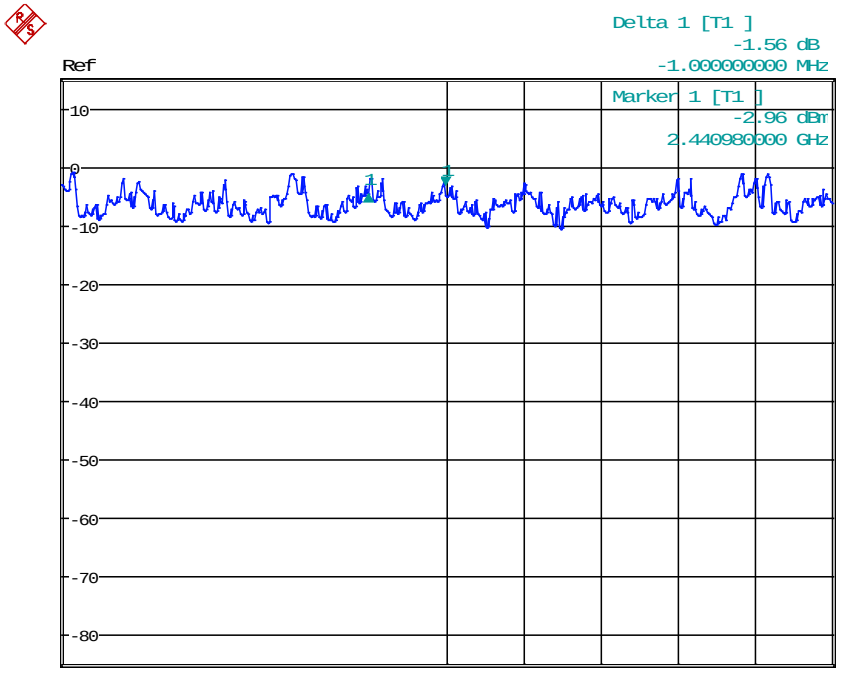


3DH5

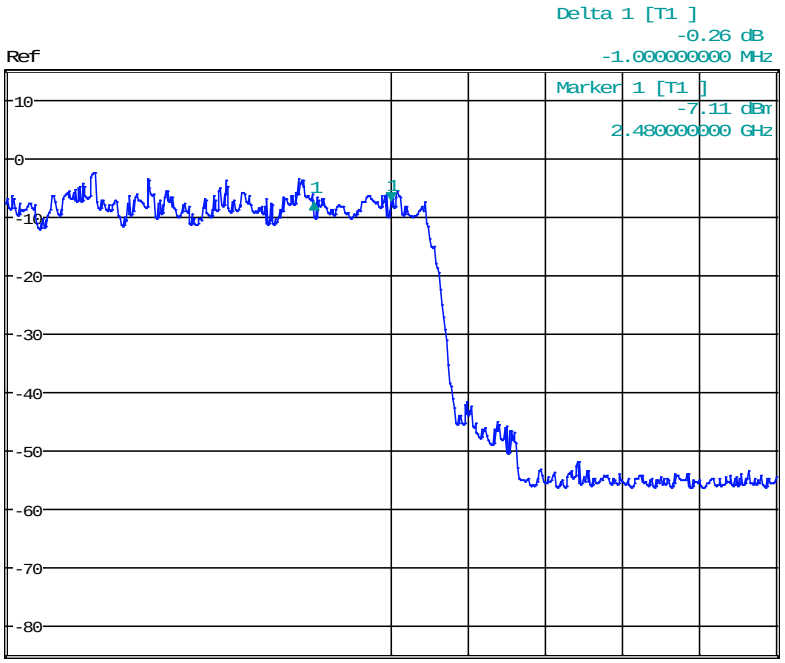
1. Lowest Channels:



2. Middle Channels:



3. Highest Channels



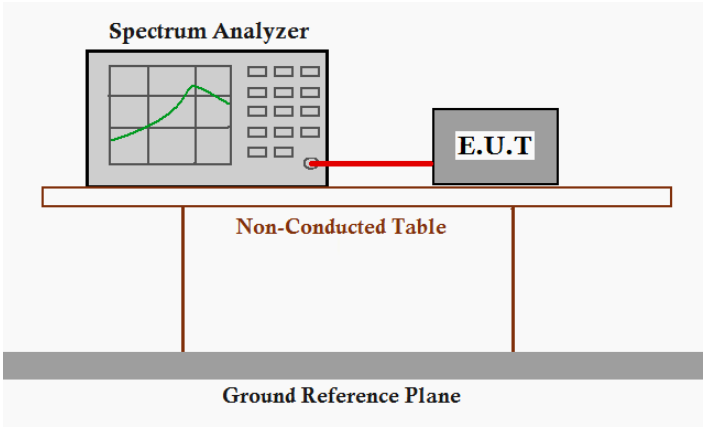
5.5 Hopping Channel Number

Test Requirement: FCC Part15 C section 15.247
(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test Method: DA 00-705

Test Status: Pre-test the EUT in hopping mode with different data packet. Compliance test in hopping with normal mode (DH5), EDR mode (2DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



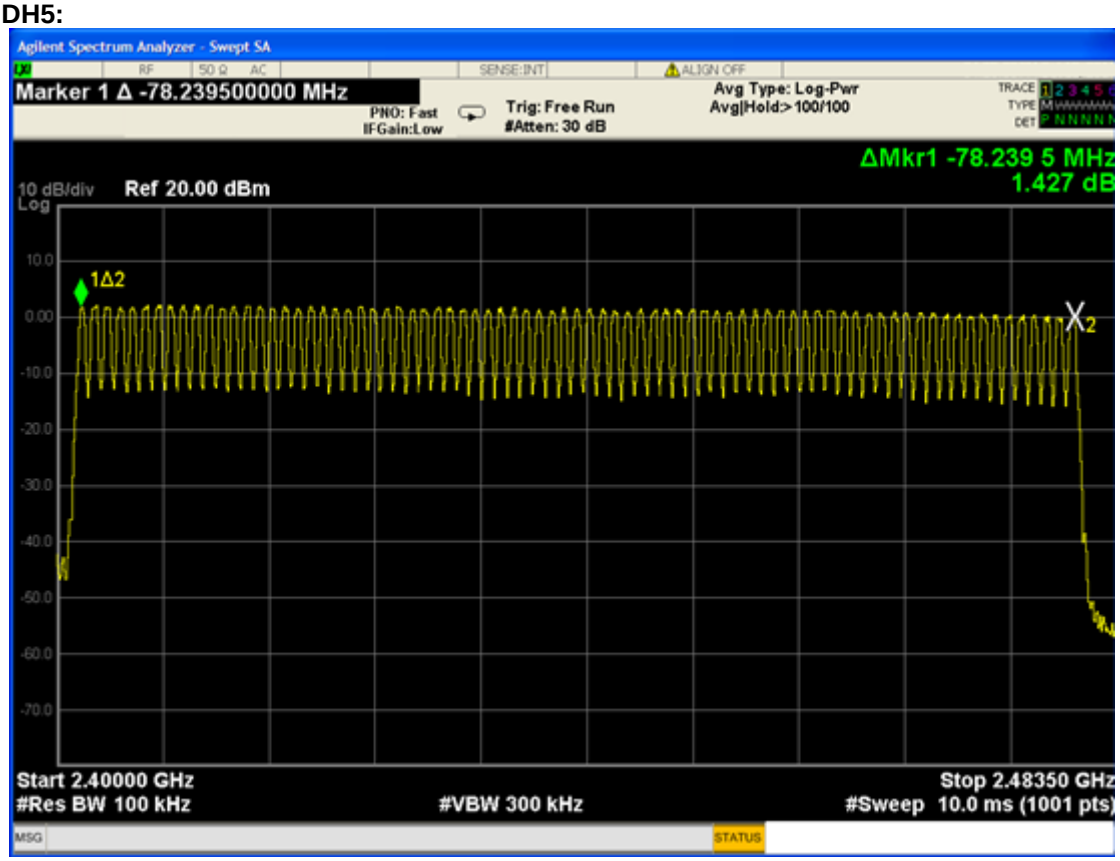
Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 kHz. VBW = 300 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: start frequency = 2400 MHz. stop frequency = 2483.5 MHz. Submit the test result graph.

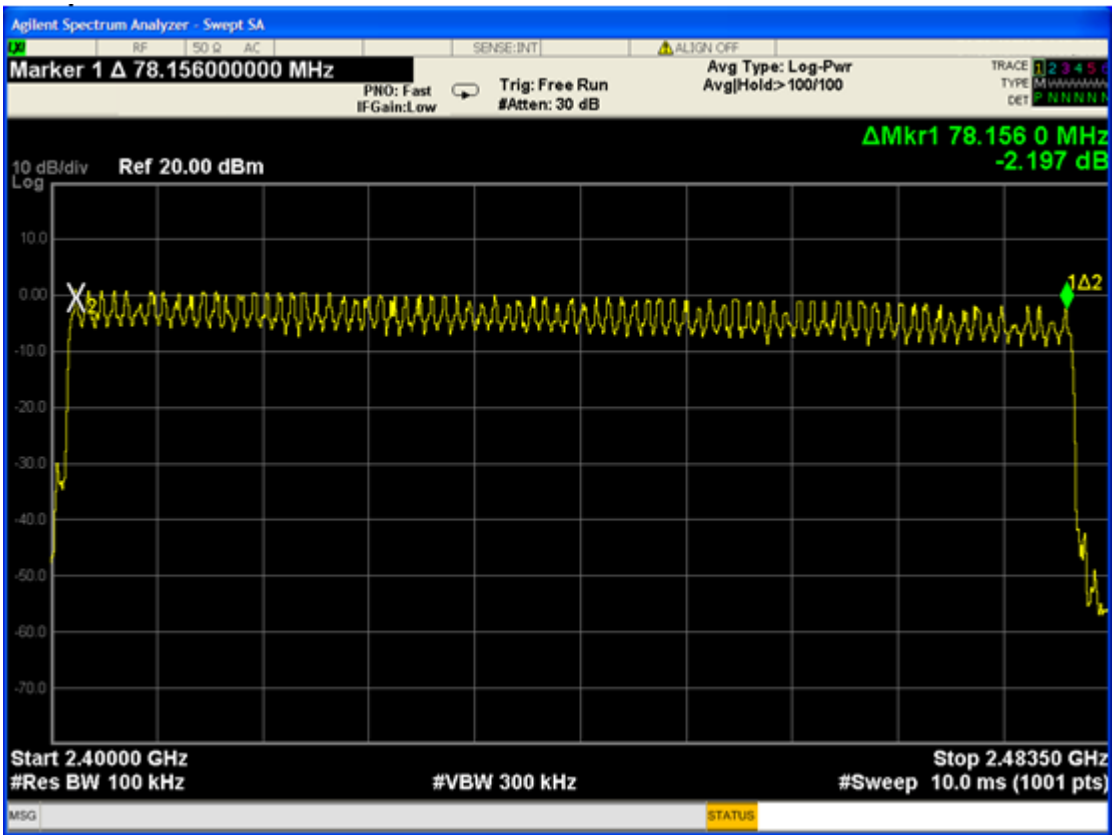
For buletooth

Test result: Total channels are 79 channels.

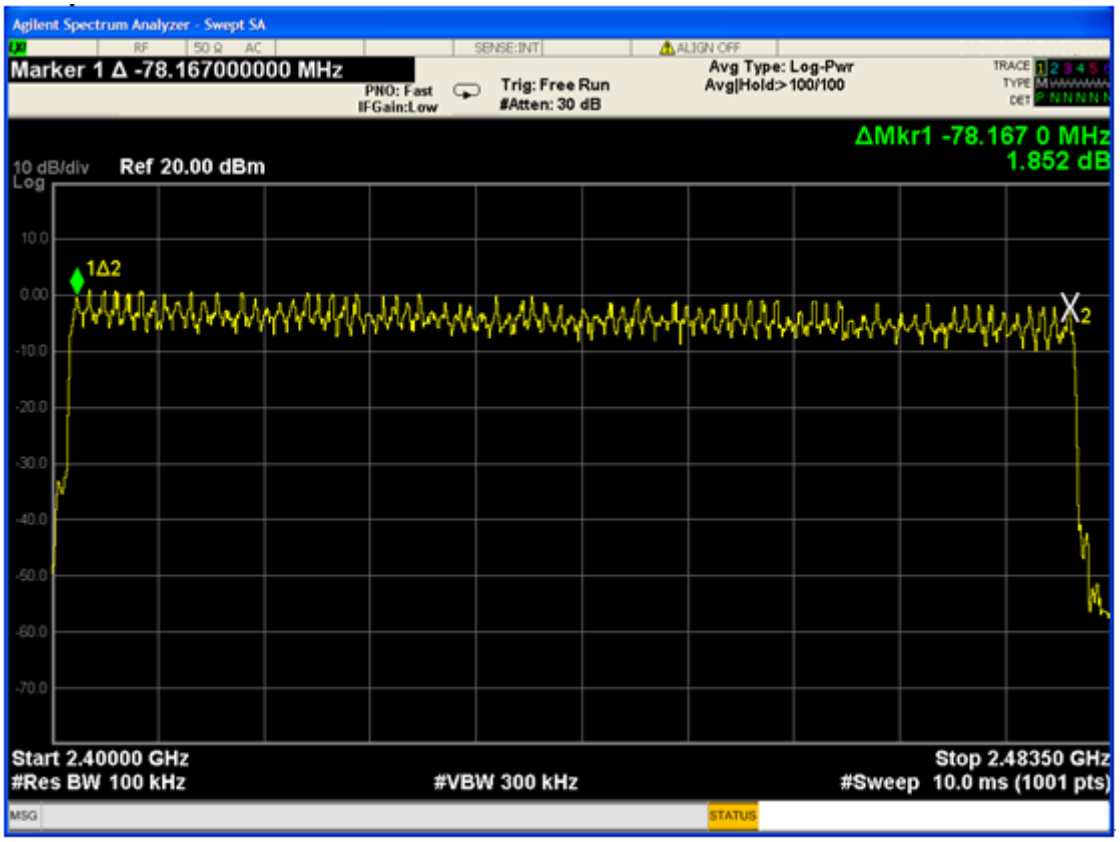
DH5:



2DH5:



3DH5:



Test result: The unit does meet the FCC requirements.

5.6 Dwell Time

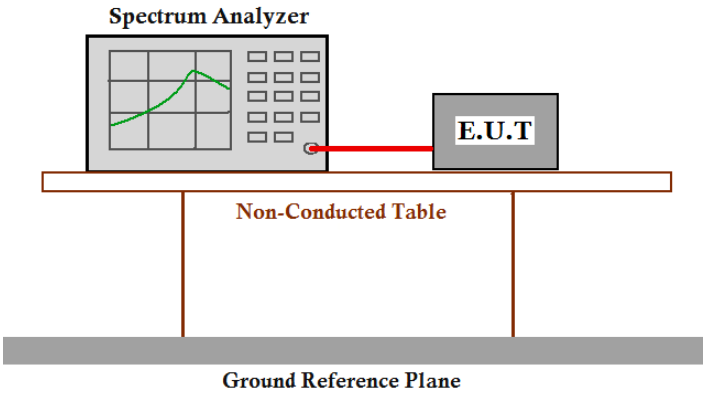
Test Requirement: FCC Part 15 C section 15.247

(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Method: DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest, middle and highest channel with different data packet. Compliance test in hopping with Normal mode (DH1, DH3 and DH5) and EDR mode (2DH1, 2DH3 and 2DH5; 3DH1, 3DH3 and 3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.

2. Set spectrum analyzer span = 0. centered on a hopping channel;
3. Set RBW = 1 MHz and VBW = 1 MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Detector Function = Peak. Trace = View;
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). Repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

Test Result:

For bluetooth

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

1. **Channel 0:** 2.402GHz

DH1 time slot = 0.395 (ms) * (1600/(2*79)) * 31.6 = 126.32 ms

DH3 time slot = 1.655 (ms) * (1600/(4*79)) * 31.6 = 264.62 ms

DH5 time slot = 2.895 (ms) * (1600/(6*79)) * 31.6 = 308.75 ms

2. **Channel 39:** 2.441GHz

DH1 time slot = 0.370 (ms) * (1600/(2*79)) * 31.6 = 118.32 ms

DH3 time slot = 1.650 (ms) * (1600/(4*79)) * 31.6 = 263.82 ms

DH5 time slot = 2.905 (ms) * (1600/(6*79)) * 31.6 = 309.82 ms

3. **Channel 78:** 2.480GHz

DH1 time slot = 0.375 (ms) * (1600/(2*79)) * 31.6 = 119.92 ms

DH3 time slot = 1.650 (ms) * (1600/(4*79)) * 31.6 = 263.82 ms

DH5 time slot = 2.900 (ms) * (1600/(6*79)) * 31.6 = 309.29 ms

4. **Channel 0:** 2.402GHz

2DH1 time slot = 0.410 (ms) * (1600/(2*79)) * 31.6 = 131.11 ms

2DH3 time slot = 1.665 (ms) * (1600/(4*79)) * 31.6 = 266.22 ms

2DH5 time slot = 1.690 (ms) * (1600/(6*79)) * 31.6 =180.24 ms

5. **Channel 39:** 2.441GHz

2DH1 time slot = 0.400 (ms) * (1600/(2*79)) * 31.6 = 127.92 ms

2DH3 time slot =1.660 (ms) * (1600/(4*79)) * 31.6 = 265.42 ms

2DH5 time slot = 1.710 (ms) * (1600/(6*79)) * 31.6 = 182.37 ms

6. **Channel 78:** 2.480GHz

2DH1 time slot = 0.410 (ms) * (1600/(2*79)) * 31.6 = 131.11 ms

2DH3 time slot =1.660 (ms) * (1600/(4*79)) * 31.6 = 265.42 ms

2DH5 time slot = 1.710 (ms) * (1600/(6*79)) * 31.6 = 182.37 ms

7 **Channel 0:** 2.402GHz

3DH1 time slot = 0.400 (ms) * (1600/(2*79)) * 31.6 = 127.92 ms

3DH3 time slot = 1.660 (ms) * (1600/(4*79)) * 31.6 = 265.42 ms

3DH5 time slot = 2.900 (ms) * (1600/(6*79)) * 31.6 = 309.29 ms

8. **Channel 39:** 2.441GHz

3DH1 time slot =0.400 (ms) * (1600/(2*79)) * 31.6 = 127.92 ms

3DH3 time slot = 1.655 (ms) * (1600/(4*79)) * 31.6 = 264.62 ms

3DH5 time slot = 2.910 (ms) * (1600/(6*79)) * 31.6 = 310.35 ms

9. **Channel 78:** 2.480GHz

3DH1 time slot = 0.410 (ms) * (1600/(2*79)) * 31.6 = 131.11 ms

3DH3 time slot = 1.650 (ms) * (1600/(4*79)) * 31.6 = 263.82 ms

3DH5 time slot = 2.905 (ms) * (1600/(6*79)) * 31.6 = 309.82 ms

The results are not greater than 0.4 seconds

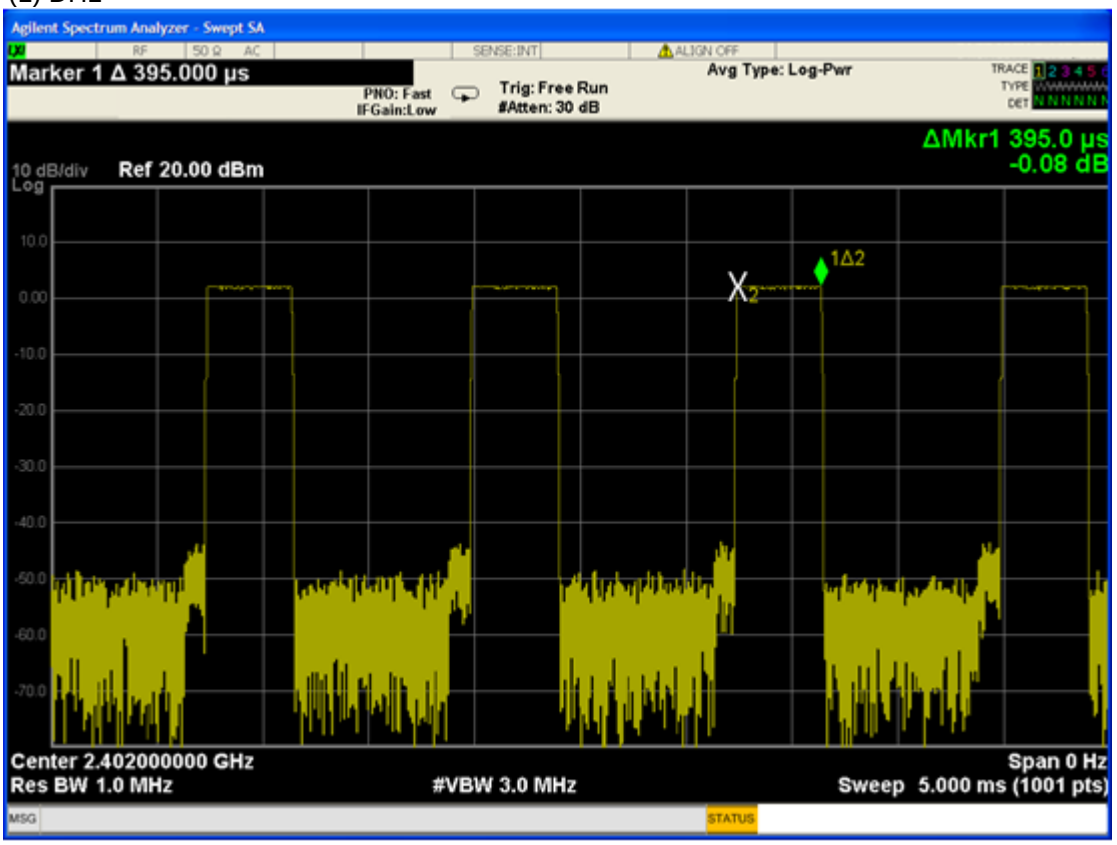
The unit does meet the FCC requirements.

For buletooth

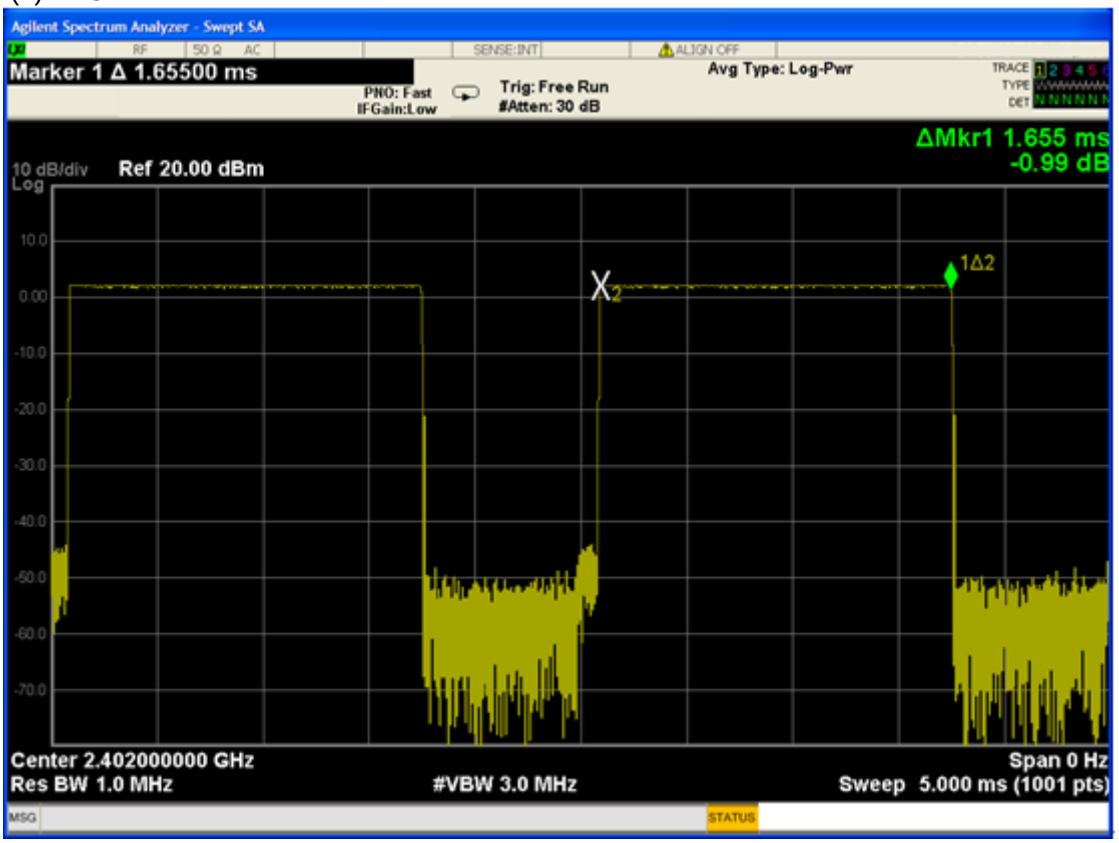
Please refer the graph as below:

1. Lowest channel (2.402 GHz):

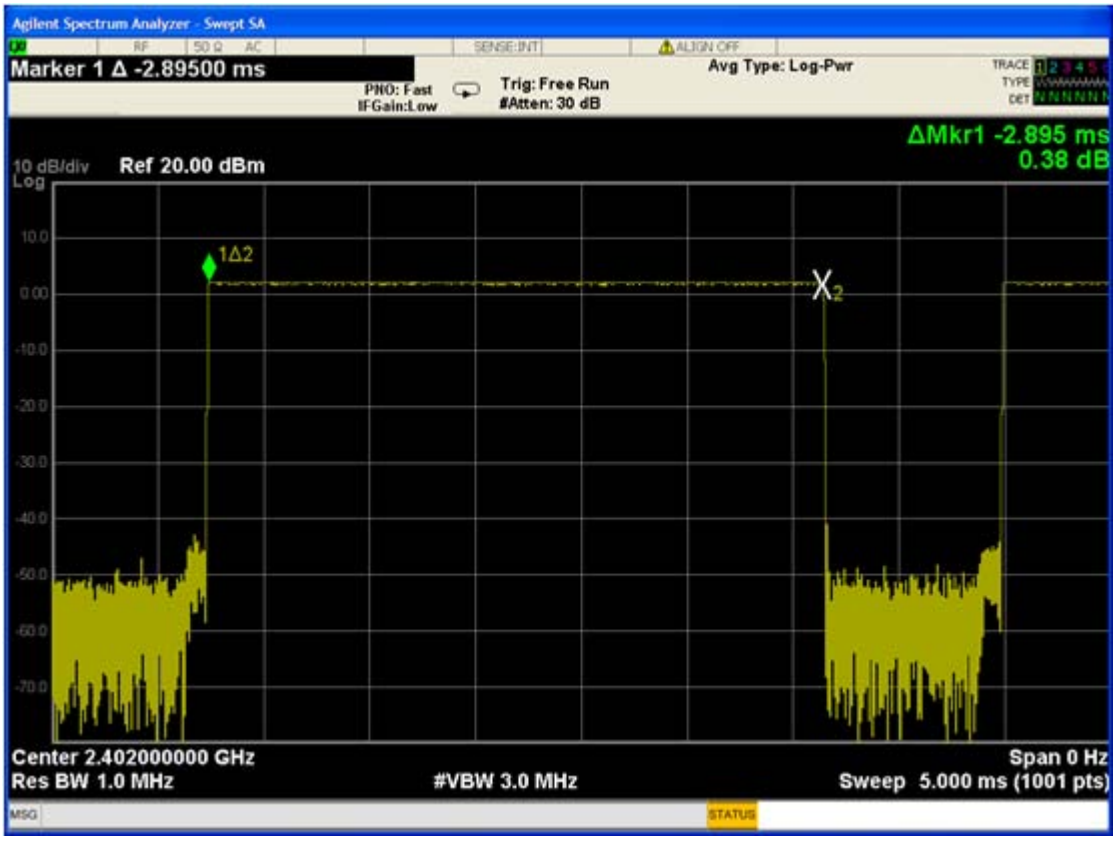
(1) DH1



(2) DH3

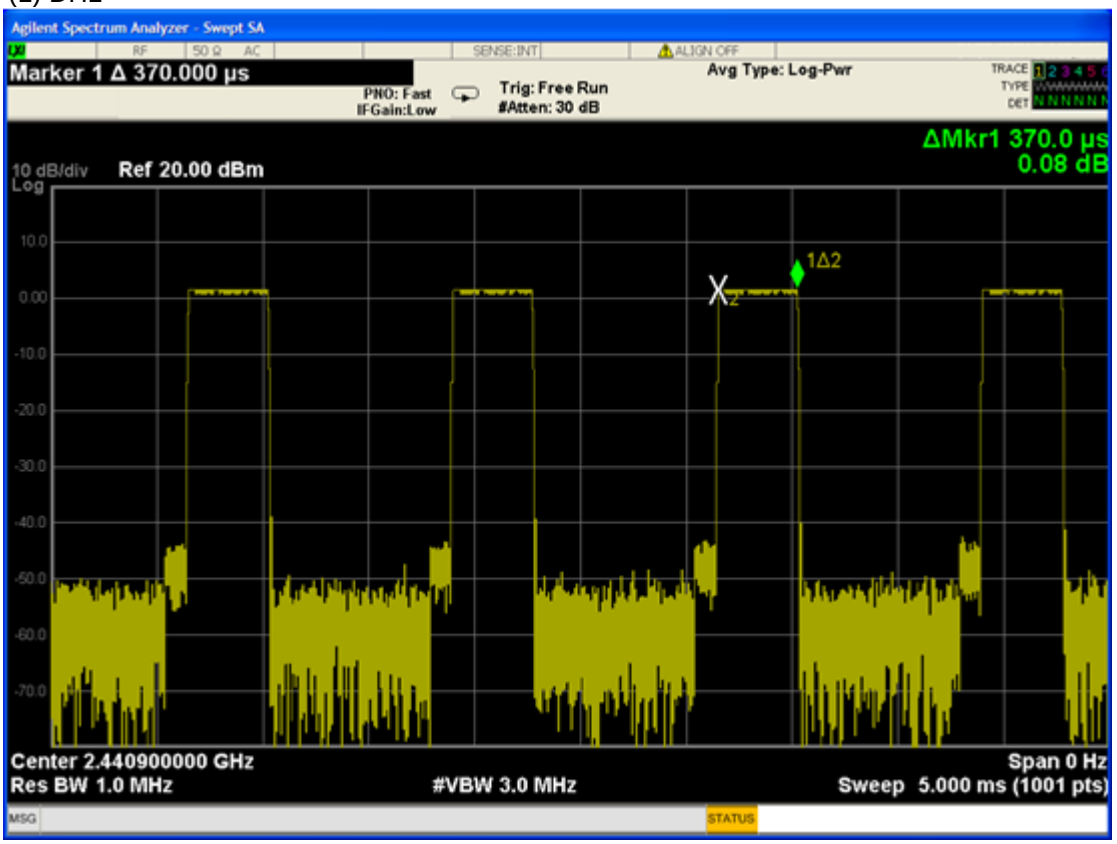


(3) DH5

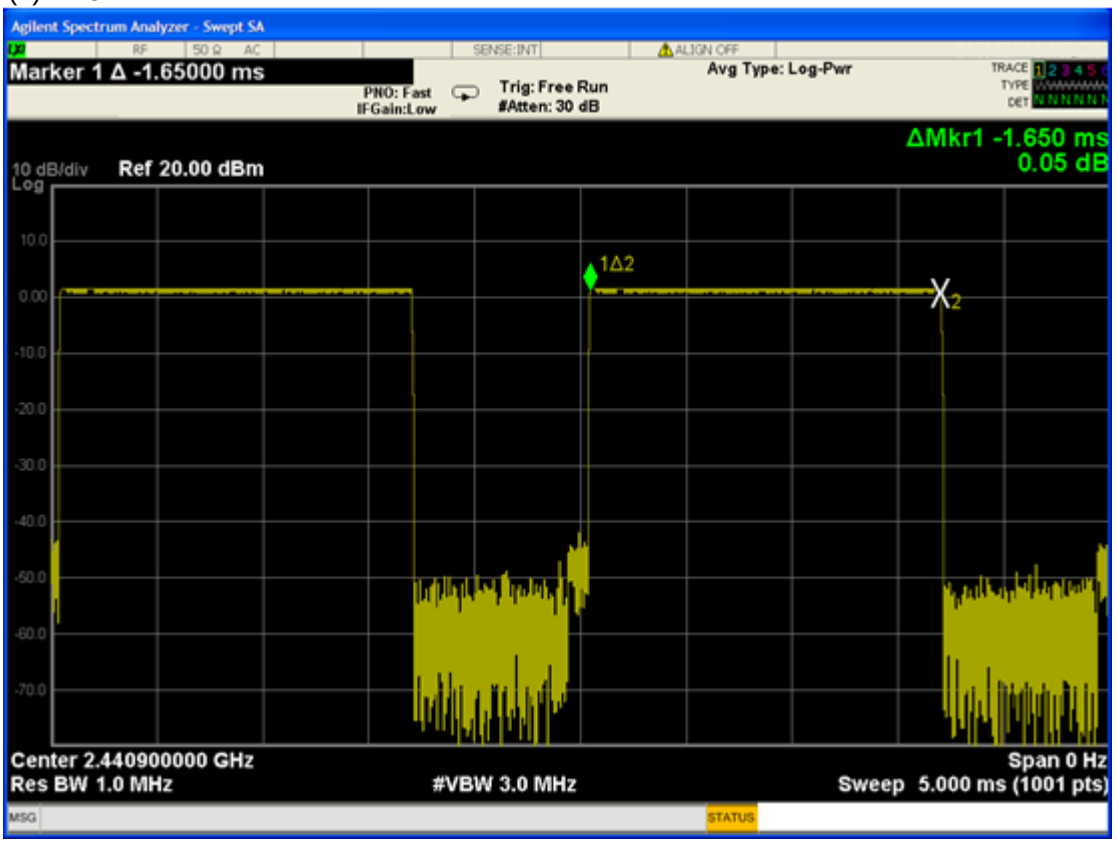


2. Middle channel (2.441 GHz):

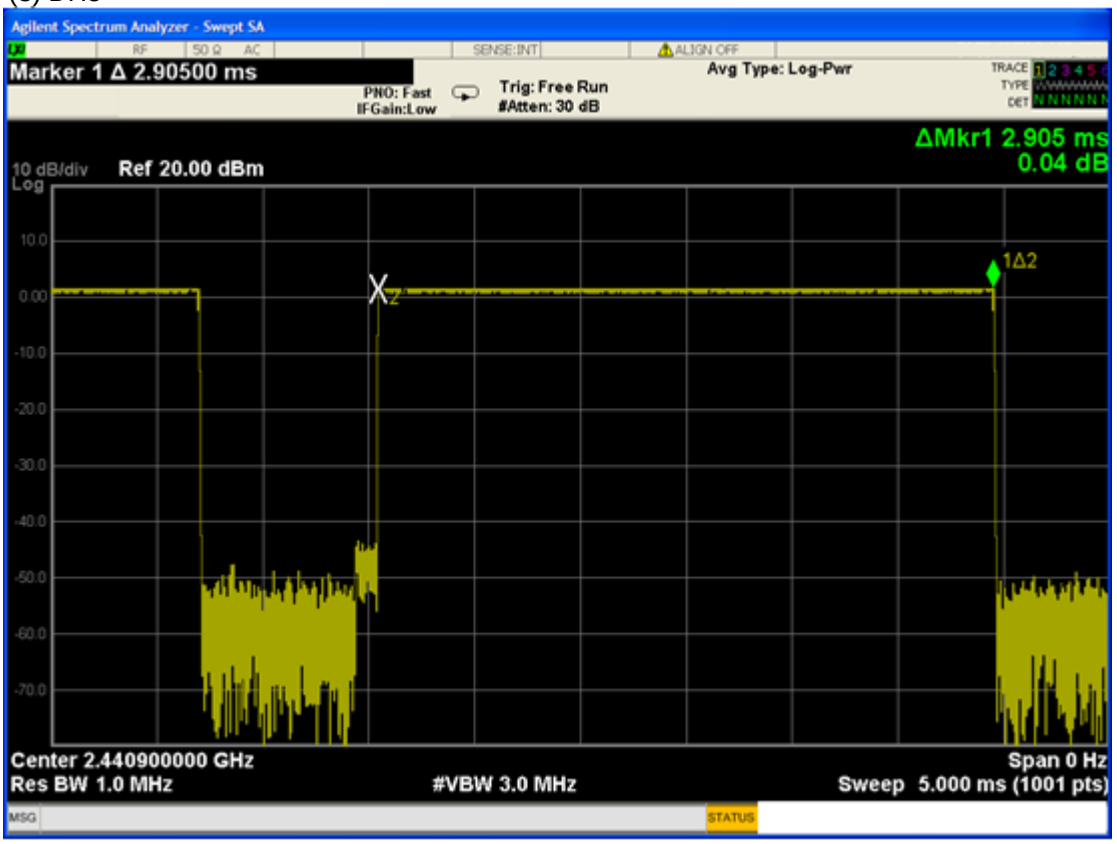
(1) DH1



(2) DH3

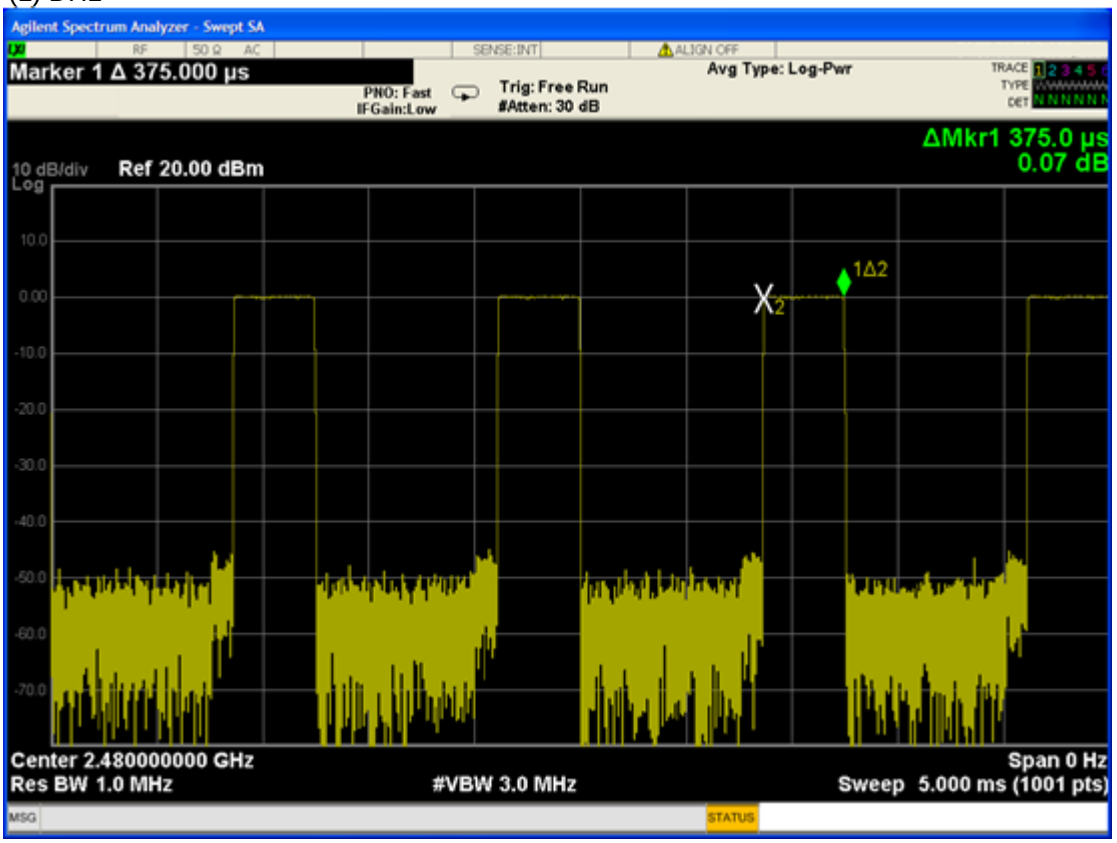

Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ -1.65000 ms
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
ΔMkr1 -1.650 ms
0.05 dB
10 dB/div
Log
Ref 20.00 dBm
1Δ2
Center 2.440900000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 5.000 ms (1001 pts)

(3) DH5

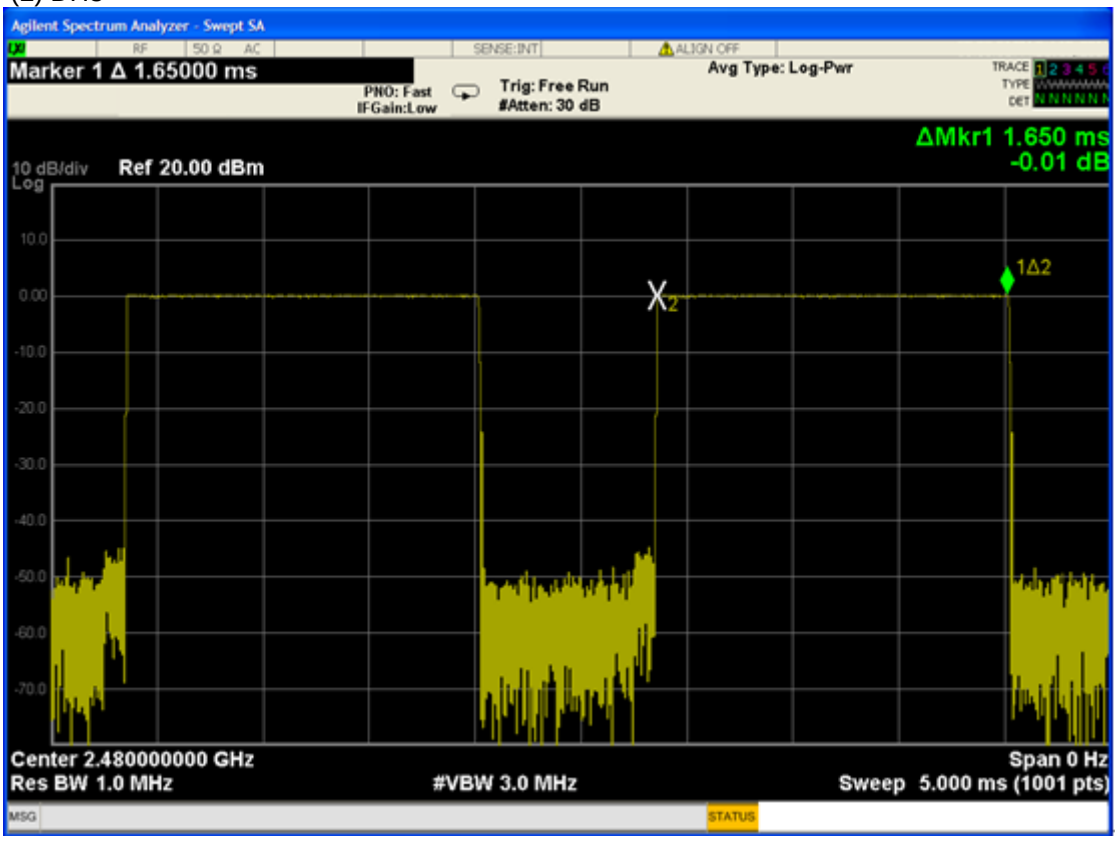

Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 2.90500 ms
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
ΔMkr1 2.905 ms
0.04 dB
10 dB/div
Log
Ref 20.00 dBm
1Δ2
Center 2.440900000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 5.000 ms (1001 pts)

3. Highest channel (2.480 GHz):

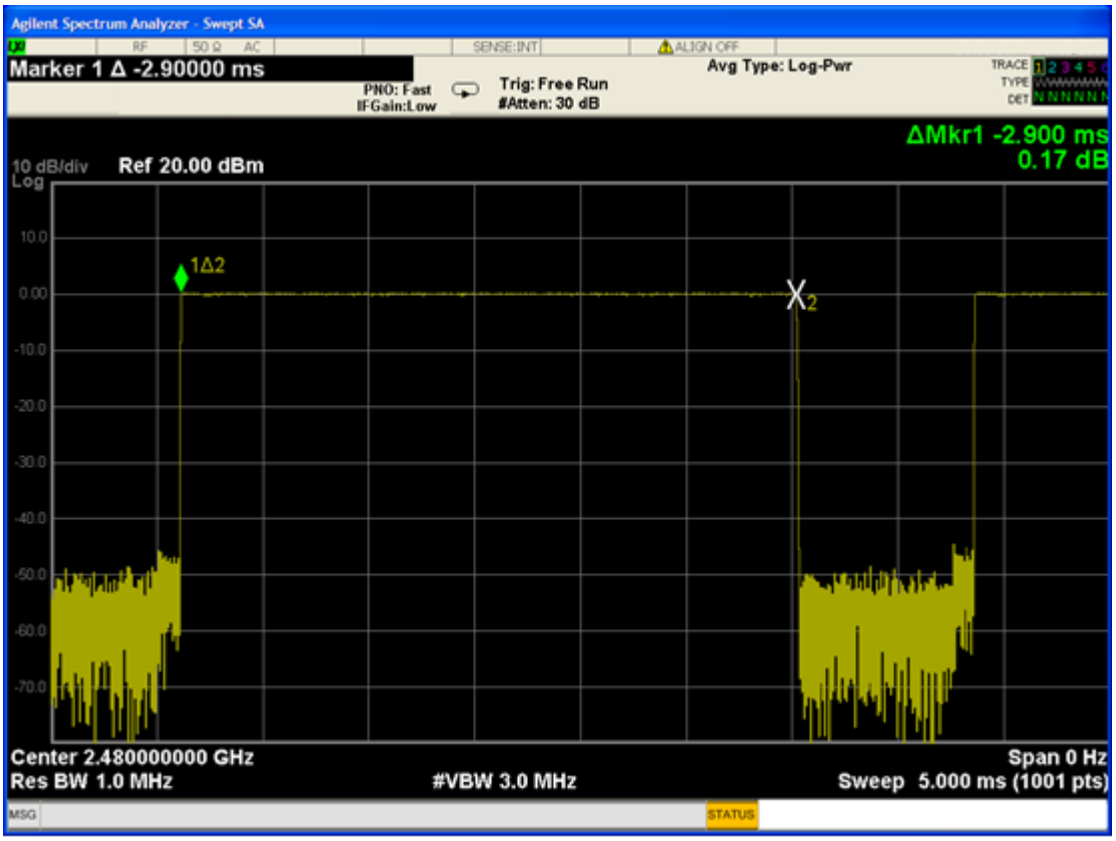
(1) DH1



(2) DH3

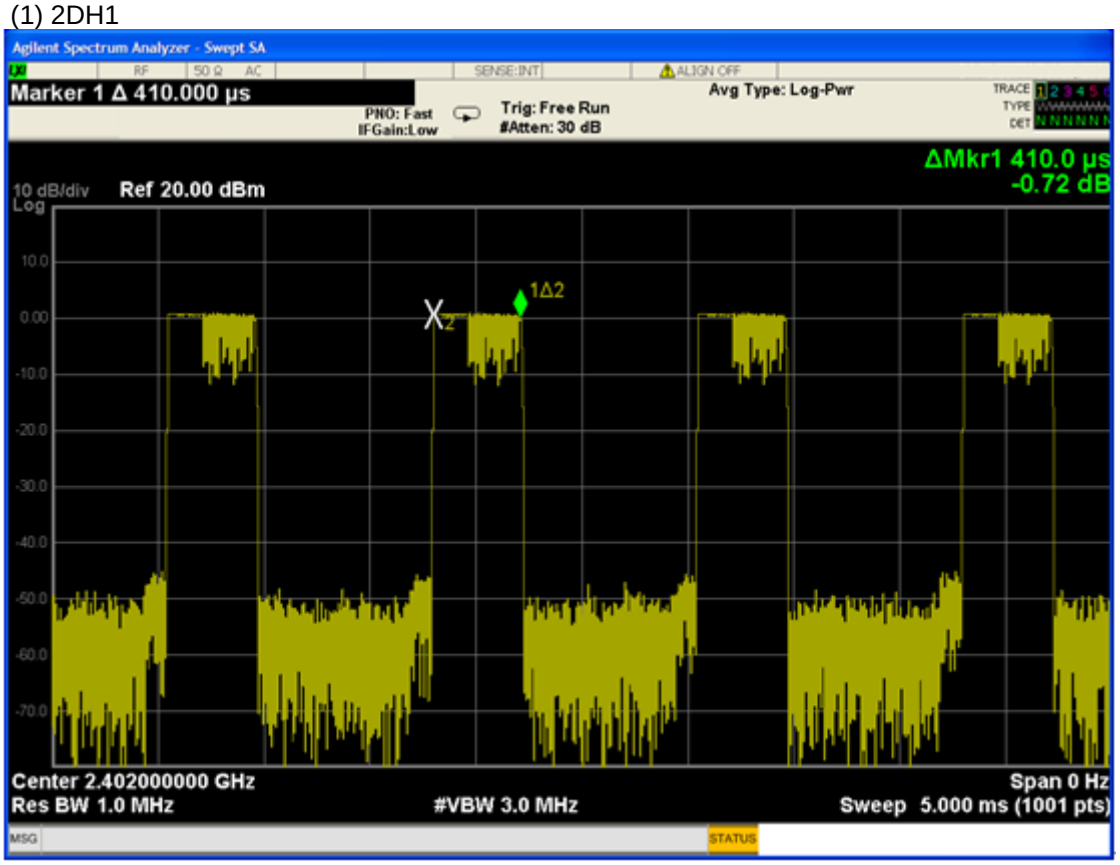


(3) DH5

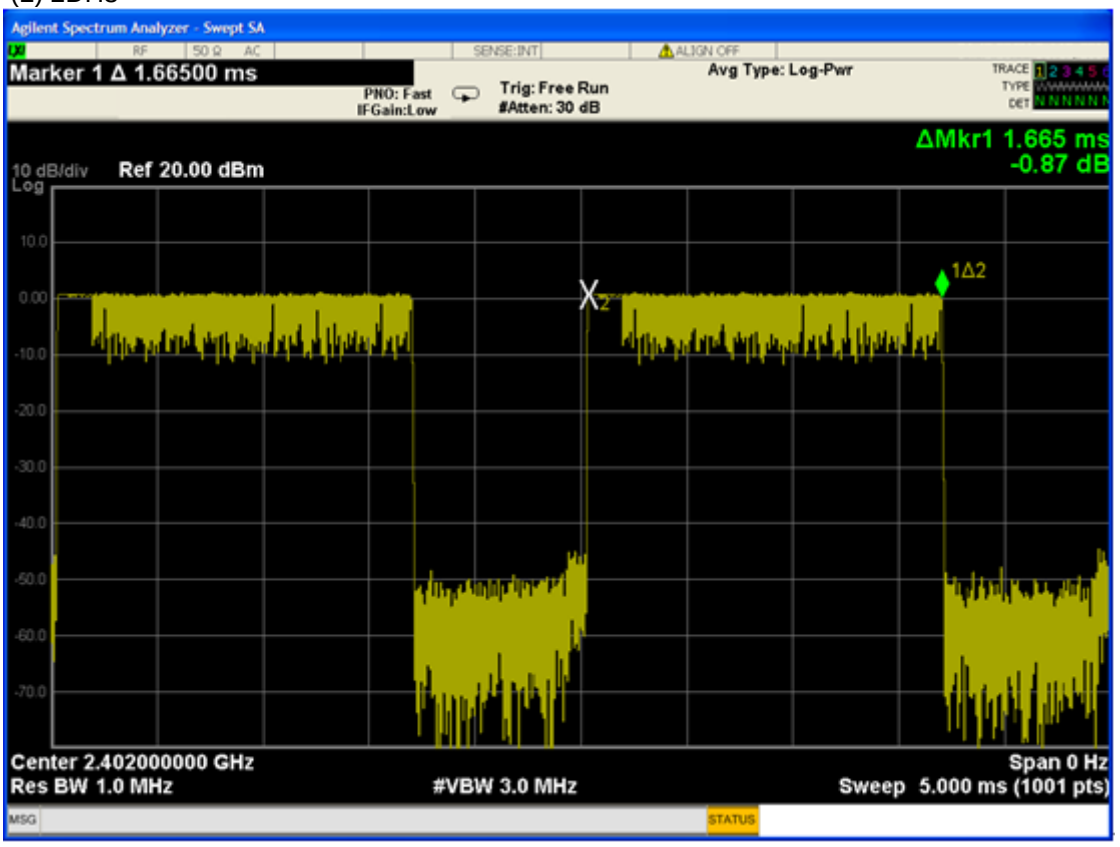


4. Lowest channel (2.402 GHz):

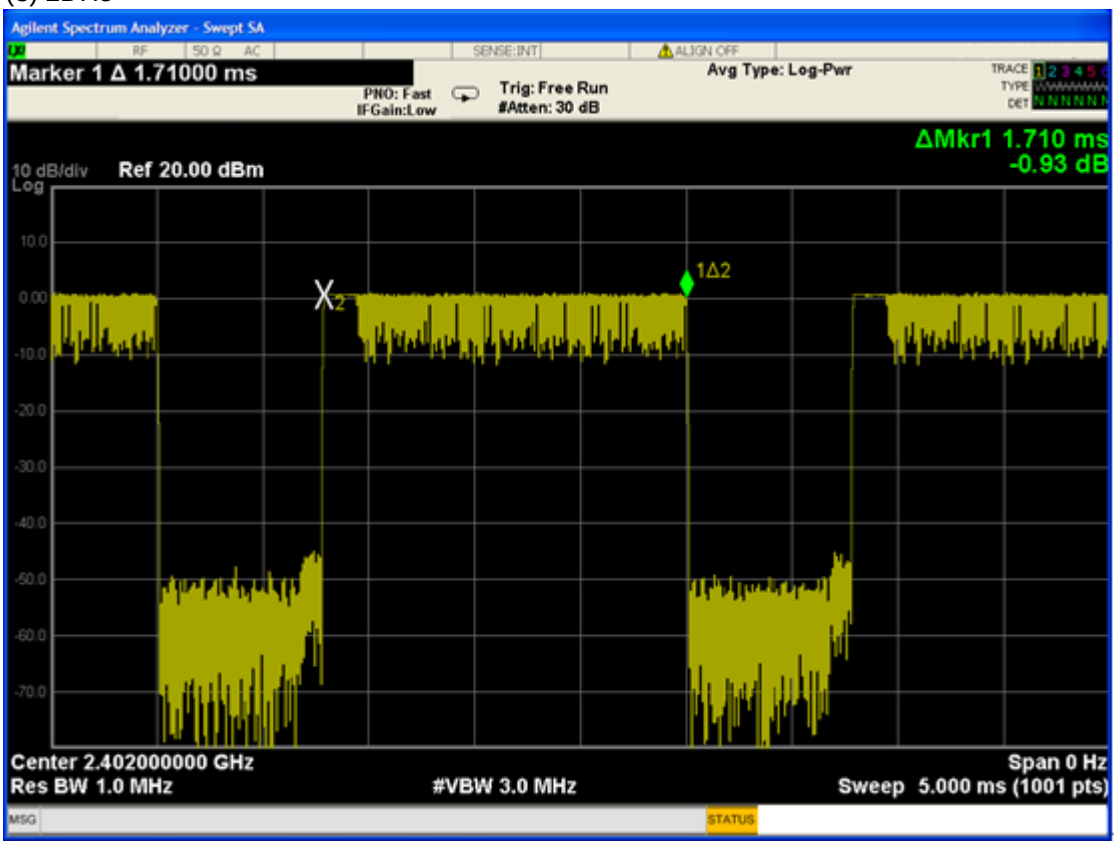
(1) 2DH1



(2) 2DH3

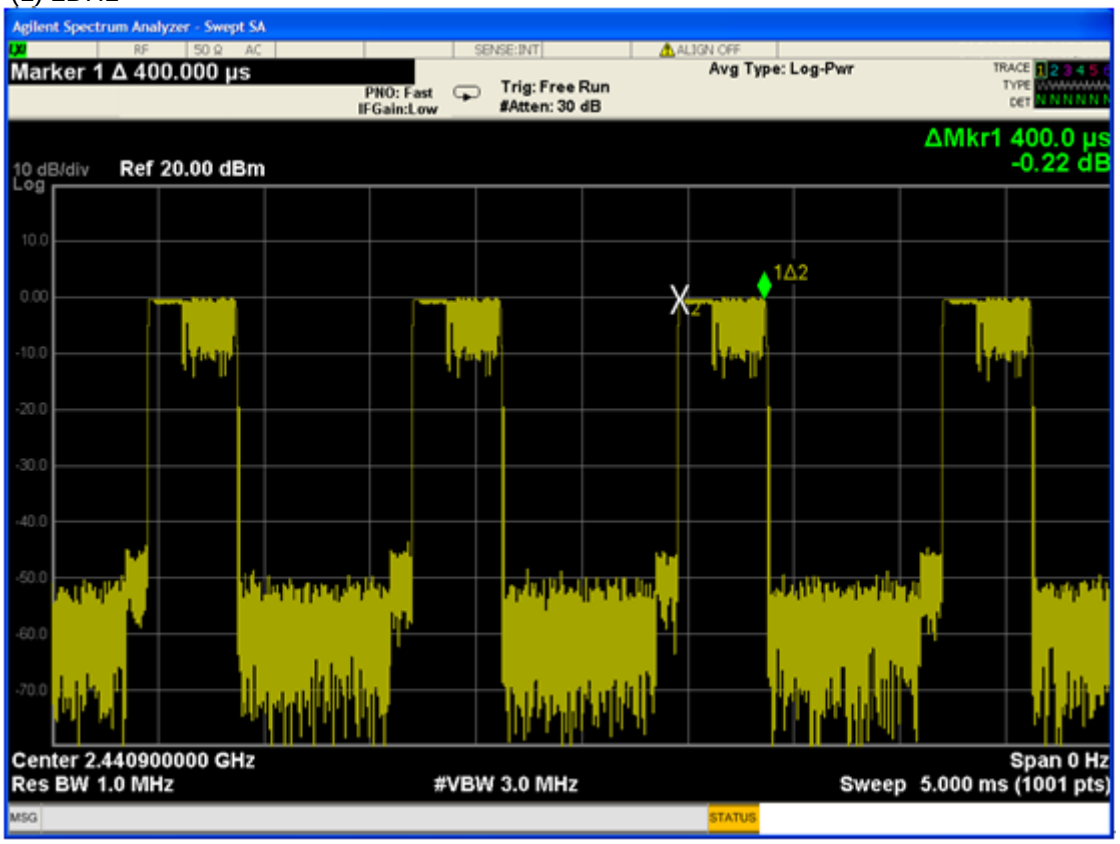

Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 1.66500 ms
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
ΔMkr1 1.665 ms
-0.87 dB
10 dB/div
Log
Ref 20.00 dBm
1Δ2
Center 2.402000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 5.000 ms (1001 pts)

(3) 2DH5

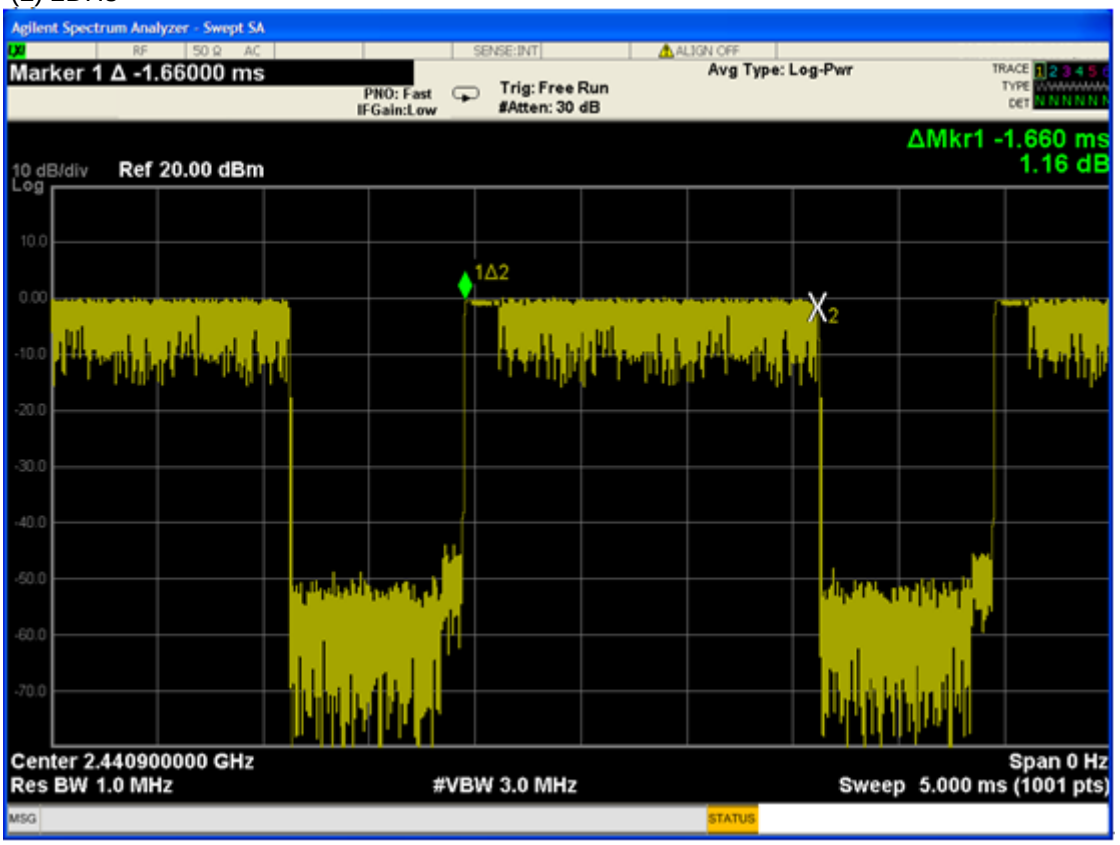

Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 1.71000 ms
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
ΔMkr1 1.710 ms
-0.93 dB
10 dB/div
Log
Ref 20.00 dBm
1Δ2
Center 2.402000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 5.000 ms (1001 pts)

5. Middle channel (2.441 GHz):

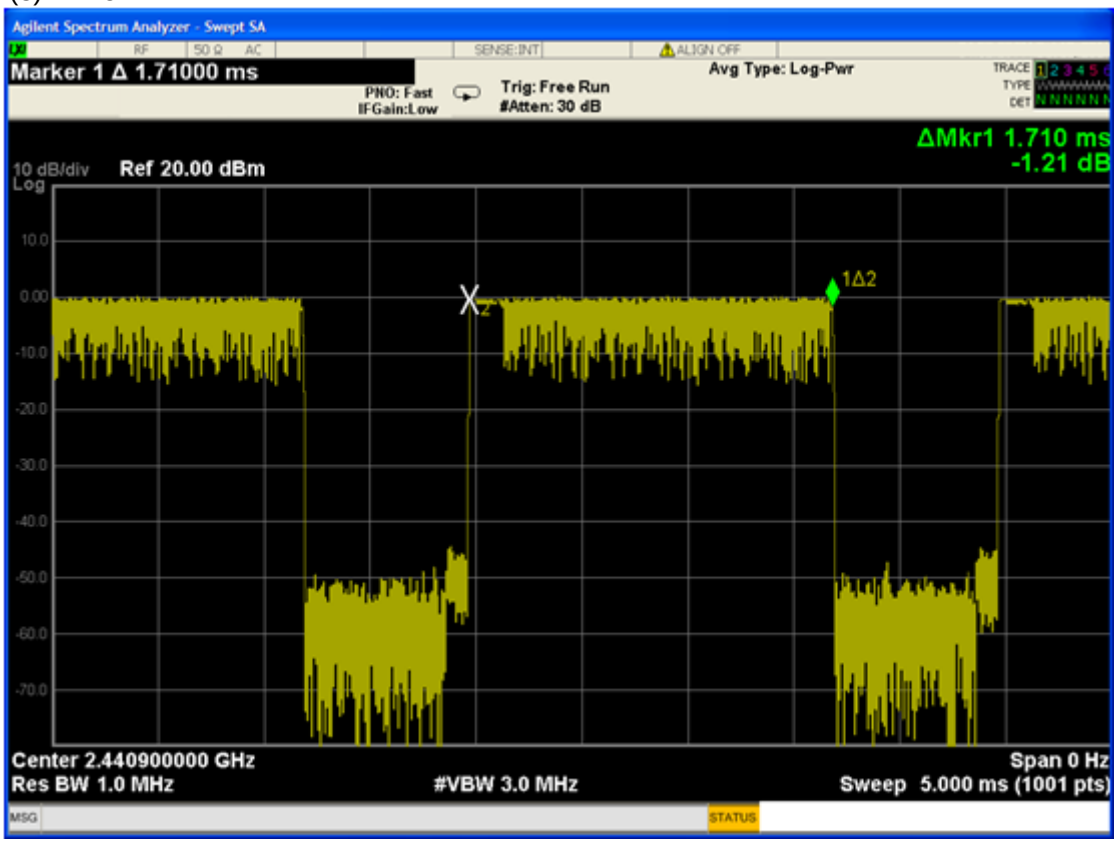
(1) 2DH1



(2) 2DH3

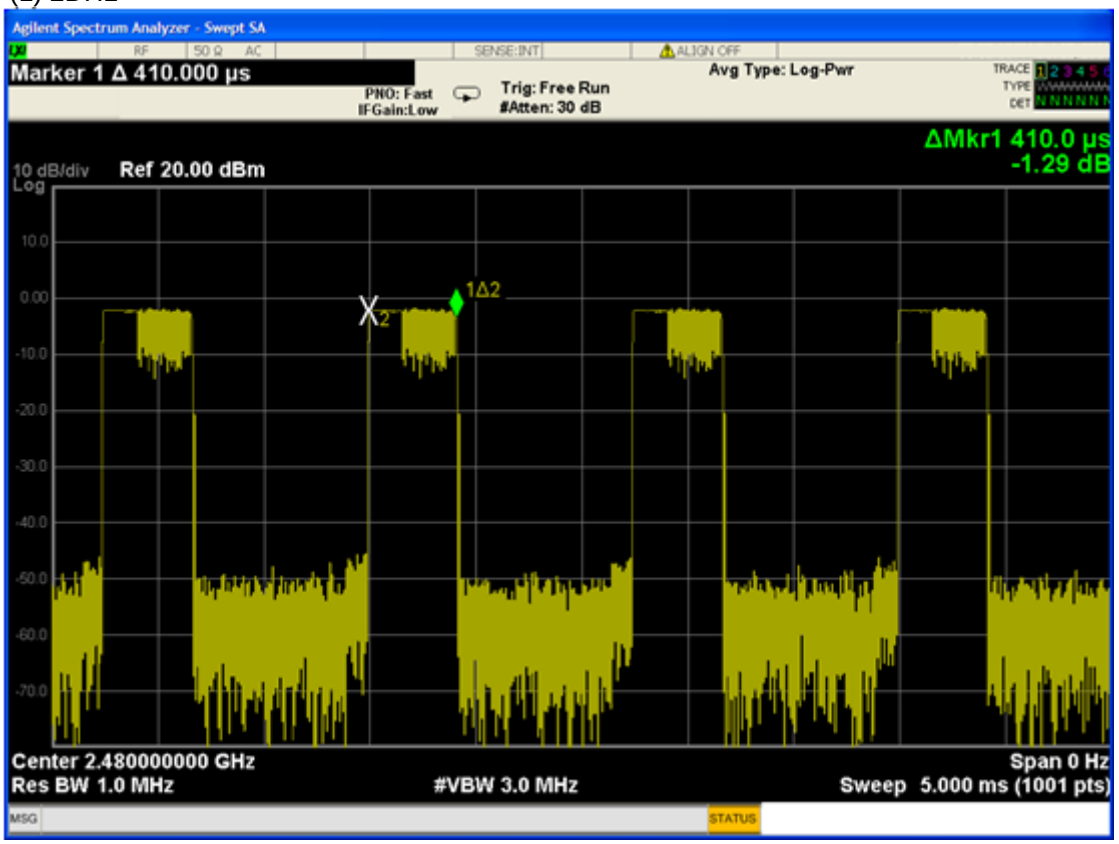


(3) 2DH5

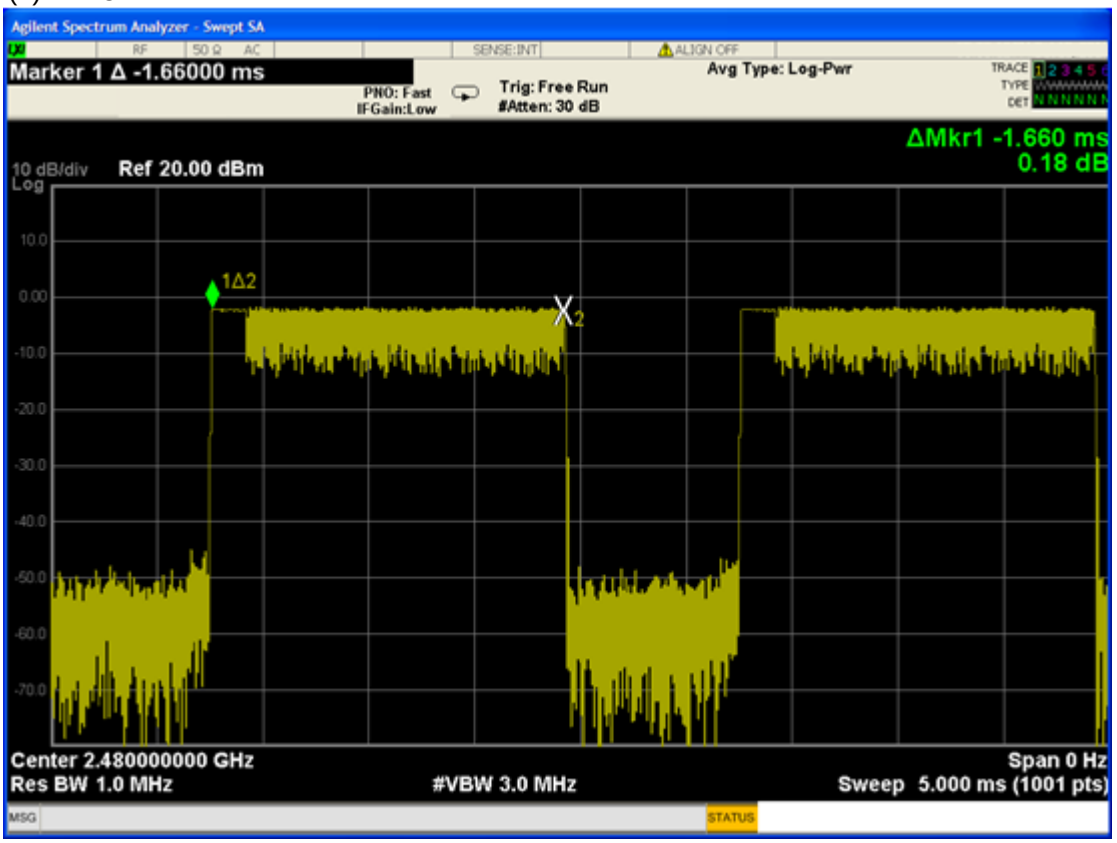


6. Highest channel (2.480 GHz):

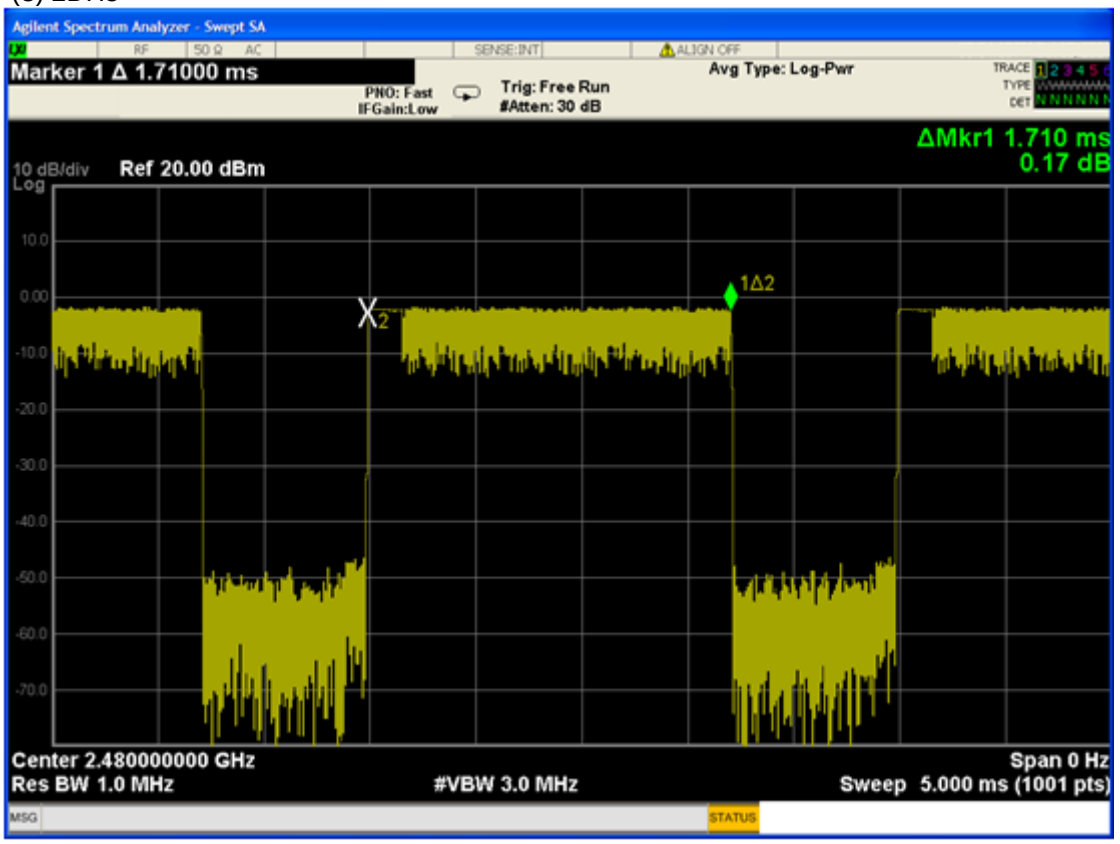
(1) 2DH1



(2) 2DH3

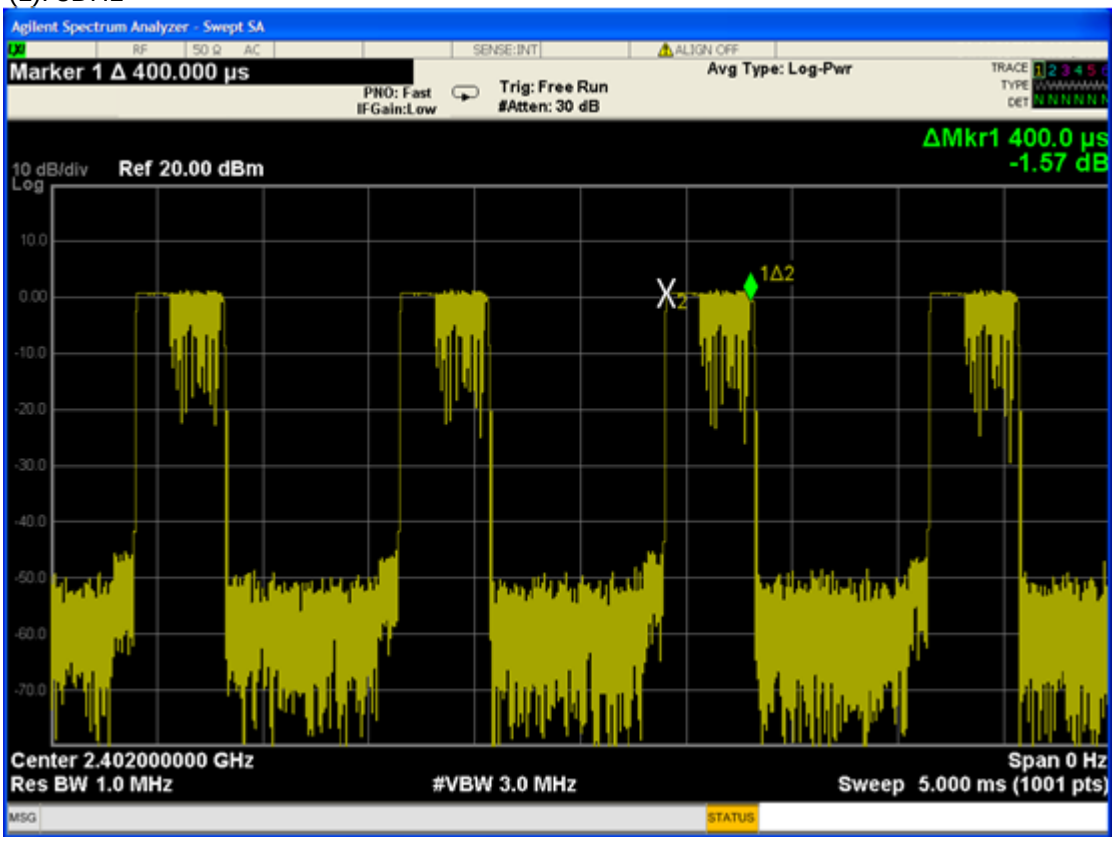

Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ -1.66000 ms
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
ΔMkr1 -1.660 ms
0.18 dB
10 dB/div
Log
Ref 20.00 dBm
1Δ2
X2
Center 2.480000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 5.000 ms (1001 pts)

(3) 2DH5

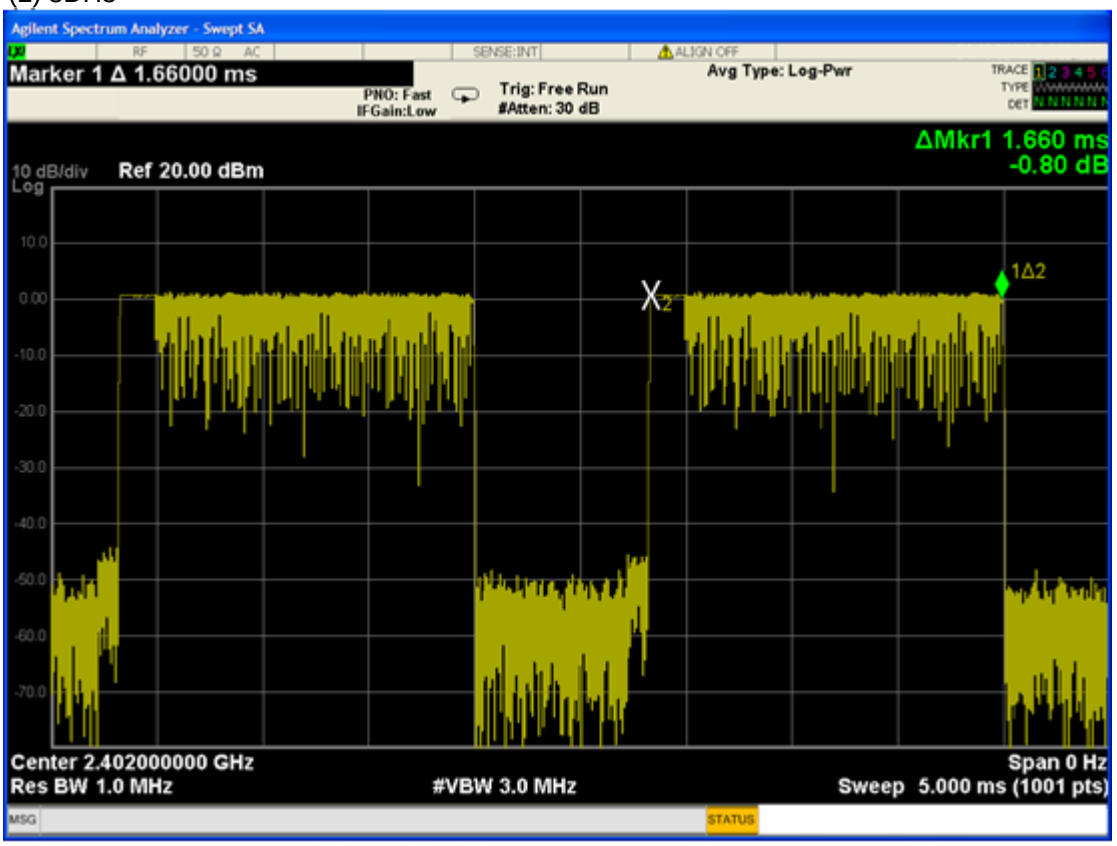

Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 1.71000 ms
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
ΔMkr1 1.710 ms
0.17 dB
10 dB/div
Log
Ref 20.00 dBm
1Δ2
X2
Center 2.480000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 5.000 ms (1001 pts)

7. Lowest channel (2.402 GHz):

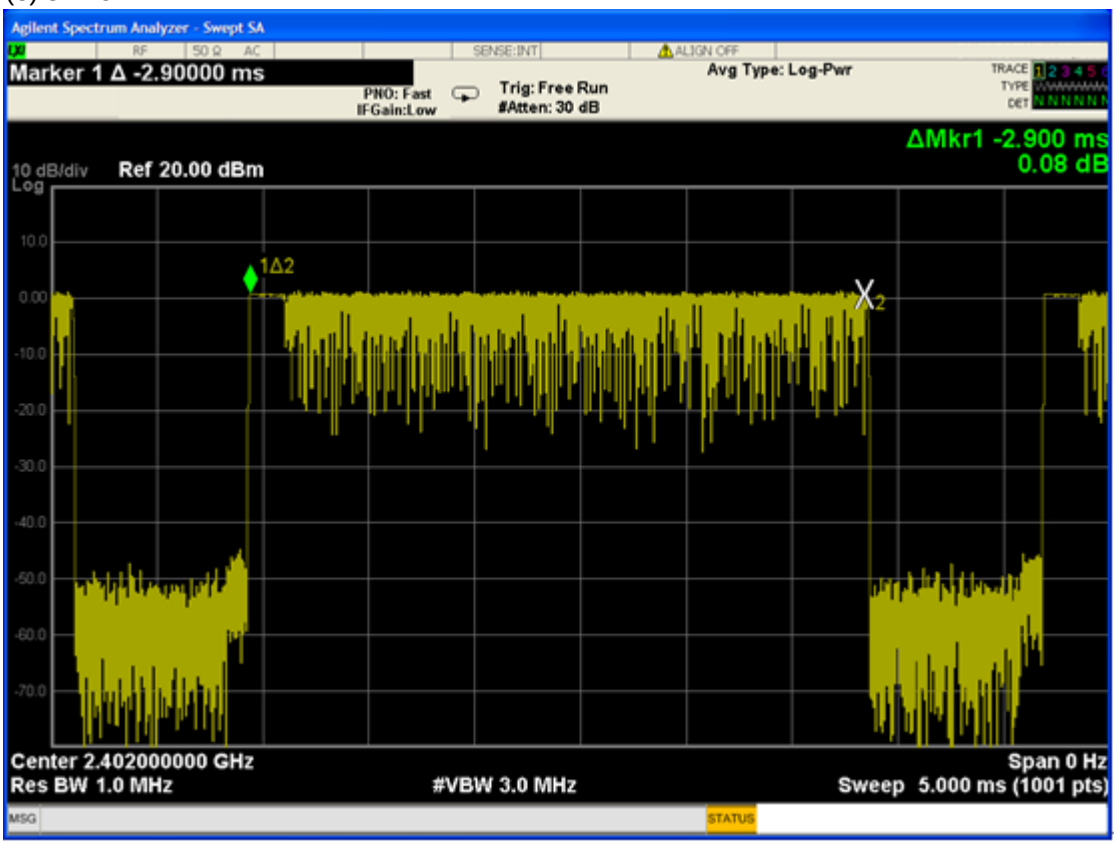
(1). 3DH1



(2) 3DH3

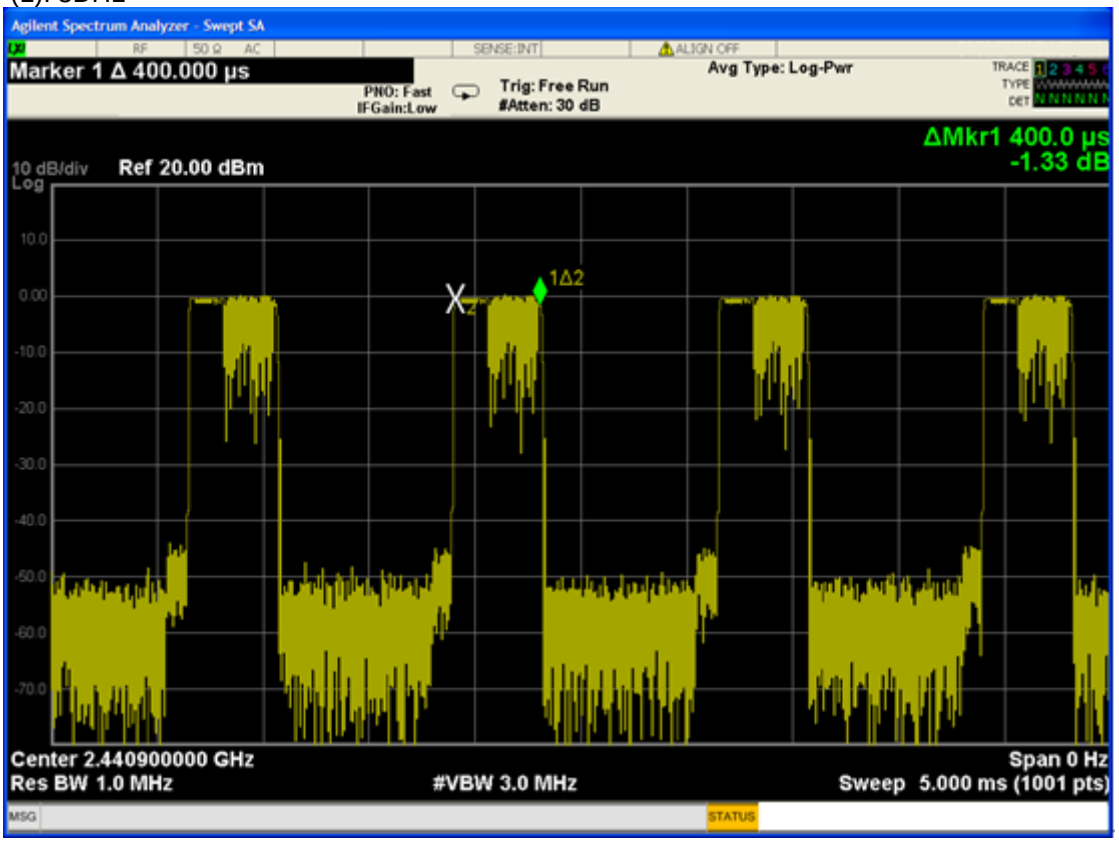


(3) 3DH5

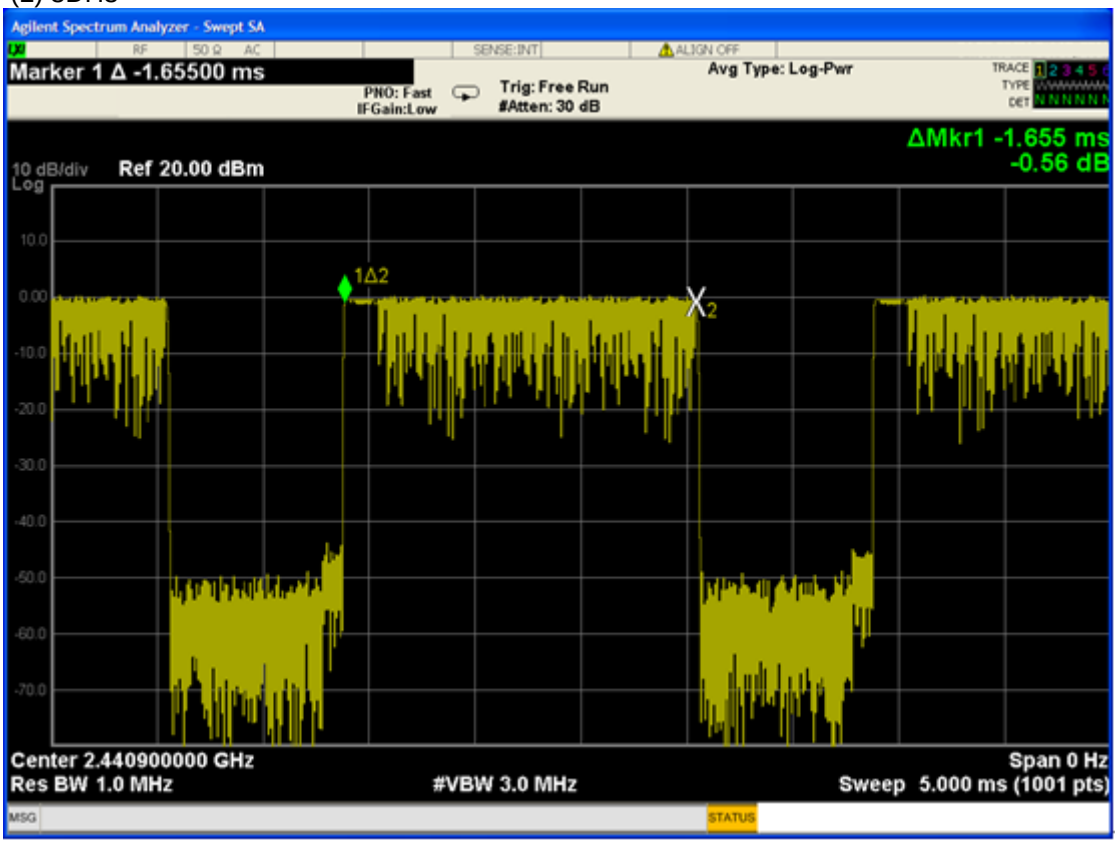


8. Middle channel (2.441 GHz):

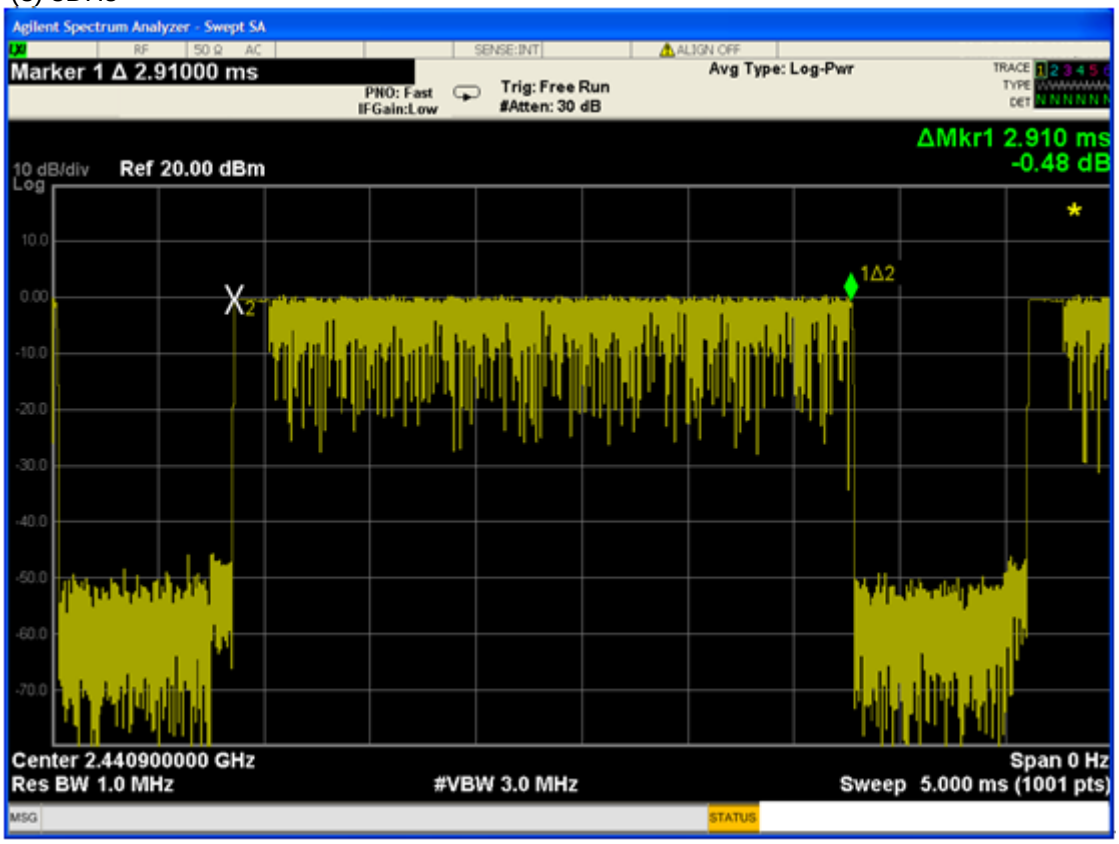
(1). 3DH1



(2) 3DH3

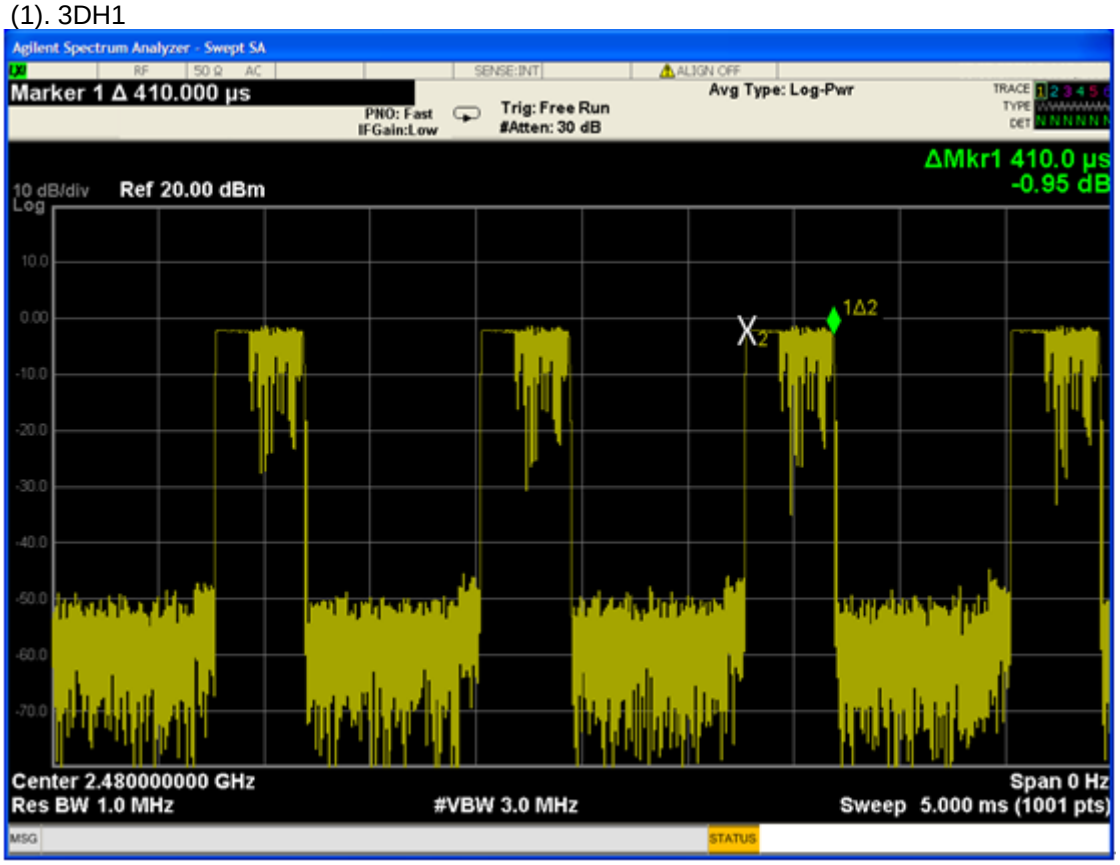

Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ -1.65500 ms
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
ΔMkr1 -1.655 ms
-0.56 dB
10 dB/div
Log
Ref 20.00 dBm
1Δ2
X2
Center 2.440900000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 5.000 ms (1001 pts)

(3) 3DH5

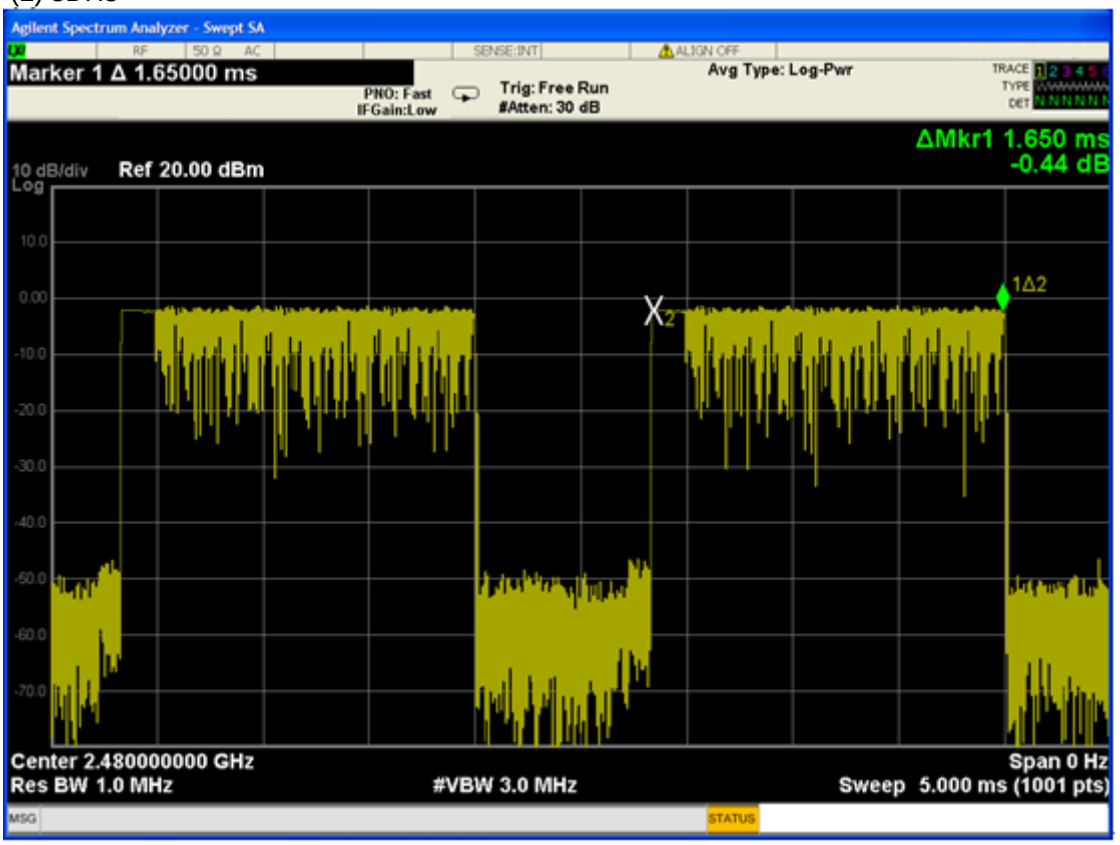

Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 2.91000 ms
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
ΔMkr1 2.910 ms
-0.48 dB
10 dB/div
Log
Ref 20.00 dBm
X2
1Δ2
Center 2.440900000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 5.000 ms (1001 pts)

9. Highest channel (2.480 GHz):

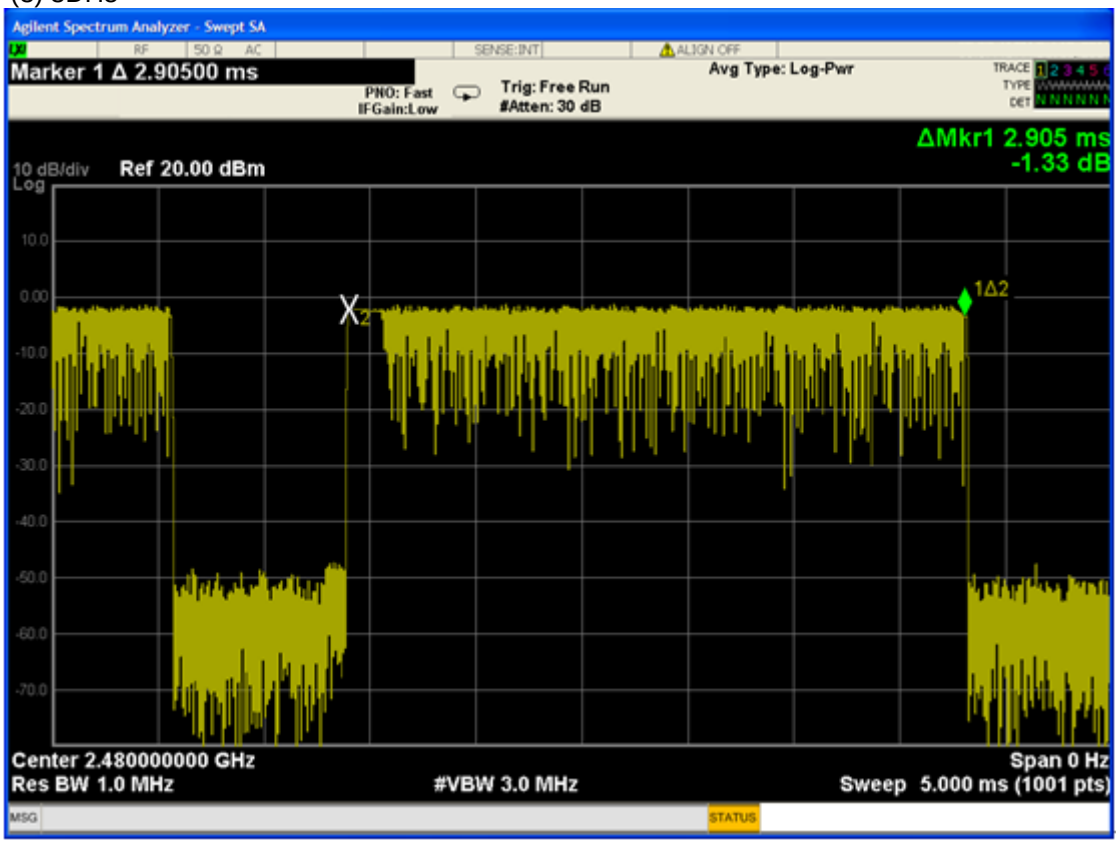
(1). 3DH1



(2) 3DH3



(3) 3DH5



Remark:

In communication data link mode (expect inquiry or page mode) the hopping rate is 1600 per second, the 79 channels will be randomly selected for RF channel, and each channel have equal probability to be selected. The hop selection scheme is defined in Clause 2.6 of Part B of Volume 2 of core specification of Bluetooth.

The Dwell time must be calculated via following formula:

Dwell time = Pulse wide x (Hopping rate / Number of channels) x Period

Period = 0.4 (seconds/ channel) x 79 (channel) = 31.6 seconds

So

Dwell time DH1= slot time * (1600/2/79) * 31.6

Dwell time DH3= slot time * (1600/4/79) * 31.6

Dwell time DH5= slot time * (1600/6/79) * 31.6

The RF channel will remain fixed for duration of a packet, that means for DH3 packet the RF frequency will remain unchanged during 3 slots (1slot=1/1600=625us), and for DH5 packet the RF frequency will remain unchanged during 5 slots, illustrated the principle as below:

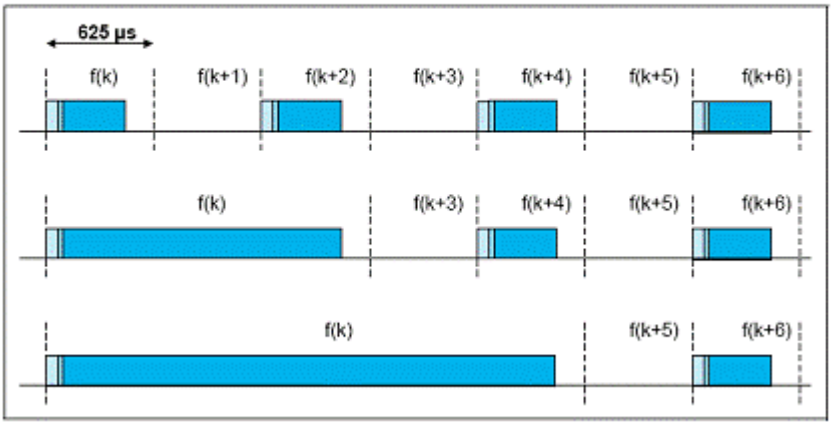


Figure 2.14: Single- and multi-slot packets.

Therefore, in a certain period for different packet types, the quantities of hops (not hopping rate 1600) are different, accurately, the quantity of hops for DH1 is double of DH3's and triple of DH5's. "for DH1 packet, 1 hop in 1 slot; for DH3 packet, ½ hop in 1 slot; for DH5 packet, 1/3 hop in 1 slot.", explained as below:

From the illustrated hopping scheme:
For DH1, in two slots, there are two hops, i.e. f(k) in Slot(k), f(k+1) in Slot(k+1), means DH1 1 hop in 1 slot;

For DH3, in four slots, there are two hops, i.e. f(k) in Slot(k) & Slot(k+1) & Slot(k+2), f(k+3) in Slot(k+3), means DH3 2 hops in four slots -> ½ hop in 1 slot;
For DH5, in six slots, there are two hops, i.e. f(k) in Slot(k) & Slot(k+1) & Slot(k+2) & Slot(k+3) & Slot(k+4), f(k+5) in Slot(k+5), means DH3 2 hops in six slots -> 1/3 hop in 1 slot.

The Hopping rate in the formula should not be fixed value, for DH1, it is 1600/2; for DH3, it is 1600/4; for DH5, it is 1600/6.
To calculate Dwell time of data transmission of Bluetooth system, the worst case is for Bluetooth PICONET that contains two devices only (although Bluetooth PICONET can support up to eight devices), and for Bluetooth data transmission, after device A sending a packet to device B, device A must get response packet from device B to continue data transmission;

For DH1 packet: assume device A is EUT, the worst case is after device A sending a DH1 packet to device B, device A gets a DH1 response packet from device B, that means device A needs 1 time slot for transmitting and 1 time slot for receiving, therefore, the actual hopping rate of device A is half of 1600, i.e. 800 hops per second for EUT;

For DH3 packet: assume device A is EUT, the worst case is after device A sending a DH3 packet to device B, device A gets a DH1 response packet from device B, that means device A needs 3 time slots for transmitting and 1 time slot for receiving, therefore, the actual hopping rate of device A is quarter of 1600, i.e. 400 hops per second for EUT;

For DH5 packet: assume device A is EUT, the worst case is after device A sending a DH5 packet to device B, device A gets a DH1 response packet from device B, that means device A needs 5 time slots for transmitting and 1 time slot for receiving, therefore, the actual hopping rate of device A is sixth of 1600, i.e. 1600/6=266.7 hops per second for EUT;

5.7 Maximum Peak Output Power

Test Requirement: FCC Part 15 C section 15.247

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

0.125 watts.

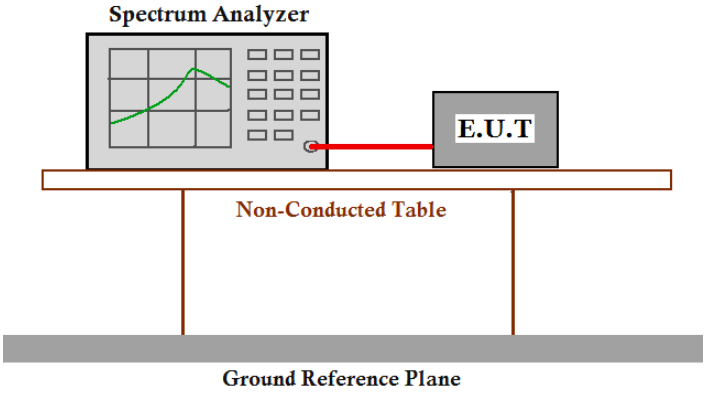
Refer to the result “Hopping channel number” of this document. The 1 watt (30.0 dBm) limit applies.

Test Method: ANSI C63.10: Clause 6.10 & DA 00-705

Test Limit:

Test mode: Pre-test the EUT in continuous transmitting mode at the lowest, middle and highest channel with different data packet. Compliance test in continuous transmitting mode with normal (DH5), EDR mode (2DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

1 . Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.

2 . Set the spectrum analyzer: RBW = 3 MHz. VBW = 3 MHz. Sweep = auto; Detector Function = Peak.

3 . Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

Test Result: (For Bluetooth)

Normal mode:

Test Channel	Fundamental Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Result
Lowest	2402	1.80	21.0	Pass
Middle	2441	0.97	21.0	Pass
Highest	2480	0.07	21.0	Pass

EDR mode(2DH5):

Test Channel	Fundamental Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Result
Lowest	2402	0.72	21.0	Pass
Middle	2441	-0.51	21.0	Pass
Highest	2480	-1.94	21.0	Pass

EDR mode(3DH5):

Test Channel	Fundamental Frequency	Output Power (dBm)	Limit (dBm)	Result
Lowest	2402	0.75	21.0	Pass
Middle	2441	-0.49	21.0	Pass
Highest	2480	-1.85	21.0	Pass

Remark: cable lose=0.5dB

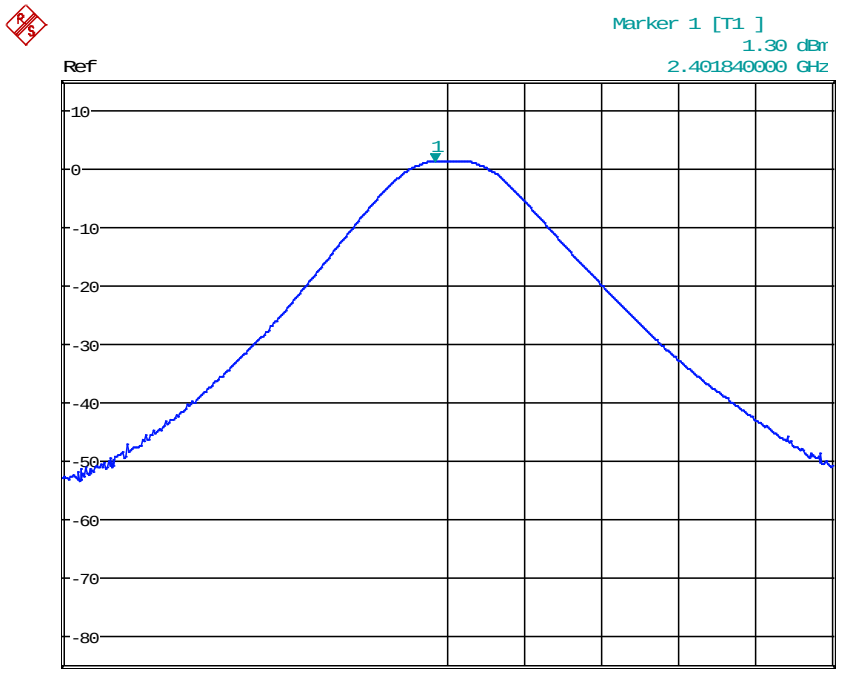
Test result: The unit does meet the FCC requirements.

Test result plot as follows:

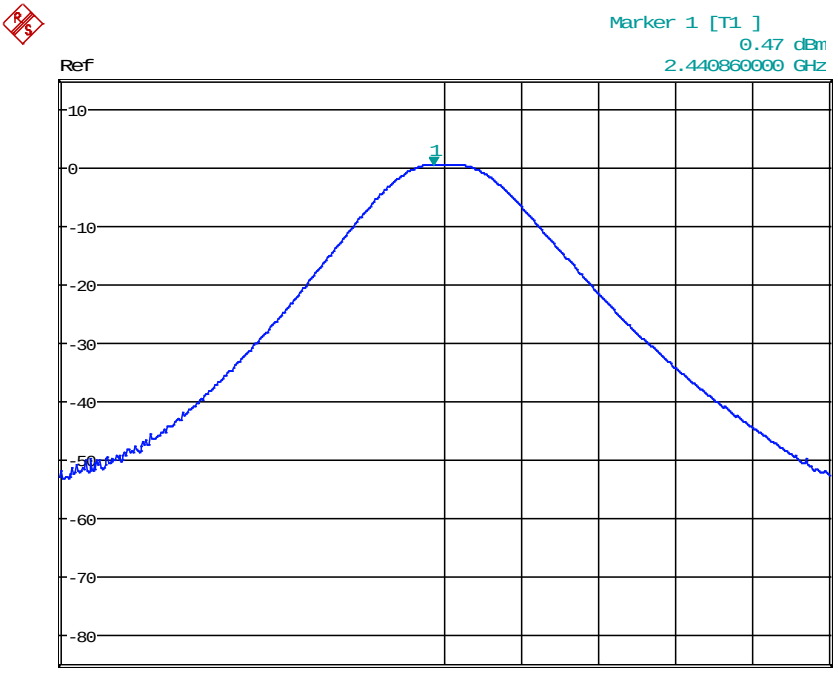
For bluetooth

Normal mode:

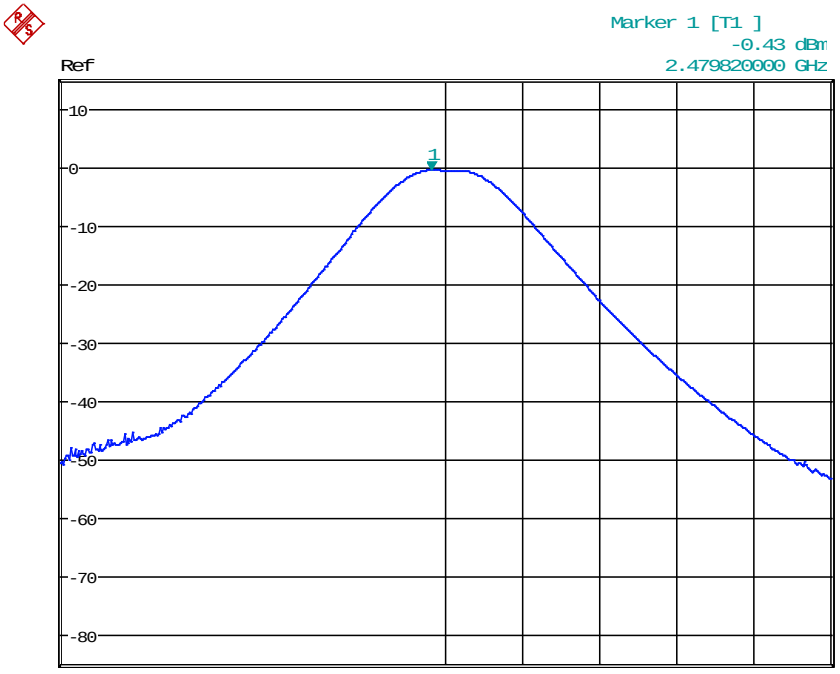
Lowest Channel:



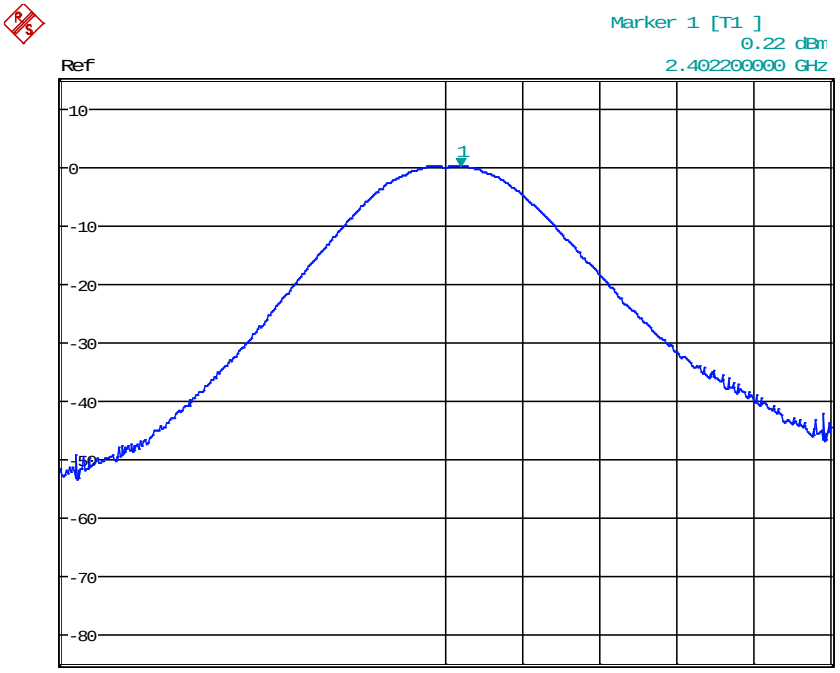
Middle Channel:



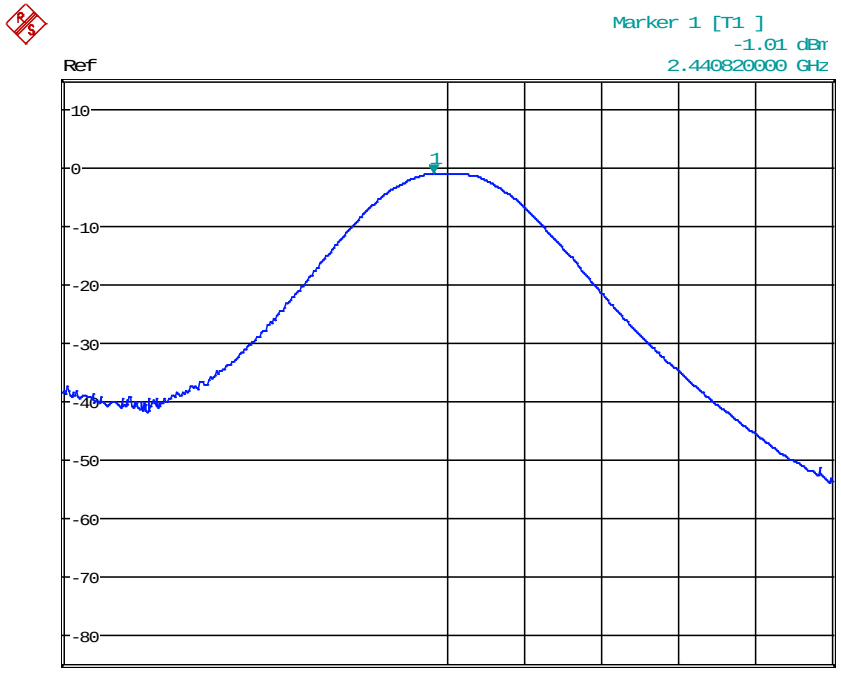
Highest Channel:



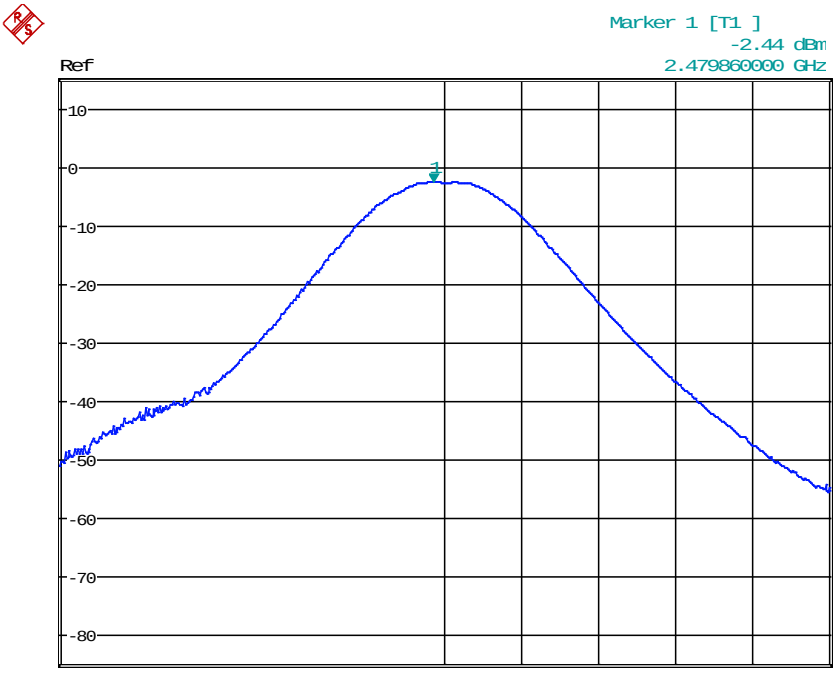
EDR mode (2DH5):
Lowest Channel:



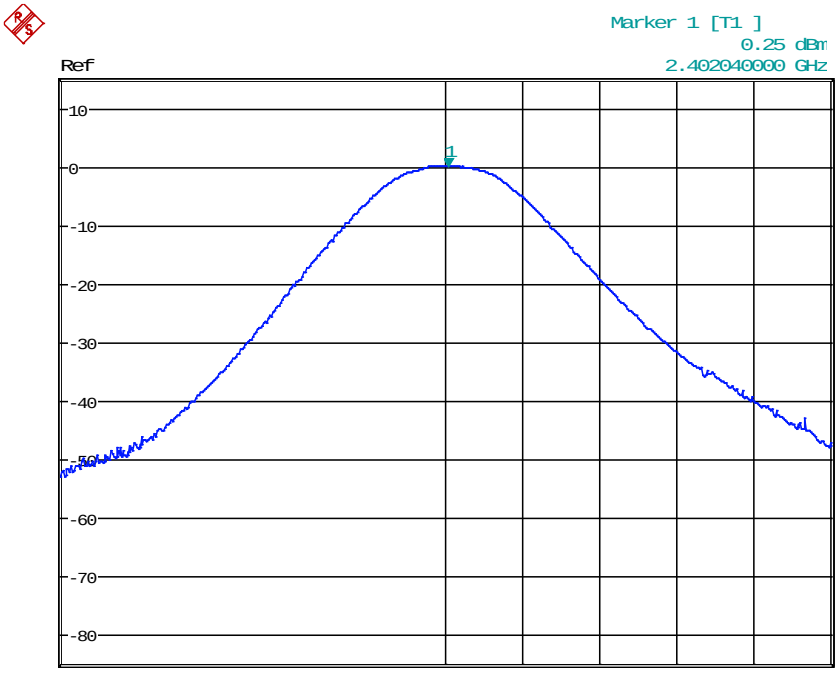
Middle Channel:



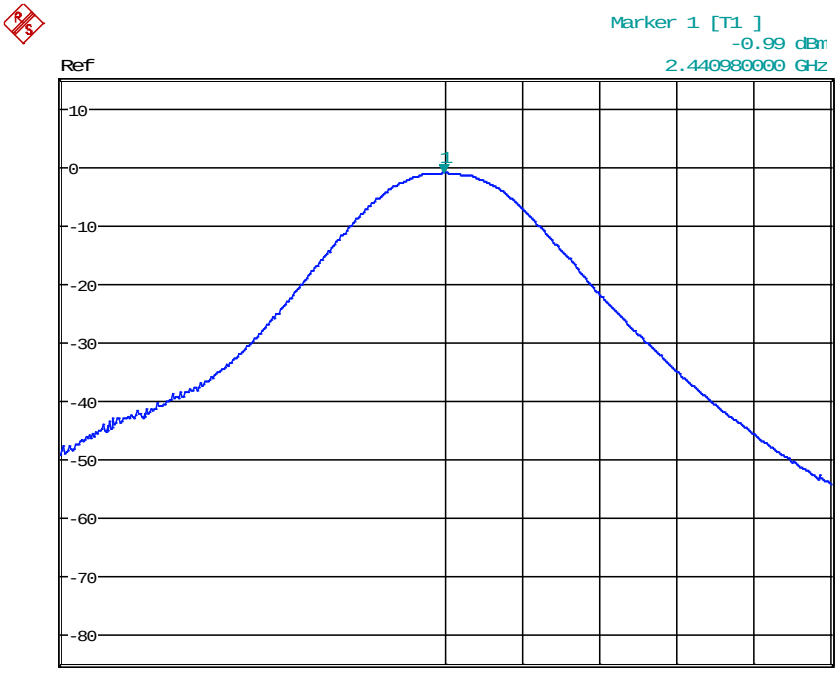
Highest Channel:



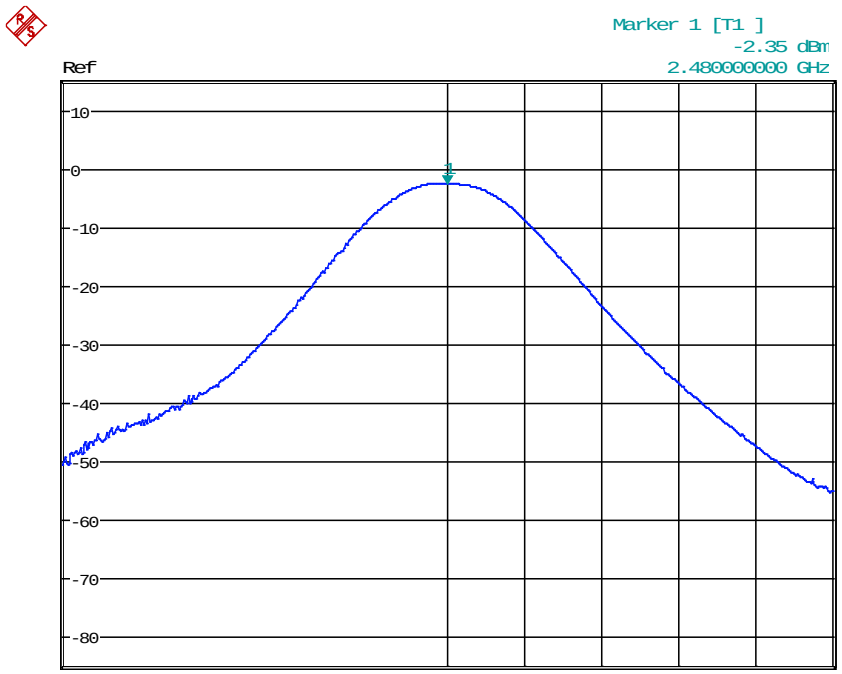
EDR mode (3DH5):
Lowest Channel:



Middle Channel:



Highest Channel:



5.8 Conducted Spurious Emissions

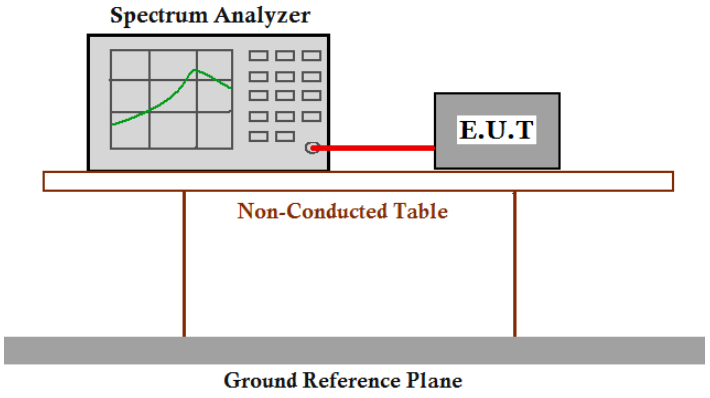
Test Requirement: FCC Part15 C section 15.247

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Based on either an RF conducted or a radiated measurement. Provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Method: ANSI C63.10: Clause 6.7 & DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest, middle and highest channel with different data packet. Compliance test in continuous transmitting mode with normal (DH5), EDR mode (2DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure:

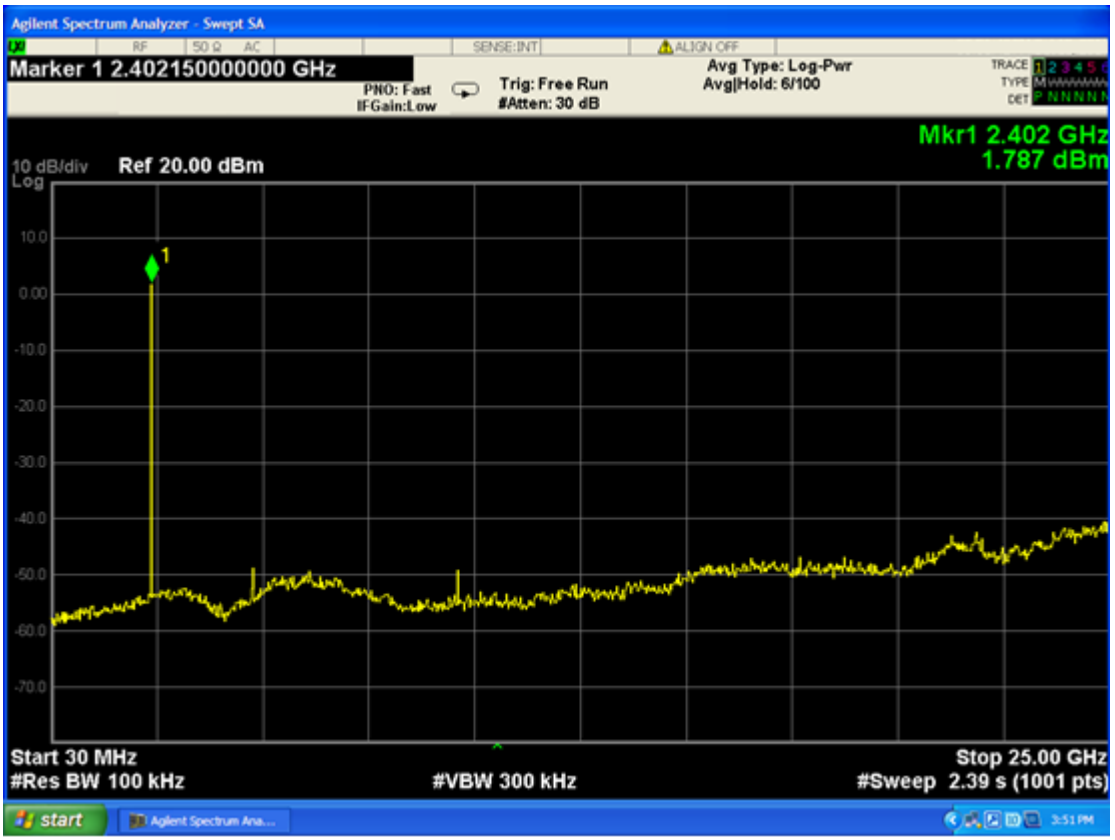
1. Remove the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 100 kHz. VBW >= RBW. Sweep = auto; Detector Function = Peak (Max. hold).

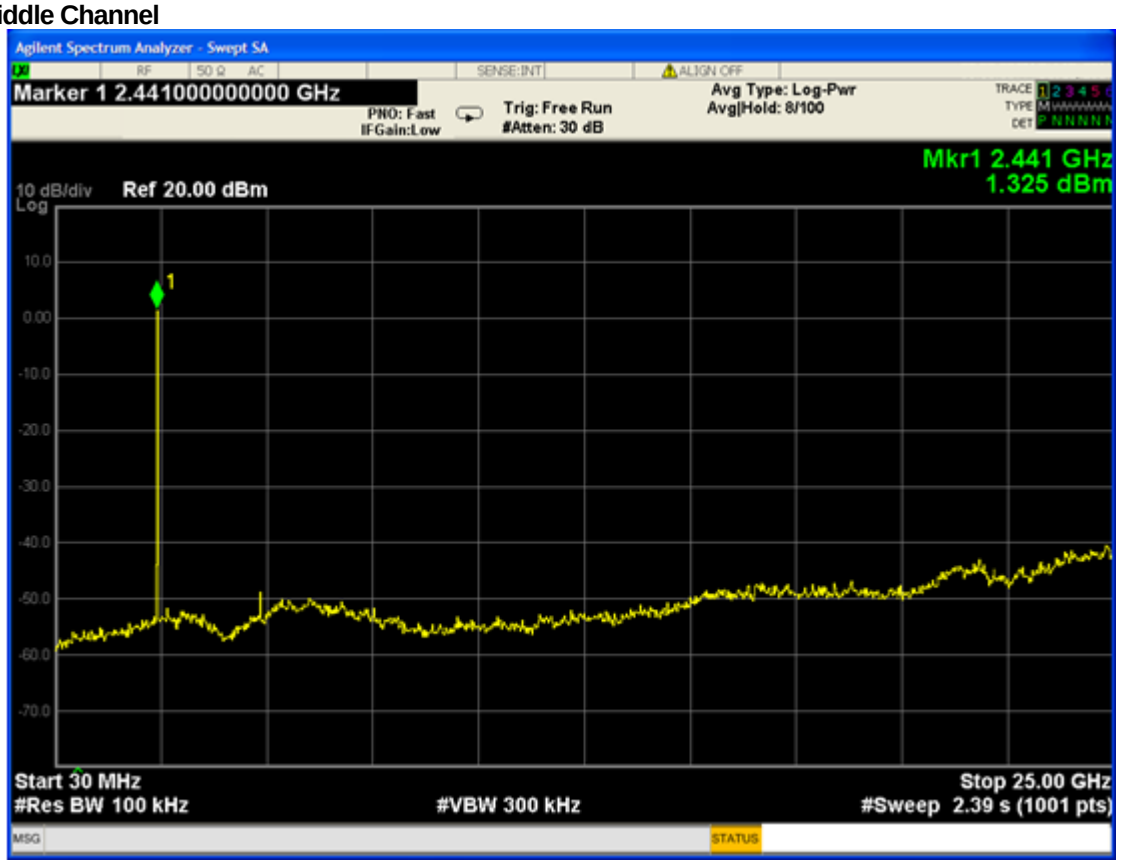
For bluetooth

Test result plot as follows (Normal mode):

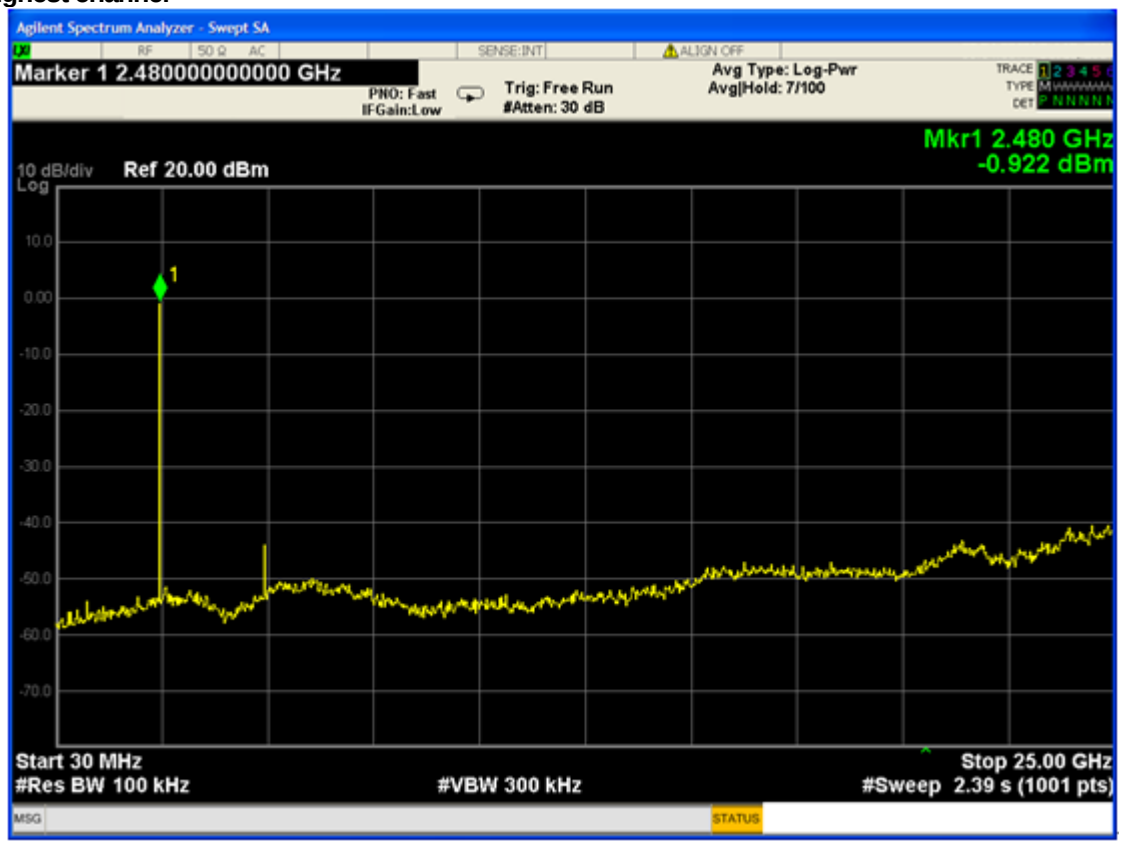
Lowest Channel:



Middle Channel

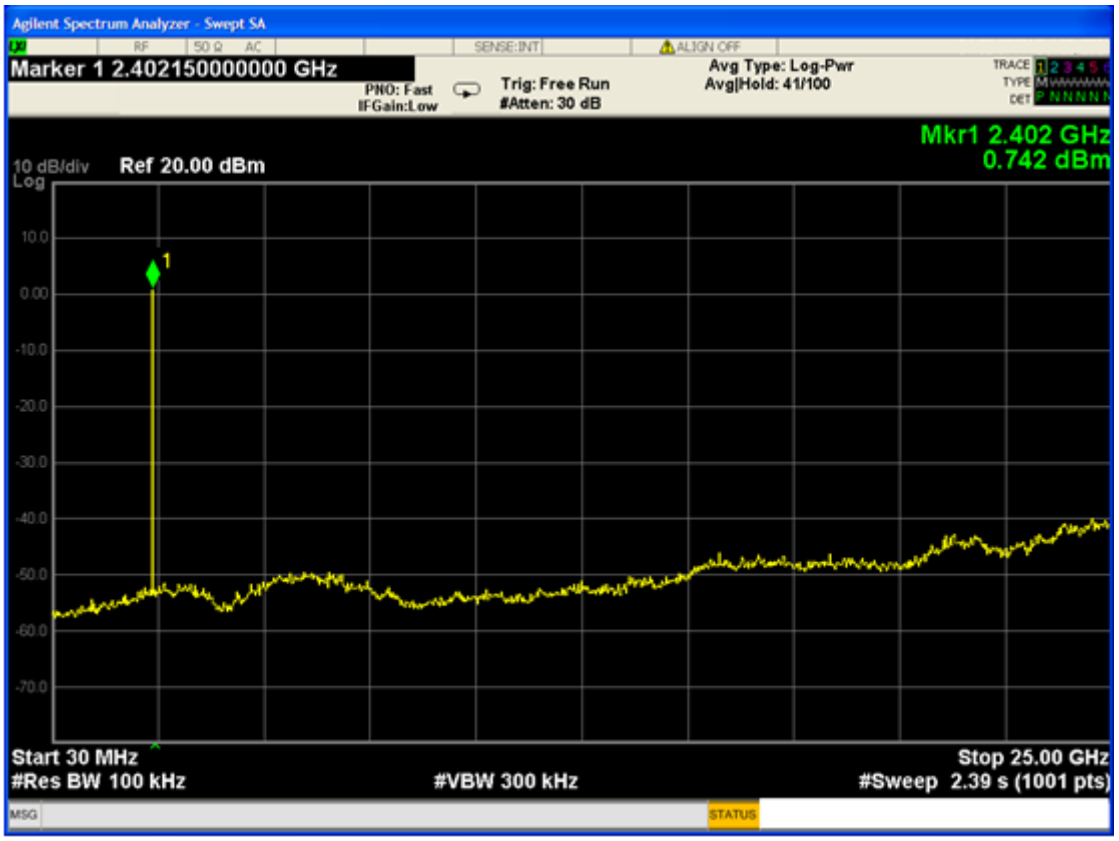


Highest channel



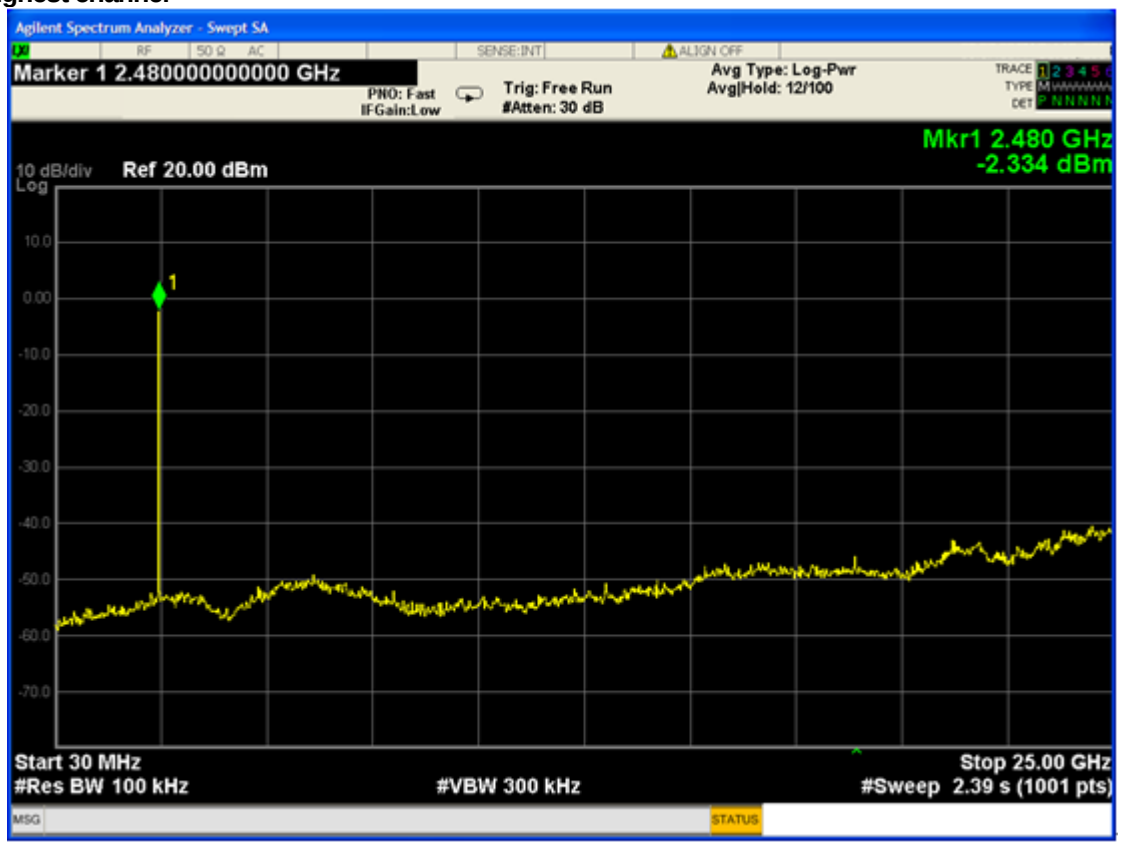
Test result plot as follows (EDR mode-2DH5):

Lowest Channel:



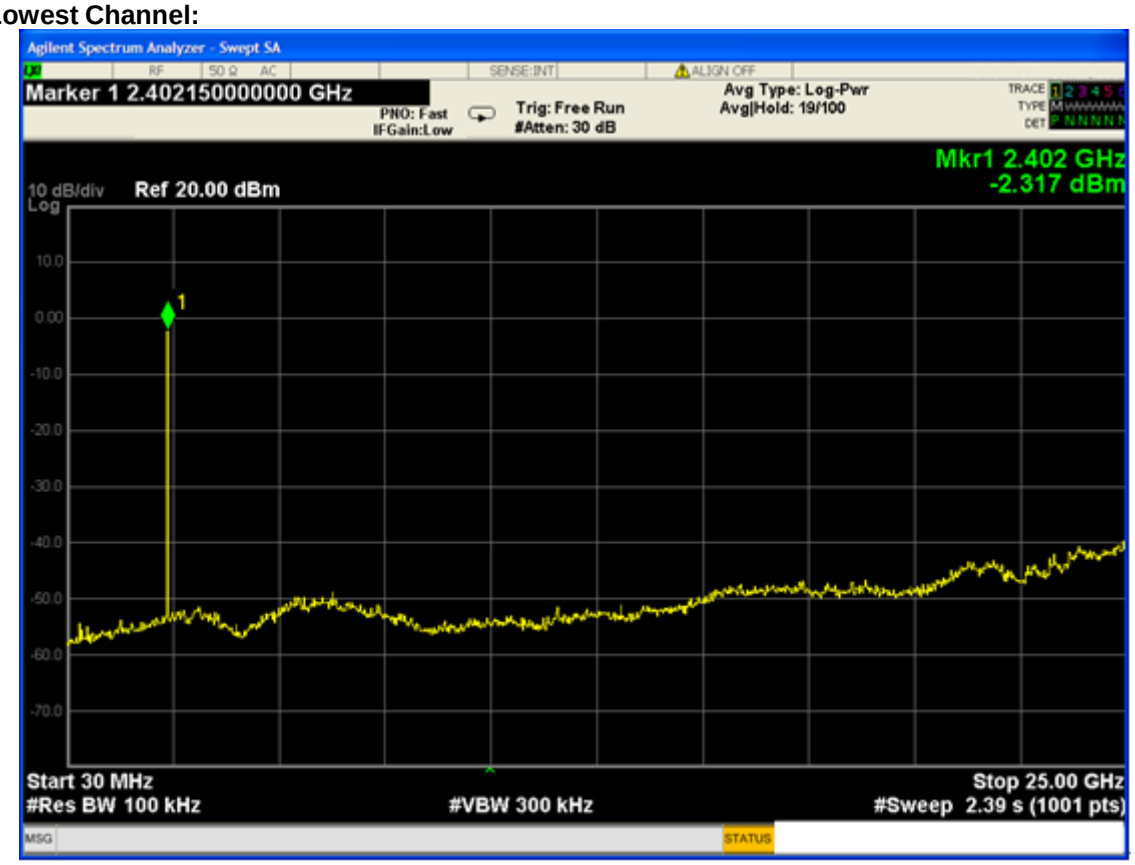
Middle Channel

Highest channel

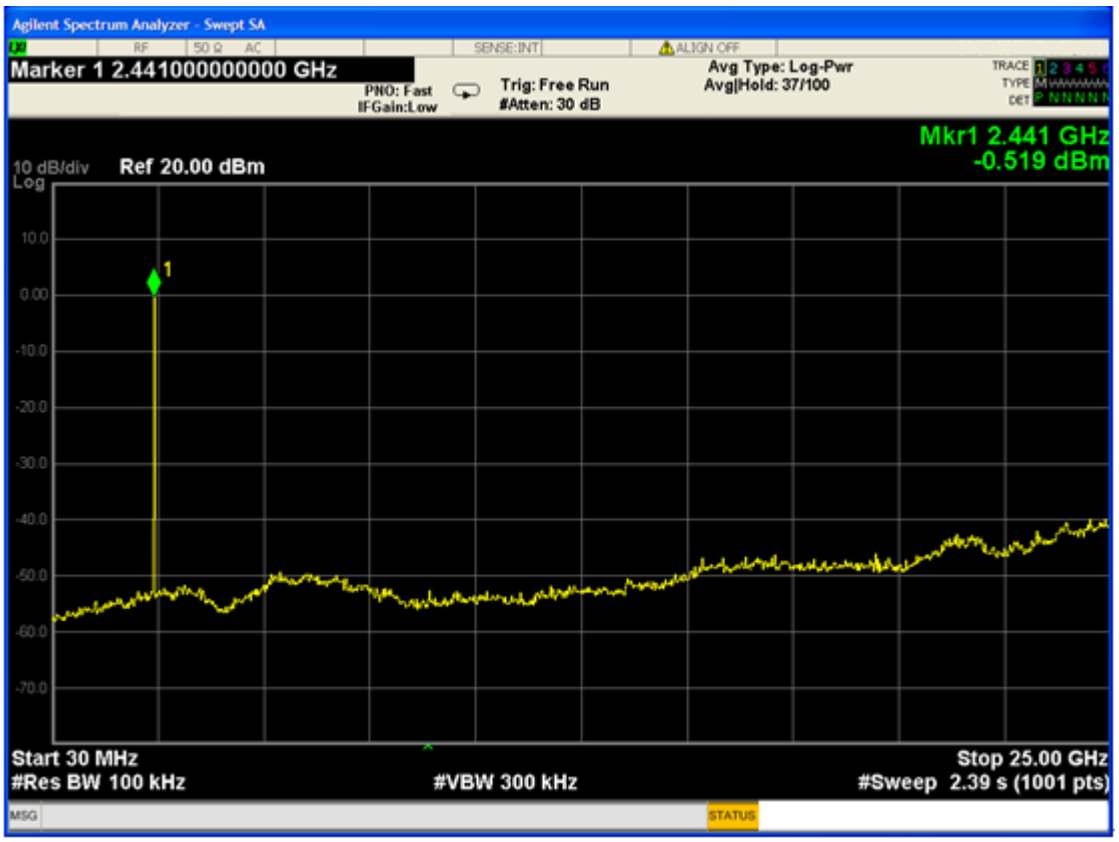


Test result plot as follows (EDR mode-3DH5):

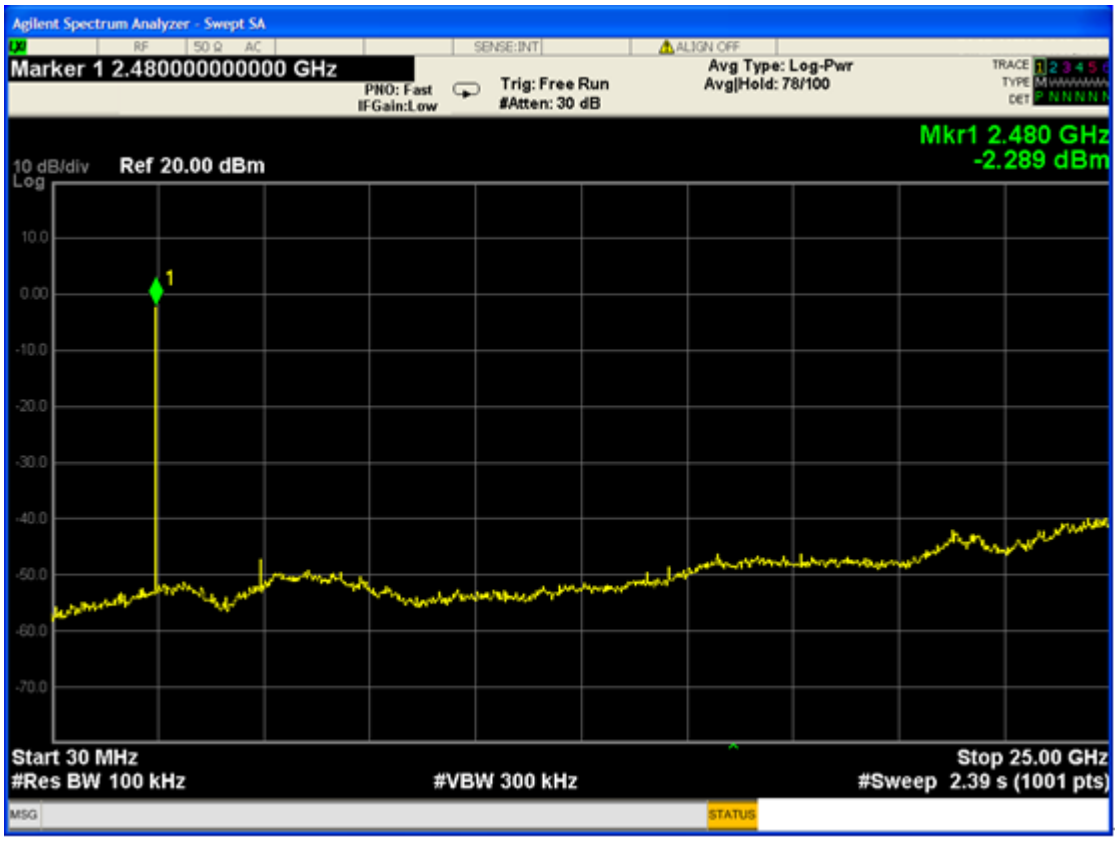
Lowest Channel:



Middle Channel



Highest channel



5.9 Radiated Spurious Emissions

Test Requirement: FCC Part15 C section 15.247

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that Contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, and provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Method: ANSI C63.10: Clause 6.4, 6.5 and 6.6 & DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest, middle and highest channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.

Detector: For PK value:

RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz, 9kHz for <30MHz
VBW ≥ RBW
Sweep = auto

Detector function = peak

Trace = max hold

For AV value:

RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz, 9kHz for <30MHz

VBW =10 Hz

Sweep = auto

Detector function = peak

Trace = max hold

15.209 Limit: 40.0 dBµV/m between 30MHz & 88MHz

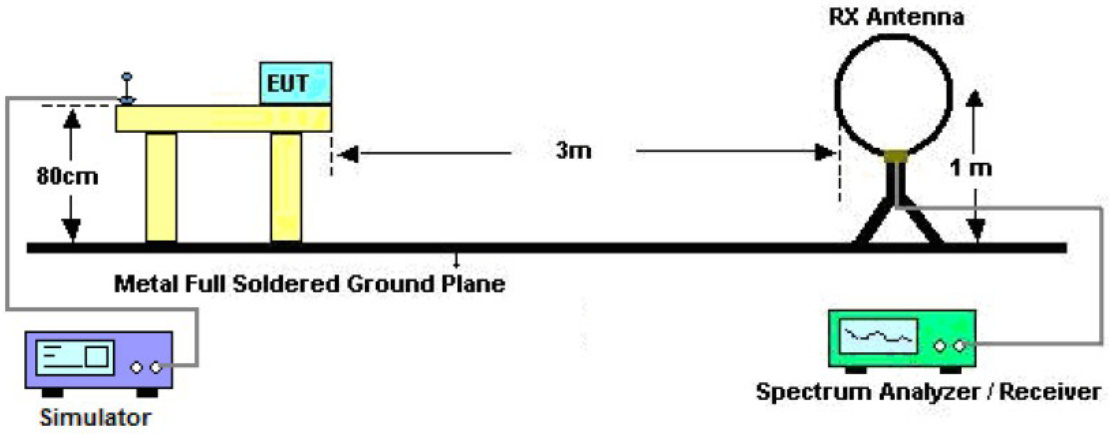
43.5 dBµV/m between 88MHz & 216MHz

46.0 dBµV/m between 216MHz & 960MHz

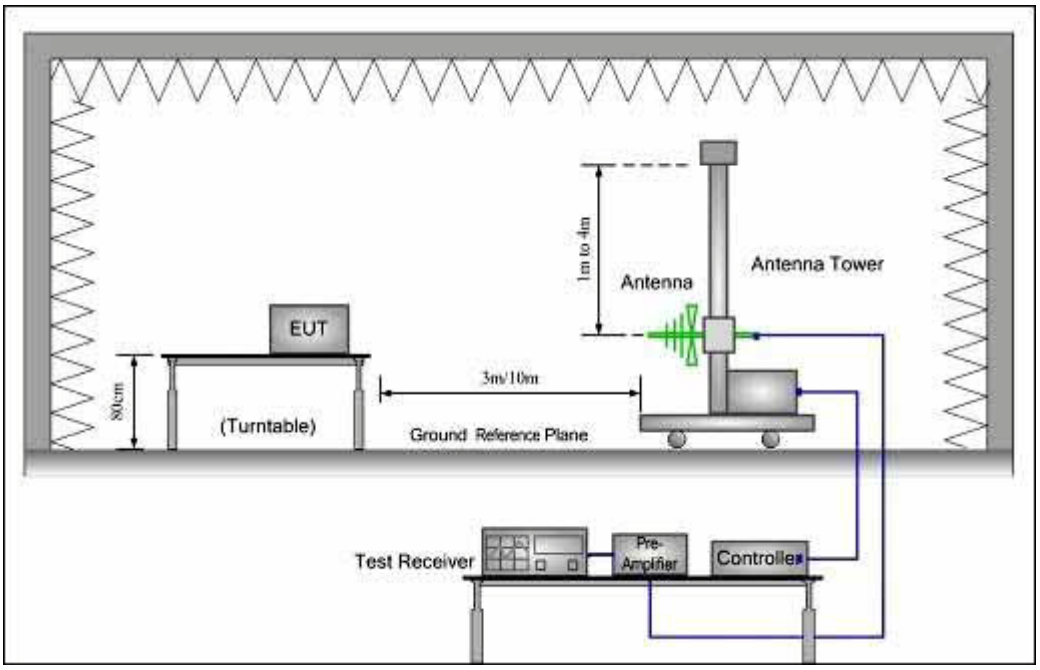
54.0 dBµV/m above 960MHz

Test Configuration:

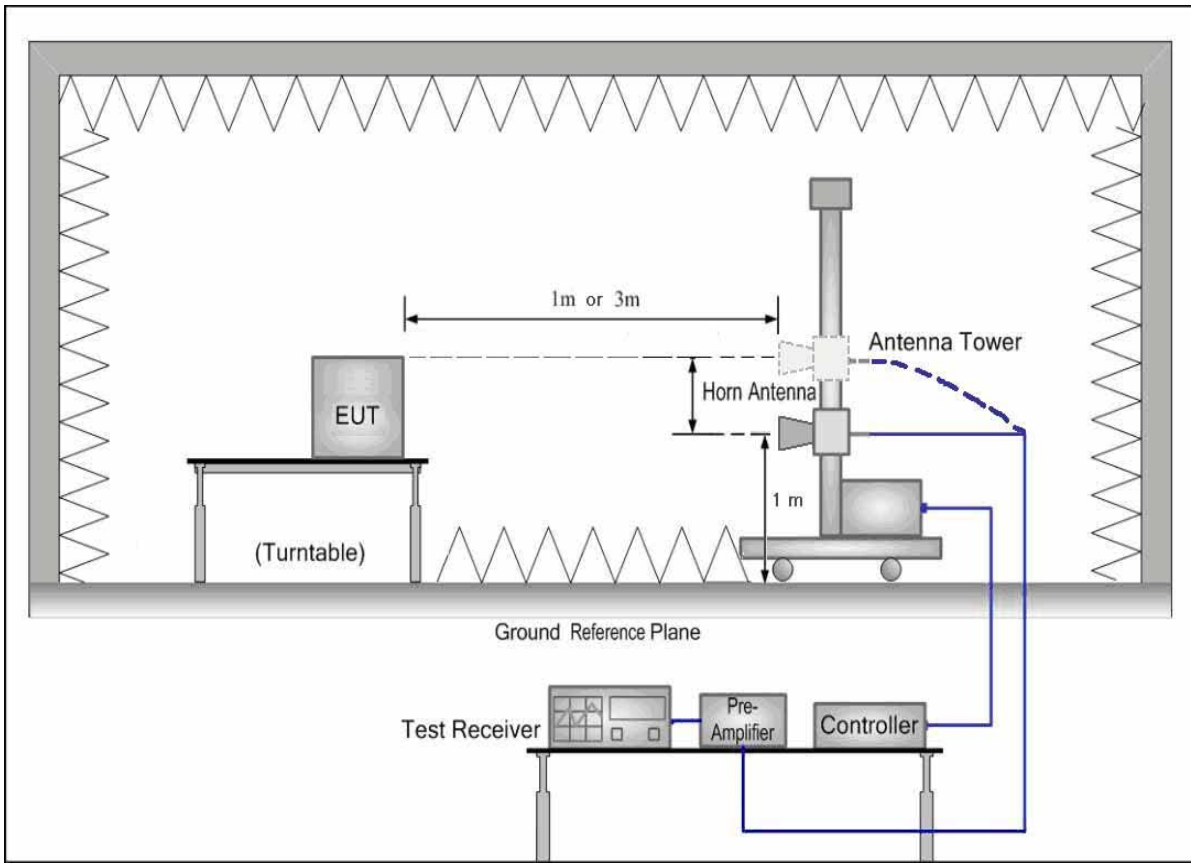
1) 9kHz to 30MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 40 GHz emissions:



Test Procedure: The procedure used was ANSI Standard C63.4:2003. The receiver was scanned from 30MHz to 25GHz.When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit.

Submit this data.

5.9.1 Harmonic and other spurious emissions

Test at low Channel in transmitting status

9kHz~30MHz Test result

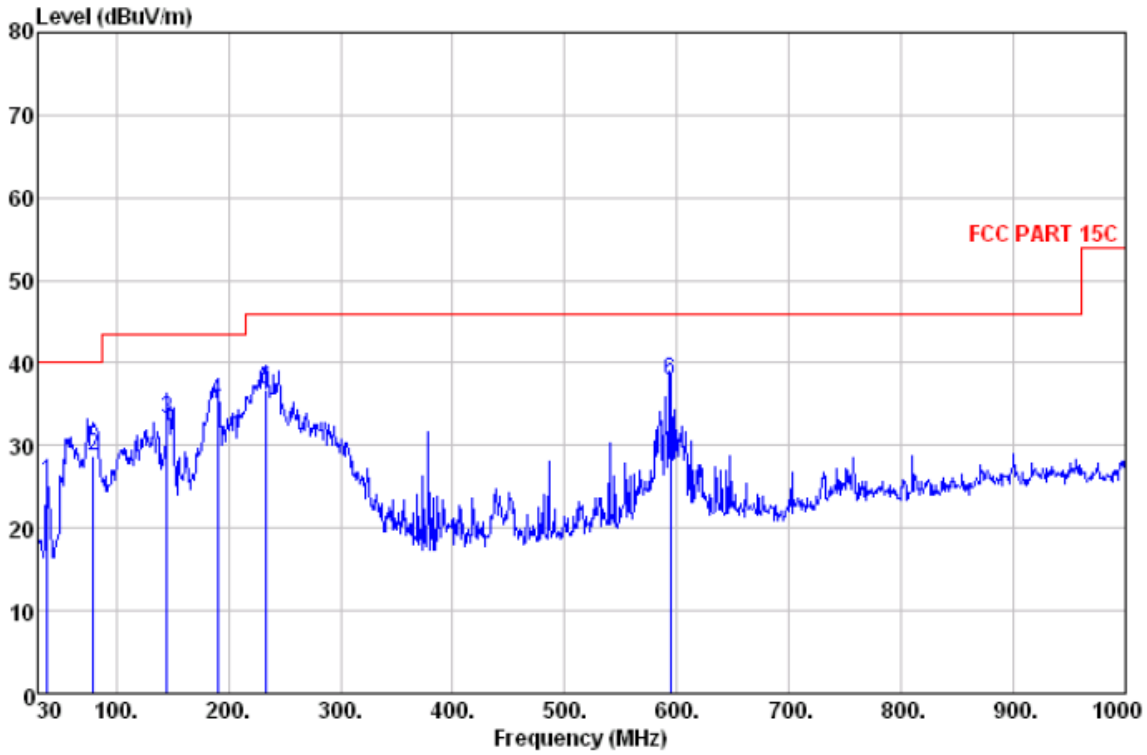
The Low frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not report

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	38.730	25.67	QP	12.79	0.71	40.00	-14.33	200	236
2	79.470	28.78	QP	7.40	1.04	40.00	-11.22	200	23
3	145.430	33.24	QP	7.37	1.44	43.50	-10.26	200	231
4	190.050	35.54	QP	8.89	1.66	43.50	-7.96	100	74
5	232.730	36.71	QP	11.04	1.85	46.00	-9.29	100	326
6	594.540	37.86	QP	20.02	3.04	46.00	-8.14	100	296

Level=Read Level + Antenna Factor + Cable Loss

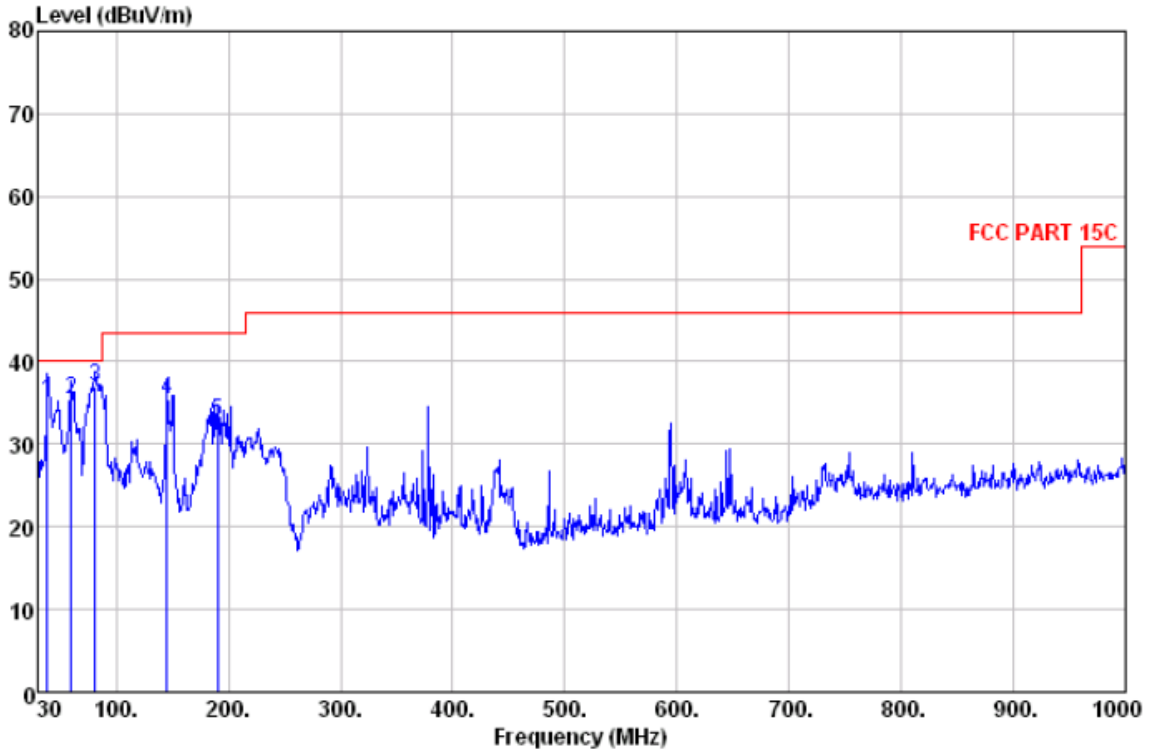
Test at low Channel in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	38.730	35.18	QP	12.79	0.71	40.00	-4.82	100	87
2	60.070	35.40	QP	6.70	0.89	40.00	-4.60	100	56
3	81.410	36.89	QP	7.49	1.05	40.00	-3.11	100	95
4	145.430	35.41	QP	7.37	1.44	43.50	-8.09	100	235
5	190.050	32.78	QP	8.89	1.66	43.50	-10.72	100	120

Level=Read Level + Antenna Factor + Cable Loss

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4804.000	34.32	9.59	27.62	34.36	50.65	74.00	V
7206.000	34.88	12.15	27.33	34.53	54.23	74.00	V
9608.000	37.72	14.41	27.14	37.69	62.68	74.00	V
4804.000	34.32	9.59	27.62	35.37	51.66	74.00	H
7206.000	34.88	12.15	27.33	36.44	56.14	74.00	H
9608.000	37.72	14.41	27.14	38.52	63.51	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4804.000	34.32	9.59	27.62	21.36	37.65	54.00	V
7206.000	34.88	12.15	27.33	19.47	39.17	54.00	V
9608.000	37.72	14.41	27.14	22.83	47.82	54.00	V
4804.000	34.32	9.59	27.62	22.71	39.00	54.00	H
7206.000	34.88	12.15	27.33	20.88	40.58	54.00	H
9608.000	37.72	14.41	27.14	22.92	47.91	54.00	H

Test at Middle Channel in transmitting status

9kHz~30MHz Test result

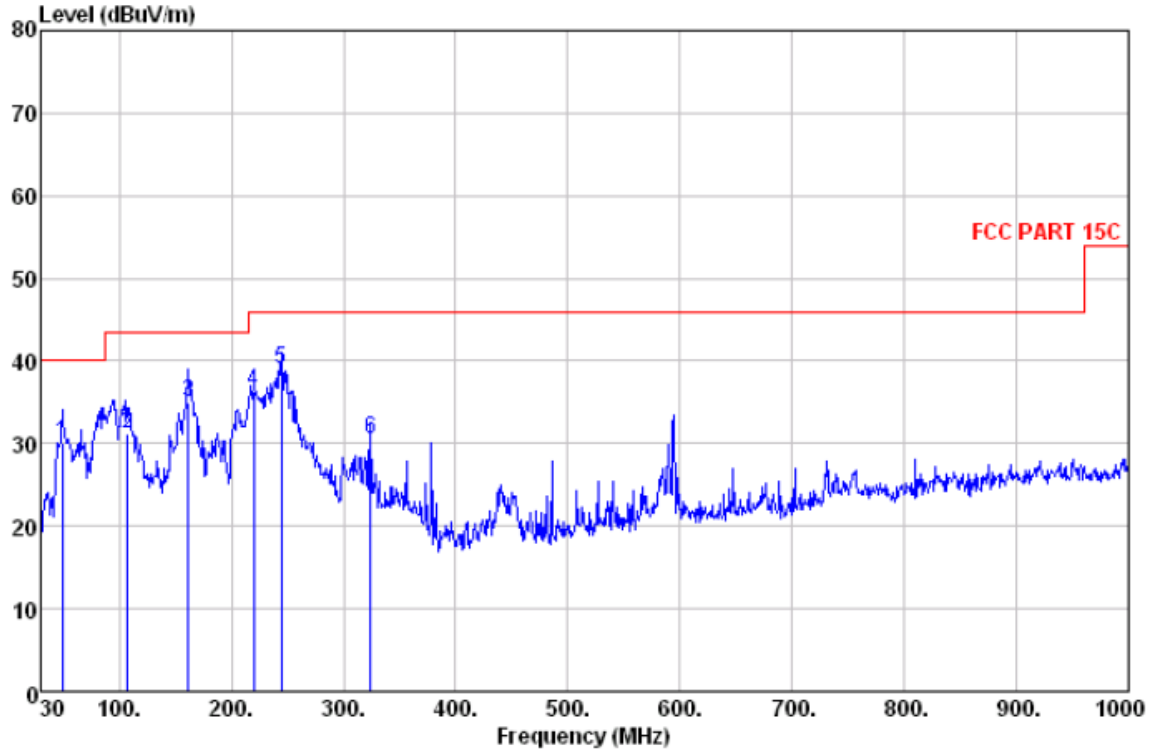
The Low frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not report

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	49.400	30.09	QP	8.57	0.80	40.00	-9.91	100	47
2	107.600	31.30	QP	8.50	1.22	43.50	-12.20	200	236
3	161.920	35.10	QP	7.68	1.52	43.50	-8.40	200	125
4	220.120	36.26	QP	10.11	1.80	46.00	-9.74	200	36
5	244.370	38.97	QP	11.16	1.90	46.00	-7.03	100	284
6	323.910	30.55	QP	14.00	2.20	46.00	-15.45	100	198

Level=Read Level + Antenna Factor + Cable Loss

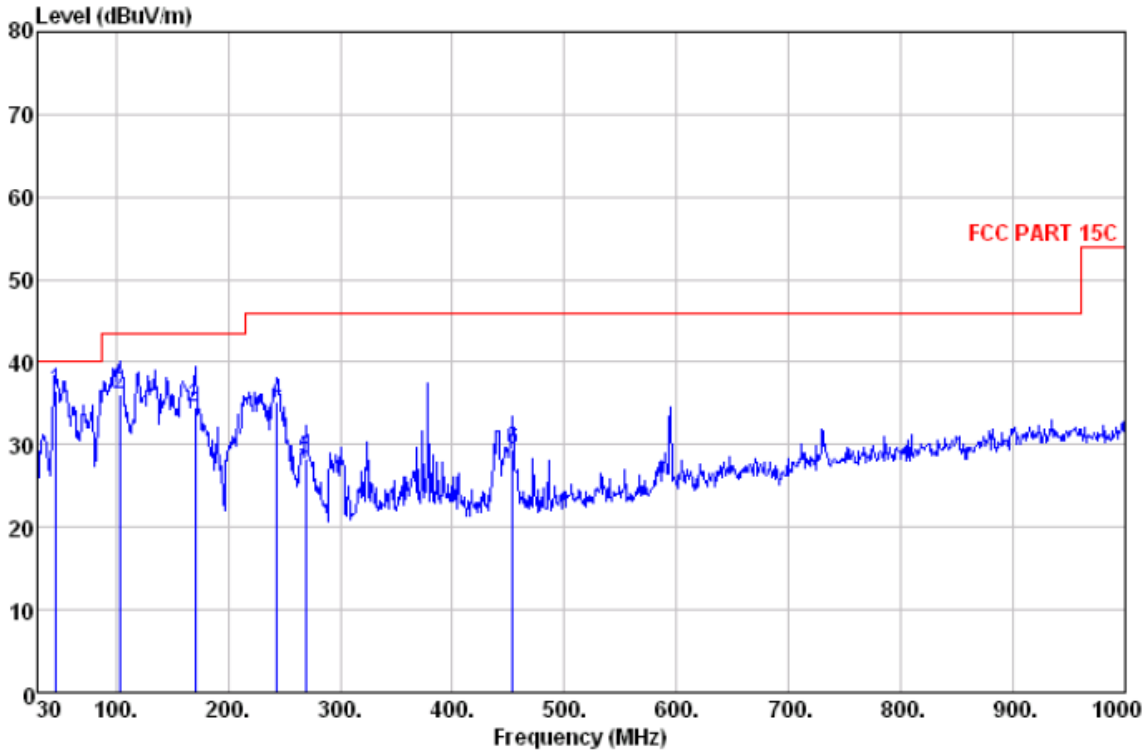
Test at Middle Channel in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	46.490	36.54	QP	9.80	0.77	40.00	-3.46	100	120
2	103.720	36.01	QP	8.55	1.19	43.50	-7.49	100	256
3	170.650	34.49	QP	8.37	1.56	43.50	-9.01	100	258
4	243.400	35.21	QP	11.10	1.90	46.00	-10.79	100	231
5	269.590	28.20	QP	12.95	2.01	46.00	-17.80	100	234
6	453.890	29.39	QP	17.00	2.64	46.00	-16.61	100	220

Level=Read Level + Antenna Factor + Cable Loss

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4882.000	34.33	9.59	27.60	35.86	52.18	74.00	V
7323.000	34.92	12.17	27.31	34.05	53.83	74.00	V
9764.000	37.91	14.49	27.13	37.68	62.95	74.00	V
4882.000	34.33	9.59	27.60	36.03	52.35	74.00	H
7323.000	34.92	12.17	27.31	36.49	56.27	74.00	H
9764.000	37.91	14.49	27.13	37.62	62.89	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4882.000	34.33	9.59	27.60	22.43	38.75	54.00	V
7323.000	34.92	12.17	27.31	23.66	43.44	54.00	V
9764.000	37.91	14.49	27.13	22.30	47.57	54.00	V
4882.000	34.33	9.59	27.60	21.49	37.81	54.00	H
7323.000	34.92	12.17	27.31	23.88	43.66	54.00	H
9764.000	37.91	14.49	27.13	23.56	48.83	54.00	H

Test at high Channel in transmitting status

9kHz~30MHz Test result

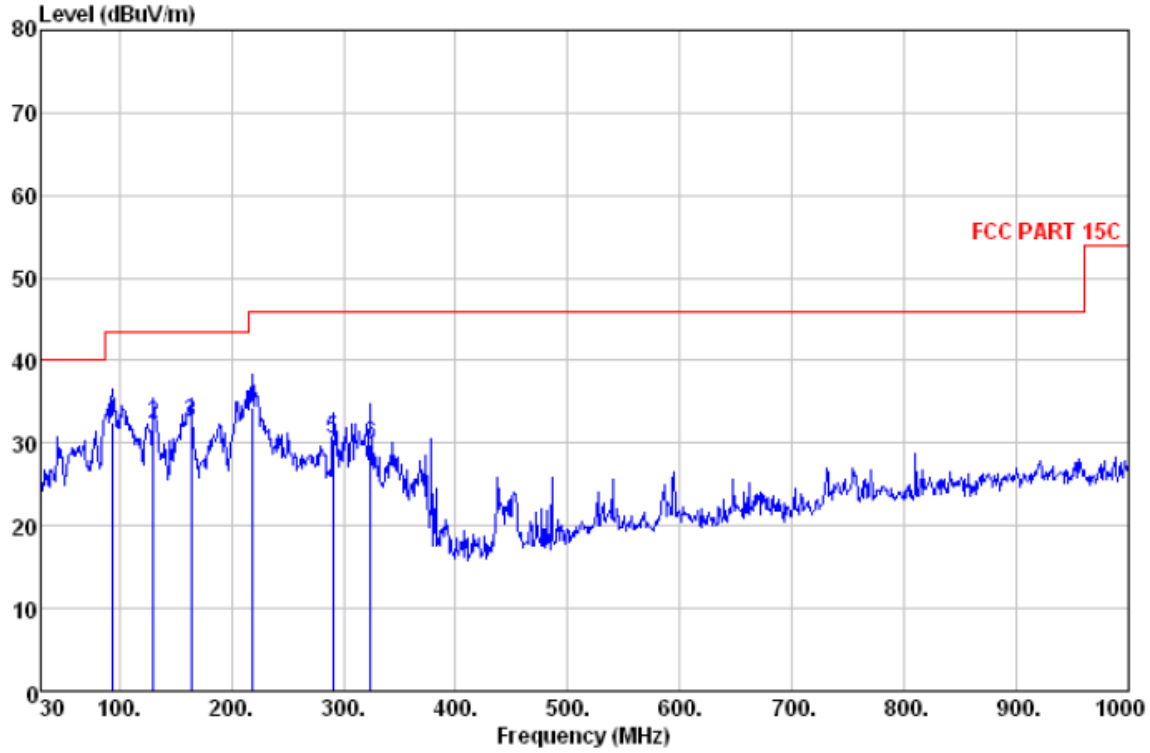
The Low frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not report

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	94.020	32.64	QP	8.36	1.13	43.50	-10.86	200	12
2	130.880	32.41	QP	7.40	1.36	43.50	-11.09	100	245
3	163.860	32.53	QP	7.57	1.53	43.50	-10.97	100	236
4	218.180	34.23	QP	9.88	1.79	46.00	-11.77	100	236
5	290.930	30.59	QP	13.37	2.09	46.00	-15.41	200	236
6	323.910	29.84	QP	14.00	2.20	46.00	-16.16	100	239

Level=Read Level + Antenna Factor + Cable Loss

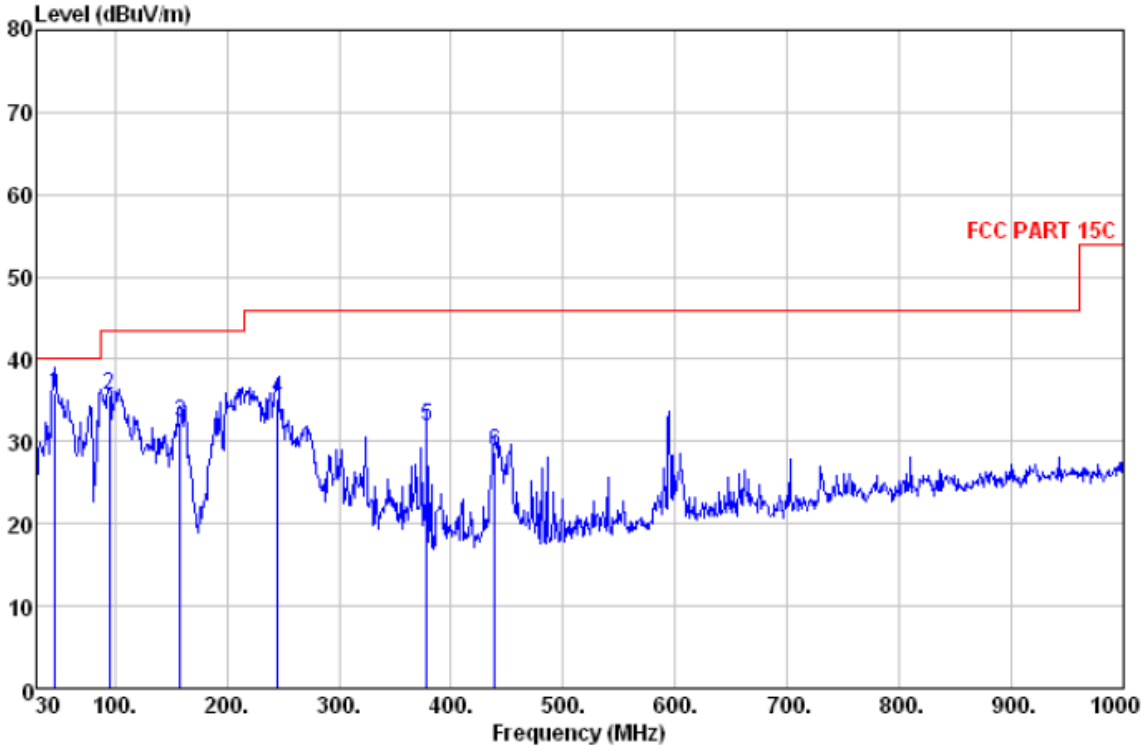
Test at High Channel in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Freq	Level	Remark	Antenna Factor	Cable Loss	Limit Line	Margin	A/pos	T/pos
	MHz	dBuV/m		dB/m	dB	dBuV/m	dB	cm	deg
1	46.490	35.94	QP	9.80	0.77	40.00	-4.06	100	120
2	94.990	35.57	QP	8.40	1.14	43.50	-7.93	100	25
3	158.040	32.41	QP	7.72	1.50	43.50	-11.09	100	236
4	245.340	35.23	QP	11.24	1.91	46.00	-10.77	100	298
5	378.230	31.82	QP	15.23	2.37	46.00	-14.18	100	341
6	439.340	28.75	QP	16.60	2.59	46.00	-17.25	100	52

Level=Read Level + Antenna Factor + Cable Loss

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4960.000	34.36	9.60	27.61	34.47	50.82	74.00	V
7440.000	34.98	12.19	27.30	35.33	55.20	74.00	V
9920.000	37.96	14.52	27.11	37.87	63.24	74.00	V
4960.000	34.36	9.60	27.61	36.32	52.67	74.00	H
7440.000	34.98	12.19	27.30	36.54	56.41	74.00	H
9920.000	37.96	14.52	27.11	38.28	63.65	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4960.000	34.36	9.60	27.61	20.46	36.81	54.00	V
7440.000	34.98	12.19	27.30	19.89	39.76	54.00	V
9920.000	37.96	14.52	27.11	23.74	49.11	54.00	V
4960.000	34.36	9.60	27.61	21.53	37.88	54.00	H
7440.000	34.98	12.19	27.30	20.95	40.82	54.00	H
9920.000	37.96	14.52	27.11	23.58	48.95	54.00	H

5.10 Radiated Emissions which fall in the restricted bands

Test Requirement: FCC Part15 C Section 15.247

(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Test Method: ANSI C63.10: Clause 6.4, 6.5 and 6.6 & DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH5) as the worst case was found.

Measurement Distance: 3m (Semi-Anechoic Chamber)

Limit: Section 15.209(a)

40.0 dBμV/m between 30MHz & 88MHz;

43.5 dBμV/m between 88MHz & 216MHz;

46.0 dBμV/m between 216MHz & 960MHz;

54.0 dBμV/m above 960MHz.

Detector: For PK value:

RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto

Detector function = peak

Trace = max hold

For AV value:

RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz

VBW =10 Hz

Sweep = auto

Detector function = peak

Trace = max hold

Test Result:

For bluetooth

1. Low Channel (2402MHz)

Antenna polarization: Vertical

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	26.65	6.45	27.78	35.28	21.29	40.60	26.61
2390.000	26.56	6.46	27.79	35.63	21.50	40.86	26.73
2500.000	25.70	6.62	27.80	35.49	21.83	40.01	26.35
2483.500	25.79	6.61	27.80	35.91	21.64	40.51	26.24

Antenna polarization: Horizontal

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	26.65	6.45	27.78	35.37	21.96	40.69	27.28
2390.000	26.56	6.46	27.79	35.79	21.44	41.02	26.67
2500.000	25.70	6.62	27.80	35.61	21.66	40.13	26.18
2483.500	25.79	6.61	27.80	35.95	21.78	40.55	26.38

2. Middle Channel (2441MHz)

Antenna polarization: Vertical

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	26.65	6.45	27.78	35.33	21.33	40.65	26.65
2390.000	26.56	6.46	27.79	35.86	21.53	41.09	26.76
2500.000	25.70	6.62	27.80	35.41	21.46	39.93	25.98
2483.500	25.79	6.61	27.80	35.72	21.75	40.32	26.35

Antenna polarization: Horizontal

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	26.65	6.45	27.78	35.26	21.62	40.58	26.94
2390.000	26.56	6.46	27.79	35.70	21.44	40.93	26.67
2500.000	25.70	6.62	27.80	35.14	21.58	39.66	26.10
2483.500	25.79	6.61	27.80	35.47	21.75	40.07	26.35

3. High Channel (2480MHz)

Antenna polarization: Vertical

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	26.65	6.45	27.78	35.33	21.63	40.65	26.95
2390.000	26.56	6.46	27.79	35.12	21.48	40.35	26.71
2500.000	25.70	6.62	27.80	35.62	21.56	40.14	26.08
2483.500	25.79	6.61	27.80	35.23	21.23	39.83	25.83

Antenna polarization: Horizontal

Frequency (MHz)	Antenna factors (dB/m)	Cable loss(dB)	Preamp factor(dB)	Peak Reading Level (dBμV)	Average Reading Level (dBμV)	Peak Emission Level (dBμV/m)	Average Emission Level (dBμV/m)
2310.000	26.65	6.45	27.78	35.37	21.60	40.69	26.92
2390.000	26.56	6.46	27.79	35.14	21.43	40.37	26.66
2500.000	25.70	6.62	27.80	35.68	21.57	40.20	26.09
2483.500	25.79	6.61	27.80	35.27	21.29	39.87	25.89

Remark: No any other emission which falls in restricted bands can be detected and be reported.

Test result: The unit does meet the FCC requirements.

5.11 Band Edges Requirement

Test Requirement: FCC Part15 C section 15.247

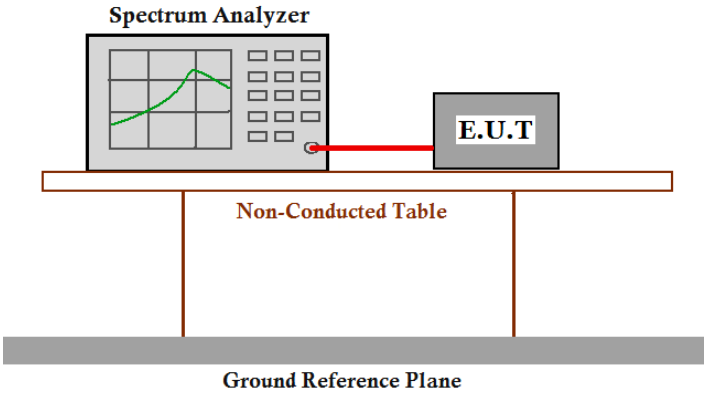
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Frequency Band: 2400 MHz to 2483.5 MHz

Test Method: ANSI C63.10: Clause 6.9 & DA 00-705

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), and highest (2480 MHz) channel and hopping mode with different data packet. Compliance test in continuous transmitting mode with normal (DH5) EDR mode (2DH5) and EDR mode (3DH5) as the worst case was found.

Test Configuration:



Test Procedure: Set RBW of spectrum analyzer to 100 kHz and VBW of spectrum analyzer to 300 kHz with suitable frequency span including 100 kHz bandwidth from band edge.

The band edges was measured and recorded Result:

The Lower Edges attenuated more than 20dB.

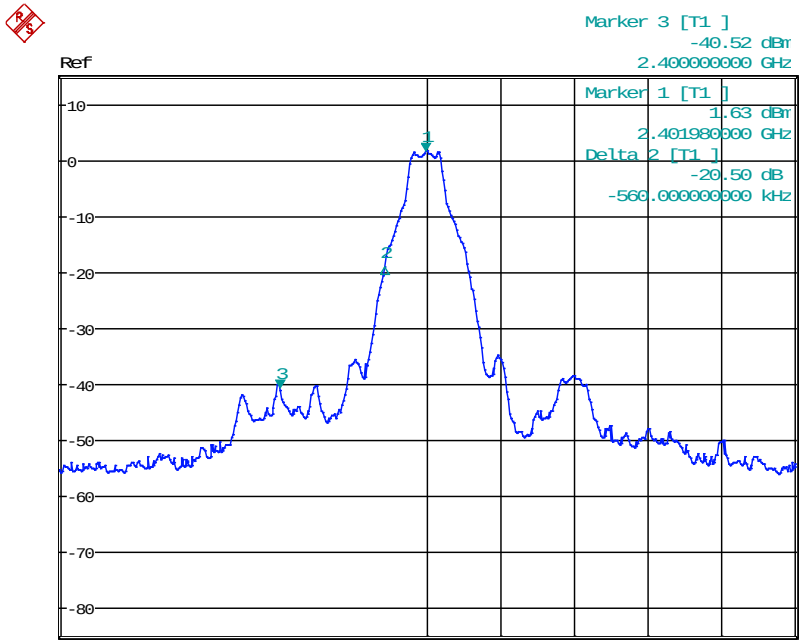
The Upper Edges attenuated more than 20dB.

The graph as below. Represents the emissions take for this device.

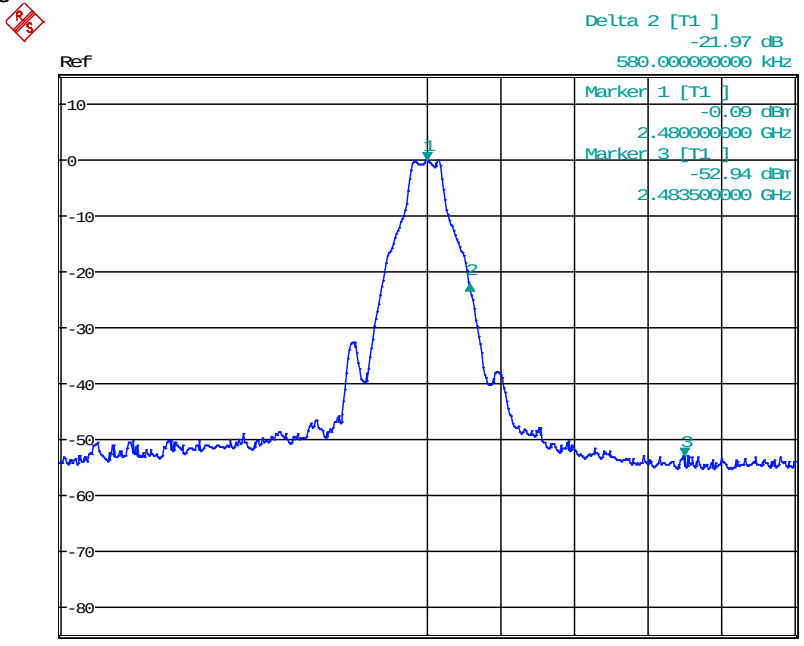
For Bluetooth

DH5:

Low channel:

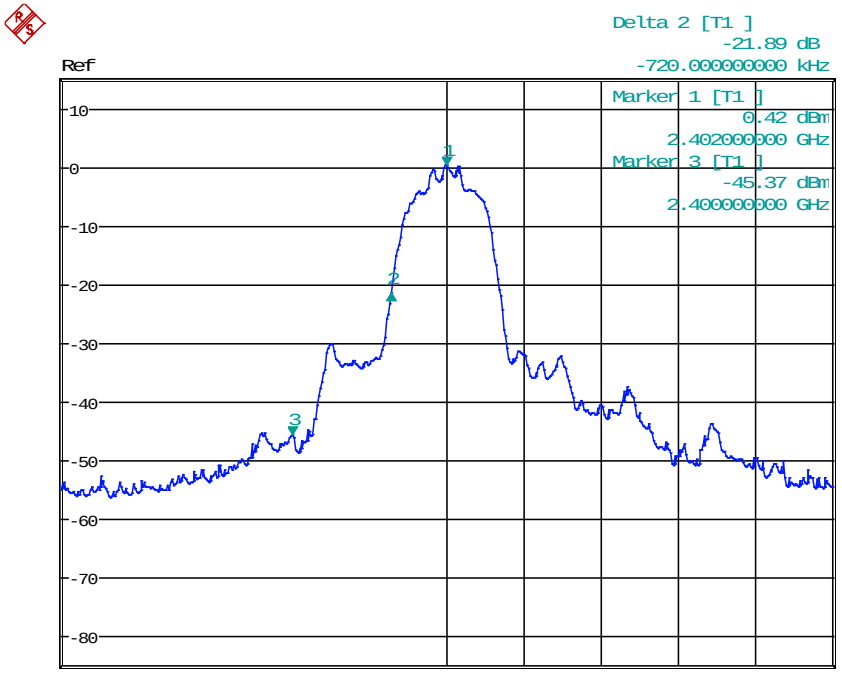


High channel:

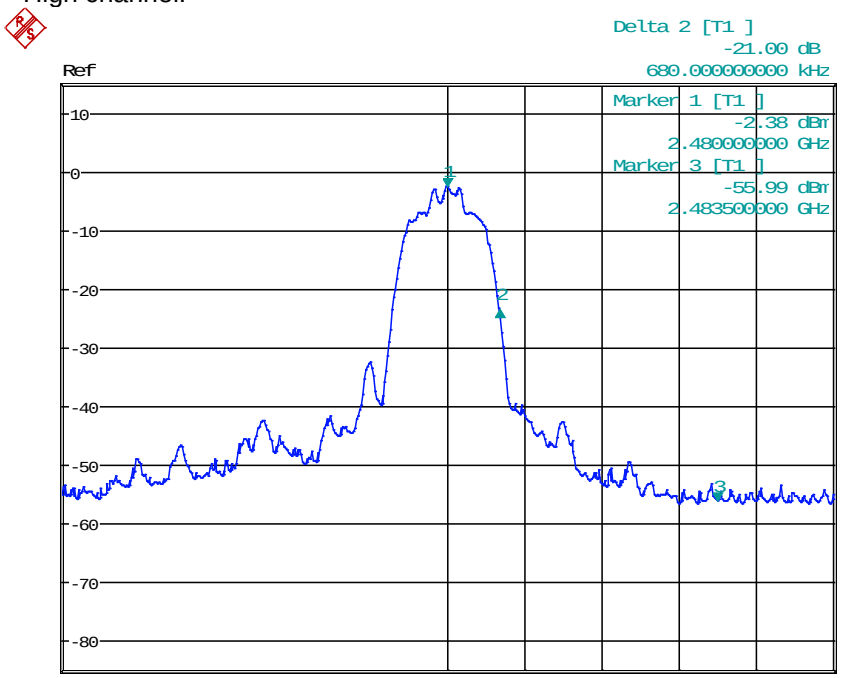


2DH5:

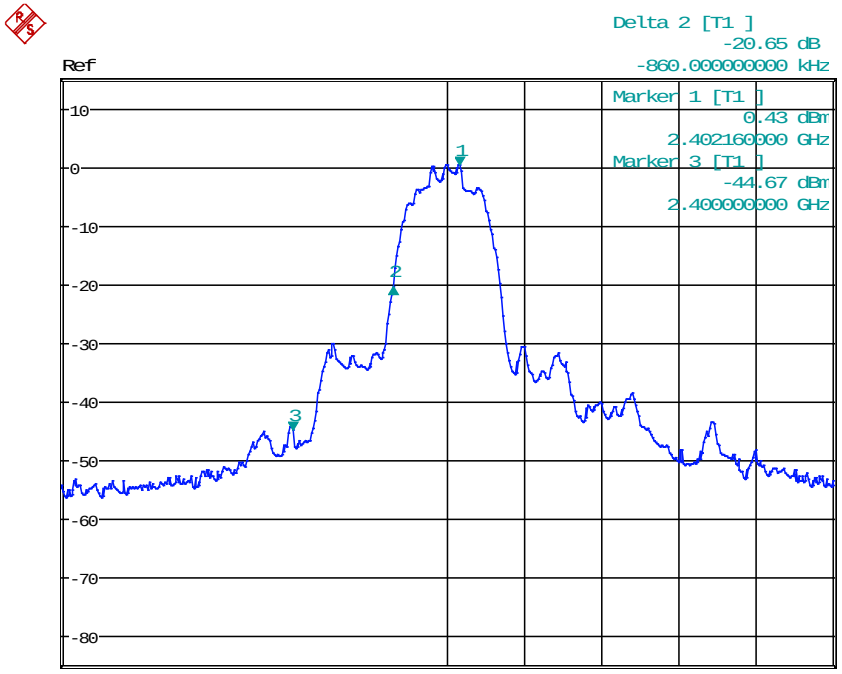
Low channel:



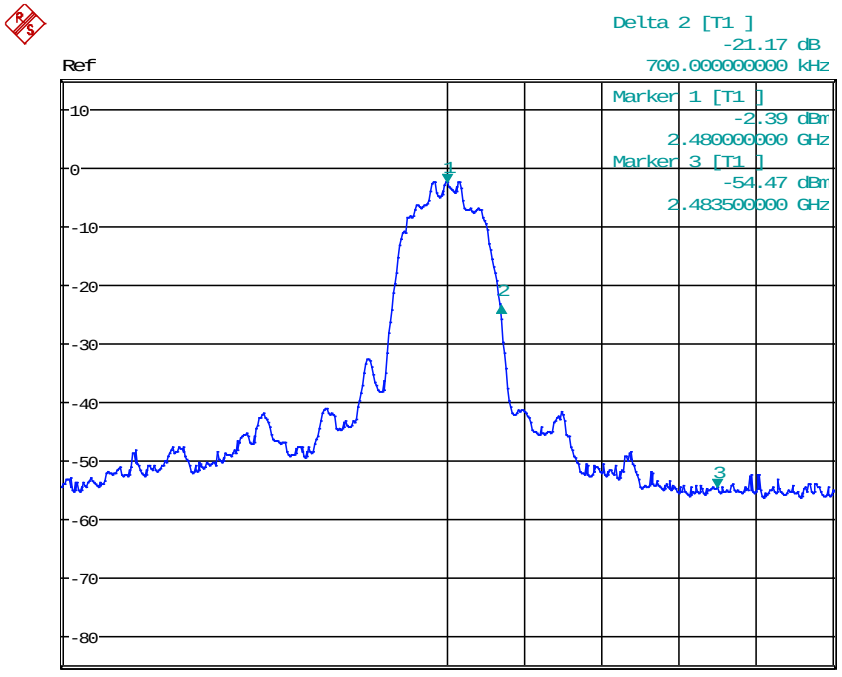
High channel:



3DH5:
Low channel:

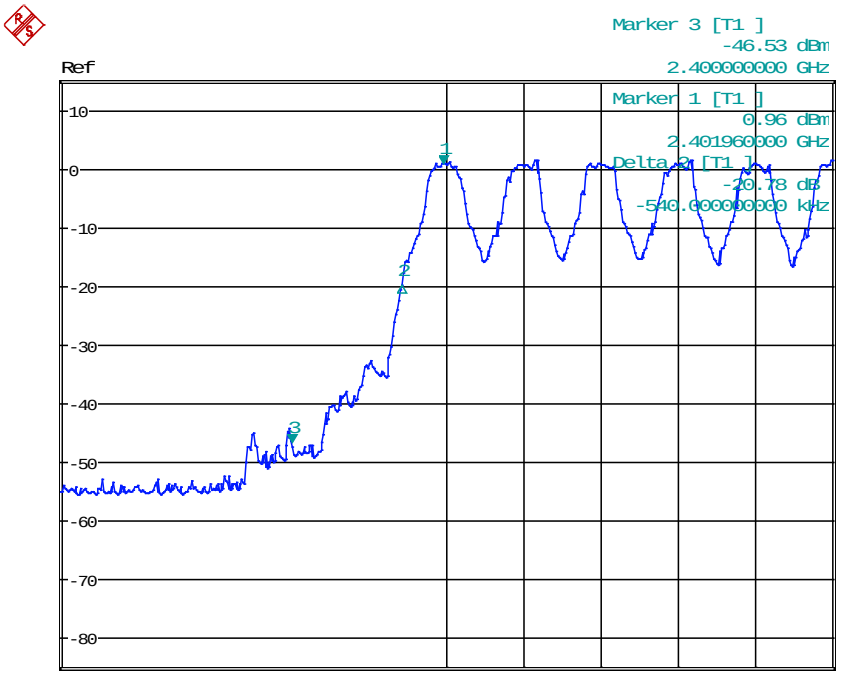


High channel:

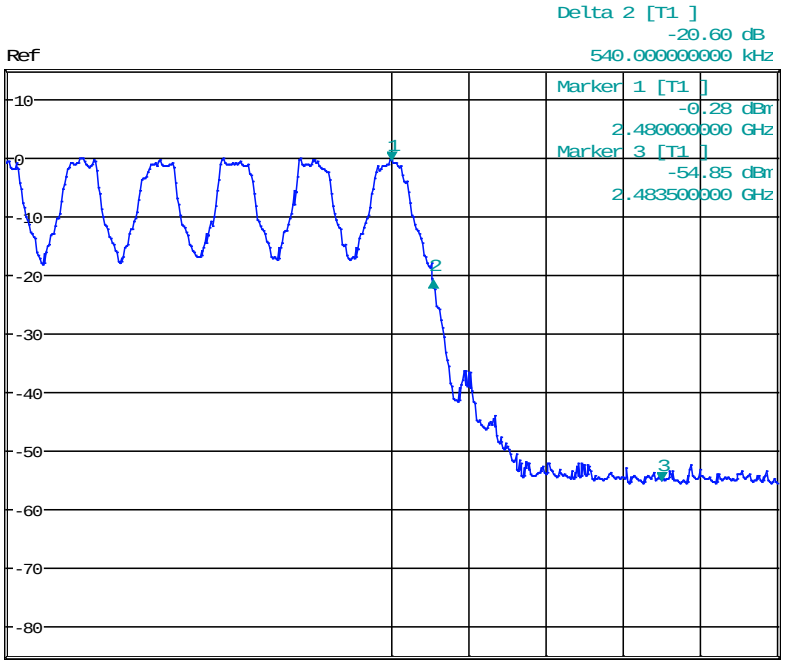


DH5:

Low channel:

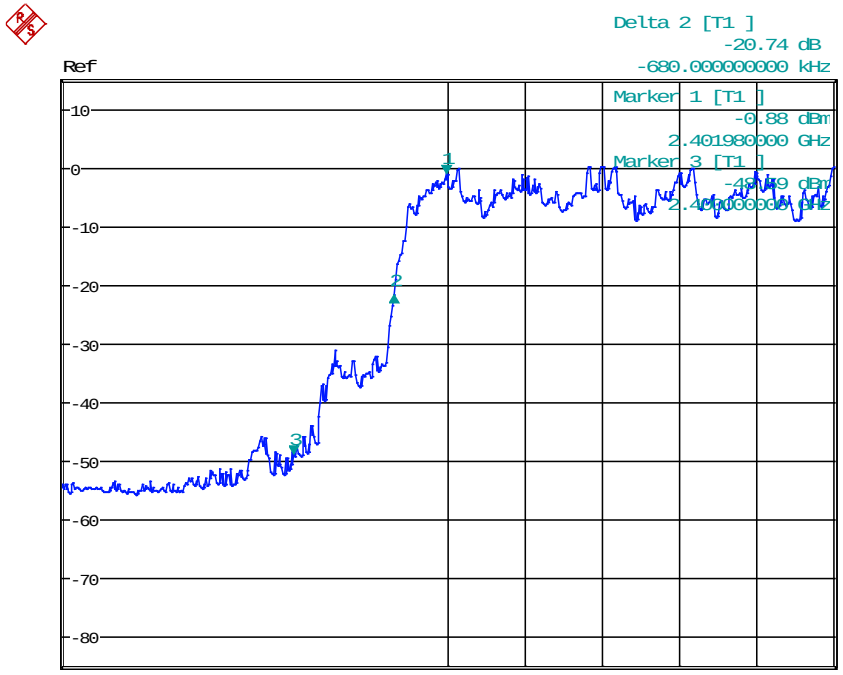


High channel:

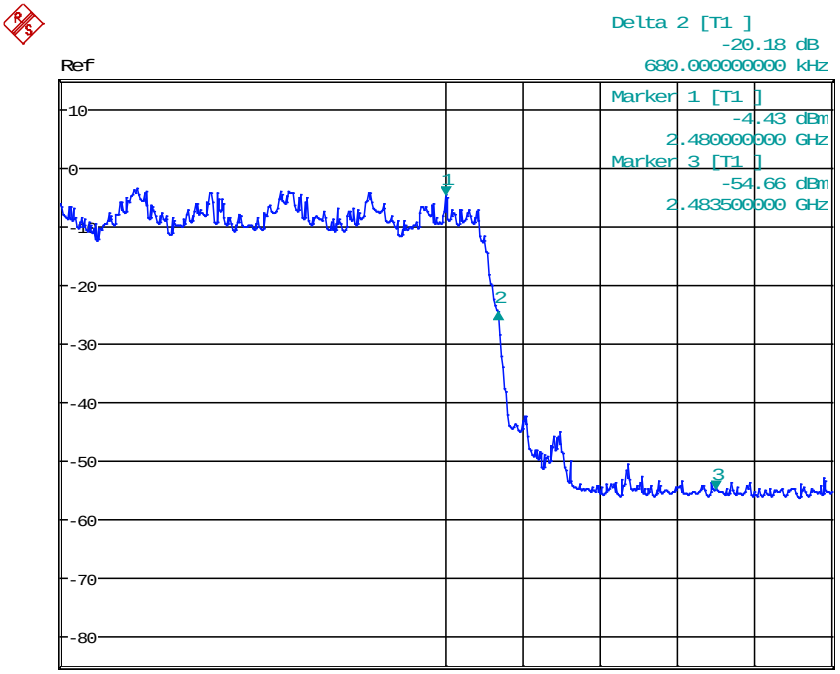


2DH5:

Low channel:

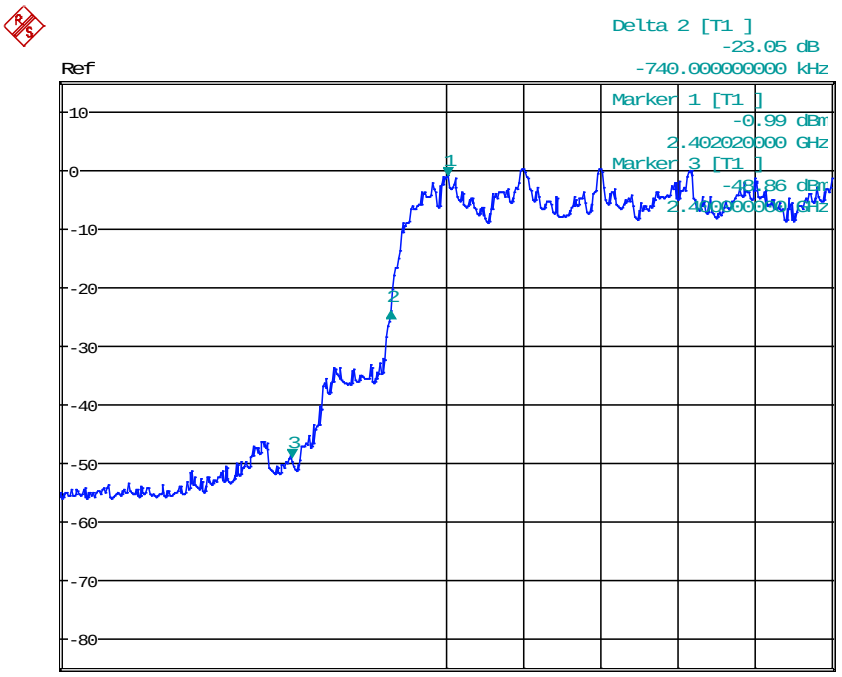


High channel:

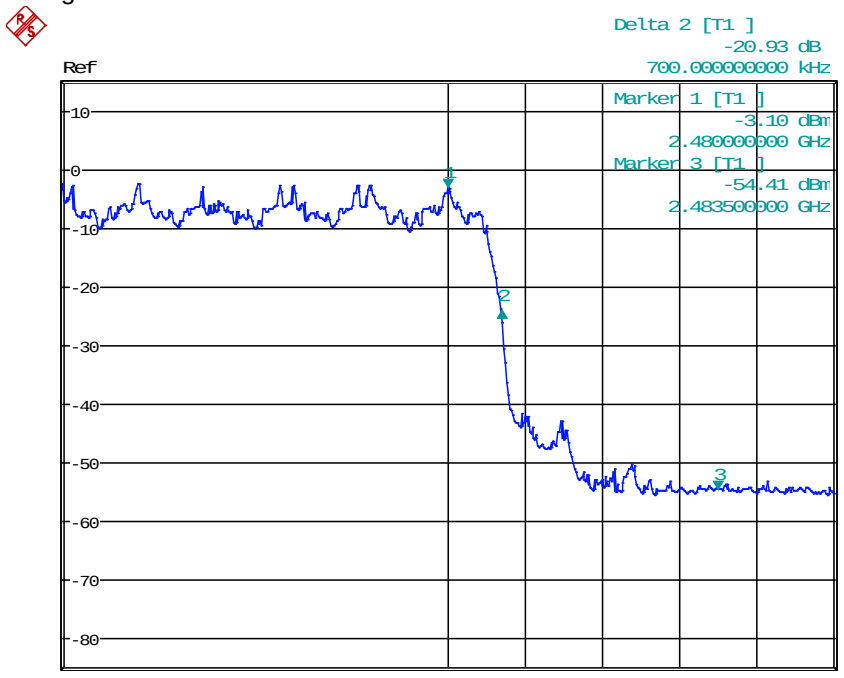


3DH5:

Low channel:



High channel:



Test result: The unit does meet the FCC requirements.

5.12 Conducted Emissions at Mains Terminals 150 kHz to 30 MHz

Test Requirement: FCC Part 15 C section 15.207

Test Method: ANSI C63.10: Clause 6.2 & DA 00-705

Frequency Range: 150 kHz to 30 MHz

Detector: Peak for pre-scan (9 kHz Resolution Bandwidth)

Test Limit

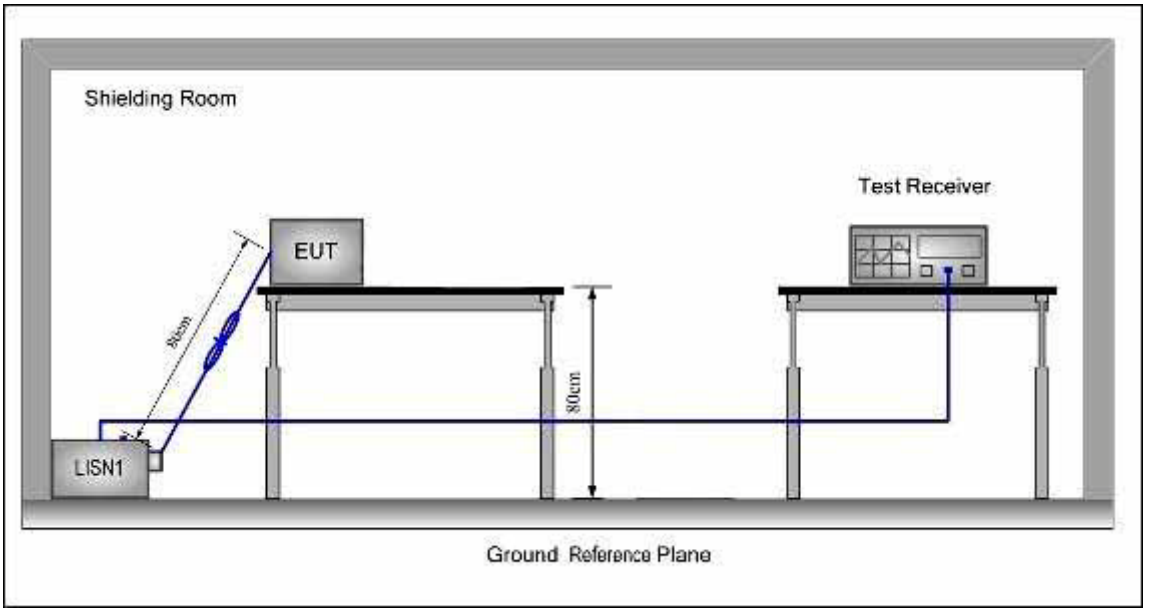
Limits for conducted disturbance at the mains ports of class B

Frequency Range	Class B Limit dB(μV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
NOTE 1 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

EUT Operation:

Test in normal operating mode. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.
Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Test Configuration:



Test procedure:

1. The mains terminal disturbance voltage test was conducted in a shielded room.

2. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, but separated from metallic contact with the ground reference plane by 0.1m of insulation.

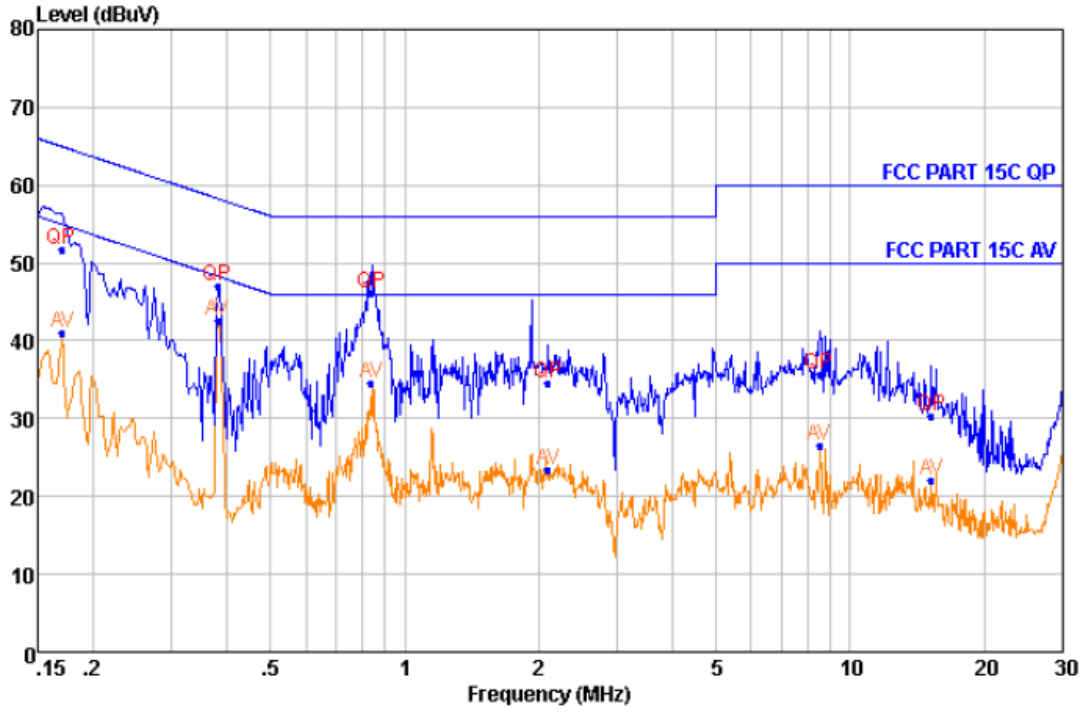
5.12.1 Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected. For EUT the communicating was worst case mode.

The following Quasi-Peak and Average measurements were performed on the EUT
Live line

Peak Scan:

Level (dBµV)



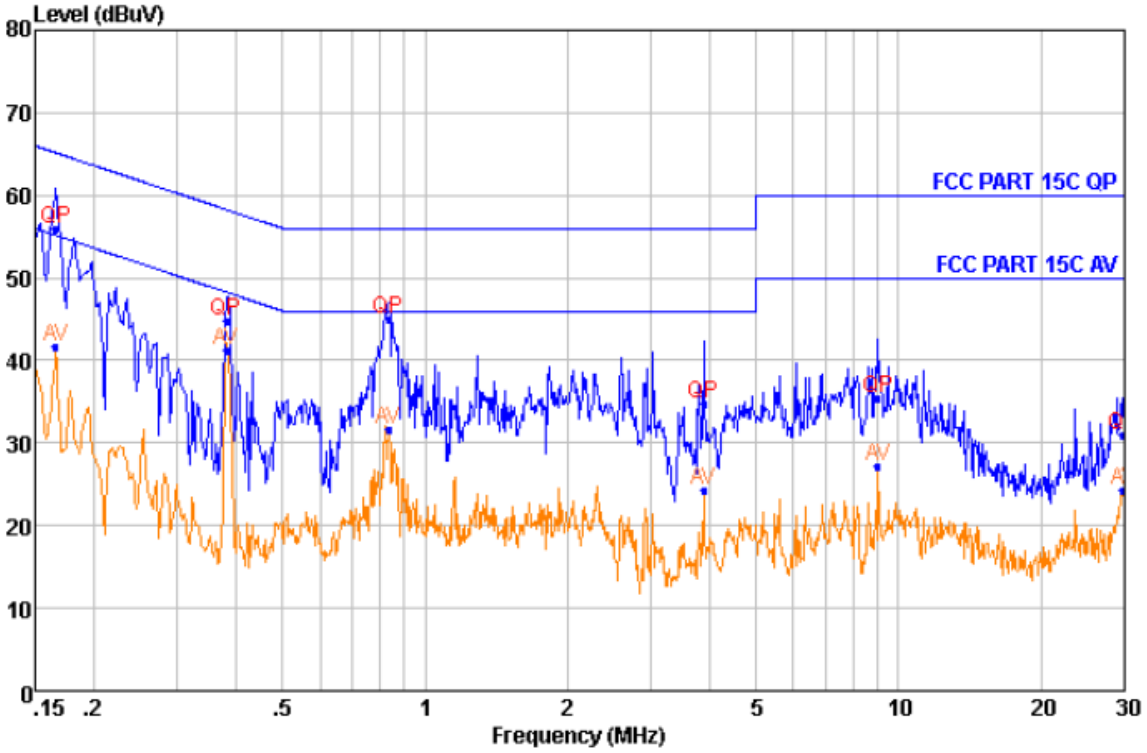
Quasi-peak and Average measurement

NO.	Freq MHz	Level dBuV	Remark	LISN Factor dB	Cable Loss dB	Limit Line dBuV	Over Limit dB
1	0.170	51.68	QP	9.44	0.40	64.96	-13.28
2	0.170	40.91	Average	9.44	0.40	54.94	-14.03
3	0.380	46.97	QP	9.40	0.43	58.27	-11.30
4	0.380	42.51	Average	9.40	0.43	48.27	-5.76
5	0.842	46.11	QP	9.27	0.46	56.00	-9.89
6	0.842	34.44	Average	9.27	0.46	46.00	-11.56
7	2.094	34.57	QP	9.32	0.49	56.00	-21.43
8	2.094	23.43	Average	9.32	0.49	46.00	-22.57
9	8.528	35.67	QP	9.34	0.55	60.00	-24.33
10	8.528	26.57	Average	9.34	0.55	50.00	-23.43
11	15.188	30.39	QP	9.38	0.57	60.00	-29.61
12	15.188	22.06	Average	9.38	0.57	50.00	-27.94

Neutral Line

Peak Scan:

Level (dBμV)



Quasi-peak and Average measurement

NO.	Freq MHz	Level dBuV	Remark	LISN Factor dB	Cable Loss dB	Limit Line dBuV	Over Limit dB
1	0.166	55.83	QP	9.38	0.39	65.16	-9.33
2	0.166	41.74	Average	9.38	0.39	55.16	-13.42
3	0.380	44.90	QP	9.36	0.43	58.27	-13.37
4	0.380	41.23	Average	9.36	0.43	48.27	-7.04
5	0.838	44.94	QP	9.37	0.46	56.00	-11.06
6	0.838	31.59	Average	9.37	0.46	46.00	-14.41
7	3.872	34.66	QP	9.42	0.52	56.00	-21.34
8	3.872	24.29	Average	9.42	0.52	46.00	-21.71
9	9.039	35.32	QP	9.52	0.55	60.00	-24.68
10	9.039	27.19	Average	9.52	0.55	50.00	-22.81
11	29.772	30.92	QP	9.94	0.60	60.00	-29.08
12	29.772	24.23	Average	9.94	0.60	50.00	-25.77

--End of Report--