

	    <p>CERTIFICATE 2518.08</p> <p>MS ISO/IEC 17025          TESTING          SAMM NO. 0825</p>																																						
<p><b>MOTOROLA PENANG ADV. COMM. LABORATORY</b>          Motorola Solutions Malaysia Sdn. Bhd.          Plot 2A Medan Bayan Lepas,          Mukim 12, S.W.D. 11900 Bayan Lepas,          Penang, Malaysia.</p>	<p><b>FCC / ISED TEST REPORT</b>  <b>Report Revision : Rev.C</b></p>																																						
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<p>Prepared By:</p> <div style="text-align: center;">   <hr style="width: 20%; margin: auto;"/> <p><b>GAN BOON TEONG</b>                  Test Personnel</p> </div>	<p>Approved Signatory:</p> <div style="text-align: center;"> <hr style="width: 20%; margin: auto;"/> <p><b>VINCENT FOONG CHUEN KIT</b>                  Responsible Engineer</p> </div>																																						

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### REVISION HISTORY

Revision History	Description	Date	Originator
Rev. A	Initial Report	18-Aug-2021	Gan Boon Teong
Rev. B	Add charger info, amend date	30-Sep-2021	Vincent Foong
Rev. C	Added AV info	14-Oct-2021	Vincent Foong

### 1.0. General Information

#### EUT Description:

<b>Technologies</b>	2.4GHz BT
<b>TX Frequency range</b>	2402MHz – 2480MHz
<b>Modulation Type</b>	GFSK, Pi/4 DQPSK,8DPSK
<b>Connector type</b>	PROGRAMMING, TEST & ALIGNMENT CABLE
<b>Antenna type</b>	Internal PCB

The EUT contains following accessory devices and data cable:

Item	Brand	Model or P/N
BATTERY PACK,BATT IMPRES LIION TIA4950 IP68 3200T	MOTOROLA	PMNN4810A
CABLE,PORTABLE PROGRAMMING CABLE	MOTOROLA	PMKN4230A
POWER SUPPLY ADAPTOR,IMPRES SUC LEVEL V SMPS NA CORD	MOTOROLA	WPLN4253B

Channel number and frequency information:

79 channels are provided to this EUT:

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

### General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, the EUT is to comply with the requirements of the following standards:

FCC 47 CFR Part 15 Subpart C  
 KDB 558074 D01 15.247 Meas Guidance v05  
 ANSI C63.10-2013

### Deviation from standard

Not applicable as no deviation from standard test method

### Modifications to EUT

For RF conducted measurements a pigtail was soldered out of the board while for radiated measurements there were no modifications to the device

### Test configuration of EUT

All relevant configurations involving radio models and accessories (including chargers, batteries, antennas) were assessed. Only worst case configurations will be included in this report.

## 2.0. Summary of Test Results

FCC Clause	ISED Clause	Test Item	Result	Remark	Serial number tested	Tested by
15.247 (b)(1)	RSS-247 5.4(b)	Conducted RF Output Power (Peak)	Pass	Highest output power: GFSK – 10.087dBm (10.20 mW) Pi/4 DQPSK - 11.115dBm (12.93 mW) 8DPSK -11.365 dBm (13.69 mW)	P4N0XP0VGL	Gan
15.247 (a)(1)	RSS-247 5.1(a) RSS-247 5.1(b)	(1) 20dB Channel Bandwidth (2) Channel Separation	Pass	GFSK – 863KF1D Pi/4 DQPSK – 1M17G1D 8DPSK - 1M18G1D	P4N0XP0VGL	Gan
15.247(a)(1)(iii)	RSS-247 5.1(d)	Number of hopping Frequency used	Pass	Meet the limit requirement.	P4N0XP0VGL	Gan
15.247(a)(1)(iii)	RSS-247 5.1(d)	Dwell time on each channel	Pass	Meet the limit requirement.	P4N0XP0VGL	Gan
15.247 (d)	RSS-247 5.5	Band Edge Conducted Spurious Emission	Pass	Worst case emission: -43.43dB	P4N0XP0VGL	Gan
15.247 (d)	RSS-247 5.5	Conducted Spurious Emission	Pass	Worst case emission: -45.78 dBm	P4N0XP0VGL	Gan
15.205, 15.209, 15.247 (d)	RSS-247 5.5	Radiated Emission within Restricted Bands	Pass	Worst case emission: 65.3866dBuV/m (8.61dB margin)	865TXP0006	Nazrin&Qawiman
15.207	RSS-Gen 8.8	AC Powerline Conducted Emission	Pass	Meet the limit requirement	865TXP0006	Iskandar
15.203	-	Antenna Requirement	NA	Internal antenna is not accessible to the end-user	NA	NA

### 3.0. Measurement Uncertainty

Measurement	Frequency	Expanded Uncertainty (k=1.96) (±)
AC Power Line Conducted Spurious Emission	150kHz ~ 30MHz	3.48 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1000MHz	5.88 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	5.84 dB
	18GHz ~ 40GHz	6.02 dB
Conducted Spurious Emissions	9kHz ~ 12.75GHz	2.82 dB

#### 4.0. Equipment List

##### Bluetooth ATE # 1 (SW Version: Ate Main\_3.1.11)

Description	Model	Serial Number	Calibration Date	Calibration Due Date
CHAMBER	SH-641	92002639	8-Dec-20	8-Dec-21
SPECTRUM ANALYZER	E4440A	MY48250919	2-Sep-19	2-Sep-21
POWER SUPPLY	6652A	3640A02941	22-Jan-21	22-Jan-22
N to N RF Cable # 1	SF126/11N/11N	NA	NA	NA

##### Radiated Emission Station (SW Version: EMC FCC RE v1.6.2)

Description	Model	Serial Number	Calibration Date	Calibration Due Date
DRG HORN FREQ.	SAS-571	719	20-Aug-19	20-Aug-21
DRG HORN FREQ.	SAS-571	566	22-Oct-19	22-Oct-21
POWER SUPPLY	N7976A	MY53410110	24-May-21	24-May-22
SIGNAL GENERATOR	SMB 100A	181117	8-Nov-18	8-Nov-21
EMI TEST RECEIVER	ESW44	101750	15-Jan-21	15-Jan-22
EMI TEST RECEIVER	ESIB26	827769/009	11-Mar-21	11-Mar-22
5m SEMI-ANECHOIC CHAMBER	S800-HX	J2308	Not Required	Not Required
BILOG ANTENNA	CBL6112B	30991	20-Aug-20	20-Aug-21
BILOG ANTENNA	CBL6112B	2964	4-May-21	4-May-22
HYGRO-THERMOMETER	SDL500	A.016800	18-May-21	18-May-22
SYSTEM CONTROLLER	SC104V	050806-1	Not Required	Not Required
TURNTABLE FLUSH MOUNT 2M	FM2011	NA	Not Required	Not Required
ANTENNA POSITIONING TOWER	TLT2	NA	Not Required	Not Required
BROAD-BAND HORN ANTENNA	BBHA9170	BBHA9170255	4-Feb-21	4-Feb-22
18 - 40GHz PREAMPLIFIER	MITEQ Hi GAIN SUCOFLEX	2006313	Not Required	Not Required
PREAMPLIFIER	PAM-0118P	361	11-Sep-20	11-Sep-23
LOOP ANTENNA	6502	00208416	15-Sep-20	15-Sep-21

##### Power Line Conducted Emission (SW Version: EMC 32 v10.60.10)

Description	Model	Serial Number	Calibration Date	Calibration Due Date
TEMPERATURE & HUMIDITY LOGGER	TM320	11203258	11-Dec-20	11-Dec-21
V-NETWORK 2-LINE	ENV216V	101039	20-July-19	20-Sep-21
EMI TEST RECEIVER	ESIB40	100307	8-Jan-21	8-Jan-22
PROGRAMMABLE AC SOURCE	61604	616040003502	4-Dec-2020	4-Dec-21

### 5.0. Test Mode Applicability and Test Channel Detail

#### Radiated Emission Test (Above 1GHz)

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).

Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Environmental Conditions
Test Mode	0 to 78	0,39,78	FHSS	GFSK, Pi/4 DQPSK,8DPSK	23.7°C, 69.4%RH

#### Radiated Emission Test (Below 1GHz)

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).

Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Environmental Conditions
Test Mode	0 to 78	0,39,78	FHSS	GFSK, Pi/4 DQPSK,8DPSK	23.7°C, 69.4%RH

#### Power Line Conducted Emission Test

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).

Following channel(s) was (were) selected for the final test as listed below.

NAEUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Environmental Conditions
Application Mode	0 to 78	AUTO	FHSS	AUTO	21.2°C, 63.9%RH

#### Antenna Port Conducted Measurement:

This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

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).

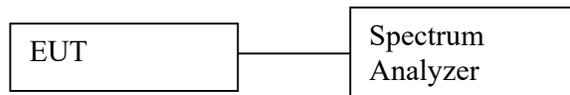
Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Environmental Conditions
Test Mode	0 to 78	0,39,78	FHSS	GFSK, Pi/4 DQPSK,8DPSK	25°C, 50.0%RH

## 6.0. Transmitter Test Parameters

### 6.1. Conducted RF Output Power (Peak)

#### 6.1.1. Test Setup



- a) Check and ensure the spectrum analyzer well calibrate.
- b) Turn on the EUT and set EUT to transmit maximum data rate with hopping disable.
- c) Connect EUT's antenna terminal to spectrum analyzer with a low loss cable.
- d) Setting of Spectrum analyzer :
  - a. RBW = > 20 dB bandwidth
  - b. VBW = RBW
  - c. Detector mode = Peak
  - d. AMPLITUDE → Scale/Div = 10 dB
  - e. Trace = Max hold
  - f. Sweep = auto
- e) Measure the captured power within the band and recording the plot.
- f) Repeat above procedure with other different mode of operation.

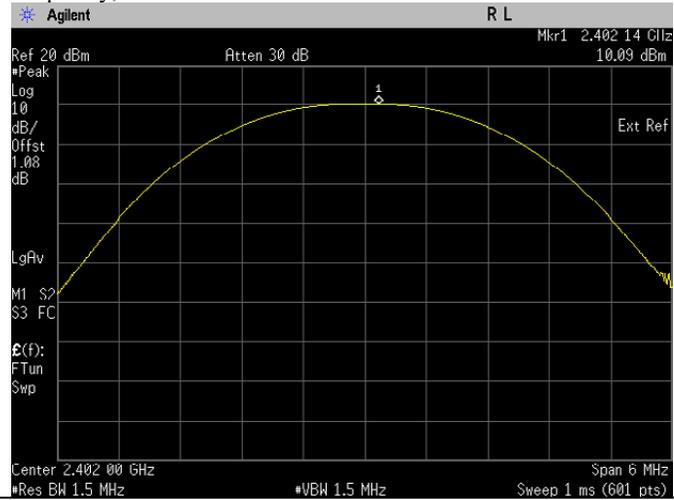
#### 6.1.2. Test Limits:

<b>Normal Condition (25 ° C)</b>
<b>≤ 125mW ( or 20.9dBm)</b>

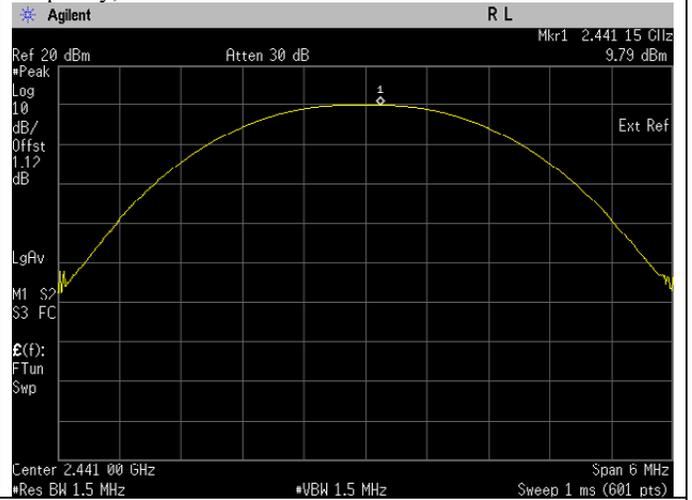
#### 6.1.3. Test Data:

Test Conditions		Test Frequency (GHz)	Results	
Modulation	Voltage(V)		dBm	Status
GFSK	7.50	2.4020	10.087	Pass
		2.4410	9.786	Pass
		2.4800	9.562	Pass
Pi/4DQPSK	7.50	2.4020	11.115	Pass
		2.4410	10.801	Pass
		2.4800	10.551	Pass
8DPSK	7.50	2.4020	11.365	Pass
		2.4410	11.058	Pass
		2.4800	10.830	Pass

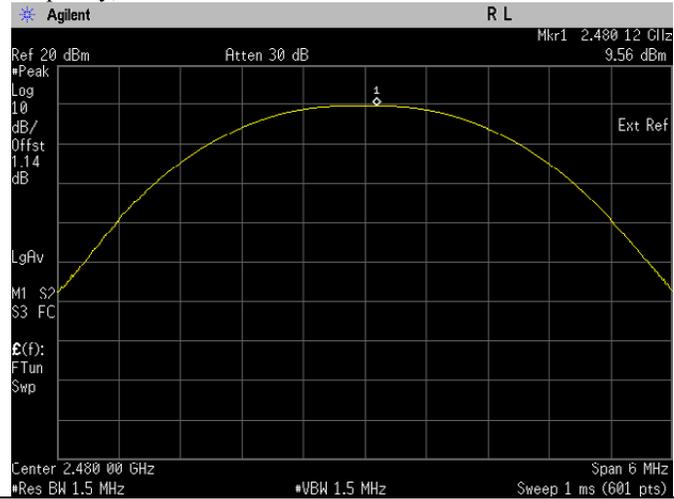
The Conducted RF Output Power test with result at low frequency, GFSK.



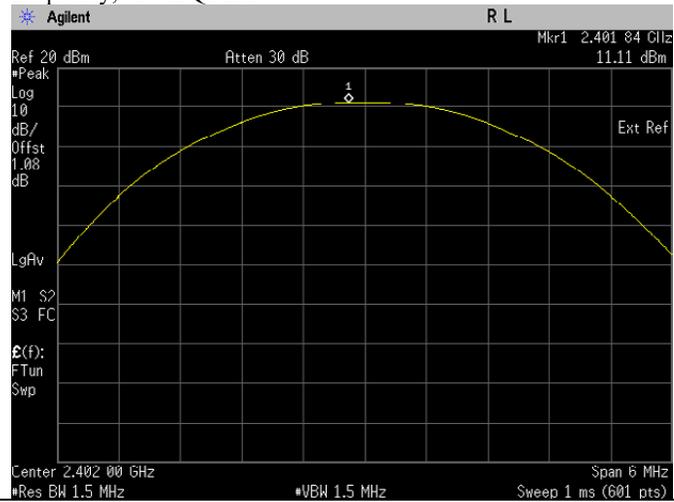
The Conducted RF Output Power test with result at mid frequency, GFSK.



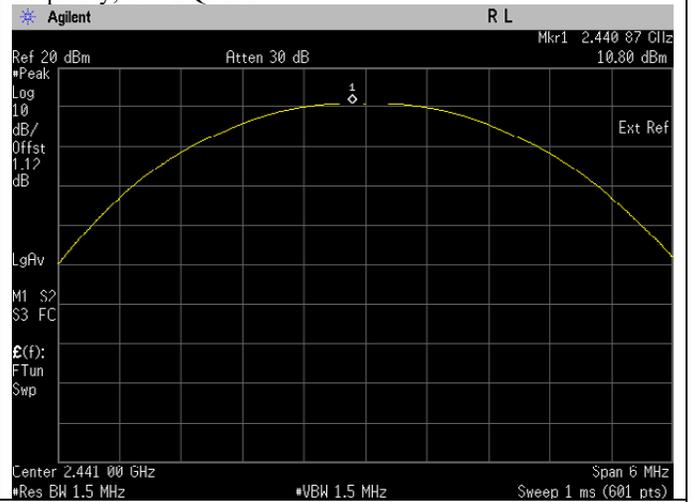
The Conducted RF Output Power test with result at high frequency, GFSK.



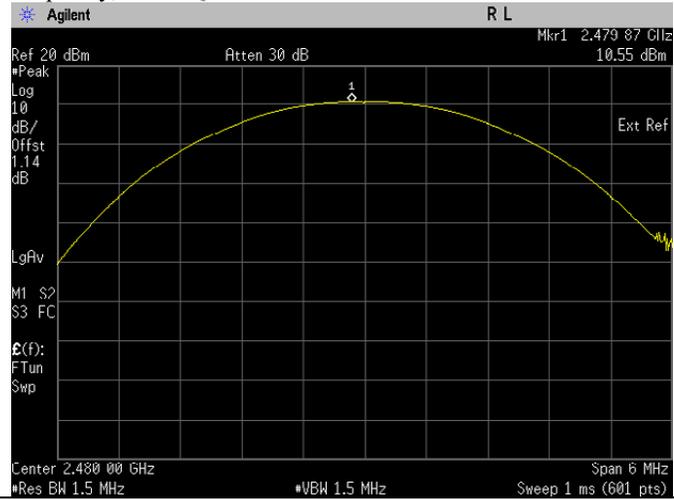
The Conducted RF Output Power test with result at low frequency, Pi/4 DQPSK.



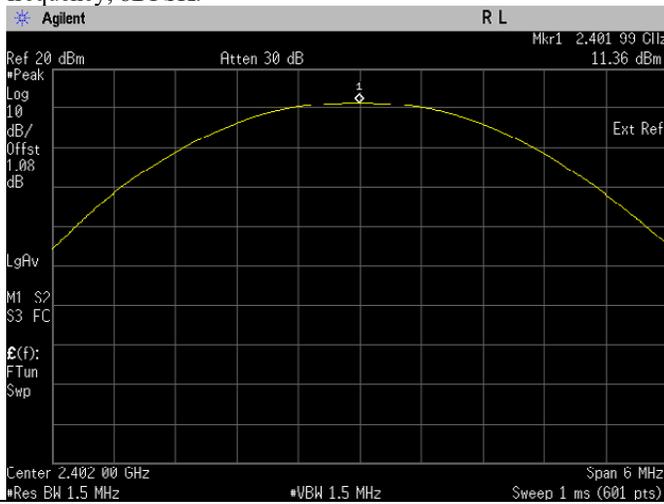
The Conducted RF Output Power test with result at mid frequency, Pi/4 DQPSK.



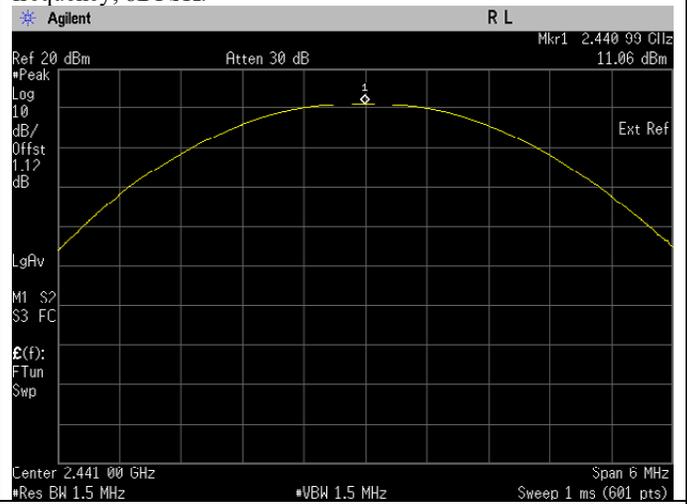
The Conducted RF Output Power test with result at high frequency, Pi/4 DQPSK.



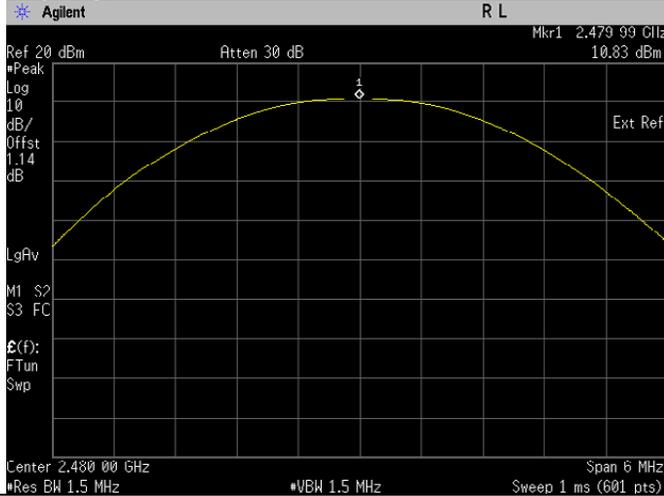
The Conducted RF Output Power test with result at low frequency, 8DPSK.



The Conducted RF Output Power test with result at mid frequency, 8DPSK.

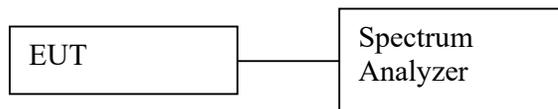


The Conducted RF Output Power test with result at high frequency, 8DPSK.



## 6.2. 20dB Channel Bandwidth

### 6.2.1. Test Setup



- a) Check and ensure the spectrum analyzer well calibrate.
- b) Turn on the EUT and set EUT to transmit maximum data rate with hopping disable.
- c) Connect EUT’s antenna terminal to spectrum analyzer with a low loss cable.
- d) Setting of Spectrum analyzer :
  - a. RBW = 30 kHz
  - b. VBW = 100 kHz
  - c. SPAN = 3 MHz, center on test frequency
  - d. AMPLITUDE → Scale/Div = 10 dB
  - e. Detector mode = Peak
  - f. Trace = Max hold
  - g. Sweep = auto
- e) Measure the freq different of two frequencies that were attenuated 20dB from peak of the emission & record the frequency difference as the emission bandwidth.
- f) Save the plot result from spectrum analyzer screen.
- g) Repeat above procedure with other different mode of operation.

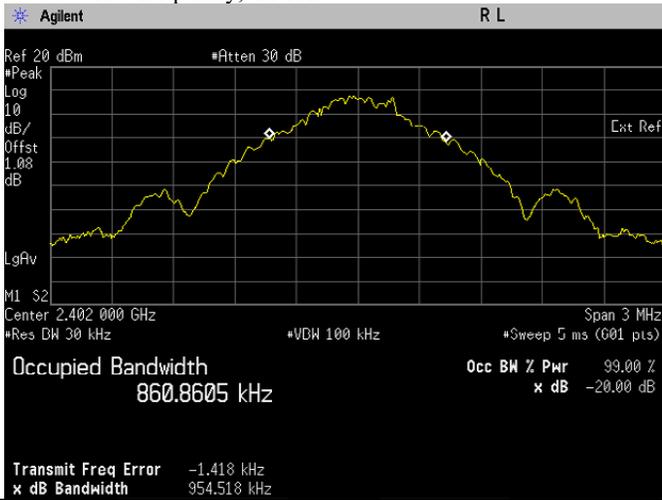
### 6.2.2. Test Limits:

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.

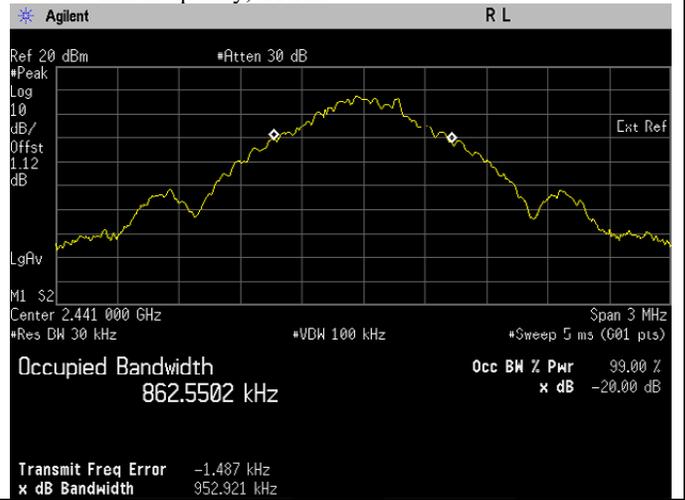
### 6.2.3. Test Data:

Test Conditions		Test Frequency TX (GHz)	Results (MHz)		
Modulation Type	Voltage(V)		20dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Status
GFSK	7.50	2.4020	0.955	0.861	Pass
		2.4410	0.953	0.863	Pass
		2.4800	0.953	0.859	Pass
Pi/4 DQPSK	7.50	2.4020	1.285	1.170	Pass
		2.4410	1.287	1.171	Pass
		2.4800	1.283	1.167	Pass
8DPSK	7.50	2.4020	1.300	1.179	Pass
		2.4410	1.295	1.177	Pass
		2.4800	1.294	1.172	Pass

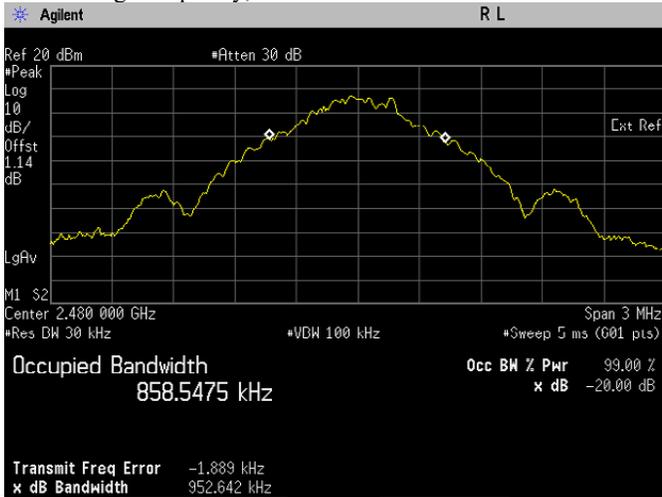
i. The 20 dB BW & occupied bandwidth test with result at low frequency, GFSK.



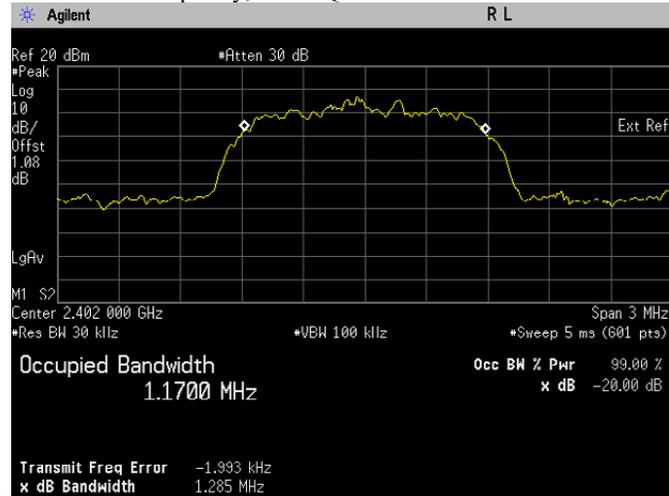
ii. The 20 dB BW & occupied bandwidth test with result at mid frequency, GFSK.



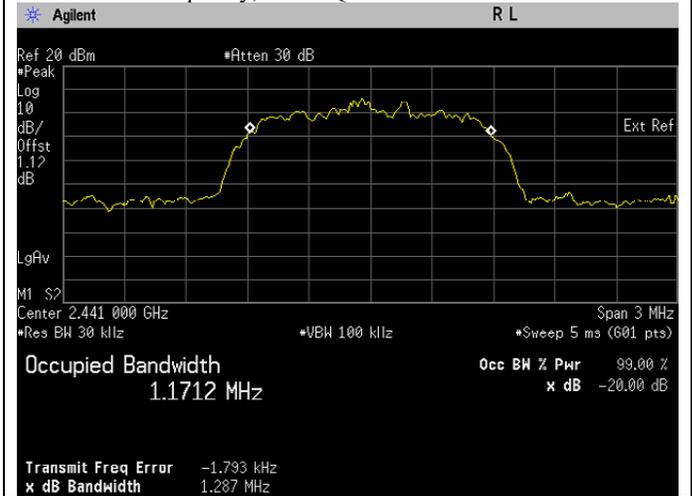
iii. The 20 dB BW & occupied bandwidth test with result at high frequency, GFSK.



i. The 20 dB BW & occupied bandwidth test with result at low frequency, Pi/4 DQPSK.



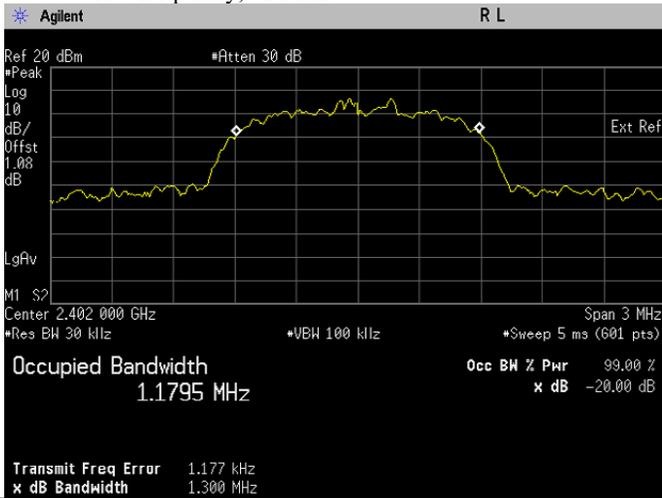
ii. The 20 dB BW & occupied bandwidth test with result at mid frequency, Pi/4 DQPSK.



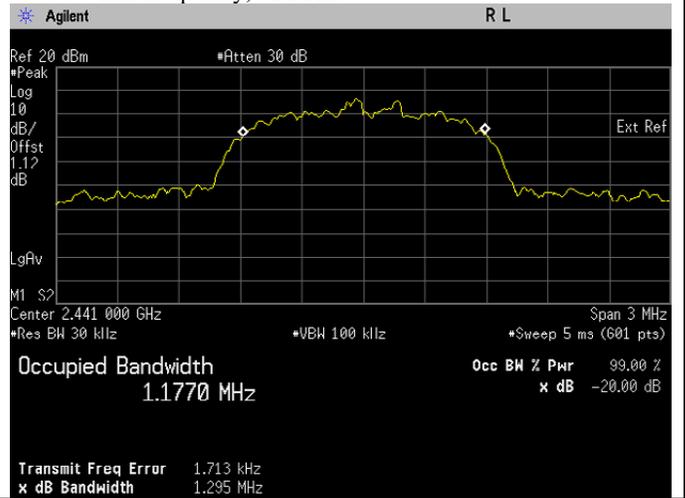
iii. The 20 dB BW & occupied bandwidth test with result at high frequency, Pi/4 DQPSK.



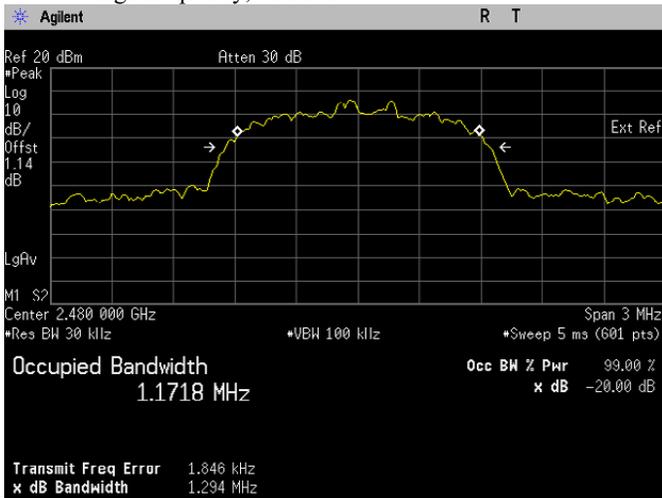
i. The 20 dB BW & occupied bandwidth test with result at low frequency, 8DPSK.



ii. The 20 dB BW & occupied bandwidth test with result at mid frequency, 8DPSK.

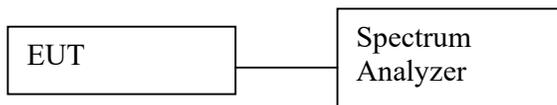


iii. The 20 dB BW & occupied bandwidth test with result at high frequency, 8DPSK.



### 6.3. Band-edge Conducted Spurious Emission

#### 6.3.1. Test Setup



- a) Check and ensure the spectrum analyzer well calibrate.
- b) Turn on the EUT and keep the EUT in hopping mode.
- c) Connect EUT’s antenna terminal to spectrum analyzer with a low loss cable.
- d) Setting of Spectrum analyzer :
  - a. RBW = 100 kHz
  - b. VBW = 300 kHz
  - c. SPAN = 4 MHz (Low channel) or 6MHz(High Channel)
  - d. Detector mode = Peak
  - e. AMPLITUDE → Scale/Div = 10 dB
  - f. Trace = Max hold
  - g. Sweep = auto
- e) Measure the captured band edge emission result and recording the plot.
- f) Repeat above on EUT with hopping disable.
- g) Repeat above procedure with other different test frequency.

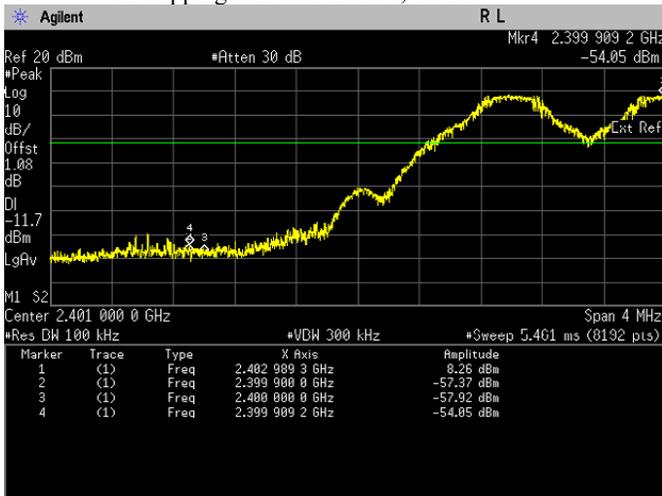
#### 6.3.2. Test Limits

<b>Normal Condition (25 ° C)</b>
<b>Shall be at least 20 dB below the peak power.</b>

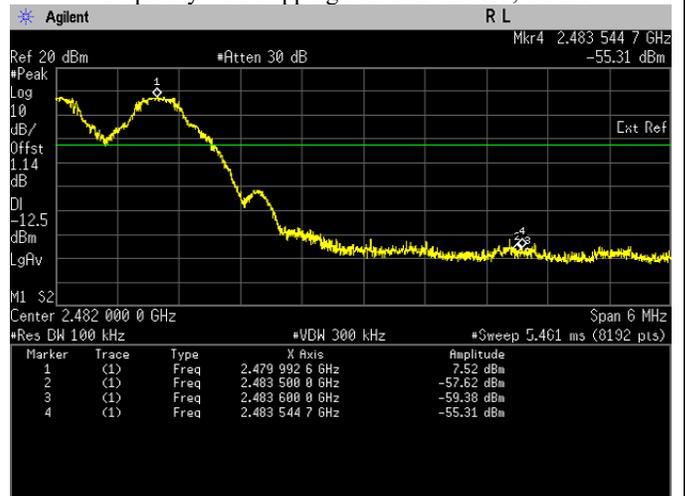
#### 6.3.3. Test Result

Test Conditions		Hopping Method	Test Frequency(GHz)	Results	
Modulation	Voltage(V)			dB	Status
GFSK	7.50	Enabled (continuously)	2.4020	-54.05	Pass
			2.4800	-55.31	Pass
		Disabled (constantly)	2.4020	-51.42	Pass
			2.4800	-53.78	Pass
Pi/4 DQPSK	7.50	Enabled (continuously)	2.4020	-52.37	Pass
			2.4800	-56.61	Pass
		Disabled (constantly)	2.4020	-49.42	Pass
			2.4800	-54.29	Pass
8DPSK	7.50	Enabled (continuously)	2.4020	-48.62	Pass
			2.4800	-56.84	Pass
		Disabled (constantly)	2.4020	-43.43	Pass
			2.4800	-53.18	Pass

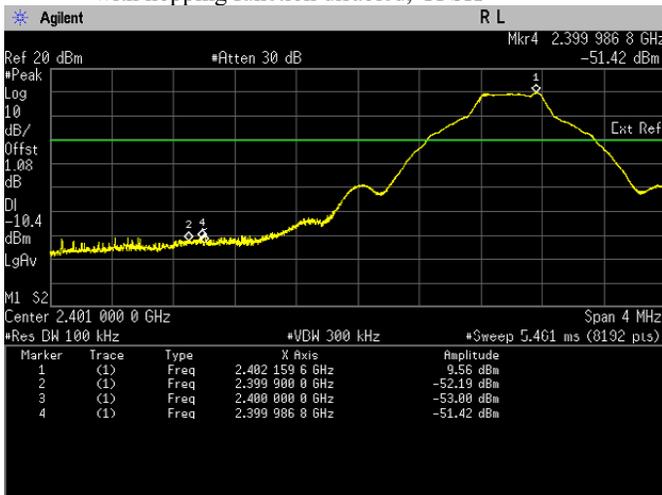
i. The highest band edge emission at low carrier frequency with hopping function enabled, GFSK



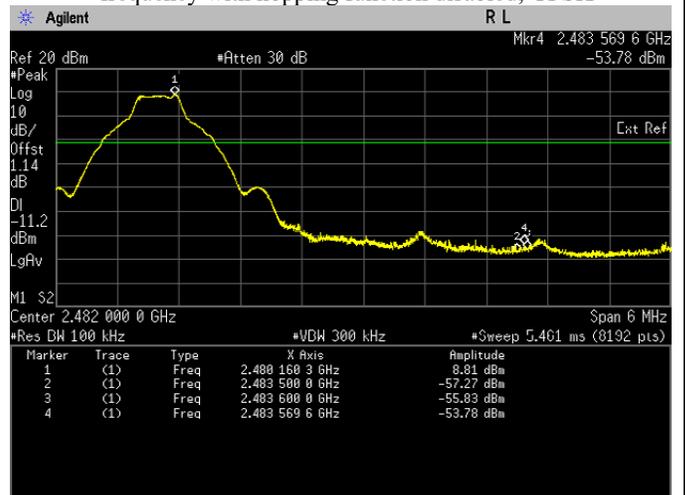
ii. The highest band edge emission at high carrier frequency with hopping function enabled, GFSK



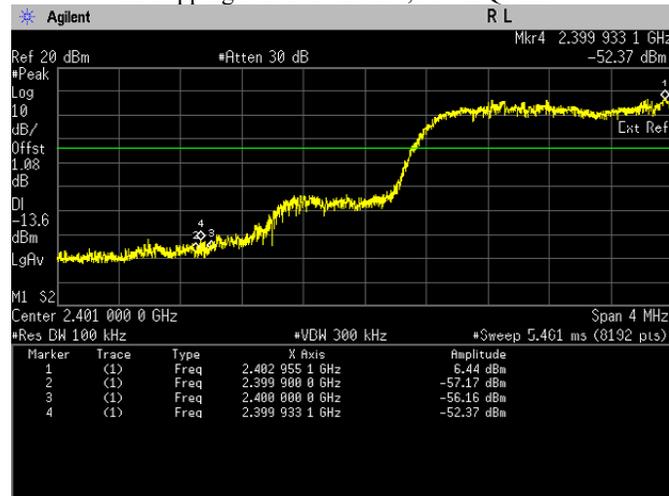
iii. The highest band edge emission at low carrier frequency with hopping function disabled, GFSK



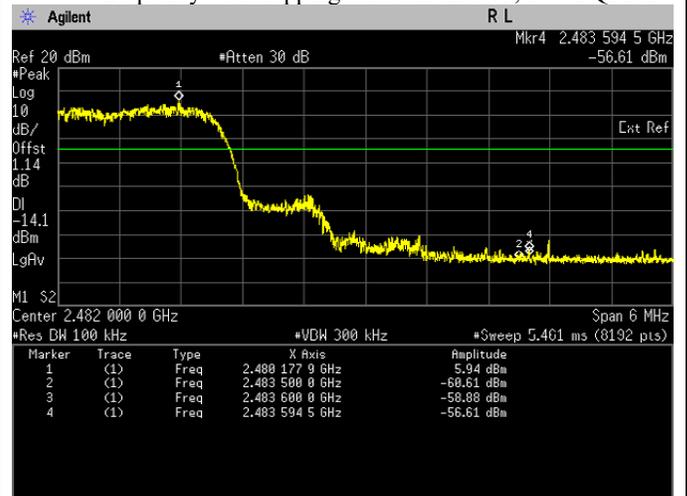
iv. The highest band edge emission at high carrier frequency with hopping function disabled, GFSK



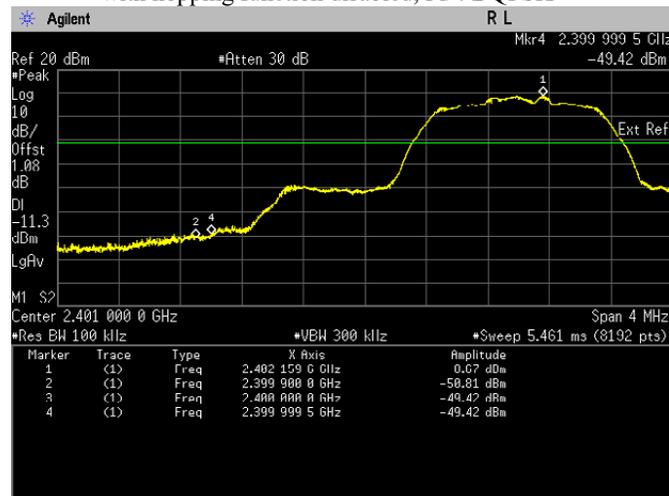
i. The highest band edge emission at low carrier frequency with hopping function enabled, Pi/4 DQPSK



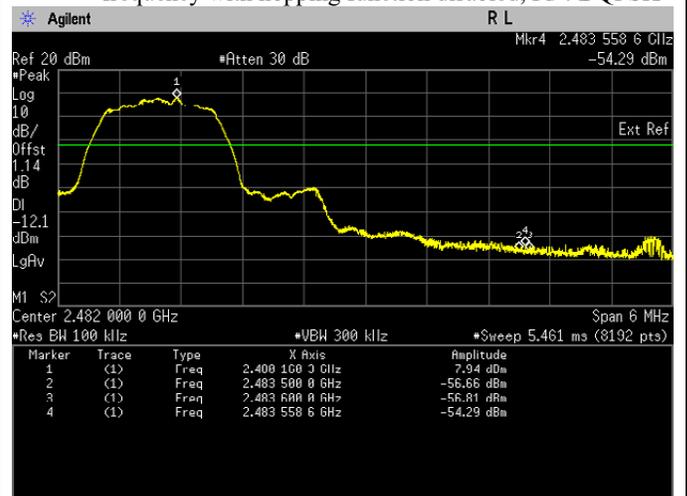
ii. The highest band edge emission at high carrier frequency with hopping function enabled, Pi/4 DQPSK



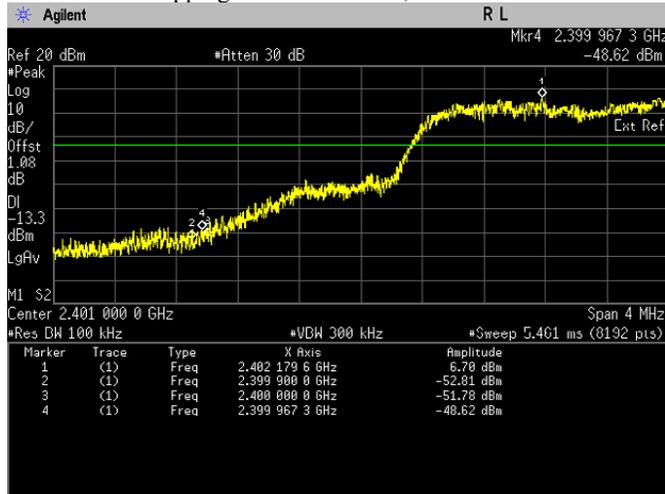
iii. The highest band edge emission at low carrier frequency with hopping function disabled, Pi/4 DQPSK



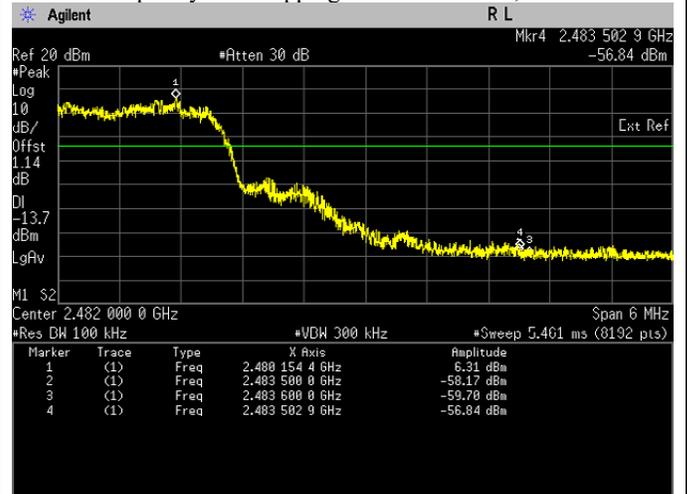
iv. The highest band edge emission at high carrier frequency with hopping function disabled, Pi/4 DQPSK



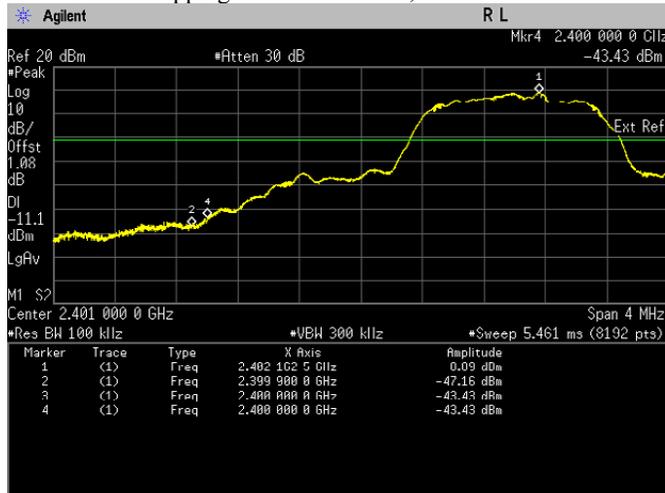
i. The highest band edge emission at low carrier frequency with hopping function enabled, 8DPSK



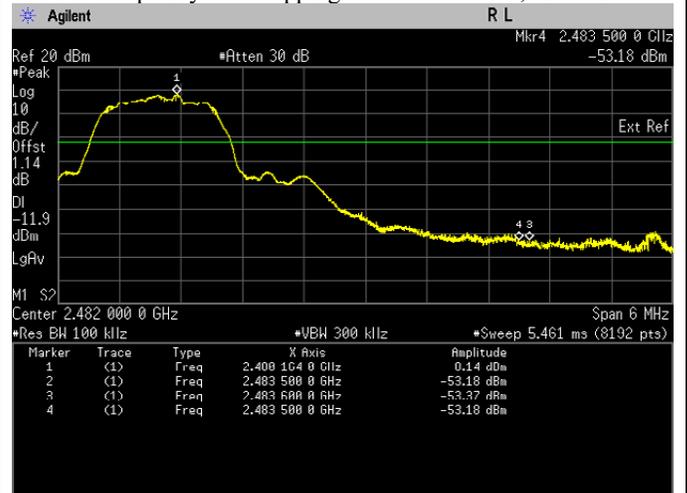
ii. The highest band edge emission at high carrier frequency with hopping function enabled, 8DPSK



iii. The highest band edge emission at low carrier frequency with hopping function disabled, 8DPSK

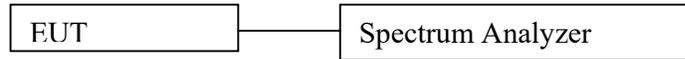


iv. The highest band edge emission at high carrier frequency with hopping function disabled, 8DPSK



## 6.4. Dwell time on each channel

### 6.4.1. Test Setup



- a) Check and ensure the spectrum analyzer well calibrate.
- b) Turn on the EUT and keep the EUT in hopping mode.
- c) Connect EUT's antenna terminal to spectrum analyzer with a low loss cable.
- d) Setting of Spectrum analyzer :
  - a. RBW = 100 kHz
  - b. VBW = 300 kHz
  - c. SPAN = Zero SPAN, center on hopping frequency
  - d. Detector mode = Peak
  - e. Trace = Max hold
  - f. Sweep time = 5second
  - g. Sweep = Single
- e) Measure total numbers of transmissions occur in 5 second and save the plot.
- f) Change the setting of spectrum analyzer :
  - a. RBW = 100 kHz
  - b. VBW = 300 kHz
  - c. Sweep time = sufficient to capture dwell time for 1 transmission
  - d. Sweep = Single
- g) Measure dwell time for 1 transmission and save the plot.
- h) Calculate accumulate dwell time in a given period equal to number of hopping frequencies x 0.4
- i) Repeat above procedure with other different mode of operation.

### 6.4.2. Test Limits:

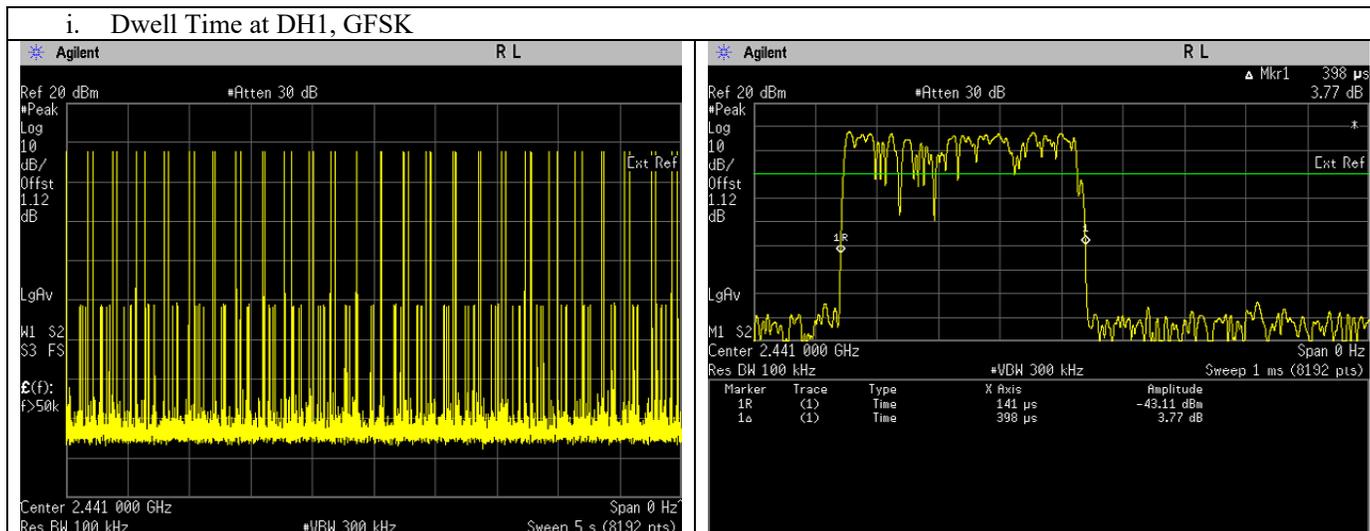
<b>Normal Condition (25 ° C)</b>
<b>≤ 400ms</b>

### 6.4.3. Test Result

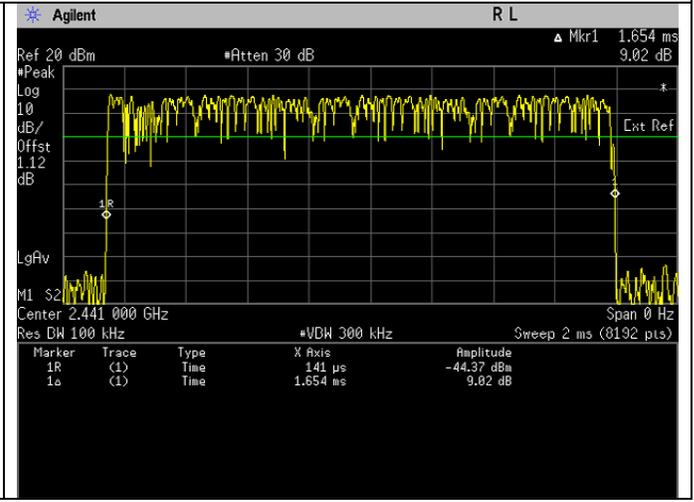
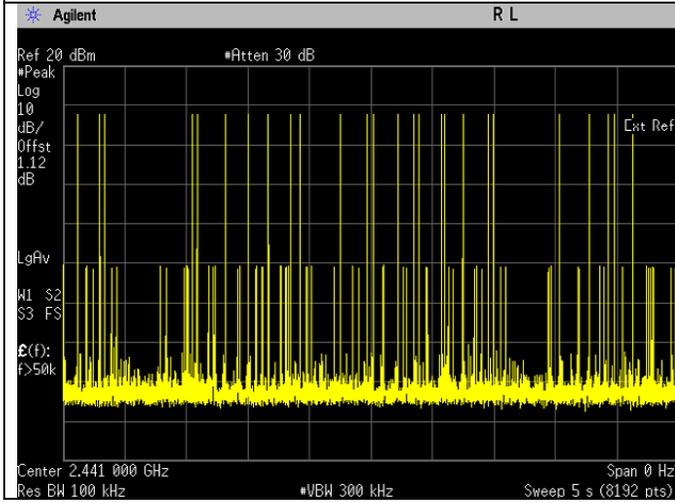
Test Conditions			Data Package	Results			
Modulation	Voltage (V)	Test Frequency (GHz)		No. of transmission in 5s (a)	Dwell time in one transmission (b) (msec)	Total accumulate dwell time in 31.6s. (c) (msec)	Status
GFSK	7.50	2.4410	DH1	52	0.398	130.798720	Pass
			DH3	27	1.654	282.238560	Pass
			DH5	18	2.903	330.245280	Pass
Pi/4 DQPSK	7.50		DH1	51	0.402	129.572640	Pass
			DH3	22	1.653	229.833120	Pass
			DH5	19	2.901	348.352080	Pass
8 DPSK	7.50		DH1	51	0.401	129.250320	Pass
			DH3	27	1.651	281.726640	Pass
			DH5	19	2.901	348.352080	Pass

**\*\*Note:** Total dwell time 31.6s (79Hopping\*0.4), (c) = (a) x 6.32 x (b)

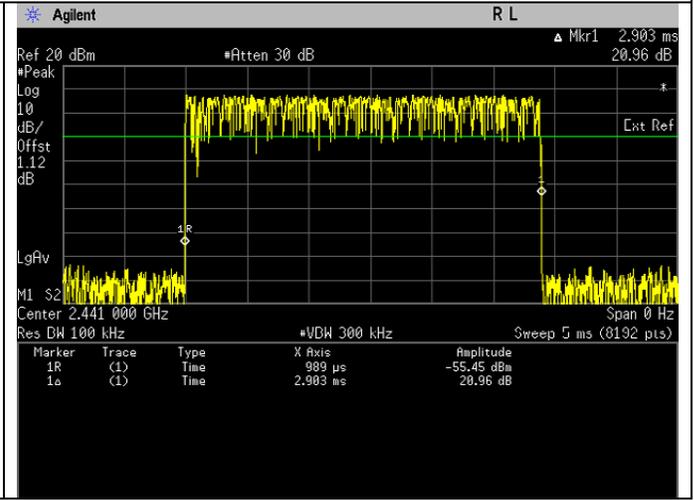
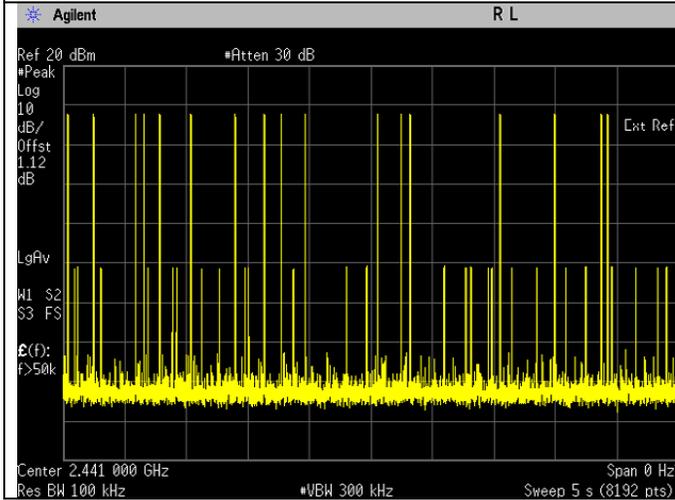
#### i. Dwell Time at DH1, GFSK



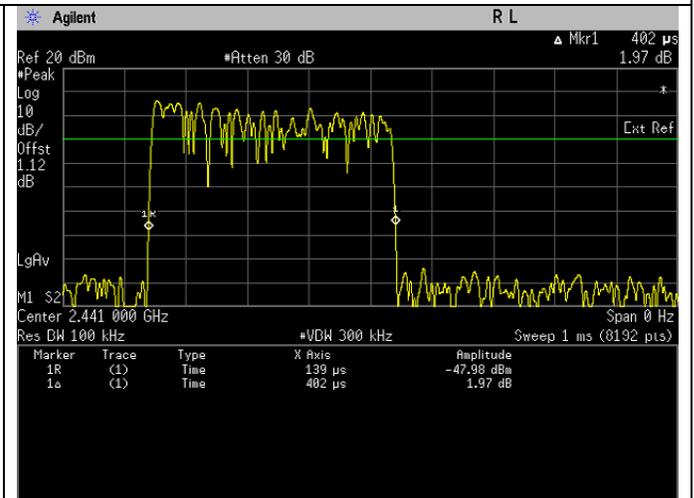
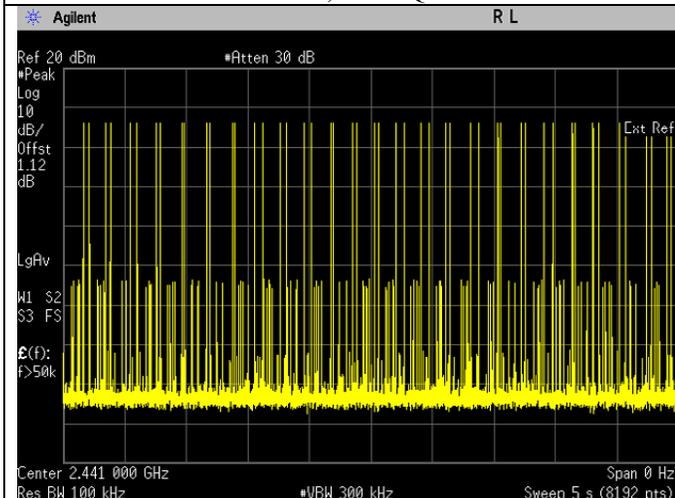
i. Dwell Time at DH3, GFSK



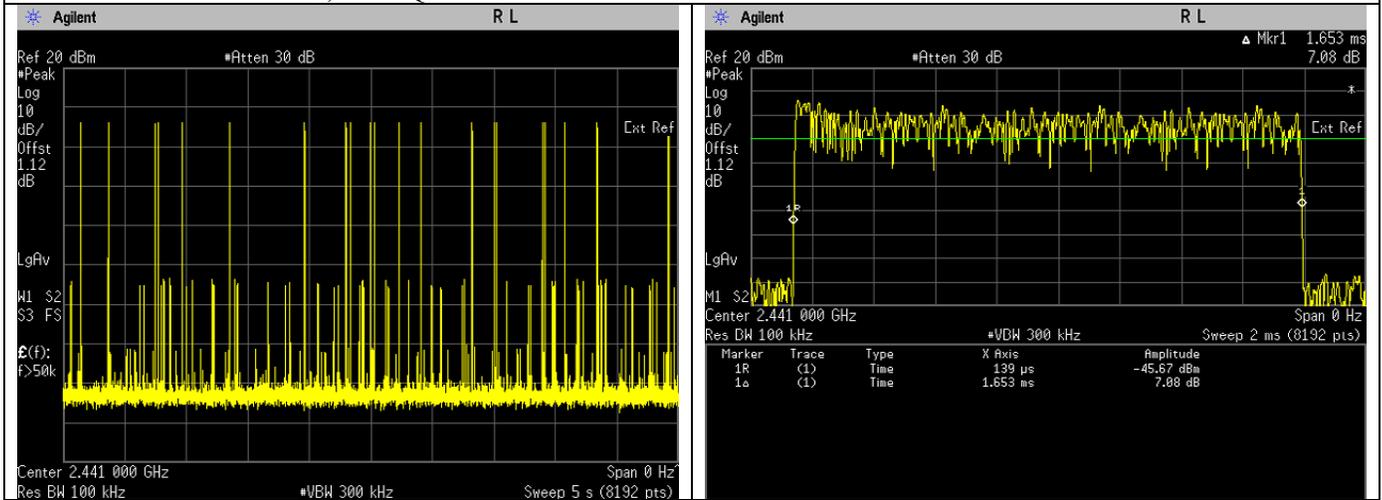
i. Dwell Time at DH5, GFSK



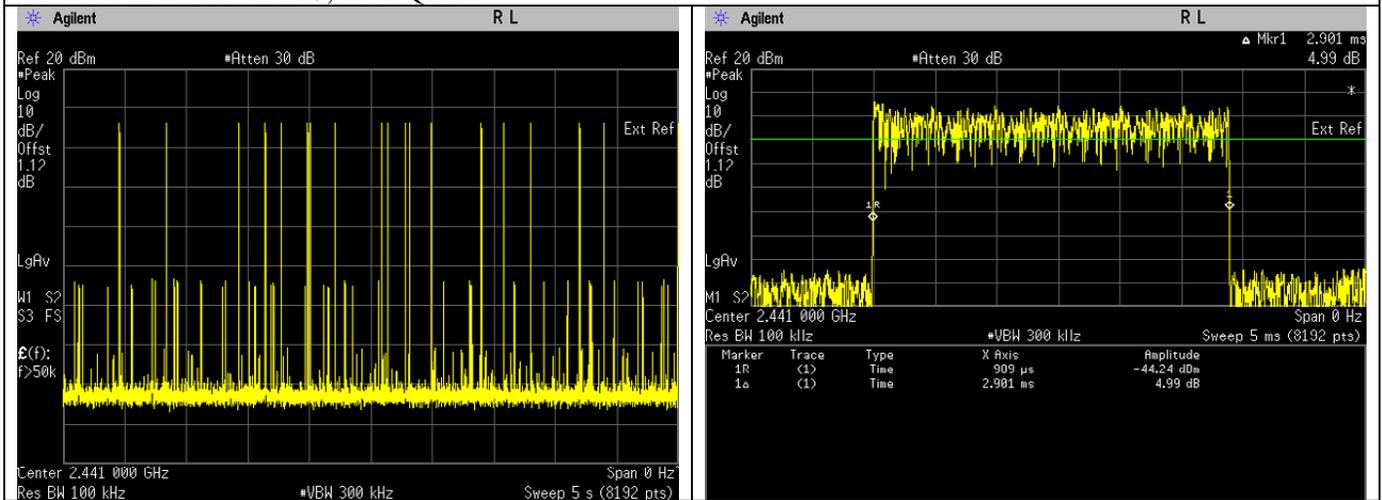
i. Dwell Time at DH1, PI/4DQPSK



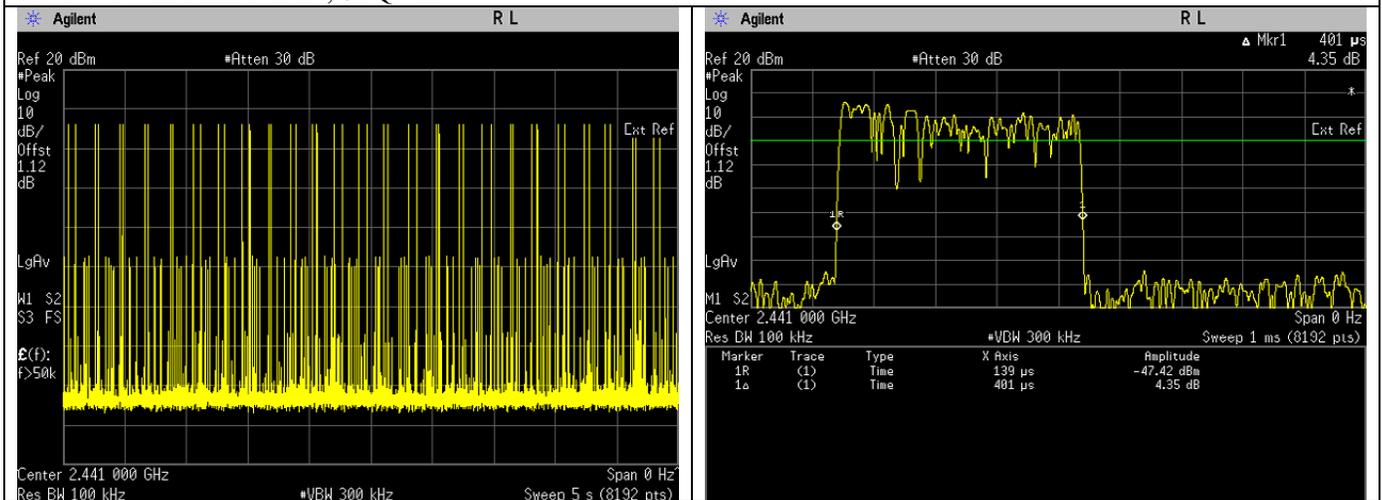
ii. Dwell Time at DH3, PI/4QPSK



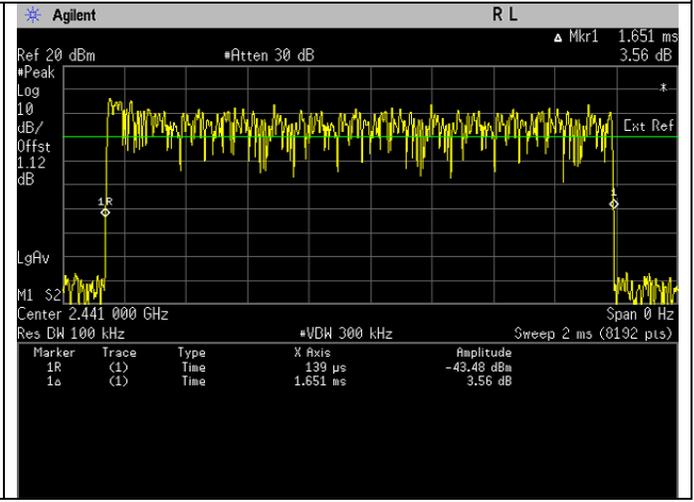
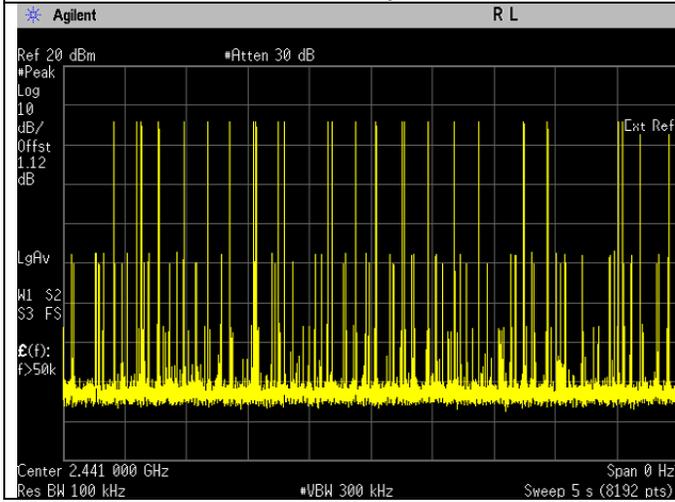
iii. Dwell Time at DH5, PI/4QPSK



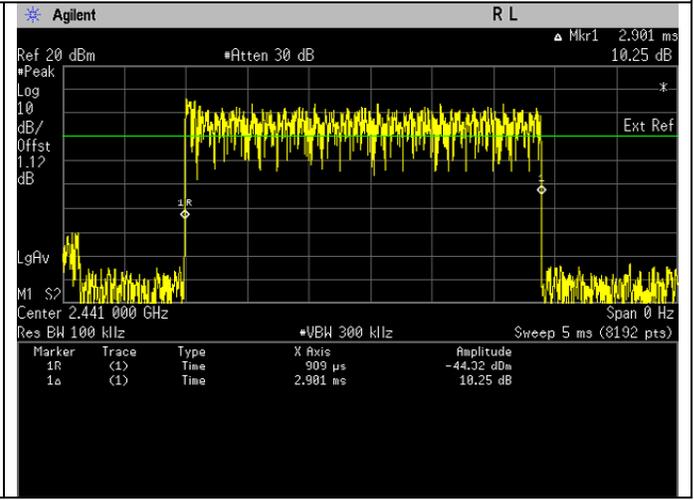
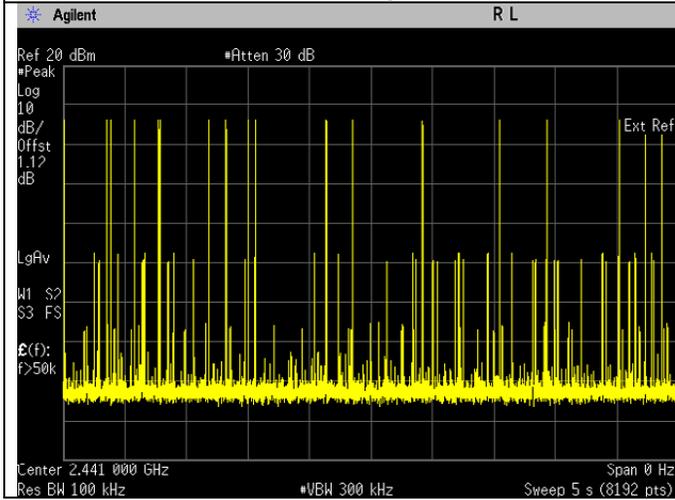
iv. Dwell Time at DH1, 8DQPSK



v. Dwell Time at DH3, 8DQPSK

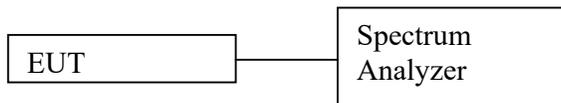


vi. Dwell Time at DH5, 8DQPSK



## 6.5. Number of hopping Frequency

### 6.5.1. Test Setup



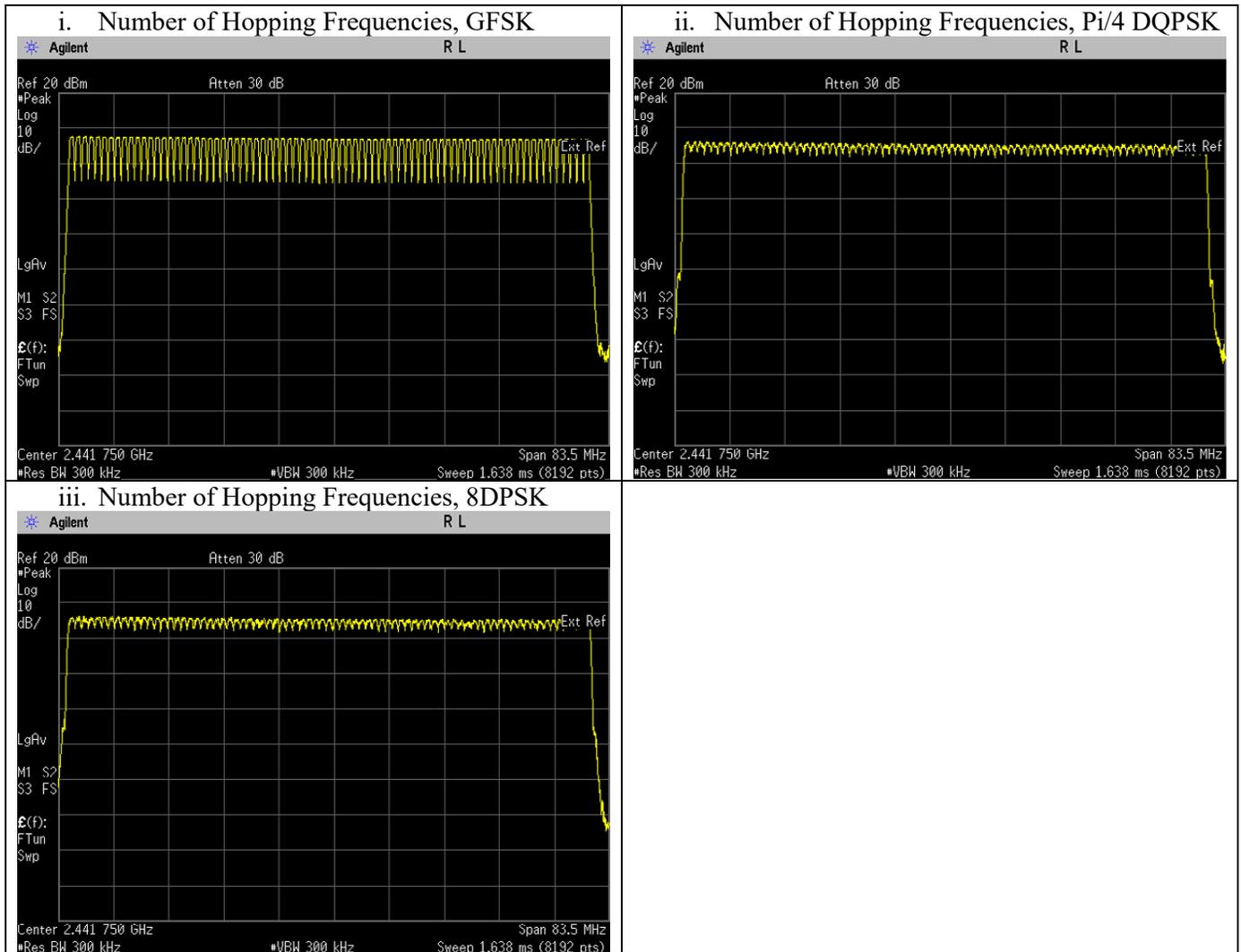
- a) Check and ensure the spectrum analyzer well calibrate.
- b) Turn on the EUT and keep the EUT in hopping mode.
- c) Connect EUT’s antenna terminal to spectrum analyzer with a low loss cable.
- d) Setting of Spectrum analyzer :
  - a. RBW = 300 kHz
  - b. VBW = 300 kHz
  - c. Detector mode = Peak
  - d. Trace = Max hold
- e) Allow the trace to stabilized & save the plot result from spectrum analyzer screen.
- f) Count number of channel frequency in the operating.
- g) Repeat above procedure for other test frequency.

### 6.5.2. Test Limits:

<b>Normal Condition (25 ° C)</b>
<b>≥ 15</b>

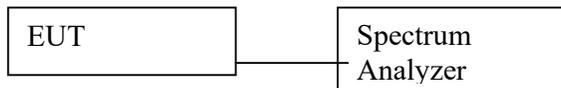
### 6.5.3. Test Result

Test Conditions		Sweep Range (GHz)	Results	
Modulation	Voltage(V)		No. of Hopping Frequencies	Status
GFSK	7.50	2.4000-2.4835	79	Pass
Pi/4DQPSK	7.50	2.4000-2.4835	79	Pass
8DPSK	7.50	2.4000-2.4835	79	Pass



## 6.6. Channel Separation

### 6.6.1. Test Setup



- a) Check and ensure the spectrum analyzer well calibrate.
- b) Turn on the EUT and keep the EUT in hopping mode.
- c) Connect EUT's antenna terminal to spectrum analyzer with a low loss cable.
- d) Setting of Spectrum analyzer :
  - a. RBW = 300 kHz
  - b. VBW = 300 kHz
  - c. SPAN = 3 MHz, center on test frequency
  - d. AMPLITUDE → Scale/Div = 5 dB
  - e. Detector mode = Peak
  - f. Trace = Max hold
  - g. Sweep = auto
- e) Measure the frequency different of these two adjacent channels with marker delta function & record the measurement results.
- f) Repeat above procedure with other different mode of operation.

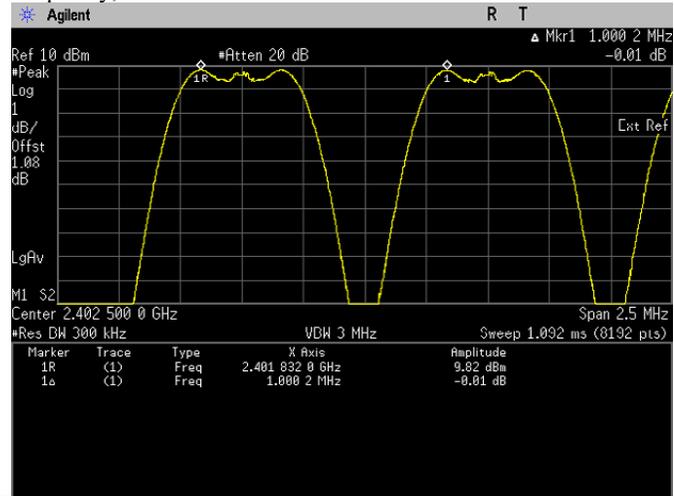
### 6.6.2. Test Limits:

<b>Normal Condition (25 ° C)</b>
<b>≥ 2/3 of 20dB Bandwidth</b>

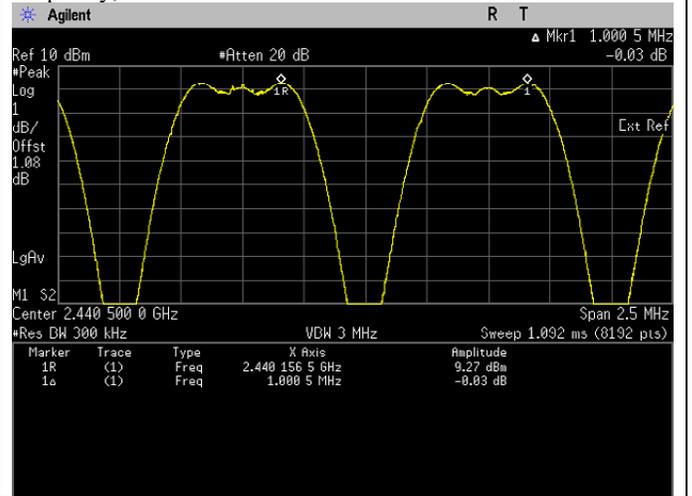
### 6.6.3. Test Result

Test Conditions		Test Frequency (GHz)	Results			
Modulation	Voltage(V)		Test Data Adjacent Channel Separation (MHz)	20dB Bandwidth (MHz)	Min Limit = 2/3 of 20dB Bandwidth (kHz)	Status
GFSK	7.50	2.4020	1.000	0.955	636.345	Pass
		2.4410	1.001	0.953	635.281	Pass
		2.4800	0.994	0.953	635.095	Pass
Pi/4DQPSK	7.50	2.4020	1.003	1.285	856.931	Pass
		2.4410	1.003	1.287	858.127	Pass
		2.4800	1.011	1.283	855.596	Pass
8DPSK	7.50	2.4020	1.009	1.300	866.885	Pass
		2.4410	0.996	1.295	863.507	Pass
		2.4800	1.004	1.294	862.133	Pass

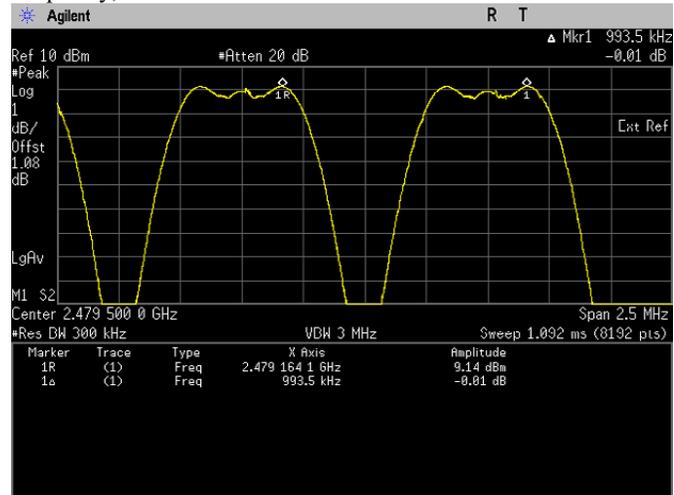
The Conducted RF Output Power test with result at low frequency, GFSK.



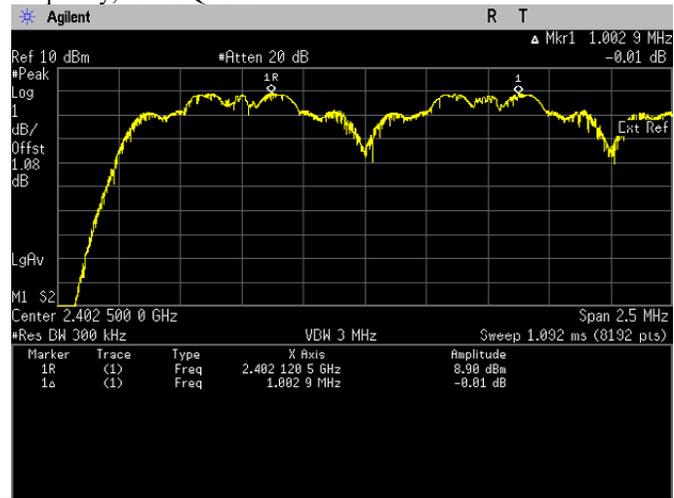
The Conducted RF Output Power test with result at mid frequency, GFSK.



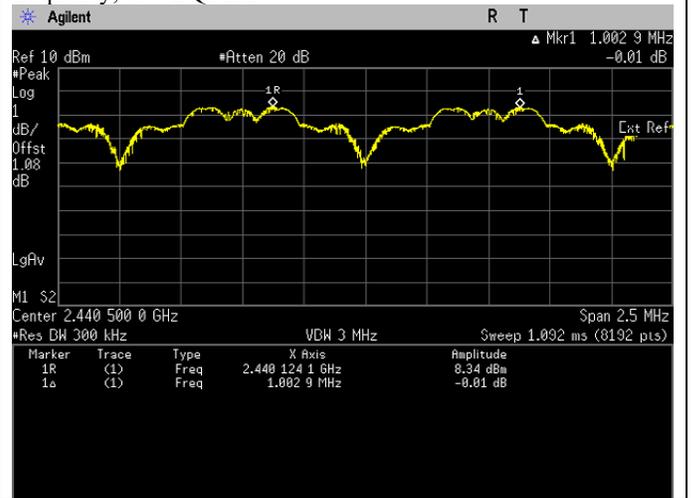
The Conducted RF Output Power test with result at high frequency, GFSK.



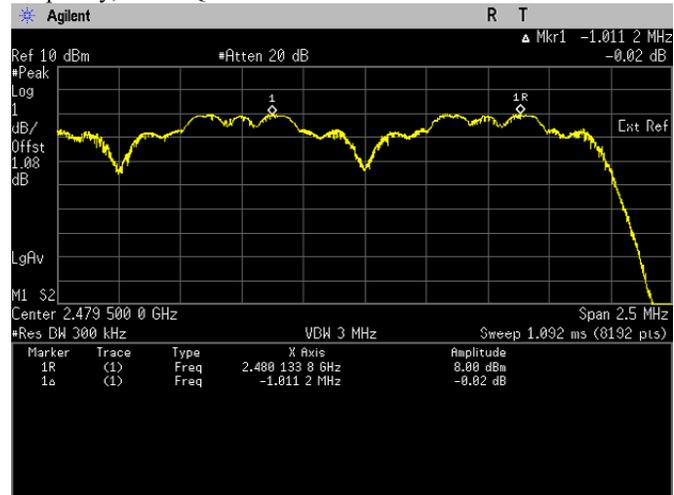
The Conducted RF Output Power test with result at low frequency, Pi/4 DQPSK.



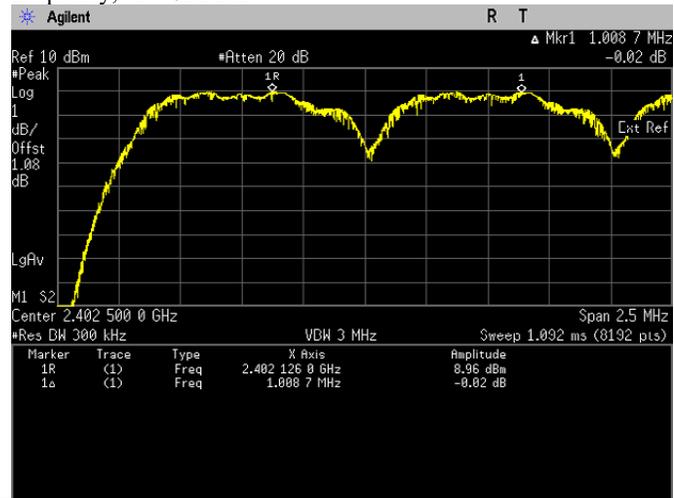
The Conducted RF Output Power test with result at mid frequency, Pi/4 DQPSK.



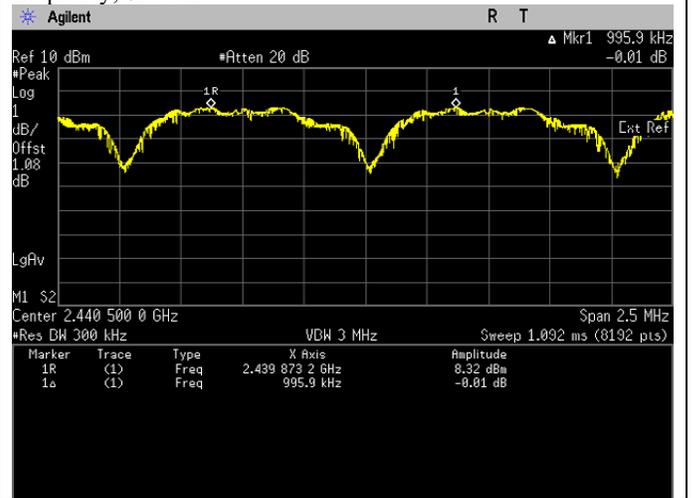
The Conducted RF Output Power test with result at high frequency, Pi/4 DQPSK.



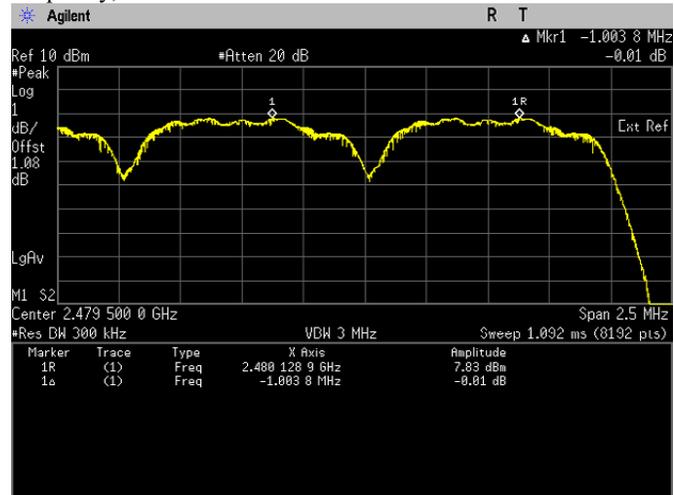
The Conducted RF Output Power test with result at low frequency, Pi/4 8DPSK.



The Conducted RF Output Power test with result at mid frequency, 8DPSK.



The Conducted RF Output Power test with result at high frequency, Pi/4 8DPSK.



## 6.7. Conducted Spurious Emission

### 6.7.1. Test Setup



- a) Check and ensure the spectrum analyzer well calibrate.
- b) Turn on the EUT and set EUT to transmit maximum data rate with hopping disable.
- c) Connect EUT's antenna terminal to spectrum analyzer with a low loss cable.
- d) Setting of Spectrum analyzer :
  - a. RBW = 100 kHz
  - b. VBW = 300 kHz
  - c. SPAN = Cover until 10<sup>th</sup> harmonic
  - d. Detector mode = Peak
  - e. AMPLITUDE → Scale/Div = 10 dB
  - f. Trace = Max hold
  - g. Sweep = auto
- e) Measure the captured spurious emission result and recording the plot.
- f) Repeat above procedure with other different mode of operation.

### 6.7.2. Test Limits:

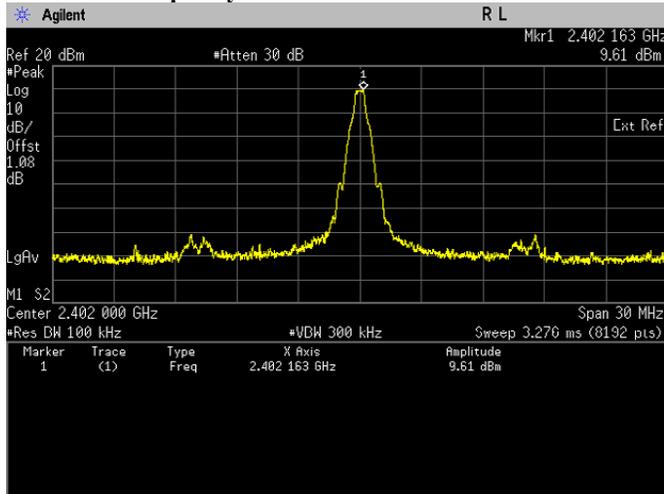
<b>Normal Condition (25 ° C)</b>
<b>Shall be at least 20 dB below for peak power.</b>

### 6.7.3. Test Data:

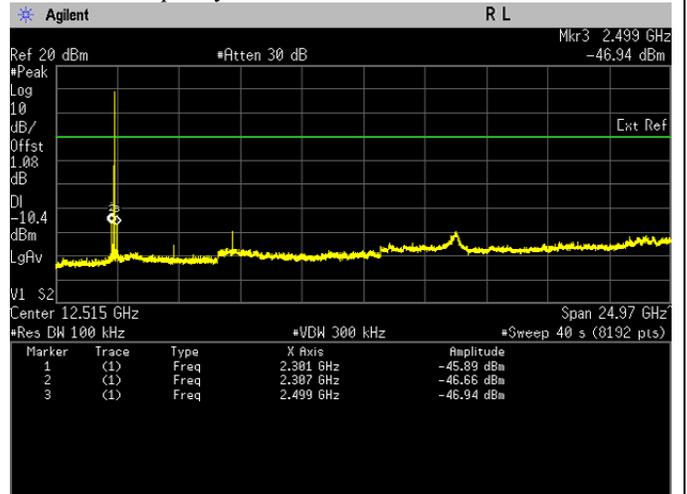
Test Conditions			Results		
Modulation	Voltage(V)	Test Frequency (GHz)	Spurs (MHz)	Level (dBm)	Status
GFSK	7.50	2.4020	2301.000	-45.891	Pass
		2.4410	2338.000	-45.778	Pass
		2.4800	2377.000	-45.827	Pass
Pi/4 DQPSK	7.50	2.4020	16333.000	-49.640	Pass
		2.4410	16245.000	-49.636	Pass
		2.4800	2585.000	-48.746	Pass
8DPSK	7.50	2.4020	2304.000	-49.079	Pass
		2.4410	2542.000	-47.645	Pass
		2.4800	2374.000	-46.590	Pass

GFSK Modulation:

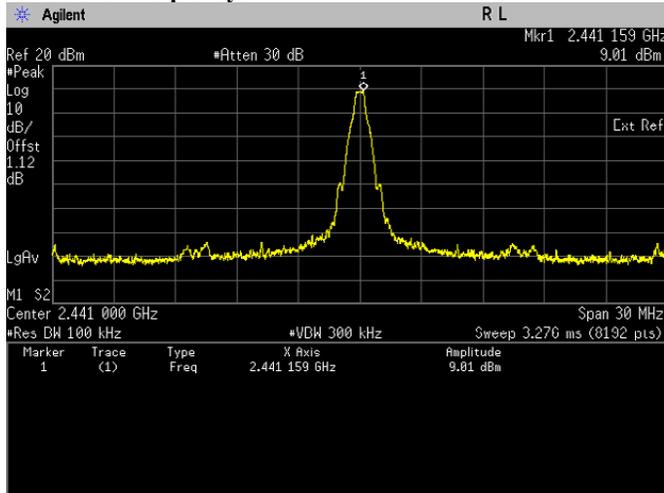
- The high emission level within the assigned band at low carrier frequency.



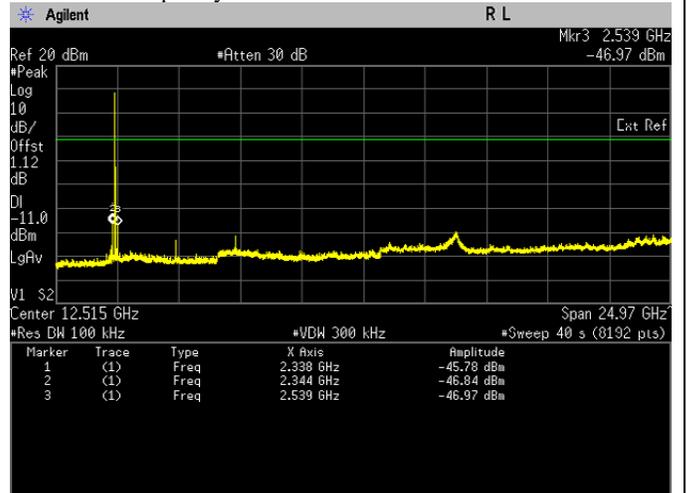
- Spurious emission measurement in 30MHz – 25GHz at low carrier frequency.



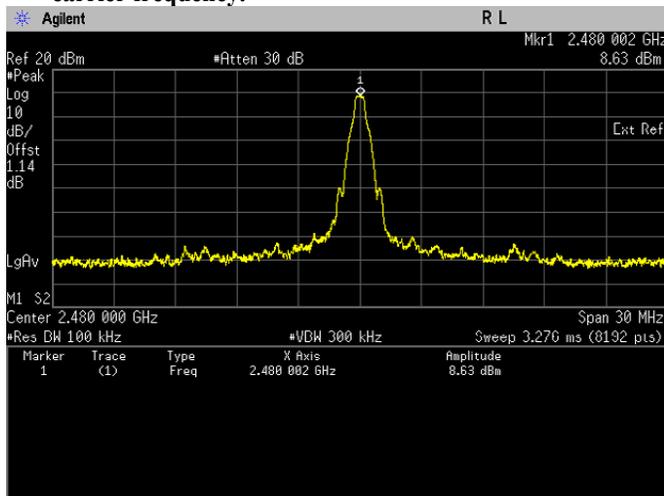
- The high emission level within the assigned band at mid carrier frequency.



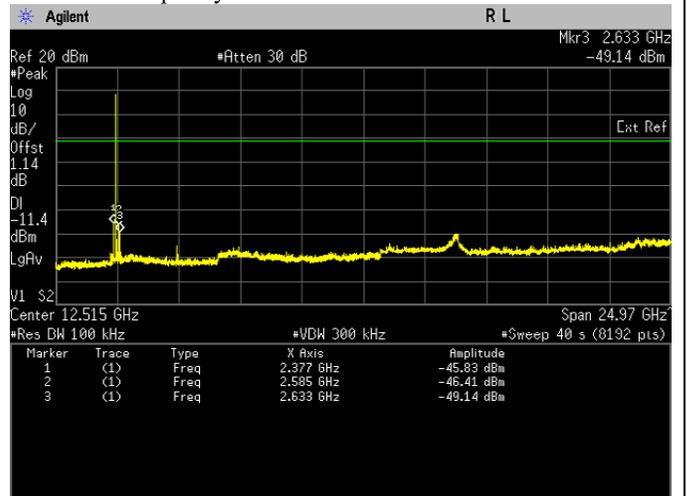
- Spurious emission measurement in 30MHz – 25GHz at mid carrier frequency.



- The high emission level within the assigned band at high carrier frequency.

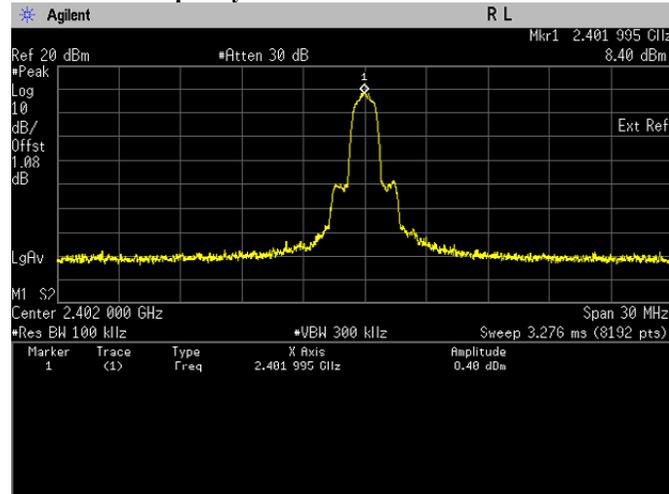


- Spurious emission measurement in 30MHz – 25GHz at high carrier frequency.

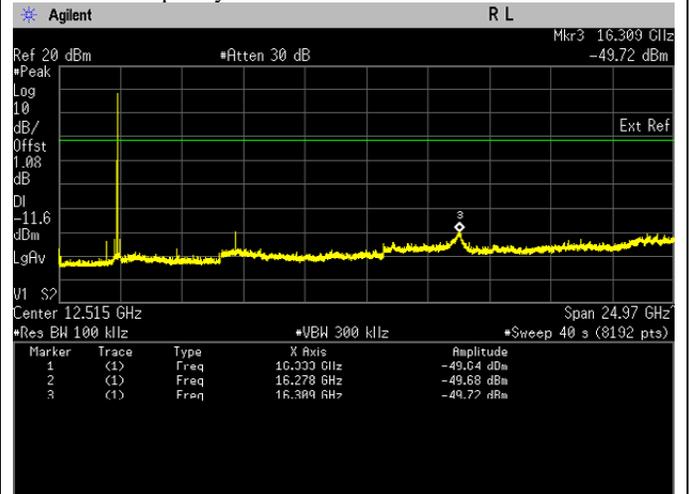


Pi/4 DQPSK Modulation:

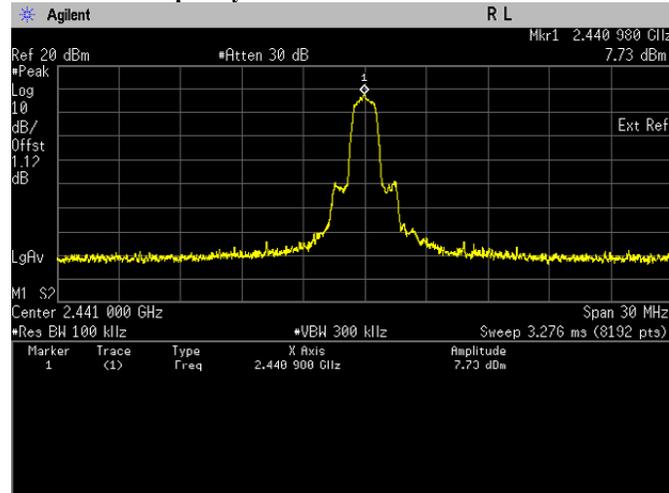
i. The high emission level within the assigned band at low carrier frequency.



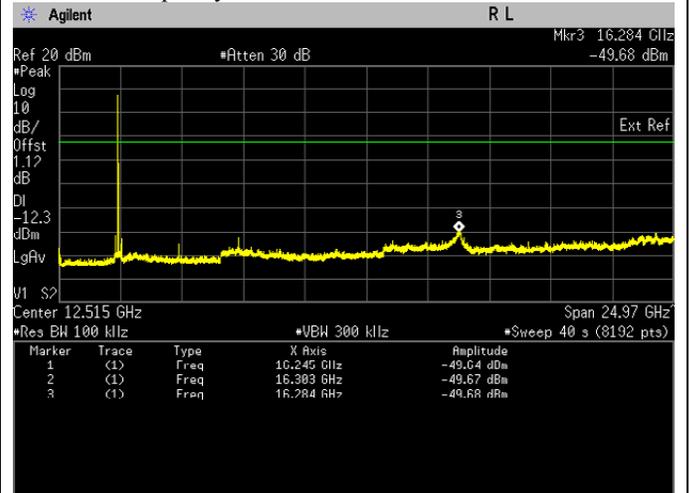
ii. Spurious emission measurement in 30MHz – 25GHz at low carrier frequency.



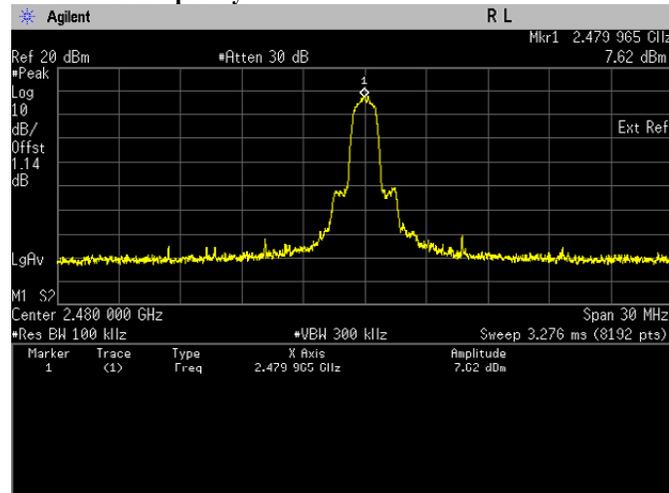
iii. The high emission level within the assigned band at mid carrier frequency.



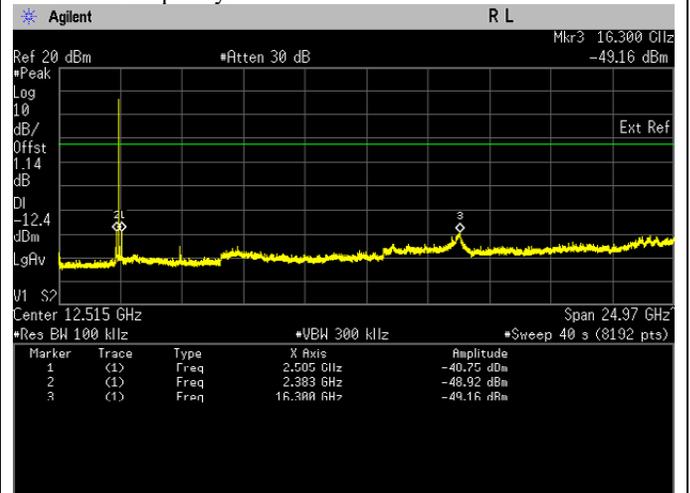
iv. Spurious emission measurement in 30MHz – 25GHz at mid carrier frequency.



v. The high emission level within the assigned band at high carrier frequency.

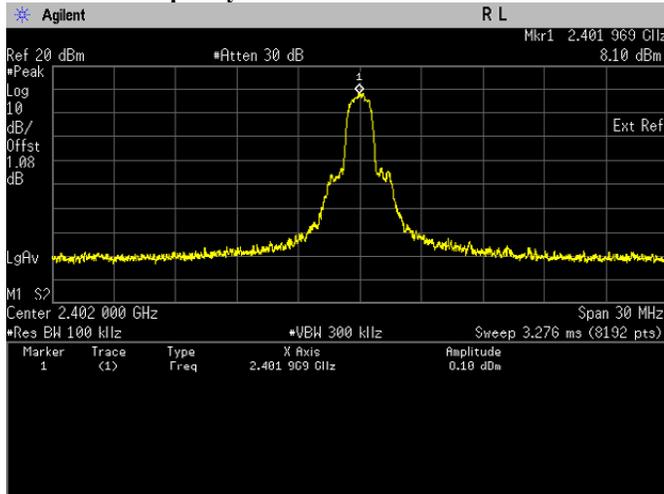


vi. Spurious emission measurement in 30MHz – 25GHz at high carrier frequency.

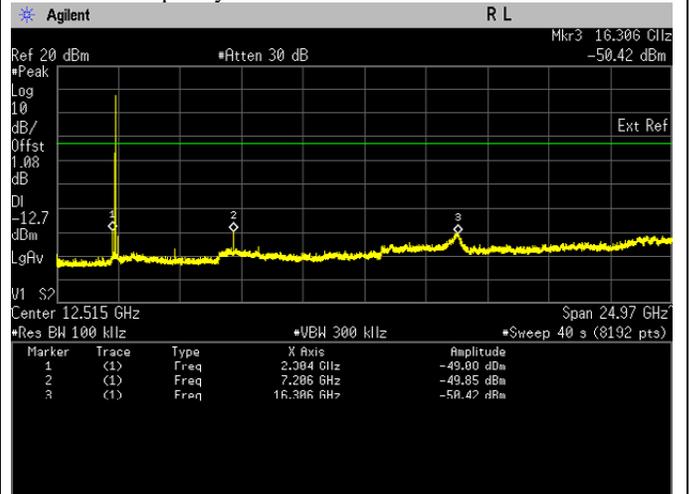


8DPSK Modulation:

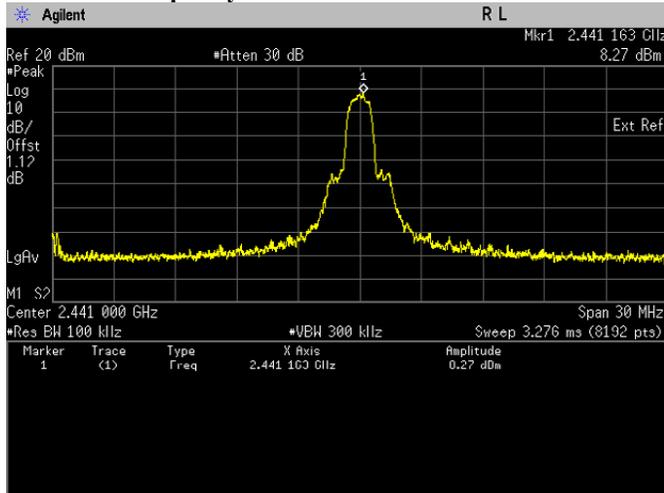
i. The high emission level within the assigned band at low carrier frequency.



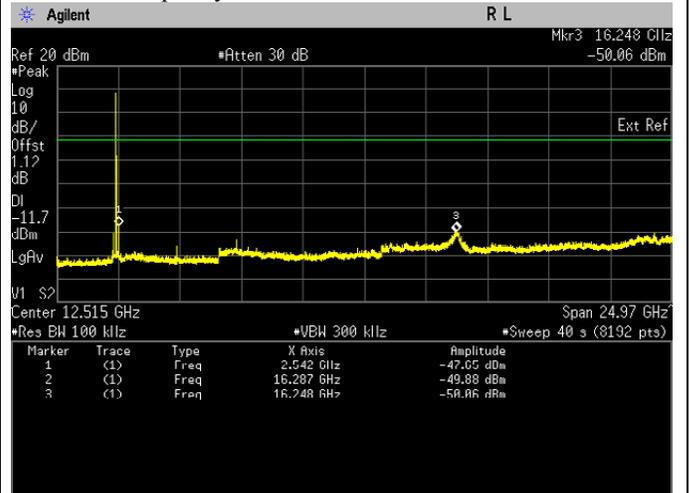
ii. Spurious emission measurement in 30MHz – 25GHz at low carrier frequency.



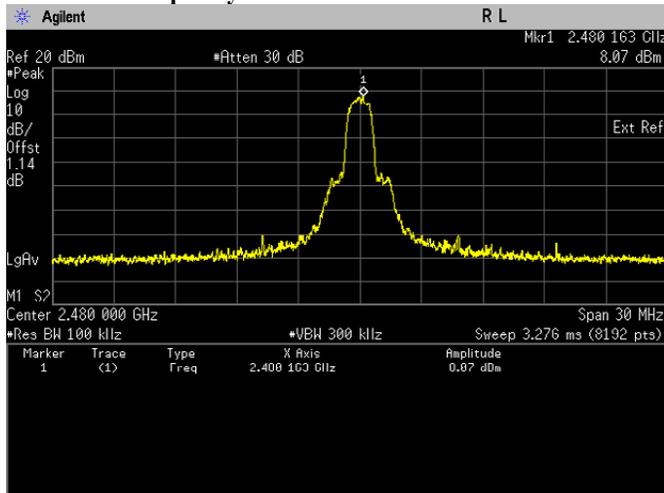
iii. The high emission level within the assigned band at mid carrier frequency.



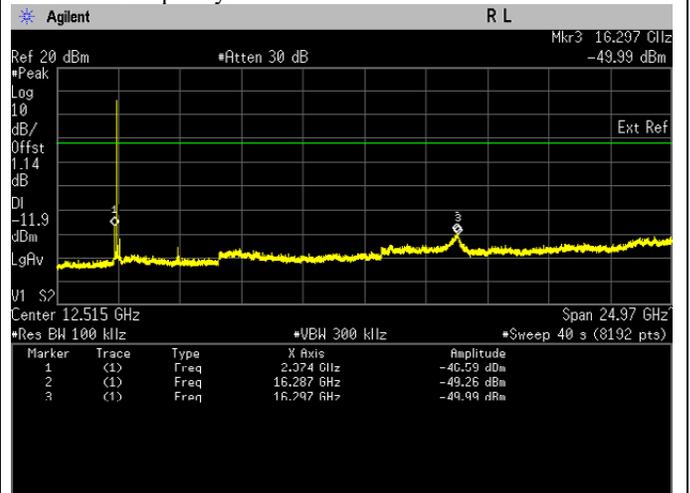
iv. Spurious emission measurement in 30MHz – 25GHz at mid carrier frequency.



v. The high emission level within the assigned band at high carrier frequency.

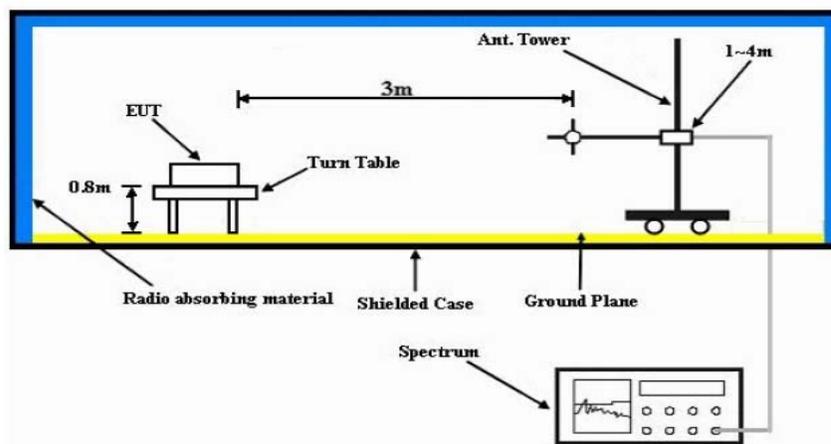


vi. Spurious emission measurement in 30MHz – 25GHz at high carrier frequency.



## 6.8. Radiated Emission within restricted Bands

### 6.8.1. Test Setup



- The EUT is placed on the top of a rotating table 0.8m (<1GHz) or 1.5m (>1GHz) above the ground at a 3m semi-anechoic chamber. The table is rotated 360 degrees to determine the position of the highest radiation.
- The EUT is set 3m away from the interference-receiving antenna, which is mounted on the top of a variable-height antenna tower.
- The antenna is Bilog/Horn antenna depend on which frequency range uses, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT is arranged to its worst case and then the antenna is tuned to heights from 1m to 4m and the rotatable table is turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system is set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode is fall within the range of 10dB from the limit specified, the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. Otherwise, the testing could be stopped and the peak values of the EUT would be reported.

#### NOTE:

- The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1GHz.
- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1 GHz.
- All modes of operation were investigated and the worst-case emissions are reported.

### 6.8.2. Test Limits:

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power.

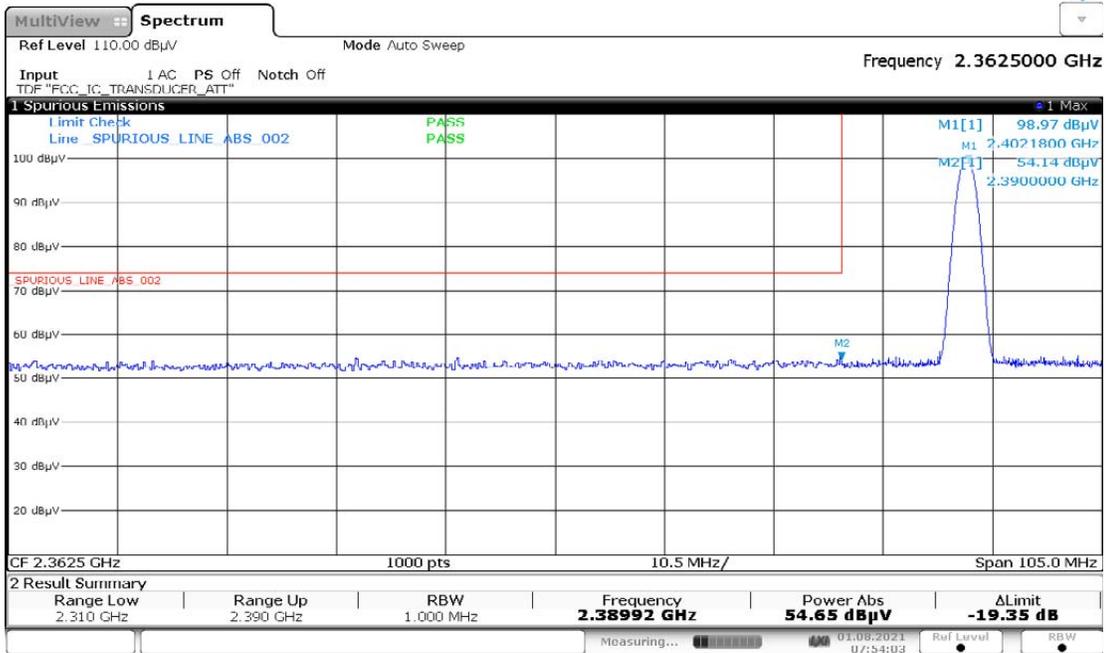
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

**NOTE:**

- a. The lower limit shall apply at the transition frequencies.
- b. Emission level (dBuV/m) = 20 log Emission level (uV/m).
- c. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

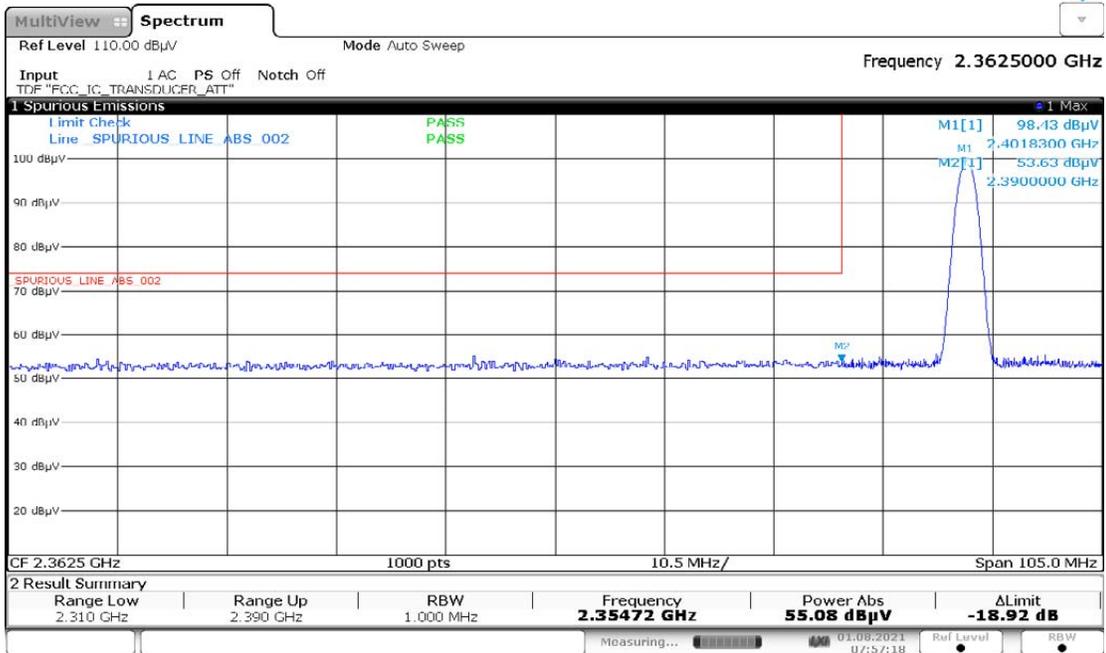


**Restricted Band Edge (Low Channel, Vertical, Peak) graphical screen shot**



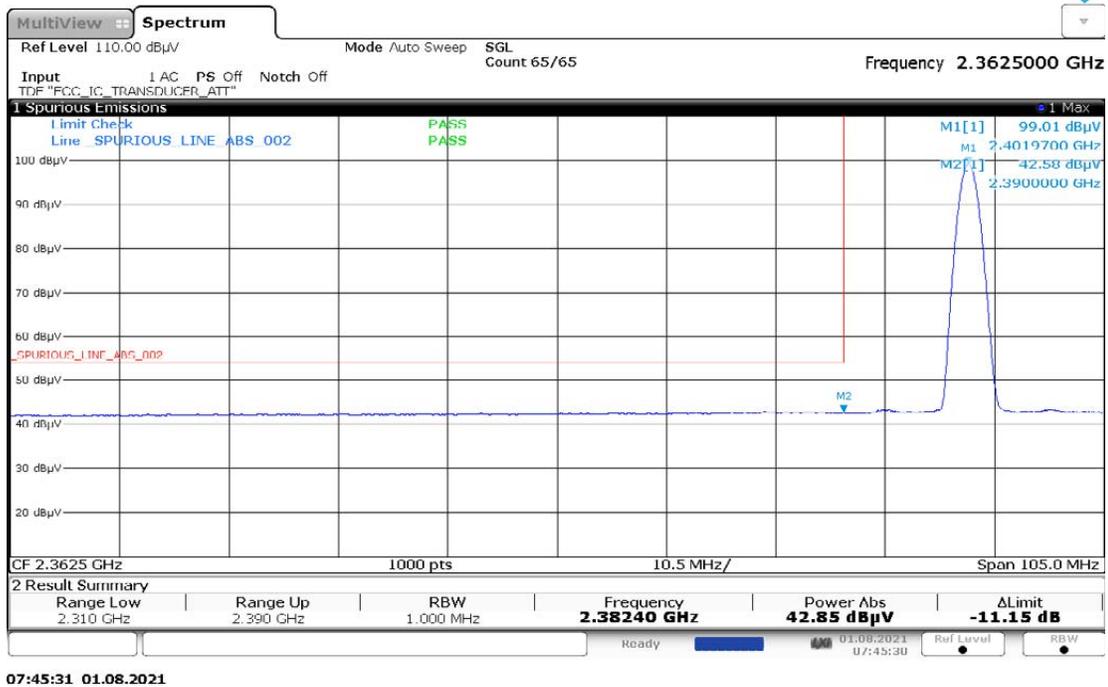
07:54:04 01.08.2021

**Restricted Band Edge (Low Channel, Horizontal, Peak) graphical screen shot**

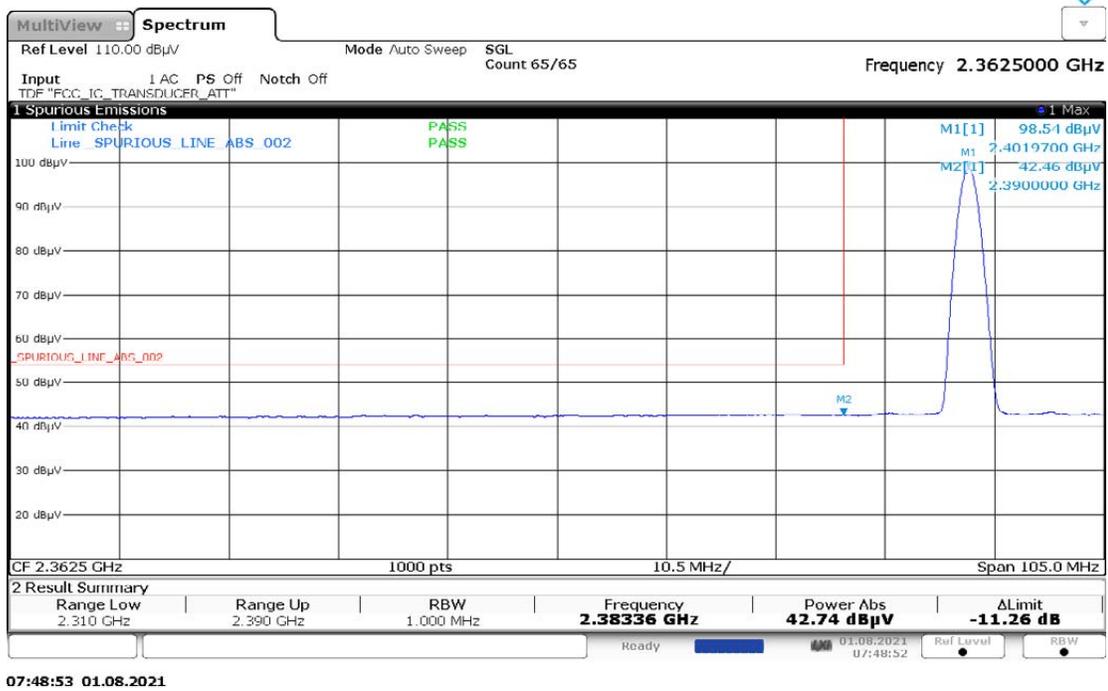


07:57:19 01.08.2021

**Restricted Band Edge (Low Channel, Vertical, Average) graphical screen shot**

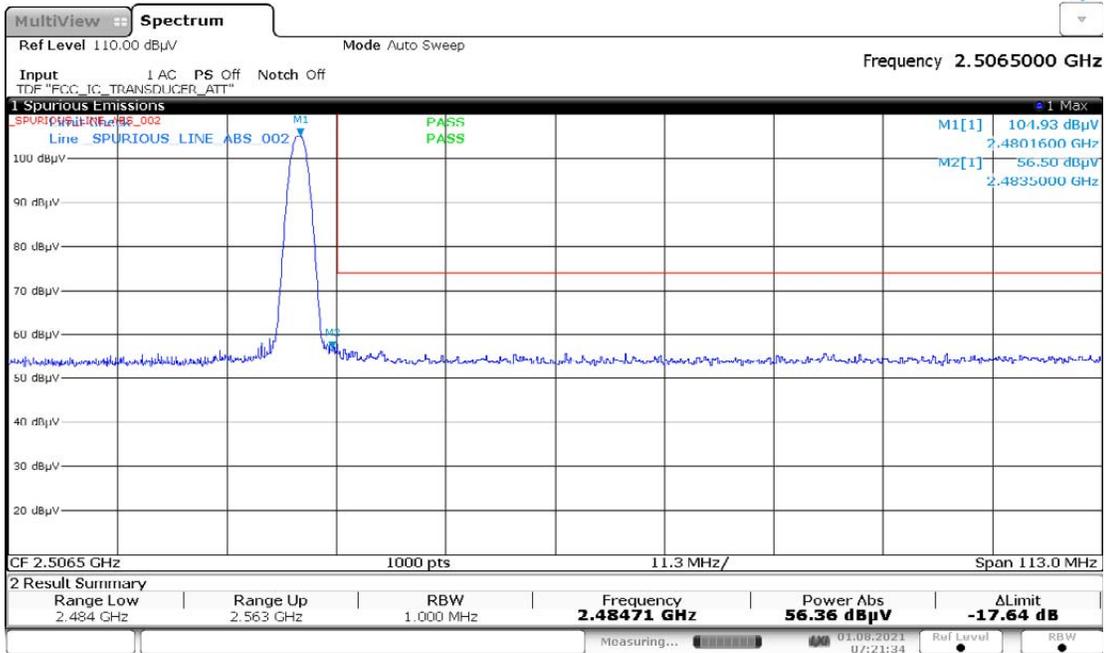


**Restricted Band Edge (Low Channel, Horizontal, Average) graphical screen shot**



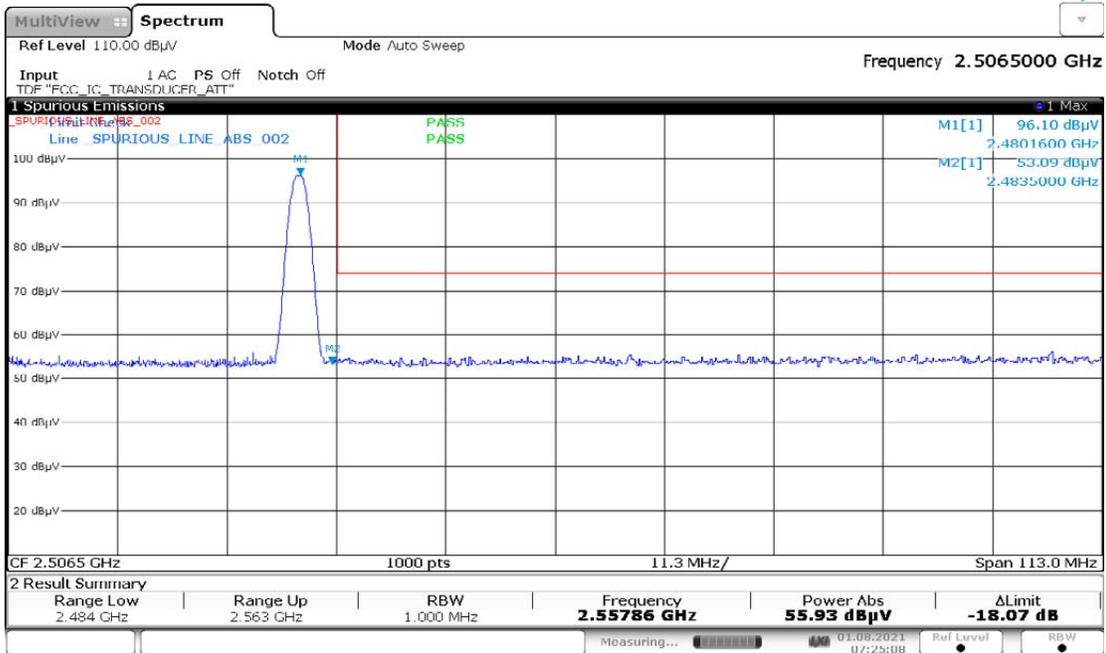


**Restricted Band Edge (High Channel, Vertical, Peak) graphical screen shot**



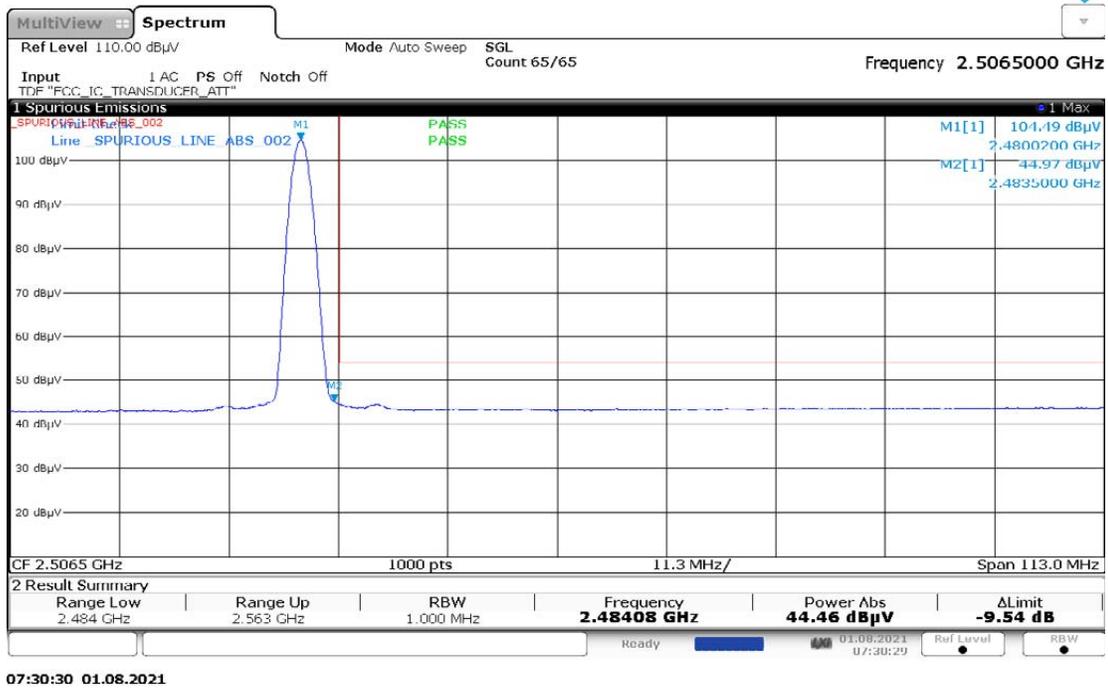
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**Restricted Band Edge (High Channel, Horizontal, Peak) graphical screen shot**

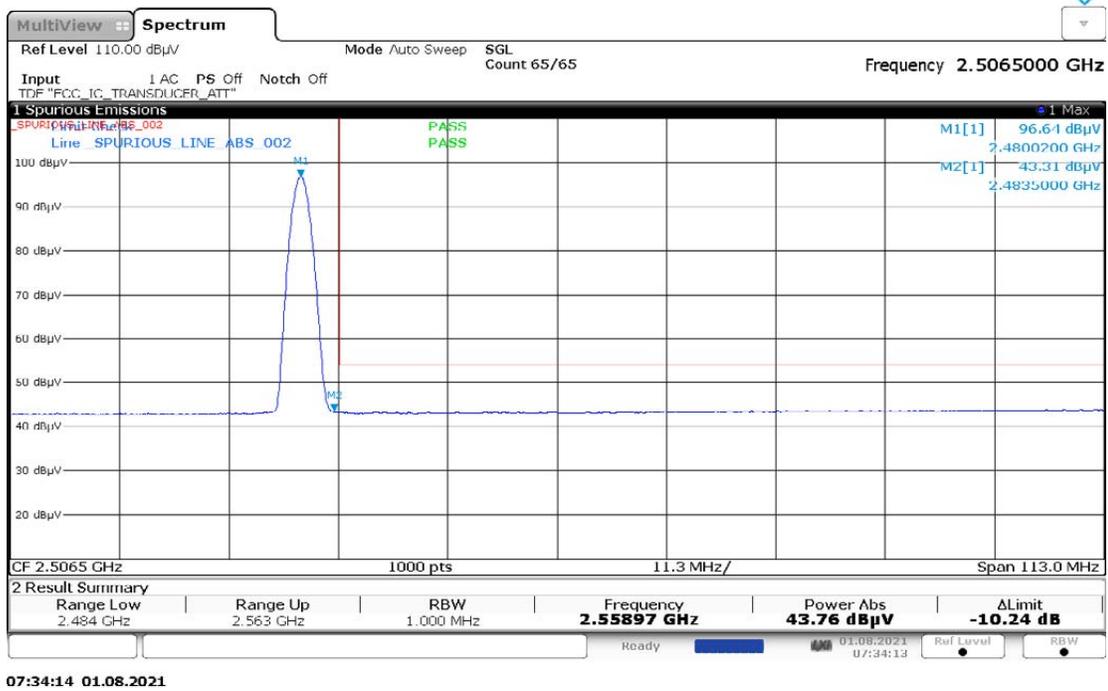


07:25:09 01.08.2021

**Restricted Band Edge (High Channel, Vertical, Average) graphical screen shot**

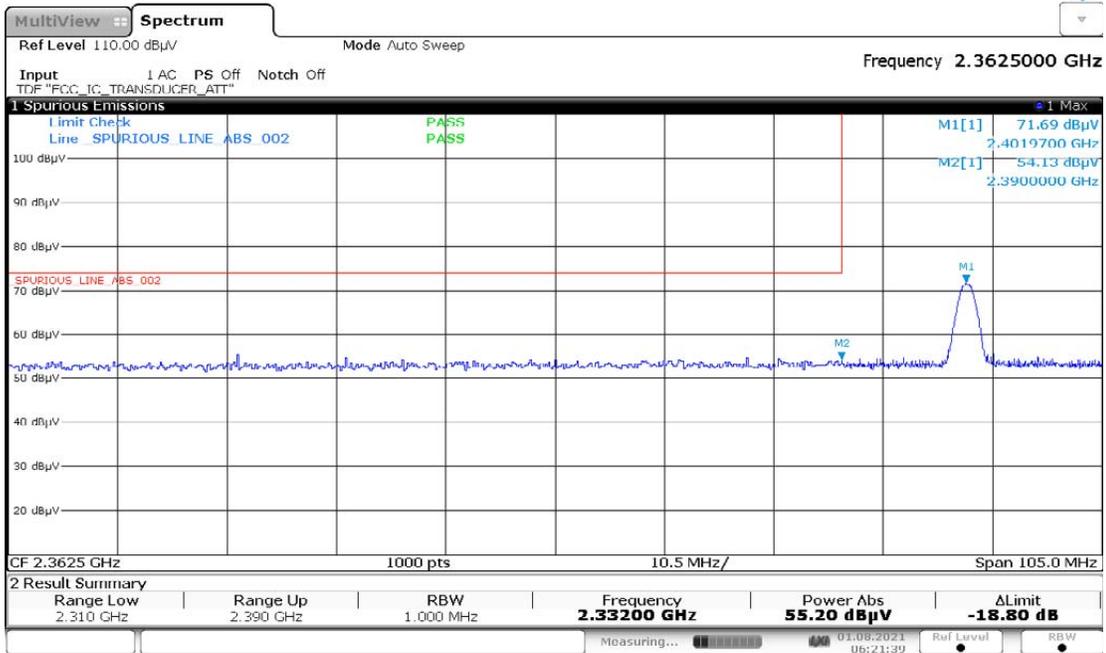


**Restricted Band Edge (High Channel, Horizontal, Average) graphical screen shot**



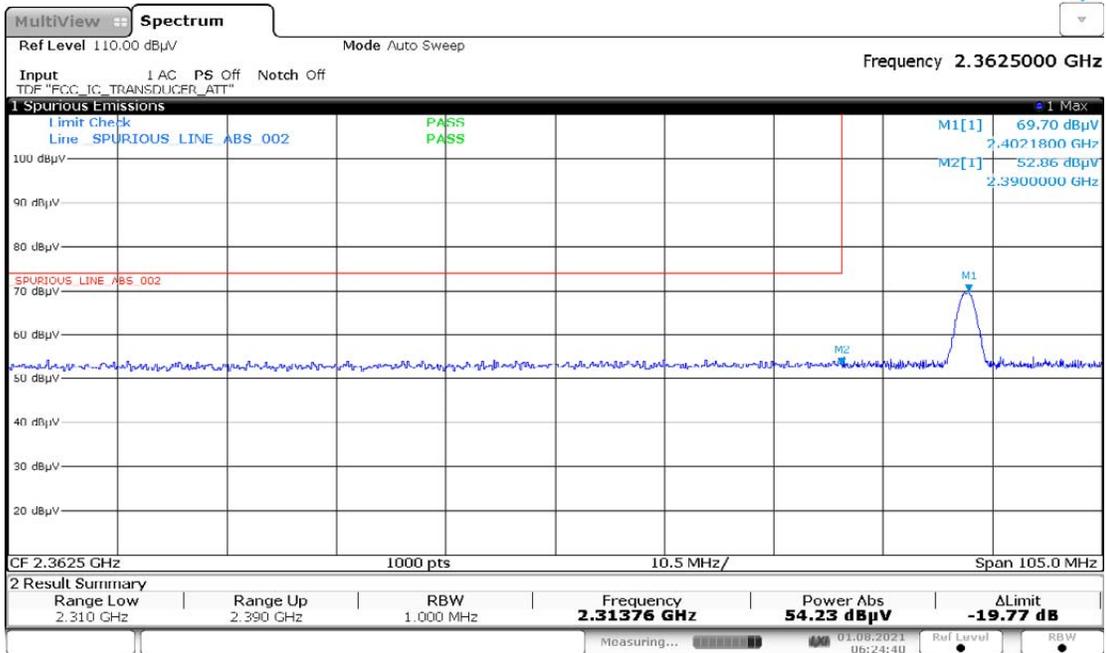


**Restricted Band Edge (Low Channel, Vertical, Peak) graphical screen shot**



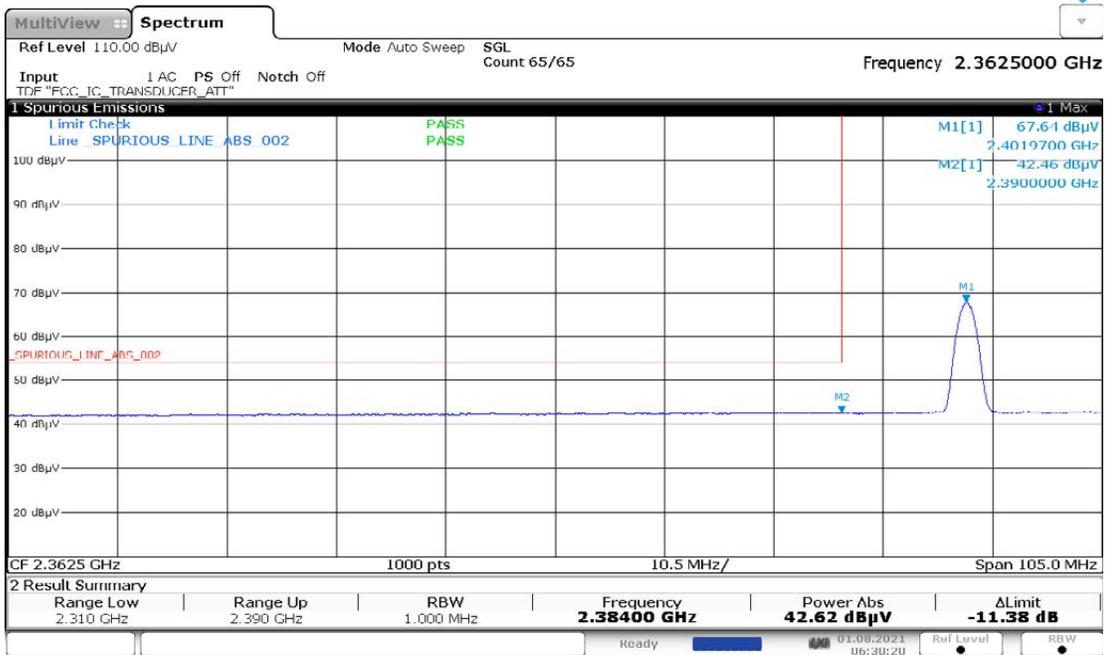
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**Restricted Band Edge (Low Channel, Horizontal, Peak) graphical screen shot**

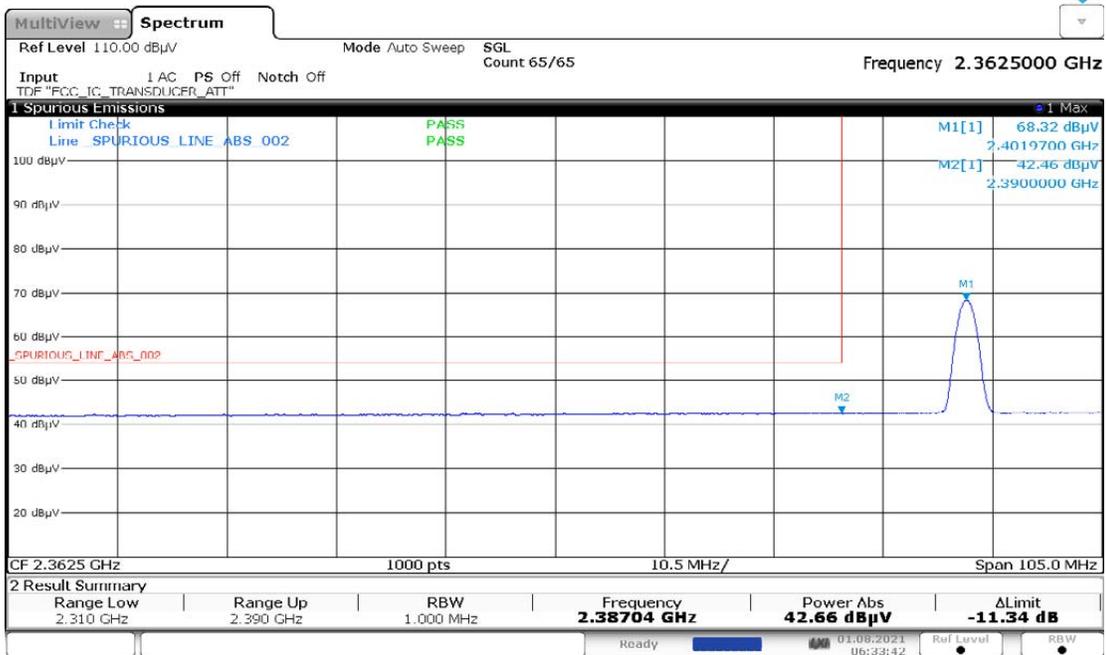


06:24:40 01.08.2021

**Restricted Band Edge (Low Channel, Vertical, Average) graphical screen shot**

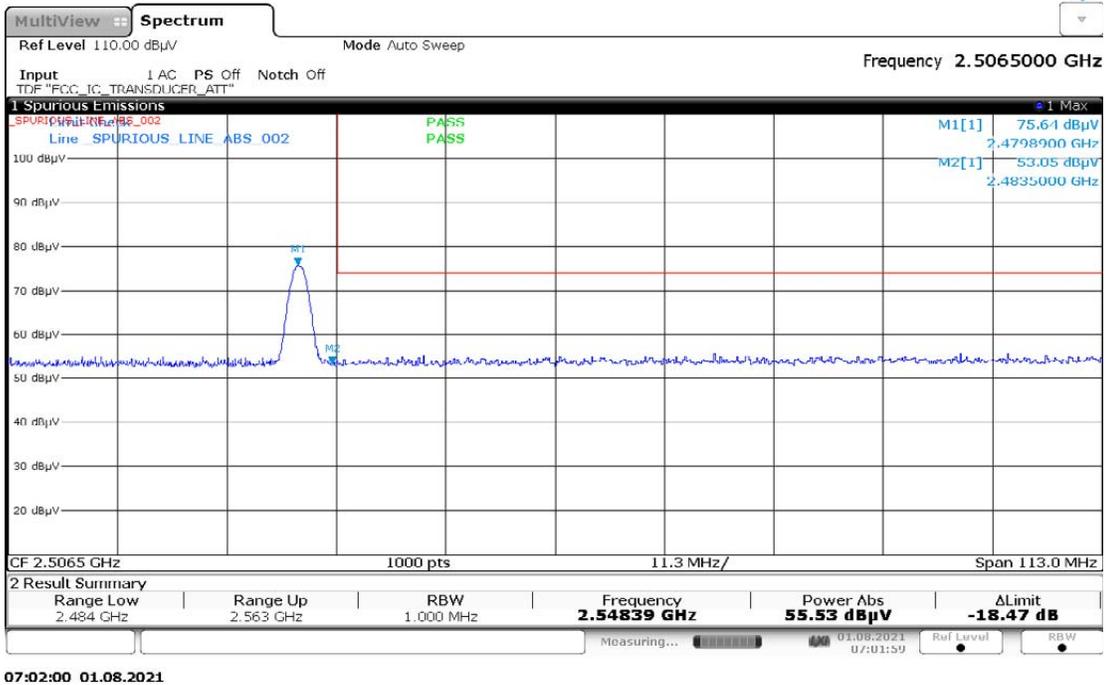


**Restricted Band Edge (Low Channel, Horizontal, Average) graphical screen shot**

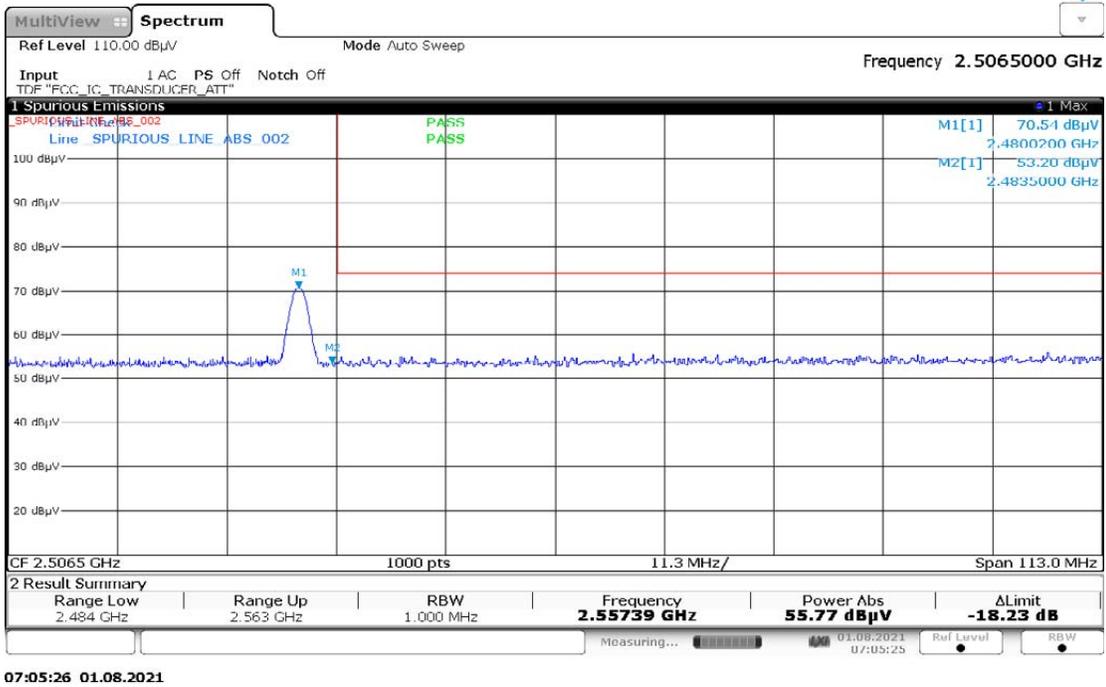




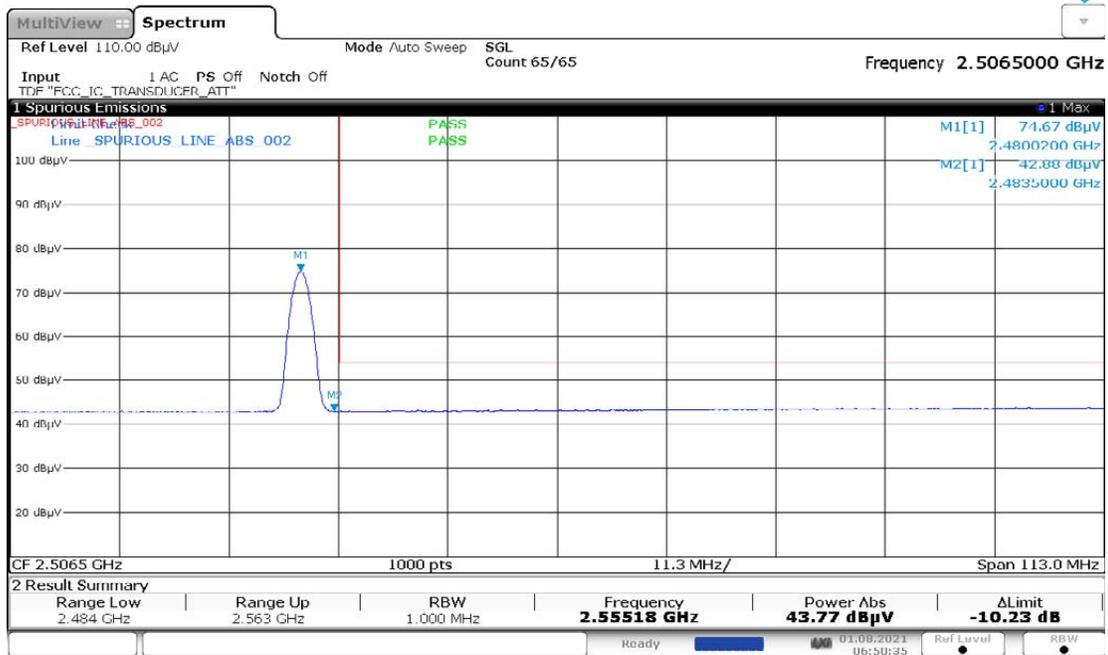
**Restricted Band Edge (High Channel, Vertical, Peak) graphical screen shot**



**Restricted Band Edge (High Channel, Horizontal, Peak) graphical screen shot**

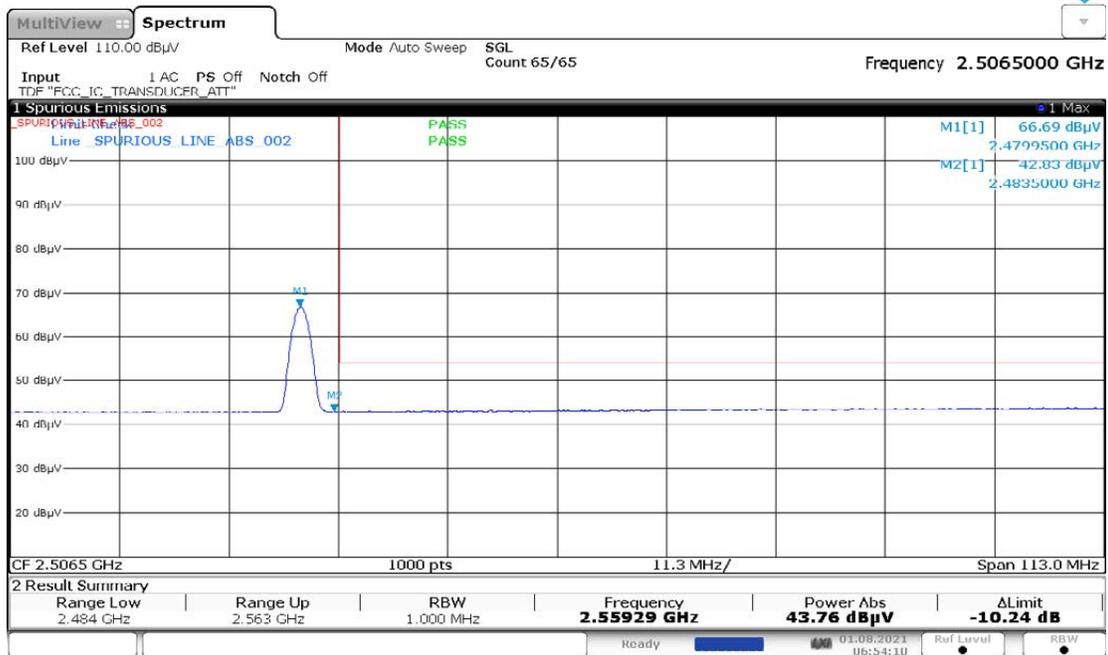


**Restricted Band Edge (High Channel, Vertical, Average) graphical screen shot**



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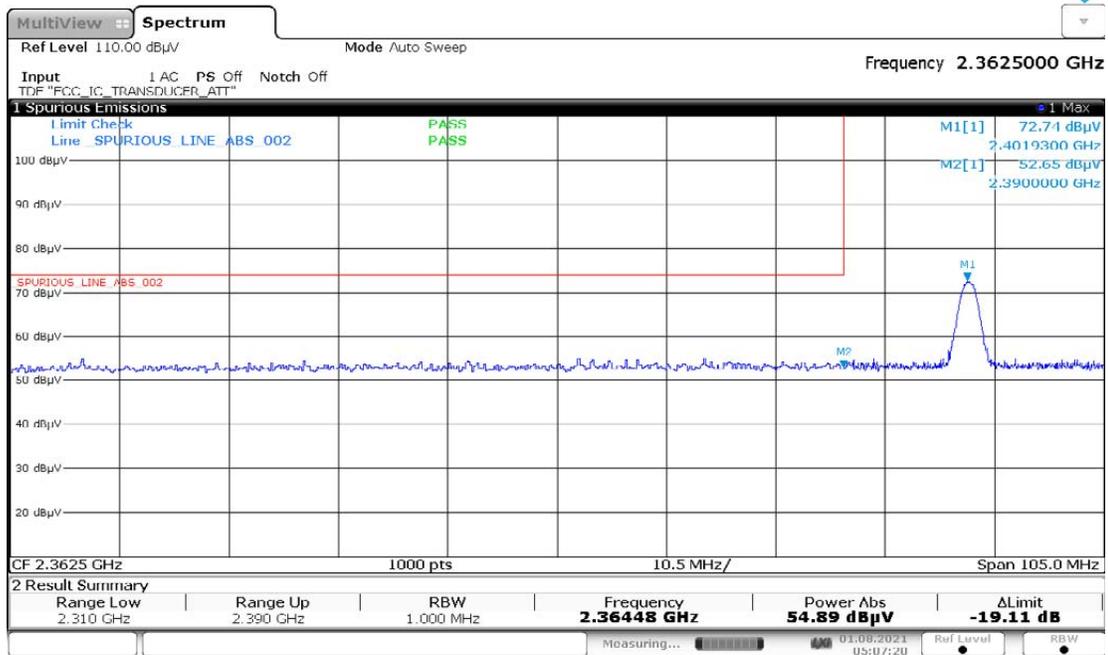
**Restricted Band Edge (High Channel, Horizontal, Average) graphical screen shot**



06:54:10 01.08.2021

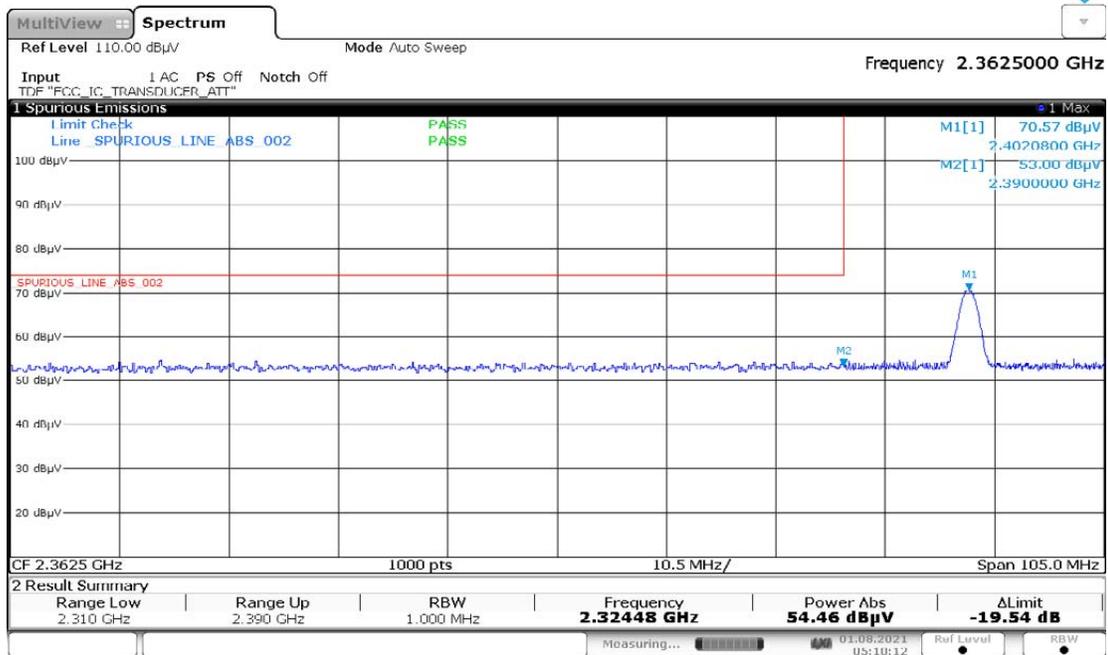


**Restricted Band Edge (Low Channel, Vertical, Peak) graphical screen shot**



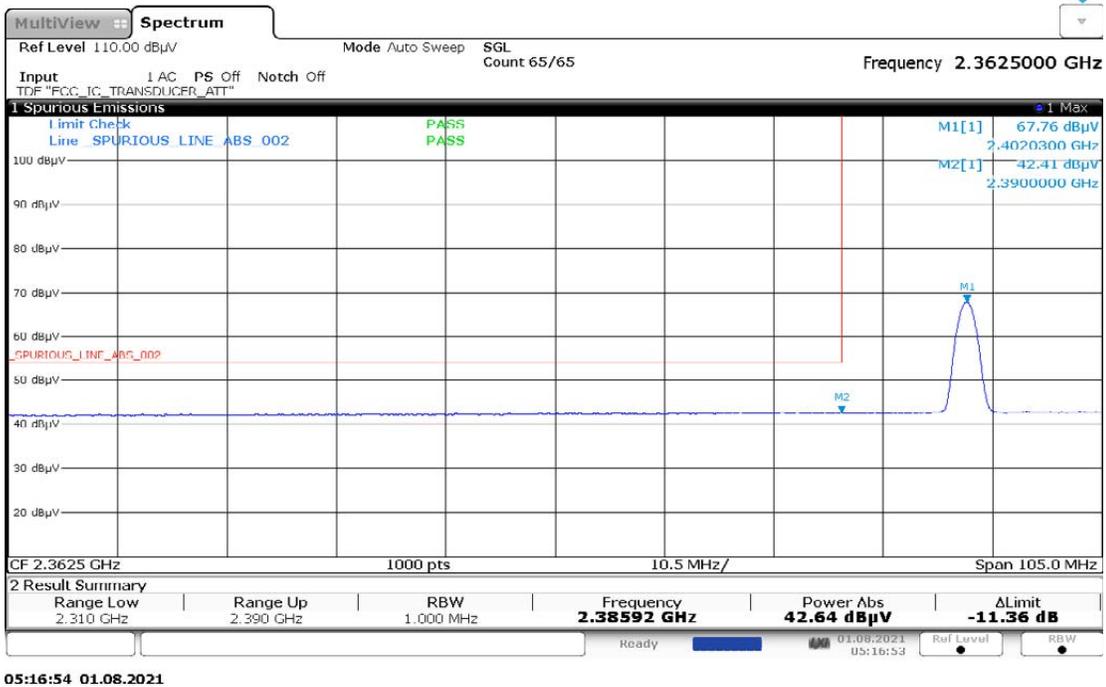
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**Restricted Band Edge (Low Channel, Horizontal, Peak) graphical screen shot**

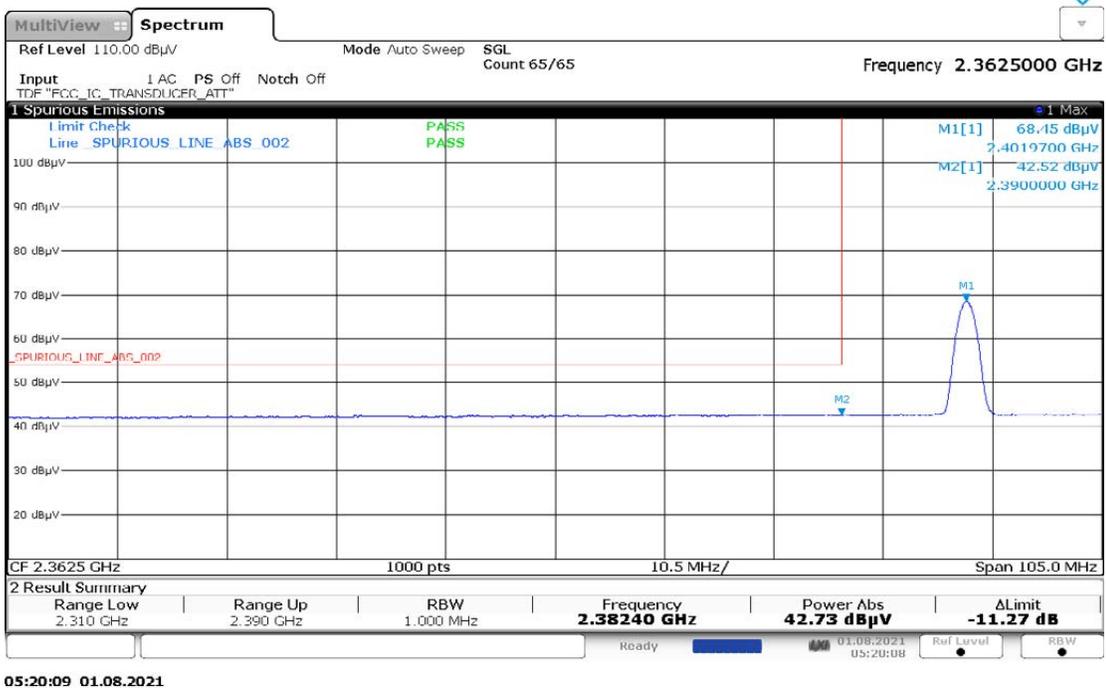


05:10:12 01.08.2021

**Restricted Band Edge (Low Channel, Vertical, Average) graphical screen shot**

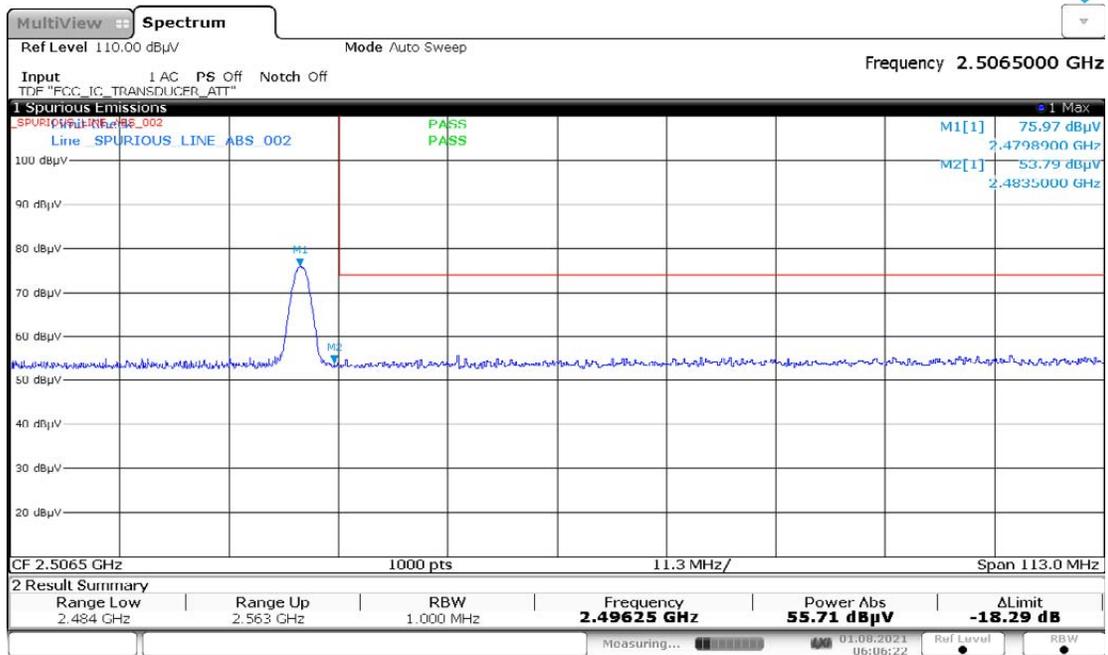


**Restricted Band Edge (Low Channel, Horizontal, Average) graphical screen shot**



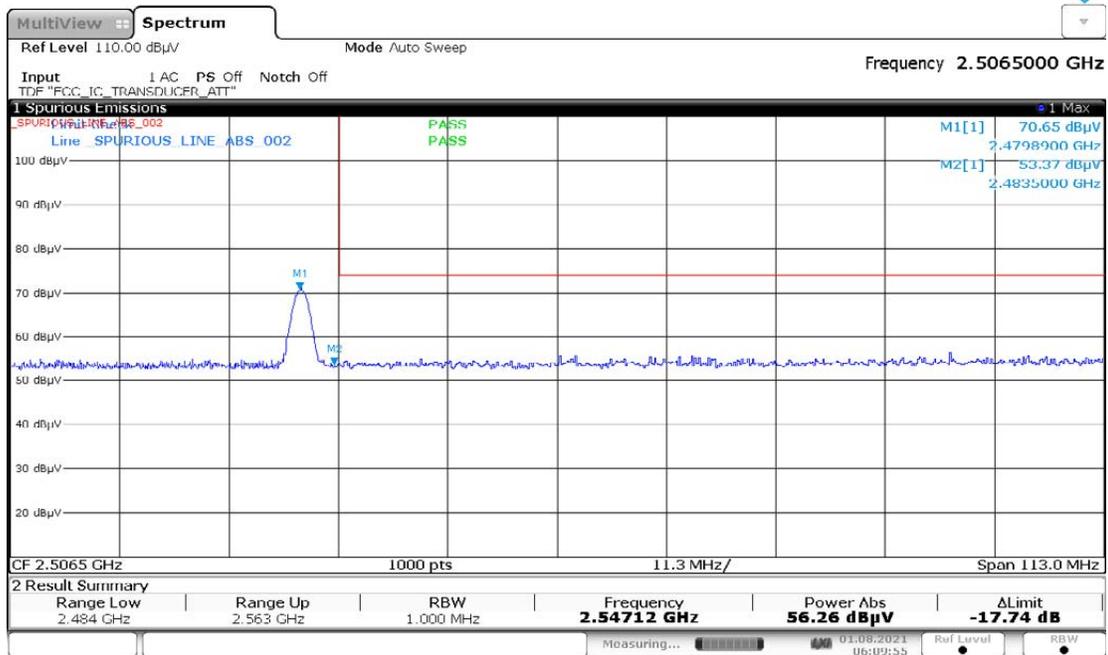


**Restricted Band Edge (High Channel, Vertical, Peak) graphical screen shot**



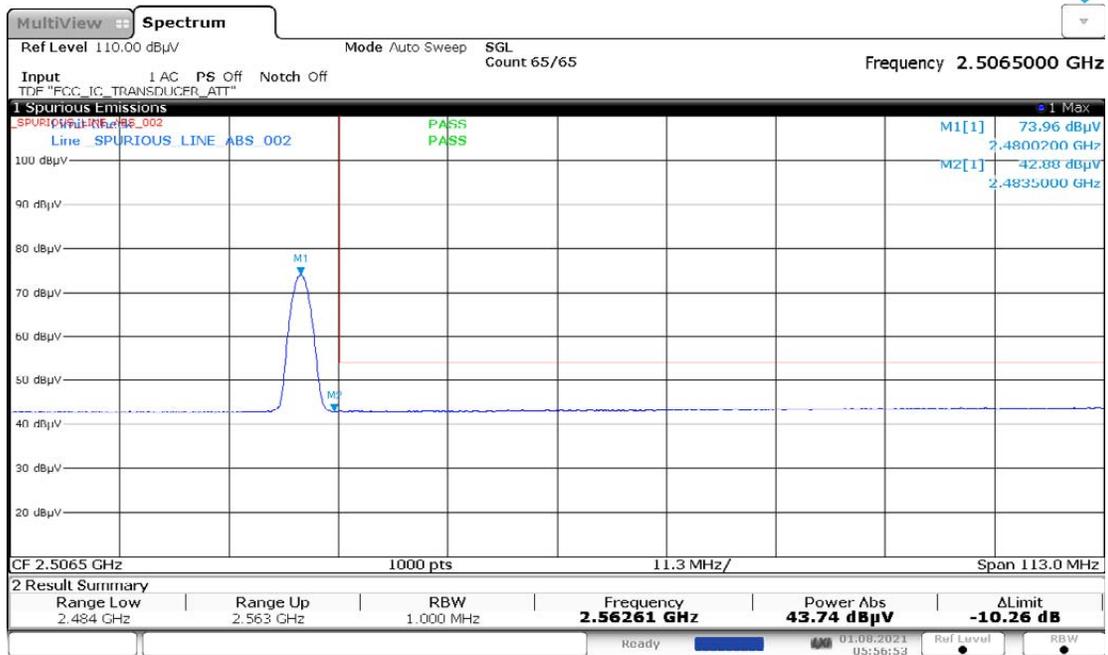
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**Restricted Band Edge (High Channel, Horizontal, Peak) graphical screen shot**



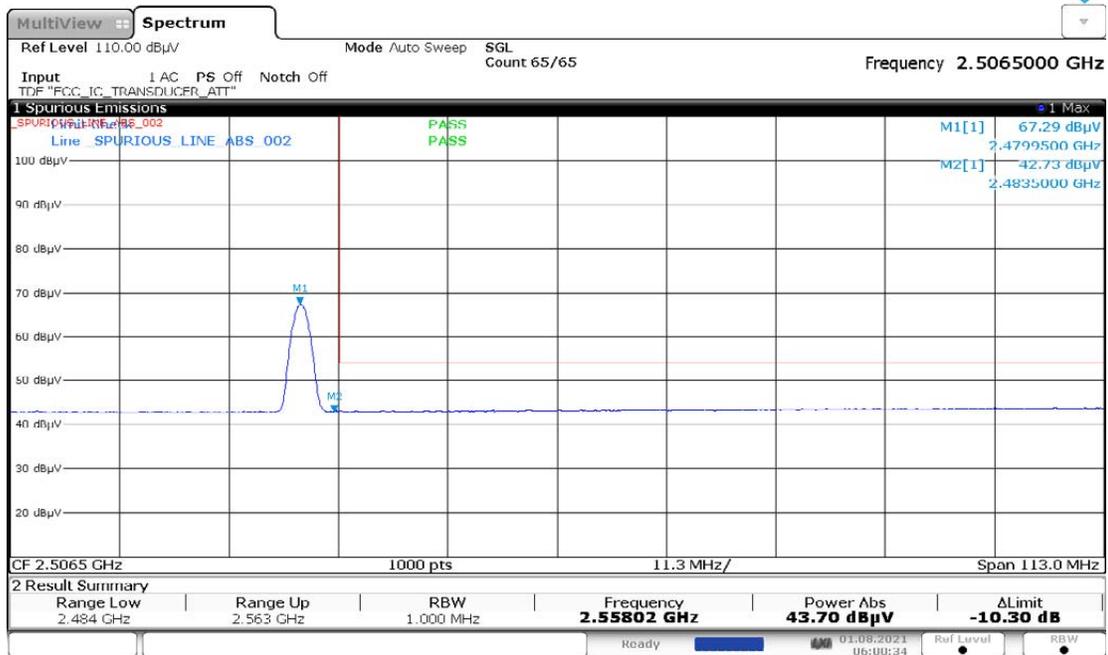
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**Restricted Band Edge (High Channel, Vertical, Average) graphical screen shot**



05:56:54 01.08.2021

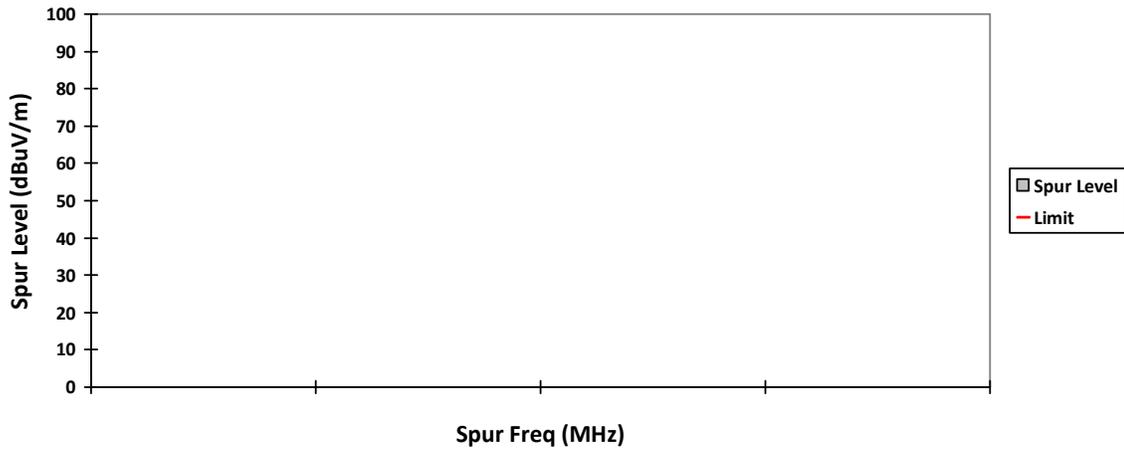
**Restricted Band Edge (High Channel, Horizontal, Average) graphical screen shot**



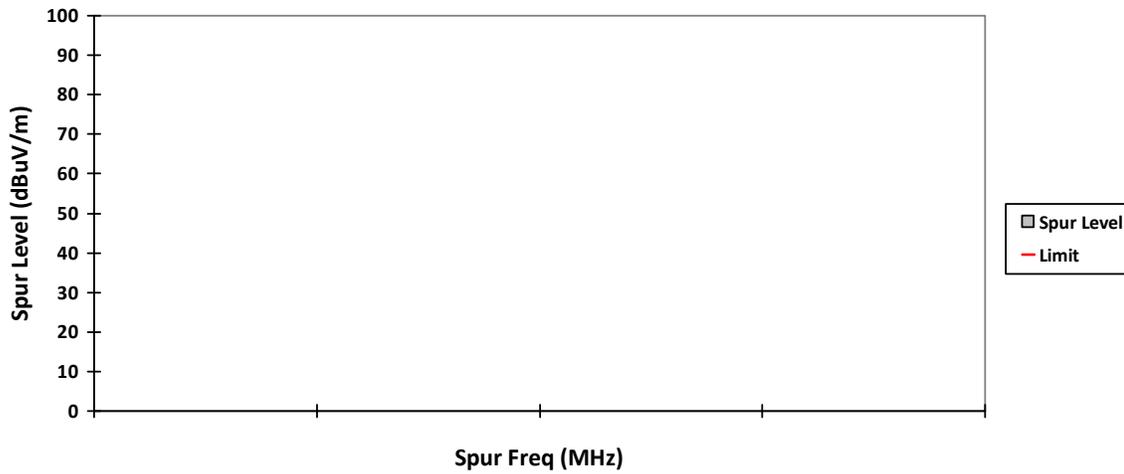
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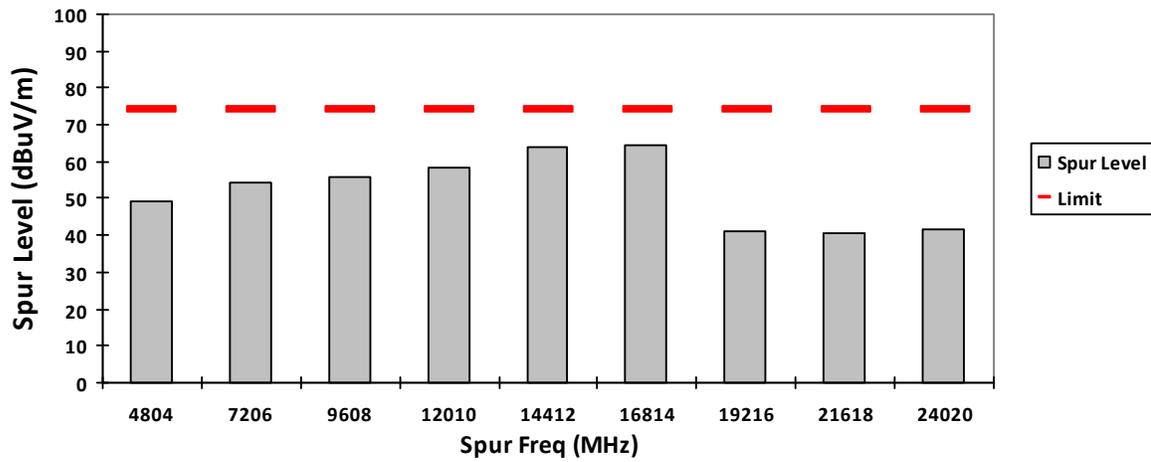
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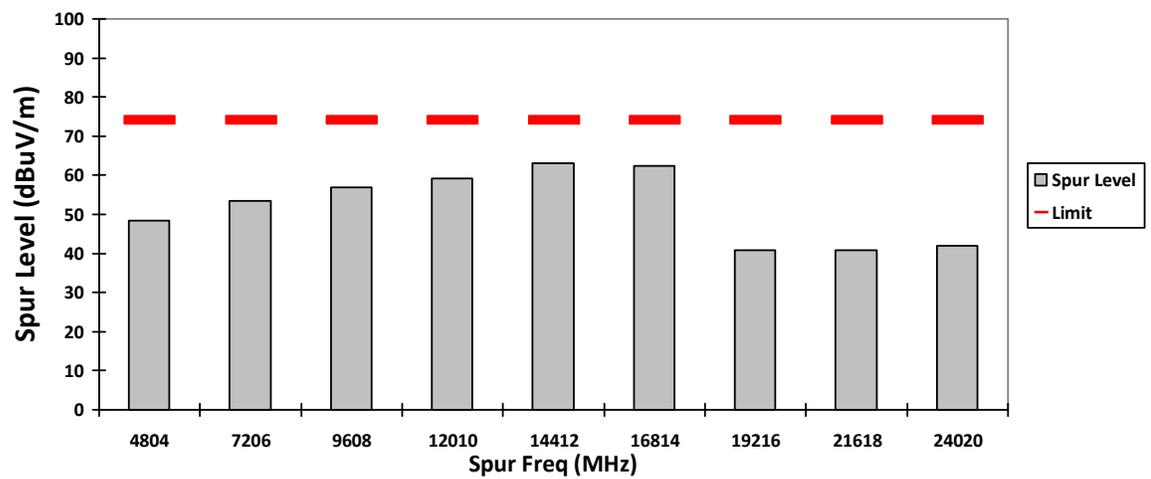
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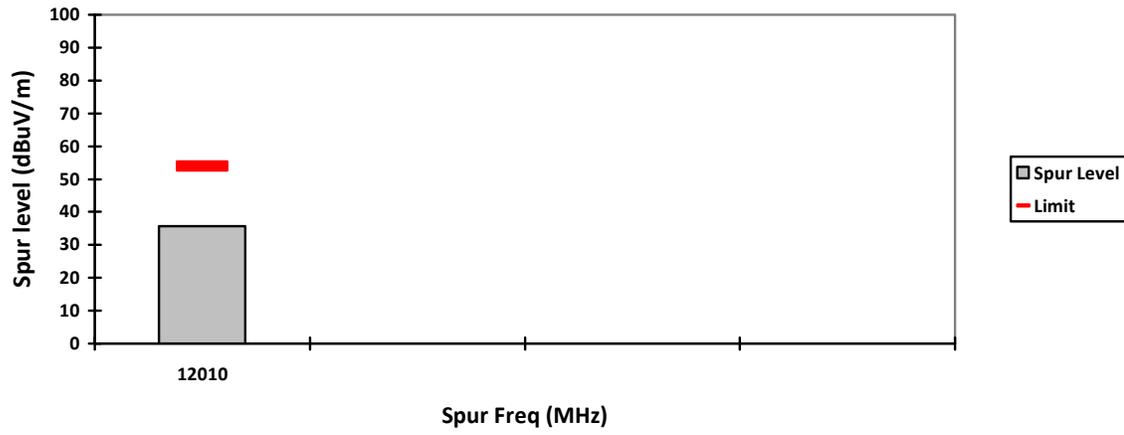
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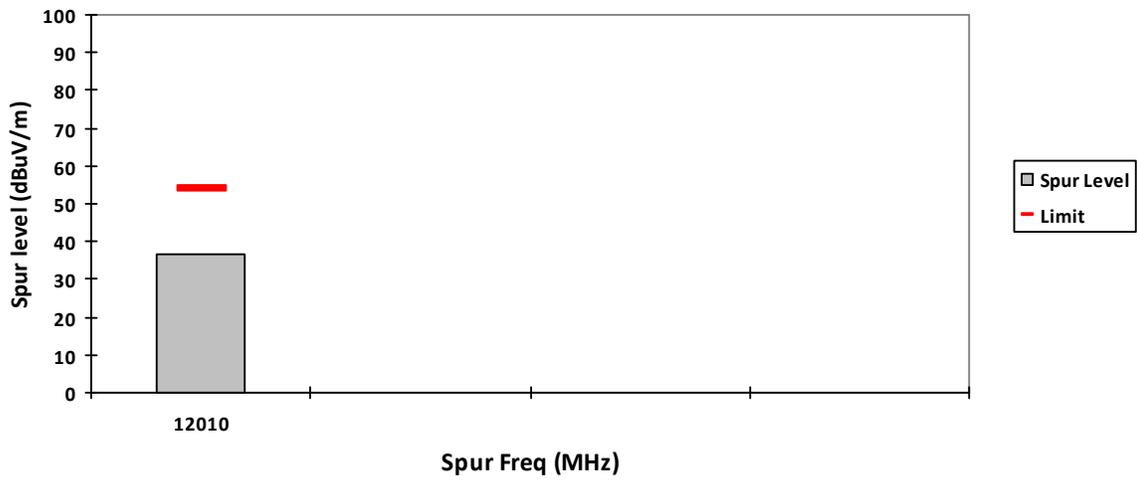
### HORIZONTAL, PK



VERTICAL, AV

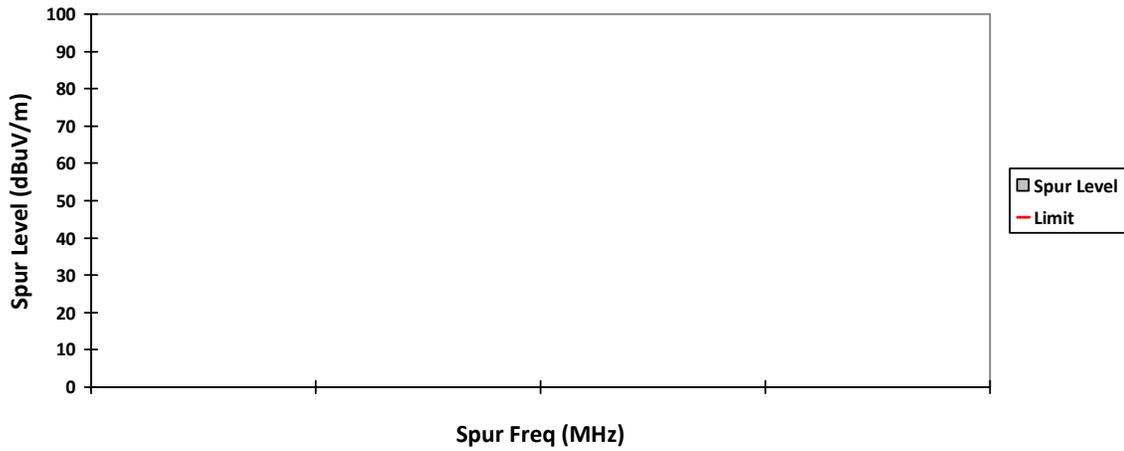


HORIZONTAL, AV

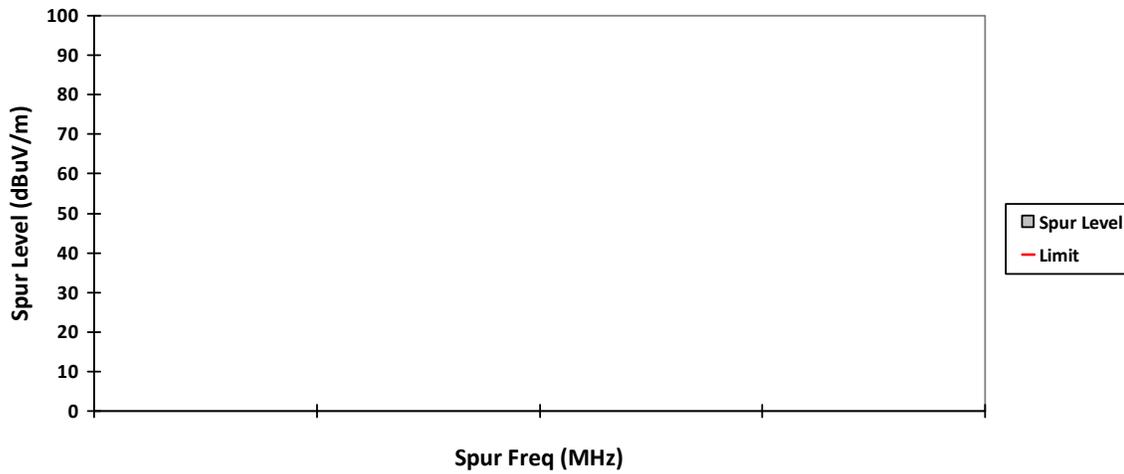




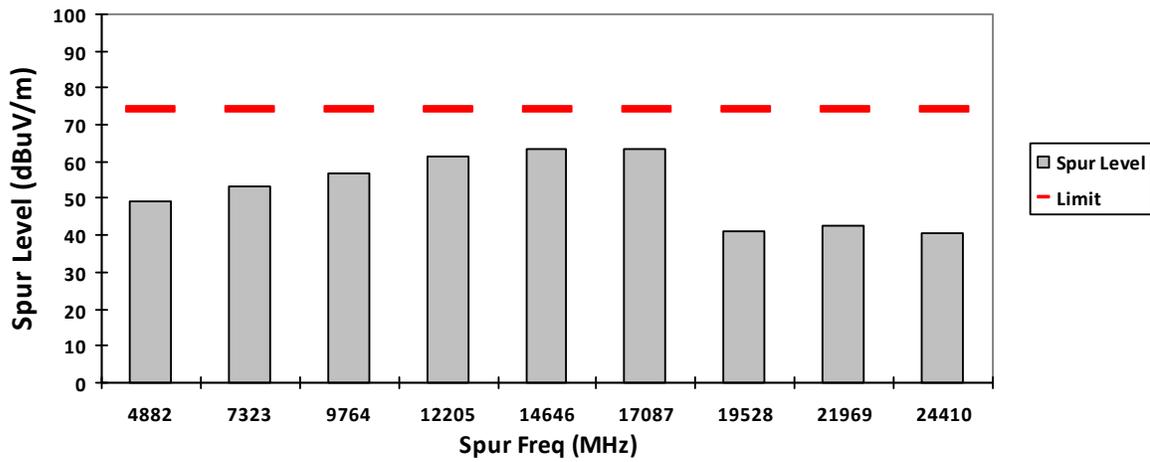
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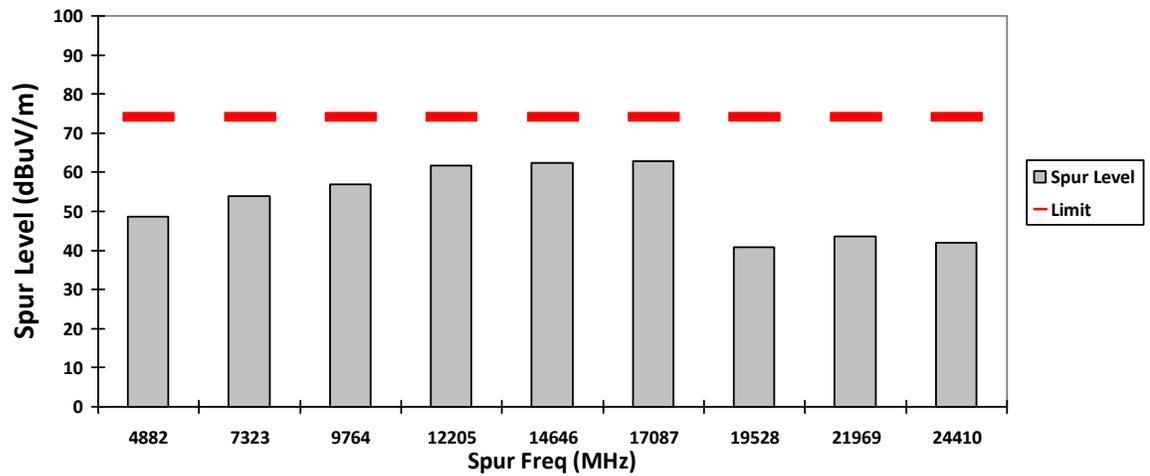
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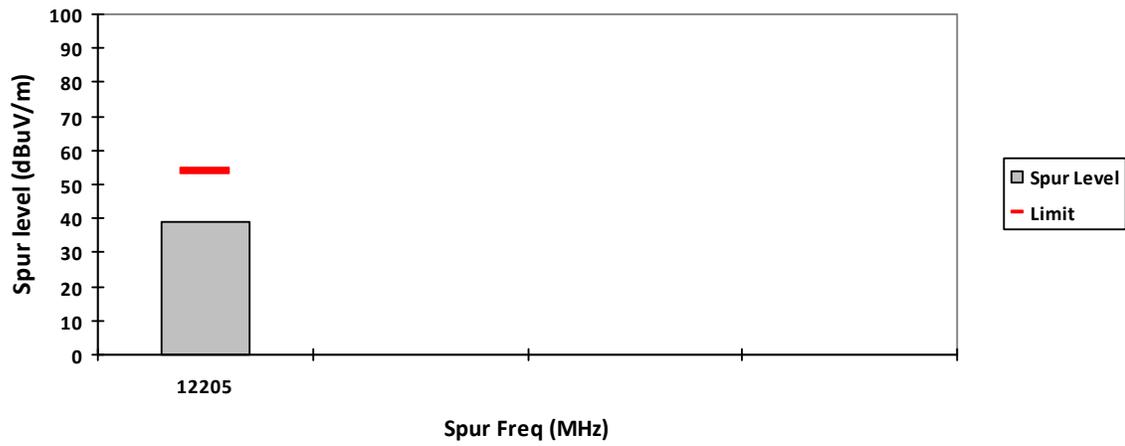
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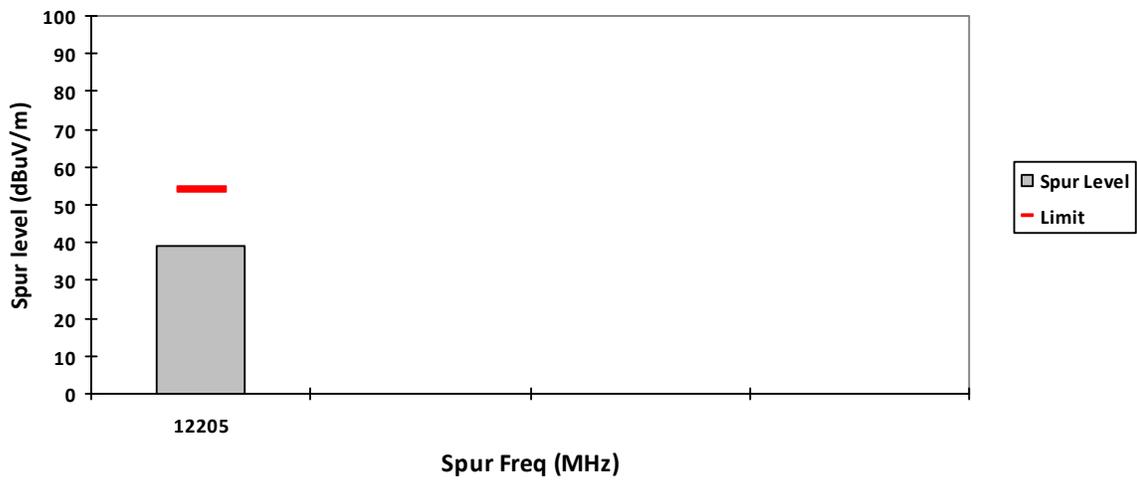
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### VERTICAL, AV

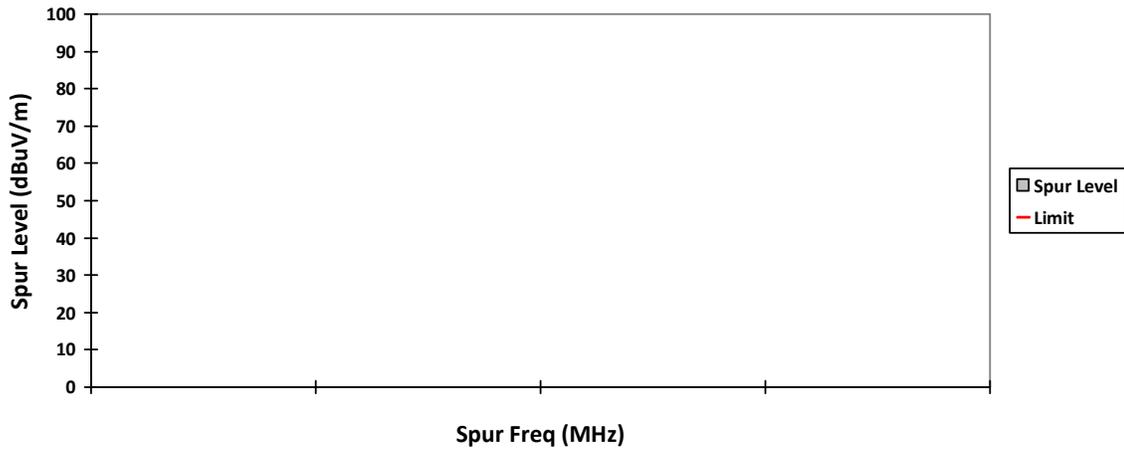


### HORIZONTAL, AV

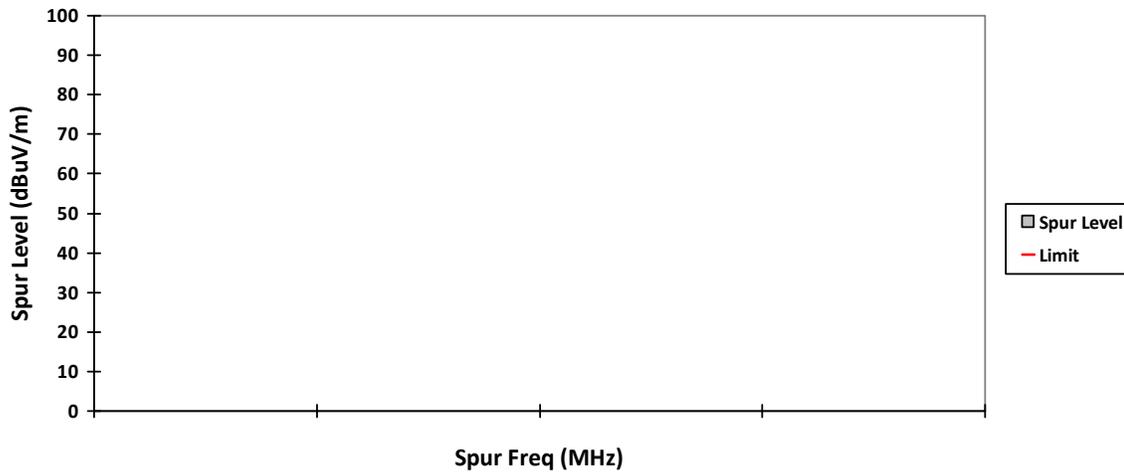




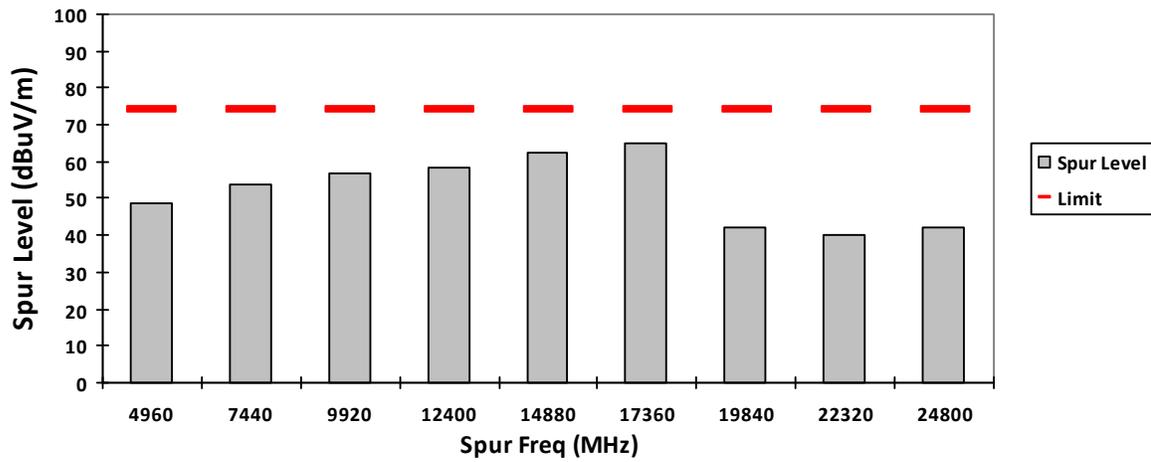
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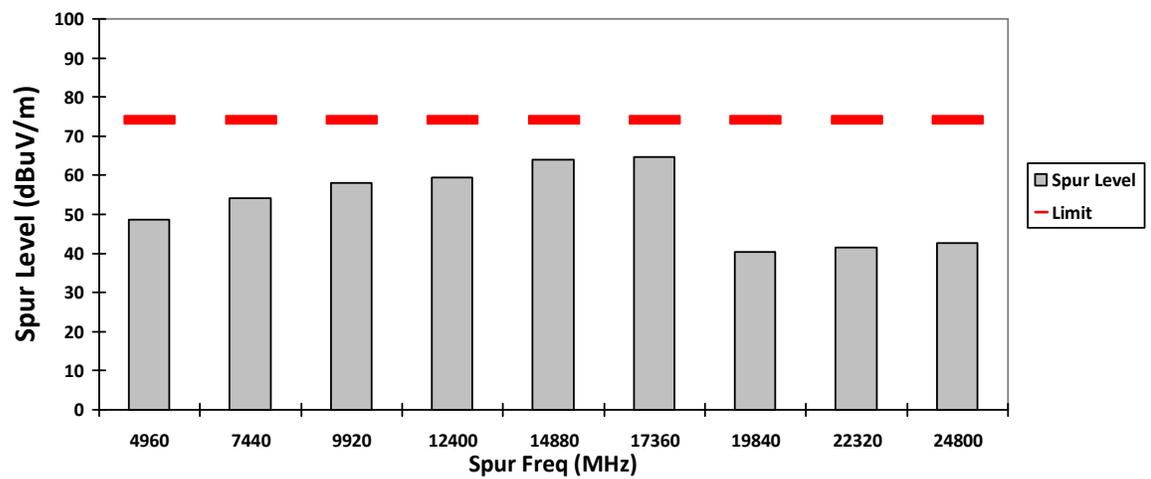
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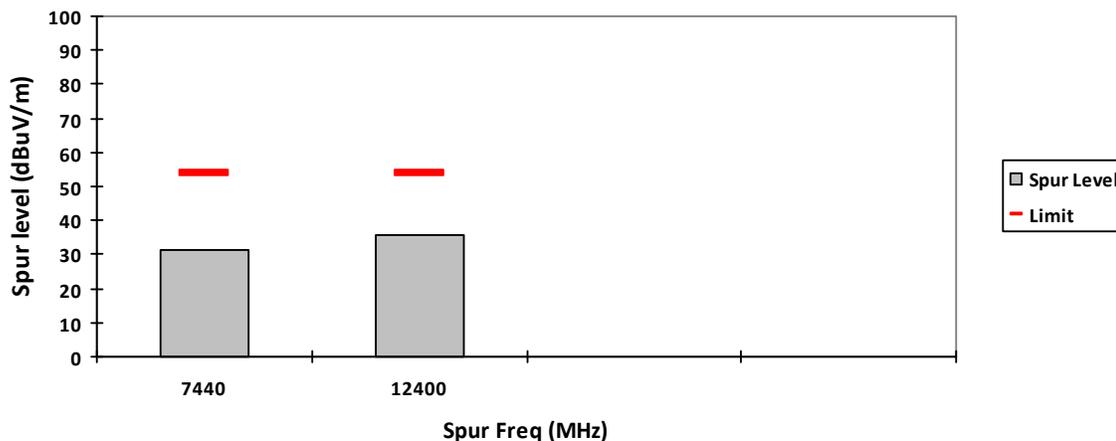
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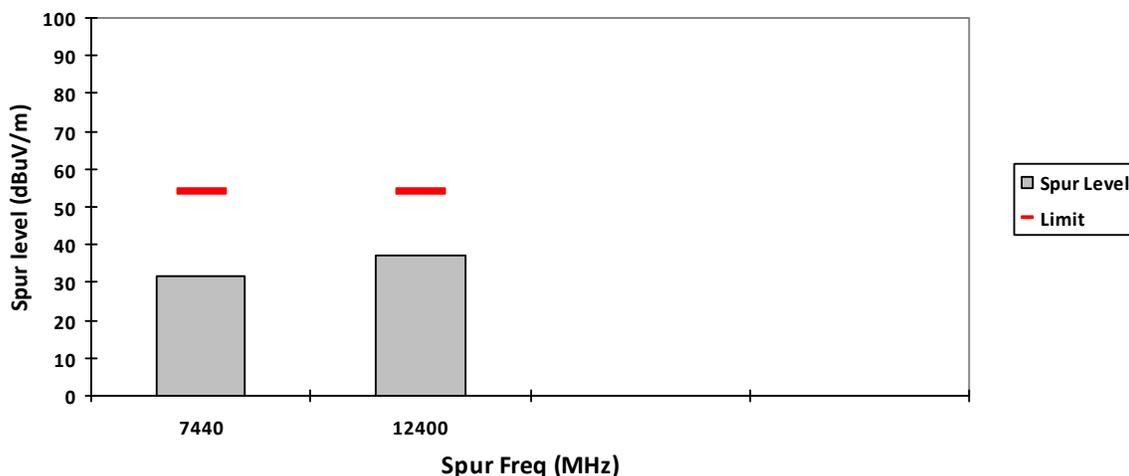
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**VERTICAL, AV**



**HORIZONTAL, AV**



**NOTE:**

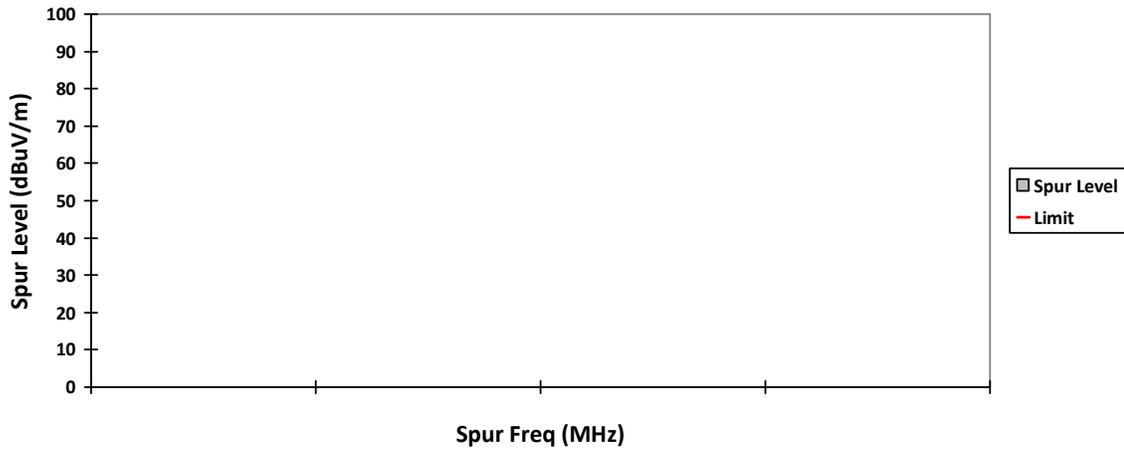
Transmitter Duty Cycle Calculation, FCC Rule 15.35 (b,c)

Based on the Bluetooth Specification Version 2.1+EDR, and worst case AFH mode, transmitter ON time is independent of packet type (DH1, DH3 and DH5) and packet length, the AFH mode Duty cycle connection factor as below:

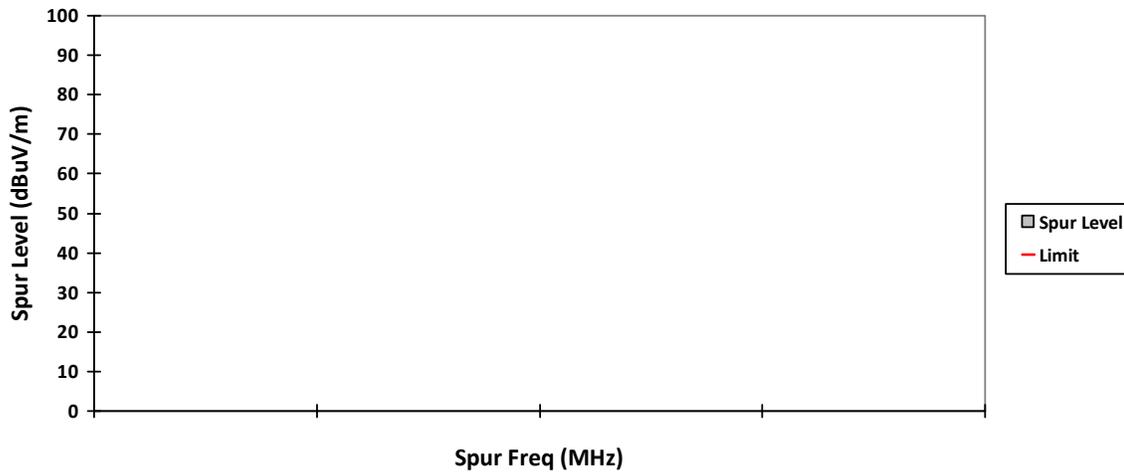
Channel hop rate = 800 hops/second (AFH Mode)  
 Adjusted channel hop rate for DH5 mode = 133.33 hops/second  
 Time per channel hop = 1 / 133.33 hops/second = 7.5 ms  
 Time to cycle through all channels = 7.5 x 20 channels = 150 ms  
 Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)  
 Worst case dwell time = 7.5 ms  
 Duty cycle connection factor =  $20\log_{10}(7.5\text{ms} / 100\text{ms}) = -22.5 \text{ dB}$



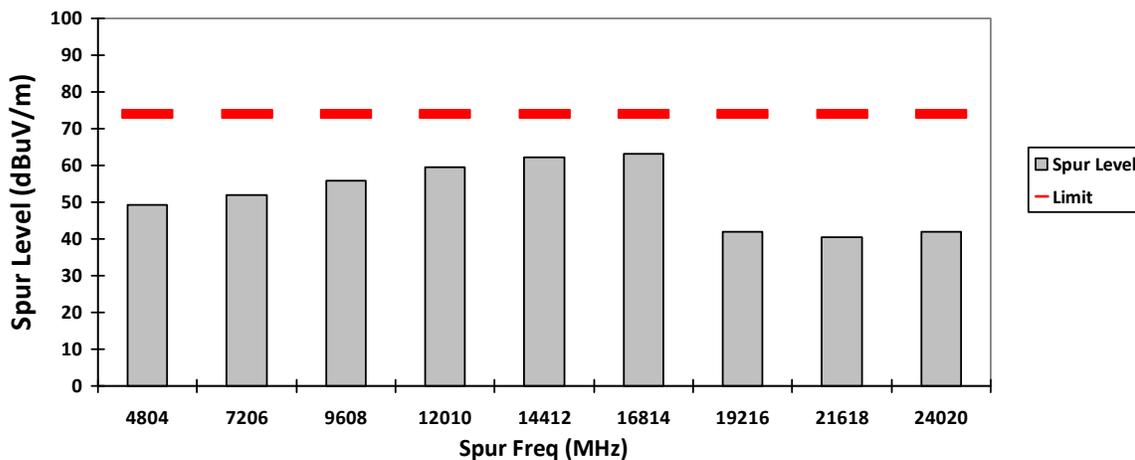
### VERTICAL, QPK



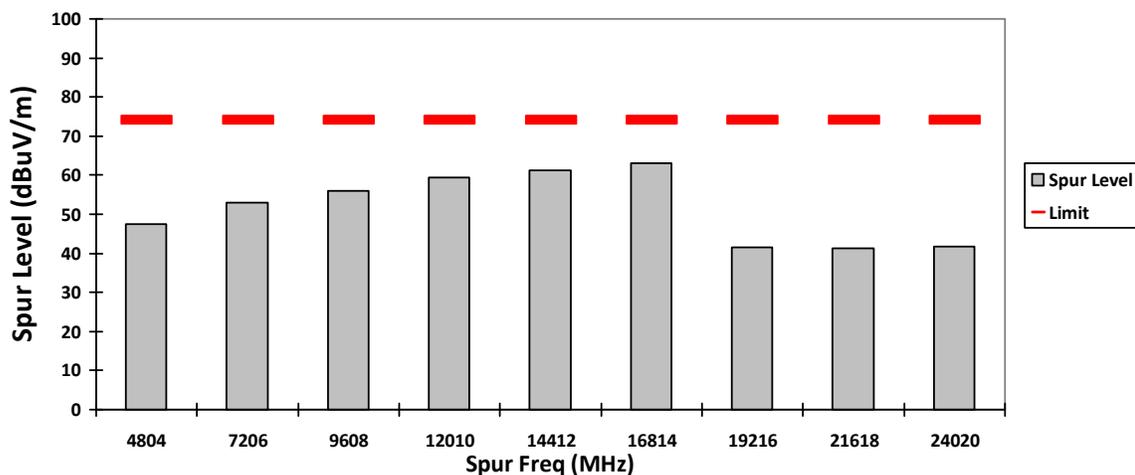
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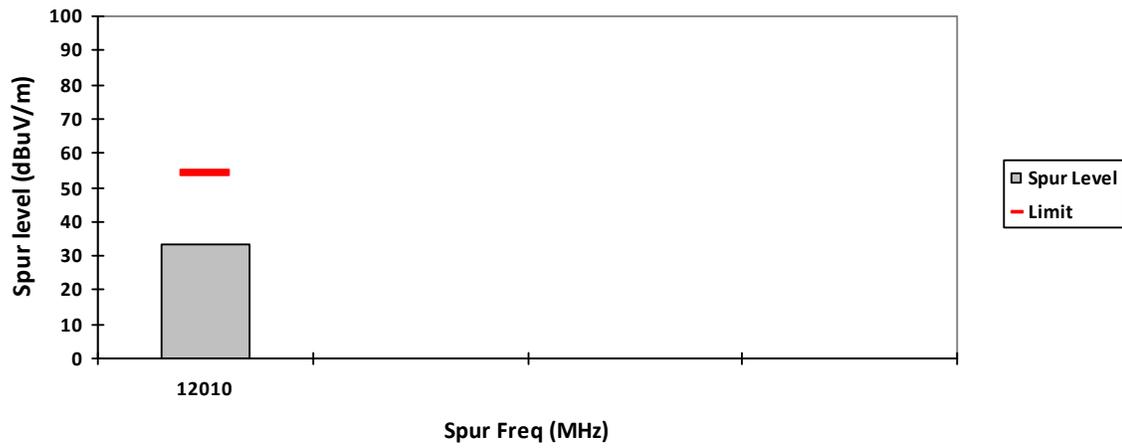
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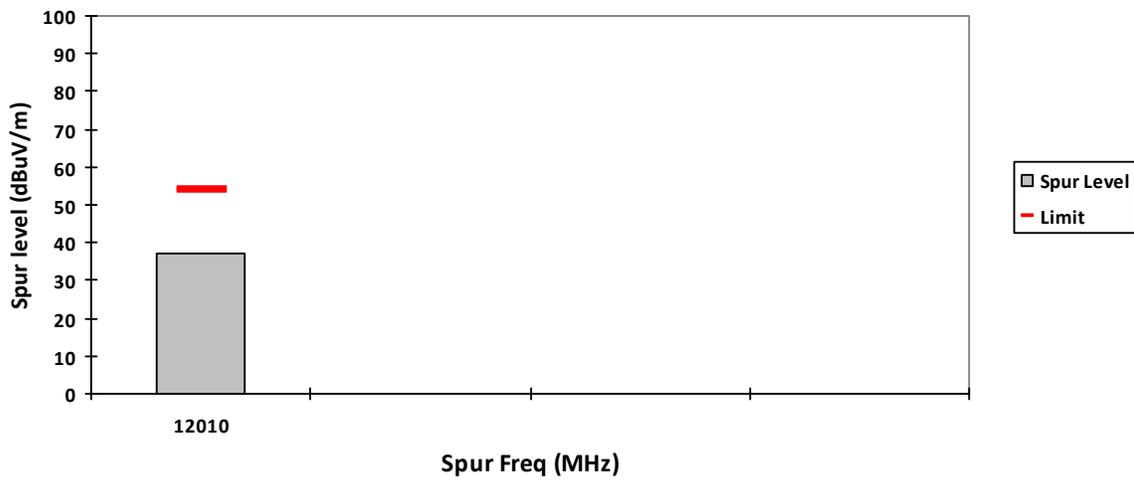
### HORIZONTAL, PK



**VERTICAL, AV**

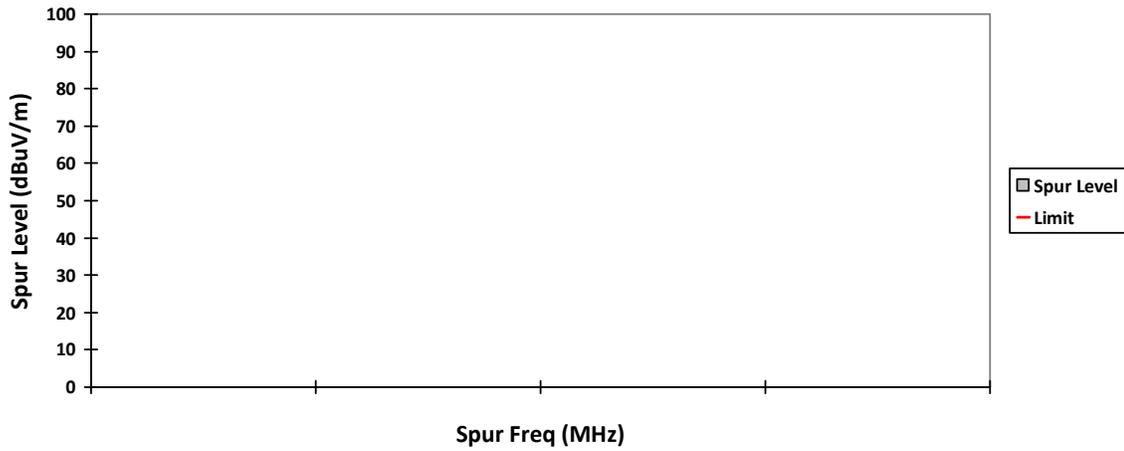


**HORIZONTAL, AV**

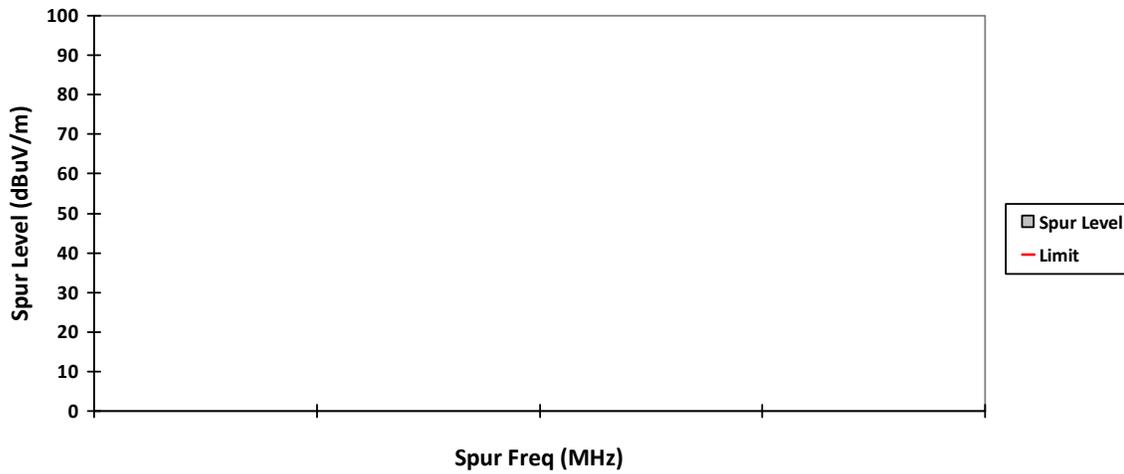




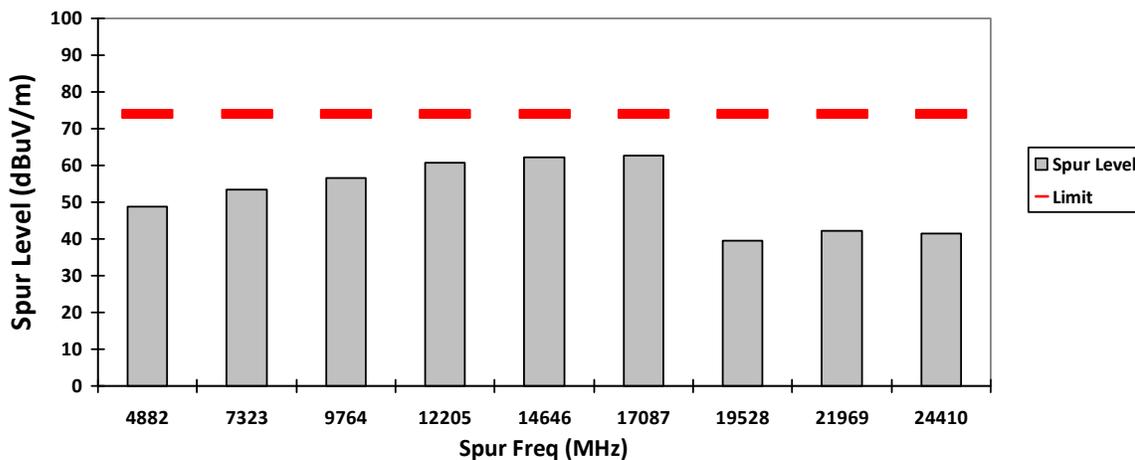
**VERTICAL, QPK**



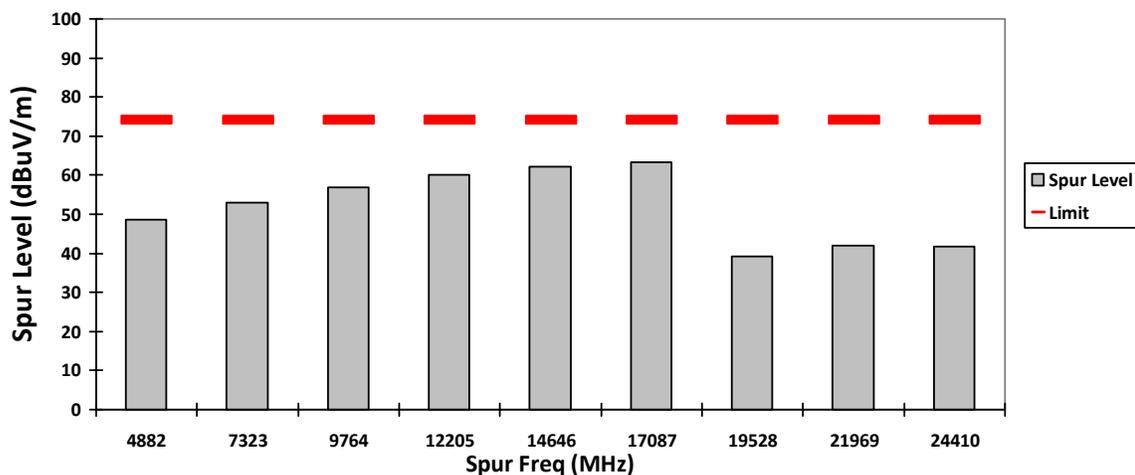
**HORIZONTAL, QPK**



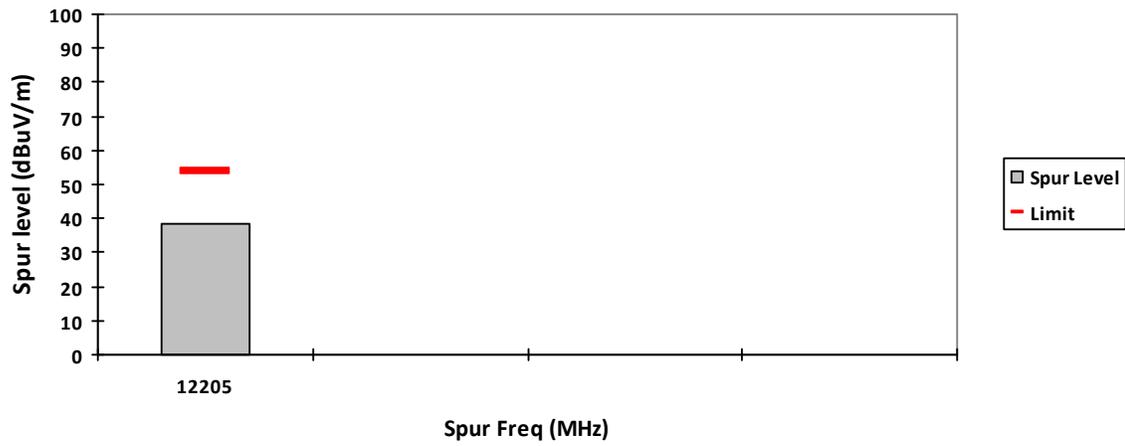
### VERTICAL, PK



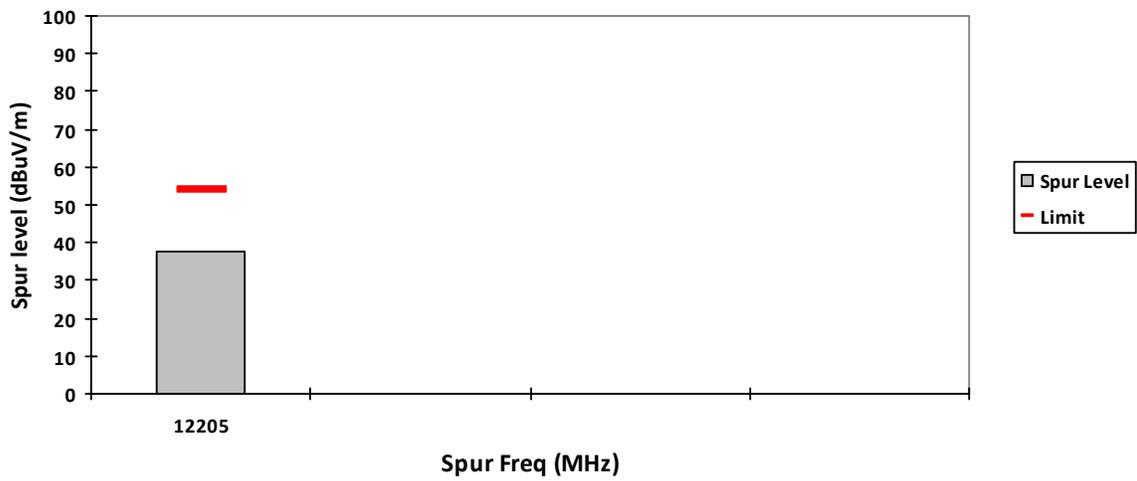
### HORIZONTAL, PK



### VERTICAL, AV

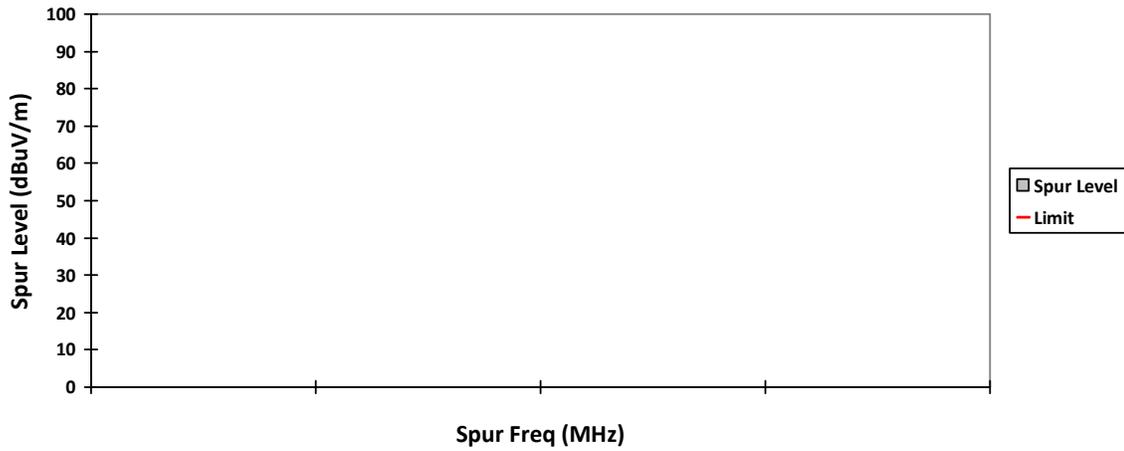


### HORIZONTAL, AV

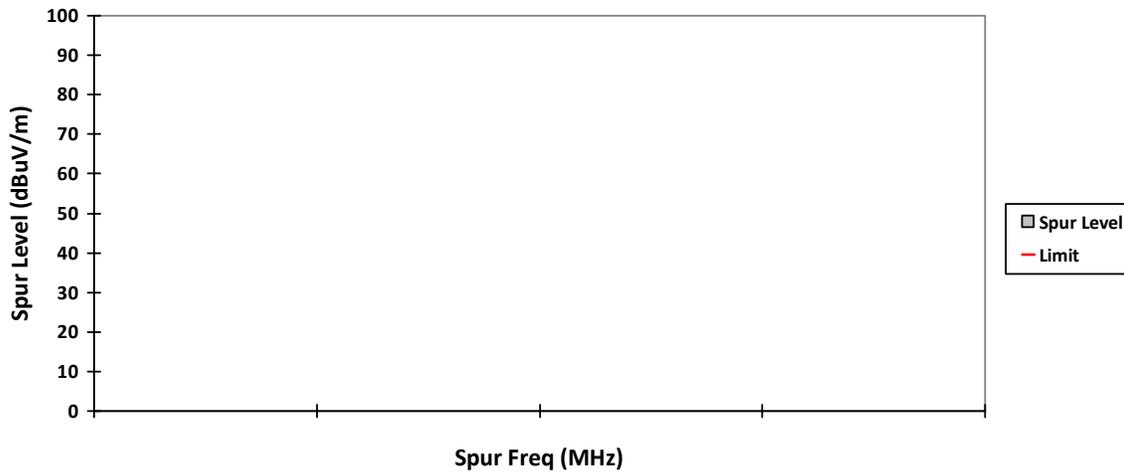




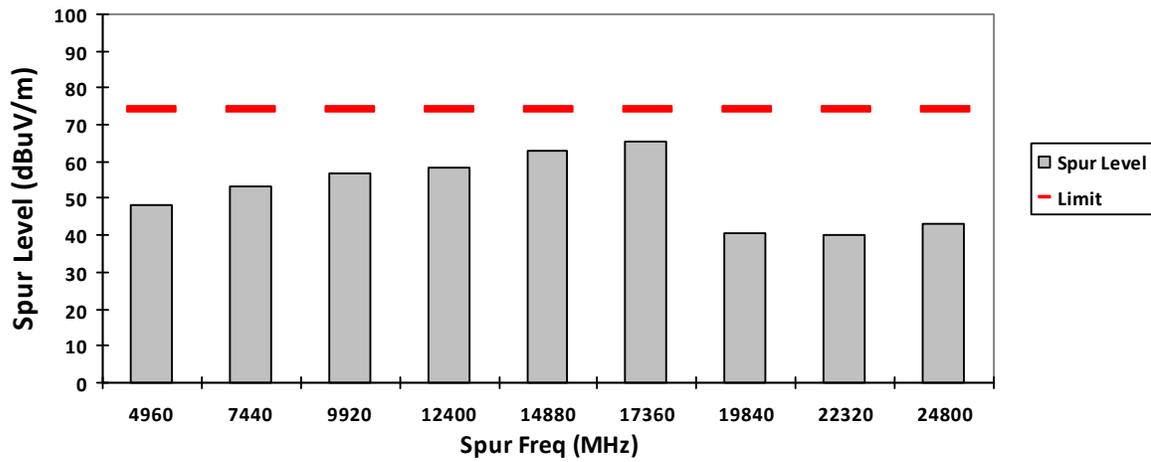
### VERTICAL, QPK



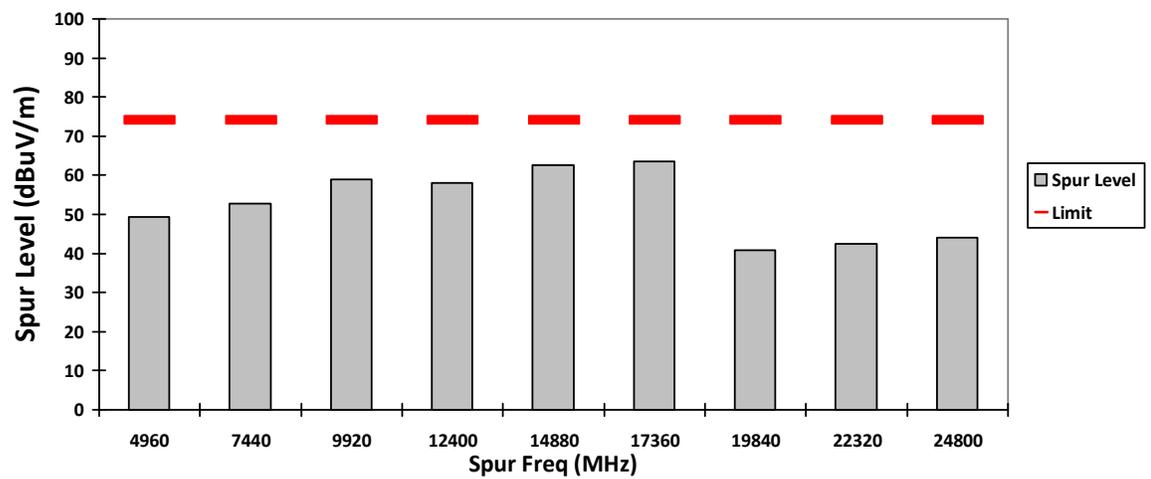
### HORIZONTAL, QPK



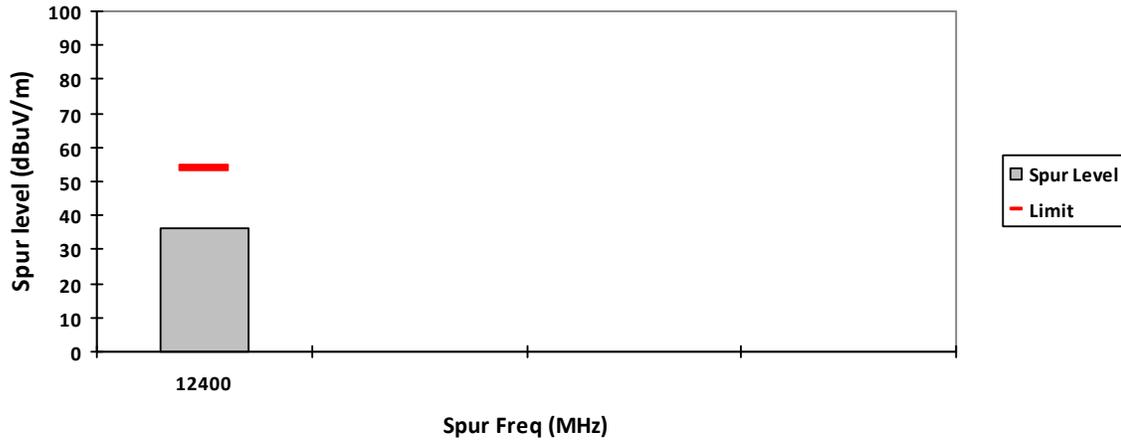
### VERTICAL, PK



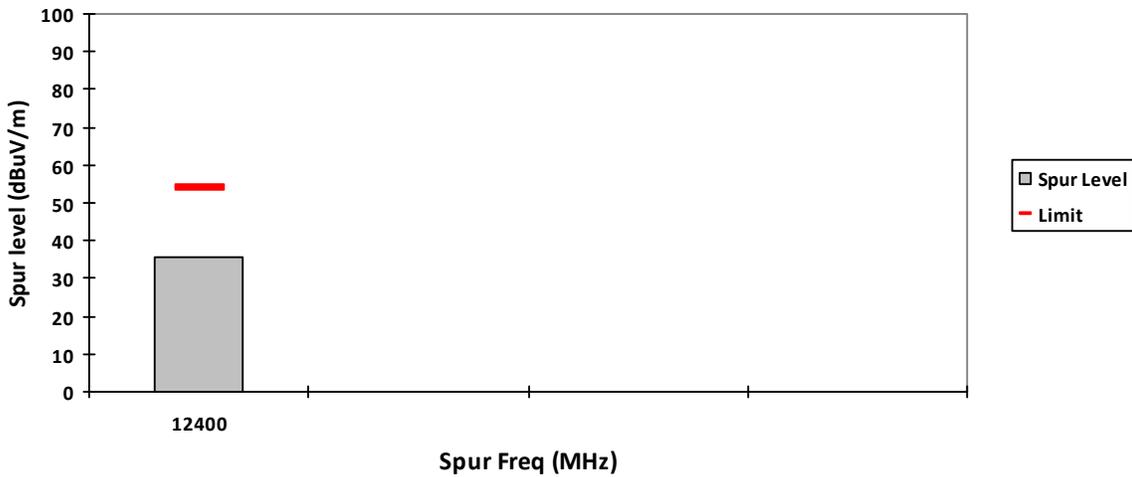
### HORIZONTAL, PK



**VERTICAL, AV**



**HORIZONTAL, AV**



**NOTE:**

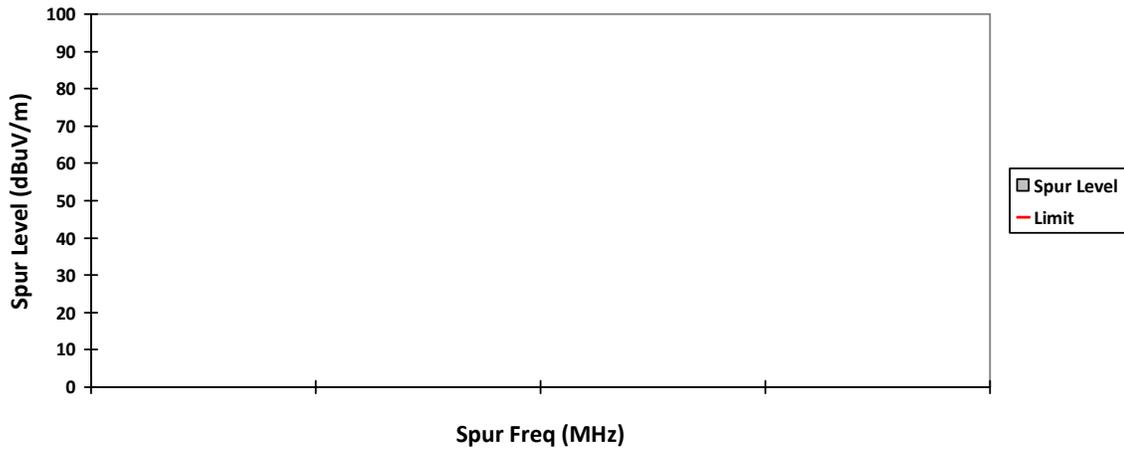
Transmitter Duty Cycle Calculation, FCC Rule 15.35 (b,c)

Based on the Bluetooth Specification Version 2.1+EDR, and worst case AFH mode, transmitter ON time is independent of packet type (DH1, DH3 and DH5) and packet length, the AFH mode Duty cycle connection factor as below:

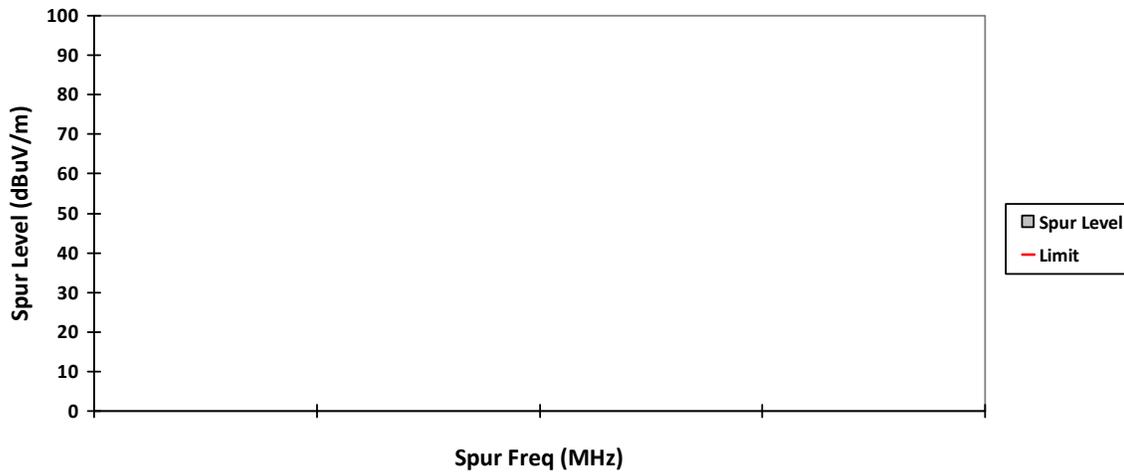
Channel hop rate = 800 hops/second (AFH Mode)  
Adjusted channel hop rate for DH5 mode = 133.33 hops/second  
Time per channel hop = 1 / 133.33 hops/second = 7.5 ms  
Time to cycle through all channels = 7.5 x 20 channels = 150 ms  
Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)  
Worst case dwell time = 7.5 ms  
Duty cycle connection factor =  $20\log_{10}(7.5\text{ms} / 100\text{ms}) = -22.5 \text{ dB}$



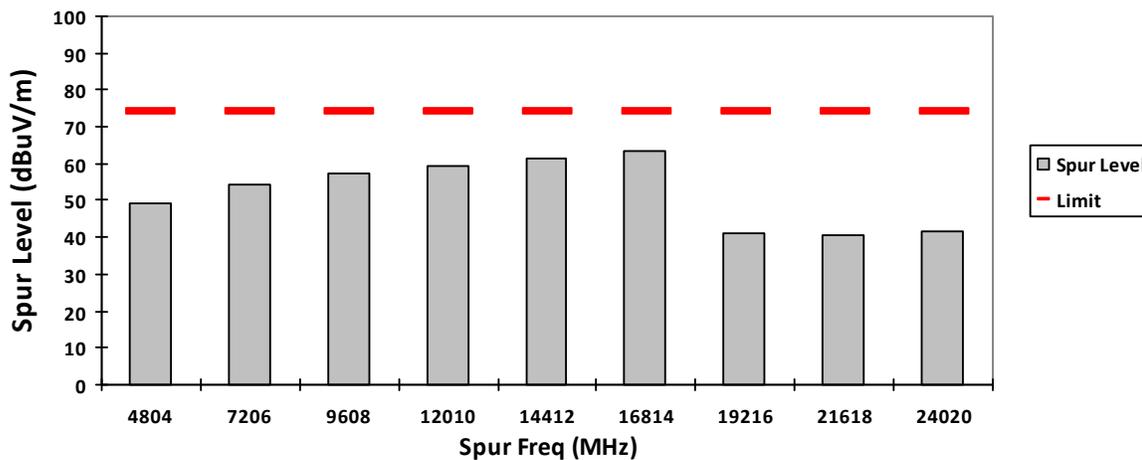
### VERTICAL, QPK



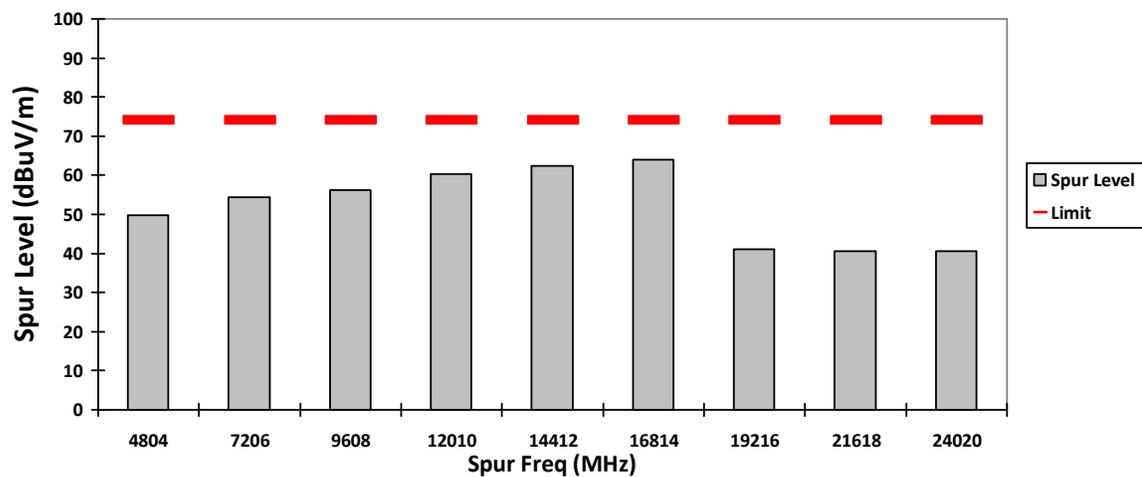
### HORIZONTAL, QPK



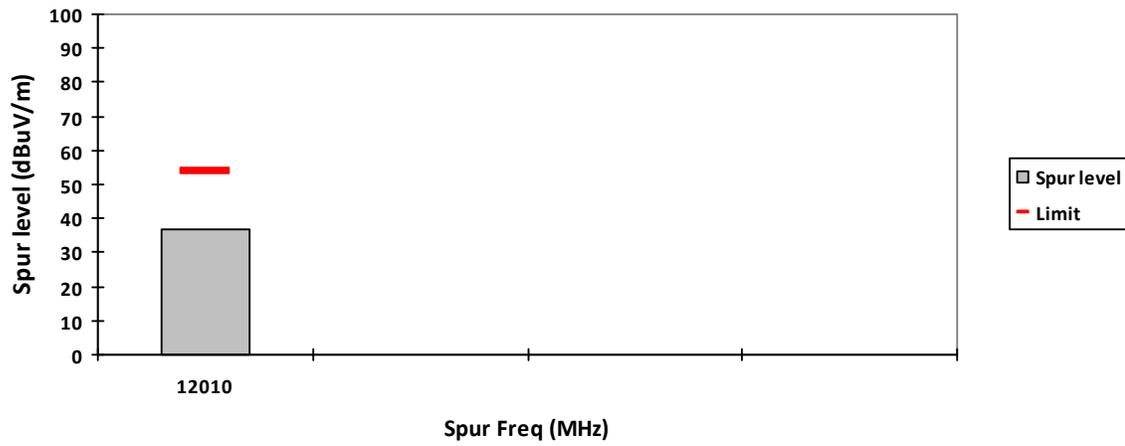
### VERTICAL, PK



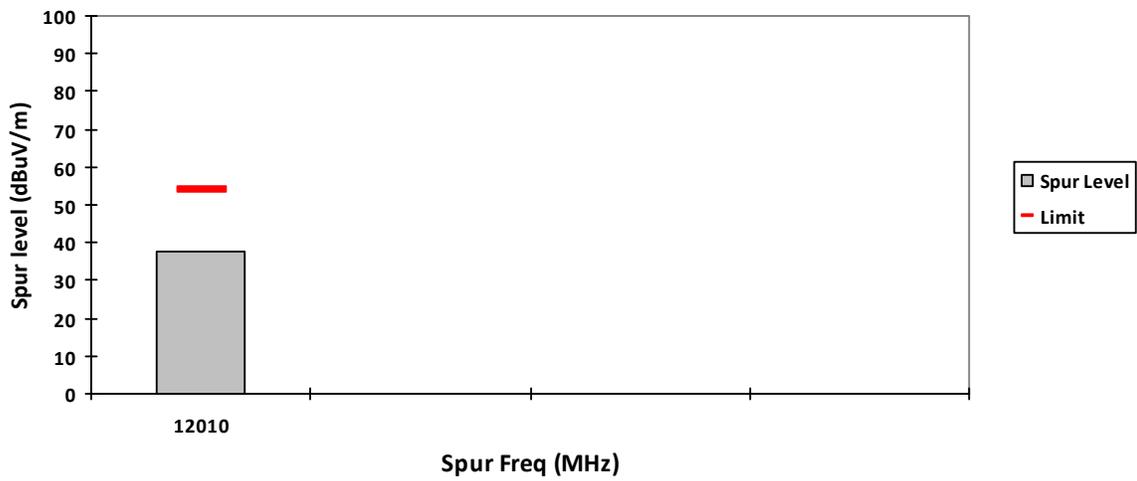
### HORIZONTAL, PK



### VERTICAL, AV

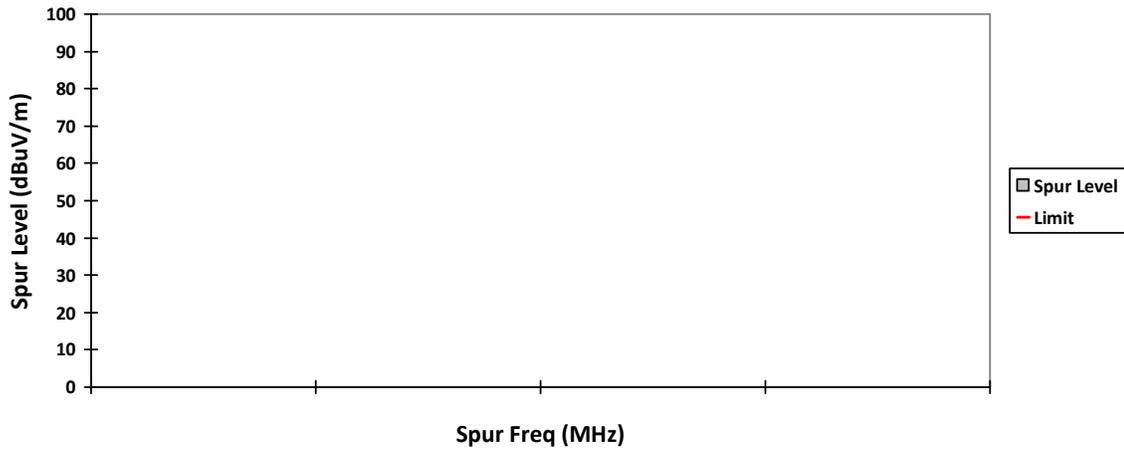


### HORIZONTAL, AV

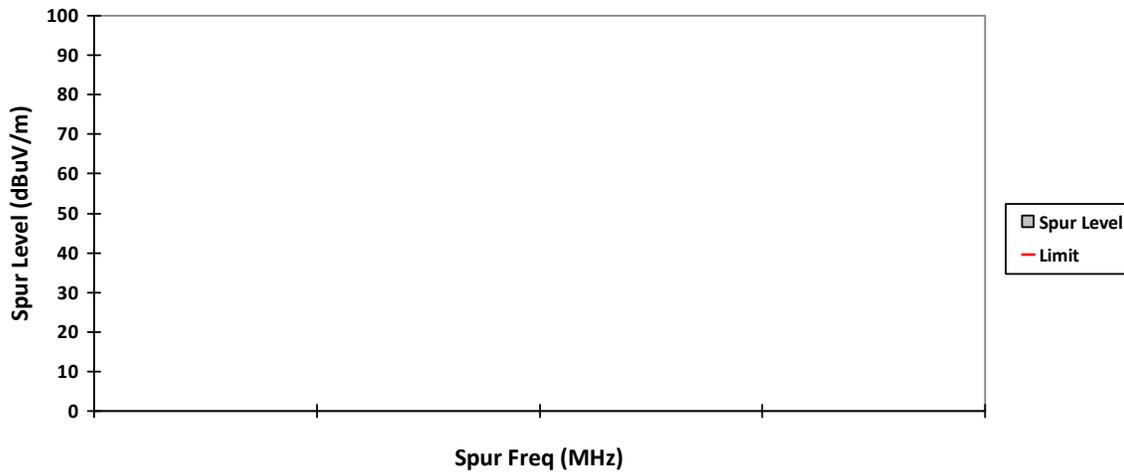




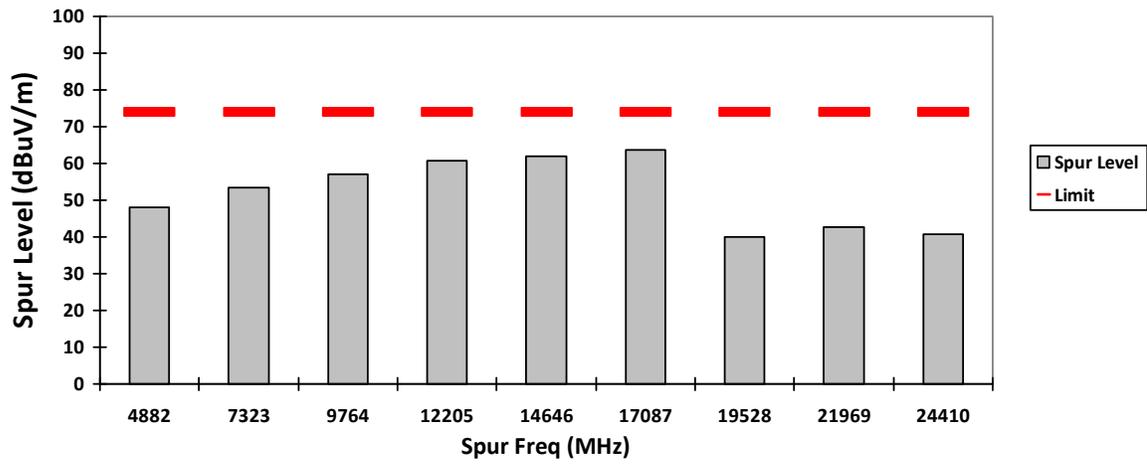
### VERTICAL, QPK



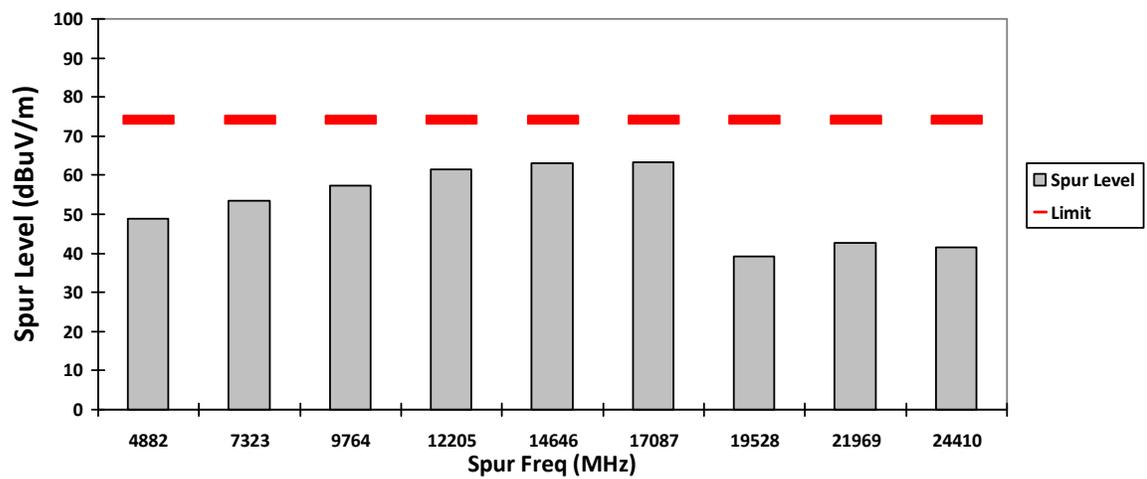
### HORIZONTAL, QPK



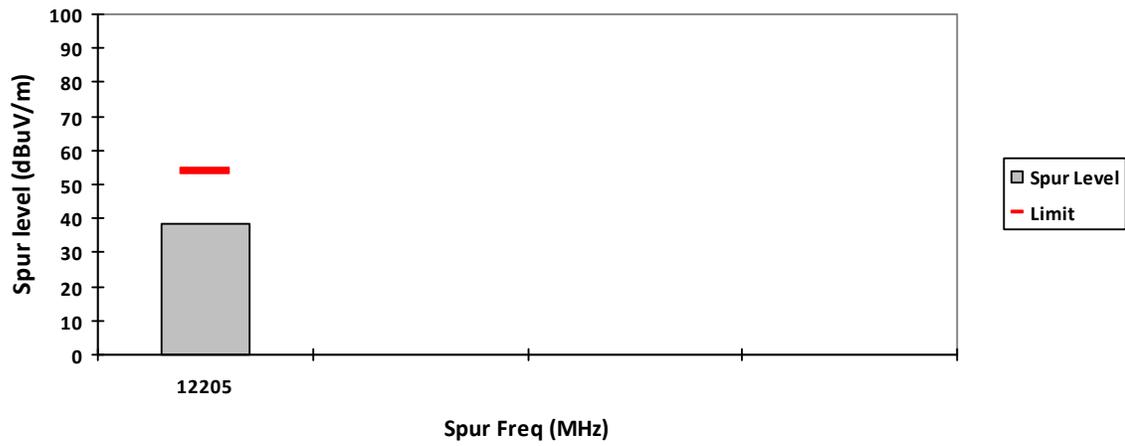
### VERTICAL, PK



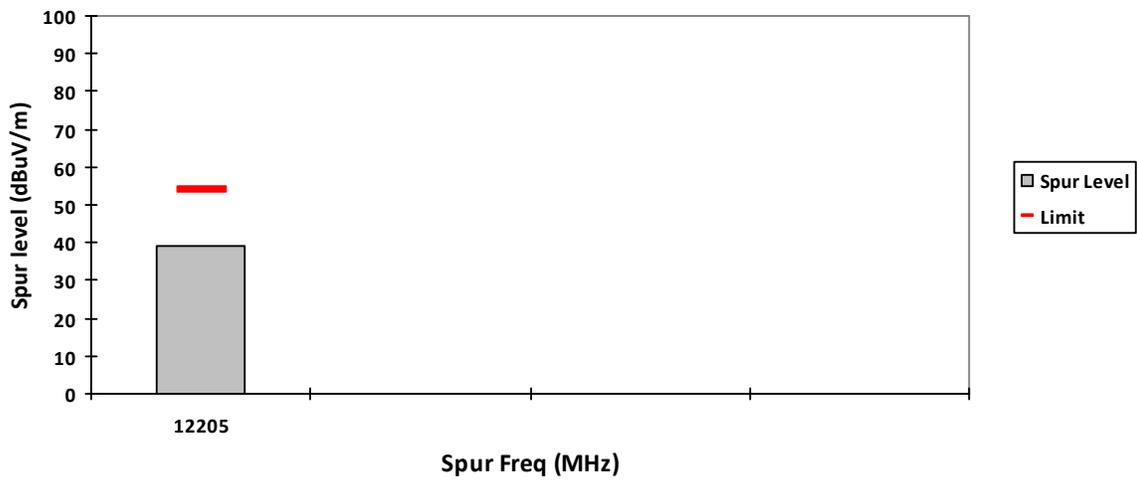
### HORIZONTAL, PK



### VERTICAL, AV

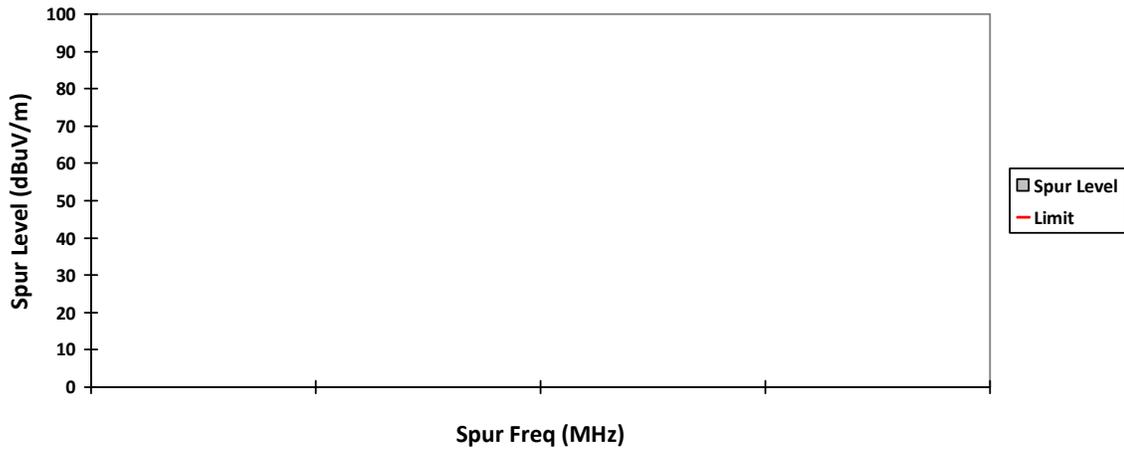


### HORIZONTAL, AV

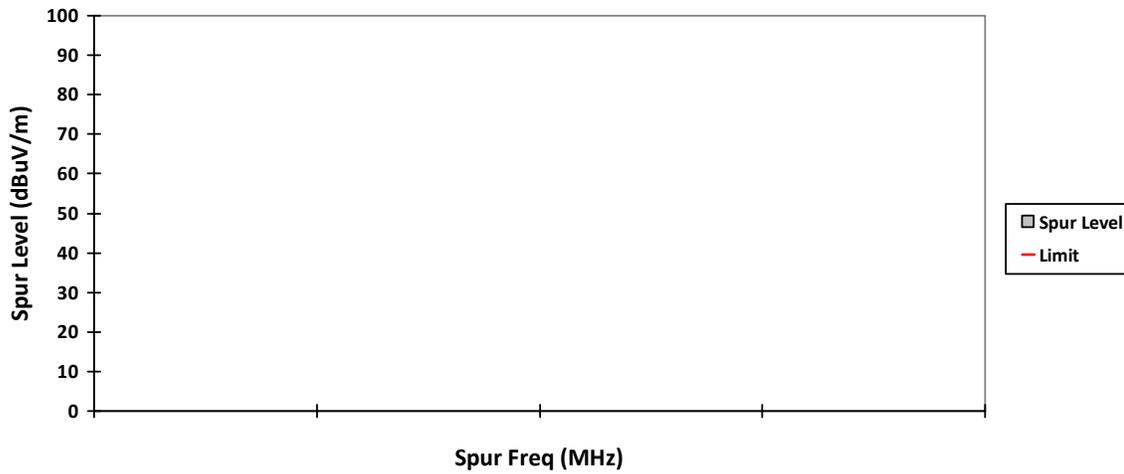




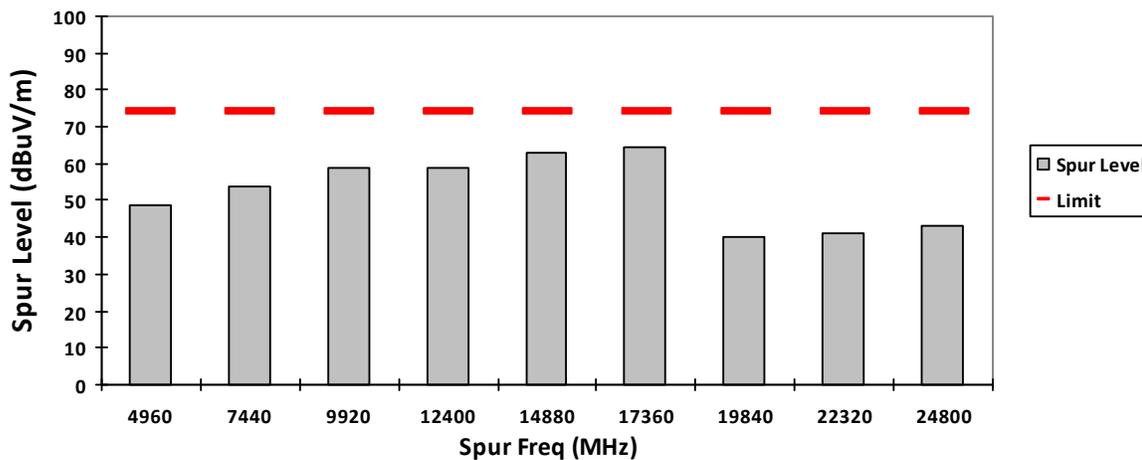
### VERTICAL, QPK



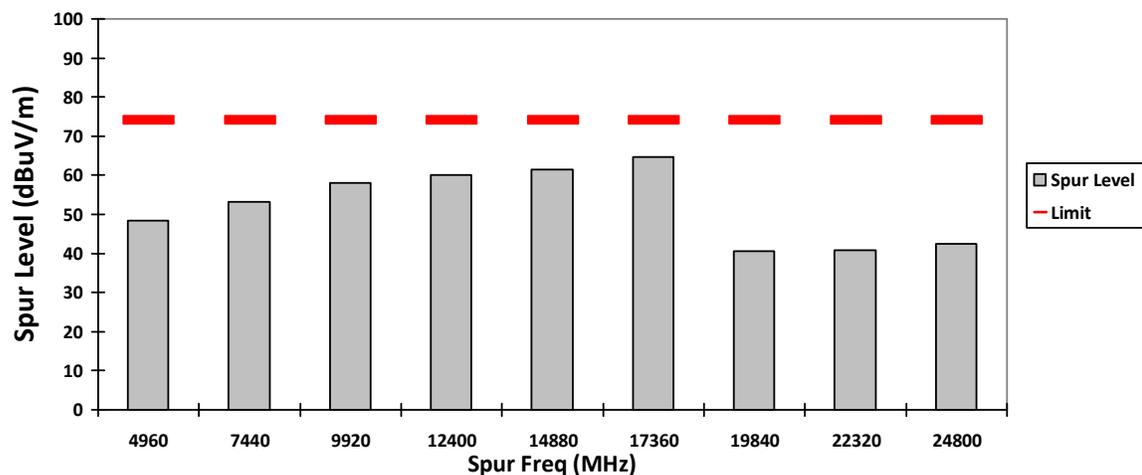
### HORIZONTAL, QPK



### VERTICAL, PK



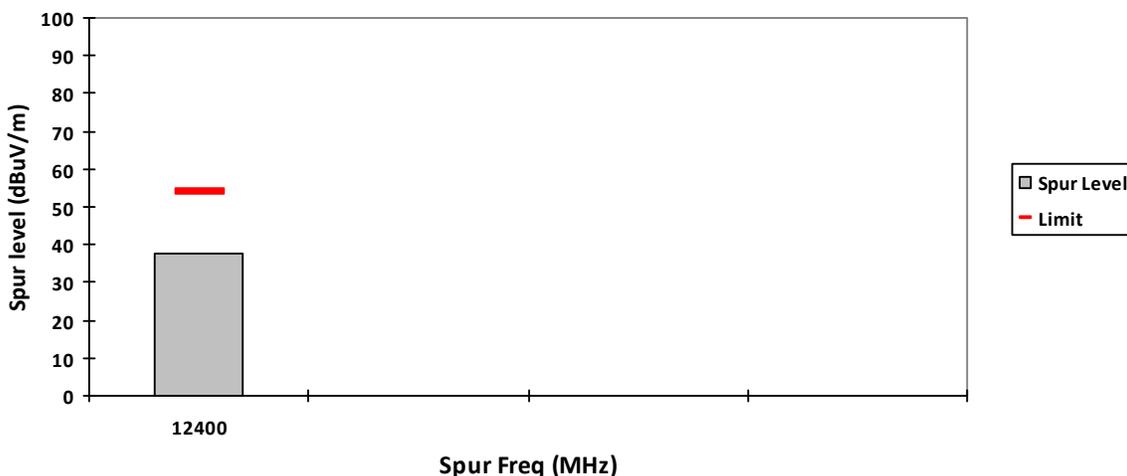
### HORIZONTAL, PK



### VERTICAL, AV



### HORIZONTAL, AV



**NOTE:**

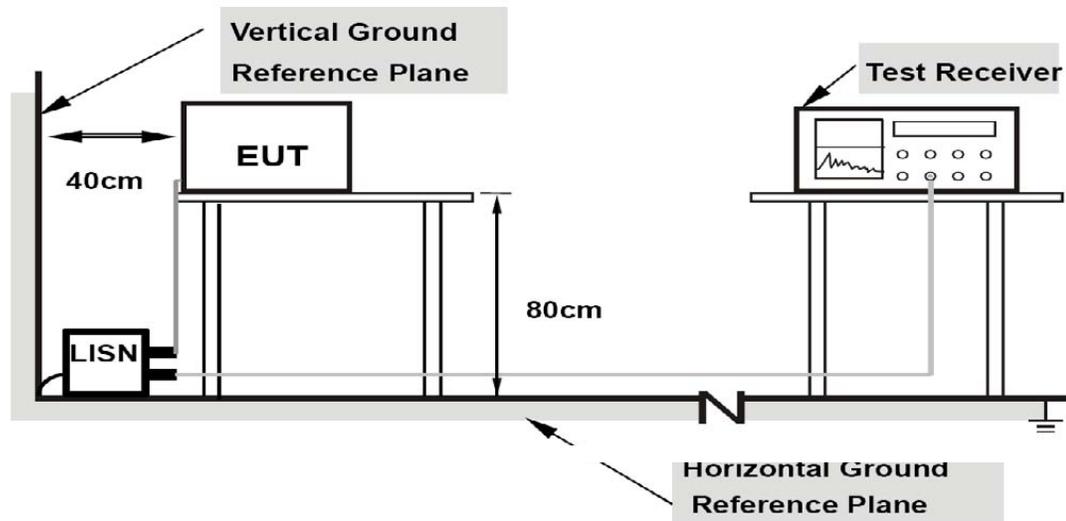
Transmitter Duty Cycle Calculation, FCC Rule 15.35 (b,c)

Based on the Bluetooth Specification Version 2.1+EDR, and worst case AFH mode, transmitter ON time is independent of packet type (DH1, DH3 and DH5) and packet length, the AFH mode Duty cycle connection factor as below:

Channel hop rate = 800 hops/second (AFH Mode)  
Adjusted channel hop rate for DH5 mode = 133.33 hops/second  
Time per channel hop = 1 / 133.33 hops/second = 7.5 ms  
Time to cycle through all channels = 7.5 x 20 channels = 150 ms  
Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)  
Worst case dwell time = 7.5 ms  
Duty cycle connection factor =  $20\log_{10}(7.5\text{ms} / 100\text{ms}) = -22.5 \text{ dB}$

## 6.9. AC Powerline Conducted Emission

### 6.9.1. Test Setup



- 1) Tests were conducted for both Receive and Transmit Mode of the EUT.
- 2) The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50uH of coupling impedance for the measuring instrument.
- 3) Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- 4) The frequency range from 150 kHz to 30MHz was measured.

**6.9.2. Test Limits:**

**For AC Power Line Conducted Test Limit can be Class A or B depends on product classification.**

**Limits for conducted disturbance at the mains ports of class A ITE**

Frequency range MHz	Limits dB(μV)	
	Quasi-peak	Average
0,15 to 0,50	79	66
0,50 to 30	73	60
NOTE The lower limit shall apply at the transition frequency.		

**Table 1: Limits for Conducted Disturbance at the Mains Ports of Class A ITE.**

**Limits for conducted disturbance at the mains ports of class B ITE**

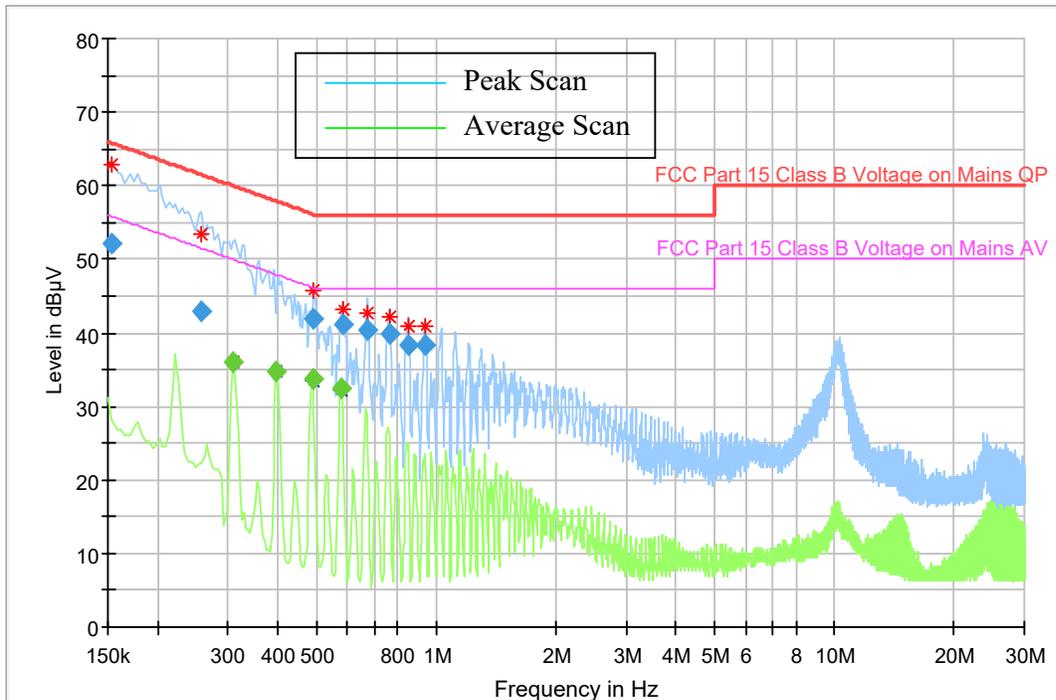
Frequency range MHz	Limits dB(μV)	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50
NOTE 1 The lower limit shall apply at the transition frequencies.		
NOTE 2 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

**Table 2: Limits for Conducted Disturbance at the Mains Ports of Class B ITE**

### 6.9.3. Test Result

#### 1) Charger + Radio in BT Tx (8DPSK)

Full Spectrum



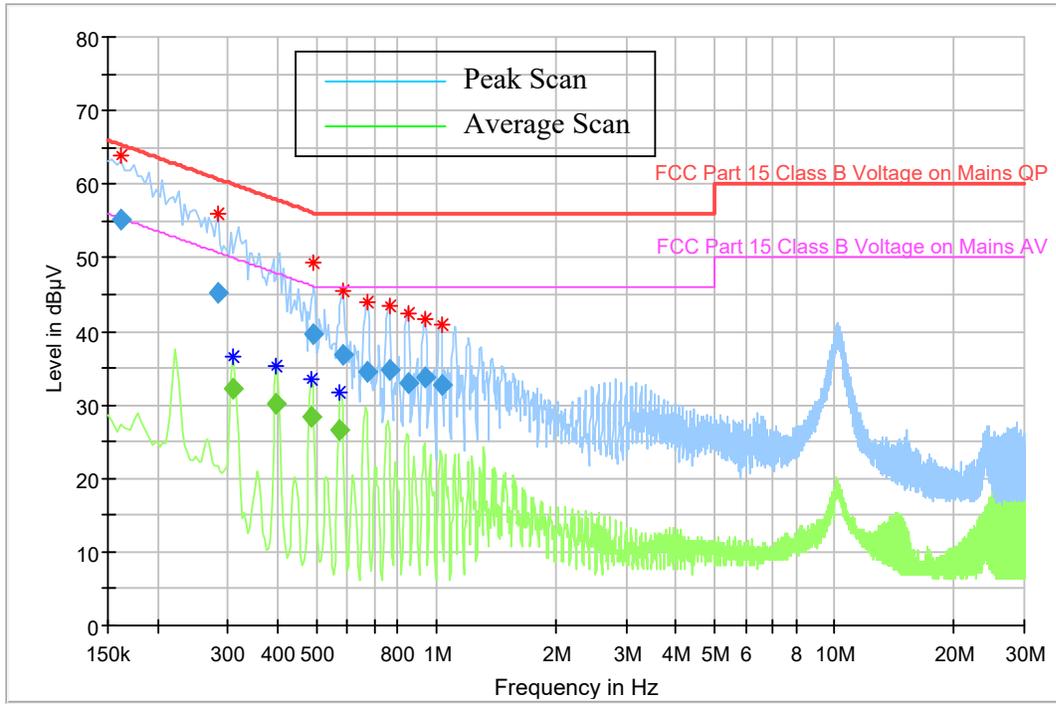
#### Quasipeak and Average Measurement

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
0.154000	52.08	---	65.78	13.70	1000.0	9.000	N	ON	10.2	PASS
0.258000	42.83	---	61.50	18.67	1000.0	9.000	N	ON	10.2	PASS
0.310000	---	36.13	49.97	13.84	1000.0	9.000	L1	ON	10.1	PASS
0.398000	---	34.71	47.90	13.18	1000.0	9.000	L1	ON	10.1	PASS
0.490000	---	33.83	46.17	12.34	1000.0	9.000	L1	ON	10.1	PASS
0.494000	41.94	---	56.10	14.16	1000.0	9.000	L1	ON	10.1	PASS
0.578000	---	32.40	46.00	13.60	1000.0	9.000	L1	ON	10.1	PASS
0.582000	41.22	---	56.00	14.78	1000.0	9.000	L1	ON	10.1	PASS
0.674000	40.37	---	56.00	15.63	1000.0	9.000	L1	ON	10.1	PASS
0.762000	39.97	---	56.00	16.03	1000.0	9.000	L1	ON	10.1	PASS
0.850000	38.40	---	56.00	17.60	1000.0	9.000	L1	ON	10.1	PASS
0.942000	38.31	---	56.00	17.69	1000.0	9.000	L1	ON	10.1	PASS

\* Expanded Uncertainty (U) = +/- 3.48dB

2) Charger + Radio in BT Tx (GFSK)

Full Spectrum



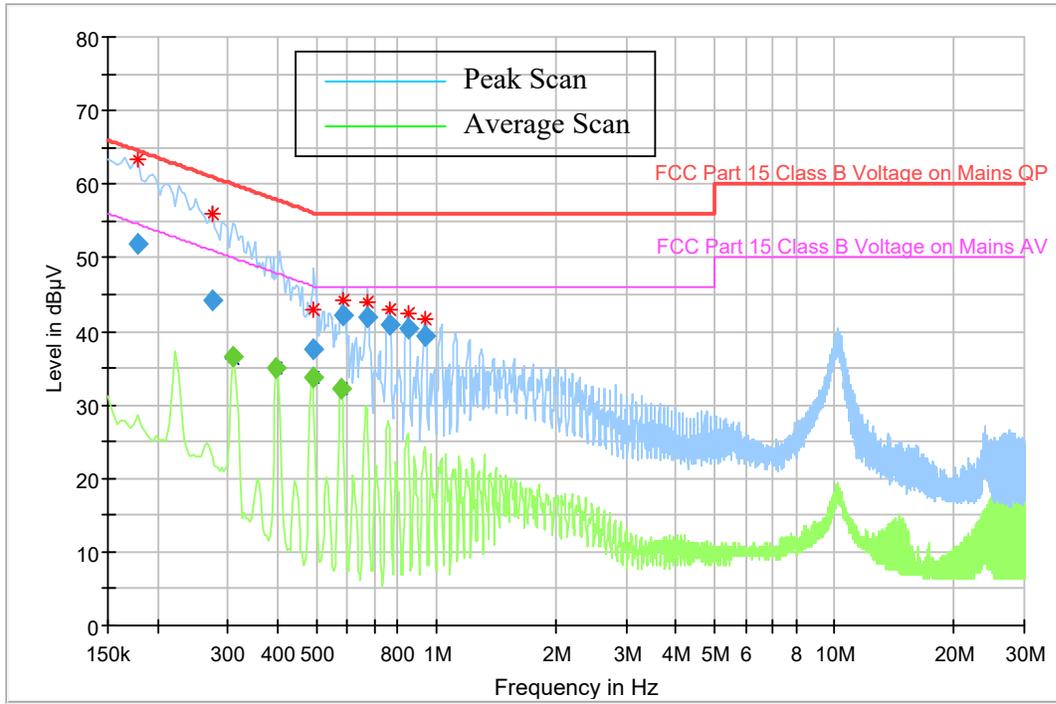
Quasipeak and Average Measurement

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
0.162000	55.15	---	65.36	10.22	1000.0	9.000	N	ON	10.2	PASS
0.282000	45.27	---	60.76	15.49	1000.0	9.000	N	ON	10.2	PASS
0.310000	---	32.22	49.97	17.75	1000.0	9.000	N	ON	10.1	PASS
0.398000	---	30.16	47.90	17.74	1000.0	9.000	N	ON	10.1	PASS
0.486000	---	28.39	46.24	17.85	1000.0	9.000	N	ON	10.1	PASS
0.494000	39.61	---	56.10	16.49	1000.0	9.000	N	ON	10.1	PASS
0.574000	---	26.66	46.00	19.34	1000.0	9.000	N	ON	10.1	PASS
0.582000	36.79	---	56.00	19.21	1000.0	9.000	N	ON	10.1	PASS
0.670000	34.58	---	56.00	21.42	1000.0	9.000	N	ON	10.1	PASS
0.762000	34.66	---	56.00	21.34	1000.0	9.000	N	ON	10.1	PASS
0.850000	32.91	---	56.00	23.09	1000.0	9.000	N	ON	10.1	PASS
0.942000	33.74	---	56.00	22.26	1000.0	9.000	N	ON	10.1	PASS
1.030000	32.61	---	56.00	23.39	1000.0	9.000	N	ON	10.1	PASS

\* Expanded Uncertainty (U) = +/- 3.48dB

3) Charger + Radio in BT Tx (DQPSK)

Full Spectrum



Quasipeak and Average Measurement

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
0.178000	51.82	---	64.58	12.76	1000.0	9.000	N	ON	10.2	PASS
0.274000	44.11	---	61.00	16.88	1000.0	9.000	L1	ON	10.2	PASS
0.310000	---	36.49	49.97	13.48	1000.0	9.000	L1	ON	10.1	PASS
0.398000	---	35.08	47.90	12.81	1000.0	9.000	L1	ON	10.1	PASS
0.490000	---	33.86	46.17	12.31	1000.0	9.000	L1	ON	10.1	PASS
0.494000	37.45	---	56.10	18.65	1000.0	9.000	N	ON	10.1	PASS
0.578000	---	32.29	46.00	13.71	1000.0	9.000	L1	ON	10.1	PASS
0.582000	42.06	---	56.00	13.94	1000.0	9.000	L1	ON	10.1	PASS
0.674000	41.86	---	56.00	14.14	1000.0	9.000	L1	ON	10.1	PASS
0.762000	40.81	---	56.00	15.19	1000.0	9.000	L1	ON	10.1	PASS
0.854000	40.30	---	56.00	15.70	1000.0	9.000	L1	ON	10.1	PASS
0.942000	39.25	---	56.00	16.75	1000.0	9.000	L1	ON	10.1	PASS

\* Expanded Uncertainty (U) = +/- 3.48dB

**END OF TEST REPORT**