

 MOTOROLA SOLUTIONS	 MS ISO/IEC 17025 TESTING SAMM No. 0825																														
MOTOROLA PENANG ADV. COMM. LABORATORY Motorola Solutions Malaysia Sdn. Bhd. Innoplex Plot 2A Medan Bayan Lepas, Mukim 12, S.W.D. 11900 Bayan Lepas, Penang, Malaysia.	FCC / ISED TEST REPORT Report Revision : Rev.B																														
<table><tr><td>Date/s Tested</td><td>: 12-September-2019 - 19-September-2019</td></tr><tr><td>Report Issue Date</td><td>: 25-September-2019</td></tr><tr><td>Manufacturer/Location</td><td>: Motorola Solutions Malaysia Sdn Bhd</td></tr><tr><td>Manufacturer/Address</td><td>: Innoplex Plot 2A, Medan Bayan lepas, Mukim 12, S.W.D. 11900 Bayan Lepas, Penang, Malaysia</td></tr><tr><td>Requestor</td><td>: AYUB, `ABDUL HAKIM</td></tr><tr><td>Product Type</td><td>: Hand-held</td></tr><tr><td>Product Version (PMN)</td><td>: WM500</td></tr><tr><td>Model Number (HVIN)</td><td>: PMMN4127A</td></tr><tr><td>Frequency Band</td><td>: 2.402 - 2.480 GHz</td></tr><tr><td>Rated / Max RF Output Power</td><td>: 2.5 mWatts / 6.3 mWatts</td></tr><tr><td>Applicant Name</td><td>: Motorola Solutions Inc</td></tr><tr><td>FCC Registrations</td><td>: 461337</td></tr><tr><td>ISED Registrations</td><td>: 109AK</td></tr><tr><td>Firmware Version (FVIN)</td><td>: D01.01.07</td></tr></table>  The equipment was tested accordance to the requirement listed below: <table><tr><td>(2.4GHz BT LE) 47 CFR Part 15C ISED RSS 247 Issue 2 February 2017</td><td>PASS</td></tr></table>		Date/s Tested	: 12-September-2019 - 19-September-2019	Report Issue Date	: 25-September-2019	Manufacturer/Location	: Motorola Solutions Malaysia Sdn Bhd	Manufacturer/Address	: Innoplex Plot 2A, Medan Bayan lepas, Mukim 12, S.W.D. 11900 Bayan Lepas, Penang, Malaysia	Requestor	: AYUB, `ABDUL HAKIM	Product Type	: Hand-held	Product Version (PMN)	: WM500	Model Number (HVIN)	: PMMN4127A	Frequency Band	: 2.402 - 2.480 GHz	Rated / Max RF Output Power	: 2.5 mWatts / 6.3 mWatts	Applicant Name	: Motorola Solutions Inc	FCC Registrations	: 461337	ISED Registrations	: 109AK	Firmware Version (FVIN)	: D01.01.07	(2.4GHz BT LE) 47 CFR Part 15C ISED RSS 247 Issue 2 February 2017	PASS
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Prepared By: Gan Boon Teong Test Personnel	Approved By: Vincent Foong Chuen Kit Deputy Technical Manager																														

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REVISION HISTORY

Revision History	Description	Date	Originator
Rev. A	Initial Report	25-September-2019	GAN BOON TEONG
Rev. B	Amended 6.2 RBW on test method	23-October-2019	Vincent Foong

1.0 General Information

EUT Description:

Technologies	2.4GHz BT LE
TX Frequency range	2402MHz – 2480MHz
Modulation Type	GFSK
Connector type	PROGRAMMING, TEST & ALIGNMENT CABLE
Antenna type	INTERNAL

The EUT contains following accessory devices and data cable:

Item	Brand	Model or P/N
POWER SUPPLY ADAPTOR,PS WALL 240VAC UNIVERSAL US/JPN ADAPTER 5VDC/1.5A L6 USB-A DETACHABLE	MOTOROLA	8397-PS000150A31-1
CABLE,1000 MM,USB-A TO USB-C,LEX L11	MOTOROLA	CB000756A01

Channel number and frequency information:

40 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

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

A pigtail was soldered out of the Bluetooth subsection to allow for conducted tests in this report.

Deviation from standard

Not applicable as no deviation from standard test method

2.0 Summary of Test Results

FCC Clause	ISED Clause	Test Item	Result	Remark	Serial number tested
15.247 (a)(2)	RSS 247 5.2 (a)	DTS & 99% Channel Bandwidth	Pass	BTLE 1M Highest 99% OCB: 1.069 MHz (1M07F1D) BTLE 2M Highest 99% OCB: 2.095 MHz (2M10F1D)	CAB19NCA014G
15.247 (b)(3)	RSS 247 5.4 (d)	Conducted RF Output Power (Average)	Pass	BTLE 1M Highest output power: 7.394 dBm BTLE 2M Highest output power: 7.617 dBm	CAB19NCA014G
15.247(e)	RSS 247 5.2 (b)	Maximum Peak Power Spectral Density	Pass	Meet the limit requirement.	CAB19NCA014G
15.247 (d)	RSS-247 5.5	Band-Edge Conducted Spurious Emission	Pass	BTLE 1M Worst case emission: -46.81 dBm BTLE 2M Worst case emission: -23.89 dBm	CAB19NCA014G
15.247 (b)	RSS-247 5.5	Conducted Spurious Emission	Pass	BTLE 1M Worst case emission: -41.30 dBm BTLE 2M Worst case emission: -40.96 dBm	CAB19NCA014G
15.205, 15.209, 15.247 (d)	RSS247 5.5	Radiated Emission within Restricted Bands	Pass	Meet the limit requirement.	CAB19NCA00YZ
15.207	RSS-Gen 8.8	AC Power Line Conducted Spurious Emission	Pass	Meet the limit requirement.	CAB19NCA00YZ
15.203	-	Antenna Requirement	NA	Internal antenna is not accessible to the end-user	NA

3.0. Measurement Uncertainty

Measurement	Frequency	Expended Uncertainty (k=1.96) (±dB)
AC Power Line Conducted Spurious Emission	150KHz ~ 30MHz	3.43
Radiated Emissions up to 1 GHz	30MHz ~ 200MHz	5.01
	200MHz ~ 1000MHz	5.01
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	5.01
	18GHz ~ 25GHz	5.01

4.0 Equipment List

Bluetooth ATE # 1 (SW Version: Ate Main_3.1.10_R2)

Description	Model	Serial Number	Calibration Date	Calibration Due Date
SPECTRUM ANALYZER	FSEK30	838495/014	19-Jul-19	19-Jul-20
SPECTRUM ANALYZER	E4443A	MY46181974	9-Aug-18	9-Aug-20
POWER SUPPLY	6033A	3004A05137	24-Jul-18	24-Jul-20

Radiated Emission Station (SW Version: EMC FCC RE v1.6.0)

Description	Model	Serial Number	Calibration Date	Calibration Due Date
DRG HORN FREQ.	SAS-571	720	21-Mar-19	21-Mar-21
DRG HORN FREQ.	SAS-571	1143	14-Feb-19	14-Feb-21
POWER SUPPLY	6032A	MY41001736	25-May-19	25-May-20
SIGNAL GENERATOR	SMB 100A	181117	8-Nov-18	8-Nov-21
EMI TEST RECEIVER	ESW44	101750	24-Jul-19	24-Jul-20
EMI TEST RECEIVER	ESIB26	100017	19-Jul-19	19-Jul-20
5m Semi-anechoic Chamber	S800-HX	J2308	Not Required	Not Required
BILOG ANTENNA	CBL6112D	25224	1-Aug-18	1-Nov-19
BILOG ANTENNA	CBL6112B	2964	16-Feb-18	16-Feb-20
DATA LOGGER	SDL500	A.016800	19-Mar-19	18-Mar-20
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	21-Dec-18	21-Dec-19
18 - 40GHz PREAMPLIFIER	Miteq Hi Gain Sucoflex	001	Not Required	Not Required
PREAMPLIFIER	PAM-0118	269	24-May-19	24-May-20
LOOP ANTENNA	6502	00203479	10-Dec-18	10-Dec-19

AC Power Line Conducted Emission Station (SW Version: EMC 32 v10.50.10)

Description	Model	Serial Number	Calibration Date	Calibration Due Date
DRG HORN FREQ.	SAS-571	720	21-Mar-19	21-Mar-21
DRG HORN FREQ.	SAS-571	1143	14-Feb-19	14-Feb-21
POWER SUPPLY	6032A	MY41001736	25-May-19	25-May-20
SIGNAL GENERATOR	SMB 100A	181117	8-Nov-18	8-Nov-21
EMI TEST RECEIVER	ESW44	101750	24-Jul-19	24-Jul-20
EMI TEST RECEIVER	ESIB26	100017	19-Jul-19	19-Jul-20

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 Type	Environmental Conditions
Test Mode	0 to 39	0,19,39	GFSK	23.3°C, 70.3%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 Type	Environmental Conditions
Test Mode	0 to 39	0,19,39	GFSK	23.3°C, 70.3%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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Environmental Conditions
Application Mode	0 to 39	AUTO	AUTO	21.1°C, 69.9%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).

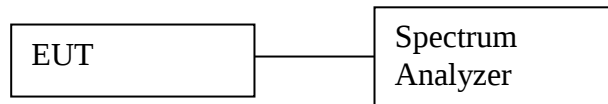
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Environmental Conditions
Test Mode	0 to 39	0,19,39	GFSK	24.6°C, 54%RH

6.0 Transmitter Test Parameters

6.1 6dB Channel Bandwidth

6.1.1 Test Setup



- 1) Check and ensure the spectrum analyzer well calibrate.
- 2) Turn on the DUT and set DUT to transmit maximum power.
- 3) Connect DUT's antenna terminal to spectrum analyzer with a low loss cable.
- 4) Setting of Spectrum analyzer :
 - a. RBW = 100 kHz
 - b. VBW = 300 kHz
 - c. Detector mode = Peak
 - d. Trace = Max hold
 - e. Sweep = auto
- 5) Measure the freq different of two frequencies that were attenuated 6dB from peak of the emission & record the frequency difference as the emission bandwidth.

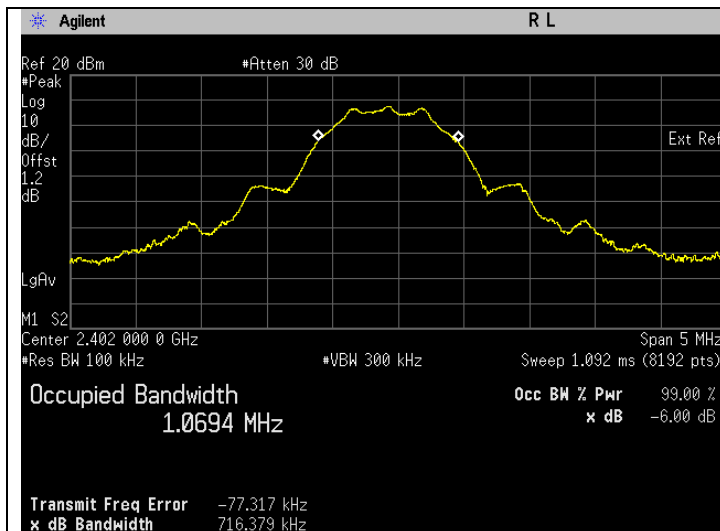
6.1.2 Test Limits:

Normal Condition (25 ° C)
≥500 kHz

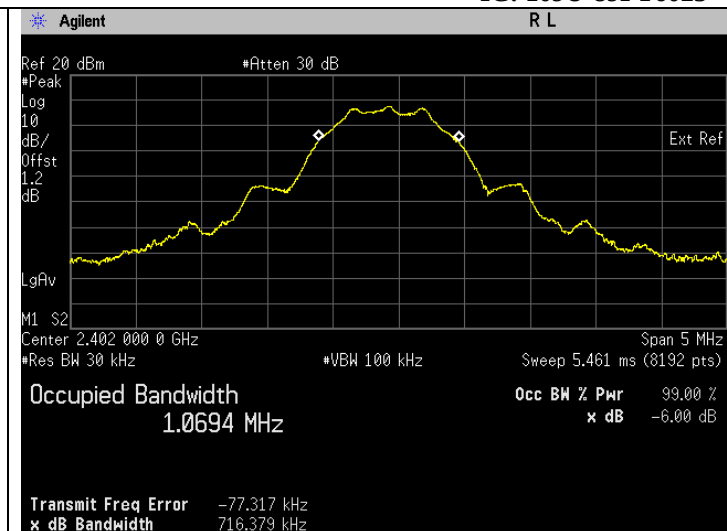
6.1.3 Test Data:

BTLE 1M

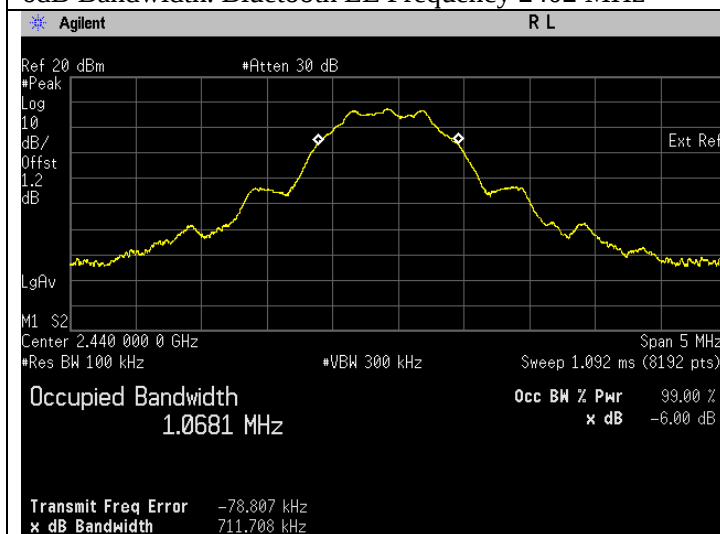
Test Conditions		Test Frequency	Results		
Standard	Modulation Type	Tx (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Status
Bluetooth L.E	GFSK	2402	0.716	1.069	Pass
Bluetooth L.E	GFSK	2440	0.712	1.068	Pass
Bluetooth L.E	GFSK	2480	0.710	1.066	Pass



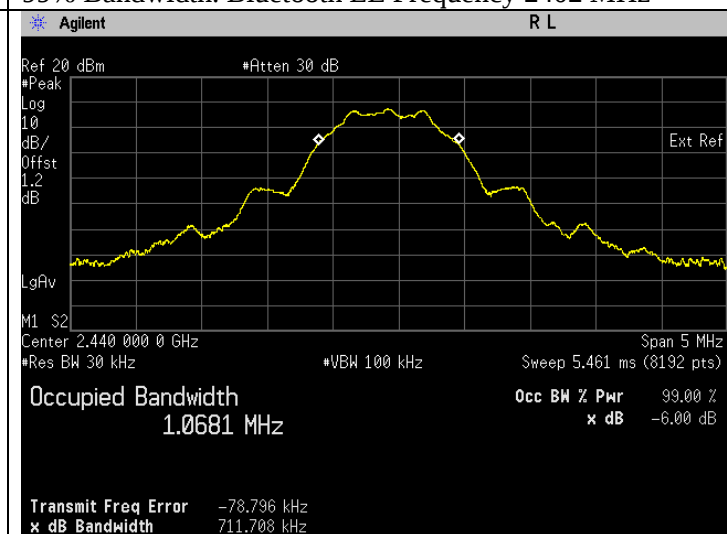
6dB Bandwidth. Bluetooth LE Frequency 2402 MHz



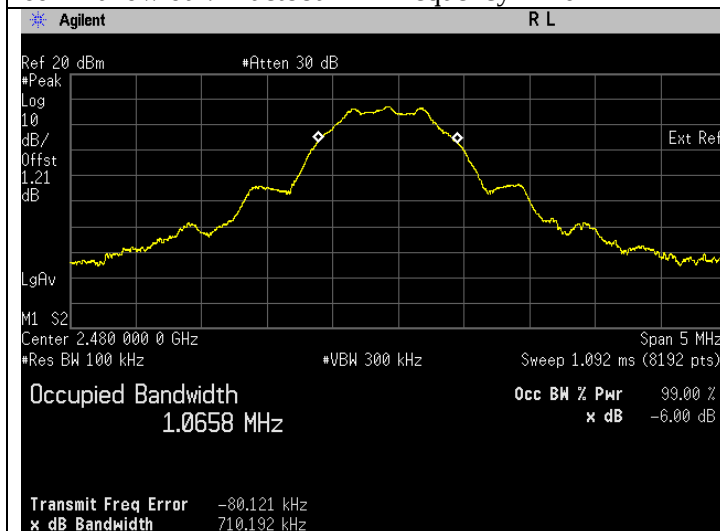
99% Bandwidth. Bluetooth LE Frequency 2402 MHz



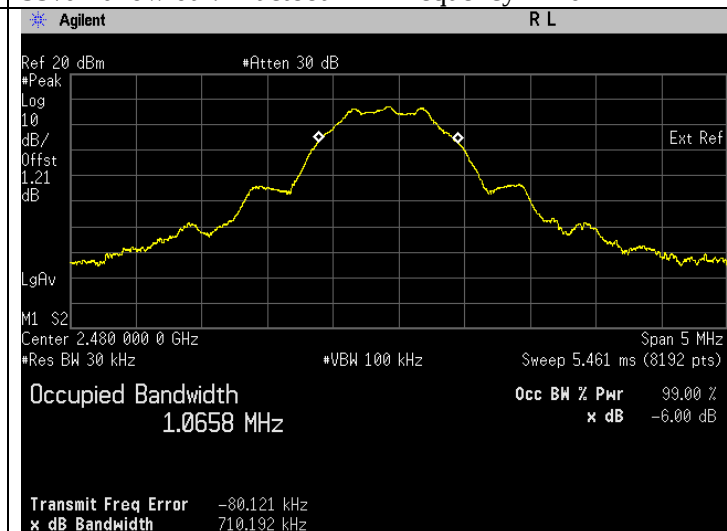
6dB Bandwidth. Bluetooth LE Frequency 2440 MHz



99% Bandwidth. Bluetooth LE Frequency 2440 MHz



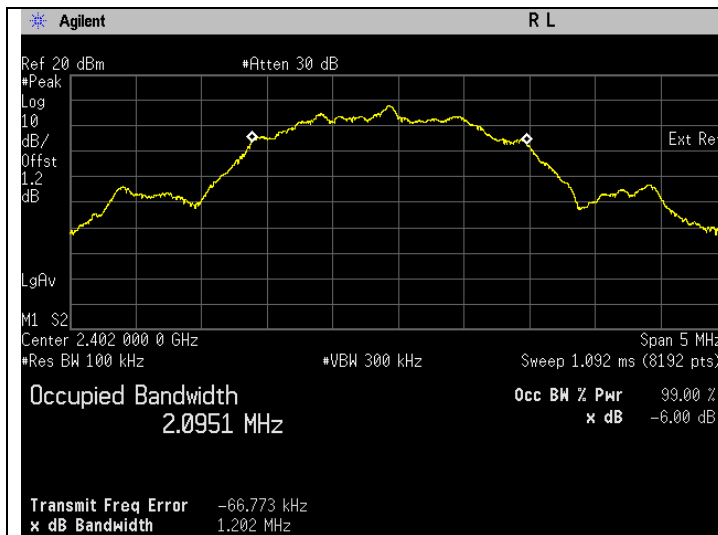
6dB Bandwidth. Bluetooth LE Frequency 2480 MHz



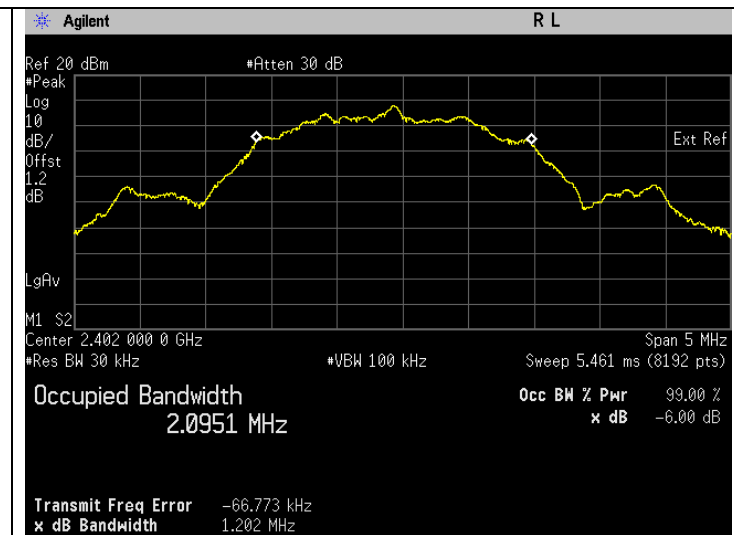
99% Bandwidth. Bluetooth LE Frequency 2480 MHz

BTLE 2M

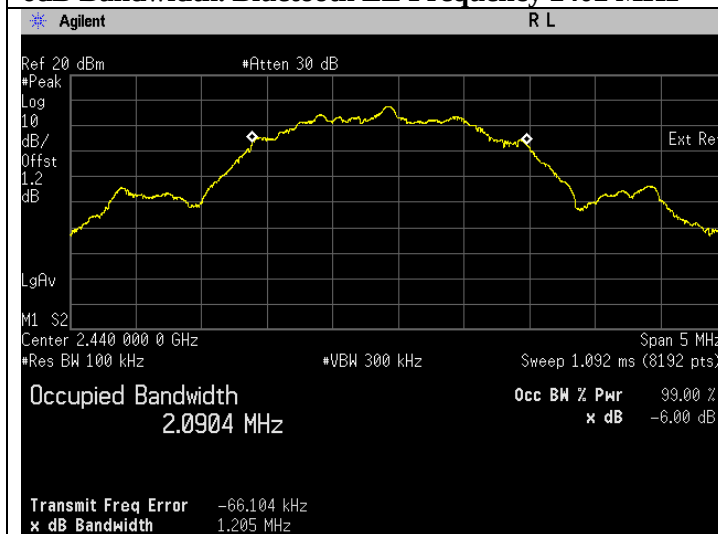
Test Conditions		Test Frequency	Results		
Standard	Modulation Type	Tx (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Status
Bluetooth L.E	GFSK	2402	1.202	2.095	Pass
Bluetooth L.E	GFSK	2440	1.205	2.090	Pass
Bluetooth L.E	GFSK	2480	1.203	2.093	Pass



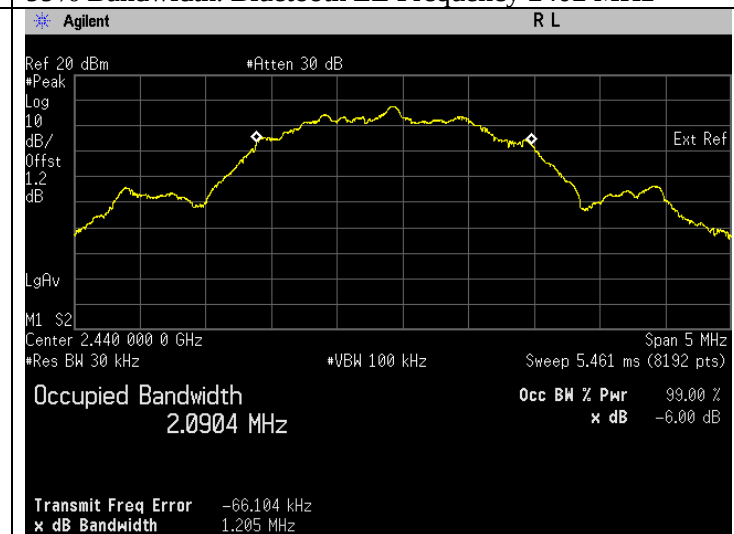
6dB Bandwidth. Bluetooth LE Frequency 2402 MHz



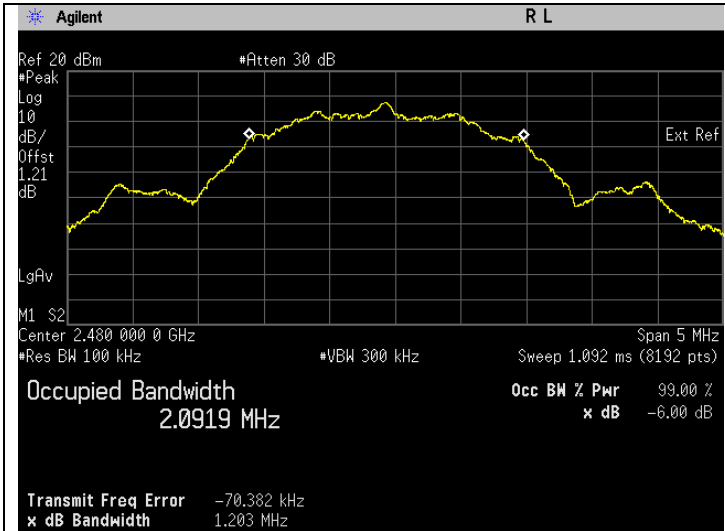
99% Bandwidth. Bluetooth LE Frequency 2402 MHz



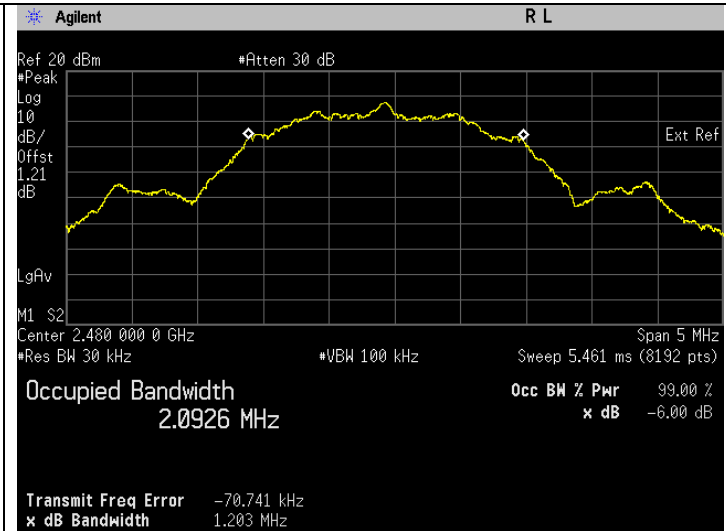
6dB Bandwidth. Bluetooth LE Frequency 2440 MHz



99% Bandwidth. Bluetooth LE Frequency 2440 MHz



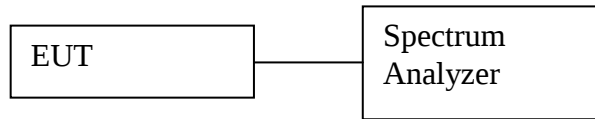
6dB Bandwidth, Bluetooth LE Frequency 2480 MHz



99% Bandwidth, Bluetooth LE Frequency 2480 MHz

6.2 Conducted RF Output Power

6.2.1 Test Setup



- 1) Check and ensure the spectrum analyzer well calibrate.
- 2) Turn on the DUT and set DUT to transmit maximum power.
- 3) Measure the duty cycle of transmitter output signal.
- 4) Setting of Spectrum analyzer :
 - a. Set the RBW = 1-5% OBW
 - b. Set the VBW $\geq [3 \times \text{RBW}]$.
 - c. Set the span $\geq [1.5 \times \text{OBW bandwidth}]$.
 - d. Detector = average.
 - e. Sweep time = auto couple.
 - f. Trace mode = free run.
 - g. Allow trace to fully stabilize.
- 5) Add in duty cycle correction into final test result.
- 6) Duty cycle correction is calculated as below:
 $10 \log (1/x)$

6.2.2 Test Limits:

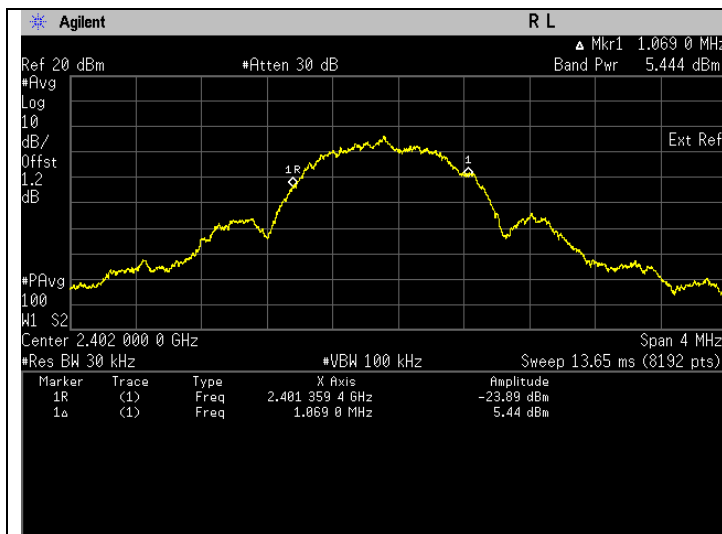
Normal Condition (25 ° C)
$\leq 1 \text{ Watt}(30 \text{ dBm})$

6.2.3 Test Data:

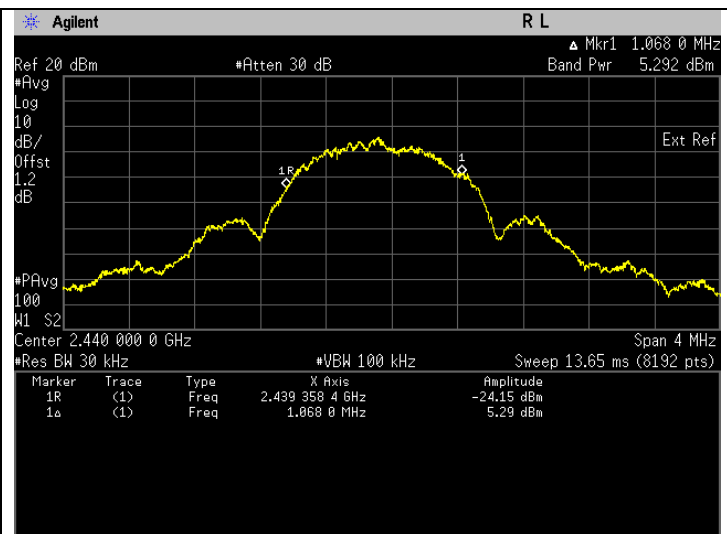
BTLE 1M

Output Power= Band Power + Duty cycle factor
=Band Power + 1.95dB

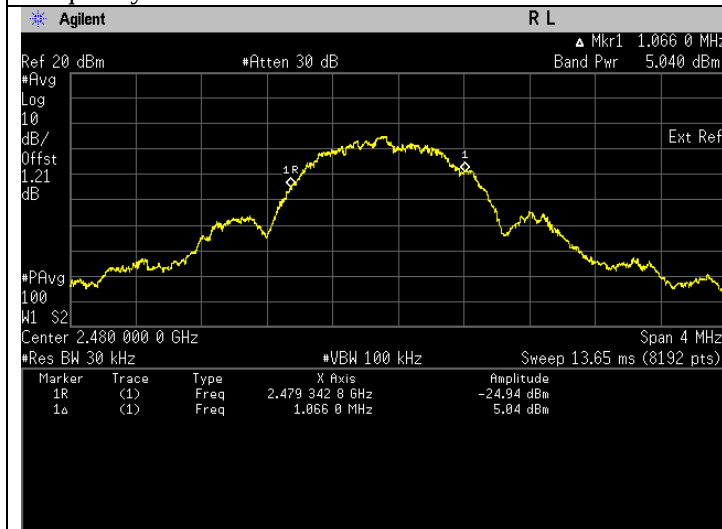
Test Conditions			Test Frequency	Results
Standard	Modulation Type	Tx (MHz)	Output Power (dBm)	Status
Bluetooth L.E	GFSK	2402	7.394	Pass
Bluetooth L.E	GFSK	2440	7.242	Pass
Bluetooth L.E	GFSK	2480	6.990	Pass



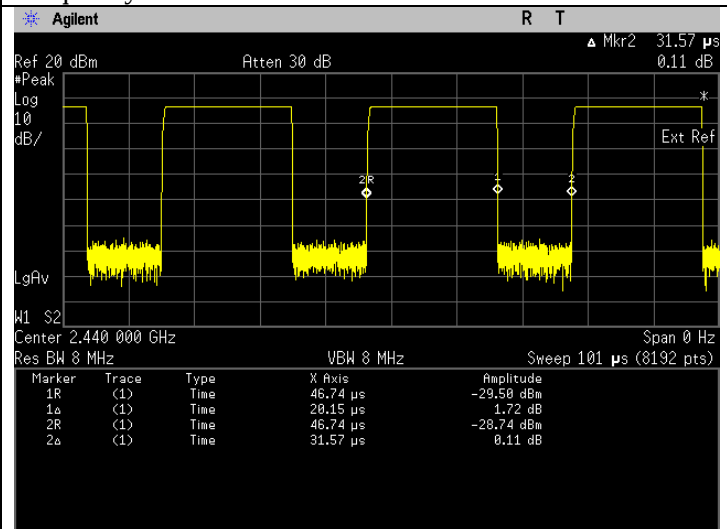
Frequency 2402 MHz



Frequency 2440 MHz



Frequency 2480 MHz

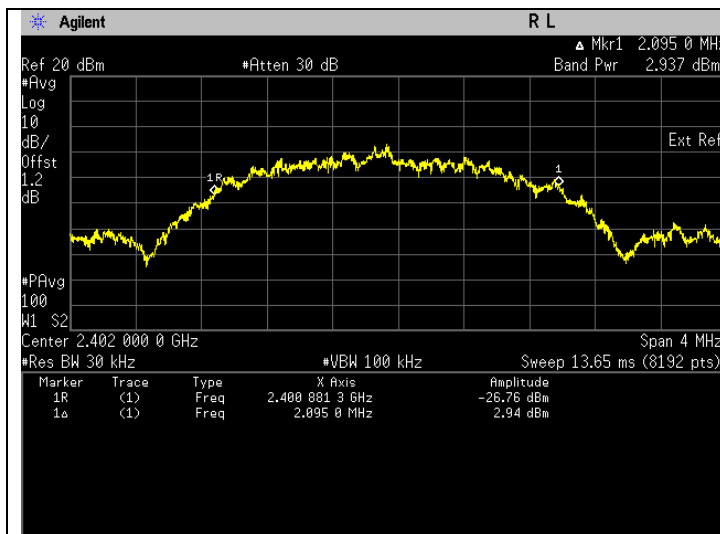


Duty Cycle

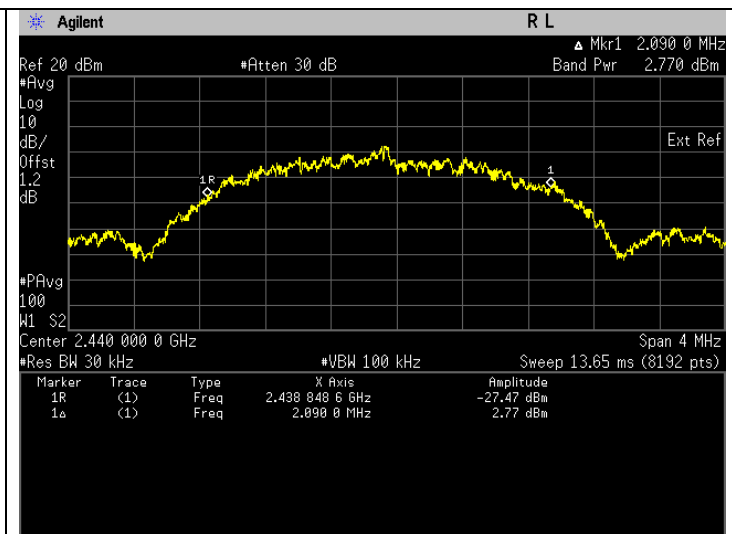
BTLE 2M

Output Power= Band Power + Duty cycle factor
=Band Power + 4.68dB

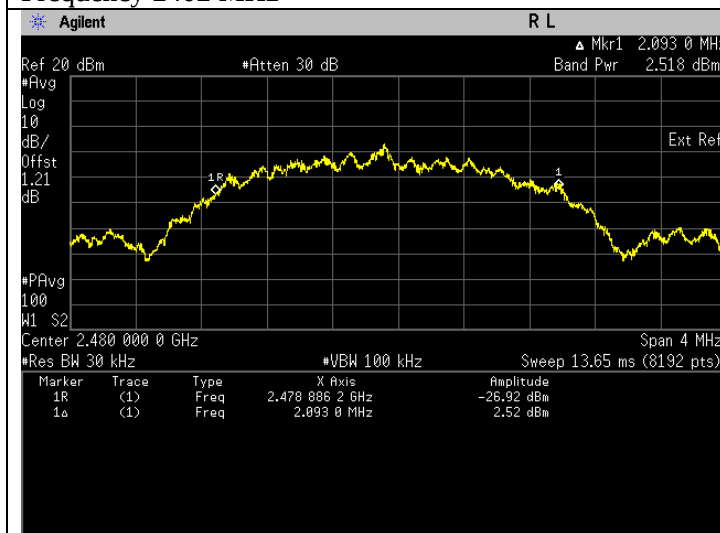
Test Conditions			Test Frequency	Results
Standard	Modulation Type	Tx (MHz)	Output Power (dBm)	Status
Bluetooth L.E	GFSK	2402	7.617	Pass
Bluetooth L.E	GFSK	2440	7.450	Pass
Bluetooth L.E	GFSK	2480	7.198	Pass



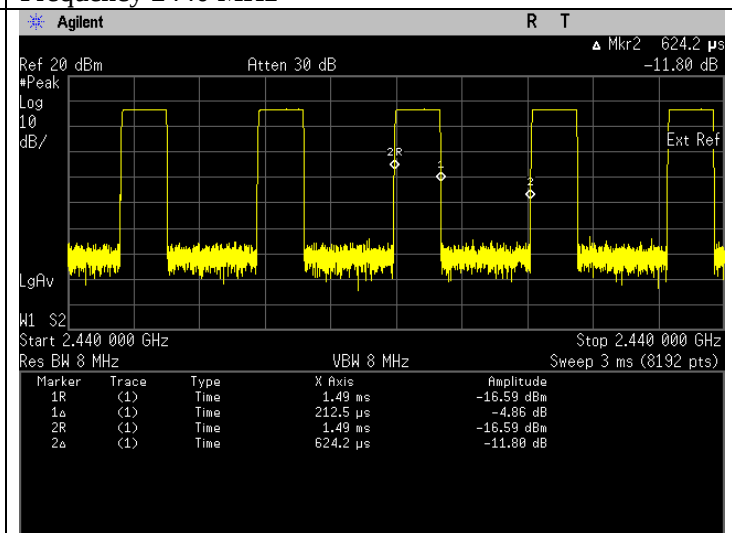
Frequency 2402 MHz



Frequency 2440 MHz



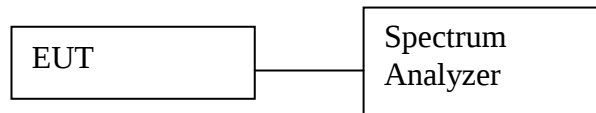
Frequency 2480 MHz



Duty Cycle

6.3 Maximum Peak Power Spectral Density

6.3.1 Test Setup



Maximum Peak

- 1) Check and ensure the spectrum analyzer well calibrate.
- 2) Turn on the DUT and set DUT to transmit maximum power.
- 3) Connect DUT's antenna terminal to spectrum analyzer with a low loss cable.
- 4) Setting of Spectrum analyzer :
 - a. Set analyzer center frequency to DTS channel center frequency.
 - b. Set the span to 1.5 times the DTS bandwidth.
 - c. Set the RBW to 3 kHz.
 - d. Set the VBW $\geq [3 \times \text{RBW}]$.
 - e. Detector = peak.
 - f. Sweep time = auto couple.
 - g. Trace mode = max hold.
 - h. Allow trace to fully stabilize.
 - i. Use the peak marker function to determine the maximum amplitude level within the RBW.
 - j. If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

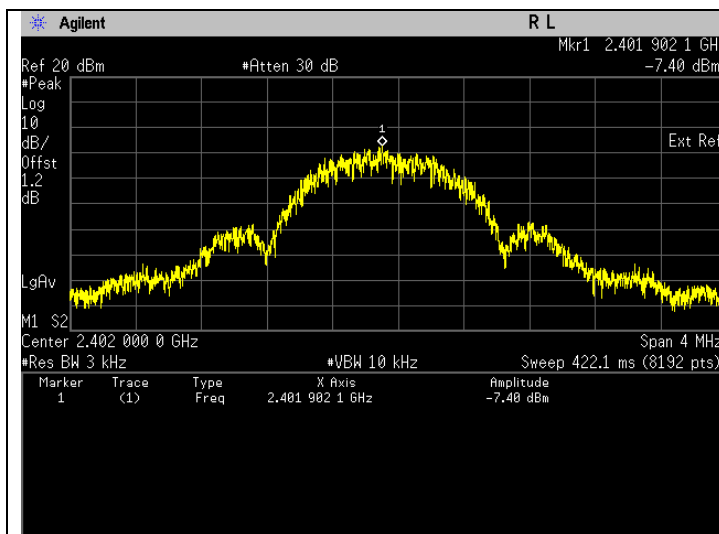
6.3.2 Test Limits:

Normal Condition (25 ° C)
$\leq 8 \text{ dBm/3kHz}$

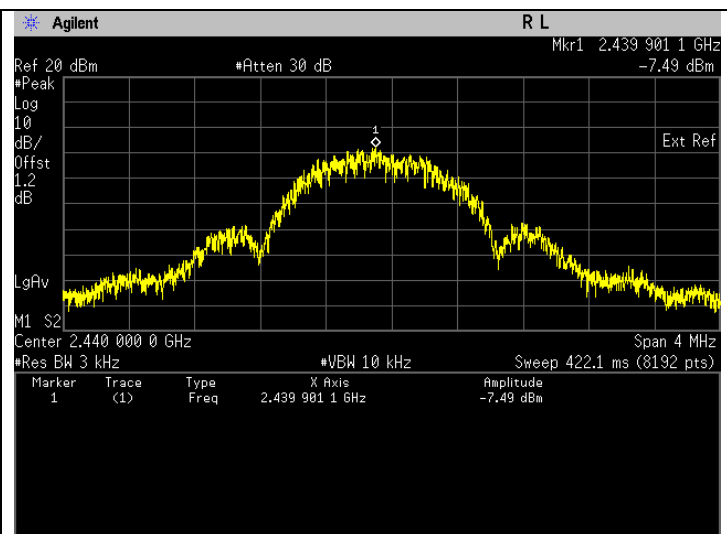
6.3.3 Test Result

BTLE 1M

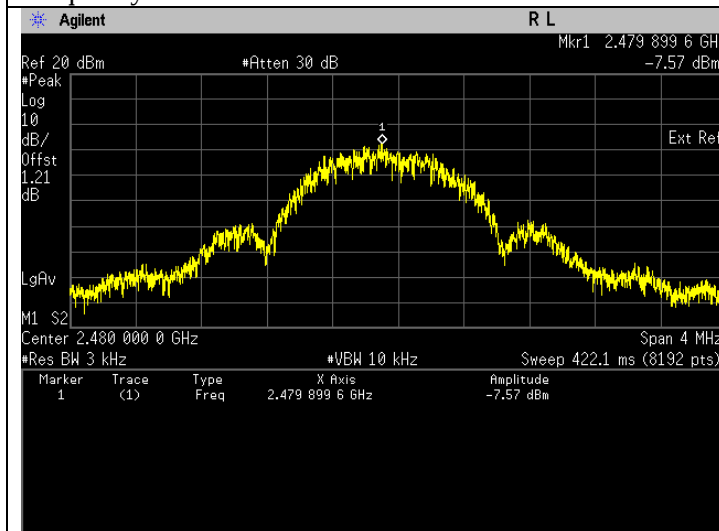
Test Conditions		Test Frequency	Results	
Standard	Modulation Type	Tx (MHz)	Power (dBm/3kHz)	Status
Bluetooth L.E.	GFSK	2402	-7.40	Pass
Bluetooth L.E.	GFSK	2440	-7.49	Pass
Bluetooth L.E.	GFSK	2480	-7.57	Pass



Maximum Power Spectral Density. Bluetooth LE
Frequency 2402 MHz



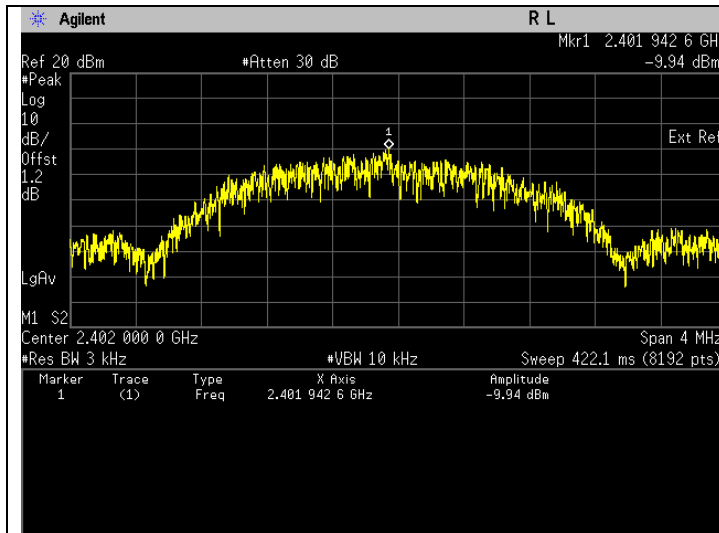
Maximum Power Spectral Density. Bluetooth LE
Frequency 2440 MHz



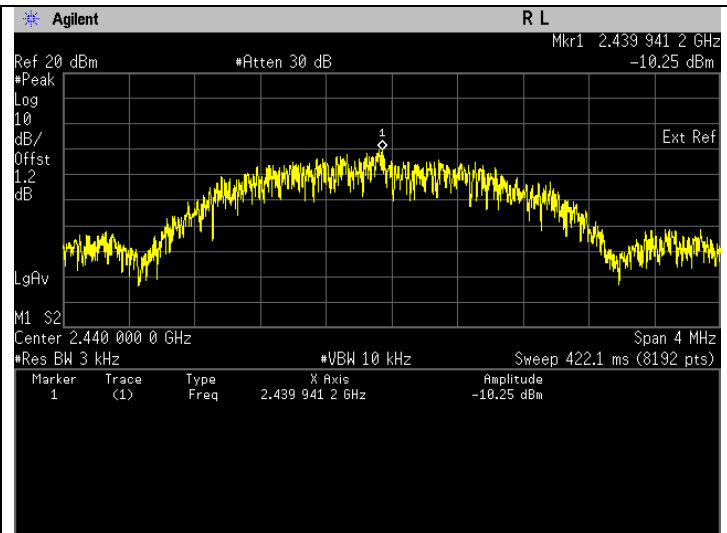
Maximum Power Spectral Density. Bluetooth LE
Frequency 2480 MHz

BTLE 2M

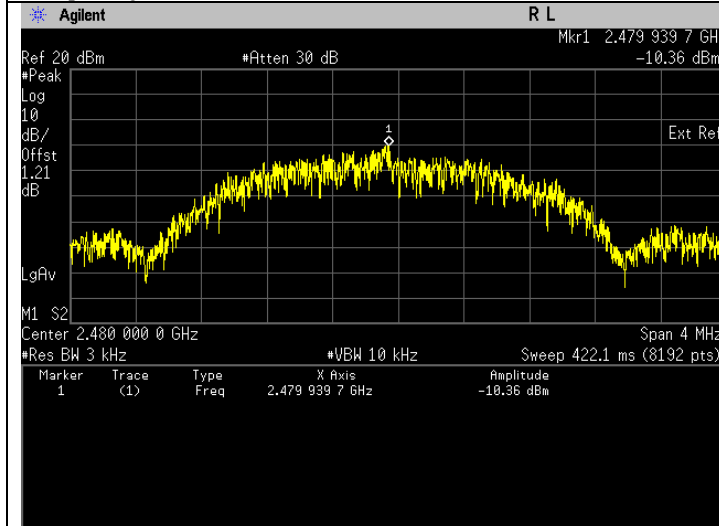
Test Conditions		Test Frequency	Results	
Standard	Modulation Type	Tx (MHz)	Power (dBm/3kHz)	Status
Bluetooth L.E.	GFSK	2402	-9.94	Pass
Bluetooth L.E.	GFSK	2440	-10.25	Pass
Bluetooth L.E.	GFSK	2480	-10.36	Pass



Maximum Power Spectral Density. Bluetooth LE
Frequency 2402 MHz



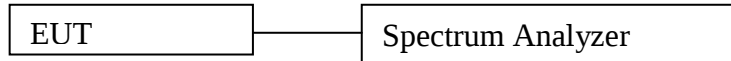
Maximum Power Spectral Density. Bluetooth LE
Frequency 2440 MHz



Maximum Power Spectral Density. Bluetooth LE
Frequency 2480 MHz

6.4 Conducted Spurious Emission

6.4.1 Test Setup



- 1) Check and ensure the spectrum analyzer well calibrate.
- 2) Turn on the DUT and set DUT to transmit maximum power.
- 3) Connect DUT's antenna terminal to spectrum analyzer with a low loss cable.
- 4) Setting of Spectrum analyzer :
 - a. RBW = 100 kHz
 - b. VBW = 300 kHz
 - c. Detector mode = Peak
 - d. Trace = Max Hold
 - e. Sweep = auto
- 5) Use the peak marker function to measure highest emission and scan up to 10th harmonic.

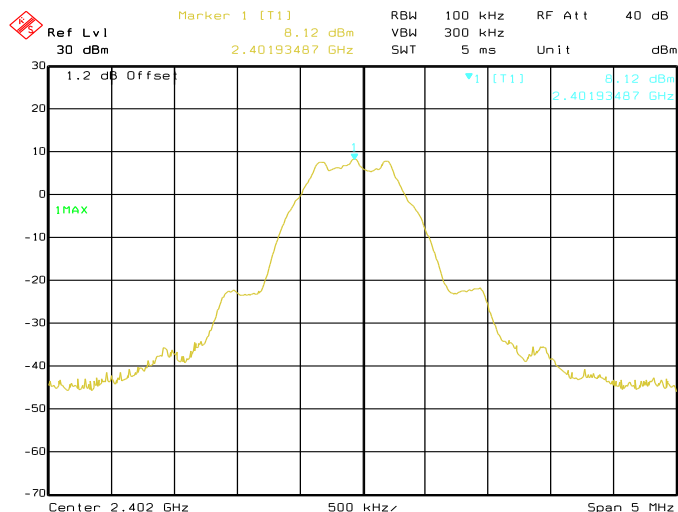
6.4.2 Test Limits:

Normal Condition (25 ° C)
Shall be at least 30 dB below peak (max) power.

6.4.3 Test Result

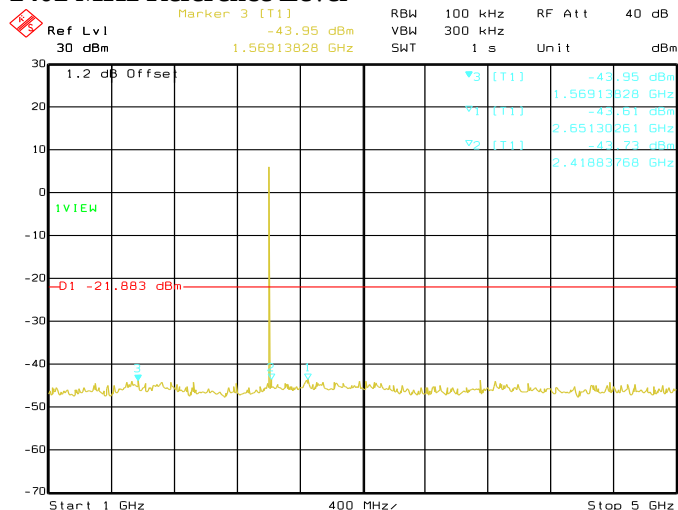
BTLE 1M

Test Conditions			Test Frequency	Results	
Standard	Modulation Type	Tx (MHz)	Spurs (MHz)	Level (dBm)	Status
Bluetooth L.E.	GFSK	2402	14188.38	-39.69	Pass
			6723.45	-40.18	Pass
			6993.99	-40.21	Pass
Bluetooth L.E.	GFSK	2440	14188.38	-39.77	Pass
			6993.99	-40.43	Pass
			6603.21	-41.30	Pass
Bluetooth L.E.	GFSK	2480	14188.38	-39.98	Pass
			6793.59	-40.16	Pass
			12695.39	-41.23	Pass



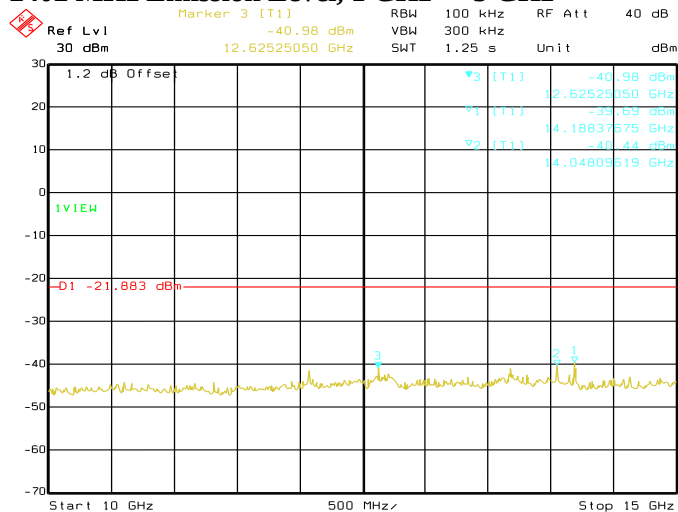
Date: 11.SEP.2019 08:42:39

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Reference Level



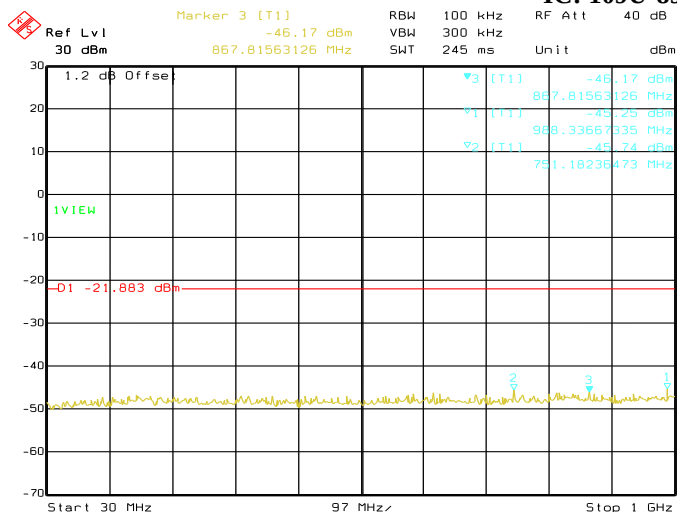
Date: 11.SEP.2019 08:44:27

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 1 GHz -> 5 GHz



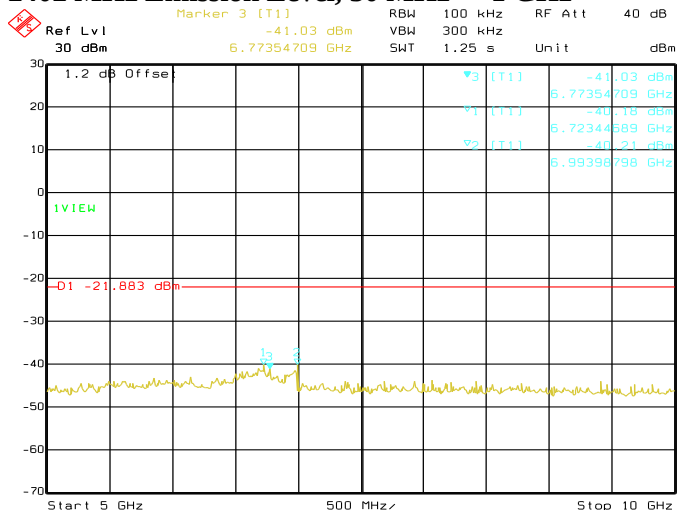
Date: 11.SEP.2019 08:46:15

Conducted Emissions. Bluetooth LE, Frequency 2402 Emission Level, 10 GHz -> 15 GHz



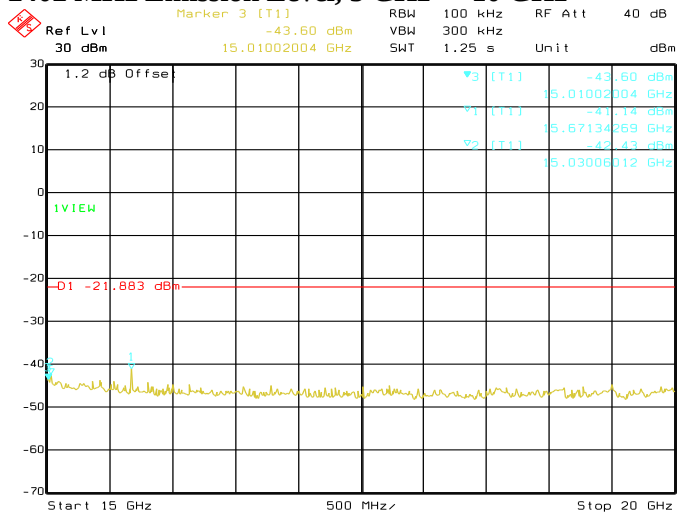
Date: 11.SEP.2019 08:43:33

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 30 MHz -> 1 GHz



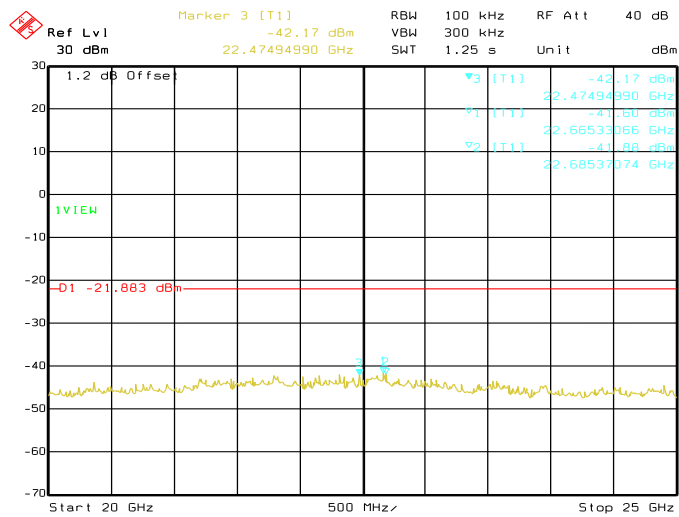
Date: 11.SEP.2019 08:45:21

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 5 GHz -> 10 GHz



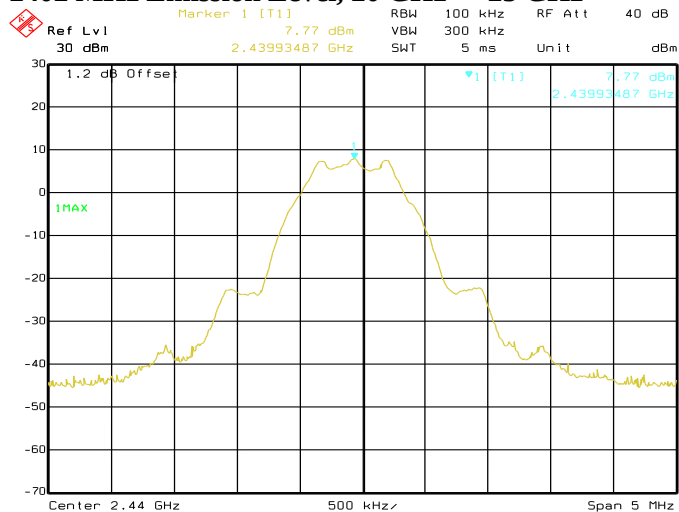
Date: 11.SEP.2019 08:47:08

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 15 GHz -> 20 GHz



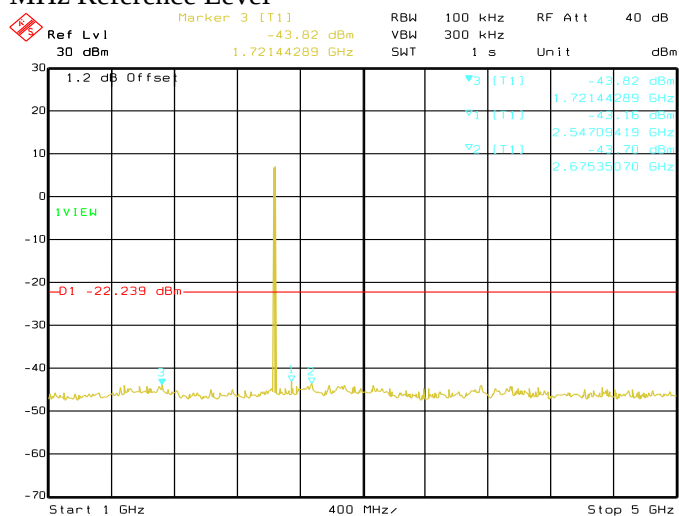
Date: 11.SEP.2019 08:48:01

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 20 GHz -> 25 GHz



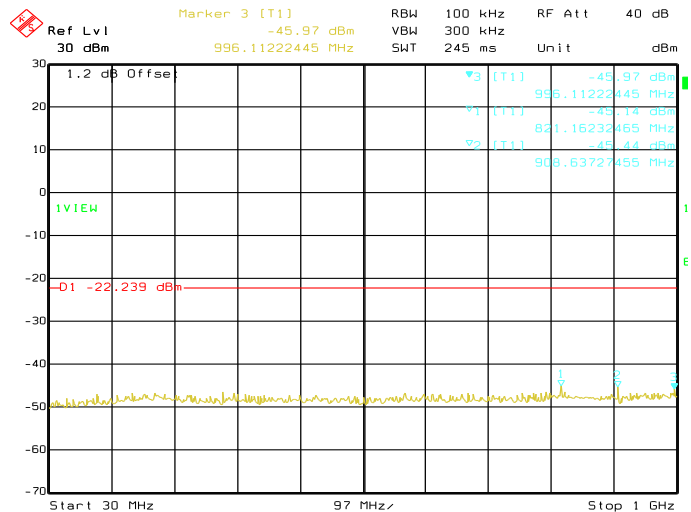
Date: 11.SEP.2019 08:50:05

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Reference Level



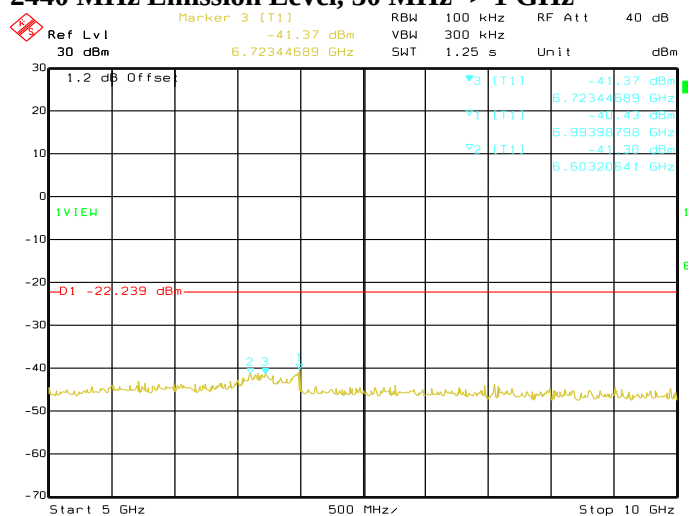
Date: 11.SEP.2019 08:51:53

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 1 GHz -> 5 GHz



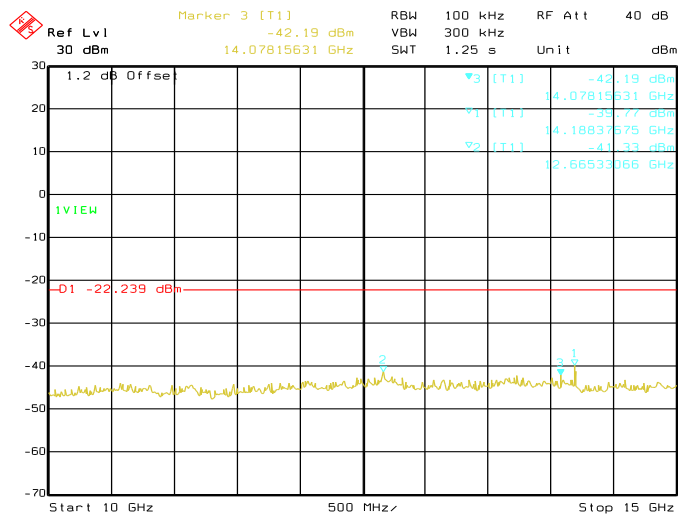
Date: 11.SEP.2019 08:50:59

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 30 MHz -> 1 GHz



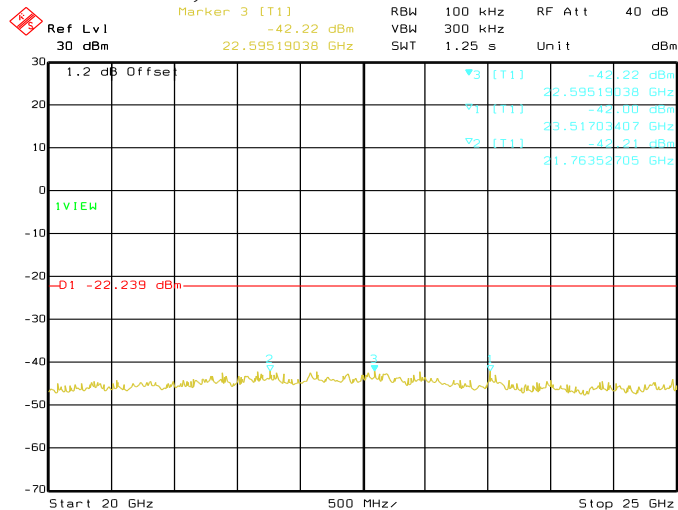
Date: 11.SEP.2019 08:52:46

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 5 GHz -> 10 GHz



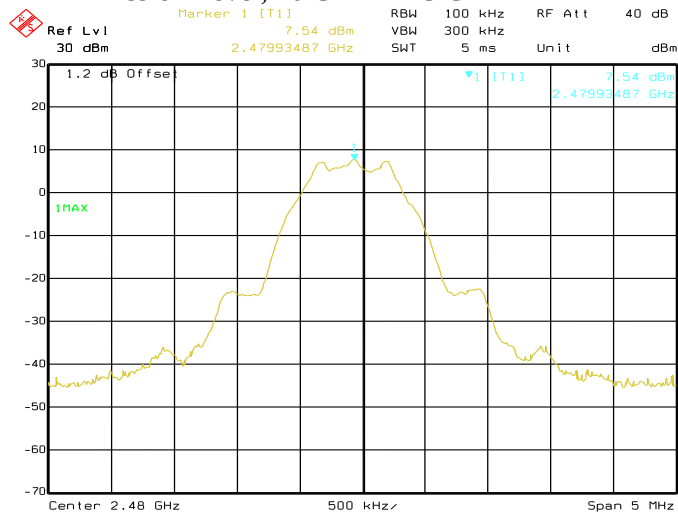
Date: 11.SEP.2019 08:53:40

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 10 GHz -> 15 GHz



Date: 11.SEP.2019 08:55:27

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 20 GHz -> 25 GHz



Date: 11.SEP.2019 08:58:22

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Reference Level



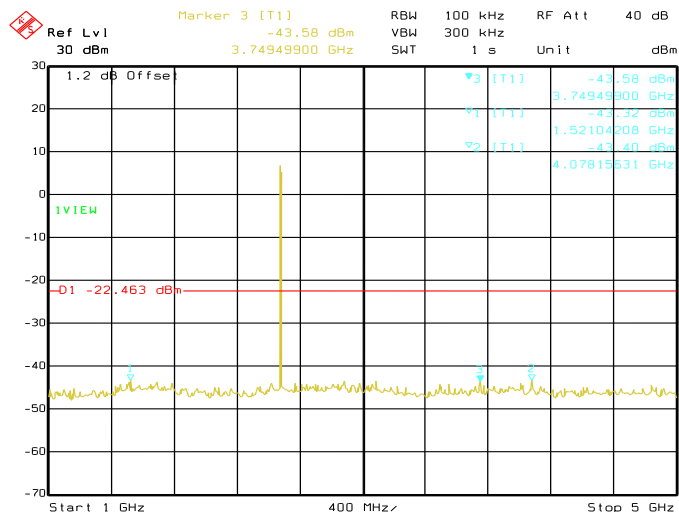
Date: 11.SEP.2019 08:59:16

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 30 MHz -> 1 GHz



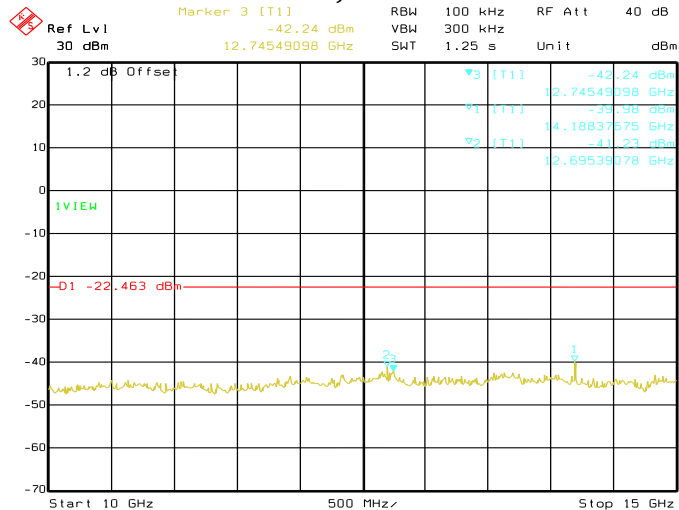
Date: 11.SEP.2019 08:59:16

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 30 MHz -> 1 GHz



Date: 11.SEP.2019 09:00:10

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 1 GHz -> 5 GHz

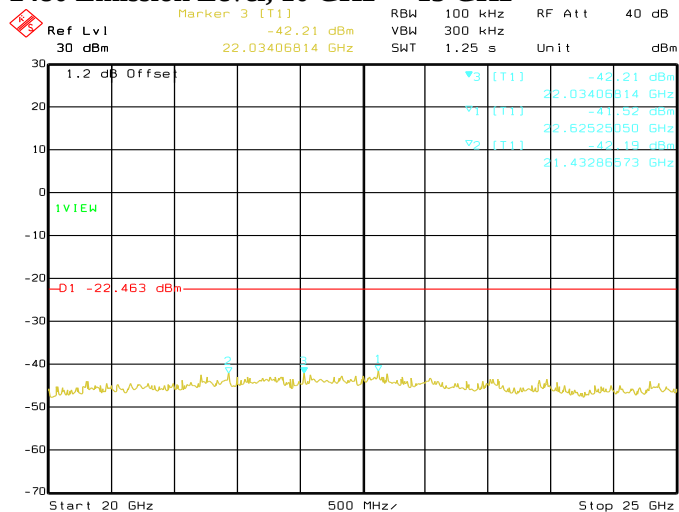


Date: 11.SEP.2019 09:01:04

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 5 GHz -> 10 GHz

Date: 11.SEP.2019 09:01:56

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 10 GHz -> 15 GHz



Date: 11.SEP.2019 09:02:50

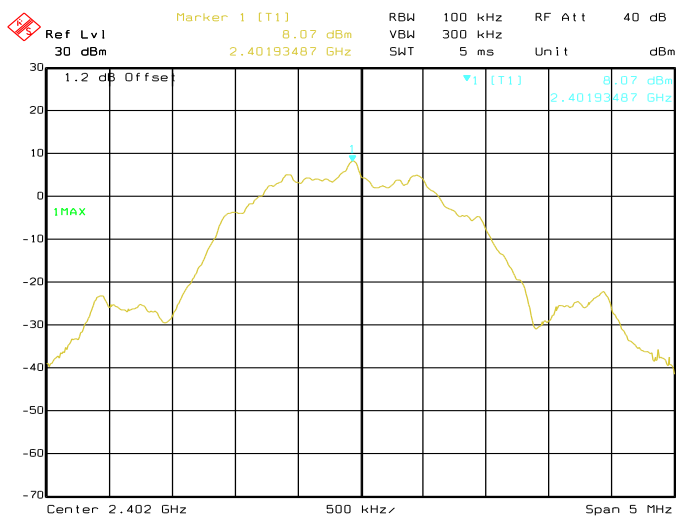
Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 15 GHz -> 20 GHz

Date: 11.SEP.2019 09:03:43

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 20 GHz -> 25 GHz

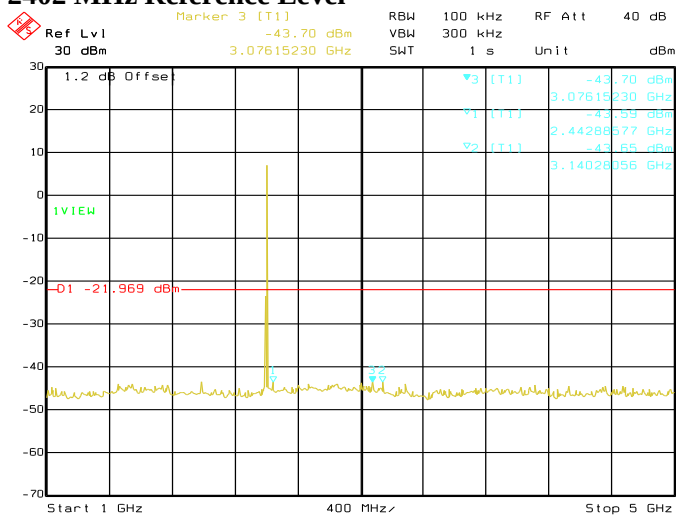
BTLE 2M

Test Conditions			Test Frequency	Results	
Standard	Modulation Type	Tx (MHz)	Spurs (MHz)	Level (dBm)	Status
Bluetooth L.E.	GFSK	2402	6983.97	-39.12	Pass
			14188.38	-39.56	Pass
			6713.43	-40.04	Pass
Bluetooth L.E.	GFSK	2440	14188.38	-39.41	Pass
			6993.99	-40.60	Pass
			6723.45	-40.96	Pass
Bluetooth L.E.	GFSK	2480	14188.38	-39.24	Pass
			6573.15	-40.63	Pass
			6933.87	-40.87	Pass



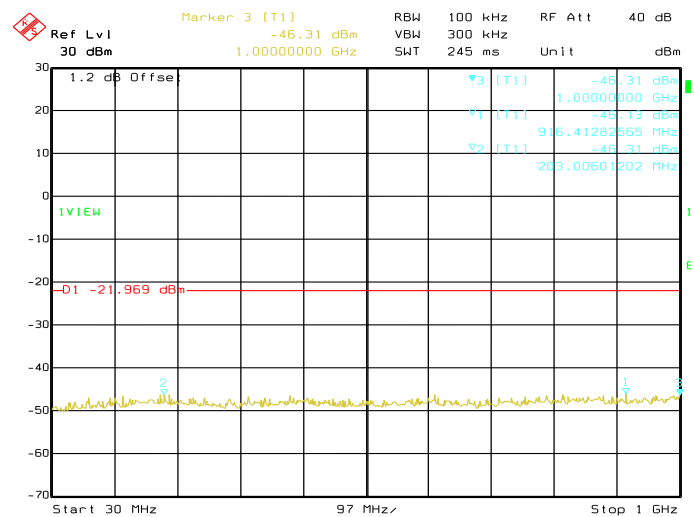
Date: 18.SEP.2019 01:42:12

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Reference Level



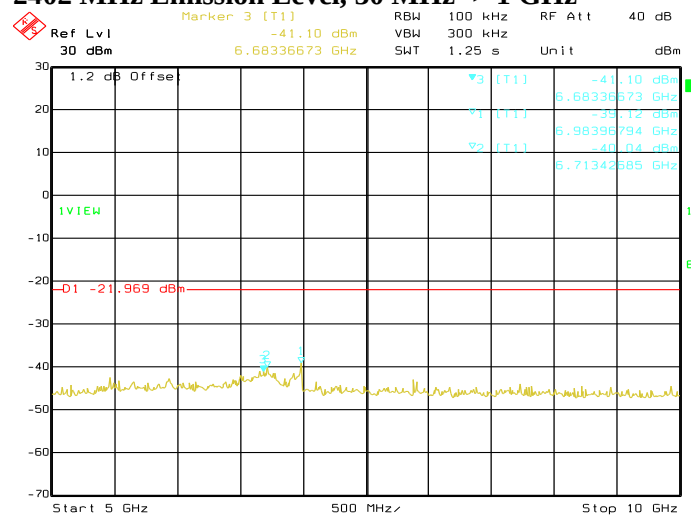
Date: 18.SEP.2019 01:44:00

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 1 GHz -> 5 GHz



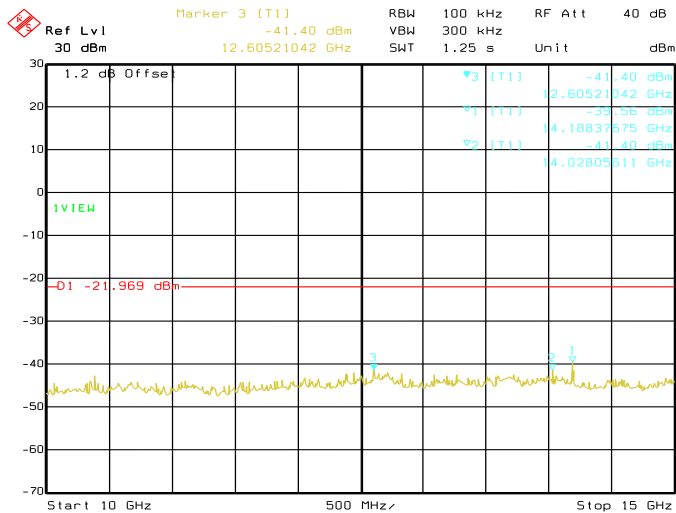
Date: 18.SEP.2019 01:43:06

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 30 MHz -> 1 GHz



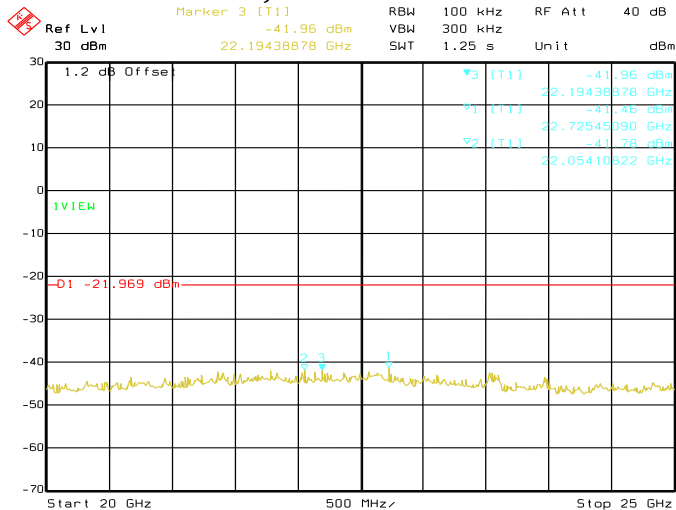
Date: 18.SEP.2019 01:44:53

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 5 GHz -> 10 GHz



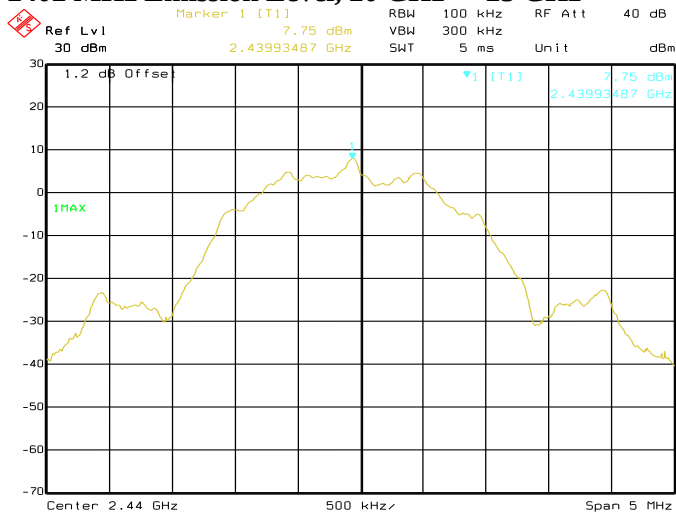
Date: 18.SEP.2019 01:45:47

Conducted Emissions. Bluetooth LE, Frequency 2402 Emission Level, 10 GHz -> 15 GHz



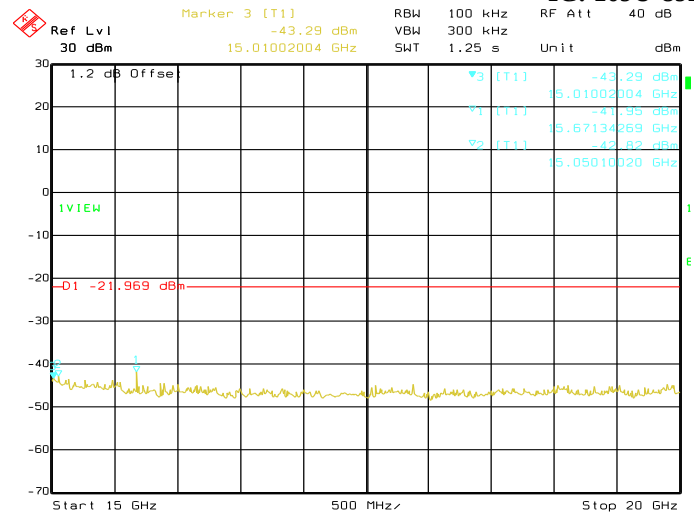
Date: 18.SEP.2019 01:47:33

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 20 GHz -> 25 GHz



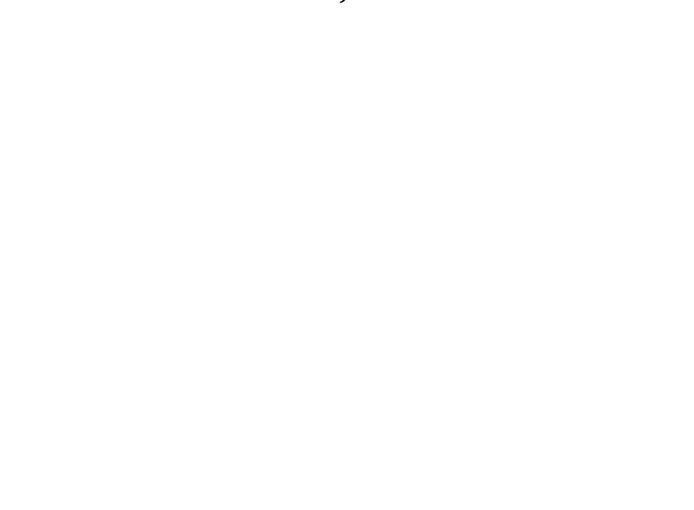
Date: 18.SEP.2019 01:52:56

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Reference Level



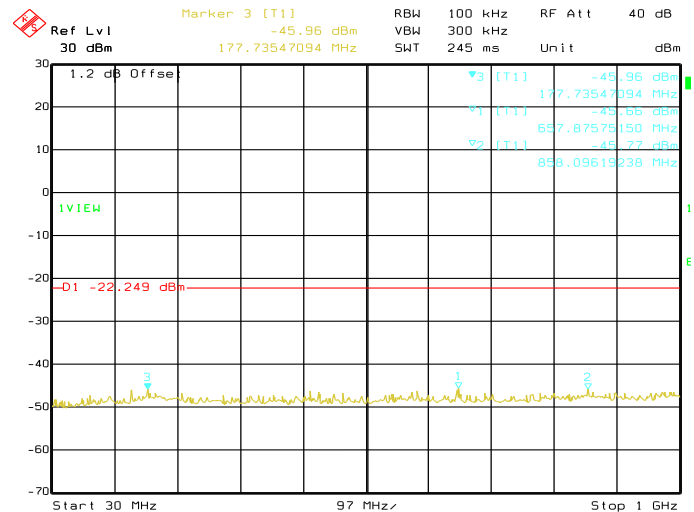
Date: 18.SEP.2019 01:46:40

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 15 GHz -> 20 GHz



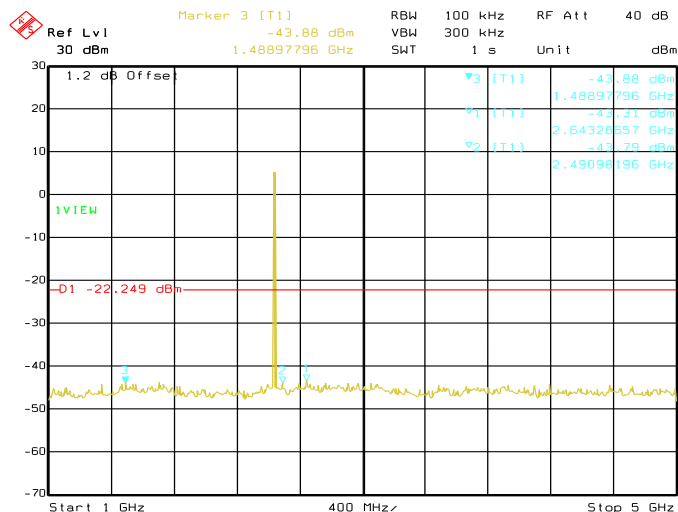
Date: 18.SEP.2019 01:47:33

Conducted Emissions. Bluetooth LE, Frequency 2402 MHz Emission Level, 20 GHz -> 25 GHz



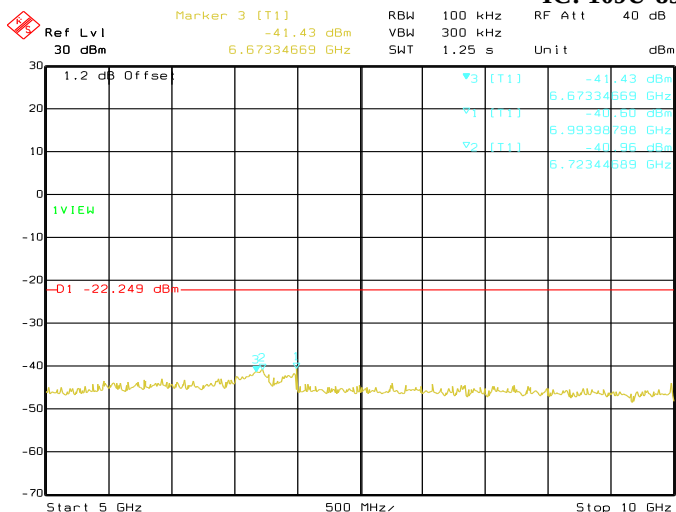
Date: 18.SEP.2019 01:53:49

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 30 MHz -> 1 GHz



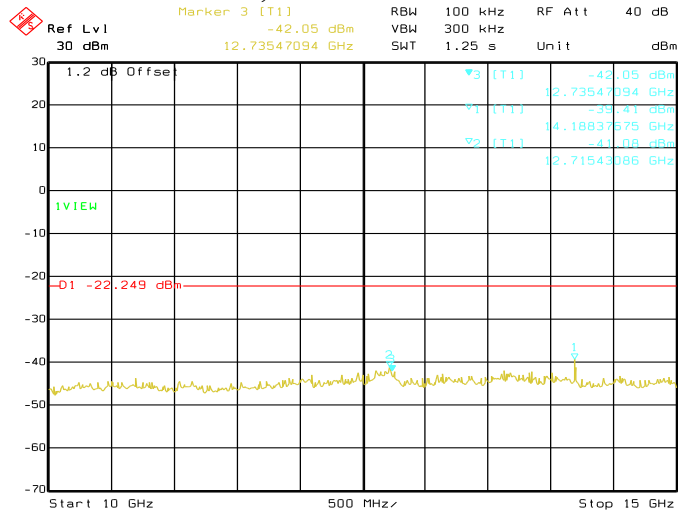
Date: 18.SEP.2019 01:54:44

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 1 GHz -> 5 GHz



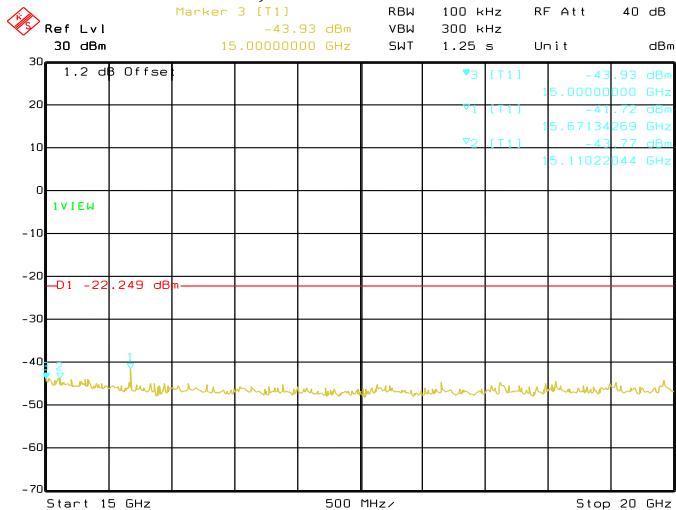
Date: 18.SEP.2019 01:55:37

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 5 GHz -> 10 GHz



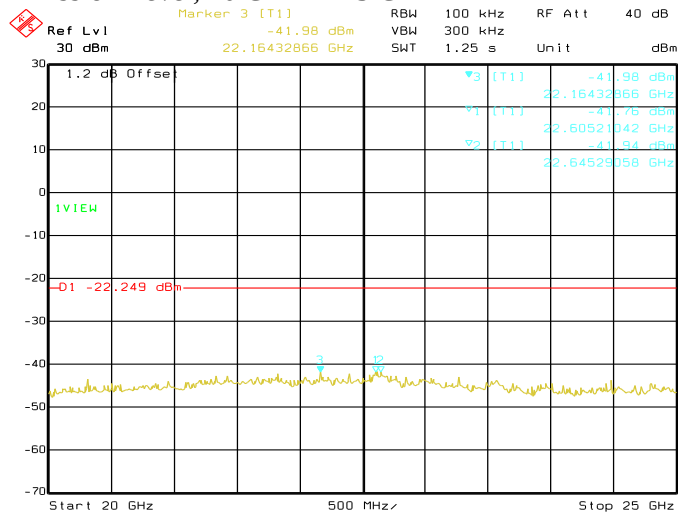
Date: 18.SEP.2019 01:56:30

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 10 GHz -> 15 GHz



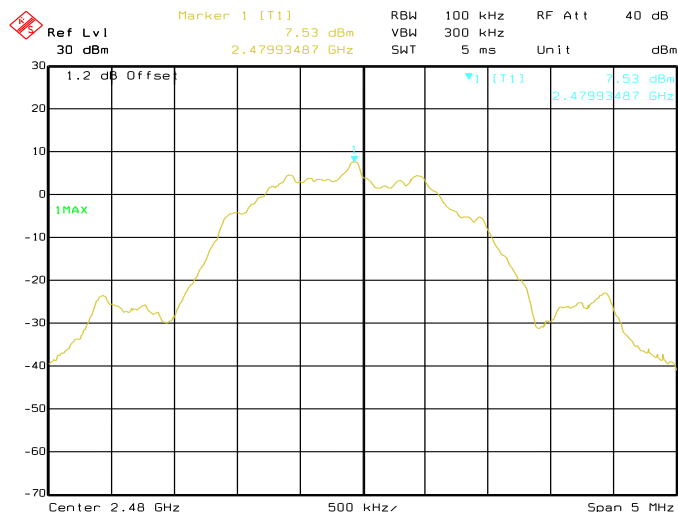
Date: 18.SEP.2019 01:57:24

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 15 GHz -> 20 GHz



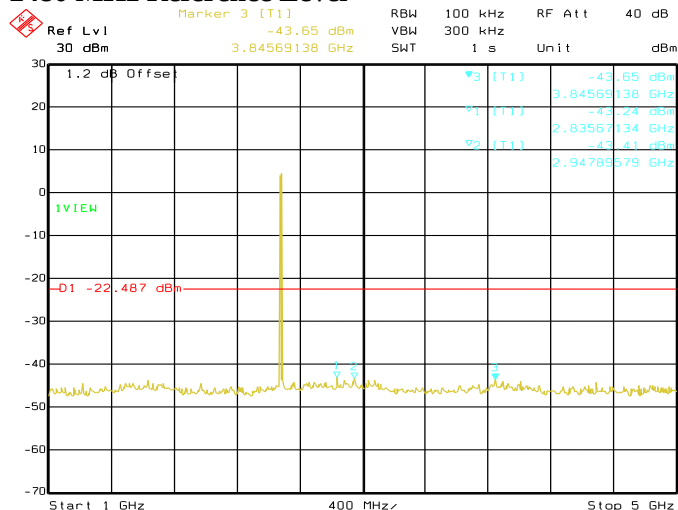
Date: 18.SEP.2019 01:58:17

Conducted Emissions. Bluetooth LE, Frequency 2440 MHz Emission Level, 20 GHz -> 25 GHz



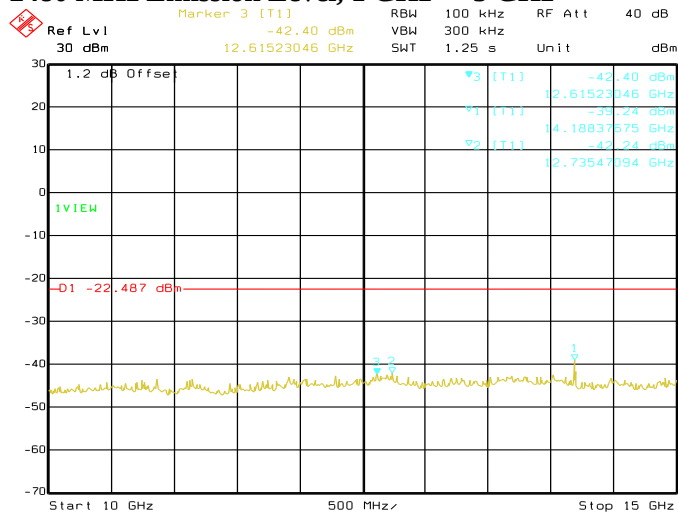
Date: 18.SEP.2019 02:02:41

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Reference Level



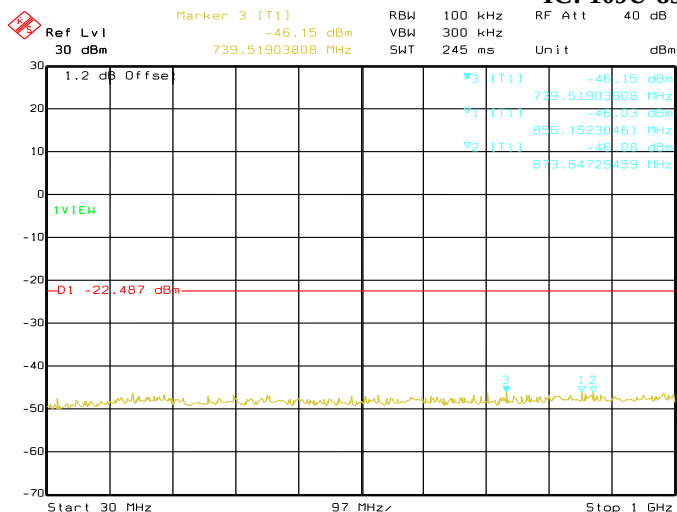
Date: 18.SEP.2019 02:04:29

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 1 GHz -> 5 GHz



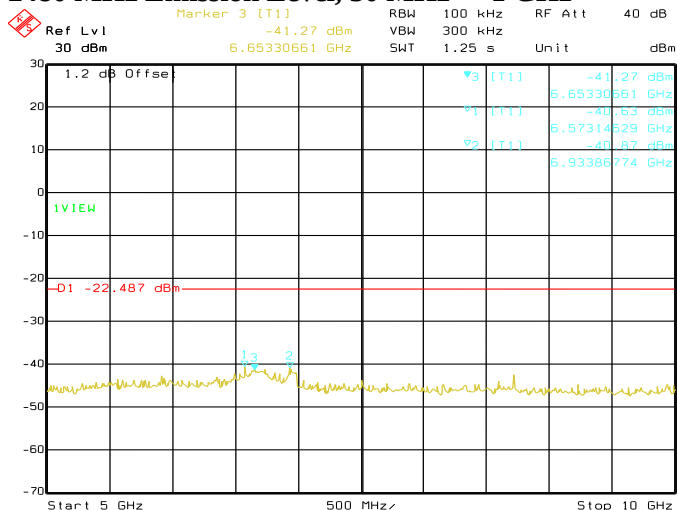
Date: 18.SEP.2019 02:06:16

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 10 GHz -> 15 GHz



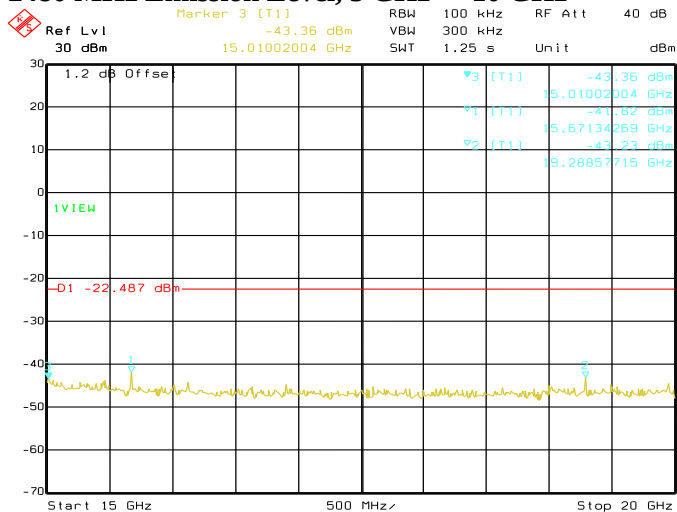
Date: 18.SEP.2019 02:03:35

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 30 MHz -> 1 GHz



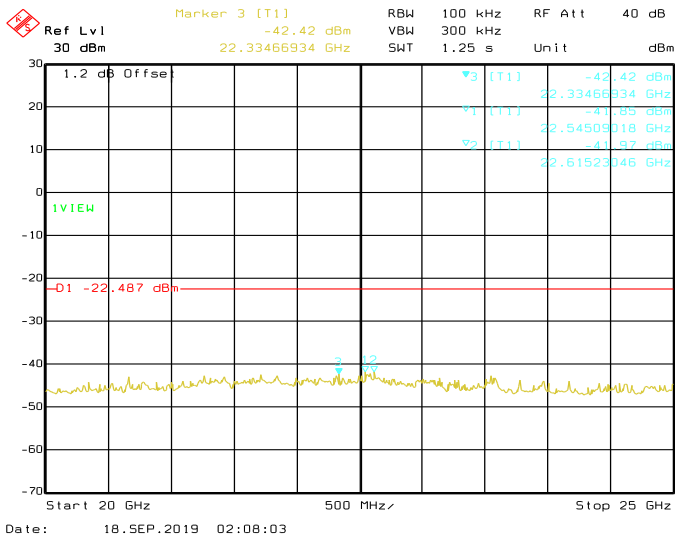
Date: 18.SEP.2019 02:05:22

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 5 GHz -> 10 GHz



Date: 18.SEP.2019 02:07:09

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 15 GHz -> 20 GHz

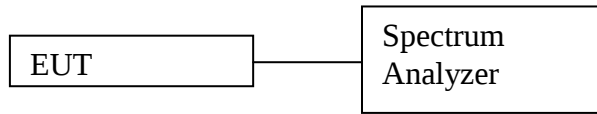


Date: 18.SEP.2019 02:08:03

Conducted Emissions. Bluetooth LE, Frequency 2480 MHz Emission Level, 20 GHz -> 25 GHz

6.5 Band edge Conducted Spurious Emission

6.5.1 Test Setup



- a) Check and ensure the spectrum analyzer well calibrate.
- b) Turn on the DUT and set DUT to transmit maximum power.
- c) Connect DUT'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. Detector mode = Peak
 - d. Trace = Max Hold
 - e. Sweep = auto
- e) Use the peak marker function to measure highest emission.

6.5.2 Test Limits:

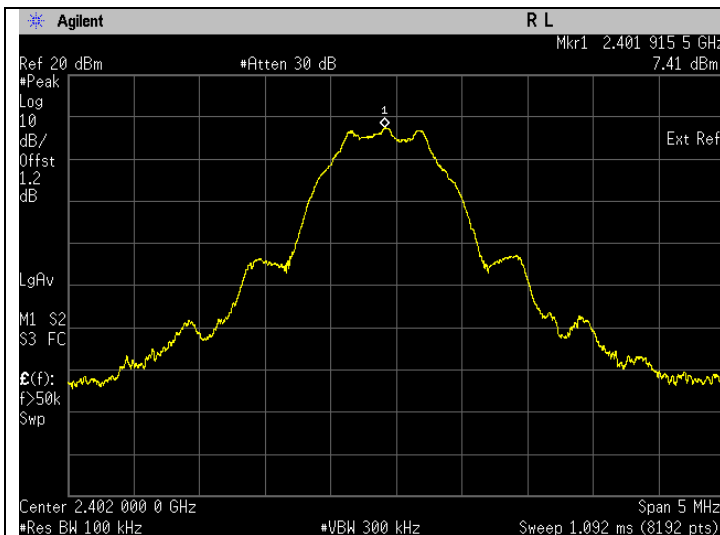
Normal Condition (25 ° C)

Shall be at least 30 dB below peak (max) power.

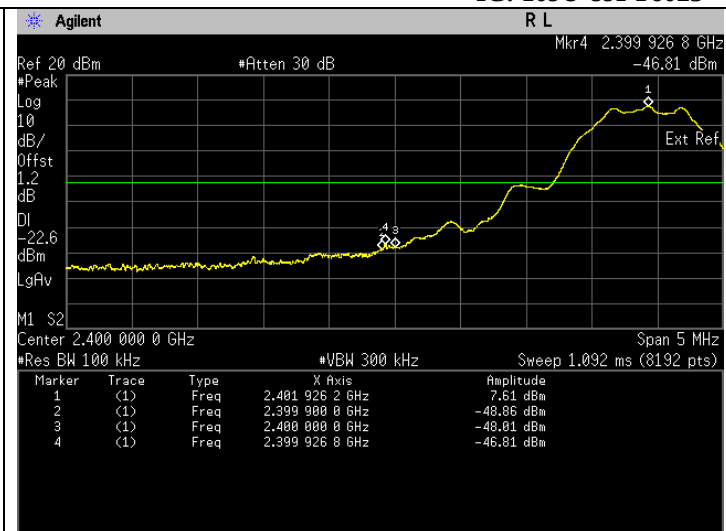
6.5.3 Test Result

BTLE 1M

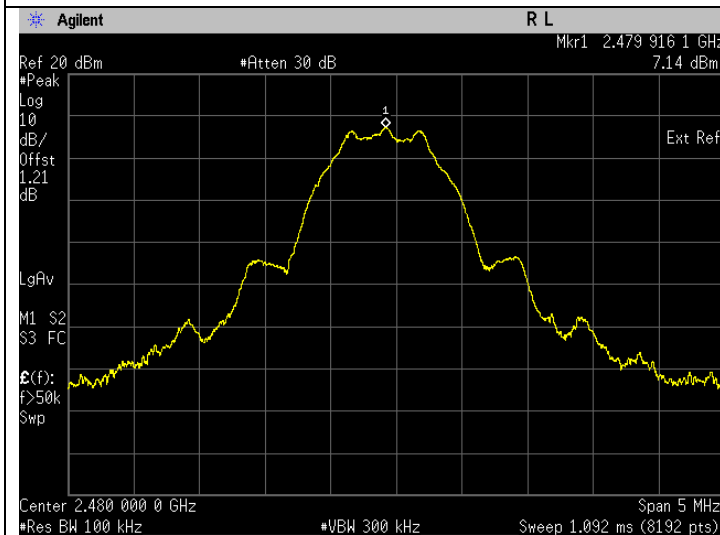
Test Conditions		Test Frequency	Results		
Standard	Modulation Type	Tx (MHz)	Frequencies (MHz)	Power (dBm)	Status
Bluetooth L.E	GFSK	2402	2399.93	-46.81	Pass
Bluetooth L.E	GFSK	2480	2483.52	-53.93	Pass



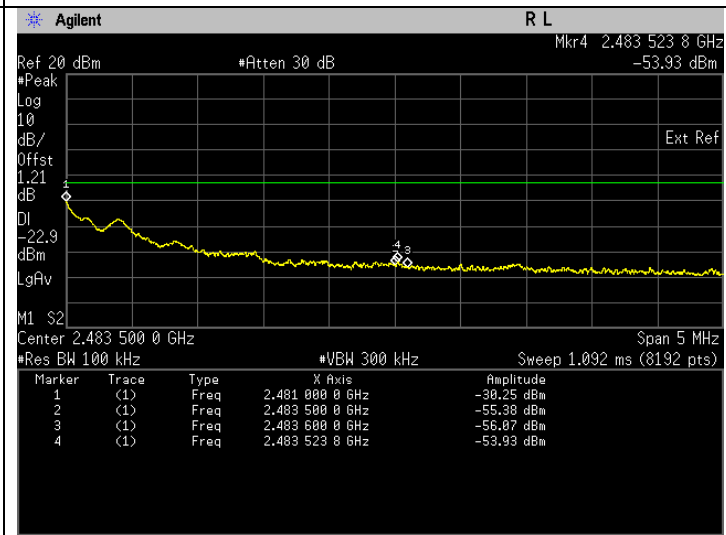
Band Edge. Bluetooth LE Frequency 2402 MHz Reference Level



Band Edge. Bluetooth LE Frequency 2402 MHz Band Edge



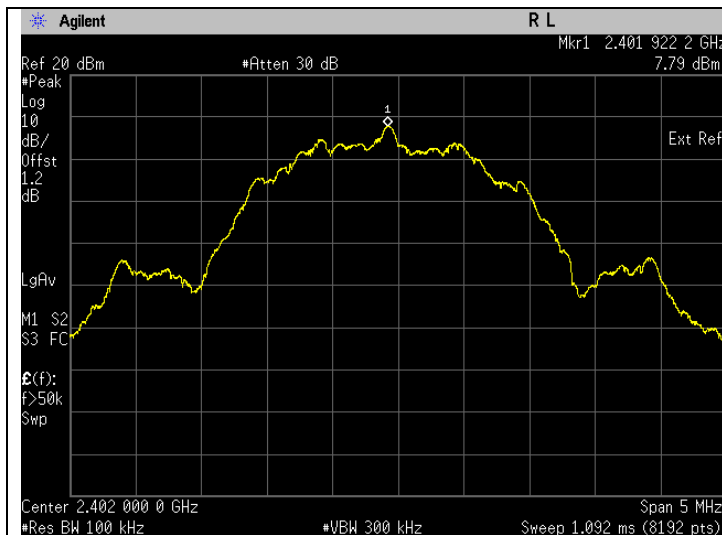
Band Edge. Bluetooth LE Frequency 2480 MHz Reference Level



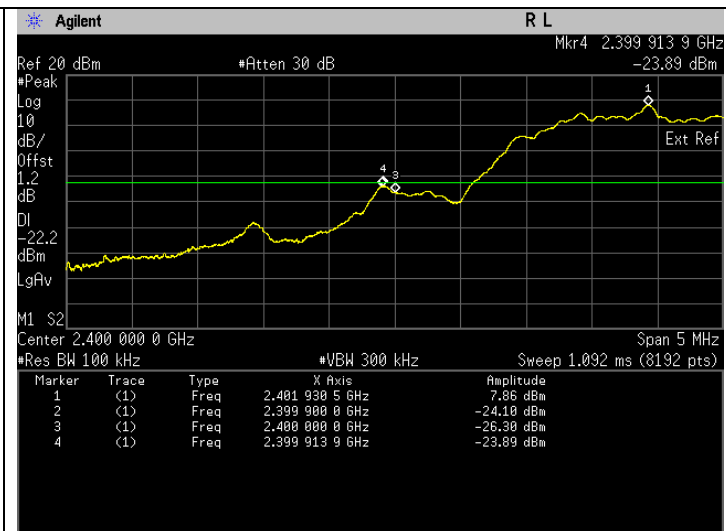
Band Edge. Bluetooth LE Frequency 2480 MHz Band Edge

BTLE 2M

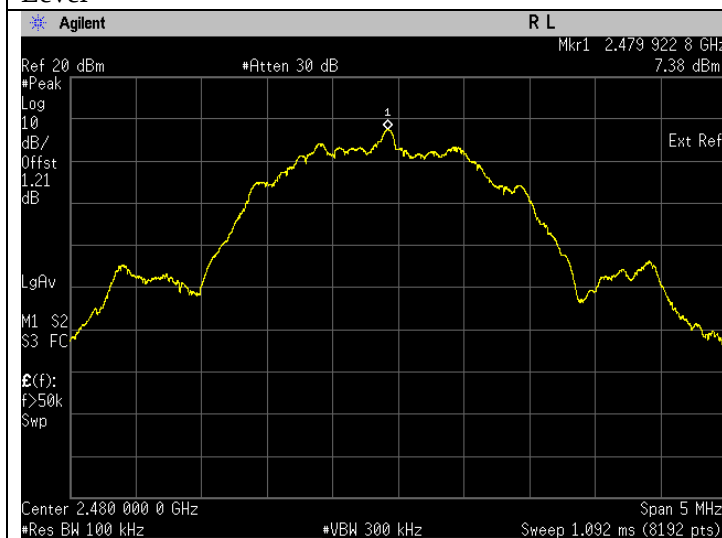
Test Conditions		Test Frequency	Results		
Standard	Modulation Type	Tx (MHz)	Frequencies (MHz)	Power (dBm)	Status
Bluetooth L.E	GFSK	2402	2399.91	-23.89	Pass
Bluetooth L.E	GFSK	2480	2483.55	-51.80	Pass



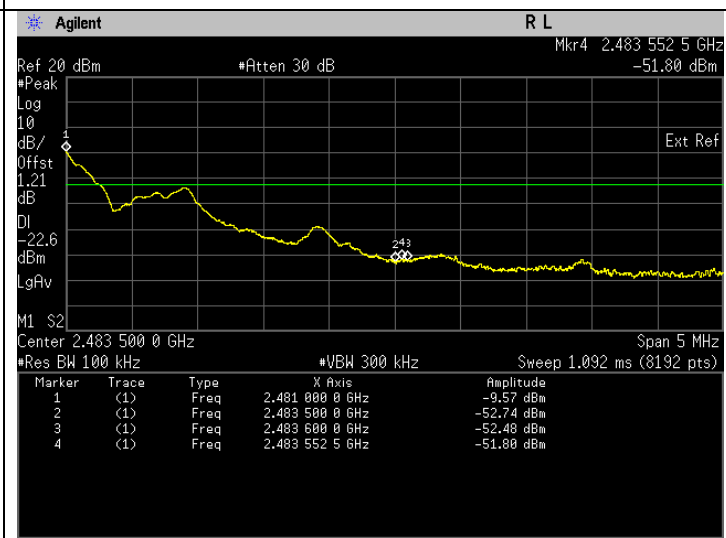
Band Edge. Bluetooth LE Frequency 2402 MHz Reference Level



Band Edge. Bluetooth LE Frequency 2402 MHz Band Edge



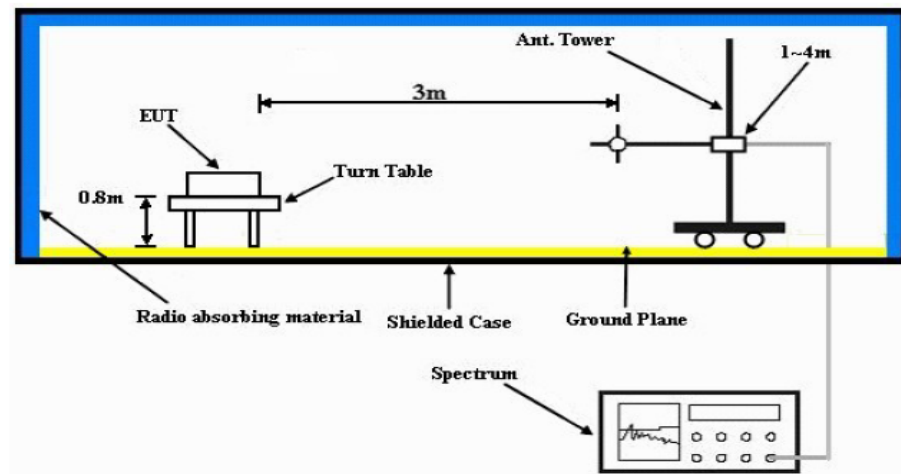
Band Edge. Bluetooth LE Frequency 2480 MHz Reference Level



Band Edge. Bluetooth LE Frequency 2480 MHz Band Edge

6.6 Radiated Emission within Restricted Bands

6.6.1 Test Setup



- The EUT is placed on the top of a rotating table 0.8m (frequency < 1GHz) or 1.5m (frequency > 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.

6.6.2 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:

- 1) The lower limit shall apply at the transition frequencies.
- 2) Emission level (dBuV/m) = 20 log Emission level (uV/m).
- 3) 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.

6.6.3 Test Results:

BTLE 1M

Test: Bluetooth SAC Restricted Band Edge
Model#: PMMN4127A S/N: CAB19NCA00YZ EMC SR ID#: 18020-EMC-00007
Battery: NA Accessory: CB000756A01, 8397-PS000150A31-1
Test Channel: Low Test Frequency: 2402.0000 MHz Test Standard: ANSI C63.10-2013
Worst Case Plane: Y-Plane (BT LE)

Restricted Band Edge (Low Channel) tabular data

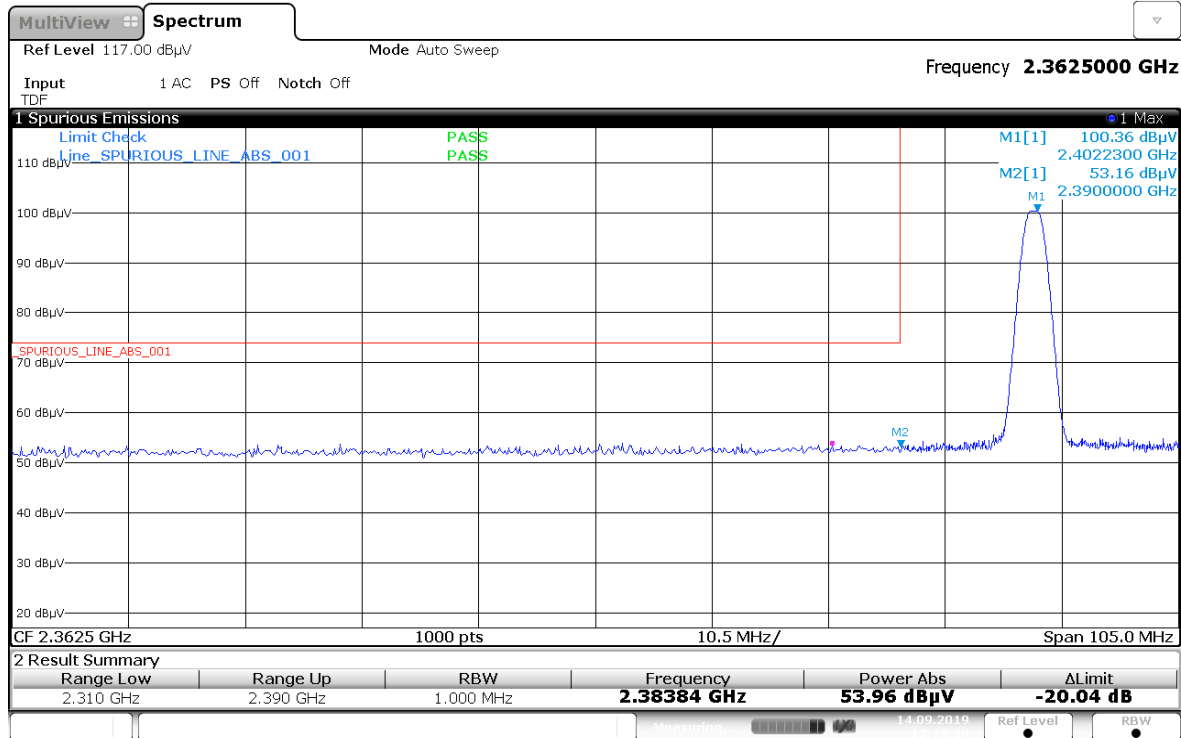
Vertical Radiated Emission Result										
Spur Freq (MHz)	Spur level QPK (dBμV/m)	Spur level PK (dBμV/m)	Spur level AV (dBμV/m)	Limit QPK (dBμV/m)	Limit PK (dBμV/m)	Limit AV (dBμV/m)	Margin QPK (dBμV/m)	Margin PK (dBμV/m)	Margin AV (dBμV/m)	Carrier PK Power (dBμV/m)
2381.6000	-	-	42.0850	-	-	54.0000	-	-	-11.9150	-
2382.8800	-	-	42.0829	-	-	54.0000	-	-	-11.9171	-
2383.2000	-	-	42.1380	-	-	54.0000	-	-	-11.8620	-
2383.8400	-	53.9639	-	-	74.0000	-	-	-20.0361	-	-
2384.0000	-	-	42.1830	-	-	54.0000	-	-	-11.8170	-
2385.2800	-	-	42.1465	-	-	54.0000	-	-	-11.8535	-
2386.0800	-	-	42.1519	-	-	54.0000	-	-	-11.8481	-
2386.4000	-	-	42.1968	-	-	54.0000	-	-	-11.8032	-
2387.8400	-	-	42.1113	-	-	54.0000	-	-	-11.8887	-
2388.4800	-	-	42.2268	-	-	54.0000	-	-	-11.7732	-
2389.4400	-	-	42.3874	-	-	54.0000	-	-	-11.6126	-
2390.0000	-	53.1360	42.2187	-	74.0000	54.0000	-	-20.8640	-11.7813	-
Horizontal Radiated Emission Result										
2370.8800	-	-	42.0393	-	-	54.0000	-	-	-11.9607	-
2371.6800	-	-	42.0983	-	-	54.0000	-	-	-11.9017	-
2375.2000	-	-	42.0236	-	-	54.0000	-	-	-11.9764	-
2379.0400	-	-	42.0490	-	-	54.0000	-	-	-11.9510	-
2381.9200	-	-	42.1154	-	-	54.0000	-	-	-11.8846	-
2382.7200	-	-	42.1619	-	-	54.0000	-	-	-11.8381	-
2383.5200	-	-	42.0937	-	-	54.0000	-	-	-11.9063	-
2383.8400	-	-	42.1287	-	-	54.0000	-	-	-11.8713	-
2385.1200	-	-	42.1708	-	-	54.0000	-	-	-11.8292	-
2387.2000	-	-	42.5006	-	-	54.0000	-	-	-11.4994	-
2388.1600	-	54.9151	-	-	74.0000	-	-	-19.0849	-	-
2390.0000	-	53.6834	42.2626	-	74.0000	54.0000	-	-20.3166	-11.7374	-

Remarks: Pass Result	Marginal Result	Fail Result
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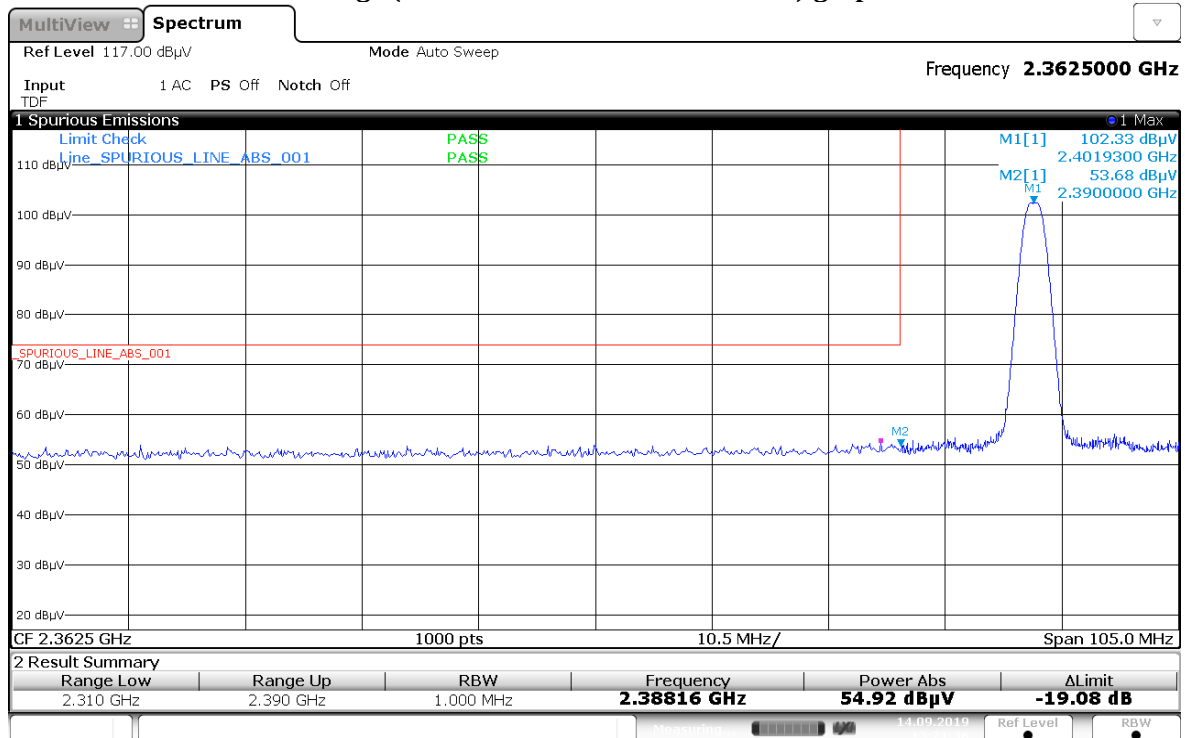
Temperature (degC):23.3
Test Performed by: Qawiman&Nazrin
System MU: 5.01dB

Humidity (%): 70.3
Test Date: Tue, Sep 17, 2019

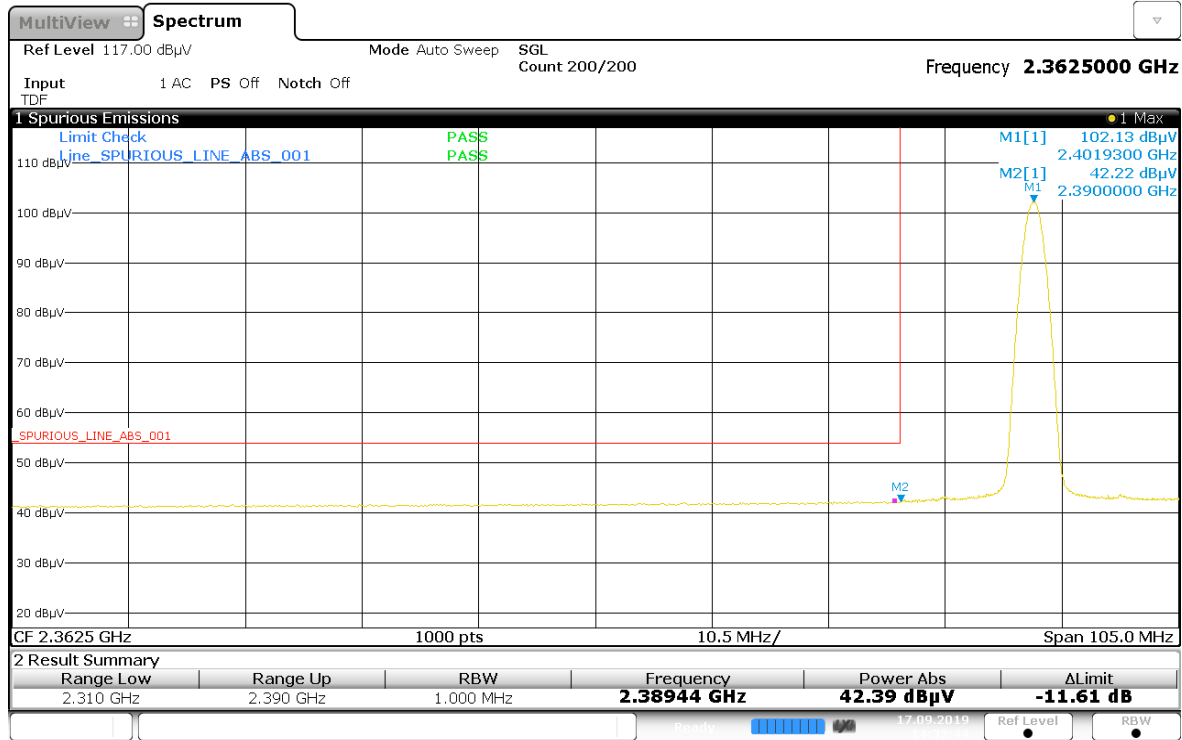
Restricted Band Edge (Low Channel, Vertical, Peak) graphical screen shot



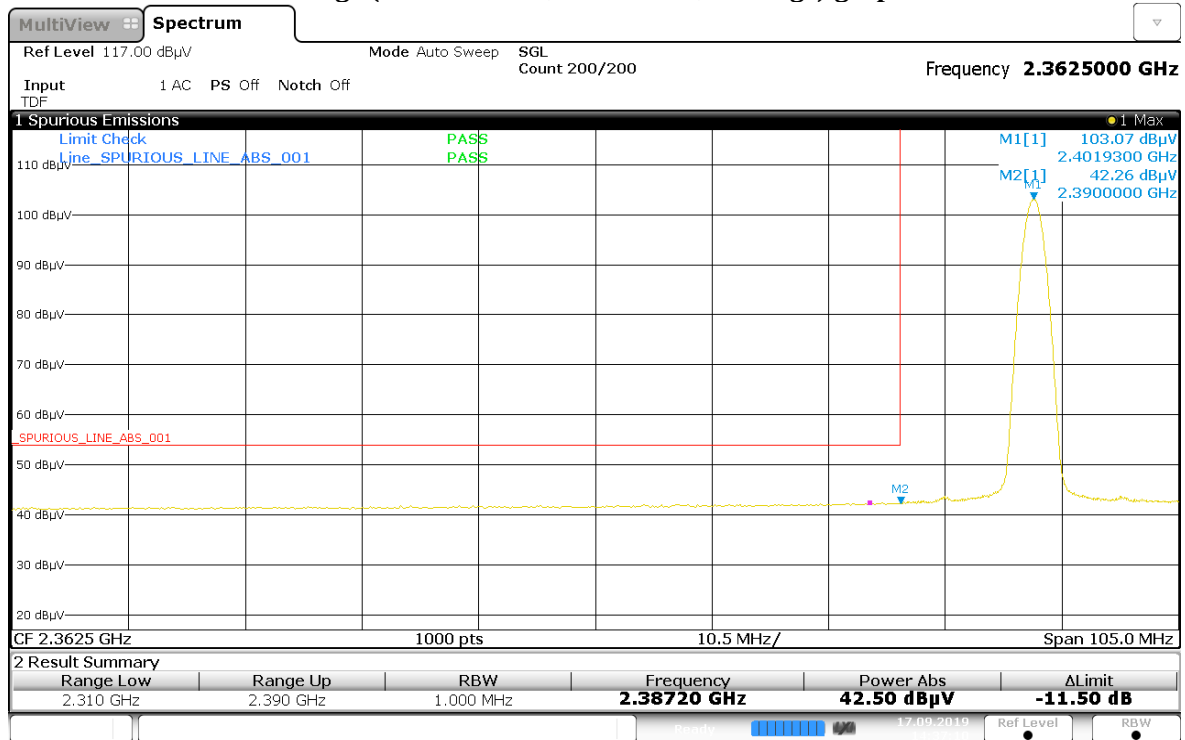
Restricted Band Edge (Low Channel, Horizontal, Peak) graphical screen shot



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



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

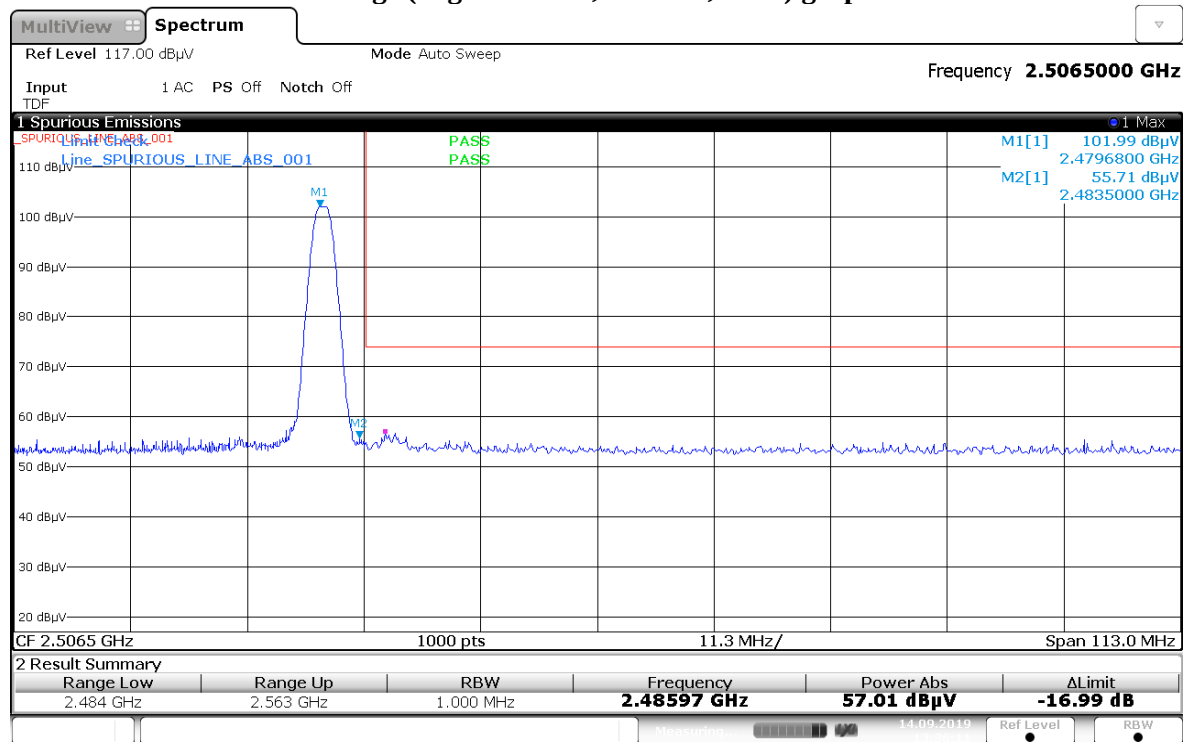


Restricted Band Edge (High Channel) tabular data

Remarks: Pass Result	Marginal Result	Fail Result
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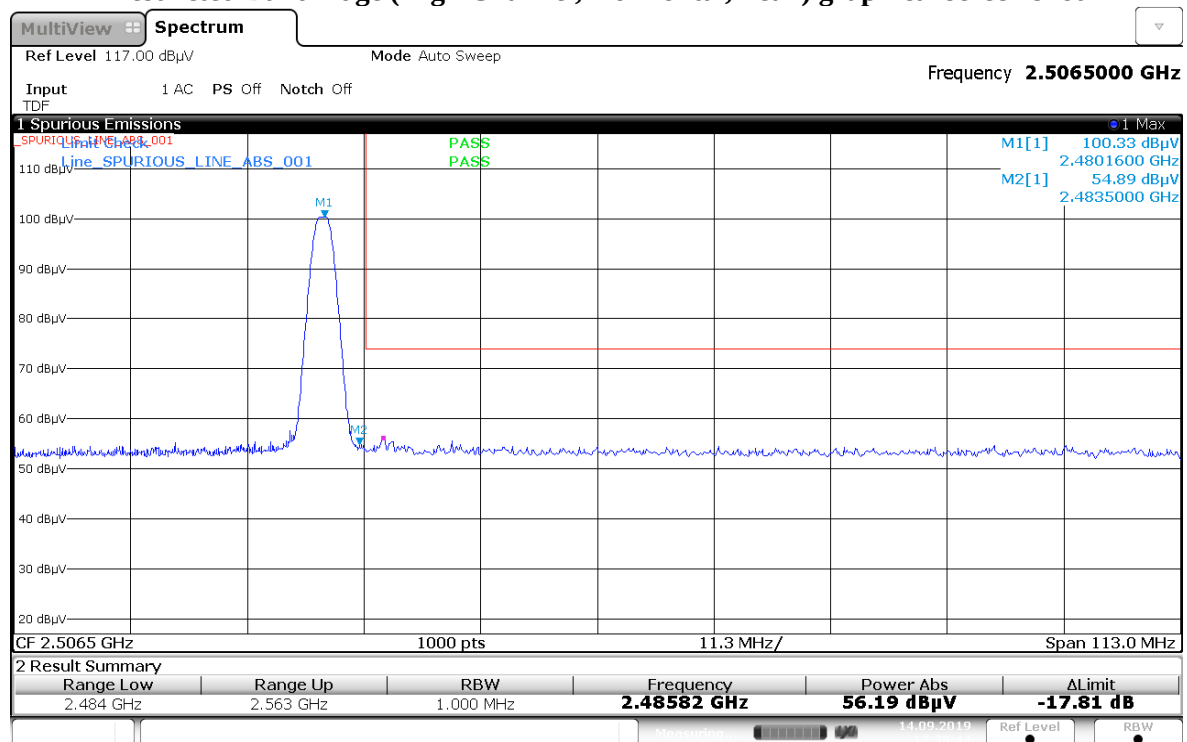
Humidity (%): 70.3
Test Date: Tue, Sep 17, 2019

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



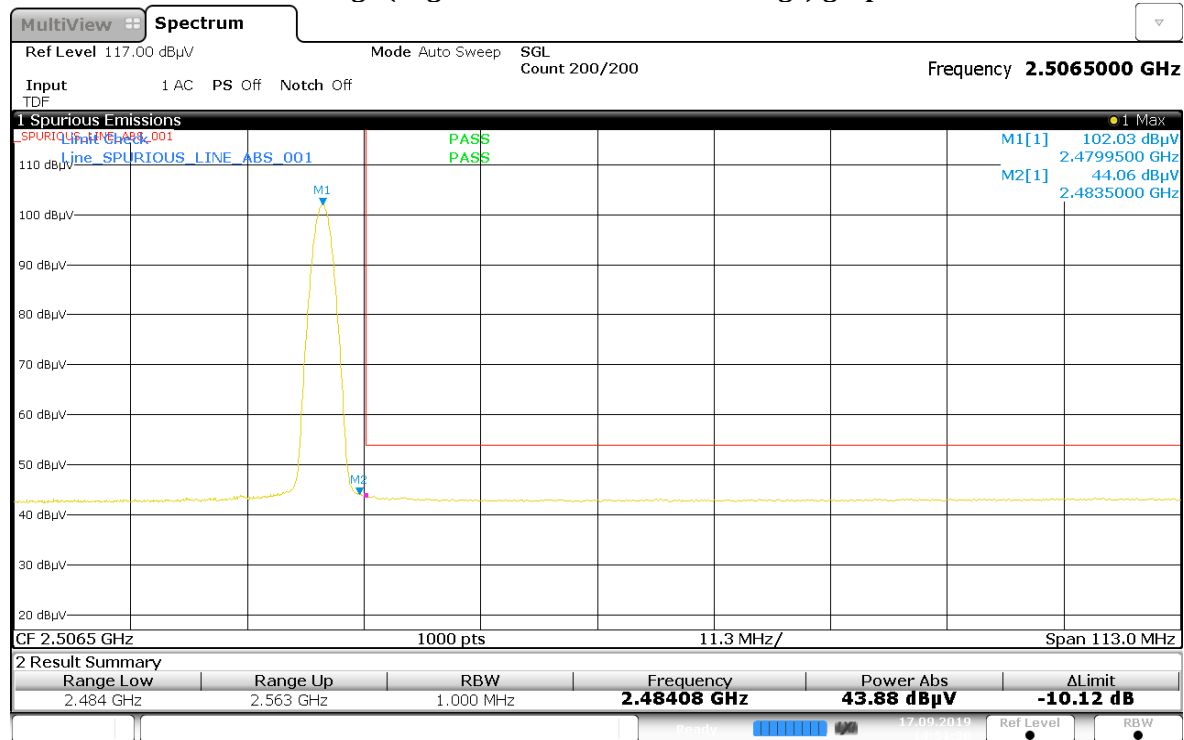
13:36:11 14.09.2019

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

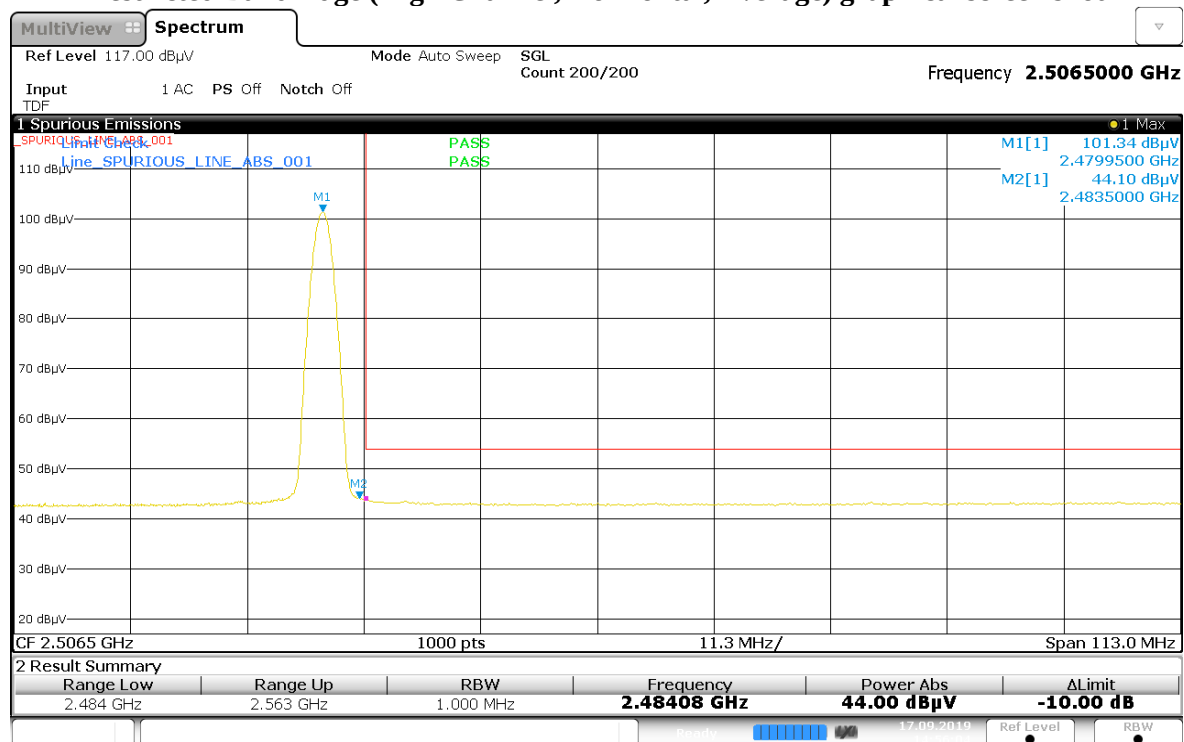


13:39:44 14.09.2019

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



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



BTLE 2M

Test: Bluetooth SAC Restricted Band Edge
Model#: PMMN4127A **S/N: CAB19NCA00YZ** **EMC SR ID#: 18020-EMC-00007**
Battery: NA **Accessory: CB000756A01, 8397-PS000150A31-1**
Test Channel: Low **Test Frequency: 2402.0000 MHz** **Test Standard: ANSI C63.10-2013**
Worst Case Plane: Y-Plane (BT LE)

Restricted Band Edge (Low Channel) tabular data

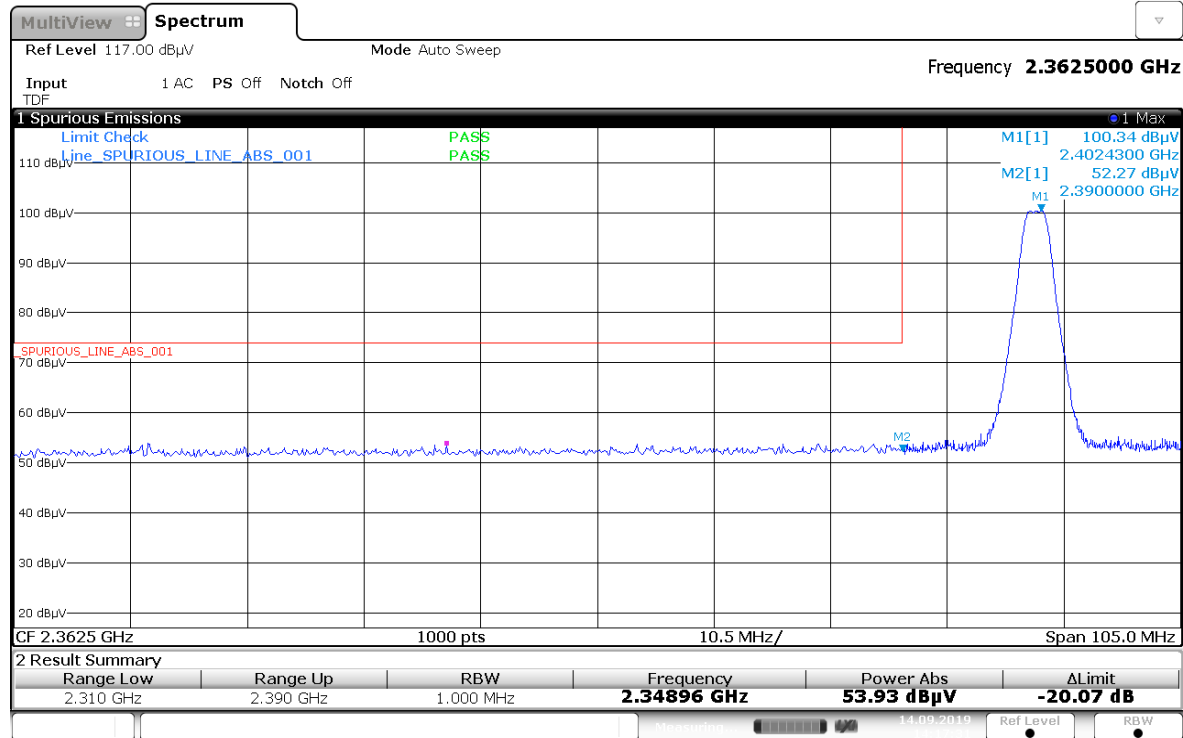
Vertical Radiated Emission Result										
Spur Freq (MHz)	Spur level QPK (dBμV/m)	Spur level PK (dBμV/m)	Spur level AV (dBμV/m)	Limit QPK (dBμV/m)	Limit PK (dBμV/m)	Limit AV (dBμV/m)	Margin QPK (dBμV/m)	Margin PK (dBμV/m)	Margin AV (dBμV/m)	Carrier PK Power (dBμV/m)
2348.9600	-	53.9281	-	-	74.0000	-	-	-20.0719	-	-
2363.3600	-	-	42.1958	-	-	54.0000	-	-	-11.8042	-
2375.2000	-	-	42.3632	-	-	54.0000	-	-	-11.6368	-
2376.4800	-	-	42.3176	-	-	54.0000	-	-	-11.6824	-
2378.7200	-	-	42.5206	-	-	54.0000	-	-	-11.4794	-
2381.7600	-	-	42.2361	-	-	54.0000	-	-	-11.7639	-
2382.2400	-	-	42.4530	-	-	54.0000	-	-	-11.5470	-
2384.1600	-	-	42.4009	-	-	54.0000	-	-	-11.5991	-
2384.6400	-	-	42.4832	-	-	54.0000	-	-	-11.5168	-
2385.2800	-	-	42.2075	-	-	54.0000	-	-	-11.7925	-
2389.7600	-	-	42.7215	-	-	54.0000	-	-	-11.2785	-
2390.0000	-	52.2667	42.4649	-	74.0000	54.0000	-	-21.7333	-11.5351	-
Horizontal Radiated Emission Result										
2370.4000	-	-	42.4759	-	-	54.0000	-	-	-11.5241	-
2375.5200	-	-	42.2782	-	-	54.0000	-	-	-11.7218	-
2376.3200	-	-	42.3023	-	-	54.0000	-	-	-11.6977	-
2377.9200	-	-	42.2390	-	-	54.0000	-	-	-11.7610	-
2378.5600	-	-	42.3895	-	-	54.0000	-	-	-11.6105	-
2380.1600	-	-	42.3481	-	-	54.0000	-	-	-11.6519	-
2381.4400	-	-	42.3328	-	-	54.0000	-	-	-11.6672	-
2382.2400	-	-	42.4055	-	-	54.0000	-	-	-11.5945	-
2382.8800	-	-	42.3621	-	-	54.0000	-	-	-11.6379	-
2387.2000	-	-	42.6279	-	-	54.0000	-	-	-11.3721	-
2387.6800	-	54.7202	-	-	74.0000	-	-	-19.2798	-	-
2390.0000	-	52.8574	42.3891	-	74.0000	54.0000	-	-21.1426	-11.6109	-

Remarks: Pass Result	Marginal Result	Fail Result
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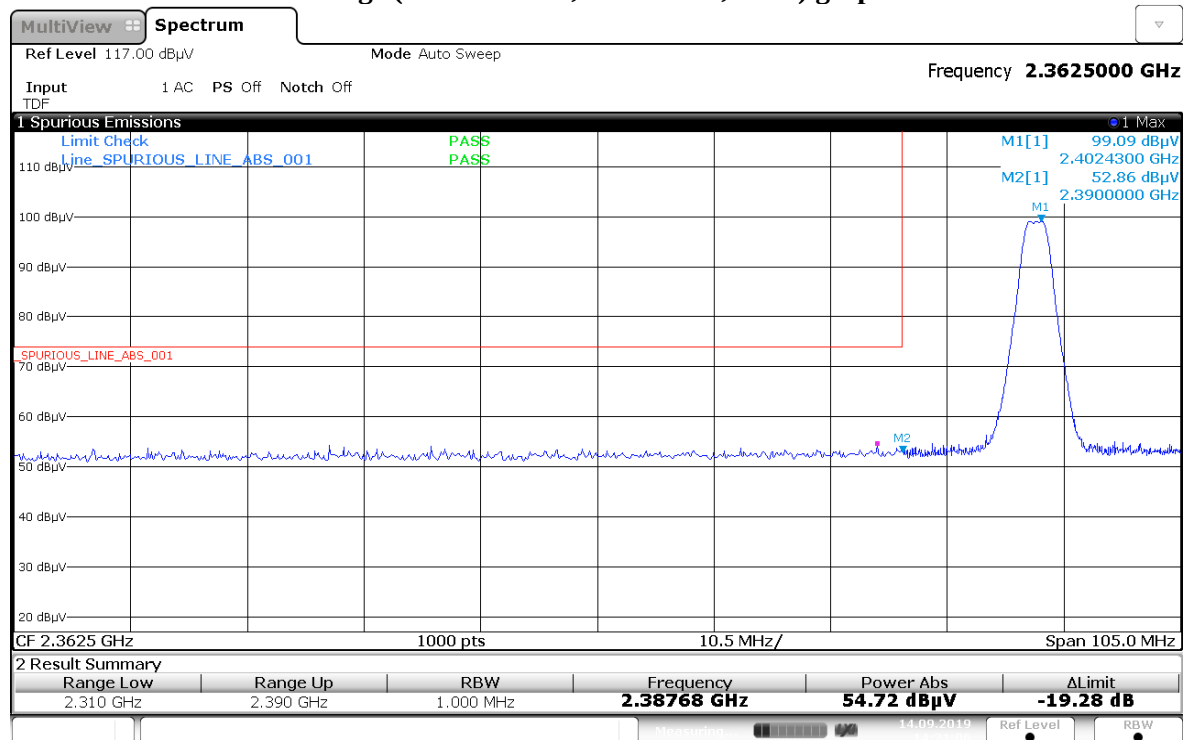
Temperature (degC):23.3
Test Performed by: Qawiman&Nazrin
System MU: 5.01dB

Humidity (%): 70.3
Test Date: Tue, Sep 17, 2019

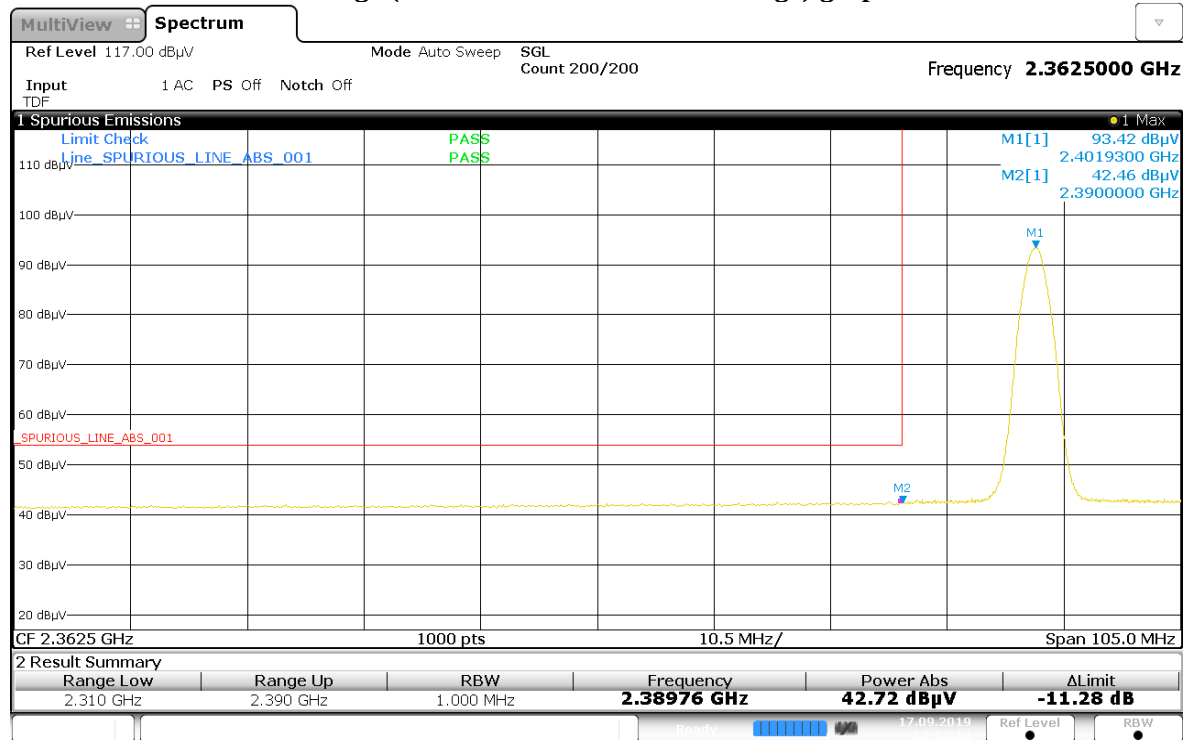
Restricted Band Edge (Low Channel, Vertical, Peak) graphical screen shot



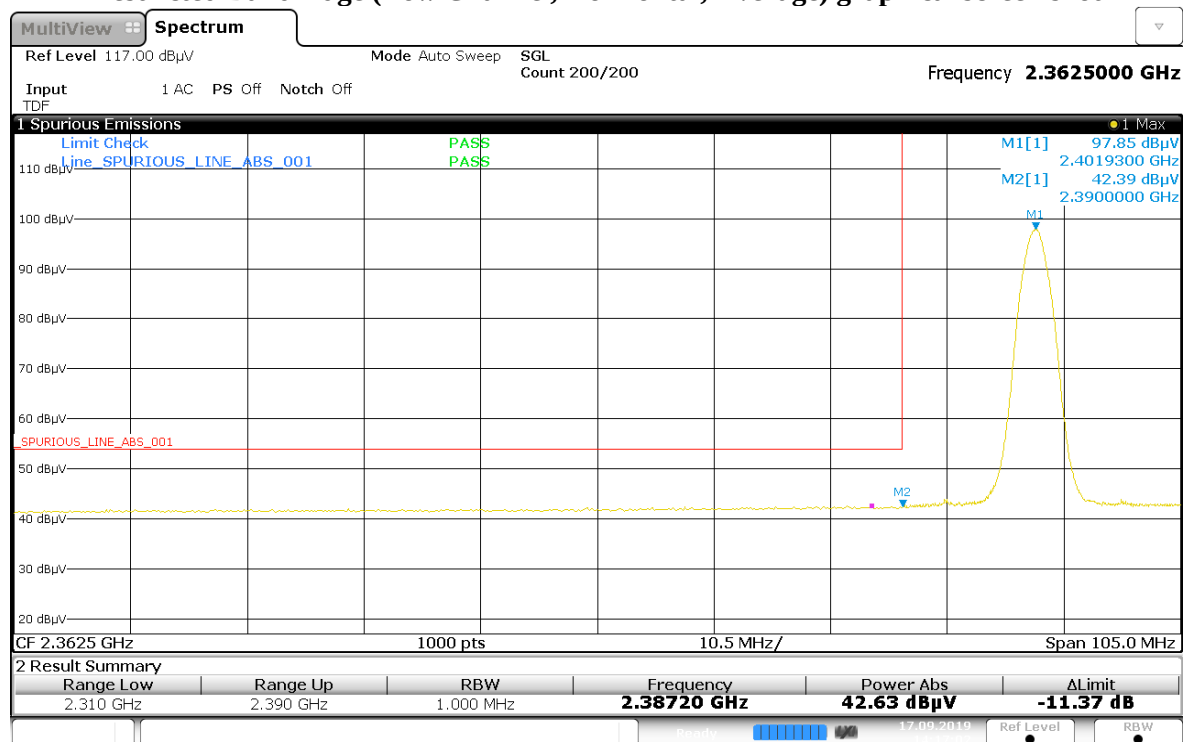
Restricted Band Edge (Low Channel, Horizontal, Peak) graphical screen shot



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



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

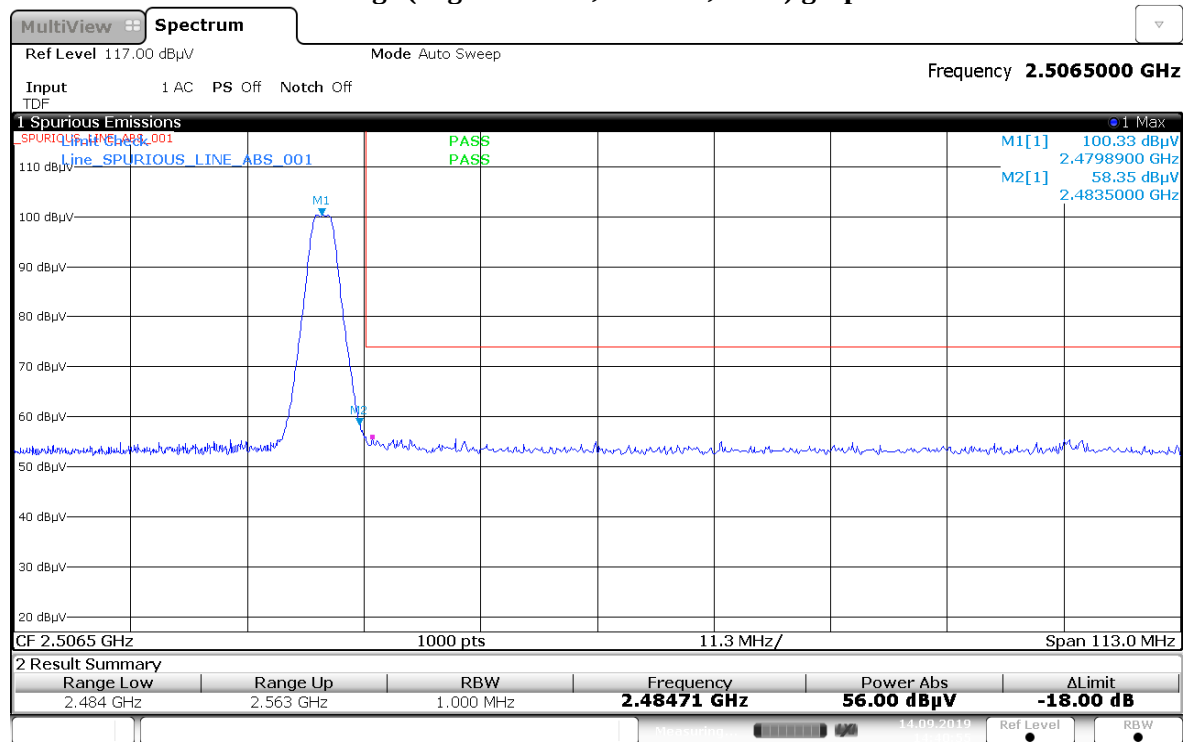


Restricted Band Edge (High Channel) tabular data

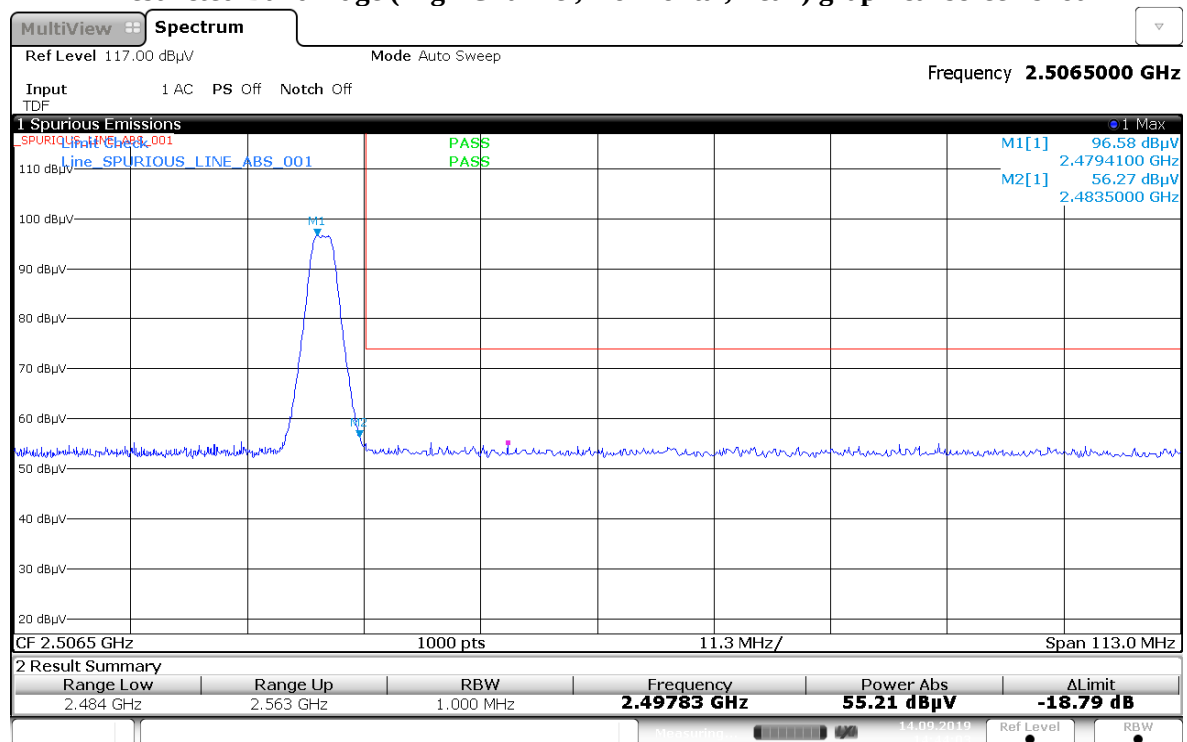
Remarks: Pass Result	Marginal Result	Fail Result
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Humidity (%): 70.3
Test Date: Tue, Sep 17, 2019

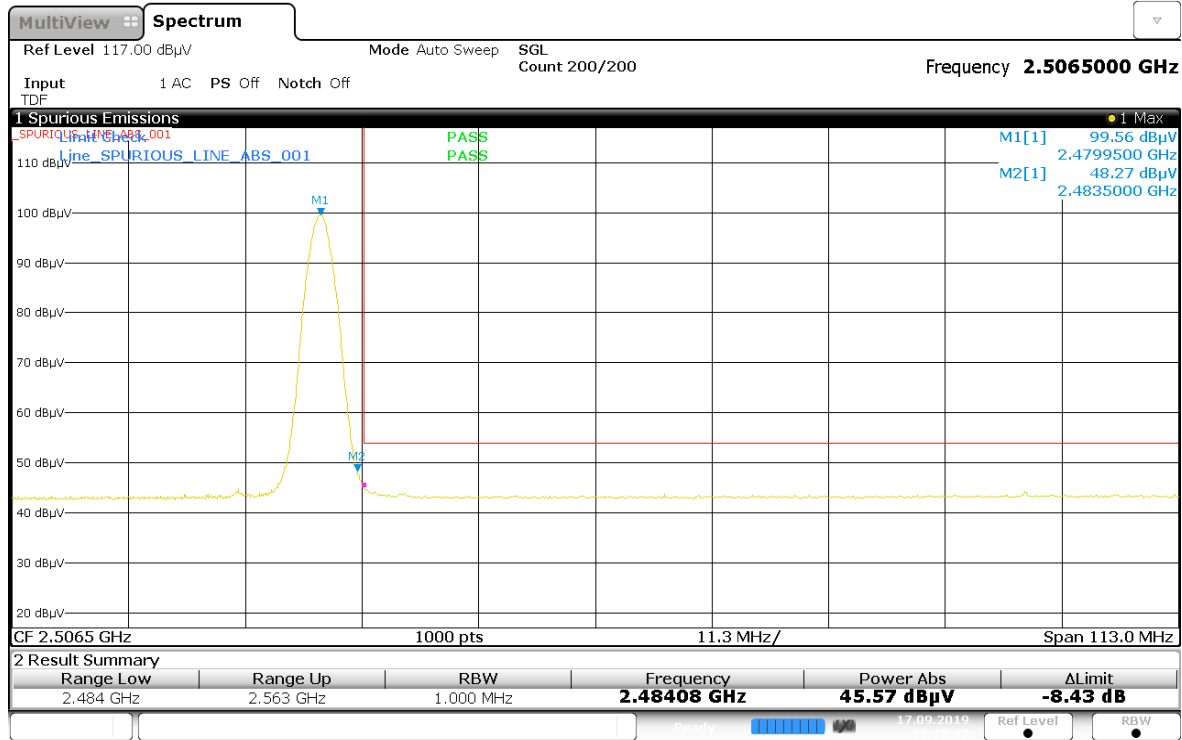
Restricted Band Edge (High Channel, Vertical, Peak) graphical screen shot



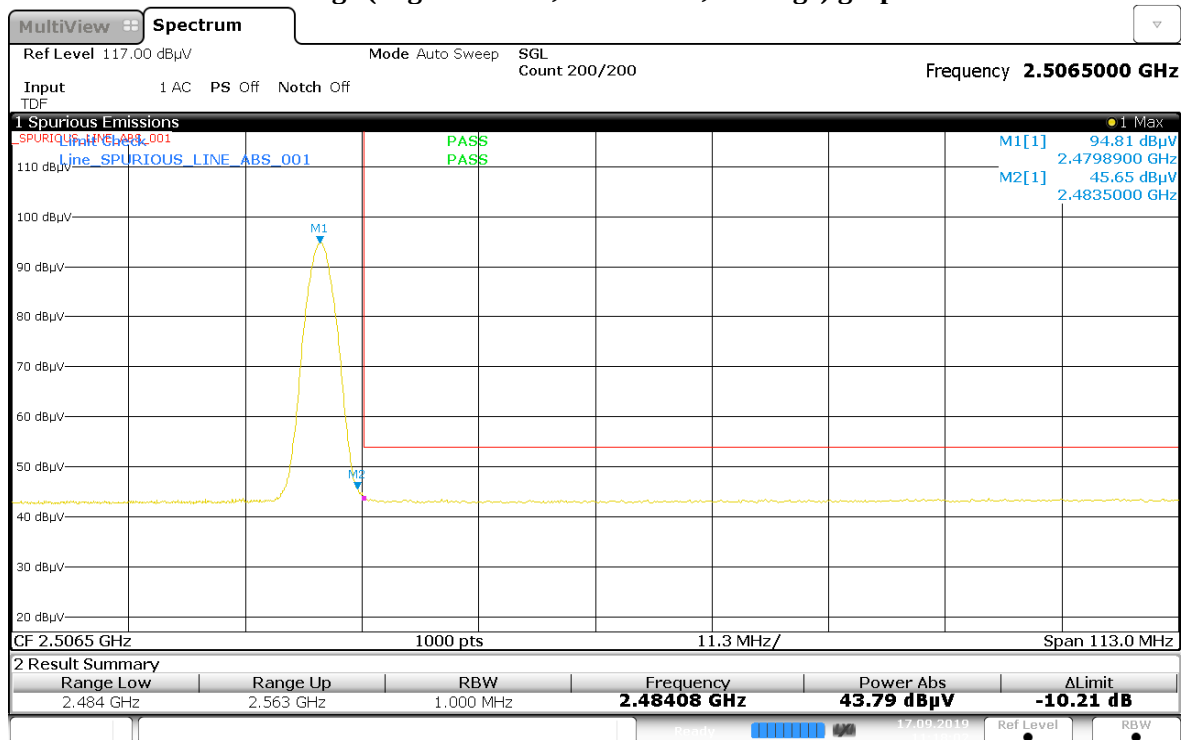
Restricted Band Edge (High Channel, Horizontal, Peak) graphical screen shot



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

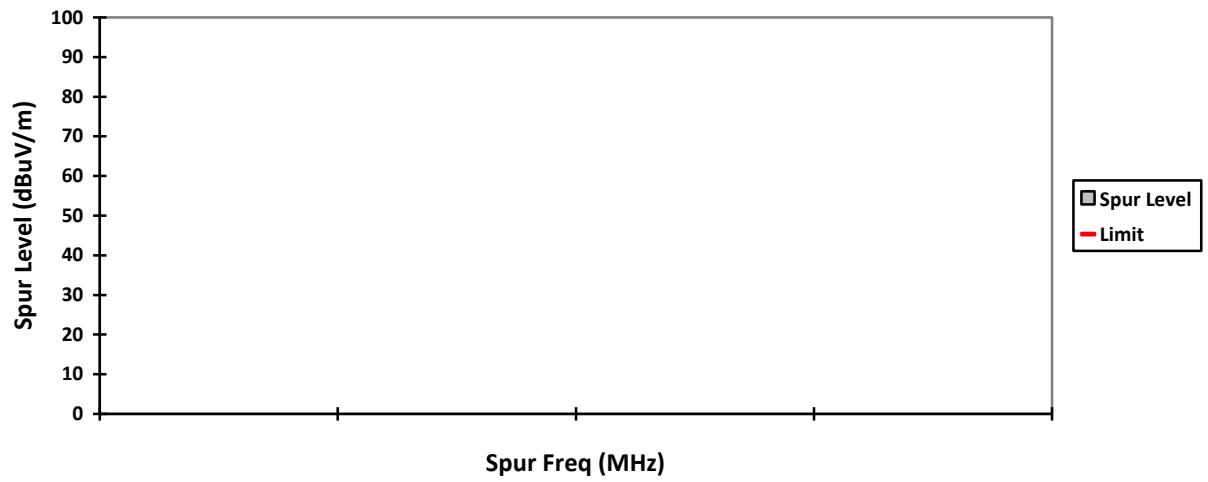


Restricted Band Edge (High Channel, Horizontal, Average) graphical screen shot

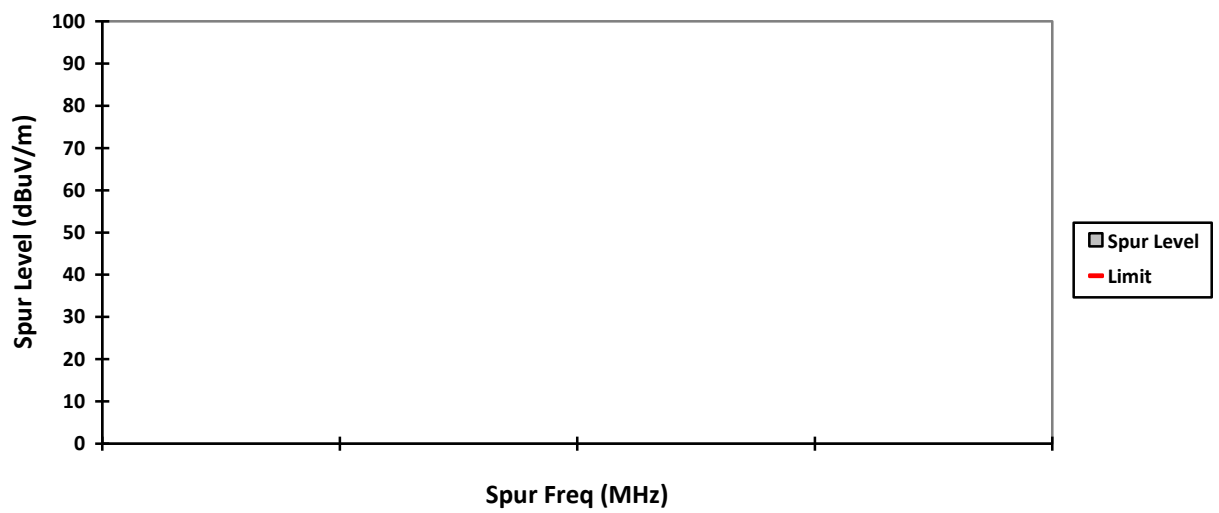


Worst Case Plane: Y-Plane (BT LE)

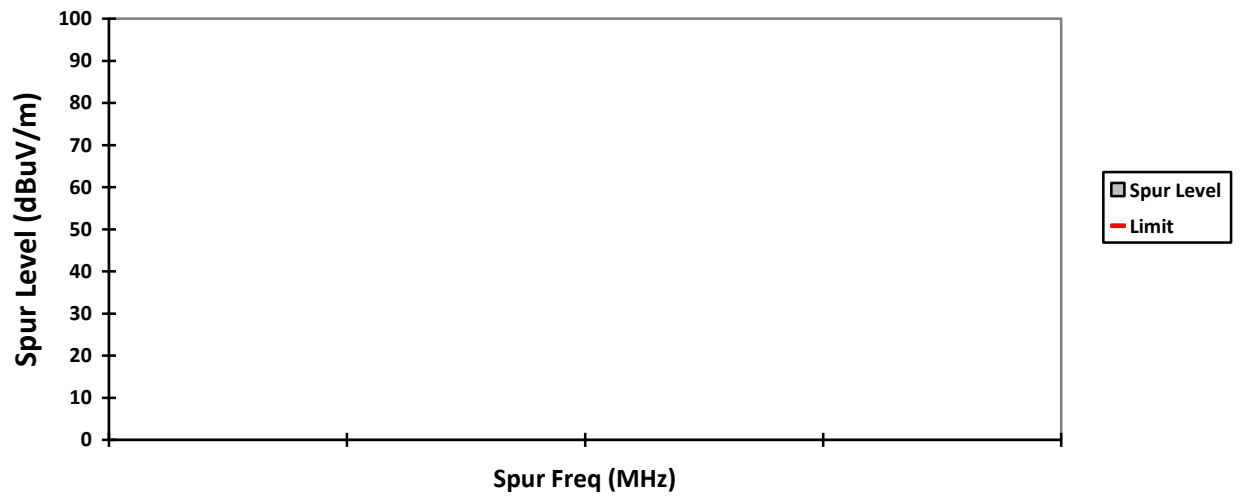
VERTICAL, QPK



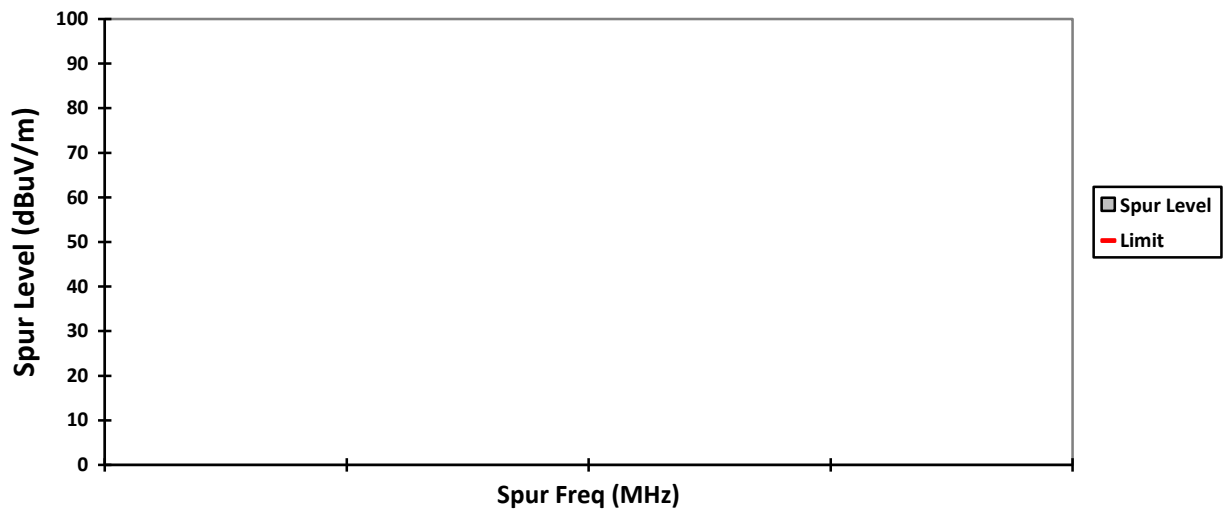
HORIZONTAL, QPK



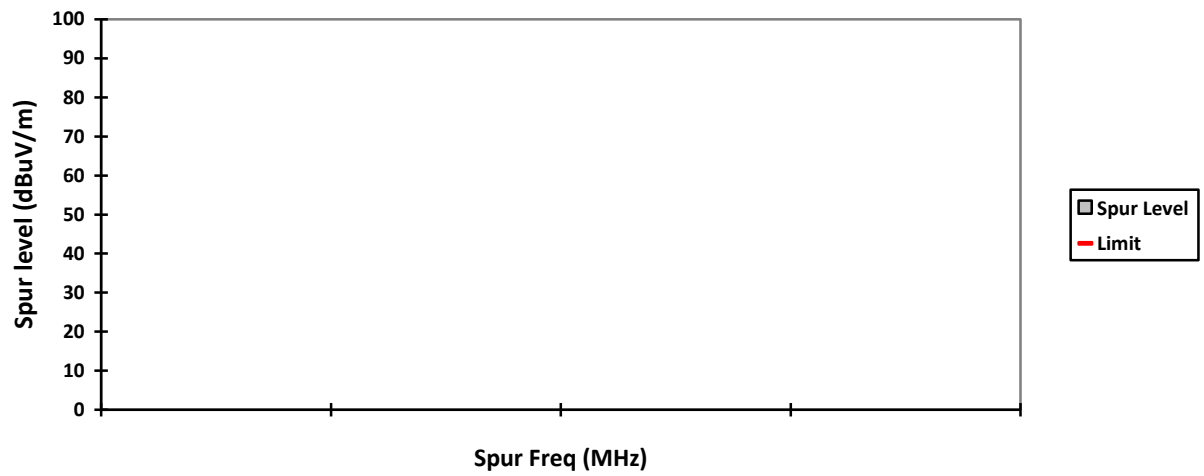
VERTICAL, PK



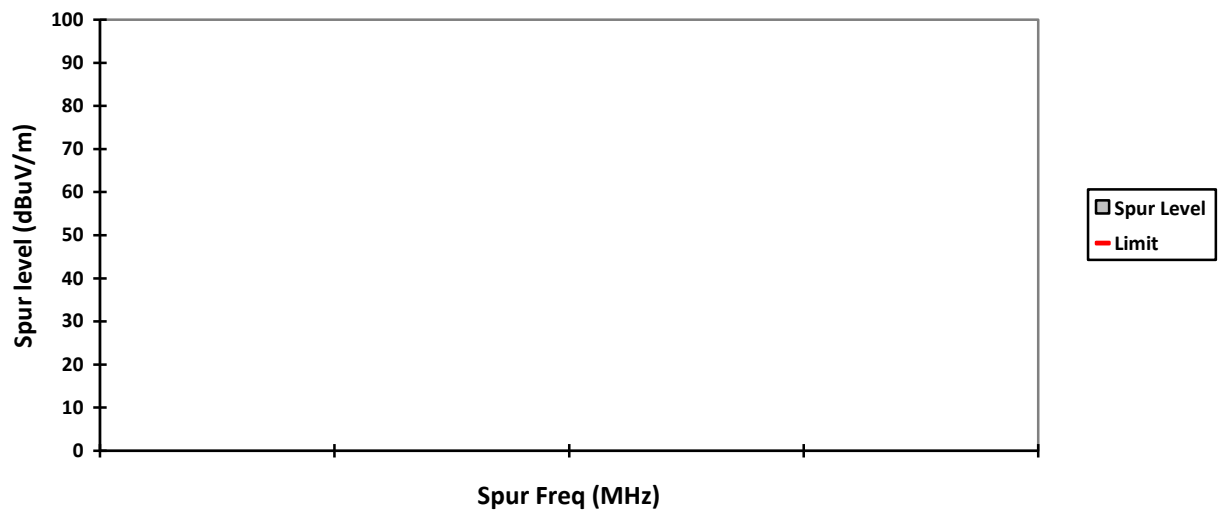
HORIZONTAL, PK



VERTICAL, AV



HORIZONTAL, AV

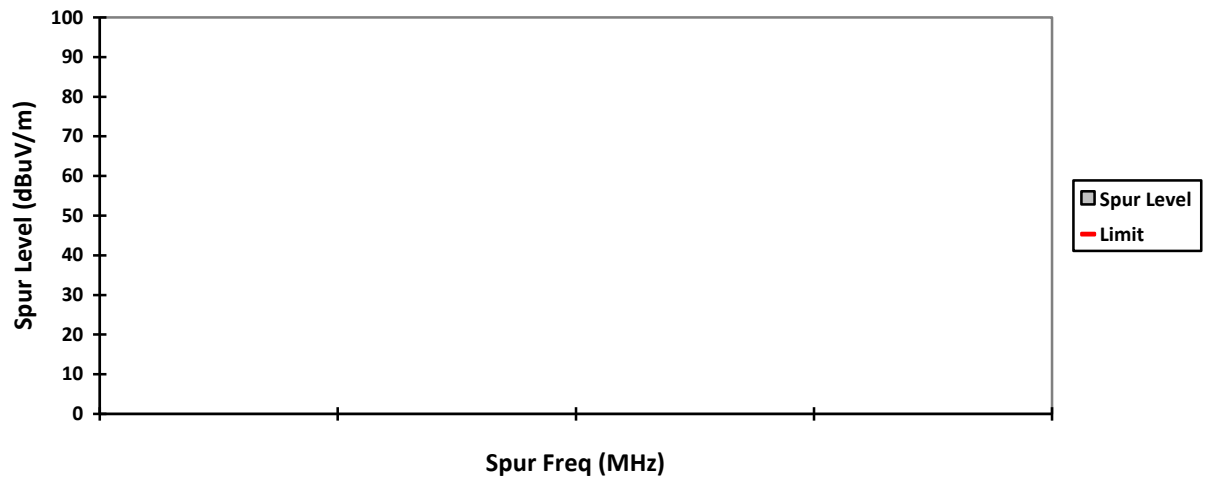


Radiated Emission (Mid Channel) tabular data

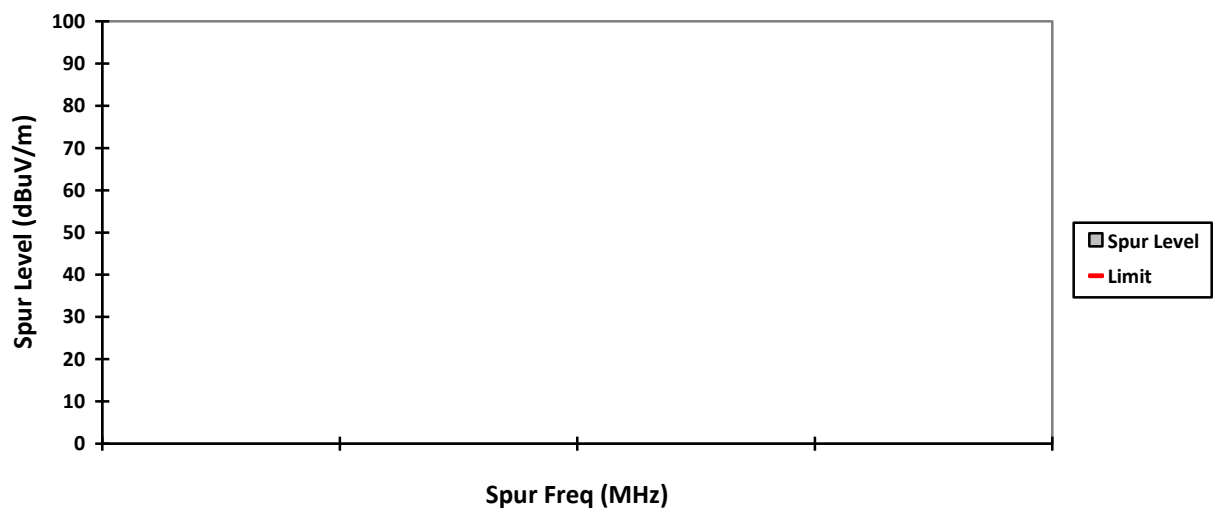
Remarks: Pass Result	Marginal Result	Fail Result
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Humidity (%): 70.1
Test Date: Mon, Sep 16, 2019

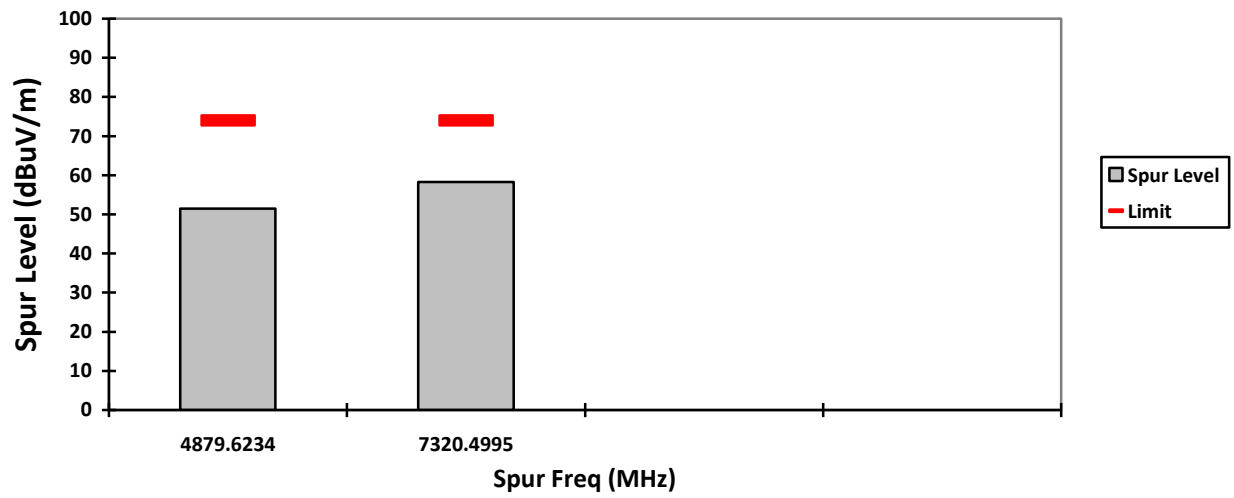
VERTICAL, QPK



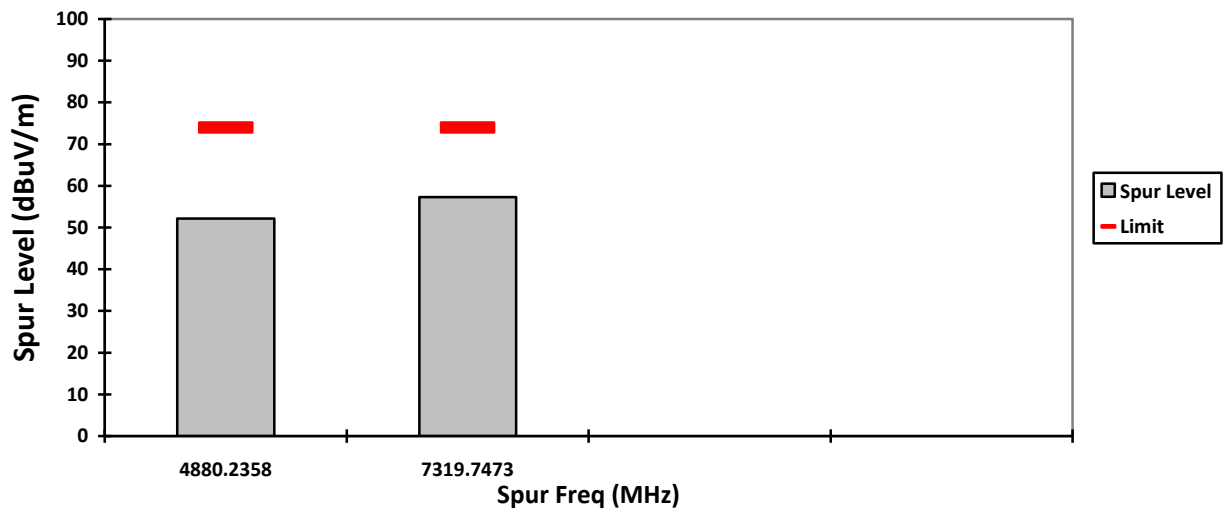
HORIZONTAL, QPK



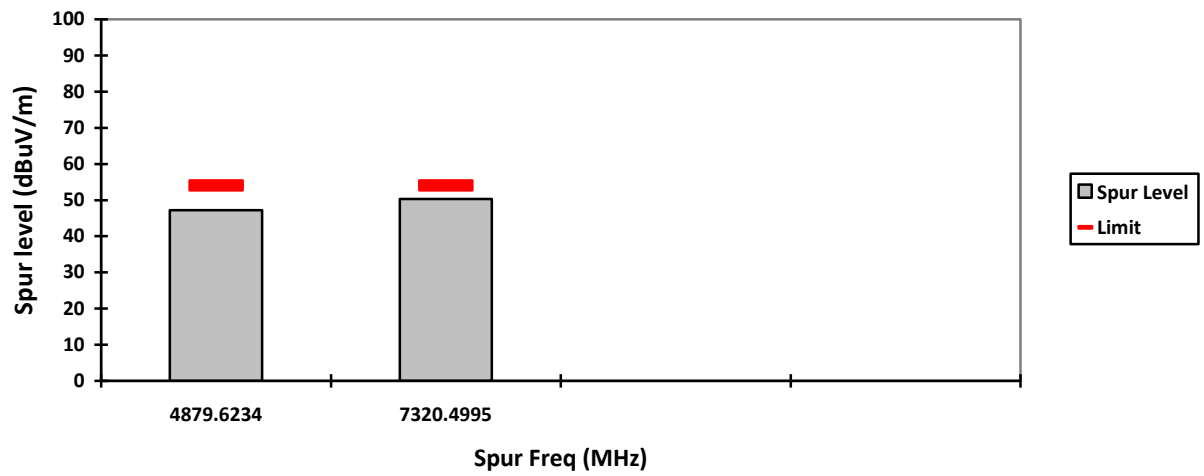
VERTICAL, PK



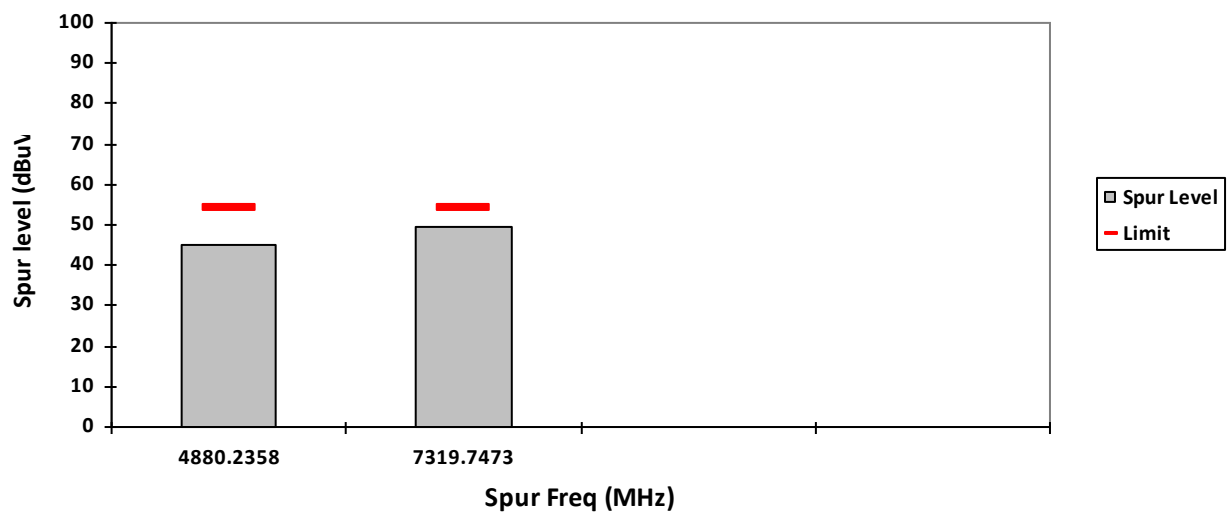
HORIZONTAL, PK



VERTICAL, AV



HORIZONTAL, AV

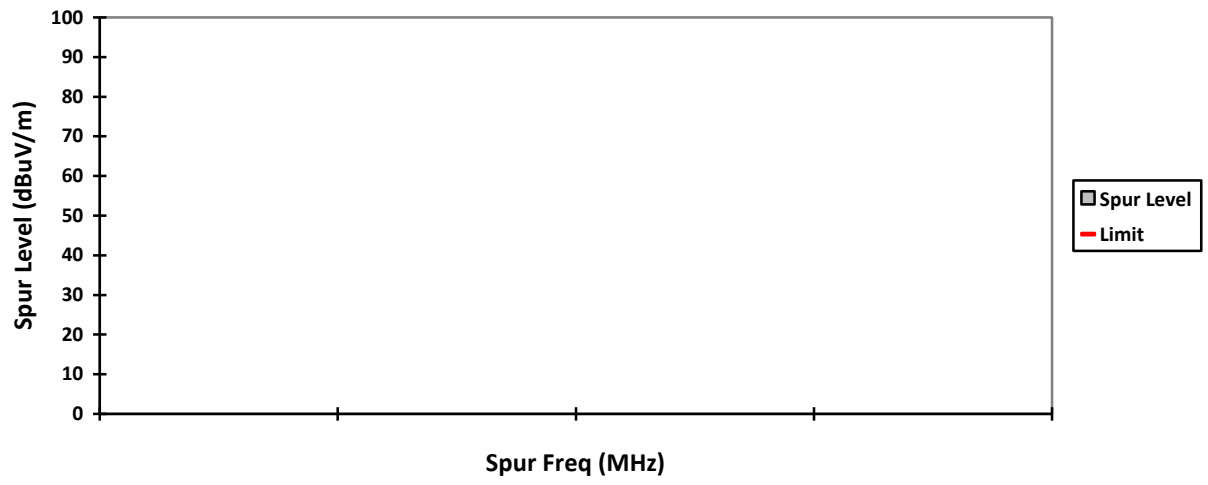


Radiated Emission (High Channel) tabular data

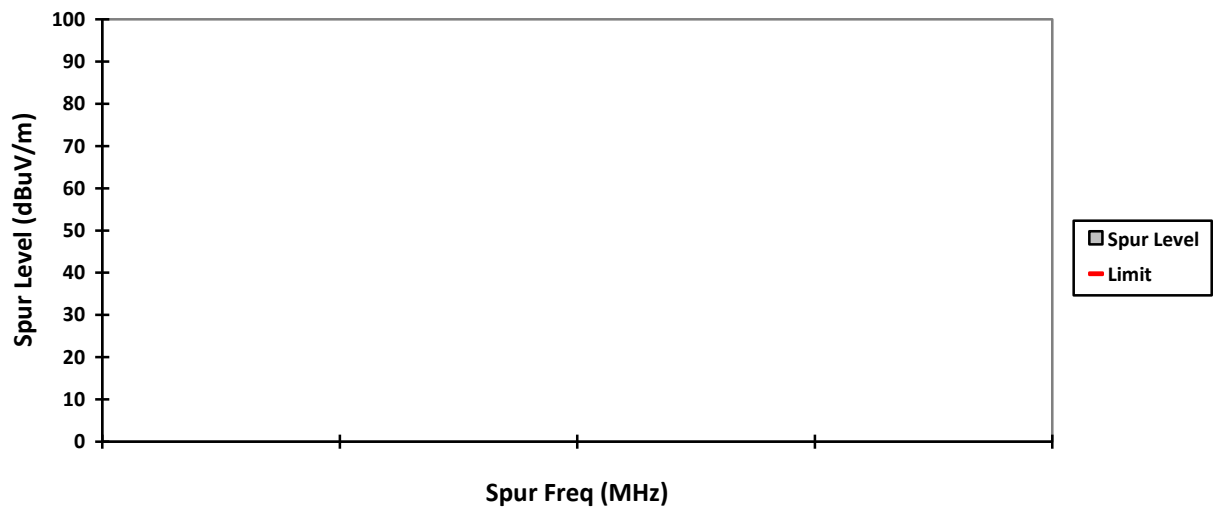
Remarks: Pass Result	Marginal Result	Fail Result
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Humidity (%): 70.1
Test Date: Mon, Sep 16, 2019

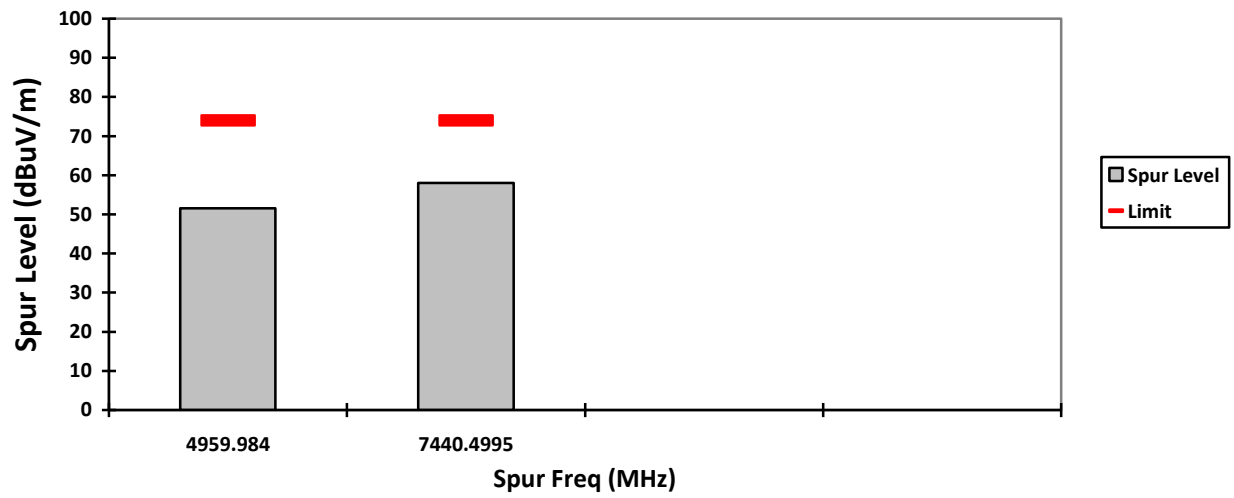
VERTICAL, QPK



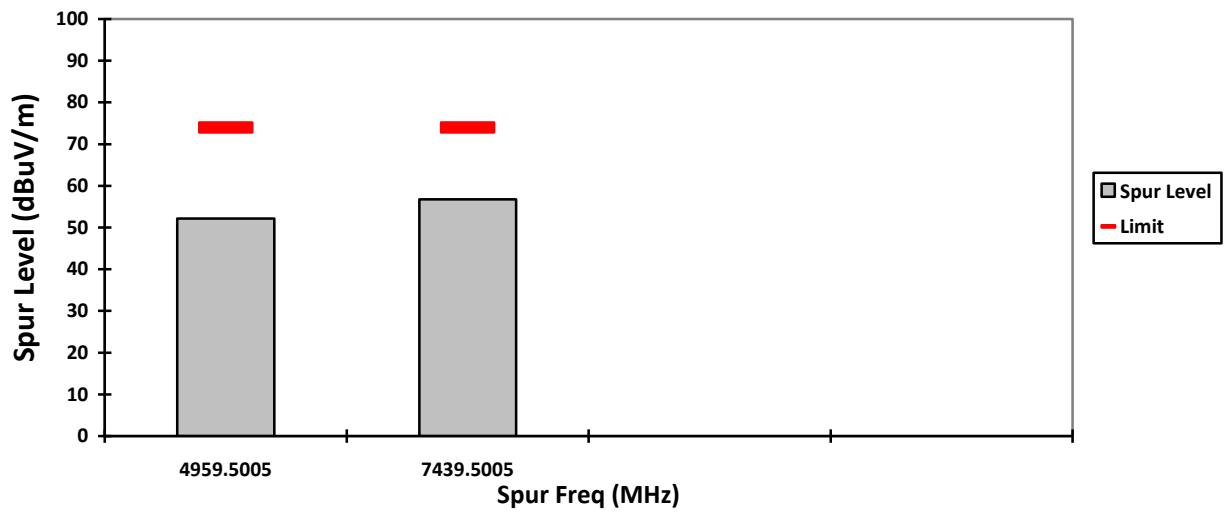
HORIZONTAL, QPK



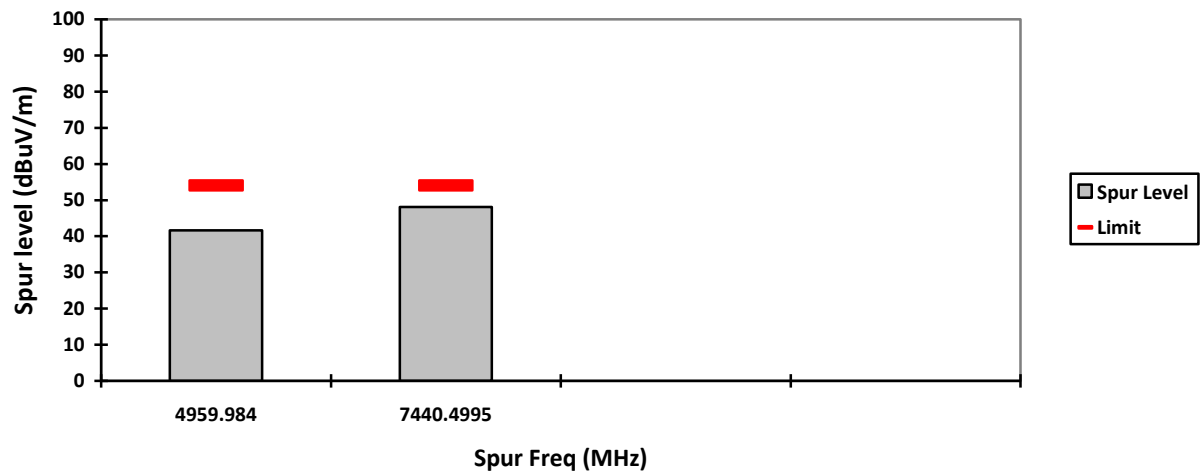
VERTICAL, PK



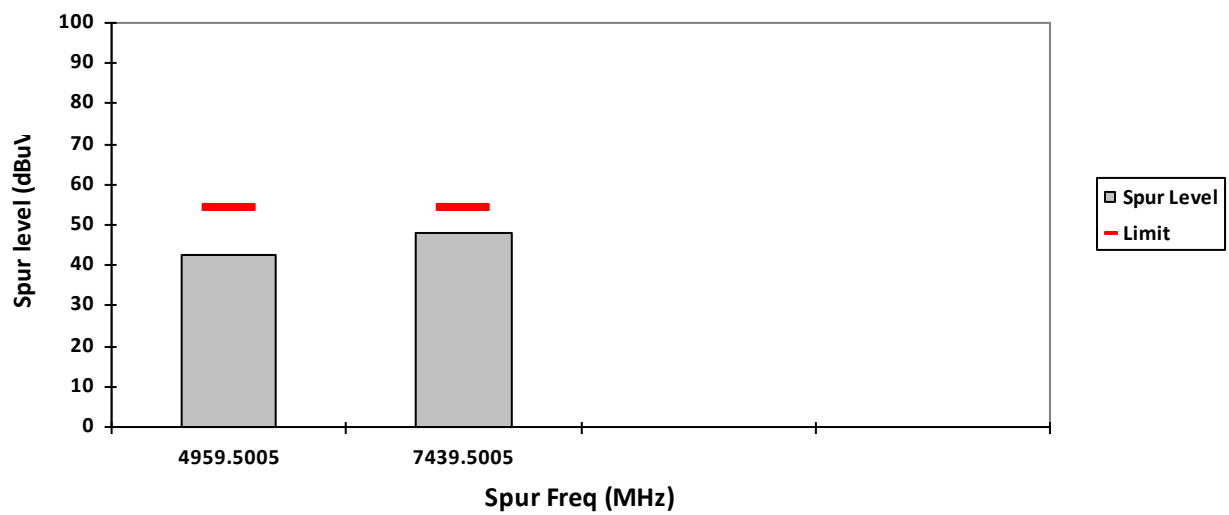
HORIZONTAL, PK



VERTICAL, AV

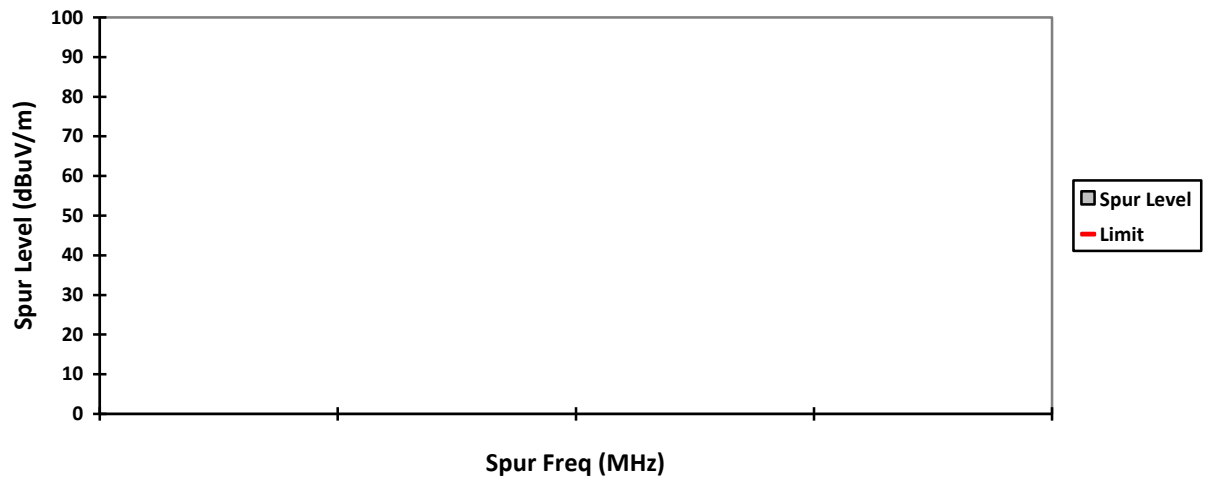


HORIZONTAL, AV

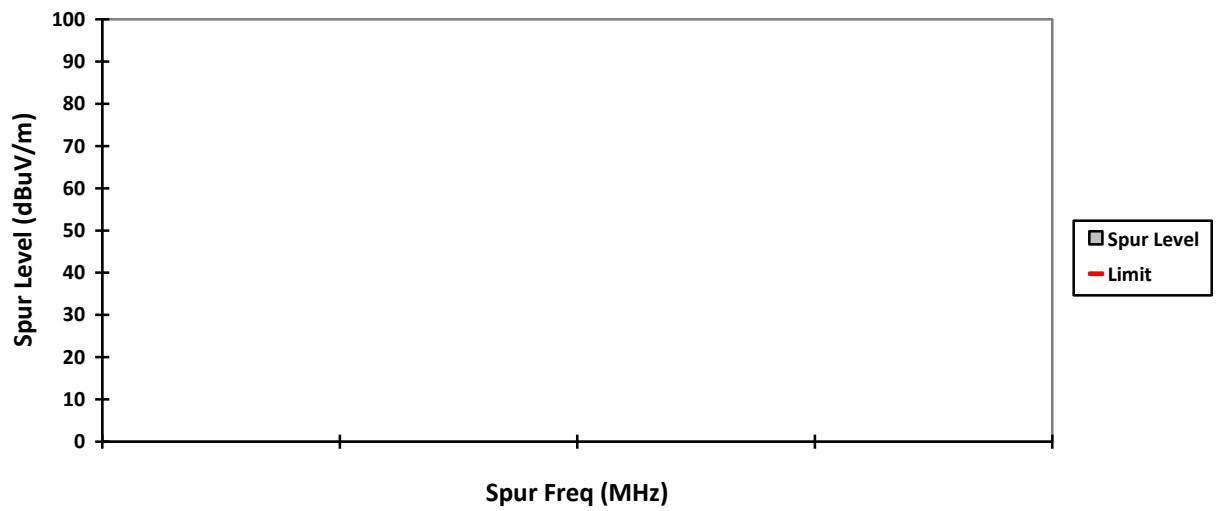


Worst Case Plane: Y-Plane (BT LE)

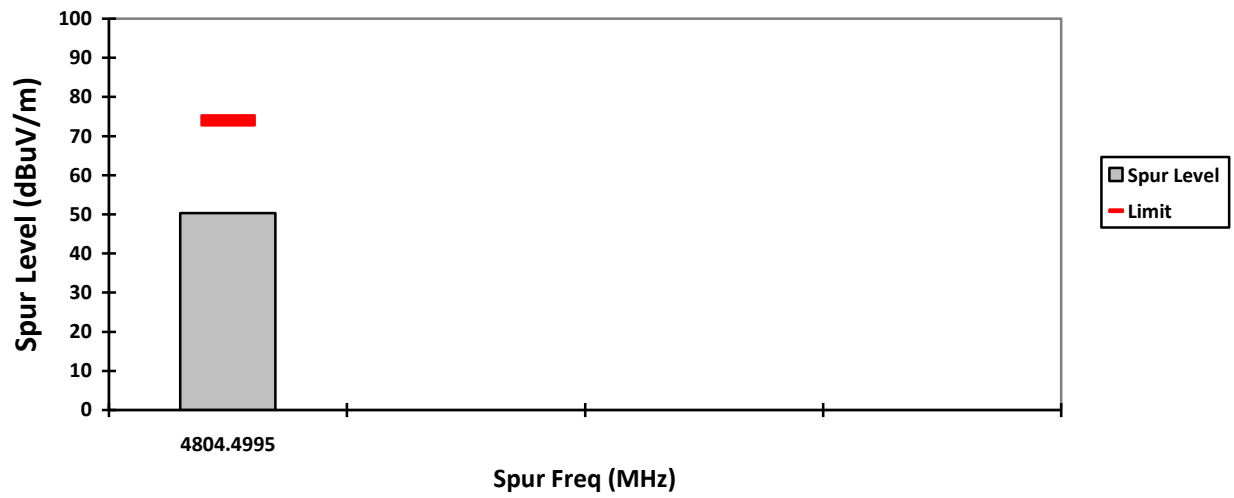
VERTICAL, QPK



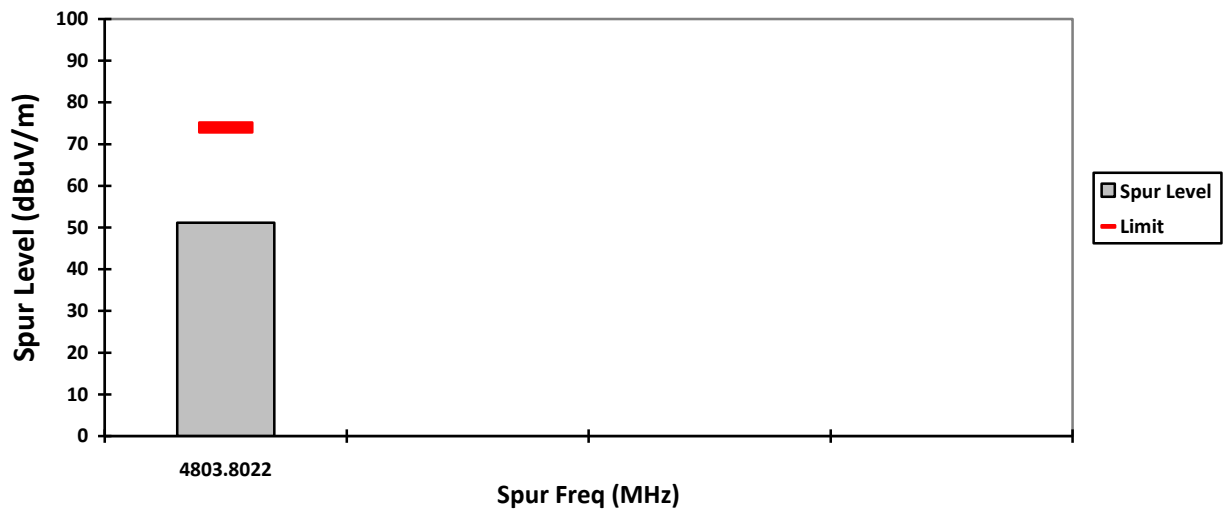
HORIZONTAL, QPK



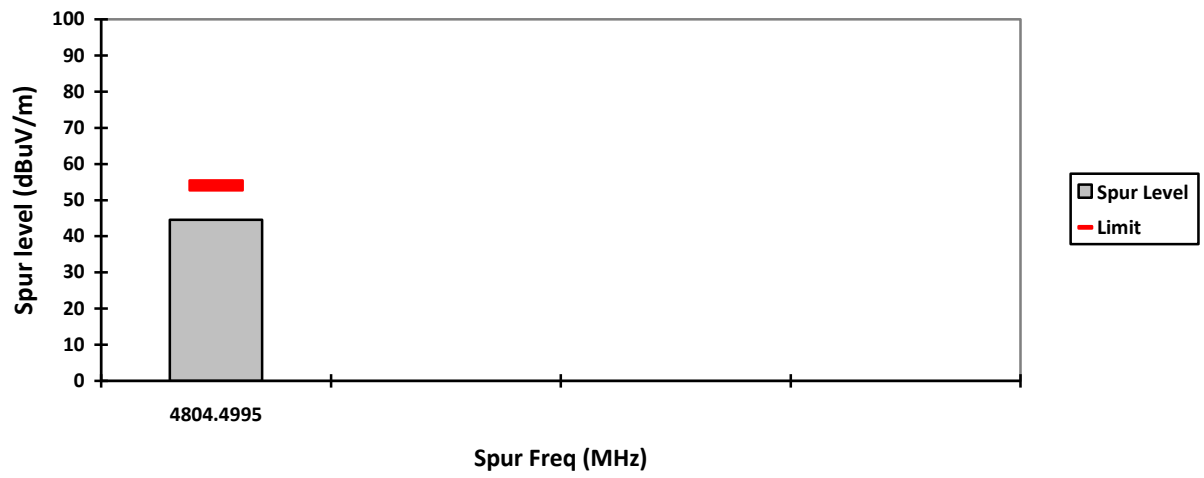
VERTICAL, PK



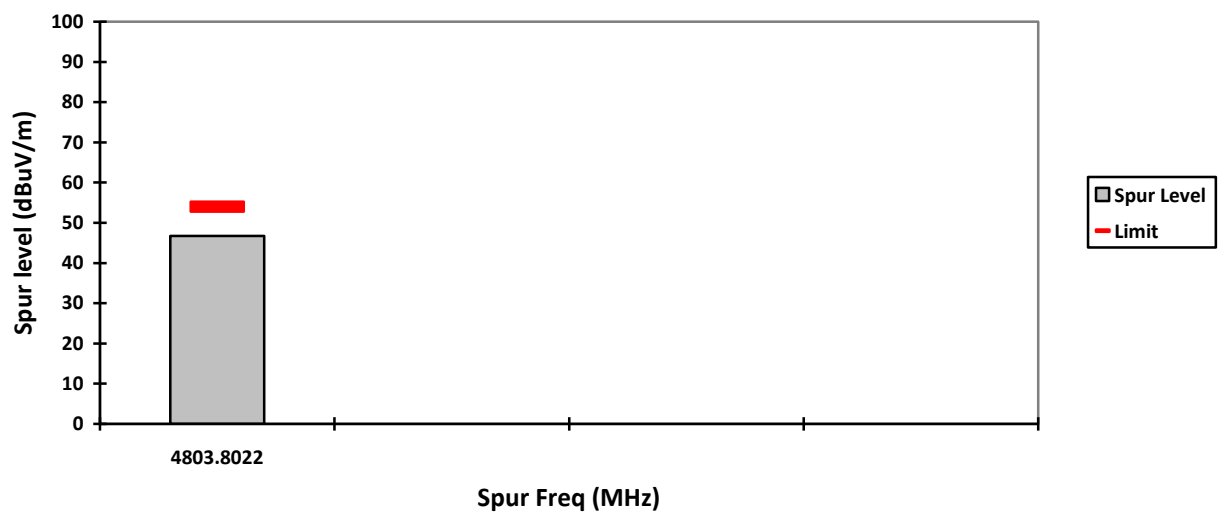
HORIZONTAL, PK



VERTICAL, AV



HORIZONTAL, AV

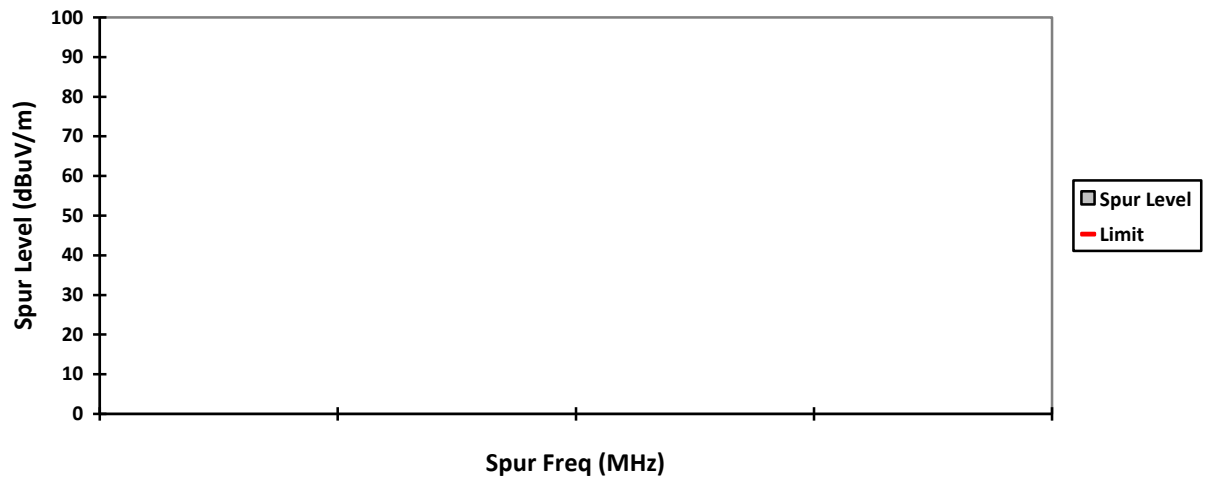


Radiated Emission (Mid Channel) tabular data

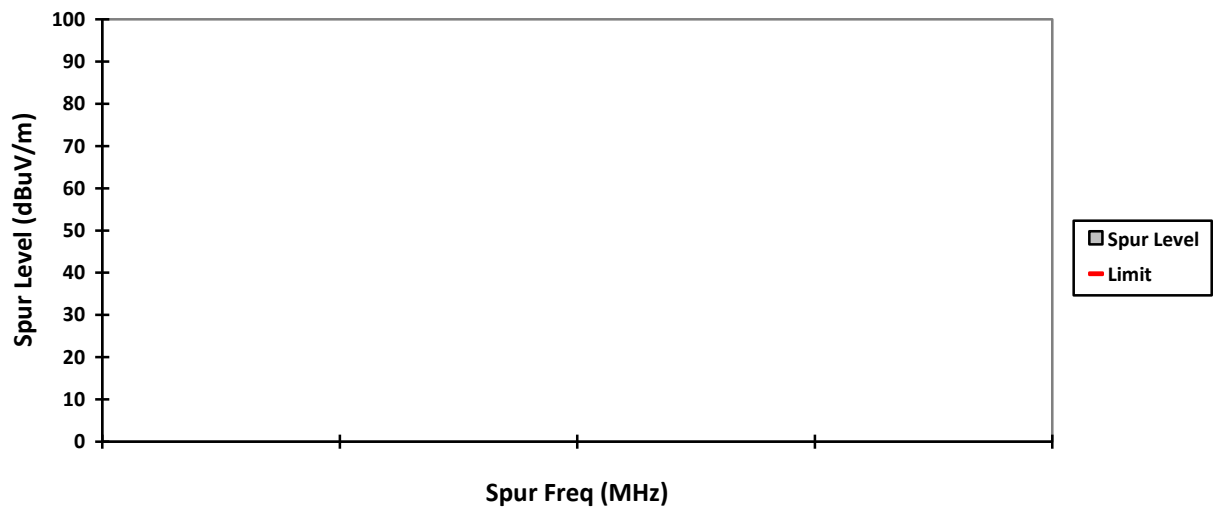
Remarks: Pass Result	Marginal Result	Fail Result
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Humidity (%): 70.1
Test Date: Mon, Sep 16, 2019

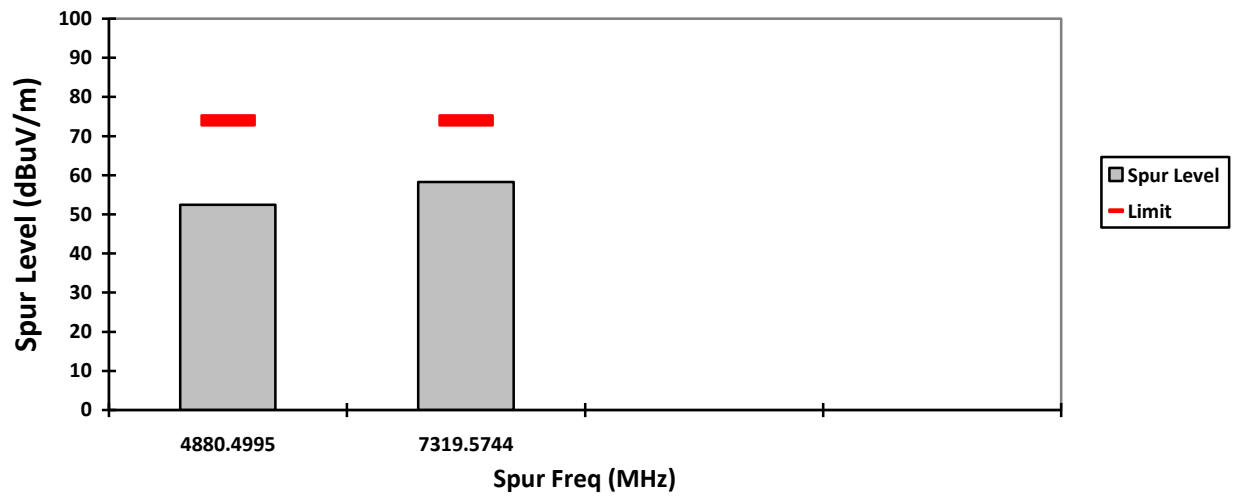
VERTICAL, QPK



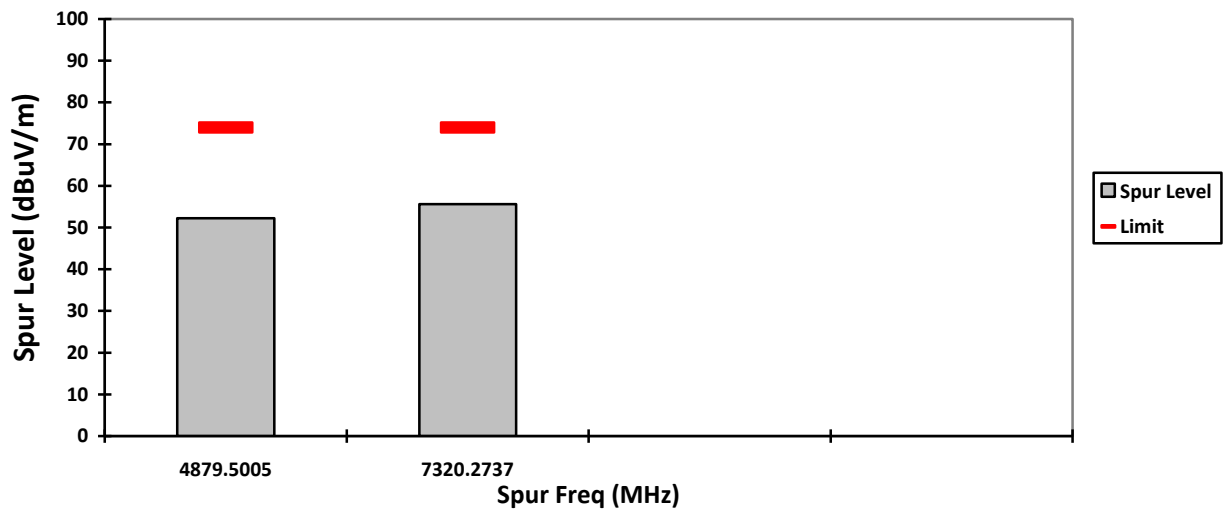
HORIZONTAL, QPK



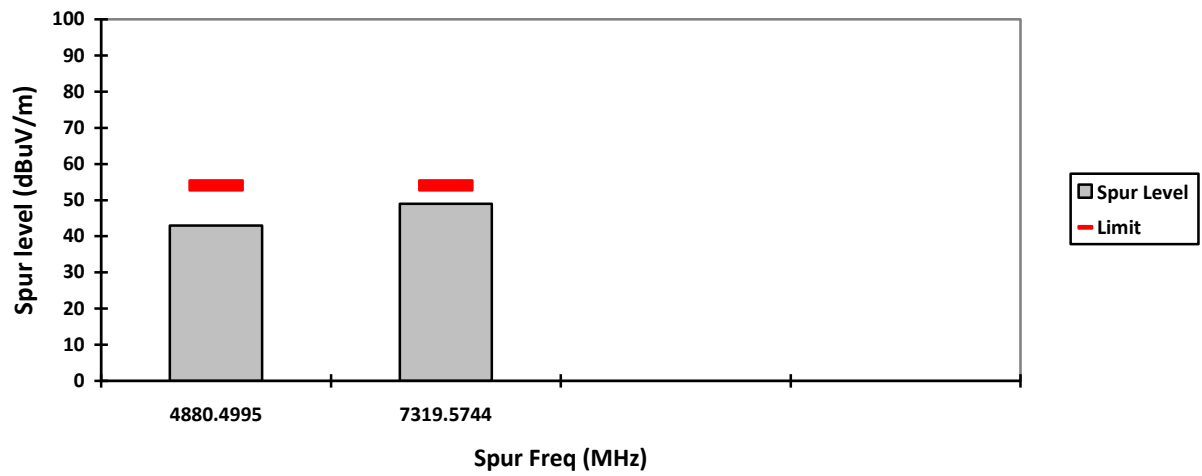
VERTICAL, PK



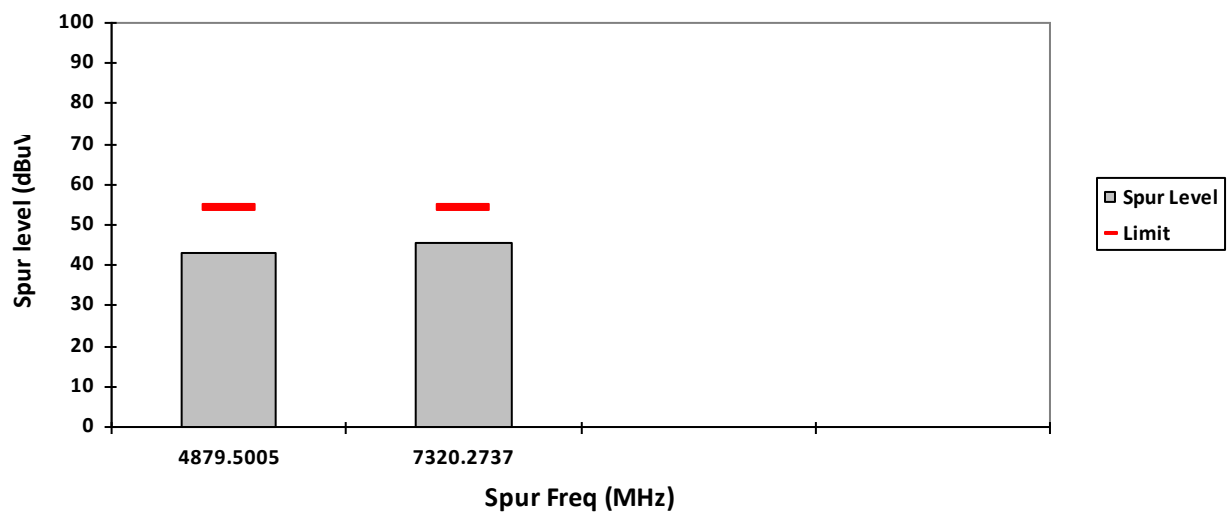
HORIZONTAL, PK



VERTICAL, AV



HORIZONTAL, AV

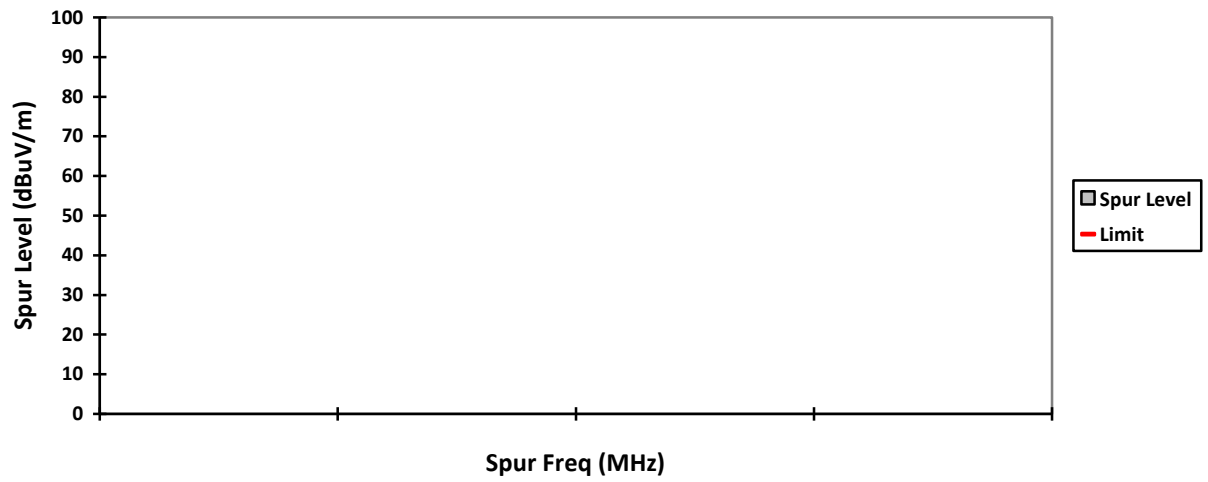


Radiated Emission (High Channel) tabular data

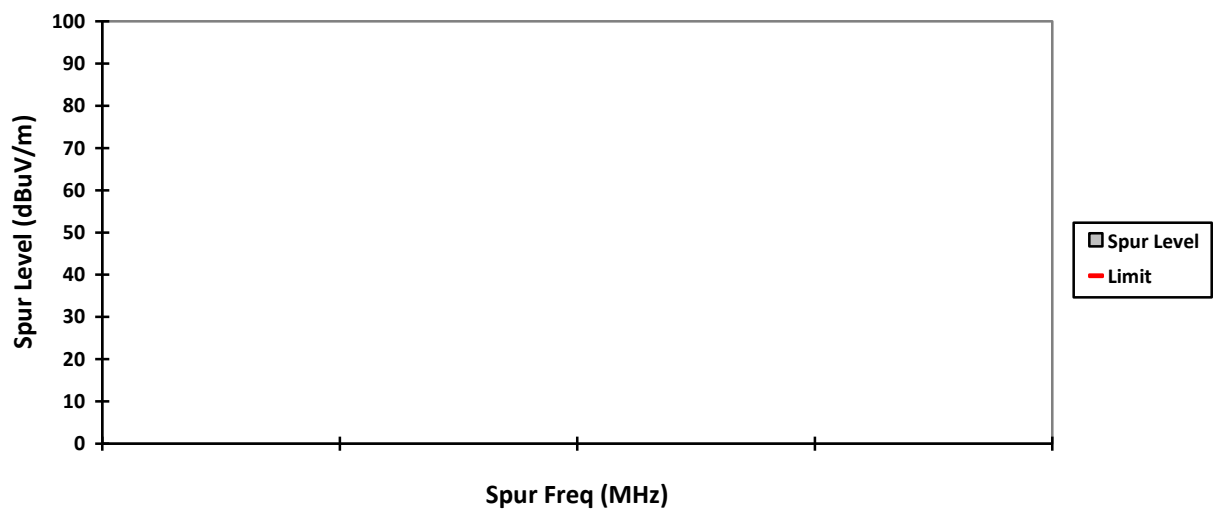
Remarks: Pass Result	Marginal Result	Fail Result
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Humidity (%): 70.1
Test Date: Mon, Sep 16, 2019

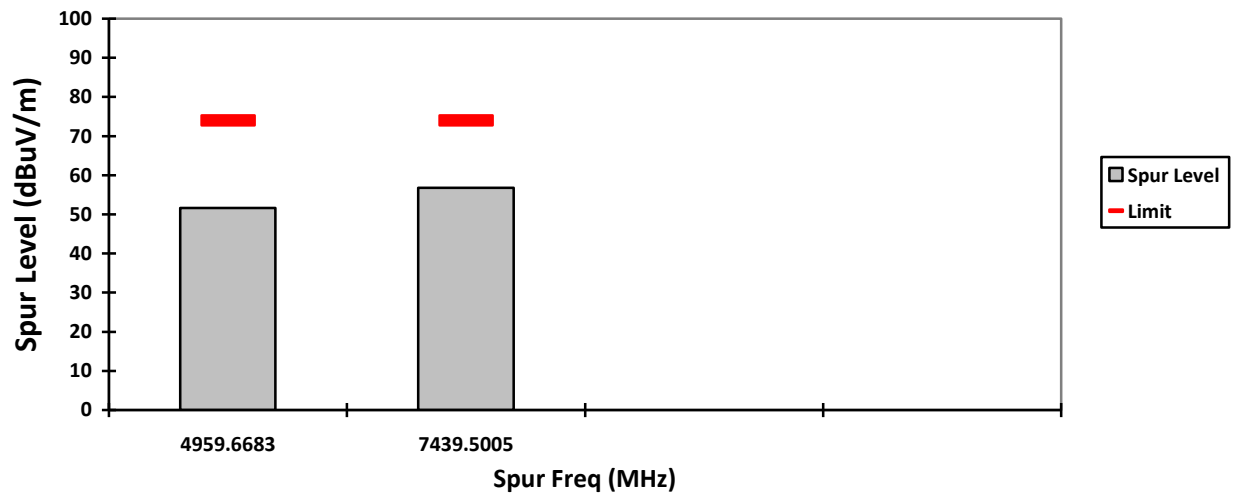
VERTICAL, QPK



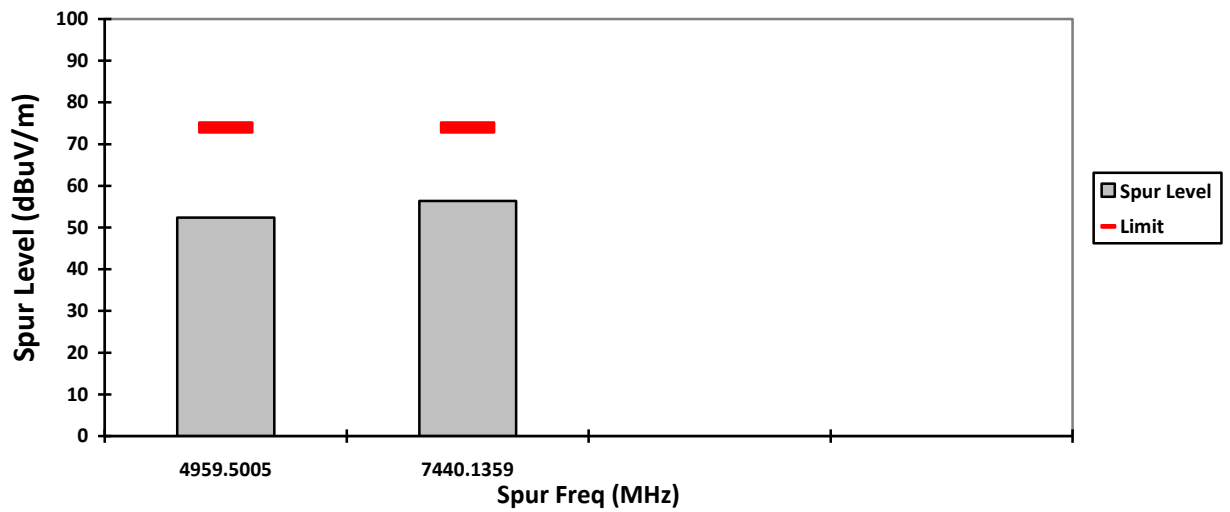
HORIZONTAL, QPK



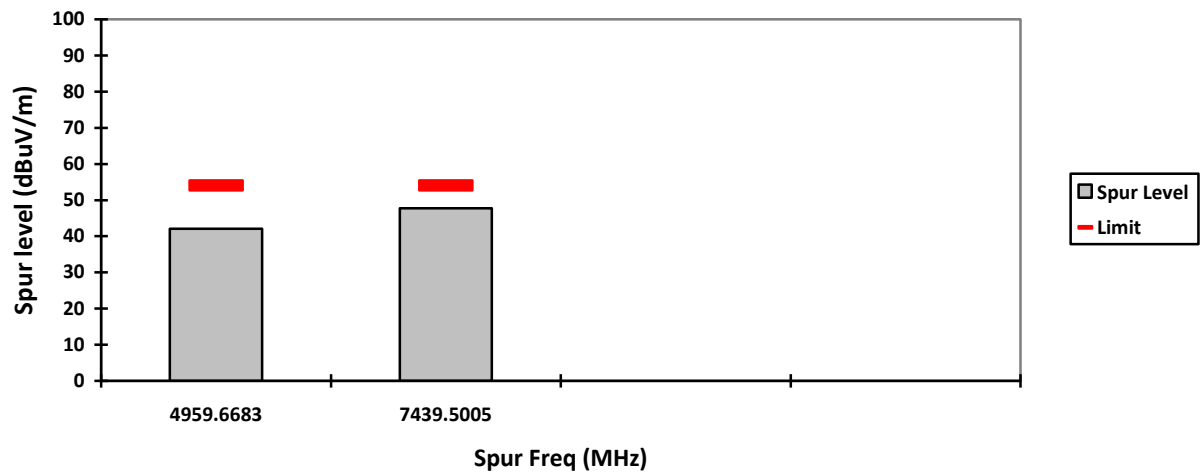
VERTICAL, PK



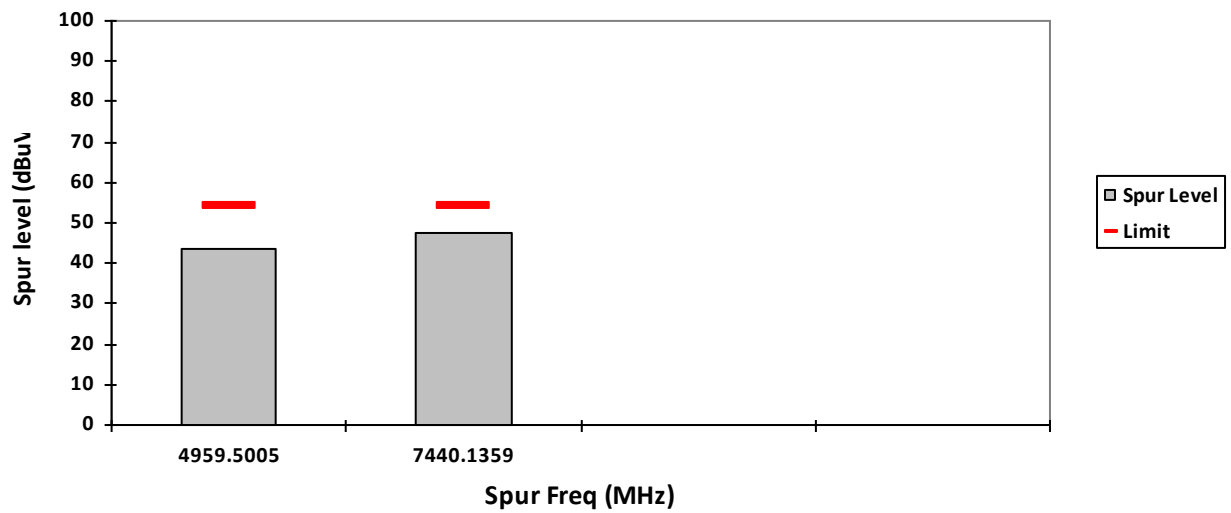
HORIZONTAL, PK



VERTICAL, AV

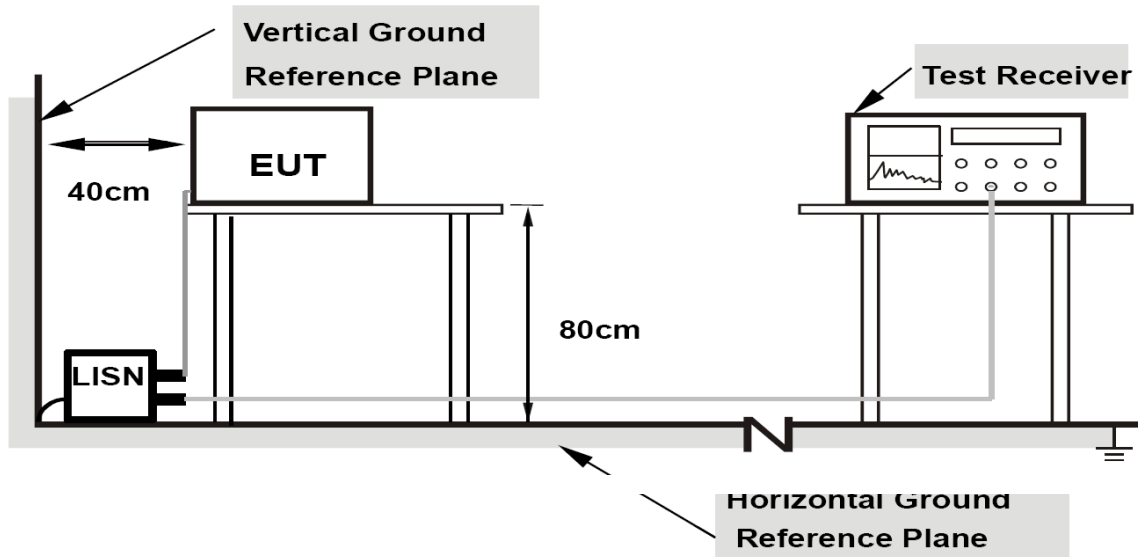


HORIZONTAL, AV



6.7 AC Powerline Conducted Emission

6.7.1 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.

6.7.2 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(μ V)	
	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**

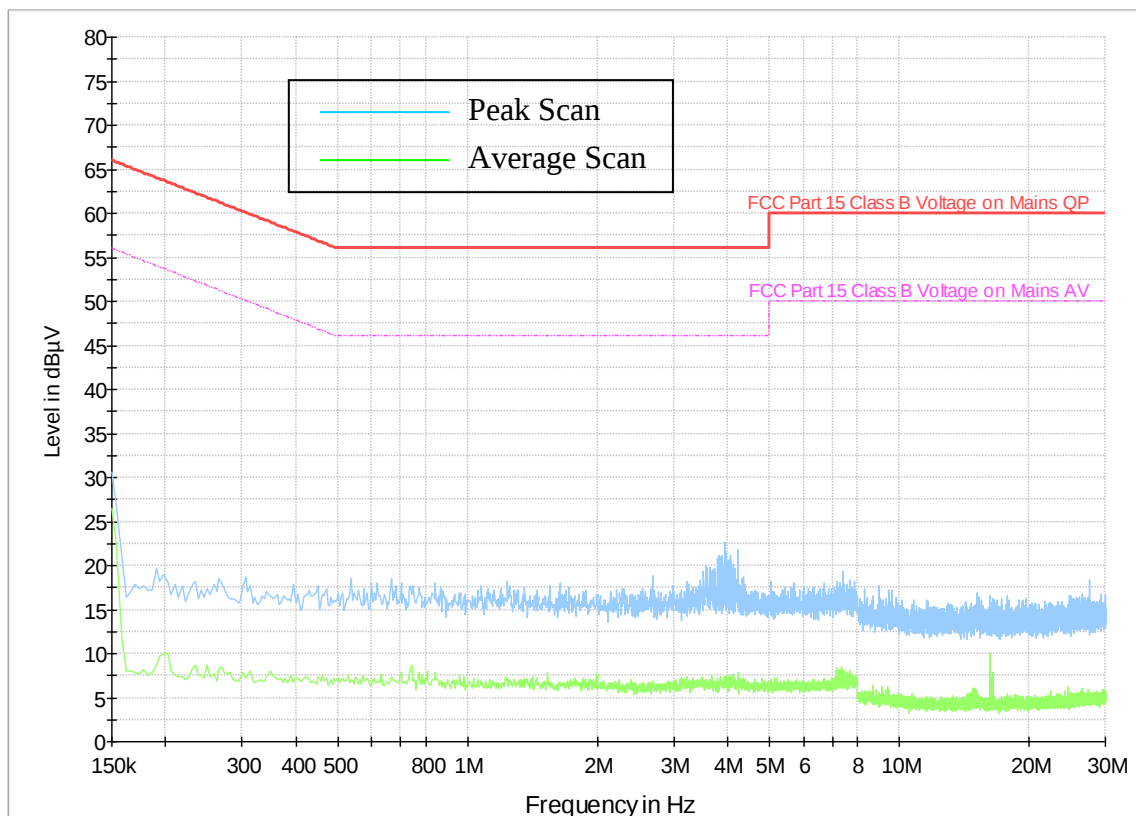
Frequency range MHz	Limits dB(μV)	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50

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

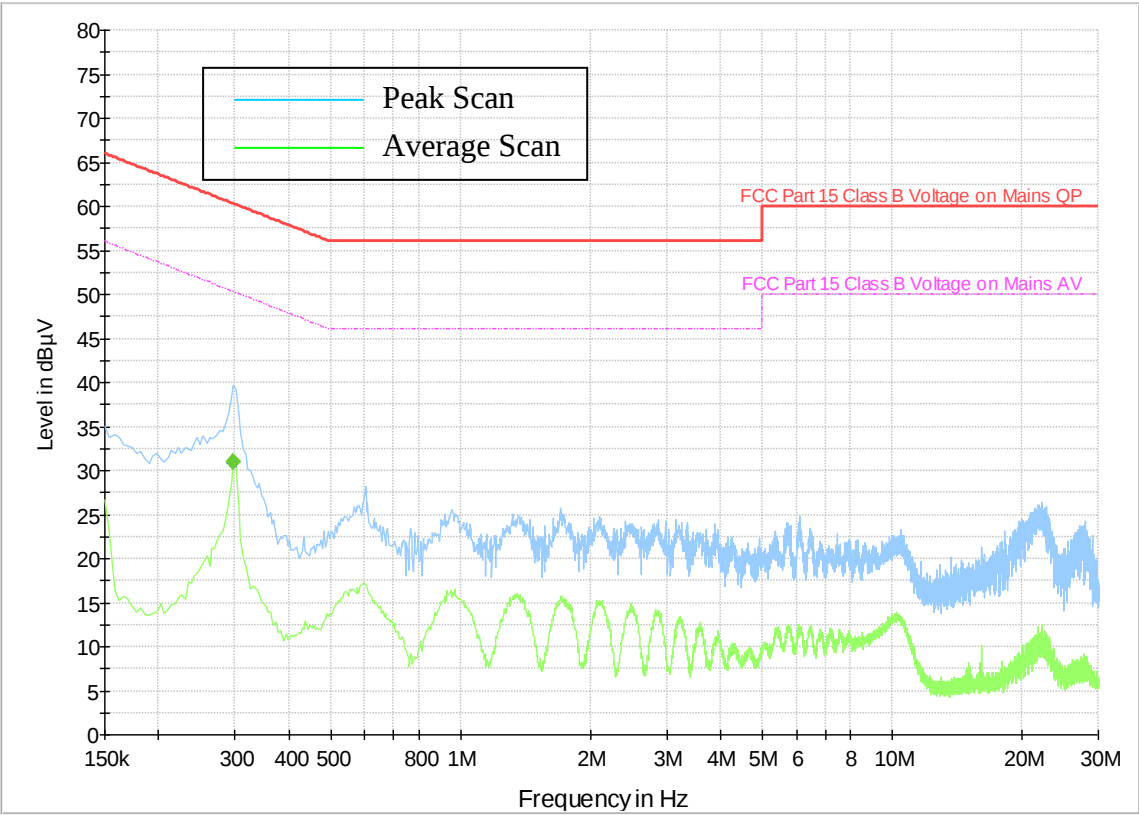
6.7.3 Test Result

1) Ambient Noise



120 VAC/60 Hz

1) RSM Bluetooth LE mode (5.0-2M)Tx



Quasipeak and Average measurement

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
0.298000	---	31.05	50.30	19.25	1000.0	9.000	N	ON	9.8	PASS

* Expanded Uncertainty (U) = +/- 3.43dB

END OF TEST REPORT