RADIO TEST REPORT
IC: 24999-BT4502

Product:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module
Trade Mark:	HopeRF
Model No.:	HM-BT4502
Family Model:	HM-BT4502B, HM-BT4502C
Report No.:	S19071704101001
Issue Date:	27 Aug. 2019

Prepared for

Shenzhen HOPE Microelectronics Co., Ltd

2/F, Building 3, Pingshan Private Enterprise Science and Technology Park, Xili Town, Nanshan District, Shenzhen 518055 China

Prepared by

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TABLE OF CONTENTS

1 TEST RESULT CERTIFICATION

Applicant's name ..... :	Shenzhen HOPE Microelectronics Co., Ltd
Address ..... :	2/F, Building 3, Pingshan Private Enterprise Science and Technology Park, Xili Town, Nanshan District, Shenzhen 518055 China
Manufacturer's Name ..... :	Shenzhen HOPE Microelectronics Co., Ltd
Address ..... :	2/F, Building 3, Pingshan Private Enterprise Science and Technology Park, Xili Town, Nanshan District, Shenzhen 518055 China
Product description	
Product name ..... :	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module
Model and/or type reference ..... :	HM-BT4502
Family Model ..... :	HM-BT4502B, HM-BT4502C

Measurement Procedure Used:

APPLICABLE STANDARDS	
APPLICABLE STANDARD/ TEST PROCEDURE	TEST RESULT
RSS-247: Issue 2 Feb 2017 RSS GEN: Issue 5 Apr 2018 ANSI C63.10-2013	Complied

This device described above has been tested by NTEK Testing Technology Co., Ltd., and the test results show that the equipment under test (EUT) is in compliance with the IC requirements. And it is applicable only to the tested sample identified in the report.
This report shall not be reproduced except in full, without the written approval of NTEK Testing Technology Co., Ltd., this document may be altered or revised by NTEK Testing Technology Co., Ltd., personnel only, and shall be noted in the revision of the document.
The test results of this report relate only to the tested sample identified in this report.

Date of Test : 14 Aug. 2019 ~ 26 Aug, 2019

Testing Engineer : (Eileen Liu)

Technical Manager : (Jason Chen)

Authorized Signatory : (Sam Chen)

2 SUMMARY OF TEST RESULTS

RSS 247			
Standard Section	**Test Item**	**Verdict**	**Remark**
RSS-Gen 8.8	Conducted Emission	PASS	
RSS-247.5.2(a)	6dB Bandwidth	PASS	
RSS-247.5.4(d)	Peak Output Power	PASS	
RSS-247.5.4(d)	Equivalent Isotropically Radiated Power	PASS	
RSS-Gen 8.9 RSS-Gen 8.10	Radiated Spurious Emission& Restricted frequency bands	PASS	
RSS-247.5.2(b)	Power Spectral Density	PASS	
RSS-Gen 6.7	99% Occupied Bandwidth	PASS	
RSS-247.5.5	Unwanted Spurious Emissions& Band Edge Emission	PASS	
RSS-Gen 6.8	Antenna Requirement	PASS	

Remark:
1. “N/A” denotes test is not applicable in this Test Report.
2. All test items were verified and recorded according to the standards and without any deviation during the test.

3 FACILITIES AND ACCREDITATIONS

3.1 FACILITIES

All measurement facilities used to collect the measurement data are located at 1/F, Building E, Fenda Science Park, Sanwei Community, Xixiang Street, Bao'an District, Shenzhen P.R. China.
The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

3.2 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description		
CNAS-Lab.	:	Accredited by CNAS, 2014.09.04 The Laboratory has been assessed and proved to be in compliance with CNAS-CL01:2006 (identical to ISO/IEC 17025:2005) The Certificate Registration Number is L5516.
IC-Registration		The Certificate Registration Number is 9270A. CAB identifier:CN0074
FCC- Accredited		Test Firm Registration Number: 463705. Designation Number: CN1184
A2LA-Lab.		The Certificate Registration Number is 4298.01 This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).
Name of Firm	:	Shenzhen NTEK Testing Technology Co., Ltd.
Site Location	:	1/F, Building E, Fenda Science Park, Sanwei Community, Xixiang Street, Bao'an District, Shenzhen 518126 P.R. China.

3.3 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y±U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	Conducted Emission Test	±1.38dB
2	RF power, conducted	±0.16dB
3	Spurious emissions, conducted	±0.21dB
4	All emissions, radiated(<1G)	±4.68dB
5	All emissions, radiated(>1G)	±4.89dB
6	Temperature	±0.5℃
7	Humidity	±2%

4 GENERAL DESCRIPTION OF EUT

Product Feature and Specification	
Equipment	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module
Trade Mark	HopeRF
IC	24999-BT4502
Model No.	HM-BT4502
Family Model	HM-BT4502B, HM-BT4502C
Model Difference	All models are the same circuit and RF module, except the model name.
Operating Frequency	2402MHz~2480MHz
Modulation	GFSK
Number of Channels	40 Channels
Antenna Type	PCB antenna
Antenna Gain	1.5dBi
Power supply	☒DC supply: 3.3V, 10mA
	☐Adapter supply:
Test Software	Engineer Mode
RF Power Setting	5dBm ~9dBm
HW Version	V1.2
FW Version	V1.0.0
SW Version	N/A

Note: Based on the application, features, or specification exhibited in User's Manual, the EUT is considered as an ITE/Computing Device. More details of EUT technical specification, please refer to the User's Manual.

Revision History

Report No.	Version	Description	Issued Date
S19071704101001	Rev.01	Initial issue of report	Aug 27, 2019

5 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

Those data rates (1Mbps for GFSK modulation) were used for all test.

The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement –X, Y, and Z-plane. The X-plane results were found as the worst case and were shown in this report.

Carrier Frequency and Channel list:

Channel	Frequency(MHz)
0	2402
1	2404
…	…
19	2440
20	2442
…	…
38	2478
39	2480

Note: fc=2402MHz+k×2MHz k=0 to 39

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Test Cases	
Test Item	Data Rate/ Modulation
	Bluetooth 5.0_LE / GFSK
AC Conducted Emission	Mode 1: normal link mode
Radiated Test Cases	Mode 1: normal link mode
	Mode 2: Bluetooth Tx Ch00_2402MHz_1Mbps/2Mbps/125Kbps/500Kbps
	Mode 3: Bluetooth Tx Ch19_2440MHz_1Mbps/2Mbps/125Kbps/500Kbps
	Mode 4: Bluetooth Tx Ch39_2480MHz_1Mbps/2Mbps/125Kbps/500Kbps
Conducted Test Cases	Mode 2: Bluetooth Tx Ch00_2402MHz_1Mbps/2Mbps/125Kbps/500Kbps
	Mode 3: Bluetooth Tx Ch19_2440MHz_1Mbps/2Mbps/125Kbps/500Kbps
	Mode 4: Bluetooth Tx Ch39_2480MHz_1Mbps/2Mbps/125Kbps/500Kbps

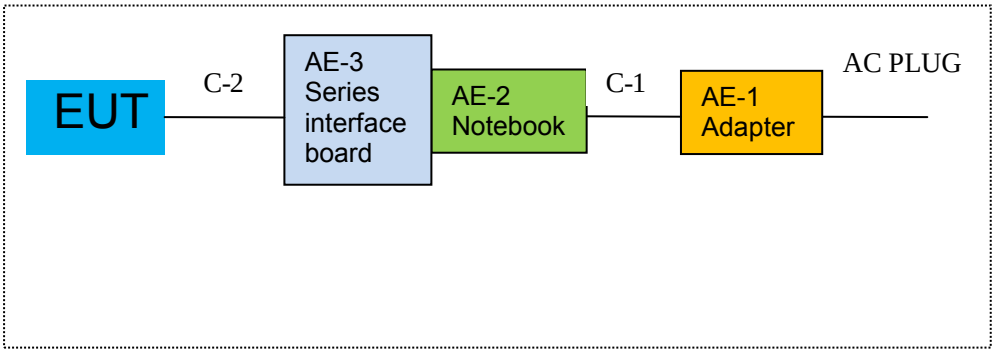
Note:

1. The engineering test program was provided and the EUT was programmed to be in continuously transmitting mode.
2. AC power line Conducted Emission was tested under maximum output power.
3. For radiated test cases, the worst mode data rate 1Mbps was reported only, because this data rate has the highest RF output power at preliminary tests, and no other significantly frequencies found in conducted spurious emission.
4. EUT is set to continuous transmission mode. duty cycle greater than 98%.

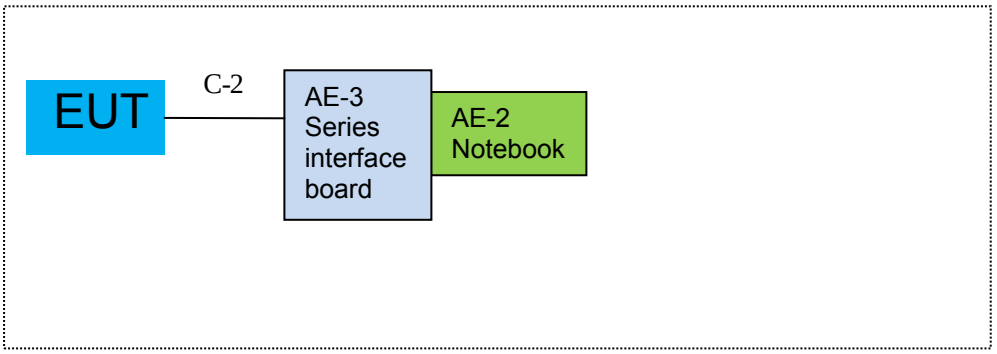
6 SETUP OF EQUIPMENT UNDER TEST

6.1 BLOCK DIAGRAM CONFIGURATION OF TEST SYSTEM

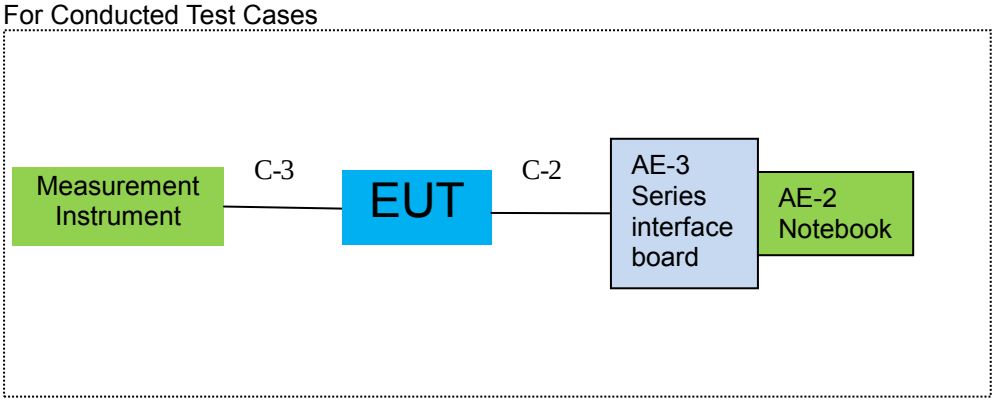
For AC Conducted Emission Mode



For Radiated Test Cases



For Conducted Test Cases



Note:The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

6.2 SUPPORT EQUIPMENT

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
AE-1	Adapter	N/A	N/A	N/A	Peripherals
AE-2	Notebook	DELL	PP10L	N/A	Peripherals
AE-3	Series interface board	N/A	N/A	N/A	Peripherals

Item	Cable Type	Shielded Type	Ferrite Core	Length
C-1	Power Cable	NO	YES	1.2m
C-2	Data Cable	NO	NO	0.5m
C-3	RF Cable	YES	NO	0.1m

Notes:

(1) The support equipment was authorized by Declaration of Confirmation.
(2) For detachable type I/O cable should be specified the length in cm in『Length』column.
(3) “YES” is means “shielded” “with core”; “NO” is means “unshielded” “without core”.

6.3 EQUIPMENTS LIST FOR ALL TEST ITEMS

Radiation& Conducted Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Spectrum Analyzer	Aglient	E4407B	MY45108040	2019.05.13	2020.05.12	1 year
2	Spectrum Analyzer	Agilent	E4440A	MY41000130	2019.03.27	2020.03.26	1 year
3	Spectrum Analyzer	R&S	FSV40	101417	2018.10.08	2019.10.07	1 year
4	Test Receiver	R&S	ESPI7	101318	2019.05.13	2020.05.12	1 year
5	Bilog Antenna	TESEQ	CBL6111D	31216	2019.04.15	2020.04.14	1 year
6	50Ω Coaxial Switch	Anritsu	MP59B	6200983705	2018.05.19	2020.05.18	2 year
7	Horn Antenna	EM	EM-AH-10180	2011071402	2019.04.15	2020.04.14	1 year
8	Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	803	2018.12.11	2019.12.10	1 year
9	Amplifier	EMC	EMC051835SE	980246	2019.08.04	2020.08.03	1 year
10	Active Loop Antenna	SCHWARZBECK	FMZB 1519 B	055	2018.12.11	2019.12.10	1 year
11	Power Meter	DARE	RPR3006W	15I00041SNO84	2019.08.04	2020.08.03	1 year
12	Test Cable (9KHz-30MHz)	N/A	R-01	N/A	2017.04.21	2020.04.20	3 year
13	Test Cable (30MHz-1GHz)	N/A	R-02	N/A	2017.04.21	2020.04.20	3 year
14	High Test Cable(1G-40GHz)	N/A	R-03	N/A	2017.04.21	2020.04.20	3 year
15	High Test Cable(1G-40GHz)	N/A	R-04	N/A	2017.04.21	2020.04.20	3 year
16	Filter	TRILTHIC	2400MHz	29	2017.04.19	2020.04.18	3 year
17	temporary antenna connector (Note)	NTS	R001	N/A	N/A	N/A	N/A
18	Temperature and Humidity Table	N/A	AR807	157223	2017.04.17	2020.04.16	3 year

Note:

We will use the temporary antenna connector (soldered on the PCB board) When conducted test And this temporary antenna connector is listed within the instrument list

AC Conduction Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Test Receiver	R&S	ESCI	101160	2019.05.13	2020.05.12	1 year
2	LISN	R&S	ENV216	101313	2019.04.15	2020.04.14	1 year
3	LISN	SCHWARZBECK	NNLK 8129	8129245	2019.05.13	2020.05.12	1 year
4	50Ω Coaxial Switch	ANRITSU CORP	MP59B	6200983704	2018.05.19	2020.05.18	2 year
5	Test Cable (9KHz-30MHz)	N/A	C01	N/A	2017.04.21	2020.04.20	3 year
6	Test Cable (9KHz-30MHz)	N/A	C02	N/A	2017.04.21	2020.04.20	3 year
7	Test Cable (9KHz-30MHz)	N/A	C03	N/A	2017.04.21	2020.04.20	3 year

Note: Each piece of equipment is scheduled for calibration once a year except the Aux Equipment & Test Cable which is scheduled for calibration every 2 or 3 years.

7 TEST REQUIREMENTS

7.1 CONDUCTED EMISSIONS TEST

7.1.1 Applicable Standard

According to RSS-Gen 8.8

7.1.2 Conformance Limit

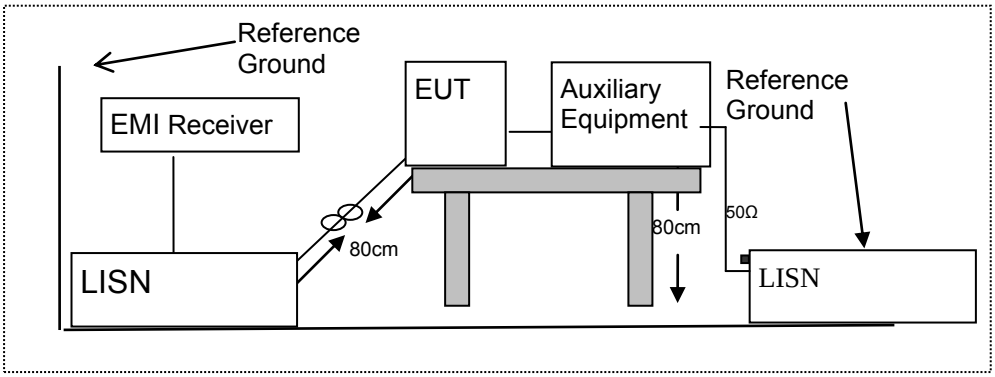
Frequency(MHz)	Conducted Emission Limit	
	Quasi-peak	Average
0.15-0.5	66-56*	56-46*
0.5-5.0	56	46
5.0-30.0	60	50

Note: 1. *Decreases with the logarithm of the frequency
2. The lower limit shall apply at the transition frequencies
3. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

7.1.3 Measuring Instruments

The Measuring equipment is listed in the section 6.3 of this test report.

7.1.4 Test Configuration



7.1.5 Test Procedure

According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 Conducted emissions the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode.

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room.
2. The EUT was placed on a table which is 0.8m above ground plane.
3. Connect EUT to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
4. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40cm long.
5. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
6. LISN at least 80 cm from nearest part of EUT chassis.
7. The frequency range from 150KHz to 30MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth(IF bandwidth=9KHz) with Maximum Hold Mode
9. For the actual test configuration, please refer to the related Item –EUT Test Photos.

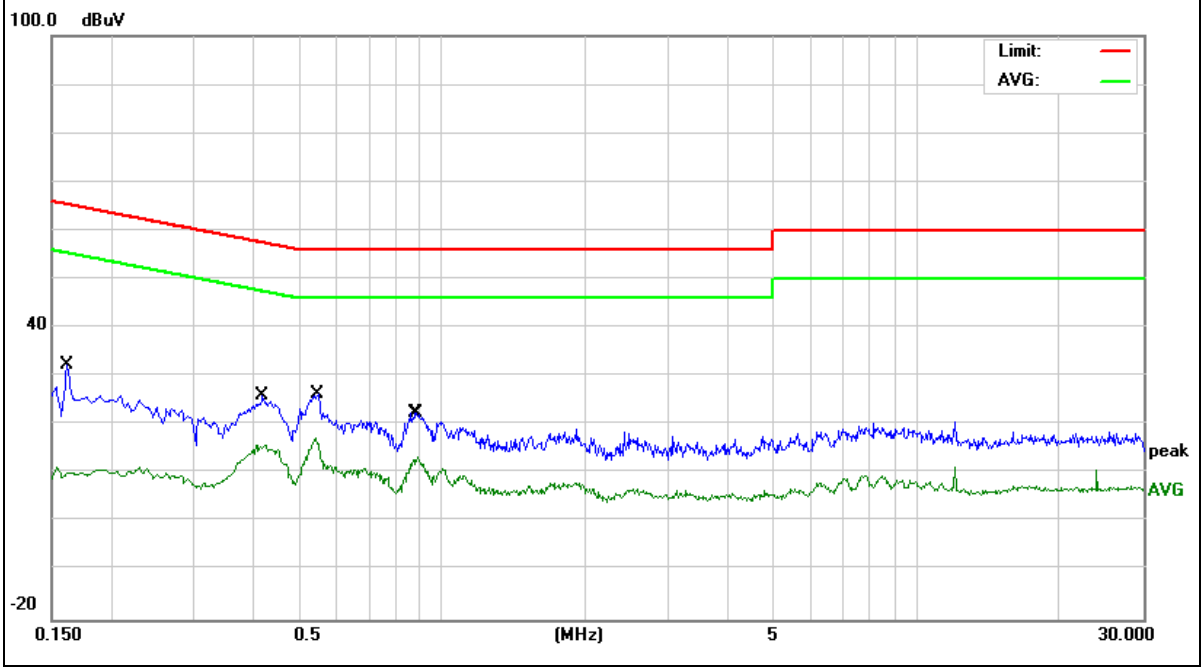
7.1.6 Test Results

EUT：	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model Name ：	HM-BT4502
Temperature：	26 ℃	Relative Humidity：	54%
Pressure：	1010hPa	Phase :	L
Test Voltage ：	DC 5V from Notebook AC 120V/60Hz	Test Mode：	Mode 1

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.1620	22.61	9.73	32.34	65.36	-33.02	QP
0.1620	1.77	9.73	11.50	55.36	-43.86	AVG
0.4220	16.19	9.75	25.94	57.41	-31.47	QP
0.4220	6.12	9.75	15.87	47.41	-31.54	AVG
0.5420	16.64	9.75	26.39	56.00	-29.61	QP
0.5420	7.56	9.75	17.31	46.00	-28.69	AVG
0.8660	12.81	9.75	22.56	56.00	-33.44	QP
0.8860	3.69	9.75	13.44	46.00	-32.56	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

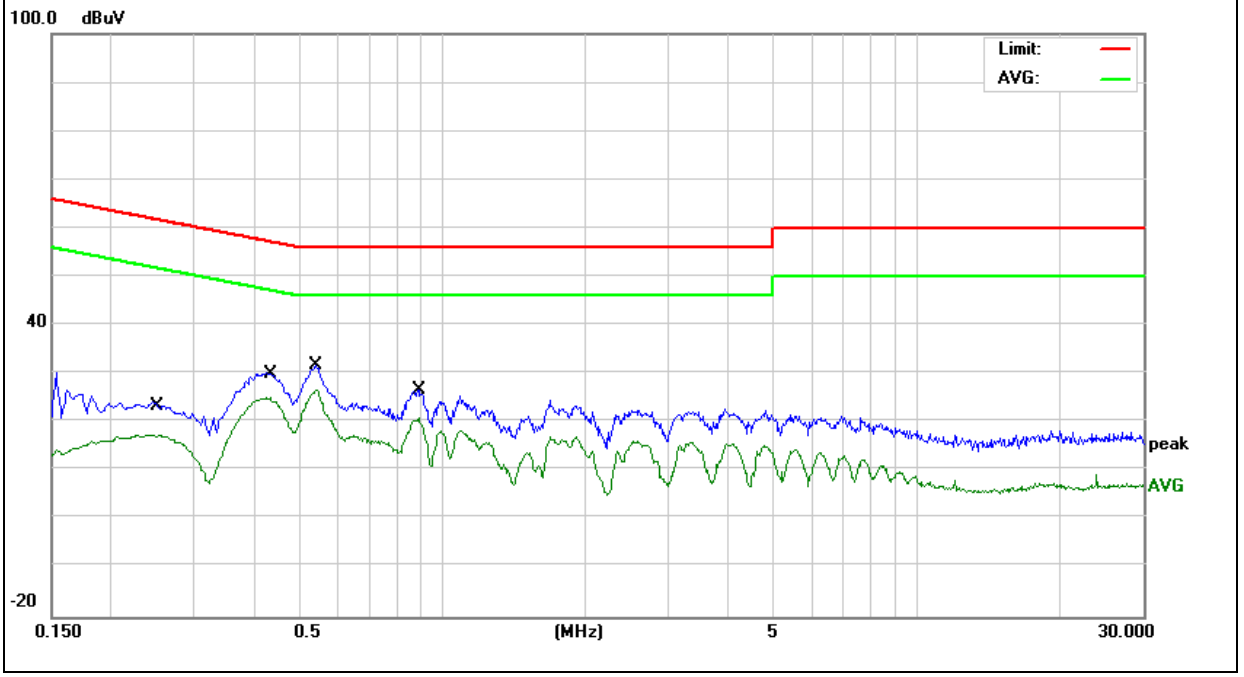


EUT：	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model Name ：	HM-BT4502
Temperature：	26 ℃	Relative Humidity：	54%
Pressure：	1010hPa	Phase :	N
Test Voltage ：	DC 5V from Notebook AC 120V/60Hz	Test Mode：	Mode 1

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.2540	14.55	9.74	24.29	61.62	-37.33	QP
0.2540	7.68	9.74	17.42	51.62	-34.20	AVG
0.4339	20.41	9.75	30.16	57.18	-27.02	QP
0.4339	15.34	9.75	25.09	47.18	-22.09	AVG
0.5420	21.87	9.75	31.62	56.00	-24.38	QP
0.5420	16.90	9.75	26.65	46.00	-19.35	AVG
0.8900	17.02	9.75	26.77	56.00	-29.23	QP
0.8900	11.06	9.75	20.81	46.00	-25.19	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

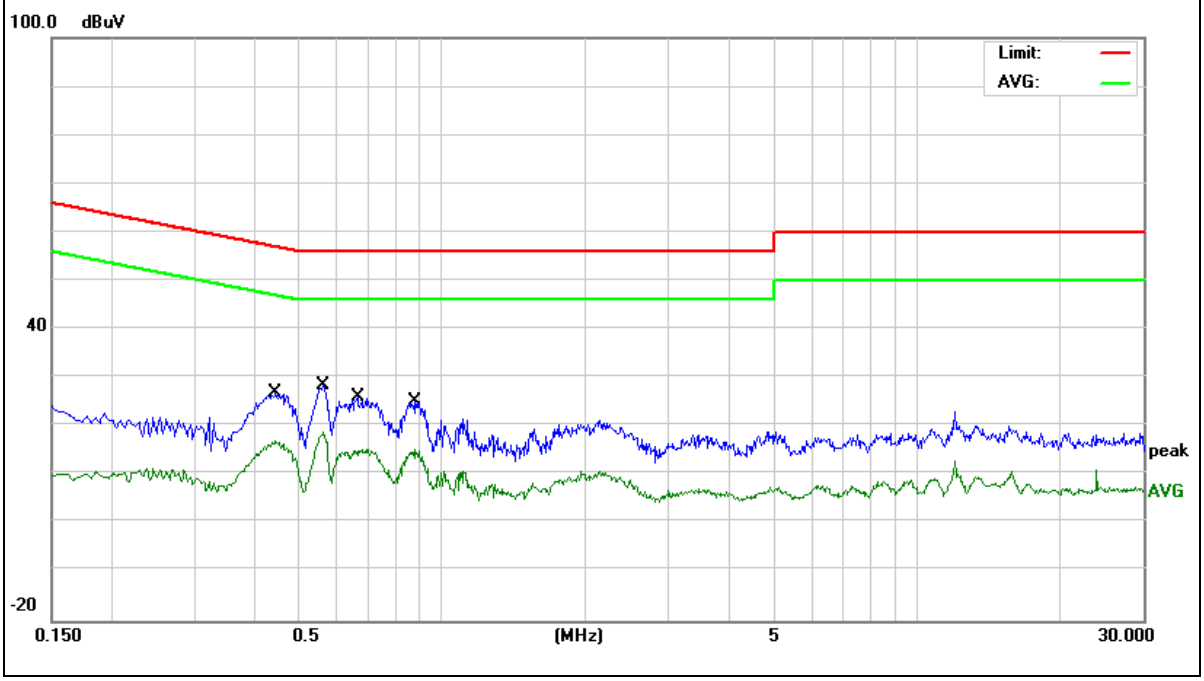


EUT：	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model Name ：	HM-BT4502
Temperature：	26 ℃	Relative Humidity：	54%
Pressure：	1010hPa	Phase :	L
Test Voltage ：	DC 5V from Notebook AC 240V/60Hz	Test Mode：	Mode 1

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.4460	17.12	9.74	26.86	56.95	-30.09	QP
0.4460	7.16	9.74	16.90	46.95	-30.05	AVG
0.5620	18.77	9.74	28.51	56.00	-27.49	QP
0.5620	8.98	9.74	18.72	46.00	-27.28	AVG
0.6620	16.37	9.74	26.11	56.00	-29.89	QP
0.6620	5.45	9.74	15.19	46.00	-30.81	AVG
0.8739	15.46	9.74	25.20	56.00	-30.80	QP
0.8739	5.43	9.74	15.17	46.00	-30.83	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

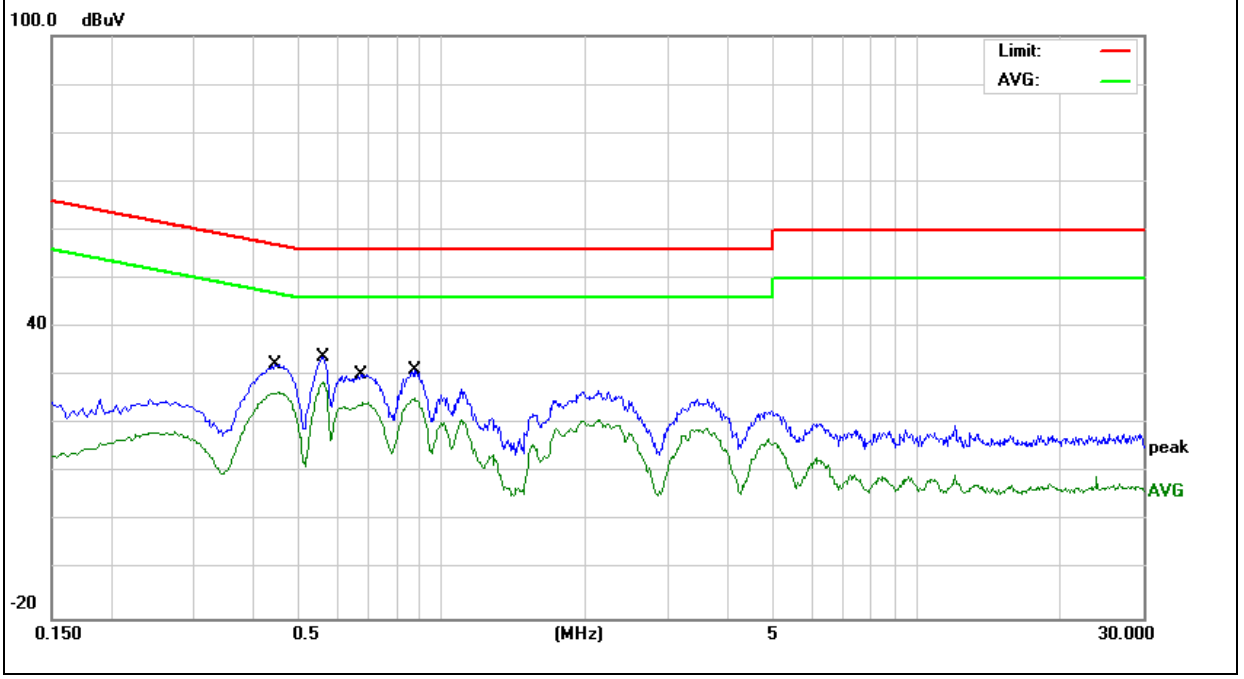


EUT：	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model Name ：	HM-BT4502
Temperature：	26 ℃	Relative Humidity：	54%
Pressure：	1010hPa	Phase :	N
Test Voltage ：	DC 5V from Notebook AC 240V/60Hz	Test Mode：	Mode 1

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.4500	22.54	9.75	32.29	56.87	-24.58	QP
0.4500	16.79	9.75	26.54	46.87	-20.33	AVG
0.5620	24.01	9.75	33.76	56.00	-22.24	QP
0.5620	18.86	9.75	28.61	46.00	-17.39	AVG
0.6820	20.42	9.75	30.17	56.00	-25.83	QP
0.6820	14.70	9.75	24.45	46.00	-21.55	AVG
0.8739	21.26	9.75	31.01	56.00	-24.99	QP
0.8739	15.77	9.75	25.52	46.00	-20.48	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.



7.2 RADIATED SPURIOUS EMISSION

7.2.1 Applicable Standard

According to RSS-Gen 8.9& 9.10.

7.2.2 Conformance Limit

According to IC RSS-Gen 8.10: radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits. According to IC RSS-Gen , Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

According to IC RSS-Gen, the level of any transmitter spurious emission in Restricted bands shall not exceed the level of the emission specified in the following table

Restricted Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance
0.009~0.490	2400/F(KHz)	20 log (uV/m)	300
0.490~1.705	2400/F(KHz)	20 log (uV/m)	30
1.705~30.0	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Limits of Radiated Emission Measurement(Above 1000MHz)

Frequency(MHz)	Class B (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Remark :1. Emission level in dBuV/m=20 log (uV/m)

2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

3. For Frequency 9kHz~30MHz: Distance extrapolation factor =40log(Specific distance/ test distance)(dB); Limit line=Specific limits(dBuV) + distance extrapolation factor.

For Frequency above 30MHz: Distance extrapolation factor =20log(Specific distance/ test distance)(dB);

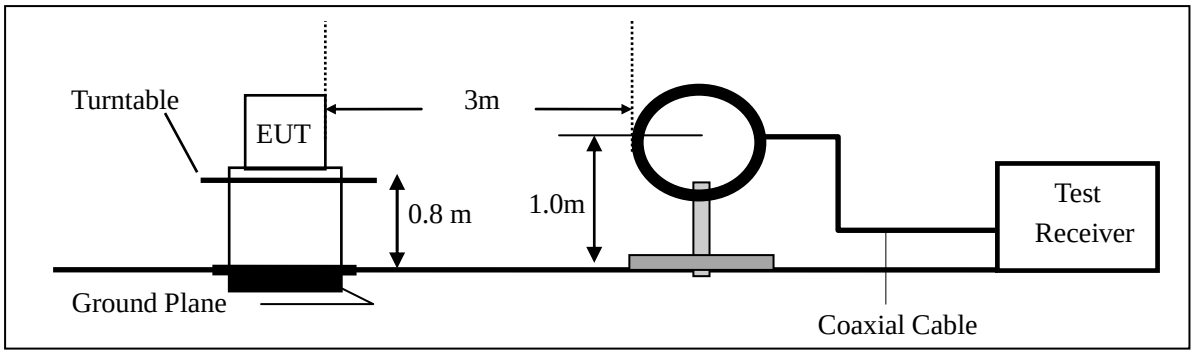
Limit line=Specific limits(dBuV) + distance extrapolation factor.

7.2.3 Measuring Instruments

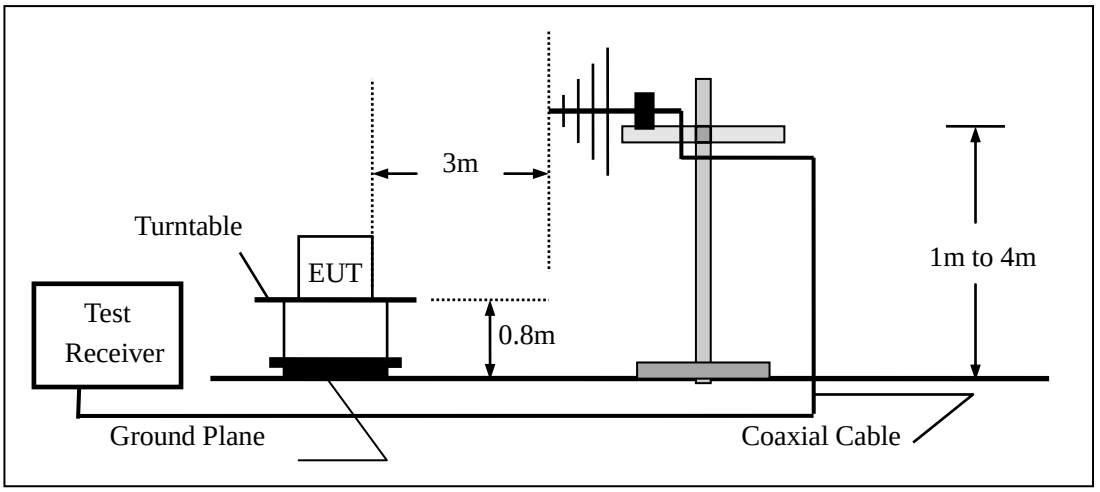
The Measuring equipment is listed in the section 6.3 of this test report.

7.2.4 Test Configuration

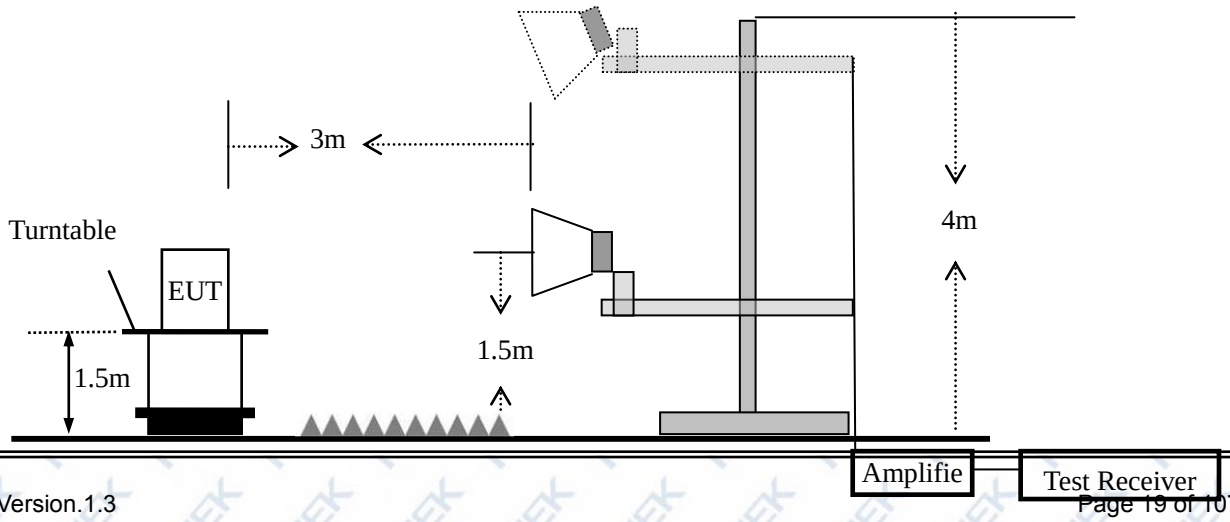
(a) For radiated emissions below 30MHz



(b) For radiated emissions from 30MHz to 1000MHz



(c) For radiated emissions above 1000MHz



7.2.5 Test Procedure

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10-2013. The test distance is 3m.The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 and CAN/CSA-CEI/IEC CISPR 22.
This test is required for any spurious emission that falls in a Restricted Band, as defined in RSS-Gen 6.13. It must be performed with the highest gain of each type of antenna proposed for use with the EUT.
Use the following spectrum analyzer settings:

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

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

Measurements shall be taken, using the following steps, at a test site that has been validated using the procedures of ANSI C63.4 or the latest CISPR 16-1-4 for measurements above 1 GHz, so as to simulate a near free-space environment (see RSS-Gen for applicable versions of ANSI and CISPR standards).
(1) Line the ground plane with absorbers between the transmitter and the receive antenna to minimize reflections. The absorbers used should have a minimum-rated attenuation of 20 dB through the measurement frequency range of interest. The absorbers shall be positioned to replicate the layout used when compliance with the applicable acceptability criterion was achieved, as set forth in the aforementioned standards on site validation.
(2) Set the height of the receive antenna to 1.5 m. The receive antenna must be one that was designed and fabricated to operate over the entire frequency range of interest, for example, an appropriate standard gain horn.
(3) The distance between the receive antenna and the radiating source shall be sufficient in order to ensure far-field conditions.
(4) Mount the transmitter at a height of 1.5 m.
(5) Configure the device under test (DUT) to produce the maximum power spectral density as measured while assessing compliance with Section 6.2.2 (i.e. channel frequency, modulation type and data rate). If the DUT is equipped with a detachable antenna and the antenna is intended for remote installation (i.e. tower-mounted), the DUT may be substituted with a suitable signal generator. The level and frequency settings on the generator shall be set so as to reproduce the maximum power spectral density, measured within a 1 MHz bandwidth, obtained while assessing compliance to Section 6.2.2.
(6) Position the transmitter or the radiating antenna so that elevation pattern measurements can be taken.
(7) Find the 0° reference point in the horizontal plane.
(8) Care should be taken when positioning the receive antenna to avoid cross-polarization. Antennas of known mounting polarization should be assessed with the receive antenna oriented in the same polarity. If the polarization of the transmit antenna is unknown or the transmit antenna can be mounted in either polarization, e.i.r.p. measurements should be performed to find which
mounting polarity provides the highest e.i.r.p. value. Testing shall be carried out with the receive antenna and the DUT mounted in each polarity.
(9) The emission shall be centred on the display of the spectrum analyzer with the following settings:
i. If the power spectral density of the DUT was assessed with a peak detector and the antenna cannot be detached from the DUT, the spectrum analyzer shall be set to a peak detector with a resolution bandwidth and video bandwidth of 1 MHz.
ii. If the power spectral density of the DUT was assessed using a sample detector with power averaging and the antenna cannot be detached from the DUT, the spectrum analyzer shall be set to a sample detector, configured to produce 100 power averages and set with a resolution bandwidth, as well as a video bandwidth of 1 MHz.

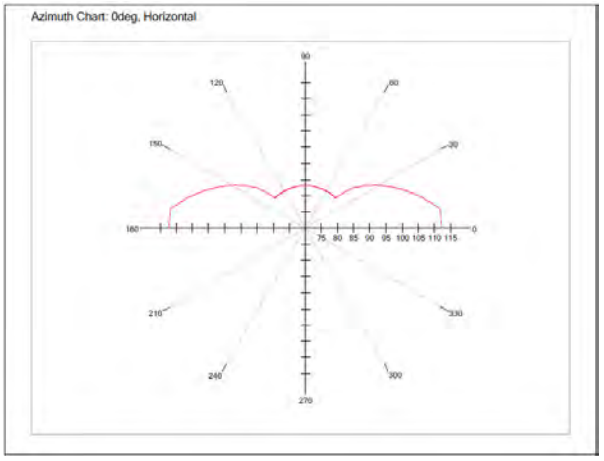
iii. If the antenna can be detached from the DUT, a continuous wave (CW) signal equal to that of the power spectral density measurement may be used, the spectrum analyzer shall be set to peak detector with a resolution bandwidth and video bandwidth of 1 MHz.

(10) Rotate the turntable 360° recording the field strength at each step. Throughout the main beam of the antenna, the step size shall be kept to a maximum of 1°.
Once outside the main beam of the antenna, the maximum step size shall be as follows, when compared to the requirements of Section 6.2.2:
i. Between 0° and 8°, maximum step size of 2°;
ii. Between 8° and 40°, maximum step size of 4°;
iii. Between 40° and 45°, maximum step size of 1°;
iv. Between 45° and 90°, maximum step size of 5°.
Once the mask reaches 90°, the mask will be inverted and the step size will follow in the same manner as above.
For the purpose of this procedure, the main beam of the antenna is defined as the 3 dB beamwidth.
(11) Convert the measured field strength values in terms of e.i.r.p. density (dBW/1 MHz) using the following equation:

□ □ □ □ □ □ □e.i.r.p density(dBW/MHz)=10log((E*r)^2/30)

E = field strength in V/m
r = measurement distance in metres

(12) Plot the results against the emission mask with reference to the horizontal plane.
(13) Using the plot, the 0° can be rotated to determine the worst-case installation tilt angle.
(14) Testing shall be performed using the highest gain antenna for every antenna type, if applicable.
(15) Antenna type(s), antenna model number(s), and worst-case tilt angle(s) necessary to remain compliant with the elevation mask requirement set forth in Section 6.2.2(3) of RSS-247 shall be clearly indicated in the user manual.
The following figure is an example of a polar elevation mask measured using the Method 1 reference to dBµV/m at 3 m.



During the radiated emission test, the Spectrum Analyzer was set with the following configurations:

Frequency Band (MHz)	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	QP	120 kHz	300 kHz
Above 1000	Peak	1 MHz	1 MHz
	Average	1 MHz	10 Hz

Note: for the frequency ranges below 30 MHz, a narrower RBW is used for these ranges but the measured value should add a RBW correction factor (RBWCF) where RBWCF [dB] =10*lg(100 [kHz]/narrower RBW [kHz]). , the narrower RBW is 1 kHz and RBWCF is 20 dB for the frequency 9 kHz to 150 kHz, and the narrower RBW is 10 kHz and RBWCF is 10 dB for the frequency 150 kHz to 30 MHz.

7.2.6 Test Results

■ Spurious Emission below 30MHz (9KHz to 30MHz)

EUT:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model No.:	HM-BT4502
Temperature:	20 ℃	Relative Humidity:	48%
Test Mode:	Mode2/Mode3/Mode4	Test By:	Eileen Liu

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
--	--	--	--	--	--	--	--

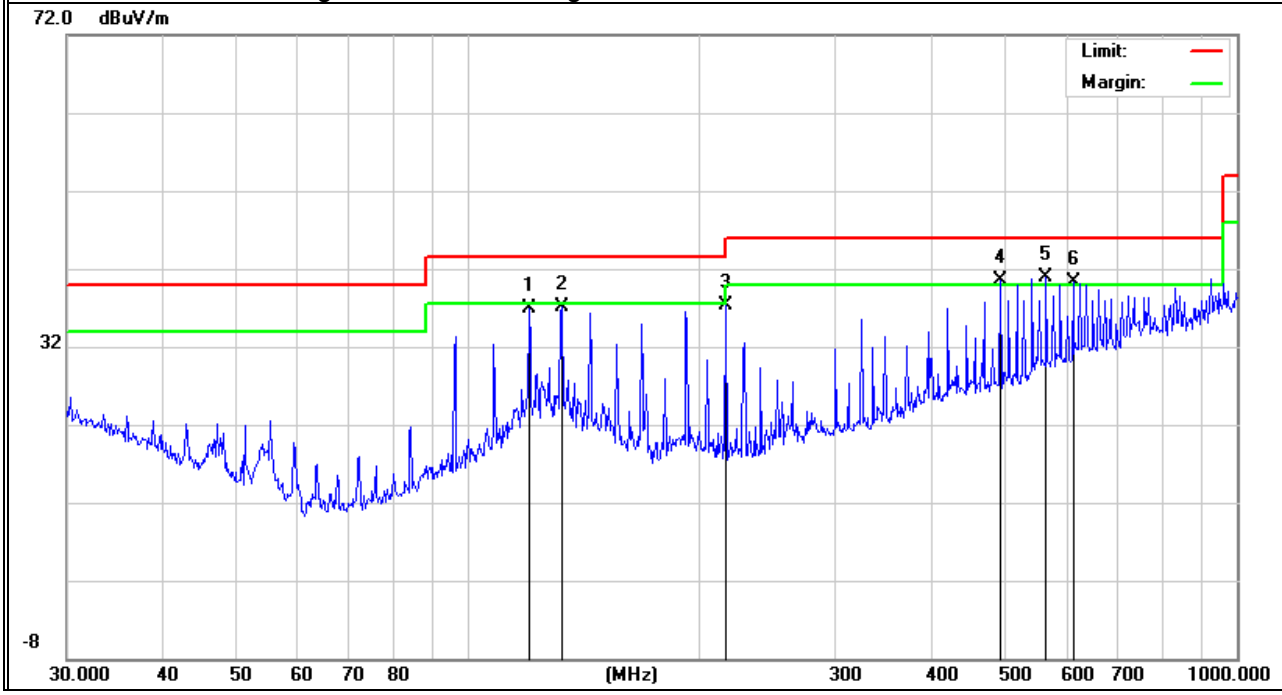
Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

■ Spurious Emission below 1GHz (30MHz to 1GHz)
All the modulation modes have been tested, and the worst result was report as below:

EUT：	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model Name ：	HM-BT4502
Temperature：	20 ℃	Relative Humidity：	48%
Pressure：	1010hPa	Test Mode：	Mode 1
Test Voltage ：	DC 5V from Notebook		

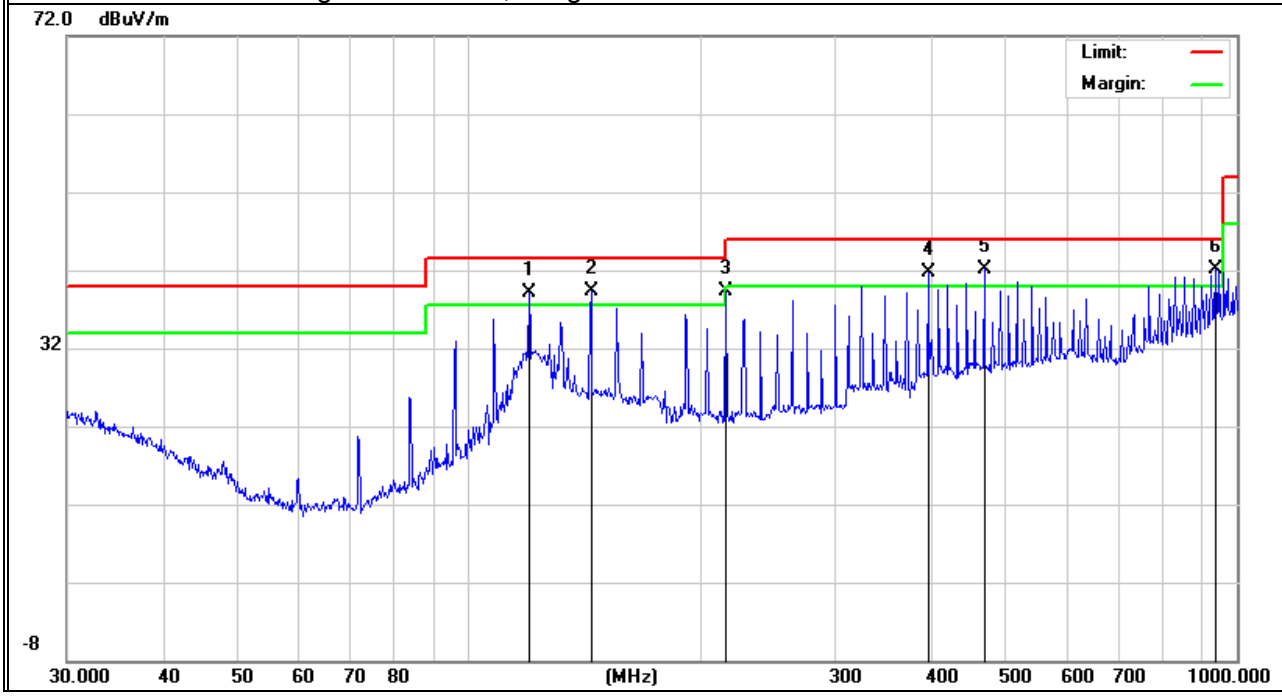
Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
V	119.8555	23.66	13.18	36.84	43.50	-6.66	QP
V	132.2204	23.76	13.43	37.19	43.50	-6.31	QP
V	216.0240	26.12	11.10	37.22	46.00	-8.78	QP
V	492.4685	18.70	21.76	40.46	46.00	-5.54	QP
V	564.6389	16.89	24.00	40.89	46.00	-5.11	QP
V	612.0642	15.64	24.57	40.21	46.00	-5.79	QP

Remark:
Absolute Level= ReadingLevel+ Factor, Margin= Absolute Level - Limit



Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
H	119.8555	25.99	13.18	39.17	43.50	-4.33	QP
H	144.3348	26.09	13.16	39.25	43.50	-4.25	QP
H	216.0240	28.20	11.10	39.30	46.00	-6.70	QP
H	396.2412	22.23	19.38	41.61	46.00	-4.39	QP
H	468.8761	21.22	20.94	42.16	46.00	-3.84	QP
H	938.8324	11.19	30.85	42.04	46.00	-3.96	QP

Remark:
Absolute Level= ReadingLevel+ Factor, Margin= Absolute Level - Limit



■ Spurious Emission Above 1GHz (1GHz to 25GHz)

EUT:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model No.:	HM-BT4502
Temperature:	20 ℃	Relative Humidity:	48%
Test Mode:	Mode2/Mode3/Mode4-2Mbps	Test By:	Eileen Liu

Frequency (MHz)	Read Level (dBμV)	Cable loss (dB)	Antenna Factor dB/m	Preamp Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark	Comment
Low Channel (2402 MHz)-Above 1G									
4804	41.99	5.21	35.59	44.30	38.49	74.00	-35.51	Pk	Vertical
4804	35.18	5.21	35.59	44.30	31.68	54.00	-22.32	AV	Vertical
7206	44.59	6.48	36.27	44.60	42.74	74.00	-31.26	Pk	Vertical
7206	29.50	6.48	36.27	44.60	27.65	54.00	-26.35	AV	Vertical
4804	52.51	5.21	35.55	44.30	48.97	74.00	-25.03	Pk	Horizontal
4804	39.33	5.21	35.55	44.30	35.79	54.00	-18.21	AV	Horizontal
7206	44.76	6.48	36.27	44.52	42.99	74.00	-31.01	Pk	Horizontal
7206	29.42	6.48	36.27	44.52	27.65	54.00	-26.35	AV	Horizontal
Mid Channel (2440 MHz)-Above 1G									
4880	41.74	5.21	35.66	44.20	38.41	74.00	-35.59	Pk	Vertical
4880	29.07	5.21	35.66	44.20	25.74	54.00	-28.26	AV	Vertical
7320	43.57	7.10	36.50	44.43	42.74	74.00	-31.26	Pk	Vertical
7320	25.60	7.10	36.50	44.43	24.77	54.00	-29.23	AV	Vertical
4880	49.10	5.21	35.66	44.20	45.77	74.00	-28.23	Pk	Horizontal
4880	31.30	5.21	35.66	44.20	27.97	54.00	-26.03	AV	Horizontal
7320	44.62	7.10	36.50	44.43	43.79	74.00	-30.21	Pk	Horizontal
7320	28.51	7.10	36.50	44.43	27.68	54.00	-26.32	AV	Horizontal
High Channel (2480 MHz)- Above 1G									
4960	43.25	5.21	35.52	44.21	39.77	74.00	-34.23	Pk	Vertical
4960	28.16	5.21	35.52	44.21	24.68	54.00	-29.32	AV	Vertical
7440	45.65	7.10	36.53	44.60	44.68	74.00	-29.32	Pk	Vertical
	27.72	7.10	36.53	44.60	26.75	54.00	-27.25	AV	Vertical
4960	48.83	5.21	35.52	44.21	45.35	74.00	-28.65	Pk	Horizontal
4960	32.90	5.21	35.52	44.21	29.42	54.00	-24.58	AV	Horizontal
7440	45.65	7.10	36.53	44.60	44.68	74.00	-29.32	Pk	Horizontal
7440	29.71	7.10	36.53	44.60	28.74	54.00	-25.26	AV	Horizontal

Note:

(1) Emission Level= Antenna Factor + Cable Loss + Read Level - Preamp Factor

(2)All other emissions more than 20dB below the limit.

(3) All rate had been tested, but only the worst data on 2Mbps rate recorded in the report.

■ Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

EUT:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model No.:	HM-BT4502
Temperature:	20 ℃	Relative Humidity:	48%
Test Mode:	Mode2 /Mode4 -2Mbps	Test By:	Eileen Liu

All the modulation modes were tested, the data of the worst mode are described in the following table

Frequency	Meter Reading	Cable Loss	Antenna Factor	Preamp Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	(dB)	dB/m	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type	
GFSK-2 Mbps									
2310.00	64.32	2.97	27.80	43.80	51.29	74	-22.71	Pk	Horizontal
2310.00	48.59	2.97	27.80	43.80	35.56	54	-18.44	AV	Horizontal
2310.00	65.23	2.97	27.80	43.80	52.20	74	-21.8	Pk	Vertical
2310.00	51.34	2.97	27.80	43.80	38.31	54	-15.69	AV	Vertical
2390.00	66.26	3.14	27.21	43.80	52.81	74	-21.19	Pk	Vertical
2390.00	47.56	3.14	27.21	43.80	34.11	54	-19.89	AV	Vertical
2390.00	66.23	3.14	27.21	43.80	52.78	74	-21.22	Pk	Horizontal
2390.00	49.02	3.14	27.21	43.80	35.57	54	-18.43	AV	Horizontal
2483.50	66.59	3.58	27.70	44.00	53.87	74	-20.13	Pk	Vertical
2483.50	49.15	3.58	27.70	44.00	36.43	54	-17.57	AV	Vertical
2483.50	63.59	3.58	27.70	44.00	50.87	74	-23.13	Pk	Horizontal
2483.50	46.52	3.58	27.70	44.00	33.80	54	-20.20	AV	Horizontal

Note: (1) All other emissions more than 20dB below the limit.
(2) All rate had been tested, but only the worst data on 2Mbps rate recorded in the report.

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■ Spurious Emission in Restricted Band 3260MHz-18000MHz

EUT:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model No.:	HM-BT4502
Temperature:	20 ℃	Relative Humidity:	48%
Test Mode:	Mode2 /Mode4-2Mbps	Test By:	Eileen Liu

All the modulation modes have been tested, and the worst result was report as below:

Frequency (MHz)	Reading Level (dBμV)	Cable Loss (dB)	Antenna dB/m	Preamp Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
3260	64.41	4.04	29.57	44.70	53.32	74	-20.68	Pk	Vertical
3260	49.95	4.04	29.57	44.70	38.86	54	-15.14	AV	Vertical
3260	64.46	4.04	29.57	44.70	53.37	74	-20.63	Pk	Horizontal
3260	47.74	4.04	29.57	44.70	36.65	54	-17.35	AV	Horizontal
3332	63.23	4.26	29.87	44.40	52.96	74	-21.04	Pk	Vertical
3332	46.52	4.26	29.87	44.40	36.25	54	-17.75	AV	Vertical
3332	64.89	4.26	29.87	44.40	54.62	74	-19.38	Pk	Horizontal
3332	47.87	4.26	29.87	44.40	37.60	54	-16.40	AV	Horizontal
17797	48.41	10.99	43.95	43.50	59.85	74	-14.15	Pk	Vertical
17797	30.12	10.99	43.95	43.50	41.56	54	-12.44	AV	Vertical
17788	47.63	11.81	43.69	44.60	58.53	74	-15.47	Pk	Horizontal
17788	30.19	11.81	43.69	44.60	41.09	54	-12.91	AV	Horizontal

Note: (1) All other emissions more than 20dB below the limit.
(2) All rate had been tested, but only the worst data on 2Mbps rate recorded in the report.

7.3 6DB BANDWIDTH

7.3.1 Applicable Standard

According to RSS-247 5.2(a)

7.3.2 Conformance Limit

The minimum -6 dB bandwidth shall be at least 500 kHz.

7.3.3 Measuring Instruments

The Measuring equipment is listed in the section 6.3 of this test report.

7.3.4 Test Setup

Please refer to Section 6.1 of this test report.

7.3.5 Test Procedure

The testing follows RSS-247 5.2(a)
The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
The path loss was compensated to the results for each measurement.
Set to the maximum power setting and enable the EUT transmit continuously.
The EUT was operating in controlled its channel.
Use the following spectrum analyzer settings:
Span = the frequency band of operation
RBW = 100KHz
VBW ≥ 3*RBW
Sweep = auto
Detector function = peak
Trace = max hold

7.3.6 Test Results

EUT:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model No.:	HM-BT4502
Temperature:	20 ℃	Relative Humidity:	48%
Test Mode:	Mode2/Mode3/Mode4	Test By:	Eileen Liu

Test data reference attachment.

7.4 99% OCCUPIED BANDWIDTH

7.4.1 Applicable Standard

According to RSS-Gen 6.7

7.4.2 Conformance Limit

No limit requirement.

7.4.3 Measuring Instruments

The Measuring equipment is listed in the section 6.3 of this test report.

7.4.4 Test Setup

Please refer to Section 6.1 of this test report.

7.4.5 Test Procedure

The testing follows RSS-Gen 6.7
The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
The path loss was compensated to the results for each measurement.
Set to the maximum power setting and enable the EUT transmit continuously.
The EUT was operating in controlled its channel.
Use the following spectrum analyzer settings:
Set RBW = 1-5% of occupied bandwidth.
Set the video bandwidth (VBW) = approximately three times the RBW.
Set Span= approximately 2 times OBW
Set Detector = Peak.
Set Trace mode = max hold.
Set Sweep = auto couple.

7.4.6 Test Results

EUT:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model No.:	HM-BT4502
Temperature:	20 ℃	Relative Humidity:	48%
Test Mode:	Mode2/Mode3/Mode4	Test By:	Eileen Liu

Test data reference attachment.

7.5 PEAK OUTPUT POWER

7.5.1 Applicable Standard

According to RSS-247 5.4(d)

7.5.2 Conformance Limit

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W.

7.5.3 Measuring Instruments

The Measuring equipment is listed in the section 6.3 of this test report.

7.5.4 Test Setup

Please refer to Section 6.1 of this test report.

7.5.5 Test Procedure

The testing follows RSS-247 5.4(d)
The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
The path loss was compensated to the results for each measurement.
Set to the maximum power setting and enable the EUT transmit continuously.
The EUT was operating in controlled its channel.
Use the following spectrum analyzer settings:
Set the RBW ≧DTS bandwidth(about 1MHz).
Set VBW =3*RBW(about 3MHz)
Set the span ≧3*RBW
Set Sweep time = auto couple.
Set Detector = peak.
Set Trace mode = max hold.
Allow trace to fully stabilize.
Use peak marker function to determine the peak amplitude level.

7.5.6 Test Results

EUT:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model No.:	HM-BT4502
Temperature:	20 ℃	Relative Humidity:	48%
Test Mode:	Mode2/Mode3/Mode4	Test By:	Eileen Liu

Test data reference attachment.

7.6 EQUIVALENT ISOTROPICALLY RADIATED POWER

7.6.1 Applicable Standard

According to RSS-247 5.4(d)

7.6.2 Conformance Limit

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the e.i.r.p. shall not exceed 4 W.

7.6.3 Measuring Instruments

The Measuring equipment is listed in the section 6.3 of this test report.

7.6.4 Test Setup

Please refer to Section 6.1 of this test report.

7.6.5 Test Procedure

The testing follows RSS-247 5.4(d)
The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
The path loss was compensated to the results for each measurement.
Set to the maximum power setting and enable the EUT transmit continuously.
The EUT was operating in controlled its channel.
Use the following spectrum analyzer settings:
Set the RBW ≧DTS bandwidth(about 1MHz).
Set VBW =3*RBW(about 3MHz)
Set the span ≧3*RBW
Set Sweep time = auto couple.
Set Detector = peak.
Set Trace mode = max hold.
Allow trace to fully stabilize.
Use peak marker function to determine the peak amplitude level.

7.6.6 Test Results

EUT:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model No.:	HM-BT4502
Temperature:	20 ℃	Relative Humidity:	48%
Test Mode:	Mode2/Mode3/Mode4	Test By:	Eileen Liu

Test data reference attachment.

7.7 POWER SPECTRAL DENSITY

7.7.1 Applicable Standard

According to RSS-247 5.2(b)

7.7.2 Conformance Limit

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

7.7.3 Measuring Instruments

The Measuring equipment is listed in the section 6.3 of this test report.

7.7.4 Test Setup

Please refer to Section 6.1 of this test report.

7.7.5 Test Procedure

The testing follows Measurement Procedure 10.3 Method AVGPSD of FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r04
This procedure may be used when the maximum (average) conducted output power was used to demonstrate compliance to the output power limit. This is the baseline method for determining the maximum (average) conducted PSD level. If the instrument has an RMS power averaging detector, it must be used; otherwise, use the sample detector. The EUT must be configured to transmit continuously (duty cycle ≥ 98%); otherwise sweep triggering/signal gating must be implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter off time is to be considered).
The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
The path loss was compensated to the results for each measurement.
Set to the maximum power setting and enable the EUT transmit continuously.
The EUT was operating in controlled its channel.
a) Set instrument center frequency to DTS channel center frequency.
b) Set span to at least 1.5 times the OBW.
c) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz. .
d) Set VBW ≥3 x RBW.
e) Detector = power averaging (RMS) or sample detector (when RMS not available).
f) Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
g) Sweep time = auto couple.
h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
i) Use the peak marker function to determine the maximum amplitude level.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing

7.7.6 Test Results

EUT:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model No.:	HM-BT4502
Temperature:	20 ℃	Relative Humidity:	48%
Test Mode:	Mode2/Mode3/Mode4	Test By:	Eileen Liu

Test data reference attachment.

7.8 CONDUCTED BAND EDGE MEASUREMENT

7.8.1 Applicable Standard

According to RSS-247 5.5

7.8.2 Conformance Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

7.8.3 Measuring Instruments

The Measuring equipment is listed in the section 6.3 of this test report.

7.8.4 Test Setup

Please refer to Section 6.1 of this test report.

7.8.5 Test Procedure

The testing follows RSS-247 5.5
The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
The path loss was compensated to the results for each measurement.
Set to the maximum power setting and enable the EUT transmit continuously.
The EUT was operating in controlled its channel.
Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
Repeat above procedures until all measured frequencies were complete.

7.8.6 Test Results

EUT:	Bluetooth Low Energy (BLE) 5.0 Data Pass-through Module	Model No.:	HM-BT4502
Temperature:	20 ℃	Relative Humidity:	48%
Test Mode:	Mode2/Mode4	Test By:	Eileen Liu

Test data reference attachment.

7.9 SPURIOUS RF CONDUCTED EMISSIONS

7.9.1 Conformance Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

7.9.2 Measuring Instruments

The Measuring equipment is listed in the section 6.3 of this test report.

7.9.3 Test Setup

Please refer to Section 6.1 of this test report.

7.9.4 Test Procedure

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW= 300KHz to measure the peak field strength , and mwasure frequeny range from 9KHz to 26.5GHz.

7.9.5 Test Results

Remark: The measurement frequency range is from 9KHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandege measurement data.

Test data reference attachment.

7.10 ANTENNA APPLICATION

7.10.1 Standard Requirement

As per RSP-100, each applicant for equipment certification must provide a list of all antenna types that may be used with the transmitter, indicating the maximum permissible antenna gain (in dBi).
When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer. The test report shall state the RF power, output power setting and spurious emission measurements, including the antenna type used.
In addition, applicants shall perform RF power and spurious emission measurements with each antenna type supplied or specified by the manufacturer for use with the transmitter.

7.10.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

7.10.3 Antenna Gain

The antenna peak gain of EUT is PCB Antenna (1.5dBi). Therefore, it is not necessary to reduce maximum peak output power limit.

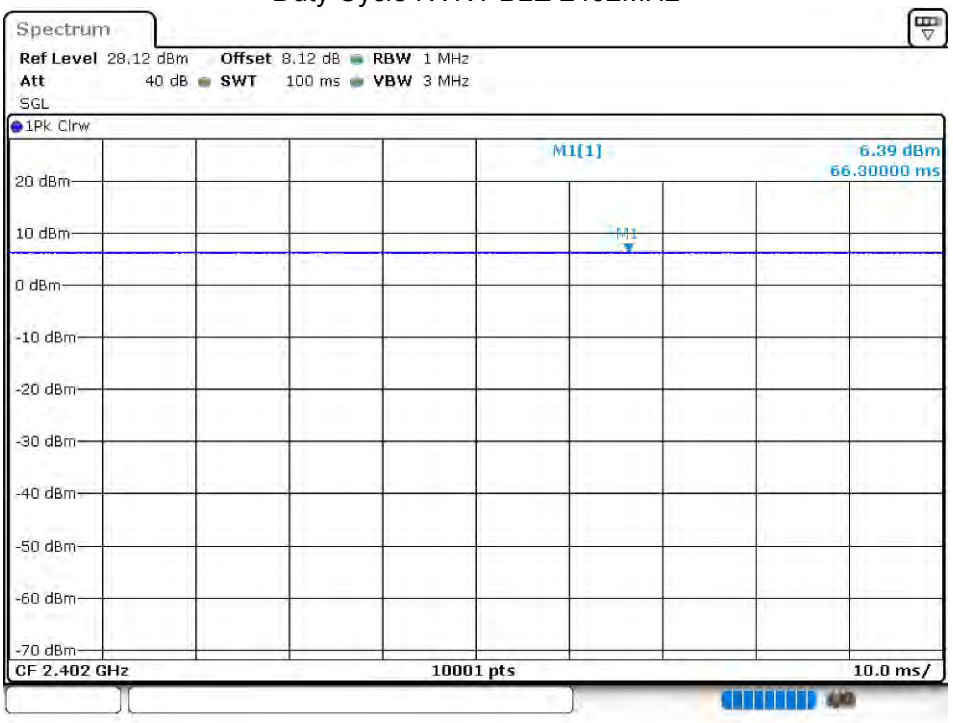
8 TEST RESULTS

8.1 1Mbps RATE DATA

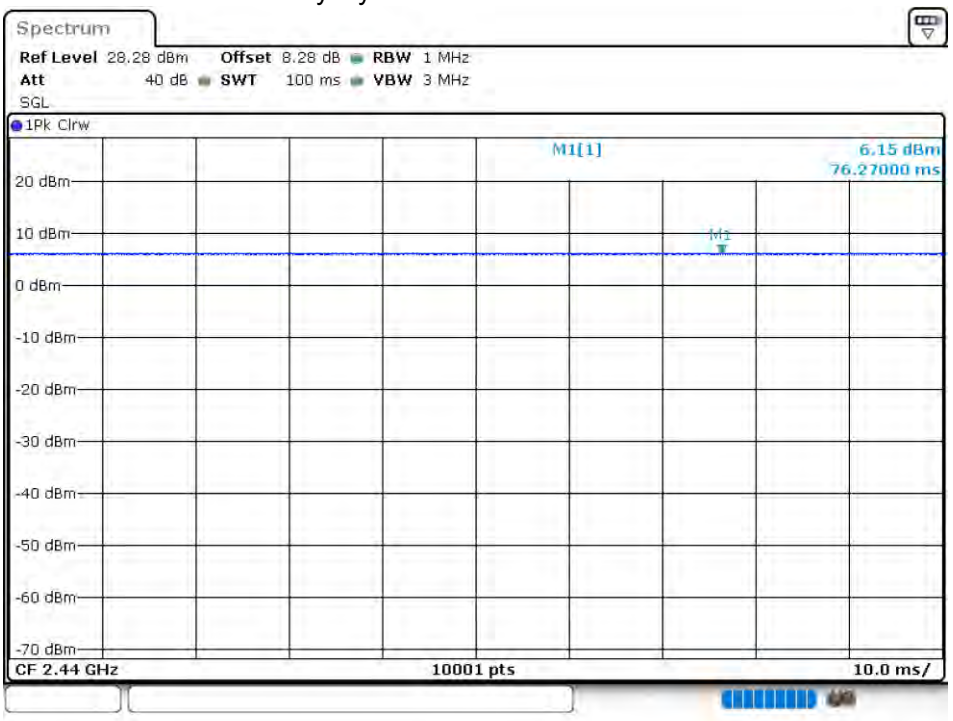
8.1.1 Duty Cycle

Condition	Mode	Frequency (MHz)	Duty Cycle (%)	Correction Factor (dB)
NVNT	BLE	2402	100	0
NVNT	BLE	2440	100	0
NVNT	BLE	2480	100	0

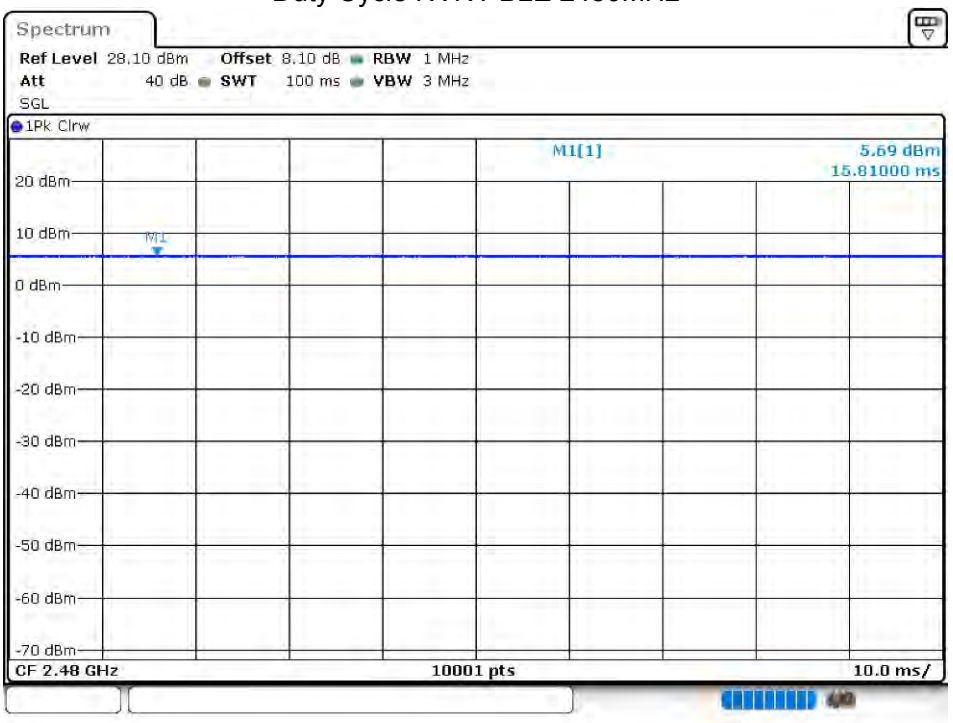
Duty Cycle NVNT BLE 2402MHz



Duty Cycle NVNT BLE 2440MHz



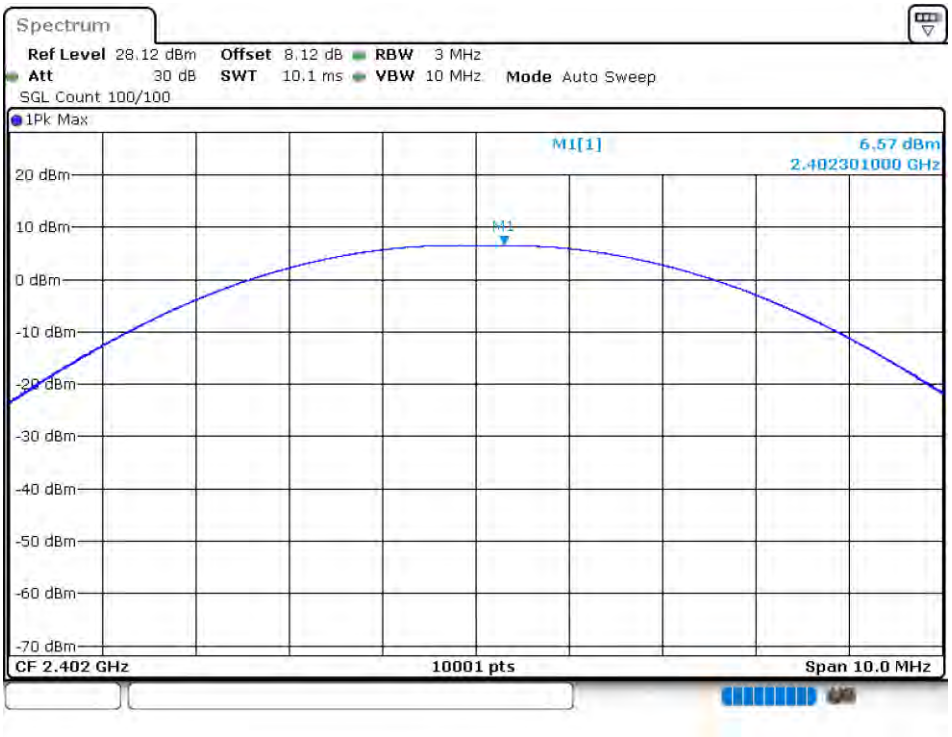
Duty Cycle NVNT BLE 2480MHz



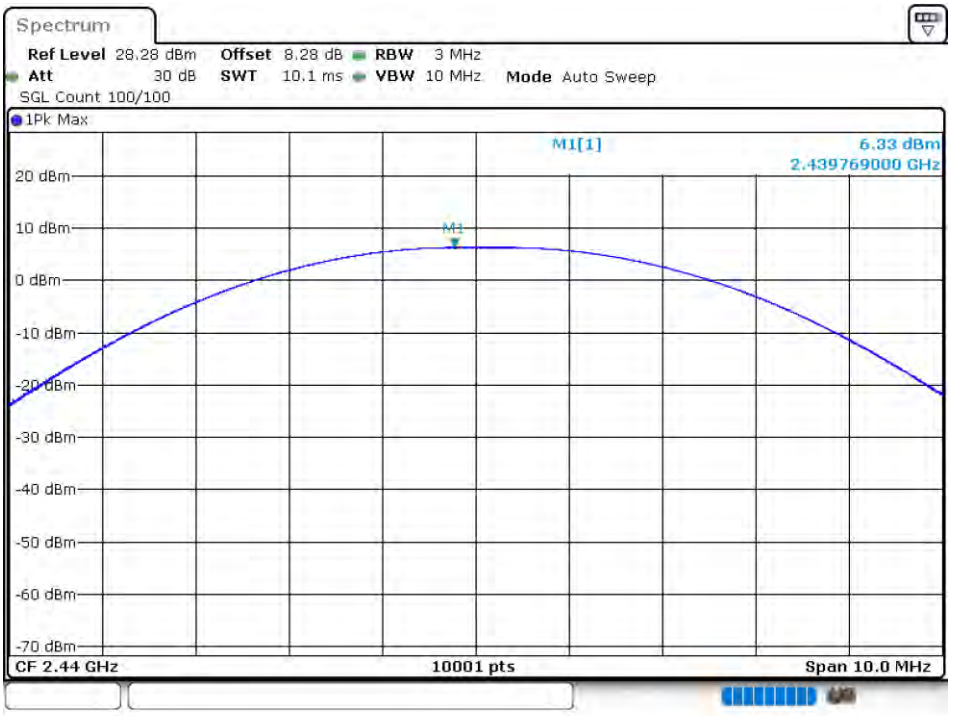
8.1.2 Maximum Conducted Output Power

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE	2402	Ant 1	6.57	0	6.57	30	Pass
NVNT	BLE	2440	Ant 1	6.33	0	6.33	30	Pass
NVNT	BLE	2480	Ant 1	5.83	0	5.83	30	Pass

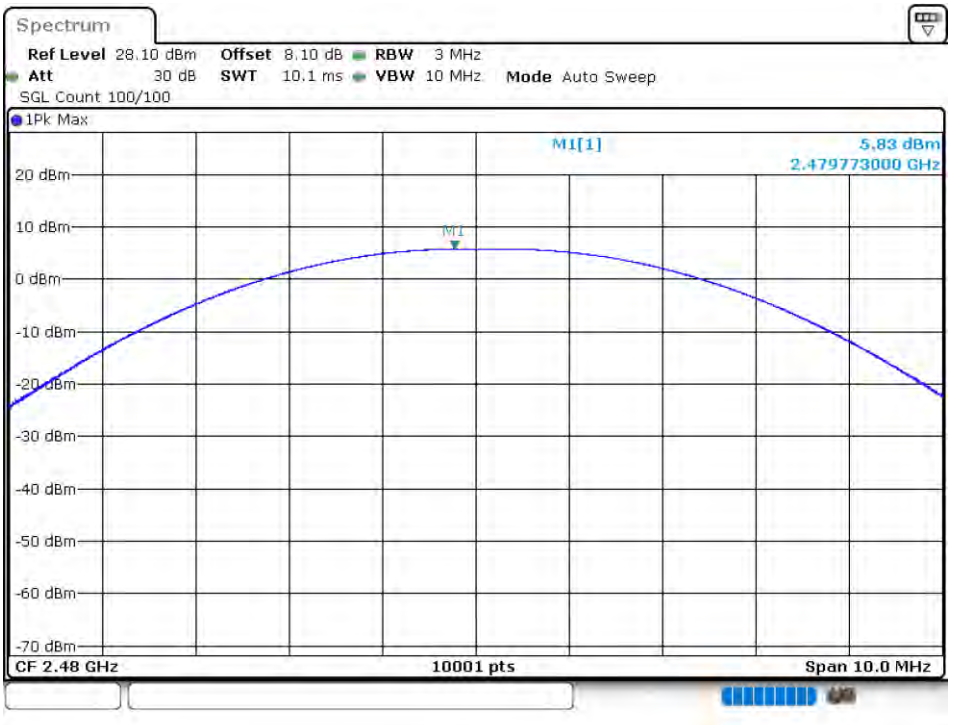
Power NVNT BLE 2402MHz Ant1



Power NVNT BLE 2440MHz Ant1



Power NVNT BLE 2480MHz Ant1



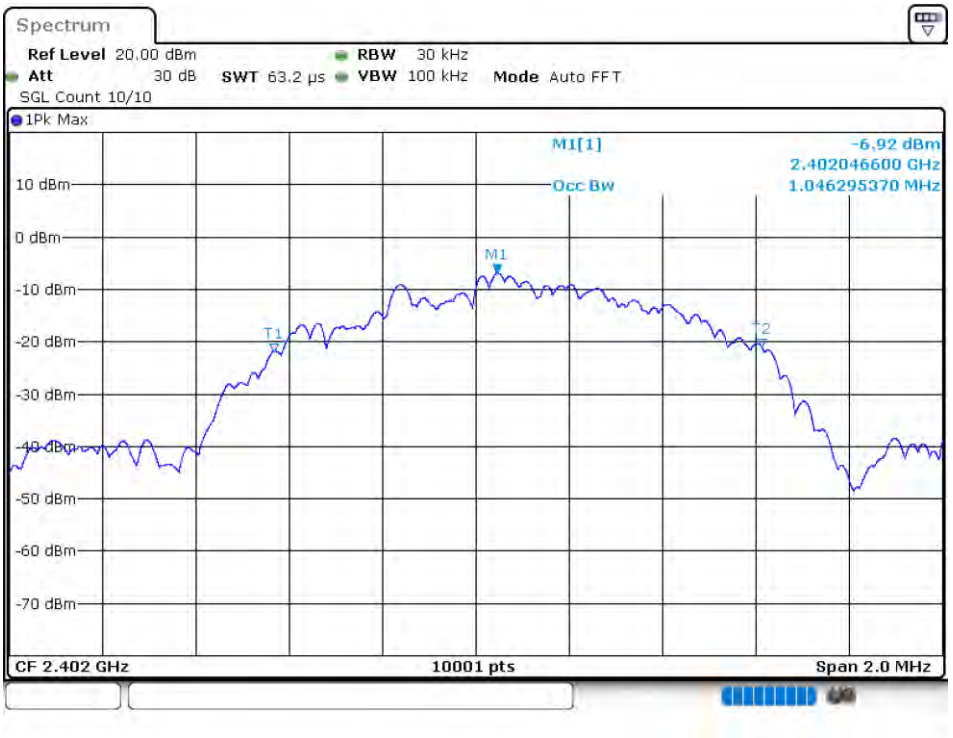
8.1.3 EQUIVALENT ISOTROPICALLY RADIATED POWER

Condition	Mode	Frequency (MHz)	Antenna	Peak Output Power (dBm)	ANT Gain (dBi)	E.I.R.P Measurement (dBm)	Limit (dBm)	Verdict
NVNT	BLE	2402	Ant 1	6.57	1.5	8.07	36	Pass
NVNT	BLE	2440	Ant 1	6.33	1.5	7.83	36	Pass
NVNT	BLE	2480	Ant 1	5.83	1.5	7.32	36	Pass

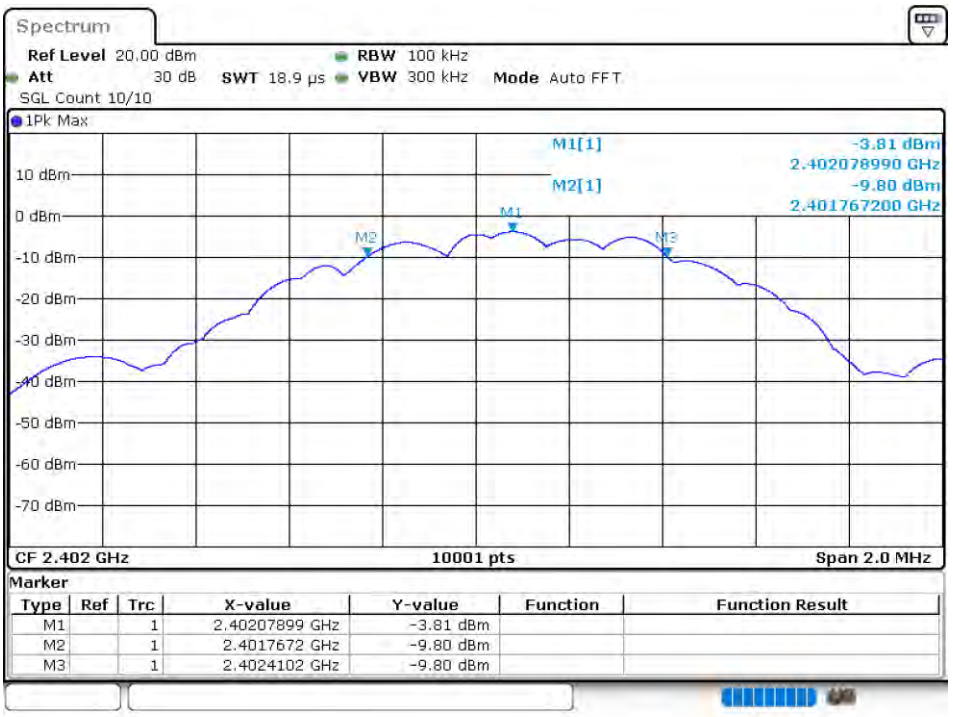
8.1.4 Occupied Channel Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
NVNT	BLE	2402	Ant 1	1.0463	0.6430	≥0.5	Pass
NVNT	BLE	2440	Ant 1	1.0559	0.6812	≥0.5	Pass
NVNT	BLE	2480	Ant 1	1.0453	0.6412	≥0.5	Pass

OBW NVNT BLE 2402MHz Ant1

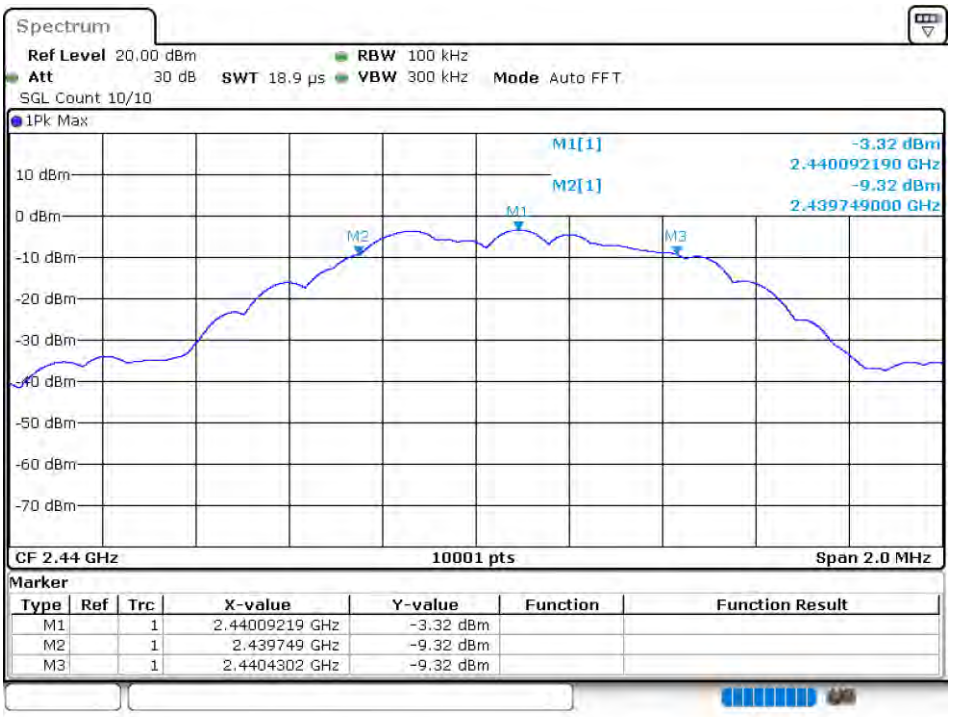


-6 dB BW NVNT BLE 2402MHz Ant1



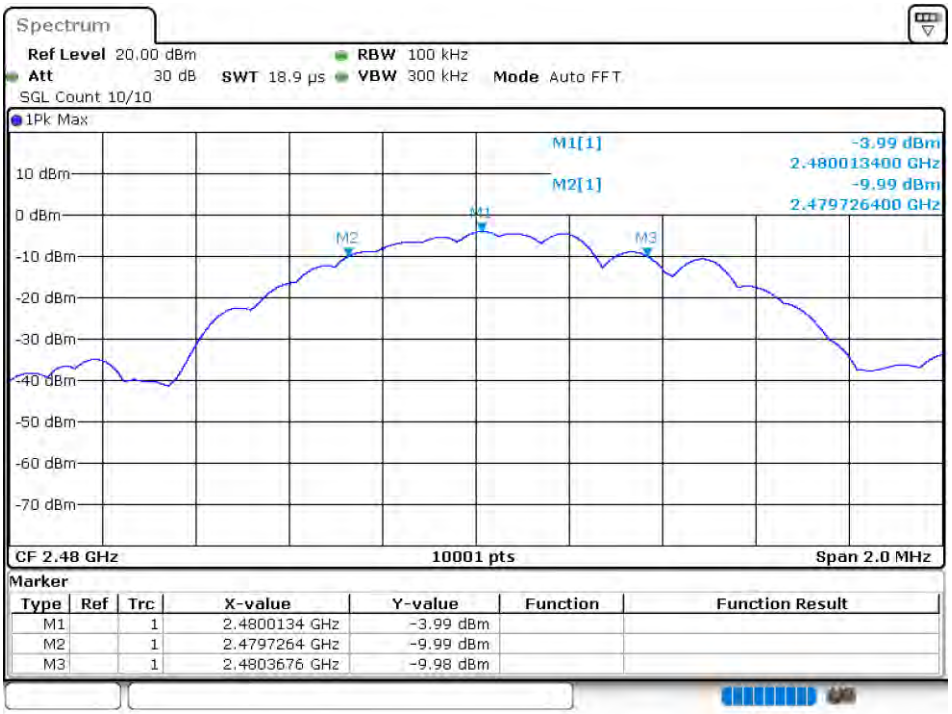
OBW NVNT BLE 2440MHz Ant1

-6 dB BW NVNT BLE 2440MHz Ant1



OBW NVNT BLE 2480MHz Ant1

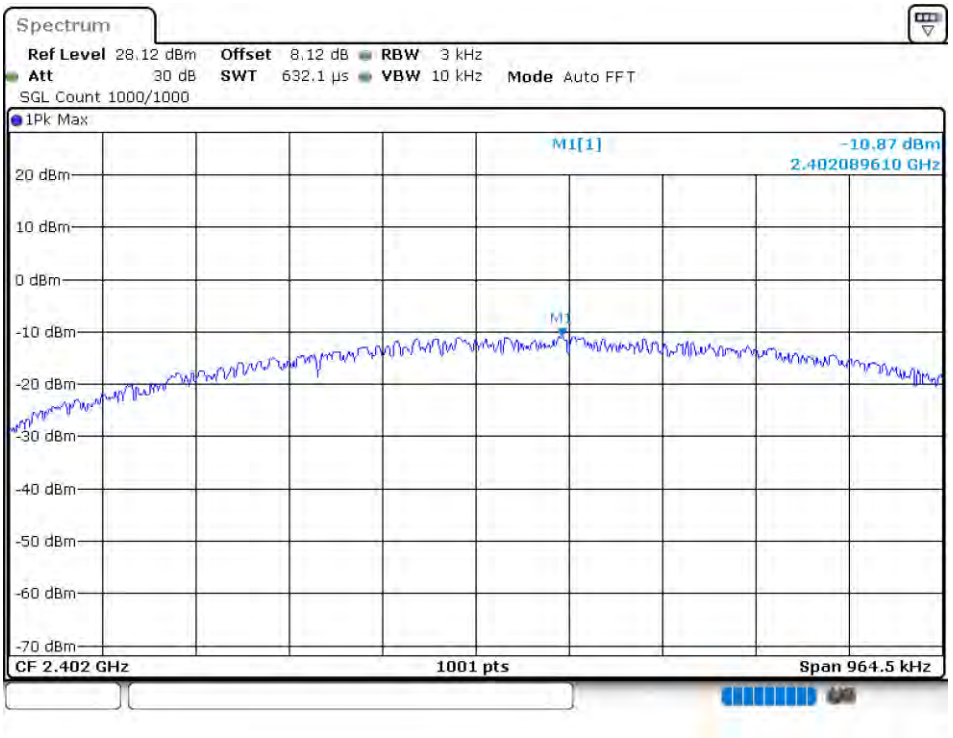
-6 dB BW NVNT BLE 2480MHz Ant1



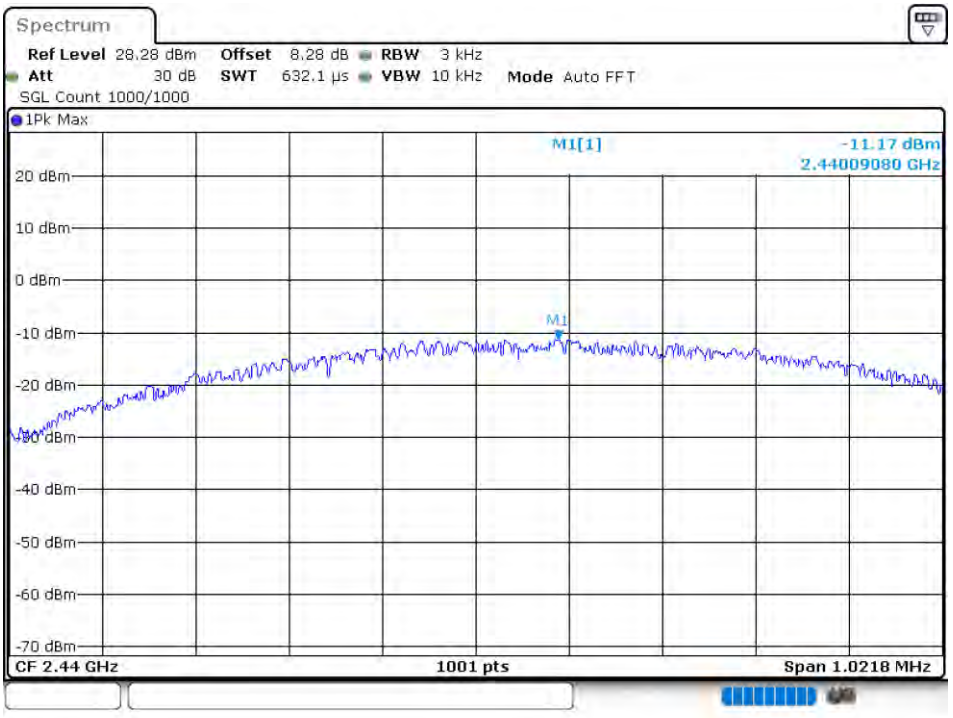
8.1.5 Maximum Power Spectral Density Level

Condition	Mode	Frequency (MHz)	Antenna	Max PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
NVNT	BLE	2402	Ant 1	-10.873	8	Pass
NVNT	BLE	2440	Ant 1	-11.173	8	Pass
NVNT	BLE	2480	Ant 1	-11.022	8	Pass

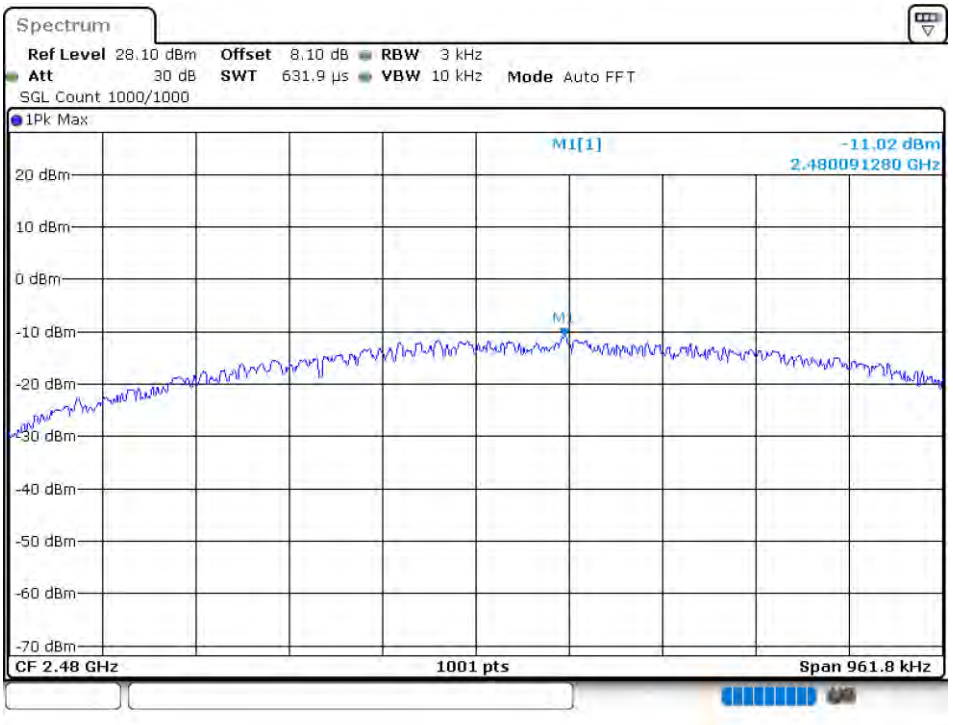
PSD NVNT BLE 2402MHz Ant1



PSD NVNT BLE 2440MHz Ant1



PSD NVNT BLE 2480MHz Ant1

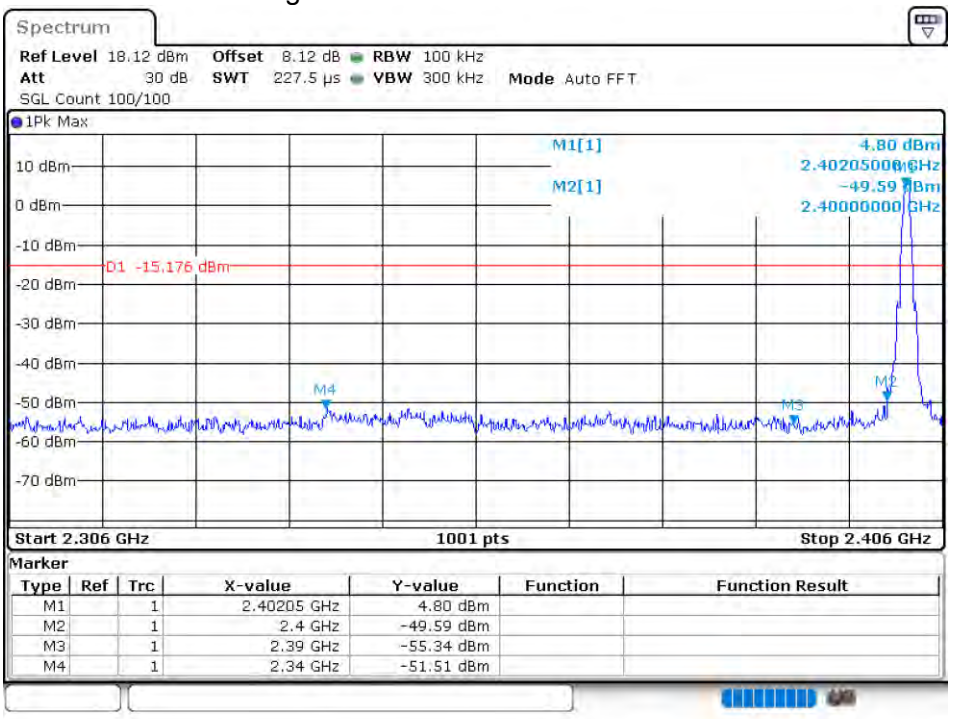


8.1.6 Band Edge

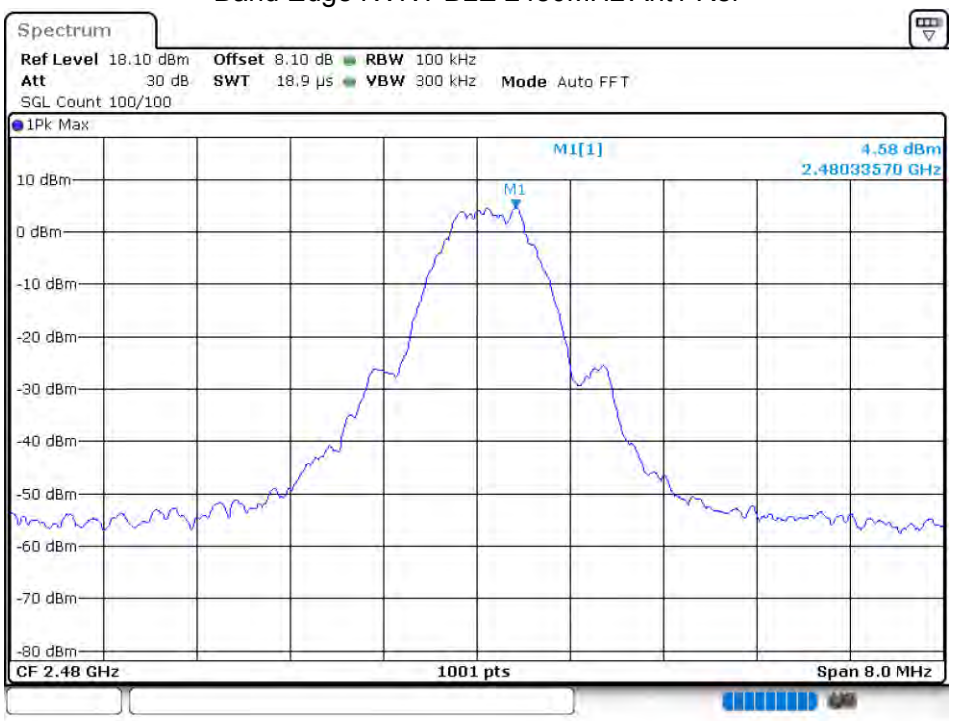
Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE	2402	Ant 1	-56.32	-20	Pass
NVNT	BLE	2480	Ant 1	-56.42	-20	Pass

Band Edge NVNT BLE 2402MHz Ant1 Ref

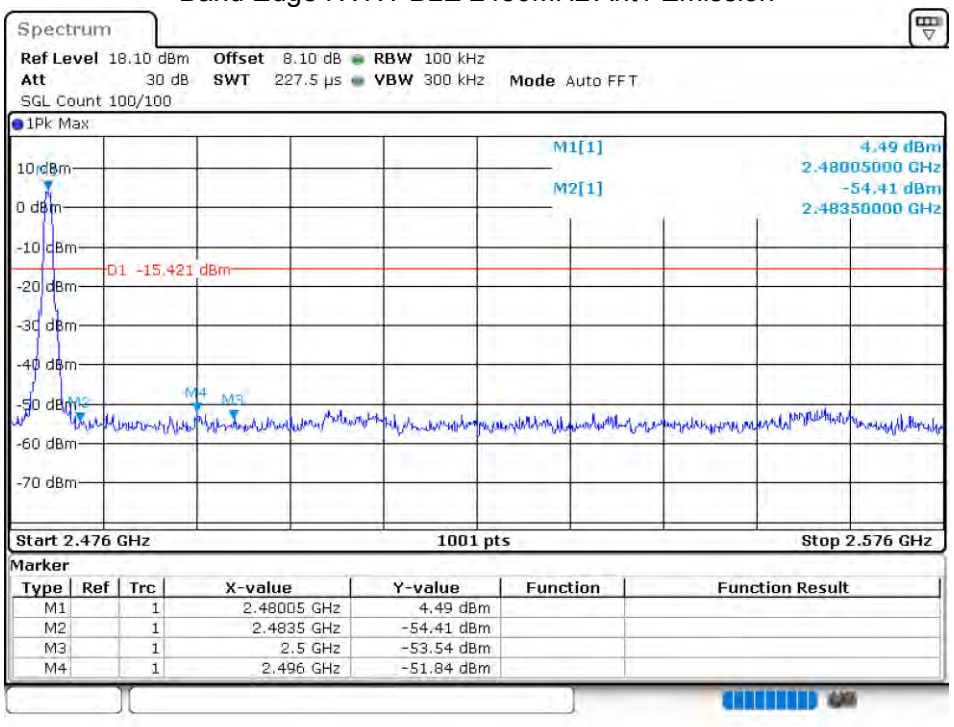
Band Edge NVNT BLE 2402MHz Ant1 Emission



Band Edge NVNT BLE 2480MHz Ant1 Ref



Band Edge NVNT BLE 2480MHz Ant1 Emission



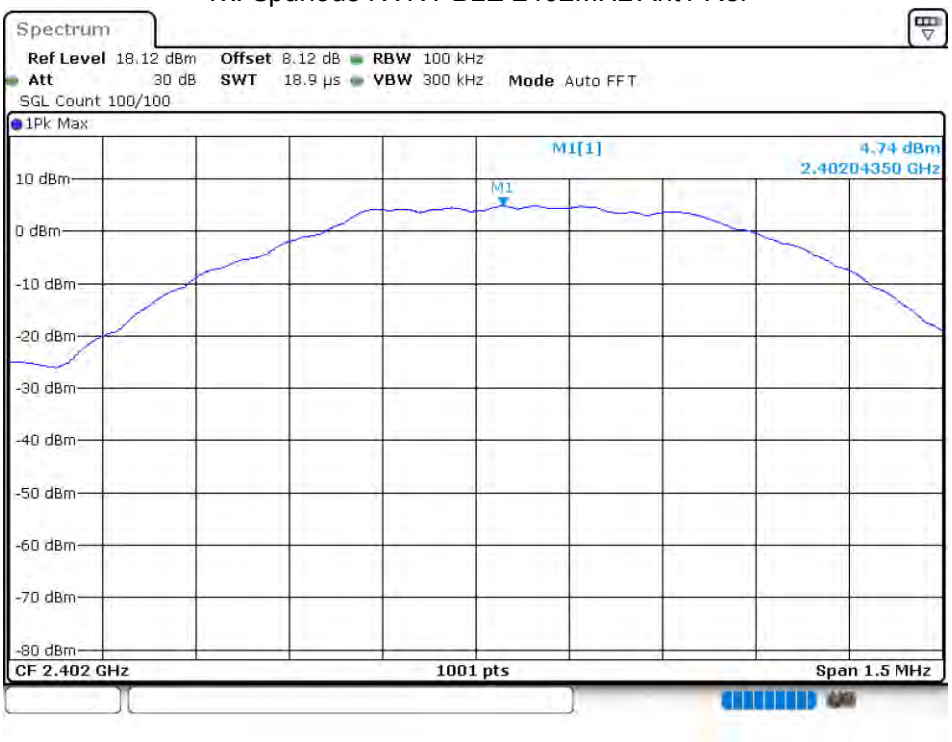
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.48005 GHz	4.49 dBm		
M2		1	2.4835 GHz	-54.41 dBm		
M3		1	2.5 GHz	-53.54 dBm		
M4		1	2.496 GHz	-51.84 dBm		

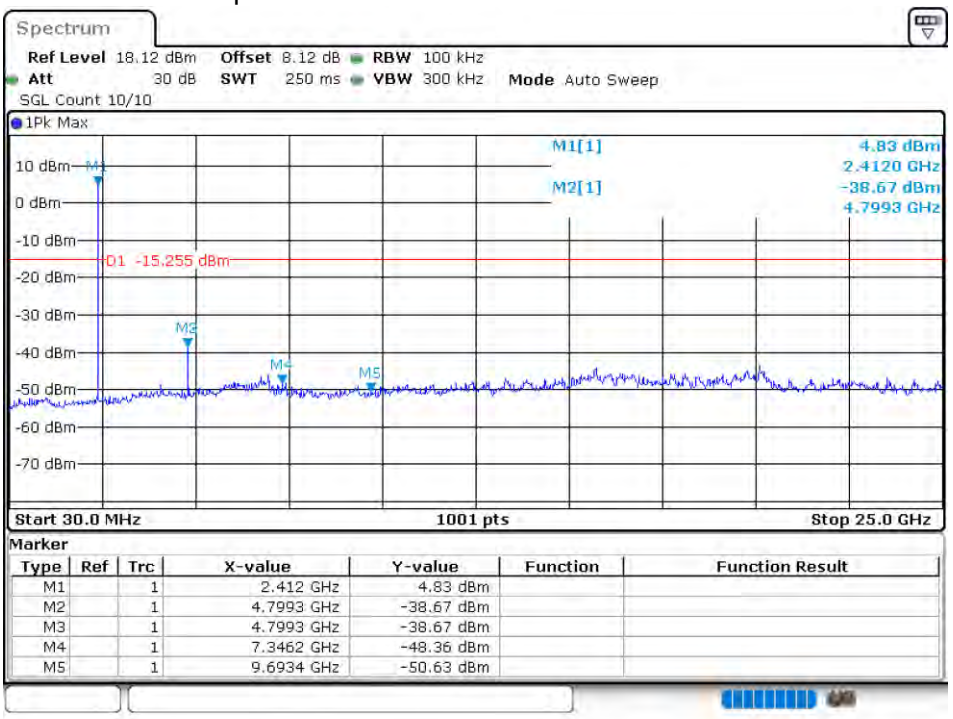
8.1.7 Conducted RF Spurious Emission

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE	2402	Ant 1	-43.41	-20	Pass
NVNT	BLE	2440	Ant 1	-44.35	-20	Pass
NVNT	BLE	2480	Ant 1	-43.83	-20	Pass

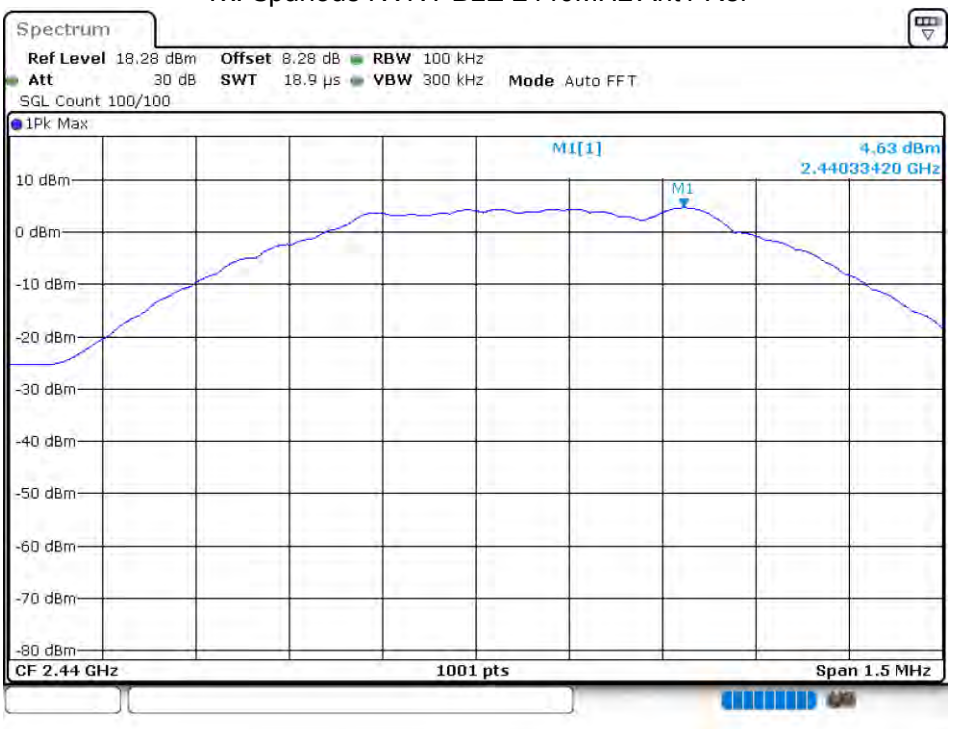
Tx. Spurious NVNT BLE 2402MHz Ant1 Ref



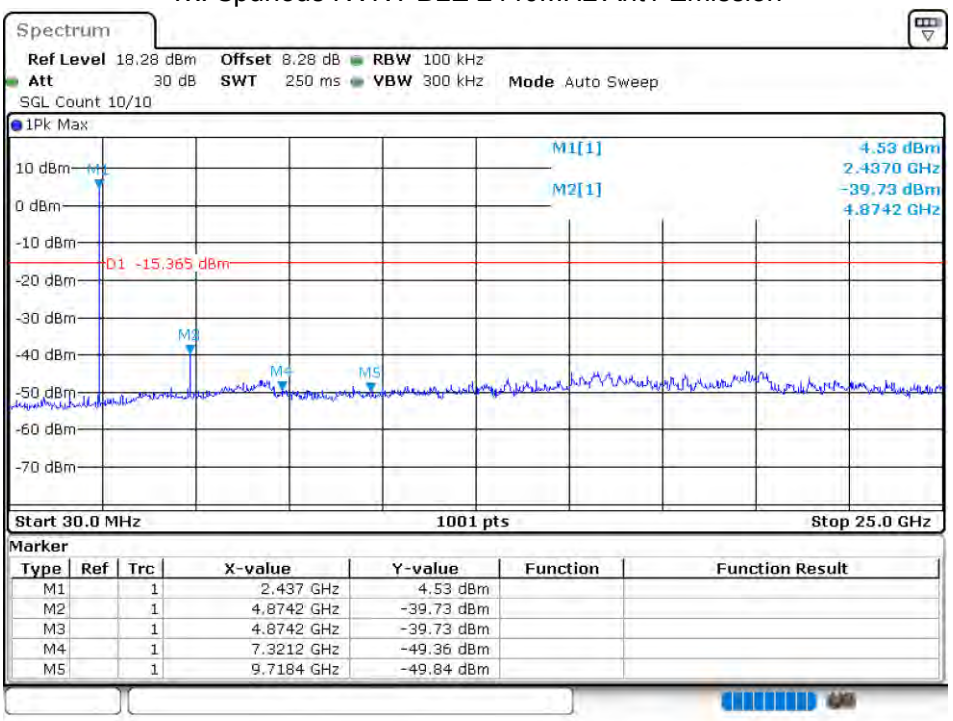
Tx. Spurious NVNT BLE 2402MHz Ant1 Emission



Tx. Spurious NVNT BLE 2440MHz Ant1 Ref



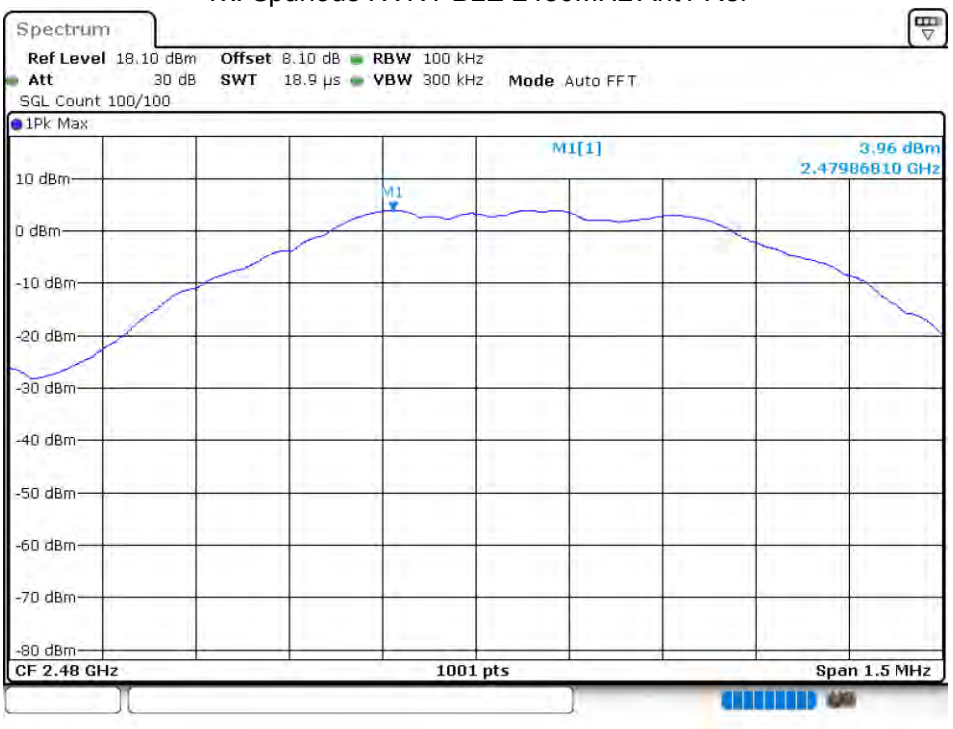
Tx. Spurious NVNT BLE 2440MHz Ant1 Emission



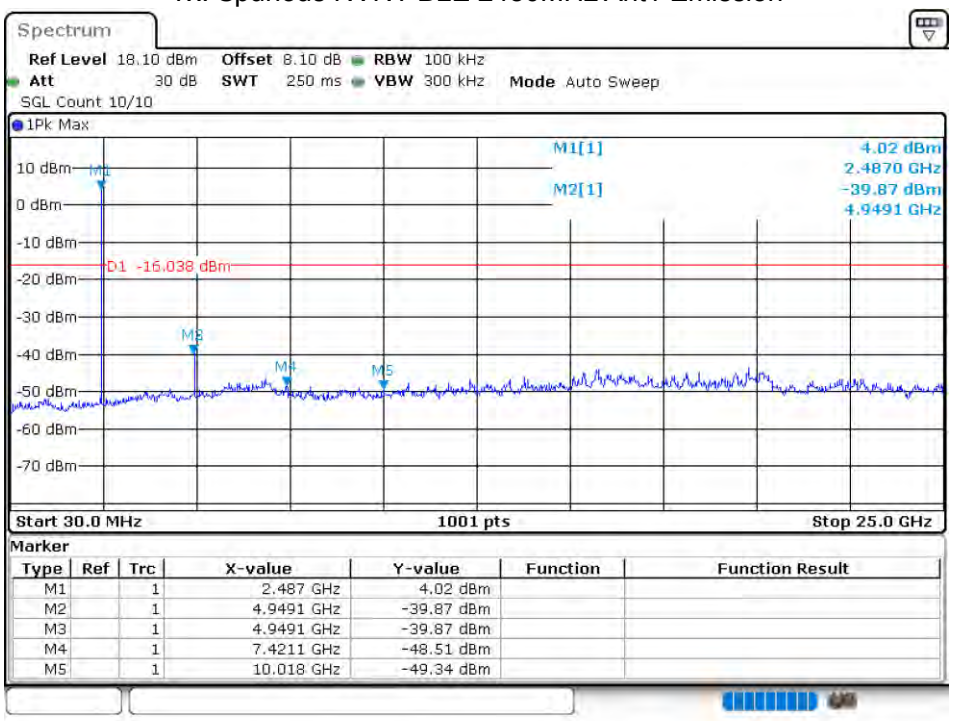
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.437 GHz	4.53 dBm		
M2		1	4.8742 GHz	-39.73 dBm		
M3		1	4.8742 GHz	-39.73 dBm		
M4		1	7.3212 GHz	-49.36 dBm		
M5		1	9.7184 GHz	-49.84 dBm		

Tx. Spurious NVNT BLE 2480MHz Ant1 Ref



Tx. Spurious NVNT BLE 2480MHz Ant1 Emission

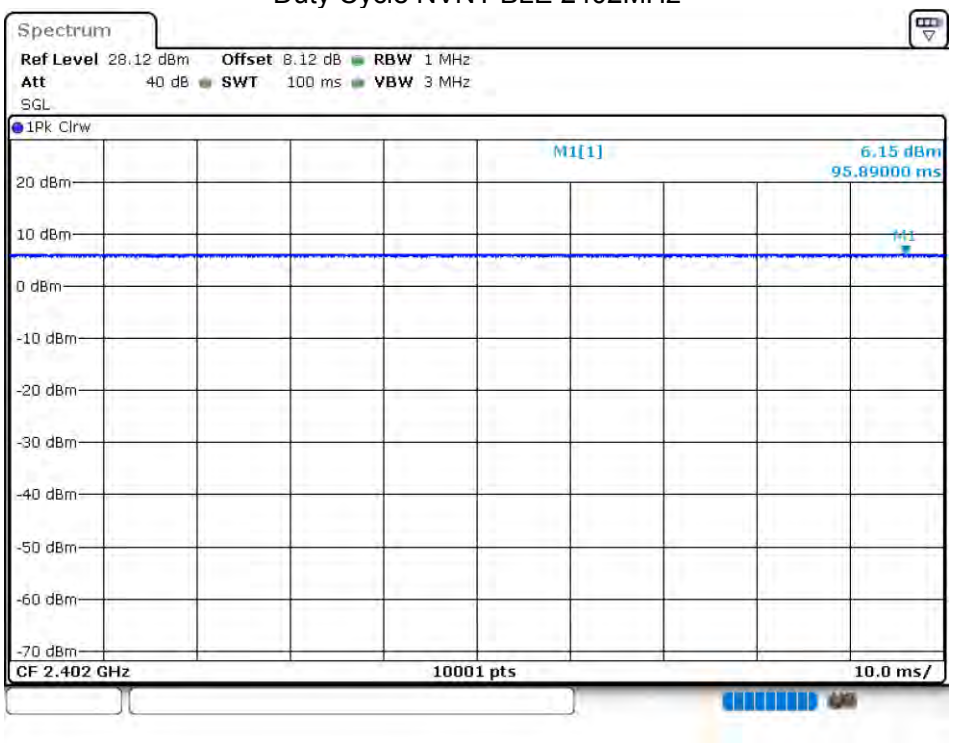


8.2 2Mbps RATE DATA

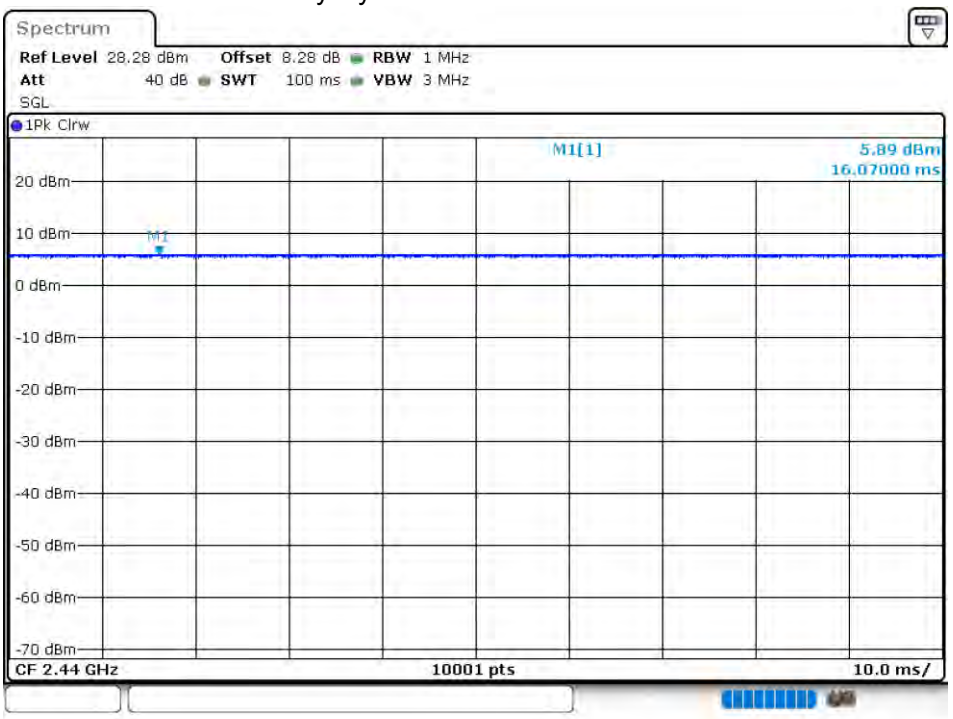
8.2.1 Duty Cycle

Condition	Mode	Frequency (MHz)	Duty Cycle (%)	Correction Factor (dB)
NVNT	BLE	2402	100	0
NVNT	BLE	2440	100	0
NVNT	BLE	2480	100	0

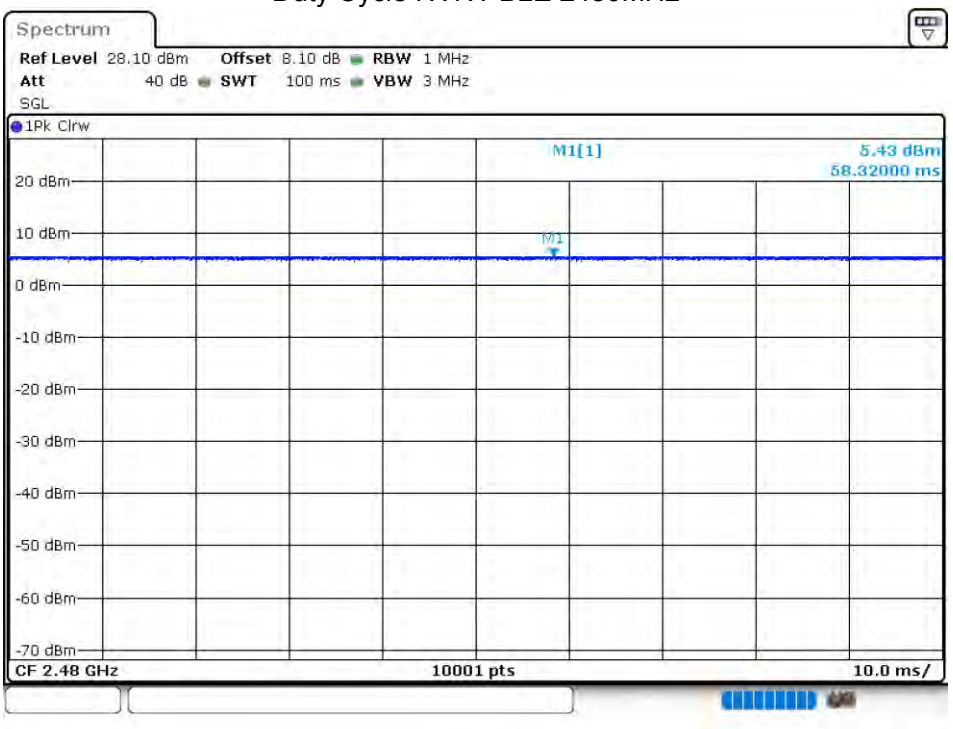
Duty Cycle NVNT BLE 2402MHz



Duty Cycle NVNT BLE 2440MHz



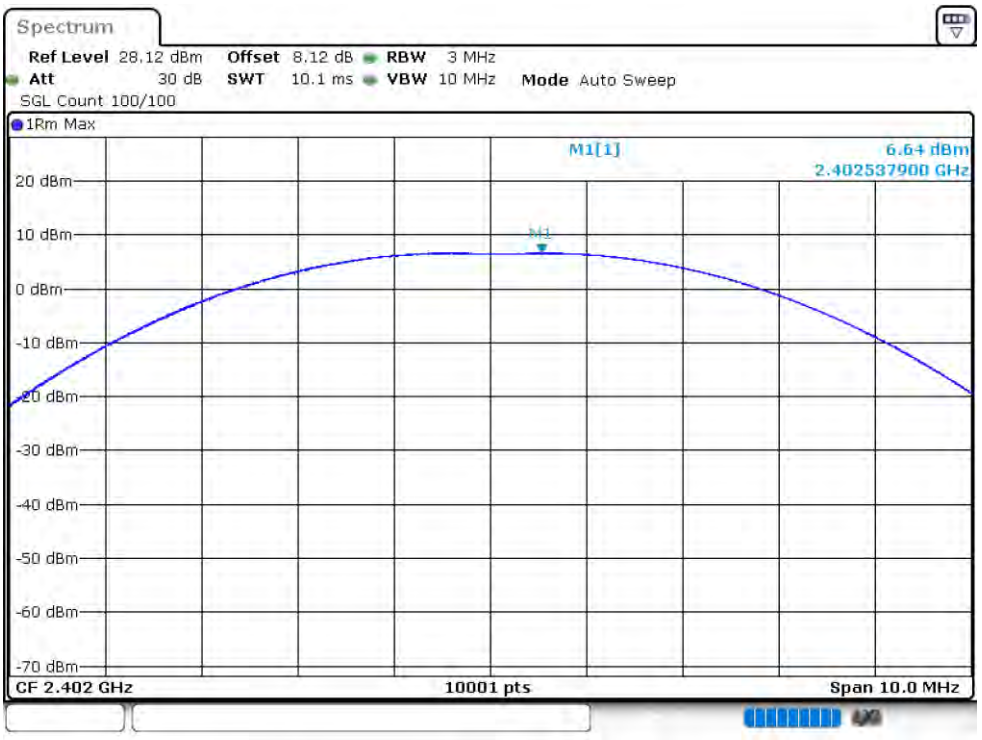
Duty Cycle NVNT BLE 2480MHz



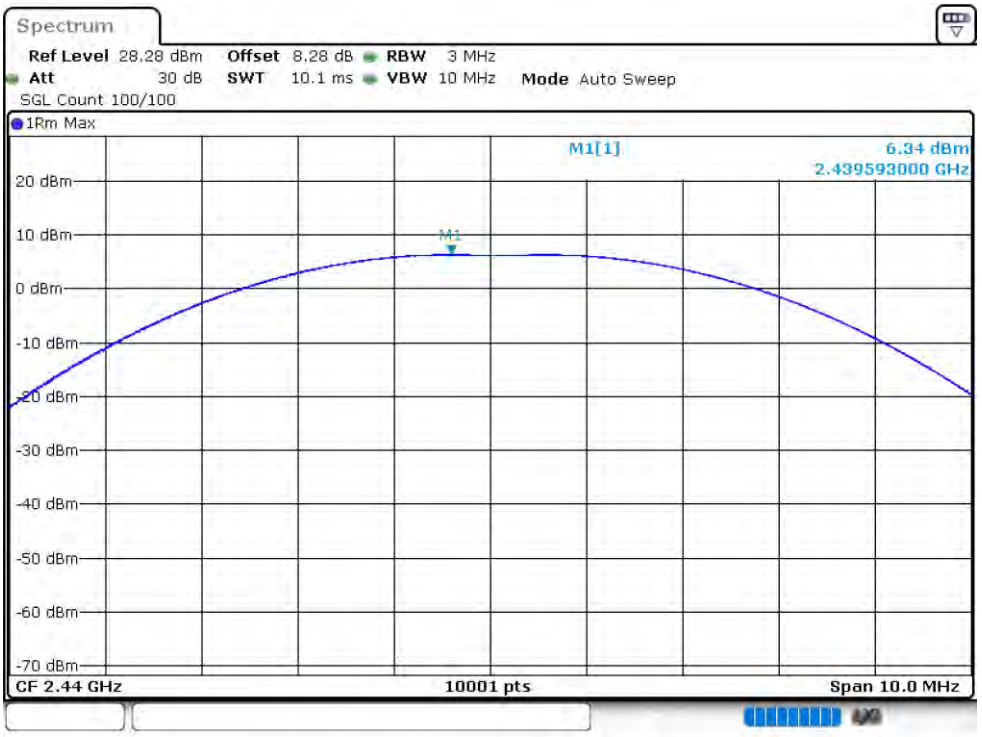
8.2.2 Maximum Conducted Output Power

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE	2402	Ant 1	6.64	0	6.64	30	Pass
NVNT	BLE	2440	Ant 1	6.34	0	6.34	30	Pass
NVNT	BLE	2480	Ant 1	5.92	0	5.92	30	Pass

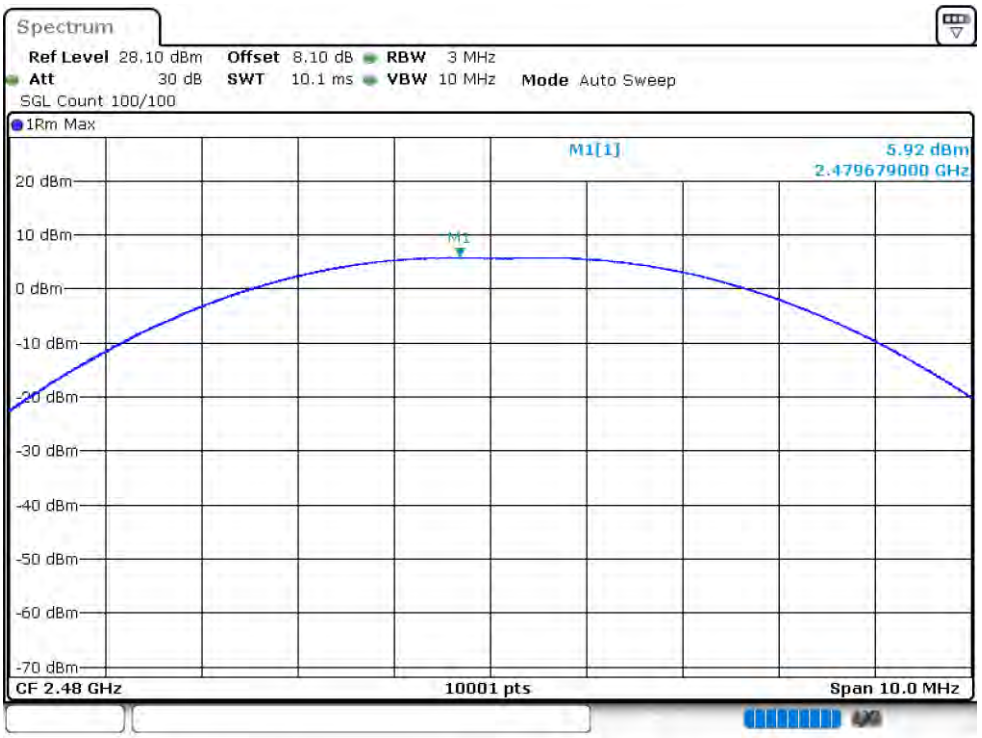
Power NVNT BLE 2402MHz Ant1



Power NVNT BLE 2440MHz Ant1



Power NVNT BLE 2480MHz Ant1



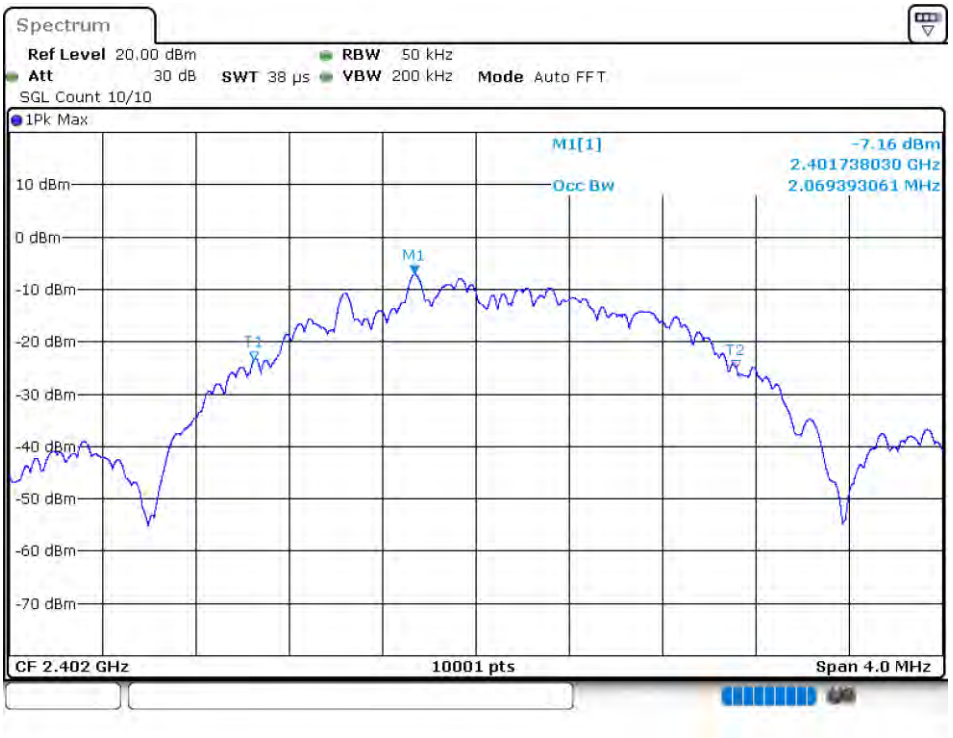
8.2.3 EQUIVALENT ISOTROPICALLY RADIATED POWER

Condition	Mode	Frequency (MHz)	Antenna	Peak Output Power (dBm)	ANT Gain (dBi)	E.I.R.P Measurement (dBm)	Limit (dBm)	Verdict
NVNT	BLE	2402	Ant 1	6.64	1.5	8.14	36	Pass
NVNT	BLE	2440	Ant 1	6.34	1.5	7.84	36	Pass
NVNT	BLE	2480	Ant 1	5.92	1.5	7.42	36	Pass

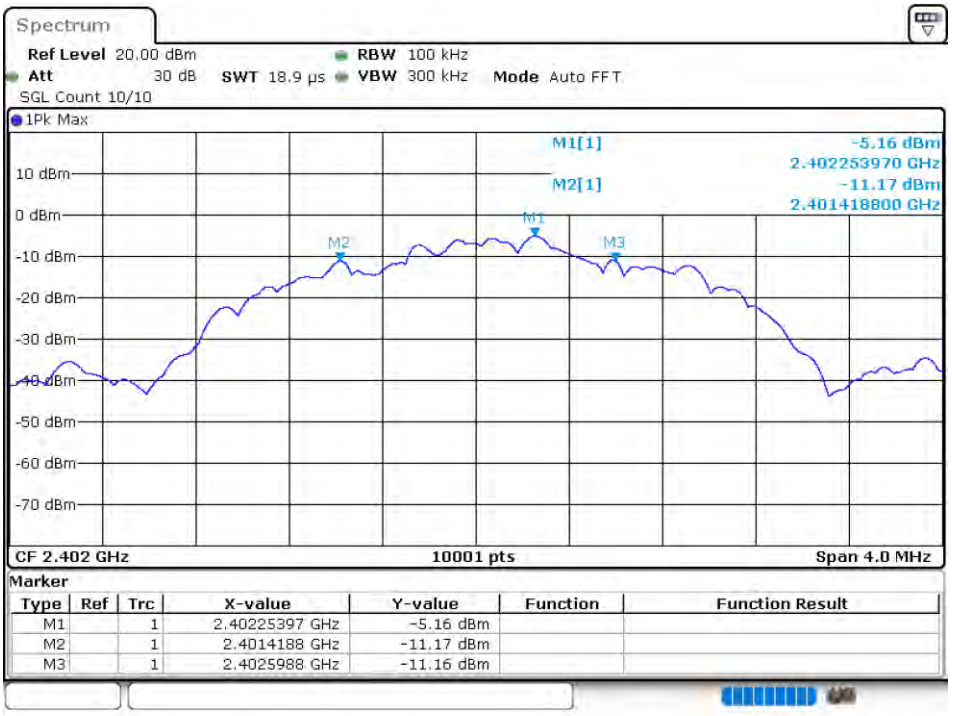
8.2.4 Occupied Channel Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
NVNT	BLE	2402	Ant 1	2.0694	1.1800	≥0.5	Pass
NVNT	BLE	2440	Ant 1	2.0742	1.2548	≥0.5	Pass
NVNT	BLE	2480	Ant 1	2.0702	1.3212	≥0.5	Pass

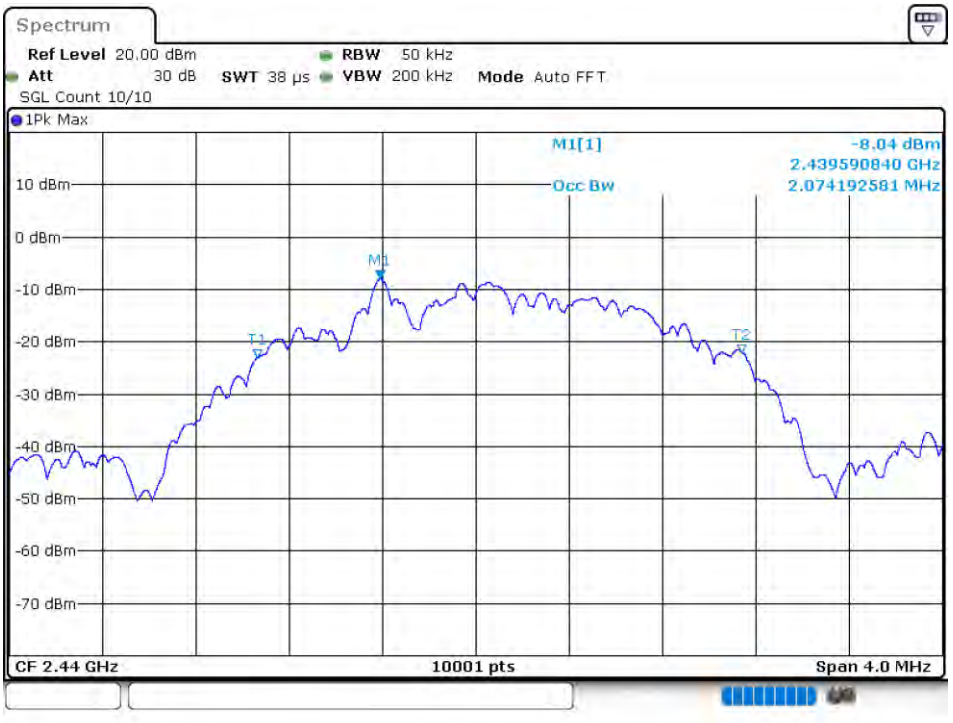
OBW NVNT BLE 2402MHz Ant1



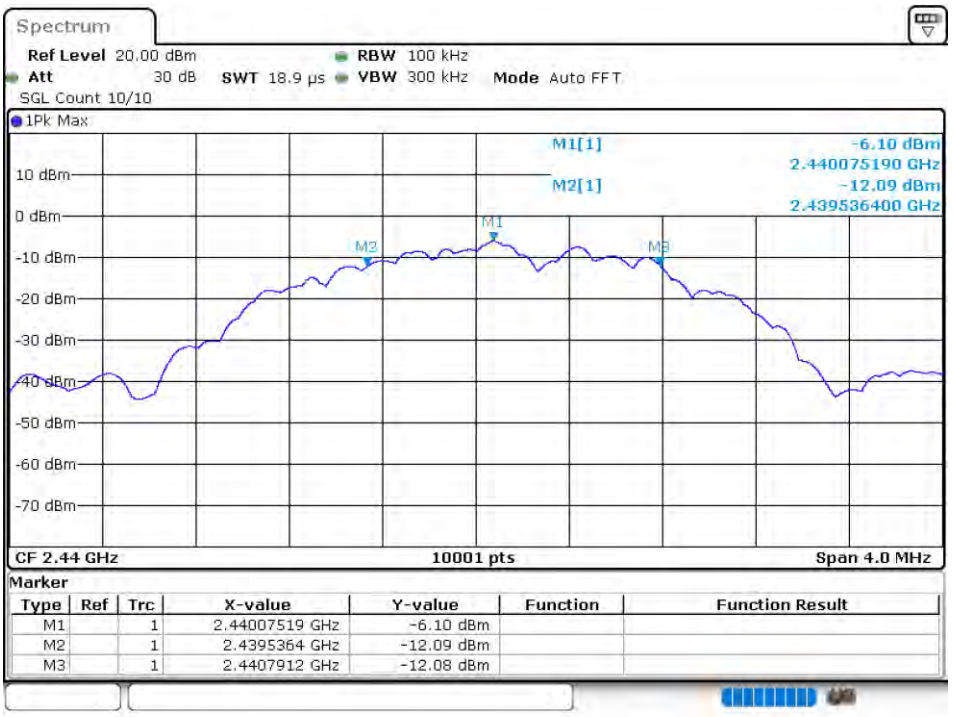
-6 dB BW NVNT BLE 2402MHz Ant1



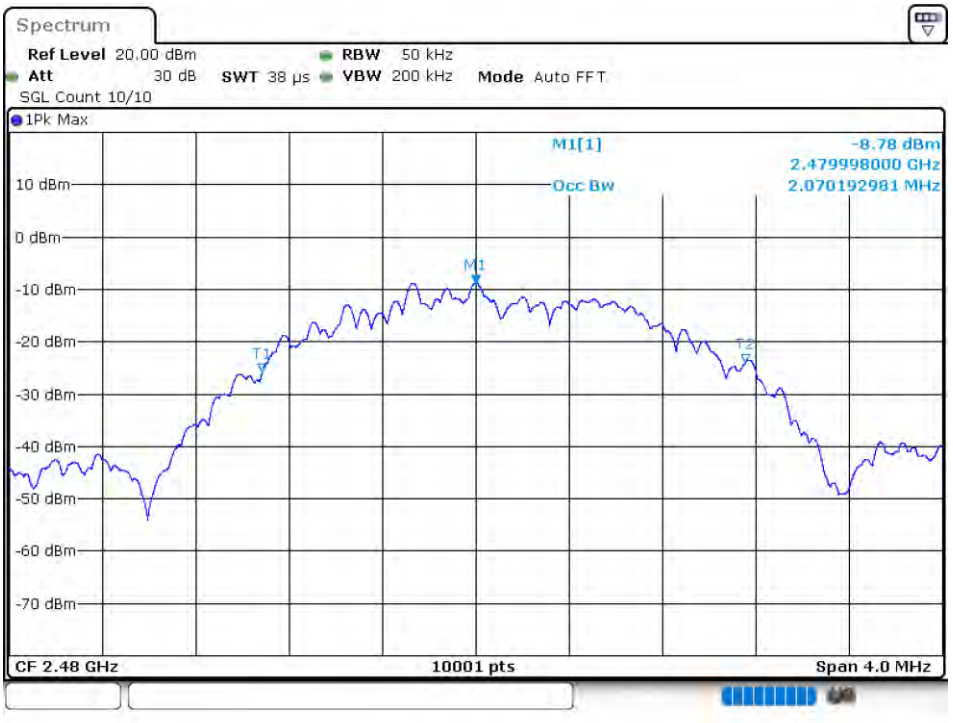
OBW NVNT BLE 2440MHz Ant1



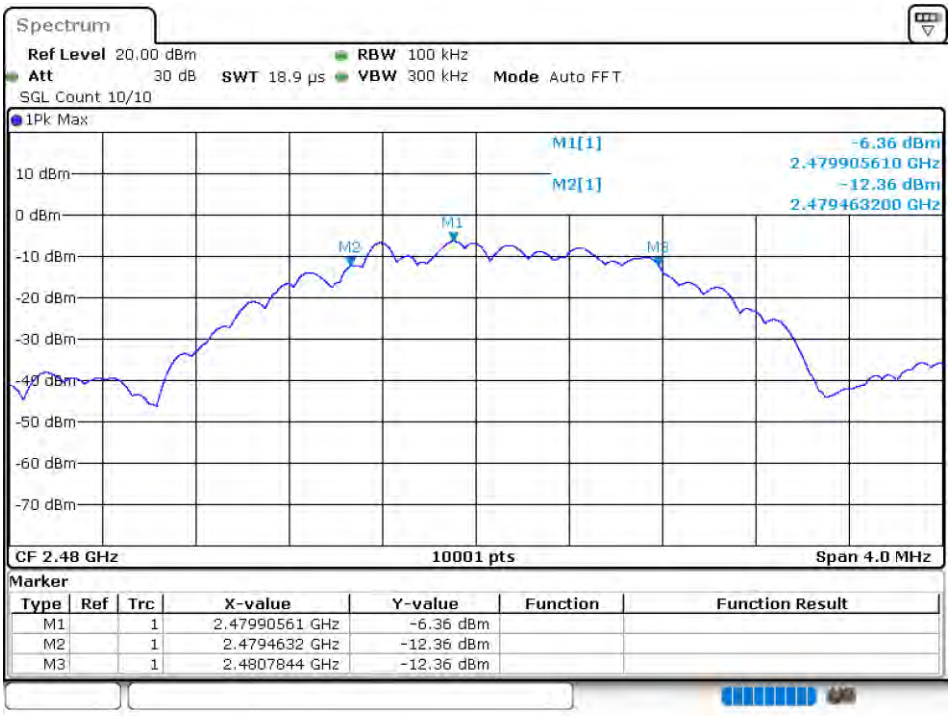
-6 dB BW NVNT BLE 2440MHz Ant1



OBW NVNT BLE 2480MHz Ant1



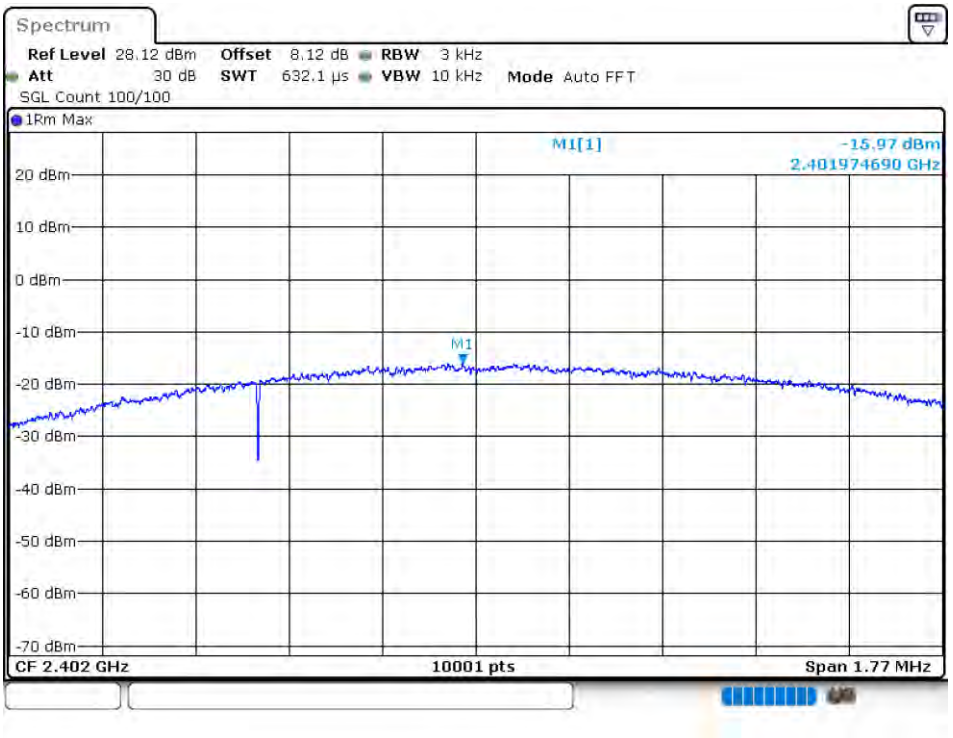
-6 dB BW NVNT BLE 2480MHz Ant1



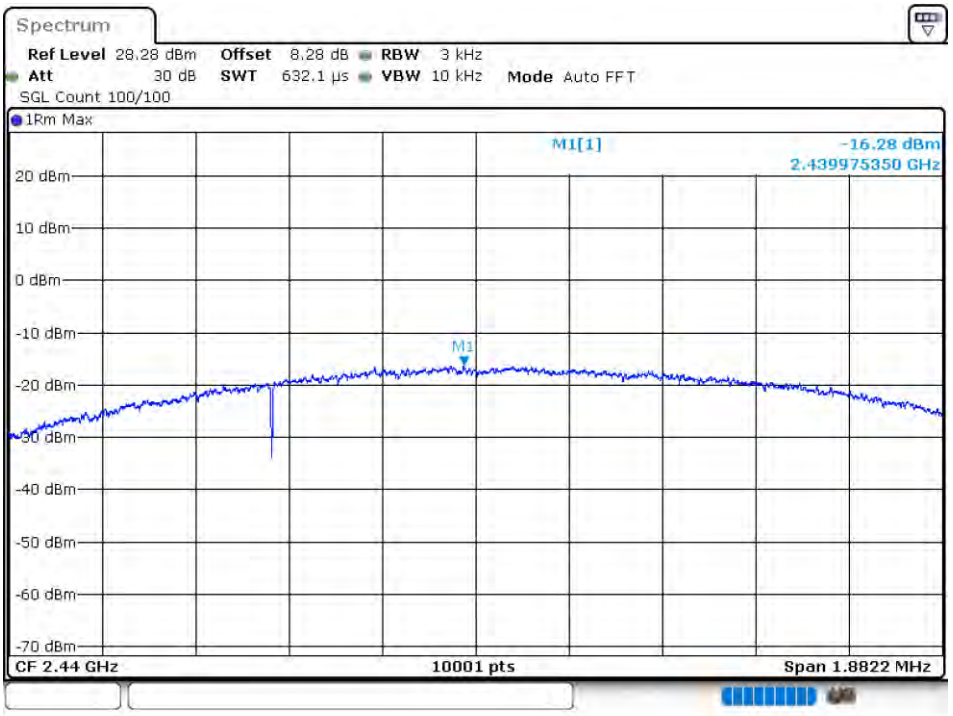
8.2.5 Maximum Power Spectral Density Level

Condition	Mode	Frequency (MHz)	Antenna	Max PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
NVNT	BLE	2402	Ant 1	-15.969	8	Pass
NVNT	BLE	2440	Ant 1	-16.285	8	Pass
NVNT	BLE	2480	Ant 1	-16.588	8	Pass

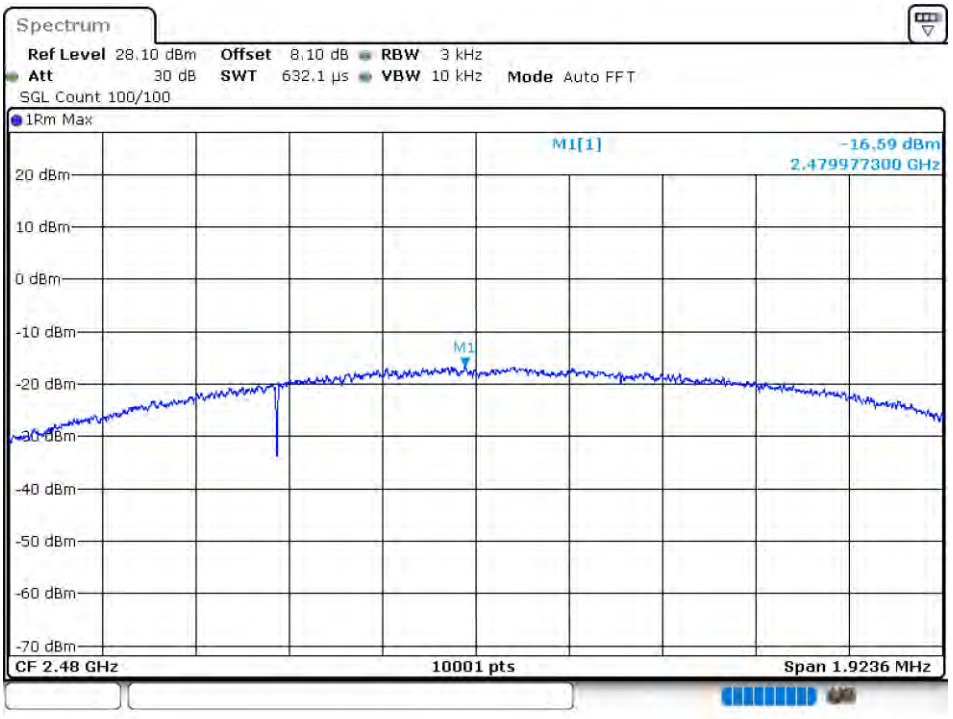
PSD NVNT BLE 2402MHz Ant1



PSD NVNT BLE 2440MHz Ant1



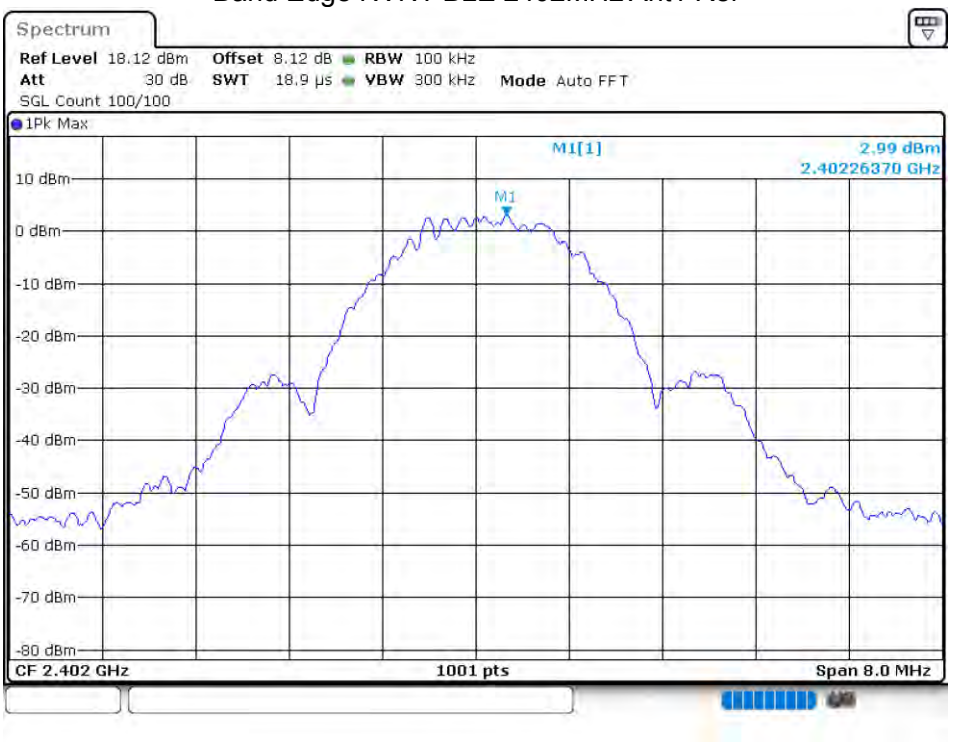
PSD NVNT BLE 2480MHz Ant1



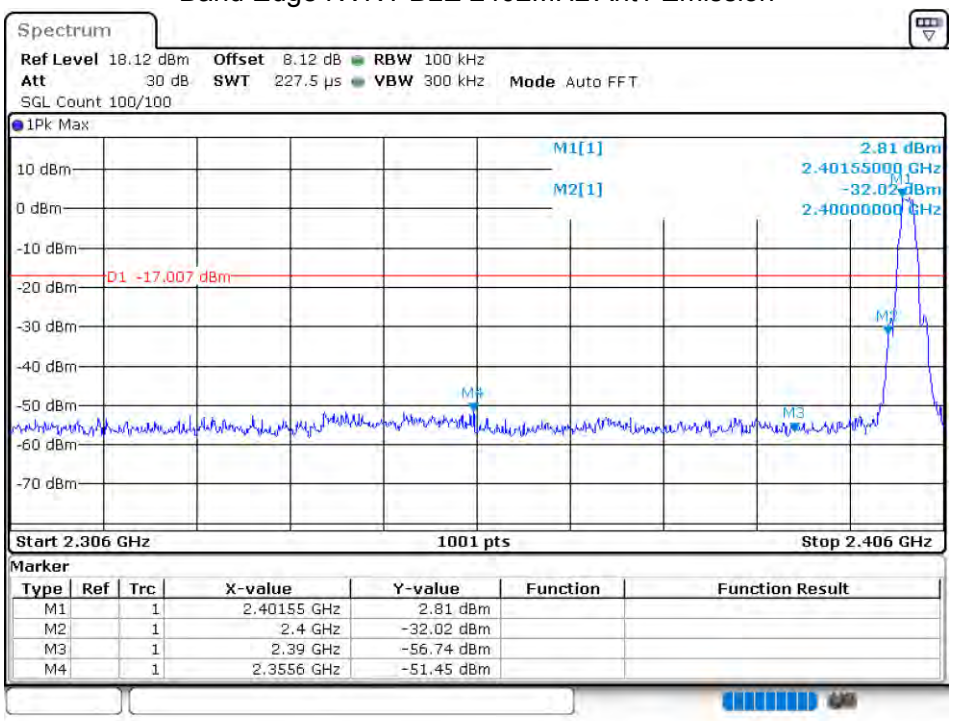
8.2.6 Band Edge

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE	2402	Ant 1	-54.44	-20	Pass
NVNT	BLE	2480	Ant 1	-53.42	-20	Pass

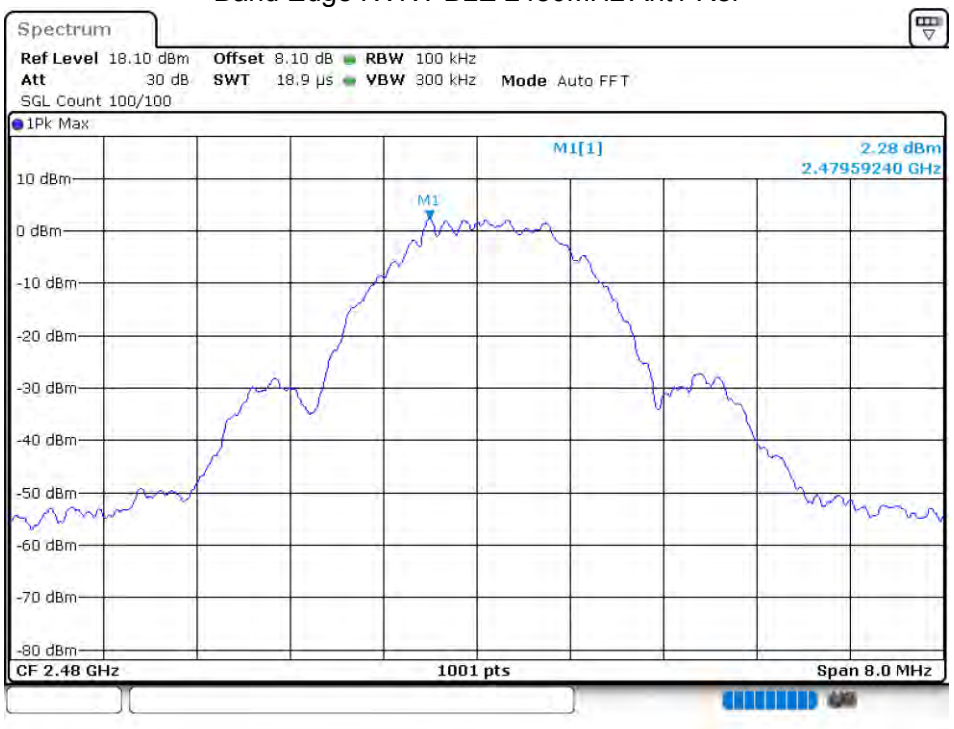
Band Edge NVNT BLE 2402MHz Ant1 Ref



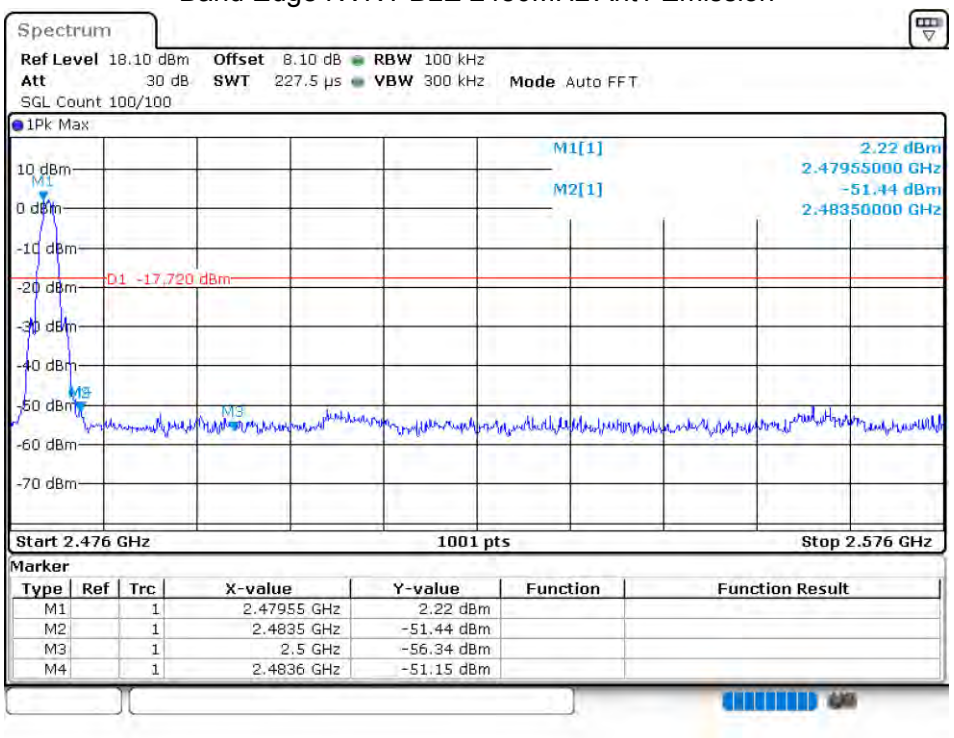
Band Edge NVNT BLE 2402MHz Ant1 Emission



Band Edge NVNT BLE 2480MHz Ant1 Ref



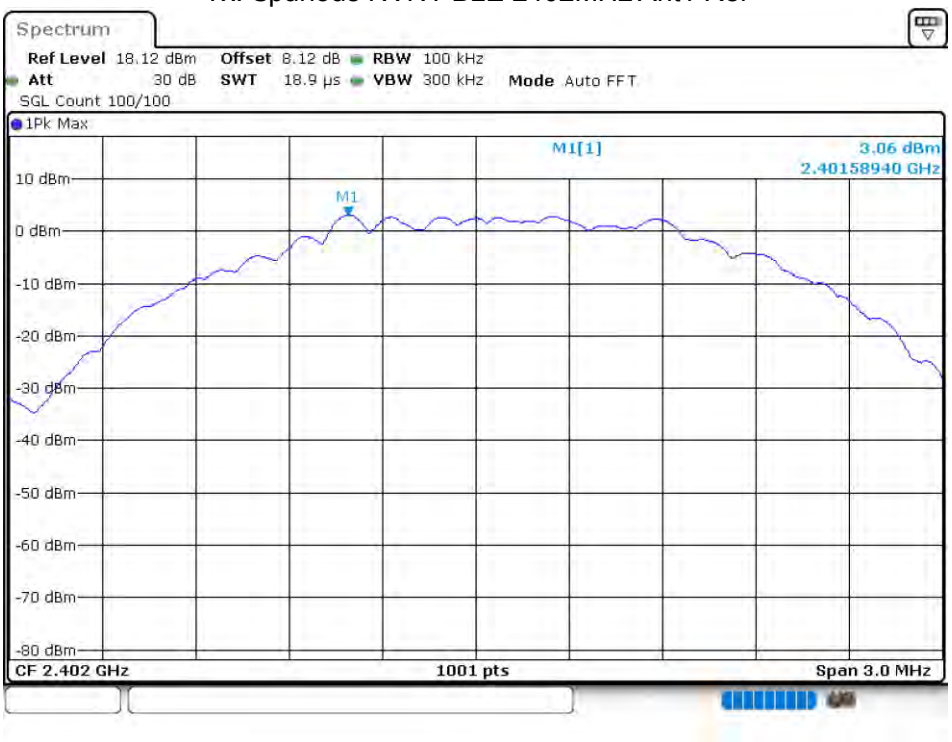
Band Edge NVNT BLE 2480MHz Ant1 Emission



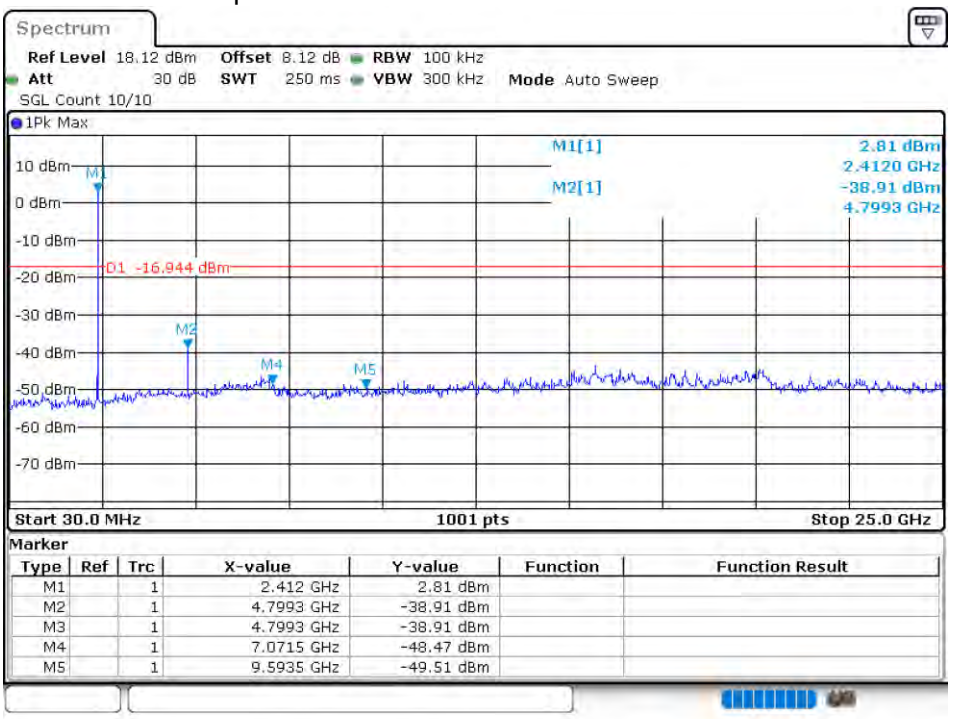
8.2.7 Conducted RF Spurious Emission

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE	2402	Ant 1	-41.96	-20	Pass
NVNT	BLE	2440	Ant 1	-42.42	-20	Pass
NVNT	BLE	2480	Ant 1	-45.23	-20	Pass

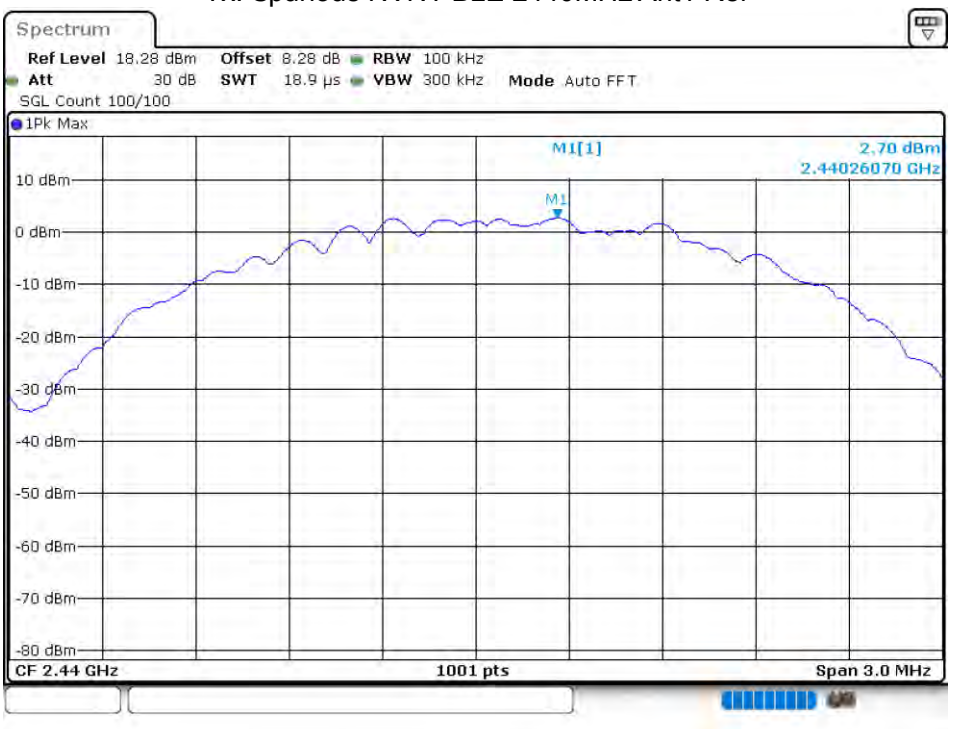
Tx. Spurious NVNT BLE 2402MHz Ant1 Ref



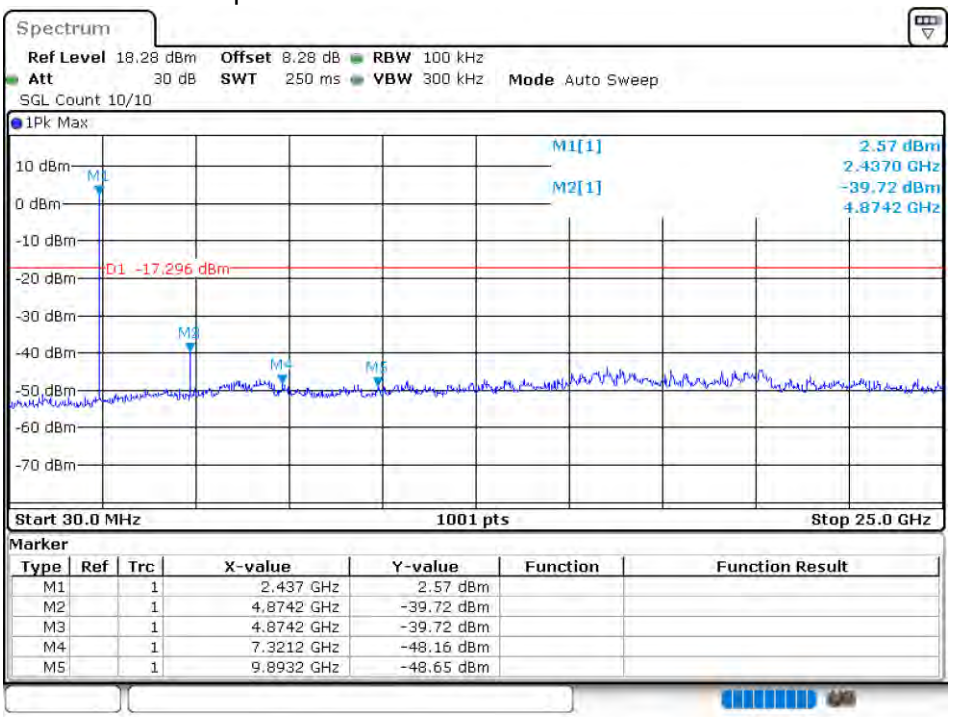
Tx. Spurious NVNT BLE 2402MHz Ant1 Emission



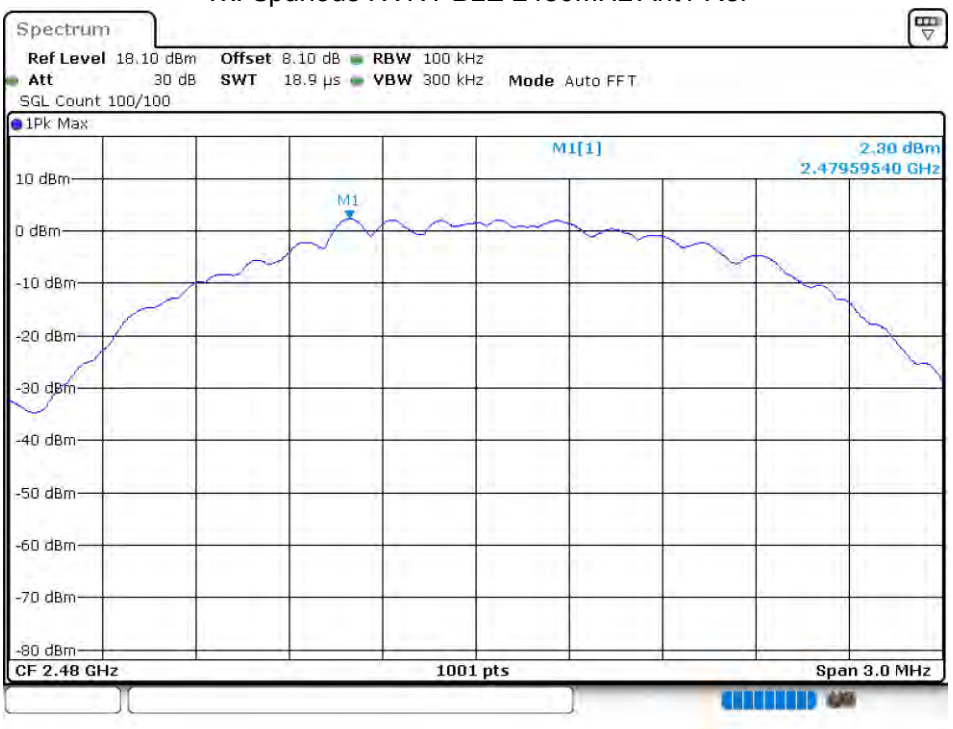
Tx. Spurious NVNT BLE 2440MHz Ant1 Ref



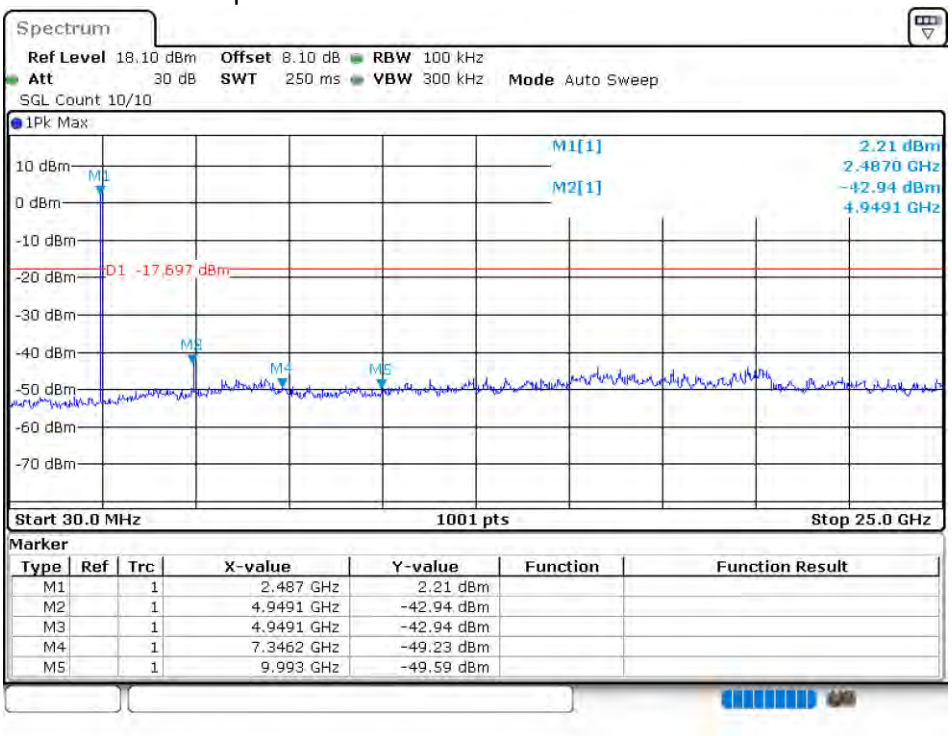
Tx. Spurious NVNT BLE 2440MHz Ant1 Emission



Tx. Spurious NVNT BLE 2480MHz Ant1 Ref



Tx. Spurious NVNT BLE 2480MHz Ant1 Emission

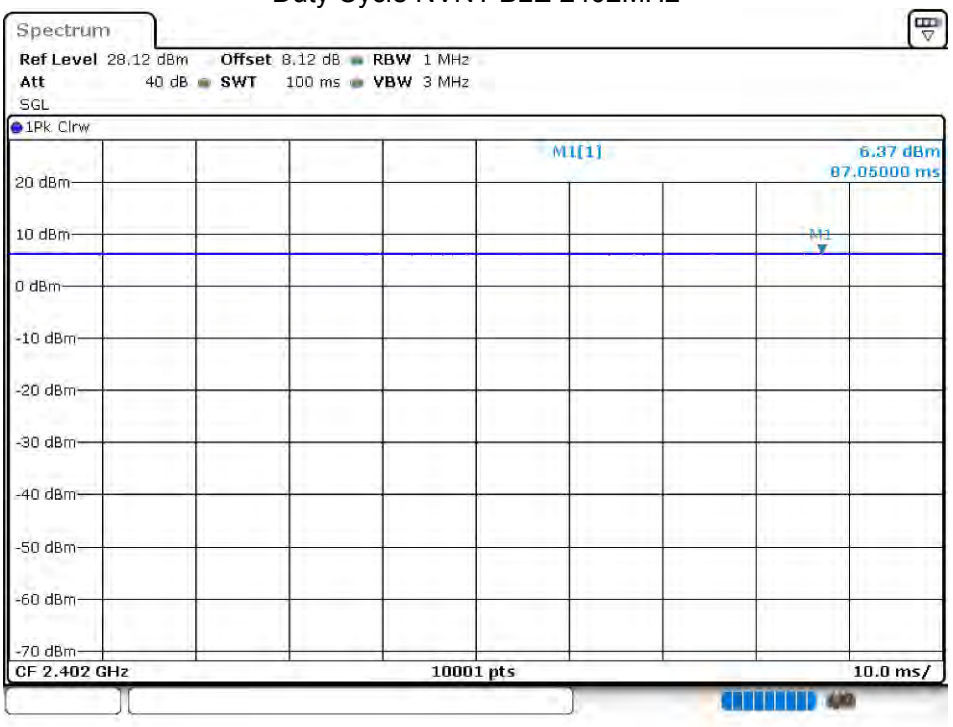


8.3 125Kbps RATE DATA

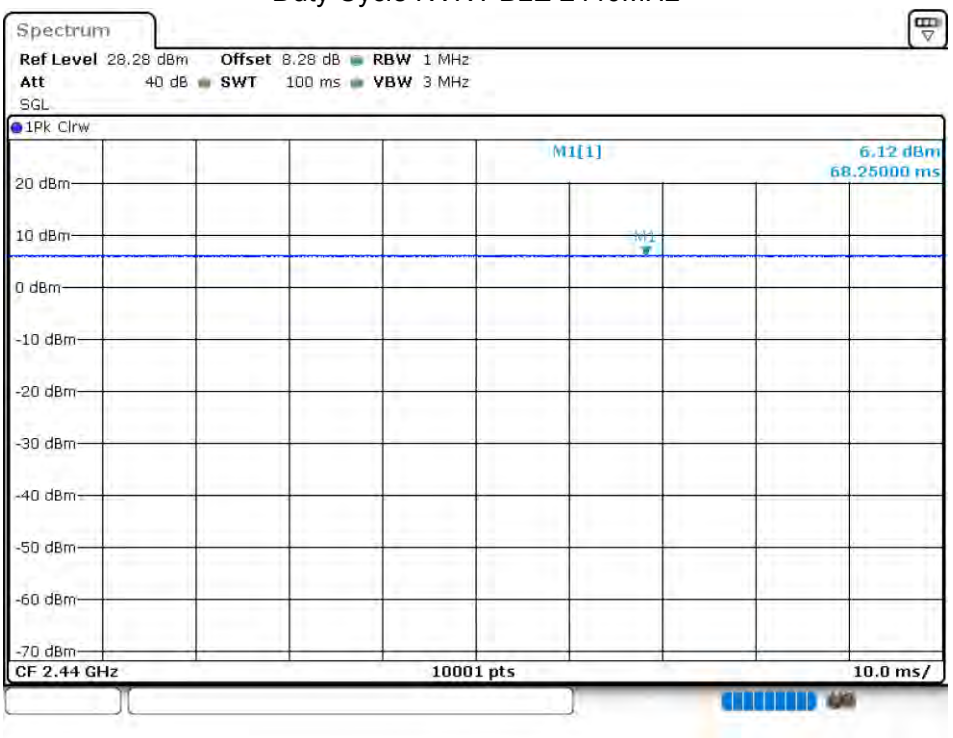
8.3.1 Duty Cycle

Condition	Mode	Frequency (MHz)	Duty Cycle (%)	Correction Factor (dB)
NVNT	BLE	2402	100	0
NVNT	BLE	2440	100	0
NVNT	BLE	2480	100	0

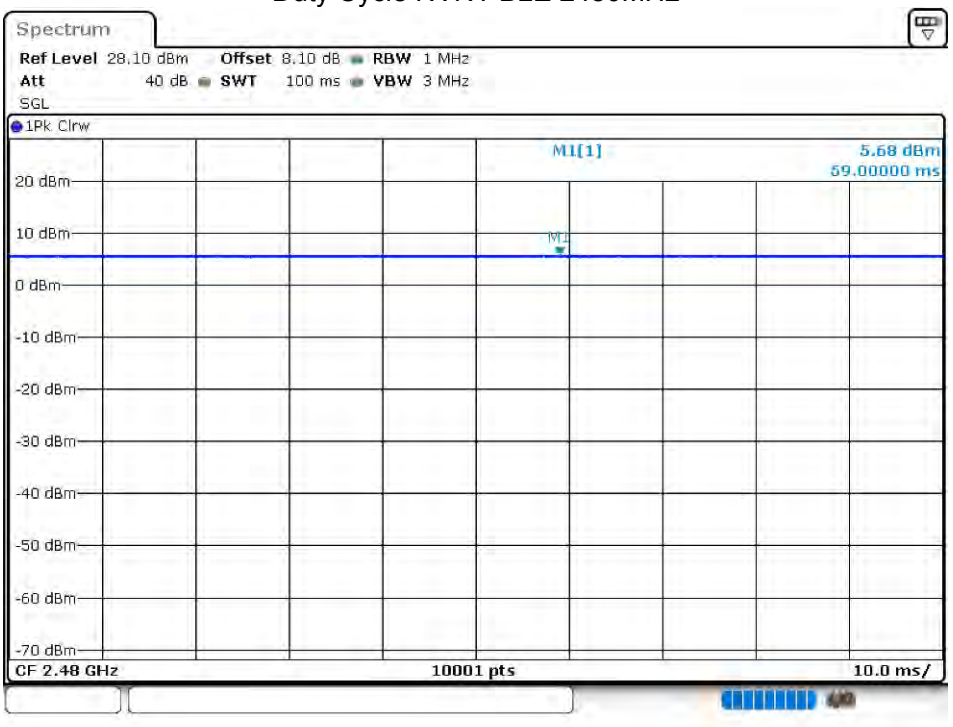
Duty Cycle NVNT BLE 2402MHz



Duty Cycle NVNT BLE 2440MHz



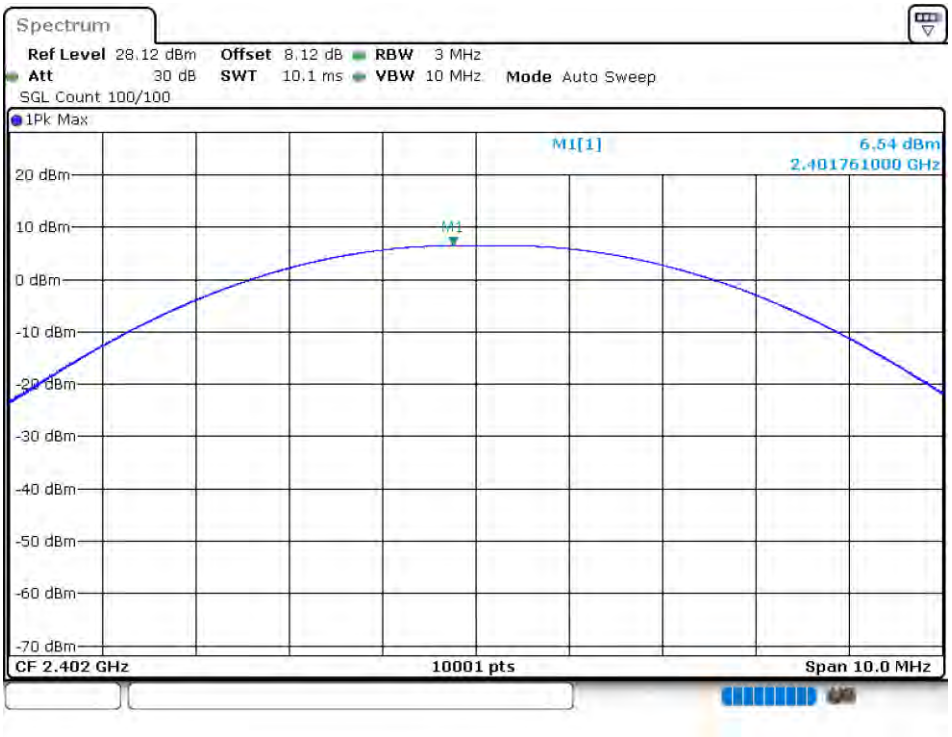
Duty Cycle NVNT BLE 2480MHz



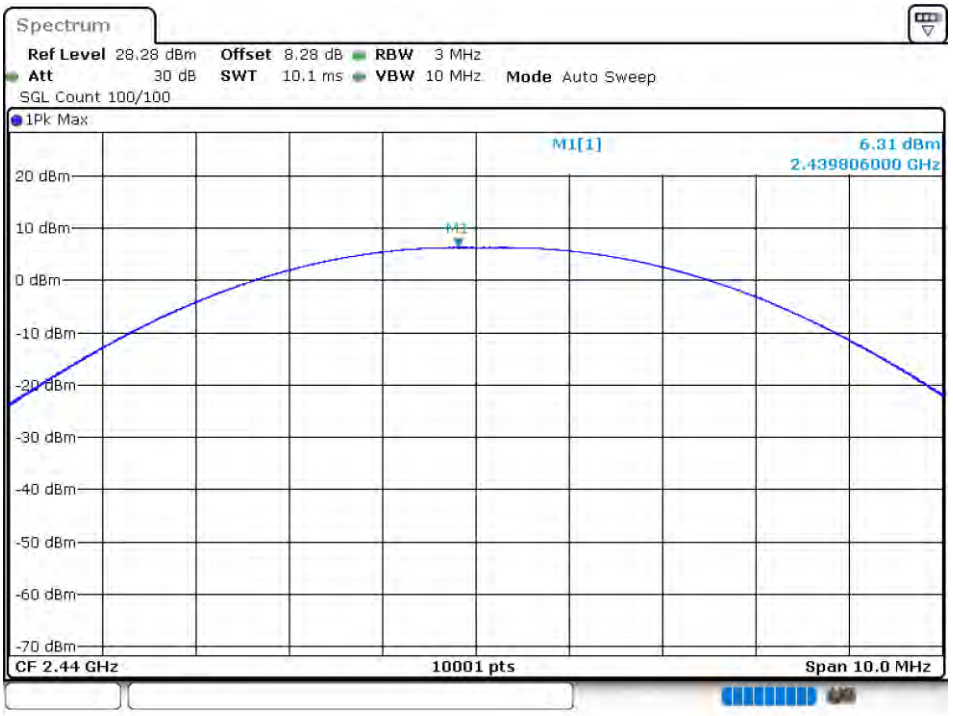
8.3.2 Maximum Conducted Output Power

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE	2402	Ant 1	6.54	0	6.54	30	Pass
NVNT	BLE	2440	Ant 1	6.31	0	6.31	30	Pass
NVNT	BLE	2480	Ant 1	5.81	0	5.81	30	Pass

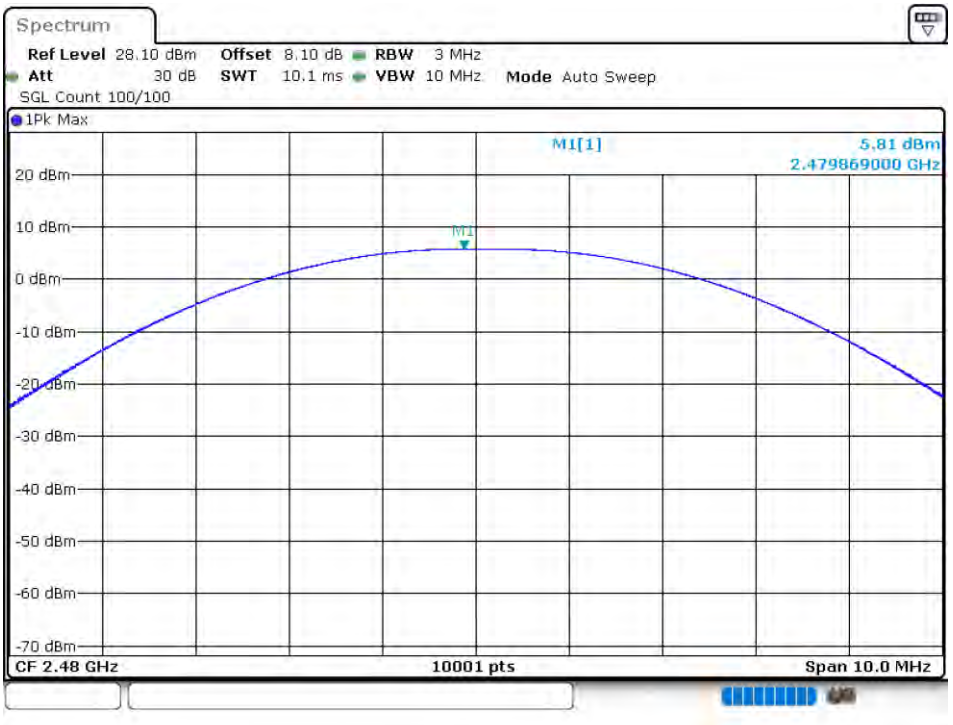
Power NVNT BLE 2402MHz Ant1



Power NVNT BLE 2440MHz Ant1



Power NVNT BLE 2480MHz Ant1



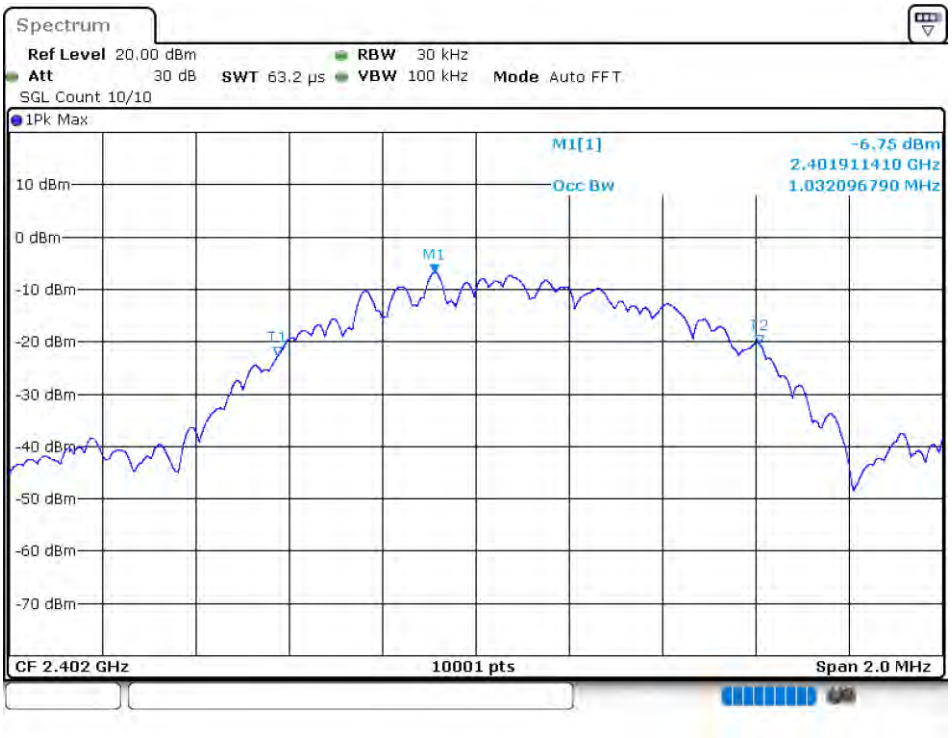
8.3.3 EQUIVALENT ISOTROPICALLY RADIATED POWER

Condition	Mode	Frequency (MHz)	Antenna	Peak Output Power (dBm)	ANT Gain (dBi)	E.I.R.P Measurement (dBm)	Limit (dBm)	Verdict
NVNT	BLE	2402	Ant 1	6.54	1.5	8.04	36	Pass
NVNT	BLE	2440	Ant 1	6.31	1.5	7.81	36	Pass
NVNT	BLE	2480	Ant 1	5.81	1.5	7.31	36	Pass

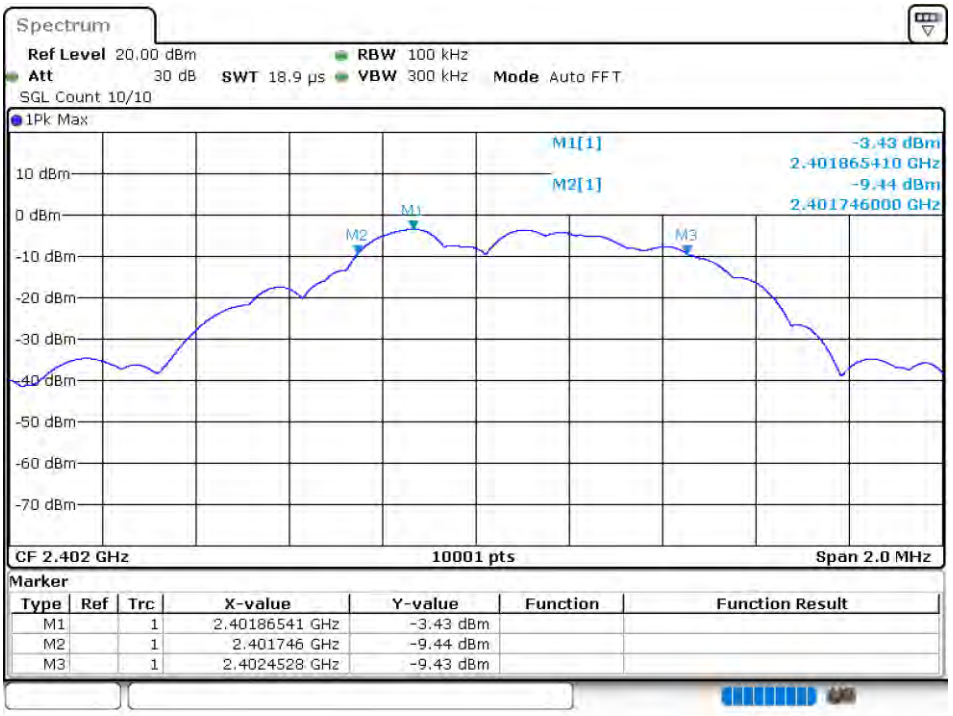
8.3.4 Occupied Channel Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
NVNT	BLE	2402	Ant 1	1.0321	0.7068	≥0.5	Pass
NVNT	BLE	2440	Ant 1	1.0389	0.7530	≥0.5	Pass
NVNT	BLE	2480	Ant 1	1.0291	0.7096	≥0.5	Pass

OBW NVNT BLE 2402MHz Ant1

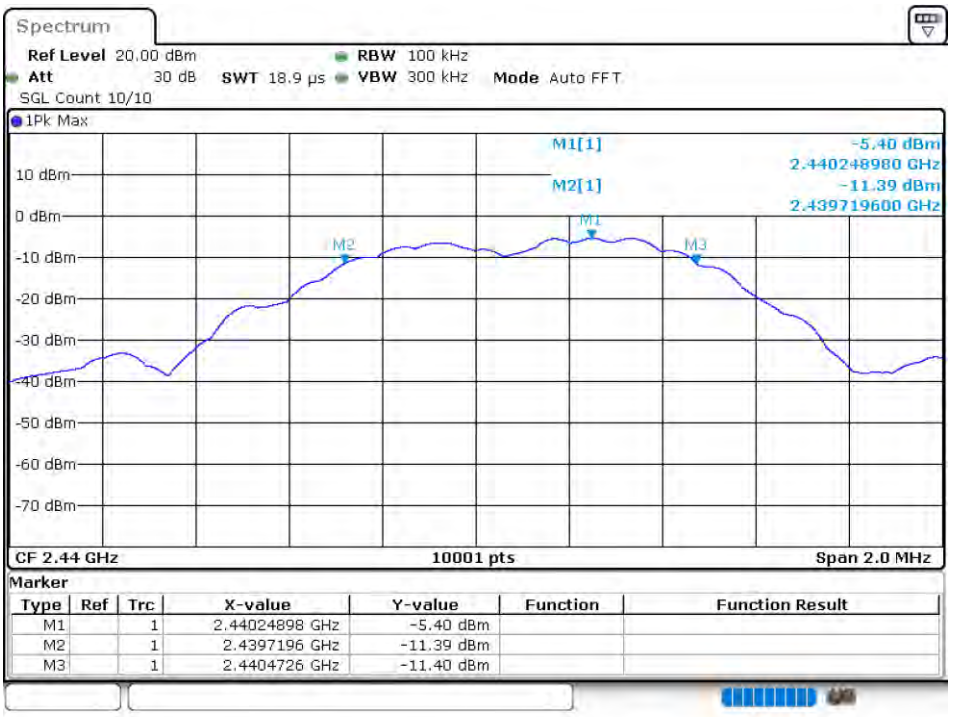


-6 dB BW NVNT BLE 2402MHz Ant1

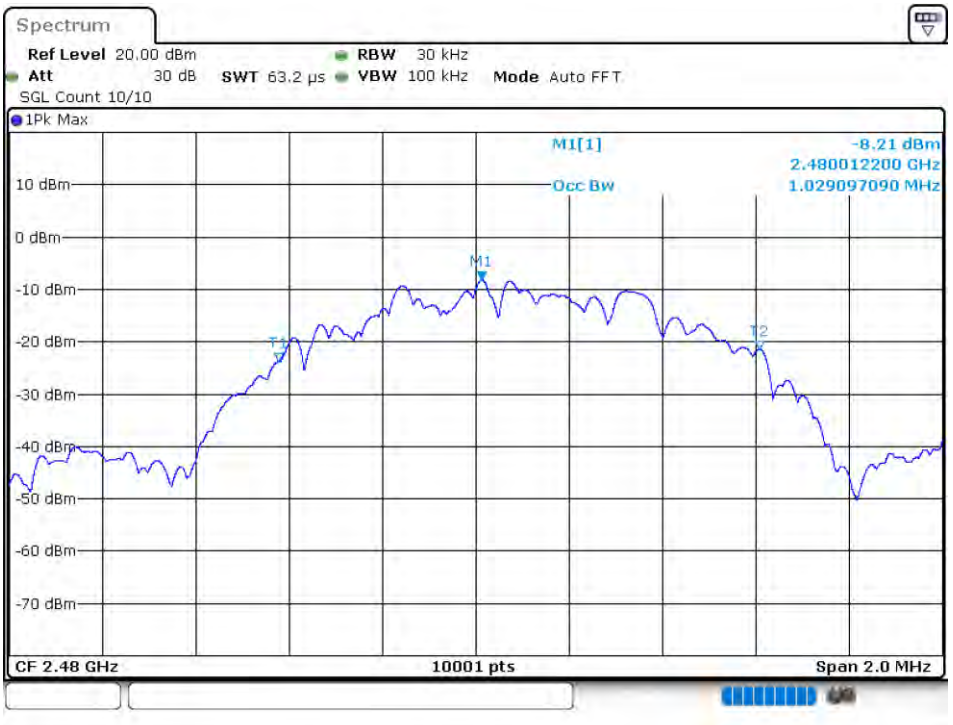


OBW NVNT BLE 2440MHz Ant1

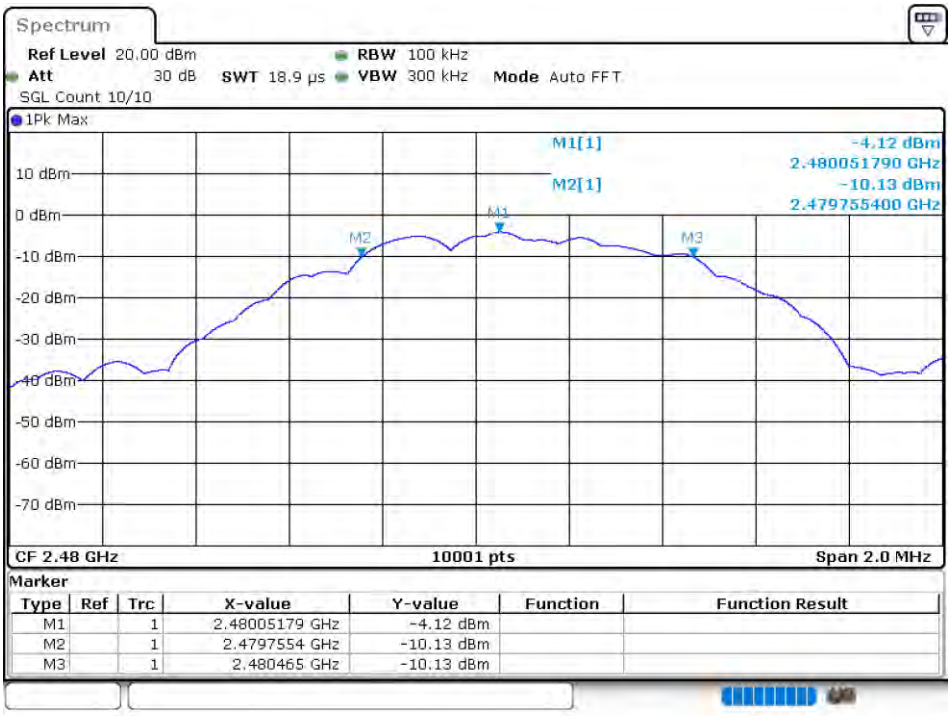
-6 dB BW NVNT BLE 2440MHz Ant1



OBW NVNT BLE 2480MHz Ant1



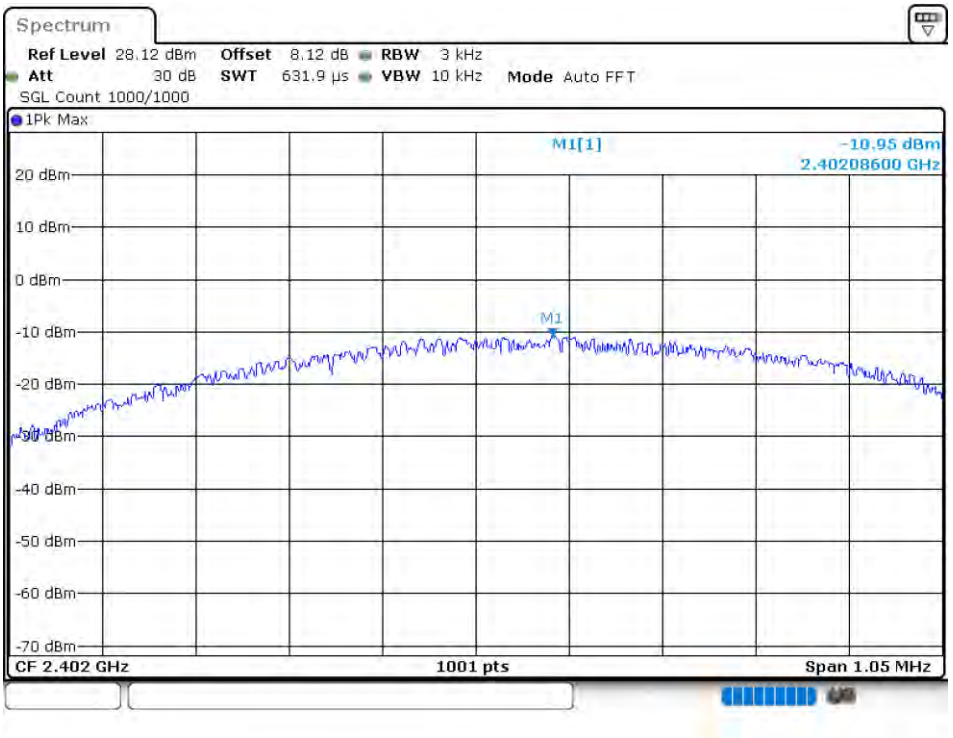
-6 dB BW NVNT BLE 2480MHz Ant1



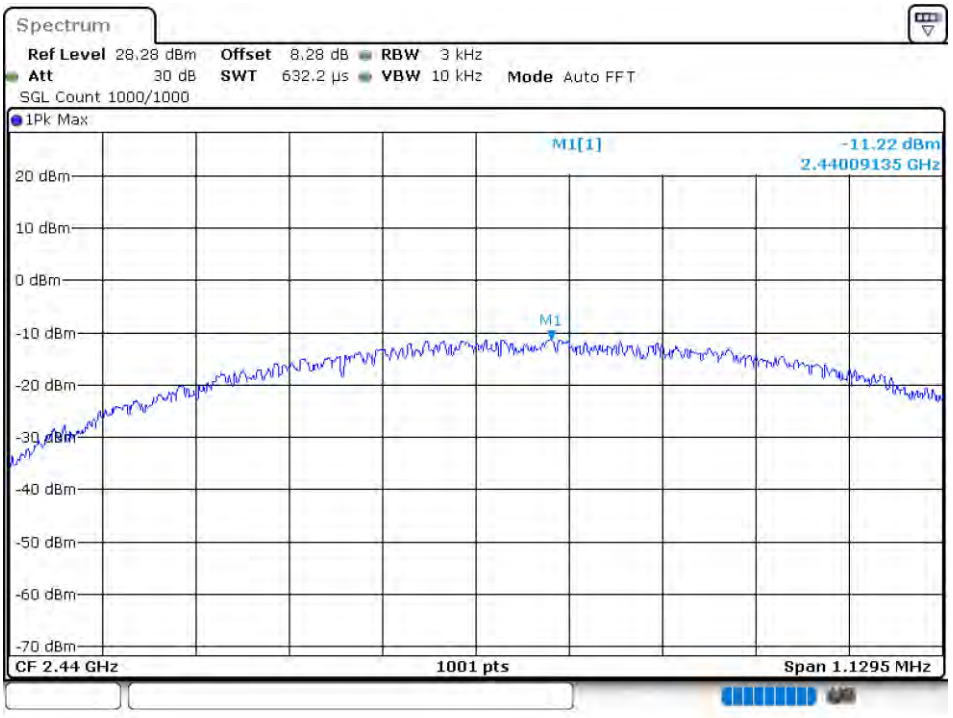
8.3.5 Maximum Power Spectral Density Level

Condition	Mode	Frequency (MHz)	Antenna	Max PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
NVNT	BLE	2402	Ant 1	-10.951	8	Pass
NVNT	BLE	2440	Ant 1	-11.222	8	Pass
NVNT	BLE	2480	Ant 1	-11.01	8	Pass

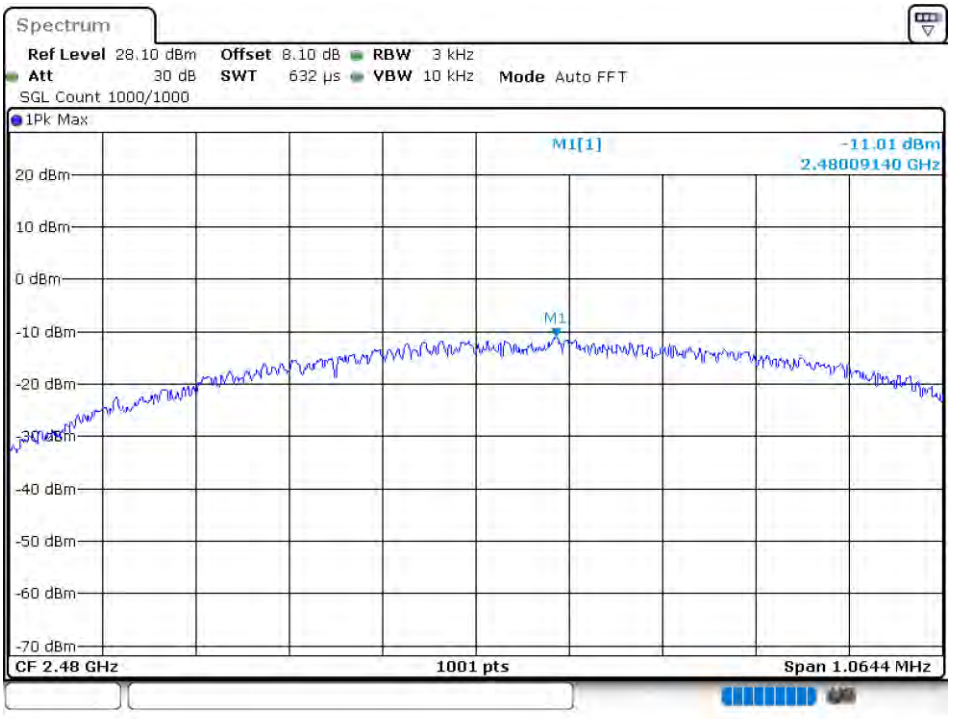
PSD NVNT BLE 2402MHz Ant1



PSD NVNT BLE 2440MHz Ant1



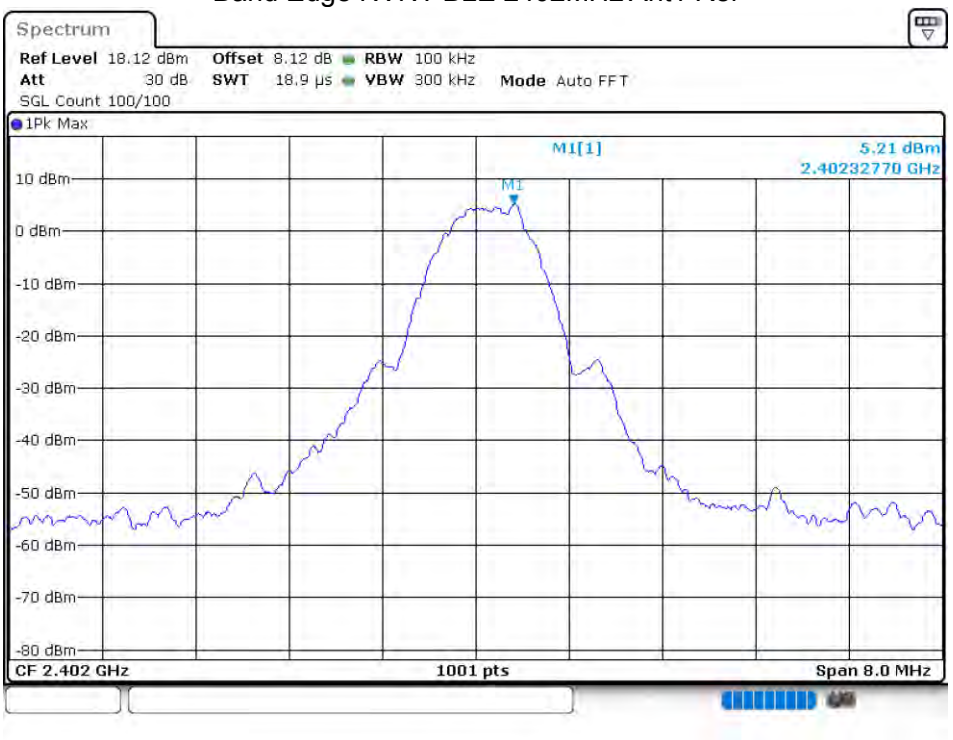
PSD NVNT BLE 2480MHz Ant1



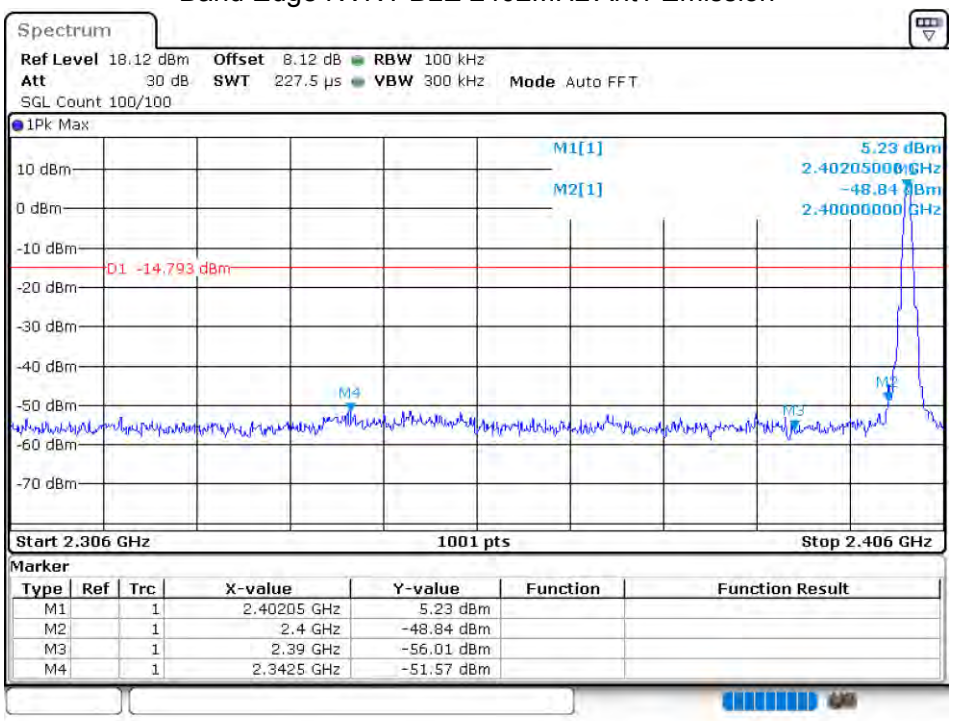
8.3.6 Band Edge

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE	2402	Ant 1	-56.78	-20	Pass
NVNT	BLE	2480	Ant 1	-55.29	-20	Pass

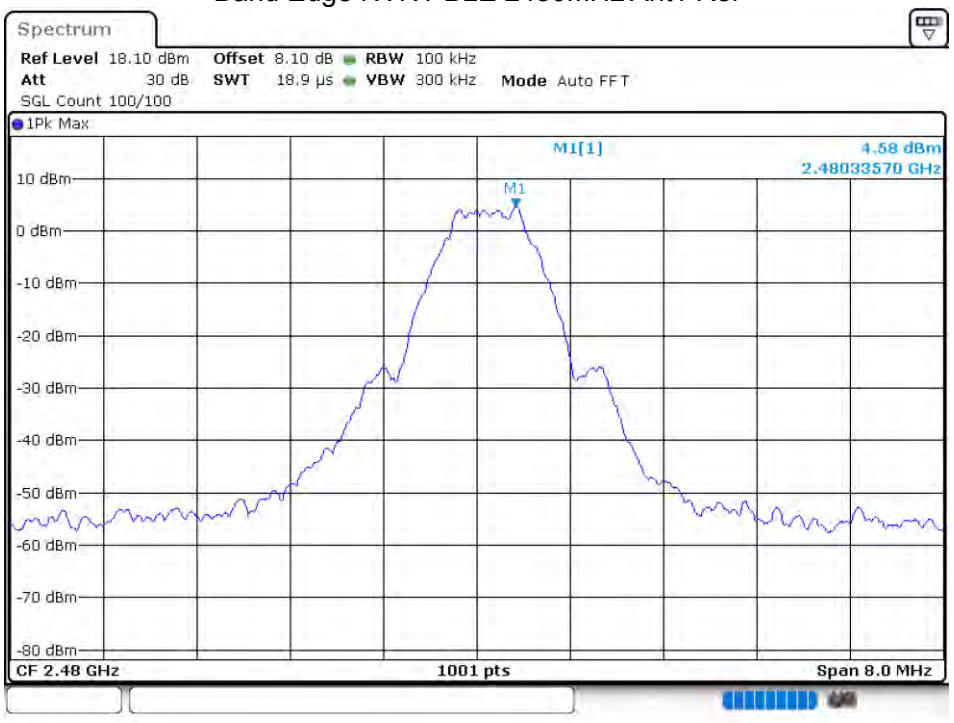
Band Edge NVNT BLE 2402MHz Ant1 Ref



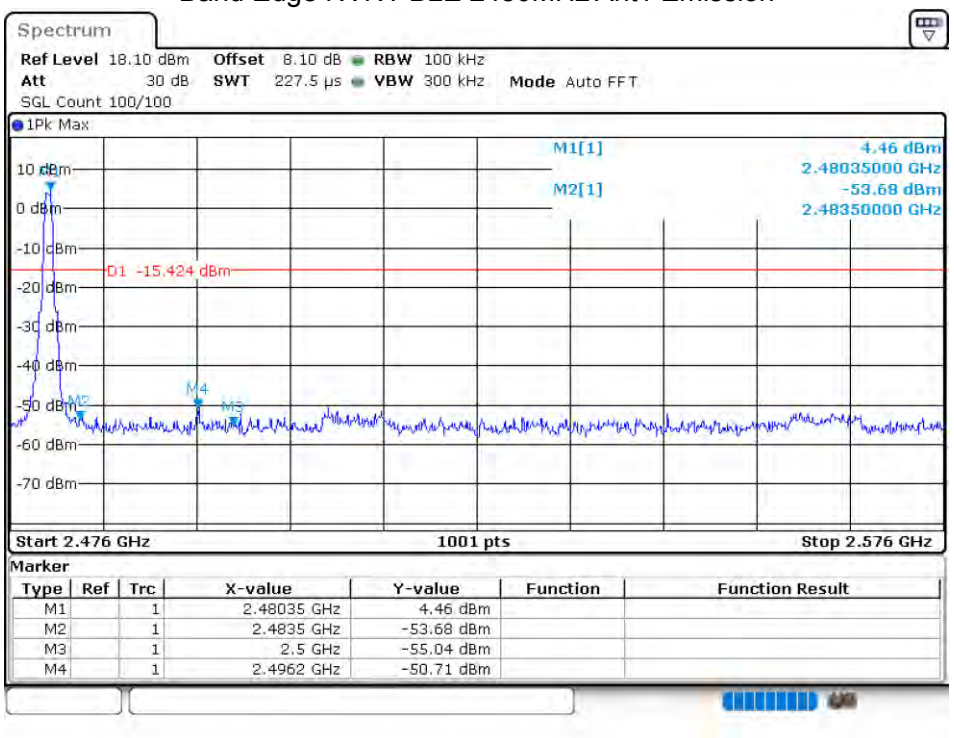
Band Edge NVNT BLE 2402MHz Ant1 Emission



Band Edge NVNT BLE 2480MHz Ant1 Ref



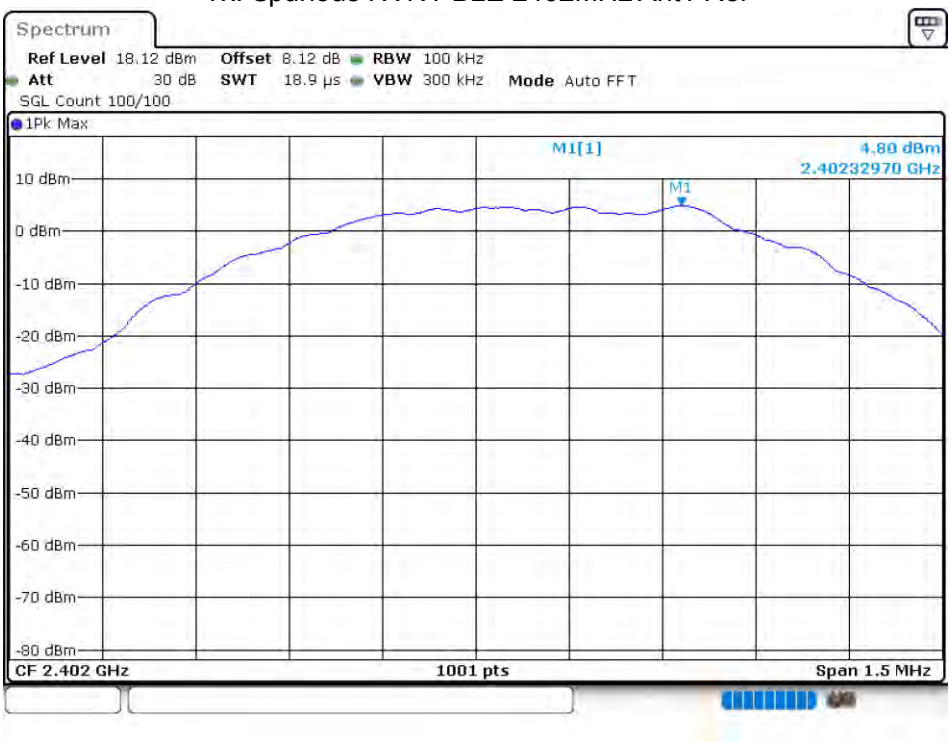
Band Edge NVNT BLE 2480MHz Ant1 Emission



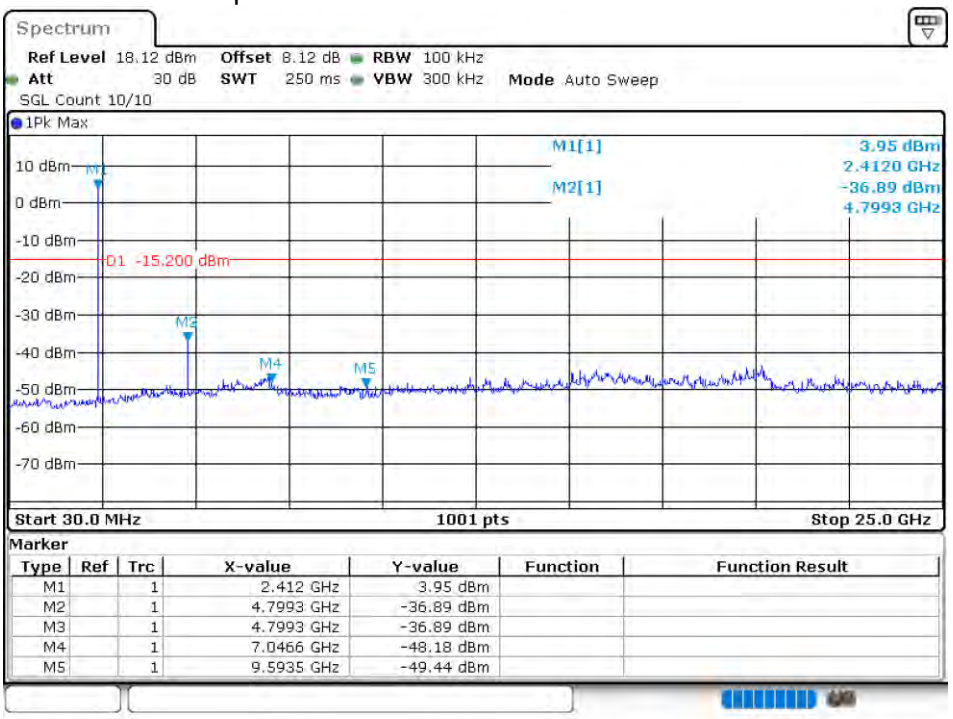
8.3.7 Conducted RF Spurious Emission

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE	2402	Ant 1	-41.69	-20	Pass
NVNT	BLE	2440	Ant 1	-44.32	-20	Pass
NVNT	BLE	2480	Ant 1	-46.22	-20	Pass

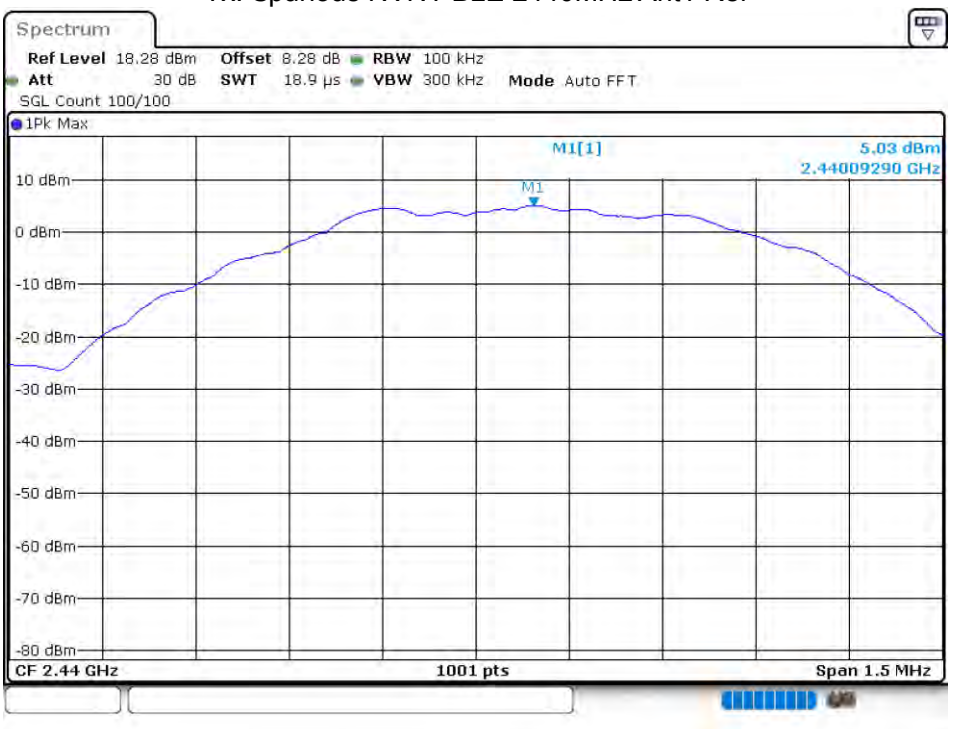
Tx. Spurious NVNT BLE 2402MHz Ant1 Ref



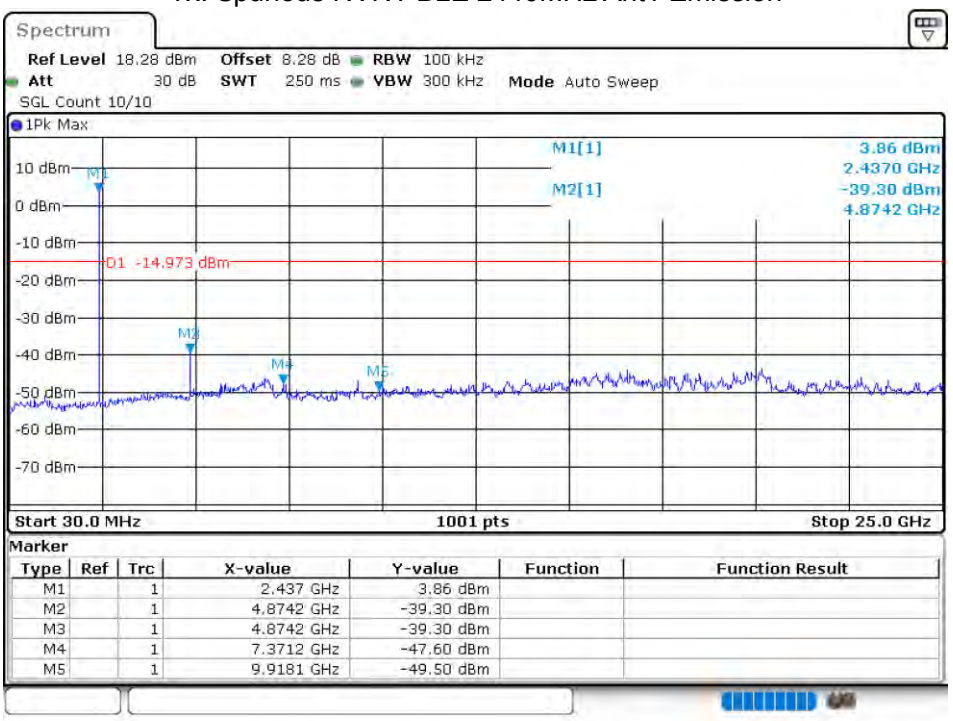
Tx. Spurious NVNT BLE 2402MHz Ant1 Emission



Tx. Spurious NVNT BLE 2440MHz Ant1 Ref



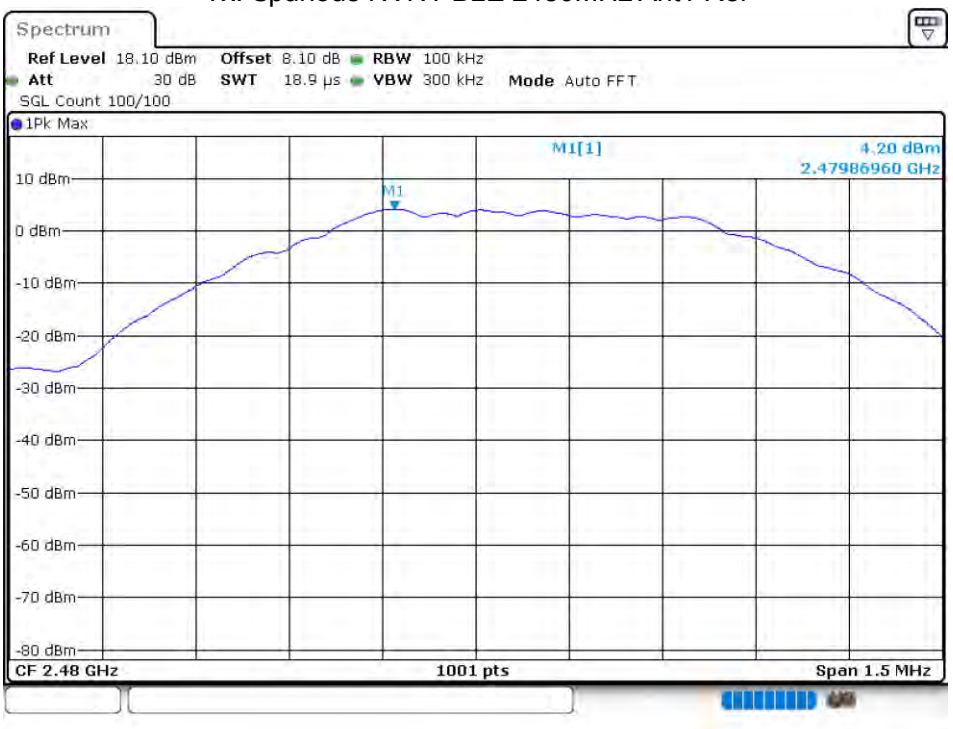
Tx. Spurious NVNT BLE 2440MHz Ant1 Emission



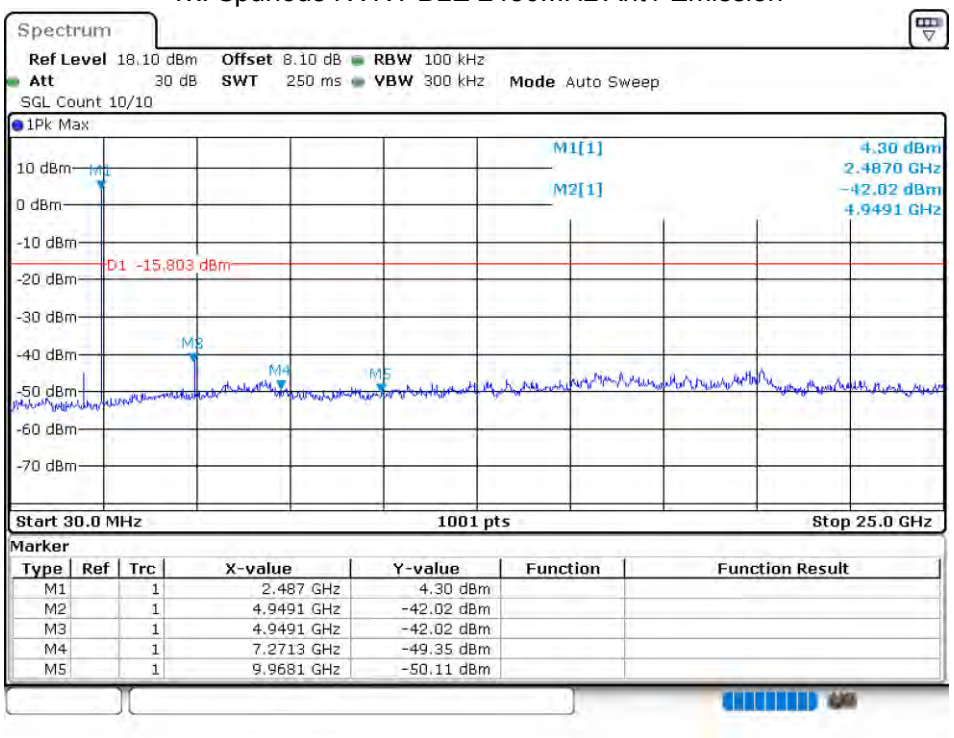
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.437 GHz	3.86 dBm		
M2		1	4.8742 GHz	-39.30 dBm		
M3		1	4.8742 GHz	-39.30 dBm		
M4		1	7.3712 GHz	-47.60 dBm		
M5		1	9.9181 GHz	-49.50 dBm		

Tx. Spurious NVNT BLE 2480MHz Ant1 Ref



Tx. Spurious NVNT BLE 2480MHz Ant1 Emission

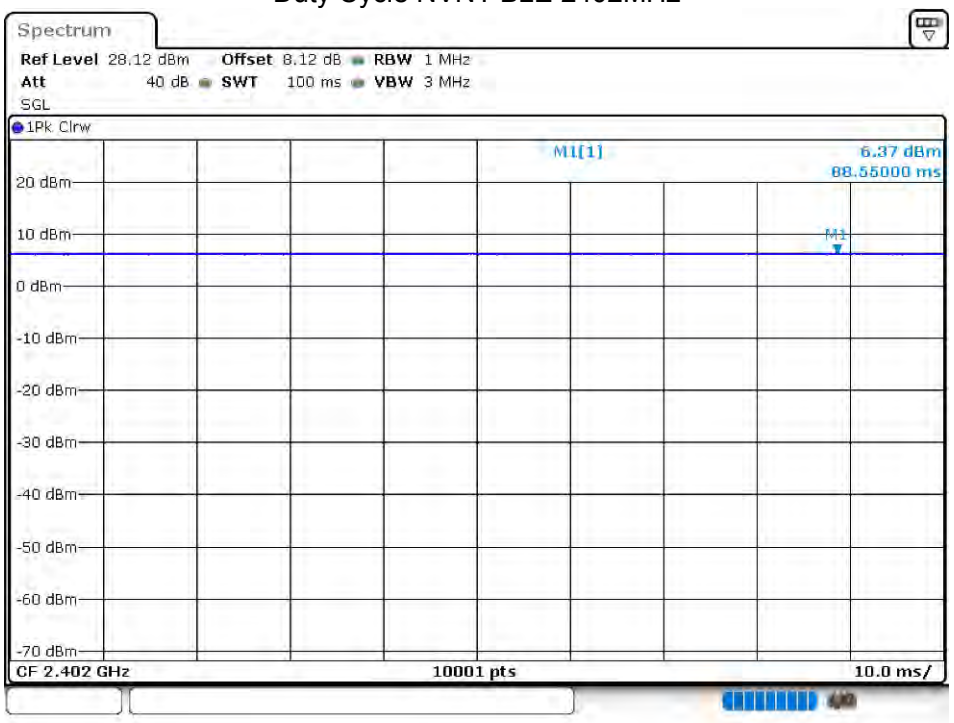


8.4 500Kbps RATE DATA

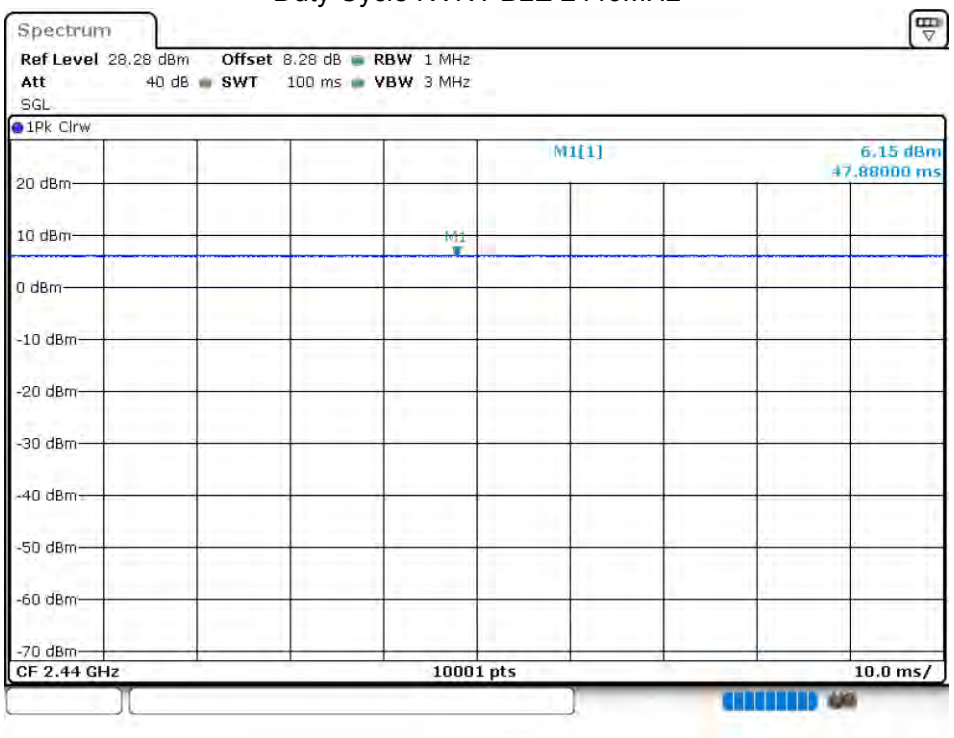
8.4.1 Duty Cycle

Condition	Mode	Frequency (MHz)	Duty Cycle (%)	Correction Factor (dB)
NVNT	BLE	2402	100	0
NVNT	BLE	2440	100	0
NVNT	BLE	2480	100	0

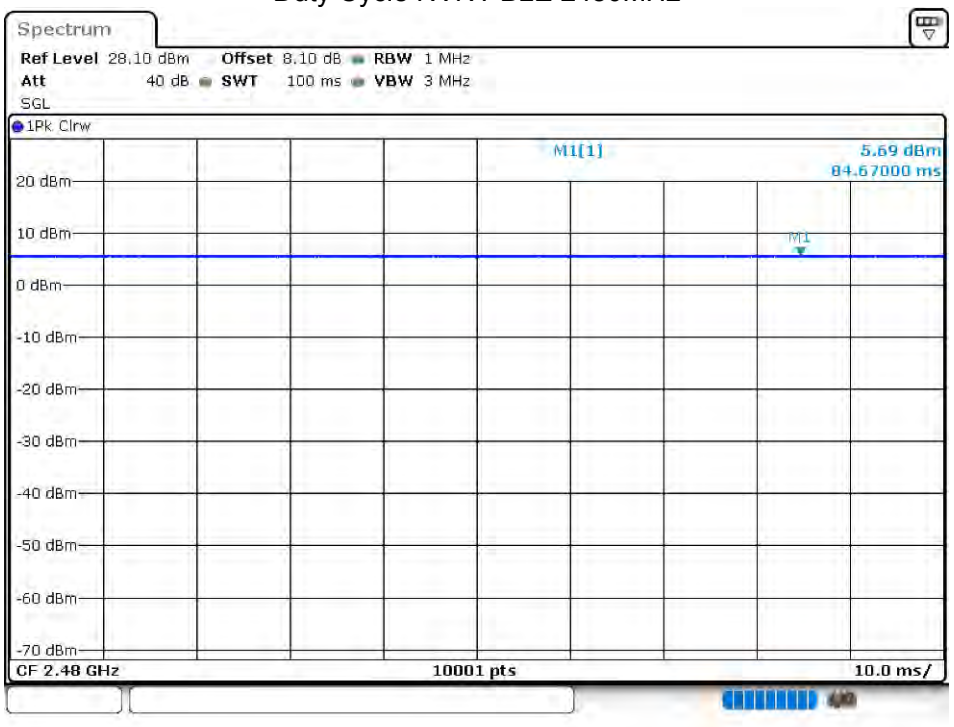
Duty Cycle NVNT BLE 2402MHz



Duty Cycle NVNT BLE 2440MHz



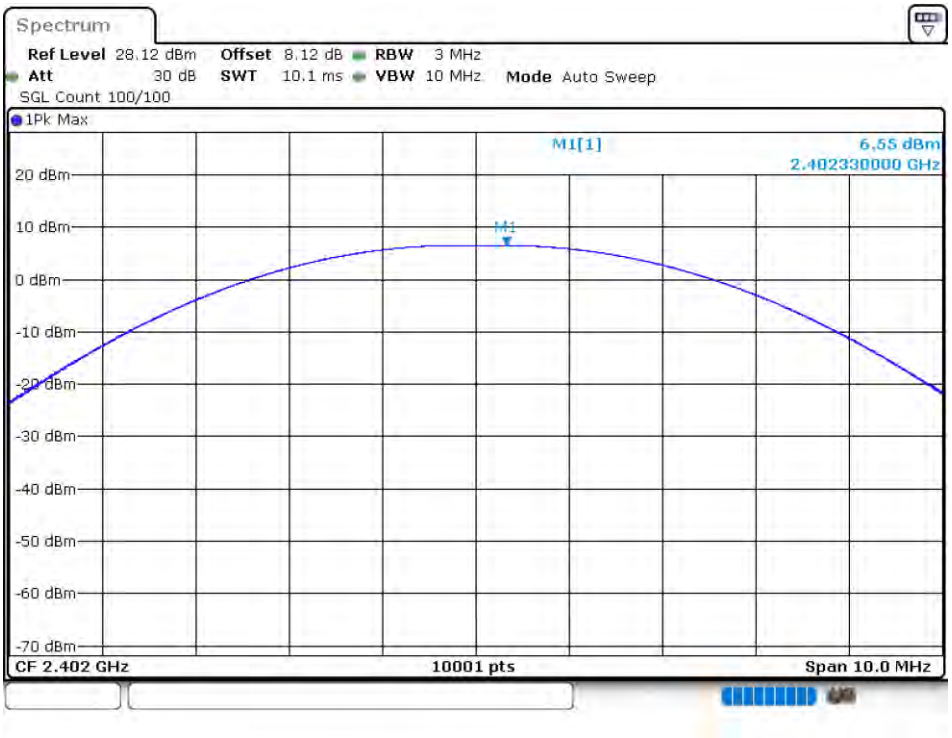
Duty Cycle NVNT BLE 2480MHz



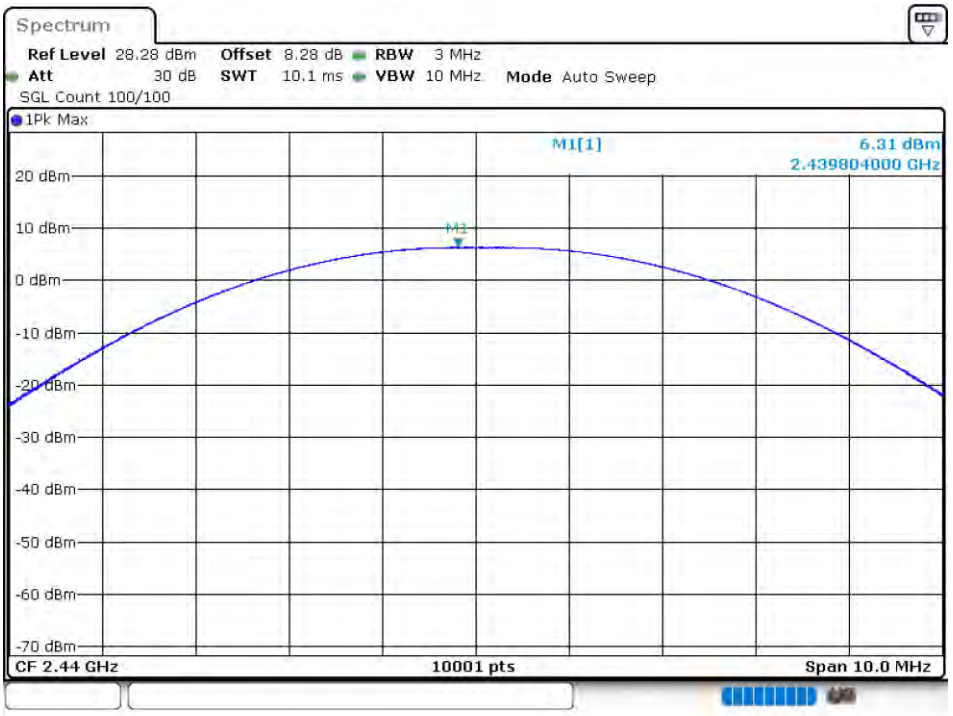
8.4.2 Maximum Conducted Output Power

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE	2402	Ant 1	6.55	0	6.55	30	Pass
NVNT	BLE	2440	Ant 1	6.31	0	6.31	30	Pass
NVNT	BLE	2480	Ant 1	5.82	0	5.82	30	Pass

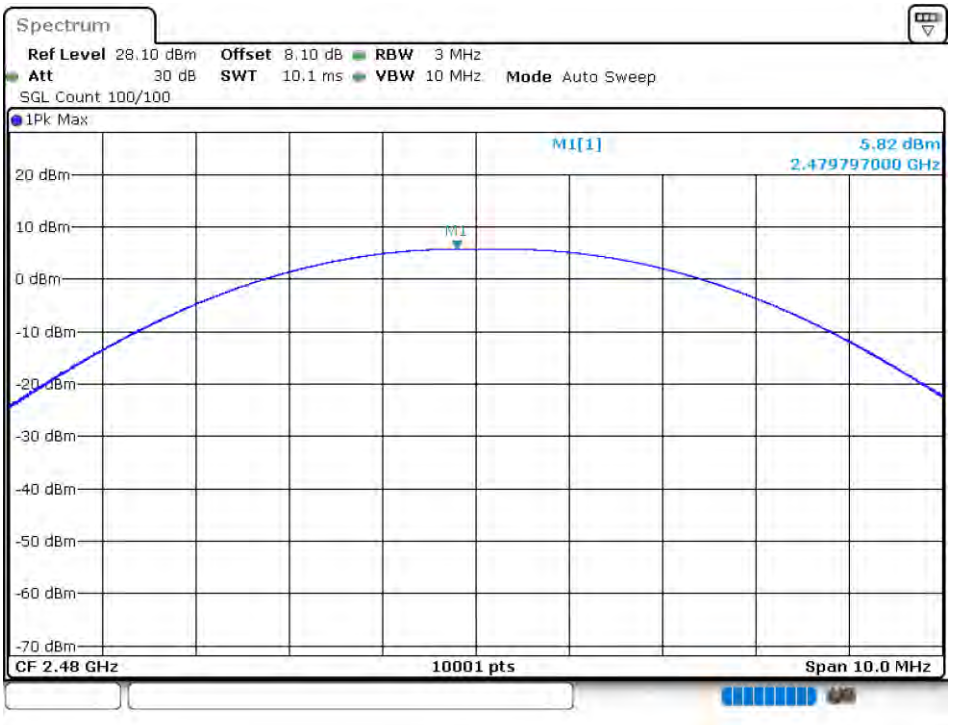
Power NVNT BLE 2402MHz Ant1



Power NVNT BLE 2440MHz Ant1



Power NVNT BLE 2480MHz Ant1



8.4.3 EQUIVALENT ISOTROPICALLY RADIATED POWER

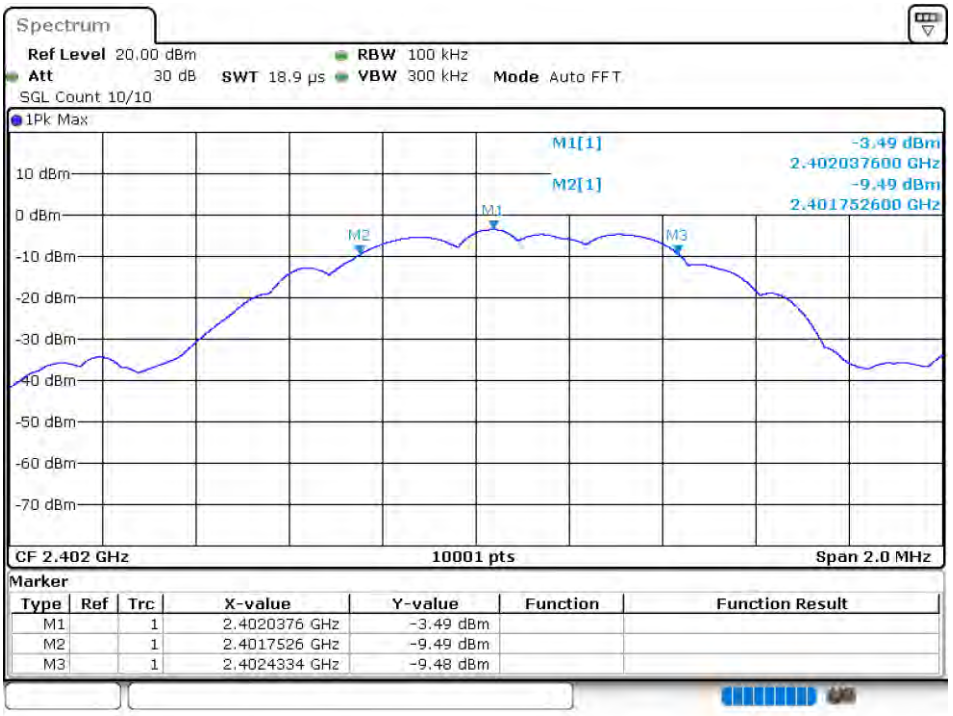
Condition	Mode	Frequency (MHz)	Antenna	Peak Output Power (dBm)	ANT Gain (dBi)	E.I.R.P Measurement (dBm)	Limit (dBm)	Verdict
NVNT	BLE	2402	Ant 1	6.55	1.5	8.05	36	Pass
NVNT	BLE	2440	Ant 1	6.31	1.5	7.81	36	Pass
NVNT	BLE	2480	Ant 1	5.82	1.5	7.32	36	Pass

8.4.4 Occupied Channel Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
NVNT	BLE	2402	Ant 1	1.0365	0.6808	≥0.5	Pass
NVNT	BLE	2440	Ant 1	1.0413	0.6080	≥0.5	Pass
NVNT	BLE	2480	Ant 1	1.0425	0.7194	≥0.5	Pass

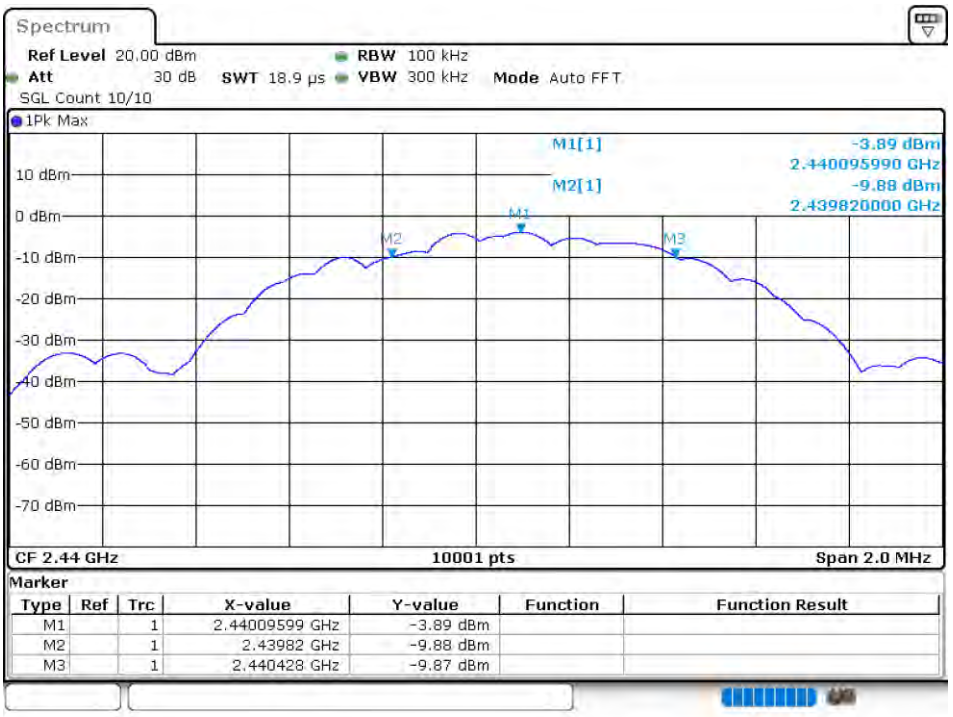
OBW NVNT BLE 2402MHz Ant1

-6 dB BW NVNT BLE 2402MHz Ant1



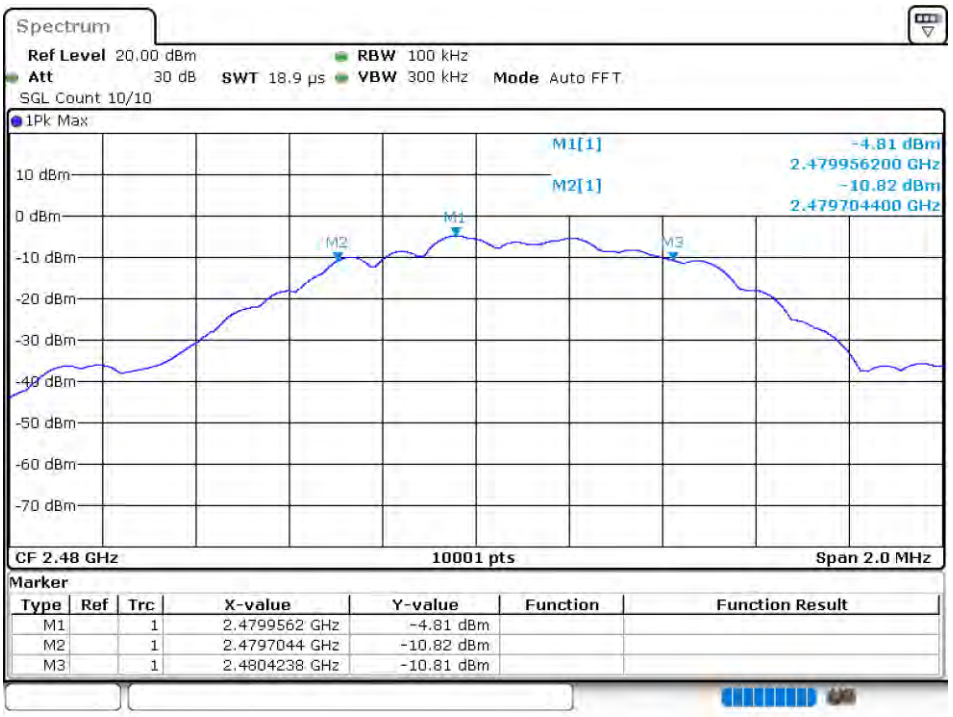
OBW NVNT BLE 2440MHz Ant1

-6 dB BW NVNT BLE 2440MHz Ant1



OBW NVNT BLE 2480MHz Ant1

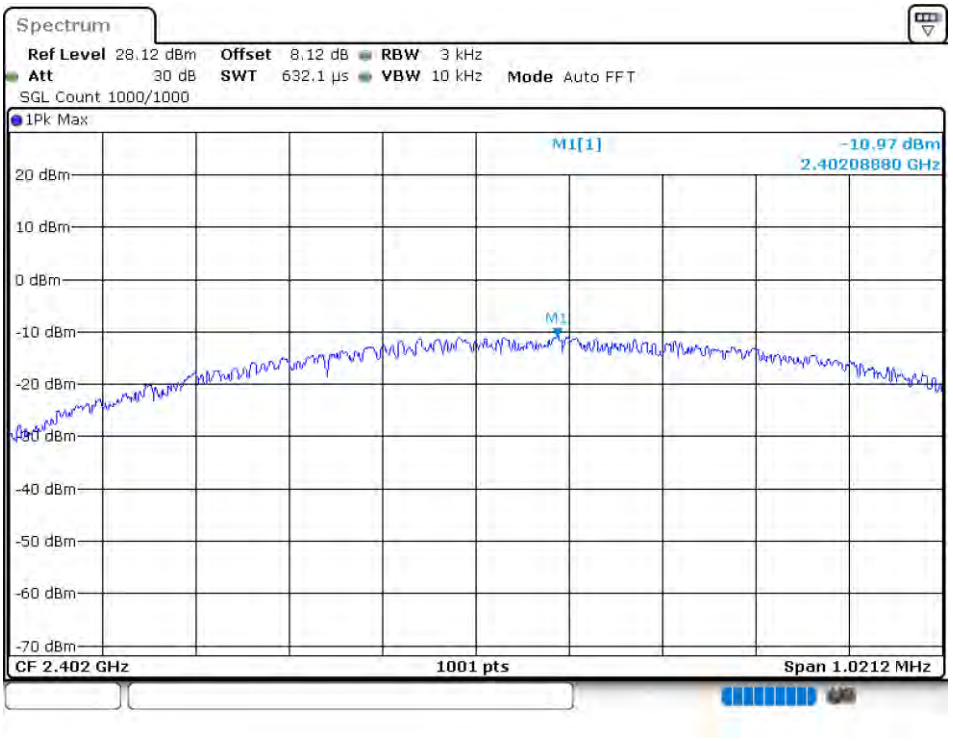
-6 dB BW NVNT BLE 2480MHz Ant1



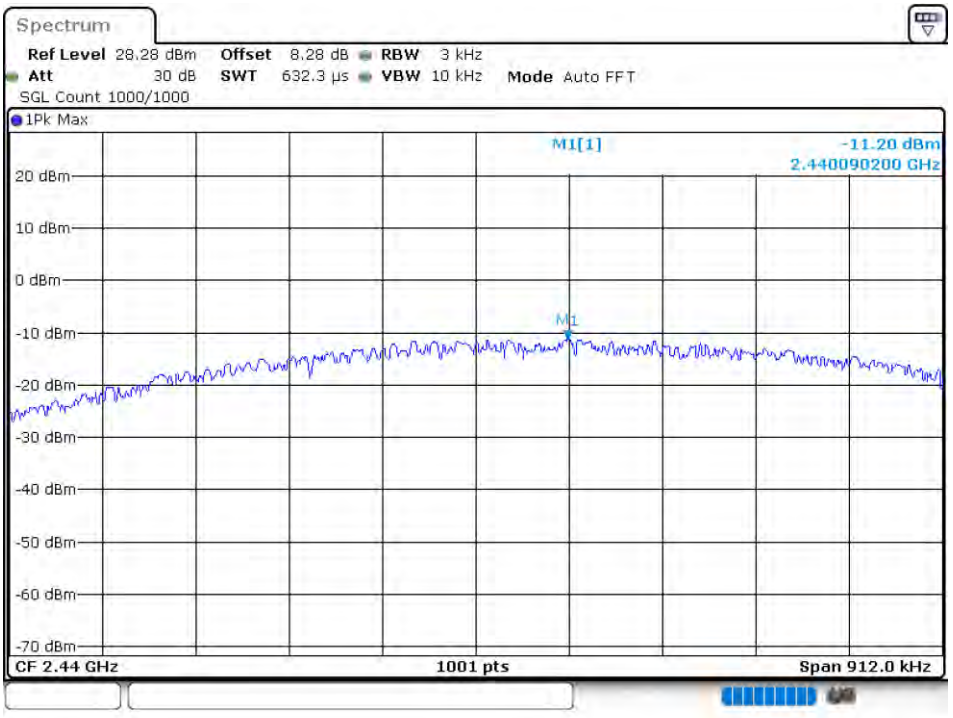
8.4.5 Maximum Power Spectral Density Level

Condition	Mode	Frequency (MHz)	Antenna	Max PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
NVNT	BLE	2402	Ant 1	-10.97	8	Pass
NVNT	BLE	2440	Ant 1	-11.201	8	Pass
NVNT	BLE	2480	Ant 1	-10.939	8	Pass

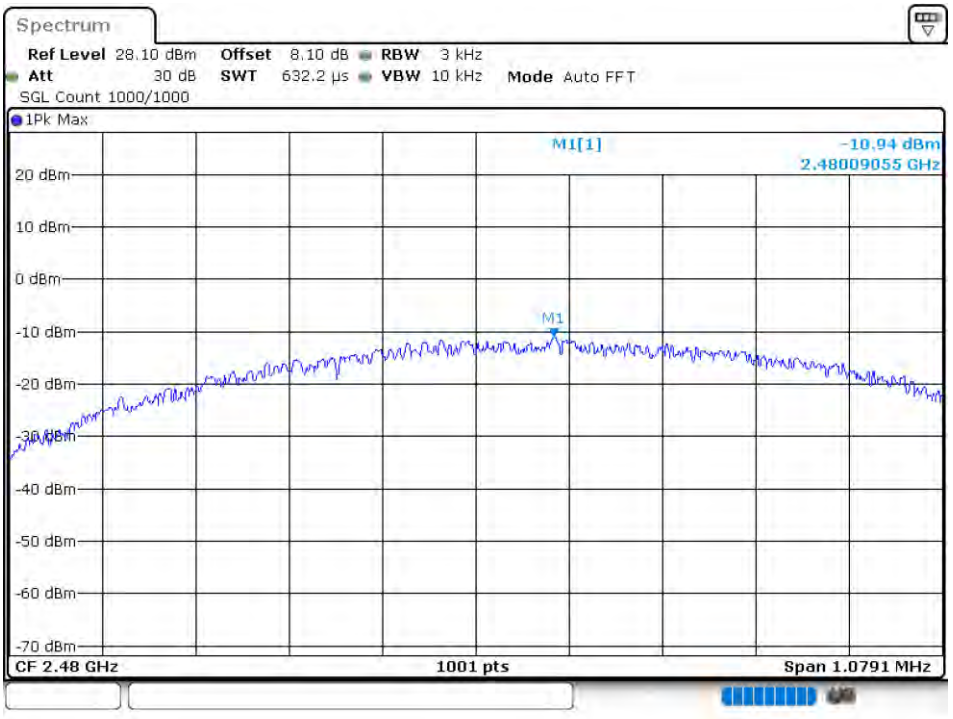
PSD NVNT BLE 2402MHz Ant1



PSD NVNT BLE 2440MHz Ant1



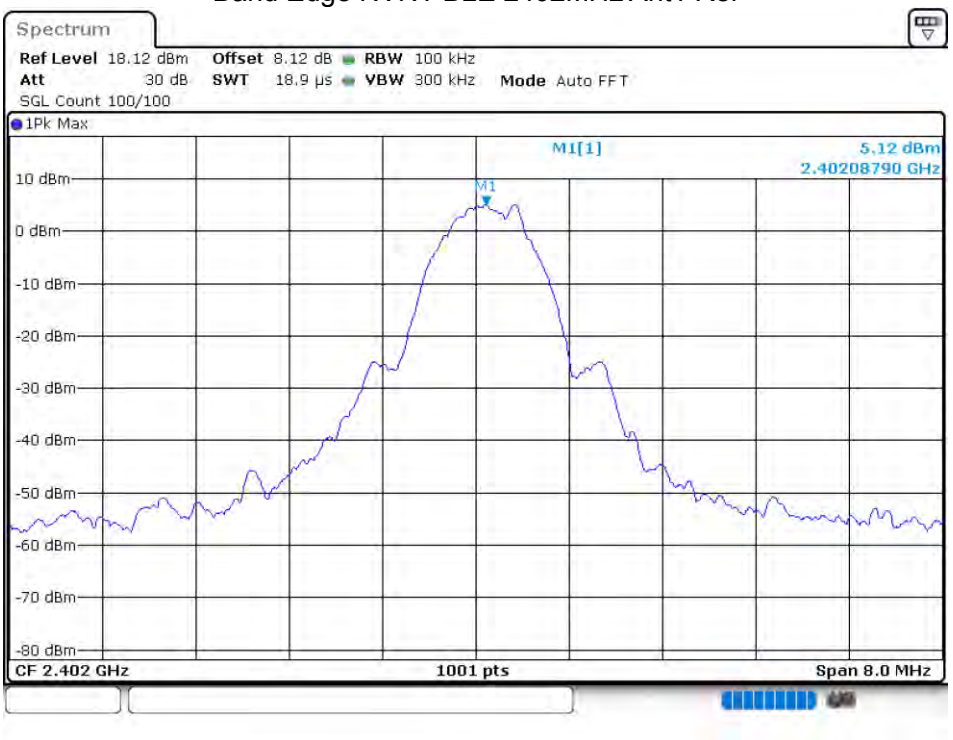
PSD NVNT BLE 2480MHz Ant1



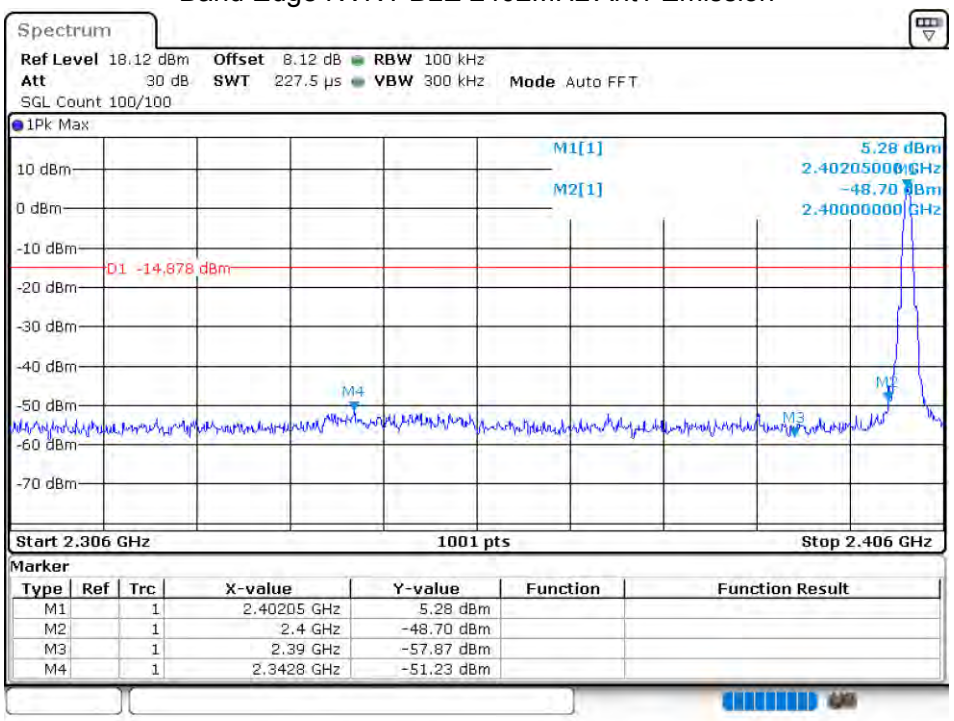
8.4.6 Band Edge

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE	2402	Ant 1	-56.34	-20	Pass
NVNT	BLE	2480	Ant 1	-55.75	-20	Pass

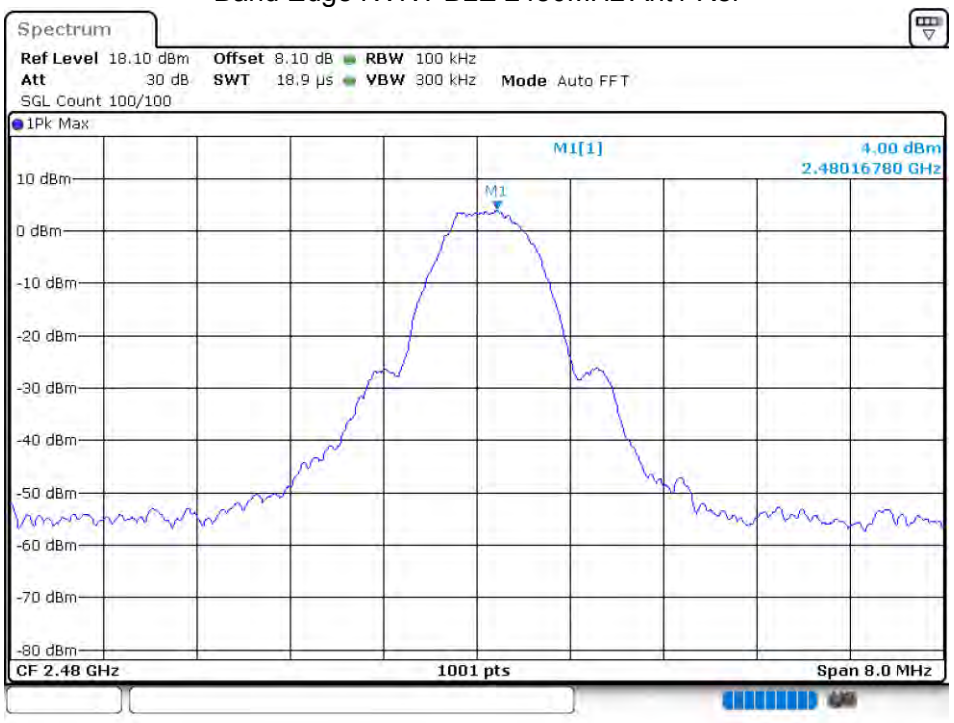
Band Edge NVNT BLE 2402MHz Ant1 Ref



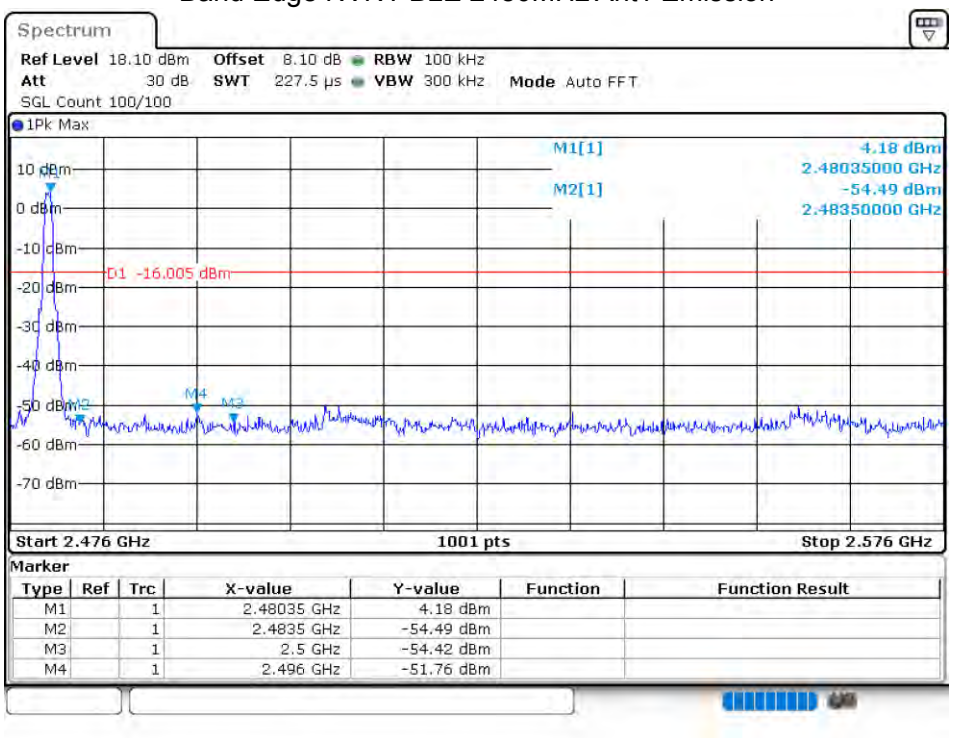
Band Edge NVNT BLE 2402MHz Ant1 Emission



Band Edge NVNT BLE 2480MHz Ant1 Ref



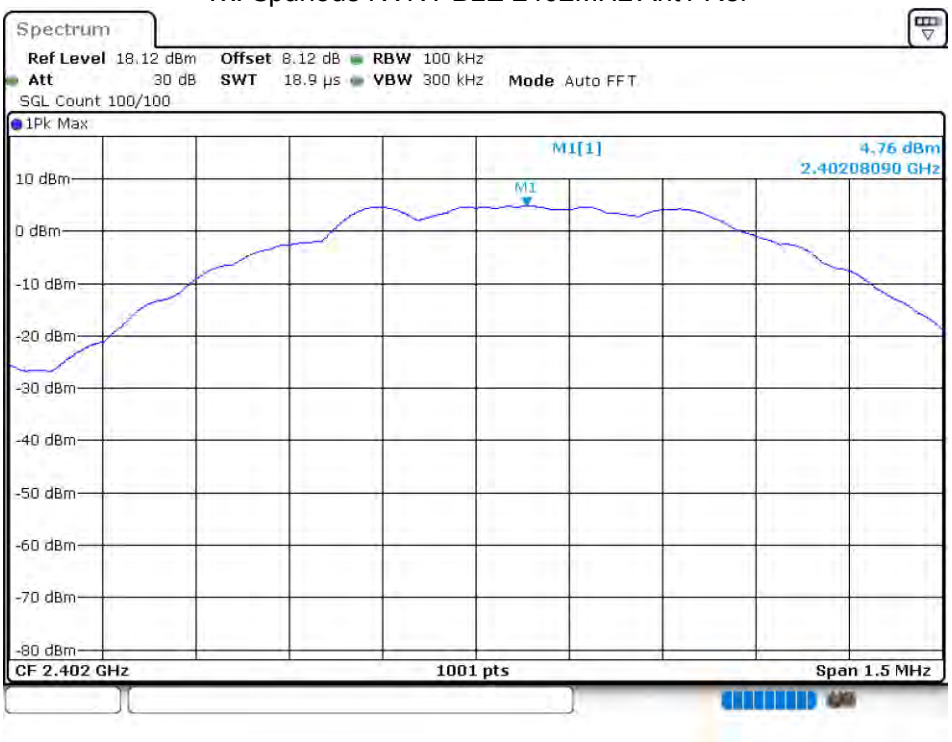
Band Edge NVNT BLE 2480MHz Ant1 Emission



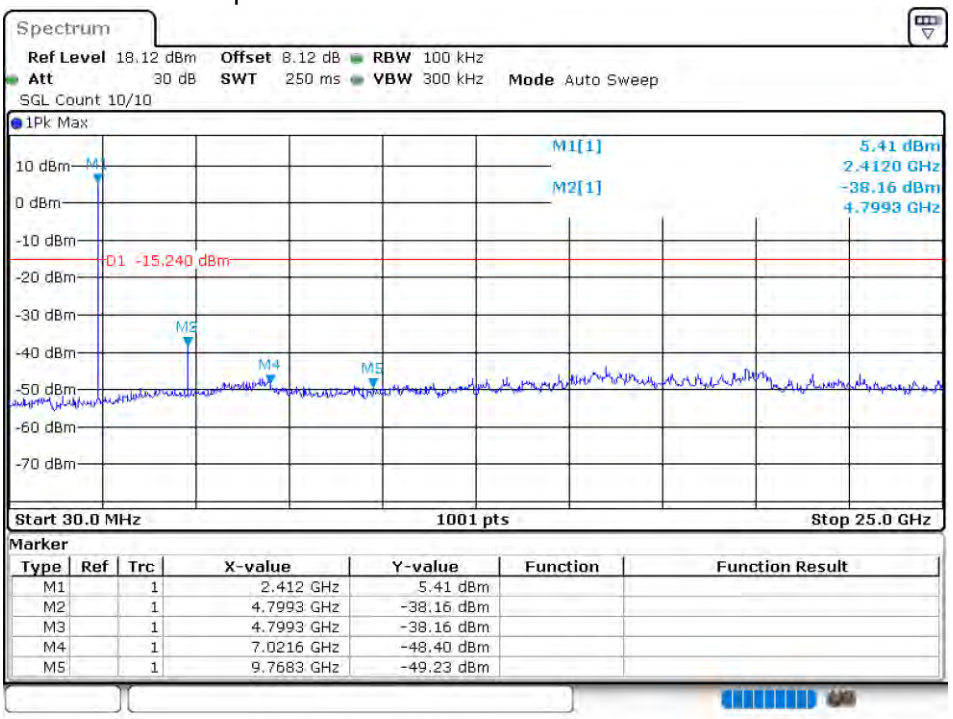
8.4.7 Conducted RF Spurious Emission

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE	2402	Ant 1	-42.91	-20	Pass
NVNT	BLE	2440	Ant 1	-44.4	-20	Pass
NVNT	BLE	2480	Ant 1	-45.25	-20	Pass

Tx. Spurious NVNT BLE 2402MHz Ant1 Ref



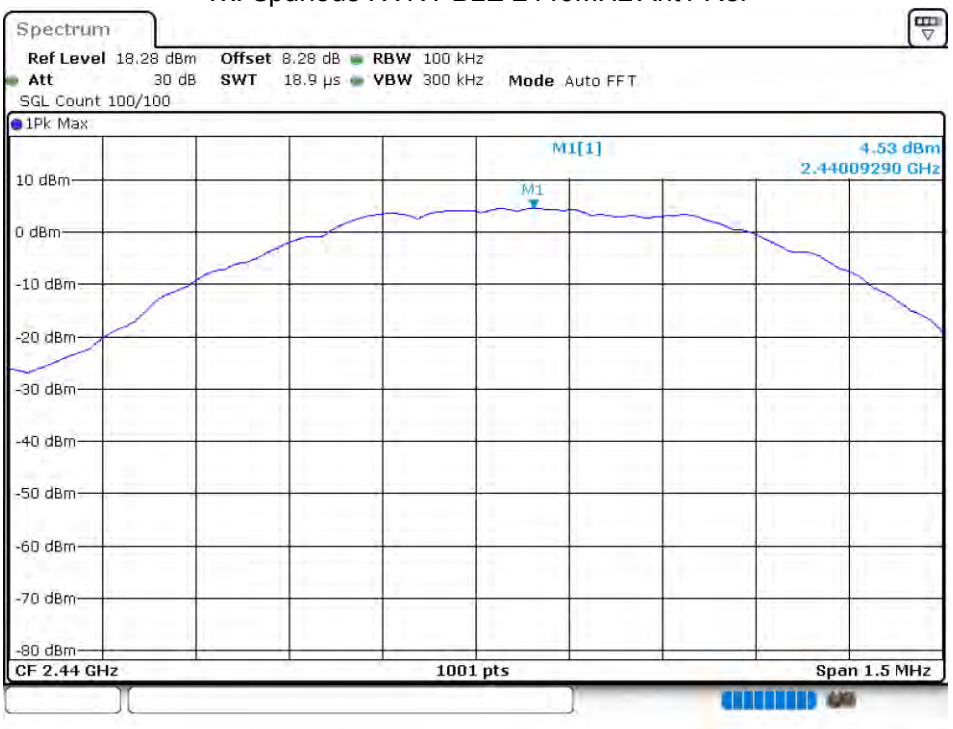
Tx. Spurious NVNT BLE 2402MHz Ant1 Emission



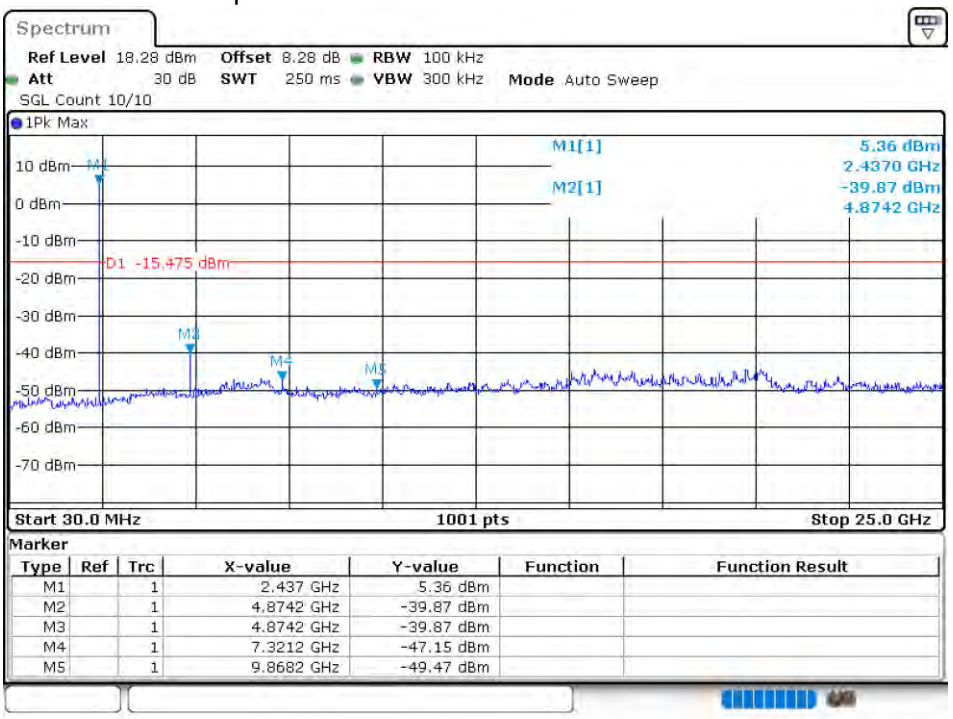
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.412 GHz	5.41 dBm		
M2		1	4.7993 GHz	-38.16 dBm		
M3		1	4.7993 GHz	-38.16 dBm		
M4		1	7.0216 GHz	-48.40 dBm		
M5		1	9.7683 GHz	-49.23 dBm		

Tx. Spurious NVNT BLE 2440MHz Ant1 Ref



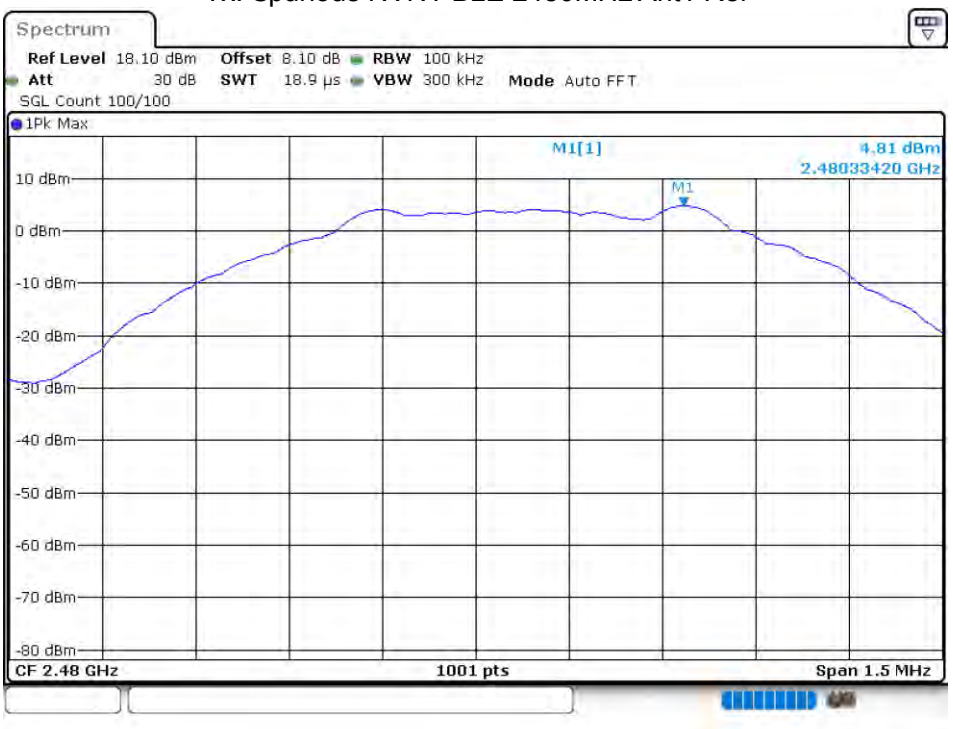
Tx. Spurious NVNT BLE 2440MHz Ant1 Emission



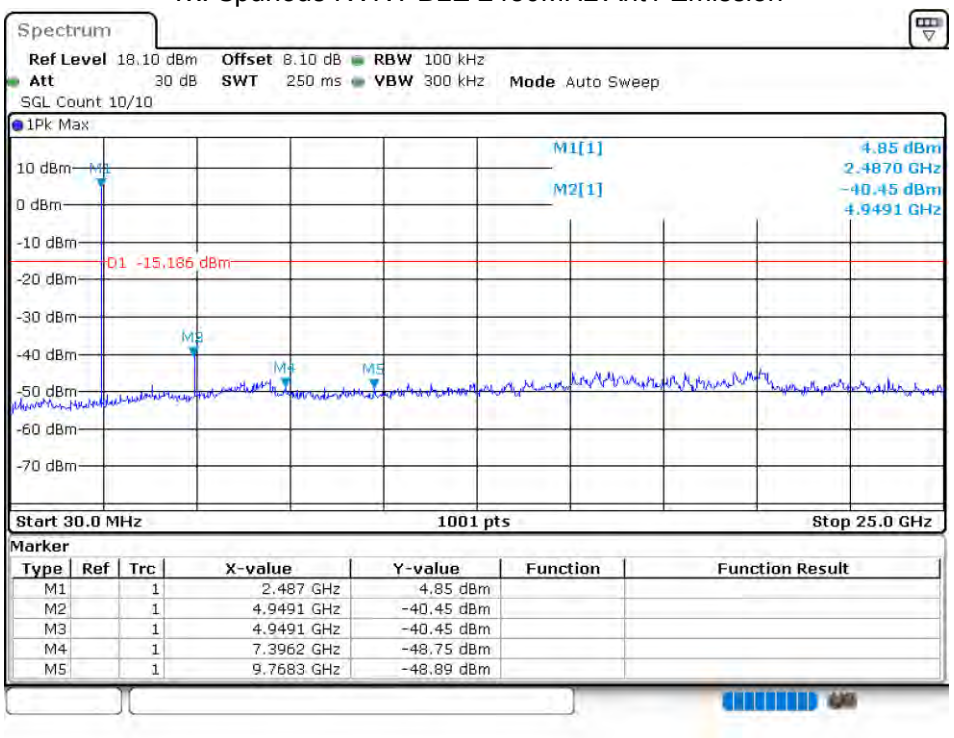
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.437 GHz	5.36 dBm		
M2		1	4.8742 GHz	-39.87 dBm		
M3		1	4.8742 GHz	-39.87 dBm		
M4		1	7.3212 GHz	-47.15 dBm		
M5		1	9.8682 GHz	-49.47 dBm		

Tx. Spurious NVNT BLE 2480MHz Ant1 Ref



Tx. Spurious NVNT BLE 2480MHz Ant1 Emission



END OF REPORT