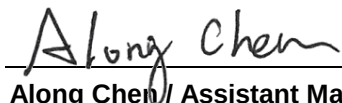


FCC Test Report

FCC ID : SQG-PINNACLE1
Equipment : LTE Modem
Model No. : Pinnacle 100
Brand Name : Laird Connectivity
Applicant : Laird Connectivity, Inc.
Address : W66N220 Commerce Court, Cedarburg,
Wisconsin 53012, USA
Standard : 47 CFR FCC Part 15.247
Received Date : Apr. 16, 2019
Tested Date : Apr. 16, 2019 ~ May 27, 2020

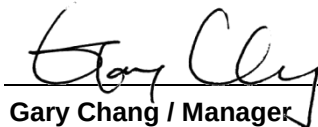
We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:



Along Chen / Assistant Manager

Approved by:



Gary Chang / Manager



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Release Record

Report No.	Version	Description	Issued Date
FR950303AE	Rev. 01	Initial issue	Jun. 11, 2020

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	AC Power Line Conducted Emissions	[dBuV]: 0.150MHz 55.61 (Margin -10.39dB) - QP	Pass
15.247(d) 15.209	Radiated Emissions	Meet the requirement of limit	Pass
15.247(b)(3)	Maximum Output Power	Power [dBm]: 6.47	Pass
15.247(a)(2)	6dB Bandwidth	Meet the requirement of limit	Pass
15.247(e)	Power Spectral Density	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	Bluetooth Mode	Ch. Freq. (MHz)	Channel Number	Data Rate
2400-2483.5	V5.0 LE	2402-2480	0-39 [40]	125 kbps
				500 kbps
				1 Mbps
				2 Mbps
Note 1: Bluetooth LE (Low energy) uses GFSK modulation.				

1.1.2 Antenna Details

Ant. No.	Brand	Model	Type	Gain (dBi)	Connector
1	LSR	001-0001	2.4GHz Dipole	2	RP-SMA Female with IPEX U.FL antenna cable
2	Laird	NanoBlue-IP04 (MAF94045)	PCB Dipole	2	IPEX U.FL
3	LSR	001-0014	2.4GHz Flex PIFA	2	IPEX U.FL
4	Laird	110-00665	Trace Monopole	2.6	NA

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.7 Vdc
-------------------	---------

1.1.4 Accessories

N/A

1.1.5 Channel List

Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
37	2402	9	2422	18	2442	28	2462
0	2404	10	2424	19	2444	29	2464
1	2406	38	2426	20	2446	30	2466
2	2408	11	2428	21	2448	31	2468
3	2410	12	2430	22	2450	32	2470
4	2412	13	2432	23	2452	33	2472
5	2414	14	2434	24	2454	34	2474
6	2416	15	2436	25	2456	35	2476
7	2418	16	2438	26	2458	36	2478
8	2420	17	2440	27	2460	39	2480

1.1.6 Test Tool and Duty Cycle

Test Tool	UwTerminal, Version: 7.94		
Duty Cycle and Duty Factor	Modulation Mode	Duty Cycle (%)	Duty Factor (dB)
	GFSK-125kbps	83.56%	0.78
	GFSK-500kbps	58.37%	2.34
	GFSK-1Mbps	63.89%	1.95
	GFSK-2Mbps	34.26%	4.65

1.1.7 Power Index of Test Tool

Low Power

Modulation Mode	Test Frequency (MHz)		
	2402	2440	2480
GFSK/125kbps	at+dtmcfg 1 -40	at+dtmcfg 1 -40	at+dtmcfg 1 -40
GFSK/500kbps	at+dtmcfg 1 -40	at+dtmcfg 1 -40	at+dtmcfg 1 -40
GFSK/1Mbps	at+dtmcfg 1 -40	at+dtmcfg 1 -40	at+dtmcfg 1 -40
GFSK/2Mbps	at+dtmcfg 1 -40	at+dtmcfg 1 -40	at+dtmcfg 1 -40

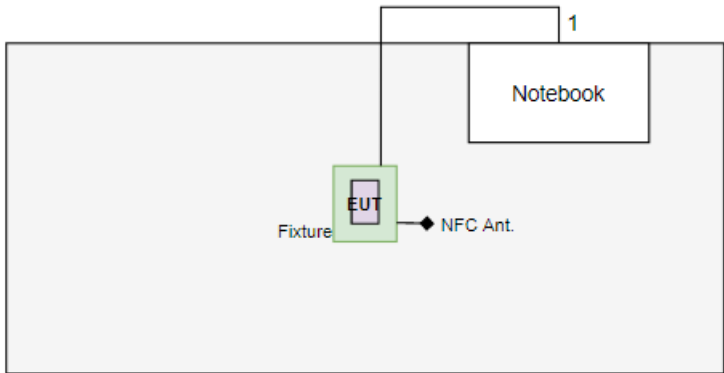
High power

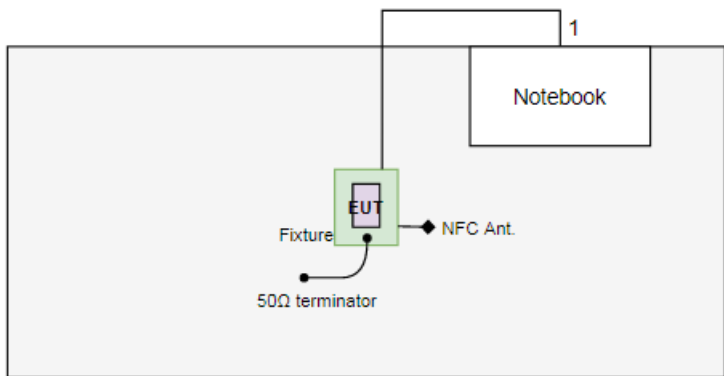
Modulation Mode	Test Frequency (MHz)		
	2402	2440	2480
GFSK/125kbps	at+dtmcfg 1 8	at+dtmcfg 1 8	at+dtmcfg 1 8
GFSK/500kbps	at+dtmcfg 1 8	at+dtmcfg 1 8	at+dtmcfg 1 8
GFSK/1Mbps	at+dtmcfg 1 8	at+dtmcfg 1 8	at+dtmcfg 1 8
GFSK/2Mbps	at+dtmcfg 1 8	at+dtmcfg 1 8	at+dtmcfg 1 8

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Remarks
1	Notebook	DELL	Latitude E6440	DoC	---
2	USB Cable	I-Gota	micro to A	---	---
3	50Ω terminator	---	---	---	---
4	Fixture	---	---	---	Provided by applicant.

1.3 Test Setup Chart

Test Setup Diagram – Conducted emission	
	
No.	Signal cable / Length (m)
1	USB, 1m shielded.

Test Setup Diagram – Radiated emission	
	
No.	Signal cable / Length (m)
1	USB, 1m shielded.

1.4 Test Equipment List and Calibration Data

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Tested Date	May 27, 2020				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101658	Dec. 12, 2019	Dec. 11, 2020
LISN	R&S	ENV216	101579	Mar. 12, 2020	Mar. 11, 2021
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 22, 2019	Oct. 21, 2020
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	Apr. 17 ~ Apr. 18, 2019				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101498	Dec. 27, 2018	Dec. 26, 2019
Receiver	R&S	ESR3	101658	Dec. 11, 2018	Dec. 10, 2019
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jul. 18, 2018	Jul. 17, 2019
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 18, 2018	Dec. 17, 2019
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 15, 2018	Nov. 14, 2019
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 09, 2018	Nov. 08, 2019
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 08, 2018	Oct. 07, 2019
Preamplifier	EMC	EMC02325	980225	Jul. 20, 2018	Jul. 19, 2019
Preamplifier	Agilent	83017A	MY39501308	Oct. 04, 2018	Oct. 03, 2019
Preamplifier	EMC	EMC184045B	980192	Aug. 09, 2018	Aug. 08, 2019
RF Cable	EMC	EMC104-SM-SM-8000	181106	Oct. 08, 2018	Oct. 07, 2019
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Oct. 08, 2018	Oct. 07, 2019
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Oct. 08, 2018	Oct. 07, 2019
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160502	Oct. 08, 2018	Oct. 07, 2019
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 08, 2018	Oct. 07, 2019
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Oct. 08, 2018	Oct. 07, 2019
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Tested Date	Apr. 16 ~ Apr. 18, 2019				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101486	Jan. 08, 2019	Jan. 07, 2020
Spectrum Analyzer	R&S	FSV40	101499	Jan. 07, 2019	Jan. 06, 2020
Power Meter	Anritsu	ML2495A	1241002	Oct. 09, 2018	Oct. 08, 2019
Power Sensor	Anritsu	MA2411B	1207366	Oct. 09, 2018	Oct. 08, 2019
DC POWER SOURCE	GW INSTEK	GPC-6030D	EM892433	Oct. 25, 2018	Oct. 24, 2019
AC POWER SOURCE	APC	AFC-500W	F312060012	Nov. 29, 2018	Nov. 28, 2019
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Tested Date	Jan. 30, 2020				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101499	Jan. 09, 2020	Jan. 08, 2021
Spectrum Analyzer	R&S	FSV40	101499	Jan. 09, 2020	Jan. 08, 2021
TEMP&HUMIDITY CHAMBER	GIANT FORCE	GCT-225-40-SP-SD	MAF1212-002	Dec. 12, 2019	Dec. 11, 2020
Power Meter	Anritsu	ML2495A	1241002	Oct. 23, 2019	Oct. 22, 2020
Power Sensor	Anritsu	MA2411B	1207366	Oct. 23, 2019	Oct. 22, 2020
DC POWER SOURCE	GW INSTEK	GPC-6030D	GES855395	Oct. 29, 2019	Oct. 28, 2020
AC POWER SOURCE	APC	AFC-500W	F312060012	Dec. 02, 2019	Dec. 01, 2020
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247

ANSI C63.10-2013

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

1.6 Deviation from Test Standard and Measurement Procedure

None

1.7 Measurement Uncertainty

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

Measurement Uncertainty	
Parameters	Uncertainty
Bandwidth	± 34.130 Hz
Conducted power	± 0.808 dB
Power density	± 0.583 dB
Conducted emission	± 2.715 dB
AC conducted emission	± 2.92 dB
Radiated emission ≤ 1 GHz	± 3.41 dB
Radiated emission > 1 GHz	± 4.59 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	23°C / 62%	Alex Tsai
Radiated Emissions	03CH01-WS	22-24°C / 66-67%	Aska Huang
RF Conducted	TH01-WS	22-24°C / 63-67%	Brad Wu Felix Sung

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- ISSED#: 10807A
- CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate	Test Configuration
AC Power Line Conducted Emissions	BT LE	2480	1Mbps	3
Radiated Emissions ≤ 1GHz	BT LE	2480	1Mbps	1, 2
Radiated Emissions > 1GHz	BT LE	2402, 2440, 2480	1Mbps 2Mbps	1, 2
Maximum Output Power	BT LE	2402, 2440, 2480	125 kbps 500 kbps 1Mbps 2Mbps	1, 2
6dB bandwidth	BT LE	2402, 2440, 2480	125 kbps 500 kbps 1Mbps 2Mbps	1, 2
Power spectral density	BT LE	2402, 2440, 2480	125 kbps 500 kbps 1Mbps 2Mbps	1, 2

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Y-plane** results were found as the worst case and were shown in this report.
2. Test configurations are as below
 - 1) Test configuration 1: Low Power with Trace Monopole antenna
 - 2) Test configuration 2: High Power with Trace Monopole antenna
 - 3) Test configuration 3: High Power with 2.4GHz Dipole antenna
3. 50Ω terminators is connected to antenna port of EUT for radiated emission measurement.

3 Transmitter Test Results

3.1 Conducted Emissions

3.1.1 Limit of Conducted Emissions

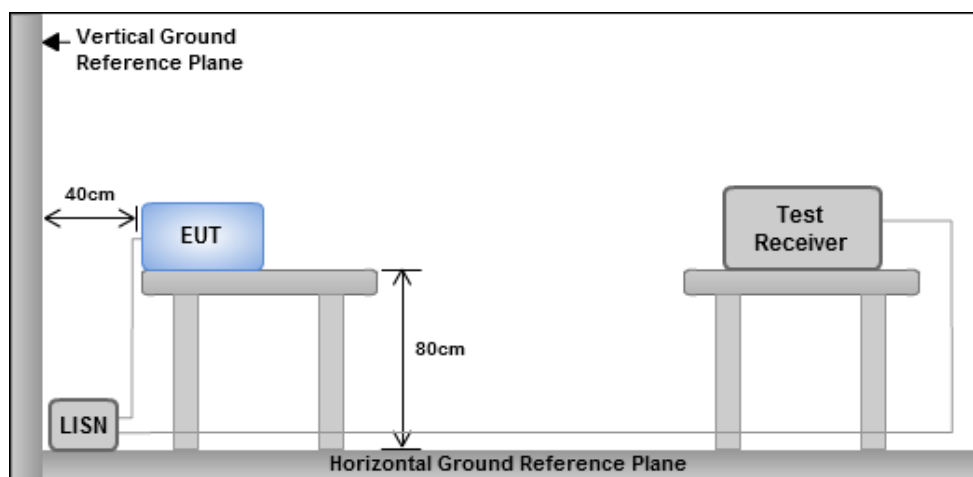
Conducted Emissions Limit		
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: * Decreases with the logarithm of the frequency.

3.1.2 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V/60Hz

3.1.3 Test Setup

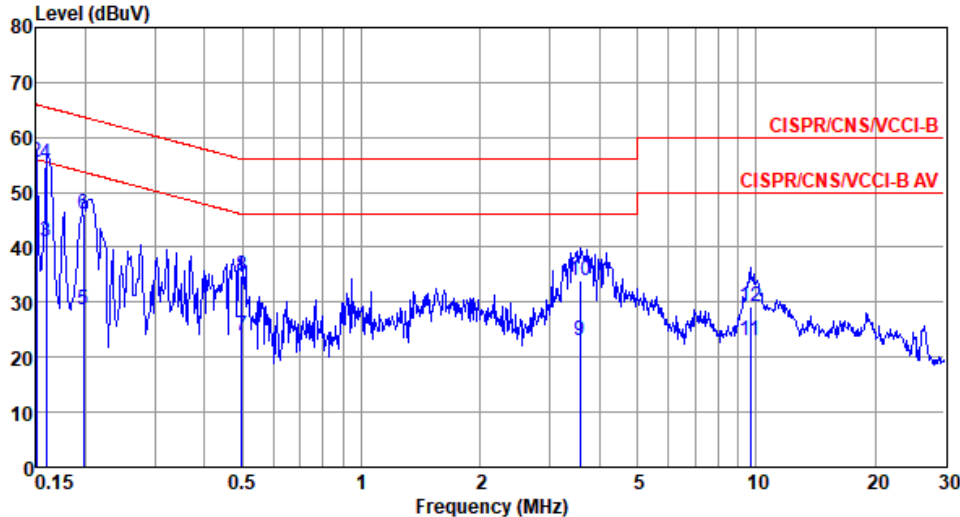


- Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

Test configuration 3: High Power with 2.4GHz Dipole antenna

3.1.4 Test Result of Conducted Emissions

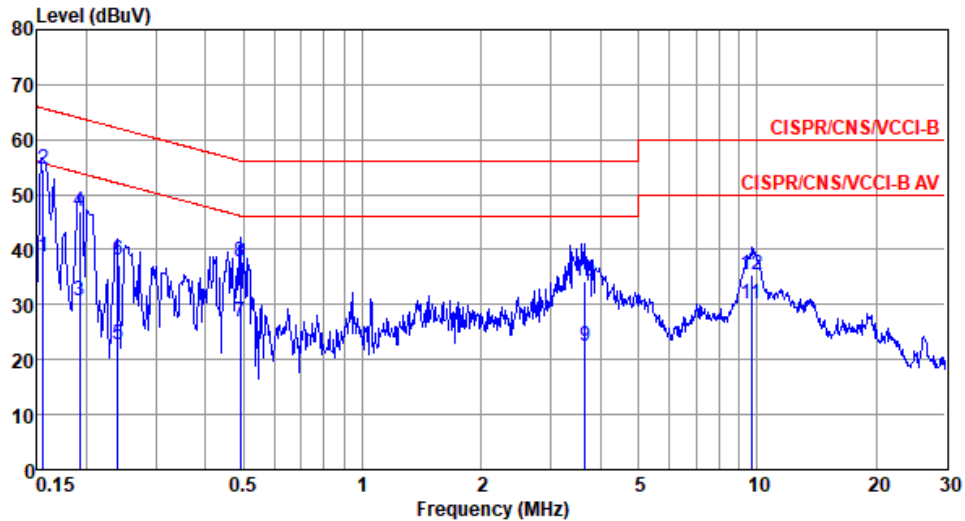
Modulation Mode	BT LE-1Mbps	Test Freq. (MHz)	2480
Power Phase	Line		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.150	38.68	56.00	-17.32	28.83	9.64	0.05	Average
2*	0.150	55.61	66.00	-10.39	45.76	9.64	0.05	QP
3	0.159	41.05	55.52	-14.47	31.19	9.64	0.05	Average
4	0.159	55.08	65.52	-10.44	45.22	9.64	0.05	QP
5	0.198	28.66	53.71	-25.05	18.78	9.63	0.06	Average
6	0.198	46.13	63.71	-17.58	36.25	9.63	0.06	QP
7	0.497	23.77	46.05	-22.28	13.78	9.63	0.09	Average
8	0.497	34.72	56.05	-21.33	24.73	9.63	0.09	QP
9	3.584	23.06	46.00	-22.94	12.77	9.65	0.27	Average
10	3.584	34.03	56.00	-21.97	23.74	9.65	0.27	QP
11	9.654	22.94	50.00	-27.06	12.46	9.69	0.39	Average
12	9.654	29.23	60.00	-30.77	18.75	9.69	0.39	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Modulation Mode	BT LE-1Mbps	Test Freq. (MHz)	2480
Power Phase	Neutral		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.156	38.77	55.69	-16.92	28.94	9.66	0.05	Average
2*	0.156	54.57	65.69	-11.12	44.74	9.66	0.05	QP
3	0.192	30.70	53.93	-23.23	20.84	9.65	0.06	Average
4	0.192	47.07	63.93	-16.86	37.21	9.65	0.06	QP
5	0.240	22.74	52.08	-29.34	12.86	9.65	0.07	Average
6	0.240	38.00	62.08	-24.08	28.12	9.65	0.07	QP
7	0.491	26.86	46.14	-19.28	16.94	9.65	0.09	Average
8	0.491	37.68	56.14	-18.46	27.76	9.65	0.09	QP
9	3.661	22.39	46.00	-23.61	12.18	9.67	0.28	Average
10	3.661	34.28	56.00	-21.72	24.07	9.67	0.28	QP
11	9.654	30.14	50.00	-19.86	19.69	9.73	0.39	Average
12	9.654	35.54	60.00	-24.46	25.09	9.73	0.39	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

3.2 6dB and Occupied Bandwidth

3.2.1 Limit of 6dB Bandwidth

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

3.2.2 Test Procedures

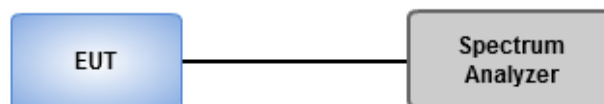
6dB Bandwidth

1. Set resolution bandwidth (RBW) = 100 kHz, Video bandwidth = 300 kHz.
2. Detector = Peak, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

1. Set resolution bandwidth (RBW) = 1% ~ 5 % of OBW, Video bandwidth = 3 x RBW
2. Detector = Sample, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Use the OBW measurement function of spectrum analyzer to measure the occupied bandwidth.

3.2.3 Test Setup



3.2.4 Test Result of 6dB and Occupied Bandwidth

Test configuration 1: Low Power with Trace Monopole antenna

Summary

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
2.4-2.4835GHz	-	-	-	-	-
BT-LE0.125_Nss1_1TX	724.638k	1.082M	1M08F1D	626.812k	1.071M
BT-LE0.5_Nss1_1TX	684.783k	1.046M	1M05F1D	673.913k	1.042M
BT-LE(1Mbps)	684.783k	1.046M	1M05F1D	673.913k	1.042M
BT-LE(2Mbps)	1.138M	2.041M	2M04F1D	1.123M	2.026M

Max-N dB = Maximum 6dB downbandwidth; **Max-OBW** = Maximum 99% occupied bandwidth;

Min-N dB = Minimum 6dB downbandwidth; **Min-OBW** = Minimum 99% occupied bandwidth;

Result

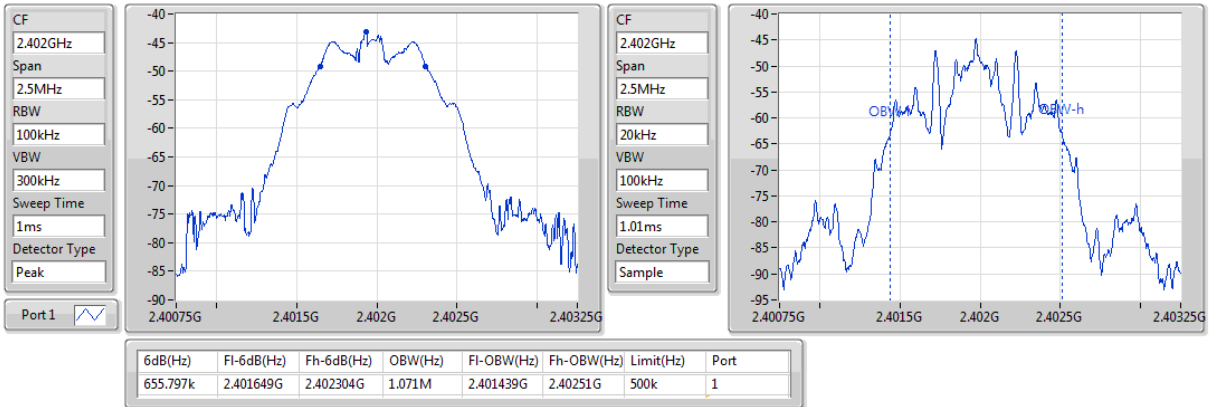
Mode	Result	Limit (Hz)	Port 1-N dB (Hz)	Port 1-OBW (Hz)
BT-LE0.125_Nss1_1TX	-	-	-	-
2402MHz	Pass	500k	655.797k	1.071M
2440MHz	Pass	500k	626.812k	1.082M
2480MHz	Pass	500k	724.638k	1.078M
BT-LE0.5_Nss1_1TX	-	-	-	-
2402MHz	Pass	500k	673.913k	1.042M
2440MHz	Pass	500k	684.783k	1.042M
2480MHz	Pass	500k	677.536k	1.046M
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	500k	684.783k	1.042M
2440MHz	Pass	500k	673.913k	1.046M
2480MHz	Pass	500k	677.536k	1.046M
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	500k	1.13M	2.026M
2440MHz	Pass	500k	1.138M	2.041M
2480MHz	Pass	500k	1.123M	2.041M

Port X-N dB = Port X 6dB downbandwidth; **Port X-OBW** = Port X 99% occupied bandwidth;

BT-LE0.125_Nss1_1TX

EBW

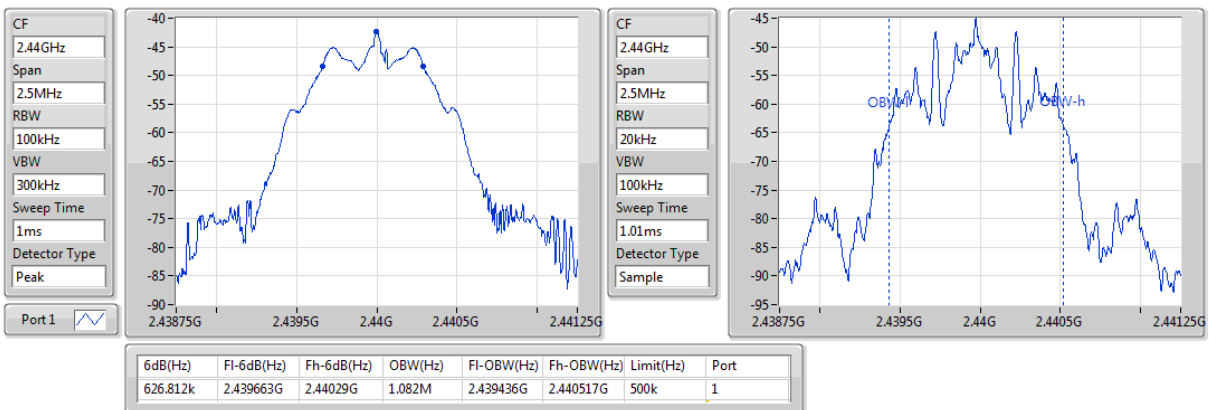
2402MHz



BT-LE0.125_Nss1_1TX

EBW

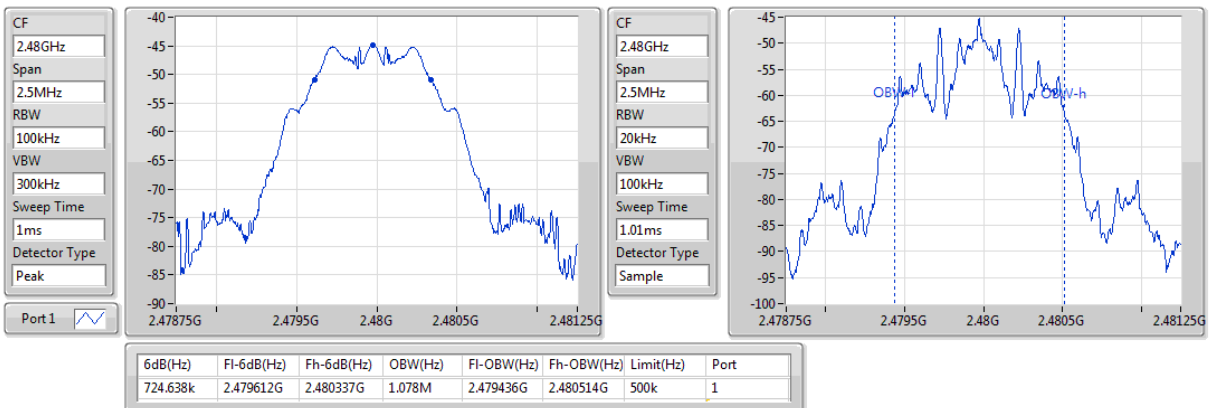
2440MHz



BT-LE0.125_Nss1_1TX

EBW

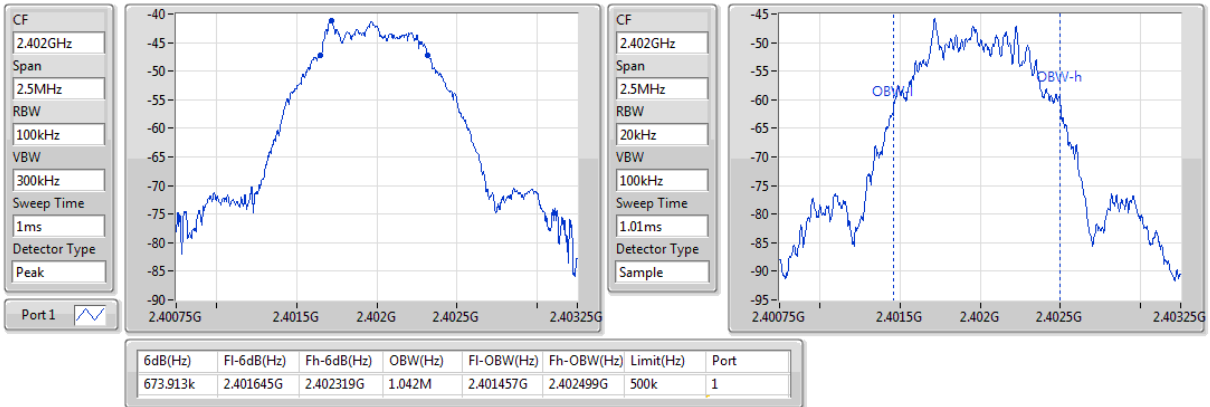
2480MHz



BT-LE0.5_Nss1_1TX

EBW

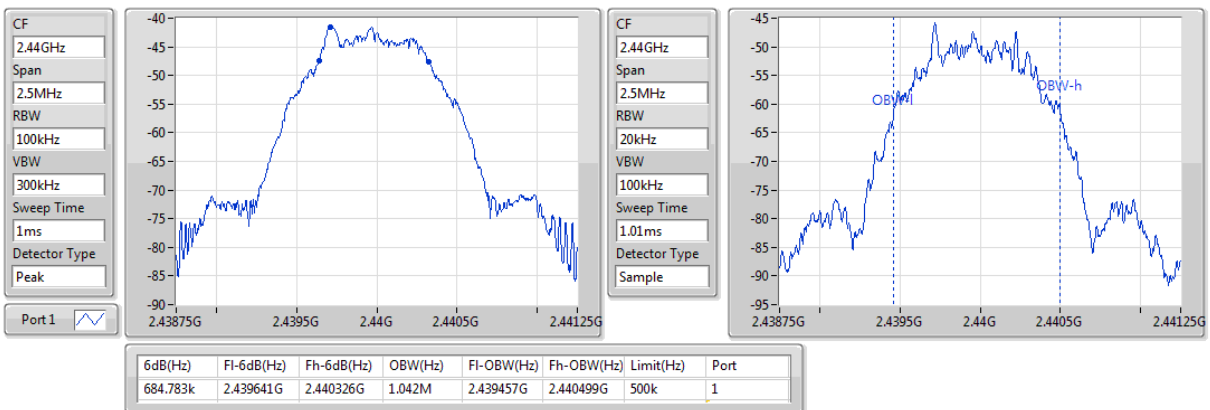
2402MHz



BT-LE0.5_Nss1_1TX

EBW

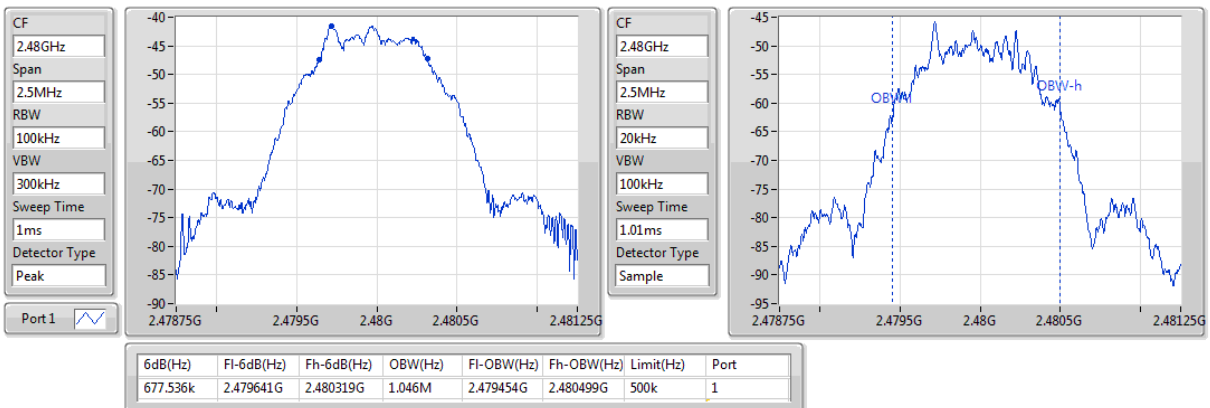
2440MHz



BT-LE0.5_Nss1_1TX

EBW

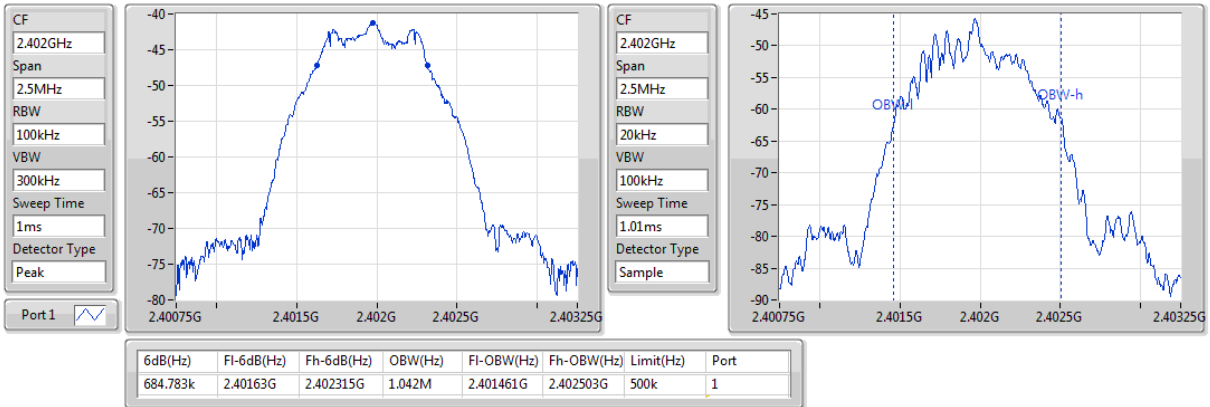
2480MHz



BT-LE(1Mbps)

EBW

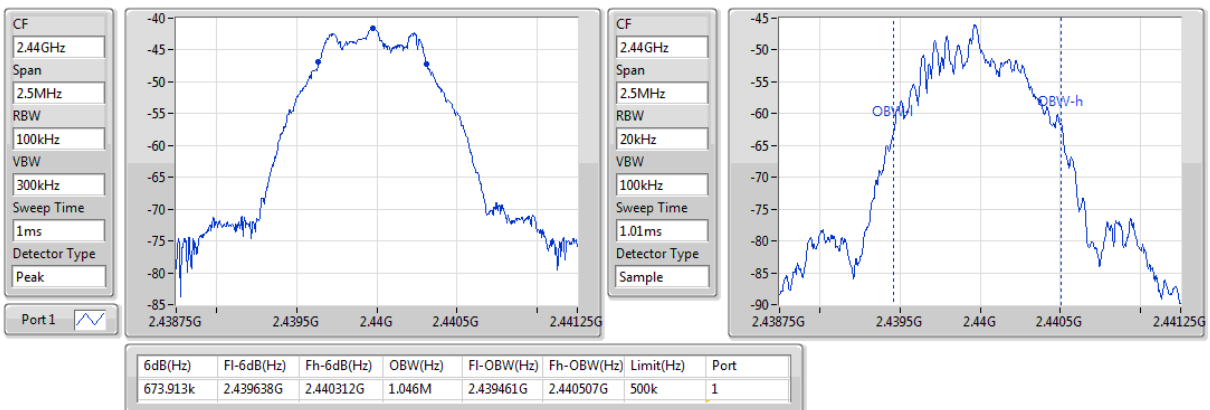
2402MHz



BT-LE(1Mbps)

EBW

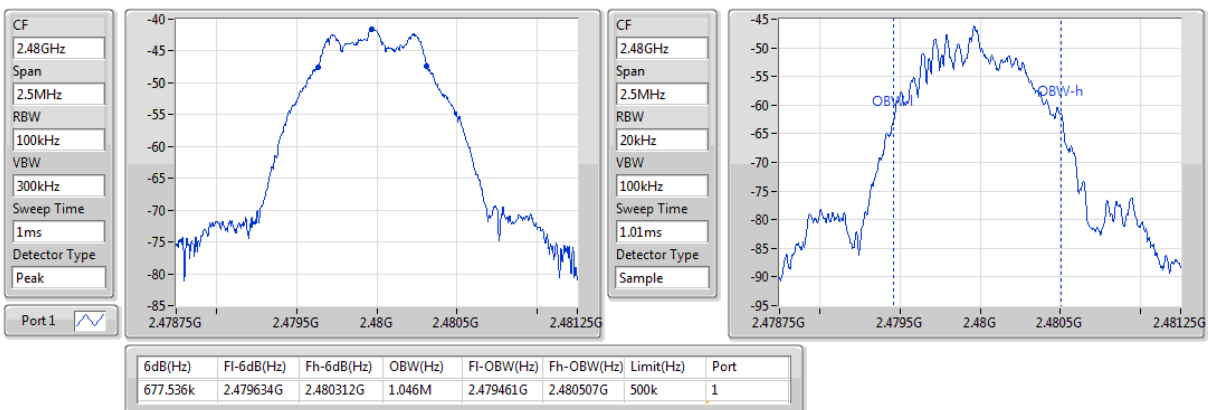
2440MHz



BT-LE(1Mbps)

EBW

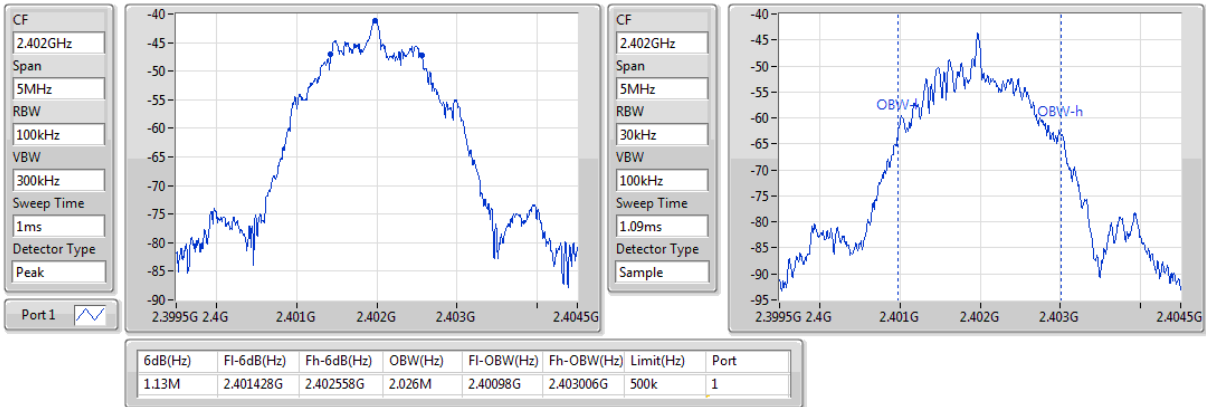
2480MHz



BT-LE(2Mbps)

EBW

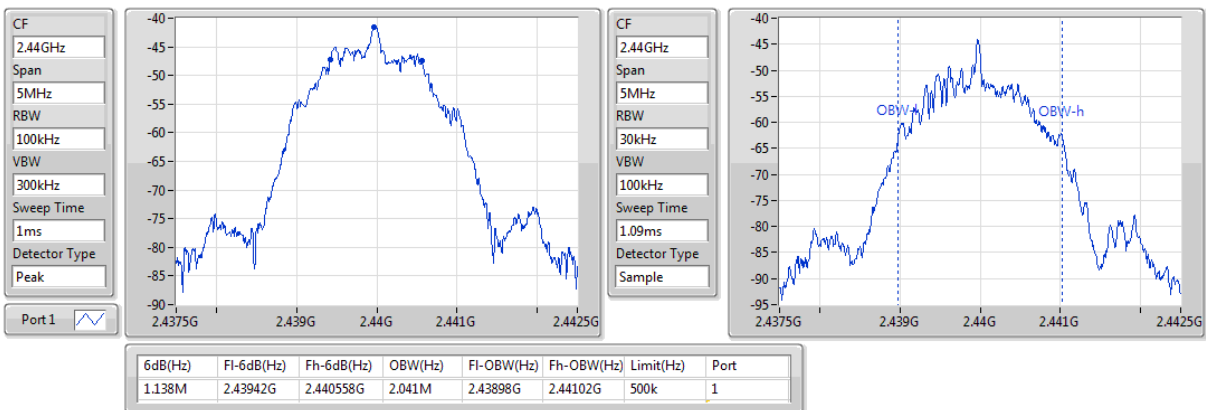
2402MHz



BT-LE(2Mbps)

EBW

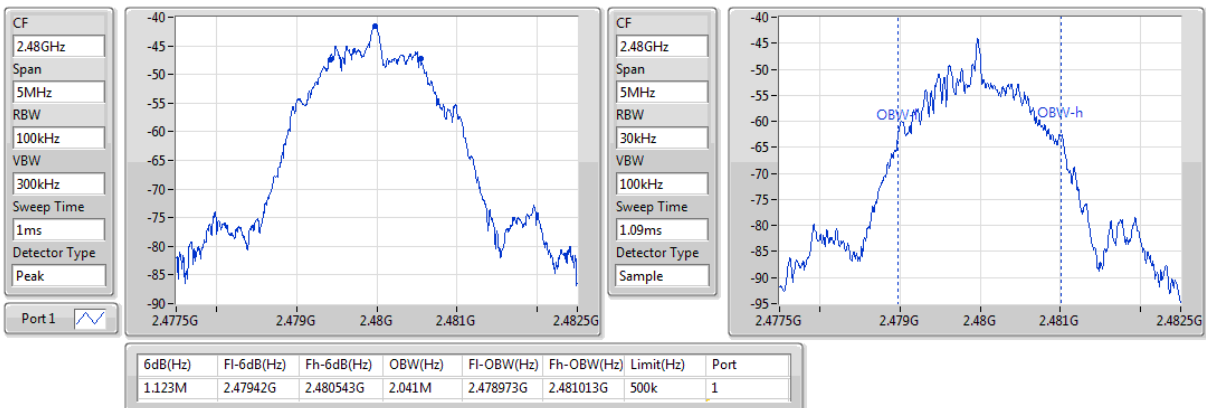
2440MHz



BT-LE(2Mbps)

EBW

2480MHz



Test configuration 2: High Power with Trace Monopole antenna

Summary

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
2.4-2.4835GHz	-	-	-	-	-
BT-LE0.125_Nss1_1TX	670.29k	1.071M	1M07F1D	608.696k	1.067M
BT-LE0.5_Nss1_1TX	684.783k	1.042M	1M04F1D	681.159k	1.035M
BT-LE(1Mbps)	684.783k	1.042M	1M04F1D	673.913k	1.035M
BT-LE(2Mbps)	1.13M	2.033M	2M03F1D	1.094M	2.026M

Max-N dB = Maximum 6dB down bandwidth; **Max-OBW** = Maximum 99% occupied bandwidth;

Min-N dB = Minimum 6dB down bandwidth; **Min-OBW** = Minimum 99% occupied bandwidth;

Result

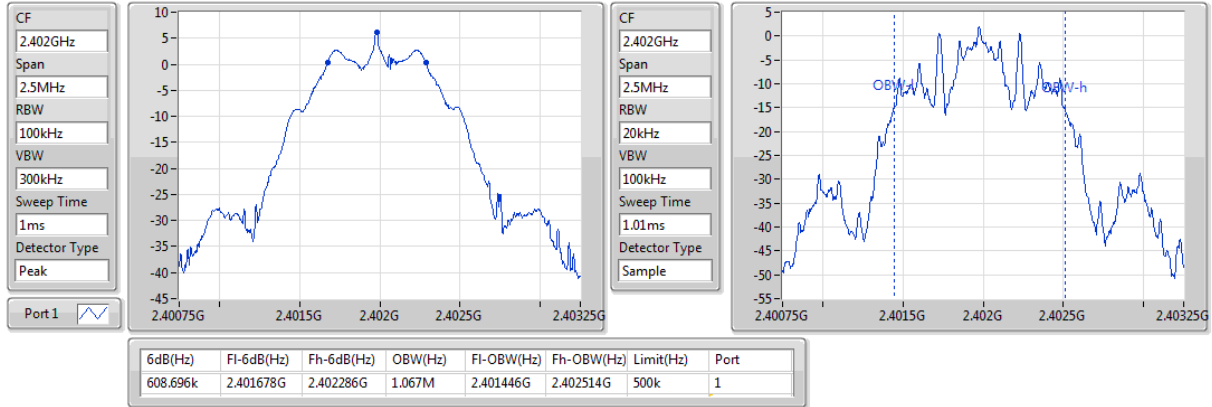
Mode	Result	Limit (Hz)	Port 1-N dB (Hz)	Port 1-OBW (Hz)
BT-LE0.125_Nss1_1TX	-	-	-	-
2402MHz	Pass	500k	608.696k	1.067M
2440MHz	Pass	500k	670.29k	1.067M
2480MHz	Pass	500k	644.928k	1.071M
BT-LE0.5_Nss1_1TX	-	-	-	-
2402MHz	Pass	500k	681.159k	1.035M
2440MHz	Pass	500k	681.159k	1.038M
2480MHz	Pass	500k	684.783k	1.042M
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	500k	673.913k	1.035M
2440MHz	Pass	500k	681.159k	1.035M
2480MHz	Pass	500k	684.783k	1.042M
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	500k	1.13M	2.026M
2440MHz	Pass	500k	1.094M	2.026M
2480MHz	Pass	500k	1.13M	2.033M

Port X-N dB = Port X 6dB down bandwidth; **Port X-OBW** = Port X 99% occupied bandwidth;

BT-LE0.125_Nss1_1TX

EBW

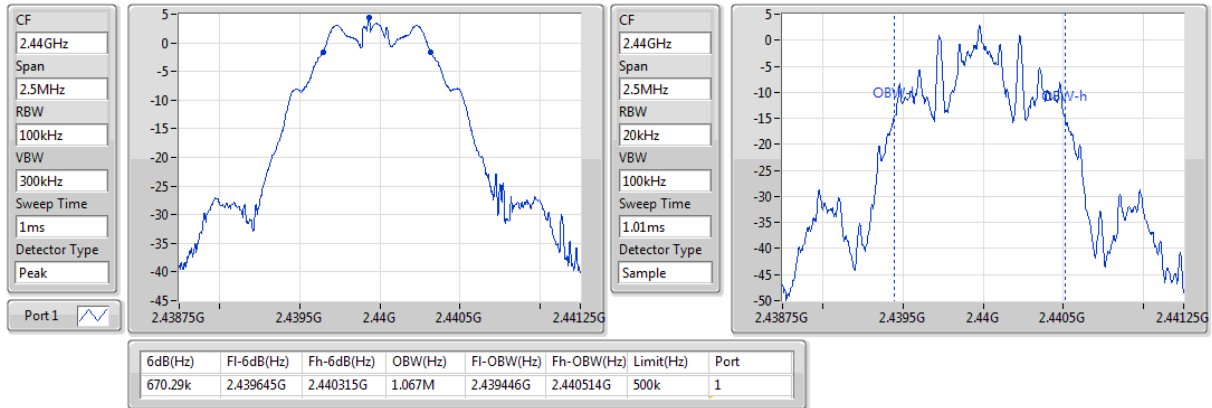
2402MHz



BT-LE0.125_Nss1_1TX

EBW

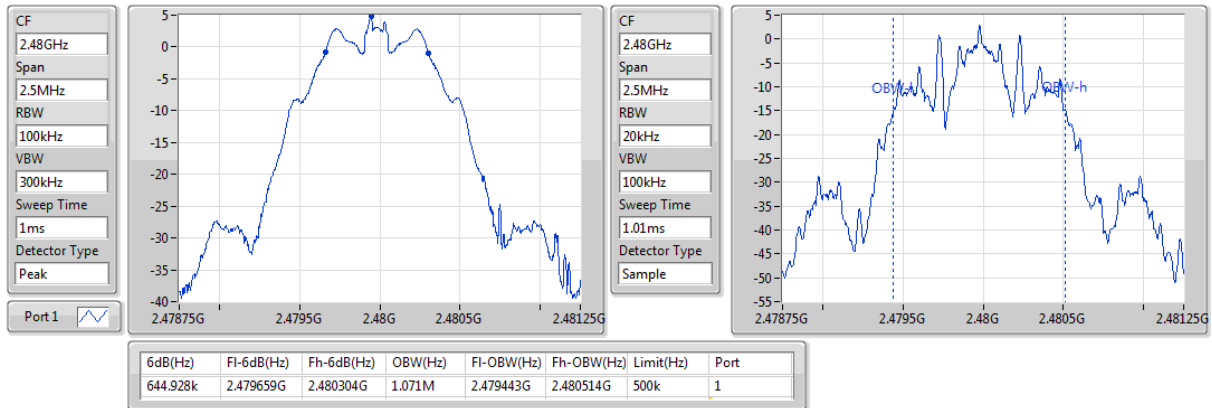
2440MHz



BT-LE0.125_Nss1_1TX

EBW

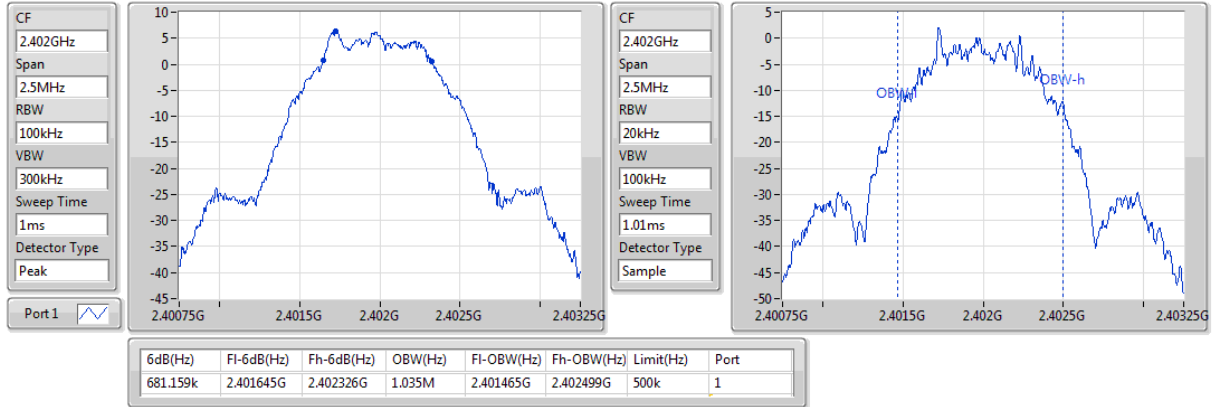
2480MHz



BT-LE0.5_Nss1_1TX

EBW

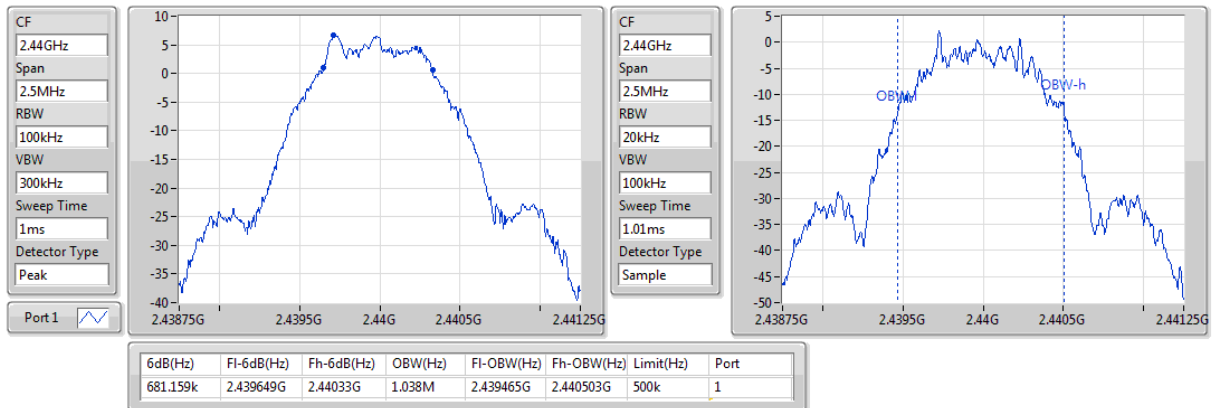
2402MHz



BT-LE0.5_Nss1_1TX

EBW

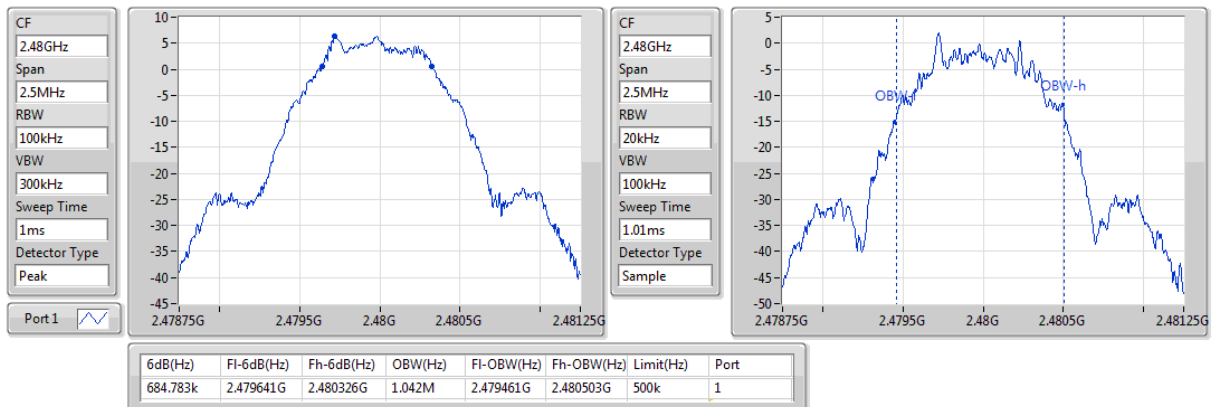
2440MHz



BT-LE0.5_Nss1_1TX

EBW

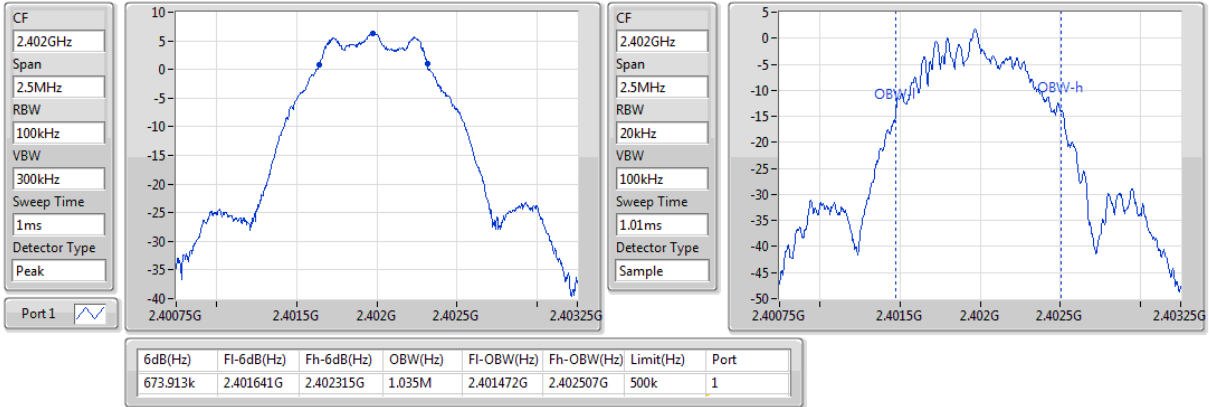
2480MHz



BT-LE(1Mbps)

EBW

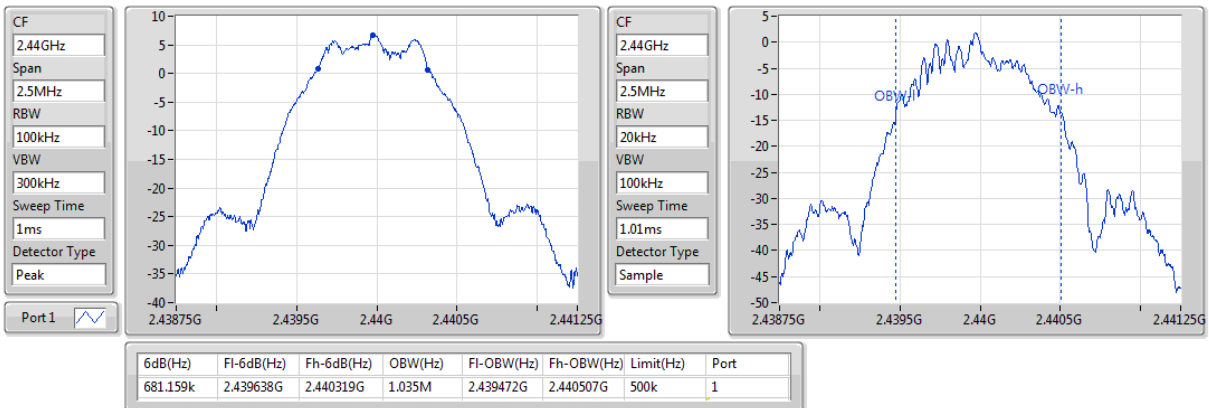
2402MHz



BT-LE(1Mbps)

EBW

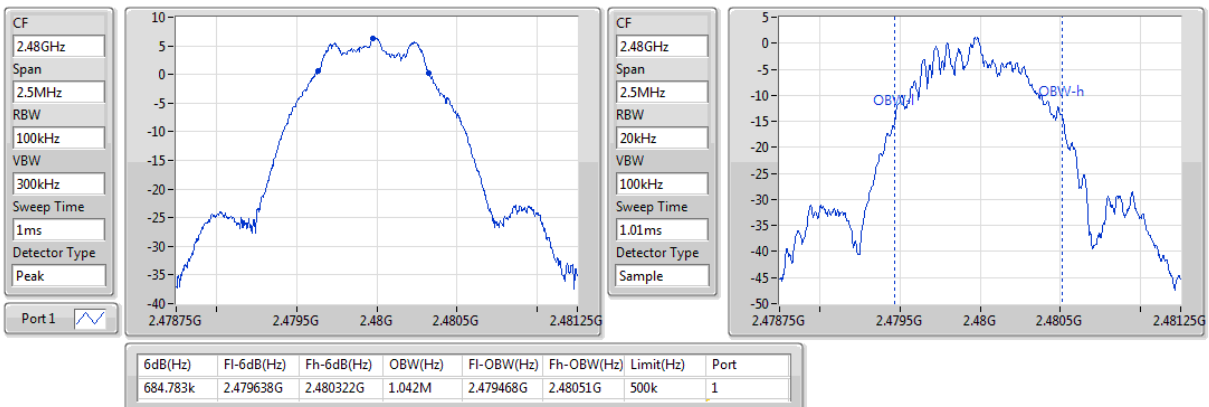
2440MHz



BT-LE(1Mbps)

EBW

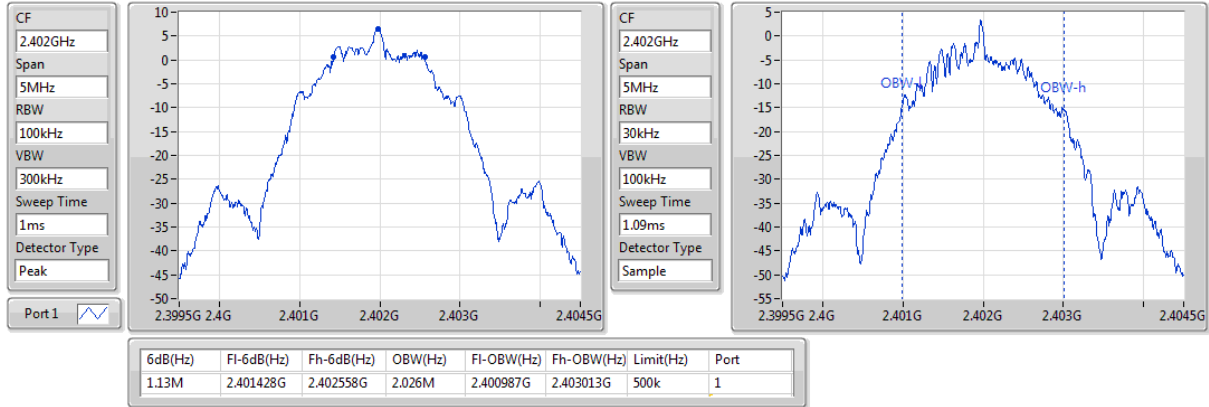
2480MHz



BT-LE(2Mbps)

EBW

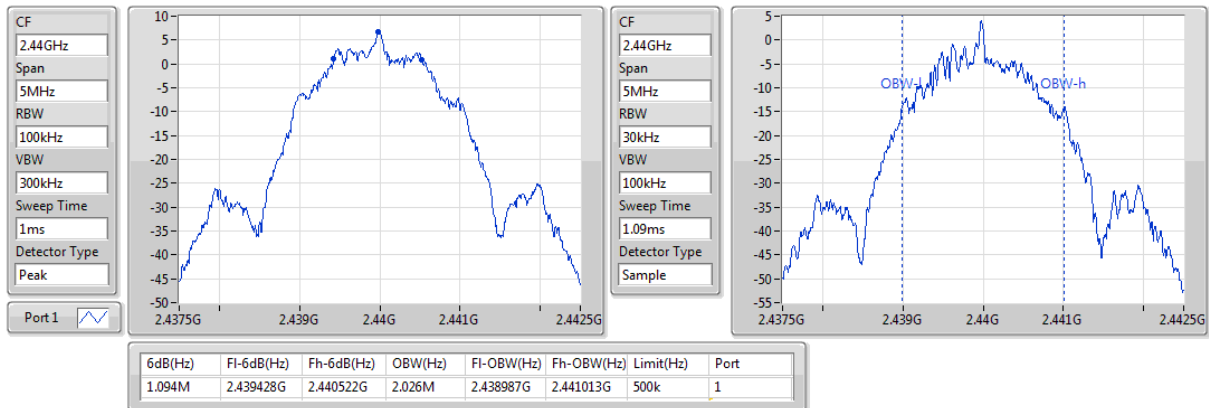
2402MHz



BT-LE(2Mbps)

EBW

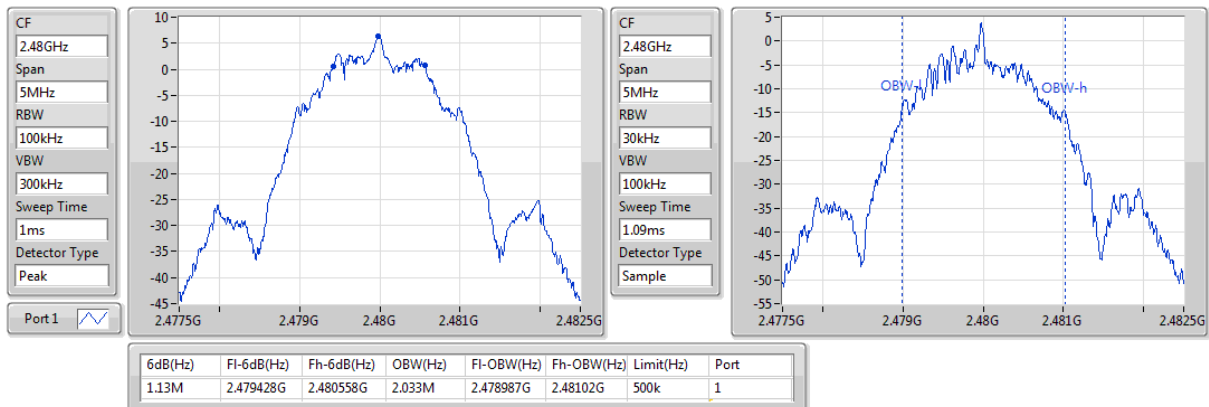
2440MHz



BT-LE(2Mbps)

EBW

2480MHz



3.3 RF Output Power

3.3.1 Limit of RF Output Power

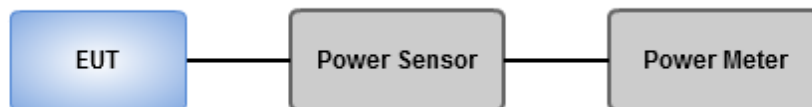
Conducted power shall not exceed 1Watt.

Antenna gain $\leq 6\text{dBi}$, no any corresponding reduction is in output power limit.

3.3.2 Test Procedures

A broadband RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.

3.3.3 Test Setup



3.3.4 Test Result of Maximum Output Power

Test configuration 1: Low Power with Trace Monopole antenna

Peak Power

Summary

Mode	Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-LE0.125_Nss1_1TX	-40.90	0.00000
BT-LE0.5_Nss1_1TX	-40.86	0.00000
BT-LE(1Mbps)	-40.77	0.00000
BT-LE(2Mbps)	-41.03	0.00000

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-LE0.125_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	-40.90	30.00
2440MHz	Pass	2.60	-41.41	30.00
2480MHz	Pass	2.60	-41.60	30.00
BT-LE0.5_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	-40.86	30.00
2440MHz	Pass	2.60	-41.37	30.00
2480MHz	Pass	2.60	-41.57	30.00
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.60	-40.77	30.00
2440MHz	Pass	2.60	-41.27	30.00
2480MHz	Pass	2.60	-41.55	30.00
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	2.60	-41.03	30.00
2440MHz	Pass	2.60	-41.54	30.00
2480MHz	Pass	2.60	-41.75	30.00

Average Power

Summary

Mode	Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-LE0.125_Nss1_1TX	-41.27	0.00000
BT-LE0.5_Nss1_1TX	-41.31	0.00000
BT-LE(1Mbps)	-41.21	0.00000
BT-LE(2Mbps)	-41.35	0.00000

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-LE0.125_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	-41.27	30.00
2440MHz	Pass	2.60	-41.79	30.00
2480MHz	Pass	2.60	-41.98	30.00
BT-LE0.5_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	-41.31	30.00
2440MHz	Pass	2.60	-41.83	30.00
2480MHz	Pass	2.60	-42.02	30.00
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.60	-41.21	30.00
2440MHz	Pass	2.60	-41.73	30.00
2480MHz	Pass	2.60	-41.93	30.00
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	2.60	-41.35	30.00
2440MHz	Pass	2.60	-41.93	30.00
2480MHz	Pass	2.60	-42.13	30.00

Note: Average power is for reference only.

Test configuration 2: High Power with Trace Monopole antenna

Peak Power

Summary

Mode	Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-LE0.125_Nss1_1TX	6.39	0.00436
BT-LE0.5_Nss1_1TX	6.41	0.00438
BT-LE(1Mbps)	6.47	0.00444
BT-LE(2Mbps)	6.38	0.00435

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-LE0.125_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	6.07	30.00
2440MHz	Pass	2.60	6.32	30.00
2480MHz	Pass	2.60	6.39	30.00
BT-LE0.5_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	6.07	30.00
2440MHz	Pass	2.60	6.35	30.00
2480MHz	Pass	2.60	6.41	30.00
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.60	6.08	30.00
2440MHz	Pass	2.60	6.40	30.00
2480MHz	Pass	2.60	6.47	30.00
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	2.60	6.05	30.00
2440MHz	Pass	2.60	6.31	30.00
2480MHz	Pass	2.60	6.38	30.00

Average Power

Summary

Mode	Power	Power
	(dBm)	(W)
2.4-2.4835GHz	-	-
BT-LE0.125_Nss1_1TX	6.37	0.00434
BT-LE0.5_Nss1_1TX	6.33	0.00430
BT-LE(1Mbps)	6.25	0.00422
BT-LE(2Mbps)	6.25	0.00422

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-LE0.125_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	6.03	30.00
2440MHz	Pass	2.60	6.28	30.00
2480MHz	Pass	2.60	6.37	30.00
BT-LE0.5_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	6.02	30.00
2440MHz	Pass	2.60	6.28	30.00
2480MHz	Pass	2.60	6.33	30.00
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.60	5.92	30.00
2440MHz	Pass	2.60	6.18	30.00
2480MHz	Pass	2.60	6.25	30.00
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	2.60	5.93	30.00
2440MHz	Pass	2.60	6.19	30.00
2480MHz	Pass	2.60	6.25	30.00

Note: Average power is for reference only.

3.4 Power Spectral Density

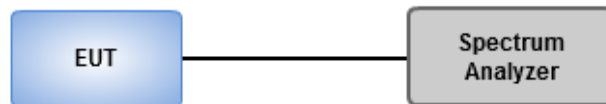
3.4.1 Limit of Power Spectral Density

Power spectral density shall not be greater than 8 dBm in any 3 kHz band.

3.4.2 Test Procedures

1. Set the RBW = 3 kHz, VBW = 10 kHz.
2. Detector = Peak, Sweep time = auto couple.
3. Trace mode = max hold, allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

3.4.3 Test Setup



3.4.4 Test Result of Power Spectral Density

Test configuration 1: Low Power with Trace Monopole antenna

Summary

Mode	PD (dBm/RBW)
2.4-2.4835GHz	-
BT-LE0.125_Nss1_1TX	-47.21
BT-LE0.5_Nss1_1TX	-47.42
BT-LE(1Mbps)	-56.30
BT-LE(2Mbps)	-58.80

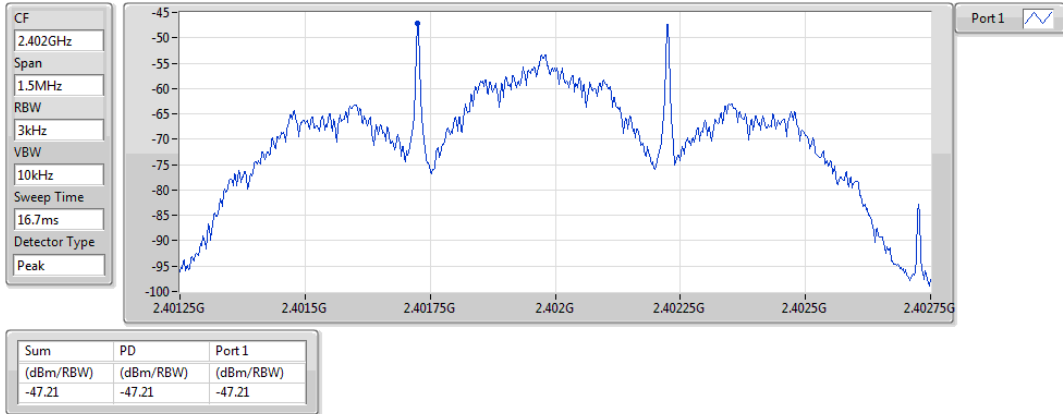
Result

Mode	Result	Gain (dBi)	PD (dBm/RBW)	PD Limit (dBm/RBW)
BT-LE0.125_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	-47.21	8.00
2440MHz	Pass	2.60	-47.51	8.00
2480MHz	Pass	2.60	-47.47	8.00
BT-LE0.5_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	-47.42	8.00
2440MHz	Pass	2.60	-47.74	8.00
2480MHz	Pass	2.60	-47.72	8.00
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.60	-56.30	8.00
2440MHz	Pass	2.60	-56.84	8.00
2480MHz	Pass	2.60	-56.76	8.00
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	2.60	-58.80	8.00
2440MHz	Pass	2.60	-59.15	8.00
2480MHz	Pass	2.60	-59.12	8.00

BT-LE0.125_Nss1_1TX

PSD

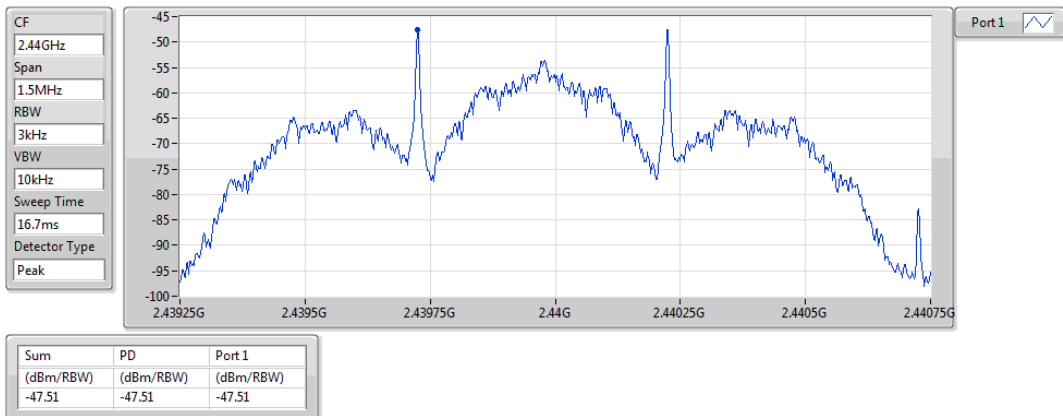
2402MHz



BT-LE0.125_Nss1_1TX

PSD

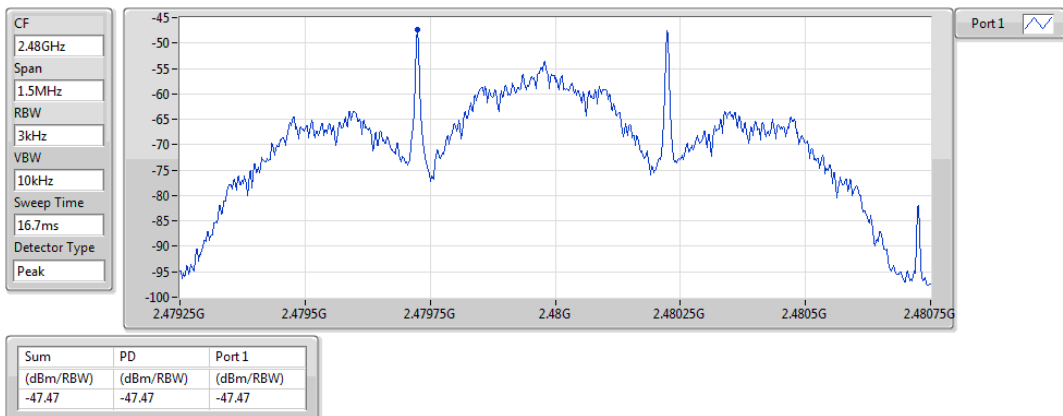
2440MHz



BT-LE0.125_Nss1_1TX

PSD

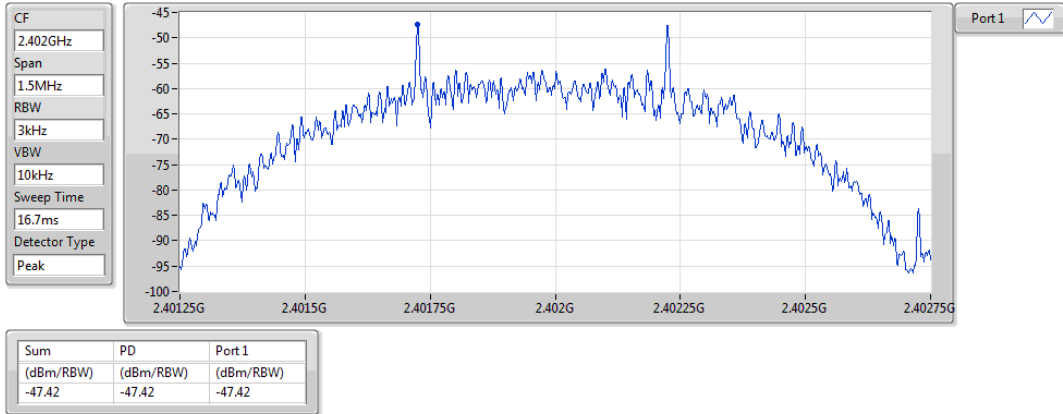
2480MHz



BT-LE0.5_Nss1_1TX

PSD

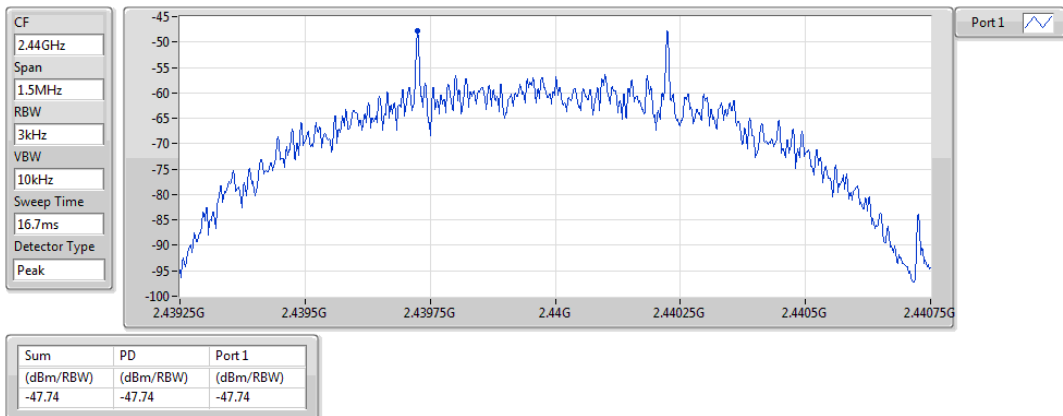
2402MHz



BT-LE0.5_Nss1_1TX

PSD

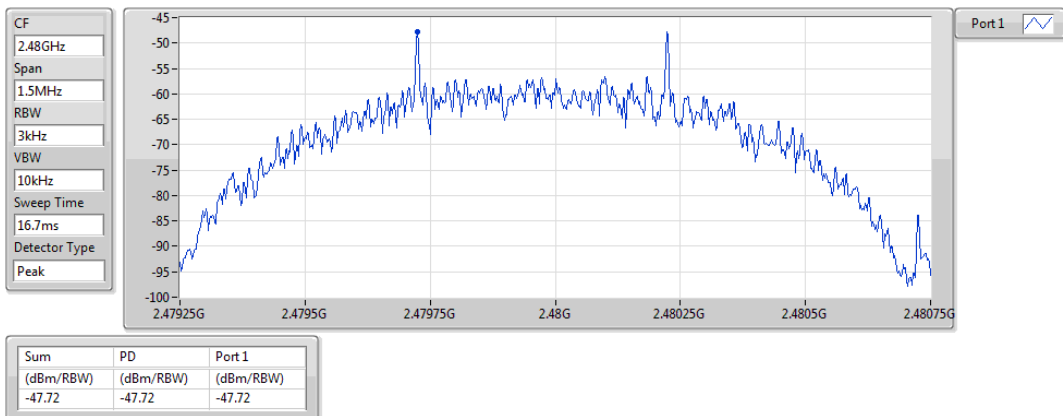
2440MHz



BT-LE0.5_Nss1_1TX

PSD

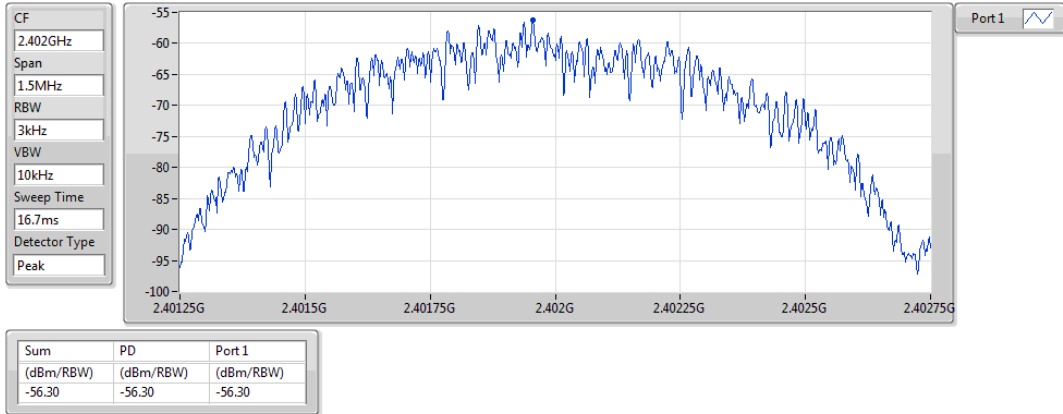
2480MHz



BT-LE(1Mbps)

PSD

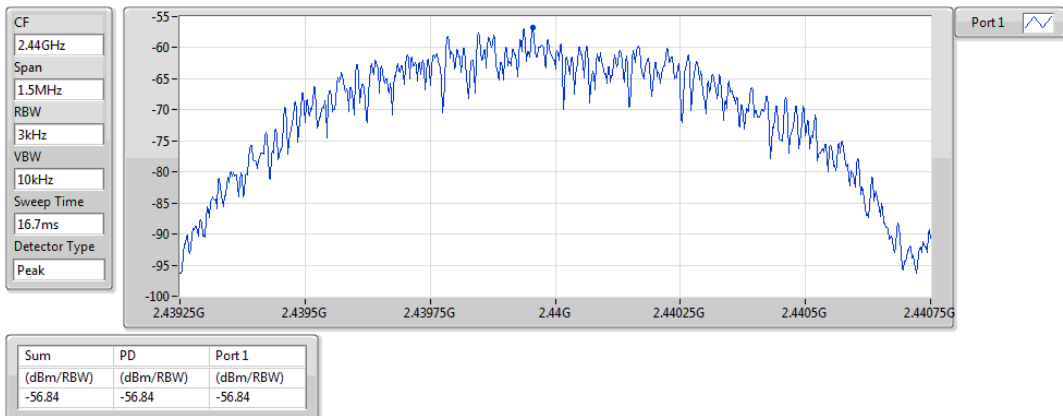
2402MHz



BT-LE(1Mbps)

PSD

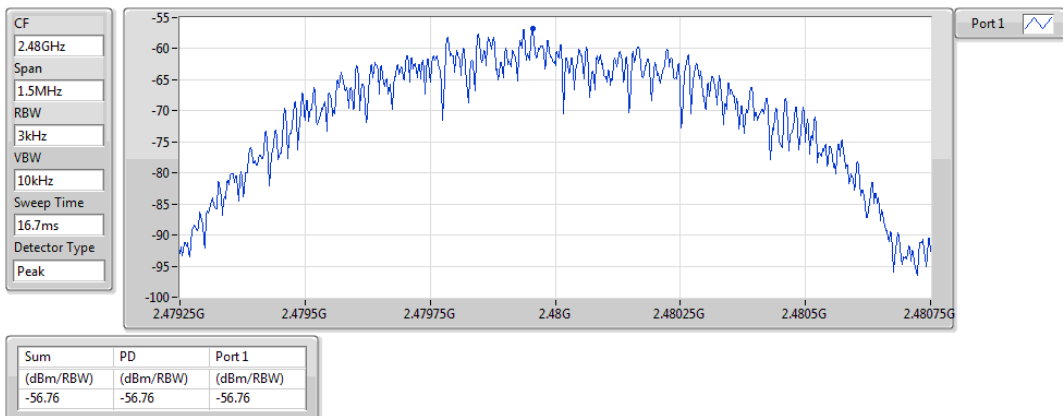
2440MHz



BT-LE(1Mbps)

PSD

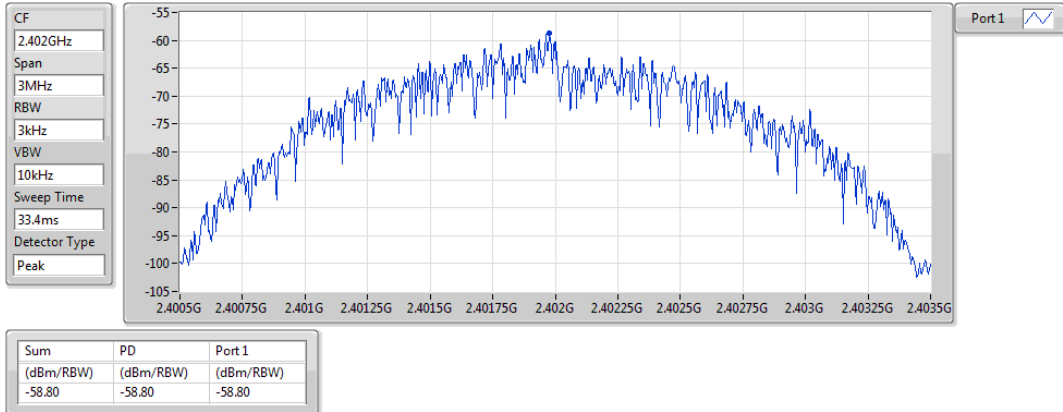
2480MHz



BT-LE(2Mbps)

PSD

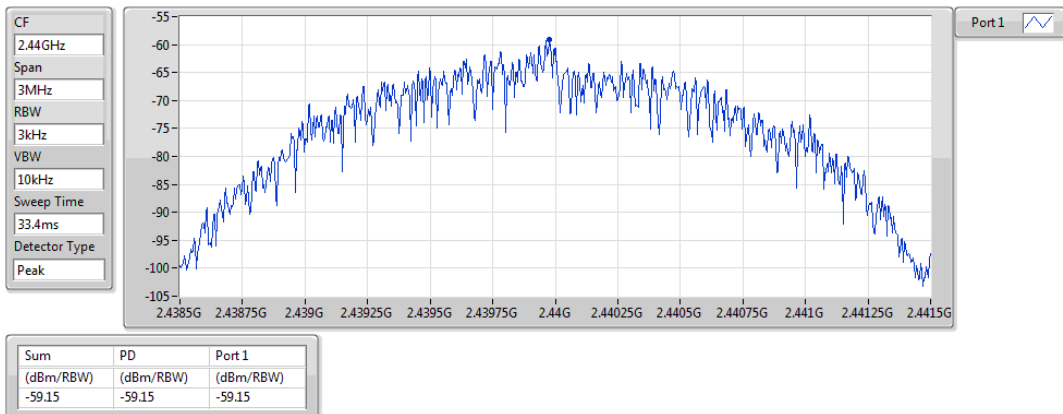
2402MHz



BT-LE(2Mbps)

PSD

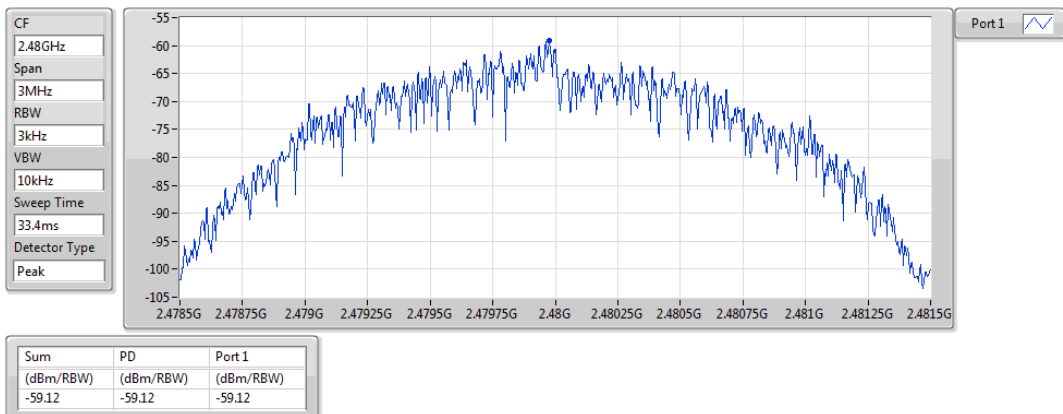
2440MHz



BT-LE(2Mbps)

PSD

2480MHz



Test configuration 2: High Power with Trace Monopole antenna

Summary

Mode	PD (dBm/RBW)
2.4-2.4835GHz	-
BT-LE0.125_Nss1_1TX	0.69
BT-LE0.5_Nss1_1TX	0.43
BT-LE(1Mbps)	-8.42
BT-LE(2Mbps)	-11.00

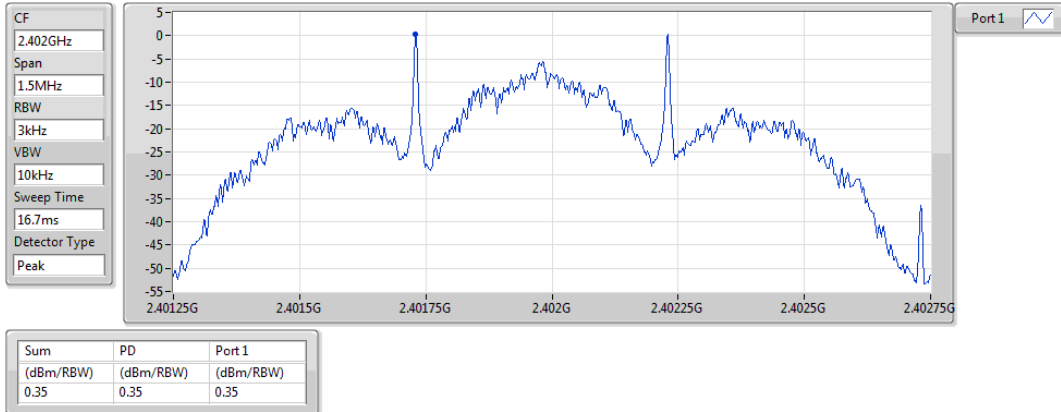
Result

Mode	Result	Gain (dBi)	PD (dBm/RBW)	PD Limit (dBm/RBW)
BT-LE0.125_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	0.35	8.00
2440MHz	Pass	2.60	0.69	8.00
2480MHz	Pass	2.60	0.47	8.00
BT-LE0.5_Nss1_1TX	-	-	-	-
2402MHz	Pass	2.60	0.14	8.00
2440MHz	Pass	2.60	0.43	8.00
2480MHz	Pass	2.60	0.11	8.00
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.60	-8.42	8.00
2440MHz	Pass	2.60	-8.56	8.00
2480MHz	Pass	2.60	-9.18	8.00
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	2.60	-11.16	8.00
2440MHz	Pass	2.60	-11.00	8.00
2480MHz	Pass	2.60	-11.37	8.00

BT-LE0.125_Nss1_1TX

PSD

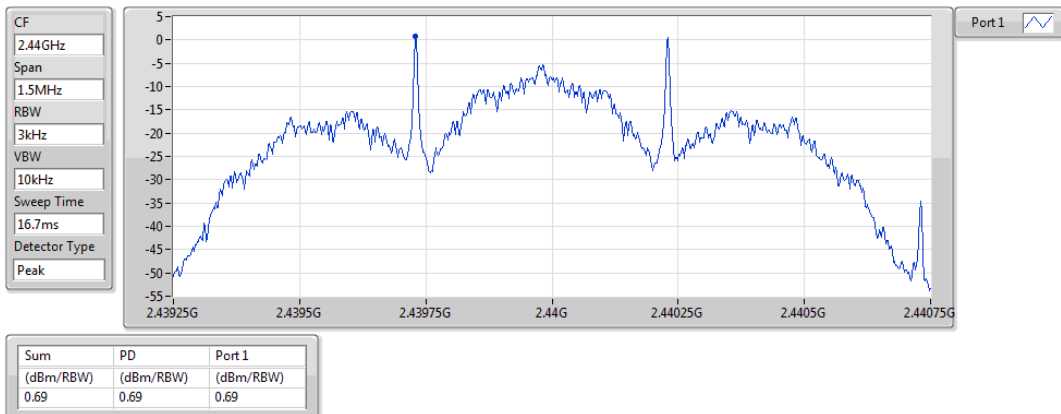
2402MHz



BT-LE0.125_Nss1_1TX

PSD

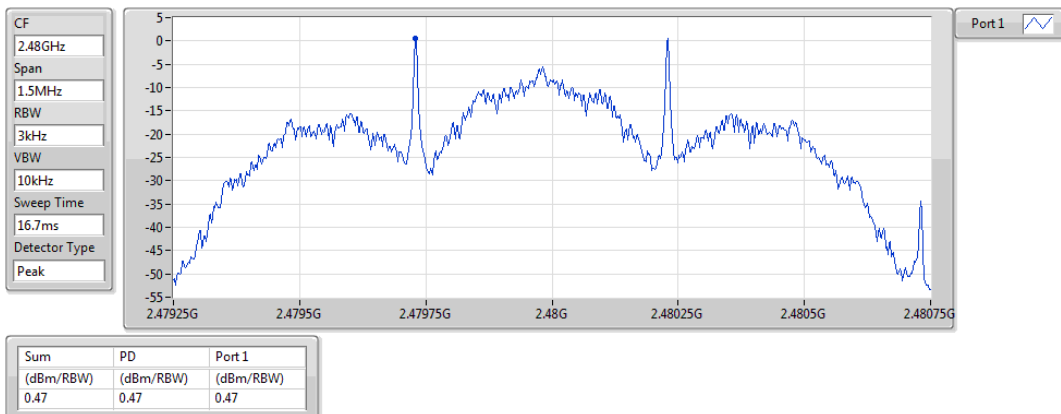
2440MHz



BT-LE0.125_Nss1_1TX

PSD

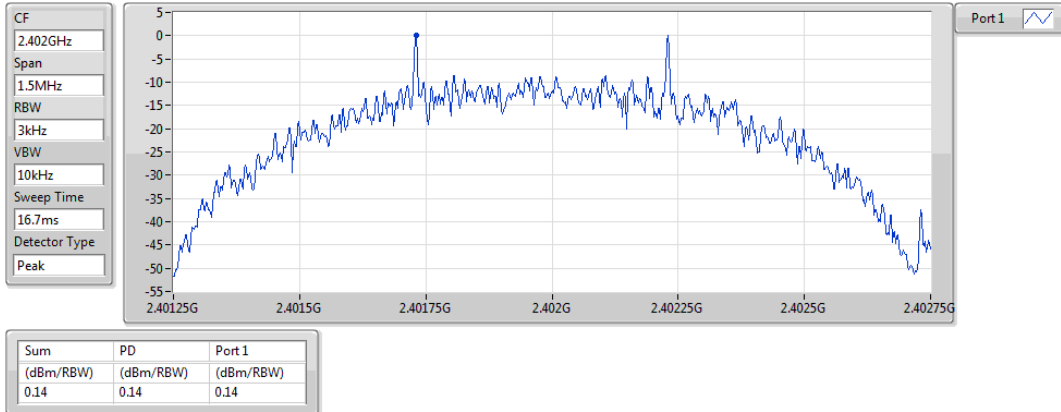
2480MHz



BT-LE0.5_Nss1_1TX

PSD

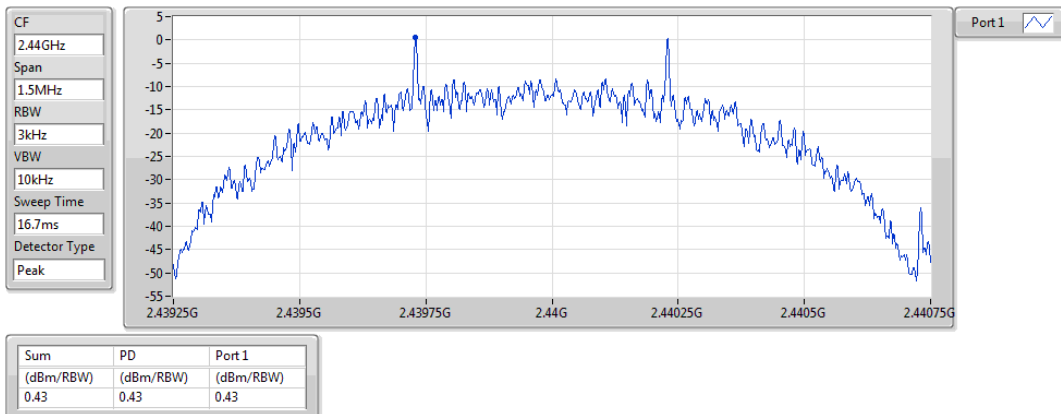
2402MHz



BT-LE0.5_Nss1_1TX

PSD

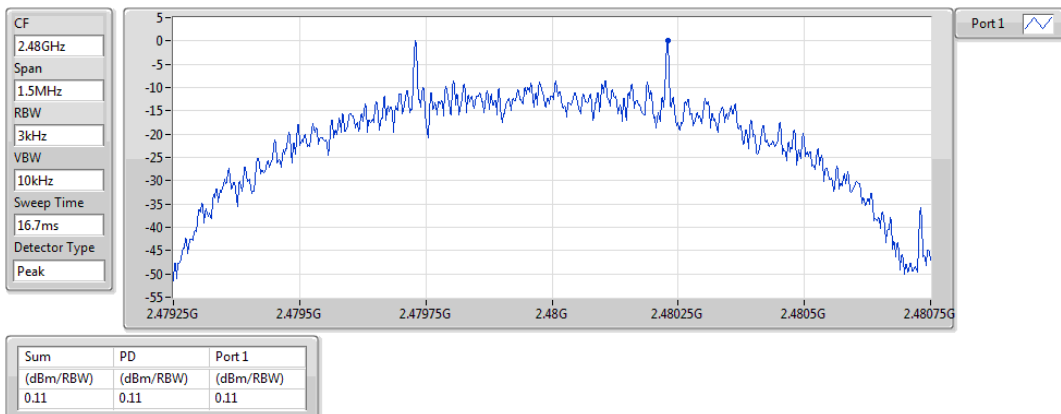
2440MHz



BT-LE0.5_Nss1_1TX

PSD

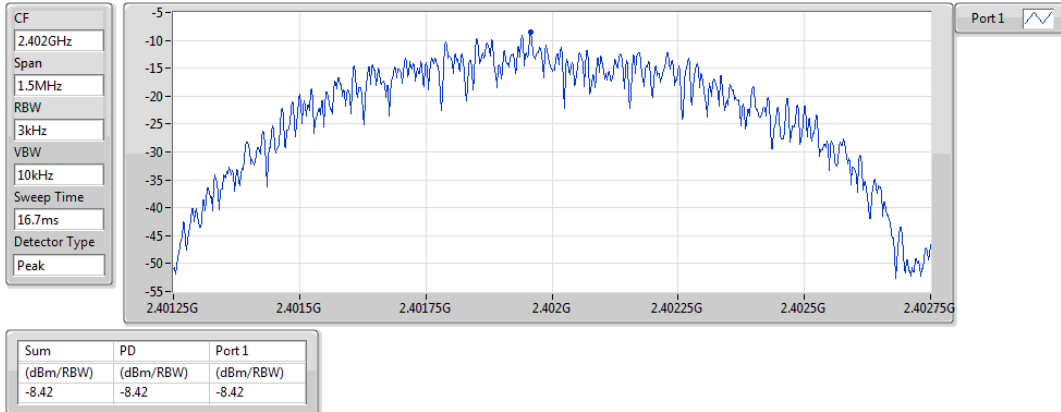
2480MHz



BT-LE(1Mbps)

PSD

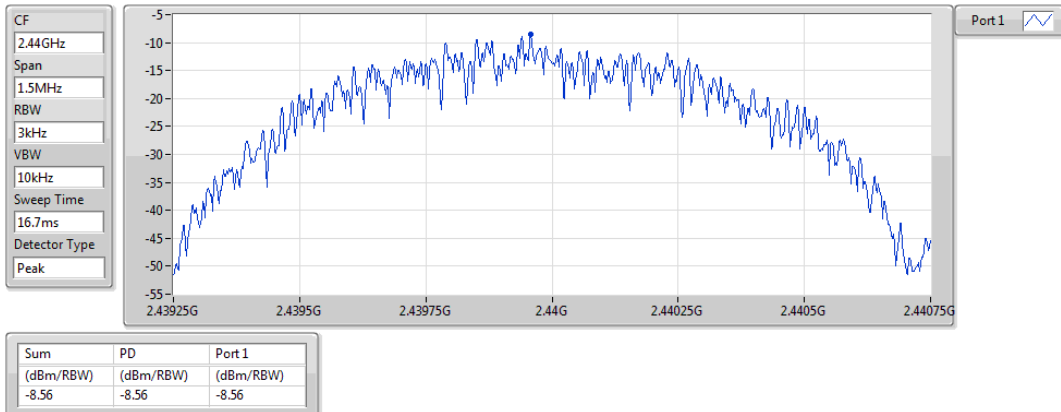
2402MHz



BT-LE(1Mbps)

PSD

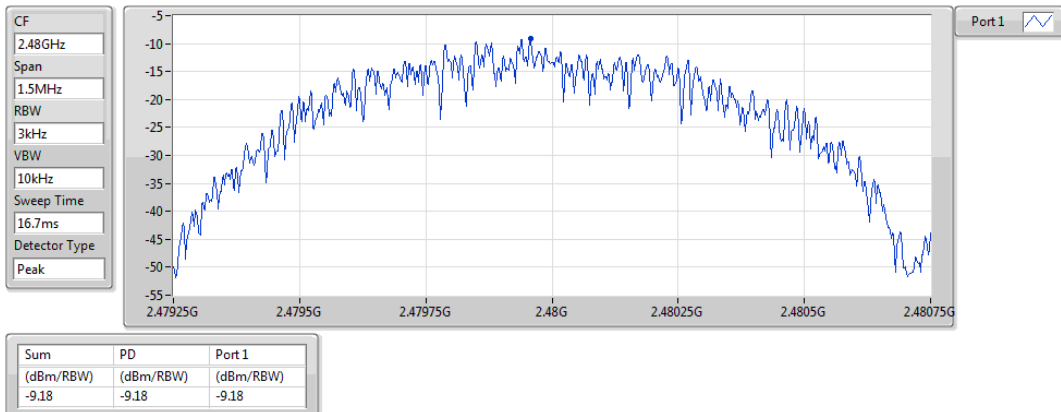
2440MHz



BT-LE(1Mbps)

PSD

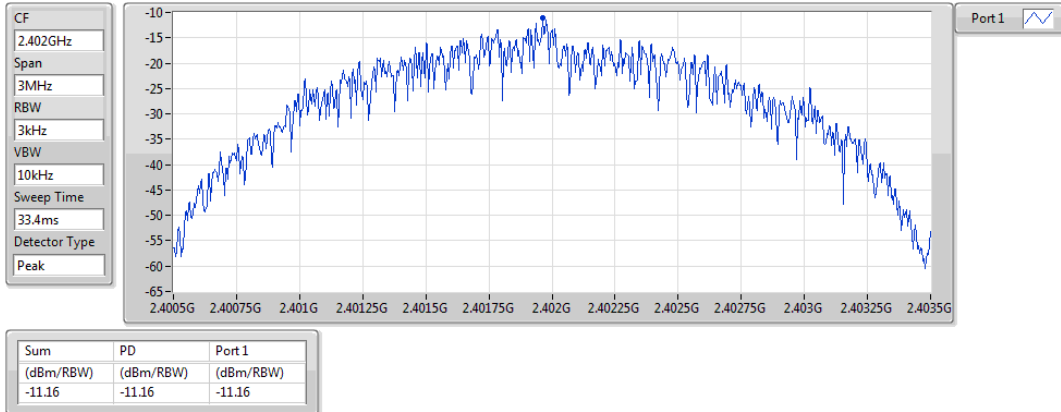
2480MHz



BT-LE(2Mbps)

PSD

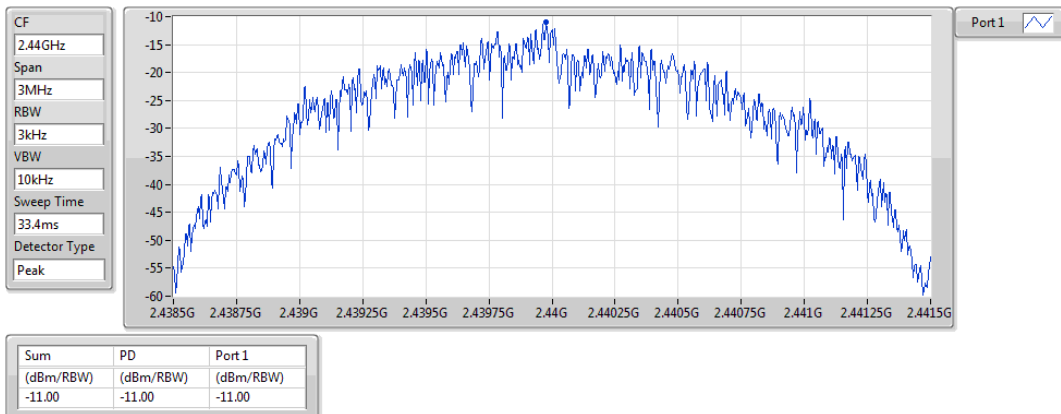
2402MHz



BT-LE(2Mbps)

PSD

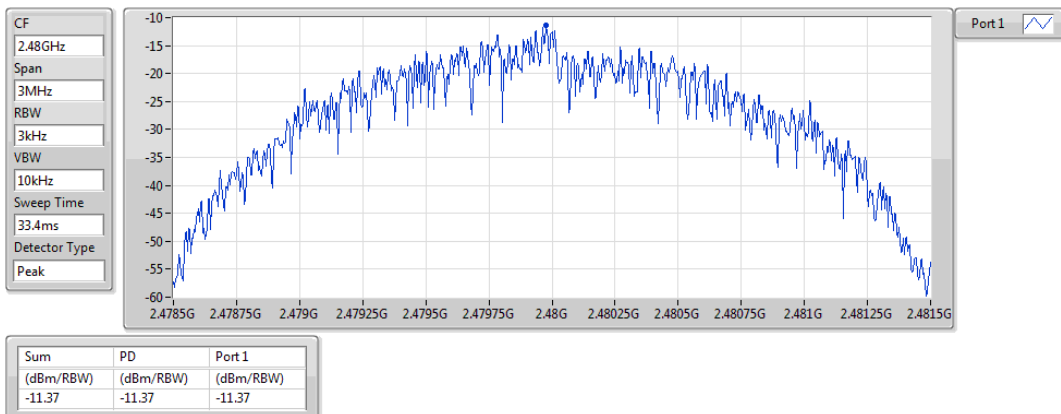
2440MHz



BT-LE(2Mbps)

PSD

2480MHz



3.5 Emissions in Restricted Frequency Bands

3.5.1 Limit of Emissions in Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Quasi-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.5.2 Test Procedures

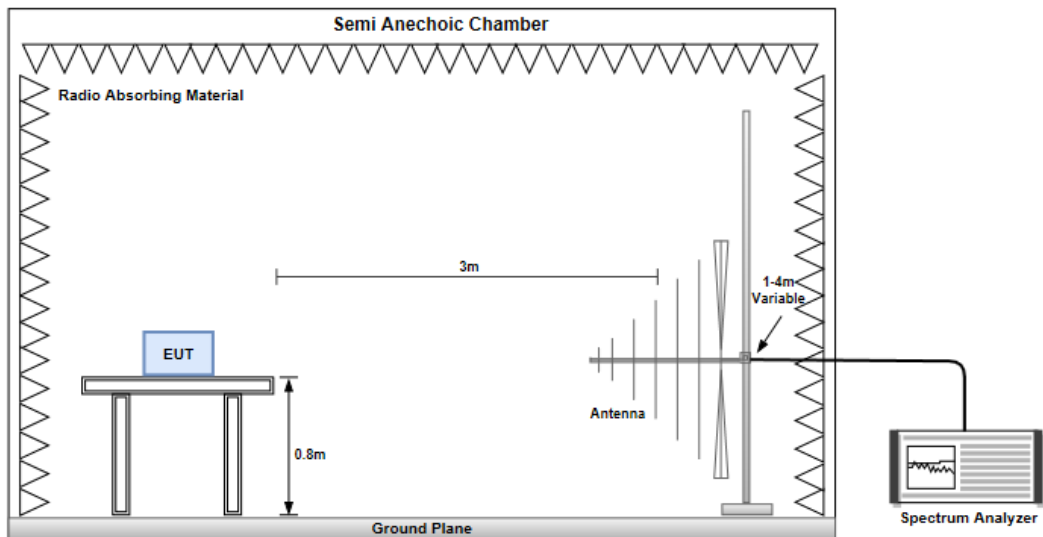
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

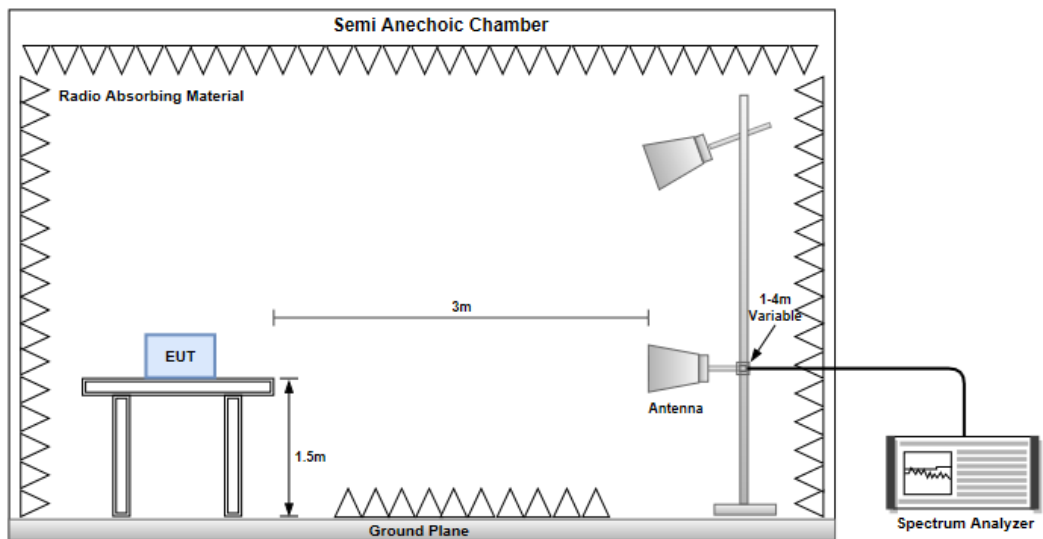
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

3.5.3 Test Setup

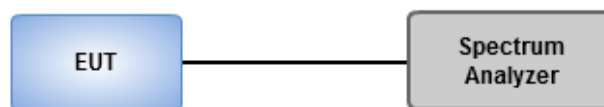
Radiated Emissions below 1 GHz



Radiated Emissions above 1 GHz



Conducted Emissions



Test configuration 1: Low Power with Trace Monopole antenna

3.5.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2480
Polarization	Horizontal		
Level (dBUV/m) </			

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2480
Polarization	Vertical		
Level (dBUV/m) <			

3.5.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2402
Polarization	Horizontal		
Level (dBuV/m)			

Modulation	BT-LE (1Mbps)		Test Freq. (MHz)		2402	
Polarization	Vertical					
Level (dBuV/m)						

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2440
Polarization	Horizontal		
Level (dBuV/m)			

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2440
Polarization	Vertical		
Level (dBuV/m)			

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2480
Polarization	Horizontal		
Level (dBuV/m)			

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2480
Polarization	Vertical		
Level (dBuV/m)			

Modulation	BT-LE (2Mbps)	Test Freq. (MHz)	2402
Polarization	Horizontal		
Level (dBUV/m)			

Modulation	BT-LE (2Mbps)		Test Freq. (MHz)		2402	
Polarization	Vertical					
Level (dBUV/m)						

Modulation	BT-LE (2Mbps)	Test Freq. (MHz)	2440
Polarization	Horizontal		
Level (dBuV/m) </			

Modulation	BT-LE (2Mbps)		Test Freq. (MHz)		2440				
Polarization	Vertical								
Level (dBuV/m)									

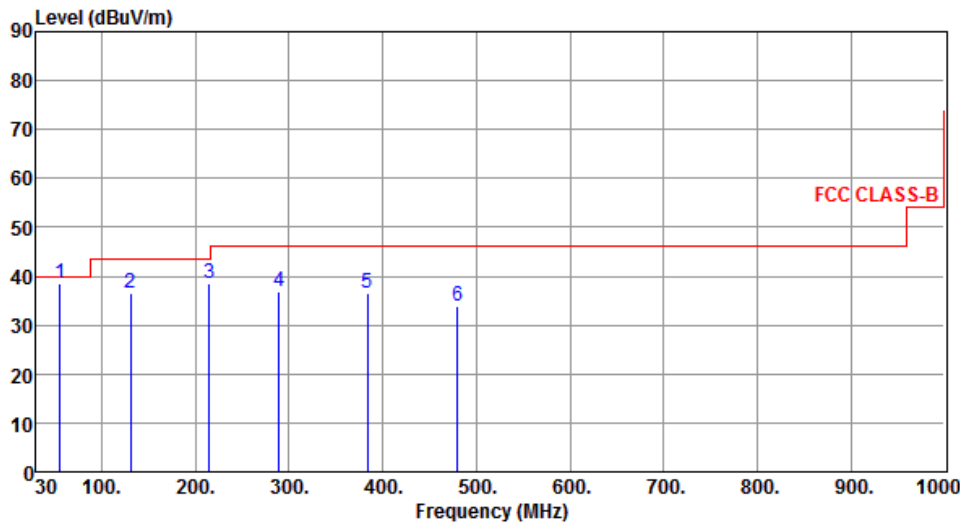
Modulation	BT-LE (2Mbps)		Test Freq. (MHz)		2480				
Polarization	Horizontal								
Level (dBuV/m) </									

Modulation	BT-LE (2Mbps)		Test Freq. (MHz)		2480				
Polarization	Vertical								
Level (dBuV/m) <									

Test configuration 2: High Power with Trace Monopole antenna

3.5.6 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2480
Polarization	Horizontal		

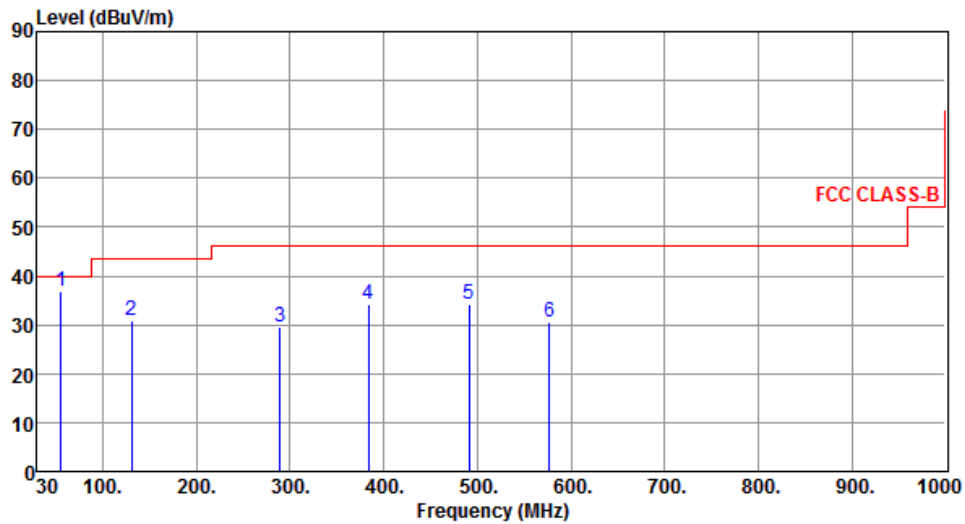


The graph displays the radiated unwanted emissions for a BT-LE transmitter. The y-axis represents the Level in dBuV/m, ranging from 0 to 90. The x-axis represents the Frequency in MHz, ranging from 30 to 1000. A red line indicates the FCC CLASS-B limit, which is 40 dBuV/m from 30 MHz to 100 MHz, 45 dBuV/m from 100 MHz to 1000 MHz. Six test results are plotted as blue vertical lines, labeled 1 through 6, corresponding to the data in the table below.

	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	55.85	38.48	40.00	-1.52	46.60	-8.12	QP	207	45
2	130.88	36.60	43.50	-6.90	46.01	-9.41	Peak	---	---
3	215.27	38.61	43.50	-4.89	49.48	-10.87	Peak	---	---
4	288.99	36.80	46.00	-9.20	44.84	-8.04	Peak	---	---
5	384.05	36.61	46.00	-9.39	42.00	-5.39	Peak	---	---
6	480.08	33.96	46.00	-12.04	37.27	-3.31	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	55.22	36.99	40.00	-3.01	45.05	-8.06	Peak	---	---
2	130.88	30.77	43.50	-12.73	40.18	-9.41	Peak	---	---
3	288.99	29.69	46.00	-16.31	37.73	-8.04	Peak	---	---
4	384.05	34.11	46.00	-11.89	39.50	-5.39	Peak	---	---
5	490.75	34.26	46.00	-11.74	37.33	-3.07	Peak	---	---
6	577.08	30.67	46.00	-15.33	31.89	-1.22	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

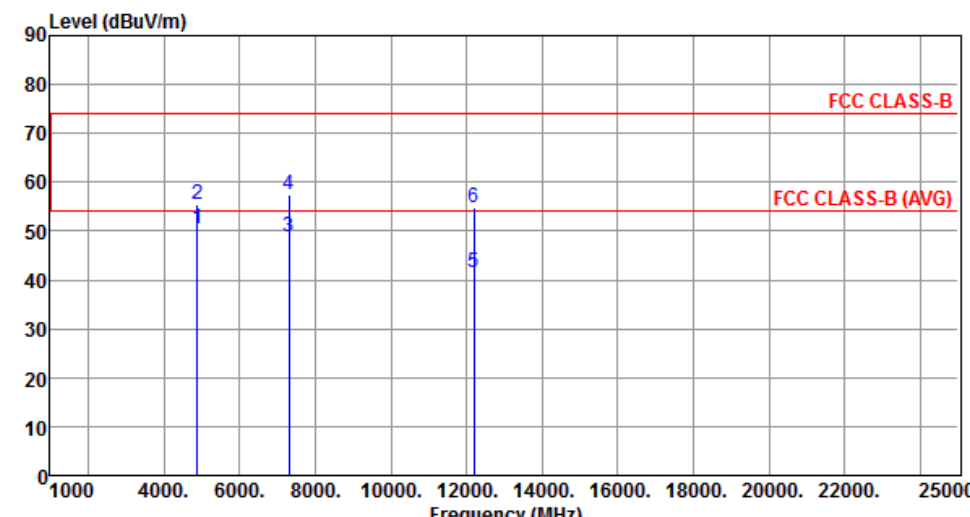
3.5.7 Transmitter Radiated Unwanted Emissions (Above 1GHz)

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2402
Polarization	Horizontal		
Level (dBuV/m) </			

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2402
Polarization	Vertical		
Level (dBuV/m)			

Modulation	BT-LE (1Mbps)		Test Freq. (MHz)		2440	
Polarization	Horizontal					
Level (dBuV/m)						

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2440
Polarization	Vertical		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	4880.00	50.48	54.00	-3.52	46.87	3.61	Average	202	355
2	4880.00	55.30	74.00	-18.70	51.69	3.61	Peak	202	355
3	7320.00	48.73	54.00	-5.27	39.93	8.80	Average	231	3
4	7320.00	57.48	74.00	-16.52	48.68	8.80	Peak	231	3
5	12200.00	41.65	54.00	-12.35	28.35	13.30	Average	100	196
6	12200.00	54.84	74.00	-19.16	41.54	13.30	Peak	100	196

Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2480
Polarization	Horizontal		
Level (dBUV/m)			

Modulation	BT-LE (1Mbps)	Test Freq. (MHz)	2480
Polarization	Vertical		
Level (dBuV/m) </			

Modulation	BT-LE (2Mbps)	Test Freq. (MHz)	2402
Polarization	Horizontal		
Level (dBuV/m) </			

Modulation	BT-LE (2Mbps)	Test Freq. (MHz)	2402
Polarization	Vertical		
Level (dBuV/m) </			

Modulation	BT-LE (2Mbps)		Test Freq. (MHz)		2440				
Polarization	Horizontal								
Level (dBuV/m)									

Modulation	BT-LE (2Mbps)	Test Freq. (MHz)	2440
Polarization	Vertical		
Level (dBUV/m)			

Modulation	BT-LE (2Mbps)	Test Freq. (MHz)	2480
Polarization	Horizontal		
Level (dBuV/m)			

Modulation	BT-LE (2Mbps)	Test Freq. (MHz)	2480
Polarization	Vertical		
Level (dBuV/m)			

Test configuration 1: Low Power with Trace Monopole antenna

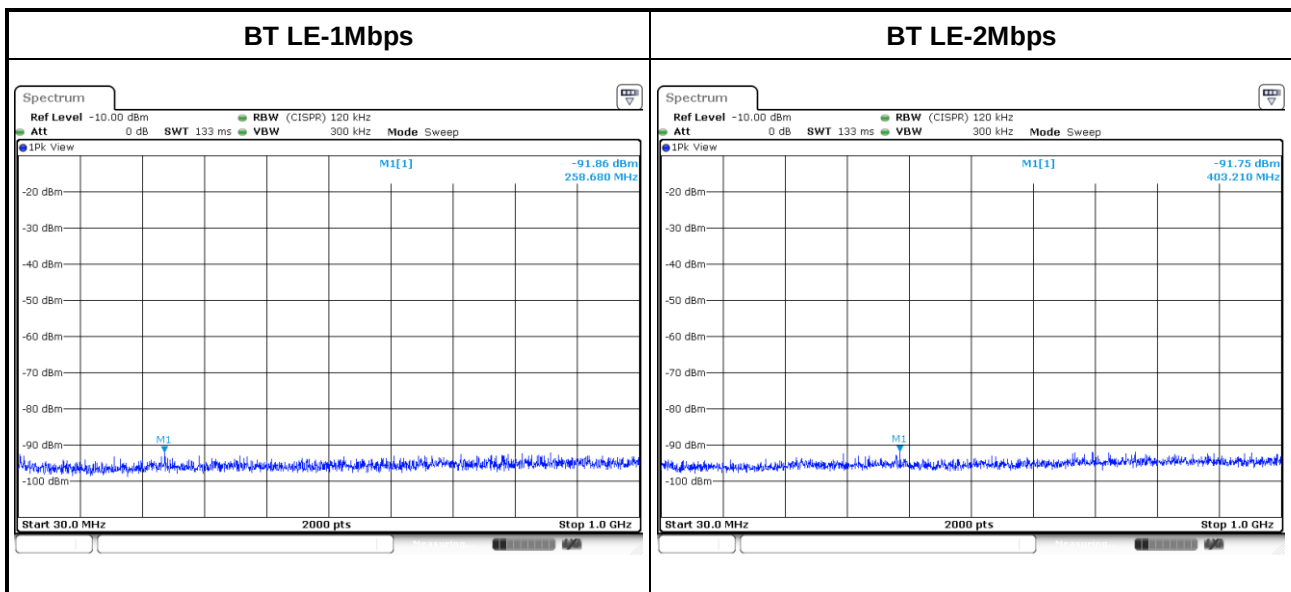
3.5.8 Transmitter Conducted Unwanted Emissions (Below 1 GHz)

Modulation Mode		BT LE-1Mbps			Frequency	2480MHz	
Range (MHz)	Max Value chain0 (dBm)	DG (dBi)	GRF (dB)	EIRP (dBm)	E-Field (dBuV/m)	Min E-Field Limit (dBuV/m)	E-Field Margin (dB)
30~1000MHz	-91.86	2.60	4.70	-84.56	10.70	40.00	-29.30

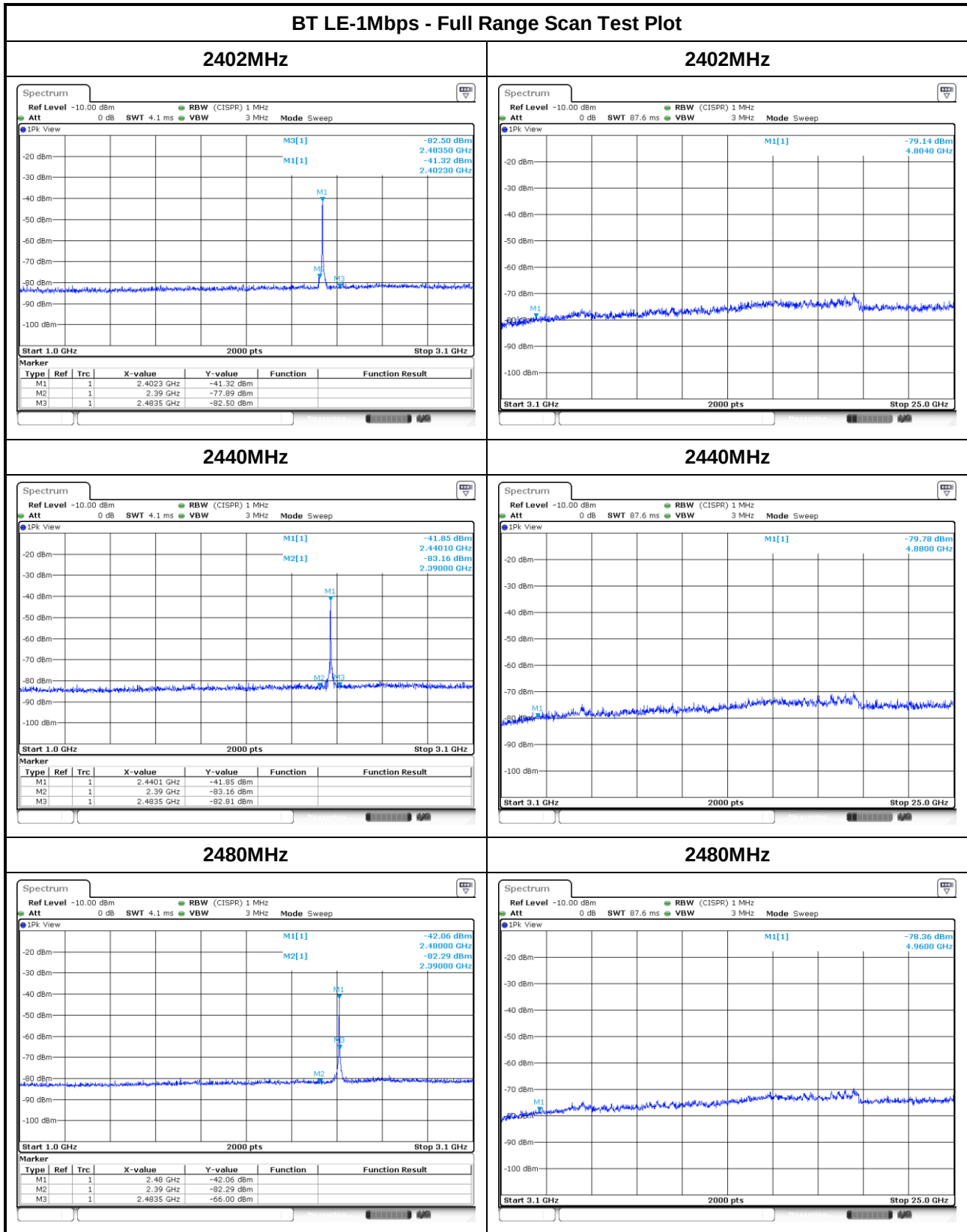
Modulation Mode		BT LE-2Mbps			Frequency	2480MHz	
Range (MHz)	Max Value chain0 (dBm)	DG (dBi)	GRF (dB)	EIRP (dBm)	E-Field (dBuV/m)	Min E-Field Limit (dBuV/m)	E-Field Margin (dB)
30~1000MHz	-91.75	2.60	4.70	-84.45	10.81	40.00	-29.19

Note:

1. GRF = Ground Reflection Factor.
2. DG = Directional Gain.
3. Worst case of emission limit below 1GHz is selected to be limit.

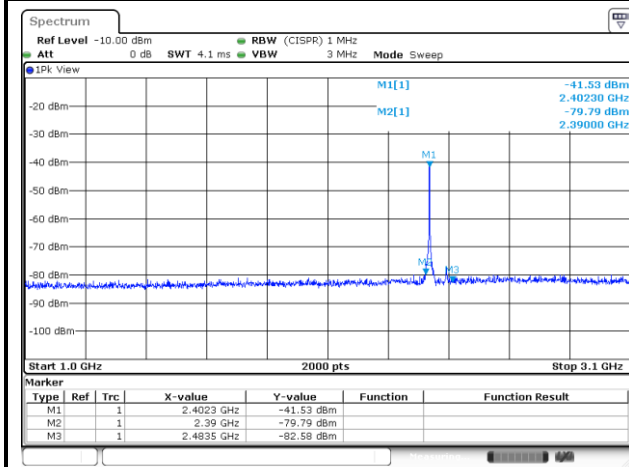


3.5.9 Transmitter Conducted Unwanted Emissions (Above 1GHz)

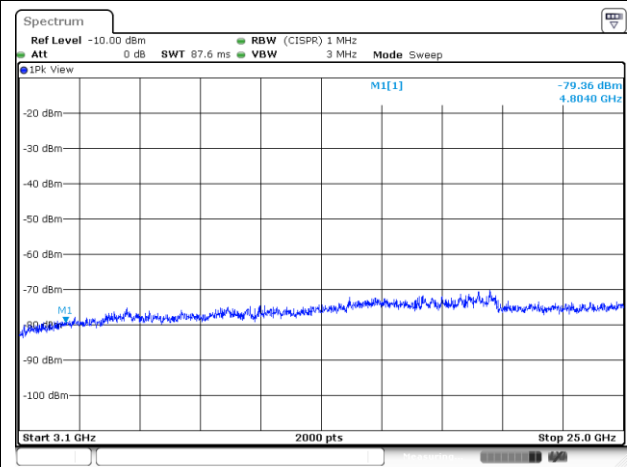


BT LE-2Mbps - Full Range Scan Test Plot

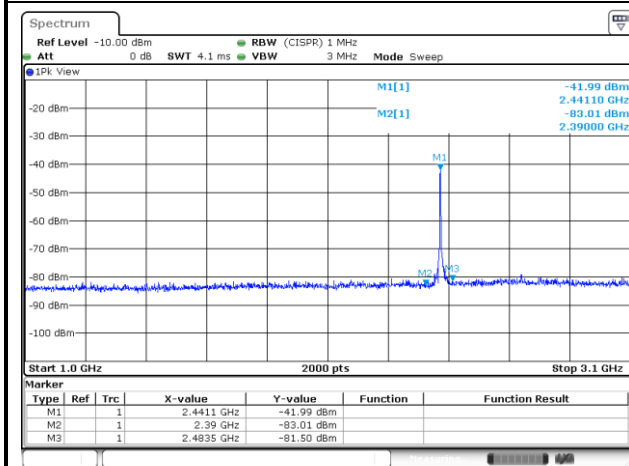
2402MHz



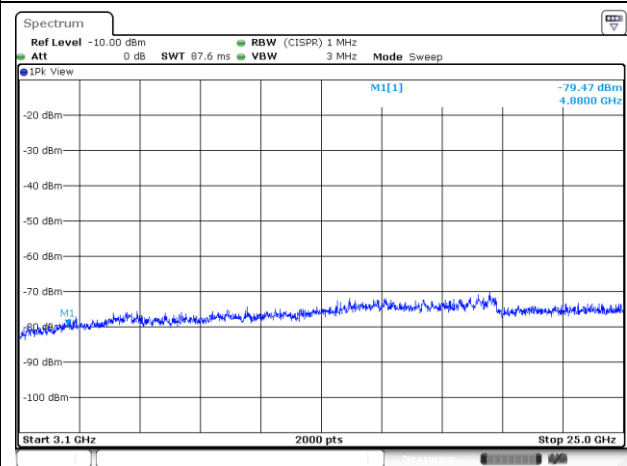
2402MHz



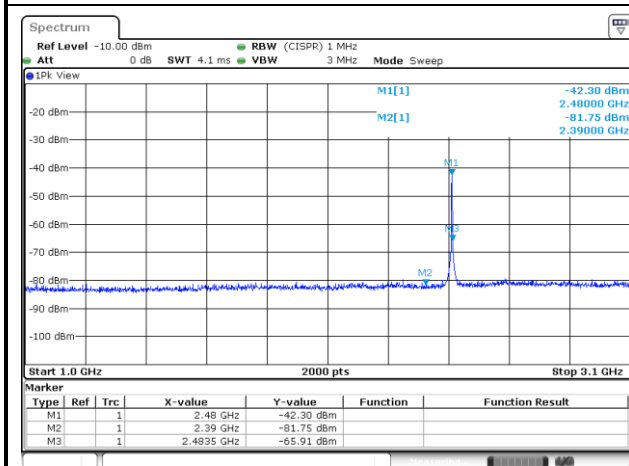
2440MHz



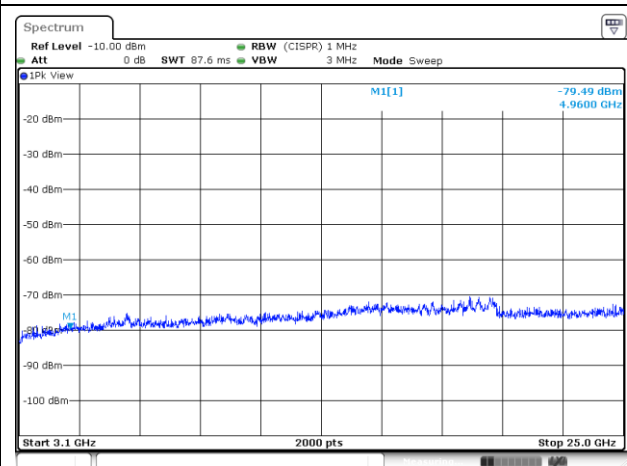
2440MHz



2480MHz



2480MHz

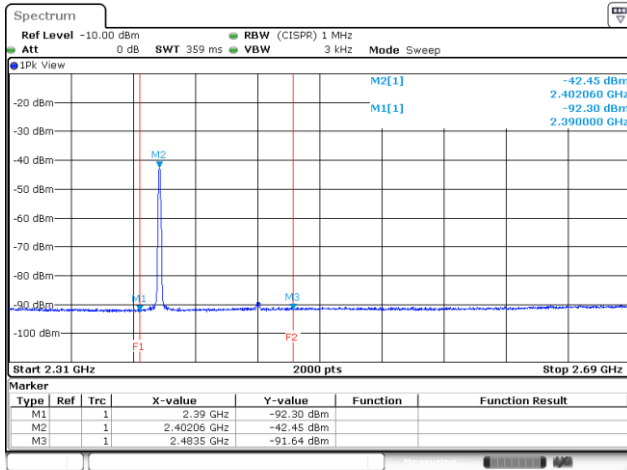


Transmitter Conducted Unwanted Emissions Results in Band Edge								
Modulation Mode		BT LE-1Mbps						
Test ch. Freq. (MHz)	Range (MHz)	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)	Remark
2402	2310~2390	-77.27	2.60	-74.67	20.59	74.00	-53.41	PK
	2310~2390	-92.30	2.60	-89.70	5.56	54.00	-48.44	AV
	2483.5~2500	-82.22	2.60	-79.62	15.64	74.00	-58.36	PK
	2483.5~2500	-91.64	2.60	-89.04	6.22	54.00	-47.78	AV
2440	2310~2390	-83.25	2.60	-80.65	14.61	74.00	-59.39	PK
	2310~2390	-91.85	2.60	-89.25	6.01	54.00	-47.99	AV
	2483.5~2500	-81.51	2.60	-78.91	16.35	74.00	-57.65	PK
	2483.5~2500	-91.42	2.60	-88.82	6.44	54.00	-47.56	AV
2480	2310~2390	-82.10	2.60	-79.50	15.76	74.00	-58.24	PK
	2310~2390	-92.07	2.60	-89.47	5.79	54.00	-48.21	AV
	2485.5~2500	-68.37	2.60	-65.77	29.49	74.00	-44.51	PK
	2483.5~2500	-89.79	2.60	-87.19	8.07	54.00	-45.93	AV

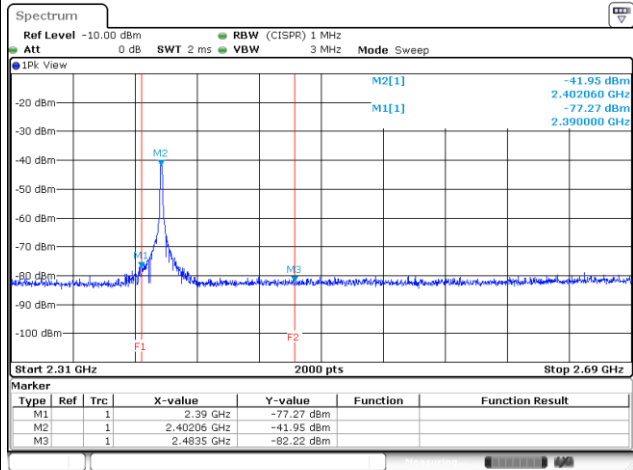
Note: DG = Directional Gain.

Band Edge Test Plot

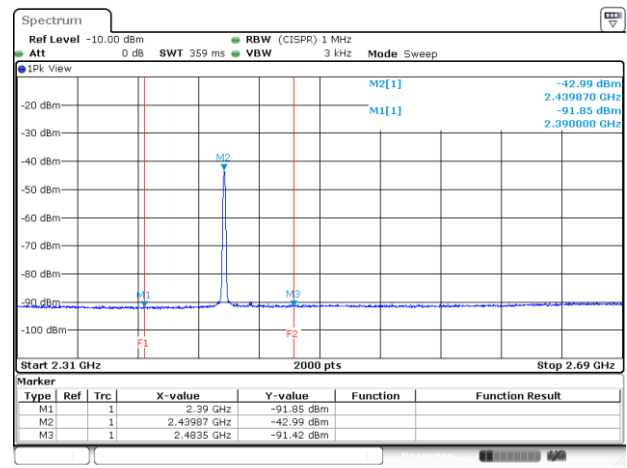
2402MHz - AV



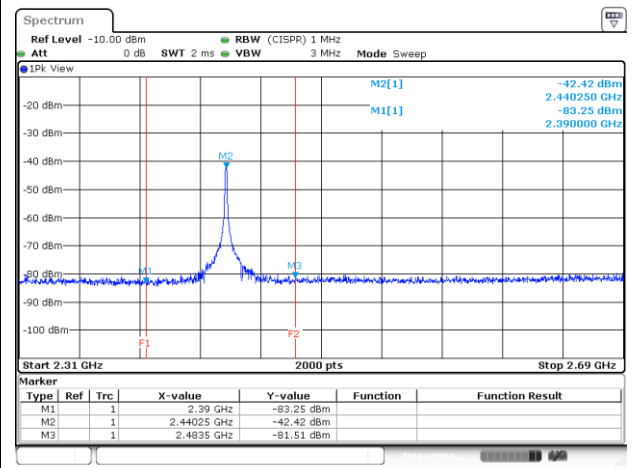
2402MHz - PK



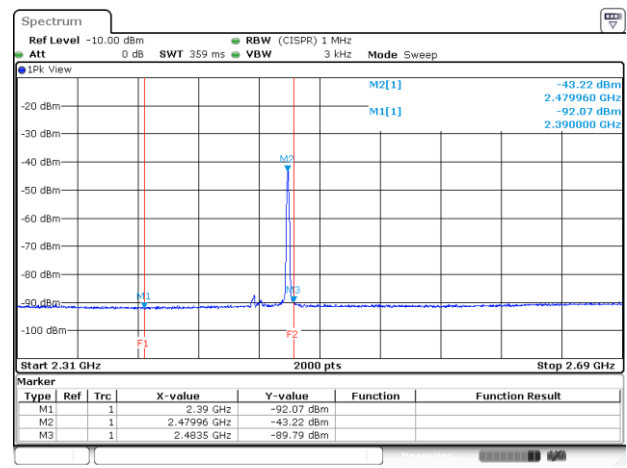
2440MHz - AV



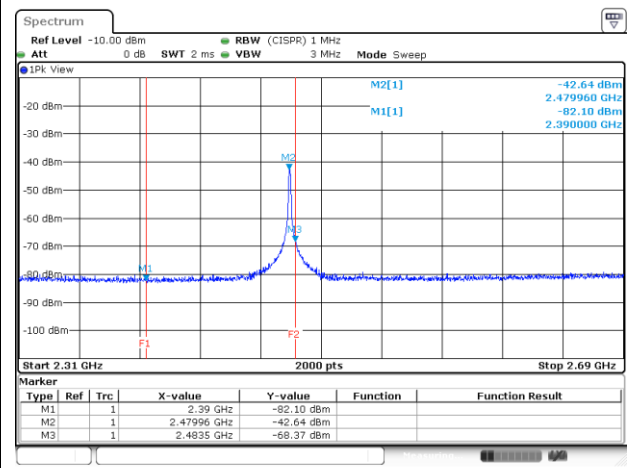
2440MHz - PK



2480MHz - AV



2480MHz - PK

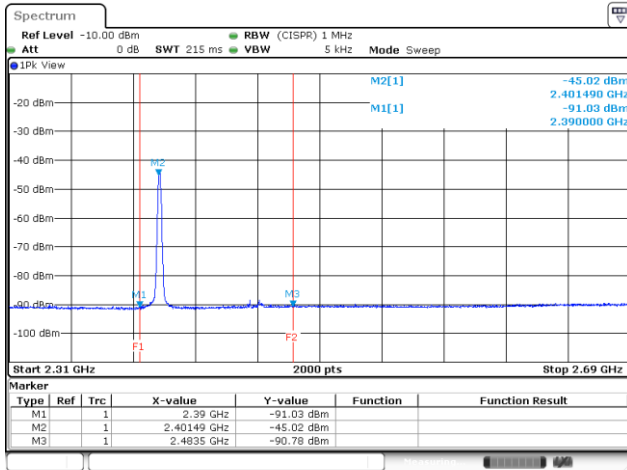


Transmitter Conducted Unwanted Emissions Results in Band Edge								
Modulation Mode		BT LE-2Mbps						
Test ch. Freq. (MHz)	Range (MHz)	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)	Remark
2402	2310~2390	-78.60	2.60	-76.00	19.26	74.00	-54.74	PK
	2310~2390	-91.03	2.60	-88.43	6.83	54.00	-47.17	AV
	2483.5~2500	-81.93	2.60	-79.33	15.93	74.00	-58.07	PK
	2483.5~2500	-90.78	2.60	-88.18	7.08	54.00	-46.92	AV
2440	2310~2390	-81.96	2.60	-79.36	15.90	74.00	-58.10	PK
	2310~2390	-91.43	2.60	-88.83	6.43	54.00	-47.57	AV
	2483.5~2500	-81.72	2.60	-79.12	16.14	74.00	-57.86	PK
	2483.5~2500	-90.78	2.60	-88.18	7.08	54.00	-46.92	AV
2480	2310~2390	-81.96	2.60	-79.36	15.90	74.00	-58.10	PK
	2310~2390	-91.43	2.60	-88.83	6.43	54.00	-47.57	AV
	2485.5~2500	-67.96	2.60	-65.36	29.90	74.00	-44.10	PK
	2483.5~2500	-88.59	2.60	-85.99	9.27	54.00	-44.73	AV

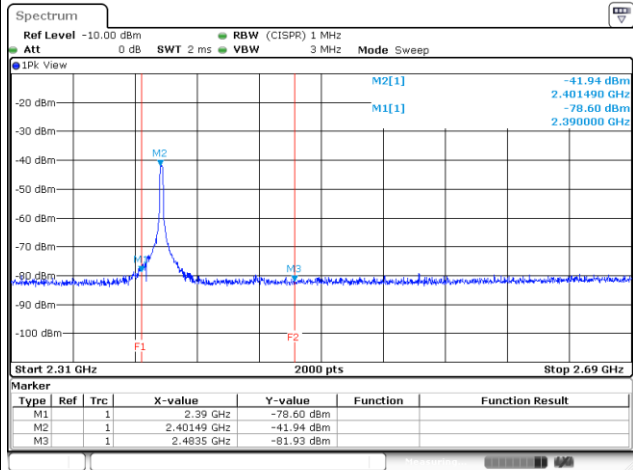
Note: DG = Directional Gain.

Band Edge Test Plot

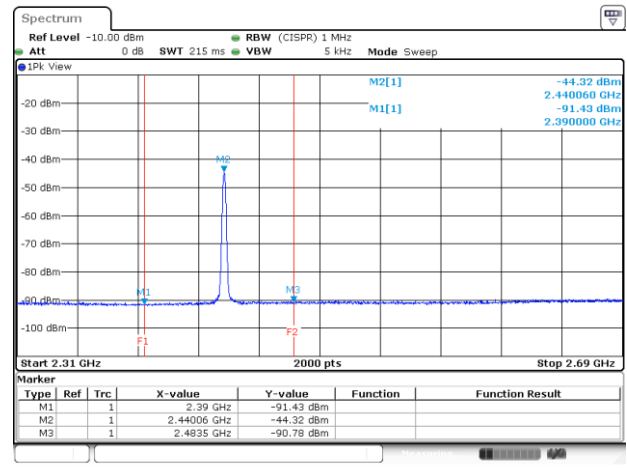
2402MHz - AV



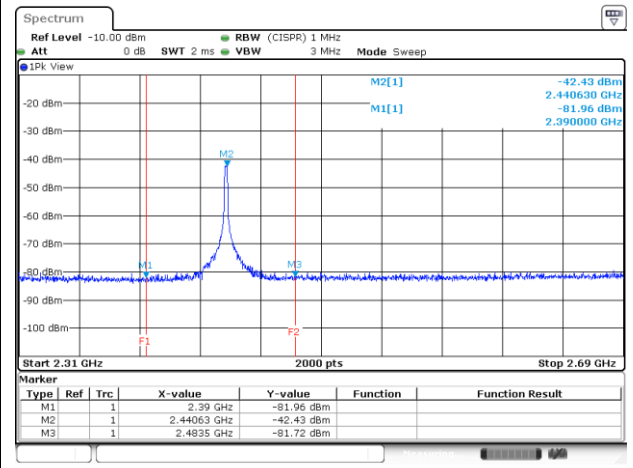
2402MHz - PK



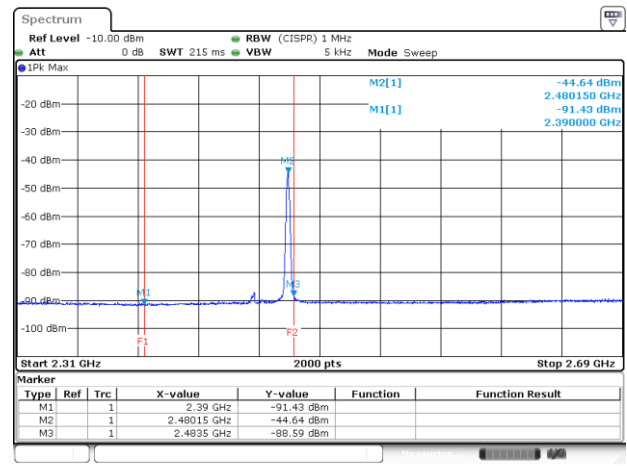
2440MHz - AV



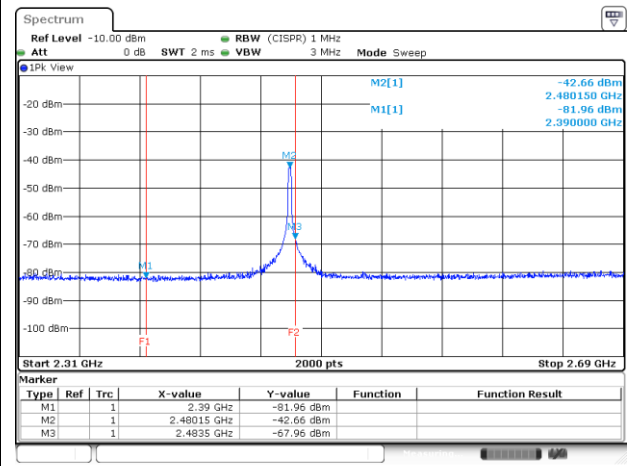
2440MHz - PK



2480MHz - AV



2480MHz - PK



Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-1Mbps		Frequency		2402MHz	
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4804.00	PK	-76.19	2.60	-73.59	21.67	74.00	-52.33
4804.00	AV note1	-	2.60	-	-	54.00	-

Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-1Mbps		Frequency		2440MHz	
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4880.00	PK	-76.28	2.60	-73.68	21.58	74.00	-52.42
4880.00	AV note1	-	2.60	-	-	54.00	-

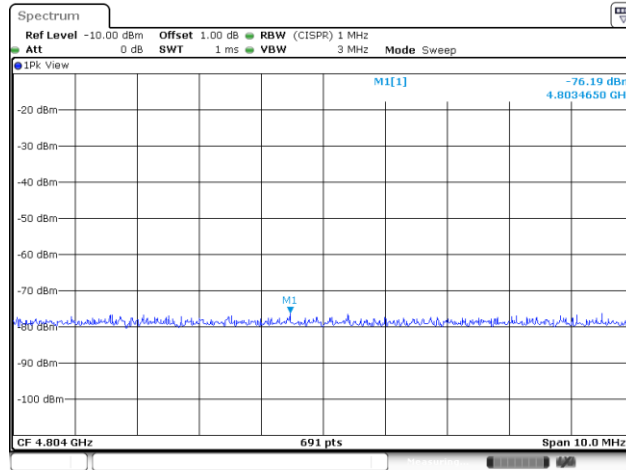
Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-1Mbps		Frequency		2480MHz	
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4960.00	PK	-75.34	2.60	-72.74	22.52	74.00	-51.48
4960.00	AV note1	-	2.60	-	-	54.00	-

Note:

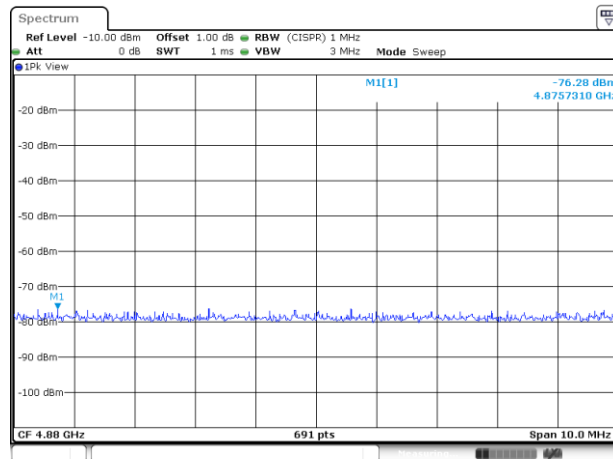
1. If the PK margin greater than 20 dB, there is no need to get AVG reading.
2. DG = Directional Gain.

Test Plots

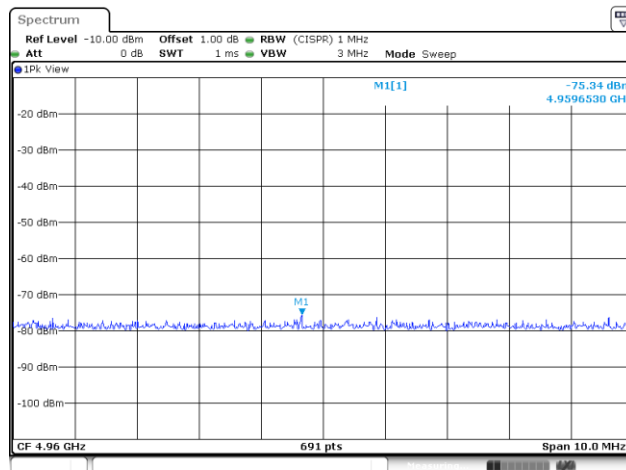
4804MHz - PK



4880MHz - PK



4960MHz - PK



Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-2Mbps		Frequency		2402MHz	
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4804.00	PK	-76.44	2.60	-73.84	21.42	74.00	-52.58
4804.00	AV note1	-	2.60	-	-	54.00	-

Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-2Mbps		Frequency		2440MHz	
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4880.00	PK	-76.29	2.60	-73.69	21.57	74.00	-52.43
4880.00	AV note1	-	2.60	-	-	54.00	-

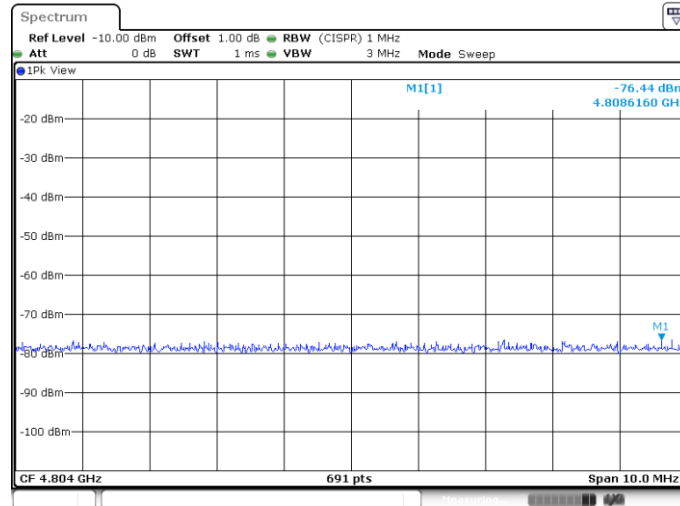
Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-2Mbps		Frequency		2480MHz	
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4960.00	PK	-76.19	2.60	-73.59	21.67	74.00	-52.33
4960.00	AV note1	-	2.60	-	-	54.00	-

Note:

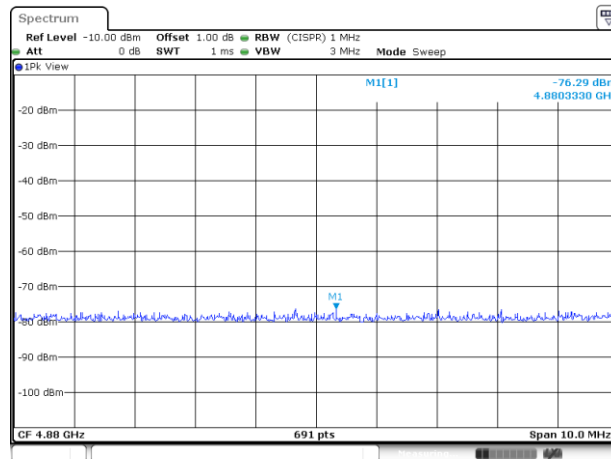
3. If the PK margin greater than 20 dB, there is no need to get AVG reading.
4. DG = Directional Gain.

Test Plots

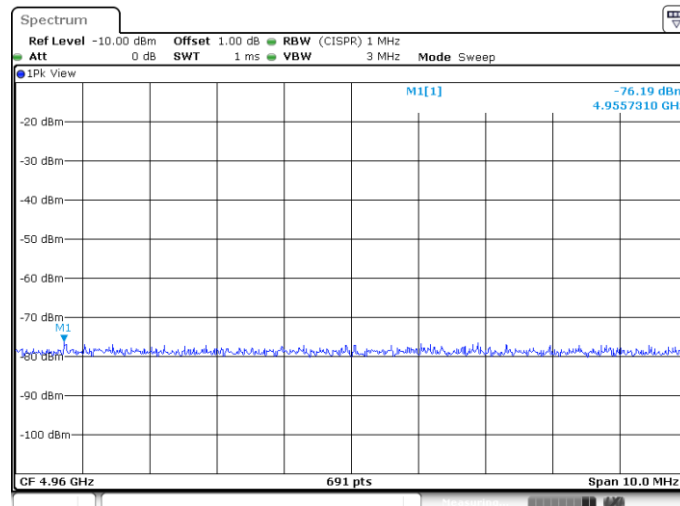
4804MHz - PK



4880MHz - PK



4960MHz - PK



Test configuration 2: High Power with Trace Monopole antenna

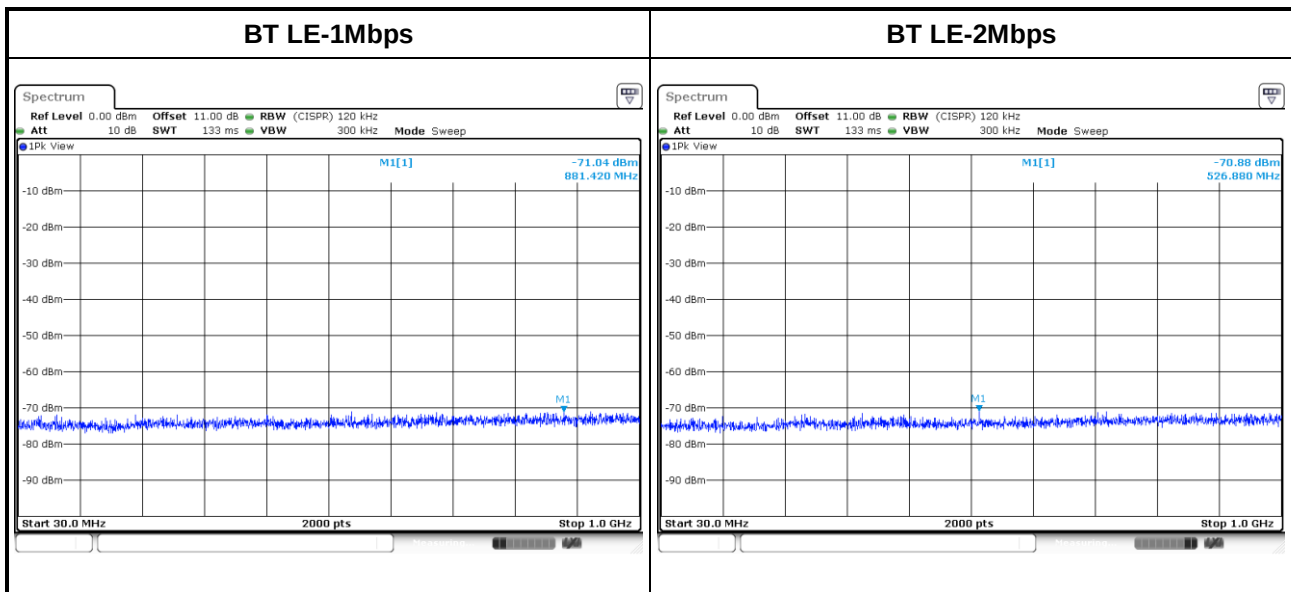
3.5.10 Transmitter Conducted Unwanted Emissions (Below 1 GHz)

Modulation Mode		BT LE-1Mbps			Frequency			2480MHz
Range (MHz)	Max Value chain0 (dBm)	DG (dBi)	GRF (dB)	EIRP (dBm)	E-Field (dBuV/m)	Min E-Field Limit (dBuV/m)	E-Field Margin (dB)	
30~1000MHz	-71.04	2.60	4.70	-63.74	31.52	40.00	-8.48	

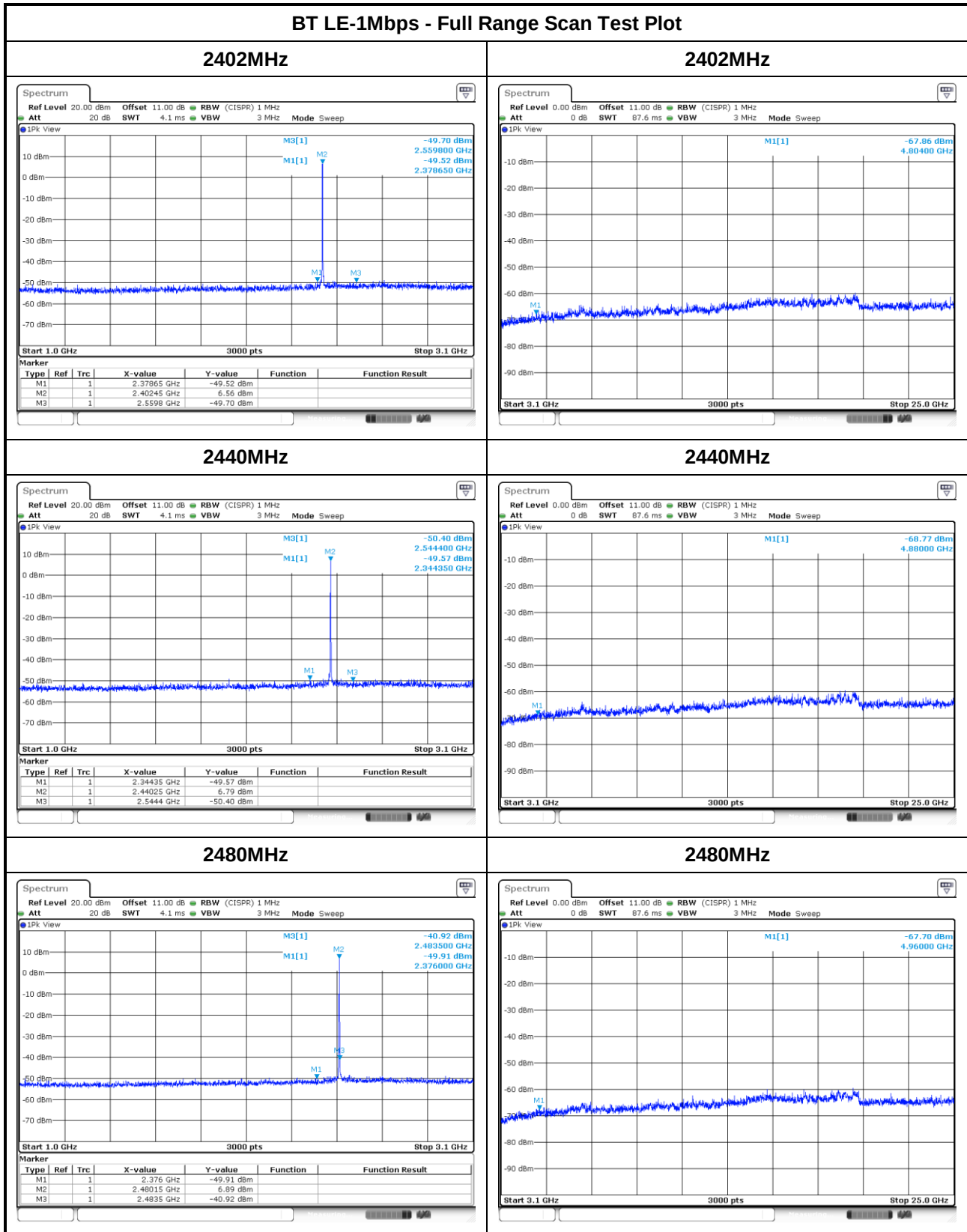
Modulation Mode		BT LE-2Mbps			Frequency			2480MHz
Range (MHz)	Max Value chain0 (dBm)	DG (dBi)	GRF (dB)	EIRP (dBm)	E-Field (dBuV/m)	Min E-Field Limit (dBuV/m)	E-Field Margin (dB)	
30~1000MHz	-70.88	2.60	4.70	-63.58	31.68	40.00	-8.32	

Note:

4. GRF = Ground Reflection Factor.
5. DG = Directional Gain.
6. Worst case of emission limit below 1GHz is selected to be limit.

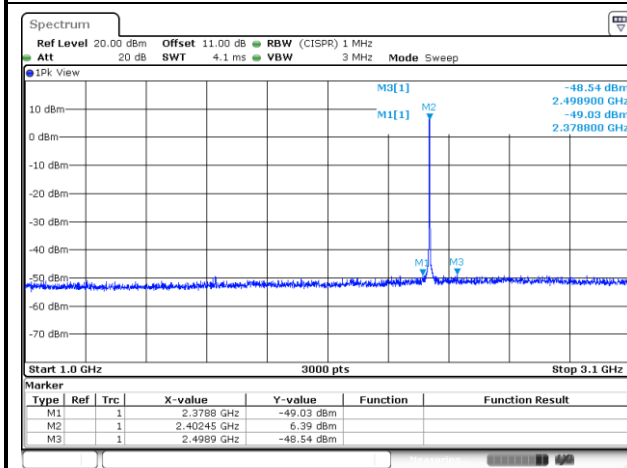


3.5.11 Transmitter Conducted Unwanted Emissions (Above 1GHz)

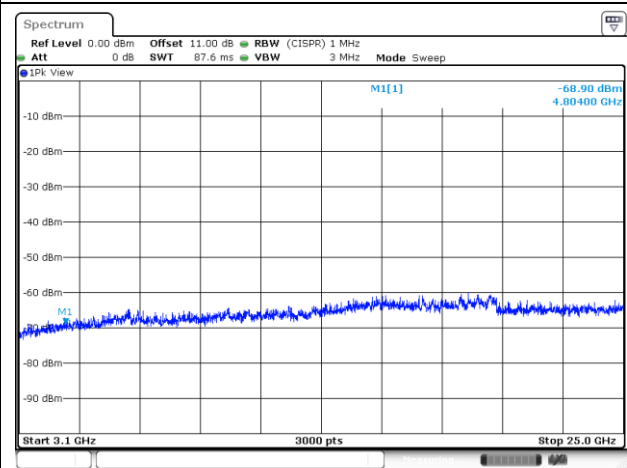


BT LE-2Mbps - Full Range Scan Test Plot

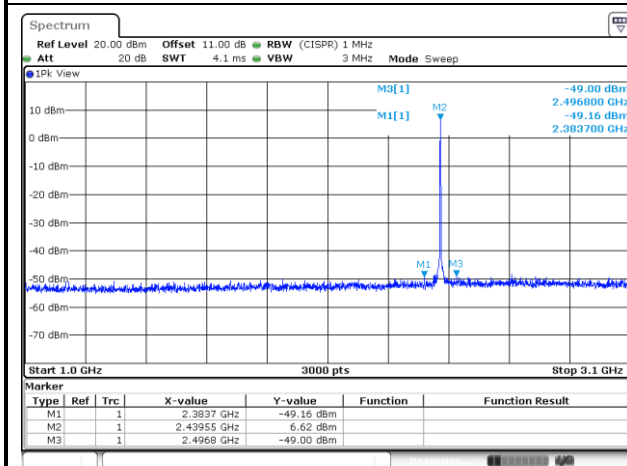
2402MHz



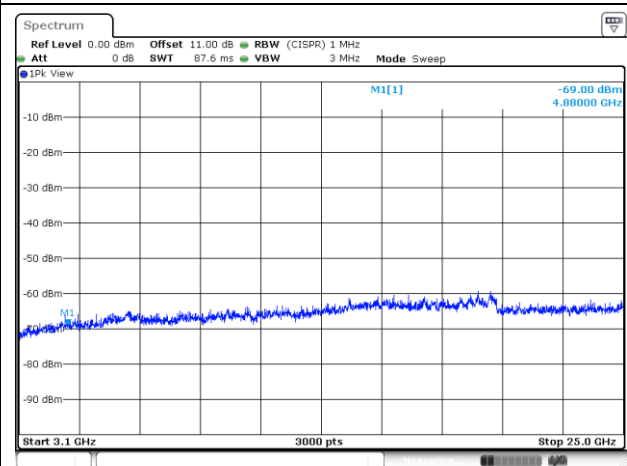
2402MHz



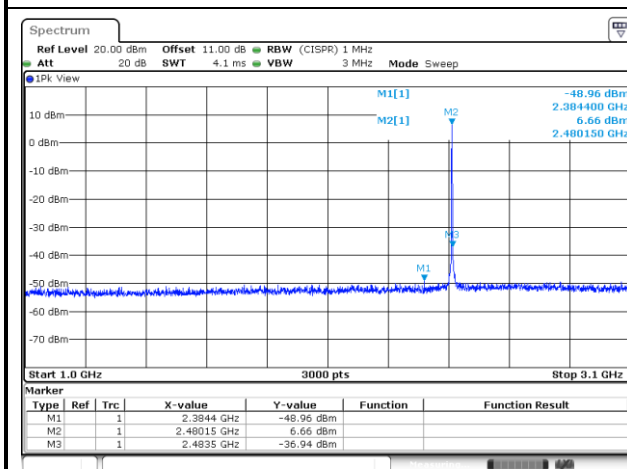
2440MHz



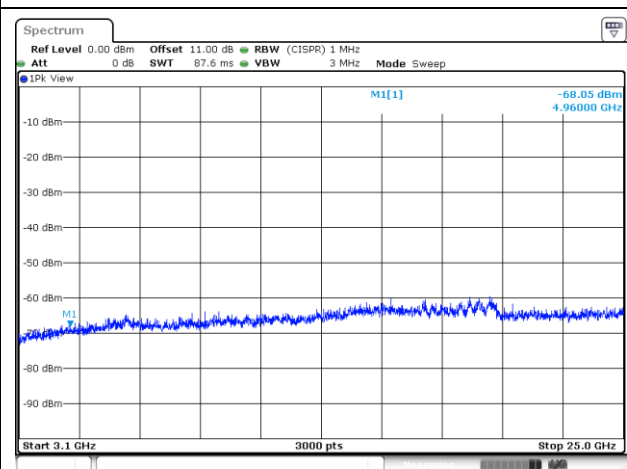
2440MHz



2480MHz



2480MHz

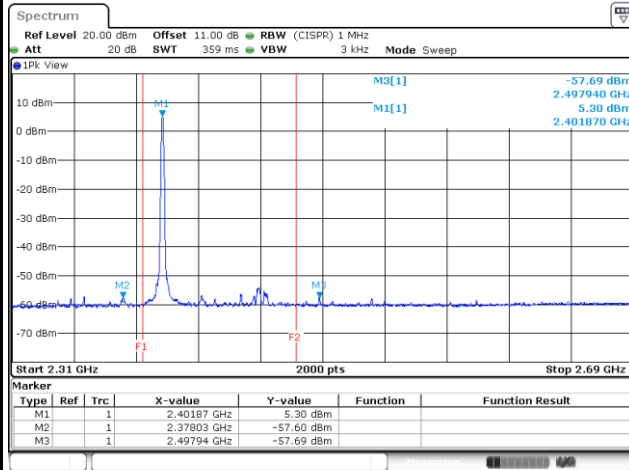


Transmitter Conducted Unwanted Emissions Results in Band Edge								
Modulation Mode		BT LE-1Mbps						
Test ch. Freq. (MHz)	Range (MHz)	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)	Remark
2402	2310~2390	-48.51	2.60	-45.91	49.35	74.00	-24.65	PK
	2310~2390	-57.60	2.60	-55.00	40.26	54.00	-13.74	AV
	2483.5~2500	-49.54	2.60	-46.94	48.32	74.00	-25.68	PK
	2483.5~2500	-57.69	2.60	-55.09	40.17	54.00	-13.83	AV
2440	2310~2390	-50.09	2.60	-47.49	47.77	74.00	-26.23	PK
	2310~2390	-57.19	2.60	-54.59	40.67	54.00	-13.33	AV
	2483.5~2500	-49.44	2.60	-46.84	48.42	74.00	-25.58	PK
	2483.5~2500	-55.94	2.60	-53.34	41.92	54.00	-12.08	AV
2480	2310~2390	-48.97	2.60	-46.37	48.89	74.00	-25.11	PK
	2310~2390	-58.09	2.60	-55.49	39.77	54.00	-14.23	AV
	2485.5~2500	-40.08	2.60	-37.48	57.78	74.00	-16.22	PK
	2483.5~2500	-52.38	2.60	-49.78	45.48	54.00	-8.52	AV

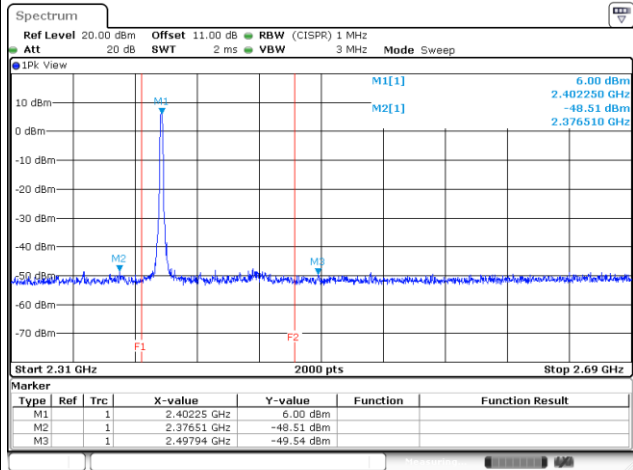
Note: DG = Directional Gain

Band Edge Test Plot

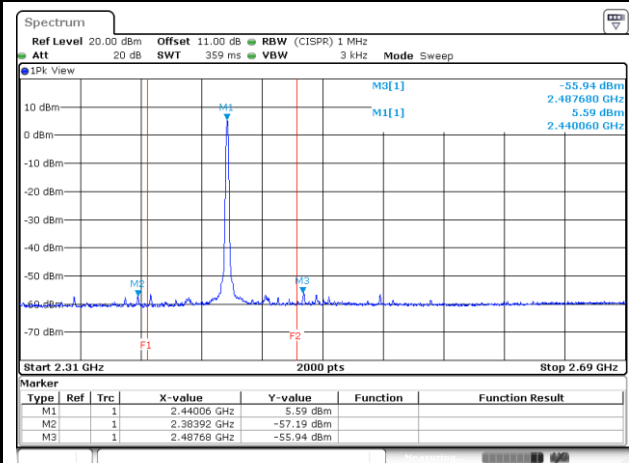
2402MHz - AV



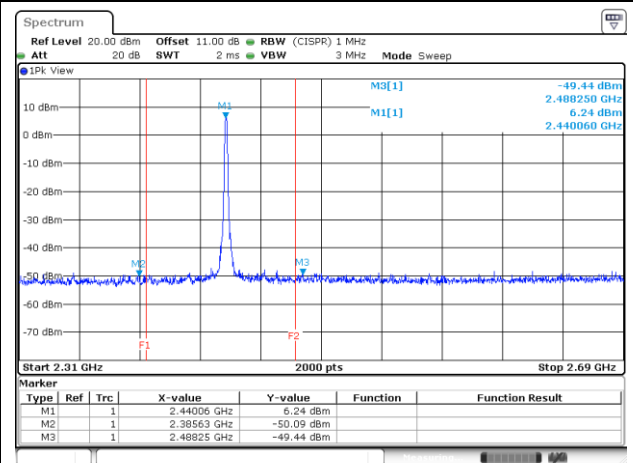
2402MHz - PK



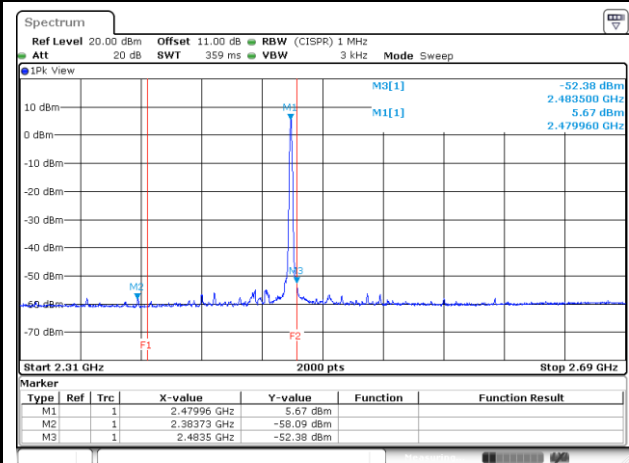
2440MHz - AV



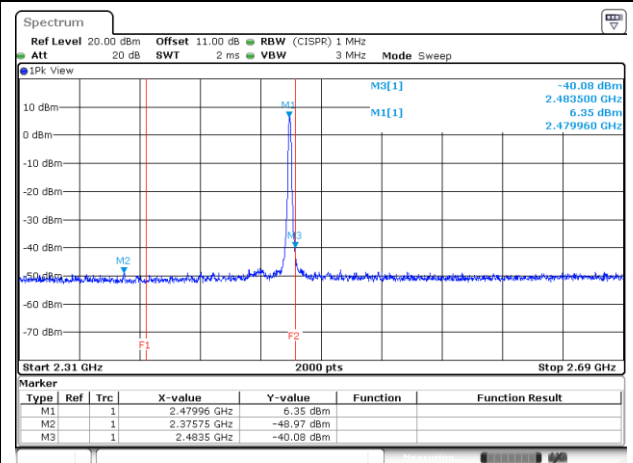
2440MHz - PK



2480MHz - AV



2480MHz - PK

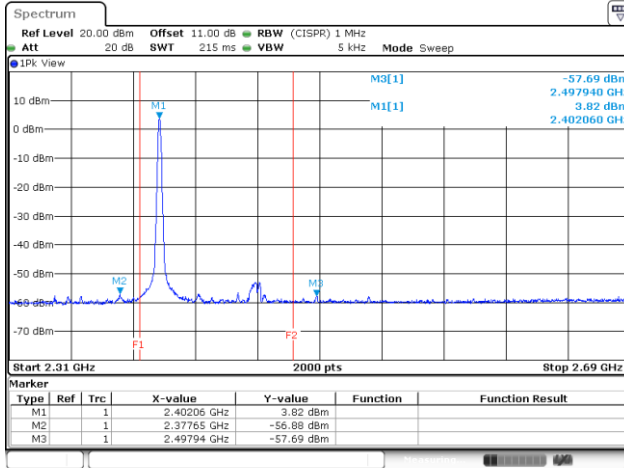


Transmitter Conducted Unwanted Emissions Results in Band Edge								
Modulation Mode		BT LE-2Mbps						
Test ch. Freq. (MHz)	Range (MHz)	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)	Remark
2402	2310~2390	-49.64	2.60	-47.04	48.22	74.00	-25.78	PK
	2310~2390	-56.88	2.60	-54.28	40.98	54.00	-13.02	AV
	2483.5~2500	-49.98	2.60	-47.38	47.88	74.00	-26.12	PK
	2483.5~2500	-57.69	2.60	-55.09	40.17	54.00	-13.83	AV
2440	2310~2390	-50.08	2.60	-47.48	47.78	74.00	-26.22	PK
	2310~2390	-57.20	2.60	-54.60	40.66	54.00	-13.34	AV
	2483.5~2500	-48.13	2.60	-45.53	49.73	74.00	-24.27	PK
	2483.5~2500	-56.78	2.60	-54.18	41.08	54.00	-12.92	AV
2480	2310~2390	-49.85	2.60	-47.25	48.01	74.00	-25.99	PK
	2310~2390	-58.10	2.60	-55.50	39.76	54.00	-14.24	AV
	2485.5~2500	-39.77	2.60	-37.17	58.09	74.00	-15.91	PK
	2483.5~2500	-48.87	2.60	-46.27	48.99	54.00	-5.01	AV

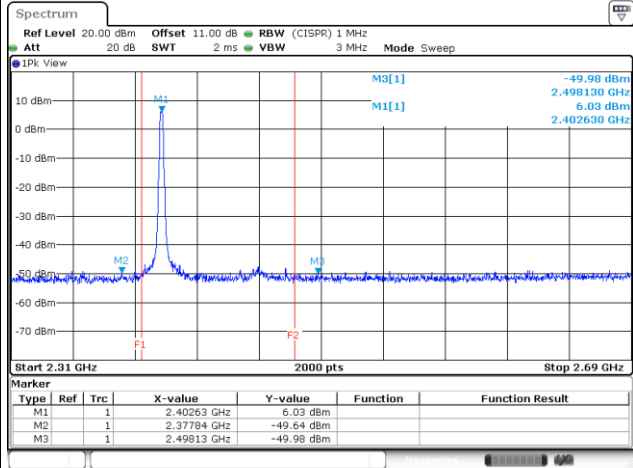
Note: DG = Directional Gain.

Band Edge Test Plot

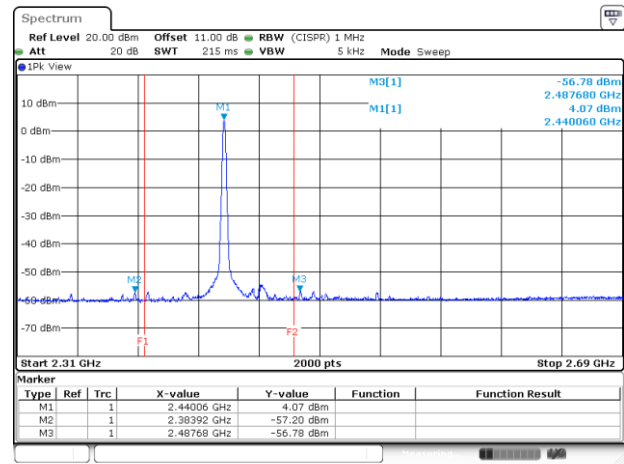
2402MHz - AV



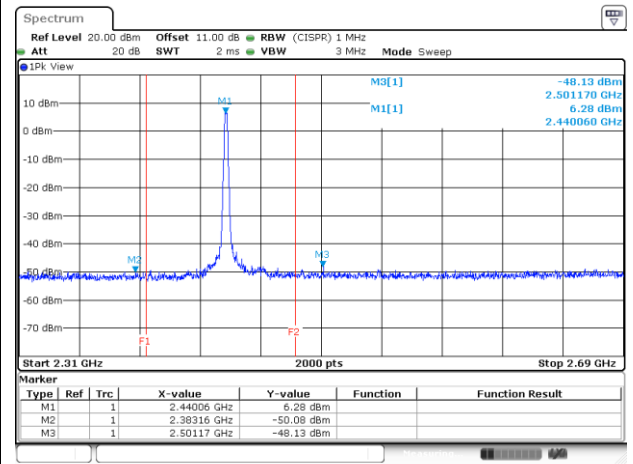
2402MHz - PK



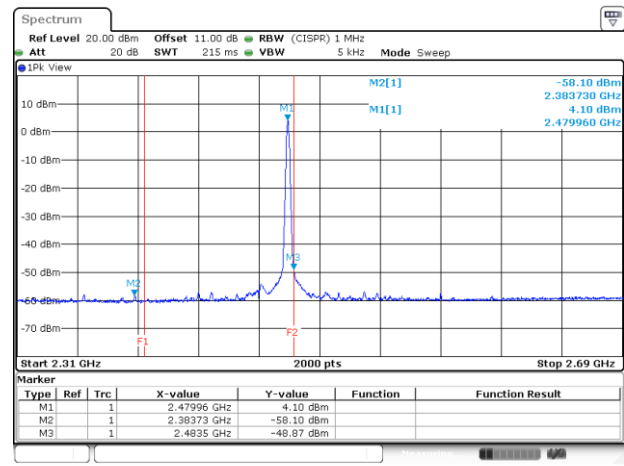
2440MHz - AV



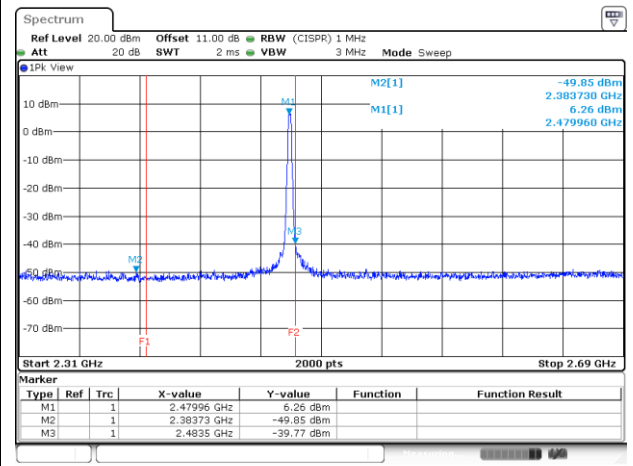
2440MHz - PK



2480MHz - AV



2480MHz - PK



Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-1Mbps		Frequency		2402MHz	
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4804.00	PK	-64.70	2.60	-62.10	33.16	74.00	-40.84
4804.00	AV	-	2.60	-	-	54.00	-

Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-1Mbps		Frequency		2440MHz	
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4880.00	PK	-66.06	2.60	-63.46	31.80	74.00	-42.20
4880.00	AV note1	-	2.60	-	-	54.00	-

Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-1Mbps		Frequency		2480MHz	
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4960.00	PK	-66.05	2.60	-63.45	31.81	74.00	-42.19
4960.00	AV note1	-	2.60	-	-	54.00	-

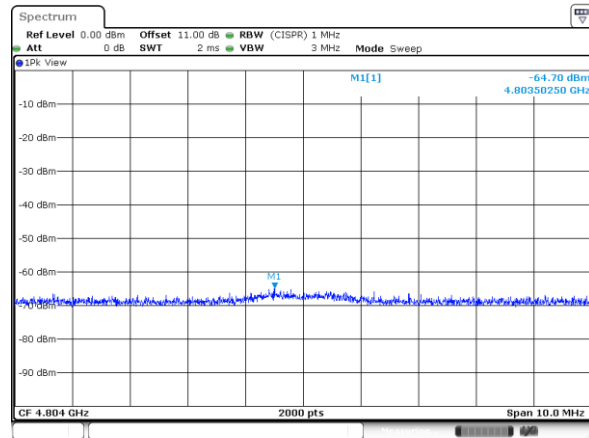
Note:

5. If the PK margin greater than 20 dB, there is no need to get AVG reading.

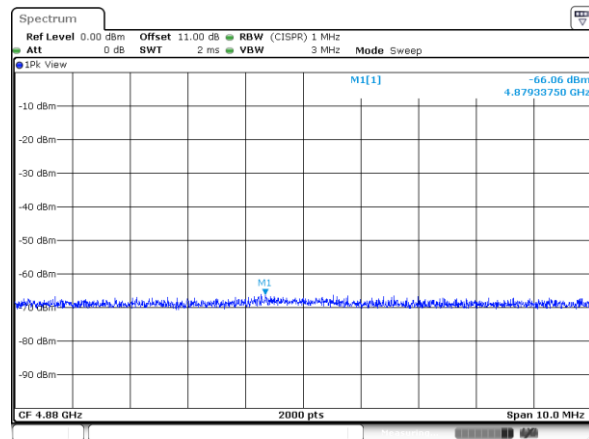
6. DG = Directional Gain.

Test Plots

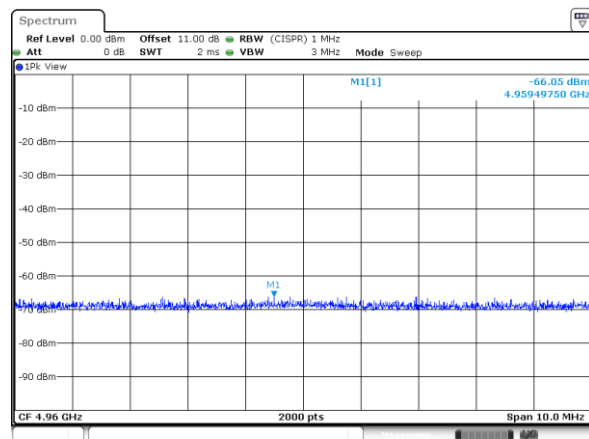
4804MHz - PK



4880MHz - PK



4960MHz - PK



Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-2Mbps			Frequency		2402MHz
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4804.00	PK	-65.74	2.60	-63.14	32.12	74.00	-41.88
4804.00	AV note1	-	2.60	-	-	54.00	-

Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-2Mbps			Frequency		2440MHz
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4880.00	PK	-66.13	2.60	-63.53	31.73	74.00	-42.27
4880.00	AV note1	-	2.60	-	-	54.00	-

Transmitter Conducted Unwanted Emissions Results in Restricted Frequency Band							
Modulation Mode		BT LE-2Mbps			Frequency		2480MHz
Freq. (MHz)	Remark	Max Value chain0 (dBm)	DG (dBi)	EIRP (dBm)	E-Field (dBuV/m)	E-Field Limit (dBuV/m)	E-Field Margin (dB)
4960.00	PK	-65.58	2.60	-62.98	32.28	74.00	-41.72
4960.00	AV note1	-	2.60	-	-	54.00	-

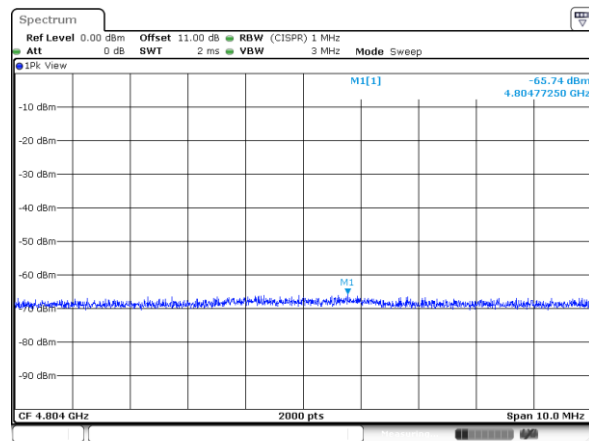
Note:

7. If the PK margin greater than 20 dB, there is no need to get AVG reading.

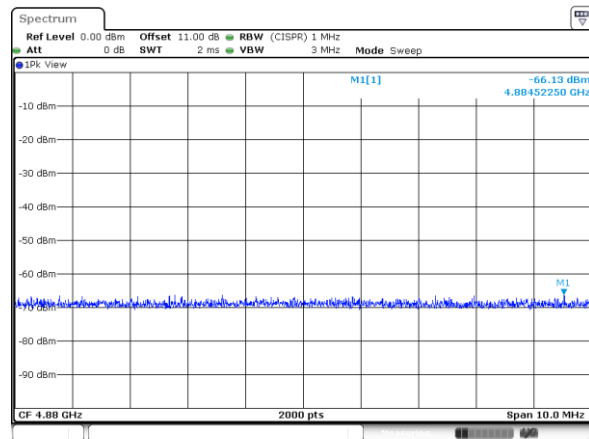
8. DG = Directional Gain.

Test Plots

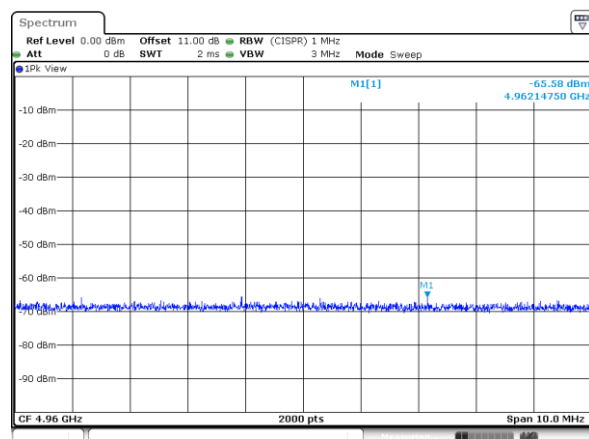
4804MHz - PK



4880MHz - PK



4960MHz - PK



3.6 Emissions in non-restricted Frequency Bands

3.6.1 Emissions in non-restricted frequency bands limit

Peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

3.6.2 Test Procedures

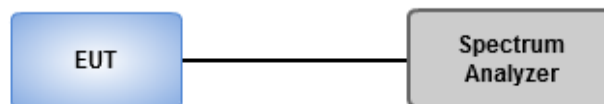
Reference level measurement

1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Use the peak marker function to determine the maximum PSD level

Emission level measurement

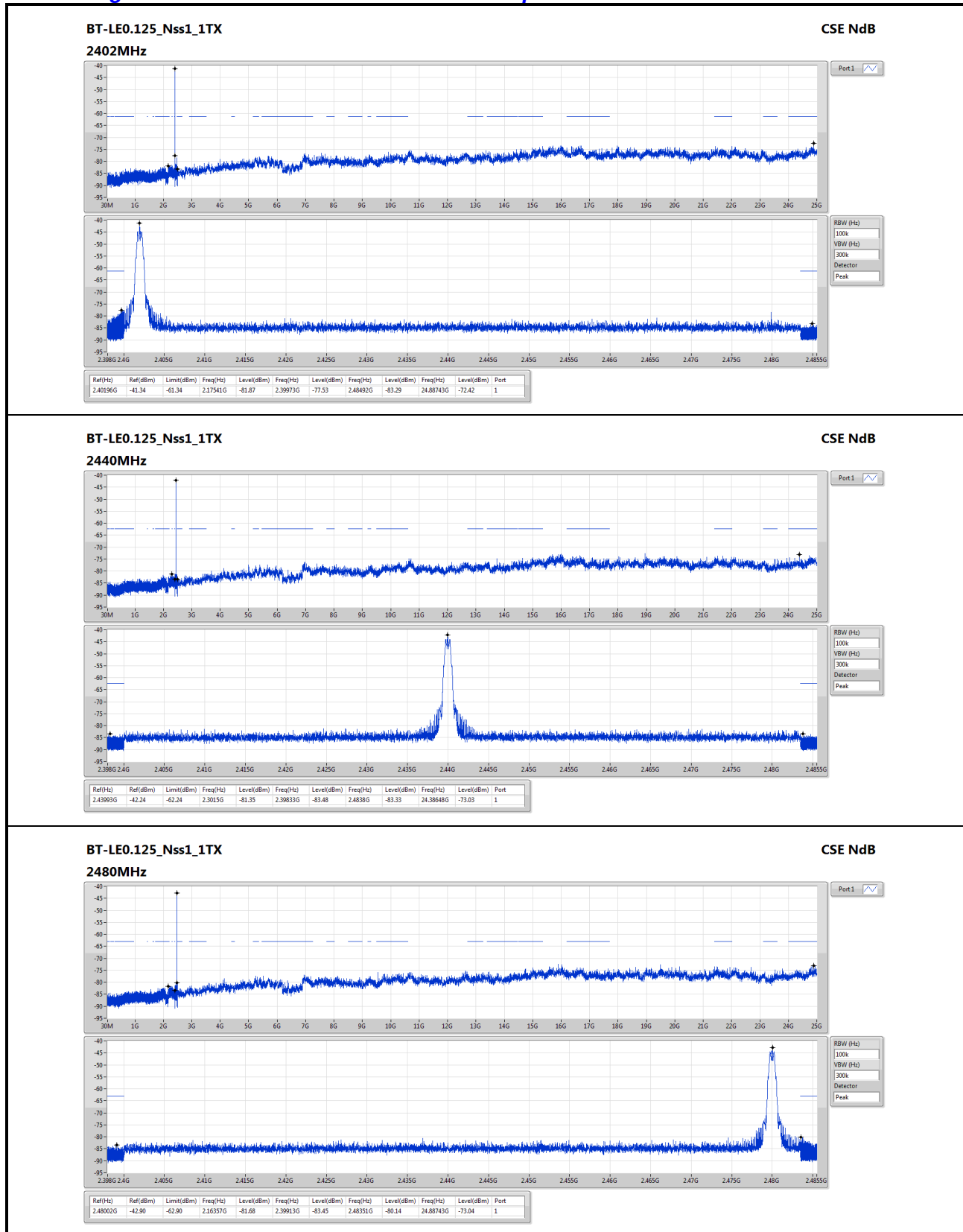
1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Scan Frequency range is up to 25GHz
4. Use the peak marker function to determine the maximum amplitude level

3.6.3 Test Setup



3.6.4 Test Result of Emissions in non-restricted Frequency Bands

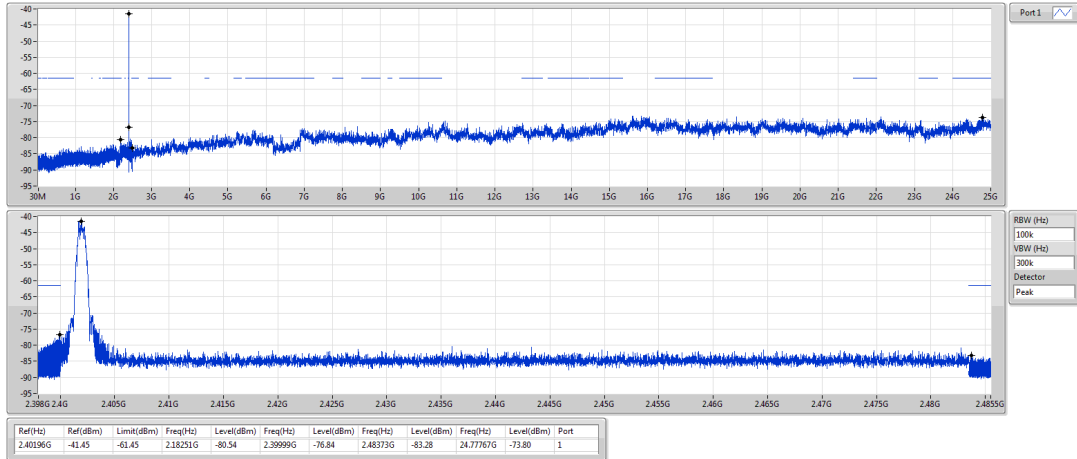
Test configuration 1: Low Power with Trace Monopole antenna



BT-LE0.5_Nss1_1TX

CSE NdB

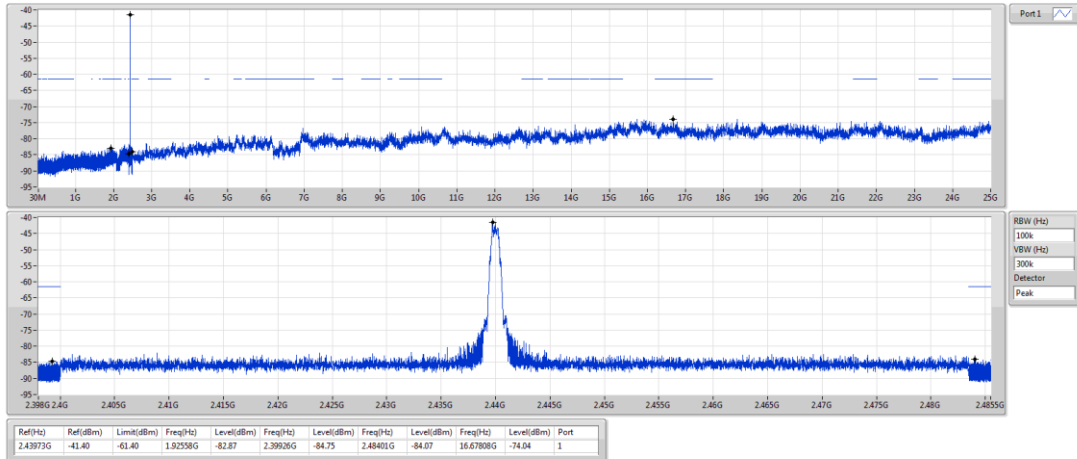
2402MHz



BT-LE0.5_Nss1_1TX

CSE NdB

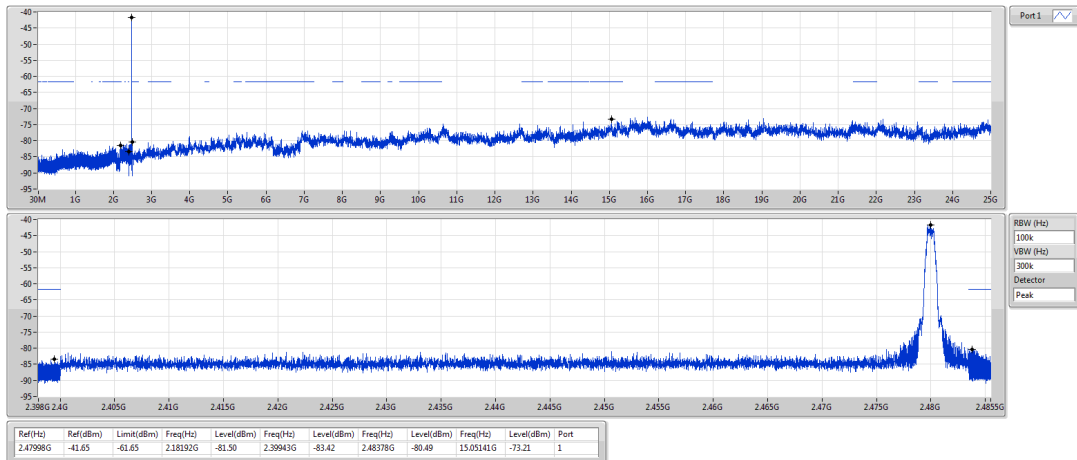
2440MHz



BT-LE0.5_Nss1_1TX

CSE NdB

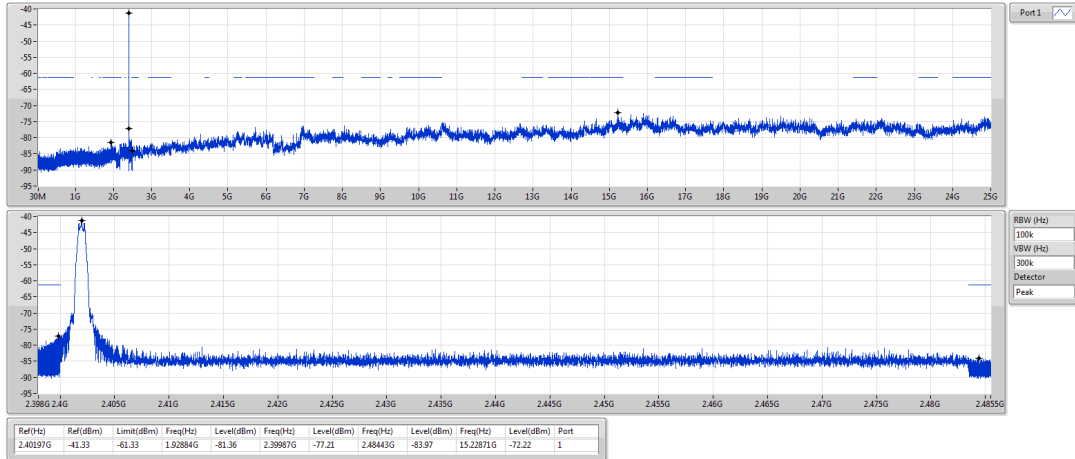
2480MHz



BT-LE(1Mbps)

CSE NdB

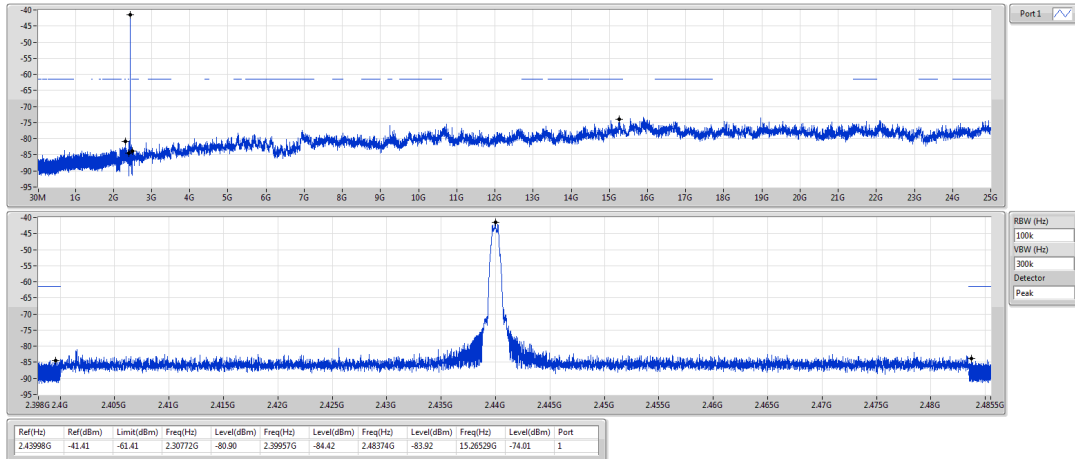
2402MHz



BT-LE(1Mbps)

CSE NdB

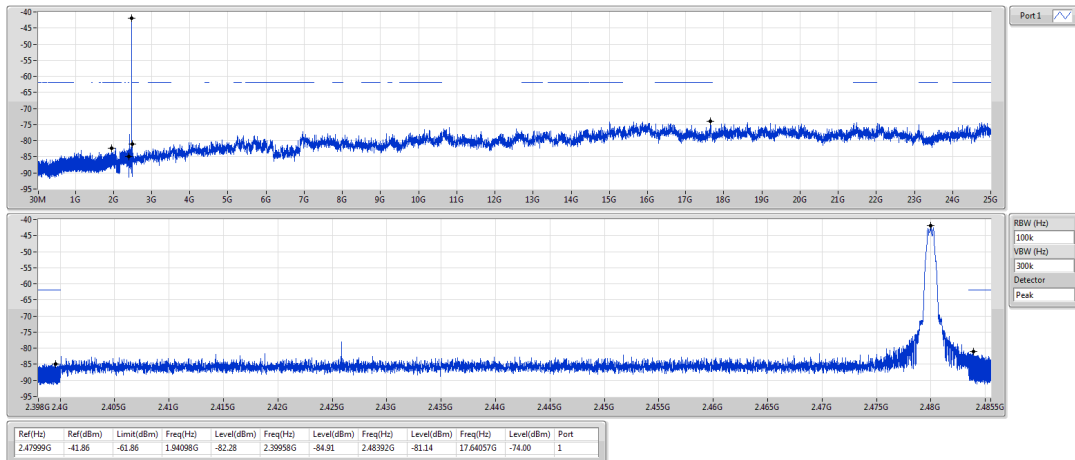
2440MHz



BT-LE(1Mbps)

CSE NdB

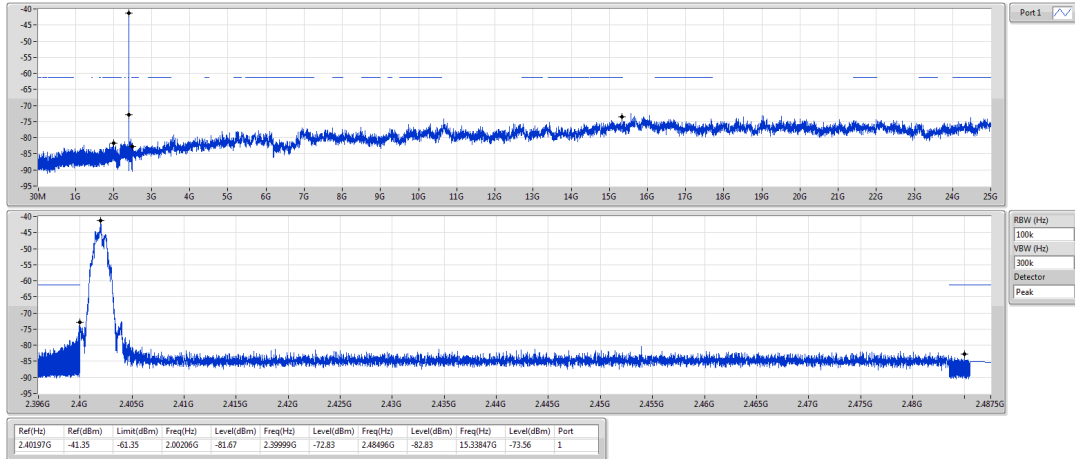
2480MHz



BT-LE(2Mbps)

CSE NdB

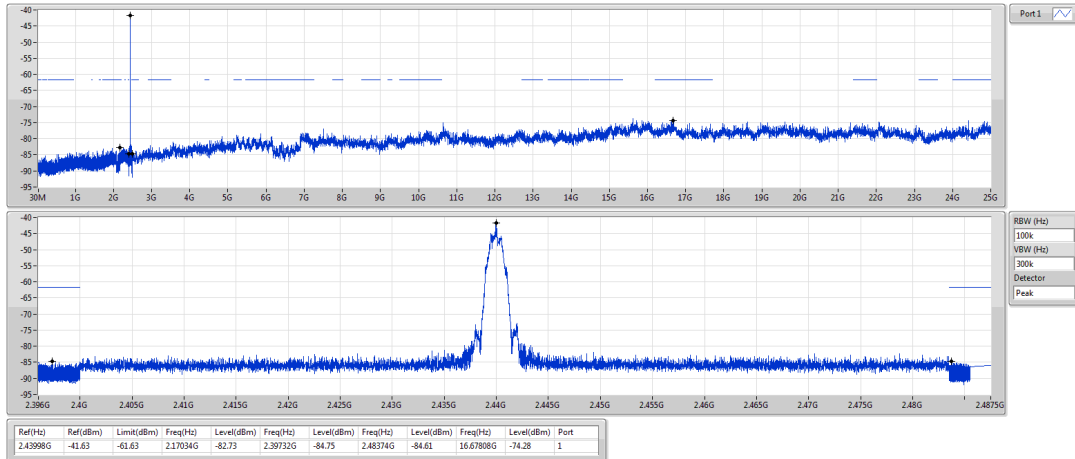
2402MHz



BT-LE(2Mbps)

CSE NdB

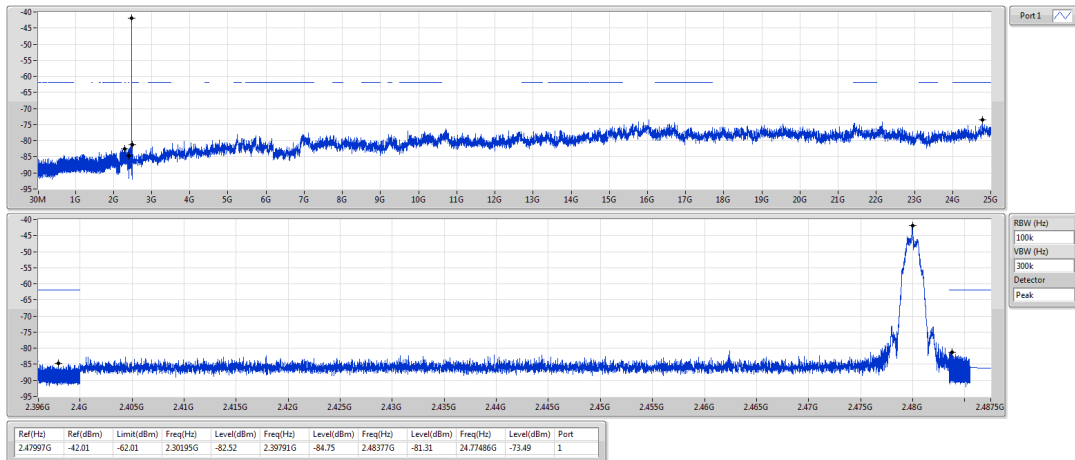
2440MHz



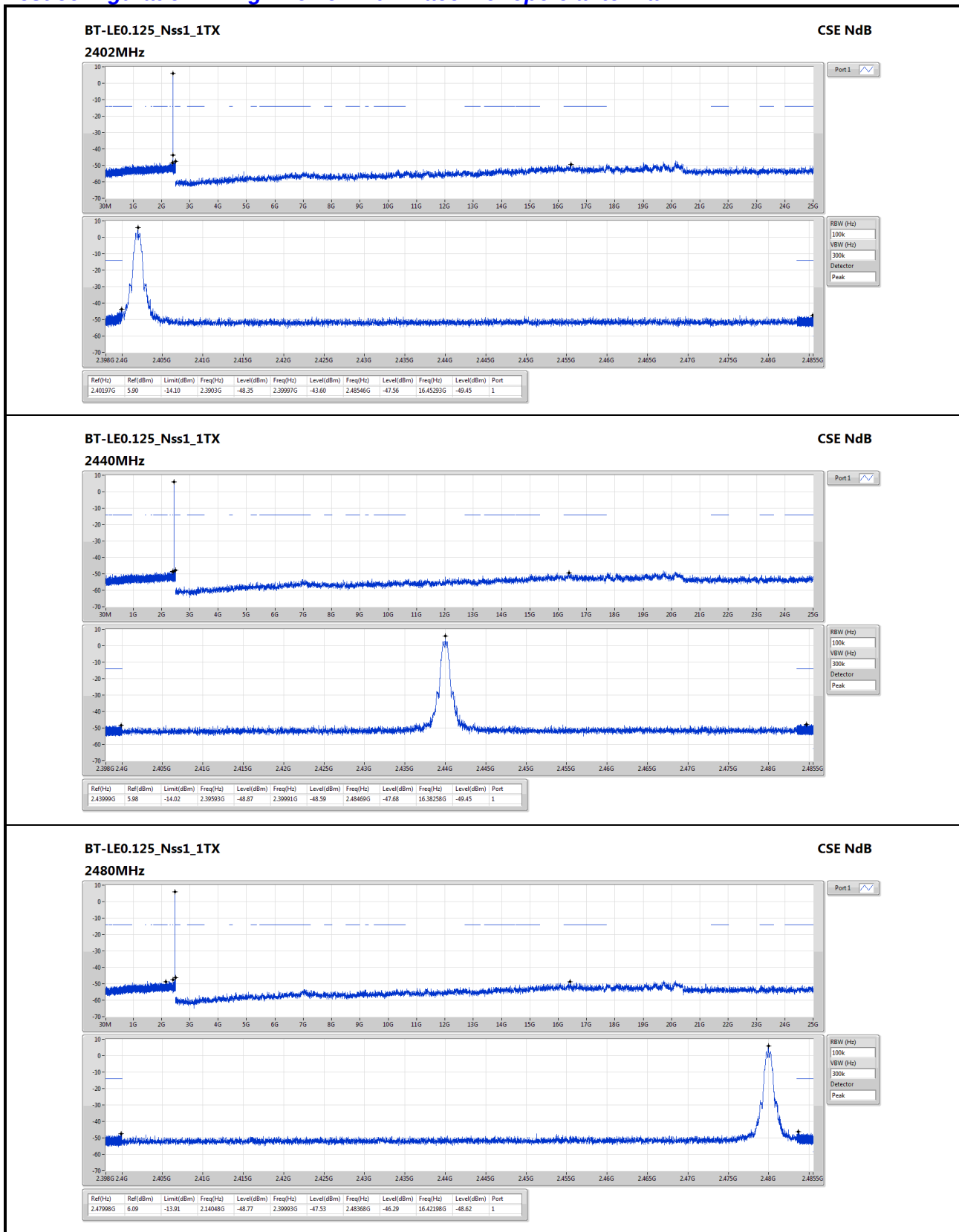
BT-LE(2Mbps)

CSE NdB

2480MHz



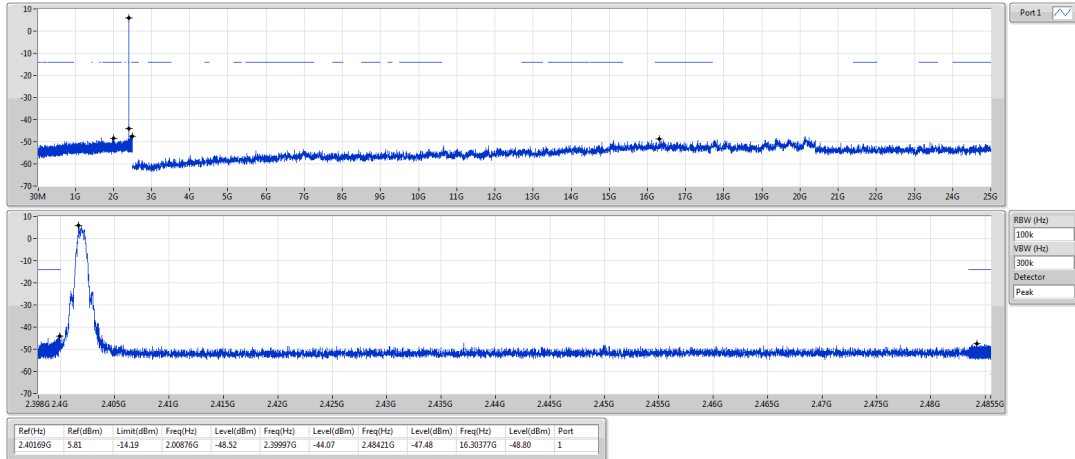
Test configuration 2: High Power with Trace Monopole antenna



BT-LE0.5_Nss1_1TX

CSE NdB

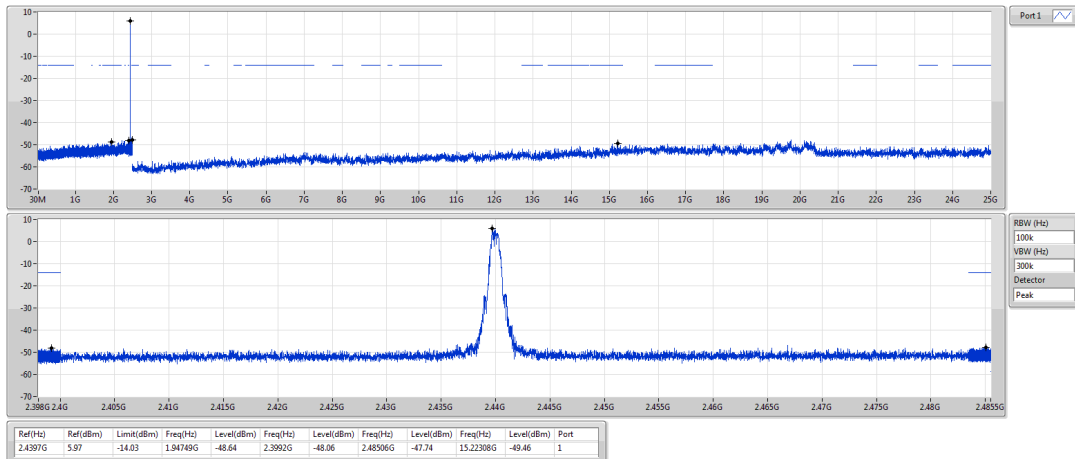
2402MHz



BT-LE0.5_Nss1_1TX

CSE NdB

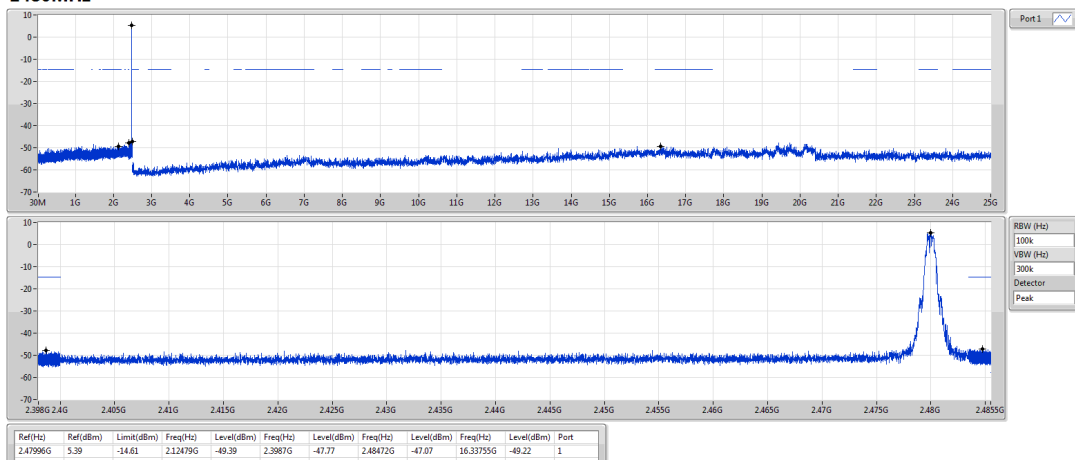
2440MHz



BT-LE0.5_Nss1_1TX

CSE NdB

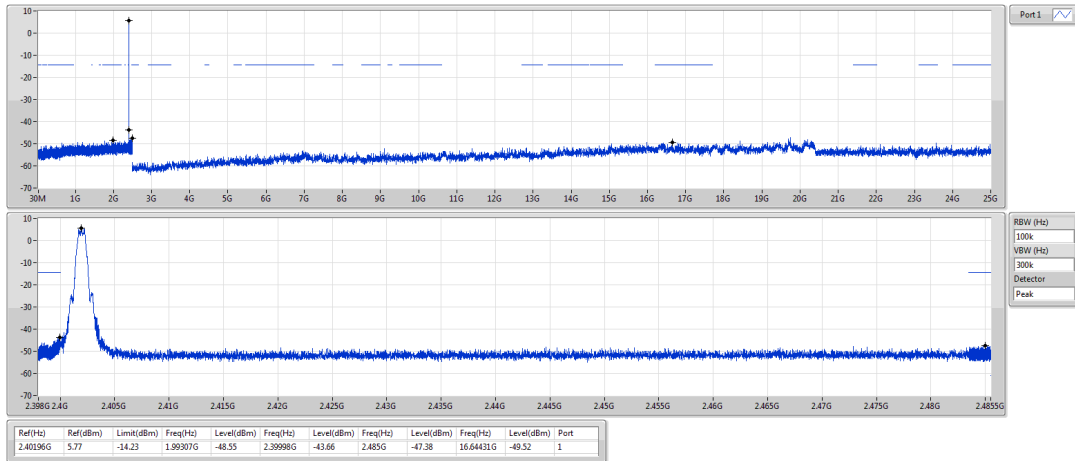
2480MHz



BT-LE(1Mbps)

2402MHz

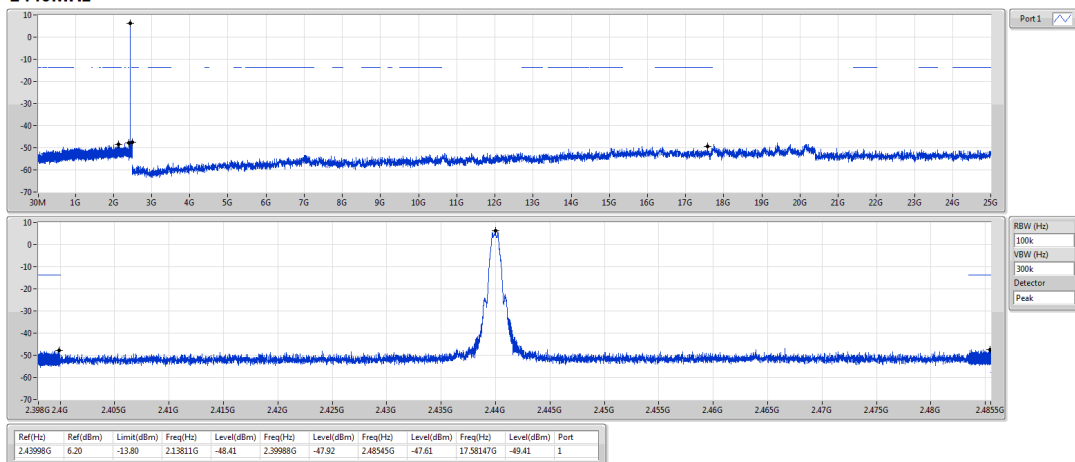
CSE NdB



BT-LE(1Mbps)

2440MHz

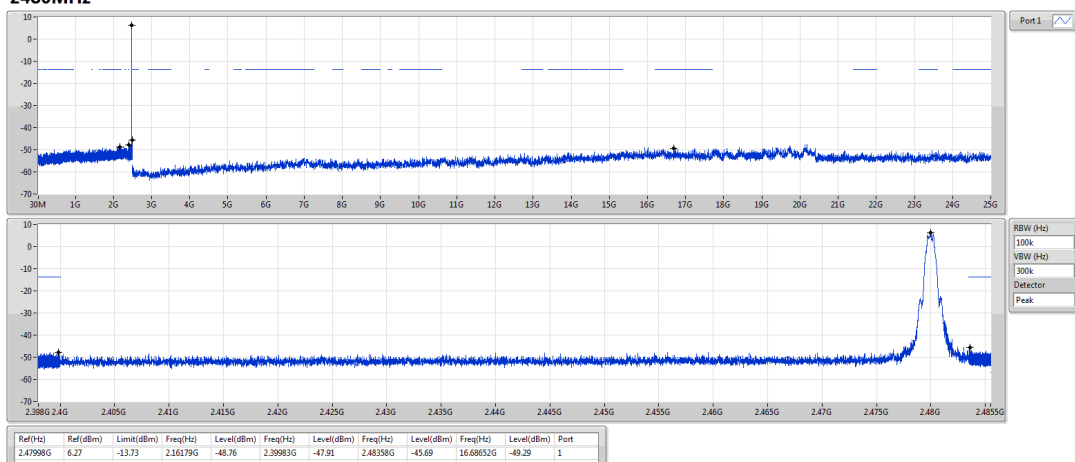
CSE NdB



BT-LE(1Mbps)

2480MHz

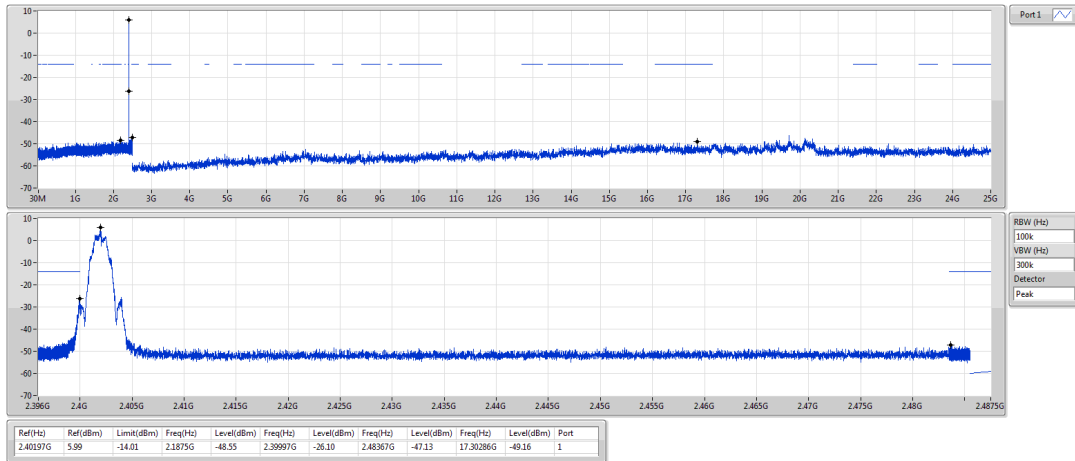
CSE NdB



BT-LE(2Mbps)

2402MHz

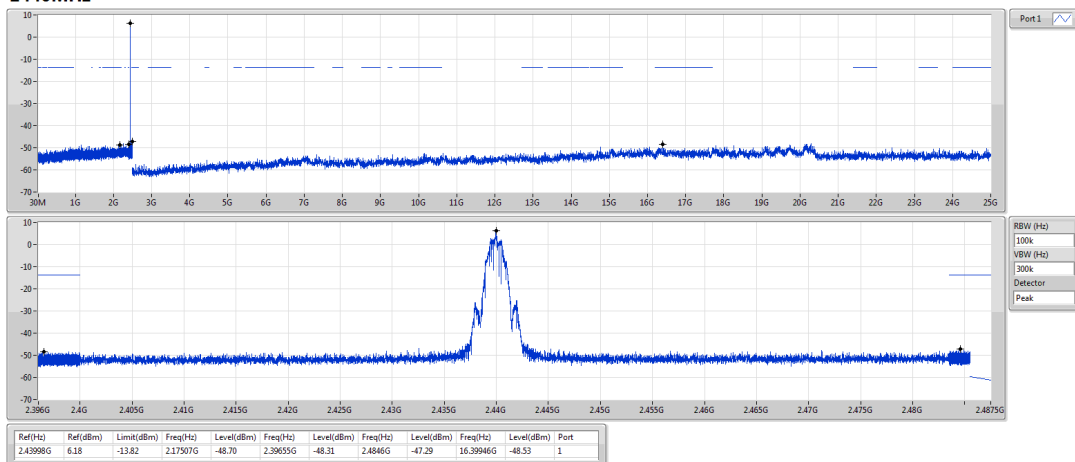
CSE NdB



BT-LE(2Mbps)

2440MHz

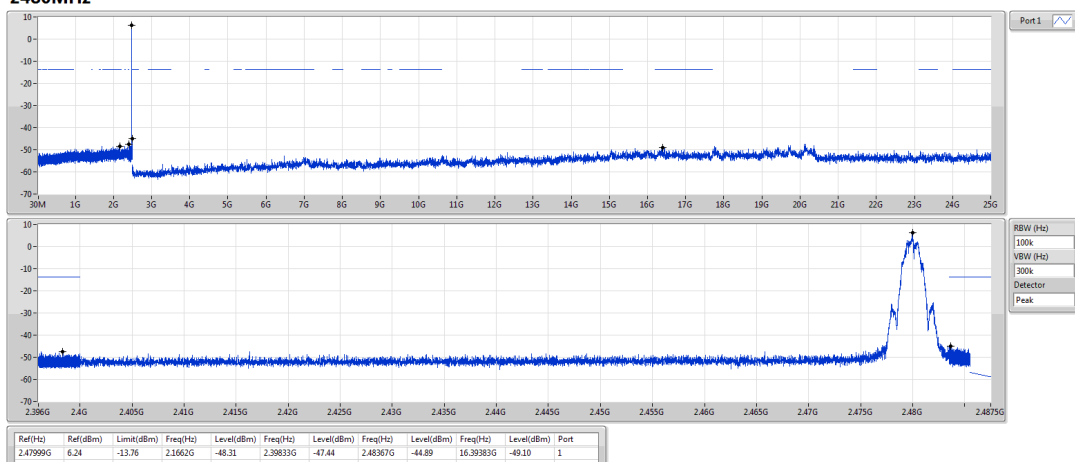
CSE NdB



BT-LE(2Mbps)

2480MHz

CSE NdB



4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

Linkou

Tel: 886-2-2601-1640

No. 30-2, Ding Fwu Tsuen, Lin
Kou District, New Taipei City,
Taiwan, R.O.C.

Kwei Shan

Tel: 886-3-271-8666

No. 3-1, Lane 6, Wen San 3rd St.,
Kwei Shan District, Tao Yuan City
333, Taiwan, R.O.C.

Kwei Shan Site II

Tel: 886-3-271-8640

No. 14-1, Lane 19, Wen San 3rd
St., Kwei Shan District, Tao Yuan
City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666

Fax: 886-3-318-0155

Email: ICC_Service@icertifi.com.tw

==END==