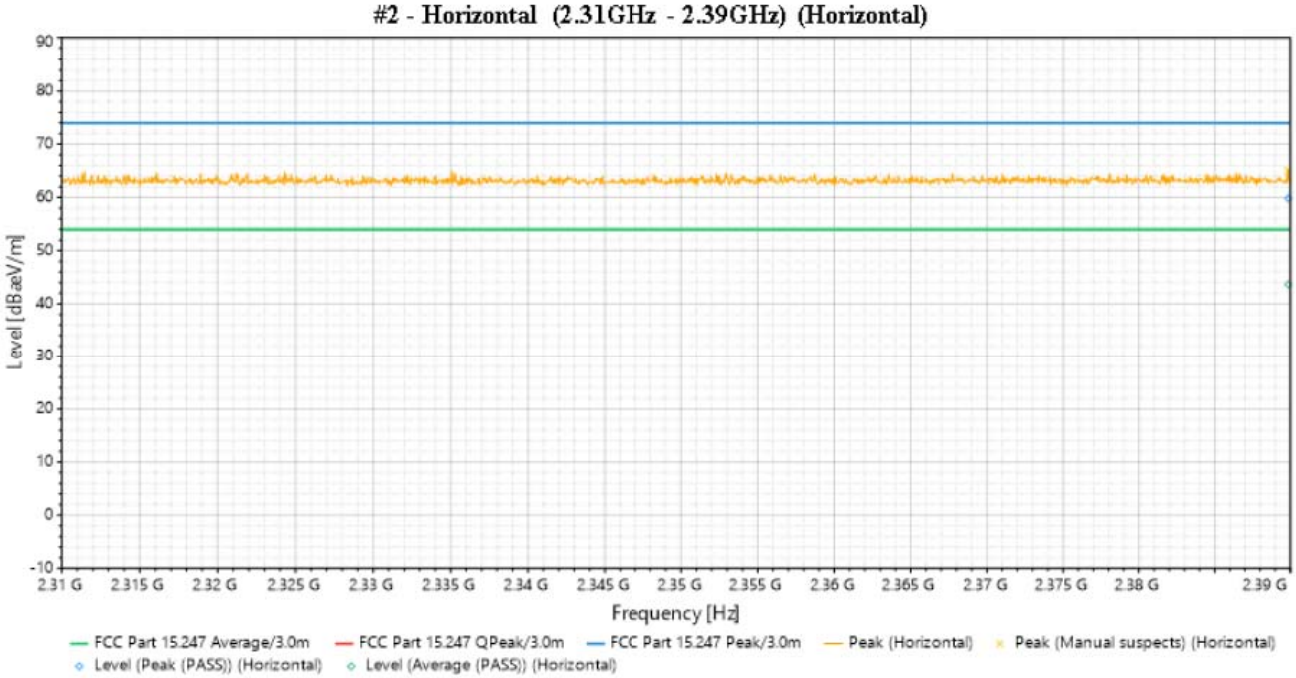
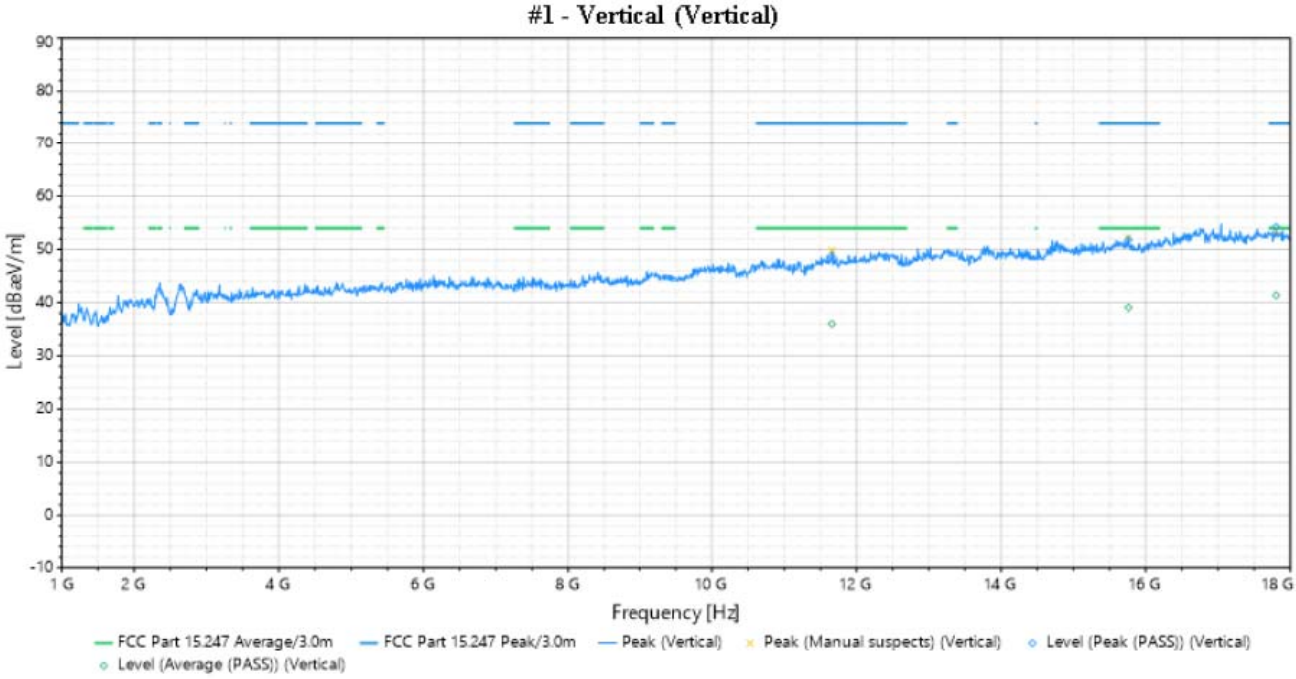


Antenna Polarity & Test Distance: Horizontal at 3m									
No.	Frequency (MHz)	Polarization	Level Peak[dB(uV/m)]	Limit Peak dB(uV/m)	Margin Peak [dB]	Height (m)	Angle (Deg)	Factor [dB(1/m)]	Measure Type/ Result
1	11779.7	Horizontal	48.746	74	-25.254	3.5	294	8.566	Peak (PASS)
2	11779.7	Horizontal	36.329	54	-17.671	3.5	294	8.566	Average (PASS)
3	15441.4	Horizontal	52.669	74	-21.331	3.5	188	9.561	Peak (PASS)
4	15441.4	Horizontal	39.597	54	-14.403	3.5	188	9.561	Average (PASS)
5	17723	Horizontal	54.828	74	-19.172	3.5	105	8.753	Peak (PASS)
6	17723	Horizontal	42.025	54	-11.975	3.5	105	8.753	Average (PASS)
7	2389.879	Horizontal	59.846	74	-14.154	3.454	254	38.314	Peak (PASS)
8	2389.879	Horizontal	43.659	54	-10.341	3.454	254	38.314	Average (PASS)

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) +Preamplifier
3. Margin value = Emission level – Limit value.
4. The emission levels of other frequencies were less than 20dB margin against the limit.

EUT Test Condition		Measurement Detail	
Input Power	3Vdcdc	Frequency Range	1GHz-26GHz
Environmental Conditions	25 deg. C, 70% RH	Tested By	Richard Dollente
Test Mode	TX MODE BLE 2440 MHz, 2Mbps Data Rate		

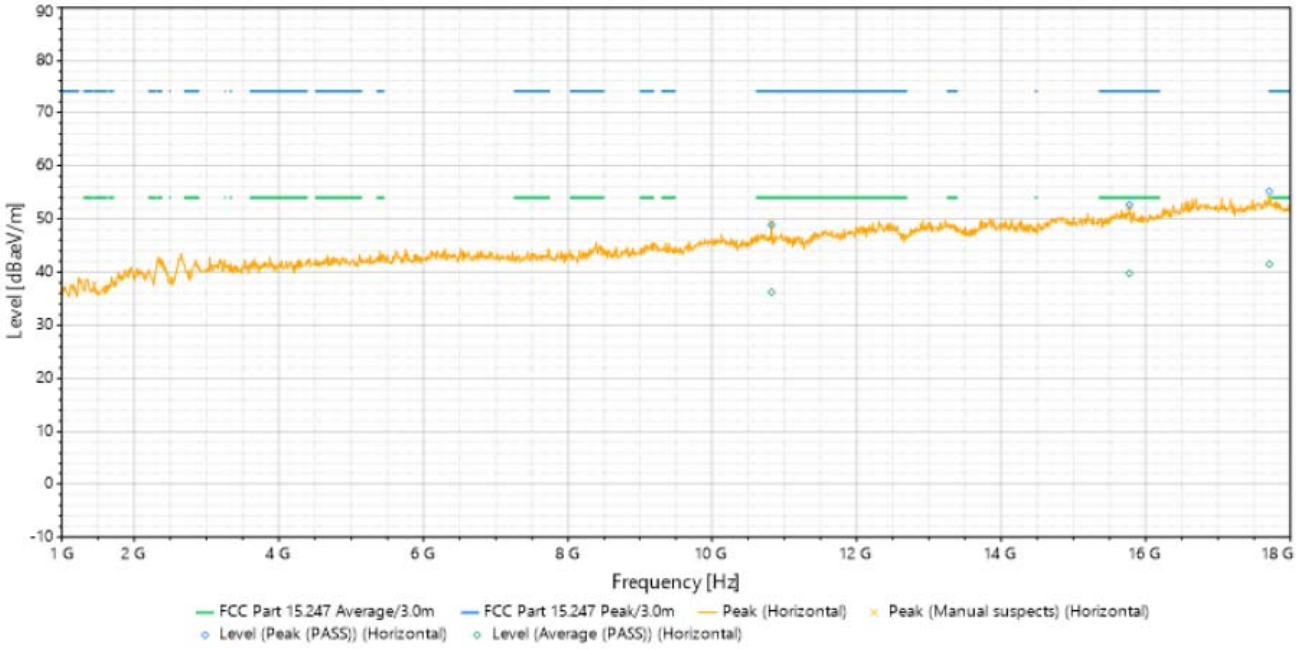


Antenna Polarity & Test Distance: Vertical at 3m									
No.	Frequency (MHz)	Polarization	Level Peak[dB(uV/m)]	Limit Peak dB(uV/m)	Margin Peak [dB]	Height (m)	Angle (Deg)	Factor [dB(1/m)]	Measure Type/ Result
1	11658.2	Vertical	48.696	74	-25.304	3.1	365	8.37	Peak (PASS)
2	11658.2	Vertical	36.001	54	-17.999	3.1	365	8.37	Average (PASS)
3	15763.2	Vertical	51.823	74	-22.177	3.1	341	10.036	Peak (PASS)
4	15763.2	Vertical	39.083	54	-14.917	3.1	341	10.036	Average (PASS)
5	17804.5	Vertical	54.234	74	-19.766	3.1	68	8.851	Peak (PASS)
6	17804.5	Vertical	41.358	54	-12.642	3.1	68	8.851	Average (PASS)

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) +Preamplifier
3. Margin value = Emission level – Limit value.
4. The emission levels of other frequencies were less than 20dB margin against the limit.

EUT Test Condition		Measurement Detail	
Input Power	3Vdcdc	Frequency Range	1GHz-26GHz
Environmental Conditions	25 deg. C, 70% RH	Tested By	Richard Dollente
Test Mode	TX MODE BLE 2440 MHz, 2Mbps Data Rate		

#2 - Horizontal (Horizontal)

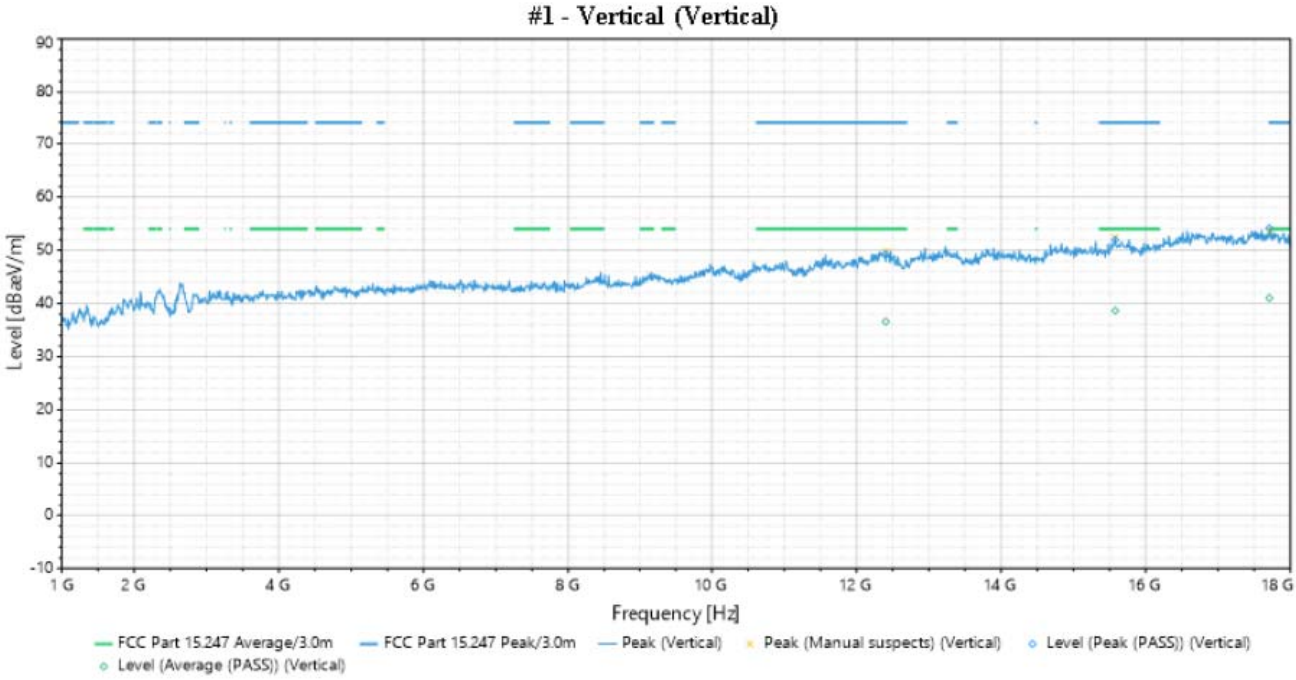


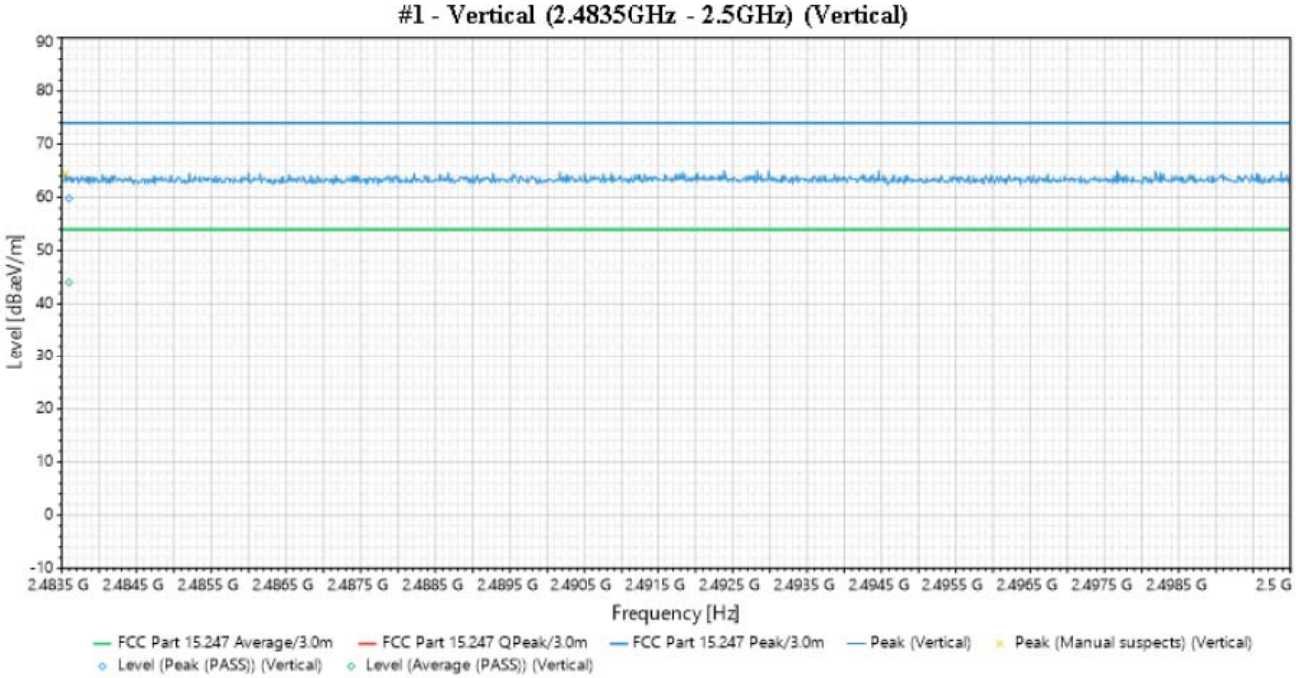
Antenna Polarity & Test Distance: Horizontal at 3m									
No.	Frequency (MHz)	Polarization	Level Peak[dB(uV/m)]	Limit Peak dB(uV/m)	Margin Peak [dB]	Height (cm)	Angle (Deg)	Factor [dB(1/m)]	Measure Type/ Result
1	10824.3	Horizontal	48.884	74	-25.116	3.5	114	7.816	Peak (PASS)
2	10824.3	Horizontal	36.236	54	-17.764	3.5	114	7.816	Average (PASS)
3	15773.7	Horizontal	52.633	74	-21.367	3.5	298	10.004	Peak (PASS)
4	15773.7	Horizontal	39.754	54	-14.246	3.5	298	10.004	Average (PASS)
5	17710.1	Horizontal	55.213	74	-18.787	3.5	202	8.777	Peak (PASS)
6	17710.1	Horizontal	41.5	54	-12.5	3.5	202	8.777	Average (PASS)

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) +Preamplifier
3. Margin value = Emission level – Limit value.
4. The emission levels of other frequencies were less than 20dB margin against the limit.

EUT Test Condition		Measurement Detail	
Input Power	3Vdcdc	Frequency Range	1GHz-26GHz
Environmental Conditions	25 deg. C, 70% RH	Tested By	Richard Dollente
Test Mode	TX MODE BLE 2480 MHz, 2Mbps Data Rate		



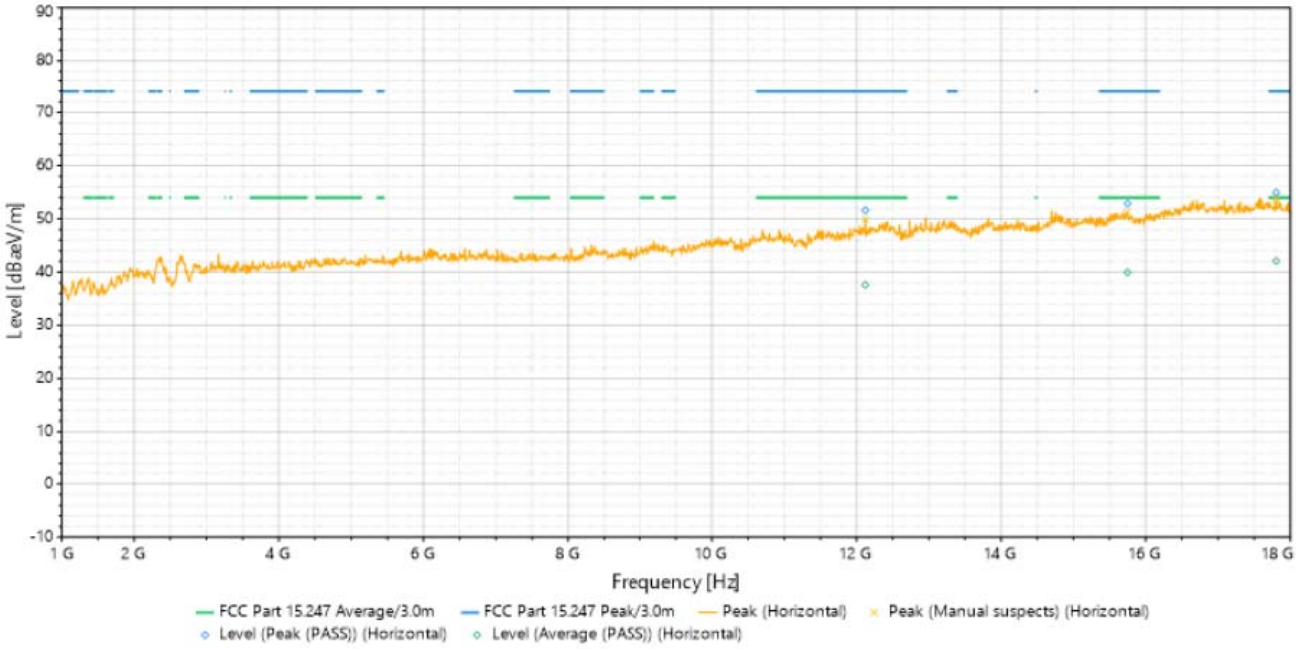


Antenna Polarity & Test Distance: Vertical at 3m									
No.	Frequency (MHz)	Polarization	Level Peak[dB(uV/m)]	Limit Peak dB(uV/m)	Margin Peak [dB]	Height (m)	Angle (Deg)	Factor [dB(1/m)]	Measure Type/ Result
1	12404.7	Vertical	49.272	74	-24.728	3.1	329	8.843	Peak (PASS)
2	12404.7	Vertical	36.588	54	-17.412	3.1	329	8.843	Average (PASS)
3	15579.5	Vertical	51.92	74	-22.08	3.1	321	9.904	Peak (PASS)
4	15579.5	Vertical	38.646	54	-15.354	3.1	321	9.904	Average (PASS)
5	17709.8	Vertical	54.129	74	-19.871	3.1	374	8.878	Peak (PASS)
6	17709.8	Vertical	41.026	54	-12.974	3.1	374	8.878	Average (PASS)
7	2483.597	Vertical	59.823	74	-14.177	2.653	67	38.629	Peak (PASS)
8	2483.597	Vertical	44.062	54	-9.938	2.653	67	38.629	Average (PASS)

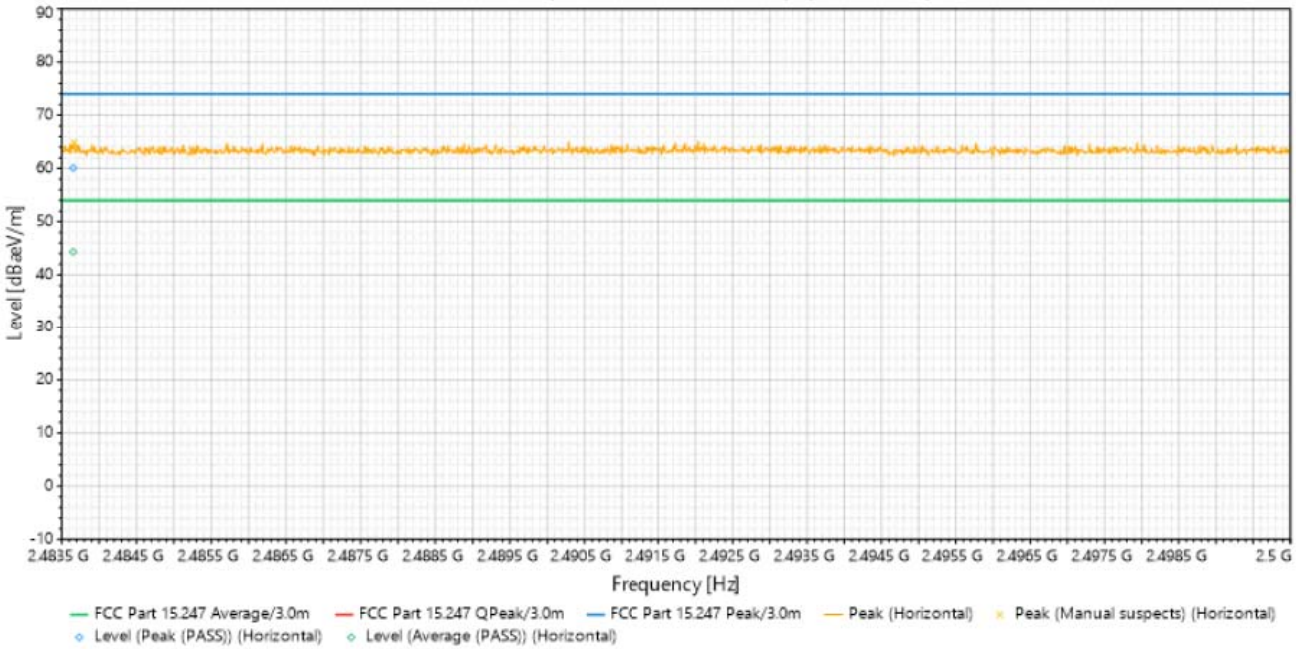
1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) +Preamplifier
3. Margin value = Emission level – Limit value.
4. The emission levels of other frequencies were less than 20dB margin against the limit.

EUT Test Condition		Measurement Detail	
Input Power	3Vdcdc	Frequency Range	1GHz-26GHz
Environmental Conditions	25 deg. C, 70% RH	Tested By	Richard Dollente
Test Mode	TX MODE BLE 2480 MHz, 2Mbps Data Rate		

#2 - Horizontal (Horizontal)



#2 - Horizontal (2.4835GHz - 2.5GHz) (Horizontal)



Antenna Polarity & Test Distance: Horizontal at 3m									
No.	Frequency (MHz)	Polarization	Level [dB(uV/m)]	Limit Peak dB(uV/m)	Margin Peak [dB]	Height (cm)	Angle (Deg)	Factor [dB(1/m)]	Measure Type/ Result
1	12123	Horizontal	51.605	74	-22.395	3.5	293	8.945	Peak (PASS)
2	12123	Horizontal	37.613	54	-16.387	3.5	293	8.945	Average (PASS)
3	15749	Horizontal	52.868	74	-21.132	3.5	363	9.973	Peak (PASS)
4	15749	Horizontal	39.944	54	-14.056	3.5	363	9.973	Average (PASS)
5	17806	Horizontal	54.962	74	-19.038	3.5	236	8.689	Peak (PASS)
6	17806	Horizontal	42.087	54	-11.913	3.5	236	8.689	Average (PASS)
7	2483.653	Horizontal	60.086	74	-13.914	1.115	355	38.633	Peak (PASS)
8	2483.653	Horizontal	44.344	54	-9.656	1.115	355	38.633	Average (PASS)

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) +Preamplifier
3. Margin value = Emission level – Limit value.
4. The emission levels of other frequencies were less than 20dB margin against the limit.

Conducted Emission Measurement

Limits of Conducted Emission Measurement :

The following standards specified below are covered in the scope of this section of the test report:

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

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

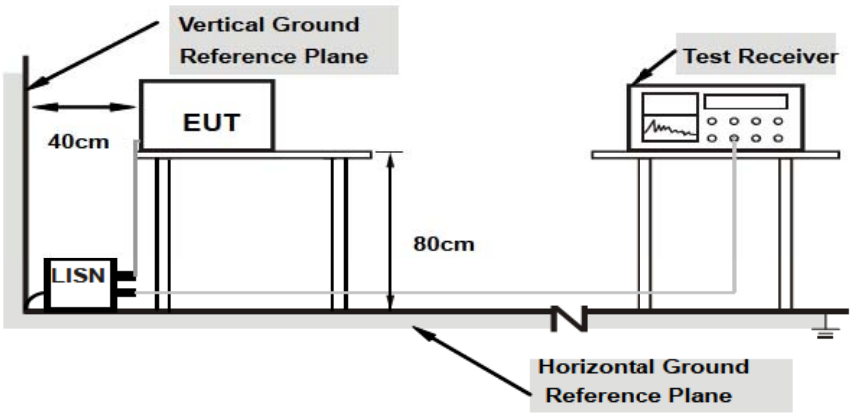
Conducted Emissions - Test Procedure

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

c. The frequency ranges from 150 kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

Conducted Emissions - Test Setup



Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo)

Test Results:

N/A

6dB Bandwidth Measurement & 99% Bandwidth Measurement

Limits of Conducted Emission Measurement :

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

Test Procedure

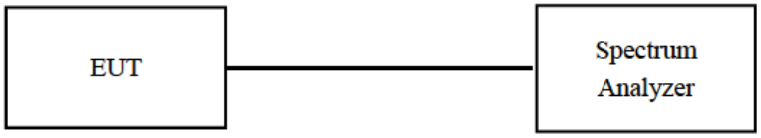
99% Bandwidth Measurement

Refer to ANSI C63.10 section 6.9.3

-6dB Bandwidth Measurement

a. Set resolution bandwidth (RBW) = 100kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

Conducted Emissions - Test Setup



Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

Test Name: 6dB Bandwidth Measurement & 99% Bandwidth Measurement			**Test Date(s):** 04/30/2024		
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2003	EMI Test Receiver	Keysight	N9030B	11/06/2023	11/06/2024
Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.					

Test Result:

DATA RATE:

1 MHz

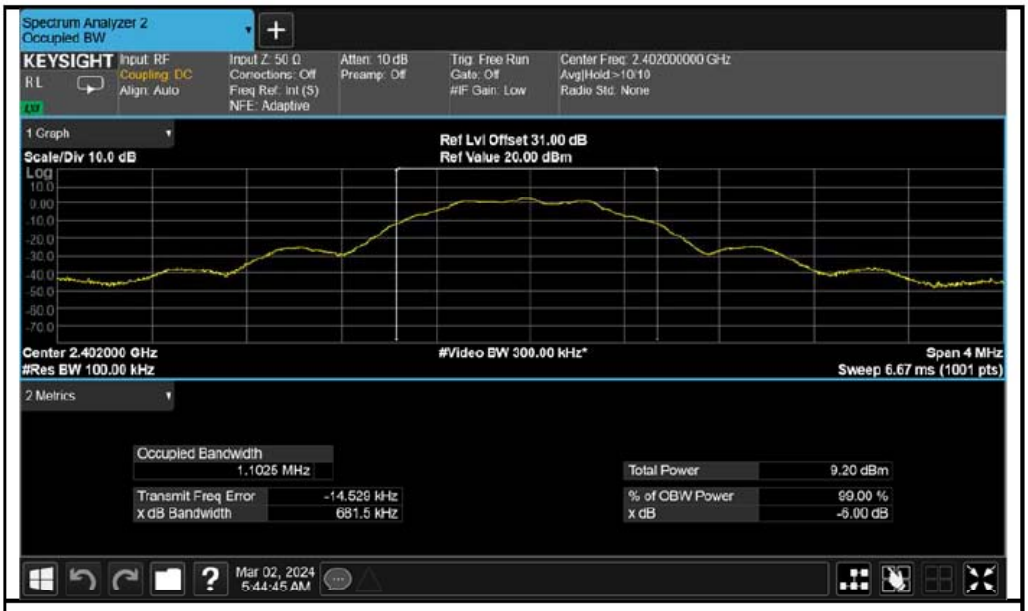
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.6815	1.0968	0.5	PASS
19	2440	0.6710	1.0963	0.5	PASS
139	2480	0.6599	1.0895	0.5	PASS

2 MHz

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	1.287	2.0720	0.5	PASS
19	2440	1.286	2.0796	0.5	PASS
139	2480	1.287	2.0800	0.5	PASS

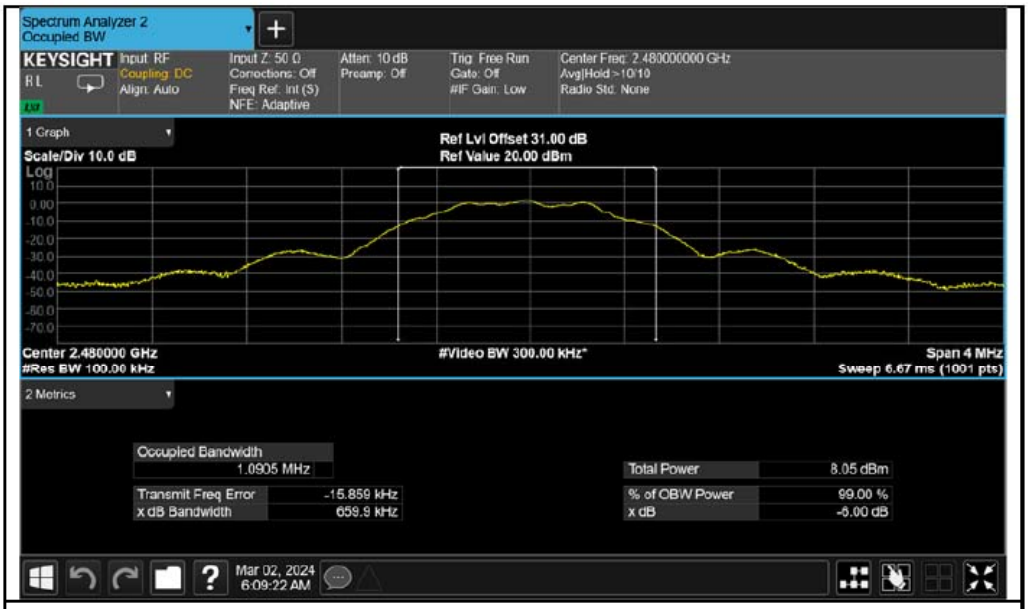
Test Plots:

-6dB Bandwidth:

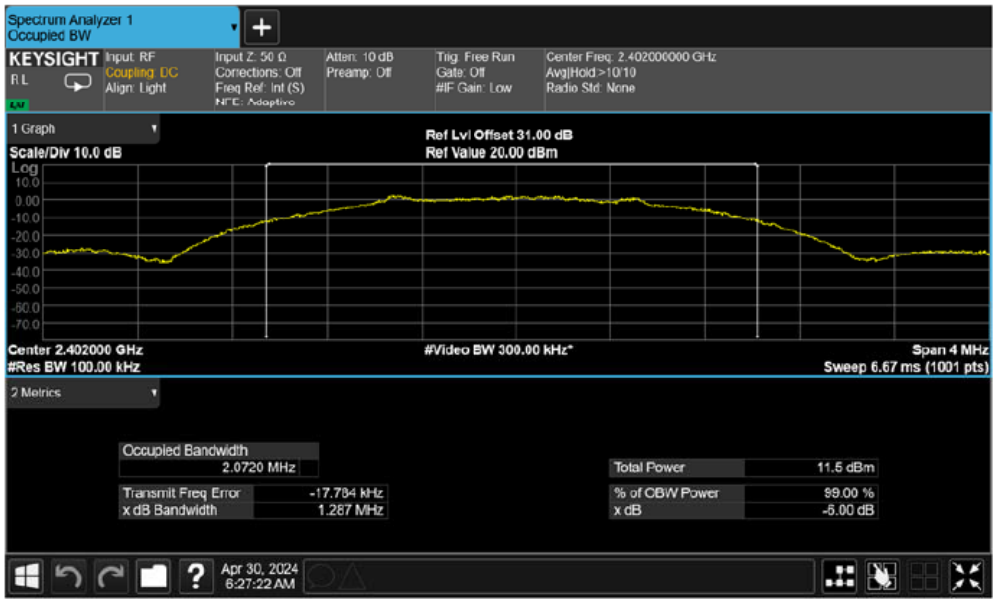


BLE-2402MHz -Data Rate- 1Mbps

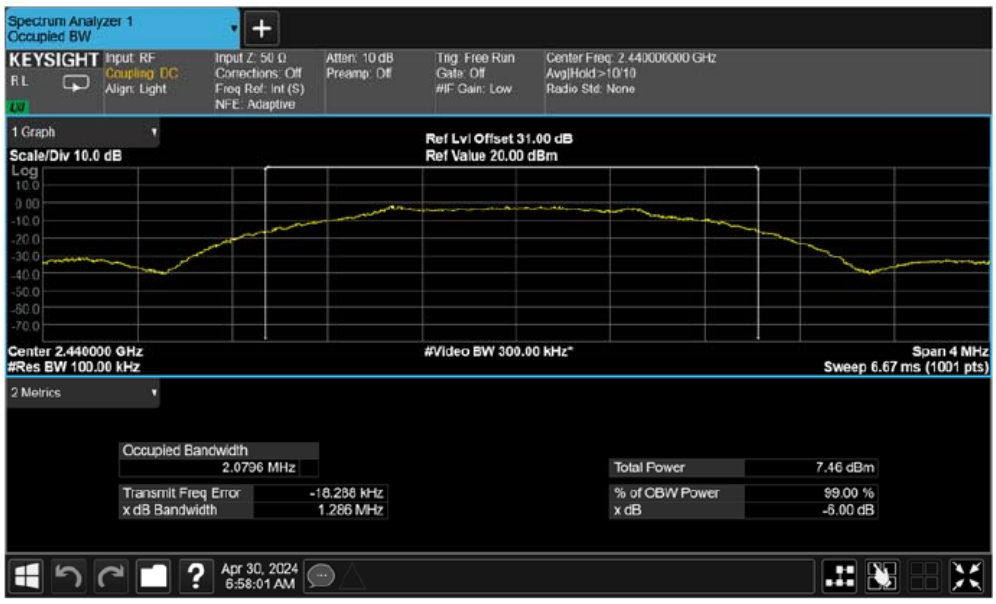
BLE-2440MHz-Data Rate- 1Mbps



BLE-2480MHz -Data Rate- 1Mbps



BLE-2402MHz -Data Rate- 2Mbps

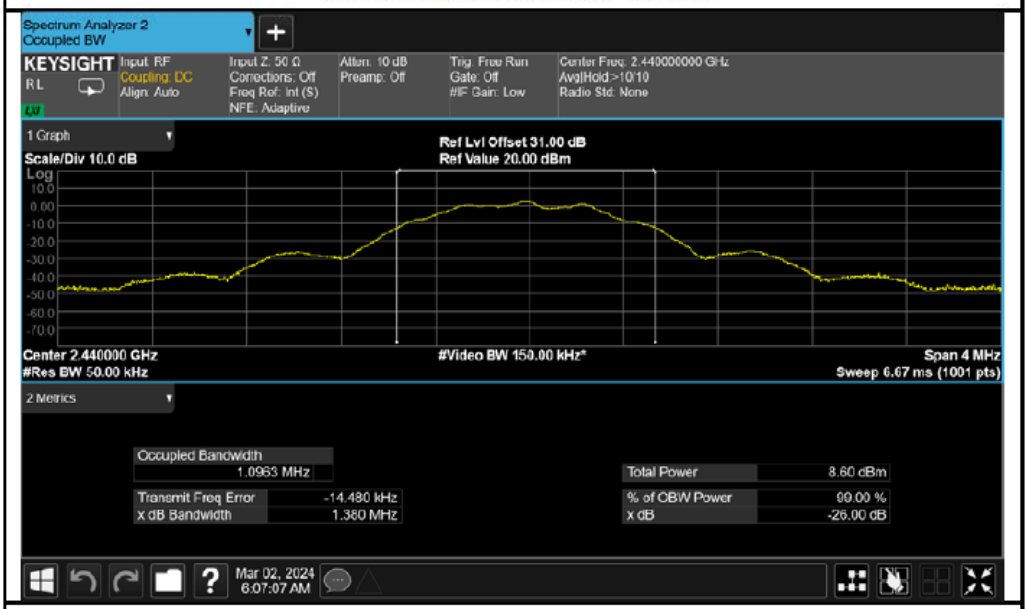


BLE-2440MHz-Data Rate- 2Mbps

BLE-2480MHz -Data Rate- 2Mbps

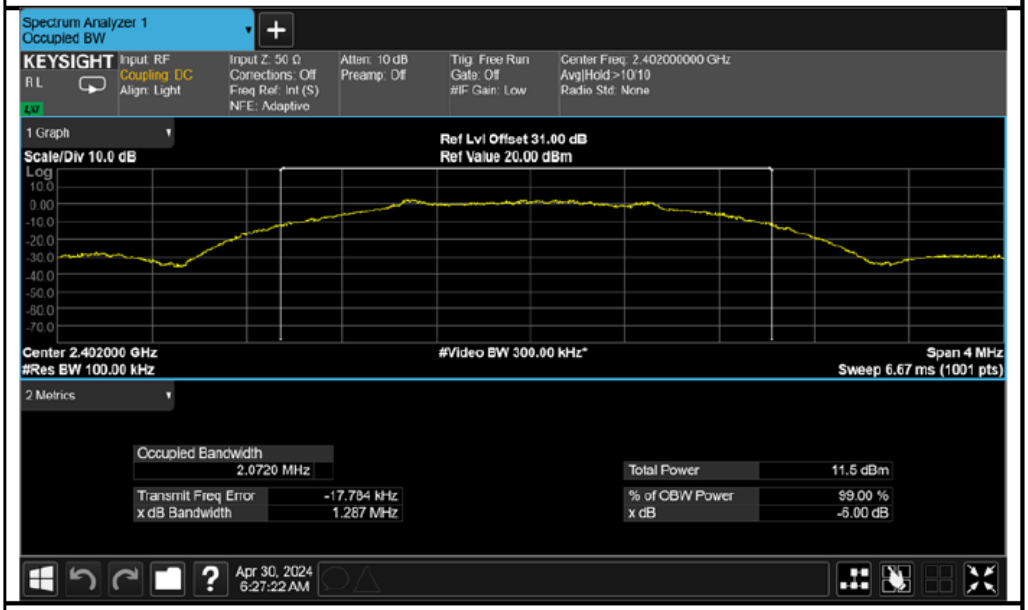
99% Occupied Bandwidth:

BLE-2402MHz -Data Rate- 1Mbps

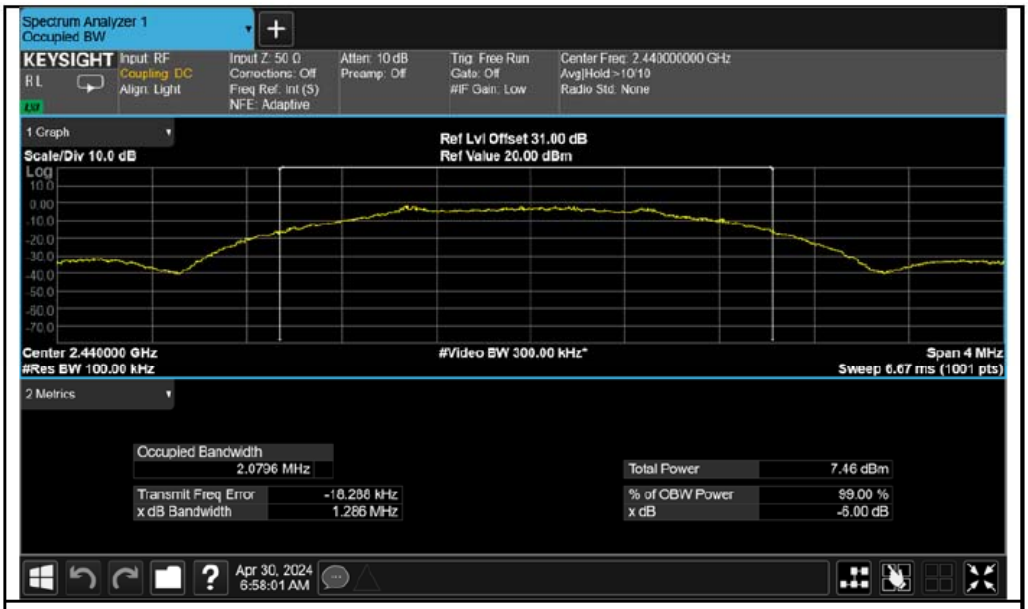


BLE-2440MHz-Data Rate- 1Mbps

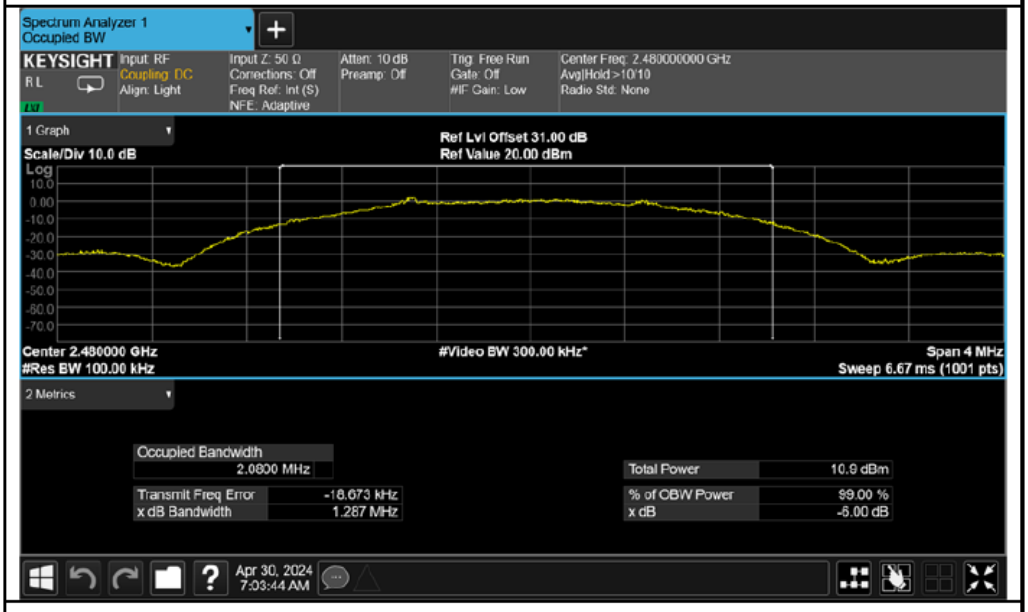
BLE-2480MHz -Data Rate- 1Mbps



BLE-2402MHz -Data Rate- 2Mbps



BLE-2440MHz-Data Rate- 2Mbps



BLE-2480MHz -Data Rate- 2Mbps

Conducted Output Power Measurement

Limits of Output Power Measurement :

FCC 15.247

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

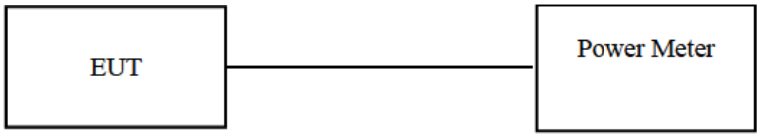
RSS 247

E.I.R.P for systems using digital modulation in the 2400–2483.5 MHz bands: 4 Watt (36.02dBm)

Test Procedure

Reference C63.10 12.3.3.2 Method PM-G
A power meter sensor was used on the output port of the EUT. A power meter was used to read the response of the power sensor. Record the power level.

Test Setup



Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

Test Name: Conducted Output Power Measurement			**Test Date(s):** 04/30/2024		
Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S4776	Power Meter	ROHDE & SCHWARZ	NRQ6	09/19/2023	09/19/2024

Test Result:

FCC

Data Rate: 1Mbps (Time-Average Power)

Channel	Frequency (MHz)	Conducted Power (dBm)
0	2402	4.68
19	2440	4.10
39	2480	4.28

Data Rate: 2Mbps (Time-Average Power)

Channel	Frequency (MHz)	Conducted Power (dBm)
0	2402	3.89
19	2440	3.50
39	2480	4.15

ISED:

Data Rate: 1Mbps (Time-Average Power)

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	EIRP (dBm)	Limit (dBm)	Pass/Fail
0	2402	4.68	30	6.68	36.02	Pass
19	2440	4.10	30	6.10	36.02	Pass
39	2480	4.28	30	6.28	36.02	Pass

Data Rate: 2Mbps (Time-Average Power)

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	EIRP (dBm)	Limit (dBm)	Pass/Fail
0	2402	3.89	30	5.89	36.02	Pass
19	2440	3.50	30	5.50	36.02	Pass
39	2480	4.15	30	6.15	36.02	Pass

Power Spectral Density Measurement

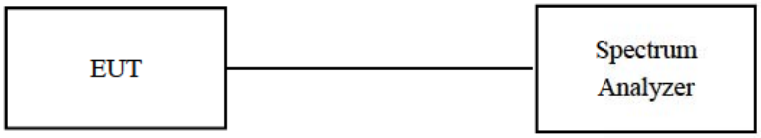
Limits of Power Spectral Measurement :

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

Test Procedure

A power meter sensor was used on the output port of the EUT. A power meter was used to read the response of the power sensor. Record the power level.

Test Setup



For the actual test configuration, please refer to the attached file (Test Setup Photo)

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

Test Name: Power Spectral Density Measurement			**Test Date(s):** 04/30/2024		
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2003	EMI Test Receiver	Keysight	N9030B	11/06/2023	11/06/2024
Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.					

Test Result:

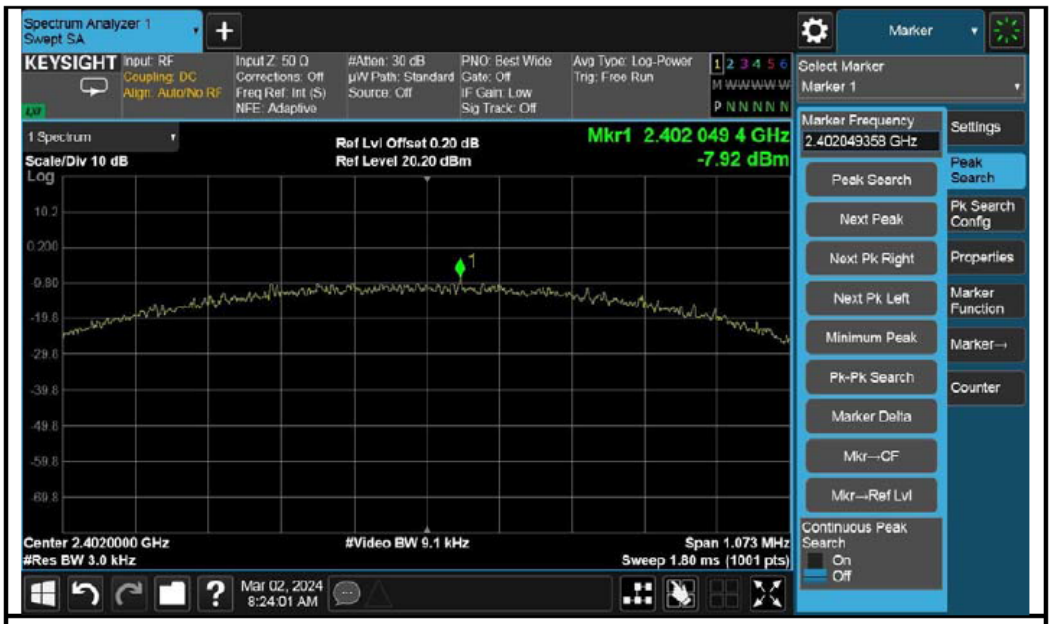
Data Rate: 1Mbps

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass/Fail
0	2402	-7.92	8	Pass
19	2440	-9.13	8	Pass
39	2480	-8.69	8	Pass

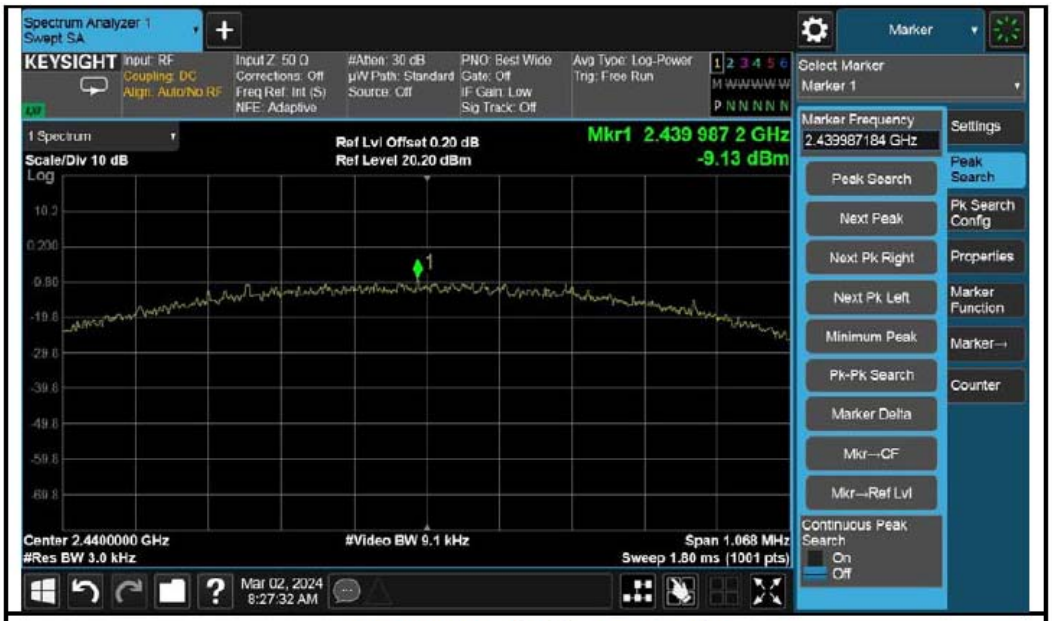
Data Rate: 2Mbps

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass/Fail
0	2402	-8.11	8	Pass
19	2440	-8.50	8	Pass
39	2480	-8.79	8	Pass

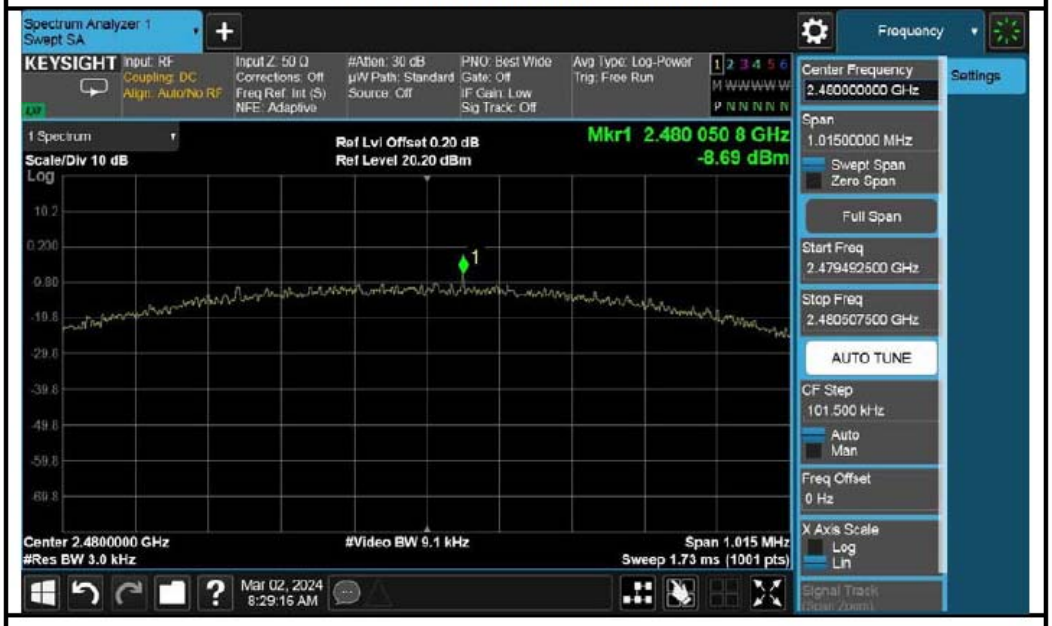
Test Plots:



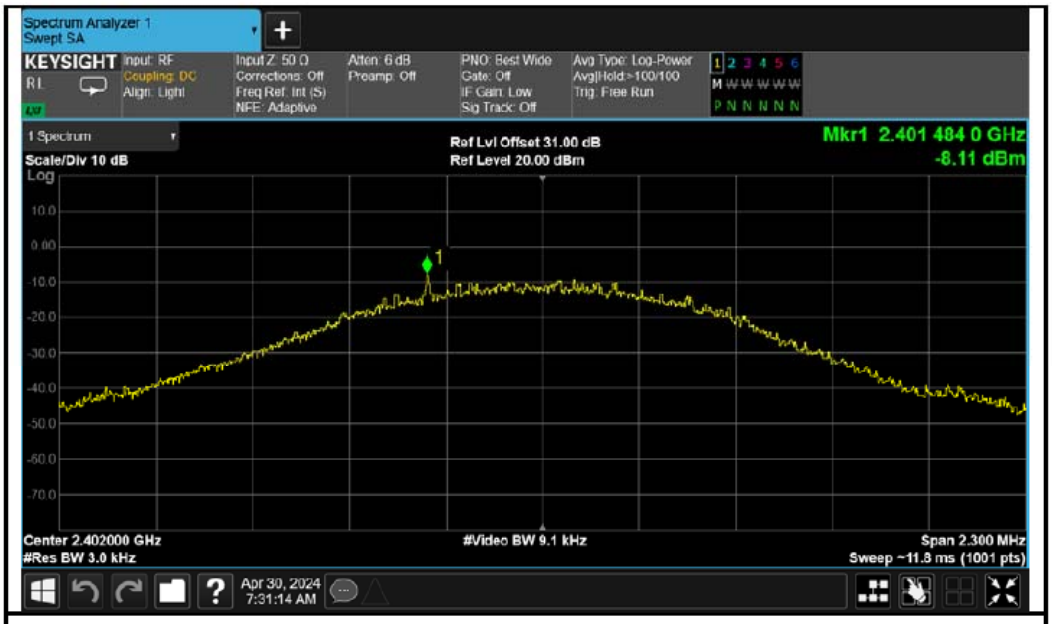
BLE-2402MHz (1Mbps Data Rate)



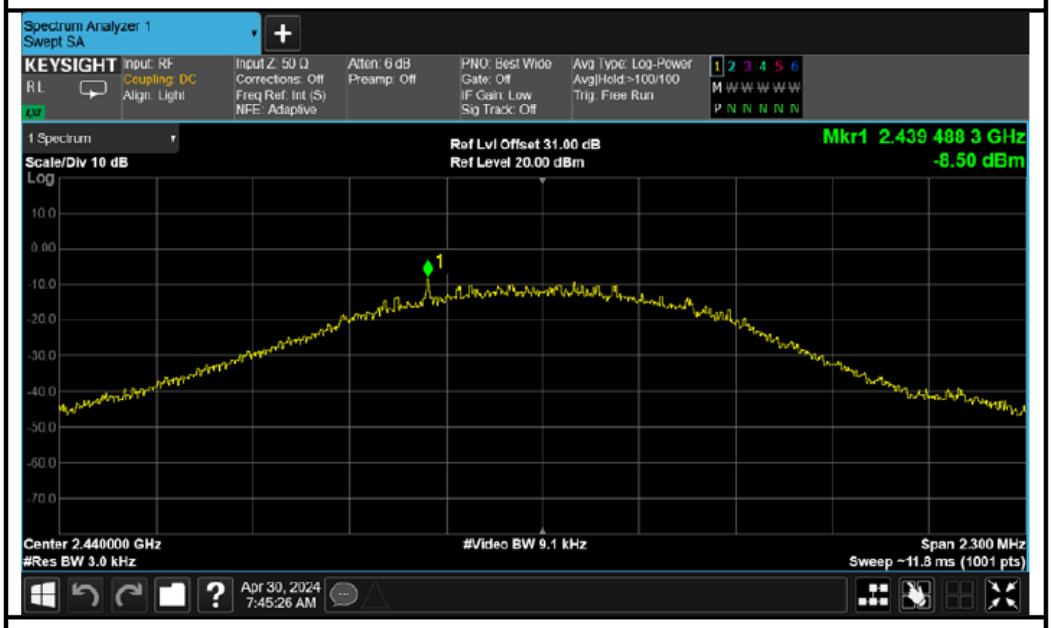
BLE-2440MHz (1Mbps Data Rate)



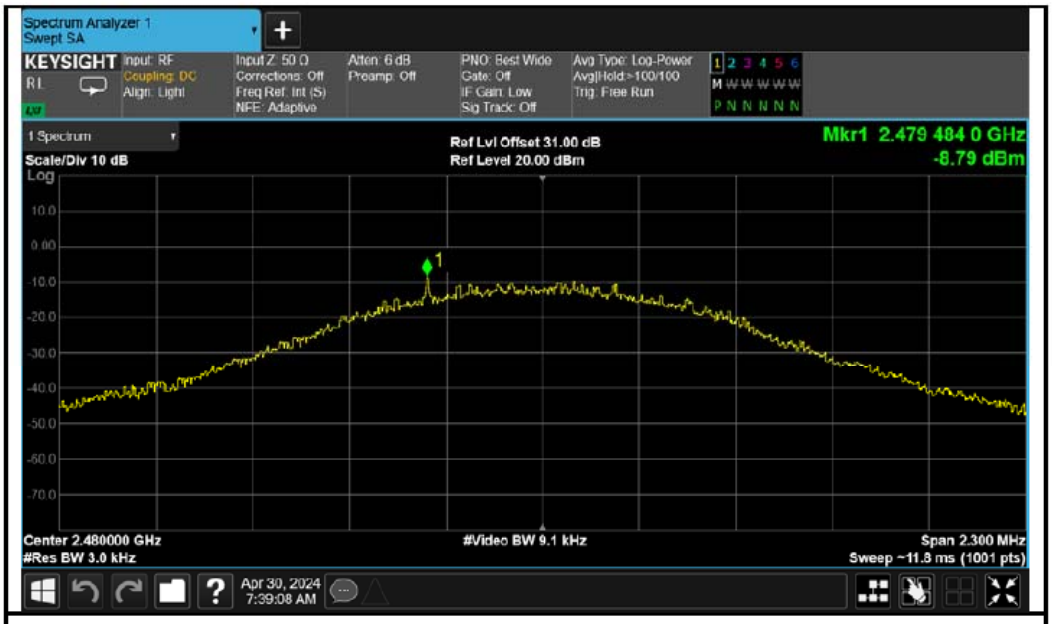
BLE-2480MHz (1Mbps Data Rate)



BLE-2402MHz (2Mbps Data Rate)



BLE-2440MHz (2Mbps Data Rate)



BLE-2480MHz (2Mbps Data Rate)

Conducted Out of Band Emission Measurement

Limits of Conducted Out of Band Emission Measurement:

Below 20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth)

Test Procedure

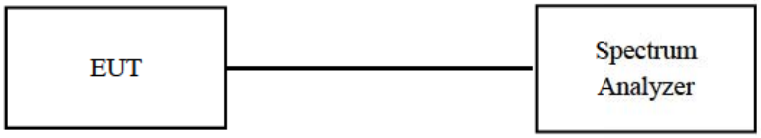
MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOBE

1. Set RBW = 100 kHz.
2. Set VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

Test Setup



For the actual test configuration, please refer to the attached file (Test Setup Photo)

Test Equipment

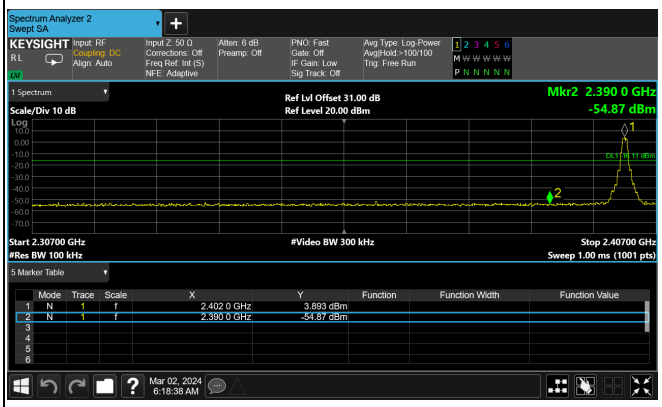
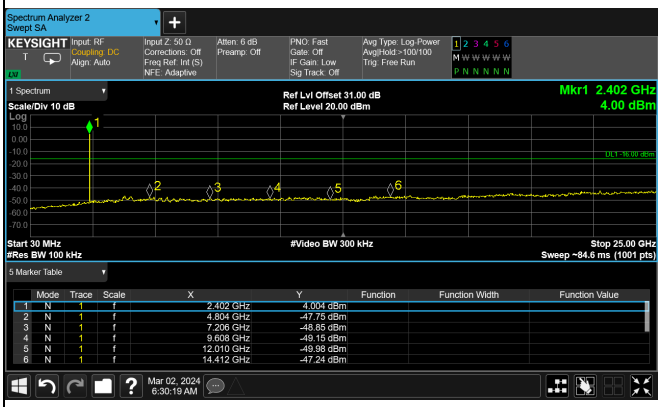
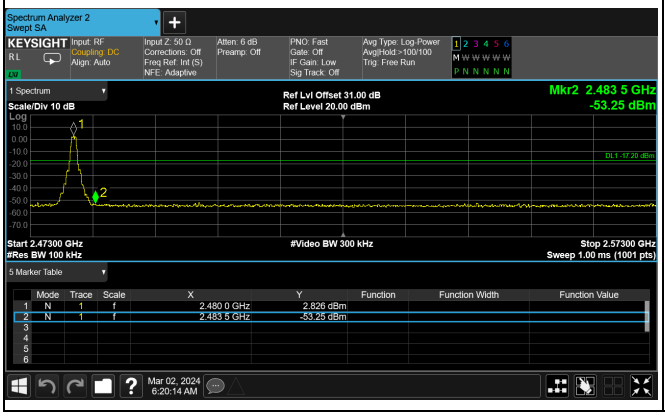
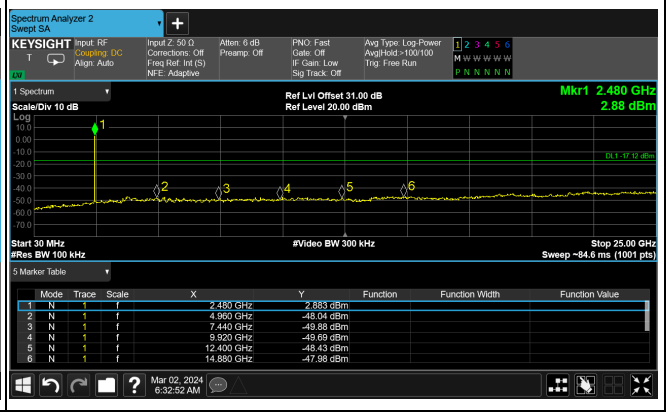
Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

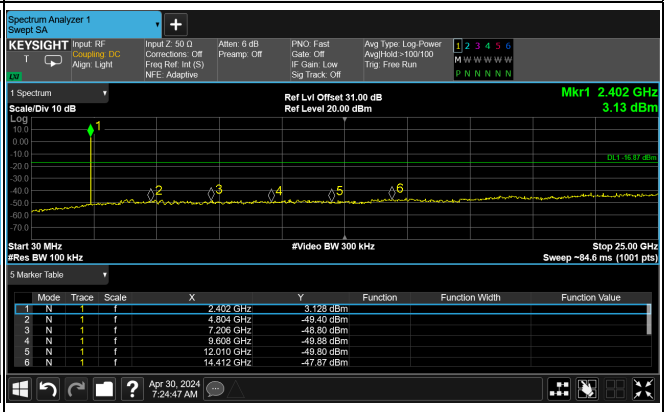
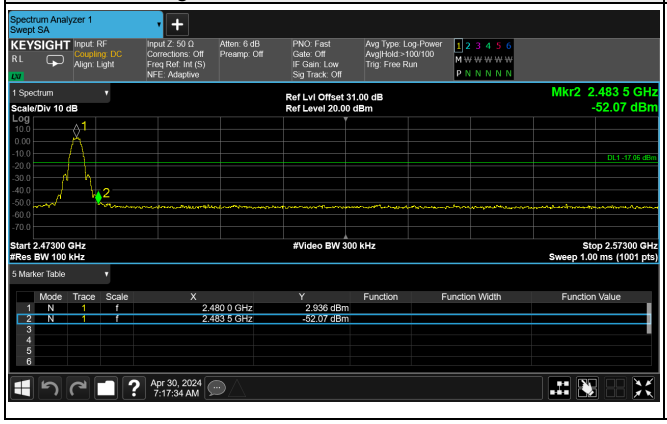
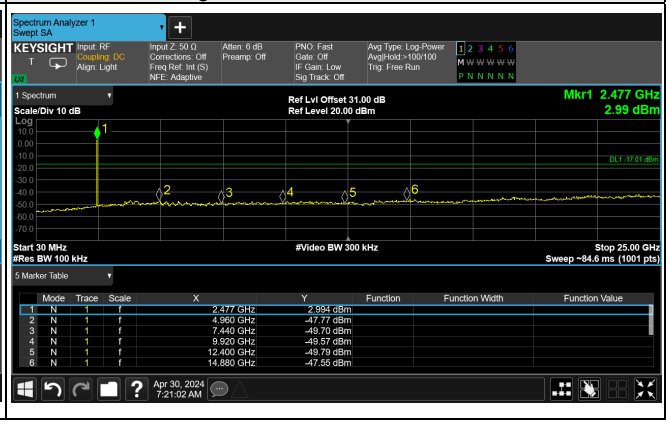
Test Name: Conducted Out of Band Emission Measurement			**Test Date(s):** 04/30/2024		
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2003	EMI Test Receiver	Keysight	N9030B	11/06/2023	11/06/2024
Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.					

Test Result:

Data Rate: 1Mbps

Low Channel 2307MHz-2407MHz	Low Channel 30 MHz-25 GHz
	
High Channel 2473MHz-2573MHz	**High Channel 30 MHz-25 GHz**
	

Data Rate: 2Mbps

Low Channel 2307MHz-2407MHz	Low Channel 30 MHz-25 GHz
	
High Channel 2473MHz-2573MHz	**High Channel 30 MHz-25 GHz**
	

IV. Pictures of test Arrangements

Please see setup photo file

END OF REPORT