Receiver Parameter	Setting
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

4.2 TEST PROCEDURE

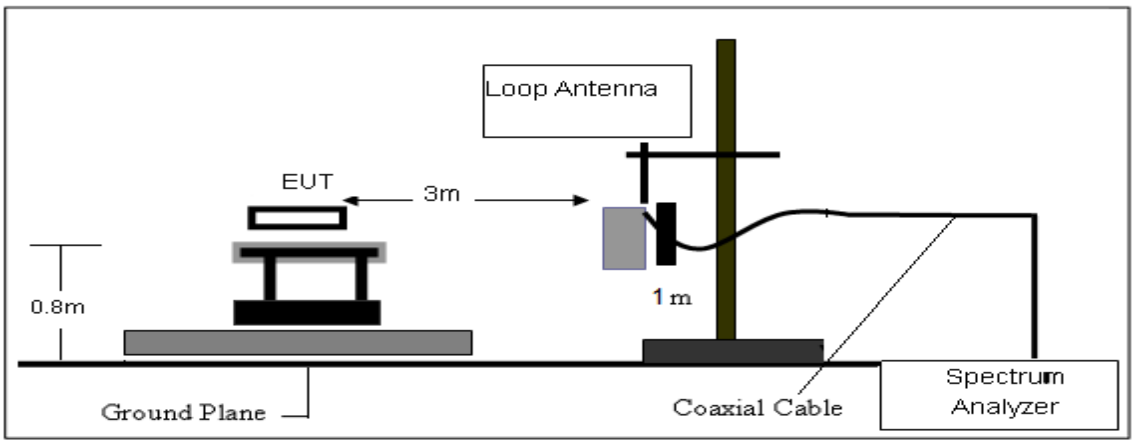
a. The measuring distance at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
b. The EUT was placed on the top of a rotating table 0.8 m (above 1GHz is 1.5 m) above the ground at a 3 m anechoic chamber test site. The table was rotated 360 degree to determine the position of the highest radiation.
c. The height of the equipment shall be 0.8 m (above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. Horizontal and vertical polarization of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and QuasiPeak detector mode will be re-measured.
e. If the Peak Mode measured value is compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and no additional QP Mode measurement was performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

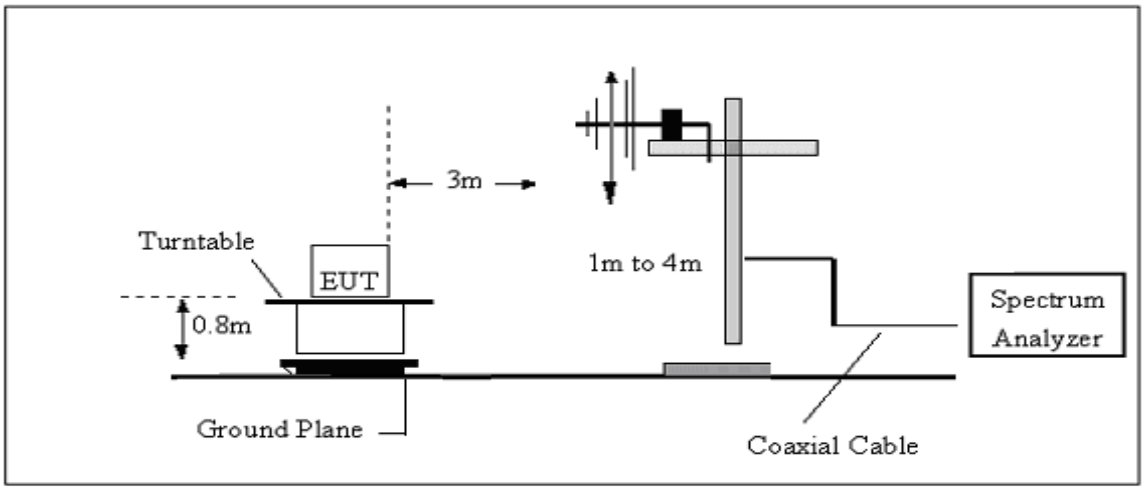
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

4.3 TEST SETUP

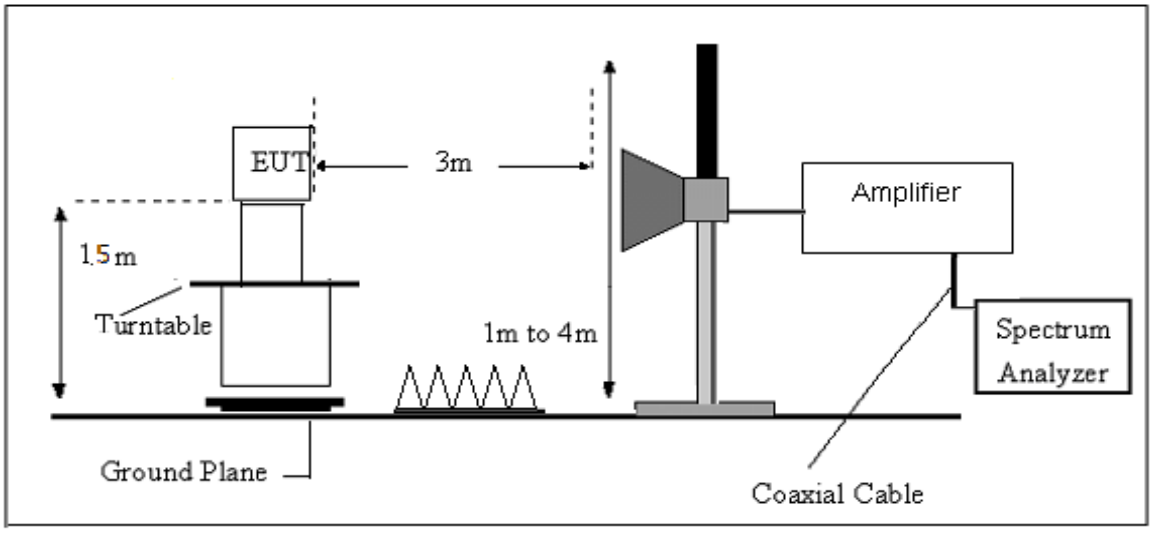
(A) Radiated Emission Test-Up Frequency Below 30MHz



(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(C) Radiated Emission Test-Up Frequency Above 1GHz



4.4 EUT OPERATING CONDITIONS

Please refer to section 3.4 of this report.

4.5 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where

FS = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

For example

Frequency	FS	RA	AF	CL	AG	Factor
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	(dB)	(dB)	(dB)
300	40	58.1	12.2	1.6	31.9	-18.1

Factor=AF+CL-AG

4.6 TEST RESULTS

(Between 9KHz – 30 MHz)

Temperature:	23.1(C)	Relative Humidtity:	60%RH
Test Voltage:	DC 3.7V	Polarization:	--
Test Mode:	TX Mode		

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	PASS
--	--	--	--	PASS

Note:

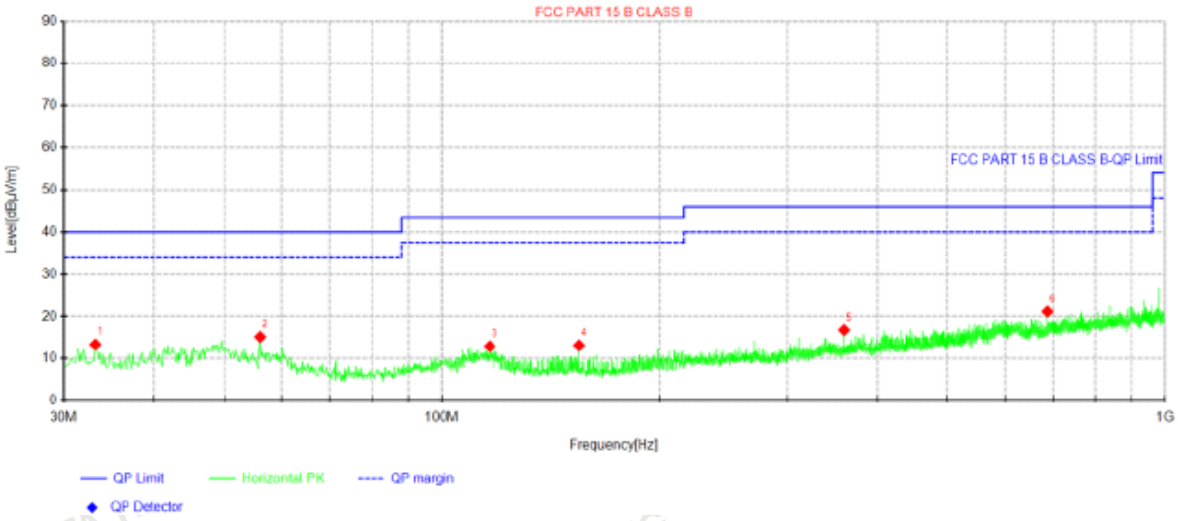
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =40 log (specific distance/test distance)(dB);

Limit line = specific limits(dBuv) + distance extrapolation factor.

(30MHz -1000MHz)

Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	DC 3.7V	Phase:	Horizontal
Test Mode:	Mode 1/2/3 (Mode 1 worst mode)		



Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	33.1525	31.48	13.30	-18.18	40.00	26.70	100	213	Horizontal
2	56.0688	32.47	15.11	-17.36	40.00	24.89	100	6	Horizontal
3	116.451	32.66	12.88	-19.78	43.50	30.62	100	205	Horizontal
4	154.766	34.81	13.11	-21.70	43.50	30.39	100	60	Horizontal
5	360.042	32.65	16.71	-15.94	46.00	29.29	100	0	Horizontal
6	687.538	32.91	21.17	-11.74	46.00	24.83	100	18	Horizontal

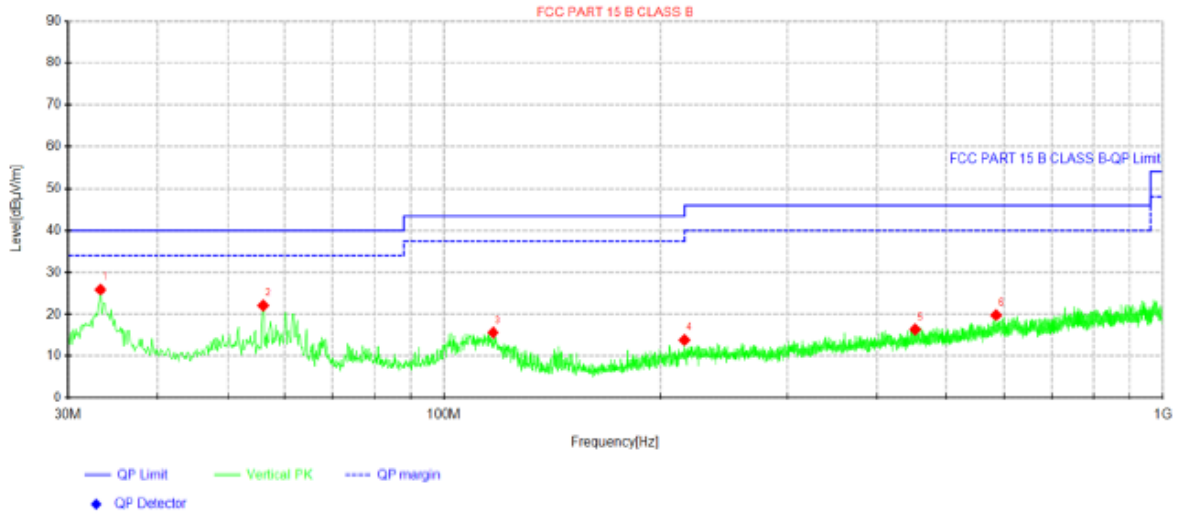
Note:1).Level (dBµV/m)= Reading (dBµV)+ Factor (dB/m)

2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin(dB) = Limit (dBµV/m) - Level (dBµV/m)

4). All modes have been tested,only show the worst case.

Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	DC 3.7V	Phase:	Vertical
Test Mode:	Mode 1/2/3 (Mode 2 worst mode)		



Suspected Data List									
NO.	Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	33.2738	44.08	25.92	-18.16	40.00	14.08	100	256	Vertical
2	56.0688	39.43	22.07	-17.36	40.00	17.93	100	359	Vertical
3	117.057	35.49	15.62	-19.87	43.50	27.88	100	357	Vertical
4	215.876	32.83	13.90	-18.93	43.50	29.60	100	0	Vertical
5	452.556	31.42	16.35	-15.07	46.00	29.65	100	289	Vertical
6	586.052	32.46	19.83	-12.63	46.00	26.17	100	129	Vertical

Note:1).Level (dBµV/m)= Reading (dBµV)+ Factor (dB/m)

2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin(dB) = Limit (dBµV/m) - Level (dBµV/m)

4). All modes have been tested,only show the worst case.

(1GHz-25GHz) Spurious emission Requirements

GFSK

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Orrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	（dB）	（dB）	（dB/m）	（dB）	(dBμV/m)	(dBμV/m)	(dB)	Type	
Low Channel (2402 MHz)										
3264.68	60.91	44.70	6.70	28.20	-9.80	51.11	74.00	-22.89	PK	Vertical
3264.68	51.26	44.70	6.70	28.20	-9.80	41.46	54.00	-12.54	AV	Vertical
3264.76	61.51	44.70	6.70	28.20	-9.80	51.71	74.00	-22.29	PK	Horizontal
3264.76	50.99	44.70	6.70	28.20	-9.80	41.19	54.00	-12.81	AV	Horizontal
4804.42	59.26	44.20	9.04	31.60	-3.56	55.70	74.00	-18.30	PK	Vertical
4804.42	49.92	44.20	9.04	31.60	-3.56	46.36	54.00	-7.64	AV	Vertical
4804.37	59.04	44.20	9.04	31.60	-3.56	55.48	74.00	-18.52	PK	Horizontal
4804.37	49.96	44.20	9.04	31.60	-3.56	46.40	54.00	-7.60	AV	Horizontal
5359.60	48.94	44.20	9.86	32.00	-2.34	46.60	74.00	-27.40	PK	Vertical
5359.60	39.16	44.20	9.86	32.00	-2.34	36.81	54.00	-17.19	AV	Vertical
5359.87	48.40	44.20	9.86	32.00	-2.34	46.06	74.00	-27.94	PK	Horizontal
5359.87	39.38	44.20	9.86	32.00	-2.34	37.04	54.00	-16.96	AV	Horizontal
7205.96	54.55	43.50	11.40	35.50	3.40	57.95	74.00	-16.05	PK	Vertical
7205.96	43.88	43.50	11.40	35.50	3.40	47.28	54.00	-6.72	AV	Vertical
7205.68	53.89	43.50	11.40	35.50	3.40	57.29	74.00	-16.71	PK	Horizontal
7205.68	43.86	43.50	11.40	35.50	3.40	47.26	54.00	-6.74	AV	Horizontal
Middle Channel (2440 MHz)										
3264.66	61.16	44.70	6.70	28.20	-9.80	51.36	74.00	-22.64	PK	Vertical
3264.66	50.67	44.70	6.70	28.20	-9.80	40.87	54.00	-13.13	AV	Vertical
3264.75	61.29	44.70	6.70	28.20	-9.80	51.49	74.00	-22.51	PK	Horizontal
3264.75	50.13	44.70	6.70	28.20	-9.80	40.33	54.00	-13.67	AV	Horizontal
4880.32	59.39	44.20	9.04	31.60	-3.56	55.83	74.00	-18.17	PK	Vertical
4880.32	50.12	44.20	9.04	31.60	-3.56	46.56	54.00	-7.44	AV	Vertical
4880.37	58.55	44.20	9.04	31.60	-3.56	54.99	74.00	-19.01	PK	Horizontal
4880.37	49.98	44.20	9.04	31.60	-3.56	46.42	54.00	-7.58	AV	Horizontal
5359.88	48.27	44.20	9.86	32.00	-2.34	45.93	74.00	-28.07	PK	Vertical
5359.88	39.41	44.20	9.86	32.00	-2.34	37.07	54.00	-16.93	AV	Vertical
5359.81	47.53	44.20	9.86	32.00	-2.34	45.19	74.00	-28.81	PK	Horizontal
5359.81	38.79	44.20	9.86	32.00	-2.34	36.44	54.00	-17.56	AV	Horizontal
7310.79	54.30	43.50	11.40	35.50	3.40	57.70	74.00	-16.30	PK	Vertical
7310.79	43.95	43.50	11.40	35.50	3.40	47.35	54.00	-6.65	AV	Vertical
7310.82	54.63	43.50	11.40	35.50	3.40	58.03	74.00	-15.97	PK	Horizontal
7310.82	44.84	43.50	11.40	35.50	3.40	48.24	54.00	-5.76	AV	Horizontal

High Channel (2480 MHz)										
3264.75	61.32	44.70	6.70	28.20	-9.80	51.52	74.00	-22.48	PK	Vertical
3264.75	51.60	44.70	6.70	28.20	-9.80	41.80	54.00	-12.20	AV	Vertical
3264.58	61.37	44.70	6.70	28.20	-9.80	51.57	74.00	-22.43	PK	Horizontal
3264.58	50.39	44.70	6.70	28.20	-9.80	40.59	54.00	-13.41	AV	Horizontal
4960.53	58.26	44.20	9.04	31.60	-3.56	54.70	74.00	-19.30	PK	Vertical
4960.53	50.54	44.20	9.04	31.60	-3.56	46.98	54.00	-7.02	AV	Vertical
4960.46	58.46	44.20	9.04	31.60	-3.56	54.90	74.00	-19.10	PK	Horizontal
4960.46	50.02	44.20	9.04	31.60	-3.56	46.46	54.00	-7.54	AV	Horizontal
5359.88	48.11	44.20	9.86	32.00	-2.34	45.76	74.00	-28.24	PK	Vertical
5359.88	40.16	44.20	9.86	32.00	-2.34	37.82	54.00	-16.18	AV	Vertical
5359.86	48.27	44.20	9.86	32.00	-2.34	45.93	74.00	-28.07	PK	Horizontal
5359.86	38.90	44.20	9.86	32.00	-2.34	36.56	54.00	-17.44	AV	Horizontal
7439.90	54.52	43.50	11.40	35.50	3.40	57.92	74.00	-16.08	PK	Vertical
7439.90	44.02	43.50	11.40	35.50	3.40	47.42	54.00	-6.58	AV	Vertical
7439.81	53.91	43.50	11.40	35.50	3.40	57.31	74.00	-16.69	PK	Horizontal
7439.81	43.82	43.50	11.40	35.50	3.40	47.22	54.00	-6.78	AV	Horizontal

Note:

1) Factor = Antenna Factor + Cable Loss – Pre-amplifier.
   Emission Level = Reading + Factor

2) The frequency emission of peak points that did not show above the forms are at least 20dB below the limit, the frequency emission is mainly from the environment noise.

4.6 TEST RESULTS (Restricted Bands Requirements)

GFSK

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Orrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	（dB）	（dB）	（dB/m）	（dB）	(dBμV/m)	(dBμV/m)	(dB)	Type	
2390.00	68.19	43.80	4.91	25.90	-12.99	55.20	74.00	-18.80	PK	Vertical
2390.00	53.17	43.80	4.91	25.90	-12.99	40.18	54.00	-13.82	AV	Vertical
2390.00	68.27	43.80	4.91	25.90	-12.99	55.28	74.00	-18.72	PK	Horizontal
2390.00	52.24	43.80	4.91	25.90	-12.99	39.25	54.00	-14.75	AV	Horizontal
2483.50	69.75	43.80	5.12	25.90	-12.78	56.97	74.00	-17.03	PK	Vertical
2483.50	52.65	43.80	5.12	25.90	-12.78	39.87	54.00	-14.13	AV	Vertical
2483.50	69.74	43.80	5.12	25.90	-12.78	56.96	74.00	-17.04	PK	Horizontal
2483.50	53.49	43.80	5.12	25.90	-12.78	40.71	54.00	-13.29	AV	Horizontal

5. CONDUCTED SPURIOUS & BAND EDGE EMISSION

5.1 LIMIT

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2300 – 2407 MHz Upper Band Edge: 2475 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

5.3 TEST SETUP

The EUT is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna termina is 50 Ohm; the path loss as the factor is calibrated to correct the reading. Make the measurement with the spectrum analyzer's resolution bandwidth(RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

5.4 EUT OPERATION CONDITIONS

Please refer to section 3.4 of this report.

5.5 TEST RESULTS

Note: The test data please refer to APPENDIX 1.

6. POWER SPECTRAL DENSITY TEST

6.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(e)	Power Spectral Density	≤8 dBm (RBW≥3KHz)	2400-2483.5	PASS

6.2 TEST PROCEDURE

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW to: 100 kHz ≥ RBW ≥ 3 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.3 TEST SETUP

6.4 EUT OPERATION CONDITIONS

Please refer to section 3.4 of this report.

6.5 TEST RESULTS

Note: The test data please refer to APPENDIX 1.

7. BANDWIDTH TEST

7.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	>= 500KHz (6dB bandwidth)	2400-2483.5	PASS

7.2 TEST PROCEDURE

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW≥3RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be≥6 dB.

7.3 TEST SETUP

7.4 EUT OPERATION CONDITIONS

Please refer to section 3.4 of this report.

7.5 TEST RESULTS

Note: The test data please refer to APPENDIX 1.

8. PEAK OUTPUT POWER TEST

8.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Output Power	1 watt or 30dBm	2400-2483.5	PASS

8.2 TEST PROCEDURE

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

Method AVGSA-2 uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction. The procedure for this method is as follows:

a) Measure the duty cycle D of the transmitter output signal as described in 11.6.
b) Set span to at least 1.5 times the OBW.
c) Set RBW = 1% to 5% of the OBW, not to exceed 1 MHz.
d) Set VBW ≥ [3 × RBW].
e) Number of points in sweep ≥ [2 × span / RBW]. (This gives bin-to-bin spacing ≤ RBW / 2, so that narrowband signals are not lost between frequency bins.)
f) Sweep time = auto.
g) Detector = RMS (i.e., power averaging), if available. Otherwise, use the sample detector mode.
h) Do not use sweep triggering. Allow the sweep to “free run.”
i) Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the ON and OFF periods of the transmitter.
j) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
k) Add [10 log (1 / D)], where D is the duty cycle, to the measured power to compute the average power during the actual transmission times (because the measurement represents an average over both the ON and OFF times of the transmission). For example, add [10 log (1/0.25)] = 6 dB if the duty cycle is 25%.

RBW ≥ DTS bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ [3 × RBW].
c) Set span ≥ [3 × RBW].
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

Integrated band power method:
The following procedure can be used when the maximum available RBW of the instrument is less than the
DTS bandwidth:
a) Set the RBW = 1 MHz.
b) Set the VBW ≥ [3 × RBW].
c) Set the span ≥ [1.5 × DTS bandwidth].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select the peak detector). If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS channel bandwidth.
PKPM1 Peak power meter method:
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

8.3 TEST SETUP

8.4 EUT OPERATION CONDITIONS
Please refer to section 3.4 of this report.

8.5 TEST RESULTS

Note: The test data please refer to APPENDIX 1.

9. ANTENNA REQUIREMENT

9.1 STANDARD REQUIREMENT

15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

9.2 EUT ANTENNA

The EUT antenna is PCB Antenna. It comply with the standard requirement.

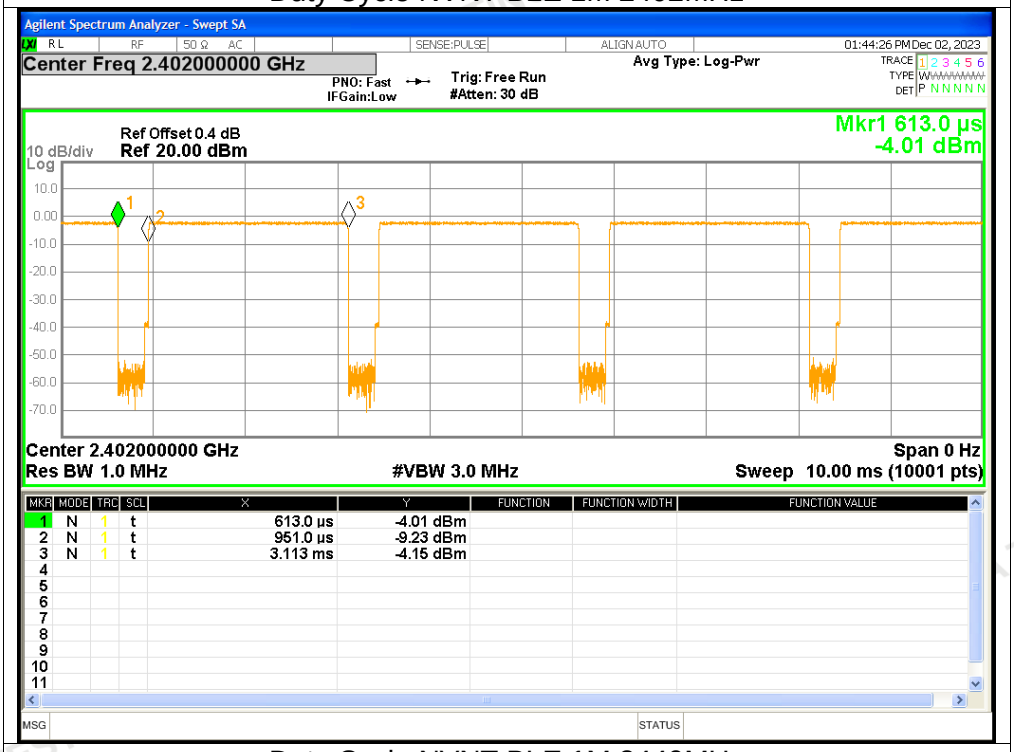
APPENDIX 1-TEST DATA

1. Duty Cycle

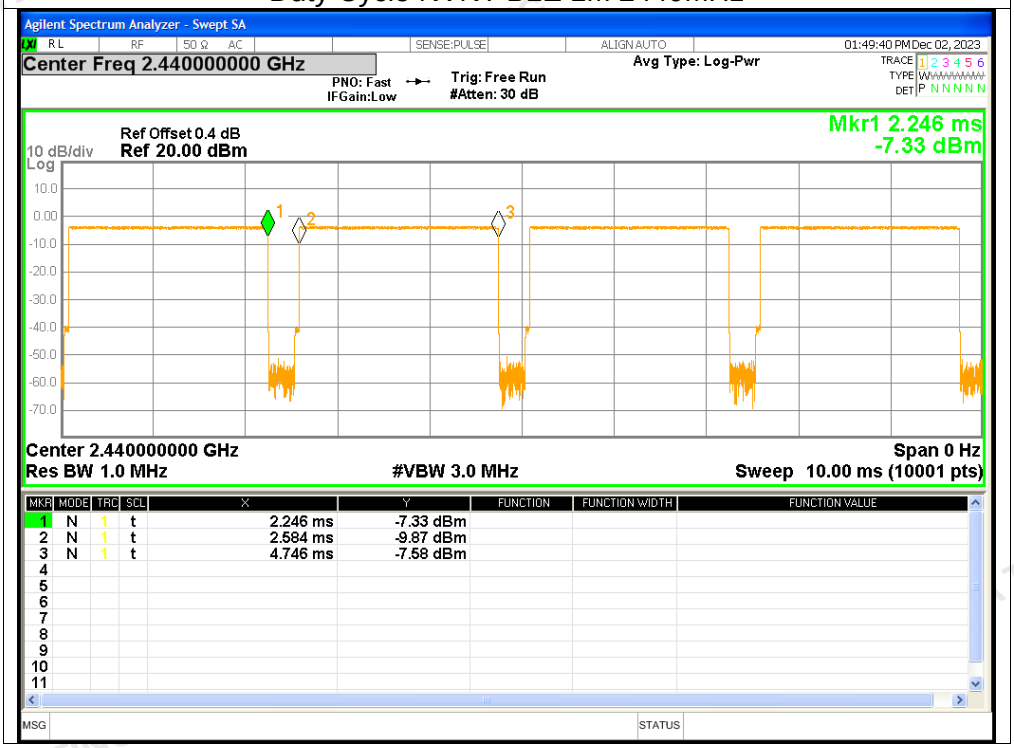
Condition	Mode	Frequency (MHz)	Duty Cycle (%)	Correction Factor (dB)	1/T (kHz)
NVNT	BLE 1M	2402	86.48	0.63	0.46
NVNT	BLE 1M	2440	86.48	0.63	0.46
NVNT	BLE 1M	2480	86.44	0.63	0.46

Test Graphs

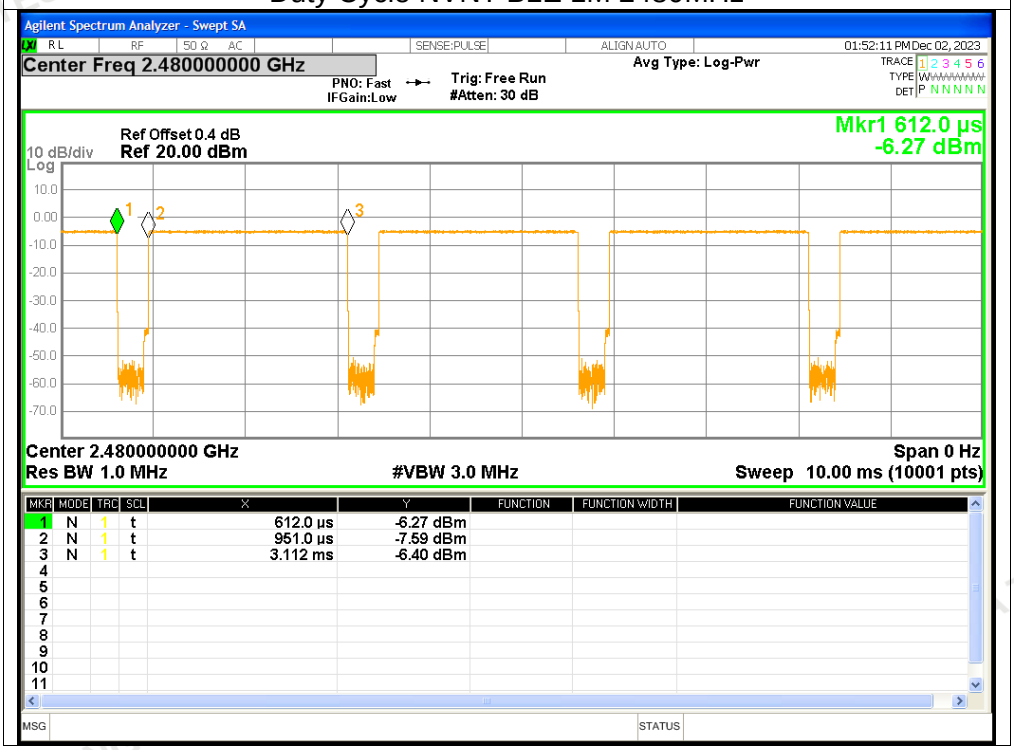
Duty Cycle NVNT BLE 1M 2402MHz



Duty Cycle NVNT BLE 1M 2440MHz



Duty Cycle NVNT BLE 1M 2480MHz

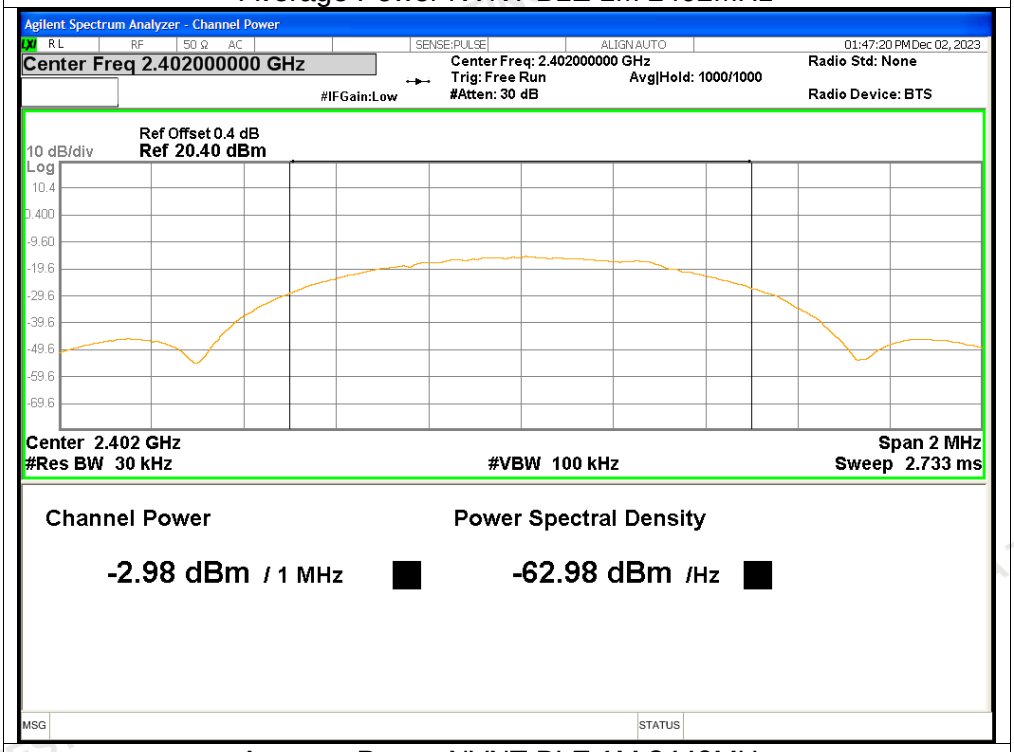


2. Maximum Average Conducted Output Power

Condition	Mode	Frequency (MHz)	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE 1M	2402	-2.98	0.63	-2.35	<=30	Pass
NVNT	BLE 1M	2440	-4.57	0.63	-3.94	<=30	Pass
NVNT	BLE 1M	2480	-5.65	0.63	-5.02	<=30	Pass

Test Graphs

Average Power NVNT BLE 1M 2402MHz



Average Power NVNT BLE 1M 2440MHz