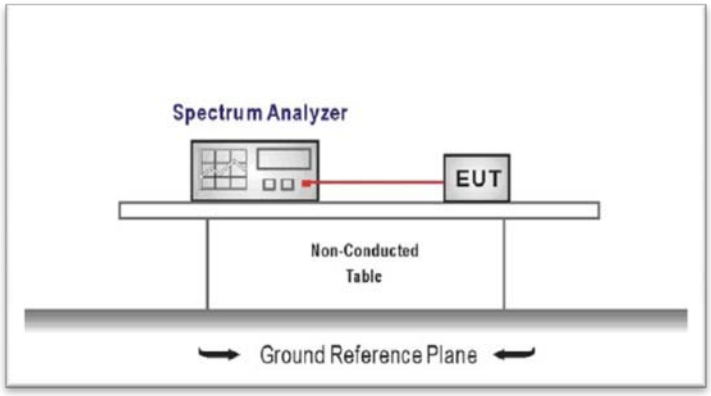
4.7. Band edge and Spurious Emission (conducted)

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section15.247 (d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

TEST CONFIGURATION



TEST PROCEDURE

1. Connect the antenna port(s) to the spectrum analyzer input.
2. **Establish a reference level by using the following procedure**
   Center frequency=DTS channel center frequency
   The span = 1.5 times the DTS bandwidth.
   RBW = 100 kHz, VBW ≥ 3 x RBW
   Detector = peak, Sweep time = auto couple, Trace mode = max hold
   Allow trace to fully stabilize
   Use the peak marker function to determine the maximum PSD level

   Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

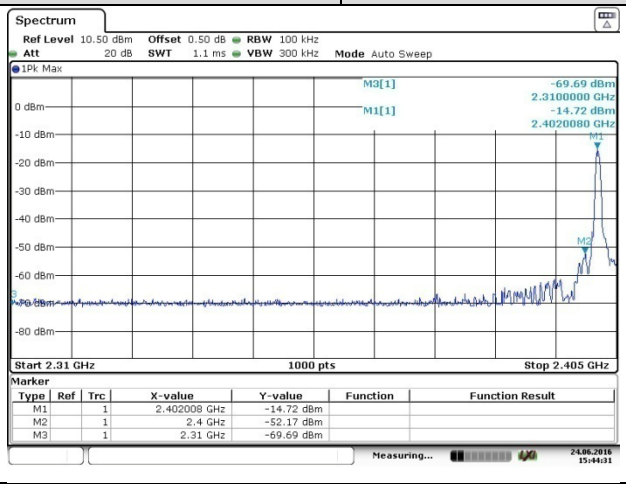
3. **Emission level measurement**
   Set the center frequency and span to encompass frequency range to be measured
   RBW = 100 kHz, VBW ≥ 3 x RBW
   Detector = peak, Sweep time = auto couple, Trace mode = max hold
   Allow trace to fully stabilize
   Use the peak marker function to determine the maximum amplitude level.
4. Place the radio in continuous transmit mode, allow the trace to stabilize, view the transmitter waveform on the spectrum analyzer.
5. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band excluding restricted frequency bands) are attenuated by at least the minimum requirements specified (at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz). Report the three highest emissions relative to the limit.

TEST RESULTS

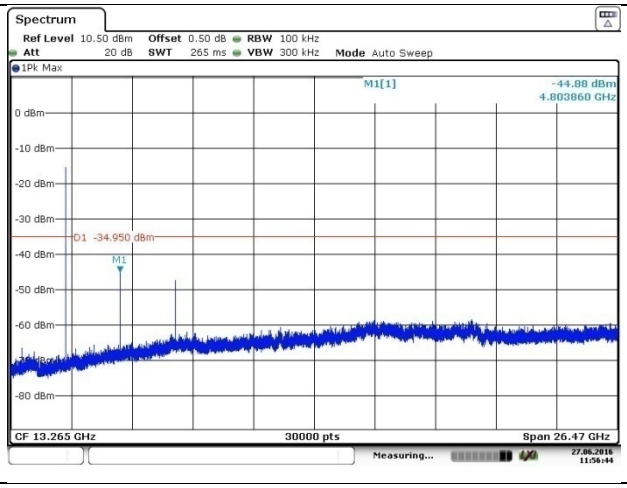
Test plot as follows:

Mode:	*BLE*	*Test channel:*	*00*

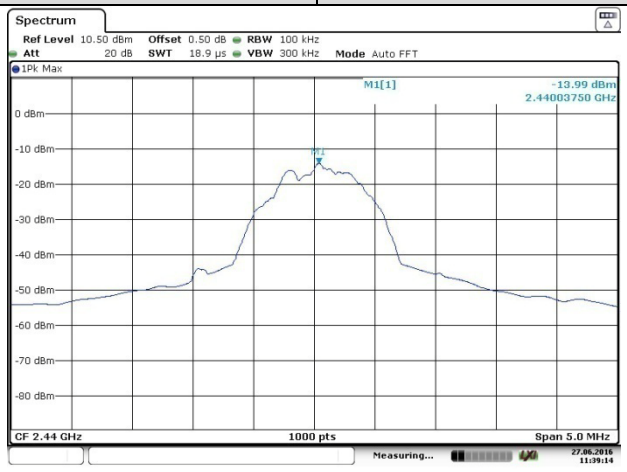
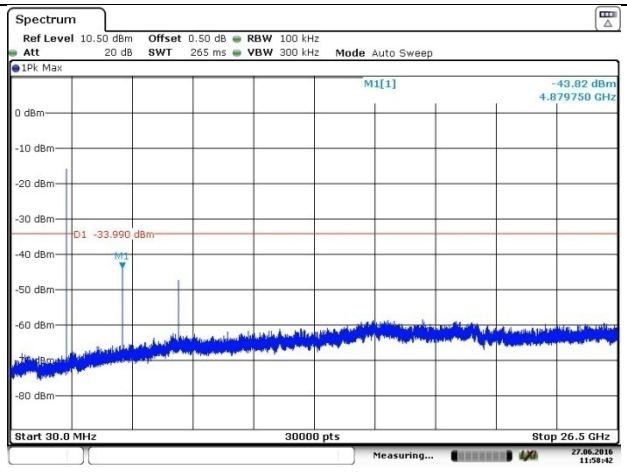
100KHz PSD Reference Level



Low bandedge Plot

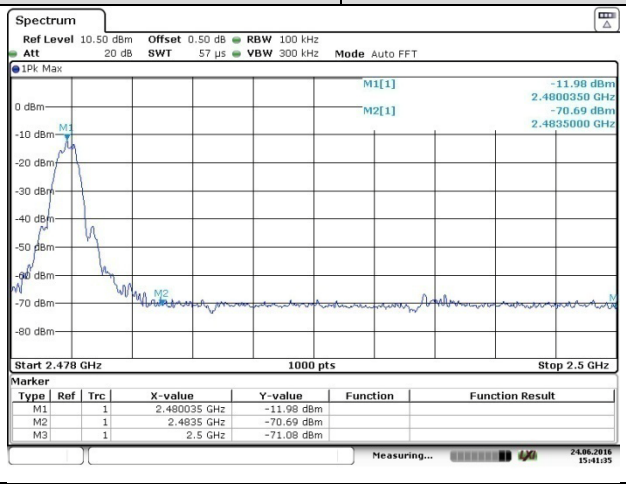


30MHz~26.5GHz

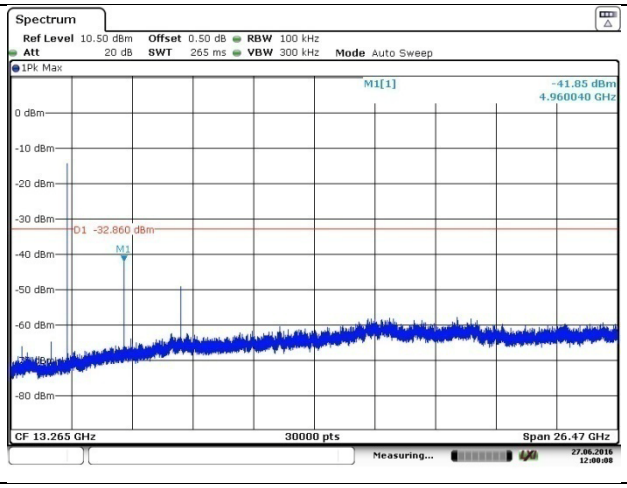
Mode:	*BLE*	*Test channel:*	*19*
			
100KHz PSD Reference Level			
			
30MHz~26.5GHz			

Mode:	*BLE*	*Test channel:*	*39*

100KHz PSD Reference Level



High bandedge Plot



30MHz~26.5GHz

4.8. Spurious Emission (radiated)

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.209

Frequency	Limit (dBuV/m @300m)	Value
0.009 MHz -0.490 MHz	2400/F(kHz)	Quasi-peak

Note:F is test frequency.

Frequency	Limit (dBuV/m @30m)	Value
0.490 MHz -1.705 MHz	24000/F(kHz)	Quasi-peak

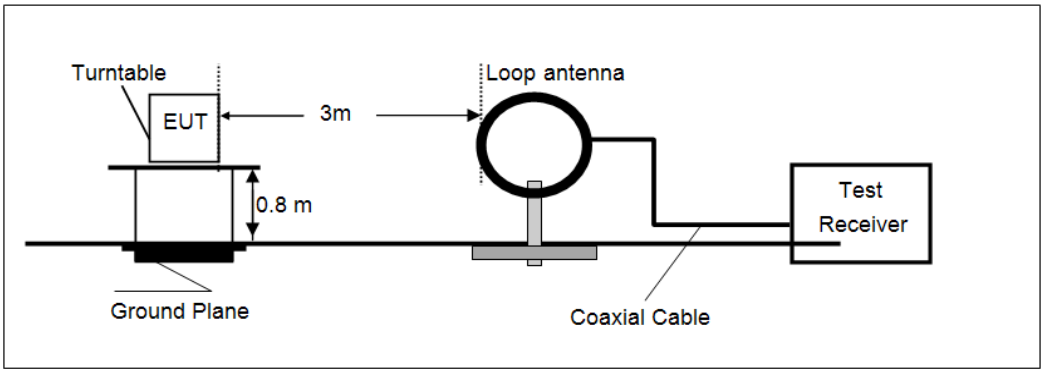
Note:F is test frequency.

Frequency	Limit (dBuV/m @30m)	Value
1.705 MHz -30.0 MHz	30	Quasi-peak

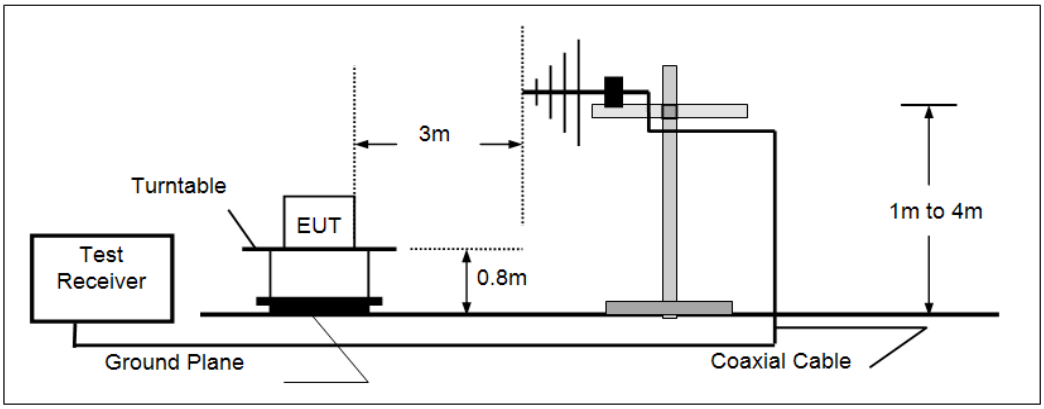
Frequency	Limit (dBuV/m @3m)	Value
30MHz-88MHz	40.00	Quasi-peak
88MHz-216MHz	43.50	Quasi-peak
216MHz-960MHz	46.00	Quasi-peak
960MHz-1GHz	54.00	Quasi-peak
Above 1GHz	54.00	Average
	74.00	Peak

TEST CONFIGURATION

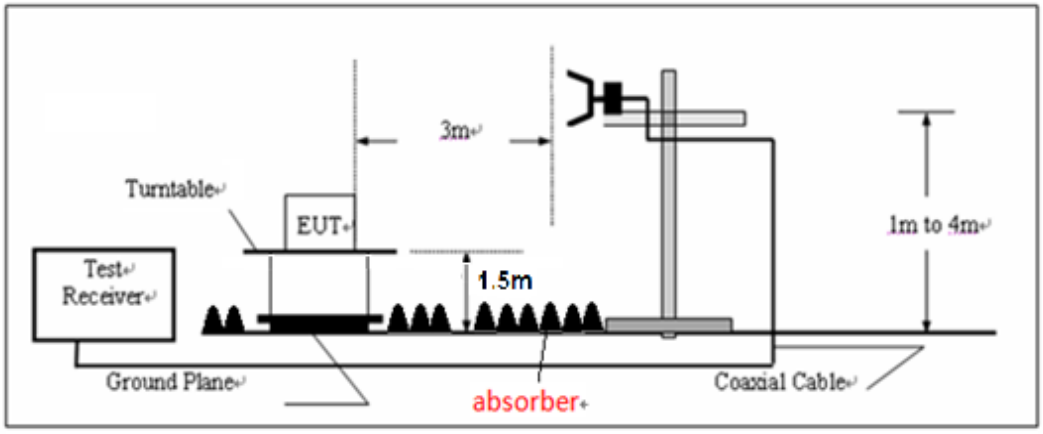
- 9KHz ~30MHz



- 30MHz ~ 1GHz



- Above 1GHz



TEST PROCEDURE

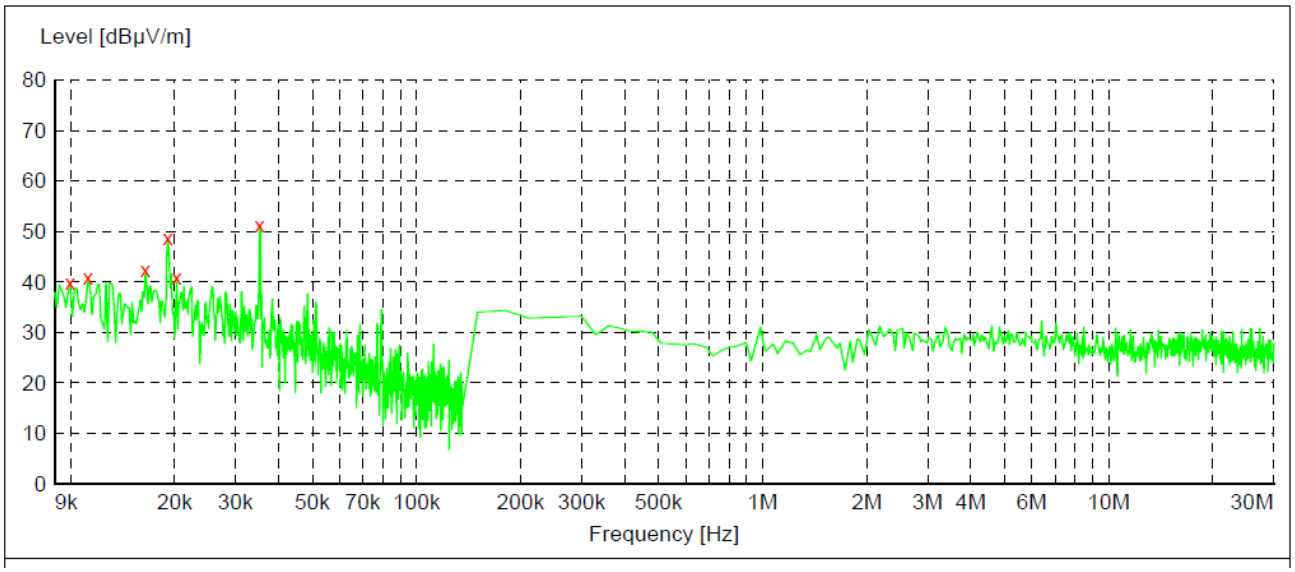
1. The EUT was tested according to ANSI C63.10:2013 for compliance to FCC 47CFR 15.247 requirements.
2. The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated360 degrees to determine the position of the maximum emission level.
3. The EUT waspositioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. Thisis repeated for both horizontal and vertical polarization of the antenna.
5. Use the following spectrum analyzer settings
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Below 1GHz, RBW=120KHz, VBW=300KHz, Sweep=auto, Detector function=peak, Trace=max hold; *If the emission level of the EUT measured by the peak detectoris 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, theemission measurement will be repeated using the quasi-peak detector and reported.*
   (3) Above 1GHz, RBW=1MHz, VBW=3MHz for Peak value
   RBW=1MHz, VBW=3MHz for Average value.

TEST RESULTS

Measurement data:

■ **9kHz ~ 30MHz**

Test mode:	Worst case mode	*Polarization*	*Horizontal*



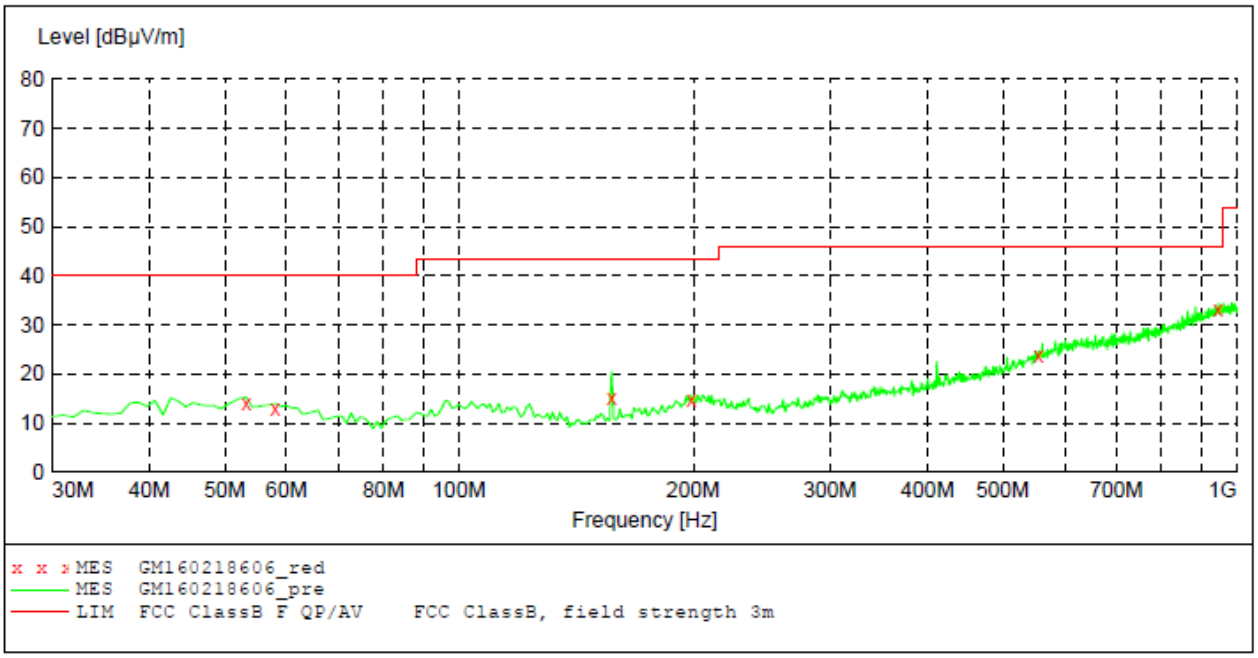
Frequency MHz	*Level dBµV/m*	*Transd dB*	*Limit* (dBuV/m @3m)	*Margin dB*	*Det.*	*Result*
0.009987	*40.00*	*22.3*	*320.31*	*280.31*	*Quasi-peak*	*Pass*
0.011256	*40.90*	*22.3*	*293.22*	*252.32*	*Quasi-peak*	*Pass*
0.016473	*42.40*	*22.2*	*225.69*	*183.29*	*Quasi-peak*	*Pass*
0.019152	*48.70*	*22.1*	*205.31*	*156.61*	*Quasi-peak*	*Pass*
0.020280	*41.00*	*22.1*	*198.34*	*157.34*	*Quasi-peak*	*Pass*
0.035226	*51.30*	*21.9*	*148.13*	*96.83*	*Quasi-peak*	*Pass*

Remark:

1. Level =Receiver Read level+ Transd
2. Transd=Antenna Factor+Cable Loss
3. The loop antenna rotated about both vertical and horizontal to find the maximum emission, so only the worst position (horizontal) was reported.
4. According to the clause 15.31(2),Limit (dBuV/m @3m)= Limit (dBuV/m @300m)+40log(300m/3m)

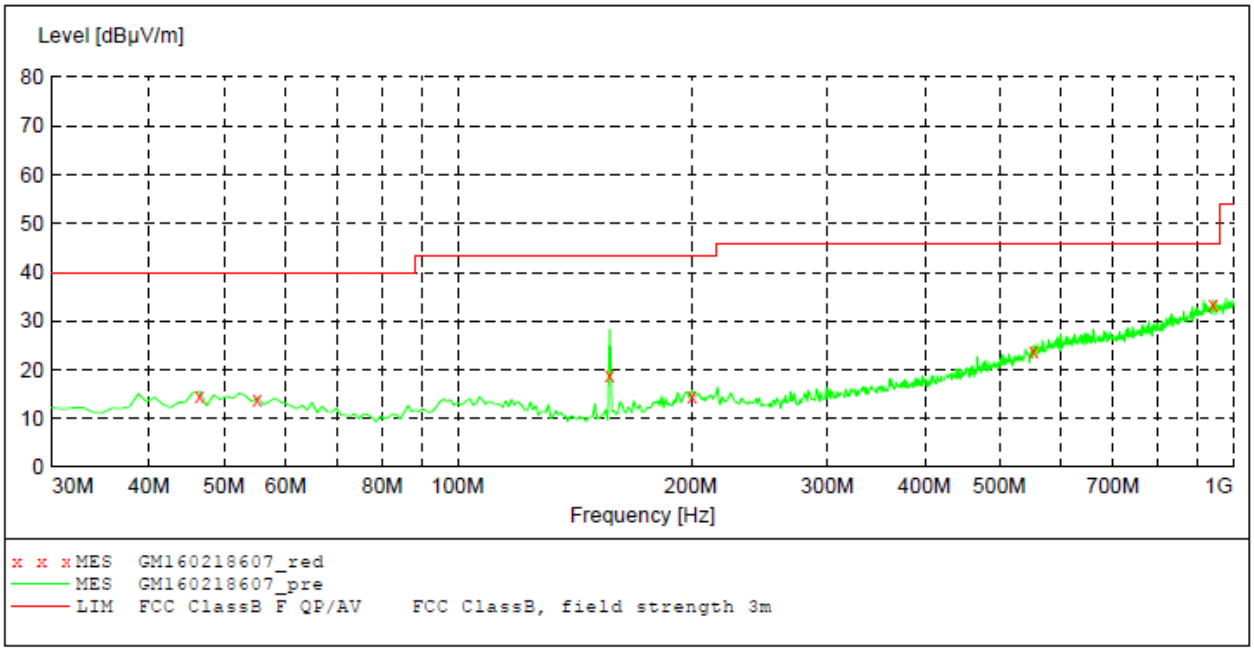
■ **30MHz ~ 1GHz**

Worst case mode	Vertical



Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
53.280000	15.20	-14.6	40.0	24.8	QP	300.0	292.00	VERTICAL
58.130000	14.00	-15.0	40.0	26.0	QP	100.0	241.00	VERTICAL
157.070000	15.50	-17.4	43.5	28.0	QP	300.0	12.00	VERTICAL
198.780000	15.80	-13.7	43.5	27.7	QP	300.0	359.00	VERTICAL
555.740000	24.70	-4.6	46.0	21.3	QP	300.0	0.00	VERTICAL
946.650000	34.30	3.6	46.0	11.7	QP	300.0	267.00	VERTICAL

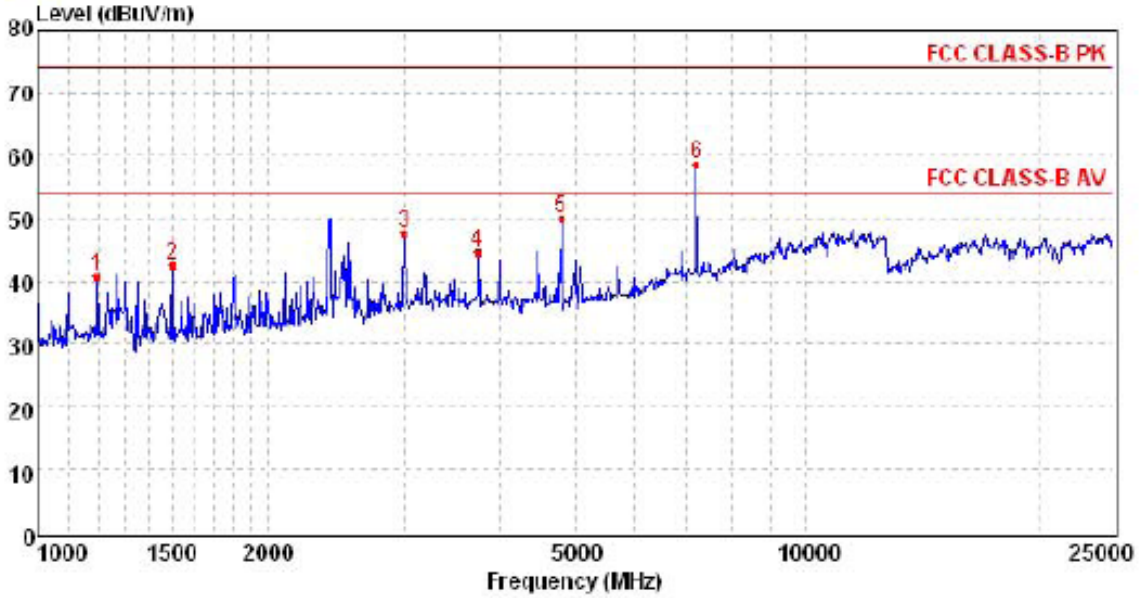
Worst case mode	Horizontal



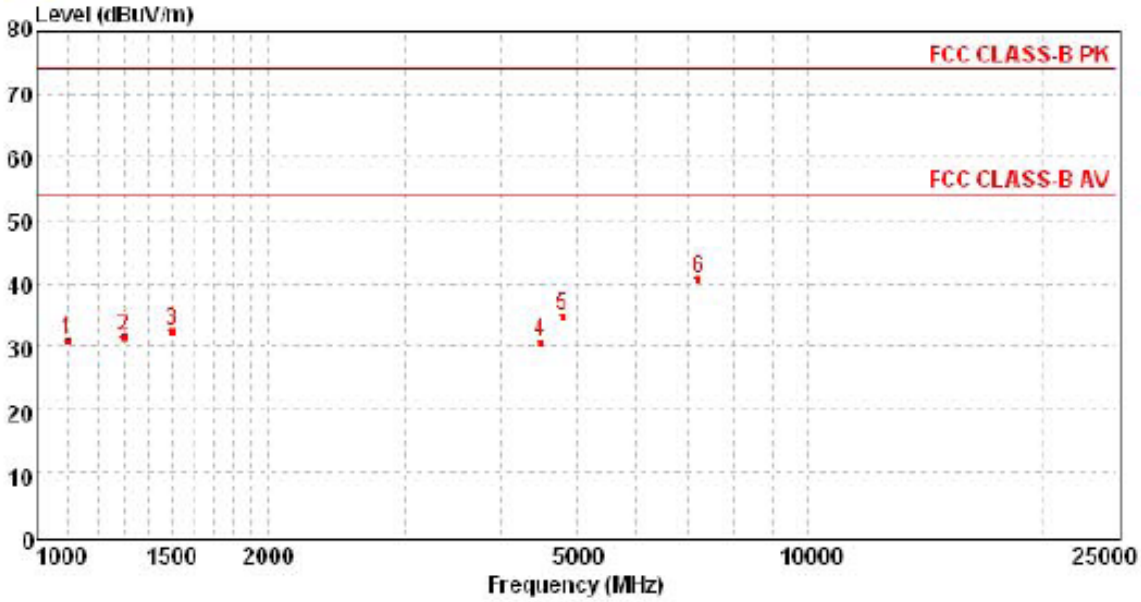
Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
46.490000	15.60	-14.6	40.0	24.4	QP	100.0	224.00	HORIZONTAL
55.220000	14.30	-14.7	40.0	25.7	QP	300.0	262.00	HORIZONTAL
157.070000	18.30	-17.4	43.5	25.2	QP	100.0	298.00	HORIZONTAL
200.720000	15.70	-13.6	43.5	27.8	QP	100.0	298.00	HORIZONTAL
552.830000	25.00	-4.8	46.0	21.0	QP	300.0	234.00	HORIZONTAL
942.770000	34.30	3.5	46.0	11.7	QP	100.0	110.00	HORIZONTAL

■ **Above 1 GHz**

CH00 for BLE	Vertical

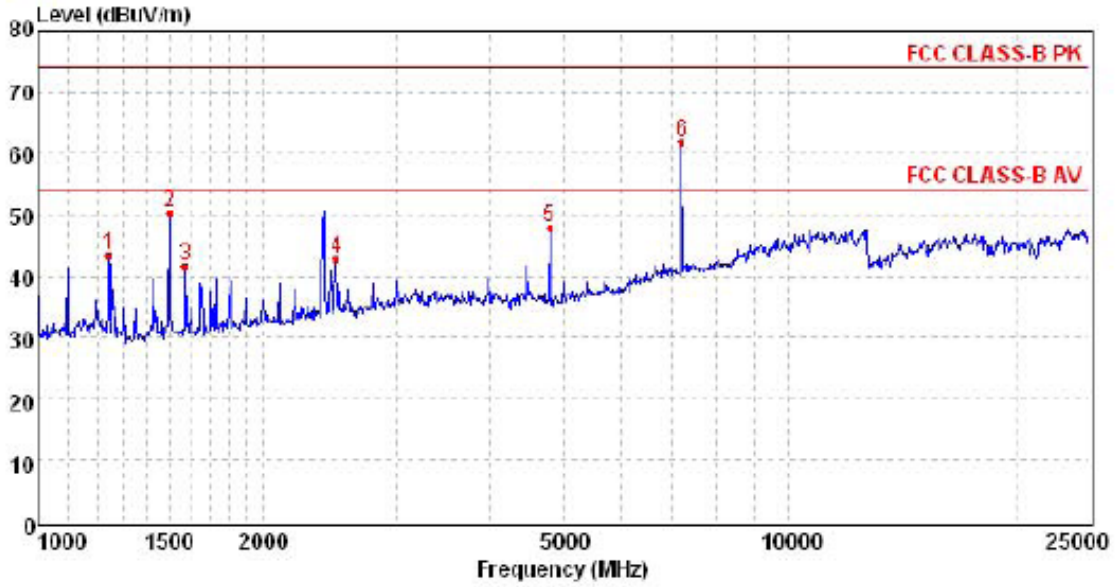


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1198.10	48.23	24.43	4.52	36.51	40.67	74.00	-33.33	Peak
2	1498.91	49.39	24.70	5.18	36.83	42.44	74.00	-31.56	Peak
3	3003.17	49.02	28.50	8.18	37.99	47.71	74.00	-26.29	Peak
4	3747.66	44.80	29.11	8.70	37.99	44.62	74.00	-29.38	Peak
5	4809.50	48.21	31.09	9.21	38.53	49.98	74.00	-24.02	Peak
6	7209.02	49.74	35.97	10.86	38.10	58.47	74.00	-15.53	Peak

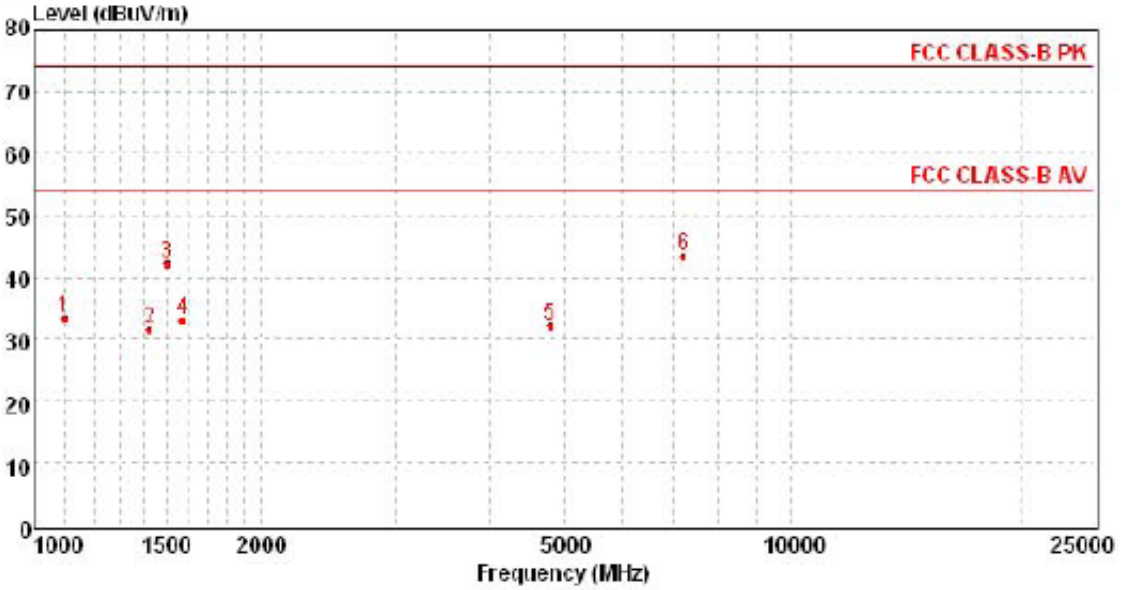


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1098.76	38.77	24.32	4.27	36.39	30.97	54.00	-23.03	Average
2	1299.77	38.95	24.53	4.76	36.63	31.61	54.00	-22.39	Average
3	1498.91	39.45	24.70	5.18	36.83	32.50	54.00	-21.50	Average
4	4501.49	29.21	30.90	8.98	38.33	30.76	54.00	-23.24	Average
5	4809.50	32.96	31.09	9.21	38.53	34.73	54.00	-19.27	Average
6	7209.02	31.88	35.97	10.86	38.10	40.61	54.00	-13.39	Average

CH00 for BLE	*Horizontal*

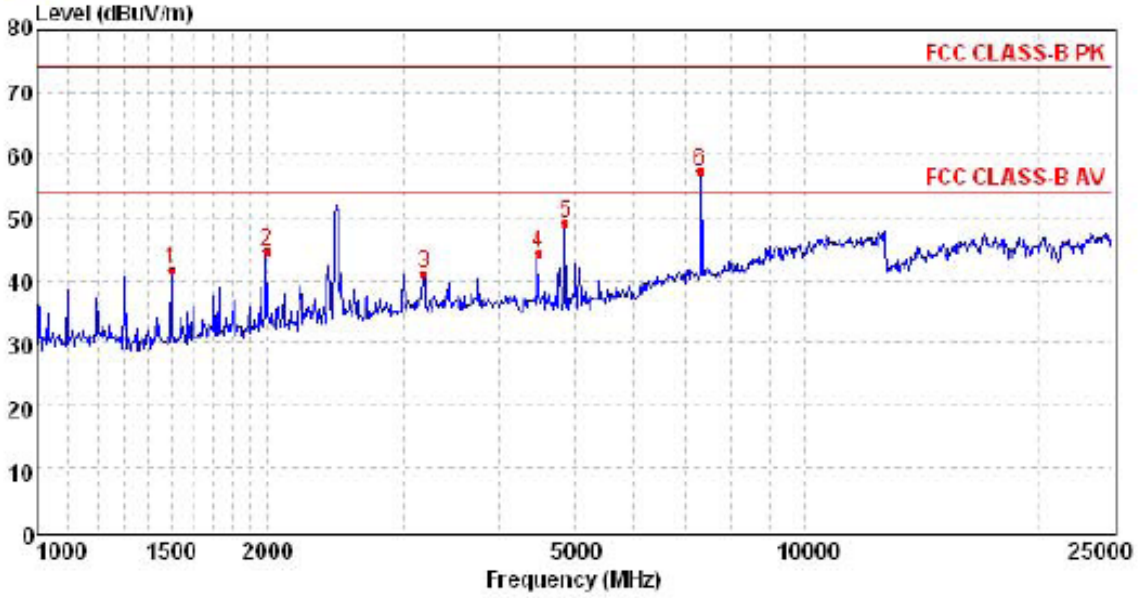


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1244.73	50.77	24.47	4.64	36.57	43.31	74.00	-30.69	Peak
2	1498.91	57.13	24.70	5.18	36.83	50.18	74.00	-23.82	Peak
3	1573.19	48.35	24.94	5.34	36.90	41.73	74.00	-32.27	Peak
4	2500.25	45.66	27.90	6.98	37.66	42.88	74.00	-31.12	Peak
5	4809.50	46.07	31.09	9.21	38.53	47.84	74.00	-26.16	Peak
6	7209.02	53.01	35.97	10.86	38.10	61.74	74.00	-12.26	Peak

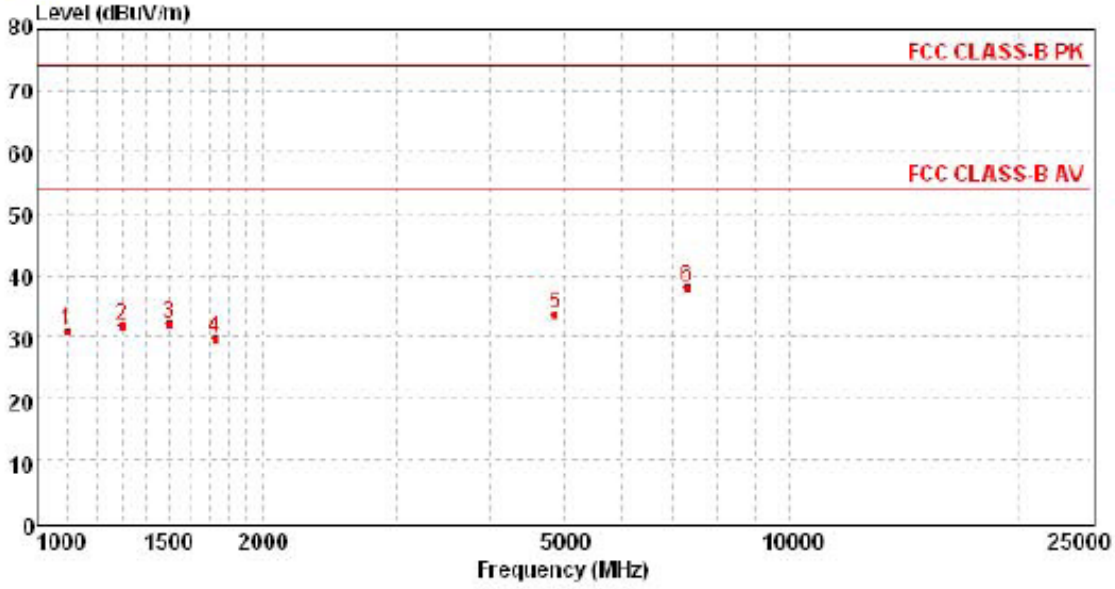


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1098.76	41.05	24.32	4.27	36.39	33.2554.00		-20.75	Average
2	1424.51	38.76	24.64	5.03	36.76	31.6754.00		-22.33	Average
3	1498.91	49.31	24.70	5.18	36.83	42.3654.00		-11.64	Average
4	1573.19	39.74	24.94	5.34	36.90	33.1254.00		-20.88	Average
5	4809.50	30.20	31.09	9.21	38.53	31.9754.00		-22.03	Average
6	7209.02	34.63	35.97	10.86	38.10	43.3654.00		-10.64	Average

CH19 for BLE	Vertical

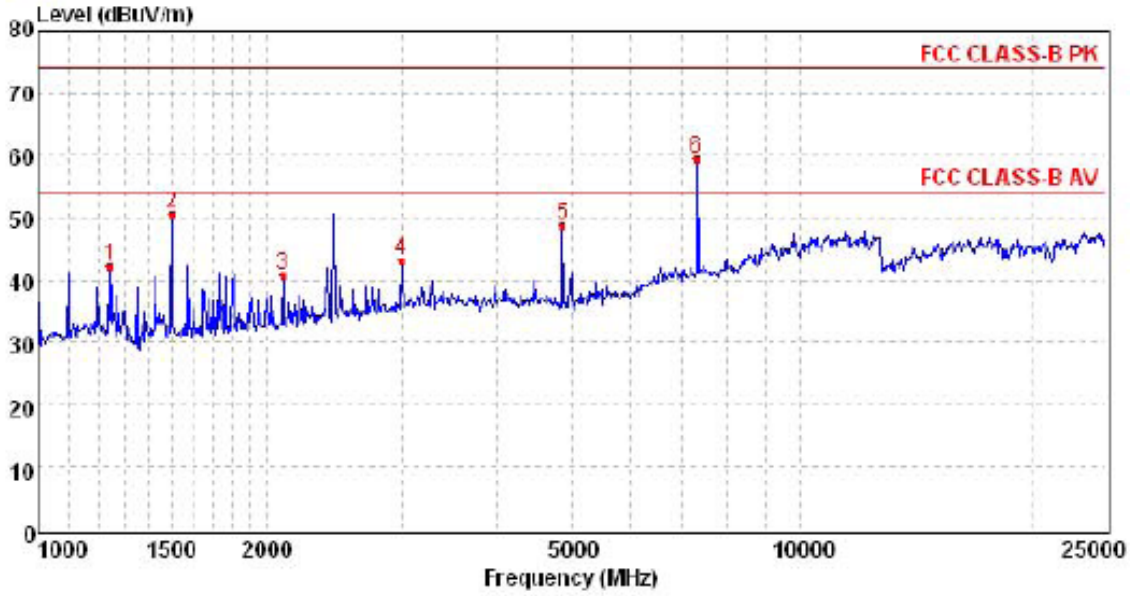


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1498.91	48.46	24.70	5.18	36.83	41.51	74.00	-32.49	Peak
2	1993.40	49.62	26.09	6.14	37.25	44.60	74.00	-29.40	Peak
3	3192.37	41.91	28.58	8.43	37.99	40.93	74.00	-33.07	Peak
4	4501.49	42.65	30.90	8.98	38.33	44.20	74.00	-29.80	Peak
5	4883.52	47.26	31.14	9.26	38.58	49.08	74.00	-24.92	Peak
6	7319.96	48.43	36.07	10.89	38.13	57.26	74.00	-16.74	Peak

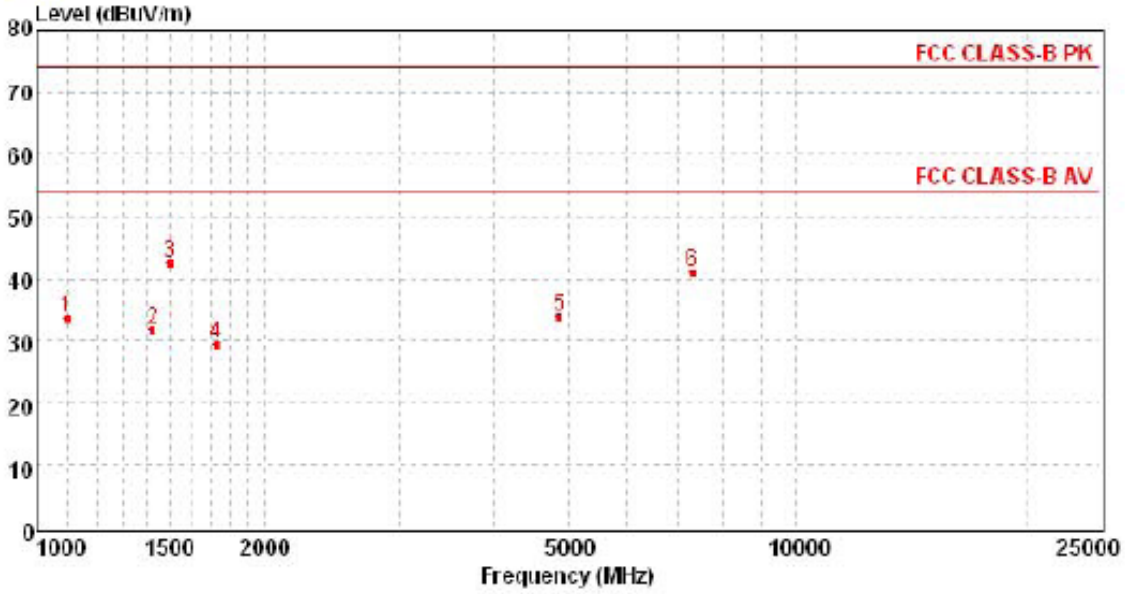


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1098.76	38.69	24.32	4.27	36.39	30.8954.00	-23.11	Average	
2	1299.77	39.08	24.53	4.76	36.63	31.7454.00	-22.26	Average	
3	1498.91	39.14	24.70	5.18	36.83	32.1954.00	-21.81	Average	
4	1724.17	35.88	25.37	5.65	37.03	29.8754.00	-24.13	Average	
5	4883.52	31.81	31.14	9.26	38.58	33.6354.00	-20.37	Average	
6	7319.96	29.32	36.07	10.89	38.13	38.1554.00	-15.85	Average	

CH19 for BLE	*Horizontal*

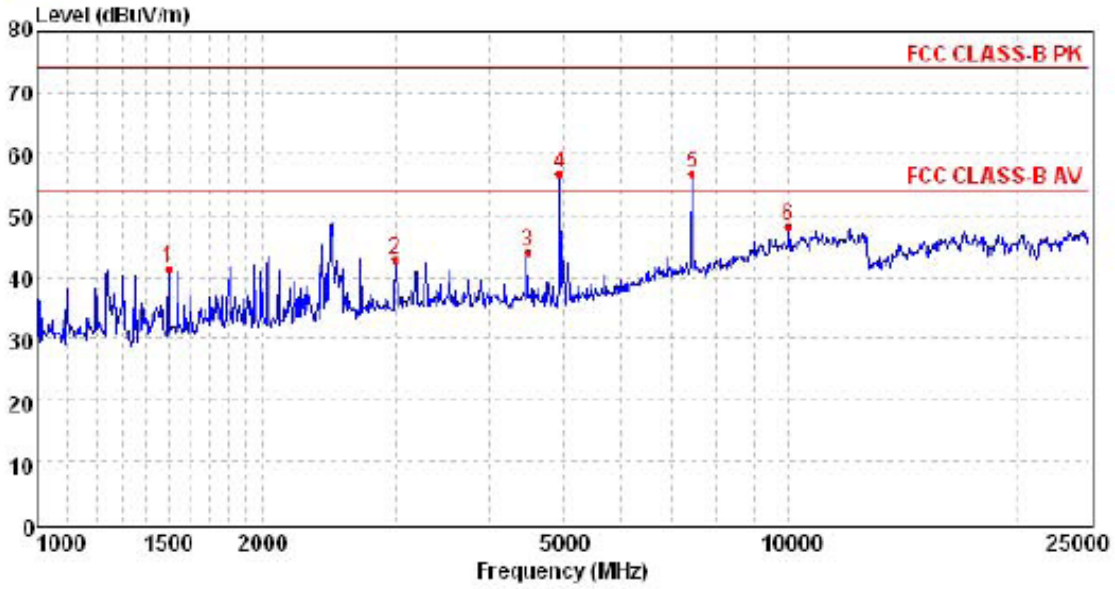


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1244.73	49.83	24.47	4.64	36.57	42.37	74.00	-31.63	Peak
2	1498.91	57.55	24.70	5.18	36.83	50.60	74.00	-23.40	Peak
3	2097.51	45.28	26.47	6.33	37.33	40.75	74.00	-33.25	Peak
4	2995.54	44.45	28.50	8.17	37.99	43.13	74.00	-30.87	Peak
5	4883.52	46.92	31.14	9.26	38.58	48.74	74.00	-25.26	Peak
6	7319.96	50.69	36.07	10.89	38.13	59.52	74.00	-14.48	Peak

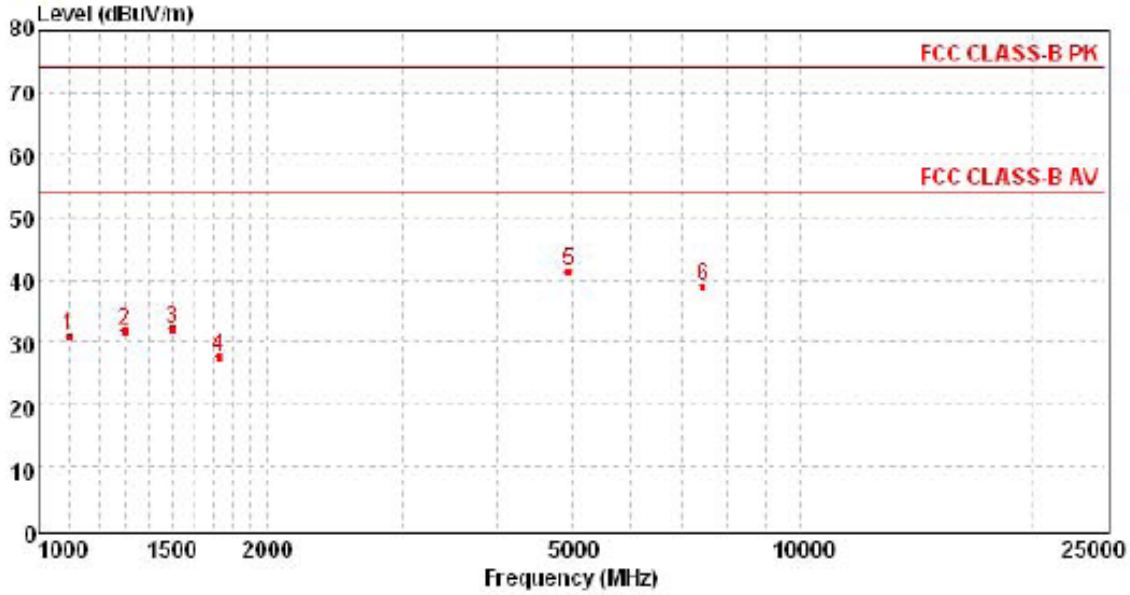


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1098.76	41.34	24.32	4.27	36.39	33.54	54.00	-20.46	Average
2	1424.51	38.80	24.64	5.03	36.76	31.71	54.00	-22.29	Average
3	1498.91	49.45	24.70	5.18	36.83	42.50	54.00	-11.50	Average
4	1724.17	35.45	25.37	5.65	37.03	29.44	54.00	-24.56	Average
5	4883.52	31.98	31.14	9.26	38.58	33.80	54.00	-20.20	Average
6	7319.96	32.19	36.07	10.89	38.13	41.02	54.00	-12.98	Average

CH39 for BLE	Vertical

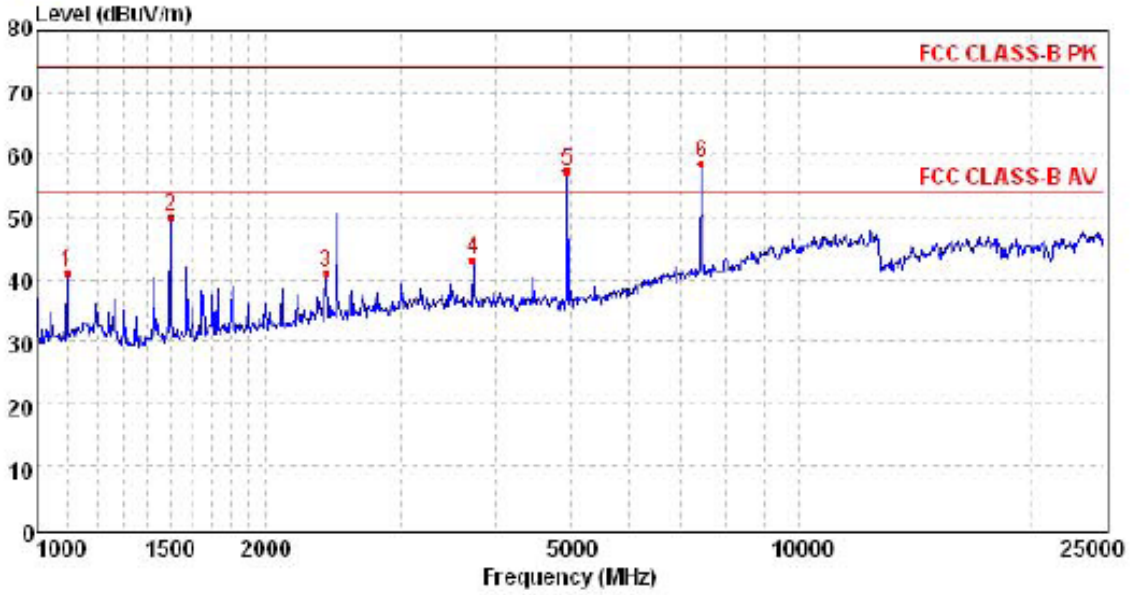


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1498.91	48.37	24.70	5.18	36.83	41.42	74.00	-32.58	Peak
2	2995.54	44.29	28.50	8.17	37.99	42.97	74.00	-31.03	Peak
3	4501.49	42.37	30.90	8.98	38.33	43.92	74.00	-30.08	Peak
4	4958.68	54.93	31.18	9.31	38.62	56.80	74.00	-17.20	Peak
5	7451.57	47.69	36.17	10.95	38.15	56.66	74.00	-17.34	Peak
6	10011.21	35.28	38.40	12.51	38.14	48.05	74.00	-25.95	Peak

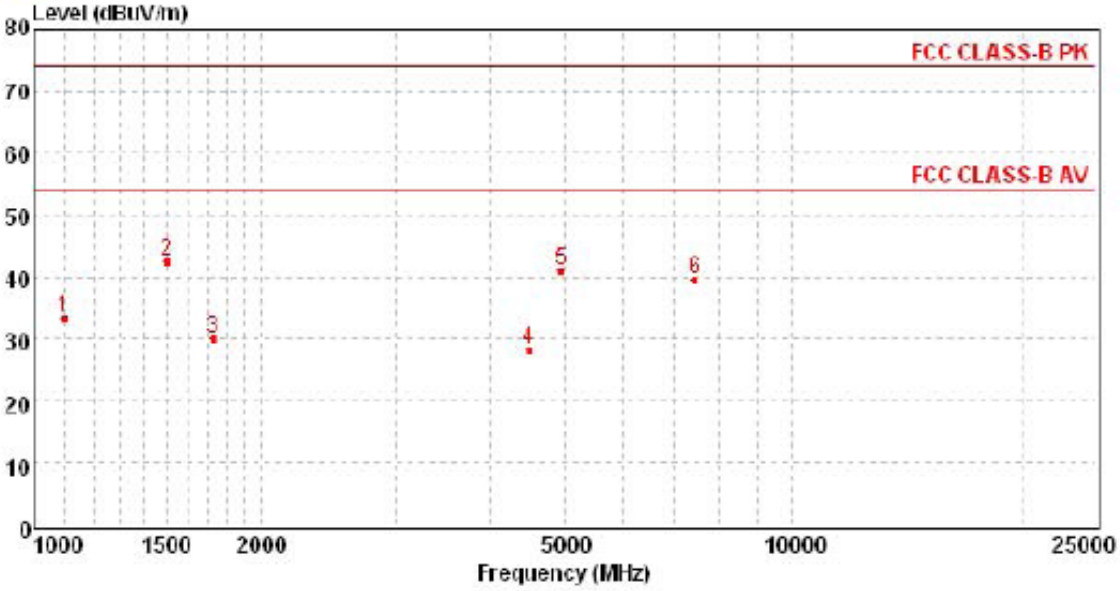


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1098.76	38.67	24.32	4.27	36.39	30.87	54.00	-23.13	Average
2	1299.77	39.06	24.53	4.76	36.63	31.72	54.00	-22.28	Average
3	1498.91	39.14	24.70	5.18	36.83	32.19	54.00	-21.81	Average
4	1724.17	33.67	25.37	5.65	37.03	27.66	54.00	-26.34	Average
5	4958.68	39.55	31.18	9.31	38.62	41.42	54.00	-12.58	Average
6	7451.57	29.89	36.17	10.95	38.15	38.86	54.00	-15.14	Average

CH 39 for BLE	*Horizontal*



Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1098.76	48.94	24.32	4.27	36.39	41.14	74.00	-32.86	Peak
2	1498.91	56.99	24.70	5.18	36.83	50.04	74.00	-23.96	Peak
3	2400.47	44.31	27.57	6.83	37.58	41.13	74.00	-32.87	Peak
4	3738.13	43.31	29.09	8.70	37.99	43.11	74.00	-30.89	Peak
5	4958.68	55.44	31.18	9.31	38.62	57.31	74.00	-16.69	Peak
6	7451.57	49.69	36.17	10.95	38.15	58.66	74.00	-15.34	Peak

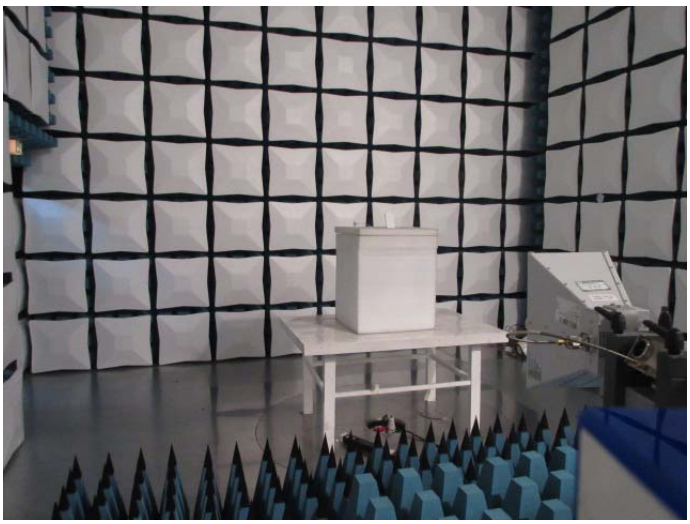


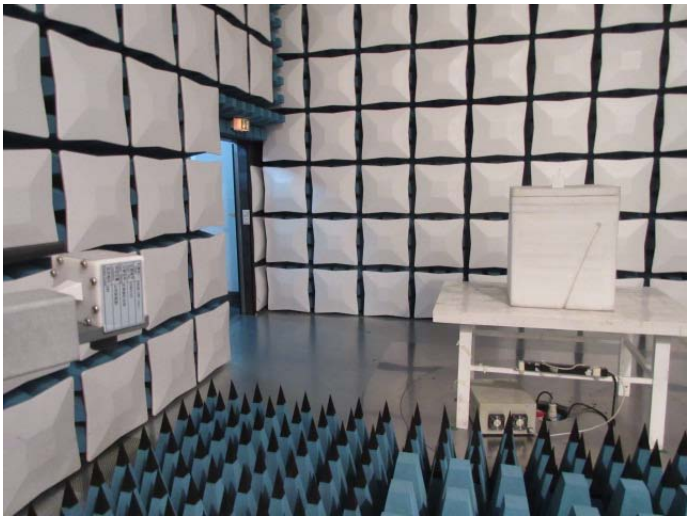
Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1098.76	41.24	24.32	4.27	36.39	33.44	54.00	-20.56	Average
2	1498.91	49.34	24.70	5.18	36.83	42.39	54.00	-11.61	Average
3	1724.17	35.99	25.37	5.65	37.03	29.98	54.00	-24.02	Average
4	4501.49	26.63	30.90	8.98	38.33	28.18	54.00	-25.82	Average
5	4958.68	39.29	31.18	9.31	38.62	41.16	54.00	-12.84	Average
6	7451.57	30.46	36.17	10.95	38.15	39.43	54.00	-14.57	Average

5. Test Setup Photos of the EUT

Conducted Emission

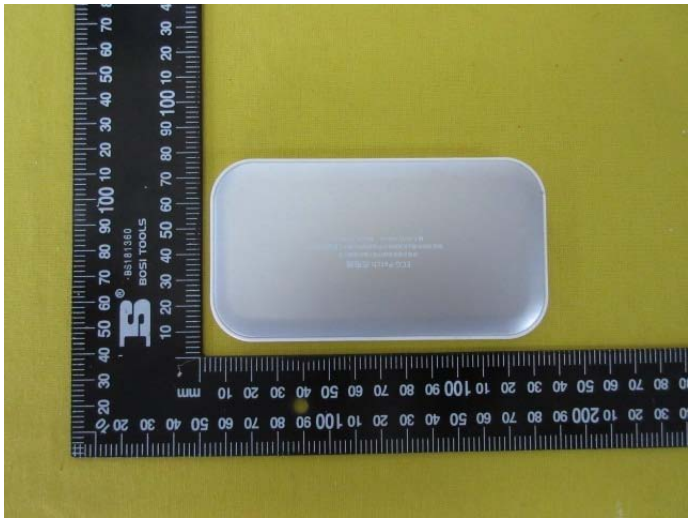
Radiated Emission



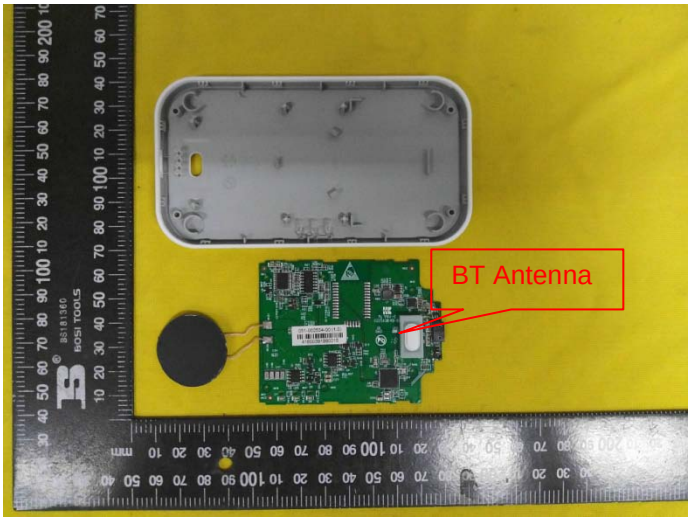


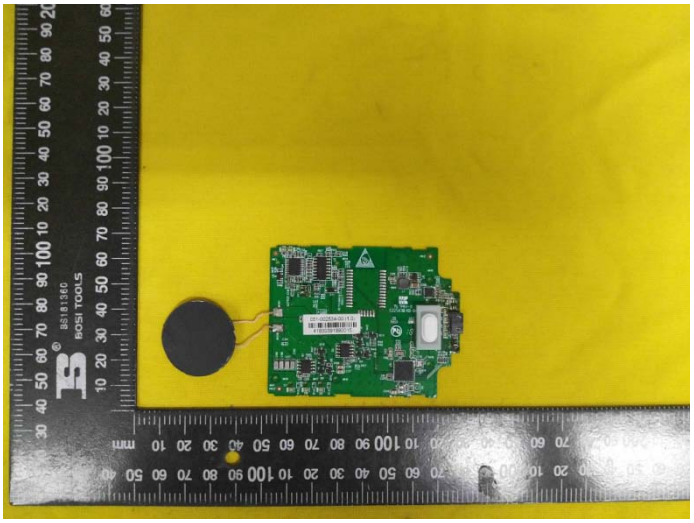
6. External and Internal Photos of the EUT

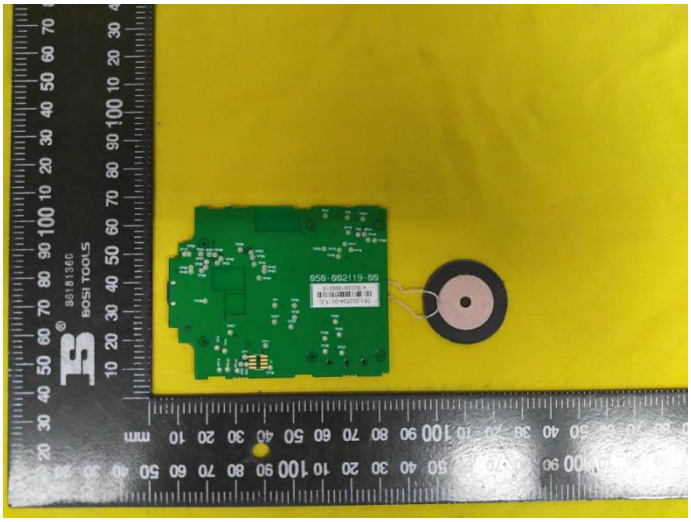
External photos



Internal photos







.....End of Report.....