

- c) Detector = Peak.
- d) Sweep time = auto.
- e) Trace mode = max hold.
- f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be longer for low duty cycle applications).

Table 1—RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Trace averaging across on and off times of the EUT transmissions followed by duty cycle correction:

If continuous transmission of the EUT (i.e., duty cycle ≥ 98 percent) cannot be achieved and the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent), then the following procedure shall be used:

- a) The EUT shall be configured to operate at the maximum achievable duty cycle.
- b) Measure the duty cycle, x , of the transmitter output signal as described in section 6.0.
- c) RBW = 1 MHz (unless otherwise specified).
- d) VBW $\geq 3 \times$ RBW.
- e) Detector = RMS, if $\text{span}/(\# \text{ of points in sweep}) \leq (\text{RBW}/2)$. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
- f) Averaging type = power (i.e., RMS).
 - 1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
 - 2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
- g) Sweep time = auto.
- h) Perform a trace average of at least 100 traces.
- i) A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

- 1) If power averaging (RMS) mode was used in step f), then the applicable correction factor is $10 \log(1/x)$, where x is the duty cycle.
- 2) If linear voltage averaging mode was used in step f), then the applicable correction factor is $20 \log(1/x)$, where x is the duty cycle.
- 3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

NOTE: Reduction of the measured emission amplitude levels to account for operational duty factor is not permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

Determining the applicable transmit antenna gain:

A conducted power measurement will determine the maximum output power associated with a restricted band emission; however, in order to determine the associated EIRP level, the gain of the transmitting antenna (in dBi) must be added to the measured output power (in dBm).

Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.

See KDB 662911 for guidance on calculating the additional array gain term when determining the effective antenna gain for a EUT with multiple outputs occupying the same or overlapping frequency ranges in the same band.

Radiated spurious emission test:

An additional consideration when performing conducted measurements of restricted band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in ANSI C63.10. All detected emissions shall comply with the applicable limits.

The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360° , and both horizontal and vertical polarizations of the

Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

5.7.4 Test Result

Note ¹: The symbol of “--” in the table which means not application.

Note ²: For the test data above 1 GHz, according the ANSI C63.10-2020, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note ³: The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

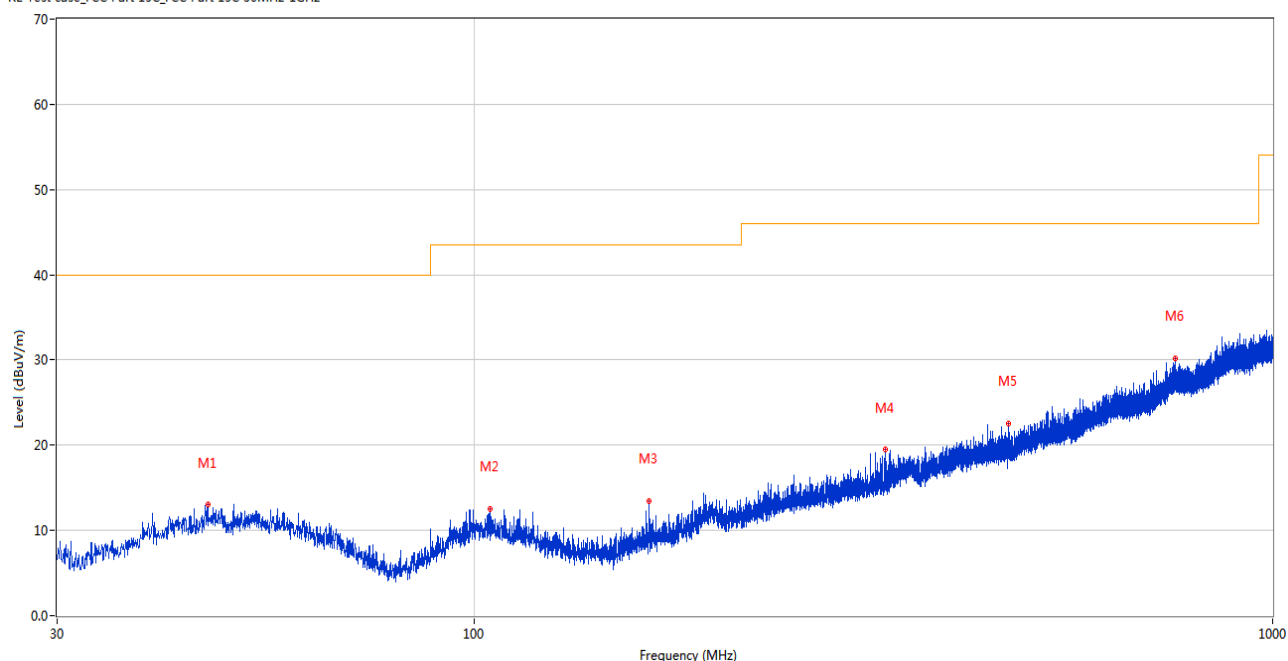
Note ⁴: The EUT was tested in charging test mode.

Note ⁵: Results (dBuV/m) = Original reading level of Spectrum Analyzer (dBuV/m) + Factor (dB)

Test Data and Plots

30 MHz to 1 GHz, ANT H

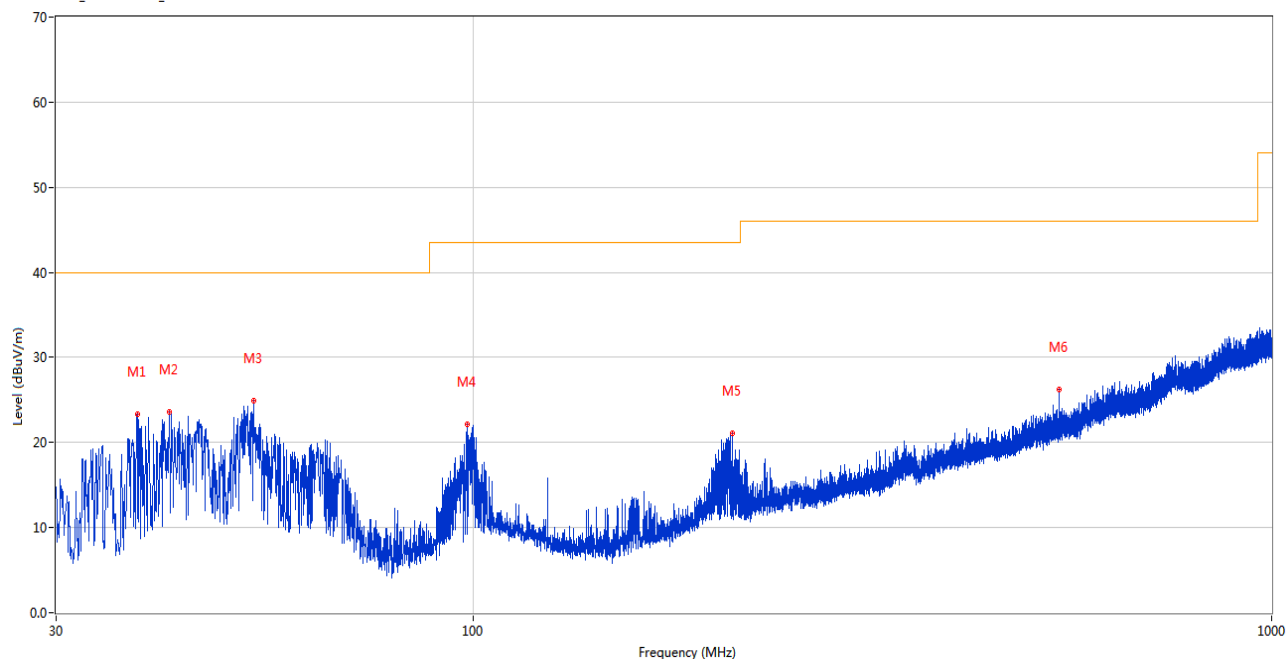
RE Test case_FCC Part 15C_FCC Part 15C 30MHz-1GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	46.344	12.99	-24.28	40.0	27.01	Peak	172.30	100	Horizontal	Pass
2	104.690	12.58	-25.58	43.5	30.92	Peak	103.50	100	Horizontal	Pass
3	165.509	13.41	-27.34	43.5	30.09	Peak	106.70	100	Horizontal	Pass
4	326.820	19.45	-20.70	46.0	26.55	Peak	115.10	100	Horizontal	Pass
5	466.160	22.52	-17.07	46.0	23.48	Peak	335.10	100	Horizontal	Pass
6	755.463	30.20	-8.69	46.0	15.80	Peak	357.60	100	Horizontal	Pass

30 MHz to 1 GHz, ANT V

RE Test case_FCC Part 15C_FCC Part 15C 30MHz-1GHz



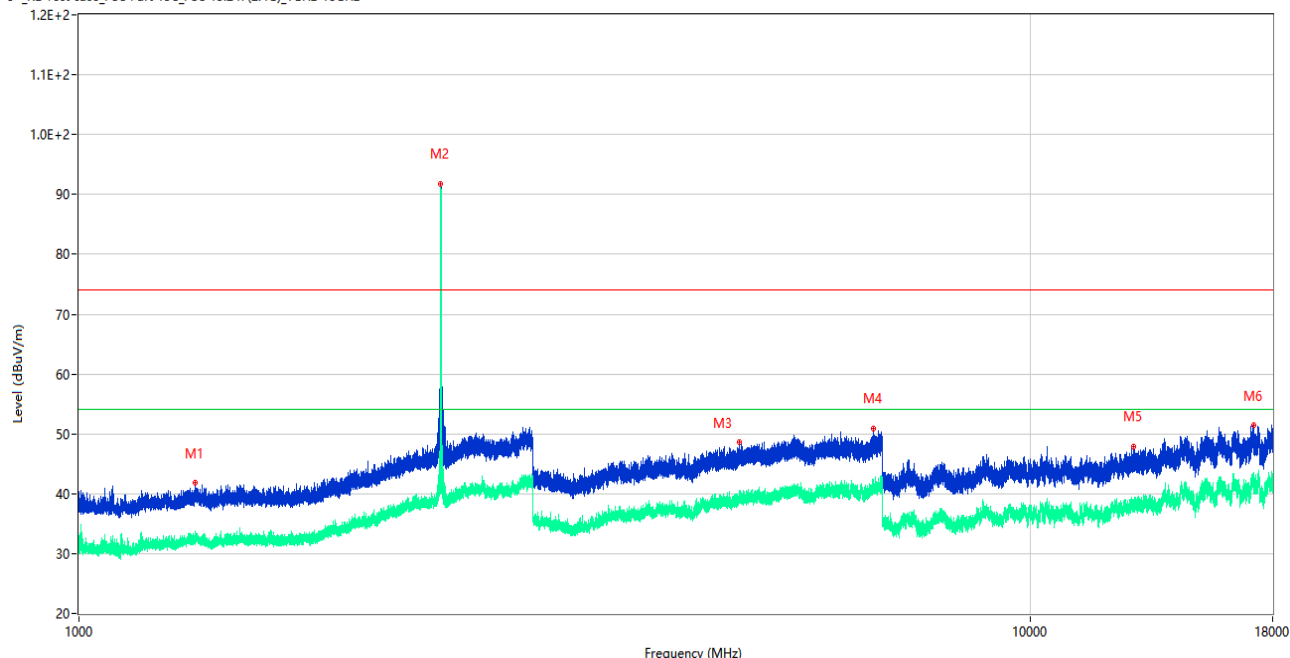
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	37.906	23.34	-26.59	40.0	16.66	Peak	111.60	100	Vertical	Pass
2	41.592	23.61	-25.19	40.0	16.39	Peak	215.90	100	Vertical	Pass
3	52.989	24.89	-24.17	40.0	15.11	Peak	133.50	100	Vertical	Pass
4	98.094	22.20	-26.03	43.5	21.30	Peak	163.10	100	Vertical	Pass
5	210.905	21.10	-24.71	43.5	22.40	Peak	203.00	100	Vertical	Pass
6	541.335	26.29	-14.75	46.0	19.71	Peak	296.30	100	Vertical	Pass

Note 1: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.

Note 2: The spurious from 18GHz-25GHz is noise only, do not show on the report.

GFSK (BLE 1Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT H

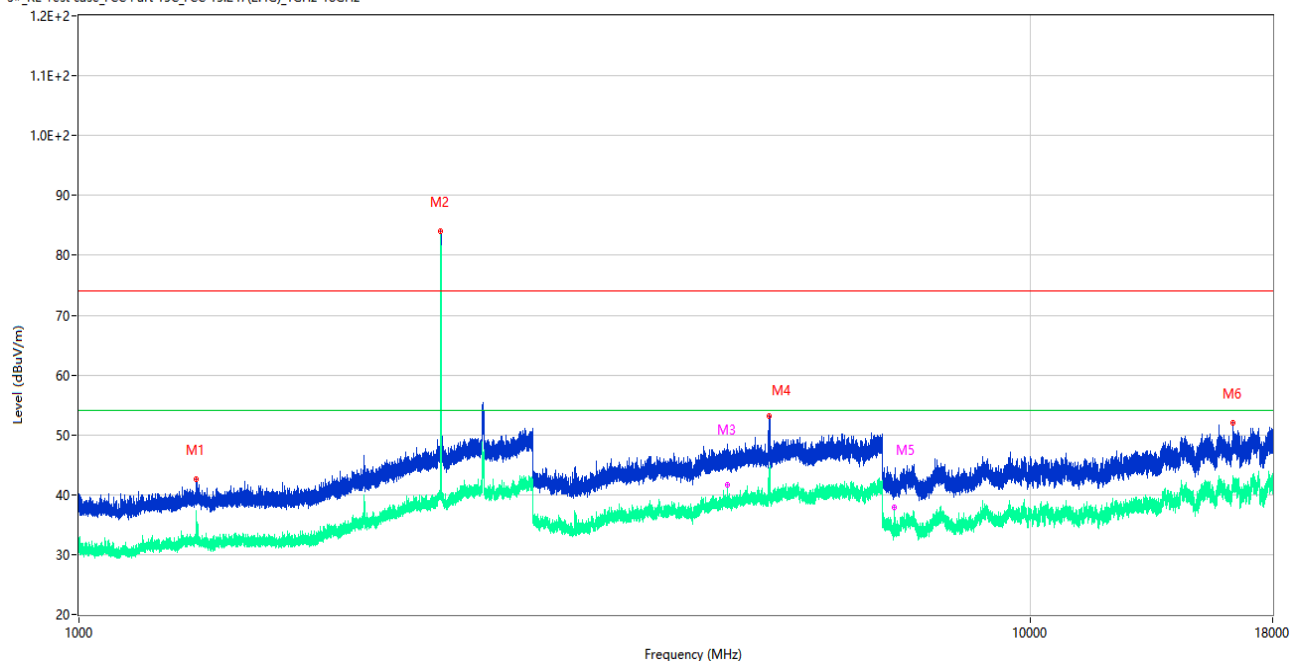
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1325.400	41.82	74.0	32.18	Peak	227.00	300	Horizontal	Pass
1**	1325.400	32.13	54.0	21.87	AV	227.00	300	Horizontal	Pass
2	2402.300	91.83	74.0	-17.83	Peak	0.00	150	Horizontal	N/A
2**	2402.300	91.27	54.0	-37.27	AV	0.00	150	Horizontal	N/A
3	4943.400	48.72	74.0	25.28	Peak	109.00	150	Horizontal	Pass
3**	4943.400	38.94	54.0	15.06	AV	109.00	150	Horizontal	Pass
4	6848.000	50.93	74.0	23.07	Peak	19.00	100	Horizontal	Pass
4**	6848.000	40.91	54.0	13.09	AV	19.00	100	Horizontal	Pass
5	12859.201	47.90	74.0	26.10	Peak	16.00	100	Horizontal	Pass
5**	12859.201	38.82	54.0	15.18	AV	16.00	100	Horizontal	Pass
6	17186.511	51.37	74.0	22.63	Peak	167.00	300	Horizontal	Pass
6**	17186.511	42.16	54.0	11.84	AV	167.00	300	Horizontal	Pass

GFSK (BLE 1Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT V

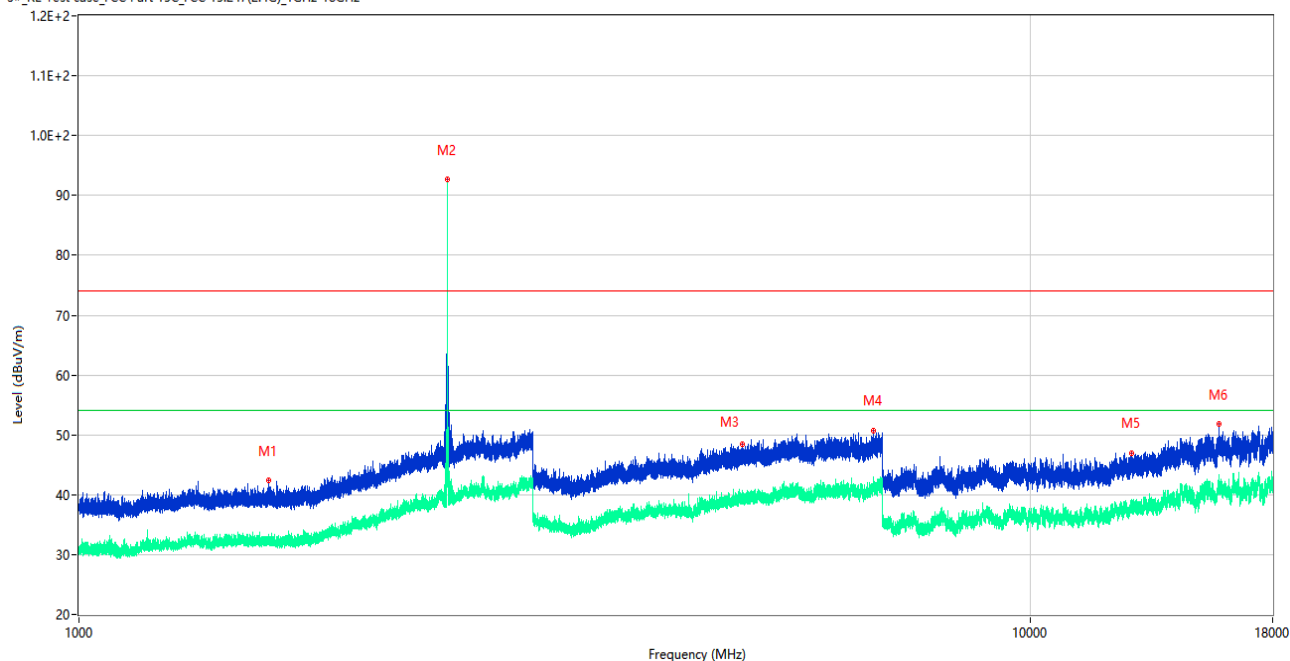
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1327.700	42.54	74.0	31.46	Peak	151.00	300	Vertical	Pass
1**	1327.700	32.36	54.0	21.64	AV	151.00	300	Vertical	Pass
2	2402.300	83.94	74.0	-9.94	Peak	49.00	150	Vertical	N/A
2**	2402.300	82.94	54.0	-28.94	AV	49.00	150	Vertical	N/A
3	4804.000	46.12	74.0	27.88	Peak	308.00	150	Vertical	Pass
3**	4804.000	41.74	54.0	12.26	AV	308.00	150	Vertical	Pass
4	5316.200	53.16	74.0	20.84	Peak	186.00	100	Vertical	Pass
4**	5316.200	44.29	54.0	9.71	AV	186.00	100	Vertical	Pass
5	7205.562	42.99	74.0	31.01	Peak	0.00	150	Vertical	Pass
5**	7205.562	37.88	54.0	16.12	AV	0.00	150	Vertical	Pass
6	16365.150	51.97	74.0	22.03	Peak	222.00	150	Vertical	Pass
6**	16365.150	41.61	54.0	12.39	AV	222.00	150	Vertical	Pass

GFSK (BLE 1Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

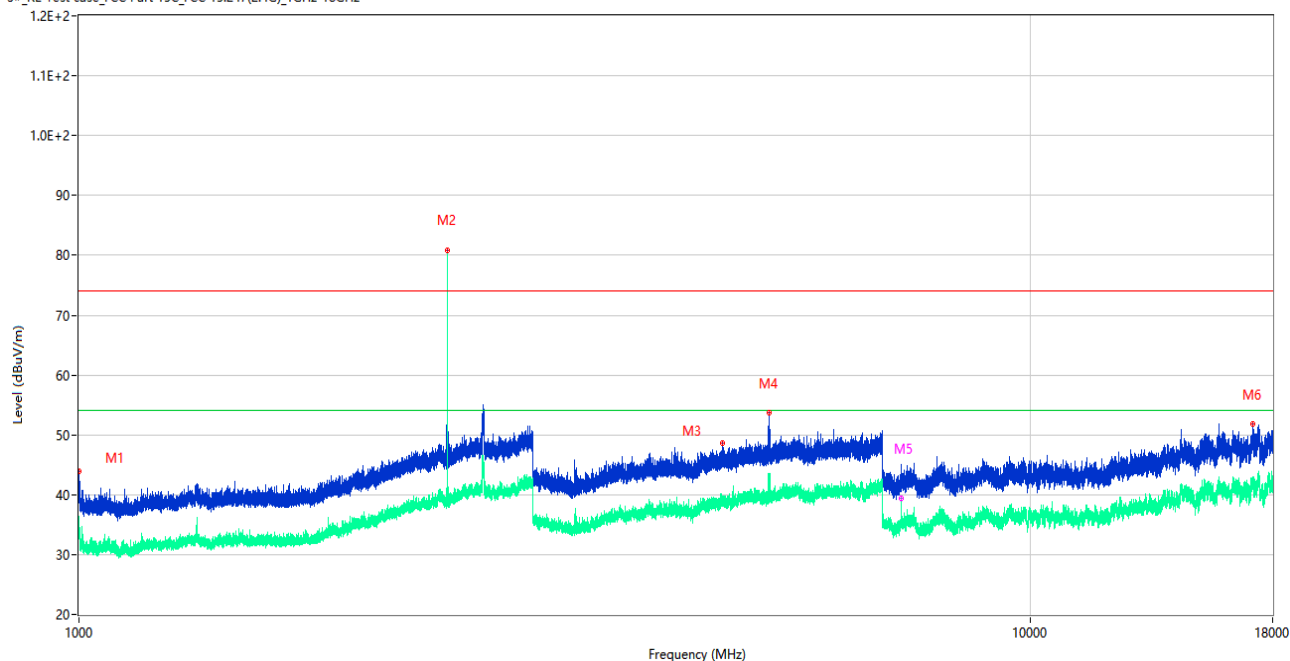
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1582.700	42.40	74.0	31.60	Peak	8.00	300	Horizontal	Pass
1**	1582.700	32.87	54.0	21.13	AV	8.00	300	Horizontal	Pass
2	2439.800	92.66	74.0	-18.66	Peak	0.00	200	Horizontal	N/A
2**	2439.800	91.37	54.0	-37.37	AV	0.00	200	Horizontal	N/A
3	4986.600	48.47	74.0	25.53	Peak	171.00	200	Horizontal	Pass
3**	4986.600	39.31	54.0	14.69	AV	171.00	200	Horizontal	Pass
4	6839.200	50.78	74.0	23.22	Peak	171.00	100	Horizontal	Pass
4**	6839.200	40.60	54.0	13.40	AV	171.00	100	Horizontal	Pass
5	12783.863	46.94	74.0	27.06	Peak	265.00	400	Horizontal	Pass
5**	12783.863	37.72	54.0	16.28	AV	265.00	400	Horizontal	Pass
6	15800.250	51.73	74.0	22.27	Peak	143.00	300	Horizontal	Pass
6**	15800.250	41.72	54.0	12.28	AV	143.00	300	Horizontal	Pass

GFSK (BLE 1Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

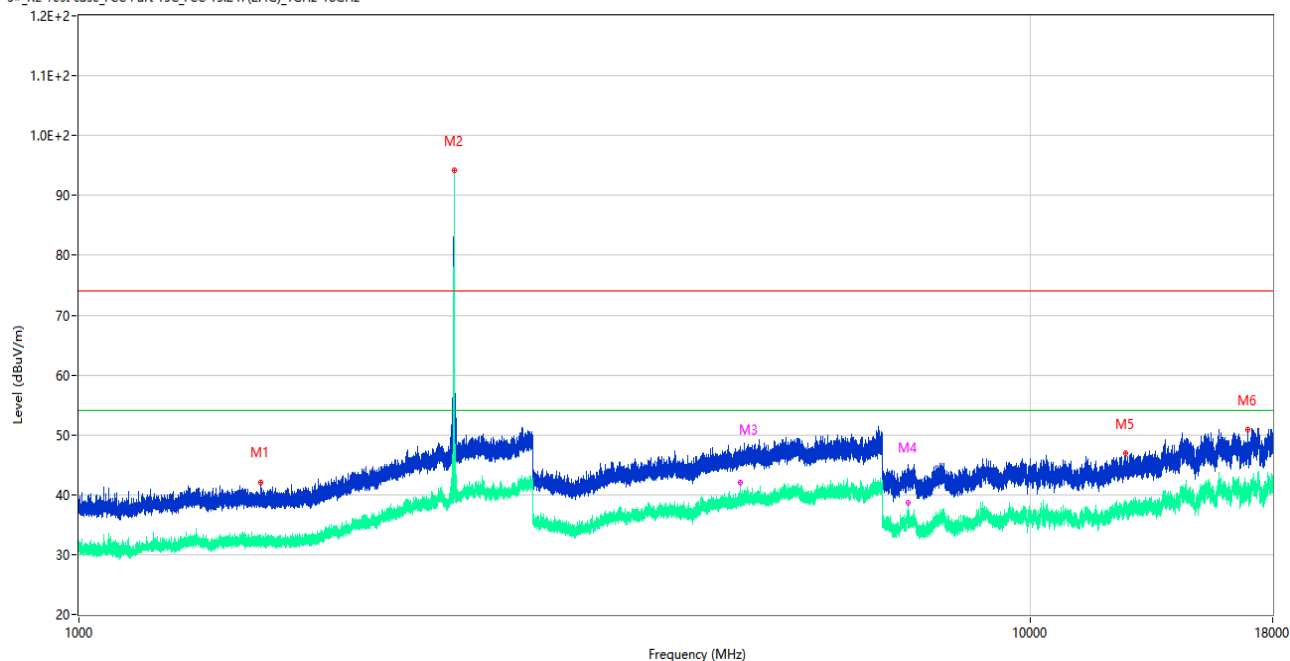
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1000.500	43.92	74.0	30.08	Peak	81.00	400	Vertical	Pass
1**	1000.500	34.05	54.0	19.95	AV	81.00	400	Vertical	Pass
2	2440.200	80.86	74.0	-6.86	Peak	199.00	100	Vertical	N/A
2**	2440.200	80.20	54.0	-26.20	AV	199.00	100	Vertical	N/A
3	4747.600	48.55	74.0	25.45	Peak	263.00	100	Vertical	Pass
3**	4747.600	38.93	54.0	15.07	AV	263.00	100	Vertical	Pass
4	5317.800	53.68	74.0	20.32	Peak	72.00	300	Vertical	Pass
4**	5317.800	43.31	54.0	10.69	AV	72.00	300	Vertical	Pass
5	7319.700	44.43	74.0	29.57	Peak	208.00	150	Vertical	Pass
5**	7319.700	39.48	54.0	14.52	AV	208.00	150	Vertical	Pass
6	17147.662	51.79	74.0	22.21	Peak	224.00	300	Vertical	Pass
6**	17147.662	41.47	54.0	12.53	AV	224.00	300	Vertical	Pass

GFSK (BLE 1Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT H

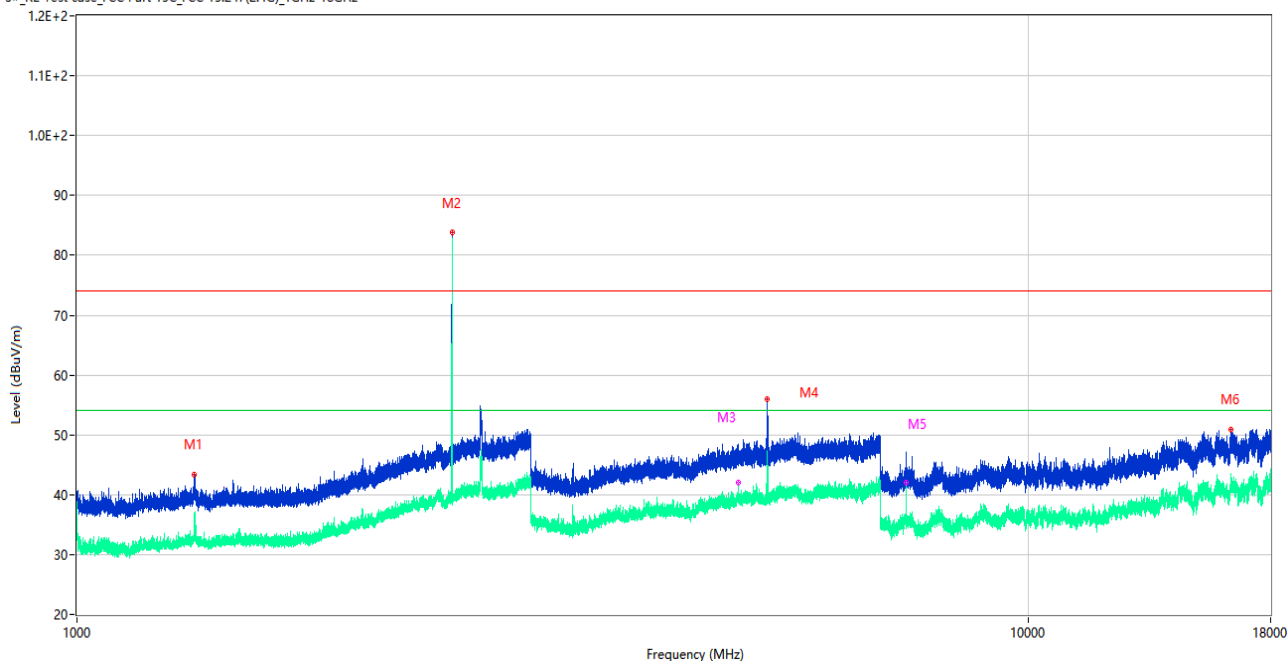
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1552.900	42.12	74.0	31.88	Peak	104.00	300	Horizontal	Pass
1**	1552.900	33.18	54.0	20.82	AV	104.00	300	Horizontal	Pass
2	2479.800	94.18	74.0	-20.18	Peak	360.00	100	Horizontal	N/A
2**	2479.800	93.69	54.0	-39.69	AV	360.00	100	Horizontal	N/A
3	4960.400	45.91	74.0	28.09	Peak	285.00	150	Horizontal	Pass
3**	4960.400	42.06	54.0	11.94	AV	285.00	150	Horizontal	Pass
4	7441.025	42.21	74.0	31.79	Peak	49.00	150	Horizontal	Pass
4**	7441.025	38.61	54.0	15.39	AV	49.00	150	Horizontal	Pass
5	12616.025	46.89	74.0	27.11	Peak	203.00	400	Horizontal	Pass
5**	12616.025	38.11	54.0	15.89	AV	203.00	400	Horizontal	Pass
6	16939.500	50.82	74.0	23.18	Peak	344.00	300	Horizontal	Pass
6**	16939.500	40.44	54.0	13.56	AV	344.00	300	Horizontal	Pass

GFSK (BLE 1Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT V

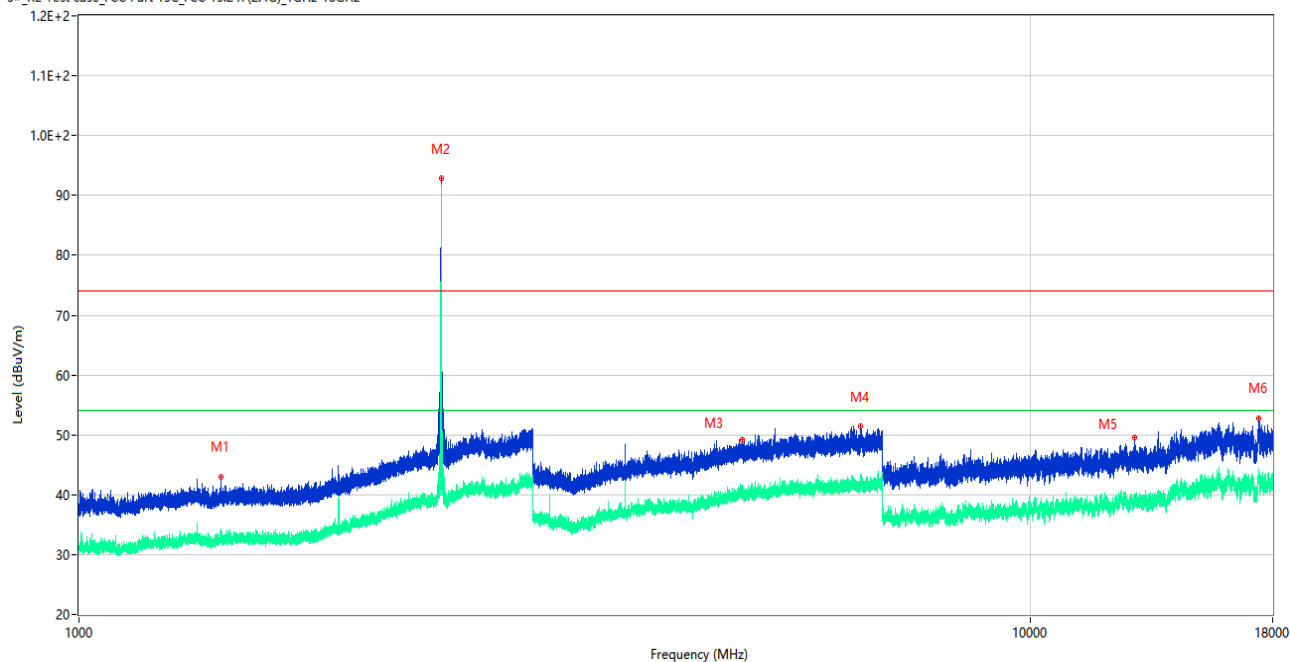
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1327.200	43.34	74.0	30.66	Peak	158.00	300	Vertical	Pass
1**	1327.200	33.74	54.0	20.26	AV	158.00	300	Vertical	Pass
2	2480.300	83.77	74.0	-9.77	Peak	55.00	150	Vertical	N/A
2**	2480.300	82.91	54.0	-28.91	AV	55.00	150	Vertical	N/A
3	4960.800	46.56	74.0	27.44	Peak	274.00	150	Vertical	Pass
3**	4960.800	42.01	54.0	11.99	AV	274.00	150	Vertical	Pass
4	5321.600	55.97	74.0	18.03	Peak	68.00	400	Vertical	Pass
4**	5321.600	41.06	54.0	12.94	AV	68.00	400	Vertical	Pass
5	7439.587	46.24	74.0	27.76	Peak	328.00	150	Vertical	Pass
5**	7439.587	41.98	54.0	12.02	AV	328.00	150	Vertical	Pass
6	16365.674	50.93	74.0	23.07	Peak	96.00	100	Vertical	Pass
6**	16365.674	41.72	54.0	12.28	AV	96.00	100	Vertical	Pass

GFSK (BLE 2Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT H

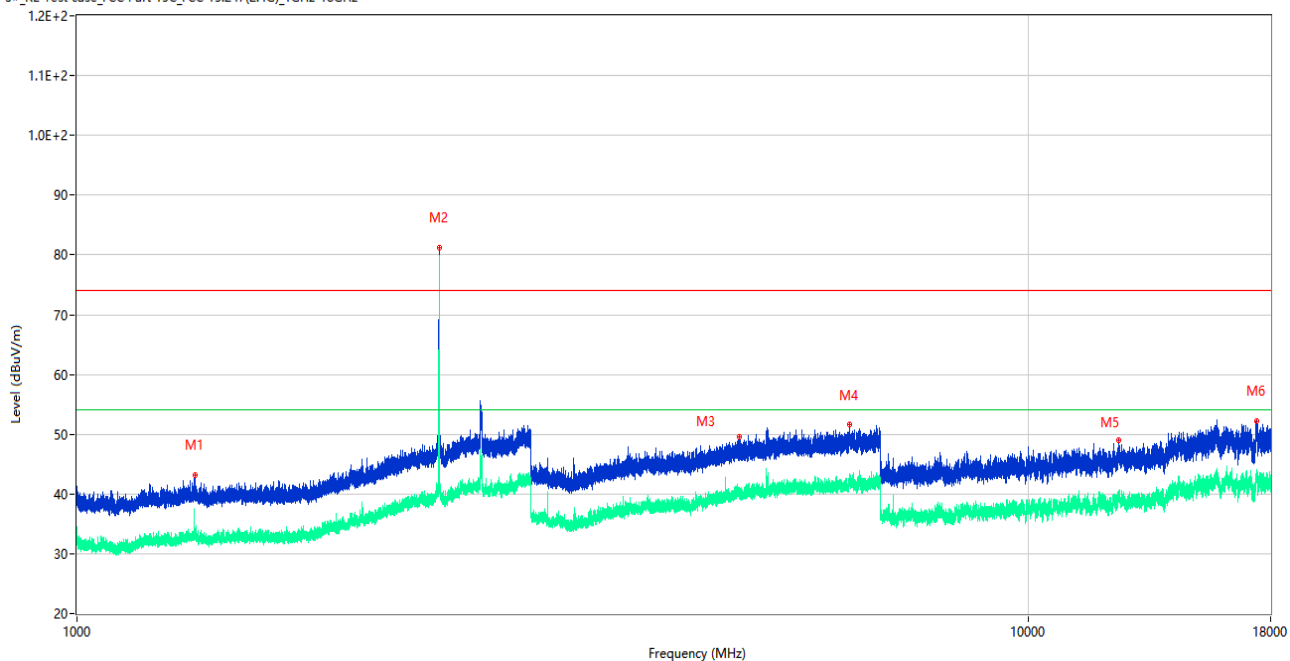
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1410.100	43.05	74.0	30.95	Peak	295.00	200	Horizontal	Pass
1**	1410.100	32.45	54.0	21.55	AV	295.00	200	Horizontal	Pass
2	2404.500	92.86	74.0	-18.86	Peak	352.00	200	Horizontal	N/A
2**	2404.500	90.04	54.0	-36.04	AV	352.00	200	Horizontal	N/A
3	4978.800	49.23	74.0	24.77	Peak	339.00	200	Horizontal	Pass
3**	4978.800	39.75	54.0	14.25	AV	339.00	200	Horizontal	Pass
4	6642.800	51.44	74.0	22.56	Peak	122.00	100	Horizontal	Pass
4**	6642.800	42.15	54.0	11.85	AV	122.00	100	Horizontal	Pass
5	12883.088	49.51	74.0	24.49	Peak	153.00	100	Horizontal	Pass
5**	12883.088	38.47	54.0	15.53	AV	153.00	100	Horizontal	Pass
6	17392.574	52.80	74.0	21.20	Peak	316.00	200	Horizontal	Pass
6**	17392.574	42.95	54.0	11.05	AV	316.00	200	Horizontal	Pass

GFSK (BLE 2Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT V

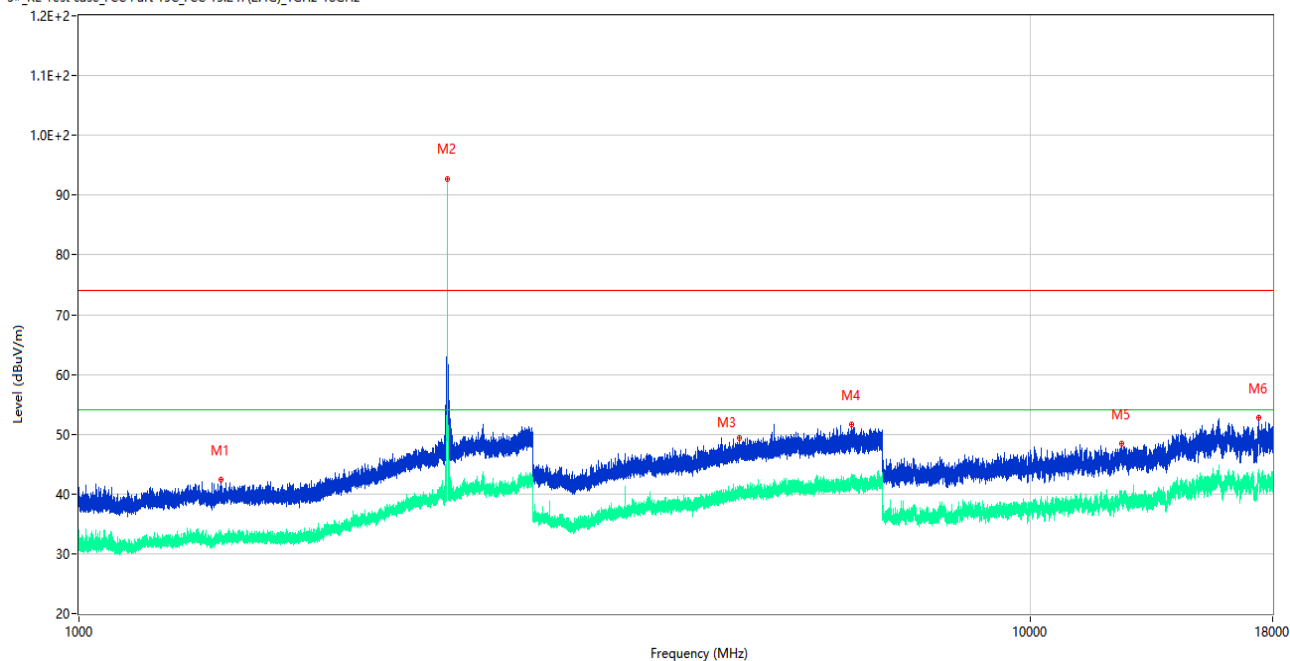
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1332.800	43.24	74.0	30.76	Peak	132.00	300	Vertical	Pass
1**	1332.800	32.88	54.0	21.12	AV	132.00	300	Vertical	Pass
2	2403.500	81.22	74.0	-7.22	Peak	334.00	100	Vertical	N/A
2**	2403.500	78.53	54.0	-24.53	AV	334.00	100	Vertical	N/A
3	4977.400	49.52	74.0	24.48	Peak	317.00	150	Vertical	Pass
3**	4977.400	40.41	54.0	13.59	AV	317.00	150	Vertical	Pass
4	6494.000	51.58	74.0	22.42	Peak	352.00	300	Vertical	Pass
4**	6494.000	42.20	54.0	11.80	AV	352.00	300	Vertical	Pass
5	12446.687	49.02	74.0	24.98	Peak	32.00	200	Vertical	Pass
5**	12446.687	39.55	54.0	14.45	AV	32.00	200	Vertical	Pass
6	17389.162	52.27	74.0	21.73	Peak	16.00	200	Vertical	Pass
6**	17389.162	44.00	54.0	10.00	AV	16.00	200	Vertical	Pass

GFSK (BLE 2Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

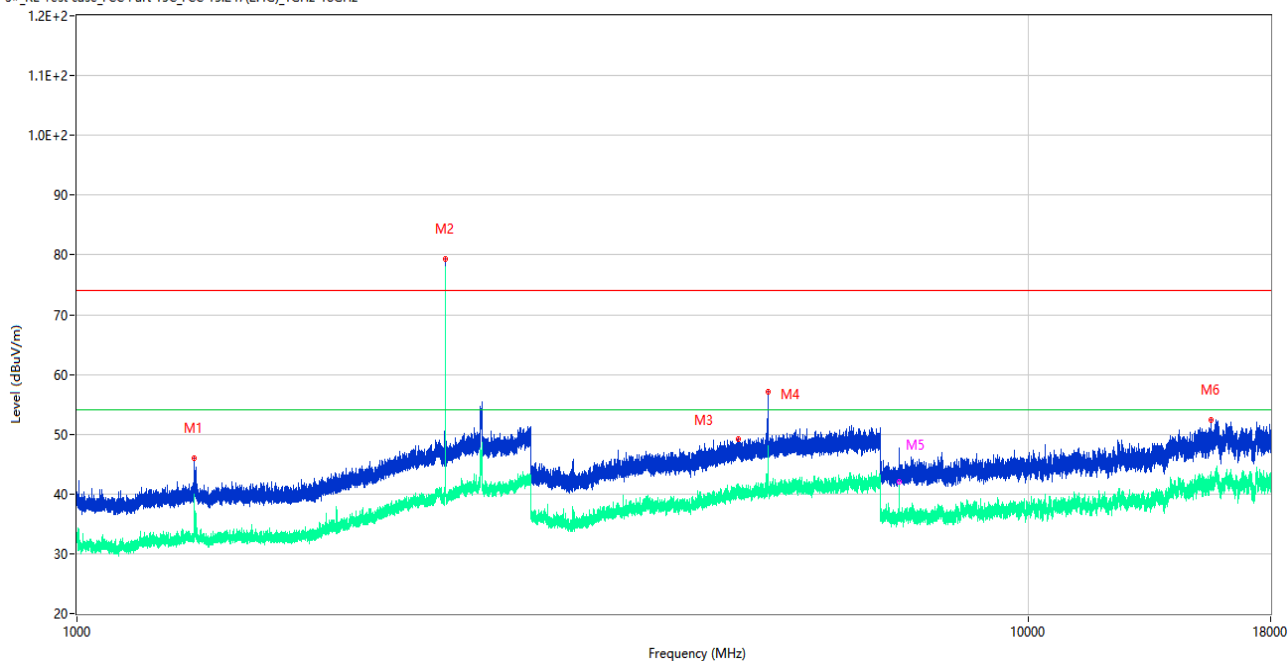
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1409.900	42.34	74.0	31.66	Peak	246.00	100	Horizontal	Pass
1**	1409.900	32.48	54.0	21.52	AV	246.00	100	Horizontal	Pass
2	2440.000	92.77	74.0	-18.77	Peak	333.00	100	Horizontal	N/A
2**	2440.000	91.06	54.0	-37.06	AV	333.00	100	Horizontal	N/A
3	4946.000	49.46	74.0	24.54	Peak	202.00	150	Horizontal	Pass
3**	4946.000	40.71	54.0	13.29	AV	202.00	150	Horizontal	Pass
4	6500.600	51.62	74.0	22.38	Peak	305.00	400	Horizontal	Pass
4**	6500.600	42.24	54.0	11.76	AV	305.00	400	Horizontal	Pass
5	12491.825	48.35	74.0	25.65	Peak	345.00	400	Horizontal	Pass
5**	12491.825	39.62	54.0	14.38	AV	345.00	400	Horizontal	Pass
6	17395.988	52.75	74.0	21.25	Peak	360.00	400	Horizontal	Pass
6**	17395.988	43.21	54.0	10.79	AV	360.00	400	Horizontal	Pass

GFSK (BLE 2Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

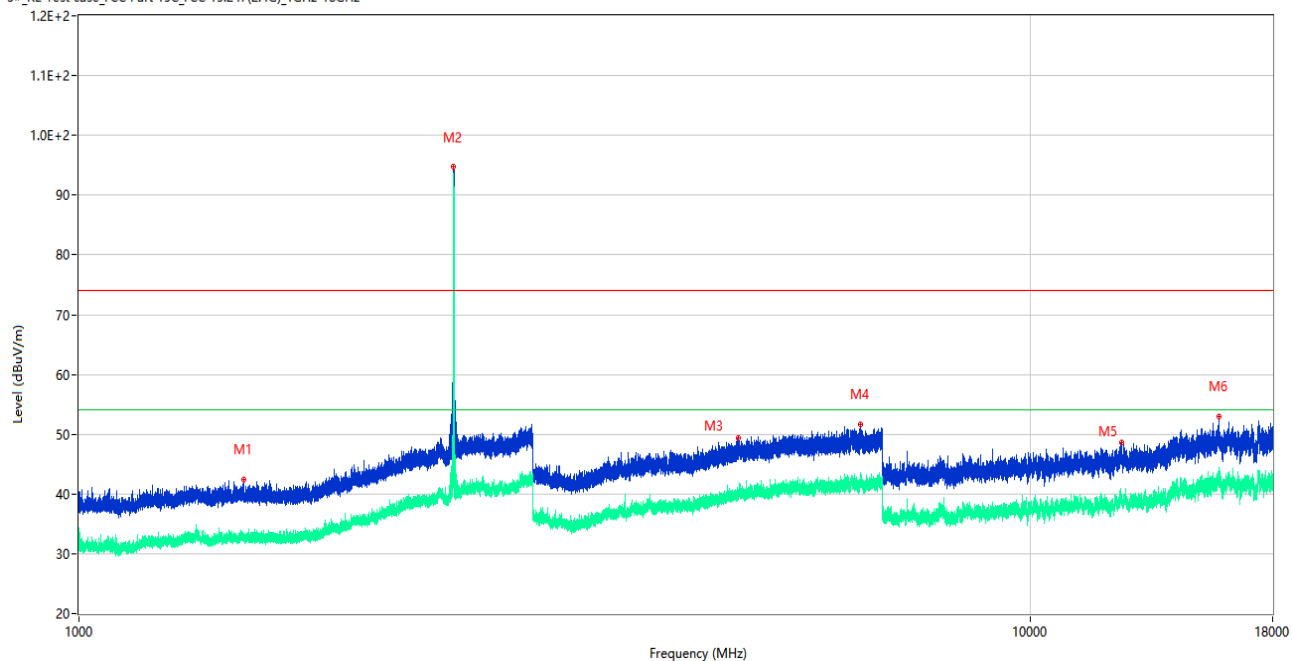
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1328.300	46.07	74.0	27.93	Peak	138.00	200	Vertical	Pass
1**	1328.300	33.99	54.0	20.01	AV	138.00	200	Vertical	Pass
2	2439.500	79.34	74.0	-5.34	Peak	119.00	150	Vertical	N/A
2**	2439.500	76.83	54.0	-22.83	AV	119.00	150	Vertical	N/A
3	4960.800	49.18	74.0	24.82	Peak	249.00	200	Vertical	Pass
3**	4960.800	40.64	54.0	13.36	AV	249.00	200	Vertical	Pass
4	5331.400	57.01	74.0	16.99	Peak	80.00	300	Vertical	Pass
4**	5331.400	41.89	54.0	12.11	AV	80.00	300	Vertical	Pass
5	7318.837	46.29	74.0	27.71	Peak	0.00	150	Vertical	Pass
5**	7318.837	42.05	54.0	11.95	AV	0.00	150	Vertical	Pass
6	15587.363	52.47	74.0	21.53	Peak	286.00	200	Vertical	Pass
6**	15587.363	42.75	54.0	11.25	AV	286.00	200	Vertical	Pass

GFSK (BLE 2Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT H

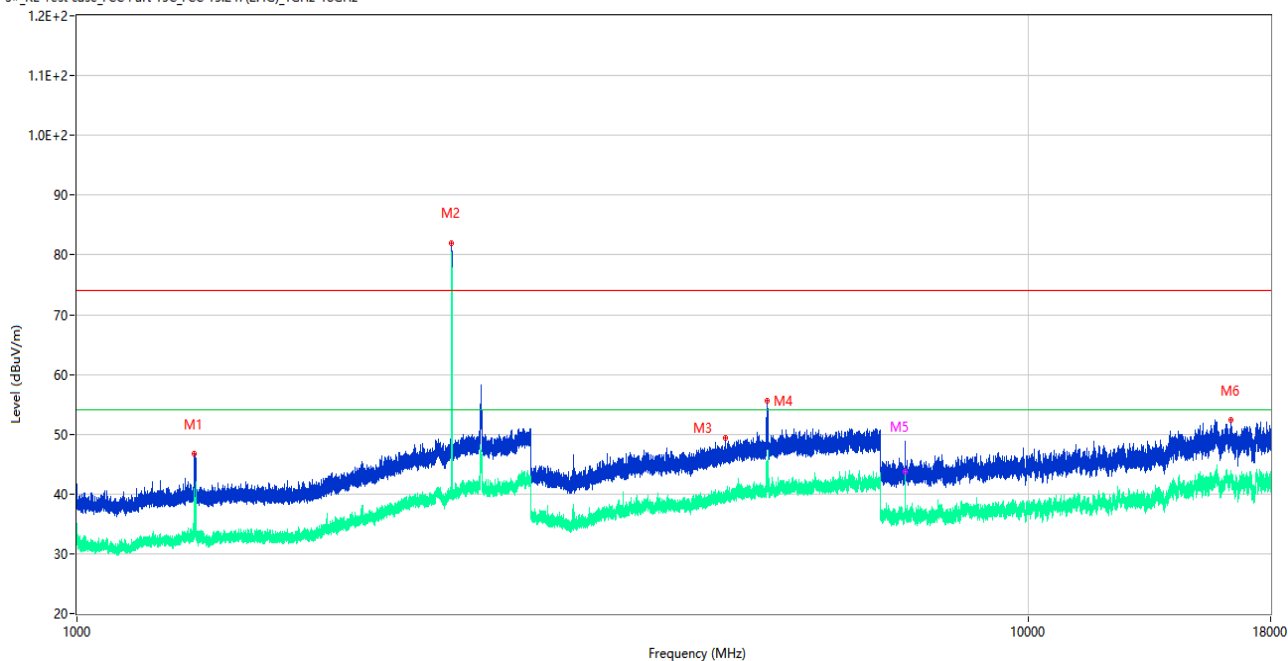
3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1490.900	42.44	74.0	31.56	Peak	0.00	200	Horizontal	Pass
1**	1490.900	32.38	54.0	21.62	AV	0.00	200	Horizontal	Pass
2	2477.500	94.74	74.0	-20.74	Peak	344.00	100	Horizontal	N/A
2**	2477.500	92.35	54.0	-38.35	AV	344.00	100	Horizontal	N/A
3	4931.600	49.40	74.0	24.60	Peak	173.00	150	Horizontal	Pass
3**	4931.600	40.36	54.0	13.64	AV	173.00	150	Horizontal	Pass
4	6636.000	51.66	74.0	22.34	Peak	81.00	200	Horizontal	Pass
4**	6636.000	41.64	54.0	12.36	AV	81.00	200	Horizontal	Pass
5	12478.599	48.53	74.0	25.47	Peak	157.00	400	Horizontal	Pass
5**	12478.599	39.34	54.0	14.66	AV	157.00	400	Horizontal	Pass
6	15794.737	53.03	74.0	20.97	Peak	187.00	400	Horizontal	Pass
6**	15794.737	44.06	54.0	9.94	AV	187.00	400	Horizontal	Pass

GFSK (BLE 2Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT V

3#_RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1327.700	46.71	74.0	27.29	Peak	152.00	100	Vertical	Pass
1**	1327.700	33.65	54.0	20.35	AV	152.00	100	Vertical	Pass
2	2477.400	82.00	74.0	-8.00	Peak	33.00	200	Vertical	N/A
2**	2477.400	78.22	54.0	-24.22	AV	33.00	200	Vertical	N/A
3	4807.600	49.37	74.0	24.63	Peak	349.00	200	Vertical	Pass
3**	4807.600	39.23	54.0	14.77	AV	349.00	200	Vertical	Pass
4	5317.600	55.52	74.0	18.48	Peak	87.00	200	Vertical	Pass
4**	5317.600	41.57	54.0	12.43	AV	87.00	200	Vertical	Pass
5	7432.975	48.00	74.0	26.00	Peak	345.00	150	Vertical	Pass
5**	7432.975	43.70	54.0	10.30	AV	345.00	150	Vertical	Pass
6	16344.674	52.35	74.0	21.65	Peak	94.00	200	Vertical	Pass
6**	16344.674	42.64	54.0	11.36	AV	94.00	200	Vertical	Pass

5.8 Band Edge (Restricted-band band-edge)

5.8.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.8.2 Test Setup

See section 4.5.3 to 4.5.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

5.8.3 Test Procedure

The following procedures may be used to determine the average field strength or power of an unwanted emission that is within 2 MHz of the authorized band-edge. Use the procedure described in 11.12.3.2.2 when using an average detector and the EUT can be configured to transmit continuously (i.e., $D \geq 98\%$). Use the procedure described in 11.12.3.2.3 when using an average detector and the EUT cannot be configured to transmit continuously but the duty cycle is constant (i.e., duty cycle variations are less than $\pm 2\%$). Use the procedure described in 11.12.3.2.4 when using an average detector for those cases where the EUT cannot be configured to transmit continuously and the duty cycle is not constant (duty cycle variations equal or exceed 2%).

If the EUT can be configured or modified to transmit continuously ($D \geq 98\%$), measured using the following method (with EUT transmitting continuously):

Use the following spectrum analyzer settings:

Set instrument center frequency to the frequency of the emission to be measured (must be within 2 MHz of the authorized band-edge).

RBW = 100 kHz.

VBW $\geq [3 \times \text{RBW}]$.

Detector = Power averaging (rms), if $[\text{span} / (\# \text{ of points in sweep})] \leq (\text{RBW} / 2)$.

Averaging type = power (i.e., rms):

As an alternative, the detector and averaging type may be set for linear voltage averaging.

Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.

Sweep time = auto.

Perform a trace average of at least 100 traces.

Compute the power by integrating the spectrum over 1 MHz using the analyzer's band-power

measurement function with band limits set equal to the emission frequency (femission) ± 0.5 MHz. If the instrument does not have a band-power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by femission) ± 0.5 MHz.

If continuous transmission of the EUT ($D \geq 98\%$) cannot be achieved and the duty cycle is constant (duty cycle variations are less $\pm 2\%$), then the following procedure may be used to measure the average power of unwanted emissions within 2 MHz of the authorized band-edge:

RBW = 100 kHz.

VBW $\geq [3 \times \text{RBW}]$.

Detector = Power averaging (rms), if $[\text{span} / (\# \text{ of points in sweep})] \leq (\text{RBW} / 2)$.

Averaging type = power (i.e., rms):

Detector = Power averaging (rms), if $[\text{span} / (\# \text{ of points in sweep})] \leq (\text{RBW} / 2)$. Satisfying this condition might require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

Averaging type = power (i.e., rms):

- 1) As an alternative, the detector and averaging type may be set for linear voltage averaging
- 2) Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.

Sweep time = auto.

Perform a trace average of at least 100 traces.

Compute the power by integrating the spectrum over 1 MHz using the instrument's band-power measurement function with band limits set equal to the emission frequency (femission) ± 0.5 MHz. If the spectrum analyzer does not have a band-power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by femission ± 0.5 MHz.

A correction factor shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:

1) If power averaging (rms) mode was used in step f), then the applicable correction factor is $[10 \log (1 / D)]$, where D is the duty cycle.

2) If linear voltage averaging mode was used in step f), then the applicable correction factor is $[20 \log (1 / D)]$, where D is the duty cycle.

3) If a specific emission is demonstrated to be continuous ($D \geq 98\%$) rather than turning ON and

OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Reduction of the measured emission amplitude levels to account for operational duty cycle is not permitted. Determining compliance is based on emission levels occurring during transmission—it is not based on an average across ON and OFF times of the transmitter.

5.8.4 Test Result

Note ¹: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Note ²: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

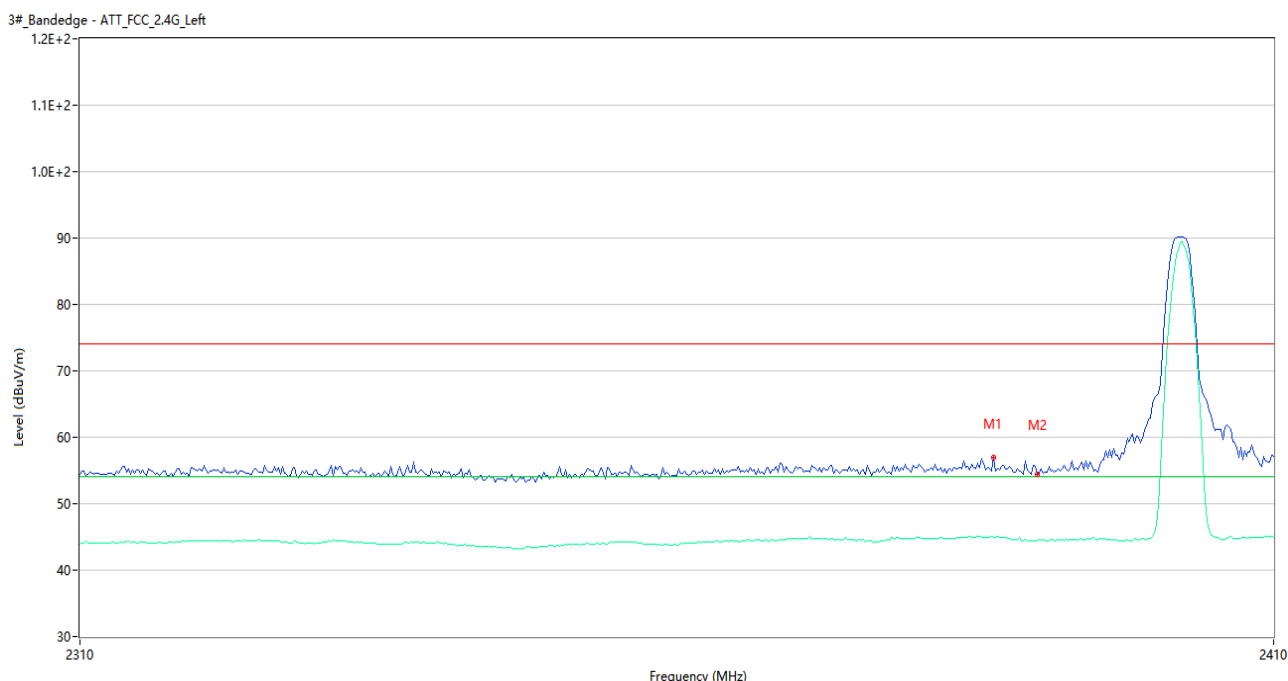
Note ³: According the ANSI C63.10-2020, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note ⁴: The Level (dBuV/m) has been corrected by factor.

Note ⁵: Both horizontal and vertical directions were pre tested, only the worst configuration has been reported in this report.

Test Data

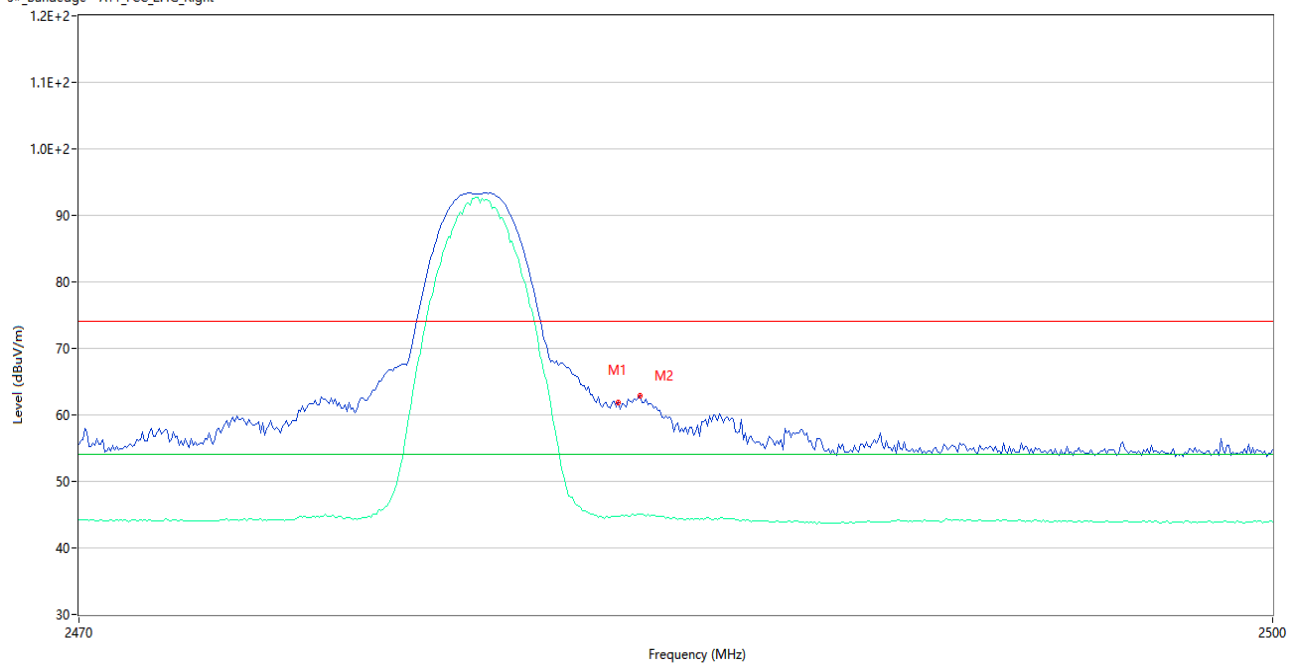
GFSK (BLE 1Mbps) LOW CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2386.167	56.97	74.0	17.03	Peak	183.00	100	Horizontal	Pass
1**	2386.167	44.92	54.0	9.08	AV	183.00	100	Horizontal	Pass
2	2389.833	54.37	74.0	19.63	Peak	35.00	100	Horizontal	Pass
2**	2389.833	44.40	54.0	9.60	AV	35.00	100	Horizontal	Pass

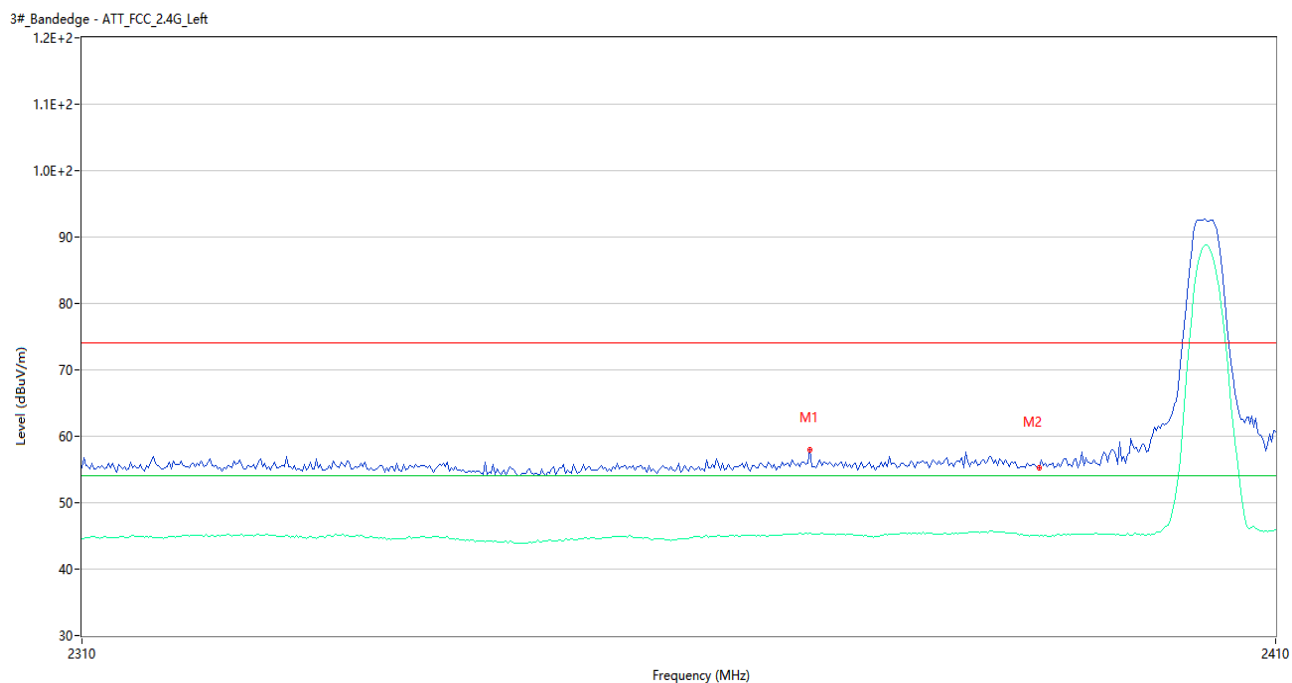
GFSK (BLE 1Mbps) HIGH CHANNEL

3#_Bandedge - ATT_FCC_2.4G_Right



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.500	61.78	74.0	12.22	Peak	0.00	150	Horizontal	Pass
1**	2483.500	44.73	54.0	9.27	AV	0.00	150	Horizontal	Pass
2	2484.050	62.80	74.0	11.20	Peak	0.00	150	Horizontal	Pass
2**	2484.050	45.14	54.0	8.86	AV	0.00	150	Horizontal	Pass

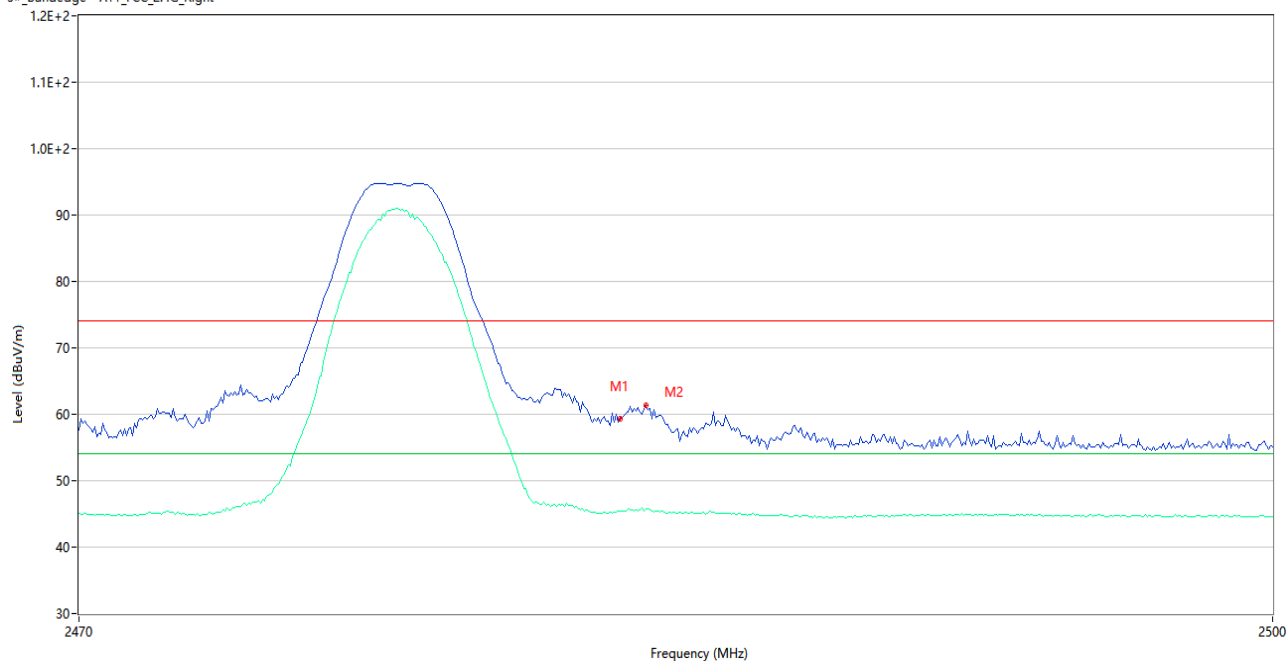
GFSK (BLE 2Mbps) LOW CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2370.500	57.91	74.0	16.09	Peak	280.00	200	Horizontal	Pass
1**	2370.500	45.39	54.0	8.61	AV	280.00	200	Horizontal	Pass
2	2389.833	55.21	74.0	18.79	Peak	12.00	150	Horizontal	Pass
2**	2389.833	44.99	54.0	9.01	AV	12.00	150	Horizontal	Pass

GFSK (BLE 2Mbps) HIGH CHANNEL

3#_Bandedge - ATT_FCC_2.4G_Right



No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.550	59.31	74.0	14.69	Peak	0.00	100	Horizontal	Pass
1**	2483.550	45.35	54.0	8.65	AV	0.00	100	Horizontal	Pass
2	2484.200	61.34	74.0	12.66	Peak	349.00	200	Horizontal	Pass
2**	2484.200	45.76	54.0	8.24	AV	349.00	200	Horizontal	Pass

5.9 Power Spectral density (PSD)

5.9.1 Limit

FCC §15.247(e)

The same method of determining the conducted output power shall be used to determine the power spectral density. If a peak output power is measured, then a peak power spectral density measurement is required. If an average output power is measured, then an average power spectral density measurement should be used.

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

5.9.2 Test Setup

See section 4.5.1 (Diagram 1) for test setup description for the antenna port. The photo of test setup please refer to ANNEX A.

5.9.3 Test Procedure

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.

Set the VBW $\geq 3 \text{ RBW}$.

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 within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.9.4 Test Result

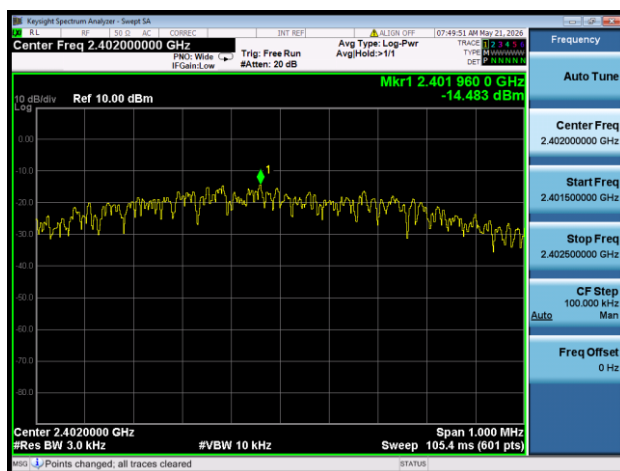
Test Data

GFSK (BLE 1Mbps)			
Channel	Spectral power density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	-14.48	8	Pass
Middle Channel	-13.78	8	Pass
High Channel	-14.23	8	Pass

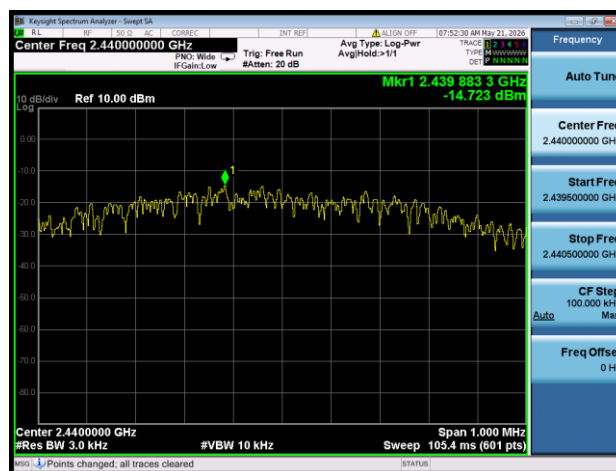
GFSK (BLE 2Mbps)			
Channel	Spectral power density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	-16.81	8	Pass
Middle Channel	-16.83	8	Pass
High Channel	-17.16	8	Pass

Test Plots

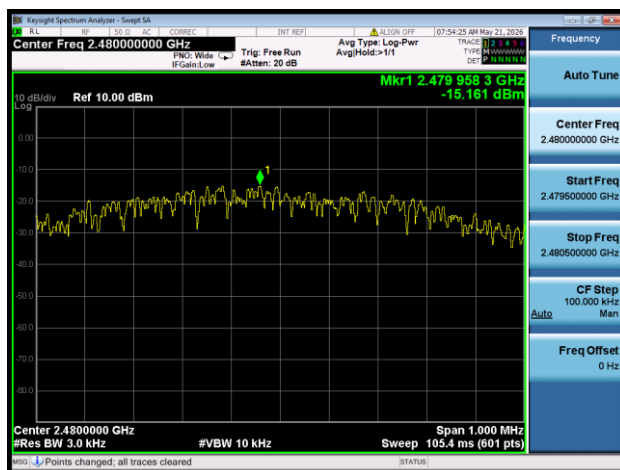
GFSK (BLE 1Mbps) LOW CHANNEL



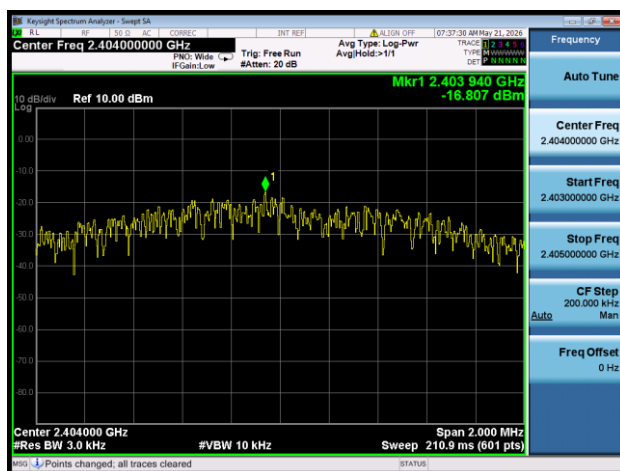
GFSK (BLE 1Mbps) MIDDLE CHANNEL



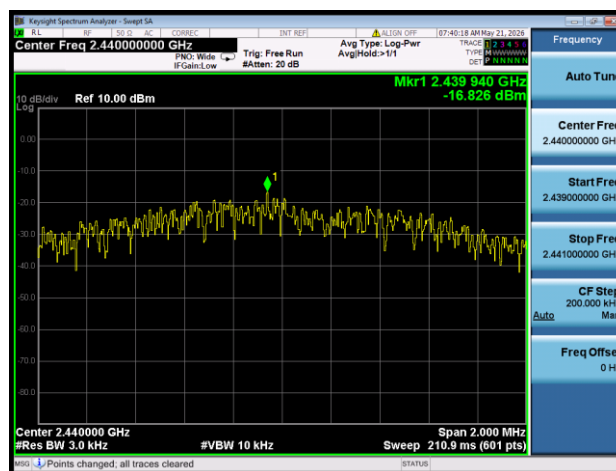
GFSK (BLE 1Mbps) HIGH CHANNEL



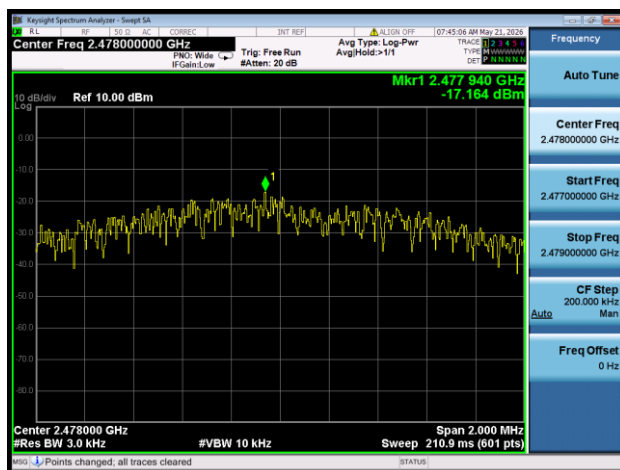
GFSK (BLE 2Mbps) LOW CHANNEL



GFSK (BLE 2Mbps) MIDDLE CHANNEL



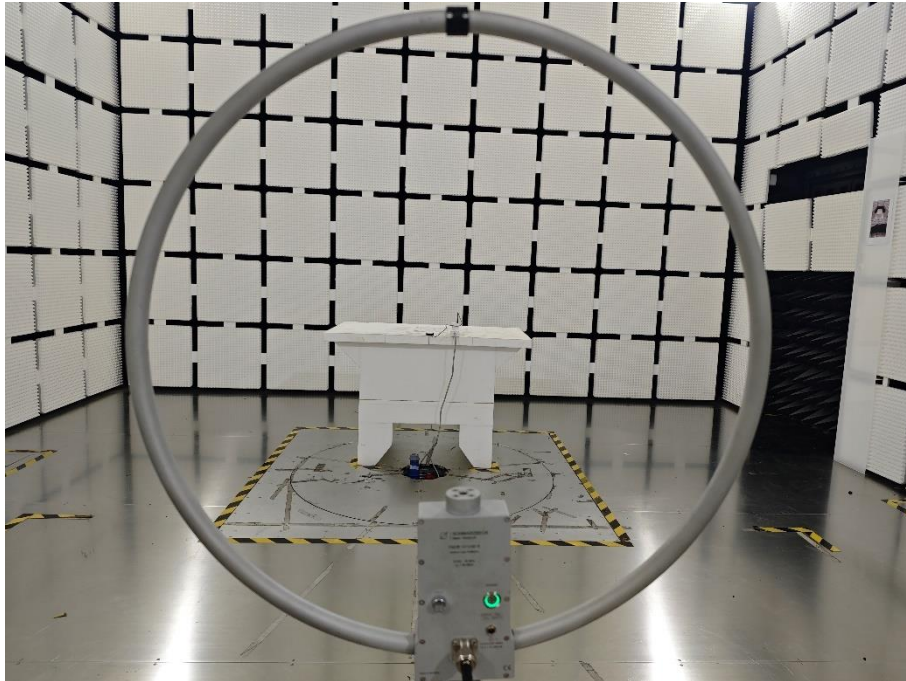
GFSK (BLE 2Mbps) HIGH CHANNEL



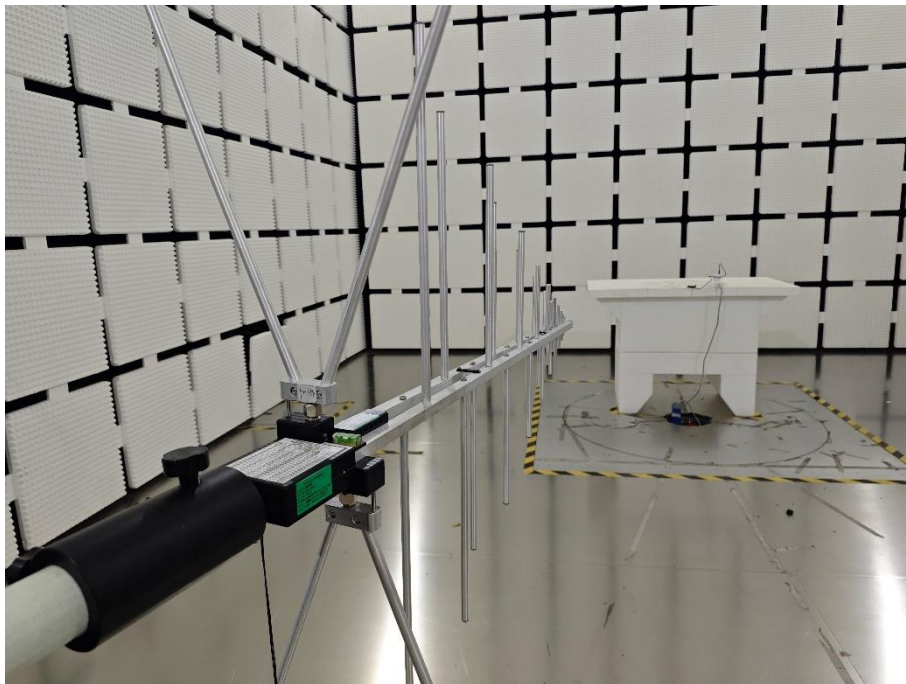
ANNEX A TEST SETUP PHOTOS

1 Radiated Test Photo

Below 30MHz



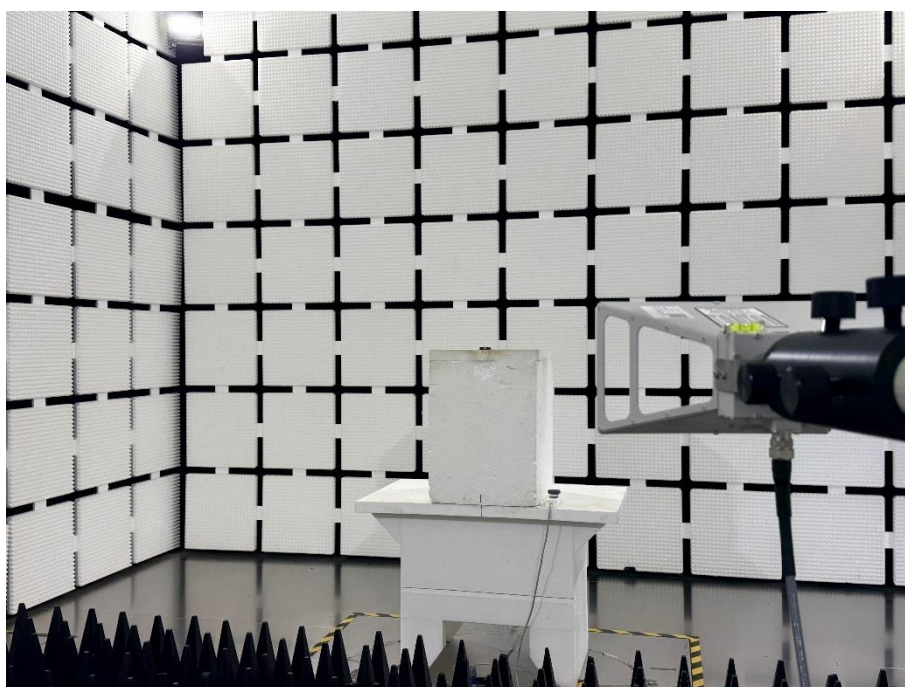
30MHz-1GHz



Close-up



Above 1GHz



Close-up

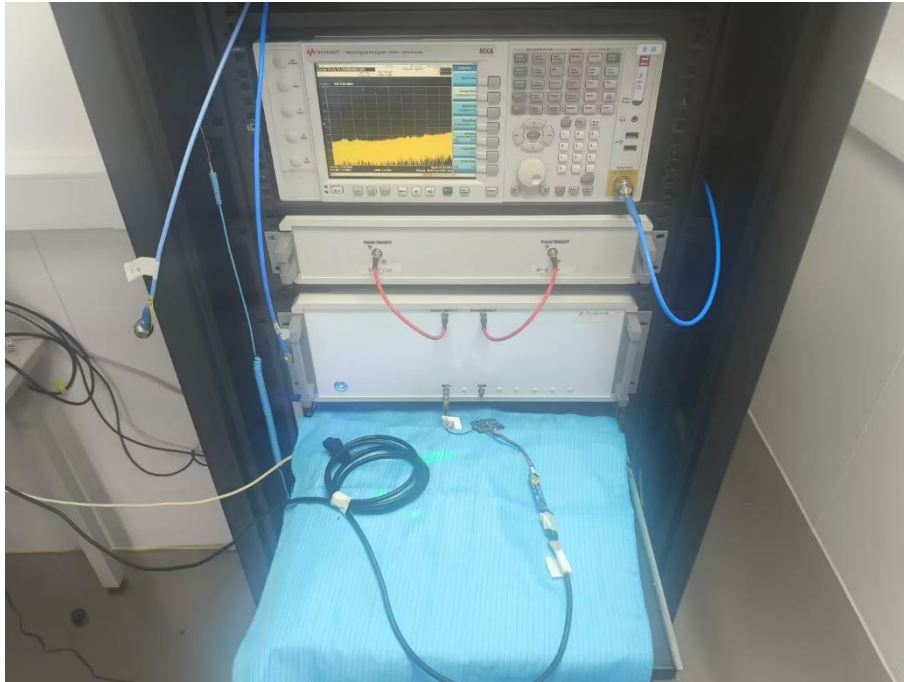


2 Conducted Test Photo

Conducted Test



Close-up



3 Conducted Emission

Photo 1



Photo 2



ANNEX B EUT EXTERNAL PHOTOS

FRONT VIEW OF EUT



REAR VIEW OF EUT



LEFT VIEW OF EUT



RIGHT VIEW OF EUT



TOP VIEW OF EUT



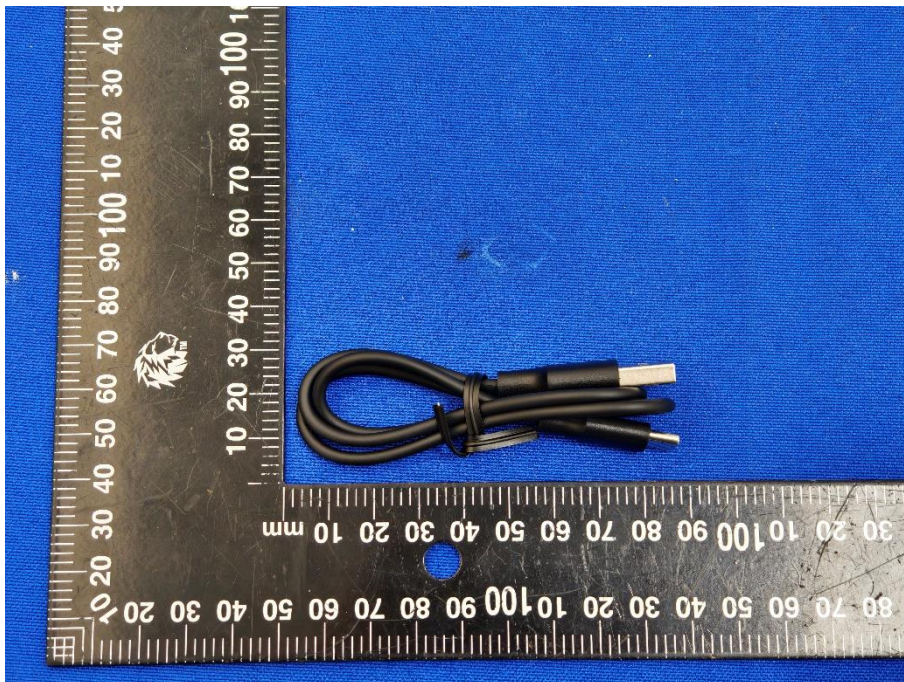
BOTTOM VIEW OF EUT



CLOSE-UP

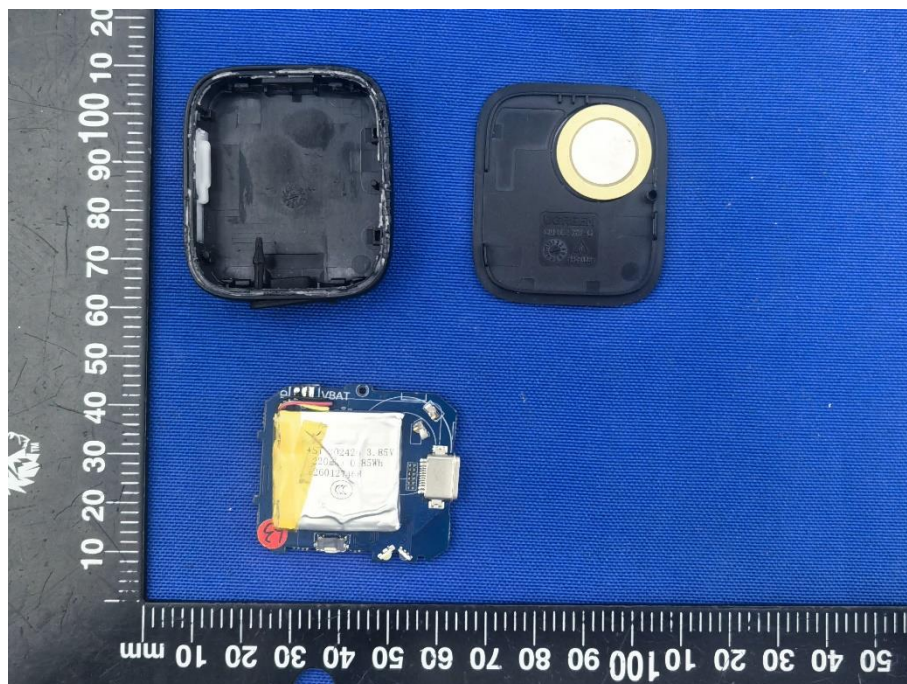


Accessory-USB Cable

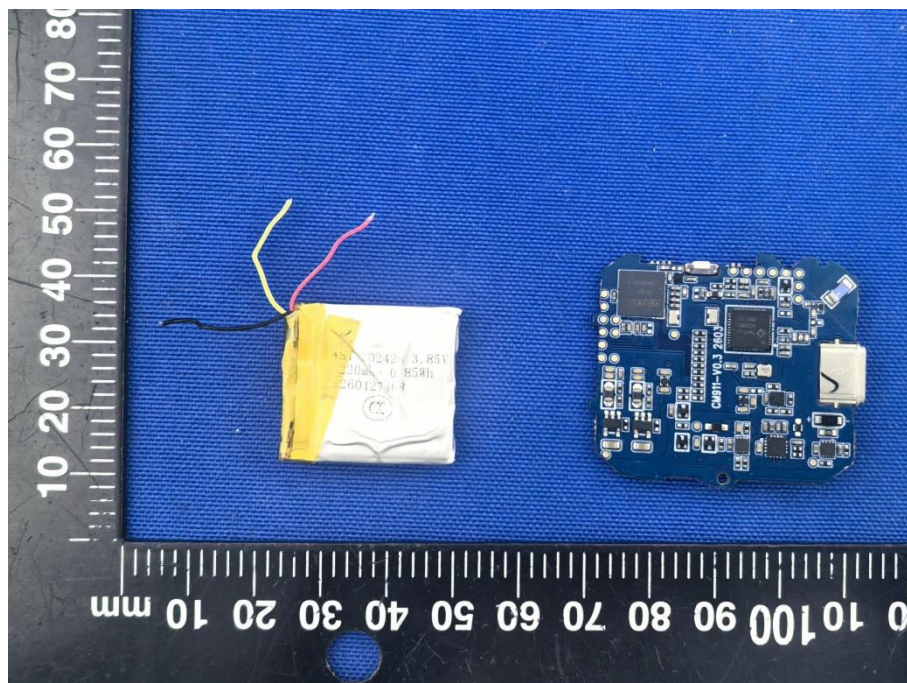


ANNEX C EUT INTERNAL PHOTOS

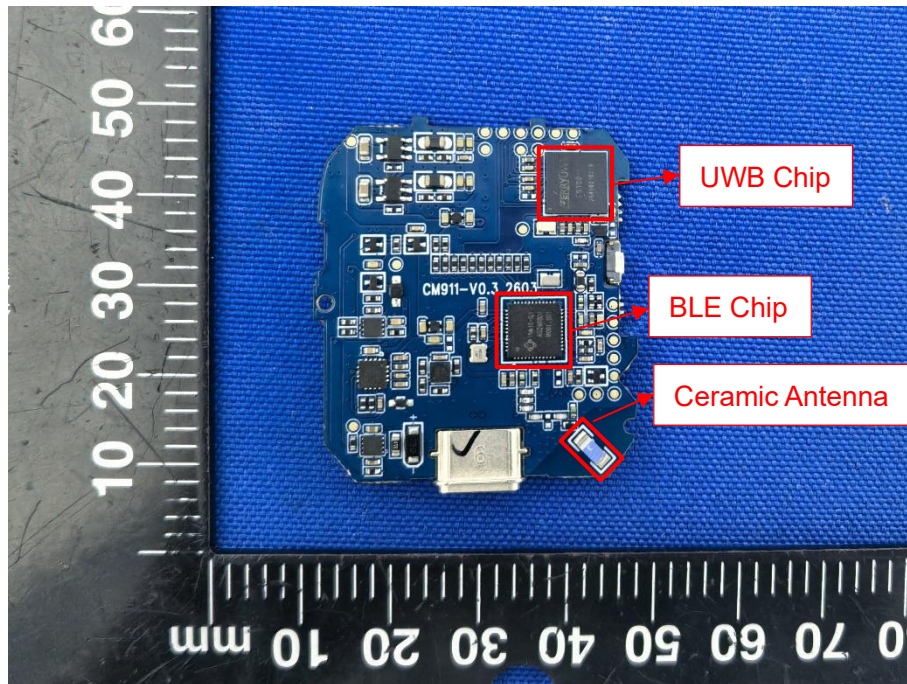
EUT UNCOVER VIEW 1



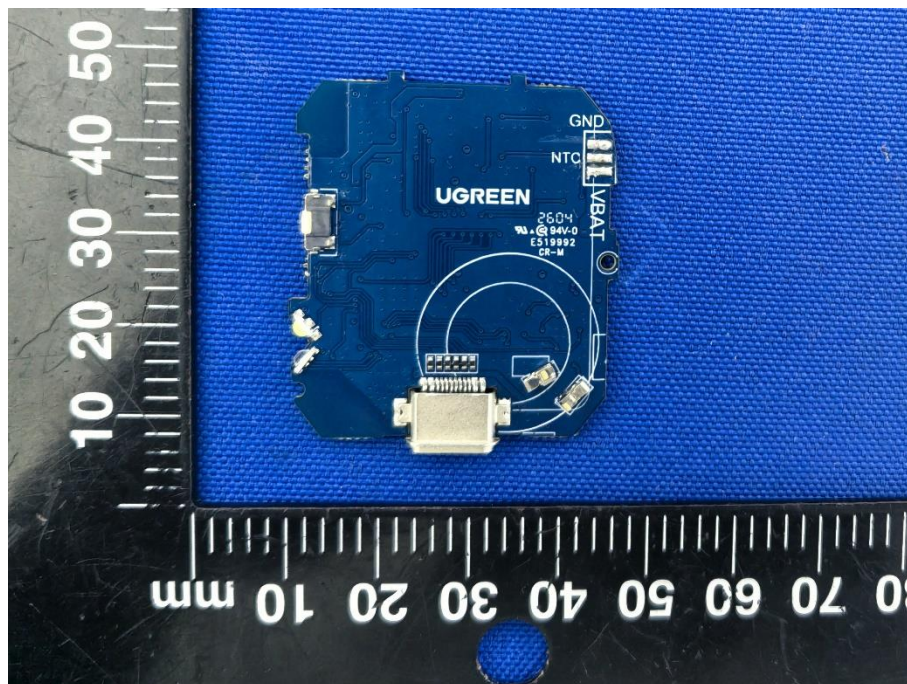
EUT UNCOVER VIEW 2



MAIN BOARD TOP VIEW



MAIN BOARD REAR VIEW



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--END OF REPORT--