

Bluetooth Low Energy for Ant.2

Test Engineer:	Kib Shi	Temperature:	20~26	°C
Test Date:	2022/6/26	Relative Humidity:	40~51	%

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	2Mbps	1	0	2402	1.994	1.14	0.50	Pass
BLE	2Mbps	1	19	2440	1.994	1.13	0.50	Pass
BLE	2Mbps	1	39	2480	1.994	1.14	0.50	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	2Mbps	1	0	2402	7.86	30.00	-2.30	5.56	36.00	Pass
BLE	2Mbps	1	19	2440	7.01	30.00	-2.30	4.71	36.00	Pass
BLE	2Mbps	1	39	2480	7.19	30.00	-2.30	4.89	36.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)
BLE	2Mbps	1	0	2402	4.83	7.30
BLE	2Mbps	1	19	2440	4.83	6.41
BLE	2Mbps	1	39	2480	4.83	6.49

TEST RESULTS DATA
Peak Power Density

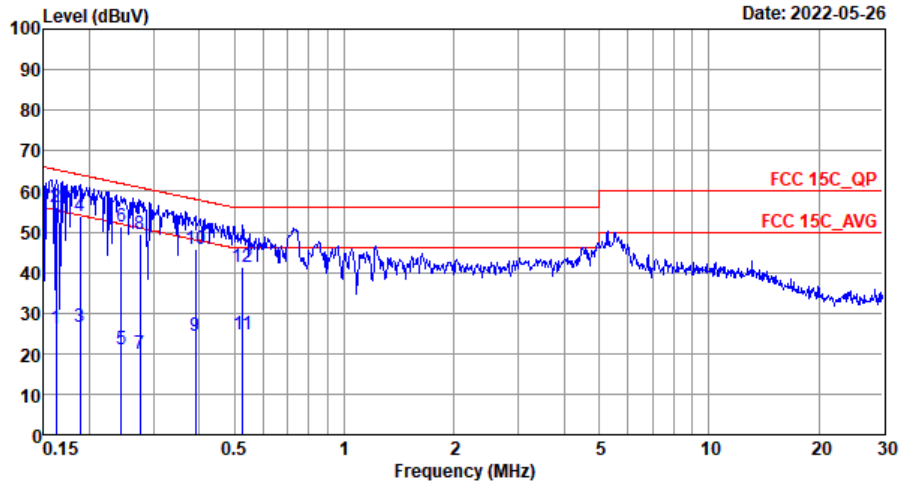
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	2Mbps	1	0	2402	4.79	-12.52	-2.30	8.00	Pass
BLE	2Mbps	1	19	2440	3.76	-13.62	-2.30	8.00	Pass
BLE	2Mbps	1	39	2480	4.25	-13.07	-2.30	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 20dBc limit.



Appendix B. AC Conducted Emission Test Results

Test Engineer :	Lily	Temperature :	22~25°C
		Relative Humidity :	50~55%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		

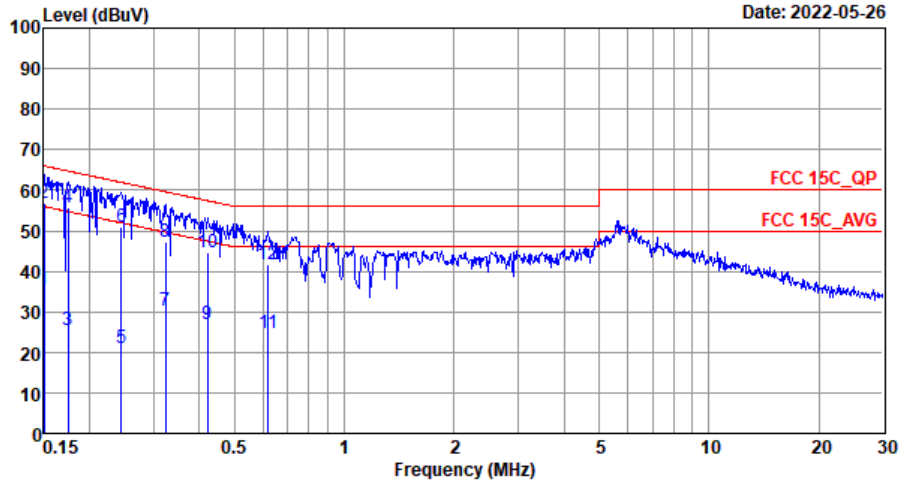


Site : CO01-SZ
 Condition: FCC 15C_QP LISN_20210901_L LINE

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.16	26.15	-29.19	55.34	5.30	10.20	10.65	Average
2 *	0.16	56.25	-9.09	65.34	35.40	10.20	10.65	QP
3	0.19	26.59	-27.52	54.11	6.10	10.20	10.29	Average
4	0.19	53.79	-10.32	64.11	33.30	10.20	10.29	QP
5	0.24	21.21	-30.74	51.95	0.50	10.18	10.53	Average
6	0.24	51.21	-10.74	61.95	30.50	10.18	10.53	QP
7	0.28	20.02	-30.92	50.94	-0.91	10.17	10.76	Average
8	0.28	49.32	-11.62	60.94	28.39	10.17	10.76	QP
9	0.39	24.20	-23.83	48.03	2.69	10.10	11.41	Average
10	0.39	45.90	-12.13	58.03	24.39	10.10	11.41	QP
11	0.53	24.54	-21.46	46.00	2.70	10.11	11.73	Average
12	0.53	41.24	-14.76	56.00	19.40	10.11	11.73	QP



Test Engineer :	Lily	Temperature :	22~25°C
		Relative Humidity :	50~55%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-SZ
 Condition: FCC 15C_QP LISN_20210901_N NEUTRAL

	Freq	Level	Over	Limit	Read	LISN	Cable	
	MHz	dBuV	Limit	Line	Level	Factor	Loss	Remark
			dB	dBuV	dBuV	dB	dB	
1	0.15	35.46	-20.54	56.00	14.30	10.31	10.85	Average
2	0.15	56.66	-9.34	66.00	35.50	10.31	10.85	QP
3	0.17	25.56	-29.16	54.72	4.80	10.29	10.47	Average
4 *	0.17	55.86	-8.86	64.72	35.10	10.29	10.47	QP
5	0.24	21.18	-30.77	51.95	0.40	10.25	10.53	Average
6	0.24	50.98	-10.97	61.95	30.20	10.25	10.53	QP
7	0.32	30.35	-19.27	49.62	9.10	10.19	11.06	Average
8	0.32	47.15	-12.47	59.62	25.90	10.19	11.06	QP
9	0.42	26.83	-20.59	47.42	5.10	10.19	11.54	Average
10	0.42	44.53	-12.89	57.42	22.80	10.19	11.54	QP
11	0.62	24.90	-21.10	46.00	3.29	10.24	11.37	Average
12	0.62	41.80	-14.20	56.00	20.19	10.24	11.37	QP

Note:

- Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
- Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)



Appendix C. Radiated Spurious Emission

For BLE 2Mbps Ant 1

2.4GHz 2400~2483.5MHz

BLE—ANT 1 (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2372.27	50.53	-23.47	74	47.47	32.86	7.07	36.87	371	41	P	H
		2385.4	41.32	-12.68	54	38.23	32.86	7.1	36.87	371	41	A	H
	*	2402	99.75	-	-	96.6	32.88	7.13	36.86	371	41	P	H
	*	2402	98.22	-	-	95.07	32.88	7.13	36.86	371	41	A	H
		2335.48	50.2	-23.8	74	47.27	32.81	7.01	36.89	100	92	P	V
		2383.58	41.21	-12.79	54	38.12	32.86	7.1	36.87	100	92	A	V
	*	2402	103.37	-	-	100.22	32.88	7.13	36.86	100	92	P	V
	*	2402	101.83	-	-	98.68	32.88	7.13	36.86	100	92	A	V
BLE CH 39 2480MHz	*	2480	101.82	-	-	98.41	32.98	7.25	36.82	371	57	P	H
	*	2480	99.63	-	-	96.22	32.98	7.25	36.82	371	57	A	H
		2483.56	49.48	-24.52	74	46.07	32.98	7.25	36.82	371	57	P	H
		2486.8	40.33	-13.67	54	36.92	32.98	7.25	36.82	371	57	A	H
	*	2480	103.41	-	-	100	32.98	7.25	36.82	298	350	P	V
	*	2480	101.21	-	-	97.8	32.98	7.25	36.82	298	350	A	V
		2483.74	51.09	-22.91	74	47.68	32.98	7.25	36.82	298	350	P	V
		2483.5	40.2	-13.8	54	36.79	32.98	7.25	36.82	298	350	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

BLE—ANT 1 (Harmonic @ 3m)

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 00 2402MHz		4800	40.23	-33.77	74	61.21	34.19	10.2	65.37	300	0	P	H
		4800	39.63	-34.37	74	60.61	34.19	10.2	65.37	100	0	P	V
BLE CH 19 2440MHz		4875	40.58	-33.42	74	61.48	34.23	10.29	65.42	300	0	P	H
		7320	42.32	-31.68	74	59.69	35.87	12.72	65.96	300	0	P	H
		4875	41.1	-32.9	74	62	34.23	10.29	65.42	100	0	P	V
		7320	42.1	-31.9	74	59.47	35.87	12.72	65.96	100	0	P	V
BLE CH 39 2480MHz		4965	40.81	-33.19	74	61.59	34.28	10.41	65.47	300	0	P	H
		7440	42.52	-31.48	74	60.15	35.89	12.79	66.31	300	0	P	H
		4965	40.25	-33.75	74	61.03	34.28	10.41	65.47	100	0	P	V
		7440	42.22	-31.78	74	59.85	35.89	12.79	66.31	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

BLE—ANT 2 (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2310	50.75	-23.25	74	47.91	32.77	6.98	36.91	321	43	P	H
		2379.68	41.49	-12.51	54	38.4	32.86	7.1	36.87	321	43	A	H
	*	2402	100.1	-	-	96.95	32.88	7.13	36.86	321	43	P	H
	*	2402	98.6	-	-	95.45	32.88	7.13	36.86	321	43	A	H
		2369.54	50.52	-23.48	74	47.46	32.86	7.07	36.87	129	76	P	V
		2384.36	41.33	-12.67	54	38.24	32.86	7.1	36.87	129	76	A	V
	*	2402	104.01	-	-	100.86	32.88	7.13	36.86	129	76	P	V
	*	2402	102.42	-	-	99.27	32.88	7.13	36.86	129	76	A	V
BLE CH 39 2480MHz	*	2480	101.81	-	-	98.4	32.98	7.25	36.82	369	48	P	H
	*	2480	99.48	-	-	96.07	32.98	7.25	36.82	369	48	A	H
		2487.22	49.17	-24.83	74	45.76	32.98	7.25	36.82	369	48	P	H
		2484.34	40.62	-13.38	54	37.21	32.98	7.25	36.82	369	48	A	H
	*	2480	102.98	-	-	99.57	32.98	7.25	36.82	335	360	P	V
	*	2480	100.74	-	-	97.33	32.98	7.25	36.82	335	360	A	V
		2483.68	49.29	-24.71	74	45.88	32.98	7.25	36.82	335	360	P	V
		2484.04	40.09	-13.91	54	36.68	32.98	7.25	36.82	335	360	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

BLE—ANT 2 (Harmonic @ 3m)

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 00 2402MHz		4800	39.9	-34.1	74	60.88	34.19	10.2	65.37	300	0	P	H
		4800	40.32	-33.68	74	61.3	34.19	10.2	65.37	100	0	P	V
BLE CH 19 2440MHz		4875	40.97	-33.03	74	61.87	34.23	10.29	65.42	300	0	P	H
		7320	41.95	-32.05	74	59.32	35.87	12.72	65.96	300	0	P	H
		4875	40.69	-33.31	74	61.59	34.23	10.29	65.42	100	0	P	V
		7320	42.56	-31.44	74	59.93	35.87	12.72	65.96	100	0	P	V
BLE CH 39 2480MHz		4965	41.02	-32.98	74	61.8	34.28	10.41	65.47	300	0	P	H
		7440	42.35	-31.65	74	59.98	35.89	12.79	66.31	300	0	P	H
		4965	40.62	-33.38	74	61.4	34.28	10.41	65.47	100	0	P	V
		7440	42.43	-31.57	74	60.06	35.89	12.79	66.31	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BLE LF		30.97	22.53	-17.47	40	29.64	24.98	0.71	32.8	-	-	P	H
		184.23	25.76	-17.74	43.5	40.03	16.68	2.06	33.01	-	-	P	H
		296.75	25.03	-20.97	46	35.16	20.15	2.63	32.91	-	-	P	H
		597.45	26.71	-19.29	46	29.97	25.52	3.73	32.51	-	-	P	H
		784.66	29.61	-16.39	46	31.11	26.78	4.28	32.56	-	-	P	H
		898.15	32.47	-13.53	46	33	27.39	4.58	32.5	-	-	P	H
		48.43	28.79	-11.21	40	44.94	15.77	1.05	32.97	-	-	P	V
		63.95	27.64	-12.36	40	46.22	13.32	1.2	33.1	-	-	P	V
		131.85	24.74	-18.76	43.5	38.12	17.72	1.74	32.84	-	-	P	V
		314.21	21.85	-24.15	46	31.5	20.55	2.7	32.9	-	-	P	V
		566.41	26.37	-19.63	46	29.54	25.77	3.63	32.57	-	-	P	V
		890.39	33.11	-12.89	46	33.71	27.36	4.56	32.52	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												



Co-location

BLE_Tx_Ch39&WCDMA850 (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	(dB)	Limit	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
					(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 39 2480MHz	*	2341.33	48.77	-25.23	74	45.81	32.81	7.04	36.89	313	52	P	H
	*	2370.19	40.1	-13.9	54	37.04	32.86	7.07	36.87	313	52	A	H
		2402	102.58	-	-	99.43	32.88	7.13	36.86	313	52	P	H
		2402	100.36	-	-	97.21	32.88	7.13	36.86	313	52	A	H
	*	2387.22	48.88	-25.12	74	45.76	32.88	7.1	36.86	102	47	P	V
	*	2389.17	39.88	-14.12	54	36.76	32.88	7.1	36.86	102	47	A	V
		2402	104.67	-	-	101.52	32.88	7.13	36.86	102	47	P	V
		2402	102.47	-	-	99.32	32.88	7.13	36.86	102	47	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BLE_Tx_Ch39&WCDMA850 (Harmonic @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	(dB)	Limit	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
					(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 39 2480MHz		4800	39.54	-34.46	74	60.52	34.19	10.2	65.37	300	0	P	H
		4800	39.76	-34.24	74	60.74	34.19	10.2	65.37	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Note symbol

*	Fundamental Frequency which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is over limit line.
P/A	Peak or Average
H/V	Horizontal or Vertical



A calculation example for radiated spurious emission is shown as below:

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 00		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H
2402MHz													

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =
Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)
= 55.45 (dBμV/m)
2. Over Limit(dB)
= Level(dBμV/m) – Limit Line(dBμV/m)
= 55.45(dBμV/m) – 74(dBμV/m)
= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)
= 43.54 (dBμV/m)
2. Over Limit(dB)
= Level(dBμV/m) – Limit Line(dBμV/m)
= 43.54(dBμV/m) – 54(dBμV/m)
= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.



Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
Bluetooth LE 2Mbps	32.87	0.206	4.859	5.1KHz

Bluetooth LE 2Mbps

