

# 3.4.5 Test Result of Conducted Band Edges Plots

Toot Engineer	Temperature :	<b>21~25</b> ℃
rest Engineer .	Relative Humidity :	51~54%

#### <1Mbps>



#### <2Mbps>

	Low Band Edge Plot on Channel 00						Hig	jh Ba	nd Eo	dge P	Plot o	n Cha	annel	39					
Spectrur		Offset	24.10 dB 🖷	PBW 1001	H7				E	Spectrur		Offset	24.10 dB 📼	PBW 100 P	Hz				
e Att	20 dB	SWT	8 ms 👄	VBW 300 k	Hz Mode	Sweep				e Att	20 dE	SWT	8 ms 👄	VBW 300 k	Hz Mode	Sweep			,
●1Pk Max					м	1[1]		2.39	-39.73 dBn 9996630 GH:	●1Pk Max					м	1[1]		2.488	43.98 dBm 86010 GHz
20 dBm										20 dBm									
10 dBm										10 dBm									
0 dBm									IMA)	0 dBm	M								
-10 dBm								1	TTA	-10 dBm									
-20 dBm	01 06 400	dDes								-20 dBm	01 06 400								
-30 dBm	01 -20.400	dom						MI		-30 dBm	1 -20,400								
-40 dBm	a tak	le croat		يەر ايت			h i k	M		-40 dBm	<i>n</i>	handa	والمتعادية والمتعاد	MI		والقار أغاد ارت	(Internalis), internal	المريحة الماريح	hine hashes
<b>Salding h</b>						<b>///////</b>		W 1	/ <b>//</b> //	-50 dBm						a if at to do i			
-60 dBm	a di man	dia a da	in tra	e totte	e transie f	i t ulut i	a who la		1	-60 dBm									
								F1				F1							
Start 2.37	5 GHz			800	l pts			Sto	2.405 GHz	Start 2.47	5 GHz			8001	pts			Stop 2	2.505 GHz
						Measur	ing									Measur			1
Date: 20.J	JN.2022 1	5:28:57								Date: 20.J	JN.2022 1	5:34:33							



#### 3.4.6 Test Result of Conducted Spurious Emission Plots

Toot Engineer	Temperature :	<b>21~25</b> ℃	
rest Engineer .	Relative Humidity :	51~54%	

#### <1Mbps>





Conducted Spurious Emission Plot on	Conducted Spurious Emission Plot on
Bluetooth LE 1Mbps GFSK Channel 39	Bluetooth LE 1Mbps GFSK Channel 39
Spectrum   Ref Level 20.00 dBm Offset 24.10 dB ● RBW 100 kHz	Spectrum         ▼           RefLevel 20.00 dBm         Offset 24.10 dB ● RBW 100 kHz
Att 10 dB SWT 29.7 ms  VBW 300 kHz Mode Sweep	Att 10 dB SWT 230 ms  VBW 300 kHz Mode Sweep
ID dBm         M1[1]         3.86 dBm           10 dBm         2.48130 GHz         -53.43 dBm           0 dBm         M1         2.99110 GHz	
-20 dBm -20 dBm -20 dBm -30 dBm -30 dBm	-10 dBm -20 dBm -30 dDm 01 -25.490 dBm
-40 dBm	-0 dBm - M2 -0 dBm
-70 dBm	-70 dBm
Date: 20.JUN.2022 15:22:43	Date: 20.JUN.2022 15:22:55



#### <2Mbps>







# 3.5 Radiated Band Edges and Spurious Emission Measurement

# 3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device is measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency	Field Strength	Measurement Distance		
(MHz)	(microvolts/meter)	(meters)		
0.009 - 0.490	2400/F(kHz)	300		
0.490 – 1.705	24000/F(kHz)	30		
1.705 – 30.0	30	30		
30 – 88	100	3		
88 – 216	150	3		
216 - 960	200	3		
Above 960	500	3		

### 3.5.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

## 3.5.3 Test Procedures

- 1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
- 2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
- 3. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
- 4. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
- 5. Corrected Reading: Antenna Factor + Cable Loss + Read Level Preamp Factor = Level
- 6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as "-".
- 7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as "-".
- 8. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW = 100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
  - (3) Set RBW = 1 MHz, VBW = 3 MHz for  $f \ge 1$  GHz for peak measurement. For average measurement:
    - VBW = 10 Hz, when duty cycle is no less than 98 percent.
    - VBW  $\geq$  1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.



# 3.5.4 Test Setup

For radiated test below 30MHz



Metal Full Soldered Ground Plane

Spectrum Analyzer / Receiver



#### For radiated test above 18GHz



### 3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which starts from 9 kHz to 30 MHz, is pre-scanned and the result which is 20 dB lower than the limit line is not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result comes out very similar.

### 3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

#### 3.5.7 Duty Cycle

Please refer to Appendix D.

### 3.5.8 Test Result of Radiated Spurious Emission (30 MHz ~ 10th Harmonic)

Please refer to Appendix B and C.



# 3.6 AC Conducted Emission Measurement

## 3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of omission (MHz)	Conducted limit (dBµV)				
rrequency or emission (winz)	Quasi-peak	Average			
0.15-0.5	66 to 56*	56 to 46*			
0.5-5	56	46			
5-30	60	50			

\*Decreases with the logarithm of the frequency.

### 3.6.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

### 3.6.3 Test Procedures

- 1. The EUT is placed 0.4 meter away from the conducting wall of the shielding room, and is kept at least 80 centimeters from any other grounded conducting surface.
- 2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- 3. All the support units are connecting to the other LISN.
- 4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- 5. The FCC states that a 50 ohm, 50 microhenry LISN shall be used.
- 6. Both Line and Neutral shall be tested in order to find out the maximum conducted emission.
- 7. The frequency range from 150 kHz to 30 MHz is scanned.
- Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9 kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.



# 3.6.4 Test Setup



# 3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix A.



# 3.7 Antenna Requirements

# 3.7.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

# 3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

# 3.7.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



# 4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	TECPEL	DTM-303A	TP201996	N/A	Nov. 16, 2021	Jun. 14, 2022~ Jun. 20, 2022	Nov. 15, 2022	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	16I00054SNO 12 (NO:113)	10MHz~6GHz	Dec. 16, 2021	Jun. 14, 2022~ Jun. 20, 2022	Dec. 15, 2022	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Aug. 30, 2021	Jun. 14, 2022~ Jun. 20, 2022	Aug. 29, 2022	Conducted (TH05-HY)
Switch Control Mainframe	E-IUSTRUME NT	ETF-1405-0	EC1900067 (BOX7)	N/A	Aug. 12, 2021	Jun. 14, 2022~ Jun. 20, 2022	Aug. 11, 2022	Conducted (TH05-HY)
AC Power Source	ACPOWER	AFC-11003G	F317040033	N/A	N/A	Jul. 04, 2022	N/A	Conduction (CO07-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Jul. 04, 2022	N/A	Conduction (CO07-HY)
Pulse Limiter	SCHWARZBE CK	VTSD 9561-F N	9561-F N00373	9kHz-200MHz	Oct. 29, 2021	Jul. 04, 2022	Oct. 28, 2022	Conduction (CO07-HY)
RF Cable	HUBER + SUHNER	RG 214/U	1358175	9kHz~30MHz	Mar. 16, 2022	Jul. 04, 2022	Mar. 15, 2023	Conduction (CO07-HY)
Two-Line V-Network	TESEQ	NNB 51	45051	N/A	Feb. 16, 2022	Jul. 04, 2022	Feb. 15, 2023	Conduction (CO07-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI7	100724	9kHz~7GHz	Feb. 24, 2022	Jul. 04, 2022	Feb. 23, 2023	Conduction (CO07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	May 13, 2022	Jun. 23, 2022~ Jun. 30, 2022	May 12, 2023	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01N -06	47020 & 06	30MHz to 1GHz	Oct. 09, 2021	Jun. 23, 2022~ Jun. 30, 2022	Oct. 08, 2022	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-1522	1G~18GHz	Mar. 10, 2022	Jun. 23, 2022~ Jun. 30, 2022	Mar. 09, 2023	Radiation (03CH16-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	00993	18GHz ~40GHz	Nov. 30, 2021	Jun. 23, 2022~ Jun. 30, 2022	Nov. 29, 2022	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1G	Jul. 05, 2021	Jun. 23, 2022~ Jun. 30, 2022	Jul. 04, 2022	Radiation (03CH16-HY)
Preamplifier	EMEC	EM18G40G	060812	18GHz~40GHz	Dec. 27, 2021	Jun. 23, 2022~ Jun. 30, 2022	Dec. 26, 2022	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2021	Jun. 23, 2022~ Jun. 30, 2022	Dec. 08, 2022	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY57290111	3Hz~26.5GHz	Dec.15, 2021	Jun. 23, 2022~ Jun. 30, 2022	Dec. 14, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11680/4P E	NA	Aug. 28, 2021	Jun. 23, 2022~ Jun. 30, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11688/4P E	NA	Aug. 28, 2021	Jun. 23, 2022~ Jun. 30, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-5 757	NA	Aug. 28, 2021	Jun. 23, 2022~ Jun. 30, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Jun. 23, 2022~ Jun. 30, 2022	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Jun. 23, 2022~ Jun. 30, 2022	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Jun. 23, 2022~ Jun. 30, 2022	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Jun. 23, 2022~ Jun. 30, 2022	N/A	Radiation (03CH16-HY)



# 5 Uncertainty of Evaluation

#### Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence	2 2 dB
of 95% (U = 2Uc(y))	2.3 dB

#### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence	E 9 dP
of 95% (U = 2Uc(y))	5.0 UB

#### Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence	5.2 dB
of 95% (U = 2Uc(y))	5.2 UB

#### Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.8 dB
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# Appendix A. AC Conducted Emission Test Results

Toot Engineer		Temperature :	<b>22.2~26.3</b> ℃	
rest Engineer .		Relative Humidity :	48.2~58.7%	

# **EUT Information**

Report NO : Test Mode : Test Voltage : Phase : 1N2541 Mode 1 120Vac/60Hz Line



Full Spectrum

# Final\_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.186000		29.64	54.21	24.57	L1	OFF	20.0
0.186000	42.41		64.21	21.80	L1	OFF	20.0
0.198000		28.30	53.69	25.39	L1	OFF	20.0
0.198000	40.97		63.69	22.72	L1	OFF	20.0
0.206000		25.66	53.37	27.71	L1	OFF	20.0
0.206000	40.05		63.37	23.32	L1	OFF	20.0
0.242000		25.77	52.03	26.26	L1	OFF	20.0
0.242000	39.86		62.03	22.17	L1	OFF	20.0
0.254000		27.63	51.63	24.00	L1	OFF	20.0
0.254000	39.74		61.63	21.89	L1	OFF	20.0
0.306000		23.55	50.08	26.53	L1	OFF	20.0
0.306000	35.86		60.08	24.22	L1	OFF	20.0
0.402000		19.63	47.81	28.18	L1	OFF	20.0
0.402000	34.05		57.81	23.76	L1	OFF	20.0
3.286000		22.03	46.00	23.97	L1	OFF	20.0
3.286000	30.11		56.00	25.89	L1	OFF	20.0
18.826000		16.91	50.00	33.09	L1	OFF	20.2
18.826000	21.87		60.00	38.13	L1	OFF	20.2

# **EUT Information**

Report NO : Test Mode : Test Voltage : Phase : 1N2541 Mode 1 120Vac/60Hz Neutral



Full Spectrum

# Final\_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.186000		31.60	54.21	22.61	Ν	OFF	20.0
0.186000	44.26		64.21	19.95	Ν	OFF	20.0
0.194000		31.48	53.86	22.38	Ν	OFF	20.0
0.194000	43.72		63.86	20.14	Ν	OFF	20.0
0.206000		28.41	53.37	24.96	Ν	OFF	20.0
0.206000	42.09		63.37	21.28	Ν	OFF	20.0
0.242000		27.33	52.03	24.70	Ν	OFF	20.0
0.242000	41.16		62.03	20.87	Ν	OFF	20.0
0.250000		29.05	51.76	22.71	Ν	OFF	20.0
0.250000	41.70		61.76	20.06	Ν	OFF	20.0
0.262000		28.68	51.37	22.69	Ν	OFF	20.0
0.262000	41.32		61.37	20.05	Ν	OFF	20.0
0.270000		27.78	51.12	23.34	Ν	OFF	20.0
0.270000	41.15		61.12	19.97	Ν	OFF	20.0
0.418000		21.28	47.49	26.21	Ν	OFF	20.0
0.418000	36.69		57.49	20.80	Ν	OFF	20.0
0.586000		19.15	46.00	26.85	Ν	OFF	20.0
0.586000	34.77		56.00	21.23	Ν	OFF	20.0
12.718000		22.17	50.00	27.83	Ν	OFF	20.2

12.718000	29.44	 60.00	30.56	Ν	OFF	20.2



# Appendix B. Radiated Spurious Emission

Tost Engineer :	Andy Vana, Karl Hou and Stoyon Wu	Temperature :	20~25°C
rest Engineer .	Andy rang, Karriou and Sleven Wu	Relative Humidity :	50~60%



## <1Mbps>

#### 2.4GHz 2400~2483.5MHz

# BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBuV/m)	Limit	Line	Level	Factor	Loss	Factor	Pos	Pos (deg)	Avg. (Ρ/Δ)	(H/V)
		2350.635	55.86	-18.14	74	40.6	27.2	18.14	30.08	145	156	P	<u>н</u>
		2341.185	45.99	-8.01	54	30.76	27.2	18.12	30.09	145	156	А	Н
	*	2402	100.08	-	-	84.5	27.41	18.24	30.07	145	156	Р	Н
	*	2402	99.14	-	-	83.56	27.41	18.24	30.07	145	156	А	Н
RIE													Н
													Н
2402MH <del>7</del>		2384.13	56	-18	74	40.52	27.34	18.21	30.07	383	199	Р	V
240210112		2383.395	45.87	-8.13	54	30.4	27.33	18.21	30.07	383	199	А	V
	*	2402	99.06	-	-	83.48	27.41	18.24	30.07	383	199	Ρ	V
	*	2402	98.23	-	-	82.65	27.41	18.24	30.07	383	199	Α	V
													V
													V
		2378.04	55.67	-18.33	74	40.24	27.31	18.2	30.08	100	156	Р	Н
		2380.84	46.14	-7.86	54	30.7	27.32	18.2	30.08	100	156	А	Н
	*	2440	98.43	-	-	82.54	27.64	18.31	30.06	100	156	Ρ	Н
	*	2440	97.23	-	-	81.34	27.64	18.31	30.06	100	156	А	Н
		2494.05	57	-17	74	40.75	27.88	18.41	30.04	100	156	Р	Н
		2492.93	46.91	-7.09	54	30.67	27.87	18.41	30.04	100	156	А	Н
2440MH-		2325.68	56.27	-17.73	74	41.07	27.2	18.09	30.09	368	196	Р	V
2440101112		2383.5	45.9	-8.1	54	30.43	27.33	18.21	30.07	368	196	А	V
	*	2440	97.09	-	-	81.2	27.64	18.31	30.06	368	196	Р	V
	*	2440	95.81	-	-	79.92	27.64	18.31	30.06	368	196	Α	V
		2488.8	56.71	-17.29	74	40.49	27.86	18.4	30.04	368	196	Ρ	V
		2488.17	46.94	-7.06	54	30.73	27.85	18.4	30.04	368	196	Α	V



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	*	2480	100.18	-	-	84.03	27.82	18.38	30.05	103	150	Р	Н
	*	2480	99.36	-	-	83.21	27.82	18.38	30.05	103	150	А	Н
		2487.48	58.05	-15.95	74	41.84	27.85	18.4	30.04	103	150	Р	Н
		2484.04	46.97	-7.03	54	30.78	27.84	18.39	30.04	103	150	А	Н
DIE													н
													н
2480MHz	*	2480	98.71	-	-	82.56	27.82	18.38	30.05	400	197	Р	V
	*	2480	97.71	-	-	81.56	27.82	18.38	30.05	400	197	А	V
		2486.72	57.22	-16.78	74	41.01	27.85	18.4	30.04	400	197	Р	V
		2493.48	46.99	-7.01	54	30.75	27.87	18.41	30.04	400	197	А	V
													V
													V
Remark	1. No 2. Al	o other spurious I results are PA	s found. SS against F	<sup>p</sup> eak and	Average lim	it line.							





#### 2.4GHz 2400~2483.5MHz

					•		,						
BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBµV/m)	Limit ( dB )	Line ( dBµV/m )	Level (dBµV)	Factor ( dB/m )	Loss (dB)	Factor (dB)	Pos (cm)	Pos (deg)	Avg. (P/A)	(H/V)
		4804	39.92	-34.08	74	61.42	32.32	12.35	66.17	-	-	P	H
													н
													Н
													н
													н
													н
													Н
													н
													н
													н
													н
BLE													н
CH 00		4804	40.19	-33.81	74	61.69	32.32	12.35	66.17	-	-	Р	V
240210172													V
													V
													V
													V
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													V

#### BLE (Harmonic @ 3m)



#### Report No. : FR1N2541B

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBuV/m)	Limit	Line ( dBuV/m )	Level (dBuV)	Factor	Loss (dB)	Factor	Pos	Pos (deg)	Avg. (Ρ/Δ)	(н/у)
		4880	40.35	-33.65	74	61.43	32.72	12.32	66.12	-	-	P	н
		7320	45.47	-28.53	74	58.23	37.08	15.88	65.72	-	-	Р	н
													н
													н
													н
													Н
													н
													н
													н
													Н
51.5													Н
													Н
2440MHz		4880	40.75	-33.25	74	61.83	32.72	12.32	66.12	-	-	Р	V
244010112		7320	45.19	-28.81	74	57.95	37.08	15.88	65.72	-	-	Р	V
													V
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													V



#### Report No. : FR1N2541B

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MU-)	(dBu)//m)	Limit	Line		Factor	Loss	Factor	Pos	Pos	Avg.	
		4960	<u>( авруля )</u> 40.29	-33.71	<u>(авруліі)</u> 74	( <b>авру</b> ) 60.95	33.12	12.28	( <b>UB</b> ) 66.06	- ( cm )	(ueg)	P	(п/v) Н
		7440	44.72	-29.28	74	57.85	36.46	16.2	65.79	_	_	Р	н
													н
													н
													н
													н
													н
													н
													н
													н
													н
BLE CH 39 2480MH7													н
		4960	40.58	-33.42	74	61.24	33.12	12.28	66.06	-	-	Р	V
2480MHz		7440	45.14	-28.86	74	58.27	36.46	16.2	65.79	-	-	Р	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
	1. No	o other spurious	s found.	1	1	1	1		1	1		1	
Remark	2. Al	l results are PA	SS against F	eak and	Average lim	it line.							
	3. Th	ne emission pos	sition marked	as "-" m	eans no sus	pected em	ission found	d with suf	ficient mar	gin agai	inst limit	line or	noise
	flo	or only.											



# <2Mbps>

#### 2.4GHz 2400~2483.5MHz

# BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		( MHz )	(dBuV/m)	Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	(H/\/)
		2380.98	55.78	-18.22	74	40.34	27.32	18.2	30.08	144	153	P	<u>нич</u> ,
		2383.92	47.97	-6.03	54	32.49	27.34	18.21	30.07	144	153	А	н
	*	2402	100.05	-	-	84.47	27.41	18.24	30.07	144	153	Р	Н
	*	2402	98.31	-	-	82.73	27.41	18.24	30.07	144	153	Α	Н
RI F													Н
													Н
2402MU-		2386.44	55.71	-18.29	74	40.22	27.35	18.21	30.07	380	199	Р	V
2402101712		2376.045	47.9	-6.1	54	32.49	27.3	18.19	30.08	380	199	А	V
	*	2402	99.38	-	-	83.8	27.41	18.24	30.07	380	199	Ρ	V
	*	2402	97.35	-	-	81.77	27.41	18.24	30.07	380	199	А	V
													V
													V
		2375.38	56.71	-17.29	74	41.3	27.3	18.19	30.08	103	154	Ρ	Н
		2379.72	48.37	-5.63	54	32.93	27.32	18.2	30.08	103	154	А	Н
	*	2440	98.58	-	-	82.69	27.64	18.31	30.06	103	154	Р	Н
	*	2440	97.01	-	-	81.12	27.64	18.31	30.06	103	154	А	Н
		2492.79	57.09	-16.91	74	40.85	27.87	18.41	30.04	103	154	Р	Н
		2493.91	49.04	-4.96	54	32.79	27.88	18.41	30.04	103	154	А	Н
2440MH-		2384.62	56.06	-17.94	74	40.58	27.34	18.21	30.07	372	194	Р	V
2440101112		2384.62	48.04	-5.96	54	32.56	27.34	18.21	30.07	372	194	А	V
	*	2440	97.18	-	-	81.29	27.64	18.31	30.06	372	194	Р	V
	*	2440	95.51	-	-	79.62	27.64	18.31	30.06	372	194	Α	V
		2490.9	57.81	-16.19	74	41.59	27.86	18.4	30.04	372	194	Р	V
		2488.17	48.74	-5.26	54	32.53	27.85	18.4	30.04	372	194	Α	V



#### Report No. : FR1N2541B

	*	2480	100 79	_	-	84 64	27 82	18.38	30.05	132	152	Р	н
		2100	100.70			01.01	21.02	10.00	00.00	102	102		
	*	2480	99.28	-	-	83.13	27.82	18.38	30.05	132	152	A	Н
		2484.04	57.57	-16.43	74	41.38	27.84	18.39	30.04	132	152	Ρ	Н
		2487.92	49.18	-4.82	54	32.97	27.85	18.4	30.04	132	152	А	Н
													Н
BLE													Н
СП 39 2480МЦ-	*	2480	99.12	-	-	82.97	27.82	18.38	30.05	400	192	Ρ	V
2400141112	*	2480	97.72	-	-	81.57	27.82	18.38	30.05	400	192	А	V
		2484.36	56.72	-17.28	74	40.53	27.84	18.39	30.04	400	192	Ρ	V
		2495.56	48.66	-5.34	54	32.41	27.88	18.41	30.04	400	192	А	V
													V
													V
Remark	<ol> <li>No other spurious found.</li> <li>All results are PASS against Peak and Average limit line.</li> </ol>												





#### 2.4GHz 2400~2483.5MHz

						<u> </u>	,						
BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBµV/m)	( dB )	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	( cm )	(deg)	(P/A)	(H/V)
		4804	39.85	-34.15	74	61.35	32.32	12.35	66.17	-	-	Р	Н
													Н
													Н
													Н
													Н
													Н
													Н
													Н
													Н
													Н
													Н
BLE													н
		4804	40.21	-33.79	74	61.71	32.32	12.35	66.17	-	-	Р	V
2402111172													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
-													V

#### BLE (Harmonic @ 3m)



#### Report No. : FR1N2541B

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBuV/m)	Limit (dB)	Line ( dBuV/m )	Level (dBuV)	Factor ( dB/m )	Loss (dB)	Factor (dB)	Pos (cm)	Pos (deg)	Avg. (P/A)	(H/V)
		4880	40.4	-33.6	74	61.48	32.72	12.32	66.12	-	-	P	н
		7320	45.47	-28.53	74	58.23	37.08	15.88	65.72	-	-	Р	н
													н
													н
													Н
													Н
													Н
													н
													н
													н
DIE													Н
													Н
2440MHz		4880	40.29	-33.71	74	61.37	32.72	12.32	66.12	-	-	Р	V
244011112		7320	45.23	-28.77	74	57.99	37.08	15.88	65.72	-	-	Р	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V



#### Report No. : FR1N2541B

Image (MHz)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image (dB)Image	BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
BLE         (AB)         (Ca)			(MH7)	(dBuV/m)	Limit	Line	Level	Factor	Loss (dB)	Factor	Pos	Pos	Avg.	нлл
BLE CH 30 44.23 -29.77 74 57.36 36.46 16.2 66.79 · I I I I I I I I I I I I I I I I I I			4965	39.92	-34.08	74	60.57	33.13	12.28	66.06	-	- ( ueg )	P	н, н
RLE CH 30 CH 30			7440	44.23	-29.77	74	57.36	36.46	16.2	65.79	-	-	Р	н
BLE         Image: matrix matrindex matrindex matrix matrix matrix matrix matrix matrix matrix m														н
BLE         Image: matrix matrindex matrindex matrix matrix matrix matrix matrix matrix matrix m														н
BLE CH 39         4965         39.58         -34.42         74         60.23         33.13         12.28         66.06         -         -         P         V           1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1														Н
BLE CH 39Image: sector														Н
BLE CH 39Image: state stat														н
BLE         Image: matrix														н
BLE CH 39Image: sector														н
BLE CH 39         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M         M														н
BLE CH 39         4965         39.58         -34.42         74         60.23         33.13         12.28         66.06         -         -         P         V           2480MHz         7440         44.96         -29.04         74         58.09         36.46         16.2         65.79         -         -         P         V           1         7440         44.96         -29.04         74         58.09         36.46         16.2         65.79         -         -         P         V           1         1         1         1         1         1         1         1         1         V           1         1         1         1         1         1         1         1         V           1         1         1         1         1         1         1         1         V           1         1         1         1         1         1         1         1         1         V           1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1 <td></td> <td>Н</td>														Н
CH 39         4965         39.58         -34.42         74         60.23         33.13         12.28         66.06         -         -         P         V           2480MHz         7440         44.96         -29.04         74         58.09         36.46         16.2         65.79         -         -         P         V                  V         V                  V         V                   V         V                  V         V                  V         V                  V         V                  V         V </td <td>BLE</td> <td></td> <td>н</td>	BLE													н
2430MHZ         7440         44.96         -29.04         74         58.09         36.46         16.2         65.79         -         -         P         V           Image: I	CH 39		4965	39.58	-34.42	74	60.23	33.13	12.28	66.06	-	-	Р	V
Image: state of the state	2480WHZ		7440	44.96	-29.04	74	58.09	36.46	16.2	65.79	-	-	Р	V
Image: state of the state														V
Image: state of the state														V
Image: state of the state														V
Image: Second														V
Image: state of the state														V
Image: Second														V
														V
														V
														V
														V
1. No other spurious found.		1. No	o other spurious	s found.										
2. All results are PASS against Peak and Average limit line. Remark	Remark	2. Al	l results are PA	SS against F	Peak and	Average lim	it line.							
3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise		3. Th	e emission pos	sition marked	l as "-" m	eans no sus	pected em	ission found	d with suf	ficient mar	gin agai	inst limit	line or	noise



### Emission below 1GHz

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBµV/m)	( dB )	( dBµV/m )	(dBµV)	(dB/m)	( dB )	( dB )	( cm )	(deg)	(P/A)	(H/V)
		55.22	26.59	-13.41	40	44.92	12.63	1.32	32.28	-	-	Ρ	Н
BLE 2.4GHz BLE LF		90.14	26.1	-17.4	43.5	42.12	14.6	1.68	32.3	-	-	Р	Н
		126.03	25.04	-18.46	43.5	37.86	17.48	1.97	32.27	-	-	Ρ	Н
		436.43	24.2	-21.8	46	29.88	23.09	3.65	32.42	-	-	Ρ	н
		577.08	28.85	-17.15	46	31.37	25.78	4.2	32.5	-	-	Ρ	н
		953.44	34.22	-11.78	46	29.34	30.64	5.41	31.17	-	-	Ρ	Н
													Н
													Н
													Н
													Н
2 4GHz													Н
BI F													н
LF		37.76	33.14	-6.86	40	43.64	20.79	1.01	32.3	-	-	Ρ	V
		51.34	33.71	-6.29	40	51.06	13.67	1.27	32.29	-	-	Р	V
		184.23	26.42	-17.08	43.5	41.35	14.88	2.42	32.23	-	-	Р	V
		579.99	27.68	-18.32	46	30.26	25.72	4.21	32.51	-	-	Ρ	V
		752.65	30.65	-15.35	46	30.14	28.1	4.75	32.34	-	-	Р	V
		958.29	34.27	-11.73	46	29.15	30.83	5.42	31.13	-	-	Р	V
													V
													V
													V
													V
													V
													V
	1. No	o other spurious	s found.										
Remark	2. All	l results are PA	SS against li	mit line.									
	3. Th	e emission pos	sition marked	l as "-" m	ieans no sus	pected err	nission foun	d and em	ussion leve	el has at	i least 60	dB ma	rgin
	ag	ainst limit or er	nission is no	ise floor	only.								

### 2 4GHz BI E (I E)



# 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 <b>over limit</b> 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.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(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	Р	Н
CH 00		<u> </u>	<u> </u>			<sup> </sup>	<u>├</u>	I	<u>├</u> ───┤	]	<u> </u>	+	<u>⊢</u> /
2402MHz		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	А	Н

- 1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
- 2. Level( $dB\mu V/m$ ) =

Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

3. Over Limit(dB) = Level(dB $\mu$ V/m) – Limit Line(dB $\mu$ V/m)

#### For Peak Limit @ 2390MHz:

- 1. Level(dB $\mu$ V/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)
- $= 55.45(dB\mu V/m) 74(dB\mu V/m)$
- = -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(dB $\mu$ V/m) Limit Line(dB $\mu$ V/m)
- $= 43.54(dB\mu V/m) 54(dB\mu V/m)$
- = -10.46(dB)

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



# Appendix C. Radiated Spurious Emission Plots

Toot Engineer :	Andy Yong, Karl Hay and Stayon Wy	Temperature :	20~25°C	
lest Engineer .	Andy rang, Kan nou and Sleven wu	Relative Humidity :	50~60%	

# Note symbol

-L	Low channel location
-R	High channel location



# <1Mbps>

#### 2.4GHz 2400~2483.5MHz

## BLE (Band Edge @ 3m)































### 2.4GHz 2400~2483.5MHz

# BLE (Harmonic @ 3m)













# <2Mbps>

### 2.4GHz 2400~2483.5MHz

## BLE (Band Edge @ 3m)































### 2.4GHz 2400~2483.5MHz

# BLE (Harmonic @ 3m)













### Emission below 1GHz



2.4GHz BLE (LF)



# Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
Bluetooth –LE for 1Mbps	60.58	378	2.65	3kHz
Bluetooth –LE for 2Mbps	30.99	194	5.15	10kHz

