

ELECTROMAGNETIC EMISSIONS **COMPLIANCE REPORT**



SINGAPORE 188720	
Manufacturer: Somnics, Inc. 5F., No. 22, Sec. 2, Shengyi Rd., Zhubei City, Hsinchu Cou 30261, Taiwan (R.O.C.)	nty
Product Name: TipTraQ Sensor	
Brand Name: PRANAQ PTE. LTD.	
Model No.: TTQ01A	
Report Number: TERF2312003177E2	
FCC ID 2BDLM-TTQ01A	
Date of EUT Received: Dec. 12, 2023	
Date of Test: Dec. 12, 2023~Feb. 01, 2024	
Issue Date: Apr. 24, 2024	

Vit. Pei

Approved By

Vito Pei

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.247.

The results of this report relate only to the sample identified in this report.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

t (886-2) 2299-3279

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Revision History								
Report Number	Revision	Description	Issue Date	Revised By	Remark			
TERF2312003177E2	00	Original	Apr. 10, 2024	Yami Kuo				
TERF2312003177E2	01	Revise the test setup diagram	Apr. 12, 2024	Yami Kuo	*			
TERF2312003177E2	02	Revise manufacturer	Apr. 24, 2024	Yami Kuo	*			

Note:

1 . The remark "*" indicates modification of the report upon requests from certification body.

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GENERAL INFORMATION 1

1.1 **Product Description**

Product Name:	TipTraQ Sensor
Brand Name:	PRANAQ PTE. LTD.
Model No.:	TTQ01A
Hardware Version:	FTV4.2
Firmware Version:	4.2.0
EUT Series No.:	N/A
Power Supply:	3.7Vdc
Test Software (Name/Version)	default

1.2 **RF Specification**

Radio Technology:	BLE
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	3.47 dBm

1.3 **Antenna Designation**

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Chip	Unictron	CW505	2400~2480	-2.60

Note: Antenna information is provided by the applicant.

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1.4 **Test Methodology of Applied Standards**

FCC Part 15, Subpart C §15.247 FCC KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10:2013

1.5 **Test Facility**

	Tot Office A Linear	Test Offe News	FCC Designa-	IC CAB
Laboratory	lest Site Address	Test Site Name	tion number	identifier
		SAC 1		
		SAC 2	-	
		SAC 3		
		Conduction 1		
	No.134, Wu Kung Road, New Taipei	Conducted 1	T 14/0007	
	Industrial Park, Wuku District, New	Conducted 2	1 00027	
	Taipei City, Taiwan.	Conducted 3		
		Conducted 4	-	
		Conducted 5		
SGS Taiwan Ltd.		Conducted 6		TW3702
Central RF Lab.	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C		
(TAF code 3702)		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B	TW0028	
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		
Note: Test site na	ame is remarked on the equipmen	t list in each sectio	n of this report a	is an indica-
tion where	measurements occurred in speci	fic test site and add	dress.	

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1.6 **Special Accessories**

There are no special accessories used while test was conducted.

1.7 **Equipment Modifications**

There was no modification incorporated into the EUT.

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SYSTEM TEST CONFIGURATION 2

EUT Configuration 2.1

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 **EUT Exercise**

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 **Test Procedure**

2.3.1 **Conducted Emissions**

The EUT is a placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 **Radiated Emissions**

The EUT is a placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 **Measurement Results Explanation Example**

2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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2.5 **Test Configuration**



2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C							
EQUIPMENT TYPE MFR MODEL NUMBER SERIAL NUMBER LAST CAL. CAL DU							
Charging Adapter	PALCONTEK	LX050100	N/A	N/A	N/A		
Charging Case	PranaQ	TTQ01Z	N/A	N/A	N/A		
		UB20-					
Charging Cable	Fullglory	AMCM1000WL-	N/A	N/A	N/A		
		M041					

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3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(a)(2)	Emission Bandwidth	Compliant
§15.247(d) §15.209	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d) §15.209	Radiated Band Edge and Spurious Emission	Compliant
§15.205	Restricted Bands	Compliant
§15.247(e)	Peak Power Density	Compliant
§15.203	Antenna Requirement	Compliant

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DESCRIPTION OF TEST MODES

Operating Frequencies 4.1

2400~2483.5 MHz							
СН	Freq. (MHz)	СН	Freq. (MHz)	СН	Freq. (MHz)	СН	Freq. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

The Worst Test Modes and Channel Details 4.2

- 1. The EUT has been tested under operating condition.
- 2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
- 3. The field strength of radiation emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.
- 4. Investigation has been done on all the possible configurations for searching the worst case.

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CONDUCTED TEST						
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)		
Bluetooth LE	0 to 39	0,19,39	GFSK	1		
TRANSMIT RADIATED EMISSION TEST (BELOW 1 GHz)						
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)		
Bluetooth LE	0 to 39	19	GFSK	1		
	TRANSMIT RAD	IATED EMISSION T	EST (ABOVE 1 GH	lz)		
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)		
Bluetooth LE	0 to 39	0,19,39	GFSK	1		

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MEASUREMENT UNCERTAINTY 5

Test Items	U	ncertaint	ÿ
AC Power Line Conducted Emission	+/-	1.54	dB
Output Power measurement	+/-	0.97	dB
Emission Bandwidth	+/-	1.38	Hz
Conducted emission measurement	+/-	0.77	dB
Peak Power Density	+/-	0.61	dB
Temperature	+/-	0.6	°C
Humidity	+/-	3	%
DC / AC Power Source	+/-	1	%

Radiated Spurious E	Radiated Spurious Emission Measurement Uncertainty						
	+/-	1.89	dB	9kHz~30MHz			
Polarization: Vortical	+/-	4.15	dB	30MHz - 1000MHz			
	+/-	3.43	dB	1GHz - 18GHz			
	+/-	3.86	dB	18GHz - 40GHz			
	+/-	1.89	dB	9kHz~30MHz			
Polarization: Horizontal	+/-	4.02	dB	30MHz - 1000MHz			
	+/-	3.43	dB	1GHz - 18GHz			
	+/-	3.86	dB	18GHz - 40GHz			
	+/-	2	dB	33GHz-50GHz			
Dedicted Coursians Emis	+/-	1.59	dB	50GHz-60GHz			
sion	+/-	1.7	dB	60GHz-90GHz			
51011	+/-	1.64	dB	90GHz-140GHz			
	+/-	3.83	dB	140GHz-220GHz			

Note:

- 1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
- 2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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MEASUREMENT EQUIPMENT USED 6

Emission from AC power line 6.1

	AC Power-Line Conducted Emission Test Site: Conduction C								
EQUIPMENT TYPE MFR		MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.				
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	974	06/19/2023	06/18/2024				
EMI Test Receiver	R&S	ESCI	101342	04/24/2023	04/23/2024				
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2023	03/26/2024				
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2023	03/26/2024				
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R				

6.2 **Conducted Measurement**

	Conducted Emission Test Site: Conducted E									
EQUIPMENT TYPE	MFR	MODEL NUMBER SERIAL NUMBER		LAST CAL.	CAL DUE.					
Spectrum Analyzer	KEYSIGHT	N9010A	MY54510568	07/07/2023	07/06/2024					
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R					
Attenuator	Marvelous	MVE2213-10	RF06	11/15/2023	11/14/2024					
DC Block	PASTERNACK	PE8210	RF157	11/15/2023	11/14/2024					
DC Power Supply	Gwinstek	SPD-3606	GEV923152	05/10/2023	05/09/2024					
Power Meter	Anritsu	ML2496A	1326001	08/22/2023	08/21/2024					
Power Sensor	Anritsu	MA2411B	1315048	08/22/2023	08/21/2024					
Power Sensor	Anritsu	MA2411B	1315049	08/22/2023	08/21/2024					

6.3 **Radiated Measurement**

	Radiated Emission Test Site: SAC D								
EQUIPMENT TYPE MFR		MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.				
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-617	12/14/2023	12/13/2024				
Horn Antenna	Schwarzbeck	BBHA9120D	1341	05/26/2023	05/25/2024				
Loop Antenna	ETS.LINDGREN	6502	143303	05/23/2023	05/22/2024				
Horn Antenna	SCHWARZBECK	BBHA9170	185	08/21/2023	08/20/2024				
3m Site NSA	SGS	966 chamber D	N/A	04/30/2023	04/29/2024				
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/29/2023	03/28/2024				
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R				
Pre-Amplifier	EMC Instruments	EMC18405SEE	980881	11/15/2023	11/14/2024				
Pre-Amplifier	EMC Instruments	EMC9135	980234	11/15/2023	11/14/2024				
Pre-Amplifier	EMC Instruments	EMC12630SE	980273	11/15/2023	11/14/2024				
Coaxial Cable	Coaxial Cable Huber+Suhner		W21.01	11/15/2023	11/14/2024				
Coaxial Cable	Huber+Suhner	EMC106-SM-SM- 7200	150703	11/15/2023	11/14/2024				

NOTE: N.C.R refers to Not Calibrated Required.

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CONDUCTED EMISSION TEST 7

7.1 **Standard Applicable:**

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range	Liı (dE	mits 3μV)
MHz	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Note

1. The lower limit shall apply at the transition frequencies

2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

7.2 **EUT Setup:**

- 1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
- 2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
- 3. The LISN was connected with 120Vac/60Hz power source.

7.3 **Test Setup**



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7.4 **Measurement Procedure:**

- 1. The EUT was placed on a table which is 0.8m above ground plane.
- 2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 3. Repeat above procedures until all phases of power being supplied by given UE are completed

7.5 **Measurement Result:**

Note: Refer to next page for measurement data and plots. Note2: The * reveals the worst-case results that closest to the limit.

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:TERF23	12003177E2	Test Site	:Conduction C)
Test Mode	:BLE		Test Date	:2024-02-01	
Power	:120V/60I	Hz	Temp./Hum	i :23.8℃/55%	
Probe	:L1		Engineer	:Howard Huar	ng
80 Level (c	dBuV)				
70.0					
60.0					
50.0					
40.0					
30.0	Norman	MARINA	$\frac{1}{h} \land \land$		
20.0		a Alba Ma	A A A A A A A A A A A A A A A A A A A	A A A A A A A A A A A A A A A A A A A	Arry
10.0					- Y
0.15	0.	5 1 Frequ	2 5 iency (MHz)	10 20	0 30
Freq.	Detector	Spectrum Reading Level	Factor A	ctual L	.imit Margin
MHz F	PK/QP/AV	dBµV	dB d	lBμV d	BμV dB
0.151	Peak	24.29	10.65 3	64.94 6	5.93 -30.99
0.173	Peak	23.18	10.65 3	33.83 6	4.80 -30.97
0.532	Peak	22.97	10.62 3	33.59 5	6.00 -22.41
0.862	Peak	18.35	10.67 2	9.03 5	6.00 -26.97
1.730	Peak	16.65	10.75 2	27.41 5	6.00 -28.59
5.262	Peak	14.14	10.95 2	25.09 6	0.00 -34.91

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Report Number	:TERF231	2003177E2	Test Sit	te	:Conduc	tion C	
Test Mode	:BLE		Test Da	ate	:2024-02	2-01	
Power	:120V/60H	Ηz	Temp./	Humi	: 23.8 °C/	55%	
Probe	:N		Engine	er	:Howard	Huang	
80 Level (0	dBuV)						
60.0							
50.0							
40.0							
30.0	when my	Å.	5.	6			
20.0 T	nt Ac	VYM	MMM	MWW	Maderhamort	mone	
0.15	0.5	5 1 Frequ	2 Jency (MHz)	5	10	20 30	
Freq.	Detector Mode	Spectrum Reading Level	Factor	Act F	ual S	Limit	Margin
MHzI	PK/QP/AV	dBµV	dB	dB	μV	dBµV	dB
0.450	D 1	00.07	40.00		00	00.00	04.07
0.150	Peak	23.97	10.66	34.	16	66.00 64.97	-31.37
0.172	Poak Poak	22.00	10.00	33. 32	68	56 00	-31.71
0.343	Peak	16.33	10.65	26	98	56.00	-22.52
1.716	Peak	13.00	10.73	23	73	56.00	-32.27
4.875	Peak	11.50	10.93	22.	43	56.00	-33.57

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PEAK OUTPUT POWER MEASUREMENT 8

8.1 **Standard Applicable:**

8.1.1 **Duty Cycle**

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

8.1.2 FCC

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.2 **Test Setup**

8.2.1 Duty Cycle



8.2.2 Output Power



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8.3 **Measurement Procedure:**

Duty Cycle 8.3.1

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. Set span = Zero
- 3. RBW = 8MHz, VBW = 8MHz,
- 4. Detector = Peak

8.3.2 **Output Power**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
- 4. Record the max. Reading as observed from Power Meter.
- Repeat above procedures until all test default channel measured was complete.

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8.4 **Duty Factor:**

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
BLE 1M	100.00	0.00	0.33	0.01

BLE_1M_LowCH00-2402

Keysight	Spectrum	Analyzer - S	wept SA									
Center	Freq	50 2.4020	Ω DC 000000	GHz		SENS	E:INT	Avg	ALIGN AUTO Type: Voltage	03:15:22 TR/	PM Jan 30, 2024	Frequency
10 dB/div	Ref Re	f Offset 1 f 30.00	0.5 dB dBm	PNO: Fas IFGain:Lo	N N	#Atten: 30	dB			∆Mkr3 3	8.000 ms 0.01 dB	Auto Tune
20.0 10.0 0.00			** <u>a</u>							3∆4		Center Freq 2.402000000 GHz
-10.0 -20.0 -30.0												Start Freq 2.402000000 GHz
-40.0 -50.0 -60.0												Stop Freq 2.402000000 GHz
Center : Res BW	2.4020 / 8 MH	00000 z	GHz	#\	вw	8.0 MHz	FUI	NCTION	Sweep	5.000 ms	Span 0 Hz (1001 pts)	CF Step 8.000000 MHz <u>Auto</u> Man
1 Δ2 2 F 3 Δ4 4 F 5	1 t 1 t 1 t 1 t	(Δ) (Δ)		3.000 ms 1.000 ms 3.000 ms 1.000 ms	(Δ) (Δ)	0.01 d 2.77 dBr 0.01 d 2.77 dBr	B n n				E	Freq Offset 0 Hz
7 8 9 10 11												Scale Type
MSG						m			STATU	JS	•	

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Output Power: 8.5

8.5.1 Peak & Avg

BLE 1M mode:

СН	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	Required Limit (dBm)
Low	2402	default	2.86	30
Mid	2440	default	3.47	30
High	2480	default	3.25	30
СН	Frequency (MHz)	Power Setting	Avg. Output Power (dBm)	Required Limit (dBm)
Low	2402	default	2.75	30
Mid	2440	default	3.33	30
High	2480	default	3.15	30

*Note:

1.Measured by power meter, cable loss 10.5 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

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EMISSION BANDWIDTH MEASUREMENT 9

9.1 **Standard Applicable**

The minimum 6 dB bandwidth shall be at least 500 kHz.

9.2 **Test Setup**



9.3 **Measurement Procedure:**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

9.3.1 6dB BW measurements

- 1. The testing follows the Measurement Procedure of the KDB 558074 D01.
- 2. Set the spectrum analyzer as RBW = 100 kHz, VBW = 3 X RBW.Span= 2 to 5 times of the OBW, Sweep=auto, Detector = Peak, and Max hold.
- 3. Mark the upper and lower frequencies of -6dB.
- 4. Repeat above procedures until all test default channel is completed.

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Measurement Result: 9.4

9.4.1 6dB BW measurements

BLE 1M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.7566	\ge 0.5	PASS
2440	0.7461	\ge 0.5	PASS
2480	0.7527	≧ 0.5	PASS

OBW_BLE 1M_LowCH00-2402MHz



OBW_BLE 1M_MidCH19-2440MHz



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OBW_BLE 1M_HighCH39-2480MHz

Center Fre	eq 2.480000000	GHz	SENSEDIT Center Freq: 2.48000000 Trig: Free Run A #Atten: 30 dB	0 GHz vg[Hold: 100/100	Radio Std: None Radio Device: BTS	Frequency
10 dB/div	Ref Offset 10.5 dE Ref 30.00 dBm	3				
20.0 10.0						Center Fre 2.480000000 GH
20.0						
40.0 50.0						
Center 2.4 Res BW	80000 GHz 100 kHz		#VBW 300 kHz		Span 3.000 MHz Sweep 1 ms	CF Ste 300.000 kH
Occup	ied Bandwidt 1.(h 0795 MH:	Total Pow	ver 9.3	2 dBm	Freq Offse
Transm x dB Ba	iit Freq Error Indwidth	38.354 kH 752.7 kH	z % of OBW z x dB	Power 9 -6	9.00 % .00 dB	он
					-	

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台灣檢驗科技股份有限公司

SGS Taiwan Ltd.



10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 **Standard Applicable**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 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, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

10.2 **Test Setup**



10.3 Measurement Procedure

Reference Level of Emission Limit: 10.3.1

- 1. Set analyzer center frequency to DTS channel center frequency.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 3. Set the span to 1.5 times the DTS channel bandwidth.
- 4. Set the RBW = 100kHz & VBW = 300 kHz.
- 5. Detector = peak.
- 6. Sweep time = auto couple.
- 7. Trace mode = max hold.
- 8. Allow trace to fully stabilize.
- 9. Use the peak marker function to determine the maximum amplitude level.

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10.3.2 **Conducted Band Edge:**

- 1. To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
- 5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
- 6. Set DL as the limit = reading on marker of reference level measurement 20dBm
- Mark the highest readings of the emissions outside of 2400MHz~2483.5MHz.
- 8. Repeat above procedures until all default test channel (low and high) was complete.

10.3.3 **Conducted Spurious Emission:**

- 1. To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 3. Set RBW = 100 kHz & VBW=300 kHz, Detector = Peak, Sweep = Auto
- 4. Allow trace to fully stabilize.
- 5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
- 6. Repeat above procedures until all default test channel measured were complete.

10.4 Measurement Result

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	1.19	-18.81
2440	1.94	-18.06
2480	1.84	-18.16

BLE 1M Reference Level of Limit

*Note:

1.cable loss as 10.5dB that offsets in the spectrum 2. Refer to next page for plots.

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Reference Level_BLE 1M_LowCH00-2402MHz

Keysight Spectrum Analyzer - Swept SA				
enter Freq 2.402000000 0	HZ PNO: Wide	Avg Type: Log-Pwr	03:30:48 PM Jan 30, 2024 TRACE 1 2 3 4 5 6 TYPE M WWWW	Frequency
Ref Offset 10.5 dB dB/div Ref 30.00 dBm	IFGain:Low #Atten: 30 dB	Mkr1 2	.402 294 3 GHz 1.19 dBm	Auto Tun
0.0				Center Fre 2.402000000 GH
0		•1		Start Fre 2.401432550 GH
				Stop Fro 2.402567450 G
0				CF St 113,490 k Auto M
.0				Freq Offs 0
1.0				Scale Ty
enter 2.4020000 GHz Res BW 100 kHz	#VBW 300 kHz	Sweep 1	Span 1.135 MHz .000 ms (1501 pts)	Log L

Reference Level_BLE 1M_MidCH19-2440MHz

Keysight Sp	ectrum Analyzer - Swept SA					- 0 ×
Center F	req 2.440000000	PNO: Wide	Trig: Free Run #Atten: 30 dB	Avg Type: Log-Pwr	03:26:42 PM Jan 30, 2024 TRACE 1 2 3 4 5 6 TVPE M WWWWW DET P N N N N N	Frequency
10 dB/div	Ref Offset 10.5 dB Ref 30.00 dBm			Mkr1 2	.440 291 0 GHz 1.94 dBm	Auto Tune
20,0						Center Freq 2.440000000 GHz
0.00				<u></u> 1		Start Free 2.439440425 GHz
-10.0						Stop Free 2.440559575 GHz
-30.0						CF Step 111.915 kH: Auto Mar
-50.0						Freq Offse 0 H
Center 2.	4400000 GHz	#1/D1M	200 kHz		Span 1.119 MHz	Scale Type
Center 2. Res BW	4400000 GHz 100 kHz	#VBW	300 kHz	Sweep 1	Span 1.119 MHz .000 ms (1501 pts)	Scale Type

Reference Level_BLE 1M_HighCH39-2480MHz

📕 Keysight Sp	ectrum Analyzer - Swept SA					
Center F	req 2.48000000	0 GHz	SENSE:DVT	Avg Type: Log-Pwr	03:39:28 PMJan 30, 2024 TRACE 1 2 3 4 5 6	Frequency
	Ref Offset 10.5 dB	IFGain:Low	#Atten: 30 dB	Mkr1 2	.480 292 8 GHz	Auto Tune
10 dB/div Log	Ref 30.00 dBm				1.84 dBm	
20.0						Center Free 2.48000000 GHz
0.00		_		•		Start Free 2.479435475 GHz
-10.0						Stop Free 2.480564525 GHz
-30.0						CF Step 112.905 kH Auto Mar
-50.0						Freq Offse 0 Hz
-68.0						Scale Type
Center 2. #Res BW	4800000 GHz 100 kHz	#VBW	300 kHz	Sweep 1	Span 1.129 MHz .000 ms (1501 pts)	Log <u>Lin</u>
MSG				STATUS		

Band Edge_BLE 1M_LowCH00-2402MHz

Keysight S	rectrum Analyzer - Sw	ept SA					
Center F	req 2.36000	00000 GHz	SENSE:	Avg	Type: Log-Pwr	03:31:42 PMJan 30, 2024 TR4CE 1 2 3 4 5 6	Frequency
		PNO: Fest IFGain:Lov	#Atten: 30 dE		Mk	r2 2 400 0 GHz	Auto Tune
10 dB/div	Ref Offset 10 Ref 30.00	dBm				-45.59 dBm	
20.0	_			_		01	Center Freq 2.36000000 GHz
-10.0 -20.0				_	_	Di/1 -18.91 (IBN)	Start Freq 2.31000000 GHz
-30.0 -40.0 -50.0 	u47404-057****	ar mana si sa s	-		mahanamma		Stop Freq 2.410000000 GHz
Center 2 #Res BV	.36000 GHz / 100 kHz	#\	/BW 300 kHz	FUNCTION	Sweep 9	Span 100.0 MHz .600 ms (1001 pts)	CF Step 10.000000 MHz Auto Man
1 N 2 N 3 4 5	1 f (Δ) 1 f	2.401 8 GHz 2.400 0 GHz	(Δ) 1.34 dBm -45.59 dBm				Freq Offset 0 Hz
6 7 8 9 10 11							Scale Type
MSG					STATLE	•	

Band Edge_BLE 1M_HighCH39-2480MHz

🔤 Keysight Sp	ectnim Analyzer - Sil	rept SA								- 0 🎫
Center F	req 2.48750	00000 GH	łz	SE)	Run	Avg	ALLON AUT Type: Log-Pr	0 03:40:22	PMJan 30, 2024	Frequency
	Ref Offset 10	IF 0.5 dB	NU: Fast Gain:Low	#Atten: 3	dB		Mk	r3 2.491 -47	350 GHz	Auto Tune
20.0	Rel 30.00	1		-						Center Freq 2.487500000 GHz
-111.0		1							DL1 -10.10 dBm	Start Freq 2.475000000 GHz
-40.0 -50.0		L	m ²	w			3	mharroornal	an a	Stop Freq 2.50000000 GHz
Center 2. #Res BW	48750 GHz 100 kHz		#VB	N 300 kHz	_		Sweep	Span 2.400 ms	25.00 MHz (1001 pts)	CF Step 2,500000 MHz Auto Man
1 N 2 N 3 N 4	f (Δ) f (Δ)	2,479 77 2,483 50 2,491 35	5 GHz (Δ 0 GHz 0 GHz (Δ	2.06 dE -49.93 dE -47.86 dE	am Sm Sm	ACTION	FUNCTION	1H FUNC	TIONWALLE	Freq Offset 0 Hz
0 7 8 9 10 11										Scale Type
MSG				1		-	STA	nus.		

Spurious Emission_BLE 1M_LowCH00-2402MHz

									Swept 24	Analyzer-	éctrum à	yslight S
Frequency	SPMJan 30, 2024 RACE 1 2 3 4 5 6 TVPE N WWWW	03:32:06 F	Avg Type: Log-Pwr			Tric: Free		00 GH	50000	12.51	req	ter i
AutoTur	DETPNNNNN				dB	#Atten: 3	iow	IFGa				
Auto Tu	.205 GHz 9.90 dBm	Ref Offset 10.5 dB Mkr4 7.205 GHz Skdiv Ref 30.00 dBm -39.90 dBm									B/div	
Center Fre	_							_	-		_	
12.515000000 G							-	-	-	1	0	\vdash
										_	1	
30.000000 Mi	DL1 -18.81 (En							-		_	-	-
								64	A2		-	\vdash
Stop Fre				-	-	-		a dia	New	-		
25,00000000 Gr											-	-
CF Ste 2.497000000 G	24.97 GHz (24971 pts)	Span 2 .387 s (2	Sweep 2			300 kHz	#VBW			GHz kHz	2.52	ter 1 s BV
Nully Int	TION WALLE	FUNCT	CTION MOTH	CTION FU		Y 0.20 45	10.10	2 402	х	(4)	RC SCI	NOOE
Freq Offs					m	-44.93 dE -42.49 dE	Hz (A)	4.804		(Δ)	1	NN
01				_	m	-39,90 dE	Hz	7.205			1 1	N
Scale Typ	_			-	-		-				+	-
Log L				_	_		-				-	
	*				-		-			-	-	

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Spurious Emission_BLE 1M_MidCH19-2440MHz

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Frequency	PMJan 30, 2024 40E 1 2 3 4 5 6	03:27/22.P TR4 TV	Log-Pwr	Avg Ty	Run	Tria: Free	łz	000000 G	12.515	req '	ter	Cer
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Start Freq 30.000000 MHz	DL1 -18:06 (Br)						1					-10.0
Stop Freq 25.00000000 GHz	-	<u>iliyy</u> tytyty	-	-			-	2		-		-40.0 -50.0
CF Step 2,497000000 GH: Auto Mar	24.97 GHz 24971 pts)	Span 2 2.387 s (2	Sweep 2			300 kHz	#VBW		GHz kHz	2.52 0	ter t s Bł	Cer #Re
Freq Offset 0 Hz	FONWALLE F	FUNCT	KET ION WADTH	CTION	Bm Bm Bm Bm	0,45 dE -45,37 dE -39,06 dE -38,37 dE	GHz (Δ) GHz GHz (Δ) GHz	× 4.88 7.32 7.31	(Δ) (Δ)		N N N N	12345
Scale Type												0 7 8 9 10 11
			STATUS							-		MSG

Spurious Emission_BLE 1M_HighCH39-2480MHz

10 mm	07.40.46.0							pt SA	lyzer - Sin	nim Ani	t Spéch	sysight
CE 1 2 3 4 5 6 PE MWWWW ET P NNNNN	TRA	Log-Pwr	Avg Type	Run	Trig: Free	st ++-	SHz NO: Fas	00000	.5150	eq 12	Fre	nter
139 GHz 56 dBm	Akr4 7.4 -38.	M					CHARLES	5 dB Bm	fiset 10	Ref 0	v	B/div
										01		
DL1 -10.16 dBm							4					
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24.97 GHz 24971 pts)	Span 2 2.387 s (2	Sweep 2			300 kHz	VBW	#1		iz Iz	52 GI 00 k	12.5 W 1	ter s B
-	10001			m m m	-0.34 dE -45.90 dE -40.06 dE -38.66 dE	ζ (Δ) ζ ζ ζ	80 GHz 60 GHz 40 GHz 39 GHz	2.4 4.9 7.4 7.4	7)	f f f f	1 1 1	N N N
				-		-						_
	Mar 30, 2024 Pi 24 4 5 4 6 k Pi 24 4 6 k Pi 24 4 6 k Pi 24 4 6 k 39 GHz 56 dBm 21 - 1816 db 4.97 GHz 4971 pts) 10 k 10 k	Didde free for 28 2025 Trade [2 2 4 5 5 Trade [2 4 5 5 Color Physics of 2 4 5 5 Color Physics of 2 4 5 5 Color Physics of 2 4 5 Ref (1 4 10 0 Ref (Log-Per Log-Per Toyle 12 3 4 201 Log 2 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4	AU22 JUINT 0044 FM (m 28, 2024) Avg Type: Log-Pwr Tref i www.wr Scient State Stat	BEINT BUTT NOT BUTT NOT <t< td=""><td>BROCHT BROWNERS <</td><td>Statisticity Statisticity Statisticity<</td><td>International Control of Control</td><td>2 4</td><td>Barrison Status Excession Excession</td><td>a dagen Single 3 a dagen Single 3 a (22,515000000 GHz P(0) Fair → Trg: Free Run Ref Offset 10.5 dB Ref Offset 10.5 dB Ref 0.00 GHz 1 0 0 0 0 HZ 1 0 0 0 0 HZ 1 0 0 0 0 HZ 1 0 0 HZ 1</td><td>Arg Type: Log-Per Exponence Exponence</td></t<>	BROCHT BROWNERS <	Statisticity Statisticity<	International Control of Control	2 4	Barrison Status Excession Excession	a dagen Single 3 a dagen Single 3 a (22,515000000 GHz P(0) Fair → Trg: Free Run Ref Offset 10.5 dB Ref Offset 10.5 dB Ref 0.00 GHz 1 0 0 0 0 HZ 1 0 0 0 0 HZ 1 0 0 0 0 HZ 1	Arg Type: Log-Per Exponence Exponence

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11 DUTY FACTOR CORRECTION FACTOR FOR RADIATED UNWANTED **EMISSION**

11.1 **Standard Applicable**

According to 15. 35(c), the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification.

11.2 **Test Setup**



11.3 Measurement Procedure

- Adjust and configure any EUT switches, controls, or input data streams to ensure that 1. the EUT is transmitting or encoded to obtain the "worst-case" pulse ON time.
- The testing follows ANSI C63.10:2013. 2.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- Set center frequency of spectrum analyzer = operating frequency. 4.
- 5. Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz, Detector = Peak, Adjust Sweep=100ms.
- 6. Repeat above procedures until all frequency of the interest measured were complete.

Average value(dBµV/m)=Peak Actual FS(dBµV/m)+ Duty Cycle Correction Factor(dB)

Duty Cycle Correction Factor(dB) = $20 \log (T_{on}/100 \text{ ms})$

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11.4 **Measurement Result:**

11.4.1 **Duty Cycle Correction Factor**

Bluetooth 1M

Time ON of 100ms: 1.200 ms Duty Cycle=1.2ms / 100ms= 0.012 Duty Cycle correction factor=20 LOG 0.012 = -38.42 dB

11.4.2 **Duty Cycle test plot**

BLE



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12 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

Spurious Emission

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 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, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

And according to §15.33(a) (1) for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

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

Note: The lower limit shall apply at the transition frequencies.

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12.1 **Test Setup**

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



(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



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



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12.2 **Measurement Procedure**

- 1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plane.
- 3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
- 4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
- 5. Set the spectrum analyzer as RBW=100 kHz and VBW=300 kHz for Peak Detector (PK) at frequency between 30MHz and 1 GHz.
- 6. Use receiver mode as RBW=120 kHz for Quasi-peak (QP) at frequency between 30MHz and 1 GHz.
- 7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Maximum Emission Measurements at frequency above 1 GHz.
- 8. According to C63.10:2013 Section 7.5 Procedure for determining the average value of pulsed emissions with duty cycle correction factor 20 log (Ton/100ms).
- 9. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
- 10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 12. Repeat above procedures until all default test channel measured were complete.

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12.3 **Field Strength Calculation**

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

FS = RA + AF + CL - AG

Where FS = *Field Strength RA* = *Reading Amplitude* AF = Antenna Factor

CL = Cable Attenuation Factor (Cable Loss) AG = Amplifier Gain

The limit of the emission level is expressed in dBuV/m, which converts 20*log(uV/m)

Actual FS($dB\mu V/m$) = SPA. Reading level($dB\mu V$) + Factor(dB) Factor(dB) = Antenna Factor(dB μ V/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

12.4 Test Results of Radiated Spurious Emissions from 9 kHz to 30 MHz

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

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12.4.1 Radiated Band Edge Measurement Result

TERF2312003177E2	Test Site	:SAC D
BLE 1M	Test Date	:2024-02-01
2402 MHz	Temp./Humi.	:23.2 ℃/63%
Bandedge	Antenna Pol.	:Vertical
E2 Plane	Engineer	:Howard Huang
E	TERF2312003177E2 BLE 1M 2402 MHz Bandedge E2 Plane	TERF2312003177E2Test SiteBLE 1MTest Date2402 MHzTemp./Humi.BandedgeAntenna Pol.E2 PlaneEngineer



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Report Number Operation Mode Test Frequency Test Mode	TERF23: BLE 1M: 2402 MF: Bandedg:	12003177E2 Iz ge	Te Te Te Ar	est Site : S est Date : 2 emp./Humi. : 2 ntenna Pol. : H	SAC D 2024-02-01 23.2 ℃/63% Horizontal	
EUT Pol	:E2 Plane	9	Er	ngineer :H	loward Huang	
120 Level (dBuV/	/m)					
70	1					
30						
2310	2330.	2350. Freque	2370. ncy (MHz)	2390.	2410	
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2335.400 2390.000	Peak Peak	54.26 52.36	-4.88 -4.58	49.38 47.77	74.00 74.00	-24.62 -26.23
Freq.	Detector Mode	Peak Actual FS (dBu\//m)	Duty Cycle Factor (dB)	Average Value (dBu\//m)	Average Limit@3m (dBu)//m)	Margin
2335.400 2390.000	Average Average	49.38 47.77	-38.42 -38.42	10.96 9.35	54.00 54.00	-43.04 -44.65

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Report Number:TERF2312003177E2Operation Mode:BLE 1MTest Frequency:2480 MHzTest Mode:BandedgeEUT Pol:E2 Plane			Te Te Te Ai Ei	Test Site:SAC DTest Date:2024-02-01Temp./Humi.:23.2 °C/63%Antenna Pol.:VerticalEngineer:Howard Huang		
Level (dBu)//r	D)					
120						
90	\frown					
70						
50 month			hanne binne Believel an order our			
30						
10						
2475	2480.	2485. Frequer	2490. ncy (MHz)	2495.	2500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
			dB	FS dBuV/m	@3m dBuV/m	dB
		ασμν	üВ	ασμνγιι	αυμνγιιί	uВ
2483.500	Peak	52.53	-5.30	47.23	74.00	-26.77
2484.250	Peak	54.78	-5.31	49.47	74.00	-24.53
Freq.	Detector	Peak Actual	Duty Cycle	Average	Average	Margin
	Mode	FS	Factor		Limit@3m	
IVIHZ	AV	(ashv/w)	(aB)	(aBuv/m)	(aBuv/m)	(an)
2483 500	Average	17 23	-38 /12	8 81	54 00	-15 10
2484.250	Average	49.47	-38.42	11.05	54.00	-42.95

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Report Number Operation Mode Test Frequency Test Mode	:TERF231 :BLE 1M :2480 MH :Bandedge	2003177E2 z	Tes Tes Ten Ant	t Site :S/ t Date :20 np./Humi. :23 enna Pol. :He	AC D 024-02-01 3.2 ℃/63% orizontal	
EUT Pol	:E2 Plane		Enç	gineer :He	oward Huang	
120 Level (dBuV/r 110 90 70 50 30	n)					
10 0 2475	2480.	2485. Frequer	2490.	2495.	2500	
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz F	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.500 2498.175	Peak Peak	54.31 54.75	-5.30 -5.42	49.01 49.34	74.00 74.00	-24.99 -24.66
Freq. MHz	Detector Mode AV	Peak Actual FS (dBµV/m)	Duty Cycle Factor (dB)	Average Value (dBuV/m)	Average Limit@3m (dBuV/m)	Margin (dB)
2483.500 2498.175	Average Average	49.01 49.34	-38.42 -38.42	10.59 10.92	54.00 54.00	-43.41 -43.08

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12.4.2 **Radiated Spurious Emission**

Report Number	:TERF2312003177E2	Test Site	:SAC D
Operation Mode	:BLE 1M	Test Date	:2024-02-01
Test Frequency	:2440 MHz	Temp./Humi.	:23.2 °C/63%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Howard Huang



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Report Numbe	er :TERF231	2003177E2		Test Site	:SAC D	
Operation Mod	de :BLE 1M			Test Date	:2024-02-01	
Test Frequenc	y :2440 MH	Z		Temp./Humi.	:23.2 °C/63%	
Test Mode	:Tx			Antenna Pol.	:Horizontal	
EUT Pol	:E2 Plane			Engineer	:Howard Huang	
100 Level (dBu 90 80 70 60 50 40 20 10 0 30	V/m)				5 6	
-		Frequen	cy (MHz)	A ()	1	
Freq.	Detector	Spectrum Reading Level	Factor	Actual FS	LIMIT @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
20.070	Deele	40.70	40.74	00.00	40.00	10.01
30.970	Peak	48.72	-18.74	29.99	40.00	-10.01
97 900	Peak	41.73	-70.90	24.03	40.00	-73.04
252,130	Peak	36.24	-17.15	19.08	46.00	-26.92
956.350	Peak	34.71	-4.02	30.70	46.00	-15.30
995.150	Peak	35.33	-3.89	31.44	54.00	-22.56

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Report Number	:TERF2312003177E2
Operation Mode	:BLE 1M
Test Frequency	:2402 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site	:SAC D			
Test Date	:2024-02-01			
Temp./Humi.	:23.2 ℃/63%			
Antenna Pol.	:Vertical			
Engineer	:Howard Huang			

100	34 6/111)					
90						
80						
70						
60	2					
50	1					
40						
30						
20						
10						
0	6100.	11200.	16300.	21400.	26500	
		Freque	ncy (MHz)			
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4804.000	Peak	43.70	0.98	44.68	74.00	-29.32
7206.000	Peak	52.16	8.13	60.29	74.00	-13.71
Freq	Detector	Peak Actual	Duty Cycle	Average	Average	Margin
1109.	Mode	FS	Factor	Value	l imit@3m	margin
MHz		(dBuV/m)	(dB)	(dBuV/m)	(dBu\//m)	(dB)
111112	/ \ v					
1001.000	•	44.00	00.40	0.00	54.00	47 74
4804.000	Average	44.68	-38.42	6.26	54.00	-4/./4
7206.000	Average	60.29	-38.42	21.87	54.00	-32.13

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Report Number	:TERF2312003177E2
Operation Mode	:BLE 1M
Test Frequency	:2402 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site	:SAC D			
Test Date	:2024-02-01			
Temp./Humi.	:23.2 ℃/63%			
Antenna Pol.	:Horizontal			
Engineer	:Howard Huang			



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Report Number	:TERF2312003177E2
Operation Mode	:BLE 1M
Test Frequency	:2440 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site	:SAC D			
Test Date	:2024-02-01			
Temp./Humi.	:23.2 ℃/63%			
Antenna Pol.	:Vertical			
Engineer	:Howard Huang			

100 Level (dE	suv/m)					
90						
80						
70						
60	2					
50	1					
40						
30						
20						
10						
0	6100.	11200.	16300.	21400.	26500	
		Freque	ncy (MHz)			
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4880.000	Peak	46.69	1.00	47.69	74.00	-26.31
7320.000	Peak	50.78	9.04	59.82	74.00	-14.18
Frea.	Detector	Peak Actual	Dutv Cvcle	Average	Average	Margin
- 1	Mode	FS	Factor	Value	Limit@3m	5
MHz	AV	(dBµV/m)	(dB)	(dBuV/m)	(dBuV/m)	(dB)
		· · · · ·		· · · · · ·	· · · · · ·	, /
4880.000	Average	47.69	-38.42	9.27	54.00	-44.73
7320.000	Average	59.82	-38.42	21.40	54.00	-32.60

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Report Number	:TERF2312003177E2
Operation Mode	:BLE 1M
Test Frequency	:2440 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site	:SAC D
Test Date	:2024-02-01
Temp./Humi.	:23.2 ℃/63%
Antenna Pol.	:Horizontal
Engineer	:Howard Huang

100 Level (dE	uv/m)					
90						
80						
70	2					
60	1					
50						
40						
30						
20						
10						
9	6100	11200	16300	21400	26500	
		Freque	ncy (MHz)	211001	20000	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4880.000	Peak	55.12	1.00	56.12	74.00	-17.88
7320.000	Peak	55.88	9.04	64.92	74.00	-9.08
Frog	Dotoctor	Pook Actual	Duty Cyclo	Average	Average	Margin
Fieq.	Modo	Feak Actual	Eactor	Value	Limit@2m	Maryin
					(dBu)//m)	(dD)
	AV	(ubµ v/m)	(UD)	(ubuv/III)	(ubuv/iii)	(ub)
4880.000	Average	56.12	-38.42	17.70	54.00	-36.30
7320.000	Average	64.92	-38.42	26.50	54.00	-27.50

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Report Number	:TERF2312003177E2
Operation Mode	:BLE 1M
Test Frequency	:2480 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site	:SAC D
Test Date	:2024-02-01
Temp./Humi.	:23.2 ℃/63%
Antenna Pol.	:Vertical
Engineer	:Howard Huang



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Report Number	:TERF2312003177E2
Operation Mode	:BLE 1M
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Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site	:SAC D
Test Date	:2024-02-01
Temp./Humi.	:23.2 ℃/63%
Antenna Pol.	:Horizontal
Engineer	:Howard Huang



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13 POWER SPECTRAL DENSITY

13.1 **Standard Applicable:**

Per Part 15.247 (e)

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

13.2 Test Setup



Measurement Procedure: 13.3

- 1. Set analyzer center frequency to DTS channel center frequency.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 3. Set the span to 1.5 times the DTS channel bandwidth.
- 4. Set the RBW = 3 kHz. & the VBW = 10 kHz
- 5. Detector = peak.
- 6. Sweep time = auto couple.
- Trace mode = max hold.
- 8. Allow trace to fully stabilize.
- 9. Use the peak marker function to determine the maximum amplitude level.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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13.4 **Measurement Result:**

BLE 1M mode

Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2402	-11.543	8	PASS
2440	-10.540	8	PASS
2480	-10.819	8	PASS

*Note:

1.cable loss as 10.5dB that offsets in the spectrum

Keysight Spectrum Analyzer - Sw	ept SA			TRACK AND ADD TO BOTH DO	
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-50.0					Freq Offset 0 Hz
60.0					Scale Type
Center 2.4020000 GH2 #Res BW 3.0 kHz	#VBW	10 kHz	Sweep 1	span 1.135 MHz 19.7 ms (1001 pts)	

PSD_BLE 1M_LowCH00-2402MHz

PSD_BLE	1M	MidCH19-2440MHz
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PSD_BLE 1M_HighCH39-2480MHz

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14 ANTENNA REQUIREMENT

14.1 **Standard Applicable:**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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 provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

14.2 Antenna Connected Construction:

The antenna complies with this requirement and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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