

# ELECTROMAGNETIC EMISSIONS **COMPLIANCE REPORT**



Applicant:	LEDGER SAS 1 rue du Mail, 75002 Paris, France				
Manufacturer:	LEDGER SAS 1 rue du Mail, 75002 Paris, France				
Product Name:	LEDGER STAX				
Brand Name:	L or LEDGER				
Model No.:	2103				
Model Difference:	N/A				
Report Number:	TERF2212002634E2				
FCC ID	2ASAL-2103				
IC:	24697-2103				
Date of EUT Received:	: December 8, 2022				
Date of Test:	December 16, 2022~December 20, 2022				
Issue Date:	January 9, 2023				
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ALNO HSICH Approved By

## 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, ISED RSS-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.

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Revision History					
Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2212002634E2	00	Original.	January 9, 2023	Karen Huang	

## 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:	LEDGER STAX
Brand Name:	L or LEDGER
Model No.:	2103
Model Difference:	N/A
Hardware Version:	DVT
Firmware Version:	MCU 5.9 +SE 1.0.0-rc5
EUT Series No.:	TE_SP_20221209624
Power Supply:	3.8Vdc
Test Software (Name/Version)	STM32CubeMonitor-RF Version 2.8.1

#### 1.2 **RF Specification**

Radio Technology:	BLE	
Frequency Range:	2402 – 2480MHz	
Channel number:	40 channels	
Modulation type:	GFSK	
Transmit Power:	BLE 1M: -0.16dBm BLE 2M: -0.22dBm	

#### 1.3 **Antenna Designation**

Antenna Type	Freq.	Peak Antenna Gain (dBi)
Slot Antenna	2.4GHz	-3.71

## Note:

Antenna information is provided by the applicant. 1.

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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 RSS-247 issue 2 Feb. 2017 RSS-Gen, Issue 5 April 2018 ANSI C63.10:2013

#### **Test Facility** 1.5

Laboratory	Test Site Address	Test Site Name	FCC Designa- tion number	IC CAB identifier
		SAC 1		
		SAC 2		
		SAC 3		
		Conduction 1		
	No.134, Wu Kung Road, New Taipei	Conducted 1		
	Industrial Park, Wuku District, New	Conducted 2	TW0027	
	Taipei City, Taiwan.	Conducted 3		
		Conducted 4	-	
		Conducted 5		
SGS Taiwan Ltd.		Conducted 6		
Central RF Lab.		Conduction C	TW0028	TW3702
(TAF code 3702)		SAC C		
		SAC D		
		SAC G		
	No.2, Keji 1st Rd., Guishan District,	Conducted A		
		Conducted B		
	Taoyuan City, Taiwan 333	Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		

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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

#### 2.1 **EUT Configuration**

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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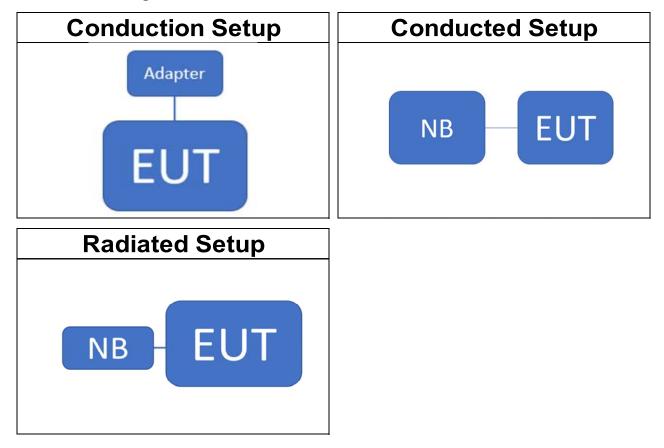
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#### 2.5 **Test Configuration**



#### 2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Adapter	Samsung Electronic Co.Ltd.	EP-T1510	N/A	N/A	N/A
USB Cable	Interplus Industry Co., Ltd	ADV-7570214	N/A	N/A	N/A
	Cor	nducted Emission Test S	Site: Conducted C		
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
USB cable	Interplus Industry Co., Ltd	ADV-7570214	N/A	N/A	N/A
Notebook	Lenovo	L480	P0002332	N/A	N/A
		Radiated Emission Te	st Site: SAC D		
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	Lenovo	T440p	P0000665	N/A	N/A
USB Cable	Interplus Industry Co., Ltd	ADV-7570214	N/A	N/A	N/A

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#### 3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	RSS-247 §5.4 d	Peak Output Power	Compliant
§15.247(a)(2)	RSS-247 §5.2 a RSS-Gen §6.7	Emission Bandwidth	Compliant
§15.247(d) §15.205 §15.209	RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10	Radiated & Conducted Band Edge and Spurious Emission	Compliant
§15.247(e)	RSS-247 §5.2 b	Peak Power Density	Compliant
§15.203	N/A	Antenna Requirement	Compliant

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#### **DESCRIPTION OF TEST MODES** 4

#### 4.1 **Operating Frequencies**

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2402 MHz	15	2430 MHz	29	2458 MHz
2	2404 MHz	16	2432 MHz	30	2460 MHz
3	2406 MHz	17	2434 MHz	31	2462 MHz
4	2408 MHz	18	2436 MHz	32	2464 MHz
5	2410 MHz	19	2438 MHz	33	2466 MHz
6	2412 MHz	20	2440 MHz	34	2468 MHz
7	2414 MHz	21	2442 MHz	35	2470 MHz
8	2416MHz	22	2444 MHz	36	2472 MHz
9	2418 MHz	23	2446 MHz	37	2474 MHz
10	2420 MHz	24	2448 MHz	38	2476 MHz
11	2422 MHz	25	2450 MHz	39	2478 MHz
12	2424 MHz	26	2452 MHz	40	2480 MHz
13	2426 MHz	27	2454 MHz		
14	2428 MHz	28	2456 MHz		

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#### 4.2 The Worst Test Modes and Channel Details

- 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.

	CONDUCTED TEST					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)		
Bluetooth LE	0 to 39	0,20,39	GFSK	1		
Bluetooth LE	0 to 39	0,20,39	GFSK	2		

RADIATED EMISSION TEST (BELOW 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	
Bluetooth LE	0 to 39	20	GFSK	1	
Bluetooth LE	0 to 39	20	GFSK	2	
F	RADIATED EM	ISSION TEST (ABO	VE 1 GHz)		
MODE	MODE AVAILABLE TESTED MODULATION		DATA RATE (Mbps)		
Bluetooth LE	0 to 39	0,20,39	GFSK	1	
Bluetooth LE	0 to 39	0,20,39	GFSK	2	

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#### **MEASUREMENT UNCERTAINTY** 5

Test Items	Uı	ncertaint	ÿ
AC Power Line Conducted Emission	+/-	2.34	dB
Output Power measurement	+/-	1	dB
Emission Bandwidth	+/-	1.53	Hz
Undesignable radiated emission measurement	+/-	1.68	dB
Peak Power Density		1.62	dB
Temperature	+/-	0.4	°C
Humidity	+/-	3.5	%
DC / AC Power Source	+/-	1	%

Radiated Spurious Emission Measurement Uncertainty						
Polarization: Vertical	+/-	2.57	dB	9kHz~30MHz		
	+/-	4.85	dB	30MHz - 1000MHz		
	+/-	4.45	dB	1GHz - 18GHz		
	+/-	4.24	dB	18GHz - 40GHz		
	+/-	2.57	dB	9kHz~30MHz		
Delerization, Herizantel	+/-	4.37	dB	30MHz - 1000MHz		
Polarization: Horizontal	+/-	4.45	dB	1GHz - 18GHz		
	+/-	4.24	dB	18GHz - 40GHz		

### 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

#### 6.1 Emission from AC power line

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	973	04/13/2022	04/12/2023	
EMI Test Receiver	R&S	ESCI	101342	04/25/2022	04/24/2023	
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2022	03/26/2023	
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2022	03/26/2023	
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 C							
EQUIPMENT TYPE	MFR	MFR MODEL NUMBER SERIAL NUMBER		LAST CAL.	CAL DUE.		
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071570	06/01/2022	05/31/2023		
Power Meter	Anritsu	ML2496A	1326001	08/11/2022	08/10/2023		
Power Sensor	Anritsu	MA2411B	1315048	08/11/2022	08/10/2023		
Power Sensor	Anritsu	MA2411B	1315049	08/11/2022	08/10/2023		
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R		
Attenuator	Marvelous	MVE2213-10	RF06	11/16/2022	11/15/2023		
Attenuator	Marvelous	MVE2213-10	RF13	11/16/2022	11/15/2023		
Attenuator	Woken	WATT-218FS-10	RF19	11/16/2022	11/15/2023		
DC Block	MITEQ	W70289-5108	RF159	11/16/2022	11/15/2023		

#### 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	9168-300	11/11/2022	11/10/2023			
Horn Antenna	Schwarzbeck	BBHA9170	185	08/22/2022	08/21/2023			
Horn Antenna	Schwarzbeck	BBHA9120D	1341	05/31/2022	05/30/2023			
Loop Antenna	ETS.LINDGREN	6502	143303	05/14/2022	05/13/2023			
3m Site NSA	SGS	966 chamber D	N/A	04/30/2022	04/29/2023			
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/24/2022	03/23/2023			
Test Software	audix	e3	E3 20923 SGS Ver.9 ( C )	N.C.R	N.C.R			
Pre-Amplifier	EMC Instruments	EM26400	971576	10/02/2022	10/01/2023			
Pre-Amplifier	EMC Instruments	EMC9135	980234	11/16/2022	11/15/2023			
Pre-Amplifier	EMC Instruments	EMC12630SE	980273	11/16/2022	11/15/2023			
Attenuator	Woken	WATT-218FS-10	RF17	11/16/2022	11/15/2023			
Coaxial Cable	Huber+Suhner	RG 214/U	W21.01	11/16/2022	11/15/2023			
Coaxial Cable	Huber Suhner	EMC106-SM-SM-7200	150703	11/16/2022	11/15/2023			
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17413/4	11/16/2022	11/15/2023			

## 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	Limits (dBµV)				
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

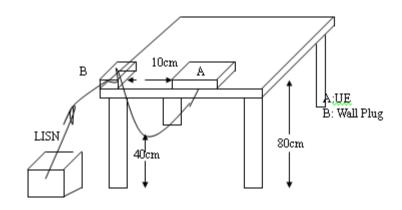
1. The lower limit shall apply at the transition frequencies

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 Test Mode Power	:TERF2212002634E2 :BLE :120V/60Hz	Test Site Test Date Temp./Humi.	:Conductio :2022-12-1 :20.4/54		
Probe	:L1	Engineer	:Howard H	uang	
80 Level (0 70.0 60.0 50.0 24,5 40.0 30.0 13 20.0 10.0					
0.15	0.5 1 Frequer	25 1cy (MHz)	10	20 30	
Freq.	Detector Spectrum Mode Reading Level		ctual FS	Limit	Margin
MHz I	PK/QP/AV dBµV	dB d	BμV	dBµV	dB
0.156 0.156 0.178 0.178 0.217 0.258	Average   20.00     QP   37.40     Average   20.00     QP   37.90     Peak   37.20     Peak   31.81     Peak   20.00	10.30410.30310.30410.30410.314	0.30 7.70 0.30 8.20 7.51 2.12	55.65 65.65 54.59 64.59 62.92 61.51	-25.35 -17.95 -24.29 -16.39 -15.41 -19.39
0.292 0.332	Peak 30.49 Peak 28.20		0.80 8.52	60.46 59.40	-19.65 -20.88

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Report Number	:TERF2212002634E2	Test Site	:Conduction	С	
Test Mode	:BLE	Test Date	:2022-12-19	)	
Power	:120V/60Hz	Temp./Humi.	:20.4/54		
Probe	:N	Engineer	:Howard Hu	ang	
80 Level (d	dBuV)			· · · · · · · ·	
70.0					
60.0					
50.0 2/1 <sub>5</sub>	6				
40.0	Mr. Nu				
30.0	1 mm han w		M		
20.0	Wr wr	and the stand and	mouth h	المسير	
10.0					
0.15	0.5 1 Freque	2 5 ncy (MHz)	10	20 30	
Freq.	Detector Spectrum		ctual	Limit Mar	rgin
	Mode Reading Level		FS	10.17	_
MHz F	PK/QP/AV dBµV	dB d	BμV	dBµV d	B
0.153	Average 20.80	10.31 3	1.11	55.82 -24	.71
0.153	QP 38.90	10.31 4	9.21	65.82 -16	.61
0.180	Average 18.40		8.70	54.50 -25	
0.180	QP 35.20		5.50	64.50 -19	
0.211	Peak 37.34		7.64	63.18 -15	
0.242	Peak 34.14		4.45	62.04 -17	
0.277	Peak 31.82	10.31 4	2.12	60.90 -18	.77
0.315	Peak 29.23	10.31 3	9.55	59.84 -20	.29

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# PEAK OUTPUT POWER MEASUREMENT

#### 8.1 **Standard Applicable:**

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt and the e.i.r.p. shall not exceed 4 W.

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.

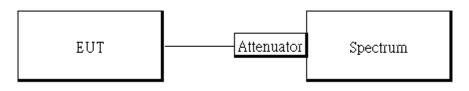
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

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.

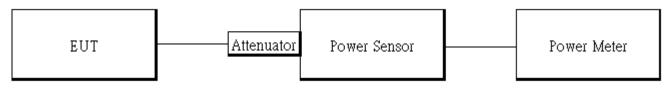
All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

#### 8.2 Test Setup

## 8.2.1 Duty Cycle



## 8.2.2 Output Power



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#### 8.3 **Measurement Procedure:**

#### 8.3.1 **Duty Cycle**

- 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.
- 5. Repeat above procedures until all test default channel measured was complete.

#### 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	67.20	1.73	2.38	3.00
BLE 2M	37.90	4.21	4.26	5.00

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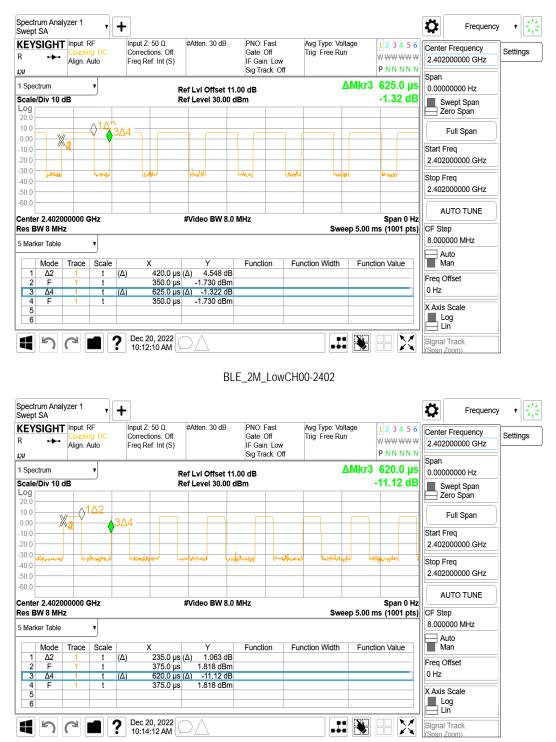
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BLE\_1M\_LowCH00-2402



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#### 8.5 **Output Power:**

#### 8.5.1 Peak & Avg

### BLE 1M mode:

СН	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	24	-0.16	30
Mid	2442	24	-0.25	30
High	2480	24	-0.28	30
СН	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2402	24	-0.42	30
Mid	2442	24	-0.46	30
High	2480	24	-0.53	30

\*Note: Measured by power meter, cable loss dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

## BLE 2M mode:

СН	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	24	-0.22	30
Mid	2442	24	-0.27	30
High	2480	24	-0.32	30
СН	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit (dBm)
Low	2402	24	-0.75	30
Mid	2442	24	-0.80	30
High	2480	24	-0.87	30

\*Note: Measured by power meter, cable loss 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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#### 8.5.2 EIRP

### **EIRP BLE 1M mode**

СН	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit		
Low	2402	24	-0.42	-3.71	-4.13	4W=	36	dBm
Mid	2442	24	-0.46	-3.71	-4.17	4W=	36	dBm
High	2480	24	-0.53	-3.71	-4.24	4W=	36	dBm

\* Note: EIRP = Average Power + Gain

### **EIRP BLE 2M mode**

СН	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)		Limit	
Low	2402	24	-0.75	-3.71	-4.46	4W=	36	dBm
Mid	2442	24	-0.80	-3.71	-4.51	4W=	36	dBm
High	2480	24	-0.87	-3.71	-4.58	4W=	36	dBm

\* Note: EIRP = Average Power + Gain

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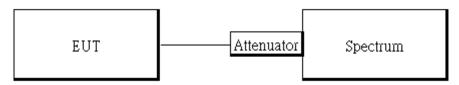


#### 9 EMISSION BANDWIDTH MEASUREMENT

#### 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. 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.
- 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 for -6dB Bandwidth test.
- 5. Set the spectrum analyzer as

RBW= 1 % to 5% of 99% Bandwidth , VBW  $\geq$  3 X RBW. Span= large enough to capture all products of the modulation process, Sweep=auto, Detector = Peak, and Max hold for 99% Bandwidth test.

- 6. Mark the peak frequency and 99%dB (upper and lower) frequency
- 7. Repeat above procedures until all test default channel is completed

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#### 9.4 **Measurement Result:**

## BLE 1M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.6747	$\ge$ 0.5	PASS
2442	0.6700	$\ge$ 0.5	PASS
2480	0.6731	$\geq$ 0.5	PASS

## **BLE 2M mode**

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	1.127	$\ge$ 0.5	PASS
2442	1.129	$\ge$ 0.5	PASS
2480	1.125	<b>≧</b> 0.5	PASS

### **BLE 1M mode**

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0079
2442	1.0059
2480	1.0035

### **BLE 2M mode**

Frequency (MHz)	99%Bandwidth (MHz)
2402	2.0241
2442	2.0241
2480	2.0149

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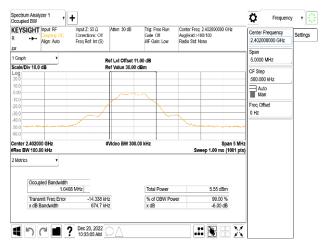
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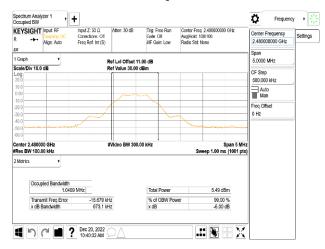
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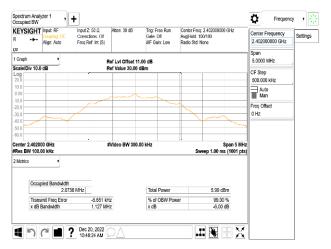
### OBW BLE 1M MidCH20-2442MHz



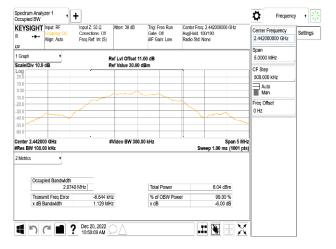
### OBW\_BLE 1M\_HighCH39-2480MHz



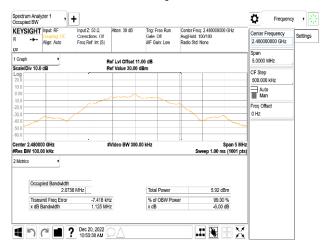
### OBW\_BLE 2M\_LowCH00-2402MHz



### OBW\_BLE 2M\_MidCH20-2442MHz



### OBW\_BLE 2M\_HighCH39-2480MHz



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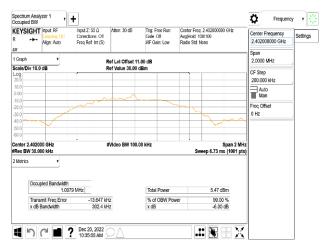
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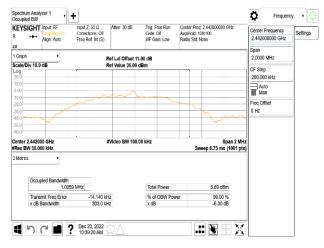
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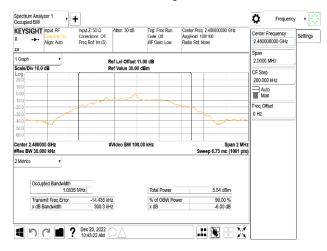
### IC OBW\_BLE 1M\_LowCH00-2402MHz



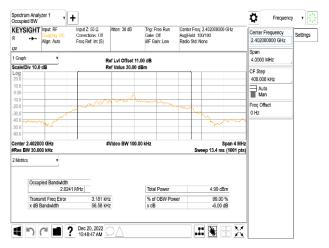
### IC OBW BLE 1M MidCH20-2442MHz



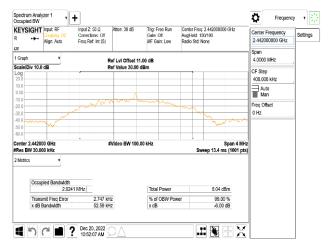
### IC OBW\_BLE 1M\_HighCH39-2480MHz



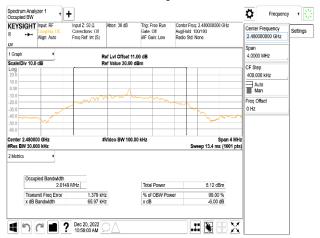
### IC OBW\_BLE 2M\_LowCH00-2402MHz



IC OBW\_BLE 2M\_MidCH20-2442MHz



### IC OBW\_BLE 2M\_HighCH39-2480MHz



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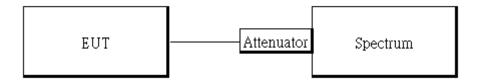


# 10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

#### 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) & RSS-Gen §8.10, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9.

#### 10.2 **Test Setup**



#### 10.3 **Measurement Procedure**

#### 10.3.1 **Reference Level of Emission Limit:**

- 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.
- 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.
- Use the peak marker function to determine the maximum amplitude level.

#### 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.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

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- 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
- 7. 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.

#### **Measurement Result** 10.4

## **BLE 1M Reference Level of Limit**

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	-1.20	-21.20
2442	-1.14	-21.14
2480	-1.27	-21.27

NOTE: cable loss as dB that offsets in the spectrum NOTE: Refer to next page for plots.

## **BLE 2M Reference Level of Limit**

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	-1.17	-21.17
2442	-1.12	-21.12
2480	-1.26	-21.26

NOTE: cable loss as dB that offsets in the spectrum

NOTE: Refer to next page for plots.

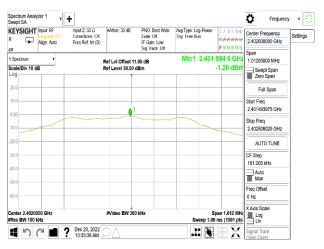
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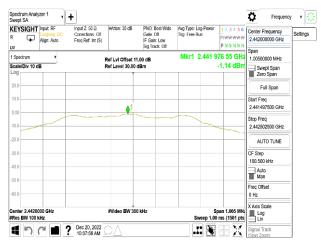
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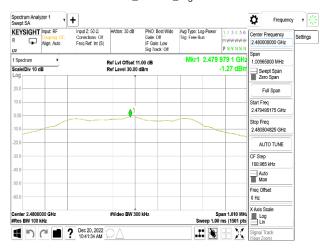
### Reference Level\_BLE 1M\_LowCH00-2402MHz



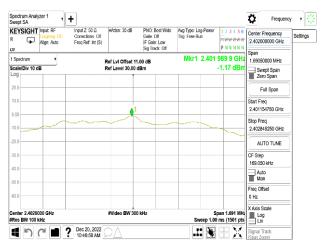
Reference Level\_BLE 1M\_MidCH20-2442MHz



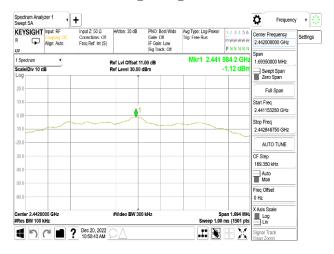
### Reference Level\_BLE 1M\_HighCH39-2480MHz

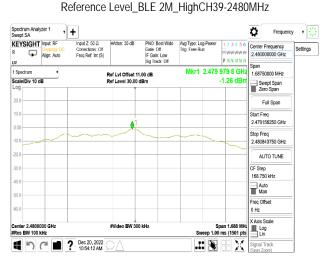


### Reference Level\_BLE 2M\_LowCH00-2402MHz



Reference Level\_BLE 2M\_MidCH20-2442MHz





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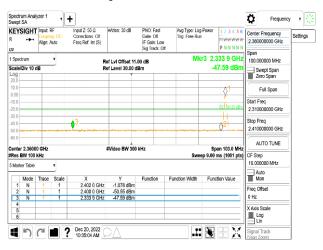
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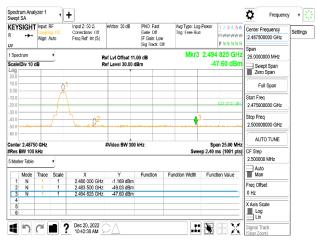
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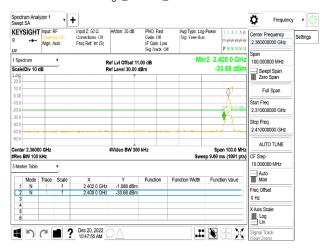
### Band Edge\_BLE 1M\_LowCH00-2402MHz



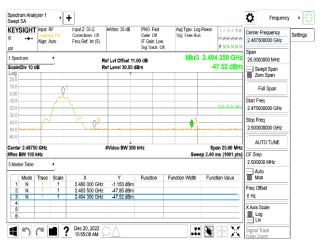
Band Edge\_BLE 1M\_HighCH39-2480MHz



### Band Edge\_BLE 2M\_LowCH00-2402MHz



### Band Edge\_BLE 2M\_HighCH39-2480MHz



Spurious Emission\_BLE 1M\_LowCH00-2402MHz



### Spurious Emission\_BLE 1M\_MidCH20-2442MHz

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	Mode	Trace	Scale	Х	Y	Function	Function Width	Fund	ton Value	Mar	1	
1	N	1	- f	2.442 GHz	-3.286 dBm					Free Off:	tes	
2	N	1	f	4.884 GHz	-48.96 dBm					0 Hz	<i>7</i> 01	
3	N	1	1	7.326 GHz	-49.70 dBm					U HZ		
4	N	1	t	22.400 GHz	-42.26 dBm					X Axis S	cale	
5										Loc		
0										Lin		
1	6		-	Dec 20, 2022			.1	1 150		Signal Tr		

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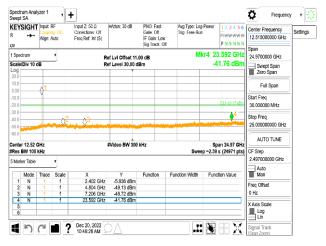
## Report No.: TERF2212002634E2 Page: 32 of 59



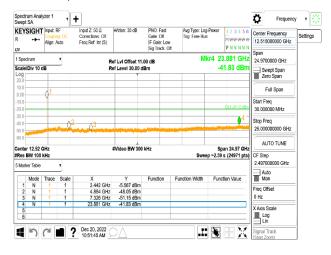
### Spurious Emission\_BLE 1M\_HighCH39-2480MHz

EYSIGH	T Input R Coupin Align: /	ng DC	Input Z: 50 Ω Corrections: Off Freq Ref. Int (S)	#Atton: 30 dB	PNO: Fast Gale: Off IF Gain: Low Sig Track: Off	Avg Type: Loj Trig: Free Ru		123456 MWWWWW PNNNNN	12.51	r Frequency 5000000 GHz	Setting
Spectrum		•		ef LvI Offset 11.		М		.605 GHz	24.3/	00000 GHz	
cale/Div 10	dB		R	ef Level 30.00 d	IBm		-4	0.48 dBm	1 3	wept Span ero Span	
0.0	61									Full Span	
10.0	1							DL1-2127 cBm	Start F 30.00	req 0000 MHz	
10.0	-	, () <sup>2</sup>	0 <sup>3</sup>					•	Stop F		
i0.0	-								25.00	0000000 GHz	
80.0	GHz			tildeo BW 300	647		\$n:	an 24 07 GHz		UTO TUNE	
enter 12.52 Res BW 10	kHz			#Video BW 300	kHz	Swee		an 24.97 GHz s (24971 pts)	A CF Ste	UTO TUNE	
a.o enter 12.52	kHz	·		#Video BW 300	kHz	Swee			A CF Ste 2.497	UTO TUNE ep '000000 GHz uto	8
enter 12.52 Res BW 101 Marker Table Mode	kHz	r Scale	X	Y	kHz	Sweet Function Wildth	ep ~2.39 :		A CF Ste 2.497	UTO TUNE ep '000000 GHz	8
enter 12.52 Res BW 101 Marker Table Mode 1 N	Trace	T Scale f	X 2.480 GHz	Y -2.765 dBm			ep ~2.39 :	s (24971 pts)	A CF Ste 2.497	UTO TUNE ep 000000 GHz uto Ian	
enter 12.52 Res BW 101 Marker Table Mode 1 N 2 N	) kHz		X 2.480 GHz 4.960 GHz	Y -2.765 dBm -47.69 dBm			ep ~2.39 :	s (24971 pts)	A CF Ste 2.497 A Freq C	UTO TUNE ep 000000 GHz uto Ian	
enter 12.52 Res BW 10 Marker Table Mode 1 N 2 N 3 N	Trace	T Scale f	X 2.480 GHz 4.990 GHz 7.440 GHz	Y -2.765 dBm -47.69 dBm -49.05 dBm			ep ~2.39 :	s (24971 pts)	A CF Ste 2.497	UTO TUNE ep 000000 GHz uto Ian	
enter 12.52 Res BW 10 Marker Table Mode 1 N 2 N 3 N 4 N	Trace	T Scale f	X 2.480 GHz 4.960 GHz	Y -2.765 dBm -47.69 dBm			ep ~2.39 :	s (24971 pts)	A CF Ste 2.497 A Freq C	UTO TUNE ep 000000 GHz uto lan 2)ffset	
enter 12.52 Res BW 10 Marker Table Mode 1 N 2 N 3 N	Trace	T Scale f	X 2.480 GHz 4.990 GHz 7.440 GHz	Y -2.765 dBm -47.69 dBm -49.05 dBm			ep ~2.39 :	s (24971 pts)	A CF Ste 2.497 A Freq C 0 Hz X Axis	UTO TUNE ap 000000 GHz uto lan Offset Scale og	

Spurious Emission\_BLE 2M\_LowCH00-2402MHz



Spurious Emission\_BLE 2M\_MidCH20-2442MHz



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Spurious Emission\_BLE 2M\_HighCH39-2480MHz

pectrum Analy wept SA	zer 1	- 1 -	ł							Ö	Frequency	,	
EYSIGHT	linput R Coupin Align: /	g DC	Input Z: 50 Q Corrections: Off Freq Ref. Int (S)	#Atton: 30 dB	PNO: Fast Gale: Off IF Gain: Lo	Trig: F	pe: Log-Po iee Run		1 2 3 4 5 6 M <del>WWWWW</del>		r Frequency 5000000 GHz	Settir	ngs
Ø					Sig Track: 0	nc			PNNNN	Span			
Spectrum	_	•		ef LvI Offset 11			Mkr4		328 GHz .82 dBm	24.97	00000 GHz		
og	в		ĸ	ef Level 30.00 d	Bm			-4	.62 UDIII		wept Span ero Span		
0.0	A1										Full Span		
10.0	Ÿ.								0L1-2128 dBm	Start F			
0.0	-							_	4		0000 MHz		
\$0.0 50.0	-	<b>~</b> (2	() <sup>3</sup>							Stop F 25.00	req 0000000 GHz		
50.0											UTO TUNE		
enter 12.52 G Res BW 100 I				#Video BW 300	KHZ		Suman		n 24.97 GHz (24971 pts)	CF St			
Marker Table	n z	τ.					aweeh.	-2.09 5	(2487 ) pisj		000000 GHz		
Mode	Trace	Scale	x	Y	Function	Function \	Vidth	Functi	on Value		uto Ian		
1 N	1	t	2.480 GHz	-5.604 dBm	1 01101011								
2 N	1	f	4.960 GHz	-49.53 dBm						Freq (	Jillsel		
3 N		- f	7.440 GHz	-50.48 dBm						0 Hz			
4 N	1	f	22.328 GHz	-41.82 dBm						V Auto	Scale		
5 6											00		
	10	10-	Dec 20, 2022	~ ^				n m	1 1		Track		

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# 11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

## 11.1 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 must also comply with the §15.209 and RSS-Gen §8.9 Table 5 and 6 limit as below.

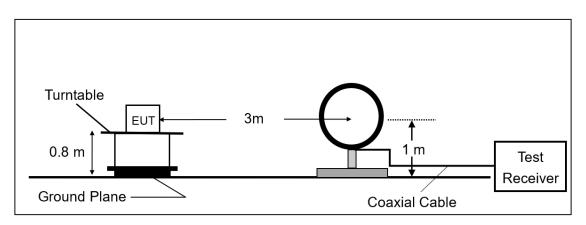
And according to §15.33(a) (1) & RSS-Gen §6.13.2.a for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

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.

## 11.2 Test Setup

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



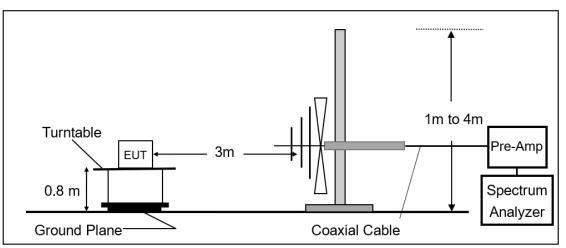
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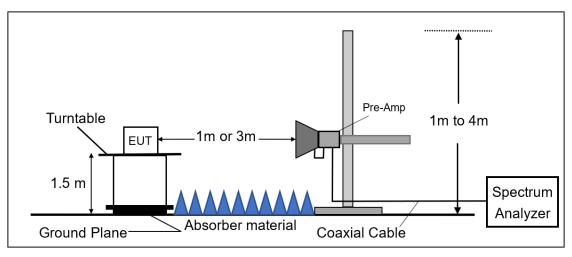
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(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



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



#### 11.3 **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.

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- 7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Maximum Emission Measurements at frequency above 1 GHz.
- 8. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Emission Measurements at frequency above 1 GHz.
- 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.

#### 11.4 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	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

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

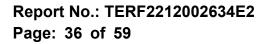
Actual  $FS(dB\mu V/m) = SPA$ . Reading level(dB $\mu V$ ) + Factor(dB) Factor(dB) = Antenna Factor(dB $\mu$ V/m) + Cable Loss(dB) – Pre\_Amplifier Gain(dB)

#### 11.5 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) & RSS-GEN §6.13.2 was not reported.

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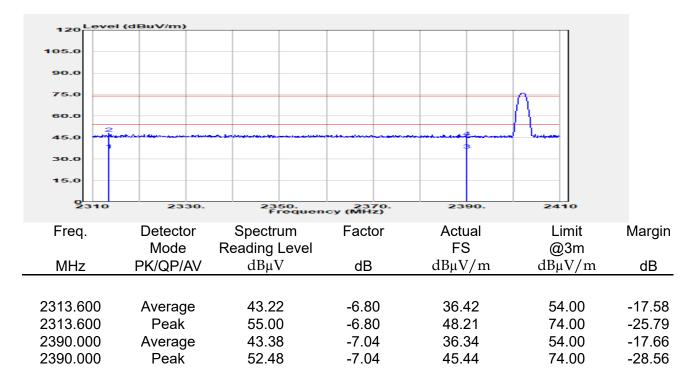




#### 11.6 **Measurement Result:**

#### 11.6.1 **Radiated Band Edge Measurement Result**

Report Number	:TERF2212002634E2	Test Site	:SAC D
Operation Mode	:BLE 1M	Test Date	:2022-12-16
Test Frequency	:2402 MHz	Temp./Humi.	:24.4/59
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:H Plane	Engineer	:Howard Huang



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Report Number	:TERF22	12002634E2		Test Site	:SAC D	
Operation Mode	BLE 1M			Test Date	:2022-12-16	
Test Frequency	:2402 M⊦	lz		Temp./Humi.	:24.4/59	
Test Mode	:Bandedg	le		Antenna Pol.	:Horizontal	
EUT Pol	:H Plane			Engineer	:Howard Huang	
120 Level (d	BuV/m)					
105.0						
90.0					0	
75.0						
60.0	>					
45.0		**************************************	4	na sharan ta sha		
30.0						
15.0						
2310	2330.	2350. Frequen	2370. cy (MHz)	2390.	2410	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode PK/QP/AV	Reading Level dBμV	dB	FS dBµV/m	@3m dBµV/m	dB
		ασμν	uВ	α <i>D</i> μ v / III	α σμν/ π	UD
2319.100	Average	43.51	-6.81	36.69	54.00	-17.31
2319.100	Peak	54.89	-6.81	48.08	74.00	-25.92
2390.000	Average	43.36	-7.04	36.32	54.00	-17.68
2390.000	Peak	52.46	-7.04	45.41	74.00	-28.59

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Margin
dB
-17.78 -27.87 -17.76 -26.00

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Report Number Operation Mode Test Frequency Test Mode EUT Pol	e :BLE 1M	)02634E2		Test Site Test Date Temp./Humi. Antenna Pol. Engineer		
120 Level (d 105.0 90.0 75.0 60.0 45.0 30.0 15.0 2475	2480.	2485. Frequen	2490. cy (MHz)	4		
Freq.	Mode Re	Spectrum eading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.500 2483.500 2492.200 2492.200	Average Peak Average Peak	43.60 52.08 43.20 54.56	-7.20 -7.20 -7.23 -7.23	36.41 44.88 35.97 47.33	54.00 74.00 54.00 74.00	-17.59 -29.12 -18.03 -26.67

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Report Number	:TERF22	12002634E2		Test Site	:SAC D	
Operation Mode	:BLE 2M			Test Date	:2022-12-16	
Test Frequency	:2402 M⊦	łz		Temp./Humi.	:24.4/59	
Test Mode	:Bandedg	je		Antenna Pol.	:Vertical	
EUT Pol	:H Plane			Engineer	:Howard Huang	
				-	-	
120 Level (d	BuV/m)					
105.0						
90.0						
75.0						
60.0						
45.0	- 100 B - B B B - B	na filiation and a standard and a standard	and the second	3	and have	
30.0						
15.0						
2310	2330.	2350. Frequen	2370. cy (MHz)	2390.	2410	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode PK/QP/AV	Reading Level dBµV	dB	FS dBµV/m	@3m dBμV/m	dB
		62 p 1	40			<u></u>
2313.800	Average	43.47	-6.80	36.67	54.00	-17.33
2313.800	Peak	54.68	-6.80	47.88	74.00	-26.12
2390.000 2390.000	Average Peak	43.95 53.21	-7.04 -7.04	36.91 46.16	54.00 74.00	-17.09 -27.84
2390.000	L Cav	JJ.Z I	-7.04	40.10	74.00	-21.04

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Report Number	:TERF22	12002634E2	7	Test Site	:SAC D	
Operation Mode	e:BLE 2M		-	Test Date	:2022-12-16	
Test Frequency	:2402 Mł	Ηz	-	Temp./Humi.	:24.4/59	
Test Mode	:Bandedg	ge	ŀ	Antenna Pol.	:Horizontal	
EUT Pol	:H Plane	-	E	Engineer	:Howard Huang	
				U	U	
120 Level (d	BuV/m)					
105.0						
90.0					0	
75.0					<u> </u>	
60.0						
45.0		****				
30.0						
15.0						
2310	2330.	2350. Frequen	2370. cy (MHz)	2390.	2410	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level	dD	FS	@3m dBuV/m	٩D
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2375.700	Average	43.38	-7.00	36.39	54.00	-17.61
2375.700	Peak	54.70	-7.00	47.70	74.00	-26.30
2390.000	Average	43.59	-7.04	36.55	54.00	-17.45
2390.000	Peak	52.87	-7.04	45.82	74.00	-28.18

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Report Number Operation Mod Test Frequency Test Mode EUT Pol	e :BLE 2M			Test Site Test Date Temp./Humi. Antenna Pol. Engineer		
120 Level (4 105.0 90.0 75.0 60.0 45.0 30.0 15.0	1BuV/m)					
2475	2480.		2490. cy (MHz)	2495.	2500	
Freq.		Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBµV/m	dBµV/m	dB
2483.500 2483.500 2486.250	Average Peak Average	43.50 52.77 43.51	-7.20 -7.20 -7.21	36.30 45.57 36.30	54.00 74.00 54.00	-17.70 -28.43 -17.70
2486.250	Peak	54.84	-7.21	47.63	74.00	-26.37

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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Report Number Operation Mode Test Frequency Test Mode EUT Pol	BLE 2M	2634E2	Test Site Test Date Temp./Humi. Antenna Pol. Engineer		
120 Level (d 105.0 90.0 75.0 60.0 45.0 30.0 15.0 2475	BuV/m)	2485. 22 Frequency (Mi	490. 2495.	2500	
Freq.		pectrum Fac ding Level	-	Limit @3m	Margin
MHz		dBµV d	B dBµV/m	-	dB
2483.500 2483.500 2485.925 2485.925	Peak Average	45.19 -7.   52.86 -7.   43.30 -7.   54.78 -7.	2045.662136.09	54.00 74.00 54.00 74.00	-16.00 -28.34 -17.91 -26.43

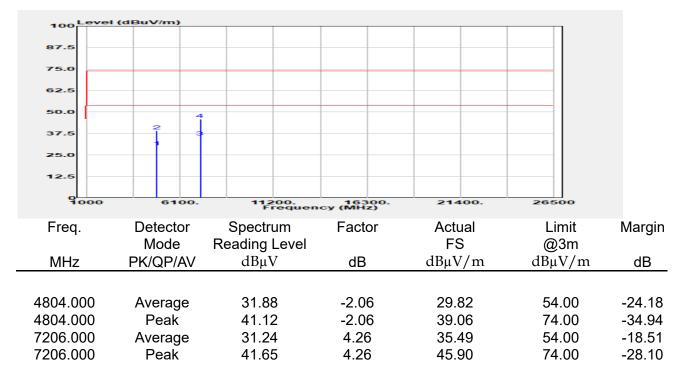
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### 11.6.2 **Radiated Spurious Emission**

Report Number	:TERF2212002634E2	Test Site	:SAC D
<b>Operation Mode</b>	:BLE 1M	Test Date	:2022-12-16
Test Frequency	:2402 MHz	Temp./Humi.	:24.4/59
Test Mode	:Tx	Antenna Pol.	:VERTICAL
EUT Pol	:H Plane	Engineer	:Howard Huang



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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Report Number	:TERF22	12002634E2	٦	Test Site	:SAC D	
Operation Mode	BLE 1M		٦	Test Date	:2022-12-16	
Test Frequency	:2402 MF	Ηz	Ţ	Temp./Humi.	:24.4/59	
Test Mode	:Tx		ŀ	Antenna Pol.	:HORIZONTAL	
EUT Pol	:H Plane		E	Engineer	:Howard Huang	
				U	5	
100 Level (d	BuV/m)					
87.5						
75.0						
62.5						
50.0	4	· ·				
37.5	2					
25.0						
12.5						
9	6100.	11200. Frequen	16300. су (МНz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	10
MHz	PK/QP/AV	dBμV	dB	dBµV/m	dBµV/m	dB
4804.000	Average	31.45	-2.06	29.39	54.00	-24.61
4804.000	Peak	41.30	-2.06	39.24	74.00	-34.76
7206.000	Average	31.38	4.26	35.64	54.00	-18.36
7206.000	Peak	40.66	4.26	44.91	74.00	-29.09

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Report Number	:TERF22	12002634E2	-	Test Site	:SAC D	
Operation Mode	e:BLE1M		-	Test Date	:2022-12-16	
Test Frequency	:2442 Mł	Ηz	-	Temp./Humi.	:24.4/59	
Test Mode	:Tx			Antenna Pol.	:VERTICAL	
EUT Pol	:H Plane		I	Engineer	:Howard Huang	
				-	-	
100 Level (d	lBuV/m)					
87.5						
75.0						
62.5						
50.0	-	•				
37.5	2	•				
25.0						
12.5						
9 1000	6100.	11200. Frequen	16300. су (MHz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level	dD	FS dBuV/m	@3m dBuV/m	٩D
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4884.000	Average	30.76	-2.12	28.64	54.00	-25.36
4884.000	Peak	40.49	-2.12	38.37	74.00	-35.63
7326.000	Average	30.73	4.73	35.46	54.00	-18.54
7326.000	Peak	40.35	4.73	45.08	74.00	-28.92

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Report Number	:TERF22	12002634E2	Т	est Site	:SAC D	
Operation Mode	BLE 1M		Т	est Date	:2022-12-16	
Test Frequency	:2442 Mł	Ηz	Т	emp./Humi.	:24.4/59	
Test Mode	:Tx		А	ntenna Pol.	:HORIZONTAL	
EUT Pol	:H Plane		E	Ingineer	:Howard Huang	
				U	C	
100 Level (d	BuV/m)					
87.5						
75.0						
62.5						
50.0	4	L				
37.5	2	3				
25.0						
12.5						
9000	6100.	11200. Frequen	16300. су (MHz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4884.000	Average	30.60	-2.12	28.47	54.00	-25.53
4884.000	Peak	40.49	-2.12	38.36	74.00	-35.64
7326.000	Average	30.64	4.73	35.36	54.00	-18.64
7326.000	Peak	39.95	4.73	44.68	74.00	-29.32

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Report Number	:TERF22	12002634E2	Т	est Site	:SAC D	
Operation Mode	:BLE 1M		Т	Test Date	:2022-12-16	
Test Frequency	:2480 MF	łz	Т	ſemp./Humi.	:24.4/59	
Test Mode	:Tx		A	Antenna Pol.	:VERTICAL	
EUT Pol	:H Plane		E	Engineer	:Howard Huang	
100 Level (di	BuV/m)					
87.5						
75.0						
62.5						
50.0		1				
37.5	2	3				
25.0						
12.5						
9000	6100.	11200. Frequen	16300. су (MHz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz F	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.000	Average	31.29	-1.59	29.69	54.00	-24.31
4960.000	Peak	41.68	-1.59	29.09 40.09	74.00	-24.51
	Average	29.92	3.95	33.87	54.00	-20.13
7440.000	Peak	40.12	3.95	44.07	74.00	-29.93

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Report Number	:TERF22	12002634E2	Te	est Site	:SAC D	
Operation Mode	e:BLE1M		Te	est Date	:2022-12-16	
Test Frequency	:2480 Mł	Ηz	Te	emp./Humi.	:24.4/59	
Test Mode	:Tx		А	ntenna Pol.	:HORIZONTAL	
EUT Pol	:H Plane		E	ngineer	:Howard Huang	
				•	C	
100 Level (d	BuV/m)					
87.5						
75.0						
62.5				_		
50.0		4				
37.5	2	8				
25.0						
12.5						
9000	6100.	11200. Frequen	16300. су (МНz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
<b>N</b> 41 1	Mode	Reading Level		FS	@3m	10
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.000	Average	31.29	-1.59	29.70	54.00	-24.30
4960.000	Peak	40.87	-1.59	39.28	74.00	-34.72
7440.000	Average	29.89	3.95	33.84	54.00	-20.16
7440.000	Peak	39.40	3.95	43.35	74.00	-30.65

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Report Number	:TERF22	12002634E2	Te	est Site	:SAC D	
Operation Mode	BLE 2M		Te	est Date	:2022-12-16	
Test Frequency	:2402 Mł	Ηz	Te	emp./Humi.	:24.4/59	
Test Mode	:Tx		A	ntenna Pol.	:VERTICAL	
EUT Pol	:H Plane		E	ngineer	:Howard Huang	
				•	-	
100 Level (d	BuV/m)					
87.5						
75.0						
62.5						
50.0	4	· · · · · · · · · · · · · · · · · · ·				
37.5	2	*				
25.0						
12.5						
9000	6100.	11200. Frequen	16300. су (MHz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level	15	FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4904 000	Average	24.04	2.06	20.00	E4 00	25.00
4804.000 4804.000	Average Peak	31.04 40.89	-2.06 -2.06	28.98 38.83	54.00 74.00	-25.02 -35.17
7206.000	Average	30.20	-2.00 4.26	30.03 34.46	74.00 54.00	-35.17 -19.54
7206.000	Peak	39.84	4.26	44.10	74.00	-29.90
			-	-		

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Report Number	:TERF22	12002634E2	Т	est Site	:SAC D	
<b>Operation Mode</b>	:BLE 2M		Т	est Date	:2022-12-16	
Test Frequency	:2402 MH	Iz	Т	emp./Humi.	:24.4/59	
Test Mode	:Tx		A	Antenna Pol.	:HORIZONTAL	
EUT Pol	:H Plane		E	Ingineer	:Howard Huang	
				0		
100 Level (di	BuV/m)					
87.5						
75.0						
62.5						
50.0	4					
37.5	2 3					
25.0						
12.5						
1000	6100.	11200. Frequen	16300. су (MHz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz F	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4804.000	Average	30.93	-2.06	28.88	54.00	-25.12
4804.000	Peak	40.75	-2.00	20.00 38.69	74.00	-25.12
	Average	31.74	4.26	36.00	54.00	-18.00
7206.000	Peak	39.53	4.26	43.79	74.00	-30.21

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Report Number	:TERF22	12002634E2	٦	lest Site	:SAC D	
Operation Mode	:BLE 2M		T	Test Date	:2022-12-16	
Test Frequency	:2442 MH	lz	T	ſemp./Humi.	:24.4/59	
Test Mode	:Tx		A	Antenna Pol.	:VERTICAL	
EUT Pol	:H Plane		E	Engineer	:Howard Huang	
100 Level (df	BuV/m)					
87.5						
75.0						
62.5						
50.0	4					
37.5	2					
25.0	1					
12.5						
9000	6100.	11200. Frequen	16300. су (MHz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz F	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4884.000	Average	30.40	-2.12	28.28	54.00	-25.72
4884.000	Average Peak	30.40 40.47	-2.12 -2.12	20.20 38.35	54.00 74.00	-25.72 -35.65
	Average	29.88	4.73	34.61	54.00	-19.39
7326.000	Peak	40.64	4.73	45.37	74.00	-28.63

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Report Number	:TERF22	12002634E2	Т	est Site	:SAC D	
Operation Mode	BLE 2M		Т	est Date	:2022-12-16	
Test Frequency	:2442 Mł	Ηz	Т	emp./Humi.	:24.4/59	
Test Mode	:Tx		A	Antenna Pol.	:HORIZONTAL	
EUT Pol	:H Plane		E	Engineer	:Howard Huang	
				0	Ũ	
100 Level (d	BuV/m)					
87.5						
75.0						
62.5						
50.0	4	F				
37.5	2	<b>3</b>				
25.0						
12.5						
9000	6100.	11200. Frequen	16300. су (MHz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4884.000	Average	30.10	-2.12	27.98	54.00	-26.02
4884.000	Peak	40.80	-2.12	38.68	74.00	-35.32
7326.000	Average	30.64	4.73	35.37	54.00	-18.63
7326.000	Peak	39.93	4.73	44.66	74.00	-29.34

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Report Number	:TERF22	12002634E2	Te	est Site	:SAC D	
<b>Operation Mode</b>	:BLE 2M		Te	est Date	:2022-12-16	
Test Frequency	:2480 MF	Ηz	Te	emp./Humi.	:24.4/59	
Test Mode	:Tx		А	ntenna Pol.	:VERTICAL	
EUT Pol	:H Plane		Е	ngineer	:Howard Huang	
					-	
100 Level (df	BuV/m)					
87.5						
75.0						
62.5						
50.0		4				
37.5	2	3				
25.0						
12.5						
1000	6100.	11200. Frequen	16300. су (МНz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	10
MHz F	PK/QP/AV	dBμV	dB	dBµV/m	dBµV/m	dB
4960.000	Average	31.36	-1.59	29.76	54.00	-24.24
4960.000	Peak	41.25	-1.59	39.65	74.00	-34.35
	Average	29.89	3.95	33.85	54.00	-20.15
7440.000	Peak	39.34	3.95	43.29	74.00	-30.71

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Report Number	:TERF22	12002634E2	Т	est Site	:SAC D	
Operation Mode	BLE 2M		Т	est Date	:2022-12-16	
Test Frequency	:2480 MH	Ηz	Т	emp./Humi.	:24.4/59	
Test Mode	:Tx		A	Antenna Pol.	:HORIZONTAL	
EUT Pol	:H Plane		E	Engineer	:Howard Huang	
				0	C	
100 Level (d	BuV/m)					
87.5						
75.0						
62.5						
50.0		4				
37.5	2	8				
25.0						
12.5						
9	6100.	11200. Frequen	16300. су (MHz)	21400.	26500	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level	15	FS	@3m	10
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.000	Average	31.18	-1.59	29.58	54.00	-24.42
4960.000	Peak	40.85	-1.59	39.26	74.00	-34.74
7440.000	Average	29.91	3.95	33.86	54.00	-20.14
7440.000	Peak	40.03	3.95	43.98	74.00	-30.02

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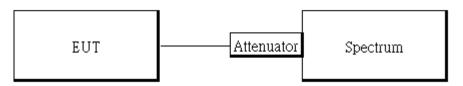


# **12 POWER SPECTRAL DENSITY**

### 12.1 **Standard Applicable:**

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.

### 12.2 **Test Setup**



### 12.3 **Measurement Procedure:**

- 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.
- 7. Trace mode = max hold.
- 8. Allow trace to fully stabilize.
- 9. Use the peak marker function to determine the maximum amplitude level.

#### 12.4 Measurement Result:

BLE 1M MODE								
Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result					
2402	-15.060	8	PASS					
2442	-14.680	8	PASS					
2480	-14.650	8	PASS					

*NOTE: cable loss as dB that offsets in the spectrum* 

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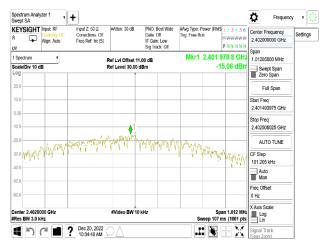
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## BLE 2M mode

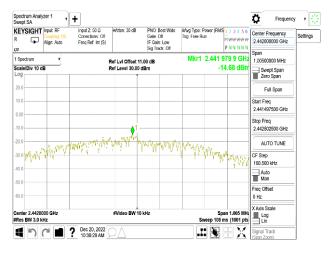
Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2402	-15.130	8	PASS
2442	-15.250	8	PASS
2480	-14.900	8	PASS

NOTE: cable loss as dB that offsets in the spectrum

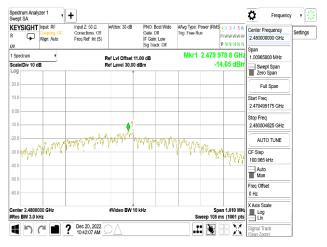


PSD\_BLE 1M\_LowCH00-2402MHz

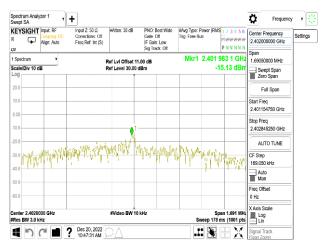
### PSD\_BLE 1M\_MidCH20-2442MHz



### PSD\_BLE 1M\_HighCH39-2480MHz



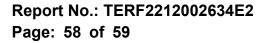




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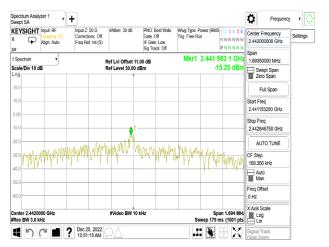
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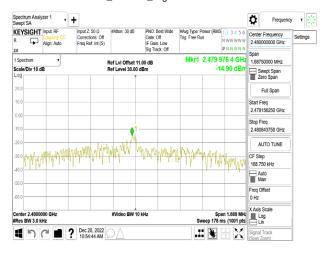




### PSD\_BLE 2M\_MidCH20-2442MHz



PSD\_BLE 2M\_HighCH39-2480MHz



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## **13 ANTENNA REQUIREMENT**

### 13.1 **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.

### 13.2 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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