

ELECTROMAGNETIC EMISSIONS **COMPLIANCE REPORT**



Applicant: Manufacturer:	Samsara, Inc. 1 De Haro Street, San Francisco, CA, 94107, USA Jabil Circuit de Mexico, S. de R.L. de C.V. Av Guadalupe 420-A Guadalajara Technology Park, Carretera a Nogales Km 13.5, Zapopan, Jal, 45010. MEXICO
Product Name:	AT11
Brand Name:	Samsara
Model No.:	030-00007
Model Difference:	N/A
Report Number:	TERF2405001260E2
FCC ID	2AIHD-AT11
Date of EUT Received:	May 6, 2024
Date of Test:	May 6, 2024 \sim May 28, 2024
Issue Date:	June 5, 2024

Approved By

Aken Huana

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.

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Revision History						
Report Number	Revision	Description	Issue Date	Revised By	Remark	
TERF2405001260E2	00	Original.	June 5, 2024	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:	AT11	
Brand Name:	Samsara	
Model No.:	030-00007	
Model Difference:	N/A	
Hardware Version:	01-01:02	
Firmware Version:	v105.12.1398	
EUT Series No.:	GRVU-9R4-FDF	
Power Supply:	3Vdc	
Test Software (Name/Version)	Putty.exe Release 0.62	

1.2 **RF Specification**

Radio Technology:	BLE
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	19.05dBm

1.3 **Antenna Designation**

Antenna Type	Freq.	Peak Antenna Gain (dBi)
Planar inverted-F	2.4GHz	-1.44

Note:

1. 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

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	T\4/0007	
	Industrial Park, Wuku District, New	Conducted 2	TW0027	
	Taipei City, Taiwan.	Conducted 3		TW3702
		Conducted 4		
		Conducted 5		
SGS Taiwan Ltd.		Conducted 6		
Central RF Lab.		Conduction C		
(TAF code 3702)		SAC C		
		SAC D		
		SAC G		
	No 2 Kaji dat Del Quichar District	Conducted A		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conducted B	TW0028	
	Tabyuan City, Taiwan 555	Conducted C		
		Conducted D		
		Conducted E		
		Conducted F	•	
		Conducted G		

tion where measurements occurred in specific test site and address.

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:

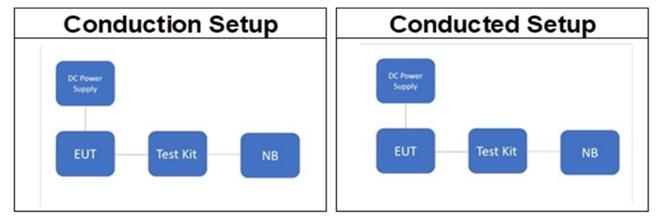
The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

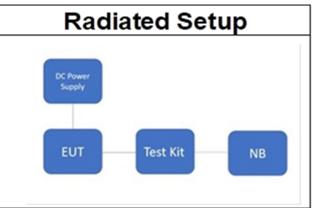
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Test Configuration 2.5





2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C						
EQUIPMENT TYPE	MFR	MFR MODEL NUMBER SERIAL NUMBER LAST CAL.			CAL DUE.	
Test kit	Mercury	FT232RL	N/A	N/A	N/A	
Notebook	Lenovo	L480	P0002332	N/A	N/A	
	C	onducted Emission 1	est Site: Conducted	D		
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
Test kit	Mercury	FT232RL	N/A	N/A	N/A	
Notebook	Lenovo	T14	P0003332	N/A	N/A	
	Radiated Emission Test Site: SAC G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
Test kit	Mercury	FT232RL	N/A	N/A	N/A	
Notebook	Lenovo	L480	P0002332	N/A	N/A	

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SUMMARY OF TEST RESULTS 3

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 4

4.1 **Operating Frequencies**

	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

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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		
	TRANSMIT RAD	DIATED EMISSION TE	EST (BELOW 1 GHz)			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)		
Bluetooth LE	0 to 39	20	GFSK	1		
	TRANSMIT RAI	Diated Emission Ti	EST (ABOVE 1 GHz)			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)		
Bluetooth LE	0 to 39	0,20,39	GFSK	1		

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MEASUREMENT UNCERTAINTY 5

Test Items	Ur	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 Emission Measurement Uncertainty						
	+/-	1.89	dB	9kHz~30MHz		
Polarization: Vertical	+/-	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 Onumieuro Envio	+/-	1.59	dB	50GHz-60GHz		
Radiated Spurious Emis- sion	+/-	1.7	dB	60GHz-90GHz		
	+/-	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

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	974	06/19/2023	06/18/2024			
EMI Test Receiver	R&S	ESCI	101342	04/29/2024	04/28/2025			
DC Power Supply	Agilent	E3640A	MY53130054	10/02/2023	10/01/2024			
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2024	03/26/2025			
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2024	03/26/2025			
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 D								
EQUIPMENT TYPE	MFR	MODEL NUMBER	LAST CAL.	CAL DUE.				
Spectrum Analyzer	KEYSIGHT	N9010B	MY60240506	06/20/2023	06/19/2024			
Power Meter	Anritsu	ML2496A	1512003	09/08/2023	09/07/2024			
Power Sensor	Anritsu	MA2411B	1339378	09/08/2023	09/07/2024			
Power Sensor	Anritsu	MA2411B	1339379	09/08/2023	09/07/2024			
DC Power Supply	Agilent	E3640A	MY53130054	10/02/2023	10/01/2024			
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R			

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6.3 **Radiated Measurement**

Radiated Emission Test Site: SAC G							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
Broadband Antenna	SCHWARZBECK	VULB 9168	1208	07/21/2023	07/20/2024		
Horn Antenna	Schwarzbeck	BBHA9170	185	08/21/2023	08/20/2024		
Horn Antenna	RF SPIN	DRH18-E	210105A18E	04/12/2024	04/11/2025		
Active Loop Antenna	COM-POWER	AL-130R	10160105	12/04/2023	12/03/2024		
3m Site NSA	SGS	966 chamber G	N/A	03/30/2024	03/29/2025		
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/17/2023	07/16/2024		
DC Power Supply	Agilent	E3640A	MY53130054	10/02/2023	10/01/2024		
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	EMC330N	980781	03/13/2024	03/12/2025		
Pre-Amplifier	EMC Instruments	EMC118A45SE	980815	05/08/2024	05/07/2025		
Coaxial Cable	EMC Instruments	EMCCFD400-NM- NM-8000-5000- 2000	210216 \ 210217 \ 210218	03/13/2024	03/12/2025		
Coaxial Cable EMC Instruments		EMC104-SM-SM- 8000-5000-5000	210219 \ 210220 \ 210221	03/13/2024	03/12/2025		

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		imits BµV)
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

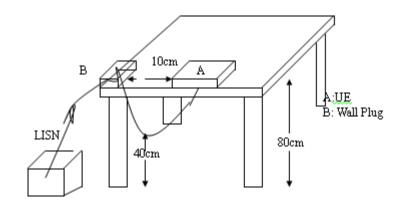
1. The lower limit shall apply at the transition frequencies

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 Probe	:TERF2405 :BLE :120V/60Hz :L1		Test Site Test Date Temp./Hu Engineer		-17 51%	
80 Level (dBuV)					
70.0						
70.0						
60.0						
50.0						
40.0				2	Mr.	
30.0					<u> </u>	
20.0	unneghtere way	minalina	MANAMA			
0.15	0.5	1 Freque	2 ency (MHz)	5 10	20 30	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
		Reading Level		FS		
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
7.083	Peak	23.75	10.97	34.71	60.00	-25.29
9.295	Peak	29.34	10.97	40.31	60.00	-23.29
12.406	Average	34.10	11.03	45.13	50.00	-4.87
12.406	QP	39.30	11.03	50.33	60.00	-9.67
12.944	Average	36.40	11.04	47.44	50.00	-2.56
12.944	QP	41.50	11.04	52.54	60.00	-7.46
13.620	Average	7.40	11.05	18.45	50.00	-31.55
13.620	QP	13.60	11.05	24.65	60.00	-35.35
18.490	Peak	32.60	11.13	43.73	60.00	-16.27

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Report Number Test Mode Power Probe	:TERF24050 :BLE :120V/60Hz :N	01260E2	Test Site Test Date Temp./Humi. Engineer	:Conductio :2024-05-1 :21.4℃/51 :Temo Che	7 %	
80 Level (dBuV)					
70.0						
60.0				A		
50.0				<u>M</u>	1910	
40.0				3		
30.0						
20.0	worldhammen	mound		5		
10.0		ALCONT ALL TH	diales 1			
0.15	0.5	1 Freque	2 5 ncy (MHz)	10	20 30	
Freq.		Spectrum ading Level	Factor A	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV	dBµV	dB
7.144	Peak	24.14	10.99	35.13	60.00	-24.87
8.908	Peak	28.64		39.64	60.00	-20.36
11.109	Average	25.50	-	36.54	50.00	-13.46
11.109	QP	29.90		40.94	60.00	-19.06
12.618	Average	3.50		14.59	50.00	-35.41
12.618	QP	8.70		19.79	60.00	-40.21
13.853 13.853	Average QP	35.90 41.10		47.02 52.22	50.00 60.00	-2.98 -7.78
18.333	Peak	32.68		43.89	60.00 60.00	-7.78
20.648	Peak	32.31		43.57	60.00	-16.43

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PEAK OUTPUT POWER MEASUREMENT

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

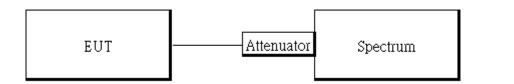
For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

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.

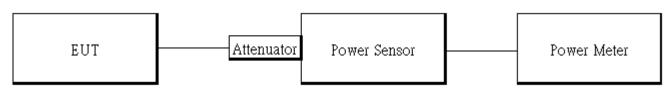
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.2 **Test Setup**

8.2.1 Duty Cycle



8.2.2 Output Power



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8.3 **Measurement Procedure:**

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	100.00	0.00	0.00	0.01

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Report No.: TERF2405001260E2 Page: 21 of 50

BLE_1M_LowCH00-2402

L → Mign. Auto Freq. Ref. Int (S) IF Came. Low M.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W	pectrum Ar wept SA	alyzer 1	•	+							$\mathbf{\dot{\mathbf{v}}}$	Frequenc	y ' [
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Image: Sector of the secto				-							L	og			
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BLE_1M_HighCH39-2480

Specti Swept	rum Anal SA	yzer 1	•	+									₽	Frequency	•
KEY RL LN	SIGHT .≁·	Input: F Couplir Align: A	ig: DC		nput Z: 50 Freq Ref: I		#Atten: 30 dB	PNO: Fa Gate: Of IF Gain: Sig Trac	f Low	Avg Type: Vo Trig: Free Ru		123456 WWWWW PNNNNN		Frequency 000000 GHz	Settings
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8.5 **Output Power:**

8.5.1 Peak & Avg

BLE 1M mode:

СН	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	Required Limit (dBm)
Low	2402	default	19.05	30
Mid	2442	default	19.03	30
High	2480	default	19.05	30
СН	Frequency Power (MHz) Setting		Avg. Output Power (dBm)	Required Limit (dBm)
Low	2402	default	19.03	30
Mid	2442	default	19.01	30
High	2480	default	19.02	30

*Note:

1.Measured by power meter, cable loss 10.8 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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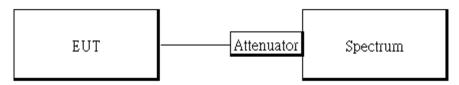


EMISSION BANDWIDTH MEASUREMENT 9

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.

9.4 **Measurement Result:**

9.4.1 6dB BW measurements

BLE 1M	mode
--------	------

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result	
2402	0.7902	≥ 0.5	PASS	
2442	0.7718	≥ 0.5	PASS	
2480	0.7821	≥ 0.5	PASS	

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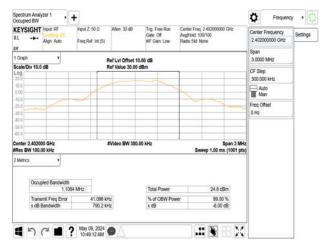
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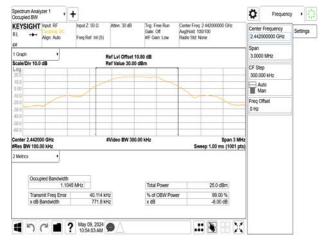
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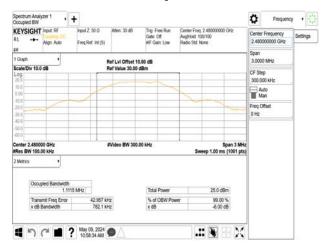
OBW_BLE 1M_LowCH00-2402MHz



OBW_BLE 1M_MidCH20-2442MHz



OBW_BLE 1M_HighCH39-2480MHz



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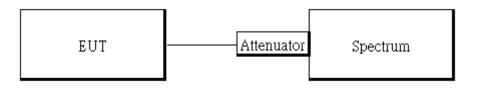


10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

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), must also comply with the radiated emission limits specified in §15.209(a).

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.
- 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.

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.
- 4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass

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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.

10.4 Measurement Result

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	17.00	-3.00
2442	17.20	-2.80
2480	17.20	-2.80
*Note	-	

BLE 1M_Reference Level of Limit

1.cable loss as 10.8dB that offsets in the spectrum 2.Refer to next page for plots.

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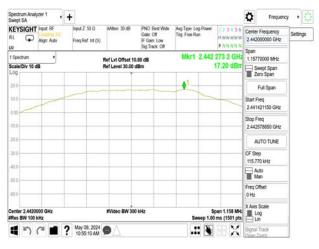
Report No.: TERF2405001260E2 Page: 28 of 50



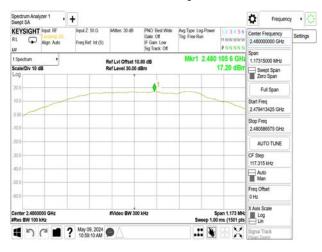
Reference Level_BLE 1M_LowCH00-2402MHz



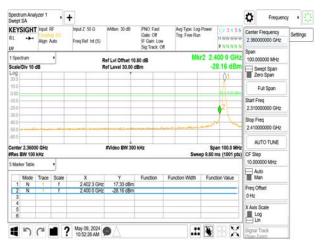
Reference Level_BLE 1M_MidCH20-2442MHz



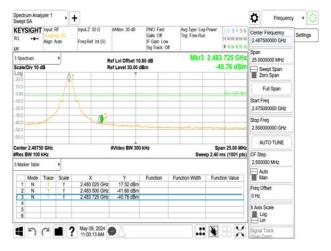
Reference Level_BLE 1M_HighCH39-2480MHz



Band Edge_BLE 1M_LowCH00-2402MHz



Band Edge_BLE 1M_HighCH39-2480MHz



Spurious Emission_BLE 1M_LowCH00-2402MHz

Spectrum Analyzer 1 Swept SA Frequency + · + ö KEYSIGHT Input RF Input Z 50 D PNO: Fast Gate: Off IF Gain: Lo Avg Type: Log-Power Trig: Free Run #Atten 30 dB Center Frequency 12.515000000 GHz Settings + Alan Auto Freq Ref. Int (S) PNNNN Sig Track Of 137 4.805 GHz 1 Spec 24.9700000 GHz Ref Lvi Offset 10.80 dB Ref Level 30.00 dBm Scale/Div 10 dB -30 84 d Swept Span Zero Span og Full Span Start Freq 30.000000 MHz 0 Stop Freq 25,000 AUTO TUNE Span 24.97 GHz eep ~2.39 s (24971 pts) enter 12.52 GH Res BW 100 kH CF Step Marker Table Auto Man Function Width Freq Offset 0 Hz X Axis Scal May 09, 2024 X .:: 💘 Signal Trac

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Spurious Emission_BLE 1M_MidCH20-2442MHz

Spectr Swept	um Anal SA	rzer 1	•	+							¢	Frequenc	• •
RL	SIGHT	Align /			nput Z: 50 () Freq Ref. Int (S)	#Atlen: 30 dB	PNO: Fast Gate: Off IF Gain: Low Sig Track: O			123456 MWWWWW PNNNNN		Frequency 5000000 GHz	Settings
Spec			•	-		tef Lvi Offset 10	80 dB			4.885 GHz	Span 24.97	00000 GHz	
Log 7	Div 10 c	A1			,	tef Level 30.00 o	18m		-	33.83 dBm	Si Za	vept Span tro Span	
10.0		1								D. I STORES	1	Full Span	
10.0 20.0		F									Start F 30.00	req 0000 MHz	
30.0 40.0 50.0			_	-	Q ³		_				Stop F 25.00	req 0000000 GHz	
60.0	12.52					#Video RW 300					A	UTO TUNE	
	12.52 G			_		Evideo BW 300	KHZ	Swe		oan 24.97 GHz s (24971 pts)	CF Ste		
5 Mark	er Table											000000 GHz	
	Mode	Trace	Scale		x	Ŷ	Function	Function Width	Fun	ction Value		ito an	
1 2	N N	1	1		2.442 GHz 4.884 GHz	-33.59 dBm					Freq O	fiset	
3	N	1	1		7.326 GHz						0 Hz		
4 5 6	N	4			4.885 GHz	-33.83 dBm						20	
4	5	C	1	?	May 09, 2024 10:56:22 AM	DA.		.:		BX	Signal		

Spurious Emission_BLE 1M_HighCH39-2480MHz



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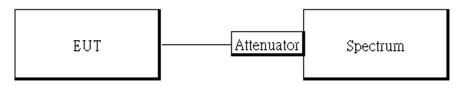


11 DUTY FACTOR CORRECTION FACTOR FOR RADIATED UNWANTED EMISSION

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

- 1. Adjust and configure any EUT switches, controls, or input data streams to ensure that the EUT is transmitting or encoded to obtain the "worst-case" pulse ON time.
- 2. The testing follows ANSI C63.10:2013.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set center frequency of spectrum analyzer = operating frequency.
- 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($dB\mu V/m$)=Peak Actual FS($dB\mu V/m$)+ Duty Cycle Correction Factor(dB)

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

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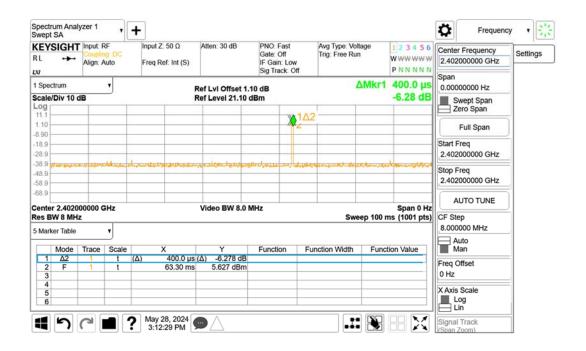


11.4 **Measurement Result:**

11.4.1 **Duty Cycle Correction Factor**

Time ON of 100ms:	0.400	ms	
Duty Cycle=0.4ms / 100ms=	0.004		
Duty Cycle correction factor=20	-47.96	dB	

11.4.2 **Duty Cycle test plot**



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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.

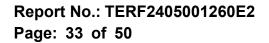
Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

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

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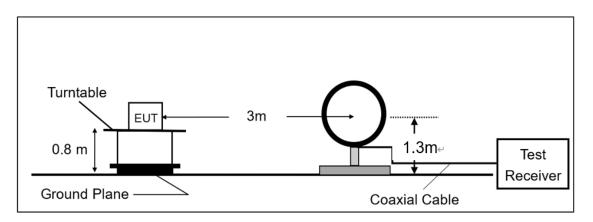
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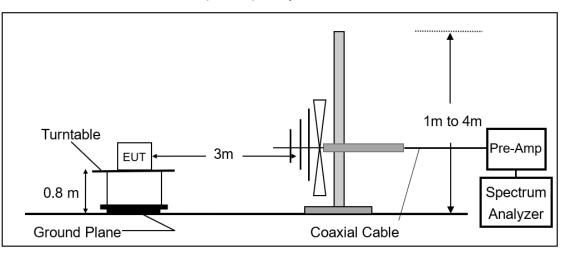


12.1 **Test Setup**

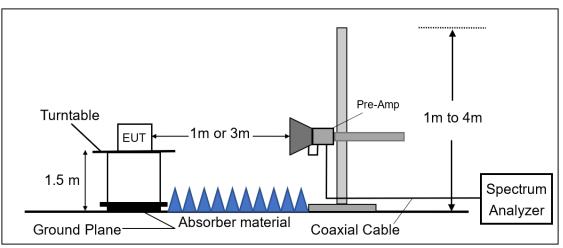
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



(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 (T_{on}/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

WhereFS = Field StrengthRA = Reading AmplitudeAF = 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 μ V/m) = SPA. Reading level(dB μ 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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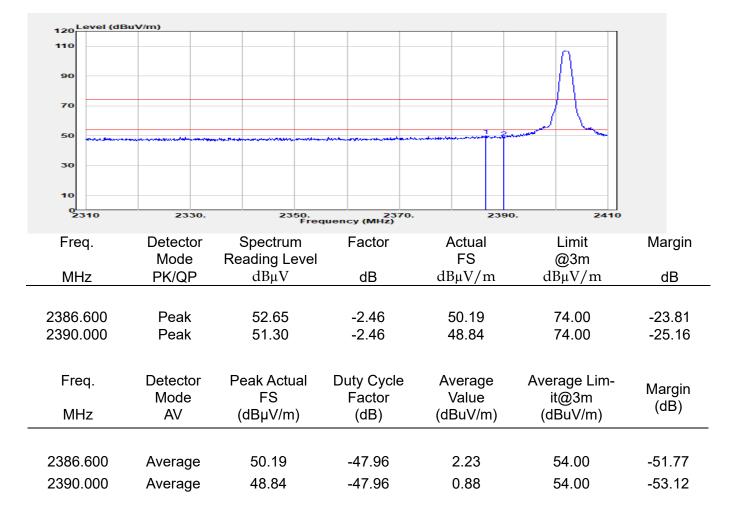
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Report No.: TERF2405001260E2 Page: 36 of 50



12.4.1 **Radiated Band Edge Measurement Result**

Report Number	:TERF2405001260E2	Test Site	:SAC G Chamber
Operation Mode	:BLE 1M	Test Date	:2024-05-16
Test Frequency	:2402 MHz	Temp./Humi.	:24.5°C/52%
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Temo Chen



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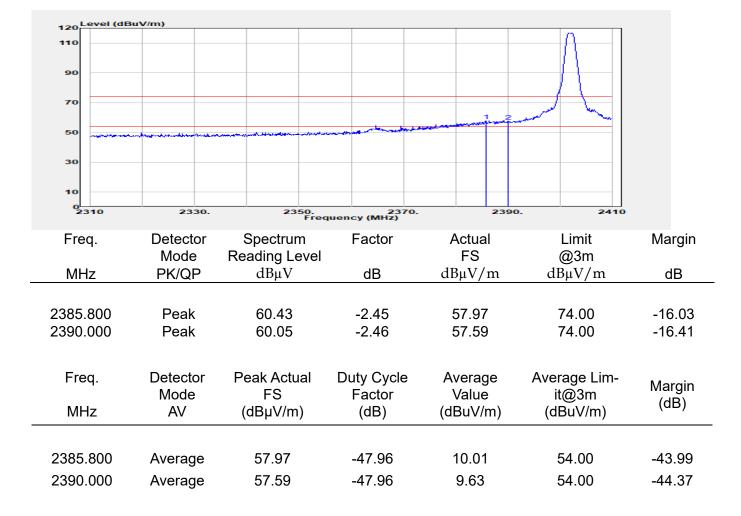
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:TERF2405001260E2
:BLE 1M
:2402 MHz
:Bandedge
:E2 Plane

Test Site	:SAC G Chamber
Test Date	:2024-05-16
Temp./Humi.	:24.5℃/52%
Antenna Pol.	:Horizontal
Engineer	:Temo Chen



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Report Number Operation Mode Test Frequency Test Mode EUT Pol	BLE 1M	Hz ge	ר ר <i>ו</i>	Гest Date Гemp./Humi. Antenna Pol.		
120 Level (dBuV	//m)					
110						
90						
70						
	×	The Provent interest	man da se			
50				16************************************	and the strain of the second states	
30						
10						
2475	2480.	2485.	2490	0. 24	95. 2500	
			uency (MHz)			
Freq.	Detector Mode	Spectrum	Factor	Actual FS	Limit	Margin
MHz	PK/QP	Reading Level dBµV	dB	dBµV/m	@3m dBµV/m	dB
		αυμν	UD	α <i>D</i> μ <i>V</i> / Π	α <i>D</i> μ v / III	UD
2483.500	Peak	62.02	-2.48	59.55	74.00	-14.45
2483.625	Peak	62.27	-2.48	59.79	74.00	-14.21
Freq.	Detector	Peak Actual	Duty Cycle	Average	Average Lim-	
ricq.	Mode	FS	Factor	Value	it@3m	Margin
MHz	AV	(dBµV/m)	(dB)	(dBuV/m)	(dBuV/m)	(dB)
2483.500	Average	59.55	-47.96	11.59	54.00	-42.41
2483.625	Average	59.79	-47.96	11.83	54.00	-42.17

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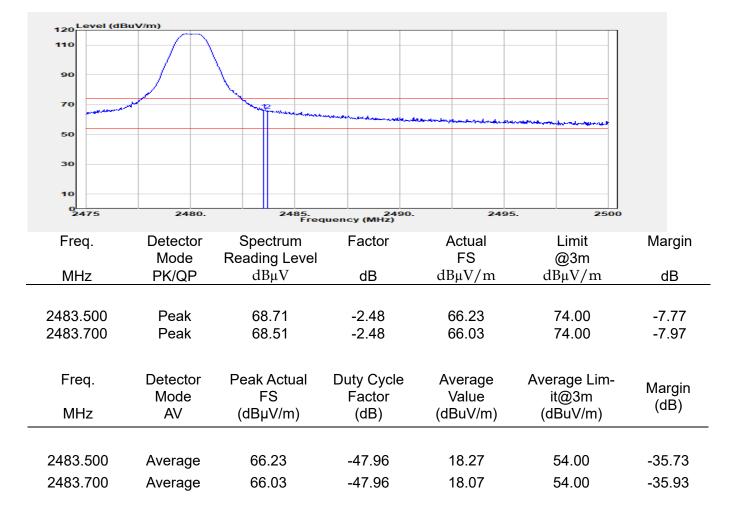
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Report Number	:TERF2405001260E2
Operation Mode	:BLE 1M
Test Frequency	:2480 MHz
Test Mode	:Bandedge
EUT Pol	:E2 Plane

Test Site	:SAC G Chamber
Test Date	:2024-05-16
Temp./Humi.	:24.5°C/52%
Antenna Pol.	:Horizontal
Engineer	:Temo Chen



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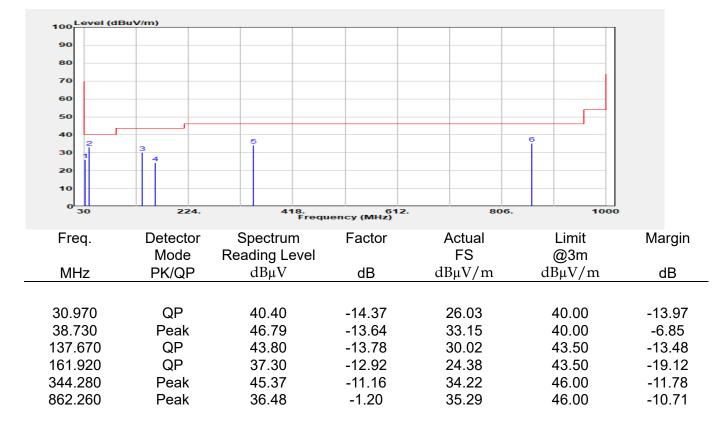
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f (886-2) 2298-0488



12.4.2 **Radiated Spurious Emission**

Report Number	:TERF2405001260E2	Test Site	:SAC G Chamber
Operation Mode	:BLE 1M	Test Date	:2024-05-16
Test Frequency	:2442 MHz	Temp./Humi.	:24.5°C/52%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Temo Chen



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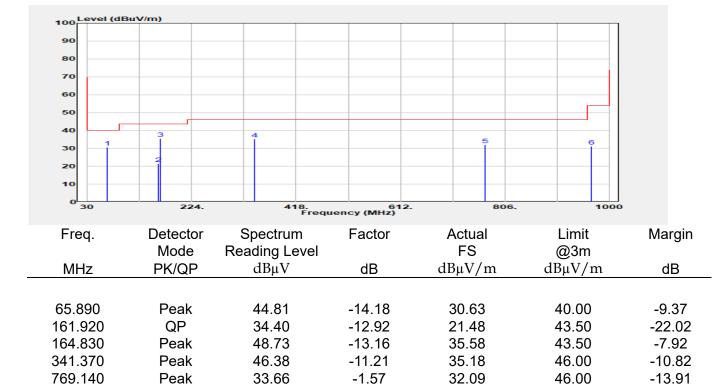
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Report Number	:TERF2405001260E2
Operation Mode	:BLE 1M
Test Frequency	:2442 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site	:SAC G Chamber
Test Date	:2024-05-16
Temp./Humi.	:24.5°C/52%
Antenna Pol.	:Horizontal
Engineer	:Temo Chen



1.21

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30.00

Peak

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31.20

54.00

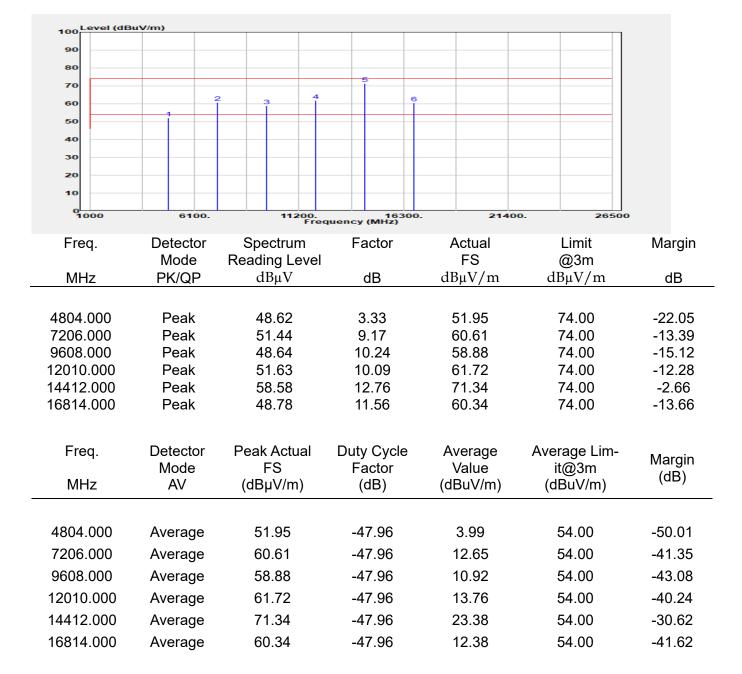
-22.80

967.990



Report Number	:TERF2405001260E2
Operation Mode	:BLE 1M
Test Frequency	:2402 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site :SAC G Chamber Test Date :2024-05-16 Temp./Humi. :24.5°C/52% Antenna Pol. :Vertical Engineer :Temo Chen



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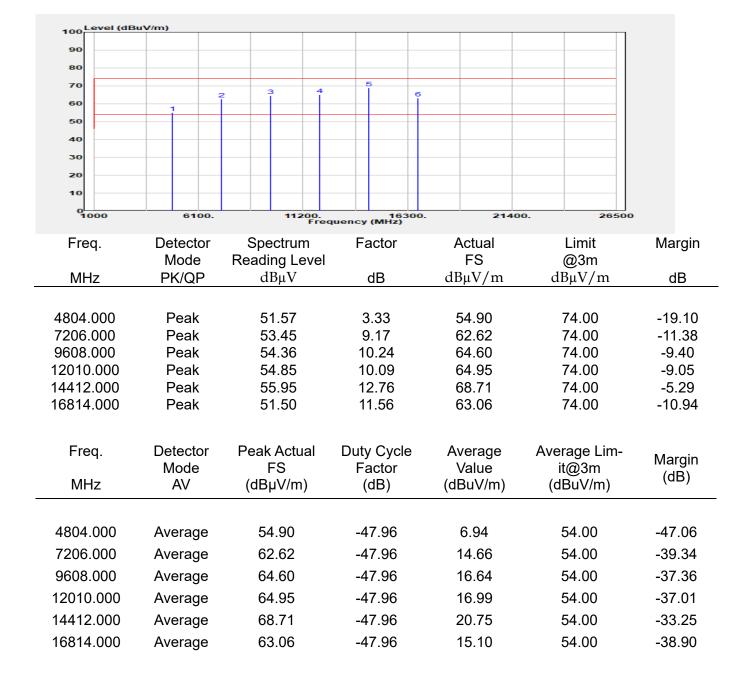
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Member of SGS Group



Report Number	:TERF2405001260E2
Operation Mode	:BLE 1M
Test Frequency	:2402 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site :SAC G Chamber Test Date :2024-05-16 Temp./Humi. :24.5°C/52% Antenna Pol. :Horizontal :Temo Chen Engineer



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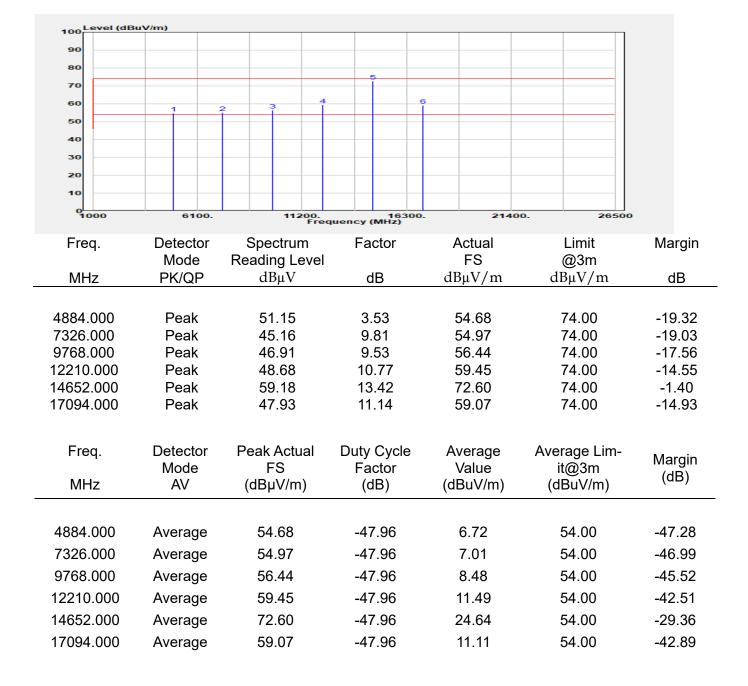
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Report Number	:TERF2405001260E2
Operation Mode	:BLE 1M
Test Frequency	:2442 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site :SAC G Chamber Test Date :2024-05-16 Temp./Humi. :24.5°C/52% Antenna Pol. :Vertical Engineer :Temo Chen



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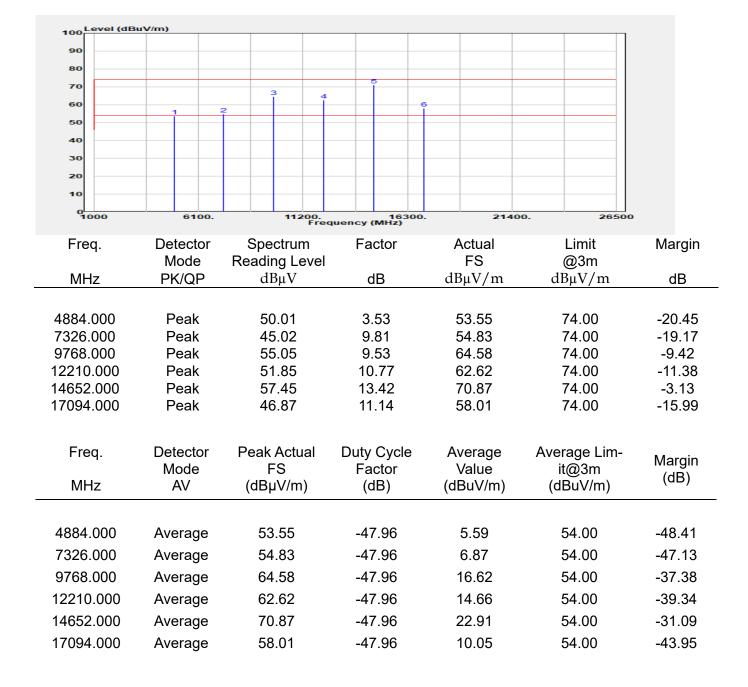
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Report Number	:TERF2405001260E2
Operation Mode	:BLE 1M
Test Frequency	:2442 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site :SAC G Chamber Test Date :2024-05-16 Temp./Humi. :24.5°C/52% Antenna Pol. :Horizontal :Temo Chen Engineer



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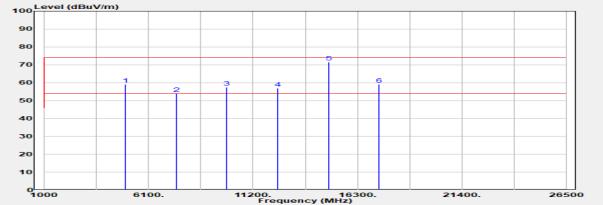
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Report Number	:TERF2405001260E2
Operation Mode	:BLE 1M
Test Frequency	:2480 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site :SAC G Chamber Test Date :2024-05-16 Temp./Humi. :24.5°C/52% Antenna Pol. :Vertical :Temo Chen Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP	dBµV	dB	dBµV/m	dBµV/m	dB
4960.000	Peak	55.18	3.86	59.04	74.00	-14.96
7440.000	Peak	43.76	10.14	53.89	74.00	-20.11
9920.000	Peak	47.54	9.95	57.49	74.00	-16.51
12400.000	Peak	45.79	11.14	56.93	74.00	-17.07
14880.000	Peak	59.29	12.33	71.62	74.00	-2.38
17360.000	Peak	47.52	11.53	59.05	74.00	-14.95
Freq.	Detector Mode	Peak Actual FS	Duty Cycle Factor	Average Value	Average Lim- it@3m	Margin
MHz						
	AV	(dBµV/m)	(dB)	(dBuV/m)	(dBuV/m)	(dB)
	AV	(dBµV/m)	(dB)	(dBuV/m)	0	(dB)
4960.000	AV	(dBµV/m) 59.04	(dB) -47.96	(dBuV/m) 11.08	0	-42.92
4960.000 7440.000		,		. ,	(dBuV/m)	
	Average	59.04	-47.96	11.08	(dBuV/m) 54.00	-42.92
7440.000	Average Average	59.04 53.89	-47.96 -47.96	11.08 5.93	(dBuV/m) 54.00 54.00	-42.92 -48.07
7440.000 9920.000	Average Average Average	59.04 53.89 57.49	-47.96 -47.96 -47.96	11.08 5.93 9.53	(dBuV/m) 54.00 54.00 54.00	-42.92 -48.07 -44.47
7440.000 9920.000 12400.000	Average Average Average Average	59.04 53.89 57.49 56.93	-47.96 -47.96 -47.96 -47.96	11.08 5.93 9.53 8.97	(dBuV/m) 54.00 54.00 54.00 54.00	-42.92 -48.07 -44.47 -45.03

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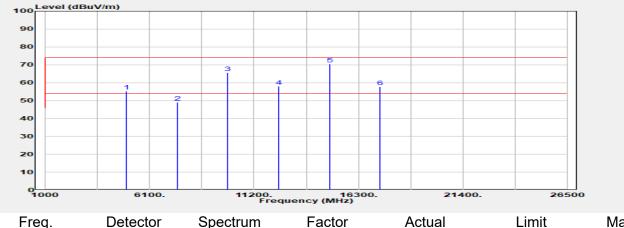
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Report Number	:TERF2405001260E2
Operation Mode	:BLE 1M
Test Frequency	:2480 MHz
Test Mode	:Tx
EUT Pol	:E2 Plane

Test Site :SAC G Chamber Test Date :2024-05-16 Temp./Humi. :24.5℃/52% Antenna Pol. :Horizontal :Temo Chen Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP	dBµV	dB	dBµV/m	dBµV/m	dB
4960.000	Peak	51.45	3.86	55.31	74.00	-18.69
7440.000	Peak	38.88	10.14	49.01	74.00	-24.99
9920.000	Peak	55.67	9.95	65.62	74.00	-8.38
12400.000	Peak	46.82	11.14	57.96	74.00	-16.04
14880.000	Peak	58.11	12.33	70.44	74.00	-3.56
17360.000	Peak	46.06	11.53	57.59	74.00	-16.41
Freq.	Detector Mode	Peak Actual FS	Duty Cycle Factor	Average Value	Average Lim- it@3m	Margin
MHz	AV	(dBµV/m)	(dB)	(dBuV/m)	(dBuV/m)	(dB)
4960.000	Average	55.31	-47.96	7.35	54.00	-46.65
7440.000	Average	49.01	-47.96	1.05	54.00	-52.95
9920.000	Average	65.62	-47.96	17.66	54.00	-36.34
12400.000	Average	57.96	-47.96	10.00	54.00	-44.00
14880.000	Average	70.44	-47.96	22.48	54.00	-31.52
17360.000	Average	57.59	-47.96	9.63	54.00	-44.37
	-					

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

13.4 Measurement Result:

BLE 1M mode

Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2402	0.97	8	PASS
2442	1.20	8	PASS
2480	1.47	8	PASS

*Note:

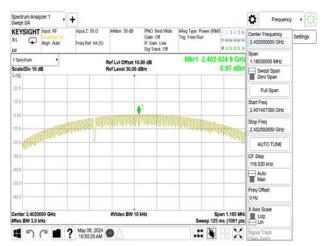
1.cable loss as 10.8dB that offsets in the spectrum

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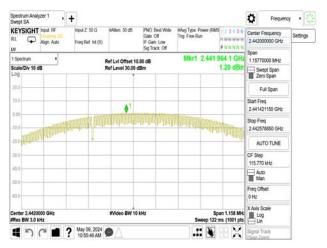
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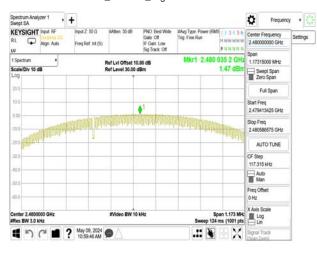
PSD_BLE 1M_LowCH00-2402MHz



PSD_BLE 1M_MidCH20-2442MHz



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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