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# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

**FCC Applicant:** ZEITBIKE LLC

298 Dalton Street, Ventura, California, United States, 93003

IC Applicant: SIGMA ELEKTRO GmbH

Dr. Julius-Leber-Str.15, 67433 Neustadt, Germany

**Product Name: ROX 11.1 EVO** 

**Brand Name:** SIGMA

**ROX 11.1 EVO** Model No.:

**Model Difference:** N/A

E2/2020/A0018 **Report Number:** 

FCC ID M5LROX111

IC: 7580A-ROX111

**FCC Rule Part:** §15.247, Cat: DTS

IC RSS: RSS-247 issue 2 Feb 2017

Issue Date: February 19, 2021

Date of Test: November 19, 2020 - December 15, 2020

Date of EUT Received: November 10, 2020

#### 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 tested as described in this report is in compliance with conducted and radiated emission limits.

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

Approved By:

Jay Lin / Asst. Supervisor





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	Revision History						
Report Number	Revision	Description	Issue Date	Remark			
E2/2020/A0018	Rev.00	Original.	February 19, 2021	Revised By: Karen Huang			

#### Note:

1 · Disclaimer

Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

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# **GENERAL INFORMATION**

# 1.1 Product Description

Product Name:	ROX 11.1 EVO			
Brand Name:	SIGMA			
Model No.:	ROX 11.1 E	EVO		
Model Difference:	N/A	N/A		
Hardware Version:	GS-EB-GB983-01-V1.0			
Software Version:	V0.70			
EUT Series No.:	GB-983 #21			
Dower Supply:	3.7Vdc from Rechargeable Li-polymer Battery or 5 Vdc from Micro USB port			
Power Supply:  Battery:		Model No.: JHY802844 3.7V, 1000mAh, 3.7Wh		

Radio Technology:	Bluetooth LE V5.0 Single mode	
Frequency Range:	2402-2480MHz	
Channel number:	40 channels	
Modulation type:	GFSK	
Transmit Power:	BLE 1M: -1.43 dBm BLE 2M: -1.45 dBm	

## 1.2 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq.	Peak An- tenna Gain (dBi)	Worst Antenna Gain
Chip	Antech	AT3216-B2R7HAA	2.4GHz	0.5	-

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# 1.3 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, Amendment 1, March 2019 ANSI C63.10:2013

## 1.4 Test Facility

SGS Taiwan Ltd. Central RF Lab (TAF code 3702) No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333

FCC Designation number: TW0028

ISED CAB identifier: TW3702

## 1.5 Special Accessories

There are no special accessories used while test was conducted.

#### 1.6 Equipment Modifications

There was no modification incorporated into the EUT.

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## SYSTEM TEST CONFIGURATION

# 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\*9m\*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

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

#### 2.4.2 For all conducted test items:

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

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# 2.5 Configuration of Tested System

Fig. 2-1 Conducted (Antenna Port) Emission Configuration

Fig 2-3 Conduction (AC Power Line) Radiated Emission





Fig 2-2 Radiated Emission



**Table 2-1 Equipment Used in Tested System** 

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2	Notebook	Lenovo	L430	P0000195	N/A	N/A
3.	Adapter	N/A	N/A	N/A	N/A	N/A

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# **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	6dB & 99% 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 §15.247(b)	N/A	Antenna Requirement	Compliant

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# **DESCRIPTION OF TEST MODES**

#### Operated in 2400 ~ 2483.5MHz Band 4.1

40 channels are provided for Bluetooth LE

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. Investigation has been done on all the possible configurations for searching the worst case.

MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (Mbps)		
	RADIATED EMISSION TEST (BELOW 1 GHz)					
Bluetooth LE	2402 to 2480	2442	GFSK	1		
Bluetooth LE	2402 to 2480	2442	GFSK	2		
	RADIATED EMISSION TEST (ABOVE 1 GHz)					
Bluetooth LE	2402 to 2480	2402, 2442, 2480	GFSK	1		
Bluetooth LE	2402 to 2480	2402, 2442, 2480	GFSK	2		

Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth LE Transmitter for channel Low, Mid and High, the worst case H position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT						
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (Mbps)		
Bluetooth LE	2402 to 2480	2402, 2442, 2480	GFSK	1		
Bluetooth LE	2402 to 2480	2402, 2442, 2480	GFSK	2		

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## **MEASUREMENT UNCERTAINTY**

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
6dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Peak Power Density	+/- 1.3 dB
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission Measurement Uncertainty				
	9kHz~30MHz: +-2.3dB			
	30MHz - 180MHz: +/- 3.37dB			
Polarization: Vertical	180MHz -417MHz: +/- 3.19dB			
Polarization. Vertical	0.417GHz-1GHz: +/- 3.19dB			
	1GHz - 18GHz: +/- 4.04dB			
	18GHz - 40GHz: +/- 4.04dB			
	9kHz~30MHz: +-2.3dB			
	30MHz - 167MHz: +/- 4.22dB			
Polarization: Horizontal	167MHz -500MHz: +/- 3.44dB			
Polarization. Horizontal	0.5GHz-1GHz: +/- 3.39dB			
	1GHz - 18GHz: +/- 4.08dB			
	18GHz - 40GHz: +/- 4.08dB			

#### 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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#### CONDUCTED EMISSION TEST

# 6.1 Standard Applicable:

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

Frequency range	Limits dB(μV)			
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		

#### **Measurement Equipment Used:**

	Conducted Emission Test Site							
<b>EQUIPMENT</b>	MFR	MODEL	SERIAL	LAST	CAL DUE.			
TYPE		NUMBER	NUMBER	CAL.				
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	974	03/25/2020	03/24/2021			
EMI Test Receiver	R&S	ESCI	101342	04/28/2020	04/27/2021			
Adapter	Sony	AC-0400-TW	3504600	N/A	N/A			
USB Cable	MI	SJX10ZM	USB to Type-c	N/A	N/A			

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

# 6.3 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.

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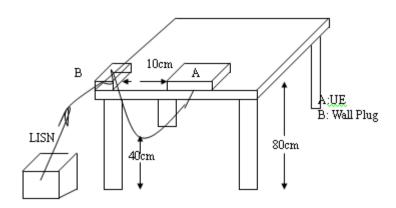
<sup>1.</sup> The lower limit shall apply at the transition frequencies

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



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# 6.4 Test SET-UP (Block Diagram of Configuration)



#### 6.5 **Measurement Procedure:**

- 1. The EUT was placed on a table which is 0.8m above ground plan.
- 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

## 6.6 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The \* reveals the worst-case results that closet to the limit.

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# AC POWER LINE CONDUCTED EMISSION TEST DATA

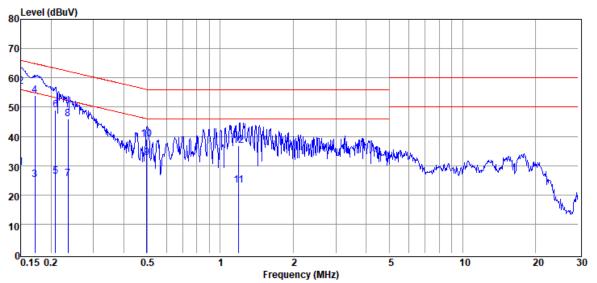
Report Number **Test Site** :Conduction Room C :E2/2020/A0018

Test Mode :BLE 1M **Test Date** :2020-12-09

:120V/60Hz Power Temp./Humi. :20.9/74

Probe :L1 Engineer :Ashton Chiu

Note:



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dΒμV	dΒμV	dB
0.15	Average	19.08	10.22	29.30	55.99	-26.69
0.15	QP	46.76	10.22	56.98	65.99	-9.01
0.17	Average	14.89	10.22	25.11	54.86	-29.75
0.17	QP	43.83	10.22	54.05	64.86	-10.81
0.21	Average	16.10	10.22	26.32	53.26	-26.94
0.21	QP	38.77	10.22	48.99	63.26	-14.27
0.24	Average	15.34	10.22	25.56	52.26	-26.70
0.24	QP	35.76	10.22	45.98	62.26	-16.28
0.50	Average	22.38	10.22	32.60	46.06	-13.46
0.50	QP	28.84	10.22	39.06	56.06	-17.00
1.19	Average	12.88	10.44	23.32	46.00	-22.68
1.19	QP	26.42	10.44	36.86	56.00	-19.14

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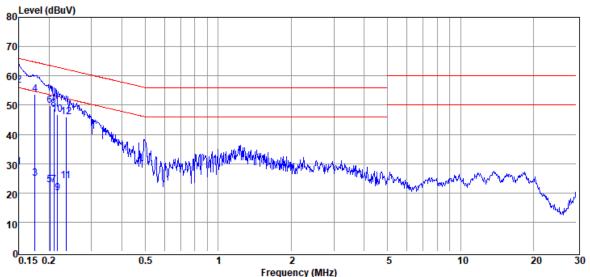
Report Number :E2/2020/A0018 Test Site :Conduction Room C

Test Mode :BLE 1M **Test Date** :2020-12-09

Power :120V/60Hz Temp./Humi. :20.9/74

Probe :N Engineer :Ashton Chiu

Note:



		ricq	uency (mnz)			
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dΒμ̈V	dB	dΒμV	dΒμV	dB
0.15	Average	18.54	10.21	28.75	55.99	-27.24
0.15	QP	46.42	10.21	56.63	65.99	-9.36
0.18	Average	14.82	10.21	25.03	54.71	-29.68
0.18	QP	43.38	10.21	53.59	64.71	-11.12
0.20	Average	12.56	10.21	22.77	53.53	-30.76
0.20	QP	39.51	10.21	49.72	63.53	-13.81
0.21	Average	12.61	10.21	22.82	53.20	-30.38
0.21	QP	38.56	10.21	48.77	63.20	-14.43
0.22	Average	9.81	10.21	20.02	52.92	-32.90
0.22	QP	36.62	10.21	46.83	62.92	-16.09
0.24	Average	13.85	10.21	24.06	52.26	-28.20
0.24	QP	35.68	10.21	45.89	62.26	-16.37

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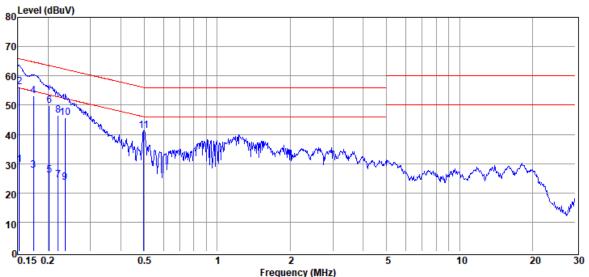
Report Number :E2/2020/A0018 Test Site :Conduction Room C

:2020-12-09 Test Mode :BLE 2M **Test Date** 

Power :120V/60Hz Temp./Humi. :20.9/74

Probe :L1 Engineer :Ashton Chiu

Note:



		rieq	uency (winz)			
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dΒμV	dB
0.15	Average	19.43	10.22	29.65	55.86	-26.21
0.15	QP	46.00	10.22	56.22	65.86	-9.64
0.17	Average	17.50	10.22	27.72	54.73	-27.01
0.17	QP	42.88	10.22	53.10	64.73	-11.63
0.20	Average	15.88	10.22	26.10	53.49	-27.39
0.20	QP	39.51	10.22	49.73	63.49	-13.76
0.22	Average	14.23	10.22	24.45	52.79	-28.34
0.22	QP	36.37	10.22	46.59	62.79	-16.20
0.24	Average	13.39	10.22	23.61	52.26	-28.65
0.24	QP	35.38	10.22	45.60	62.26	-16.66
0.50	Peak	31.13	10.22	41.35	56.05	-14.70

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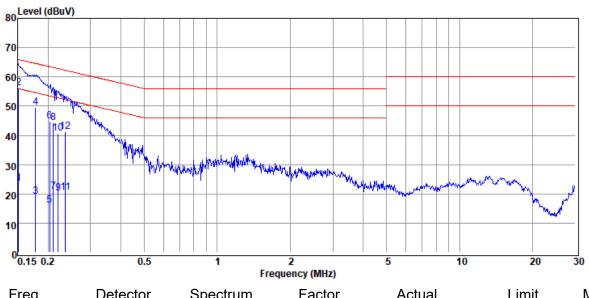
Report Number :E2/2020/A0018 Test Site :Conduction Room C

:2020-12-09 Test Mode :BLE 2M **Test Date** 

Power :120V/60Hz Temp./Humi. :20.9/74

Probe :N Engineer :Ashton Chiu

Note:



		1104	donoy (mile)			
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dΒμ̈V	dB	dΒμV	dΒμV	dB
0.15	Average	13.27	10.21	23.48	55.92	-32.44
0.15	QP	46.12	10.21	56.33	65.92	-9.59
0.18	Average	8.80	10.21	19.01	54.60	-35.59
0.18	QP	39.47	10.21	49.68	64.60	-14.92
0.20	Average	5.80	10.21	16.01	53.45	-37.44
0.20	QP	34.59	10.21	44.80	63.45	-18.65
0.21	Average	10.68	10.21	20.89	53.19	-32.30
0.21	QP	34.11	10.21	44.32	63.19	-18.87
0.22	Average	10.01	10.21	20.22	52.78	-32.56
0.22	QP	30.51	10.21	40.72	62.78	-22.06
0.24	Average	10.20	10.21	20.41	52.24	-31.83
0.24	QP	30.99	10.21	41.20	62.24	-21.04

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#### PEAK OUTPUT POWER MEASUREMENT

## 7.1 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.

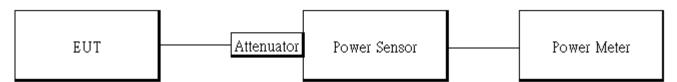
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

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.

#### **Measurement Equipment Used:**

Conducted Emission Test Site							
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.		
TYPE		NUMBER	NUMBER	CAL.			
Power Meter	Anritsu	ML2496A	1804002	04/06/2020	04/05/2021		
Power Sensor	Anritsu	MA2411B	1726105	04/06/2020	04/05/2021		
Power Sensor	Anritsu	MA2411B	1726106	04/06/2020	04/05/2021		
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071570	06/25/2020	06/24/2021		
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021		
DC Block	PASTERNACK	PE8210	RF152	11/19/2020	11/18/2021		

## 7.3 Test Set-up:



#### 7.4 **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.
- 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.

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# 7.5 Duty Factor:

Mode: BLE (1M)

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

# Duty Cycle\_BLE\_1M\_MidCH20-2442



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Mode: BLE (2M)

	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
BLE 2M	100.00	0.00	0.33	1.00

#### Duty Cycle\_BLE\_2M\_MidCH20-2442



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## 7.6 Output Power:

#### 7.6.1 Peak & Avg

Mode: BLE (1M)

СН	Frequency (MHz)	Peak Power Output (dBm)	Required Limit
Low	2402	-1.43	1 Watt = 30 dBm
Mid	2442	-1.78	1 Watt = 30 dBm
High	2480	-2.13	1 Watt = 30 dBm
СН	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit
Low	2402	-1.72	1 Watt = 30 dBm
Mid	2442	-2.08	1 Watt = 30 dBm
High	2480	-2.48	1 Watt = 30 dBm

<sup>\*</sup>Note: Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offseted to

Mode: BLE (2M)

#### **BLE 2M mode:**

СН	Frequency (MHz)	Peak Power Output (dBm)	Required Limit
0	2402	-1.45	1 Watt = 30 dBm
20	2442	-1.77	1 Watt = 30 dBm
39	2480	-2.11	1 Watt = 30 dBm
BLE 2M mode:			
СН	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit
0	2402	-1.74	1 Watt = 30 dBm
20	2442	-2.08	1 Watt = 30 dBm
39	2480	-2.44	1 Watt = 30 dBm

\*Note: Measured by power meter, cable loss as 10.8 dB that offsets on the power meter in Peak

\*Note: Measured by power meter, as cable loss+ Duty cycle factor that offsets on the power meter

\*Note: Max. Output include tune up tolerance Power is average power

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#### 7.6.2 **EIRP**

Mode: BLE (1M)

СН	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit		İ
Low	2402	-1.72	0.50	-1.22	4W=	36	dBm
Mid	2442	-2.08	0.50	-1.58	4W=	36	dBm
High	2480	-2.48	0.50	-1.98	4W=	36	dBm

<sup>\*</sup> Note: EIRP = Average Power + Gain

Mode: BLE (2M)

#### **EIRP**

СН	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
0	2402	-1.74	0.50	-1.24	4W= 36 dBm
20	2442	-2.08	0.50	-1.58	4W= 36 dBm
39	2480	-2.44	0.50	-1.94	4W= 36 dBm

\* Note: EIRP = Average Power + Gain

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# 8 6DB & 99% BANDWIDTH MEASUREMENT

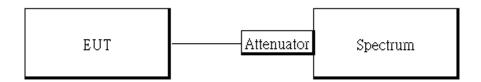
#### 8.1 Standard Applicable

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

## 8.2 Measurement Equipment Used

Conducted Emission Test Site						
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071570	06/25/2020	06/24/2021	
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021	
DC Block	PASTERNACK	PE8210	RF152	11/19/2020	11/18/2021	
Temperature Chamber	TERCHY	MHK-120LK	1020582	07/08/2020	07/07/2021	

## 8.3 Test Set-up:



#### 8.4 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.
- 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 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 ≥ 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
- Repeat above procedures until all test default channel is completed

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#### 8.5 Measurement Result:

Mode: BLE (1M)

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.7329	> 0.5	PASS
2442	0.7229	> 0.5	PASS
2480	0.7498	> 0.5	PASS

#### **BLE** mode

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.064
2442	1.0628
2480	1.0625

Mode: BLE (2M)

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

Frequency (MHz)	6dB BW (MHz)	BW (MHz)	Result
2402	1.297	> 0.5	PASS
2442	1.308	> 0.5	PASS
2480	1.255	> 0.5	PASS

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

Frequency (MHz)	99%Bandwidth (MHz)		
2402	2.077		
2442	2.0938		
2480	2.1095		

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Span 2.0000 MHz

CF Step 200.000 kHz

Auto Man Freq Offset 0 Hz

Auto Man

Freq Offset 0 Hz

an 2 MH

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#### OBW 6dB BLE 1M LowCH00-2402 IC OBW 99% BLE 1M LowCH00-2402 Frequency • KEYSIGHT Input RF KEYSIGHT Input RE Span 5.0000 MHz Ref Lvi Offset 10.80 dB Ref Value 20.00 dBm Ref Lvi Offset 10.80 dB Ref Value 20.00 dBm Scale/Div 10.0 dB CF Step 500,000 kHz Auto Man Freq Offset 0 Hz eep 15.1 ms (1001 pts) Occupied Bandwidth 1.0754 MHz Occupied Bandwidth 1.0640 MHz Total Power 5.48 dBm 5.83 dBm % of OBW Power x dB % of OBW Power x dB Transmit Freq Error 81.041 kHz x dB Bandwidth 732.9 kHz Transmit Freq Error x dB Bandwidth 99.00 % -6.00 dB ■ ? Dec 14, 2020 9:37:32 AM .:: 🕷 :: X (1 5) (2 1 7 Dec 14, 2020 9:44:02 AM .:: 🗑 🗆 🗙 OBW 6dB BLE 1M MidCH20-2442 IC OBW 99% BLE 1M MidCH20-2442 KEYSIGHT Input RF KEYSIGHT Input RF 1 Graph 1 Graph Scale/Div 10 0 dB Scale/Div 10.0 dB Auto Man Freq Offset 0 Hz Occupied Bandwidth 1.0858 MHz Occupied Bandwidth 1.0628 MHz Transmit Freq Error x dB Bandwidth Transmit Freq Error 79.709 kHz x dB Bandwidth 722.9 kHz % of OBW Power x dB % of OBW Power x dB 1 9 C 14, 2020 ■ ? Dec 14, 2020 ● 9.53.00 AM .:: 🕷 -- 💢 OBW 6dB\_BLE\_1M\_HighCH39-2480 IC OBW 99%\_BLE\_1M\_HighCH39-2480 Frequency + KEYSIGHT Input RF Trig. Free Run Gata: Off #F Gain: Low KEYSIGHT Input RF Input Z 50 Q Corrections: Off Freg Ret. Int (S) Atten 20 dB 1 Graph Scale/Div 10.0 dB 5.0000 MHz 1 Graph Scale/Div 10.0 dB Ref Lvi Offset 10.80 dB Ref Value 20.00 dBm Ref Lvi Offset 10.80 dB Ref Value 20.00 dBm

2.0000 MHz CF Step 500.000 kHz CF Step 200.000 kHz Auto Man Auto Man Freq Offset 0 Hz Freq Offset 0 Hz Center 2.480000 GHz #Res BW 100.00 kHz Center 2.480000 GHz #Res BW 20.000 kHz #Video BW 62,000 kHz Sweep 15.1 ms (1001 pts) Sweep 1.00 ms (1001 pts) Occupied Bandwidth 1.0625 MHz Occupied Bandwidth 1.0844 MHz Total Power 4.64 dBm Total Power 4.84 dBm % of OBW Power % of OBW Power Transmit Freq Error Transmit Freq Error ■ ? Dec 14, 2020 ● .:: 🔻 - X 1 5 C 1 ? Dec 14, 2020 9 .:: 🙀 -- X

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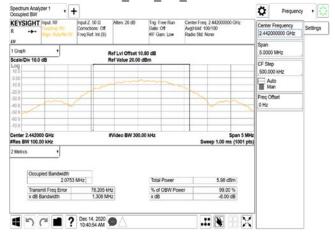
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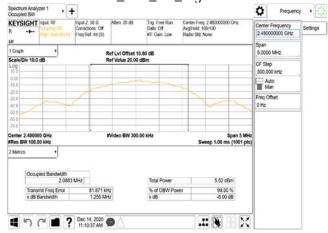
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#### OBW 6dB BLE 2M LowCH00-2402 Frequency • ٥ Input Z 50 D Alten 20 dB Corrections: Off Freq Ref. Int (S) KEYSIGHT Input RF Span 5.0000 MHz Ref Lvi Offset 10.80 dB Ref Value 20.00 dBm Scale/Div 10.0 dB CF Step 500,000 kHz Auto Man Freq Offset 0 Hz Occupied Band width 2.0724 MHz % of OBW Power x dP Transmit Freq Error x dB Bandwidth 99.00 % -6.00 dB ■ ? Dec 14, 2020 ● .: N - X

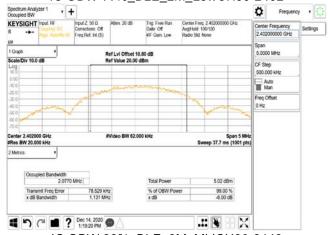
#### OBW 6dB BLE 2M MidCH20-2442



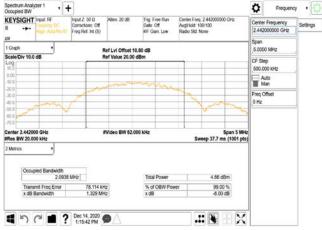
## OBW 6dB\_BLE\_2M\_HighCH39-2480



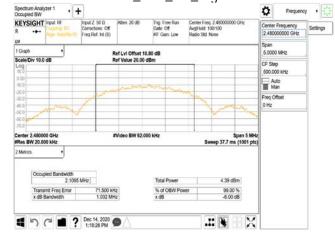
#### IC OBW 99% BLE 2M LowCH00-2402



IC OBW 99% BLE 2M MidCH20-2442



IC OBW 99%\_BLE\_2M\_HighCH39-2480



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## CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

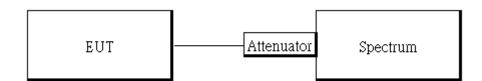
## 9.1 Standard Applicable

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.

#### **Measurement Equipment Used:**

Conducted Emission Test Site						
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071570	06/25/2020	06/24/2021	
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021	
DC Block	PASTERNACK	PE8210	RF152	11/19/2020	11/18/2021	
Temperature Chamber	TERCHY	MHK-120LK	1020582	07/08/2020	07/07/2021	

#### Test SET-UP:



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#### 9.4 Measurement Procedure

#### 9.4.1 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.

#### 9.4.2 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 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.

#### 9.4.3 **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.

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#### 9.5 Measurement Result

Mode: BLE (1M)

#### Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)			
2402	-1.81	-21.81			
2442	-1.96	-21.96			
2480	-3.11	-23.11			

NOTE: cable loss as 10.8dB that offsets in the spectrum

NOTE: Refer to next page for plots.

Mode: BLE (2M)

#### **Reference Level of Limit**

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	-3.24	-23.24
2442	-3.01	-23.01
2480	-3.14	-23.14

NOTE: cable loss as dB that offsets in the spectrum

NOTE: Refer to next page for plots.

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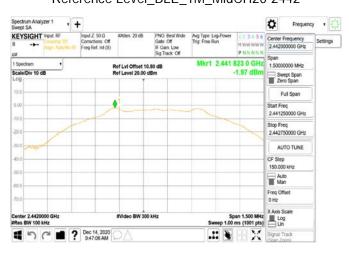


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## Reference Level BLE 1M LowCH00-2402

# Input Z 50 Ω Corrections: Off Freq Ref. Int (S) KEYSIGHT Input RF 1.50000000 MHz Scale/Div 10 dB -1.81 d Swept Span Zero Span Full Span 2.401250000 GHz 2.402750000 GHz AUTO TUNE Man Auto Freq Offset Span 1.500 MHz Sweep 1.00 ms (1001 pts) X Axis Scale Log Log Lin Signal Track Scan Zoom ■ ? Dec 14, 2020 9:38:07 AM

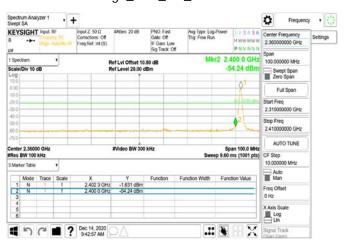
# Reference Level BLE 1M MidCH20-2442



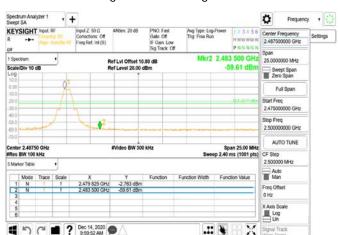
# Reference Level\_BLE\_1M\_HighCH39-2480



#### Band Edge BLE 1M LowCH00-2402



## Band Edge\_BLE\_1M\_HighCH39-2480



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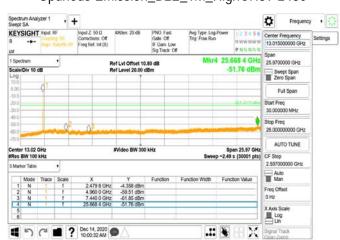
# Spurious Emission\_BLE\_1M\_LowCH00-2402

# | Specific Manager | Specific Ma

Spurious Emission\_BLE\_1M\_MidCH20-2442



Spurious Emission\_BLE\_1M\_HighCH39-2480



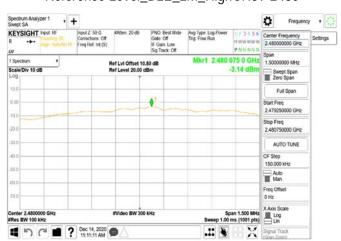
#### Reference Level BLE 2M LowCH00-2402



Reference Level BLE 2M MidCH20-2442



Reference Level\_BLE\_2M\_HighCH39-2480



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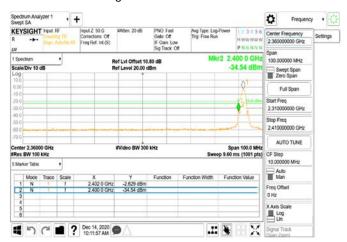
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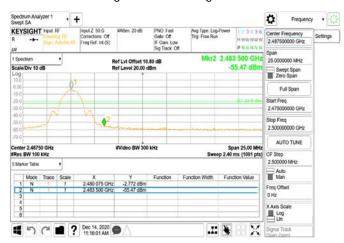


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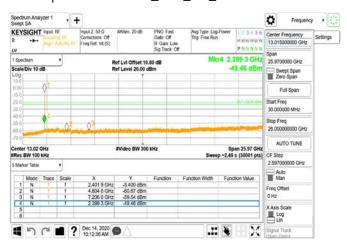
# Band Edge\_BLE\_2M\_LowCH00-2402



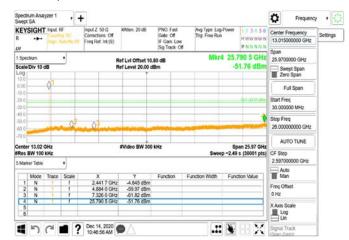
## Band Edge\_BLE\_2M\_HighCH39-2480



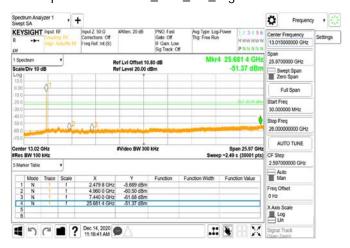
#### Spurious Emission BLE 2M LowCH00-2402



Spurious Emission\_BLE\_2M\_MidCH20-2442



## Spurious Emission\_BLE\_2M\_HighCH39-2480



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#### 10 RADIATED BANDEDGE 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 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:

- 1. The lower limit shall apply at the transition frequencies.
- 2. Emission level (dB $\mu$ V/m) = 20 log Emission level ( $\mu$ V/m)

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# 10.2 Measurement Equipment Used

966 Chamber						
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
Broadband Antenna	TESEQ	CBL 6112D	35240	09/08/2020	09/07/2021	
Horn Antenna	Schwarzbeck	BBHA9170	184	12/25/2019	12/24/2020	
Horn Antenna	Schwarzbeck	BBHA9120D	1187	01/10/2020	01/09/2021	
Loop Antenna	ETS.LINDGREN	6502	143303	04/28/2020	04/27/2021	
EMI Test Receiver	R&S	ESU 40	100363	04/29/2020	04/28/2021	
Pre-Amplifier	EMC Instruments	EMC330	980096	11/19/2020	11/18/2021	
Pre-Amplifier	EMC Instruments	EMC0011830	980199	11/19/2020	11/18/2021	
Pre-Amplifier	EMC Instruments	EMC184045B	980135	10/27/2020	10/26/2021	
Attenuator	Marvelous	WATT-218FS-10	RF20	11/19/2020	11/18/2021	
Band Rejection Filter	Micro-Tronics	BRM50701-01	RF201	11/19/2020	11/18/2021	
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	11/19/2020	11/18/2021	
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/19/2020	11/18/2021	

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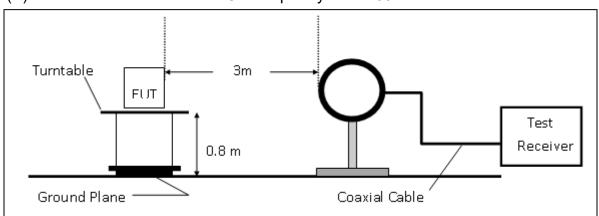
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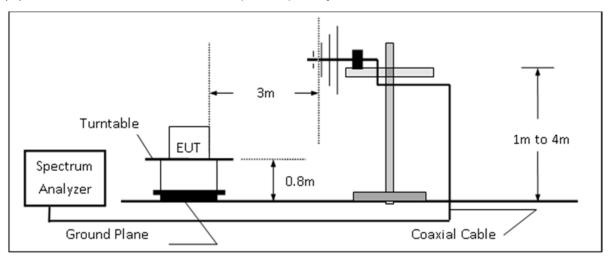
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#### 10.3 Test SET-UP

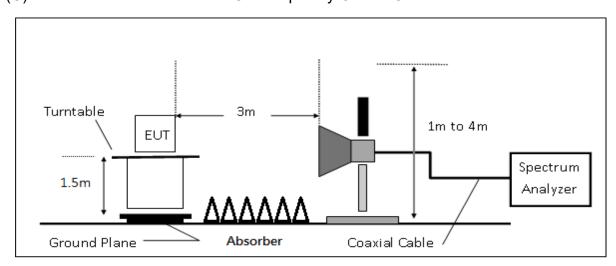
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



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



## (C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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#### 10.4 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 plan.
- 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=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
- 6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
- 7. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
- 8. 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.
- 9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 10. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
- 11. Repeat above procedures until all default test channel measured were complete.

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#### **Field Strength Calculation** 10.5

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 $(dB\mu V) + Factor(dB)$ 

 $Factor(dB) = Antenna\ Factor(dB\mu V/m) + Cable\ Loss(dB) - Pre\ Amplifier\ Gain(dB)$ 

# 10.6 Test Results of Radiated Spurious Emissions form 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.

#### 10.7 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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#### 10.7.1 Radiated Band Edge Measurement Result

Mode: BLE (1M)

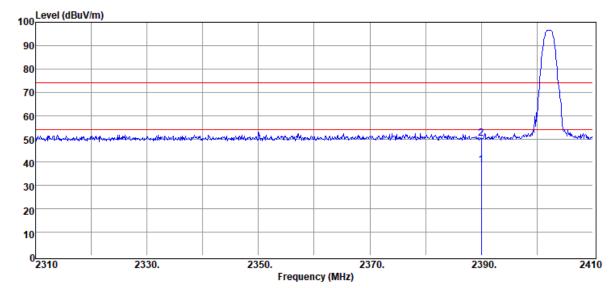
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

Test Frequency :2402 MHz Temp./Humi. :21.1/75

Test Mode :BE CH Low Antenna Pol. :VERTICAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
2390.00	Average	34.86	3.76	38.62	54.00	-15.38
2390.00	Peak	46.38	3.76	50.14	74.00	-23.86

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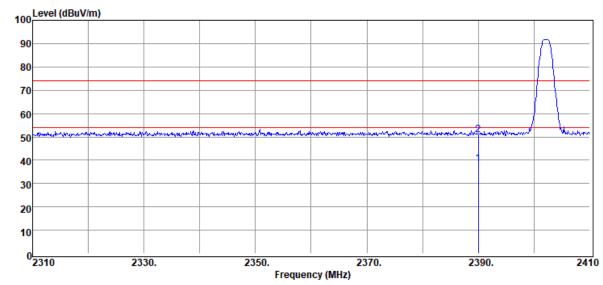
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

**Test Frequency** :2402 MHz Temp./Humi. :21.1/75

**Test Mode** :BE CH Low Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	34.71	3.76	38.47	54.00	-15.53
2390.00	Peak	47.13	3.76	50.89	74.00	-23.11

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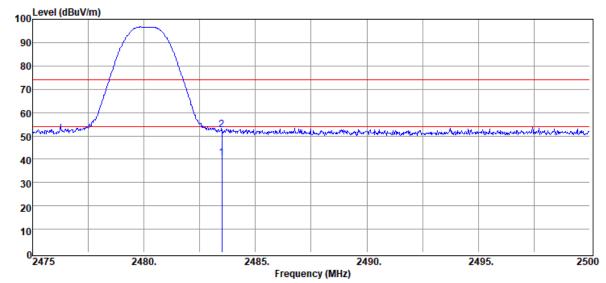
Report Number Test Site :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

Test Frequency :2480 MHz Temp./Humi. :21.1/75

Test Mode :BE CH High Antenna Pol. :VERTICAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
2483.50	Average	36.18	4.42	40.60	54.00	-13.40
2483.50	Peak	48.09	4.42	52.51	74.00	-21.49

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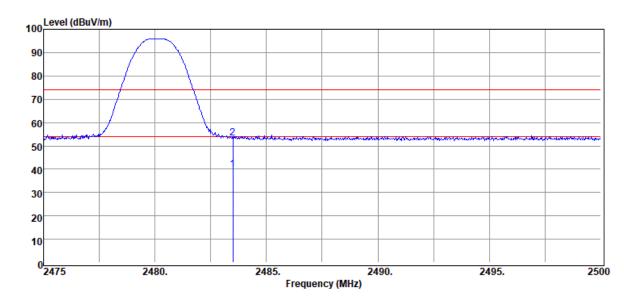
Report Number :E2/2020/A0018 **Test Site** :966 Chamber C

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

**Test Frequency** :2480 MHz Temp./Humi. :21.1/75

**Test Mode** :BE CH High Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
2483.50	Average	35.40	4.42	39.82	54.00	-14.18
2483.50	Peak	48.75	4.42	53.17	74.00	-20.83

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Mode: BLE (2M)

Report Number **Test Site** :966 Chamber C :E2/2020/A0018

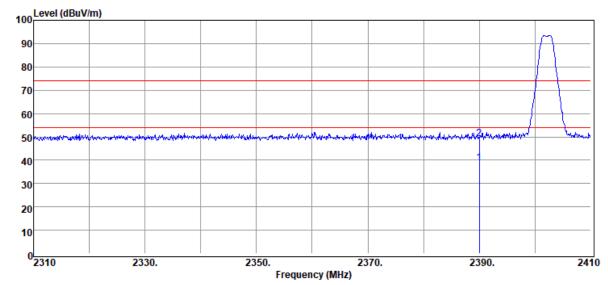
**Operation Mode Test Date** :BLE 2M :2020-12-08

**Test Frequency** :2402 MHz Temp./Humi. :20.8/74

Test Mode :BE CH Low Antenna Pol. :VERTICAL

**EUT Pol** :H Plan :Ashton Chiu Engineer

setting



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμ̈V	dB	dBµV/m	dBµV/m	dB
2390.00	Average	34.88	3.76	38.64	54.00	-15.36
2390.00	Peak	45.34	3.76	49.10	74.00	-24.90

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Report Number **Test Site** :966 Chamber C :E2/2020/A0018

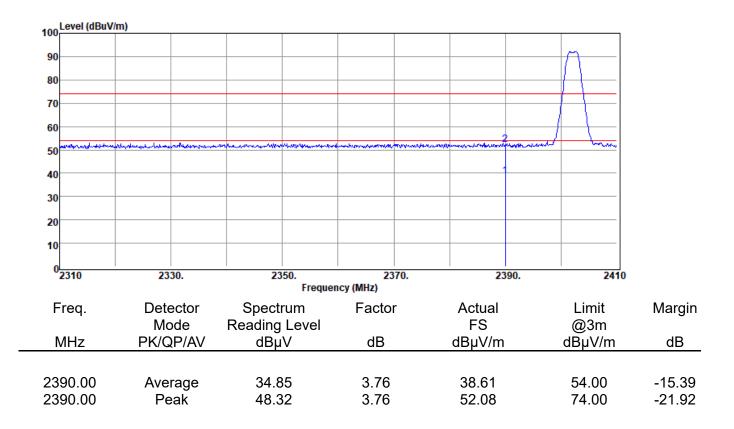
**Operation Mode** :BLE 2M **Test Date** :2020-12-08

**Test Frequency** :2402 MHz Temp./Humi. :20.8/74

Test Mode :BE CH Low Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu

setting



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Report Number Test Site :966 Chamber C :E2/2020/A0018

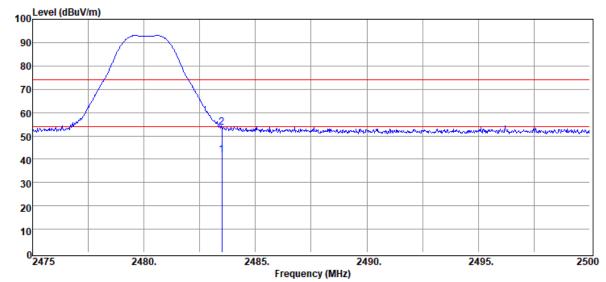
**Operation Mode** :BLE 2M **Test Date** :2020-12-08

**Test Frequency** :2480 MHz Temp./Humi. :20.8/74

Test Mode :BE CH High Antenna Pol. :VERTICAL

**EUT Pol** :H Plan Engineer :Ashton Chiu

setting



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dΒμV/m	dB
2483.50	Average	37.58	4.42	42.00	54.00	-12.00
2483.50	Peak	49.31	4.42	53.73	74.00	-20.27

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Report Number :E2/2020/A0018 **Test Site** :966 Chamber C

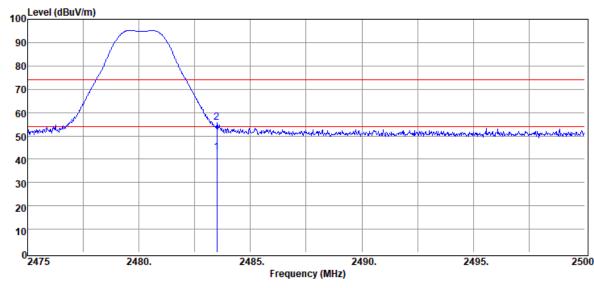
**Operation Mode** :BLE 2M **Test Date** :2020-12-08

**Test Frequency** :2480 MHz Temp./Humi. :20.8/74

Test Mode :BE CH High Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu

setting



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level	ID.	FS.	@3m	15
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2483.50	Average	38.57	4.42	42.99	54.00	-11.01
2483.50	Peak	51.23	4.42	55.65	74.00	-18.35

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#### 10.7.2 Radiated Spurious Emission from 30MHz to 1000MHz (Worst Case)

Mode: BLE (1M)

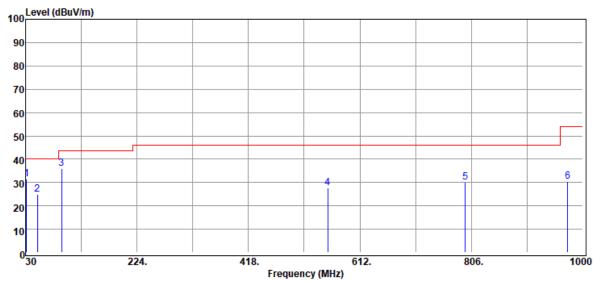
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

Test Frequency :2442 MHz Temp./Humi. :22.8/62

Test Mode :TX CH MID Antenna Pol. :VERTICAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dΒμV/m	dB
						_
31.94	Peak	35.71	-4.14	31.57	40.00	-8.43
50.37	Peak	41.42	-16.51	24.91	40.00	-15.09
93.05	Peak	53.36	-17.20	36.16	43.50	-7.34
555.74	Peak	31.42	-3.63	27.79	46.00	-18.21
795.33	Peak	30.17	-0.18	29.99	46.00	-16.01
973.81	Peak	29.42	1.06	30.48	54.00	-23.52

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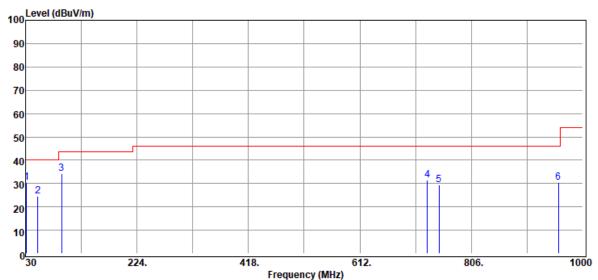
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

**Test Frequency** :2442 MHz Temp./Humi. :22.8/62

Test Mode :TX CH MID Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



		•				
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
31.94	Peak	34.76	-4.14	30.62	40.00	-9.38
51.34	Peak	41.98	-17.33	24.65	40.00	-15.35
93.05	Peak	51.41	-17.20	34.21	43.50	-9.29
729.37	Peak	34.05	-2.47	31.58	46.00	-14.42
749.74	Peak	31.36	-2.09	29.27	46.00	-16.73
957.32	Peak	29.22	1.08	30.30	46.00	-15.70

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Mode: BLE (2M)

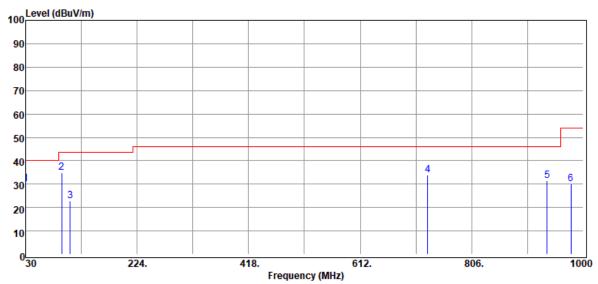
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode Test Date** :BLE 2M :2020-12-08

**Test Frequency** :2442 MHz Temp./Humi. :22.8/62

Test Mode :TX CH MID Antenna Pol. :VERTICAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
30.00	Peak	33.21	-3.13	30.08	40.00	-9.92
93.05	Peak	52.16	-17.20	34.96	43.50	-8.54
107.60	Peak	37.60	-14.72	22.88	43.50	-20.62
729.37	Peak	36.37	-2.47	33.90	46.00	-12.10
936.95	Peak	30.34	1.09	31.43	46.00	-14.57
978.66	Peak	28.83	1.30	30.13	54.00	-23.87

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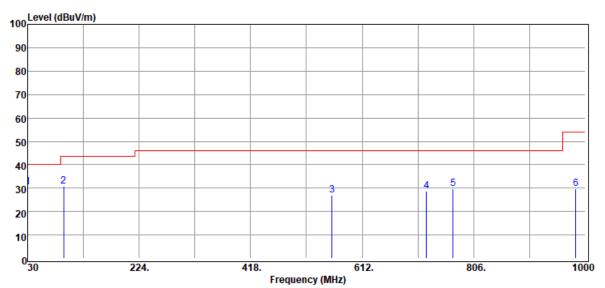
Report Number :E2/2020/A0018 **Test Site** :966 Chamber C

**Operation Mode** :BLE 2M **Test Date** :2020-12-08

**Test Frequency** :2442 MHz Temp./Humi. :22.8/62

**Test Mode** :TX CH MID Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
30.00	Peak	33.59	-3.13	30.46	40.00	-9.54
93.05	Peak	47.86	-17.20	30.66	43.50	-12.84
559.62	Peak	30.82	-3.68	27.14	46.00	-18.86
723.55	Peak	31.19	-2.61	28.58	46.00	-17.42
770.11	Peak	30.62	-0.86	29.76	46.00	-16.24
983.51	Peak	28.35	1.30	29.65	54.00	-24.35

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#### Radiated Spurious Emission above 1GHz 10.7.3

Mode: BLE (1M)

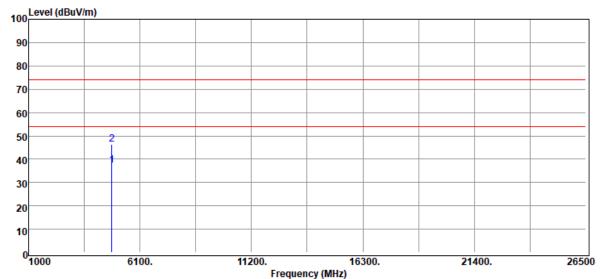
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

Test Frequency :2402 MHz Temp./Humi. :21.8/74

Test Mode :TX CH LOW Antenna Pol. :VERTICAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,							
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin		
MHz	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB		
4804.00 4804.00	Average Peak	23.15 32.16	14.07 14.07	37.22 46.23	54.00 74.00	-16.78 -27.77		

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4804.00

Peak

Report No.: E2/2020/A0018

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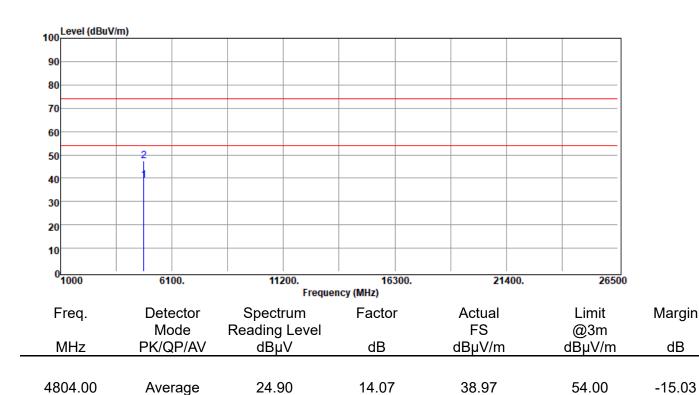
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

**Test Frequency** :2402 MHz Temp./Humi. :21.8/74

Test Mode :TX CH LOW Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



14.07

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47.40

74.00

-26.60



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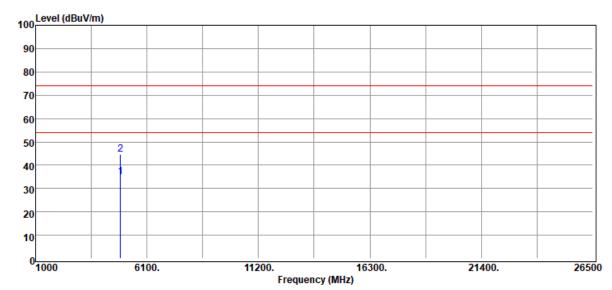
Report Number Test Site :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

**Test Frequency** :2442 MHz Temp./Humi. :21.8/71

Test Mode :TX CH MID Antenna Pol. :VERTICAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
4884.00	Average	20.67	14.21	34.88	54.00	-19.12
4884.00	Peak	30.45	14.21	44.66	74.00	-29.34

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4884.00

Report No.: E2/2020/A0018

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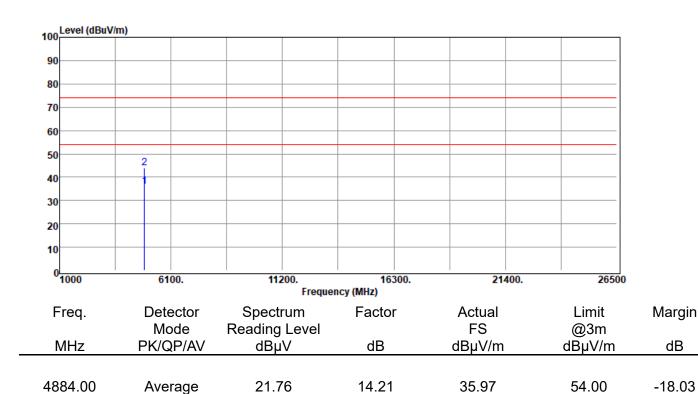
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

**Test Frequency** :2442 MHz Temp./Humi. :21.8/71

Test Mode :TX CH MID Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



14.21

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43.97

Peak

74.00

-30.03



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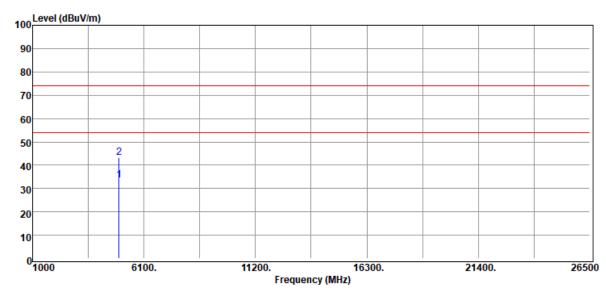
Report Number Test Site :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

Test Frequency :2480 MHz Temp./Humi. :21.8/71

Test Mode :TX CH HIGH Antenna Pol. :VERTICAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dΒμV/m	dB
4960.00	Average	19.42	14.13	33.55	54.00	-20.45
4960.00	Peak	29.21	14.13	43.34	74.00	-30.66

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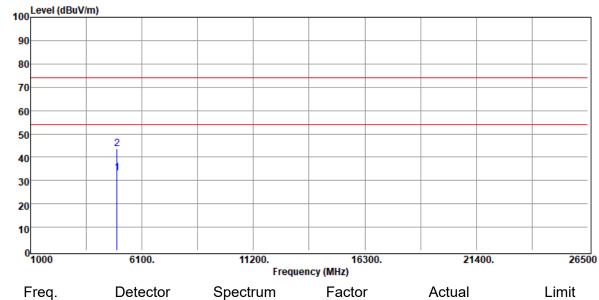
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 1M **Test Date** :2020-12-08

**Test Frequency** :2480 MHz Temp./Humi. :21.8/71

**Test Mode** :TX CH HIGH Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dΒμV/m	dB
4960.00	Average	19.19	14.13	33.32	54.00	-20.68
4960.00	Peak	29.62	14.13	43.75	74.00	-30.25

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Mode: BLE (2M)

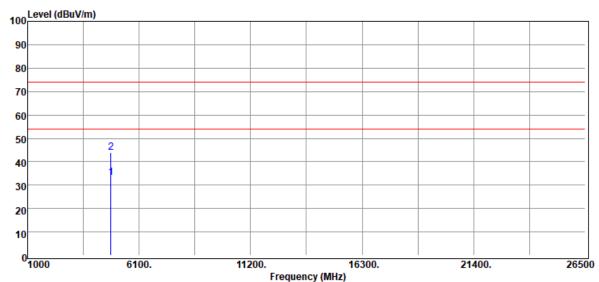
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode Test Date** :BLE 2M :2020-12-08

**Test Frequency** :2402 MHz Temp./Humi. :21.8/64

Test Mode :TX CH LOW Antenna Pol. :VERTICAL

**EUT Pol** :H Plan :Ashton Chiu Engineer



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
 MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
4804.00	Average	19.14	14.07	33.21	54.00	-20.79
4804.00	Peak	29.93	14.07	44.00	74.00	-30.00

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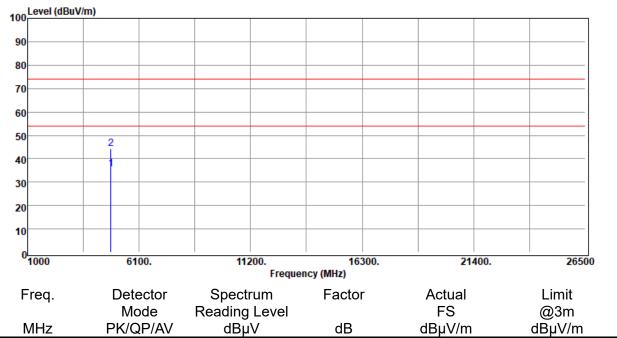
Report Number :E2/2020/A0018 **Test Site** :966 Chamber C

**Operation Mode** :BLE 2M **Test Date** :2020-12-08

**Test Frequency** :2402 MHz Temp./Humi. :21.8/64

**Test Mode** :TX CH LOW Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
4804.00	Average	21.54	14.07	35.61	54.00	-18.39
4804.00	Peak	30.31	14.07	44.38	74.00	-29.62

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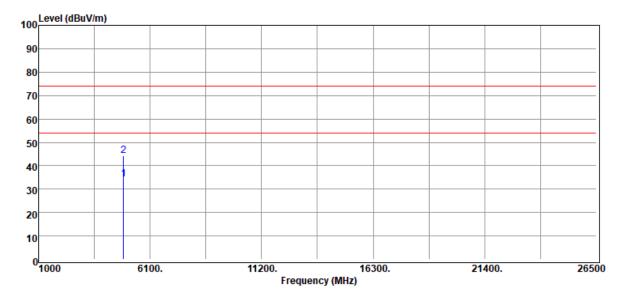
Report Number Test Site :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 2M **Test Date** :2020-12-08

**Test Frequency** :2442 MHz Temp./Humi. :21.8/64

Test Mode :TX CH MID Antenna Pol. :VERTICAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
4884.00	Average	19.97	14.21	34.18	54.00	-19.82
4884.00	Peak	30.10	14.21	44.31	74.00	-29.69

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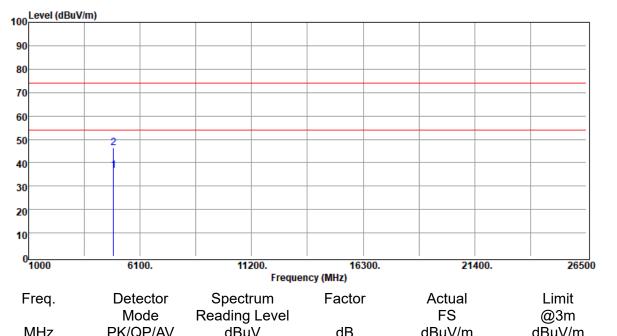
Report Number :E2/2020/A0018 **Test Site** :966 Chamber C

**Operation Mode** :BLE 2M **Test Date** :2020-12-08

**Test Frequency** :2442 MHz Temp./Humi. :21.8/64

**Test Mode** :TX CH MID Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
4884.00	Average	22.54	14.21	36.75	54.00	-17.25
4884.00	Peak	32.18	14.21	46.39	74.00	-27.61

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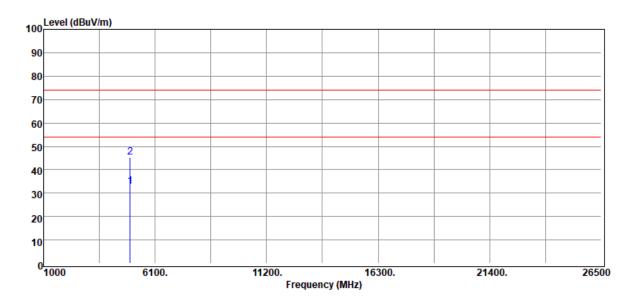
Report Number Test Site :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 2M **Test Date** :2020-12-08

**Test Frequency** :2480 MHz Temp./Humi. :21.8/64

Test Mode :TX CH HIGH Antenna Pol. :VERTICAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4960.00	Average	18.64	14.13	32.77	54.00	-21.23
4960.00	Peak	31.12	14.13	45.25	74.00	-28.75

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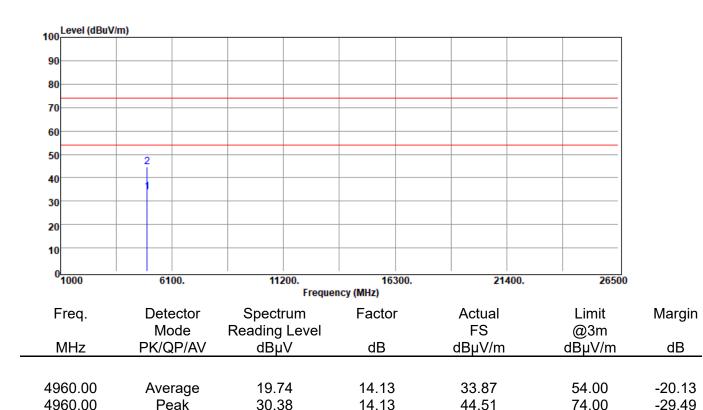
Report Number **Test Site** :966 Chamber C :E2/2020/A0018

**Operation Mode** :BLE 2M **Test Date** :2020-12-08

**Test Frequency** :2480 MHz Temp./Humi. :21.8/64

Test Mode :TX CH HIGH Antenna Pol. :HORIZONTAL

**EUT Pol** :H Plan Engineer :Ashton Chiu



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### 11 POWER SPECTRAL DENSITY

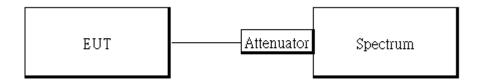
# 11.1 Standard Applicable:

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.

### 11.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.
TYPE		NUMBER	NUMBER	CAL.	
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071570	06/25/2020	06/24/2021
Attenuator	Marvelous	MVE2213-10	RF09	11/19/2020	11/18/2021
DC Block	PASTERNACK	PE8210	RF152	11/19/2020	11/18/2021
Temperature Chamber	TERCHY	MHK-120LK	1020582	07/08/2020	07/07/2021

### 11.3 Test Set-up:



### 11.4 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.

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#### 11.5 Measurement Result:

Mode: BLE (1M)

Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
2402	-13.97	8	PASS
2442	-13.66	8	PASS
2480	-14.58	8	PASS

NOTE: cable loss as 10.8dB that offsets in the spectrum

Mode: BLE (2M)

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

BEE Ziii iiiodo						
	Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result		
	2402	-15.66	8	PASS		
	2442	-16.09	8	PASS		
	2480	-17.82	8	PASS		

NOTE: cable loss as 10.8dB that offsets in the spectrum

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Swept Span Zero Span

Full Span

2.401250000 GH

2.402750000 GH

Man Man

Freq Offset 0 Hz

AUTO TUNE

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### Power Density BLE 1M LowCH00-2402

# Power Density BLE 2M LowCH00-2402



Span 1.500 MHz
Sweep 158 ms (1001 pts)

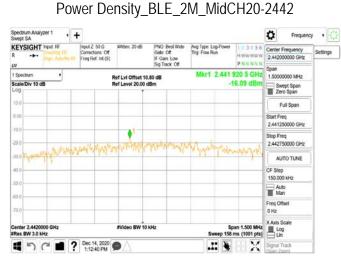
Lin
Signal Track
Span Zoom #Res BW 3.0 kHz 1 5 C 1 ? Dec 14, 2020 0

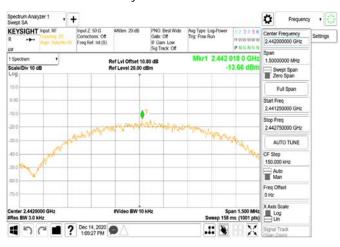
put Z 50 Ω prections: Off eq Ref. Int (S)

KEYSIGHT Input RF

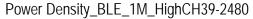
Scale/Div 10 dB

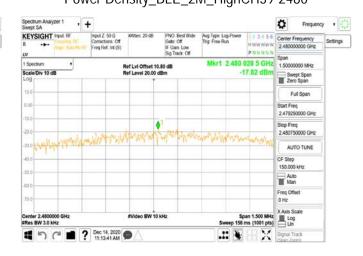
Power Density\_BLE\_1M\_MidCH20-2442

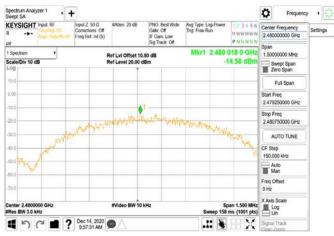




Power Density\_BLE\_2M\_HighCH39-2480







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# 12 ANTENNA REQUIREMENT

# 12.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

#### 12.2 Antenna Connected Construction:

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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