

# **ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT**

Applicant:	LUMENUS LLC 800 Wilshire Blvd #200 Los Angeles, CA 90017
Product Name:	ioLight
Brand Name:	Lumenus
Model No.:	ioLight-1.0
Model Difference:	N/A
Report Number:	E2/2019/B0067
FCC ID:	2AVGQ-IOLIGHT1
FCC Rule Part:	§15.247, Cat: DTS
Issue Date:	Feb. 18, 2020
Date of Test:	Nov. 29, 2019 ~Jan. 30, 2020
Date of EUT Received:	Nov. 29, 2019

#### We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory 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: \_CHUN; CHIZEH, CHIEN

Chun Chieh Chen / Supervisor



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Revision History						
Report Number	Report Number     Revision     Description     Issue Date     Remark					
E2/2019/B0067	Rev.00	Original.	Feb. 18, 2020	Revised By: Karen Huang		

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#### **GENERAL INFORMATION** 1

### **1.1 Product Description**

Product Name:	ioLight		
Brand Name:	Lumenus		
Model No.:	ioLight-1.0		
Model Difference:	N/A		
Product HW Version:	N/A		
Product SW Version:	N/A		
Micro-USB Cable:	Model No.: 1Q1221191-SL, Supplier: SUNCA Co., Ltd.		
	3.7Vdc from Rechargeable Li-polymer Battery or 5 Vdc from Micro-USB Cable		
Power Supply:	Model No.: lipo 3.7V 2200mah 653585,Battery:Supplier: Shen Zhen Chuangxinjia Smart Technology Co., Ltd		

Radio Technology:	Bluetooth LE Single mode
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	-5.59 dBm

### 1.2 Antenna Designation

Antenna	Freq.	Peak Antenna
Type	(MHz)	Gain (dBi)
Meandered Inverted-F Antenna	2.4GHz	1.6

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### 1.3 Test Methodology of Applied Standards

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

### 1.4 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory (TAF code 0513) No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333

FCC Designation number: TW0002

### 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.

### 1.7 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.

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# 2 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.

## 2.4 Measurement Results Explanation Example

### 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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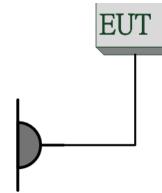
# 2.5 Configuration of Tested System Fig. 2-1 Conducted (Antenna Port) Emission Configuration



### Fig 2-2 Radiated Emission



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



ltem	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1	BLE Test Software	N/A	N/A	N/A	N/A	N/A
2	Notebook	Lenovo	T470	P0001293	N/A	N/A
3	Adapter	HSHONGAHAING	MUC-5K	AC-USB012	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)	6dB Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.205 §15.209 §15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	Peak Power Density	Compliant
§15.203 §15.247(b)	Antenna Requirement	Compliant

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

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

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.

AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (Mbps)			
RADIATED EMISSION TEST (BELOW 1 GHz)						
2402 to 2480	2442	GFSK	1			
RADIATED EMISSION TEST (ABOVE 1 GHz)						
2402 to 2480	2402, 2442, 2480	GFSK	1			
	FREQUENCY (MHz) RADIA 2402 to 2480 RADIA	FREQUENCY (MHz) TESTED FREQUENCY (MHz)   RADIATED EMISSION TEST (   2402 to 2480 2442   RADIATED EMISSION TEST (	FREQUENCY (MHz)TESTED FREQUENCY (MHz)MODULATIONRADIATED EMISSION TEST (BELOW 1 GHz)2402 to 24802442GFSKRADIATED EMISSION TEST (ABOVE 1 GHz)			

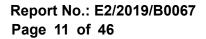
**Note:** The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth LE Transmitter for channel Low, Mid and High, the worst case E2 position was reported.

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		

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#### MEASUREMENT UNCERTAINTY 5

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							
	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. Horizontai	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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# 6 CONDUCTED EMISSION TEST

### 6.1 Standard Applicable:

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

	Limits									
Frequency range	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									

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.

### 6.2 Measurement Equipment Used:

	Conducted Emission Test Site										
EQUIPMENT	MENT MFR MODEL SERIAL LAST										
TYPE		NUMBER	NUMBER	CAL.							
LISN	TESEQ	NNB 51	36076	02/13/2019	02/12/2020						
EMI Test Receiver	R&S	ESCI	101300	11/14/2019	11/13/2020						

### 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.

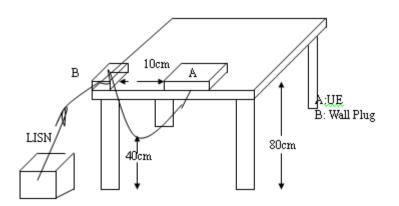
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## 6.4 Test SET-UP (Block Diagram of Configuration)



### 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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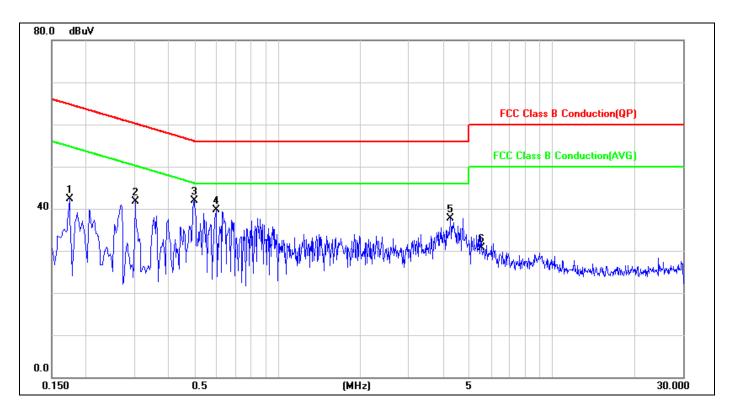
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### AC POWER LINE CONDUCTED EMISSION TEST DATA

Description:	Operation	Date:	2020/01/17
Line:	L1	Temp.(°C)/Hum.(%):	20.1 (°C)/62%
Test Voltage:	AC 120V/60Hz	Test By:	Ashton
Report:	E2/2019/B0067	-	



		Freq.	Reading	Factor	Measure-	Limit	Over		
No.	Mk.				ment			Detector	Comment
		(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)		
1		0.1740	22.84	19.51	42.35	64.77	-22.42	peak	
2		0.3020	22.07	19.63	41.70	60.19	-18.49	peak	
3	*	0.4980	22.06	19.76	41.82	56.03	-14.21	peak	
4		0.5980	19.85	19.76	39.61	56.00	-16.39	peak	
5		4.2580	17.83	19.92	37.75	56.00	-18.25	peak	
6		5.5580	10.81	19.92	30.73	60.00	-29.27	peak	

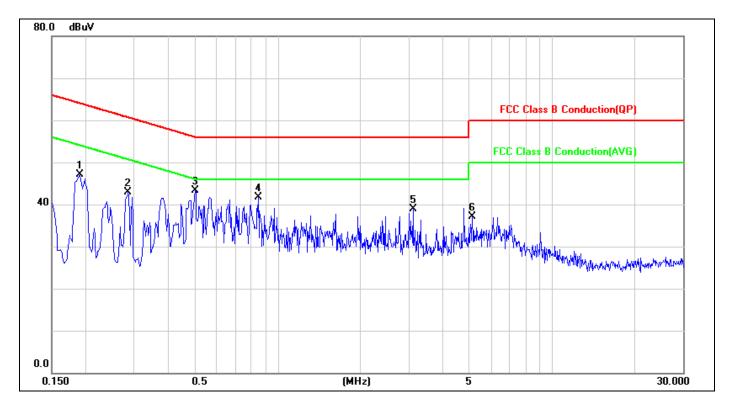
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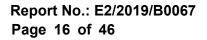
Description:	Operation	Date:	2020/01/17
Line:	Ν	Temp.(°C)/Hum.(%):	20.1 (°C)/62%
Test Voltage:	AC 120V/60Hz	Test By:	Ashton
Report:	E2/2019/B0067		



		Freq.	Reading	Factor	Measure-	Limit	Over	_	
No.	Mk.	(MHz)	(dBuV)	(dB)	ment (dBuV)	(dBuV)	(dB)	Detector	Comment
		1 /							
1		0.1900	27.41	19.76	47.17	64.04	-16.87	peak	
2		0.2860	23.14	19.84	42.98	60.64	-17.66	peak	
3	*	0.5020	23.39	19.97	43.36	56.00	-12.64	peak	
4		0.8500	21.72	19.98	41.70	56.00	-14.30	peak	
5		3.1180	18.74	20.17	38.91	56.00	-17.09	peak	
6		5.1380	16.92	20.14	37.06	60.00	-22.94	peak	

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# 7 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.

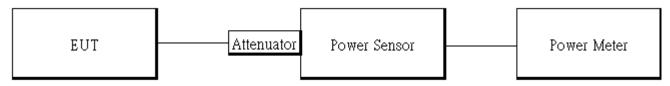
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

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.

### 7.2 Measurement Equipment Used:

Conducted Emission Test Site										
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.					
Power Meter	Anritsu	ML2496A	1326001	08/05/2019	08/04/2020					
Power Sensor	Anritsu	MA2411B	1315048	08/05/2019	08/04/2020					
Power Sensor	Anritsu	MA2411B	1315049	08/05/2019	08/04/2020					
Attenuator	Marvelous	MVE2213-10	RF80	11/20/2019	11/19/2020					

### 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:

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log ( 1/Duty Cycle )	1/T (kHz)	VBW setting (kHz)	
BLE	61.60	2.10	2.60	3.00	

### Duty Cycle\_BLE\_1M\_MidCH20-2442

		Spect		Analyzer - S																			
	R	Erc	RF	50 2.442	Ω		<u><u></u><u></u></u>				SEN	SE:INT		A	g Typ	IN AUTO		05:22:0		Dec 09,		-	Frequency
	nter	FIE	، p	2.4420	000	000	PN	IZ NO: Fas Sain:Lo	st ↔ ow		: Free en: 30	e Run 0 dB		~	9119	 9.0			DET	E WWW P N N	NNN	Γ	Auto Tune
	dB/div			f Offset f 20.00													ΔΙ	Mkr3	6: -0	25.0 ).05	μs dB	L	
Log 10. 0.0			Ŷ	∆ <u>2</u> 3∆4	4																1		Center Fred 2.442000000 GHz
-20.1 -30.1 -40.1	0					in the			17m		ava			Wester		elyger. <sup>g</sup>							Start Fred 2.442000000 GH2
-50.1 -60.1 -70.1	0		яr —	чид. 		vyn yd			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		- All-Sold		4					ALANA .	r.		4~*!		<b>Stop Fred</b> 2.442000000 GH2
Re	nter s BW	81	мн	_	Gł	lz ×		#	VBW	8.0 N	ИНz		FUN	CTION	FU	<u> </u>		00 ms	s (1	oan 0 001	pts)	Αι	CF Step 8.000000 MH: <u>Ito</u> Mar
1 2 3 4 5 6	∆4 F	1111	t t t	(Δ) (Δ)			50. 62	5.0 µs .00 µs 5.0 µs .00 µs	s (Δ)	-5.	0.27 52 dE 0.05 52 dE	3m dB				 							Freq Offse 0 Hz
7 8 9 10 11																							
MSG																STAT	rus						

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### 7.6 Output Power:

#### 7.6.1 Peak & Avg

СН	Frequency (MHz)	Peak Power Output (dBm)	Required Limit
Low	2402	-5.93	1 Watt = 30 dBm
Mid	2442	-5.99	1 Watt = 30 dBm
High	2480	-5.59	1 Watt = 30 dBm
СН	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit
Low	2402	-6.25	1 Watt = 30 dBm
Mid	2442	-6.31	1 Watt = 30 dBm
High	2480	-5.77	1 Watt = 30 dBm

\*Note: Measured by power meter, cable loss as 1 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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# 8 6DB BANDWIDTH MEASUREMENT

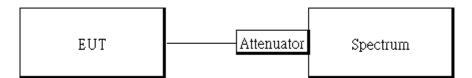
### 8.1 Standard Applicable

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.							
			_									
Power Meter	Anritsu	ML2496A	1326001	08/05/2019	08/04/2020							
Power Sensor	Anritsu	MA2411B	1315048	08/05/2019	08/04/2020							
Power Sensor	Anritsu	MA2411B	1315049	08/05/2019	08/04/2020							
Attenuator	Marvelous	MVE2213-10	RF80	11/20/2019	11/19/2020							
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/06/2019	03/05/2020							
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020							

### 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. For 6dB Bandwidth:

Set the spectrum analyzer as RBW=100 kHz, VBW= 3\*RBW, Span = 5MHz, Detector=Peak, Sweep=auto.

- 5. Mark the peak frequency and –6dB (upper and lower) frequency.
- 6. For 99% Bandwidth:

Set the spectrum analyzer as RBW=1%, VBW=3\*RBW, Span = 2MHz, Detector=Sample, Sweep=auto.

- 7. Turn on the 99% bandwidth function, max reading.
- 8. Repeat above procedures until all test default channel is completed

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#### 8.5 **Measurement Result:**

6dB

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result	
2402	0.7133	> 0.5	PASS	
2442	0.705	> 0.5	PASS	
2480	0.7042	> 0.5	PASS	

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#### OBW 6dB\_BLE\_1M\_LowCH00-2402

🚺 Keysight Spec	trum Analyzer - Occupied Bi	v				- 6 -
Center Fr	eq 2.402000000	GHz Cente	SENSE:INT r Freq: 2.402000000 GHz	Radio	8:32 PM Dec 10, 2019 Std: None	Frequency
		Trig: I	FreeRun Avg Hold 1: 30 dB	i: 100/100 Radio	Device: BTS	
		in Galicon				
10 dB/div	Ref Offset 1 dB Ref 20.00 dBn	n				
Log 10.0						
0.00						Center Freq 2.402000000 GHz
-10.0						2.40200000 GH2
-20.0						
-30.0						
-40.0						
-50.0				-		
-60.0						
-70.0					_	
Center 2.4	102 CH2				Span 5 MHz	<u> </u>
#Res BW		#	VBW 300 kHz		Sweep 1 ms	CF Step 500.000 kHz
Occup	ied Bandwidt	'n	Total Power	0.25 dBn	<u>ו</u>	<u>Auto</u> Man
occup		 1126 MHz				
						Freq Offset 0 Hz
Transm	nit Freq Error	-19.797 kHz	OBW Power	99.00 %	6	0 H2
x dB Ba	andwidth	713.3 kHz	x dB	-6.00 dE	3	
MSG				STATUS		

#### OBW 6dB BLE 1M MidCH20-2442

equency										ectrum Analyzer	Keysight Sp					
	Fi	55 PMDec 10, 2019 Std: None		ALIGN AUTO	000 GHz	SE:INT eq: 2.442000	Center Fr	Hz	2000000 G		Renter F					
	s	Device: BTS	Radio De	100/100	Trig: Free Run Avg Hold: 100/100 #Atten: 30 dB			-+	#IFGain:Low							
									fset 1 dB 0.00 dBm		) dB/div					
enter Fro											0.0					
2000000 Gi		_								_	.00					
						$\sim$	$\sim$	++			0.0					
							r	+ /			0.0					
											0.0					
	~~~~										0.0					
											0.0					
											2.0					
CF Ste 500.000 ki		weep 1 ms			łz	W 300 ki	#VE									
Ma	Auto		) dBm	0.40	wer	Total Po			ndwidth	pied Ba	Occu					
Freq Offs							Ηz	111 MI	1.1							
01			9.00 %	99	wer	OBW Po	kHz	-12.140	Error	mit Freq	Trans					
			00 dB	-6.		x dB	kHz	705.0	h	Bandwidt	x dB B					
	ms Auto		Sw 0 dBm 9.00 %	99	#VBW 300 kHz Total Power OBW Power			zenter 2.442 GHz Res BW 100 kHz Occupied Bandwidth 1.1111 MHz Transmit Freq Error -12.140 kHz x dB Bandwidth 705.0 kHz								

#### OBW 6dB BLE 1M HighCH39-2480

Keysight Spectrum Analyzer - Oco				• • • • •
R № 50 Ω Center Freq 2.48000	00000 GHz Ce	SENSE:INT Inter Freq: 2.480000000 GHz Ig: Free Run Avg Hold tten: 30 dB	ALIGN AUTO 06:55:49 PM Dec 10, 20 Radio Std: None I: 100/100 Radio Device: BTS	Frequency
Ref Offset 0 dB/div Ref 20.0				
0 9 10.0				Center Fre 2.48000000 GH
0.0				
40.0				-
0.0				
enter 2.48 GHz Res BW 100 kHz		#VBW 300 kHz	Span 5 Mi Sweep 1 n	ns 500.000 kH
Occupied Band		Total Power	1.14 dBm	Auto Ma
	1.1093 MHz			Freq Offse
Transmit Freq Err	or -29.809 kHz	OBW Power	99.00 %	он
x dB Bandwidth	704.2 kHz	x dB	-6.00 dB	
30			STATUS	

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# 9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

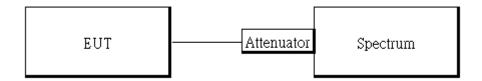
### 9.1 Standard Applicable

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

	Conducted Emission Test Site										
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.						
Power Meter	Anritsu	ML2496A	1326001	08/05/2019	08/04/2020						
Power Sensor	Anritsu	MA2411B	1315048	08/05/2019	08/04/2020						
Power Sensor	Anritsu	MA2411B	1315049	08/05/2019	08/04/2020						
Attenuator	Marvelous	MVE2213-10	RF80	11/20/2019	11/19/2020						
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/06/2019	03/05/2020						
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020						

### 9.2 Measurement Equipment Used:

### 9.3 Test SET-UP:



### 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.

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- 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. Mark the highest reading of the emission as the reference level measurement.
- **7.** Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 kHz immediately outside the authorized (2400~2483.5MHz) be attenuated by 20dB at least relative to the maximum emission of power.
- 8. Repeat above procedures until all default test channel (low, middle, 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

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

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	-7.14	-27.14
2442	-6.98	-26.98
2480	-6.21	-26.21

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

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Frequency

Auto Tu

**Center Fre** 

Start Fre

2.310000000 G Stop Fre 10000000 G

CF Step 10.000000 MH

Freq Offset 0 H

Freque

Auto Tu

Center Fre

Start Fre 50000

Stop Fre 2.50000000 G

CF Step 2.500000 MHz

Freq Offse 0 H2

M

NNNN

1

-27.14 2

MDec 10, 2019 ≈ 1 2 3 4 5 6

DET P NNNN Mkr3 2.483 600 GHz -48.49 dBm

Span 25.00 MH

Sweep 2.400 ms (1001 pts)

Mkr3 2.390 0 GHz -56.99 dBm

Span 100.0 MHz Sweep 9.600 ms (1001 pts)

Band Edge\_BLE\_1M\_LowCH00-2402

2.399 9 GHz 2.390 0 GHz

hter Freq 2.487500000 GHz PNO: Fast ↔ #ff:faiht.ow #Atten: 30 dB

¢3

2.479 975 GHz 2.483 500 GHz 2.483 600 GHz

#VBW 300 kHz

-5.91 dB 48.09 dB 48.49 dB

Ref Offset 1 dB Ref 20.00 dBm

Center 2.48750 GHz

Res BW 100 kHz

1 N 2 N 3 N

#VBW 300 kHz

-42.76 dBn -56.99 dBn

Band Edge\_BLE\_1M\_HighCH39-2480

ALIGN AUTO Avg Type: Log-Pwr

Ref Offset 1 dB Ref 20.00 dB

enter 2.36000 GHz

Res BW 100 kH

SI MATRI N 1 N 1 f 2 N 1 f 3 N 1 f



#### Reference Level BLE 1M LowCH00-2402

	um Analyzer - Swept SA							
R enter Fre	q 2.4020000		SENSE:INT	Avg Typ	e: Log-Pwr	TRACI	E 1 2 3 4 5 6	Frequency
dB/div	Ref Offset 1 dB Ref 20.00 dBn	IFGain:Low	#Atten: 30 dB		Mkr1 2	.401 973	3 0 GHz 14 dBm	Auto Tur
0.0								Center Fr 2.402000000 G
00			•	-				Start Fr 2.401250000 G
1.0								Stop Fr 2.402750000 G
							~	CF St 150.000 k Auto M
								Freq Offs 0
enter 2.40	20000 GHz					Span 1.	.500 MHz	
Res BW 10	00 kHz	#VE	W 300 kHz		Sweep 1	.000 ms (		

#### Reference Level\_BLE\_1M\_MidCH20-2442

	ectrum Analyzer - Swept									
Center F	req 2.442000	0000 GH	Z O: Wide -+		Run		LIGN AUTO	TRAC	M Dec 10, 2019 E 1 2 3 4 5 6 P NNNNN	Frequency
10 dB/div	Ref Offset 1 dB Ref 20.00 dE	IFG	ain:Low	#Atten: 3	0 dB		Mkr1 2	2.441 97	6 0 GHz 98 dBm	Auto Tune
10.0										Center Fred 2.442000000 GH:
-10.0			~	•		-				Start Free 2.441250000 GH
-20.0										Stop Fre 2.442750000 GH
-40.0									~	CF Ste 150.000 kH Auto Ma
-60.0										Freq Offse 0 H
	4420000 GHz								.500 MHz	
#Res BW	100 KHŻ		#VBW	300 kHz			Sweep /	-	1001 pts)	

#### Reference Level BLE 1M HighCH39-2480

Keysight Sp R	ectrum Analyzer - Swept SA					
	req 2.48000000	0 GHz PNO: Wide	SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr	06:56:24 PM Dec 10, 2019 TRACE 1 2 3 4 5 6 TYPE MWWWW	Frequency
0 dB/div	Ref Offset 1 dB Ref 20.00 dBm	PNO: Wide IFGain:Low	#Atten: 30 dB	Mkr1	2.479 961 0 GHz -6.21 dBm	Auto Tu
10.0						Center Fr 2.480000000 G
0.0			•1			Start Fr 2.479250000 G
0.0						Stop Fr 2.480750000 G
0.0						CF St 150.000 M
						Freq Off
0.0						
	4800000 GHz 100 kHz	#VBW	300 kHz	Sweep	Span 1.500 MHz 1.000 ms (1001 pts)	
sa				STAT	JS	

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#### Spurious Emission\_BLE\_1M\_LowCH00-2402

🊺 Keysight Sp	ectrum Analyzer - Sv							- ¢ 💌
Center F	req 13.015	000000 GHz	SENSI	A	Lign Auto	TRAC	MDec 10, 2019 2 1 2 3 4 5 6 2 M	Frequency
10 dB/div	Ref Offset 1 Ref 20.00	IFGain:Low			 Mk	r4 2.39	3 GHz 28 dBm	Auto Tune
10.0 0.00	1							Center Free 13.015000000 GH
-20.0	4						-27.14 dBn	Start Fre 30.000000 MH
-50.0 -60.0 -70.0	-	2						Stop Fre 26.00000000 GH
Center 13 #Res BW	100 kHz	#V	BW 300 kHz	FUNCTION	Sweep 2	2.482 s (3	5.97 GHz 0001 pts)	CF Ste 2.597000000 GH Auto Ma
1 N 2 N 3 N 4 N 5 6 7		2.401 9 GHz 4.804 0 GHz 7.206 0 GHz 2.399 3 GHz	-8,98 dBr -58,62 dBn -58,66 dBn -47,28 dBn	n n				Freq Offse 0 H
7 8 9 10 11								
ISG					STATUS			

#### Spurious Emission\_BLE\_1M\_MidCH20-2442

Keysight Spi	ectrum Analyzer - Sw							- 6 ×
Center F	req 13.0150	000000 GHz	SENSE		ALIGN AUTO	TRAC	E 1 2 3 4 5 6	Frequency
10 dB/div	Ref Offset 1 Ref 20.00		#Atten: 30 c		 Mkr	ہ 4 25.95	5 0 GHz 32 dBm	Auto Tune
10.0 0.00 -10.0	1							Center Fre 13.015000000 GH
-20.0 -30.0 -40.0							-26.98 dBn	Start Fre 30.000000 MH
60.0 60.0 -70.0		× 3		, <b>1</b>	a dia araa			Stop Fre 26.000000000 GH
Center 13 #Res BW	100 kHz	x	BW 300 kHz		Sweep 2	2.482 s (3	5.97 GHz 0001 pts)	CF Ste 2.597000000 GH Auto Ma
1 N 1 2 N 1 3 N 1 4 N 1 5 6	† †	2.441 7 GHz 4.884 0 GHz 7.326 0 GHz 25.955 0 GHz	-7,77 dBn -54.02 dBn -60.06 dBn -49.82 dBn	n n				Freq Offse 0 ⊦
7 8 9 10 11							≣.	
e 📄 👘					STATUS	1	•	

### Spurious Emission\_BLE\_1M\_HighCH39-2480

Keysight Spei R	ctrum Analyzer	r - Swept SA 50 Ω DC		SENS	E:INT		ALIGN AUTO	07:01:54 P	M Dec 10, 2019	
nter Fr		15000000	GHz PNO: Fast			Avg Type	e: Log-Pwr	TRAC	ET P NNNN	Frequency
	Ref Offse	et 1 dB	IFGain:Low	#Atten: 30			Mkr	4 25.98	0 1 GHz	Auto Tu
dB/div	Ref 20.							-49.	61 dBm	
.0	_									Center Fr
	1			++						13.015000000 0
.0	1	_								
0			-						-26.21 dBm	Start F
0										30.000000 M
0		୍ର <sup>2</sup>							4	
0		and a syles	() <sup>1</sup>				A Martine	distributed in		Stop F
0			-							26.000000000
ntor 12	.02 GHz							Enan 2	5.97 GHz	CF S
	100 kHz		#VB	W 300 kHz			Sweep		0001 pts)	2.597000000
MODE TR		×		Y		CTION FUI	NCTION WOTH	FUNCTI	ON VALUE	Auto 1
N 1	1	4.9	79 8 GHz 60 0 GHz	-7.43 dB	m				_	Freq Off
N 1 N 1	1		40 0 GHz 80 1 GHz	-61.09 dBr -49.61 dBr					_	Frequin
									_	
							STATU	s		

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台灣檢驗科技股份有限公司
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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 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:

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

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### **10.2 Measurement Equipment Used**

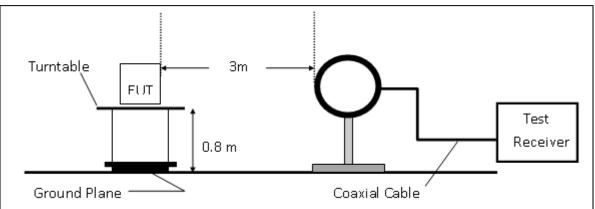
966 Chamber							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
Broadband Antenna	TESEQ	CBL 6112D	35240	09/09/2019	09/08/2020		
Horn Antenna	Schwarzbeck	BBHA9170	184	12/27/2018	12/26/2019		
Horn Antenna	Schwarzbeck	BBHA9120D	1187	01/09/2019	01/08/2020		
Loop Antenna	ETS.LINDGREN	6502	143303	04/25/2019	04/24/2020		
EMI Test Receiver	R&S	ESU 40	100363	04/15/2019	04/14/2020		
Pre-Amplifier	<b>EMC</b> Instruments	EMC330	980096	11/20/2019	11/19/2020		
Pre-Amplifier	EMC Instruments	EMC0011830	980199	11/20/2019	11/19/2020		
Pre-Amplifier	EMC Instruments	EMC184045B	980135	11/20/2019	11/19/2020		
Attenuator	Woken	WATT-218FS-10	RF25	11/20/2019	11/19/2020		
Highpass Filter	Micro Tronics	BRM50701-01	G008	11/20/2019	11/19/2020		
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	11/20/2019	11/19/2020		
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/20/2019	11/19/2020		

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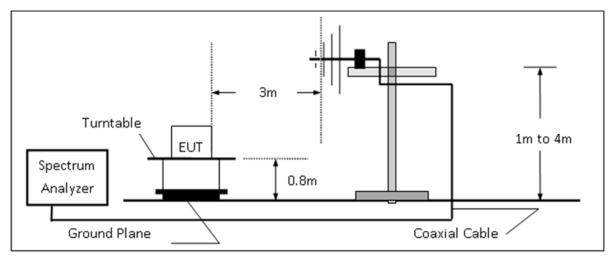
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### 10.3 Test SET-UP

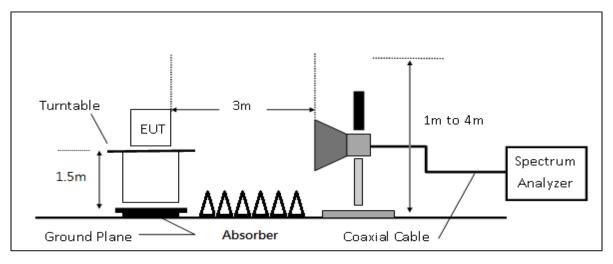




(B) Radiated Emission Test Set-Up, Frequency form 30MHz to 1000MHz



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



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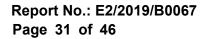
### **10.4 Measurement Procedure**

- 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.
- 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.</li>
- 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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### 10.5 Field Strength Calculation

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

FS = RA + AF + CL - AG

*Where* FS = Field 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( $dB\mu V/m$ ) = 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) was not reported.

### 10.7 Measurement Result:

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

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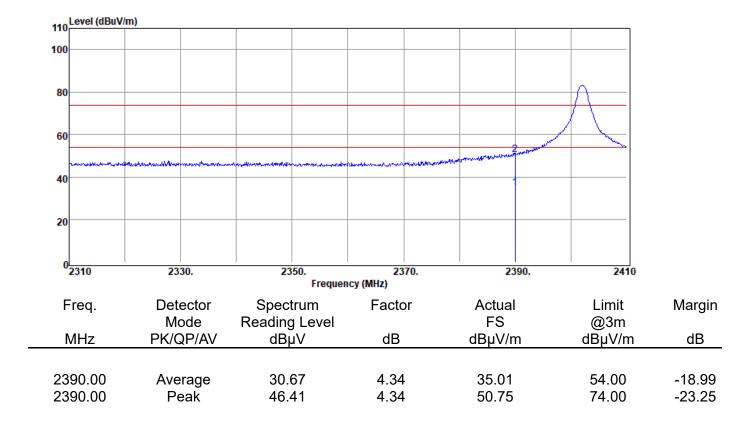
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### 10.7.1 Radiated Band Edge Measurement Result

Report Number	:E2/2019/B0067	Test Date	:2019-12-13
Operation Mode	:BLE 1M	Temp./Humi.	:23.3/56
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:BE CH LOW	Engineer	:Ashton
EUT Pol	:E2 Plan		



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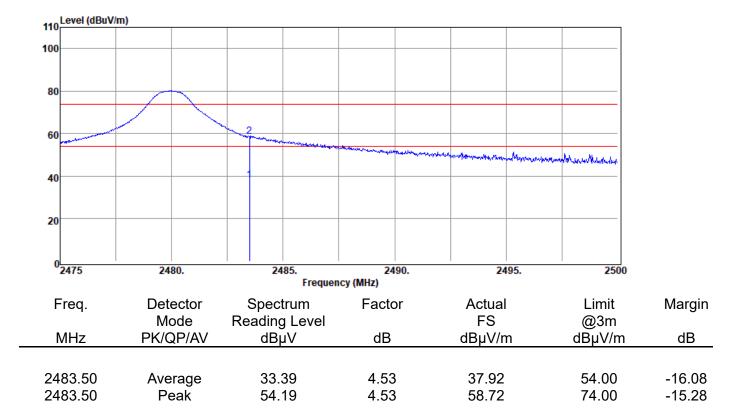


Report Number Operation Mode	:E2/2019/E :BLE 1M	30067		Test Date Temp./Humi.	:2019-12-13 :23.3/56	
Test Channel	:2402 MHz	7		Antenna Pol.	:HORIZONT/	1
Test Mode	:BE CH LC				:Ashton	
		JVV		Engineer	ASITION	
EUT Pol	:E2 Plan					
110	)					
100						
80						
					+	
60				2		
			have and a start of the second	and an and a start of the start		
40	and a second	And the second				
20						
0	2220	2250	2270	2200		
0 2310	2330.	2350. Frequen	2370. Icy (MHz)	2390.	2410	
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2200.00	Average	20.47	4.24	34.51	F4 00	10.40
2390.00 2390.00	Average Peak	30.17 54.45	4.34 4.34	34.51 58.79	54.00 74.00	-19.49 -15.21
2000.00	reak	01.10	1.01	00:10	14.00	10.21

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Report Number	:E2/2019/B0067	Test Date	:2019-12-13
Operation Mode	:BLE 1M	Temp./Humi.	:23.4/56
Test Channel	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:BE CH HIGH	Engineer	:Ashton
EUT Pol	:E2 Plan		



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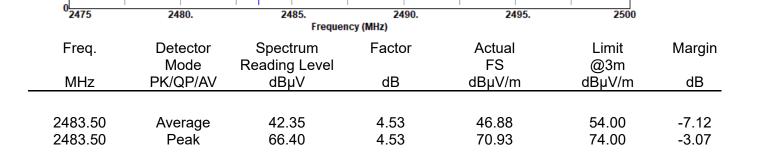


60

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20

Report Number	:E2/2019/B0067	Т	lest Date	:2019-12-13
Operation Mode	:BLE 1M	Т	ſemp./Humi.	:23.4/56
Test Channel	:2480 MHz	A	Antenna Pol.	:HORIZONTAL
Test Mode	:BE CH HIGH	E	Engineer	:Ashton
EUT Pol	:E2 Plan			
110 Level (dBuV/m)				
100				
	$\wedge$			
80				
	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~			



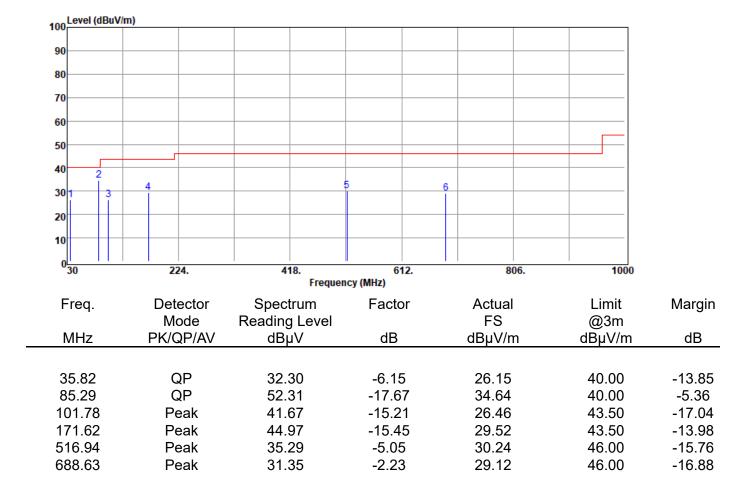
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### 10.7.2 Radiated Spurious Emission from 30MHz to 1000MHz

Report Number	:E2/2019/B0067	Test Date	:2019-12-13
Operation Mode	:BLE 1M	Temp./Humi.	:23.3/55
Test Channel	:2442 MHz	Antenna Pol.	:VERTICAL
Test Mode	:TX CH MID	Engineer	:Ashton
EUT Pol	:E2 Plan		



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1000



30 20 10

0 30

5

224.

Report Number	:E2/2019/B0067			Test Dat	te	:2019-12-	.13	
Operation Mode	:BLE 1M	:BLE 1M			Temp./Humi. :23.3/55		:23.3/55	
Test Channel	:2442 MHz			Antenna	a Pol.	:HORIZO	NTAL	
Test Mode	:TX CH MID				Enginee	er	:Ashton	
EUT Pol	:E2 Plan							
100 Level (dBuV/m)								
90								
80								

Frequency (MHz) Freq. Detector Spectrum Factor Actual Limit Margin FS Mode Reading Level @3m PK/QP/AV MHz dBµV dB dBµV/m dBµV/m dB 74.62 Peak 53.20 -18.26 34.94 40.00 -5.06 85.29 QP 54.10 -17.67 36.43 40.00 -3.57 171.62 QP 52.39 -15.45 36.94 43.50 -6.56 177.44 53.53 -15.52 -5.49 Peak 38.01 43.50 257.95 Peak 44.73 -10.59 34.14 46.00 -11.86 516.94 33.19 46.00 -12.81 Peak 38.24 -5.05

612.

806.

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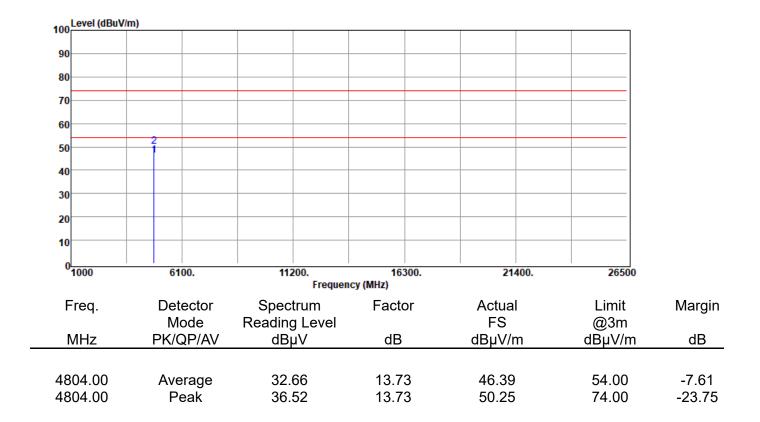
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### 10.7.3 Radiated Spurious Emission above 1GHz

Report Number	:E2/2019/B0067	Test Date	:2019-12-13
Operation Mode	:BLE 1M	Temp./Humi.	:23.4/56
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:TX CH LOW	Engineer	:Ashton
EUT Pol	:E2 Plan		



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Test Date



:E2/2019/B0067

**Report Number** 

	,_0,0,1			leer Bute	.2010 12 10	
Operation Mode	e :BLE 1M			Temp./Humi.	:23.4/56	
Test Channel	:2402 MHz	2		Antenna Pol.	:HORIZONT	AL
Test Mode	:TX CH LC	)W		Engineer	:Ashton	
EUT Pol	:E2 Plan			9		
EUTFO	.EZ FIAII					
100 Level (dBuV/n	n)					
90						
80						
70						
60						
50	1					
40						
30						
20						
10						
0	6100.	11200.	16300.	21400.	26500	
		Frequen				
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
					= 1 00	o 46
4804.00	Average	33.79	13.73	47.52	54.00	-6.48
4804.00	Peak	37.23	13.73	50.96	74.00	-23.04

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Test Date



:E2/2019/B0067

**Report Number** 

t Channel t Mode	:2442 MHz :TX CH MII			Antenna Pol. Engineer	ol. :VERTICAL :Ashton		
T Pol	:E2 Plan						
100 Level (dBuV/m)							
90							
80							
70							
60							
50	2						
40							
30							
20							
10							
0 <mark></mark> 1000	6100.	11200. Freque	16300. ncy (MHz)	21400.	26500		
Freq.	Detector	Spectrum	Factor	Actual	Limit		

Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
Average	28.23	13.75	41.98	54.00	-12.02
Peak	33.49	13.75	47.24	74.00	-26.76
	Mode PK/QP/AV Average	Mode Reading Level PK/QP/AV dBµV Average 28.23	ModeReading LevelPK/QP/AVdBµVAverage28.2313.75	ModeReading LevelFSPK/QP/AVdBµVdBdBµV/mAverage28.2313.7541.98	Mode PK/QP/AVReading Level dBµVFS dB@3m dBµV/mAverage28.2313.7541.9854.00

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Test Date



:E2/2019/B0067

**Report Number** 

4884.00

Operation Mode Test Channel Test Mode EUT Pol	:BLE 1M :2442 MHz :TX CH MI :E2 Plan		Te Ai Ei		:23.4/56 :HORIZONT/ :Ashton	AL
100 Level (dBuV/m)						
90						
80						
70						
60						
50	1					
40						
30						
20						
10						
0	6100.	11200.	16300.	21400.	26500	
1000	0100.		icy (MHz)	21400.	20500	
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4884.00	Average	33.54	13.75	47.29	54.00	-6.71

13.75

51.19

37.44

Peak

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-22.81



Report Number Operation Mode Test Channel Test Mode EUT Pol	:E2/2019/B0067 :BLE 1M :2480 MHz :TX CH HIGH :E2 Plan			Test Da Temp./ Antenn Engine	Humi. a Pol.	:2019-12 :23.4/56 :VERTIC :Ashton	
100 Level (dBuV/m)		 1	1			· · · · · · · · · · · · · · · · · · ·	
90							
80							
70							
60	2						
50	1						

0							
°1000	6100.	11200. Frequenc	16300. cy (MHz)	21400.	26500	0	
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
4960.00 4960.00	Average Peak	34.32 38.72	13.74 13.74	48.06 52.46	54.00 74.00	-5.94 -21.54	

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Test Date



:E2/2019/B0067

**Report Number** 

4960.00

Peak

Operation Test Char Test Mode EUT Pol	nnel	:24 :TX	.E 1M 80 MHz ( CH HIC 2 Plan			Temp./Humi. Antenna Pol. Engineer		:23.4/56 :HORIZC :Ashton	NTAL		
100	(dBuV/m)					1					
90											
80											
70											
60		2									
50		1									
40											
30											
20											
10											
0 <mark>0</mark> 0		61	<b>00.</b>	112	200. Frequei	16: ncy (MHz)	300.	21	<b>400.</b>	2650	0
Freq			ector ode	Spect Reading		Facto	or	Actua FS	I	Limit @3m	Margin
MHz	<u> </u>		QP/AV	dB		dB		dBµV/i	m	dBµV/m	n dB
4960.0	00	Ave	erage	37.3	39	13.7	4	51.13	}	54.00	-2.87

13.74

54.34

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-19.66



# **11 POWER SPECTRAL DENSITY**

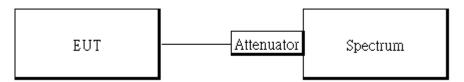
## 11.1 Standard Applicable:

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.						
Power Meter	Anritsu	ML2496A	1326001	08/05/2019	08/04/2020					
Power Sensor	Anritsu	MA2411B	1315048	08/05/2019	08/04/2020					
Power Sensor	Anritsu	MA2411B	1315049	08/05/2019	08/04/2020					
Attenuator	Marvelous	MVE2213-10	RF80	11/20/2019	11/19/2020					
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	03/06/2019	03/05/2020					
DC Block	PASTERNACK	PE8210	RF256	11/20/2019	11/19/2020					

### 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
- For defining Restricted Band Edge Limit: Set the RBW = 100kHz & VBW = 300 kHz.
- 6. Detector = peak.
- 7. Sweep time = auto couple.
- 8. Trace mode = max hold.
- 9. Allow trace to fully stabilize.
- 10. Use the peak marker function to determine the maximum amplitude level.

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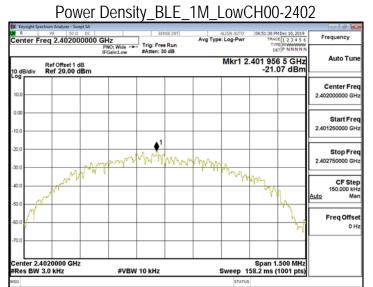
Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only



### **11.5 Measurement Result:**

Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result
2402	-21.07	8	PASS
2442	-20.67	8	PASS
2480	-19.91	8	PASS

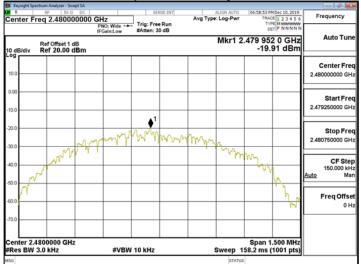
NOTE: cable loss as 1dB that offsets in the spectrum



### Power Density\_BLE\_1M\_MidCH20-2442

Keysight Spectrum Analyzer									
Center Freq 2.442		IZ Ю:Wide ↔		Run		ALIGN AUTO	TRACE	Dec 10, 2019	Frequency
Ref Offse	IFC t1dB	Sain:Low	#Atten: 3			Mkr1 2	.441 965	5 5 GHz 7 dBm	Auto Tune
- <b>og</b> 10.0									Center Fred 2.442000000 GH2
10.00									Start Free 2.441250000 GH:
30.0	- Ary	m	nynh	mm	mm	Maria			Stop Free 2.442750000 GHz
40.0 MM	WAY I I					, . <sub>4</sub> J	W BW	h	CF Step 150.000 kH Auto Mar
60.0								) M	Freq Offse
70.0 Center 2.4420000 0 #Res BW 3.0 kHz	3Hz	#VBW	10 kHz			Sweep 1	Span 1. 58.2 ms (7	500 MHz 1001 pts)	
ISG						STATUS	5		

### Power Density\_BLE\_1M\_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.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

In case of point-to-point operation, the power shall be reduced by the one dB for every 3 dB that the directional gain of antenna exceeds 6dBi.

### 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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