



## MEASUREMENT REPORT

### FCC PART 15.247 (Bluetooth-LE)

**FCC ID** : 2ALJ3AP35X  
**APPLICANT** : HAN Networks Co., Ltd.  
**Application Type** : Certification  
**Product** : HAN Access Point  
**Model No.** : AP351  
**Brand Name** : HANNETWORKS, HAN NETWORKS  
**FCC Classification** : Digital Transmission System (DTS)  
**FCC Rule Part(s)** : Part15 Subpart C (Section 15.247)  
**Test Procedure(s)** : ANSI C63.10-2013  
**Received Date** : March 17, 2021  
**Test Date** : April 15~ June 12, 2021  
**Tested By** : *Fran Chev*  
( Fran Chen )  
**Reviewed By** : *Paddy Chen*  
( Paddy Chen )  
**Approved By** : *Chenz Ker*  
( Chenz Ker )



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Taiwan) Co., Ltd.

### Revision History

Report No.	Version	Description	Issue Date	Note
2107TW0105-U2	1.0	Original Report	2021-08-01	Valid

Note: This is a copy report based on MRT original report (report No.: 2105TW0102-U2). It only changed the information of the applicant and the product. The hardware and software of the product are the same.

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### 1.1. Applicant

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101-A16, 1st Floor, Building 3, No.9 compound, Yongfeng Road, Haidian District, Beijing, P.R. China

<input type="checkbox"/>	<b>Test Site - MRT Suzhou Laboratory</b>
	<b>Laboratory Location (Suzhou - Wuzhong)</b> D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
	<b>Laboratory Location (Suzhou - SIP)</b> 4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China
	<b>Laboratory Accreditations</b>
	A2LA: 3628.01 FCC: CN1166 VCCI: R-20025, G-20034, C-20020, T-20020
	CNAS: L10551 ISED: CN0001
<input type="checkbox"/>	<b>Test Site - MRT Shenzhen Laboratory</b>
	<b>Laboratory Location (Shenzhen)</b> 1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China
	<b>Laboratory Accreditations</b>
	A2LA: 3628.02 FCC: CN1284
	CNAS: L10551 ISED: CN0105
<input checked="" type="checkbox"/>	<b>Test Site - MRT Taiwan Laboratory</b>
	<b>Laboratory Location (Taiwan)</b> No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)
	<b>Laboratory Accreditations</b>
	TAF: L3261-190725 FCC: 291082, TW3261
	CNAS: L3261 ISED: TW3261

## 2. PRODUCT INFORMATION

### 2.1. Equipment Description

Product Name	HAN Access Point
Model No.	AP351
Brand Name	HANNETWORKS, HAN NETWORKS
Operating Temperature	0 ~ 45 °C
Wi-Fi Specification	802.11a/b/g/n/ac/ax
Bluetooth Specification	V 5.1 Single Mode
Accessories	
AC/DC Adapter	Model: ADP-50GR B Input: 100-240V ~ 50/60Hz, 1.3A Output: 48.0V, 1.042A, 50.1W MAX
PoE Injector	Model: POE60U-1BT-X Input: 100-240V ~ 1.5A, 50/60Hz Output: 56.0V, 0.535A, (Pin 3,6+ to pin 1,2 Return); 56V dc, 0.535A(pin 4,5+ to Pin 7,8 Return)

Note: The AC/DC adapter and PoE Injector are not sold with product.

### 2.2. Product Specification Subjective to this Report

Bluetooth Frequency	2402~2480MHz
Channel Number	40
Type of modulation	GFSK
Data Rate	up to 2Mbps
Antenna Type	Dipole Antenna
Antenna Gain	3.5dBi

Note:

1. For other features of this EUT, test report will be issued separately.
2. The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.

### 2.3. Working Frequencies for this Report

Channel	Frequency	Channel	Frequency	Channel	Frequency
00	2402 MHz	01	2404 MHz	02	2406 MHz
03	2408 MHz	04	2410 MHz	05	2412 MHz
06	2414 MHz	07	2416 MHz	08	2418 MHz
09	2420 MHz	10	2422 MHz	11	2424 MHz
12	2426 MHz	13	2428 MHz	14	2430 MHz
15	2432 MHz	16	2434 MHz	17	2436 MHz
18	2438 MHz	19	2440 MHz	20	2442 MHz
21	2444 MHz	22	2446 MHz	23	2448 MHz
24	2450 MHz	25	2452 MHz	26	2454 MHz
27	2456 MHz	28	2458 MHz	29	2460 MHz
30	2462 MHz	31	2464 MHz	32	2466 MHz
33	2468 MHz	34	2470 MHz	35	2472 MHz
36	2474 MHz	37	2476 MHz	38	2478 MHz
39	2480 MHz	--	--	--	--

### 2.4. Description of Available Antennas

Antenna Type	Frequency Band (MHz)	T <sub>x</sub> Paths	Max Antenna Gain (dBi)	Directional Gain (dBi)		Beamforming Directional Gain (dBi)
				For Power	For PSD	
PIFA Antenna	2400 ~ 2483.5	4	3.9	3.9	9.92	9.92
Dipole Antenna	5150 ~ 5350	4	3.8	3.8	9.82	9.82
PIFA & Dipole Antenna	5470 ~ 5850	8	3.9	BW $\geq$ 40M, 3.9 BW=20M, 6.9	12.93	12.93
Scanning						
Dipole Antenna	2400 ~ 2483.5	1	3.5	3.5	3.5	--
Dipole Antenna	5150 ~ 5250 & 5725 ~5850	1	3.9	3.9	3.9	--
Bluetooth						
Dipole	2400 ~ 2483.5	1	3.5	3.5	3.5	--

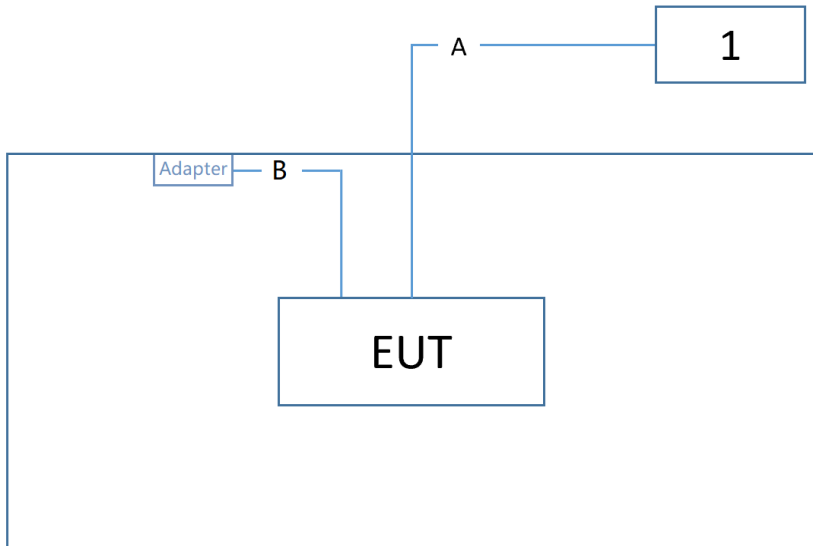
Antenna						
Remark: 1. The EUT supports Cyclic Delay Diversity (CDD) mode and beamforming mode. 2. All antenna information (Antenna type and Peak Gain) is provided by the manufacturer. 3. High gain antenna power setting will be reduced according to difference value of antenna gain declared by applicant.						

## 2.5. Test Mode

Test Mode	Mode 1: Transmit by BLE-1Mbps
	Mode 2: Transmit by BLE-2Mbps

## 2.6. Configuration of Test System

The device was tested per the guidance ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated emissions testing and AC line conducted testing.

Connection Diagram - Radiated Emission testing & AC Conducted Emissions		
		
Cable Type		Cable Description
A	LAN Cable	Non shielded, > 10m
B	Power Cable	Non shielded, 1.25m

## 2.7. Test System Details

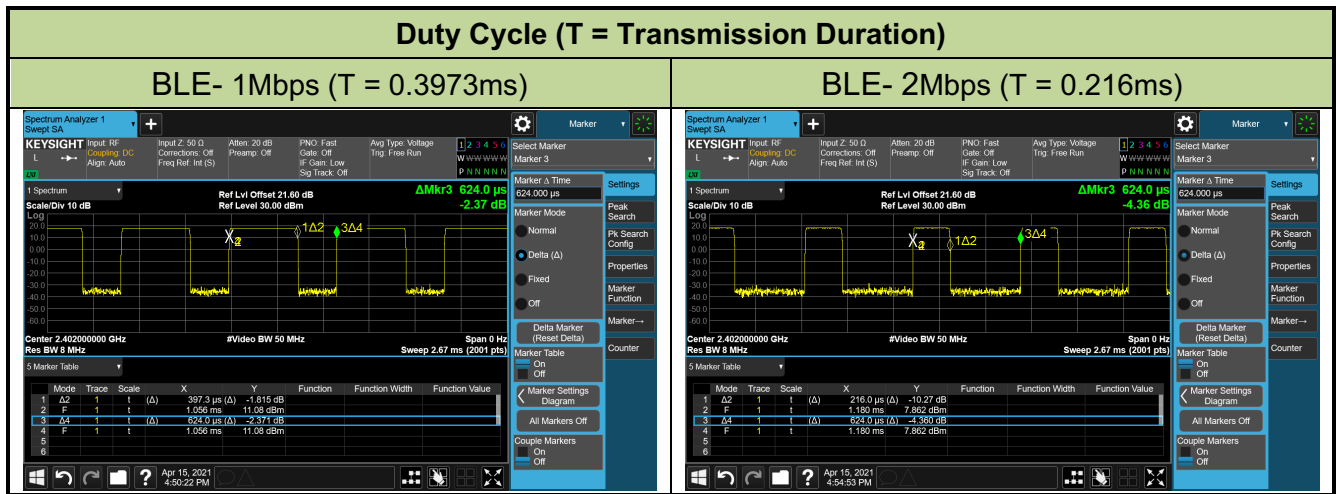
Product		Manufacturer	Model No.
1	Notebook	Dell	P62G



## 2.8. Duty Cycle

The maximum achievable duty cycles were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
BLE- 1Mbps	63.67%
BLE- 2Mbps	34.62%



## 2.9. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

## 2.10. Description of Test Software

The test utility software used during testing was "IPOP", and the version was 4.0.

## 2.11. Test Environment Condition

Ambient Temperature	15°C~35°C
Relative Humidity	20%RH ~75%RH

### 3. ANTENNA REQUIREMENTS

#### **Excerpt from §15.203 of the FCC Rules/Regulations:**

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

- The antenna of the device is **permanently attached**.
- There are no provisions for connection to an external antenna.

#### **Conclusion:**

The unit complies with the requirement of §15.203.

#### 4. TEST EQUIPMENT CALIBRATION DATE

##### Conducted Emissions – SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Two-Line V-Network	R&S	ENV216	MRTTWA00020	1 year	2022/4/28
Cable	Rosnol	N1C50-RG400-B 1C50-500CM	MRTTWE00013	1 year	2022/6/20
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2022/3/24

##### Radiated Emissions – AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Broadband TRILOG Antenna	Schwarzbeck	VULB 9162	MRTTWA00001	1 year	2021/10/5
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2022/3/24
Active Loop Antenna	Schwarzbeck	FMZB 1519B	MRTTWA00002	1 year	2022/5/6
Broadband Horn antenna	Schwarzbeck	BBHA 9120D	MRTTWA00003	1 year	2022/4/21
Breitband Hornantenna	Schwarzbeck	BBHA 9170	MRTTWA00004	1 year	2022/4/28
Broadband Amplifier	Schwarzbeck	BBV 9721	MRTTWA00006	1 year	2022/4/26
Broadband Preamplifier	Schwarzbeck	BBV 9718	MRTTWA00005	1 year	2022/4/21
Cable	HUBERSUHNER	SF106	MRTTWE00010	1 year	2022/6/15
Cable	Rosnol	K1K50-UP0264- K1K50-4M	MRTTWE00012	1 year	2022/6/20

##### Conducted Test Equipment – SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2021/10/14
EXA Signal Analyzer	KEYSIGHT	N9010B	MRTTWA00074	1 year	2021/7/14
USB Wideband Power Sensor	KEYSIGHT	U2021XA	MRTTWA00015	1 year	2022/3/24

##### Test Software

Software	Version	Function
e3	9.160520a	EMI Test Software
EMI	V3	EMI Test Software

## 5. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k = 2$ .

<b>Conducted Emission- Power Line</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): 0.15MHz~30MHz: $\pm 2.53\text{dB}$
<b>Radiated Spurious Emission</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): 9kHz~30MHz: $\pm 3.92\text{dB}$ 30MHz~1GHz: $\pm 4.25\text{dB}$ 1GHz~18GHz: $\pm 4.40\text{dB}$ 18GHz~40GHz: $\pm 4.45\text{dB}$
<b>Frequency Error</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): $\pm 78.4\text{Hz}$
<b>Conducted Power</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): $\pm 0.84\text{dB}$
<b>Conducted Spurious Emission</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): $\pm 2.65\text{ dB}$
<b>Occupied Bandwidth</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): 3.3%
<b>Temp. / Humidity</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): $\pm 0.82^{\circ}\text{C} / \pm 3\%$
<b>DC Voltage</b>
Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ ): $\pm 0.3\%$

## 6. TEST RESULT

### 6.1. Summary

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	6dB Bandwidth	$\geq 500\text{kHz}$	Conducted	Pass	Section 6.2
N/A	99% Bandwidth	N/A		N/A	
15.247(b)(3)	Output Power	$\leq 1\text{Watt}$		Pass	Section 6.3
15.247(e)	Power Spectral Density	$\leq 8\text{dBm} / 3\text{kHz}$		Pass	Section 6.4
15.247(d)	Band Edge / Out-of-Band Emissions	$\geq 20\text{dBc (Peak)}$		Pass	Section 6.5
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	Radiated	Pass	Section 6.6 Section 6.7
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits >	Line Conducted	Pass	Section 6.8

#### Notes:

- 1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 2) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.

## 6.2. 6dB Bandwidth Measurement

### 6.2.1. Test Limit

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

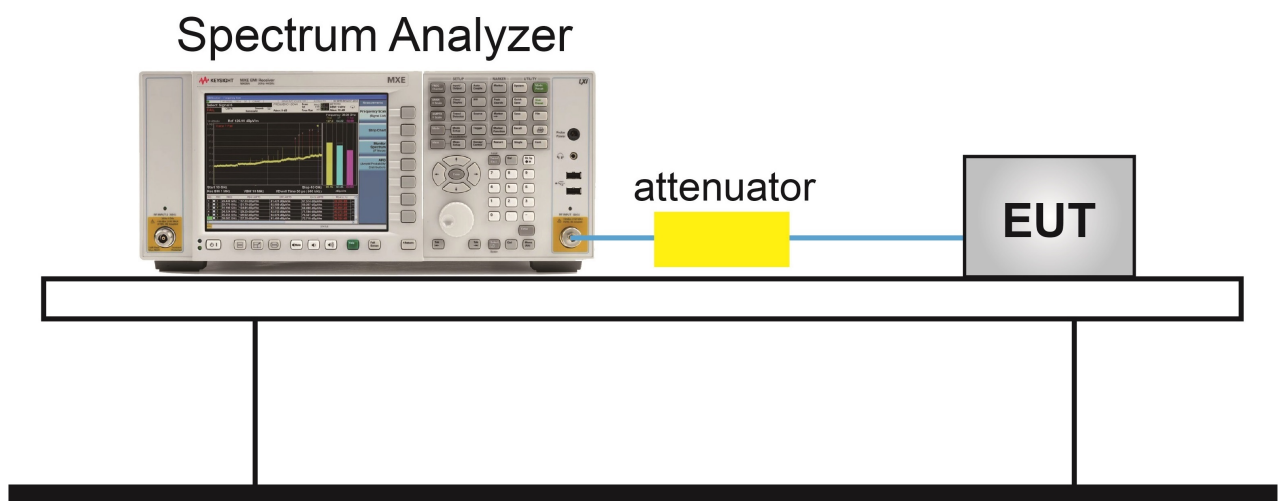
### 6.2.2. Test Procedure used

ANSI C63.10-2013 - Section 11.8

### 6.2.3. Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to  $X = 6$ . The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3.  $VBW \geq 3 \times RBW$
4. Detector = Peak
5. Trace mode = Max hold
6. Sweep = Auto couple
7. Allow the trace was allowed to stabilize

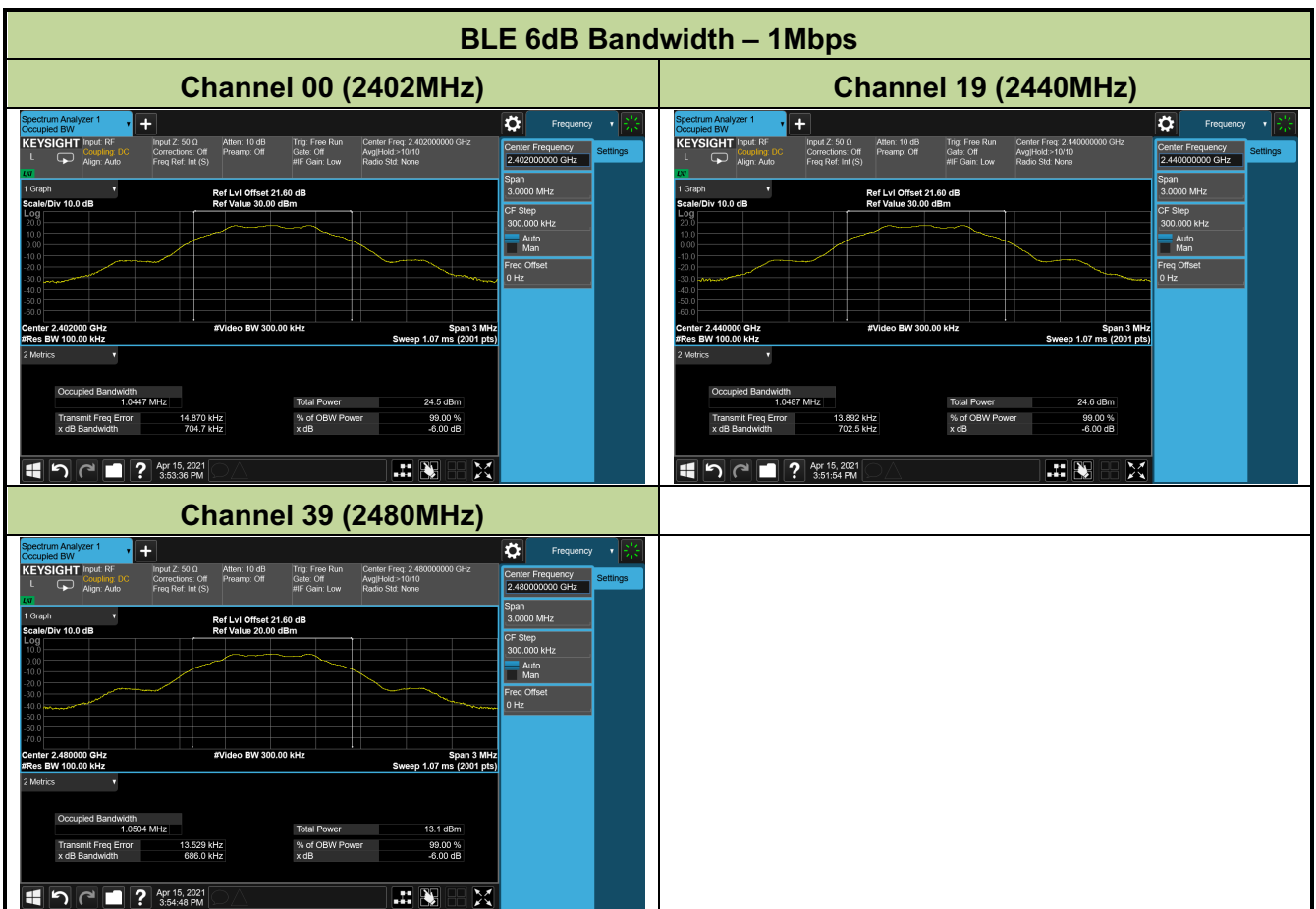
### 6.2.4. Test Setup



### 6.2.5. Test Result

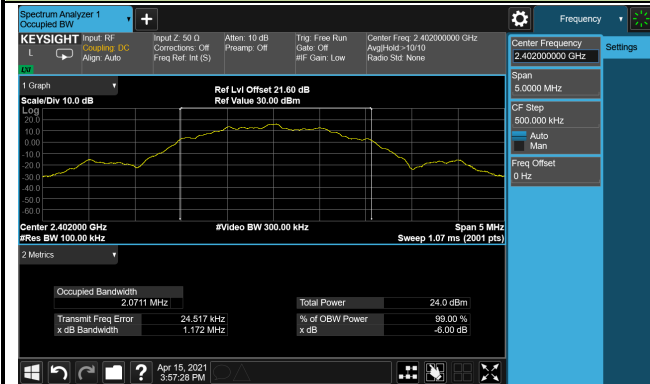
Test Site	SR2	Test Engineer	Peter
Test Date	2021/04/15~2021/05/11		

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
BLE	1	00	2402	0.705	$\geq 0.5$	Pass
BLE	1	19	2440	0.703	$\geq 0.5$	Pass
BLE	1	39	2480	0.686	$\geq 0.5$	Pass
BLE	2	00	2402	1.172	$\geq 0.5$	Pass
BLE	2	19	2440	1.169	$\geq 0.5$	Pass
BLE	2	39	2480	1.141	$\geq 0.5$	Pass



## BLE 6dB Bandwidth – 2Mbps

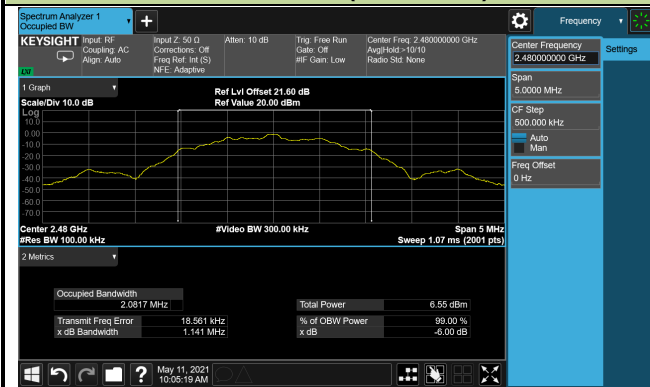
### Channel 00 (2402MHz)



### Channel 19 (2440MHz)



### Channel 39 (2480MHz)





### **6.3. Output Power Measurement**

#### **6.3.1. Test Limit**

The maximum output power shall be less 1 Watt (30dBm).

#### **6.3.2. Test Procedure Used**

ANSI C63.10-2013 - Section 11.9.1.3

ANSI C63.10-2013 - Section 11.9.2.3.2

#### **6.3.3. Test Setting**

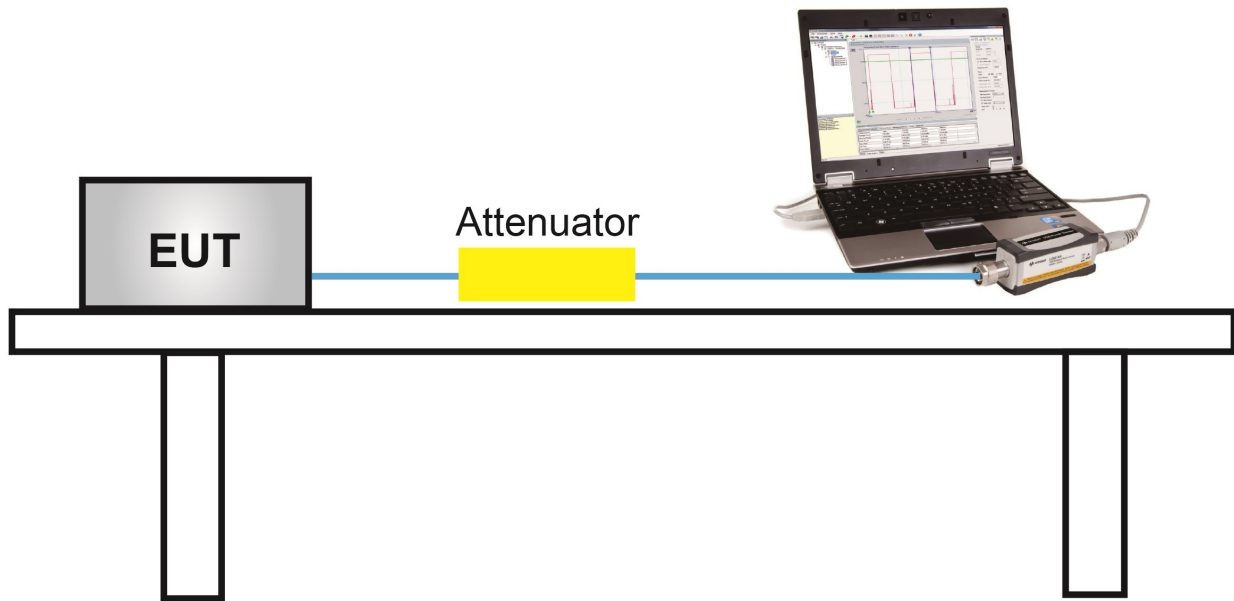
##### **Method PKPM1 (Peak Power Measurement)**

Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

##### **Method AVGPM-G (Measurement using a gated RF average-reading power meter)**

Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

### 6.3.4. Test Setup



### 6.3.5. Test Result of Output Power

Test Site	SR2	Test Engineer	Peter
Test Date	2021/04/22		

### Test Result of Peak Output Power

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Result
BLE	1	00	2402	18.00	≤ 30.00	Pass
BLE	1	19	2440	18.03	≤ 30.00	Pass
BLE	1	39	2480	7.12	≤ 30.00	Pass
BLE	2	00	2402	16.98	≤ 30.00	Pass
BLE	2	19	2440	18.04	≤ 30.00	Pass
BLE	2	39	2480	1.88	≤ 30.00	Pass

### Test Result of Average Output Power (Reporting Only)

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	Average Power (dBm)	Limit (dBm)	Result
BLE	1	00	2402	17.68	≤ 30.00	Pass
BLE	1	19	2440	17.71	≤ 30.00	Pass
BLE	1	39	2480	6.39	≤ 30.00	Pass
BLE	2	00	2402	16.64	≤ 30.00	Pass
BLE	2	19	2440	17.75	≤ 30.00	Pass
BLE	2	39	2480	-0.07	≤ 30.00	Pass

## 6.4. Power Spectral Density Measurement

### 6.4.1. Test Limit

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

The same method of determining the conducted output power shall be used to determine the power spectral density.

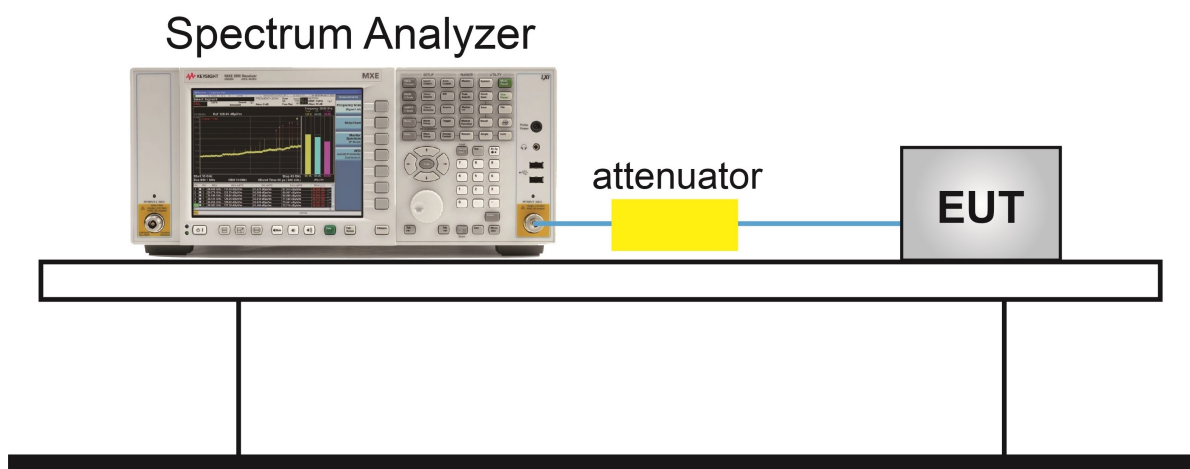
### 6.4.2. Test Procedure Used

ANSI C63.10-2013 - Section 11.10.2

### 6.4.3. Test Setting

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the OBW
3. RBW = 3kHz
4. VBW = 10kHz
5. Detector = Peak
6. Sweep time = Auto couple
7. Trace mode = Max hold
8. Trace was allowed to stabilize

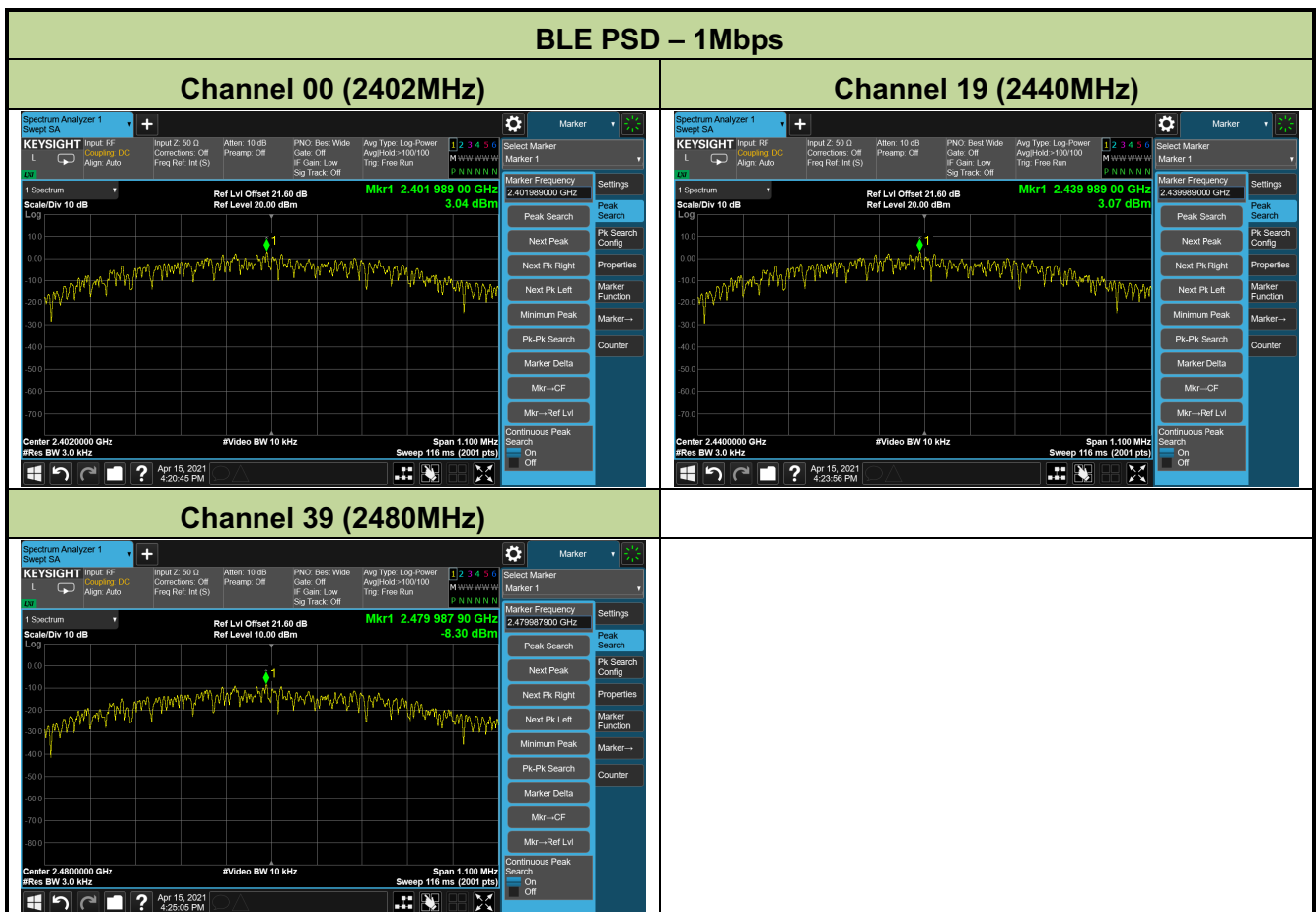
### 6.4.4. Test Setup



### 6.4.5. Test Result

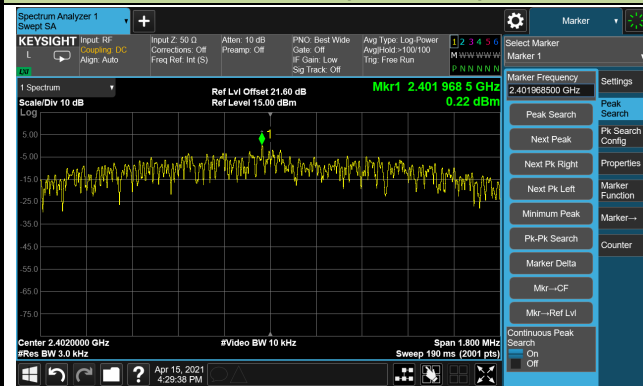
Test Site	SR2	Test Engineer	Peter
Test Date	2021/04/15~2021/05/11		

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	PSD Result (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
BLE	1	00	2402	3.04	≤ 8.00	Pass
BLE	1	19	2440	3.07	≤ 8.00	Pass
BLE	1	39	2480	-8.30	≤ 8.00	Pass
BLE	2	00	2402	0.22	≤ 8.00	Pass
BLE	2	19	2440	1.30	≤ 8.00	Pass
BLE	2	39	2480	-17.46	≤ 8.00	Pass

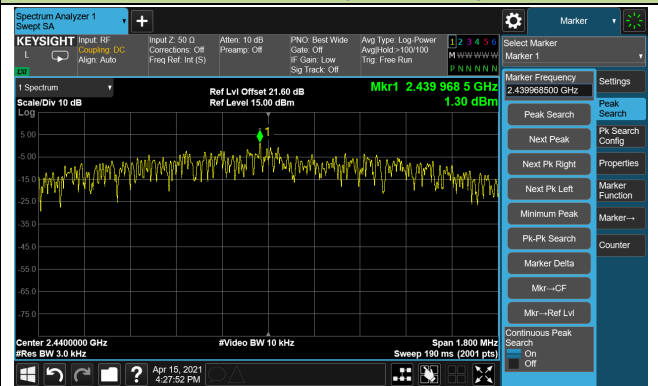


## BLE PSD – 2Mbps

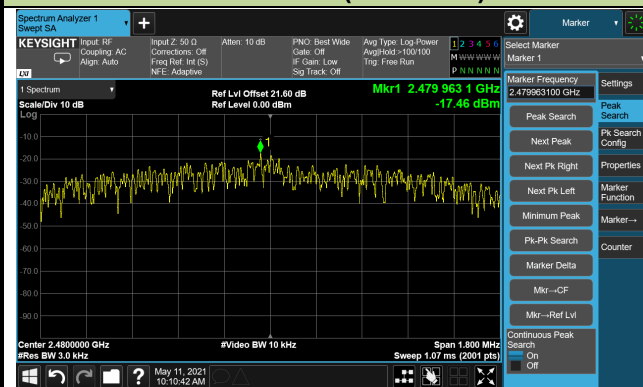
### Channel 00 (2402MHz)



### Channel 19 (2440MHz)



### Channel 39 (2480MHz)



## **6.5. Conducted Band Edge and Out-of-Band Emissions**

### **6.5.1. Test Limit**

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the PSD procedure.

### **6.5.2. Test Procedure Used**

ANSI C63.10-2013 - Section 11.11

### **6.5.3. Test Setting**

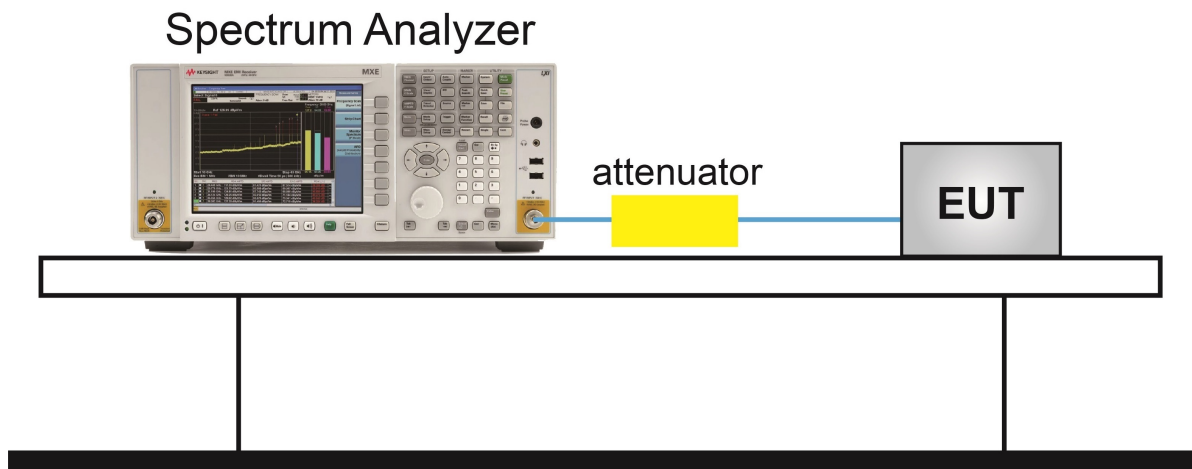
#### **Reference level measurement**

1. Set instrument center frequency to DTS channel center frequency
2. Set the span to  $\geq 1.5$  times the DTS bandwidth
3. Set the RBW = 100 kHz
4. Set the VBW  $\geq 3 \times$  RBW
5. Detector = Peak
6. Sweep time = Auto couple
7. Trace mode = Max hold
8. Allow trace to fully stabilize

#### **Emission level measurement**

1. Set the center frequency and span to encompass frequency range to be measured
2. RBW = 100kHz
3. VBW = 300kHz
4. Detector = Peak
5. Trace mode = Max hold
6. Sweep time = Auto couple
7. The trace was allowed to stabilize

#### 6.5.4. Test Setup





### 6.5.5. Test Result

Test Site	SR2	Test Engineer	Peter
Test Date	2021/04/15~2021/05/11		

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	Limit	Result
BLE	1	00	2402	20dBc	Pass
BLE	1	19	2440	20dBc	Pass
BLE	1	39	2480	20dBc	Pass
BLE	2	00	2402	20dBc	Pass
BLE	2	19	2440	20dBc	Pass
BLE	2	39	2480	20dBc	Pass

