



FCC RF Test Report

For

Shenzhen Hangshi Technology Co.,Ltd

Test Standards:	Part 15C Subpart C §15.247		
Product Description:	Bluetooth Keyboard		
Tested Model:	<u>HB220B</u>		
Additional Model No.:	<u>HB220</u>		
Brand Name:	<u>N/A</u>		
FCC ID:	2AKHJ-HB220B		
Classification	Digital Spread Spectrum (DSS)		
Report No.:	EC1908013RF01		
Tested Date:	2019-08-20 to 2019-08-29		
Issued Date:	2019-08-29		
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Note: The test results in this report apply exclusively to the tested model / sample. Without written approval of Hunan Ecloud Testing Technology Co., Ltd., the test report shall not be reproduced except in full.



Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2019.08.29	Valid	Original Report



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Summary of Test Result

FCC Rule	Description	Limit	Result	Remark
15.247(a)(1)	20dB Bandwidth	NA	Pass	-
-	99% Bandwidth	-	Pass	-
15.247(a)(1)	Hopping Channel Separation	≥ 2/3 of 20dB BW	Pass	-
15.247(a)(1)	Number of Channels	≥ 15Chs	Pass	-
15.247(a)(1)	Average Time of Occupancy	≤ 0.4sec in 31.6sec period	Pass	-
15.247(b)(1)	Peak Output Power	≤ 125 mW	Pass	-
15.247(d)	Conducted Band Edges	≤ 20dBc	Pass	-
15.247(d)	Conducted Spurious Emission	≤ 20dBc	Pass	-
15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 6.06 dB at 203.63 MHz
15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 24.56 dB at 19.122 MHz
15.203 & 15.247(b) Antenna Requirement		N/A	Pass	-



1 Test Laboratory

1.1 Test facility

CNAS (accreditation number: L11138)

Hunan Ecloud Testing Technology Co., Ltd. has obtained the accreditation of China National Accreditation

Service for Conformity Assessment (CNAS).

FCC (Designation number: CN1244, Test Firm Registration Number: 793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission

list of test facilities recognized to perform electromagnetic emissions measurements.

ISED(CAB identifier: CN0012, ISED# :24347)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of

innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

A2LA (Certificate Code : 4895.01)

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory

Accreditation to perform electromagnetic emission measurement.



2 General Description

2.1 Applicant

Shenzhen Hangshi Technology Co.,Ltd

Hangshi Technology Park, Democracy West Industry Area, Shajing Town, Bao'an District, Shenzhen, China.

2.2 Manufacturer

Shenzhen Hangshi Technology Co.,Ltd

Hangshi Technology Park, Democracy West Industry Area, Shajing Town, Bao'an District, Shenzhen, China.

2.3 General Description Of EUT

Product	Bluetooth Keyboard		
Model No.	HB220B		
Additional No.	HB220		
Difference Description	HB220B have backlight , HB220 doesn't have backlight ,		
Difference Description	and does not have any effect on any other RF functions.		
FCC ID	2AKHJ-HB220B		
Power Supply	5Vdc (adapter or host equipment)		
	3.7Vdc (Li-ion, polymer)		
Modulation Technology	FHSS		
Modulation Type	GFSK		
Operating Frequency	2402MHz~2480MHz		
Number Of Channel	79		
Max. Output Power	Bluetooth BR(1Mbps) : -2.610 dBm (0.0005 W)		
Antenna Type	PCB Antenna type with 1.87dBi gain		
HW Version V1.0			
SW Version	V1.0		
I/O Ports	Refer to user's manual		
Cable Supplied	USB cable: Unshielded, detachable, 1.0m		

NOTE:

- 1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
- 2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.



2.4 Modification of EUT

No modifications are made to the EUT during all test items.

2.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

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

Remark:

1. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.





3 Test Configuration of Equipment Under Test

3.1 Descriptions of Test Mode

The transmitter has a maximum peak conducted output power as follows:

Channel	Frequency	Mode	Bluetooth RF Output Power
Ch00	2402MHz	GFSK	-2.610
Ch39	2441MHz	GFSK	-3.494
Ch78	2480MHz	GFSK	-5.620

Remark:

1.All the test data for each data rate were verified, but only the worst case was reported.

2. The data rate was set in 1Mbps for all the test items due to the highest RF output power.



3.2 Test Mode

3.2.1 Antenna Port Conducted Measurement

Summary table of Test Cases				
Test Item	Data Rate / Modulation			
	Bluetooth BR 1Mbps			
	GFSK			
Conducted	Mode 1: CH00_2402 MHz			
Test Cases	Mode 2: CH39_2441 MHz			
Test Cases	Mode 3: CH78_2480 MHz			

3.2.2 Radiated Emission Test (Below 1GHz)

Radiated	Bluetooth BR 1Mbps GFSK
Test Cases	Mode 1: CH00_2402 MHz

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible

combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type. X orientation was worst-case orientation; therefore, all

final radiated testing was performed with the EUT in $\ensuremath{\mathsf{X}}$ orientation.

2. Following channel(s) was (were) selected for the final test as listed above

3.2.3 Radiated Emission Test (Above 1GHz)

	Bluetooth BR 1Mbps GFSK		
Radiated	Mode 1: CH00_2402 MHz		
Test Cases	Mode 2: CH39_2441 MHz		
	Mode 3: CH78_2480 MHz		

Note : 1. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it

was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

2. Following channel(s) was (were) selected for the final test as listed above

3. For frequency above 18GHz, the measured value is much lower than the limit, therefore, it is not reflected in the report.



3.2.4 Power Line Conducted Emission Test:

AC	
Conducted	Mode 1 : Bluetooth Link + USB Cable (Charging from Adapter)
Emission	

3.3 Support Equipment

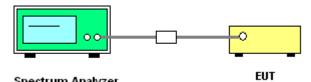
ltem	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Adapter	Tongxingrui	TX-0501000-AD001	DOC	N/A	N/A
2.	USB Cable	N/A	N/A	N/A	N/A	unshielded 0.8m
3.	Notebook	Lenovo	E470C	FCC DoC	N/A	shielded cable DC O/P 1.8 m unshielded AC I/P cable1.2 m

3.4 Test Setup

The EUT is continuously communicating to the Bluetooth tester during the tests.

EUT was set in the Hidden menu mode to enable BT communications.

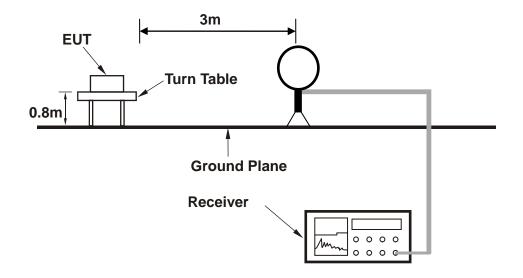
Setup diagram for Conducted Test



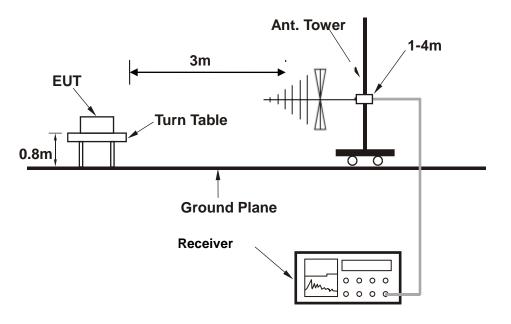
Spectrum Analyzer



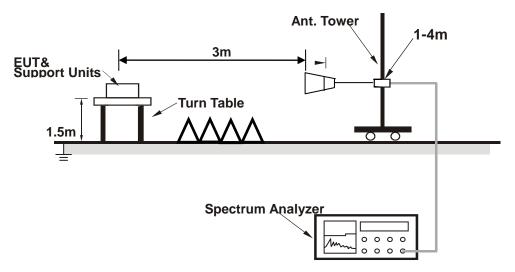
Setup diagram for Raidation(9KHz~30MHz) Test



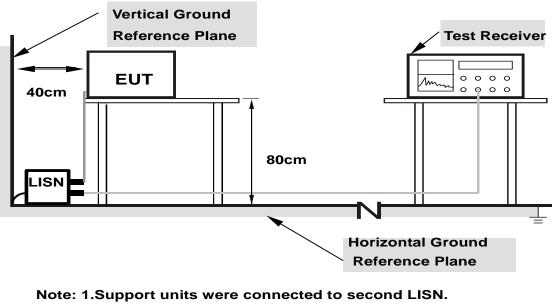
Setup diagram for Raidation(Below 1G) Test



Setup diagram for Raidation(Above1G) Test



Setup diagram for AC Conducted Emission Test



2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes



3.5 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 attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 5 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 5 + 10 = 15 (dB)

For all radiated test items:

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level



4 Test Result

4.1 20dB and 99% Bandwidth Measurement

4.1.1 Limit of 20dB and 99% Bandwidth

None; for reporting purposes only.

4.1.2 Test Procedures

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.
 - Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel;

 $RBW \ge 1\%$ of the 20 dB bandwidth; $VBW \ge RBW$; Sweep = auto; Detector function = peak; Trace = max hold.

4. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.

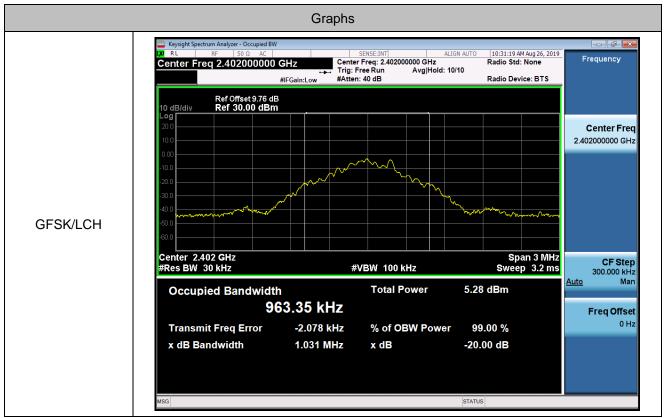
Span = approximately 1.5 to 5 times the 99% bandwidth, centered on a hopping channel; RBW \geq 1% of the 99% bandwidth; VBW \geq RBW; Sweep = auto; Detector function = sample; Trace = max hold.



4.1.3	Test Result of 20dB	Bandwidth and	d 99% Bandwidth
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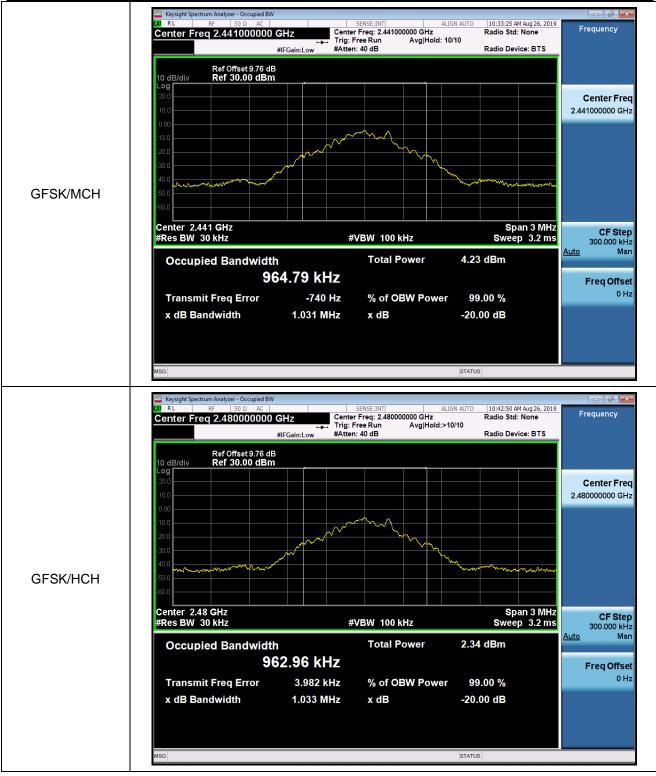
Test Mode :	Transmitti	ng	Temperatu	re :	24~26°⊂	
Test Engineer :	Victorique	Victorique Gao Relativo		umidity :	50~53%	
Mode	Channel.	hannel. 20dB Bandwid		99%	6 OBW [MHz]	Verdict
GFSK	LCH	1.031			0.96335	PASS
GFSK	MCH	1.028			0.96479	PASS
GFSK	НСН	1.028			0.96296	PASS

99% Bandwidth Plot



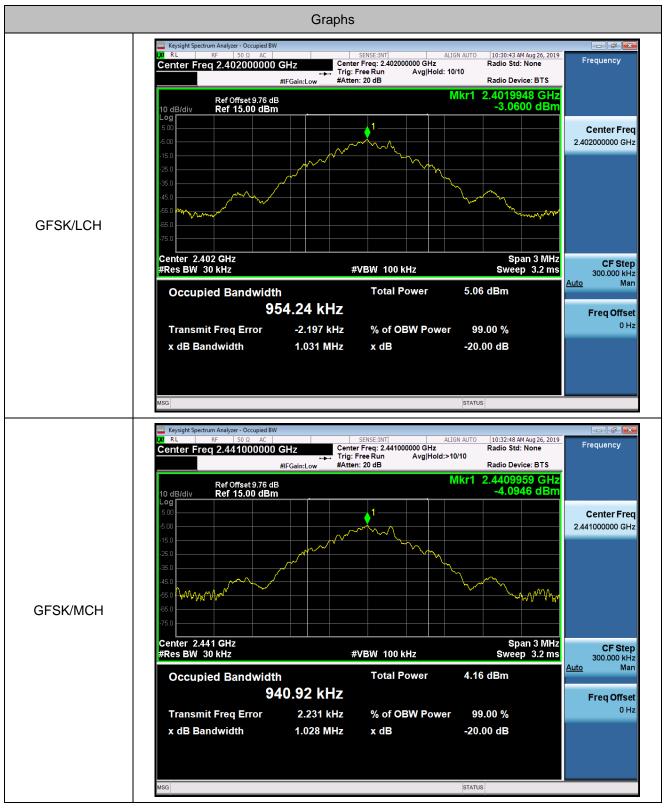


Report No.: EC1908013RF01



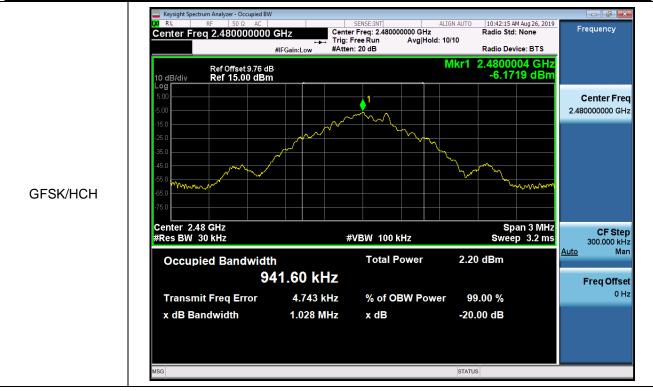


20dB Bandwidth Plot





Report No.: EC1908013RF01





4.2 Hopping Channel Separation Measurement

4.2.1 Limit of Hopping Channel Separation

FCC §15.247 (a) (1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

4.2.2 Test Procedures

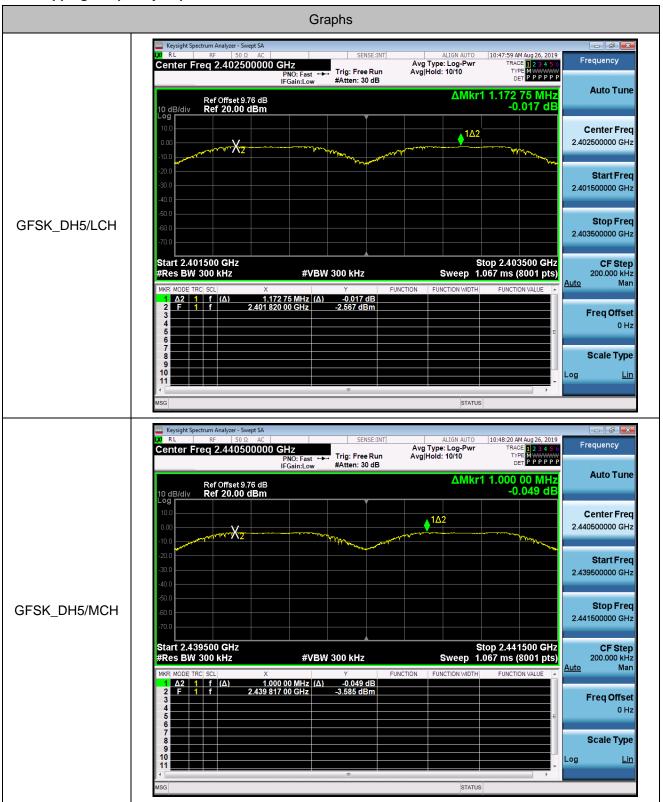
- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

4.2.3 Test Result of Hopping Channel Separation

Test Mode :	Transmit	ting	Temperature :	24~26℃		
Test Engineer :	Victorique	e Gao	Relative Humidity :	50~53%		
Mode	Channel.	Carrier Fre	equency Separation [I	VHz]	Verdict	
GFSK_DH5	LCH	1.173			PASS	
GFSK_DH5	MCH	1.000			PASS	
GFSK_DH5	НСН		1.345		PASS	



Hopping Frequency Separation Plot





	Keysight Spectrum Analyzer - Swept SA SENSE:INT ALIGN AUTO 10:48:45 AM Aug 26, 201 M RL RF 50 Ω AC SENSE:INT ALIGN AUTO 10:48:45 AM Aug 26, 201 Center Freq 2.479500000 GHz PNO: Fast → IFGain:Low Trig: Free Run #Atten: 30 dB Avg Type: Log-Pwr Avg Hold: 10/10 Trig: PP P P	6 ₩ P
	Ref Offset 9.76 dB ΔMkr1 1.344 75 MH; -0.095 dE 10 dB/div Ref 20.00 dBm -0.095 dE 10 0 -0.095 dE -0.095 dE 10 0 -0.095 dE -0.095 dE	Auto Tune Center Freq 2.479500000 GHz
	-10.0 -20.0 -30.0 -40.0 -50.0	Start Freq 2.478500000 GHz
GFSK_DH5/HCH	-60.0 -70.0 Start 2.478500 GHz Stop 2.480500 GHz	Stop Freq 2.480500000 GHz CF Step
	#Res BW 300 kHz #VBW 300 kHz Sweep 1.067 ms (8001 pts MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE 1 Δ2 1 f (Δ) 1.344 75 MHz (Δ) -0.095 dB FUNCTION WIDTH FUNCTION VALUE FUNCTION VALUE	Auto Man
	6 7 7 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	Scale Type Log <u>Lin</u>
	MSG STATUS	



4.3 Number of Channel Measurement

4.3.1 Limits of Number of Hopping Frequency

FCC§15.247(a)(1)(iii)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

4.3.2 Test Procedure

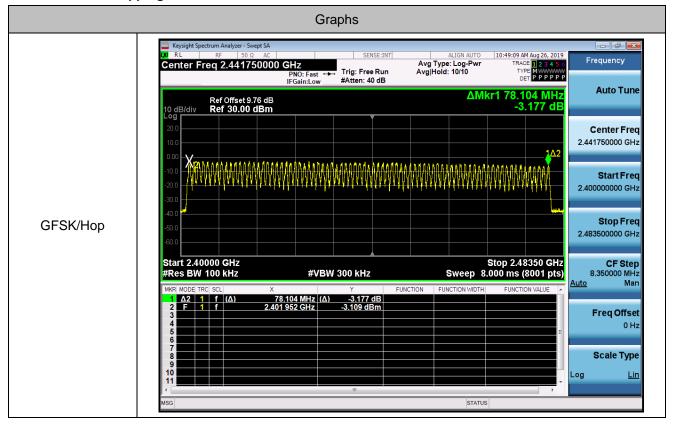
- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

4.3.3 Test Result of Number of Hopping Frequency

Test Mode :	-	Transmitt	ing	Temperature :	24~26 ℃		
Test Engineer :	•	Victorique	e Gao	Relative Humidity :	50~53%		
Mode	Cha	annel.	Number of Hopping Channel			Verdict	
GFSK	F	Нор	79			PASS	



Number of Hopping Channels





4.4 Average Time of Occupancy Measurement

4.4.1 Limit of Average Time of Occupancy

FCC §15.247 (a) (1) (iii)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

4.4.2 Test Procedures

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

4. The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements.

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

Test channel: 2441MHz as blow:

DH1 time slot= Burst Width (ms)*(1600/ (2*79))*31.6

DH3 time slot= Burst Width (ms)*(1600/ (4*79))*31.6

DH5 time slot= Burst Width (ms)*(1600/ (6*79))*31.6

4.4.3 Test Result of Dwell Time

Test Mode :		Trar	smitting	Temperature :	24~26°C	
Test Engineer :		Victo	orique Gao	Relative Humic	lity: 50~53%	
Mode	Packet	Chann	Burst Width	Total		Verdict
wode	Fackel	el	[ms/hop/ch]	Hops[hop*ch]	Dwell Time[s]	verdict
GFSK	DH1	LCH	0.43	320	0.138	PASS
GFSK	DH1	MCH	0.43	320	0.138	PASS
GFSK	DH1	HCH	0.43	320	0.138	PASS
GFSK	DH3	LCH	1.67	160	0.267	PASS
GFSK	DH3	MCH	1.67	160	0.267	PASS
GFSK	DH3	HCH	1.67	160	0.267	PASS
GFSK	DH5	LCH	2.91	106.67	0.31	PASS
GFSK	DH5	MCH	2.91	106.67	0.31	PASS
GFSK	DH5	HCH	2.91	106.67	0.31	PASS



The Average Time of Occupancy Plot

	Graphs	
	Keysight Spectrum Analyzer - Swept SA μ RF SΩ AC SENSE:INT ALIGN AUTO 10:44:13 AM Aug 26, 2019	
	Center Freq 2.402000000 GHz Trig Delay-1.250 ms Avg Type: Log-Pwr TRACE 1 2 3 4 5 6 Trig: Video Trig: Video	Frequency
	ΔMkr2 425.0 μs 10 dB/div Ref 20.00 dBm 0.17 dB	Auto Tune
	Logy 10.0 0.00 -10.0	Center Freq 2.402000000 GHz
	-20.0 -30.0 -40.0 -40.0	Start Freq 2.402000000 GHz
GFSK_DH1/LCH	-50.0 160.0 -70.0	Stop Freq 2.402000000 GHz
	MKR MODE TRC SCL X Y FUNCTION VIDTH FUNCTION VALUE	CF Step 1.000000 MHz <u>Auto</u> Man
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Freq Offset 0 Hz
		Scale Type Log <u>Lin</u>
	MSG STATUS	
		Frequency
	M RL RF 50 Ω AC SENSE:INT ALIGN AUTO 10:44:36 AM Aug 26, 2019 Center Freq 2.441000000 GHz Trig Delay-1.250 ms Avg Type: Log-Pwr TracE II 2 3 4 5 6 PNO: Fast → IfGain:Low #Atten: 30 dB Avg Type: Log-Pwr TracE II 2 3 4 5 6 Other Freq 2.441000000 GHz PNO: Fast → #Atten: 30 dB Avg Type: Log-Pwr TracE II 2 3 4 5 6 10 dB/div Ref 20.00 dBm 0.28 dB 0.28 dB 0.28 dB	
	M RL RF 50 Ω AC SENSE:INT ALIGN AUTO 10:44:36 AM Aug 26, 2019 Center Freq 2.441000000 GHz PNO: Fast IFGain:Low Trig Delay-1.250 ms #Atten: 30 dB Avg Type: Log-Pwr TYPE TRACE 2.34 5 G TYPE 0 dB/div Ref 20.00 dBm 0.28 dB 0.28 dB 0.28 dB 10.0 10.0 1 2Δ1 0.000	Frequency
	OM RL RF 50 Ω AC SENSE:INT ALIGN AUTO 10:44:36 AM Aug 26, 2019 Center Freq 2.441000000 GHz Trig Delay-1.250 ms Avg Type: Log-Pwr Trace 1/2 34 5 o PNO: Fast	Frequency Auto Tune Center Freq
GFSK_DH1/MCH	M RL RF 50 Ω AC SENSE:INT ALIGN AUTO 10:44:36 AM Aug 26, 2019 Center Freq 2.441000000 GHz Trig Delay-1.250 ms Avg Type: Log-Pwr Trace 1/2 34 5 o PNO: Fast POO: Fast	Frequency Auto Tune Center Freq 2.44100000 GHz Start Freq
GFSK_DH1/MCH	M RL RF 50 Ω AC SENSE:INT ALIGN AUTO 10:44:36 AM Aug 26, 2019 Center Freq 2.441000000 GHz Trig Delay-1.250 ms Avg Type: Log-Pwr Trace 12, 23, 45 G PNO: Fast FGain.Low Trig Delay-1.250 ms Avg Type: Log-Pwr Trace 12, 23, 45 G O dB/div Ref 20.00 dBm O.28 dB O.28 dB O.28 dB 100 dB 1 2Δ1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 1.000000 MHz
GFSK_DH1/MCH	M RL RF 50 Ω AC SENSE:INT ALIGN AUTO 10:44:36 AM Aug 26, 2019 Center Freq 2.441000000 GHz Trig Delay-1.250 ms Avg Type: Log-Pwr Trace 12 2 3 4 5 0 PNO: Fast POO: Fast <td>Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz</td>	Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz
GFSK_DH1/MCH	MRL PF 50.0 AC SENSE:INT ALION AUTO 10:44:36 AM Aug 26, 2019 Center Freq 2.441000000 GHz PNO: Fast Trig Delay-1.250 ms Avg Type: Log-Pwr Triace 2.3 4 56 ID dB/div Ref 20.00 dBm O.28 dB O.28 dB O.28 dB ID dB/div Ref 20.00 dBm O.28 dB O.28 dB ID dB/div Ref 20.00 dBm O.28 dB O.28 dB ID dB/div Ref 20.00 dBm Sense Sense Sense O.28 dB ID dB/div Ref 20.00 dBm O.28 dB O.28 dB O.28 dB ID dB/div Ref 20.00 dBm Sense O.28 dB O.28 dB ID dB/div Ref 20.00 dBm Sense O.28 dB O.28 dB ID dB/div Ref 20.00 dBm Sense Sense Sense Sense ID dB/div ID dave ID dave ID dave ID dave Sense Sense ID dave ID dave ID dave ID dave ID dave Sense Sense Sense ID dave ID dave ID dave ID dave ID dave ID dave <	Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 1.000000 MHz Auto Man Freq Offset



	🔤 Keysight Spectrum Analyzer - Swept SA 👘 💌
	M RL RF 50 Ω AC SENSE:INT ALIGN AUTO 10:44:59 AM Aug 26, 2019 Center Freq 2.480000000 GHz Trig Delay-1.250 ms Avg Type: Log-Pwr TRACE 1 2 3 4 5 6 PNO: Fast Trig: Video Trig: Video Trig: Video Trig: Video
	IFGein:Low #Atten: 30 dB DET PPPPP Auto Tune ΔΜkr2 425.0 μs 0.87 dB Auto Tune
	Log Center Freq 10.0 2.48000000 GHz
	-10.0 -20.0 -20.0 -30.0
GFSK_DH1/HCH	-40.0 -50.0 -50.0
	-70.0 2.48000000 GHz Center 2.48000000 GHz Span 0 Hz
	Res BW 1.0 MHz #VBW 1.0 MHz Sweep 5.000 ms (1001 pts) 1.000000 MHz MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE Auto Man 1 N 1 t 1.235 ms -16.28 dBm FUNCTION WIDTH FUNCTION VALUE Man
	2 Δ1 1 t (Δ) 425.0 μs (Δ) 0.87 dB Freq Offset 3 4 5 5 6 5 6 5 6 5 6 5 5 6 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
	7 8 8 8 Scale Type 9 9 9 9 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 <t< td=""></t<>
	Keysight Spectrum Analyzer - Swept SA Image: Sense:INT ALIGN AUTO 10:45:33 AM Aug 26, 2019 Center Freq 2.402000000 GHz Trig Delay-2.600 ms Avg Type: Log-Pwr TRACE 2 3 4 5 6 PNO: Fast →→ Trig: Video Trig: Video Trig: Video Trig: Video
	ΔMkr2 1.670 ms 10 dB/div Ref 20.00 dBm -0.09 dB
	Log 10.0 0.00 2.402000000 GHz 2.402000000 GHz
	-10.0 TRIOLVL -20.0 Start Freq -30.0 2.40200000 GHz
GFSK_DH3/LCH	-40.0 -60.0 -60.0 -60.0
	-70.0 Center 2.402000000 GHz Res BW 1.0 MHz #VBW 1.0 MHz Sweep 10.00 ms (1001 pts) 1.000000 MHz
	MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE A
	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	8 Scale Type 9 Scale Type 10 Log
	MSG STATUS



	🔤 Keysight Spectrum Analyzer - Swept SA	
	Off RL RF 50 Ω AC SENSE:INT ALIGN AUTO 10:45:55 AM Aug 26, 2019 Center Freq 2.441000000 GHz Trig Delay-2.500 ms Avg Type: Log-Pwr TRACE [] 2:3:45 G Fr PNO: Fast → #Aften: 30 dB O Det PPPPP P	equency
	ΔMkr2 1.670 ms 10 dB/div Ref 20.00 dBm -0.04 dB	Auto Tune
		Center Freq 1000000 GHz
	-20.0 TROLV.	Start Freq 1000000 GHz
GFSK_DH3/MCH	-50.0 turbharadharadharadharadharadharadharadhar	Stop Freq 1000000 GHz
	Center 2.441000000 GHz Span 0 Hz Res BW 1.0 MHz #VBW 1.0 MHz Sweep 10.00 ms (1001 pts) MKR MODE TRC SCL X Y FUNCTION FUNCTION VIDTH FUNCTION VIDTH	CF Step .000000 MHz Man
	1 N 1 t 2.480 ms -13.41 dBm	Freq Offset 0 Hz
		Scale Type <u>Lin</u>
	MSG STATUS	
	Keysight Spectrum Analyzer - Swept SA W RL RF 50 Q AC SENSE:INT ALIGN AUTO 10:46:18 AM Aug 26, 2019 Center Freq 2.480000000 GHz Trig Delay-2.500 ms Avg Type: Log-Pwr TRACE 12:34.5.6 Fr	equency
	PNO: Fast → Trig: Video IFGain:Low #Atten: 30 dB DET PPPPPP ΔMkr2 1.670 HS	Auto Tune
		Center Freq 0000000 GHz
		Start Freq 0000000 GHz
GFSK_DH3/HCH	-50.0 ๆกันนุ่งใหม่แหน่งแหน่งผู้สารที่การใน (การการการการการการการการการการการการการก	Stop Freq
	Auto	CF Step .000000 MHz Man
	1 N 1 t 2.480 ms -15.41 dBm	Freq Offset 0 Hz
		Scale Type <u>Lin</u>
	11 III III <td></td>	



	Center Freq 2.402000000 GHz Trig Delay-3.750 ms Aug Type: Log-Pwr TRACE [] 2 3 4 5 6 TYPE Frequency PNO: Fast +	
	Log 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0	GHz
GFSK_DH5/LCH	40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40.0 <th< td=""><td>GHz</td></th<>	GHz
	MKR MODE TRC SCL X Y FUNCTION FUNCTION FUNCTION VALUE F 1 N 1 t 3.720 ms -12.27 dBm -11.27 dBm	Man Set) Hz
	MsG STATUS Status	×
	Center Freq 2.441000000 GHz PNO: Fast IFGain:Low PNO: Fast PNO: Fast PNO	ıne
	10.0 Center Fr 0.00 1 2Δ1 2.4100000 G 10.0 7R0ELVE 7R0ELVE Start Fr 30.0 2.4100000 G 2.4100000 G 2.4100000 G	GHz req
GFSK_DH5/MCH	-400 -400 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500 -500	req GHz
	MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE 1 N 1 t 3.705 ms -13.35 dBm -13	MHz Man
	6 Scale Ty	/pe Lin



	Keysight Spectrum Analyzer - Swept SA
	M RL RF 50 Ω AC SENSE:INT ALIGN AUTO 10:47:37 AM Aug 26, 2019 Center Freq 2.480000000 GHz Trig Delay-3.750 ms Avg Type: Log-Pwr TRACE 12 3 4 5 6
	PNO: Fast +
	ΔMkr2 2.910 ms
	10 dB/div Ref 20.00 dBm 4.06 dB
	10.0 Center Freq
	0.00 2.480000000 GHz
	-10.0
	-20.0
	-30.0 2.480000000 GHz
	-50.0 had at an installed a state at a state of the state
GFSK_DH5/HCH	-60.0 Stop Freq 2.48000000 GHz
	-70.0
	Center 2.480000000 GHz CF Step
	Res BW 1.0 MHz #VBW 1.0 MHz Sweep 15.00 ms (1001 pts) 1.000000 MHz
	MKR_MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE Auto 1 N 1 t 3.720 ms -27.44 dBm -27.44 dBm - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
	$\frac{2}{3} \Delta 1 \frac{1}{1} t (\Delta) \frac{2,120 \text{ ms}}{2,910 \text{ ms}} (\Delta) \frac{4,06 \text{ dB}}{4,06 \text{ dB}}$ Freq Offset
	4 0 Hz
	8 Scale Type
	9 10 10 Log Lin
	MSG



4.5 Peak Output Power Measurement

4.5.1 Limit of Peak Output Power

Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts.

4.5.2 Test Procedures

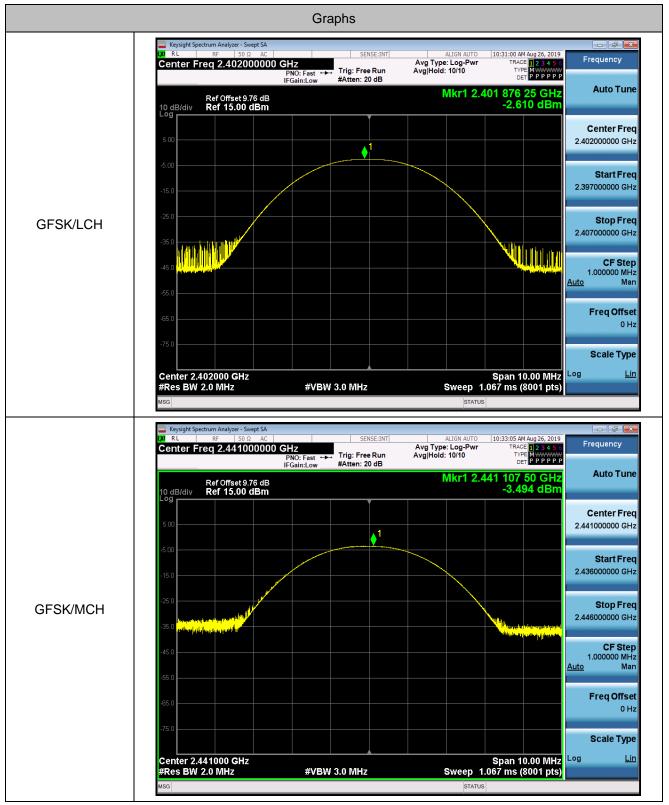
- 1.Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

4.5.3 Test Result of Peak Output Power

Test Mode :		Transmitting		Temperature :	24~26	°C
Test Engineer :		Victorique G	Gao Relative Humidity : 50		50~53	8%
Mode	C	hannel.	Maximum Pe	eak Output Power [dl	3m]	Verdict
GFSK		LCH	-2.610			PASS
GFSK		MCH	-3.494			PASS
GFSK		HCH		-5.620		PASS

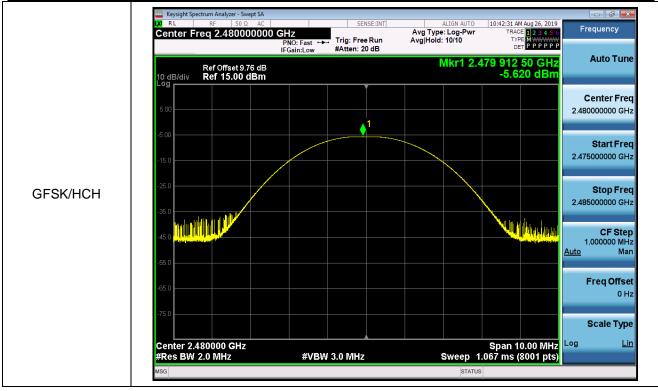


Peak Output Power Polt





Report No.: EC1908013RF01





4.6 Conducted Band Edges Measurement

4.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

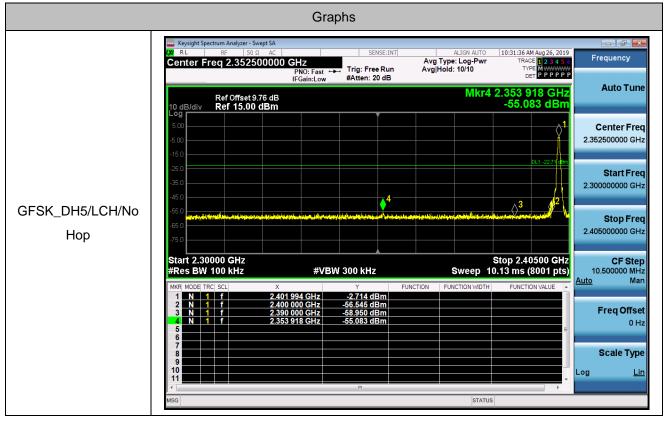
4.6.2 Test Procedures

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3.Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
- 4. Enable hopping function of the EUT and then repeat step 1~3.

4.6.3 Test Result of Conducted Band Edges

Test Mode :		Transmitting		Temperature :		24~26° ℃		
Test Engineer	:	Victorique Gao Relative Humidity : 50~53%		3%				
Mode	Channel	Carrier Frequency [MHz]	Carrier Power [dBm]	Frequenc y Hopping	Ma: Spurie Leve [dBr	ous el	Limit [dBm]	Verdic t
GFSK DH5	LCH	2402	-2.714	Off	-55.083		-22.71	PASS
GF3K_DH3	Lon	2402	-3.222	On	-60.476		-23.22	PASS
GFSK DH5	НСН	2480	-5.738	Off	-56.314		-25.74	PASS
GFSK_DHS		2400	-5.660	On	-62.558		-25.66	PASS

Conducted Band Edge Polt





		Å
GFSK_DH5/LCH/Hop	PN0: Fast →→ Trig: Free Run Av IFGain:Low #Atten: 10 dB Ref Offset 9.76 dB	ALIGN AUTO 10:49:29 AM Aug 26, 2019 vg Type: Log-Pwr TRACE 2 3 4 3 6 rg Hold: 10/10 TYPE M 2 3 4 3 6 TYPE M 2
	10 dB/div Ref 9.76 dBm	Center Freq 2.352500000 GHz 0:1-2922 for Start Freq 2.30000000 GHz
	30.2	2.40500000 GHz 2.40500000 GHz Stop 2.40500 GHz 10.500000 MHz 10.500000 MHz Auto Man
	1 1 f 2.403 005 GHz -3.222 dBm 2 N 1 f 2.403 005 GHz -3.222 dBm 3 N 1 f 2.400 000 GHz -61.572 dBm 3 N 1 f 2.379 000 GHz -62.608 dBm 4 N 1 f 2.379 170 GHz -60.476 dBm 5 - - - - 6 - - - - 7 - - - - 8 - - - - 9 - - - - 10 - - - - 11 - - - -	Freq Offset 0 Hz Scale Type Log Lin
	Keysight Spectrum Analyzer - Swept SA X RL RF 50 Ω	STATUS
GFSK_DH5/HCH/No Hop		wg Type: Log-Pwr TRACE 2.34 5 6 Frequency rg Hold: 10/10 TYPE MWWWWG DET P P P P P Auto Tune Mkr4 2.488 393 GHz -56.314 dBm Center Freq 2.493500000 GHz
	-15.0 -25.0 -35.0 -45.0 -65.0 -75.0 -75.0	Ct1-2574 dBm Ct1-2574 dBm Start Freq 2.477000000 GHz Stop Freq 2.51000000 GHz
	Start 2.47700 GHz #Res BW 100 kHz #VBW 300 kHz MKR MODE TRC; SCL X Y FUNCTION 1 N 1 f 2.480 003 GHz -5.738 dBm 2 N 1 f 2.483 500 GHz -58.539 dBm	
	3 N 1 f 2.500 000 GHz -58.320 dBm 4 N 1 f 2.488 393 GHz -56.314 dBm 5 - - - - 6 - - - - 7 - - - - 8 - - - - 9 - - - - 10 - - - - 11 - - - -	Freq Offset 0 Hz Scale Type Log Lin
	< III	· · ·



Report No.: EC1908013RF01

	Keysight Spectrum Analyzer - Swept SA Kar RL RF 50 Ω AC Center Freq 2.493500000 GHz PNO: Fast ↔→ IFGaint.low		ALIGN AUTO 10:49:50 AM Aug 26, 2019 Vvg Type: Log-Pwr TRACE 2 3 4 5 6 vg Hold: 10/10 TYPE DET P P P P P P	Frequency
	Ref Offset 9.76 dB 10 dB/div Ref 9.76 dBm		Mkr4 2.485 052 GHz -62.558 dBm	Auto Tune
	Log -0.24 -10.2 -20.2		DL1 -25 66 dBn	Center Freq 2.493500000 GHz
	-30.2 -40.2 -50.2		43	Start Freq 2.477000000 GHz
GFSK_DH5/HCH/Hop	-60.2 -70.2 -60.2	Martha Carlanda Ace	Auto Andrea Andrea Andrea Andrea	Stop Freq 2.510000000 GHz
	Start 2.47700 GHz #Res BW 100 kHz #VBW 3 MKR MODE TRC SCL X	300 kHz	Stop 2.51000 GHz Sweep 3.200 ms (1001 pts)	CF Step 3.300000 MHz Auto Man
	1 N 1 f 2.478 188 GHz 2 N 1 f 2.483 500 GHz - 3 N 1 f 2.500 000 GHz -	-5.660 dBm 68.142 dBm 64.424 dBm 62.558 dBm		Freq Offset 0 Hz
	7 8 9 10 11			Scale Type
	4 MSG		STATUS	



4.7 Conducted Spurious Emission Measurement

4.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

4.7.2 Test Procedure

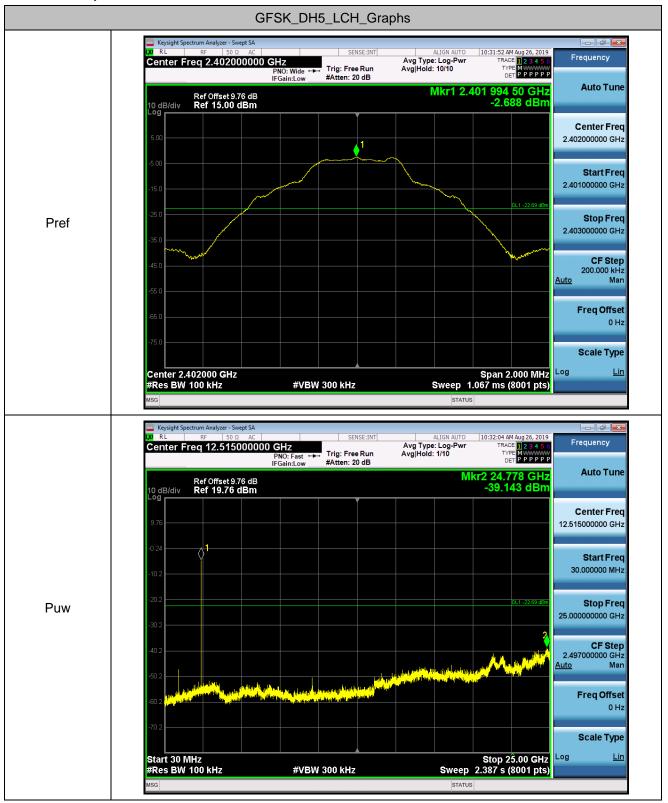
- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4.Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
- 5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

Test Mode :	-	Transmitt	ing	Temperature :24~26°C		24~26° ⊂	
Test Engineer	: \	Victorique	e Gao	Relative	Humidity :	50~53%	
Mode	Cha	annel	Pref [dBm]	Puw[o	dBm]	Verdict
GFSK	L	.CH	-2.688		<liı< td=""><td>nit</td><td>PASS</td></liı<>	nit	PASS
GFSK	Μ	ICH	-3.722		<liı< td=""><td>nit</td><td>PASS</td></liı<>	nit	PASS
GFSK	Н	ICH	-5.741		<liı< td=""><td>nit</td><td>PASS</td></liı<>	nit	PASS

4.7.3 Test Result of Conducted Spurious Emission

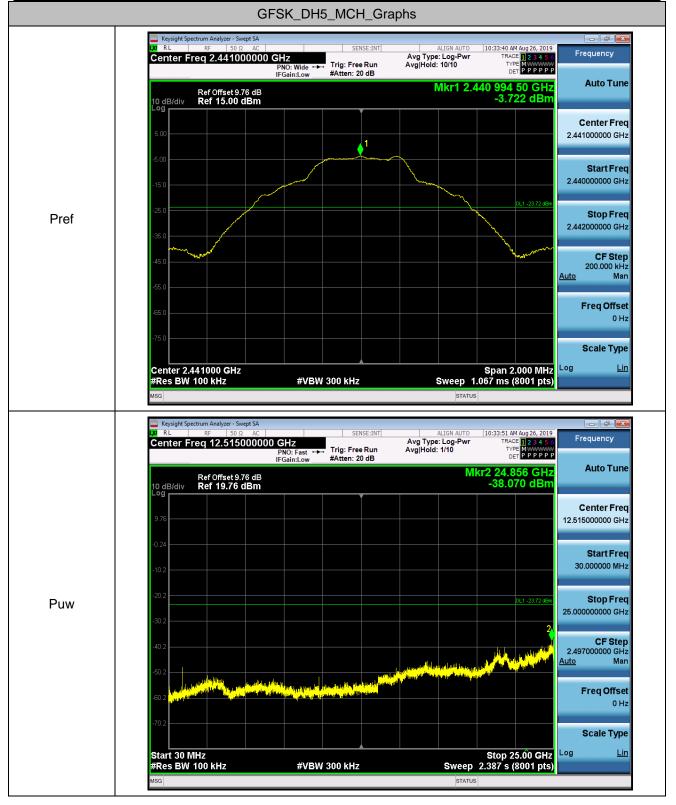


Conducted Spurious Emission Polt



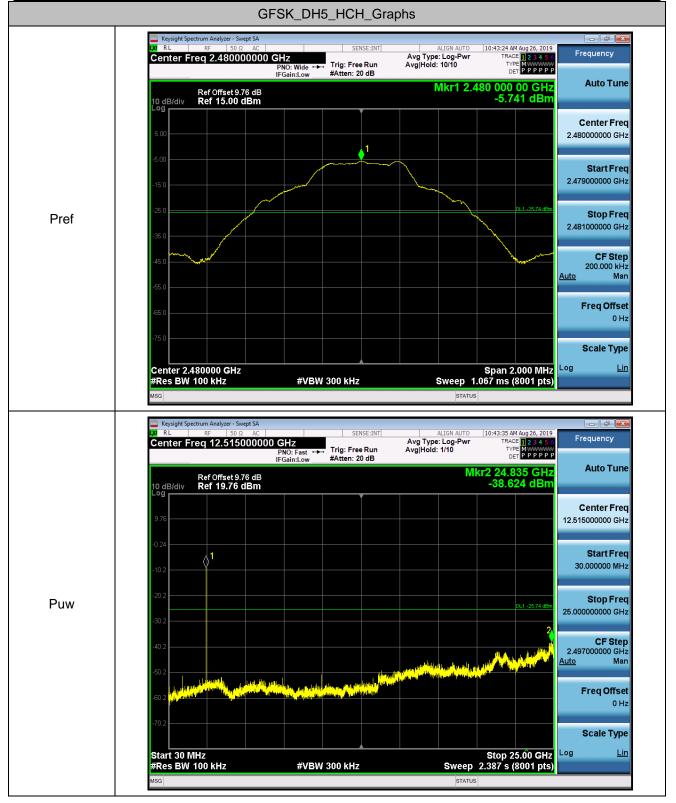


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4.8 Radiated Band Edges and Spurious Emission Measurement

4.8.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3



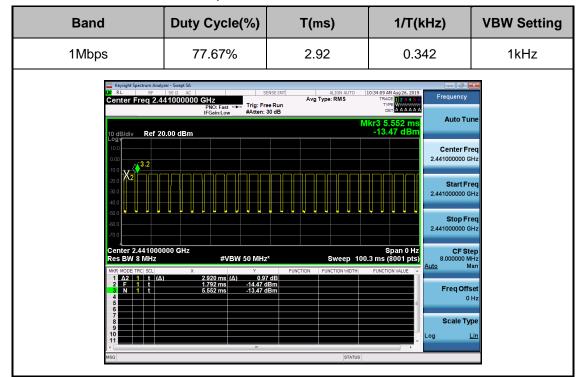


4.8.2 Test Procedures

- 1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
- 2. The measurement distance is 3 meter.
- 3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
- 4. Set to the maximum power setting and enable the EUT transmit continuously.
- 5. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW RBW; Sweep = auto;
 Detector function = peak; Trace = max hold for peak
 - (3) For average measurement:

VBW = 10 Hz, when duty cycle is no less than 98 percent.

VBW \geq 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.



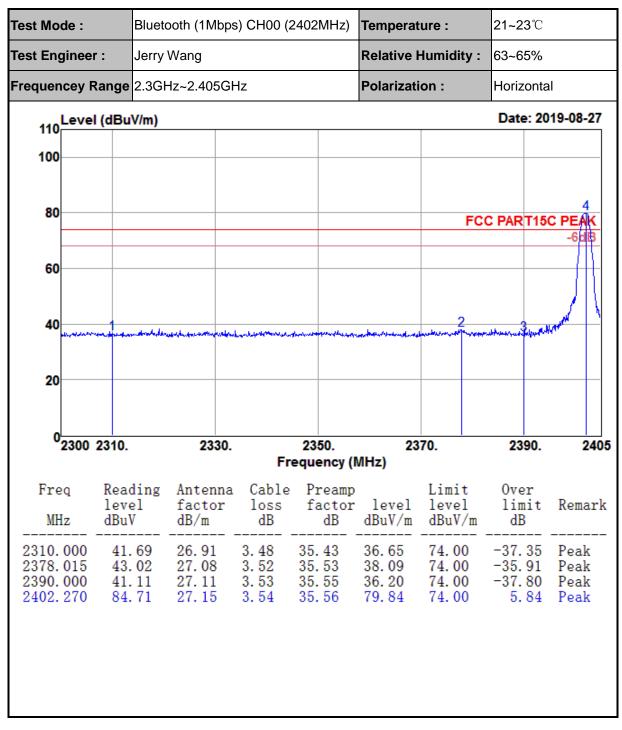
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level



4.8.3 Test Results of Radiated Spurious Emissions (9 kHz ~ 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 line per 15.31(o) was not reported.

4.8.4 Test Result of Radiated Spurious at Band Edges

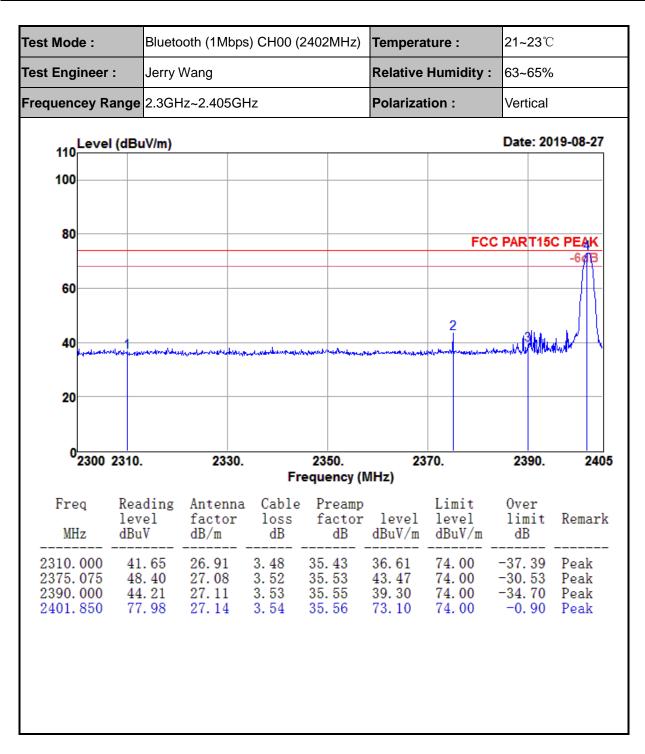




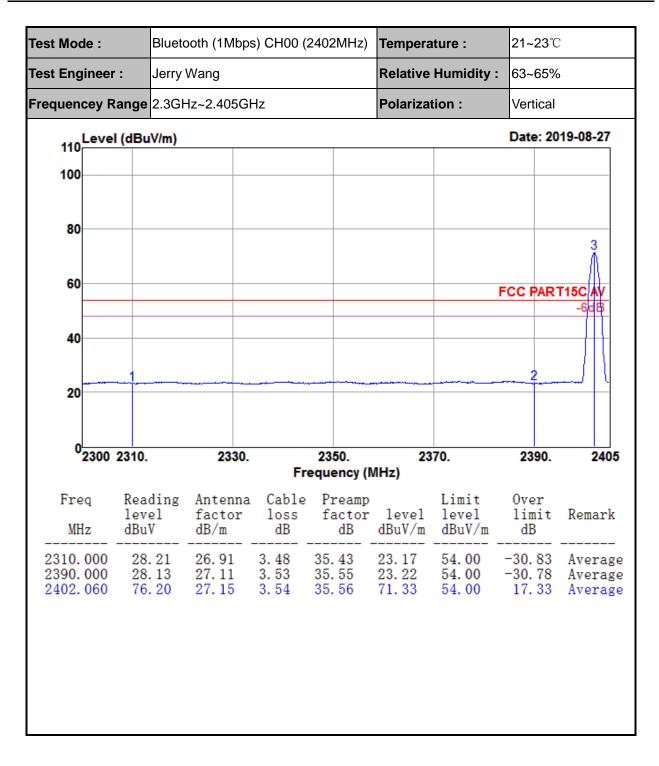


Test Mode :		Blueto	ooth (1N	lbp	s) CH00 (2402MH	z)	Tempera	ature :	21	~23 ℃	2	
Test Enginee	r:	Jerry	Wang					Relative Humidity : 63~65%					
Frequencey F	Range	2.3GH	lz~2.40	5GI	Hz			Polarization : Horizontal					
110	l (dBu\	//m)							1	Dat	te: 20	19-08	-27
100													
80													4
60										FCC	PAR	T15C	AV IB
40									2				
20		<u> </u>									3		
0 <mark></mark> 2300	2310.		233	30.	Fre	2350. equency	(M		70.	2	390.	:	2405
Freq MHz	Read leve dBuV	1	Anten facto dB/m		Cable loss dB	Pream facto dB	r	level dBuV/m	Limit level dBuV/m	Ov li d	mit	Rem	ark
2310.000 2378.015 2390.000 2401.955	28. 32. 28. 84.	68 76	26.91 27.08 27.11 27.15		3.48 3.52 3.53 3.54	35.43 35.53 35.55 35.56		23. 30 27. 75 23. 85 79. 54	54.00 54.00 54.00 54.00	-26 -30		Ave	rage rage rage rage

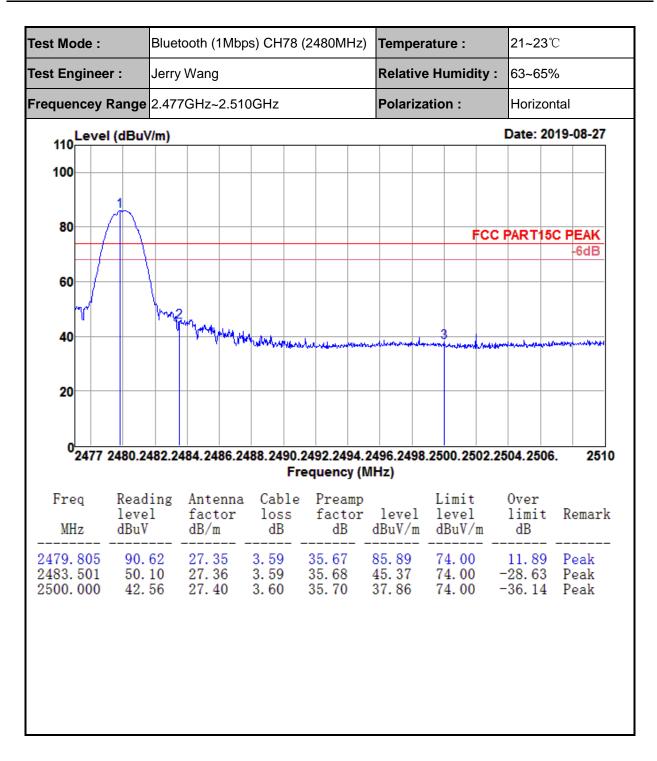














Test Mode :		Blueto	ooth (1	Mbp	s) CH7	'8 (2480MHz)	Bluetooth (1Mbps) CH78 (2480MHz) Temperature : 21~					2 1~23 ℃		
Test Engineer :		Jerry	Wang						Relativ	ve H	umidi	ty :	63~65	%		
Frequencey Ra	nge	2.477	GHz~2	2.510)GHz			Polarization : Horizontal								
110 Level (d	dBuV	/m)											Date: 2	2019-	08-27	
100																
80	h															
60												F		RT15		
															-6dB	
40																
		2		~~~~			w.m.m.	~~			3	~~~				
20																
⁰ 2477 24	80.24	82.24	84.248	36.24			2492.2494			98.2	500.25	02.2	504.250	06.	251	
Ence I	Deed		Anto				equency (ΠZ)	,	.imit		0ver			
]	Readi Level		Ante	or	los	s	facto			1]	level		limit	R	emark	
	lBuV		dB/m		dB		dB	_	dBuV/r		lBuV/		dB			
2479.970 2483.500	88.8		27.3 27.3		3.59 3.59		35.67 35.68		83.79 24.82		54. 00 54. 00		29.79 -29.18		verag verag	
2500.000	29. 1		27.4		3.60		35.70		24.42		54.00		-29. 58		verag	



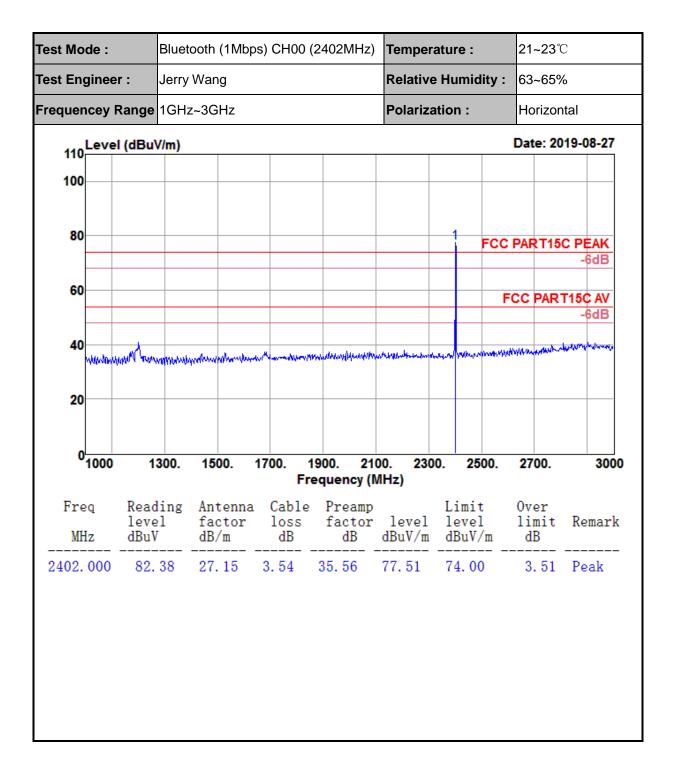
Frequency (MHz) Freq Reading Antenna Cable Preamp Limit Over	Frequencey Range 2.477GHz-2.510GHz Polarization : Vertical 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Test Mode :	Bluetooth (1Mbp	s) CH78 (2	2480MHz)	Tempera	ture :	21~23 ℃	
Level (dBuV/m) Date: 2019-08-28 100 0 FCC PART15C PEAK 60 60 FCC PART15C PEAK 60 0 60 0 0 FCC PART15C PEAK 60 0 60 0 0 FCC PART15C PEAK 60 0 60 0 0 60 0 0 60 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 10 </th <th>Level (dBuV/m) Date: 2019-08-28 100 0 FCC PART 15C PEAK 60 0 FCC PART 15C PEAK 60 0 6dB 00 0 FCC PART 15C PEAK 60 0 6dB 00 0 FCC PART 15C PEAK 6dB 6dB 6dB 00 0 FCC PART 15C PEAK 6d0 0 0 0 0 6dB 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</th> <th>Test Engineer :</th> <th>Jerry Wang</th> <th></th> <th></th> <th>Relative</th> <th>Humidity :</th> <th>63~65%</th> <th></th>	Level (dBuV/m) Date: 2019-08-28 100 0 FCC PART 15C PEAK 60 0 FCC PART 15C PEAK 60 0 6dB 00 0 FCC PART 15C PEAK 60 0 6dB 00 0 FCC PART 15C PEAK 6dB 6dB 6dB 00 0 FCC PART 15C PEAK 6d0 0 0 0 0 6dB 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Test Engineer :	Jerry Wang			Relative	Humidity :	63~65%	
100 80 60 60 60 60 60 60 60 60 60 6	100 80 60 60 60 60 60 60 60 60 60 6	Frequencey Range	2.477GHz~2.510)GHz		Polarization : Vertical			
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60 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	60 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1					FCC	PART15	C PEAK
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Freq Reading Antenna Cable Preamp Limit Over level factor loss factor level level limit Remark MHz dBuV dB/m dB dB dBuV/m dBuV/m dB 2479.772 90.68 27.35 3.59 35.67 85.95 74.00 11.95 Peak 2483.500 50.62 27.36 3.59 35.68 45.89 74.00 -28.11 Peak	Freq Reading level Antenna Cable loss Preamp factor Limit level Over limit dB MHz dBuV dB/m dB dB dBuV/m dB 2479.772 90.68 27.35 3.59 35.67 85.95 74.00 11.95 Peak 2483.500 50.62 27.36 3.59 35.68 45.89 74.00 -28.11 Peak	⁰ 2477 2480.2	482.2484.2486.24	488.2490.2 Fre	2492.2494.2 equency (N	2496.2498. (Hz)	2500.2502.2	2504.2506	. 2510
2483.500 50.62 27.36 3.59 35.68 45.89 74.00 -28.11 Peak	2483.500 50.62 27.36 3.59 35.68 45.89 74.00 -28.11 Peak	leve	l factor	Cable loss	Preamp factor	level	level	limit	Remark
		2483.500 50.	62 27.36	3.59	35.68	45.89	74.00	-28.11	Peak



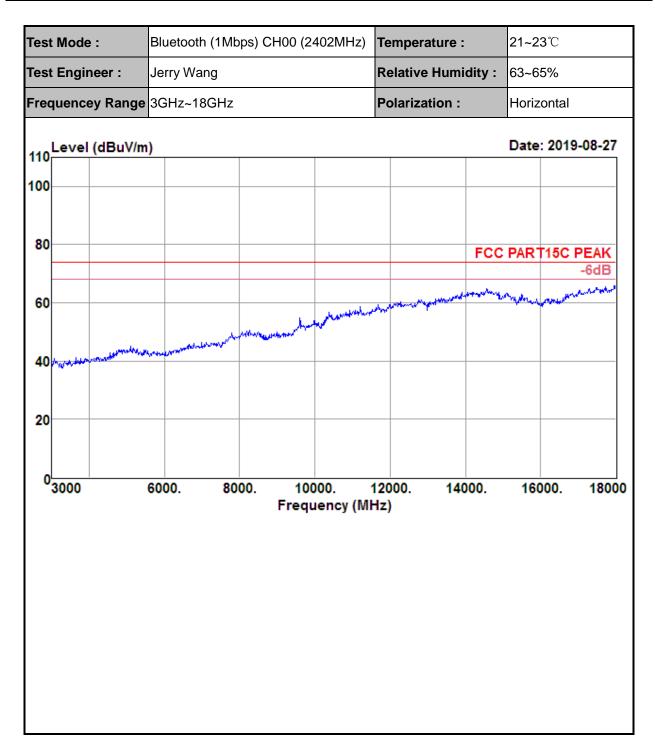
Test Mode :		Bluet	ooth (1Mbp	os) CH78 (ature :	21~23 ℃	21~23 ℃		
Test Engine	er :	Jerry	Wang			Relative	Humidity :	63~65%	
Frequencey	Range	2.477	GHz~2.51	0GHz		Polarization : Vertical			
110	el (dBu\	//m)						Date: 20	19-08-27
100									
80	\wedge								
60								FCC PAR	F15C AV -6dB
40									
20		2							
0 <mark></mark>	2480.24	482.24	84.2486.24		2492.2494.: equency (N		.2500.2502.	2504.2506	. 2510
Freq MHz	Read leve dBuV	1	Antenna factor dB/m		Preamp factor dB	level	Limit level dBuV/m	Over limit dB	Remark
2479.970 2483.500 2500.000	86. 29. 28.	40	27.36		35. 67 35. 68 35. 70	24.67	54.00 54.00 54.00		Average Average Average



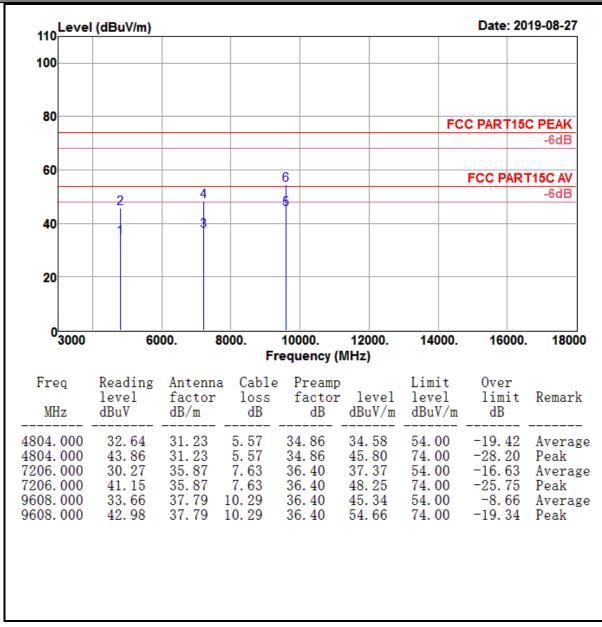
4.8.5 Test Result of Radiated Spurious Emission (1GHz ~ 10th Harmonic)









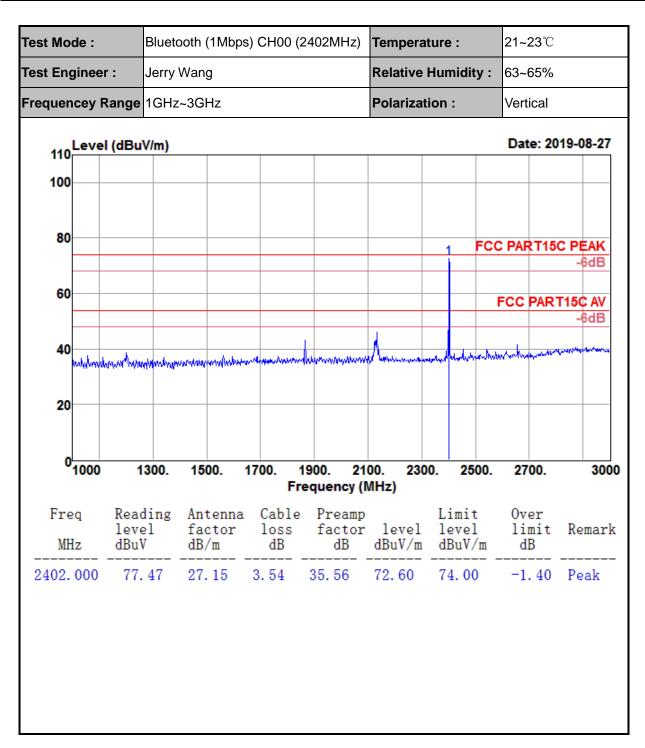


Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

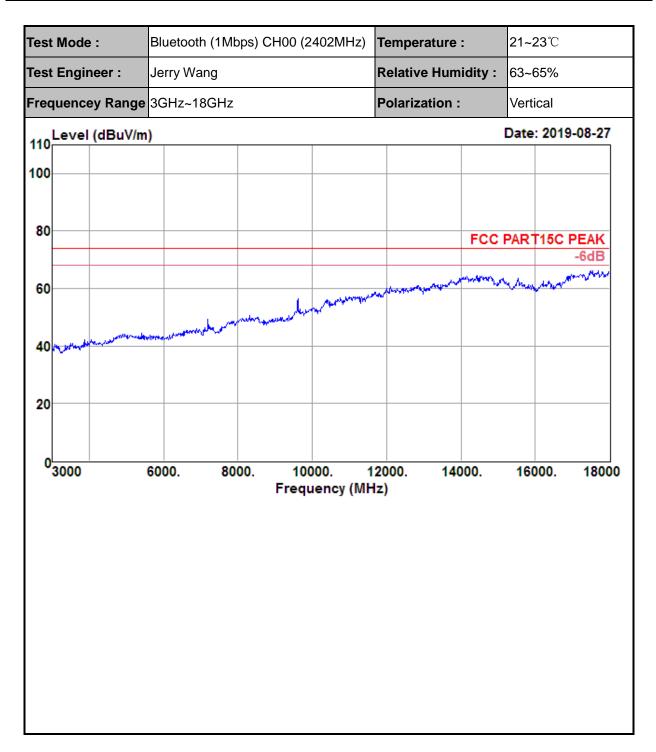
ECLOUD





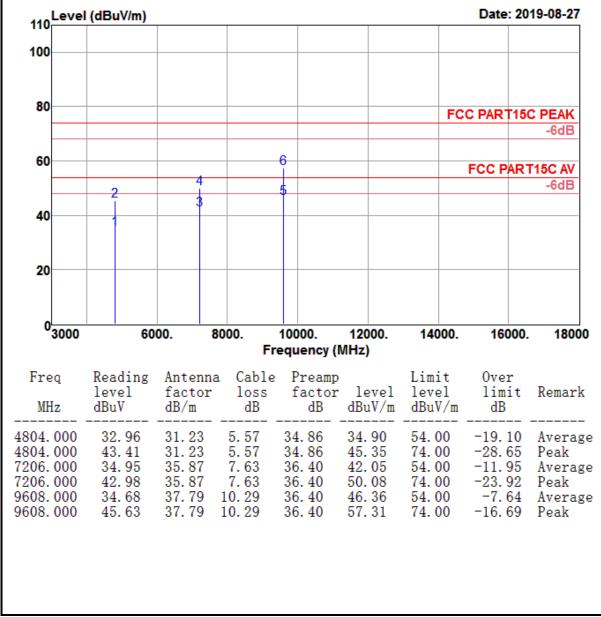








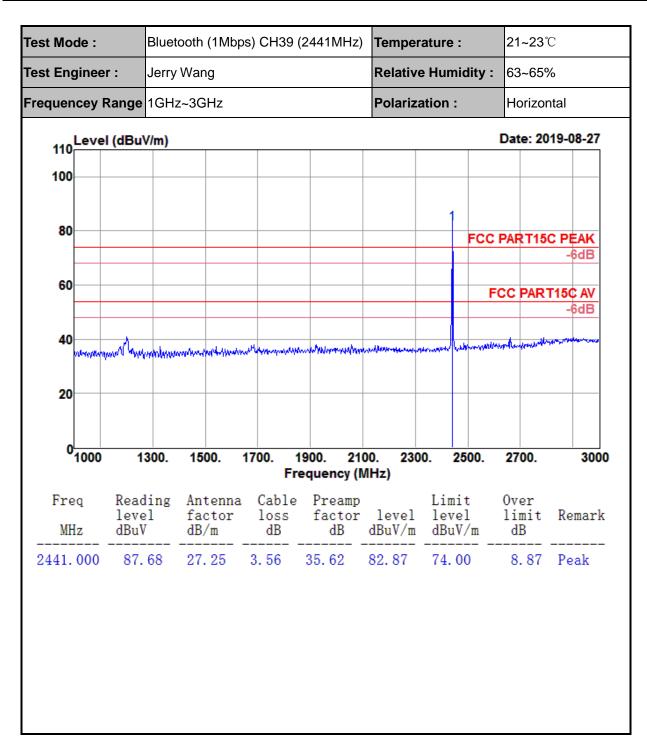
Report No.: EC1908013RF01



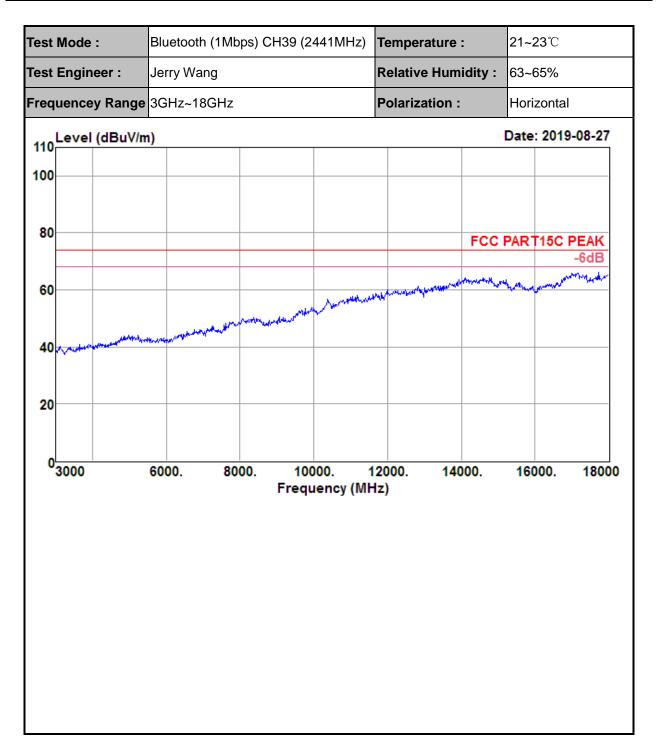
Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.



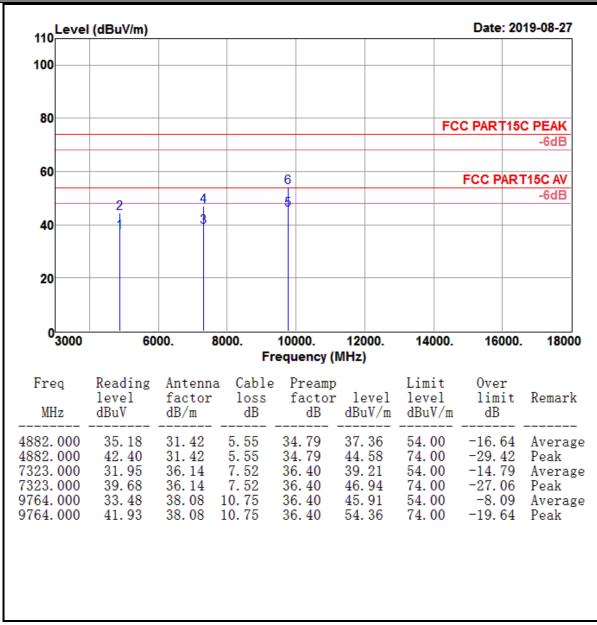








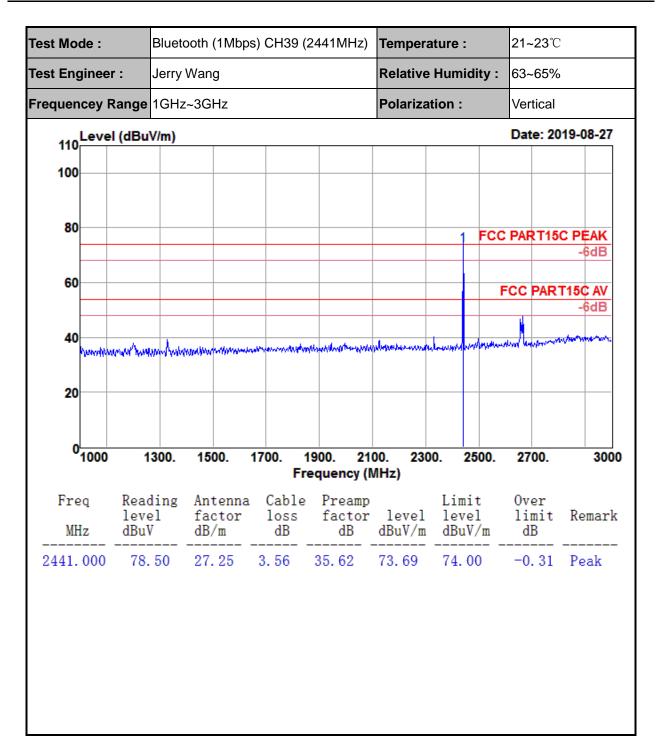




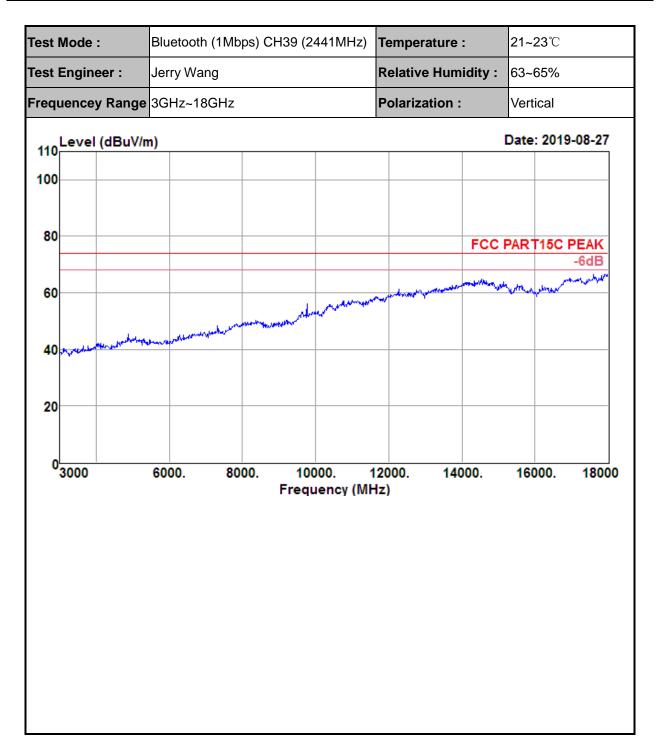
Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

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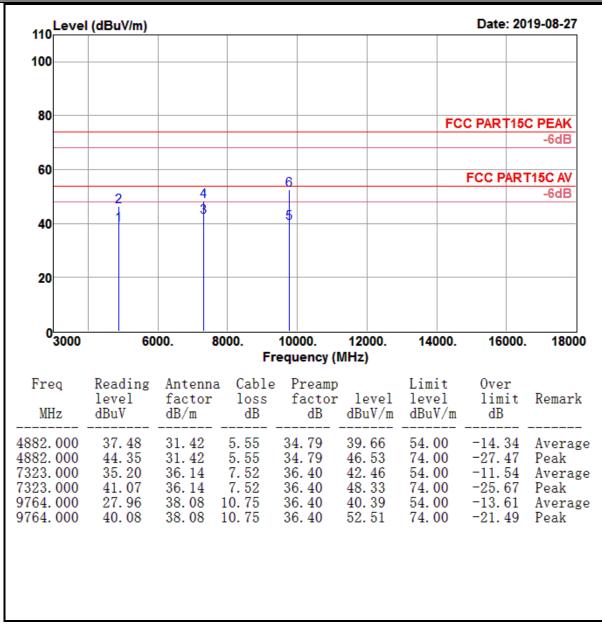








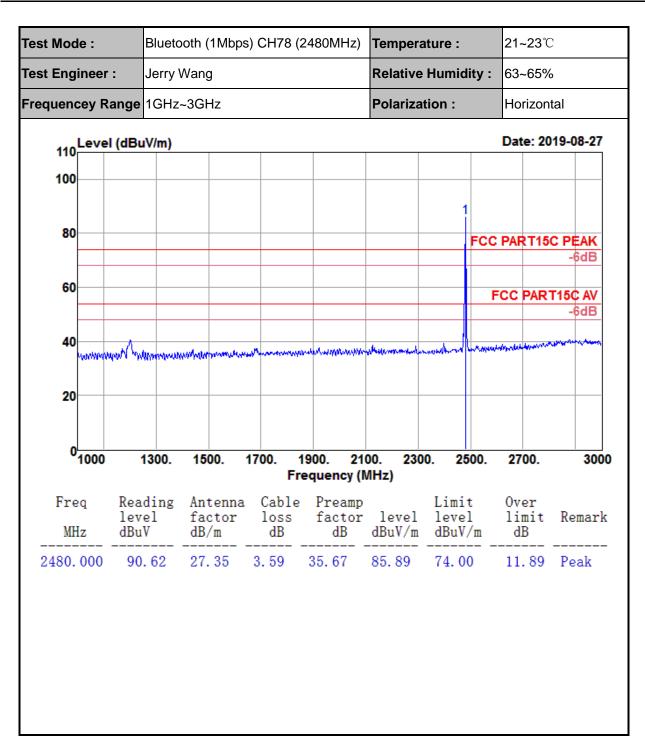




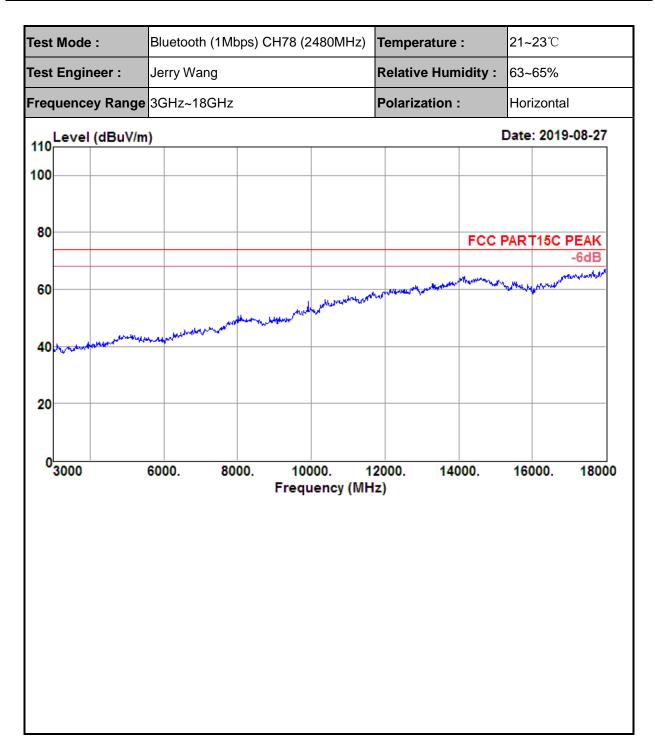
Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

ECLOUD





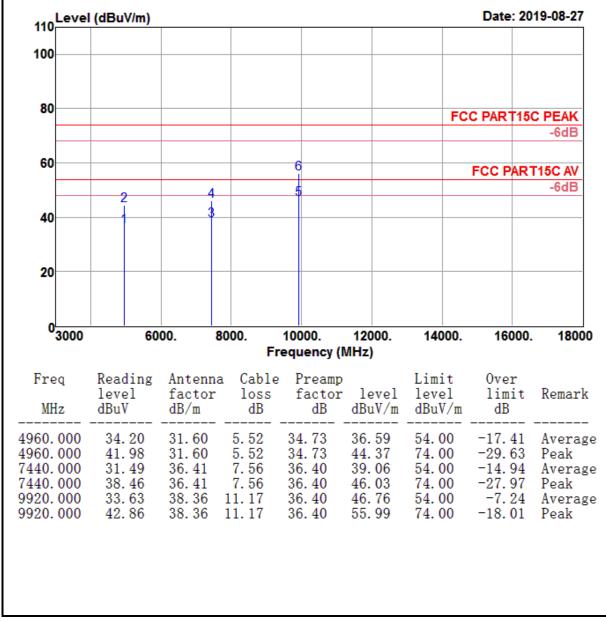






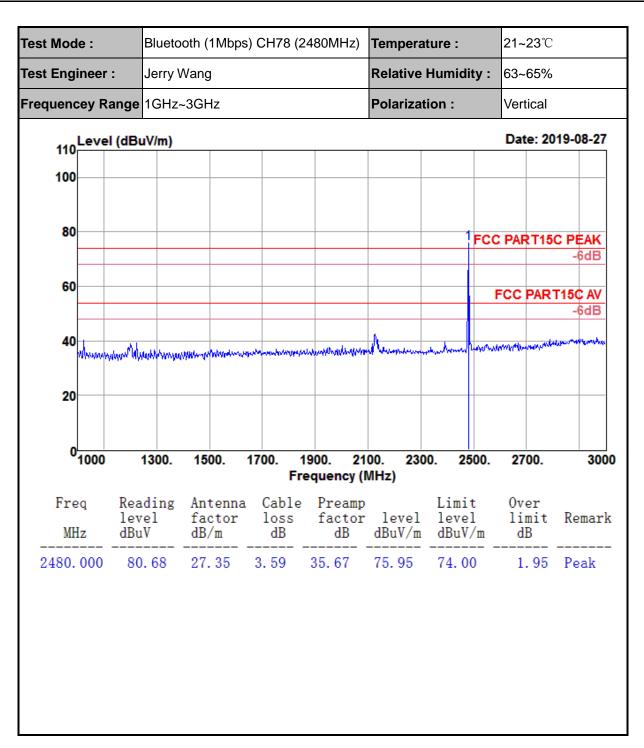
ECLOUD

Report No.: EC1908013RF01

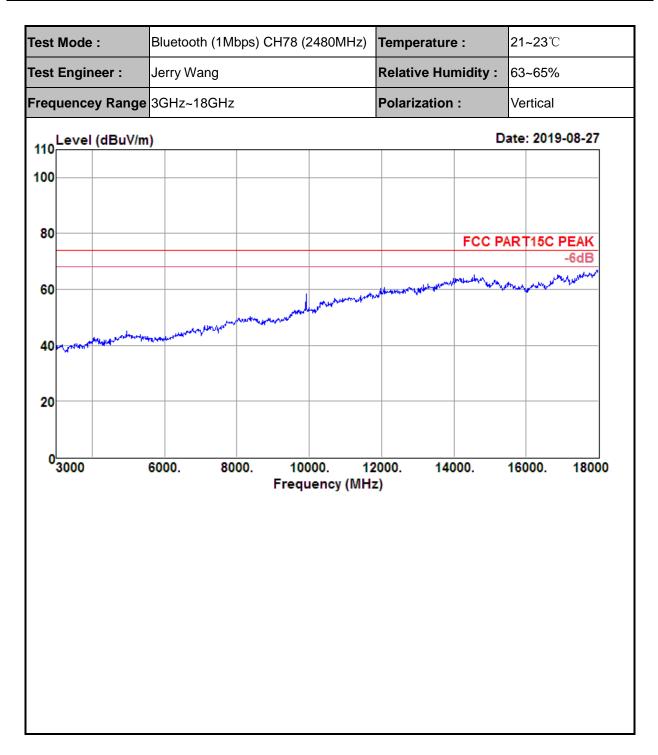


Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

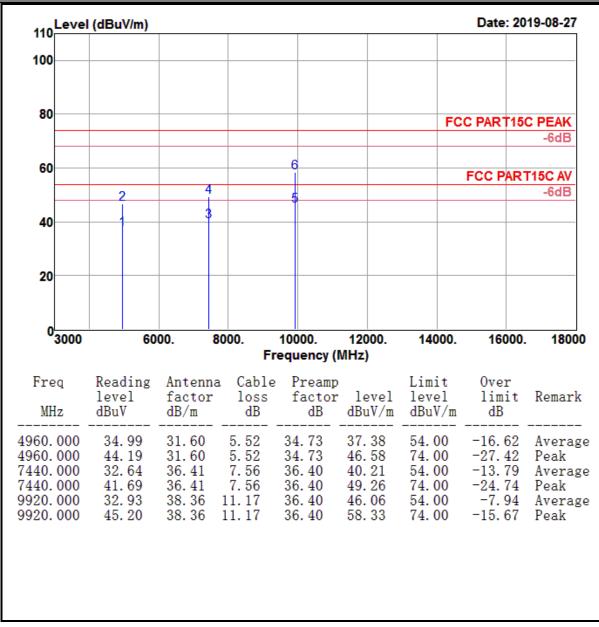












Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

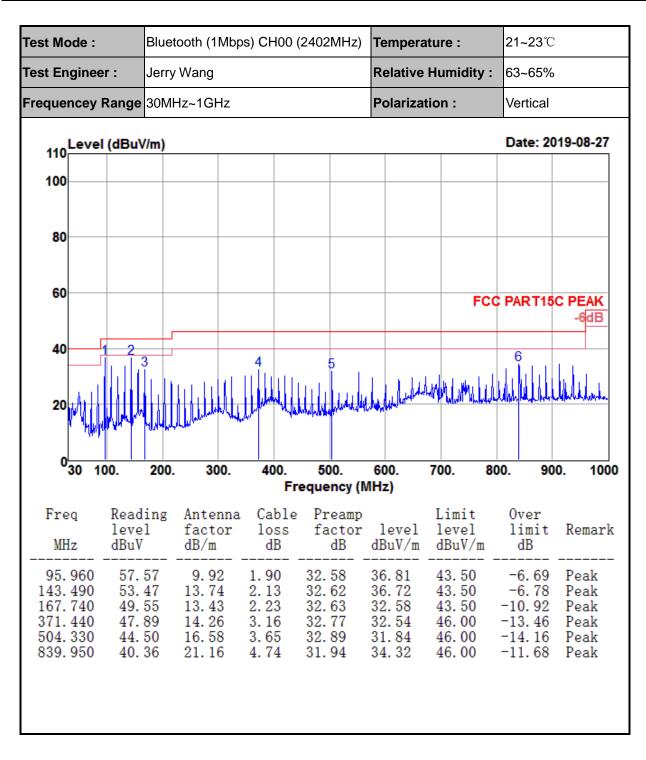
ECLOUD



4.8.6 Test Result of Radiated Spurious Emission (30MHz ~ 1GHz)

Test Mode :		Blueto	ooth (1Mk	ops) CH00	(2402MHz)	Tempera	iture :	21~23 ℃		
Test Engine	er:	Jerry	Wang			Relative	Humidity :	63~65%	63~65%	
Frequencey	Range	30MH	lz~1GHz			Polarizat	tion :	Horizonta	al	
110	(dBuV	m)						Date: 20	19-08-27	
100										
80										
60							FCC	PART15	C PEAK -6dB	
40 20	2 					ledgelderstaat	ud Madelal de la			
030 10	00.	200.	300.	400.	500.	600.	700. 80	00. 90		
00 1		200.		Fr	equency (N				0. 1000	
Freq MHz	Readi level dBuV	ng	Antenna factor dB/m		equency (N	(Hz)	Limit level dBuV/m	Over limit dB	0. 1000 Remark	







4.9 AC Conducted Emission Measurement

4.9.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

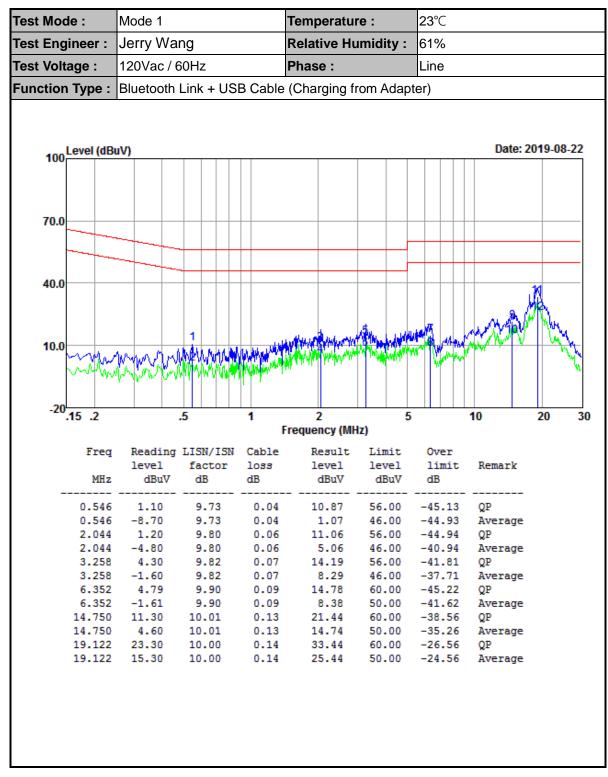
Frequency of omission (MHz)	Conducted limit (dBµV)					
Frequency of emission (MHz)	Quasi-peak	Average				
0.15-0.5	66 to 56*	56 to 46*				
0.5-5	56	46				
5-30	60	50				

*Decreases with the logarithm of the frequency.

4.9.2 Test Procedures

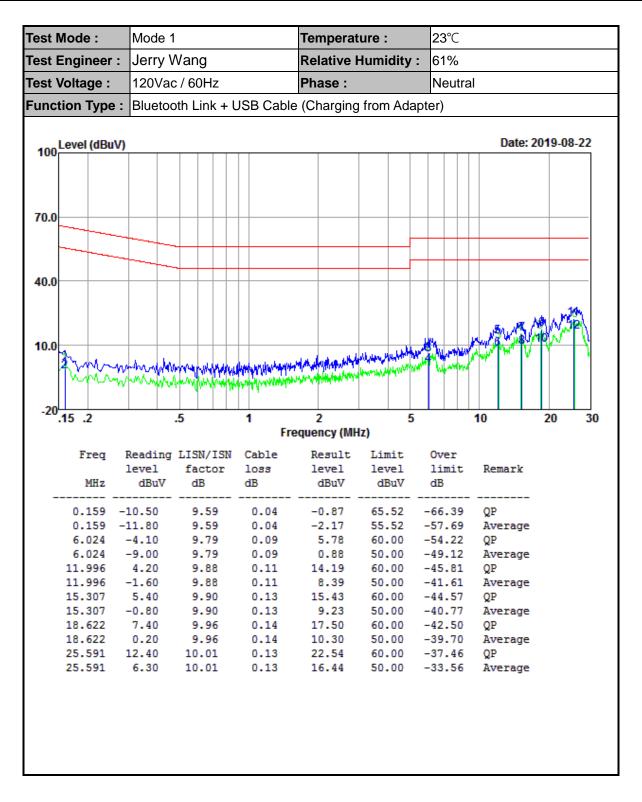
- 7. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- 8. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- 9. All the support units are connecting to the other LISN.
- 10. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- 11. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
- 12. Both sides of AC line were checked for maximum conducted interference.
- 13. The frequency range from 150 kHz to 30 MHz was searched.
- 14. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.





4.9.3 Test Result of AC Conducted Emission







4.10 Antenna Requirements

4.10.1 Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded..

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

4.10.2 Antenna Connected Construction

An embedded-in antenna design is used.

4.10.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	Keysight	N9010A	MY56070788	2019/1/23	2020/1/22	Conducted
Power Sensor	Keysight	U2021XA	MY56510025	2019/1/23	2020/1/22	Conducted
Power Sensor	Keysight	U2021XA	MY57030005	2019/1/23	2020/1/22	Conducted
Power Sensor	Keysight	U2021XA	MY56510018	2019/1/23	2020/1/22	Conducted
Power Sensor	Keysight	U2021XA	MY56480002	2019/1/23	2020/1/22	Conducted
Thermal Chamber	Sanmtest	SMC-408-CD	2435	2019/05/09	2020/05/08	Conducted
Base Station	R&S	CMW 270	101231	2019/1/23	2020/1/22	Conducted
Signal Generator (Blocker)	Keysight	N5171B	MY56200661	2019/1/23	2020/1/22	Conducted

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV 40	101433	2019/2/18	2020/2/17	Radiation
Amplifier	Sonoma	310	363917	2019/1/22	2020/1/21	Radiation
Amplifier	Schwarzbeck	BBV 9718	327	2019/1/22	2020/1/21	Radiation
Amplifier	Narda	TTA1840-35-HG	2034380	2019/05/15	2020/05/14	Radiation
Broadband Antenna	Schwarzbeck	VULB 9168	9168-757	2017-03-03	2020-03-02	Radiation
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2017-03-03	2020-03-02	Radiation
Horn Antenna	COM-POWER	AH-1840	101117	2018-06-20	2021-06-19	Radiation
Test Software	Auidx	E3	6.111221a	N/A	N/A	Radiation
Filter	Micro-Tronics	BRM 50702	G266	N/A	N/A	Radiation

N/A: No Calibration Required



6 Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.60dB
	30MHz ~ 1GMHz	5.05dB
Radiated emission	1GHz ~ 18GHz	5.06 dB
	18GHz ~ 40GHz	3.65dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

-----End of the report-----