RADIO TEST REPORT

Test Report No. : 4787971961-E2V2

Applicant	:	**TAIYO YUDEN CO., LTD.**
Type of Equipment	:	**Bluetooth Dual-mode Module**
Model No.	:	**EYSGCC**
FCC ID	:	**RYYEYSGCC**
Test regulation	:	**FCC Part 15 Subpart C: 2017**
Test Result	:	**Complied**

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Korea has been accredited.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)

Date of test: June 14, 2017 to July 05, 2017

Representative test engineer:

Junwhan Lee
Senior test Engineer
Consumer Technology Division

Approved by:

Sunggil Park
Lead test Engineer
Consumer Technology Division

ACCREDITED
TL-637

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 4787971961-E2V1

Revision	Test report No.	Date	Page revised	Contents
- Original	4787971961-E2V1	June 30, 2017	-	-
1	4787971961-E2V2	July 05, 2017	7,10,12	Added description

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SECTION 1: Customer information

Company Name	:	TAIYO YUDEN CO., LTD.
Address	:	8-1,Sakae-cho, Takasaki-shi, Gunma 370-8522 ,Japan
Telephone Number	:	+81-(0)27 324 2313
Facsimile Number	:	+81-(0)27 324 2314
Contact Person	:	Mitsuo Takagi

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Bluetooth Dual-mode Module
Model No.	:	EYSGCC
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 2.7 V to 4.3 V(Typical DC 3.7 V)
Receipt Date of Sample	:	May 22, 2017
Country of Mass-production	:	Japan
Condition of EUT	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

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2.2 Product Description

Model: EYSGCC (referred to as the EUT in this report) is a Bluetooth Dual-mode Module.

Radio Specification

[Bluetooth]

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz – 2480 MHz
Modulation	:	FHSS
Power Supply (radio part input)	:	DC 3.7 V
Antenna type	:	PCB Antenna
Antenna Gain	:	-0.8 dBi
Clock frequency (Maximum)	:	26MHz

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C FCC Part 15 final revised on June 14, 2017 and effective July 14, 2017
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiator Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz

*The revision on June 14, 2017, does not affect the test specification applied to the EUT.

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3.2 Procedures and results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods	**FCC:** Section 15.207 *2)	**PK** 25.7 dB, 3.696 MHz, L **PK** 13.62 dB, 27.24 MHz, N	Complied	-
	IC: RSS-Gen 8.8	**IC:** RSS-Gen 8.8			
Carrier Frequency Separation	**FCC:** FCC Public Notice DA 00-705	**FCC:** Section15.247(a)(1)	See data.	Complied	Conducted
	IC: -	**IC:** RSS-247 5.1 (b)			
20dB Bandwidth	**FCC:** FCC Public Notice DA 00-705	**FCC:** Section15.247(a)(1)		Complied	Conducted
	IC: -	**IC:** RSS-247 5.1 (a)			
Number of Hopping Frequency	**FCC:** FCC Public Notice DA 00-705	**FCC:** Section15.247(a)(1)(iii)		Complied	Conducted
	IC: -	**IC:** RSS-247 5.1 (d)			
Dwell time	**FCC:** FCC Public Notice DA 00-705	**FCC:** Section15.247(a)(1)(iii)		Complied	Conducted
	IC: -	**IC:** RSS-247 5.1 (d)			
Maximum Peak Output Power	**FCC:** FCC Public Notice DA 00-705	**FCC:** Section15.247(a)(b)(1)		Complied	Conducted
	IC: RSS-Gen 6.12	**IC:** RSS-247 5.4 (b)			
Spurious Emission & Band Edge Compliance	**FCC:** FCC Public Notice DA 00-705	**FCC:** Section15.247(d)	7.85 dB 2246.00 MHz, AV, Horizontal	Complied	Conducted (9kHz to 26.5GHz)/ Radiated (above 9 kHz) *1)
	IC: RSS-Gen 6.13	**IC:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

Note: UL Korea, Inc.'s EMI Work Procedures No. UL-QI-1720(00), UL-QI-1723(00), UL-QI-1724(00), UL-QI-1725(00), UL-QI-1726(00), UL-QI-1728(00), UL-QI-1730(00), UL-QI-1731(00)
*1) Radiated test was selected over 9 kHz based on section 15.247(d).
*2) CISPR22 Limit applied on the test plot.

* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

FCC Part 15.31 (e)

This EUT provides stable voltage (DC 1.35V) constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	**IC:** RSS-Gen 6.6	**IC:** -	N/A	-	Conducted

Other than above, no addition, exclusion nor deviation has been made from the standard.

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3.4 Uncertainty

EMI
Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	2.32 dB
Radiated Disturbance, Below 1GHz	4.14 dB
Radiated Disturbance, Above 1 GHz	5.97 dB

Uncertainty figures are valid to a confidence level of 95%.

3.5 Test Location

UL Korea, Ltd. Suwon Lab. IAS Lab. code: TL-637
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea
Telephone: +82 31 337 9902, Facsimile: +82 31 213 5433

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 semi-anechoic chamber	2324M-1	9.1 x 9.1 x 6.3	2.3 x 2.3	3 m
No.2 semi-anechoic chamber	2324M-1	9.1 x 9.1 x 6.3	2.3 x 2.3	3 m
No.1 shielded room	-	4.0 x 3.4 x 3.0	N/A	-
No.2 shielded room	-	4.0 x 3.4 x 3.0	N/A	-
No.3 shielded room	-	4.6 x 4.0 x 3.0	4.6 x 4.0	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Bluetooth (BT): Transmitting (Tx), Payload: PRBS9

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Conducted Emission	Tx (Hopping Off) DH5	2480 MHz
Spurious Emission (Conducted/Radiated)	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Carrier Frequency Separation	Tx (Hopping On) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
20dB Bandwidth	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Number of Hopping Frequency	Tx (Hopping On) DH5, 3DH5	-
Dwell time	Tx (Hopping On), -DH1, DH3, DH5 -3DH1, 3DH3, 3DH5	-
Maximum Peak Output Power	Tx (Hopping Off) DH5, 2DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Band Edge Compliance (Conducted)	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2480 MHz
99% Occupied Bandwidth	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2441 MHz 2480 MHz

*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test)
*2DH mode (2Mb/s EDR: pi/4DQPSK) was excluded for other tests than power measurement by using 3DH mode (3 Mb/s EDR: 8DPSK) as a representative.
* It is considered that the non-tested packet type (e.g. inquiry) can be omitted as it is complied with above all test items based on Bluetooth Core specification.

*EUT has the power settings by the software as follows;

Power settings:	BDR:	Ext.=255,	Int.=50
	EDR:	Ext.=255,	Int.=50
Software:	CSR Blue Test 3 2.6.2.632		

*This setting of software is the worst case.
Any conditions under the normal use do not exceed the condition of setting.
In addition, end users cannot change the settings of the output power of the product.

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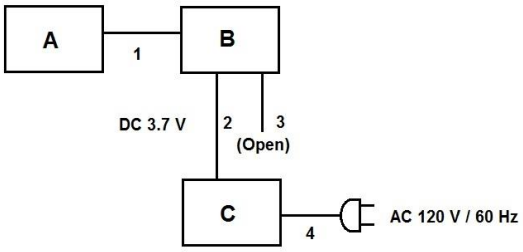
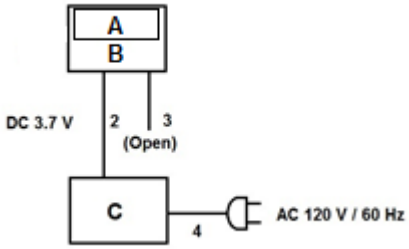
4.2 Configuration and peripherals



[Radiated test, Conducted Emission test set-up]



[Antenna port conducted test set-up]

* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Bluetooth dual mode module	EYSGCC	0000A4170417 *1) AC3FA40017B1 *2)	TAIYO YUDEN CO., LTD	EUT
B	Module Jig	PB-TE8635-3	AC3FA40017AF *1) AC3FA40017B0 *2)	TAIYO YUDEN CO., LTD	
C	DC Power supply	E3640A	MY54236144	Agilent	

*1) Used for Antenna Terminal conducted test
(Cable loss of module jig already applied correction factor of spectrum analyzer and offset of power meter)
*2) Used for Conducted Emission test and Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal & DC	0.2	Unshielded	Unshielded	Use only radiated and conducted emission test
2	DC	2.0	Unshielded	Unshielded	-
3	USB	0.3	Unshielded	Unshielded	-
4	AC	1.5	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure and conditions

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Detector	**: QP and CISPR AV**
Measurement range	**: 0.15 MHz - 30 MHz**
Test data	**: APPENDIX**
Test result	**: Pass**

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SECTION 6: Radiated Spurious Emission

Test Procedure

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz and 150 cm for above 1GHz. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.
For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements.(Pre-scans to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.)
For band edge measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1/T (on time) for average measurement.

GFSK = 1/T = 1 / 0.0029S = 350Hz.

The minimum VBW was 350Hz, but test receiver (ESU40) couldn't set value 350Hz. Due to this reason, testing VBW was set to 500Hz (Worst cases).
The spectrum from 1GHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band. (From 30MHz to 1GHz, test was performed with the EUT set to transmit at the channel with highest output power)
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

Note : Emission was pre-scanned from 9KHz to 30MHz; No emissions were detected which was at least 20dB below the specification limit (consider distance correction factor). Per FCC part 15.31(o), test results were not reported.

Test Antennas are used as below;

Frequency	30 MHz to 1 GHz	Above 1 GHz
Antenna Type	Bilog	Horn

Frequency	Below 1 GHz	Above 1GHz	
Instrument used	Test Receiver	Test Receiver	
Detector	QP	PK	AV
IF Bandwidth	BW 120 kHz	Spurious RBW: 1 MHz VBW: 3 MHz Band Edge RBW: 1 MHz VBW: 3 MHz	Spurious RBW: 1 MHz VBW: 500 Hz Band Edge RBW: 1 MHz VBW: 500 Hz
Test Distance	3 m	3 m (1GHz – 26.5GHz)	

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement range : 30 MHz - 26.5 GHz
Test data : APPENDIX
Test result : Pass

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SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
20dB Bandwidth	3 MHz	30 kHz	100 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	> Three times of RBW	Auto	Sample	Clear write	Spectrum Analyzer
Maximum Peak Output Power	10 MHz	3MHz	50MHz	Auto	Peak	Max Hold	Spectrum Analyzer
AVG Output Power	-	-	-	-	Average *1)	-	Power meter
Carrier Frequency Separation	3 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Number of Hopping Frequency	30 MHz	300 kHz	910 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Dwell Time	Zero Span	300 kHz, 8 MHz	300 kHz, 50 MHz	As necessary capture the entire dwell time per hopping channel	Peak	Clear Write	Spectrum Analyzer
Conducted Spurious Emission *2)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				
	30 MHz to 26.5 GHz	100 kHz	300 kHz				
Conducted Spurious Emission Band Edge compliance	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

*1) Reference data
*2) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.

Then, wide-band noise near the limit was checked separately, however the noise was low enough as shown in the chart.
(9 kHz - 150 kHz: RBW = 200Hz, 150 kHz - 30 MHz: RBW = 10 kHz).

The test results and limit are rounded off to two decimals place, so some differences might be observed.

Test data : APPENDIX
Test result : Pass

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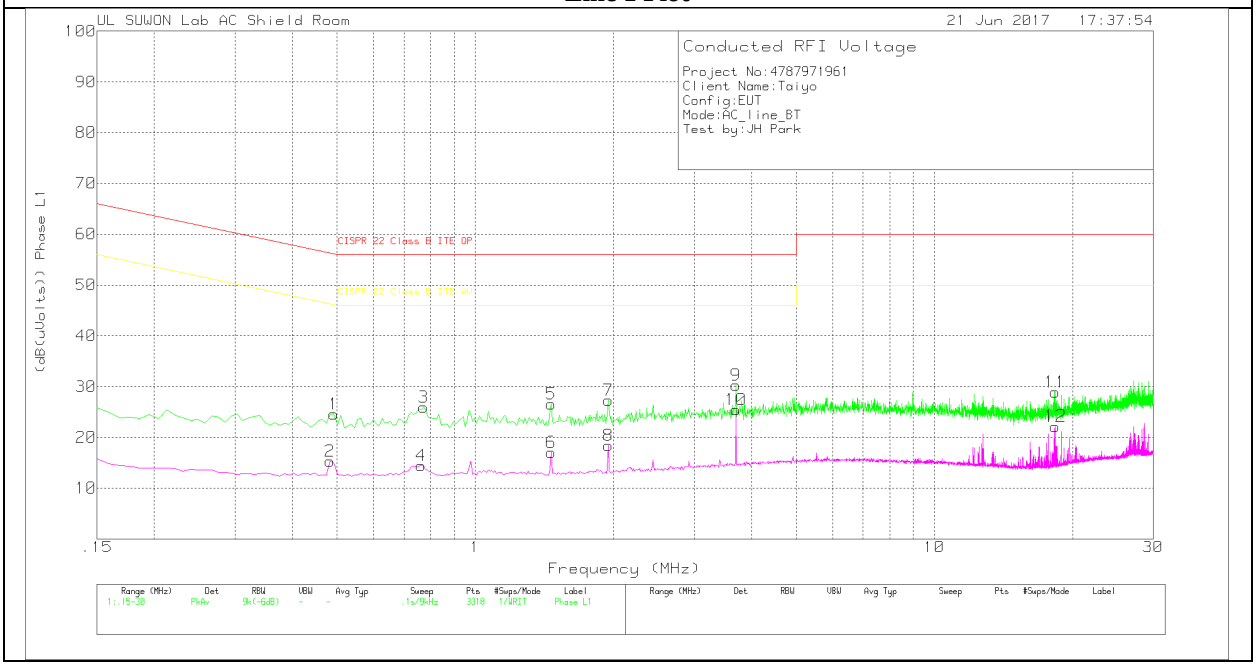
APPENDIX 1: Test data

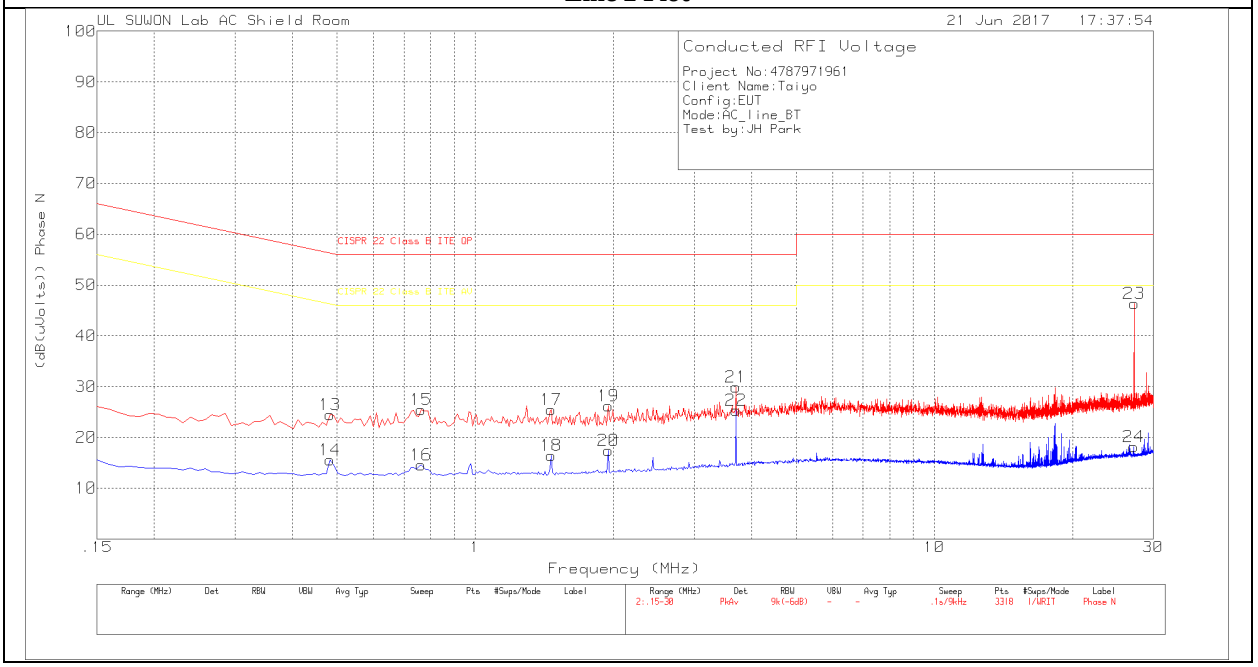
Conducted Emission

Test place	Suwon Lab. No.3 Shield room 3
Report No.	4787971961-E2V2
Date	June 21, 2017
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	JH Park
Mode	Tx, Hopping Off, DH5, 2480MHz

Line 1 Plot



Line 2 Plot



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LINE 1 RESULTS

Trace Markers

Phase L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101837_with ex-cord_L1	CABLELOSS(dB)	Corrected Reading (dB(uVolts))	CISPR 22 Class B ITE QP	Margin (dB)	CISPR 22 Class B ITE AV	Margin (dB)
1	.492	14.48	Pk	9.9	.2	24.58	56.13	-31.55	-	-
2	.483	5.2	Av	9.9	.2	15.3	-	-	46.29	-30.99
3	.771	15.82	Pk	9.9	.2	25.92	56	-30.08	-	-
4	.762	4.3	Av	9.9	.2	14.4	-	-	46	-31.6
5	1.464	16.43	Pk	9.8	.3	26.53	56	-29.47	-	-
6	1.464	6.99	Av	9.8	.3	17.09	-	-	46	-28.91
7	1.95	17.3	Pk	9.7	.3	27.3	56	-28.7	-	-
8	1.95	8.41	Av	9.7	.3	18.41	-	-	46	-27.59
9	3.696	20.2	Pk	9.8	.3	30.3	56	-25.7	-	-
10	3.696	15.38	Av	9.8	.3	25.48	-	-	46	-20.52
11	18.366	18.26	Pk	10.3	.4	28.96	60	-31.04	-	-
12	18.366	11.47	Av	10.3	.4	22.17	-	-	50	-27.83

Pk - Peak detector

Av - Average detection

LINE 2 RESULTS

Trace Markers

Phase N .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101837_with ex-cord_N	CABLELOSS(dB)	Corrected Reading (dB(uVolts))	CISPR 22 Class B ITE QP	Margin (dB)	CISPR 22 Class B ITE AV	Margin (dB)
13	.483	14.34	Pk	9.9	.2	24.44	56.29	-31.85	-	-
14	.483	5.42	Av	9.9	.2	15.52	-	-	46.29	-30.77
15	.762	15.33	Pk	9.9	.2	25.43	56	-30.57	-	-
16	.762	4.42	Av	9.9	.2	14.52	-	-	46	-31.48
17	1.464	15.38	Pk	9.8	.3	25.48	56	-30.52	-	-
18	1.464	6.36	Av	9.8	.3	16.46	-	-	46	-29.54
19	1.95	16.21	Pk	9.7	.3	26.21	56	-29.79	-	-
20	1.95	7.41	Av	9.7	.3	17.41	-	-	46	-28.59
21	3.696	19.8	Pk	9.8	.3	29.9	56	-26.1	-	-
22	3.696	15.22	Av	9.8	.3	25.32	-	-	46	-20.68
23	27.24	35.18	Pk	10.9	.3	46.38	60	-13.62	-	-
24	27.159	6.94	Av	10.9	.3	18.14	-	-	50	-31.86

Pk - Peak detector

Av - Average detection

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20dB Bandwidth and Carrier Frequency Separation

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 16, 2017
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off, DH5

Mode	Freq. [MHz]	20dB Bandwidth [MHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.937	1.000	>= 0.624
DH5	2441.0	0.933	1.000	>= 0.622
DH5	2480.0	0.934	1.000	>= 0.623
3DH5	2402.0	1.269	1.000	>= 0.846
3DH5	2441.0	1.259	1.000	>= 0.839
3DH5	2480.0	1.260	1.000	>= 0.840

Limit: Two-thirds of 20dB Bandwidth or 25kHz (whichever is greater).
No limit applies to 20dB Bandwidth.

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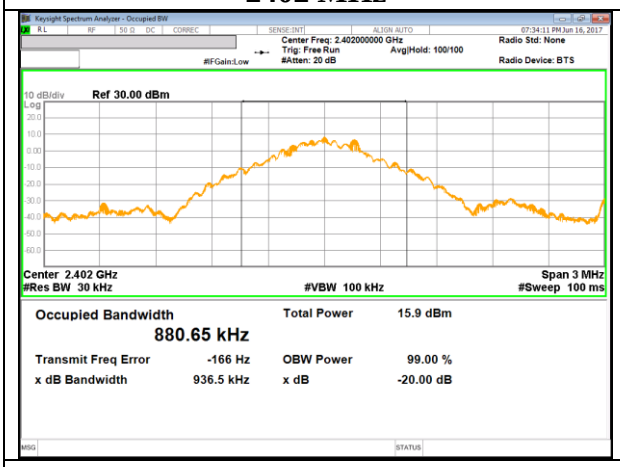
20dB Bandwidth and Carrier Frequency Separation

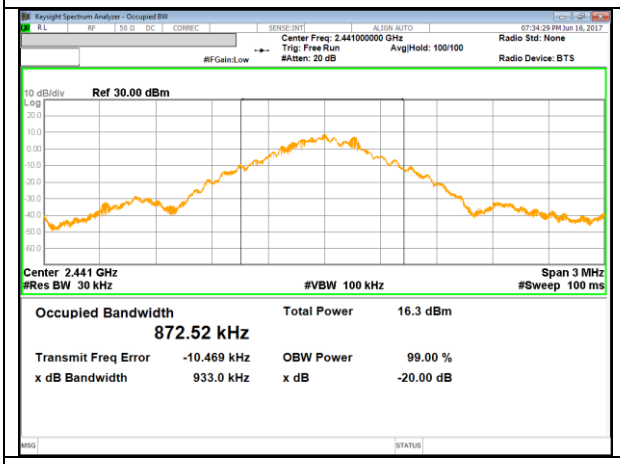
DH5

20 dB Bandwidth

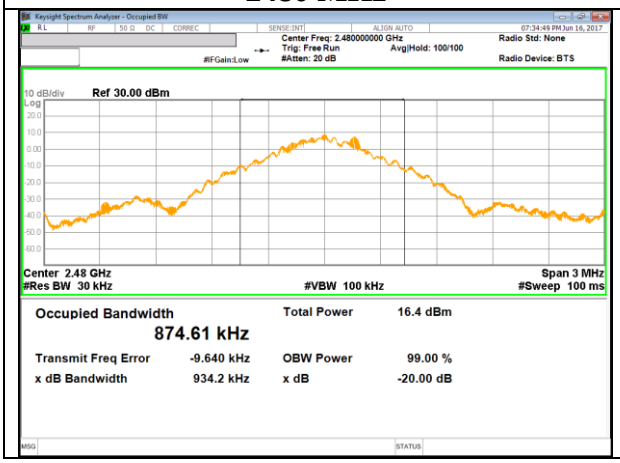
2402 MHz



2441 MHz

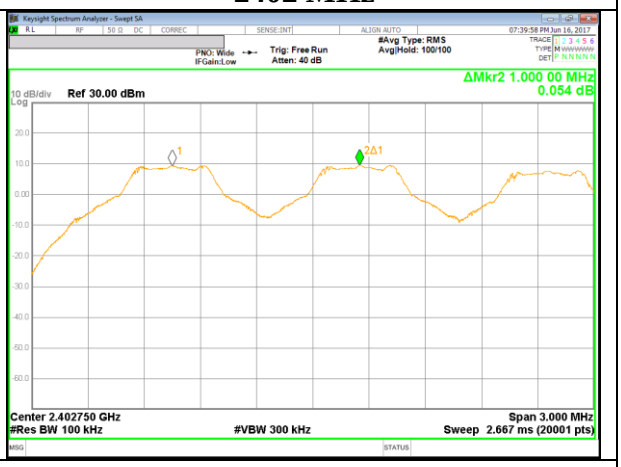


2480 MHz

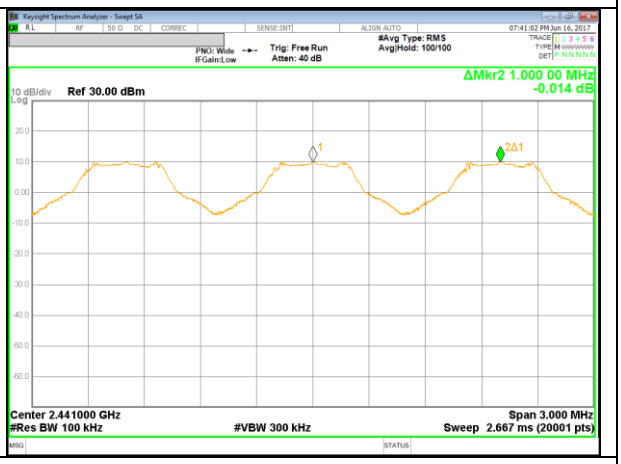


Carrier Frequency Separation

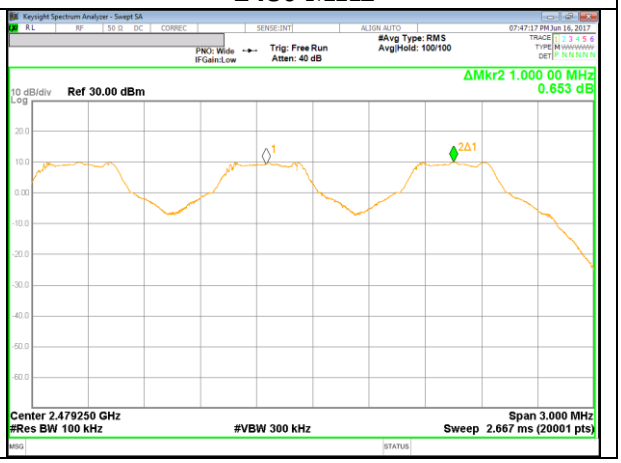
2402 MHz



2441 MHz



2480 MHz



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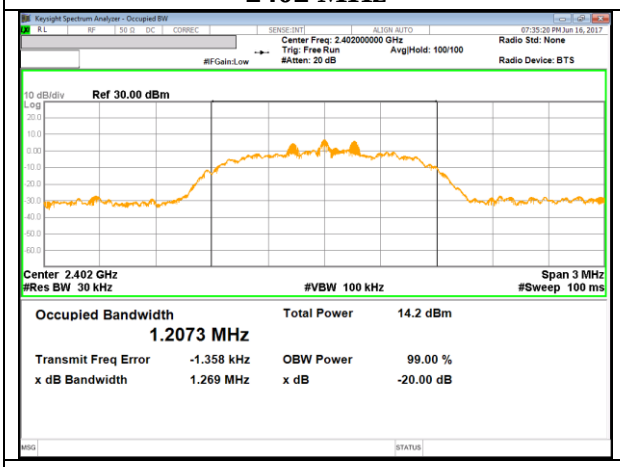
20dB Bandwidth and Carrier Frequency Separation

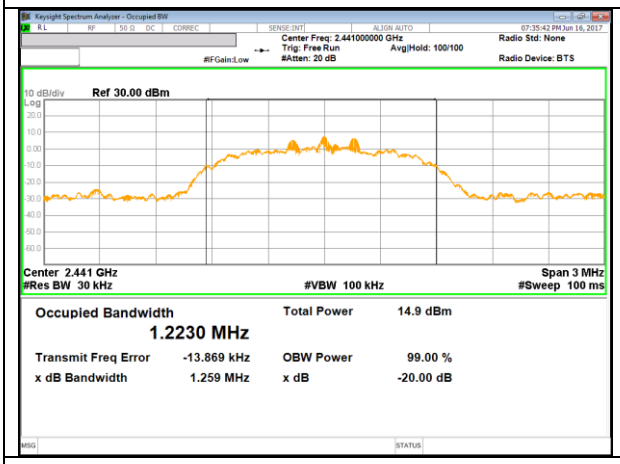
3DH5

20 dB Bandwidth

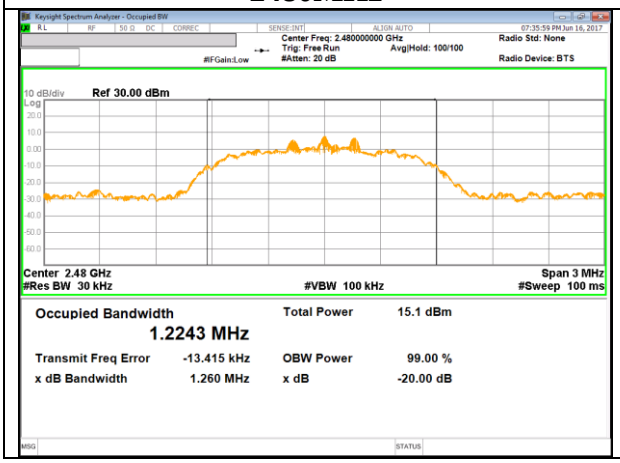
2402 MHz



2441MHz

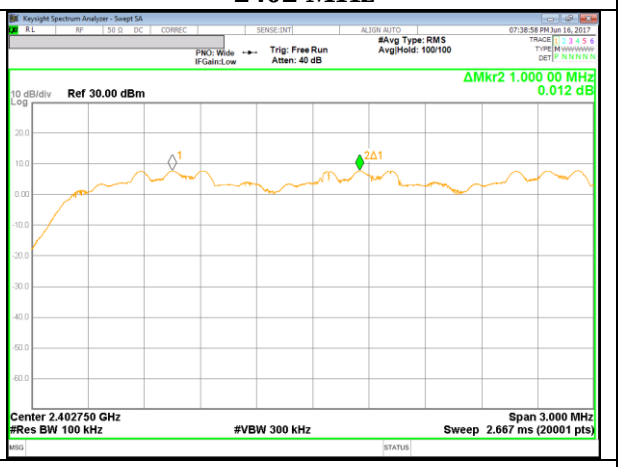


2480MHz

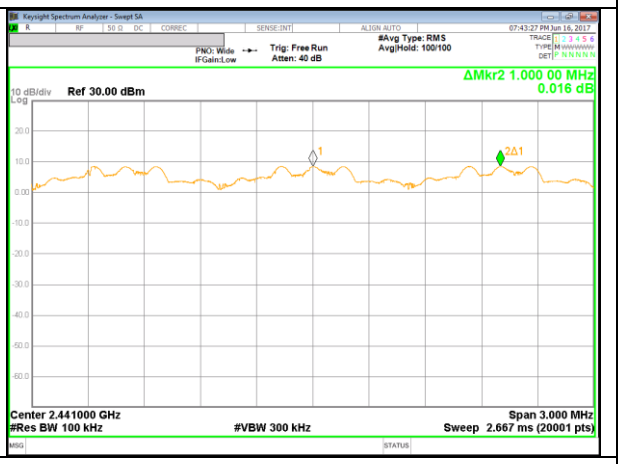


Carrier Frequency Separation

2402 MHz



2441 MHz



2480 MHz

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Number of Hopping Frequency

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 16, 2017
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping On

Mode	Number of channel [channels]	Limit [channels]
DH5	79	>= 15
3DH5	79	>= 15

Test was not performed at AFH mode whose number of hopping channel is 20 channels because this Bluetooth radio is in compliance of Bluetooth Specification.

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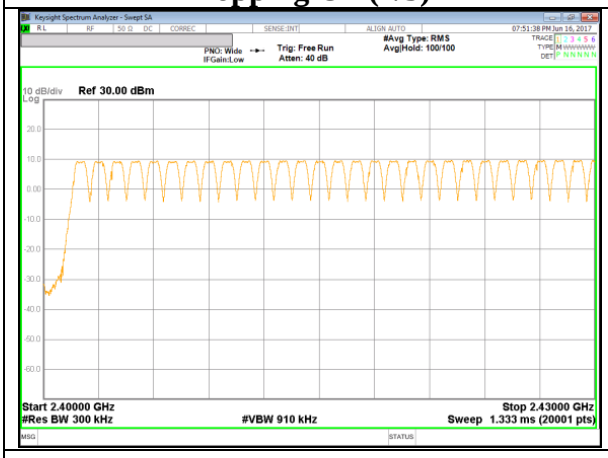
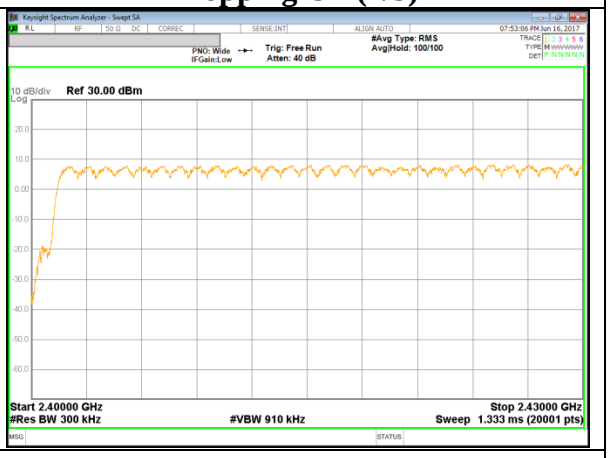
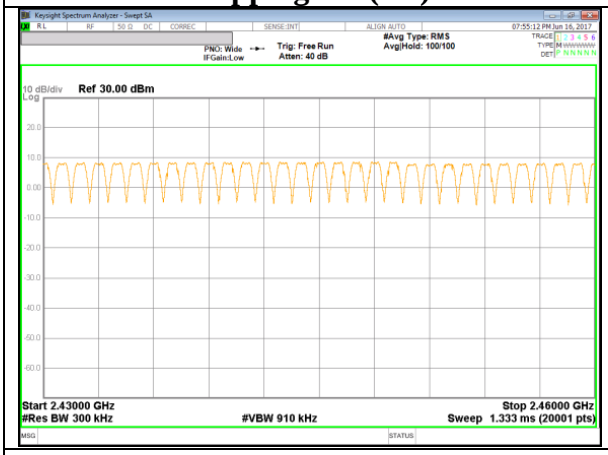
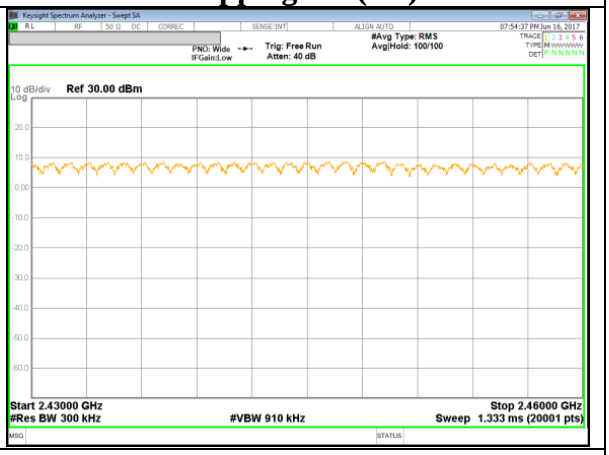
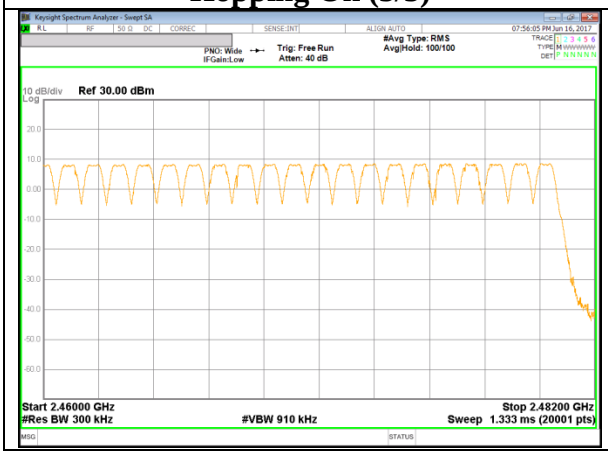
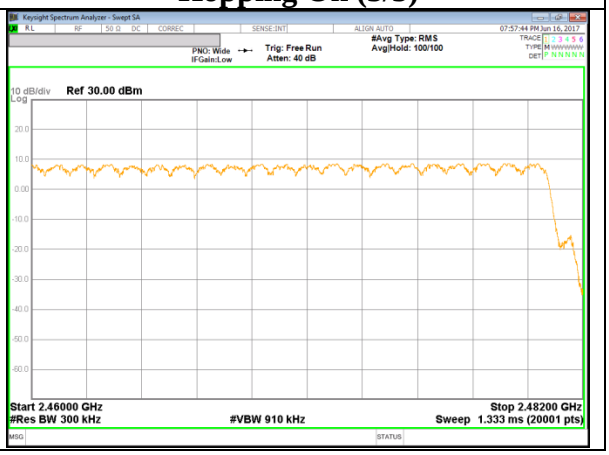
Number of Hopping Frequency

DH5	3DH5
Hopping On (1/3)	**Hopping On (1/3)**
	
Hopping On (2/3)	**Hopping On (2/3)**
	
Hopping On (3/3)	**Hopping On (3/3)**
	

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Dwell time

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 16, 2017
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping On

Mode	Number of transmission in a 31.6(79 Hopping x 0.4) / 12.8 (32 Hopping x 0.4) second period	Length of transmission [msec]	Result [msec]
DH1	32.0 times / 3.16 sec. x 31.6 sec. = 320 times	0.386	124
DH3	16.0 times / 3.16 sec. x 31.6 sec. = 160 times	1.643	263
DH5	11.0 times / 3.16 sec. x 31.6 sec. = 110 times	2.891	318
3DH1	32.0 times / 3.16 sec. x 31.6 sec. = 320 times	0.394	126
3DH3	16.0 times / 3.16 sec. x 31.6 sec. = 160 times	1.650	264
3DH5	11.0 times / 3.16 sec. x 31.6 sec. = 110 times	2.899	319

Sample Calculation
Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	32	32	32	32	32	32
DH3	16	16	16	16	16	16
DH5	11	11	11	11	11	11
3DH1	32	32	32	32	32	32
3DH3	16	16	16	16	16	16
3DH5	11	11	11	11	11	11

Sample Calculation
Average = Summation (Sampling 1 to 5) / 5

This device complies with the Bluetooth protocol for FHSS operation, employing a pseudo random channel selection and hopping rate to ensure that the occupancy time in N x 0.4s, where N is the number of channels being used in the hopping sequence ($20 \leq N \leq 79$), is always less than 0.4s regardless of packet size. This is confirmed in the test report for N = 79.

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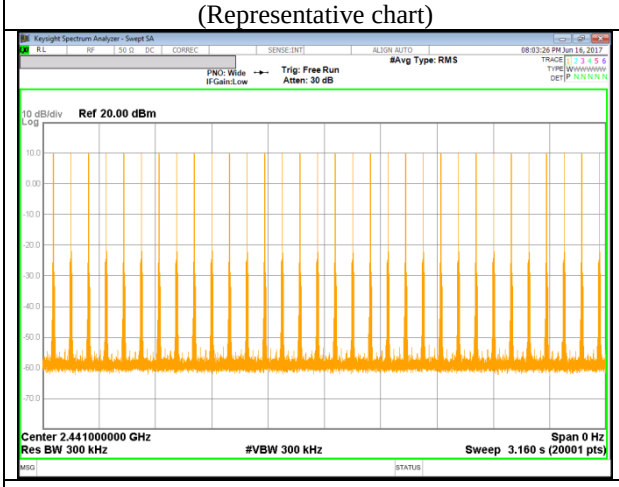
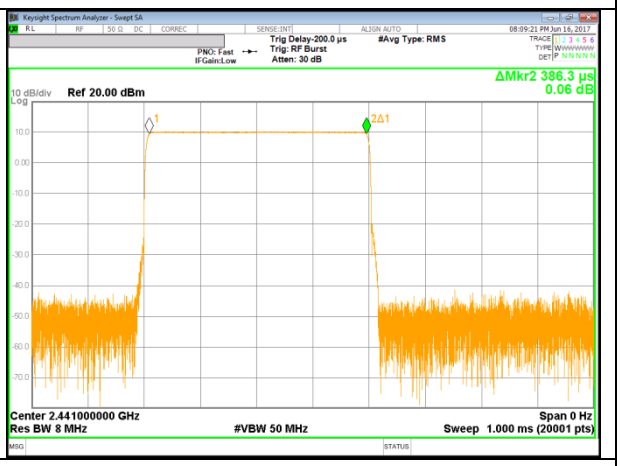
Dwell time

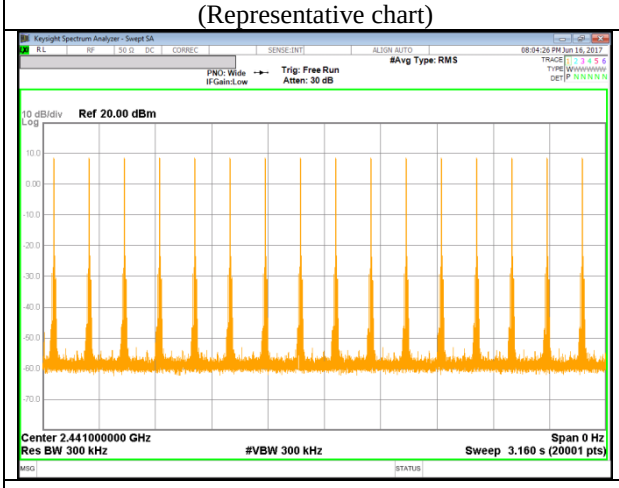
DH1 (1/2)
(Representative chart)



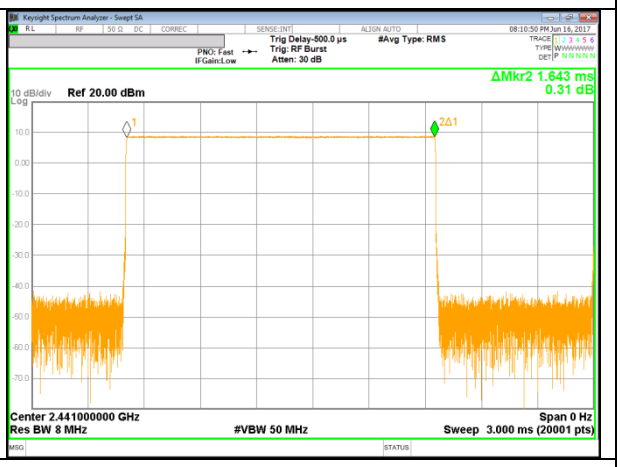
DH1 (2/2)



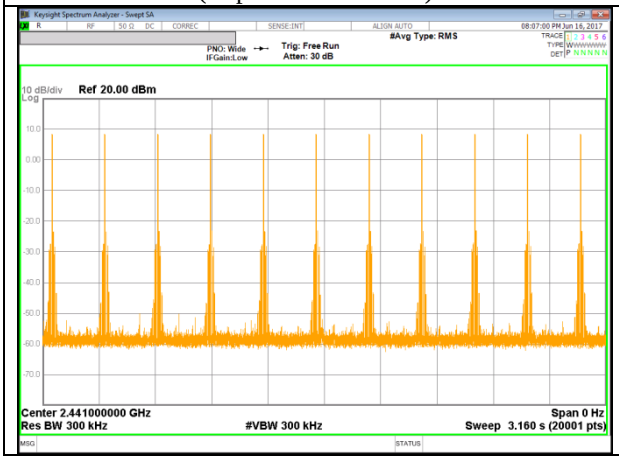
DH3 (1/2)
(Representative chart)



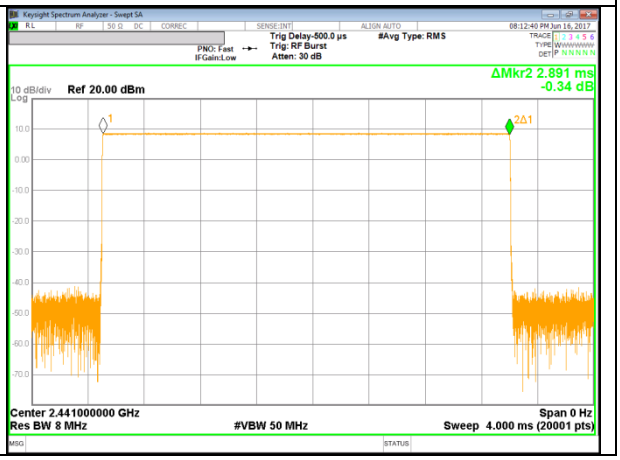
DH3 (2/2)



DH5 (1/2)
(Representative chart)



DH5 (2/2)



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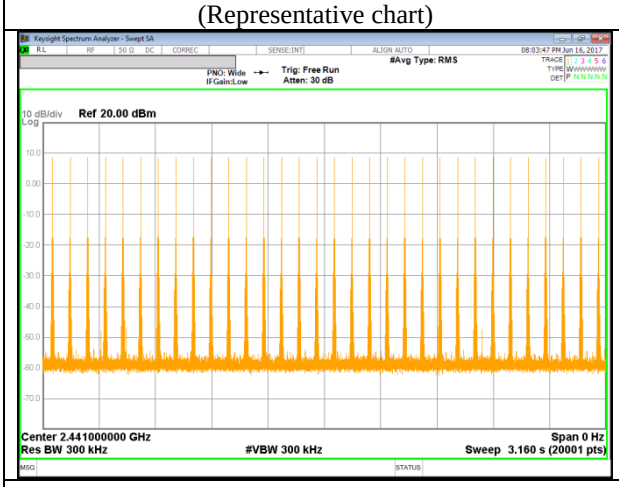
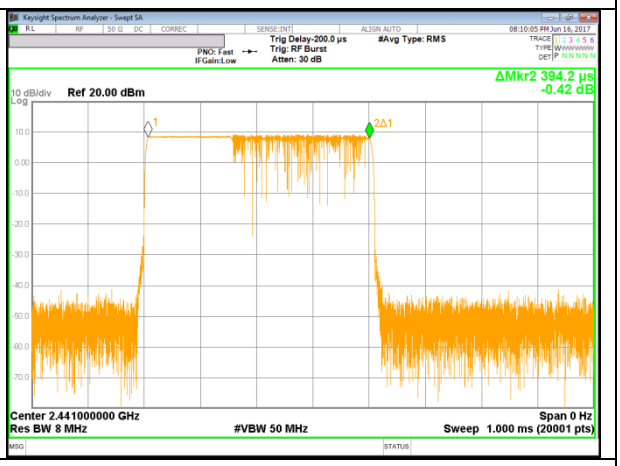
Dwell time

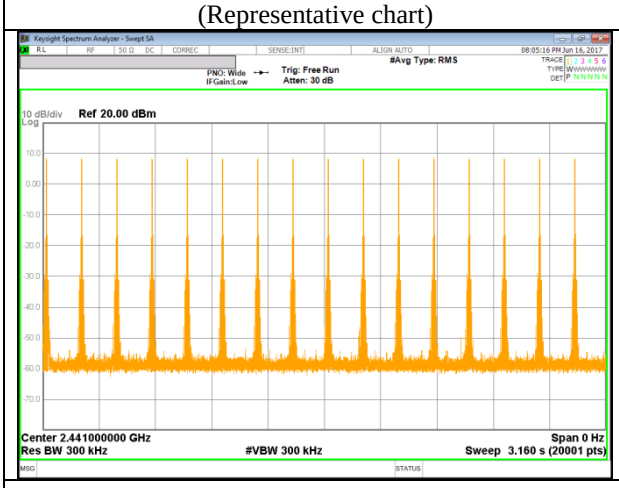
3DH1 (1/2)
(Representative chart)



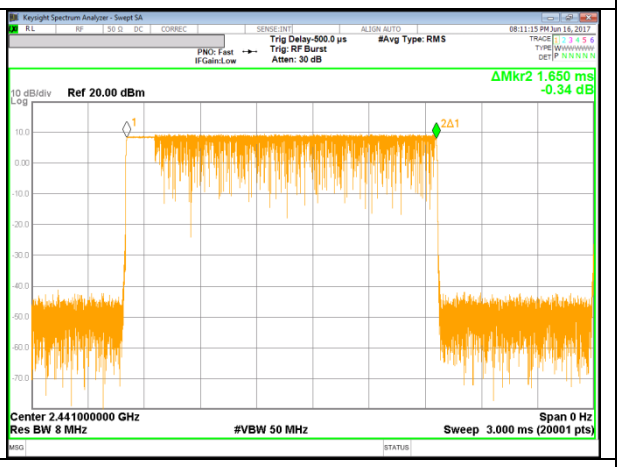
3DH1 (2/2)



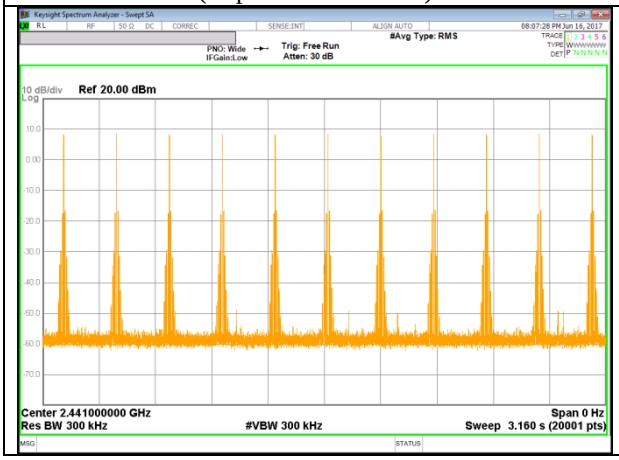
3DH3 (1/2)
(Representative chart)



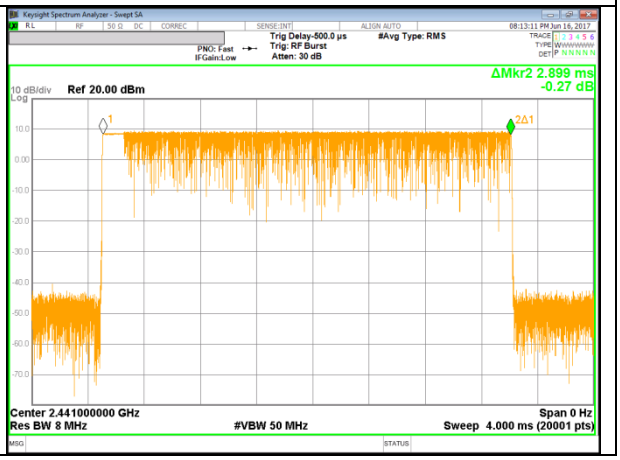
3DH3 (2/2)



3DH5 (1/2)
(Representative chart)



3DH5 (2/2)



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Maximum Peak Output Power

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 16, 2017
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off

Mode	Freq.	Reading	Result		Limit		Margin
	[MHz]	[dBm]	[dBm]	[mW]	[dBm]	[mW]	[dB]
DH5	2402.0	7.882	7.882	6.14	20.96	125	13.08
DH5	2441.0	9.935	9.935	9.85	20.96	125	11.03
DH5	2480.0	10.056	10.056	10.13	20.96	125	10.90
2DH5	2402.0	8.564	8.564	7.18	20.96	125	12.40
2DH5	2441.0	9.176	9.176	8.27	20.96	125	11.78
2DH5	2480.0	9.327	9.327	8.56	20.96	125	11.63
3DH5	2402.0	8.820	8.820	7.62	20.96	125	12.14
3DH5	2441.0	9.353	9.353	8.62	20.96	125	11.61
3DH5	2480.0	9.521	9.521	8.96	20.96	125	11.44

Test was not performed at AFH mode, because the decrease of number of channel (min: 20ch) at AFH mode does not influence on the output power and bandwidth of the EUT.
As this device had AFH mode and frequency separation could not meet the requirement of over 20dB BW without 2/3 relaxation, 125mW power limit was applied to it.

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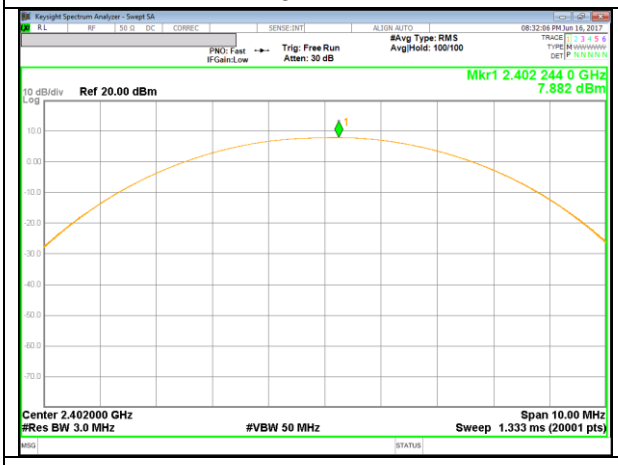
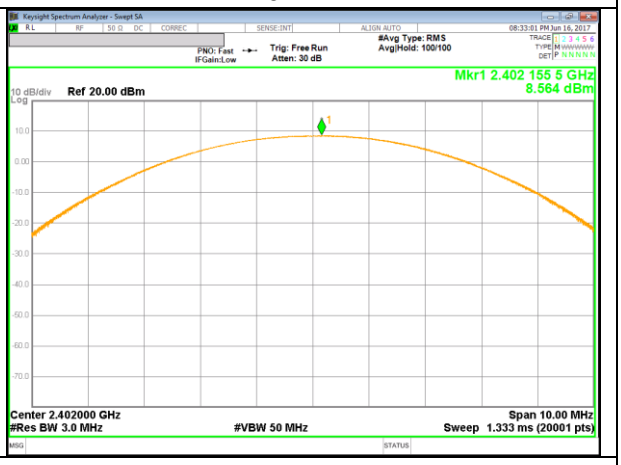
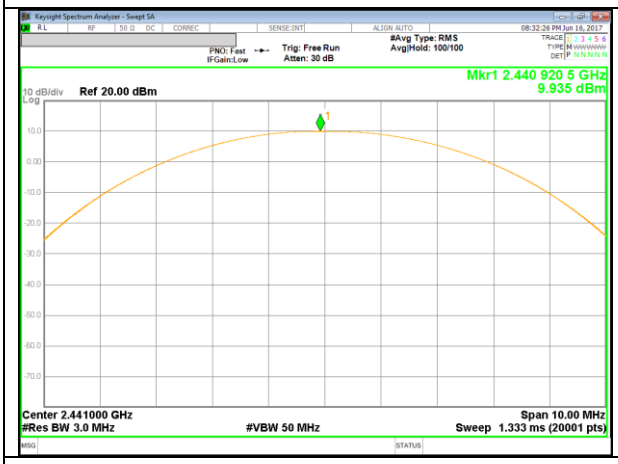
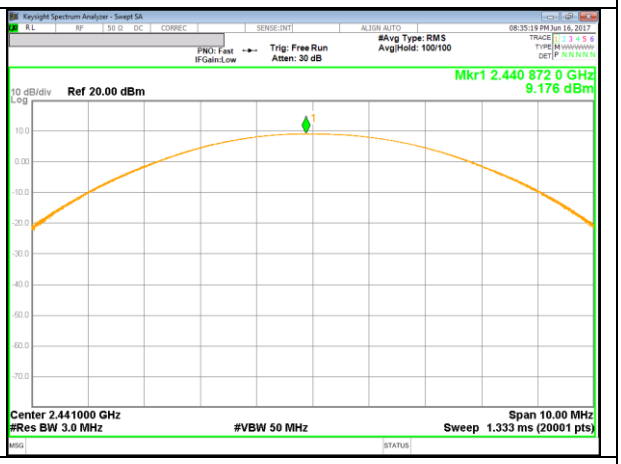
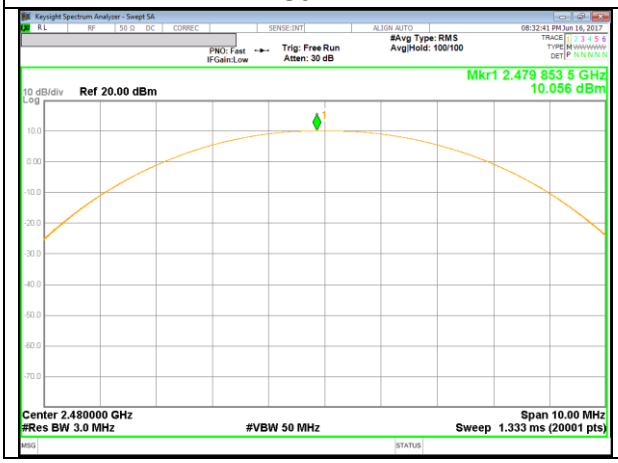
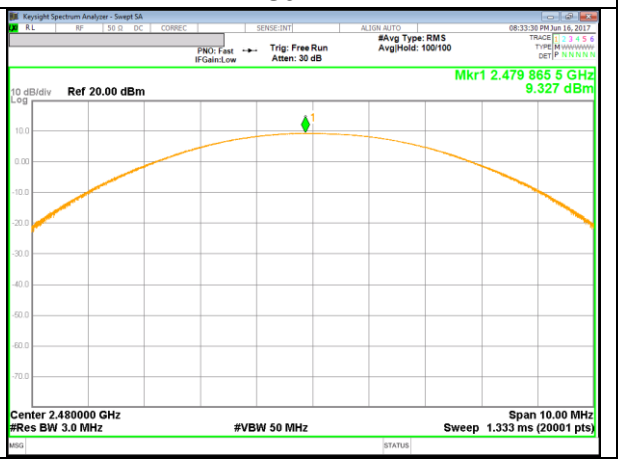
Maximum Peak Output Power

DH5	2DH5
2402 MHz	**2402 MHz**
	
2441MHz	**2441 MHz**
	
2480MHz	**2480 MHz**
	

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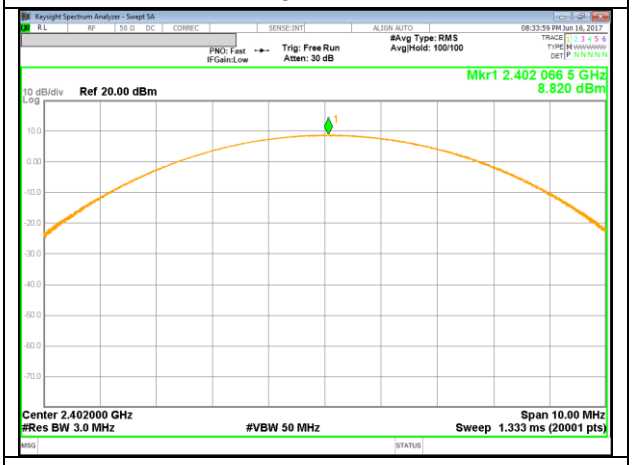
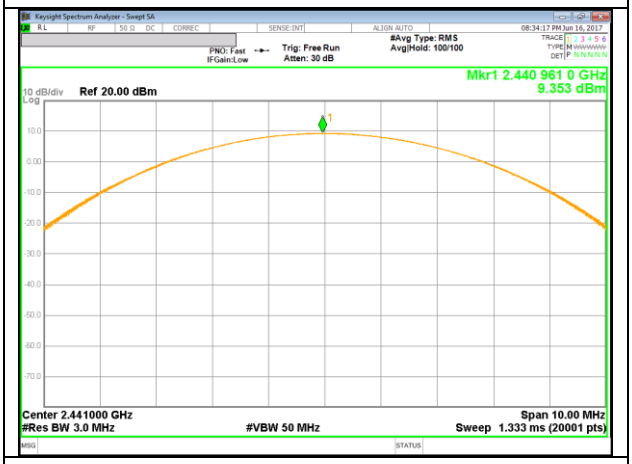
Maximum Peak Output Power

3DH5

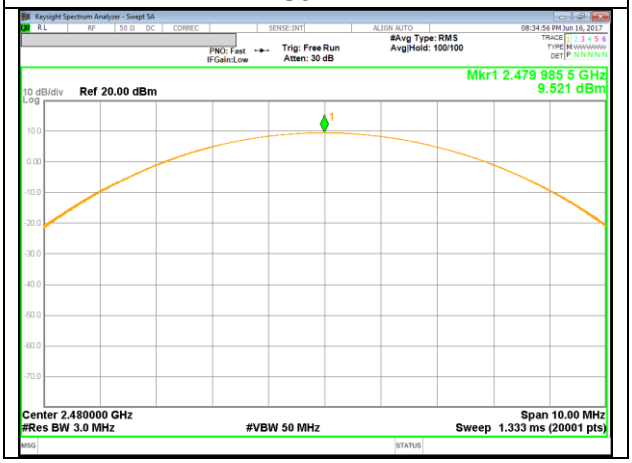
2402 MHz



2441MHz



2480MHz



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Average Output Power
(Reference data for RF Exposure)

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 16, 2017
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off

Mode	Freq.	Reading	Result (Frame power)		Duty factor	Result (Burst power)	
	[MHz]	[dBm]	[dBm]	[mW]	[dB]	[dBm]	[mW]
DH5	2402.0	8.168	8.168	6.56	1.13	9.30	8.51
DH5	2441.0	8.613	8.613	7.27	1.13	9.74	9.42
DH5	2480.0	8.712	8.712	7.43	1.13	9.84	9.64
2DH5	2402.0	5.503	5.503	3.55	1.11	6.61	4.58
2DH5	2441.0	6.272	6.272	4.24	1.11	7.38	5.47
2DH5	2480.0	6.483	6.483	4.45	1.11	7.59	5.74
3DH5	2402.0	5.565	5.565	3.60	1.11	6.68	4.65
3DH5	2441.0	6.289	6.289	4.26	1.11	7.40	5.49
3DH5	2480.0	6.504	6.504	4.47	1.11	7.61	5.77

The cable insertion loss of 0.83dB was entered as an offset in the power meter to allow for direct reading of power.

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Burst Rate Confirmation

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 16, 2017
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off

DH5

Tx on / (Tx on + Tx off) =	**0.771**
Tx on / (Tx on + Tx off) * 100 =	**77.1 %**
Duty factor = 10 * log (3.75 / 2.892) =	**1.13 dB**

2DH5

Tx on / (Tx on + Tx off) =	**0.774**
Tx on / (Tx on + Tx off) * 100 =	**77.4 %**
Duty factor = 10 * log (3.75 / 2.902) =	**1.11 dB**

3DH5

Tx on / (Tx on + Tx off) =	**0.774**
Tx on / (Tx on + Tx off) * 100 =	**77.4 %**
Duty factor = 10 * log (3.75 / 2.902) =	**1.11 dB**

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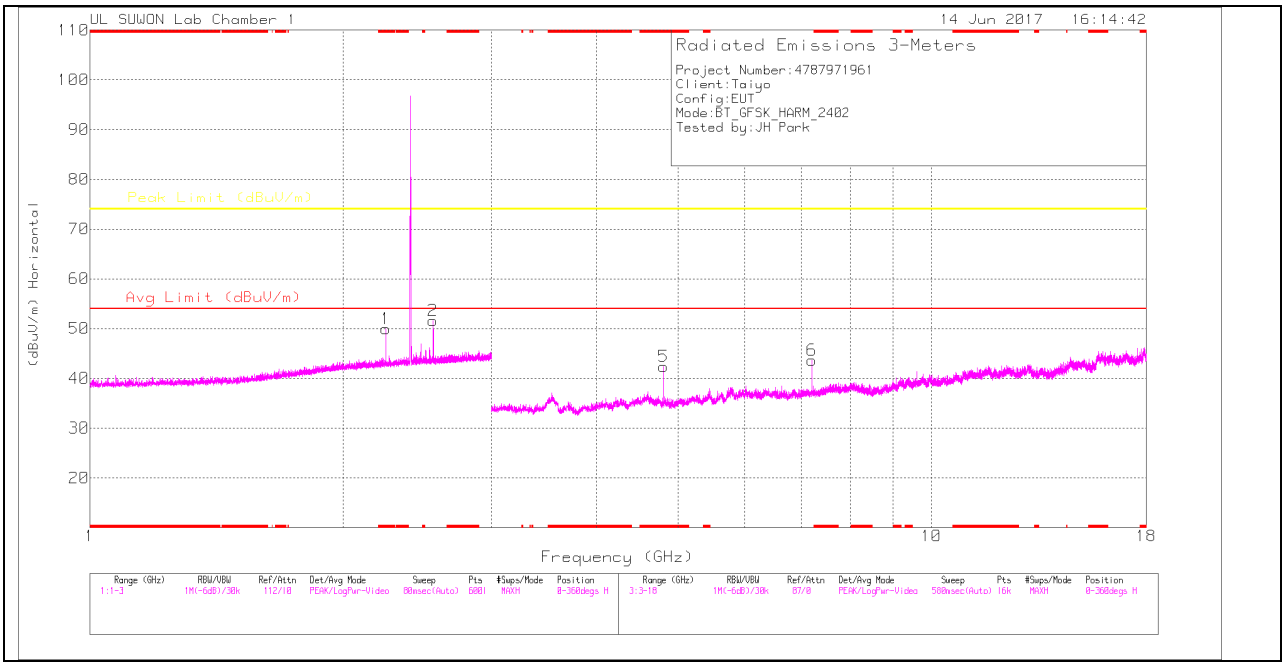
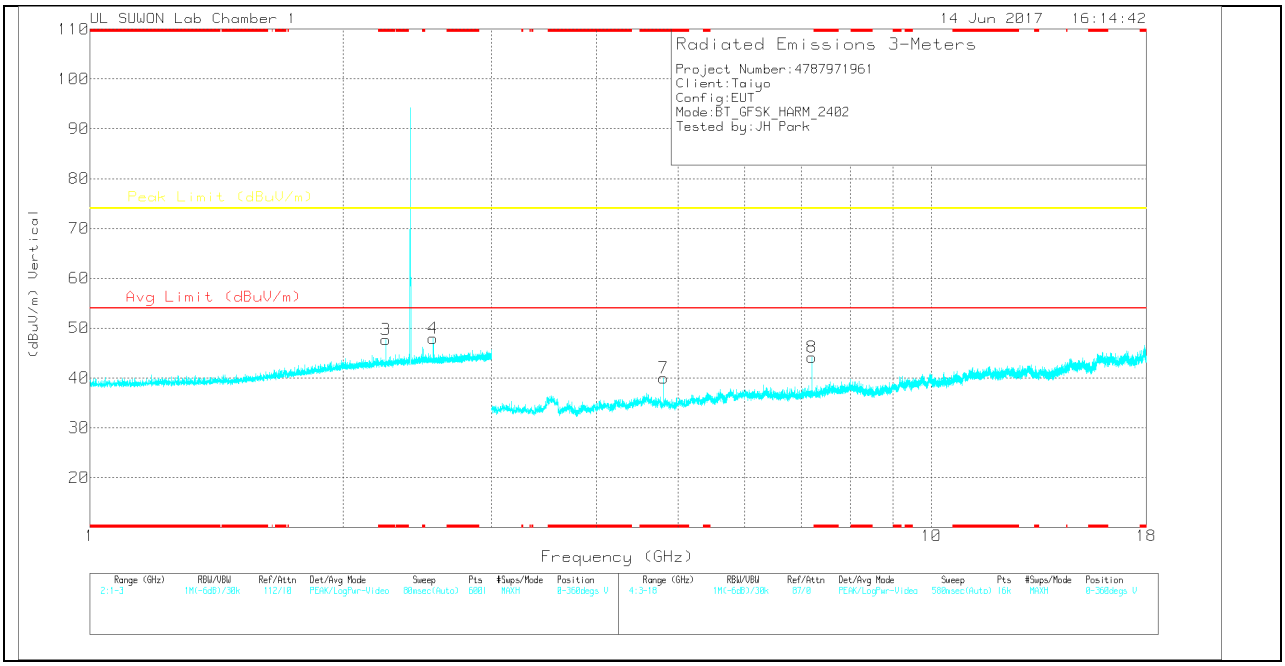
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E2V2
Date	June 14, 2017
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	JH Park
Mode	Tx, Hopping Off, DH5 2402 MHz

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



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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LOW CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.246	47.34	PK	31.5	-28.9	49.94	-	-	74	-24.06	0-360	150	H
2	2.558	48.16	PK	32	-28.5	51.66	-	-	74	-22.34	0-360	150	H
3	* 2.246	45.14	PK	31.5	-28.9	47.74	-	-	74	-26.26	0-360	250	V
4	2.558	44.4	PK	32	-28.5	47.9	-	-	74	-26.1	0-360	250	V
5	* 4.804	42.42	PK	34	-34	42.42	-	-	74	-31.58	0-360	150	H
6	7.206	39.02	PK	35.7	-31.1	43.62	-	-	74	-30.38	0-360	150	H
7	* 4.804	39.93	PK	34	-34	39.93	-	-	74	-34.07	0-360	150	V
8	7.205	39.58	PK	35.7	-31.1	44.18	-	-	74	-29.82	0-360	150	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.247	59.4	PK2	31.5	-28.9	62	-	-	74	-12	155	181	H
* 2.246	43.55	VA1T	31.5	-28.9	46.15	54	-7.85	-	-	155	181	H
* 2.246	50.73	PK2	31.5	-28.9	53.33	-	-	74	-20.67	117	326	V
* 2.246	37.04	VA1T	31.5	-28.9	39.64	54	-14.36	-	-	117	326	V
2.558	53.91	PK2	32	-28.6	57.31	-	-	74	-16.69	158	139	H
2.558	51.02	PK2	32	-28.6	54.42	-	-	74	-19.58	83	101	V
* 4.804	48.99	PK2	34	-34	48.99	-	-	74	-25.01	44	128	V
* 4.803	49.76	PK2	34	-34	49.76	-	-	74	-24.24	113	280	H
* 4.804	37.04	VA1T	34	-34	37.04	54	-16.96	-	-	44	128	V
* 4.804	39.2	VA1T	34	-34	39.2	54	-14.8	-	-	113	280	H
7.206	47.18	PK2	35.7	-31.1	51.78	-	-	74	-22.22	208	111	H
7.205	47.69	PK2	35.7	-31.1	52.29	-	-	74	-21.71	19	379	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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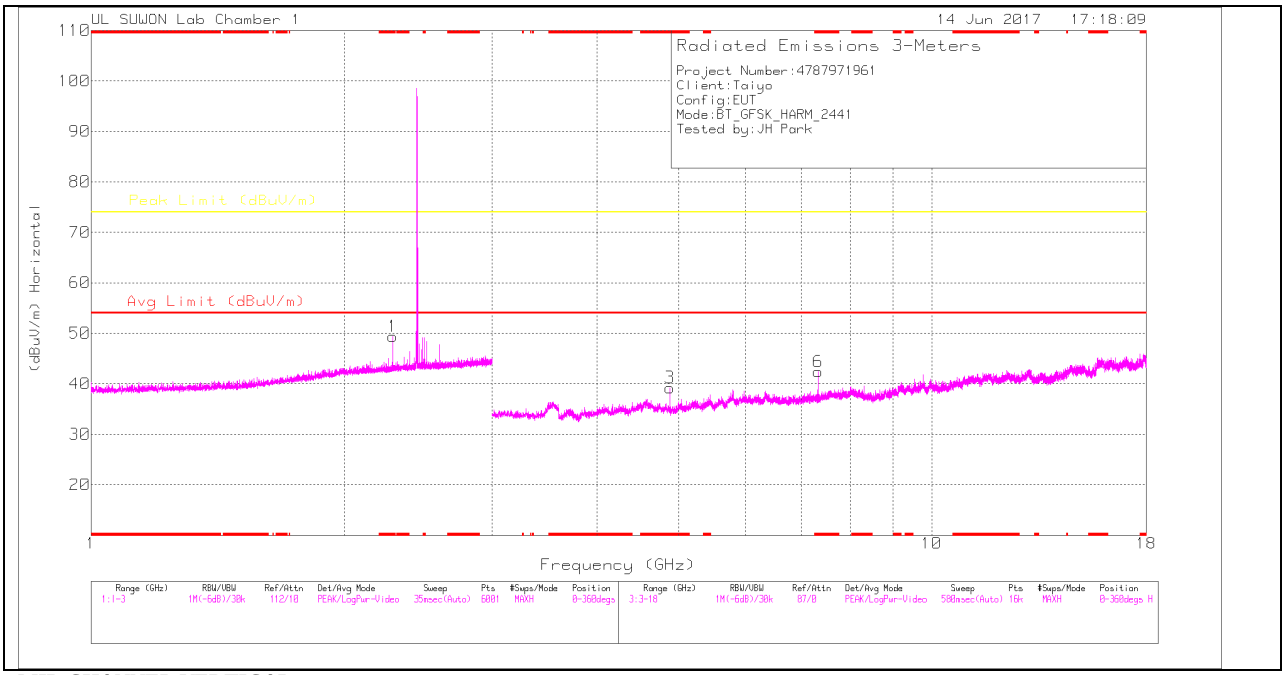
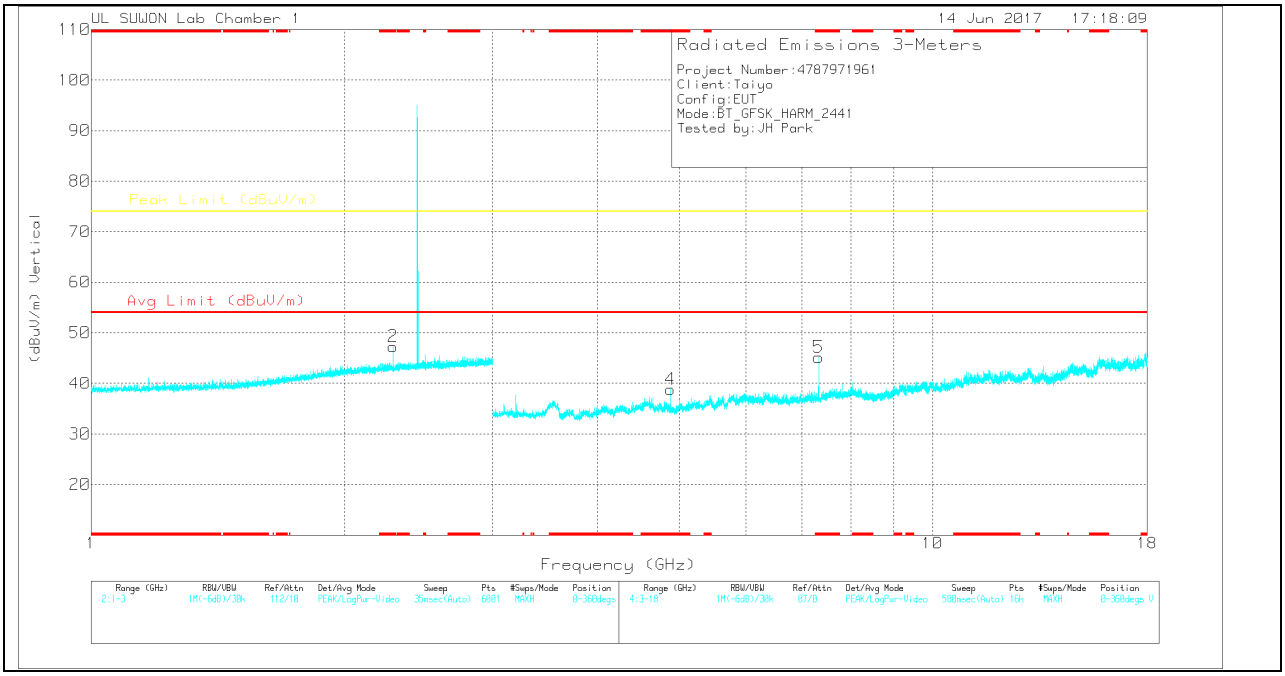
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E2V2
Date	June 14, 2017
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	JH Park
Mode	Tx, Hopping Off, DH5 2441 MHz

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



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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MID CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.285	46.56	PK	31.6	-28.8	49.36	-	-	74	-24.64	0-360	150	H
2	* 2.285	44.5	PK	31.6	-28.8	47.3	-	-	74	-26.7	0-360	250	V
3	* 4.881	39.42	PK	34	-34.2	39.22	-	-	74	-34.78	0-360	150	H
6	* 7.323	37.51	PK	35.8	-30.9	42.41	-	-	74	-31.59	0-360	150	H
4	* 4.882	38.92	PK	34	-34.1	38.82	-	-	74	-35.18	0-360	150	V
5	* 7.323	40.26	PK	35.8	-30.9	45.16	-	-	74	-28.84	0-360	250	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK – Peak Detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.283	61.05	PK2	31.6	-28.8	63.85	-	-	74	-10.15	152	170	H
* 2.285	42.6	VA1T	31.6	-28.8	45.4	54	-8.6	-	-	152	170	H
* 2.284	50.41	PK2	31.6	-28.8	53.21	-	-	74	-20.79	73	181	V
* 2.285	37.37	VA1T	31.6	-28.8	40.17	54	-13.83	-	-	73	181	V
* 4.882	48.92	PK2	34	-34.2	48.72	-	-	74	-25.28	197	262	V
* 4.882	49.01	PK2	34	-34.1	48.91	-	-	74	-25.09	187	155	H
* 7.324	46.27	PK2	35.8	-30.9	51.17	-	-	74	-22.83	218	137	H
* 7.322	47.42	PK2	35.8	-30.9	52.32	-	-	74	-21.68	274	353	V
* 4.882	37.69	VA1T	34	-34.2	37.49	54	-16.51	-	-	197	262	V
* 4.882	38.37	VA1T	34	-34.2	38.17	54	-15.83	-	-	187	155	H
* 7.323	35.84	VA1T	35.8	-30.9	40.74	54	-13.26	-	-	218	137	H
* 7.323	38.43	VA1T	35.8	-30.9	43.33	54	-10.67	-	-	274	353	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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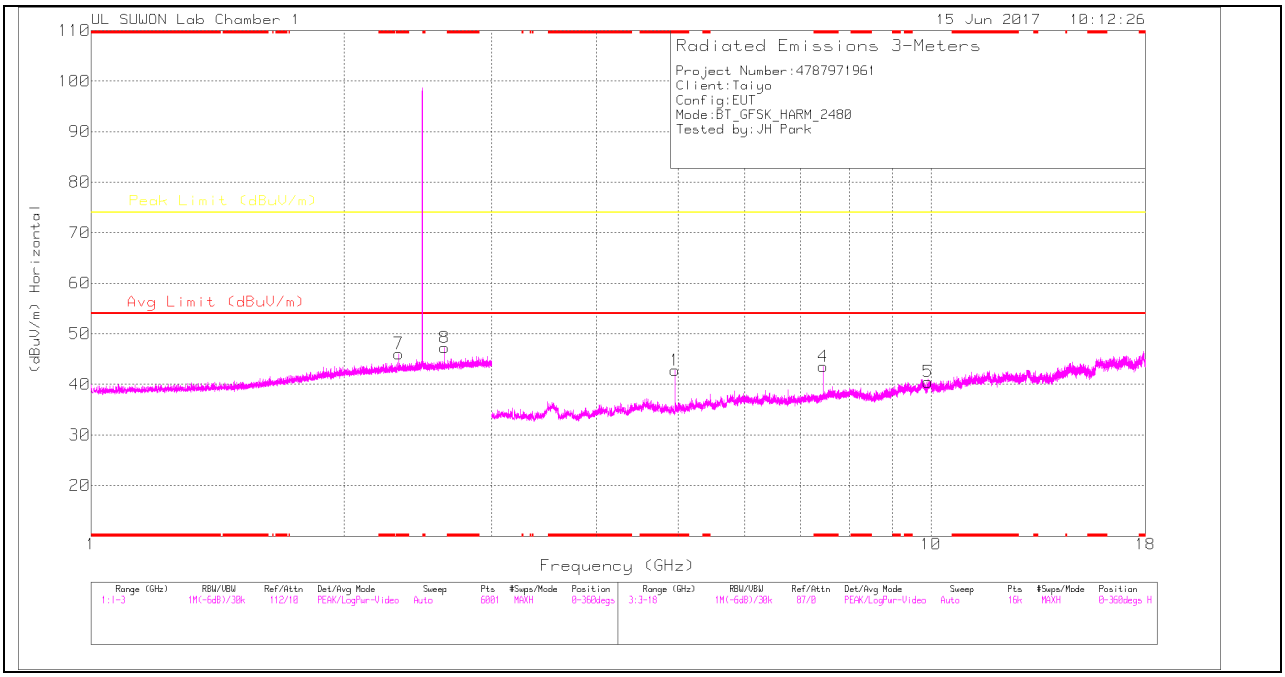
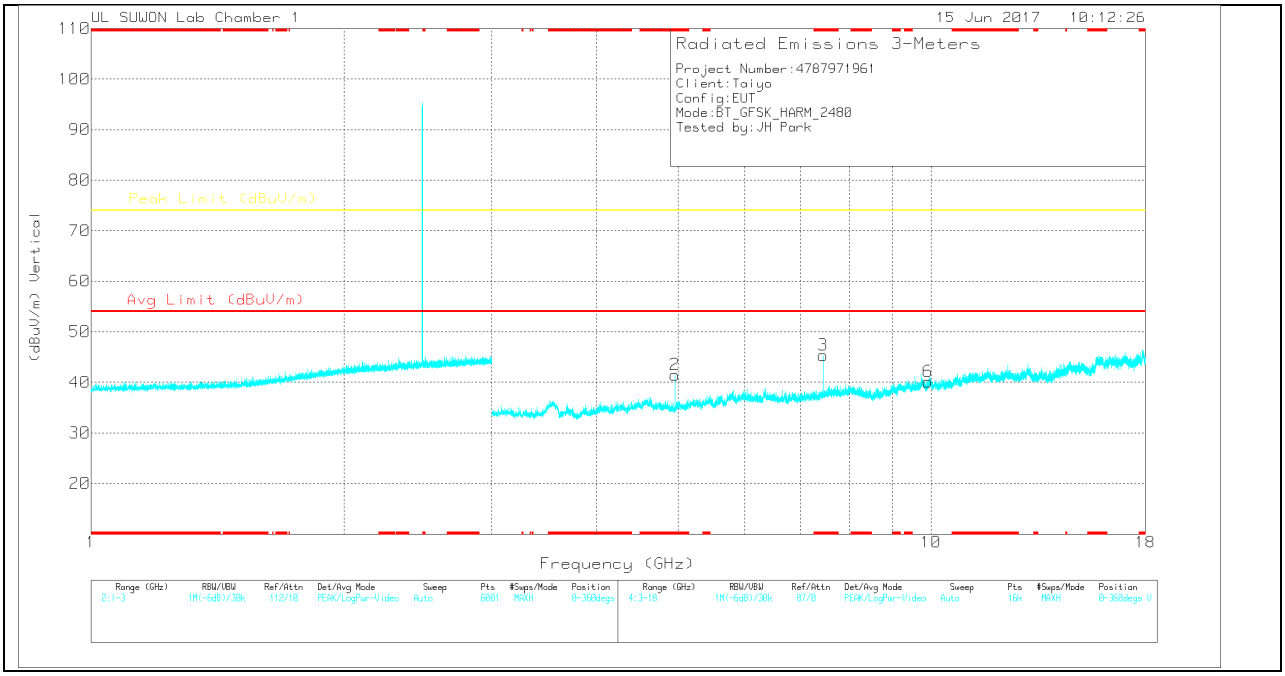
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E2V2
Date	June 15, 2017
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	JH Park
Mode	Tx, Hopping Off, DH5 2480 MHz

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



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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HIGH CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
7	* 2.324	43.17	PK	31.7	-28.8	46.07	-	-	74	-27.93	0-360	150	H
8	2.636	43.66	PK	32.1	-28.5	47.26	-	-	74	-26.74	0-360	150	H
1	* 4.959	42.85	PK	34	-34.1	42.75	-	-	74	-31.25	0-360	250	H
4	* 7.44	38.83	PK	35.8	-31.1	43.53	-	-	74	-30.47	0-360	150	H
5	9.918	31.1	PK	37.4	-28	40.5	-	-	74	-33.5	0-360	150	H
2	* 4.959	41.58	PK	34	-34.1	41.48	-	-	74	-32.52	0-360	250	V
3	* 7.44	40.64	PK	35.8	-31.1	45.34	-	-	74	-28.66	0-360	250	V
6	9.925	30.43	PK	37.4	-27.7	40.13	-	-	74	-33.87	0-360	150	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK – Peak Detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.325	58.37	PK2	31.7	-28.8	61.27	-	-	74	-12.73	199	165	H
* 2.324	40.3	VA1T	31.7	-28.8	43.2	54	-10.8	-	-	199	165	H
2.636	51.52	PK2	32.1	-28.5	55.12	-	-	74	-18.88	200	146	H
* 7.44	37.41	VA1T	35.8	-31.1	42.11	54	-11.89	-	-	223	107	H
* 4.96	50.93	PK2	34	-34.1	50.83	-	-	74	-23.17	59	366	H
* 4.96	49.98	PK2	34	-34.1	49.88	-	-	74	-24.12	360	388	V
* 7.44	47.39	PK2	35.8	-31	52.19	-	-	74	-21.81	243	135	V
* 7.439	47.29	PK2	35.8	-31.1	51.99	-	-	74	-22.01	195	169	H
* 4.96	45.06	VA1T	34	-34.1	44.96	54	-9.04	-	-	59	366	H
* 4.96	43.23	VA1T	34	-34.1	43.13	54	-10.87	-	-	360	388	V
* 7.44	38.62	VA1T	35.8	-31.1	43.32	54	-10.68	-	-	243	135	V
* 7.44	37.16	VA1T	35.8	-31.1	41.86	54	-12.14	-	-	195	169	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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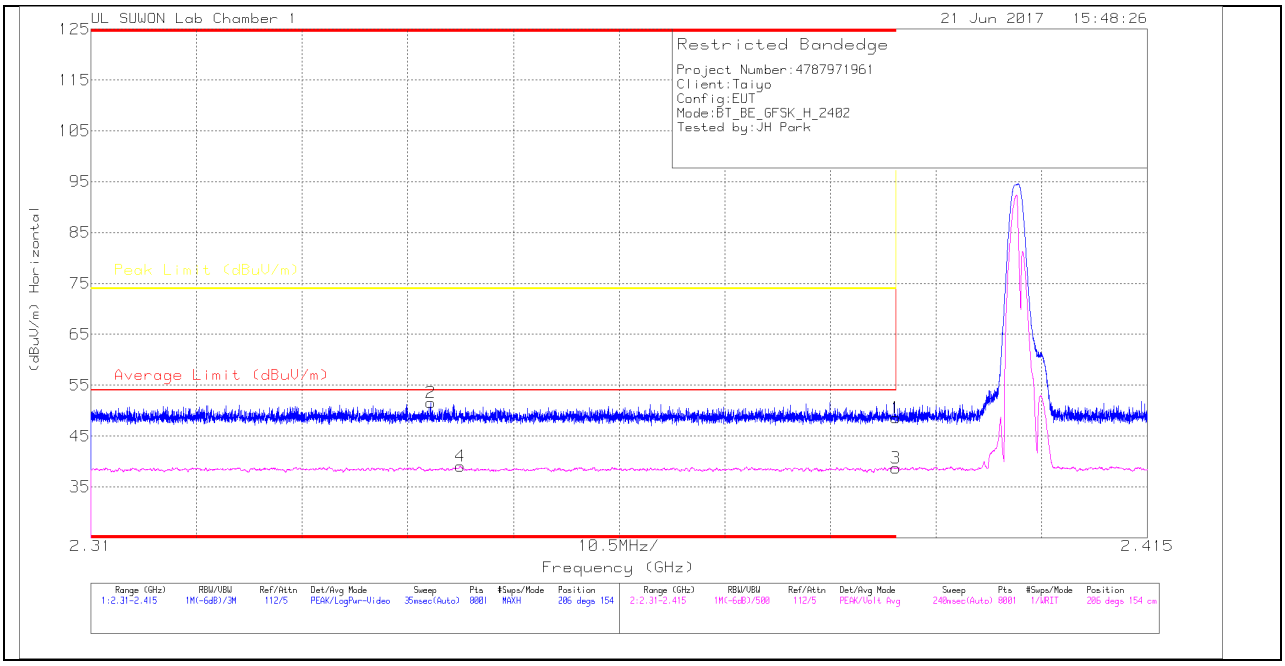
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E2V2
Date	June 21, 2017
Temperature / Humidity	24 deg. C / 42 % RH
Engineer	JH Park
Mode	Tx, Hopping Off, DH5 2402 MHz, 2480MHz

RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00168717	10dB_Att(dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	45.99	Pk	31.3	-28.7	48.59	-	-	74	-25.41	206	154	H
2	* 2.344	49.21	Pk	31.2	-28.8	51.61	-	-	74	-22.39	206	154	H
3	* 2.39	36.06	VA1T	31.3	-28.7	38.66	54	-15.34	-	-	206	154	H
4	* 2.347	36.62	VA1T	31.2	-28.8	39.02	54	-14.98	-	-	206	154	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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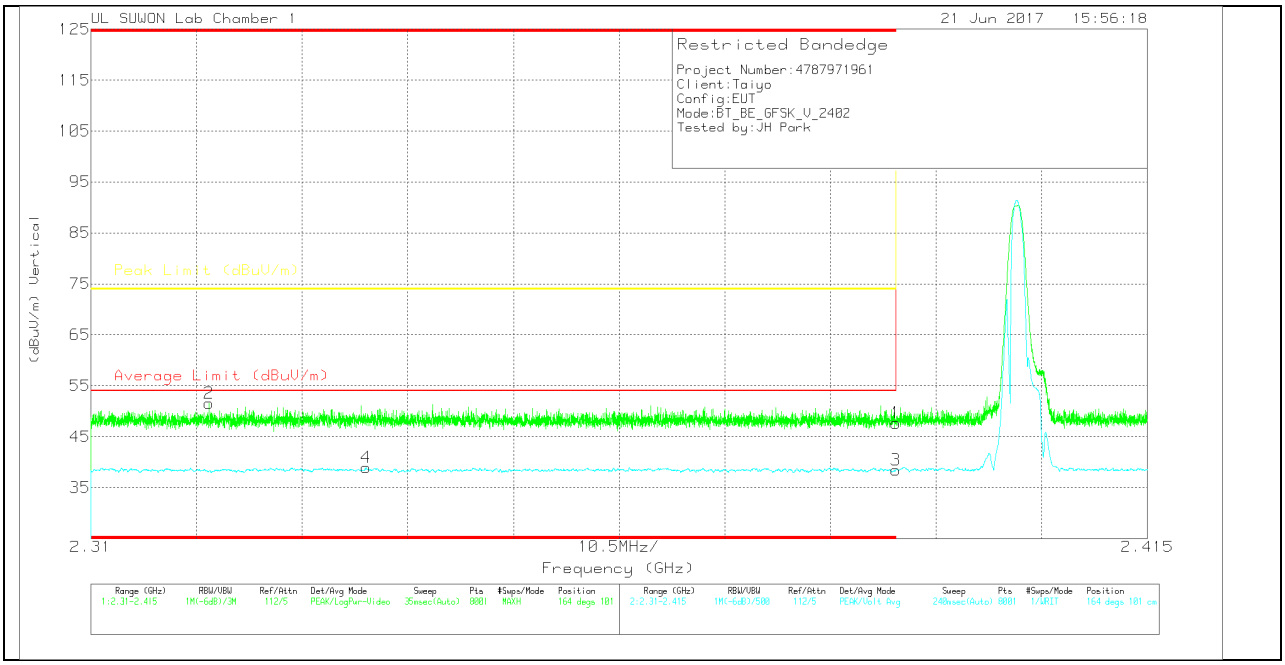
VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531 _3117_00 168717	10dB_Att(dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	45.07	Pk	31.3	-28.7	47.67	-	-	74	-26.33	164	101	V
2	* 2.322	49.14	Pk	31.2	-28.8	51.54	-	-	74	-22.46	164	101	V
3	* 2.39	35.82	VA1T	31.3	-28.7	38.42	54	-15.58	-	-	164	101	V
4	* 2.337	36.5	VA1T	31.2	-28.8	38.9	54	-15.1	-	-	164	101	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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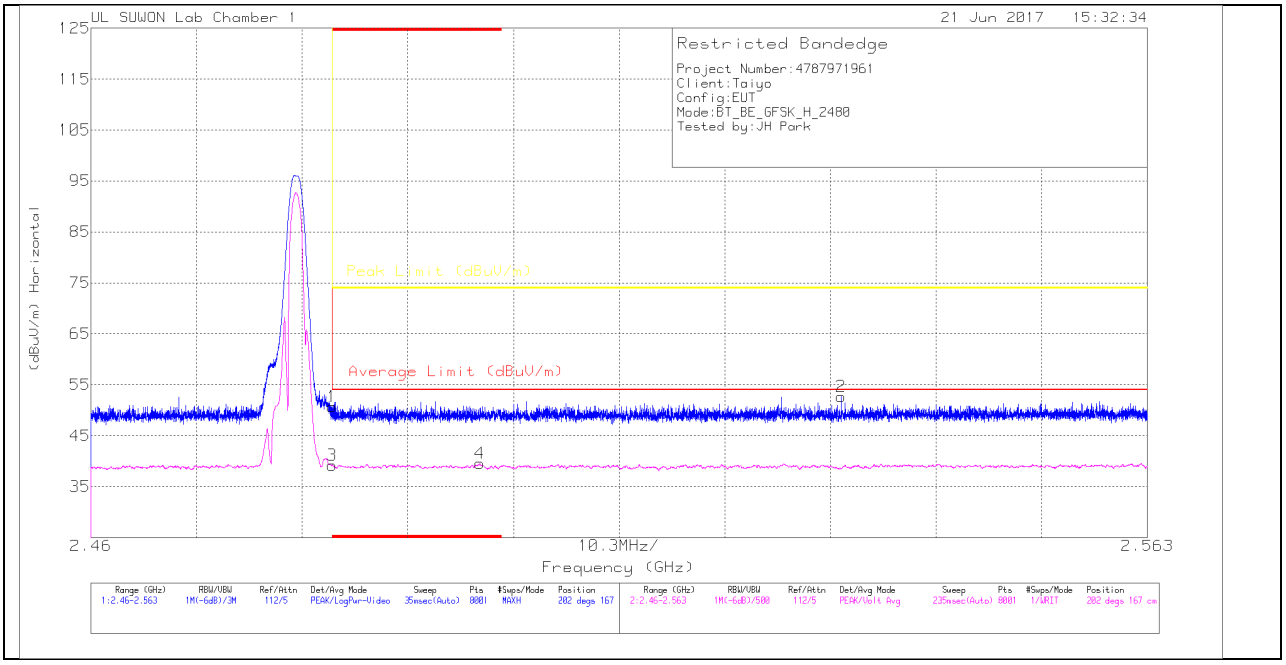
RESTRICTED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531 _3117_00 168717	10dB_Att(dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	47.76	Pk	31.6	-28.7	50.66	-	-	74	-23.34	202	167	H
2	2.533	49.71	Pk	31.7	-28.7	52.71	-	-	74	-21.29	202	167	H
3	* 2.484	36.31	VA1T	31.6	-28.7	39.21	54	-14.79	-	-	202	167	H
4	* 2.498	36.53	VA1T	31.6	-28.6	39.53	54	-14.47	-	-	202	167	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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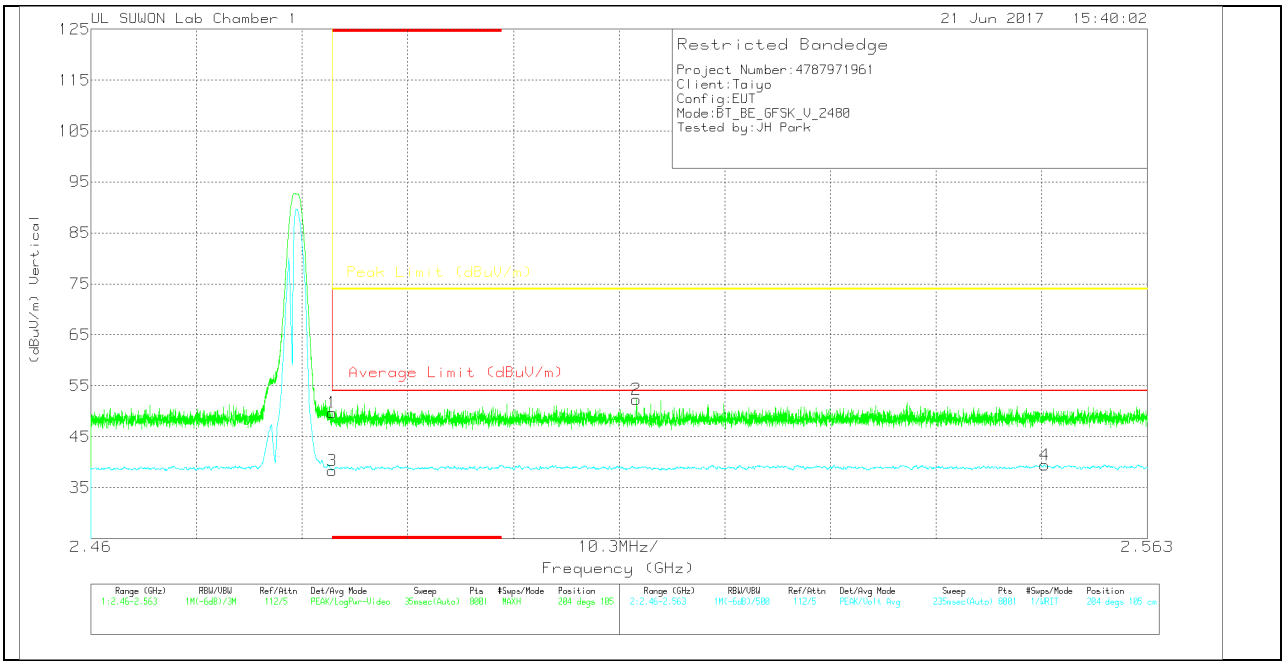
VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531 _3117_00 168717	10dB_Att(dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	46.77	Pk	31.6	-28.7	49.67	-	-	74	-24.33	204	105	V
2	2.513	49.3	Pk	31.6	-28.6	52.3	-	-	74	-21.7	204	105	V
3	* 2.484	35.43	VA1T	31.6	-28.7	38.33	54	-15.67	-	-	204	105	V
4	2.553	36.26	VA1T	31.7	-28.5	39.46	54	-14.54	-	-	204	105	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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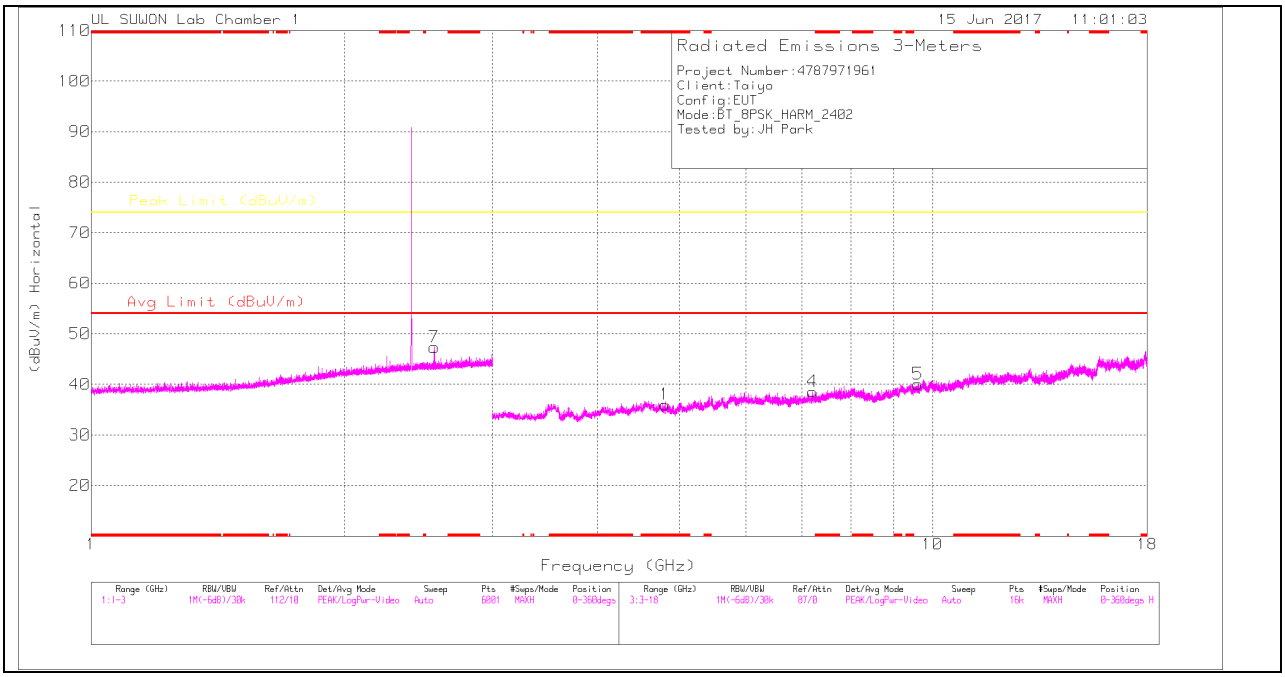
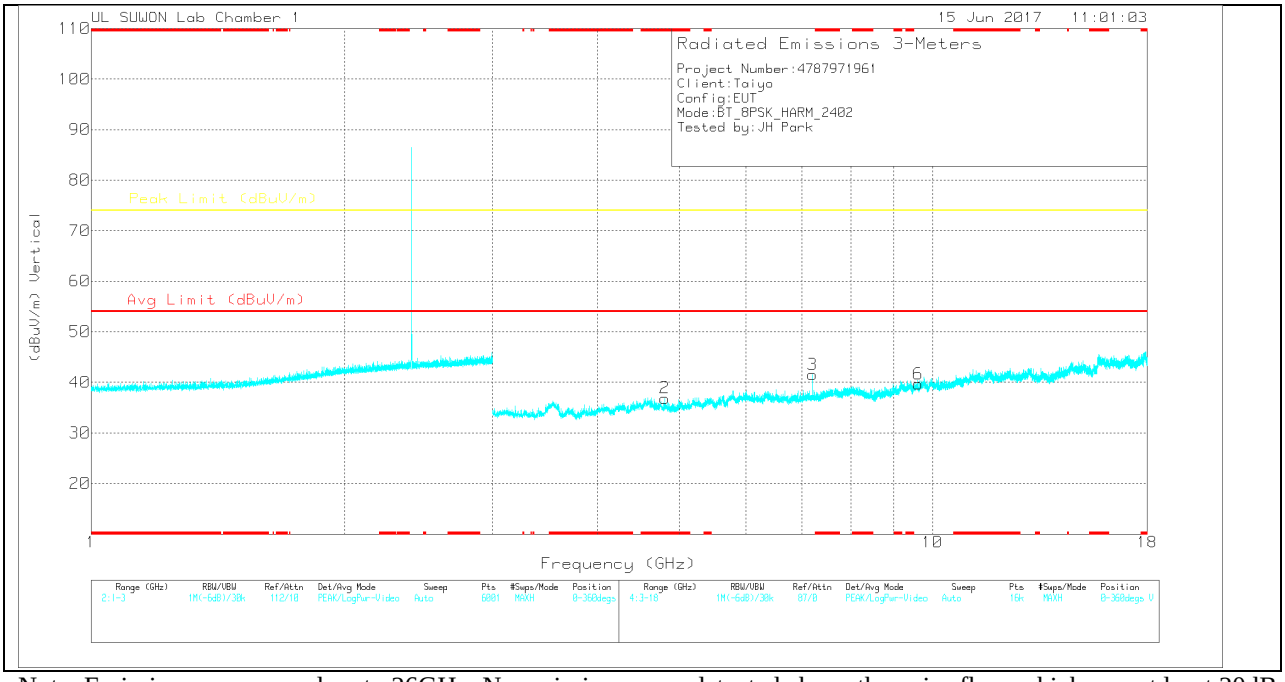
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E2V2
Date	June 15, 2017
Temperature / Humidity	26 deg. C / 48 % RH
Engineer	JH Park
Mode	Tx, Hopping Off, 3DH5 2402 MHz

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



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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LOW CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
7	2.558	43.94	PK	32	-28.6	47.34	-	-	74	-26.66	0-360	150	H
1	* 4.804	36	PK	34	-34	36	-	-	74	-38	0-360	150	H
4	7.206	33.99	PK	35.7	-31.1	38.59	-	-	74	-35.41	0-360	150	H
5	9.61	31.27	PK	37	-28.2	40.07	-	-	74	-33.93	0-360	250	H
2	* 4.805	36.87	PK	34	-34	36.87	-	-	74	-37.13	0-360	150	V
3	7.206	36.91	PK	35.7	-31.1	41.51	-	-	74	-32.49	0-360	250	V
6	9.613	30.94	PK	37	-28.3	39.64	-	-	74	-34.36	0-360	250	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK – Peak Detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.559	51.98	PK2	32	-28.5	55.48	-	-	74	-18.52	205	149	H
* 2.325	58.37	PK2	31.7	-28.8	61.27	-	-	74	-12.73	199	165	H
* 2.324	40.3	VA1T	31.7	-28.8	43.2	54	-10.8	-	-	199	165	H
* 7.44	37.41	MAv1	35.8	-31.1	42.11	54	-11.89	-	-	223	107	H
7.206	45.54	PK2	35.7	-31.1	50.14	-	-	74	-23.86	190	127	H
7.206	45.43	PK2	35.7	-31.1	50.03	-	-	74	-23.97	348	315	V
* 7.44	47.39	PK2	35.8	-31	52.19	-	-	74	-21.81	243	135	V
* 7.439	47.29	PK2	35.8	-31.1	51.99	-	-	74	-22.01	195	169	H
* 4.96	43.23	VA1T	34	-34.1	43.13	54	-10.87	-	-	360	388	V
* 7.44	38.62	VA1T	35.8	-31.1	43.32	54	-10.68	-	-	243	135	V
* 7.44	37.16	VA1T	35.8	-31.1	41.86	54	-12.14	-	-	195	169	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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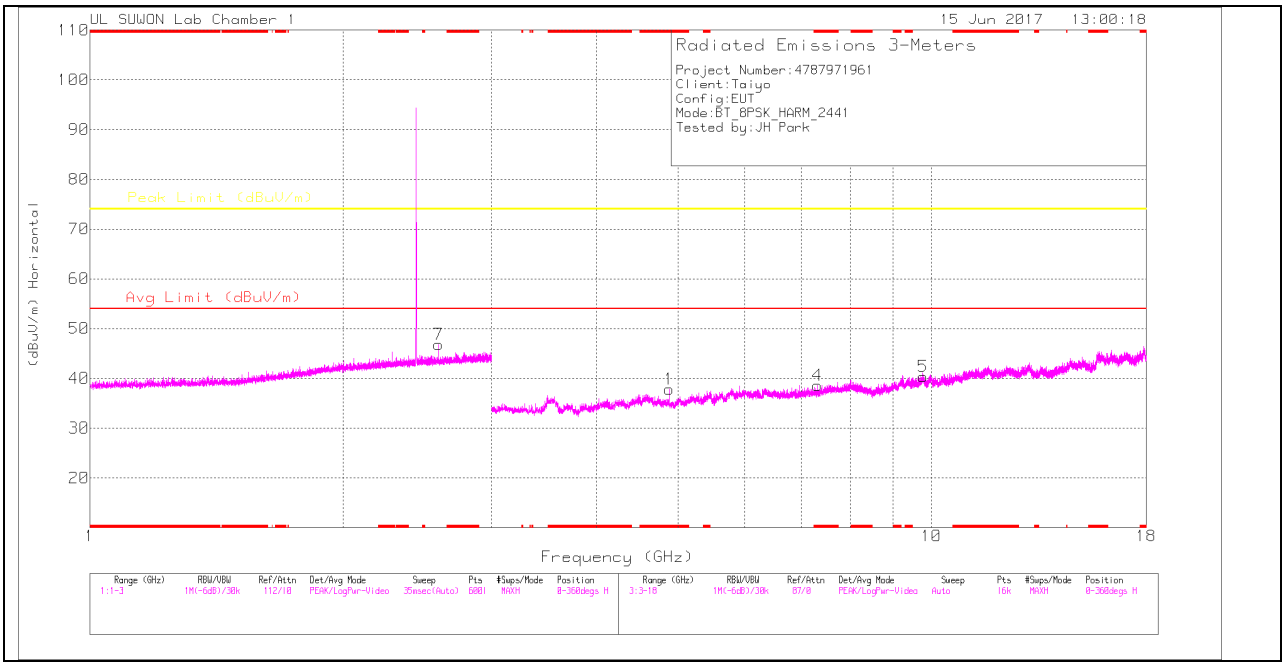
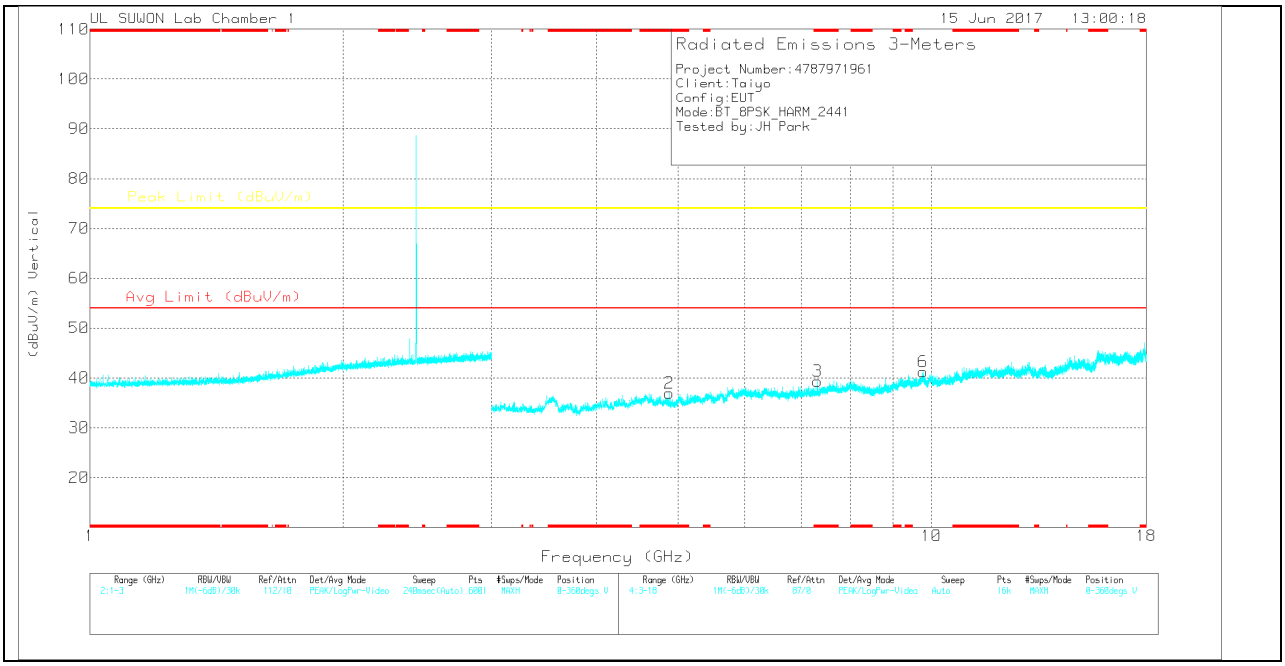
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E2V2
Date	June 15, 2017
Temperature / Humidity	26 deg. C / 48 % RH
Engineer	JH Park
Mode	Tx, Hopping Off, 3DH5 2441 MHz

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



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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MID CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
7	2.597	43.34	PK	32.1	-28.6	46.84	-	-	74	-27.16	0-360	150	H
1	* 4.881	38.09	PK	34	-34.2	37.89	-	-	74	-36.11	0-360	150	H
4	* 7.323	33.65	PK	35.8	-30.9	38.55	-	-	74	-35.45	0-360	150	H
5	9.768	30.53	PK	37.2	-27.4	40.33	-	-	74	-33.67	0-360	250	H
2	* 4.881	37.16	PK	34	-34.2	36.96	-	-	74	-37.04	0-360	150	V
3	* 7.323	34.4	PK	35.8	-30.9	39.3	-	-	74	-34.7	0-360	150	V
6	9.768	31.41	PK	37.2	-27.4	41.21	-	-	74	-32.79	0-360	250	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK – Peak Detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.596	51.75	PK2	32.1	-28.5	55.35	-	-	74	-18.65	206	149	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

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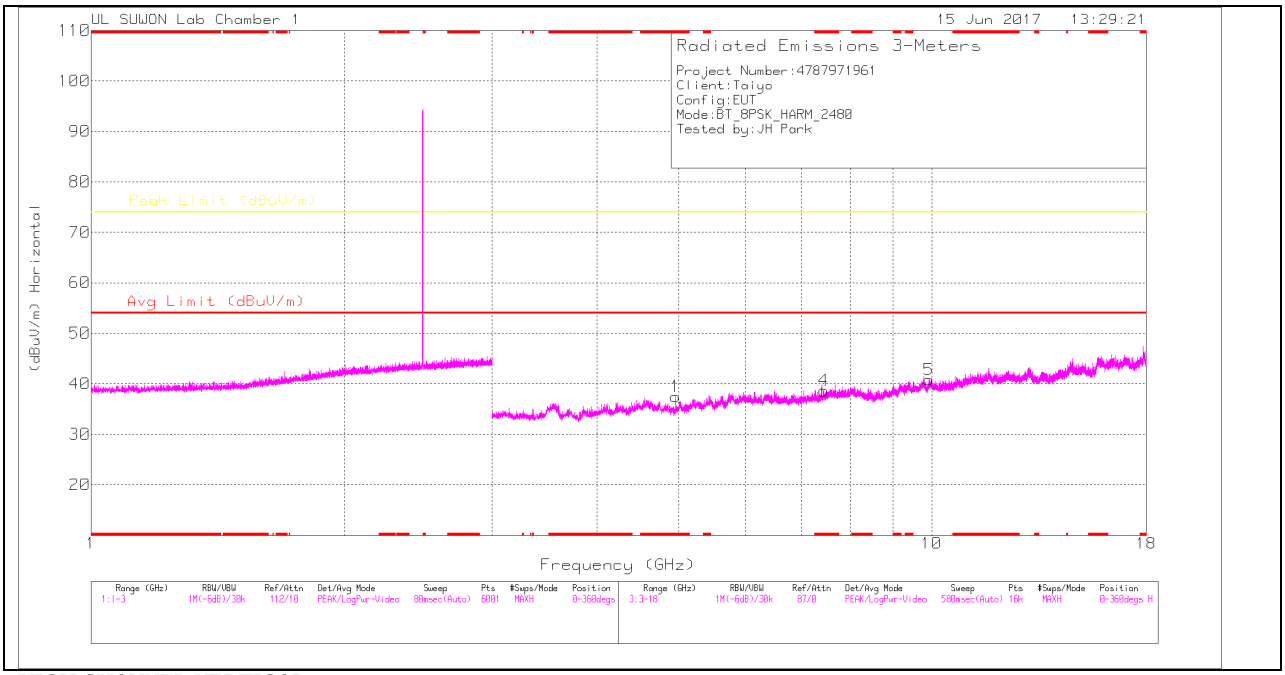
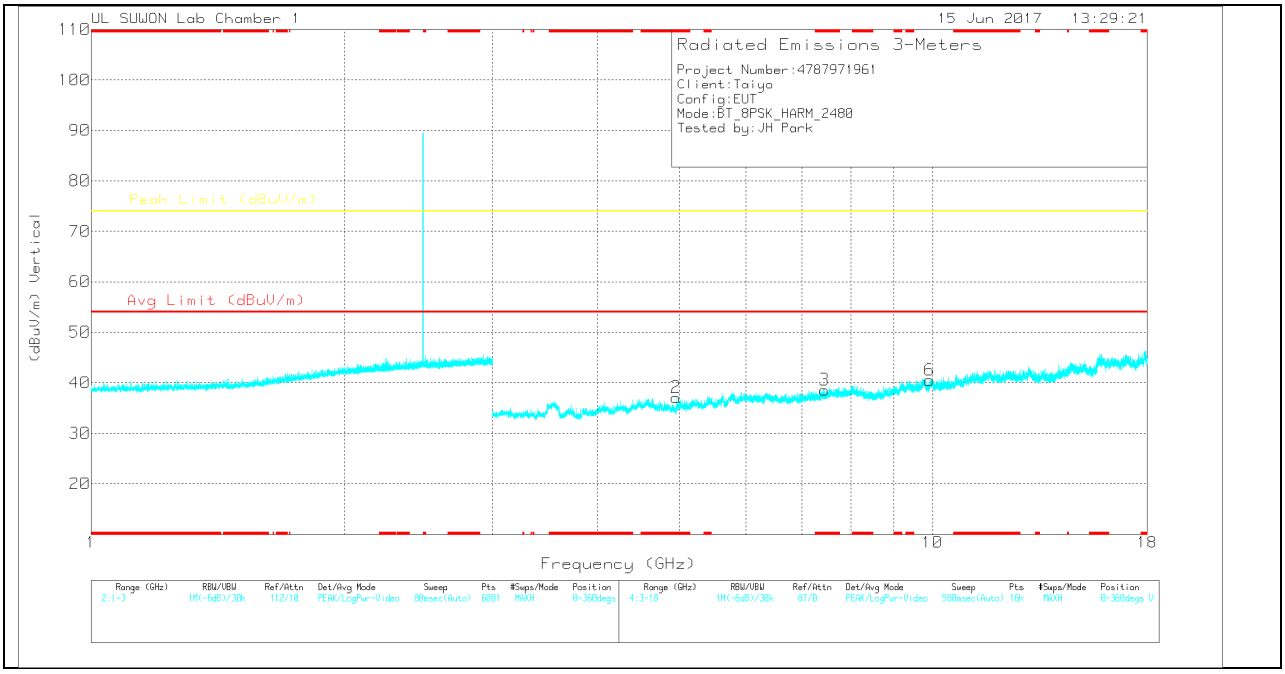
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E2V2
Date	June 14, 2017
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	JH Park
Mode	Tx, Hopping Off, 3DH5 2480 MHz

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



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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HIGH CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	3Ghz_HP(dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.959	37.55	PK	34	-34.1	37.45	-	-	74	-36.55	0-360	250	H
4	* 7.439	33.94	PK	35.8	-31.1	38.64	-	-	74	-35.36	0-360	150	H
5	9.918	31.38	PK	37.4	-28	40.78	-	-	74	-33.22	0-360	250	H
2	* 4.959	37.2	PK	34	-34.1	37.1	-	-	74	-36.9	0-360	150	V
3	* 7.44	33.87	PK	35.8	-31.1	38.57	-	-	74	-35.43	0-360	250	V
6	9.918	31.1	PK	37.4	-28	40.5	-	-	74	-33.5	0-360	150	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK – Peak Detector

Note: Only peak measurement was performed. Because peak measurement result of unwanted emission is less than average limt (54dBuV/m).

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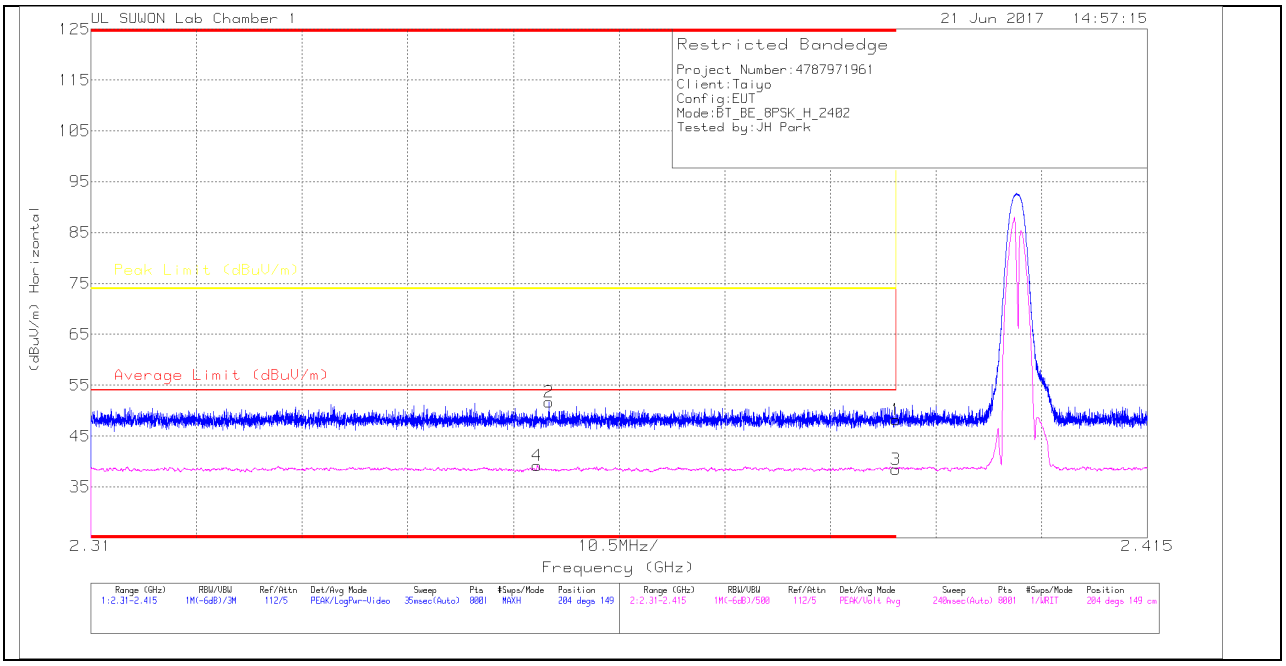
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E2V2
Date	June 21, 2017
Temperature / Humidity	24 deg. C / 42 % RH
Engineer	JH Park
Mode	Tx, Hopping Off, 3DH5 2402 MHz, 2480MHz

RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00168717	10dB_Att(dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	45.66	Pk	31.3	-28.7	48.26	-	-	74	-25.74	204	149	H
2	* 2.356	49.31	Pk	31.2	-28.8	51.71	-	-	74	-22.29	204	149	H
3	* 2.39	35.9	VA1T	31.3	-28.7	38.5	54	-15.5	-	-	204	149	H
4	* 2.354	36.69	VA1T	31.2	-28.7	39.19	54	-14.81	-	-	204	149	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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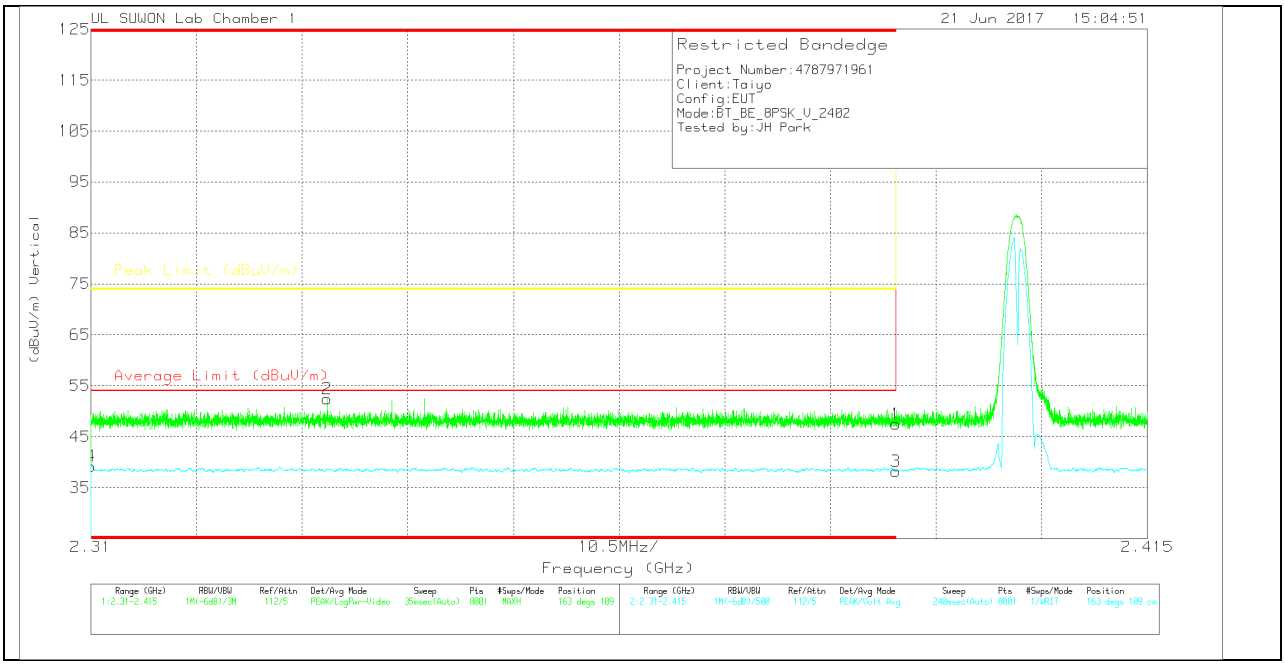
VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531 _3117_00 168717	10dB_Att(dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	44.91	Pk	31.3	-28.7	47.51	-	-	74	-26.49	163	109	V
2	* 2.333	49.92	Pk	31.2	-28.7	52.42	-	-	74	-21.58	163	109	V
3	* 2.39	35.6	VA1T	31.3	-28.7	38.2	54	-15.8	-	-	163	109	V
4	* 2.31	36.69	VA1T	31.2	-28.7	39.19	54	-14.81	-	-	163	109	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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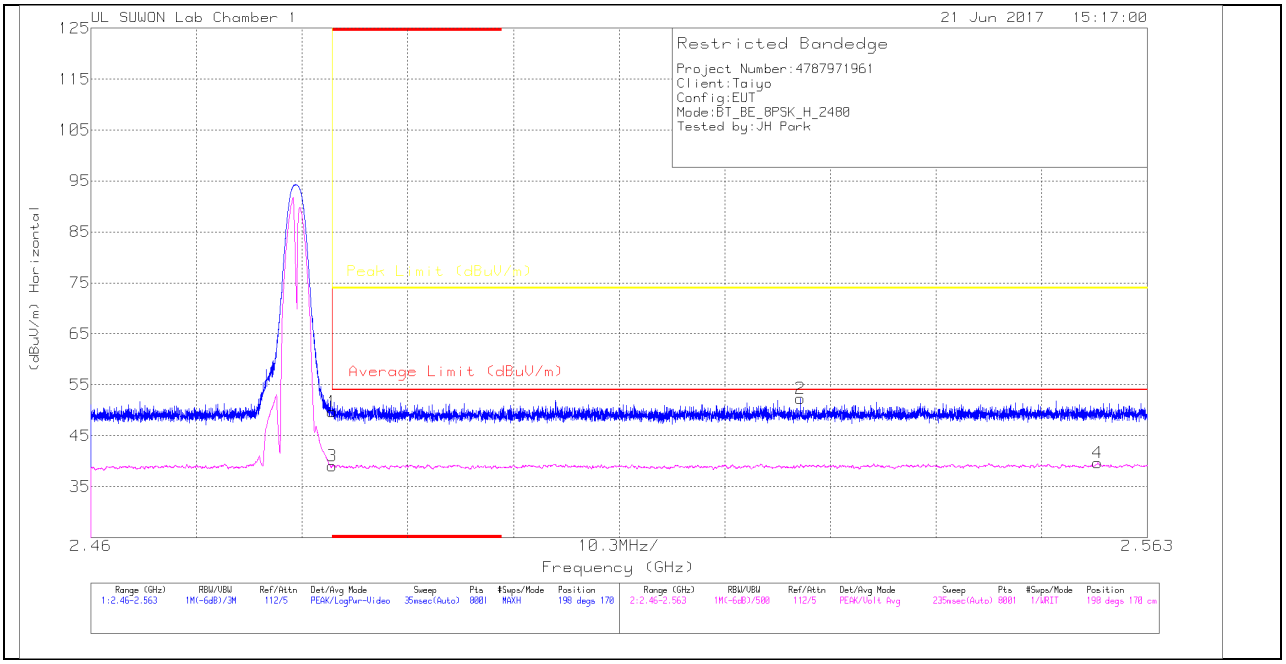
RESTRICTED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00168717	10dB_Att(dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	46.79	Pk	31.6	-28.7	49.69	-	-	74	-24.31	198	170	H
2	2.529	49.31	Pk	31.7	-28.7	52.31	-	-	74	-21.69	198	170	H
3	* 2.484	36.13	VA1T	31.6	-28.7	39.03	54	-14.97	-	-	198	170	H
4	2.558	36.64	VA1T	31.7	-28.6	39.74	54	-14.26	-	-	198	170	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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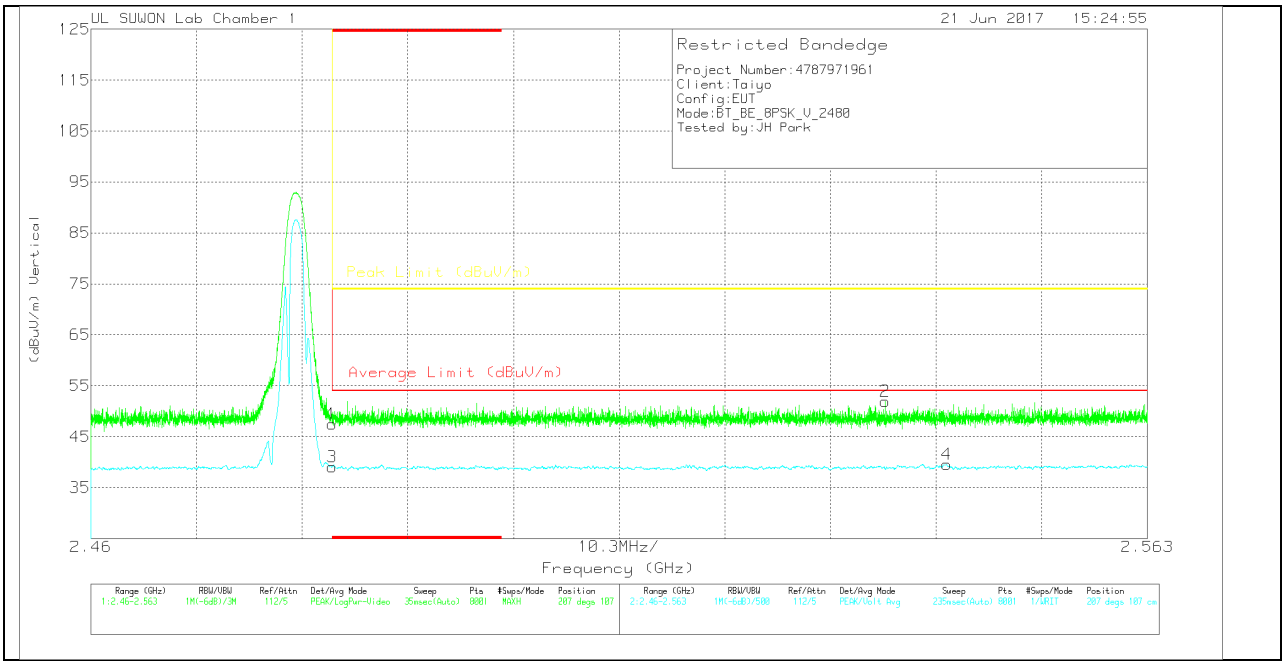
VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531 _3117_00 168717	10dB_Att(dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	44.55	Pk	31.6	-28.7	47.45	-	-	74	-26.55	207	107	V
2	2.537	48.89	Pk	31.7	-28.6	51.99	-	-	74	-22.01	207	107	V
3	* 2.484	36.18	VA1T	31.6	-28.7	39.08	54	-14.92	-	-	207	107	V
4	2.543	36.44	VA1T	31.7	-28.6	39.54	54	-14.46	-	-	207	107	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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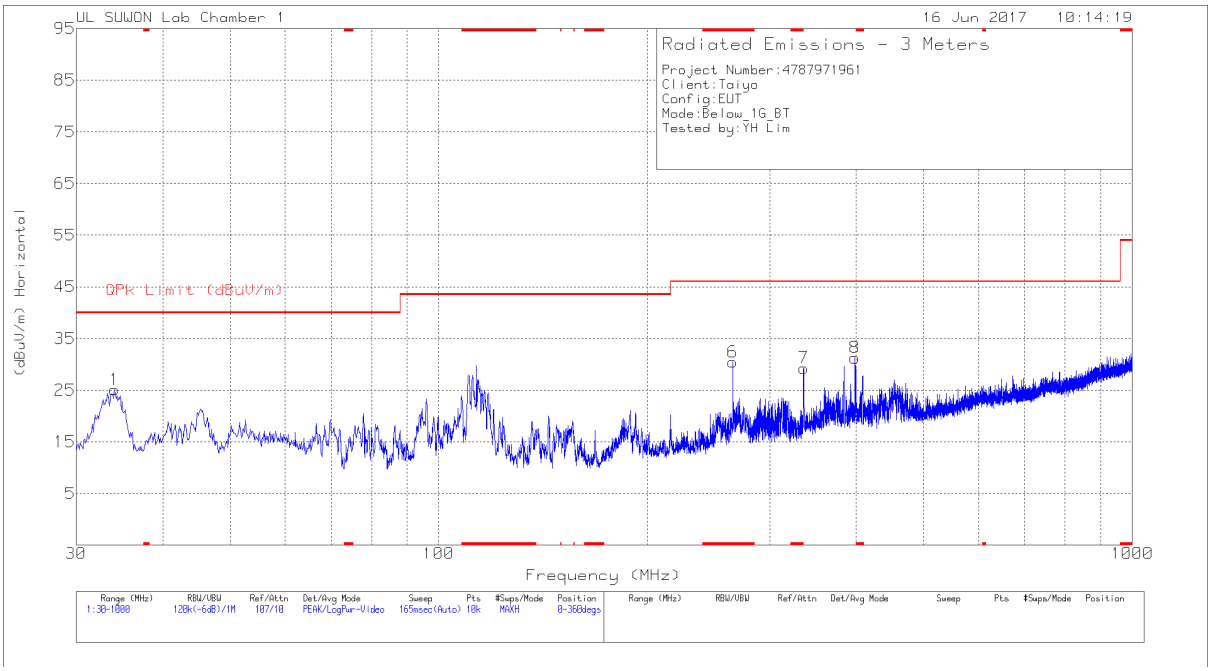
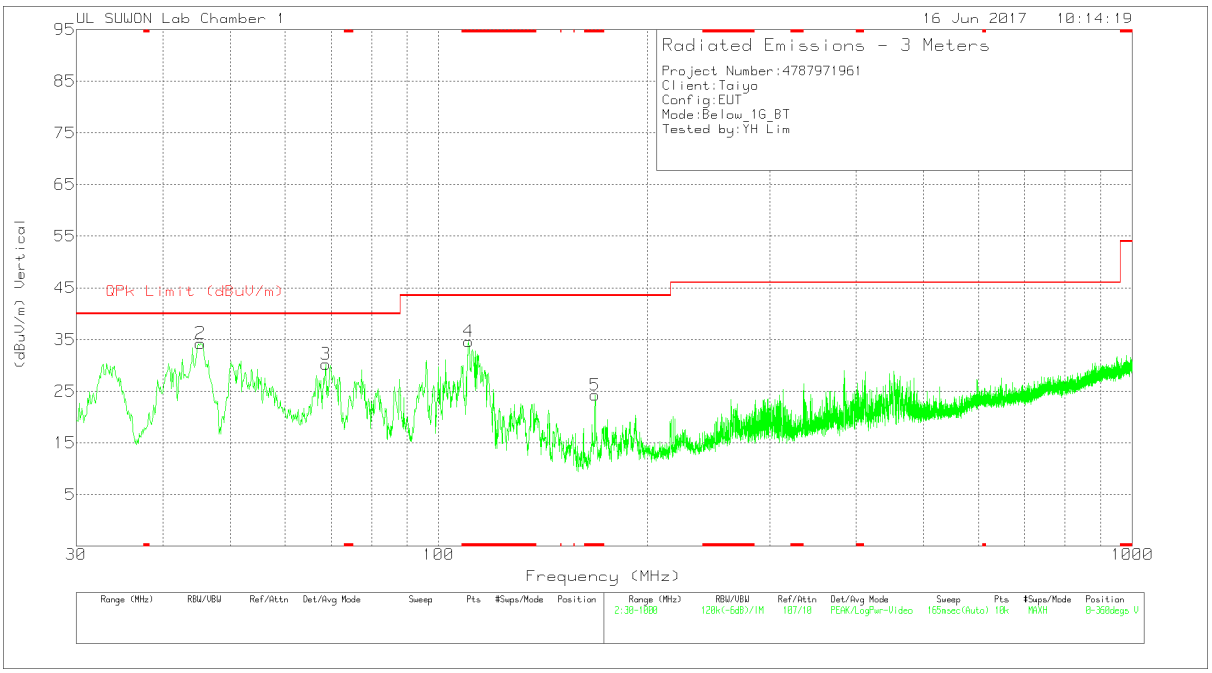
Radiated Spurious Emission
(Plot data, Worst case)

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E2V2
Date	June 16, 2017
Temperature / Humidity	27 deg. C / 45 % RH
Engineer	JH Park
Mode	Tx, Hopping Off, DH5 2480MHz

HORIZONTAL PLOT



VERTICAL PLOT



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BELOW 1 GHz TABLE

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	VULB9163_750(dB)	30-1000MHz (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	34.074	42.91	Pk	10.6	-28.4	25.11	40	-14.89	0-360	300	H
6	* 265.613	43.97	Pk	12.6	-26.1	30.47	46.02	-15.55	0-360	100	H
7	336.035	40.51	Pk	14.4	-25.6	29.31	46.02	-16.71	0-360	100	H
8	398.406	40.87	Pk	15.5	-25.1	31.27	46.02	-14.75	0-360	200	H
2	45.326	48.77	Pk	13.6	-28.1	34.27	40	-5.73	0-360	100	V
3	68.703	47.85	Pk	10	-27.6	30.25	40	-9.75	0-360	100	V
4	* 110.413	50.55	Pk	11.3	-27.2	34.65	43.52	-8.87	0-360	100	V
5	* 167.934	42.35	Pk	8.8	-26.9	24.25	43.52	-19.27	0-360	100	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	VULB9163_750(dB)	30-1000MHz(dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
45.4415	44.39	Qp	13.6	-28.1	29.89	40	-10.11	146	108	V
* 110.3925	48.02	Qp	11.3	-27.2	32.12	43.52	-11.4	160	100	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Qp - Quasi-Peak detector

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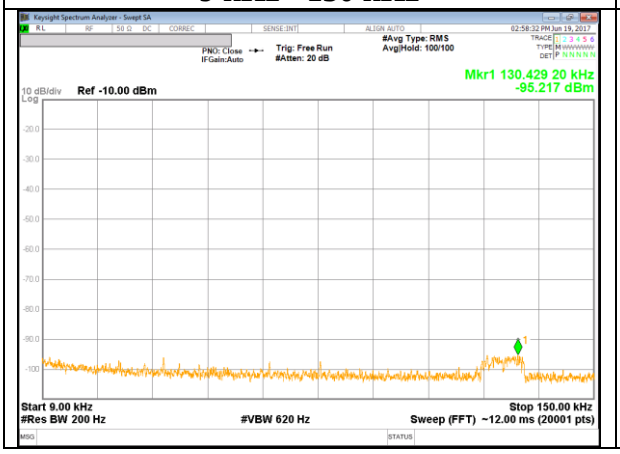
Conducted Spurious Emission

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 19, 2017
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off, DH5

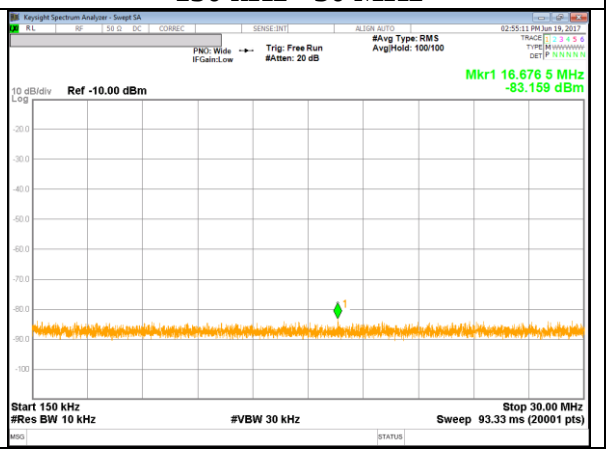
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on RF conducted measurement.

2402 MHz

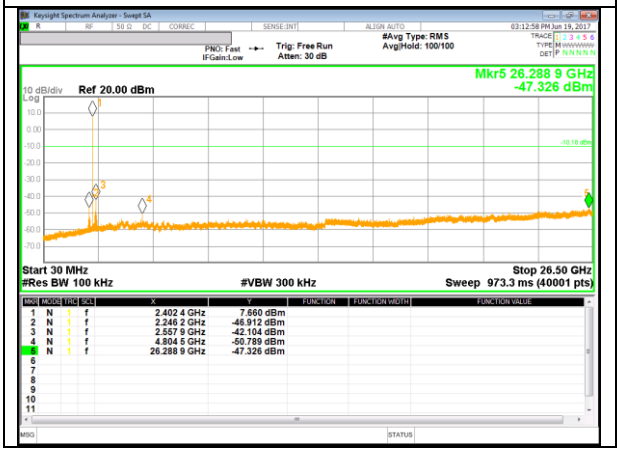
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz – 26.5 GHz



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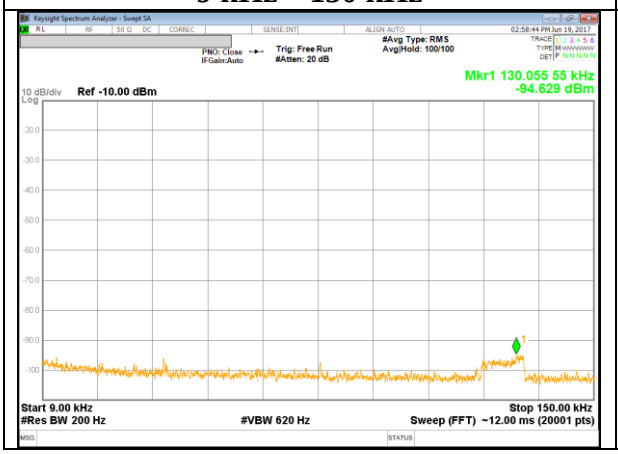
Conducted Spurious Emission

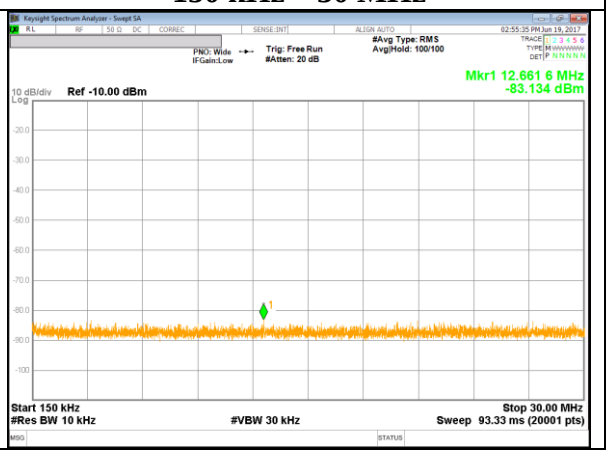
Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 19, 2017
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off, DH5

2441 MHz

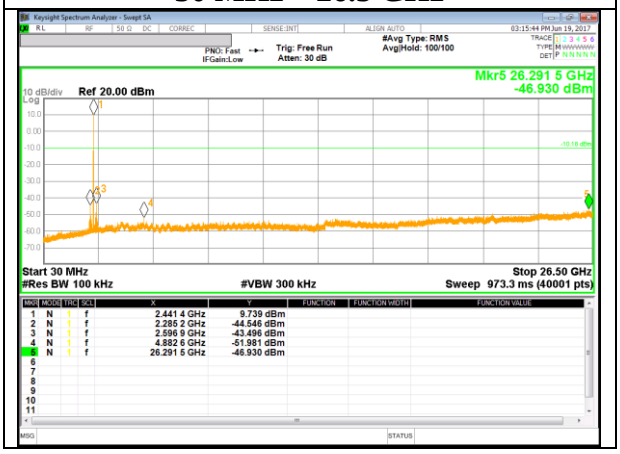
9 kHz – 150 kHz



150 kHz – 30 MHz



30 MHz – 26.5 GHz



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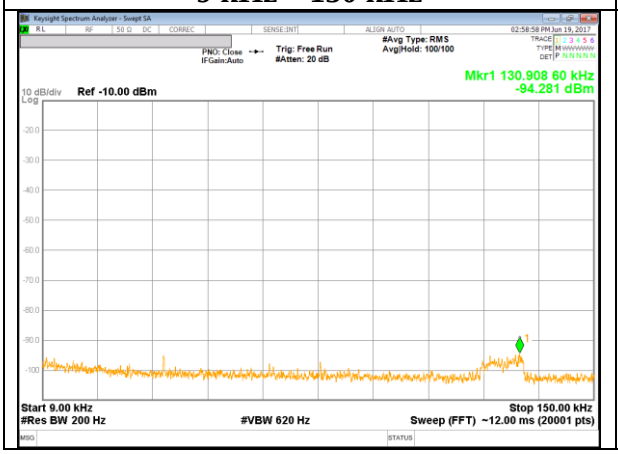
Conducted Spurious Emission

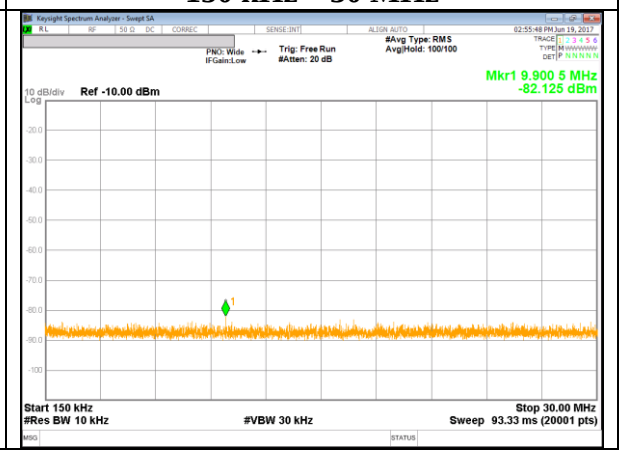
Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 19, 2017
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off, DH5

2480 MHz

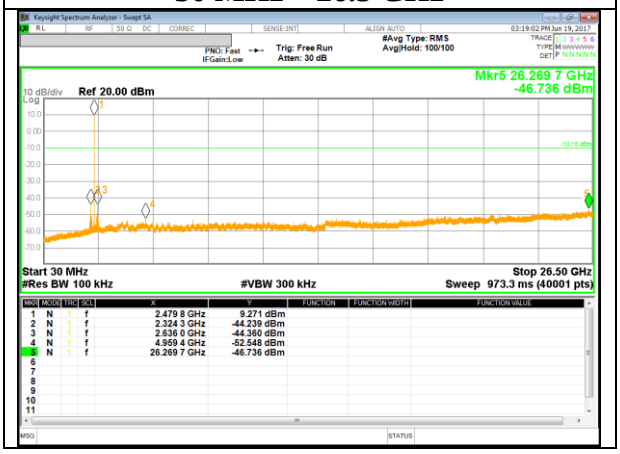
9 kHz – 150 kHz



150 kHz – 30 MHz



30 MHz – 26.5 GHz



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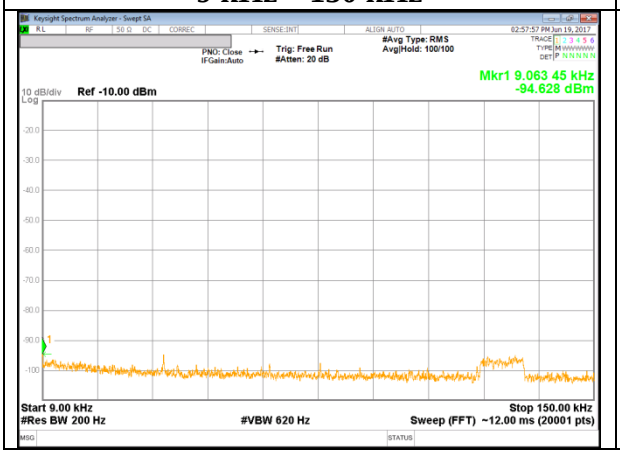
Conducted Spurious Emission

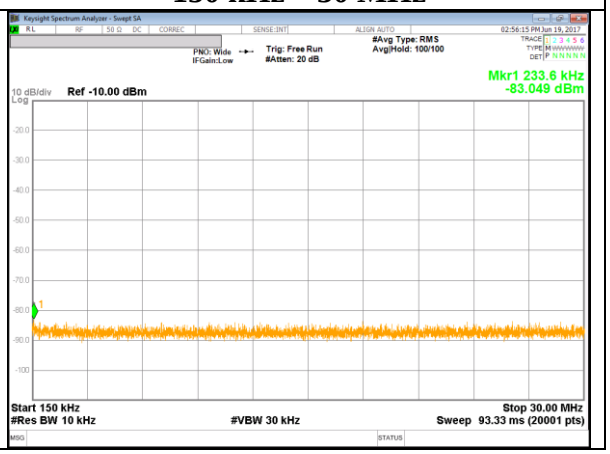
Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 19, 2017
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off, 3DH5

2402 MHz

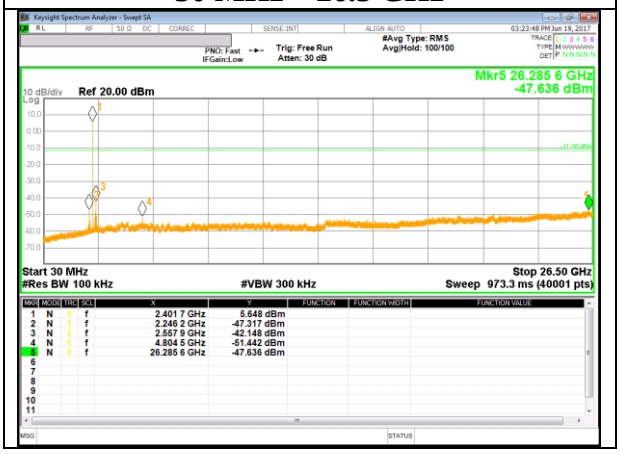
9 kHz – 150 kHz



150 kHz – 30 MHz



30 MHz – 26.5 GHz



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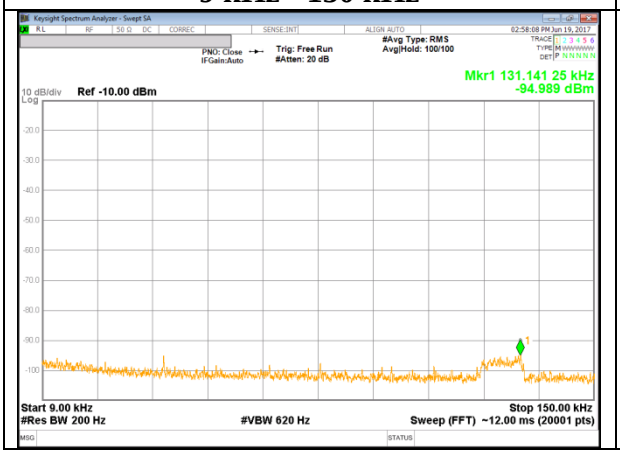
Conducted Spurious Emission

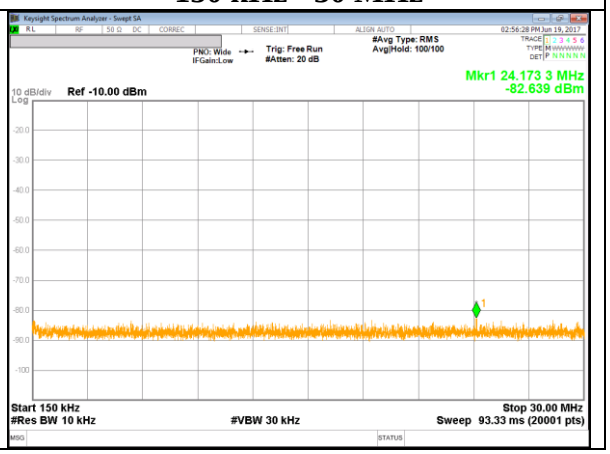
Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 19, 2017
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off, 3DH5

2441 MHz

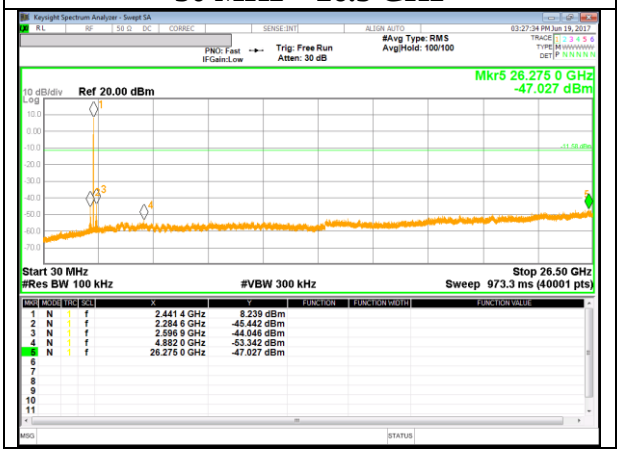
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz – 26.5 GHz



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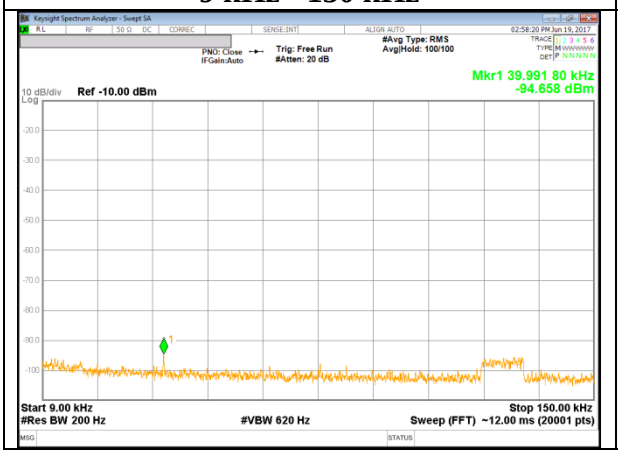
Conducted Spurious Emission

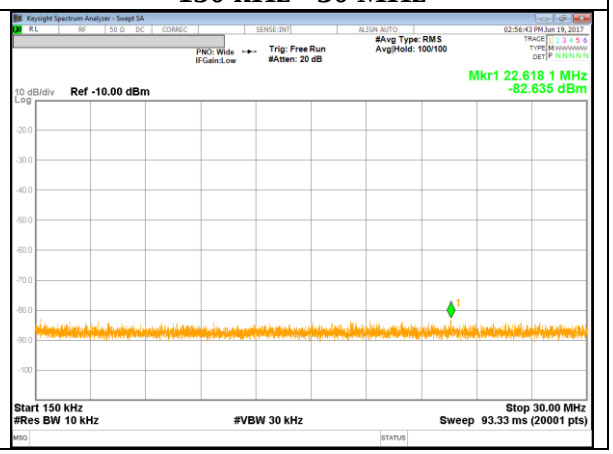
Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 19, 2017
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off, 3DH5

2480 MHz

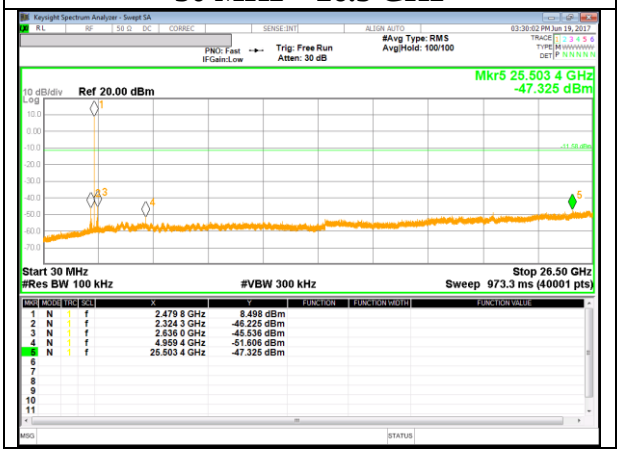
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz – 26.5 GHz



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Conducted Emission Band Edge compliance

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 16, 2017
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off, DH5

In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on RF conducted measurement.

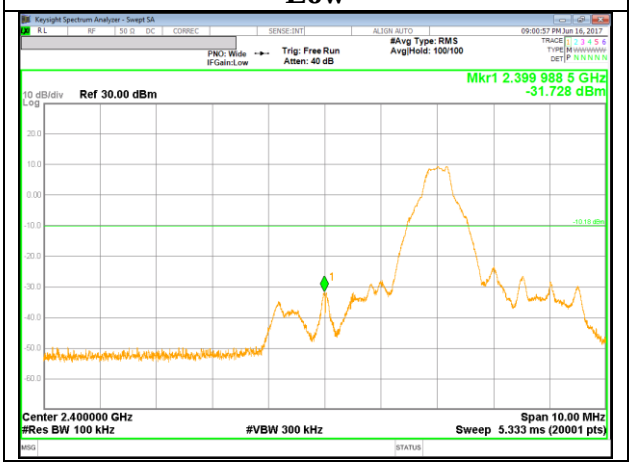
Hopping On

Low

High

Hopping Off

Low



High

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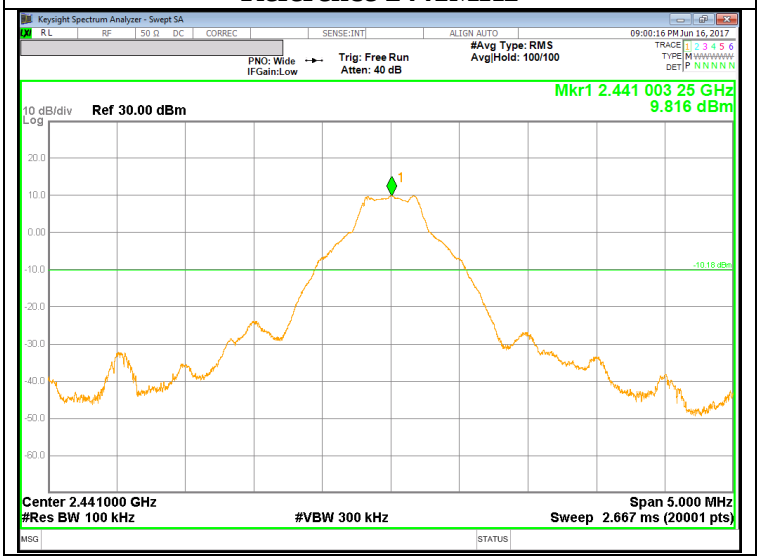
Reference 2441MHz



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Conducted Emission Band Edge compliance

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 16, 2017
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Seokhwan Hong
Mode	Tx, Hopping Off, 3DH5

In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on RF conducted measurement.

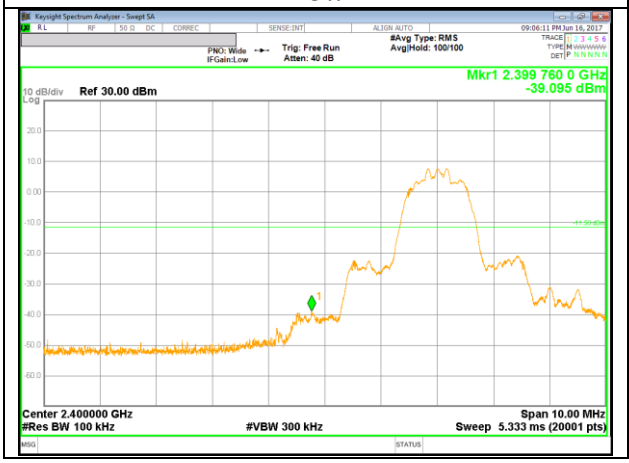
Hopping On

Low

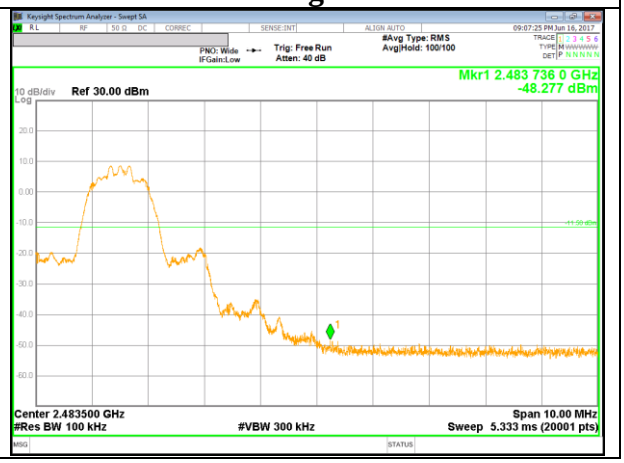
High

Hopping Off

Low



High



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Reference 2441MHz

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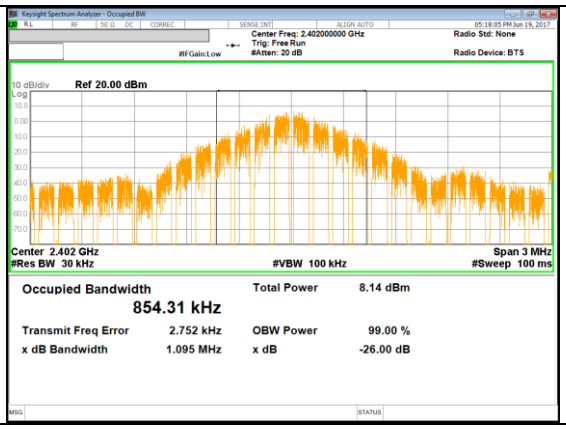
99%Occupied Bandwidth

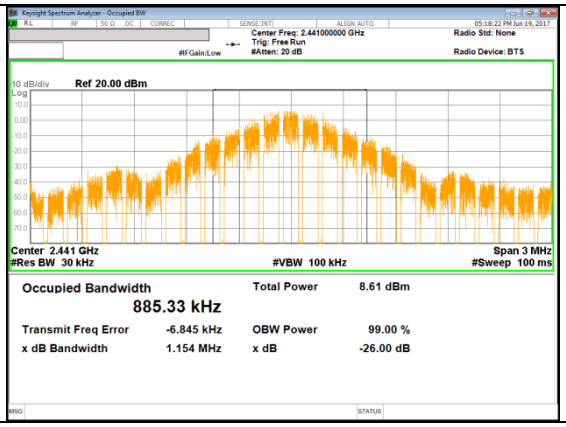
Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 19, 2017
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Seokhwan Hong
Mode	Tx Hopping Off

Hopping Off, DH5

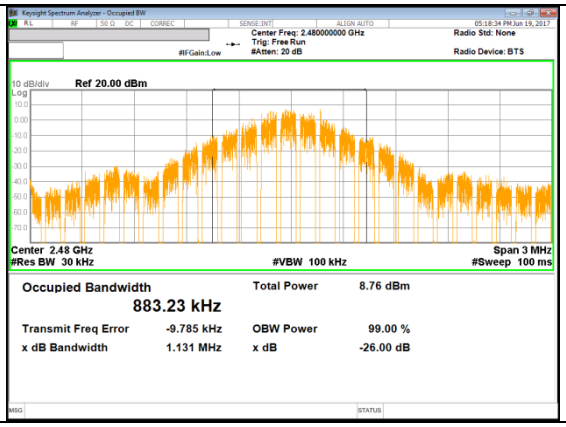
2402 MHz



2441 MHz

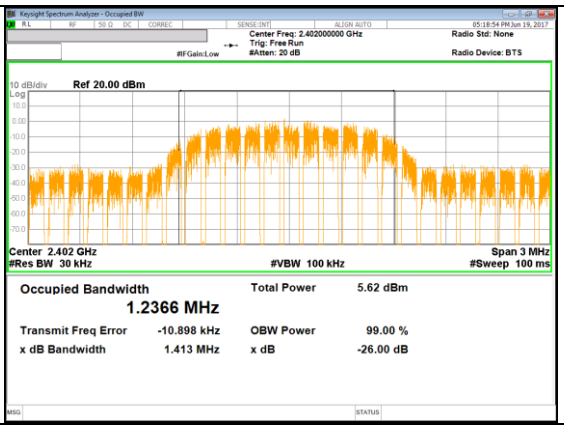


2480 MHz

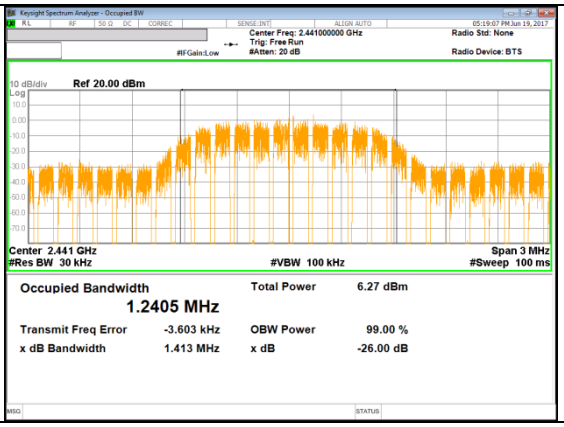


Hopping Off, 3DH5

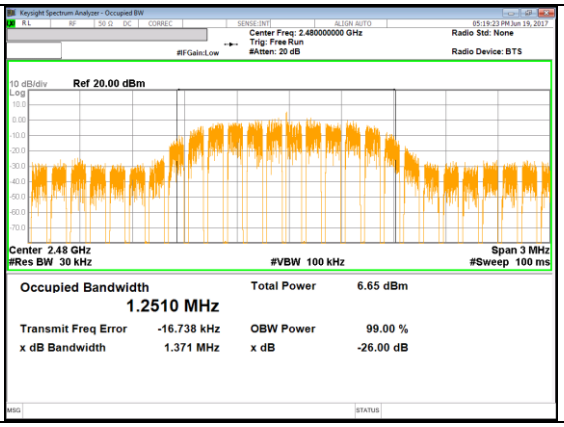
2402 MHz



2441 MHz



2480 MHz



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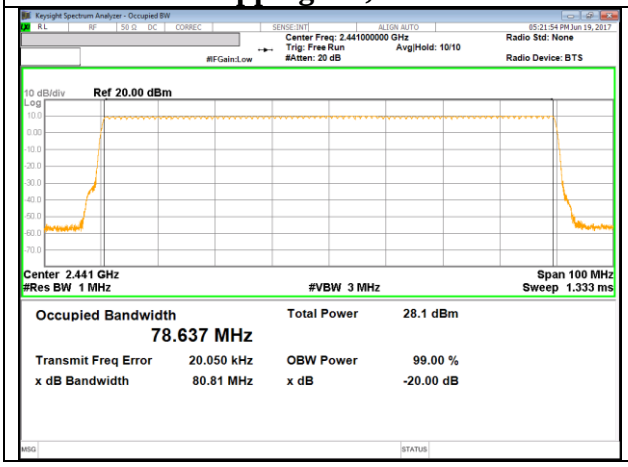
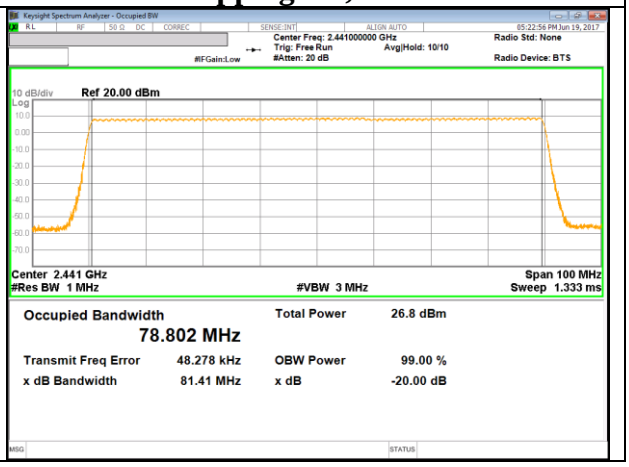
99% Occupied Bandwidth

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E2V2
Date	June 19, 2017
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Seokhwan Hong
Mode	Tx Hopping On

Hopping On, DH5	Hopping On, 3DH5
	

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APPENDIX 2: Test instruments

Test equipment

Test Equipment List				
Description	**Manufacturer**	**Model**	**S/N**	**Cal Due**
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	750	10-14-18
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	04-25-17
				04-14-19
Antenna, Horn, 18 GHz	ETS	3115	00167211	10-14-18
Antenna, Horn, 18 GHz	ETS	3117	00168724	06-17-17
				05-31-19
Antenna, Horn, 18 GHz	ETS	3117	00168717	06-17-17
				05-31-19
Antenna, Horn, 40 GHz	ETS	3116C	00166155	11-30-17
Antenna, Horn, 40 GHz	ETS	3116C-PA	00168841	12-15-17
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-17-17
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-16-17
Preamplifier	ETS	3115-PA	00167475	08-17-17
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-16-17
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-17-17
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	03-09-18
Average Power Sensor	Agilent / HP	U2000	MY54270007	08-17-17
DC Power supply	Agilent / HP	E3640A	MY54236144	08-16-17
DC Power supply	Agilent / HP	E3640A	MY54226395	08-16-17
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-17-17
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-16-17
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-16-17
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	009	08-17-17
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	015	08-16-17
High Pass Filter 3GHz	Micro-Tronics	HPM17543	010	08-17-17
High Pass Filter 3GHz	Micro-Tronics	HPM17543	015	08-16-17
High Pass Filter 6GHz	Micro-Tronics	HPM17542	009	08-17-17
LISN	R&S	ENV-216	101837	08-16-17
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	11-25-17
UL Software				
Description	**Manufacturer**	**Model**	**Version**	
Radiated software	UL	UL EMC	Ver 9.5	
AC Line Conducted software	UL	UL EMC	Ver 9.5	

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