



RADIO TEST REPORT

Test Report No. : 4787971961-E1V2

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: May 23, 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



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

CONTENTS	PAGE
SECTION 1: Customer information.....	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results.....	6
SECTION 4: Operation of E.U.T. during testing.....	9
SECTION 5: Conducted Emission.....	11
SECTION 6: Radiated Spurious Emission	12
SECTION 7: Antenna Terminal Conducted Tests.....	14
APPENDIX 1: Test data	15
6dB Bandwidth	17
Maximum Peak Output Power	18
Average Output Power	19
Radiated Spurious Emission	21
Conducted Spurious Emission	33
Power Density	37
99% Occupied Bandwidth	39
APPENDIX 2: Test instruments	40
APPENDIX 3: Photographs of test setup	41
Conducted Emission	41
Radiated Spurious Emission	42
Worst Case Position (Horizontal: X-axis/ Vertical:X-axis).....	44
Antenna Port Conducted	45

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

2.2 Product Description

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

Radio Specification

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

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 Radiators
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.

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 25.6 dB, 3.696 MHz, N	Complied	-
	IC: RSS-Gen 8.8	IC: RSS-Gen 8.8			
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(a)(2)	See data.	Complied	Conducted
	IC: -	IC: RSS-247 5.2(a)			
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(b)(3)		Complied	Conducted
	IC: RSS-Gen 6.12	IC: RSS-247 5.4(d)			
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(e)		Complied	Conducted
	IC: -	IC: RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(d)	5.87 dB 2246.00 MHz, AVG, 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) and KDB 558074 D01 DTS Meas Guidance v04 12.2.7.

*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 1.35 V) 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.

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

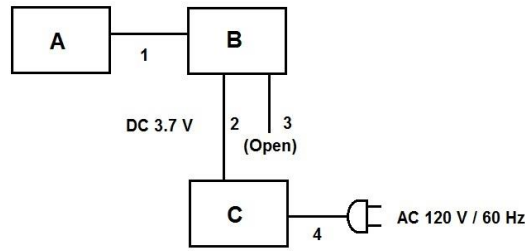
Refer to APPENDIX.

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

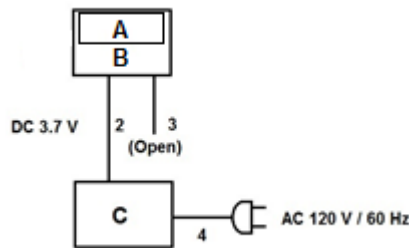
4.1 Operating Mode(s)

Mode	Remarks*
Bluetooth Low Energy	PRBS9
<p>*Power of the EUT was set by the software as follows; Length: 37 Bit pattern : 0 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.</p> <p>*Test Frequency 2402MHz, 2440MHz, 2480MHz</p>	

4.2 Configuration and peripherals



[Radiated test, AC power line conducted 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	-

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

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 antenna to EUT distance is 3 meters. 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, then the video bandwidth is set to 3 MHz for peak measurements and add duty cycle factor for average measurements. (Restricted bandedge, Final detection of spurious harmonic emissions)

Duty cycle factor = $10 \log(1/x)$. For this sample: $DCF = 10\log(1/0.610) = 2.15\text{dB}$
(Test Receiver or Spectrum Analyzer round it up to 2.15dB)

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.

The spectrum from 1 GHz 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.

Unwanted emissions within Restricted Bands are measured using traditional radiated procedures.
Band edge emissions within Restricted Bands are measured using RMS with duty cycle factor offset method.

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 1 GHz	
Instrument used	Test Receiver	Test Receiver	
Detector	QP	PK	AV *1)
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: <u>12.2.5.2</u> RBW: 1 MHz VBW: 3 MHz Detector: RMS Trace: 100 traces Duty factor was added to the results.
Test Distance	3 m	3 m (1GHz – 26.5GHz)	

*1) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v04".

- 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

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
6dB Bandwidth	1.5 MHz	100 kHz	300 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
Peak Power Density	1.5 times the 99% Bandwidth	3 kHz	10 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *2)
Conducted Spurious Emission *3)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	10 kHz	30 kHz				
	30MHz to 26.5GHz	100kHz	300kHz				

*1) Reference data

*2) Section 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v04".

*3) 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 = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz).

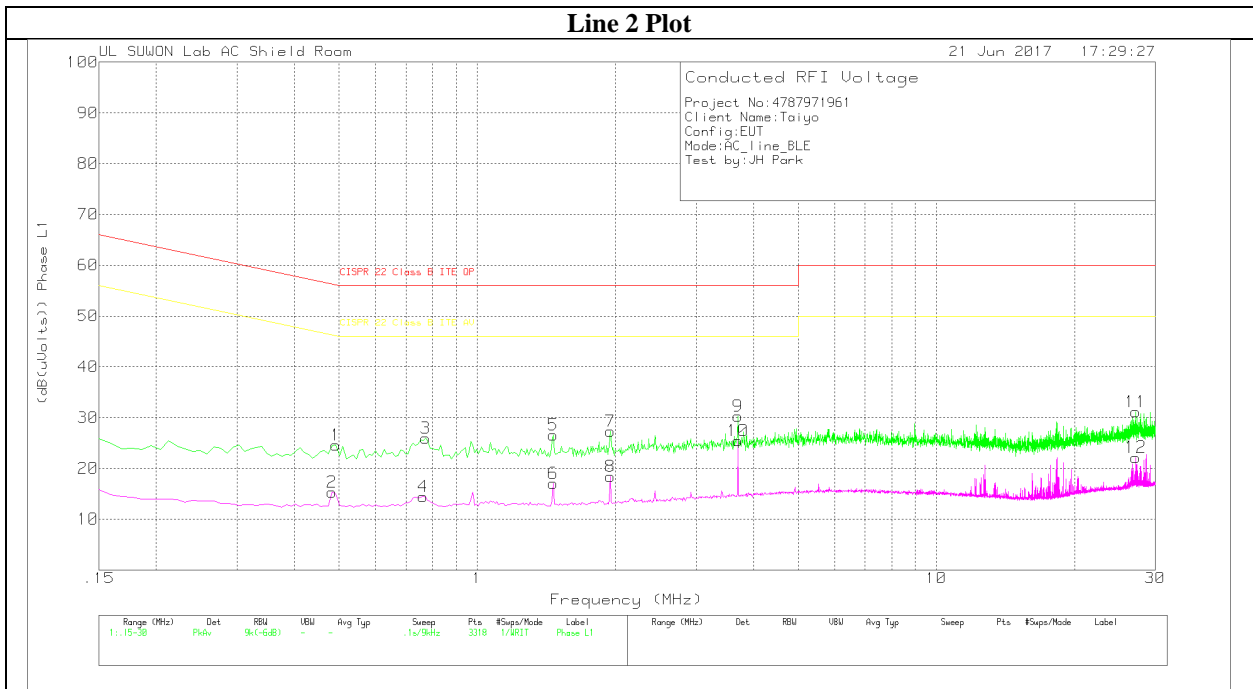
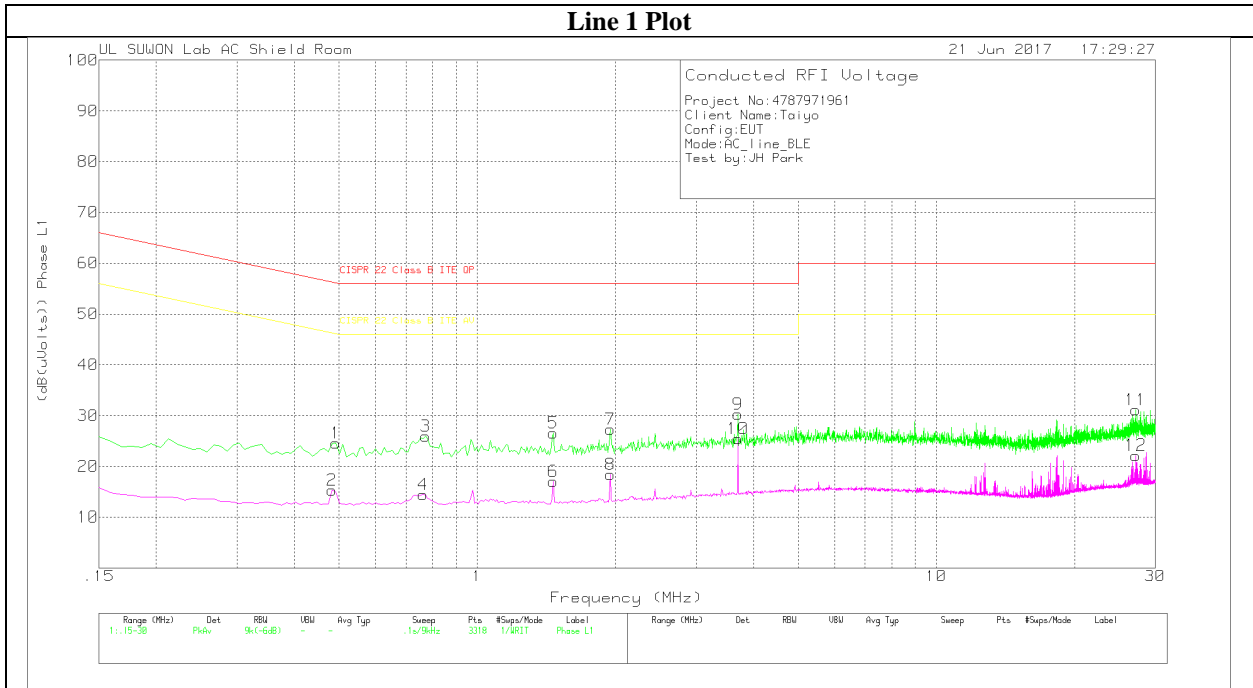
The test results and limit are rounded off to two decimals place, so some differences might be observed.

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

Test place	Suwon Lab. No.3 Shield room 3
Report No.	4787971961-E1V2
Date	June 21, 2017
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	JH Park
Mode	Tx BT LE , 2440 MHz



LINE 1 RESULTS

Trace Markers

Phase L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101837_w ith ex-cord_L 1	CABLELOS S(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	27.159	20.23	Pk	10.6	.3	31.13	60	-28.87	-	-
12	27.159	11.27	Av	10.6	.3	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_w ith ex-cord_N	CABLELOS S(dB)	Corrected Reading (dB(uVolts)	CISPR 22 Class B ITE QP	Margin (dB)	CISPR 22 Class B ITE AV	Margin (dB)
13	.483	14.72	Pk	9.9	.2	24.82	56.29	-31.47	-	-
14	.483	5.28	Av	9.9	.2	15.38	-	-	46.29	-30.91
15	.771	16.2	Pk	9.9	.2	26.3	56	-29.7	-	-
16	.771	4.19	Av	9.9	.2	14.29	-	-	46	-31.71
17	1.464	15.5	Pk	9.8	.3	25.6	56	-30.4	-	-
18	1.464	6.18	Av	9.8	.3	16.28	-	-	46	-29.72
19	1.95	15.96	Pk	9.7	.3	25.96	56	-30.04	-	-
20	1.95	7.36	Av	9.7	.3	17.36	-	-	46	-28.64
21	3.696	20.3	Pk	9.8	.3	30.4	56	-25.6	-	-
22	3.696	15.32	Av	9.8	.3	25.42	-	-	46	-20.58
23	18.366	18.48	Pk	10.6	.4	29.48	60	-30.52	-	-
24	18.366	11.73	Av	10.6	.4	22.73	-	-	50	-27.27

Pk - Peak detector

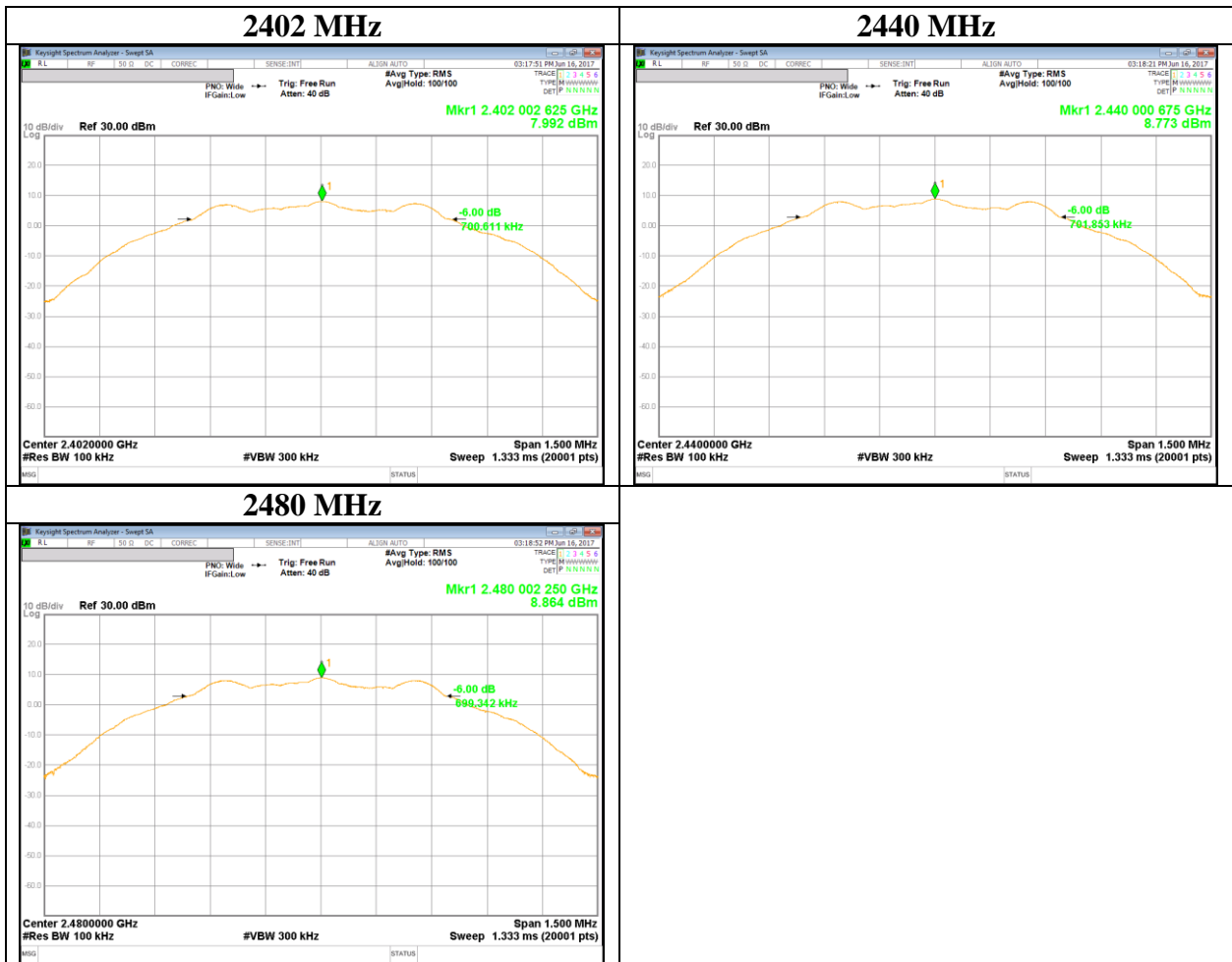
Av - Average detection

6dB Bandwidth

Test place : Suwon Lab. No.1 Measurement Room / Shielded Room
Report No. : 4787971961-E1V2
Date : June 16, 2017
Temperature / Humidity : 22 deg. C / 56 % RH
Engineer : Seokhwan Hong
Mode : Tx BT LE

Mode	Frequency [MHz]	6dB Bandwidth [kHz]	Limit [kHz]
BT LE	2402	700.611	> 500
	2440	701.853	> 500
	2480	699.342	> 500

6dB Bandwidth

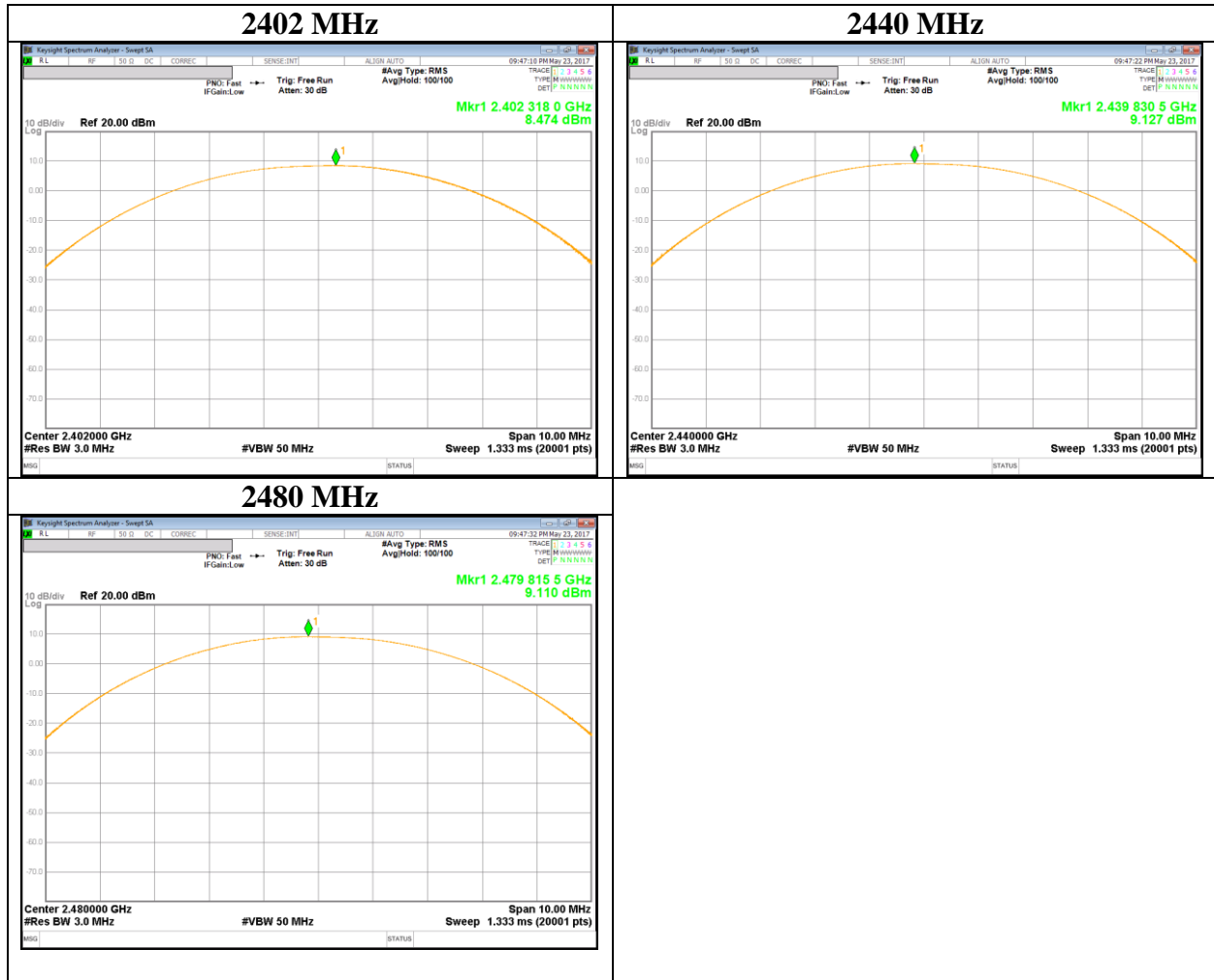


Maximum Peak Output Power

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E1V2
Date	June 16, 2017
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Seokhwan Hong
Mode	Tx BT LE

Freq.	Reading	Result		Limit		Margin
		[dBm]	[mW]	[dBm]	[mW]	
2402	8.474	8.474	7.04	30.00	1000	21.53
2440	9.127	9.127	8.18	30.00	1000	20.87
2480	9.110	9.110	8.15	30.00	1000	20.89

Maximum Peak Output Power



Average Output Power
(Reference data for RF Exposure)

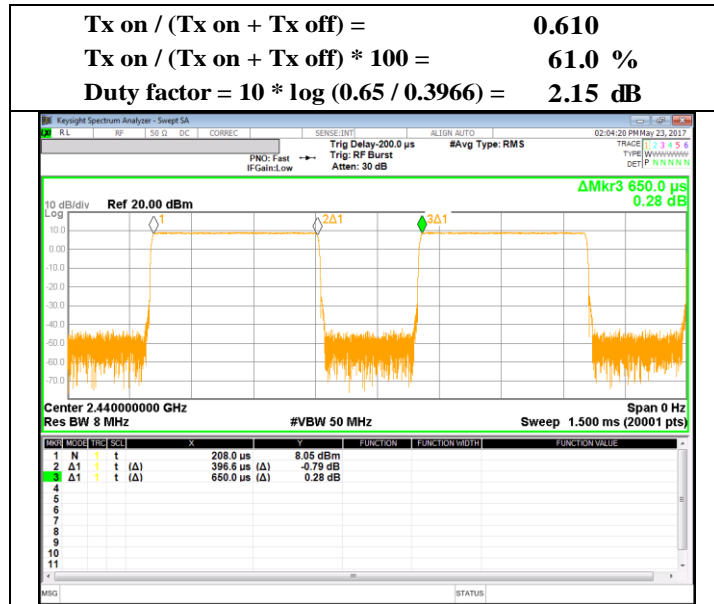
Test place Suwon Lab. No.1 Measurement Room / Shielded Room
Report No. 4787971961-E1V2
Date June 16, 2017
Temperature / Humidity 22 deg. C / 56 % RH
Engineer Seokhwan Hong
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
		[dBm]	[mW]		[dBm]	[mW]
2402	5.799	5.799	3.80	2.15	7.949	6.24
2440	6.516	6.516	4.48	2.15	8.666	7.36
2480	6.478	6.478	4.44	2.15	8.628	7.29

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

Burst rate confirmation

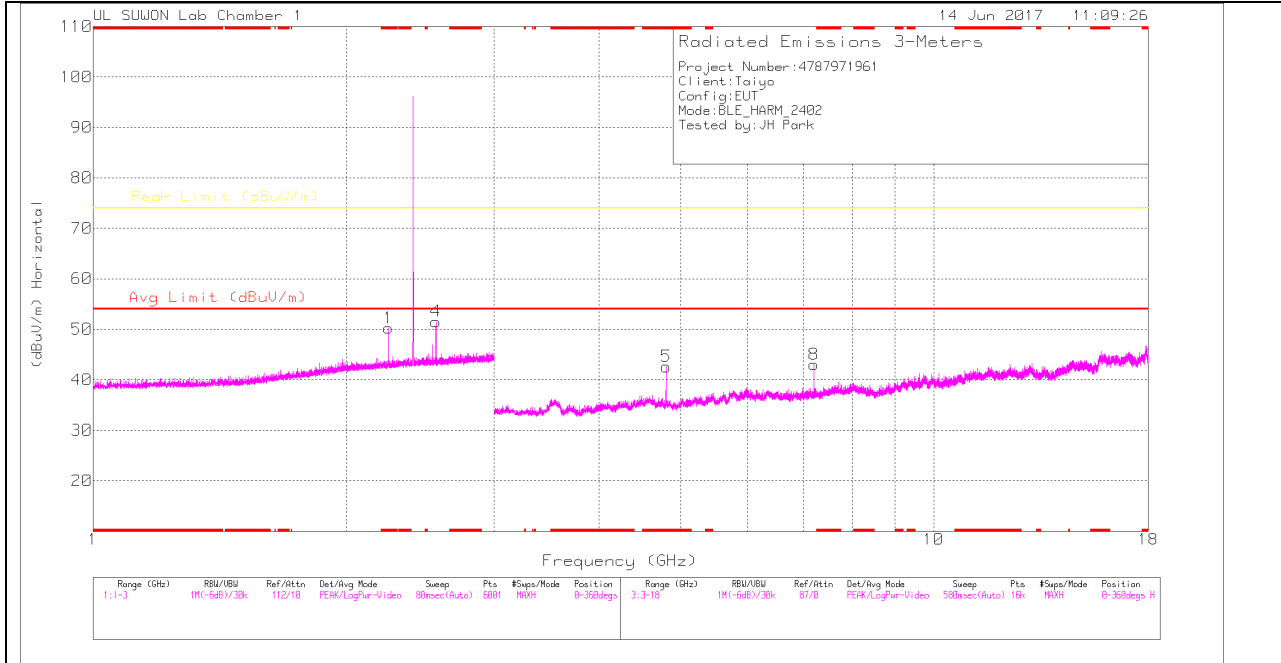
Report No. 4787971961-E1V2
Date May 23, 2017
Temperature / Humidity 23 deg. C / 47 % RH
Engineer Seokhwan Hong
Mode Tx BT LE
Report No. 4787971961-E1V2



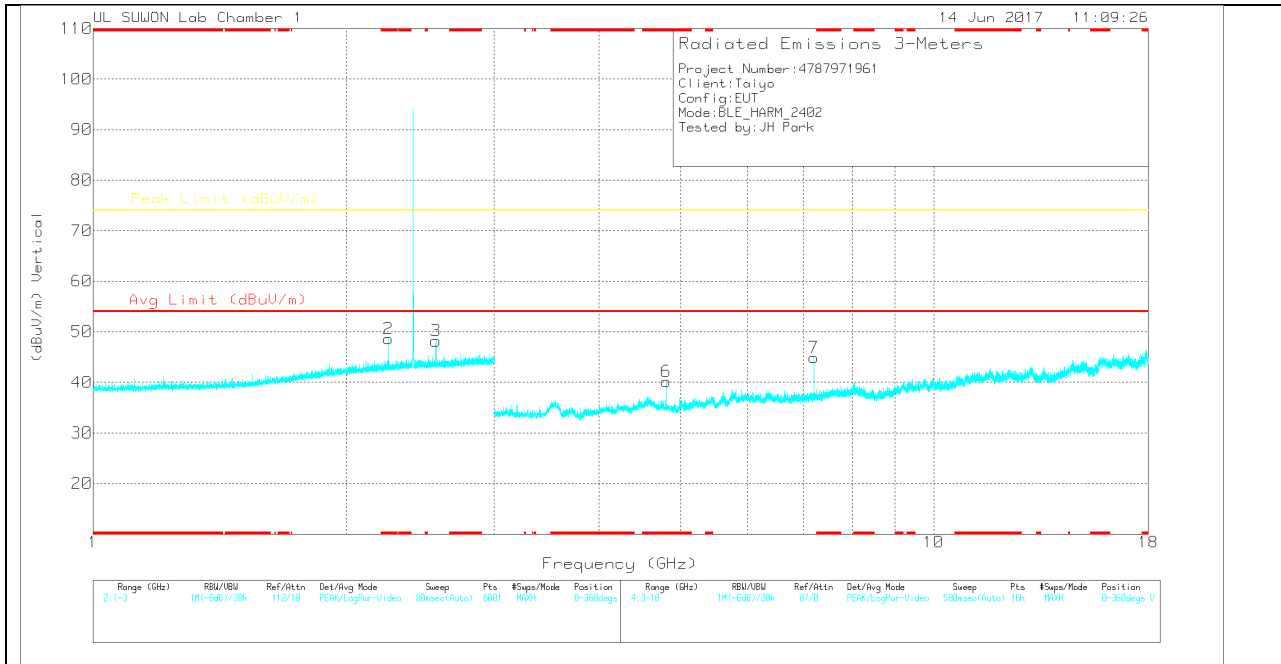
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E1V2
Date	June 14, 2017
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	JH Park
Mode	Tx BT LE, 2402MHz

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.

LOW CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(001687 17)_150619	10dB_Att(dB)	DC Corr (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	47.62	PK	31.5	-28.9	0	50.22	-	-	74	-23.78	0-360	150	H
4	2.558	48.15	PK	32	-28.6	0	51.55	-	-	74	-22.45	0-360	150	H
2	* 2.246	46.01	PK	31.5	-28.9	0	48.61	-	-	74	-25.39	0-360	250	V
3	2.558	44.81	PK	32	-28.6	0	48.21	-	-	74	-25.79	0-360	250	V
5	* 4.804	42.61	PK	34	-34	0	42.61	-	-	74	-31.39	0-360	150	H
8	7.206	38.4	PK	35.7	-31.1	0	43	-	-	74	-31	0-360	150	H
6	* 4.804	40.18	PK	34	-34	0	40.18	-	-	74	-33.82	0-360	150	V
7	7.206	40.28	PK	35.7	-31.1	0	44.88	-	-	74	-29.12	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(001 68717)_1 50619	10dB_Att(dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.246	53.99	PK2	31.5	-28.9	0	56.59	-	-	74	-17.41	154	149	H
* 2.246	45.53	MAv1	31.5	-28.9	0	48.13	54	-5.87	-	-	154	149	H
* 2.246	52.24	PK2	31.5	-28.9	0	54.84	-	-	74	-19.16	148	113	V
* 2.246	41.08	MAv1	31.5	-28.9	0	43.68	54	-10.32	-	-	148	113	V
2.558	52.83	PK2	32	-28.6	0	56.23	-	-	74	-17.77	158	102	V
2.558	53.64	PK2	32	-28.6	0	57.04	-	-	74	-16.96	154	156	H
* 4.804	41.85	MAv1	34	-34	2.15	44	54	-10	-	-	111	162	H
* 4.804	39.43	MAv1	34	-34	2.15	41.58	54	-12.42	-	-	50	125	V
* 4.805	50.96	PK2	34	-34	0	50.96	-	-	74	-23.04	111	162	H
* 4.803	49.63	PK2	34	-34	0	49.63	-	-	74	-24.37	50	125	V
7.207	48.17	PK2	35.7	-31.1	0	52.77	-	-	74	-21.23	204	116	V
7.206	47.32	PK2	35.7	-31.1	0	51.92	-	-	74	-22.08	189	142	H

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

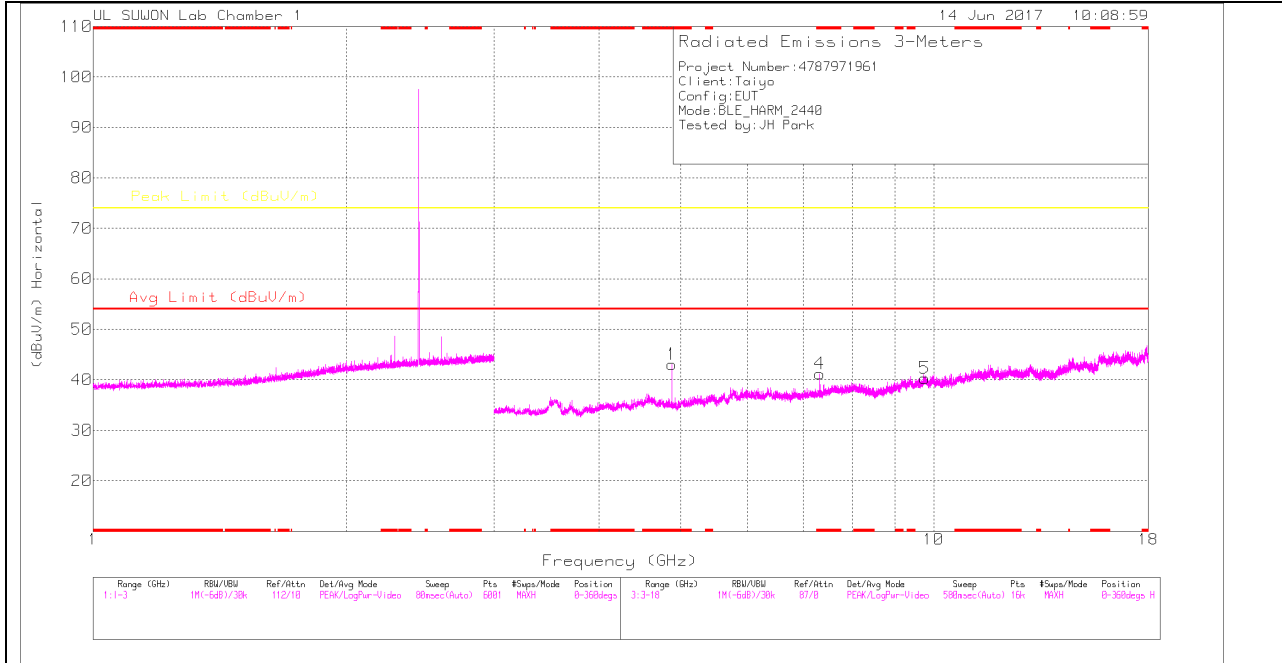
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

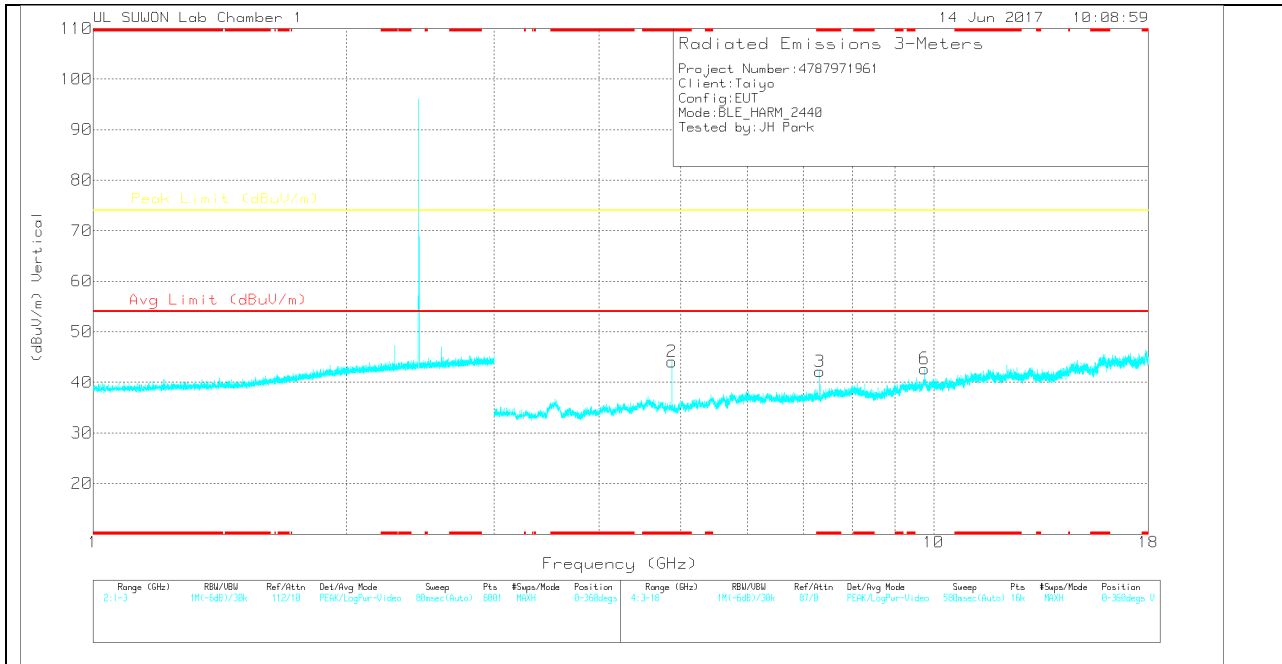
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E1V2
Date	June 14, 2017
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	JH Park
Mode	Tx BT LE, 2440MHz

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.

MID CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717_150619)	3Ghz_HP(dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.88	43.25	PK	34	-34.2	0	43.05	-	-	74	-30.95	0-360	150	H
4	* 7.321	36.41	PK	35.8	-31	0	41.21	-	-	74	-32.79	0-360	150	H
5	9.759	30.61	PK	37.2	-27.5	0	40.31	-	-	74	-33.69	0-360	250	H
2	* 4.881	44.3	PK	34	-34.2	0	44.1	-	-	74	-29.9	0-360	250	V
3	* 7.321	37.36	PK	35.8	-31	0	42.16	-	-	74	-31.84	0-360	150	V
6	9.758	32.99	PK	37.2	-27.5	0	42.69	-	-	74	-31.31	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)	3Ghz_HP(dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.879	51.18	PK2	34	-34.2	0	50.98	-	-	74	-23.02	163	107	H
* 4.88	41.93	MAv1	34	-34.2	2.15	43.88	54	-10.12	-	-	163	107	H
* 4.88	52.56	PK2	34	-34.2	0	52.36	-	-	74	-21.64	60	102	V
* 4.88	44.48	MAv1	34	-34.2	2.15	46.43	54	-7.57	-	-	60	102	V
* 7.319	47.14	PK2	35.8	-31	0	51.94	-	-	74	-22.06	21	118	V
* 7.319	36.04	MAv1	35.8	-31	2.15	42.99	54	-11.01	-	-	21	118	V
* 7.319	46.5	PK2	35.8	-31	0	51.3	-	-	74	-22.7	164	137	H
* 7.32	35.28	MAv1	35.8	-31	2.15	42.23	54	-11.77	-	-	164	137	H
9.759	41	PK2	37.2	-27.5	0	50.7	-	-	74	-23.3	116	100	H
9.758	41.13	PK2	37.2	-27.5	0	50.83	-	-	74	-23.17	13	391	V

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

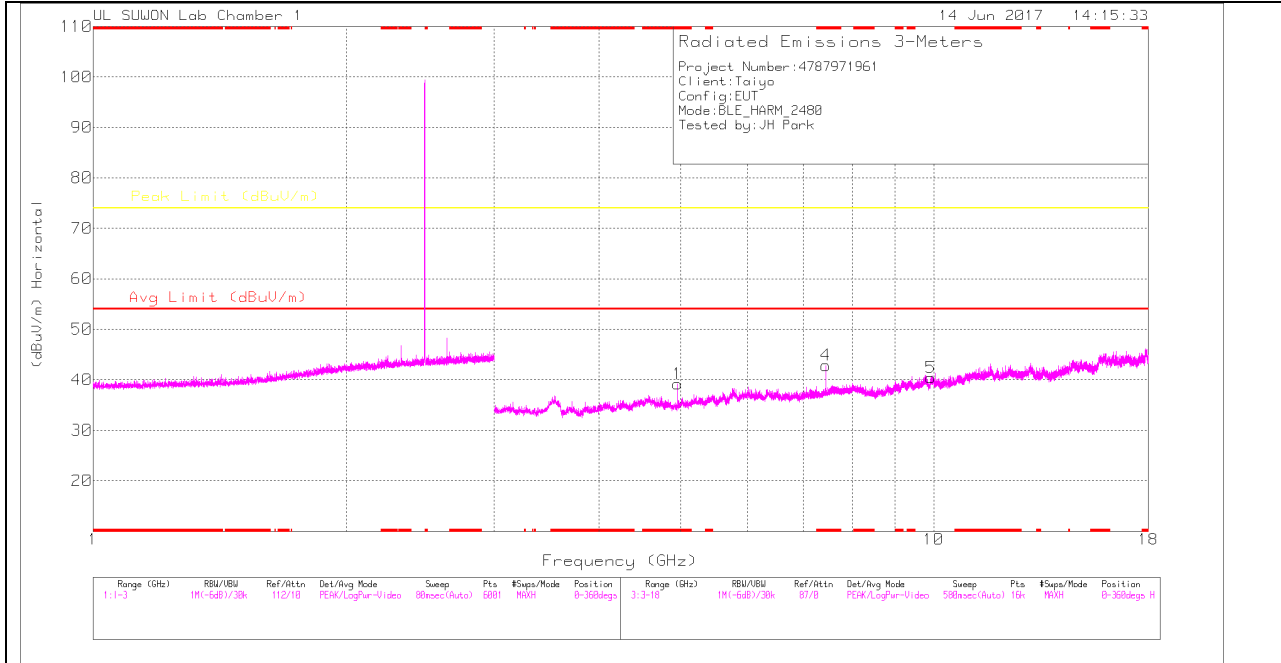
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

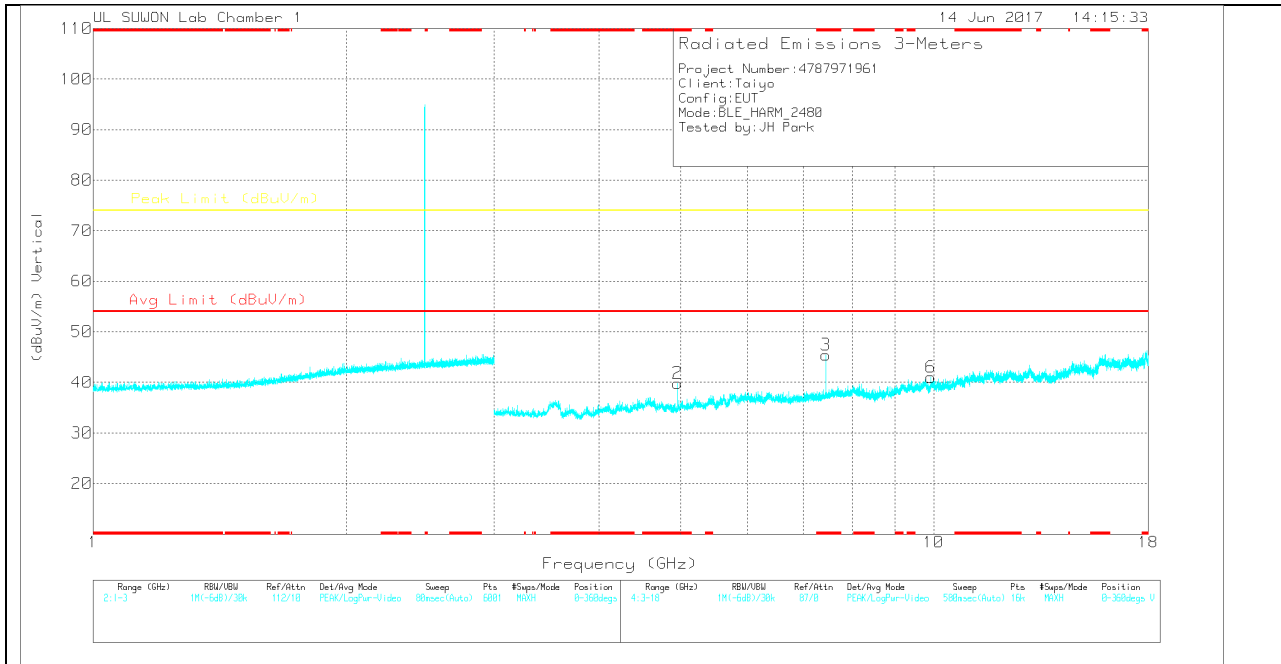
Radiated Spurious Emission

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E1V2
Date	June 14, 2017
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	JH Park
Mode	Tx BT LE, 2480MHz

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.

HIGH CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(001687 17_150619)	3Ghz_HP(dB)	DC Corr (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	39.27	PK	34	-34.1	0	39.17	-	-	74	-34.83	0-360	150	H
4	* 7.441	38.05	PK	35.8	-31	0	42.85	-	-	74	-31.15	0-360	150	H
5	9.918	31.01	PK	37.4	-28	0	40.41	-	-	74	-33.59	0-360	250	H
2	* 4.96	39.94	PK	34	-34.1	0	39.84	-	-	74	-34.16	0-360	250	V
3	* 7.439	40.72	PK	35.8	-31.1	0	45.42	-	-	74	-28.58	0-360	250	V
6	9.924	31.39	PK	37.4	-27.8	0	40.99	-	-	74	-33.01	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(001 68717_1 50619)	3Ghz_HP(dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.96	49.17	PK2	34	-34.1	0	49.07	-	-	74	-24.93	276	356	H
* 4.96	39.05	MAv1	34	-34.1	2.15	41.1	54	-12.9	-	-	276	356	H
* 4.959	48.98	PK2	34	-34.1	0	48.88	-	-	74	-25.12	141	106	V
* 4.96	38.44	MAv1	34	-34.1	2.15	40.49	54	-13.51	-	-	141	106	V
* 7.439	49.01	PK2	35.8	-31.1	0	53.71	-	-	74	-20.29	205	101	V
* 7.439	38.27	MAv1	35.8	-31.1	2.15	45.12	54	-8.88	-	-	205	101	V
* 7.44	47.9	PK2	35.8	-31	0	52.7	-	-	74	-21.3	212	131	H
* 7.439	37.57	MAv1	35.8	-31.1	2.15	44.42	54	-9.58	-	-	212	131	H
* 7.441	47.7	PK2	35.8	-31	0	52.5	-	-	74	-21.5	217	107	V
* 7.439	38.65	MAv1	35.8	-31.1	2.15	45.5	54	-8.5	-	-	217	107	V
* 7.439	47.54	PK2	35.8	-31.1	0	52.24	-	-	74	-21.76	223	107	H
* 7.44	37.41	MAv1	35.8	-31.1	2.15	44.26	54	-9.74	-	-	223	107	H

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

PK2 - KDB558074 Method: Maximum Peak

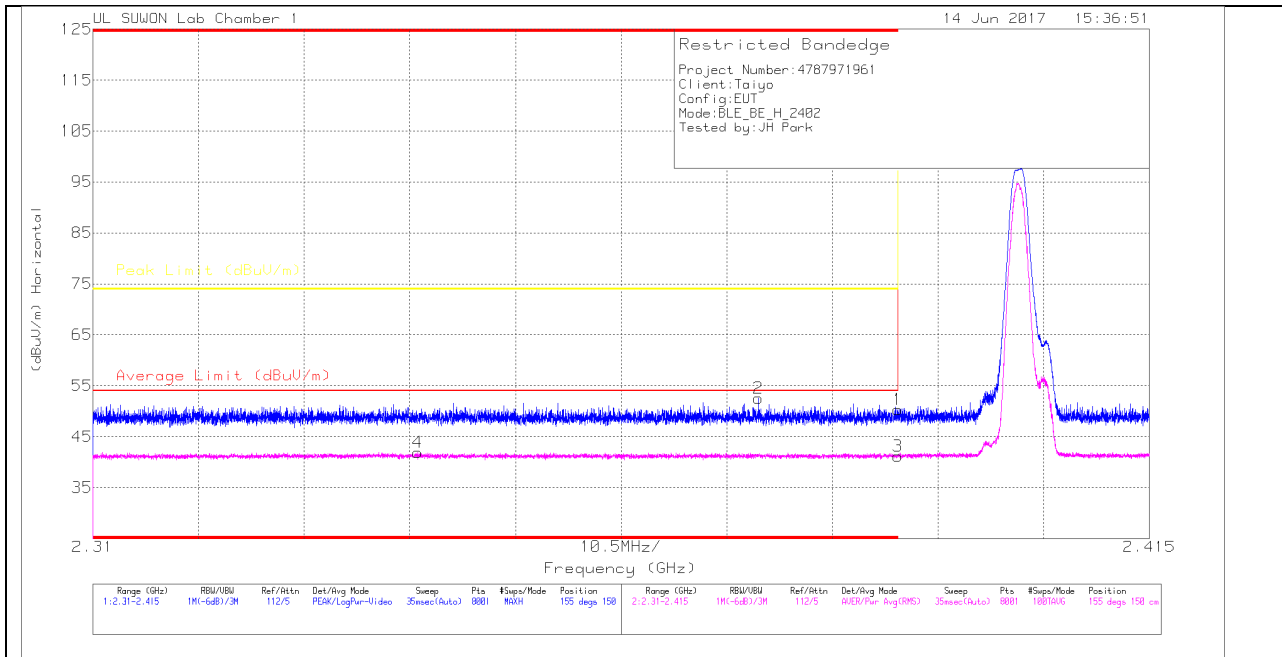
MAv1 - KDB558074 Option 1 Maximum RMS Average

Radiated Spurious Emission

Test place : Suwon Lab. No.1 Semi Anechoic Chamber
Report No. : 4787971961-E1V2
Date : June 14, 2017
Temperature / Humidity : 27 deg. C / 51 % RH
Engineer : JH Park
Mode : Tx BT LE, 2402MHz, 2480MHz

RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

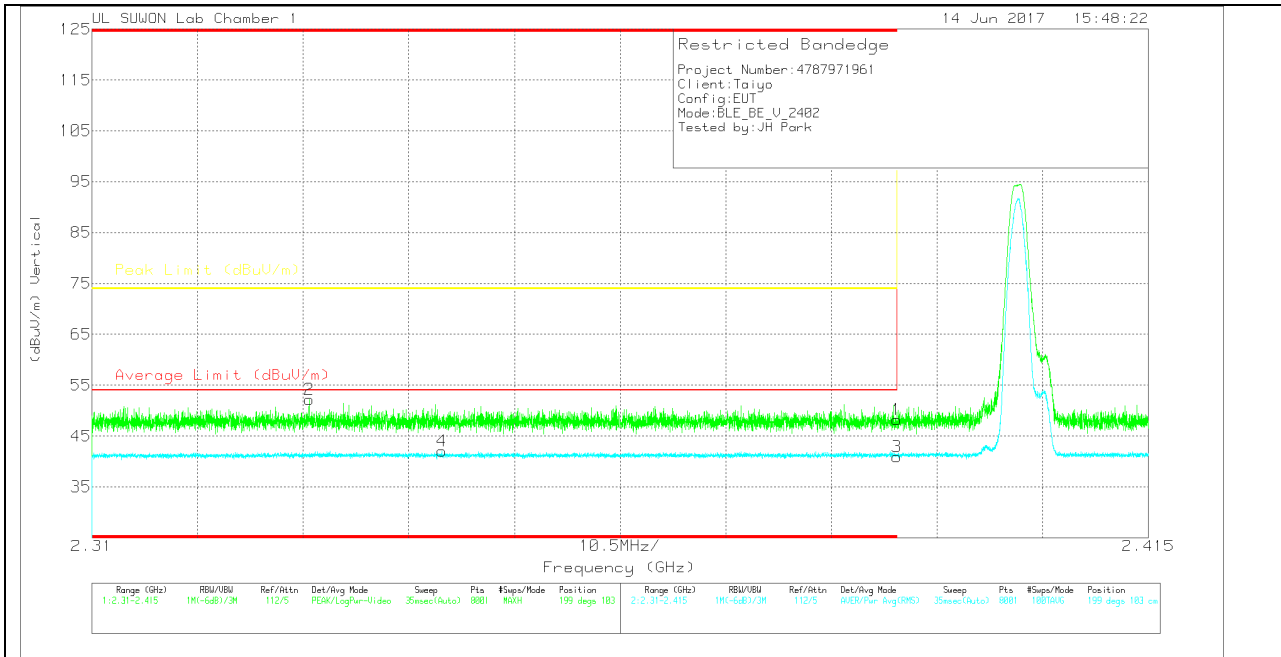
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168 717)_150619	10dB_Att(dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	47.24	Pk		-28.7	0	50.34	-	-	74	-23.66	155	150	H
2	* 2.376	49.44	Pk		-28.7	0	52.54	-	-	74	-21.46	155	150	H
3	* 2.39	35.95	RMS		-28.7	2.15	41.2	54	-12.8	-	-	155	150	H
4	* 2.342	36.9	RMS		-28.8	2.15	41.95	54	-12.05	-	-	155	150	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	DC Corr (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	45.13	Pk		-28.7	0	48.23	-	-	74	-25.77	199	103	V
2	* 2.332	49.25	Pk		-28.8	0	52.15	-	-	74	-21.85	199	103	V
3	* 2.39	35.63	RMS		-28.7	2.15	40.88	54	-13.12	-	-	199	103	V
4	* 2.345	36.99	RMS		-28.8	2.15	42.04	54	-11.96	-	-	199	103	V

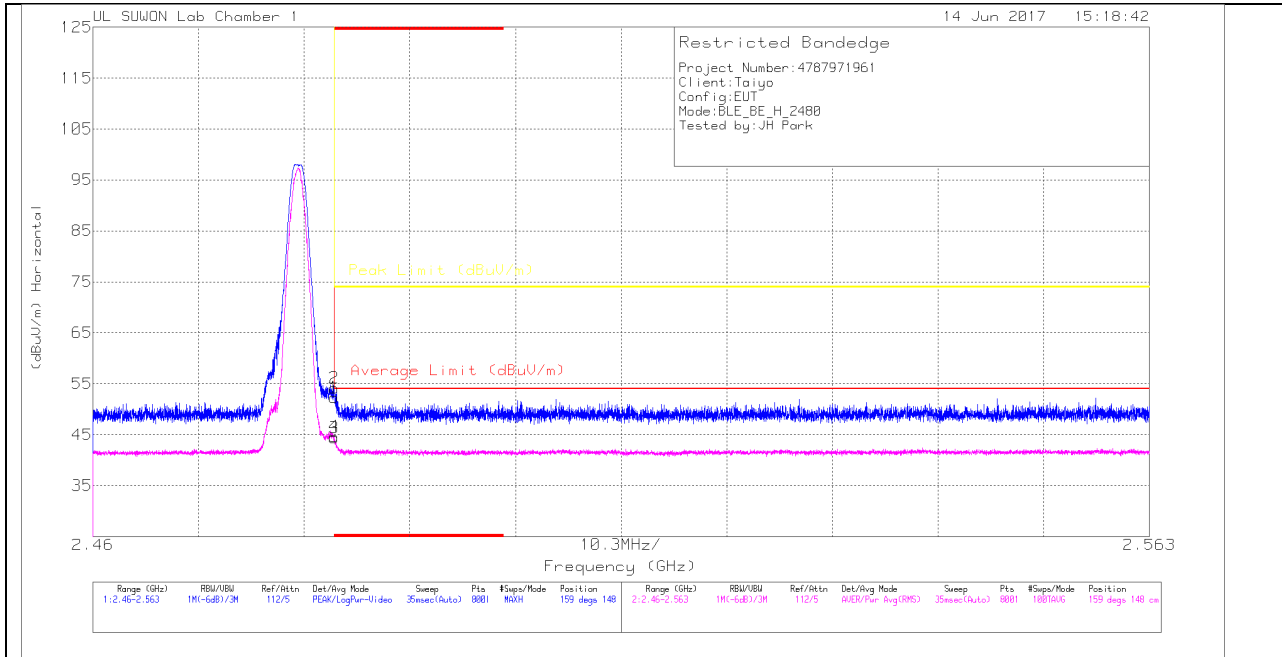
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

RESTRICTED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

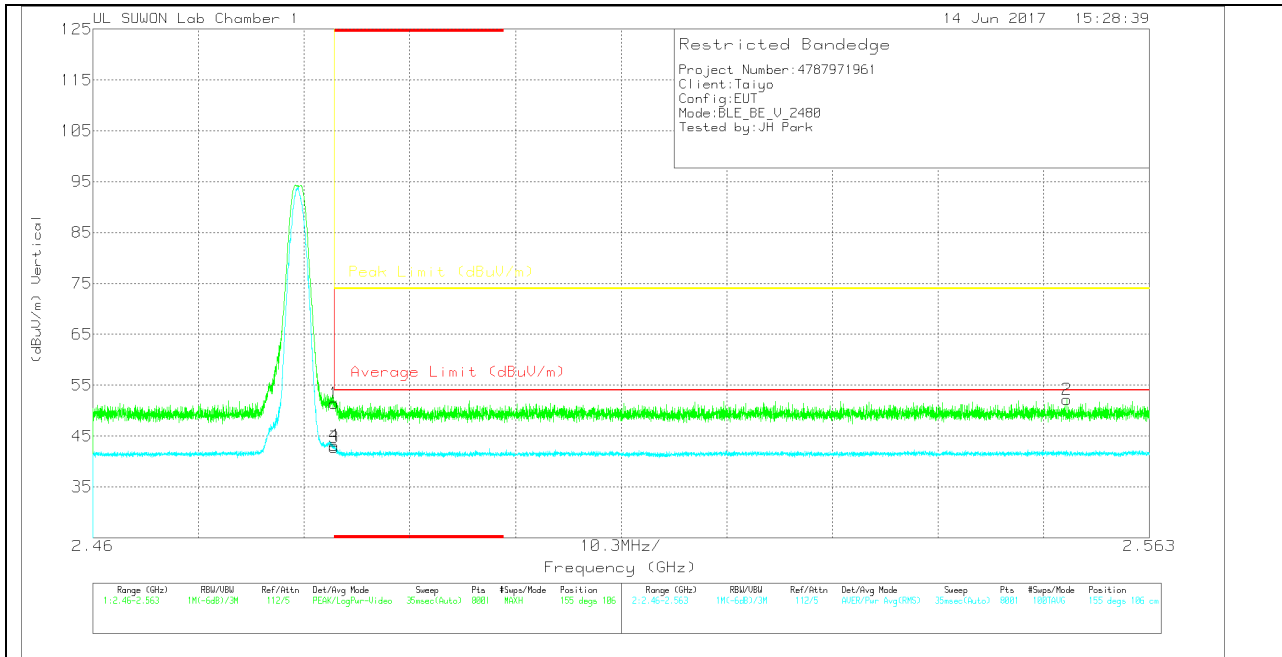
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(001687 17)_150619	10dB_Att(dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	48.97	Pk	32	-28.7	0	52.27	-	-	74	-21.73	159	148	H
2	* 2.484	50.83	Pk	32	-28.7	0	54.13	-	-	74	-19.87	159	148	H
3	* 2.484	38.98	RMS	32	-28.7	2.15	44.43	54	-9.57	-	-	159	148	H
4	* 2.484	39.15	RMS	32	-28.7	2.15	44.6	54	-9.4	-	-	159	148	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117(00168717)_150619	10dB_Att(dB)	DC Corr (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	48.13	Pk	32	-28.7	0	51.43	-	-	74	-22.57	155	106	V
2	2.555	48.83	Pk	32	-28.6	0	52.23	-	-	74	-21.77	155	106	V
3	* 2.484	37.32	RMS	32	-28.7	2.15	42.77	54	-11.23	-	-	155	106	V
4	* 2.484	37.68	RMS	32	-28.7	2.15	43.13	54	-10.87	-	-	155	106	V

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

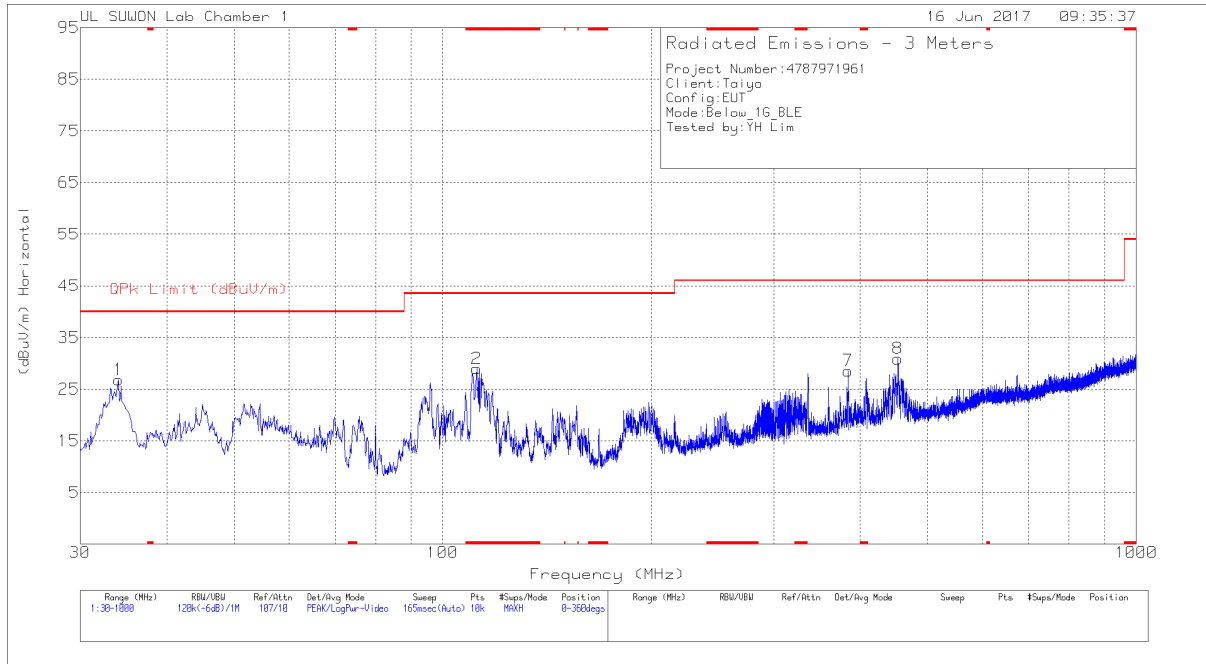
Pk - Peak detector

RMS - RMS detection

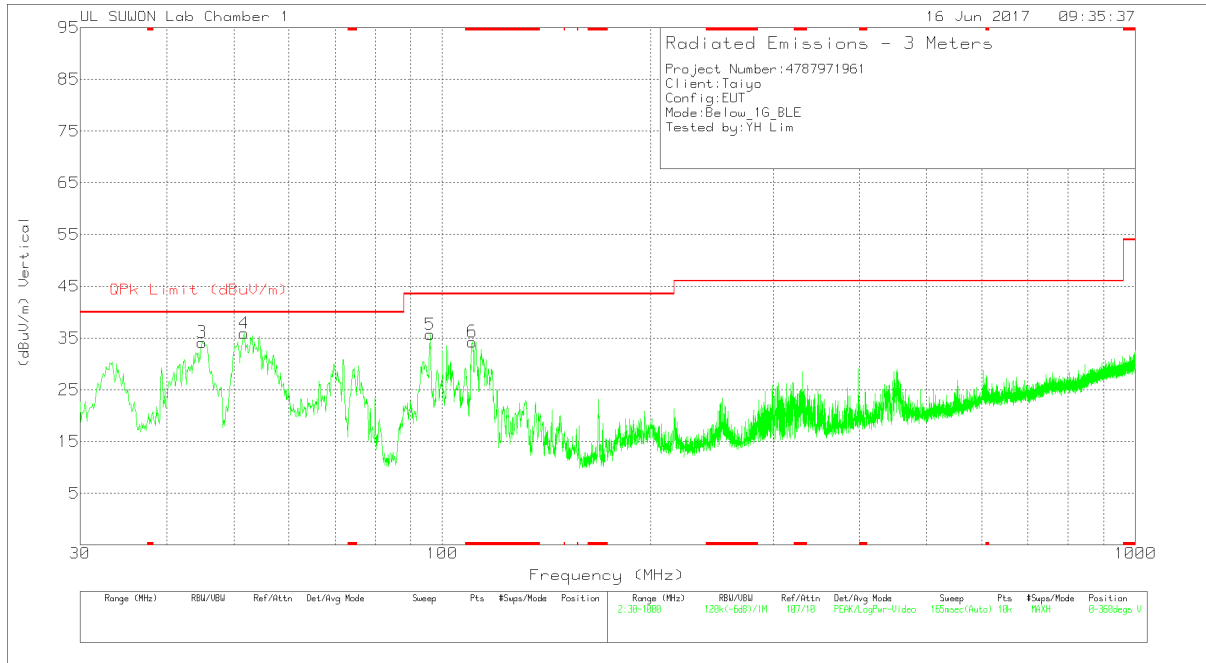
Radiated Spurious Emission (Plot data, Worst case)

Test place	Suwon Lab. No.1 Semi Anechoic Chamber
Report No.	4787971961-E1V2
Date	June 16, 2017
Temperature / Humidity	27 deg. C / 45 % RH
Engineer	YH Lim
Mode	Tx BT LE , 2440 MHz

HORIZONTAL PLOT



VERTICAL PLOT



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	44.63	Pk	10.6	-28.4	26.83	40	-13.17	0-360	300	H
2	* 111.965	45.07	Pk	11.1	-27.2	28.97	43.52	-14.55	0-360	400	H
7	384.05	38.96	Pk	14.8	-25.2	28.56	46.02	-17.46	0-360	100	H
8	452.92	39.71	Pk	15.9	-24.7	30.91	46.02	-15.11	0-360	200	H
3	45.035	48.66	Pk	13.6	-28.1	34.16	40	-5.84	0-360	100	V
4	51.728	49.92	Pk	13.8	-27.8	35.92	40	-4.08	0-360	100	V
5	95.96	52.11	Pk	10.9	-27.3	35.71	43.52	-7.81	0-360	100	V
6	* 110.413	50.17	Pk	11.3	-27.2	34.27	43.52	-9.25	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)	30-1000M Hz(dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
45.0545	45.99	Qp	13.6	-28.1	31.49	40	-8.51	117	101	V
51.7968	45.62	Qp	13.8	-27.8	31.62	40	-8.38	153	101	V

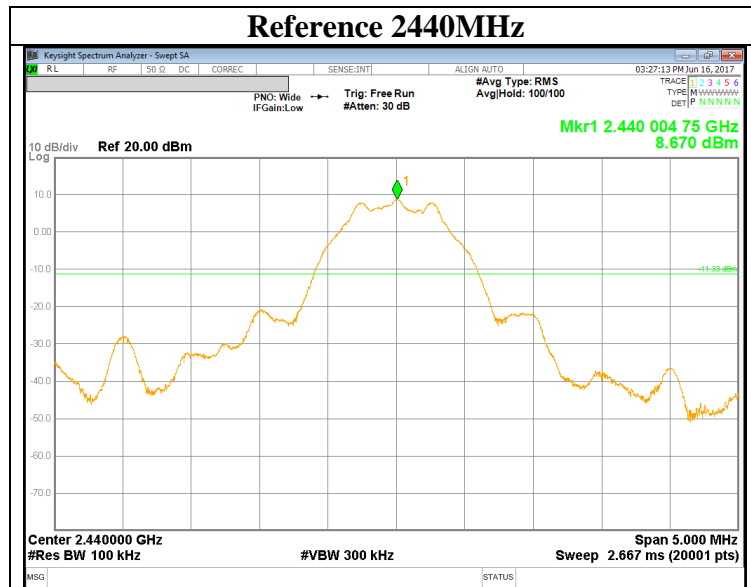
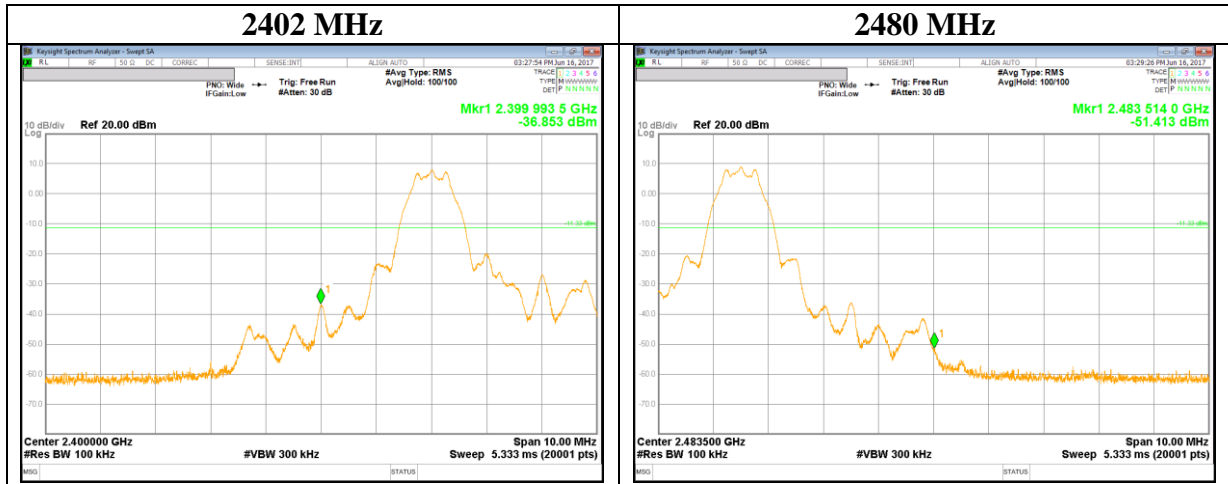
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Qp - Quasi-Peak detector

Conducted Spurious Emission (Band Edge)

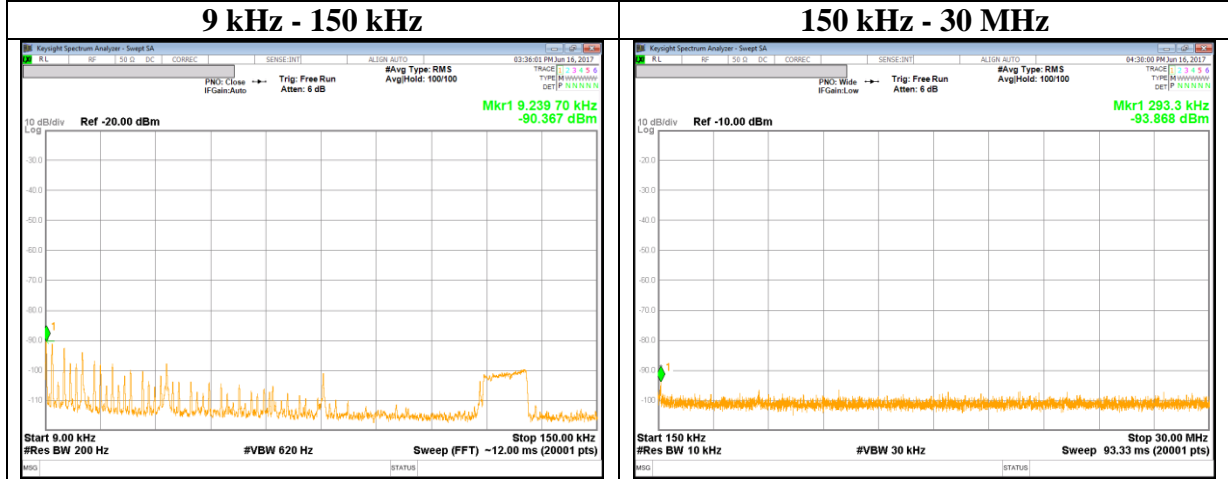
Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E1V2
Date	June 16, 2017
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Seokhwan Hong
Mode	Tx BT LE, 2480MHz

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.



Conducted Spurious Emission

Test place : Suwon Lab. No.1 Measurement Room / Shielded Room
Report No. : 4787971961-E1V2
Date : June 16, 2017
Temperature / Humidity : 22 deg. C / 56 % RH
Engineer : Seokhwan Hong
Mode : Tx BT LE, 2402MHz

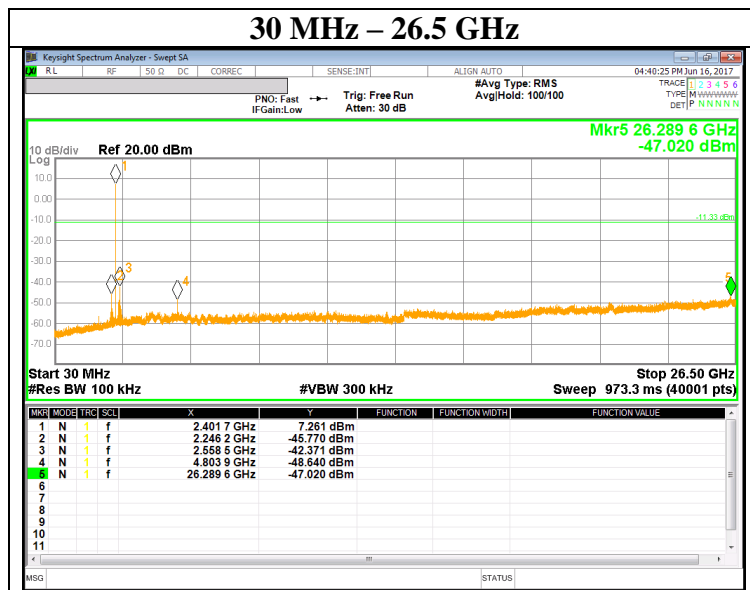


Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.24	-90.4	0.50	0.0	2.0	1	-87.9	300	6.0	-26.6	48.2	74.8	
293.30	-93.9	0.50	0.0	2.0	1	-91.4	300	6.0	-30.1	18.2	48.3	

$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

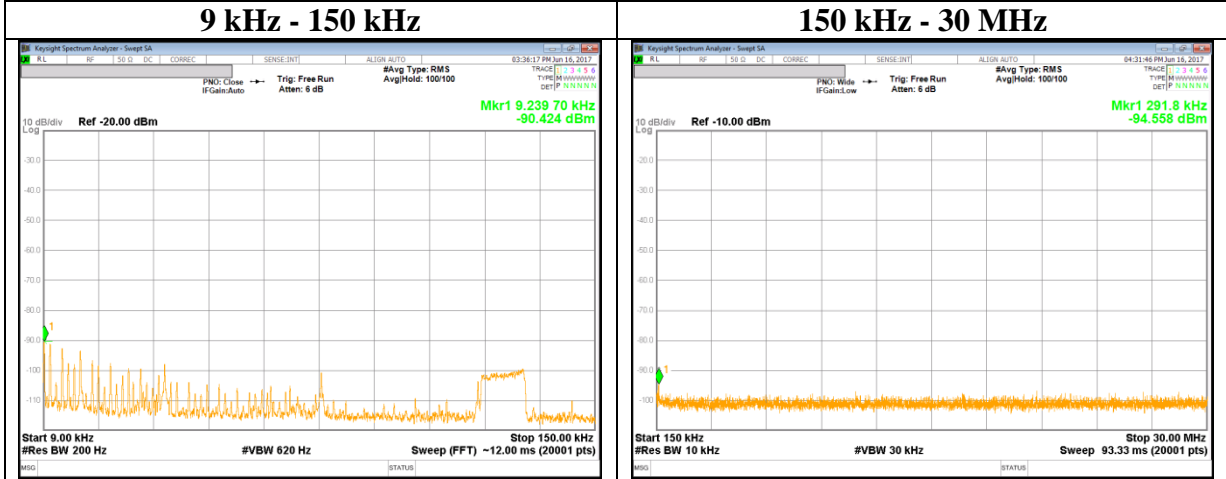
N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.



Conducted Spurious Emission

Test place : Suwon Lab. No.1 Measurement Room / Shielded Room
Report No. : 4787971961-E1V2
Date : June 16, 2017
Temperature / Humidity : 22 deg. C / 56 % RH
Engineer : Seokhwan Hong
Mode : Tx BT LE, 2440MHz

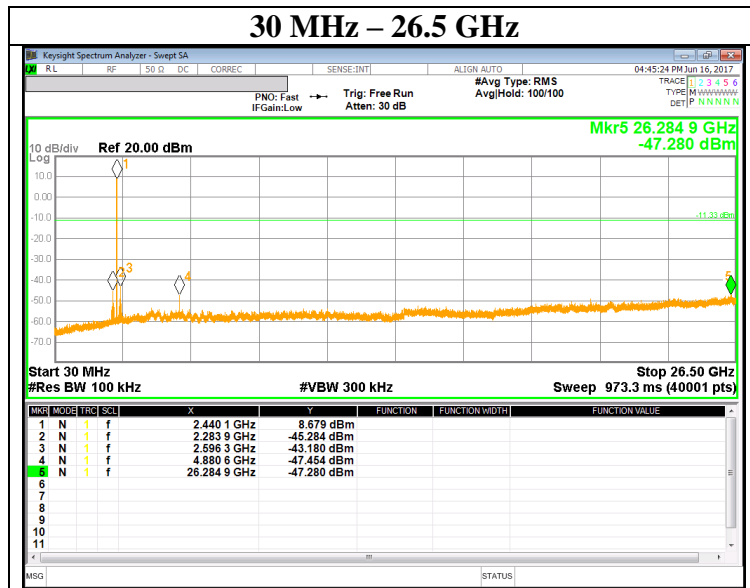


Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.24	-90.4	0.50	0.0	2.0	1	-87.9	300	6.0	-26.7	48.2	74.9	
291.80	-94.6	0.50	0.0	2.0	1	-92.1	300	6.0	-30.8	18.3	49.1	

$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log(\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

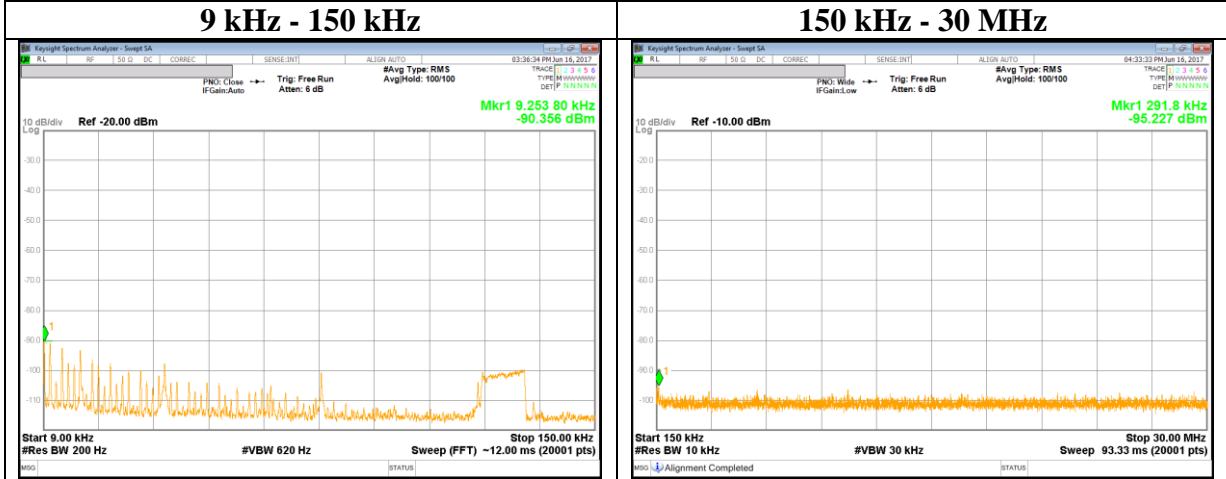
N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.



Conducted Spurious Emission

Test place : Suwon Lab. No.1 Measurement Room / Shielded Room
Report No. : 4787971961-E1V2
Date : June 16, 2017
Temperature / Humidity : 22 deg. C / 56 % RH
Engineer : Seokhwan Hong
Mode : Tx BT LE, 2480MHz

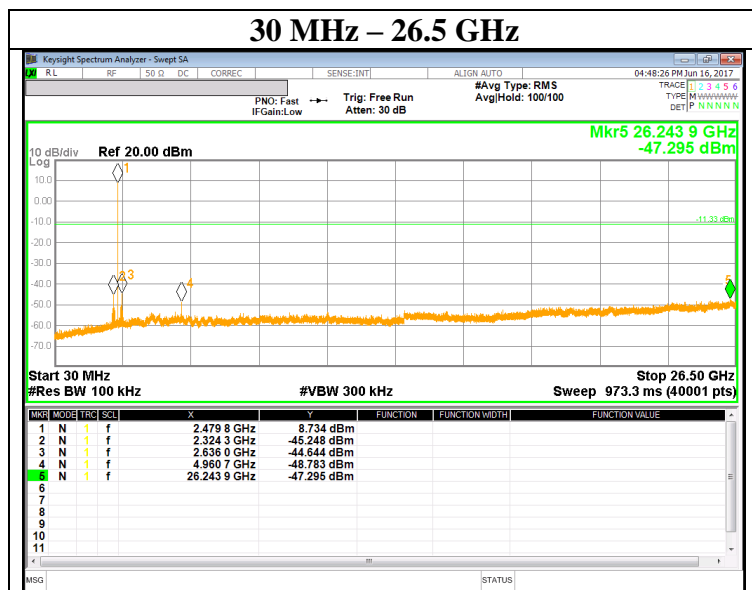


Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.25	-90.4	0.50	0.0	2.0	1	-87.9	300	6.0	-26.6	48.2	74.8	
291.80	-95.2	0.50	0.0	2.0	1	-92.7	300	6.0	-31.5	18.3	49.8	

$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

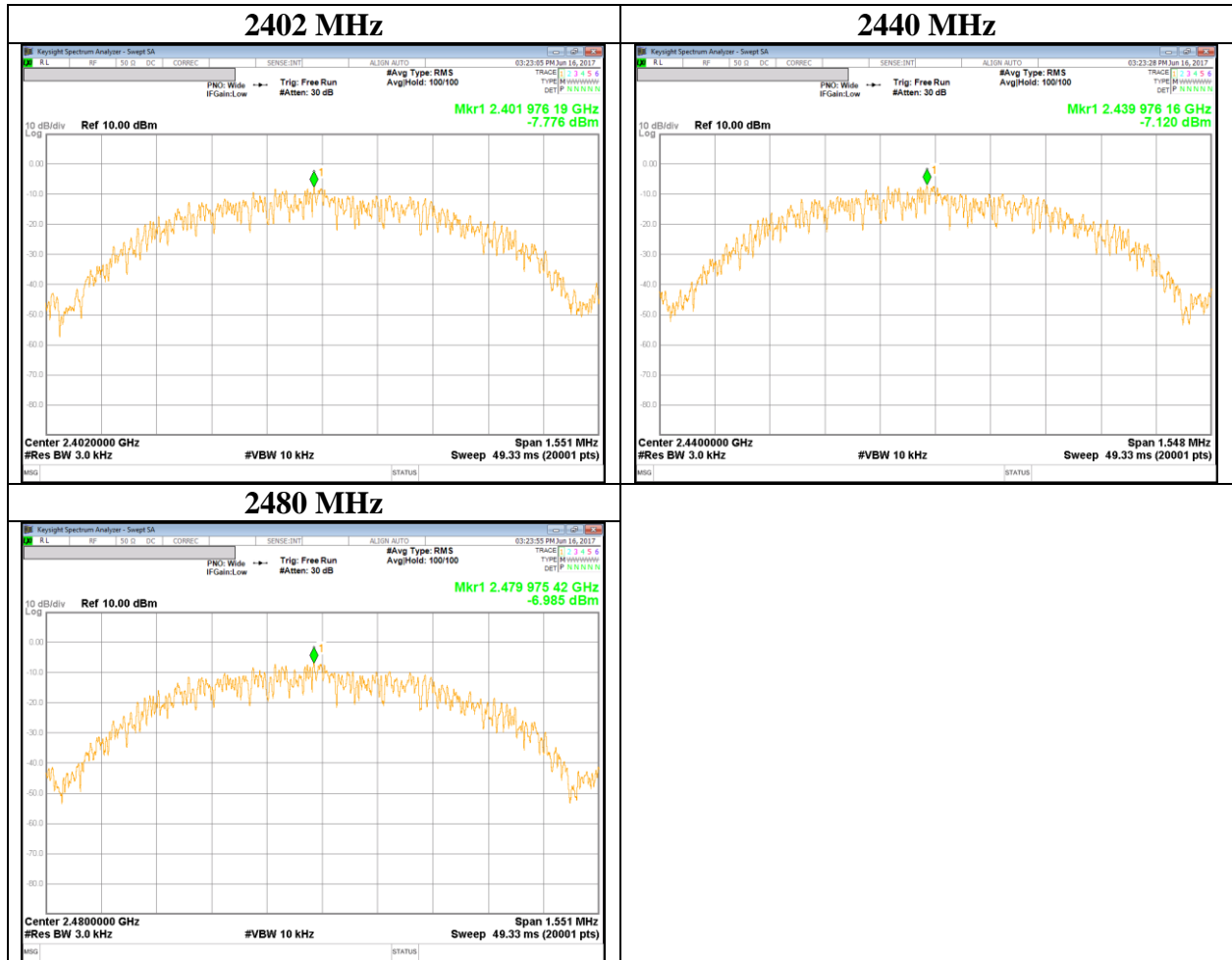


Power Density

Test place Suwon Lab. No.1 Measurement Room / Shielded Room
Report No. 4787971961-E1V2
Date June 16, 2017
Temperature / Humidity 22 deg. C / 56 % RH
Engineer Seokhwan Hong
Mode Tx BT LE

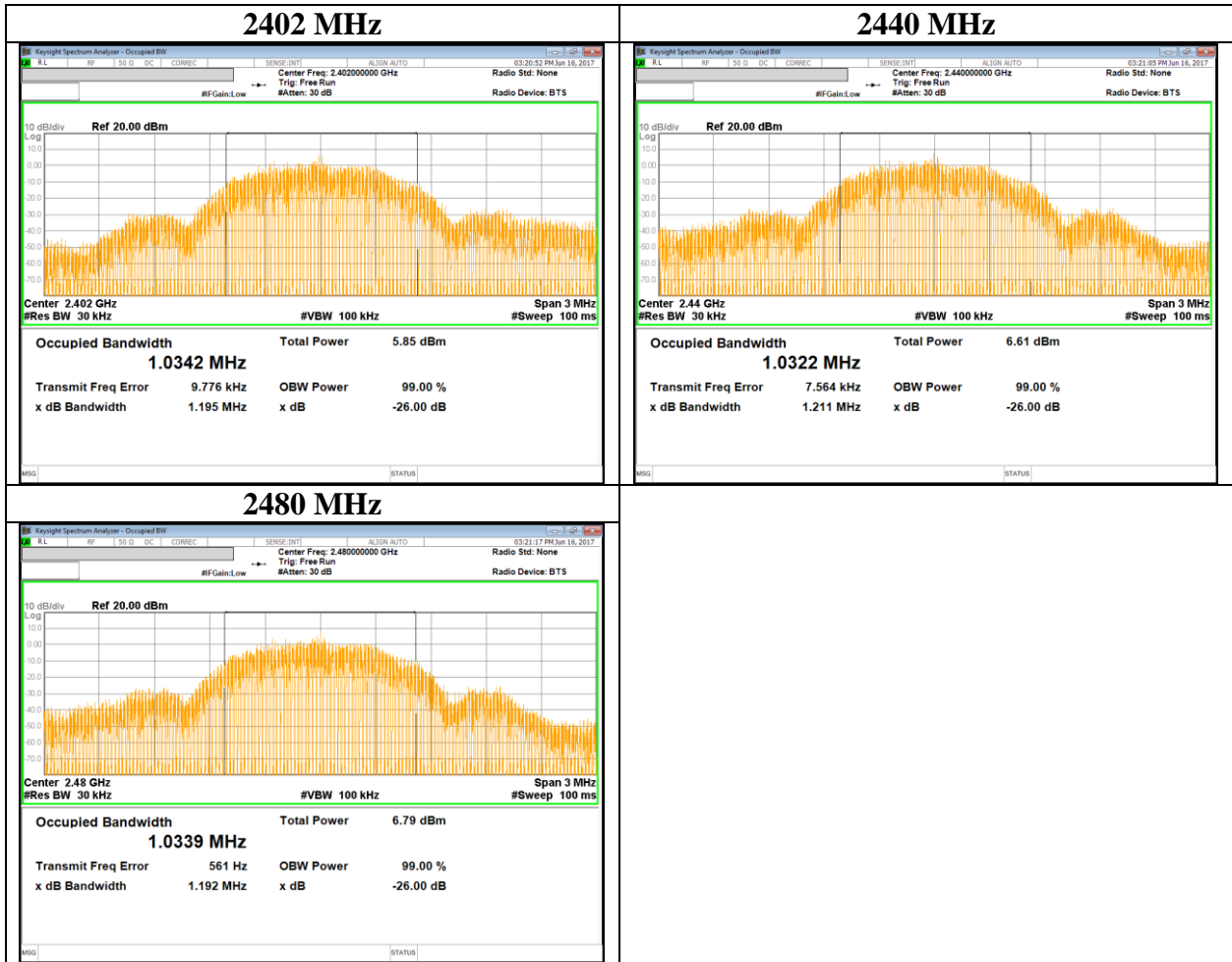
Freq.	Reading	Result	Limit	Margin
[MHz]	[dBm]	[dBm]	[dBm]	[dB]
2402.00	-7.78	-7.78	8.00	15.78
2440.00	-7.12	-7.12	8.00	15.12
2480.00	-6.99	-6.99	8.00	14.99

Power Density



99% Occupied Bandwidth

Test place	Suwon Lab. No.1 Measurement Room / Shielded Room
Report No.	4787971961-E1V2
Date	June 16, 2017
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Seokhwan Hong
Mode	Tx BT LE



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
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
DC Power supply	Agilent / HP	E3640A	MY54236144	08-16-17
DC Power supply	Agilent / HP	E3640A	MY54226395	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
High Pass Filter 6GHz	Micro-Tronics	HPM17542	016	08-16-17
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	11-25-17
LISN	R&S	ENV-216	101837	08-16-17
UL Software				
Description	Manufacturer	Model	Version	
Radiated software	UL	UL EMC	Ver 9.5	
AC Line Conducted software	UL	UL EMC	Ver 9.5	