

## **FCC 15.247 2.4 GHz Report**

**for**

**Organic Response Pty Ltd**

**Level 1, 10 York Street, Richmond, Victoria 3121, Australia**

**Product Name : Controller P2UL (w/ Sensor Node and Backpack)**  
**Model Name : 460-09113**  
**FCC ID : 2AJPE-461-10001**

**Prepared by: : AUDIX Technology Corporation,  
EMC Department**



## TABLE OF CONTENTS

Description	Page
TEST REPORT CERTIFICATION .....	4
<b>1. REPORT HISTORY.....</b>	<b>5</b>
<b>2. SUMMARY OF TEST RESULTS .....</b>	<b>6</b>
<b>3. GENERAL INFORMATION .....</b>	<b>7</b>
3.1. Description of EUT .....	7
3.2. EUT Specifications Assessed in Current Report .....	8
3.3. Test Configuration .....	9
3.4. Tested Supporting System List .....	10
3.5. Setup Configuration .....	10
3.6. Operating Condition of EUT .....	10
3.7. Description of Test Facility .....	11
3.8. Measurement Uncertainty .....	11
<b>4. MEASUREMENT EQUIPMENT LIST .....</b>	<b>12</b>
4.1. Conducted Emission Measurement .....	12
4.2. Radiated Emission Measurement .....	12
4.3. RF Conducted Measurement .....	12
<b>5. CONDUCTED EMISSION MEASUREMENT .....</b>	<b>13</b>
5.1. Block Diagram of Test Setup .....	13
5.2. Power Line Conducted Emission Limit .....	13
5.3. Test Procedure .....	13
5.4. Conducted Emission Measurement Results .....	14
<b>6. RADIATED EMISSION MEASUREMENT .....</b>	<b>16</b>
6.1. Block Diagram of Test Setup .....	16
6.2. Radiated Emission Limits .....	17
6.3. Test Procedure .....	18
6.4. Measurement Result Explanation .....	19
6.5. Test Results .....	19
<b>7. 6dB BANDWIDTH MEASUREMENT .....</b>	<b>30</b>
7.1. Block Diagram of Test Setup .....	30
7.2. Specification Limits .....	30
7.3. Test Procedure .....	30
7.4. Test Results .....	30
<b>8. MAXIMUM PEAK OUTPUT POWER MEASUREMENT .....</b>	<b>32</b>
8.1. Block Diagram of Test Setup .....	32
8.2. Specification Limits .....	32
8.3. Test Procedure .....	32
8.4. Test Results .....	33
<b>9. EMISSION LIMITATIONS MEASUREMENT .....</b>	<b>34</b>
9.1. Block Diagram of Test Setup .....	34
9.2. Specification Limits .....	34
9.3. Test Procedure .....	34
9.4. Test Results .....	35
<b>10. POWER SPECTRAL DENSITY .....</b>	<b>38</b>
10.1. Block Diagram of Test Setup .....	38

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<b>10.2. Specification Limits .....</b>	<b>38</b>
<b>10.3. Test Procedure .....</b>	<b>38</b>
<b>10.4. Test Results.....</b>	<b>39</b>
<b>11. DEVIATION TO TEST SPECIFICATIONS.....</b>	<b>40</b>
<b>APPENDIX A TEST PHOTOGRAPHS</b>	

## TEST REPORT CERTIFICATION

Applicant : Organic Response Pty Ltd  
Manufacture : Flextronics Mukachevo  
Product Name : Controller P2UL (w/ Sensor Node and Backpack)  
Model No. : 460-09113  
Serial No. : N/A  
Power Supply : AC 100-277V, 60Hz (Via Controller P2UL power Cord)

Rules of Compliance and Measurement Standards:

CFR 47 FCC Part 15 Subpart C:2015

ANSI C63.10:2013

KDB 558074 D01 DTS Meas Guidance v03r05

**AUDIX Technology Corp.** tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report. **AUDIX Technology Corp.** does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

Date of Test: 2016. 08. 23 ~ 09. 10

Date of Report: 2016. 09. 12

Producer: Sabrina Wang  
(Sabrina Wang/Administrator)

Signatory: Ben Cheng  
(Ben Cheng/Manager)

## 1. REPORT HISTORY

Revision	Date	Revision Summary	Report Number
0	2016. 09. 12	Original Report.	EM-F160596

## 2. SUMMARY OF TEST RESULTS

Rule	Description	Results
15.207	Conducted Emission	<b>PASS</b>
15.247(d)/15.205	Radiated Band Edge and Radiated Spurious Emission	<b>PASS</b>
15.247(a)(2)	6dB Bandwidth	<b>PASS</b>
15.247(b)(3)	Maximum Peak Output	<b>PASS</b>
15.247(d)	Conducted Band Edges and Conducted Spurious Emission	<b>PASS</b>
15.247 (e)	Peak Power Spectral Density	<b>PASS</b>
15.203	Antenna Requirement	<b>PASS</b>

### 3. GENERAL INFORMATION

#### 3.1. Description of EUT

Product	Controller P2UL (w/ Sensor Node and Backpack)	
Model Name	460-09113	
	The Controller P2UL (w/ Sensor Node and Backpack) is a system contains 3 units as below, where only M/N: 461-10001 embedded with RF function subject and tested in this report.	
	<b>System Contains</b>	<b>Model Name</b>
	Controller P2UL	460-09113
	Sensor Node	448-09322
	Backpack	461-10001
Serial Number	N/A	
FCC ID	2AJPE-461-10001	
Applicant	Organic Response Pty Ltd Level 1, 10 York Street, Richmond, Victoria 3121, Australia	
Manufacturer	Flextronics Mukachevo 4, Berehivska - Bichna St., Mukachevo, Transcarpathian Region, 89600, Ukraine	
RF Features	Bluetooth Low Energy (BLE)	
Transmit Type	1T1R	
Antenna Type / Max Gain	PCB Antenna / 0 dBi	
Date of Receipt	2016. 08. 03	
Accessories	• Wall Switch	
	• Backpack	
	• Sensor Node	
	• RJ12-RJ12 Cable: Unshielded, Detachable, 0.20m	
	• JST-RJ45 Cable: Unshielded, Detachable, 0.50m	
	• AC Power Cord: Unshielded, Detachable, 1.8m (3C)	

### 3.2. EUT Specifications Assessed in Current Report

Mode	Fundamental Range (MHz)	Channel Number	Modulation	Data Rate (Mbps)
BLE	2402-2480	40	GFSK	1

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



### 3.3. Test Configuration

Mode	Duty Cycle (x)	T (ms)	Duty Cycle Factor (dB)
BLE	0.662	0.6243	1.79

Note: When duty cycle is less than 98% (0.98) that duty cycle factor  $10\log(1/x)$  is needed to add in conducted test items measured in average detector.

Item		Test Channel
Radiated Test Case	Radiated Band Edge <sup>Note1</sup>	37/39
	Radiated Spurious Emission (30MHz-1GHz) <sup>Note1</sup>	37/17/39
	Radiated Spurious Emission (Above 1GHz) <sup>Note1</sup>	37/17/39
Conducted Test Case	6dB Bandwidth	37/17/39
	Peak Power Spectral Density	37/17/39
	Peak Output Power	37/17/39
	Band Edge	37/39
	Spurious Emission	37/17/39

Note 1:

☒ Mobile Device

☐ Portable Device, and 3 axis were assessed. The worst scenario for Radiated Spurious Emission as follow:

- ☐ Lie
- ☐ Side
- ☐ Stand

### 3.4. Tested Supporting System List

#### 3.4.1. Support Peripheral Unit

No.	Product	Brand	Model No.	Serial No.	Approval
1.	Notebook PC	acer	MS2362	N/A	FCC ID: PPD-AR5B22

#### 3.4.2. Cable Lists

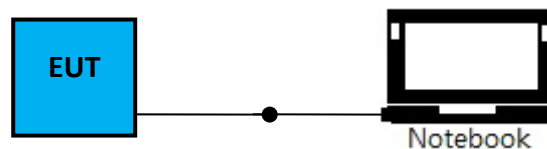
No.	Cable Description Of The Above Support Units
1.	JST to RS232+ RS232 to USB Cable: Unshielded, Detachable, 0.50m +1.8m Adapter: Chicony, M/N CPA09-A065N1, DC Cord: Shielded, Undetachable, 1.8m, Bonded a ferrite core AC Power Cord: Unshielded, Detachable, 1.8m

### 3.5. Setup Configuration

#### 3.5.1. EUT Configuration for Power Line & Radiated Emission



#### 3.5.2. EUT Configuration for Conducted Test Items



### 3.6. Operating Condition of EUT

Test program “Realterm” is used for enabling EUT RF function under continues transmitting and choosing data rate/ channel.

### 3.7. Description of Test Facility

Test Firm Name	:	<b>AUDIX Technology Corporation</b> <b>EMC Department</b> No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan
Test Location & Facility	:	<b>No. 8 Shielded Room</b> <b>Semi Anechoic Chamber &amp;</b> <b>Fully Anechoic Chamber</b> No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan
NVLAP Lab. Code	:	200077-0
TAF Accreditation No	:	1724
FCC OET Designation	:	TW1004 & TW1090

### 3.8. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conduction Test	150kHz~30MHz	±3.5dB
Radiation Test (Distance: 3m)	30MHz~1000MHz	± 3.68dB
	Above 1GHz	± 5.82dB

Remark : Uncertainty =  $ku_c(y)$

Test Item	Uncertainty
6dB Bandwidth	± 0.05kHz
Maximum peak output power	± 0.33dB
Power spectral density	± 0.13dB
Conducted Emission Limitations	± 0.13dB

## 4. MEASUREMENT EQUIPMENT LIST

### 4.1. Conducted Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESR3	101774	2016. 02. 04	1 Year
2.	A.M.N.	R&S	ENV4200	825358/003	2016. 04. 21	1 Year
3.	Pulse Limiter	R&S	ESH3-Z2	100354	2016. 01. 17	1 Year
4.	Test Software	Audix	e3	V.6.120424	N.C.R.	N.C.R.

### 4.2. Radiated Emission Measurement

#### 4.2.1. Frequency Range 9kHz~1000MHz (Semi-Anechoic Chamber)

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2015. 09. 14	1 Year
2.	Test Receiver	R & S	ESCS30	100338	2016. 06. 22	1 Year
3.	Amplifier	HP	8447D	2944A06305	2016. 02. 23	1 Year
4.	Bilog Antenna	CHASE	CBL6112D	33821	2016. 01. 30	1 Year
5.	Loop Antenna	R&S	HFH2-Z2	891847/27	2015. 12. 24	1 Year
6.	Test Software	Audix	e3	V.6.110601	N.C.R.	N.C.R.

#### 4.2.2. Frequency Range Above 1GHz (Fully Anechoic Chamber)

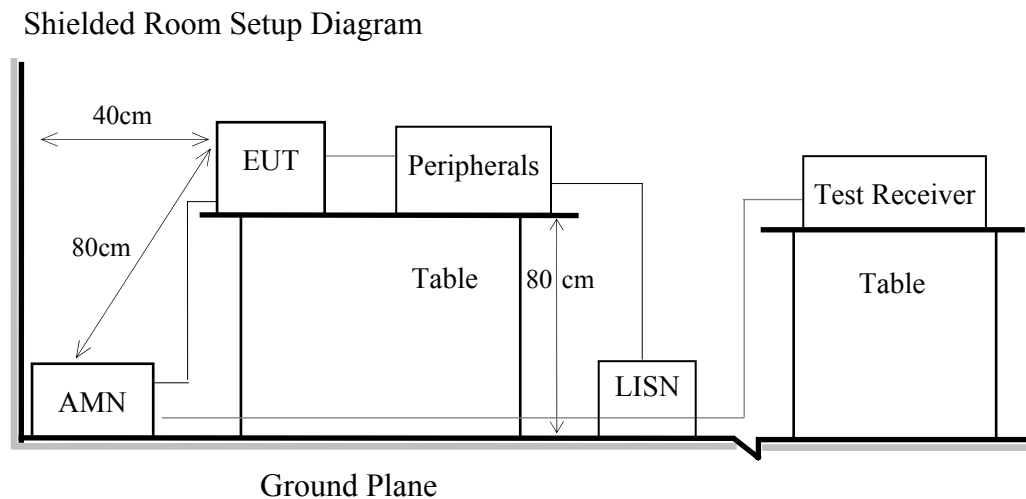
Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	E4446A	US44300366	2016. 08. 19	1 Year
2.	Amplifier	Sonoma	310N	187161	2016. 06. 14	1 Year
3.	2.4GHz Notch Filter	K&L	7NSL10-2441.5E130.5-00	1	2016. 07. 27	1 Year
4.	Horn Antenna	ETS-Lindgren	3117	00135902	2016. 03. 05	1 Year
5.	Horn Antenna	EMCO	3116	2653	2015. 10. 20	1 Year
6.	Test Software	Audix	e3	V.6.110601	N.C.R.	N.C.R.

### 4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-507	MY52220264	2016. 08. 09	1 Year
2.	Power Meter	Anritsu	ML2495A	1145008	2015. 10. 23	1 Year
3.	Power Sensor	Anritsu	MA2411B	1126096	2015. 10. 23	1 Year

## 5. CONDUCTED EMISSION MEASUREMENT

### 5.1. Block Diagram of Test Setup



### 5.2. Power Line Conducted Emission Limit

Frequency	Conducted Limit	
	Quasi-Peak Level	Average Level
150kHz ~ 500kHz	66 ~ 56 dB $\mu$ V	56 ~ 46 dB $\mu$ V
500kHz ~ 5MHz	56 dB $\mu$ V	46 dB $\mu$ V
5MHz ~ 30MHz	60 dB $\mu$ V	50 dB $\mu$ V

Remark 1.: If the average limit is met when using a Quasi-Peak detector, the measurement using the average detector is not required.

2.: The lower limit applies to the band edges.

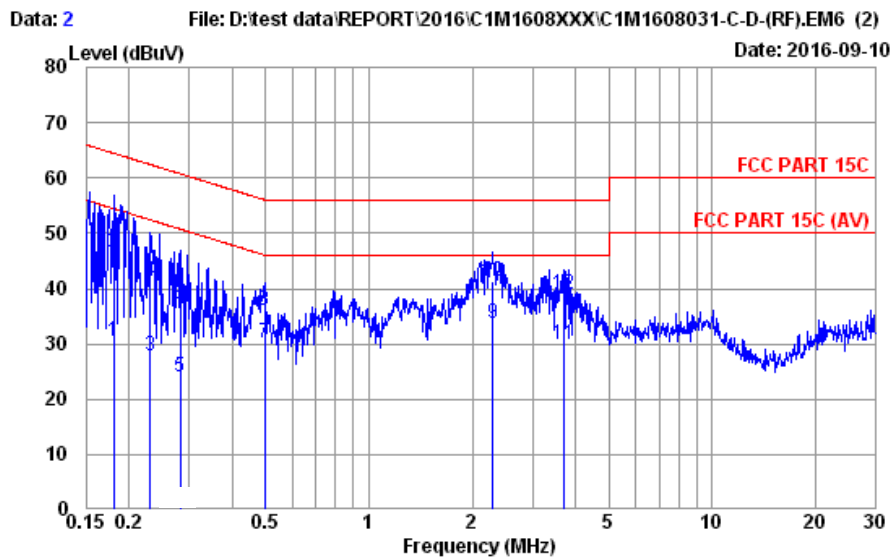
### 5.3. Test Procedure

- 5.3.1. To set up the EUT as indicated in ANSI C 63.10. The EUT was placed on the table which has 80 cm height to the ground and 40 cm distance to the conducting wall.
- 5.3.2. Power supplier of the EUT was connected to the AC mains through an Artificial Mains Network (A.M.N.).
- 5.3.3. The AC power supplies to all peripheral devices must be provided through line impedance stabilization network (L.I.S.N.)
- 5.3.4. Checking frequency range from 150 kHz to 30 MHz and record the emission which does not have 20 dB below limit.

## 5.4. Conducted Emission Measurement Results

PASSED.

Test Date	2016/09/10	Temp./Hum.	24°C/52%
Test Voltage	AC 277V, 60Hz		



Site no. : No.8 Shielded Room Data no. : 2  
Condition : ENV4200 100169 LISN Phase : NEUTRAL  
Limit : FCC PART 15C  
Env. / Ins. : 24°C / 52% ESR3 (1774) Engineer : Jemy  
EUT : 460-09113  
Power Rating : 277Vac/60Hz  
Test Mode : Operating

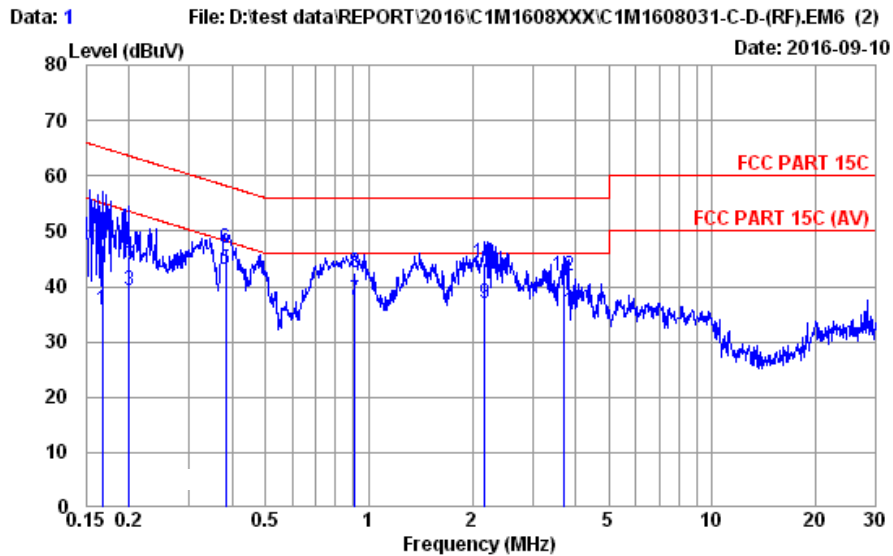
	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.181	11.37	0.02	9.86	9.33	30.58	54.46	23.88	Average
2	0.181	11.37	0.02	9.86	25.39	46.64	64.46	17.82	QP
3	0.230	11.24	0.02	9.86	6.81	27.93	52.44	24.51	Average
4	0.230	11.24	0.02	9.86	20.06	41.18	62.44	21.26	QP
5	0.282	11.17	0.02	9.86	2.96	24.01	50.76	26.75	Average
6	0.282	11.17	0.02	9.86	16.27	37.32	60.76	23.44	QP
7	0.497	11.05	0.03	9.86	9.20	30.14	46.05	15.91	Average
8	0.497	11.05	0.03	9.86	15.06	36.00	56.05	20.05	QP
9	2.297	11.09	0.08	9.86	12.69	33.72	46.00	12.28	Average
10	2.297	11.09	0.08	9.86	20.39	41.42	56.00	14.58	QP
11	3.700	11.18	0.11	9.87	8.80	29.96	46.00	16.04	Average
12	3.700	11.18	0.11	9.87	17.89	39.05	56.00	16.95	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.

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Test Date	2016/09/10	Temp./Hum.	24°C/52%
Test Voltage	AC 277V, 60Hz		



Site no. : No.8 Shielded Room Data no. : 1  
Condition : ENV4200 100169 LISN Phase : LINE  
Limit : FCC PART 15C  
Env. / Ins. : 24°C / 52% ESR3 (1774) Engineer : Jemy  
EUT : 460-09113  
Power Rating : 277Vac/60Hz  
Test Mode : Operating

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.168	10.77	0.02	9.86	15.10	35.75	55.08	19.33	Average
2	0.168	10.77	0.02	9.86	26.85	47.50	65.08	17.58	QP
3	0.200	10.75	0.02	9.86	18.74	39.37	53.62	14.25	Average
4	0.200	10.75	0.02	9.86	24.69	45.32	63.62	18.30	QP
5	0.383	10.63	0.03	9.86	22.58	43.10	48.21	5.11	Average
6	0.383	10.63	0.03	9.86	26.49	47.01	58.21	11.20	QP
7	0.909	10.61	0.05	9.86	17.09	37.61	46.00	8.39	Average
8	0.909	10.61	0.05	9.86	21.85	42.37	56.00	13.63	QP
9	2.173	10.60	0.08	9.86	16.42	36.96	46.00	9.04	Average
10	2.173	10.60	0.08	9.86	23.59	44.13	56.00	11.87	QP
11	3.681	10.70	0.11	9.87	14.81	35.49	46.00	10.51	Average
12	3.681	10.70	0.11	9.87	21.18	41.86	56.00	14.14	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.

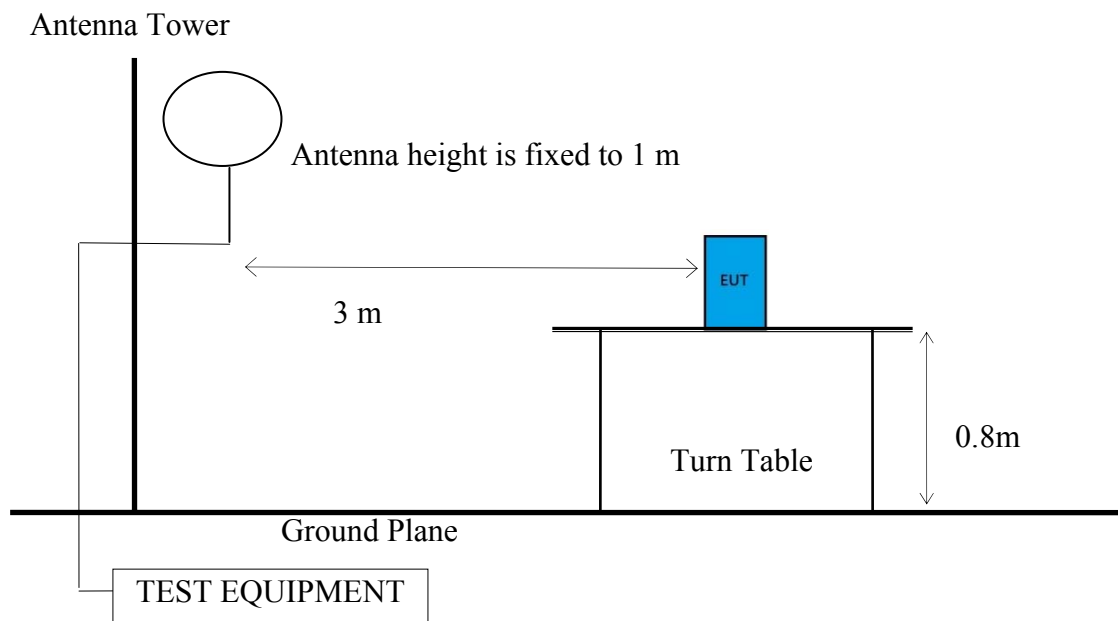
## 6. RADIATED EMISSION MEASUREMENT

### 6.1. Block Diagram of Test Setup

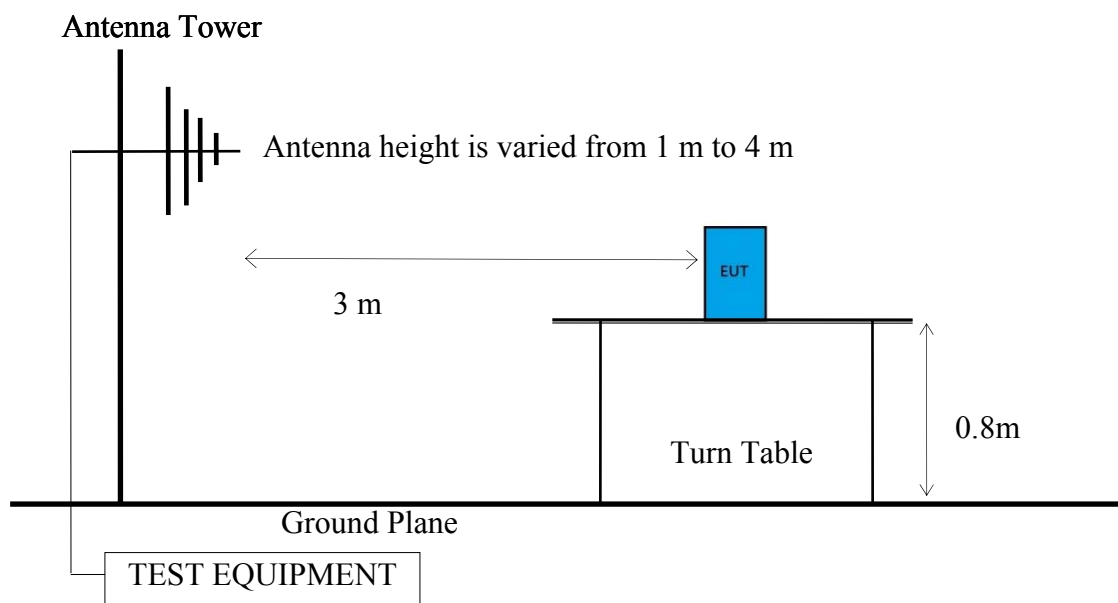
#### 6.1.1. Block Diagram of EUT

Indicated as section 3.5

#### 6.1.2. Semi Anechoic Chamber (3m) Setup Diagram for 9kHz-30MHz

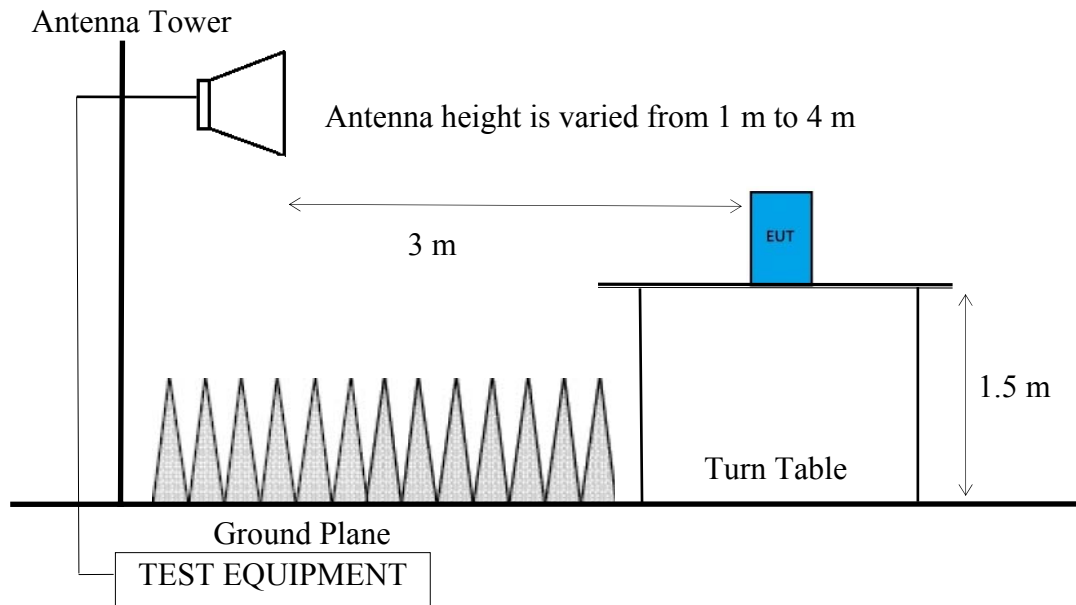


#### 6.1.3. Semi Anechoic Chamber (3m) Setup Diagram for 30-1000 MHz





#### 6.1.4. Fully Anechoic Chamber (3m) Setup Diagram for above 1GHz



## 6.2. Radiated Emission Limits

In any 100kHz bandwidth outside the frequency band, the radio frequency power produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205/RSS-Gen Section 8.10 table 6, must also comply with the radiated emission limits specified as below.

Frequency (MHz)	Distance (m)	Limits	
		dB $\mu$ V/m	$\mu$ V/m
0.009 - 0.490	300	67.6	2400/kHz
0.490 - 1.705	30	87.6	24000/kHz
1.705 - 30	30	29.5	30
30 - 88	3	40.0	100
88- 216	3	43.5	150
216- 960	3	46.0	200
Above 960	3	54.0	500
Above 1000	3	74.0 dB $\mu$ V/m (Peak) 54.0 dB $\mu$ V/m (Average)	

Remark : (1) dB $\mu$ V/m = 20 log ( $\mu$ V/m)

- (2) The tighter limit applies to the edge between two frequency bands.
- (3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
- (4) Fundamental and emission fall within operation band are exempted from this section.
- (5) Pursuant to ANSI C63.10: 6.6.4.3, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

### 6.3. Test Procedure

#### Frequency Range 9kHz~30MHz:

The EUT setup on the turn table which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

(1) RBW = 9kHz with peak and average detector.

(2) Detector: average and peak (9kHz-490kHz)

Q.P. (490kHz-30MHz)

#### Frequency Range 30MHz ~ 40GHz:

The EUT setup on the turn find table which has 80 cm (for 30-1000 MHz) and 1.5m (for above 1GHz) height to the ground. The turn table rotated 360 degrees and antenna varied from 1 m to 4 m to find the maximum emission level. Both horizontal and vertical polarization are required. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

#### Frequency below 1 GHz:

Spectrum Analyzer is used for pre-testing with following setting:

(1) RBW = 120KHz

(2) VBW  $\geq 3 \times$  RBW.

(3) Detector = Peak.

(4) Sweep time = auto.

(5) Trace mode = max hold.

(6) Allow sweeps to continue until the trace stabilizes.

(7) When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required. Otherwise using Q.P. for finally measurement.

**Frequency above 1GHz to 10th harmonic:****Peak Detector:**

- (1) RBW = 1MHz
- (2) VBW  $\geq 3 \times$  RBW.
- (3) Detector = Peak.
- (4) Sweep time = auto.
- (5) Trace mode = max hold.
- (6) Allow sweeps to continue until the trace stabilizes.
- (7) When peak-detected value is lower than limit that the measurement using the average detector is not required. Otherwise using average for finally measurement.

**Average Detector:****■ Option 1:**

- (1) RBW = 1MHz
- (2) VBW  $\geq 1/T$ .

Modulation Type	T (ms)	1/ T (kHz)	VBW Setting (kHz)
BLE	0.6243	1.60	1.60

N/A: 1/ T is not implemented when duty cycle presented in section 3.5 is  $\geq 98\%$ .

- (1) Detector = Peak.
- (2) Sweep time = auto.
- (3) Trace mode = max hold.
- (4) Allow sweeps to continue until the trace stabilizes.

**□ Option 2:**

Average Emission Level = Peak Emission Level + D.C.C.F.

**6.4. Measurement Result Explanation**

- Peak Emission Level = Antenna Factor + Cable Loss + Meter Reading
- Average Emission Level = Antenna Factor + Cable Loss + Meter Reading
- Average Emission Level = Peak Emission Level + DCCF  
Duty Cycle Correction Factor (DCCF) =  $20\log(TX_{on}/TX_{on+off})$  presented in section 3.5
- EPR = Peak Emission Level - 95.2dB - 2.14dB

**6.5. Test Results**

**PASSED.**

Test Date	2016/09/10	Temp./Hum.	25°C/40%
Test Voltage	AC 277V, 60Hz		

### 6.5.1. Emissions within Restricted Frequency Bands

#### 6.5.1.1. Frequency 9kHz~30MHz

**The emissions (9kHz~30MHz) not reported for there is no emission be found.**

#### 6.5.1.2. Frequency Below 1 GHz

Mode	BLE	Frequency	TX 2402MHz
------	-----	-----------	------------

#### Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
277.35	12.81	4.51	13.67	30.99	46.00	15.01	Peak
480.08	16.71	6.30	14.49	37.50	46.00	8.50	Peak
828.31	20.18	7.27	8.94	36.39	46.00	9.61	Peak

#### Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
30.00	18.62	2.32	8.14	29.08	40.00	10.92	Peak
504.33	17.03	6.44	12.06	35.53	46.00	10.47	Peak
830.25	20.20	7.28	8.54	36.02	46.00	9.98	Peak

Mode	BLE	Frequency	TX 2440MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB $\mu$ V)	Emission Level (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	Detector
275.41	12.78	4.50	14.46	31.74	46.00	14.26	Peak
480.08	16.71	6.30	13.21	36.22	46.00	9.78	Peak
828.31	20.18	7.27	9.20	36.65	46.00	9.35	Peak

**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB $\mu$ V)	Emission Level (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	Detector
30.97	18.07	2.34	9.75	30.16	40.00	9.84	Peak
504.33	17.03	6.44	12.77	36.24	46.00	9.76	Peak
831.22	20.20	7.28	9.03	36.51	46.00	9.49	Peak

Mode	BLE	Frequency	TX 2480MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB $\mu$ V)	Emission Level (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	Detector
276.38	12.79	4.51	15.08	32.38	46.00	13.62	Peak
455.83	16.38	6.12	13.87	36.37	46.00	9.63	Peak
828.31	20.18	7.27	9.24	36.69	46.00	9.31	Peak

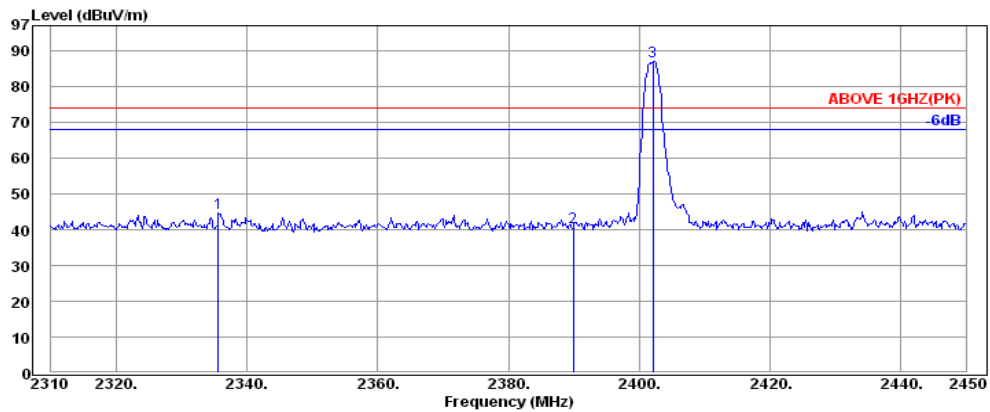
**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB $\mu$ V)	Emission Level (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	Detector
30.97	18.07	2.34	9.79	30.20	40.00	9.80	Peak
504.33	17.03	6.44	12.61	36.08	46.00	9.92	Peak
828.31	20.18	7.27	8.95	36.40	46.00	9.60	Peak

### 6.5.1.3. Frequency Above 1 GHz to 10<sup>th</sup> harmonics

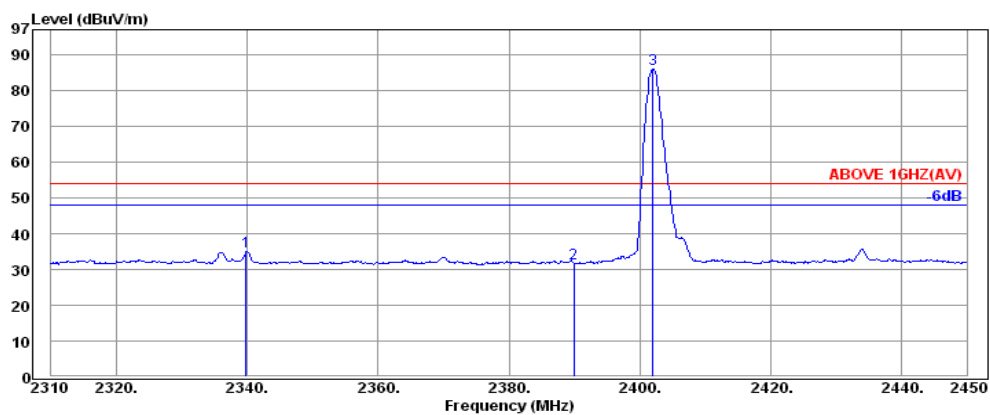
#### Band Edge:

Mode	BLE	Frequency	TX 2402MHz
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#### Antenna at Horizontal Polarization

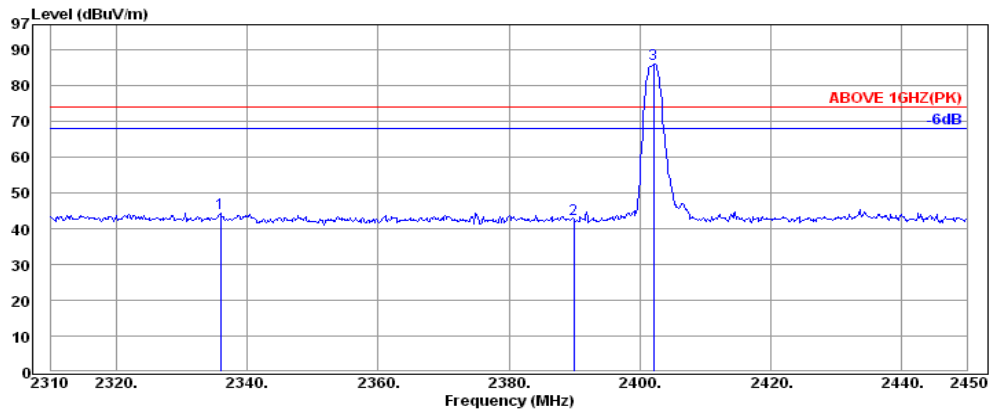
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2335.62	32.08	6.01	6.43	44.52	74.00	29.48	Peak
2389.94	32.16	6.08	2.53	40.77	74.00	33.23	Peak
2402.12	32.16	6.09	48.76	87.01	---	---	Peak



#### Antenna at Horizontal Polarization

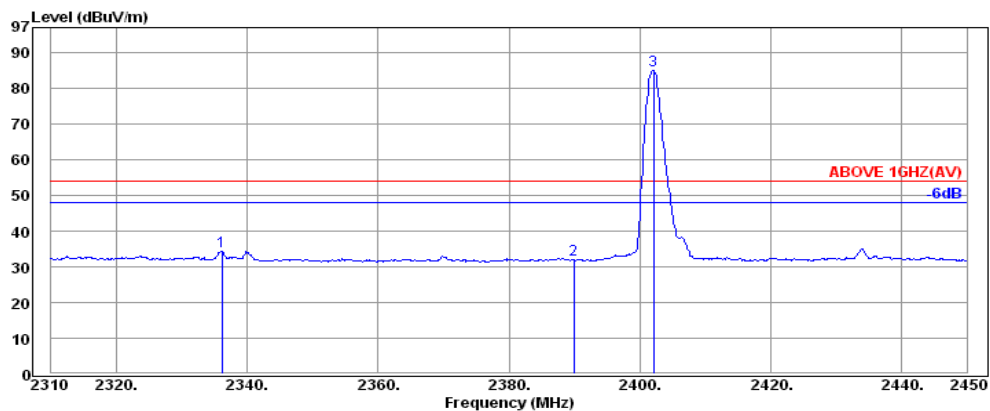
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2339.82	32.08	6.01	-3.12	34.97	54.00	19.03	Average
2389.94	32.16	6.08	-6.41	31.83	54.00	22.17	Average
2401.98	32.16	6.09	47.73	85.98	---	---	Average

Mode	BLE	Frequency	TX 2402MHz
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#### Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2335.90	32.08	6.01	6.33	44.42	74.00	29.58	Peak
2389.94	32.16	6.08	4.48	42.72	74.00	31.28	Peak
2402.12	32.16	6.09	47.77	86.02	---	---	Peak

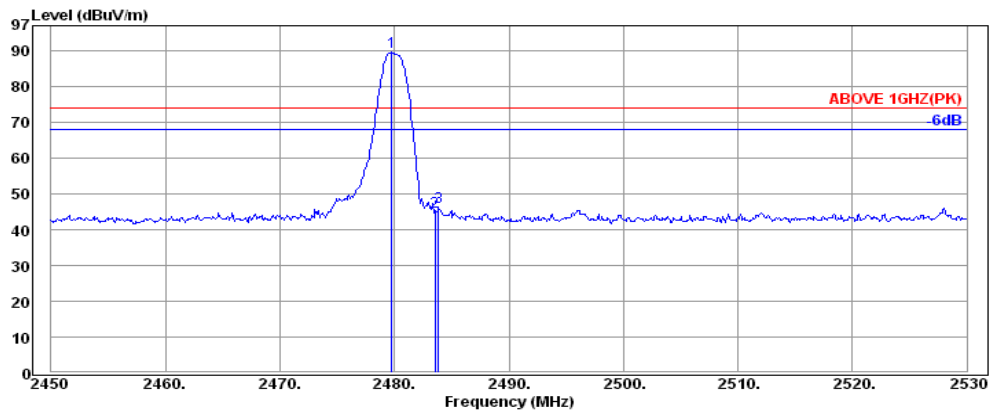


#### Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2336.18	32.08	6.01	-3.72	34.37	54.00	19.63	Average
2389.94	32.16	6.08	-6.29	31.95	54.00	22.05	Average
2402.12	32.16	6.09	46.74	84.99	---	---	Average

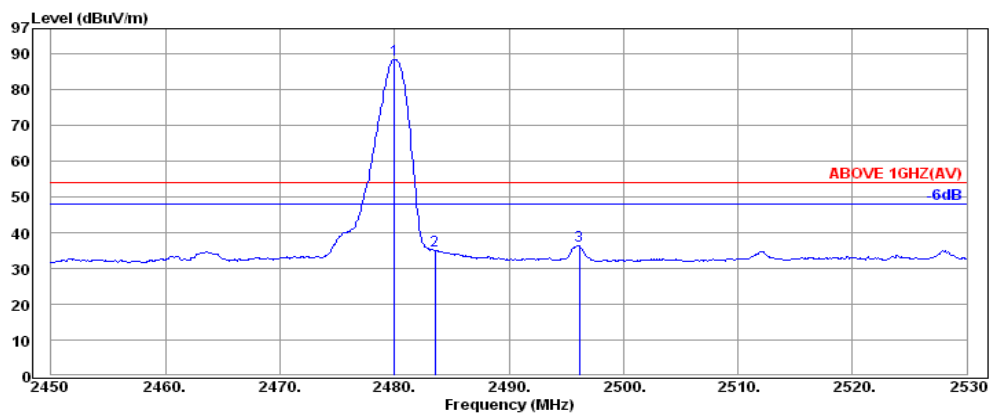


Mode	BLE	Frequency	TX 2480MHz
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#### Antenna at Vertical Polarization

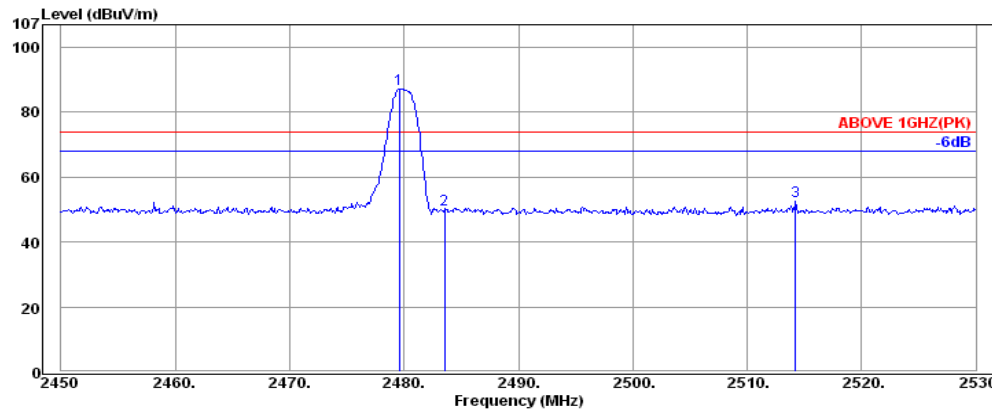
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2479.76	32.28	6.18	51.05	89.51	---	---	Peak
2483.52	32.28	6.19	6.49	44.96	74.00	29.04	Peak
2483.84	32.28	6.19	7.79	46.26	74.00	27.74	Peak



#### Antenna at Vertical Polarization

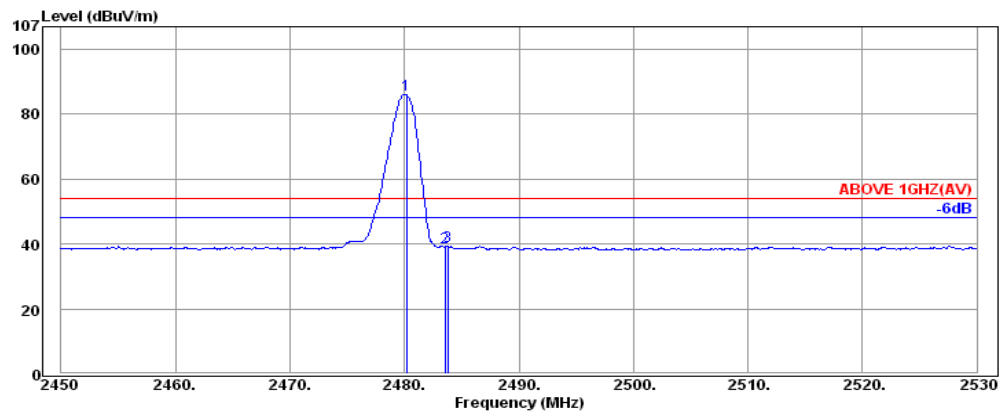
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.00	32.28	6.18	49.90	88.36	---	---	Average
2483.52	32.28	6.19	-3.55	34.92	54.00	19.08	Average
2496.16	32.30	6.20	-2.21	36.29	54.00	17.71	Average

Mode	BLE	Frequency	TX 2480MHz
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#### Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2479.60	32.28	6.18	48.86	87.32	---	---	Peak
2483.52	32.28	6.19	11.39	49.86	74.00	24.14	Peak
2514.24	32.32	6.22	13.99	52.53	74.00	21.47	Peak



#### Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2480.16	32.28	6.18	47.71	86.17	---	---	Average
2483.52	32.28	6.19	0.57	39.04	54.00	14.96	Average
2483.76	32.28	6.19	0.80	39.27	54.00	14.73	Average

#### 6.5.2. Emissions outside the frequency band:

The emissions (up to 25GHz) not reported for there is no emission be found.

Mode	BLE	Frequency	TX 2402MHz
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#### Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4810.00	34.22	8.87	12.57	55.66	74.00	18.34	Peak
4810.00	34.22	8.87	8.89	51.98	54.00	2.02	Average
1996.00	31.60	5.28	8.00	44.88	54.00	9.12	Peak
2044.00	31.65	5.39	6.16	43.20	54.00	10.80	Peak

#### Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
1784.00	30.04	4.94	11.03	46.01	54.00	7.99	Peak
1850.00	30.52	5.05	11.43	47.00	54.00	7.00	Peak
1994.00	31.48	5.28	12.35	49.11	54.00	4.89	Peak

Mode	BLE	Frequency	TX 2440MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB $\mu$ V)	Emission Level (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	Detector
1794.00	30.16	4.95	6.23	41.34	54.00	12.66	Peak
1880.00	30.76	5.10	7.54	43.40	54.00	10.60	Peak
2246.00	31.94	5.90	5.03	42.87	54.00	11.13	Peak
4885.00	34.26	9.14	11.98	55.38	74.00	18.62	Peak
4885.00	34.26	9.14	8.75	52.15	54.00	1.85	Average

**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB $\mu$ V)	Emission Level (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	Detector
1784.00	30.04	4.94	9.80	44.78	54.00	9.22	Peak
1916.00	31.00	5.15	11.93	48.08	54.00	5.92	Peak
1994.00	31.48	5.28	10.91	47.67	54.00	6.33	Peak

Mode	BLE	Frequency	TX 2480MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB $\mu$ V)	Emission Level (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	Detector
1806.00	30.16	4.97	5.57	40.70	54.00	13.30	Peak
1906.00	30.88	5.14	5.82	41.84	54.00	12.16	Peak
1996.00	31.60	5.28	5.77	42.65	54.00	11.35	Peak
4960.00	34.29	9.40	9.91	53.60	54.00	0.40	Peak

**Antenna at Vertical Polarization**

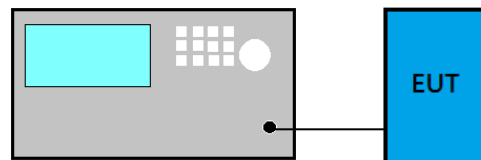
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB $\mu$ V)	Emission Level (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	Detector
1780.00	30.04	4.93	10.79	45.76	54.00	8.24	Peak
1896.00	30.88	5.12	12.10	48.10	54.00	5.90	Peak
1970.00	31.36	5.24	12.75	49.35	54.00	4.65	Peak

**6.5.3. Emissions in Non-restricted Frequency Bands**

Pursuant to KDB 558074 D01 DTS Meas Guidance v03r05 that emission levels below the 15.209 general radiated emissions limits is not required.

## 7. 6dB BANDWIDTH MEASUREMENT

### 7.1. Block Diagram of Test Setup



### 7.2. Specification Limits

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

### 7.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v03r05:

■ Option 2

- (1) Set RBW = 100 kHz.
- (2) Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
- (3) Detector = Peak.
- (4) Trace mode = max hold.
- (5) Sweep = auto couple.
- (6) Allow the trace to stabilize.
- (7) Setting channel bandwidth function x dB to -6 dB to record the final bandwidth.

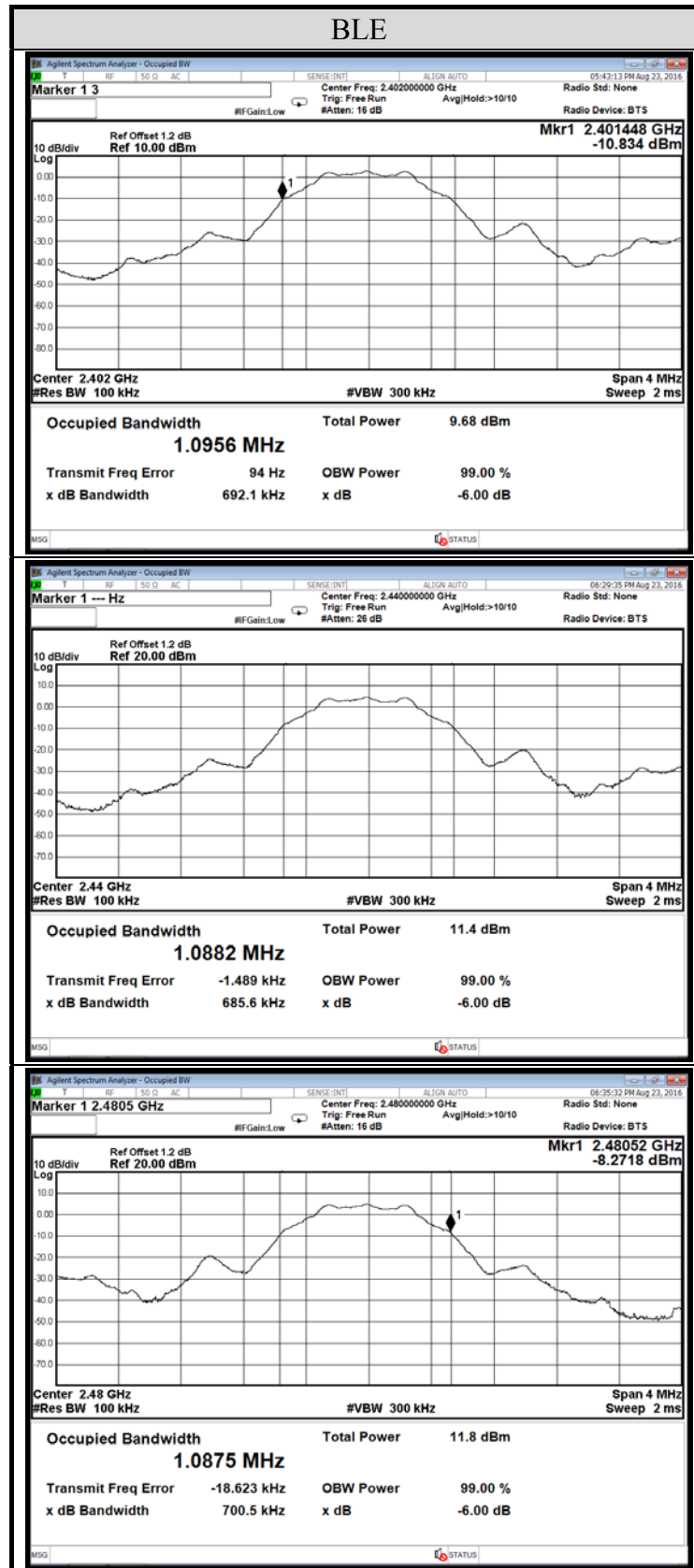
### 7.4. Test Results

Test Date	2016/08/23	Temp./Hum.	26°C/58%
Cable Loss	1.2dB	Test Voltage	AC 277V, 60Hz

#### 7.4.1. 6dB Bandwidth Result

Mode	Centre Frequency (MHz)	6 dB Bandwidth (MHz)
BLE	2402	0.6921
	2440	0.6856
	2480	0.7005

## 7.4.2. Measurement Plots



## 8. MAXIMUM PEAK OUTPUT POWER MEASUREMENT

### 8.1. Block Diagram of Test Setup



### 8.2. Specification Limits

The Limits of maximum Peak Output Power for digital modulation in 2400-2483.5MHz is : 1Watt. (30dBm)

### 8.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v03r05:

☒ **PKPM1 Peak power meter method:**

EUT is connected to power sensor and record the maximum output power.

☐ **Method AVGPM (Measurement using an RF average power meter):**

EUT is connected to power sensor and record the maximum average output power and duty cycle factor is added when duty cycle presented in section 3.5 is < 98%.

☐ **Method AVGSA-2 (Spectrum channel power)**

- (1) Set span to at least 1.5 times the OBW
- (2) Set RBW = 1 -5% of OBW
- (3) Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
- (4) Detector = RMS.
- (5) Trace mode = trace average at least 100 traces
- (6) Sweep = auto couple.
- (7) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges.
- (8) Duty cycle factor is added when duty cycle presented in section 3.5 is < 98%.



## 8.4. Test Results

Test Date	2016/08/23	Temp./Hum.	26°C/58%
Cable Loss	---	Test Voltage	AC 277V, 60Hz

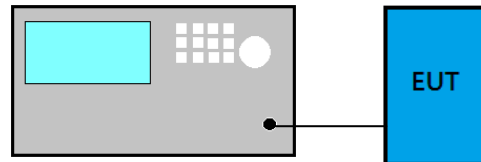
### 8.4.1. Peak Output Power

Mode	Centre Frequency (MHz)	Peak Output Power		Limit
		(dBm)	(W)	
BLE	2402	-4.79	0.000332	< 30 dBm (1 W)
	2440	-4.61	0.000346	
	2480	-3.93	0.000405	

Note: The results have been included cable loss.

## 9. EMISSION LIMITATIONS MEASUREMENT

### 9.1. Block Diagram of Test Setup



### 9.2. Specification Limits

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (See Section 15.205(c)).

### 9.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v03r05:

#### ■ Reference Level

- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: 100 kHz.
- (4) Set the VBW  $\geq 3 \times$  RBW.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully stabilize to find the max PSD as reference level.

#### ■ Emission Level Measurement

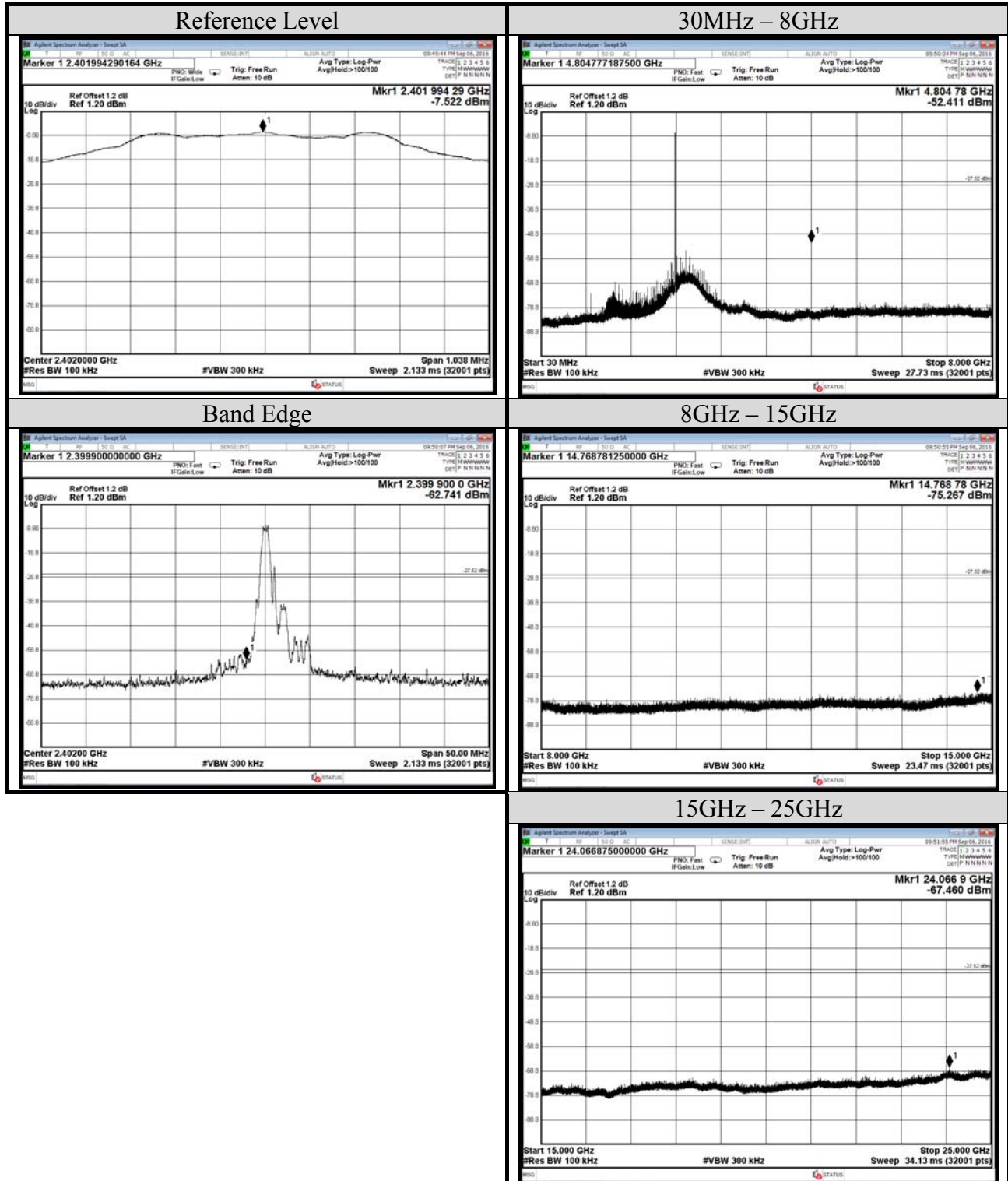
- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: 100 kHz.
- (4) Set the VBW  $\geq 3 \times$  RBW.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully stabilize to find the max level.

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## 9.4. Test Results

Test Date	2016/09/06	Temp./Hum.	25°C/58%
Mode	BLE	Frequency	TX 2402MHz
Cable Loss	1.2dB	Test Voltage	AC 277V, 60Hz



File Number: C1M1608031

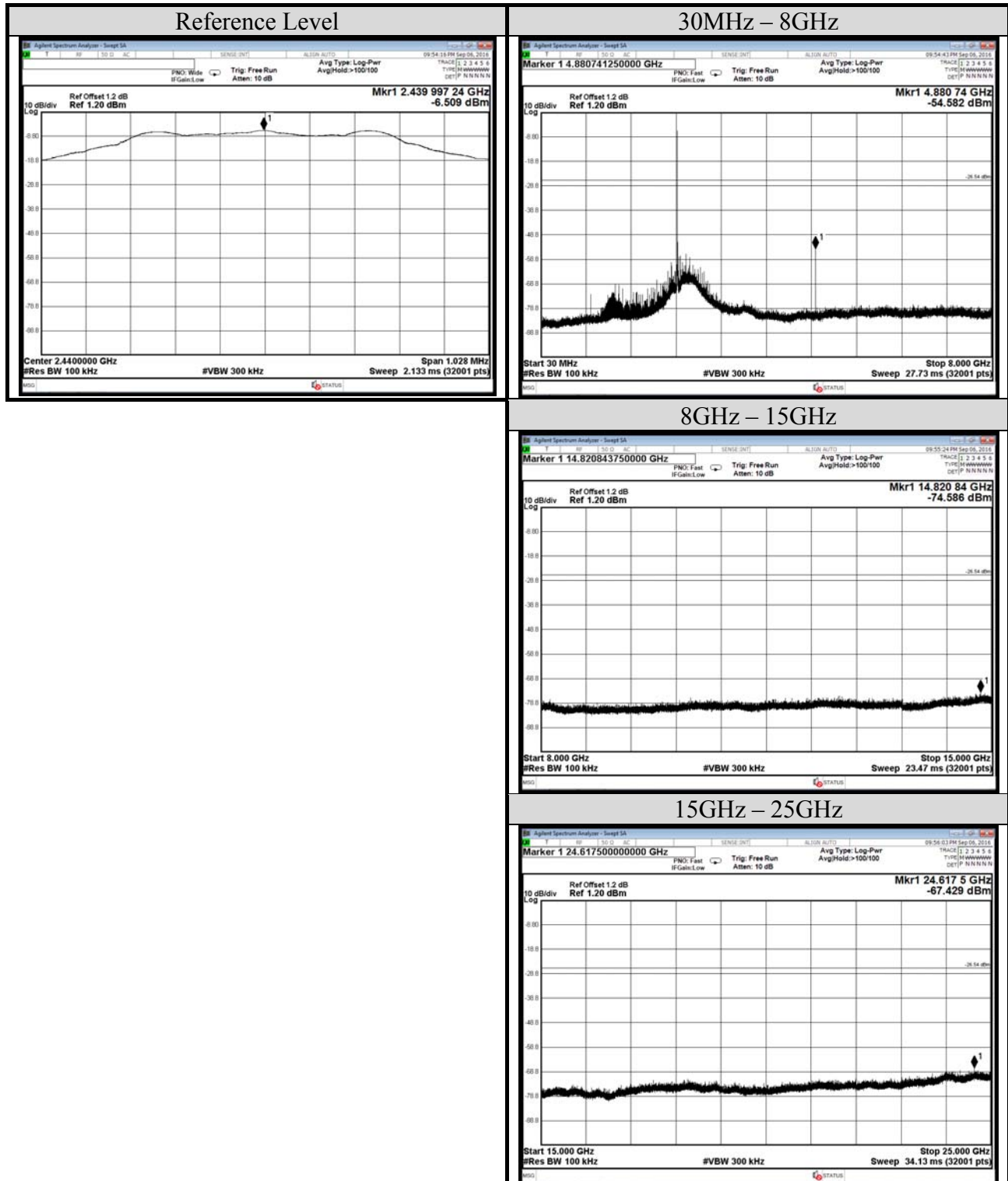
Report Number: EM-F160596

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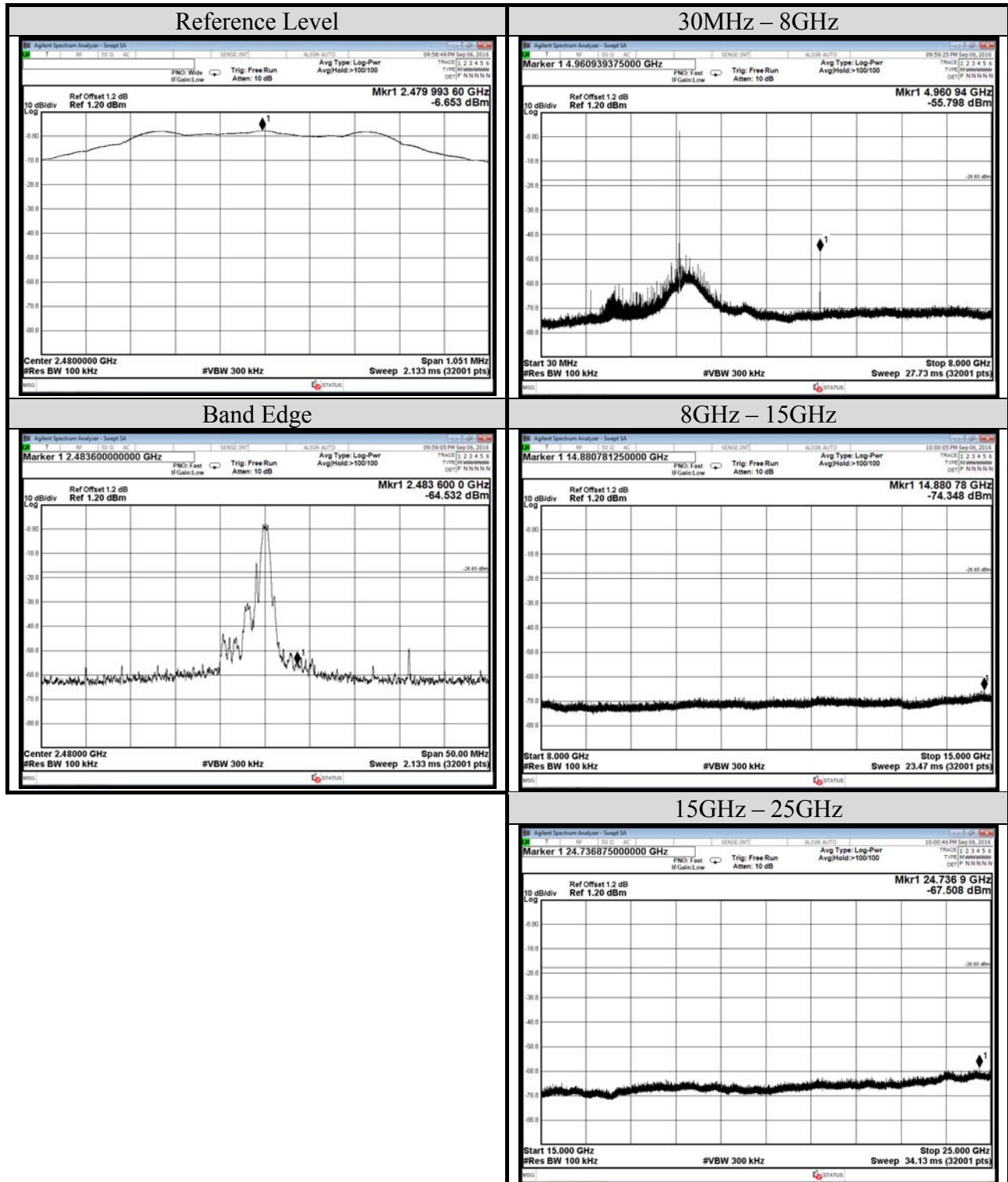
Test Date	2016/09/06	Temp./Hum.	25°C/58%
Mode	BLE	Frequency	TX 2440MHz
Cable Loss	1.2dB	Test Voltage	AC 277V, 60Hz



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Test Date	2016/09/06	Temp./Hum.	25°C/58%
Mode	BLE	Frequency	TX 2480MHz
Cable Loss	1.2dB	Test Voltage	AC 277V, 60Hz



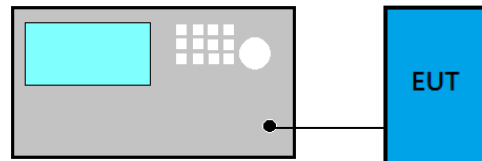
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## 10. POWER SPECTRAL DENSITY

### 10.1. Block Diagram of Test Setup



### 10.2. Specification Limits

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band.

### 10.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v03r05:

#### ☒ Method PKPSD (peak PSD)

- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- (4) Set the VBW  $\geq 3 \times \text{RBW}$ .
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully stabilize.
- (9) Use the peak marker function to determine the maximum amplitude level.
- (10) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

#### ☐ Method AVGPSD-2

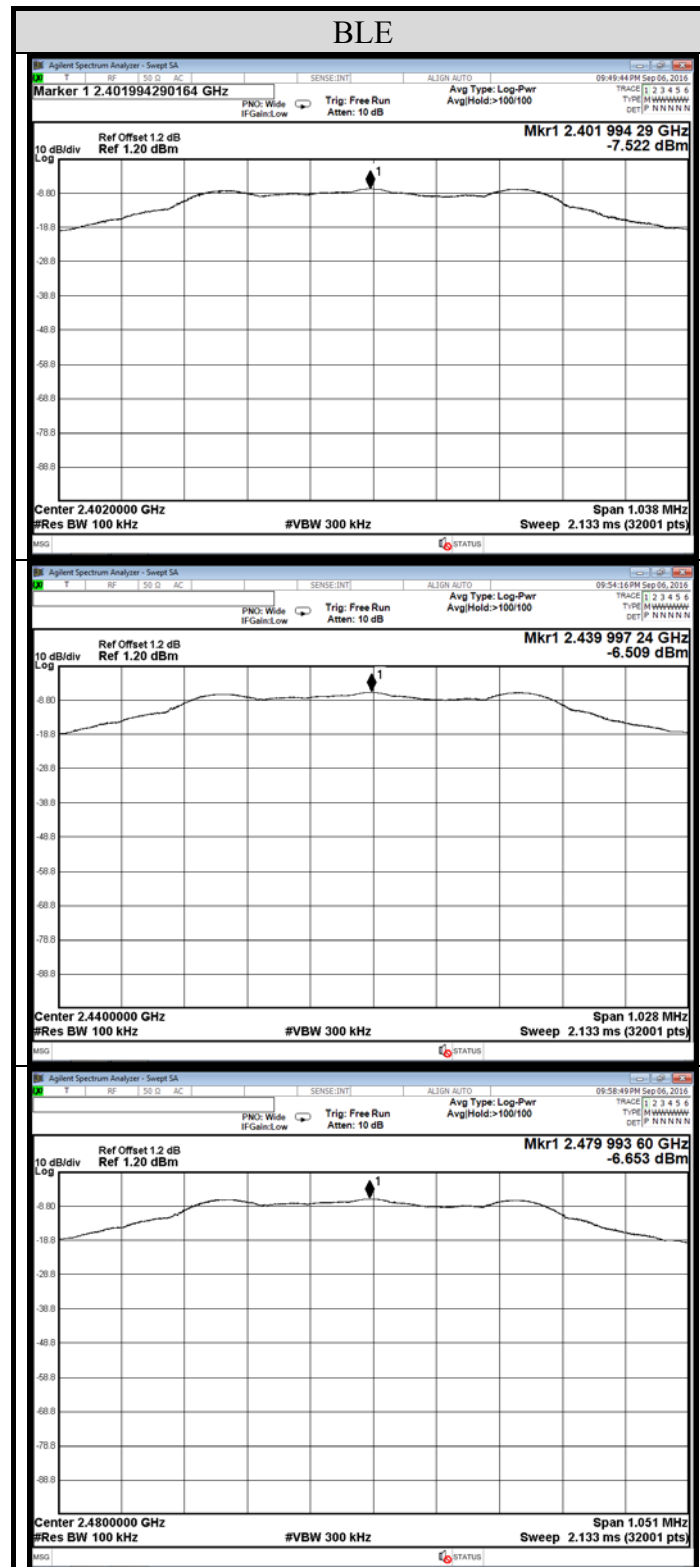
- (1) Using peak PSD procedure step 1 to step 4.
- (2) Detector = RMS detector
- (3) Sweep time = auto couple
- (4) Trace mode = trace averaging over a minimum of 100 traces
- (5) Use the peak marker function to determine the maximum amplitude level.
- (6) Duty cycle factor is added when duty cycle presented in section 3.5.1.  $< 98\%$ .
- (7) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

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## 10.4. Test Results

Test Date	2016/09/06	Temp./Hum.	25°C/58%
Cable Loss	1.2dB	Test Voltage	AC 277V, 60Hz



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Report Number: EM-F160596

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## **11.DEVIATION TO TEST SPECIFICATIONS**

**【NONE】**