Audix Technology Corp.
No. 53-11, Dingfu, Linkou, Dist.,
New Taipei City244, Taiwan

Tel: +886 2 26099301
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FCC 15.247
2.4 GHz Test Report

for

Authentrend Technology Inc.

2F., No.639, Ruiguang Rd. Neihu Dist, Taipei City, 114, Taiwan

Product Name	**:**	**Bluetooth Fingerprint Authenticator**
Model Name	**:**	**ATKey.BLE**
Brand	**:**	**AuthenTrend**
FCC ID	**:**	**2AOPY-ATKEYBLE1**

Prepared by: : AUDIX Technology Corporation, EMC Department

Testing Laboratory
1724

TESTING
NVLAP LAB CODE 200077-0

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TEST REPORT CERTIFICATION

Applicant	:	Authentrend Technology Inc.
Factory	:	Might Electronic Co., Ltd.
EUT Description		
(1) Product	:	Bluetooth Fingerprint Authenticator
(2) Model	:	ATKey.BLE
(3) Brand	:	AuthenTrend
(4) Power Rating	:	DC 5V (USB)

Applicable Standards:

47 CFR FCC Part 15 Subpart C
ANSI C63.10:2013
KDB 558074 D01 DTS Meas Guidance v04

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 Report: 2017. 12. 29

Reviewed by: (Tina Huang/Administrator)

Approved by: (Ben Cheng/Manager)

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1. REVISION RECORD OF TEST REPORT

Edition No	Issued Data	Revision Summary	Report Number
0	2017. 12. 29	Original Report	EM-F170801

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2. SUMMARY OF TEST RESULTS

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

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3. GENERAL INFORMATION

3.1. Description of Application

Applicant	Authentrend Technology Inc. 2F., No.639, Ruiguang Rd. Neihu Dist, Taipei City, 114, Taiwan
Factory	Might Electronic Co., Ltd. No. 40-1, Lin 2, Yuan-Shan Tsuen, Hsin-Feng Hsiang, Hsin-Chu Hsien, Taiwan R.O.C.
Product	Bluetooth Fingerprint Authenticator
Model	ATKey.BLE
Brand	AuthenTrend

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3.2. Description of EUT

Test Model	ATKey.BLE
Serial Number	N/A
Power Rating	DC 5V (Via USB) or DC 3.7V (Via Battery)
RF Features	BLE
Transmit Type	1T1R
Sample Status	Production
Date of Receipt	2017. 10. 24
Date of Test	2017. 10. 26~ 12. 19
I/O Ports List	• One USB Port
Accessories Supplied	None

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3.3. Antenna Information

No.	Antenna Part Number	Manufacture	Antenna Type	Frequency	Max Gain (dBi)
1	RFANT3216120A1T	Walsin Technology Corporation	Chip Antenna	2450 ± 50MHz	**2.13 (Peak)**

3.4. EUT Specifications Assessed in Current Report

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

Channel List (BLE)			
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

3.5. Descriptions of Key Components

None

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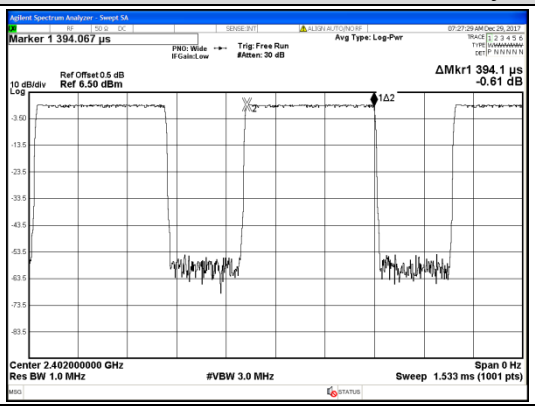
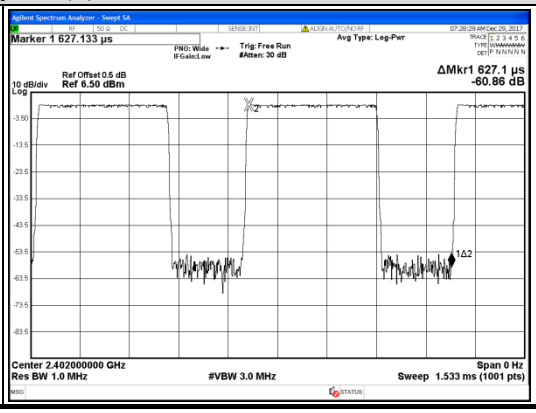
3.6. Test Configuration

Mode	Duty Cycle (x)	T (ms)	Duty Cycle Factor (dB)
BLE	0.62	0.394	2.076

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

Mode	Duty Cycle (x)
BLE	 

AC Conduction	
Test Case	Normal operation

Item		Mode	Data Rate	Test Channel
Radiated Test Case	Radiated Band Edge Note1	BLE	1Mbps	37/39
	Radiated Spurious Emission Note1	BLE	1Mbps	37/17/39
Conducted Test Case	6dB Bandwidth	BLE	1Mbps	37/17/39
	Peak Power Spectral Density	BLE	1Mbps	37/17/39
	Peak Output Power	BLE	1Mbps	37/17/39
	Band Edge	BLE	1Mbps	37/39
	Spurious Emission	BLE	1Mbps	37/17/39

Note 1:
☐Mobile Device.
■Portable Device, and 3 axis were assessed.
■ Lie ☐ Side ☐ Stand

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3.7. Tested Supporting System List

3.7.1. Support Peripheral Unit

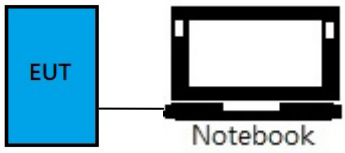
No.	Product	Brand	Model No.	Serial No.	Approval
1.	Notebook PC	acer	N16Q2	NXGDWTA012 7320DB9C7600	Contains FCC ID: PPD-QCNFA435 Contains IC: 4104A-QCNFA435
2.	Test Jig	N/A	N/A	N/A	N/A

3.7.2. Cable Lists

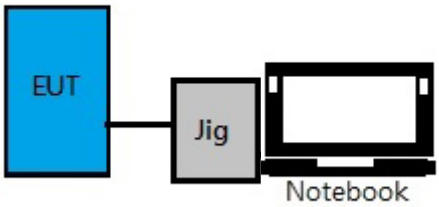
No.	Cable Description Of The Above Support Units
1.	Adapter: Chicony, M/N A11-065N1A DC Cord：Shielded, Undetachable, 1.8m, Bonded a ferrite core AC Power Cord：Unshielded, Detachable, 1.0m
2.	Cable: Unshielded, Undetachable, 1.0m

3.8. Setup Configuration

3.8.1. EUT Configuration for Power Line



3.8.2. EUT Configuration for Radiated Emission & RF Conducted Test Items



3.9. Operating Condition of EUT

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

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3.10.Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan Tel: +886-2-26092133 Fax: +886-2-26099303 Website : www.audixtech.com Contact e-mail: attemc_report@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2005 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724 (3) FCC OET Designation No. TW1004 & TW1090 & TW1724
Test Facilities	(1) No. 7 Shielding Room (2) Semi-Anechoic Chamber (IC Test Site Registration No.: 5183B-1) (3) Fully Anechoic Chamber (IC Test Site Registration No.: 5183B-4)

3.11.Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conduction Test	150kHz~30MHz	±3.50dB
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

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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	ESCI	101276	2017. 03. 23	1 Year
2.	A.M.N.	R&S	ESH2-Z5	100366	2017. 07. 20	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-1539-3	2017. 01. 13	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	101495	2017. 01. 16	1 Year
5.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.7 S/R	2017. 04. 21	1 Year
6.	Test Software	Audix	e3	V.120619C	N.C.R.	N.C.R.

4.2. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2017. 09. 13	1 Year
2.	Spectrum Analyzer	Agilent	N9010A-526	MY52220368	2017. 11. 08	1 Year
3.	Test Receiver	R & S	ESCS30	100338	2017. 06. 19	1 Year
4.	Amplifier	HP	8447D	2944A06305	2017. 02. 16	1 Year
5.	Amplifier	Sonoma	310N	187161	2017. 06. 08	1 Year
6.	Bilog Antenna	CHASE	CBL6112D	33821	2017. 01. 21	1 Year
7.	Loop Antenna	R&S	HFH2-Z2	891847/27	2016. 12. 23	1 Year
8.	Double-Ridged Waveguide Horn	ETS-Lindgren	3117	00135902	2017. 03. 08	1 Year
9.	Horn Antenna	COM-POWER	AH-840	101092	2017. 05. 04	1 Year
10.	2.4GHz Notch Filter	K&L	7NSL10-244 1.5E130.5-00	1	2017. 07. 26	1 Year
11.	3GHz Notch Filter	Microwave	H3G018G1	484798	2017. 08. 25	1 Year
12.	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. Due
1.	Spectrum Analyzer	Agilent	N9030A-526	MY53310269	2017. 01. 03	1 Year

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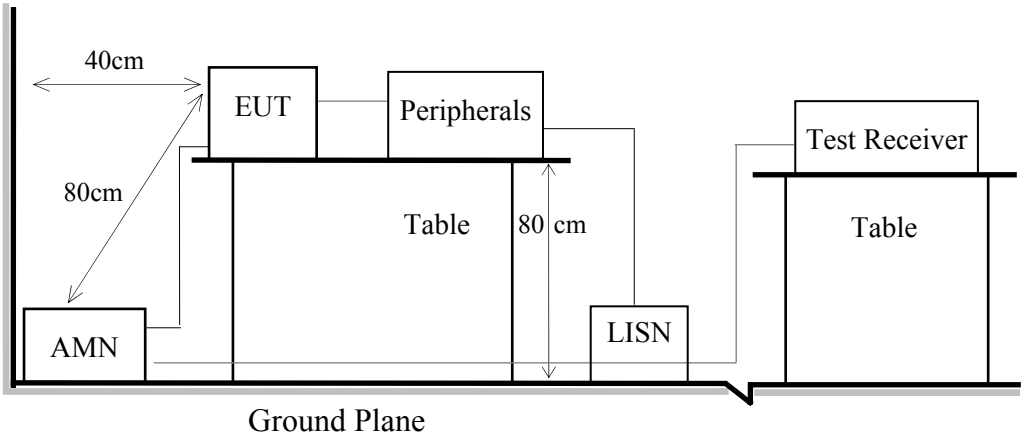
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.9

5.1.2. Shielded Room Setup Diagram



5.2. Conducted Emission Limit

Frequency	Conducted Limit	
	Quasi-Peak Level	Average Level
150kHz ~ 500kHz	66 ~ 56 dBμV	56 ~ 46 dBμV
500kHz ~ 5MHz	56 dBμV	46 dBμV
5MHz ~ 30MHz	60 dBμV	50 dBμV

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.

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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. Test Results

Please refer to Appendix A.

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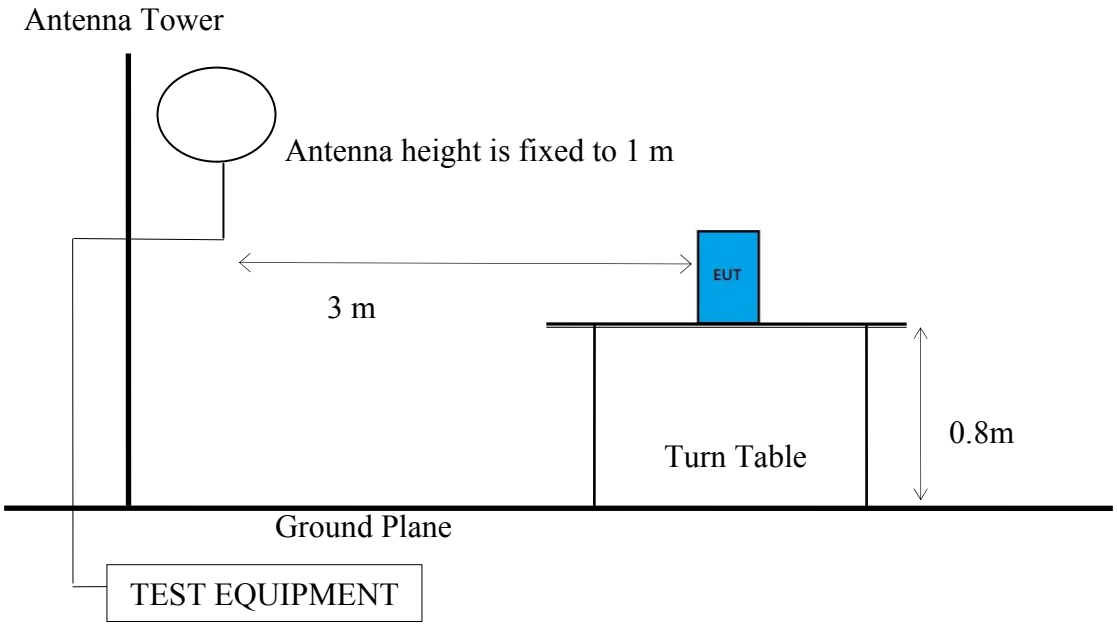
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

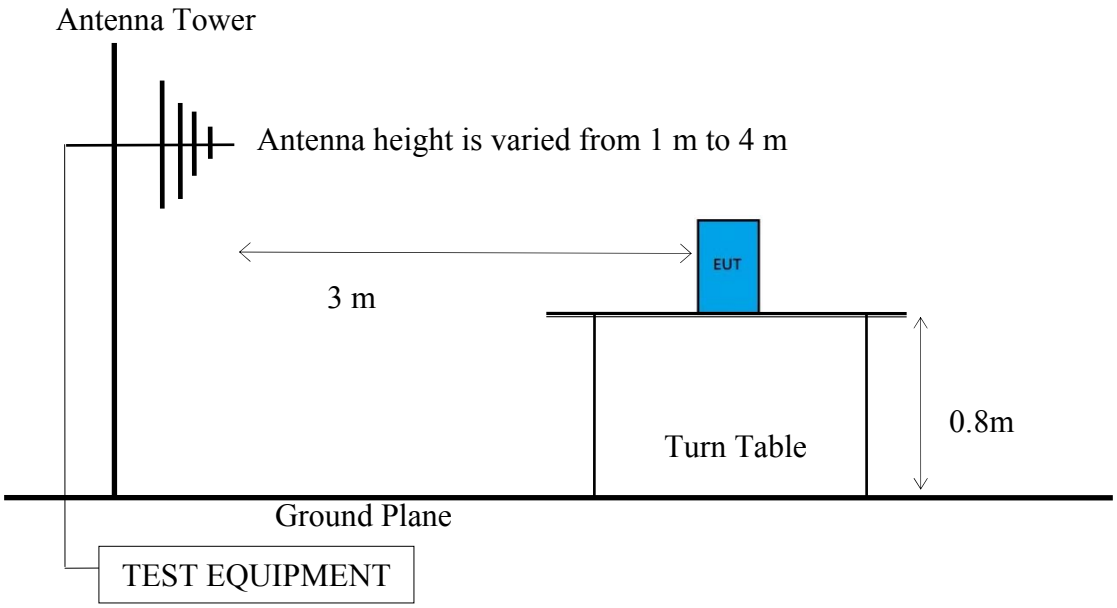
6.1.1. Block Diagram of EUT

Indicated as section 3.9

6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000 MHz



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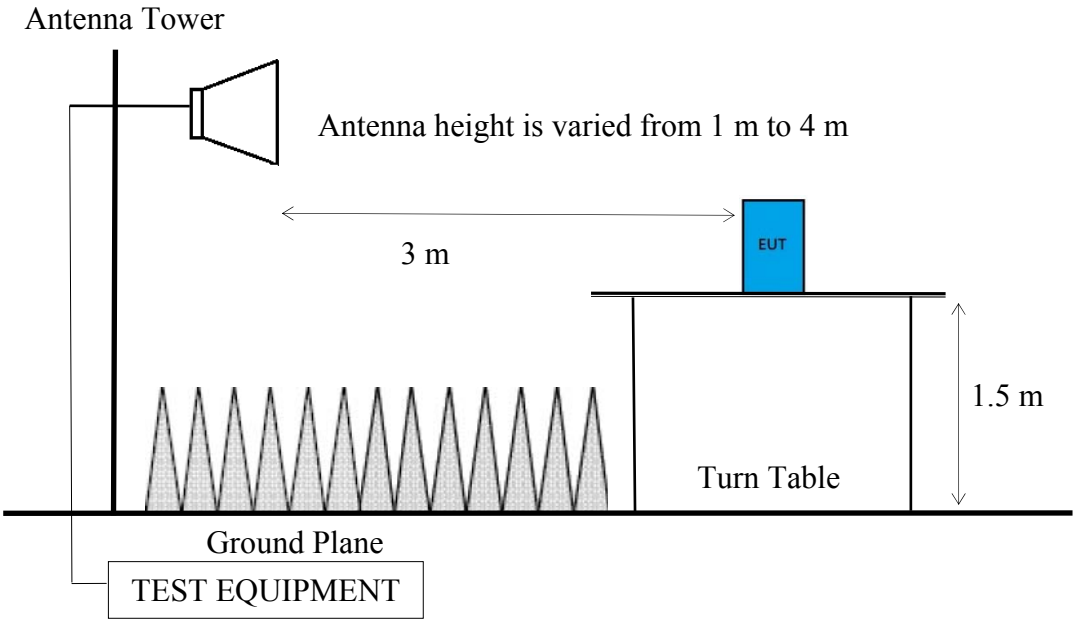
6.1.4. Setup Diagram for above 1GHz



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, must also comply with the radiated emission limits specified as below.

Frequency (MHz)	Distance (m)	Limits	
		dBμV/m	μV/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 dBμV/m (Peak) 54.0 dBμV/m (Average)	

Remark：(1) dBμV/m = 20 log (μV/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.

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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 ~ 25GHz:
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 ≥ 3 x 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 (up to 25 GHz):
Peak Detector:
(1)RBW = 1MHz
(2)VBW ≥ 3 x 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 detector for finally measurement.

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Average Detector:

■**Option 1:**

(1)RBW = 1MHz

(2)VBW ≥ 1/ T.

Modulation Type	T (ms)	1/ T (kHz)	VBW Setting (kHz)
BLE	0.394	2.5	2.5

N/A: 1/ T is not implemented when duty cycle presented in section 3.6 is ≥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 l=Antenna Factor + Cable Loss + Meter Reading

☐Average Emission Level= Peak Emission Level+ DCCF

Duty Cycle Correction Factor (DCCF)= 20log (TX_{on}/TX_{on+off}) presented in section 3.7

☐ERP= Peak Emission Level-95.2dB-2.14dB

6.5. Test Results

Please refer to Appendix A.

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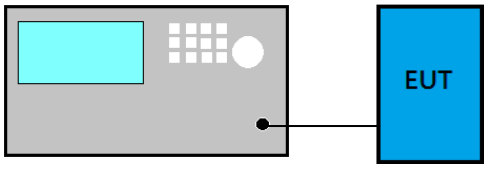
7. 6dB BANDWIDTH

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 v04:

(1) Set RBW = 100 kHz.
(2) Set the video bandwidth (VBW) ≥ 3 × 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

Please refer to Appendix A

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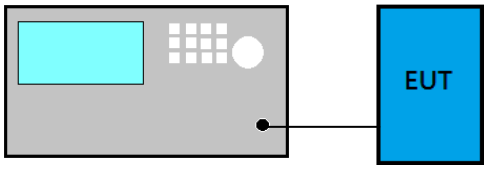
8. MAXIMUM PEAK OUTPUT POWER

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), and E.I.R.P.: 4Watt (36dBm)

8.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v04:

☐**PKPM1 Peak power meter method:**

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

■**Maximum peak conducted output power method:**

(1) Set the RBW ≥ DTS bandwidth
(2) Set RBW ≥ 3 × RBW
(3) Set span ≥ 3 × RBW.
(4) Sweep time = auto couple
(5) Detector = peak.
(6) Trace mode = max hold.
(7) Allow trace to fully stabilize.
(8) Use peak marker function to determine the peak amplitude level.

8.4. Test Results

Please refer to Appendix A

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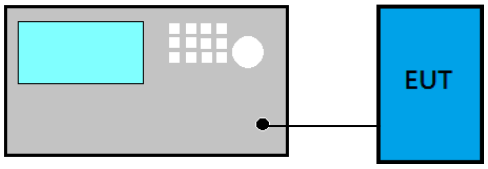
9. EMISSION LIMITATIONS

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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, that the required attenuation shall be 30 dB instead of 20 dB.

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 v04:

■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 ≥ 3 × 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.

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■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 ≥ 3 × 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.

9.4. Test Results

Please refer to Appendix A

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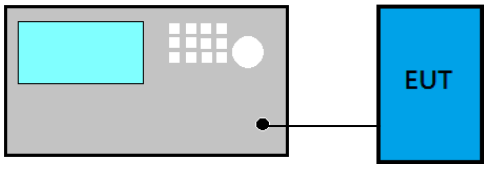
10. POWER SPECTRAL DENSITY

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 v04:

■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 kHz ≤ RBW ≤ 100 kHz.
(4) Set the VBW ≥ 3 × 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 3.6 < 98%.
(7) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

10.4. Test Results

Please refer to Appendix A

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11. DEVIATION TO TEST SPECIFICATIONS

【NONE】

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APPDNDIX A

TEST DATA AND PLOTS

(Model: ATKey.BLE)

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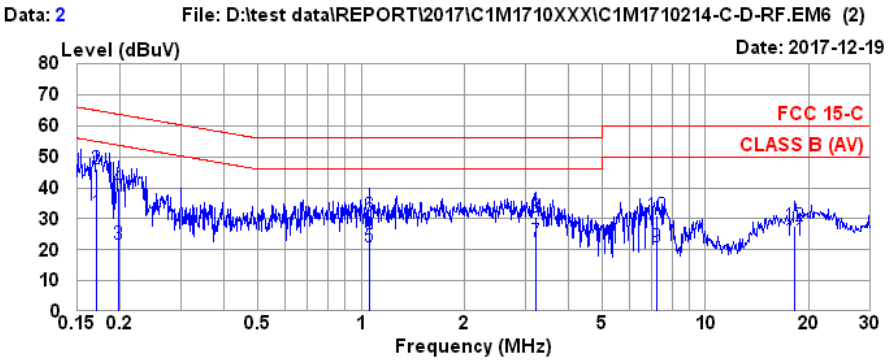
A.1 CONDUCTED EMISSION

Test Date	2017/12/19	Temp./Hum.	23℃/56%
Test Voltage	AC 120V/60Hz (via Notebook PC)		



Site no. : No.7 Shielded Room
Condition : ESH2-Z5 366(ADAPTER)
Limit : FCC 15-C
Env. / Ins. : 23*C / 56% ESCI(1276)
EUT : ATkey.BLE
Power Rating : 120Vac/60Hz (via NB)
Test Mode : Operating

Data no. : 2
Phase : NEUTRAL
Engineer : Nick Du

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBµV)	Emission Level (dBµV)	Limits (dBµV)	Margin (dB)	Remark
1	0.170	0.18	0.03	9.86	21.63	31.70	54.94	23.24	Average
2	0.170	0.18	0.03	9.86	35.94	46.01	64.94	18.93	QP
3	0.198	0.17	0.04	9.86	11.60	21.67	53.69	32.02	Average
4	0.198	0.17	0.04	9.86	29.71	39.78	63.69	23.91	QP
5	1.054	0.22	0.05	9.86	10.69	20.82	46.00	25.18	Average
6	1.054	0.22	0.05	9.86	20.98	31.11	56.00	24.89	QP
7	3.224	0.30	0.15	9.87	12.26	22.58	46.00	23.42	Average
8	3.224	0.30	0.15	9.87	20.20	30.52	56.00	25.48	QP
9	7.249	0.46	0.20	9.88	10.34	20.88	50.00	29.12	Average
10	7.249	0.46	0.20	9.88	20.66	31.20	60.00	28.80	QP
11	18.135	0.93	0.29	9.93	11.95	23.10	50.00	26.90	Average
12	18.135	0.93	0.29	9.93	16.67	27.82	60.00	32.18	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
2. If the average limit is met when useing a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

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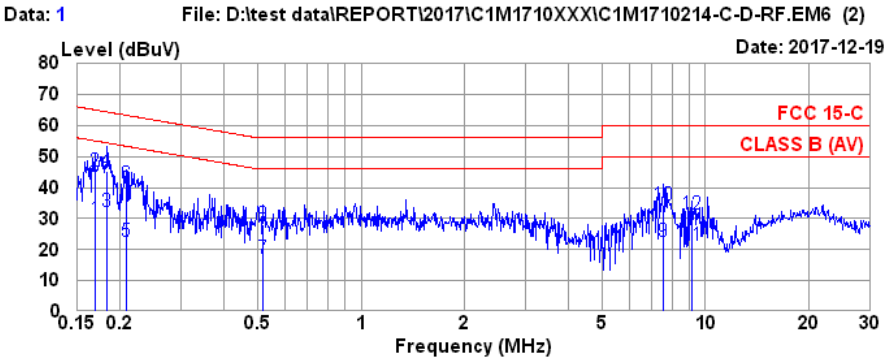
Test Date	2017/12/19	Temp./Hum.	23℃/56%
Test Voltage	AC 120V/60Hz (via Notebook PC)		



Site no. : No.7 Shielded Room
Condition : ESH2-Z5 366(ADAPTER)
Limit : FCC 15-C
Env. / Ins. : 23*C / 56% ESCI(1276)
EUT : ATkey.BLE
Power Rating : 120Vac/60Hz (via NB)
Test Mode : Operating

Data no. : 1
Phase : LINE
Engineer : Nick Du

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBµV)	Emission Level (dBµV)	Limits (dBµV)	Margin (dB)	Remark
1	0.169	0.17	0.03	9.86	19.65	29.71	55.03	25.32	Average
2	0.169	0.17	0.03	9.86	35.35	45.41	65.03	19.62	QP
3	0.183	0.17	0.04	9.86	22.01	32.08	54.33	22.25	Average
4	0.183	0.17	0.04	9.86	35.23	45.30	64.33	19.03	QP
5	0.208	0.16	0.04	9.86	12.68	22.74	53.27	30.53	Average
6	0.208	0.16	0.04	9.86	30.83	40.89	63.27	22.38	QP
7	0.519	0.19	0.04	9.86	7.00	17.09	46.00	28.91	Average
8	0.519	0.19	0.04	9.86	17.87	27.96	56.00	28.04	QP
9	7.566	0.50	0.20	9.88	12.07	22.65	50.00	27.35	Average
10	7.566	0.50	0.20	9.88	23.91	34.49	60.00	25.51	QP
11	9.157	0.55	0.22	9.89	10.67	21.33	50.00	28.67	Average
12	9.157	0.55	0.22	9.89	20.87	31.53	60.00	28.47	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
2. If the average limit is met when useing a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

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A.2 RADIATED EMISSION

Test Date	2017/10/26	Temp./Hum.	23℃/53%
Test Voltage	DC 5V (via Notebook PC)		

A.2.1 Emissions within Restricted Frequency Bands

A.2.1.1 Frequency 9kHz~30MHz

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

A.2.1.2 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
144.46	17.47	2.77	8.78	29.02	43.50	14.48	Peak
240.49	18.57	3.73	21.71	44.01	46.00	1.99	Peak
336.52	20.50	4.80	19.37	44.67	46.00	1.33	Peak
431.58	22.43	5.85	13.79	42.07	46.00	3.93	Peak
671.17	24.81	6.99	2.70	34.50	46.00	11.50	Peak
969.93	27.52	8.63	1.19	37.34	54.00	16.66	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
191.99	15.62	3.26	18.27	37.15	43.50	6.35	Peak
335.55	20.50	4.80	14.19	39.49	46.00	6.51	Peak
384.05	21.69	5.38	12.48	39.55	46.00	6.45	Peak
480.08	22.95	6.27	9.36	38.58	46.00	7.42	Peak
745.86	25.36	7.33	5.91	38.60	46.00	7.40	Peak
961.20	27.46	8.59	1.58	37.63	54.00	16.37	Peak

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Mode	BLE	Frequency	TX 2440MHz

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
143.49	17.55	2.76	16.13	36.44	43.50	7.06	Peak
191.99	15.62	3.26	22.56	41.44	43.50	2.06	Peak
263.77	19.26	3.95	22.00	45.21	46.00	0.79	Peak
360.77	21.13	5.10	19.43	45.66	46.00	0.34	Peak
481.05	22.95	6.27	11.22	40.44	46.00	5.56	Peak
673.11	24.81	7.00	4.83	36.64	46.00	9.36	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
143.49	17.55	2.76	6.56	26.87	43.50	16.63	Peak
191.99	15.62	3.26	17.98	36.86	43.50	6.64	Peak
335.55	20.50	4.80	13.88	39.18	46.00	6.82	Peak
480.08	22.95	6.27	9.71	38.93	46.00	7.07	Peak
575.14	24.29	6.67	6.21	37.17	46.00	8.83	Peak
941.80	27.25	8.46	2.37	38.08	46.00	7.92	Peak

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Mode	BLE	Frequency	TX 2480MHz

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
144.46	17.47	2.77	15.87	36.11	43.50	7.39	Peak
191.02	15.61	3.25	22.02	40.88	43.50	2.62	Peak
240.49	18.57	3.73	22.23	44.53	46.00	1.47	Peak
336.52	20.50	4.80	19.19	44.49	46.00	1.51	Peak
479.11	22.94	6.26	8.29	37.49	46.00	8.51	Peak
996.12	27.80	8.81	4.26	40.87	54.00	13.13	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
191.99	15.62	3.26	18.31	37.19	43.50	6.31	Peak
335.55	20.50	4.80	14.29	39.59	46.00	6.41	Peak
432.55	22.44	5.86	11.51	39.81	46.00	6.19	Peak
481.05	22.95	6.27	8.59	37.81	46.00	8.19	Peak
575.14	24.29	6.67	5.90	36.86	46.00	9.14	Peak
845.77	26.33	7.87	3.60	37.80	46.00	8.20	Peak

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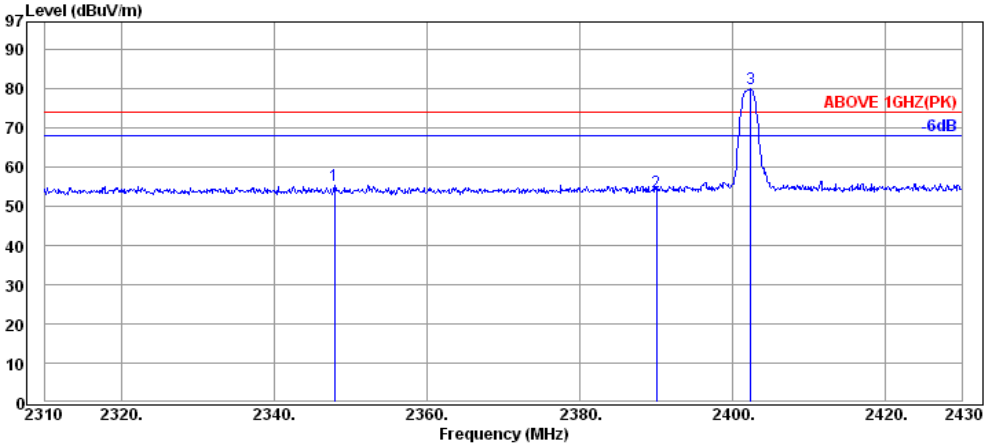
A.2.1.3 Frequency Above 1 GHz to 10th harmonics

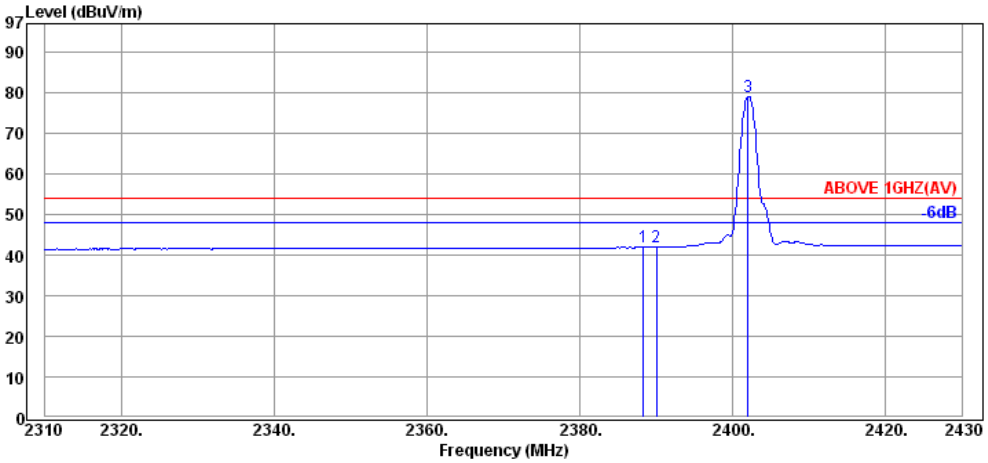
Band Edge:

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
2347.92	32.08	6.51	16.88	55.47	74.00	18.53	Peak
2390.04	32.16	6.57	15.02	53.75	74.00	20.25	Peak
2402.40	32.16	6.57	41.25	79.98	---	---	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
2388.36	32.16	6.57	3.21	41.94	54.00	12.06	Average
2390.04	32.16	6.57	3.17	41.90	54.00	12.10	Average
2402.04	32.16	6.57	40.30	79.03	---	---	Average

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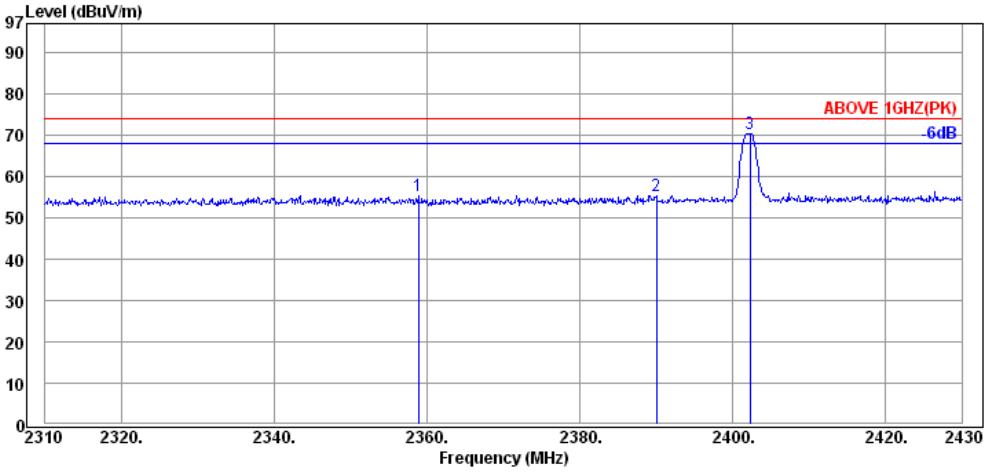
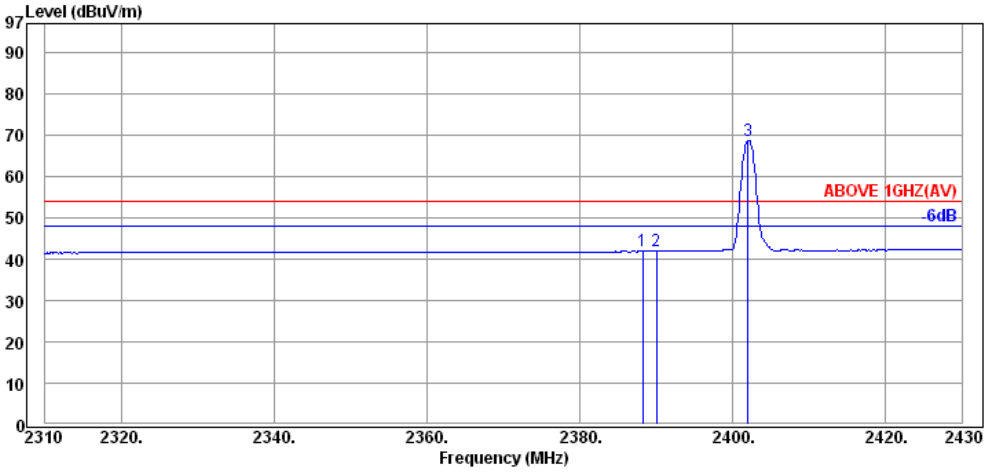
Mode	BLE	Frequency	TX 2402MHz



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
2358.84	32.11	6.53	16.70	55.34	74.00	18.66	Peak
2390.04	32.16	6.57	16.56	55.29	74.00	18.71	Peak
2402.28	32.16	6.57	31.77	70.50	---	---	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
2388.24	32.16	6.57	3.16	41.89	54.00	12.11	Average
2390.04	32.16	6.57	3.12	41.85	54.00	12.15	Average
2402.04	32.16	6.57	30.05	68.78	---	---	Average

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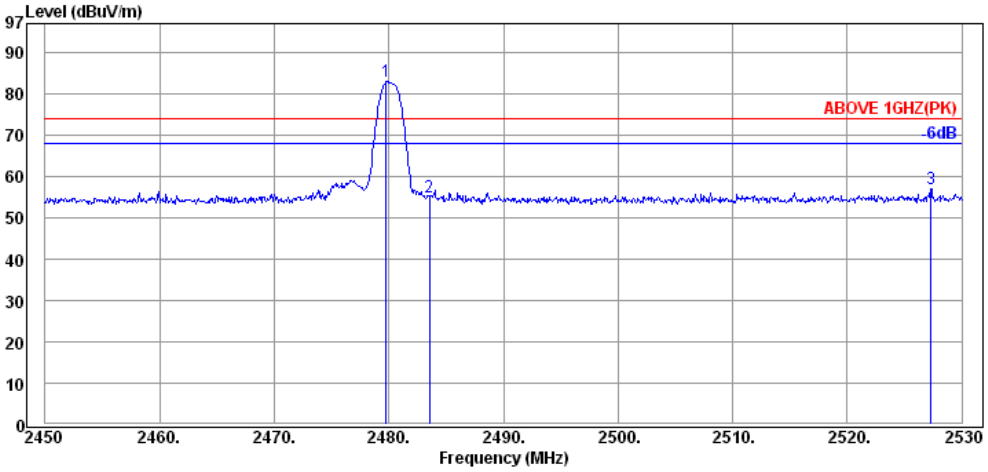
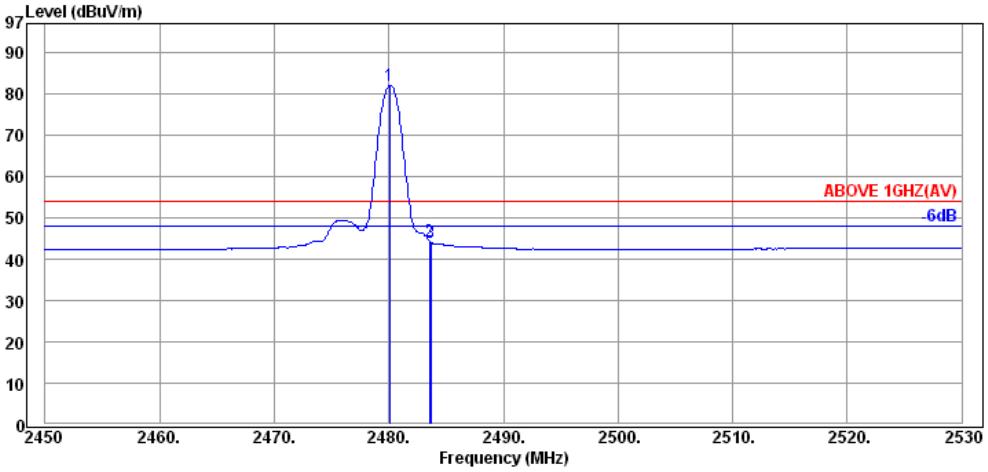
Mode	BLE	Frequency	TX 2480MHz



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
2479.76	32.28	6.67	43.99	82.94	---	---	Peak
2483.52	32.28	6.67	15.91	54.86	74.00	19.14	Peak
2527.28	32.34	6.74	18.00	57.08	74.00	16.92	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
2480.08	32.28	6.67	43.07	82.02	---	---	Average
2483.52	32.28	6.67	5.48	44.43	54.00	9.57	Average
2483.68	32.28	6.67	5.05	44.00	54.00	10.00	Average

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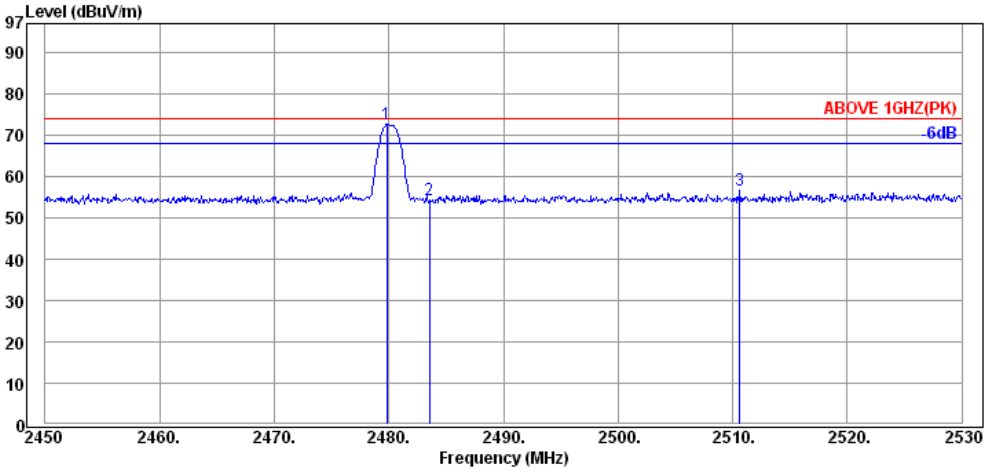
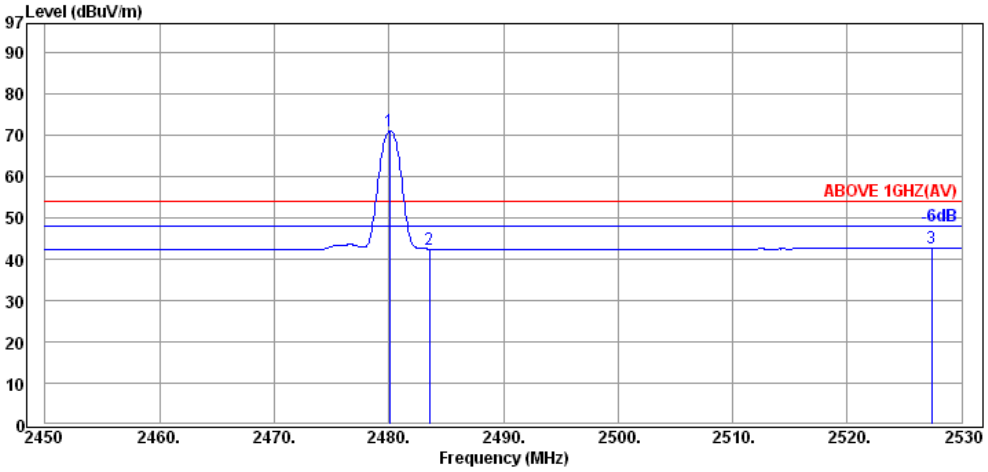
Mode	BLE	Frequency	TX 2480MHz



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
2479.84	32.28	6.67	33.75	72.70	---	---	Peak
2483.52	32.28	6.67	15.35	54.30	74.00	19.70	Peak
2510.64	32.32	6.72	17.47	56.51	74.00	17.49	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
2480.08	32.28	6.67	32.11	71.06	---	---	Average
2483.52	32.28	6.67	3.49	42.44	54.00	11.56	Average
2527.36	32.34	6.74	3.67	42.75	54.00	11.25	Average

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A.2.2 Emissions outside the frequency band:

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

Mode	BLE	Frequency	TX 2402MHz

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
4805.00	34.22	9.54	4.65	48.41	54.00	5.59	Peak
7205.00	35.80	11.80	-0.50	47.10	54.00	6.90	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
4805.00	34.22	9.54	2.57	46.33	54.00	7.67	Peak
7205.00	35.80	11.80	-0.33	47.27	54.00	6.73	Peak

Mode	BLE	Frequency	TX 2440MHz

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
4880.00	34.25	9.56	4.73	48.54	54.00	5.46	Peak
7320.00	35.80	11.92	-2.02	45.70	54.00	8.30	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
4880.00	34.25	9.56	2.10	45.91	54.00	8.09	Peak
7320.00	35.80	11.92	-0.86	46.86	54.00	7.14	Peak

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Mode	BLE	Frequency	TX 2480MHz

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
4880.00	34.25	9.56	-0.15	43.66	54.00	10.34	Peak
7440.00	35.80	12.04	-1.82	46.02	54.00	7.98	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
4960.00	34.29	9.60	3.41	47.30	54.00	6.70	Peak
7440.00	35.80	12.04	-1.46	46.38	54.00	7.62	Peak

A.2.3 Emissions in Non-restricted Frequency Bands:

Pursuant to KDB 558074 D01 DTS Meas Guidance v04 that emission levels below the 15.209 general radiated emissions limits is not required.

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A.3 6dB BANDWIDTH

Test Date	2017/10/26	Temp./Hum.	24℃/52%
Cable Loss	0.5dB	Test Voltage	DC 5V (via Notebook PC)

A.3.1 6dB Bandwidth Result

Mode	Centre Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz) (Reference only)	Limit
BLE	2402	0.7082	1.0939	>500kHz
	2440	0.7039	1.0936	
	2480	0.7029	1.0923	

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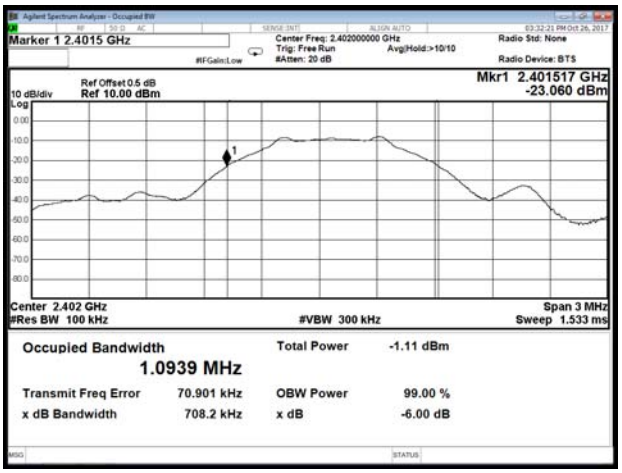
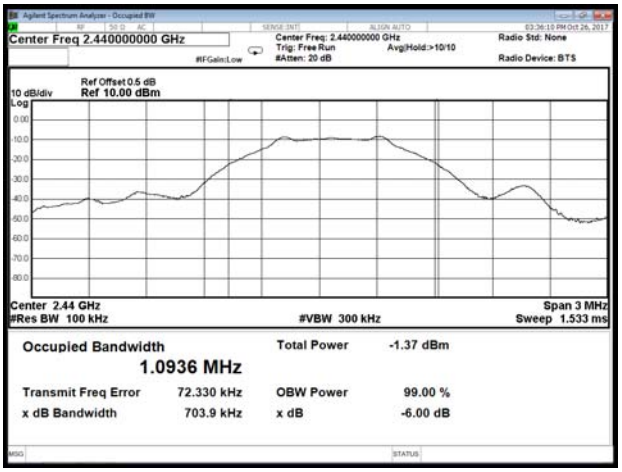
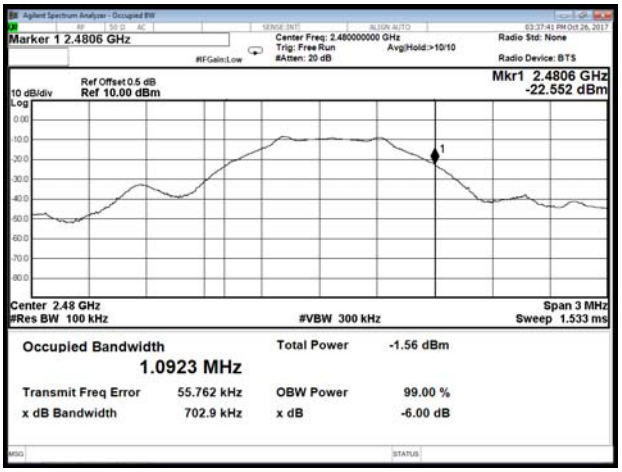
A.3.2 Measurement Plots

BLE







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A.4 MAXIMUM PEAK OUTPUT POWER

Test Date	2017/10/26	Temp./Hum.	24℃/52%
Cable Loss	0.5dB	Test Voltage	DC 5V (via Notebook PC)

A.4.1 Peak Output Power

Mode	Centre Frequency (MHz)	Peak Output Power (dBm)		Limit
		dBm	W	
BLE	2402	-8.026	0.000158	< 30dBm (1W)
	2440	-8.204	0.000151	
	2480	-8.246	0.000150	

Note: The results have been included cable loss.

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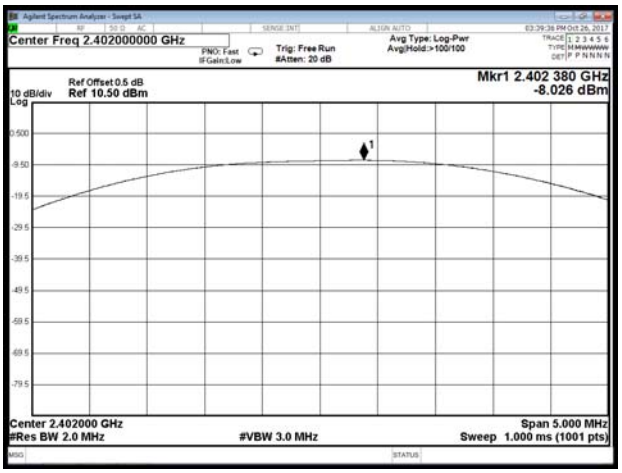
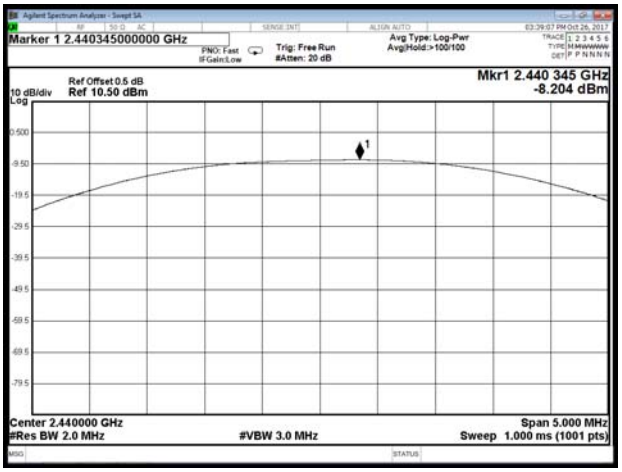
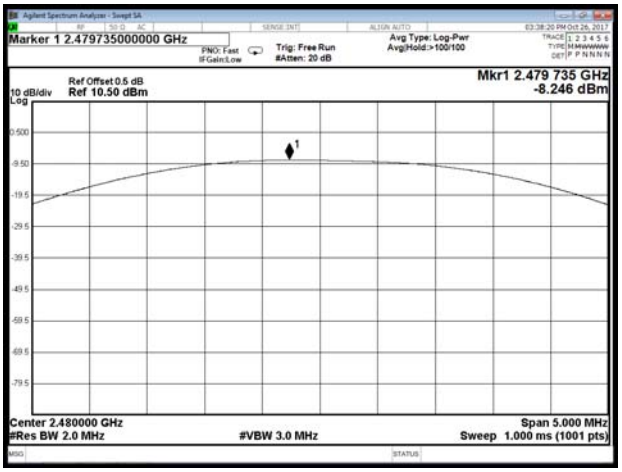
A.4.2 Measurement Plots

BLE







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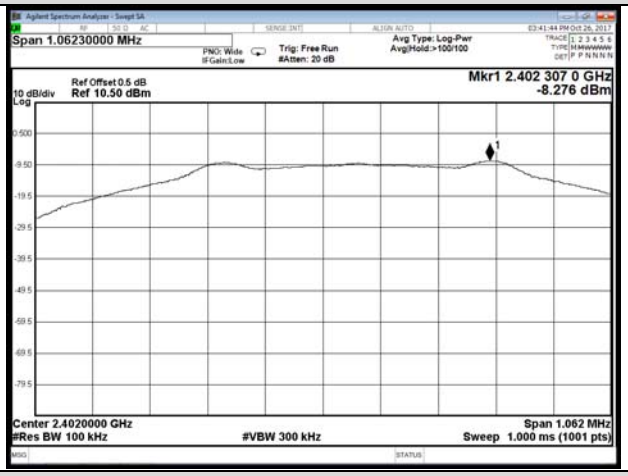
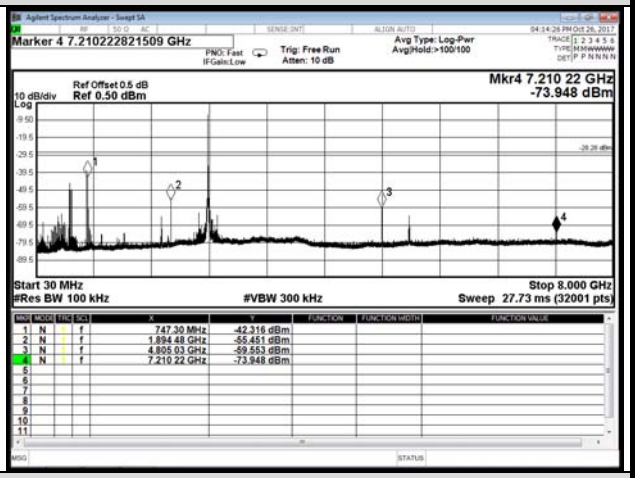
A.5 EMISSION LIMITATIONS

Test Date	2017/10/26	Temp./Hum.	24℃/52%
Cable Loss	0.50dB	Test Voltage	DC 5V (via Notebook PC)
Mode	BLE	Frequency	TX 2402MHz
Simultaneous Factor10 log(n) (Note: “n” is antenna number)			0

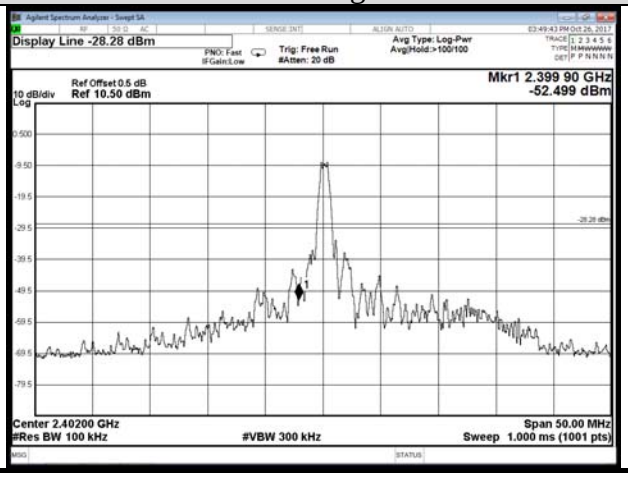
Reference Level



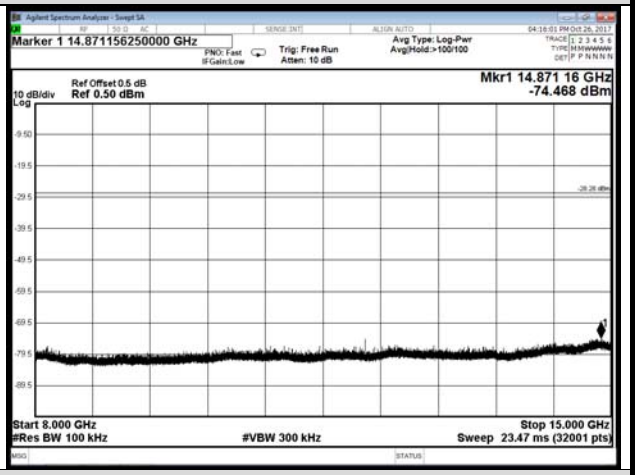
30MHz – 8GHz



Band Edge



8GHz – 15GHz



15GHz – 25GHz

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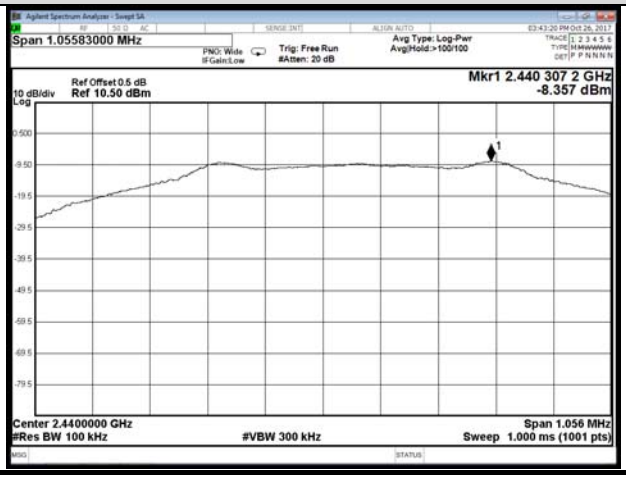
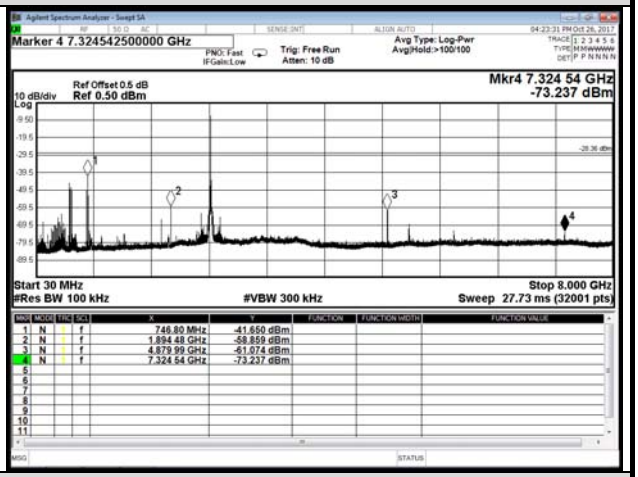
Test Date	2017/10/26	Temp./Hum.	24℃/52%
Cable Loss	0.50dB	Test Voltage	DC 5V (via Notebook PC)
Mode	BLE	Frequency	TX 2440MHz
Simultaneous Factor10 log(n) (Note: “n” is antenna number)			0

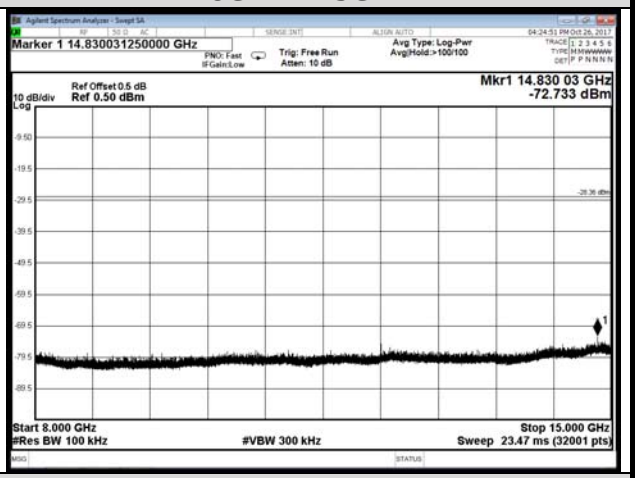
Reference Level



30MHz – 8GHz



8GHz – 15GHz



15GHz – 25GHz

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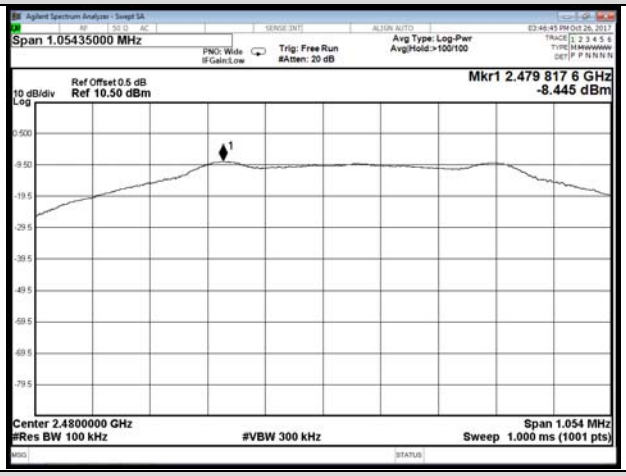
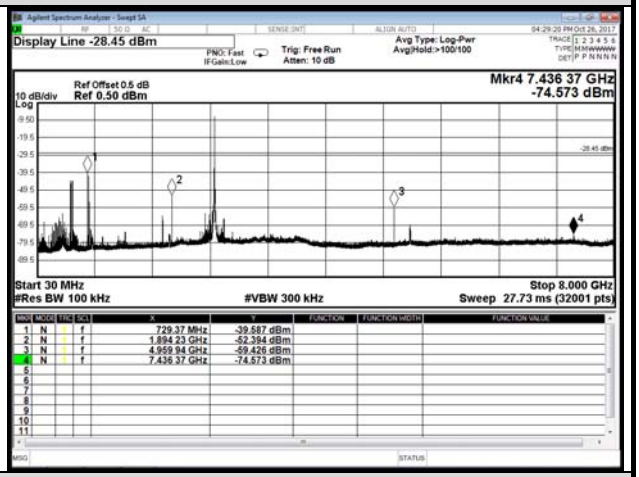
Test Date	2017/10/26	Temp./Hum.	24℃/52%
Cable Loss	0.50dB	Test Voltage	DC 5V (via Notebook PC)
Mode	BLE	Frequency	TX 2480MHz
Simultaneous Factor10 log(n) (Note: “n” is antenna number)			0

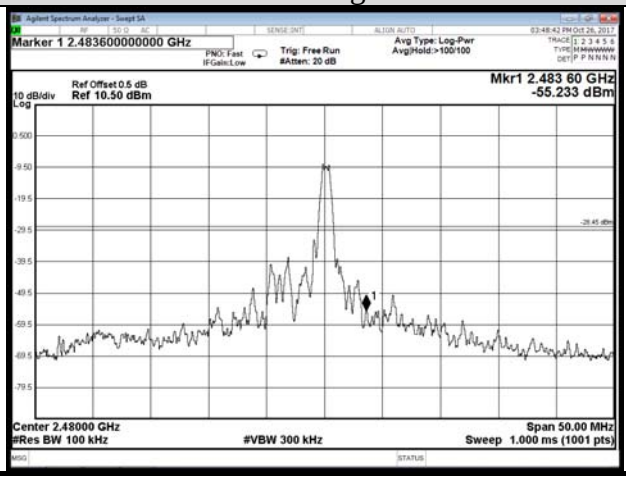
Reference Level



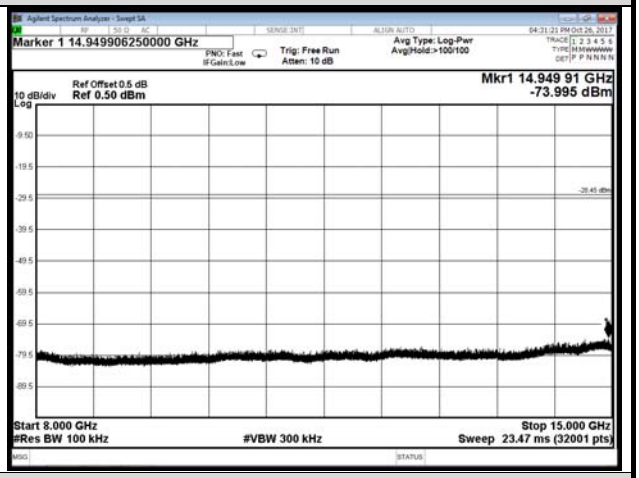
30MHz – 8GHz



Band Edge



8GHz – 15GHz



15GHz – 25GHz

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A.6 POWER SPECTRAL DENSITY

Test Date	2017/10/26	Temp./Hum.	24℃/52%
Cable Loss	0.50dB	Test Voltage	DC 5V (via Notebook PC)
Mode	BLE		
Simultaneous Factor10 log(n) (Note: “n” is antenna number)			0

A.6.1 Power Spectral Density Result

Mode	Centre Frequency (MHz)	Power Spectral Density (dBm)	Limit
BLE	2402	-8.276	< 8 dBm/3kHz
	2440	-8.357	
	2480	-8.445	

Note: All results have been included cable loss and Simultaneous Factor.

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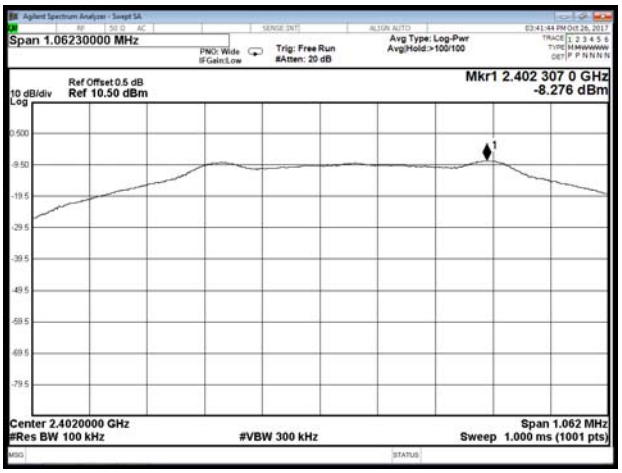
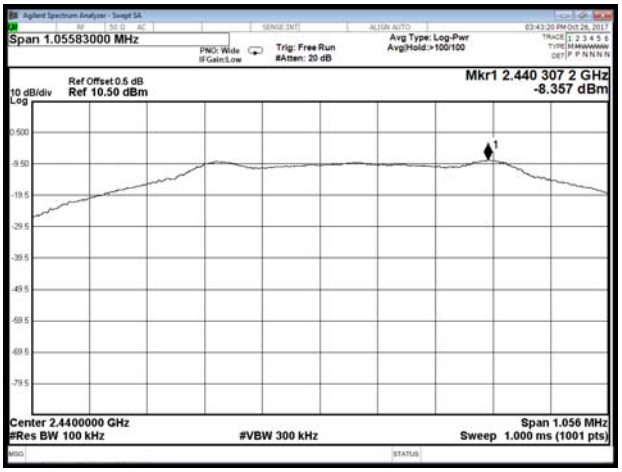
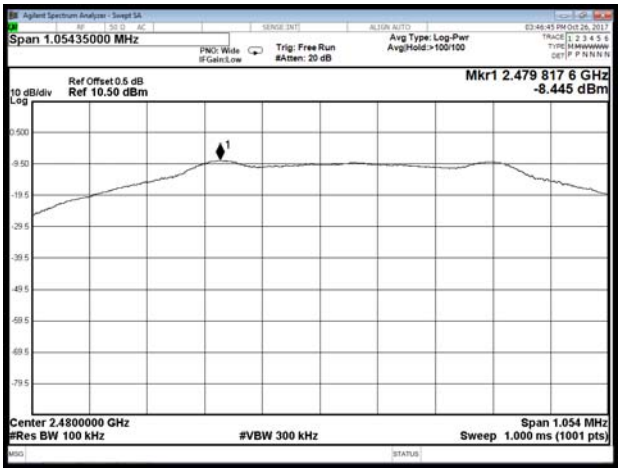
A.6.2 Measurement Plots

BLE







Note: All results have been included cable loss and Simultaneous Factor.

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APPDNDIX B

TEST PHOTOGRAPHS

(Model: ATKey.BLE)

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