FCC Test Report

Report No.: LGD-ESH-P19112802B-1

FCC ID: Q4B-P3B

Product: BLE and 6LoWPAN Wireless module

Test Model: IPPAN3-B-LROT

Received Date: Dec.08, 2019

Test Date: Mar.15 to May.29, 2020

Issued Date: Jun.02, 2020

Applicant: The Watt Stopper, Inc.

Address: 2700 Zanker Road Suite 168 San Jose California United States

Manufacturer: Shanghai Legrand Electrical Co., Ltd

Address: 1/F, Building 1, No. 1358 Xiangyang Road, Minhang District, Shanghai, China

Issued By: BUREAU VERITAS ADT (Shanghai) Corporation

Lab Address: No. 829, Xinzhuan Road, Shanghai, P.R.China (201612)

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Release Control Record

Issue No.	Description	Date Issued
LGD-ESH-P19112802B-1	Original release	Jun.02, 2020

1 Certificate of Conformity

Product: BLE and 6LoWPAN Wireless module

Brand: legrand

Test Model: IPPAN3-B-LROT

Applicant: The Watt Stopper, Inc.

Test Date: Mar.15 to May.29, 2020

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)
ANSI C63.10:2013

The above equipment has been tested by **BUREAU VERITAS ADT (Shanghai) Corporation**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Scott XU , **Date:** Jun.02, 2020

Scott XU

Project Engineer

Approved by : , **Date:** Jun.02, 2020

Daniel Sun

EMC Lab Manager

2 Summary of Test Results

The EUT has been tested according to the following specifications:

47 CFR FCC Part 15, Subpart C (SECTION 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.205 / 15.209 / 15.247(d)	Radiated Emissions Measurement	PASS	Meet the requirement of limit.
15.247(d)	Emissions in non-restricted frequency bands	PASS	Meet the requirement of limit.
15.247(a)(2)	6dB bandwidth	PASS	Meet the requirement of limit.
15.247(b)	Conducted power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used.

2.1 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Hybrid antenna(25MHz-1.5GHz)	Schwarzbeck	VULB9168	E1A1012	Feb.08,20	Feb.07,21
Horn Antenna(1GHz -18GHz)	Schwarzbeck	BBHA9120D	E1A1017	Aug.26,19	Aug.25,20
Pre-Amplifier(100kHz-1.3GHz)	Agilent	8447D	E1A2001	Oct.18, 19	Oct.17, 20
Pre-Amplifier(1GHz-26.5GHz)	Agilent	8449B	E1A2002	Mar. 25, 20	Mar. 24, 21
EMI test recerver	R&S	ESR7	E1R1005	Dec.04, 19	Dec.03, 20
Spectrum Analyzer	Keysight	N9030B	E1S1003	Jul.23,19	Jul.22, 20
EMI test recerver	R&S	ESCS30	E1R1001	Mar.25, 20	Mar.24, 21
LISN	R&S	ENV216	E1L1011	Jul.18, 19	Jul.17, 20
Humidity&Temp Tester	Baolima	WS508	E1H1011	Apr. 03, 20	Apr. 02, 21
Power Meter	Anritsu	ML2495A	E1P5003	Mar. 03, 20	Mar. 02, 21
Test Software	ADT	ADT_COND_V 7.3.1	N/A	N/A	N/A
Test Software	Toscend	JS32-RE	N/A	N/A	N/A
Test Software	Toscend	JS1120	N/A	N/A	N/A

2.2 Measurement Uncertainty

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

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

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.83 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.36 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.47 dB
	6GHz ~ 18GHz	3.75 dB
	18GHz ~ 40GHz	3.30 dB

2.3 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

802.15.4

Product	BLE and 6LoWPAN Wireless module
Brand	legrand
Test Model	IPPAN3-B-LROT
Power Rating	2.0-3.3Vdc
Modulation Type	O-QPSK
Modulation Technology	DSSS
Operating Frequency	2405MHz to 2480MHz
Number of Channel	16
Antenna Type	Ant 1:Ceramic Ant 2:Dipole
Antenna Connector	--
Antenna Gain	Ant 1:0.5dBi Ant 2:2.0dBi

BLE

Product	BLE and 6LoWPAN Wireless module
Brand	legrand
Test Model	IPPAN3-B-LROT
Power Rating	2.0-3.3Vdc
Modulation Type	GFSK
Modulation Technology	Bluetooth Low Energy 5.0
Operating Frequency	2402 ~ 2480MHz
Number of Channel	40
Antenna Type	Ant 1:Ceramic Ant 2:Dipole
Antenna Gain	Ant 1:0.5dBi Ant 2:2.0dBi

Note:1. For more details, please refer to the User's manual of the EUT.

3.2 Description of Test Modes

16 channels are provided for 802.15.4.

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
11	2405 MHz	19	2445 MHz
12	2410 MHz	20	2450 MHz
13	2415 MHz	21	2455 MHz
14	2420 MHz	22	2460 MHz
15	2425 MHz	23	2465 MHz
16	2430 MHz	24	2470 MHz
17	2435 MHz	25	2475 MHz
18	2440 MHz	26	2480 MHz

40 channels are provided for Bluetooth LE.

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
0	2402 MHz	20	2442 MHz
1	2404 MHz	21	2444 MHz
2	2406 MHz	22	2446 MHz
3	2408 MHz	23	2448 MHz
4	2410 MHz	24	2450 MHz
5	2412 MHz	25	2452 MHz
6	2414 MHz	26	2454 MHz
7	2416 MHz	27	2456 MHz
8	2418 MHz	28	2458 MHz
9	2420 MHz	29	2460 MHz
10	2422 MHz	30	2462 MHz
11	2424 MHz	31	2464 MHz
12	2426 MHz	32	2466 MHz
13	2428 MHz	33	2468 MHz
14	2430 MHz	34	2470 MHz
15	2432 MHz	35	2472 MHz
16	2434 MHz	36	2474 MHz
17	2436 MHz	37	2476 MHz
18	2438 MHz	38	2478 MHz
19	2440 MHz	39	2480 MHz

3.2.1 Test Mode Applicability:

EUT Configure Mode	Applicable to				Description
	RE ≥ 1G	RE < 1G	PLC	APCM	
-	√	√	√	√	-

Where **RE≥1G:** Radiated Emission above 1GHz **RE≤1G:** Radiated Emission below 1GHz

PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

Radiated Emission Test (Above 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.15.4	11 to 26	11,18, 26	DSSS	OQPSK	250kbps

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	BLE	0 to 39	0, 19, 39	GFSK

Radiated Emission Test (Below 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Power Line Conducted Emission Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.15.4	11 to 26	18	DSSS	OQPSK	250kbps

Antenna Port Conducted Measurement

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.15.4	11 to 26	11,18, 26	DSSS	OQPSK	250kbps

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	BLE	0 to 39	0	GFSK

3.2.2 Test Condition:

Applicable to	Normal Environmental Conditions	Normal Input Power
RE ≥ 1G	25deg. C, 60%RH	DC 3.3V
RE < 1G	25deg. C, 60%RH	DC 3.3V
PLC	25deg. C, 60%RH	DC 3.3V
APCM	25deg. C, 60%RH	DC 3.3V

3.3 Duty Cycle of Test Signal

The Duty Cycle of the EUT is 91.30%.

Note: Duty Cycle Factor = 10*log (1/Duty Cycle). Duty Cycle Factor =0.40

Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

FCC Part 15, Subpart C (15.247)

KDB 558074 D01 DTS Meas Guidance v05r02

ANSI C63.10:2013

All relaxed test items have been performed and recorded as per the above standard.

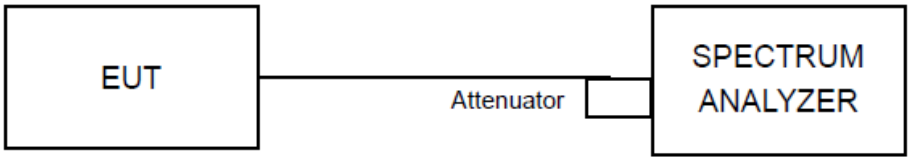
4 Test Procedure and Results

4.1 6dB Bandwidth Measurement

4.1.1 Limit

For digital modulation systems, the minimum 6dB bandwidth shall be at least 500 kHz

4.1.2 Test Setup



4.1.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” for compliance to FCC 47CFR 15.247 requirements (clause 8.2).

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 RBW, peak detector with maximum hold) is implemented by the instrumentation function.

4.1.4 Deviation of Test Standard

No deviation.

4.1.5 Test Results

802.15.4-Ant 1

Channel	Frequency (MHz)	99% Occpuied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
11	2405	2.2053	1.142	0.5	Pass
18	2440	2.2111	1.139	0.5	Pass
26	2480	2.2190	1.166	0.5	Pass

Spectrum Plot
802.15.4(2405MHz)

802.15.4(2440MHz)

802.15.4(2480MHz)

802.15.4-Ant 2

Channel	Frequency (MHz)	99% Occpuied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
11	2405	2.1981	1.185	0.5	Pass
18	2440	2.2213	1.168	0.5	Pass
26	2480	2.2180	1.177	0.5	Pass

Spectrum Plot
802.15.4(2405MHz)

802.15.4(2440MHz)

802.15.4(2480MHz)

BLE-Ant 1

Channel	Frequency (MHz)	99% Occpuied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	1.0706	0.705	0.5	Pass
19	2440	1.0738	0.703	0.5	Pass
39	2480	1.0757	0.705	0.5	Pass

Spectrum Plot
BLE(2402MHz)

BLE (2440MHz)

BLE(2480MHz)

BLE-Ant 2

Channel	Frequency (MHz)	99% Occpuied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	1.0705	0.702	0.5	Pass
19	2440	1.0713	0.703	0.5	Pass
39	2480	1.0747	0.702	0.5	Pass

Spectrum Plot
BLE(2402MHz)

BLE(2440MHz)

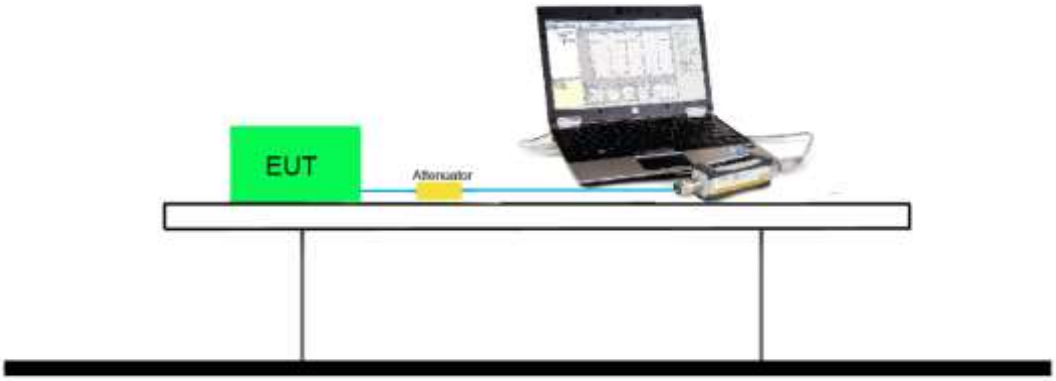
BLE(2480MHz)

4.2 Conducted Output Power Measurement

4.2.1 Limit

For systems using digital modulation in the 2400 – 2483.5 MHz bands: 1 Watt (30 dBm)

4.2.2 Test Setup



4.2.3 Test Procedures

Method PKPM1 (Peak Power Measurement)

Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

Method AVGPM-G (Measurement using a gated RF average-reading power meter)

Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required

4.2.4 Deviation of Test Standard

No deviation.

4.2.5 Test Results

802.15.4-Ant 1

Channel	Frequency (MHz)	Duty Cycle Factor	Peak Power (dBm)	Final Peak Power (dBm)	Limit (dBm)	Pass / Fail
11	2405	0.40	5.07	5.47	30	Pass
18	2440	0.40	5.34	5.74	30	Pass
26	2480	0.40	-1.46	-1.06	30	Pass

802.15.4-Ant 2

Channel	Frequency (MHz)	Duty Cycle Factor	Peak Power (dBm)	Final Peak Power (dBm)	Limit (dBm)	Pass / Fail
11	2405	0.40	11.04	11.44	30	Pass
18	2440	0.40	11.60	12.00	30	Pass
26	2480	0.40	3.89	4.29	30	Pass

BLE-Ant 1

Channel	Frequency (MHz)	Duty Cycle Factor	Peak Power (dBm)	Final Peak Power (dBm)	Limit (dBm)	Pass / Fail
0	2402	0.40	-6.43	-6.03	30	Pass
19	2440	0.40	-5.17	-4.77	30	Pass
39	2480	0.40	-3.96	-3.56	30	Pass

BLE-Ant 2

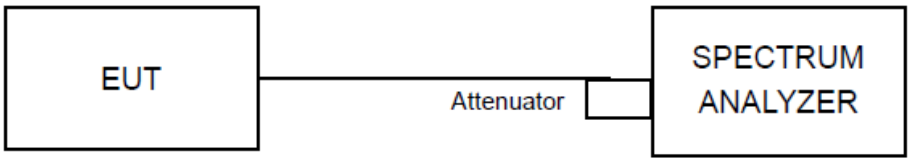
Channel	Frequency (MHz)	Duty Cycle Factor	Peak Power (dBm)	Final Peak Power (dBm)	Limit (dBm)	Pass / Fail
0	2402	0.40	-1.85	-1.45	30	Pass
19	2440	0.40	-1.57	-1.17	30	Pass
39	2480	0.40	-1.32	-0.92	30	Pass

4.3 Power Spectral Density Measurement

4.3.1 Limit

The Maximum of Power Spectral Density Measurement is 8 dBm in any 3 kHz band.

4.3.2 Test Setup



4.3.3 Test Procedures

The power output per FCC § 15.247(e) was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" (clause 10.5) for compliance to FCC 47CFR 15.247 requirements.

a) Measure the duty cycle (x) of the transmitter output signal.

b) Set instrument center frequency to DTS channel center frequency.

c) Set span to at least 1.5 OBW.

d) Set RBW to: 3 kHz $\leqslant$ RBW $\leqslant$ 100 kHz.

e) Set VBW $\geqslant$ 3 RBW.

f) Detector = power averaging (RMS) or sample detector (when RMS not available).

g) Ensure that the number of measurement points in the sweep $\geqslant$ 2 span/RBW.

h) Sweep time = auto couple.

i) Do not use sweep triggering. Allow sweep to "free run".

j) Employ trace averaging (RMS) mode over a minimum of 100 traces.

k) Use the peak marker function to determine the maximum amplitude level.

l) Add 10 log (1/x), where x is the duty cycle measured in step (a, to the measured PSD to compute the average PSD during the actual transmission time.

m) If resultant value exceeds the limit, then reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

4.3.4 Deviation of Test Standard

No deviation.

4.3.5 Test Results

802.15.4-Ant 1

Channel	Frequency (MHz)	Duty Cycle Factor	PSD (dBm/3kHz)	Final PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
11	2405	0.40	-8.70	-8.30	8	Pass
18	2440	0.40	-8.55	-8.15	8	Pass
26	2480	0.40	-15.18	-14.78	8	Pass

Spectrum Plot
802.15.4(2405MHz)

802.15.4(2440MHz)

802.15.4(2480MHz)

802.15.4-Ant 2

Channel	Frequency (MHz)	Duty Cycle Factor	PSD (dBm/3kHz)	Final PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
11	2405	0.40	-4.20	-3.80	8	Pass
18	2440	0.40	-2.34	-1.94	8	Pass
26	2480	0.40	-11.30	-10.9	8	Pass

Spectrum Plot
802.15.4(2405MHz)

802.15.4(2440MHz)

802.15.4(2480MHz)

BLE- Ant 1

Channel	Frequency (MHz)	Duty Cycle Factor	PSD (dBm/3kHz)	Final PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
0	2402	0.40	-22.41	-22.01	8	Pass
19	2440	0.40	-21.45	-21.05	8	Pass
39	2480	0.40	-20.23	-19.83	8	Pass

Spectrum Plot
BLE (2402MHz)

BLE (2440MHz)

BLE (2480MHz)

BLE- Ant 2

Channel	Frequency (MHz)	Duty Cycle Factor	PSD (dBm/3kHz)	Final PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
0	2402	0.40	-17.50	-17.10	8	Pass
19	2440	0.40	-17.52	-17.12	8	Pass
39	2480	0.40	-17.65	-17.25	8	Pass

Spectrum Plot
BLE (2402MHz)

BLE (2440MHz)

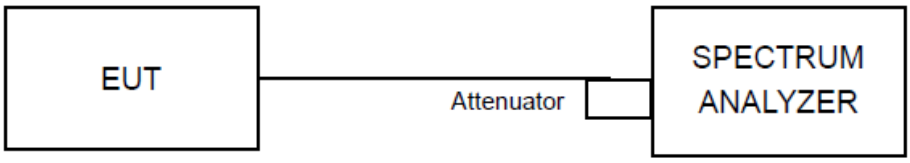
BLE (2480MHz)

4.4 Emissions in non-restricted frequency bands

4.4.1 Limit

Below 30 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

4.4.2 Test Setup



4.4.3 Test Procedures

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW ⩾ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOBE

1. Set RBW = 100 kHz.
2. Set VBW ⩾ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.

6. Allow trace to fully stabilize.

7. Use the peak marker function to determine the maximum amplitude level.

4.4.4 Deviation of Test Standard

No deviation.

4.4.5 Test Results

802.15.4-Ant 1

Channel	Frequency (MHz)	Pass / Fail
11	2405	Pass
18	2440	Pass
26	2480	Pass

Spectrum Plot
802.15.4(2405MHz)

802.15.4(2440MHz)

802.15.4(2480MHz)

Spectrum Plot

802.15.4(2405MHz)-Bandedge

802.15.4(2480MHz) -Bandedge

Spectrum Plot
802.15.4(2405MHz) Out-of-Band Emissions

Spectrum Plot

802.15.4(2440MHz) Out-of-Band Emissions

Spectrum Plot
802.15.4(2480MHz) Out-of-Band Emissions

802.15.4-Ant 2

Channel	Frequency (MHz)	Pass / Fail
11	2405	Pass
18	2440	Pass
26	2480	Pass

Spectrum Plot

802.15.4(2405MHz)

802.15.4(2440MHz)

802.15.4(2480MHz)

Spectrum Plot

802.15.4(2405MHz)-Bandedge

802.15.4(2480MHz) -Bandedge

Spectrum Plot
802.15.4(2405MHz) Out-of-Band Emissions

Spectrum Plot
802.15.4(2440MHz) Out-of-Band Emissions

Spectrum Plot
802.15.4(2480MHz) Out-of-Band Emissions

BLE-Ant 1

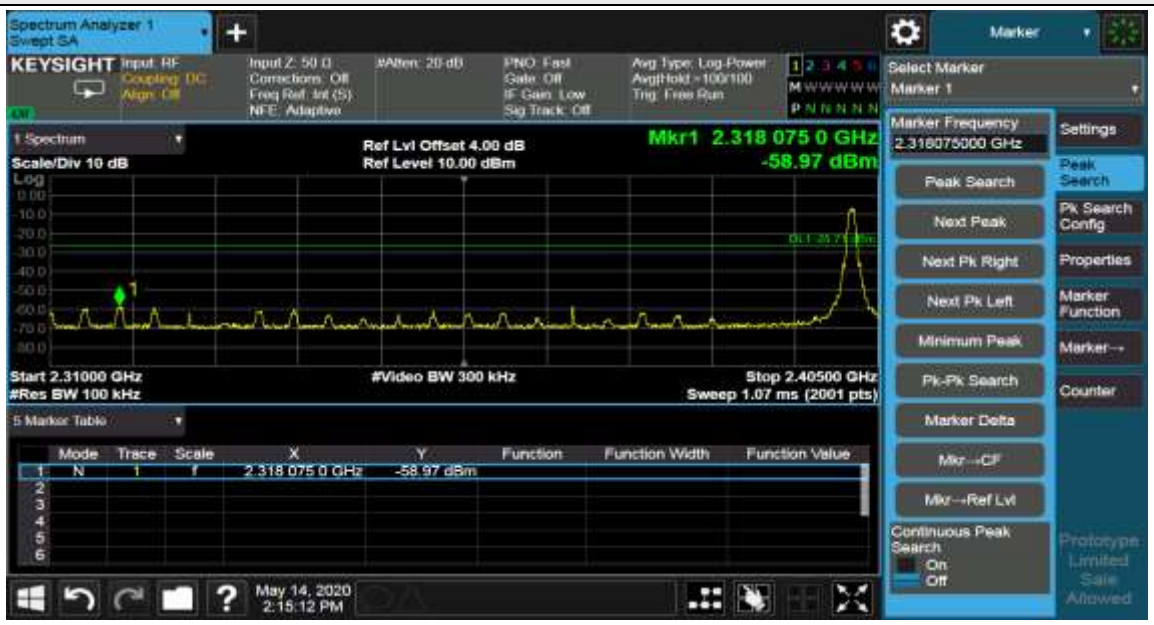
Channel	Frequency (MHz)	Pass / Fail
1	2402	Pass
19	2440	Pass
39	2480	Pass

Spectrum Plot
BLE (2402MHz)

BLE (2440MHz)

BLE (2480MHz)

Spectrum Plot
BLE (2402MHz) Band Edge



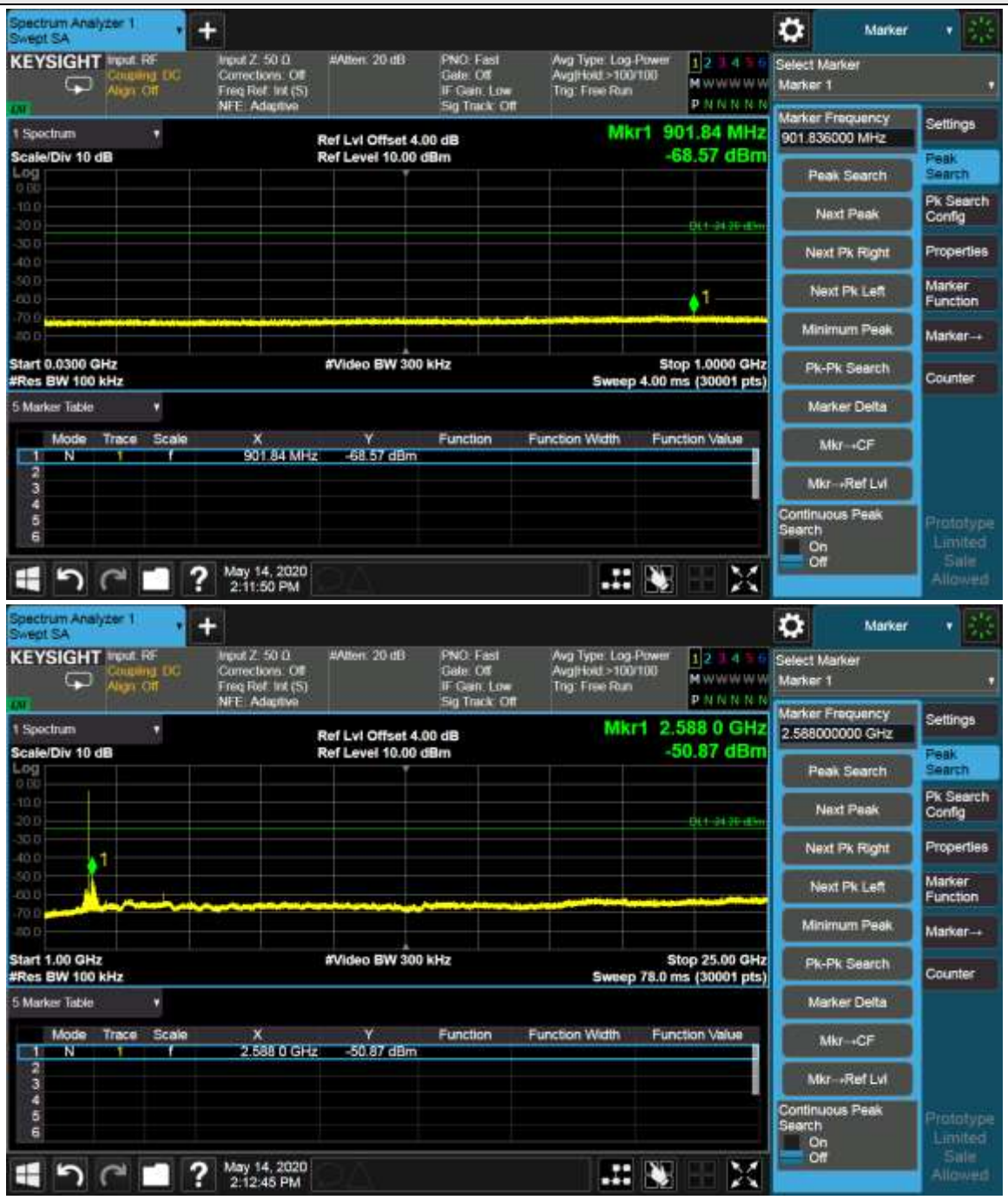
BLE (2480MHz) Band Edge

Spectrum Plot
BLE (2402MHz) Out-of-Band Emissions

Spectrum Plot

BLE (2440MHz) Out-of-Band Emissions

Spectrum Plot
BLE (2480MHz) Out-of-Band Emissions



BLE-Ant 2

Channel	Frequency (MHz)	Pass / Fail
1	2402	Pass
19	2440	Pass
39	2480	Pass

Spectrum Plot
BLE (2402MHz)

BLE (2440MHz)

BLE (2480MHz)

Spectrum Plot

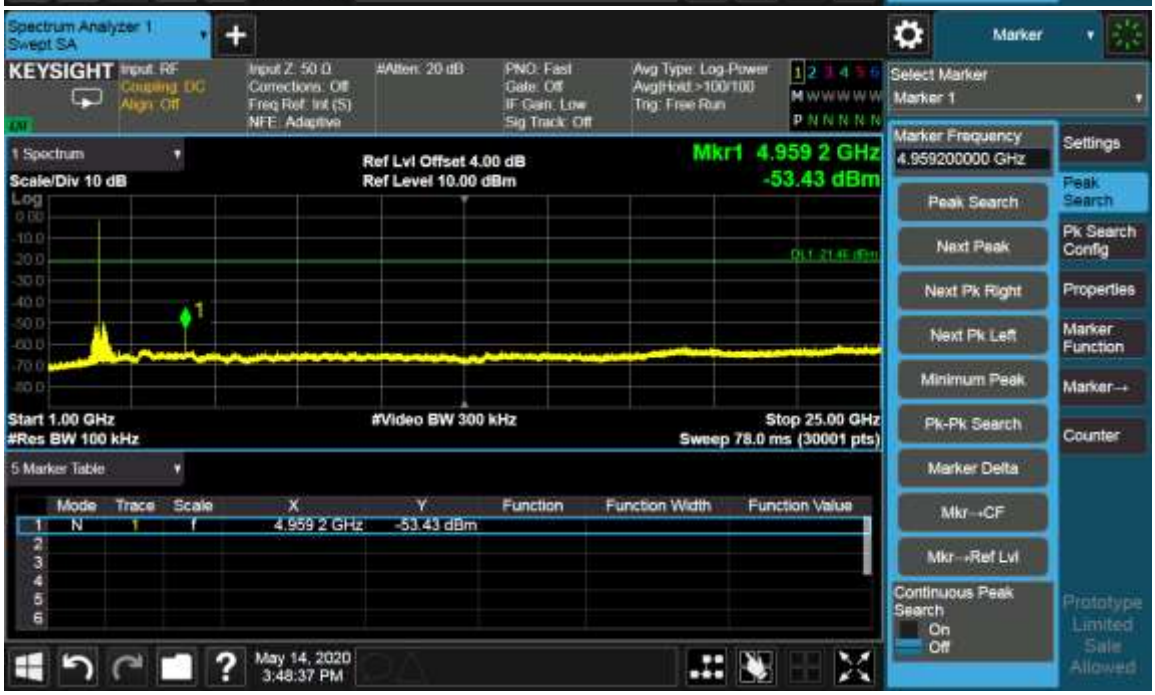
BLE (2402MHz) Band Edge

BLE (2480MHz) Band Edge

Spectrum Plot
BLE (2402MHz) Out-of-Band Emissions

Spectrum Plot
BLE (2440MHz) Out-of-Band Emissions

Spectrum Plot
BLE (2480MHz) Out-of-Band Emissions



4.5 Radiated Emission Measurement

4.5.1 Limits

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

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

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.5.2 Test Procedures

For Radiated emission below 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degree to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. Both X and Y axes of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotate table was turned from

0 degree to 360 degree to find the maximum reading.

e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

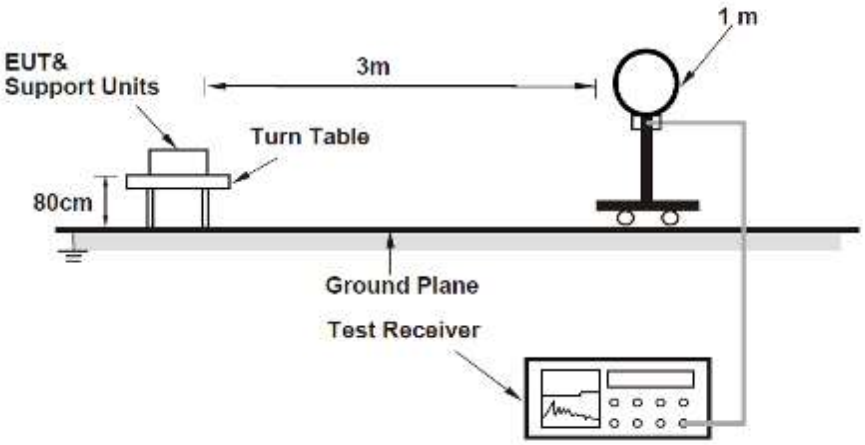
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for RMS Average (Duty cycle < 98 %) for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle $\geqslant$ 98 %) for Average detection (AV) at frequency above 1 GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

4.5.3 Deviation from Test Standard

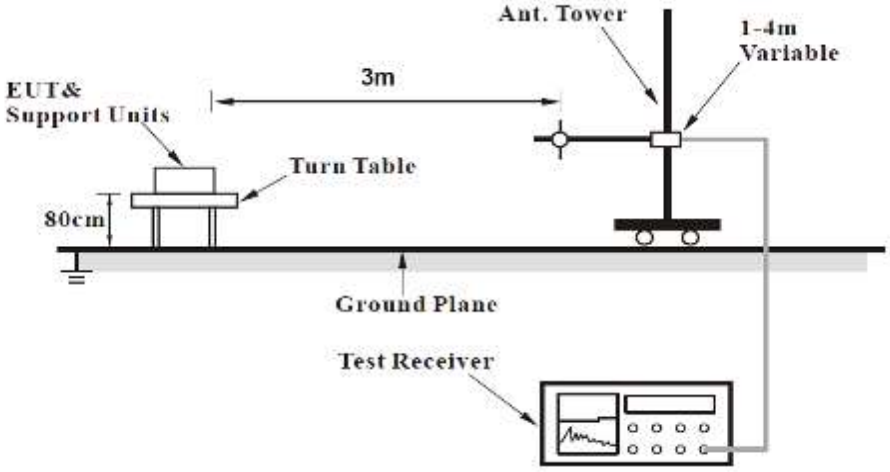
No deviation.

4.5.4 Test Setup

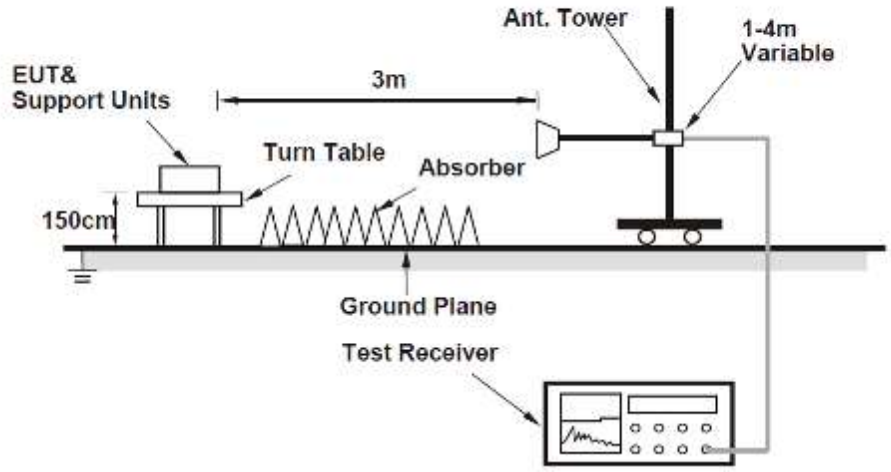
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.5.5 EUT Operating Conditions

a. Placed the EUT on a testing table.

b. Use the software to control the EUT under transmission condition continuously at specific channel frequency.

4.5.6 Test Results

Radiated Emissions Range 9kHz~30MHz

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

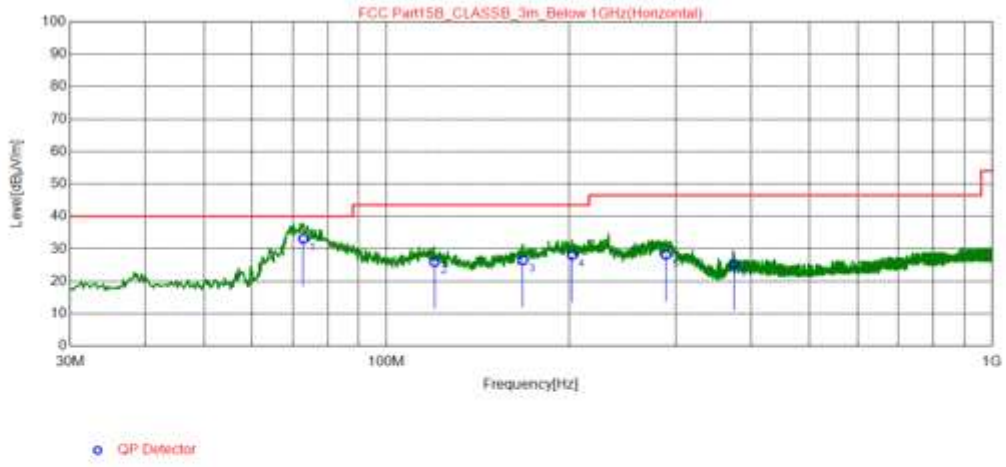
Radiated Emissions Range 30MHz~1GHz

Working with worst case:

Mode	802.15.4-2440MHz	**Detector Function**	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	**Antenna Polarity**	Horizontal

Test Plot:

Test Graph



NO.	Freq. [MHz]	QP Reading [dBµV/m]	Factor [dB]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	72.87	45.64	-12.58	33.06	40.00	6.94	100	206	Horizontal
2	120.0	37.65	-11.71	25.94	43.50	17.56	100	220	Horizontal
3	167.9	35.75	-9.27	26.48	43.50	17.02	100	229	Horizontal
4	202.6	40.31	-12.24	28.07	43.50	15.43	100	234	Horizontal
5	289.3	37.64	-9.47	28.17	46.50	18.33	100	331	Horizontal
6	374.9	33.28	-7.99	25.29	46.50	21.21	100	201	Horizontal

REMARKS:

1. Emission Level(dBuV/m) = Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

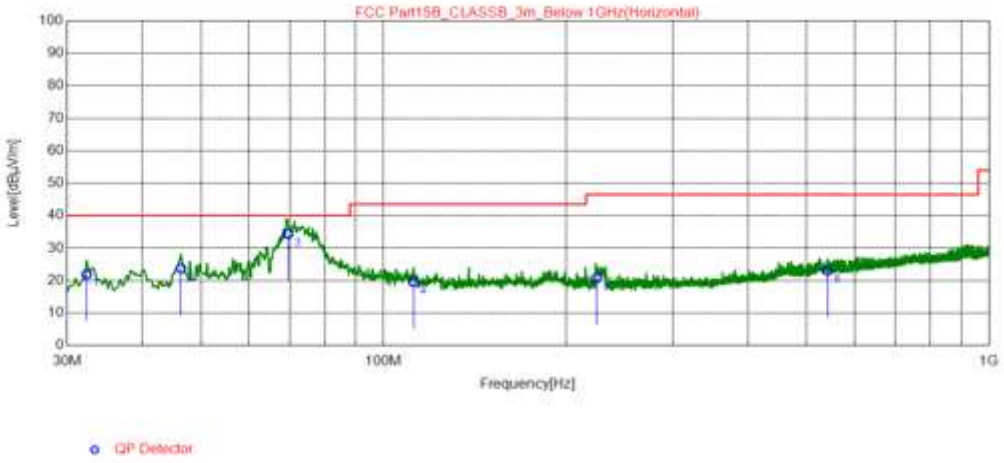
3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Mode	802.15.4-2440MHz	**Detector Function**	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	**Antenna Polarity**	Vertical

Test Plot:

Test Graph



NO.	Freq. [MHz]	QP Reading [dBµV/m]	Factor [dB]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	32.32	32.28	-10.42	21.86	40.00	18.14	100	280	Vertical
2	46.29	33.33	-9.61	23.72	40.00	16.28	100	266	Vertical
3	69.57	46.45	-12.04	34.41	40.00	5.59	100	256	Vertical
4	112.2	31.5	-12.00	19.50	43.50	24.00	100	251	Vertical
5	224.5	32.04	-11.31	20.73	46.50	25.77	100	218	Vertical
6	541.1	28.22	-5.20	23.02	46.50	23.48	100	40	Vertical

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Radiated Emission Range 1GHz~10th Harmonic

802.15.4-Ant 1

Channel	TX Channel 11	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4803.7500	31.73	74.00	-42.27	-9.42	H	PK
2	4804.6000	28.36	54.00	-25.64	-9.42	H	AV
3	4803.7500	32.51	74.00	-41.49	-9.42	V	PK
4	4804.6000	27.65	54.00	-26.35	-9.42	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 18	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4880.2500	33.57	74.00	-40.43	-9.32	H	PK
2	4880.2500	27.20	54.00	-26.80	-9.32	H	AV
3	4880.2500	32.18	74.00	-41.82	-9.32	V	PK
4	4880.2500	26.95	54.00	-27.05	-9.32	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 26	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4960.1500	33.94	74.00	-40.06	-9.23	H	PK
2	4960.1500	28.91	54.00	-25.09	-9.23	H	AV
3	4960.1500	33.50	74.00	-40.50	-9.23	V	PK
4	4960.1500	28.60	54.00	-25.40	-9.23	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

802.15.4-Ant 2

Channel	TX Channel 11	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4804.6000	34.46	74.00	-39.54	-9.42	H	PK
2	4804.6000	27.84	54.00	-26.16	-9.42	H	AV
3	4803.7500	32.69	74.00	-41.31	-9.42	V	PK
4	4804.6000	28.08	54.00	-25.92	-9.42	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 18	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4880.2500	33.34	74.00	-40.66	-9.32	H	PK
2	4880.2500	27.48	54.00	-26.52	-9.32	H	AV
3	4880.2500	32.46	74.00	-41.54	-9.32	V	PK
4	4880.2500	28.83	54.00	-25.17	-9.32	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 26	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4960.1500	31.71	74.00	-42.29	-9.23	H	PK
2	4960.1500	27.67	54.00	-26.33	-9.23	H	AV
3	4960.1500	34.24	74.00	-39.76	-9.23	V	PK
4	4960.1500	27.96	54.00	-26.04	-9.23	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

BLE-Ant 1

Below is the worst test data

Channel	TX Channel 0	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4804.60	31.76	74.00	-42.24	-9.42	H	PK
2	4804.60	29.21	54.00	-24.79	-9.42	H	AV
3	4804.60	30.30	74.00	-43.70	-9.42	V	PK
4	4803.75	26.82	54.00	-27.18	-9.42	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 19	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4880.25	32.23	74.00	-41.77	-9.32	H	PK
2	4880.25	27.01	54.00	-26.99	-9.32	H	AV
3	4880.25	30.23	74.00	-43.77	-9.32	V	PK
4	4876.85	27.19	54.00	-26.81	-9.32	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 39	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4959.30	32.77	74.00	-23.02	-9.23	H	PK
2	4961.00	27.36	54.00	-8.84	-9.23	H	AV
3	4960.15	42.46	74.00	-40.96	-9.23	V	PK
4	4961.00	37.21	54.00	-26.21	-9.23	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

BLE-Ant 2

Below is the worst test data

Channel	TX Channel 0	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4804.60	30.53	74.00	-43.47	-9.42	H	PK
2	4804.60	27.45	54.00	-26.55	-9.42	H	AV
3	4804.60	30.53	74.00	-43.47	-9.42	V	PK
4	4804.60	27.25	54.00	-26.75	-9.42	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 19	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4880.25	30.71	74.00	-43.29	-9.32	H	PK
2	4880.25	27.01	54.00	-26.99	-9.32	H	AV
3	4880.25	32.03	74.00	-41.97	-9.32	V	PK
4	4876.85	28.57	54.00	-25.43	-9.32	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

Channel	TX Channel 39	**Detector Function**	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Correction Factor (dB/m)**	**Antenna Polarity**	**Detector**
1	4959.30	31.87	74.00	-42.13	-9.23	H	PK
2	4961.00	27.83	54.00	-26.17	-9.23	H	AV
3	4960.15	32.18	74.00	-41.82	-9.23	V	PK
4	4961.00	27.73	54.00	-26.27	-9.23	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value

4.6 Conducted Emission Measurement

4.6.1 Limits

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.6.2 Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

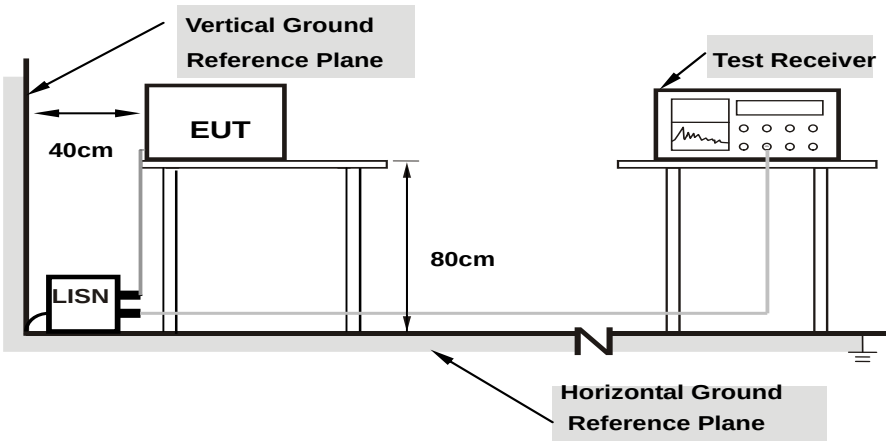
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.6.3 Deviation from Test Standard

No deviation.

4.6.4 Test Setup



Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.6.5 EUT Operating Conditions

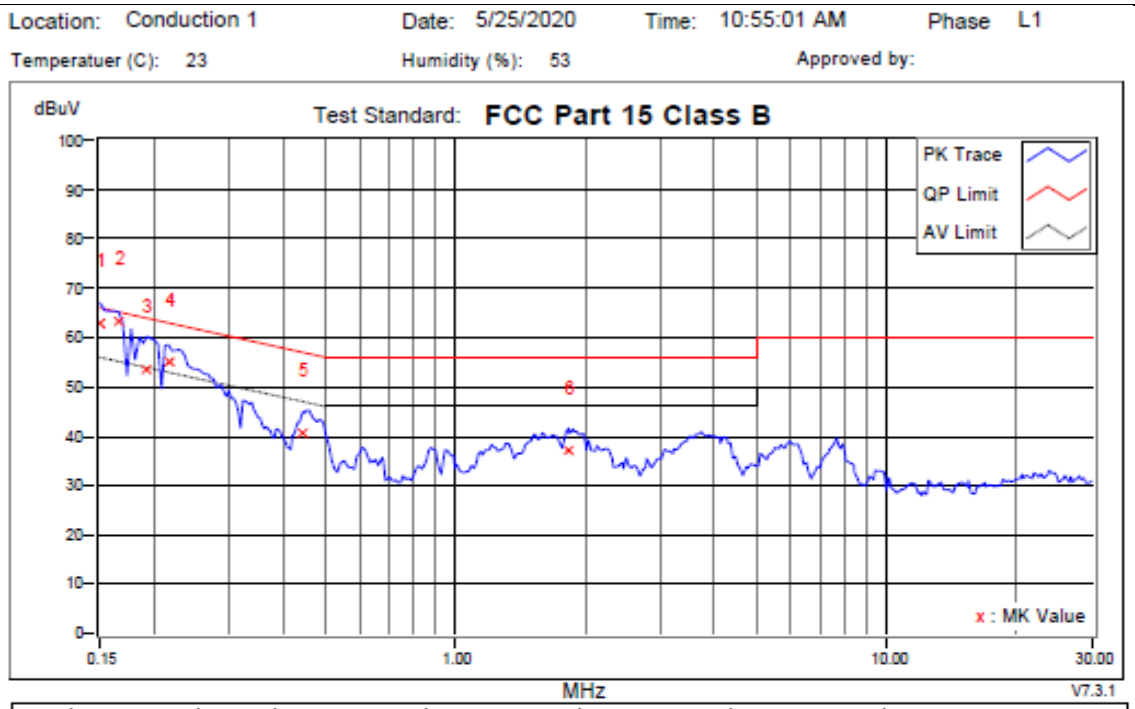
Same as 4.1.6.

4.6.6 Test Results

Working While Worst case

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)

Test Plot:



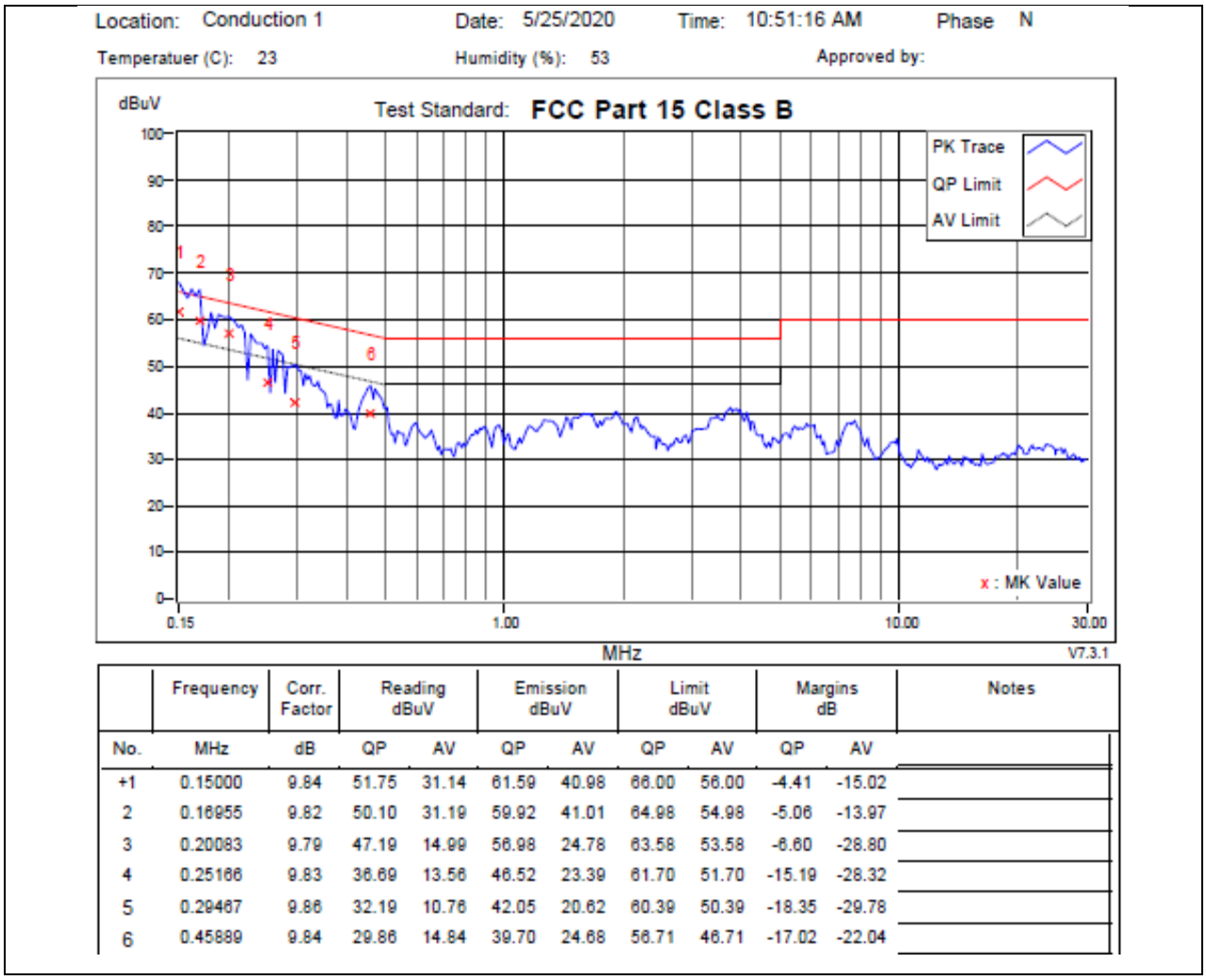
	Frequency	Corr. Factor	Reading dBuV		Emission dBuV		Limit dBuV		Margins dB		Notes
No.	MHz	dB	QP	AV	QP	AV	QP	AV	QP	AV	
1	0.15000	9.83	53.03	33.74	62.86	43.57	66.00	56.00	-3.14	-12.43	
+2	0.16564	9.84	53.30	36.08	63.14	45.92	65.18	55.18	-2.04	-9.26	
3	0.19301	9.85	43.51	21.93	53.36	31.78	63.91	53.91	-10.55	-22.13	
4	0.21647	9.82	45.07	26.34	54.89	36.16	62.95	52.95	-8.06	-16.79	
5	0.44325	9.70	30.94	20.19	40.64	29.89	57.00	47.00	-16.36	-17.11	
6	1.83283	9.72	27.41	18.22	37.13	27.94	56.00	46.00	-18.87	-18.06	

REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

Test Plot:



No.	Frequency MHz	Corr. Factor dB	Reading dBuV QP	Reading dBuV AV	Emission dBuV QP	Emission dBuV AV	Limit dBuV QP	Limit dBuV AV	Margins dB QP	Margins dB AV	Notes
+1	0.15000	9.84	51.75	31.14	61.59	40.98	66.00	56.00	-4.41	-15.02	
2	0.16955	9.82	50.10	31.19	59.92	41.01	64.98	54.98	-5.06	-13.97	
3	0.20083	9.79	47.19	14.99	56.98	24.78	63.58	53.58	-6.60	-28.80	
4	0.25166	9.83	36.69	13.56	46.52	23.39	61.70	51.70	-15.19	-28.32	
5	0.29467	9.86	32.19	10.76	42.05	20.62	60.39	50.39	-18.35	-29.78	
6	0.45889	9.84	29.86	14.84	39.70	24.68	56.71	46.71	-17.02	-22.04	

4.7 Radiated Restricted Band Edge Measurement

4.7.1 Test Limit

For 15.205 requirement:

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part15, must also comply with the radiated emission limits specified in Section 15.209(a).

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (GHz)
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
1 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(2)
13.36 - 13.41	--	--	--

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47CFR must not exceed the limits shown in Table per Section 15.209.

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [uV/m]	Measured Distance [Meters]
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

4.7.2 Test Procedure Reference

ANSI C63.10 Section 6.3 (General Requirements)

ANSI C63.10 Section 6.6 (Standard test method above 1GHz)

4.7.3 Test Procedures

Peak Field Strength Measurements

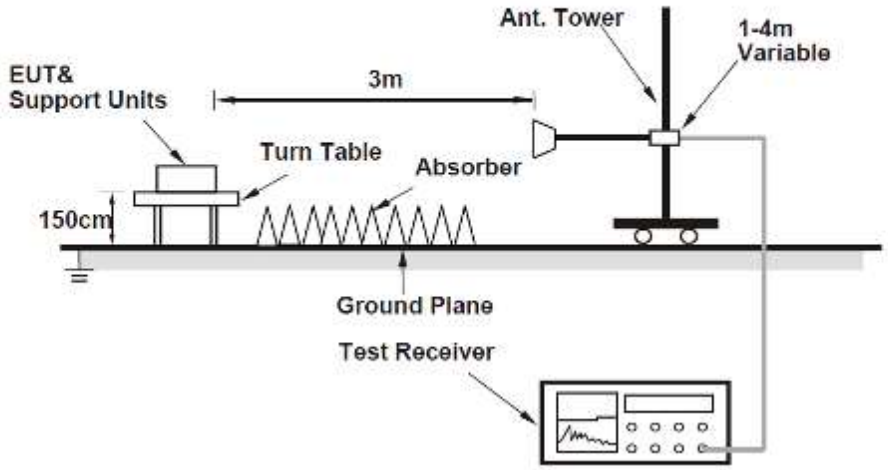
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Average Measurements above 1GHz (Method VB)

8. 1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
9. 2. RBW = 1MHz
10. 3. VBW; If the EUT is configured to transmit with duty cycle ≥ 98%, set VBW = 10 Hz.
11. If the EUT duty cycle is < 98%, set VBW ≥ 1/T. T is the minimum transmission duration.
12. 4. Detector = Peak
13. 5. Sweep time = auto
14. 6. Trace mode = max hold
15. 7. Trace was allowed to stabilize

4.7.4 Test Setup

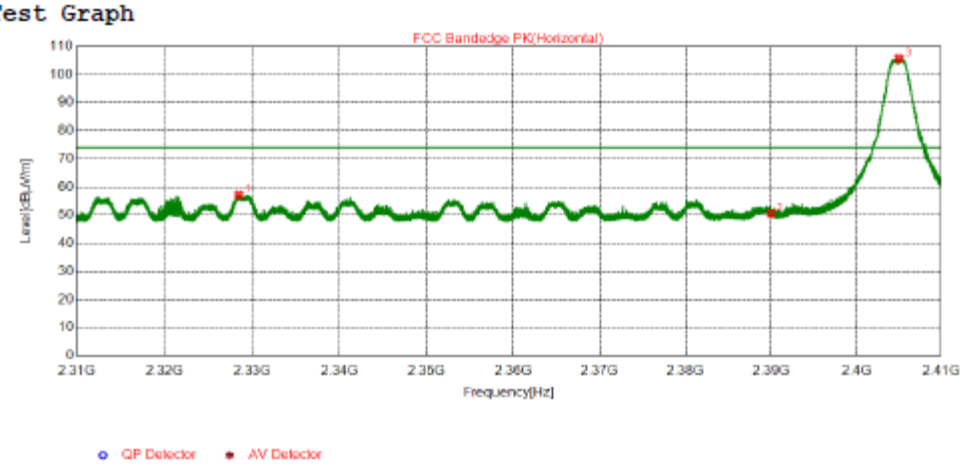
For Radiated emission above 1GHz



4.7.5 Test Results

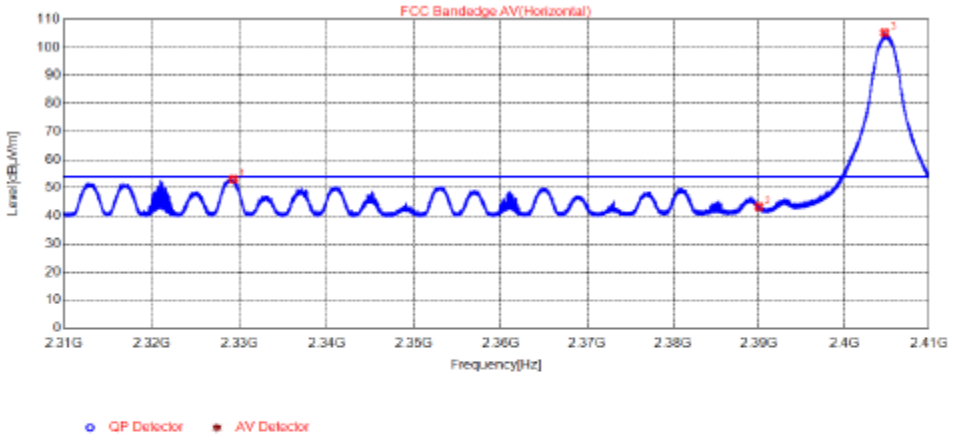
Test Plot-Ant 1
802.15.4-2405MHz/ Horizontal

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2328.4600	52.37	57.16	74.00	16.84	175	316	Horizontal	PK
2	2390.0000	45.74	50.66	74.00	23.34	175	340	Horizontal	PK
3	2405.0300	100.75	105.70	74.00	-31.70	175	316	Horizontal	PK

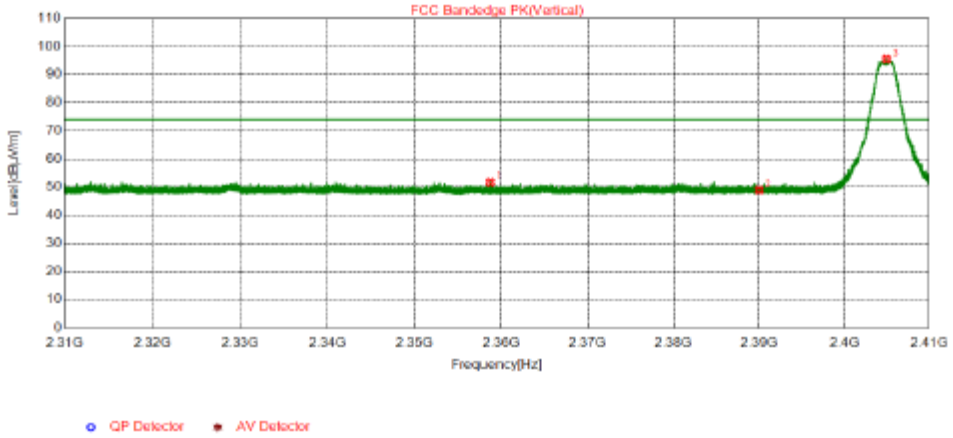
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2329.2600	48.30	53.09	54.00	0.91	175	288	Horizontal	AV
2	2390.0000	38.34	43.26	54.00	10.74	175	288	Horizontal	AV
3	2404.7800	100.27	105.22	54.00	-51.22	165	342	Horizontal	AV

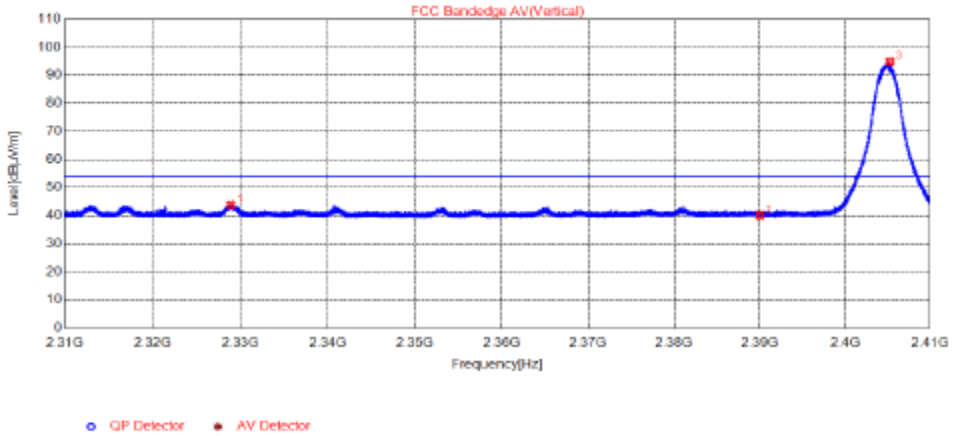
Test Plot-Ant 1
802.15.4-2405MHz / Vertical

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2358.7050	46.84	51.70	74.00	22.30	165	72	Vertical	PK
2	2390.0000	44.04	48.96	74.00	25.04	175	215	Vertical	PK
3	2404.9800	90.53	95.48	74.00	-21.48	175	215	Vertical	PK

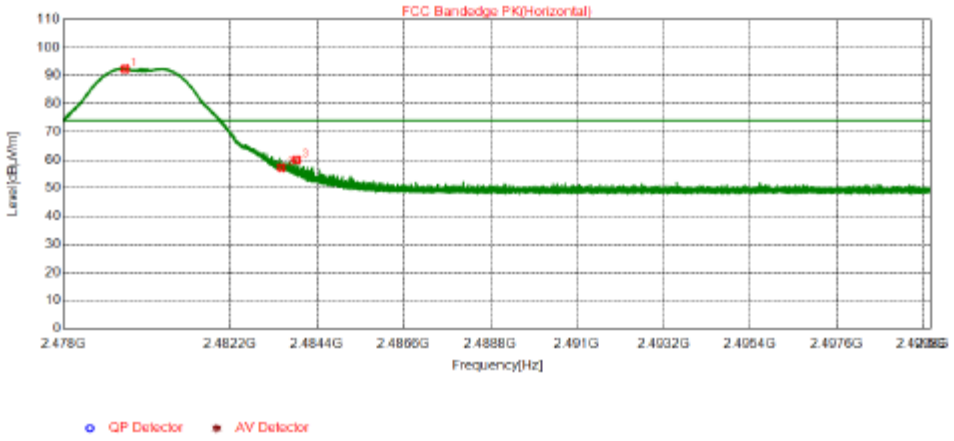
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2328.8550	38.99	43.78	54.00	10.22	175	194	Vertical	AV
2	2390.0000	35.19	40.11	54.00	13.89	155	24	Vertical	AV
3	2405.2750	89.96	94.91	54.00	-40.91	175	242	Vertical	AV

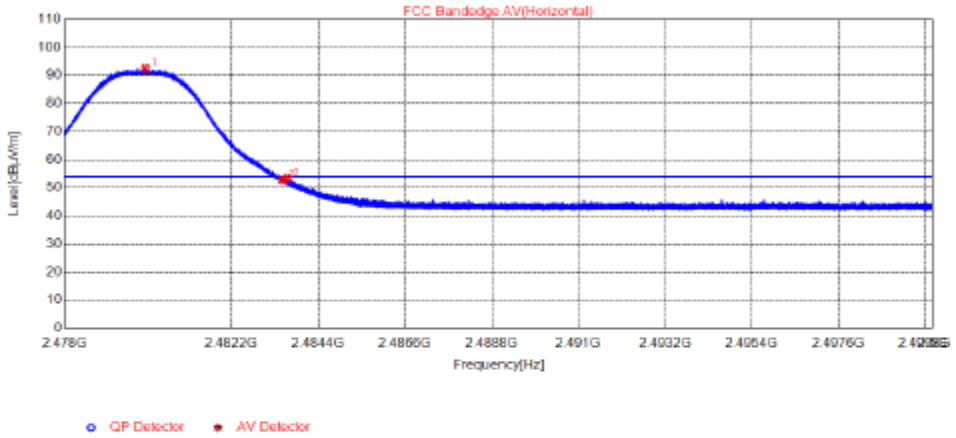
Test Plot-Ant 1
802.15.4-2480MHz / Horizontal

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.5532	87.33	92.41	74.00	-18.41	175	339	Horizontal	PK
2	2483.5000	52.18	57.27	74.00	16.73	175	290	Horizontal	PK
3	2483.8916	54.99	60.08	74.00	13.92	175	339	Horizontal	PK

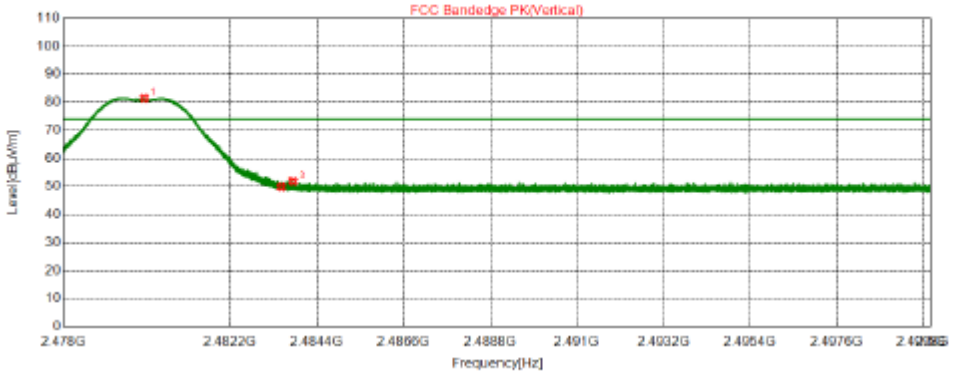
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2480.0372	87.43	92.51	54.00	-38.51	175	332	Horizontal	AV
2	2483.5000	47.64	52.73	54.00	1.27	175	282	Horizontal	AV
3	2483.6232	46.37	53.46	54.00	0.54	175	282	Horizontal	AV

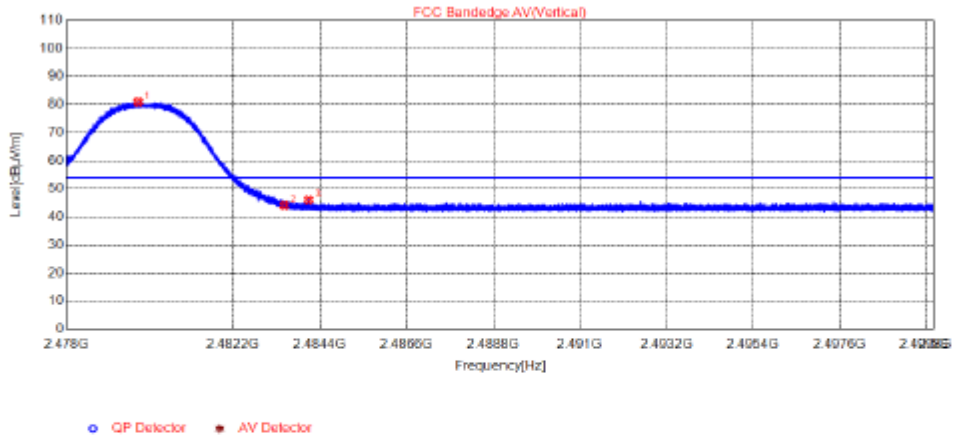
Test Plot-Ant 1
802.15.4-2480MHz/Vertical

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2480.0361	76.38	81.46	74.00	-7.46	155	271	Vertical	PK
2	2483.5000	44.80	49.89	74.00	24.11	165	69	Vertical	PK
3	2483.8047	46.76	51.85	74.00	22.15	155	271	Vertical	PK

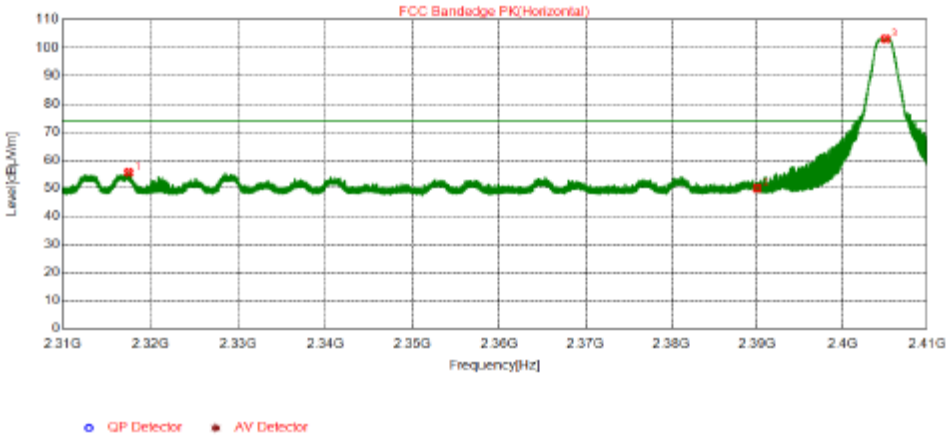
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.8095	75.89	80.97	54.00	-26.97	165	242	Vertical	AV
2	2483.5000	39.04	44.13	54.00	9.87	175	215	Vertical	AV
3	2484.1226	40.89	45.98	54.00	8.02	155	239	Vertical	AV

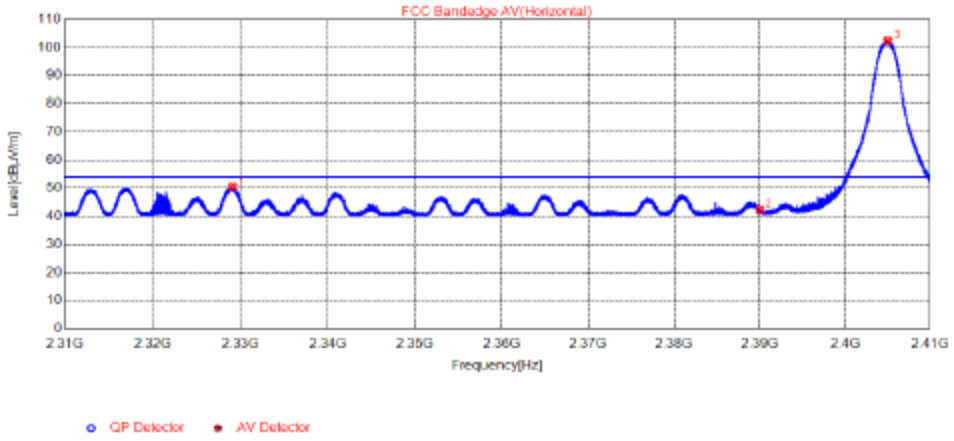
Test Plot-Ant 2
802.15.4-2405MHz/ Horizontal

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2317.4950	50.89	55.66	74.00	18.34	175	69	Horizontal	PK
2	2390.0000	45.13	50.05	74.00	23.95	175	264	Horizontal	PK
3	2405.1000	98.19	103.14	74.00	-29.14	175	264	Horizontal	PK

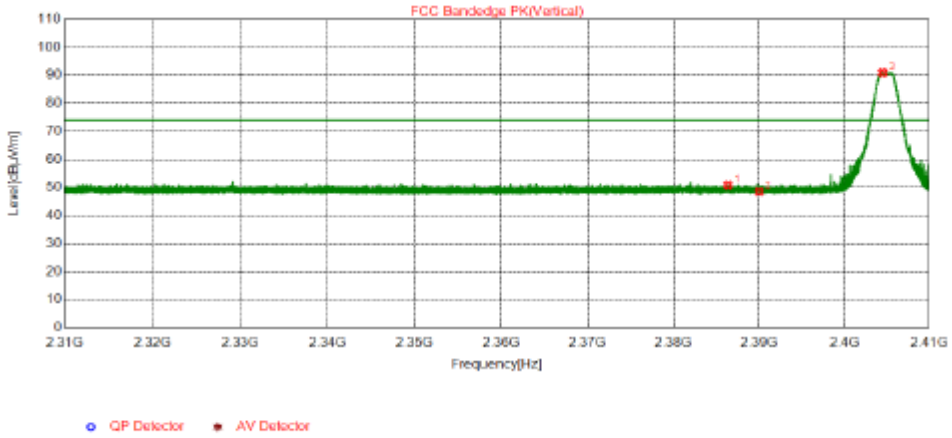
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2329.0700	45.66	50.45	54.00	3.55	175	286	Horizontal	AV
2	2390.0000	37.34	42.26	54.00	11.74	175	286	Horizontal	AV
3	2405.0400	97.52	102.47	54.00	-48.47	175	286	Horizontal	AV

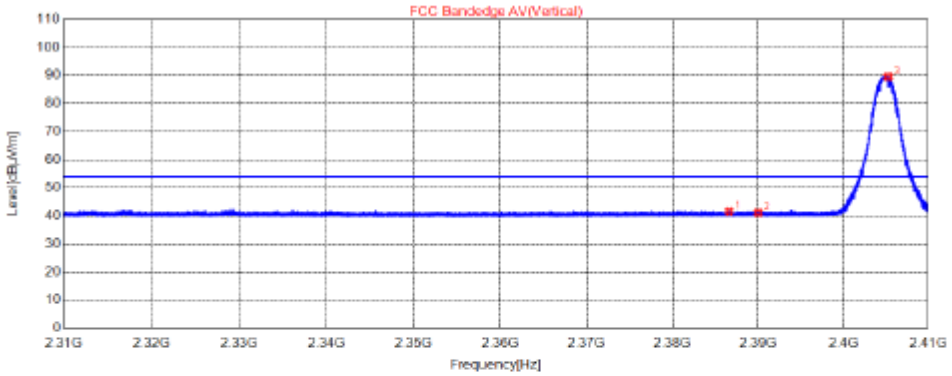
Test Plot-Ant 2
802.15.4-2405MHz / Vertical

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2386.3600	45.97	50.89	74.00	23.11	175	287	Vertical	PK
2	2390.0000	43.60	48.52	74.00	25.48	175	141	Vertical	PK
3	2404.5250	85.99	90.94	74.00	-16.94	175	141	Vertical	PK

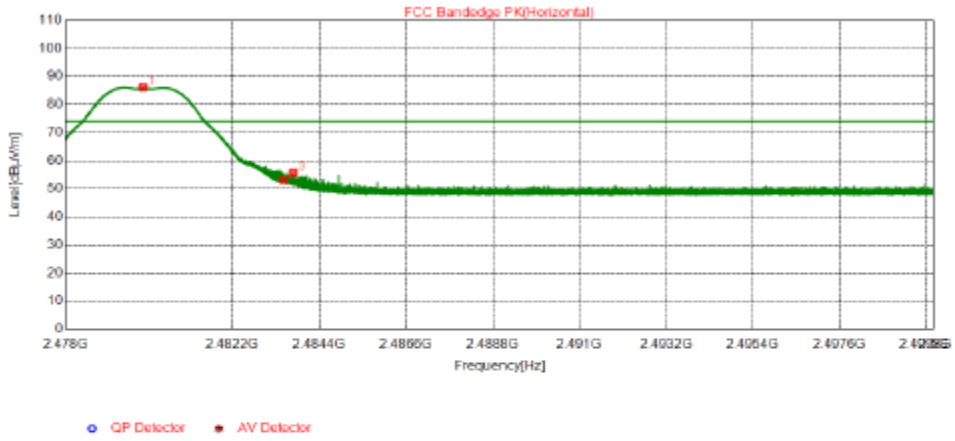
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2386.6050	36.73	41.65	54.00	12.35	175	266	Vertical	AV
2	2390.0000	36.28	41.20	54.00	12.80	175	290	Vertical	AV
3	2405.2800	84.66	89.61	54.00	-35.61	175	169	Vertical	AV

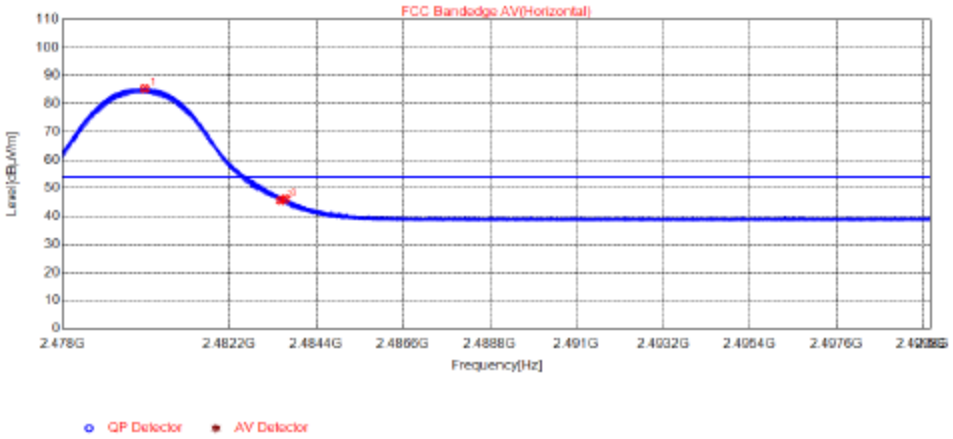
Test Plot-Ant 2
802.15.4-2480MHz / Horizontal

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.9536	81.07	86.15	74.00	-12.15	155	326	Horizontal	PK
2	2483.5000	48.10	53.19	74.00	20.81	175	326	Horizontal	PK
3	2483.7519	50.60	55.69	74.00	18.31	175	326	Horizontal	PK

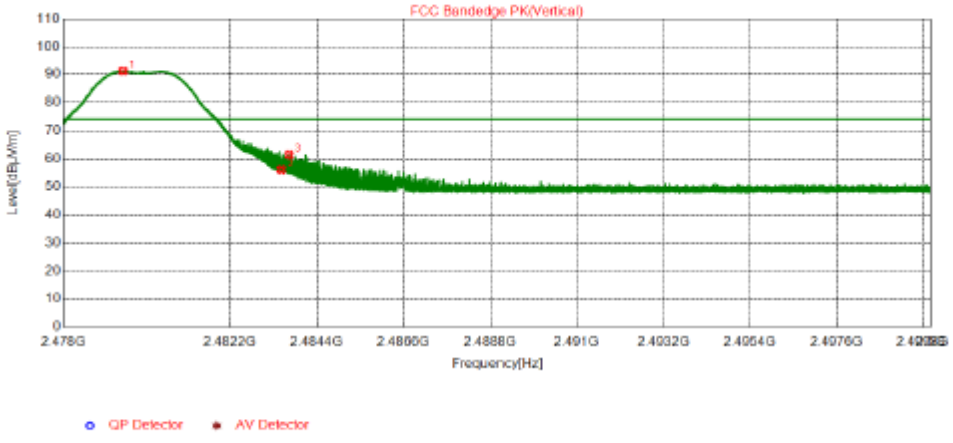
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2480.0713	80.35	85.43	54.00	-31.43	155	340	Horizontal	AV
2	2483.5000	40.49	45.58	54.00	8.42	155	156	Horizontal	AV
3	2483.6199	41.04	46.13	54.00	7.87	155	319	Horizontal	AV

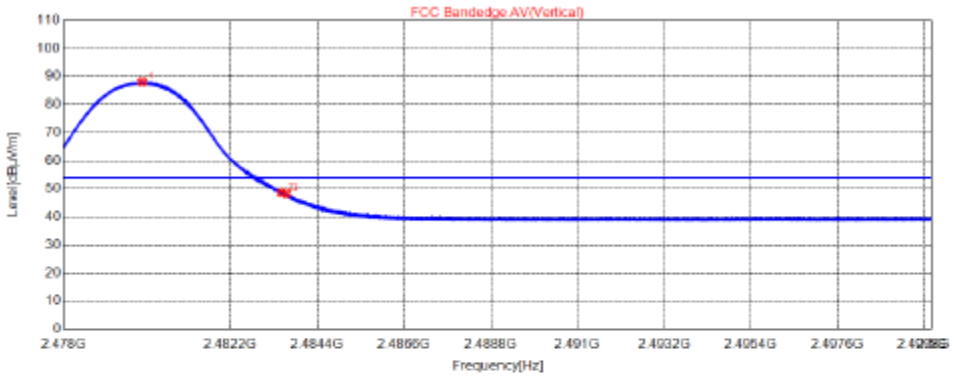
Test Plot-Ant 2
802.15.4-2480MHz/Vertical

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.5059	86.21	91.29	74.00	-17.29	155	209	Vertical	PK
2	2483.5000	51.05	56.14	74.00	17.86	175	109	Vertical	PK
3	2483.7002	56.36	61.45	74.00	12.55	155	209	Vertical	PK

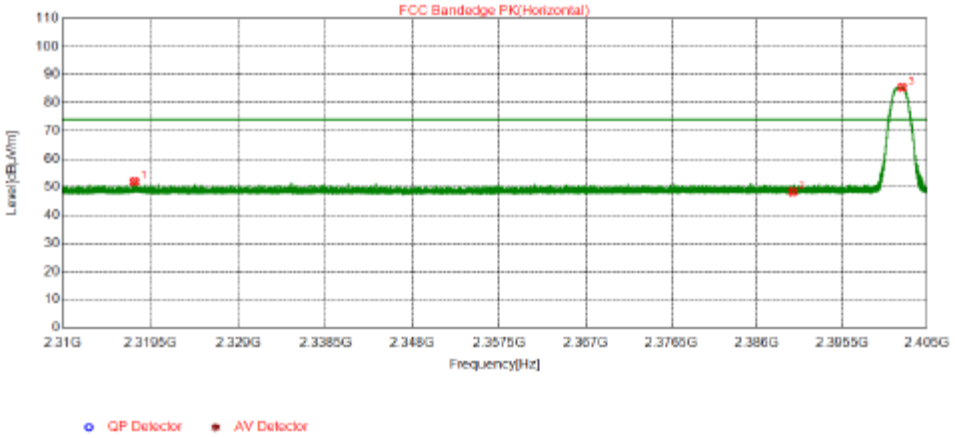
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.9811	83.04	88.12	54.00	-34.12	175	245	Vertical	AV
2	2483.5000	43.52	48.61	54.00	5.39	155	224	Vertical	AV
3	2483.6298	43.15	48.24	54.00	5.76	155	184	Vertical	AV

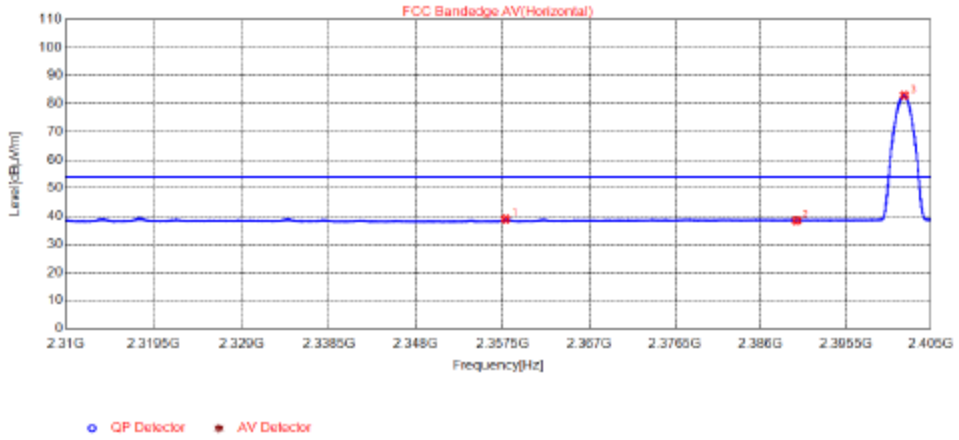
Test Plot-Ant 1
BLE-2402MHz/ Horizontal

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2317.7568	47.25	52.02	74.00	21.98	175	285	Horizontal	PK
2	2390.0000	43.40	48.32	74.00	25.68	165	326	Horizontal	PK
3	2402.1928	80.54	85.49	74.00	-11.49	175	84	Horizontal	PK

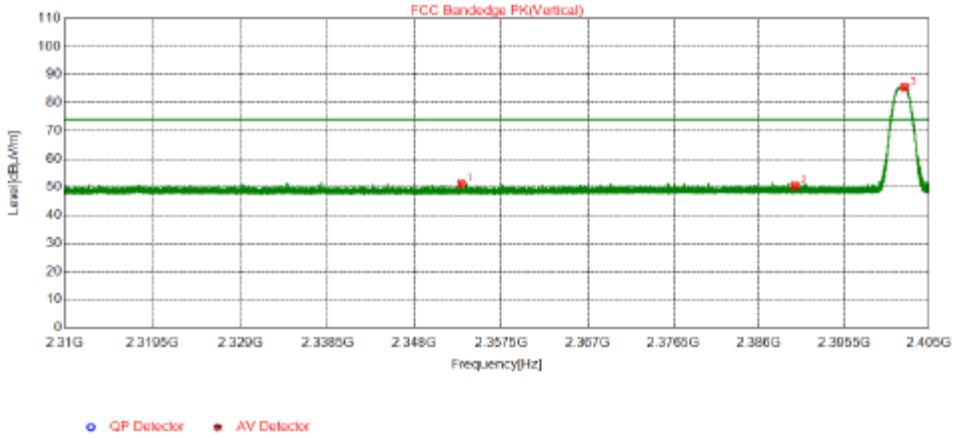
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2357.8183	34.16	39.03	54.00	14.97	175	93	Horizontal	AV
2	2390.0000	33.58	38.50	54.00	15.50	155	133	Horizontal	AV
3	2402.0075	78.03	82.98	54.00	-28.98	175	277	Horizontal	AV

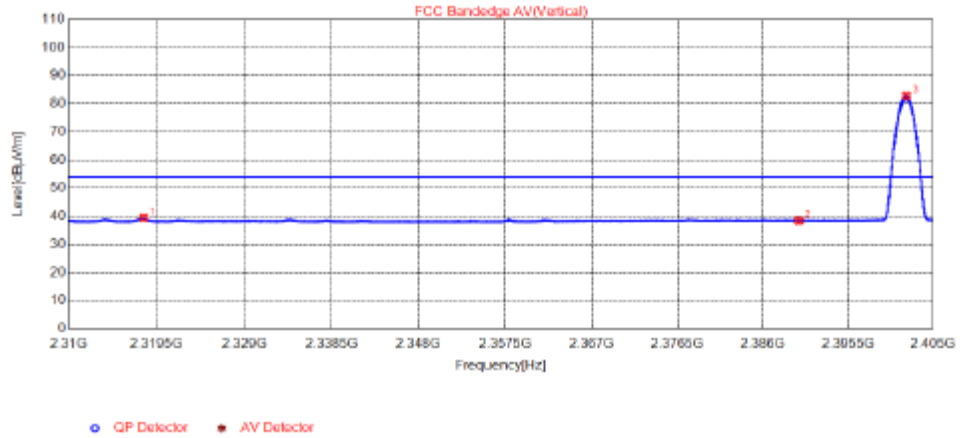
Test Plot-Ant 1
BLE-2402MHz/ Vertical

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2353.1205	46.39	51.24	74.00	22.76	155	268	Vertical	PK
2	2390.000	45.58	50.50	74.00	23.50	155	268	Vertical	PK
3	2402.2498	80.57	85.52	74.00	-11.52	175	84	Vertical	PK

Test Graph

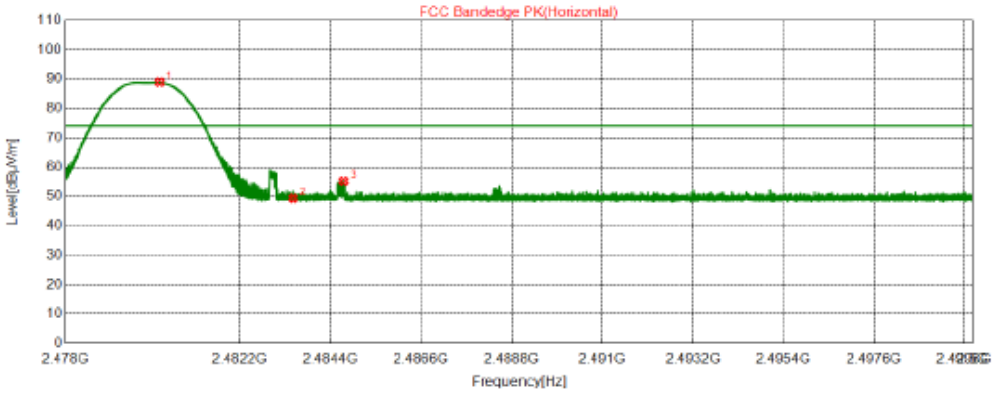


NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2318.0940	34.68	39.45	54.00	14.55	175	277	Vertical	AV
2	2390.0000	33.53	38.45	54.00	15.55	175	134	Vertical	AV
3	2401.9885	77.87	82.82	54.00	-28.82	165	83	Vertical	AV

Test Plot-Ant 1

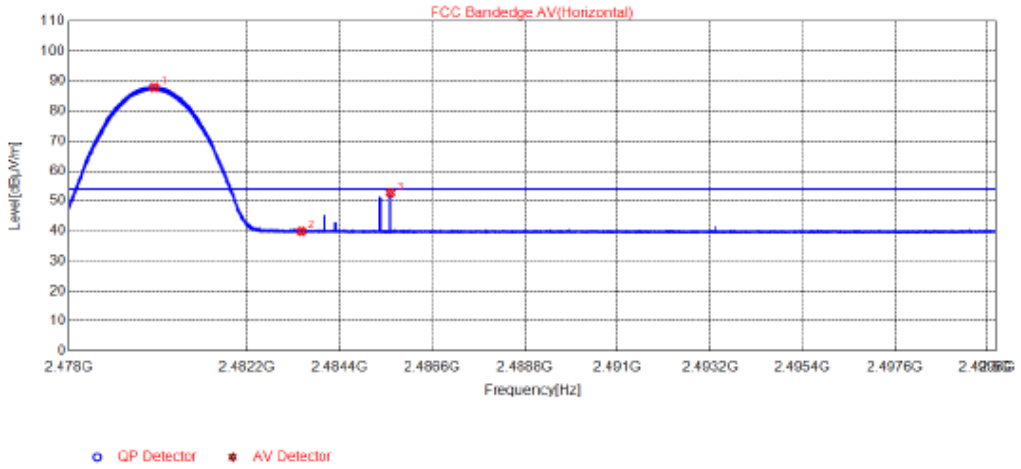
BLE-2480MHz/ Horizontal

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2480.2715	83.79	88.88	74.00	-14.88	175	252	Horizontal	PK
2	2483.5000	44.33	49.42	74.00	24.58	155	117	Horizontal	PK
3	2484.7243	50.18	55.27	74.00	18.73	175	34	Horizontal	PK

Test Graph

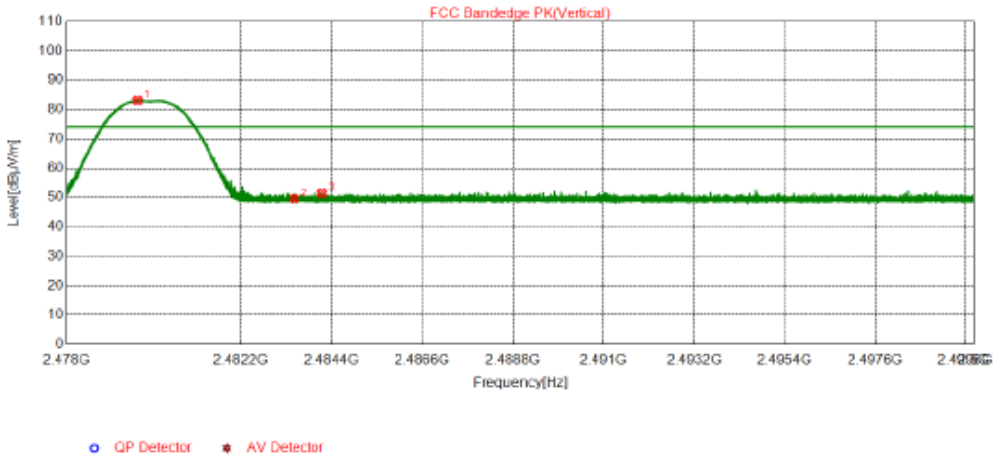


NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2480.0218	82.78	87.86	54.00	-33.86	175	251	Horizontal	AV
2	2483.5000	34.80	39.89	54.00	14.11	175	251	Horizontal	AV
3	2485.6087	47.64	52.73	54.00	1.27	155	94	Horizontal	AV

Test Plot-Ant 1

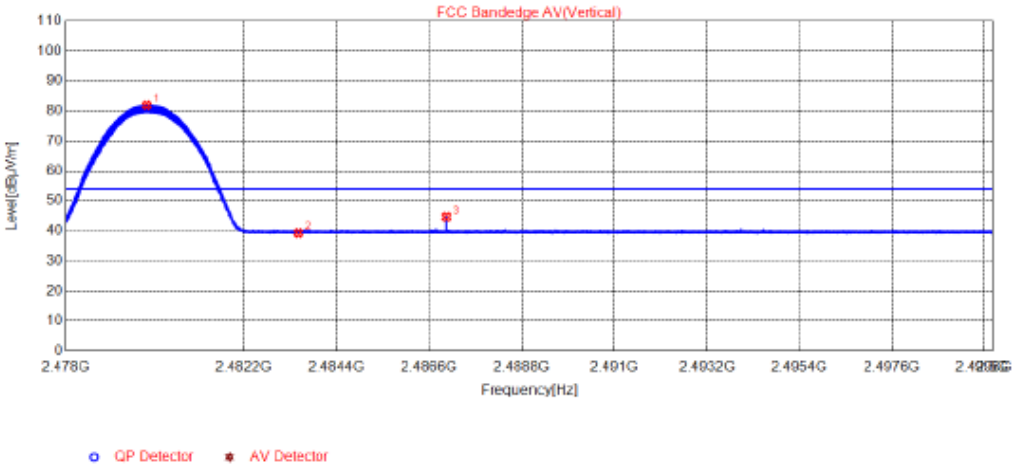
BLE-2480MHz/ Vertical

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.7083	77.93	83.01	74.00	-9.01	155	252	Vertical	PK
2	2483.5000	44.55	49.64	74.00	24.36	155	152	Vertical	PK
3	2484.1732	46.40	51.49	74.00	22.51	165	58	Vertical	PK

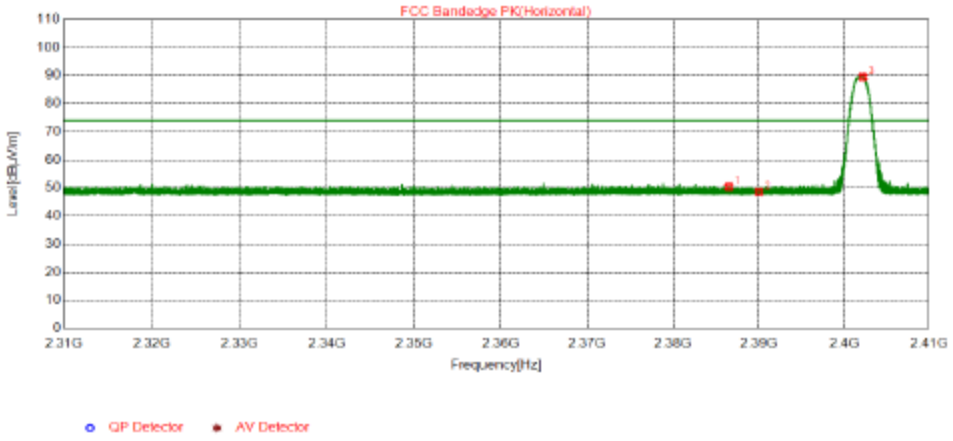
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.9096	76.81	81.89	54.00	-27.89	165	255	Vertical	AV
2	2483.5000	34.25	39.34	54.00	14.66	165	302	Vertical	AV
3	2487.0112	39.58	44.68	54.00	9.32	155	216	Vertical	AV

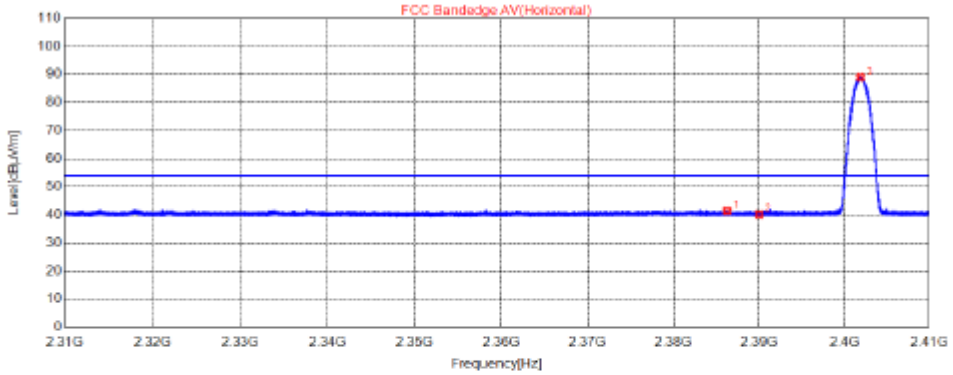
Test Plot-Ant 2
BLE-2402MHz/ Horizontal

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2386.5050	45.52	50.44	74.00	23.56	175	218	Horizontal	PK
2	2390.0000	43.71	48.63	74.00	25.37	155	244	Horizontal	PK
3	2402.2100	84.57	89.52	74.00	-15.52	175	339	Horizontal	PK

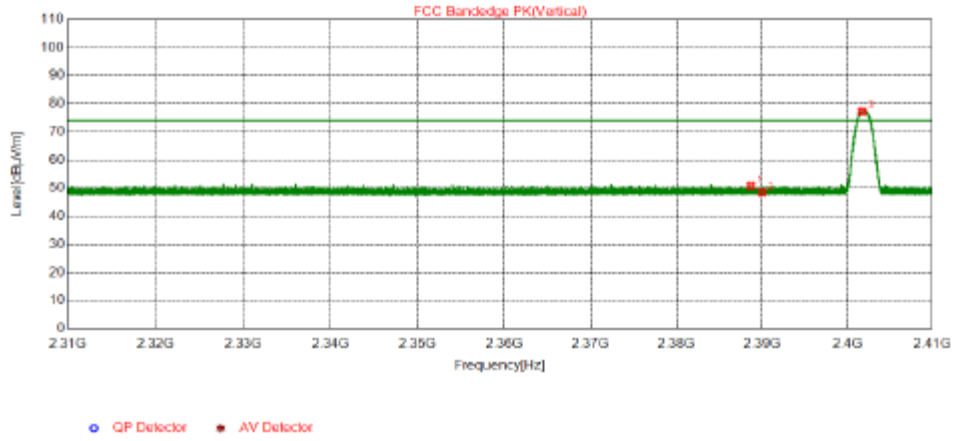
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2386.2500	36.61	41.52	54.00	12.48	155	44	Horizontal	AV
2	2390.0000	35.32	40.24	54.00	13.76	165	320	Horizontal	AV
3	2401.9150	84.10	89.05	54.00	-35.05	175	312	Horizontal	AV

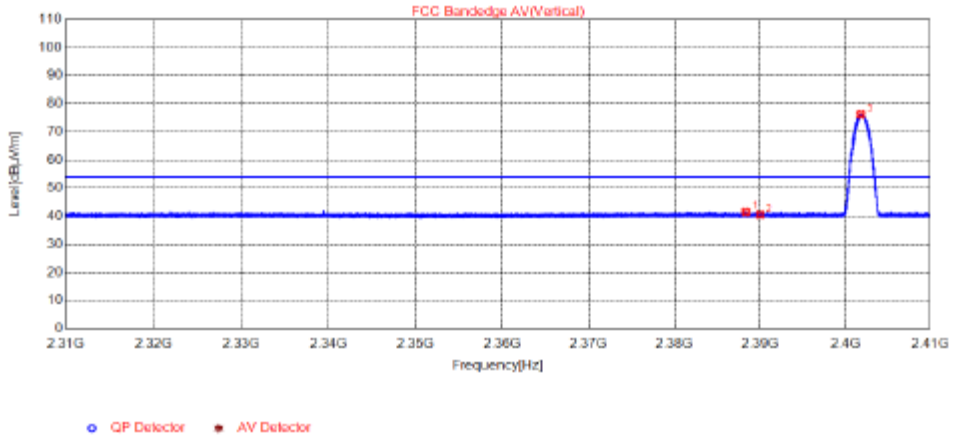
Test Plot-Ant 2
BLE-2402MHz/ Vertical

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2388.6900	45.96	50.88	74.00	23.12	155	48	Vertical	PK
2	2390.0000	43.55	48.47	74.00	25.53	165	312	Vertical	PK
3	2401.7500	72.32	77.27	74.00	-3.27	175	194	Vertical	PK

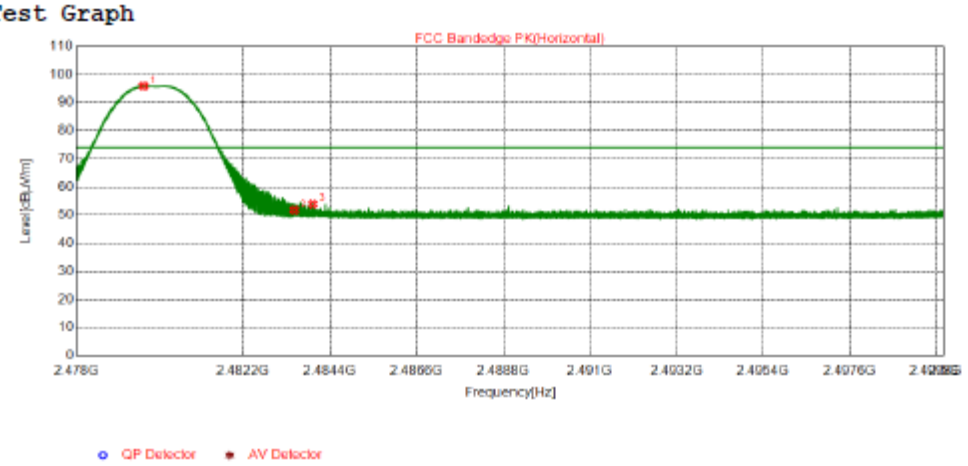
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2388.3350	36.67	41.59	54.00	12.41	175	239	Vertical	AV
2	2390.0000	35.71	40.63	54.00	13.37	155	117	Vertical	AV
3	2401.8300	71.35	76.30	54.00	-22.30	175	191	Vertical	AV

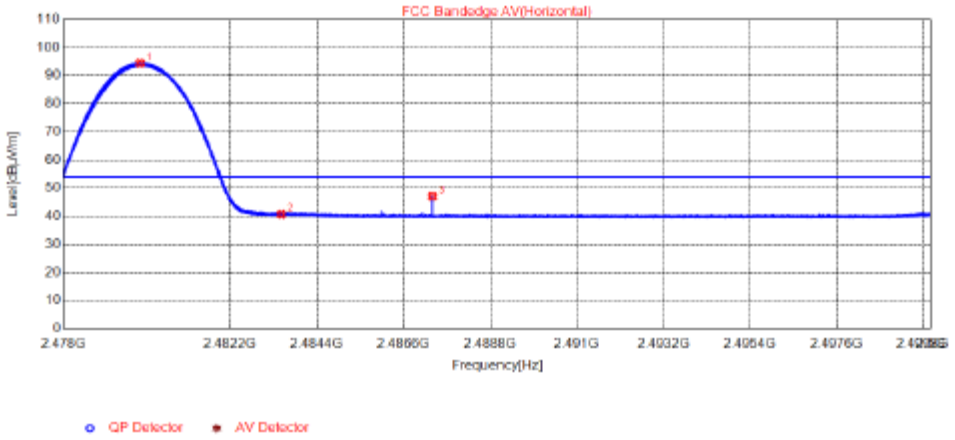
Test Plot-Ant 1
BLE-2480MHz/ Horizontal

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.6929	90.79	95.87	74.00	-21.87	175	142	Horizontal	PK
2	2483.5000	46.74	51.83	74.00	22.17	165	184	Horizontal	PK
3	2483.9763	48.89	53.98	74.00	20.02	175	58	Horizontal	PK

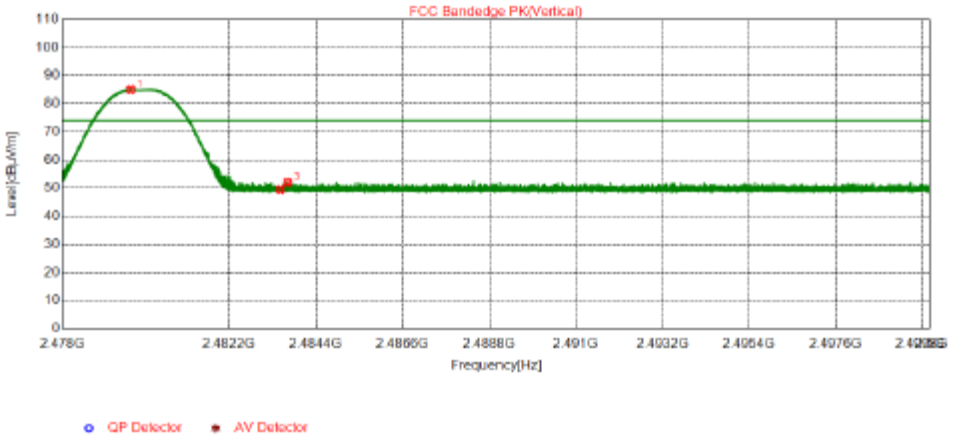
Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.9349	89.32	94.40	54.00	-40.40	175	185	Horizontal	AV
2	2483.5000	35.64	40.73	54.00	13.27	155	164	Horizontal	AV
3	2487.3368	41.98	47.08	54.00	6.92	175	62	Horizontal	AV

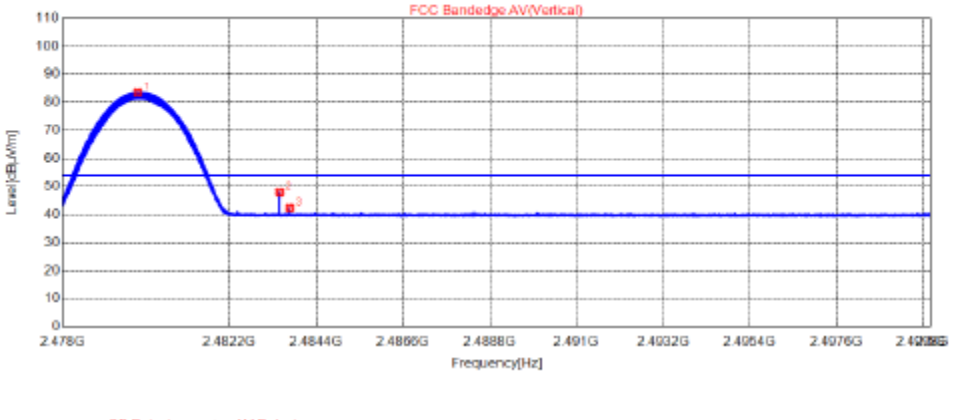
Test Plot-Ant 2
BLE-2480MHz/ Vertical

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.7215	79.95	85.03	74.00	-11.03	165	236	Vertical	PK
2	2483.5000	44.43	49.52	74.00	24.48	155	310	Vertical	PK
3	2483.6903	47.08	52.17	74.00	21.83	175	259	Vertical	PK

Test Graph



NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2479.8931	78.45	83.53	54.00	-29.53	165	216	Vertical	AV
2	2483.4802	42.89	47.98	54.00	6.02	155	62	Vertical	AV
3	2483.7376	37.26	42.35	54.00	11.65	155	62	Vertical	AV

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

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