MEASUREMENT REPORT

FCC PART 15 Subpart C ZigBee 802.15.4

FCC ID:	Q9DAPIN0514515
APPLICANT:	Hewlett Packard Enterprise Company
Application Type:	Certification
Product:	ACCESS POINT
Model No.:	APIN0514, APIN0515
Brand Name:	aruba a Hewlett Packard Enterprise company , Hewlett Packard Enterprise
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part15 Subpart C (Section 15.247)
Test Procedure(s):	ANSI C63.10-2013, KDB 558074 D01v05
Test Date:	June 19 ~ August 10, 2018

Reviewed By: Paddy Chen
(Paddy Chen)

Approved By: Chenz Ker
(Chenz Ker)

Testing Laboratory
3261

The test results relate only to the samples tested.
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

Revision History

Report No.	Version	Description	Issue Date	Note
1811TW0111-U4	Rev. 01	Initial report	08-30-2018	Valid

CONTENTS

Description Page

§2.1033 General Information

Applicant:	Hewlett Packard Enterprise Company
Applicant Address:	6280 America Center Drive, San Jose, CA 95002
Manufacturer:	Hewlett Packard Enterprise Company
Manufacturer Address:	6280 America Center Drive, San Jose, CA 95002
Test Site:	MRT Technology (Taiwan) Co., Ltd
Test Site Address:	No. 38, Fuxing Second Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C)
MRT FCC Registration No.:	153292
Test Device Serial No.:	APIN0514: Conducted Sample S/N: CS18640008 Radiated Sample S/N: CS18640008
	APIN0515: Conducted Sample S/N: CQK85T0010 Radiated Sample S/N: CQK85T0010

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Fuxing Rd., Taoyuan, Taiwan (R.O.C)

- **MRT facility is a FCC registered (Reg. No. 153292) test facility with the site description report on file and is designated by the FCC as an Accredited Test Film.**
- **MRT facility is an IC registered (MRT Reg. No. 21723-1) test laboratory with the site description on file at Industry Canada.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (TAF) under the American Association for Laboratory Accreditation Program (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC, Industry Taiwan, EU and TELEC Rules.**

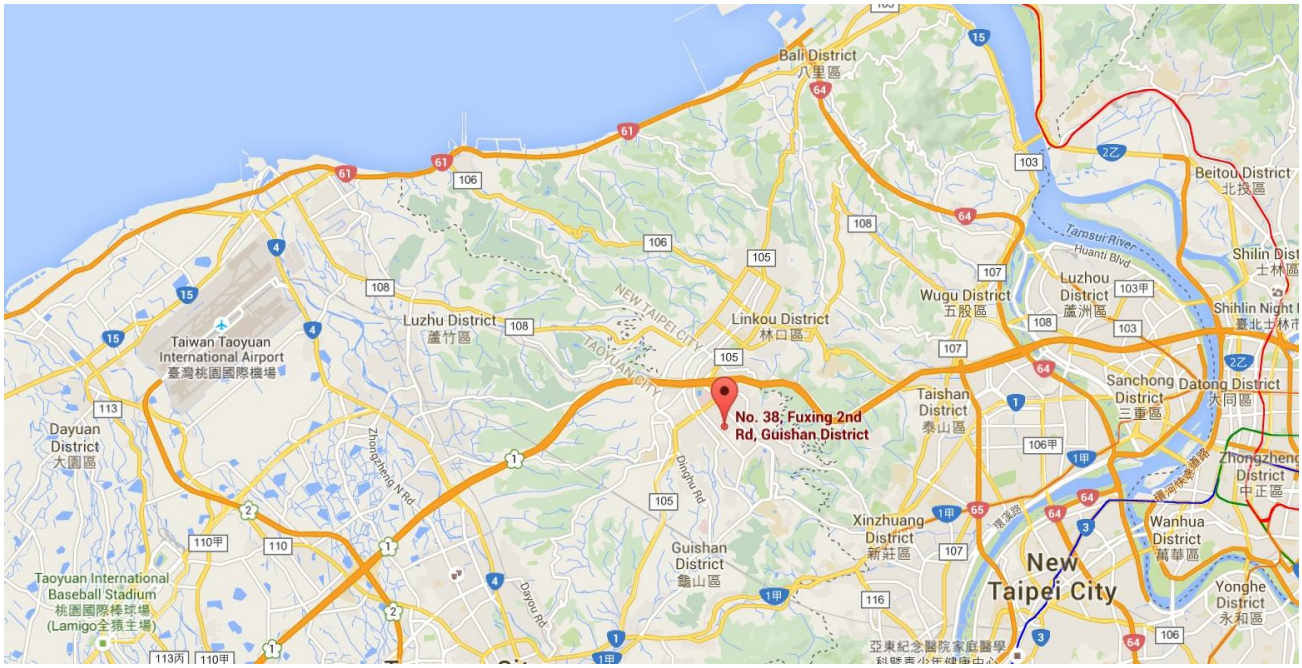
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taoyuan City. These measurement tests were conducted at the MRT Technology (Taiwan) Co., Ltd. Facility located at No.38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan (R.O.C).



2. PRODUCT INFORMATION

2.1. Feature of Equipment under Test

Product Name:	ACCESS POINT
Model No.:	APIN0514, APIN0515
Brand Name:	aruba a Hewlett Packard Enterprise company , Hewlett Packard Enterprise
Wi-Fi Specification:	802.11a/b/g/n/ac/ax
Bluetooth Specification:	v4.2 single mode
Zigbee Specification:	802.15.4
Software Version:	v1.0
Operating Temperature:	0 ~ 50 °C
Power Type:	AC Adapter or POE input
Operating Environment:	Indoor Use

Note: The difference between models is that EUT use different antenna and appearance, APIN0514 use some external antennas, but APIN0515 use internal antenna, other hardware and software are the same. Besides, each model has its own power parameter value.

2.2. Product Specification Subjective to this Report

Frequency Range:	2405 ~ 2480 MHz
Channel Number:	16
Type of Modulation:	O-QPSK

Note: For other features of this EUT, test report will be issued separately.

2.3. Working Frequencies for this report

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

2.4. Description of Available Antennas

Model No.: APIN0514

Antenna No.	Directionality	Frequency Band (GHz)	Model No.	Max Peak Gain (dBi)	BF Gain (dBi)	CDD Directional Gain (dBi)	
						For Power	For PSD
Wi-Fi External Antenna List (2.4GHz 2*2 MIMO, 5GHz 4*4 MIMO)							
1	Omni	2.4	AP-ANT-40	**4.0**	3.01	4.0	7.01
		5		5.0	6.02	5.0	11.02
2	Omni	2.4	AP-ANT-19	3.0	3.01	3.0	6.01
		5		**6.0**	6.02	6.0	12.02
3	Omni	2.4	AP-ANT-1W	3.8	3.01	3.8	6.81
		5		5.8	6.02	5.8	11.82
4	Omni	2.4	AP-ANT-13B	2.3	3.01	2.3	5.31
		5		4.0	6.02	4.0	10.02
5	Omni	2.4	AP-ANT-20W	**2.0**	3.01	2.0	5.01
		5		**2.0**	6.02	2.0	8.02
6 (Note 3)	Directional	2.4	AP-ANT-45	4.5	0.00	4.5	4.50
		5		5.5	3.01	5.5	8.51
7 (Note 3)	Directional	2.4	AP-ANT-48	**8.5**	0.00	8.5	8.5
		5		**8.5**	3.01	8.5	11.51
Bluetooth & ZigBee Internal Antenna							
PCB		2.4		4.9			

Model No.: APIN0515

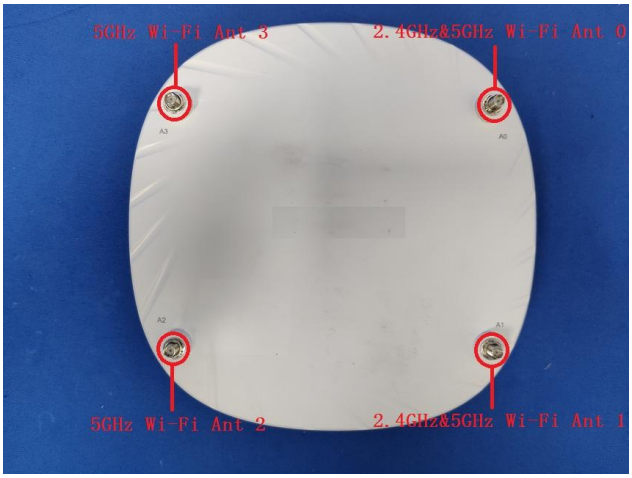
Directionality	Frequency Band (GHz)	Max Peak Gain (dBi)	BF Gain (dBi)	CDD Directional Gain (dBi)	
				For Power	For PSD
Wi-Fi Internal Antenna List (2.4GHz 2*2 MIMO, 5GHz 4*4 MIMO)					
Omni	2.4	3.77	3.01	3.77	6.78
Omni	5	4.55	5.97	4.55	10.52
Bluetooth & ZigBee Internal Antenna					
PCB	2.4	3.5			

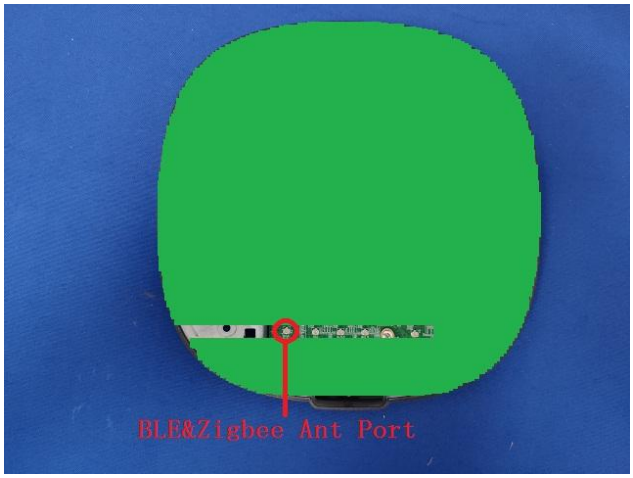
Note:

1. The EUT supports Cyclic Delay Diversity (CDD) mode, and CDD signals are correlated.
   For CDD transmissions, directional gain is calculated as follows, N_{ANT} = 2, N_{SS} = 1.
   If all antennas have the same gain, G_{ANT}, Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.
   - For power spectral density (PSD) measurements on all devices,
     Array Gain = 10 log (N_{ANT}/ N_{SS}) dB = 3.01;
   - For power measurements on IEEE 802.11 devices,
     Array Gain = 0 dB for N_{ANT} ≤ 4;
2. The EUT also supports Beam Forming mode, and the Beam Forming support 802.11n/ac/ax, not include 802.11a/b/g. Directional gain = G_{ANT} + BF Gain, BF Gain was declared by the applicant.
3. Two antennas have Cross-Polarized design, the detail see the antenna specification.
4. For model APIN0514, the final test antenna list was shown as below table.

Antenna	Conducted Testing	Radiated Testing
Omni Antenna 1# (Max 2.4GHz Omni ANT)	N/A	Yes
Omni Antenna 2# (Max 5GHz Omni ANT)	N/A	Yes
Omni Antenna 5# (Min 2.4GHz&5GHz Omni ANT)	Yes (High Power Setting)	Yes
Directional Antenna 7# (Max 2.4GHz&5GHz Directional ANT)	N/A	Yes

2.5. Description of Antenna RF Port

<table>
<tr><td colspan="7">Antenna RF Port</td></tr>
<tr><td>--</td><td colspan="2">2.4GHz RF Port</td><td colspan="4">5GHz RF Port</td></tr>
<tr><td>Software Control Port</td><td>Ant 0</td><td>Ant 1</td><td>Ant 0</td><td>Ant 1</td><td>Ant 2</td><td>Ant 3</td></tr>
<tr><td colspan="7">APIN0514</td></tr>
<tr><td colspan="7"> 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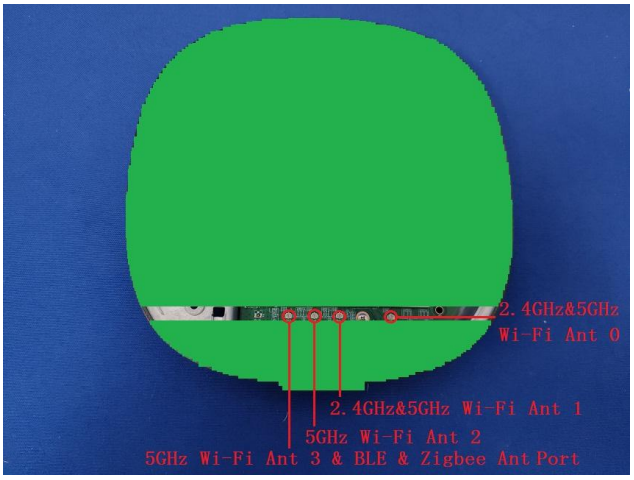
<tr><td colspan="7"> 
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2.6. Test Mode

Test Mode	Mode 1: Transmit by ZigBee

2.7. Description of Test Software

The test utility software used during testing was “telnet.exe”

Model No.	Test Mode	Test Frequency (MHz)	Power Parameter Value
APIN0514	ZigBee	2405	8.0
		2440	8.0
		2475	8.0
		2480	0.0
APIN0515	ZigBee	2405	8.0
		2440	8.0
		2475	8.0
		2480	0.0

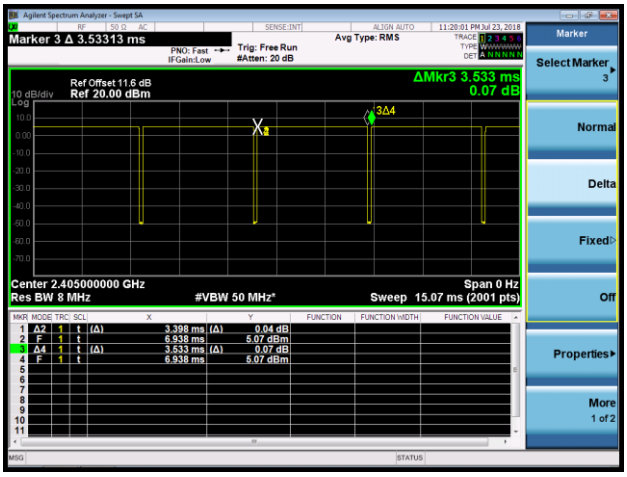
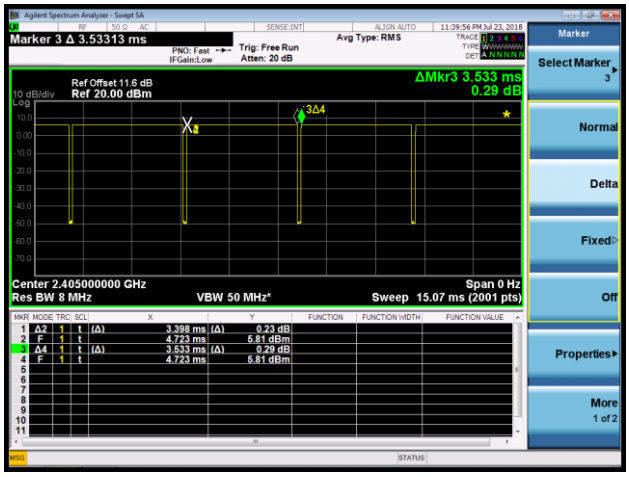
2.8. Device Capabilities

This device contains the following capabilities:

802.11a/b/g/n/ac/ax Wi-Fi, Bluetooth v4.2 single mode and Zigbee devices.

Note: 2.4GHz WLAN (DTS) operation is possible in 20MHz, and 40MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Model No.	Test Mode	Duty Cycle
APIN0514	ZigBee	96.18%
APIN0515	ZigBee	96.18%

Duty Cycle (T = Transmission Duration)	
APIN0514	APIN0515
802.15.4 (T = 3.398ms)	802.15.4 (T = 3.398ms)
	

2.9. Test Configuration

The **ACCESS POINT** was tested per the guidance of ANSI C63.10-2013. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

2.10. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.11. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. DESCRIPTION of TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 558074 D01v05 were used in the measurement.

Deviation from measurement procedure…….....None

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.
For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.
Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

4. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

For APIN0515

- The antenna of the ACCESS POINT is permanently attached.
- There are no provisions for connection to an external antenna.

For APIN0514

- The antenna of the ACCESS POINT uses a reversed SMA connector.

Conclusion:

The unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR3	MRTTWA00045	1 year	2019/03/17
Two-Line V-Network	R&S	ENV216	MRTTWA00019	1 year	2019/03/23
Two-Line V-Network	R&S	ENV216	MRTTWA00020	1 year	2019/03/23
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2019/06/08

Radiated Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Signal Analyzer	R&S	FSV40	MRTTWA00007	1 year	2019/03/02
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2019/03/16
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MRTTWA00005	1 year	2019/04/06
Broadband Amplifier	SCHWARZBECK	BBV 9721	MRTTWA00006	1 year	2019/04/06
Acitve Loop Antenna	SCHWARZBECK	FMZB 1519B	MRTTWA00002	1 year	2019/04/06
Broadband TRILOG Antenna	SCHWARZBECK	VULB 9162	MRTTWA00001	1 year	2019/04/06
Broadband Hornantenna	SCHWARZBECK	BBHA 9120D	MRTTWA00003	1 year	2019/04/06
Breitband Hornantenna	SCHWARZBECK	BBHA 9170	MRTTWA00004	1 year	2019/04/06
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2019/06/08

Conducted Test Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2018/07/10
				1 year	2019/07/10
PSA Series Spectrum Analyzer	Agilent	E4447A	MRTTWA00060	1 year	2018/12/11
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00014	1 year	2019/03/18
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00015	1 year	2019/03/18
Programmable Temperature & Humidity Chamber	TEN BILLION	TTH-B3UP	MRTTWA00036	1 year	2019/05/10
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2019/06/08

Software	Version	Function
e3	V 8.3.5	EMI Test Software

6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

AC Conducted Emission Measurement - SR2
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement - AC1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 25GHz: 4.76dB
Spurious Emissions, Conducted - SR1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 0.78dB
Output Power - SR1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 1.13dB
Power Spectrum Density - SR1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 1.15dB
Occupied Bandwidth - SR1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 0.28%

7. TEST RESULT

7.1. Summary

Product Name: **ACCESS POINT**

FCC ID: **Q9DAPIN0514515**

FCC Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	6dB Bandwidth	≥ 500kHz	Conducted	Pass	Section 7.2
15.247(b)(3)	Output Power	≤ 30dBm		Pass	Section 7.3
15.247(e)	Power Spectral Density	≤ 8dBm/3kHz		Pass	Section 7.4
15.247(d)	Band Edge / Out-of-Band Emissions	≥ 20dBc(Peak)		Pass	Section 7.5
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	Radiated	Pass	Section 7.6 & 7.7
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 7.8

Note: The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.

7.2. 6dB Bandwidth Measurement

7.2.1.Test Limit

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

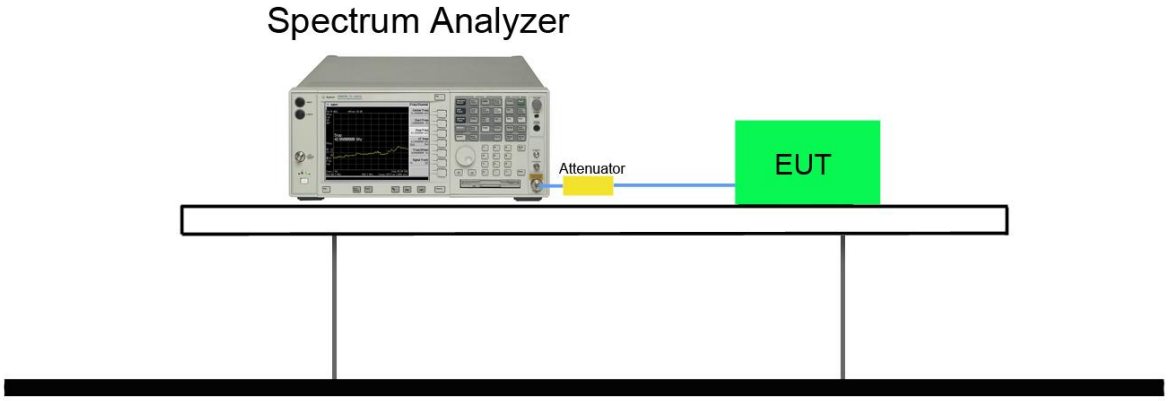
7.2.2.Test Procedure used

ANSI C63.10-2013 Section 11.8

7.2.3.Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace was allowed to stabilize

7.2.4.Test Setup



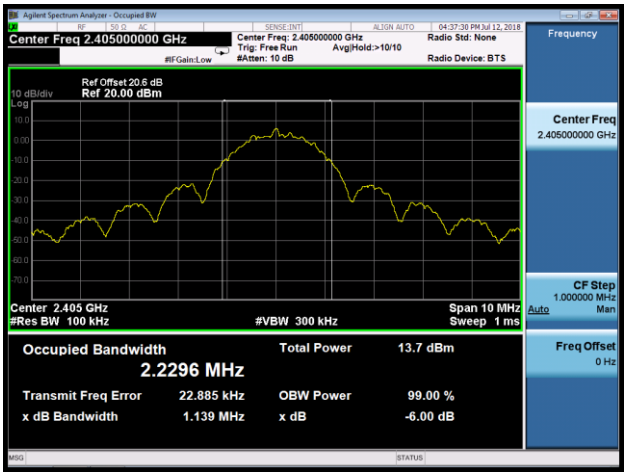
7.2.5.Test Result

Product	ACCESS POINT	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	54%
Test Site	SR2	Test Date	2018/06/27
Model No.	APIN0514	Test Item	6dB Bandwidth

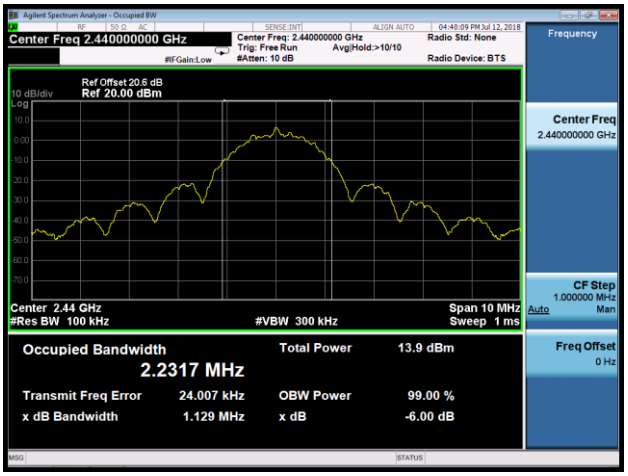
Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.15.4	O-QPSK	11	2405	1.14	≥ 0.5	Pass
802.15.4	O-QPSK	18	2440	1.13	≥ 0.5	Pass
802.15.4	O-QPSK	26	2480	1.13	≥ 0.5	Pass

802.15.4 6dB Bandwidth Bandwidth

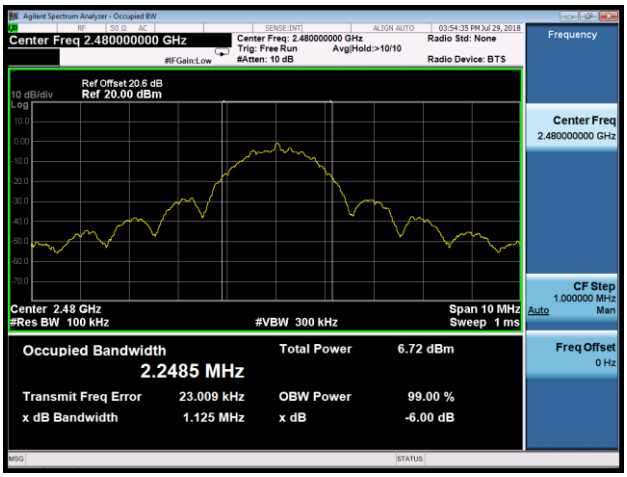
Channel 11 (2405MHz)



Channel 18 (2440MHz)



Channel 26 (2480MHz)

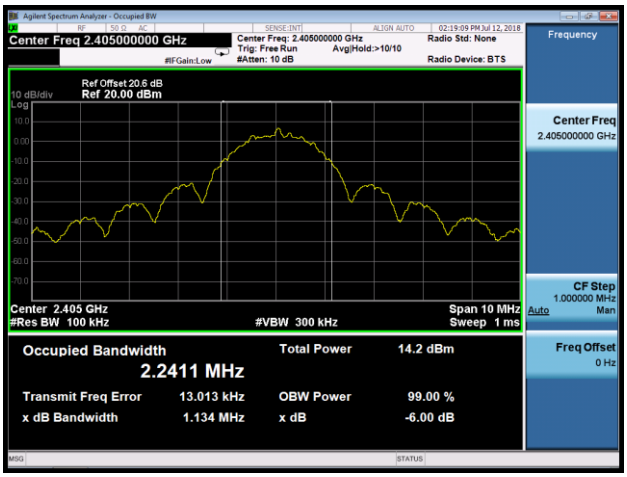


Product	ACCESS POINT	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	54%
Test Site	SR2	Test Date	2018/06/27
Model No.	APIN0515	Test Item	6dB Bandwidth

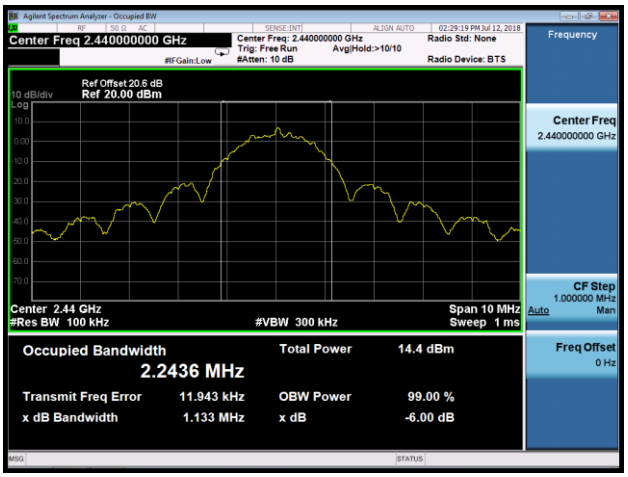
Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.15.4	O-QPSK	11	2405	1.13	≥ 0.5	Pass
802.15.4	O-QPSK	18	2440	1.13	≥ 0.5	Pass
802.15.4	O-QPSK	26	2480	1.14	≥ 0.5	Pass

802.15.4 6dB Bandwidth Bandwidth

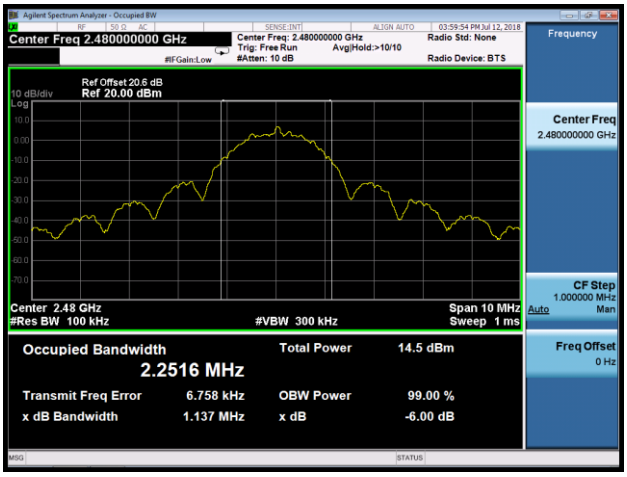
Channel 11 (2405MHz)



Channel 18 (2440MHz)



Channel 26 (2480MHz)



7.3. Output Power Measurement

7.3.1.Test Limit

The maximum output power shall be less 1 Watt (30dBm).

The conducted output power limit specified in paragraph FCC Part 15.247(b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs FCC Part 15.247(b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.3.2.Test Procedure Used

ANSI C63.10 Section 11.9.1.3

ANSI C63.10 Section 11.9.2.3

7.3.3.Test Setting

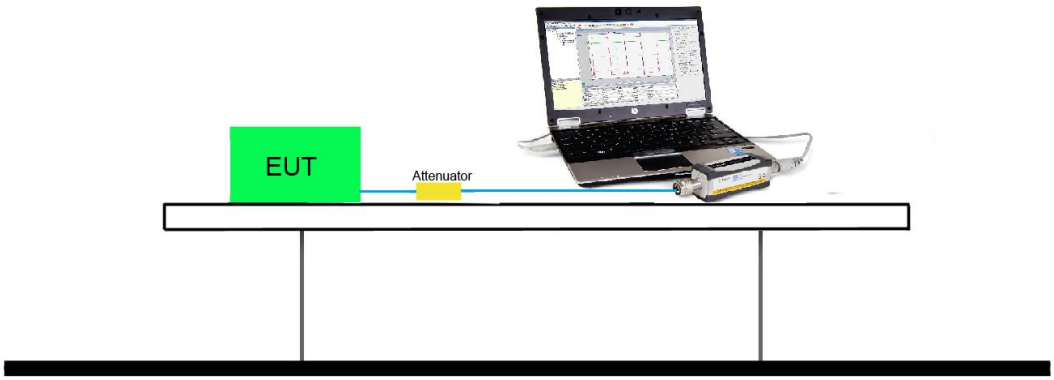
Method PKPM1 (Peak Power Measurement)

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.

Average Power Measurement

Average power measurements were perform only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.

7.3.4.Test Setup



7.3.5.Test Result of Output Power

Product	ACCESS POINT	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	54%
Test Site	SR2	Test Date	2018/06/25
Model No.	APIN0514	Test Item	Output Power

Test Result of Peak Output Power

Test Mode	Modulation Mode	Channel No.	Freq. (MHz)	Peak Power (dBm)	Limit (dBm)	Result
802.15.4	O-QPSK	11	2405	6.78	≤ 30.00	Pass
802.15.4	O-QPSK	18	2440	6.91	≤ 30.00	Pass
802.15.4	O-QPSK	25	2475	7.10	≤ 30.00	Pass
802.15.4	O-QPSK	26	2480	0.88	≤ 30.00	Pass

Note: E.I.R.P (dBm) = Max Average Power (dBm) + Antenna Gain (dBi) = 7.10 dBm + 4.9 dBi = 12.00 dBm.

Test Result of Average Output Power (Reporting Only)

Test Mode	Modulation Mode	Channel No.	Freq. (MHz)	Average Power (dBm)	Limit (dBm)	Result
802.15.4	O-QPSK	11	2405	6.13	≤ 30.00	Pass
802.15.4	O-QPSK	18	2440	6.49	≤ 30.00	Pass
802.15.4	O-QPSK	25	2475	6.69	≤ 30.00	Pass
802.15.4	O-QPSK	26	2480	-0.76	≤ 30.00	Pass

Note: E.I.R.P (dBm) = Max Average Power (dBm) + Antenna Gain (dBi) = 6.69 dBm + 4.9 dBi = 11.59 dBm.

Product	ACCESS POINT	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	54%
Test Site	SR2	Test Date	2018/06/25
Model No.	APIN0515	Test Item	Output Power

Test Result of Peak Output Power

Test Mode	Modulation Mode	Channel No.	Freq. (MHz)	Peak Power (dBm)	Limit (dBm)	Result
802.15.4	O-QPSK	11	2405	7.15	≤ 30.00	Pass
802.15.4	O-QPSK	18	2440	7.33	≤ 30.00	Pass
802.15.4	O-QPSK	25	2475	7.36	≤ 30.00	Pass
802.15.4	O-QPSK	26	2480	1.24	≤ 30.00	Pass

Note: E.I.R.P (dBm) = Max Average Power (dBm) + Antenna Gain (dBi) = 7.36 dBm + 3.5 dBi = 10.86 dBm.

Test Result of Average Output Power (Reporting Only)

Test Mode	Modulation Mode	Channel No.	Freq. (MHz)	Average Power (dBm)	Limit (dBm)	Result
802.15.4	O-QPSK	11	2405	6.78	≤ 30.00	Pass
802.15.4	O-QPSK	18	2440	6.95	≤ 30.00	Pass
802.15.4	O-QPSK	25	2475	6.98	≤ 30.00	Pass
802.15.4	O-QPSK	26	2480	0.15	≤ 30.00	Pass

Note: E.I.R.P (dBm) = Max Average Power (dBm) + Antenna Gain (dBi) = 6.98 dBm + 3.5 dBi = 10.48 dBm.

7.4. Power Spectral Density Measurement

7.4.1.Test Limit

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

The same method of determining the conducted output power shall be used to determine the power spectral density.

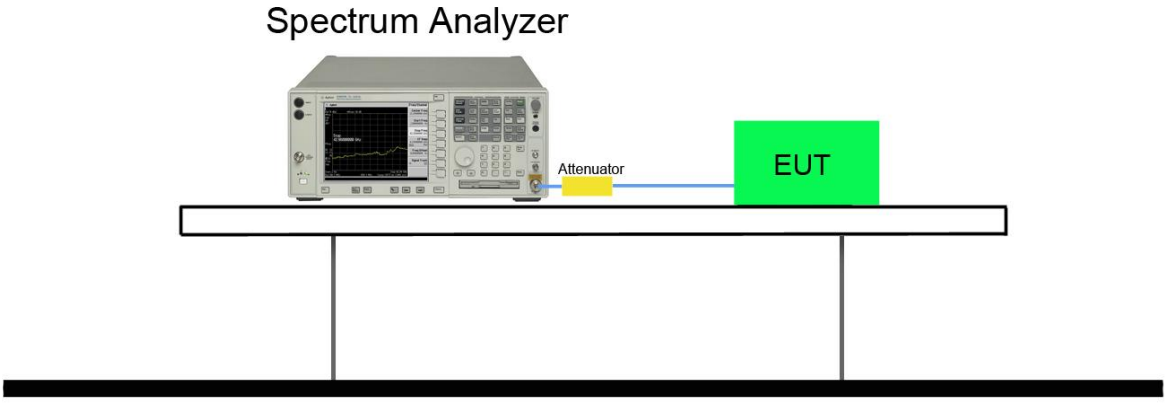
7.4.2.Test Procedure Used

ANSI C63.10 Section 11.10.2

7.4.3.Test Setting

1. Measure the duty cycle (x) of the transmitter output signal.
2. Set instrument center frequency to DTS channel center frequency.
3. Set span to at least 1.5 times the OBW.
4. RBW = 10 kHz.
5. VBW = 30 kHz.
6. Detector = RMS.
7. Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
8. Sweep time = auto couple.
9. Don’t use sweep triggering. Allow sweep to “free run”.
10. Employ trace averaging (RMS) mode over a minimum of 100 traces.
11. Use the peak marker function to determine the maximum amplitude level.
12. 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.
13. Add Constant Factor = 10*log(3kHz / 10kHz) = -5.23.

7.4.4.Test Setup



7.4.5.Test Result

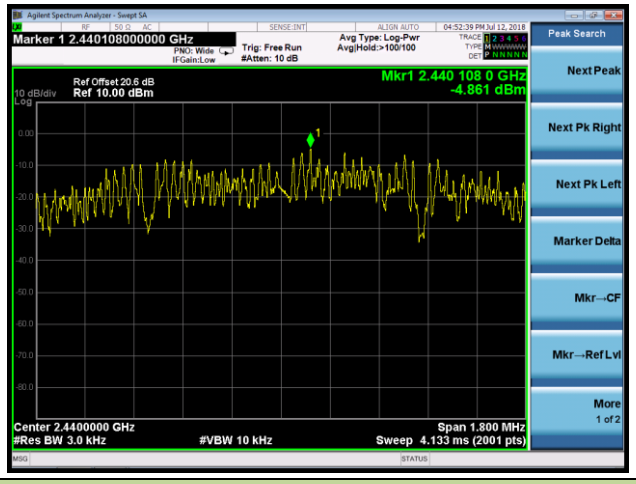
Product	ACCESS POINT	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	54%
Test Site	SR2	Test Date	2018/07/12
Model No.	APIN0514	Test Item	Power Spectral Density

Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	PK PSD (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
802.15.4	O-QPSK	11	2405	-5.06	≤ 8.00	Pass
802.15.4	O-QPSK	18	2440	-4.86	≤ 8.00	Pass
802.15.4	O-QPSK	25	2475	-4.65	≤ 8.00	Pass
802.15.4	O-QPSK	26	2480	-12.21	≤ 8.00	Pass

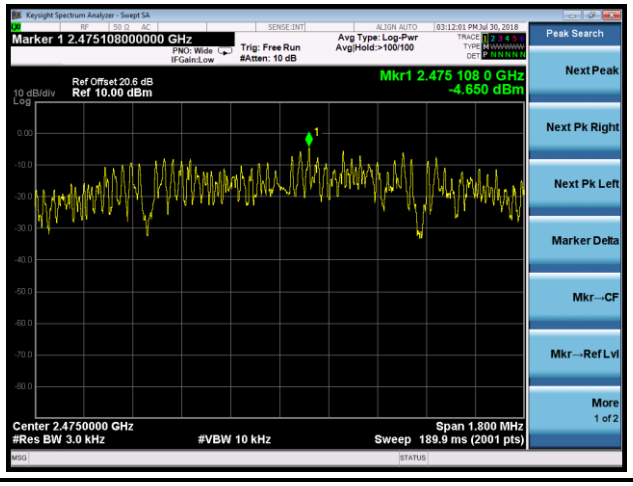
802.15.4 Power Density

Channel 11 (2405MHz)

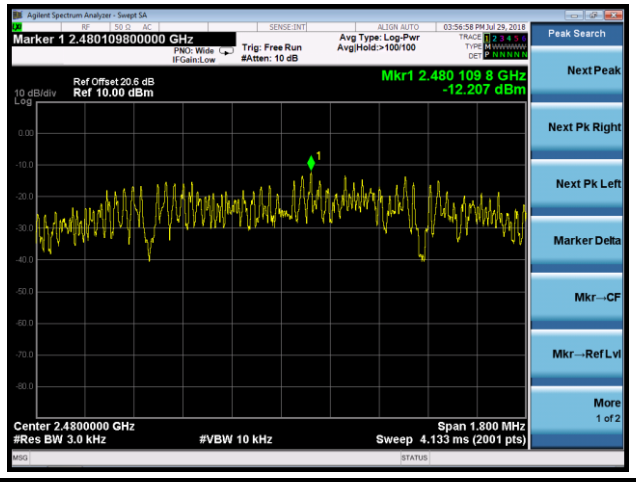
Channel 18 (2440MHz)



Channel 25 (2475MHz)



Channel 26 (2480MHz)

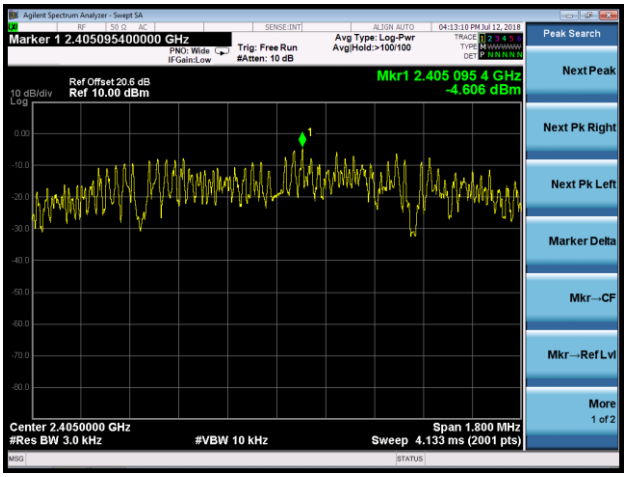


Product	ACCESS POINT	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	54%
Test Site	SR2	Test Date	2018/07/12
Model No.	APIN0515	Test Item	Power Spectral Density

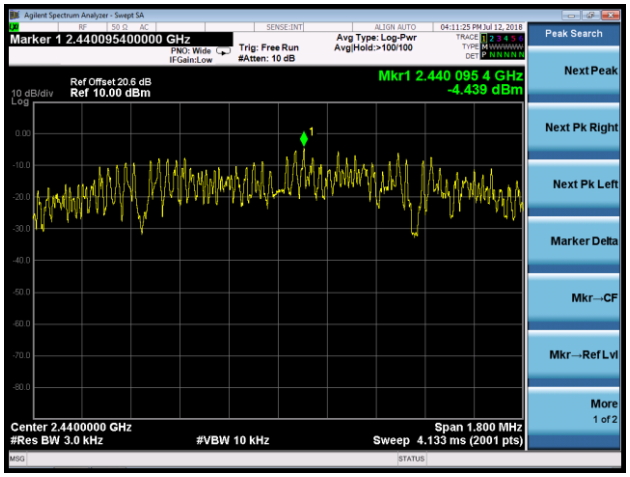
Test Mode	Modulation Mode	Channel No.	Frequency (MHz)	PK PSD (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
802.15.4	O-QPSK	11	2405	-4.61	≤ 8.00	Pass
802.15.4	O-QPSK	18	2440	-4.44	≤ 8.00	Pass
802.15.4	O-QPSK	25	2475	-4.46	≤ 8.00	Pass
802.15.4	O-QPSK	26	2480	-12.82	≤ 8.00	Pass

802.15.4 Power Density

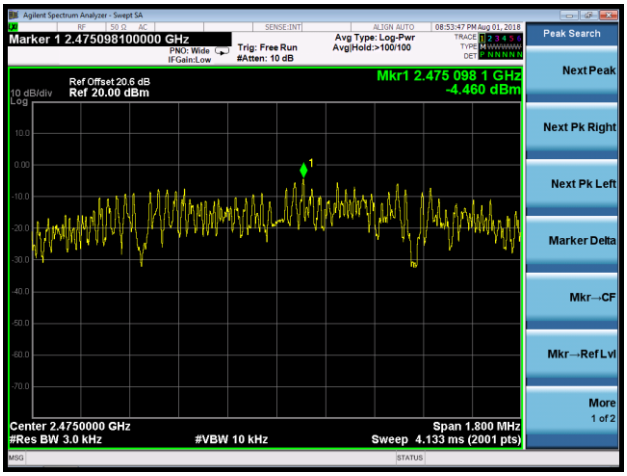
Channel 11 (2405MHz)



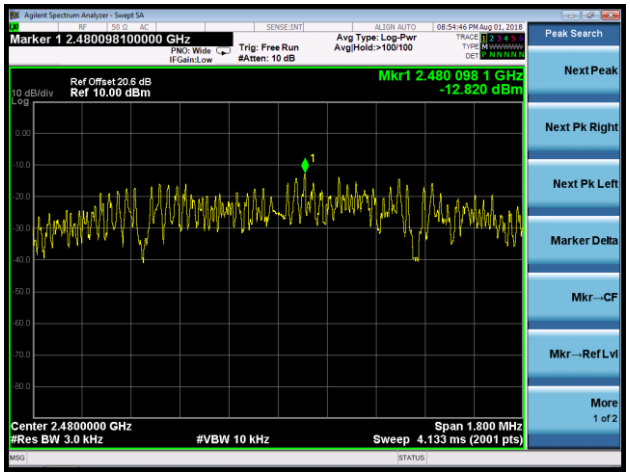
Channel 18 (2440MHz)



Channel 26 (2475MHz)



Channel 26 (2480MHz)



7.5. Conducted Band Edge and Out-of-Band Emissions

7.5.1.Test Limit

The limit for out-of-band spurious emissions at the band edge is 30dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth per the PSD procedure.

7.5.2.Test Procedure Used

KDB 558074 D01v05 - Section 11.2 & Section 11.3

7.5.3.Test Settitng

Reference level measurement

1. Set instrument center frequency to DTS channel center frequency
2. Set the span to ≥ 1.5 times the DTS bandwidth
3. Set the RBW = 100 kHz
4. Set the VBW ≥ 3 x RBW
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Allow trace to fully stabilize

Emission level measurement

1. Start frequency was set to 30MHz and stop frequency was set to 25GHz (separated into two plots per channel)
2. RBW = 1.3MHz
3. VBW = 4MHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

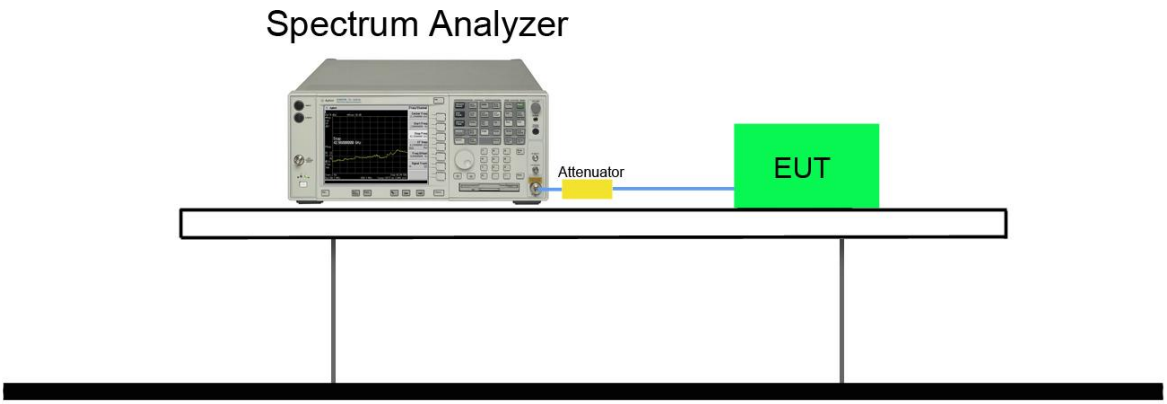
Test Notes

1. RBW was set to 1.3MHz rather than 100kHz in order to increase the measurement speed.

2. The display line shown in the following plots denotes the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, since the traces in the following plots are measured with a 1.3MHz RBW, the display line may not necessarily appear to be 20dB below the level of the fundamental in a 1.3MHz bandwidth.

3. For plots showing conducted spurious emissions near the limit, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.

7.5.4.Test Setup



7.5.5.Test Result

Product	ACCESS POINT	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	54%
Test Site	SR2	Test Date	2018/07/12
Model No.	APIN0514	Test Item	Conducted Band Edge and Out-of-Band Emissions

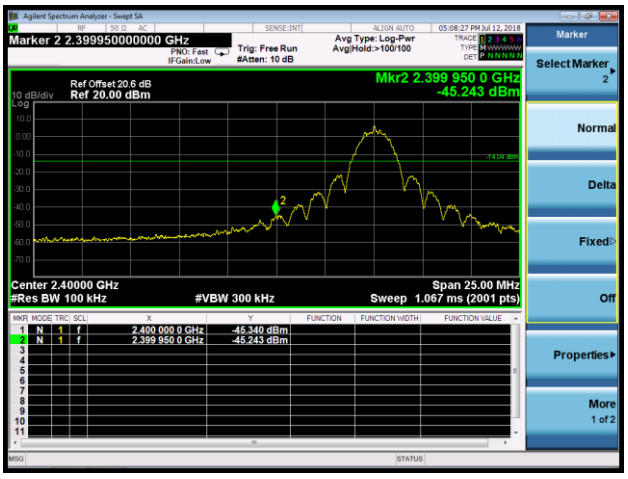
Test Mode	Data Rate / MCS	Channel No.	Frequency (MHz)	Limit	Result
802.15.4	O-QPSK	11	2405	20dBc	Pass
802.15.4	O-QPSK	18	2440	20dBc	Pass
802.15.4	O-QPSK	26	2480	20dBc	Pass

802.15.4 Out-of-Band Emissions - APIN0514

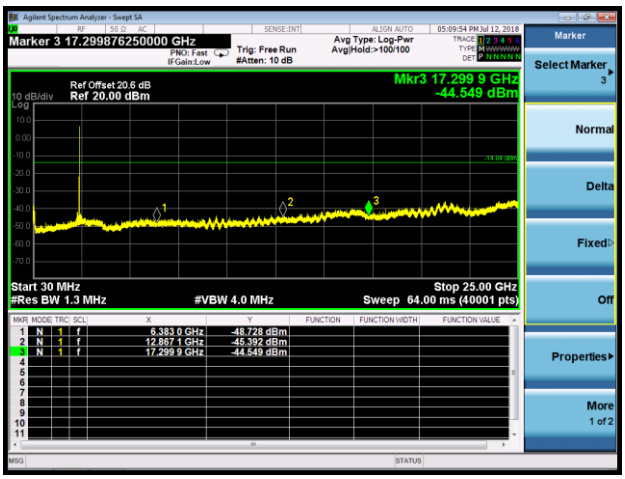
Channel 11 (2405MHz)

100kHz PSD Reference Level

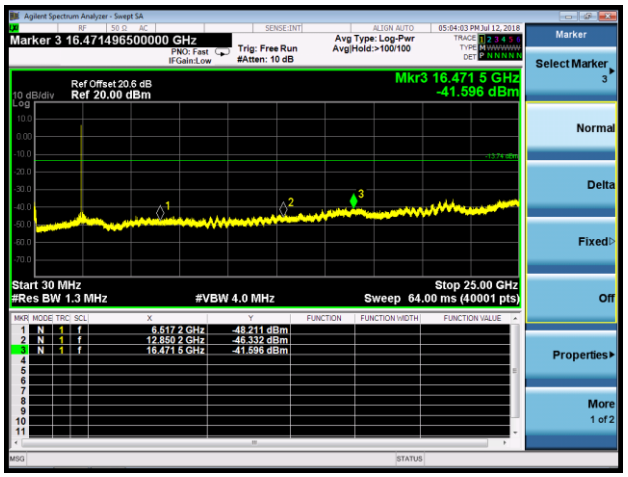
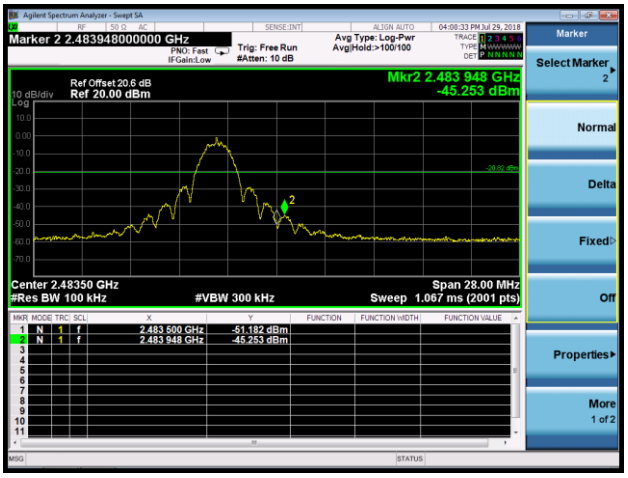
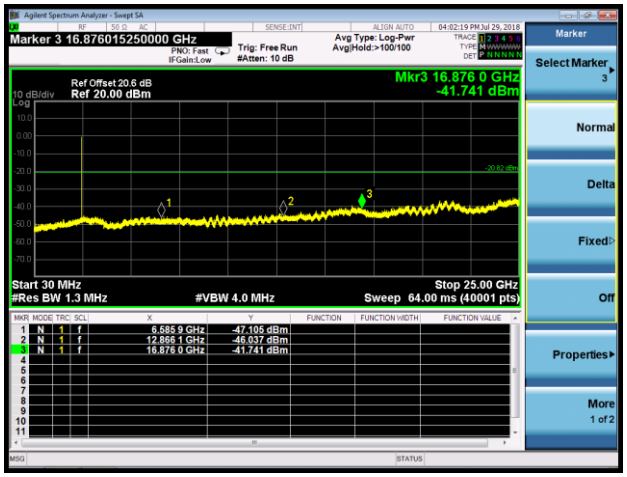
Low Band Edge



Spurious Emission



Note: The Value of the Display Line is -14.06dBm

Channel 18 (2440MHz)	
100kHz PSD Reference Level	Spurious Emission
	
Note: The Value of the Display Line is -13.74dBm	
Channel 26 (2480MHz)	
100kHz PSD Reference Level	High Band Edge
	
Spurious Emission	
	Note: The Value of the Display Line is -20.82dBm

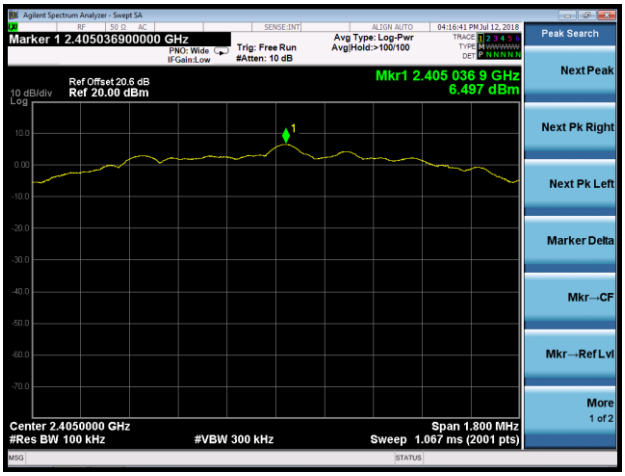
Product	ACCESS POINT	Temperature	25°C
Test Engineer	Kevin Ker	Relative Humidity	54%
Test Site	SR2	Test Date	2018/07/12
Model No.	APIN0515	Test Item	Conducted Band Edge and Out-of-Band Emissions

Test Mode	Data Rate / MCS	Channel No.	Frequency (MHz)	Limit	Result
802.15.4	O-QPSK	11	2405	20dBc	Pass
802.15.4	O-QPSK	18	2440	20dBc	Pass
802.15.4	O-QPSK	26	2480	20dBc	Pass

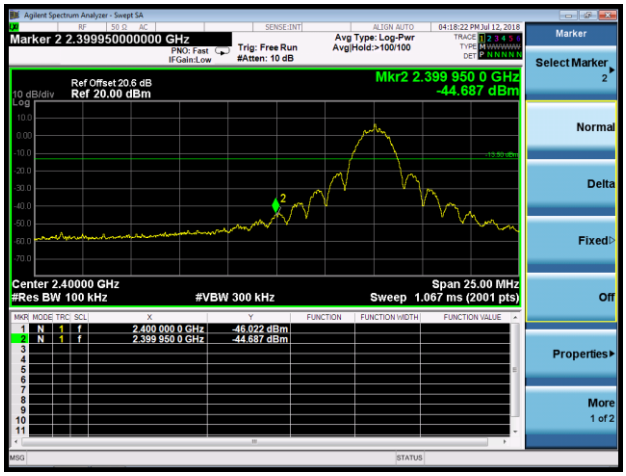
802.15.4 Out-of-Band Emissions - APIN0515

Channel 11 (2405MHz)

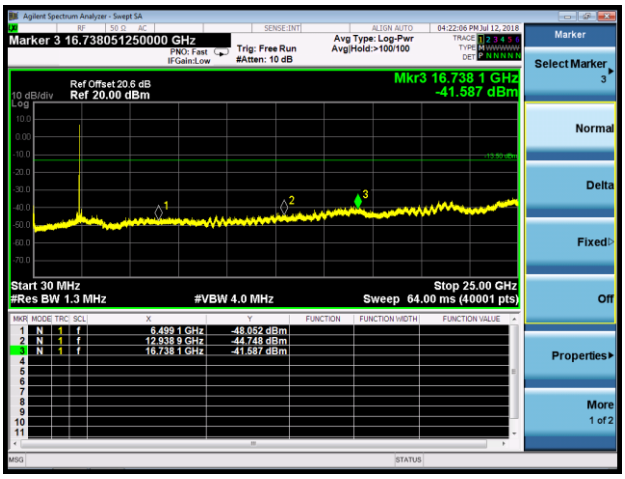
100kHz PSD Reference Level



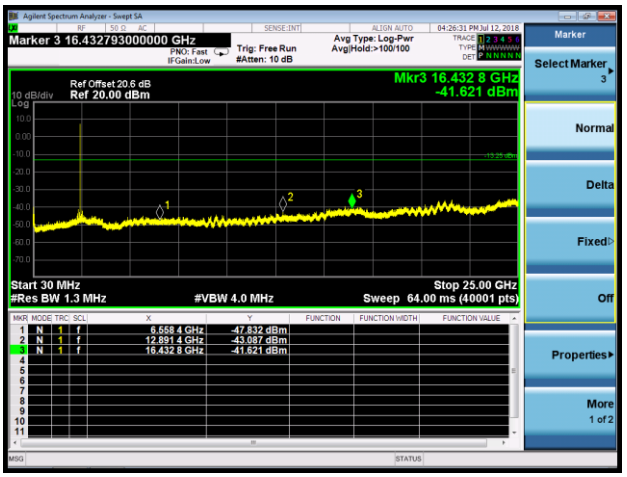
Low Band Edge

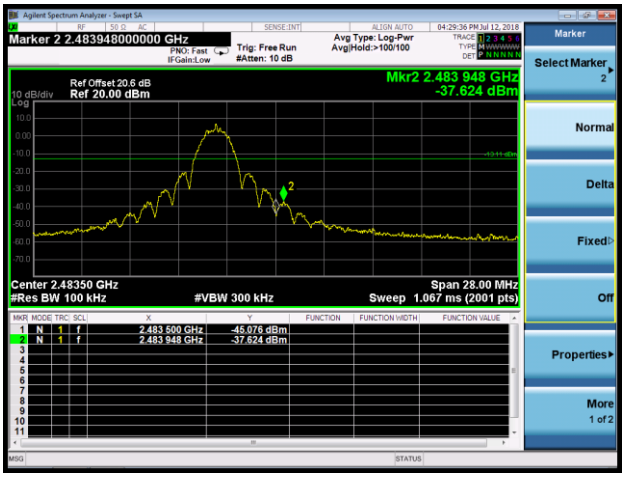
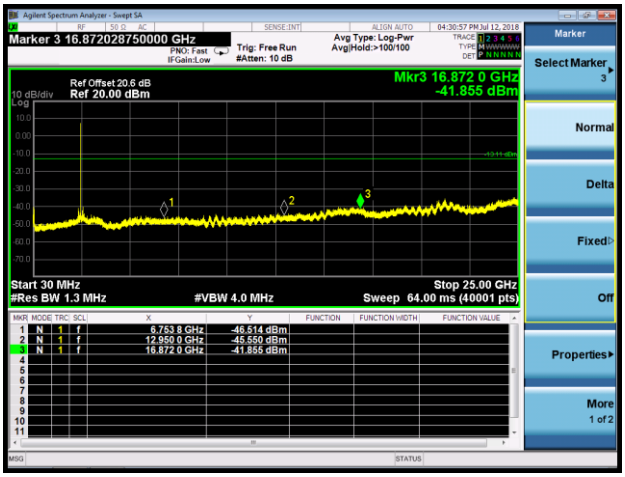


Spurious Emission



Note: The Value of the Display Line is -13.50dBm

Channel 18 (2440MHz)	
100kHz PSD Reference Level	Spurious Emission
	
Note: The Value of the Display Line is -13.25dBm	

Channel 26 (2480MHz)	
100kHz PSD Reference Level	High Band Edge
	
Spurious Emission	
	Note: The Value of the Display Line is -13.11dBm

7.6. Radiated Spurious Emission Measurement

7.6.1.Test Limit

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR 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

7.6.2.Test Procedure Used

ANSI C63.10 Section 6.3 (General Requirements)

ANSI C63.10 Section 6.4 (Standard test method below 30MHz)

ANSI C63.10 Section 6.5 (Standard test method above 30MHz to 1GHz)

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

7.6.3.Test Setting

Table 1 - RBW as a function of frequency

Frequency	RBW
9 ~ 150 kHz	200 ~ 300 Hz
0.15 ~ 30 MHz	9 ~ 10 kHz
30 ~ 1000 MHz	100 ~ 120 kHz

Quasi-Peak Measurements below 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest

2. Span was set greater than 1MHz

3. RBW = as specified in Table 1

4. Detector = CISPR quasi-peak

5. Sweep time = auto couple

6. Trace was allowed to stabilize

Peak Measurements above 1GHz

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

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest

2. RBW = 1MHz

3. VBW; If the EUT is configured to transmit with duty cycle ≥ 98%, set VBW = 10 Hz.

If the EUT duty cycle is < 98%, set VBW ≥ 1/T. T is the minimum transmission duration.

4. Detector = Peak

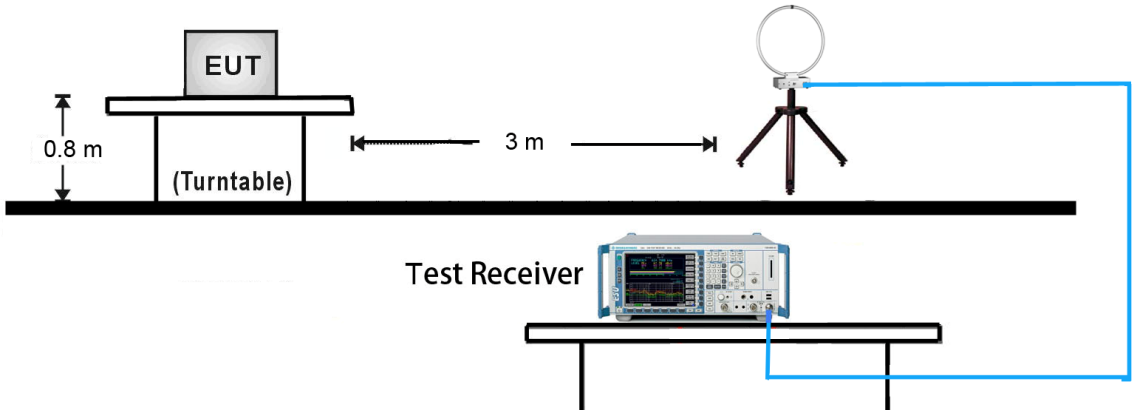
5. Sweep time = auto

6. Trace mode = max hold

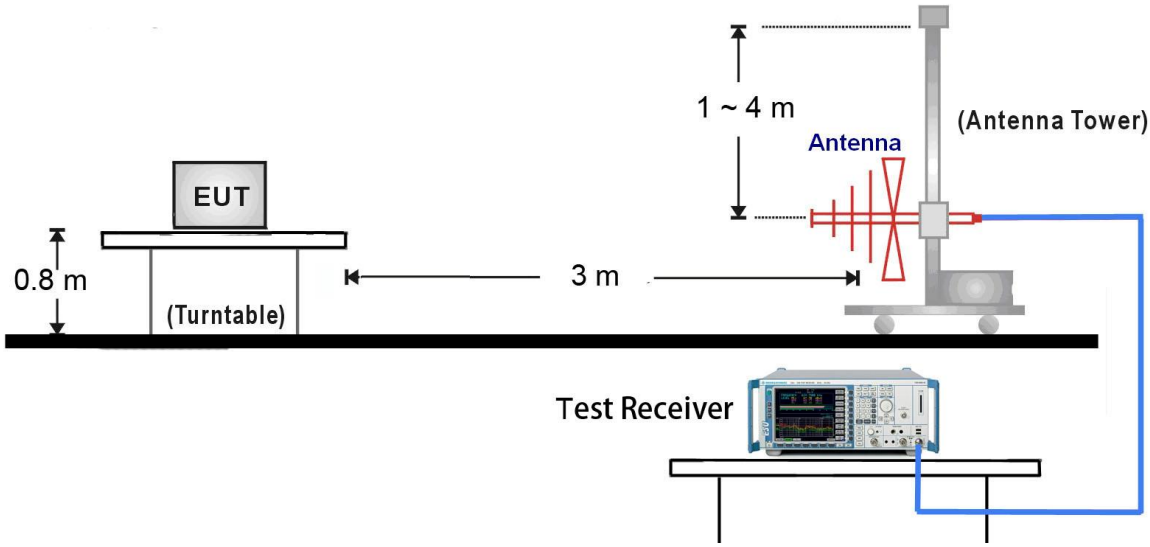
7. Trace was allowed to stabilize

7.6.4.Test Setup

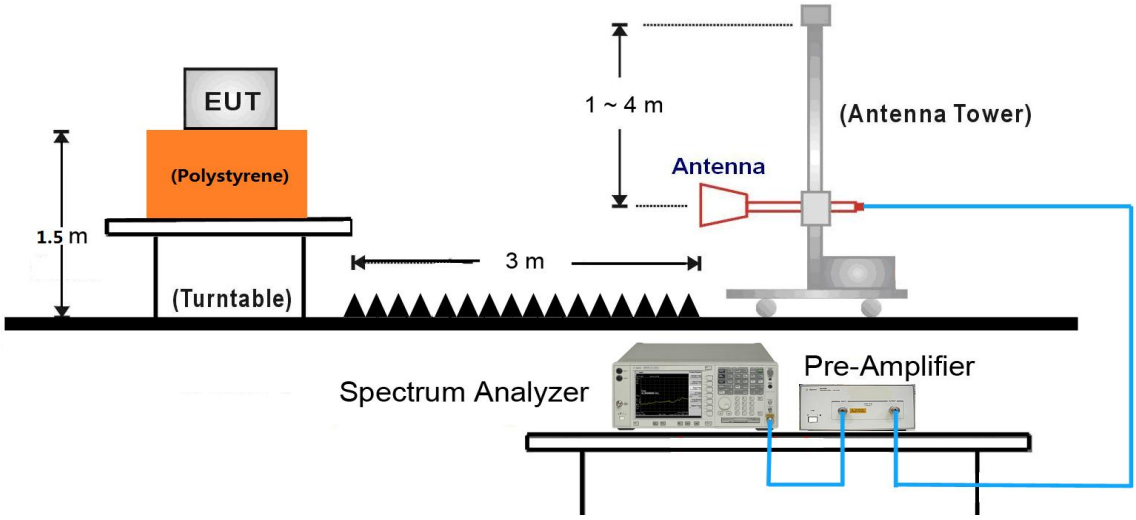
9kHz ~ 30MHz Test Setup:



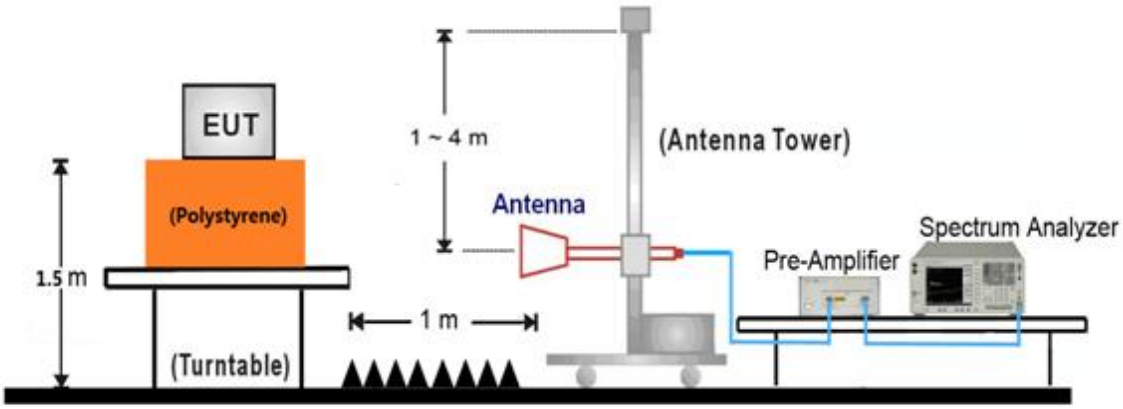
30MHz ~ 1GHz Test Setup:



1GHz ~ 18GHz Test Setup:



18GHz ~25GHz Test Setup:



Note: This item was performed with the ZigBee antenna connected.

7.6.5.Test Result

Product	ACCESS POINT	Temperature	26°C
Test Engineer	Kevin Ker	Relative Humidity	56%
Test Site	AC1	Test Date	2018/06/23
Model No.	APIN0514	Test Channel	11
Remark	1. Average measurement was not performed if peak level lower than average limit. So the margin was calculated using the average limit for emissions fall within the restricted bands. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	7077.5	35.3	11.3	46.6	81.7	-35.1	Peak	Horizontal
*	7893.5	37.1	12.4	49.5	81.7	-32.2	Peak	Horizontal
	8199.5	37.4	12.0	49.4	54.0	-4.60	Peak	Horizontal
	9100.5	32.9	14.4	47.3	54.0	-6.70	Peak	Horizontal
*	7077.5	36.9	11.3	48.2	81.7	-33.5	Peak	Vertical
*	7910.5	37.2	12.4	49.6	81.7	-32.1	Peak	Vertical
	8199.5	37.1	12.0	49.1	54.0	-4.90	Peak	Vertical
	9083.5	34.1	14.4	48.5	54.0	-5.50	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (101.7dBμV/m) or 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB)

Product	ACCESS POINT	Temperature	26°C
Test Engineer	Kevin Ker	Relative Humidity	56%
Test Site	AC1	Test Date	2018/06/23
Model No.	APIN0514	Test Channel	18
Remark	1. Average measurement was not performed if peak level lower than average limit. So the margin was calculated using the average limit for emissions fall within the restricted bands. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	7128.5	35.9	11.7	47.6	82.4	-34.8	Peak	Horizontal
*	7817.0	35.5	12.4	47.9	82.4	-34.5	Peak	Horizontal
	8131.5	35.9	12.2	48.1	54.0	-5.90	Peak	Horizontal
	9100.5	34.2	14.4	48.6	54.0	-5.40	Peak	Horizontal
*	7137.0	34.7	11.7	46.4	82.4	-36.0	Peak	Vertical
*	7876.5	35.9	12.4	48.3	82.4	-34.1	Peak	Vertical
	8199.5	35.8	12.0	47.8	54.0	-6.20	Peak	Vertical
	9117.5	34.2	14.5	48.7	54.0	-5.30	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is 20dBc of the fundamental emission level (102.4dBμV/m) or 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB)

Product	ACCESS POINT	Temperature	26°C
Test Engineer	Kevin Ker	Relative Humidity	56%
Test Site	AC1	Test Date	2018/06/23
Model No.	APIN0514	Test Channel	26
Remark	1. Average measurement was not performed if peak level lower than average limit. So the margin was calculated using the average limit for emissions fall within the restricted bands. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	7137.0	35.2	11.7	46.9	76.3	-36.5	Peak	Horizontal
*	7876.5	36.3	12.4	48.7	76.3	-34.7	Peak	Horizontal
	8208.0	37.2	11.9	49.1	54.0	-4.9	Peak	Horizontal
	9092.0	34.1	14.4	48.5	54.0	-5.5	Peak	Horizontal
*	7154.0	36.2	11.9	48.1	76.3	-35.3	Peak	Vertical
*	7885.0	34.8	12.4	47.2	76.3	-36.2	Peak	Vertical
	8199.5	36.9	12.0	48.9	54.0	-5.1	Peak	Vertical
	9092.0	33.9	14.4	48.3	54.0	-5.7	Peak	Vertical

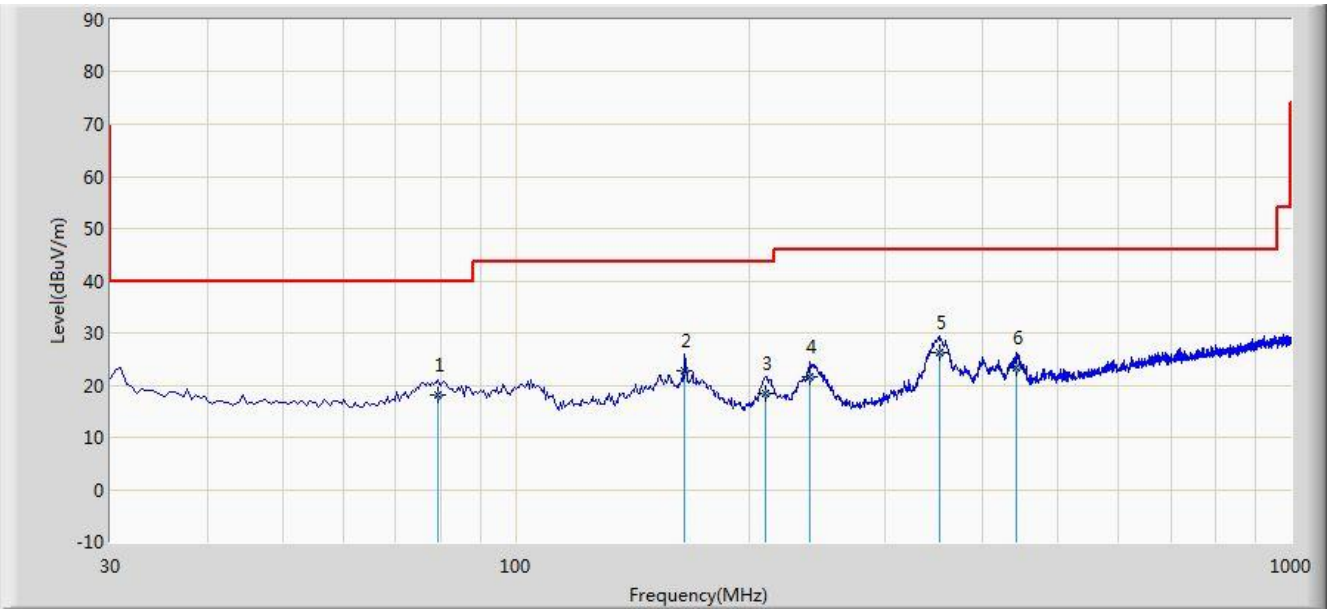
Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (96.3dBμV/m) or 15.209 which is higher.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB)

The Worst Case of Radiated Emission below 1GHz:

Site: AC1	Time: 2018/07/08 - 17:30
Limit: FCC_Part15.209_RSE(3m)	Engineer: Kevin Ker
Probe: VULB9162_0.03GHz_8GHz	Polarity: Horizontal
EUT: ACCESS POINT(APIN0514)	Power: AC 120V/60Hz
Test Mode: There is the worst case within frequency range 30MHz~1GHz.	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			79.470	18.000	8.632	-22.000	40.000	9.368	QP
2			165.315	22.898	12.731	-20.602	43.500	10.167	QP
3			210.420	18.424	5.849	-25.076	43.500	12.575	QP
4			240.005	21.491	7.924	-24.509	46.000	13.567	QP
5		*	353.010	26.135	10.042	-19.865	46.000	16.094	QP
6			441.765	23.346	5.826	-22.654	46.000	17.519	QP

Note 1: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.