FCC Test Report
(Class II Permissive Change)

Product Name	WAH0001
Model No.	QI-150P
FCC ID.	2AOV3QI-150P

Applicant	Hitachi Information & Telecommunication Engineering, Ltd.
Address	Queen's Tower B 22F, 2-3-3, Minatomirai, Nishi-ku, Yokohama 220-6122, Japan

Date of Receipt	May. 10, 2018
Issued Date	Jul. 16, 2018
Report No.	1850118R-RFUSP25V00
Report Version	V1.0

Testing Laboratory
3023

Test Report

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Product Name	WAH0001
Applicant	Hitachi Information & Telecommunication Engineering, Ltd.
Address	Queen's Tower B 22F, 2-3-3, Minatomirai, Nishi-ku, Yokohama 220-6122, Japan
Manufacturer	Hitachi Information & Telecommunication Engineering, Ltd.
Model No.	QI-150P
FCC ID.	2AOV3QI-150P
EUT Rated Voltage	DC 3.3V
EUT Test Voltage	DC 3.3V
Trade Name	Hitachi Information & Telecommuniation Engineering, Ltd
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2017 ANSI C63.4: 2014, ANSI C63.10: 2013 KDB 558074 D01 DTS Meas Guidance v04
Test Result	Complied

Documented By : Anny Chou

(Senior Adm. Specialist / Anny Chou)

Tested By : Paul Jiang

(Engineer / Paul Jiang)

Approved By :

(Director / Vincent Lin)

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1. GENERAL INFORMATION

1.1. EUT Description

Product Name	WAH0001
Trade Name	Hitachi Information & Telecommuniation Engineering, Ltd
Model No.	QI-150P
FCC ID.	2AOV3QI-150P
Frequency Range	2402 – 2480MHz
Channel Number	V4.1: 40CH
Type of Modulation	V4.1: GFSK(1Mbps)
Antenna Type	Dipole Antenna
Channel Control	Auto
Antenna Gain	Refer to the table “Antenna List”

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	STAF	T17-002-1054	Dipole Antenna	0.65dBi for 2.4 GHz

Note: The antenna of EUT is conforming to FCC 15.203.

Center Frequency of Each Channel: (For V4.1)

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

Note:

1. The EUT is a WAH0001 with a built-in WiGig、WLAN and Bluetooth transceiver, this report for Bluetooth V4.1.
2. These tests were conducted on a sample for the purpose of demonstrating compliance of Bluetooth transmitter with Part 15 Subpart C Paragraph 15.247 for spread spectrum devices.
3. This is to request a Class II permissive change for FCC ID: 2AOV3QI-150P, originally granted on 07/25/2018.

   The major change filed under this application is:

   Change #1: Reduce the Output Power through firmware(only reduce Bluetooth Output Power, WLAN Output Power haven't changes), All other hardware is identical with original granted.

   #2: Addition one new antenna(WLAN and Bluetooth), the antenna type is different, the antenna gain is lower than the original application.

Test Mode	Mode 1: Transmit - BLE (GFSK)

1.2. Operational Description

The EUT is a WAH0001 with built-in 2.4GHz Bluetooth V4.1 transceiver. The number of the channels is 40 in Bluetooth V4.1 mode. This device provides three kinds of transmitting speed and modulation, respectively GFSK(1Mbps) . The antenna is Printed on Dipole Antenna and provides diversity function to improve the receiving function.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. The transmitter is presented with a continuous data stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its 40 channels.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted.

The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

The EUT is forward-compatible with the impending Bluetooth Low Energy operating mode, which provides a dramatic reduction in the power consumption of the Bluetooth radio and baseband. The primary application for this mode is to provide support for low data rate devices, such as sensors and remote controls.

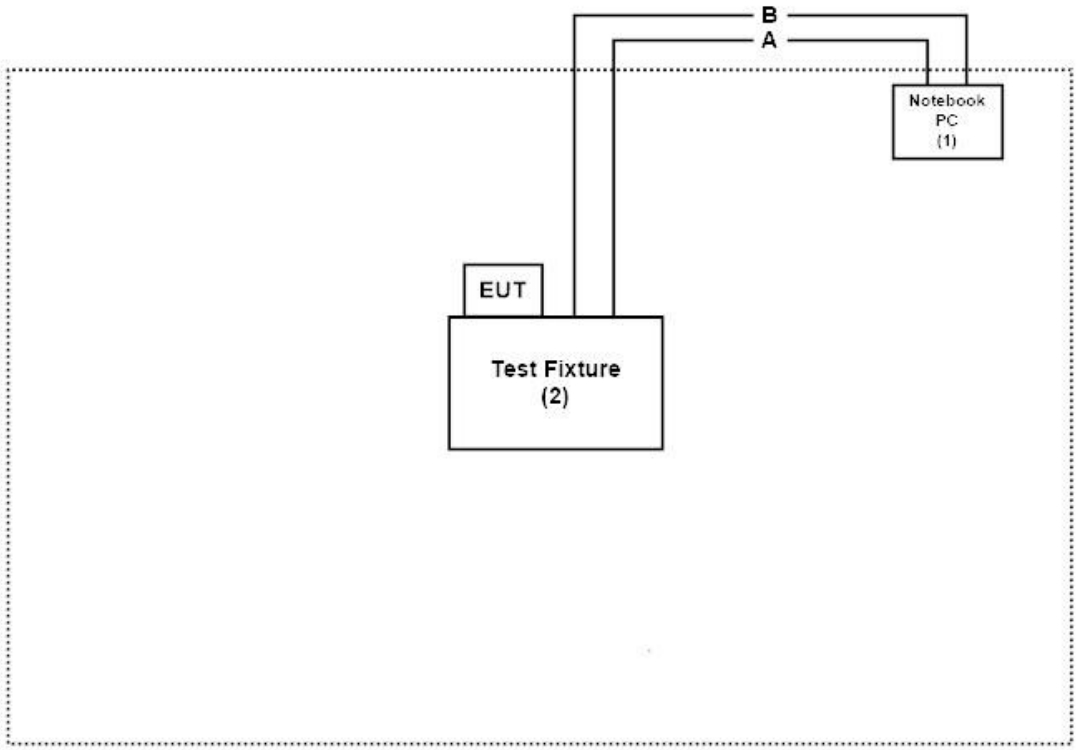
1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	Notebook PC	DELL	Latitude E5440	B6TYTZ1	Non-shielded, 1.8m
2	Test Fixture	Hitachi Information & Telecommuniation Engineering, Ltd	N/A	N/A	Non-shielded, 1.8m

Signal Cable Type		Signal cable Description
A	LAN Cable	Non-shielded, 3m
B	USB Cable	Shielded, 1.2m

1.4. Configuration of Tested System



1.5. EUT Exercise Software

1. Setup the EUT as shown in Section 1.4.
2. Execute software ” Qualcomm v3.0.244.0” on the Notebook PC.
3. Configure the test mode, the test channel, and the data rate.
4. Press “OK” to start the continuous Transmit.
5. Verify that the EUT works properly.

1.6. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	30-65
Barometric pressure (mbar)	860-1060	950-1000

The related certificate for our laboratories about the test site and management system can be downloaded from DEKRA Testing and Certification Co., Ltd. Web Site:
http://www.dekra.com.tw/english/about/certificates.aspx?bval=5
The address and introduction of DEKRA Testing and Certification Co., Ltd. laboratories can be founded in our Web site: http://www.dekra.com.tw/index_en.aspx

Site Description: Accredited by TAF
Accredited Number: 3023

Site Name: DEKRA Testing and Certification Co., Ltd
Site Address: No.5-22, Ruishukeng, Linkou Dist., New Taipei City 24451, Taiwan, R.O.C.
TEL : 886-2-8601-3788 / FAX : 886-2-8601-3789
E-Mail : info.tw@dekra.com

FCC Accreditation Number: TW3023

1.7. List of Test Equipment

For Conducted measurements /CB3/SR8

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Date	Due. Date
	Temperature Chamber	WIT GROUP	TH-1S-B	EQ-201-00146	2018/2/12	2019/2/11
X	Spectrum Analyzer	Agilent	N9010A	MY48030495	2017/10/13	2018/10/12
X	Peak Power Analyzer	Keysight	8990B	MY51000410	2017/7/19	2018/7/18
X	Wideband Power Sensor	Keysight	N1923A	MY56080003	2018/7/6	2019/7/5
X	Wideband Power Sensor	Keysight	N1923A	MY56080004	2018/7/6	2019/7/5
	EMI Test Receiver	R&S	ESCS 30	100369	2017/11/7	2018/11/6
	LISN	R&S	ESH3-Z5	836679/017	2018/2/9	2019/2/8
	LISN	R&S	ENV216	100097	2018/2/9	2019/2/8
	Coaxial Cable	DEKRA	RG 400	LC018-RG	2018/6/22	2019/6/21

For Radiated measurements /Site3/CB8

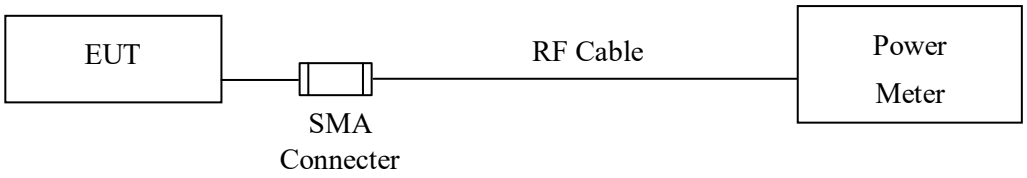
	Equipment	Manufacturer	Model No.	Serial No.	Cali. Date	Due. Date
X	Spectrum Analyzer	R&S	FSP40	100170	2018/3/12	2019/3/11
	Loop Antenna	Teseq	HLA6121	37133	2017/10/13	2018/10/12
X	Bilog Antenna	Schaffner Chase	CBL6112B	2707	2018/6/25	2019/6/24
X	Coaxial Cable	DEKRA	RG 214	LC003-RG	2018/6/15	2019/6/14
X	Pre-Amplifier	Jet-Power	JPA-10M1G33	170101000330010	2017/7/19	2018/7/18
X	Horn Antenna	ETS-Lindgren	3117	00135205	2018/5/3	2019/5/2
X	Pre-Amplifier	EMCI	EMC012630SE	980210	2018/4/10	2019/4/9
X	Coaxial Cable	QuieTek	SF-106	LC035/37/41-SF LC038-SF,LC037-SF	2018/6/21	2019/6/20
	Amplifier + Cable	EMCI	EMC184045SE	980370	2018/3/21	2019/3/20
	Horn Antenna	Com-Power	AH-840	101043	2018/1/9	2019/1/8
X	Filter	MicroTRON	BRM50701	019	2017/11/21	2018/11/20
	Filter	Microwave Circuits	N0257881	36681	2018/1/22	2019/1/21

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with “X” are used to measure the final test results.
3. Test Software version :QuieTek EMI 2.0 V2.1.113.

2. Peak Power Output

2.1. Test Setup



2.2. Limit

The maximum peak power shall be less 1Watt.

2.3. Test Procedure

Tested according to DTS test procedure of KDB 558074 for compliance to FCC 47CFR 15.247 requirements. The maximum peak conducted output power using KDB 558074 section 9.1.3 PKPM1 Peak power meter method.

2.4. Uncertainty

± 1.19 dB

2.5. Test Result of Peak Power Output

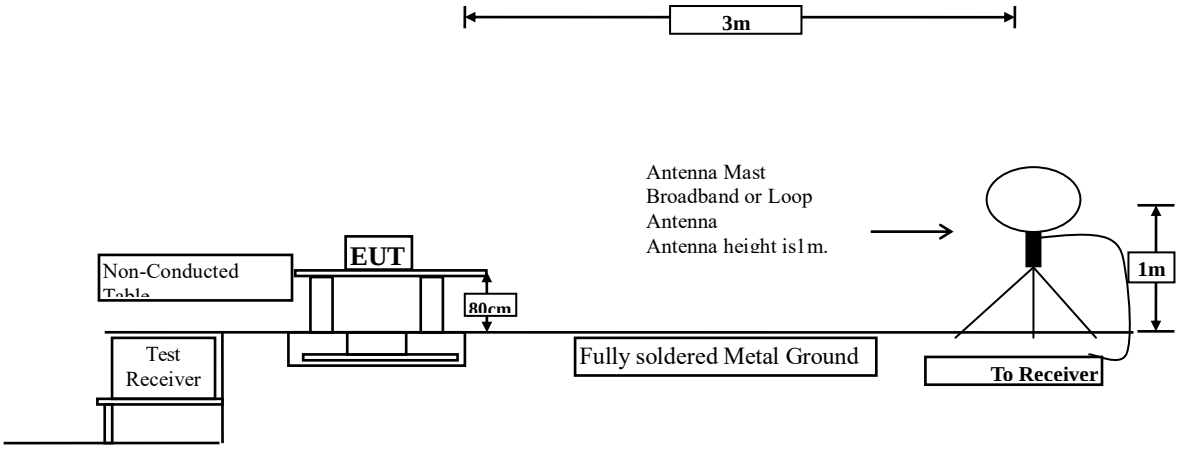
Product : WAH0001
Test Item : Peak Power Output
Test Site : No.3 OATS
Test date : 2018/07/10
Test Mode : Mode 1: Transmit - BLE (GFSK)

Channel No.	Frequency (MHz)	Measurement (dBm)	Required Limit	Result
Channel 00	2402.00	1.89	1 Watt= 30 dBm	Pass
Channel 19	2440.00	2.24	1 Watt= 30 dBm	Pass
Channel 39	2480.00	1.85	1 Watt= 30 dBm	Pass

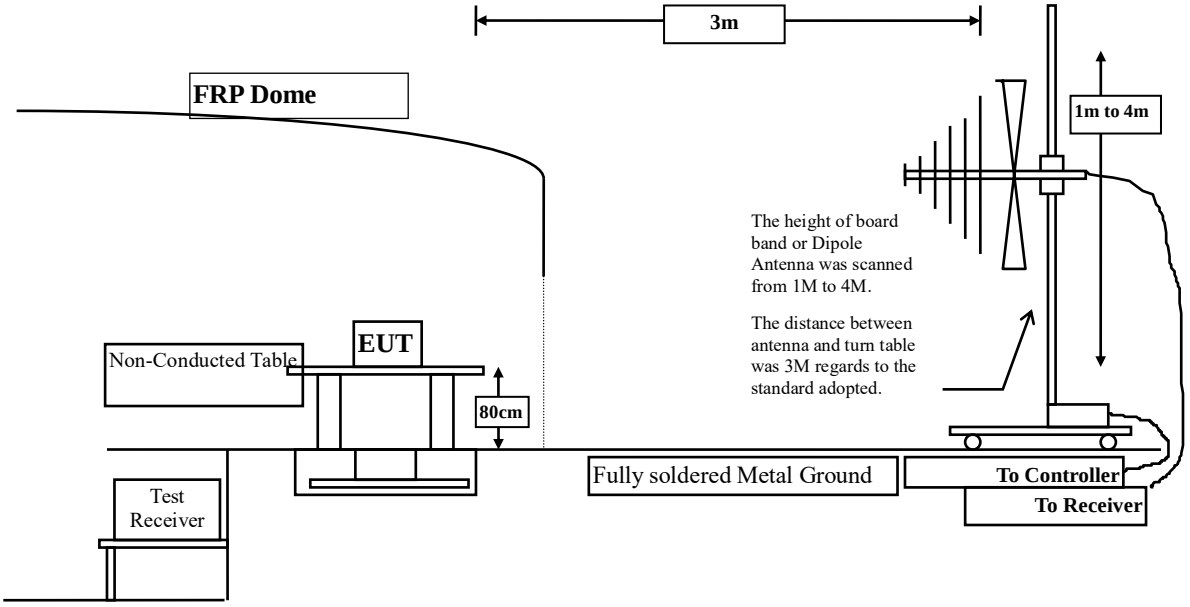
3. Radiated Emission

3.1. Test Setup

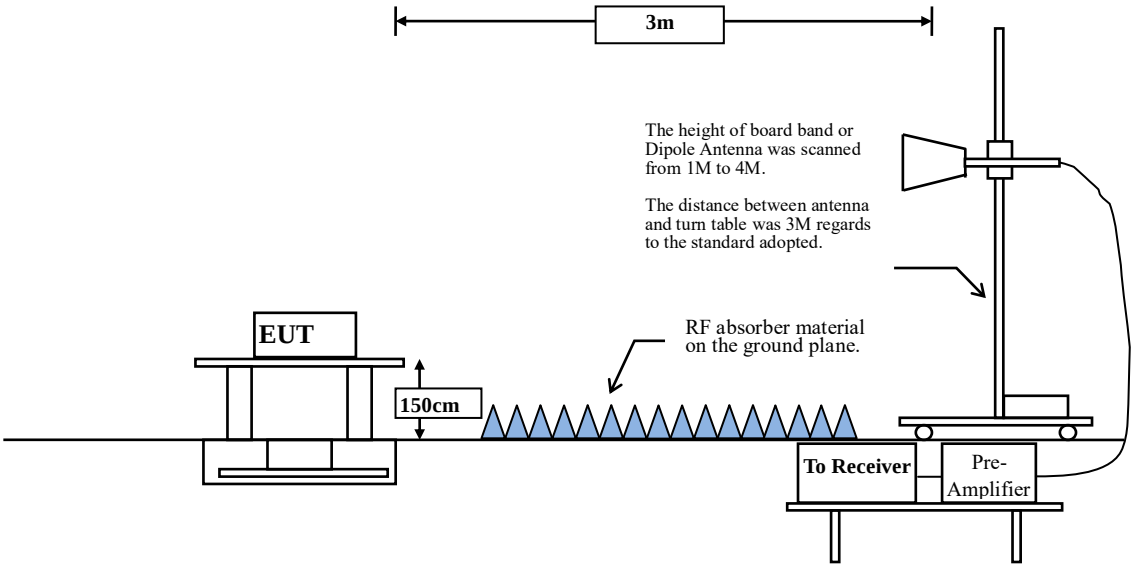
Under 30MHz



Below 1GHz



Above 1GHz


3m
The height of board band or Dipole Antenna was scanned from 1M to 4M.
The distance between antenna and turn table was 3M regards to the standard adopted.
EUT
150cm
RF absorber material on the ground plane.
To Receiver
Pre-Amplifier

3.2. Limits

➢ **General Radiated Emission Limits**

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209 Limits		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
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

Remarks: 1. RF Voltage (dBμV) = 20 log RF Voltage (uV)
2. In the Above Table, the tighter limit applies at the band edges.
3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

3.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground,when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

The turn table is rotated 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2013 on radiated measurement.

The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz is 1MHz.

Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.

The worst radiated emission is measured in the Open Area Test Site on the Final Measurement.

The measurement frequency range form 9kHz - 10th Harmonic of fundamental was investigated.

RBW and VBW Parameter setting:

According to KDB 558074 section 12.2.4. Peak power measurement procedure

RBW = as specified in Table 1.

VBW ≥ 3 x RBW.

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
> 1000 MHz	1 MHz

According to KDB 558074 section 12.2.5. Average power measurement procedure

RBW = 1MHz.

VBW = 10Hz, when duty cycle ≥ 98 %

VBW ≥ 1/T, when duty cycle < 98 %

(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
BLE	64.81	0.4058	2464	3000

Note: Duty Cycle Refer to Section 5.

3.4. Uncertainty

± 4.08 dB above 1GHz

± 4.22 dB below 1GHz

3.5. Test Result of Radiated Emission

Product : WAH0001
Test Item : Harmonic Radiated Emission
Test Site : No.3 OATS
Test date : 2018/07/09
Test Mode : Mode 1: Transmit - BLE (GFSK)(2402MHz)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBμV	dBμV/m	dB	dBμV/m
Horizontal					
Peak Detector:					
4804.000	2.342	43.960	46.302	-27.698	74.000
7206.000	9.700	39.560	49.260	-24.740	74.000
9608.000	10.395	38.970	49.365	-24.635	74.000
Average					
Detector:					
--					
Vertical					
Peak Detector:					
4804.000	2.754	42.930	45.684	-28.316	74.000
7206.000	10.177	39.740	49.917	-24.083	74.000
9608.000	10.848	39.140	49.987	-24.013	74.000
Average					
Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report..

Product	:	WAH0001
Test Item	:	Harmonic Radiated Emission
Test Site	:	No.3 OATS
Test date	:	2018/07/09
Test Mode	:	Mode 1: Transmit - BLE (GFSK) (2440MHz)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBμV	dBμV/m	dB	dBμV/m
Horizontal					
Peak Detector:					
4880.000	1.916	43.840	45.757	-28.243	74.000
7320.000	9.901	39.710	49.611	-24.389	74.000
9760.000	9.801	39.480	49.281	-24.719	74.000
Average					
Detector:					
--					
Vertical					
Peak Detector:					
4880.000	2.377	43.070	45.447	-28.553	74.000
7320.000	10.505	39.530	50.035	-23.965	74.000
9760.000	10.435	39.820	50.255	-23.745	74.000
Average					
Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : WAH0001
Test Item : Harmonic Radiated Emission
Test Site : No.3 OATS
Test date : 2018/07/09
Test Mode : Mode 1: Transmit - BLE (GFSK) (2480MHz)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBμV	dBμV/m	dB	dBμV/m
Horizontal					
Peak Detector:					
4960.000	2.387	43.840	46.227	-27.773	74.000
7440.000	10.517	39.210	49.727	-24.273	74.000
9920.000	10.042	39.530	49.572	-24.428	74.000
Average					
Detector:					
--					
Vertical					
Peak Detector:					
4960.000	3.203	42.630	45.834	-28.166	74.000
7440.000	11.176	40.510	51.686	-22.314	74.000
9920.000	11.081	39.410	50.491	-23.509	74.000
Average					
Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : WAH0001
Test Item : General Radiated Emission
Test Site : No.3 OATS
Test date : 2018/07/06
Test Mode : Mode 1: Transmit - BLE (GFSK) (2440MHz)

Frequency	Correct Factor	Reading Level	Measurement Level	Margin	Limit
MHz	dB	dBμV	dBμV/m	dB	dBμV/m
Horizontal					
76.560	-10.885	45.080	34.195	-5.805	40.000
241.460	-15.822	46.148	30.326	-15.674	46.000
404.420	-8.498	37.684	29.186	-16.814	46.000
499.480	-7.470	41.008	33.538	-12.462	46.000
802.120	-3.725	41.569	37.844	-8.156	46.000
961.200	-3.242	36.800	33.558	-20.442	54.000
Vertical					
90.140	-7.193	39.312	32.119	-11.381	43.500
350.100	-10.603	38.879	28.276	-17.724	46.000
499.480	-9.660	47.922	38.262	-7.738	46.000
600.360	-8.328	39.132	30.804	-15.196	46.000
802.120	-7.115	34.303	27.188	-18.812	46.000
926.280	-6.762	31.847	25.085	-20.915	46.000

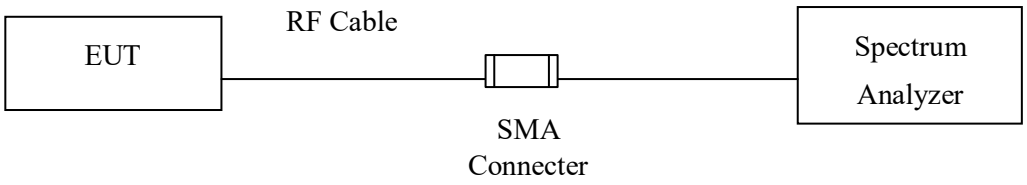
Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
4. The emission levels of other frequencies are very lower than the limit and not show in test report.
5. No emission found between lowest internal used/generated frequency to 30MHz.

4. Band Edge

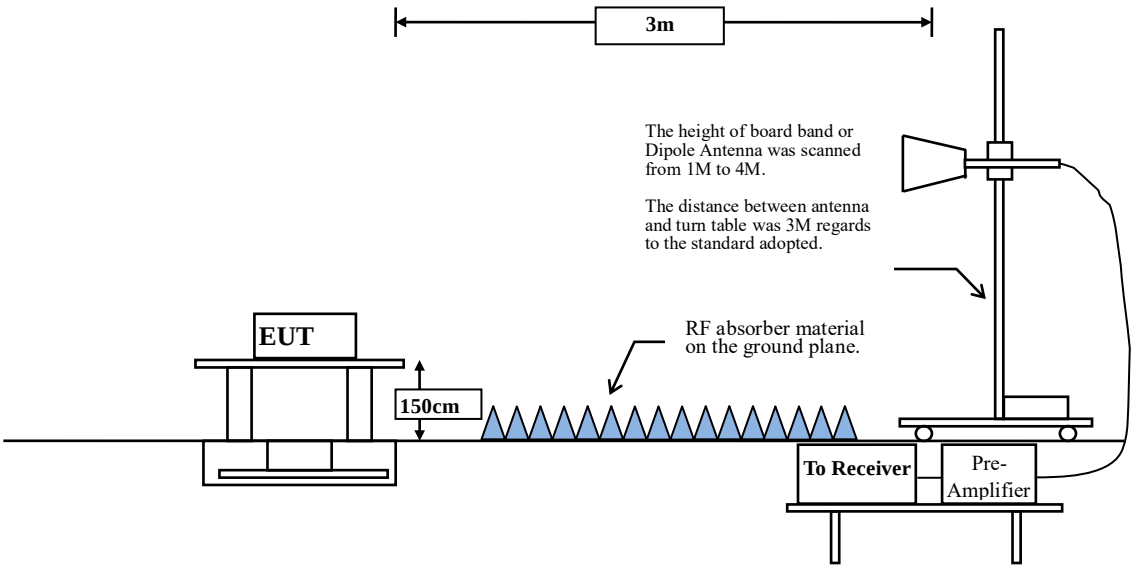
4.1. Test Setup

RF Conducted Measurement



RF Radiated Measurement:

Above 1GHz



4.2. Limit

According to FCC Section 15.247(d). In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

4.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.
The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.

RBW and VBW Parameter setting:

According to KDB 558074 section 12.2.4. Peak power measurement procedure

RBW = as specified in Table 1.

VBW ≥ 3 x RBW.

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
> 1000 MHz	1 MHz

According to KDB 558074 section 12.2.5. Average power measurement procedure

RBW = 1MHz.

VBW = 10Hz, when duty cycle ≥ 98 %

VBW ≥ 1/T, when duty cycle < 98 %

(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
BLE	64.81	0.4058	2464	3000

Note: Duty Cycle Refer to Section 5.

4.4. Uncertainty

± 4.08 dB above 1GHz

± 4.22 dB below 1GHz

4.5. Test Result of Band Edge

Product : WAH0001
Test Item : Band Edge
Test Site : No.3 OATS
Test date : 2018/07/05
Test Mode : Mode 1: Transmit - BLE (GFSK) (2402MHz)

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Result
00 (Peak)	2369.130	6.382	35.547	41.929	74.00	54.00	Pass
00 (Peak)	2390.000	6.474	33.869	40.344	74.00	54.00	Pass
00 (Peak)	2400.000	6.528	48.530	55.058	--	--	--
00 (Peak)	2402.174	6.541	77.983	84.524	--	--	--
00 (Average)	2376.087	6.413	19.153	25.566	74.00	54.00	Pass
00 (Average)	2390.000	6.474	18.090	24.565	74.00	54.00	Pass
00 (Average)	2400.000	6.528	34.507	41.035	--	--	--
00 (Average)	2402.029	6.540	76.033	82.573	--	--	--

Figure Channel 00: Horizontal (Peak)

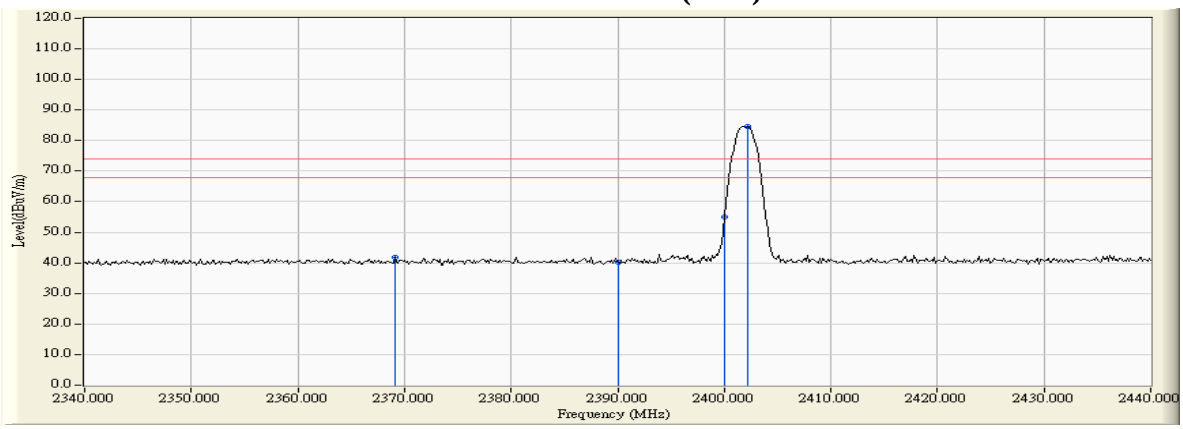
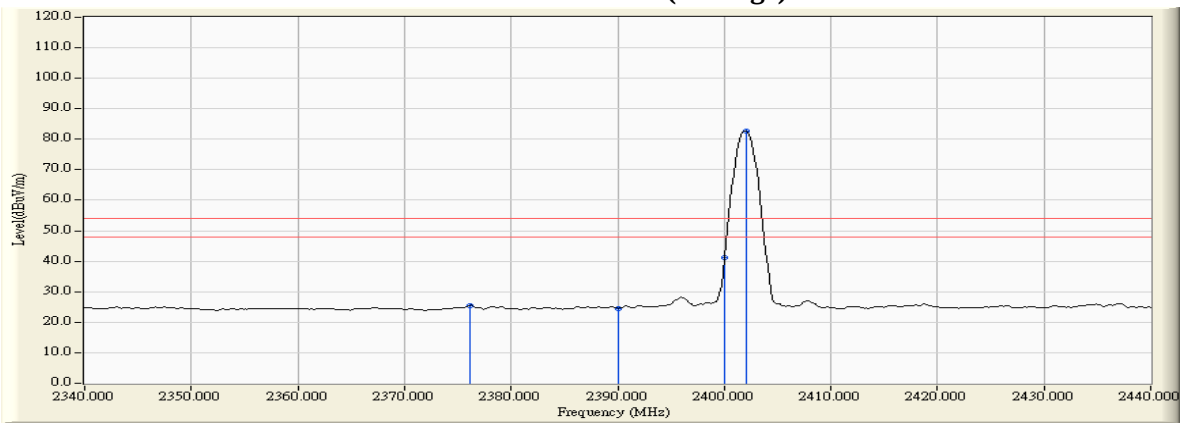


Figure Channel 00: Horizontal (Average)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : WAH0001
Test Item : Band Edge
Test Site : No.3 OATS
Test date : 2018/07/05
Test Mode : Mode 1: Transmit - BLE (GFSK) (2402MHz)

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Result
00 (Peak)	2369.710	5.964	37.452	43.416	74.00	54.00	Pass
00 (Peak)	2390.000	5.880	34.759	40.640	74.00	54.00	Pass
00 (Peak)	2400.000	5.879	55.626	61.505	--	--	--
00 (Peak)	2401.739	5.883	85.193	91.076	--	--	--
00 (Average)	2383.913	5.906	24.030	29.936	74.00	54.00	Pass
00 (Average)	2390.000	5.880	21.663	27.544	74.00	54.00	Pass
00 (Average)	2400.000	5.879	41.092	46.971	--	--	--
00 (Average)	2402.029	5.884	83.019	88.903	--	--	--

Figure Channel 00: Vertical (Peak)

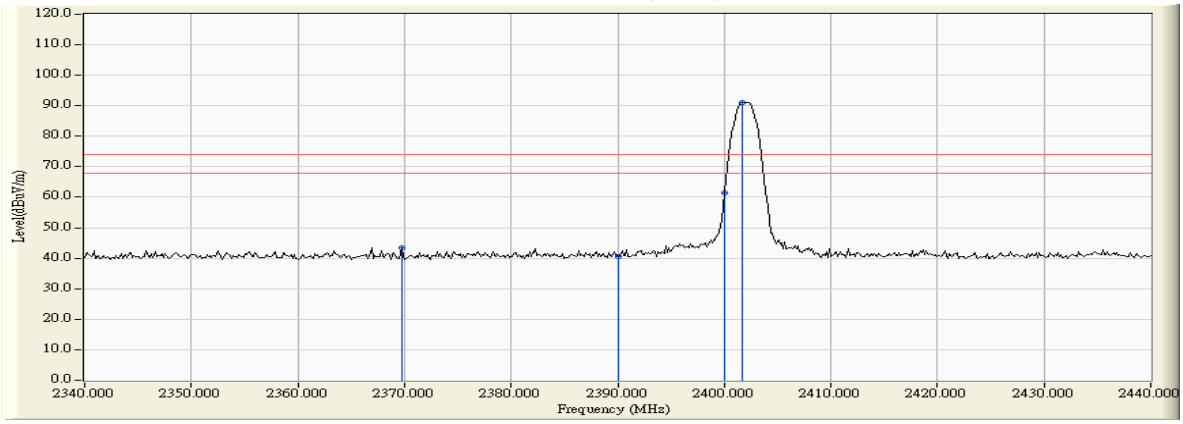
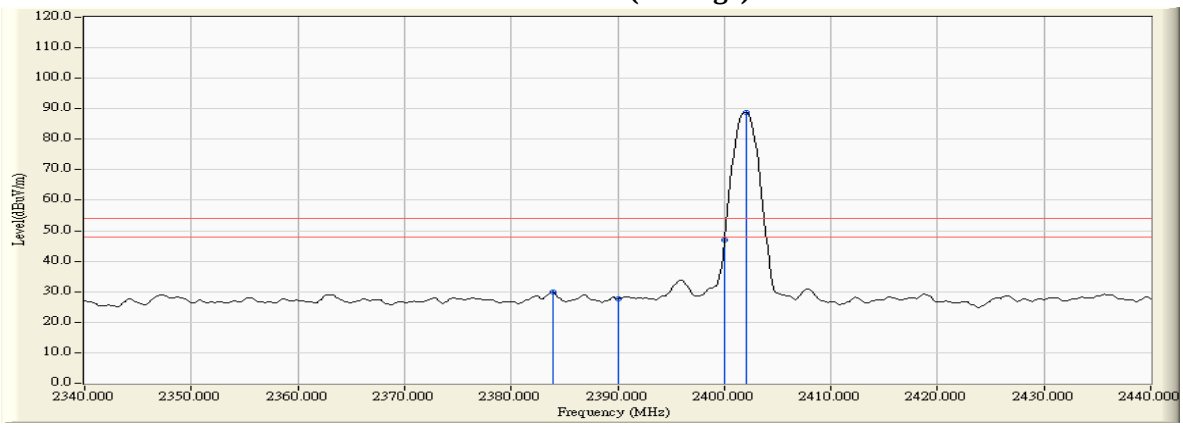


Figure Channel 00: Vertical (Average)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : WAH0001
Test Item : Band Edge
Test Site : No.3 OATS
Test date : 2018/07/05
Test Mode : Mode 1: Transmit - BLE (GFSK) (2480MHz)

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Result
39 (Peak)	2479.732	7.084	79.953	87.036	--	--	--
39 (Peak)	2483.500	7.110	36.435	43.545	74.00	54.00	Pass
39 (Peak)	2499.877	7.190	36.960	44.150	74.00	54.00	Pass
39 (Average)	2480.022	7.086	77.974	85.059	--	--	--
39 (Average)	2483.500	7.110	20.087	27.197	74.00	54.00	Pass
39 (Average)	2490.167	7.157	24.924	32.081	74.00	54.00	Pass

Figure Channel 39: Horizontal (Peak)

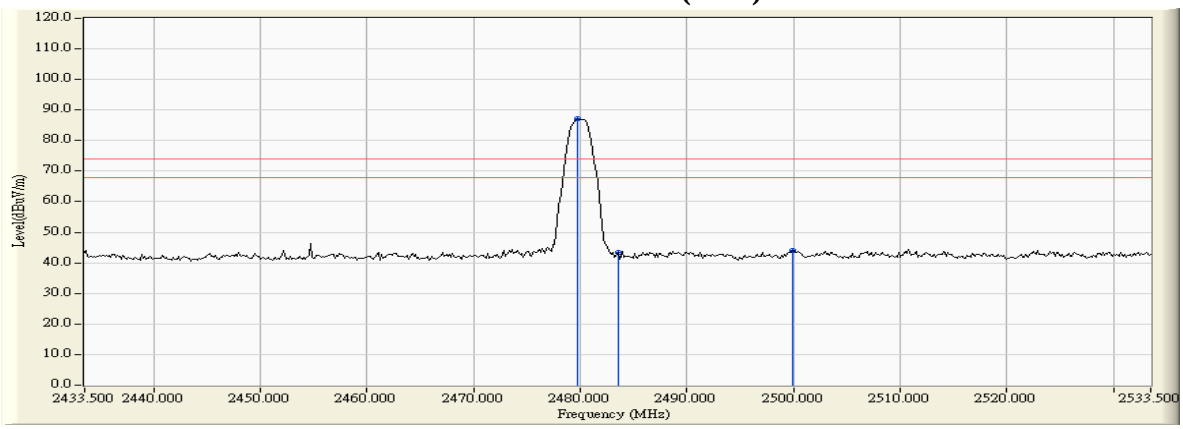
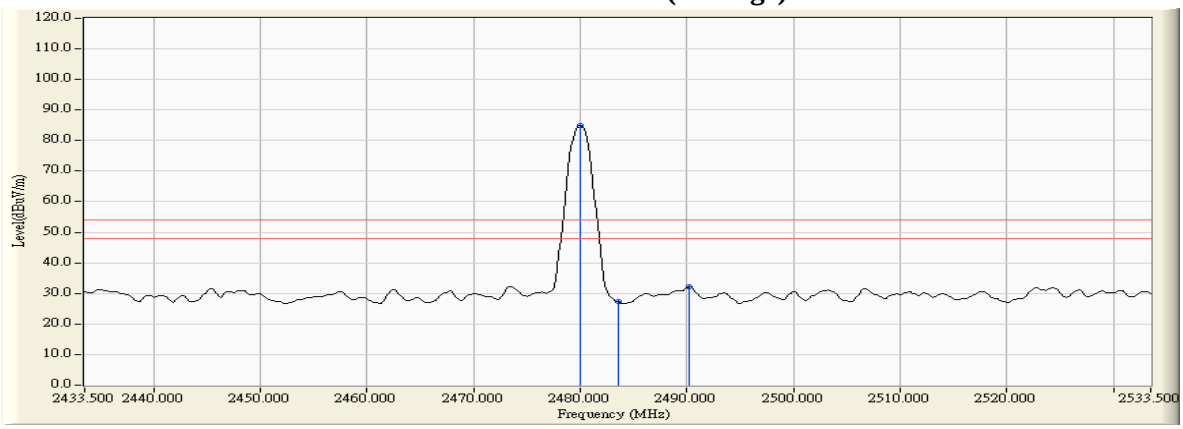


Figure Channel 39: Horizontal (Average)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : WAH0001
Test Item : Band Edge
Test Site : No.3 OATS
Test date : 2018/07/05
Test Mode : Mode 1: Transmit - BLE (GFSK) (2480MHz)

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Result
39 (Peak)	2479.732	6.340	86.480	92.820	--	--	--
39 (Peak)	2483.500	6.363	38.762	45.125	74.00	54.00	Pass
39 (Peak)	2499.877	6.447	40.188	46.635	74.00	54.00	Pass
39 (Average)	2480.022	6.342	84.742	91.084	--	--	--
39 (Average)	2483.500	6.363	20.155	26.518	74.00	54.00	Pass
39 (Average)	2500.022	6.448	26.764	33.212	74.00	54.00	Pass

Figure Channel 39: Vertical (Peak)

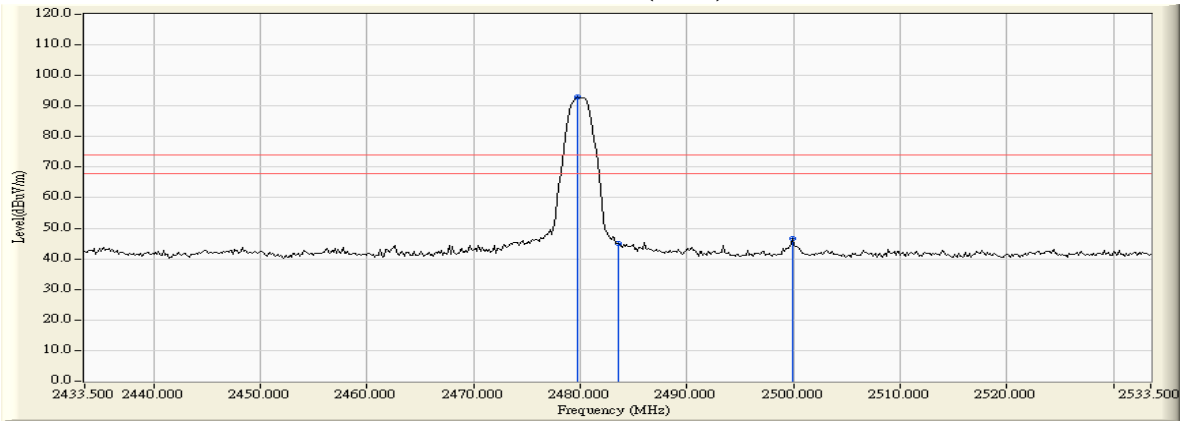
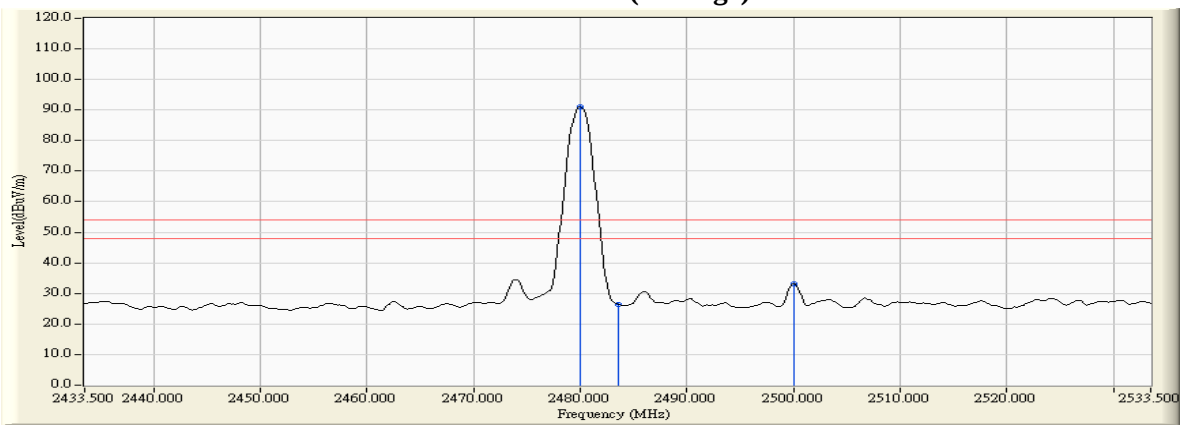


Figure Channel 39: Vertical (Average)

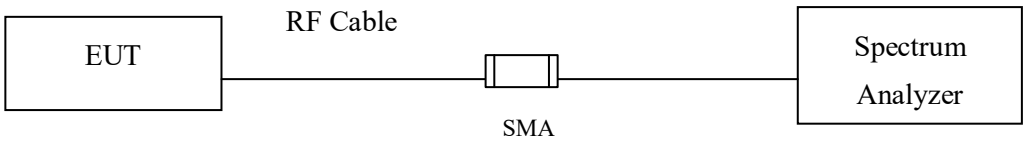


Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

5. Duty Cycle

5.1. Test Setup



5.2. Test Procedure

The EUT was setup according to ANSI C63.10 2013; tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

5.3. Uncertainty

± 25msec

5.4. Test Result of Duty Cycle

Product : WAH0001
Test Item : Duty Cycle
Test Mode : Transmit

Duty Cycle Formula:
Duty Cycle = Ton / (Ton + Toff)
Duty Factor = 10 Log (1/Duty Cycle)

Results:

2.4GHz band	Ton (ms)	Ton + Toff (ms)	Duty Cycle (%)	Duty Factor (dB)
BLE	0.4058	0.6261	64.81	1.88