

Test Report

FCC Part15 Subpart C

Product Name : Wahoo GPS BIKE COMPUTER

Model No. : WFCC1

FCC ID : PADWF112

IC : 10563A-WF112

Applicant : Wahoo Fitness, LLC.

Address : 90 W. Wieuca Road, #110, Atlanta, Georgia,
30342 United States

Date of Receipt : Oct. 12, 2015

Test Date : Oct. 13, 2015~ Nov.03, 2015

Issued Date : Nov. 05, 2015

Report No. : 15A0041R-RF-US-P06V01

Report Version : V 1.0



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration of the equipment and evaluated measurement uncertainty herein.

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Test Report Certification

Issued Date : Nov. 05, 2015

Report No. : 15A0041R-RF-US-P06V01



Product Name : Wahoo GPS BIKE COMPUTER
Applicant : Wahoo Fitness, LLC.
Address : 90 W. Wieuca Road, #110, Atlanta, Georgia, 30342 United States
Manufacturer : Weifang GoerTek Electronics Co.,Ltd
Address : Gaoxin 2 Road, Free Trade Zone, Weifang, Shandong, 261205, P.R.China
Model No. : WFCC1
FCC ID : PADWF112
IC : 10563A-WF112
EUT Voltage : DC 3.5V-4.2V
Brand Name : Wahoo
Applicable Standard : FCC CFR Title 47 Part 15 Subpart C: 2014
ANSI C63.4: 2014; ANSI C63.10: 2013
Industry Canada RSS-Gen Issue 4/RSS-247 Issue 1
Test Result : Complied
Performed Location : Suzhou EMC Laboratory
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TEL: +86-512-6251-5088 / FAX: +86-512-6251-5098
FCC Registration Number: 800392; IC Lab Code: 4075B

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We, **Quietek Corporation**, are an independent EMC and safety consultancy that was established the whole facility in our laboratories. The test facility has been accredited/accepted(audited or listed) by the following related bodies in compliance with ISO 17025, EN 45001 and specified testing scope:

Taiwan R.O.C.	:	BSMI, NCC, TAF
USA	:	FCC
Japan	:	VCCI
China	:	CNAS

The related certificate for our laboratories about the test site and management system can be downloaded from Quietek Corporation's Web Site :<http://www.quietek.com/tw/ctg/cts/accreditations.htm>
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History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
15A0041R-RF-US-P06V01	V1.0	Initial Issued Report	Nov. 05, 2015

1. General Information

1.1. EUT Description

Product Name	Wahoo GPS BIKE COMPUTER
Brand Name	Wahoo
Model No.	WFCC1
Working Voltage	DC 3.5V-4.2V
Bluetooth Specification	V3.0+V4.1
Frequency Range	2402- 2480 MHz
Channel Number	V3.0: 79 V4.1: 40
Channel Separation	V3.0: 1MHz V4.1: 2MHz
Type of Modulation	V3.0: GFSK, Pi/4 DQPSK, 8DPSK V4.1: GFSK
Data Rate	V3.0: 1Mbps(GFSK), 2Mbps(Pi/4 DQPSK), 3Mbps (8DPSK) V4.1: 1Mbps(GFSK)
Antenna Type	Reference to Antenna List
Peak Antenna Gain	Reference to Antenna List

Bluetooth Working Frequency of Each Channel: (For V3.0)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
00	2402 MHz	01	2403 MHz	02	2404 MHz	03	2405 MHz
04	2406 MHz	05	2407 MHz	06	2408 MHz	07	2409 MHz
08	2410 MHz	09	2411 MHz	10	2412 MHz	11	2413 MHz
12	2414 MHz	13	2415 MHz	14	2416 MHz	15	2417 MHz
16	2418 MHz	17	2419 MHz	18	2420 MHz	19	2421 MHz
20	2422 MHz	21	2423 MHz	22	2424 MHz	23	2425 MHz
24	2426 MHz	25	2427 MHz	26	2428 MHz	27	2429 MHz
28	2430 MHz	29	2431 MHz	30	2432 MHz	31	2433 MHz
32	2434 MHz	33	2435 MHz	34	2436 MHz	35	2437 MHz
36	2438 MHz	37	2439 MHz	38	2440 MHz	39	2441 MHz
40	2442 MHz	41	2443 MHz	42	2444 MHz	43	2445 MHz
44	2446 MHz	45	2447 MHz	46	2448 MHz	47	2449 MHz
48	2450 MHz	49	2451 MHz	50	2452 MHz	51	2453 MHz
52	2454 MHz	53	2455 MHz	54	2456 MHz	55	2457 MHz
56	2458 MHz	57	2459 MHz	58	2460 MHz	59	2461 MHz
60	2462 MHz	61	2463 MHz	62	2464 MHz	63	2465 MHz
64	2466 MHz	65	2467 MHz	66	2468 MHz	67	2469 MHz
68	2470 MHz	69	2471 MHz	70	2472 MHz	71	2473 MHz
72	2474 MHz	73	2475 MHz	74	2476 MHz	75	2477 MHz
76	2478 MHz	77	2479 MHz	78	2480 MHz	N/A	N/A

Bluetooth Antenna List

Antenna	Manufacturer	Model No.	Peak Gain
PIFA Antenna	Walsin	N/A	2.58dBi for 2.4GHz

1.2 Mode of Operation

QuieTek has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Transmitter-1Mbps(GFSK_DH5)
Mode 2: Transmitter-2Mbps(Pi/4 DQPSK_DH5)
Mode 3: Transmitter-3Mbps(8DPSK_DH5)

Note:

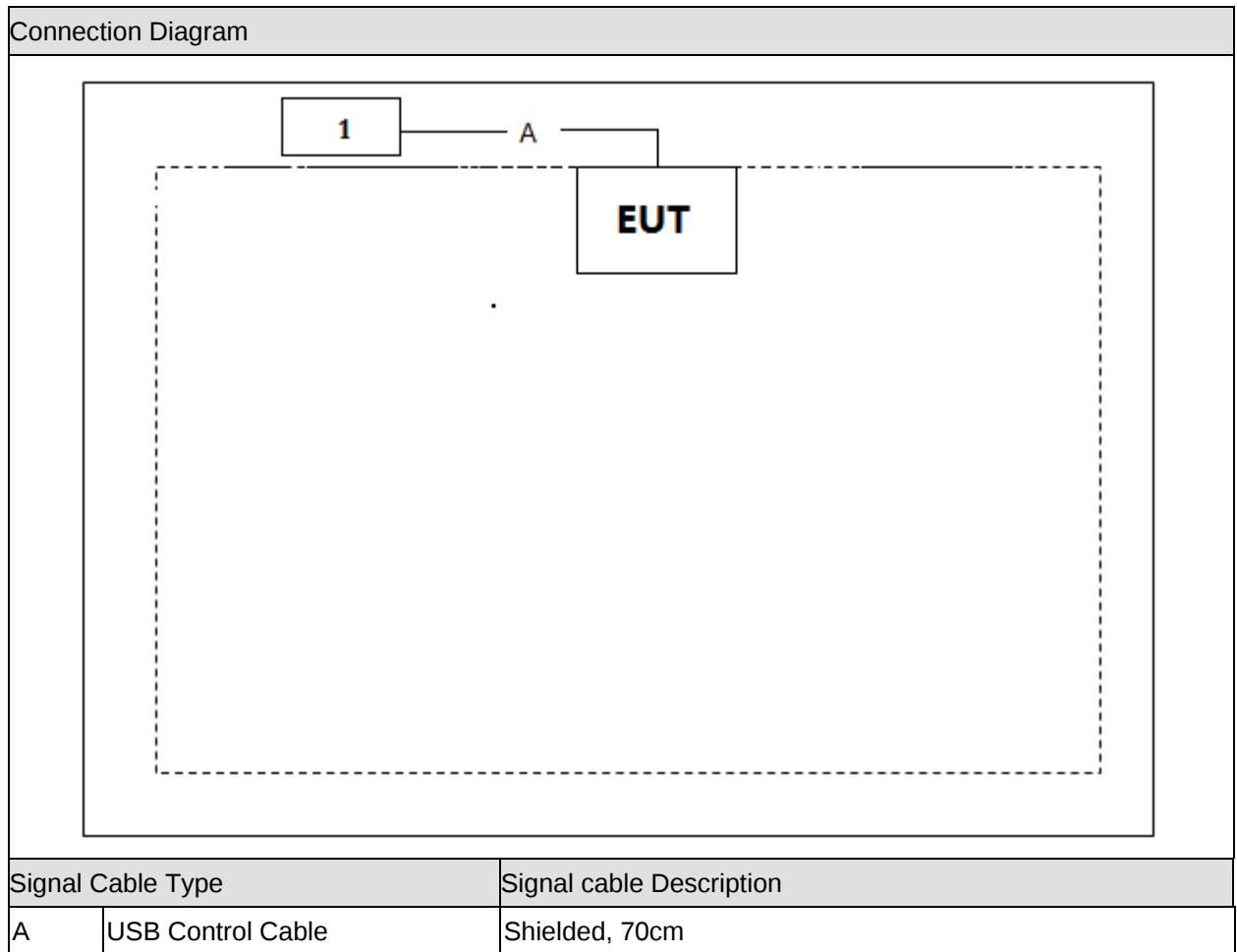
1. For portable device, radiated spurious emission was verified over X, Y, Z Axis, and shown the worst case on this report.
2. Regards to the frequency band operation for systems using FHSS modulation: normal operation (hopping) was selected to test for conducted, and the lowest, highest frequency channel for radiation spurious test.
3. The extreme test condition for voltage and temperature were declared by the manufacturer.
4. The reading values of all the test items contain cable loss.

1.3 Tested System Details

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

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	N/A	N/A	N/A	N/A	N/A

1.4 Configuration of Tested System



1.5 EUT Exercise Software

1	Setup the EUT and simulators as shown on above.
2	Turn on the power of all equipment.
3	Run the RF test software "Blue Test 3", and set the test mode and channel, then press OK to start continue Transmit.

2. Technical Test

2.1. Summary of Test Result

- ☒ No deviations from the test standards
☐ Deviations from the test standards as below description:

For FCC

Performed Test Item	Normative References	Test Performed	Deviation
Conducted Emission	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.207	Yes	No
Radiated Emission	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.209	Yes	No
20dB Bandwidth	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.247(a)(1)	Yes	No
Carrier Frequency Separation	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.247(a)(1)	Yes	No
Number of Hopping Frequencies	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.247(a)(1)(iii)	Yes	No
Time of Occupancy (Dwell Time)	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.247(a)(1)(iii)	Yes	No
Peak Output Power	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.247(b)(1)	Yes	No
Band-edge Compliance of RF Conducted Emissions	FCC CFR Title 47 Part 15 Subpart C: 2014 Section 15.215(c), 15.247(d)	Yes	No
Spurious RF Conducted Emissions	FCC CFR Title 47 Part 15 Subpart C: 2014 15.247(d)	Yes	No
Radiated Emission Band Edge	FCC CFR Title 47 Part 15 Subpart C: 2014 15.247(d)	Yes	No

For IC

Performed Test Item	Normative References	Test Performed	Deviation
Conducted Emission	RSS-Gen Issue 4 Section 8.8	Yes	No
Radiated Emission	RSS-Gen Issue 4 Section 8.9	Yes	No
20dB Bandwidth	RSS-247 Issue 1 Section 5.1	Yes	No
Carrier Frequency Separation	RSS-247 Issue 1 Section 5.1	Yes	No
Number of Hopping Frequencies	RSS-247 Issue 1 Section 5.1	Yes	No
Time of Occupancy (Dwell Time)	RSS-247 Issue 1 Section 5.1	Yes	No
Peak Output Power	RSS-247 Issue 1 Section 5.4	Yes	No
Band-edge Compliance of RF Conducted Emissions	RSS-247 Issue 1 Section 5.5	Yes	No
Spurious RF Conducted Emissions	RSS-247 Issue 1 Section 5.5	Yes	No
Radiated Emission Band Edge	RSS-Gen Issue 4 Section 8.10	Yes	No

2.2. Test Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	21
Humidity (%RH)	25-75	50
Barometric pressure (mbar)	860-1060	950-1000

3. Conducted Emission

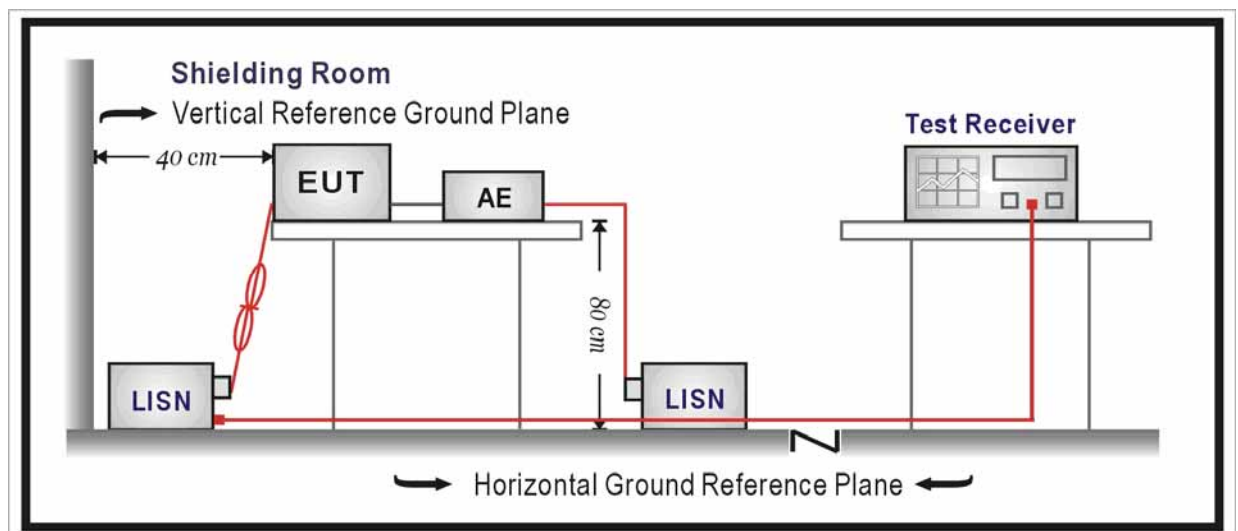
3.1. Test Equipment

Conducted Emission / TR-1

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
EMI Test Receiver	R&S	ESCI	100726	2016.03.10
Two-Line V-Network	R&S	ENV216	100043	2016.03.10
Two-Line V-Network	R&S	ENV216	100044	2016.09.16
50ohm Coaxial Switch	Anritsu	MP59B	6200464462	2016.03.01
50ohm Termination	SHX	TF2	07081401	2016.09.16
Temperature/Humidity Meter	zhicheng	ZC1-2	TR1-TH	2016.01.07

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

3.2. Test Setup



3.3. Limit

FCC Part 15 Subpart C Paragraph 15.207 Limits		
Frequency (MHz)	QP (dBuV)	AV (dBuV)
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

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

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

3.4. Test Procedure

According to FCC ANSI C63.4: 2014 & ANSI C63.10: 2013.

The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)

Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.

The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

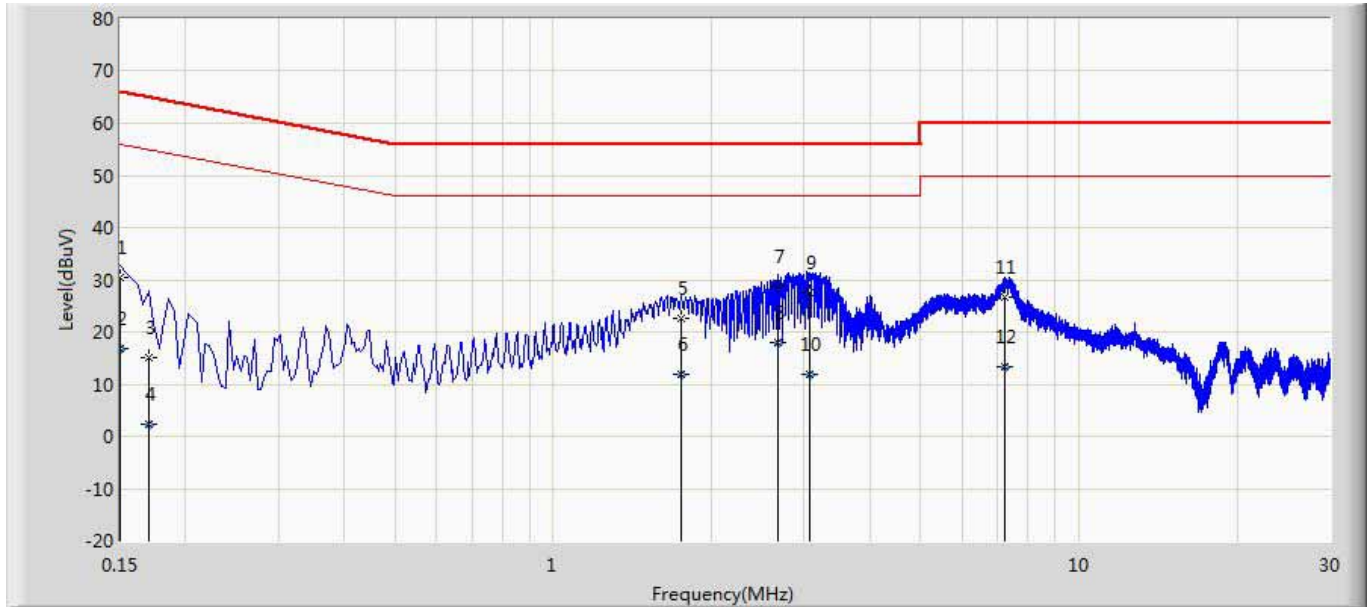
Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

3.5. Uncertainty

The measurement uncertainty is defined as ± 2.02 dB

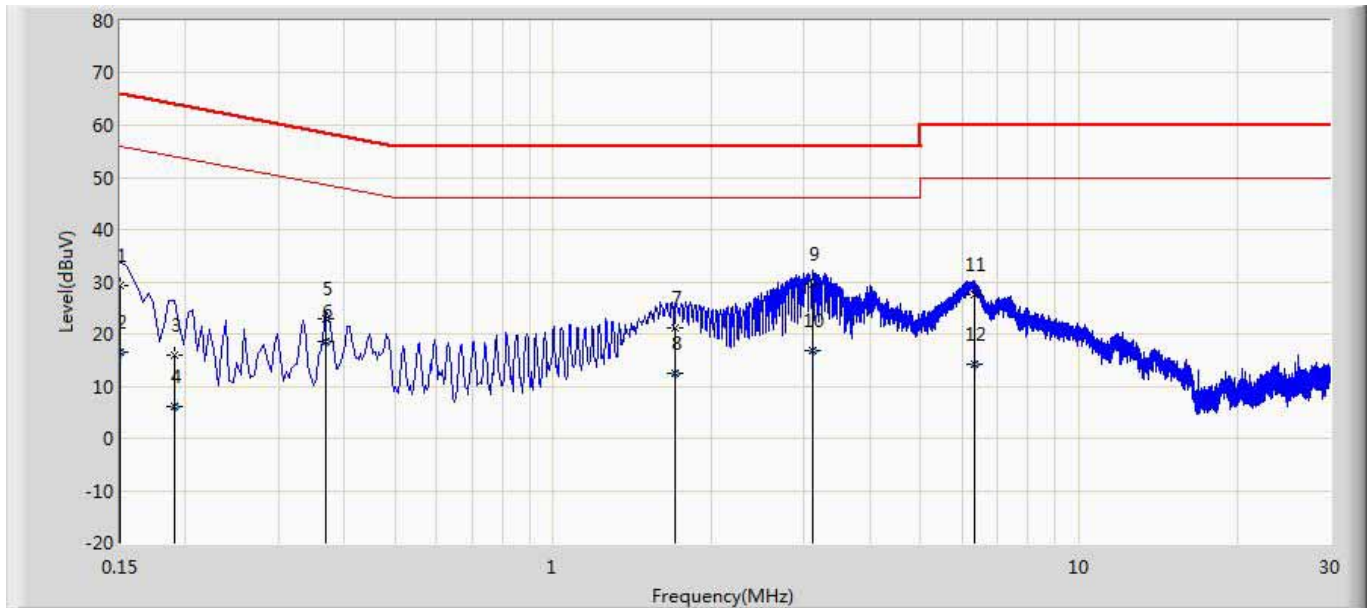
3.6. Test Result

Site: TR1	Time: 2015/10/19 - 16:02
Limit: FCC_Part15.107_CE_AC Power_ClassB	Margin: 0
Probe: ENV216_101044(0.009-30MHz)	Polarity: Line
EUT: Wahoo GPS BIKE COMPUTER	Power: AC 120V/60Hz
Note: Mode 1	



No	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1		0.150	30.541	20.722	-35.459	66.000	9.819	QP
2		0.150	16.938	7.119	-39.062	56.000	9.819	AV
3		0.170	15.193	5.375	-49.767	64.960	9.818	QP
4		0.170	2.195	-7.623	-52.765	54.960	9.818	AV
5		1.750	22.488	12.704	-33.512	56.000	9.784	QP
6		1.750	11.775	1.990	-34.225	46.000	9.784	AV
7	*	2.674	28.682	18.886	-27.318	56.000	9.795	QP
8		2.674	18.112	8.317	-27.888	46.000	9.795	AV
9		3.066	27.575	17.769	-28.425	56.000	9.806	QP
10		3.066	11.868	2.062	-34.132	46.000	9.806	AV
11		7.246	26.592	16.689	-33.408	60.000	9.903	QP
12		7.246	13.302	3.399	-36.698	50.000	9.903	AV

Site: TR1	Time: 2015/10/19 - 16:08
Limit: FCC_Part15.107_CE_AC Power_ClassB	Margin: 0
Probe: ENV216_101044(0.009-30MHz)	Polarity: Neutral
EUT: Wahoo GPS BIKE COMPUTER	Power: AC 120V/60Hz
Note: Mode 1	



No	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1		0.150	29.235	19.289	-36.765	66.000	9.946	QP
2		0.150	16.571	6.625	-39.429	56.000	9.946	AV
3		0.190	16.026	6.132	-48.011	64.037	9.894	QP
4		0.190	6.022	-3.872	-48.014	54.037	9.894	AV
5		0.370	23.036	13.074	-35.465	58.501	9.962	QP
6		0.370	18.565	8.603	-29.936	48.501	9.962	AV
7		1.710	21.033	11.070	-34.967	56.000	9.964	QP
8		1.710	12.380	2.416	-33.620	46.000	9.964	AV
9	*	3.122	29.647	19.650	-26.353	56.000	9.997	QP
10		3.122	16.717	6.720	-29.283	46.000	9.997	AV
11		6.314	27.514	17.355	-32.486	60.000	10.159	QP
12		6.314	14.180	4.021	-35.820	50.000	10.159	AV

Note: All the low ,middle and high channels of all different modes are investigated, and only report the worst case.

4. Radiated Emission

4.1. Test Equipment

Radiated Emission / AC-2

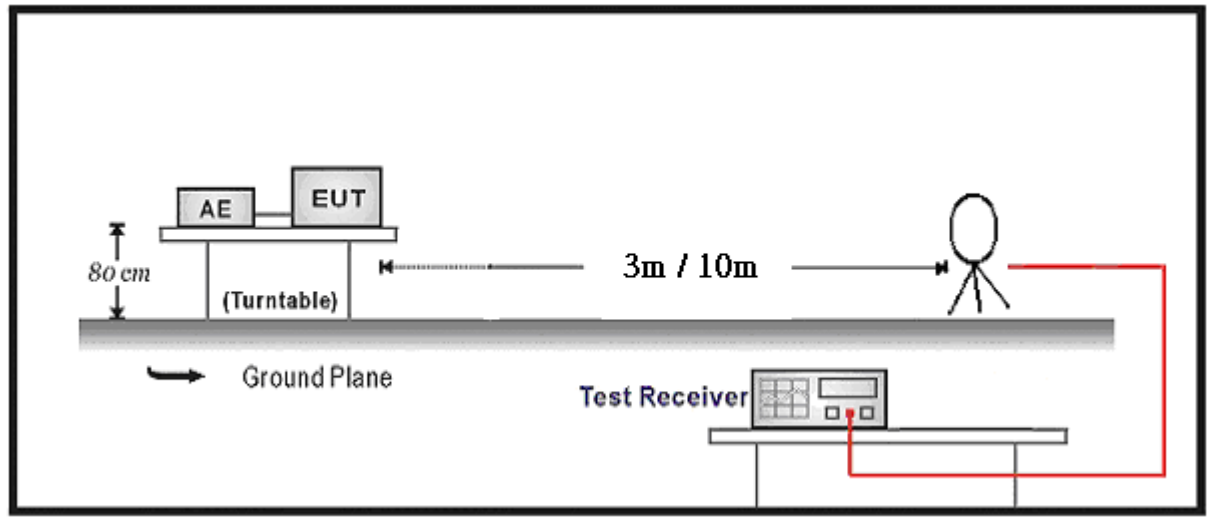
Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
EMI Test Receiver	R&S	ESCI	100573	2016.03.10
Loop Antenna	R&S	HFH2-Z2	833799/003	2015.11.25
Bilog Antenna	Teseq GmbH	CBL6112D	27611	2016.10.10
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC2-C	2016.03.01
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC2-TH	2016.01.07

Radiated Emission / AC-5

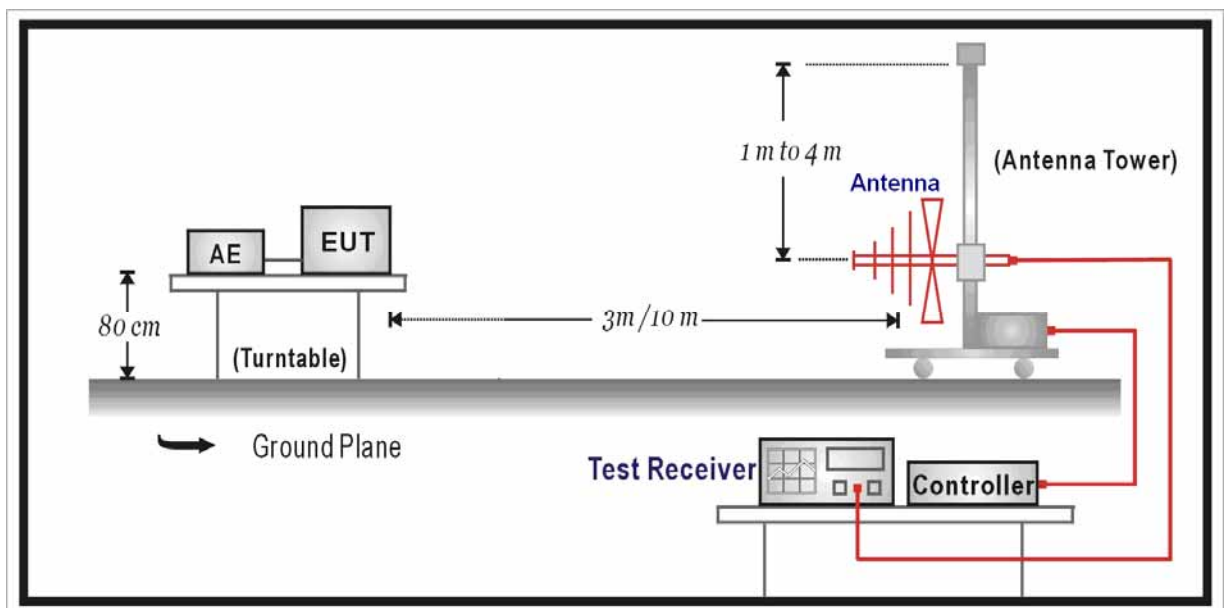
Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.03.10
Preamplifier	Miteq	NSP1800-25	1364185	2016.05.03
Preamplifier	QuieTek	AP-040G	CHM-0906001	2016.05.03
Bilog Antenna	Teseq GmbH	CBL6112D	27612	2016.10.15
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	499	2016.06.08
Broad-Band Horn Antenna	Schwarzbeck	BBHA9170	294	2016.04.10
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C1	2016.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C2	2016.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 102	AC5-C3	2016.03.01
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC5-TH	2016.01.07

4.2. Test Setup

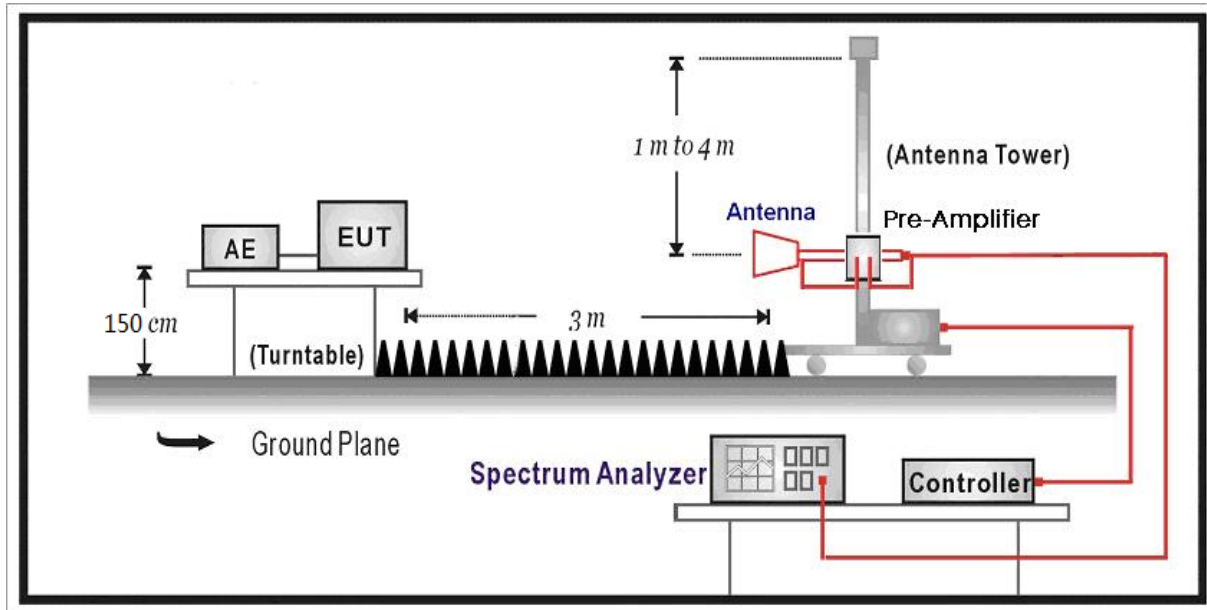
Below 30MHz Test Setup:



Below 1GHz Test Setup:



Above 1GHz Test Setup:



4.3. Limit

FCC Part 15 Subpart C Paragraph 15.209		
Frequency (MHz)	Distance (m)	Level (dBuV/m)
30 - 88	3	40
88 - 216	3	43.5
216 - 960	3	46
Above 960	3	54

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

Note 2: Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

Note 3: E field strength (dBuV/m) = 20 log E field strength (uV/m)

4.4. Test Procedure

According to ANSI C63.4: 2014; ANSI C63.10: 2013.

The EUT is placed on a turn table which is 1.5 meter for above 1G and 0.8 meter for below 1G 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 C63.4: 2014 on radiated measurement.

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

The frequency range from 30MHz to 10th harmonic is checked.

Note: When doing emission measurement above 1GHz, the horn antenna will be bended down a little (as horn antenna has the narrow beamwidth) in order to keeping the antenna in the “cone of radiation” of EUT. The 3dB beamwidth is 60~10 degrees for H-plane and 90~10 degrees for E-plane.

4.5. Uncertainty

The measurement uncertainty above 1G is defined as ± 3.9 dB
below 1G is defined as ± 3.8 dB

4.6. Test Result

All of the test result shown indicates the worst case, and spectrum analyzer parameters setting as shown below:

Peak detector: RBW = 1MHz, VBW = 3MHz, sweep time = 200ms;

Average detector: RBW = 1MHz, VBW = 10Hz, sweep time = auto.

Measure Level = Reading Level + Cable Loss + Antenna Factor – Preamplifier Gain

Mode 1: Transmitter-1Mbps(GFSK_DH5)

CH	Antenna	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
0	H	4804.0	51.4	-6.7	44.7	54(Note3)	-9.3	PK
	V	4804.0	52.0	-6.7	45.3	54(Note3)	-8.7	PK
	H	7206.0	50.5	-2.9	47.6	54(Note3)	-6.4	PK
	V	7206.0	50.1	-2.9	47.2	54(Note3)	-6.8	PK
	H	9608.0	47.4	0.9	48.3	54(Note3)	-5.7	PK
	V	9608.0	47.4	0.9	48.3	54(Note3)	-5.7	PK
39	H	4882.0	50.9	-6.6	44.3	54(Note3)	-9.7	PK
	V	4882.0	51.4	-6.7	44.7	54(Note3)	-9.3	PK
	H	7324.0	49.9	-2.8	47.1	54(Note3)	-6.9	PK
	V	7323.1	50.6	-2.7	47.9	54(Note3)	-6.1	PK
	H	9764.0	50.7	1.3	52	54(Note3)	-2.0	PK
	V	9764.0	48.5	1.3	49.8	54(Note3)	-4.2	PK
78	H	4960.0	56.8	-6.3	50.5	54(Note3)	-3.5	PK
	V	4960.0	50.8	-6.4	44.4	54(Note3)	-9.6	PK
	H	7443.0	48.3	-2.6	45.7	54(Note3)	-8.3	PK
	V	7440.0	48.6	-2.6	46.0	54(Note3)	-8.0	PK
	H	9920.0	49.8	0.8	50.6	54(Note3)	-3.4	PK
	V	9920.0	48.7	0.8	49.5	54(Note3)	-4.5	PK

Note 1: The test frequency range, 9kHz~30MHz, 18GHz~25GHz, both of the worst case are at least 6dB below the limits, therefore no data appear in the report.

2: This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.

3: Measure Level = Reading Level + Factor.

Mode 2: Transmitter-2Mbps(Pi/4 DQPSK _DH5)

CH	Antenna	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
0	H	4804.0	51.8	-6.7	45.1	54(Note3)	-8.9	PK
	V	4804.0	52.0	-6.6	45.4	54(Note3)	-8.6	PK
	H	7206.0	50.6	-2.9	47.7	54(Note3)	-6.3	PK
	V	7206.0	51.2	-2.9	48.3	54(Note3)	-5.7	PK
	H	9608.0	46.9	1.0	47.9	54(Note3)	-6.1	PK
	V	9608.0	47.2	0.9	48.1	54(Note3)	-5.9	PK
39	H	4882.0	51.6	-6.6	45.0	54(Note3)	-9.0	PK
	V	4882.0	51.2	-6.6	44.6	54(Note3)	-9.4	PK
	H	7324.0	50.7	-2.7	48.0	54(Note3)	-6.0	PK
	V	7323.0	51.0	-2.8	48.2	54(Note3)	-5.8	PK
	H	9764.0	50.5	1.3	51.8	54(Note3)	-2.2	PK
	V	9764.0	48.8	1.3	50.1	54(Note3)	-3.9	PK
78	H	4960.0	57.6	-6.3	51.3	54(Note3)	-2.7	PK
	V	4960.0	57.4	-6.3	51.1	54(Note3)	-2.9	PK
	H	7443.0	49.4	-2.6	46.8	54(Note3)	-7.2	PK
	V	7440.0	48.7	-2.6	46.1	54(Note3)	-7.9	PK
	H	9920.0	48.8	0.9	49.7	54(Note3)	-4.3	PK
	V	9920.0	49.0	0.8	49.8	54(Note3)	-4.2	PK

Note 1: The test frequency range, 9kHz~30MHz, 18GHz~25GHz, both of the worst case are at least 6dB below the limits, therefore no data appear in the report.

2: This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.

3: Measure Level = Reading Level + Factor.

Mode 3: Transmitter-3Mbps(8DPSK_DH5)

CH	Antenna	Frequency (MHz)	Reading Level (dBuV/m)	Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
0	H	4808.0	45.6	-6.6	52.2	54(Note3)	-1.8	PK
	V	4799.5	45.3	-6.6	51.9	54(Note3)	-2.1	PK
	H	7206.0	47.2	-2.9	50.1	54(Note3)	-3.9	PK
	V	7206.0	48.1	-2.9	51.0	54(Note3)	-3.0	PK
	H	9608.0	48.2	0.9	47.3	54(Note3)	-6.7	PK
	V	9608.0	47.7	0.9	46.8	54(Note3)	-7.2	PK
39	H	4882.0	46.1	-6.7	52.7	54(Note3)	-1.3	PK
	V	4882.0	44.9	-6.6	51.5	54(Note3)	-2.5	PK
	H	7324.0	47.2	-2.7	50.0	54(Note3)	-4.0	PK
	V	7323.0	47.2	-2.7	49.9	54(Note3)	-4.1	PK
	H	9764.0	50.1	1.3	48.7	54(Note3)	-5.3	PK
	V	9764.0	50.0	1.3	48.7	54(Note3)	-5.3	PK
78	H	4960.0	45.9	-6.3	52.2	54(Note3)	-1.8	PK
	V	4960.0	46.3	-6.3	52.6	54(Note3)	-1.4	PK
	H	7440.0	45.9	-2.6	48.6	54(Note3)	-5.4	PK
	V	7443.0	46.5	-2.6	49.2	54(Note3)	-4.8	PK
	H	9920.0	50.4	0.8	49.6	54(Note3)	-4.4	PK
	V	9920.0	50.0	0.8	49.1	54(Note3)	-4.9	PK

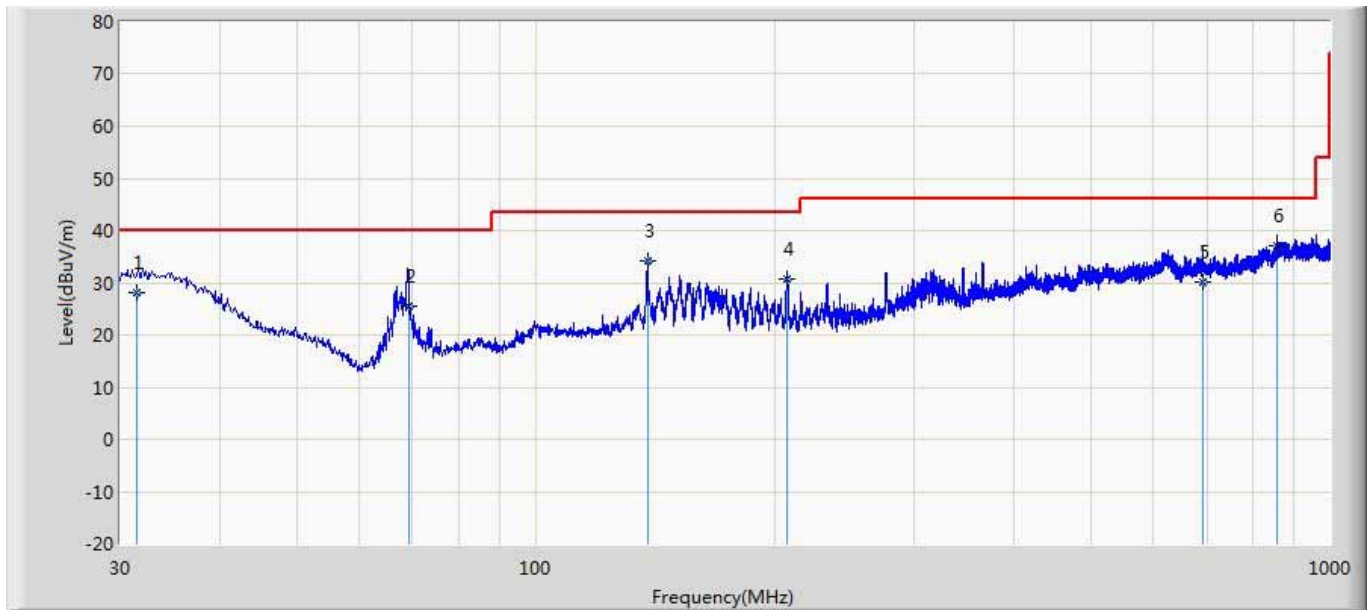
Note 1: The test frequency range, 9kHz~30MHz, 18GHz~25GHz, both of the worst case are at least 6dB below the limits, therefore no data appear in the report.

2: This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.

3: Measure Level = Reading Level + Factor.

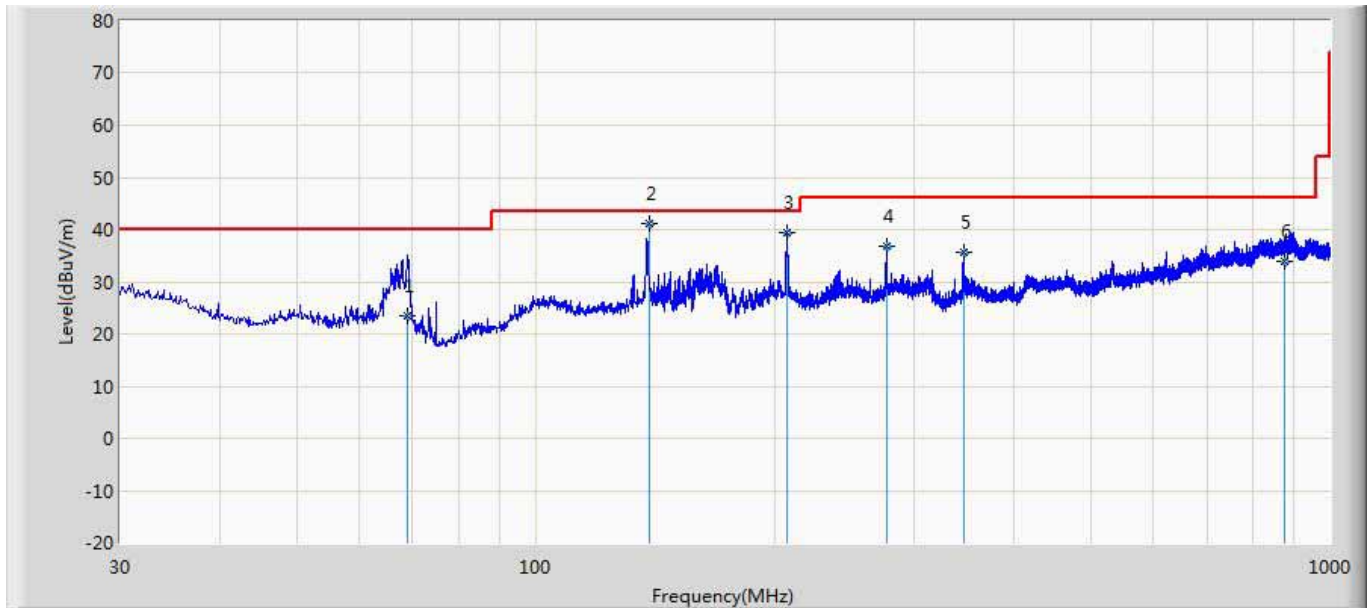
The worst case of Radiated Emission below 1GHz:

Engineer: Yves	
Site: AC2	Time: 2015/10/20 - 11:55
Limit: FCC_Part15.109_RE(3m)_ClassB	Margin: 0
Probe: AC2_10M(30-1000M)	Polarity: Horizontal
EUT: Wahoo GPS BIKE COMPUTER	Power: AC 120V/60Hz
Note: Mode 1	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		31.516	28.075	0.800	-11.925	40.000	27.275	QP
2		69.430	25.365	13.918	-14.635	40.000	11.447	QP
3		138.393	34.307	16.767	-9.193	43.500	17.540	QP
4		207.731	30.709	13.445	-12.791	43.500	17.264	QP
5		691.703	30.203	1.000	-15.797	46.000	29.203	QP
6	*	859.564	37.235	4.912	-8.765	46.000	32.322	QP

Engineer: Yves	
Site: AC2	Time: 2015/10/20 - 12:15
Limit: FCC_Part15.109_RE(3m)_ClassB	Margin: 0
Probe: AC2_10M(30-1000M)	Polarity: Vertical
EUT: Wahoo GPS BIKE COMPUTER	Power: AC 120V/60Hz
Note: Mode 1	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		69.023	23.544	8.333	-16.456	40.000	15.211	QP
2	*	138.919	41.082	22.700	-2.418	43.500	18.382	QP
3		207.612	39.439	16.024	-4.061	43.500	23.414	QP
4		277.014	36.815	12.376	-9.185	46.000	24.439	QP
5		346.305	35.740	11.520	-10.260	46.000	24.220	QP
6		878.403	33.821	0.648	-12.179	46.000	33.173	QP

5. 20dB Bandwidth

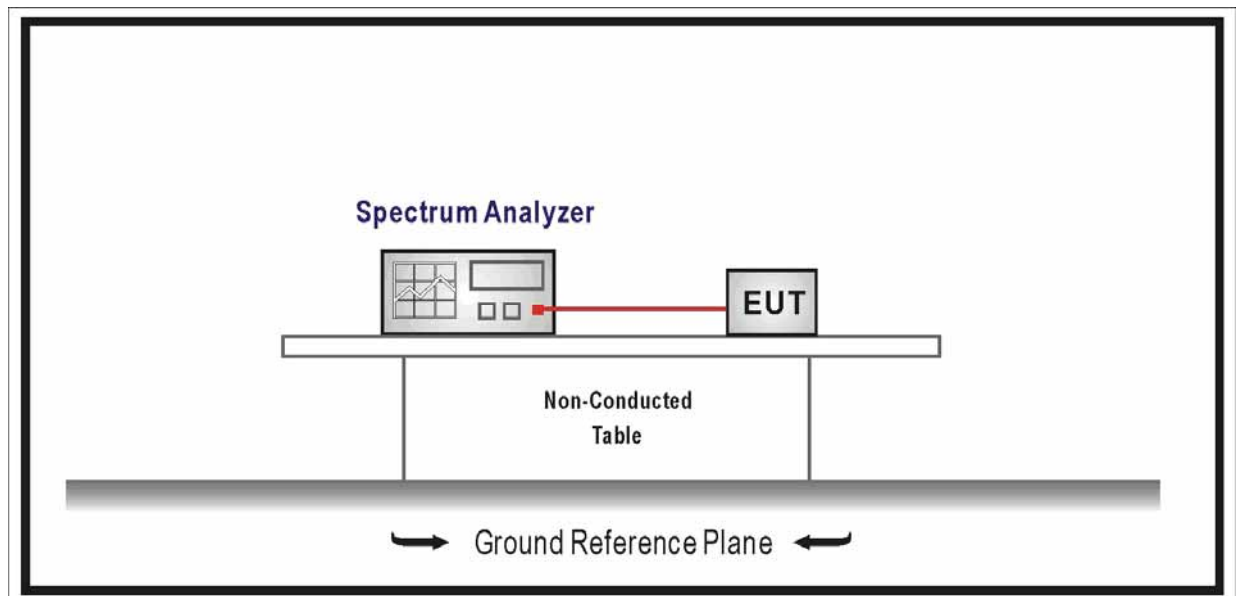
5.1 Test Equipment

20dB Bandwidth / TR8

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.03.10
Temperature/Humidity Meter	Zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

5.2 Test Setup



5.3 Limit

- For frequency hopping systems operating in 2400-2483.5 MHz band, no limitation.
- For frequency hopping systems operating in 902-928 MHz band, the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
- For frequency hopping systems operating in 5725-5850 MHz band, the maximum 20 dB bandwidth of the hopping channel is 1 MHz.

5.4 Test Procedure

According to ANSI C63.10: 2013& ANSI C63.4: 2014

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel

RBW $\geq$ 1% of the 20dB bandwidth

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize.

Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.

5.5 Uncertainty

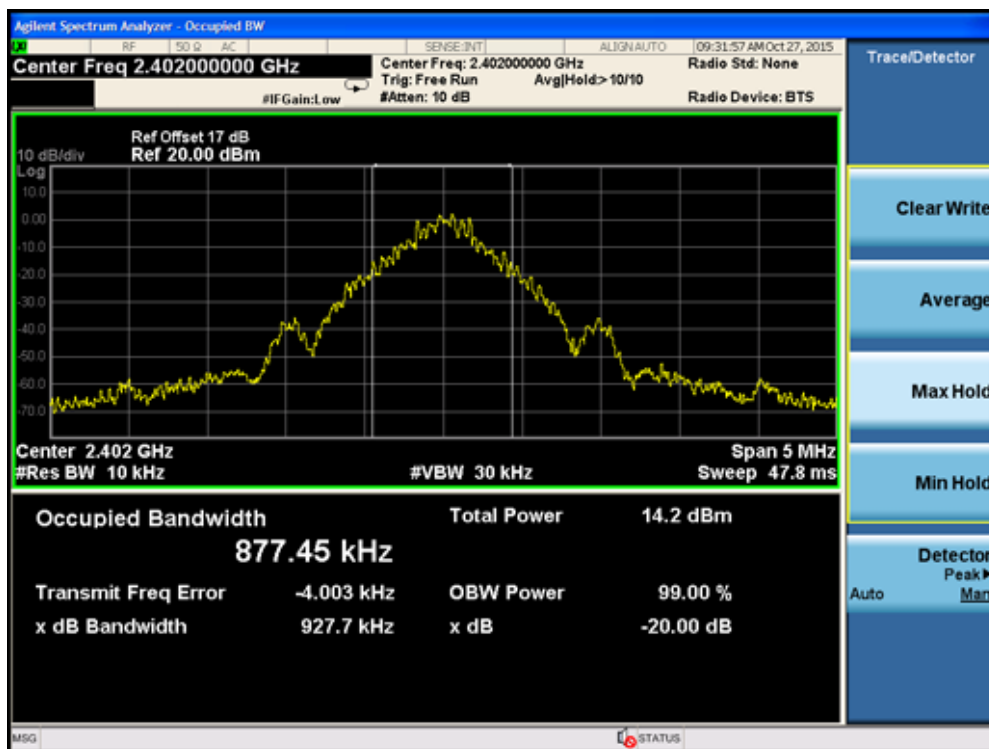
The measurement uncertainty is defined as ± 1 kHz

5.6 Test Result

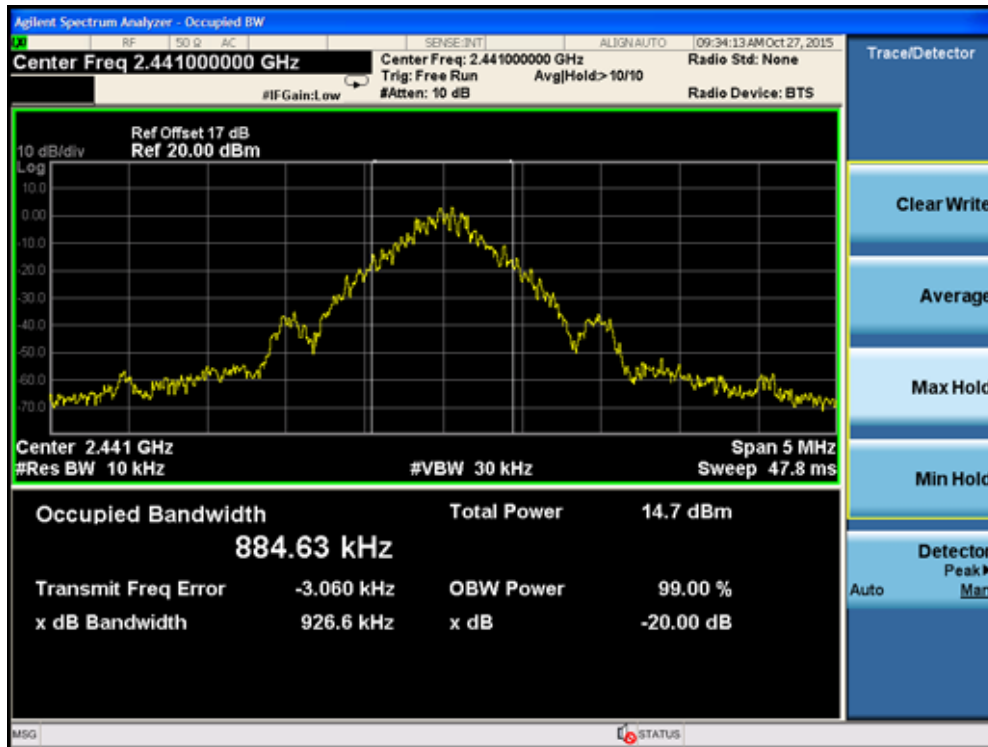
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Occupied Bandwidth
Test Site	:	TR-8
Test Mode	:	Mode 1: Transmitter-1Mbps (GFSK_DH5)

Channel No.	Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
00	2402	927.70	877.45
39	2441	926.60	884.63
78	2480	927.30	892.54

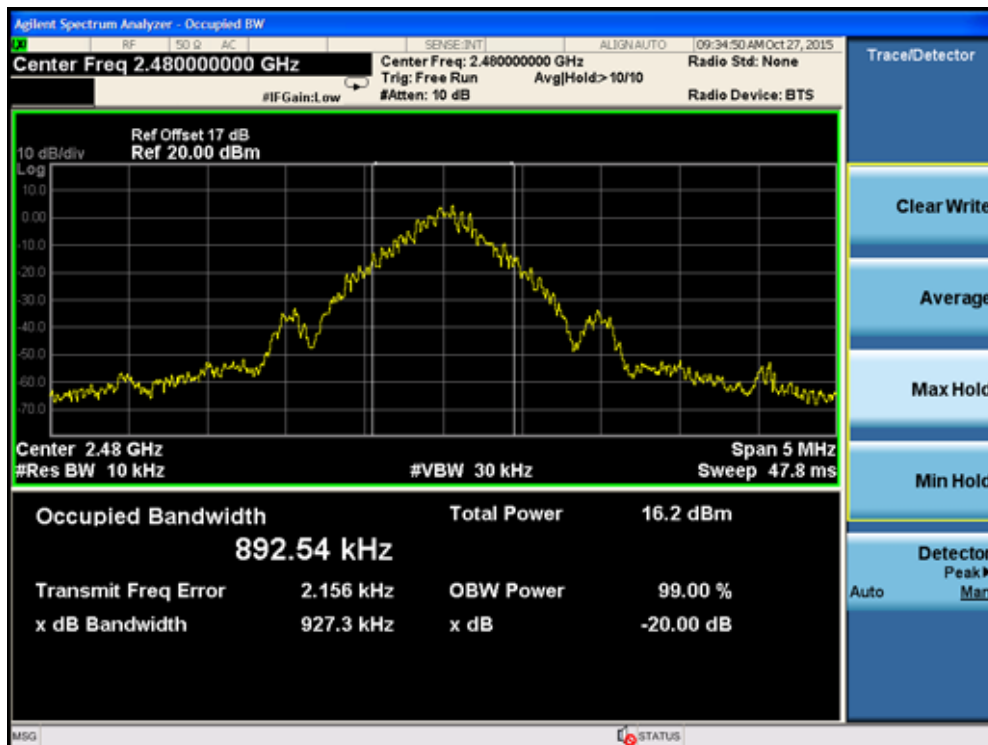
Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)



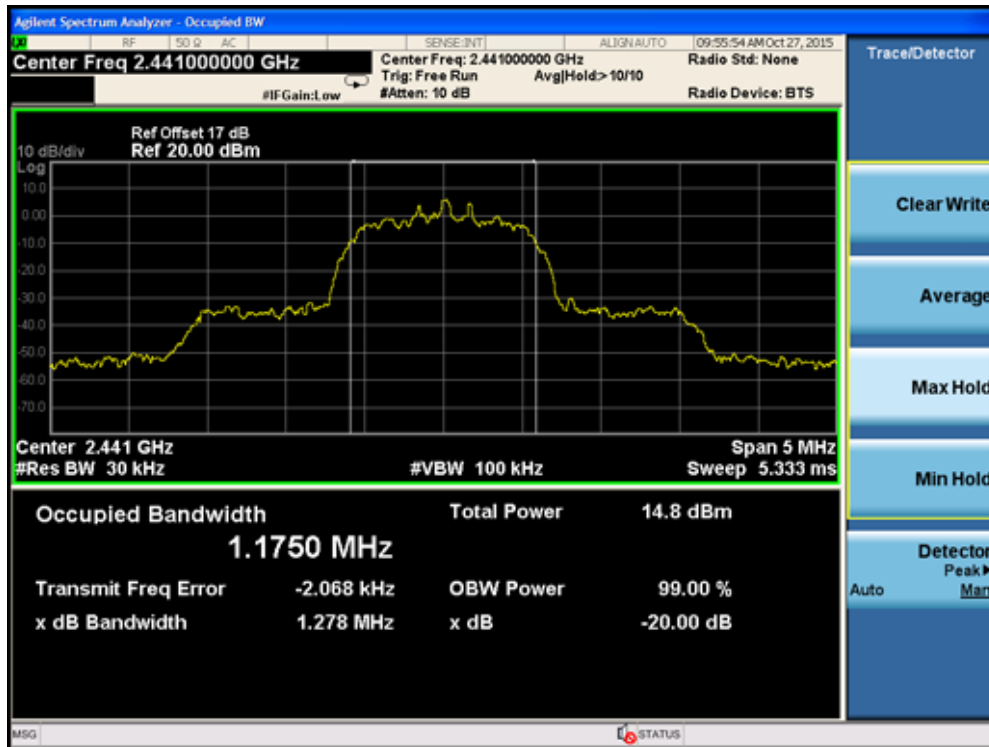
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Occupied Bandwidth
Test Site	:	TR-8
Test Mode	:	Mode 2: Transmitter-2Mbps (Pi/4 DQPSK_DH5)

Channel No.	Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
00	2402	1283.0	1169.5
39	2441	1278.0	1175.0
78	2480	1281.0	1170.2

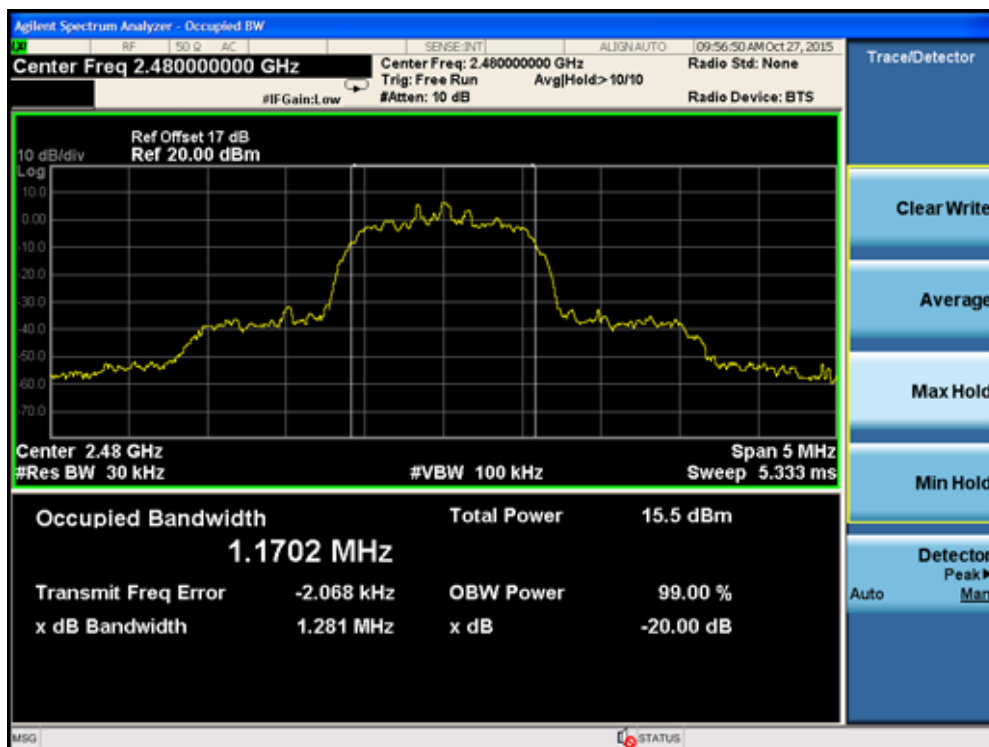
Channel 00 (2402MHz)



Channel 39 (2441MHz)



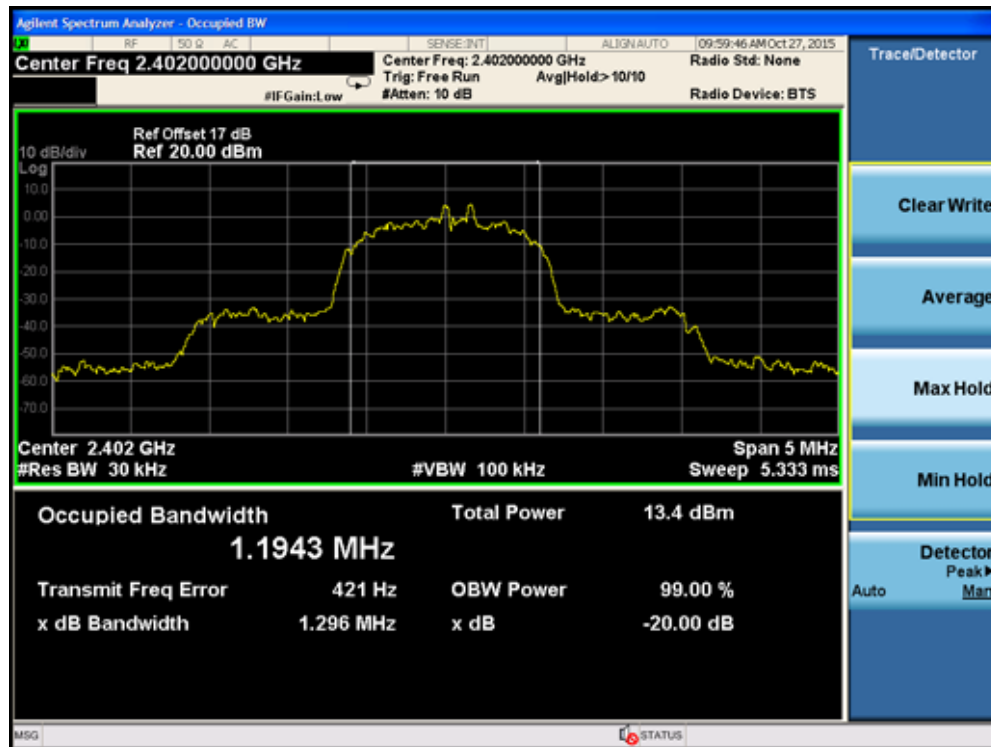
Channel 78 (2480MHz)



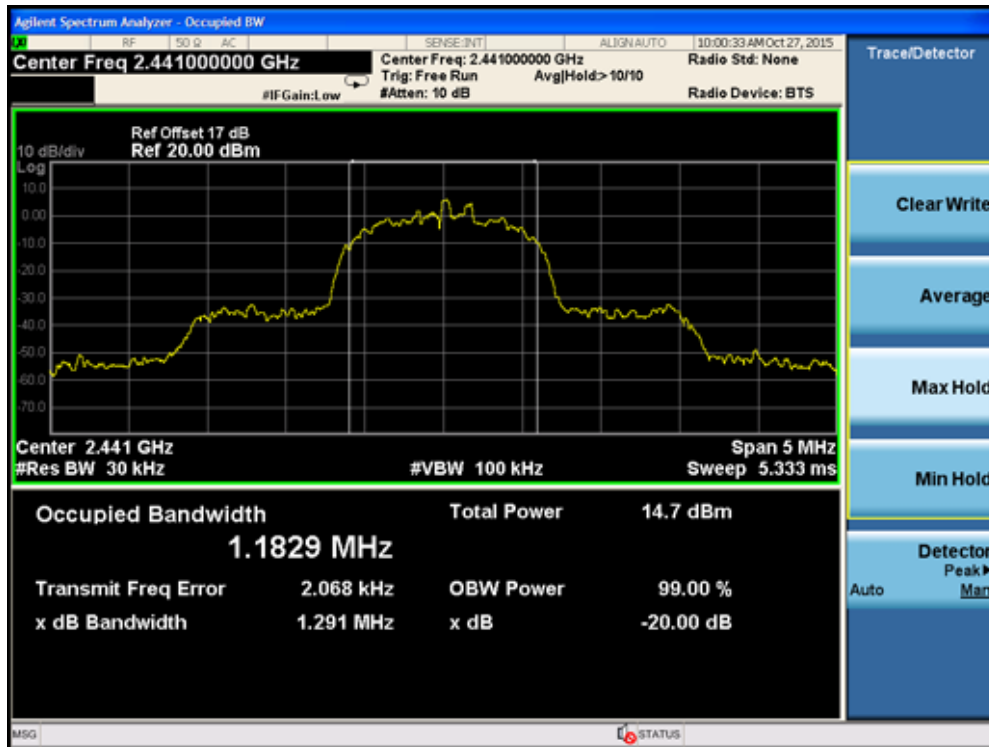
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Occupied Bandwidth
Test Site	:	TR-8
Test Mode	:	Mode 3: Transmitter-3Mbps (8DPSK_DH5)

Channel No.	Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
00	2402	1296.0	1194.3
39	2441	1291.0	1182.9
78	2480	1292.0	1181.3

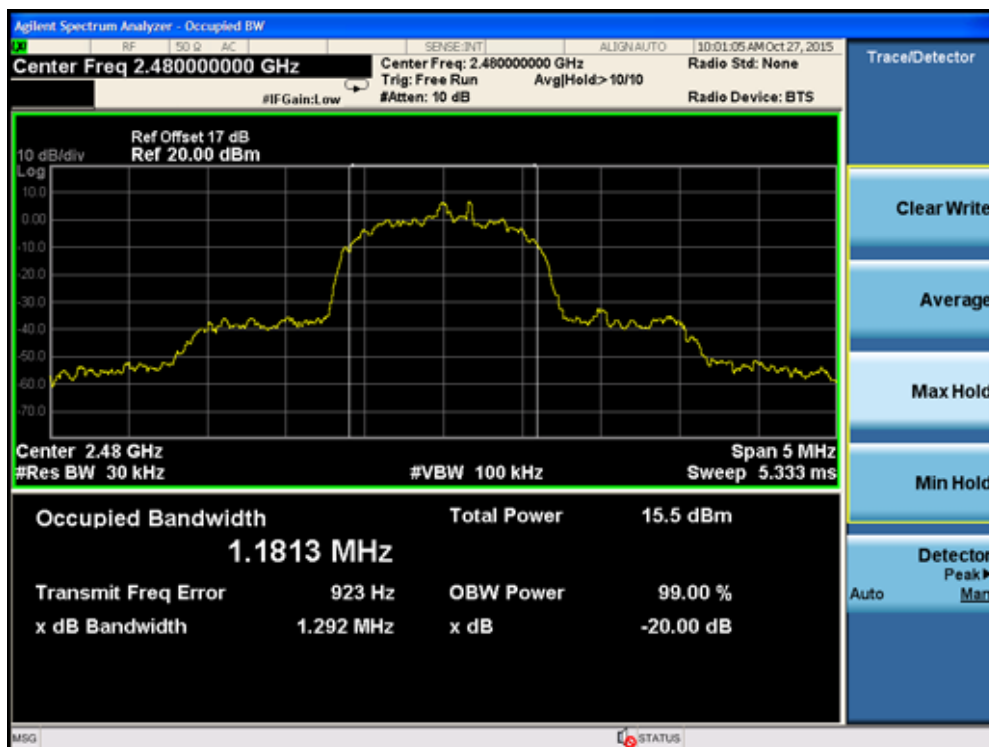
Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)



6. Carrier Frequency Separation

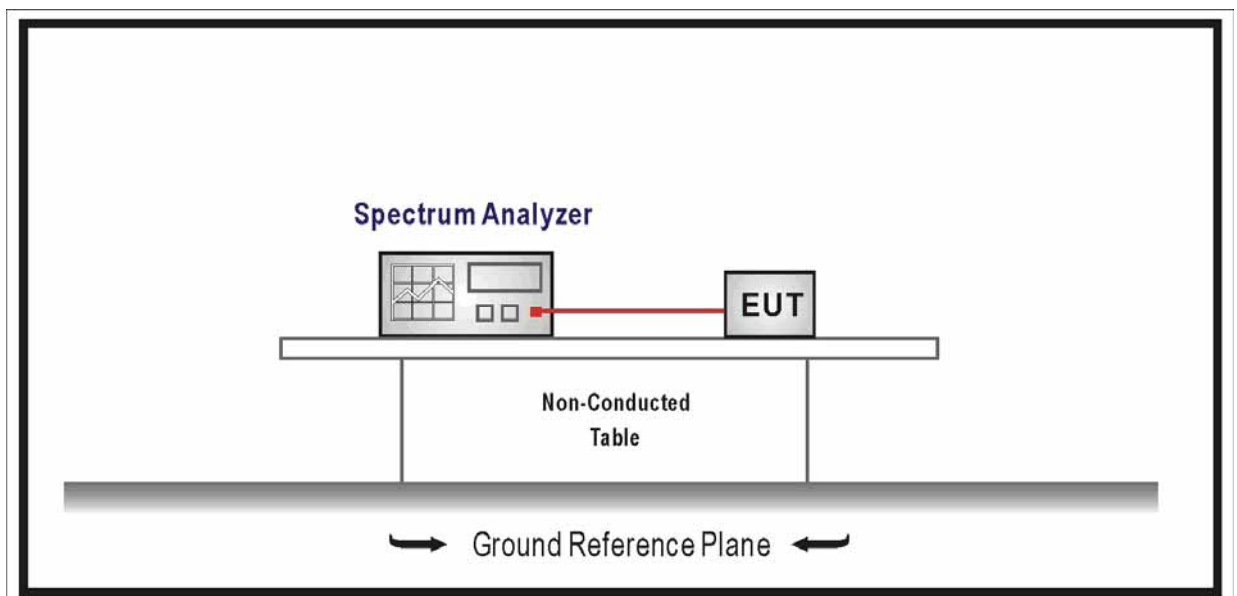
6.1. Test Equipment

Carrier Frequency Separation / TR-8

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.03.10
Temperature/Humidity Meter	Zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

6.2. Test Setup



6.3. Limit

- Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping

channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

- For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
- Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

6.4. Test Procedure

According to ANSI C63.10: 2013& ANSI C63.4: 2014

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) $\geq$ 1% of the span

Video (or Average) Bandwidth VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

6.5. Uncertainty

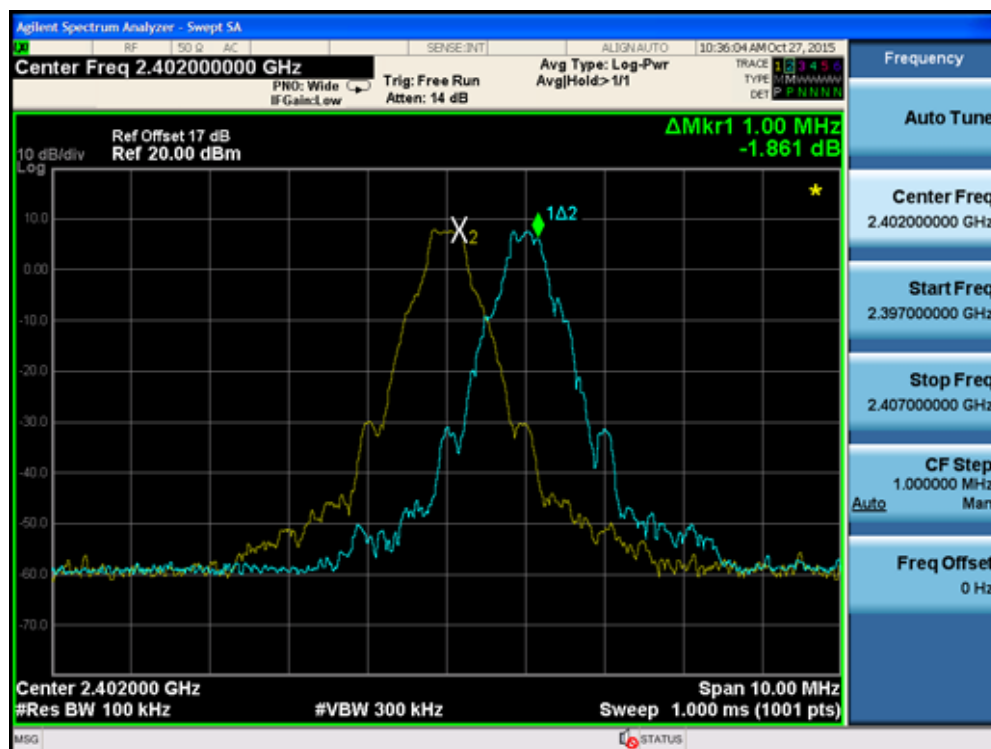
The measurement uncertainty is defined as ± 1 kHz

6.6. Test Result

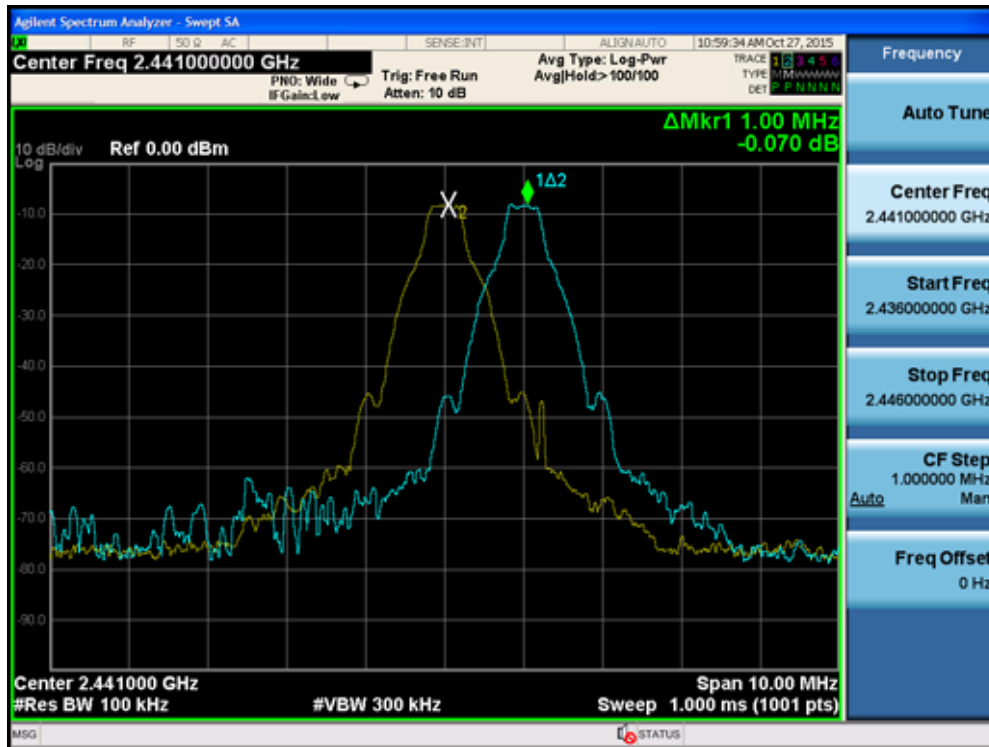
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Carrier Frequency Separation
Test Site	:	TR-8
Test Mode	:	Mode 1: Transmitter-1Mbps (GFSK_DH5)

Channel No.	Frequency (MHz)	Carrier Frequency Separation (kHz)	Limit (kHz)	Result
00	2402	1000	>25 kHz or 2/3 of 20 dB BW	Pass
39	2441	1000	>25 kHz or 2/3 of 20 dB BW	Pass
78	2480	1000	>25 kHz or 2/3 of 20 dB BW	Pass

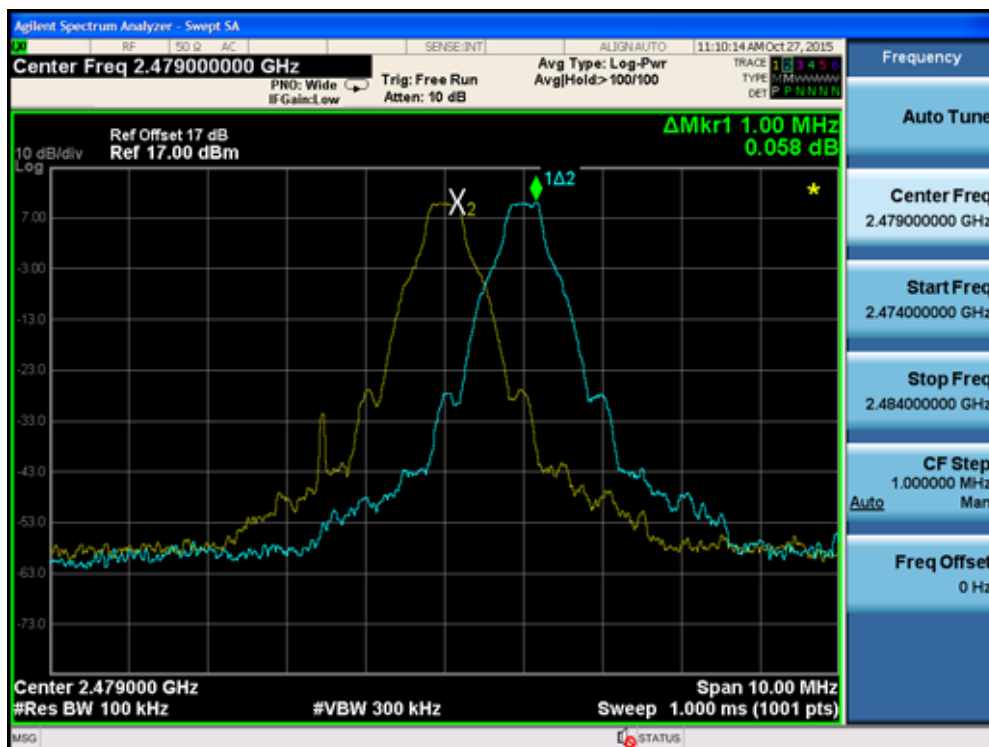
Channel 00 (2402MHz)



Channel 39 (2441MHz)



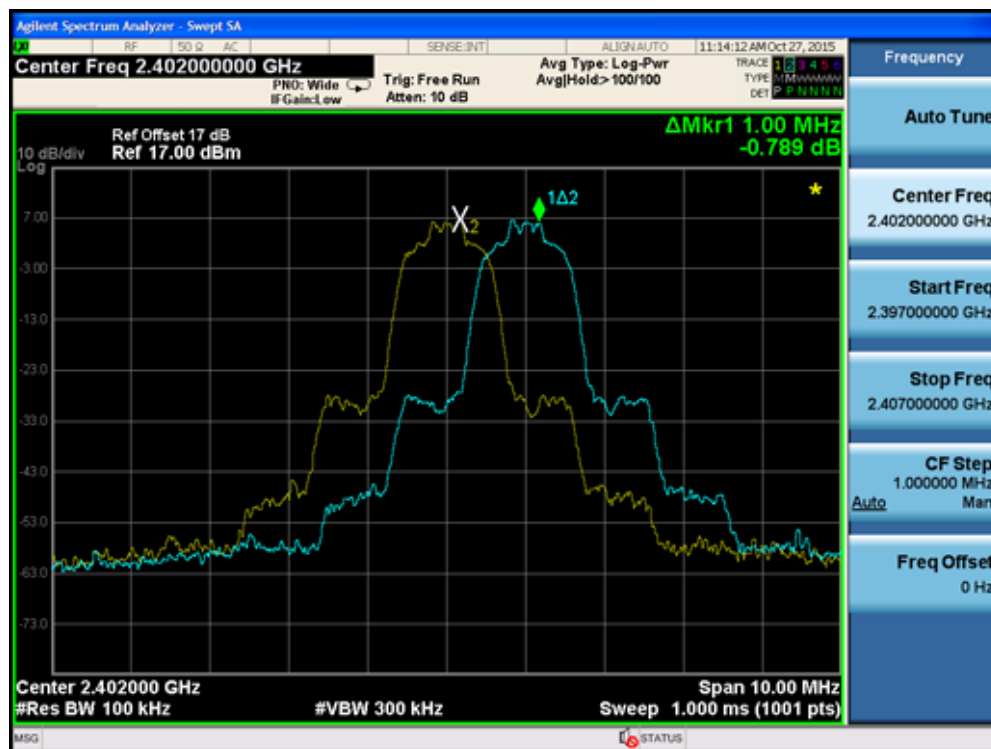
Channel 78 (2480MHz)



Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Carrier Frequency Separation
Test Site	:	TR-8
Test Mode	:	Mode 2: Transmitter-2Mbps (Pi/4 DQPSK_DH5)

Channel No.	Frequency (MHz)	Carrier Frequency Separation (kHz)	Limit (kHz)	Result
00	2402	1000	>25 kHz or 2/3 of 20 dB BW	Pass
39	2441	1000	>25 kHz or 2/3 of 20 dB BW	Pass
78	2480	1000	>25 kHz or 2/3 of 20 dB BW	Pass

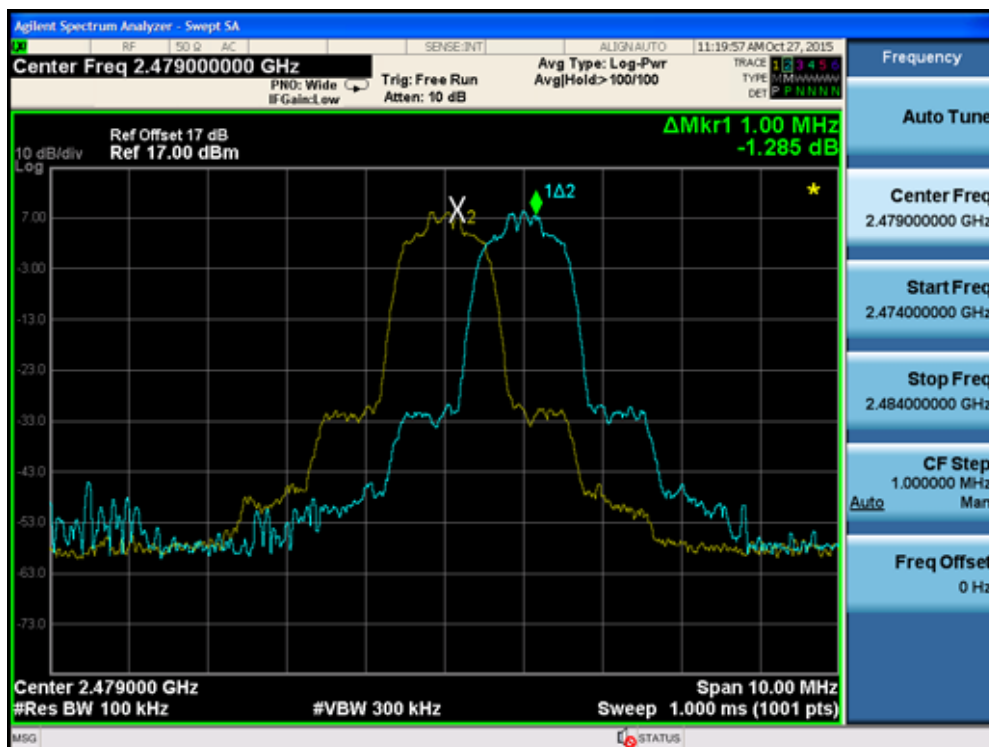
Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)



Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Carrier Frequency Separation
Test Site	:	TR-8
Test Mode	:	Mode 3: Transmitter-3Mbps (8DPSK_DH5)

Channel No.	Frequency (MHz)	Carrier Frequency Separation (kHz)	Limit (kHz)	Result
00	2402	1000	>25 kHz or 2/3 of 20 dB BW	Pass
39	2441	1000	>25 kHz or 2/3 of 20 dB BW	Pass
78	2480	1000	>25 kHz or 2/3 of 20 dB BW	Pass

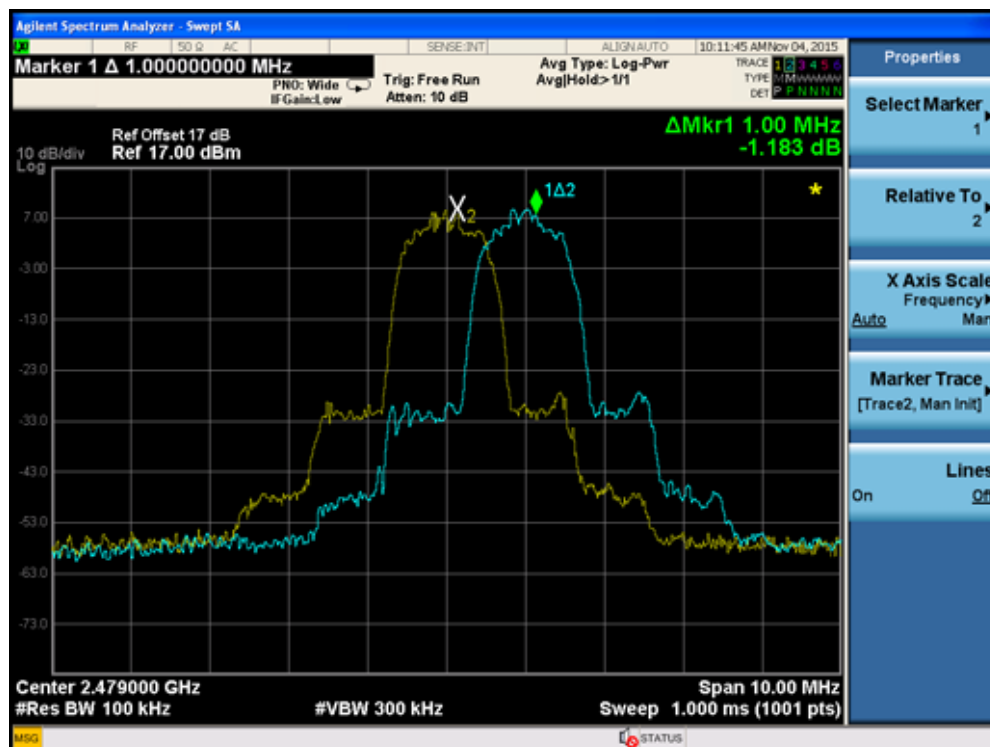
Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)



7. Number of Hopping Frequencies

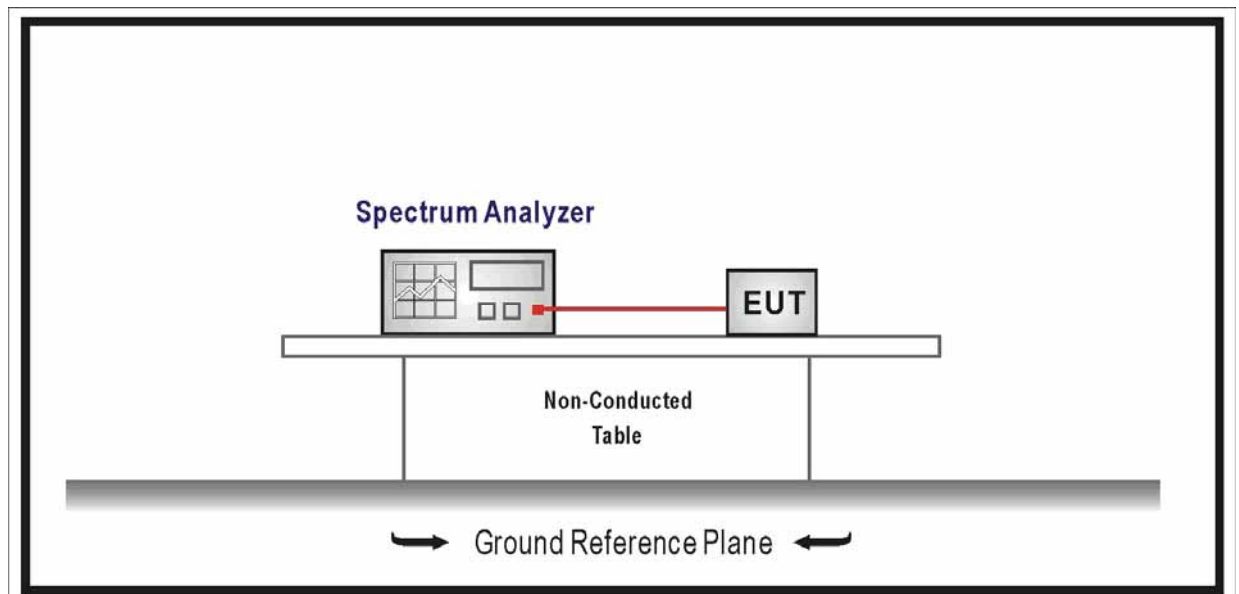
7.1. Test Equipment

Number of Hopping Frequencies / TR-8

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.03.10
Temperature/Humidity Meter	Zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

7.2. Test Setup



7.3. Limit

- For frequency hopping systems operating in the 2400-2483.5 MHz band shall use at least 15 hopping frequencies.
- For frequency hopping systems operating in 902-928 MHz band shall use at least 50 hopping frequencies.
- For frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies.

7.4. Test Procedure

According to ANSI C63.10: 2013& ANSI C63.4: 2014

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW $\geq$ 1% of the span

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. It may prove necessary to bread the span up to sections, in order to clearly show all of the hopping frequencies.

7.5. Uncertainty

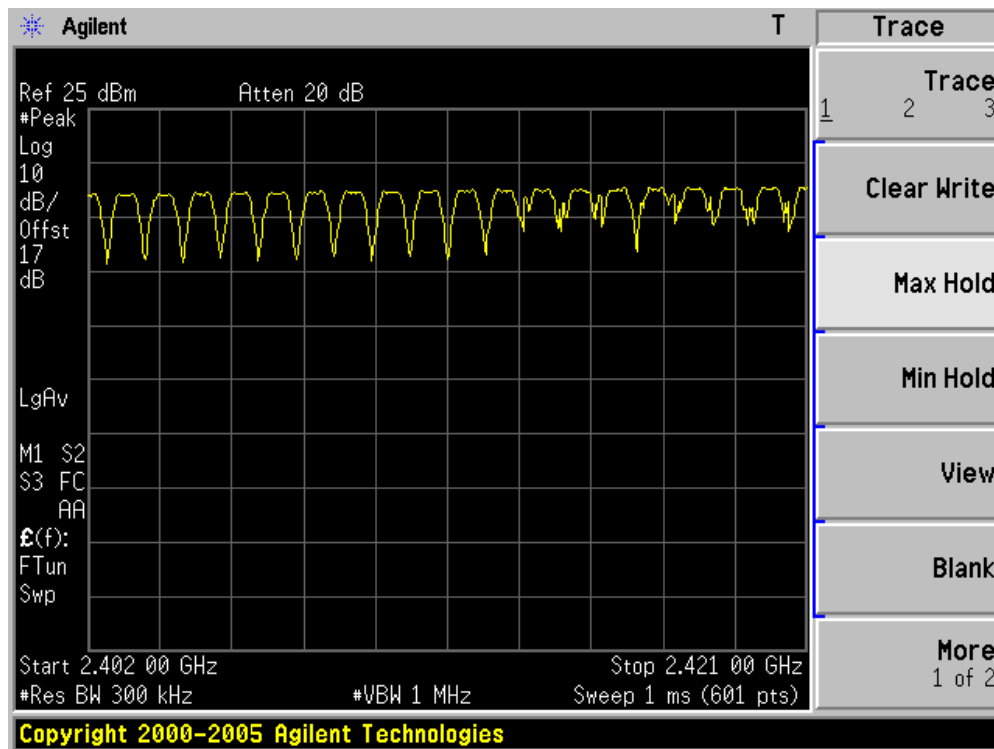
The measurement uncertainty is defined as ± 1 kHz

7.6. Test Result

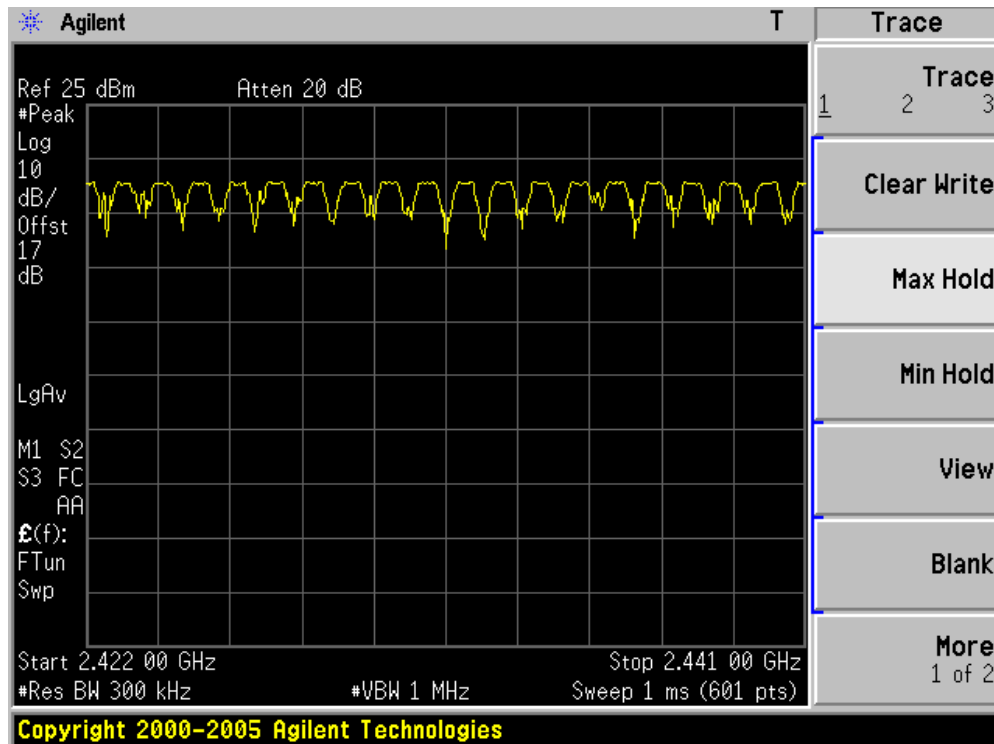
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Number of Hopping Frequencies
Test Site	:	TR-8
Test Mode	:	Mode 1: Transmitter-1Mbps (GFSK_DH5)

Frequency Band (MHz)	Number of Hopping Frequencies	Limit	Result
2400 - 2483.5	79	>15	Pass

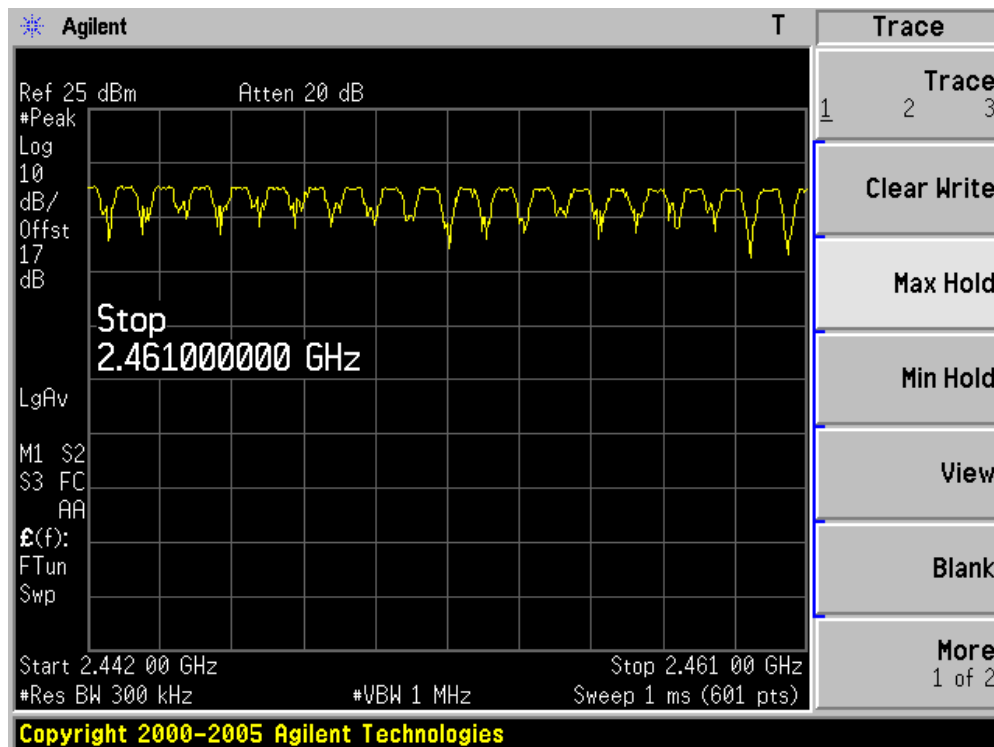
2402 - 2421 MHz



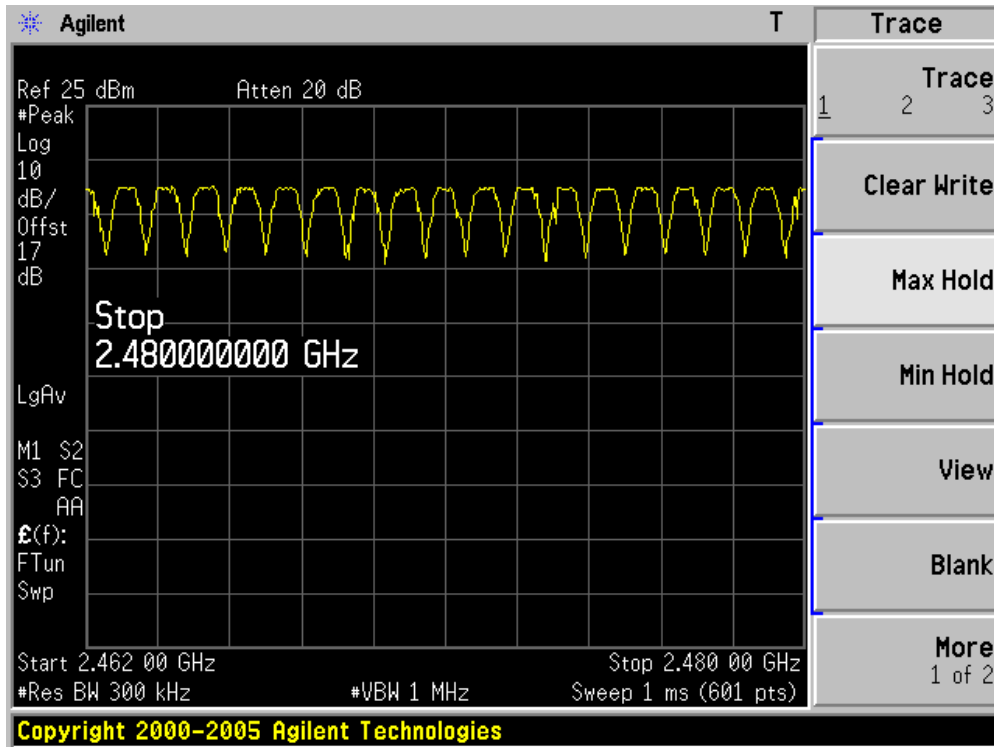
2422 - 2441 MHz



2442 - 2461 MHz



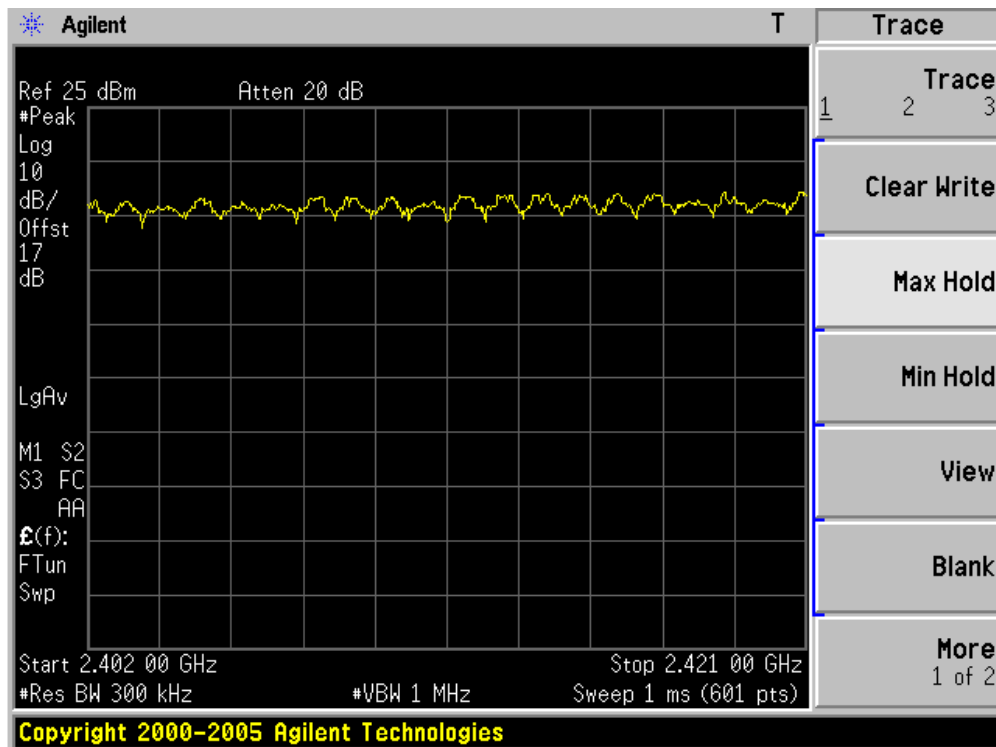
2462 - 2480 MHz



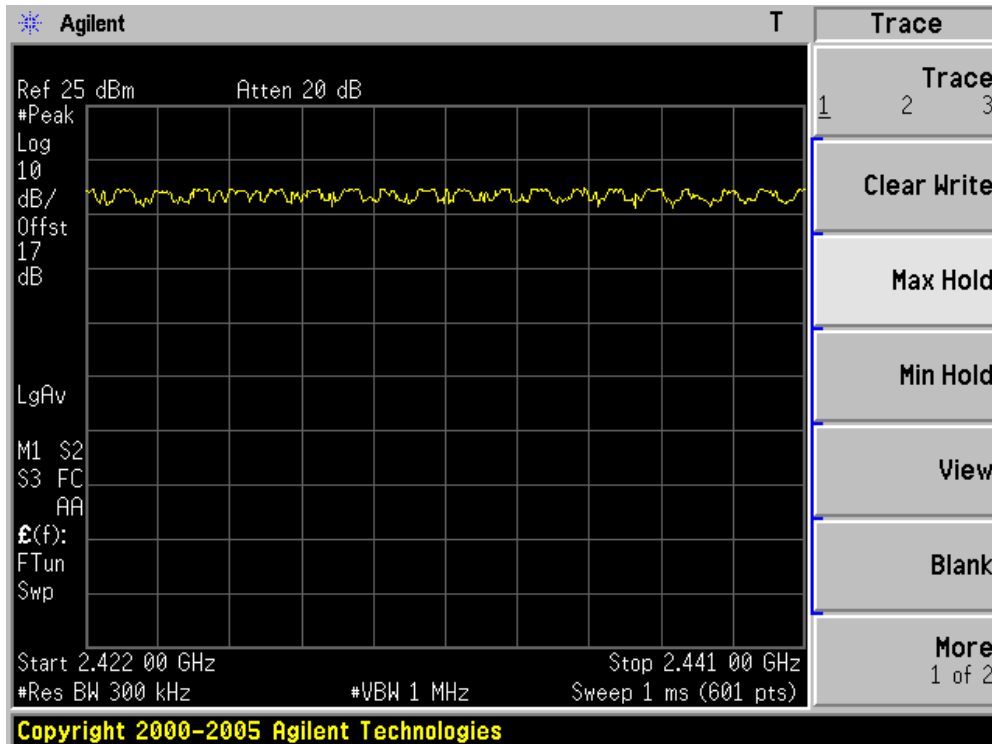
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Number of Hopping Frequencies
Test Site	:	TR-8
Test Mode	:	Mode 2: Transmitter-2Mbps (Pi/4 DQPSK_DH5)

Frequency Band (MHz)	Number of Hopping Frequencies	Limit	Result
2400 - 2483.5	79	>15	Pass

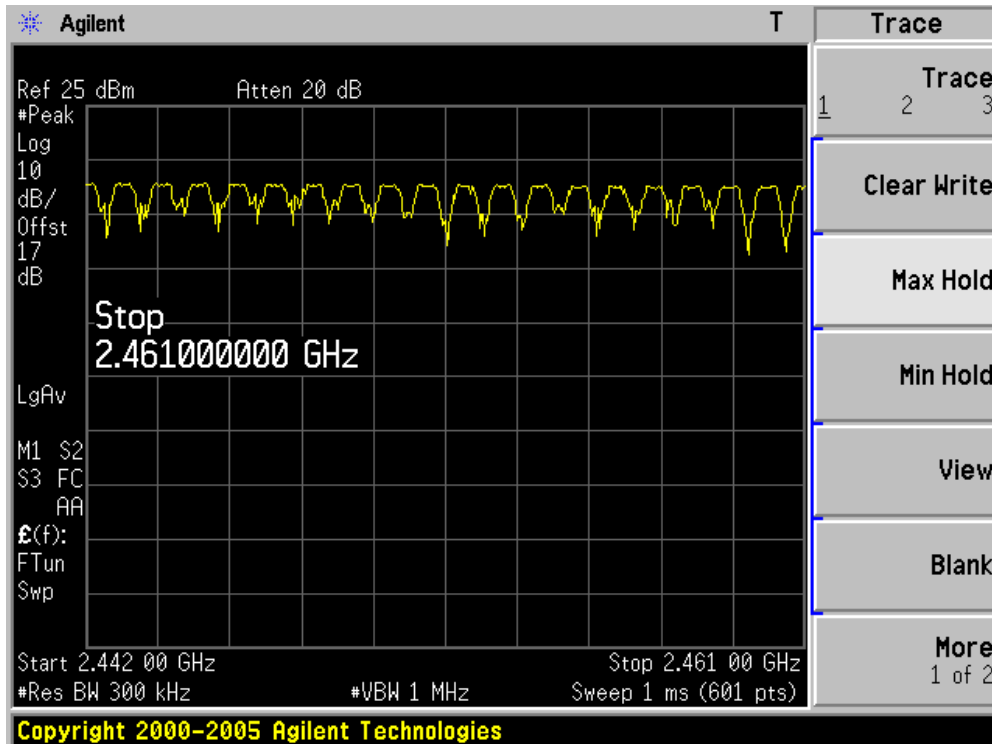
2402 - 2421 MHz



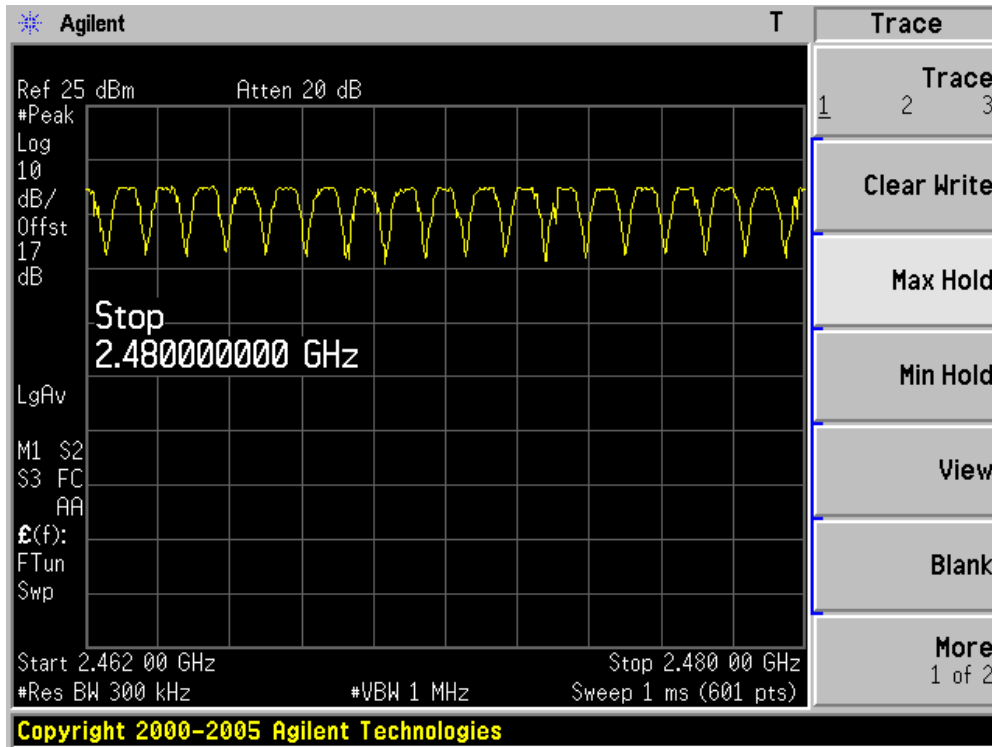
2422 - 2441 MHz



2442 - 2461 MHz



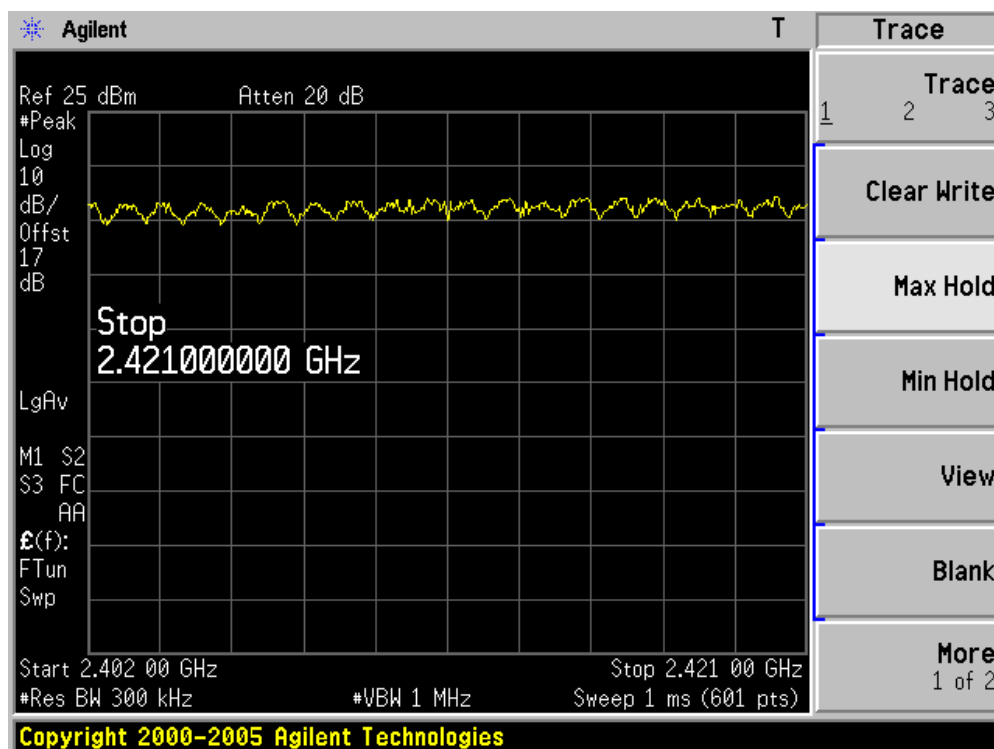
2462 - 2480 MHz



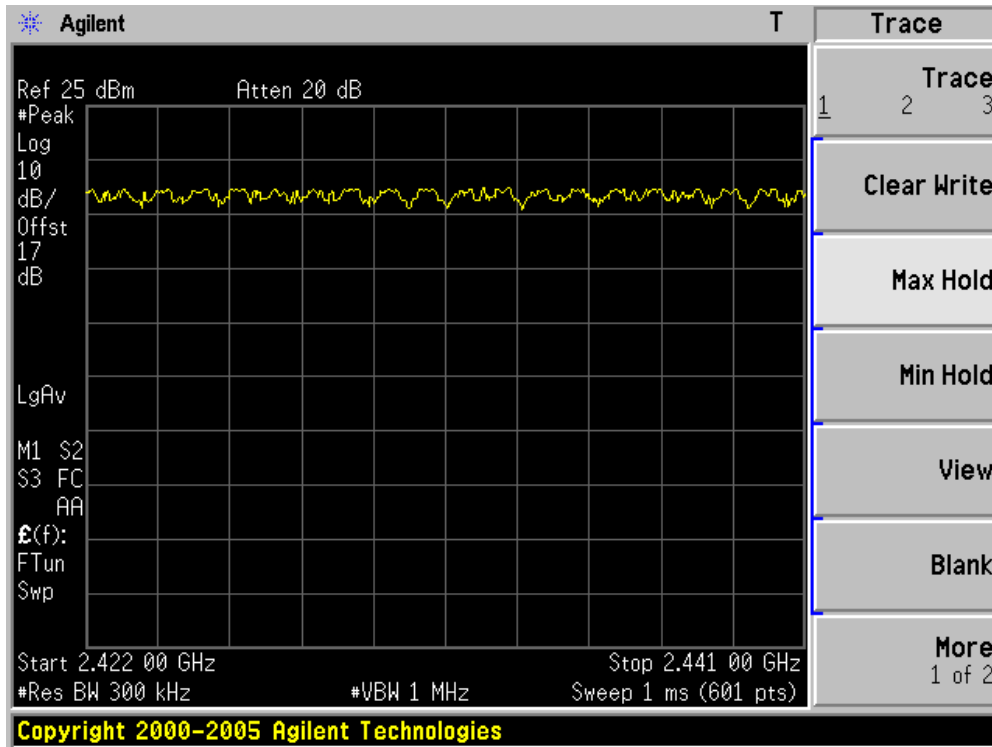
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Number of Hopping Frequencies
Test Site	:	TR-8
Test Mode	:	Mode 3: Transmitter-3Mbps (8DPSK_DH5)

Frequency Band (MHz)	Number of Hopping Frequencies	Limit	Result
2400 - 2483.5	79	>15	Pass

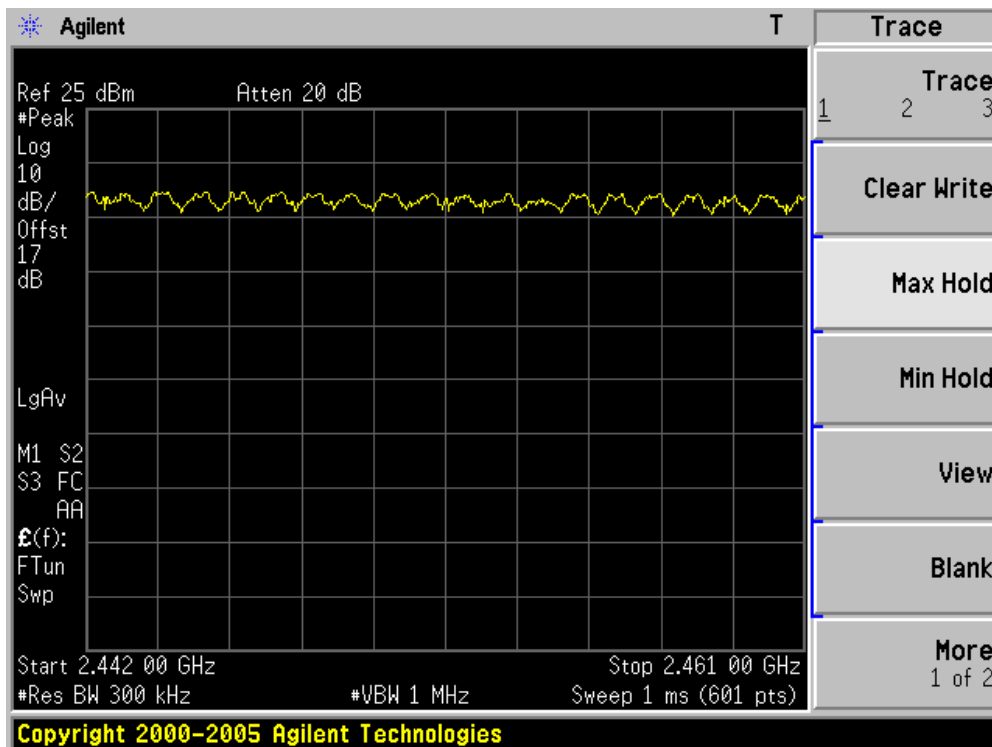
2402 - 2421 MHz



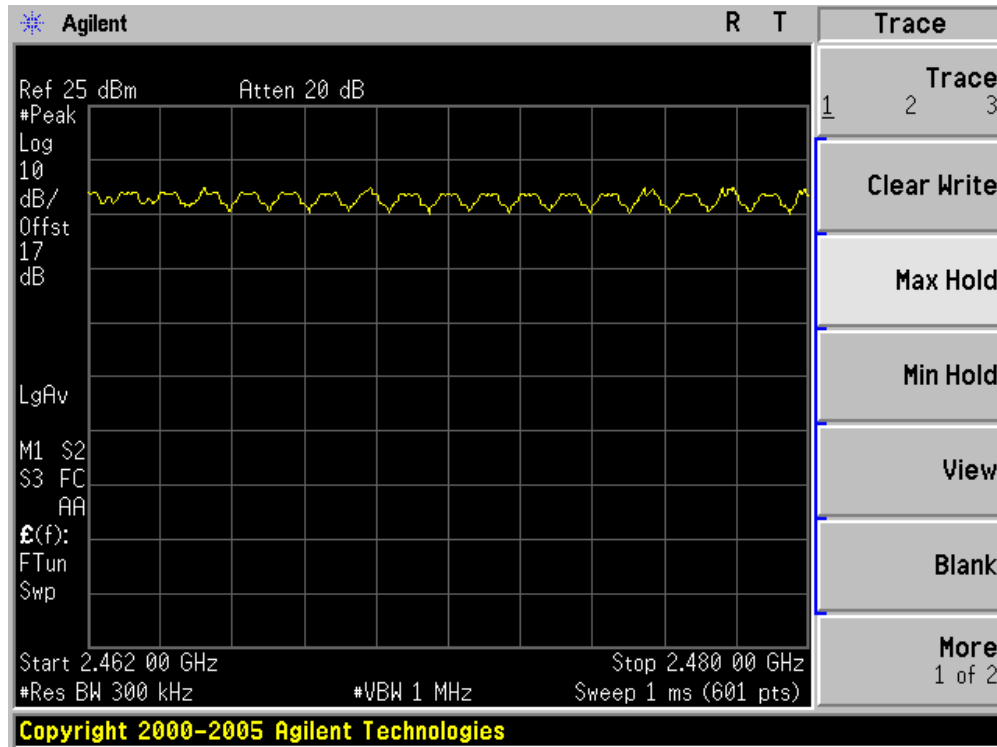
2422 - 2441 MHz



2442 - 2461 MHz



2462 - 2480 MHz



8. Time of Occupancy (Dwell Time)

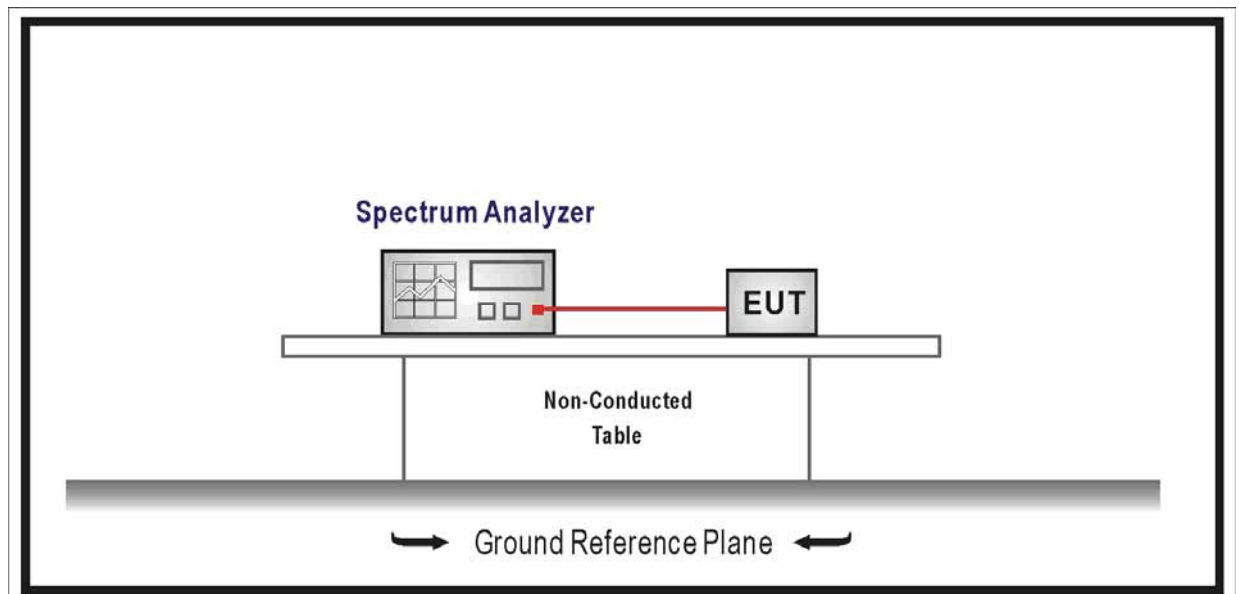
8.1. Test Equipment

Time of Occupancy (Dwell Time) / TR-8

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.03.10
Temperature/Humidity Meter	Zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

8.2. Test Setup



8.3. Limit

- For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
- Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75

hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

- Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

8.4. Test Procedure

According to ANSI C63.10: 2013& ANSI C63.4: 2014

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel

RBW = 1MHz

VBW $\geq$ RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.

8.5. Uncertainty

The measurement uncertainty is defined as ± 0.1 us

8.6. Test Result

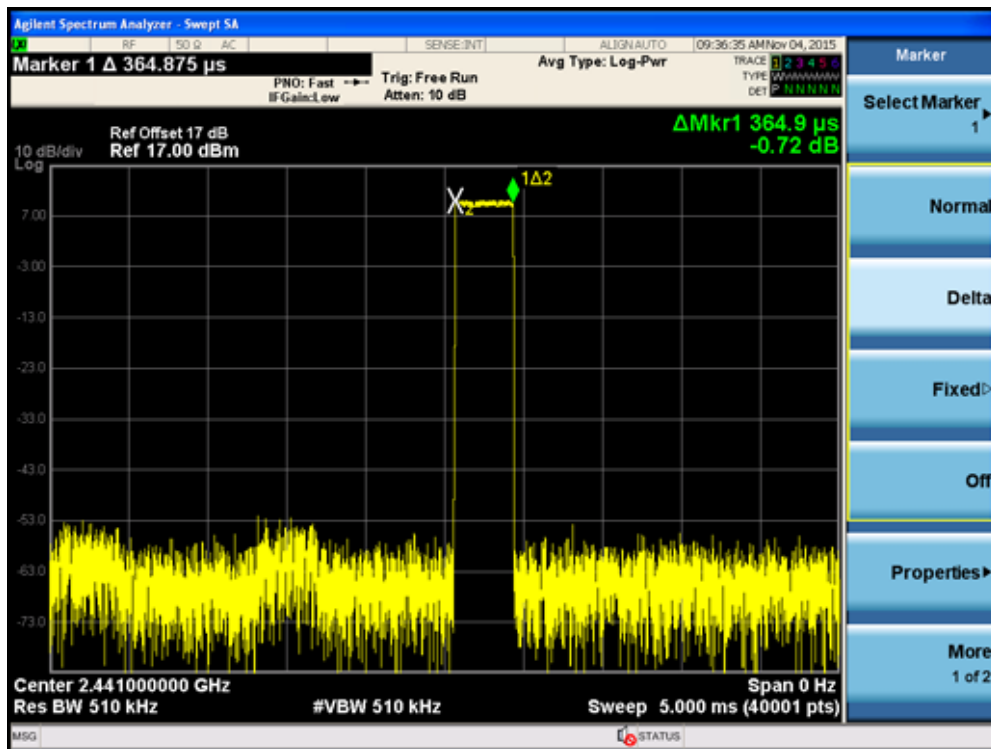
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Time of Occupancy (Dwell Time)
Test Site	:	TR-8
Test Mode	:	Transmitter-1Mbps (GFSK_DH1)

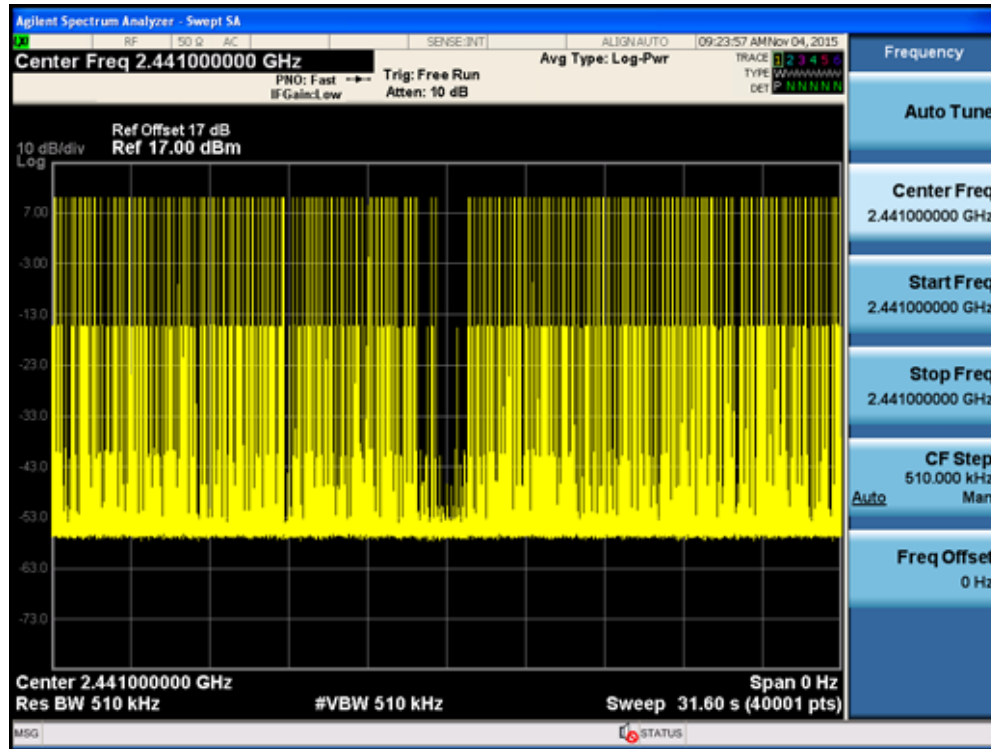
Channel No.	Frequency (MHz)	Time of Occupancy (ms)	Limit (ms)	Result
39	2441	125.195	< 400	Pass

Test Time Period: $0.4 \times 79 = 31.6 \text{ sec}$.

- 2441MHz, The Maximum Occupancy Time Within 31.6sec: $0.365 \text{ ms} \times 343 = 125.195 \text{ msec}$

Channel 39 (2441MHz)-(DH1)





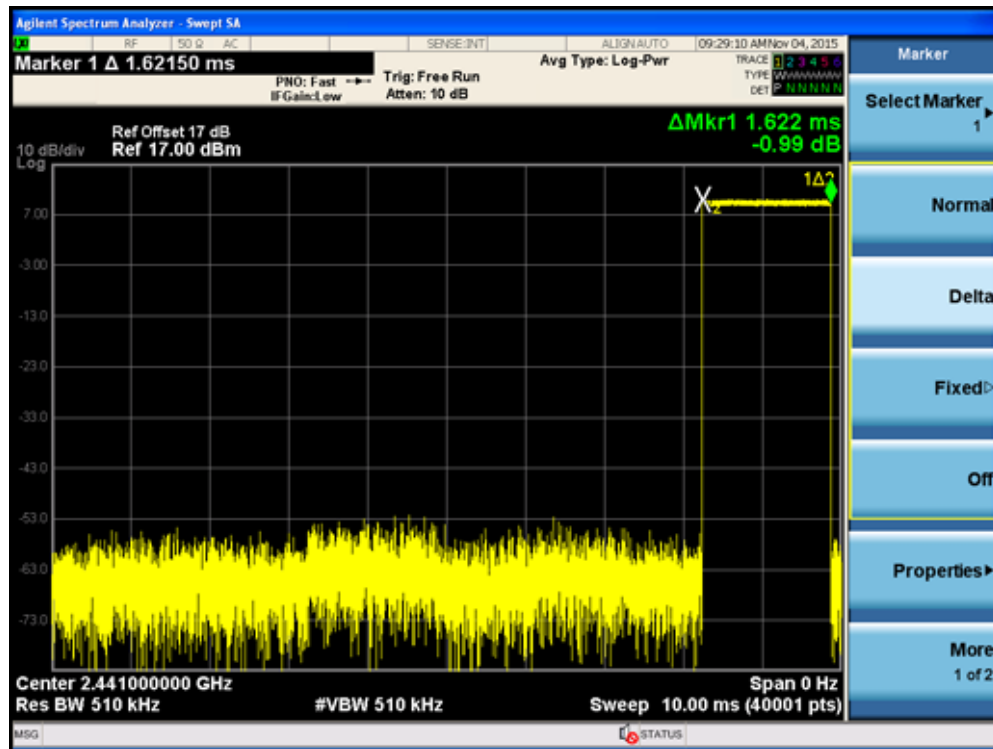
Product	:	Bluetooth headset
Test Item	:	Time of Occupancy (Dwell Time)
Test Site	:	TR-8
Test Mode	:	Transmitter-1Mbps (GFSK_DH3)

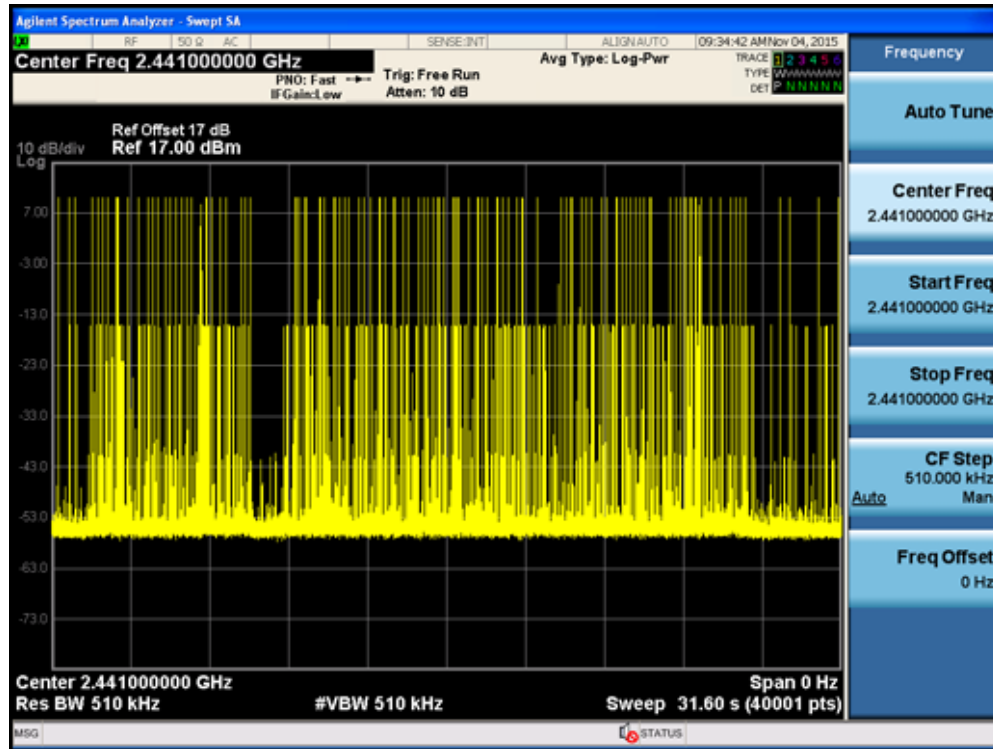
Channel No.	Frequency (MHz)	Time of Occupancy (ms)	Limit (ms)	Result
39	2441	270.874	< 400	Pass

Test Time Period: $0.4 \times 79 = 31.6 \text{ sec}$.

- 2441MHz, The Maximum Occupancy Time Within 31.6sec: $1.622 \text{ ms} \times 167 = 270.874 \text{ msec}$

Channel 39 (2441MHz) - (DH3)





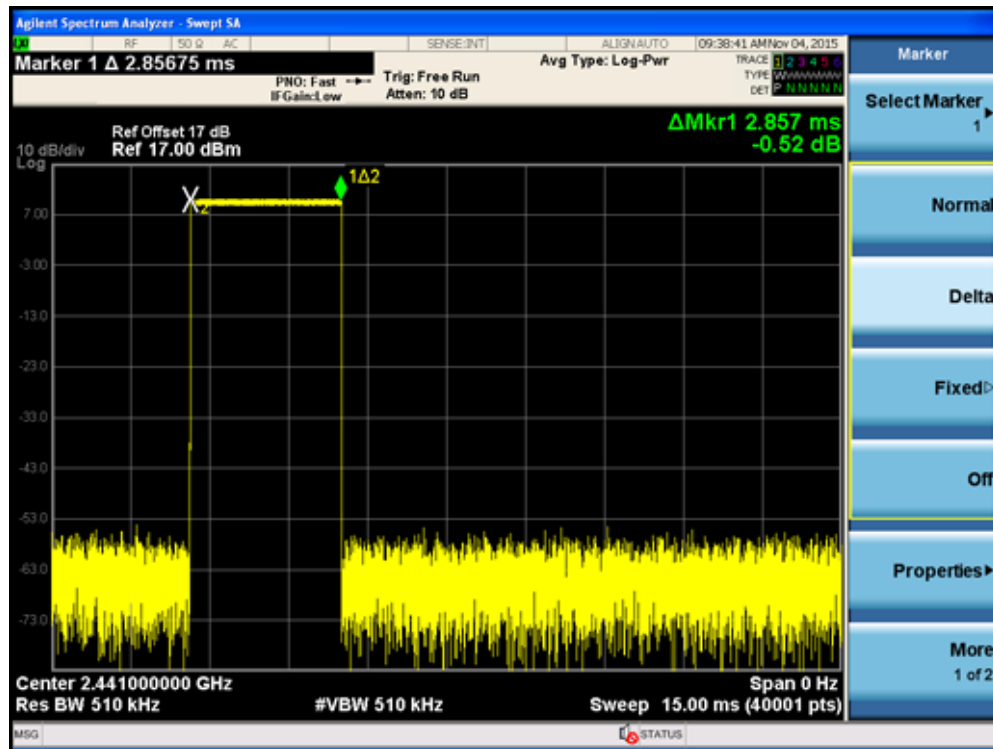
Product	:	Bluetooth headset
Test Item	:	Time of Occupancy (Dwell Time)
Test Site	:	TR-8
Test Mode	:	Transmitter-1Mbps (GFSK_DH5)

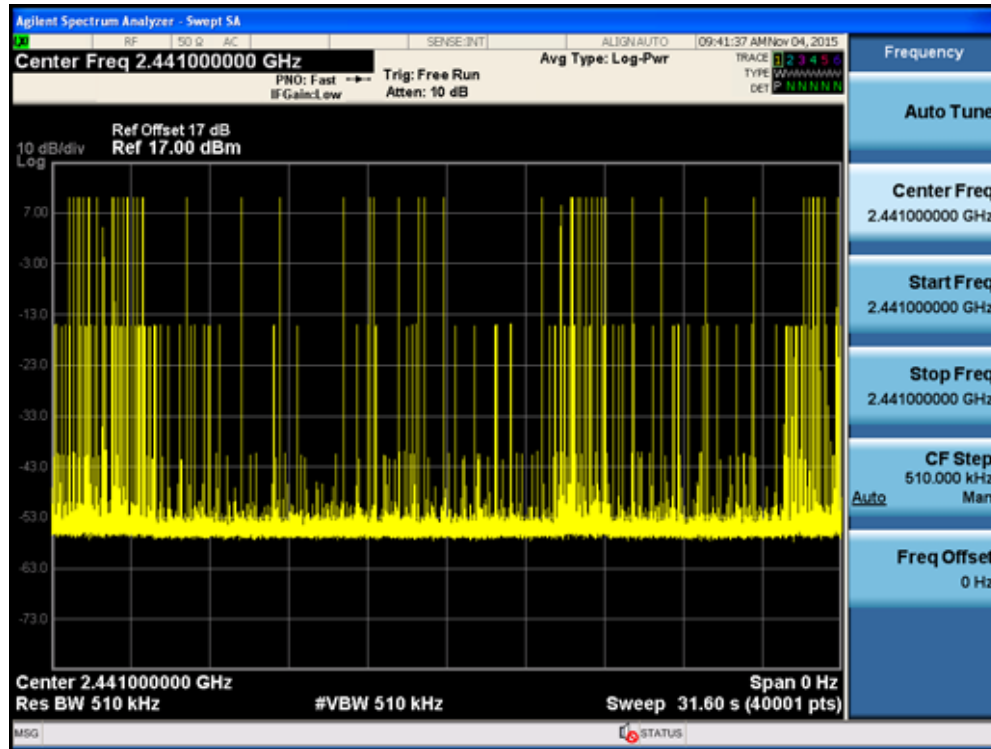
Channel No.	Frequency (MHz)	Time of Occupancy (ms)	Limit (ms)	Result
39	2441	211.418	< 400	Pass

Test Time Period: $0.4 \times 79 = 31.6$ sec.

- 2441MHz, The Maximum Occupancy Time Within 31.6sec: $2.857\text{ms} \times 74 = 211.418\text{msec}$

Channel 39 (2441MHz) - (DH5)





9. Peak Output Power

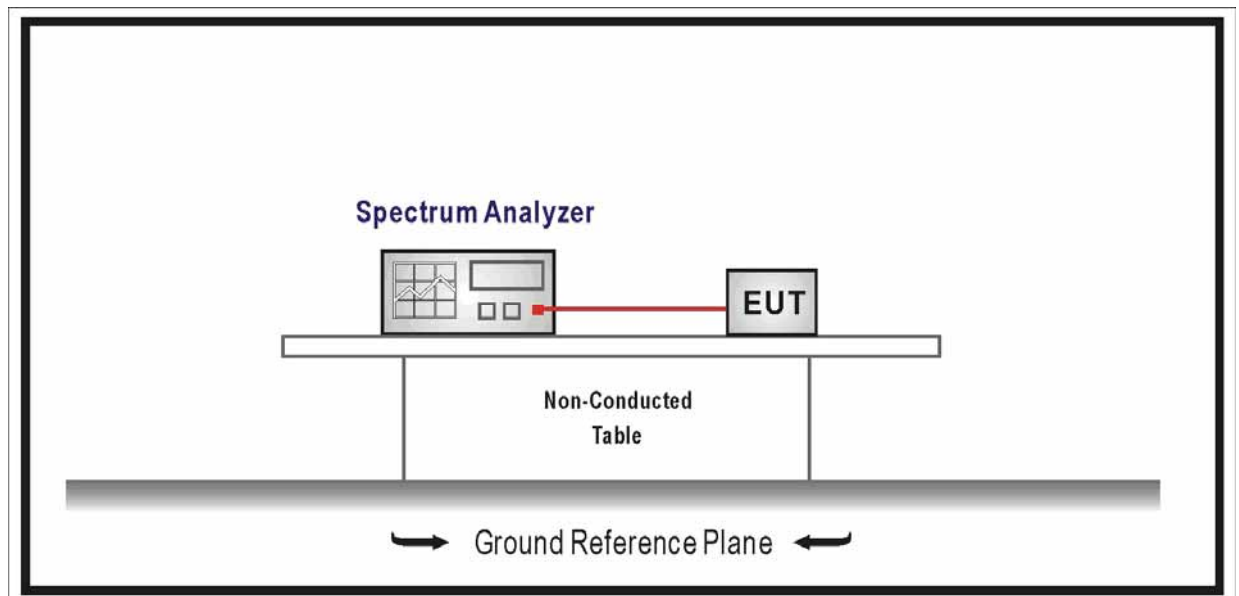
9.1. Test Equipment

Peak Output Power / TR-8

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.03.10
Temperature/Humidity Meter	Zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

9.2. Test Setup



9.3. Limit

- For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
- For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

Note: the conducted output power limit specified above is based on the use the antennas with

directional gains that do not exceed 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values above, as appropriate, by the amount in dB that the directional gain of antenna exceeds 6 dBi.

9.4. Test Procedure

According to ANSI C63.10: 2013& ANSI C63.4: 2014

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured.

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (don't forget added the external attenuation and cable loss).

9.5. Uncertainty

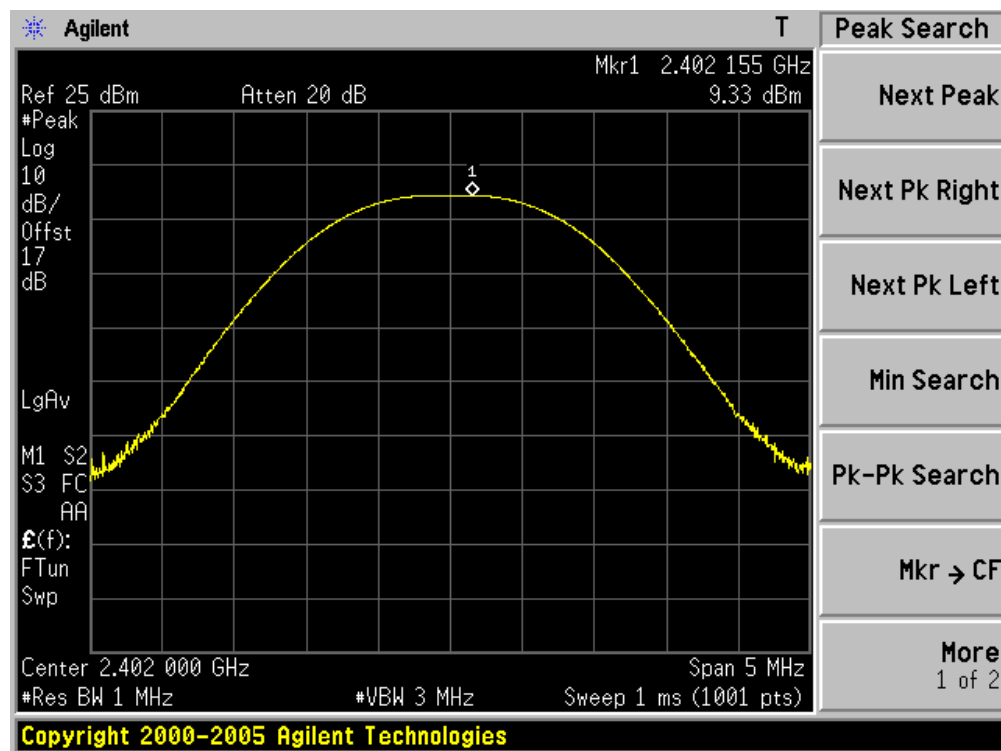
The measurement uncertainty is defined as ± 1.0 dB

9.6. Test Result

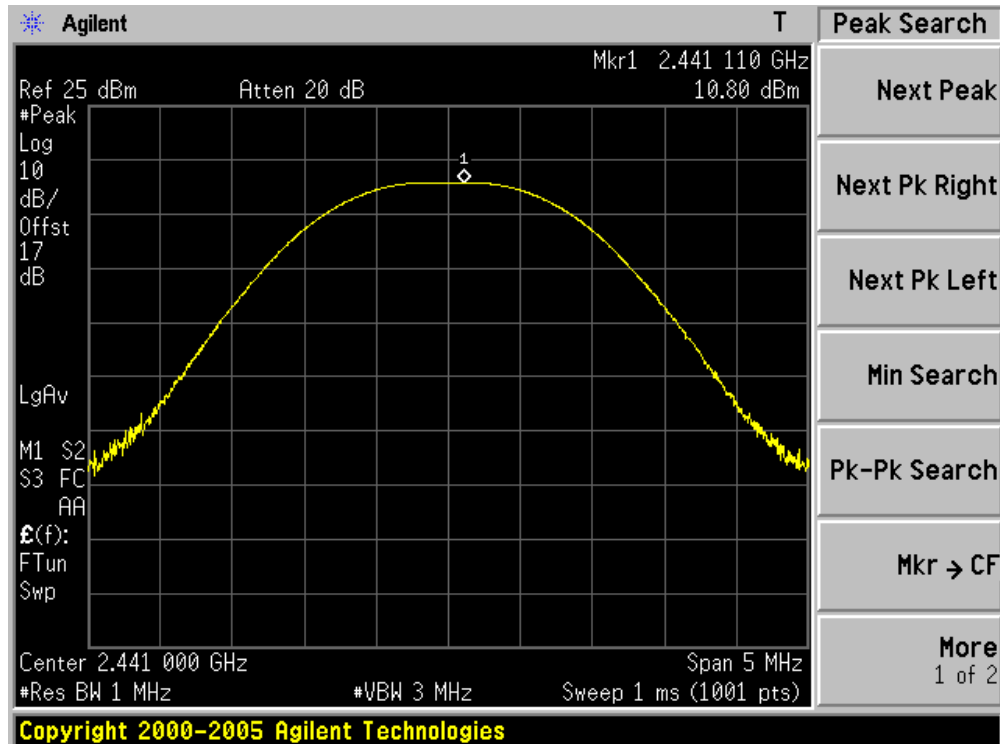
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Power Output
Test Site	:	TR-8
Test Mode	:	Mode 1: Transmitter-1Mbps (GFSK_DH5)

Channel No.	Frequency (MHz)	Measurement Power Output (dBm)	Limit (dBm)	Result
0	2402	9.33	30.00	Pass
39	2441	10.80	30.00	Pass
78	2480	10.02	30.00	Pass

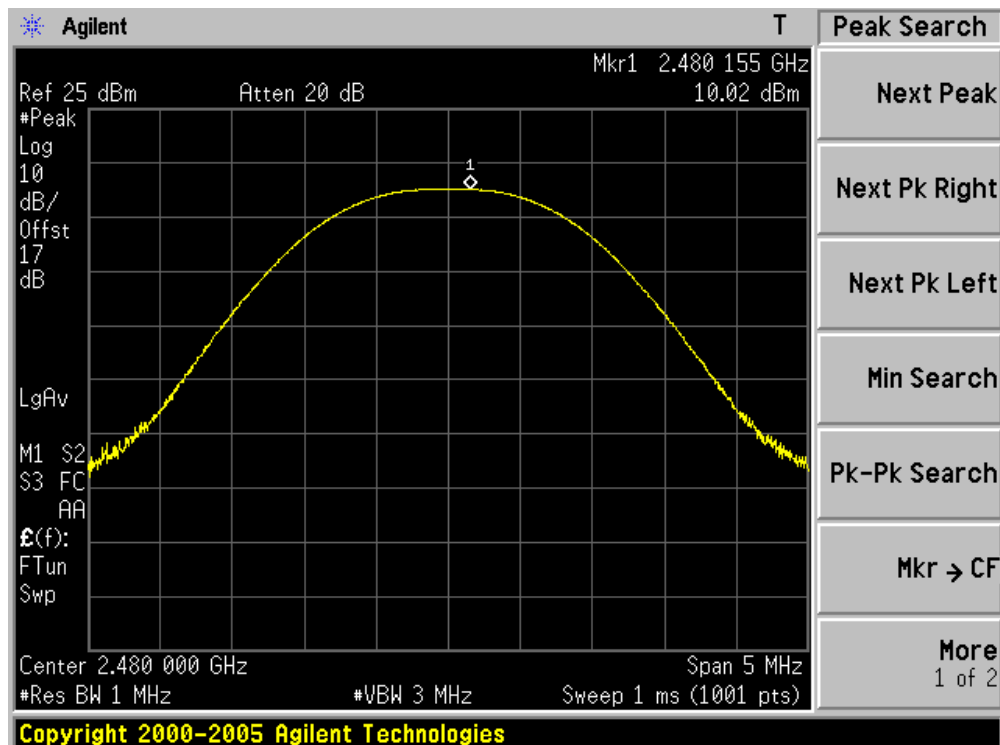
DH5 2402MHz



DH5 2441MHz



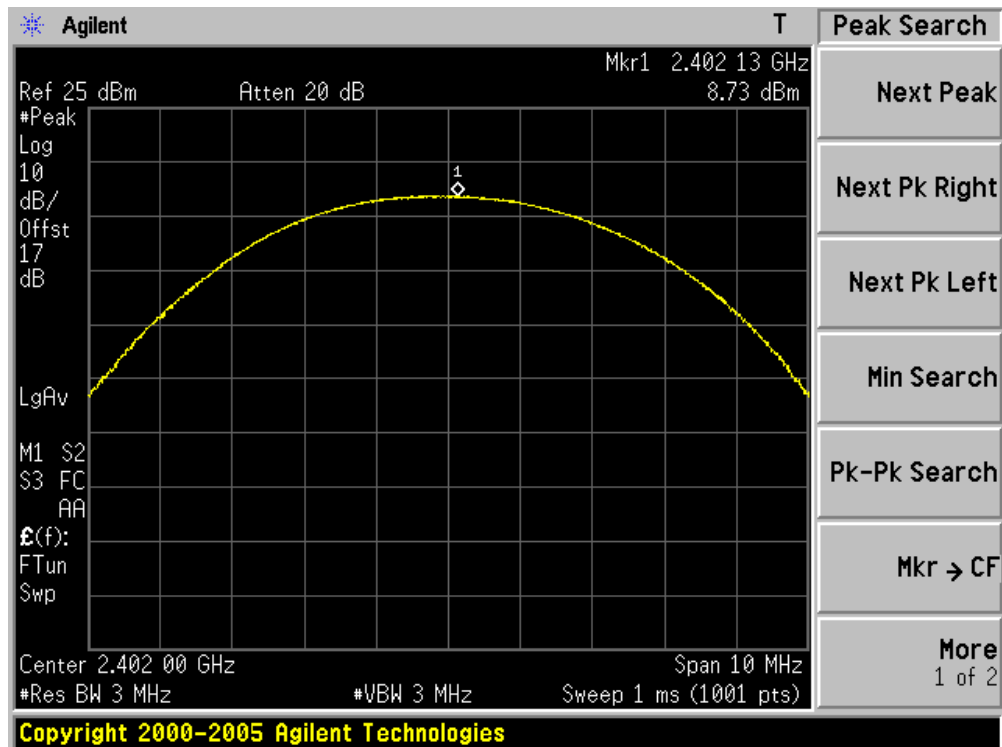
DH5 2480MHz



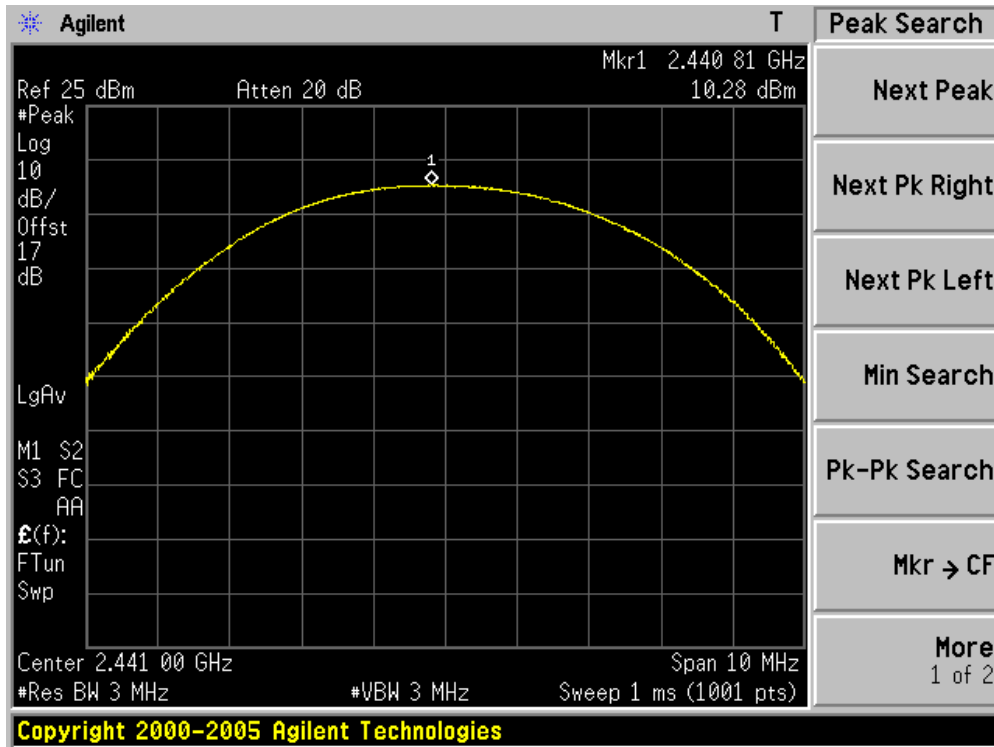
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Power Output
Test Site	:	TR-8
Test Mode	:	Mode 2: Transmitter-2Mbps (Pi/4 DQPSK_DH5)

Channel No.	Frequency (MHz)	Measurement Power Output (dBm)	Limit (dBm)	Result
0	2402	8.73	30.00	Pass
39	2441	10.28	30.00	Pass
78	2480	9.38	30.00	Pass

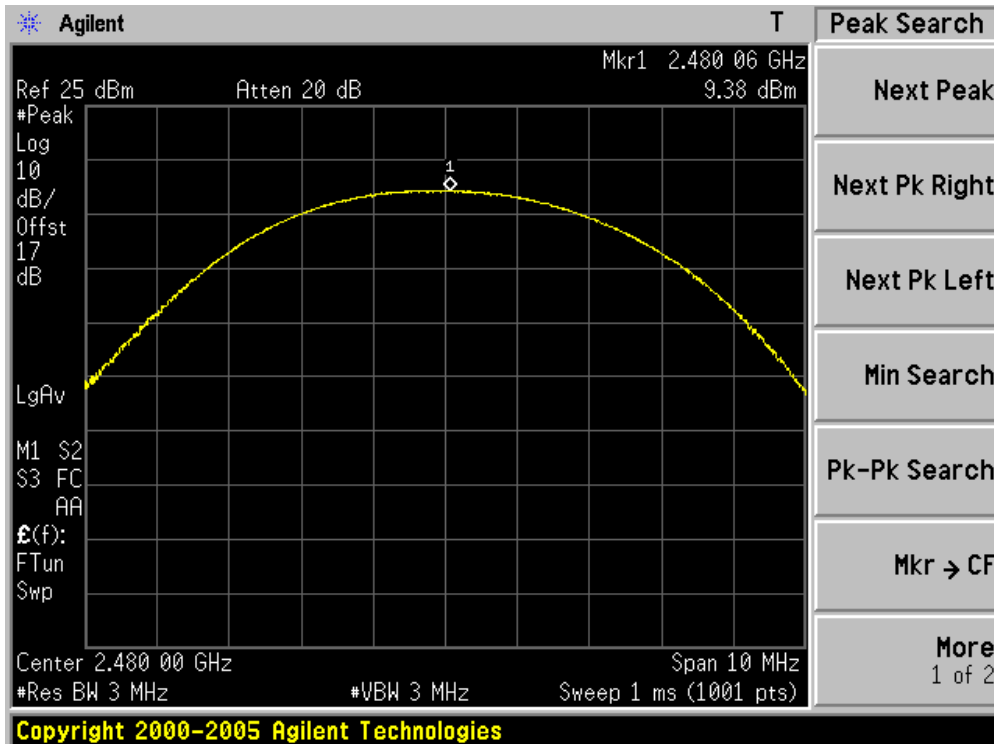
2DH5 2402MHz



2DH5 2441MHz



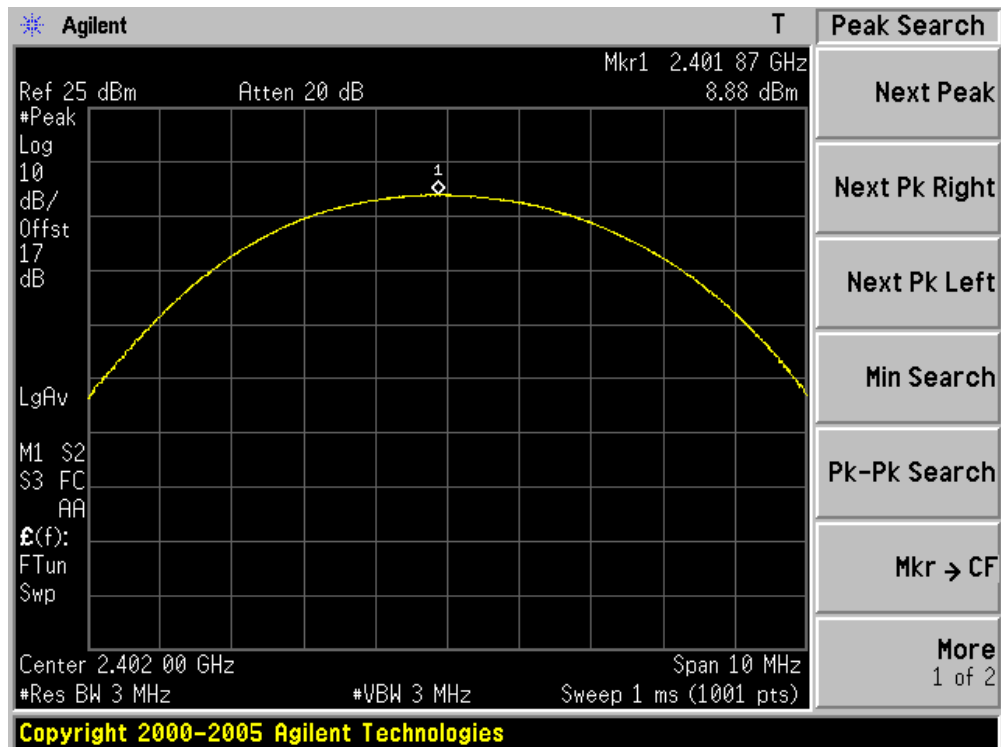
2DH5 2480MHz



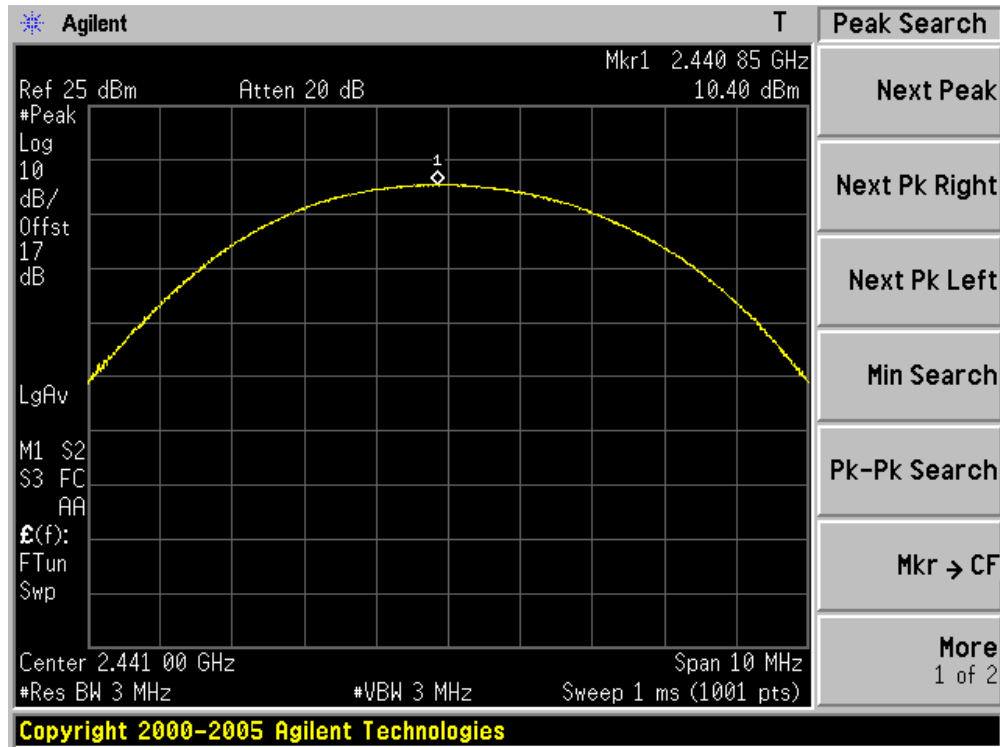
Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Power Output
Test Site	:	TR-8
Test Mode	:	Mode 3: Transmitter-3Mbps (8DPSK_DH5)

Channel No.	Frequency (MHz)	Measurement Power Output (dBm)	Limit (dBm)	Result
0	2402	8.88	30.00	Pass
39	2441	10.40	30.00	Pass
78	2480	9.51	30.00	Pass

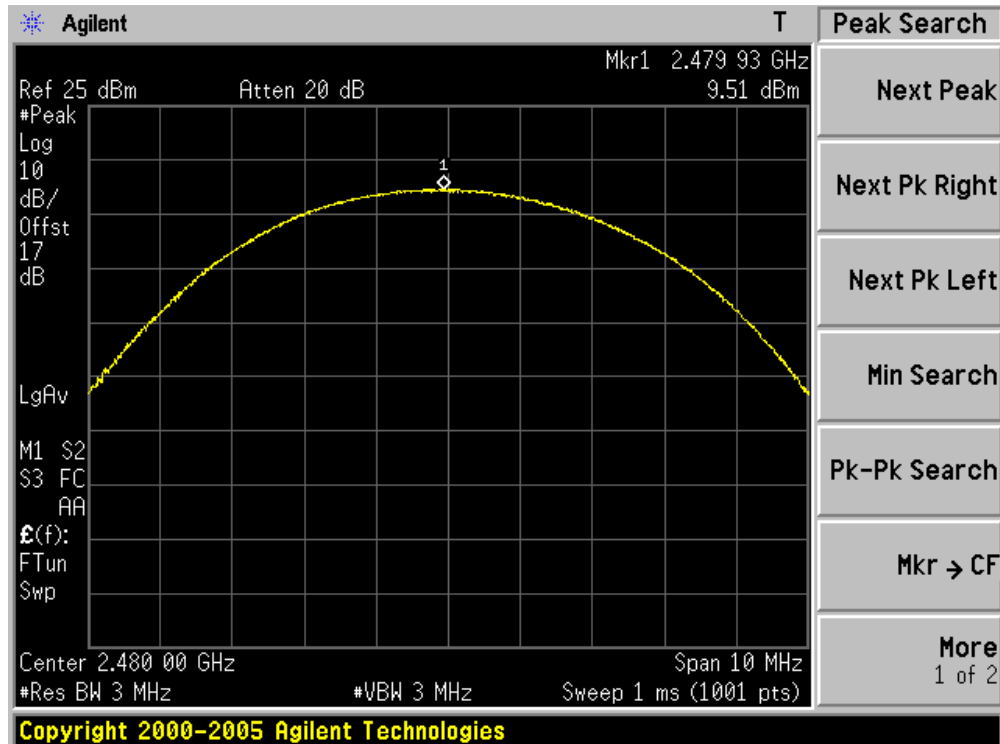
3DH5 2402MHz



3DH5 2441MHz



3DH5 2480MHz



10. Band-edge Compliance of RF Conducted Emissions

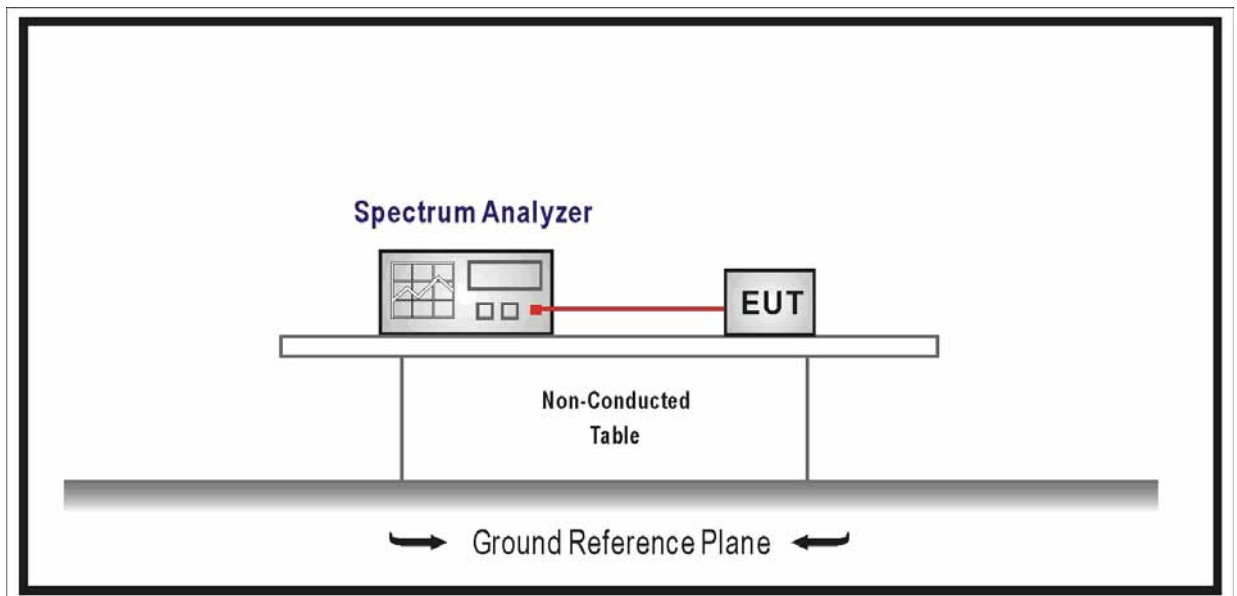
10.1. Test Equipment

Band-edge Compliance of RF Conducted Emissions / TR-8

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.03.10
Temperature/Humidity Meter	Zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

10.2. Test Setup



10.3. Limit

- Intentional radiators operating under the alternative provisions to the general emission limits as contained in 15.217 through 15.257 and in Subpart E of FCC part 15, must be designed to ensure that 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.
- 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 a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted or a radiated 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) of FCC part 15 is not required.

10.4. Test Procedure

According to ANSI C63.10: 2013& ANSI C63.4: 2014

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation.

RBW $\geq$ 1% of the span

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge.

Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section.

Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

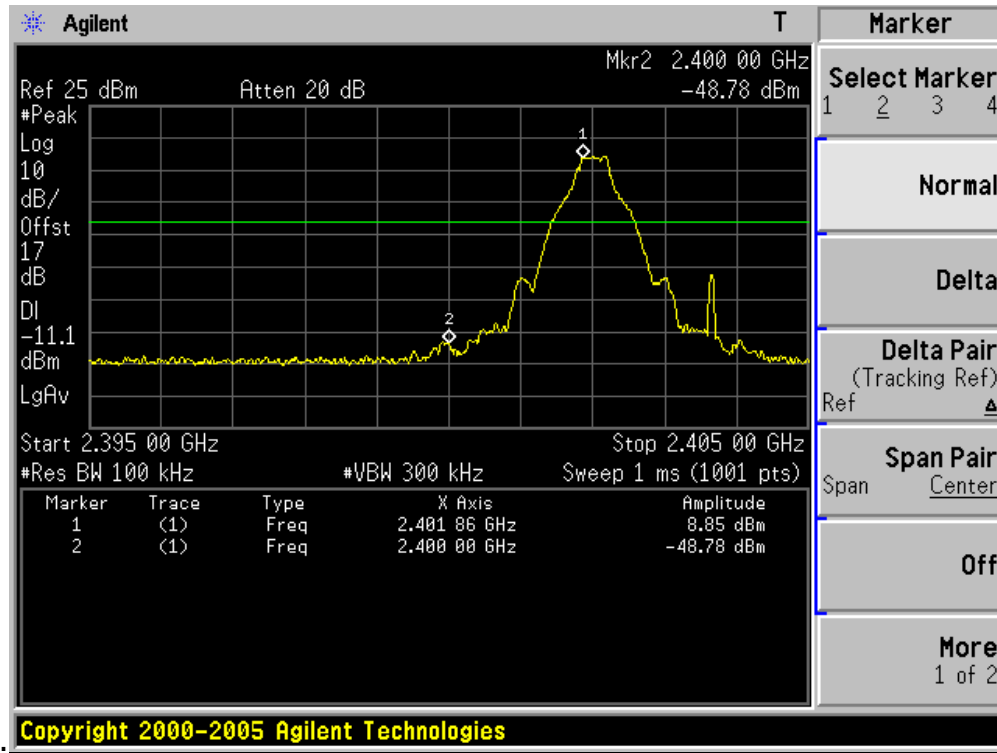
10.5. Uncertainty

The measurement uncertainty is defined as ± 1.0 dB

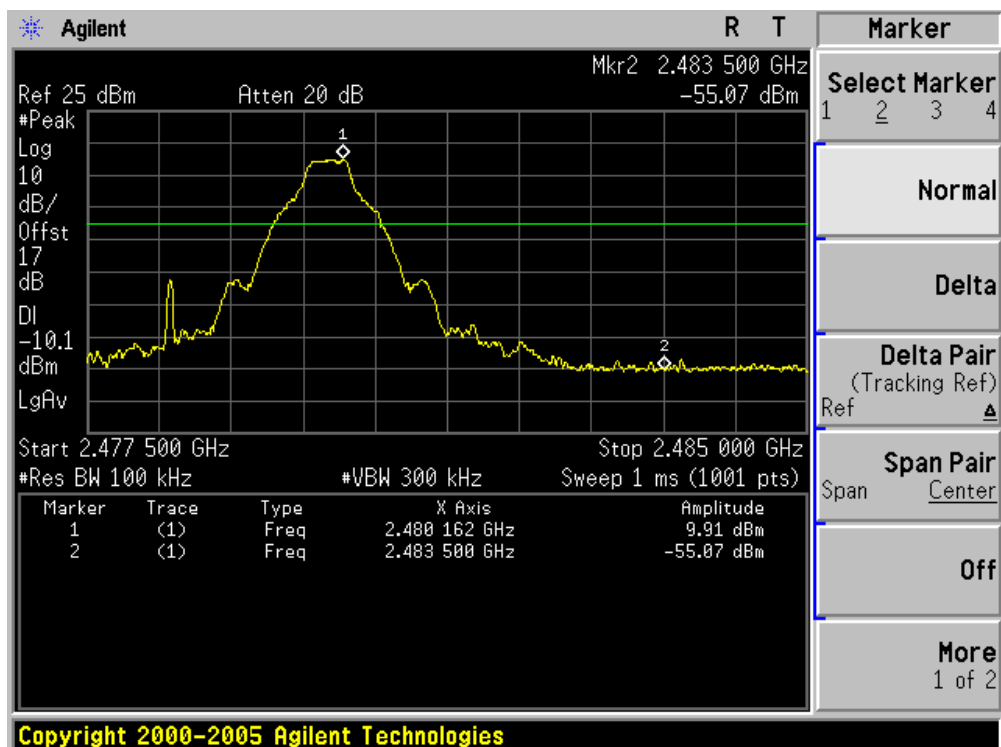
10.6. Test Result

Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Band-edge Compliance of RF Conducted Emissions
Test Site	:	TR-8
Test Mode	:	Mode 1: Transmitter-1Mbps (GFSK_DH5)

Channel 00 (2402MHz)

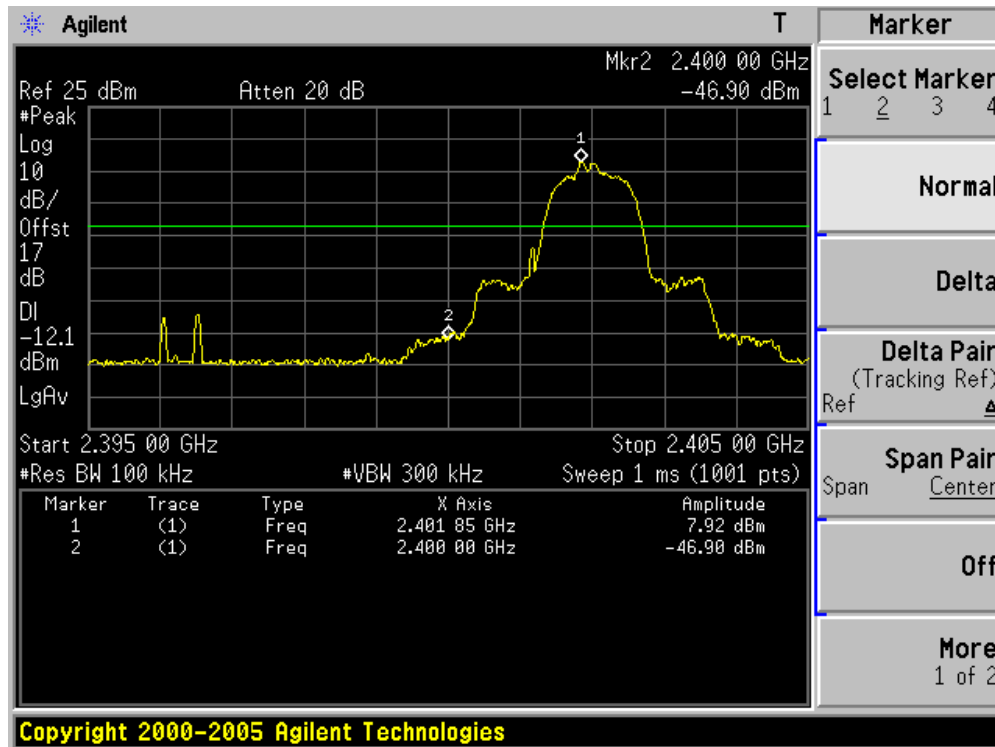


Channel 78 (2480MHz)

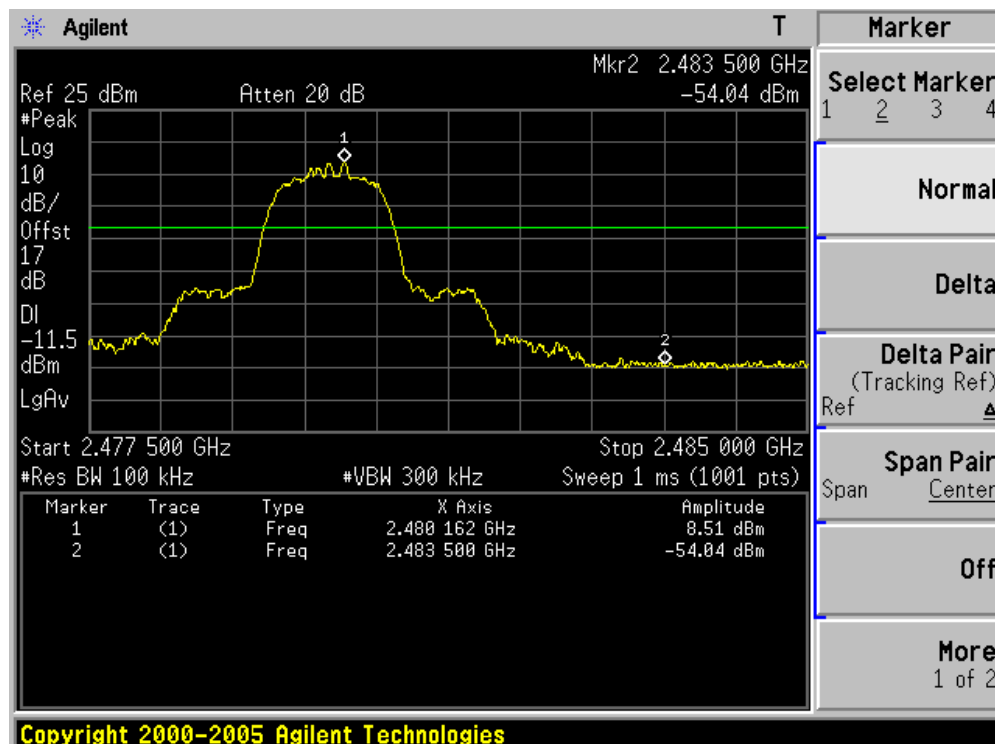


Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Band-edge Compliance of RF Conducted Emissions
Test Site	:	TR-8
Test Mode	:	Mode 2: Transmitter-2Mbps (Pi/4 DQPSK_DH5)

Channel 00 (2402MHz)

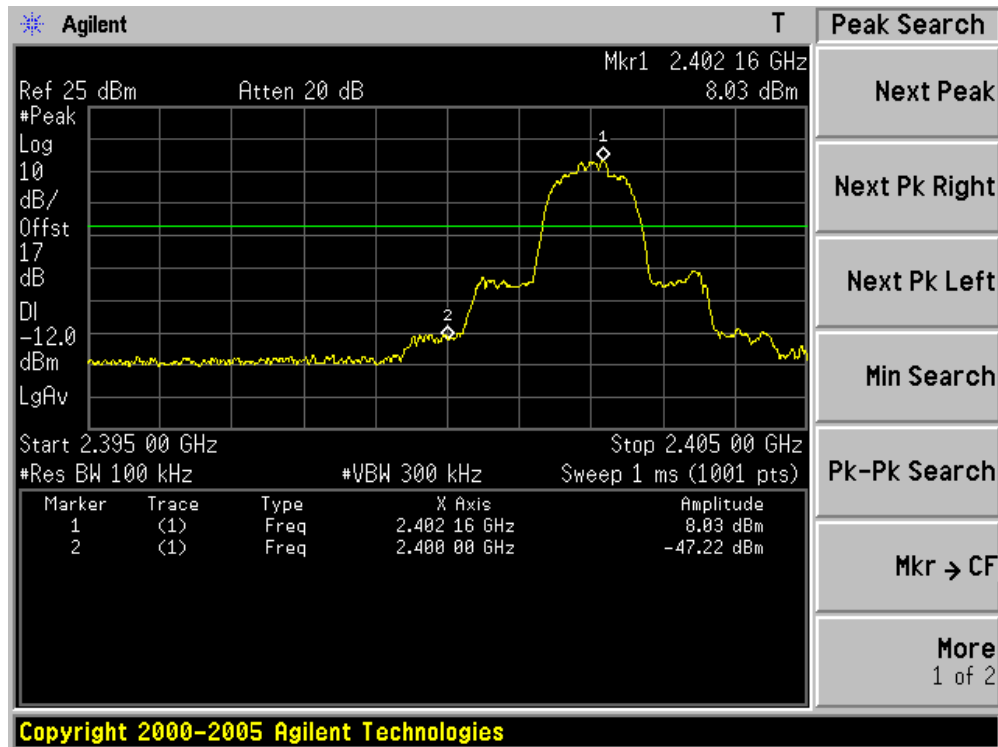


Channel 78 (2480MHz)

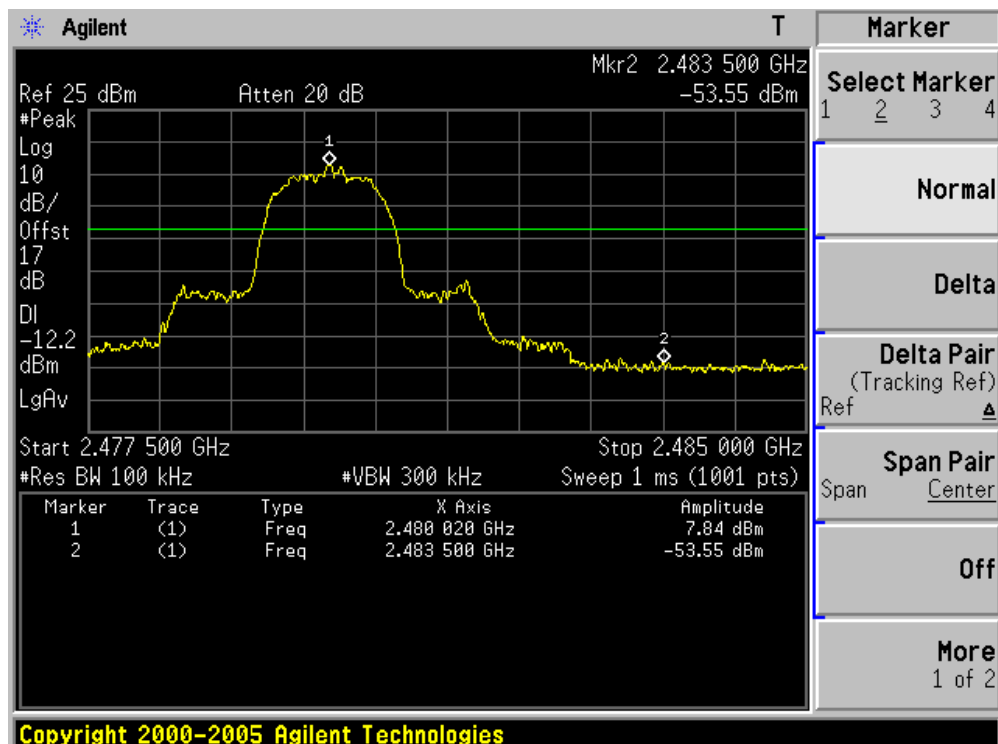


Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Band-edge Compliance of RF Conducted Emissions
Test Site	:	TR-8
Test Mode	:	Mode 3: Transmitter-3Mbps (8DPSK_DH5)

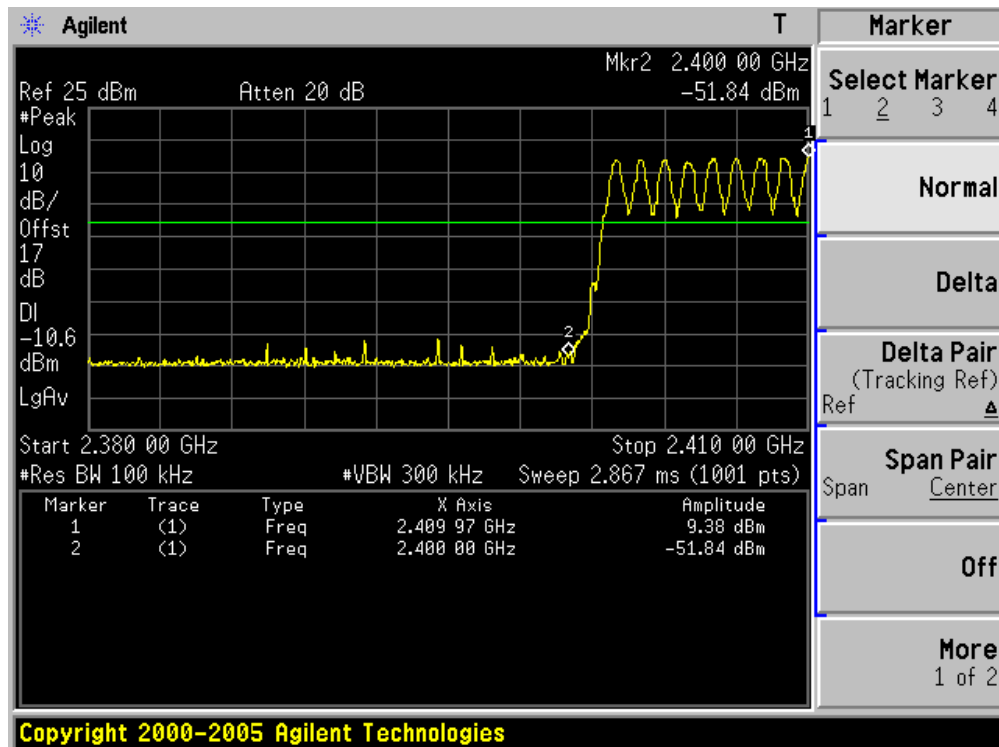
Channel 00 (2402MHz)

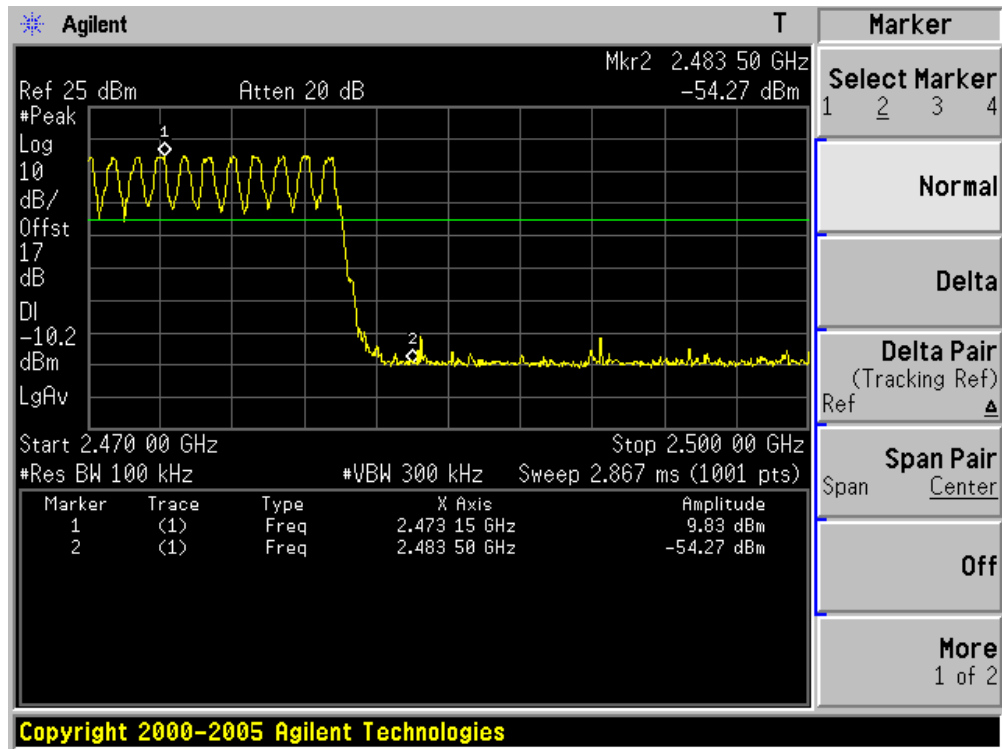


Channel 78 (2480MHz)



Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Band-edge Compliance of RF Conducted Emissions
Test Site	:	TR-8
Test Mode	:	Mode: Hopping Mode





11. Spurious RF Conducted Emissions

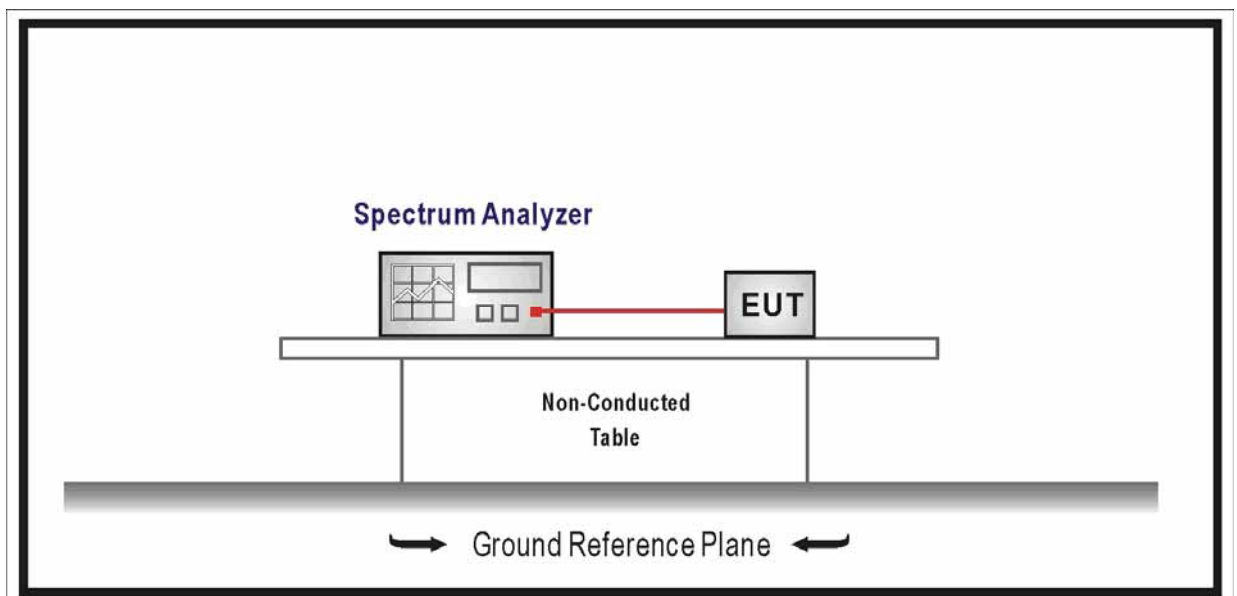
11.1. Test Equipment

Spurious RF Conducted Emissions / TR-8

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.03.10
Temperature/Humidity Meter	Zhicheng	ZC1-2	TR8-TH	2016.04.09

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

11.2. Test Setup



11.3. Limit

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 a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted or a radiated 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) of FCC part 15 is not required.

11.4. Test Procedure

According to ANSI C63.10: 2013.

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

The level displayed must comply with the limit specified in this section.

11.5. Uncertainty

The measurement uncertainty is defined as ± 1.0 dB

11.6. Test Result

Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Spurious RF Conducted Emissions
Test Site	:	TR-8
Test Mode	:	Mode 1: Transmitter-1Mbps (GFSK_DH5)

Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)

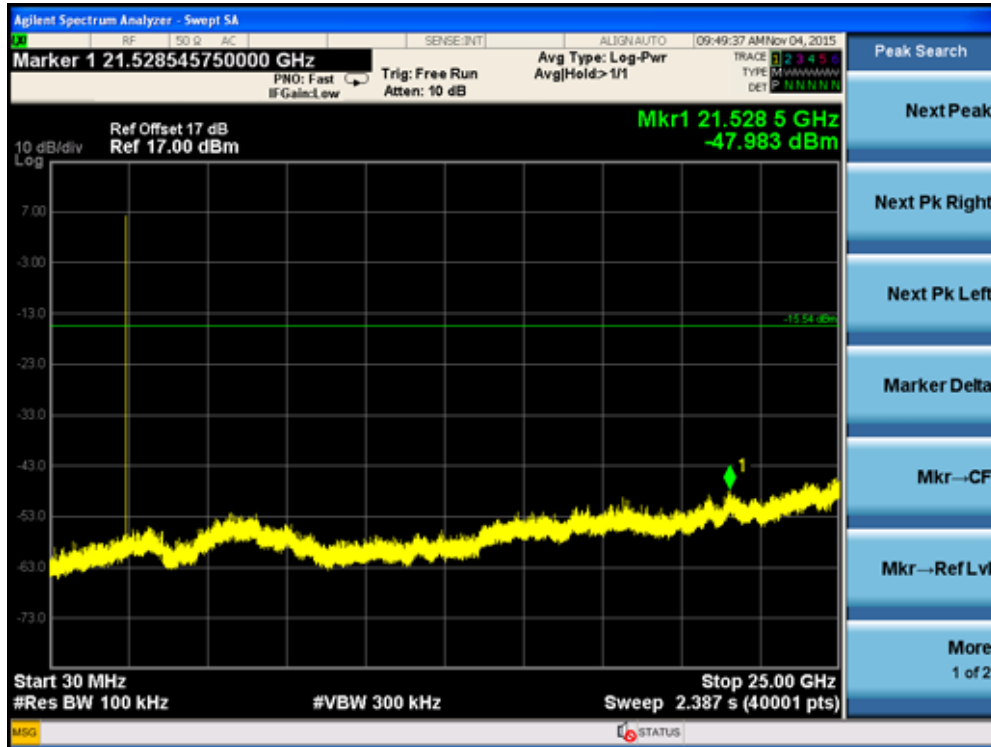


Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Spurious RF Conducted Emissions
Test Site	:	TR-8
Test Mode	:	Mode 2: Transmitter-2Mbps (Pi/4 DQPSK_DH5)

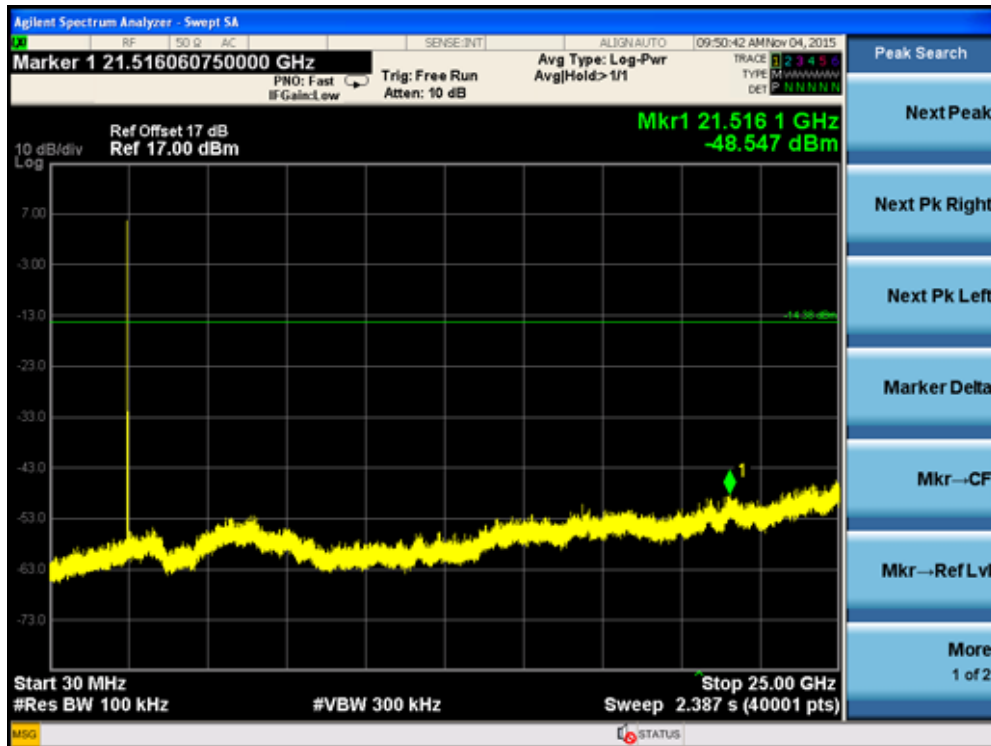
Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)

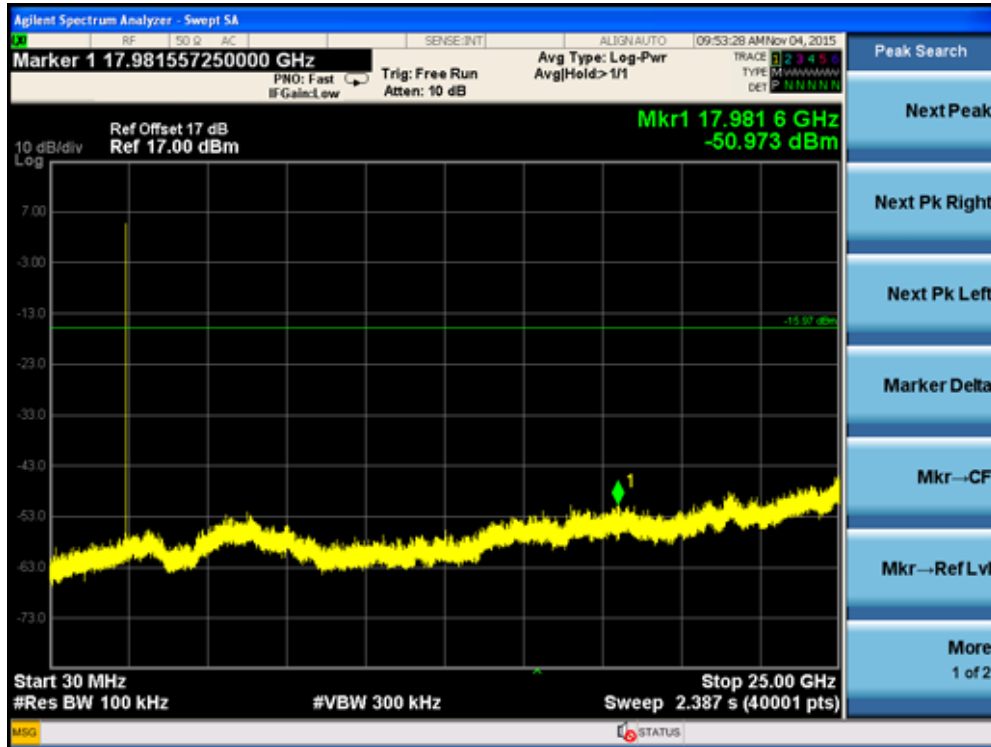


Product	:	Wahoo GPS BIKE COMPUTER
Test Item	:	Spurious RF Conducted Emissions
Test Site	:	TR-8
Test Mode	:	Mode 3: Transmitter-3Mbps (8DPSK_DH5)

Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)



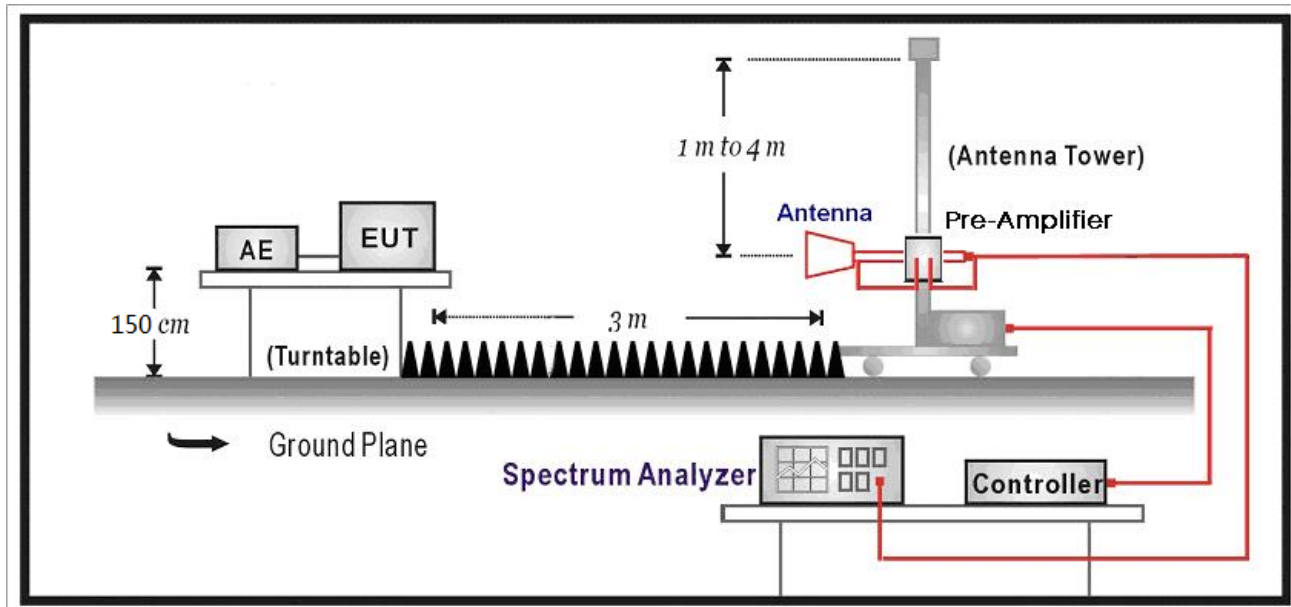
12. Radiated Emission Band Edge

12.1. Test Equipment

☒ Radiated Emission Band Edge / AC-5

Instrument	Manufacturer	Type No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2016.03.10
Preamplifier	Miteq	NSP1800-25	1364185	2016.05.03
Preamplifier	QuieTek	AP-040G	CHM-0906001	2016.05.03
Bilog Antenna	Teseq GmbH	CBL6112D	27612	2016.10.15
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	733	2016.02.26
DRG Horn	ETS-Lindgren	3117	00167055	2016.07.16
Broad-Band Horn Antenna	Schwarzbeck	BBHA9170	294	2016.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C1	2016.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C2	2016.03.01
Coaxial Cable	Huber+Suhner	SUCOFLEX 102	AC5-C3	2016.08.07
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC5-TH	2016.01.07

12.2. Test Setup



12.3. Limit

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part 15, must also comply with the radiated emission limits specified in Section 15.209(a) of FCC part 15.

12.4. Test Procedure

According to ANSI C63.10: 2013& ANSI C63.4: 2014

This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205 of FCC part 15. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.4 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with

sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b) of FCC part 15.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209 of FCC Part 15. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from $20\log(\text{dwell time}/100 \text{ ms})$, in an effort to demonstrate compliance with the 15.209 limit of FCC part 15.

If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative “marker-delta” method may be employed.

12.5. Uncertainty

The measurement uncertainty above 1G is defined as $\pm 3.9 \text{ dB}$

below 1G is defined as $\pm 3.8 \text{ dB}$

12.6. Test Result

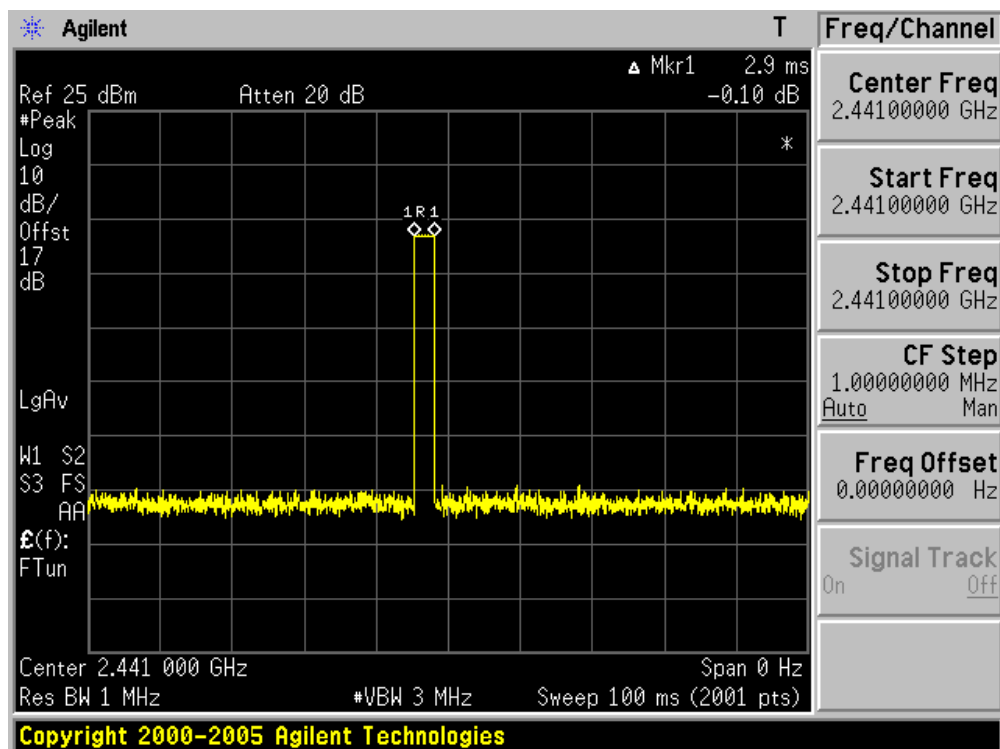
All of the test result shown indicates the worst case, and spectrum analyzer parameters setting as shown below:

Peak detector: RBW = 1MHz, VBW = 3MHz, sweep time = 200ms;

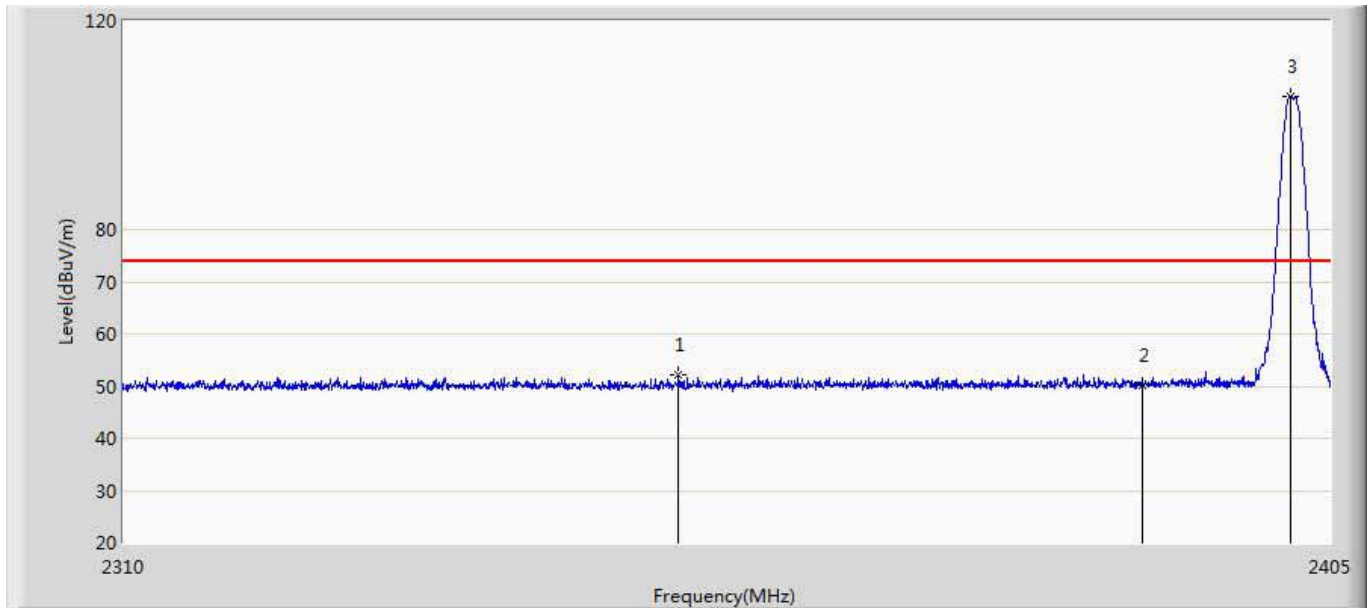
Average = Peak Measure Level+ Duty Factor

Duty Factor= $20 \cdot \text{LOG}(\text{Pulse Number} \cdot \text{On Time}/100) = -30.75\text{dB}$ in worst condition in normal use.

Pulse Number



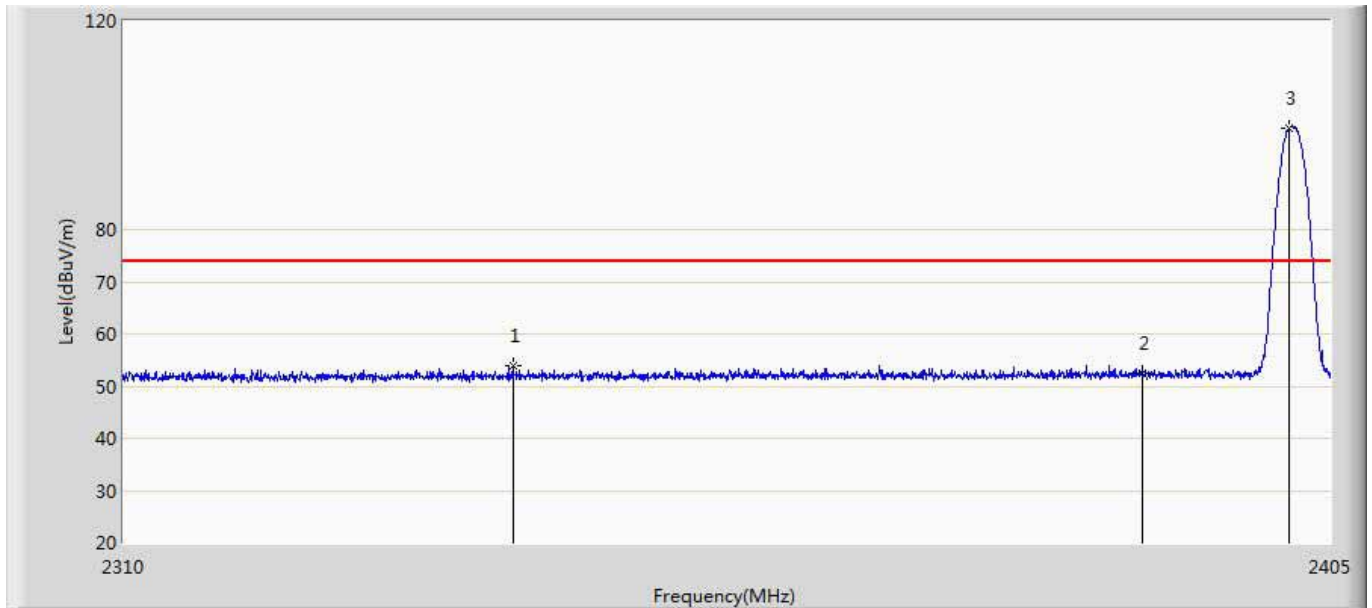
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 14:22
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2402Mhz by DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2353.272	52.043	14.787	-21.957	74.000	37.256	PK
2		2390.000	50.142	12.787	-23.858	74.000	37.355	PK
3	*	2401.817	105.587	68.245	N/A	N/A	37.342	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1		2353.272	52.043	21.293	-32.707	54.000	-30.75	AV
2		2390.000	50.142	19.392	-34.608	54.000	-30.75	AV
3	*	2401.817	105.587	74.837	N/A	N/A	-30.75	AV

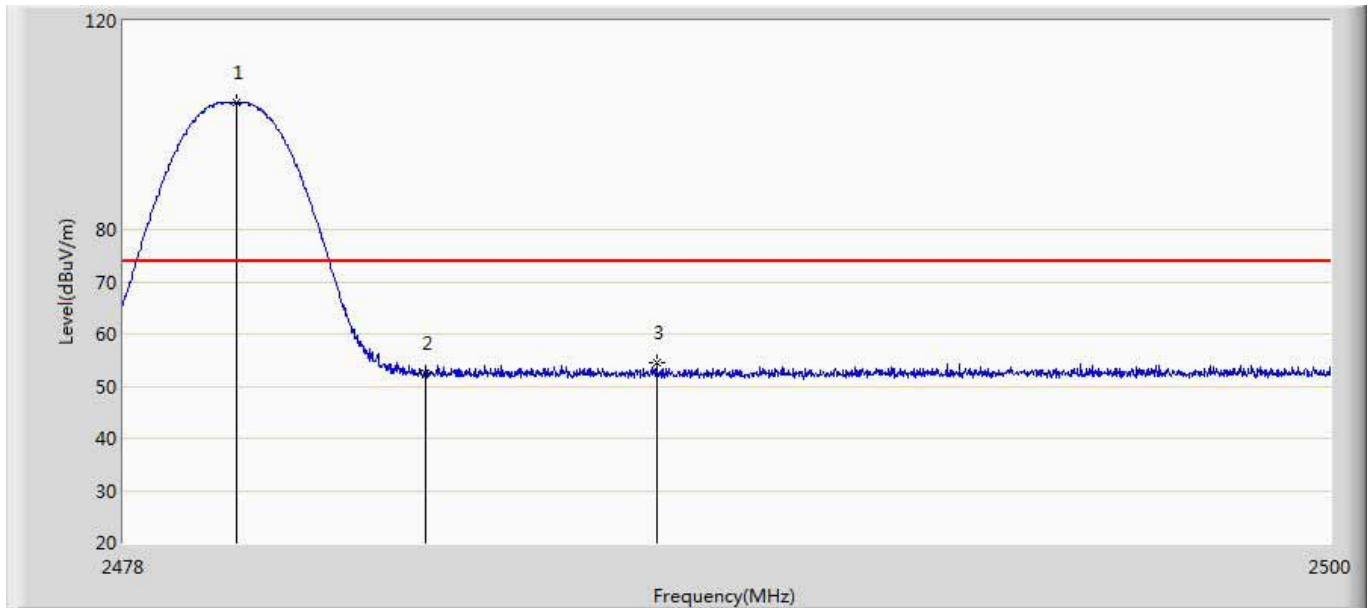
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 14:26
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2402Mhz by DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2340.258	53.907	16.674	-20.093	74.000	37.233	PK
2		2390.000	52.523	15.168	-21.477	74.000	37.355	PK
3	*	2401.722	99.461	62.119	N/A	N/A	37.342	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1		2340.258	53.907	23.157	-30.843	54.000	-30.75	AV
2	*	2390.000	52.523	21.773	-32.227	54.000	-30.75	AV
3	*	2401.722	99.461	68.711	N/A	N/A	-30.75	AV

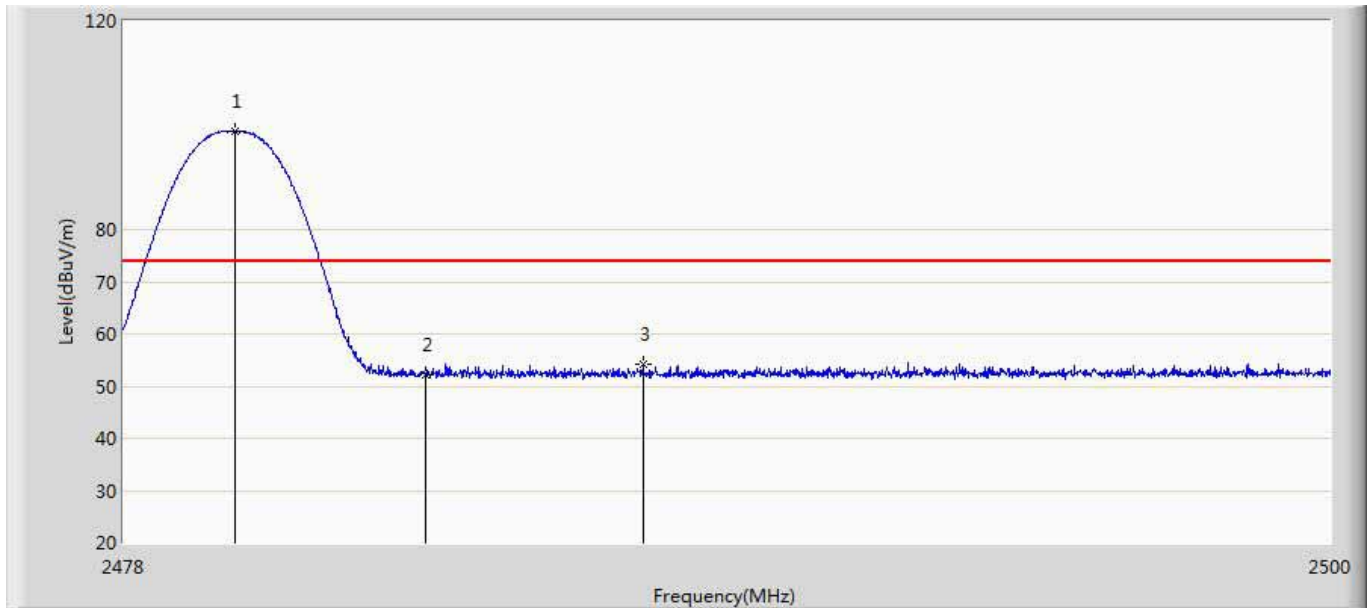
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 14:32
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2480Mhz by DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2480.046	104.386	66.900	N/A	N/A	37.486	PK
2		2483.500	52.400	14.889	-21.600	74.000	37.511	PK
3		2487.702	54.496	16.954	-19.504	74.000	37.541	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1	*	2480.046	104.386	73.636	N/A	N/A	-30.75	AV
2		2483.500	52.400	21.650	-32.35	54.000	-30.75	AV
3		2487.702	54.496	23.746	-30.254	54.000	-30.75	AV

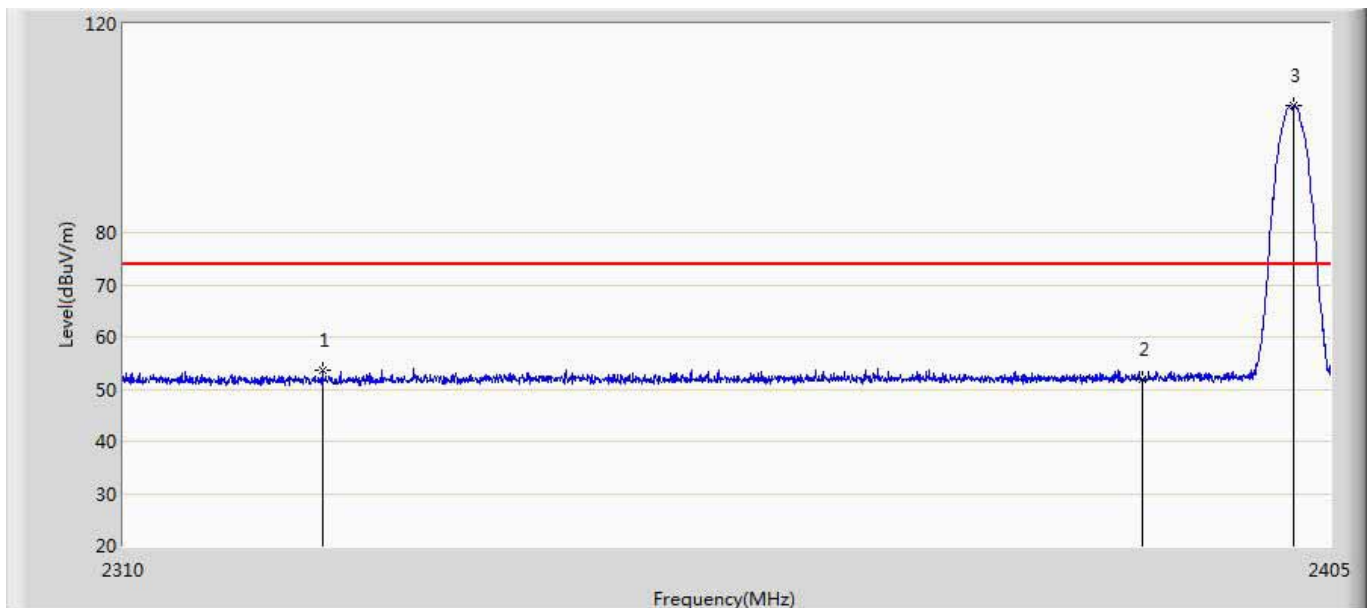
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 14:36
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2480Mhz by DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2480.024	98.917	61.431	N/A	N/A	37.486	PK
2		2483.500	52.267	14.756	-21.733	74.000	37.511	PK
3		2487.449	54.161	16.621	-19.839	74.000	37.540	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1	*	2480.024	98.917	68.167	N/A	N/A	-30.75	AV
2		2483.500	52.267	21.517	-32.483	54.000	-30.75	AV
3		2487.449	54.161	23.411	-30.589	54.000	-30.75	AV

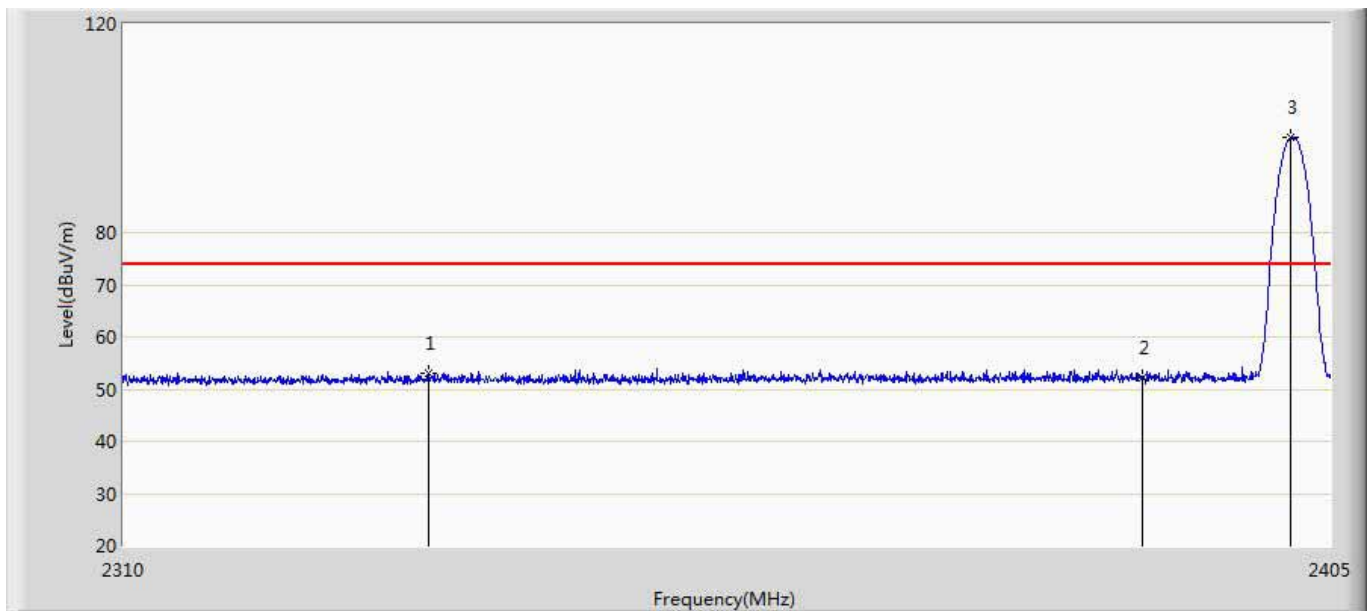
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 14:40
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2402Mhz by 2DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2325.437	53.541	16.285	-20.459	74.000	37.255	PK
2		2390.000	51.867	14.512	-22.133	74.000	37.355	PK
3	*	2402.103	104.491	67.149	N/A	N/A	37.342	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1		2325.437	53.541	22.791	-31.209	54.000	-30.75	AV
2		2390.000	51.867	21.117	-32.883	54.000	-30.75	AV
3	*	2402.103	104.491	73.741	N/A	N/A	-30.75	AV

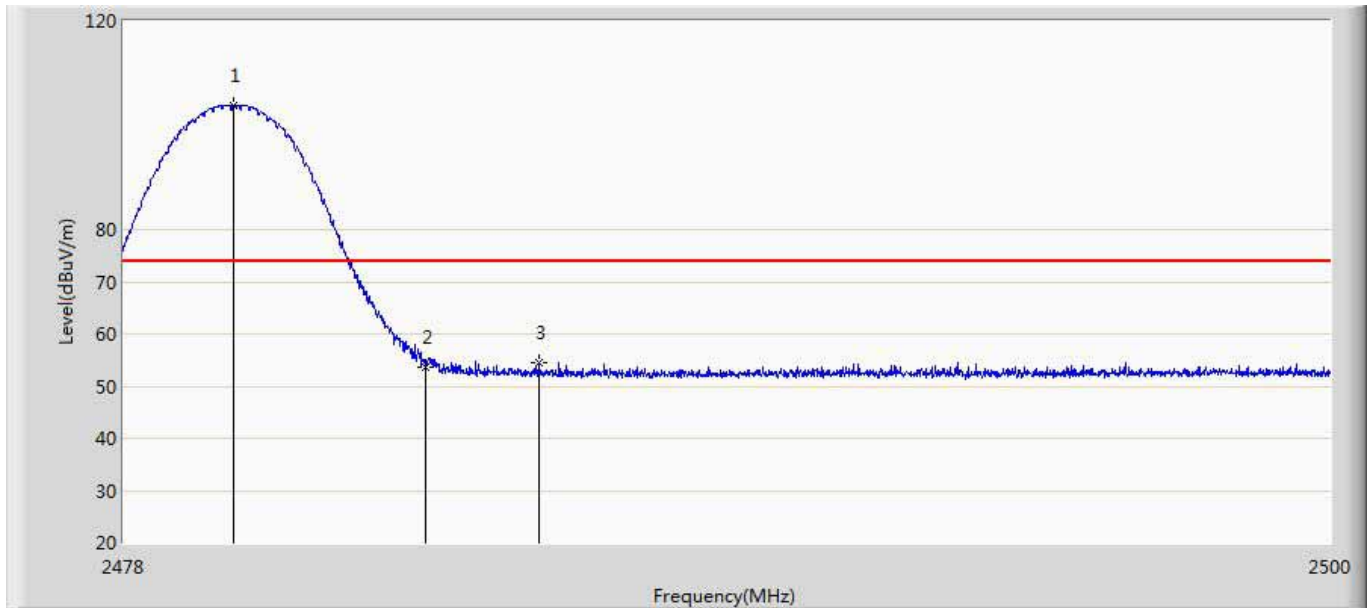
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 14:43
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2402Mhz by 2DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2333.702	53.102	15.856	-20.898	74.000	37.246	PK
2		2390.000	52.162	14.807	-21.838	74.000	37.355	PK
3	*	2401.817	98.121	60.779	N/A	N/A	37.342	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1		2333.702	53.102	22.352	-31.648	54.000	-30.75	AV
2	*	2390.000	52.162	21.412	-32.588	54.000	-30.75	AV
3	*	2401.817	98.121	67.371	N/A	N/A	-30.75	AV

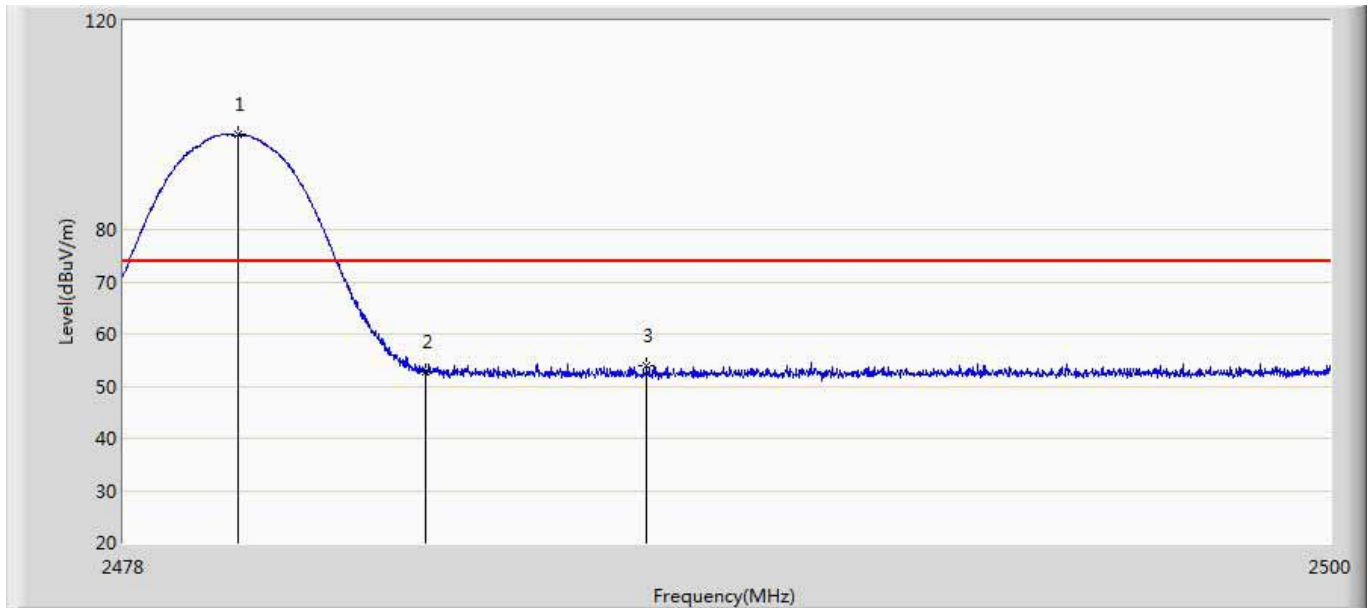
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 14:48
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2480Mhz by 2DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2480.013	103.751	66.265	N/A	N/A	37.486	PK
2		2483.500	53.729	16.218	-20.271	74.000	37.511	PK
3		2485.546	54.416	16.890	-19.584	74.000	37.526	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1	*	2480.013	103.751	73.001	N/A	N/A	-30.75	AV
2		2483.500	53.729	22.979	-31.021	54.000	-30.75	AV
3		2485.546	54.416	23.666	-30.334	54.000	-30.75	AV

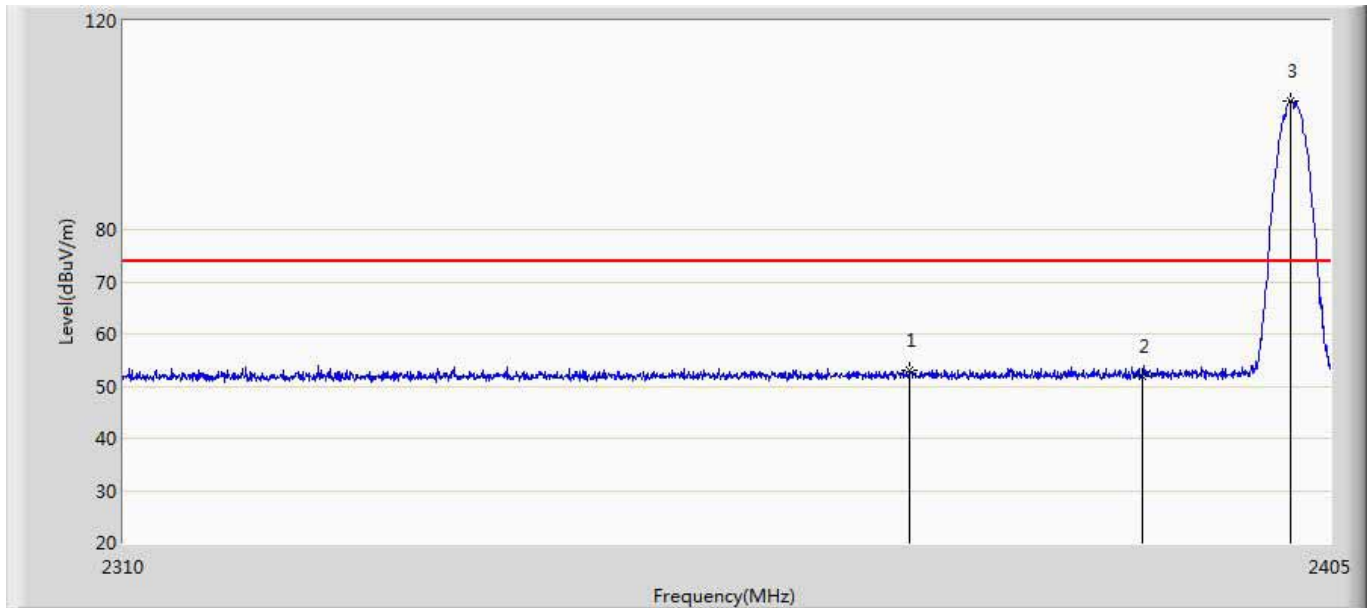
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 14:51
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2480Mhz by 2DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2480.079	98.220	60.733	N/A	N/A	37.486	PK
2		2483.500	52.814	15.303	-21.186	74.000	37.511	PK
3		2487.526	53.822	16.282	-20.178	74.000	37.540	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1	*	2480.079	98.220	67.47	N/A	N/A	-30.75	AV
2		2483.500	52.814	22.064	-31.936	54.000	-30.75	AV
3		2487.526	53.822	23.072	-30.928	54.000	-30.75	AV

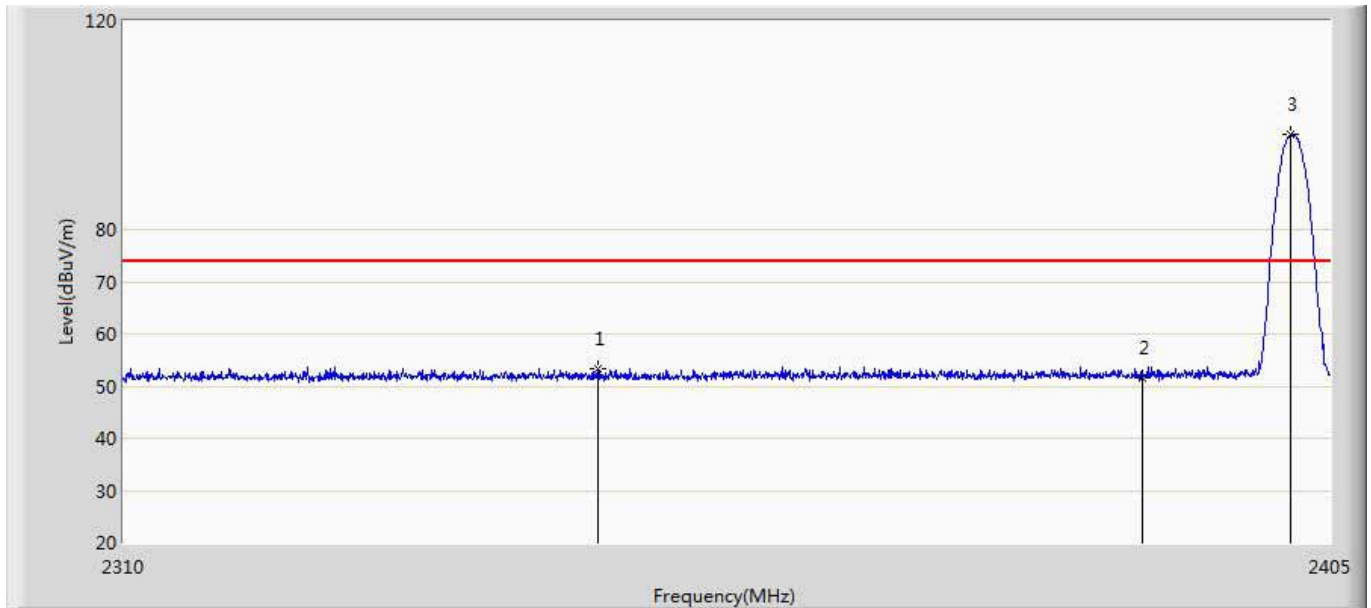
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 14:54
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2402Mhz by 3DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2371.417	52.952	15.621	-21.048	74.000	37.331	PK
2		2390.000	51.785	14.430	-22.215	74.000	37.355	PK
3	*	2401.865	104.697	67.355	N/A	N/A	37.342	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1		2371.417	52.952	22.202	-31.798	54.000	-30.75	AV
2		2390.000	51.785	21.035	-32.965	54.000	-30.75	AV
3	*	2401.865	104.697	73.947	N/A	N/A	-30.75	AV

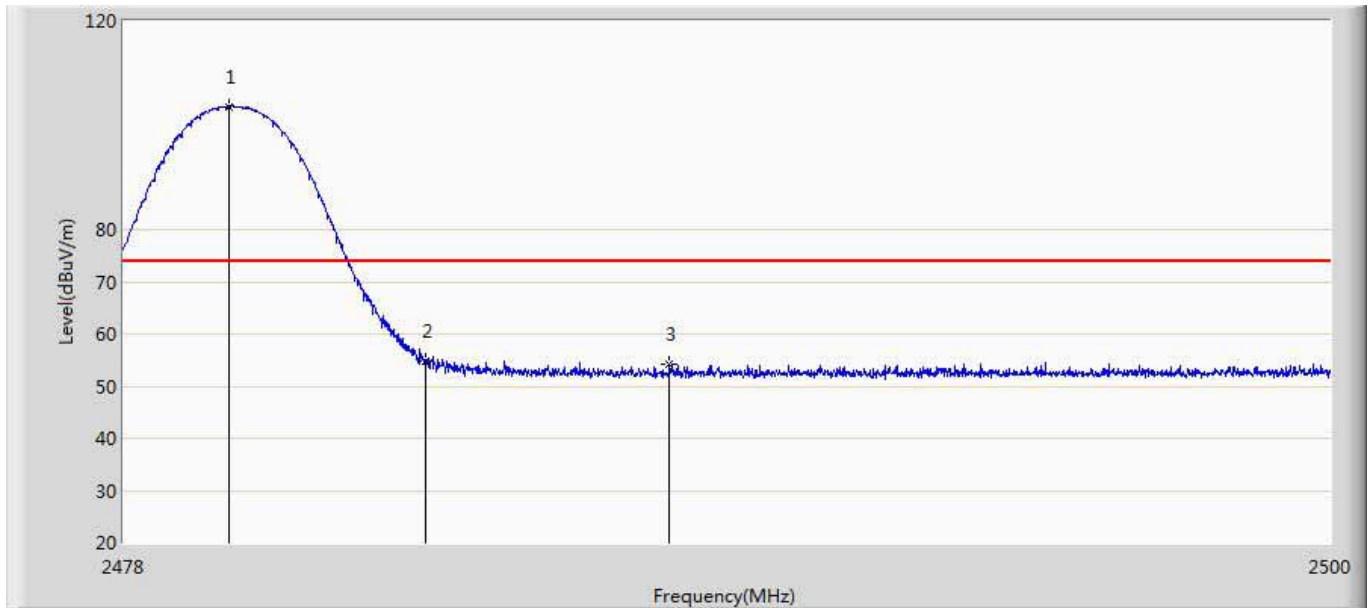
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 14:58
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2402Mhz by 3DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2346.907	53.391	16.153	-20.609	74.000	37.239	PK
2		2390.000	51.709	14.354	-22.291	74.000	37.355	PK
3	*	2401.817	98.143	60.801	N/A	N/A	37.342	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1		2346.907	53.391	22.641	-31.359	54.000	-30.75	AV
2		2390.000	51.709	20.959	-33.041	54.000	-30.75	AV
3	*	2401.817	98.143	67.393	N/A	N/A	-30.75	AV

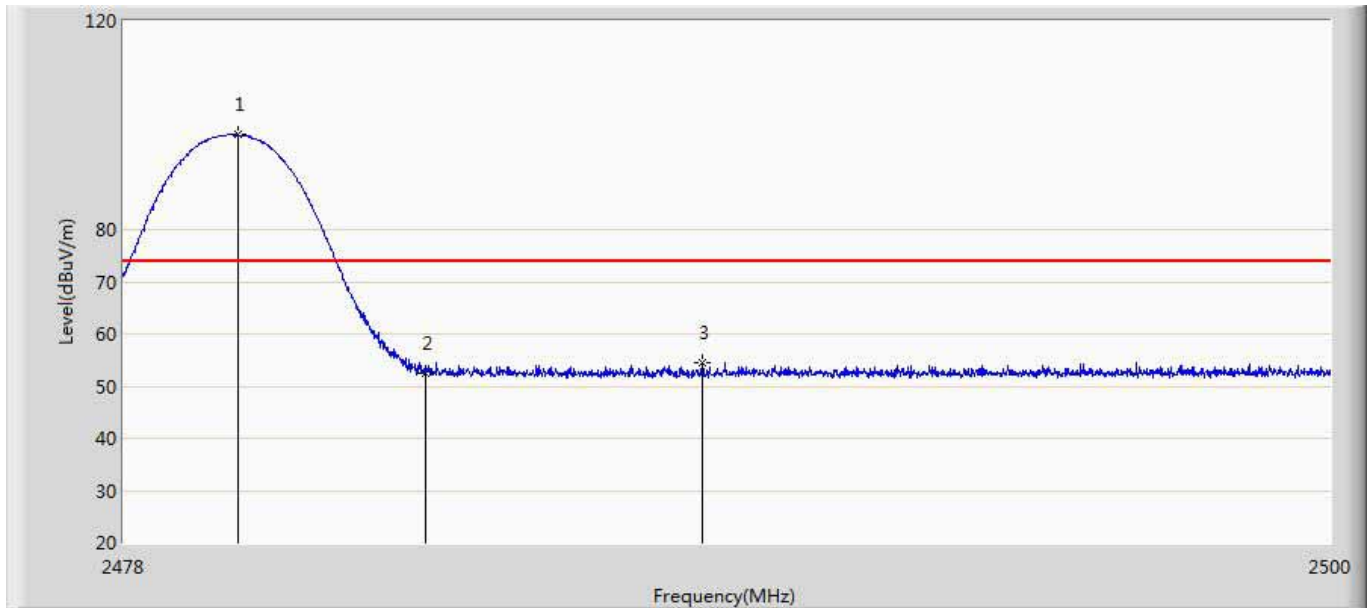
Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 15:03
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Horizontal
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2480Mhz by 3DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2479.914	103.622	66.137	N/A	N/A	37.485	PK
2		2483.500	54.877	17.366	-19.123	74.000	37.511	PK
3		2487.933	54.252	16.709	-19.748	74.000	37.544	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1	*	2479.914	103.622	72.872	N/A	N/A	-30.75	AV
2		2483.500	54.877	24.127	-29.873	54.000	-30.75	AV
3		2487.933	54.252	23.502	-30.498	54.000	-30.75	AV

Engineer: Scott	
Site: AC5	Time: 2015/10/30 - 15:06
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00167055(1-18GHz)	Polarity: Vertical
EUT: Wahoo GPS BIKE COMPUTER	Power: By Battery
Note: Mode 1:Transmit at CH2480Mhz by 3DH5	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2480.079	98.136	60.649	N/A	N/A	37.486	PK
2		2483.500	52.492	14.981	-21.508	74.000	37.511	PK
3		2488.527	54.431	16.883	-19.569	74.000	37.547	PK

No	Mark	Frequency (MHz)	Peak Level (dBuV/m)	AV Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Duty Factor (dB)	Type
1	*	2480.079	98.136	67.386	N/A	N/A	-30.75	AV
2		2483.500	52.492	21.742	-32.258	54.000	-30.75	AV
3		2488.527	54.431	23.681	-30.319	54.000	-30.75	AV

— The End —