

FCC Test Report

Product Name	HR FLOW SENSOR
Model No.	HR FLOW SENSOR
FCC ID.	2AD4S-LEZYNE-HR01

Applicant	Lezyne USA, Incorporated
Address	645 Tank Farm Road Unit F San Luis Obispo Califorina 93401 United States

Date of Receipt	July 26, 2016
Issued Date	Aug. 25, 2016
Report No.	1680006R-RFUSP01V00
Report Version	V1.0



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 report of the equipment and evaluated measurement uncertainty herein.

This report must not be used to claim product endorsement by TAF or any agency of the government.

The test report shall not be reproduced without the written approval of QuieTek Corporation.

Test Report

Issued Date: Aug. 25, 2016

Report No.: 1680006R-RFUSP01V00



Product Name	HR FLOW SENSOR
Applicant	Lezyne USA, Incorporated
Address	645 Tank Farm Road Unit F San Luis Obispo California 93401 United States
Manufacturer	Lezyne USA, Incorporated
Model No.	HR FLOW SENSOR
FCC ID.	2AD4S-LEZYNE-HR01
EUT Rated Voltage	DC 3V (Power by Battery)
EUT Test Voltage	DC 3V (Power by Battery)
Trade Name	LEZYNE
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2015 ANSI C63.4: 2014, ANSI C63.10: 2013 KDB 558074 D01 DTS Meas Guidance v03r05
Test Result	Complied

Documented By :

Genie Chang

(Senior Adm. Specialist / Genie Chang)

Tested By :

Nick Chen

(Engineer / Nick Chen)

Approved By :

Vincent Lin

(Director / Vincent Lin)

TABLE OF CONTENTS

Description	Page
1. GENERAL INFORMATION	4
1.1. EUT Description.....	4
1.2. Operational Description.....	6
1.3. Tested System Details.....	7
1.4. Configuration of Tested System	7
1.5. EUT Exercise Software	7
1.6. Test Facility	8
2. CONDUCTED EMISSION	9
2.1. Test Equipment	9
2.2. Test Setup	9
2.3. Limits.....	10
2.4. Test Procedure	10
2.5. Uncertainty	10
2.6. Test Result of Conducted Emission.....	11
3. PEAK POWER OUTPUT	12
3.1. Test Equipment	12
3.2. Test Setup	12
3.3. Limit	12
3.4. Test Procedure	12
3.5. Uncertainty	12
3.6. Test Result of Peak Power Output	13
4. RADIATED EMISSION	14
4.1. Test Equipment	14
4.2. Test Setup	14
4.3. Limits.....	15
4.4. Test Procedure	17
4.5. Uncertainty	17
4.6. Test Result of Radiated Emission.....	18
5. RF ANTENNA CONDUCTED TEST	22
5.1. Test Equipment	22
5.2. Test Setup	22
5.3. Limits.....	22
5.4. Test Procedure	22
5.5. Uncertainty	22
5.6. Test Result of RF Antenna Conducted Test	23
6. BAND EDGE	26
6.1. Test Equipment	26
6.2. Test Setup	27
6.3. Limit	27
6.4. Test Procedure	28
6.5. Uncertainty	28
6.6. Test Result of Band Edge	29
7. 6DB BANDWIDTH.....	33
7.1. Test Equipment	33
7.2. Test Setup	33
7.3. Limits.....	33
7.4. Test Procedure	33
7.5. Uncertainty	33
7.6. Test Result of 6dB Bandwidth.....	34
8. POWER DENSITY	37
8.1. Test Equipment	37
8.2. Test Setup	37
8.3. Limits.....	37
8.4. Test Procedure	37
8.5. Uncertainty	37
8.6. Test Result of Power Density	38
9. EMI REDUCTION METHOD DURING COMPLIANCE TESTING	41
Attachment 1: EUT Test Photographs	
Attachment 2: EUT Detailed Photographs	

1. GENERAL INFORMATION

1.1. EUT Description

Product Name	HR FLOW SENSOR
Trade Name	LEZYNE
Model No.	HR FLOW SENSOR
FCC ID.	2AD4S-LEZYNE-HR01
Frequency Range	2402 – 2480MHz
Channel Number	40CH
Type of Modulation	GFSK(1Mbps)
Antenna Type	PCB Antenna
Channel Control	Auto
Antenna Gain	Refer to the table “Antenna List”

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	TEXAS INSTRUMENTS	N/A	PCB Antenna	5.3dBi for 2.4 GHz

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

Center Frequency of Each Channel: (For V4.0)

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 HR FLOW SENSOR with a built-in 2.4GHz Bluetooth V4.0 transceiver.
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. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.
4. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.

Test Mode	Mode 1: Transmit - BLE mode
-----------	-----------------------------

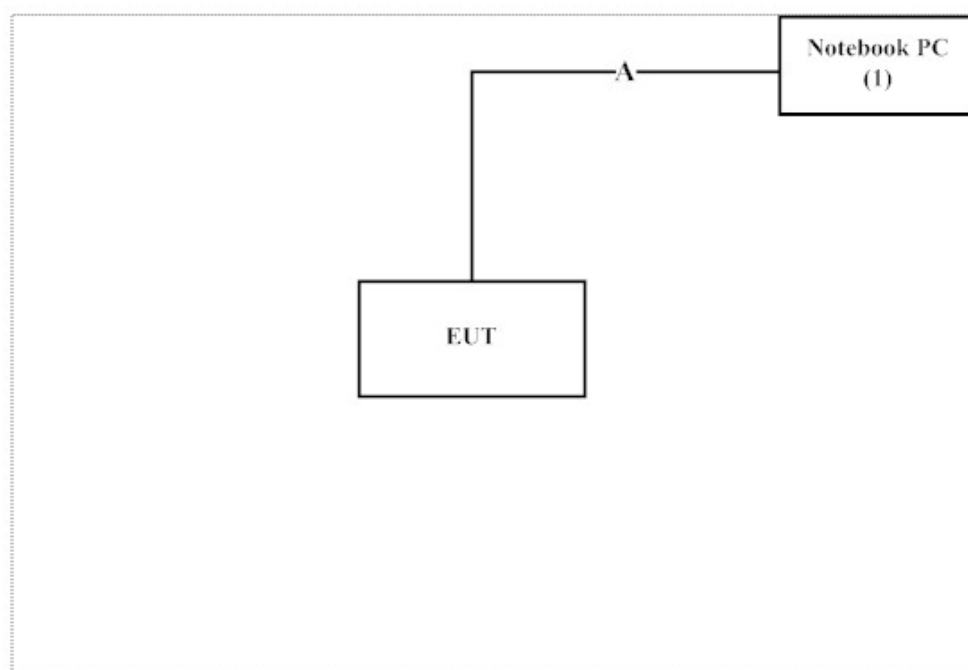
1.3. Tested System Details

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	HG26TZ1	Shielded, 1.8m

Signal Cable Type			Signal cable Description
A	Signal Cable		Non-Shielded, 0.8m, with one ferrite core bonded.

1.4. Configuration of Tested System



1.5. EUT Exercise Software

1. Setup the EUT as shown in Section 1.4.
2. Execute software "Tera Term V4.64" 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

Quietek Corporation's Web Site: <http://www.quietek.com/chinese/about/certificates.aspx?bval=5>

The address and introduction of Quietek Corporation's laboratories can be founded in our Web site:

<http://www.quietek.com/>

Site Description: File on
Federal Communications Commission
FCC Engineering Laboratory
7435 Oakland Mills Road
Columbia, MD 21046
Registration Number: 92195

Site Name: Quietek Corporation
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 : service@quietek.com

FCC Accreditation Number: TW1014

2. Conducted Emission

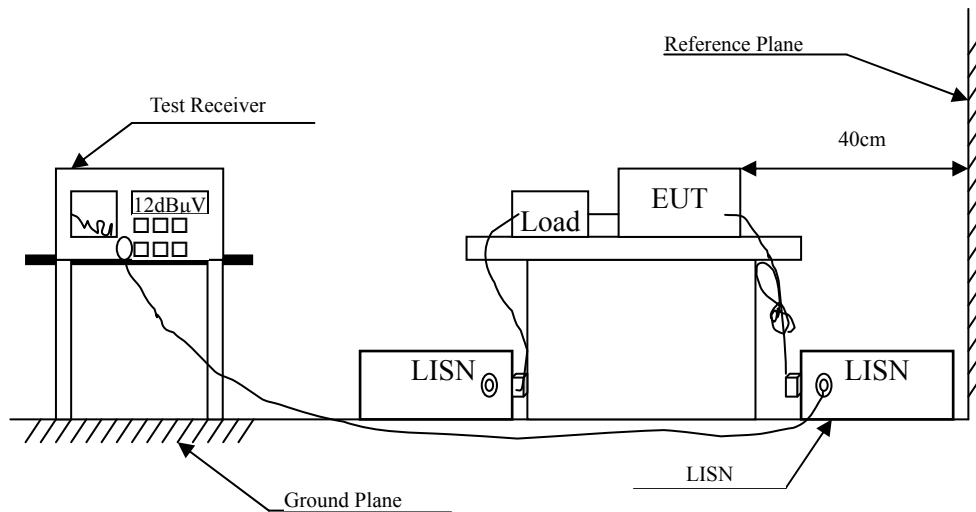
2.1. Test Equipment

	Equipment	Manufacturer	Model No. / Serial No.	Last Cal.	Last Cal.	Remark
X	Test Receiver	R & S	ESCS 30 / 825442/018	Sep., 2015	Sep., 2016	
X	Artificial Mains Network	R & S	ENV4200 / 848411/10	Feb., 2016	Feb., 2017	Periphe
X	LISN	R & S	ESH3-Z5 / 825562/002	Feb., 2016	Feb., 2017	EUT
	DC LISN	Schwarzbeck	8226 / 176	Mar., 2016	Mar., 2017	EUT
X	Pulse Limiter	R & S	ESH3-Z2 / 357.8810.52	Feb., 2016	Feb., 2017	
	No.1 Shielded Room					

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked by "X" are used to measure the final test results.

2.2. Test Setup



2.3. Limits

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

Remarks: In the above table, the tighter limit applies at the band edges.

2.4. Test Procedure

The EUT and Peripherals are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.

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

The EUT was setup to ANSI C63.4, 2014; tested to DTS test procedure of FCC KDB-558074 for compliance to FCC 47CFR Subpart C requirements.

2.5. Uncertainty

± 2.26 dB

2.6. Test Result of Conducted Emission

Owing to the EUT use battery supply voltage, this test item is not performed.

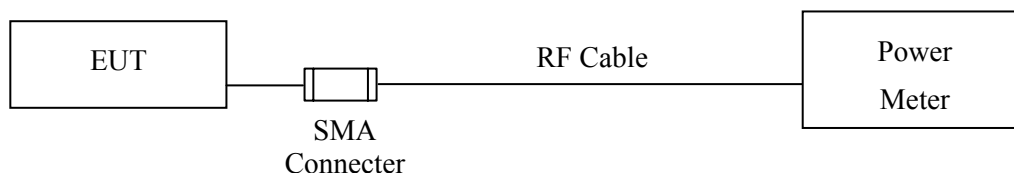
3. Peak Power Output

3.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.	Due Cal.
X	Power Meter	Anritsu	ML2495A/6K00003357	May, 2016	May, 2017
X	Power Sensor	Anritsu	MA2411B/0738448	Jun., 2016	Jun., 2017

Note: 1. All equipments are calibrated every one year.
2. The test instruments marked by “X” are used to measure the final test results.

3.2. Test Setup



3.3. Limit

The maximum peak power shall be less 1Watt.

3.4. 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 9.1.2 PKPM1 Peak power meter method.

3.5. Uncertainty

± 1.19 dB

3.6. Test Result of Peak Power Output

Product : HR FLOW SENSOR
 Test Item : Peak Power Output
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit - BLE mode

Channel No.	Frequency (MHz)	Measurement (dBm)	Required Limit	Result
Channel 00	2402.00	3.66	1 Watt= 30 dBm	Pass
Channel 19	2440.00	3.70	1 Watt= 30 dBm	Pass
Channel 39	2480.00	3.78	1 Watt= 30 dBm	Pass

4. Radiated Emission

4.1. Test Equipment

The following test equipments are used during the radiated emission test:

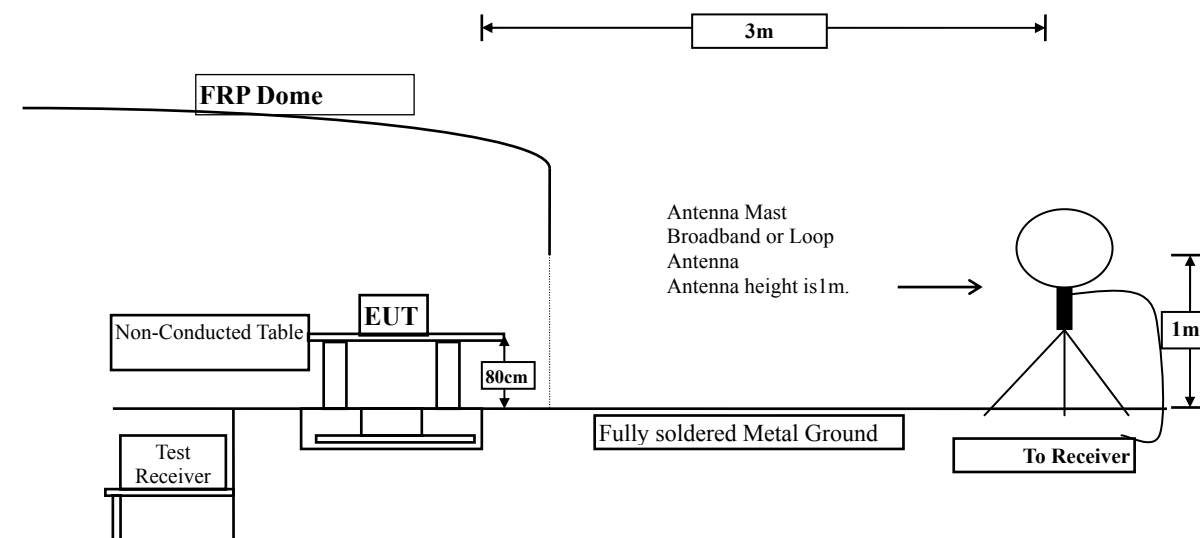
Test Site	Equipment	Manufacturer	Model No./Serial No.	Last Cal.	Due Cal.
☒ Site # 3	X Magnetic Loop Antenna	Teseq	HLA6121/ 37133	Sep., 2015	Sep., 2016
	X Bilog Antenna	Schaffner Chase	CBL6112B/ 2707	Jun., 2016	Jun., 2017
	X EMI Test Receiver	R&S	ESCS 30/838251/ 001	Jun., 2016	Jun., 2017
	X Coaxial Cable	QTK(Arnist)	RG 214/ LC003-RG	Jun., 2016	Jun., 2017
	X Coaxial signal switch	Arnist	MP59B/ 6200798682	Jun., 2016	Jun., 2017

Test Site	Equipment	Manufacturer	Model No./Serial No.	Last Cal.	Due Cal.
☒ CB # 8	X Spectrum Analyzer	R&S	FSP40/ 100339	Oct, 2015	Oct, 2016
	X Horn Antenna	ETS-Lindgren	3117/ 35205	Mar, 2016	Mar, 2017
	X Horn Antenna	Schwarzbeck	BBHA9170/209	Jan., 2016	Jan., 2017
	X Horn Antenna	TRC	AH-0801/95051	Aug., 2016	Aug., 2017
	X Pre-Amplifier	EMCI	EMC012630SE/980210	Jan., 2016	Jan., 2017
	X Pre-Amplifier	MITEQ	JS41-001040000-58-5P/153945	Jul., 2016	Jul., 2017
	X Pre-Amplifier	NARDA	DBL-1840N506/013	Jul., 2016	Jul., 2017

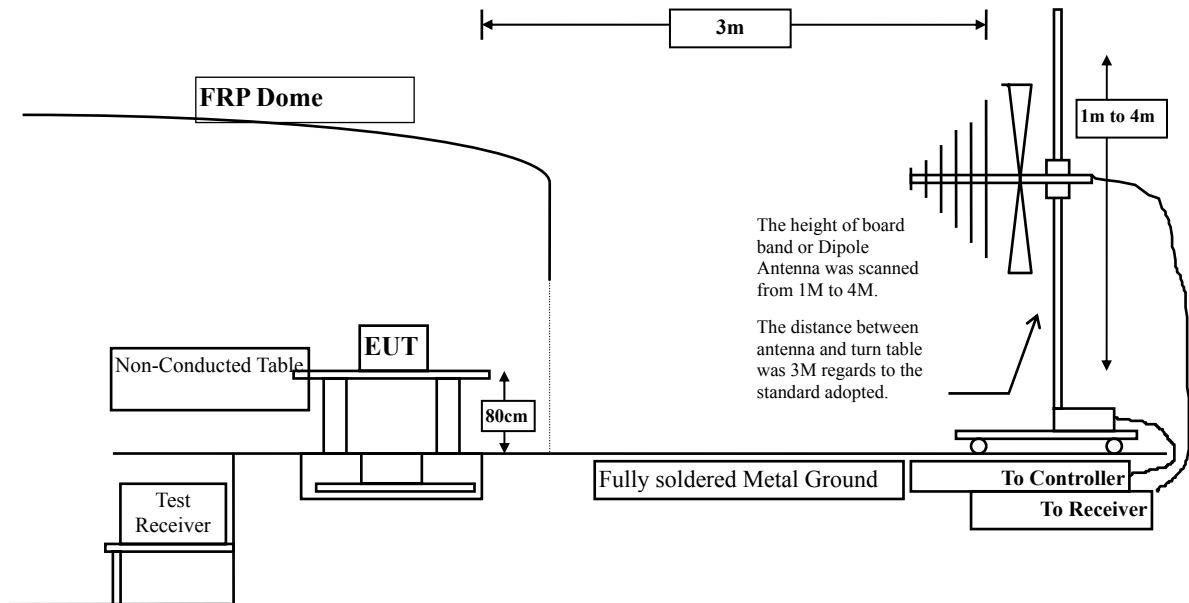
- Note: 1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with “X” are used to measure the final test results.

4.2. Test Setup

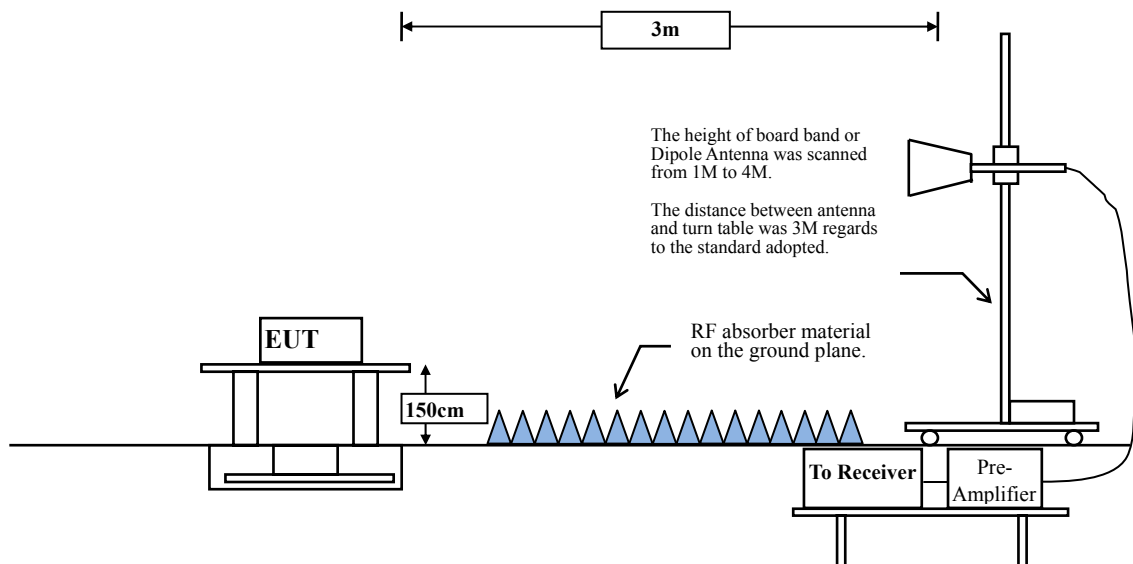
Under 30MHz



Below 1GHz



Above 1GHz



4.3. 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.

4.4. 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 from 9kHz - 10th Harmonic of fundamental was investigated.

4.5. Uncertainty

± 4.08 dB above 1GHz

± 4.22 dB below 1GHz

4.6. Test Result of Radiated Emission

Product : HR FLOW SENSOR
Test Item : Harmonic Radiated Emission
Test Site : CB8
Test Mode : Mode 1: Transmit - BLE mode(2402MHz)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dB μ V	dB μ V/m	dB	dB μ V/m
Horizontal					
Peak Detector:					
4804.000	-4.632	50.790	46.158	-27.842	74.000
7206.000	-1.054	55.590	54.536	-19.464	74.000
9608.000	1.393	46.580	47.974	-26.026	74.000
Average					
Detector:					
7206.000	-1.054	49.950	48.896	-5.104	54.000
Vertical					
Peak Detector:					
4804.000	-4.632	49.410	44.778	-29.222	74.000
7206.000	-1.054	52.990	51.936	-22.064	74.000
9608.000	1.393	46.580	47.974	-26.026	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. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : HR FLOW SENSOR
 Test Item : Harmonic Radiated Emission
 Test Site : CB8
 Test Mode : Mode 1: Transmit - BLE mode (2440MHz)

Frequency MHz	Correct Factor dB	Reading Level dBμV	Measurement Level dBμV/m	Margin dB	Limit dBμV/m
Horizontal					
Peak Detector:					
4880.000	-4.542	51.990	47.448	-26.552	74.000
7320.000	-0.947	54.300	53.353	-20.647	74.000
9760.000	1.659	47.630	49.289	-24.711	74.000
Average Detector:					
--					
Vertical					
Peak Detector:					
4880.000	-4.542	49.200	44.658	-29.342	74.000
7320.000	-0.947	54.550	53.603	-20.397	74.000
9760.000	1.659	47.630	49.289	-24.711	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. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : HR FLOW SENSOR
 Test Item : Harmonic Radiated Emission
 Test Site : CB8
 Test Mode : Mode 1: Transmit - BLE mode (2480MHz)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dB μ V	dB μ V/m	dB	dB μ V/m
Horizontal					
Peak Detector:					
4960.000	-4.430	51.870	47.441	-26.559	74.000
7440.000	-0.828	51.530	50.701	-23.299	74.000
9920.000	1.836	47.270	49.106	-24.894	74.000
Average					
Detector:					
--					
Vertical					
Peak Detector:					
4960.000	-4.430	50.140	45.711	-28.289	74.000
7440.000	-0.828	54.060	53.231	-20.769	74.000
9920.000	1.836	45.400	47.236	-26.764	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. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : HR FLOW SENSOR
 Test Item : General Radiated Emission
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit - BLE mode (2440MHz)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBμV	dBμV/m	dB	dBμV/m
Horizontal					
53.899	-11.377	44.138	32.761	-7.239	40.000
287.261	-10.567	41.907	31.340	-14.660	46.000
335.058	-9.344	43.972	34.629	-11.371	46.000
479.855	-6.163	41.383	35.220	-10.780	46.000
600.754	-3.633	42.770	39.138	-6.862	46.000
949.391	0.963	37.700	38.663	-7.337	46.000
Vertical					
191.667	-13.436	46.990	33.553	-9.947	43.500
263.362	-11.573	48.644	37.070	-8.930	46.000
479.855	-6.163	42.575	36.412	-9.588	46.000
648.551	-3.247	39.729	36.483	-9.517	46.000
768.043	-1.311	34.039	32.729	-13.271	46.000
949.391	0.963	33.773	34.736	-11.264	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.
8. No emission found between lowest internal used/generated frequency to 30MHz.

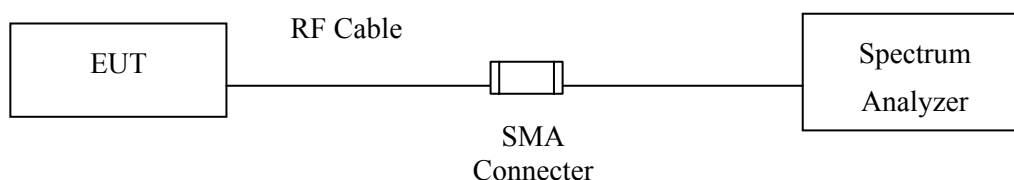
5. RF Antenna Conducted Test

5.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.	Due Cal..
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun., 2016	Jun., 2017
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun., 2016	Jun., 2017
X	Spectrum Analyzer	R&S	FSV30 / 103464	Dec, 2015	Dec, 2016

Note: 1. All equipments are calibrated every one year.
2. The test instruments Marked "X" are used to measure the final test results.

5.2. Test Setup



5.3. Limits

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.

5.4. Test Procedure

The EUT was tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

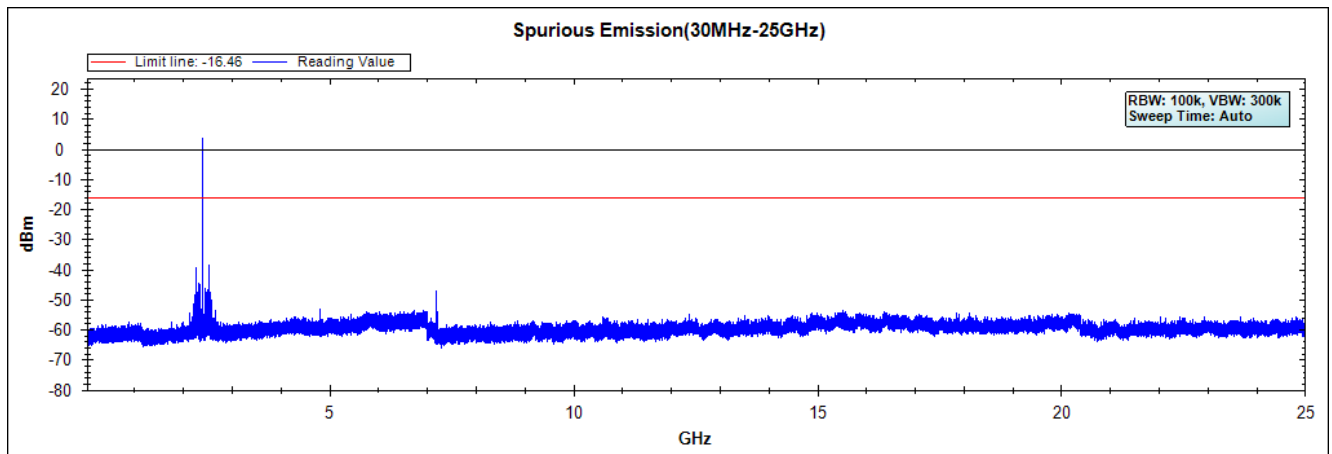
5.5. Uncertainty

$\pm 1.20\text{dB}$

5.6. Test Result of RF Antenna Conducted Test

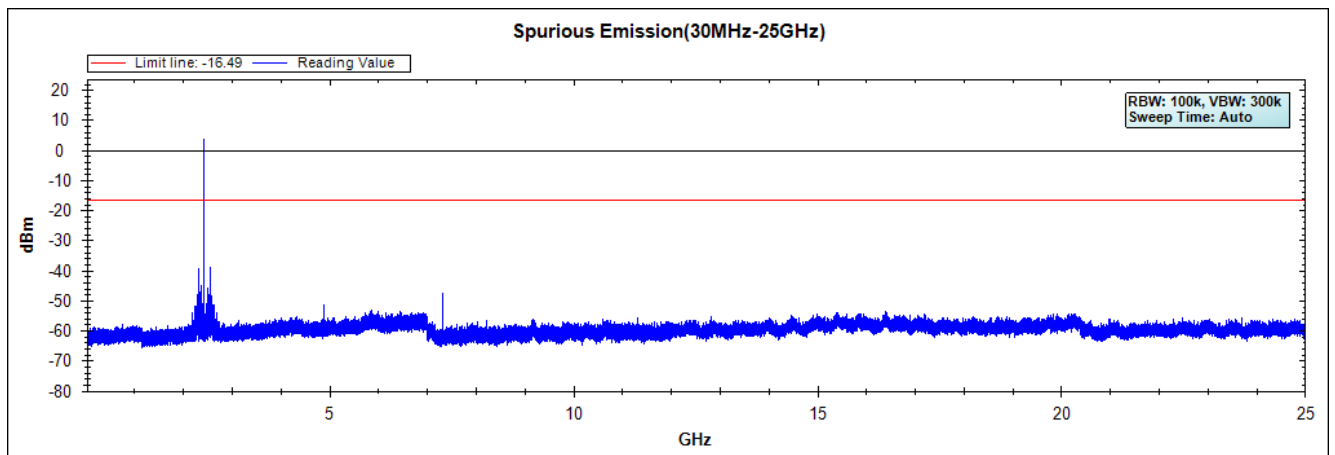
Product : HR FLOW SENSOR
 Test Item : RF Antenna Conducted Test
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit - BLE mode

Figure Channel 00:



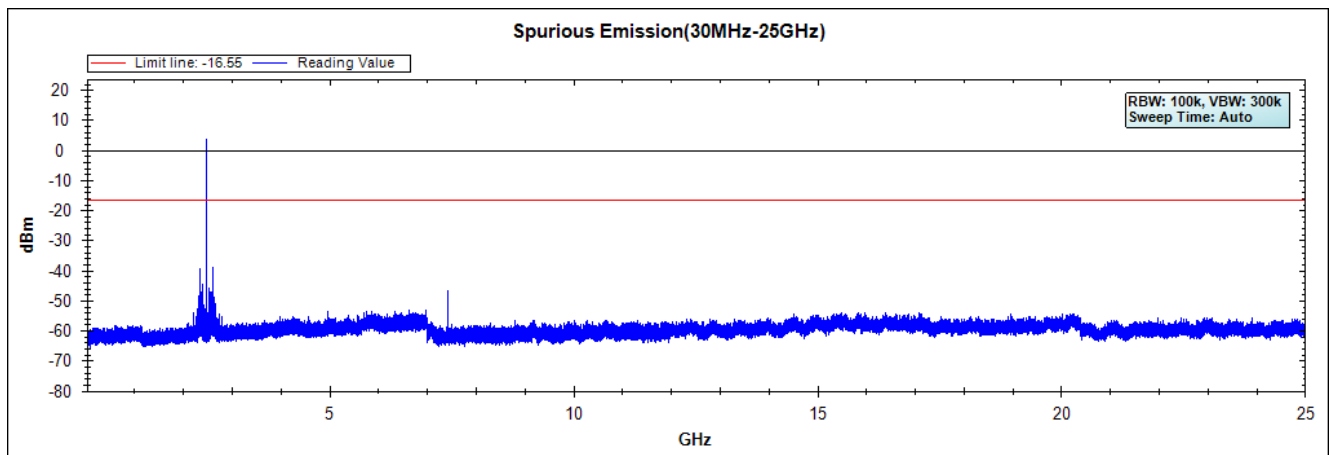
Product : HR FLOW SENSOR
 Test Item : RF Antenna Conducted Test
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit - BLE mode

Figure Channel 19:



Product : HR FLOW SENSOR
 Test Item : RF Antenna Conducted Test
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit - BLE mode

Figure Channel 39:



6. Band Edge

6.1. Test Equipment

RF Conducted Measurement

The following test equipments are used during the band edge tests:

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.	Due Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2016	Jun, 2017
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2016	Jun, 2017
X	Spectrum Analyzer	R&S	FSV30 / 103464	Dec, 2015	Dec, 2016

RF Radiated Measurement:

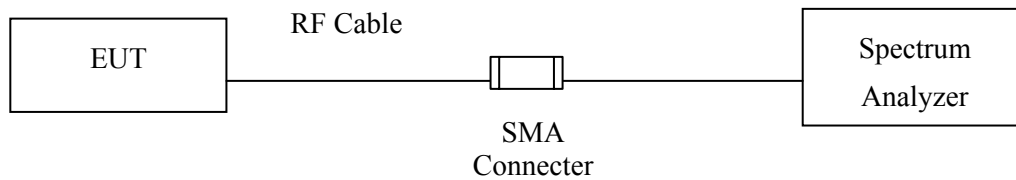
The following test equipments are used during the band edge tests:

Test Site		Equipment	Manufacturer	Model No./Serial No.	Last Cal.	Due Cal.
☒ CB # 8	X	Spectrum Analyzer	R&S	FSP40/ 100339	Oct, 2015	Oct, 2016
	X	Horn Antenna	ETS-Lindgren	3117/ 35205	Mar, 2016	Mar, 2017
	X	Horn Antenna	Schwarzbeck	BBHA9170/209	Jan, 2016	Jan, 2017
	X	Horn Antenna	TRC	AH-0801/95051	Aug, 2016	Aug, 2017
	X	Pre-Amplifier	EMCI	EMC012630SE/980210	Jan, 2016	Jan, 2017
	X	Pre-Amplifier	MITEQ	JS41-001040000-58-5P/153945	Jul, 2016	Jul, 2017
	X	Pre-Amplifier	NARDA	DBL-1840N506/013	Jul, 2016	Jul, 2017

- Note:
1. All equipments are calibrated every one year.
 2. The test instruments marked by "X" are used to measure the final test results.

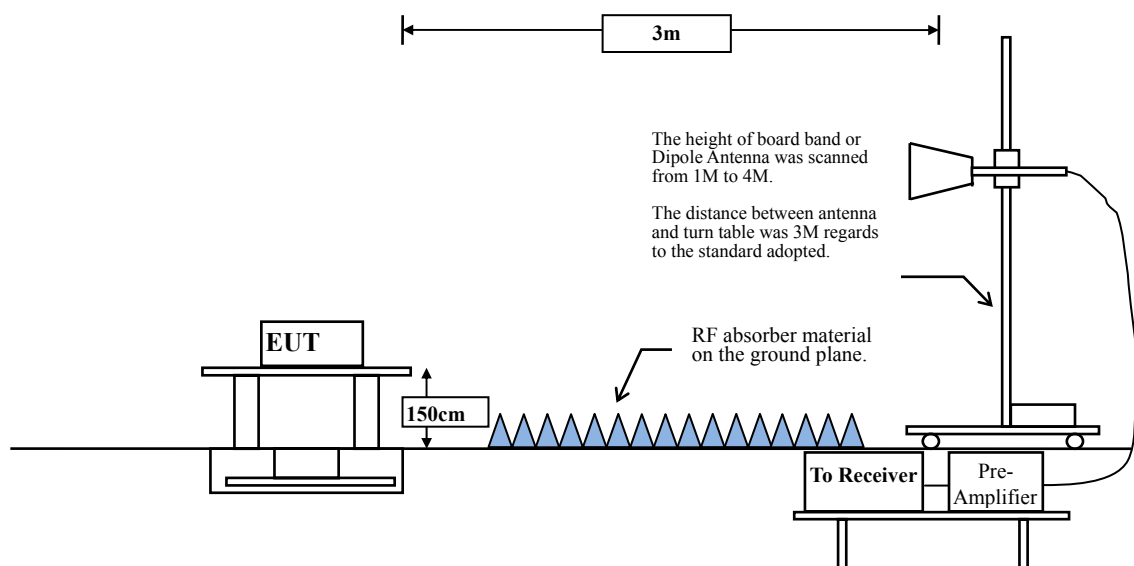
6.2. Test Setup

RF Conducted Measurement



RF Radiated Measurement:

Above 1GHz



6.3. Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. 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)).

6.4. 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.

6.5. Uncertainty

± 4.08 dB above 1GHz

± 4.22 dB below 1GHz

6.6. Test Result of Band Edge

Product : HR FLOW SENSOR
Test Item : Band Edge
Test Site : CB8
Test Mode : Mode 1: Transmit - BLE mode

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)	2354.638	11.736	39.868	51.604	74.00	54.00	Pass
00 (Peak)	2390.000	11.897	36.190	48.087	74.00	54.00	Pass
00 (Peak)	2400.000	11.935	47.195	59.130	--	--	--
00 (Peak)	2401.884	11.942	85.758	97.700	--	--	--
00 (Average)	2355.362	11.739	28.017	39.756	74.00	54.00	Pass
00 (Average)	2390.000	11.897	23.966	35.863	74.00	54.00	Pass
00 (Average)	2400.000	11.935	37.917	49.852	--	--	--
00 (Average)	2402.174	11.943	84.754	96.697	--	--	--

Figure Channel 00:

Horizontal (Peak)

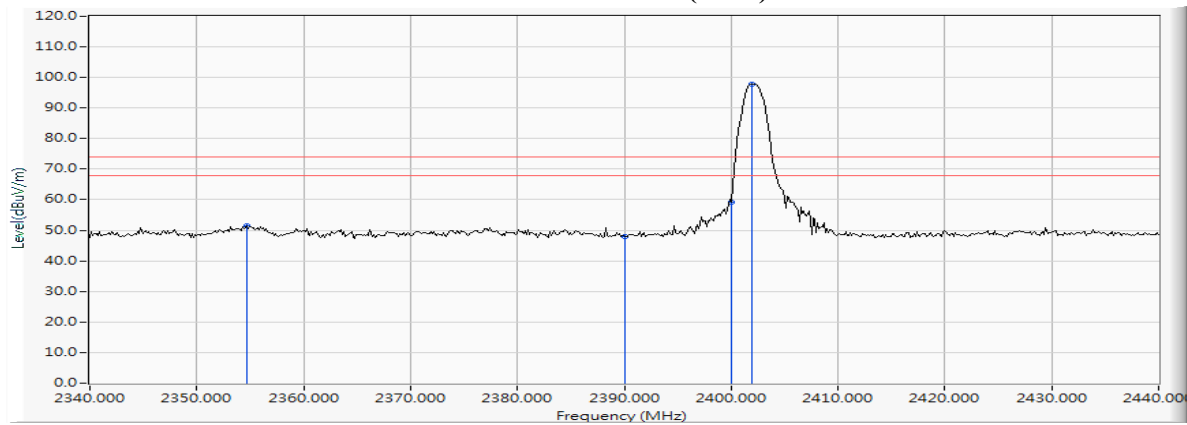
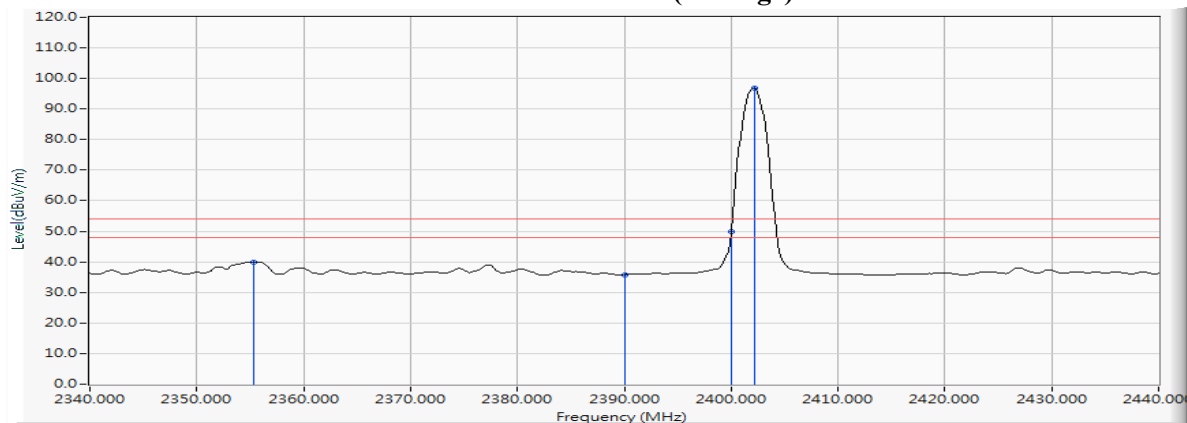


Figure Channel 00:

Horizontal (Average)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measurement Level = Reading Level + Correct Factor.
6. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : HR FLOW SENSOR
Test Item : Band Edge
Test Site : CB8
Test Mode : Mode 1: Transmit - BLE mode

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)	2386.087	11.882	38.550	50.432	74.00	54.00	Pass
00 (Peak)	2390.000	11.897	35.135	47.032	74.00	54.00	Pass
00 (Peak)	2400.000	11.935	43.144	55.079	--	--	--
00 (Peak)	2401.884	11.942	78.506	90.448	--	--	--
00 (Average)	2384.203	11.875	24.152	36.027	74.00	54.00	Pass
00 (Average)	2390.000	11.897	23.742	35.639	74.00	54.00	Pass
00 (Average)	2400.000	11.935	31.723	43.658	--	--	--
00 (Average)	2402.029	11.943	77.554	89.496	--	--	--

Figure Channel 00: Vertical (Peak)

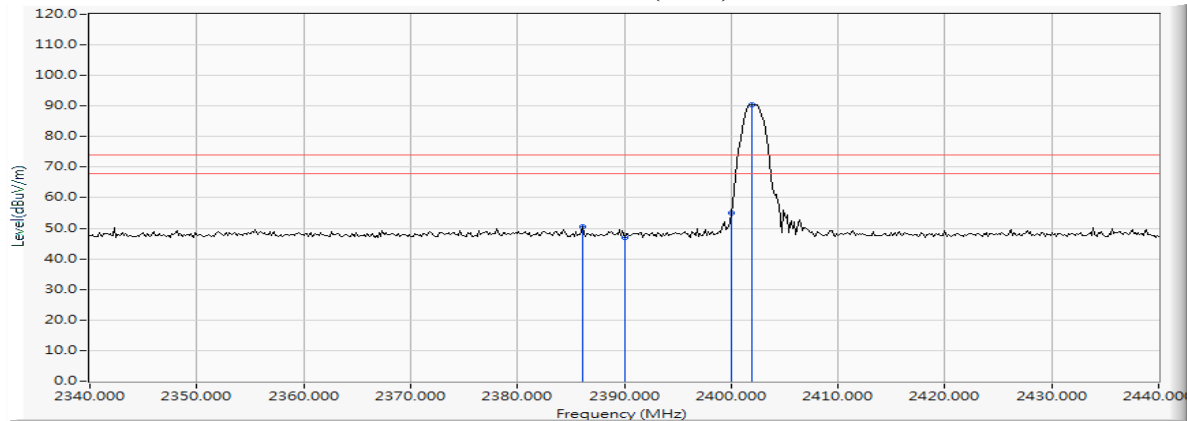
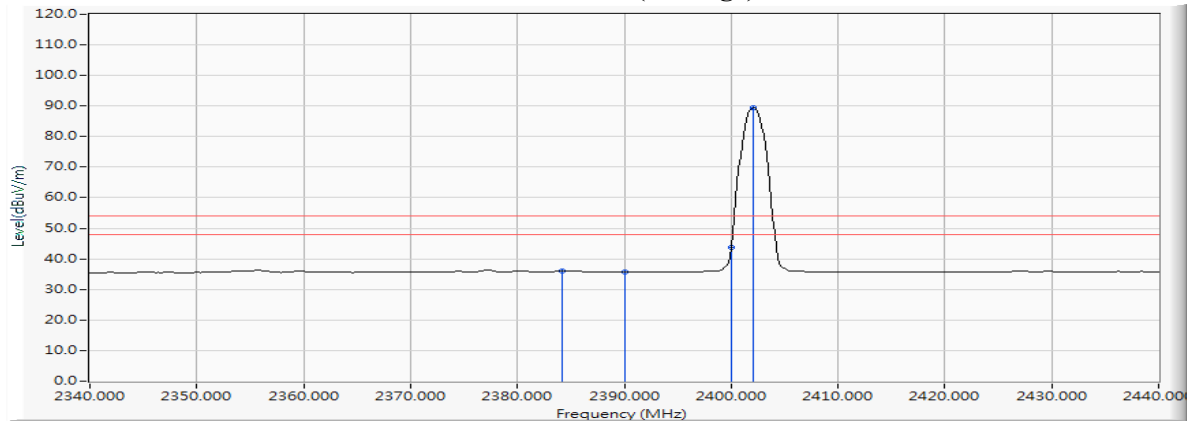


Figure Channel 00: Vertical (Average)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measurement Level = Reading Level + Correct Factor.
6. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : HR FLOW SENSOR
Test Item : Band Edge
Test Site : CB8
Test Mode : Mode 1: Transmit - BLE mode

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)	2479.877	12.257	84.503	96.761	--	--	--
39 (Peak)	2483.500	12.272	48.799	61.071	74.00	54.00	Pass
39 (Average)	2480.167	12.258	83.510	95.769	--	--	--
39 (Average)	2483.500	12.272	25.490	37.762	74.00	54.00	Pass
39 (Average)	2526.399	12.390	26.156	38.546	74.00	54.00	Pass

Figure Channel 39: Horizontal (Peak)

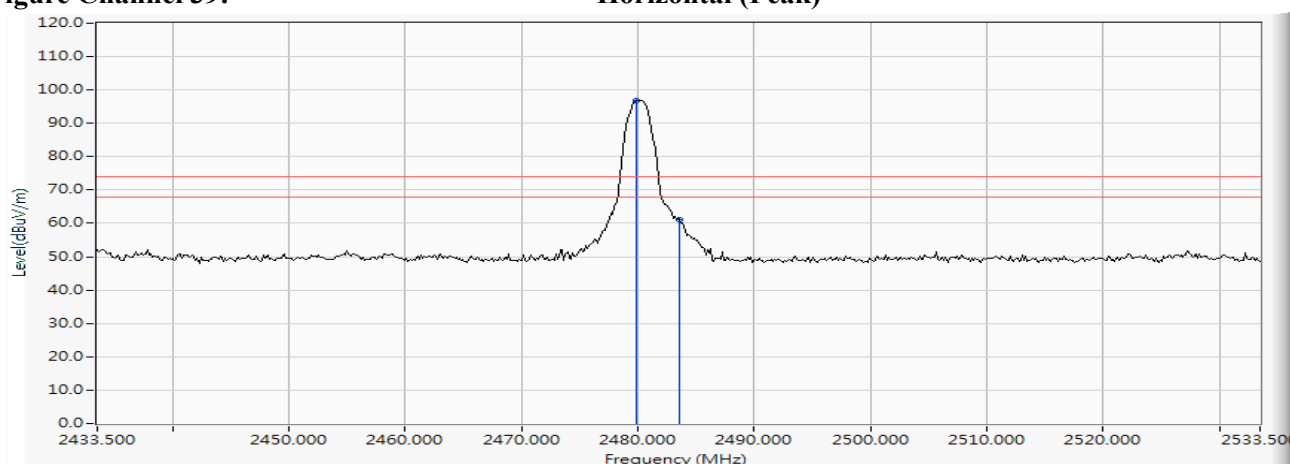
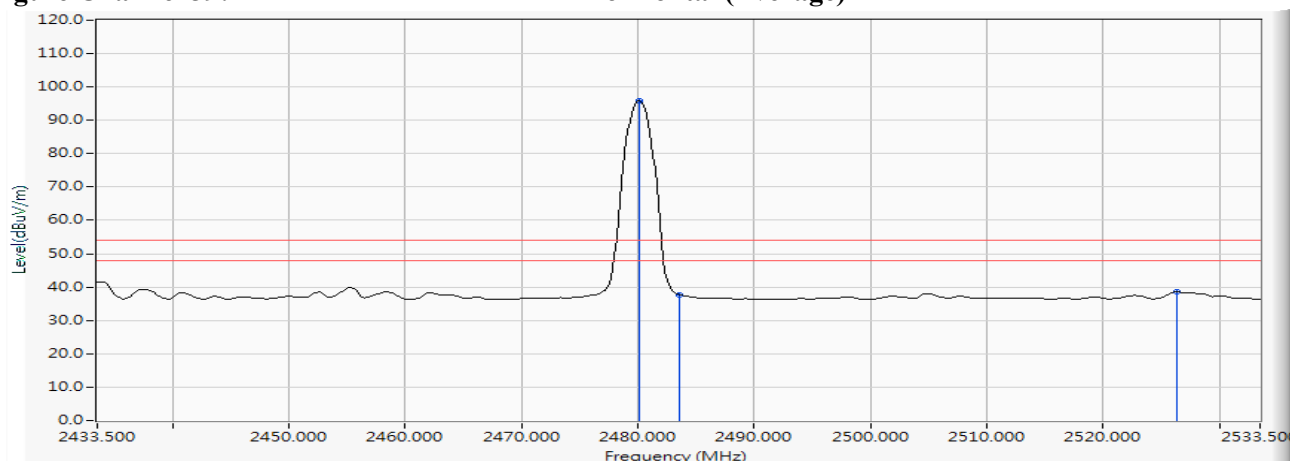


Figure Channel 39: Horizontal (Average)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measurement Level = Reading Level + Correct Factor.
6. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : HR FLOW SENSOR
Test Item : Band Edge
Test Site : CB8
Test Mode : Mode 1: Transmit - BLE mode

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)	2480.312	12.260	75.219	87.478	--	--	--
39 (Peak)	2483.500	12.272	41.017	53.289	74.00	54.00	Pass
39 (Average)	2480.022	12.258	74.235	86.493	--	--	--
39 (Average)	2483.500	12.272	24.128	36.400	74.00	54.00	Pass

Figure Channel 39: Vertical (Peak)

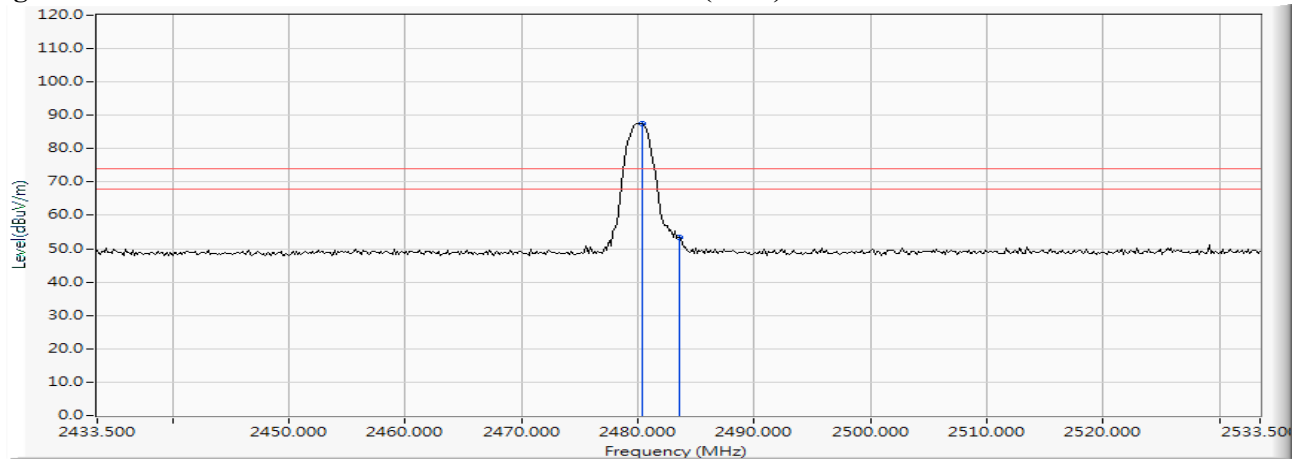
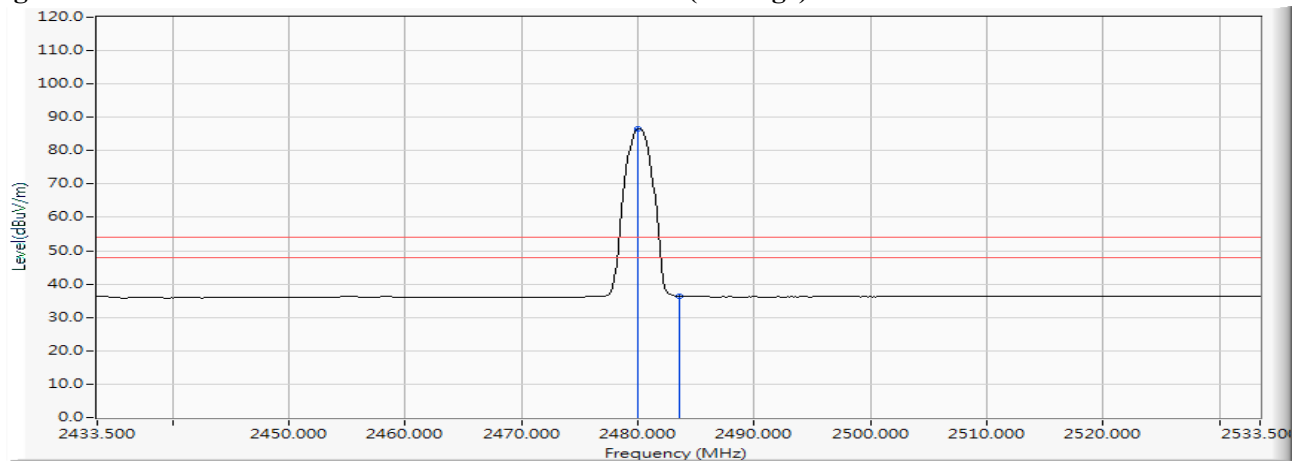


Figure Channel 39: Vertical (Average)



Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measurement Level = Reading Level + Correct Factor.
6. The average measurement was not performed when the peak measured data under the limit of average detection.

7. 6dB Bandwidth

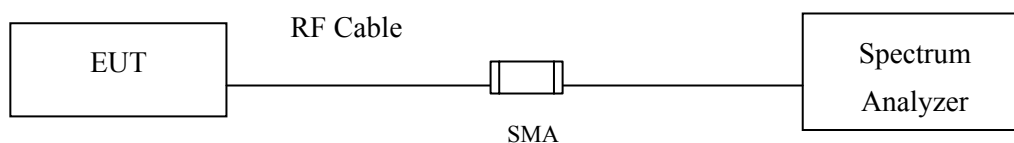
7.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.	Due Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2016	Jun, 2017
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2016	Jun, 2017
X	Spectrum Analyzer	R&S	FSV30 / 103464	Dec, 2015	Dec, 2016

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with “X” are used to measure the final test results.

7.2. Test Setup



7.3. Limits

The minimum bandwidth shall be at least 500 kHz.

7.4. 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.

Set RBW = 1-5% of the emission bandwidth, VBW $\geq$ 3*RBW

7.5. Uncertainty

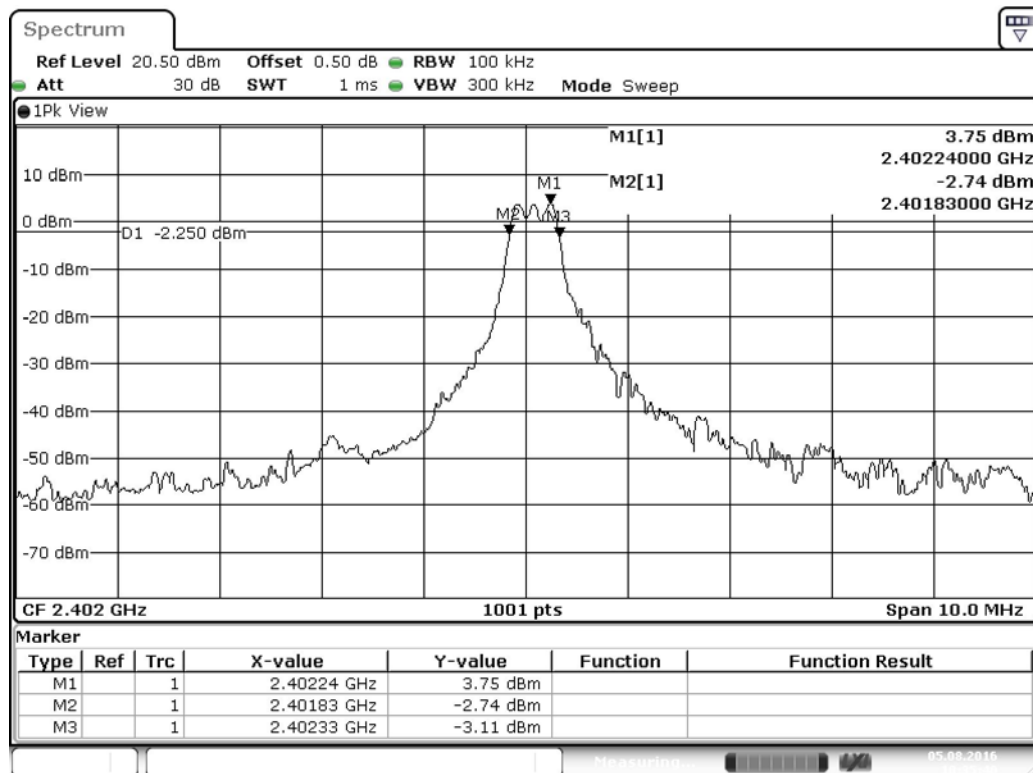
$\pm$ 283Hz

7.6. Test Result of 6dB Bandwidth

Product : HR FLOW SENSOR
 Test Item : 6dB Bandwidth Data
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit - BLE mode (2402MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
00	2402	500	≥ 500	Pass

Figure Channel 00:

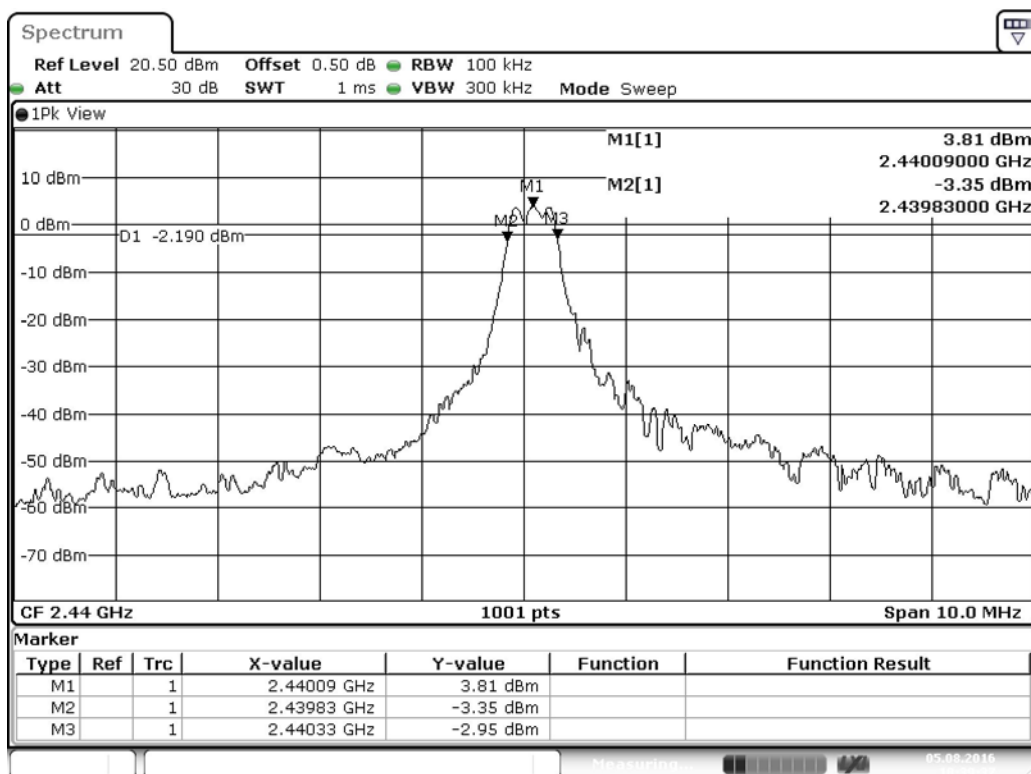


Date: 5.AUG.2016 10:35:41

Product : HR FLOW SENSOR
 Test Item : 6dB Bandwidth Data
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit - BLE mode (2440MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
19	2440	500	≥ 500	Pass

Figure Channel 19:

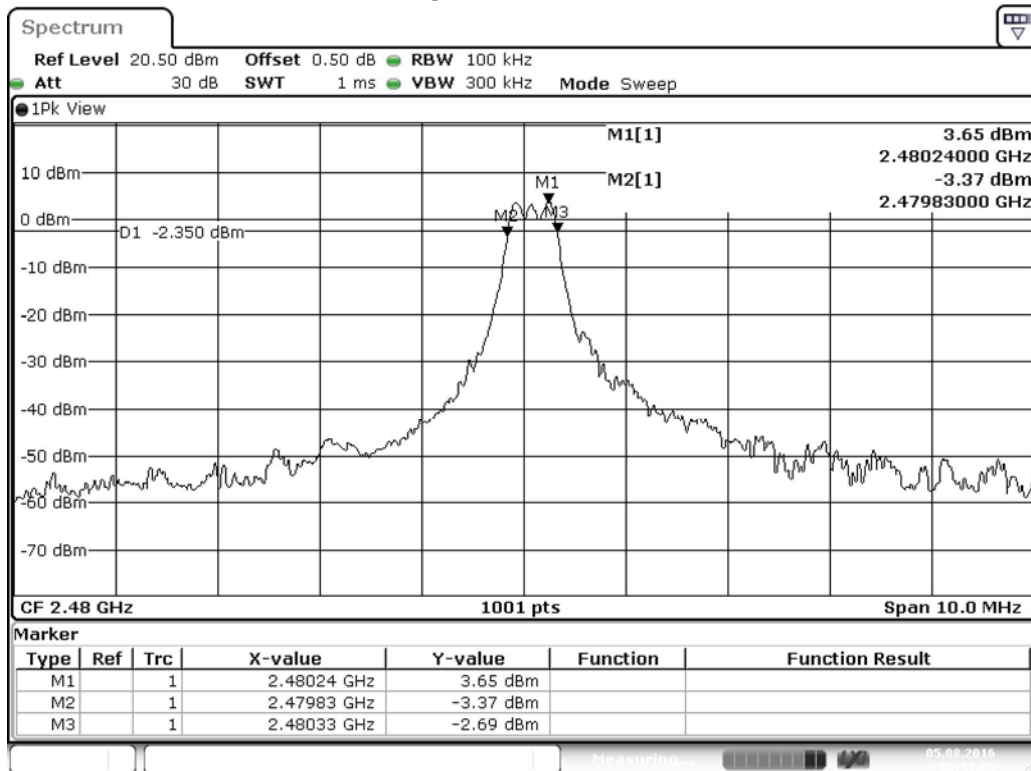


Date: 5.AUG.2016 10:39:38

Product : HR FLOW SENSOR
Test Item : 6dB Bandwidth Data
Test Site : No.3 OATS
Test Mode : Mode 1: Transmit - BLE mode (2480MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
39	2480	500	≥ 500	Pass

Figure Channel 39:



Date: 5.AUG.2016 10:44:04

8. Power Density

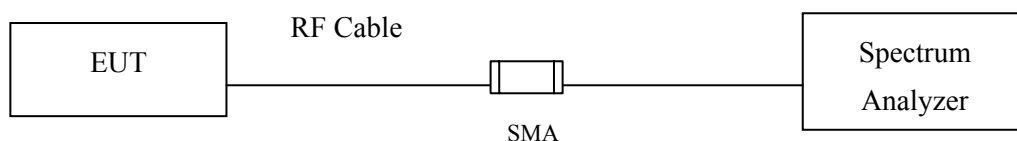
8.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.	Due Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2016	Jun, 2017
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2016	Jun, 2017
X	Spectrum Analyzer	R&S	FSV30 / 103464	Dec, 2015	Dec, 2016

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with “X” are used to measure the final test results.

8.2. Test Setup



8.3. Limits

The transmitted power density averaged over any 1 second interval shall not be greater +8dBm in any 3kHz bandwidth.

8.4. Test Procedure

The EUT was setup according to ANSI C63.10: 2013, the maximum power spectral density using KDB 558074 section 10.2 PKPSD (peak PSD) method.

8.5. Uncertainty

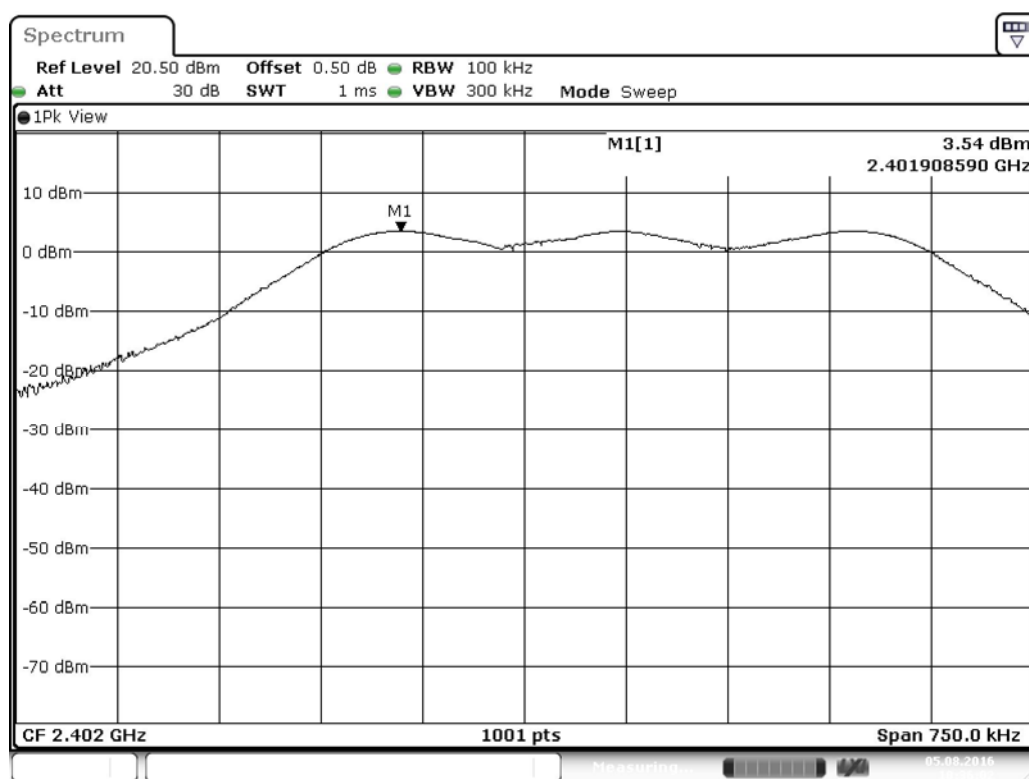
± 1.20 dB

8.6. Test Result of Power Density

Product : HR FLOW SENSOR
 Test Item : Power Density Data
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit - BLE mode (2402MHz)

Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
00	2402	3.540	$\leq 8\text{dBm}$	Pass

Figure Channel 00:



Date: 5.AUG.2016 10:36:02

Product : HR FLOW SENSOR
 Test Item : Power Density Data
 Test Site : No.3OATS
 Test Mode : Mode 1: Transmit - BLE mode (2440MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
19	2440	3.510	$\leq 8\text{dBm}$	Pass

Figure Channel 19:

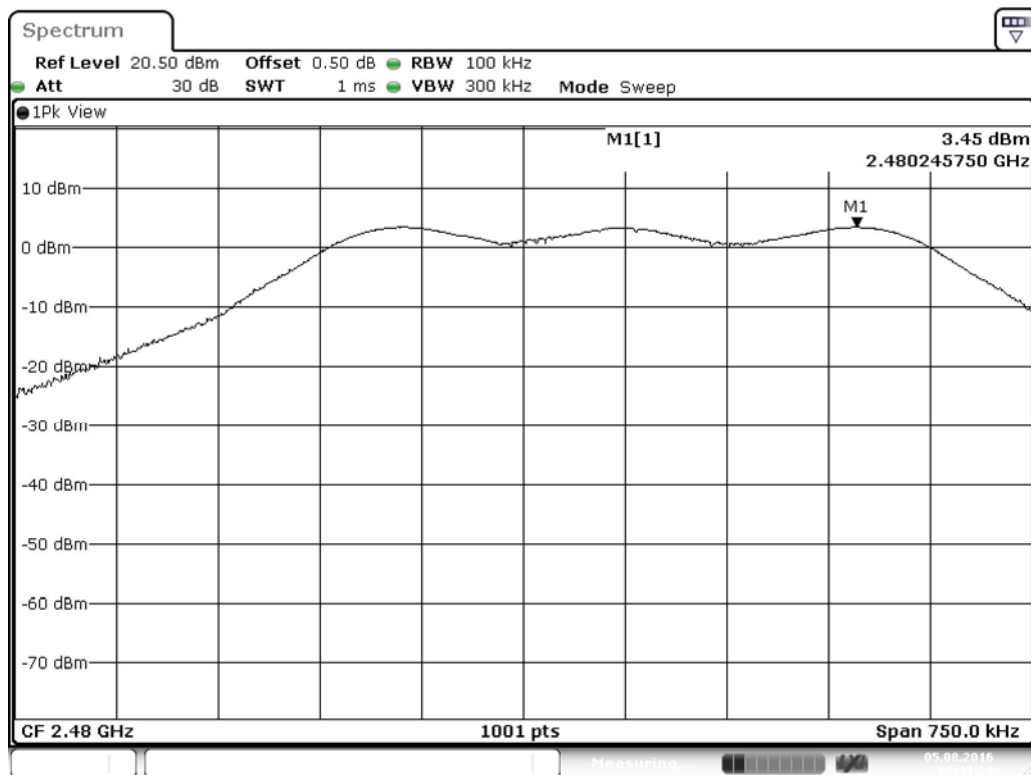


Date: 5.AUG.2016 10:39:59

Product : HR FLOW SENSOR
 Test Item : Power Density Data
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit - BLE mode (2480MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
39	2480	3.450	$\leq 8\text{dBm}$	Pass

Figure Channel 39:



Date: 5.AUG.2016 10:44:25

9. EMI Reduction Method During Compliance Testing

No modification was made during testing.

Attachment 1: EUT Test Photographs

Attachment 2: EUT Detailed Photographs