

ReGrow Helmet Inc

TEST REPORT

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Radio Spectrum TEST REPORT

Applicant:	ReGrow Helmet Inc Unit 105, 264 Queens Quay West Toronto, Ontario Canada M5J 1B5
Product:	Regrow Helmet with BT4.0 & WiFi
Model No.:	RGH1
Brand Name:	Regrow Helmet
FCC ID:	2AUSE-RGH1
Test Method/ Standard:	47 CFR FCC Part 15.249 & ANSI C63.10 2013
Test By:	Intertek Testing Services Taiwan Ltd., Hsinchu Laboratory No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li, Shiang-Shan District, Hsinchu City, Taiwan



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Revision History

Report No.	Issue Date	Revision Summary
190700233TWN-001	Jul. 23, 2019	Original report

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Summary of Tests

Test	Reference	Results
20dB Bandwidth	15.215(c)	Pass
Radiated Emission test	15.249(c), 15.209	Pass
Emission on the Band Edge	15.249(d)	Pass
Conducted Emission of AC Power	15.207	Pass
Antenna Requirement	15.203	Pass

1. General Information**1.1 Identification of the EUT**

Product:	Regrow Helmet with BT4.0 & WiFi
Model No.:	RGH1
Operating Frequency:	2402 MHz ~ 2480 MHz
Channel Number:	2402+2k MHz, k=0~39
Access scheme:	OFDM
Rated Power:	DC 12V from adapter
Power Cord:	N/A
Sample receiving date:	May 27, 2019
Sample condition:	Workable
Test Date(s):	Jun. 18, 2019 ~ Jul. 12, 2019

1.2 Antenna description

Antenna Gain : -0.9 dBi

Antenna Type : Chip Antenna

Connector Type : Fixed

1.3 Peripherals equipment

No.	Model no.	Specification
Adapter	EM1024QU	I/P: 100-240V~, 1.0~0.5A, 50-60Hz O/P: 12V, 2A

1.4 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Data cable
Notebook PC	DELL	Latitude E5420	HXYJBT1	USB shielded cable 0.8 meter

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Paragraph 15.249 for non-spread spectrum devices.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band were all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

TX mode: EUT use 「Tera Term」 entering test mode to change different channel and modulation.

3. 20dB Bandwidth test

3.1 Operating environment

Temperature:	26	°C
Relative Humidity:	59	%
Atmospheric Pressure:	1008	hPa

3.2 Test setup & procedure

Step 1: The 20dB bandwidth was measured using a 50 ohm spectrum analyzer

Step 2: The span range for the SA display shall be between two times and five times the OBW.

Step 3: The nominal IF filter bandwidth (3 dB RBW) should be approximately 1 % to 5 % of the OBW, unless otherwise specified, depending on the applicable requirement.

Step 4: The test was performed at 1 channel. The maximum 20dB modulation bandwidth is in the following Table.

3.3 Measured data of modulated bandwidth test results

Single TX		
Mode	Frequency (MHz)	20dB Occupied Bandwidth (MHz)
BLE	2402	1.098
	2440	1.093
	2480	1.102

Please see the plot below.

20dB Bandwidth @ BLE Channel 0



20dB Bandwidth @ BLE Channel 19

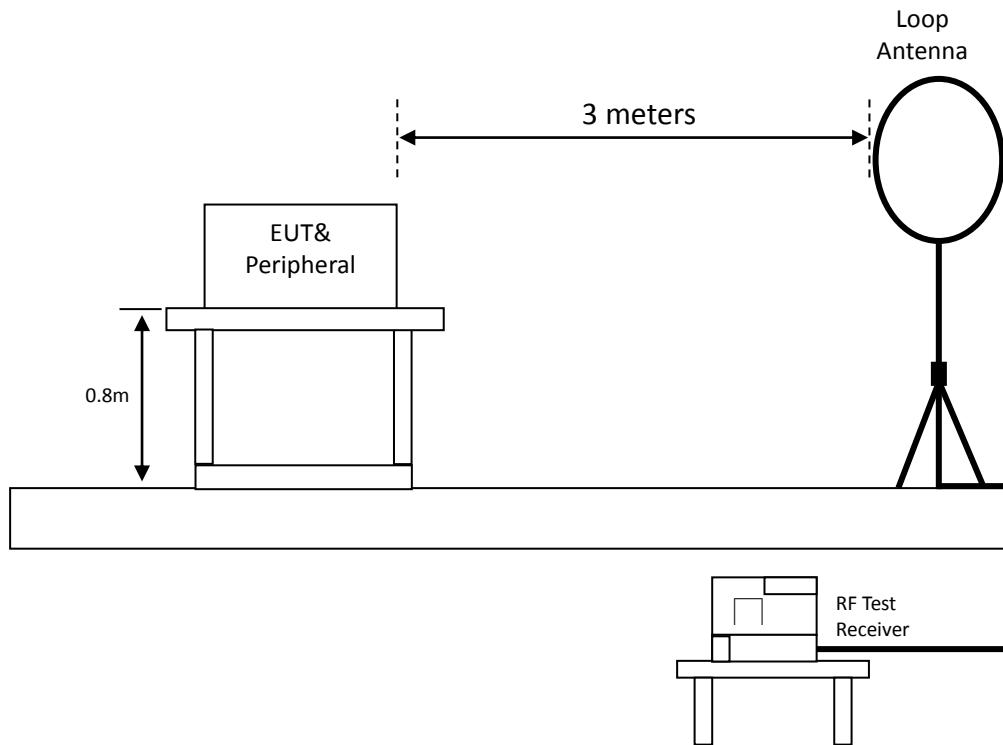


20dB Bandwidth @ B1E Channel 39

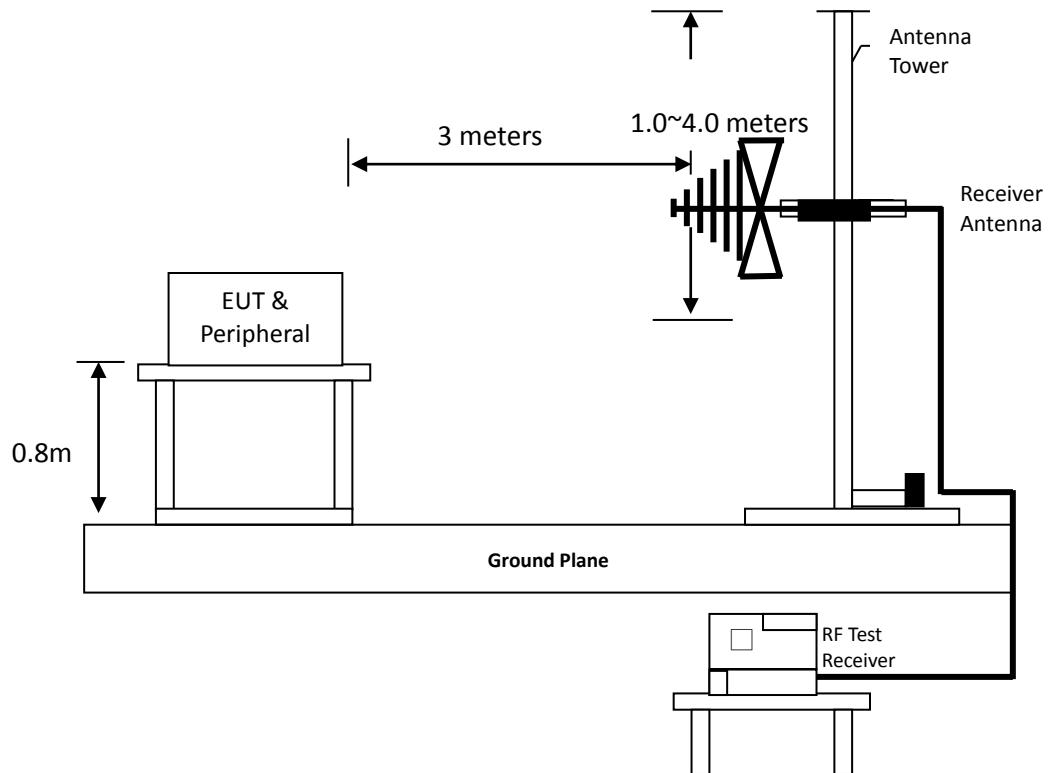


4. Radiated emission test FCC 15.249 (C)**4.1 Operating environment**

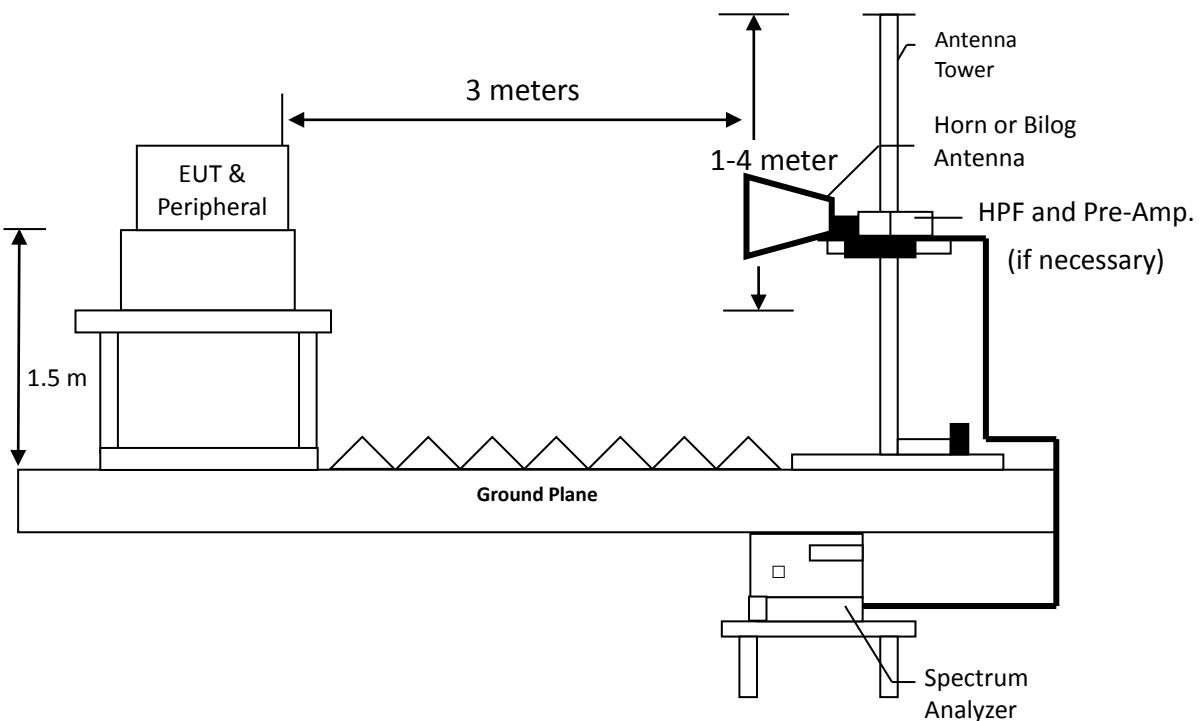
Temperature:	25	°C
Relative Humidity:	59	%
Atmospheric Pressure:	1008	hPa

4.2 Test setup & procedure**Radiated emission from 9kHz to 30MHz uses Loop Antenna:**

Radiated emission below 1GHz using Bilog Antenna



Radiated emission above 1GHz using Horn Antenna



Radiated emissions were investigated cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 10Hz VBW record Average reading. (15.209 paragraph), the Peak reading (1 MHz RBW/ 3 MHz VBW) recorded also on the report.

The EUT for testing is arranged on a turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

4.3 Emission limit

4.3.1 Fundamental and harmonics emission limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(mV/m@3m)	(dBuV/m@3m)	(uV/m@3m)	(dBuV/m@3m)
2400-2483.5	50	94	500	54

4.3.2 General radiated emission limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

Frequency MHz	15.209 Limits (dB μ V/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

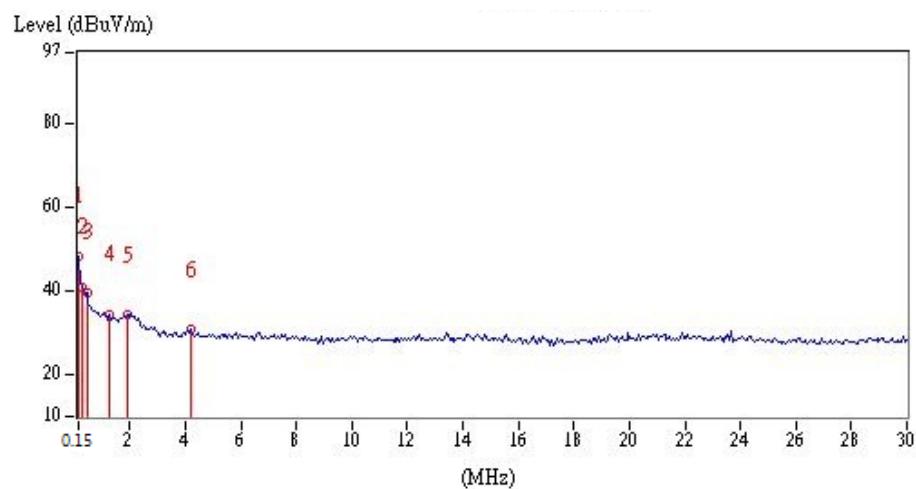
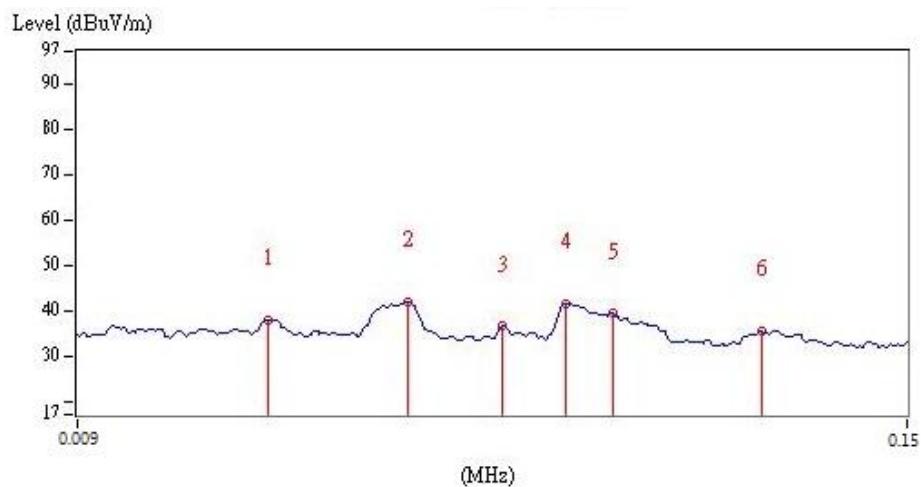
Remark:

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

4.4 Radiated spurious emission test data**4.4.1 Measurement results: frequency range from 9 kHz to 30 MHz**

EUT: RGH1

Polarity (circle)	Frequency (MHz)	Detection value	Factor (dB/m)	Reading (dB μ V)	Value (dB μ V/m)	Limit @ 3m (dB μ V/m)	Tolerance (dB)
Plane	0.04	PK	18.83	19.06	37.90	115.56	-77.66
Plane	0.07	PK	18.54	23.37	41.91	110.70	-68.79
Plane	0.08	PK	18.41	18.05	36.46	109.54	-73.08
Plane	0.09	PK	18.32	23.25	41.57	108.52	-66.95
Plane	0.10	QP	18.26	21.14	39.40	107.60	-68.20
Plane	0.13	PK	18.27	17.18	35.45	105.33	-69.88
Plane	0.15	PK	18.27	30.03	48.31	104.08	-55.77
Plane	0.27	PK	18.31	22.61	40.92	98.98	-58.06
Plane	0.45	PK	18.37	21.24	39.61	94.54	-54.93
Plane	1.28	QP	18.73	15.69	34.41	65.46	-31.05
Plane	1.94	QP	18.81	15.54	34.36	69.54	-35.18
Plane	4.21	QP	19.29	11.45	30.74	69.54	-38.80



4.4.2 Measurement results: frequencies equal to or less than 1 GHz

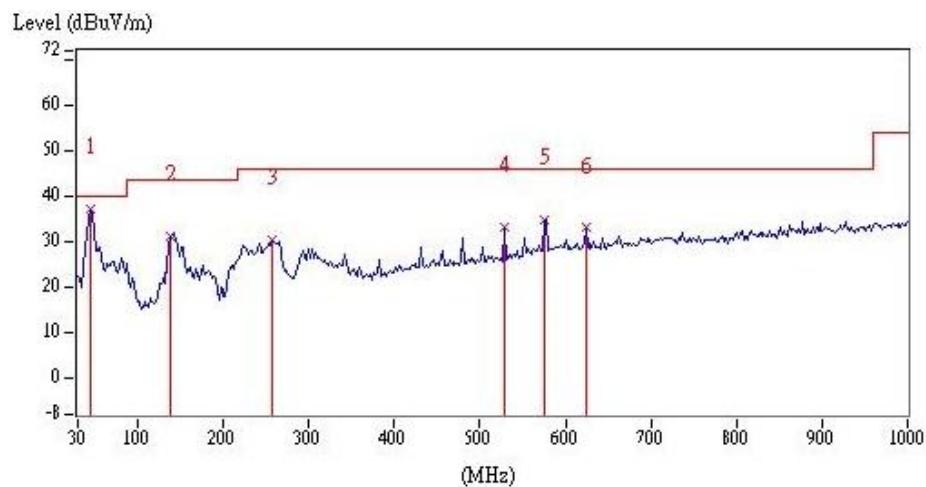
The test was performed continuously transmitting mode. The worst case occurred at TX Channel 39

EUT: RGH1

Worst case: TX Channel 39

Ant. Pol. (H/V)	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)
Vertical	45.52	QP	20.36	16.99	37.35	40.00	-2.65
Vertical	138.64	QP	19.62	11.70	31.32	43.50	-12.18
Vertical	256.98	QP	20.47	10.01	30.47	46.00	-15.53
Vertical	528.58	QP	26.59	6.68	33.27	46.00	-12.73
Vertical	575.14	QP	27.67	7.21	34.87	46.00	-11.13
Vertical	623.64	QP	28.63	4.46	33.09	46.00	-12.91

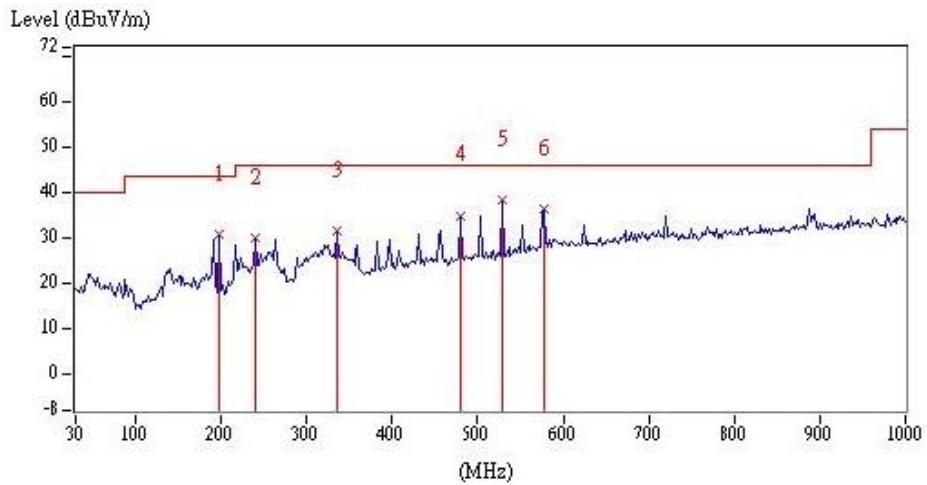
Remark: Corr. Factor = Antenna Factor + Cable Loss



EUT: RGH1
Worst case: TX Channel 39

Ant. Pol. (H/V)	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)
Horizontal	196.84	QP	17.78	12.86	30.63	43.50	-12.87
Horizontal	239.52	QP	20.20	9.76	29.96	46.00	-16.04
Horizontal	336.52	QP	22.31	9.27	31.58	46.00	-14.42
Horizontal	480.08	QP	25.75	9.20	34.95	46.00	-11.05
Horizontal	528.58	QP	26.59	11.66	38.26	46.00	-7.74
Horizontal	577.08	QP	27.72	8.50	36.22	46.00	-9.78

Remark: Corr. Factor = Antenna Factor + Cable Loss



4.4.3 Measurement results: frequency above 1GHz

EUT: RGH1

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)
BLE_Ch0	4804	PK	V	8.30	36.09	44.39	74.00	-29.61
	4804	PK	H	8.30	35.83	44.13	74.00	-29.87
BLE_Ch19	4880	PK	V	8.65	38.38	47.03	74.00	-26.97
	4880	PK	H	8.65	36.34	45.00	74.00	-29.00
BLE_Ch39	4960	PK	V	9.02	37.54	46.55	74.00	-27.45
	4960	PK	H	9.02	36.00	45.01	74.00	-28.99

Remark: Correction Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Pre_Amplifier Gain

4.4.4 Measurement results: Fundamental

EUT: RGH1

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)
BLE_Ch0	2402	PK	V	34.51	59.67	94.18	114.00	-19.82
	2402	AV	V	34.51	15.60	50.11	94.00	-43.89
	2402	PK	H	34.51	62.74	97.25	114.00	-16.75
	2402	AV	H	34.51	16.66	51.17	94.00	-42.83
BLE_Ch19	2440	PK	V	34.61	61.45	96.05	114.00	-17.95
	2440	AV	V	34.61	16.81	51.42	94.00	-42.58
	2440	PK	H	34.61	65.10	99.70	114.00	-14.30
	2440	AV	H	34.61	17.72	52.33	94.00	-41.67
BLE_Ch39	2480	PK	V	34.70	62.30	97.00	114.00	-17.00
	2480	AV	V	34.70	16.89	51.59	94.00	-42.41
	2480	PK	H	34.70	65.36	100.06	114.00	-13.94
	2480	AV	H	34.70	17.45	52.15	94.00	-41.85

Remark: Correction Factor = Antenna Factor + Cable Loss

5. Radiated emission on the band edge FCC 15.249(d)**5.1 Operating environment**

Temperature:	25	°C
Relative Humidity:	50	%
Atmospheric Pressure:	1008	hPa

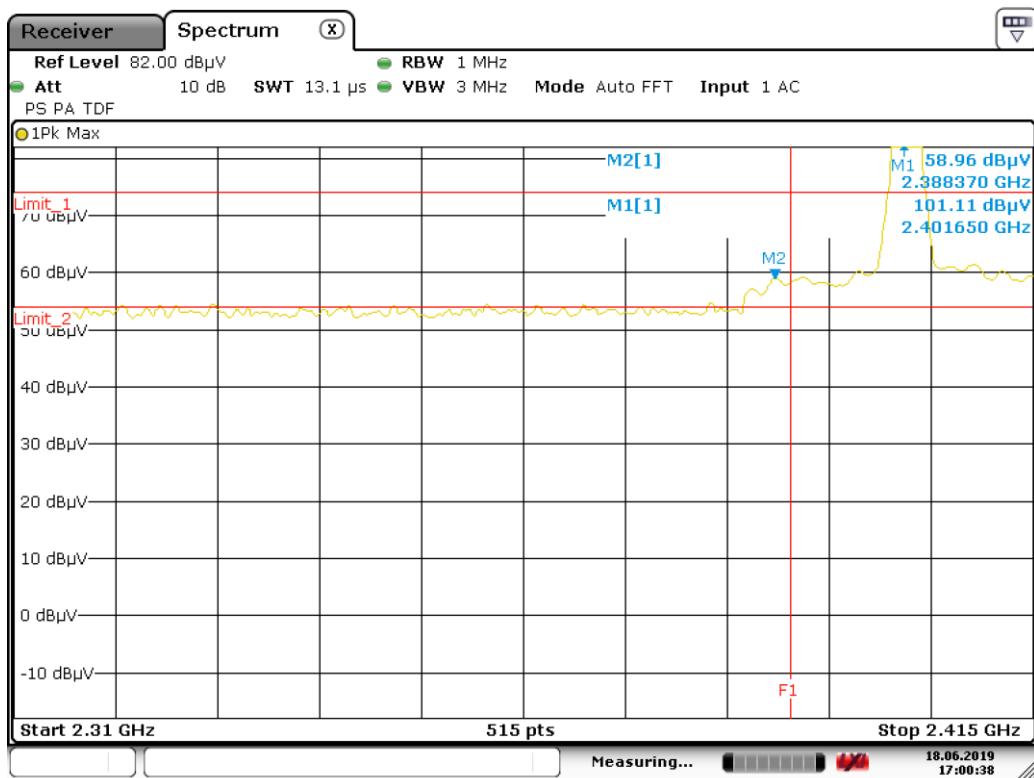
5.2 Radiated emission on the band edge test data

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol.	Correction Factor (dB/m)	Reading (dB μ V)	Corrected Reading (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)	Restricted band (MHz)
BLE	2388.37	PK	H	34.48	24.48	58.96	74	-15.04	2310~2390
	2366.17	AV	H	34.42	7.24	41.66	54	-12.34	
	2483.50	PK	H	34.71	26.49	61.20	74	-12.80	2483.5~2500
	2483.50	AV	H	34.71	7.32	42.03	54	-11.97	

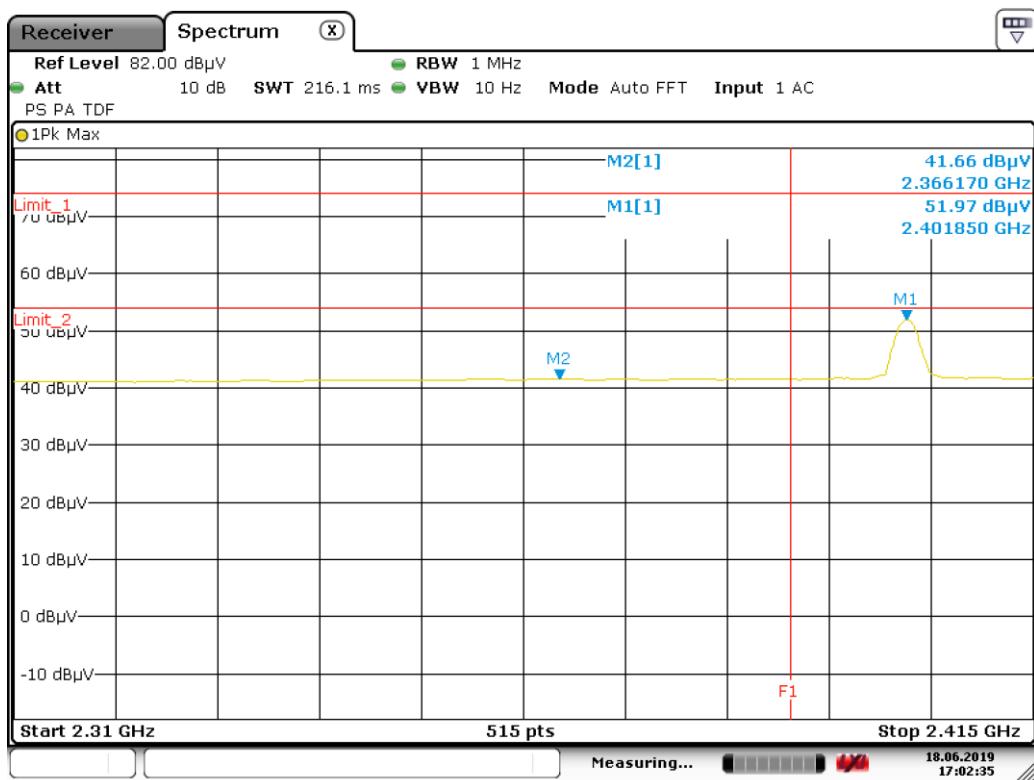
Remark: Correction Factor = Antenna Factor + Cable Loss

Bandedge @ mode BLE Ch0 Peak



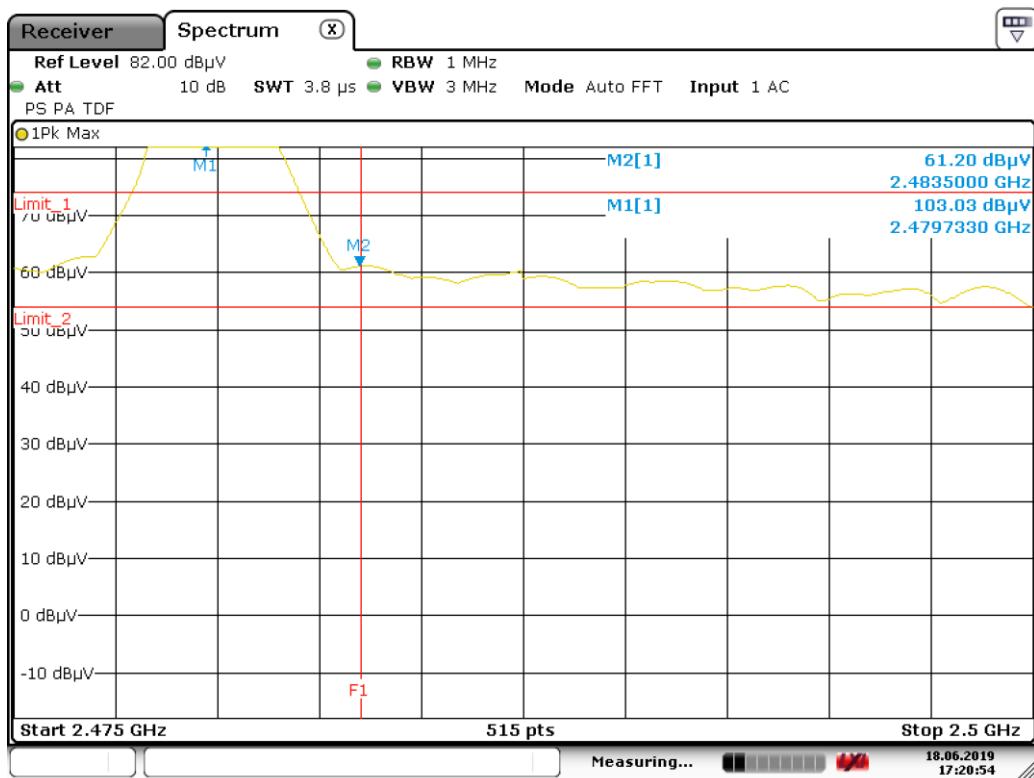
Date: 18.JUN.2019 17:00:39

Bandedge @ mode BLE Ch0 Average



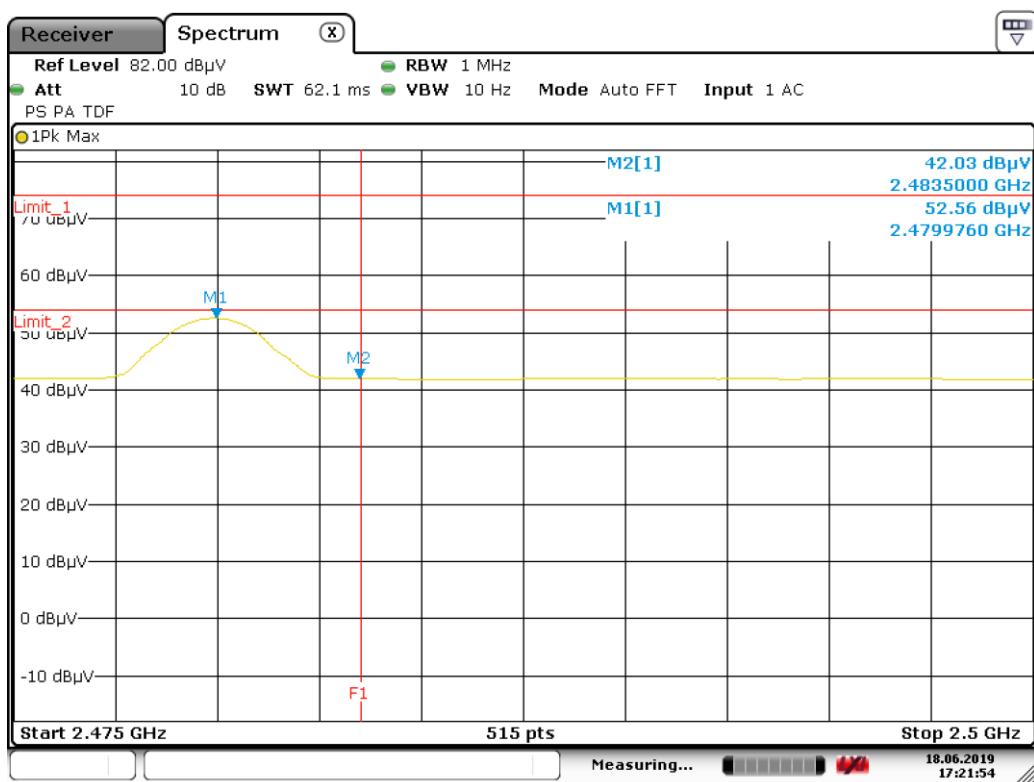
Date: 18.JUN.2019 17:02:35

Bandedge @ mode BLE Ch39 Peak



Date: 18.JUN.2019 17:20:55

Bandedge @ mode BLE Ch39 Average



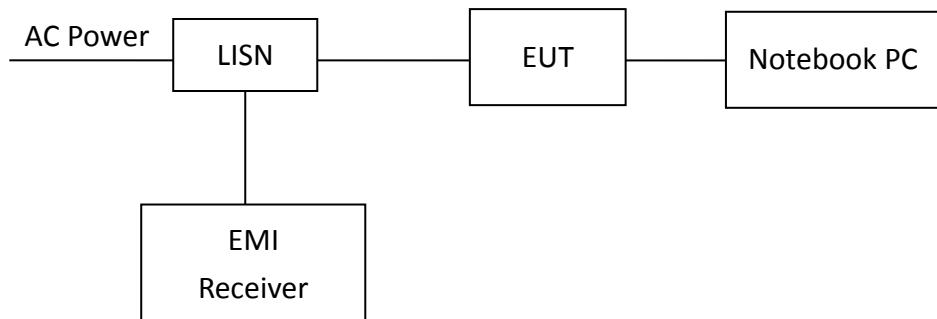
Date: 18.JUN.2019 17:21:55

6. AC Power Line Conducted Emission**6.1 Measuring instrument setting**

Receiver Function	Setting
Detector	QP
Start frequency	0.15MHz
Stop frequency	30MHz
IF bandwidth	9 kHz
Attenuation	10dB

6.2 Test Procedure

Step 1	Configure the EUT according to ANSI C63.10:2013. The EUT or host of EHT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
Step 2	Connect EUT or host of EUT to the power mains through a line impedance stabilization network.
Step 3	All the companion devices are connected to the other LISN. The LISN should provide 50Uh/50ohms coupling impedance.
Step 4	The frequency range from 150 kHz to 30MHz was searched.
Step 5	Set the test-receiver system to peak detector and specified bandwidth with maximum hold mode.
Step 6	The measurement has to be done between each power line and ground at the power terminal.

6.3 Test Diagram

6.4 Limit

Frequency (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56	56 – 46
0.50~5.00	56	46
5.00~30.0	60	50

6.5 Operating Environment Condition

Temperature (°C) :	26
Relative Humidity (%) :	61
Atmospheric Pressure (hPa) :	1008
Test Date :	2019/07/12

6.6 Test Results

Phase: Live Line

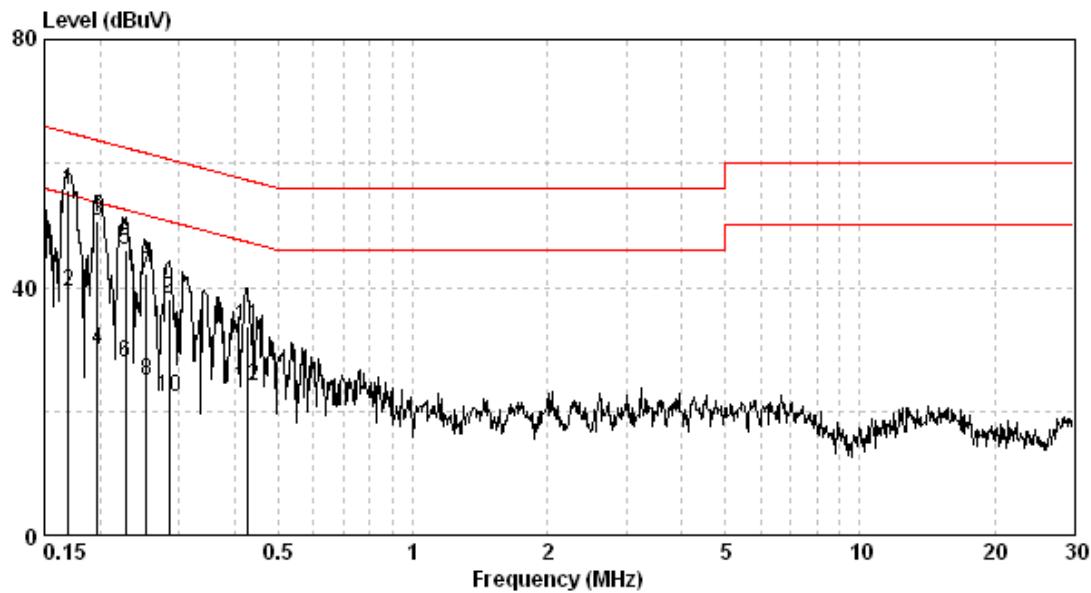
Model No.: RGH1

Test Condition: Tx mode

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB) QP AV
0.169	9.70	45.99	55.69	64.99	29.53	39.23	54.99	-9.30 -15.76
0.198	9.69	40.94	50.63	63.71	20.30	29.99	53.71	-13.09 -23.72
0.228	9.69	36.45	46.14	62.52	18.21	27.90	52.52	-16.38 -24.62
0.253	9.69	32.64	42.33	61.64	15.21	24.90	51.64	-19.32 -26.74
0.285	9.69	28.50	38.19	60.68	12.59	22.28	50.68	-22.48 -28.40
0.428	9.70	23.86	33.56	57.29	14.46	24.16	47.29	-23.73 -23.13

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



Phase: Neutral Line

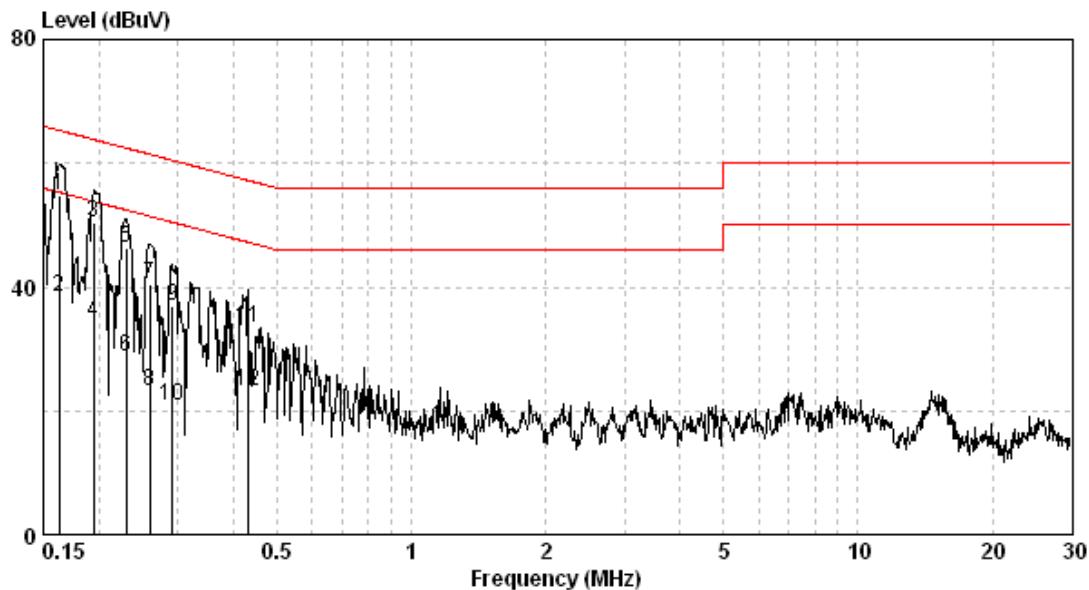
Model No.: RGH1

Test Condition: Tx mode

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB) QP	Margin (dB) AV
0.162	9.71	45.04	54.75	65.34	28.59	38.30	55.34	-10.59	-17.04
0.194	9.71	40.70	50.41	63.84	24.48	34.19	53.84	-13.43	-19.66
0.230	9.71	36.47	46.18	62.44	19.03	28.74	52.44	-16.26	-23.70
0.260	9.71	30.87	40.58	61.42	13.58	23.29	51.42	-20.84	-28.13
0.292	9.71	27.35	37.06	60.46	11.06	20.77	50.46	-23.39	-29.69
0.431	9.71	23.72	33.43	57.24	13.36	23.07	47.24	-23.81	-24.17

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



Appendix A: Test equipment list

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
ESCI EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2018/11/14	2019/11/13
Spectrum Analyzer	Rohde & Schwarz	FSP30	100137	2018/09/03	2019/09/02
Signal Analyzer	Agilent	N9030A	MY51380492	2018/08/24	2019/08/23
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONI C	FMZB1519	1519-067	2019/04/19	2020/04/17
Broadband Antenna	SHWARZBECK	VULB 9168	9168-172	2019/06/05	2020/06/03
Horn Antenna (1-18G)	SHWARZBECK	BBHA 9120 D	9120D-456	2019/02/01	2020/01/31
Pre-Amplifier	MITEQ	JS4-26004000--27 -8A	828825	2018/08/28	2019/08/27
Power Meter	Anritsu	ML2495A	0844001	2018/10/29	2019/10/28
Power Sensor	Anritsu	MA2411B	0738452	2018/10/29	2019/10/28
966-2(A) Cable 9kHz~26.5GHz	SUHNER	SMA / EX 100	N/A	2018/08/07	2019/08/06
966-2(B) Cable 9kHz~26.5GHz	SUHNER	SUCOFLEX 104P	CB0005	2018/08/07	2019/08/06
RF Cable 9kHz~26.5GHz	SUHNER	SUCOFLEX 102	CB0006	2019/05/02	2020/04/30
Hight Pass Filter	Wainwright	WHKX3.0/18G-12 SS	N/A	2019/05/30	2020/05/28
966-2_3m Semi-Anechoic Chamber	966_2	CEM-966_2	N/A	2019/02/23	2020/02/22

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Receiver	R&S	ESCI	100059	2018/11/07	2019/11/06
Two-Line V-Network	R&S	ENV216	101159	2018/06/01	2019/05/31
Two-Line -V-Network	R&S	ESH3-Z5	825562/003	2018/09/03	2019/09/02
CON-1 Shielded Room	N/A	N/A	N/A	NCR	NCR
CON-1 Cable	SUHNER	SUCOFLEX-104	26438414	2019/05/02	2020/04/30
Test software	Audix	e3	4.20040112L	NCR	NCR

Note: No Calibration Required (NCR).

Appendix B: Measurement Uncertainty

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

Item	Uncertainty
Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.2 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.28 dB
Vertically polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	4.29 dB
Horizontally polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	4.29 dB
Vertically polarized Radiated disturbances from 18GHz~26.5GHz in a semi-anechoic chamber at a distance of 1m	2.45 dB
Horizontally polarized Radiated disturbances from 18GHz~26.5GHz in a semi-anechoic chamber at a distance of 1m	2.45 dB
Radiated disturbances from 9kHz~30MHz in a semi-anechoic chamber at a distance of 3m	2.99 dB
Emission on the Band Edge Test	4.29 dB
20dB Bandwidth	7.69 %
AC Power Line Conducted Emission	2.59 dB

Note: The statement of conformity to this test service with decision rule not includes the measurement uncertainty. The identified critical influencing factors are based on the standard requirements and controlled.