

Sigknow Biomedical Co.,Ltd.

TEST REPORT

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Radio Spectrum TEST REPORT

Applicant:	Sigknow Biomedical Co.,Ltd. 6F-A., No.760, Sec. 4, Bade Rd., Songshan Dist., Taipei City 105, Taiwan
Product:	ECG recorder & patch
Model No.:	UG02, UG02xxx
Brand Name:	SIGKNOW
FCC ID:	2ATKN-UG02
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
181000406TWN-001	Jan. 08, 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:	ECG recorder& patch
Model No.:	UG02
Operating Frequency:	2402 MHz ~ 2480 MHz
Channel Number:	2402+2k MHz, k= 0~39
Access scheme:	GFSK
Modulation:	OFDM
Rated Power:	1. DC 3.7V from battery 2. DC 5V from USB port
Power Cord:	N/A
Sample receiving date:	Nov. 29, 2018
Sample condition:	Workable
Test Date(s):	Dec. 04, 2018 ~ Dec. 17, 2018

1.2 Additional information about the EUT

The customer confirmed UG02xxx is a series model to UG02 (EUT).

Explanation of model designation UG02xxx:

The 1st "x" denote: Selling Area (Language) ; for example, value "T" means Taiwan, "C" means China

The 2nd "x" denote: Recording time ; this digit is a number. For example, "3" means recording for 3 days.

The 3rd "x" denote: Accessory, Labels, Packing ; this digit is for different accessory configuration, different labels, or different packing cosmetic design . For example, value "R" means recorder only. "S" means whole set.

1.3 Antenna description

Antenna Gain : 0.1 dBi

Antenna Type : Chip Antenna

Connector Type : Fixed

1.4 Peripherals equipment

Peripherals name	Brand	Model No.	Serial No.	Data Cable
Notebook PC	DELL	Vostro 3350	7KFQNT1	N/A

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: The EUT power on to entering test mode and press the button to change different channel.

The signal is maximized through rotation and placement in the three orthogonal axes.



X axis



Y axis



Z axis

After verifying three axes, we found the maximum electromagnetic field was occurred at Z axis. The final test data was executed under this configuration.

3. 20dB Bandwidth test

3.1 Operating environment

Temperature:	25	°C
Relative Humidity:	50	%
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	1.008
	2440	1.039
	2480	1.069

Please see the plot below.

20dB Bandwidth @ BLE_Channel 0



20dB Bandwidth @ BLE_Channel 19



20dB Bandwidth @ BLE_Channel 39



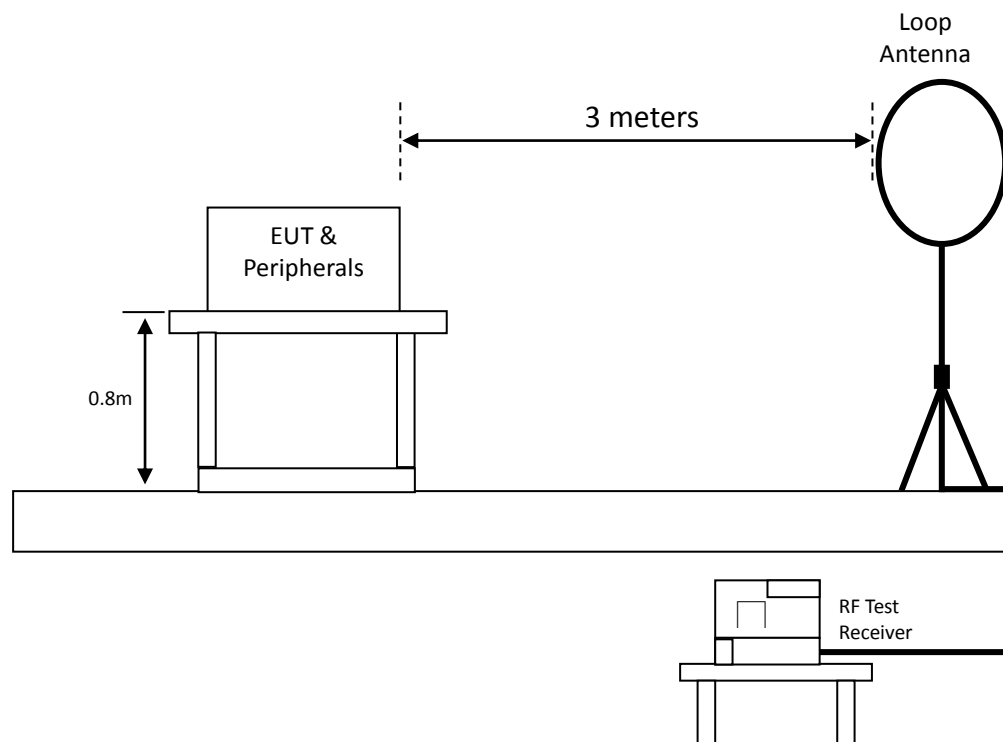
4. Radiated emission test FCC 15.249 (C)

4.1 Operating environment

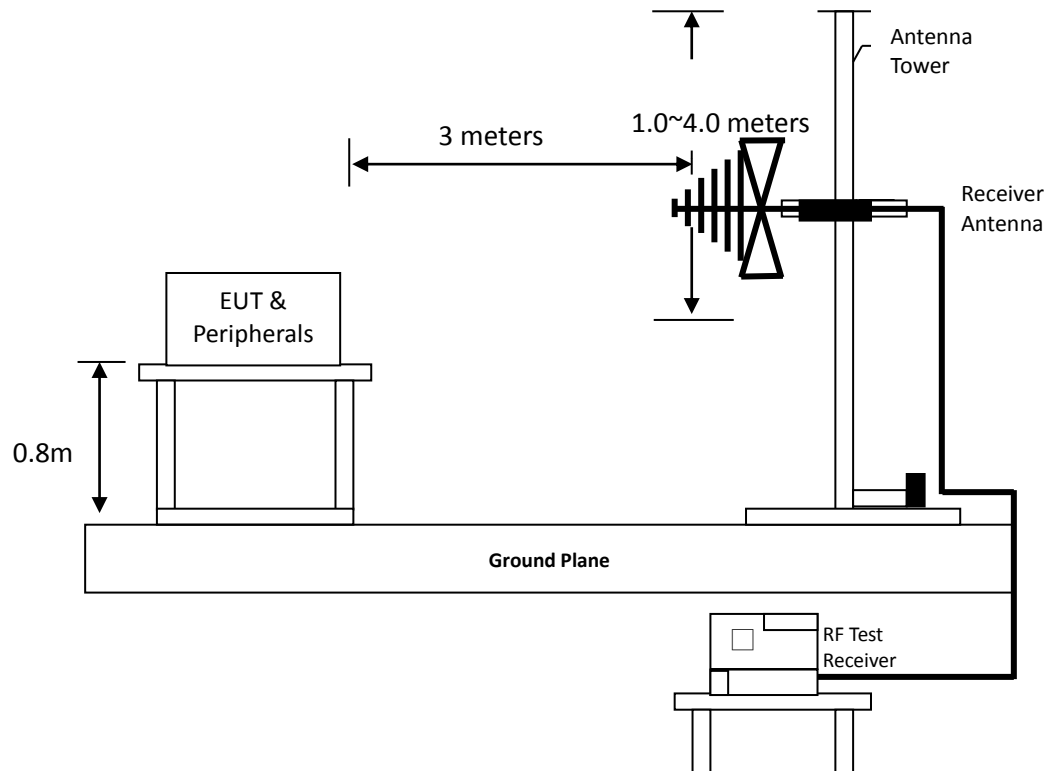
Temperature:	25	°C
Relative Humidity:	50	%
Atmospheric Pressure:	1008	hPa

4.2 Test setup & procedure

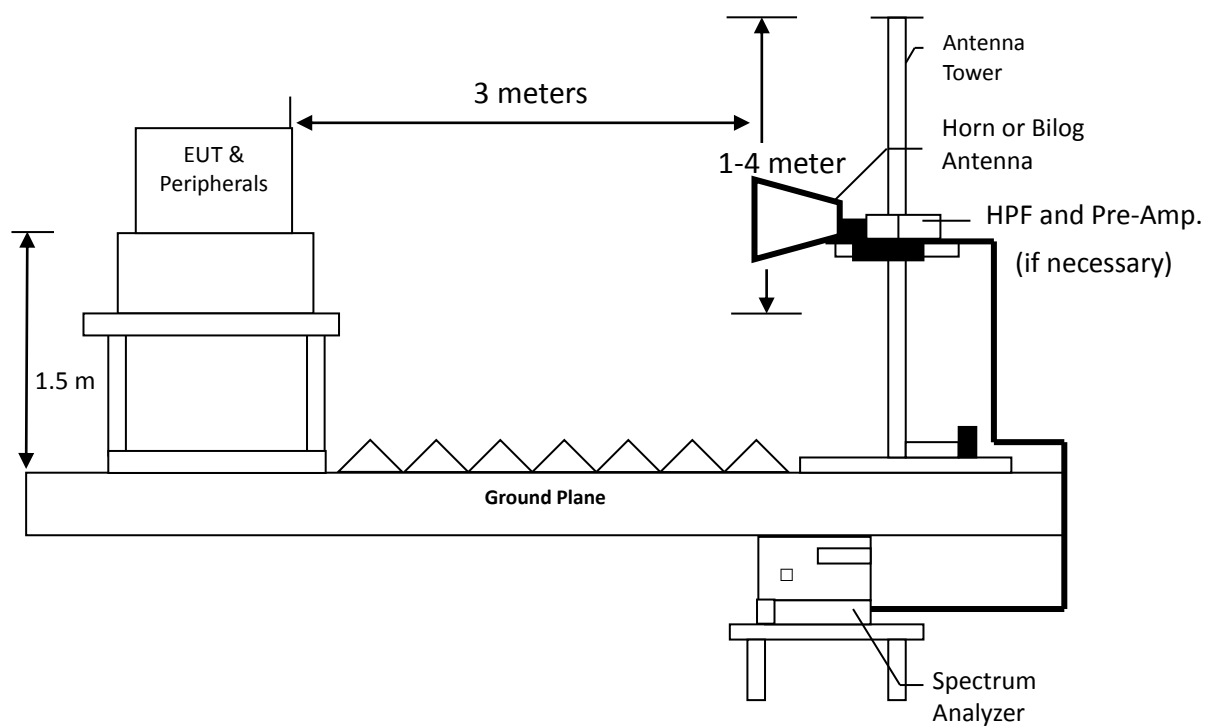
Radiated emission from 9kHz to 30MHz uses Loop Antenna:



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 (dBμV/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:

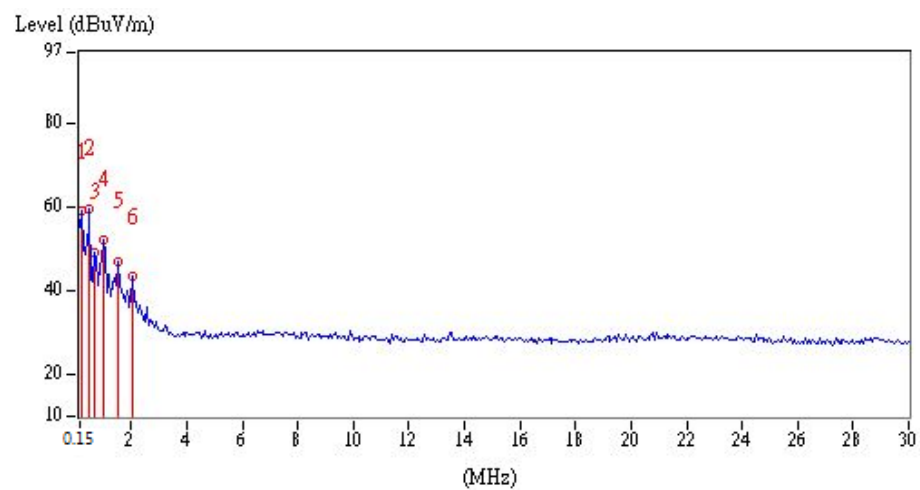
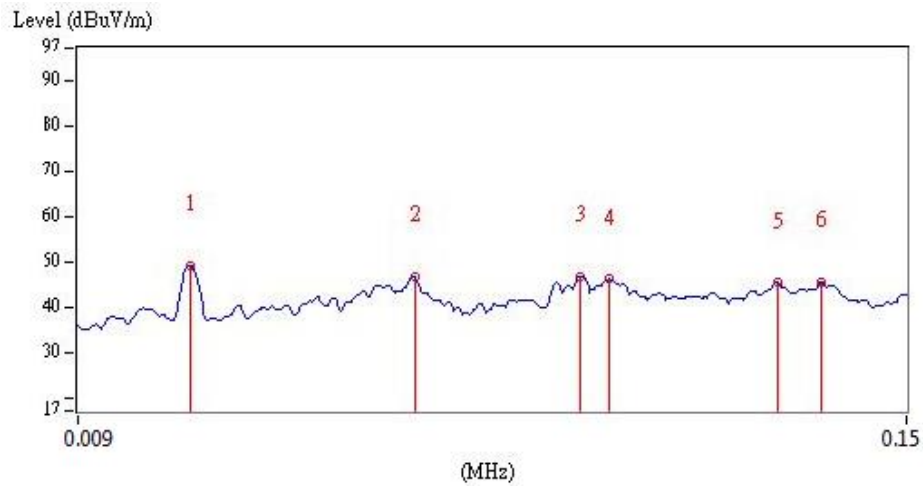
1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

4.4 Radiated spurious emission test data

4.4.1 Measurement results: frequency range from 9 kHz to 30 MHz

EUT: UG02

Polarity (circle)	Frequency (MHz)	Detection value	Factor (dB/m)	Reading (dBμV)	Value (dBμV/m)	Limit @ 3m (dBμV/m)	Tolerance (dB)
Plane	0.03	PK	19.51	29.56	49.07	118.06	-68.99
Plane	0.07	PK	18.96	27.65	46.61	110.70	-64.09
Plane	0.09	PK	18.79	27.97	46.76	108.52	-61.76
Plane	0.10	QP	18.76	27.30	46.06	107.60	-61.54
Plane	0.13	PK	18.77	26.53	45.30	105.33	-60.03
Plane	0.14	PK	18.77	26.69	45.46	104.68	-59.22
Plane	0.21	PK	18.79	40.26	59.05	101.16	-42.11
Plane	0.51	QP	18.69	41.03	59.72	73.45	-13.73
Plane	0.69	QP	18.69	30.62	49.31	70.83	-21.52
Plane	0.99	QP	18.69	33.69	52.38	67.69	-15.31
Plane	1.52	QP	18.68	28.32	47.00	63.97	-16.97
Plane	2.06	QP	18.67	24.79	43.46	69.54	-26.08



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

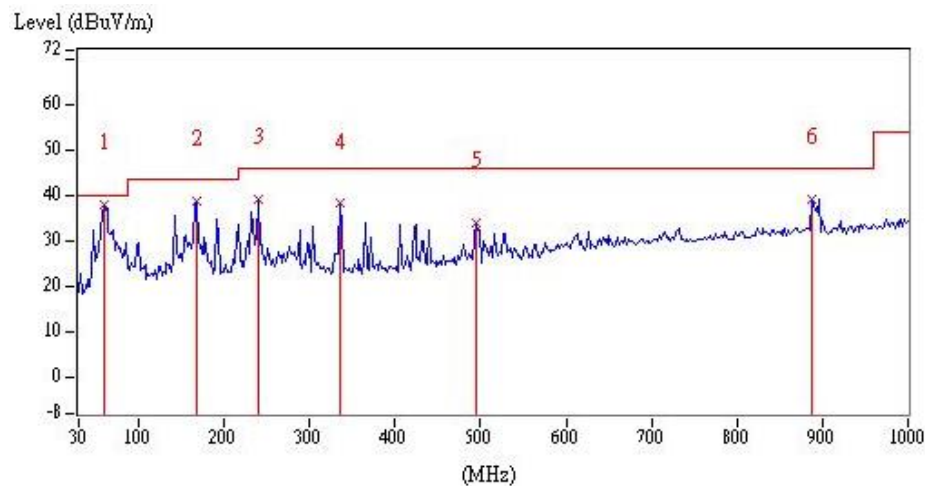
The test was performed continuously transmitting mode. The worst case occurred at TX Channel 0

EUT: UG02

Worst case: TX Channel 0

Ant. Pol. (H/V)	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Vertical	59.10	QP	20.02	18.00	38.02	40.00	-1.98
Vertical	167.74	QP	20.19	18.81	39.00	43.50	-4.50
Vertical	239.52	QP	20.10	19.24	39.34	46.00	-6.66
Vertical	336.52	QP	22.31	16.00	38.31	46.00	-7.69
Vertical	495.60	QP	26.00	8.20	34.20	46.00	-11.80
Vertical	887.48	QP	32.42	6.82	39.24	46.00	-6.76

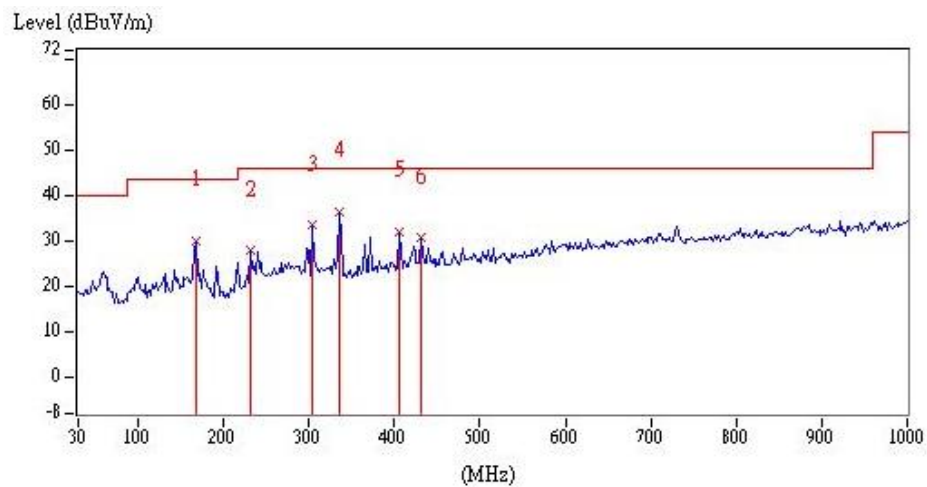
Remark: Corr. Factor = Antenna Factor + Cable Loss



EUT: UG02
Worst case: TX Channel 0

Ant. Pol. (H/V)	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Horizontal	167.74	QP	20.19	9.90	30.09	43.50	-13.41
Horizontal	231.76	QP	19.54	8.44	27.98	46.00	-18.02
Horizontal	303.54	QP	21.53	11.95	33.48	46.00	-12.52
Horizontal	336.52	QP	22.31	14.26	36.57	46.00	-9.43
Horizontal	406.36	QP	24.18	7.99	32.17	46.00	-13.83
Horizontal	431.58	QP	24.87	5.83	30.70	46.00	-15.30

Remark: Corr. Factor = Antenna Factor + Cable Loss



4.4.3 Measurement results: frequency above 1GHz

EUT: UG02

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
BLE_Ch0	4804	PK	V	2.45	53.72	56.17	74.00	-17.83
	4804	PK	V	2.45	29.58	32.03	74.00	-41.97
	4804	PK	H	2.45	53.36	55.81	74.00	-18.19
	4804	PK	H	2.45	29.53	31.98	74.00	-42.02
BLE_Ch19	4880	PK	V	2.83	47.41	50.24	74.00	-23.76
	4880	PK	H	2.83	47.61	50.44	74.00	-23.56
BLE_Ch39	4960	PK	V	3.23	42.06	45.29	74.00	-28.71
	4960	PK	H	3.23	39.50	42.73	74.00	-31.27

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

4.4.4 Measurement results: Fundamental

EUT: UG02

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
BLE_Ch0	2402	PK	V	34.37	41.34	75.71	114.00	-38.29
	2402	AV	V	34.37	5.17	39.54	94.00	-54.46
	2402	PK	H	34.37	40.65	75.02	114.00	-38.98
	2402	AV	H	34.37	5.22	39.59	94.00	-54.41
BLE_Ch19	2440	PK	V	34.36	40.16	74.52	114.00	-39.48
	2440	AV	V	34.36	5.18	39.54	94.00	-54.46
	2440	PK	H	34.36	40.60	74.96	114.00	-39.04
	2440	AV	H	34.36	5.05	39.41	94.00	-54.59
BLE_Ch39	2480	PK	V	34.35	36.47	70.82	114.00	-43.18
	2480	AV	V	34.35	4.86	39.21	94.00	-54.79
	2480	PK	H	34.35	38.69	73.04	114.00	-40.96
	2480	AV	H	34.35	4.99	39.34	94.00	-54.66

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

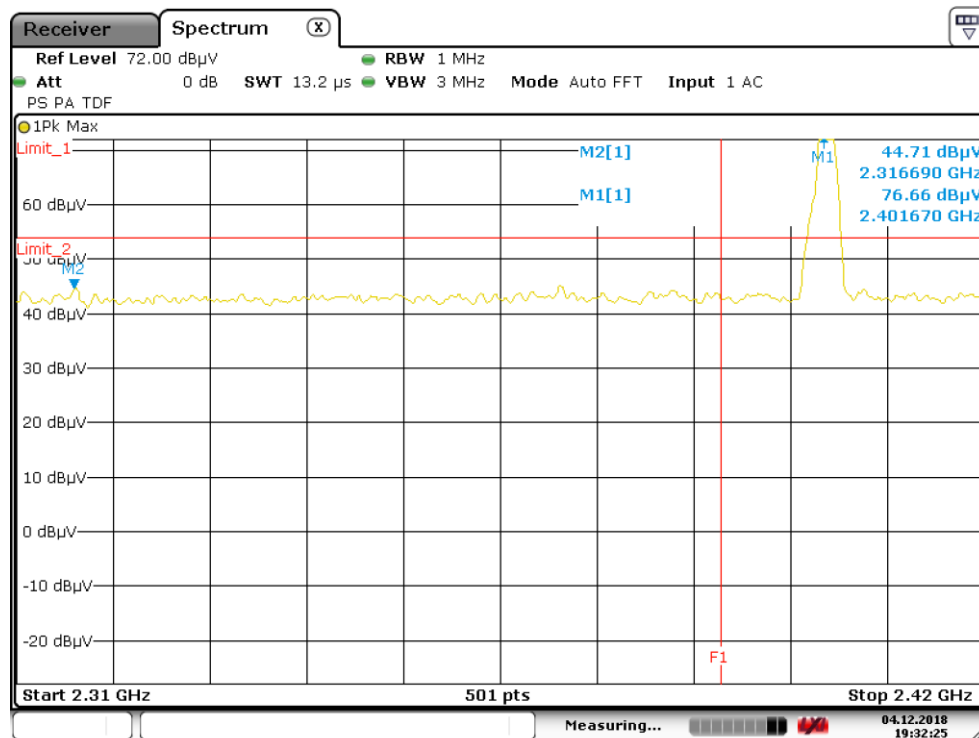
5.2 Radiated emission on the band edge test data

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 (2470MHz) or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)	Restricted band (MHz)
BLE Channel 0	2316.69	PK	V	34.38	10.33	44.71	74	-29.29	2310~2390
	2386.51	AV	V	34.37	-3.24	31.13	54	-22.87	
BLE Channel 39	2492.39	PK	V	34.35	10.55	44.90	74	-29.10	2483.5~2500
	2499.48	AV	V	34.35	-2.82	31.53	54	-22.47	

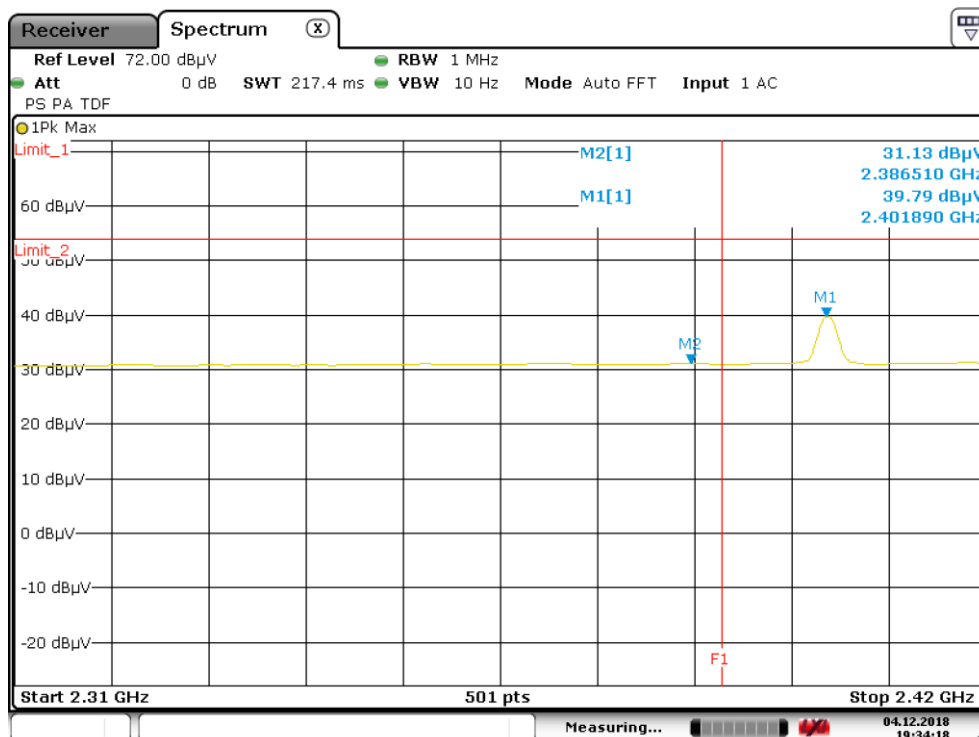
Remark: Correction Factor = Antenna Factor + Cable Loss

Restricted Band Bandedge @ BLE Mode Ch0 PK



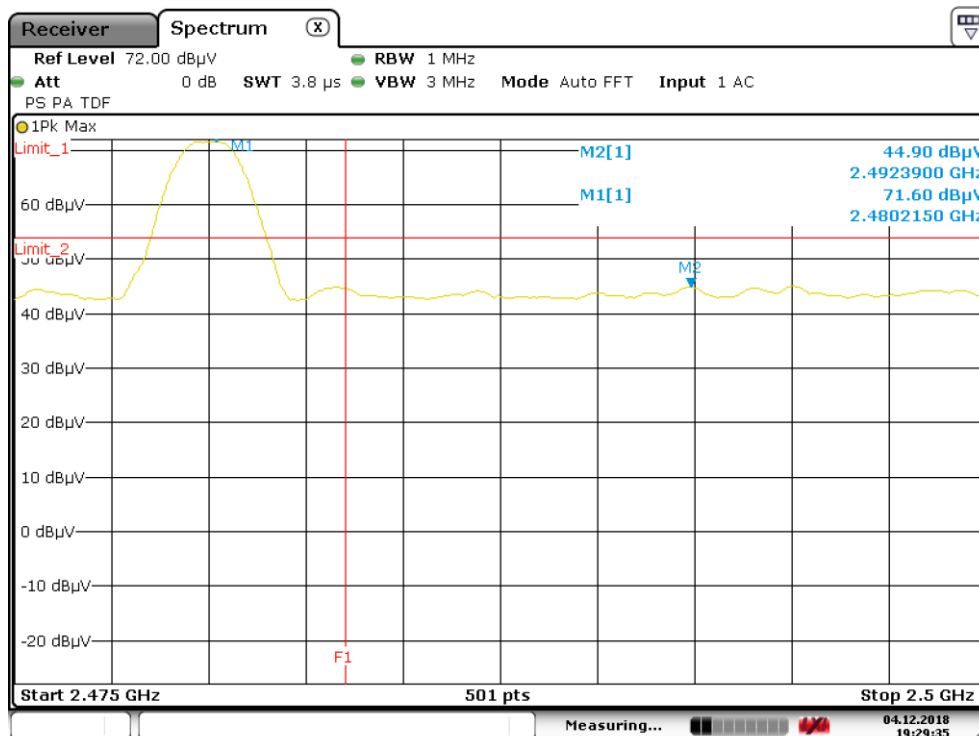
Date: 4.DEC.2018 19:32:25

Restricted Band Bandedge @ BLE Mode Ch0 AV



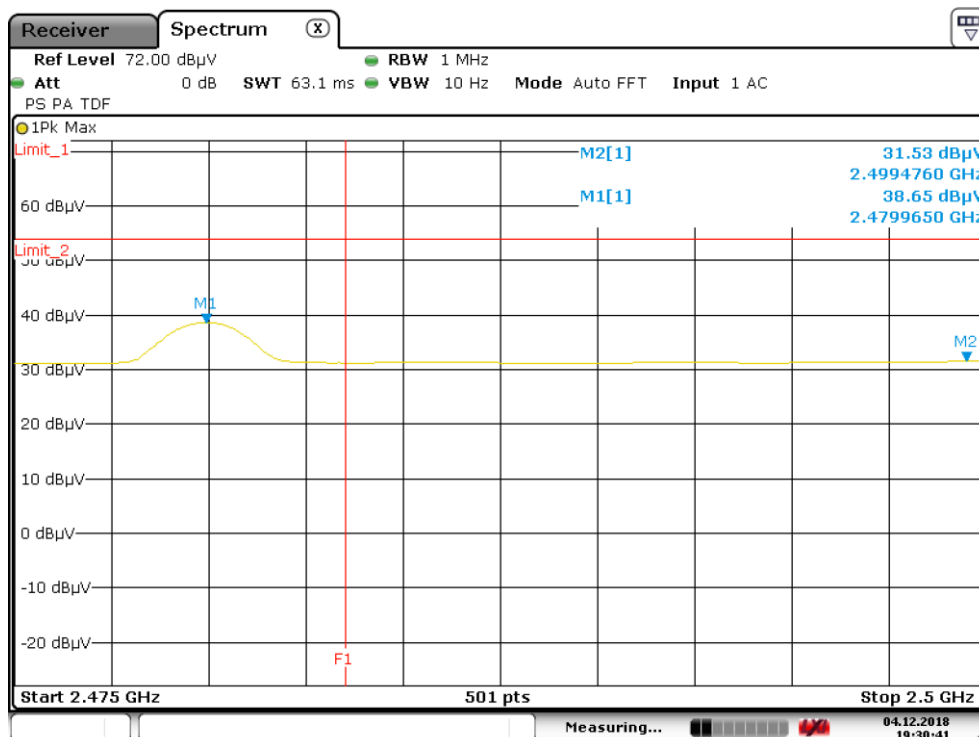
Date: 4.DEC.2018 19:34:18

Restricted Band Bandedge @ BLE Mode Ch39 PK



Date: 4.DEC.2018 19:29:35

Restricted Band Bandedge @ BLE Mode Ch39 AV



Date: 4.DEC.2018 19:30:42

6. AC Power Line Conducted Emission

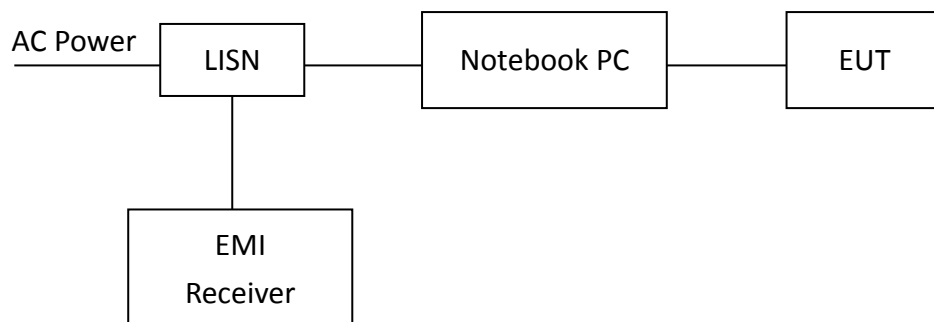
6.1 Measuring instrument setting

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) :	25
Relative Humidity (%) :	50
Atmospheric Pressure (hPa) :	1008
Test Date :	2018/12/11

6.6 Test Results

Phase: Live Line

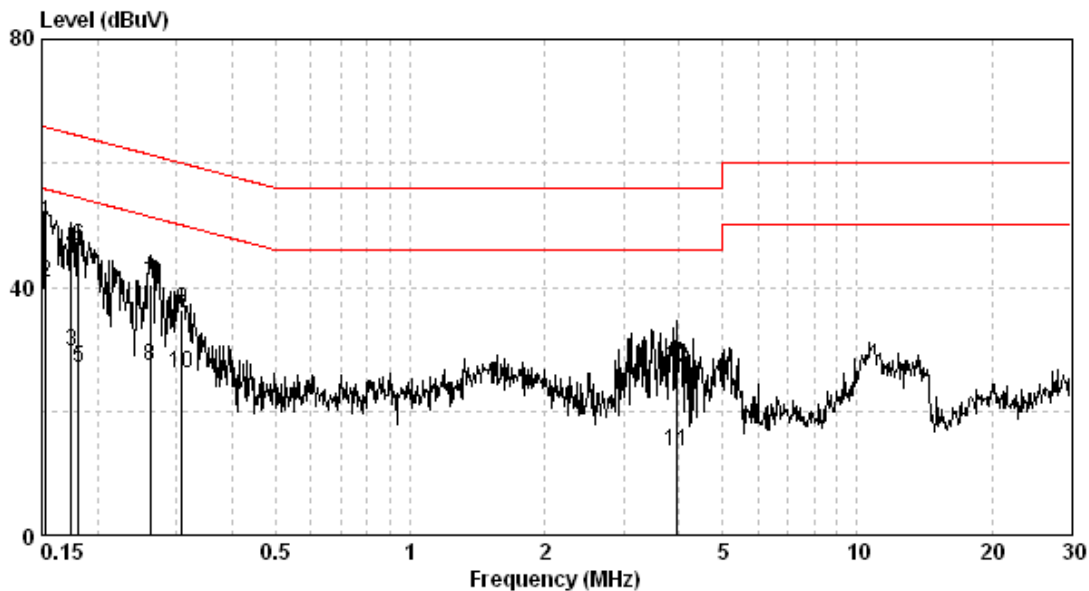
Model No.: UG02

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
0.153	9.73	40.77	50.50	65.82	31.04	40.77	55.82	-15.32	-15.05
0.175	9.73	36.15	45.88	64.72	19.86	29.59	54.72	-18.84	-25.13
0.182	9.73	36.90	46.63	64.42	17.22	26.95	54.42	-17.78	-27.46
0.262	9.73	30.72	40.45	61.38	17.61	27.35	51.38	-20.93	-24.03
0.308	9.73	26.47	36.20	60.02	16.22	25.95	50.02	-23.82	-24.06
3.943	9.85	17.07	26.92	56.00	3.57	13.42	46.00	-29.08	-32.58

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)



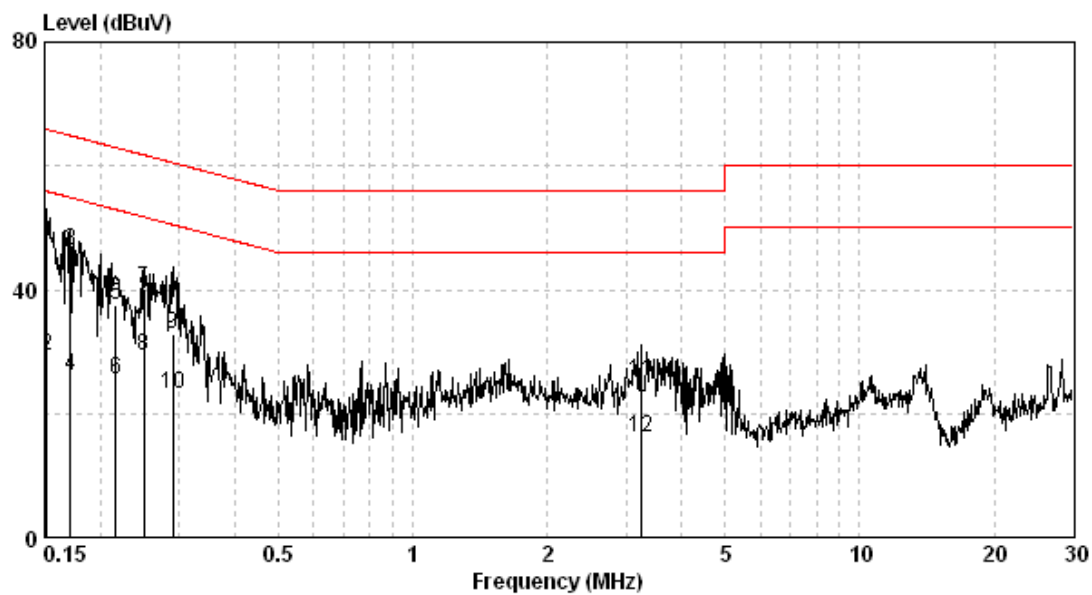
TEST REPORT

Phase: Neutral Line
Model No.: UG02
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
0.152	9.74	39.79	49.53	65.91	19.45	29.19	55.91	-16.38	-26.72
0.171	9.74	36.55	46.29	64.90	16.37	26.11	54.90	-18.61	-28.79
0.216	9.74	27.78	37.53	62.96	15.76	25.50	52.96	-25.44	-27.46
0.251	9.74	30.45	40.19	61.73	19.65	29.39	51.73	-21.54	-22.34
0.291	9.74	23.20	32.94	60.50	13.42	23.17	50.50	-27.56	-27.33
3.241	9.85	15.46	25.31	56.00	6.27	16.13	46.00	-30.69	-29.87

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	100245	2018/02/23	2019/02/22
Horn Antenna (1-18G)	SHWARZBECK	BBHA 9120 D	9120D-456	2018/01/23	2019/01/22
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2017/09/04	2020/09/02
Broadband Antenna	SHWARZBECK	VULB 9168	9168-172	2018/04/23	2019/04/22
Pre-Amplifier	EMC Co.	EMC12635SE	980205	2018/12/10	2019/12/09
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
Signal Analyzer	Agilent	N9030A	MY51380492	2018/08/24	2019/08/23
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	2018/05/03	2019/05/02
966-2_3m Semi-Anechoic Chamber	966_2	CEM-966_2	N/A	2018/03/05	2019/03/04
High Pass Filter	Wainwright	WHKX3.0/18G-12SS	N/A	2018/06/01	2019/05/31
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONIC	FMZB1519	1519-067	2018/04/17	2019/04/16
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	124781	2018/09/21	2019/09/20

Note: No Calibration Required (NCR)

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	2018/05/03	2019/05/02
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	5.14 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.22 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	3.54 dB
Emission on the Band Edge Test	4.29 dB
20dB Bandwidth	7.69 %
AC Power Line Conducted Emission	2.48 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.