

Vpatch Cardio Pty Ltd.

TEST REPORT

REPORT NUMBER
180800266TWN-001

ISSUE DATE

Feb. 22, 2019

PAGES
25

DOCUMENT CONTROL NUMBER

© 2019 INTERTEK



Radio Spectrum

TEST REPORT

| | |
|-------------------------------|--|
| Applicant: | Vpatch Cardio Pty Ltd. Level 1, 1221 Toorak Road, Camberwell, Victoria, 3124, Australia. |
| Product: | ECG Remote Event Monitor |
| Model No.: | 301 |
| Brand Name: | 3G Vcell |
| FCC ID: | 2ARNZ-1002 |
| 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 |



Prepared and Checked by:

A handwritten signature in black ink that reads 'Durant Wei'.

Durant Wei
Engineer

Approved by:

A handwritten signature in black ink that reads 'Rico Deng'.

Rico Deng
Supervisor

Revision History

| Report No. | Issue Date | Revision Summary |
|------------------|---------------|------------------|
| 180800266TWN-001 | Feb. 22, 2019 | Original report |

Table of Contents

| | |
|--|----|
| Summary of Tests | 4 |
| 1. General Information | 5 |
| 1.1 Identification of the EUT | 5 |
| 1.2 Antenna description | 5 |
| 2. Test specifications..... | 6 |
| 2.1 Test standard | 6 |
| 2.2 Operation mode | 6 |
| 3. 20dB Bandwidth test | 7 |
| 3.1 Operating environment | 7 |
| 3.2 Test setup & procedure | 7 |
| 3.3 Measured data of modulated bandwidth test results..... | 7 |
| 4. Radiated emission test FCC 15.249 (C) | 9 |
| 4.1 Operating environment | 9 |
| 4.2 Test setup & procedure | 9 |
| 4.3 Emission limit | 11 |
| 4.3.1 Fundamental and harmonics emission limits..... | 11 |
| 4.3.2 General radiated emission limits..... | 12 |
| 4.4 Radiated spurious emission test data..... | 13 |
| 4.4.2 Measurement results: frequencies equal to or less than 1 GHz | 13 |
| 4.4.3 Measurement results: frequency above 1GHz..... | 15 |
| 4.4.4 Measurement results: Fundamental | 16 |
| 5. Radiated emission on the band edge FCC 15.249(d) | 17 |
| 5.1 Operating environment | 17 |
| 5.2 Radiated emission on the band edge test data | 17 |
| 6. AC Power Line Conducted Emission | 19 |
| 6.1 Measuring instrument setting..... | 19 |
| 6.2 Test Procedure | 19 |
| 6.3 Test Diagram | 19 |
| 6.4 Limit..... | 20 |
| 6.5 Operating Environment Condition | 20 |
| 6.6 Test Results | 21 |
| Appendix A: Test equipment list..... | 23 |
| Appendix B: Measurement Uncertainty..... | 25 |

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 Remote Event Monitor |
| Model No.: | 301 |
| Operating Frequency: | Single channel |
| Channel Number: | 2466MHz |
| Rated Power: | DC 4.2V from adapter |
| Power Cord: | N/A |
| Sample receiving date: | Aug. 20, 2018 |
| Sample condition: | Workable |
| Test Date(s): | Oct. 08, 2018 ~ Jan. 24, 2019 |
| Note: | 2.4GHz ISM Band and WWAN cannot transmit simultaneously |

1.2 Adapter information

The EUT will be supplied with a power supply from below list:

| No. | Model no. | Specification |
|-----------|-----------|---|
| Adapter 1 | Type 2200 | I/P: 100-240Vac, 50-60Hz O/P: 4.2V, 1.3A |

1.3 Antenna description

Antenna Type: PCB printed F-type antenna

Antenna Gain: 0.0dBi

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 Press the button entering test mode.

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



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.

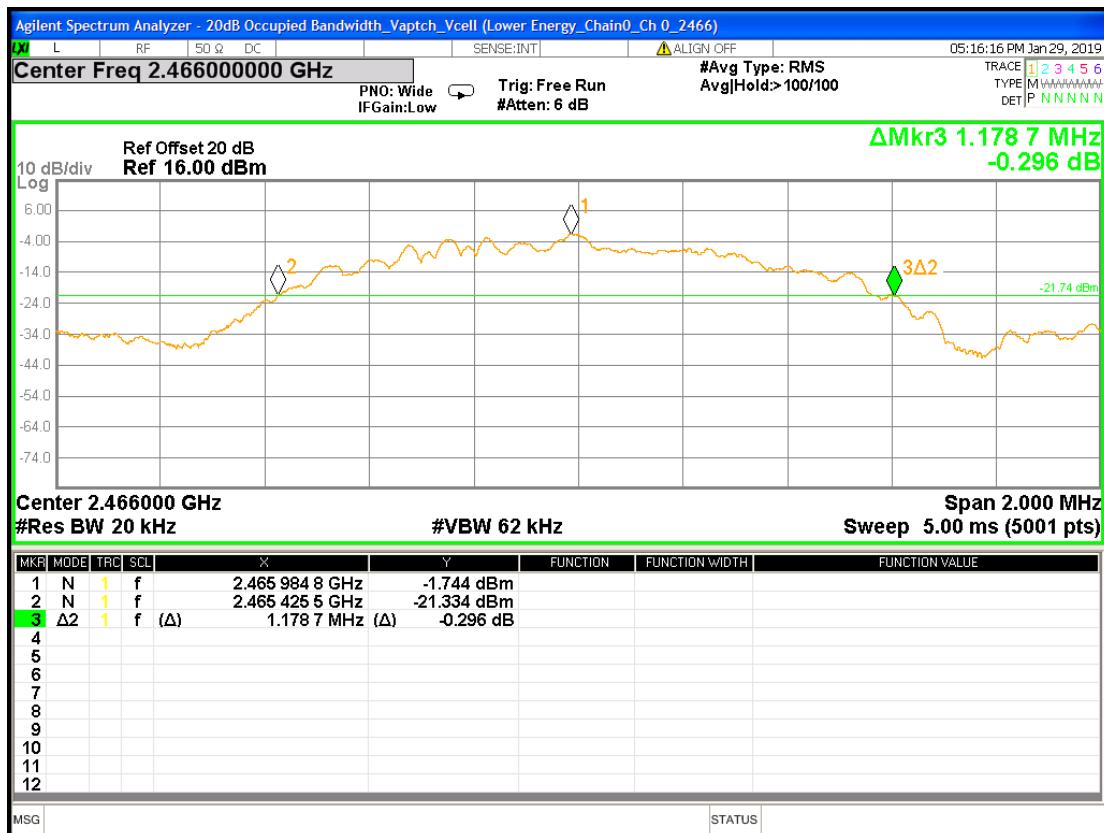
Step 4: The test was performed at 1 channel. The maximum 20dB modulation bandwidth is in the following Table.

3.3 Measured data of modulated bandwidth test results

| Single TX | | |
|-----------|-----------------|-------------------------------|
| Mode | Frequency (MHz) | 20dB Occupied Bandwidth (MHz) |
| ANT+ | 2466 | 1.1787 |

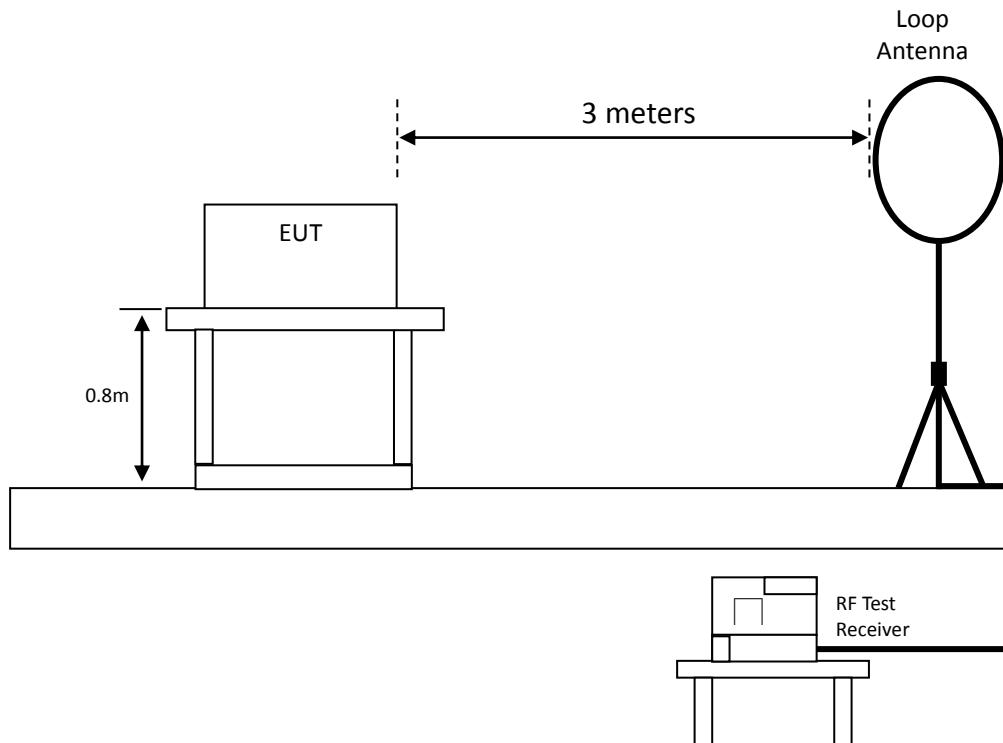
Please see the plot below.

Vcell 20dB Bandwidth @ ANT+ 2466MHz

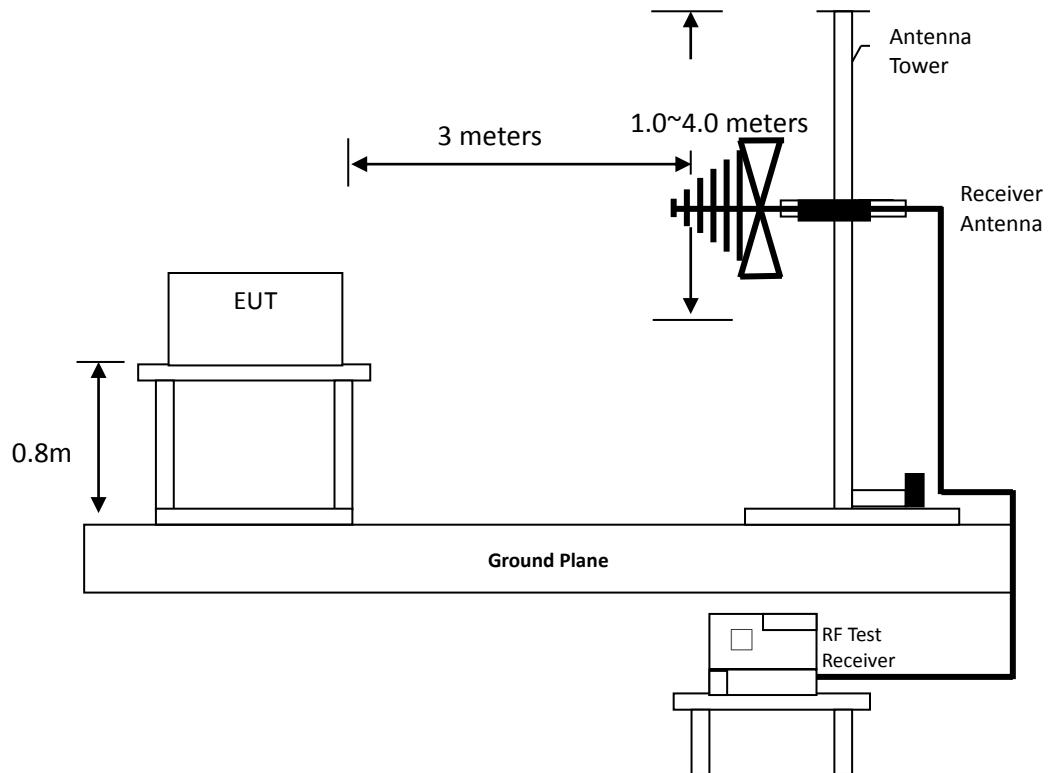


4. Radiated emission test FCC 15.249 (C)**4.1 Operating environment**

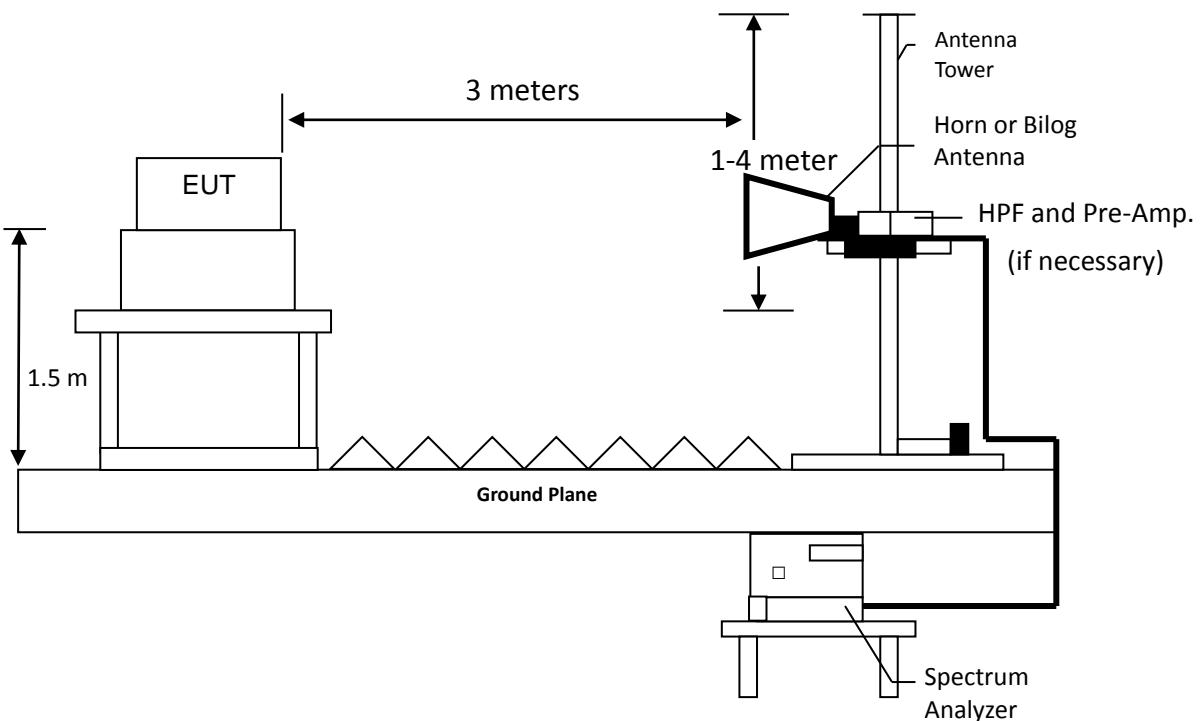
| | | |
|-----------------------|------|-----|
| Temperature: | 25 | °C |
| Relative Humidity: | 50 | % |
| Atmospheric Pressure: | 1008 | hPa |

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 (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

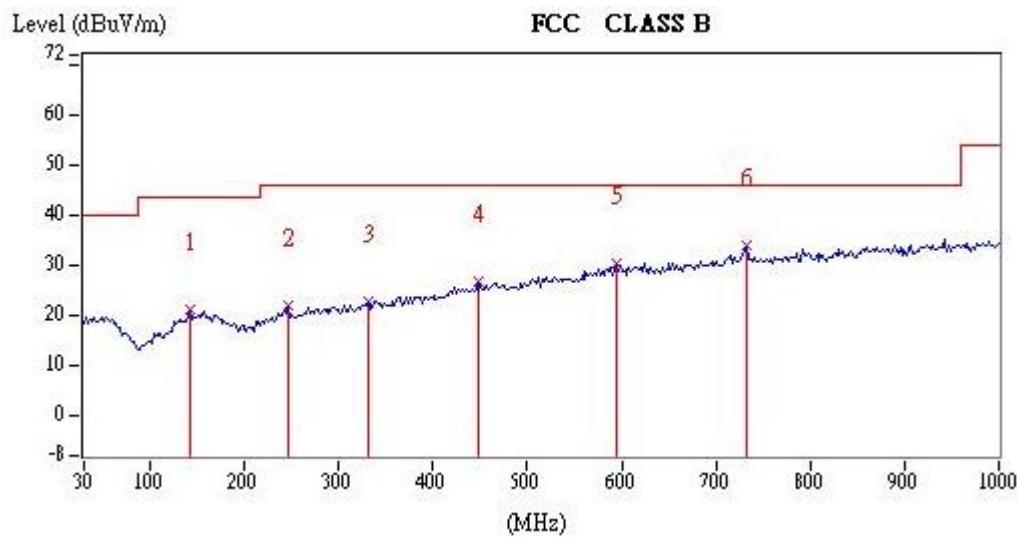
4.4 Radiated spurious emission test data**4.4.2 Measurement results: frequencies equal to or less than 1 GHz**

Polarity: Vertical

| Frequency | Factor | Reading | Emission | Limit | Margin |
|-----------|--------|------------|--------------|--------------|--------|
| MHz | dB | dB μ V | dB μ V/m | dB μ V/m | dB |
| 142.52 | 19.89 | 1.18 | 21.08 | 43.50 | -22.42 |
| 247.28 | 20.31 | 1.60 | 21.91 | 46.00 | -24.09 |
| 330.70 | 22.17 | 0.53 | 22.70 | 46.00 | -23.30 |
| 447.10 | 25.30 | 1.48 | 26.78 | 46.00 | -19.22 |
| 594.54 | 28.18 | 2.12 | 30.30 | 46.00 | -15.70 |
| 732.28 | 30.45 | 3.36 | 33.80 | 46.00 | -12.20 |

Remark:

1. Factor = Antenna Factor (dB/m) + Cable Loss (dB)
2. Emission (dB μ V/m) = Factor (dB) + Reading (dB μ V)
3. Margin (dB) = Emission (dB μ V/m) – Limit (dB μ V/m)

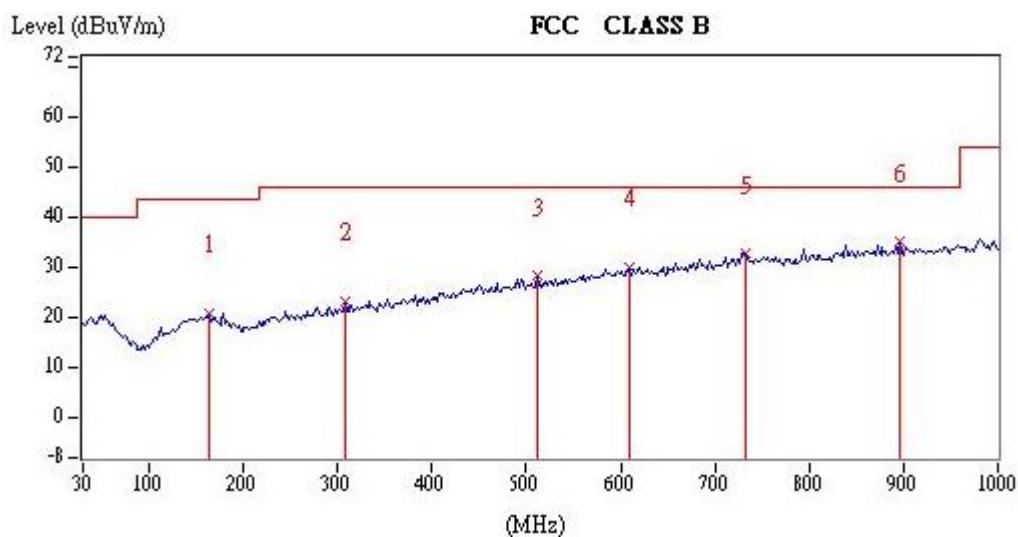


Polarity: Horizontal

| Frequency | Factor | Reading | Emission | Limit | Margin |
|-----------|--------|------------|--------------|--------------|--------|
| MHz | dB | dB μ V | dB μ V/m | dB μ V/m | dB |
| 163.86 | 20.29 | 0.52 | 20.80 | 43.50 | -22.70 |
| 307.42 | 21.63 | 1.71 | 23.33 | 46.00 | -22.67 |
| 511.12 | 26.27 | 1.99 | 28.26 | 46.00 | -17.74 |
| 610.06 | 28.46 | 1.55 | 30.01 | 46.00 | -15.99 |
| 732.28 | 30.45 | 2.31 | 32.76 | 46.00 | -13.24 |
| 895.24 | 32.51 | 2.65 | 35.17 | 46.00 | -10.83 |

Remark:

1. Factor = Antenna Factor (dB/m) + Cable Loss (dB)
2. Emission (dB μ V/m) = Factor (dB) + Reading (dB μ V)
3. Margin (dB) = Emission (dB μ V/m) – Limit (dB μ V/m)



4.4.3 Measurement results: frequency above 1GHz

| 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) |
|------|--------------------|----------------------------------|-----------------------|--------------------------------|-------------------------|--|----------------------------------|----------------|
| ANT+ | 4932 | PK | V | 6.34 | 47.43 | 53.77 | 74.00 | -20.23 |
| | 4932 | AV | V | 6.34 | 33.35 | 39.69 | 54.00 | -14.31 |
| | 7398 | PK | V | 14.75 | 33.66 | 48.41 | 74.00 | -25.59 |
| | 4932 | PK | H | 6.34 | 48.15 | 54.49 | 74.00 | -19.51 |
| | 4932 | AV | H | 6.34 | 33.44 | 39.78 | 54.00 | -14.22 |
| | 7398 | PK | H | 14.75 | 50.01 | 64.76 | 74.00 | -9.24 |
| | 9864 | PK | H | 17.26 | 48.66 | 65.92 | 74.00 | -8.08 |

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

4.4.4 Measurement results: Fundamental

| 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) |
|------|--------------------|----------------------------------|-----------------------|--------------------------------|-------------------------|--|----------------------------------|----------------|
| ANT+ | 2466 | PK | V | 34.36 | 47.25 | 81.61 | 114.00 | -32.39 |
| | 2466 | AV | V | 34.36 | 33.27 | 67.63 | 94.00 | -26.37 |
| | 2466 | PK | H | 34.36 | 49.42 | 83.78 | 114.00 | -30.22 |
| | 2466 | AV | H | 34.36 | 35.44 | 69.80 | 94.00 | -24.20 |

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 |

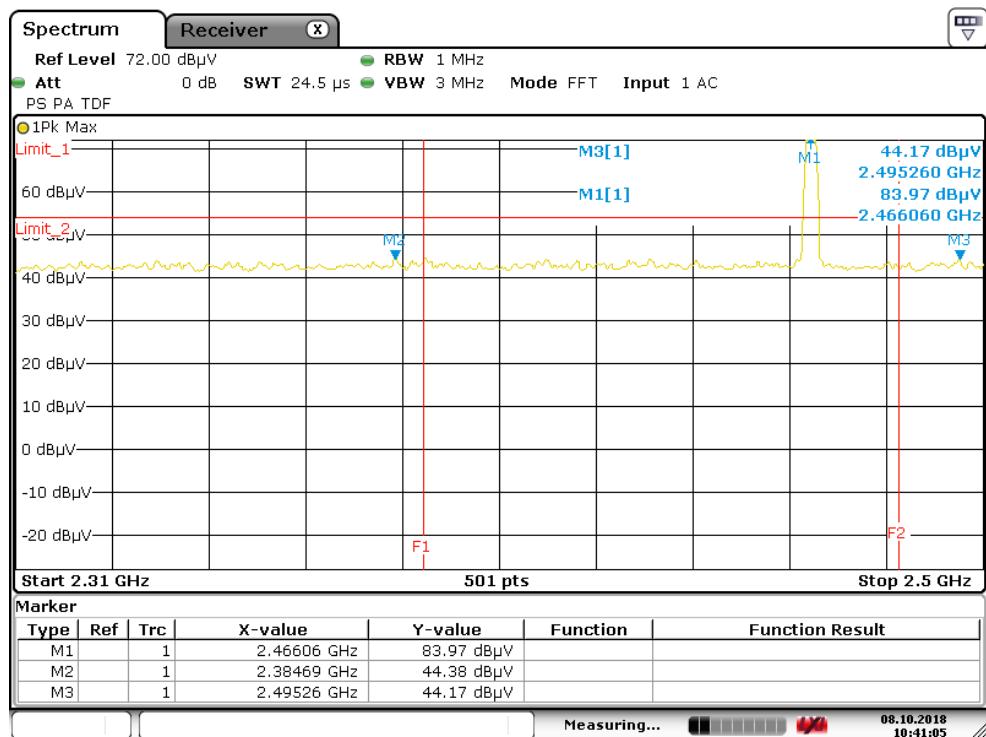
5.2 Radiated emission on the band edge test data

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 (dB μ V) | Corrected Reading (dB μ V/m) | Limit @ 3 m (dB μ V/m) | Margin (dB) | Restricted band (MHz) |
|------|-----------------|----------------------------|-----------------|--------------------------|----------------------|----------------------------------|----------------------------|-------------|-----------------------|
| ANT+ | 2384.69 | PK | V | 34.37 | 10.01 | 44.38 | 74 | -29.62 | 2310~2390 |
| | 2382.04 | AV | V | 34.37 | -3.52 | 30.85 | 54 | -23.15 | |
| | 2495.26 | PK | V | 34.35 | 9.82 | 44.17 | 74 | -29.83 | 2483.5~2500 |
| | 2499.81 | AV | V | 34.35 | -3.16 | 31.19 | 54 | -22.81 | |

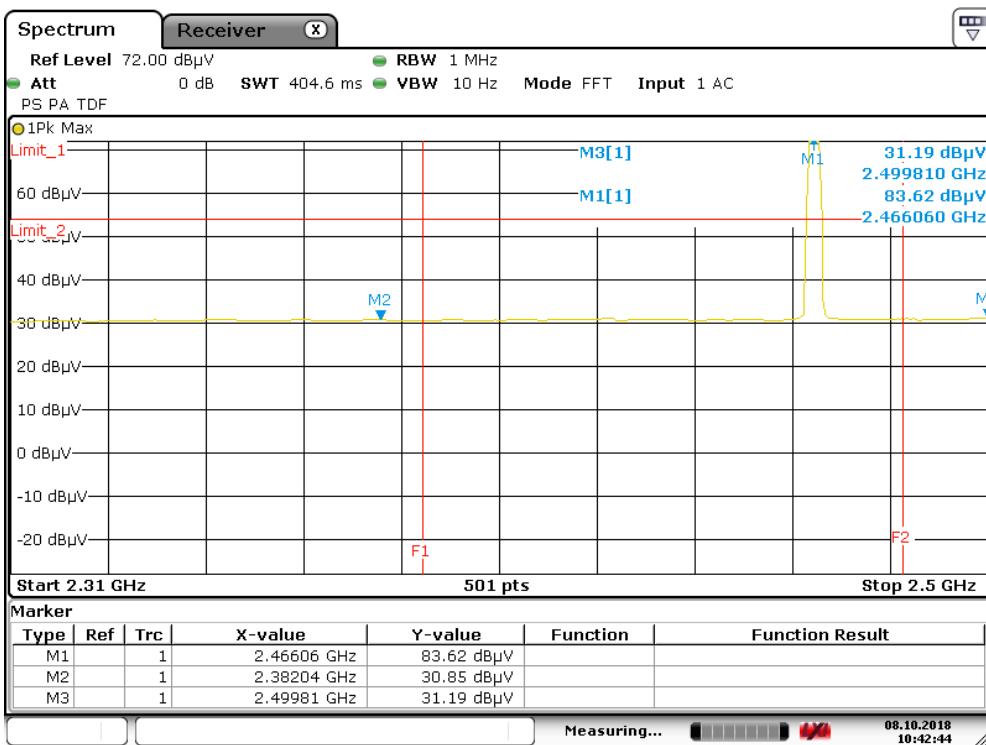
Remark: Correction Factor = Antenna Factor + Cable Loss

Vcell_Bandedge @ mode ANT+ 2466MHz Peak



Date: 8.OCT.2018 10:41:05

Vcell_Bandedge @ mode ANT+ 2466MHz Average



Date: 8.OCT.2018 10:42:44

6. AC Power Line Conducted Emission

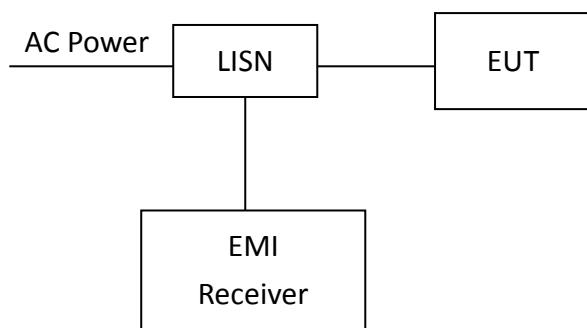
6.1 Measuring instrument setting

| 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 (%) : | 68 |
| Atmospheric Pressure (hPa) : | 1010 |

6.6 Test Results

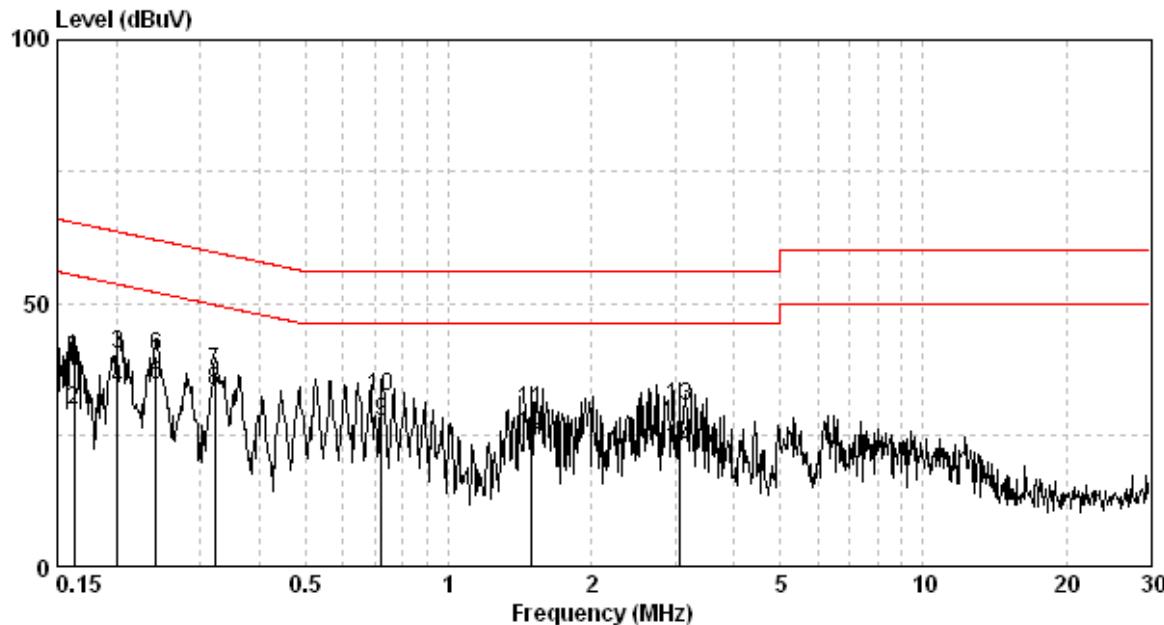
Phase: Live Line

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 | 9.69 | 29.99 | 39.68 | 65.34 | 20.15 | 29.83 | 55.34 | -25.66 | -25.51 |
| 0.201 | 9.68 | 30.57 | 40.25 | 63.58 | 24.10 | 33.78 | 53.58 | -23.33 | -19.80 |
| 0.242 | 9.68 | 30.20 | 39.89 | 62.04 | 24.64 | 34.32 | 52.04 | -22.15 | -17.72 |
| 0.322 | 9.69 | 27.13 | 36.81 | 59.66 | 23.75 | 33.44 | 49.66 | -22.85 | -16.23 |
| 0.724 | 9.71 | 22.41 | 32.12 | 56.00 | 17.80 | 27.50 | 46.00 | -23.88 | -18.50 |
| 1.487 | 9.75 | 19.96 | 29.72 | 56.00 | 15.30 | 25.06 | 46.00 | -26.28 | -20.94 |
| 3.058 | 9.80 | 20.68 | 30.48 | 56.00 | 12.40 | 22.21 | 46.00 | -25.52 | -23.79 |

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)



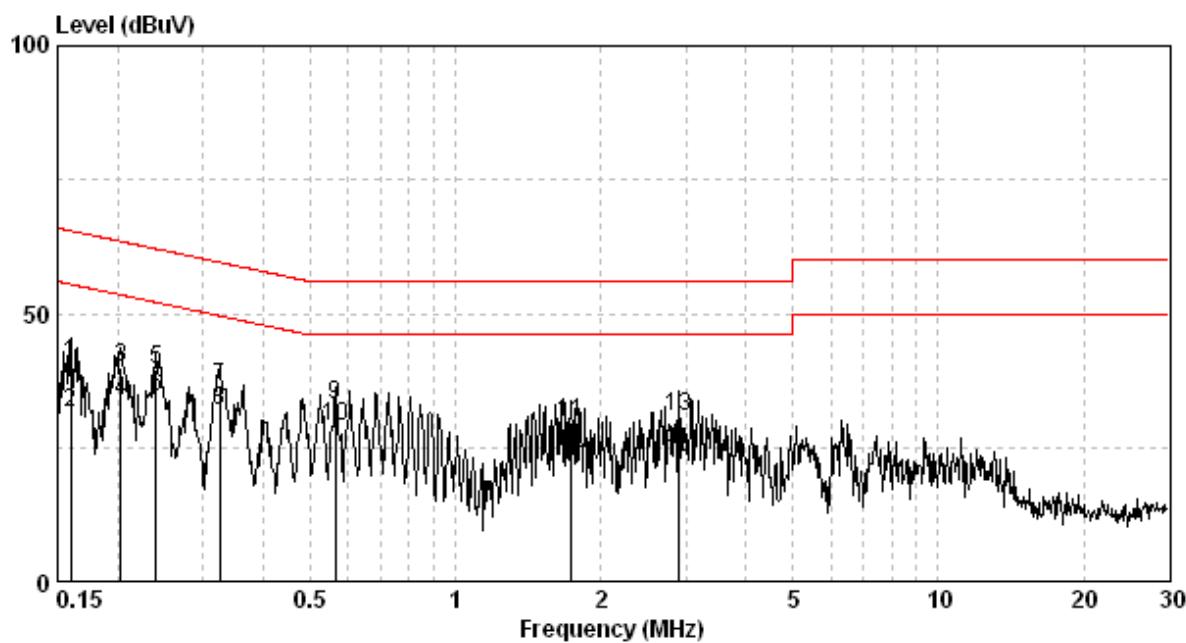
Phase: Neutral Line

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 |
|-----------------|-------------------|-------------------|-----------------|-----------------|-------------------|-----------------|-----------------|----------------|----------------|
| 0.160 | 9.69 | 30.88 | 40.57 | 65.47 | 21.63 | 31.32 | 55.47 | -24.90 | -24.15 |
| 0.203 | 9.68 | 30.12 | 39.80 | 63.49 | 24.19 | 33.87 | 53.49 | -23.70 | -19.62 |
| 0.240 | 9.68 | 29.74 | 39.42 | 62.08 | 24.66 | 34.34 | 52.08 | -22.66 | -17.75 |
| 0.325 | 9.68 | 26.75 | 36.42 | 59.57 | 22.22 | 31.90 | 49.57 | -23.15 | -17.67 |
| 0.564 | 9.69 | 23.17 | 32.86 | 56.00 | 19.19 | 28.88 | 46.00 | -23.14 | -17.12 |
| 1.734 | 9.77 | 20.08 | 29.85 | 56.00 | 14.07 | 23.84 | 46.00 | -26.15 | -22.16 |
| 2.900 | 9.80 | 20.87 | 30.68 | 56.00 | 12.45 | 22.25 | 46.00 | -25.32 | -23.75 |

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 |

Note: No Calibration Required (NCR)

| Test Equipment/ Test site | Brand | Model No. | Serial No. | Calibration Date | Next Calibration Date |
|------------------------------|--------|--------------------------|-------------|---------------------|-----------------------------|
| EMI Test Receiver | R&S | ESR7 | 101822 | 2018/06/12 | 2019/06/11 |
| Two-Line V-Network | R&S | ENV216 | 101160 | 2018/07/24 | 2019/07/23 |
| Two-Line -V-Network | R&S | ESH3-Z5 | 838979/014 | 2018/09/03 | 2019/09/02 |
| CON-2 Shielded Room | N/A | N/A | N/A | NCR | NCR |
| CON-2 Cable | SUHNER | EMCCFD300-BM- NM-6000 | 170502 | 2018/05/07 | 2019/05/06 |
| 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 | 3.64 dB |
| Horizontally polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m | 3.64 dB |
| Vertically polarized Radiated disturbances from 18GHz~40GHz in a semi-anechoic chamber at a distance of 3m | 2.68 dB |
| Horizontally polarized Radiated disturbances from 18GHz~40GHz in a semi-anechoic chamber at a distance of 3m | 2.68 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 | 3.64 dB |
| 20dB Bandwidth | 1.22 dB |
| AC Power Line Conducted Emission | 2.48 dB |