



FCC Part 15C Measurement and Test Report

For

Ultimate IOT (Shanghai) Technology Ltd.

Bldg. C, No. 888, Huanhu West 2nd Rd., Nanhui New Town, Pudong New

Dist., Shanghai 200120 China

FCC ID: 2ATY4-UIOT-ZM-V41

FCC Rule(s): FCC Part 15.247

Product Description: ZigBee

Tested Model: UIOT_ZM_V4.1

Report No.: WTX20X01004120W

Sample Receipt Date: Jan.20, 2020

Tested Date: Jan.20, 2020 to Feb.27, 2020

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Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen SEM Test Technology Co., Ltd.



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Report version

| Version No. | Date of issue | Description |
|-------------|---------------|-------------|
| Rev.00 | Feb.27, 2020 | Original |
| / | / | / |

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: Ultimate IOT (Shanghai) Technology Ltd.
Address of applicant: Bldg. C, No. 888, Huanhu West 2nd Rd., Nanhui New Town, Pudong New Dist., Shanghai 200120 China

Manufacturer: Ultimate IOT (Henan) Technology Ltd.
Address of manufacturer: Bldg. 3, No. 67, Dongqing St., High-tech Industrial Development Zone, Zhengzhou 450001 China

| General Description of EUT | |
|---|--------------|
| Product Name: | ZigBee |
| Trade Name: | UIOT |
| Model No.: | UIOT_ZM_V4.1 |
| Adding Model(s): | / |
| Rated Voltage: | DC3.3V |
| Software Version: | V4.05 |
| Hardware Version: | ZG_ZM_V4.1 |
| <i>Note: The test data is gathered from a production sample provided by the manufacturer.</i> | |

| Technical Characteristics of EUT | |
|----------------------------------|---------------------|
| Support Standards: | IEEE802.15.4 |
| Frequency Range: | 2405-2475MHz |
| RF Output Power: | 9.78dBm (Conducted) |
| Type of Modulation: | OQPSK |
| Quantity of Channels: | 15 |
| Channel Separation: | 5MHz |
| Type of Antenna: | External Antenna |
| Antenna Gain: | 2.0dBi |

1.2 Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

558074 D01 DTS Meas Guidance v05r02: GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, KDB 558074 D01 DTS Meas Guidance v05r02.

The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

1.4 Test Facility

Address of the test laboratory

Laboratory: Shenzhen SEM Test Technology Co., Ltd.

Address: 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C. (518101)

FCC – Registration No.: 125990

Shenzhen SEM Test Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. The Designation Number is CN5010, and Test Firm Registration Number is 125990.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Shenzhen SEM Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.



1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

| Test Mode List | | |
|----------------|-------------|---------|
| Test Mode | Description | Remark |
| TM1 | Low | 2405MHz |
| TM2 | Middle | 2440MHz |
| TM3 | High | 2475MHz |

| Test Conditions | |
|--------------------|-----------|
| Temperature: | 22~25 °C |
| Relative Humidity: | 50~55 %. |
| ATM Pressure: | 1019 mbar |

| EUT Cable List and Details | | | |
|----------------------------|------------|---------------------|------------------------|
| Cable Description | Length (m) | Shielded/Unshielded | With / Without Ferrite |
| / | / | / | / |

| Special Cable List and Details | | | |
|--------------------------------|------------|---------------------|------------------------|
| Cable Description | Length (m) | Shielded/Unshielded | With / Without Ferrite |
| USB CABLE | 0.8 | Unshielded | Without Ferrite |

| Auxiliary Equipment List and Details | | | |
|--------------------------------------|--------------|--------------------|---------------|
| Description | Manufacturer | Model | Serial Number |
| Computer | Lenovo | ThinkPad Edge E445 | / |

1.6 Measurement Uncertainty

| Measurement uncertainty | | |
|--------------------------------|------------|--------------------|
| Parameter | Conditions | Uncertainty |
| RF Output Power | Conducted | ±0.42dB |
| Occupied Bandwidth | Conducted | ±1.5% |
| Power Spectral Density | Conducted | ±1.8dB |
| Conducted Spurious Emission | Conducted | ±2.17dB |
| Conducted Emissions | Conducted | 9-150kHz ±3.74dB |
| | | 0.15-30MHz ±3.34dB |
| Transmitter Spurious Emissions | Radiated | 30-200MHz ±4.52dB |
| | | 0.2-1GHz ±5.56dB |
| | | 1-6GHz ±3.84dB |
| | | 6-18GHz ±3.92dB |

1.7 Test Equipment List and Details

| No. | Description | Manufacturer | Model | Serial No. | Cal Date | Due Date |
|-----------|-------------------|------------------------|-----------------------|-------------|------------|------------|
| SEMT-1072 | Spectrum Analyzer | Agilent | E4407B | MY41440400 | 2019-04-30 | 2020-04-29 |
| SEMT-1031 | Spectrum Analyzer | Rohde & Schwarz | FSP30 | 836079/035 | 2019-04-30 | 2020-04-29 |
| SEMT-1007 | EMI Test Receiver | Rohde & Schwarz | ESVB | 825471/005 | 2019-04-30 | 2020-04-29 |
| SEMT-1008 | Amplifier | Agilent | 8447F | 3113A06717 | 2019-04-30 | 2020-04-29 |
| SEMT-1043 | Amplifier | C&D | PAP-1G18 | 2002 | 2019-04-30 | 2020-04-29 |
| SEMT-1011 | Broadband Antenna | Schwarz beck | VULB9163 | 9163-333 | 2019-05-05 | 2021-05-04 |
| SEMT-1042 | Horn Antenna | ETS | 3117 | 00086197 | 2019-05-05 | 2021-05-04 |
| SEMT-1121 | Horn Antenna | Schwarzbeck | BBHA 9170 | BBHA9170582 | 2019-05-05 | 2021-05-04 |
| SEMT-1069 | Loop Antenna | Schwarz beck | FMZB 1516 | 9773 | 2019-05-05 | 2021-05-04 |
| SEMT-1001 | EMI Test Receiver | Rohde & Schwarz | ESPI | 101611 | 2019-04-30 | 2020-04-29 |
| SEMT-1003 | L.I.S.N | Schwarz beck | NSLK8126 | 8126-224 | 2019-04-30 | 2020-04-29 |
| SEMT-1002 | Pulse Limiter | Rohde & Schwarz | ESH3-Z2 | 100911 | 2019-04-30 | 2020-04-29 |
| SEMT-1168 | Pre-amplifier | Direction Systems Inc. | PAP-0126 | 14141-12838 | 2019-04-30 | 2020-04-29 |
| SEMT-1169 | Pre-amplifier | Direction Systems Inc. | PAP-2640 | 14145-14153 | 2019-04-30 | 2020-04-29 |
| SEMT-1163 | Spectrum Analyzer | Rohde & Schwarz | FSP40 | 100612 | 2019-04-30 | 2020-04-29 |
| SEMT-1170 | DRG Horn Antenna | A.H. SYSTEMS | SAS-574 | 571 | 2019-05-05 | 2021-05-04 |
| SEMT-1166 | Power Limiter | Agilent | N9356B | MY45450376 | 2019-04-30 | 2020-04-29 |
| SEMT-1048 | RF Limiter | ATTEN | AT-BSF-2400~2500 | / | 2019-04-30 | 2020-04-29 |
| SEMT-1076 | RF Switcher | Top Precision | RCS03-A2 | / | 2019-04-30 | 2020-04-29 |
| SEMT-C001 | Cable | Zheng DI | LL142-07-07-10M(A) | / | 2019-03-18 | 2020-03-17 |
| SEMT-C002 | Cable | Zheng DI | ZT40-2.92J-2.92J-6M | / | 2019-03-18 | 2020-03-17 |
| SEMT-C003 | Cable | Zheng DI | ZT40-2.92J-2.92J-2.5M | / | 2019-03-18 | 2020-03-17 |
| SEMT-C004 | Cable | Zheng DI | 2M0RFC | / | 2019-03-18 | 2020-03-17 |
| SEMT-C005 | Cable | Zheng DI | 1M0RFC | / | 2019-03-18 | 2020-03-17 |
| SEMT-C006 | Cable | Zheng DI | 1M0RFC | / | 2019-03-18 | 2020-03-17 |



| Software List | | | |
|--|---------------------|--------------|----------------|
| Description | Manufacturer | Model | Version |
| EMI Test Software (Radiated Emission)* | Farad | EZ-EMC | RA-03A1 |
| EMI Test Software (Conducted Emission)* | Farad | EZ-EMC | RA-03A1 |

*Remark: indicates software version used in the compliance certification testing



2. SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test Item | Result |
|---------------------------|-----------------------------------|---------------|
| § 2.1091 | RF Exposure | Compliant |
| §15.203; §15.247(b)(4)(i) | Antenna Requirement | Compliant |
| §15.205 | Restricted Band of Operation | Compliant |
| §15.207(a) | Conducted Emission | Compliant |
| §15.247(e) | Power Spectral Density | Compliant |
| §15.247(a)(2) | 6 dB Bandwidth | Compliant |
| §15.247(b)(3) | RF Output Power | Compliant |
| §15.209(a) | Radiated Emission | Compliant |
| §15.247(d) | Band Edge (Out of Band Emissions) | Compliant |

N/A: not applicable



3. RF Exposure

3.1 Standard Applicable

According to §1.1307 and §2.1091, the mobile or fixed transmitter must comply the RF exposure requirements.

3.2 Test Result

This product complied with the requirement of the RF exposure, please see the RF Exposure Report.

4. Antenna Requirement

4.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

4.2 Evaluation Information

This product has an External antenna, fulfill the requirement of this section.



5. Power Spectral Density

5.1 Standard Applicable

According to 15.247(a)(1)(iii), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.2 Test Procedure

According to the KDB 558074, such specifications require that the same method as used to determine the conducted output power shall also be used to determine the power spectral density. The test method of power spectral density as below:

- a) Set instrument center frequency to DTS channel center frequency.
- b) Set span to at least 1.5 times the OBW.
- c) Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set VBW $\geq 3 \times \text{RBW}$.
- e) Detector = power averaging (RMS) or sample detector (when RMS not available).
- f) Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span}/\text{RBW}$.
- g) Sweep time = auto couple.
- h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
- i) Use the peak marker function to determine the maximum amplitude level.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

5.3 Summary of Test Results/Plots

| Test Mode | Test Channel | Power Spectral Density dBm/3kHz | Limit dBm/3kHz |
|-----------|--------------|------------------------------------|-------------------|
| ZigBee | Low | -2.56 | 8 |
| | Middle | -3.11 | 8 |
| | High | -2.08 | 8 |

Please refer to the following test plots:



| | |
|---------------|--|
| <p>Low</p> | |
| <p>Middle</p> | |
| <p>High</p> | |



6. 6dB Bandwidth

6.1 Standard Applicable

According to 15.247(a)(2), systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

6.2 Test Procedure

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.3 Summary of Test Results/Plots

| Test Mode | Test Channel | 6 dB Bandwidth MHz | Limit kHz |
|-----------|--------------|-----------------------|--------------|
| ZigBee | Low | 2.606 | ≥ 500 |
| | Middle | 2.621 | ≥ 500 |
| | High | 2.600 | ≥ 500 |

Please refer to the following test plots:



| | |
|---------------|---|
| <p>Low</p> | <p>Agilent R T</p> <p>Ch Freq 2.405 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 2.40500000 GHz</p> <p>Ref 15 dBm Atten 25 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 2.405 GHz Span 5 MHz #Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts)</p> <p>Occupied Bandwidth 2.2955 MHz</p> <p>Occ BW % Pwr 99.00 % x dB -20.00 dB</p> <p>Transmit Freq Error 54.026 kHz x dB Bandwidth 2.606 MHz</p> <p>Freq/Channel</p> <p>Center Freq 2.40500000 GHz</p> <p>Start Freq 2.40250000 GHz</p> <p>Stop Freq 2.40750000 GHz</p> <p>CF Step 500.000000 kHz Auto Man</p> <p>Freq Offset 0.00000000 Hz</p> <p>Signal Track On Off</p> <p>Scale Type Log Lin</p> |
| <p>Middle</p> | <p>Agilent R T</p> <p>Ch Freq 2.44 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 2.44000000 GHz</p> <p>Ref 15 dBm Atten 25 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 2.44 GHz Span 5 MHz #Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts)</p> <p>Occupied Bandwidth 2.3385 MHz</p> <p>Occ BW % Pwr 99.00 % x dB -20.00 dB</p> <p>Transmit Freq Error 48.670 kHz x dB Bandwidth 2.621 MHz</p> <p>Freq/Channel</p> <p>Center Freq 2.44000000 GHz</p> <p>Start Freq 2.43750000 GHz</p> <p>Stop Freq 2.44250000 GHz</p> <p>CF Step 500.000000 kHz Auto Man</p> <p>Freq Offset 0.00000000 Hz</p> <p>Signal Track On Off</p> <p>Scale Type Log Lin</p> |
| <p>High</p> | <p>Agilent R T</p> <p>Ch Freq 2.475 GHz Trig Free</p> <p>Occupied Bandwidth</p> <p>Center 2.47500000 GHz</p> <p>Ref 15 dBm Atten 25 dB</p> <p>#Peak Log 10 dB/ Offst 1 dB</p> <p>Center 2.475 GHz Span 5 MHz #Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts)</p> <p>Occupied Bandwidth 2.3183 MHz</p> <p>Occ BW % Pwr 99.00 % x dB -20.00 dB</p> <p>Transmit Freq Error 55.371 kHz x dB Bandwidth 2.600 MHz</p> <p>Freq/Channel</p> <p>Center Freq 2.47500000 GHz</p> <p>Start Freq 2.47250000 GHz</p> <p>Stop Freq 2.47750000 GHz</p> <p>CF Step 500.000000 kHz Auto Man</p> <p>Freq Offset 0.00000000 Hz</p> <p>Signal Track On Off</p> <p>Scale Type Log Lin</p> |

7. RF Output Power

7.1 Standard Applicable

According to 15.247(b)(3), for systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

7.2 Test Procedure

- a) Set the RBW \geq DTS bandwidth.
- b) Set VBW \geq 3 RBW.
- c) Set span \geq 3 RBW
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

7.3 Summary of Test Results/Plots

| Test Mode | Test Channel | Reading dBm | Output Power mW | Limit mW |
|-----------|--------------|----------------|--------------------|-------------|
| ZigBee | Low | 9.78 | 9.51 | 1000 |
| | Middle | 9.37 | 8.65 | 1000 |
| | High | 8.76 | 7.52 | 1000 |



| | |
|---------------|--|
| <p>Low</p> | |
| <p>Middle</p> | |
| <p>High</p> | |

8. Field Strength of Spurious Emissions

8.1 Standard Applicable

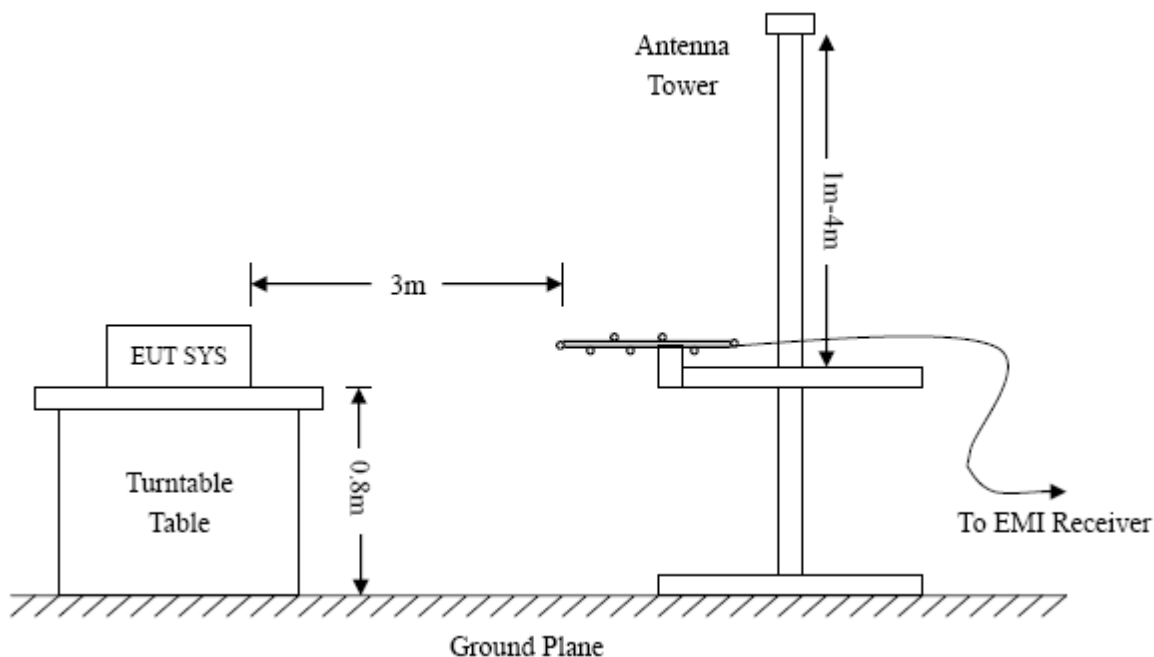
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

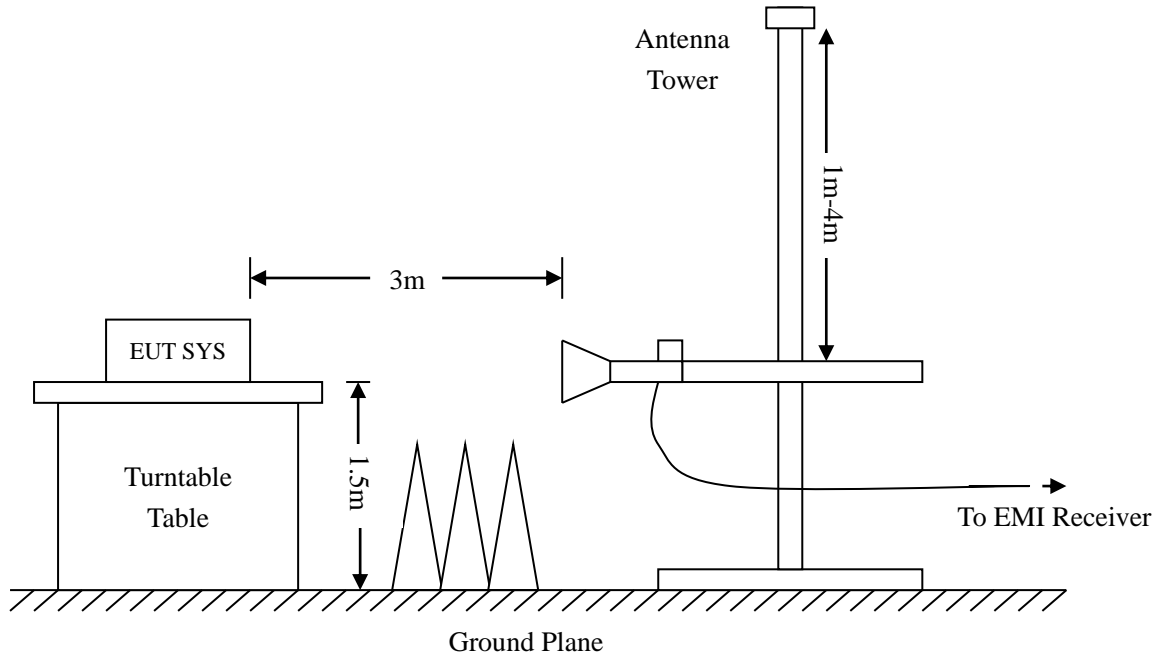
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

8.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm.





Frequency :9kHz-30MHz
 RBW=10KHz,
 VBW =30KHz
 Sweep time= Auto
 Trace = max hold
 Detector function = peak

Frequency :30MHz-1GHz
 RBW=120KHz,
 VBW=300KHz
 Sweep time= Auto
 Trace = max hold
 Detector function = peak, QP

Frequency :Above 1GHz
 RBW=1MHz,
 VBW=3MHz(Peak), 10Hz(AV)
 Sweep time= Auto
 Trace = max hold
 Detector function = peak, AV

8.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dB μ V means the emission is 6dB μ V below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

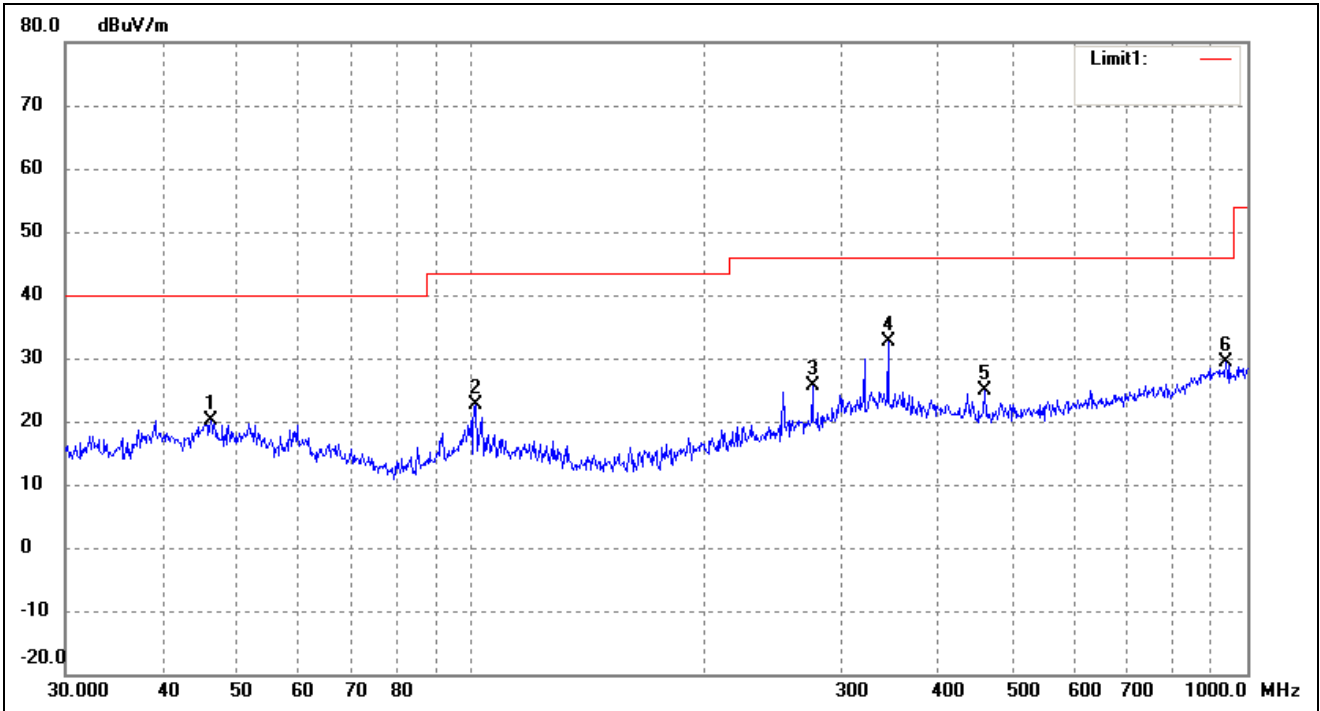
8.4 Summary of Test Results/Plots

Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.



➤ Spurious Emissions Below 1GHz

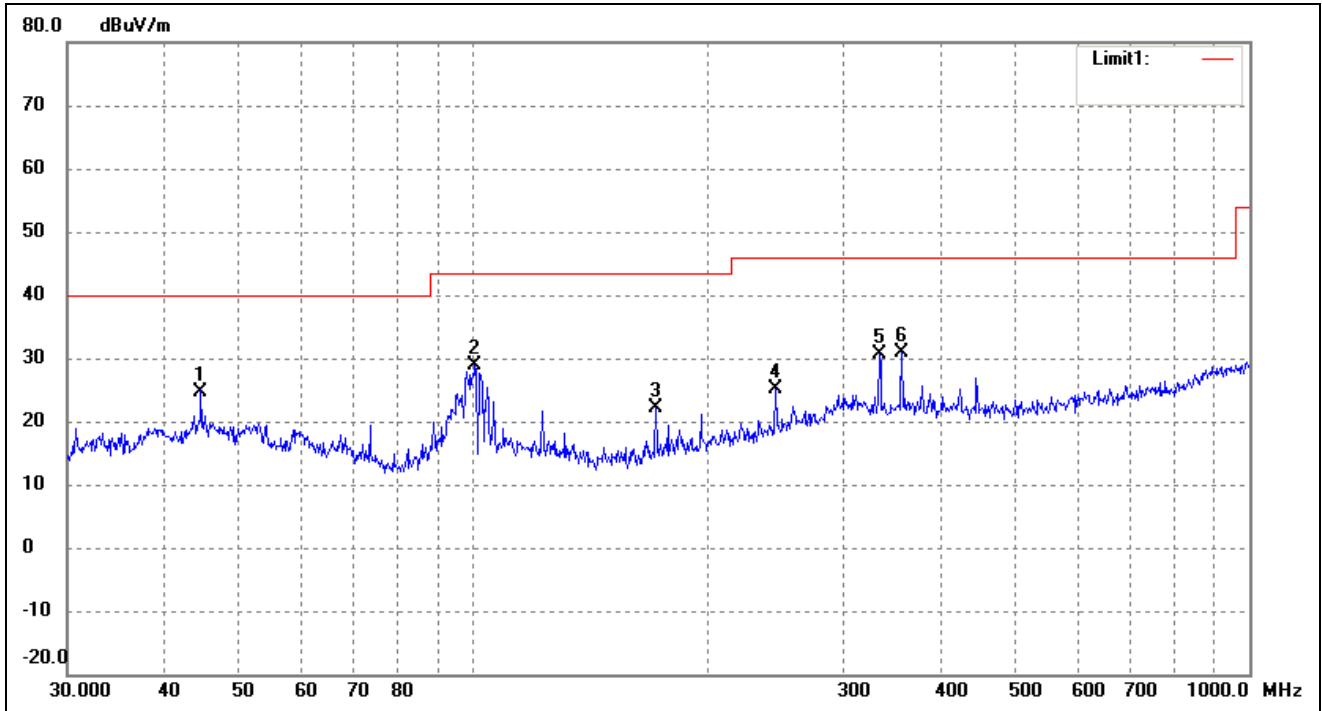
| | | | |
|--------------|-----|-----------|------------|
| Test Channel | Low | Polarity: | Horizontal |
|--------------|-----|-----------|------------|



| No. | Frequency (MHz) | Reading (dBuV/m) | Correct (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Degree () | Height (cm) | Remark |
|-----|-----------------|------------------|----------------|-----------------|----------------|-------------|------------|-------------|--------|
| 1 | 46.1780 | 34.09 | -13.86 | 20.23 | 40.00 | -19.77 | 57 | 100 | peak |
| 2 | 101.2885 | 37.50 | -14.89 | 22.61 | 43.50 | -20.89 | 94 | 100 | peak |
| 3 | 275.1570 | 35.51 | -9.98 | 25.53 | 46.00 | -20.47 | 56 | 100 | peak |
| 4 | 344.3855 | 40.35 | -7.78 | 32.57 | 46.00 | -13.43 | 115 | 100 | peak |
| 5 | 459.1144 | 32.99 | -8.19 | 24.80 | 46.00 | -21.20 | 139 | 100 | peak |
| 6 | 938.8326 | 30.34 | -0.99 | 29.35 | 46.00 | -16.65 | 156 | 100 | peak |



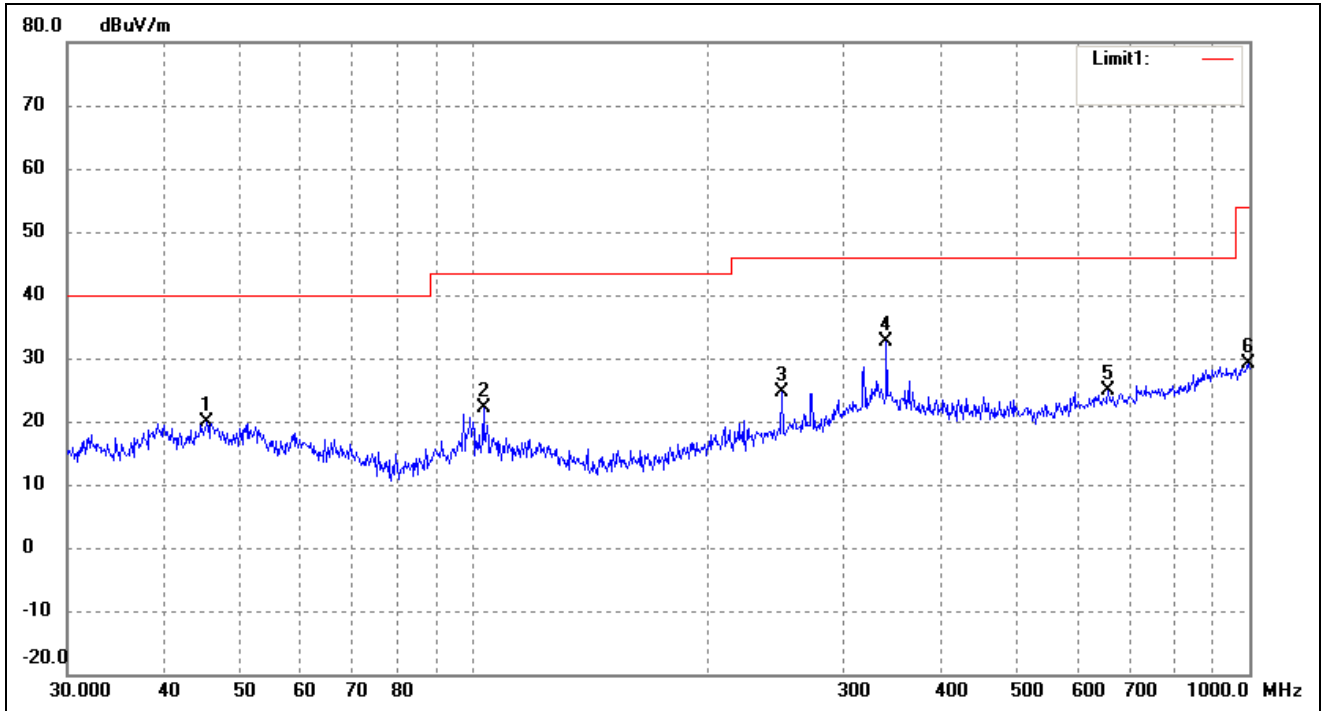
| | | | |
|--------------|-----|-----------|----------|
| Test Channel | Low | Polarity: | Vertical |
|--------------|-----|-----------|----------|



| No. | Frequency (MHz) | Reading (dBuV/m) | Correct (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Degree () | Height (cm) | Remark |
|-----|-----------------|------------------|----------------|-----------------|----------------|-------------|------------|-------------|--------|
| 1 | 44.5868 | 38.71 | -13.96 | 24.75 | 40.00 | -15.25 | 339 | 100 | peak |
| 2 | 100.5806 | 43.92 | -14.92 | 29.00 | 43.50 | -14.50 | 254 | 100 | peak |
| 3 | 171.9946 | 37.54 | -15.51 | 22.03 | 43.50 | -21.47 | 63 | 100 | peak |
| 4 | 245.0900 | 35.95 | -10.82 | 25.13 | 46.00 | -20.87 | 104 | 100 | peak |
| 5 | 333.6867 | 38.90 | -8.17 | 30.73 | 46.00 | -15.27 | 197 | 100 | peak |
| 6 | 356.6758 | 38.63 | -7.69 | 30.94 | 46.00 | -15.06 | 280 | 100 | peak |



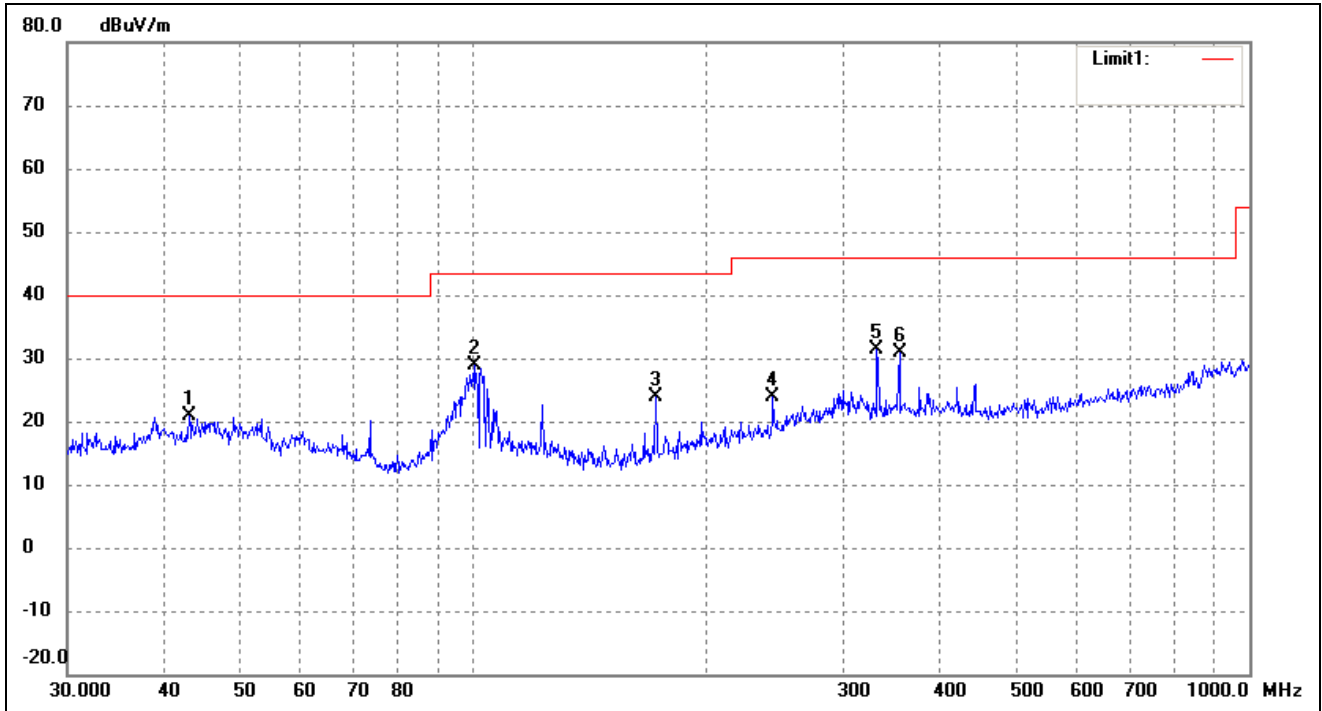
| | | | |
|--------------|--------|-----------|------------|
| Test Channel | Middle | Polarity: | Horizontal |
|--------------|--------|-----------|------------|



| No. | Frequency (MHz) | Reading (dBuV/m) | Correct (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Degree () | Height (cm) | Remark |
|-----|-----------------|------------------|----------------|-----------------|----------------|-------------|------------|-------------|--------|
| 1 | 45.3755 | 33.74 | -13.91 | 19.83 | 40.00 | -20.17 | 263 | 100 | peak |
| 2 | 103.0800 | 36.89 | -14.88 | 22.01 | 43.50 | -21.49 | 97 | 100 | peak |
| 3 | 249.4250 | 35.09 | -10.54 | 24.55 | 46.00 | -21.45 | 116 | 100 | peak |
| 4 | 340.7817 | 40.56 | -7.91 | 32.65 | 46.00 | -13.35 | 98 | 100 | peak |
| 5 | 658.8362 | 30.63 | -5.72 | 24.91 | 46.00 | -21.09 | 199 | 100 | peak |
| 6 | 996.4996 | 29.63 | -0.48 | 29.15 | 54.00 | -24.85 | 228 | 100 | peak |



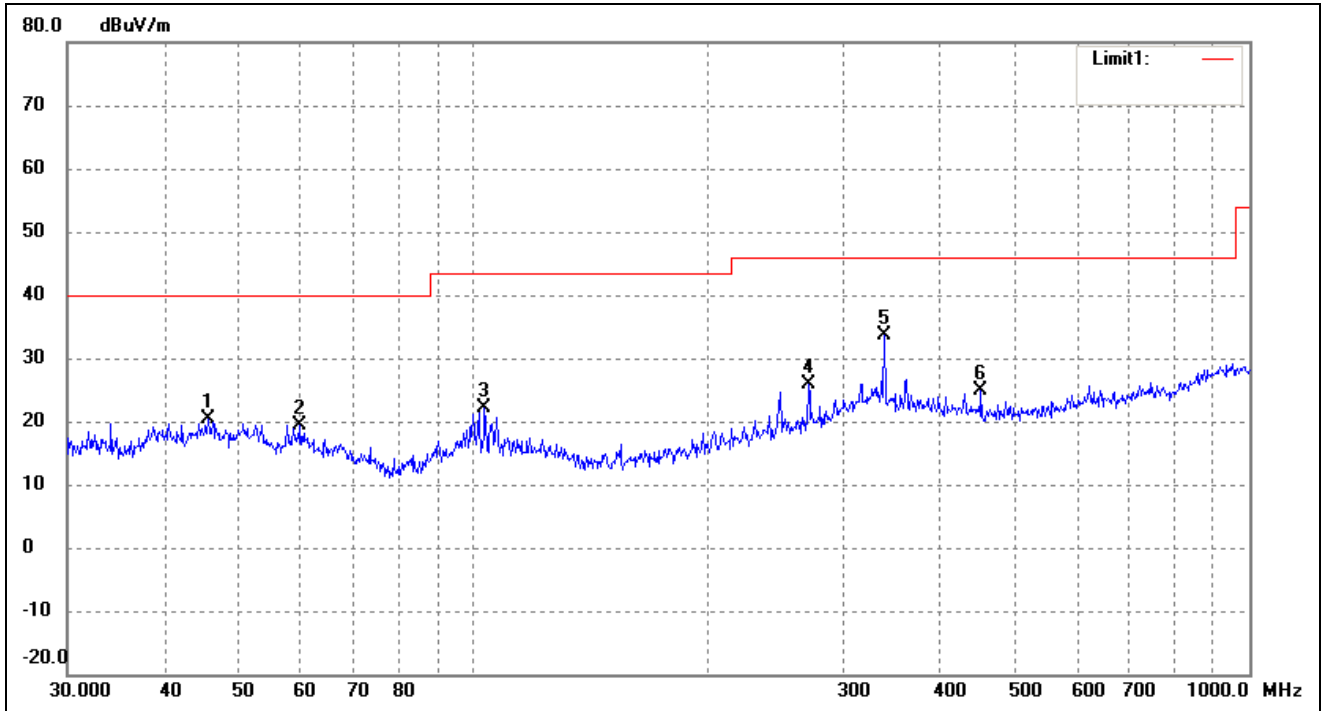
| | | | |
|--------------|--------|-----------|----------|
| Test Channel | Middle | Polarity: | Vertical |
|--------------|--------|-----------|----------|



| No. | Frequency (MHz) | Reading (dBuV/m) | Correct (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Degree () | Height (cm) | Remark |
|-----|-----------------|------------------|----------------|-----------------|----------------|-------------|------------|-------------|--------|
| 1 | 43.0505 | 34.84 | -14.02 | 20.82 | 40.00 | -19.18 | 107 | 100 | peak |
| 2 | 100.5806 | 43.84 | -14.92 | 28.92 | 43.50 | -14.58 | 265 | 100 | peak |
| 3 | 171.9946 | 39.44 | -15.51 | 23.93 | 43.50 | -19.57 | 76 | 100 | peak |
| 4 | 243.3772 | 34.69 | -10.92 | 23.77 | 46.00 | -22.23 | 210 | 100 | peak |
| 5 | 331.3547 | 39.55 | -8.26 | 31.29 | 46.00 | -14.71 | 311 | 100 | peak |
| 6 | 354.1831 | 38.57 | -7.65 | 30.92 | 46.00 | -15.08 | 171 | 100 | peak |



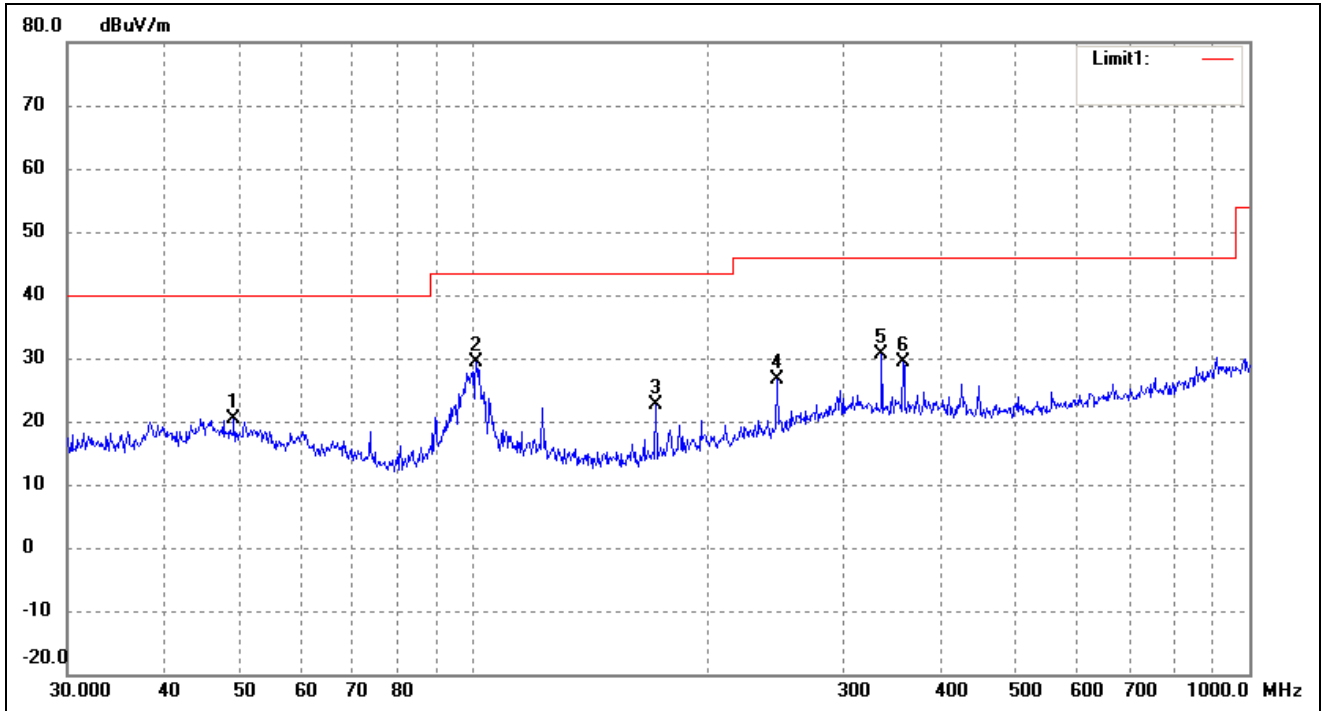
| | | | |
|--------------|------|-----------|------------|
| Test Channel | High | Polarity: | Horizontal |
|--------------|------|-----------|------------|



| No. | Frequency (MHz) | Reading (dBuV/m) | Correct (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Degree () | Height (cm) | Remark |
|-----|-----------------|------------------|----------------|-----------------|----------------|-------------|------------|-------------|--------|
| 1 | 45.5348 | 34.25 | -13.90 | 20.35 | 40.00 | -19.65 | 155 | 100 | peak |
| 2 | 59.8588 | 34.50 | -15.15 | 19.35 | 40.00 | -20.65 | 120 | 100 | peak |
| 3 | 103.4421 | 37.05 | -14.86 | 22.19 | 43.50 | -21.31 | 125 | 100 | peak |
| 4 | 270.3748 | 36.04 | -10.08 | 25.96 | 46.00 | -20.04 | 109 | 100 | peak |
| 5 | 338.4001 | 41.73 | -8.00 | 33.73 | 46.00 | -12.27 | 178 | 100 | peak |
| 6 | 451.1350 | 33.13 | -8.24 | 24.89 | 46.00 | -21.11 | 206 | 100 | peak |



| | | | |
|--------------|------|-----------|----------|
| Test Channel | High | Polarity: | Vertical |
|--------------|------|-----------|----------|



| No. | Frequency (MHz) | Reading (dBuV/m) | Correct (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Degree () | Height (cm) | Remark |
|-----|-----------------|------------------|----------------|-----------------|----------------|-------------|------------|-------------|--------|
| 1 | 49.1866 | 34.10 | -13.68 | 20.42 | 40.00 | -19.58 | 73 | 100 | peak |
| 2 | 100.9340 | 44.21 | -14.91 | 29.30 | 43.50 | -14.20 | 303 | 100 | peak |
| 3 | 171.9946 | 38.13 | -15.51 | 22.62 | 43.50 | -20.88 | 67 | 100 | peak |
| 4 | 245.9509 | 37.42 | -10.76 | 26.66 | 46.00 | -19.34 | 329 | 100 | peak |
| 5 | 336.0352 | 38.78 | -8.08 | 30.70 | 46.00 | -15.30 | 305 | 100 | peak |
| 6 | 357.9287 | 37.04 | -7.71 | 29.33 | 46.00 | -16.67 | 113 | 100 | peak |



➤ Spurious Emissions Above 1GHz

| Frequency (MHz) | Reading (dBuV/m) | Correct dB | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Polar H/V | Detector |
|------------------------|---------------------|---------------|--------------------|-------------------|----------------|--------------|----------|
| Low Channel-2405MHz | | | | | | | |
| 4810 | 66.66 | -3.53 | 63.13 | 74 | -10.87 | H | PK |
| 4810 | 48.36 | -3.53 | 44.83 | 54 | -9.17 | H | AV |
| 7215 | 56.79 | -0.50 | 56.29 | 74 | -17.71 | H | PK |
| 7215 | 41.08 | -0.50 | 40.58 | 54 | -13.42 | H | AV |
| 4810 | 65.69 | -3.53 | 62.16 | 74 | -11.84 | V | PK |
| 4810 | 43.07 | -3.53 | 39.54 | 54 | -14.46 | V | AV |
| 7215 | 59.33 | -0.50 | 58.83 | 74 | -15.17 | V | PK |
| 7215 | 43.18 | -0.50 | 42.68 | 54 | -11.32 | V | AV |
| Middle Channel-2440MHz | | | | | | | |
| 4880 | 67.03 | -3.41 | 63.62 | 74 | -10.38 | H | PK |
| 4880 | 46.99 | -3.41 | 43.58 | 54 | -10.42 | H | AV |
| 7320 | 56.00 | -0.42 | 55.58 | 74 | -18.42 | H | PK |
| 7320 | 41.67 | -0.42 | 41.25 | 54 | -12.75 | H | AV |
| 4880 | 64.39 | -3.41 | 60.98 | 74 | -13.02 | V | PK |
| 4880 | 43.69 | -3.41 | 40.28 | 54 | -13.72 | V | AV |
| 7320 | 59.81 | -0.42 | 59.39 | 74 | -14.61 | V | PK |
| 7320 | 42.43 | -0.42 | 42.01 | 54 | -11.99 | V | AV |
| High Channel-2475MHz | | | | | | | |
| 4950 | 66.88 | -3.38 | 63.50 | 74 | -10.50 | H | PK |
| 4950 | 46.15 | -3.38 | 42.77 | 54 | -11.23 | H | AV |
| 7425 | 58.53 | -0.35 | 58.18 | 74 | -15.82 | H | PK |
| 7425 | 40.05 | -0.35 | 39.70 | 54 | -14.30 | H | AV |
| 4950 | 65.04 | -3.38 | 61.66 | 74 | -12.34 | V | PK |
| 4950 | 44.43 | -3.38 | 41.05 | 54 | -12.95 | V | AV |
| 7425 | 60.64 | -0.35 | 60.29 | 74 | -13.71 | V | PK |
| 7425 | 43.91 | -0.35 | 43.56 | 54 | -10.44 | V | AV |

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

9. Out of Band Emissions

9.1 Standard Applicable

According to §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 a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

9.2 Test Procedure

According to the KDB 558074, the band-edge radiated test method as follows:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2420MHz for low bandedge, 2460MHz to 2500MHz for the high bandedge)

RBW = 1MHz, VBW = 1MHz for peak value measured

RBW = 1MHz, VBW = 10Hz for average value measured

Sweep = auto; Detector function = peak/average; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

According to the KDB 558074, the conducted spurious emissions test method as follows:

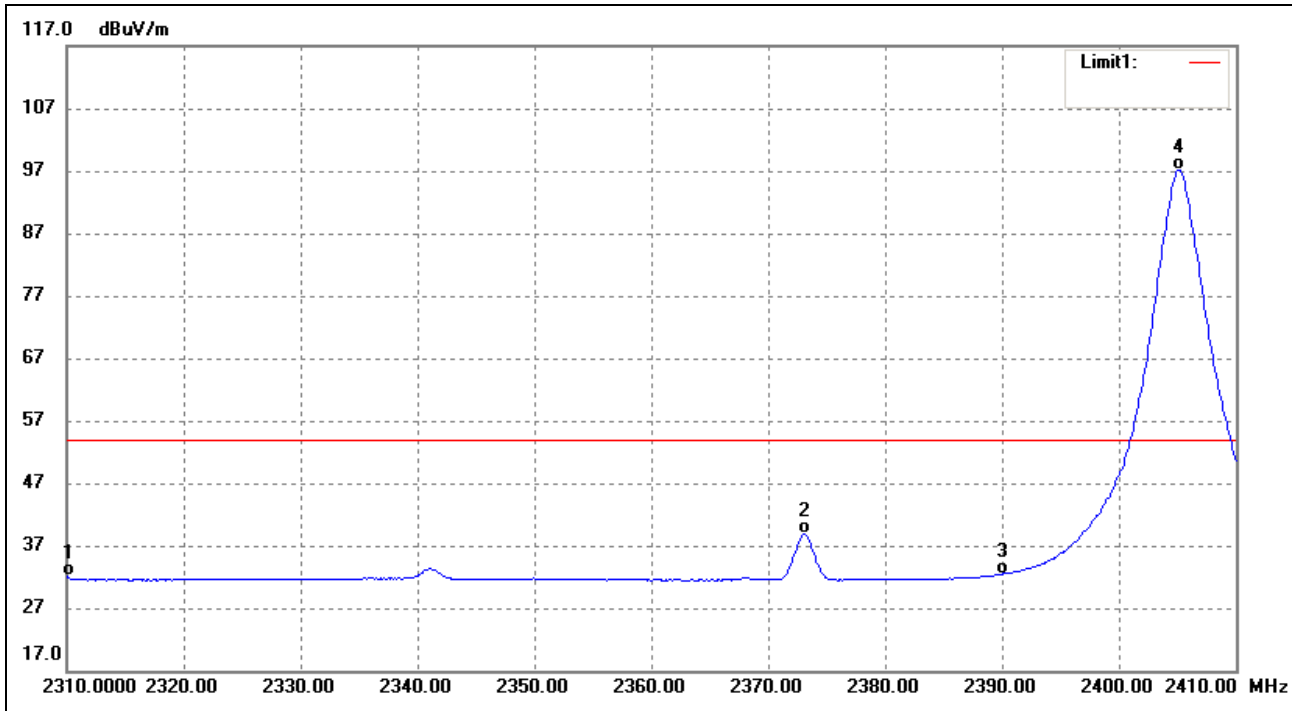
1. Set start frequency to DTS channel edge frequency.
2. Set stop frequency so as to encompass the spectrum to be examined.
3. Set RBW = 100 kHz.
4. Set VBW \geq 300 kHz.
5. Detector = peak.
6. Trace Mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize (this may take some time, depending on the extent of the span).
9. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in section 8.1. Report the three highest emissions relative to the limit.



9.3 Summary of Test Results/Plots

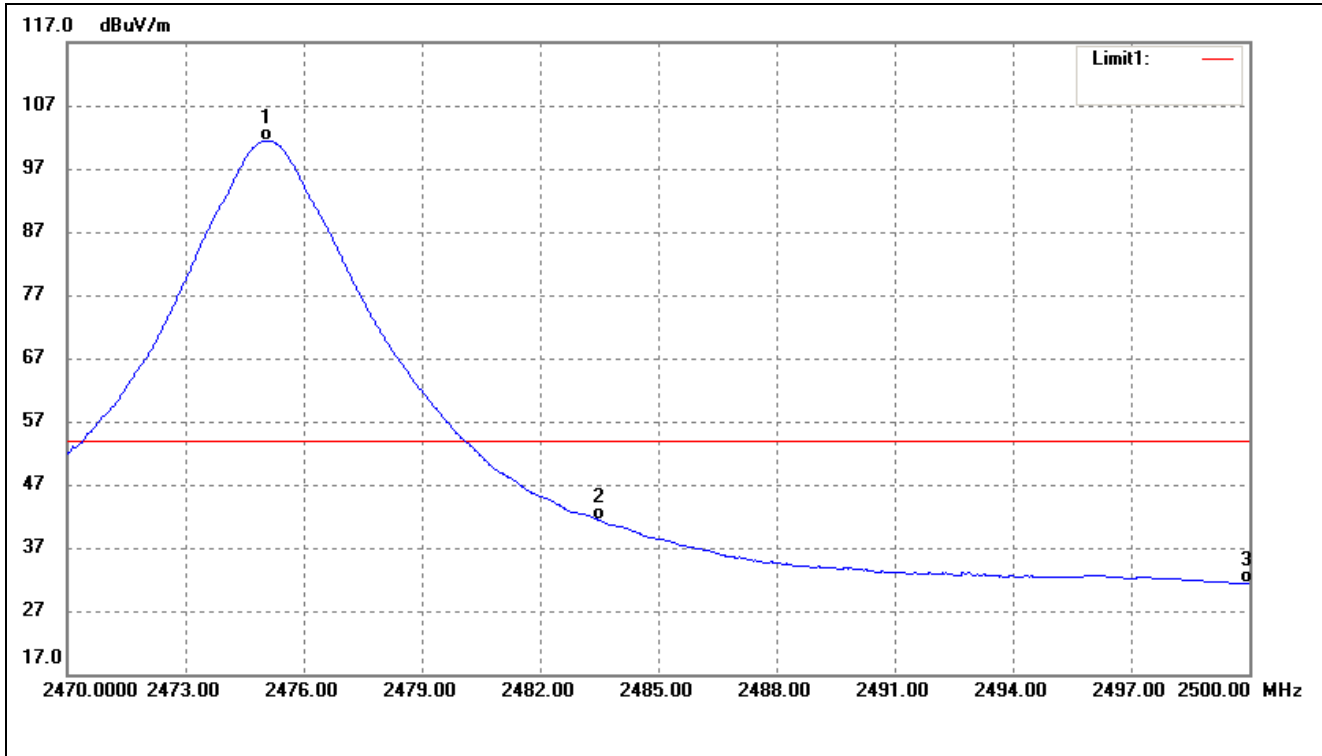
| | | | |
|--------------|-----|-----------|-------------------------|
| Test Channel | Low | Polarity: | Horizontal (worst case) |
|--------------|-----|-----------|-------------------------|



| No. | Frequency (MHz) | Reading (dBuV/m) | Correct (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|------------------|----------------|-----------------|----------------|-------------|------------------|
| 1 | 2310.000 | 41.43 | -9.66 | 31.77 | 54.00 | -22.23 | Average Detector |
| | | 54.49 | -9.66 | 44.83 | 74.00 | -29.17 | Peak Detector |
| 2 | 2373.100 | 49.38 | -9.54 | 39.84 | 54.00 | -14.16 | Average Detector |
| | | 58.32 | -9.54 | 48.78 | 74.00 | -25.22 | Peak Detector |
| 3 | 2390.000 | 42.42 | -9.50 | 32.92 | 54.00 | -21.08 | Average Detector |
| | | 56.31 | -9.50 | 46.81 | 74.00 | -27.19 | Peak Detector |
| 4 | 2405.100 | 111.62 | -9.48 | 102.14 | / | / | Average Detector |
| | | 114.02 | -9.48 | 104.54 | / | / | Peak Detector |



| | | | |
|--------------|------|-----------|-------------------------|
| Test Channel | High | Polarity: | Horizontal (worst case) |
|--------------|------|-----------|-------------------------|



| No. | Frequency (MHz) | Reading (dBuV/m) | Correct Factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|------------------|--------------------|-----------------|----------------|-------------|------------------|
| 1 | 2475.070 | 110.82 | -9.33 | 101.49 | / | / | Average Detector |
| | 2474.560 | 113.08 | -9.34 | 103.74 | / | / | Peak Detector |
| 2 | 2483.500 | 50.71 | -9.31 | 41.40 | 54.00 | -12.60 | Average Detector |
| | 2483.500 | 62.39 | -9.31 | 53.08 | 74.00 | -20.92 | Peak Detector |
| 3 | 2500.000 | 40.60 | -9.28 | 31.32 | 54.00 | -22.68 | Average Detector |
| | 2500.000 | 53.65 | -9.28 | 44.37 | 74.00 | -29.63 | Peak Detector |

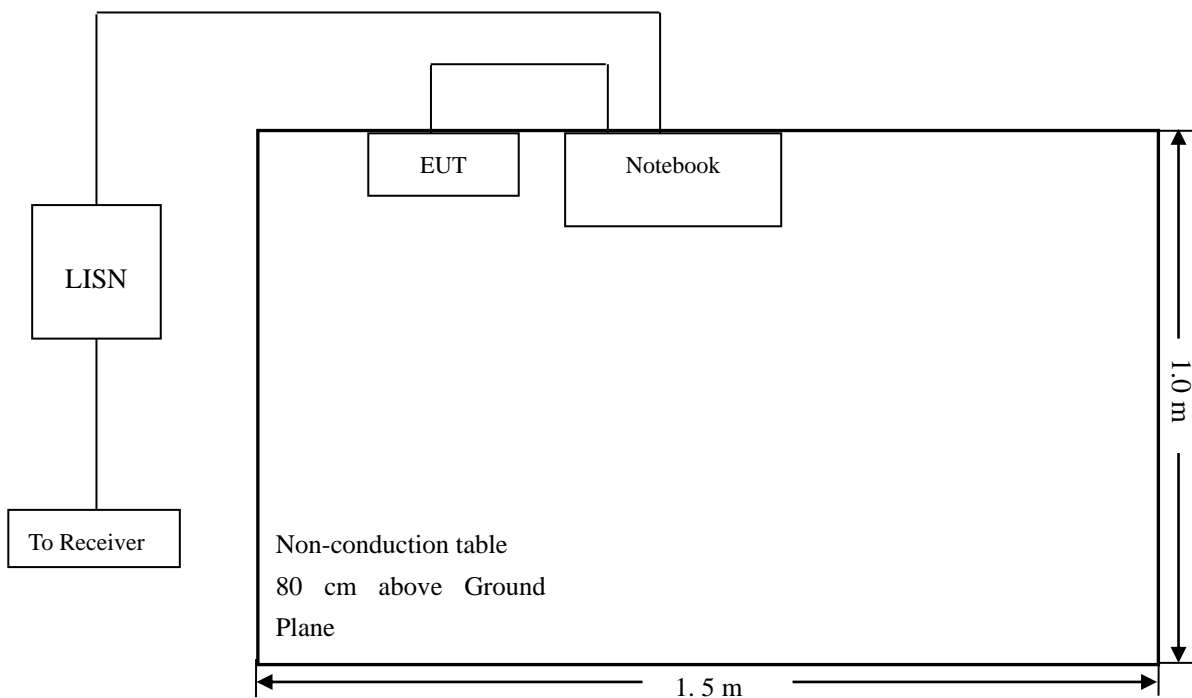
10. Conducted Emissions

10.1 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm.

10.2 Basic Test Setup Block Diagram



10.3 Test Receiver Setup

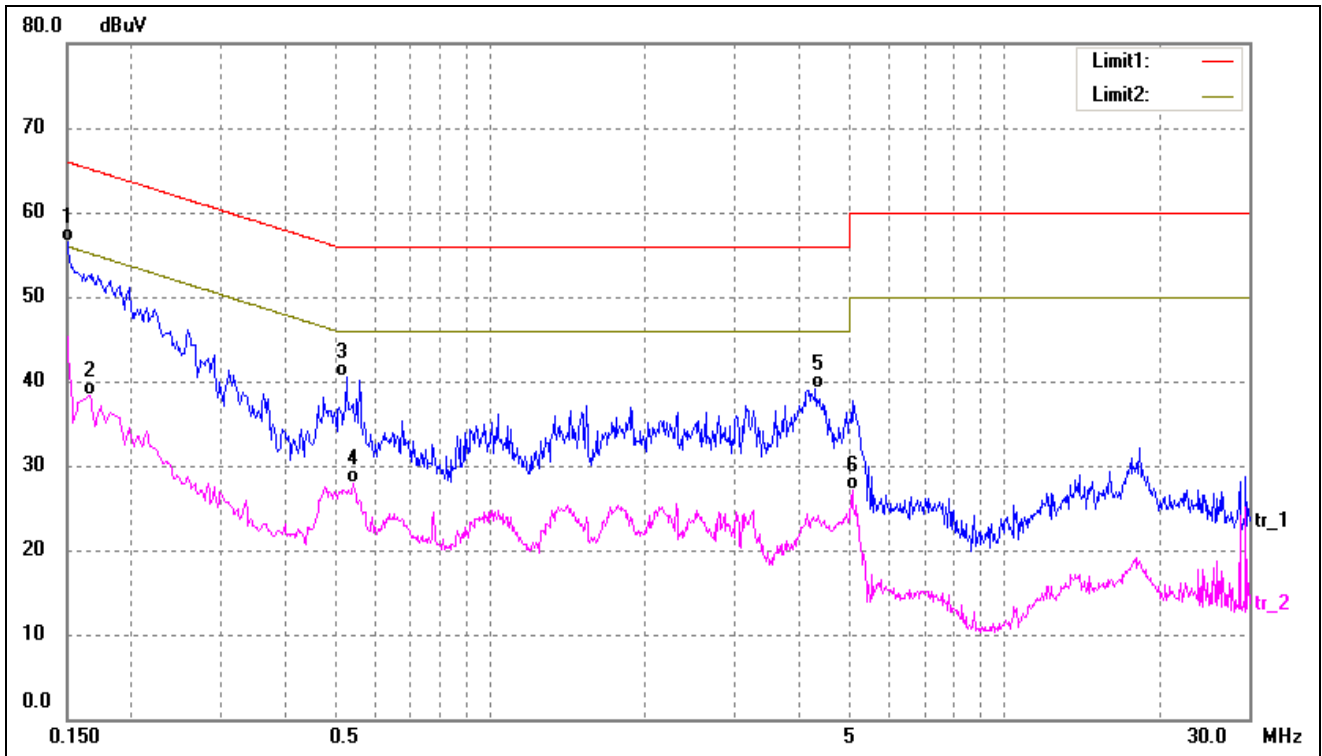
During the conducted emission test, the test receiver was set with the following configurations:

| | |
|------------------------------------|---------|
| Start Frequency | 150 kHz |
| Stop Frequency | 30 MHz |
| Sweep Speed | Auto |
| IF Bandwidth..... | 10 kHz |
| Quasi-Peak Adapter Bandwidth | 9 kHz |
| Quasi-Peak Adapter Mode | Normal |

10.4 Summary of Test Results/Plots



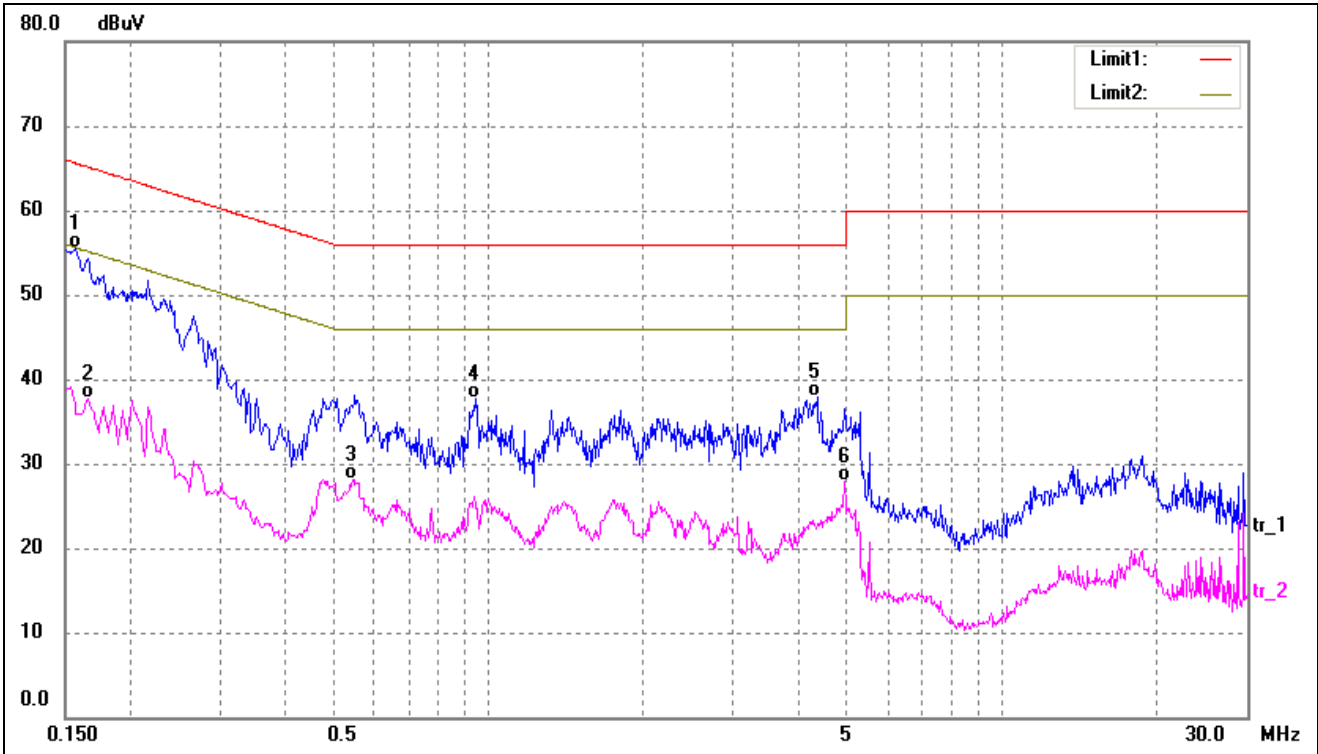
| | | | | |
|-----------|---------------|-------------|-----------|---------|
| Test Mode | Communication | AC120V 60Hz | Polarity: | Neutral |
|-----------|---------------|-------------|-----------|---------|



| No. | Frequency (MHz) | Reading (dBuV) | Correct (dB/m) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Detector |
|-----|-----------------|----------------|----------------|---------------|--------------|-------------|----------|
| 1* | 0.1500 | 46.51 | 9.95 | 56.46 | 65.99 | -9.53 | QP |
| 2 | 0.1660 | 28.39 | 9.95 | 38.34 | 55.15 | -16.81 | AVG |
| 3 | 0.5260 | 30.51 | 10.03 | 40.54 | 56.00 | -15.46 | QP |
| 4 | 0.5420 | 17.79 | 10.03 | 27.82 | 46.00 | -18.18 | AVG |
| 5 | 4.3140 | 28.80 | 10.33 | 39.13 | 56.00 | -16.87 | QP |
| 6 | 5.0739 | 16.81 | 10.39 | 27.20 | 50.00 | -22.80 | AVG |



| | | | | |
|-----------|---------------|-------------|-----------|------|
| Test Mode | Communication | AC120V 60Hz | Polarity: | Line |
|-----------|---------------|-------------|-----------|------|



| No. | Frequency (MHz) | Reading (dBuV) | Correct (dB/m) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Detector |
|-----|-----------------|----------------|----------------|---------------|--------------|-------------|----------|
| 1* | 0.1580 | 45.57 | 9.95 | 55.52 | 65.56 | -10.04 | QP |
| 2 | 0.1660 | 27.72 | 9.95 | 37.67 | 55.15 | -17.48 | AVG |
| 3 | 0.5460 | 18.17 | 10.03 | 28.20 | 46.00 | -17.80 | AVG |
| 4 | 0.9460 | 27.42 | 10.31 | 37.73 | 56.00 | -18.27 | QP |
| 5 | 4.3780 | 27.48 | 10.34 | 37.82 | 56.00 | -18.18 | QP |
| 6 | 4.9500 | 17.44 | 10.38 | 27.82 | 46.00 | -18.18 | AVG |

***** END OF REPORT *****