



**FCC 47 CFR PART 15 SUBPART C  
(Class II Permissive Change)**

**TEST REPORT**

**For**

**RFID 13.56MHz Wireless Module**

**Model: DWRFID1501**

**Trade Name: DELL**

*Issued to*

**Dell Inc.**

**One Dell Way Round Rock Texas 78682 United States**

*Issued by*

**Compliance Certification Services Inc.**

**No.11, Wugong 6th Rd., Wugu Dist.,  
New Taipei City 24891, Taiwan. (R.O.C.)**

**<http://www.ccsrf.com>**

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**Issued Date: April 22, 2015**



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**Revision History**

| Rev. |  | Issue<br>Date  |  | Revisions     | Effect<br>Page | Revised By |
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| 00   |  | April 22, 2015 |  | Initial Issue | ALL            | Doris Chu  |



## TABLE OF CONTENTS

|                                                          |           |
|----------------------------------------------------------|-----------|
| <b>1. TEST RESULT CERTIFICATION.....</b>                 | <b>4</b>  |
| <b>2. EUT DESCRIPTION .....</b>                          | <b>5</b>  |
| <b>3. TEST METHODOLOGY .....</b>                         | <b>6</b>  |
| 3.1 EUT CONFIGURATION .....                              | 6         |
| 3.2 EUT EXERCISE .....                                   | 6         |
| 3.3 GENERAL TEST PROCEDURES .....                        | 6         |
| 3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS ..... | 7         |
| 3.5 DESCRIPTION OF TEST MODES .....                      | 7         |
| <b>4. INSTRUMENT CALIBRATION.....</b>                    | <b>8</b>  |
| 4.1 MEASURING INSTRUMENT CALIBRATION .....               | 8         |
| 4.2 MEASUREMENT EQUIPMENT USED .....                     | 8         |
| 4.3 MEASUREMENT UNCERTAINTY .....                        | 9         |
| <b>5. FACILITIES AND ACCREDITATIONS .....</b>            | <b>10</b> |
| 5.1 FACILITIES .....                                     | 10        |
| 5.2 EQUIPMENT .....                                      | 10        |
| 5.3 TABLE OF ACCREDITATIONS AND LISTINGS .....           | 11        |
| <b>6. SETUP OF EQUIPMENT UNDER TEST .....</b>            | <b>12</b> |
| 6.1 SETUP CONFIGURATION OF EUT .....                     | 12        |
| 6.2 SUPPORT EQUIPMENT.....                               | 12        |
| <b>7. FCC PART 15.225 REQUIREMENTS.....</b>              | <b>13</b> |
| 7.1 20 DB BANDWIDTH .....                                | 13        |
| 7.2 RADIATED EMISSIONS .....                             | 15        |
| 7.3 FREQUENCY STABILITY .....                            | 22        |
| 7.4 POWERLINE CONDUCTED EMISSIONS .....                  | 25        |
| <b>APPENDIX I PHOTOGRAPHS OF TEST SETUP .....</b>        | <b>28</b> |
| <b>APPENDIX 1 - PHOTOGRAPHS OF EUT</b>                   |           |



## 1. TEST RESULT CERTIFICATION

**Applicant:** Dell Inc.  
One Dell Way Round Rock Texas 78682 United States

**Equipment Under Test:** RFID 13.56MHz Wireless Module

**Trade Name:** DELL

**Model:** DWRFID1501

**Date of Test:** April 17 ~ 23, 2015

| APPLICABLE STANDARDS         |                         |
|------------------------------|-------------------------|
| STANDARD                     | TEST RESULT             |
| FCC 47 CFR Part 15 Subpart C | No non-compliance noted |

### We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2009 and the energy emitted by the sample tested as described in this report is in compliance with the requirements of FCC Rules Part 15.225.

The test results of this report relate only to the tested sample identified in this report.

*Approved by:*

*Reviewed by:*

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Miller Lee  
Manager  
Compliance Certification Services Inc.

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Angel Cheng  
Section Manager  
Compliance Certification Services Inc.



## 2. EUT DESCRIPTION

|                                   |                                                                                                                                                                                              |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product</b>                    | RFID 13.56MHz Wireless Module                                                                                                                                                                |
| <b>Trade Name</b>                 | DELL                                                                                                                                                                                         |
| <b>Model Number</b>               | DWRFID1501                                                                                                                                                                                   |
| <b>Model Difference</b>           | N/A                                                                                                                                                                                          |
| <b>Received Date</b>              | April 13, 2015                                                                                                                                                                               |
| <b>Power Supply</b>               | 1. Vdc from Power Adapter<br>DELL / HA65NM130<br>I/P: 100-240VAC, 50-60Hz, 1.7A<br>O/P: 19.5VDC, 3.34A<br>2. Powered from battery<br>11.1V, 3166mAh                                          |
| <b>Frequency Range</b>            | 13.56MHz                                                                                                                                                                                     |
| <b>Modulation Technique</b>       | ASK                                                                                                                                                                                          |
| <b>Number of Channels</b>         | 1 Channel                                                                                                                                                                                    |
| <b>Antenna Designation</b>        | WNC / 81EAA215.G38<br>Loop Antenna / Gain: 0 dBi                                                                                                                                             |
| <b>Class II Permissive Change</b> | The product RFID 13.56MHz Wireless Module will be installed in the following models of notebooks/laptops: Model: P26S<br>Product name: Notebook Computer /<br>Brand name: DELL / Model: P26S |

**Remark:**

1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: **E2K-DWRFID1501** filing to comply with Section 15.225 of the FCC Part 15, Subpart C Rules.



### **3. TEST METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI C63.10:2009 and FCC CFR 47 Part 15.207, 15.209 and 15.225.

#### **3.1 EUT CONFIGURATION**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

#### **3.2 EUT EXERCISE**

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

#### **3.3 GENERAL TEST PROCEDURES**

##### **Conducted Emissions**

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in ANSI C63.10:2009. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

##### **Radiated Emissions**

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in ANSI C63.10:2009.



### 3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

- (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz                        | MHz                 | MHz             | GHz              |
|----------------------------|---------------------|-----------------|------------------|
| 0.090 - 0.110              | 16.42 - 16.423      | 399.9 - 410     | 4.5 - 5.15       |
| <sup>1</sup> 0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614       | 5.35 - 5.46      |
| 2.1735 - 2.1905            | 16.80425 - 16.80475 | 960 - 1240      | 7.25 - 7.75      |
| 4.125 - 4.128              | 25.5 - 25.67        | 1300 - 1427     | 8.025 - 8.5      |
| 4.17725 - 4.17775          | 37.5 - 38.25        | 1435 - 1626.5   | 9.0 - 9.2        |
| 4.20725 - 4.20775          | 73 - 74.6           | 1645.5 - 1646.5 | 9.3 - 9.5        |
| 6.215 - 6.218              | 74.8 - 75.2         | 1660 - 1710     | 10.6 - 12.7      |
| 6.26775 - 6.26825          | 108 - 121.94        | 1718.8 - 1722.2 | 13.25 - 13.4     |
| 6.31175 - 6.31225          | 123 - 138           | 2200 - 2300     | 14.47 - 14.5     |
| 8.291 - 8.294              | 149.9 - 150.05      | 2310 - 2390     | 15.35 - 16.2     |
| 8.362 - 8.366              | 156.52475 -         | 2483.5 - 2500   | 17.7 - 21.4      |
| 8.37625 - 8.38675          | 156.52525           | 2655 - 2900     | 22.01 - 23.12    |
| 8.41425 - 8.41475          | 156.7 - 156.9       | 3260 - 3267     | 23.6 - 24.0      |
| 12.29 - 12.293             | 162.0125 - 167.17   | 3332 - 3339     | 31.2 - 31.8      |
| 12.51975 - 12.52025        | 167.72 - 173.2      | 3345.8 - 3358   | 36.43 - 36.5     |
| 12.57675 - 12.57725        | 240 - 285           | 3600 - 4400     | ( <sup>2</sup> ) |
| 13.36 - 13.41              | 322 - 335.4         |                 |                  |

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

- (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

### 3.5 DESCRIPTION OF TEST MODES

The EUT (model: DWRFID1501) had been tested under engineering test mode condition and the EUT staying in continuous transmitting mode.



## 4. INSTRUMENT CALIBRATION

### 4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

### 4.2 MEASUREMENT EQUIPMENT USED

#### Equipment Used for Emissions Measurement

**Remark:** Each piece of equipment is scheduled for calibration once a year and Loop Antenna is scheduled for calibration once three years.

| Wugu 966 Chamber A |                    |         |               |                 |
|--------------------|--------------------|---------|---------------|-----------------|
| Name of Equipment  | Manufacturer       | Model   | Serial Number | Calibration Due |
| Spectrum Analyzer  | Agilent            | E4446A  | US42510268    | 09/18/2015      |
| EMI Test Receiver  | R&S                | ESCI    | 100064        | 05/30/2015      |
| Loop Antenna       | EMCO               | 6502    | 8905/2356     | 06/11/2015      |
| Bilog Antenna      | Sunol Sciences     | JB3     | A030105       | 08/19/2015      |
| Horn Antenna       | EMCO               | 3117    | 00055165      | 01/26/2016      |
| Turn Table         | CCS                | CC-T-1F | N/A           | N.C.R           |
| Antenna Tower      | CCS                | CC-A-1F | N/A           | N.C.R           |
| Controller         | CCS                | CC-C-1F | N/A           | N.C.R           |
| Test S/W           | EZ-EMC (CCS-3A1RE) |         |               |                 |

| Conducted Emissions Test Site   |               |           |               |                 |
|---------------------------------|---------------|-----------|---------------|-----------------|
| Name of Equipment               | Manufacturer  | Model     | Serial Number | Calibration Due |
| Spectrum Analyzer               | Agilent       | E4446A    | US42510252    | 11/23/2015      |
| Thermostatic/Hrgrosatic Chamber | TAICHY        | MHG-150LF | 930619        | 10/07/2015      |
| AC Power Source                 | EXTECH        | 6205      | 1140845       | N.C.R           |
| DC Power Supply                 | ABM           | 8301HD    | D011531       | N.C.R           |
| Power Meter                     | Anritsu       | ML2495A   | 1012009       | 06/03/2015      |
| Power Sensor                    | Anritsu       | MA2411A   | 0917072       | 06/03/2015      |
| Spectrum Analyzer               | ROHDE&SCHWARZ | FSV40     | 101073        | 07/09/2015      |

| Conducted Emission room # B |              |           |               |                 |
|-----------------------------|--------------|-----------|---------------|-----------------|
| Name of Equipment           | Manufacturer | Model     | Serial Number | Calibration Due |
| EMI Test Receiver           | R&S          | ESCI      | 101073        | 09/18/2015      |
| LISN                        | R&S          | ENV216    | 101054        | 05/18/2015      |
| LISN                        | SCHWARZBECK  | NSLK 8127 | 8127-541      | 11/25/2015      |
| Capacitive Voltage Probe    | FCC          | F-CVP-1   | 100185        | 03/12/2016      |
| Test S/W                    | CCS-3A1-CE   |           |               |                 |



#### 4.3 MEASUREMENT UNCERTAINTY

| PARAMETER                             | UNCERTAINTY |
|---------------------------------------|-------------|
| Powerline Conducted Emission          | +/- 1.2575  |
| 3M Semi Anechoic Chamber / 30M~200M   | +/- 4.0138  |
| 3M Semi Anechoic Chamber / 200M~1000M | +/- 3.9483  |
| 3M Semi Anechoic Chamber / 1G~8G      | +/- 2.5975  |
| 3M Semi Anechoic Chamber / 8G~18G     | +/- 2.6112  |
| 3M Semi Anechoic Chamber / 18G~26G    | +/- 2.7389  |
| 3M Semi Anechoic Chamber / 26G~40G    | +/- 2.9683  |

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



## **5. FACILITIES AND ACCREDITATIONS**

### **5.1 FACILITIES**

All measurement facilities used to collect the measurement data are located at

☐ No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.

Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)

Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045

☐ No.81-1, Lane 210, Bade 2nd Rd., Lujhu Township, Taoyuan County 33841,

TAIWAN, R.O.C.

Tel: 886-3-324-0332 / Fax: 886-3-324-5235

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10:2009 and CISPR Publication 22.

### **5.2 EQUIPMENT**

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, ridged waveguide, horn and/or Loop. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

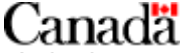
Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."



### 5.3 TABLE OF ACCREDITATIONS AND LISTINGS

| Country | Agency          | Scope of Accreditation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Logo                                                                                                              |
|---------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| USA     | FCC             | 3M Semi Anechoic Chamber (FCC MRA: TW1309) to perform FCC Part 15 measurements                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <br>FCC MRA: TW1309            |
| Taiwan  | TAF             | LP0002, RTTE01, FCC Method-47 CFR Part 15 Subpart C, D, E, RSS-210, RSS-310<br>IDA TS SRD, AS/NZS 4268, AS/NZS 4771, TS 12.1 & 12.2, ETSI EN 300 440-1, ETSI EN 300 440-2, ETSI EN 300 328, ETSI EN 300 220-1, ETSI EN 300 220-2, ETSI EN 301 893, ETSI EN 301 489-1/3/7/17<br>FCC OET Bulletin 65 + Supplement C, EN 50360, EN 50361, EN 50371, RSS 102, EN 50383, EN 50385, EN 50392, IEC 62209, CNS 14958-1, CNS 14959<br>FCC Method -47 CFR Part 15 Subpart B<br>IEC / EN 61000-3-2, IEC / EN 61000-3-3, IEC / EN 61000-4-2/3/4/5/6/8/11 | <br>Testing Laboratory<br>1309 |
| Canada  | Industry Canada | 3M Semi Anechoic Chamber (IC 2324G-1 / IC 2324G-2) to perform                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <br>IC 2324G-1<br>IC 2324G-2   |

\* No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.



## 6. SETUP OF EQUIPMENT UNDER TEST

### 6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix I for the actual connections between EUT and support equipment.

### 6.2 SUPPORT EQUIPMENT

| No. | Device Type | Brand | Model | Series No. | FCC ID | Data Cable | Power Cord |
|-----|-------------|-------|-------|------------|--------|------------|------------|
|     | N/A         |       |       |            |        |            |            |

**Remark:**

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.



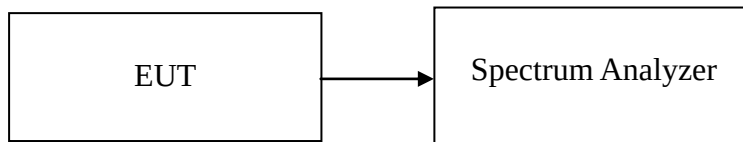
## 7. FCC PART 15.225 REQUIREMENTS

### 7.1 20 DB BANDWIDTH

#### LIMIT

None; for reporting purposes only.

#### Test Configuration



#### TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW= 5.1kHz, VBW = 10kHz, Span = 500kHz, Sweep = auto.
4. Mark the peak frequency and 20dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

#### TEST RESULTS

*No non-compliance noted.*



## Test Plot

Agilent

R T

▲ Mkr2 10.9 kHz  
0.16 dB

Ref -17 dBm

Atten 10 dB

#Peak  
Log  
10  
dB/

DI  
-83.4  
dBm

LgAv

V1 S2

Center 13.560 0 MHz

Span 500 kHz

#Res BW 3 kHz

#VBW 10 kHz

Sweep 52.72 ms (601 pts)

| Marker | Trace | Type | X Axis       | Amplitude  |
|--------|-------|------|--------------|------------|
| 1      | (1)   | Freq | 13.560 0 MHz | -63.37 dBm |
| 2R     | (1)   | Freq | 13.554 1 MHz | -82.36 dBm |
| 2Δ     | (1)   | Freq | 10.9 kHz     | 0.16 dB    |



## 7.2 RADIATED EMISSIONS

### LIMIT

According to §15.225,

- (a) The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15,848 microvolts / meter at 30 meters.
- (b) Within the bands 13.410 – 13.553 MHz and 13.567 -13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts / meter at 30 meters.
- (c) Within the bands 13.110 – 13.410 MHz and 13.710 – 14.010 MHz the field strength of any emissions shall not exceed 106 microvolts / meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110 – 14.010 MHz and shall not exceed the general radiated emission limits in §15.209.

According to §15.225, except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

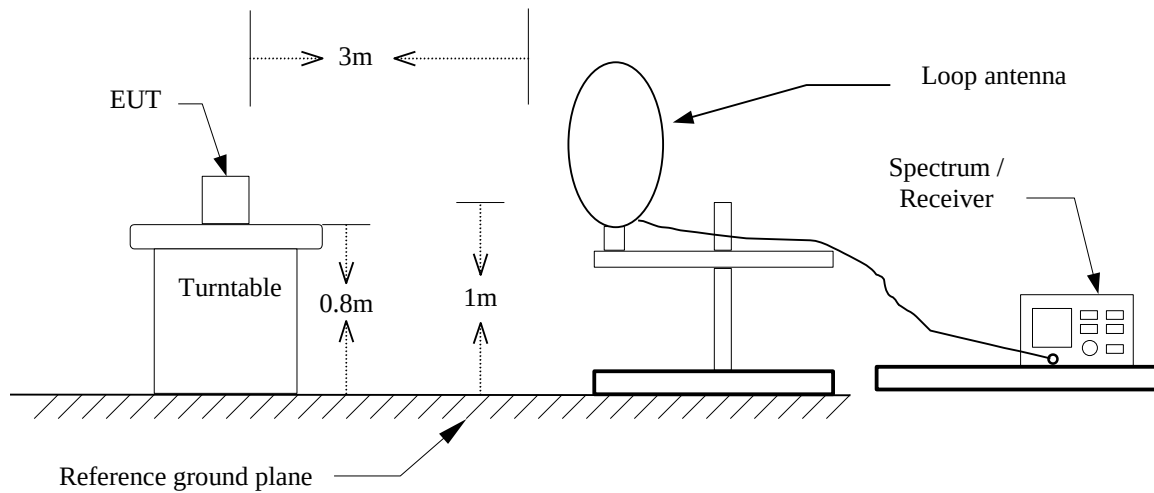
| Frequency<br>(MHz) | Field Strength<br>( $\mu$ V/m at meter) | Measurement Distance<br>(meter) |
|--------------------|-----------------------------------------|---------------------------------|
| 0.009 – 0.490      | 2400 / F (kHz)                          | 300                             |
| 0.490 – 1.705      | 24000 / F (kHz)                         | 30                              |
| 1.705 – 30.0       | 30                                      | 30                              |
| 30 - 88            | 100**                                   | 3                               |
| 88-216             | 150**                                   | 3                               |
| 216-960            | 200**                                   | 3                               |
| Above 960          | 500                                     | 3                               |

*\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.*

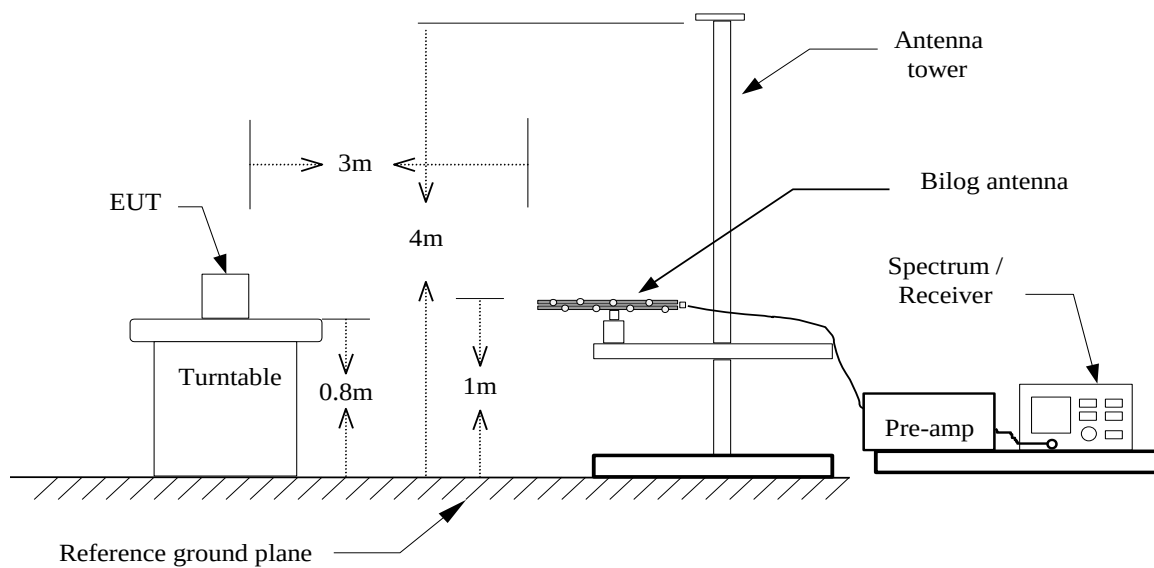


## Test Configuration

**9kHz ~ 30MHz**



**30MHz ~ 1GHz**





## **TEST PROCEDURE**

### **For 9kHz ~ 30MHz**

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, The center of the loop shall be 1 m above the ground then to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Set the spectrum analyzer in the following setting as:  
RBW=10kHz / VBW=30kHz / Sweep=AUTO
6. Repeat above procedures until the measurements for all frequencies are complete.

### **For 30MHz ~ 1GHz**

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:  
RBW=100kHz / VBW=300kHz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.



Operation Mode: TX mode

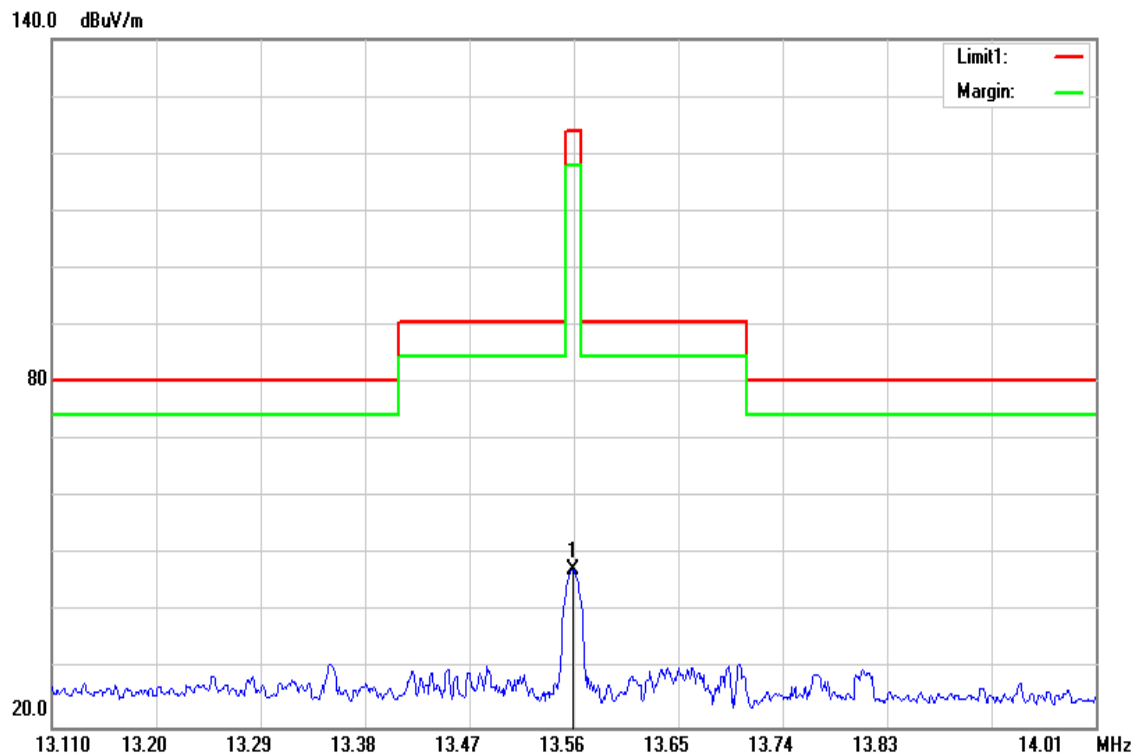
Test Date: April 17, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.



| Frequency (MHz) | Reading (dBuV) | Correction Factor (dB/m) | Result (dBuV/m) | Limit 3m (dBuV/m) | Margin (dB) | Detector Mode (PK/QP/AVG) |
|-----------------|----------------|--------------------------|-----------------|-------------------|-------------|---------------------------|
| 13.5591         | 32.75          | 14.66                    | 47.41           | 124               | -76.59      | PK                        |

**Remark:**

1. Measuring frequencies from 9kHz to the 1GHz.
2. Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.
3. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
4.  $\text{Margin (dB)} = \text{Result (dBuV/m)} - \text{Limit (dBuV/m)}$ .

**9kHz ~ 490kHz**

**Operation Mode:** TX mode                      **Test Date:** April 17, 2015  
**Temperature:** 27°C                              **Tested by:** Andy Shi  
**Humidity:** 53 % RH

| Frequency (MHz) | Reading (dBuV) | Correction Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector Mode (PK/QP/AVG) |
|-----------------|----------------|--------------------------|-----------------|----------------|-------------|---------------------------|
| 0.2221          | 45.91          | -17.27                   | 28.64           | 113.13         | -84.49      | Peak                      |
| 0.2533          | 44.75          | -17.30                   | 27.45           | 110.88         | -83.43      | Peak                      |
| 0.2880          | 42.66          | -17.31                   | 25.35           | 108.38         | -83.03      | Peak                      |
| 0.3346          | 41.95          | -17.32                   | 24.63           | 105.01         | -80.38      | Peak                      |
| 0.4049          | 40.83          | -17.33                   | 23.50           | 99.94          | -76.44      | Peak                      |
| 0.4352          | 40.37          | -17.34                   | 23.03           | 97.75          | -74.72      | Peak                      |

**Remark:**

1. Measuring frequencies from 9kHz to the 1GHz.
2. Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.
3. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
4.  $\text{Margin (dB)} = \text{Result (dBuV/m)} - \text{Limit (dBuV/m)}$ .

**490kHz ~ 30MHz**

**Operation Mode:** TX mode                      **Test Date:** April 17, 2015  
**Temperature:** 27°C                              **Tested by:** Andy Shi  
**Humidity:** 53 % RH

| Frequency (MHz) | Reading (dBuV) | Correction Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector Mode (PK/QP/AVG) |
|-----------------|----------------|--------------------------|-----------------|----------------|-------------|---------------------------|
| 4.7394          | 24.81          | -14.75                   | 10.06           | 69.50          | -59.44      | Peak                      |
| 6.9232          | 26.73          | -13.03                   | 13.70           | 69.50          | -55.80      | Peak                      |
| 10.9070         | 12.66          | -10.13                   | 2.53            | 69.50          | -66.97      | Peak                      |
| 18.7567         | 14.02          | -5.14                    | 8.88            | 69.50          | -60.62      | Peak                      |
| 22.7701         | 10.27          | -2.76                    | 7.51            | 69.50          | -61.99      | Peak                      |
| 25.3374         | 12.71          | -1.36                    | 11.35           | 69.50          | -58.15      | Peak                      |

**Remark:**

1. Measuring frequencies from 9kHz to the 1GHz.
2. Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.
3. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
4.  $\text{Margin (dB)} = \text{Result (dBuV/m)} - \text{Limit (dBuV/m)}$ .

**30MHz ~ 1GHz****Operation Mode:** TX mode**Test Date:** April 17, 2015**Temperature:** 27°C**Tested by:** Andy Shi**Humidity:** 53 % RH

| Frequency (MHz) | Reading (dBuV) | Correction Factor (dB/m) | Result (dBuV/m) | Limit 3m (dBuV/m) | Margin (dB) | Ant.Pol. (H/V) | Detector Mode (PK/QP/AVG) |
|-----------------|----------------|--------------------------|-----------------|-------------------|-------------|----------------|---------------------------|
| 120.2100        | 43.74          | -17.37                   | 26.37           | 43.50             | -17.13      | V              | Peak                      |
| 191.9900        | 41.17          | -18.26                   | 22.91           | 43.50             | -20.59      | V              | Peak                      |
| 336.5200        | 38.02          | -15.52                   | 22.50           | 46.00             | -23.50      | V              | Peak                      |
| 575.1400        | 40.13          | -10.75                   | 29.38           | 46.00             | -16.62      | V              | Peak                      |
| 732.2800        | 36.40          | -8.20                    | 28.20           | 46.00             | -17.80      | V              | Peak                      |
| 813.7600        | 34.19          | -7.21                    | 26.98           | 46.00             | -19.02      | V              | Peak                      |
| 120.2100        | 43.25          | -17.37                   | 25.88           | 43.50             | -17.62      | H              | Peak                      |
| 203.6300        | 50.29          | -17.80                   | 32.49           | 43.50             | -11.01      | H              | Peak                      |
| 321.0000        | 46.08          | -15.90                   | 30.18           | 46.00             | -15.82      | H              | Peak                      |
| 596.4800        | 36.09          | -10.54                   | 25.55           | 46.00             | -20.45      | H              | Peak                      |
| 732.2800        | 34.47          | -8.20                    | 26.27           | 46.00             | -19.73      | H              | Peak                      |
| 840.9200        | 34.66          | -6.89                    | 27.77           | 46.00             | -18.23      | H              | Peak                      |

**Remark:**

1. Measuring frequencies from 9kHz to the 1GHz.
2. Radiated emissions measured were made with an instrument using peak/quasi-peak/average detector mode.
3. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
4.  $\text{Margin (dB)} = \text{Result (dBuV/m)} - \text{Limit (dBuV/m)}$ .



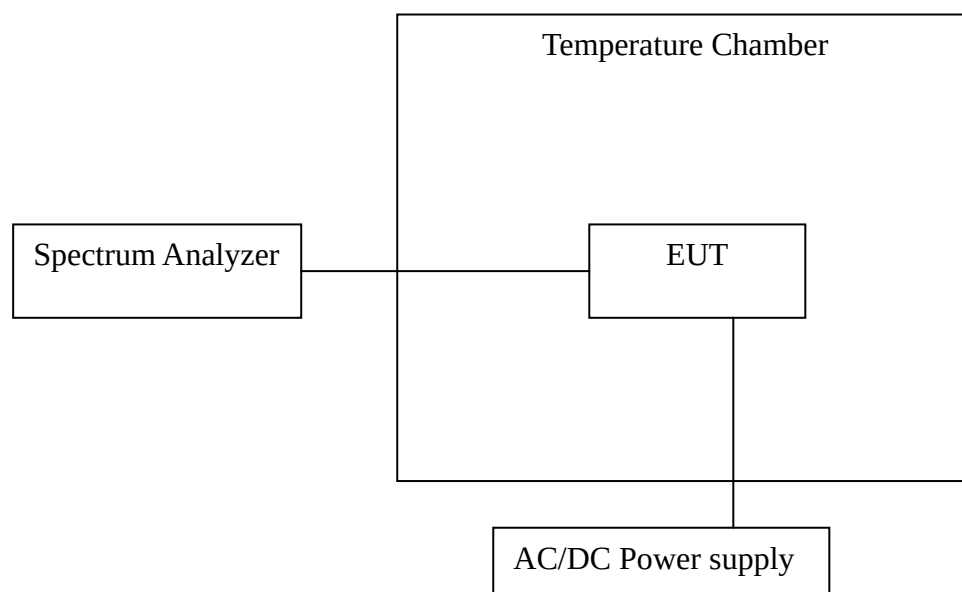
## 7.3 FREQUENCY STABILITY

### LIMIT

According to §15.225(e), the frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

### Test Configuration

#### Temperature and Voltage Measurement (under normal and extreme test conditions)



### TEST PROCEDURE

1. Turn the EUT off, and place it inside the environmental temperature chamber.
2. Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.
3. Set the spectrum analyzer as RBW=1kHz, VBW = RBW, Span = 200kHz, Sweep = auto.
4. Turn the EUT on and record the operating frequency at startup and two, five, and ten minutes after the EUT is energized.
5. Switch off the EUT and Lower the chamber temperature by not more than 10 °C and allow the temperature inside the chamber to stabilize.
6. Mark the peak frequency and measure the frequency tolerance using frequency counter function.
7. Repeat step 4 through step 6 down to the lowest specified temperature.

**TEST RESULTS***No non-compliance noted.***Temperature Variations**

| Temperature (°C) | Voltage (V) | Measured Time (m) | Measured Frequency (MHz) | Delta Frequency (Hz) | Tolerance (%) | Limit (± %) | Margin (%) | Result (Pass/Fail) |
|------------------|-------------|-------------------|--------------------------|----------------------|---------------|-------------|------------|--------------------|
| 50               | 120         | start up          | 13.56019                 | 190                  | 0.00140       | 0.01        | -0.00860   | Pass               |
|                  |             | 2                 | 13.56028                 | 280                  | 0.00206       | 0.01        | -0.00794   | Pass               |
|                  |             | 5                 | 13.56027                 | 270                  | 0.00199       | 0.01        | -0.00801   | Pass               |
|                  |             | 10                | 13.56020                 | 200                  | 0.00147       | 0.01        | -0.00853   | Pass               |
| 40               | 120         | start up          | 13.56053                 | 530                  | 0.00391       | 0.01        | -0.00609   | Pass               |
|                  |             | 2                 | 13.56054                 | 540                  | 0.00398       | 0.01        | -0.00602   | Pass               |
|                  |             | 5                 | 13.56047                 | 470                  | 0.00347       | 0.01        | -0.00653   | Pass               |
|                  |             | 10                | 13.56041                 | 410                  | 0.00302       | 0.01        | -0.00698   | Pass               |
| 30               | 120         | start up          | 13.56039                 | 390                  | 0.00288       | 0.01        | -0.00712   | Pass               |
|                  |             | 2                 | 13.56058                 | 580                  | 0.00428       | 0.01        | -0.00572   | Pass               |
|                  |             | 5                 | 13.56048                 | 480                  | 0.00354       | 0.01        | -0.00646   | Pass               |
|                  |             | 10                | 13.56028                 | 280                  | 0.00206       | 0.01        | -0.00794   | Pass               |
| 20               | 120         | start up          | 13.56040                 | 400                  | 0.00295       | 0.01        | -0.00705   | Pass               |
|                  |             | 2                 | 13.56067                 | 670                  | 0.00494       | 0.01        | -0.00506   | Pass               |
|                  |             | 5                 | 13.56042                 | 420                  | 0.00310       | 0.01        | -0.00690   | Pass               |
|                  |             | 10                | 13.56023                 | 230                  | 0.00170       | 0.01        | -0.00830   | Pass               |
| 10               | 120         | start up          | 13.56003                 | 30                   | 0.00022       | 0.01        | -0.00978   | Pass               |
|                  |             | 2                 | 13.56049                 | 490                  | 0.00361       | 0.01        | -0.00639   | Pass               |
|                  |             | 5                 | 13.56000                 | 0                    | 0.00000       | 0.01        | -0.01000   | Pass               |
|                  |             | 10                | 13.56022                 | 220                  | 0.00162       | 0.01        | -0.00838   | Pass               |
| 0                | 120         | start up          | 13.56013                 | 130                  | 0.00096       | 0.01        | -0.00904   | Pass               |
|                  |             | 2                 | 13.56047                 | 470                  | 0.00347       | 0.01        | -0.00653   | Pass               |
|                  |             | 5                 | 13.56040                 | 400                  | 0.00295       | 0.01        | -0.00705   | Pass               |
|                  |             | 10                | 13.56039                 | 390                  | 0.00288       | 0.01        | -0.00712   | Pass               |
| -10              | 120         | start up          | 13.56023                 | 230                  | 0.00170       | 0.01        | -0.00830   | Pass               |
|                  |             | 2                 | 13.56048                 | 480                  | 0.00354       | 0.01        | -0.00646   | Pass               |
|                  |             | 5                 | 13.56041                 | 410                  | 0.00302       | 0.01        | -0.00698   | Pass               |
|                  |             | 10                | 13.56062                 | 620                  | 0.00457       | 0.01        | -0.00543   | Pass               |
| -20              | 120         | start up          | 13.56007                 | 70                   | 0.00052       | 0.01        | -0.00948   | Pass               |
|                  |             | 2                 | 13.56000                 | 0                    | 0.00000       | 0.01        | -0.01000   | Pass               |
|                  |             | 5                 | 13.56015                 | 150                  | 0.00111       | 0.01        | -0.00889   | Pass               |
|                  |             | 10                | 13.56064                 | 640                  | 0.00472       | 0.01        | -0.00528   | Pass               |

**Voltage Variations**

| Temp.<br>(°C) | Voltage<br>(V) | Measured<br>Frequency<br>(MHz) | Delta<br>Frequency<br>(Hz) | Tolerance<br>(%) | Limit<br>(± %) | Margin<br>(%) | Result<br>(Pass/Fail) |
|---------------|----------------|--------------------------------|----------------------------|------------------|----------------|---------------|-----------------------|
| 20            | 102            | 13.56012                       | 120                        | 0.00088          | 0.01           | -0.00912      | Pass                  |
|               | 120            | 13.56013                       | 130                        | 0.00096          | 0.01           | -0.00904      | Pass                  |
|               | 138            | 13.56012                       | 120                        | 0.00088          | 0.01           | -0.00912      | Pass                  |



## 7.4 POWERLINE CONDUCTED EMISSIONS

### **LIMIT**

According to §15.207(a), except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency Range<br>(MHz) | Limits<br>(dB $\mu$ V) |           |
|--------------------------|------------------------|-----------|
|                          | Quasi-peak             | Average   |
| 0.15 to 0.50             | 66 to 56*              | 56 to 46* |
| 0.50 to 5                | 56                     | 46        |
| 5 to 30                  | 60                     | 50        |

\* Decreases with the logarithm of the frequency.

### **TEST PROCEDURE**

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

**TEST RESULTS**

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

**Operation Mode:** Normal Link

**Test Date:** April 23, 2015

**Temperature:** 26°C

**Tested by:** David Shu

**Humidity:** 60% RH

| Freq. (MHz) | QP Reading (dBuV) | AV Reading (dBuV) | Corr. factor (dB) | QP Result (dBuV) | AV Result (dBuV) | QP Limit (dBuV) | AV Limit (dBuV) | QP Margin (dB) | AV Margin (dB) | Note |
|-------------|-------------------|-------------------|-------------------|------------------|------------------|-----------------|-----------------|----------------|----------------|------|
| 0.2340      | 37.02             | 28.12             | 0.19              | 37.21            | 28.31            | 62.31           | 52.31           | -25.10         | -24.00         | L1   |
| 0.2580      | 31.91             | 25.98             | 0.19              | 32.10            | 26.17            | 61.50           | 51.50           | -29.40         | -25.33         | L1   |
| 0.6300      | 29.08             | 22.54             | 0.19              | 29.27            | 22.73            | 56.00           | 46.00           | -26.73         | -23.27         | L1   |
| 0.9940      | 30.82             | 23.98             | 0.20              | 31.02            | 24.18            | 56.00           | 46.00           | -24.98         | -21.82         | L1   |
| 2.2180      | 33.31             | 27.46             | 0.13              | 33.44            | 27.59            | 56.00           | 46.00           | -22.56         | -18.41         | L1   |
| 6.6980      | 26.10             | 20.30             | 0.27              | 26.37            | 20.57            | 60.00           | 50.00           | -33.63         | -29.43         | L1   |
| 0.2100      | 38.94             | 24.08             | 0.19              | 39.13            | 24.27            | 63.21           | 53.21           | -24.08         | -28.94         | L2   |
| 0.4260      | 31.56             | 18.55             | 0.19              | 31.75            | 18.74            | 57.33           | 47.33           | -25.58         | -28.59         | L2   |
| 0.8940      | 29.73             | 23.29             | 0.20              | 29.93            | 23.49            | 56.00           | 46.00           | -26.07         | -22.51         | L2   |
| 1.9100      | 31.65             | 25.24             | 0.13              | 31.78            | 25.37            | 56.00           | 46.00           | -24.22         | -20.63         | L2   |
| 2.8900      | 32.79             | 26.97             | 0.14              | 32.93            | 27.11            | 56.00           | 46.00           | -23.07         | -18.89         | L2   |
| 12.3380     | 25.49             | 18.69             | 0.49              | 25.98            | 19.18            | 60.00           | 50.00           | -34.02         | -30.82         | L2   |

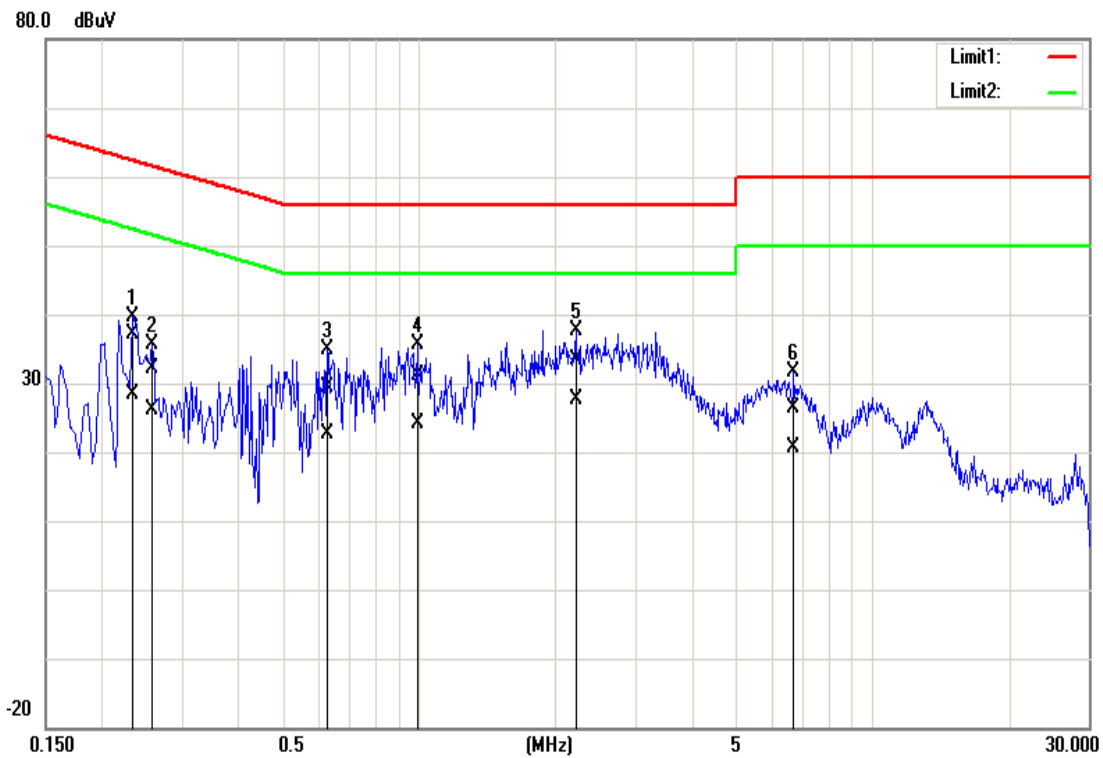
**Remark:**

1. The measuring frequencies range between 0.15 MHz and 30 MHz.
2. The emissions measured in the frequency range between 0.15 MHz and 30MHz were made with an instrument using Quasi-peak detector and Average detector.
3. The IF bandwidth of SPA between 0.15MHz and 30MHz was 10kHz. The IF bandwidth of Test Receiver between 0.15MHz and 30MHz was 9kHz.
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)
5. "-" means Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.



## Test Plots

### Conducted emissions (Line 1)



### Conducted emissions (Line 2)

