

**SK TECH CO., LTD.**

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# Certificate of Compliance

|                                                                                                                |                                                                                                                                                                                             |                                                                                                                 |                         |
|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------|
| Test Report No.:                                                                                               | SKTTRT-060526-017                                                                                                                                                                           |                                                                                                                 |                         |
| NVLAP CODE:                                                                                                    | 200220-0                                                                                                                                                                                    |                                                                                                                 |                         |
| Applicant:                                                                                                     | OptiPlus, Inc.                                                                                                                                                                              |                                                                                                                 |                         |
| Applicant Address:                                                                                             | 1112 Seonil Technopia B'd. 440 Sangdaewon dong, Jungwon gu, Seongnam city, Gyeonggi do, 462-726 Korea                                                                                       |                                                                                                                 |                         |
| Manufacturer:                                                                                                  | OptiPlus, Inc.                                                                                                                                                                              |                                                                                                                 |                         |
| Manufacturer Address:                                                                                          | 1112 Seonil Technopia B'd. 440 Sangdaewon dong, Jungwon gu, Seongnam city, Gyeonggi do, 462-726 Korea                                                                                       |                                                                                                                 |                         |
| Device Under Test:                                                                                             | Digital Audio FM Transmitter Adapter System (FM Transmitter, Audio Converter)                                                                                                               |                                                                                                                 |                         |
| FCC ID:<br>IC:                                                                                                 | R39-DFS1000T<br>6470A-DFS1000T                                                                                                                                                              | Model No.:                                                                                                      | DFS1000T<br>DFS1000R ** |
| Receipt No.:                                                                                                   | SKTEU06-0214                                                                                                                                                                                | Date of receipt:                                                                                                | April 13, 2006          |
| Date of Issue:                                                                                                 | May 26, 2006                                                                                                                                                                                |                                                                                                                 |                         |
| Location of Testing:                                                                                           | SK TECH CO., LTD.<br>820-2, Wolmoon-Ri, Wabu-Up, Namyangju-Si, Kyunggi-Do, Korea                                                                                                            |                                                                                                                 |                         |
| Test Procedure:                                                                                                | ANSI C63.4, RSS-Gen Issue 1                                                                                                                                                                 |                                                                                                                 |                         |
| Test Specification:                                                                                            | 47CFR Part 15 Rules, RSS-210 Issue 6                                                                                                                                                        |                                                                                                                 |                         |
| FCC Equipment Class:<br>IC Equipment Category:                                                                 | DXX - Part 15 Low Power Communication Device Transmitter<br>RSS-210 Issue 6: Category I Equipment, Annex 2.8                                                                                |                                                                                                                 |                         |
| Test Result:                                                                                                   | The above-mentioned device has been tested and passed.                                                                                                                                      |                                                                                                                 |                         |
| Tested & Reported by: Jong-Soo, Yoon                                                                           |                                                                                                                                                                                             | Approved by: Jae-Kyung, Bae                                                                                     |                         |
| <br>2006.05.26<br>Signature |                                                                                                                                                                                             | <br>2006.05.26<br>Signature |                         |
| Other Aspects:                                                                                                 | Certification procedure is required to FM Transmitter, Model DFS1000T. However, this report covers the measurement results for Audio Converter, Model DFS1000R, as a Class B digital device |                                                                                                                 |                         |
| Abbreviations:                                                                                                 | · OK, Pass = passed · Fail = failed · N/A = not applicable                                                                                                                                  |                                                                                                                 |                         |

- This test report is not permitted to copy partly without our permission.
- This test result is dependent on only equipment to be used.
- This test result is based on a single evaluation of one sample of the above mentioned.
- This test report must not be used to claim product endorsement by NVLAP or any agency of the U.S Government.
- We certify that this test report has been based on the measurement standards that is traceable to the national or International standards.



NVLAP Lab. Code: 200220-0



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## **1. GENERAL**

These tests were performed using the test procedure outlined in ANSI C63.4, 2003 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.239 for Low Power Communication Device Transmitter. The EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards.

We attest to the accuracy of data. All measurements reported herein were performed by SK Tech Co., Ltd. and were made under Chief Engineer's supervision.

We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

## **2. TEST SITE**

SK TECH Co., Ltd.

### **2.1 Location**

820-2, Wolmoon Ri, Wabu-Up, Namyangju-Si, Kyunggi-Do, Korea

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.

This laboratory is accredited by NVLAP for NVLAP Lab. Code: 200220-0 and DATech for DAR-Registration No.: DAT-P-076197-01



## 2.2 List of Test and Measurement Instruments

| Description                           | Manufacturer  | Model #       | Serial #    |   |
|---------------------------------------|---------------|---------------|-------------|---|
| Spectrum Analyzer                     | Agilent       | E4405B        | US40520856  | ☑ |
| EMC Spectrum Analyzer                 | Agilent       | E7405A        | US40240203  | ☑ |
| EMI Test Receiver                     | Rohde&Schwarz | ESIB40        | 100277      | ☑ |
| EMI Test Receiver                     | Rohde&Schwarz | ESVS10        | 825120/008  |   |
| EMI Test Receiver                     | Rohde&Schwarz | ESVS10        | 834468/013  |   |
| EMI Test Receiver                     | Rohde&Schwarz | ESHS10        | 835871/002  |   |
| EMI Test Receiver                     | Rohde&Schwarz | ESHS10        | 862970/019  | ☑ |
| Artificial Mains Network              | Rohde&Schwarz | ESH3-Z5       | 836679/018  | ☑ |
| Pre-amplifier                         | HP            | 8447F         | 3113A05153  | ☑ |
| Pre-amplifier                         | MITEQ         | AFS44         | 1116321     |   |
| Pre-amplifier                         | MITEQ         | AFS44         | 1116322     |   |
| Power Meter                           | Agilent       | E4418B        | US39402179  |   |
| Power Sensor                          | HP            | 8485A         | 3318A13916  |   |
| Oscilloscope                          | Agilent       | 54820A        | US40240160  |   |
| Diode detector                        | Agilent       | 8473C         | 1882A03173  |   |
| VHF Precision Dipole Antenna (TX/RX)  | Schwarzbeck   | VHAP          | 1014 / 1015 |   |
| UHF Precision Dipole Antenna (TX/RX)  | Schwarzbeck   | UHAP          | 989 / 990   |   |
| Loop Antenna                          | Schwarzbeck   | HFH2-Z2       | 863048/019  |   |
| TRILOG Broadband Antenna              | Schwarzbeck   | VULB9160      | 3141        | ☑ |
| Biconical Antenna                     | Schwarzbeck   | VHA9103       | 2265        | ☑ |
| Log-Periodic Antenna                  | Schwarzbeck   | UHALP9107     | 1819        | ☑ |
| Horn Antenna                          | AH Systems    | SAS-200/571   | 304         |   |
| Horn Antenna                          | EMCO          | 3115          | 00040723    |   |
| Horn Antenna                          | EMCO          | 3115          | 00056768    |   |
| Vector Signal Generator               | Agilent       | E4438C        | MY42080359  |   |
| PSG analog signal generator           | Agilent       | E8257D-520    | MY45141255  |   |
| DC Power Supply                       | HP            | 6634A         | 2926A-01078 |   |
| DC Power Supply                       | HP            | 6268B         | 2542A-07856 |   |
| Digital Multimeter                    | HP            | HP3458A       | 2328A14389  |   |
| PCS Interface                         | HP            | 83236B        | 3711J00881  |   |
| CDMA Mobile Test Set                  | HP            | 8924C         | US35360253  |   |
| Hygro/Thermo Graph                    | SATO          | PC-5000TRH-II | -           | ☑ |
| Temperature/Humidity Chamber          | All Three     | ATH-50M       | 20030425    |   |
| Function/Arbitrary Waveform Generator | Agilent       | 33220A        | MY44005753  | ☑ |

## 2.3 Test Date

Date of Application : April 13, 2006

Date of Test : April 18, 2006 ~ May 25, 2006

## 2.4 Test Environment

See each test item's description.



### 3. DESCRIPTION OF THE EQUIPMENT UNDER TEST

The EUT is a FM transmitter and a part of the system installed in trains. The system consists of two parts; one Audio Converter (Model DFS1000R) and FM transmitter (Model DFS1000T). The product specification described herein was obtained from product data sheet or user's manual.

#### 3.1 Rating and Physical Characteristics

|                           | Digital Audio FM Transmitter Adapter System             |                                                                                               |
|---------------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Product Name              | Audio Converter **                                      | <b>FM Transmitter</b>                                                                         |
| Model Name                | DFS1000R                                                | <b>DFS1000T</b>                                                                               |
| Intended Use              | Analog to digital converter                             | FM transmitter for broadcasting                                                               |
| Power source              | 90 - 260 VAC                                            | 90 - 260 VAC                                                                                  |
| Local Oscillator or X-Tal | 12.888 MHz                                              | 7.6 MHz                                                                                       |
| Transmit Frequency        | -                                                       | 88.1 MHz and 88.5 MHz, simultaneously transmitting at two frequencies                         |
| Antenna Type              | -                                                       | Standard BNC cable, 10 m long, shielding removed about 1 m                                    |
| Type of Modulation        | -                                                       | FM                                                                                            |
| External Ports            | Analog stereo INPUT<br>Digital Serial Audio OUTPUT (×2) | Digital Serial Audio INPUT<br>Digital Serial Audio OUTPUT<br>Antenna connector (×4, BNC type) |

**\*\* This report covers the measurement results for Model DFS1000R as a Class B digital device.**

#### 3.2 Equipment Modifications

None

#### 3.3 Submitted Documents

Block diagram

Schematic diagram

Part List

PCB Layout

User manual



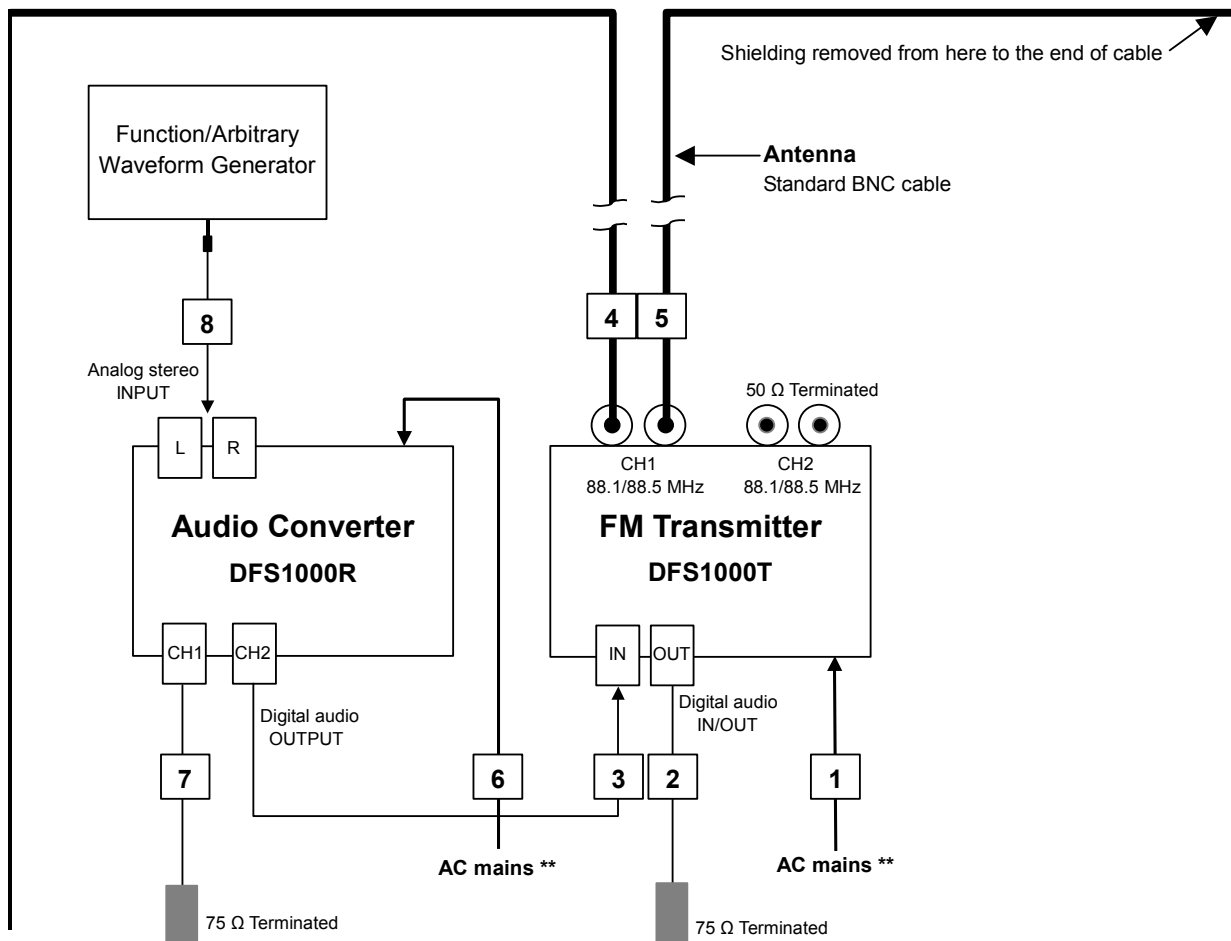
## 4. MEASUREMENT CONDITIONS

### 4.1 Description of test configuration

The EUT, FM Transmitter model DFS1000T, was configured for testing in a typical fashion.

The EUT is not a stand-alone device. The digital audio signals from the Audio Converter model DFS1000R were fed to the input terminal of the FM Transmitter.

The EUT transmitted FM modulated signals simultaneously at the operating frequencies of 88.1 MHz and 88.5 MHz once the EUT powered.



\*\* For conducted emission measurements, both tested.

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**4.2 List of Peripherals**

| Equipment Type                        | Manufacturer | Model  | S/N        |
|---------------------------------------|--------------|--------|------------|
| Function/Arbitrary Waveform Generator | Agilent      | 33220A | MY44005753 |

**4.3 Type of Used Cables**

| # | START           |                   | END                |            | Cable  |                    |
|---|-----------------|-------------------|--------------------|------------|--------|--------------------|
|   | Name            | I/O Port          | Name               | I/O Port   | Length | Shielded           |
| 1 | FM Transmitter  | AC power IN       | AC Mains           | -          | 1.5 m  | YES                |
| 2 | FM Transmitter  | Digital audio OUT | Termination        | -          | 5 m    | YES                |
| 3 | FM Transmitter  | Digital audio IN  | Audio Converter    | Audio OUT  | 4 m    | YES                |
| 4 | FM Transmitter  | ANT (88.1 MHz)    | Antenna cable      | -          | 10 m   | YES (9m) / No (1m) |
| 5 | FM Transmitter  | ANT (88.5 MHz)    | Antenna cable      | -          | 10 m   | YES (9m) / No (1m) |
| 6 | Audio Converter | AC power IN       | AC Mains           | -          | 1.5 m  | YES                |
| 7 | Audio Converter | Digital audio OUT | Termination        | -          | 5 m    | YES                |
| 8 | Audio Converter | Analog audio IN   | Function generator | Signal OUT | 1.2 m  | NO                 |

**4.4 Uncertainty**

| Measurement Item      | Combined Standard Uncertainty<br>$U_c$ | Expanded Uncertainty<br>$U = KU_c$ ( $K = 2$ ) |
|-----------------------|----------------------------------------|------------------------------------------------|
| Radiated disturbance  | $\pm 2.30$ dB                          | $\pm 4.60$ dB                                  |
| Conducted disturbance | $\pm 1.96$ dB                          | $\pm 3.92$ dB                                  |



## 5. TEST AND MEASUREMENTS

### Summary of Test Results

| Requirement                  | CFR 47 Section         | RSS Standards                     | Report Section | Test Result |
|------------------------------|------------------------|-----------------------------------|----------------|-------------|
| Antenna Requirement          | 15.203                 | RSS-Gen, 7.1.4                    | 5.1            | PASS        |
| Conducted Emissions          | 15.207(a)              | RSS-Gen, 7.2.2                    | 5.2            | PASS        |
| Occupied bandwidth           | 15.239(a)<br>15.215(c) | RSS-210, A2.8<br>RSS-Gen, 4.4.1   | 5.3            | PASS        |
| Field Strength (Fundamental) | 15.239(b)              | RSS-210, A2.8                     | 5.4            | PASS        |
| Radiated Spurious Emissions  | 15.239(c), 15.209(a)   | RSS-210, A2.8<br>RSS-210, Table 2 | 5.4            | PASS        |

### 5.1 ANTENNA REQUIREMENT

#### 5.1.1 Regulation

##### FCC 47CFR15 – 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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

##### RSS-Gen, Issue 1 - 7.1.4

A transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

#### 5.1.2 Result:

**PASS**

The transmitter uses a standard BNC antenna connector. However the transmitter and antenna should be professionally installed. See operational description document.



## 5.2 CONDUCTED EMISSIONS

### 5.2.1 Regulation

According to §15.207(a), 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 $\Omega$  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 of emission (MHz) | Conducted limit (dB $\mu$ V) |            |
|-----------------------------|------------------------------|------------|
|                             | Quasi-peak                   | Average    |
| 0.15 – 0.5                  | 66 to 56 *                   | 56 to 46 * |
| 0.5 – 5                     | 56                           | 46         |
| 5 – 30                      | 60                           | 50         |

\* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

### 5.2.2 Test Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50 $\Omega$ /50 $\mu$ H LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

**5.2.3 Test Results:****PASS****Table 1: Measured values of the Conducted Emissions (Model DFS1000T)**

| Frequency [MHz]        | Reading [dBμV] | L / N | CF [dB] | CL [dB] | Actual [dBμV] | Limit [dBμV] | Margin [dB] |
|------------------------|----------------|-------|---------|---------|---------------|--------------|-------------|
| <b>QUASI-PEAK DATA</b> |                |       |         |         |               |              |             |
| 0.195                  | 39.66          | N     | 0.12    | 0.02    | 39.80         | 63.82        | 24.02       |
| 0.260                  | 38.08          | L     | 0.13    | 0.02    | 38.23         | 61.43        | 23.20       |
| 0.325                  | 36.56          | L     | 0.13    | 0.04    | 36.73         | 59.58        | 22.85       |
| 0.395                  | 35.45          | L     | 0.13    | 0.04    | 35.62         | 57.96        | 22.34       |
| 0.460                  | 35.07          | L     | 0.13    | 0.04    | 35.24         | 56.69        | 21.45       |
| 0.525                  | 35.05          | L     | 0.13    | 0.04    | 35.22         | 56.00        | 20.78       |
| 0.590                  | 35.74          | L     | 0.13    | 0.04    | 35.91         | 56.00        | 20.09       |
| 0.655                  | 39.25          | L     | 0.14    | 0.05    | 39.44         | 56.00        | 16.56       |
| 1.535                  | 31.98          | N     | 0.14    | 0.07    | 32.19         | 56.00        | 23.81       |
| 5.085                  | 27.70          | N     | 0.21    | 0.16    | 28.07         | 60.00        | 31.93       |
| 13.670                 | 31.60          | N     | 0.51    | 0.27    | 32.38         | 60.00        | 27.62       |
|                        |                |       |         |         |               |              |             |
|                        |                |       |         |         |               |              |             |
| <b>AVERAGE DATA</b>    |                |       |         |         |               |              |             |
| 0.195                  | 37.02          | L     | 0.13    | 0.02    | 37.17         | 53.82        | 16.65       |
| 0.260                  | 36.85          | L     | 0.13    | 0.02    | 37.00         | 51.43        | 14.43       |
| 0.325                  | 35.29          | L     | 0.13    | 0.04    | 35.46         | 49.58        | 14.12       |
| 0.395                  | 34.21          | L     | 0.13    | 0.04    | 34.38         | 47.96        | 13.58       |
| 0.460                  | 33.84          | L     | 0.13    | 0.04    | 34.01         | 46.69        | 12.68       |
| 0.525                  | 33.84          | L     | 0.13    | 0.04    | 34.01         | 46.00        | 11.99       |
| 0.590                  | 34.42          | L     | 0.13    | 0.04    | 34.59         | 46.00        | 11.41       |
| 0.655                  | 37.91          | L     | 0.14    | 0.05    | 38.10         | 46.00        | 7.90        |
| 1.535                  | 26.25          | N     | 0.14    | 0.07    | 26.46         | 46.00        | 19.54       |
| 5.085                  | 23.06          | N     | 0.21    | 0.16    | 23.43         | 50.00        | 26.57       |
| 13.670                 | 22.90          | N     | 0.51    | 0.27    | 23.68         | 50.00        | 26.32       |
|                        |                |       |         |         |               |              |             |
|                        |                |       |         |         |               |              |             |
|                        |                |       |         |         |               |              |             |

**Margin (dB) = Limit – Actual****[Actual = Reading + CF + CL]**

L/N = LINE / NEUTRAL

CF/CL = Correction Factor and Cable Loss

NOTE: The frequency range was scanned from 150 kHz to 30 MHz. All emissions not reported were more than 20 dB below the specified limit.

**Table 2: Measured values of the Conducted Emissions (Model DFS1000R)**

| Frequency [MHz]        | Reading [dBμV] | L / N | CF [dB] | CL [dB] | Actual [dBμV] | Limit [dBμV] | Margin [dB] |
|------------------------|----------------|-------|---------|---------|---------------|--------------|-------------|
| <b>QUASI-PEAK DATA</b> |                |       |         |         |               |              |             |
| 0.195                  | 37.43          | N     | 0.12    | 0.02    | 37.57         | 63.82        | 26.25       |
| 0.260                  | 35.90          | N     | 0.12    | 0.02    | 36.04         | 61.43        | 25.39       |
| 0.325                  | 32.91          | N     | 0.12    | 0.04    | 33.07         | 59.58        | 26.51       |
| 0.39                   | 31.69          | N     | 0.12    | 0.04    | 31.85         | 58.06        | 26.21       |
| 0.455                  | 29.85          | N     | 0.12    | 0.04    | 30.01         | 56.78        | 26.77       |
| 0.52                   | 30.61          | L     | 0.13    | 0.04    | 30.78         | 56.00        | 25.22       |
| 0.585                  | 33.37          | L     | 0.13    | 0.04    | 33.54         | 56.00        | 22.46       |
| 0.645                  | 32.35          | L     | 0.14    | 0.05    | 32.54         | 56.00        | 23.46       |
| 0.715                  | 24.98          | L     | 0.14    | 0.05    | 25.17         | 56.00        | 30.83       |
| 1.750                  | 28.48          | L     | 0.15    | 0.07    | 28.70         | 56.00        | 27.30       |
| 2.975                  | 23.45          | N     | 0.15    | 0.11    | 23.71         | 56.00        | 32.29       |
| 3.715                  | 21.81          | N     | 0.15    | 0.11    | 22.07         | 56.00        | 33.93       |
| 5.945                  | 20.17          | N     | 0.21    | 0.16    | 20.54         | 60.00        | 39.46       |
| <b>AVERAGE DATA</b>    |                |       |         |         |               |              |             |
| 0.195                  | 33.90          | N     | 0.12    | 0.02    | 34.04         | 53.82        | 19.78       |
| 0.260                  | 32.77          | N     | 0.12    | 0.02    | 32.91         | 51.43        | 18.52       |
| 0.325                  | 30.79          | N     | 0.12    | 0.04    | 30.95         | 49.58        | 18.63       |
| 0.390                  | 28.60          | N     | 0.12    | 0.04    | 28.76         | 48.06        | 19.30       |
| 0.455                  | 28.19          | N     | 0.12    | 0.04    | 28.35         | 46.78        | 18.43       |
| 0.52                   | 29.77          | N     | 0.12    | 0.04    | 29.93         | 46.00        | 16.07       |
| 0.585                  | 30.58          | L     | 0.13    | 0.04    | 30.75         | 46.00        | 15.25       |
| 0.645                  | 29.53          | L     | 0.14    | 0.05    | 29.72         | 46.00        | 16.28       |
| 0.715                  | 20.79          | L     | 0.14    | 0.05    | 20.98         | 46.00        | 25.02       |
| 1.750                  | 20.12          | L     | 0.15    | 0.07    | 20.34         | 46.00        | 25.66       |
| 2.975                  | 21.94          | N     | 0.15    | 0.11    | 22.20         | 46.00        | 23.80       |
| 3.715                  | 20.62          | N     | 0.15    | 0.11    | 20.88         | 46.00        | 25.12       |
| 5.945                  | 18.36          | N     | 0.21    | 0.16    | 18.73         | 50.00        | 31.27       |
|                        |                |       |         |         |               |              |             |

**Margin (dB) = Limit – Actual****[Actual = Reading + CF + CL]**

L/N = LINE / NEUTRAL

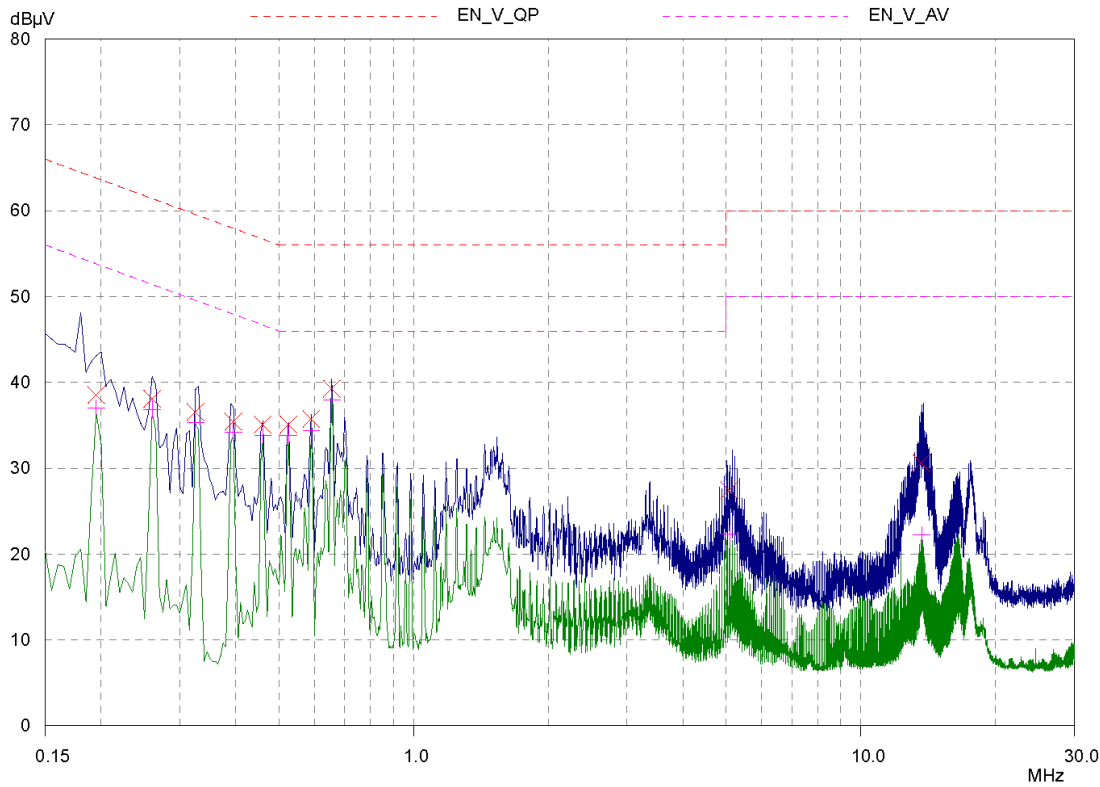
CF/CL = Correction Factor and Cable Loss

NOTE: The frequency range was scanned from 150 kHz to 30 MHz. All emissions not reported were more than 20 dB below the specified limit.



Figure 1. Plot of the Conducted Emissions (Model DFS1000T)

Line – PE



Neutral – PE

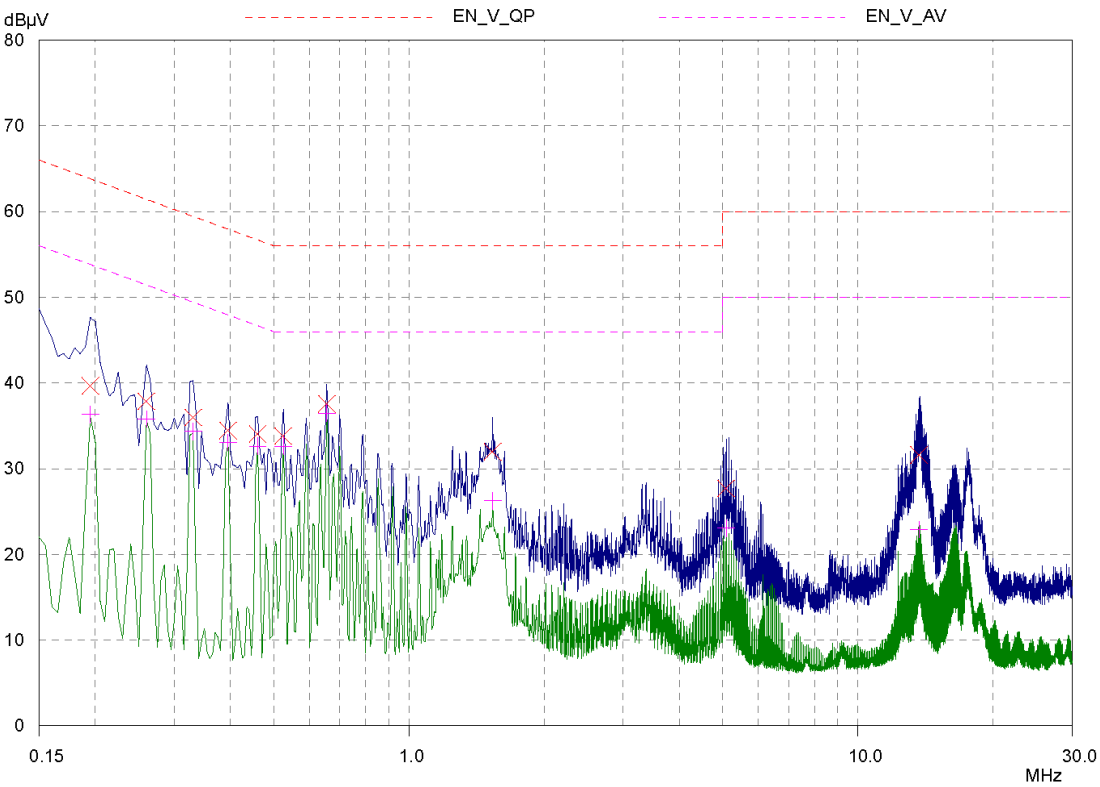
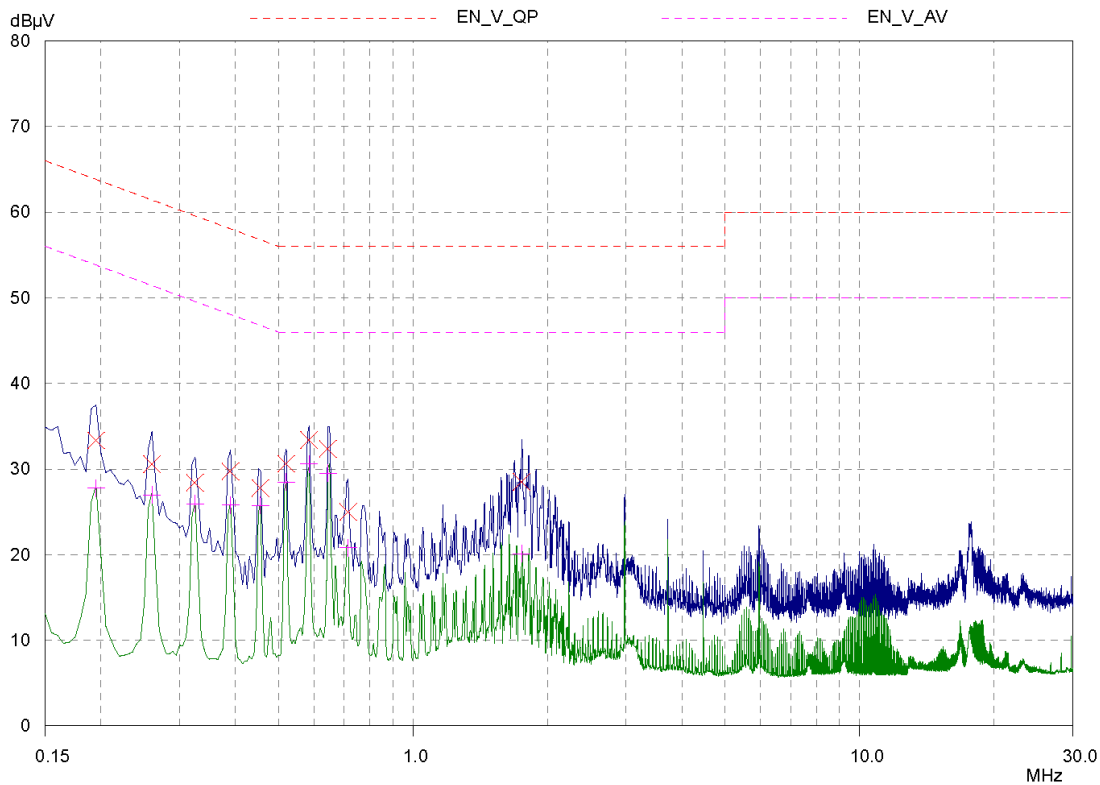


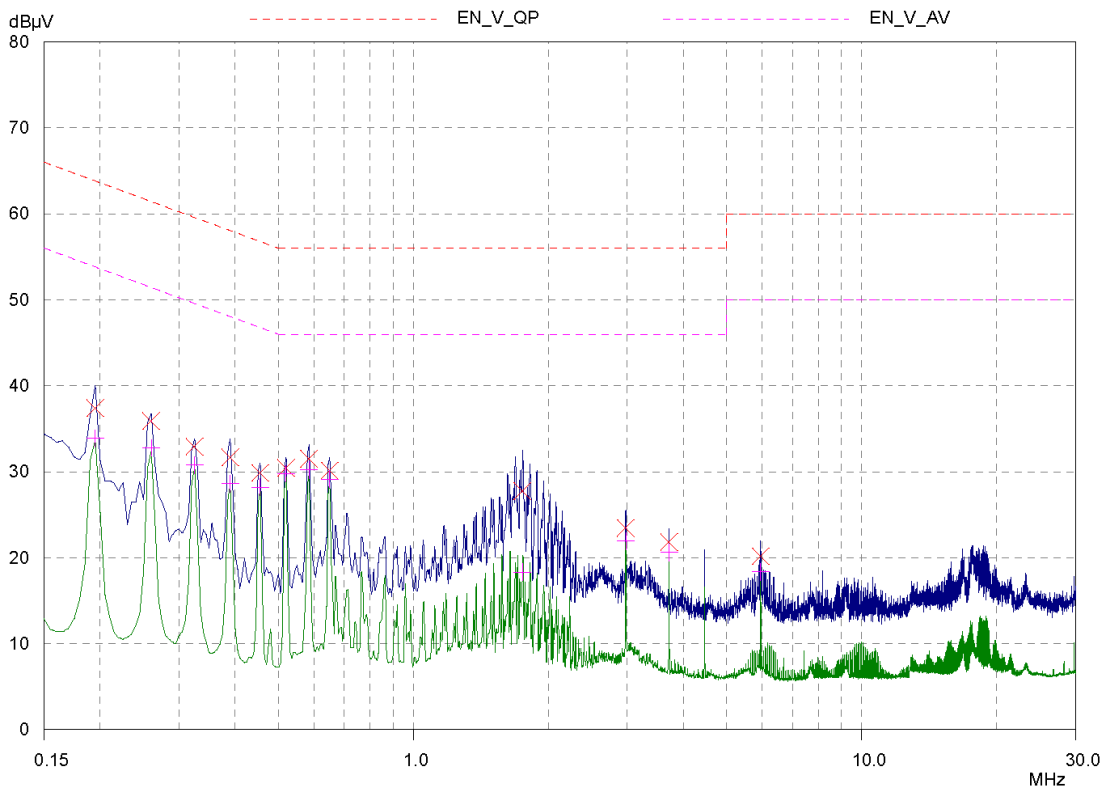


Figure 2. Plot of the Conducted Emissions (Model DFS1000R)

Line – PE



Neutral – PE





## 5.3 OCCUPIED BANDWIDTH

### 5.3.1 Regulation

FCC 47CFR15 – 15.239(a)

Emissions from the intentional radiator shall be confined within a band 200 kHz wide centered on the operating frequency. The 200 kHz band shall lie wholly within the frequency range of 88-108 MHz.

RSS-210, Issue 6 – A2.8

The occupied bandwidth shall not exceed 200 kHz.

### 5.3.2 Test Procedure

1. Connect the antenna port of the EUT to RF input on the spectrum analyzer.
2. Set the SPAN to capture all products of the modulation process, including the emission skirts.
3. Set the RBW to as close to 1% of the selected span as is possible without being below 1%.
4. Set the DETECTOR to sample where practical.  
[REMARK: the function of the PEAK HOLD was used, Sweep Count = 300 & Single]
5. Measure the 99% occupied bandwidth.
6. Repeat until all the rest channels are investigated.

Modulating signal: 1 kHz, maximum-rated input: 1 Vrms

### 5.3.3 Test Results:

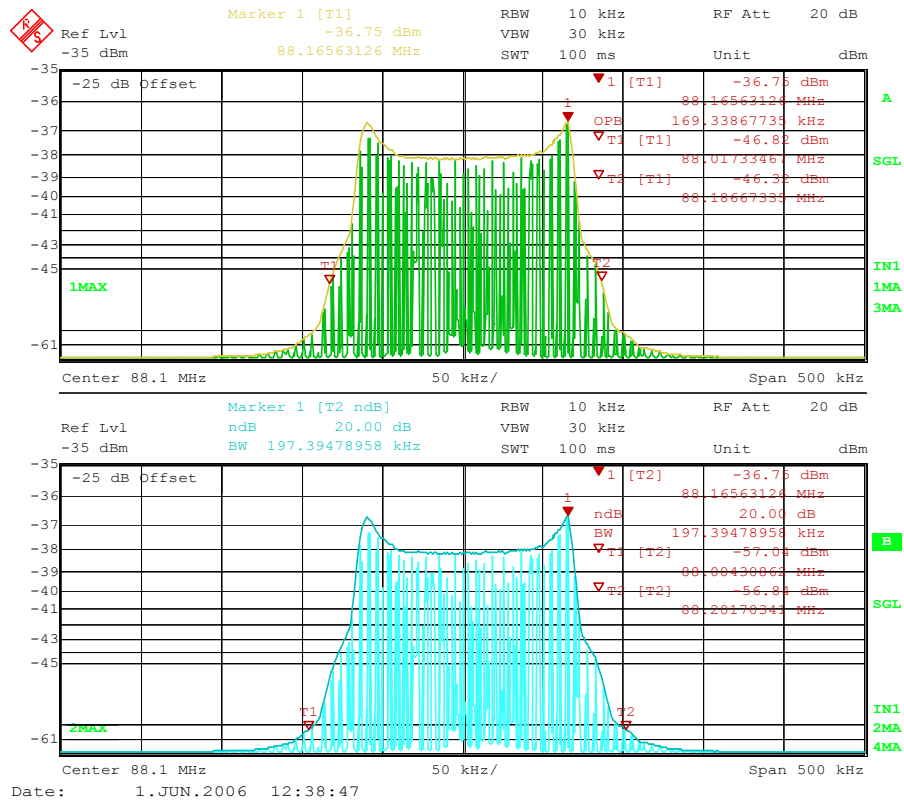
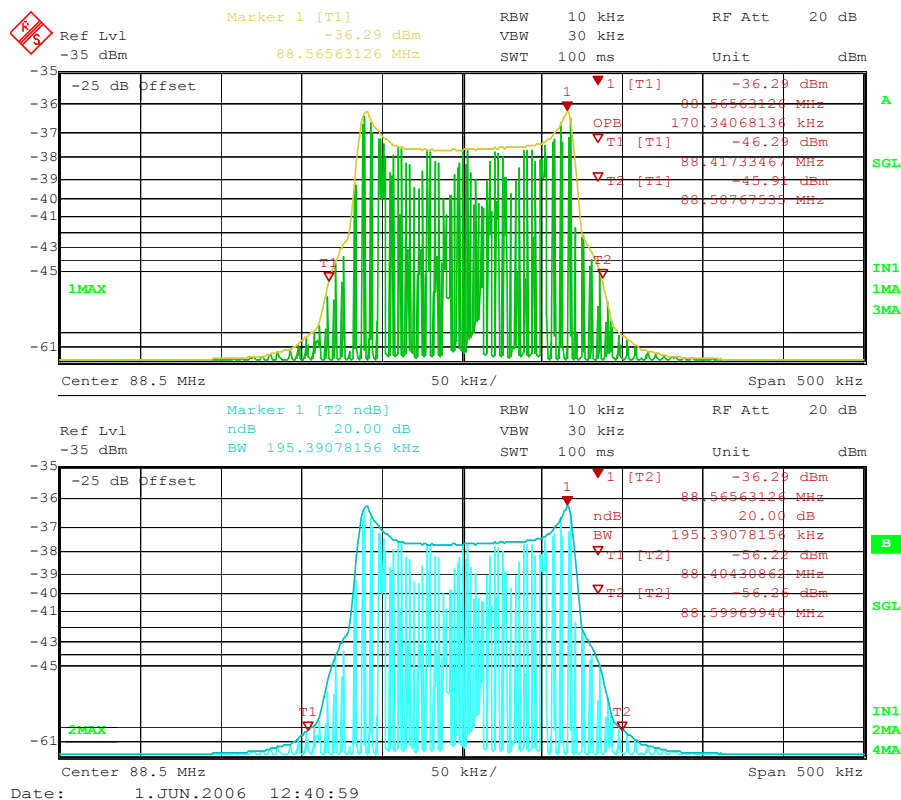
**PASS**

**Table 3: Measured values of the Occupied bandwidth**

| Center frequency (MHz) | Limit (kHz) | Measured occupied bandwidth (kHz) |         |
|------------------------|-------------|-----------------------------------|---------|
|                        |             | 99 % OBW                          | 20dB BW |
| 88.1                   | 200         | 169.34                            | 197.39  |
| 88.5                   | 200         | 170.34                            | 195.39  |

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**Figure 3: Plot of the Occupied bandwidth****Measured at the 88.1 MHz antenna port****Measured at the 88.5 MHz antenna port**



## 5.4 RADIATED EMISSIONS

### 5.4.1 Regulation

FCC 47CFR15 – 15.239(b)

The field strength of any emissions within the permitted 200 kHz band shall not exceed 250 microvolts/meter at 3 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in Section 15.35 for limiting peak emissions apply.

RSS-210, Issue 6 – A2.8

The field strength shall comply with the following:

- (1) not exceeding 250 microvolts/m measured at 3 metres with an averaging meter (equivalent to 19 nW e.i.r.p.). Any type of modulation (and carrier frequencies within the 88-108 MHz band) may be used for this category; or
- (2) not exceeding 100 microvolts/m measured at 30 metres (equivalent to 1000  $\mu$ V/m measured at 3 metres, equivalent to 300 nW e.i.r.p. ) only if the modulation is FM and the carrier frequencies are chosen from the following set: 88.1; 88.3; 88.5; 107.7; 107.9 MHz (i.e. spaced every 200 kHz).

| Fundamental frequency<br>(MHz) | Field strength of fundamental<br>( $\mu$ V/m @ 3m) | Field strength of fundamental<br>(dB $\mu$ V/m @ 3m) |
|--------------------------------|----------------------------------------------------|------------------------------------------------------|
| 88-108                         | 250                                                | 48.0                                                 |

FCC 47CFR15 – 15.239(c)

(c) The field strength of any emissions radiated on any frequency outside of the specified 200 kHz band shall not exceed the general radiated emission limits in Section 15.209.

RSS-210, Issue 6 – A2.8

Outside this 200 kHz band (as well as outside the band 88-108 MHz), Table 2 limits apply.

| Frequency<br>(MHz) | Field strength<br>( $\mu$ V/m @ 3m) | Field strength<br>(dB $\mu$ V/m @ 3m) |
|--------------------|-------------------------------------|---------------------------------------|
| 30–88              | 100                                 | 40.0                                  |
| 88–216             | 150                                 | 43.5                                  |
| 216–960            | 200                                 | 46.0                                  |
| Above 960          | 500                                 | 54.0                                  |

\*\* The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

**5.4.2 Test Procedure**

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 30 to 1000 MHz using the TRILOG broadband antenna, and from 1000 MHz to 18000 MHz using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
7. The EUT was operated in transmitting mode. The measurements were performed while transmitting 88.1 MHz and 88.5 MHz.

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**5.4.3 Test Results:****PASS****Table 4: Measured values of the Field strength**

| Frequency<br>[MHz]                                                  | Receiver<br>Bandwidth<br>[kHz] | Pol.<br>(V/H) | Antenna<br>Height<br>[m] | Table<br>Angle<br>[°] | Reading<br>[dB(μV)] | Amp<br>Gain<br>[dB] | AF / CL<br>[dB(1/m)] | Actual<br>[dB(μV/m)] | Limit<br>[dB(μV/m)] | Margin<br>[dB] |
|---------------------------------------------------------------------|--------------------------------|---------------|--------------------------|-----------------------|---------------------|---------------------|----------------------|----------------------|---------------------|----------------|
| <b>Emissions AVERAGE DATA 15.239(b) Bands</b>                       |                                |               |                          |                       |                     |                     |                      |                      |                     |                |
| 88.10                                                               | 120                            | H             | 1.81                     | 292                   | 63.4                | 28.0                | 7.9/0.8              | 44.1                 | 48.0                | 3.9            |
| 88.50                                                               | 120                            | H             | 2.00                     | 73                    | 65.7                | 28.0                | 8.2/0.8              | 46.7                 | 48.0                | 1.3            |
| <b>Emissions PEAK DATA 15.239(b) Bands</b>                          |                                |               |                          |                       |                     |                     |                      |                      |                     |                |
| 88.10                                                               | 120                            | H             | 1.81                     | 292                   | 65.5                | 28.0                | 7.9/0.8              | 46.2                 | 68.0                | 21.8           |
| 88.50                                                               | 120                            | H             | 2.00                     | 73                    | 67.4                | 28.0                | 8.2/0.8              | 48.4                 | 68.0                | 19.6           |
| <b>Emissions Quasi-peak DATA 15.209; general radiated emissions</b> |                                |               |                          |                       |                     |                     |                      |                      |                     |                |
| 73.73                                                               | 120                            | H             | 2.65                     | 30                    | 45.6                | 28.4                | 5.9/0.6              | 23.7                 | 40.0                | 16.3           |
| 193.40                                                              | 120                            | H             | 1.00                     | 270                   | 44.9                | 27.4                | 16.0/1.3             | 34.8                 | 43.5                | 8.7            |
| 273.41                                                              | 120                            | H             | 1.24                     | 311                   | 35.8                | 27.0                | 18.1/1.5             | 28.4                 | 46.0                | 17.6           |
| 279.58                                                              | 120                            | H             | 1.20                     | 36                    | 37.9                | 26.9                | 18.3/1.5             | 30.8                 | 46.0                | 15.2           |
| 353.28                                                              | 120                            | H             | 1.00                     | 188                   | 37.4                | 27.3                | 17.0/1.6             | 28.7                 | 46.0                | 17.3           |
| 359.46                                                              | 120                            | H             | 1.00                     | 183                   | 39.9                | 27.3                | 17.2/1.6             | 31.4                 | 46.0                | 14.6           |
| 365.60                                                              | 120                            | H             | 1.00                     | 184                   | 40.4                | 27.4                | 17.3/1.7             | 32.0                 | 46.0                | 14.0           |
| 380.93                                                              | 120                            | H             | 1.00                     | 327                   | 46.4                | 27.6                | 17.8/1.7             | 38.3                 | 46.0                | 7.7            |
| 405.52                                                              | 120                            | H             | 1.00                     | 48                    | 50.3                | 27.8                | 17.9/1.7             | 42.1                 | 46.0                | 3.9            |
| 430.09                                                              | 120                            | H             | 1.00                     | 55                    | 51.2                | 27.9                | 17.5/1.8             | 42.6                 | 46.0                | 3.4            |
| 451.60                                                              | 120                            | H             | 1.00                     | 22                    | 36.7                | 27.7                | 17.9/1.9             | 28.8                 | 46.0                | 17.2           |
| 457.75                                                              | 120                            | H             | 1.00                     | 13                    | 41.7                | 27.7                | 18.0/1.9             | 33.9                 | 46.0                | 12.1           |
| 464.10                                                              | 120                            | H             | 1.00                     | 184                   | 35.9                | 27.8                | 18.1/1.9             | 28.1                 | 46.0                | 17.9           |
| 602.12                                                              | 120                            | H             | 1.43                     | 42                    | 43.2                | 28.5                | 21.0/2.2             | 37.9                 | 46.0                | 8.1            |

**Margin (dB) = Limit – Actual****[Actual = Reading – Amp Gain + AF + CL]**

1. H = Horizontal, V = Vertical Polarization

2. AF/CL = Antenna Factor and Cable Loss

NOTE: The spectrum was scanned from 30 MHz to 1 GHz. All emissions not reported were more than 20 dB below the specified limit or in the noise floor.