



## Center for Quality Engineering

**Test Report No.: D12L0001**

**FCC ID: SZV-STM300C**

**IC: 5713A-STM300C**

**Order No.:** D12L

**Pages:** 26

**Munich, Aug 31, 2010**

**Client:** EnOcean GmbH

**Equipment Under Test:** Transmitter Module STM300C/TCM300C + Helix Antenna

**Manufacturer:** EnOcean GmbH

**Task:** Conformance test according to the test specifications mentioned below

**Test Specification(s):** FCC 47 CFR Part 15  
IC RSS-210

**Result:** The EUT complies with the requirements of the specification.

The results relate only to the items tested as described in this test report.

**approved by:**

**Date**

**Signature**

Neuhäusler  
Lab Manager Wireless & Software

Aug 31, 2010

Gabel  
Qualification Engineer

Aug 31, 2010

This document was signed electronically.

## CONTENTS

|                                                                                                   |           |
|---------------------------------------------------------------------------------------------------|-----------|
| <b>1 Summary .....</b>                                                                            | <b>4</b>  |
| <b>2 References .....</b>                                                                         | <b>5</b>  |
| 2.1 Specifications .....                                                                          | 5         |
| 2.2 Glossary of Terms .....                                                                       | 5         |
| <b>3 General Information .....</b>                                                                | <b>6</b>  |
| 3.1 Identification of Client .....                                                                | 6         |
| 3.2 Test Laboratory .....                                                                         | 6         |
| 3.3 Time Schedule .....                                                                           | 6         |
| 3.4 Participants .....                                                                            | 6         |
| <b>4 Equipment Under Test .....</b>                                                               | <b>7</b>  |
| 4.1 Description of EUT .....                                                                      | 7         |
| 4.2 Configuration of EUT .....                                                                    | 8         |
| 4.3 Operating Conditions .....                                                                    | 9         |
| 4.4 Compliance Criteria .....                                                                     | 9         |
| <b>5 General Description of Tests .....</b>                                                       | <b>10</b> |
| 5.1 Tested Carrier Frequencies .....                                                              | 10        |
| 5.2 Calibration of the Test Equipment .....                                                       | 10        |
| <b>6 Test Results .....</b>                                                                       | <b>11</b> |
| 6.1 Test No. 1: Conducted Emissions ([1] § 15.207) .....                                          | 11        |
| 6.2 Test No. 2: Field strength correction for pulse operation (Duty Cycle) ([1] § 15.35(c)) ..... | 11        |
| 6.2.1 Purpose .....                                                                               | 11        |
| 6.2.2 Limits .....                                                                                | 11        |
| 6.2.3 EUT Operating Condition .....                                                               | 11        |
| 6.2.4 Test Configuration .....                                                                    | 11        |
| 6.2.5 Test Procedure and Results .....                                                            | 12        |
| 6.2.6 Test Protocol .....                                                                         | 12        |
| 6.3 Test No. 3: Field strength of the fundamental wave ([1] § 15.231(b), [3] A1.1.2) .....        | 14        |
| 6.3.1 Purpose .....                                                                               | 14        |
| 6.3.2 Limits .....                                                                                | 14        |
| 6.3.3 EUT Operating Condition .....                                                               | 14        |
| 6.3.4 Test Configuration .....                                                                    | 14        |
| 6.3.5 Test Procedure and Results .....                                                            | 15        |
| 6.3.6 Test Protocol .....                                                                         | 15        |
| 6.4 Test No. 4: Radiated Emissions (9kHz – 30MHz) ([1] § 15.209; [3] T1, 3) .....                 | 16        |
| 6.4.1 Purpose .....                                                                               | 16        |

|                                                                                           |           |
|-------------------------------------------------------------------------------------------|-----------|
| 6.4.2 Limits .....                                                                        | 16        |
| 6.4.3 EUT Operating Condition .....                                                       | 16        |
| 6.4.4 Test Configuration .....                                                            | 17        |
| 6.4.5 Test Procedure and Results .....                                                    | 17        |
| 6.4.6 Test Protocol .....                                                                 | 18        |
| 6.5 Test No. 5: Radiated Emissions (30MHz – 1GHz) ([1] § 15.209, 231(b); [3] T1, 2) ..... | 19        |
| 6.5.1 Purpose .....                                                                       | 19        |
| 6.5.2 Limits .....                                                                        | 19        |
| 6.5.3 EUT Operating Condition .....                                                       | 20        |
| 6.5.4 Test Configuration .....                                                            | 20        |
| 6.5.5 Test Procedure and Results .....                                                    | 20        |
| 6.5.6 Test Protocol .....                                                                 | 20        |
| 6.6 Test No. 6: Radiated Emissions (1GHz – 4GHz) ([1] § 15.209, 231(b); [3] T1, 2) .....  | 22        |
| 6.6.1 Purpose .....                                                                       | 22        |
| 6.6.2 Limits .....                                                                        | 22        |
| 6.6.3 EUT Operating Condition .....                                                       | 23        |
| 6.6.4 Test Configuration .....                                                            | 23        |
| 6.6.5 Test Procedure and Results .....                                                    | 23        |
| 6.6.6 Test Protocol .....                                                                 | 24        |
| 6.7 Test No. 7: Emission Bandwidth ([1] § 15.231(c); [3] A1.1.3) .....                    | 25        |
| 6.8 Test No. 8: Transmit Duration ([1] § 15.231(a)) .....                                 | 25        |
| <b>7 Test Data .....</b>                                                                  | <b>26</b> |
| 7.1 Part List of the Test Equipment.....                                                  | 26        |

The test report shall not be reproduced except in full without the written approval of the testing laboratory

## 1 Summary

The measurements described in this report were conducted pursuant to 47 CFR § 2.947, § 2.1041 and [1] § 15.31. All applicable paragraphs of the [1] 47 CFR part 15 of the most current version of the rules were considered.

The following tests were performed according to the FCC rules in order to verify the compliance of the EUT with the FCC requirements:

| Test No. | Measurement                                                | FCC Rule                                            | Page Number of this Report | Result    |
|----------|------------------------------------------------------------|-----------------------------------------------------|----------------------------|-----------|
| 1        | Conducted Emissions                                        | [1] § 15.207                                        | 11                         | n/p       |
| 2        | Field strength correction for pulse operation (Duty Cycle) | [1] § 15.35(c)                                      | 11                         | -         |
| 3        | Field strength of the fundamental wave                     | [1] § 15.231(b)<br>[3] Annex 1.1.2, Table 4         | 14                         | compliant |
| 4        | Radiated Emissions (9kHz – 30MHz)                          | [1] § 15.209<br>[3] Table 1 and 3                   | 16                         | compliant |
| 5        | Radiated Emissions (30MHz – 1GHz)                          | [1] § 15.205, 15.209 15.231(b)<br>[3] Table 1 and 2 | 19                         | compliant |
| 6        | Radiated Emissions (1GHz – 4GHz)                           | [1] § 15.205, 15.209 15.231(b)<br>[3] Table 1 and 2 | 22                         | compliant |
| 7        | Emission Bandwidth                                         | [1] § 15.231(c)<br>[3] Annex 1.1.3                  | 25                         | n/p       |
| 8        | Transmit Duration                                          | [1] § 15.231(a)<br>[3] Annex 1.1.1                  | 25                         | n/p       |

**Table 1-1: Results – Summary**

## 2 References

### 2.1 Specifications

| No. | Standard           | Title                                                                                                                                                                        | Date    |
|-----|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| [1] | FCC 47 CFR Part 15 | Code of Federal Regulations,<br>Title 47: Telecommunication<br>Part 15: Radio Frequency Devices                                                                              | 2009-10 |
| [2] | ANSI C63.4-2003    | American National Standard for<br>Methods of Measurement of Radio Noise Emissions from<br>Low-Voltage Electrical and Electronic Equipment in the<br>Range of 9 kHz to 40 GHz | 2004-01 |
| [3] | RSS-210 Issue 7    | Radio Standards Specification<br>Low-power Licence-exempt<br>Radiocommunication Devices<br>(All Frequency Bands):<br>Category I Equipment                                    | 2007-06 |

### 2.2 Glossary of Terms

|        |                                                             |
|--------|-------------------------------------------------------------|
| °C     | Degree Celsius                                              |
| AC     | Alternating Current                                         |
| ANT    | Antenna                                                     |
| chk    | checked against a calibrated reference                      |
| cnn    | calibration not necessary                                   |
| DAR    | Deutscher Akkreditierungsrat (German Accreditation Council) |
| DATEch | Deutsche Akkreditierungsstelle Technik e.V.                 |
| dB     | Decibel                                                     |
| dBc    | Decibel per Carrier                                         |
| dBm    | Decibel per Milliwatt                                       |
| EUT    | Equipment Under Test                                        |
| ind    | for indication only                                         |
| kbps   | Kilobits per second                                         |
| max    | Maximum                                                     |
| min    | Minimum                                                     |
| n/a    | Not Applicable                                              |
| n/p    | Not Performed                                               |
| P      | Power                                                       |
| Pmax   | Maximum Output Power                                        |
| Prat   | Rated Output Power                                          |
| RBW    | Resolution Bandwidth                                        |
| Ref    | Reference                                                   |
| RF     | Radio Frequency                                             |
| RMS    | Root Mean Square                                            |
| RX     | Receive Path                                                |
| SW     | Software                                                    |
| T      | Temperature                                                 |
| TRX    | Transceiver                                                 |
| TX     | Transmit Path                                               |
| V      | Volt                                                        |
| W      | Watt                                                        |
| w/     | with                                                        |
| w/o    | without                                                     |

The test report shall not be reproduced except in full without the written approval of the testing laboratory

### 3 General Information

#### 3.1 Identification of Client

EnOcean GmbH  
Kolpingstr. 18a  
82041 Oberhaching  
Dr. Wolfgang Heller

#### 3.2 Test Laboratory

Center for Quality Engineering  
SGS Germany GmbH  
Hofmannstraße 50  
81379 München

Federal Communications Commission (FCC):  
Testfirm registration numbers – MZ2: 97242

Industry Canada (IC):  
Company number: 9058A  
Test-site number: – MZ2: 9058A-2

#### 3.3 Time Schedule

| Test No.:      | 1, 7, 8 | 2            | 3, 4, 5, 6   |
|----------------|---------|--------------|--------------|
| Start of Test: | n/p     | Aug 12, 2010 | Aug 12, 2010 |
| End of Test:   |         | Aug 12, 2010 | Aug 12, 2010 |

#### 3.4 Participants

| Name               | Function                   |
|--------------------|----------------------------|
| Michael Sperling   | Accredited Testing, Editor |
| Katarzyna Jagiello | Accredited Testing         |

The test report shall not be reproduced except in full without the written approval of the testing laboratory

## 4 Equipment Under Test

The tested equipment is representative for serial production.

### 4.1 Description of EUT

The tested Transmitter-Module (extended by a helix antenna module) transmits control data by using ASK modulation through its 315MHz carrier signal.

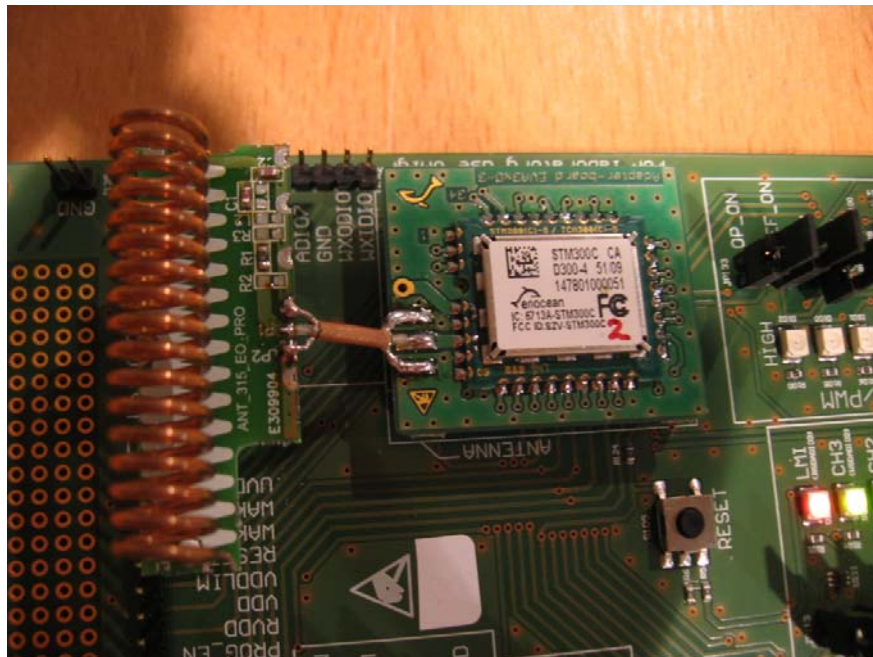


Figure 4-1: Photo of EUT (Transmitter Modul and Helix Antenna)

## 4.2 Configuration of EUT

The used different EUT configurations are shown by the following tables.

|                                     |                                                       |
|-------------------------------------|-------------------------------------------------------|
| <b>Module Type</b>                  | Transmitter-Module                                    |
| <b>Operating Band</b>               | 315MHz                                                |
| <b>Operating Frequency</b>          | 315MHz                                                |
| <b>Rated Output Power (Prat)</b>    | n/a                                                   |
| <b>Modulation Type</b>              | ASK (OOK)                                             |
| <b>Operation w/o modulation</b>     | No                                                    |
| <b>Emission designator</b>          | 373KA1D                                               |
| <b>Antenna Type</b>                 | Helix Antenna                                         |
| <b>Number of Antenna Ports</b>      | 1                                                     |
| <b>Gain</b>                         | n/a                                                   |
| <b>Power Src. Type</b>              | Electro-dynamic DC supply system/Battery <sup>1</sup> |
| <b>Battery type (if applicable)</b> | Li Mn (CR2032) <sup>1</sup>                           |
| <b>Voltage nominal</b>              | 3V                                                    |
| <b>minimal</b>                      | 3V                                                    |
| <b>maximum:</b>                     | 6V                                                    |

1) During the tests the electro-dynamic DC supply system was replaced by a 3V Li Mn battery to allow continuous operation of the EUT.

**Table 4-1: Overview of EUT Configuration**

The tests were performed with one EUT.

The used EUT configuration is shown by the following table.

| Module Name                                                                     | Serial-No. | Module Type        | Config. |
|---------------------------------------------------------------------------------|------------|--------------------|---------|
| Transmitter Module<br>STM300C <sup>1</sup> +<br>Helix Antenna<br>ANT_315_EO_PRO | none       | Transmitter-Module | A       |

1) Except of 4 none RF relevant IO pins TCM300C and STM300C are functionally identical.

**Table 4-2: Configuration of EUT**

For a functional description of the module, please refer to the appropriate related parts and exhibit sections of this certification application.

### 4.3 Operating Conditions

If not stated otherwise, the following standard setup procedure for the EUT was used:

The EUT was set up in a continuously transmitting operating mode. The TX signal was thus permanently activated during the test. To do so the pulse train which will be sent only once (after manual activation) during normal operation was repeated each 250ms.

The EUT was supplied with 3V DC by a new Li Mn battery.

### 4.4 Compliance Criteria

The EUT must fulfil the requirements (described in the specifications mentioned in chapter 2.1, Specifications) for the selected test cases.

## 5 General Description of Tests

### 5.1 Tested Carrier Frequencies

The measurements were performed on 1 carrier frequency, according to the following table:

| Frequency [MHz] | Remark                          |
|-----------------|---------------------------------|
| 315             | Only possible carrier frequency |

**Table 5-1: Carrier Frequency**

### 5.2 Calibration of the Test Equipment

All relevant test equipment has a valid calibration from an external calibration laboratory. Additionally the used spectrum and EMI analyzers have a built-in self-calibration procedure. This calibration procedure was activated prior to the measurements so that the analyzer is deemed accurate. High quality cables were used to connect the measurement equipment. The actual loss of the attenuators and the cables was measured with a high precision network analyzer and taken into account for all measurements.

The test report shall not be reproduced except in full without the written approval of the testing laboratory

## 6 Test Results

### 6.1 Test No. 1: Conducted Emissions ([1] § 15.207)

Not performed.

### 6.2 Test No. 2: Field strength correction for pulse operation (Duty Cycle) ([1] § 15.35(c))

#### 6.2.1 Purpose

When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed according to [1] § 15.35(c) the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted.

#### 6.2.2 Limits

According to [1] § 15.35(b) the duty cycle correction factor must be not below -20dB.

#### 6.2.3 EUT Operating Condition

The standard setup procedure as described in section 4.3 of this report was used.

#### 6.2.4 Test Configuration

The measurement of the duty cycle of the EUT's pulse train was performed with a probe antenna by means of a spectrum analyzer operating in the zero span mode. For the parts list of used test equipment see chapter 7.1



Figure 6-1: Test Configuration – Duty Cycle

## 6.2.5 Test Procedure and Results

The duty cycle correction factor (dB) was calculated with following formula:

$$CF = 20 \log \frac{t_p}{100ms}$$

With:

CF: Duty cycle correction factor

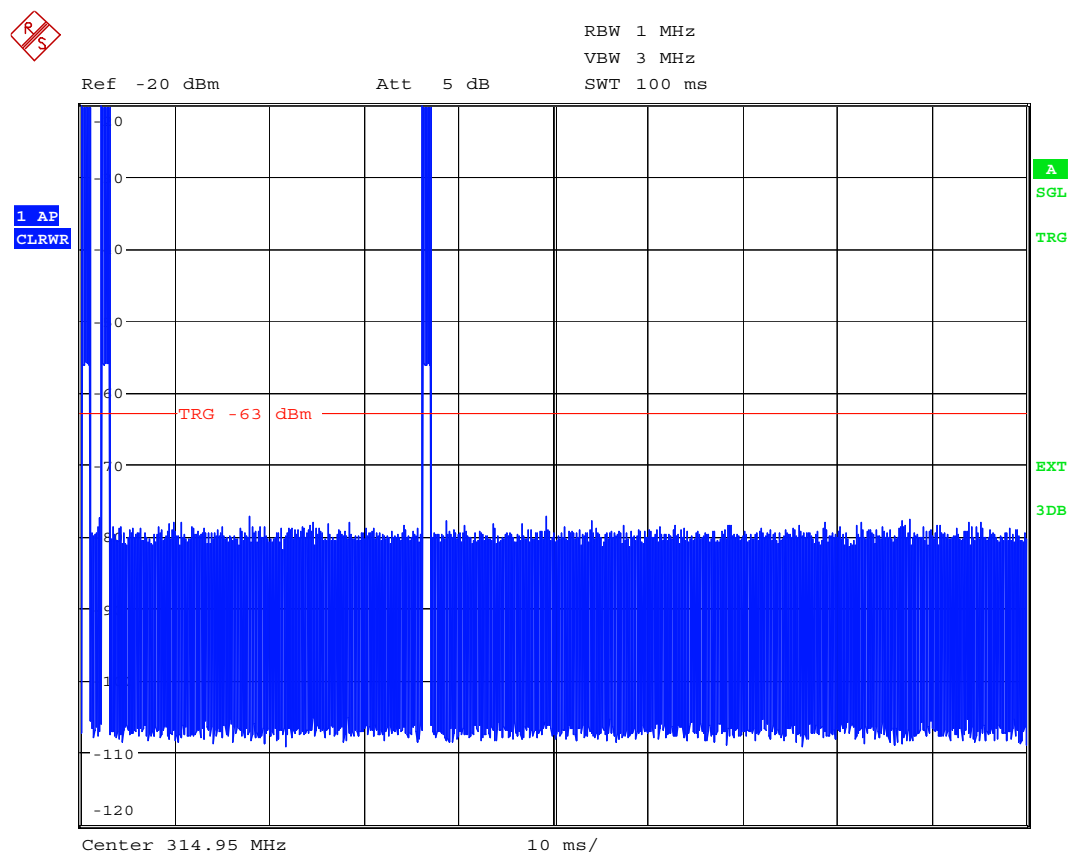
$t_p$ : Puls duration

| $t_p$ [ms] | $t_i$ [ms] | CF [dB] calculated | CF [dB] used<br>( $\geq -20$ dB) |
|------------|------------|--------------------|----------------------------------|
| 3 x 0.994  | 100        | -30.5              | -20.0                            |

Table 6-1: Results – Duty Cycle

## 6.2.6 Test Protocol

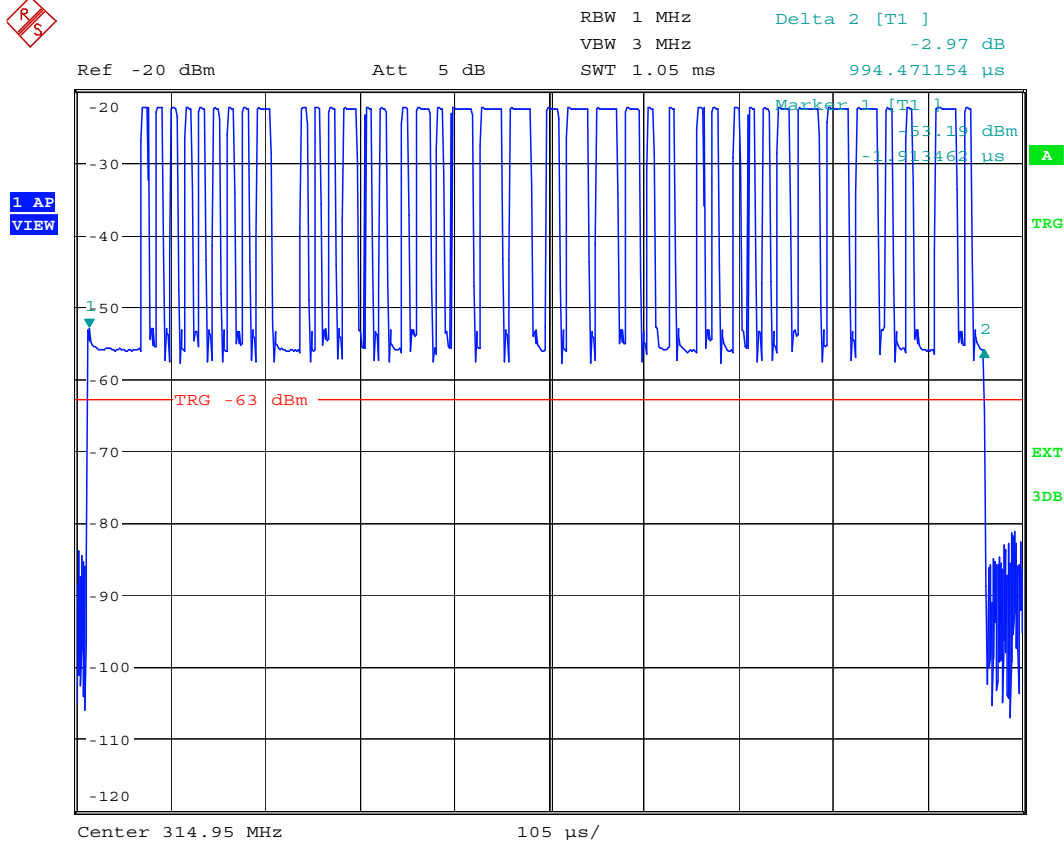
The following figures show the pulse train details (time domain)



Transient Power x -10Ch

Date: 12.AUG.2010 13:18:51

Figure 6-2: Duty Cycle (100ms with complete Pulse Train)



Transient Power x -10Ch  
Date: 12.AUG.2010 13:13:58

**Figure 6-3: Duty Cycle (Pulse details)**

**The determined duty cycle correction factor will be applied for the field strength and radiated emission measurements**

The test report shall not be reproduced except in full without the written approval of the testing laboratory

### 6.3 Test No. 3: Field strength of the fundamental wave ([1] § 15.231(b), [3] A1.1.2)

#### 6.3.1 Purpose

The measurement of the field strength of the fundamental wave of the EUT was performed pursuant to [2] Clause 13.1.4 to verify that the field strength of the fundamental wave does not exceed the specified limit.

#### 6.3.2 Limits

According to [1] § 15.231(b) and [3] A1.1.2, the field strength of the fundamental wave must not exceed following field strength levels:

| Frequency of Emission [MHz] | Field strength [μV/m]   | Field strength [dBμV/m] | Meas. Distance [m] |
|-----------------------------|-------------------------|-------------------------|--------------------|
| 40.66–40.70                 | 2250                    | 67.0                    | 3                  |
| 70–130                      | 1250                    | 61.9                    | 3                  |
| 130–174                     | 1250–3750 <sup>1</sup>  | 61.9–71.5               | 3                  |
| 174–260                     | 3750                    | 71.5                    | 3                  |
| 260–470                     | 3750–12500 <sup>1</sup> | 71.6–81.9               | 3                  |
| <b>315</b>                  | <b>6042<sup>2</sup></b> | <b>75.6</b>             | <b>3</b>           |
| Above 470                   | 12500                   | 81.9                    | 3                  |

1) Linear interpolation

2) Calculated by linear interpolation

**Table 6-2: Limits – Field Strength of Fundamental Wave**

#### 6.3.3 EUT Operating Condition

The standard setup procedure as described in section 4.3 of this report was used.

#### 6.3.4 Test Configuration

The measurements were performed in an anechoic chamber. The radiated test site complies with the site attenuation requirements of [2] and is listed with the FCC and IC. The resolution bandwidth used during the emission measurement was as follows:

30MHz – 1GHz: 120kHz

For the parts list of used test equipment see chapter 7.1



Figure 6-4: Test Configuration – Field Strength of Fundamental Wave

### 6.3.5 Test Procedure and Results

This investigation is performed with a broadband antenna and a receiver with peak detector. The field strength is measured in a distance of 3m with an antenna in horizontal and vertical polarization, the antenna height is varied from 1 to 4 m and the EUT is turned around 360° to maximize the emission. The used bandwidth for the measurement is 120 kHz.

| Frequency [MHz]          | Average [dBμV/m] <sup>1</sup> | Meas. Time [ms] | Height [cm] | Polarization | Azimuth [deg] | Corr. [dB]        | Margin [dB] | Limit [dBμV/m] |
|--------------------------|-------------------------------|-----------------|-------------|--------------|---------------|-------------------|-------------|----------------|
| 315.000000               | 54.0                          | 1000.0          | 1000.0      | H            | 113.0         | 15.2              | 21.6        | 75.6           |
| Measurement Uncertainty: |                               |                 |             |              |               | +3.1 dB / -3.9 dB |             |                |

1) The average field strength was calculated by applying the duty cycle correction factor of -20dB (see chapter 6.2) to the measured peak field strength.

Table 6-3: Results – Field Strength of Fundamental Wave

### 6.3.6 Test Protocol

See chapter 6.5.6 for the test protocol of the fundamental wave field strength measurement.

**The measured field strength of the fundamental wave was found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.**

## 6.4 Test No. 4: Radiated Emissions (9kHz – 30MHz) ([1] § 15.209; [3] T1, 3)

### 6.4.1 Purpose

The radiated emissions of the EUT were measured pursuant to [2] Clause 13.1.4. The measurement was performed to verify that emissions radiated directly from the cabinet, control circuits, power leads or intermediate circuit elements are attenuated below the specified limits.

### 6.4.2 Limits

At frequencies equal to or less than 1000MHz, compliance with the limits in [1] § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. According to [1] § 15.209 and [3] Table 1 and 3 the radiated emissions of an intentional radiator must not exceed following field strength levels:

| Frequency of Emission [MHz] | Field strength [μV/m] | Field strength [dBμV/m]  | Meas. Distance [m] |
|-----------------------------|-----------------------|--------------------------|--------------------|
| 0.009–0.490                 | 2400/F [kHz]          | 88.5 – 53.8 <sup>1</sup> | 300                |
| 0.490–1.705                 | 24000/F [kHz]         | 53.8 – 43 <sup>1</sup>   | 30                 |
| 1.705–30                    | 30                    | 49.5 <sup>1</sup>        | 30                 |

1): Limit adapted to a measurement distance of 3m!

**Table 6-4: Limits – Radiated Emissions (9kHz – 30MHz)**

According to [1] § 15.205(a) the field strength of emissions in the following restricted bands of operation shall not exceed the limits of [1] § 15.209.

| MHz             | MHz             | MHz               | GHz               |
|-----------------|-----------------|-------------------|-------------------|
| 0.090–0.110     | 6.215–6.2       | 8.41425–8.41475   | 16.69475–16.69525 |
| 0.495–0.505     | 6.26775–6.26825 | 12.29–12.293      | 16.80425–16.80475 |
| 2.1735–2.1905   | 6.31175–6.31225 | 12.51975–12.52025 | 25.5–25.67        |
| 4.125–4.128     | 8.291–8.294     | 12.57675–12.57725 |                   |
| 4.17725–4.17775 | 8.362–8.366     | 13.36–13.41       |                   |
| 4.20725–4.20775 | 8.37625–8.38675 | 16.42–16.423      |                   |

**Table 6-5: Restricted Bands (9kHz – 30MHz)**

### 6.4.3 EUT Operating Condition

The standard setup procedure as described in section 4.3 of this report was used.

## 6.4.4 Test Configuration

The measurements were performed in an anechoic chamber. The radiated test site complies with the site attenuation requirements of [2] and is listed with the FCC and IC. The resolution bandwidth used during the emission measurement was as follows:

9kHz – 150 kHz: 200Hz  
150kHz – 30MHz: 9kHz

For the parts list of used test equipment see chapter 7.1

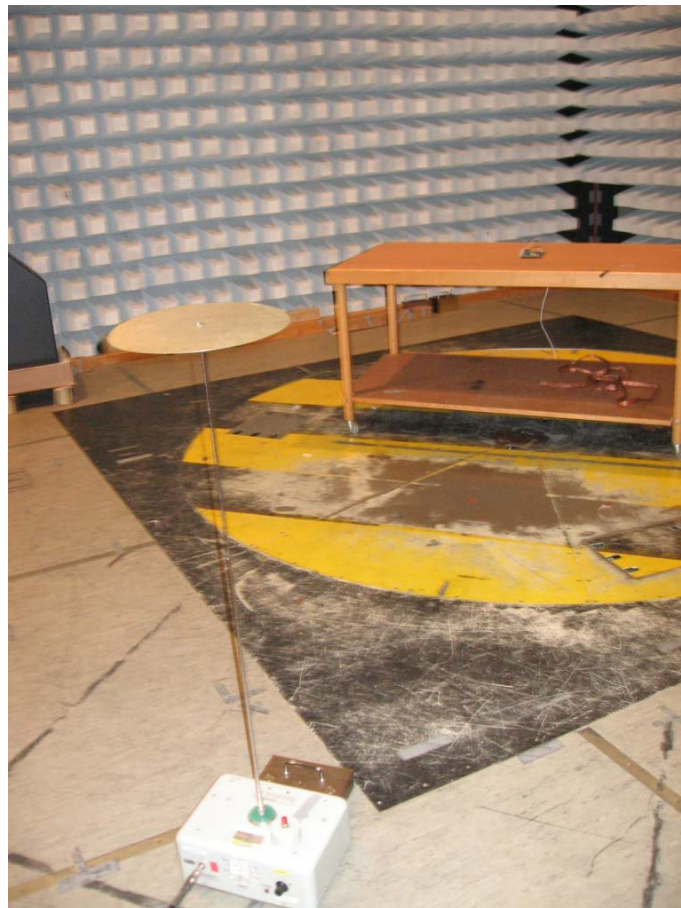


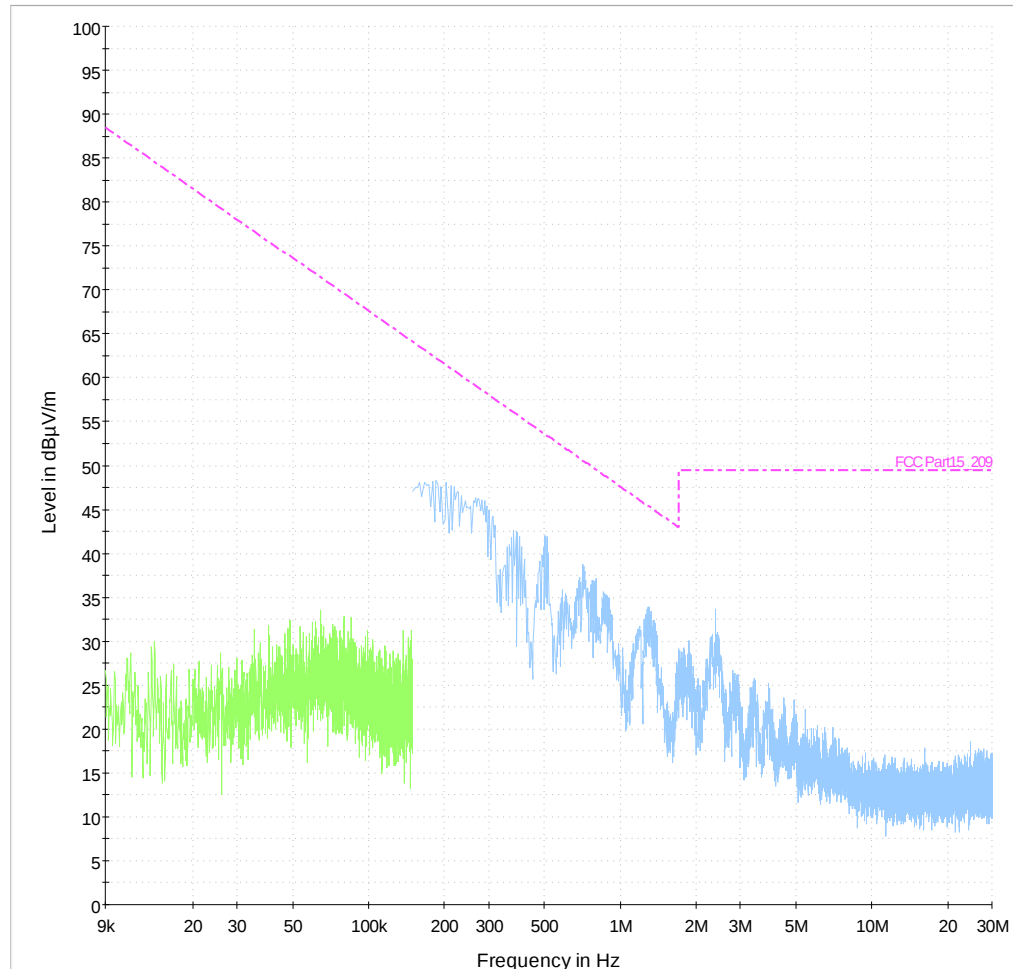
Figure 6-5: Test Configuration – Radiated Emissions (9kHz – 30MHz)

## 6.4.5 Test Procedure and Results

This investigation is performed with the EUT turned around 360° to maximize the emission. The spectrum analyzer is set to 'peak' mode from 9 kHz to 30 MHz. On any emission over the limit, the spectrum analyzer is set to 'average' mode for 9 kHz to 150 kHz and the spectrum analyzer is set to quasi-peak mode between 150 kHz and 30 MHz. The rod antenna is positioned 3 meters from the closest point of any part of the test sample. The antenna counterpoise is grounded.

## 6.4.6 Test Protocol

The following figure shows the test protocol of the radiated emissions (9kHz – 30MHz) measurement.



**Figure 6-6: Radiated Emissions (9kHz – 30MHz)**

The measured emission levels were found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

## 6.5 Test No. 5: Radiated Emissions (30MHz – 1GHz) ([1] § 15.209, 231(b); [3] T1, 2)

### 6.5.1 Purpose

The radiated emissions of the EUT were measured pursuant to [2] Clause 13.1.4. The measurement was performed to verify that emissions radiated directly from the cabinet, control circuits, power leads or intermediate circuit elements are attenuated below the specified limits.

### 6.5.2 Limits

At frequencies equal to or less than 1000MHz radiated emissions shall be attenuated to CISPR quasi peak limits specified by [1] § 15.209 and [3] Table 1 and 2 (general limits) or to the limits specified by [1] § 15.231(b), whichever limit permits a higher field strength.

According to [1] § 15.209 and [3] Table 1 and 2 the radiated emissions of an intentional radiator must not exceed following field strength levels:

| Frequency of Emission [MHz] | Field strength [μV/m] | Field strength [dBμV/m] | Meas. Distance [m] |
|-----------------------------|-----------------------|-------------------------|--------------------|
| 30–88                       | 100                   | 40                      | 3                  |
| 88–216                      | 150                   | 43.5                    | 3                  |
| 216–960                     | 200                   | 46                      | 3                  |
| Above 960                   | 500                   | 54                      | 3                  |

**Table 6-6: Limits – Radiated Emissions (30MHz – 1GHz) (§ 15.209)**

According to [1] § 15.231(b) the radiated emissions of an intentional radiator must not exceed following field strength levels:

| Frequency of Emission [MHz] | Field strength [μV/m]    | Field strength [dBμV/m] | Meas. Distance [m] |
|-----------------------------|--------------------------|-------------------------|--------------------|
| 40.66–40.70                 | 225                      | 47.0                    | 3                  |
| 70–130                      | 125                      | 41.9                    | 3                  |
| 130–174                     | 125–375 <sup>1</sup>     | 41.9–51.5               | 3                  |
| 174–260                     | 375                      | 51.5                    | 3                  |
| 260–470                     | 375–1250 <sup>1</sup>    | 51.6–61.9               | 3                  |
| <b>315</b>                  | <b>604.2<sup>2</sup></b> | <b>55.6</b>             | <b>3</b>           |
| Above 470                   | 1250                     | 61.9                    | 3                  |

1) Linear interpolation

2) Calculated by linear interpolation

**Table 6-7: Limits – Radiated Emissions (30MHz – 1GHz) (§ 15.231(b))**

According to [1] § 15.205(a) the field strength of emissions in the following restricted bands of operation shall not exceed the limits of [1] § 15.209.

| MHz        | MHz                 | MHz             | MHz       |
|------------|---------------------|-----------------|-----------|
| 37.5–38.25 | 123–138             | 162.0125–167.17 | 399.9–410 |
| 73–74.6    | 149.9–150.05        | 167.72–173.2    | 608–614   |
| 74.8–75.2  | 156.52475–156.52525 | 240–285         | 960–1000  |
| 108–121.94 | 156.7–156.9         | 322–335.4       |           |

**Table 6-8: Restricted Bands (30MHz – 1GHz)**

## 6.5.3 EUT Operating Condition

The standard setup procedure as described in section 4.3 of this report was used.

## 6.5.4 Test Configuration

The measurements were performed in an anechoic chamber. The radiated test site complies with the site attenuation requirements of [2] and is listed with the FCC and IC. The resolution bandwidth used during the emission measurement was as follows:

30MHz – 1GHz: 120kHz

For the parts list of used test equipment see chapter 7.1



**Figure 6-7: Test Configuration – Radiated Emissions (30MHz – 1GHz)**

## 6.5.5 Test Procedure and Results

This investigation is performed with a broadband antenna and a receiver with peak detector. The field strength is measured in a distance of 3m with an antenna in horizontal and vertical polarization, the antenna height is varied from 1 to 4 m and the EUT is turned around 360° to maximize the emission. The used bandwidth for the measurement is 120 kHz and a step size of 60 kHz is applied.

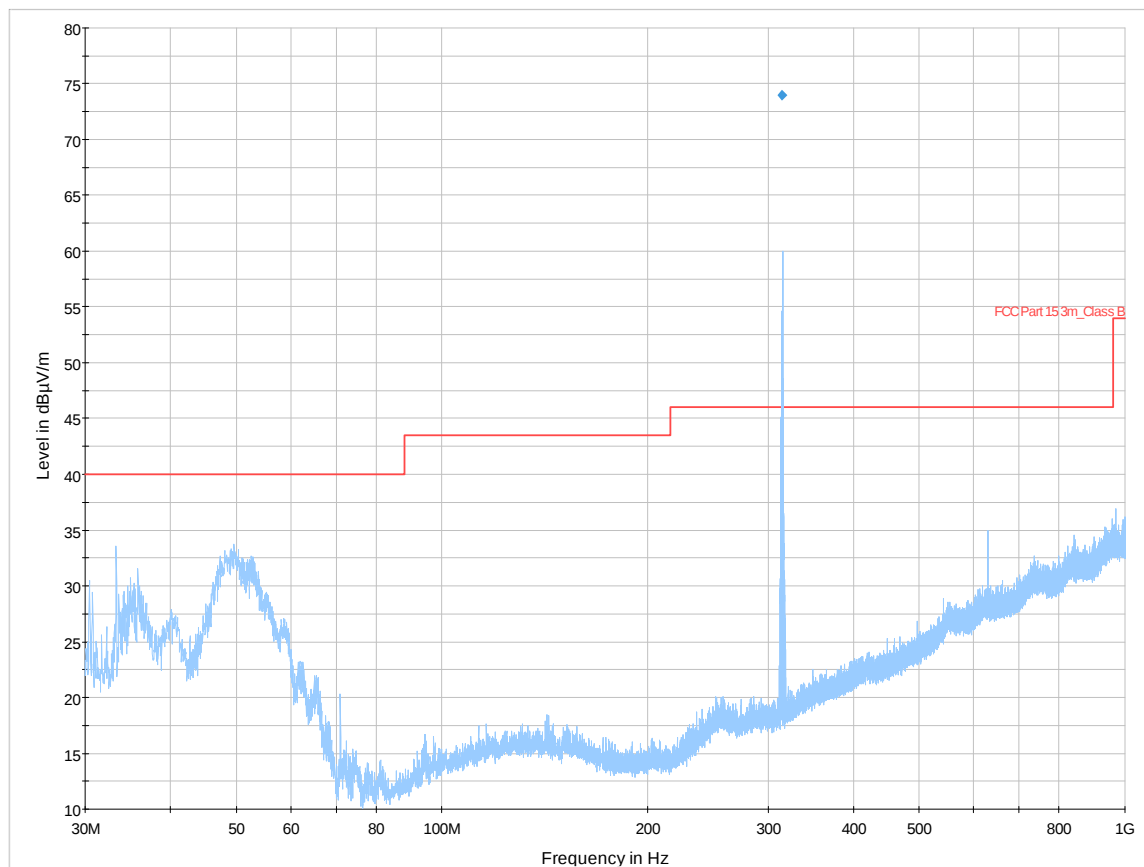
| Frequency [MHz]          | Average [dBμV/m] <sup>1</sup> | Meas. Time [ms] | Height [cm] | Polarization | Azimuth [deg] | Corr. [dB]        | Margin [dB] | Limit [dBμV/m] |
|--------------------------|-------------------------------|-----------------|-------------|--------------|---------------|-------------------|-------------|----------------|
| 315.000000               | 54.0                          | 1000.0          | 150.0       | H            | 113.0         | 15.2              | -           | Carrier        |
| Measurement Uncertainty: |                               |                 |             |              |               | +3.1 dB / -3.9 dB |             |                |

1) The average field strength was calculated by applying the duty cycle correction factor of -20dB (see chapter 6.2) to the measured peak field strength.

**Table 6-9: Results – Radiated Emissions (30MHz – 1GHz)**

## 6.5.6 Test Protocol

The following figure shows the test protocol of the radiated emissions (30MHz – 1GHz) measurement.



**Figure 6-8: Radiated Emissions (30MHz – 1GHz)**

**The measured emission levels were found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.**

The test report shall not be reproduced except in full without the written approval of the testing laboratory

## 6.6 Test No. 6: Radiated Emissions (1GHz – 4GHz) ([1] § 15.209, 231(b); [3] T1, 2)

### 6.6.1 Purpose

The radiated emissions of the EUT were measured pursuant to [2] Clause 13.1.4. The measurement was performed to verify that emissions radiated directly from the cabinet, control circuits, power leads or intermediate circuit elements are attenuated below the specified limits.

### 6.6.2 Limits

At frequencies above 1GHz radiated emissions shall be attenuated to average limits specified by, [1] § 15.209 and [3] Table 1 and 2 (general limits) or to the limits specified by [1] § 15.231(b), whichever limit permits a higher field strength.

According to [1] § 15.209 and [3] Table 1 and 2 the radiated emissions of an intentional radiator must not exceed following field strength levels:

| Frequency of Emission [MHz] | Field strength [μV/m] | Field strength [dBμV/m] | Meas. Distance [m] |
|-----------------------------|-----------------------|-------------------------|--------------------|
| Above 960                   | 500                   | 54                      | 3                  |

**Table 6-10: Limits – Radiated Emissions (1GHz – 4GHz) (§ 15.209)**

According to [1] § 15.231(b) the radiated emissions of an intentional radiator must not exceed following field strength levels:

| Frequency of Emission [MHz] | Field strength [μV/m]    | Field strength [dBμV/m] | Meas. Distance [m] |
|-----------------------------|--------------------------|-------------------------|--------------------|
| 40.66–40.70                 | 225                      | 47.0                    | 3                  |
| 70–130                      | 125                      | 41.9                    | 3                  |
| 130–174                     | 125–375 <sup>1</sup>     | 41.9–51.5               | 3                  |
| 174–260                     | 375                      | 51.5                    | 3                  |
| 260–470                     | 375–1250 <sup>1</sup>    | 51.6–61.9               | 3                  |
| <b>315</b>                  | <b>604.2<sup>2</sup></b> | <b>55.6</b>             | <b>3</b>           |
| Above 470                   | 1250                     | 61.9                    | 3                  |

1) Linear interpolation

2) Calculated by linear interpolation

**Table 6-11: Limits – Radiated Emissions (1GHz – 4GHz) (§ 15.231(b))**

According to [1] § 15.205(a) the field strength of emissions in the following restricted bands of operation shall not exceed the limits of [1] § 15.209.

| MHz           | MHz           | MHz         | MHz         |
|---------------|---------------|-------------|-------------|
| 1000–1240     | 1660–1710     | 2483.5–2500 | 3345.8–3358 |
| 1300–1427     | 1718.8–1722.2 | 2690–2900   | 3600–4000   |
| 1435–1626.5   | 2200–2300     | 3260–3267   |             |
| 1645.5–1646.5 | 2310–2390     | 3332–3339   |             |

**Table 6-12: Restricted Bands (1GHz – 4GHz)**

### 6.6.3 EUT Operating Condition

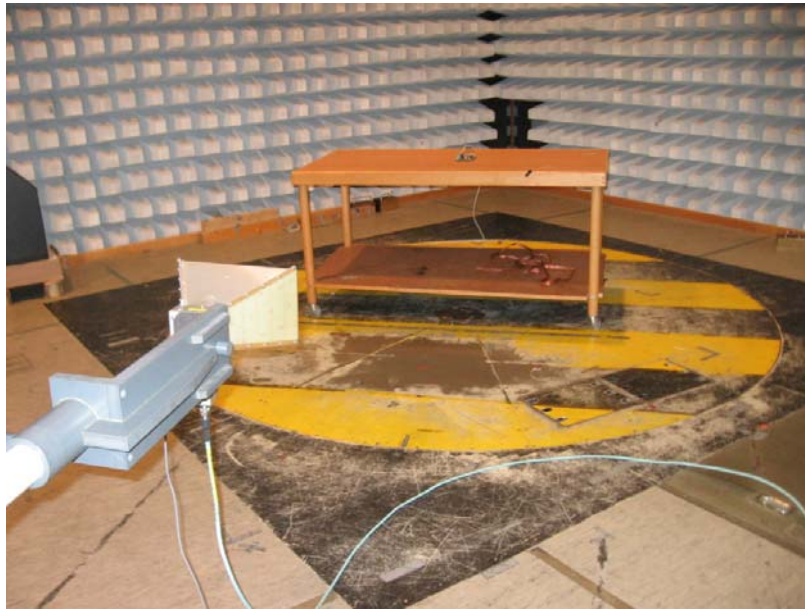
The standard setup procedure as described in section 4.3 of this report was used.

### 6.6.4 Test Configuration

The measurements were performed in an anechoic chamber. The radiated test site complies with the site attenuation requirements of [2] and is listed with the FCC and IC. The resolution bandwidth used during the emission measurement was as follows:

1GHz – 4GHz: 1MHz

For the parts list of used test equipment see chapter 7.1



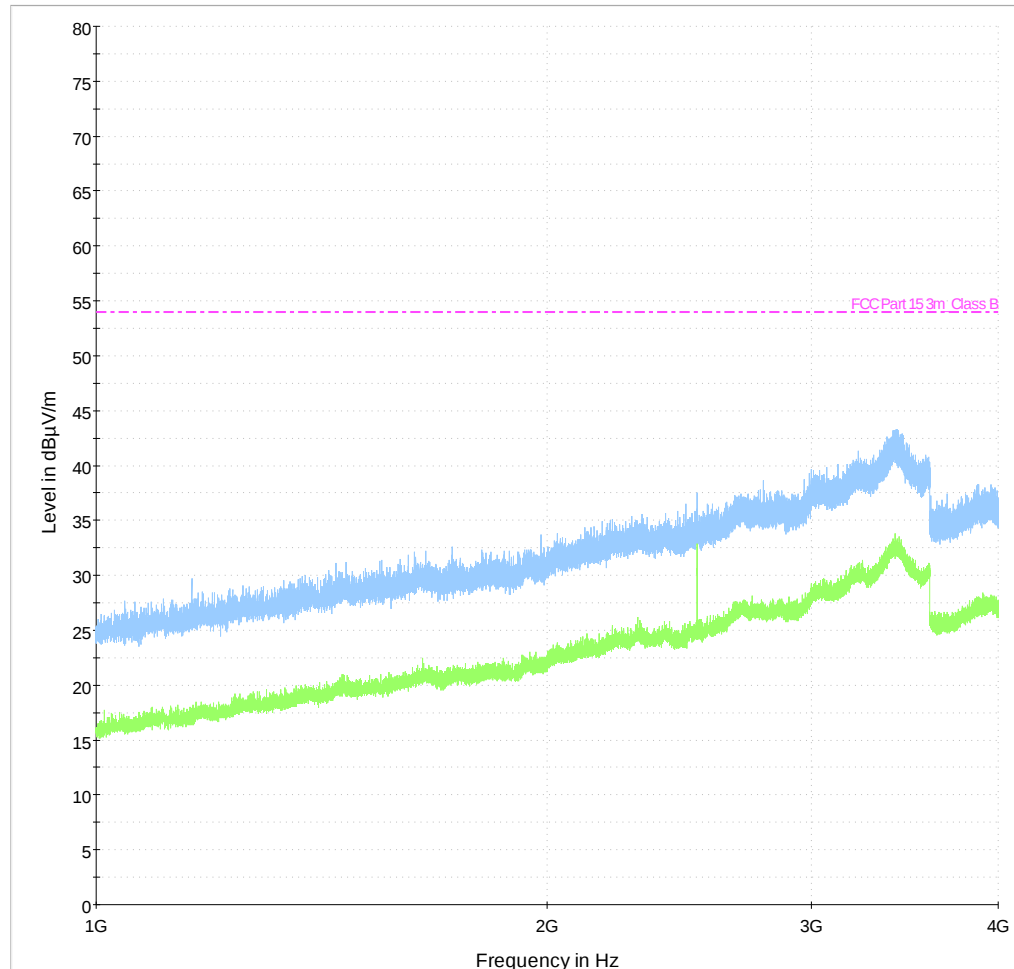
**Figure 6-9: Test Configuration – Radiated Emissions (1GHz – 4GHz)**

### 6.6.5 Test Procedure and Results

This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

## 6.6.6 Test Protocol

The following figure shows the test protocol of the radiated emissions (1GHz – 4GHz) measurement.



**Figure 6-10: Radiated Emissions (1GHz – 4GHz)**

The measured emission levels were found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

**6.7 Test No. 7: Emission Bandwidth ([1] § 15.231(c); [3] A1.1.3)**

Not performed

**6.8 Test No. 8: Transmit Duration ([1] § 15.231(a))**

Not performed

The test report shall not be reproduced except in full without  
the written approval of the testing laboratory

## 7 Test Data

### 7.1 Part List of the Test Equipment

| No. | Test Equipment     | Type (Manufacturer)          | Identification No. | Calibration date | Calibration due | Test No. |
|-----|--------------------|------------------------------|--------------------|------------------|-----------------|----------|
| 1   | EMI receiver       | ESU26 R&S                    | P1326              | 07/2009          | 07/2011         | 4,5,6    |
| 2   | Test Chamber 2     | -                            | P0337              | 02/2010          | 02/2011         | 4,5,6    |
| 3   | Antenna (MZ2)      | 3115 Emco                    | P0961              | 04/2010          | 04/2012         | 6        |
| 4   | Preamplifier (MZ2) | AFS4-00101800-35-S-4-L Miteq | P1193              | 12/2009          | 12/2010         | 6        |
| 5   | Antenna            | CBL6111 Chase                | P0018              | 03/2010          | 03/2011         | 5        |
| 6   | Antenna            | 95010-1                      | P0065              | 07/2009          | 07/2011         | 4        |

**Table 7-1: Part List of the EMC Measurement Test Equipment**

| No. | Test Equipment     | Type (Manufacturer) | Identification No. | Calibration date | Calibration due | Test No. |
|-----|--------------------|---------------------|--------------------|------------------|-----------------|----------|
| 1   | Signal Analyzer    | FSG 13 (R&S)        | F0995              | 04/2009          | 11/2010         | 2        |
| 2   | Frequency Standard | Rubisource (Datum)  | F0076              | 11/2009          | 05/2011         | 2        |

**Table 7-2: Part List of the RF Measurement Test Equipment**

The test report shall not be reproduced except in full without the written approval of the testing laboratory