



December 2, 2013

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## Prüfbericht / Test Report

Nr. / No. 20820838-26357-7 (Edition 2)

Applicant: Bartec GmbH

Type of equipment: UHF Reader (external antenna)

Type designation: MC92N0ex RFID-UHF

Order No.: --

Test standards: FCC Code of Federal Regulations,  
CFR 47, Part 15,  
Sections 15.205, 15.207, 15.215 and 15.247

Industry Canada Radio Standards Specifications  
RSS-Gen Issue 2, Section 7.2.2 and  
RSS-210 Issue 7, Sections 2.2, A8 (Category I Equipment)

### Note:

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## 1 Description of the Equipment Under Test (EUT)

| General data of EUT             |   |
|---------------------------------|---|
| Type designation <sup>1</sup> : | UHF Reader (external antenna)   |
| Version:                        | --  |
| Serial number(s):               | 1314100505472   |
| Manufacturer:                   | Bartec GmbH   |
| Type of equipment:              | MC92N0ex RFID-UHF   |
| Version:                        | As received   |
| FCC ID:                         | TBUUHFG1  |
| Industry Canada ID:             | 5736C-UHFG1   |
| Additional parts/accessories:   | Accumulator: BARTEC – Type: 17-A1Z0-0002,<br>Charging cradle: SYMBOL TECHNOLOGIES INC. – Part: CRD9000-1001SR, Model: CRD9000-1000, S/N: 12153000500777<br>Power supply: HIPRO – P/N: PWRS-14000-148R Rev. C,<br>Model: HP-A0502R3D, S/N: F33351234012660 |

<sup>1</sup> Type designation of the system if EUT consists of more than one part.

### Technical data of EUT

|                              |                     |
|------------------------------|---------------------|
| Application frequency range: | N/A                 |
| Frequency range:             | 902 – 928 MHz       |
| Operating frequency:         | 902.75 - 927.25 MHz |
| Type of modulation:          | ASK                 |
| Number of RF-channels:       | 50                  |
| Channel spacing:             |                     |

Pseudo-random List

| Channel No. | Center Frequency | Channel No. | Center Frequency | Channel No. | Center Frequency |
|-------------|------------------|-------------|------------------|-------------|------------------|
| 1           | 914,75 MHz       | 18          | 917,75 MHz       | 35          | 921,75 MHz       |
| 2           | 920,25 MHz       | 19          | 907,75 MHz       | 36          | 926,75 MHz       |
| 3           | 925,75 MHz       | 20          | 902,75 MHz       | 37          | 915,75 MHz       |
| 4           | 909,25 MHz       | 21          | 914,25 MHz       | 38          | 911,25 MHz       |
| 5           | 920,75 MHz       | 22          | 924,25 MHz       | 39          | 904,75 MHz       |
| 6           | 907,25 MHz       | 23          | 919,25 MHz       | 40          | 915,25 MHz       |
| 7           | 922,25 MHz       | 24          | 908,25 MHz       | 41          | 905,75 MHz       |
| 8           | 927,25 MHz       | 25          | 903,25 MHz       | 42          | 921,25 MHz       |
| 9           | 919,75 MHz       | 26          | 910,25 MHz       | 43          | 926,25 MHz       |
| 10          | 906,25 MHz       | 27          | 916,75 MHz       | 44          | 918,75 MHz       |
| 11          | 911,75 MHz       | 28          | 924,75 MHz       | 45          | 912,75 MHz       |
| 12          | 903,75 MHz       | 29          | 918,25 MHz       | 46          | 923,75 MHz       |
| 13          | 909,75 MHz       | 30          | 923,25 MHz       | 47          | 905,25 MHz       |
| 14          | 917,25 MHz       | 31          | 916,25 MHz       | 48          | 913,25 MHz       |
| 15          | 925,25 MHz       | 32          | 910,75 MHz       | 49          | 922,75 MHz       |
| 16          | 912,25 MHz       | 33          | 904,25 MHz       | 50          | 908,75 MHz       |
| 17          | 906,75 MHz       | 34          | 913,75 MHz       |             |                  |

|   |         |
|---|---------|
| Designation of emissions <sup>2</sup> : | 40K0A1D |
|---|---------|

|                         |  |
|-------------------------|--|
| Type of antenna:        | Integrated   |
| Size/length of antenna: | N/A  |
| Connection of antenna:  | <input type="checkbox"/> detachable <input checked="" type="checkbox"/> not detachable |

|                                  |  |
|----------------------------------|--|
| Type of power supply:            | DC supply  |
| Specifications for power supply: | nominal voltage: 7.4 V<br>minimum voltage: 7.4 V<br>maximum voltage: 8.4 V |
|                                  | nominal frequency: DC Hz   |

<sup>2</sup> Also known as "Class of Emission".

Type of power supply of cradle:

AC supply

Specifications for power supply of the  
cradle:

nominal voltage: 115 V V

minimum voltage: -- V

maximum voltage: -- V

nominal frequency: AC 50/60Hz

## 2 Administrative Data

### Application details

|                           |  |
|---------------------------|--|
| Applicant (full address): | Bartec GmbH<br>Max-Eyth-Str. 16<br>97980 Bad Mergentheim - Germany |
| Contact person:           | Ralph Lanig  |
| Order number:             | --   |
| Receipt of EUT:           | 15 July 2013   |
| Date(s) of test:          | August, September 2013   |
| Note(s):                  |  |

### Report details

|                |                  |
|----------------|------------------|
| Report number: | 20820838-26357-7 |
| Edition:       | 2                |
| Issue date:    | December 2, 2013 |

### 3 Identification of the Test Laboratory

| Details of the Test Laboratory          |  |
|---|--|
| Company name:                           | TÜV SÜD Product Service GmbH                                 |
| Address:                                | Aeussere Fruehlingstrasse 45<br>D-94315 Straubing<br>Germany |
| Laboratory accreditation:               | DAR-Registration No. D-PL-11321-11-01                        |
| FCC test site registration number       | 90926  |
| Industry Canada test site registration: | 3050A-2  |
| Contact person:                         | Mr. Johann Roidt   |
|   | Phone: +49 9421 5522-0<br>Fax: +49 9421 5522-99              |

## 4 Summary

### Summary of test results

The tested sample complies with the requirements set forth in the

**Code of Federal Regulations CFR 47, Part 15, Sections 15.107, 15.109, 15.205, 15.207, 15.215, 15.247 and 2.1093**

of the Federal Communication Commission (FCC) and the

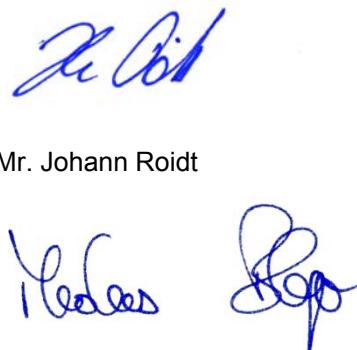
**Radio Standards Specifications  
ICES-003 Issue 4 (Class A), Sections, 5.2 and 5.4  
RSS-Gen Issue 2, Sections 7.2.2 and  
RSS-210 Issue 7, Sections 2.2, 2.6 and A8 (Category I Equipment)**

of Industry Canada (IC).

### Personnel involved in this report

Laboratory Manager:

Mr. Johann Roidt



Responsible for testing:

Mr. Markus Biberger

Responsible for test report:

Mr. Markus Biberger

## 5 Operation Mode and Configuration of EUT

### Operation Mode(s)

- 1 Transmit on 902.75 MHz
- 2 Transmit on 915.25 MHz
- 3 Transmit on 927.25 MHz
- 4 Transmit on all channels (hopping enabled)
- 5 Charging mode (RFID reader switched off automatically by operating system)

### Configuration(s) of EUT

EUT is voltage supplied via accumulator, operation will be done by test software supplied by applicant

### List of ports and cables

| Port | Description | Classification <sup>3</sup> | Cable type | Cable length |
|------|-------------|-----------------------------|------------|--------------|
| --   | --          | --                          | --         | --           |

### List of devices connected to EUT

| Item | Description         | Type Designation | Serial no. or ID | Manufacturer |
|------|---------------------|------------------|------------------|--------------|
| 1    | Transponder 902 MHz | Unique           | N/A              | --           |

### List of support devices

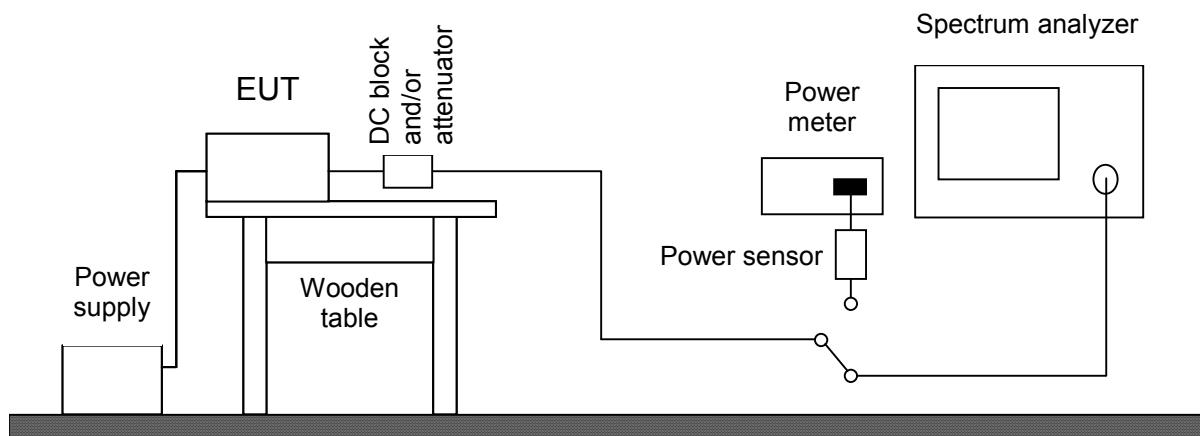
| Item | Description | Type Designation | Serial no. or ID | Manufacturer        |
|------|-------------|------------------|------------------|---------------------|
| 1    | Cradle Dock | CRD9000-1001SR   | 12153000500777   | Symbol Technologies |
| 2    | AC Adapter  | PWRS-14000-148R  | F33351234012660  | HIPRO               |

<sup>3</sup> Ports shall be classified as ac power, dc power or signal/control port

## 6 Measurement Procedures

### 6.1 Conducted Output Power

| <b>Measurement Procedure: (radiated)</b>   |   |
|--|---|
| Rules and specifications:  | CFR 47 Part 15, section 15.247 (b) (2)<br>IC RSS-Gen Issue 3 [5] or IC RSS-210 Issue 8 [4], section A8.4 (1) [4]                                      |
| Measurement setup:   | <input type="checkbox"/> Conducted: See below<br><input checked="" type="checkbox"/> Radiated: Radiated Emission in Fully or Semi Anechoic Room (6.5) |
| If antenna conducted tests cannot be performed on this device, radiated tests to show compliance with the peak output power limit specified in Section 15.247(b) and the spurious RF conducted emission limit specified in Section 15.247(c) are acceptable. (According Public Notice DA 00-0705)  |   |
| Conducted output power is measured at the RF output terminals (e.g. antenna connector if antenna is detachable) when the transmitter is adjusted in accordance with the tune-up procedure, if applicable. The RF output terminals are connected to a spectrum analyzer and/or a power meter with appropriate sensor. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). The electrical characteristics of the radio frequency load attached to the output terminals shall be stated, if applicable. |   |
| If a spectrum analyzer is used and no other settings are specified resolution bandwidth shall be selected according to the carrier frequency $f_c$ and set to 10 kHz ( $150 \text{ kHz} \leq f_c < 30 \text{ MHz}$ ), 100 kHz ( $30 \text{ MHz} \leq f_c < 1 \text{ GHz}$ ) or 1 MHz ( $f_c \geq 1 \text{ GHz}$ ). The video bandwidth shall be at least three times greater than the resolution bandwidth. The settings used have to be indicated within the appropriate test record(s).  |   |



Test instruments used:

| Used                                | Type              | Model   | Serial No. or ID | Manufacturer    |
|-------------------------------------|-------------------|---------|------------------|-----------------|
| <input checked="" type="checkbox"/> | Spectrum Analyzer | FSP 30  | 100063           | Rohde & Schwarz |
| <input type="checkbox"/>            | EMI test receiver | ESPI7   | 836914/0002      | Rohde & Schwarz |
| <input type="checkbox"/>            | EMI test receiver | ESMI    | 839379/013       | Rohde & Schwarz |
|                                     |                   |         | 839587/006       |                 |
| <input type="checkbox"/>            | Power meter       | NRVS    | 836856/015       | Rohde & Schwarz |
| <input type="checkbox"/>            | Peak power sensor | NRV-Z31 | 8579604.03       | Rohde & Schwarz |
| <input type="checkbox"/>            | Power sensor      | NRV-Z52 | 837901/030       | Rohde & Schwarz |
| <input type="checkbox"/>            | Power sensor      | NRV-Z4  | 863828/015       | Rohde & Schwarz |
| <input type="checkbox"/>            | DC-block          | 7006    | A2798            | Weinschel       |
| <input checked="" type="checkbox"/> | Attenuator        | 4776-10 | 9412             | Narda           |
| <input type="checkbox"/>            | Attenuator        | 4776-20 | 9503             | Narda           |

## 6.2 Bandwidth Measurements

| <b>Measurement Procedure:</b>   |   |
|---|---|
| Rules and specifications:   | CFR 47 Part 15, section 15.247 (a) (1) (i)<br>IC RSS-Gen Issue 3 [5] or IC RSS-210 Issue 8 [4], section A8.1 (c) [4]                                  |
| Measurement setup:  | <input type="checkbox"/> Conducted: See below<br><input checked="" type="checkbox"/> Radiated: Radiated Emission in Fully or Semi Anechoic Room (6.5) |
| If antenna is detachable bandwidth measurements shall be performed at the antenna connector (conducted measurement) when the transmitter is adjusted in accordance with the tune-up procedure, if applicable. The RF output terminals are connected to a spectrum analyzer. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). The electrical characteristics of the radio frequency load attached to the output terminals shall be stated, if applicable. |   |
| If radiated measurements are performed the same test setups and instruments are used as with radiated emission measurements for the appropriate frequency range.  |   |
| The analyzer settings are specified by the test description of the appropriate test record(s).  |   |

### 6.3 Conducted AC Powerline Emission

#### Measurement Procedure:

Rules and specifications: CFR 47 Part 15, section 15.207 (a)  
 IC RSS-Gen Issue 3 [5] or IC RSS-210 Issue 8 [4], section 7.2.4 [5]

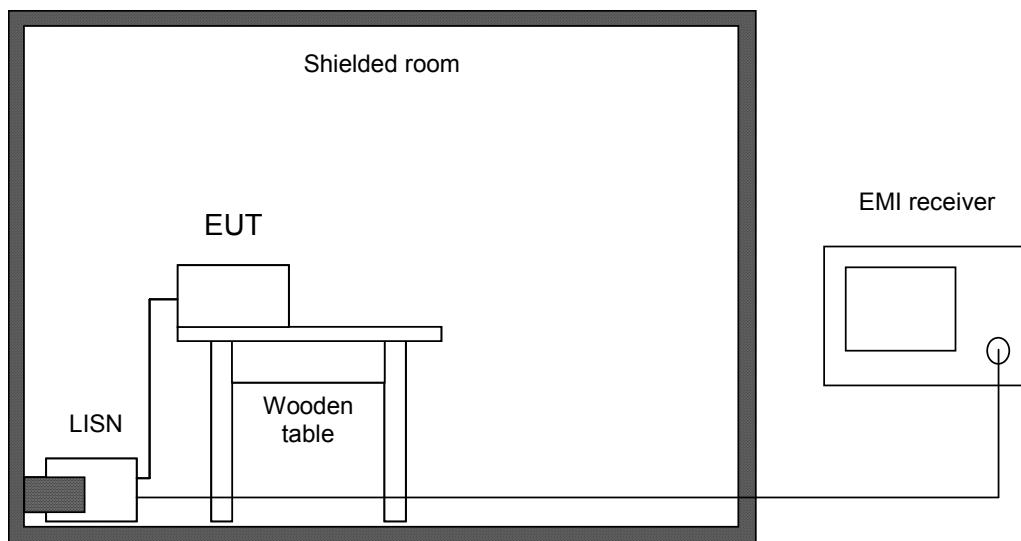
Conducted emission tests in the frequency range 150 kHz to 30 MHz are performed using Line Impedance Stabilization Networks (LISNs). To simplify testing with quasi-peak and average detector the following procedure is used:

First the whole spectrum of emission caused by the equipment under test (EUT) is recorded with detector set to peak using CISPR bandwidth of 10 kHz. After that all emission levels having less margin than 10 dB to or exceeding the average limit are retested with detector set to quasi-peak.

If average limit is kept with quasi-peak levels no additional scan with average detector is necessary. In cases of emission levels between quasi-peak and average limit an additional scan with detector set to average is performed.

According to ANSI C63.4, section 13.1.3.1, testing of intentional radiators with detachable antenna shall be performed using a suitable dummy load connected to the antenna output terminals. Otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended.

Testing with dummy load may be necessary to distinguish (unintentional) conducted emissions on the supply lines from (intentional) emissions radiated by the antenna and coupling directly to supply lines and/or LISN. Usage of dummy load has to be stated in the appropriate test record(s) and notes should be added to clarify the test setup.



Test instruments used:

| Used                                | Type                     | Model    | Serial No. or ID | Manufacturer       |
|-------------------------------------|--------------------------|----------|------------------|--------------------|
| <input checked="" type="checkbox"/> | EMI receiver             | ESHS 10  | 860043/016       | Rohde & Schwarz    |
| <input checked="" type="checkbox"/> | LISN                     | ESH3-Z5  | 862770/021       | Rohde & Schwarz    |
| <input type="checkbox"/>            | LISN                     | ESH3-Z5  | 830952/025       | Rohde & Schwarz    |
| <input type="checkbox"/>            | Artificial mains network | ESH 2-Z5 | 842966/004       | Rohde & Schwarz    |
| <input type="checkbox"/>            | Shielded room            | No. 1    | 1451             | Albatross Projects |
| <input checked="" type="checkbox"/> | Shielded room            | No. 4    | 3FD-100 544      | Euroshield         |

## 6.4 Radiated Emission Measurement 9 kHz to 30 MHz

### Measurement Procedure:

Rules and specifications: CFR 47 Part 15, section 15.247 (d), 15.205 (a), 15.209 (a), IC RSS-Gen Issue 3 [5] or IC RSS-210 Issue 8 [4], section A8.5 [4], 2.5 [4], 7.2.2 [5]

Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. This configuration is also used for recording the spectrum of intentional radiators.

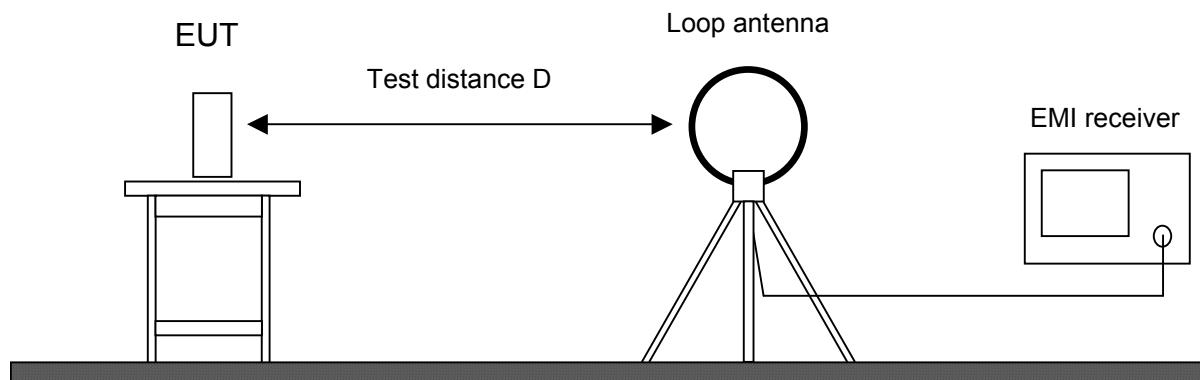
Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

If worst case emission of the EUT cannot be recorded with EUT in standard position and loop antenna in vertical polarization the EUT (or the radiating part of the EUT) is rotated by 90 degrees instead of changing the loop antenna to horizontal polarization. This procedure is selected to minimize the influence of the environment (e.g. effects caused by the floor especially with longer distances).

Final measurement is performed at a test distance D of 30 meters using an open field test site. In case the regulation requires testing at other distances, the result is extrapolated by either making measurements at an additional distance D of 10 meters to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). In cases of very low emissions measurements are performed at shorter distances and results are extrapolated to the required distance. The provisions of CFR 47 Part 15 sections 15.31(d) and (f)(2) apply. According to CFR 47 Part 15 section 15.209(d) final measurement is performed with detector function set to quasi-peak except for the frequency bands 9 to 90 kHz and 110 to 490 kHz where, for non-pulsed operation, average detector is employed.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.



Test instruments used:

| Used                                | Type                 | Model    | Serial No. or ID         | Manufacturer       |
|-------------------------------------|----------------------|----------|--------------------------|--------------------|
| <input checked="" type="checkbox"/> | Spectrum Analyzer    | FSP 30   | 100063                   | Rohde & Schwarz    |
| <input type="checkbox"/>            | EMI test receiver    | ESMI     | 839379/013<br>839587/006 | Rohde & Schwarz    |
| <input checked="" type="checkbox"/> | Test receiver        | ESHS 10  | 860043/016               | Rohde & Schwarz    |
| <input type="checkbox"/>            | Preamplifier         | CPA9231A | 3393                     | Schaffner          |
| <input type="checkbox"/>            | Loop antenna         | HFH2-Z2  | 882964/1                 | Rohde & Schwarz    |
| <input checked="" type="checkbox"/> | Fully anechoic room  | No. 2    | 1452                     | Albatross Projects |
| <input type="checkbox"/>            | Semi-anechoic room   | No. 3    | 1453                     | Siemens            |
| <input checked="" type="checkbox"/> | Open field test site | EG 1     | 1450                     | Senton             |

## 6.5 Radiated Emission in Fully or Semi Anechoic Room

### Measurement Procedure:

Rules and specifications: CFR 47 Part 15, section 15.247 (d), 15.205 (a), 15.209 (a),  
IC RSS-Gen Issue 3 [5] or IC RSS-210 Issue 8 [4],  
section A8.5 [4], 2.5 [4], 7.2.2 [5]

Radiated emission in fully or semi anechoic room is measured in the frequency range from 30 MHz to the maximum frequency as specified in CFR 47 Part 15 section 15.33.

Measurements are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 100 kHz (below 1 GHz) or 1 MHz (above 1 GHz).

Testing up to 1 GHz is performed with a linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna"). For testing above 1 GHz horn antennas are used.

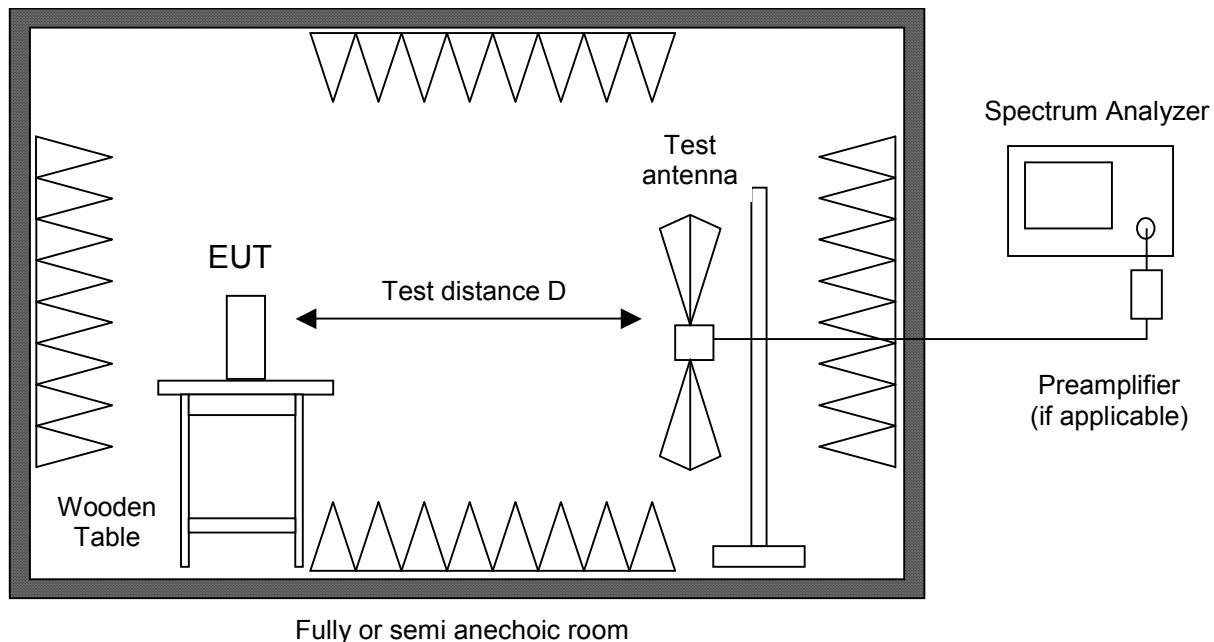
All tests below 18 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance is reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation factor of 20 dB/decade. If required, preamplifiers are used for the whole frequency range. Special care is taken to avoid overload, using appropriate attenuators and filters, if necessary.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

During testing the EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

For final testing below 1 GHz an open field test-site is used and the plots recorded in the fully or semi anechoic room are indicated as prescans.



Test instruments used:

| Used                                | Type                     | Model                | Serial No. or ID         | Manufacturer       |
|-------------------------------------|--------------------------|----------------------|--------------------------|--------------------|
| <input checked="" type="checkbox"/> | Spectrum Analyzer        | FSP 30               | 100063                   | Rohde & Schwarz    |
| <input type="checkbox"/>            | Spectrum analyzer        | R 3271               | 05050023                 | Advantest          |
| <input type="checkbox"/>            | EMI test receiver        | ESMI                 | 839379/013<br>839587/006 | Rohde & Schwarz    |
| <input checked="" type="checkbox"/> | Preamplifier             | CPA9231A             | 3393                     | Schaffner          |
| <input type="checkbox"/>            | Preamplifier             | R14601               |                          | Advantest          |
| <input checked="" type="checkbox"/> | Preamplifier 1-8 GHz     | AFS3-00100800-32-LN  | 847743                   | Miteq              |
| <input type="checkbox"/>            | Preamplifier 0.5-8 GHz   | AMF-4D-005080-25-13P | 860149                   | Miteq              |
| <input checked="" type="checkbox"/> | Preamplifier 8-18 GHz    | ACO/180-3530         | 32641                    | CTT                |
| <input type="checkbox"/>            | External Mixer           | WM782A               | 845881/005               | Tektronix          |
| <input type="checkbox"/>            | Harmonic Mixer           | FS-Z30               | 843389/007               | Rohde & Schwarz    |
|                                     | Accessories              |                      |                          |                    |
| <input checked="" type="checkbox"/> | Trilog broadband antenna | VULB 9163            | 9163-188                 | Schwarzbeck        |
| <input checked="" type="checkbox"/> | Horn antenna             | 3115                 | 9508-4553                | EMCO               |
| <input type="checkbox"/>            | Horn antenna             | 3160-03              | 9112-1003                | EMCO               |
| <input checked="" type="checkbox"/> | Horn antenna             | 3160-04              | 9112-1001                | EMCO               |
| <input checked="" type="checkbox"/> | Horn antenna             | 3160-05              | 9112-1001                | EMCO               |
| <input checked="" type="checkbox"/> | Horn antenna             | 3160-06              | 9112-1001                | EMCO               |
| <input checked="" type="checkbox"/> | Horn antenna             | 3160-07              | 9112-1008                | EMCO               |
| <input type="checkbox"/>            | Horn antenna             | 3160-08              | 9112-1002                | EMCO               |
| <input type="checkbox"/>            | Horn antenna             | 3160-09              | 9403-1025                | EMCO               |
| <input type="checkbox"/>            | Horn antenna             | 3160-10              | 399185                   | EMCO               |
| <input checked="" type="checkbox"/> | Fully anechoic room      | No. 2                | 1452                     | Albatross Projects |
| <input type="checkbox"/>            | Semi-anechoic room       | No. 3                | 1453                     | Siemens            |

## 6.6 Radiated Emission at Alternative Test Site

### Measurement Procedure:

Rules and specifications: CFR 47 Part 15, section 15.247 (d), 15.205 (a), 15.209 (a),  
IC RSS-Gen Issue 3 [5] or IC RSS-210 Issue 8 [4],  
section A8.5 [4], 2.5 [4], 7.2.2 [5]

Radiated emission in the frequency range 30 MHz to 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4 for alternative test sites. A linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used. The measurement bandwidth of the test receiver is set to 120 kHz with quasi-peak detector selected.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are tested in the position producing the highest emission relative to the limit as verified by prescans in fully anechoic room.

If no prescan in a fully anechoic room is used first a peak scan is performed in four positions to get the whole spectrum of emission caused by EUT with the measuring antenna raised and lowered from 1 to 4 m to find table position, antenna height and antenna polarization for the maximum emission levels.

Data reduction is applied to these results to select those levels having less margin than 10 dB to or exceeding the limit using subranges and limited number of maximums. Further maximization is following.

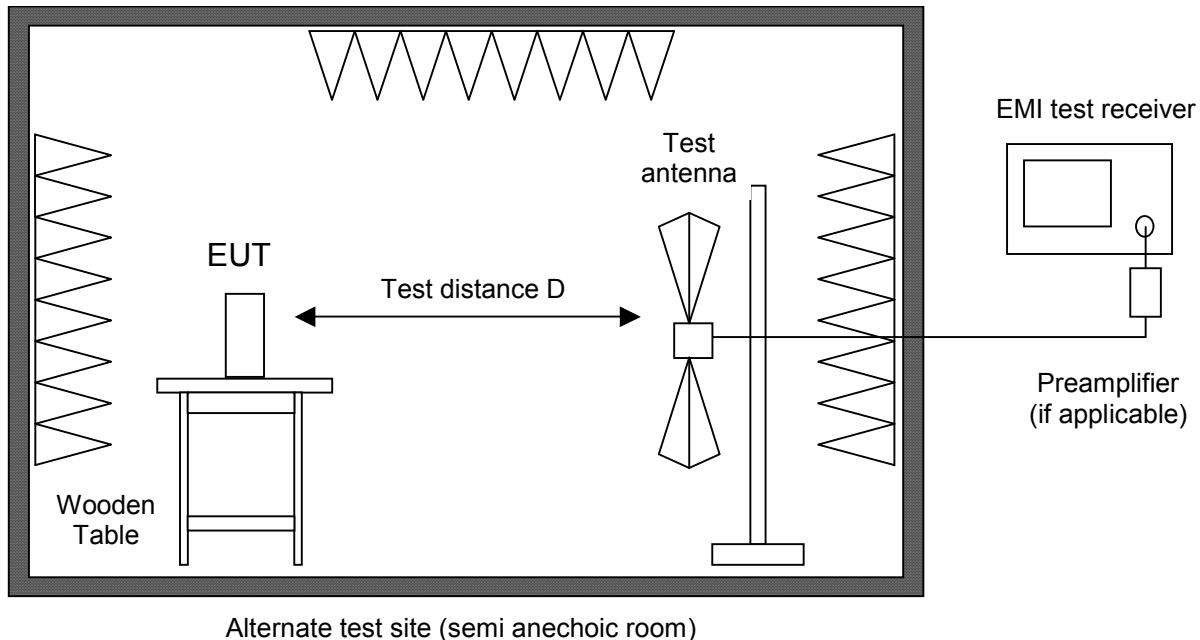
With detector of the test receiver set to quasi-peak final measurements are performed immediately after frequency zoom (for drifting disturbances) and maximum adjustment.

Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

In cases where prescans in a fully anechoic room are taken (e. g. if EUT is operating for a short time only or battery is discharged quickly) final measurements with quasi-peak detector are performed manually at frequencies indicated by prescan with EUT rotating all around and receiving antenna raising and lowering within 1 meter to 4 meters to find the maximum levels of emission.

Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

For measuring emissions of intentional radiators and receivers a test distance D of 3 meters is selected. Testing of unintentional radiators is performed at a distance of 10 meters. If limits specified for 3 meters shall be used for measurements performed at 10 meters distance the limits are calculated according to CFR 47 Part 15 section 15.31(d) and (f)(1) using an inverse linear-distance extrapolation factor of 20 dB/decade.



Alternate test site (semi anechoic room)

Test instruments used:

| Type  | Designation | Inv.-no. | Serial No. or ID | Manufacturer    |
|---|-------------|----------|------------------|-----------------|
| <input type="checkbox"/> EMI test receiver  | ESU8        | 2044     | 100232           | Rohde & Schwarz |
| <input type="checkbox"/> Trilog antenna     | Cabin no. 8 | 1802     | 9163-214         | Schwarzbeck     |
| <input type="checkbox"/> Semi anechoic room | No. 8       | 2057     | ---              | Albatross       |

## 7 Photographs Taken During Testing

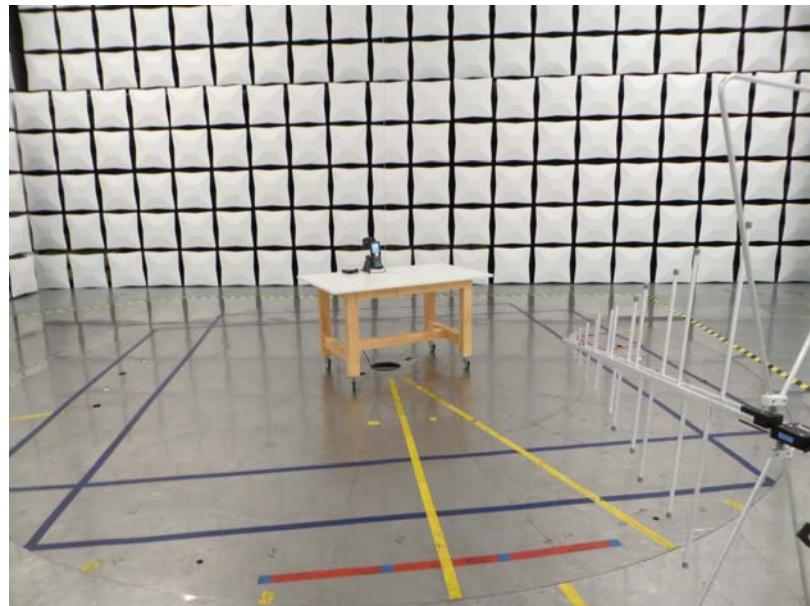
## Test setup for conducted AC powerline emission measurement



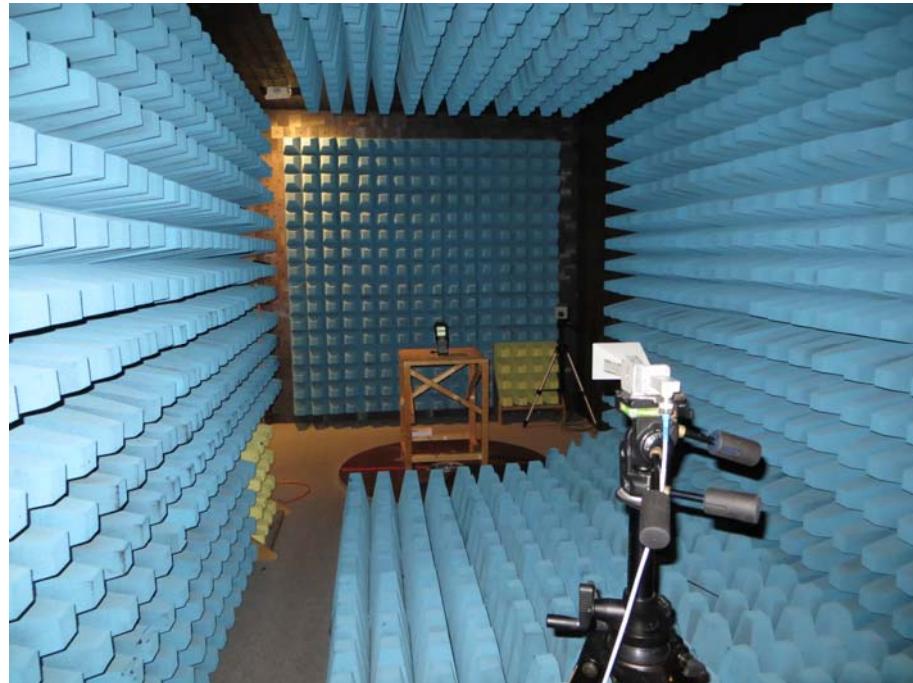
### Test setup for radiated emission measurement 9 kHz – 30 MHz



## Test setup for radiated emission measurement (Semi anechoic room)



## Test setup for radiated emission measurement (fully anechoic room)



## Test Results

| <b>FCC CFR 47 Parts 15 [2]</b>      |  |             |                    |
|-------------------------------------|--|-------------|--------------------|
| <i>Section(s)</i>                   | <i>Test</i>  | <i>Page</i> | <i>Result</i>      |
| 2.202(a)                            | Occupied bandwidth                                   | 27          | Recorded           |
| 15.204                              | Antenna requirement                                  | ---         | Integrated Antenna |
| 15.247 (a) (1) (i)                  | Channel Bandwidth                                    | 31          | Test passed        |
| 2.201, 2.202                        | Class of emission                                    | 35          | Calculated         |
| 15.247(a)(1)                        | Hopping channel separation                           | 39          | Test passed        |
| 15.247(a)(1)(i)                     | Number of hopping frequencies used                   | 42          | Test passed        |
| 15.247(a)(1)(i)                     | Time occupancy on any channel                        | 44          | Test passed        |
| 15.247(b)(2)                        | Maximum peak output power                            | 46          | Test passed        |
| 15.207                              | Conducted AC powerline emission<br>150 kHz to 30 MHz | 49          | Test passed        |
| 15.205(a)<br>15.209(a)<br>15.247(d) | Radiated emission<br>9 kHz to 10 GHz                 | 51          | Test passed        |
| 15.247(i)<br>2.1093                 | RF exposure requirement                              | 68          | Test passed        |

**IC RSS-210 Issue 8 [4] / RSS Gen Issue 3 [5]**

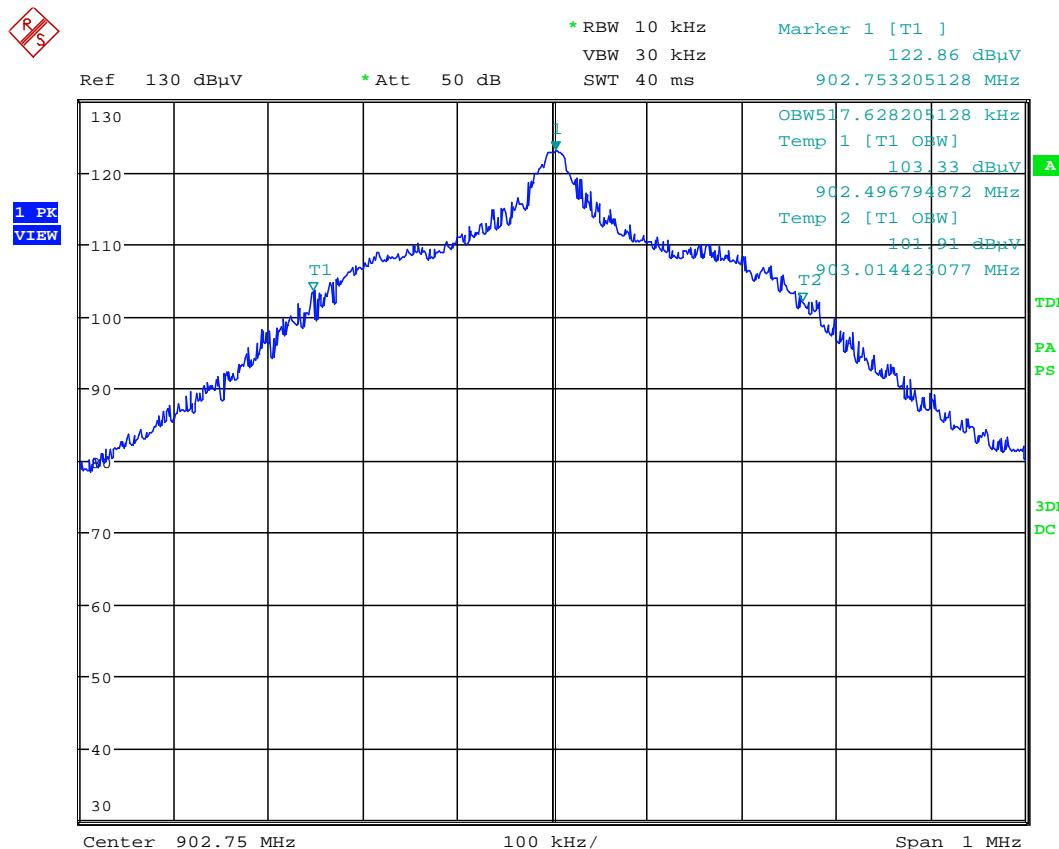
| Section(s)           | Test  | Page | Result                                    |
|----------------------|---|------|---|
| 4.6.1                | Occupied Bandwidth                                | 27   | Recorded                                  |
| 7.1.4                | Antenna requirement                               | ---  | Integrated antenna                        |
| A8.1(c)              | Channel bandwidth                                 | 31   | Test passed                               |
| 3.2(h), 8            | Designation of emissions                          | 35   | Calculated                                |
| A8.1(b)              | Hopping channel separation                        | 39   | Test passed                               |
| A8.1(c)              | Number of hopping frequencies used                | 42   | Test passed                               |
| A8.1(c)              | Time occupancy on any channel                     | 44   | Test passed                               |
| A8.4(1)              | Maximum peak output power                         | 46   | Test passed                               |
| 7.2.4                | Conducted AC powerline emission 150 kHz to 30 MHz | 49   | Test passed                               |
| 7.2.2<br>2.5<br>A8.5 | Radiated emission<br>9 kHz to 10 GHz              | 51   | Test passed                               |
| 5.5                  | Exposure of Humans to RF Fields                   | 68   | Exempted from<br>SAR and RF<br>evaluation |

## 7.1 Occupied Bandwidth

| Rules and specifications: | IC RSS-Gen Issue 3, section 4.6.1   |                       |                              |                 |       |                    |        |                    |         |
|---------------------------|---|-----------------------|------------------------------|-----------------|-------|--------------------|--------|--------------------|---------|
| Description:              | <p>The occupied bandwidth according to CFR 47 Part 2, section 2.202(a), is measured as the 99% emission bandwidth, i.e. below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5% of the total mean power radiated by a given emission.</p> <p>The occupied bandwidth according to ANSI C63.4, annex H.6; is measured as the frequency range defined by the points that are 26 dB down relative to the maximum level of the modulated carrier.</p> <p>The resolution bandwidth of the spectrum analyzer shall be set to a value greater than 5.0% of the allowed bandwidth. If no bandwidth specifications are given, the following guidelines are used:</p> <table border="1"><thead><tr><th>Fundamental frequency</th><th>Minimum resolution bandwidth</th></tr></thead><tbody><tr><td>9 kHz to 30 MHz</td><td>1 kHz</td></tr><tr><td>30 MHz to 1000 MHz</td><td>10 kHz</td></tr><tr><td>1000 MHz to 40 GHz</td><td>100 kHz</td></tr></tbody></table> <p>The video bandwidth shall be at least three times greater than the resolution bandwidth.</p> | Fundamental frequency | Minimum resolution bandwidth | 9 kHz to 30 MHz | 1 kHz | 30 MHz to 1000 MHz | 10 kHz | 1000 MHz to 40 GHz | 100 kHz |
| Fundamental frequency     | Minimum resolution bandwidth  |                       |                              |                 |       |                    |        |                    |         |
| 9 kHz to 30 MHz           | 1 kHz   |                       |                              |                 |       |                    |        |                    |         |
| 30 MHz to 1000 MHz        | 10 kHz  |                       |                              |                 |       |                    |        |                    |         |
| 1000 MHz to 40 GHz        | 100 kHz   |                       |                              |                 |       |                    |        |                    |         |
| Measurement procedure:    | Bandwidth Measurements (6.2)  |                       |                              |                 |       |                    |        |                    |         |

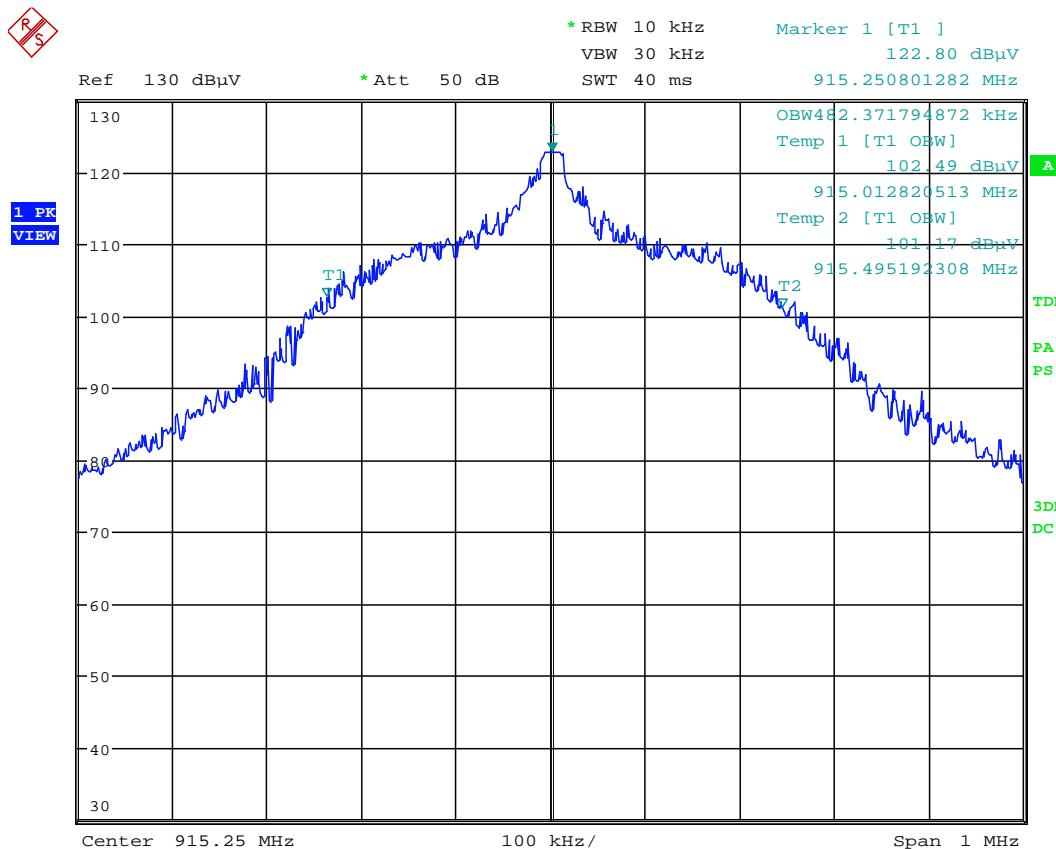
|               |                                  |
|---------------|----------------------------------|
| Comment:      | Operating mode 1 & 2 & 3         |
| Date of test: | September 6, 2013                |
| Test site:    | Fully anechoic room, cabin no. 2 |

## Operating mode 1:



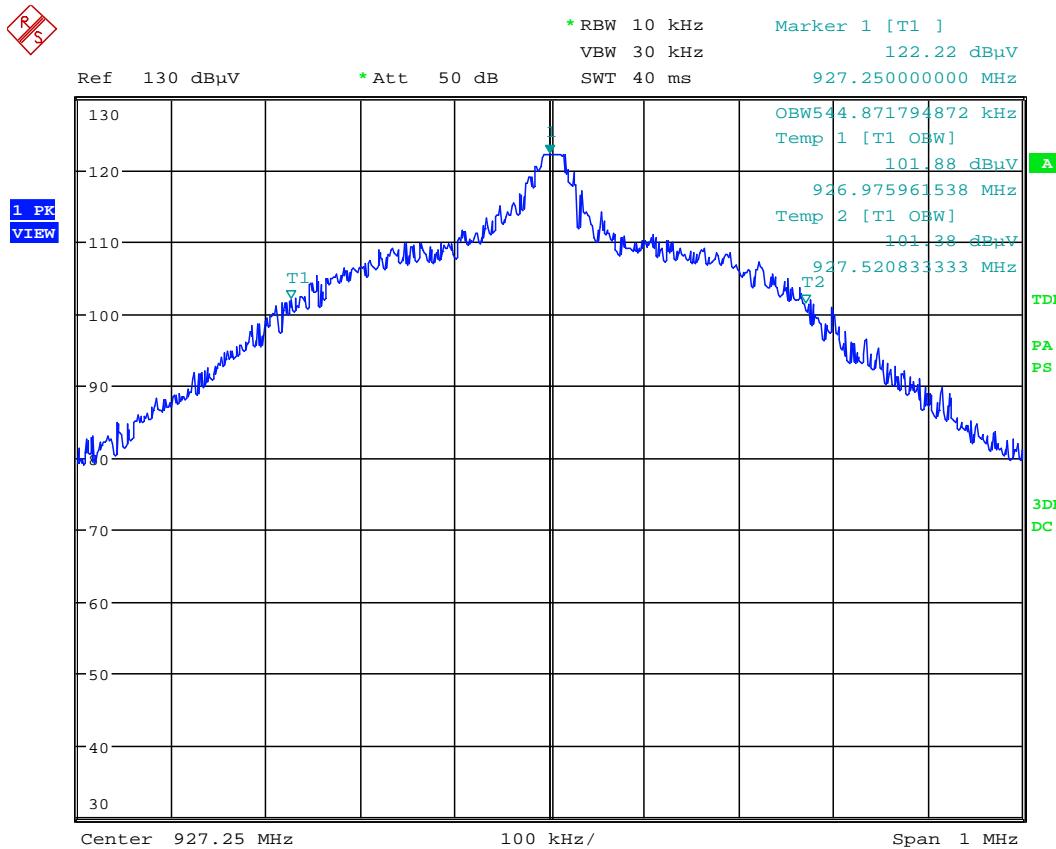
Occupied Bandwidth (99 %): **517.6 kHz**

## Operating mode 2:



Occupied Bandwidth (99 %): **482.4 kHz**

### Operating mode 3:



Occupied Bandwidth (99 %): **544.9 kHz**

## 7.2 Bandwidth of the Emission

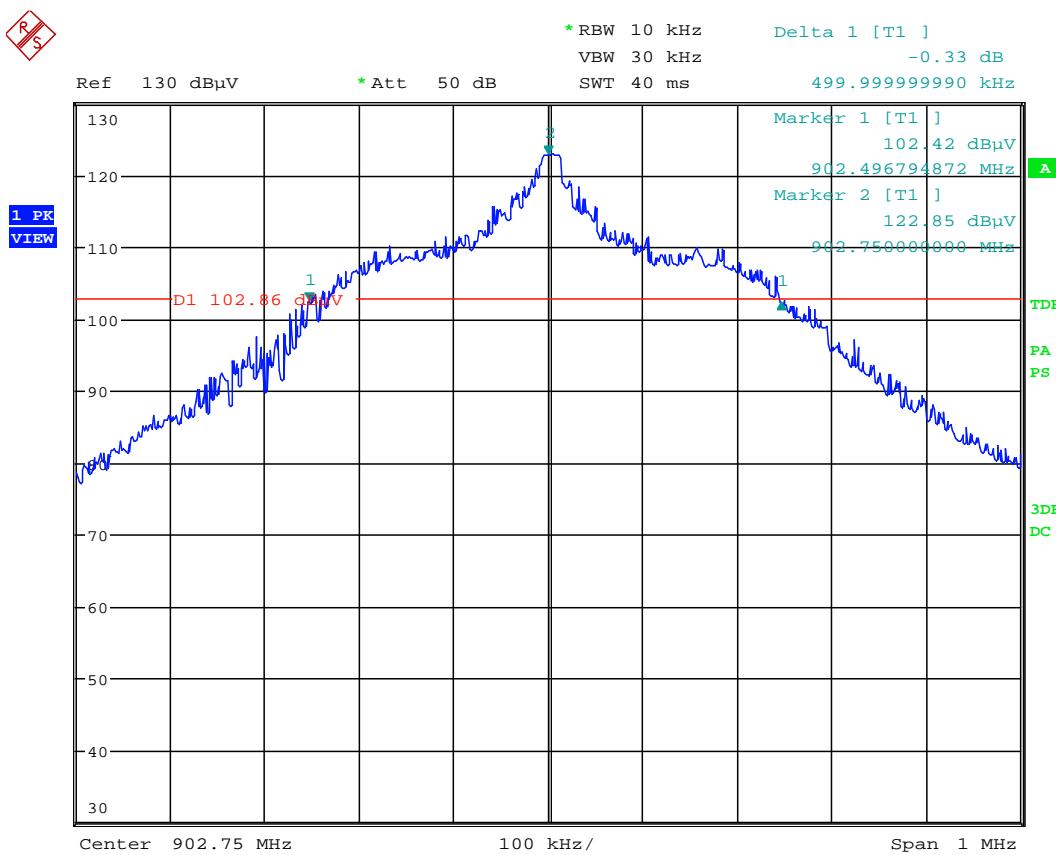
| Rules and specifications: | CFR 47 Part 15, section 15.247 (a) (1) (i)<br>IC RSS-Gen Issue 3 [5] or IC RSS-210 Issue 8 [4], section A8.1 (c) [4]   |                       |                              |                 |       |                    |        |                    |         |
|---------------------------|--|-----------------------|------------------------------|-----------------|-------|--------------------|--------|--------------------|---------|
| Description:              | <p>The 20 dB bandwidth of the emission is measured as the frequency range defined by the points that are 20 dB down relative to the maximum level of the modulated carrier.</p> <p>For intentional radiators operating under the alternative provisions to the general emission limits the requirement to contain the 20 dB bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.</p> <p>The resolution bandwidth of the spectrum analyzer shall be set to a value greater than 5.0% of the allowed bandwidth. If no bandwidth specifications are given, the following guidelines are used:</p> <table border="1"><thead><tr><th>Fundamental frequency</th><th>Minimum resolution bandwidth</th></tr></thead><tbody><tr><td>9 kHz to 30 MHz</td><td>1 kHz</td></tr><tr><td>30 MHz to 1000 MHz</td><td>10 kHz</td></tr><tr><td>1000 MHz to 40 GHz</td><td>100 kHz</td></tr></tbody></table> <p>The video bandwidth shall be at least three times greater than the resolution bandwidth.</p> | Fundamental frequency | Minimum resolution bandwidth | 9 kHz to 30 MHz | 1 kHz | 30 MHz to 1000 MHz | 10 kHz | 1000 MHz to 40 GHz | 100 kHz |
| Fundamental frequency     | Minimum resolution bandwidth   |                       |                              |                 |       |                    |        |                    |         |
| 9 kHz to 30 MHz           | 1 kHz  |                       |                              |                 |       |                    |        |                    |         |
| 30 MHz to 1000 MHz        | 10 kHz   |                       |                              |                 |       |                    |        |                    |         |
| 1000 MHz to 40 GHz        | 100 kHz  |                       |                              |                 |       |                    |        |                    |         |
| Measurement procedure:    | Bandwidth Measurements (6.2)   |                       |                              |                 |       |                    |        |                    |         |

|               |                                  |
|---------------|----------------------------------|
| Comment:      | Operating mode 1 & 2 & 3         |
| Date of test: | September 6, 2013                |
| Test site:    | Fully anechoic room, cabin no. 2 |

## Operating mode 1:

Bandwidth (- 20 dB):

**105.8 kHz**



|                               |                                    |  |
|-------------------------------|------------------------------------|--|
| Permitted frequency band:     | <b>902 – 928 MHz</b>               |  |
| 20 dB bandwidth:              | <b>500 kHz</b>                     |  |
| Carrier frequency stability:  | <input type="checkbox"/> specified | <input checked="" type="checkbox"/> not specified  |
| Maximum frequency tolerances: | <b>+0 kHz</b><br><b>- 0 kHz</b>    |  |
| Bandwidth of the emission:    | <b>500 kHz</b>                     | <b>within permitted frequency band<sup>4</sup>:</b><br><input checked="" type="checkbox"/> yes <input type="checkbox"/> no |

Test Result:

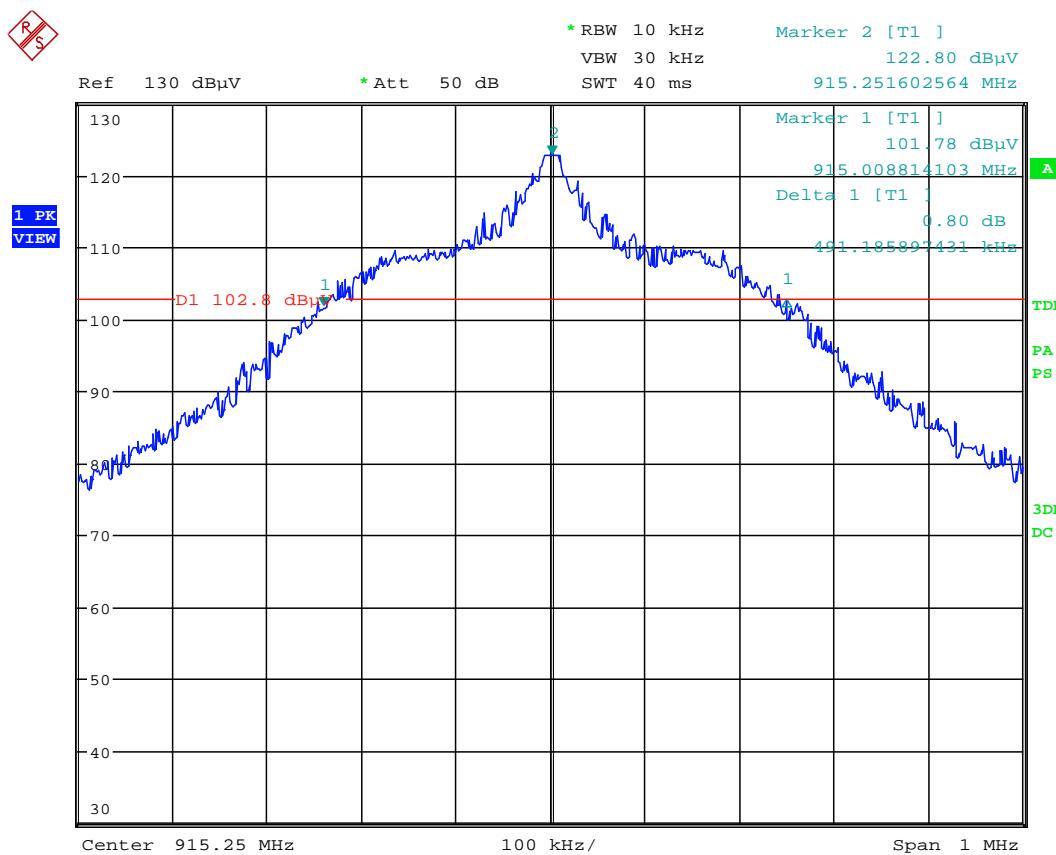
Test passed

<sup>4</sup> If a frequency stability is not specified, it is recommended that the fundamental emission is kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

## Operating mode 2:

Bandwidth (- 20 dB):

**109 kHz**



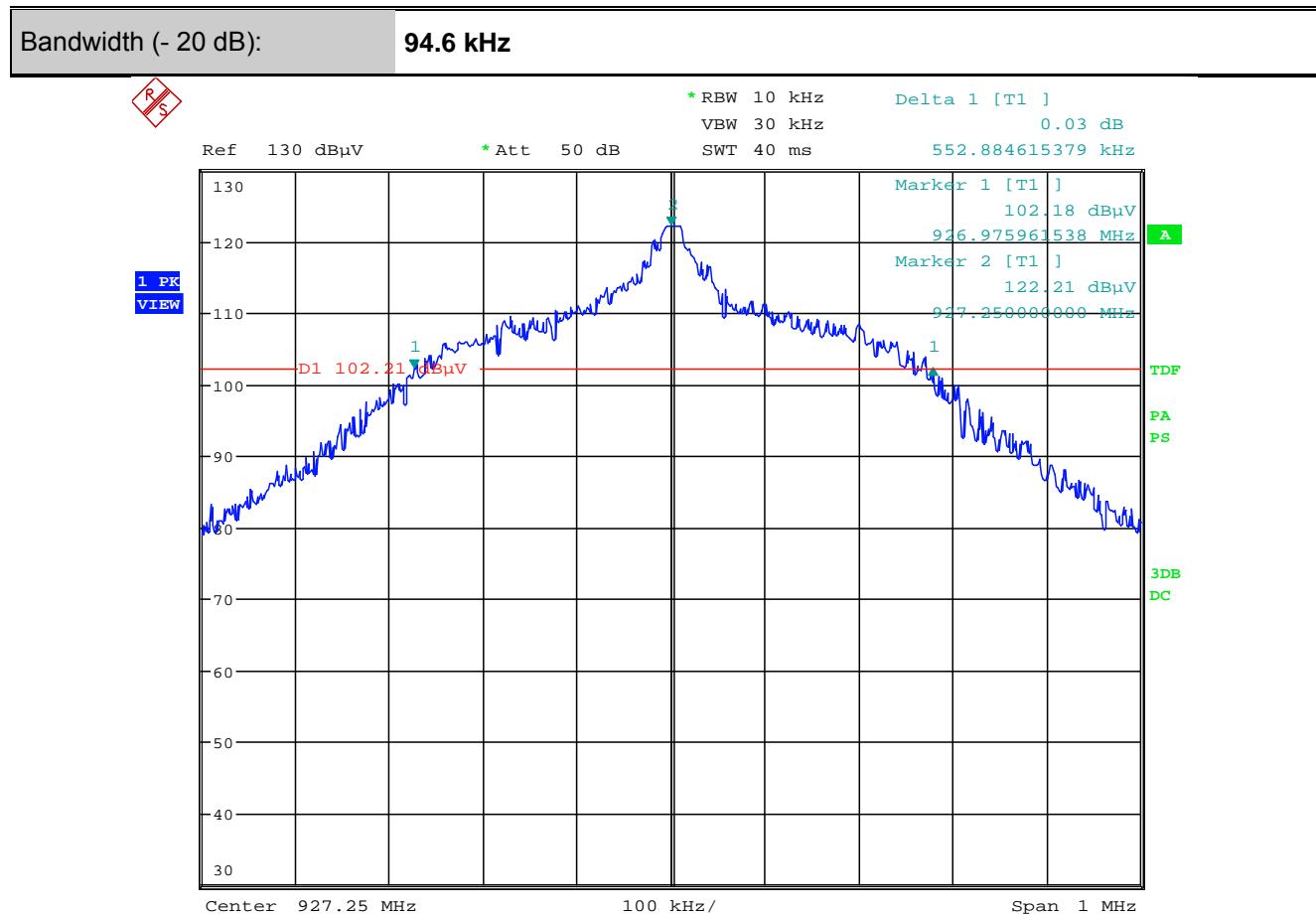
|                               |   |   |
|-------------------------------|---|---|
| Permitted frequency band:     | <b>902 – 928 MHz</b>                                |   |
| 20 dB bandwidth:              | <b>491 kHz</b>                                      |   |
| Carrier frequency stability:  | <input type="checkbox"/> specified                  | <input checked="" type="checkbox"/> not specified |
| Maximum frequency tolerances: | <b>+0 kHz</b><br><b>- 0 kHz</b>                     |   |
| Bandwidth of the emission:    | <b>491 kHz</b>                                      |   |
|                               | <b>within permitted frequency band<sup>5</sup>:</b> |   |
|                               | <input checked="" type="checkbox"/> yes             | <input type="checkbox"/> no                       |

Test Result:

Test passed

<sup>5</sup> If a frequency stability is not specified, it is recommended that the fundamental emission is kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

**Operating mode 3:**



|                               |   |   |
|-------------------------------|---|---|
| Permitted frequency band:     | <b>902 – 928 MHz</b>  |   |
| 20 dB bandwidth:              | <b>553 kHz</b>  |   |
| Carrier frequency stability:  | <input type="checkbox"/> specified  | <input checked="" type="checkbox"/> not specified |
| Maximum frequency tolerances: | +0 kHz<br>- 0 kHz   |   |
| Bandwidth of the emission:    | <b>553 kHz</b> <b>within permitted frequency band<sup>6</sup>:</b><br><input checked="" type="checkbox"/> yes <input type="checkbox"/> no |   |

|              |             |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|

<sup>6</sup> If a frequency stability is not specified, it is recommended that the fundamental emission is kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

### 7.3 Designation of Emissions

|                           |   |
|---------------------------|---|
| Rules and specifications: | CFR 47 Part 2, sections 2.201 and 2.202<br>IC RSS-Gen Issue 3, sections 8 |
| Guide:                    | ANSI C63.4 / TRC-43   |

|                     |                      |
|---------------------|----------------------|
| Type of modulation: | Amplitude Modulation |
|---------------------|----------------------|

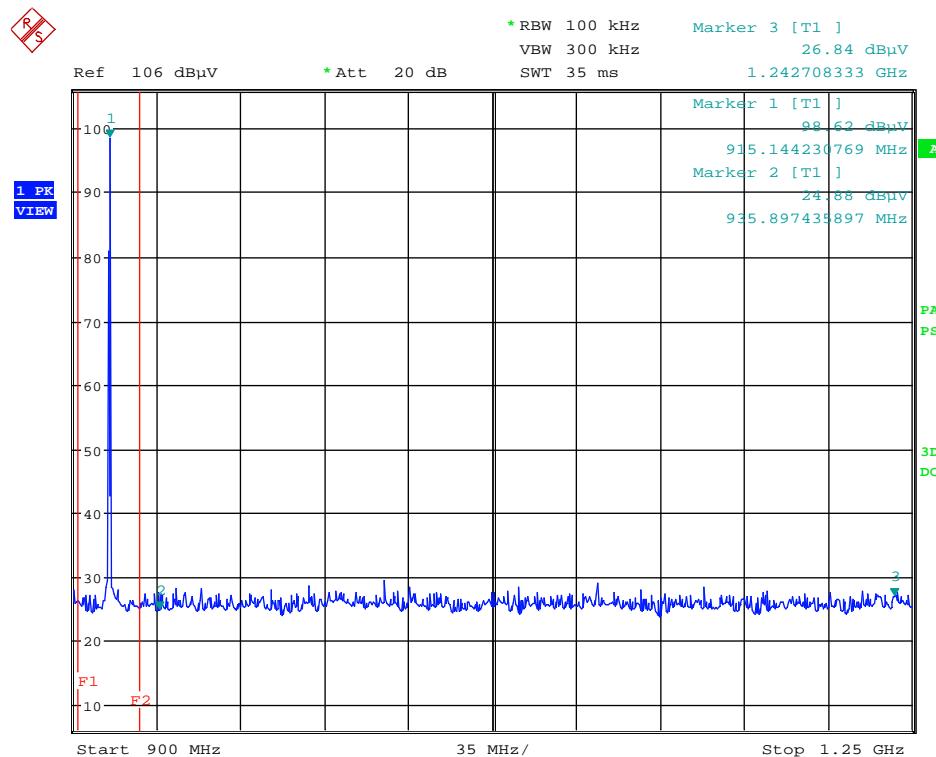
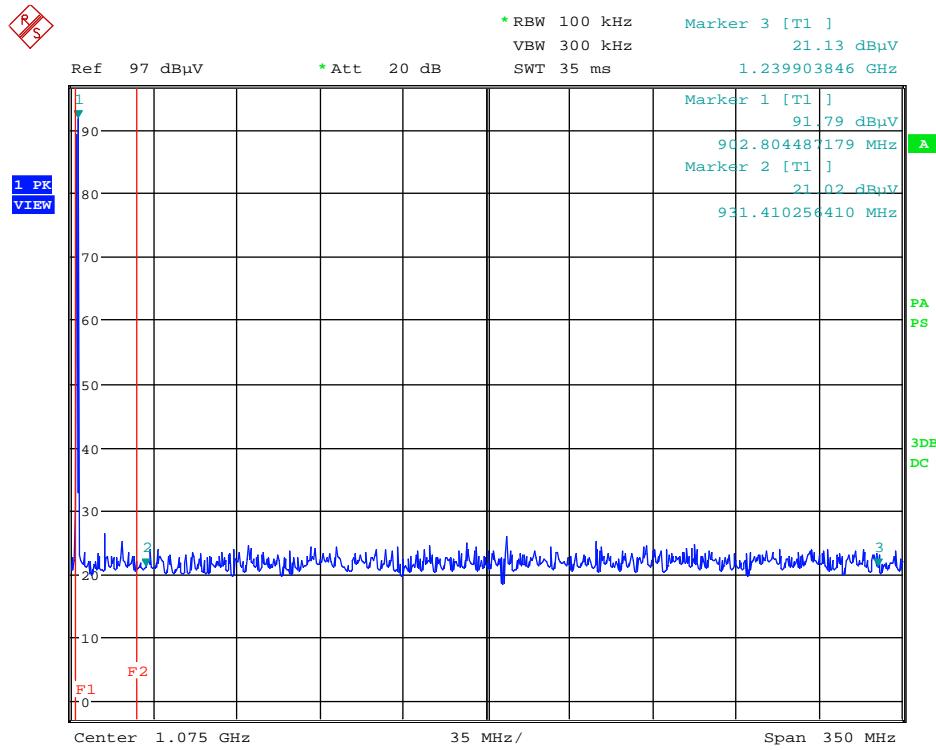
|                                       |   |
|---------------------------------------|---|
| $B_n = \text{Necessary Bandwidth}$    | $B_n = 2BK$   |
| $B = \text{Modulation rate}$          | $B = 40 \text{ kbs} = 20 \text{ kHz}$                     |
| $K = \text{Overall numerical factor}$ | $K = 1$   |
| Calculation:                          | $B_n = 2 \cdot (20 \text{ kHz}) \cdot 1 = 40 \text{ kHz}$ |

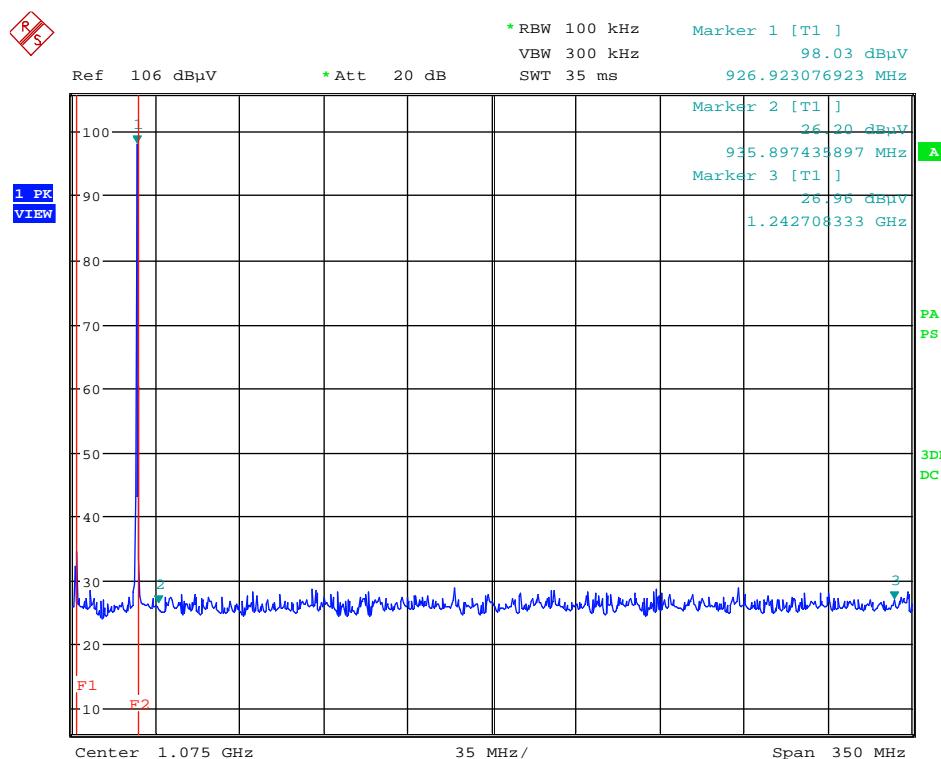
|                           |                |
|---------------------------|----------------|
| Designation of Emissions: | <b>40K0A1D</b> |
|---------------------------|----------------|

## 7.4 Restricted Bands of Operation

| Rules and specifications: | CFR 47 Part 15, section 15.205(a)<br>IC RSS-210 Issue 7, section 2.2(a)  |               |                  |  |
|---------------------------|--|---------------|------------------|--|
| Guide:                    | ANSI C63.4   |               |                  |  |
| Limit:                    | Only spurious emissions are permitted in any of the frequency bands listed in CFR 47 Part 15, section 15.205(a) or IC RSS 210 Issue 7, section 2.2(a). |               |                  |  |
| 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               | 156.7–156.9  | 2483.5–2500   | 17.7–21.4        |  |
| 8.37625–8.38675           | 162.0125–167.17  | 2690–2900     | 22.01–23.12      |  |
| 8.41425–8.41475           | 167.72–173.2   | 3260–3267     | 23.6–24.0        |  |
| 12.29–12.293              |  | 3332–3339     | 31.2–31.8        |  |
| MHz                       | MHz  | MHz           | GHz              |  |
| 12.51975–12.52025         | 240–285  | 3345.8–3358   | 36.43–36.5       |  |
| 12.57675–12.57725         | 322–335.4  | 3600–4400     | ( <sup>2</sup> ) |  |
|                           |  |               |                  |  |
| Measurement procedure:    | Radiated Emission in Fully or Semi Anechoic Room (6.5)   |               |                  |  |

|                |                                  |
|----------------|----------------------------------|
| Comment:       | Operating mode 1 & 2 & 3         |
| Date of test:  | September 6, 2013                |
| Test site:     | Fully anechoic room, cabin no. 2 |
| Test distance: | 3 meters                         |





Test Result:

Test passed

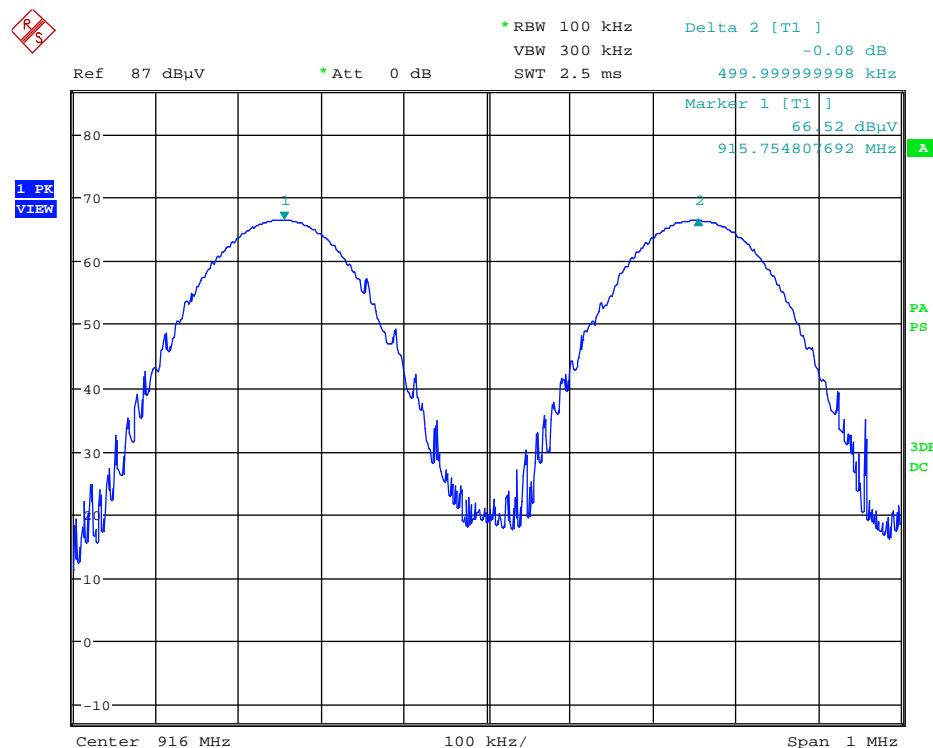
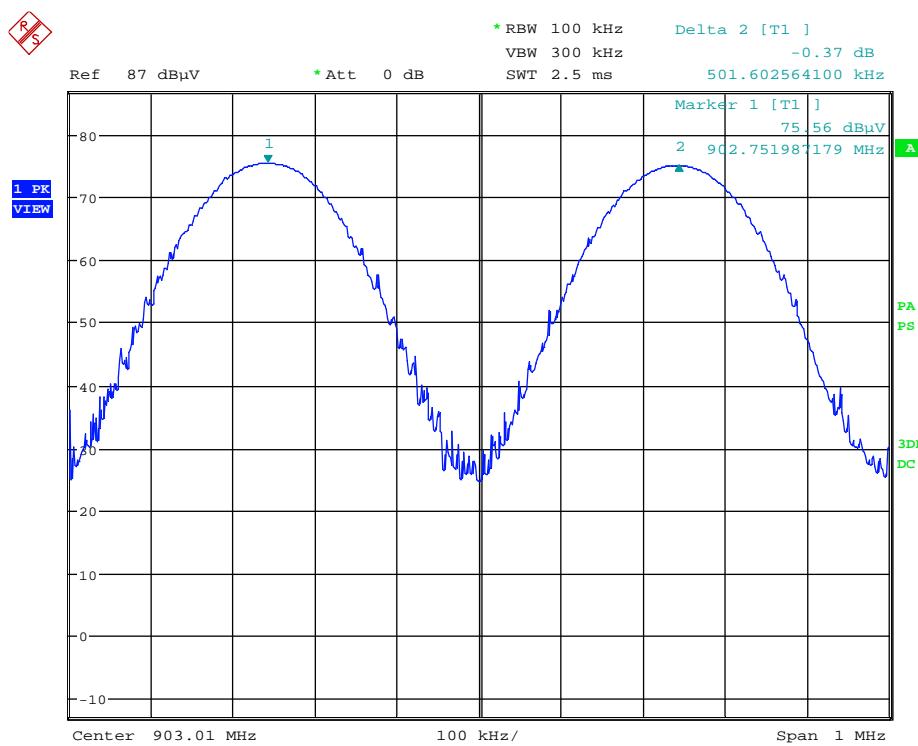
## 7.5 Hopping channel separation

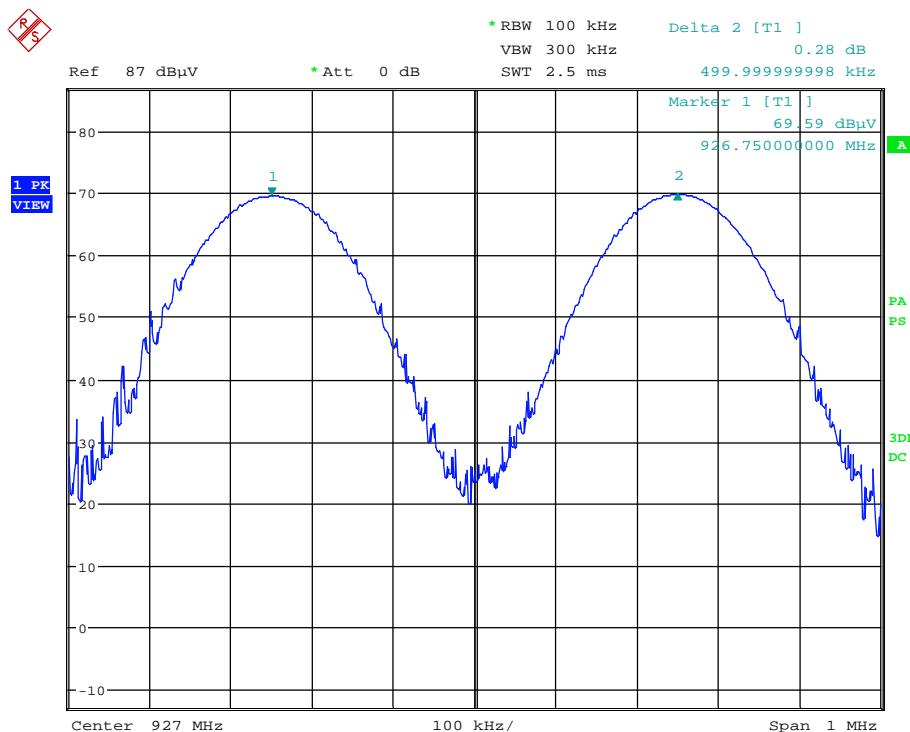
|                           |  |
|---------------------------|--|
| Rules and specifications: | CFR 47 Part 15, section 15.247 (a) (1)<br>IC RSS-210 Issue 8 [4], section A8.1(c)  |
| Limit:                    | Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. |
| Measurement procedure:    | Radiated Emission in Fully or Semi Anechoic Room (6.5)   |

|                |                                  |
|----------------|----------------------------------|
| Comment:       | Operating mode 1 & 2 & 3         |
| Date of test:  | September 6, 2013                |
| Test site:     | Fully anechoic room, cabin no. 2 |
| Test distance: | 3 meters                         |

| Frequency<br>(MHz) | Channel separation<br>(kHz) | Limit<br>(kHz) | Result |
|--------------------|-----------------------------|----------------|--------|
| 902.75             | 502                         | > 105.8        | Pass   |
| 915.25             | 500                         | > 109          | Pass   |
| 927.25             | 500                         | > 94.6         | Pass   |

|              |             |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|





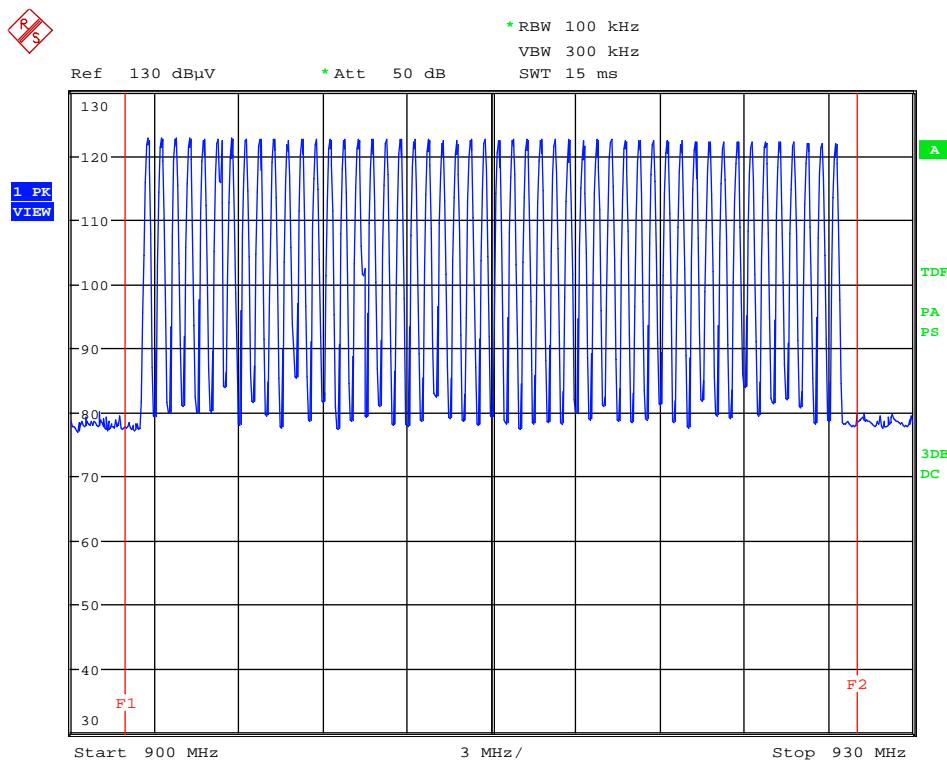
## 7.6 Number of hopping frequencies used

|                           |  |
|---------------------------|--|
| Rules and specifications: | CFR 47 Part 15, section 15.247(a)(1)(i)<br>IC RSS-210 Issue 8, section A8.1(c)[4]  |
| Guide:                    | ANSI C63.4   |
| Limit:                    | If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies. |
| Measurement procedure:    | Radiated Emission in Fully or Semi Anechoic Room (6.5)   |

|                |                                  |
|----------------|----------------------------------|
| Comment:       | Operating mode 4                 |
| Date of test:  | September 6, 2013                |
| Test site:     | Fully anechoic room, cabin no. 2 |
| Test distance: | 3 meters                         |

| Frequencies | Limit | Result |
|-------------|-------|--------|
| 50          | ≥ 50  | Pass   |

|              |             |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|



## 7.7 Time occupancy on any channel

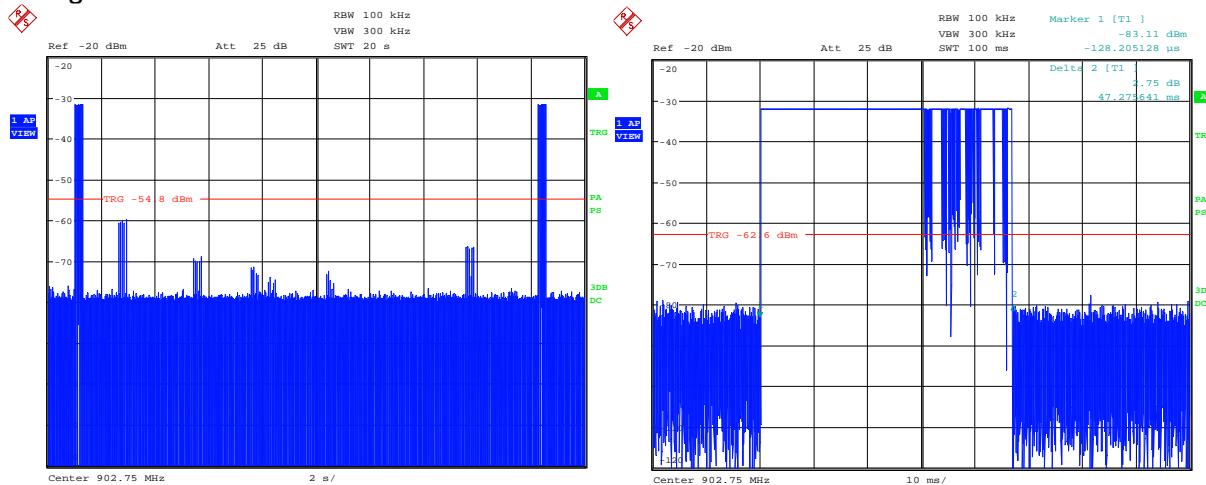
|                           |   |
|---------------------------|---|
| Rules and specifications: | CFR 47 Part 15, section 15.247(a)(1)(i)<br>IC RSS-210 Issue 8, section A8.1(c)[4]   |
| Guide:                    | ANSI C63.4  |
| Limit:                    | If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 seconds period. |
| Measurement procedure:    | Radiated Emission in Fully or Semi Anechoic Room (6.5)  |

|                |   |
|----------------|---|
| Comment:       | Since the EUT uses a cycle-time of approximately 15 s to use all hopping channels the evaluation was taken for 15 s instead of 20 s. Thus the limit for average time occupancy calculates to 0.3 seconds within a 15 second period. |
| Date of test:  | September 6, 2013   |
| Test site:     | Fully anechoic room, cabin no. 2  |
| Test distance: | 3 meters  |

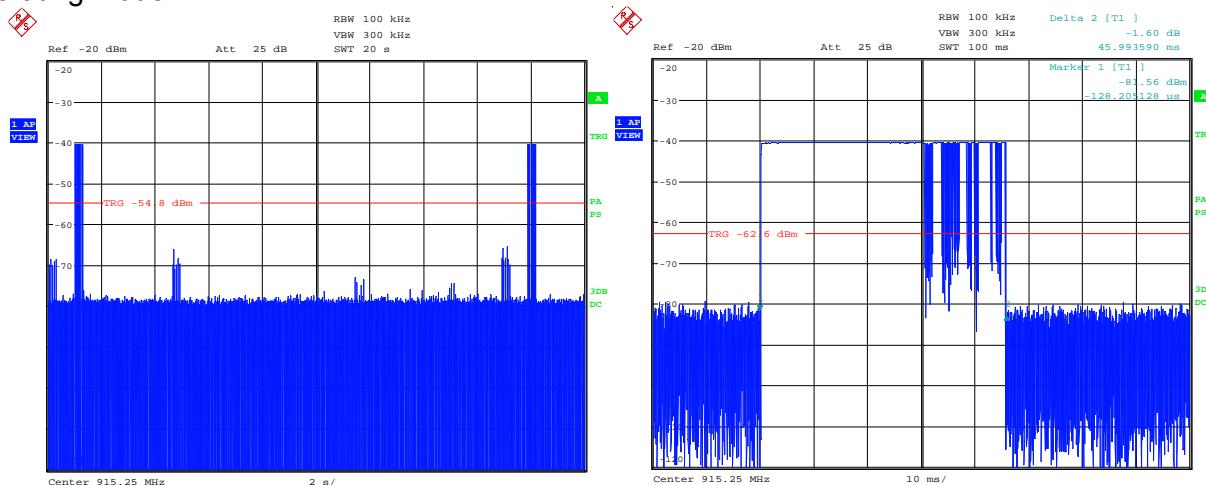
| Frequency (MHz) | Number of transmission in 20 s | Length of transmission time (ms) | Result (ms) | Limit (ms in a 20 s period) |
|-----------------|--------------------------------|----------------------------------|-------------|-----------------------------|
| 902.75          | 2                              | 47.3                             | 94.6        | 400                         |
| 915.25          | 2                              | 46.0                             | 92.0        | 400                         |
| 927.25          | 2                              | 48.2                             | 96.4        | 400                         |

|              |             |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|

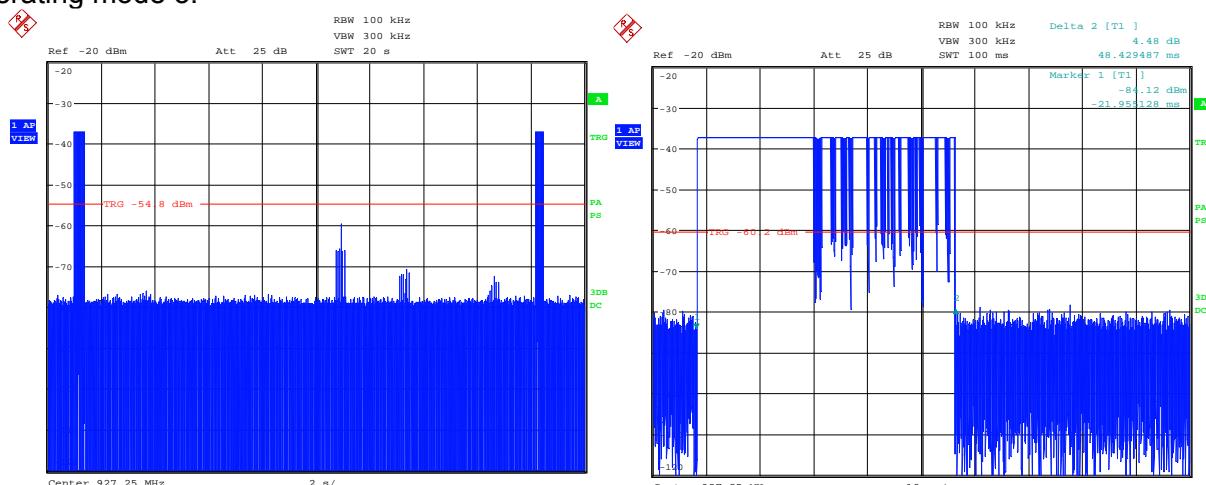
### Operating mode 1:



### Operating mode 2:



### Operating mode 3:



## 7.8 Maximum output power

|                           |  |
|---------------------------|--|
| Rules and specifications: | CFR 47 Part 15, section 15.247(b)(2)<br>IC RSS-210 Issue 8, section A8.4(1)[4]   |
| Guide:                    | ANSI C63.4 / Public Notice DA 00-0705  |
| Limit:                    | The maximum output power is 1 W (30 dBm) for systems employing at least 50 hopping channels; and 0.25 W (24 dBm) for systems employing less than 50 hopping channels but at least 25 hopping channels. |
| Measurement procedure:    | Radiated Output Power  |

|                |                                  |
|----------------|----------------------------------|
| Comment:       | Operating mode 1 & 2 & 3         |
| Date of test:  | September 6, 2013                |
| Test site:     | Fully anechoic room, cabin no. 2 |
| Test distance: | 3 meters                         |

Following calculation will be used for transmitter peak power:

$$P = \frac{(E * d)^2}{30G}$$

Where:

E is the measured maximum fundamental field strength in V/m, utilizing a RBW  $\geq$  the 20 dB bandwidth of the emission,  $VBW > RBW$ , peak detector function. Follow the procedures in C63.4-1992 with respect to maximizing the emission.

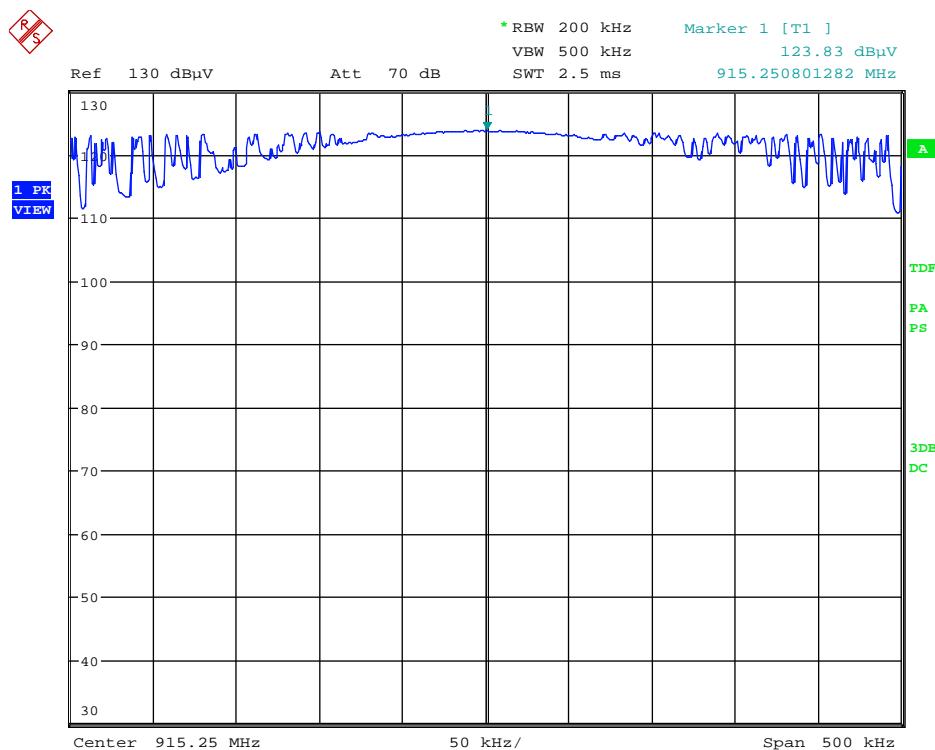
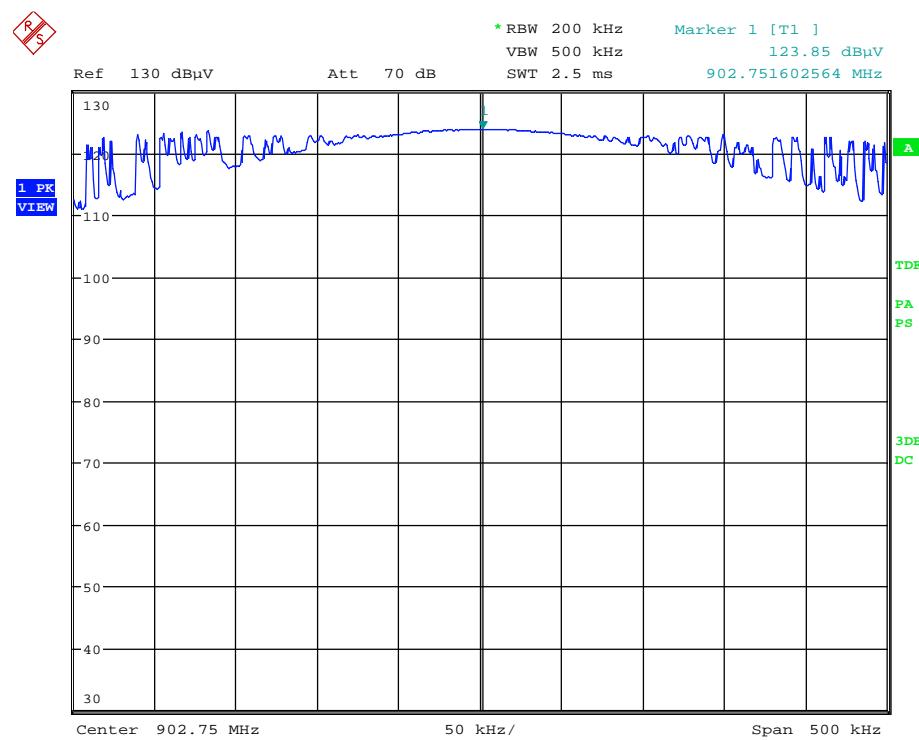
G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.

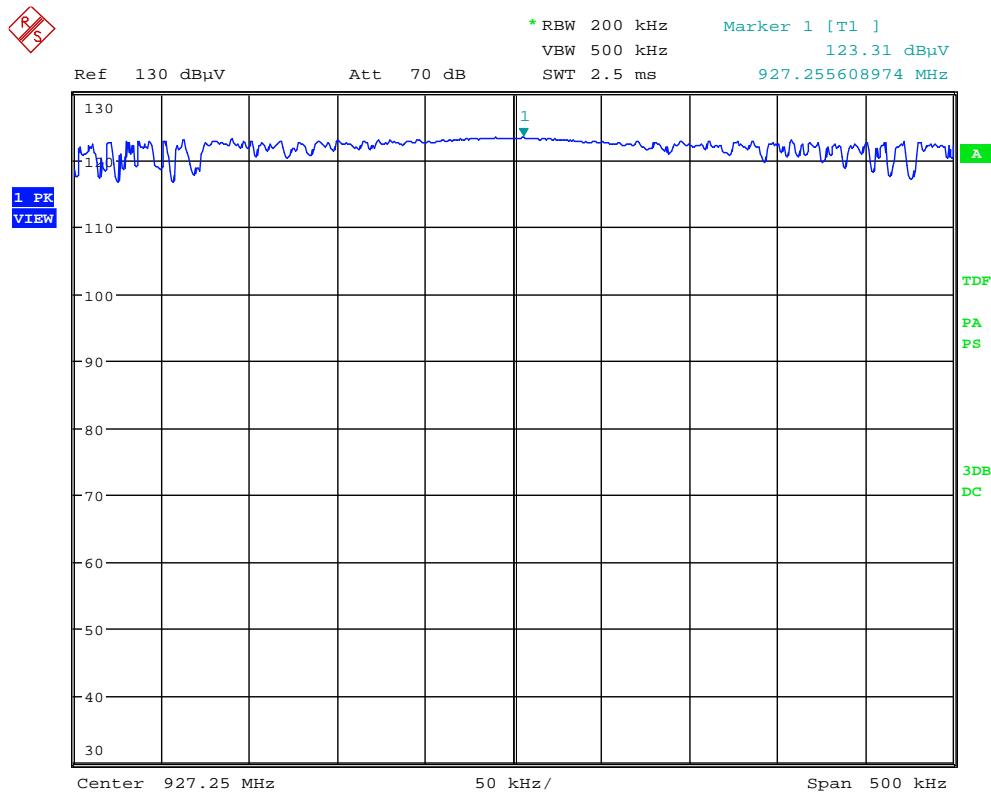
d is the distance in meters from which the field strength was measured.

P is the power in watts for which you are solving:

| Frequency (MHz) | Measured field strength (V/m) | Measurement distance (m) | Gain of transmitting antenna (numeric) | Power (W) | Limit (W) |
|-----------------|-------------------------------|--------------------------|--|-----------|-----------|
| 902.75          | 1.557758                      | 3                        | 2.82                                   | 0.26      | $\leq 1$  |
| 915.25          | 1.554175                      | 3                        | 2.82                                   | 0.26      | $\leq 1$  |
| 927.25          | 1.463862                      | 3                        | 2.82                                   | 0.23      | $\leq 1$  |

|              |             |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|





## 7.9 Conducted Powerline Emission Measurement 150 kHz to 30 MHz

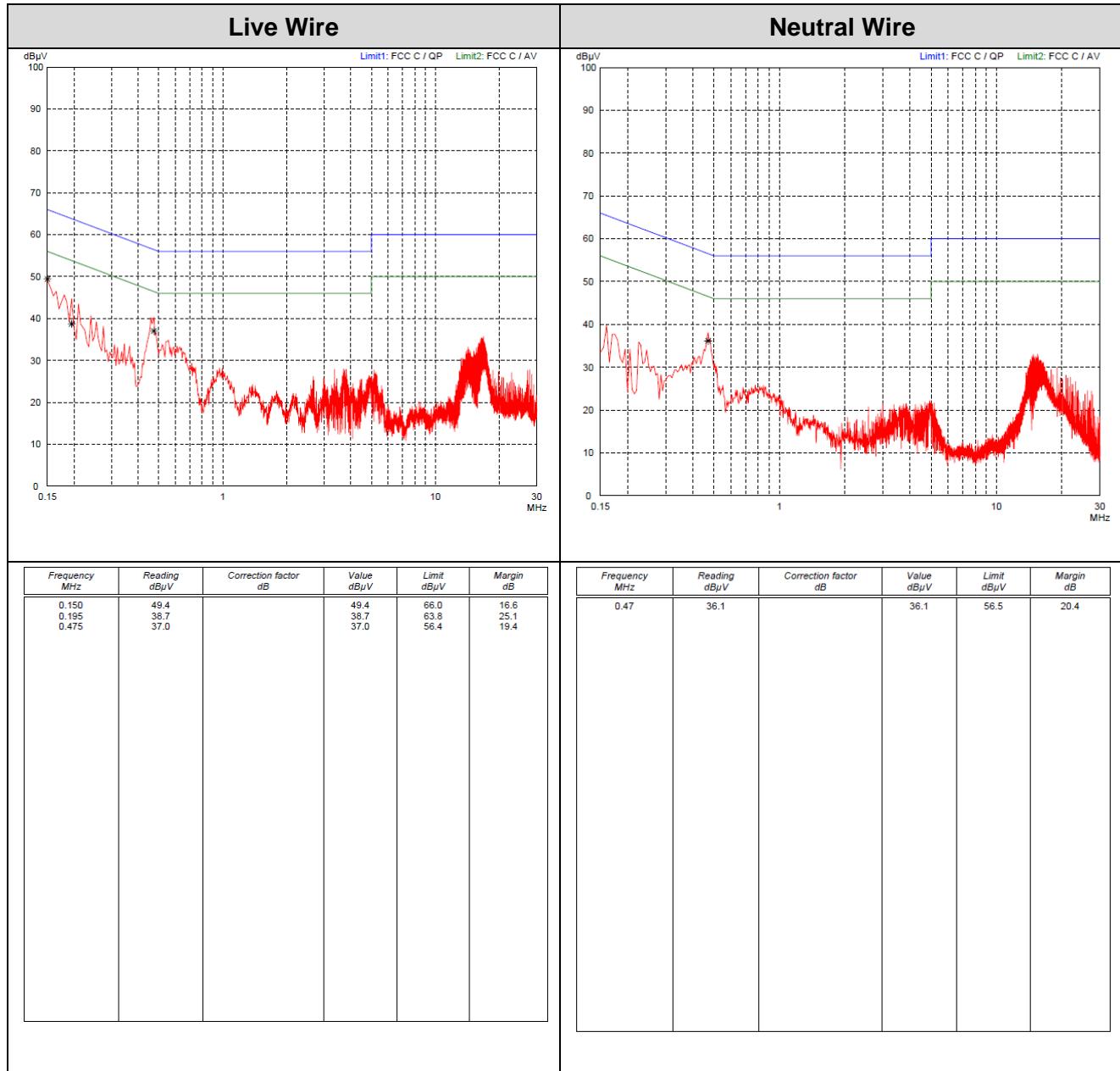
|                           |   |                              |          |
|---------------------------|---|------------------------------|----------|
| Rules and specifications: | CFR 47 Part 15, section 15.207<br>IC RSS-GEN Issue 3, section 7.2.4 |                              |          |
| Guide:                    | ANSI C63.4 / CISPR 22   |                              |          |
| Limit:                    | 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       |
| Measurement procedure:    | Conducted AC Powerline Emission (6.3)                               |                              |          |

|               |  |
|---------------|--|
| Comment:      | Operating mode 5<br>$U_{AC} = 115 \text{ V} / 60 \text{ Hz}$ |
| Date of test: | 30 July 2013   |
| Test site:    | Shielded room, cabin no. 1                                   |

|              |             |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|

Tested on:

AC Input of the charging cradle,  $U_{AC} = 115 \text{ V} / 60 \text{ Hz}$



### Sample calculation of final values:

$$\text{Final Value (dB}\mu\text{V)} = \text{Reading Value (dB}\mu\text{V)} + \text{Correction Factor (dB)}$$

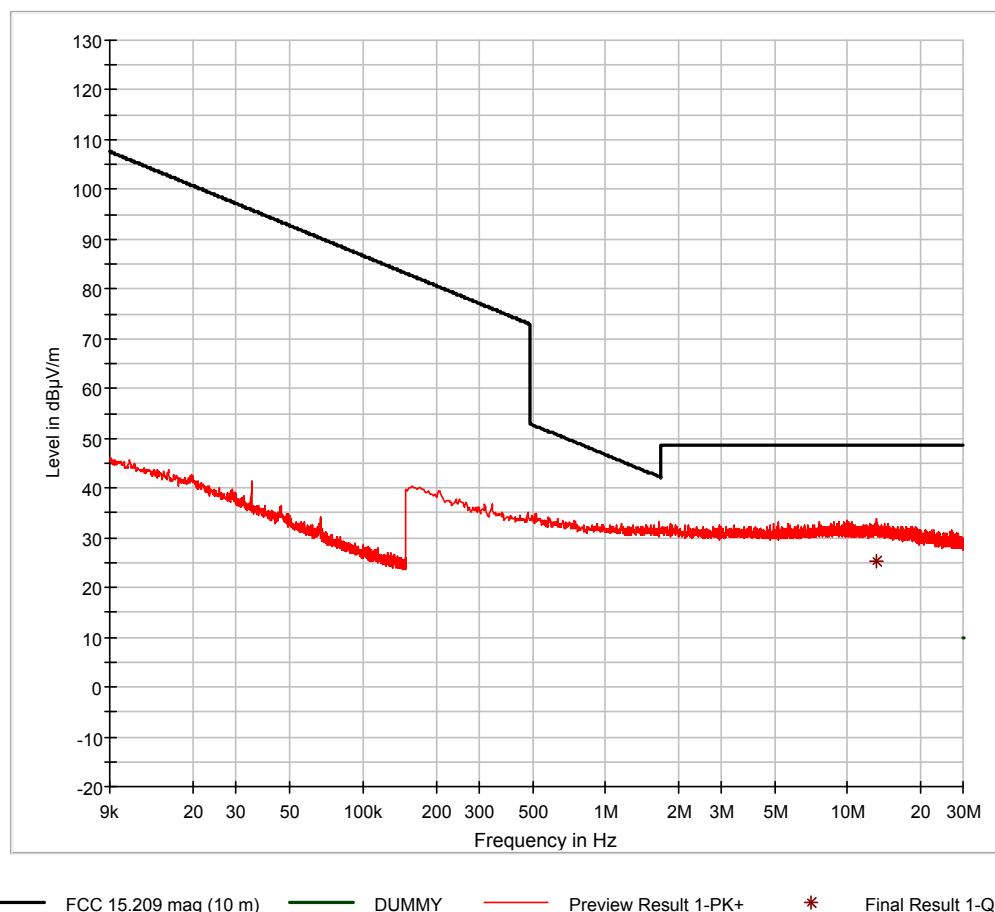
## 7.10 Radiated Emission Measurement 9 kHz to 30 MHz

|   |   |                             |                               |                                 |
|---|---|-----------------------------|-------------------------------|---------------------------------|
| Rules and specifications:   | CFR 47 Part 15, sections 15.247(d), 15.205(a) and 15.209(a)<br>IC RSS-210 Issue 8, section A8.5[4], 2.5[4] and 7.2.2[5] |                             |                               |                                 |
| Guide:  | ANSI C63.4  |                             |                               |                                 |
| Limit:  | Frequency of Emission (MHz)   | Field Strength ( $\mu$ V/m) | Field Strength (dB $\mu$ V/m) | Measurement Distance d (meters) |
|   | 0.009 - 0.490   | 2400/F(kHz)                 | 67.6 - 20 · log(F(kHz))       | 300                             |
|   | 0.490 - 1.705   | 24000/F(kHz)                | 87.6 - 20 · log(F(kHz))       | 30                              |
|   | 1.705 - 30.000  | 30                          | 29.5                          | 30                              |
| Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission. |   |                             |                               |                                 |
| Measurement procedure:  | Radiated Emission Measurement 9 kHz to 30 MHz (6.4)   |                             |                               |                                 |

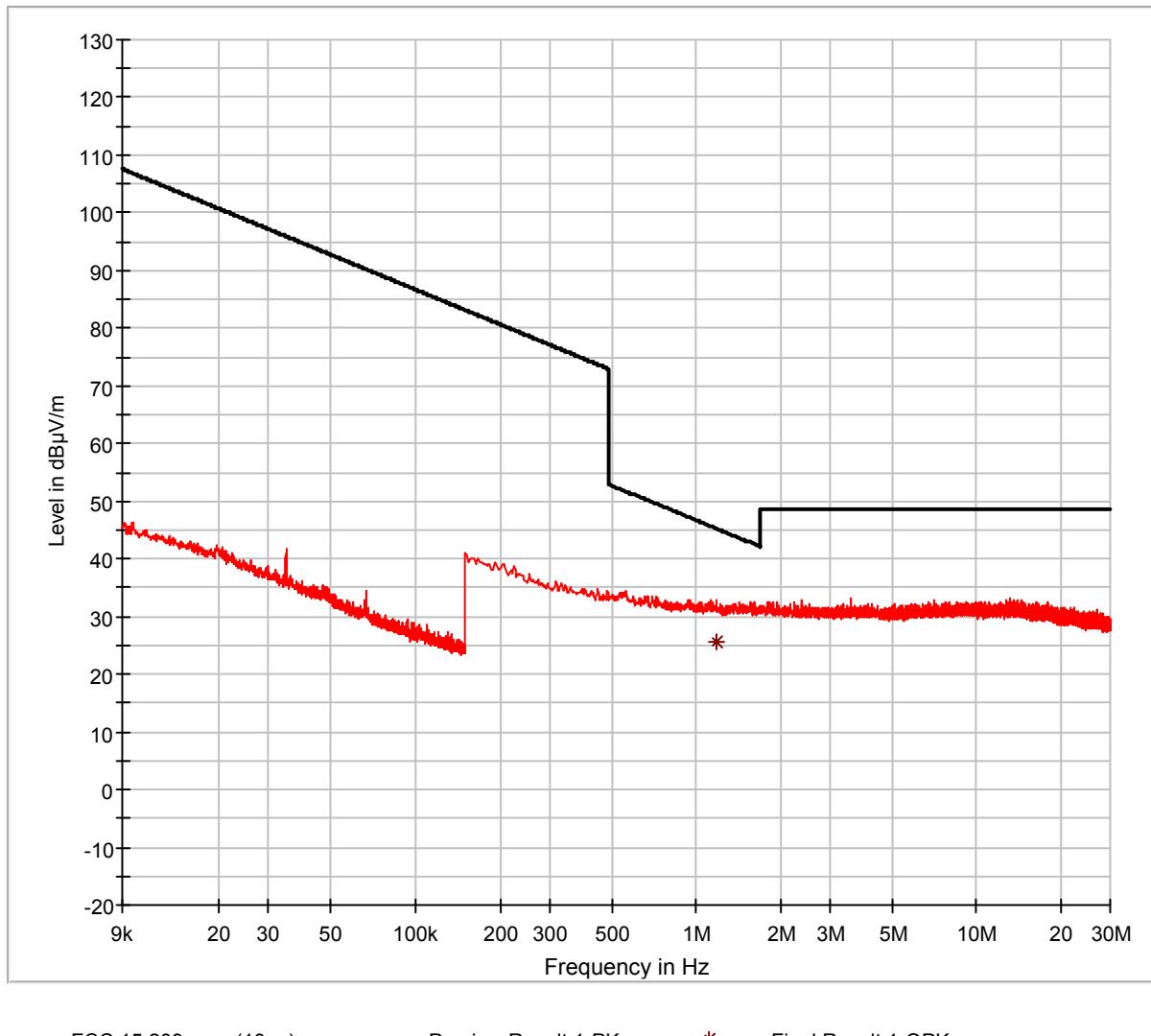
|               |                           |
|---------------|---------------------------|
| Comment:      | Operating mode 1, 2, 3, 5 |
| Date of test: | September 2, 2013         |
| Test site:    | Open field test site      |

|              |             |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|

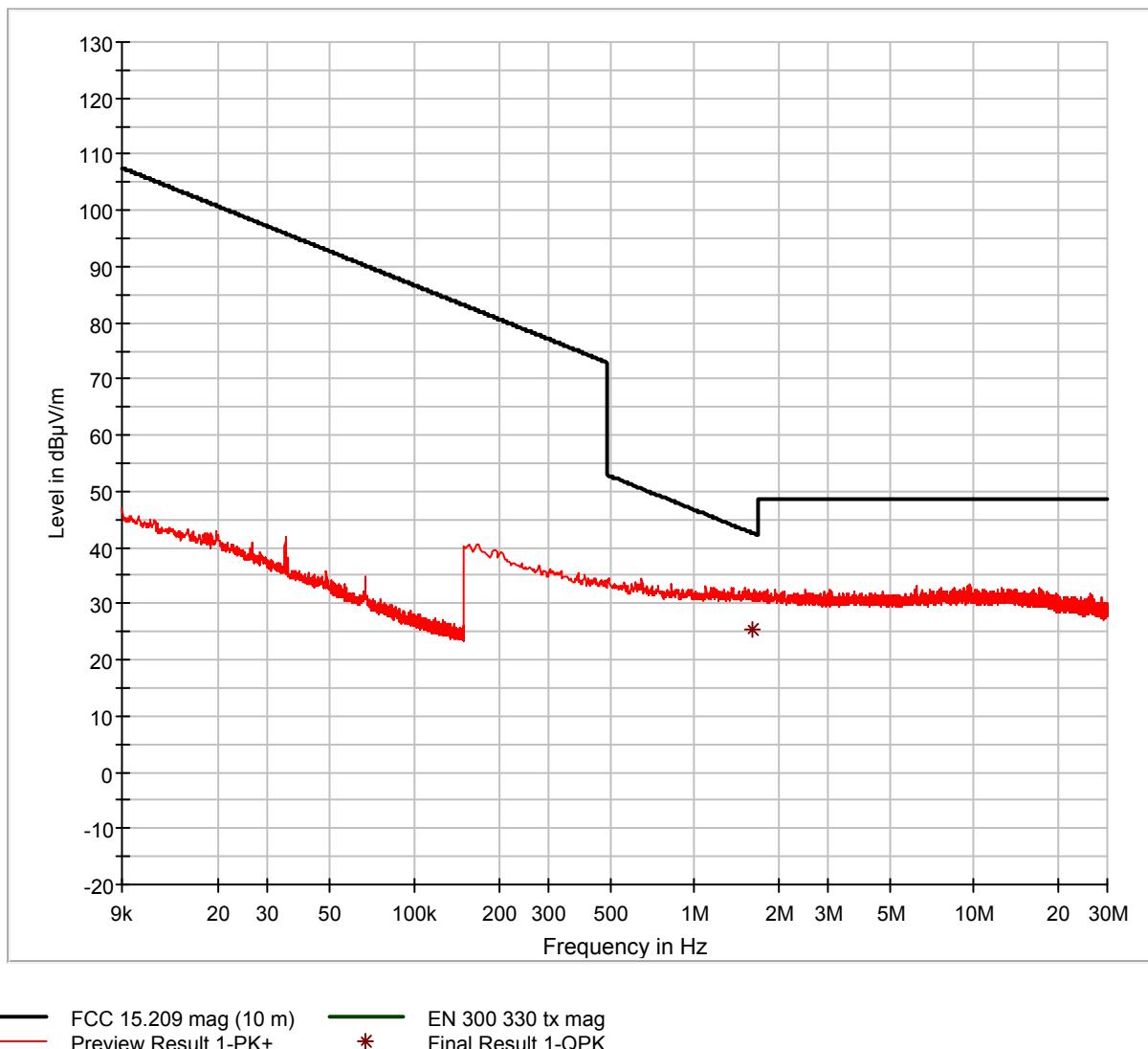
Operating mode 1:



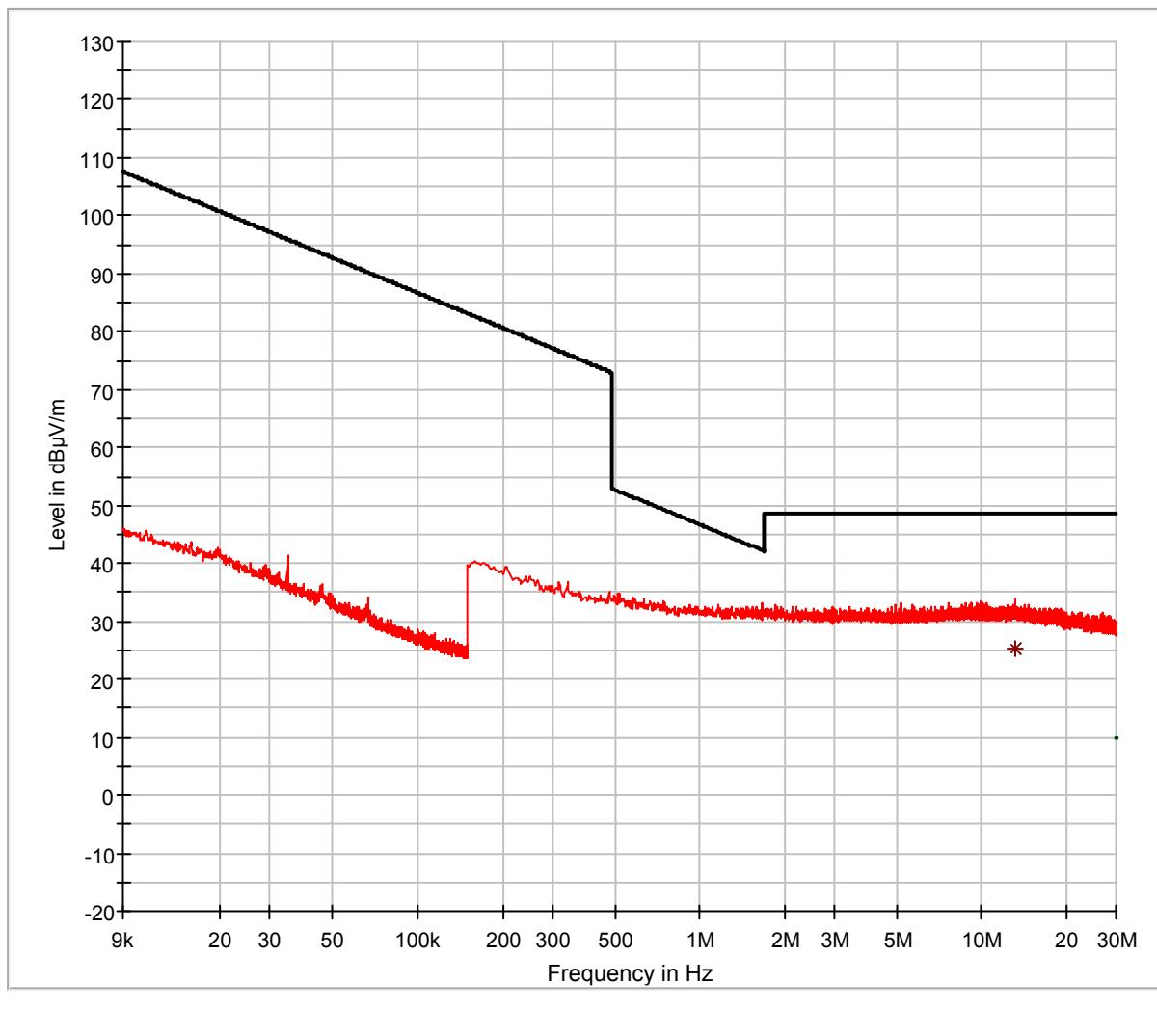
Operating mode 2:



Operating mode 3:



Operating mode 5:



**Sample calculation of final values:**

$$\text{Final Value (dB}\mu\text{V/m)} = \text{Reading Value (dB}\mu\text{V)} + \text{Correction Factor (dB/m)}$$

## 7.11 Radiated Emission Measurement 30 MHz to 10 GHz

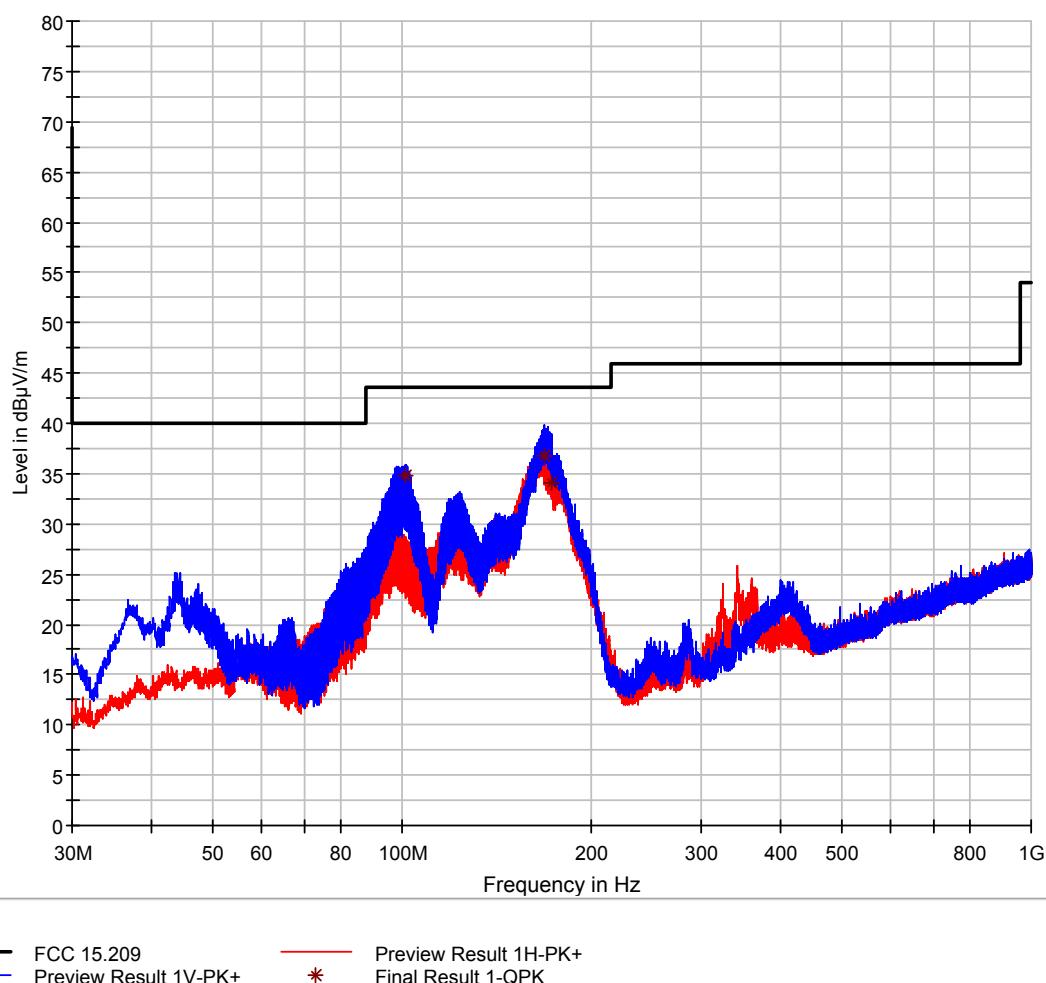
|                           |   |                       |                         |
|---------------------------|---|-----------------------|-------------------------|
| Rules and specifications: | CFR 47 Part 15, sections 15.247(d), 15.205(a) and 15.209(a)<br>IC RSS-210 Issue 8, section A8.5[4], 2.5[4] and 7.2.2[5] |                       |                         |
| Guide:                    | ANSI C63.4  |                       |                         |
| Limit:                    | Frequency of Emission (MHz)   | Field Strength (μV/m) | Field Strength (dBμV/m) |
|                           | 30 - 88   | 100                   | 40.0                    |
|                           | 88 - 216  | 150                   | 43.5                    |
|                           | 216 - 960   | 200                   | 46.0                    |
|                           | Above 960   | 500                   | 54.0                    |
|                           | Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.               |                       |                         |
| Measurement procedures:   | Radiated Emission in Fully or Semi Anechoic Room (6.5)  |                       |                         |

|                |   |
|----------------|---|
| Comment:       | Operating mode 1, 2, 3, 5   |
| Date of test:  | September 2, 3, 4, 2013   |
| Test site:     | Frequencies ≤ 1 GHz: Semi-anechoic room, cabin no. 8<br>Frequencies > 1 GHz: Fully anechoic room, cabin no. 2 |
| Test distance: | 3 meters  |

|              |             |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|

### Operating mode 5

#### Horizontal / Vertical Polarisation



#### Final Results 1:

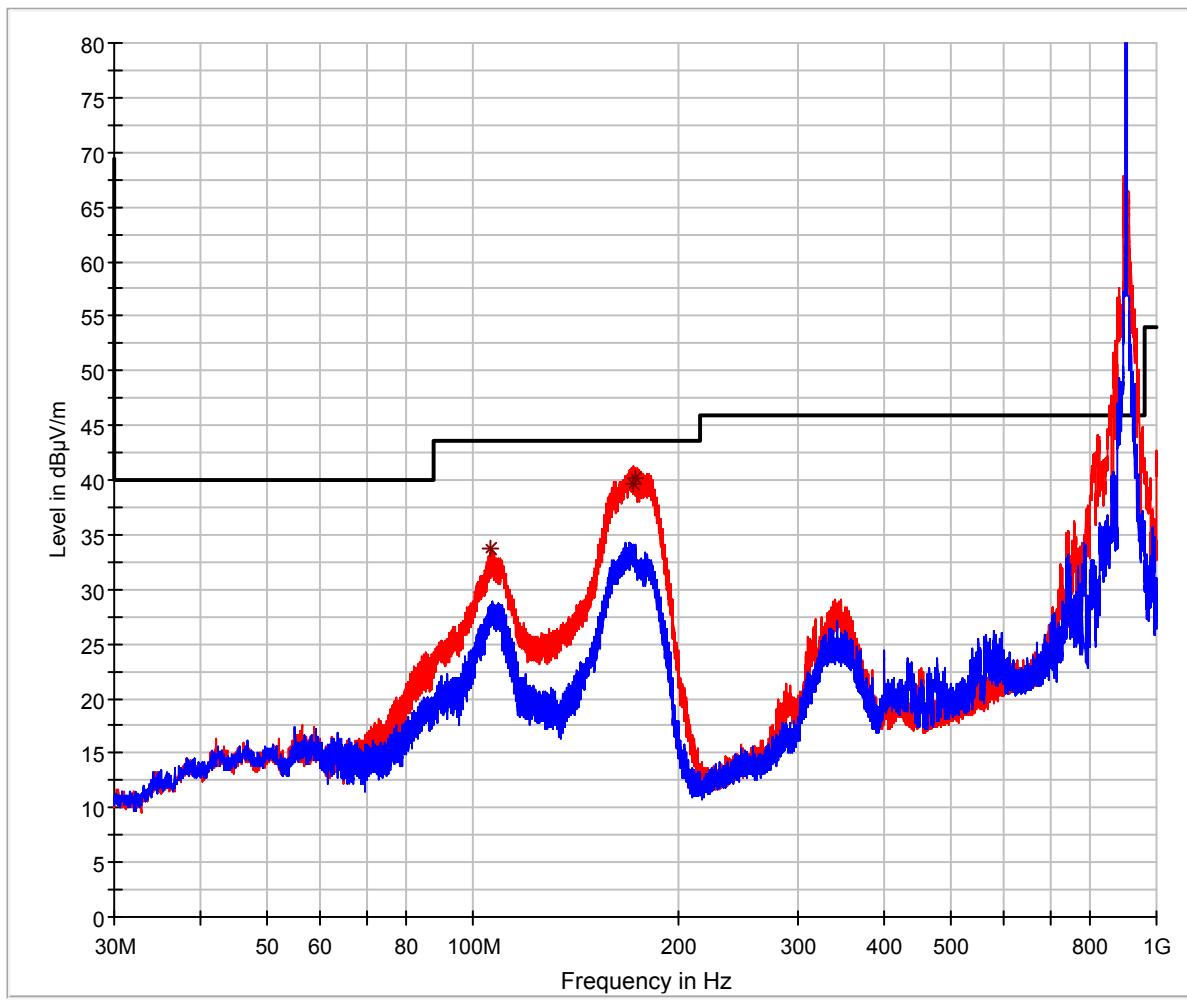
| Frequenc<br>y<br>MHz | QuasiPe<br>ak<br>dBµV/m | Meas.<br>Time<br>ms | Bandwidt<br>h<br>kHz | Height<br>cm | Polarizati<br>on | Azimuth<br>deg | Corr.<br>dB | Margin<br>dB | Limit<br>dBµV/m |
|----------------------|-------------------------|---------------------|----------------------|--------------|------------------|----------------|-------------|--------------|-----------------|
| 101,87               | 34,8                    | 1000,0              | 120,000              | 116,0        | V                | -93,0          | 13,8        | 8,7          | 43,5            |
| 168,79               | 36,8                    | 1000,0              | 120,000              | 100,0        | V                | 5,0            | 10,4        | 6,7          | 43,5            |
| 173,41               | 34,1                    | 1000,0              | 120,000              | 100,0        | V                | -11,0          | 10,4        | 9,4          | 43,5            |

#### Sample calculation of final values:

$$\text{Final Value (dBµV/m)} = \text{Reading Value (dBµV)} + \text{Correction Factor (dB/m)}$$

**Operating mode 1:**

**Horizontal / Vertical Polarisation**

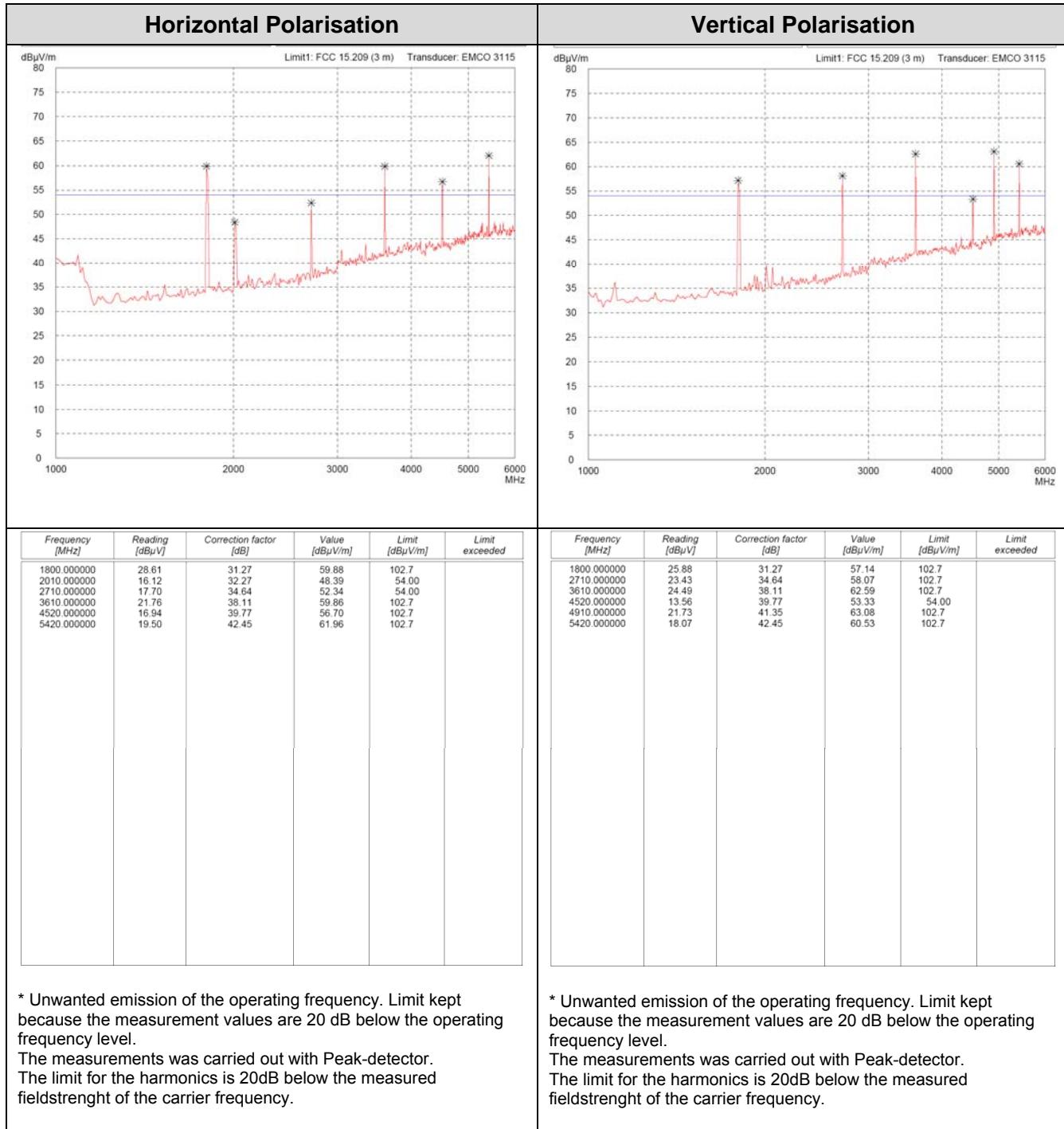


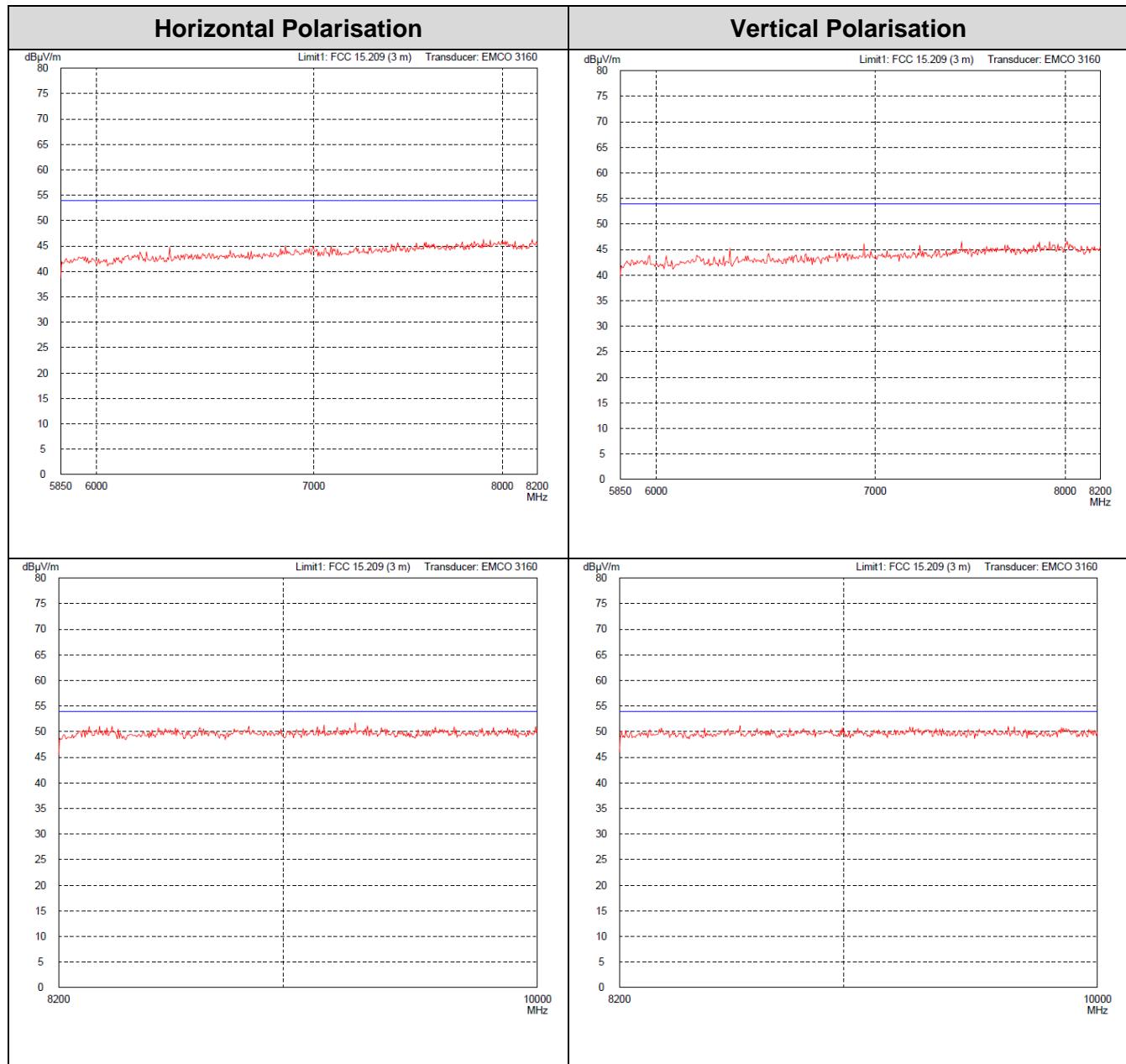
— FCC 15.209  
 — Preview Result 1H-PK+  
 — Preview Result 1V-PK+      \* Final Result 1-QPK

**Final Results 1:**

| Frequenc<br>y<br>MHz | QuasiPe<br>ak<br>dBµV/m | Meas.<br>Time<br>ms | Bandwidt<br>h<br>kHz | Height<br>cm | Polarizati<br>on | Azimuth<br>deg | Corr.<br>dB | Margin<br>dB | Limit<br>dBµV/m |
|----------------------|-------------------------|---------------------|----------------------|--------------|------------------|----------------|-------------|--------------|-----------------|
| 106,05               | 33,7                    | 1000,0              | 120,000              | 304,0        | H                | 95,0           | 13,8        | 9,8          | 43,5            |
| 172,61               | 39,7                    | 1000,0              | 120,000              | 116,0        | H                | 85,0           | 10,4        | 3,8          | 43,5            |
| 172,95               | 40,2                    | 1000,0              | 120,000              | 151,0        | H                | 95,0           | 10,4        | 3,3          | 43,5            |
| *902,74              | 122,7                   | 1000,0              | 120,000              | 216,0        | H                | -181,0         | 24,9        | -76,7        |                 |

\* Operating frequency!



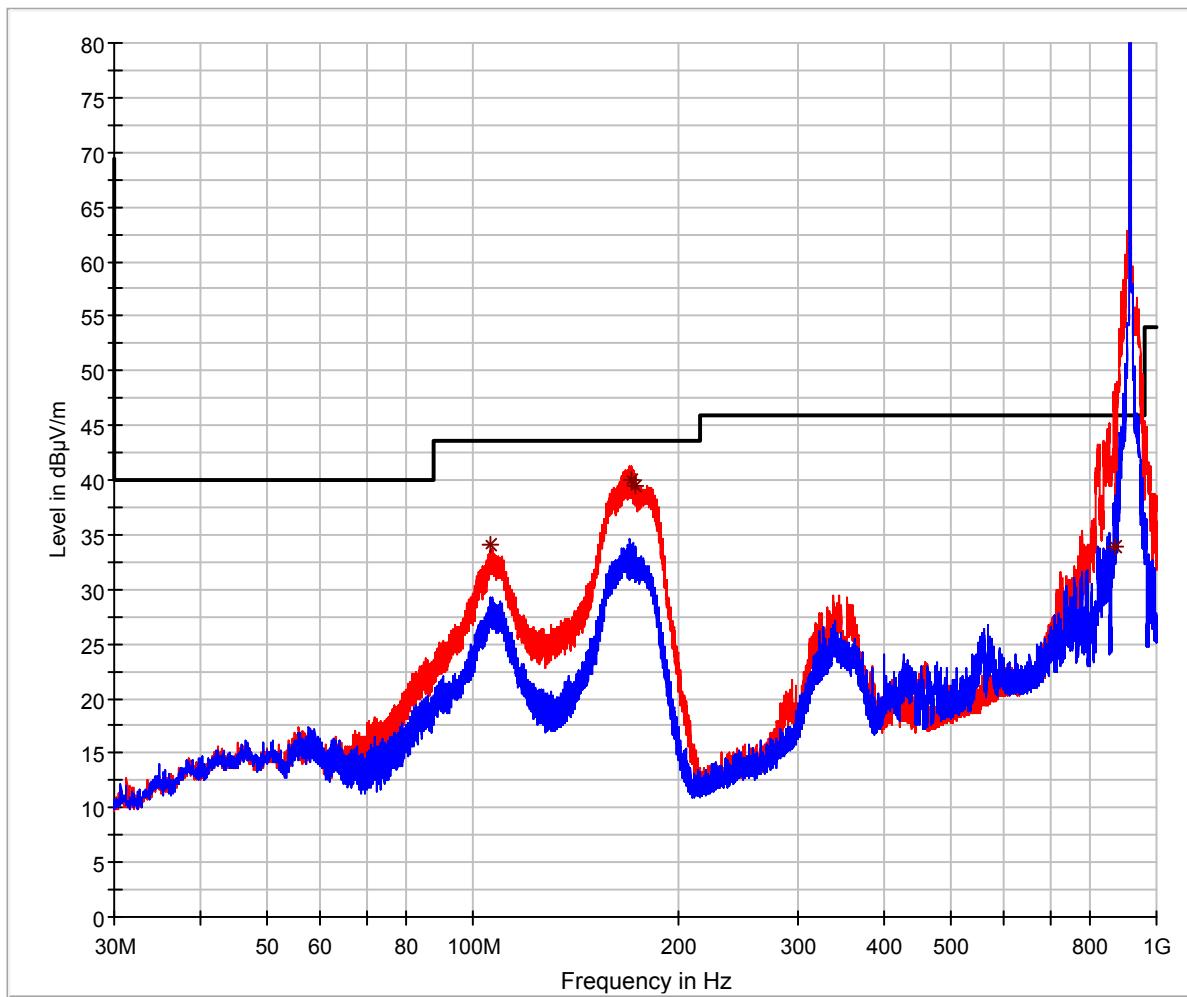


#### Sample calculation of final values:

$$\text{Final Value (dB}\mu\text{V/m)} = \text{Reading Value (dB}\mu\text{V)} + \text{Correction Factor (dB/m)}$$

**Operating mode 2:**

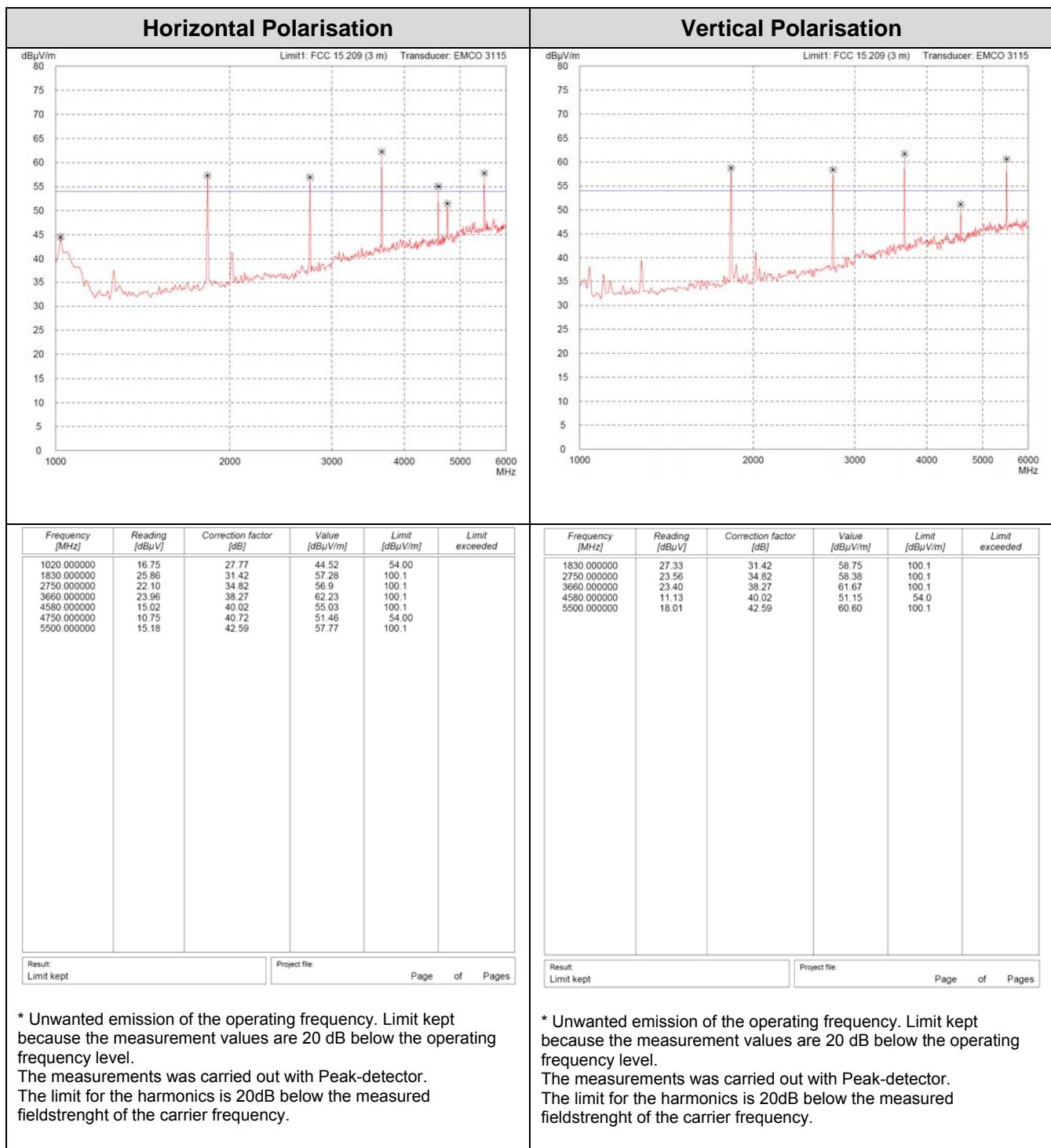
**Horizontal / Vertical Polarisation**

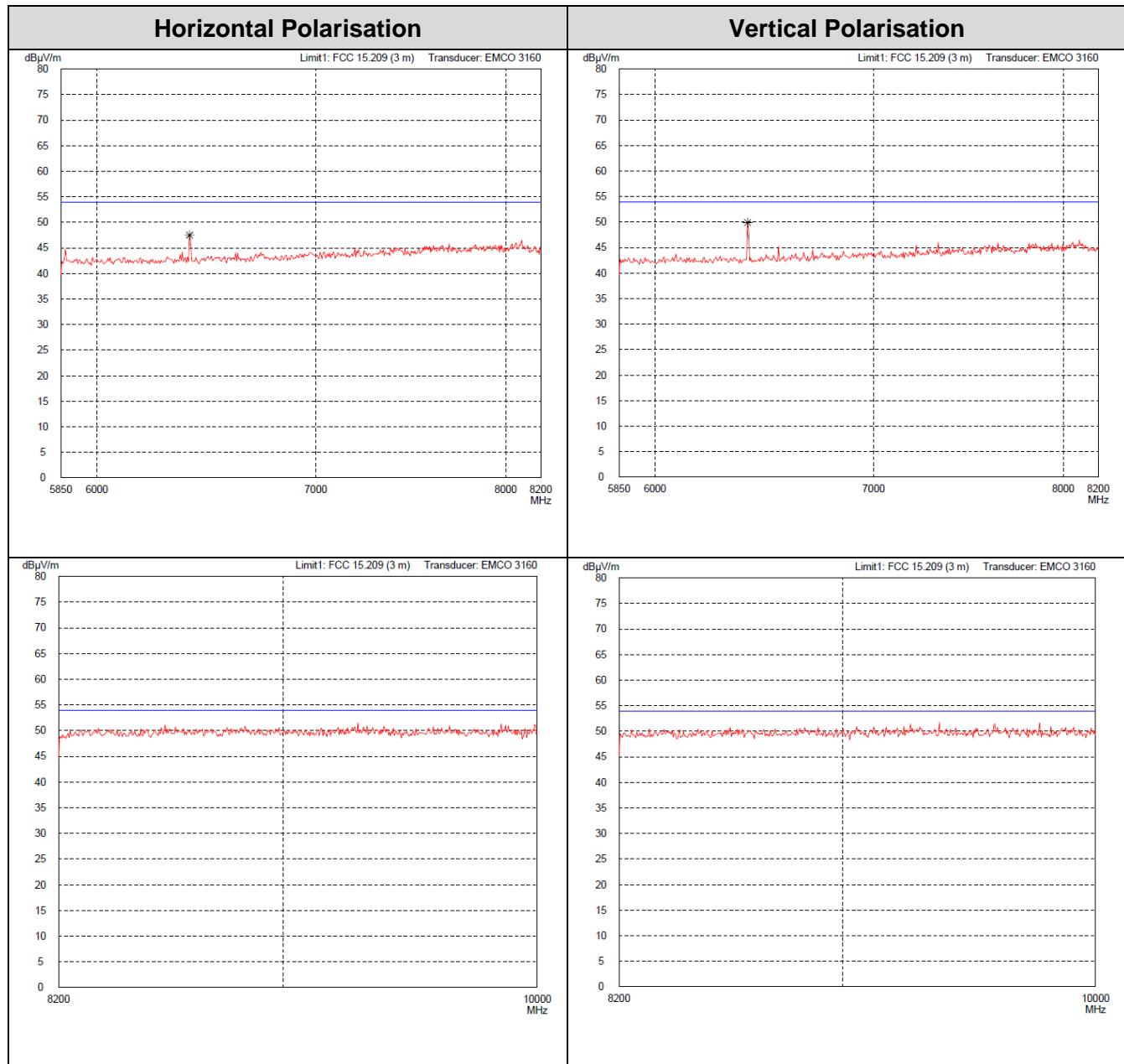


**Final Results 1:**

| Frequenc<br>y<br>MHz | QuasiPe<br>ak<br>dB $\mu$ V/m | Meas.<br>Time<br>ms | Bandwidt<br>h<br>kHz | Height<br>cm | Polarizati<br>on | Azimuth<br>deg | Corr.<br>dB | Margin<br>dB | Limit<br>dB $\mu$ V/m |
|----------------------|-------------------------------|---------------------|----------------------|--------------|------------------|----------------|-------------|--------------|-----------------------|
| 106,44               | 34,1                          | 1000,0              | 120,000              | 323,0        | H                | 90,0           | 13,7        | 9,4          | 43,5                  |
| 170,67               | 40,1                          | 1000,0              | 120,000              | 158,0        | H                | 95,0           | 10,4        | 3,4          | 43,5                  |
| 173,30               | 39,5                          | 1000,0              | 120,000              | 150,0        | H                | 91,0           | 10,4        | 4,0          | 43,5                  |
| 871,16               | 34,0                          | 1000,0              | 120,000              | 152,0        | H                | -181,0         | 24,6        | 12,0         | 46,0                  |
| 915,26*              | 120,1                         | 1000,0              | 120,000              | 320,0        | H                | -181,0         | 25,1        | -74,1        |                       |

\* Operating frequency!



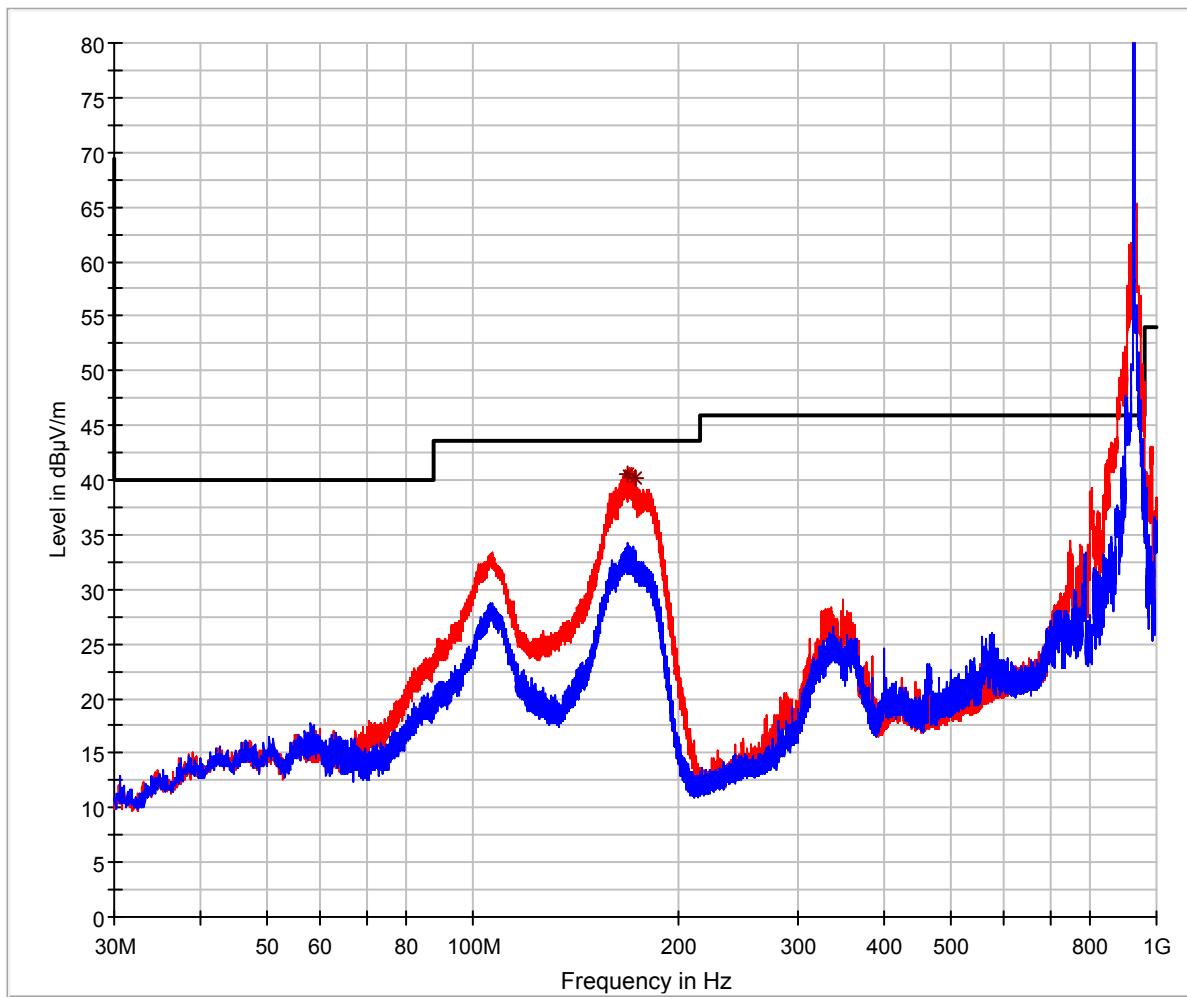


### Sample calculation of final values:

$$\text{Final Value (dB}\mu\text{V/m)} = \text{Reading Value (dB}\mu\text{V)} + \text{Correction Factor (dB/m)}$$

**Operating mode 3:**

**Horizontal / Vertical Polarisation**

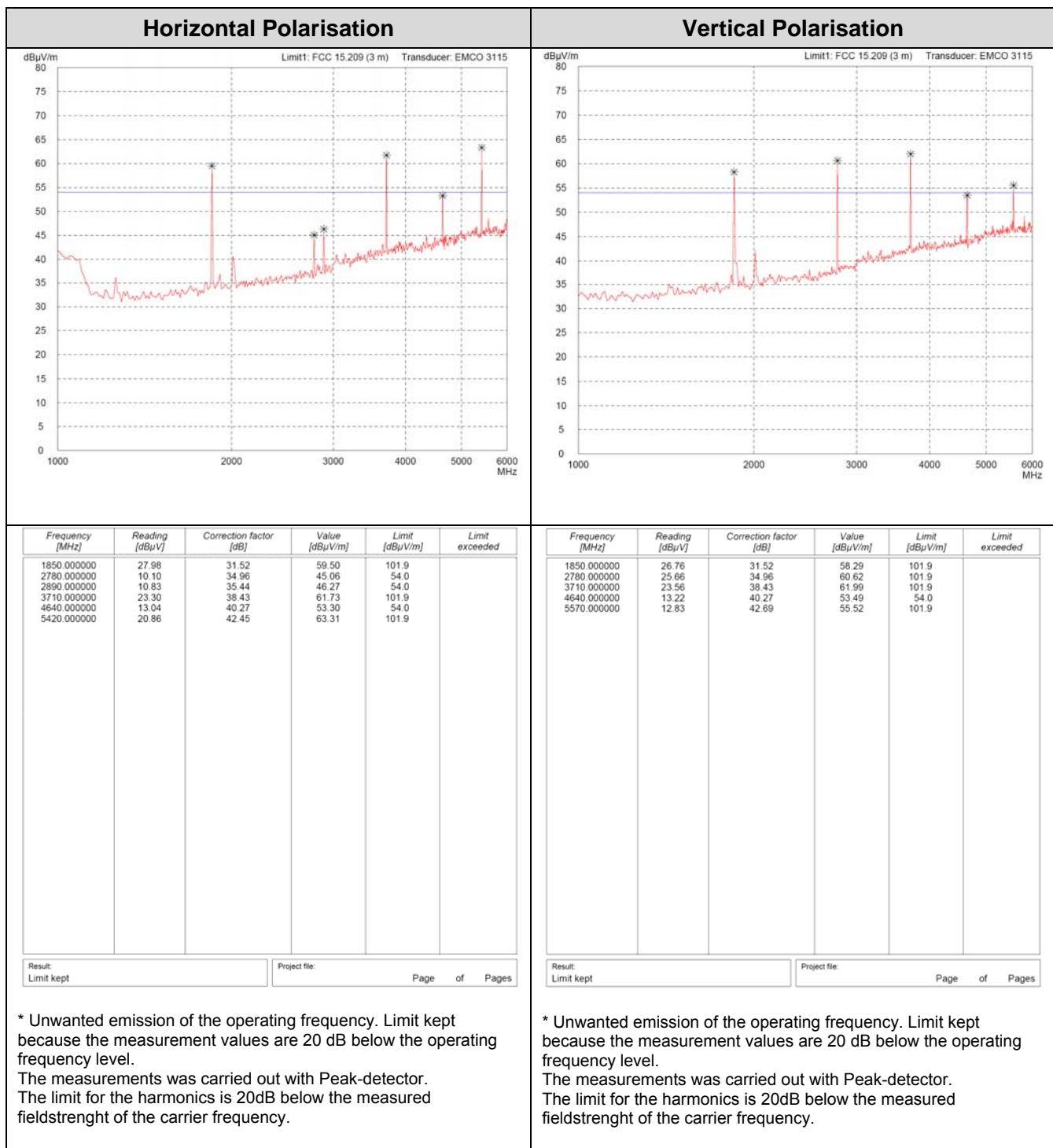


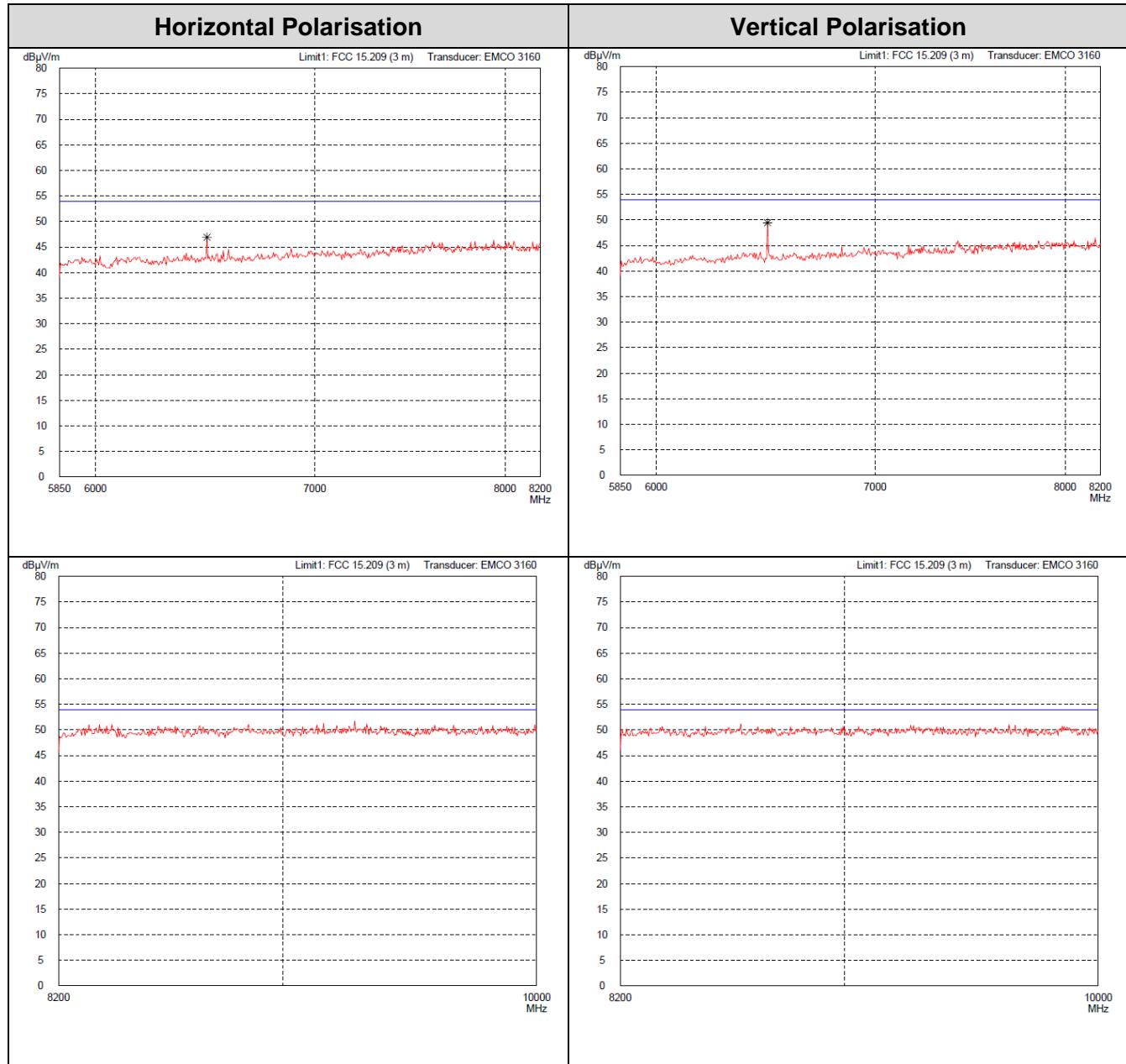
— FCC 15.209  
 — Preview Result 1H-PK+  
 — Preview Result 1V-PK+      \* Final Result 1-QPK

**Final Results 1:**

| Frequenc<br>y<br>MHz | QuasiPe<br>ak<br>dBµV/m | Meas.<br>Time<br>ms | Bandwidt<br>h<br>kHz | Height<br>cm | Polarizati<br>on | Azimuth<br>deg | Corr.<br>dB | Margin<br>dB | Limit<br>dBµV/m |
|----------------------|-------------------------|---------------------|----------------------|--------------|------------------|----------------|-------------|--------------|-----------------|
| 169,18               | 40,6                    | 1000,0              | 120,000              | 147,0        | H                | 88,0           | 10,4        | 2,9          | 43,5            |
| 173,00               | 40,1                    | 1000,0              | 120,000              | 116,0        | H                | 90,0           | 10,4        | 3,4          | 43,5            |
| 927,26*              | 121,9                   | 1000,0              | 120,000              | 210,0        | H                | -186,0         | 25,2        | -75,9        |                 |

\* Operating frequency!





### Sample calculation of final values:

$$\text{Final Value (dB}\mu\text{V/m)} = \text{Reading Value (dB}\mu\text{V)} + \text{Correction Factor (dB/m)}$$

## 7.12 RF exposure requirement

| Rules and specifications:                                     | CFR 47 Part 15, section 15.247(i)<br>CFR 47 Part 1, sections 1.1307(b)(1) |                                   |   |                          |  |
|---|---|-----------------------------------|---|--------------------------|--|
| Guide:  | OET Bulletin 65, Edition 97-01  |                                   |   |                          |  |
| Limits:   | Limits for general population / uncontrolled exposure                     |                                   |   |                          |  |
| Frequency Range (MHz)   | Electric Field Strength (E) (V/m)   | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/cm <sup>2</sup> ) | Averaging Time (minutes) |  |
| 0.3 - 1.34  | 614   | 1.63                              | (100)*                                  | 30                       |  |
| 1.34 - 30   | 824 / f   | 2.19 / f                          | (180 / f <sup>2</sup> )*                | 30                       |  |
| 30 - 300  | 27.5  | 0.073                             | 0.2                                     | 30                       |  |
| 300 - 1500  | ---   | ---                               | f/1500                                  | 30                       |  |
| 1500 - 100000   | ---   | ---                               | 1.0                                     | 30                       |  |
| f = frequency in MHz<br>* Plane-wave equivalent power density |   |                                   |   |                          |  |

| Spectral power density  |  | Declared by applicant               | Measured                            |
|-------------------------|--|-------------------------------------|-------------------------------------|
| Prediction 7:           | $S = P G / 4 \pi R^2$  |                                     |                                     |
| Where:                  | <p>S = Power density</p> <p>P = Power input of antenna</p> <p>G = Power gain of the antenna relativ to an isotropic radiator</p> <p>R = Distance to the center of radiation of the antenna</p> |                                     |                                     |
| Maximum output power:   | P = 28.6 dBm = 724.44 mW   |                                     | <input checked="" type="checkbox"/> |
| Antenna gain:           | G = 2.5 dBi = 2.82   | <input checked="" type="checkbox"/> |                                     |
| Prediction distance:    | R = 20 cm  |                                     |                                     |
| Power density at 20 cm: | <b>S = 0.406 mW/cm<sup>2</sup></b>   |                                     |                                     |
| Limit                   | <b>S<sub>lim</sub> = 0.602 mW/cm<sup>2</sup></b>   |                                     |                                     |

|              |             |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|

<sup>7</sup> MPE Prediction of MPE according to equation from page 19 of OET Bulletin 65, Ed. 97-01

## 7.13 Exposure of Humans to RF Fields

|                           |                                 |
|---------------------------|---------------------------------|
| Rules and specifications: | IC RSS-Gen Issue 3, section 5.6 |
| Guide:                    | IC RSS-102 Issue 4, section 2.5 |

| Exposure of Humans to RF Fields  |   | Applicable | Declared by applicant               | Measured                 | Exemption |
|--|---|------------|-------------------------------------|--------------------------|-----------|
| The antenna is   |   |            |                                     |                          |           |
| <input type="checkbox"/> detachable  |   |            |                                     |                          |           |
| The conducted output power (CP in watts) is measured at the antenna connector:   | $CP = \dots \text{ W}$  |            |                                     | <input type="checkbox"/> |           |
| The effective isotropic radiated power (EIRP in watts) is calculated using   |   |            | <input type="checkbox"/>            |                          |           |
| <input type="checkbox"/> the numerical antenna gain: $G = \dots$   | $EIRP = G \cdot CP \Rightarrow EIRP = \dots \text{ W}$                |            | <input type="checkbox"/>            |                          |           |
| <input type="checkbox"/> the field strength <sup>8</sup> in V/m: $FS = \dots \text{ V/m}$  |   |            | <input type="checkbox"/>            |                          |           |
|  | $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP = \dots \text{ W}$ |            |                                     |                          |           |
| with:  |   |            |                                     |                          |           |
| Distance between the antennas in m: $D = \dots \text{ m}$  |   |            | <input type="checkbox"/>            |                          |           |
| <input checked="" type="checkbox"/> not detachable   |   |            |                                     |                          |           |
| A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by <sup>8</sup> : | $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP = 0.728 \text{ W}$ |            |                                     |                          |           |
| with:  |   |            |                                     |                          |           |
| Field strength in V/m: $FS = 1.558 \text{ V/m}$  |   |            | <input checked="" type="checkbox"/> |                          |           |
| Distance between the two antennas in m: $D = .3 \text{ m}$   |   |            | <input checked="" type="checkbox"/> |                          |           |
| Selection of output power  |   |            |                                     |                          |           |
| The output power TP is the higher of the conducted or effective isotropic radiated power (e.i.r.p.):                             | $TP = 0.728 \text{ W}$  |            |                                     |                          |           |

<sup>8</sup> The conversion formula is valid only for properly matched antennas. In other cases the transmitter output power may have to be measured by a terminated measurement when applying the exemption clauses. If an open area test site is used for field strength measurement, the effect due to the metal ground reflecting plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.

|  |  | Applicable                                    | Declared by applicant | Measured                            | Exemption                           |
|--|--|---|-----------------------|-------------------------------------|-------------------------------------|
| Exposure of Humans to RF Fields (continued)  |  |   |                       |                                     |                                     |
| Separation distance between the user and the transmitting device is  |  |   |                       |                                     |                                     |
| <input checked="" type="checkbox"/> less than or equal to 20 cm  |  | <input type="checkbox"/> greater than 20 cm   |                       | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Transmitting device is   |  |   |                       |                                     |                                     |
| <input type="checkbox"/> in the vicinity of the human head   |  | <input checked="" type="checkbox"/> body-worn |                       | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| SAR evaluation   |  |   |                       |                                     |                                     |
| <p>SAR evaluation is required if the separation distance between the user and the device is less than or equal to 20 cm.</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> The device operates from 3 kHz up to 1 GHz inclusively and with output power (i.e. the higher of the conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 200 mW for general public use and 1000 mW for controlled use.</li> <li><input type="checkbox"/>;</li> <li><input type="checkbox"/> The device operates above 1 GHz and up to 2.2 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 100 W for general public use and 500 W for controlled use.</li> <li><input type="checkbox"/> The device operates above 2.2 GHz and up to 3 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use.</li> <li><input type="checkbox"/> The device operates above 3 GHz and up to 6 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 10 mW for general public use and 50 mW for controlled use.</li> <li><input type="checkbox"/> SAR evaluation is documented in test report no. ....</li> </ul> |  |   |                       |                                     | <input checked="" type="checkbox"/> |
| RF exposure evaluation   |  |   |                       |                                     |                                     |
| <p>RF exposure evaluation is required if the separation distance between the user and the device is greater than 20 cm.</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> The device operates below 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 2.5 W.</li> <li><input type="checkbox"/> The device operates at or above 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 5 W.</li> <li><input type="checkbox"/> RF exposure evaluation is documented in test report no. ....</li> </ul>   |  |   |                       |                                     | <input checked="" type="checkbox"/> |

## 8 Referenced Regulations

All tests were performed with reference to the following regulations and standards:

|                                     |                |   |  |
|-------------------------------------|----------------|---|--|
| <input checked="" type="checkbox"/> | CFR 47 Part 2  | Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)   | October 1, 2012                                      |
| <input checked="" type="checkbox"/> | CFR 47 Part 15 | Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)   | October 1, 2012                                      |
| <input checked="" type="checkbox"/> | ANSI C63.4     | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz                                     | December 11, 2003<br>(published on January 30, 2004) |
| <input type="checkbox"/>            | ANSI C63.4     | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz                                     | June 7, 2009<br>(published on September 15, 2009)    |
| <input checked="" type="checkbox"/> | RSS-Gen        | Radio Standards Specification RSS-Gen Issue 3 containing General Requirements and Information for the Certification of Radiocommunication Equipment, published by Industry Canada                       | December 2010  |
| <input checked="" type="checkbox"/> | RSS-210        | Radio Standards Specification RSS-210 Issue 8 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, published by Industry Canada                         | December 2010  |
| <input type="checkbox"/>            | RSS-310        | Radio Standards Specification RSS-310 Issue 3 for Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category II Equipment, published by Industry Canada                        | December 2010  |
| <input checked="" type="checkbox"/> | RSS-102        | Radio Standards Specification RSS-102 Issue 4: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), published by Industry Canada                             | March 2010,<br>footnote 13 updated December 2010     |
| <input type="checkbox"/>            | ICES-003       | Interference-Causing Equipment Standard ICES-003 Issue 4 for Digital Apparatus, published by Industry Canada  | February 7, 2004                                     |
| <input checked="" type="checkbox"/> | CISPR 22       | Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, "Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement" | 1997   |

|                                     |                                 |  |               |
|-------------------------------------|---------------------------------|--|---------------|
| <input type="checkbox"/>            | CAN/CSA-<br>CEI/IEC<br>CISPR 22 | Limits and Methods of Measurement of Radio<br>Disturbance Characteristics of Information<br>Technology Equipment   | 2002          |
|                                     |                                 | CAN/CSA CISPR 22-10<br>Information technology equipment -<br>Radio disturbance characteristics -<br>Limits and methods of measurement<br>(Adopted IEC CISPR 22:2008, sixth edition, 2008-09) |               |
| <input type="checkbox"/>            | CAN/CSA<br>CISPR 22-10          | Information technology equipment -<br>Radio disturbance characteristics -<br>Limits and methods of measurement<br>(Adopted IEC CISPR 22:2008, sixth edition, 2008-09)                        | 2010          |
| <input checked="" type="checkbox"/> | TRC-43                          | Notes Regarding Designation of Emissions (Including<br>Necessary Bandwidth and Classification), Class of<br>Station and Nature of Service, published by Industry<br>Canada                   | October, 2008 |

## 9 Test Equipment List with Calibration Data

| Type                                 | Inv.-No. | Type Designation | Serial Number | Manufacturer          | Calibration Organization | Last Calibration | Next Calibration |
|--------------------------------------|----------|------------------|---------------|-----------------------|--------------------------|------------------|------------------|
| V-network                            | 1059     | ESH3-Z5          | 894785/005    | Rohde & Schwarz       | Rohde & Schwarz          | 08/2013          | 08/2015          |
| V-network                            | 1060     | ESH3-Z5          | 862770/021    | Rohde & Schwarz       | Rohde & Schwarz          | 05/2012          | 05/2014          |
| V-network                            | 1218     | ESH3-Z5          | 830952/025    | Rohde & Schwarz       | Rohde & Schwarz          | 08/2011          | 08/2013          |
| EMI test receiver                    | 1028     | ESHS10           | 860043/016    | Rohde & Schwarz       | Rohde & Schwarz          | 03/2013          | 09/2014          |
| EMI test receiver                    | 2044     | ESU8             | 100232        | Rohde & Schwarz       | Rohde & Schwarz          | 07/2012          | 01/2014          |
| Spectrum analyser                    | 1666     | FSP30            | 100063        | Rohde & Schwarz       | Rohde & Schwarz          | 11/2012          | 05/2014          |
| Preamplifier                         | 1651     | CPA9231A         | 3393          | Schaffner Electrotest | TÜV SÜD PS-EMC-STR       | 09/2012          | 09/2014          |
| Double ridged waveguide horn antenna | 1516     | 3115             | 9508-4553     | EMCO Elektronik       | Seibersdorf Laboratories | 11/2012          | 11/2014          |
| Horn antenna                         | 1014     | 3160-07          | 9112-1008     | EMCO Elektronik       |                          | see note 1       |                  |
| Loop antenna                         | 1016     | HFH2-Z2          | 882964/0001   | Rohde & Schwarz       | Rohde & Schwarz          | 11/2012          | 05/2014          |
| TRILOG Broadband Antenna             | 1802     | VULB 9163        | 9163-214      | Schwarzbeck           | Rohde & Schwarz          | 05/2013          | 11/2014          |
| TRILOG Broadband Antenna             | 2058     | VULB 9163        | 9163-408      | Schwarzbeck           | Rohde & Schwarz          | 11/2012          | 05/2014          |

Note 1: No calibration required.

Note 2: Not calibrated separately but with the whole test system when recording calibration data.

Note 3: No calibration required. Devices are checked before use.

Note 4: No calibration required. Devices are checked by calibrated equipment during test.

## 10 Revision History

| <b>Revision History</b> |             |                  |   |
|-------------------------|-------------|------------------|---|
| <i>Edition</i>          | <i>Date</i> | <i>Issued by</i> | <i>Modifications</i>  |
| 1                       | 09-18-2013  | M. Biberger      | First Edition   |
| 2                       | 12-02-2013  | M. Biberger      | Second Edition, OBW, Note to radiated emission added, Test instruments used changed |