

# EMI – TEST REPORT

- FCC Part 15.247, RSS247 -

**Type / Model Name** : EBI 10-System (IF 100, IF 100-1, IF 150, IF 200)

**Product Description** : Wireless data logger system

**Applicant** : Xylem Analytics Germany GmbH

**Address** : Dr.-Karl-Slevogt-Strasse 1

82362 WEILHEIM, GERMANY

**Manufacturer** : Xylem Analytics Germany GmbH

**Address** : Dr.-Karl-Slevogt-Strasse 1

82362 WEILHEIM, GERMANY

**Licence holder** : Xylem Analytics Germany GmbH

**Address** : Dr.-Karl-Slevogt-Strasse 1

82362 WEILHEIM, GERMANY

**Test Result** according to the standards  
listed in clause 1 test standards:

**POSITIVE**

**Test Report No. :** **T40058-00-10HS**

05. September 2016

Date of issue



Deutsche  
Akkreditierungsstelle  
D-PL-12030-01-01  
D-PL-12030-01-02

The test report merely corresponds to the test sample.  
It is not permitted to copy extracts of these test results  
without the written permission of the test laboratory.

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Attachment A as separate supplement

## 1 TEST STANDARDS

The tests were performed according to following standards:

### **FCC Rules and Regulations Part 15, Subpart A - General (September 2015)**

|                                   |                                               |
|-----------------------------------|-----------------------------------------------|
| Part 15, Subpart A, Section 15.31 | Measurement standards                         |
| Part 15, Subpart A, Section 15.33 | Frequency range of radiated measurements      |
| Part 15, Subpart A, Section 15.35 | Measurement detector functions and bandwidths |

### **FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September 2015)**

|                                    |                                                                                 |
|------------------------------------|---------------------------------------------------------------------------------|
| Part 15, Subpart C, Section 15.203 | Antenna requirement                                                             |
| Part 15, Subpart C, Section 15.204 | External radio frequency power amplifiers and antenna modifications             |
| Part 15, Subpart C, Section 15.205 | Restricted bands of operation                                                   |
| Part 15, Subpart C, Section 15.207 | Conducted limits                                                                |
| Part 15, Subpart C, Section 15.209 | Radiated emission limits, general requirements                                  |
| Part 15, Subpart C, Section 15.247 | Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz |

ANSI C63.10: 2013                      Testing Unlicensed Wireless Devices

ETSI TR 100 028 V1.3.1: 2001-03,                      Electromagnetic Compatibility and Radio Spectrum Matters (ERM);  
Uncertainties in the Measurement of Mobile Radio Equipment  
Characteristics—Part 1 and Part 2

KDB 558074 D01 v03r05                      Guidance for performing compliance measurements on DTS  
operating under §15.247, April 8, 2016.

## **2 EQUIPMENT UNDER TEST**

### **2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT A**

### **2.2 Equipment type**

ZigBee, fixed station

### **2.3 Short description of the equipment under test (EUT)**

Interface for data logging system. The system consists of a fixed interface and one up to 4 mobile data logger (EBI10 Series, EBI100 Series). The interface identifies a logger in the programming slot via 13.56 MHz RFID-Transceiver. In the mobile data logger is a RFID-Tag only. A 2.4 GHz "ZigBee" port (Chipset according IEEE 802.15.4) is used for data exchange, communication and programming the data logger. The power supply as stand alone system is normally via USB, cascaded up to max. 3 systems the 15 VDC power supply have to be used.

Number of tested samples: 1

Serial number, IF200: 20007277, Firmware number: 2.08

#### **EUT configuration:**

(The CDF filled by the applicant can be viewed at the test laboratory.)

### **2.4 Variants of the EUT**

| Variant | Device-Name | Comment   | Antenna    |
|---------|-------------|-----------|------------|
| I01     | IF200       | Interface | external   |
| I02     | IF100       | Interface | external   |
| I03     | IF100-1     | Interface | integrated |
| I04     | IF150       | Interface | integrated |
| I05     | IF300       | Interface | integrated |

Note: The interface IF 200, with external antenna AN2400-1901RS, has the most options and is as worst case selected for test.

### **2.5 Operation frequency and channel plan**

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan:

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 11      | 2405      | 19      | 2445      |
| 12      | 2410      | 20      | 2450      |
| 13      | 2415      | 21      | 2455      |
| 14      | 2420      | 22      | 2460      |
| 15      | 2425      | 23      | 2465      |
| 16      | 2430      | 24      | 2470      |
| 17      | 2435      | 25      | 2475      |
| 18      | 2440      | 26      | 2480      |

Note: the marked frequencies are determined for final testing.

## 2.6 Transmit operating modes

The EUT allows the user to switch the transmission on or off. There are no further operating modes.

The EUT use O-QPSK modulation and may provide following data rate:

- 250 kbps (kbps = *kilobits per second*)

## 2.7 Antenna

The following antennas shall be used with the EUT:

| Number | Type | Certification name                         | Plug  | Frequency range (GHz) | Gain (dBi) |
|--------|------|--------------------------------------------|-------|-----------------------|------------|
| 1      | Omni | AN2400-1901RS (Monopole)                   | SMA-R | 2.4                   | 5          |
| 2      | Omni | AL 112 (Monopole)                          | SMA-R | 2.4                   | -7.8       |
| 3      | Omni | rod antenna (Monopole)                     | SMA-R | 2.4                   | 2          |
| 4      | Omni | PCB meander antenna (Inverted F, Monopole) | none  | 2.4                   | 5          |

Note: There are variants with antenna connector. This variants are not able to connect to the PCB meander antenna. Variants without antenna connector are only able to use the integrated PCB meander antenna.

## 2.8 Power supply system utilised

Power supply voltage,  $V_{nom}$  : 15 VDC (external AC mains adapter)

Power supply voltage (alternative) : USB supply voltage 5 VDC

## 2.9 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- USB-Cable (host to client) 1 m                      Model : As usual in trade
- Notebook for control                                      Model : Toshiba
- Power supply, 100 V-230 VAC, 15 VDC                      Model : GlobTek, GT-41080-1817-9-2-9

## 2.10 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X-position. The tests are carried out in the following frequency band:

**2400 MHz – 2483.5 MHz**

Preliminary tests are performed to find the worst case mode from all possible combinations between available modulations and data rates. The maximum output power depends on used data rate. The output power can not be set.

**For the final test the following channels and test modes are selected:**

| IEEE Standard | Available channel | Tested channels | Power setting | Modulation | Modulation type | Data rate |
|---------------|-------------------|-----------------|---------------|------------|-----------------|-----------|
| 802.15.4      | 11 to 26          | 11, 18, 26      | Pmax          | DSSS       | O-QPSK          | 250 kbps  |

- TX continuous mode

## 2.11 Test jig

No special test jig is used for testing.

## 2.12 Test software

For testing, the interface is set in TX-continuous mode. The test software is available for testing only.

### **3 TEST RESULT SUMMARY**

Operating in the 2400 MHz – 2483.5 MHz:

| FCC Rule Part | RSS Rule Part  | Description                            | Result         |
|---------------|----------------|----------------------------------------|----------------|
| 15.207(a)     | RSS-Gen, 8.8   | AC power line conducted emissions      | passed         |
| 15.247(a)(2)  | RSS247, 5.2(1) | -6 dB EBW                              | passed         |
| 15.247(b)(3)  | RSS247, 5.4(4) | Maximum peak conducted output power    | passed         |
| 15.247(b)(4)  | RSS247, 5.4(4) | Defacto limit                          | not applicable |
| 15.247(d)     | RSS247, 5.5    | Unwanted emissions, conducted          | passed         |
| 15.247(d)     | RSS-Gen, 8.9   | Radiated emissions in restricted bands | passed         |
| 15.247(e)     | RSS247, 5.2(2) | PSD                                    | passed         |
| 15.203        | -              | Antenna requirement                    | passed         |
| -             | RSS-Gen, 6.11  | Transmitter frequency stability        | Not tested     |
| -             | RSS-Gen, 6.6   | 99 % Bandwidth                         | passed         |

The mentioned new RSS Rule Parts in the above table are related to:

RSS Gen, Issue 4, November 2014

RSS 247, Issue 1, May 2015

### 3.1 Final assessment

The equipment under test fulfills the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 24 May 2016

Testing concluded on : 15 June 2016

Checked by:



Eduard Stangl  
I confirm the  
correctness of this  
document!  
2016.09.07 14:08:49  
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\_\_\_\_\_  
Eduard Stangl  
Technical Director

Tested by:



Hermann Smetana  
I am the author of  
this document  
2016.09.05  
13:38:56 +02'00'

\_\_\_\_\_  
Hermann Smetana  
Radio Team

## **4 TEST ENVIRONMENT**

### **4.1 Address of the test laboratory**

**CSA Group Bayern GmbH  
Ohmstrasse 1-4  
94342 STRASSKIRCHEN  
GERMANY**

### **4.2 Environmental conditions**

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

### **4.3 Statement of the measurement uncertainty**

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor  $k = 2$ . The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

| <b>Measurement Type</b>             | <b>Range</b>           | <b>Confidence Level</b> | <b>Calculated Uncertainty</b> |
|-------------------------------------|------------------------|-------------------------|-------------------------------|
| AC power line conducted emissions   | 0.15 MHz to 30 MHz     | 95%                     | $\pm 3.29$ dB                 |
| EBW and OBW                         | 2400 MHz to 3000 MHz   | 95%                     | $\pm 2.5 \times 10^{-7}$      |
| Maximum peak conducted output power | 2400 MHz to 3000 MHz   | 95%                     | $\pm 0.62$ dB                 |
| Power spectral density              | 2400 MHz to 3000 MHz   | 95%                     | $\pm 0.62$ dB                 |
| Conducted Spurious Emissions        | 9 kHz to 10000 MHz     | 95%                     | $\pm 2.15$ dB                 |
| Conducted Spurious Emissions        | 10000 MHz to 40000 MHz | 95%                     | $\pm 3.47$ dB                 |
| Radiated Spurious Emissions         | 9 kHz to 30 MHz        | 95%                     | $\pm 3.53$ dB                 |
| Radiated Spurious Emissions         | 30 MHz to 1000 MHz     | 95%                     | $\pm 3.71$ dB                 |
| Radiated Spurious Emissions         | 1000 MHz to 10000 MHz  | 95%                     | $\pm 2.34$ dB                 |
| Field strength of the fundamental   | 100 kHz to 100 MHz     | 95%                     | $\pm 3.53$ dB                 |

## 4.4 Measurement protocol for FCC and ISCED

### 4.4.1 General information

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

**IC 3009A-1**

The Anechoic chamber is a listed test site under the Canadian Test-Sites File-No:

**IC 3009A-2**

In compliance with RSS 247 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

#### 4.4.1.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

#### 4.4.1.2 Details of test procedures

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.10 - "Testing Unlicensed Wireless Devices". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

## 5 TEST CONDITIONS AND RESULTS

### 5.1 AC power line conducted emissions

For test instruments and accessories used see section 6 Part A 4.

#### 5.1.1 Description of the test location

Test location:                      Shielded Room S2

#### 5.1.2 Photo documentation of the test set-up



#### 5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

#### 5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10 described under item 6.2. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

**5.1.5 Test result**

Frequency range: 0.15 MHz - 30 MHz  
Min. limit margin 12.33 dB at 15.357 MHz

Limit according to FCC Part 15, Section 15.207(a):

| Frequency of Emission<br>(MHz) | Conducted Limit (dB $\mu$ V) |            |
|--------------------------------|------------------------------|------------|
|                                | Quasi-peak                   | Average    |
| 0.15-0.5                       | 66 to 56 *                   | 56 to 46 * |
| 0.5-5                          | 56                           | 46         |
| 5-30                           | 60                           | 50         |

\* Decreases with the logarithm of the frequency

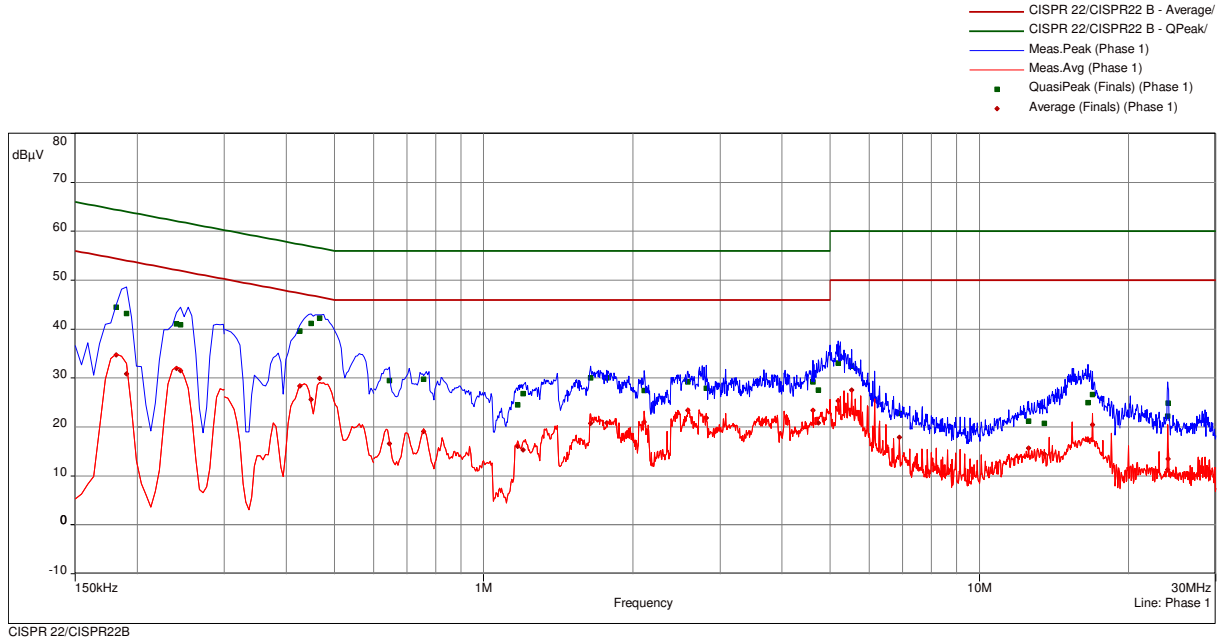
The requirements are **FULFILLED**.

**Remarks:** For detailed test result please see the following test protocols.

**5.1.6 Test protocol**

Test point L1  
 Operation mode: Cont. Tx at 2.4 GHz  
 Remarks: Connection via USB – all ports are free

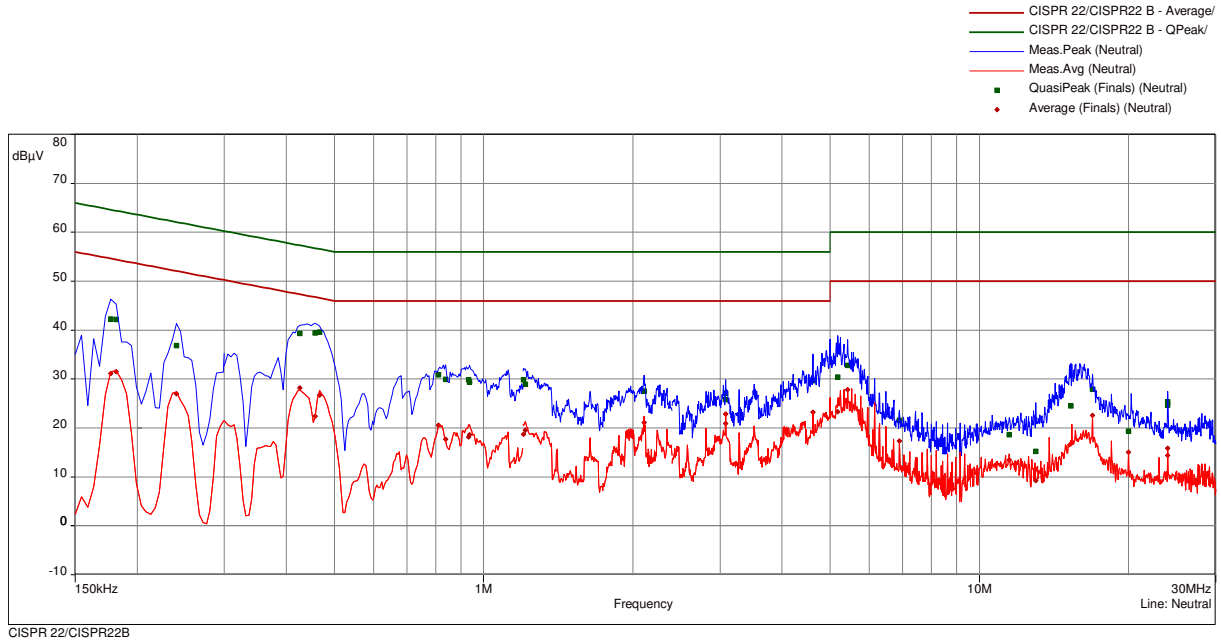
Result: passed



| freq<br>MHz | SR | QP<br>dB(μV) | margin<br>dB | limit<br>dB | AV<br>dB(μV) | margin<br>dB | limit<br>dB | line    | corr<br>dB |
|-------------|----|--------------|--------------|-------------|--------------|--------------|-------------|---------|------------|
| 0.1815      | 1  | 44.49        | 19.93        | 64.42       | 34.75        | 19.67        | 54.42       | Phase 1 | 9.84       |
| 0.1905      | 1  | 43.22        | 20.80        | 64.01       | 30.89        | 23.13        | 54.01       | Phase 1 | 9.83       |
| 0.24        | 1  | 41.05        | 21.05        | 62.10       | 31.96        | 20.13        | 52.10       | Phase 1 | 9.83       |
| 0.2445      | 1  | 40.89        | 21.05        | 61.94       | 31.55        | 20.40        | 51.94       | Phase 1 | 9.83       |
| 0.426       | 2  | 39.56        | 17.77        | 57.33       | 28.42        | 18.91        | 47.33       | Phase 1 | 9.81       |
| 0.4485      | 2  | 41.19        | 15.71        | 56.90       | 25.59        | 21.31        | 46.90       | Phase 1 | 9.82       |
| 0.4665      | 2  | 42.31        | 14.27        | 56.58       | 29.90        | 16.67        | 46.58       | Phase 1 | 9.82       |
| 0.645       | 3  | 29.49        | 26.51        | 56.00       | 16.57        | 29.43        | 46.00       | Phase 1 | 9.81       |
| 0.7575      | 3  | 29.77        | 26.23        | 56.00       | 19.11        | 26.89        | 46.00       | Phase 1 | 9.80       |
| 1.1715      | 3  | 24.49        | 31.51        | 56.00       | 16.05        | 29.95        | 46.00       | Phase 1 | 9.80       |
| 1.2         | 3  | 26.80        | 29.20        | 56.00       | 15.33        | 30.67        | 46.00       | Phase 1 | 9.80       |
| 1.6455      | 4  | 30.04        | 25.96        | 56.00       | 20.73        | 25.27        | 46.00       | Phase 1 | 9.79       |
| 1.7715      | 4  | 30.02        | 25.98        | 56.00       | 20.80        | 25.20        | 46.00       | Phase 1 | 9.79       |
| 2.109       | 4  | 27.43        | 28.57        | 56.00       | 21.01        | 24.99        | 46.00       | Phase 1 | 9.80       |
| 2.58        | 5  | 29.22        | 26.78        | 56.00       | 23.41        | 22.59        | 46.00       | Phase 1 | 9.79       |
| 2.814       | 5  | 27.88        | 28.12        | 56.00       | 21.87        | 24.13        | 46.00       | Phase 1 | 9.79       |
| 4.614       | 5  | 29.23        | 26.77        | 56.00       | 23.39        | 22.61        | 46.00       | Phase 1 | 9.81       |
| 4.74        | 5  | 27.55        | 28.45        | 56.00       | 20.79        | 25.21        | 46.00       | Phase 1 | 9.82       |
| 5.1915      | 6  | 33.08        | 26.92        | 60.00       | 25.34        | 24.66        | 50.00       | Phase 1 | 9.83       |
| 5.5245      | 6  | 32.41        | 27.59        | 60.00       | 27.58        | 22.42        | 50.00       | Phase 1 | 9.82       |
| 6.906       | 6  | 22.78        | 37.22        | 60.00       | 17.85        | 32.15        | 50.00       | Phase 1 | 9.84       |
| 12.5745     | 7  | 21.19        | 38.81        | 60.00       | 15.72        | 34.28        | 50.00       | Phase 1 | 10.00      |
| 13.5285     | 7  | 20.72        | 39.28        | 60.00       | 14.47        | 35.53        | 50.00       | Phase 1 | 10.04      |
| 16.566      | 7  | 24.95        | 35.05        | 60.00       | 17.30        | 32.70        | 50.00       | Phase 1 | 10.18      |
| 16.926      | 7  | 26.63        | 33.37        | 60.00       | 20.48        | 29.52        | 50.00       | Phase 1 | 10.19      |
| 23.97       | 8  | 22.26        | 37.74        | 60.00       | 11.24        | 38.76        | 50.00       | Phase 1 | 10.34      |
| 24.06       | 8  | 24.90        | 35.10        | 60.00       | 13.46        | 36.54        | 50.00       | Phase 1 | 10.34      |

Test point: N  
 Operation mode: Cont. Tx at 2.4 GHz  
 Remarks: Connection via USB – all ports are free

Result: passed



| freq    | SR | QP     | margin | limit | AV     | margin | limit | line    | corr  |
|---------|----|--------|--------|-------|--------|--------|-------|---------|-------|
| MHz     |    | dB(μV) | dB     | dB    | dB(μV) | dB     | dB    |         | dB    |
| 0.177   | 9  | 42.27  | 22.35  | 64.63 | 31.14  | 23.49  | 54.63 | Neutral | 9.85  |
| 0.1815  | 9  | 42.22  | 22.20  | 64.42 | 31.53  | 22.89  | 54.42 | Neutral | 9.85  |
| 0.24    | 9  | 36.85  | 25.25  | 62.10 | 27.01  | 25.09  | 52.10 | Neutral | 9.84  |
| 0.426   | 10 | 39.38  | 17.96  | 57.33 | 28.18  | 19.15  | 47.33 | Neutral | 9.81  |
| 0.4575  | 10 | 39.41  | 17.33  | 56.74 | 22.44  | 24.29  | 46.74 | Neutral | 9.82  |
| 0.4665  | 10 | 39.58  | 17.00  | 56.58 | 26.74  | 19.83  | 46.58 | Neutral | 9.82  |
| 0.8115  | 11 | 30.90  | 25.10  | 56.00 | 20.57  | 25.43  | 46.00 | Neutral | 9.81  |
| 0.8385  | 11 | 29.98  | 26.02  | 56.00 | 17.67  | 28.33  | 46.00 | Neutral | 9.81  |
| 0.933   | 11 | 29.85  | 26.15  | 56.00 | 18.18  | 27.82  | 46.00 | Neutral | 9.82  |
| 0.9375  | 11 | 29.42  | 26.58  | 56.00 | 18.61  | 27.39  | 46.00 | Neutral | 9.82  |
| 1.2045  | 12 | 29.90  | 26.10  | 56.00 | 18.73  | 27.27  | 46.00 | Neutral | 9.80  |
| 1.2135  | 12 | 28.95  | 27.05  | 56.00 | 19.58  | 26.42  | 46.00 | Neutral | 9.80  |
| 2.109   | 12 | 27.54  | 28.46  | 56.00 | 21.07  | 24.93  | 46.00 | Neutral | 9.80  |
| 3.075   | 13 | 27.07  | 28.93  | 56.00 | 22.85  | 23.15  | 46.00 | Neutral | 9.79  |
| 3.0795  | 13 | 25.83  | 30.17  | 56.00 | 20.96  | 25.04  | 46.00 | Neutral | 9.79  |
| 4.614   | 13 | 29.66  | 26.34  | 56.00 | 23.24  | 22.76  | 46.00 | Neutral | 9.81  |
| 5.1825  | 14 | 30.36  | 29.64  | 60.00 | 23.35  | 26.65  | 50.00 | Neutral | 9.82  |
| 5.43    | 14 | 32.83  | 27.17  | 60.00 | 27.80  | 22.20  | 50.00 | Neutral | 9.81  |
| 6.906   | 14 | 21.56  | 38.44  | 60.00 | 17.37  | 32.63  | 50.00 | Neutral | 9.81  |
| 11.481  | 15 | 18.65  | 41.35  | 60.00 | 13.49  | 36.51  | 50.00 | Neutral | 9.85  |
| 12.993  | 15 | 15.24  | 44.76  | 60.00 | 9.26   | 40.74  | 50.00 | Neutral | 9.88  |
| 15.3105 | 15 | 24.49  | 35.51  | 60.00 | 16.83  | 33.17  | 50.00 | Neutral | 9.95  |
| 16.917  | 15 | 27.89  | 32.11  | 60.00 | 22.63  | 27.37  | 50.00 | Neutral | 10.00 |
| 19.992  | 16 | 19.35  | 40.65  | 60.00 | 15.07  | 34.93  | 50.00 | Neutral | 10.13 |
| 23.997  | 16 | 25.36  | 34.64  | 60.00 | 15.90  | 34.10  | 50.00 | Neutral | 9.96  |
| 24.0105 | 16 | 24.72  | 35.28  | 60.00 | 14.36  | 35.64  | 50.00 | Neutral | 9.96  |

Test point

L1

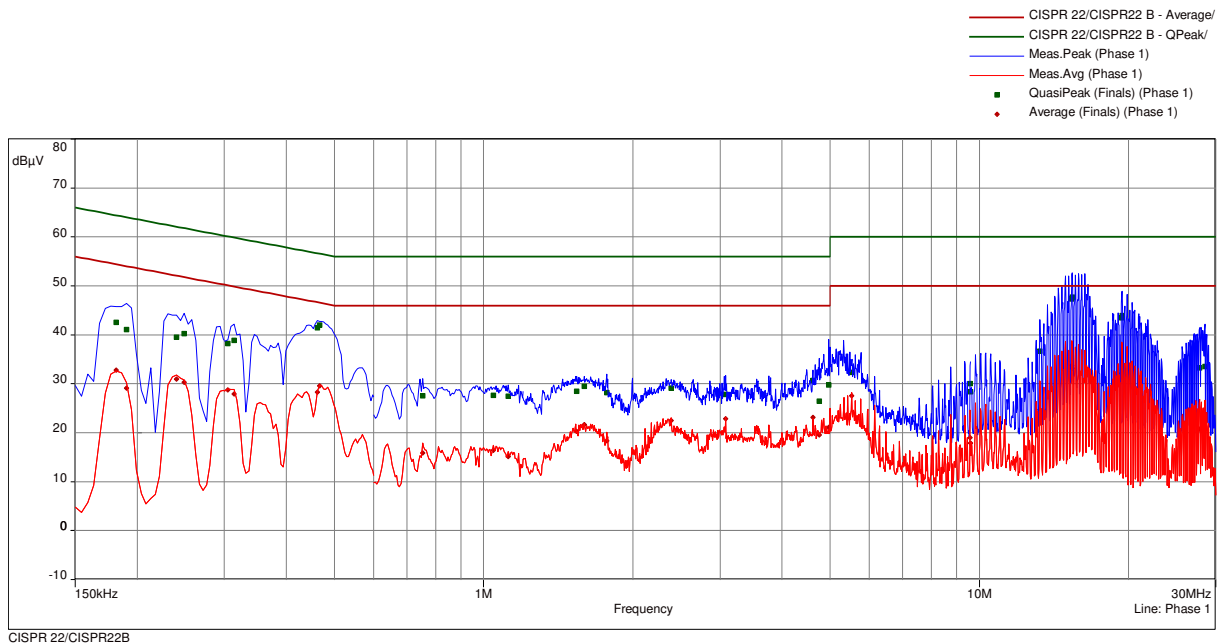
Result: passed

Operation mode:

active Connection at 2.4 GHz with logger in port 3

Remarks:

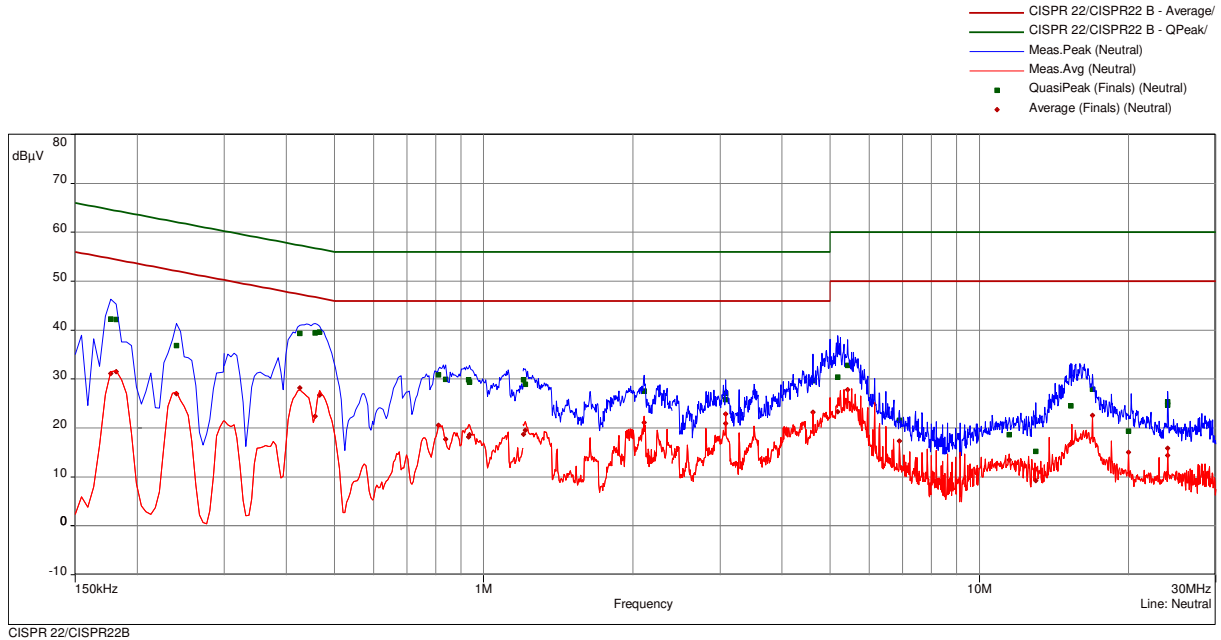
Connection via USB



| freq    | SR | QP     | margin | limit | AV     | margin | limit | line    | corr  |
|---------|----|--------|--------|-------|--------|--------|-------|---------|-------|
| MHz     |    | dB(μV) | dB     | dB    | dB(μV) | dB     | dB    |         | dB    |
| 0.1815  | 1  | 42.52  | 21.90  | 64.42 | 32.76  | 21.65  | 54.42 | Phase 1 | 9.84  |
| 0.1905  | 1  | 41.06  | 22.95  | 64.01 | 29.10  | 24.91  | 54.01 | Phase 1 | 9.83  |
| 0.24    | 1  | 39.54  | 22.56  | 62.10 | 30.97  | 21.13  | 52.10 | Phase 1 | 9.83  |
| 0.249   | 1  | 40.25  | 21.54  | 61.79 | 30.36  | 21.44  | 51.79 | Phase 1 | 9.83  |
| 0.3045  | 2  | 38.27  | 21.85  | 60.12 | 28.76  | 21.35  | 50.12 | Phase 1 | 9.82  |
| 0.3135  | 2  | 38.90  | 20.98  | 59.88 | 27.94  | 21.94  | 49.88 | Phase 1 | 9.82  |
| 0.462   | 2  | 41.47  | 15.19  | 56.66 | 28.28  | 18.38  | 46.66 | Phase 1 | 9.82  |
| 0.4665  | 2  | 42.00  | 14.57  | 56.58 | 29.55  | 17.03  | 46.58 | Phase 1 | 9.82  |
| 0.753   | 3  | 27.52  | 28.48  | 56.00 | 15.87  | 30.13  | 46.00 | Phase 1 | 9.80  |
| 1.0455  | 3  | 27.63  | 28.37  | 56.00 | 16.41  | 29.59  | 46.00 | Phase 1 | 9.81  |
| 1.122   | 3  | 27.48  | 28.52  | 56.00 | 15.14  | 30.86  | 46.00 | Phase 1 | 9.81  |
| 1.542   | 4  | 28.43  | 27.57  | 56.00 | 20.27  | 25.73  | 46.00 | Phase 1 | 9.78  |
| 1.596   | 4  | 29.52  | 26.48  | 56.00 | 21.65  | 24.35  | 46.00 | Phase 1 | 9.79  |
| 1.7715  | 4  | 28.20  | 27.80  | 56.00 | 18.31  | 27.69  | 46.00 | Phase 1 | 9.79  |
| 2.3925  | 4  | 29.09  | 26.91  | 56.00 | 22.45  | 23.55  | 46.00 | Phase 1 | 9.79  |
| 3.0795  | 5  | 27.79  | 28.21  | 56.00 | 22.87  | 23.13  | 46.00 | Phase 1 | 9.80  |
| 4.6185  | 5  | 30.66  | 25.34  | 56.00 | 23.10  | 22.90  | 46.00 | Phase 1 | 9.81  |
| 4.758   | 5  | 26.43  | 29.57  | 56.00 | 19.57  | 26.43  | 46.00 | Phase 1 | 9.82  |
| 4.971   | 6  | 29.72  | 26.28  | 56.00 | 21.09  | 24.91  | 46.00 | Phase 1 | 9.82  |
| 5.5245  | 6  | 32.33  | 27.67  | 60.00 | 27.57  | 22.43  | 50.00 | Phase 1 | 9.82  |
| 9.588   | 6  | 30.04  | 29.96  | 60.00 | 19.02  | 30.98  | 50.00 | Phase 1 | 9.89  |
| 9.5925  | 6  | 28.43  | 31.57  | 60.00 | 17.86  | 32.14  | 50.00 | Phase 1 | 9.89  |
| 13.254  | 7  | 36.63  | 23.37  | 60.00 | 24.68  | 25.32  | 50.00 | Phase 1 | 10.03 |
| 15.3825 | 7  | 47.35  | 12.65  | 60.00 | 33.75  | 16.25  | 50.00 | Phase 1 | 10.13 |
| 15.387  | 7  | 47.67  | 12.33  | 60.00 | 33.19  | 16.81  | 50.00 | Phase 1 | 10.13 |
| 19.4025 | 8  | 43.49  | 16.51  | 60.00 | 32.18  | 17.82  | 50.00 | Phase 1 | 10.30 |
| 19.407  | 8  | 43.98  | 16.02  | 60.00 | 31.33  | 18.67  | 50.00 | Phase 1 | 10.30 |
| 27.804  | 8  | 33.25  | 26.75  | 60.00 | 20.77  | 29.23  | 50.00 | Phase 1 | 10.34 |
| 28.524  | 8  | 33.53  | 26.47  | 60.00 | 20.77  | 29.23  | 50.00 | Phase 1 | 10.34 |

Test point N  
 Operation mode: active Connection at 2.4 GHz with logger in port 3  
 Remarks: Connection via USB

Result: passed



| freq    | SR | QP     | margin | limit | AV     | margin | limit | line    | corr  |
|---------|----|--------|--------|-------|--------|--------|-------|---------|-------|
| MHz     |    | dB(μV) | dB     | dB    | dB(μV) | dB     | dB    |         | dB    |
| 0.177   | 9  | 42.27  | 22.35  | 64.63 | 31.14  | 23.49  | 54.63 | Neutral | 9.85  |
| 0.1815  | 9  | 42.22  | 22.20  | 64.42 | 31.53  | 22.89  | 54.42 | Neutral | 9.85  |
| 0.24    | 9  | 36.85  | 25.25  | 62.10 | 27.01  | 25.09  | 52.10 | Neutral | 9.84  |
| 0.426   | 10 | 39.38  | 17.96  | 57.33 | 28.18  | 19.15  | 47.33 | Neutral | 9.81  |
| 0.4575  | 10 | 39.41  | 17.33  | 56.74 | 22.44  | 24.29  | 46.74 | Neutral | 9.82  |
| 0.4665  | 10 | 39.58  | 17.00  | 56.58 | 26.74  | 19.83  | 46.58 | Neutral | 9.82  |
| 0.8115  | 11 | 30.90  | 25.10  | 56.00 | 20.57  | 25.43  | 46.00 | Neutral | 9.81  |
| 0.8385  | 11 | 29.98  | 26.02  | 56.00 | 17.67  | 28.33  | 46.00 | Neutral | 9.81  |
| 0.933   | 11 | 29.85  | 26.15  | 56.00 | 18.18  | 27.82  | 46.00 | Neutral | 9.82  |
| 0.9375  | 11 | 29.42  | 26.58  | 56.00 | 18.61  | 27.39  | 46.00 | Neutral | 9.82  |
| 1.2045  | 12 | 29.90  | 26.10  | 56.00 | 18.73  | 27.27  | 46.00 | Neutral | 9.80  |
| 1.2135  | 12 | 28.95  | 27.05  | 56.00 | 19.58  | 26.42  | 46.00 | Neutral | 9.80  |
| 2.109   | 12 | 27.54  | 28.46  | 56.00 | 21.07  | 24.93  | 46.00 | Neutral | 9.80  |
| 3.075   | 13 | 27.07  | 28.93  | 56.00 | 22.85  | 23.15  | 46.00 | Neutral | 9.79  |
| 3.0795  | 13 | 25.83  | 30.17  | 56.00 | 20.96  | 25.04  | 46.00 | Neutral | 9.79  |
| 4.614   | 13 | 29.66  | 26.34  | 56.00 | 23.24  | 22.76  | 46.00 | Neutral | 9.81  |
| 5.1825  | 14 | 30.36  | 29.64  | 60.00 | 23.35  | 26.65  | 50.00 | Neutral | 9.82  |
| 5.43    | 14 | 32.83  | 27.17  | 60.00 | 27.80  | 22.20  | 50.00 | Neutral | 9.81  |
| 6.906   | 14 | 21.56  | 38.44  | 60.00 | 17.37  | 32.63  | 50.00 | Neutral | 9.81  |
| 11.481  | 15 | 18.65  | 41.35  | 60.00 | 13.49  | 36.51  | 50.00 | Neutral | 9.85  |
| 12.993  | 15 | 15.24  | 44.76  | 60.00 | 9.26   | 40.74  | 50.00 | Neutral | 9.88  |
| 15.3105 | 15 | 24.49  | 35.51  | 60.00 | 16.83  | 33.17  | 50.00 | Neutral | 9.95  |
| 16.917  | 15 | 27.89  | 32.11  | 60.00 | 22.63  | 27.37  | 50.00 | Neutral | 10.00 |
| 19.992  | 16 | 19.35  | 40.65  | 60.00 | 15.07  | 34.93  | 50.00 | Neutral | 10.13 |
| 23.997  | 16 | 25.36  | 34.64  | 60.00 | 15.90  | 34.10  | 50.00 | Neutral | 9.96  |
| 24.0105 | 16 | 24.72  | 35.28  | 60.00 | 14.36  | 35.64  | 50.00 | Neutral | 9.96  |

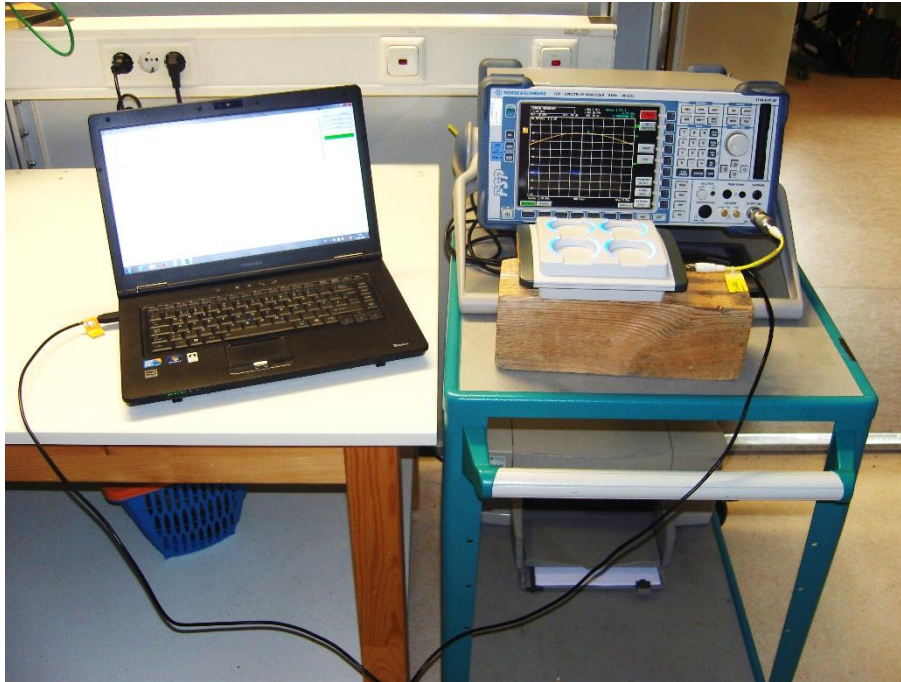
## 5.2 EBW and OBW

For test instruments and accessories used see section 6 Part **MB**.

### 5.2.1 Description of the test location

Test location: AREA4

### 5.2.2 Photo documentation of the test set-up



### 5.2.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(2):

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 5.2.4 Description of Measurement

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitted bandwidth at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. An alternative is to use the bandwidth measurement of the analyser.

Spectrum analyser settings for EBW 6dB:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Sweep time: 5 s, Span: 2 EBW;

Spectrum analyser settings for OBW:

RBW: 1-5% OBW, VBW: 3 RBW, Detector: Max peak, Sweep time: 5 s, Span: 2 OBW;

### 5.2.5 Test result

| Channel | Centre frequency (MHz) | 6 dB bandwidth (MHz) | Minimum limit (MHz) |
|---------|------------------------|----------------------|---------------------|
| 11      | 2405                   | 1.587                | 0.5                 |
| 18      | 2440                   | 1.587                | 0.5                 |
| 26      | 2480                   | 1.582                | 0.5                 |

| Channel | Centre frequency (MHz) | 99 % bandwidth (MHz) |
|---------|------------------------|----------------------|
| 11      | 2405                   | 2.473                |
| 18      | 2440                   | 2.466                |
| 26      | 2480                   | 2.474                |

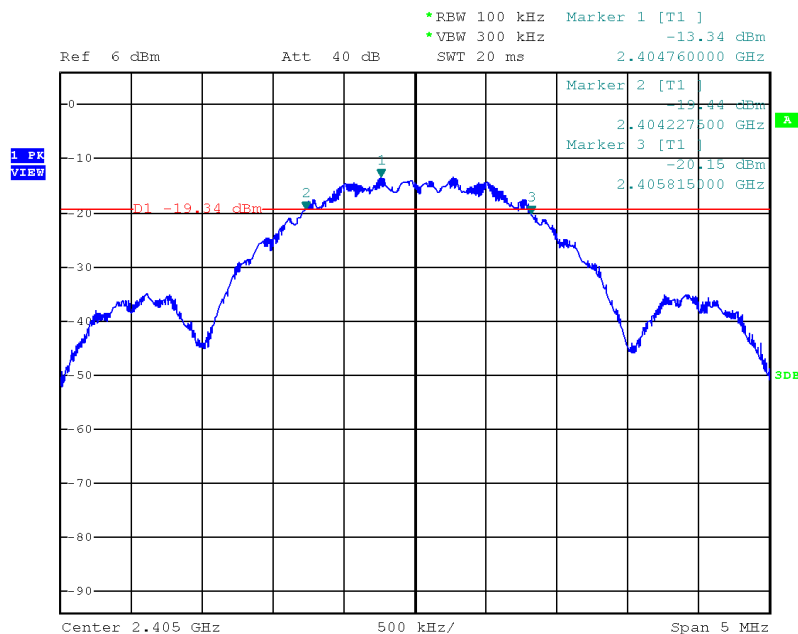
Limit according to FCC Part 15, Section 15.247(b)(2):  
The minimum 6 dB bandwidth shall be at least 500 kHz.

The requirements are **FULFILLED**.

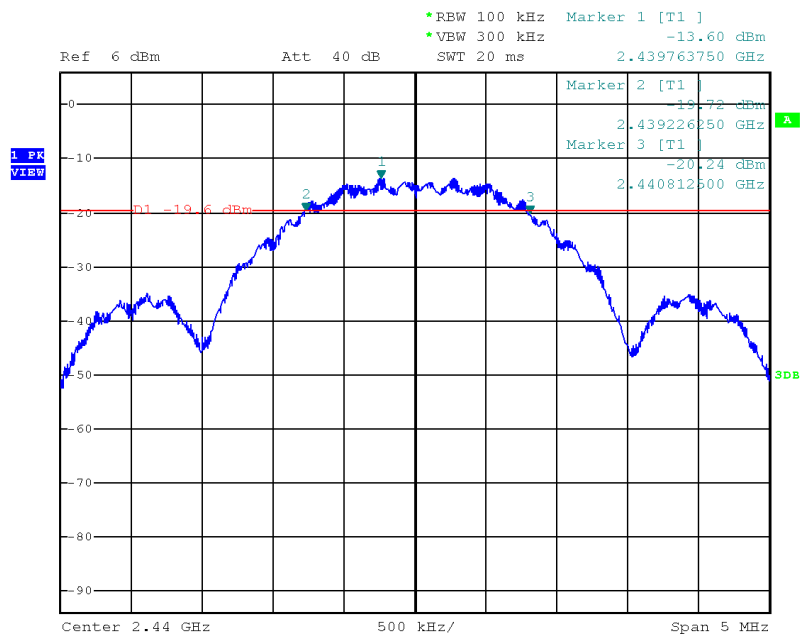
**Remarks:** For detailed test result please see the following test protocols.

### 5.2.6 Test protocols EBW 6 dB

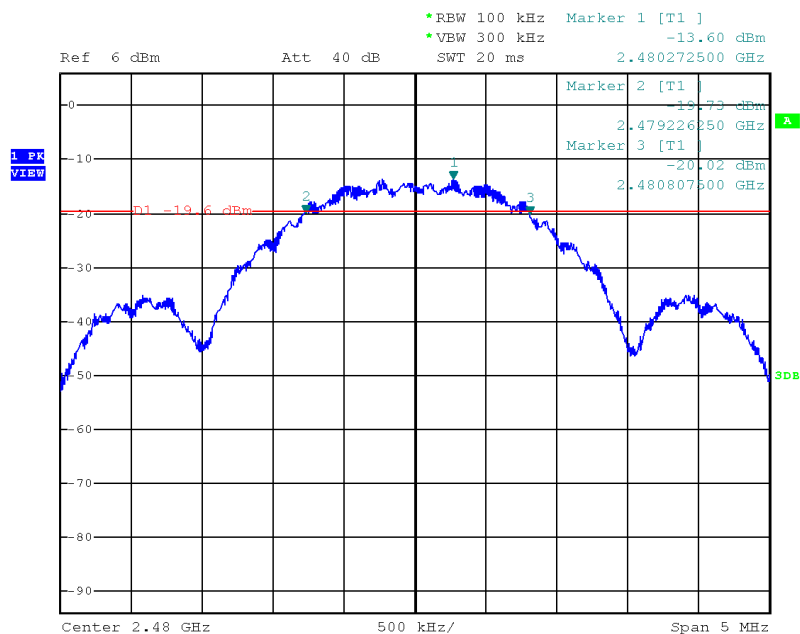
#### Channel 11 (2405 MHz)



Channel 18 (2440 MHz)

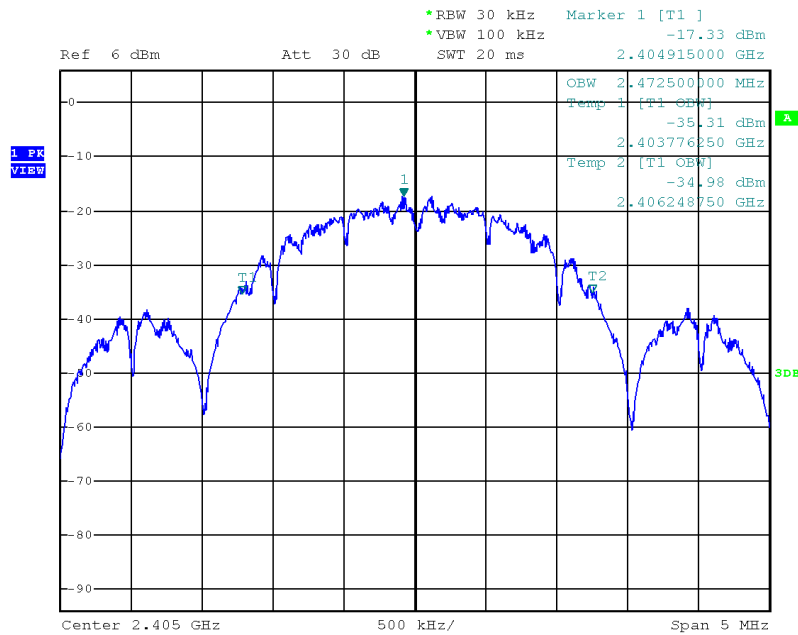


Channel 26 (2480 MHz)

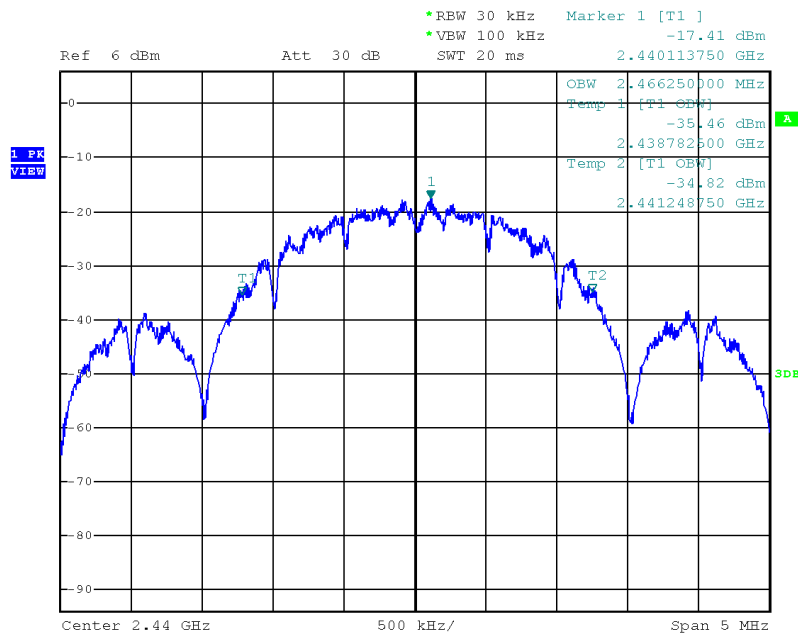


## 5.2.7 Test protocols OBW

Channel 11 (2405 MHz)



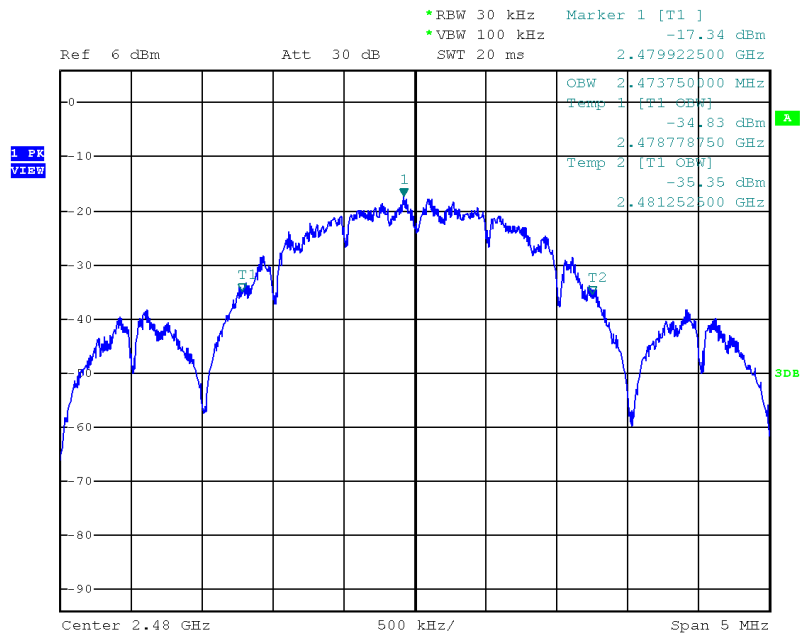
Channel 18 (2440 MHz)



FCC ID: VQ5-EBIIFXXX

IC: 7412A-EBIIFXXX

Channel 26 (2480 MHz)



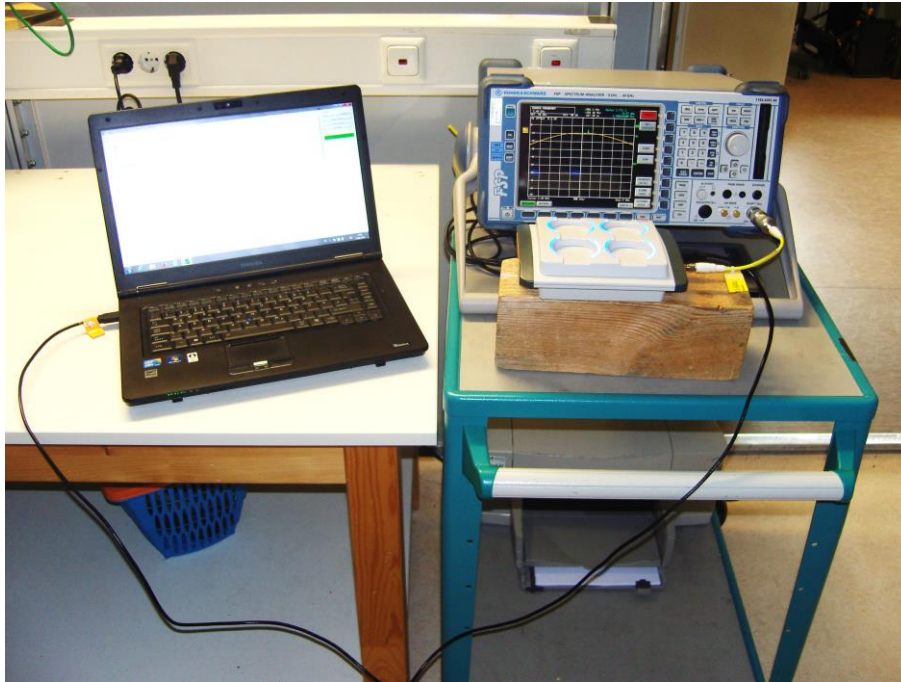
### 5.3 Maximum peak conducted output power

For test instruments and accessories used see section 6 Part **CPC 3**.

#### 5.3.1 Description of the test location

Test location: AREA4

#### 5.3.2 Photo documentation of the test set-up



#### 5.3.3 Applicable standard

According to FCC Part 15, Section 15.247(b)(3):

For systems using digital modulation in the 2400-2483.5 MHz the maximum peak conducted output power of the transmitter shall not exceed 1 Watt.

#### 5.3.4 Description of Measurement

The maximum peak conducted output power is measured using a spectrum analyser following the procedure set out in KDB 558074, item 9.1.1. The EUT is set in TX continuous mode while measuring.

#### 5.3.5 Test result

| 802.15.4, 250 kbps, TX  |           | Test results |                        |             |
|-------------------------|-----------|--------------|------------------------|-------------|
|                         |           | A (dBm)      | Peak power limit (dBm) | Margin (dB) |
| Lowest frequency: CH11  |           |              |                        |             |
| $T_{nom}$               | $V_{nom}$ | -2.6         | 30.0                   | -32.6       |
| Middle frequency: CH18  |           |              |                        |             |
| $T_{nom}$               | $V_{nom}$ | -2.2         | 30.0                   | -32.2       |
| Highest frequency: CH26 |           |              |                        |             |
| $T_{nom}$               | $V_{nom}$ | -1.4         | 30.0                   | -31.4       |

Peak Power Limit according to FCC Part 15, Section 15.247(b)(3):

| Frequency<br>(MHz) | Peak Power Limit |            |
|--------------------|------------------|------------|
|                    | (dBm)            | (W)        |
| 902-928            | 30               | 1.0        |
| <b>2400-2483.5</b> | <b>30</b>        | <b>1.0</b> |
| 5725-5850          | 30               | 1.0        |

The requirements are **FULFILLED**.

Remarks:

## 5.4 EIRP, Defacto limit

For test instruments and accessories used see section 6 Part **CPC 3**.

### 5.4.1 Description of the test location

Test location: NONE

Remarks: Not applicable, the antenna gain is less 6 dBi.

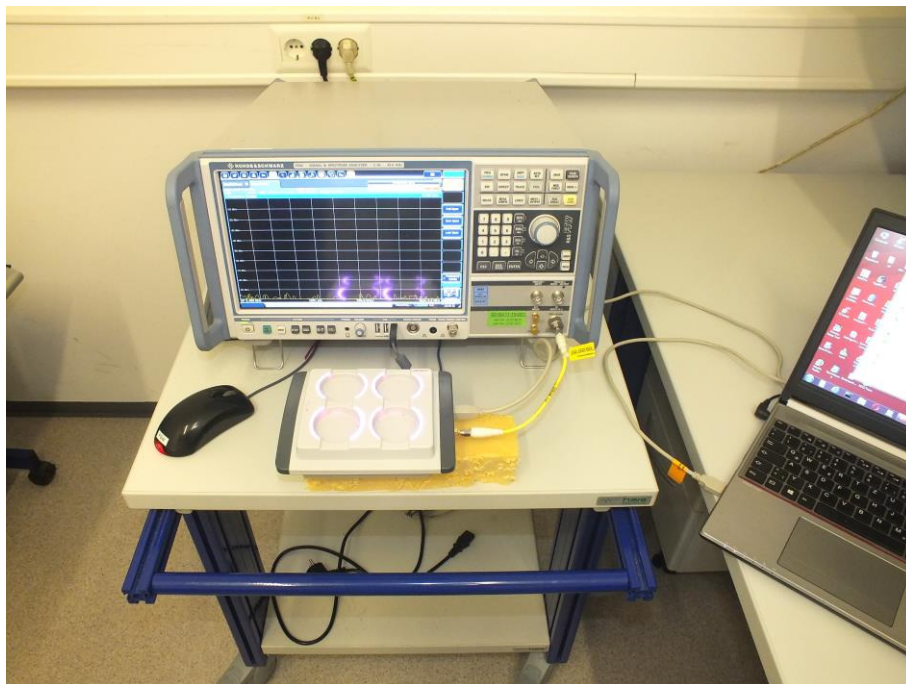
## 5.5 Power spectral density

For test instruments and accessories used see section 6 Part **MB**.

### 5.5.1 Description of the test location

Test location: AREA4

### 5.5.2 Photo documentation of the test set-up



### 5.5.3 Applicable standard

According to FCC Part 15, Section 15.247(e):

For digitally modulated systems, the power spectral density radiated from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the radiated output power shall be used to determine the power spectral density.

#### 5.5.4 Description of Measurement

The measurement is performed using the procedure 10.2 set out in KDB-558074. Therefore the PKPSD is measured conducted. The max peak is located and measured with the spectrum analyser and the marker set to peak. A transducer is used to compensate the insertion loss of the cable.

Spectrum analyser settings:

RBW: 3 kHz, VBW: 10 kHz, Detector: Peak, Sweep time: Auto

#### 5.5.5 Test result

| 802.15.4, 250 kbps, 1 TX    |           | Test results conducted  |                       |               |                          |                |
|-----------------------------|-----------|-------------------------|-----------------------|---------------|--------------------------|----------------|
|                             |           | PD [Pmax]<br>(dBm/3kHz) | Antenna Gain<br>(dBi) | EIRP<br>(dBm) | EIRP Limit<br>(dBm/3kHz) | Margin<br>(dB) |
| Lowest frequency: 2405 MHz  |           |                         |                       |               |                          |                |
| $T_{nom}$                   | $V_{nom}$ | -24.6                   | 5.0                   | -19.6         | 14.0                     | -33.6          |
| Middle frequency: 2440 MHz  |           |                         |                       |               |                          |                |
| $T_{nom}$                   | $V_{nom}$ | -24.8                   | 5.0                   | -19.8         | 14.0                     | -33.8          |
| Highest frequency: 2480 MHz |           |                         |                       |               |                          |                |
| $T_{nom}$                   | $V_{nom}$ | -25.2                   | 5.0                   | -20.2         | 14.0                     | -34.2          |

Power spectral density limit according to FCC Part 15, Section 15.247(e):

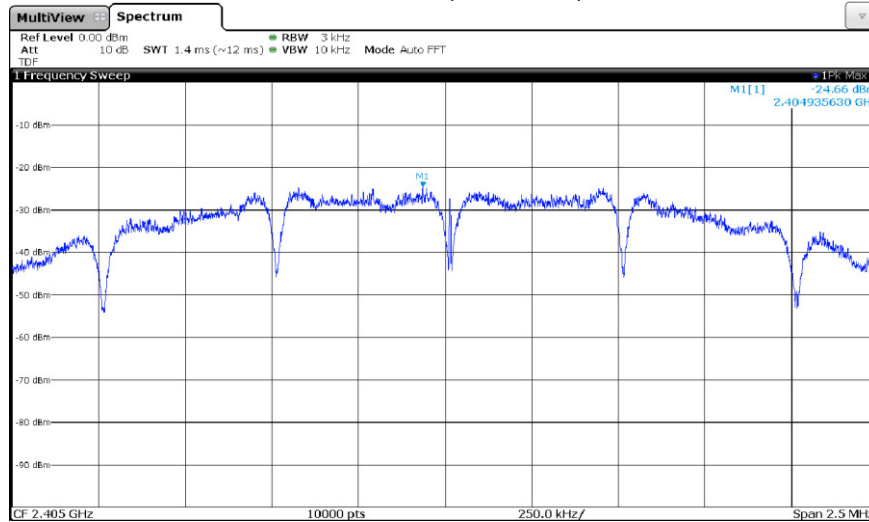
| Frequency<br>(MHz) | Power spectral density limit (EIRP) |
|--------------------|-------------------------------------|
|                    | (dBm/3 kHz)                         |
| 2400 - 2483.5      | 14                                  |

The requirements are **FULFILLED**.

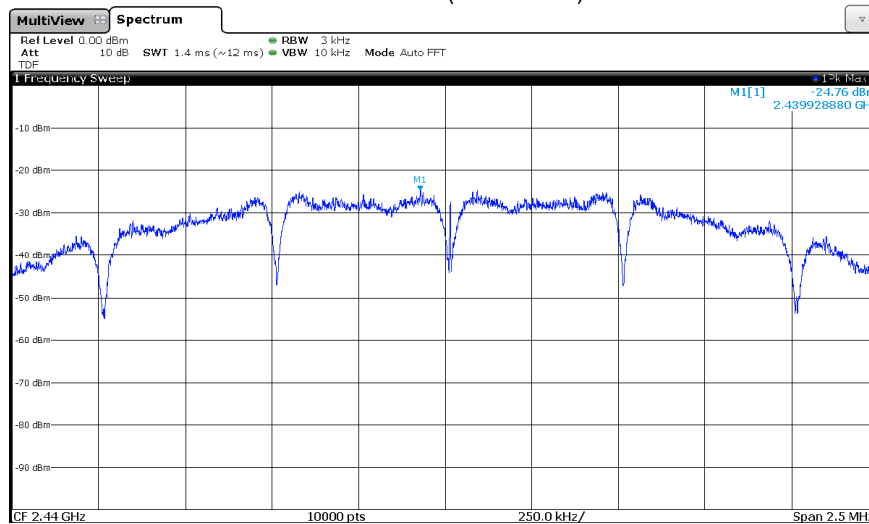
**Remarks:** For detailed test result please see the following test protocols.

### 5.5.6 Test protocols

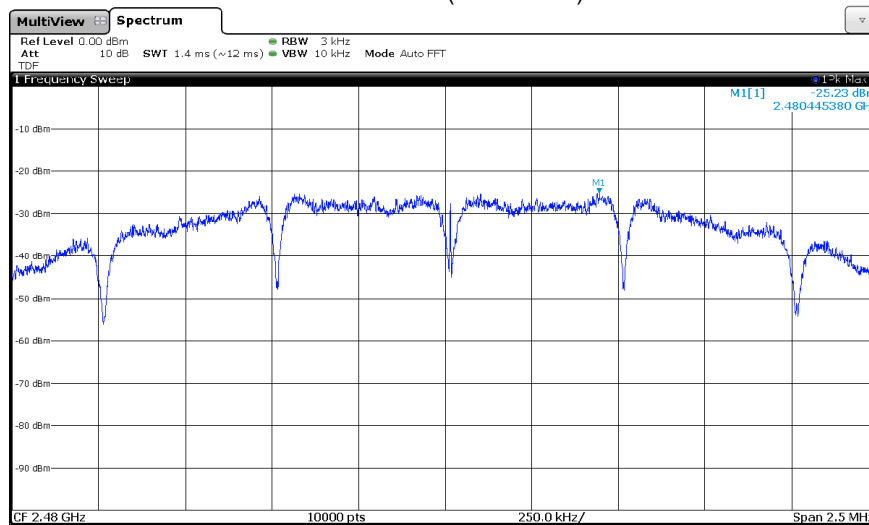
Channel 11 (2405 MHz)



Channel 18 (2440 MHz)



Channel 26 (2480 MHz)



## 5.6 Radiated emissions in restricted bands

For test instruments and accessories used see section 6 Part **SER 2**, **SER 3**.

### 5.6.1 Description of the test location

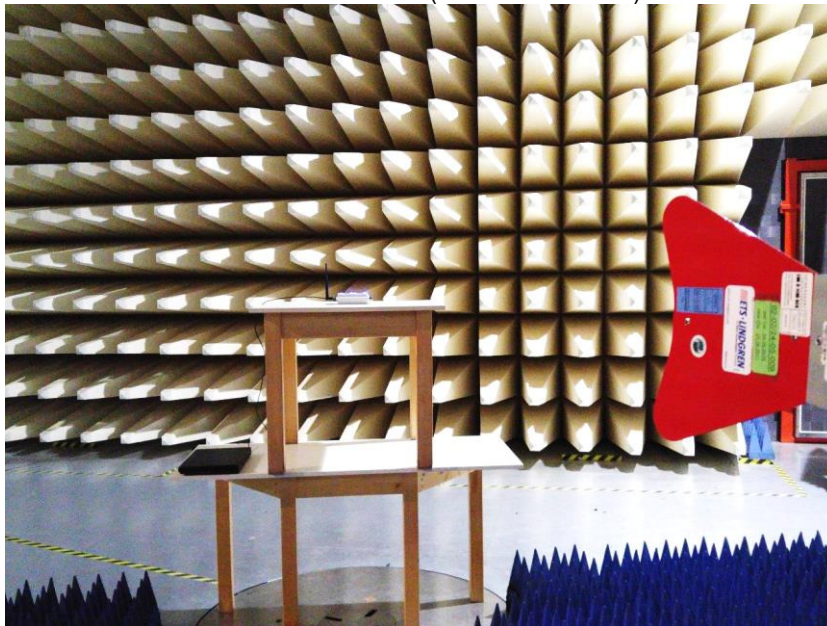
Test location: OATS 1  
Test location: Anechoic Chamber 1  
Test distance: 3 m  
Test distance: 1 m (for frequencies > 18GHz)

### 5.6.2 Photo documentation of the test set-up

Open area test site (30 MHz – 1000 MHz)



Anechoic chamber (1 GHz – 18 GHz)





Horn Antenna (18 GHz – 25 GHz)



### 5.6.3 Applicable standard

According to FCC Part 15, Section 15.205(a):

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

### 5.6.4 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

EMC Test receiver settings for SER2:

RBW: 120 MHz, Detector: Quasi peak, Mes. Time: 1 s,

Spectrum analyser settings for SER3:

RBW: 1 MHz, VBW: 3 MHz, Detector: Max. peak, Trace: Max. hold, Sweep: Auto

Due to the small output power the spurious emissions are measured > 1 GHz RBW 1 MHz and against the general limit.

### 5.6.5 Test result

#### Emissions 30 MHz – 1000 MHz

| Test conditions: TX continuous |               |       |                  |          |          |        |          |
|--------------------------------|---------------|-------|------------------|----------|----------|--------|----------|
| CH11, Pre-scan                 |               |       | Test results     |          |          |        |          |
| Start <i>f</i>                 | Stop <i>f</i> | RBW   | Maximum emission |          | Limit    | Margin | Detector |
| (MHz)                          | (MHz)         | (kHz) | (MHz)            | (dBμV/m) | (dBμV/m) | (dB)   |          |
| 30                             | 1000          | 120   | 58.00            | 28.6     | 40.0     | -11.4  | QP       |
| 30                             | 1000          | 120   | 256.00           | 35.8     | 46.0     | -10.2  | QP       |
| 30                             | 1000          | 120   | 304.00           | 43.0     | 46.0     | -3.0   | QP       |
| 30                             | 1000          | 120   | 336.00           | 39.4     | 46.0     | -6.6   | QP       |
| 30                             | 1000          | 120   | 368.00           | 40.6     | 46.0     | -5.4   | QP       |
| 30                             | 1000          | 120   | 963.00           | 37.5     | 54.0     | -16.5  | QP       |
| Measurement uncertainty        |               |       |                  | ±6 dB    |          |        |          |

| Test conditions: TX continuous |               |       |                  |          |          |        |          |
|--------------------------------|---------------|-------|------------------|----------|----------|--------|----------|
| CH18, Pre-scan                 |               |       | Test results     |          |          |        |          |
| Start <i>f</i>                 | Stop <i>f</i> | RBW   | Maximum emission |          | Limit    | Margin | Detector |
| (MHz)                          | (MHz)         | (kHz) | (MHz)            | (dBμV/m) | (dBμV/m) | (dB)   |          |
| 30                             | 1000          | 120   | 58.00            | 27.6     | 40.0     | -12.4  | QP       |
| 30                             | 1000          | 120   | 256.00           | 37.9     | 46.0     | -8.1   | QP       |
| 30                             | 1000          | 120   | 304.00           | 43.6     | 46.0     | -2.4   | QP       |
| 30                             | 1000          | 120   | 368.00           | 41.3     | 46.0     | -4.7   | QP       |
| 30                             | 1000          | 120   | 868.00           | 36.6     | 46.0     | -9.4   | QP       |
| 30                             | 1000          | 120   | 963.00           | 37.6     | 54.0     | -16.4  | QP       |
| Measurement uncertainty        |               |       |                  | ±6 dB    |          |        |          |

| Test conditions: TX continuous |               |       |                  |          |          |        |          |
|--------------------------------|---------------|-------|------------------|----------|----------|--------|----------|
| CH26, Peak pre-scan            |               |       | Test results     |          |          |        |          |
| Start <i>f</i>                 | Stop <i>f</i> | RBW   | Maximum emission |          | Limit    | Margin | Detector |
| (MHz)                          | (MHz)         | (kHz) | (MHz)            | (dBμV/m) | (dBμV/m) | (dB)   |          |
| 30                             | 1000          | 120   | 58.00            | 20.9     | 40.0     | -19.1  | QP       |
| 30                             | 1000          | 120   | 256.00           | 36.8     | 46.0     | -9.2   | QP       |
| 30                             | 1000          | 120   | 272.00           | 38.6     | 46.0     | -7.4   | QP       |
| 30                             | 1000          | 120   | 304.00           | 44.4     | 46.0     | -1.6   | QP       |
| 30                             | 1000          | 120   | 368.00           | 41.3     | 46.0     | -4.7   | QP       |
| 30                             | 1000          | 120   | 868.00           | 36.6     | 46.0     | -9.4   | QP       |
| Measurement uncertainty        |               |       |                  | ±6 dB    |          |        |          |

**Emissions 1 GHz – 25 GHz**

| Test conditions: TX continuous |               |       |                  |          |          |        |          |
|--------------------------------|---------------|-------|------------------|----------|----------|--------|----------|
| CH11, Peak pre-scan            |               |       | Test results     |          |          |        |          |
| Start <i>f</i>                 | Stop <i>f</i> | RBW   | Maximum emission |          | AVLimit  | Margin | Detector |
| (MHz)                          | (MHz)         | (kHz) | (MHz)            | (dBμV/m) | (dBμV/m) | (dB)   |          |
| 1000                           | 2400          | 1000  | 1199.00          | 47.1     | 54.0     | -6.9   | Pk       |
| 2483.5                         | 4000          | 1000  | 2493.50          | 46.7     | 54.0     | -7.3   | Pk       |
| 4000                           | 8000          | 1000  | 4810.40          | 64.6     | 54.0     | 10.6   | Pk       |
| 4000                           | 8000          | 1000  | 4810.40          | 52.4     | 54.0     | -1.6   | AV       |
| 4000                           | 8000          | 1000  | 7213.80          | 62.7     | 54.0     | 8.7    | Pk       |
| 8000                           | 12000         | 1000  | 11961.00         | 53.9     | 54.0     | -0.1   | Pk       |
| 12000                          | 18000         | 1000  | 17843.75         | 55.6     | 54.0     | 1.6    | Pk       |
| 12000                          | 18000         | 1000  | 17843.75         | 53.5     | 54.0     | -0.5   | AV       |
| 18000                          | 25000         | 1000  | 19632.63         | 47.4     | 54.0     | -6.6   | Pk       |
| Measurement uncertainty        |               |       |                  | ±6 dB    |          |        |          |

Note: Up from 7.5 GHz to 25 GHz only noise could be observed.

| Test conditions: TX continuous |               |       |                  |          |          |        |          |
|--------------------------------|---------------|-------|------------------|----------|----------|--------|----------|
| CH18, Peak pre-scan            |               |       | Test results     |          |          |        |          |
| Start <i>f</i>                 | Stop <i>f</i> | RBW   | Maximum emission |          | AVLimit  | Margin | Detector |
| (MHz)                          | (MHz)         | (kHz) | (MHz)            | (dBμV/m) | (dBμV/m) | (dB)   |          |
| 1000                           | 2400          | 1000  | 1598.00          | 44.7     | 54.0     | -9.3   | Pk       |
| 2483.5                         | 4000          | 1000  | 2496.00          | 44.3     | 54.0     | -9.7   | Pk       |
| 4000                           | 8000          | 1000  | 4879.00          | 54.3     | 54.0     | 0.3    | Pk       |
| 4000                           | 8000          | 1000  | 4879.00          | 52.4     | 54.0     | -1.6   | AV       |
| 8000                           | 12000         | 1000  | 11952.00         | 54.4     | 54.0     | 0.4    | Pk       |
| 8000                           | 12000         | 1000  | 11952.00         | 52.1     | 54.0     | -1.9   | AV       |
| 12000                          | 18000         | 1000  | 17828.00         | 57.3     | 54.0     | 3.3    | Pk       |
| 12000                          | 18000         | 1000  | 17828.00         | 53.6     | 54.0     | -0.4   | AV       |
| 18000                          | 25000         | 1000  | 18101.25         | 47.4     | 54.0     | -6.7   | Pk       |
| Measurement uncertainty        |               |       |                  | ±6 dB    |          |        |          |

Note: Up from 7.5 GHz to 25 GHz only noise could be observed.

| Test conditions: TX continuous |               |       |                  |          |          |        |          |
|--------------------------------|---------------|-------|------------------|----------|----------|--------|----------|
| CH26, Peak pre-scan            |               |       | Test results     |          |          |        |          |
| Start <i>f</i>                 | Stop <i>f</i> | RBW   | Maximum emission |          | AVLimit  | Margin | Detector |
| (MHz)                          | (MHz)         | (kHz) | (MHz)            | (dBμV/m) | (dBμV/m) | (dB)   |          |
| 1000                           | 2400          | 1000  | 1597.00          | 45.8     | 54.0     | -8.2   | Pk       |
| 2483.5                         | 4000          | 1000  | 2631.00          | 43.0     | 54.0     | -11.0  | Pk       |
| 4000                           | 8000          | 1000  | 4959.00          | 53.8     | 54.0     | -0.2   | Pk       |
| 8000                           | 12000         | 1000  | 11915.00         | 54.6     | 54.0     | 0.6    | Pk       |
| 8000                           | 12000         | 1000  | 11915.00         | 50.9     | 54.0     | -3.1   | AV       |
| 12000                          | 18000         | 1000  | 17894.00         | 58.3     | 54.0     | 4.3    | Pk       |
| 12000                          | 18000         | 1000  | 17894.00         | 53.7     | 54.0     | -0.3   | AV       |
| 18000                          | 25000         | 1000  | 21060.53         | 47.4     | 54.0     | -6.6   | Pk       |
| Measurement uncertainty        |               |       |                  | ±6 dB    |          |        |          |

Note: Up from 7.5 GHz to 25 GHz only noise could be observed.

Radiated limits according to FCC Part 15 Section 15.209(a) for spurious emissions which fall in restricted bands:

| Frequency<br>(MHz) | Field strength of spurious emissions |                       | Measurement distance<br>(metres) |
|--------------------|--------------------------------------|-----------------------|----------------------------------|
|                    | ( $\mu\text{V/m}$ )                  | dB( $\mu\text{V/m}$ ) |                                  |
| 0.009-0.490        | 2400/F (kHz)                         |                       | 300                              |
| 0.490-1.705        | 24000/F (kHz)                        |                       | 30                               |
| 1.705-30           | 30                                   | 29.5                  | 30                               |
| 30-88              | 100                                  | 40                    | 3                                |
| 88-216             | 150                                  | 43.5                  | 3                                |
| 216-960            | 200                                  | 46                    | 3                                |
| Above 960          | 500                                  | 54                    | 3                                |

#### Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

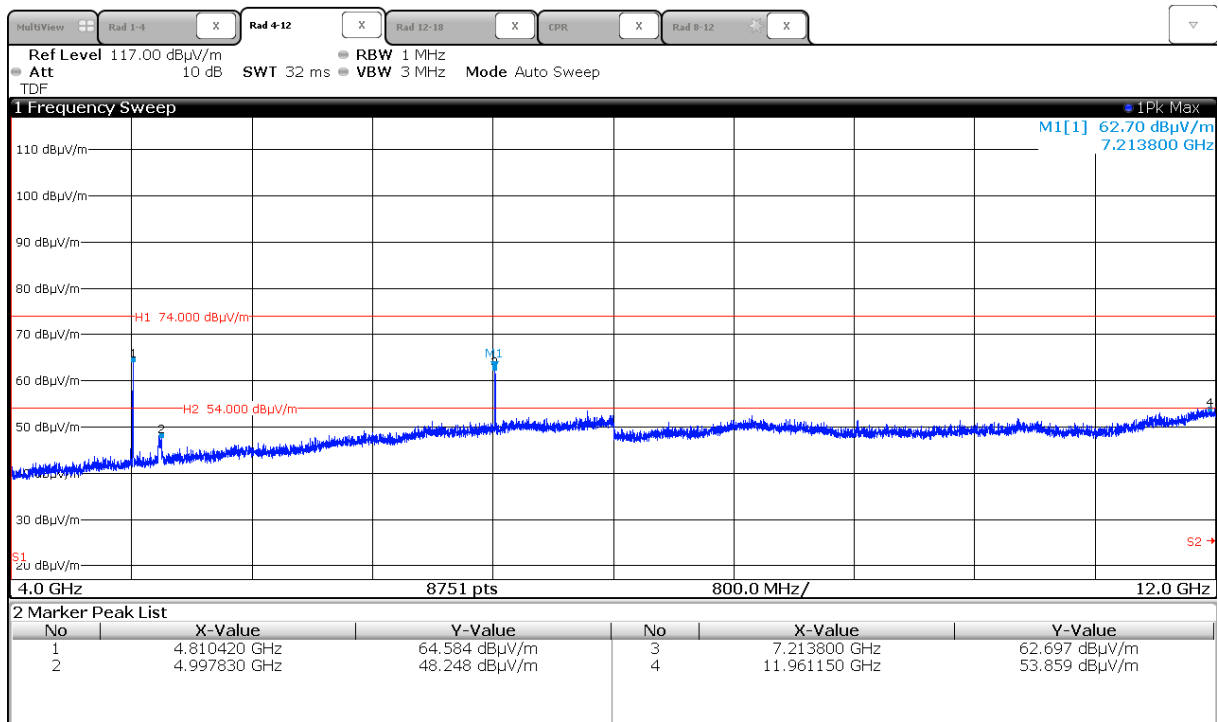
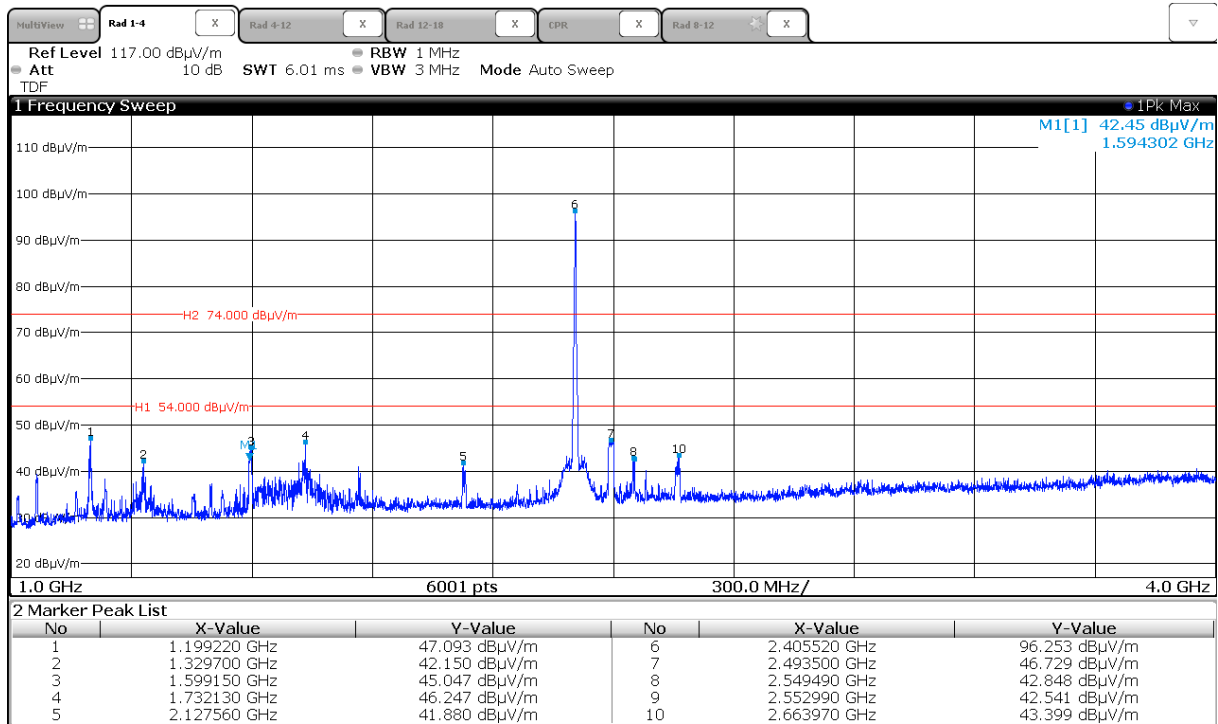
| MHz                 | MHz                   | MHz             | GHz           |
|---------------------|-----------------------|-----------------|---------------|
| 0.090 – 0.110       | 16.42 – 16.423        | 399.9 – 410     | 4.5 – 5.15    |
| 0.495 – 0.505       | 16.69475 – 16.69525   | 608 – 614       | 5.35 – 5.46   |
| 2.1735 – 2.1905     | 16.80425 – 16.80475   | 960 – 1240      | 7.25 – 7.75   |
| 4.125 – 4.128       | 25.5 – 25.67          | 1300 – 1427     | 8.025 – 8.5   |
| 4.17725 – 4.17775   | 37.5 – 38.25          | 1435 – 1626.5   | 9.0 – 9.2     |
| 4.20725 – 4.20775   | 73 – 74.6             | 1645.5 – 1646.5 | 9.3 – 9.5     |
| 6.215 – 6.218       | 74.8 – 75.2           | 1660 – 1710     | 10.6 – 12.7   |
| 6.26775 – 6.26825   | 108 – 121.94          | 1718.8 – 1722.2 | 13.25 – 13.4  |
| 6.31175 – 6.31225   | 123 – 138             | 2200 – 2300     | 14.47 – 14.5  |
| 8.291 – 8.294       | 149.9 – 150.05        | 2310 – 2390     | 15.35 – 16.2  |
| 8.362 – 8.366       | 156.52475 – 156.52525 | 2483.5 – 2500   | 17.7 – 21.4   |
| 8.37625 – 8.38675   | 156.7 – 156.9         | 2690 – 2900     | 22.01 – 23.12 |
| 8.41425 – 8.41475   | 162.0125 – 167.17     | 3260 – 3267     | 23.6 – 24.0   |
| 12.29 – 12.293      | 167.72 – 173.2        | 3332 – 3339     | 31.2 – 31.8   |
| 12.51975 – 12.52025 | 240 – 285             | 3345.8 – 3358   | 36.43 – 36.5  |
| 12.57675 – 12.57725 | 322 – 335.4           | 3600 – 4400     | Above 38.6    |

The requirements are **FULFILLED**.

**Remarks:** The measurement was performed up to the 10<sup>th</sup> harmonic. For detailed test results please see the following test protocols. The worst case plots are shown only.

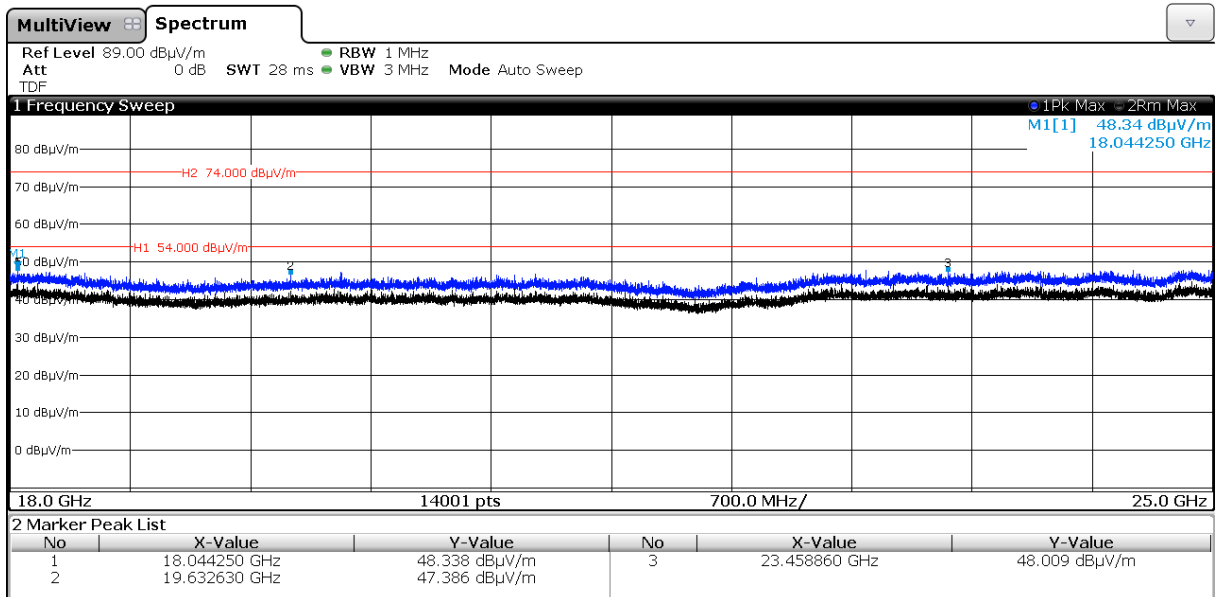
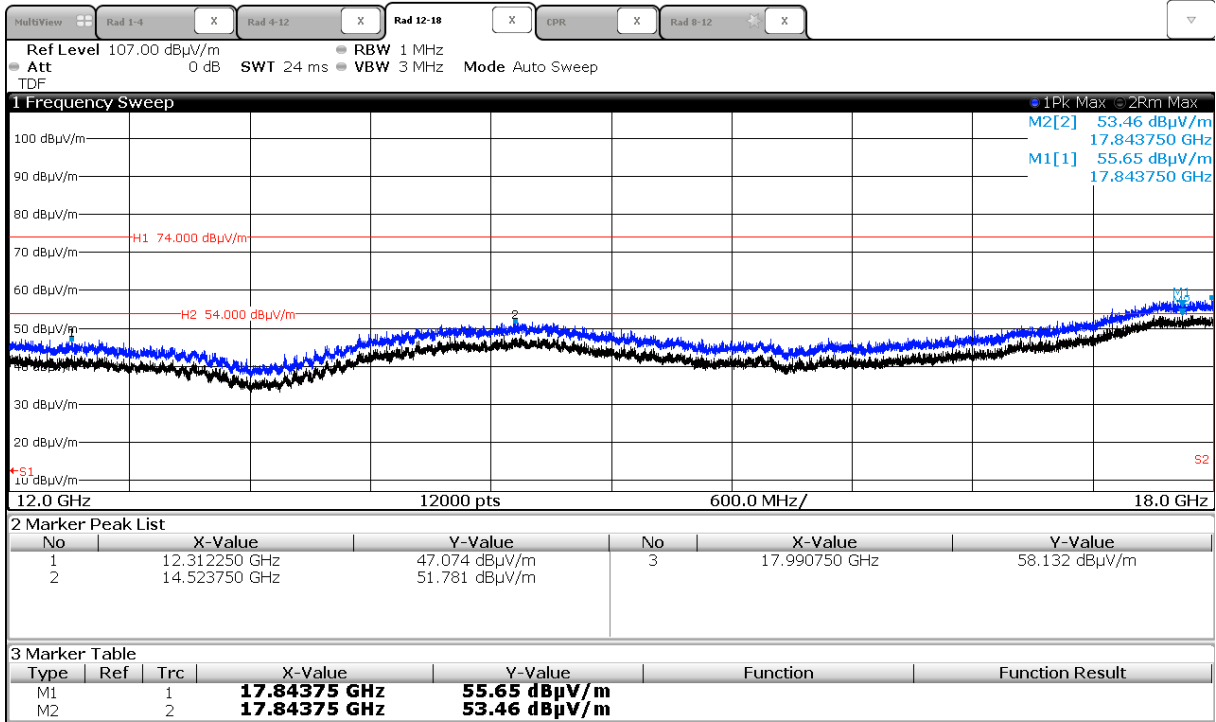
## 5.6.6 Test protocols radiated emissions SER3

### Channel 11



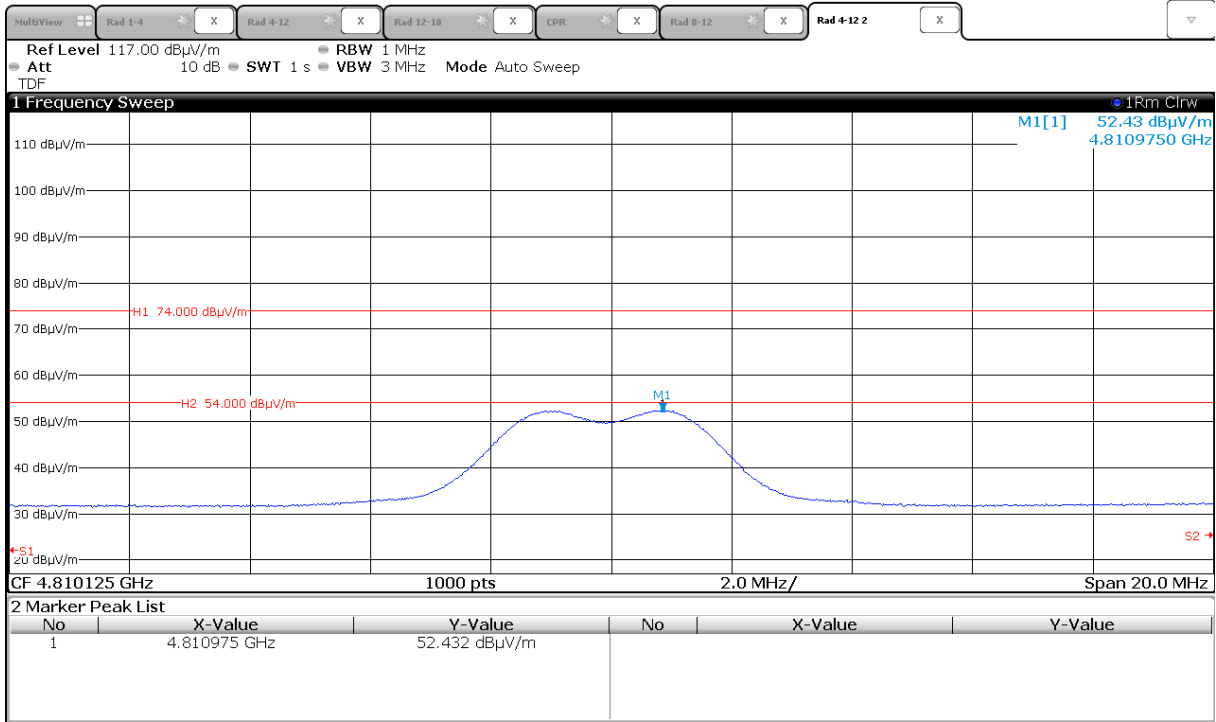
FCC ID: VQ5-EBIIFXXX

IC: 7412A-EBIIFXXX

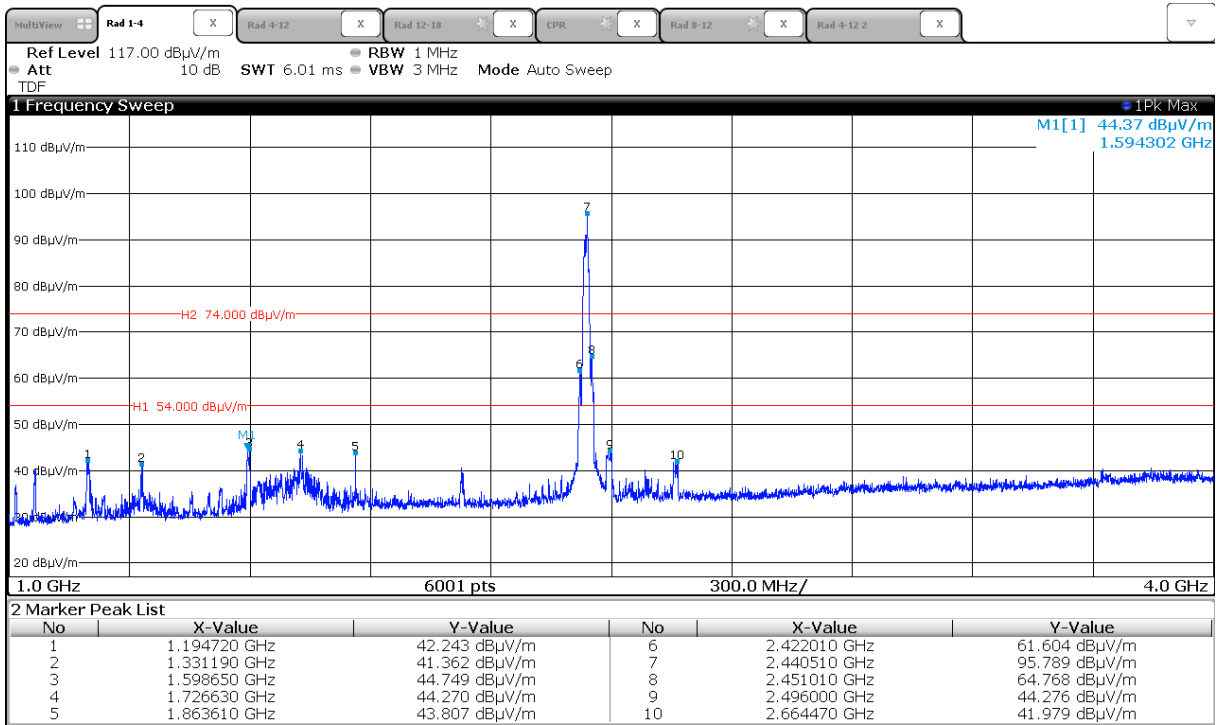


FCC ID: VQ5-EBIIFXXX

IC: 7412A-EBIIFXXX

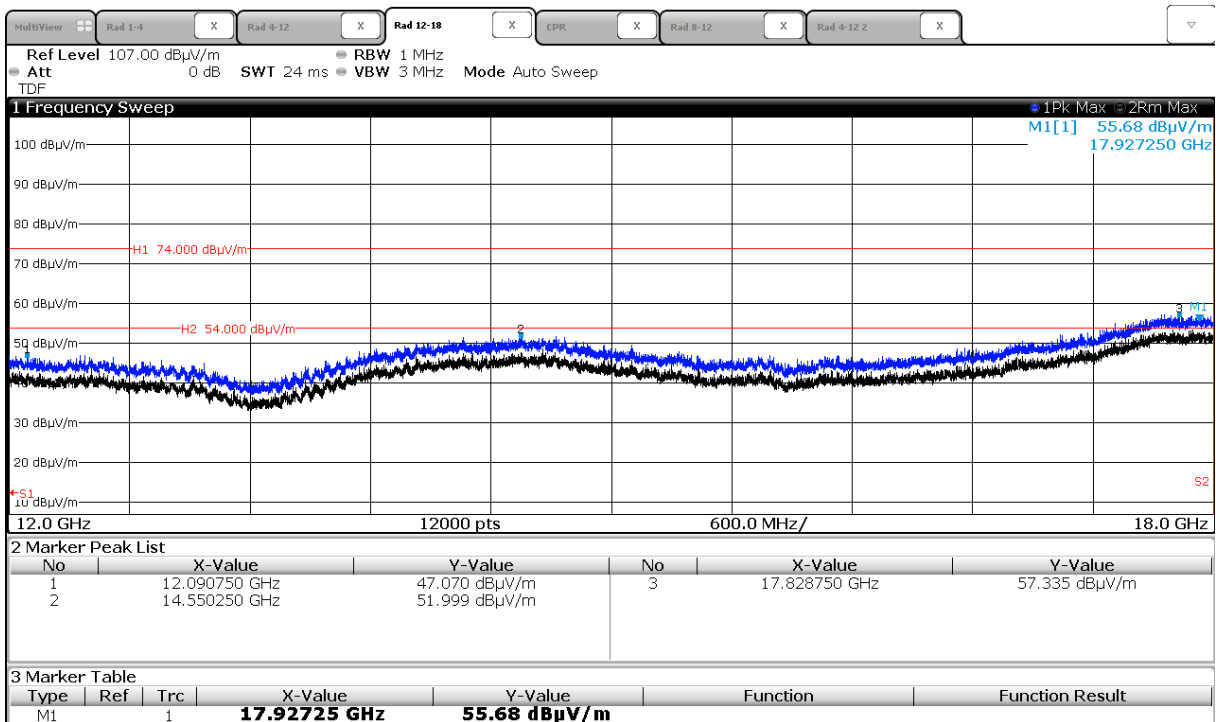
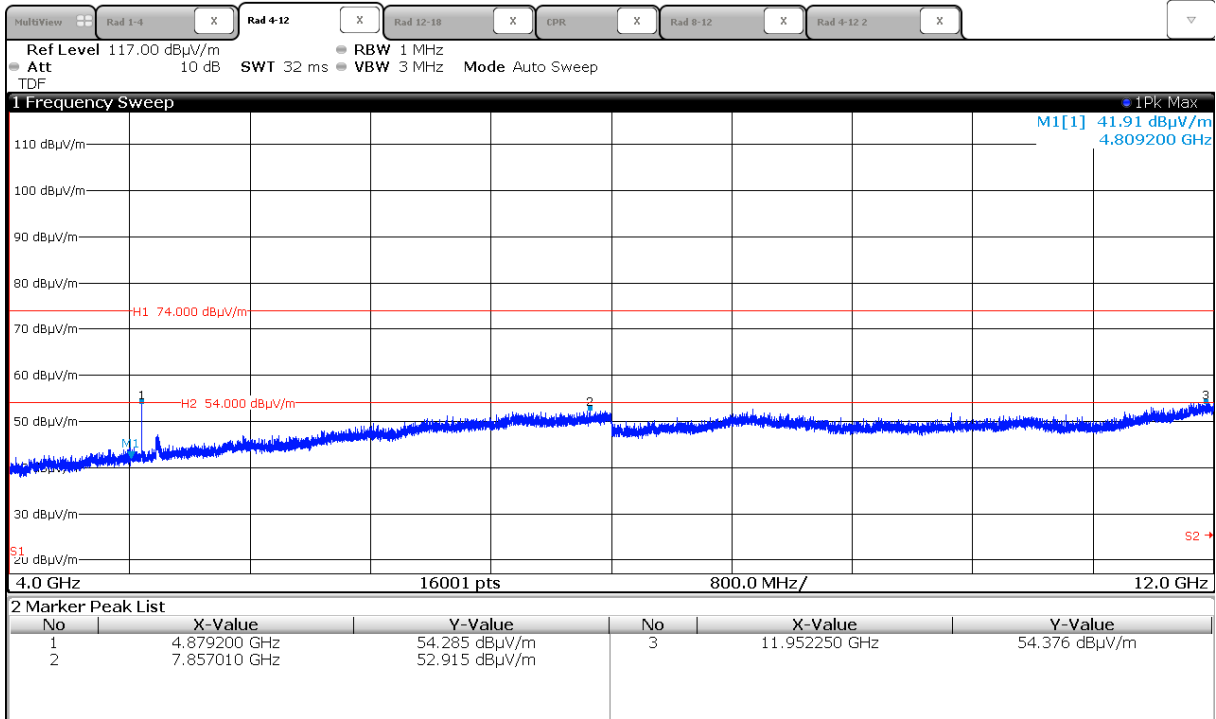


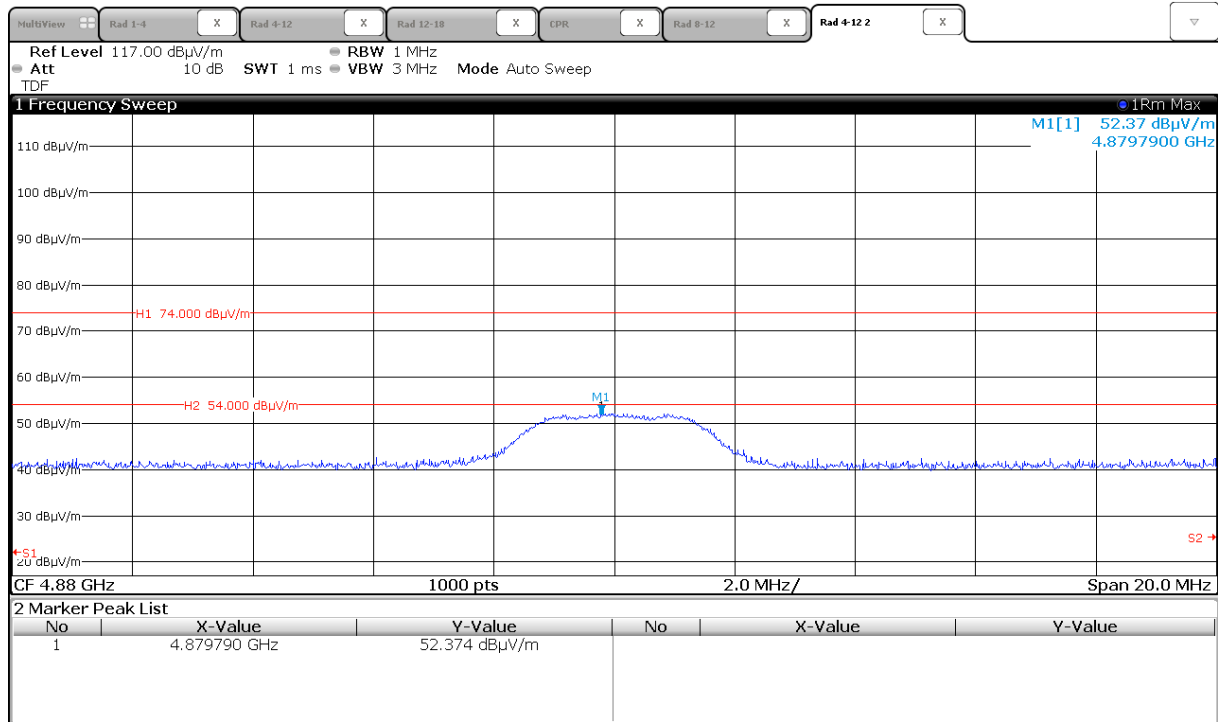
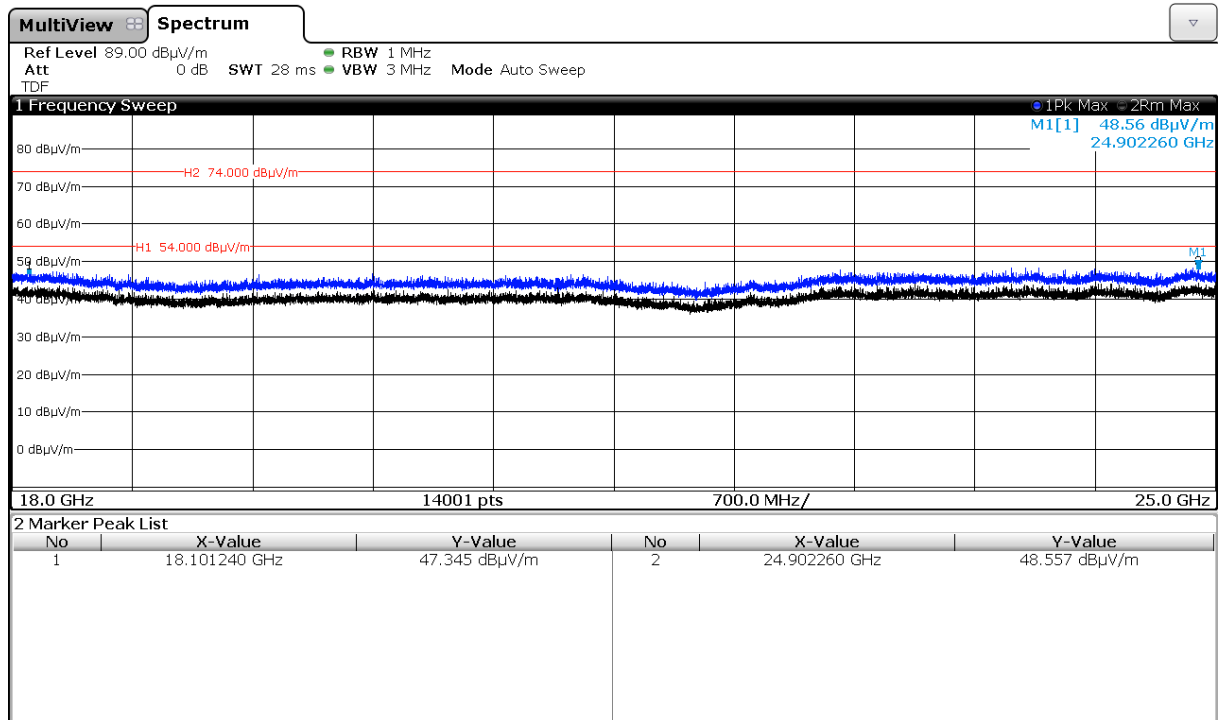
## Channel 18



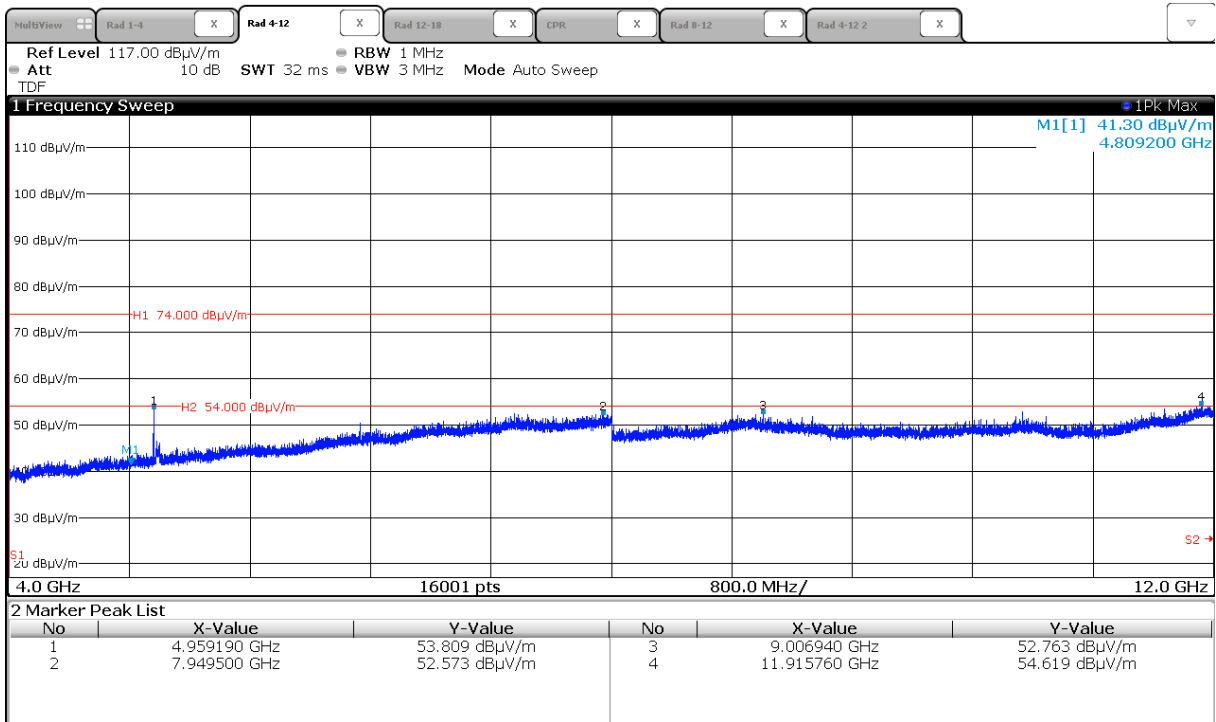
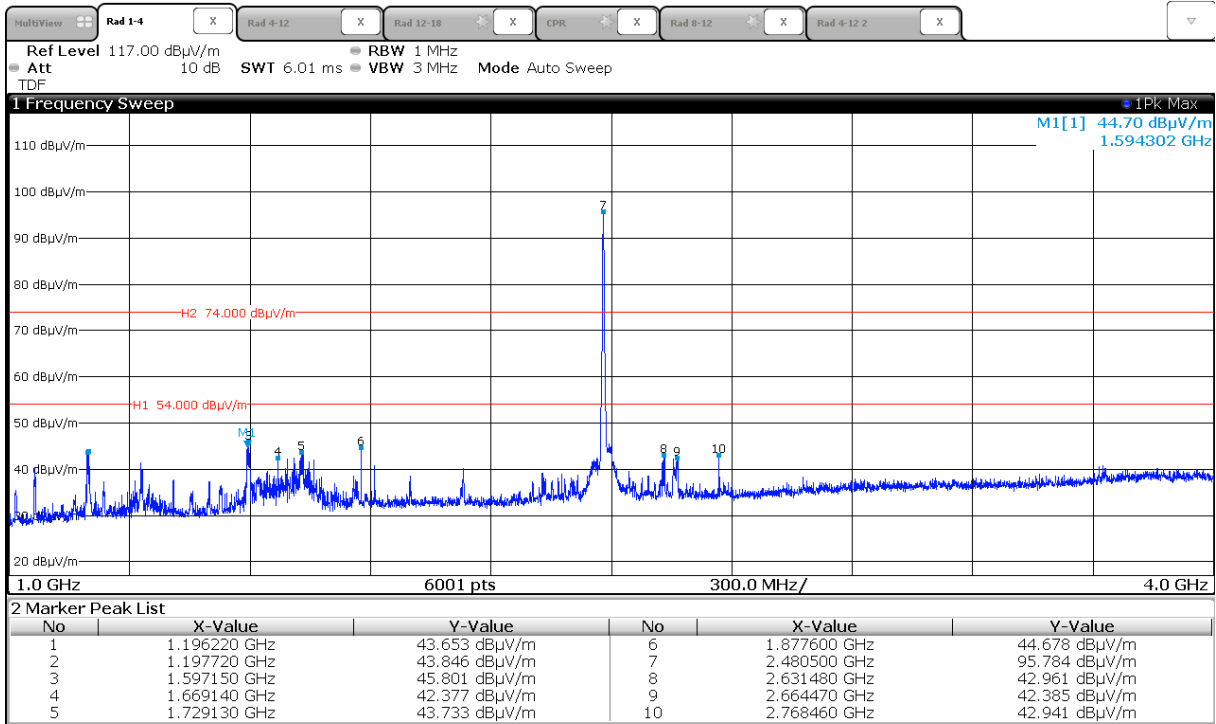
FCC ID: VQ5-EBIIFXXX

IC: 7412A-EBIIFXXX



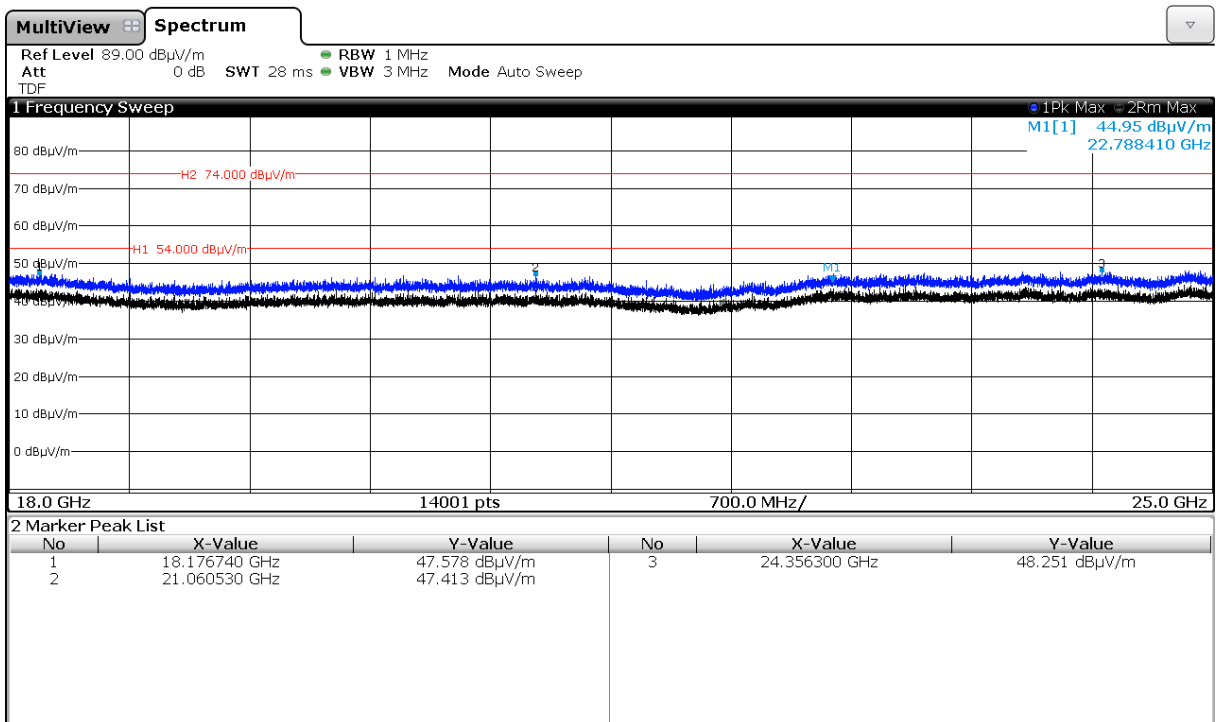
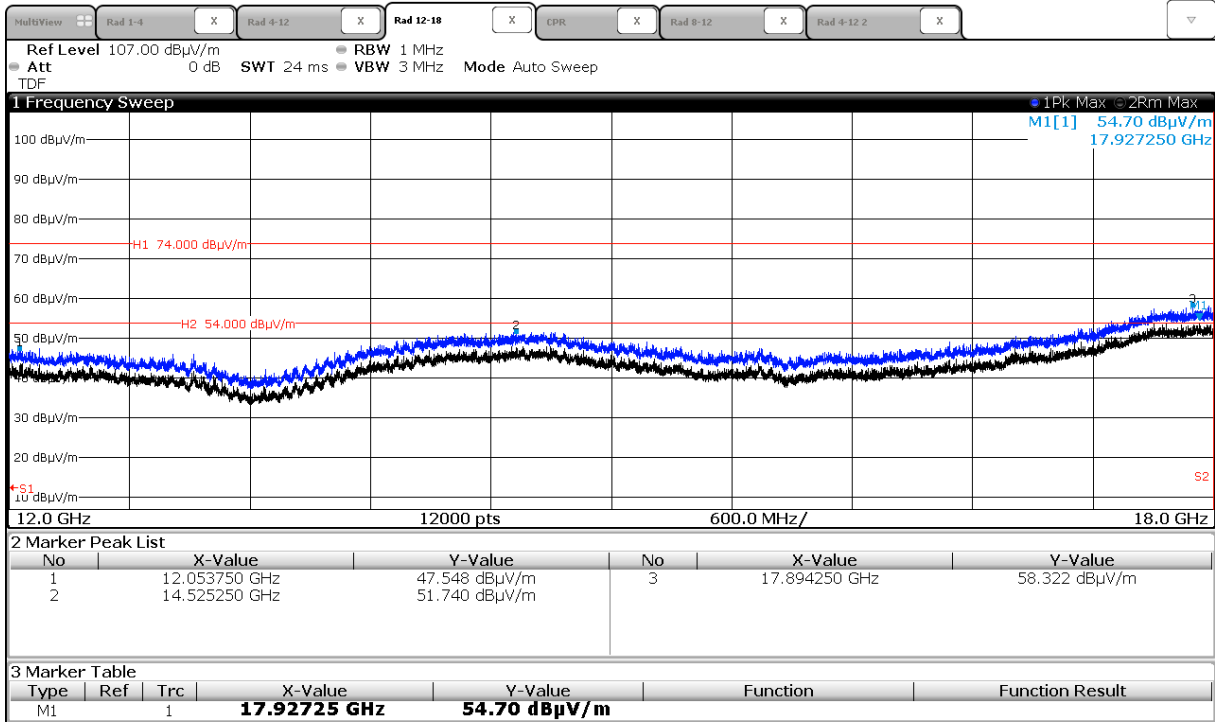


Channel 26



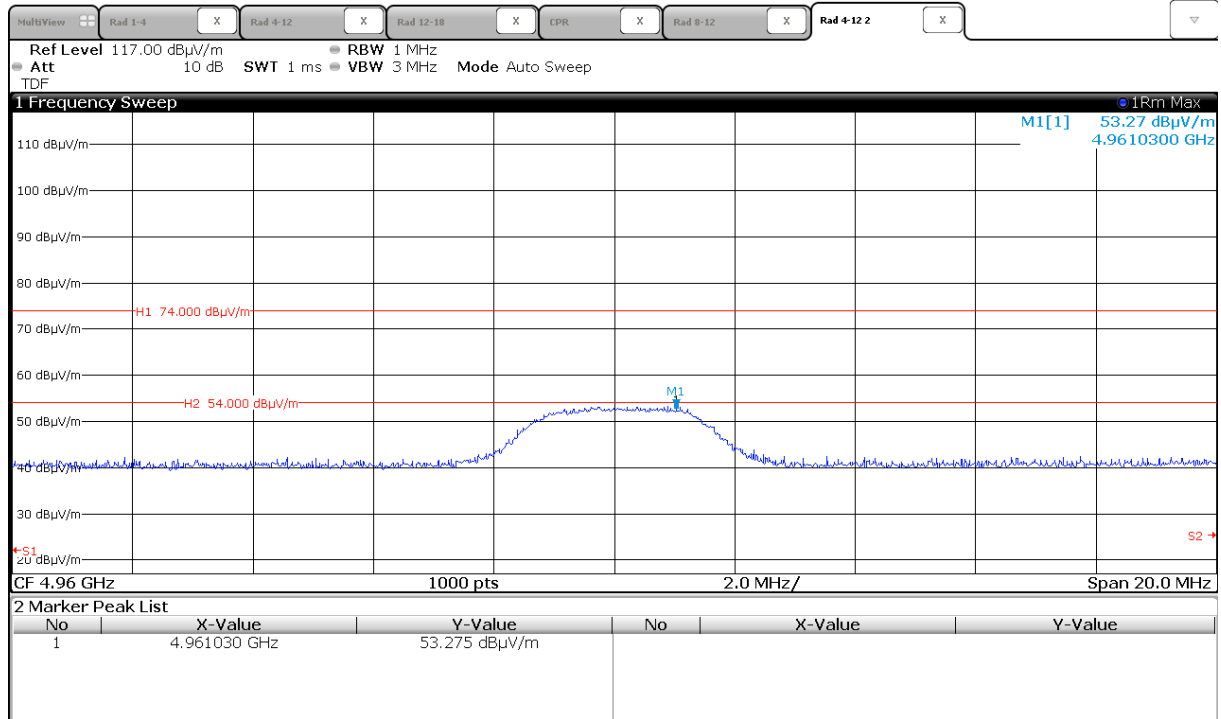
FCC ID: VQ5-EBIIFXXX

IC: 7412A-EBIIFXXX



FCC ID: VQ5-EBIIFXXX

IC: 7412A-EBIIFXXX



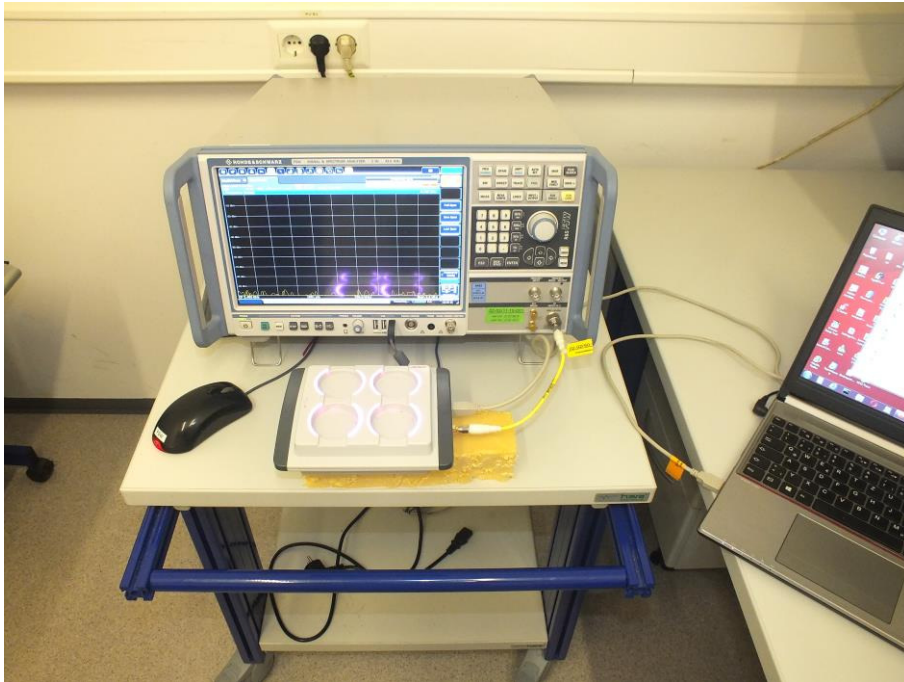
## 5.7 Unwanted emissions, conducted

For test instruments and accessories used see section 6 Part **SEC 1-3**.

### 5.7.1 Description of the test location

Test location: AREA4

### 5.7.2 Photo documentation of the test set-up



### 5.7.3 Applicable standard

According to FCC Part 15, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a) (see Section 15.205(c)).

### 5.7.4 Description of Measurement

The spurious emissions are measured conducted using a spectrum analyser in a test setup following the procedures set out in KDB 558074 for DTS. The transmitter is set to the lowest operating frequency (CH11), the middle (CH18) and to the highest operating frequency (CH26). The frequency spectrum outside from the operating frequency range (2400 - 2483.5 MHz) is scanned for emissions that exceed the limit. The measurement is performed at normal test conditions in modulated TX continuous mode.

Spectrum analyser settings for SEC 1-3:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max. peak, Trace: Max. hold, Sweep: Auto

**5.7.5 Test result**

According to FCC Part 15, Section 15.205(a):

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

| Test conditions: TX continuous |               |       |                  |       |           |        |          |
|--------------------------------|---------------|-------|------------------|-------|-----------|--------|----------|
| CH11, Pre-scan                 |               |       | Test results     |       |           |        |          |
| Start <i>f</i>                 | Stop <i>f</i> | RBW   | Maximum emission |       | Limit     | Margin | Detector |
| (MHz)                          | (MHz)         | (kHz) | (MHz)            | (dBm) | 20dB down | (dB)   |          |
| 30                             | 1000          | 100   | 239.99           | -59.7 | -34.0     | -25.7  | Pk       |
| 1000                           | 2400          | 100   | 2400.00          | -57.2 | -34.0     | -23.2  | Pk       |
| 2483.5                         | 4000          | 100   | 2548.83          | -69.8 | -34.0     | -35.8  | Pk       |
| 4000                           | 25000         | 100   | 4810.08          | -45.4 | -34.0     | -11.4  | Pk       |
| 4000                           | 25000         | 100   | 7215.00          | -60.4 | -34.0     | -26.4  | Pk       |
| 4000                           | 25000         | 100   | 9620.13          | -69.4 | -34.0     | -35.4  | Pk       |
| Measurement uncertainty        |               |       |                  | ±3 dB |           |        |          |

| Test conditions: TX continuous |               |       |                  |       |           |        |          |
|--------------------------------|---------------|-------|------------------|-------|-----------|--------|----------|
| CH18, Pre-scan                 |               |       | Test results     |       |           |        |          |
| Start <i>f</i>                 | Stop <i>f</i> | RBW   | Maximum emission |       | Limit     | Margin | Detector |
| (MHz)                          | (MHz)         | (kHz) | (MHz)            | (dBm) | 20dB down | (dB)   |          |
| 30                             | 1000          | 100   | 304.00           | -61.1 | -34.0     | -27.1  | Pk       |
| 1000                           | 2400          | 100   | 2400.00          | -78.5 | -34.0     | -44.5  | Pk       |
| 2483.5                         | 4000          | 100   | 2483.50          | -79.5 | -34.0     | -45.5  | Pk       |
| 4000                           | 25000         | 100   | 4880.01          | -44.3 | -34.0     | -10.3  | Pk       |
| 4000                           | 25000         | 100   | 7320.00          | -63.0 | -34.0     | -29.0  | Pk       |
| 4000                           | 25000         | 100   | 9759.99          | -75.5 | -34.0     | -41.5  | Pk       |
| Measurement uncertainty        |               |       |                  | ±3 dB |           |        |          |

| Test conditions: TX continuous |               |       |                  |       |           |        |          |
|--------------------------------|---------------|-------|------------------|-------|-----------|--------|----------|
| CH26, Pre-scan                 |               |       | Test results     |       |           |        |          |
| Start <i>f</i>                 | Stop <i>f</i> | RBW   | Maximum emission |       | Limit     | Margin | Detector |
| (MHz)                          | (MHz)         | (kHz) | (MHz)            | (dBm) | 20dB down | (dB)   |          |
| 30                             | 1000          | 100   | 303.99           | -59.8 | -34.0     | -25.7  | Pk       |
| 1000                           | 2400          | 100   | 2400.00          | -76.2 | -34.0     | -42.2  | Pk       |
| 2483.5                         | 4000          | 100   | 2483.50          | -53.9 | -34.0     | -19.9  | Pk       |
| 4000                           | 25000         | 100   | 4960.02          | -45.3 | -34.0     | -11.3  | Pk       |
| 4000                           | 25000         | 100   | 7440.12          | -63.8 | -34.0     | -29.8  | Pk       |
| 4000                           | 25000         | 100   | 16828.88         | -74.2 | -34.0     | -40.2  | Pk       |
| Measurement uncertainty        |               |       |                  | ±3 dB |           |        |          |

Limit according to FCC Part 15, Section 15.247(d) for emissions falling not in restricted bands:

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

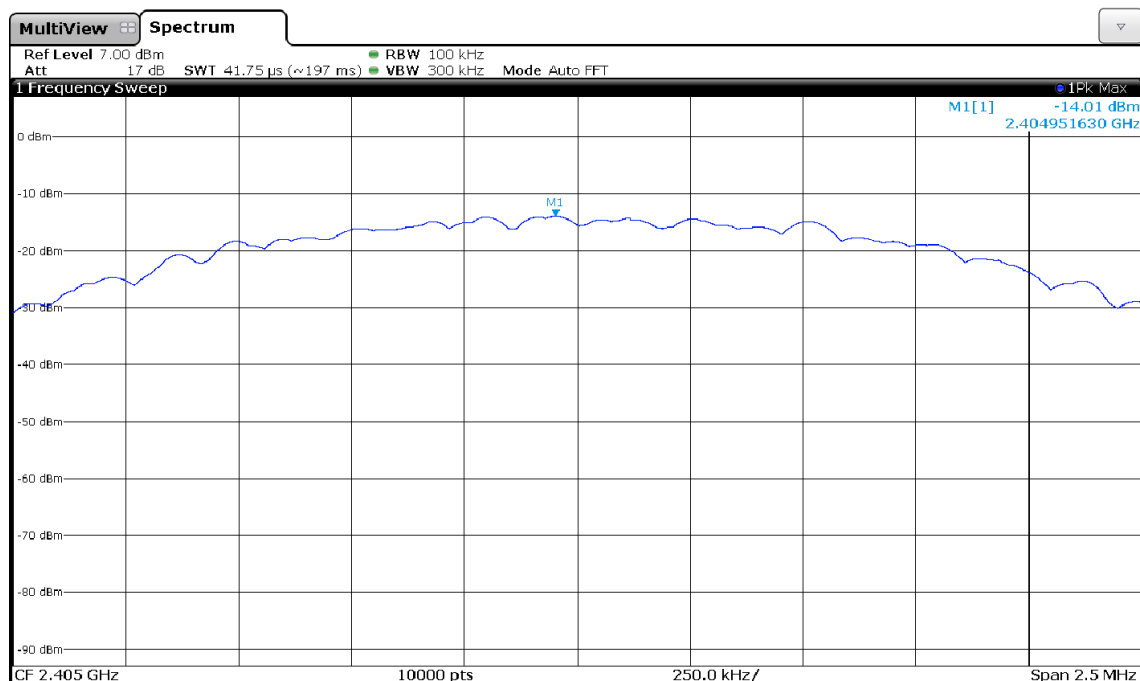
| Frequency<br>(MHz) | Spurious emission limit                            |
|--------------------|----------------------------------------------------|
| Below 1000         | 20 dB below the highest level of the desired power |
| Above 1000         | 20 dB below the highest level of the desired power |

The requirements are **FULFILLED**.

**Remarks:** For detailed test result please see the following test protocols.

## 5.7.6 Test protocols spurious emissions conducted

### Determination of the reference level and limit



Determination of the limit:

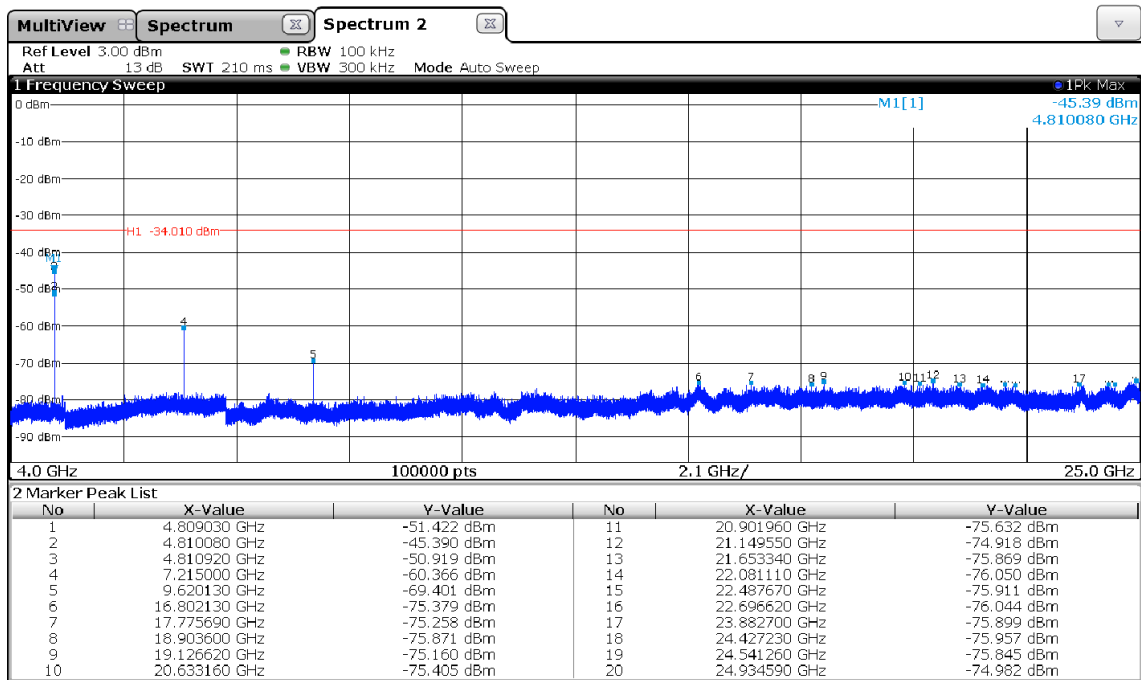
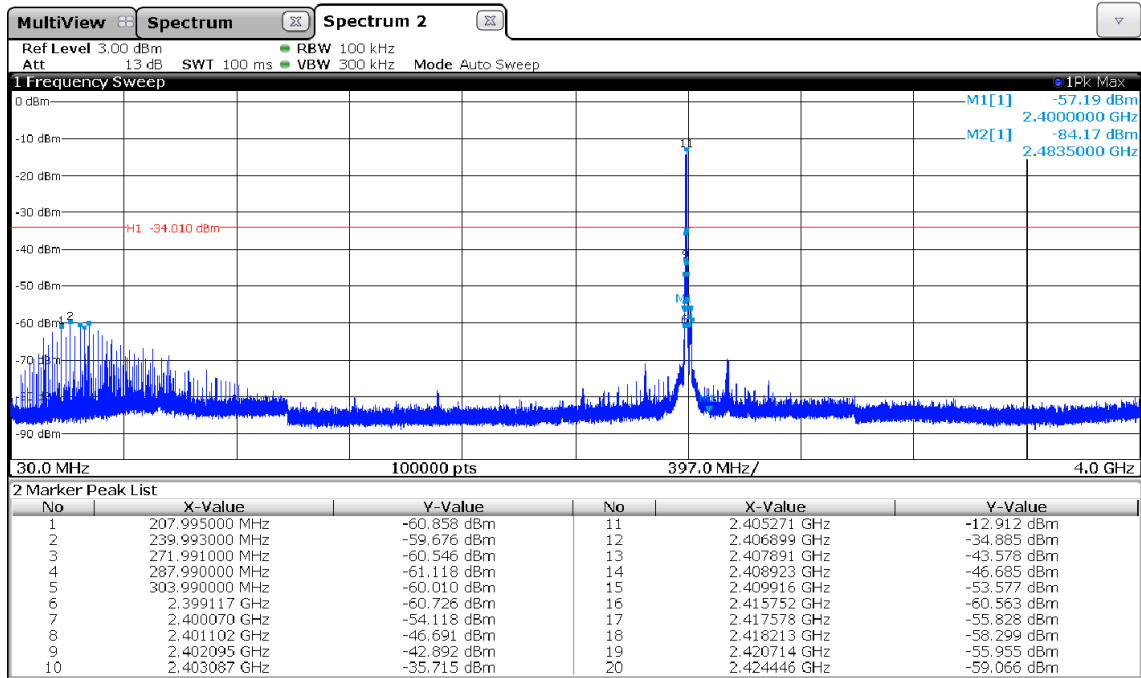
Reference level = -14.01 dBm;

Applicable method is 20 dB down from reference level.

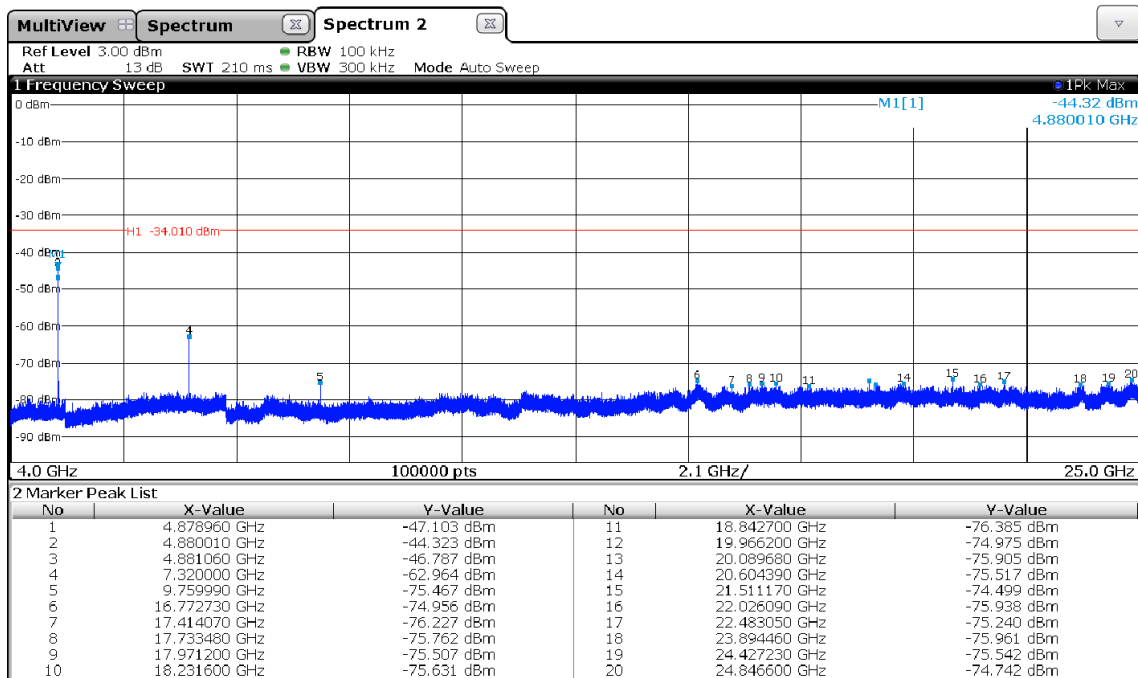
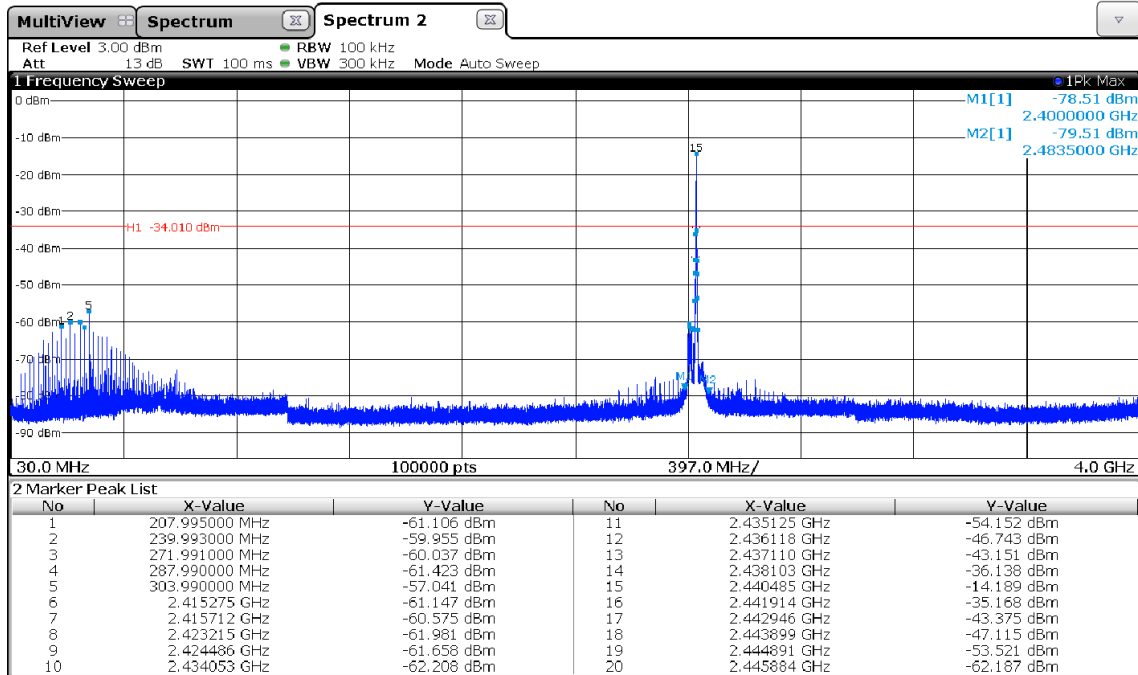
**Limit = -14.01 dBm – 20 dB = -34.01 dBm;**

Plots of spurious emissions conducted out of operating frequency bands (-20 dBc):

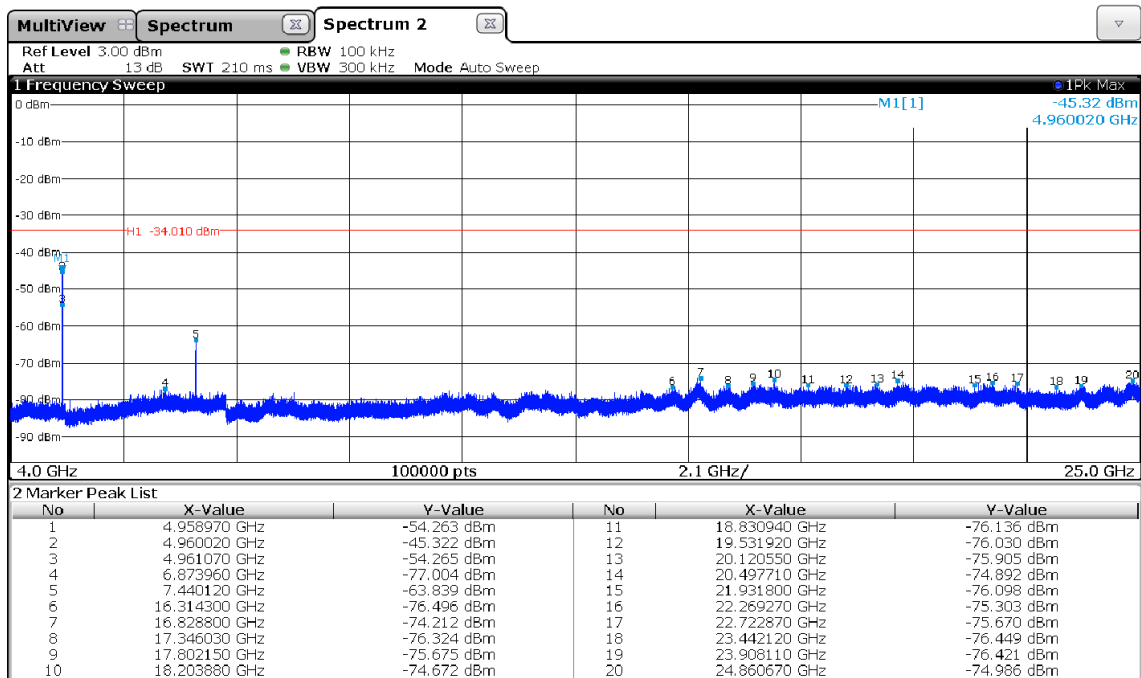
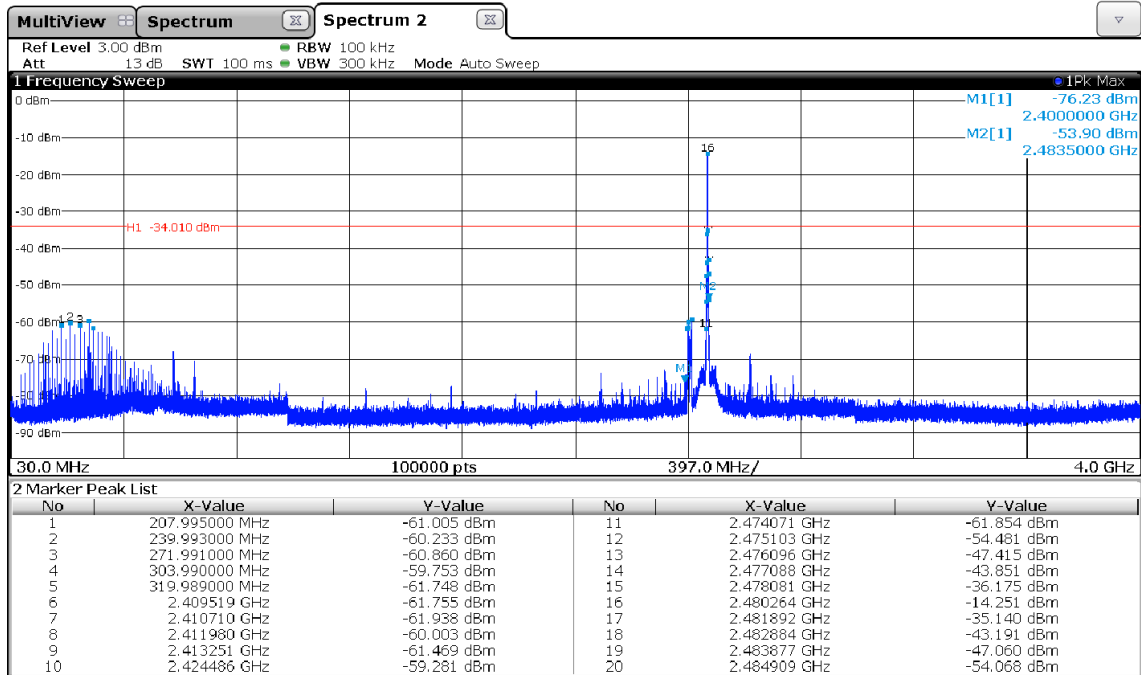
Channel 11:



Channel 18:



Channel 26:



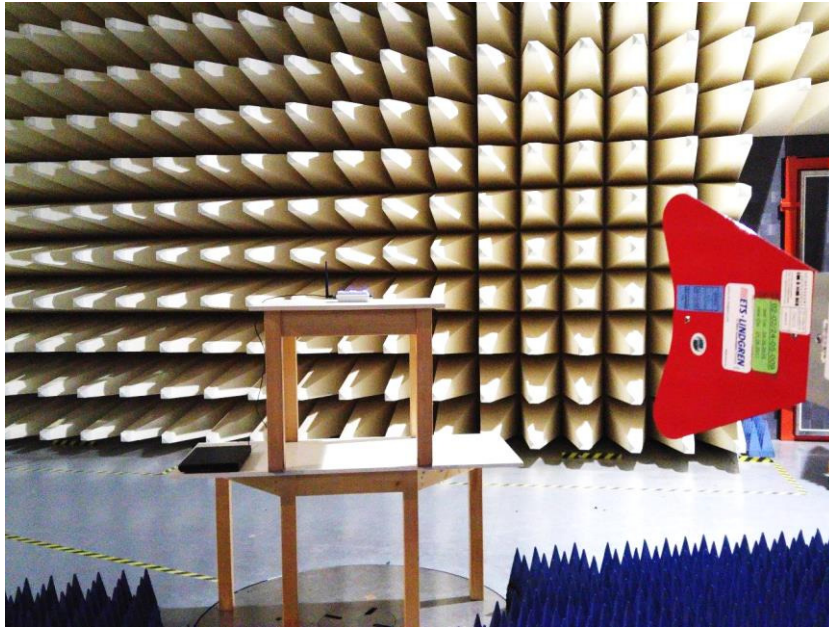
## 5.8 Band edge compliance

For test instruments and accessories used see section 6 Part **SER 3**.

### 5.8.1 Description of the test location

Test location: Anechoic chamber 1

### 5.8.2 Photo documentation of the test set-up



### 5.8.3 Applicable standard

According to FCC Part 15C, Section 15.247(d):

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 5.8.4 Description of Measurement

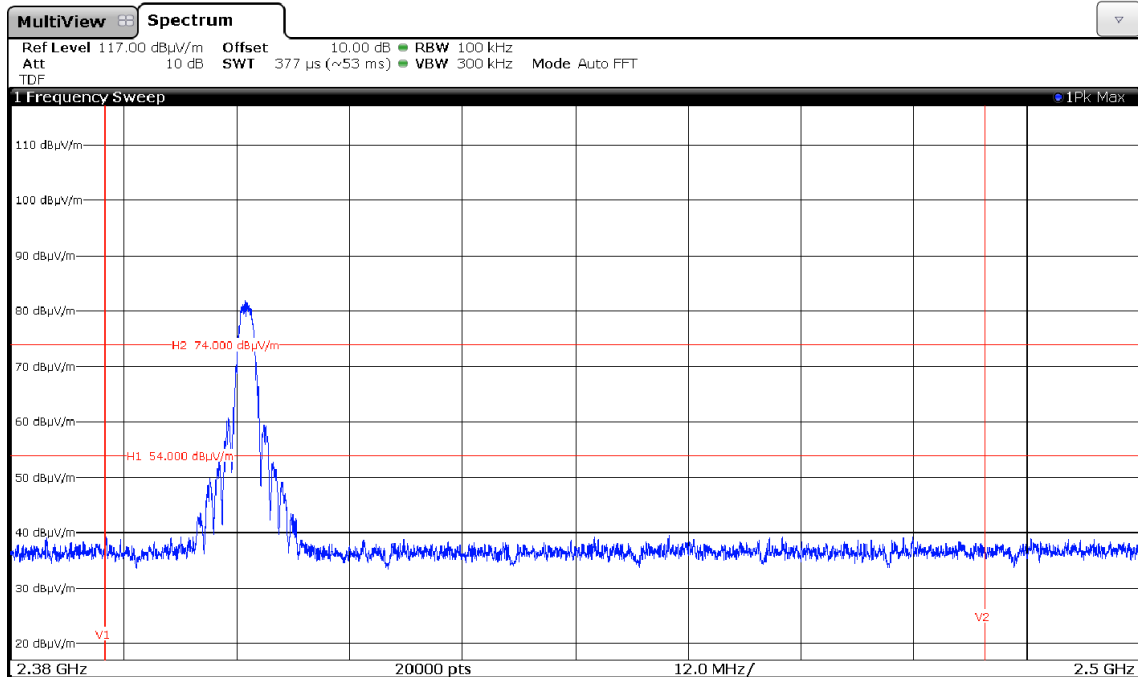
A spectrum analyser is used to measure the field strength of the radiated emissions at the band edges. The EUT was operating in normal transmit mode at the assigned frequency according KDB 558074, 4/8/2016.

Spectrum analyser settings:

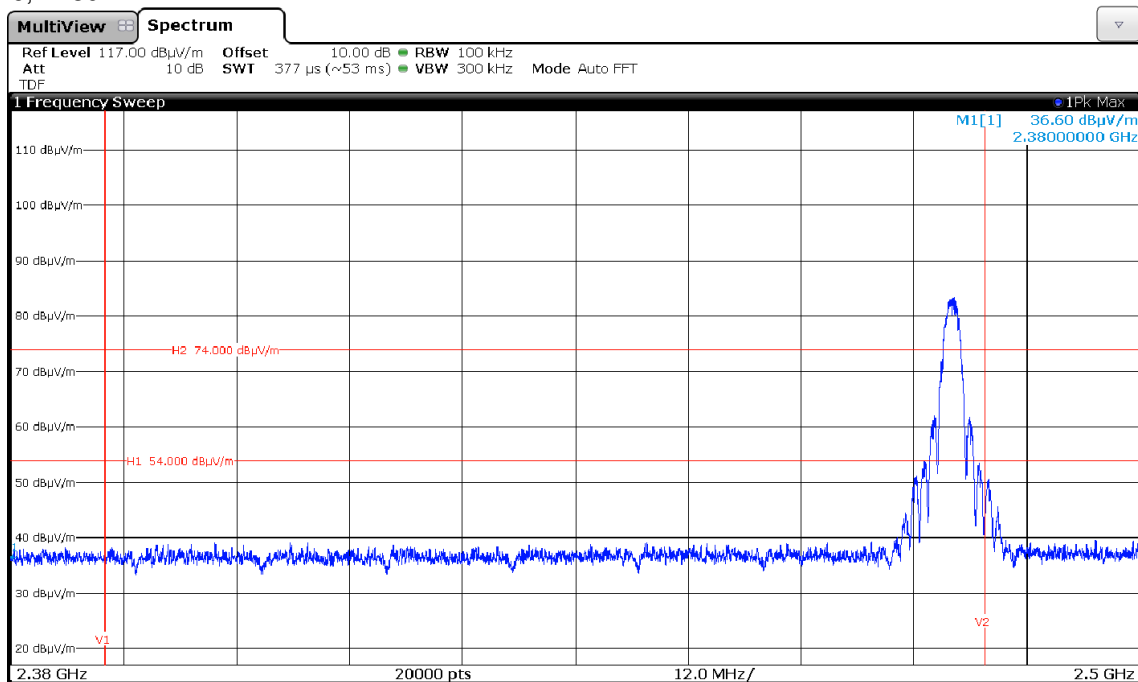
RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Trace: Max hold, Sweep: auto

### 5.8.5 Test result

Channel 11, 2405 MHz:



Channel 26, 2480 MHz



Note:

- Only the results for vertical polarisation are shown, as the higher emission.
- The vertical red line "V1" marks the upper edge of the restricted band from 2310 – 2390 MHz.
- The vertical red line "V2" marks the lower edge of the restricted band from 2483.5 – 2500 MHz.

The requirements are **FULFILLED**.

Remarks:

## 5.9 Antenna application

For test instruments and accessories used see section 6 Part **CPC3**.

### 5.9.1 Description of the test location

Test location: NONE

### 5.9.2 Applicable standard

According to FCC Part 15C, Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has either an integrated antenna or an SMA-R antenna jack. No other antenna can be used with the device.

The supplied antennas meets the requirements of part 15.203 and 15.204.

Remarks:

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## **6 USED TEST EQUIPMENT AND ACCESSORIES**

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

| <b>Test ID</b> | <b>Model Type</b>      | <b>Equipment No.</b> | <b>Next Calib.</b> | <b>Last Calib.</b> | <b>Next Verif.</b> | <b>Last Verif.</b> |
|----------------|------------------------|----------------------|--------------------|--------------------|--------------------|--------------------|
| <b>A 4</b>     | ESHS 30                | 02-02/03-05-002      | 14/07/2017         | 14/07/2016         |                    |                    |
|                | ESH 2 - Z 5            | 02-02/20-05-004      | 26/10/2017         | 26/10/2015         | 09/12/2016         | 09/06/2016         |
|                | N-4000-BNC             | 02-02/50-05-138      |                    |                    |                    |                    |
|                | N-1500-N               | 02-02/50-05-140      |                    |                    |                    |                    |
|                | ESH 3 - Z 2            | 02-02/50-05-155      | 06/11/2016         | 06/11/2015         | 04/02/2017         | 04/08/2016         |
| <b>CPC 3</b>   | FSP 40                 | 02-02/11-11-001      | 28/10/2016         | 28/10/2015         |                    |                    |
|                | FSW43                  | 02-02/11-15-001      | 25/07/2017         | 25/07/2016         |                    |                    |
|                | KMS102-0.2 m           | 02-02/50-11-020      |                    |                    |                    |                    |
| <b>MB</b>      | FSP 40                 | 02-02/11-11-001      | 28/10/2016         | 28/10/2015         |                    |                    |
|                | FSW43                  | 02-02/11-15-001      | 25/07/2017         | 25/07/2016         |                    |                    |
|                | KMS102-0.2 m           | 02-02/50-11-020      |                    |                    |                    |                    |
| <b>SEC 1-3</b> | FSW43                  | 02-02/11-15-001      | 25/07/2017         | 25/07/2016         |                    |                    |
|                | KMS102-0.2 m           | 02-02/50-11-020      |                    |                    |                    |                    |
| <b>SER 2</b>   | ESVS 30                | 02-02/03-05-003      | 08/07/2017         | 08/07/2016         |                    |                    |
|                | VULB 9168              | 02-02/24-05-005      | 20/04/2017         | 20/04/2016         | 20/10/2016         | 20/04/2016         |
|                | NW-2000-NB             | 02-02/50-05-113      |                    |                    |                    |                    |
|                | KK-EF393/U-16N-21N20 m | 02-02/50-12-018      |                    |                    |                    |                    |
|                | KK-SD_7/8-2X21N-33,0M  | 02-02/50-15-028      |                    |                    |                    |                    |
| <b>SER 3</b>   | FSP 40                 | 02-02/11-11-001      | 28/10/2016         | 28/10/2015         |                    |                    |
|                | FSW43                  | 02-02/11-15-001      | 25/07/2017         | 25/07/2016         |                    |                    |
|                | JS4-18004000-30-5A     | 02-02/17-05-017      |                    |                    |                    |                    |
|                | AFS5-12001800-18-10P-6 | 02-02/17-06-002      |                    |                    |                    |                    |
|                | AFS4-01000400-10-10P-4 | 02-02/17-13-002      |                    |                    |                    |                    |
|                | AMF-4F-04001200-15-10P | 02-02/17-13-003      |                    |                    |                    |                    |
|                | 3117                   | 02-02/24-05-009      | 24/05/2017         | 24/05/2016         |                    |                    |
|                | BBHA 9170              | 02-02/24-05-015      | 24/05/2019         | 24/05/2016         | 24/05/2017         | 24/05/2016         |
|                | R1 _ 18 - 40 GHz       | 02-02/30-09-002      | 07/06/2017         | 07/06/2016         |                    |                    |
|                | Sucoflex N-2000-SMA    | 02-02/50-05-075      |                    |                    |                    |                    |
|                | KMS102-0.2 m           | 02-02/50-11-016      |                    |                    |                    |                    |
|                | SF104/11N/11N/1500MM   | 02-02/50-13-015      |                    |                    |                    |                    |