



# RF – TEST REPORT

- FCC Part 15.247, RSS-247 -

**Type / Model Name** : M2UHF-RFID Midrange

**Product Description** : Plug-in module UHF RFID reader

**Applicant** : ACD Elektronik GmbH

**Address** : Engelberg 2

88480 ACHSTETTEN, GERMANY

**Manufacturer** : ACD Elektronik GmbH

**Address** : Engelberg 2

88480 ACHSTETTEN, GERMANY

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

**POSITIVE**

**Test Report No. :** 80086559-00 Rev\_0

28. March 2022

Date of issue



Deutsche  
Akkreditierungsstelle  
D-PL-12030-01-03  
D-PL-12030-01-04

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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 (October 2021)**

|                                   |                                               |
|-----------------------------------|-----------------------------------------------|
| 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 2021)**

|                                    |                                                                                 |
|------------------------------------|---------------------------------------------------------------------------------|
| 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);<br>Uncertainties in the Measurement of Mobile Radio Equipment<br>Characteristics—Part 1 and Part 2 |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                       |                                                                                                                                                   |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| KDB 558074 D01 v05r02 | Guidance for compliance measurements on DTS; FHSS and hybrid<br>system devices operating under Section 15.247 of the FCC rules,<br>April 2, 2019. |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|

## **ISED Canada Rules and Regulations (October 2021)**

|                                    |                                                                                                                                                                    |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RSS-Gen, Issue 5 + Amendment 1 + 2 | General Requirements for Compliance of Radio Apparatus                                                                                                             |
| RSS-247, Issue 2                   | Digital Transmission Systems (DTSS), Frequency Hopping Systems<br>(FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices                                    |
| ANSI C63.10: 2013                  | Testing Unlicensed Wireless Devices                                                                                                                                |
| ETSI TR 100 028 V1.3.1: 2001-03,   | Electromagnetic Compatibility and Radio Spectrum Matters (ERM);<br>Uncertainties in the Measurement of Mobile Radio Equipment<br>Characteristics—Part 1 and Part 2 |

## **2 EQUIPMENT UNDER TEST**

### **2.1 Information provided by the Client**

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

### **2.2 Sampling**

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according to his/her instructions.

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

### **2.4 General remarks**

The plug-in module UHF-RFID-Reader can only be operated together with the host device M2SmartSE. This was also tested in this condition.

### **2.5 Equipment type**

M2UHF-RFID reader

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

The EUT is a plug-in module M2UHF RFID reader for a smart PC used for reading active and passive tags. While charging RFID is disabled, charging via USB is not possible. Battery charging via external charger only.

|                           |                                 |
|---------------------------|---------------------------------|
| Number of tested samples: | 2                               |
| Serial number:            | 195000000258 (conducted sample) |
|                           | 195000000257 (radiated sample)  |
| Firmware version:         | 01.09.00.000                    |

### **2.7 Variants of the EUT**

There are no variants:

## 2.8 Operation frequency and channel plan

The operating frequency is 902 to 928 MHz.

Note: the marked frequencies are determined for final testing.

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 1       | 902.75          | 26      | 915.25          |
| 2       | 903.25          | 27      | 915.75          |
| 3       | 903.75          | 28      | 916.25          |
| 4       | 904.25          | 29      | 916.75          |
| 5       | 904.75          | 30      | 917.25          |
| 6       | 905.25          | 31      | 917.75          |
| 7       | 905.75          | 32      | 918.25          |
| 8       | 906.25          | 33      | 918.75          |
| 9       | 906.75          | 34      | 919.25          |
| 10      | 907.25          | 35      | 919.75          |
| 11      | 907.75          | 36      | 920.25          |
| 12      | 908.25          | 37      | 920.75          |
| 13      | 908.75          | 38      | 921.25          |
| 14      | 909.25          | 39      | 921.75          |
| 15      | 909.75          | 40      | 922.25          |
| 16      | 910.25          | 41      | 922.75          |
| 17      | 910.75          | 42      | 923.25          |
| 18      | 911.25          | 43      | 923.75          |
| 19      | 911.75          | 44      | 924.25          |
| 20      | 912.25          | 45      | 924.75          |
| 21      | 912.75          | 46      | 925.25          |
| 22      | 913.25          | 47      | 925.75          |
| 23      | 913.75          | 48      | 926.25          |
| 24      | 914.25          | 49      | 926.75          |
| 25      | 914.75          | 50      | 927.25          |

## 2.9 Transmit operating modes

Mode 1: PR-ASK, M4

Mode 3: DSB-ASK, FM0

Note: Mode 1 and 3 are used for USA and Canada.

## 2.10 Antenna

The EUT uses a PCB antenna, no replacement is possible.

## 2.11 Power supply system utilised

Power supply voltage,  $V_{nom}$  : 3.8 V/DC (Li-Ion battery)

## 2.12 Peripheral devices and interface cables

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

- Smart PC Model : M2SmartSE, ACD
- Laboratory power supply Model : PS 3032-20 B, Elektro-Automatik

\*Note: For radiated measurements a battery pack was used, thus no lab power supply was connected during radiated measurements.

## 2.13 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.

EUT Orientation:



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

| Available channel | Tested channels | Power setting | Modulation type |
|-------------------|-----------------|---------------|-----------------|
| 1 to 50           | 1, 25, 50       | $P_{\max}$    | PR-ASK          |
| 1 to 50           | 1, 25, 50       | $P_{\max}$    | DSB-ASK         |

- TX modulated, hopping enabled
- TX modulated, hopping disabled

### 2.13.1 Test jig

No test jig used.

### 2.13.2 Test software

The test software for the EUT provides free power setting, the special test mode TX continuous mode, modulated. The EUT was set with test modulation to transmit data during the tests with a maximum duty cycle (x) from an internal packet generator. Only for the test the appropriate test software is available.

### 3 TEST RESULT SUMMARY

Operating in the 902 MHz – 928 MHz band:

| FCC Rule Part   | RSS Rule Part   | Description                       | Result         |
|-----------------|-----------------|-----------------------------------|----------------|
| 15.207(a)       | RSS-Gen, 8.8    | AC power line conducted emissions | not applicable |
| 15.247(a)(1)(i) | RSS-247, 5.1(c) | 20 dB EBW, OBW                    | passed         |
| 15.247(a)(1)    | RSS-247, 5.1(b) | Channel separation                | passed         |
| 15.247(a)(1)(i) | RSS-247, 5.1(c) | Dwell time                        | passed         |
| 15.247(b)(2)    | RSS-247, 5.4(a) | Peak power                        | passed         |
| 15.247(d)       | RSS-247, 5.5    | Unwanted emissions                | passed         |
| 15.247(d)       | RSS-247, 5.5    | Out-of-band emission              | passed         |
| 15.247(d)       | RSS-Gen, 8.10   | Emissions in restricted bands     | passed         |
| 15.247(a)(1)    | RSS-247, 5.1(a) | Receiver input bandwidth          | passed         |
| 15.247(a)(1)(i) | RSS-247, 5.4(c) | Number of hopping channels        | passed         |
| 15.247(a)(1)    | RSS-247, 5.1(a) | Equal hopping frequency use       | passed         |
| 15.203          | RSS-247, 5.4(b) | Antenna requirement               | passed         |

The mentioned RSS Rule Parts in the above table are related to:  
 RSS-Gen, Issue 5 + Amendment 1 + Amendment 2, February 2021  
 RSS-247, Issue 2, February 2017

#### 3.1 Final assessment

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

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

Testing commenced on : 11 October 2021

Testing concluded on : 07 February 2022

Checked by:

Tested by:

\_\_\_\_\_  
 Klaus Gegenfurtner  
 Teamleader Radio

\_\_\_\_\_  
 Laurin Roth  
 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 / 2011 + A1 / 2014 „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.

| Measurement Type                  | Range                  | Confidence Level | Calculated Uncertainty   |
|-----------------------------------|------------------------|------------------|--------------------------|
| AC power line conducted emissions | 0.15 MHz to 30 MHz     | 95%              | $\pm 3.29$ dB            |
| EBW and OBW                       | 2400 MHz to 30000 MHz  | 95%              | $\pm 2.5 \times 10^{-7}$ |
| Output power ERP, radiated        | 1000 MHz to 7000 MHz   | 95%              | $\pm 2.71$ dB            |
| Field strength of the fundamental | 1000 MHz to 7000 MHz   | 95%              | $\pm 2.71$ dB            |
| Power spectral density            | 2400 MHz to 3000 MHz   | 95%              | $\pm 0.62$ dB            |
| Spurious Emissions, conducted     | 9 kHz to 10000 MHz     | 95%              | $\pm 2.15$ dB            |
| Spurious Emissions, conducted     | 10000 MHz to 40000 MHz | 95%              | $\pm 3.47$ dB            |
| Spurious Emissions, radiated      | 9 kHz to 30 MHz        | 95%              | $\pm 3.53$ dB            |
| Spurious Emissions, radiated      | 30 MHz to 1000 MHz     | 95%              | $\pm 4.44$ dB            |
| Spurious Emissions, radiated      | 1000 MHz to 30000 MHz  | 95%              | $\pm 2.34$ dB            |
| Spurious Emissions, radiated      | 30000 MHz to 40000 MHz | 95%              | $\pm 5.13$ dB            |



## 4.4 Conformity Decision Rule

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

## 4.5 Measurement protocol for FCC and ISED

### 4.5.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

**FCC: DE 0011**  
**ISED: DE0009**

### 4.5.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

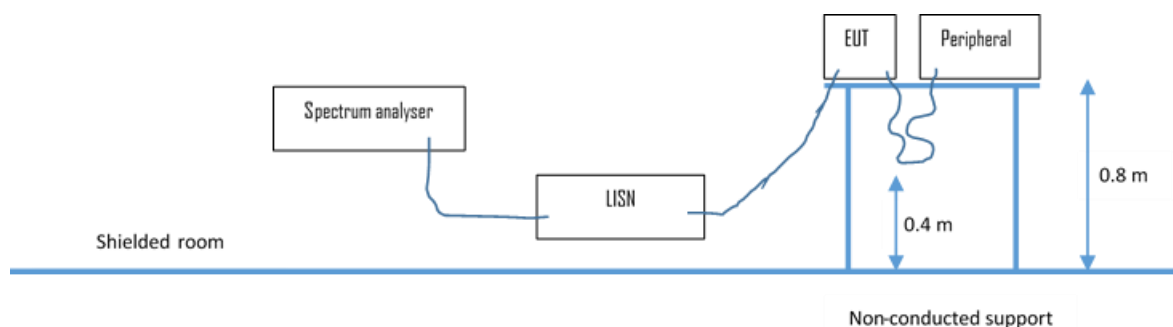
#### 4.5.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions.

### 4.5.3 Details of test procedures

#### 4.5.3.1 Conducted emission

Test setup according ANSI C63.10



The final level, expressed in dB $\mu$ V, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dB $\mu$ V and  $\mu$ V, the following conversions apply:

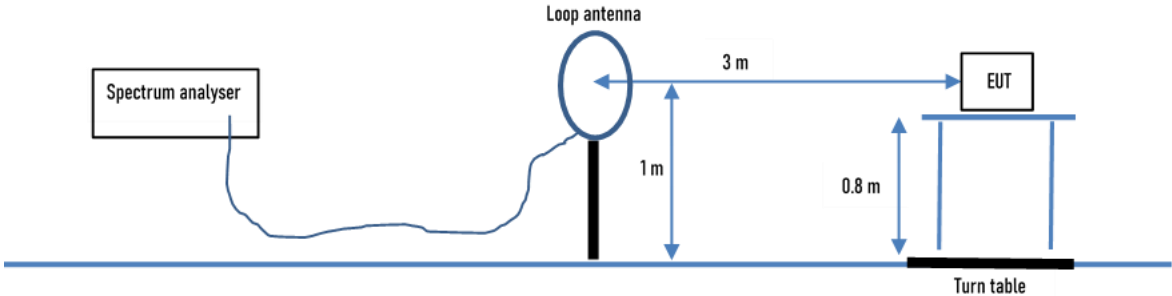
$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50  $\Omega$  / 50  $\mu$ H (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

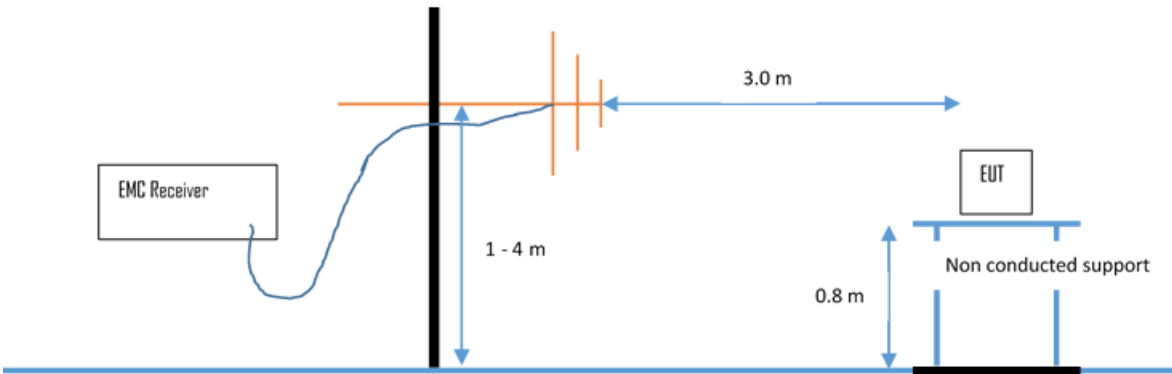
#### 4.5.3.2 Radiated emission

##### 4.5.3.2.1 OATS1 test site (9 kHz - 30 MHz): Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied along the site axis and the EUT is rotated 360 degrees.

##### 4.5.3.2.2 OATS1 test site (30 MHz - 1 GHz): Test setup according ANSI C63.10.



Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees. The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:

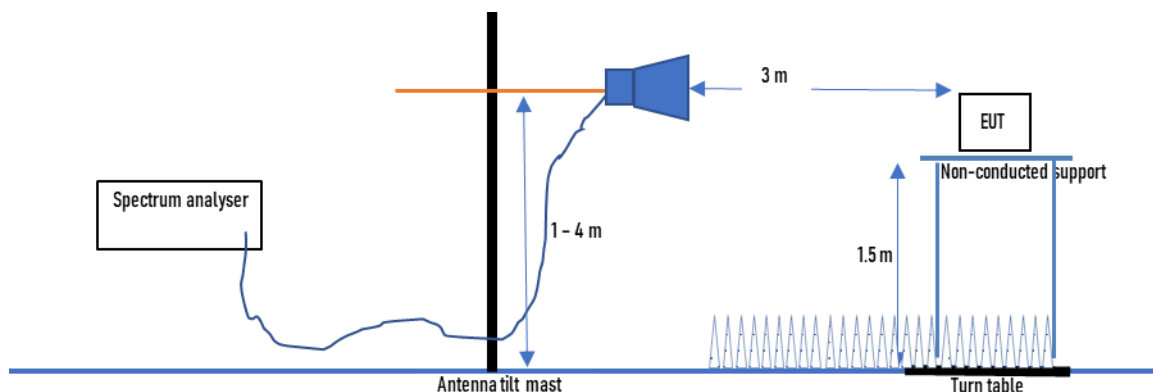
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

| Frequency<br>(MHz) | Level<br>(dBµV) | + | Factor<br>(dB) | = | Level<br>(dBµV/m) | - | Limit<br>(dBµV/m) | = | Delta<br>(dB) |
|--------------------|-----------------|---|----------------|---|-------------------|---|-------------------|---|---------------|
| 719.0              | 75.0            | + | 32.6           | = | 107.6             | - | 110.0             | = | -2.4          |

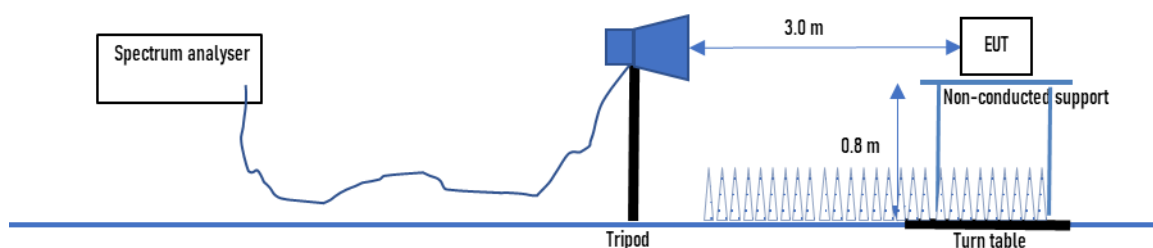
##### 4.5.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

#### 4.5.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)



Emissions from the EUT are measured in the frequency range 18 GHz up to 40 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 0.8 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limits are adopted.

## 5 TEST CONDITIONS AND RESULTS

### 5.1 Conducted emissions

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

#### 5.1.1 Description of the test location

Test location: NONE

Remarks: The measurement is not applicable, while charging RFID is disabled.

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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.

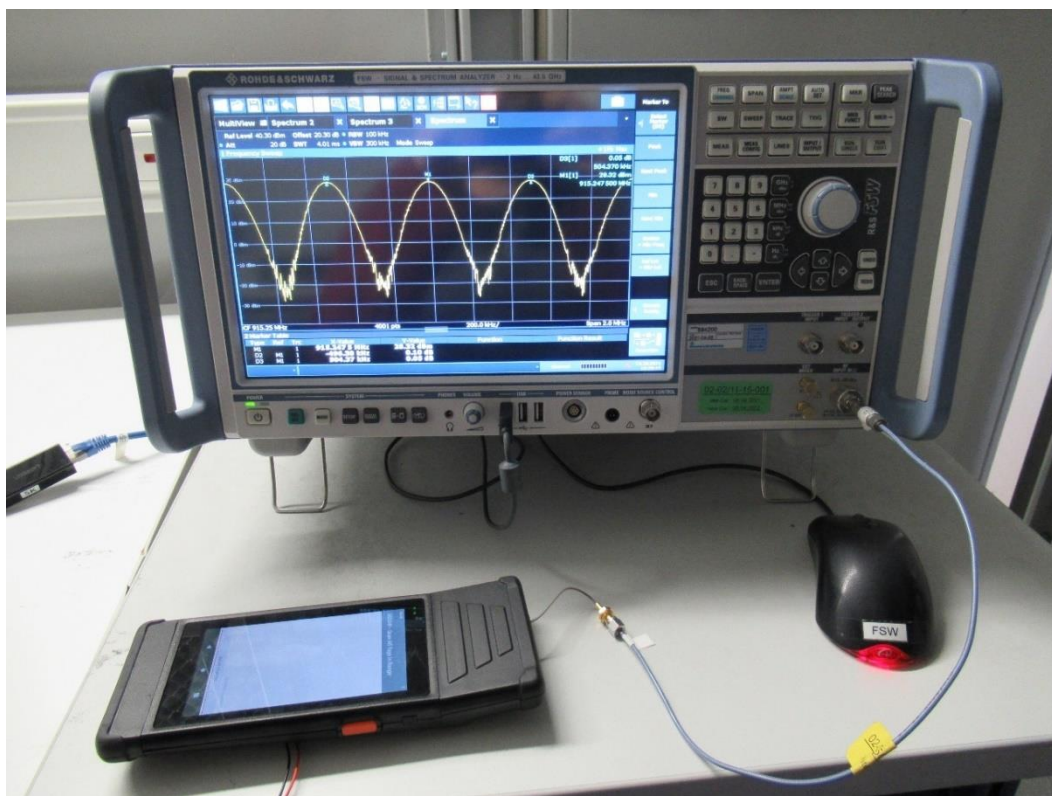
## 5.2 Emission bandwidth

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

### 5.2.1 Description of the test location

Test location: Shielded Room S4

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



### 5.2.3 Applicable standard

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

(a)(1) Frequency hopping systems shall have hopping carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

(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 is measured at an amplitude level reduced from the seeence level by a specified ratio of -20 dB. The seeence level is the level of the highest signal amplitude observed from the transmitter at either the fundamental frequency or the first-order modulation products in all typical modes of operation including the unmodulated carrier, even if atypical.

Analyser settings:

RBW: 1-5% of OBW, VBW:  $\approx 3 \times$  RBW, Span: 2-5 x OBW

Detector: Peak, Trace mode: Max hold, Sweep time: auto

### 5.2.5 Test result

Mode 1:

| 20dB bandwidth |         |         |              |
|----------------|---------|---------|--------------|
| Centre $f$     | $f_1$   | $f_2$   | Measured EBW |
| (MHz)          | (MHz)   | (MHz)   | (kHz)        |
| 902.750        | 902.729 | 902.771 | 42.735       |
| 914.750        | 914.728 | 914.772 | 42.639       |
| 927.250        | 927.228 | 927.271 | 42.764       |

| 99% bandwidth |         |         |              |
|---------------|---------|---------|--------------|
| Centre $f$    | $f_1$   | $f_2$   | Measured OBW |
| (MHz)         | (MHz)   | (MHz)   | (kHz)        |
| 902.750       | 902.722 | 902.778 | 55.293       |
| 914.750       | 914.722 | 914.778 | 56.131       |
| 927.250       | 927.222 | 927.278 | 56.542       |

| Operating frequency band | 20 dB Bandwidth             |
|--------------------------|-----------------------------|
| (MHz)                    | (MHz)                       |
| $f_{\text{low}} > 902$   | $f_{\text{low}} = 902.729$  |
| $f_{\text{high}} < 928$  | $f_{\text{high}} = 927.271$ |

Mode 3:

| 20dB bandwidth |         |         |              |
|----------------|---------|---------|--------------|
| Centre $f$     | $f_1$   | $f_2$   | Measured EBW |
| (MHz)          | (MHz)   | (MHz)   | (kHz)        |
| 902.750        | 902.584 | 902.915 | 330.7        |
| 914.748        | 914.584 | 914.914 | 329.9        |
| 927.249        | 927.087 | 927.412 | 325.7        |

| 99% bandwidth |         |         |              |
|---------------|---------|---------|--------------|
| Centre $f$    | $f_1$   | $f_2$   | Measured OBW |
| (MHz)         | (MHz)   | (MHz)   | (kHz)        |
| 902.750       | 902.546 | 902.954 | 407.794      |
| 914.750       | 914.542 | 914.956 | 413.827      |
| 927.249       | 927.044 | 927.455 | 411.372      |

| Operating frequency band | 20 dB Bandwidth             |
|--------------------------|-----------------------------|
| (MHz)                    | (MHz)                       |
| $f_{\text{low}} > 902$   | $f_{\text{low}} = 902.584$  |
| $f_{\text{high}} < 928$  | $f_{\text{high}} = 927.412$ |

Bandwidth limit according to FCC Part 15, Section 15.247(a)(1)(i):

For frequency hopping systems operating in the 902-928 MHz band: The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

The requirements are **FULFILLED**.

**Remarks:** For detailed test results please see the following test protocol.

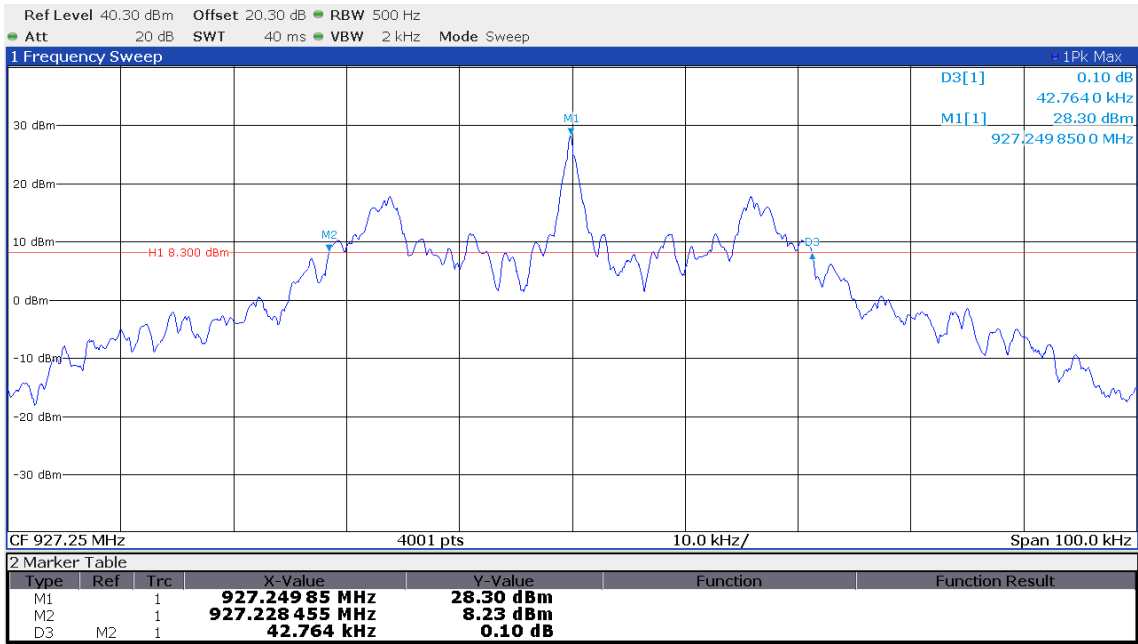
The OBW99 is measured for RSS only.

5.2.6 Test protocol

20dB Emission Bandwidth:

Mode 1:

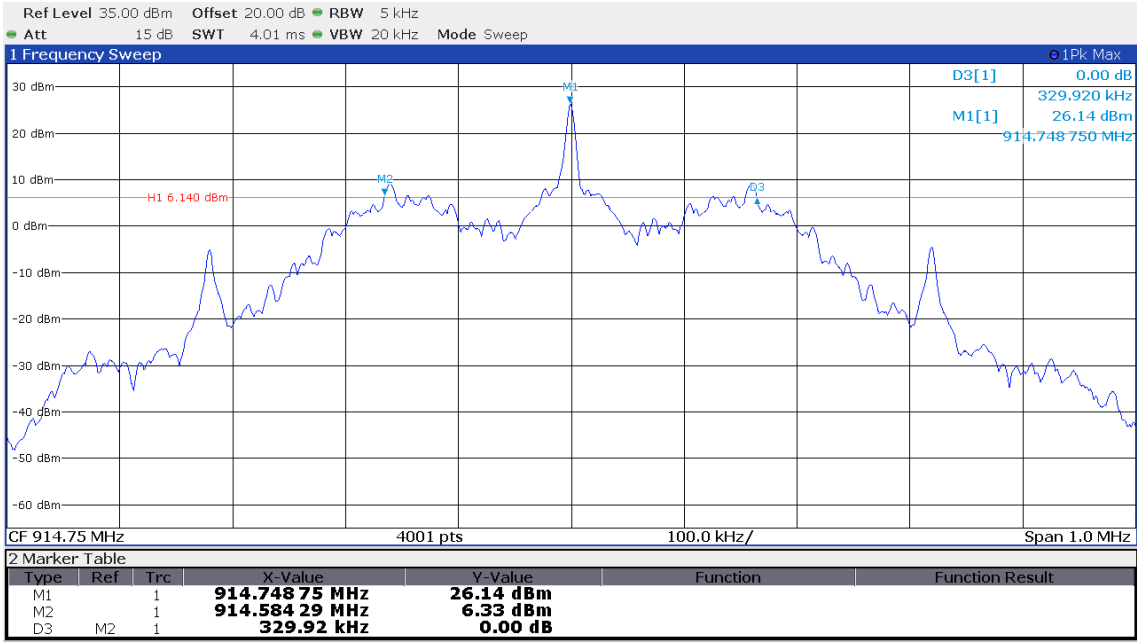
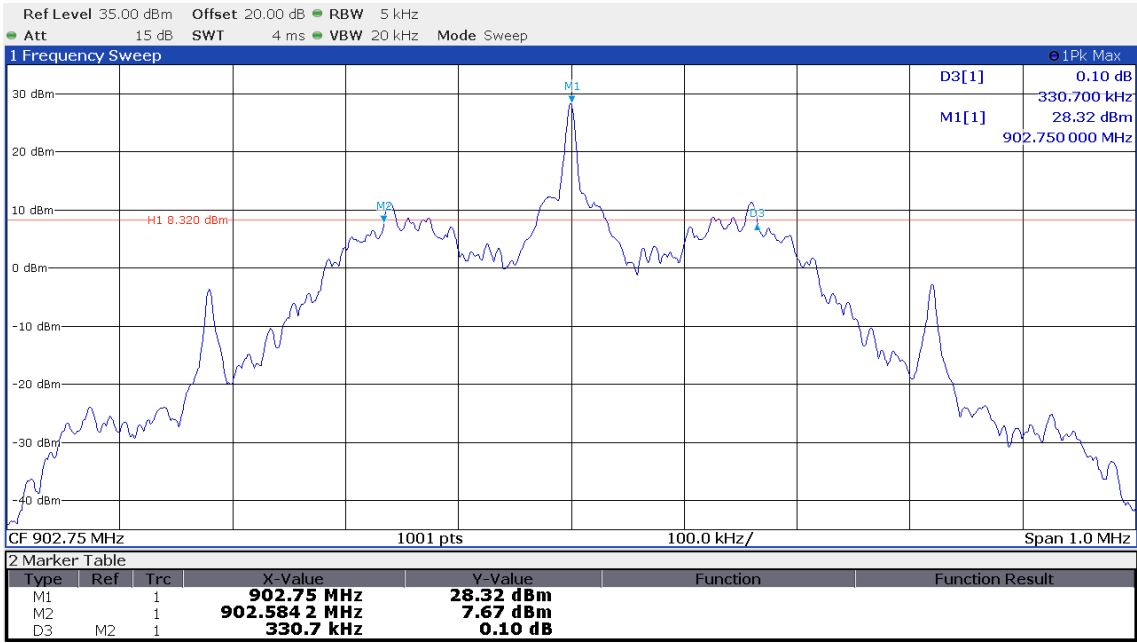


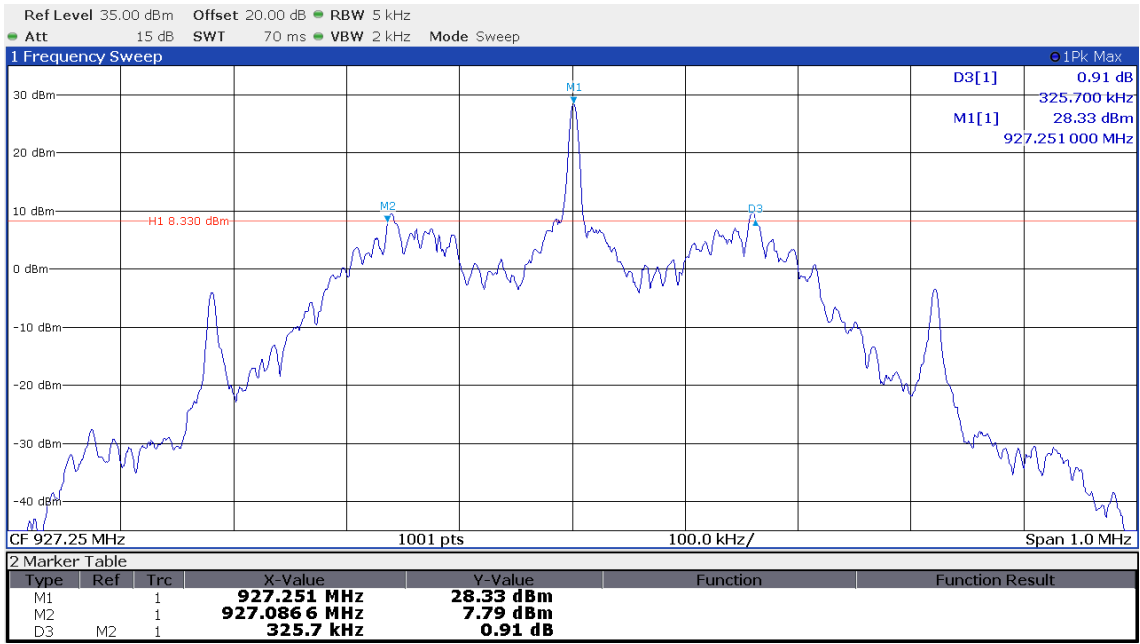


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.



Mode 3:

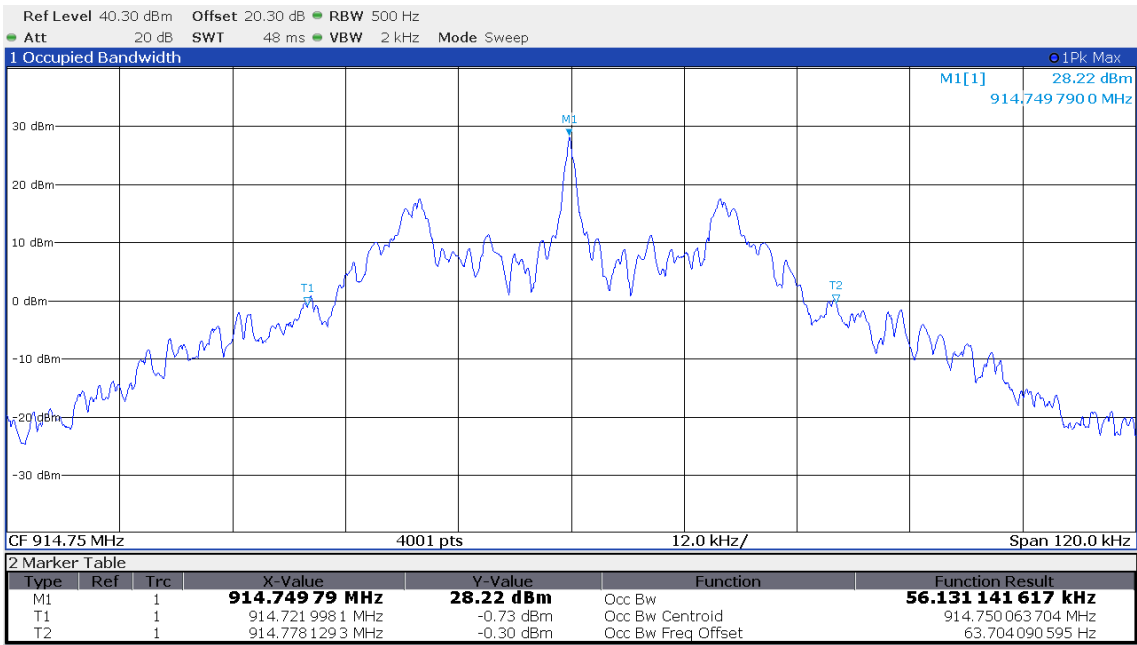


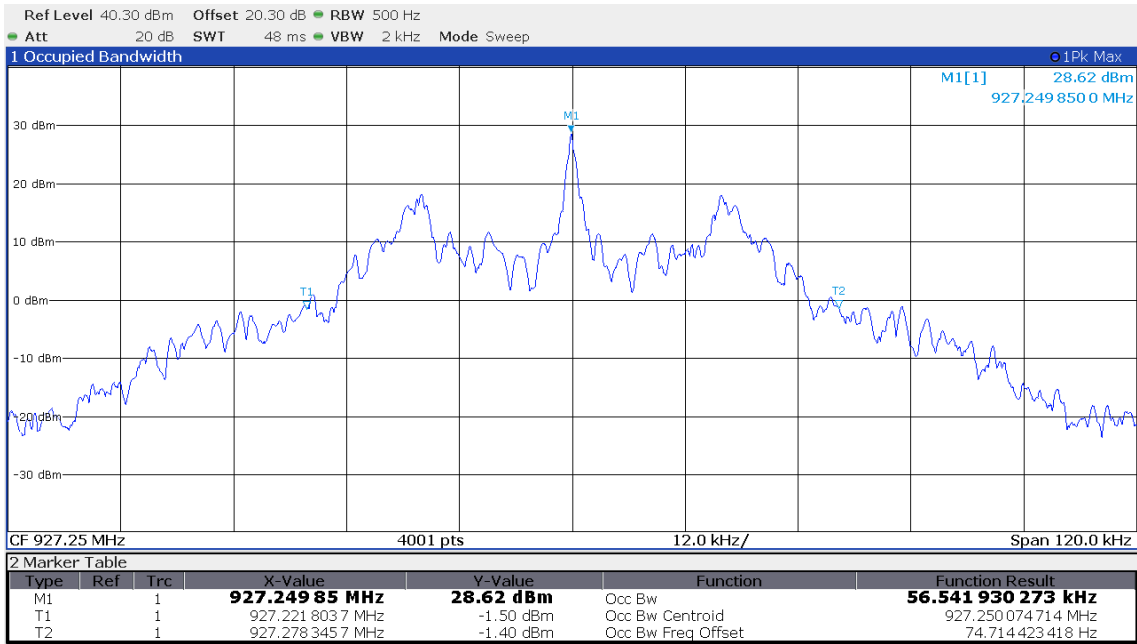


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

99% Occupied Bandwidth:

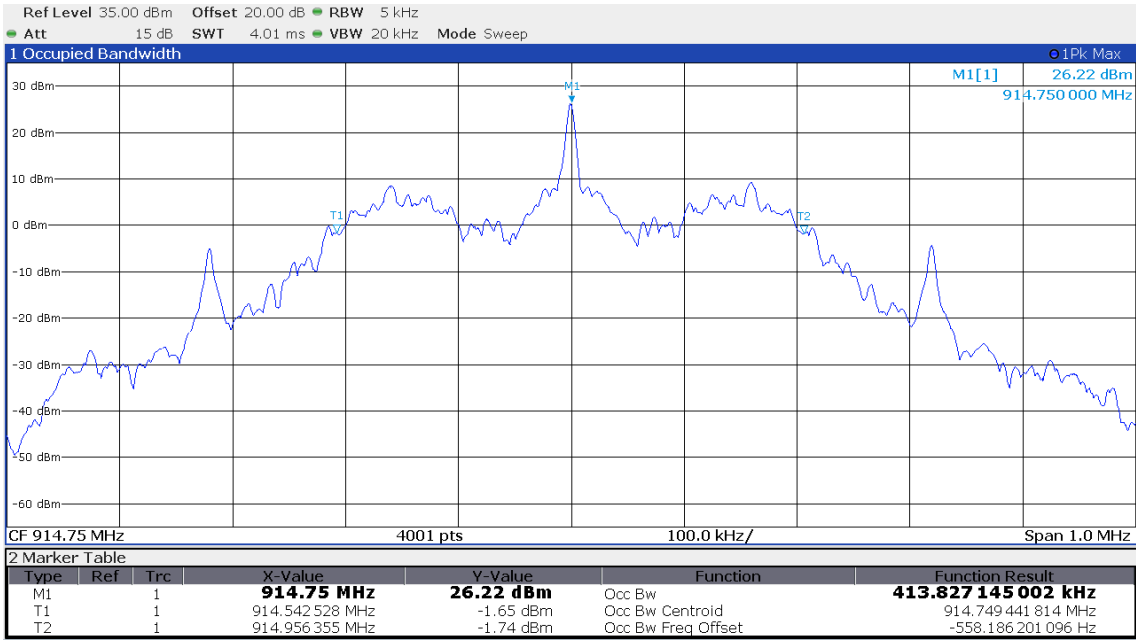
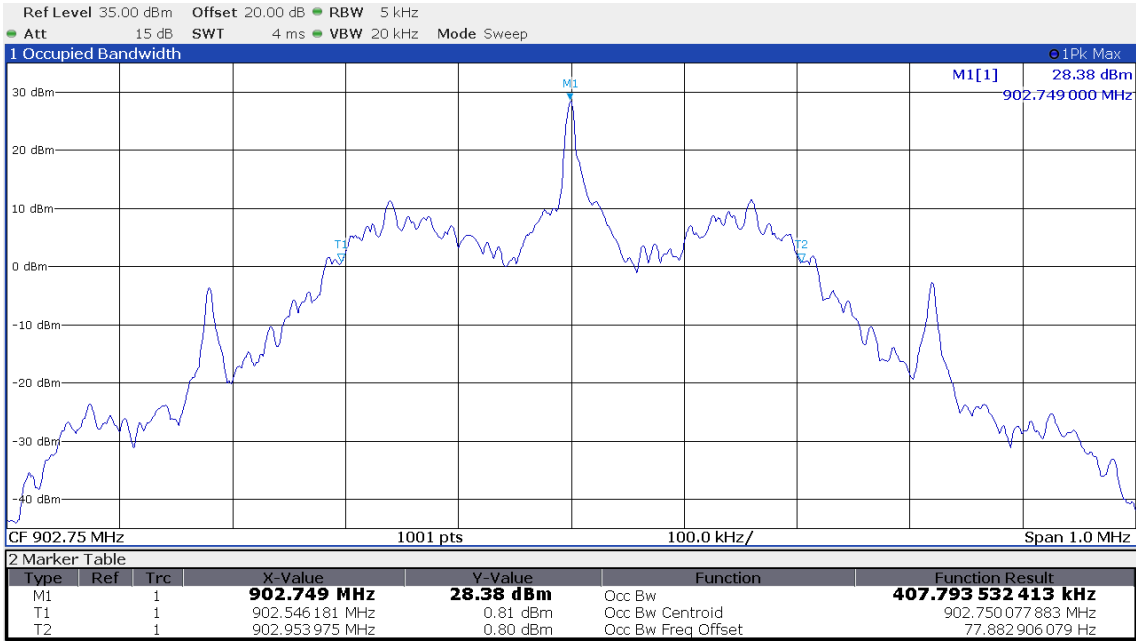
Mode 1:

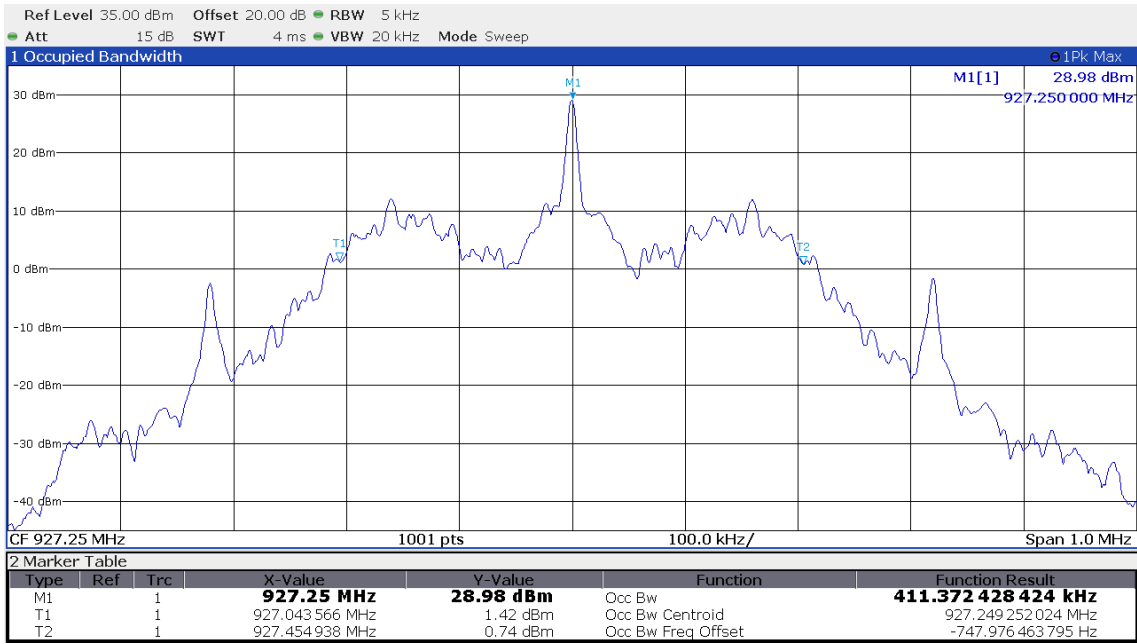




The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

Mode 3:





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.

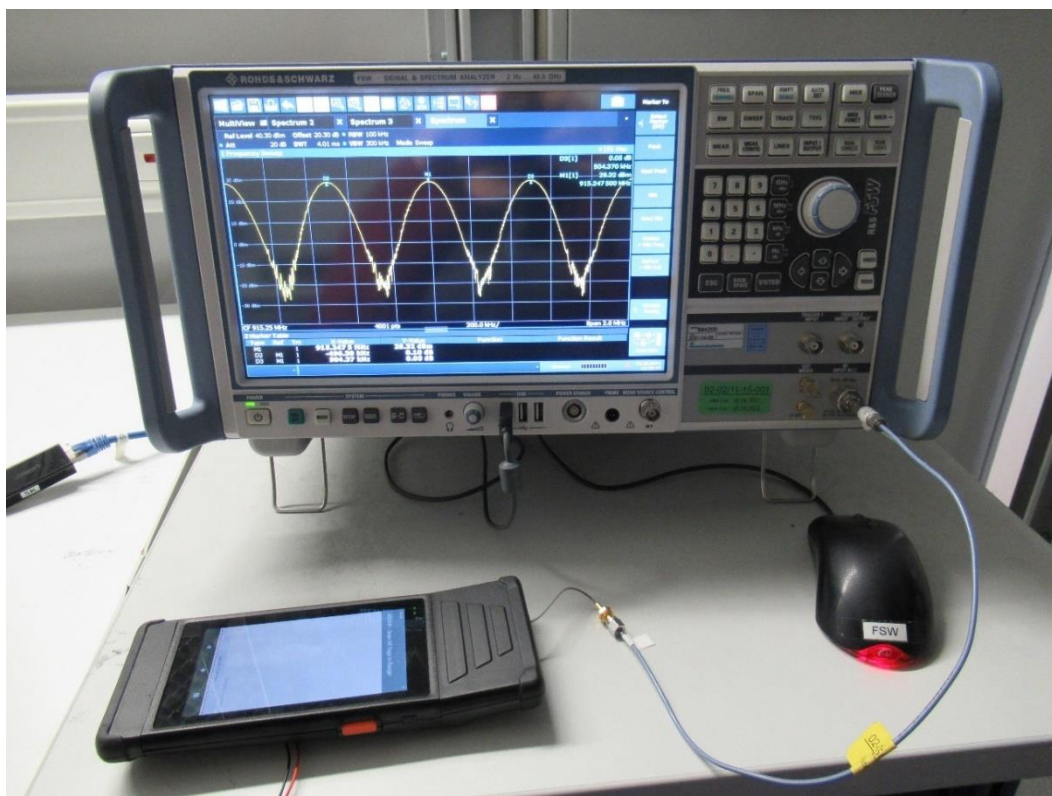
### 5.3 Maximum peak output power conducted

For test instruments and accessories used see section 6 Part **CPC 2**.

#### 5.3.1 Description of the test location

Test location:                      Shielded Room S4

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



#### 5.3.3 Applicable standard

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

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

#### 5.3.4 Description of Measurement

A spectrum analyser is connected to the output of the transmitter via a suitable attenuator while EUT is operating in transmit mode using the assigned frequency according to ANSI C63.10, 7.8.5.

Analyser settings:

RBW: > 20dB EBW, VBW  $\geq$  RBW, Span:  $\approx 5 \times 20$ dB EBW,

Detector: Max peak, Trace: Max hold, Sweep time: auto

### 5.3.5 Test result

Mode 1:

| Channel | f      | A     | Limit | Delta |
|---------|--------|-------|-------|-------|
|         | (MHz)  | (dBm) | (dBm) | (dB)  |
| CH1     | 902.75 | 28.9  | 30    | -1.1  |
| CH26    | 915.25 | 28.8  | 30    | -1.2  |
| CH50    | 927.25 | 28.8  | 30    | -1.2  |

Mode 3:

| Channel | f      | A     | Limit | Delta |
|---------|--------|-------|-------|-------|
|         | (MHz)  | (dBm) | (dBm) | (dB)  |
| CH1     | 902.75 | 28.6  | 30    | -1.4  |
| CH26    | 915.25 | 28.9  | 30    | -1.1  |
| CH50    | 927.25 | 28.2  | 30    | -1.8  |

Peak Power Limit according to FCC Part 15C, Section 15.247(b)(2):

| Frequency | Peak power limit |        |
|-----------|------------------|--------|
| (MHz)     | (dBm)            | (Watt) |
| 902 - 928 | 30               | 1      |

The requirements are **FULFILLED**.

**Remarks:** For detailed test results please see the following test protocol.

---

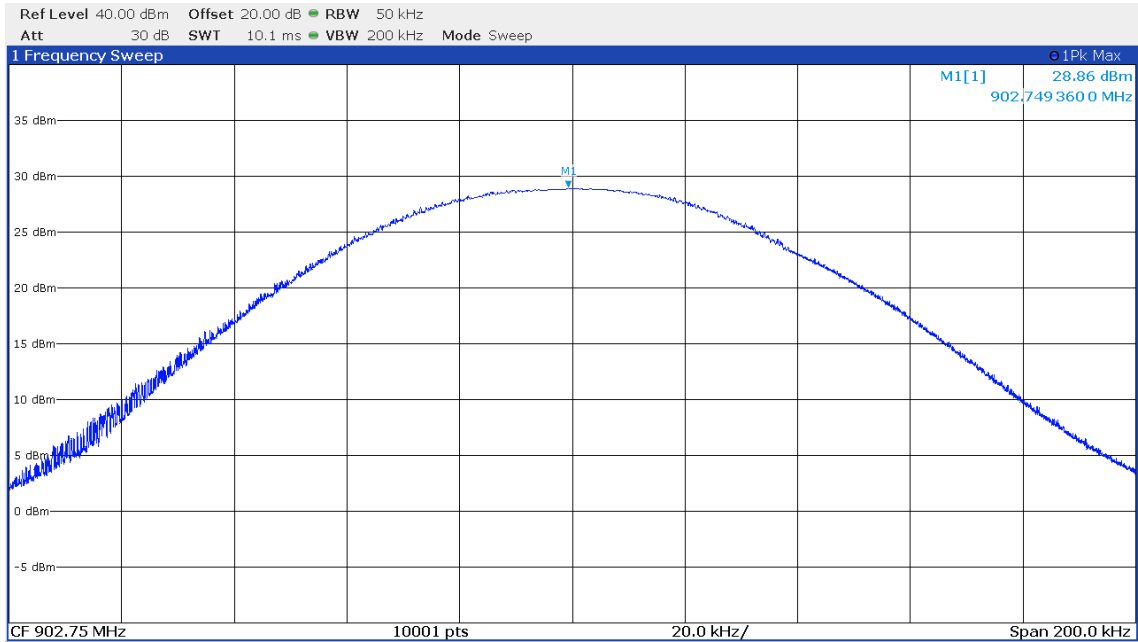
The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.



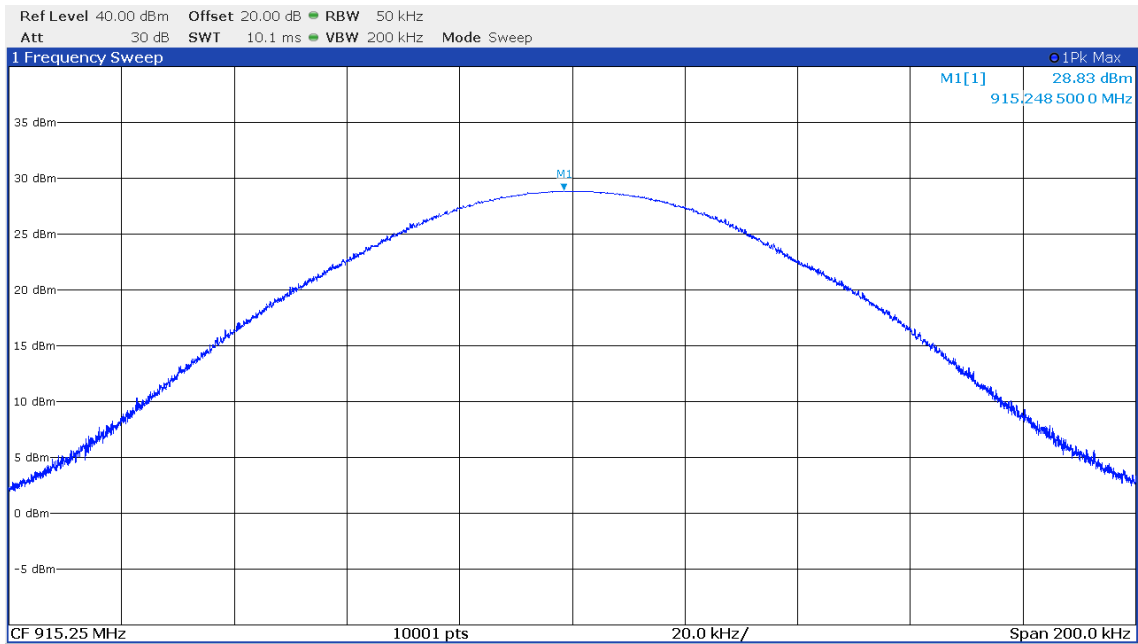
5.3.6 Test protocol

Mode 1:

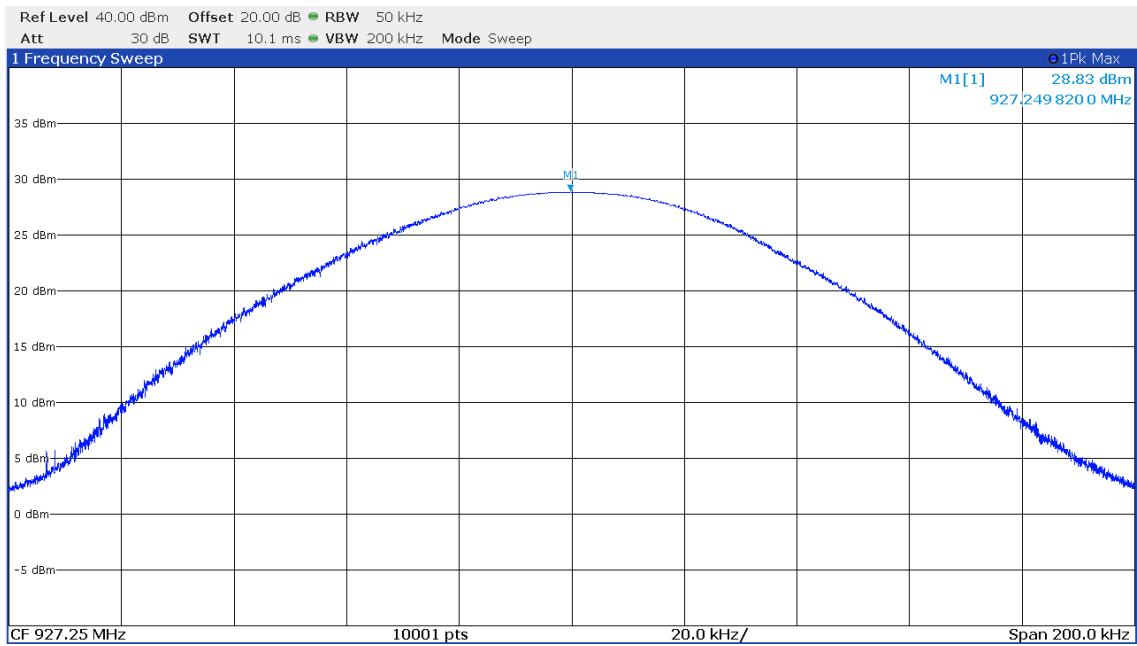
CH1



CH26

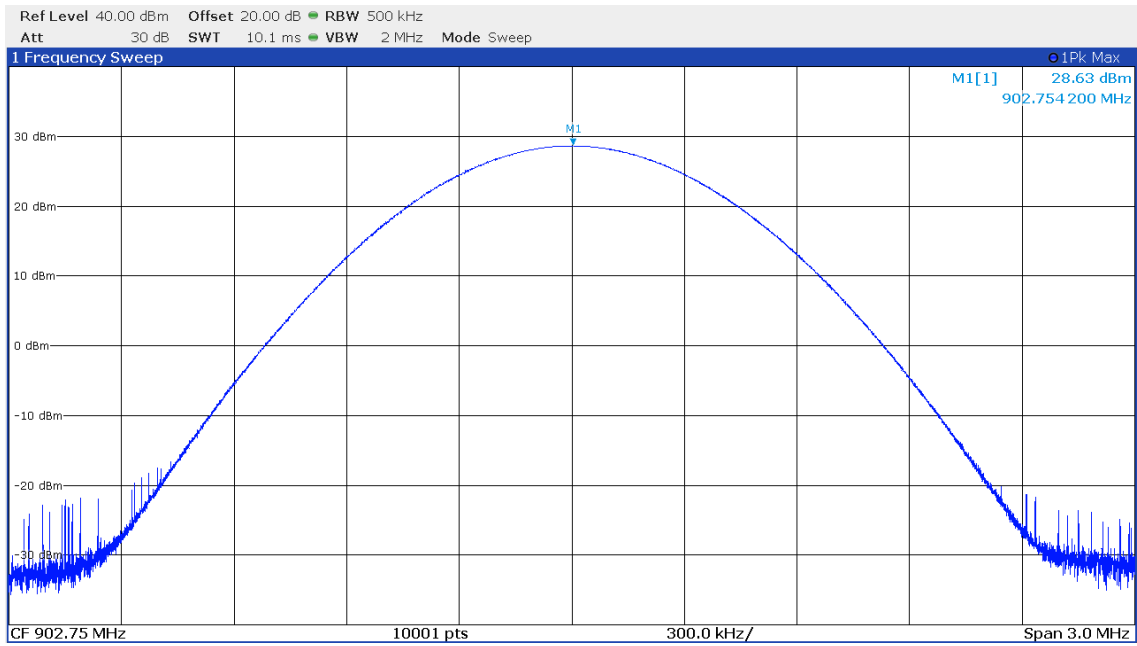


CH50

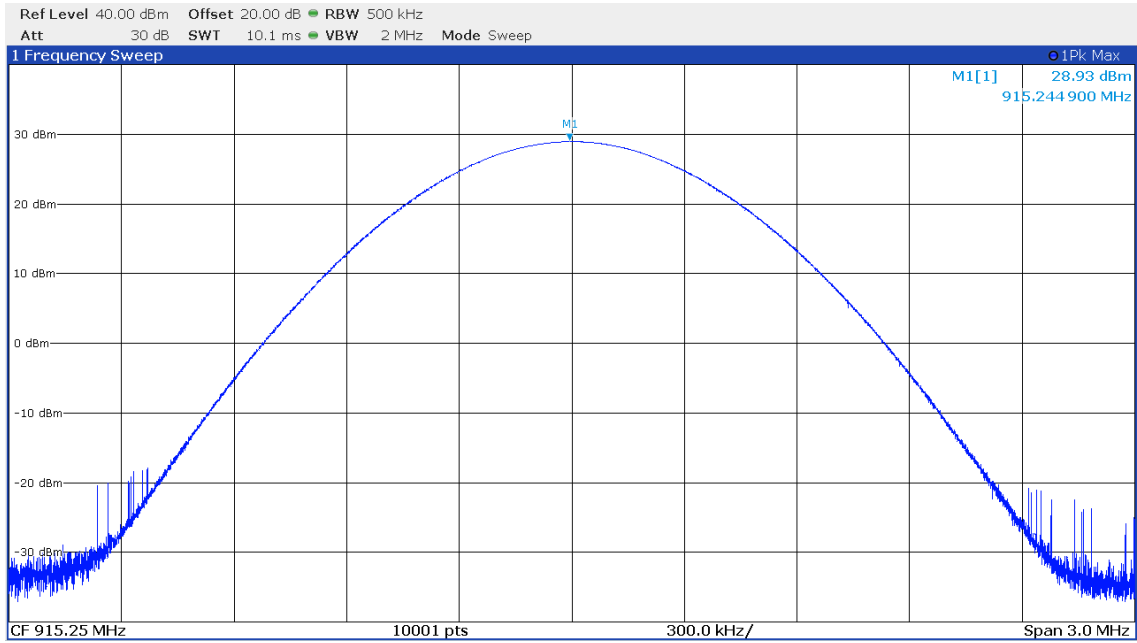


Mode 3:

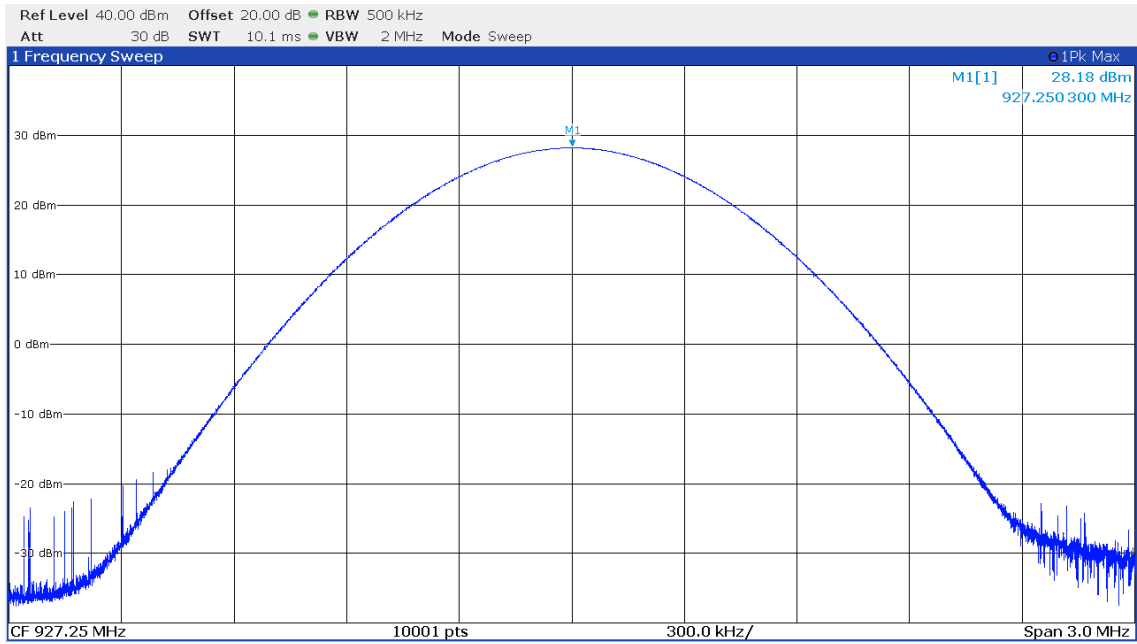
CH1



CH26



CH50



## 5.4 Spurious emissions

For test instruments and accessories used see section 6 Part **SEC2 and SEC3**.

### 5.4.1 Description of the test location

Test location: NONE

### 5.4.2 Applicable standard

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

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the 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 a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

**Remarks:** Not applicable, the EUT holds the general limits, see clause 5.6.

---

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.

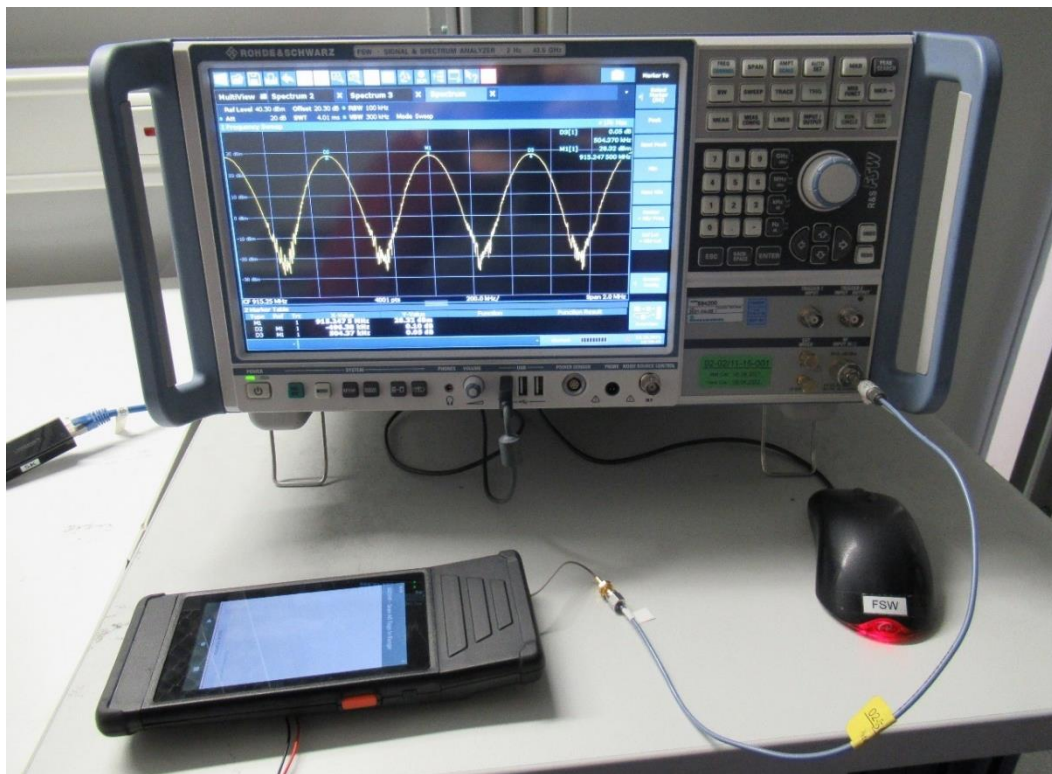
## 5.5 Band edge compliance

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

### 5.5.1 Description of the test location

Test location: Shielded Room S4

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



### 5.5.3 Applicable standard

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

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the 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. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

ANSI C63.10, 7.8.6: For band-edge measurements, use the band-edge procedure in 6.10. Band-edge measurements shall be tested both on single channels, and with the EUT hopping.

### 5.5.4 Description of Measurement

A spectrum analyser is connected to the output of the transmitter via a suitable attenuator while EUT was operating in transmit mode at the assigned frequency according ANSI C63.10, 6.10.

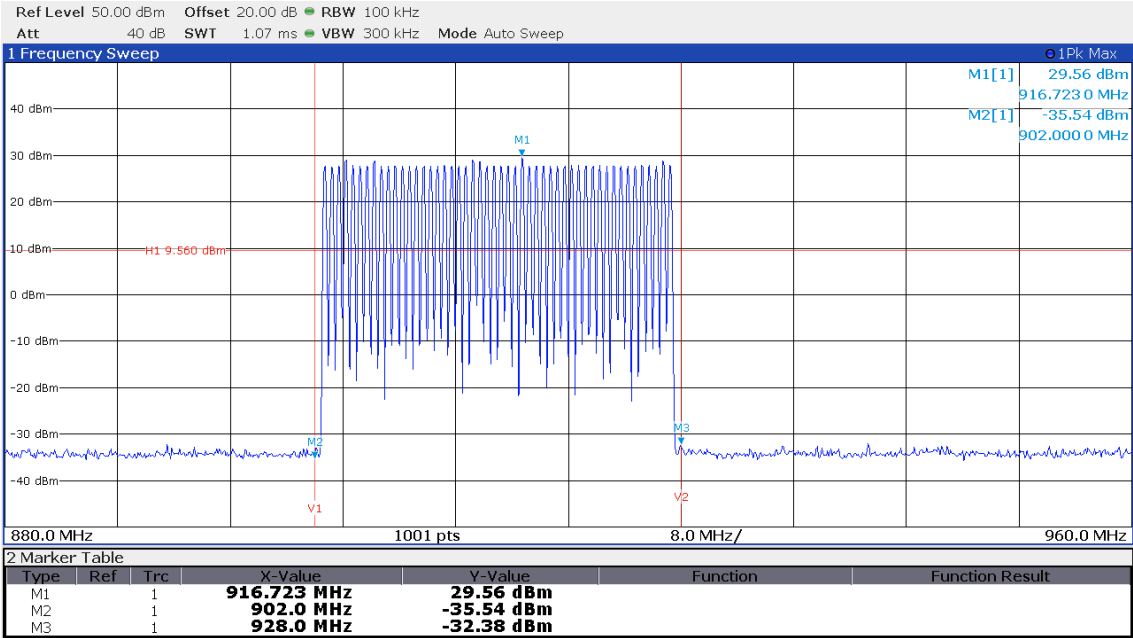
Spectrum analyser settings:

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

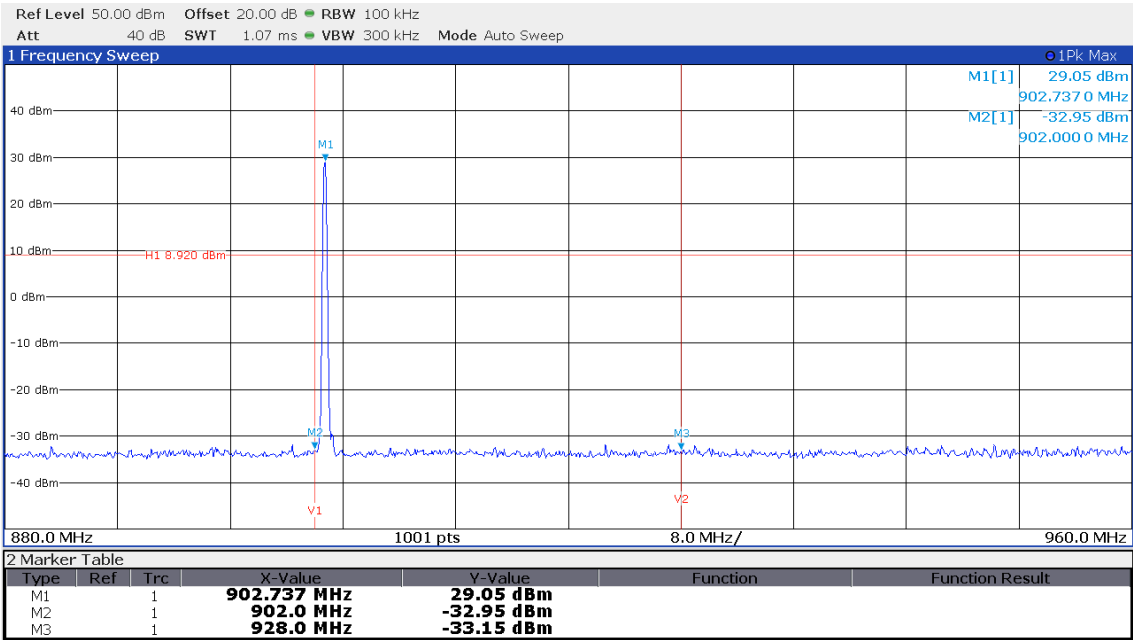
5.5.5 Test result

Mode 1:

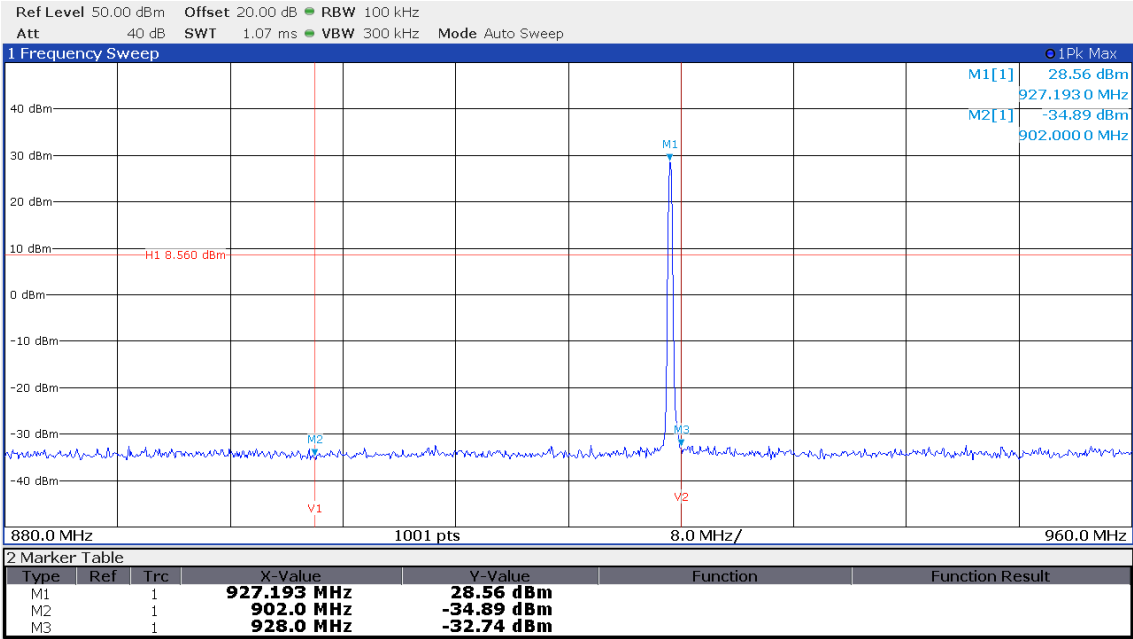
Hopping:



CH1

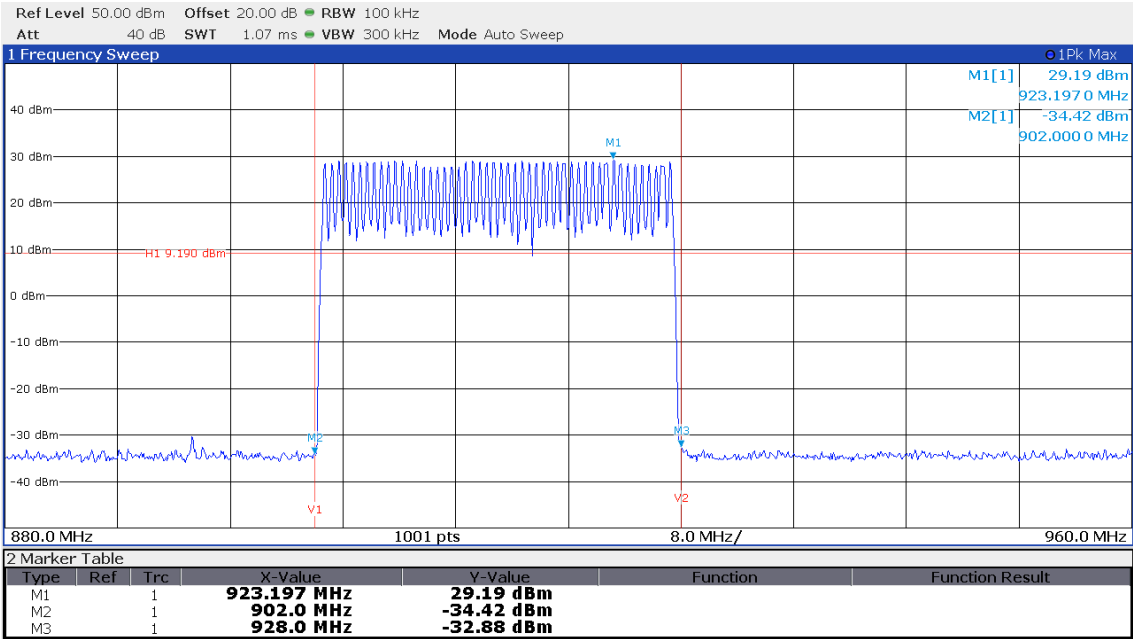


CH50

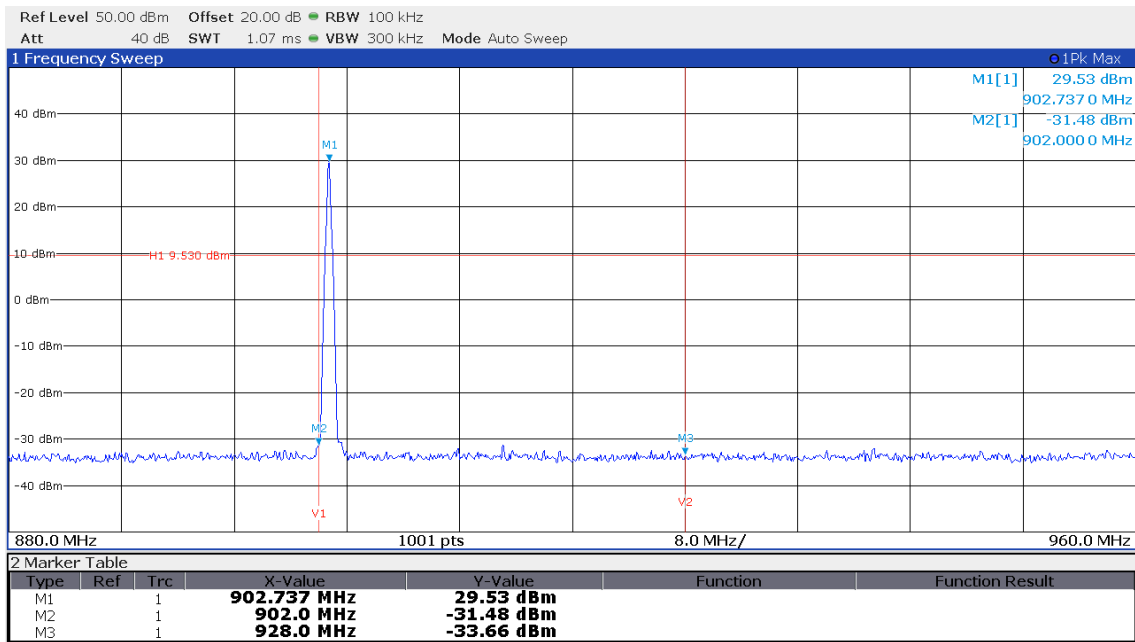


Mode 3:

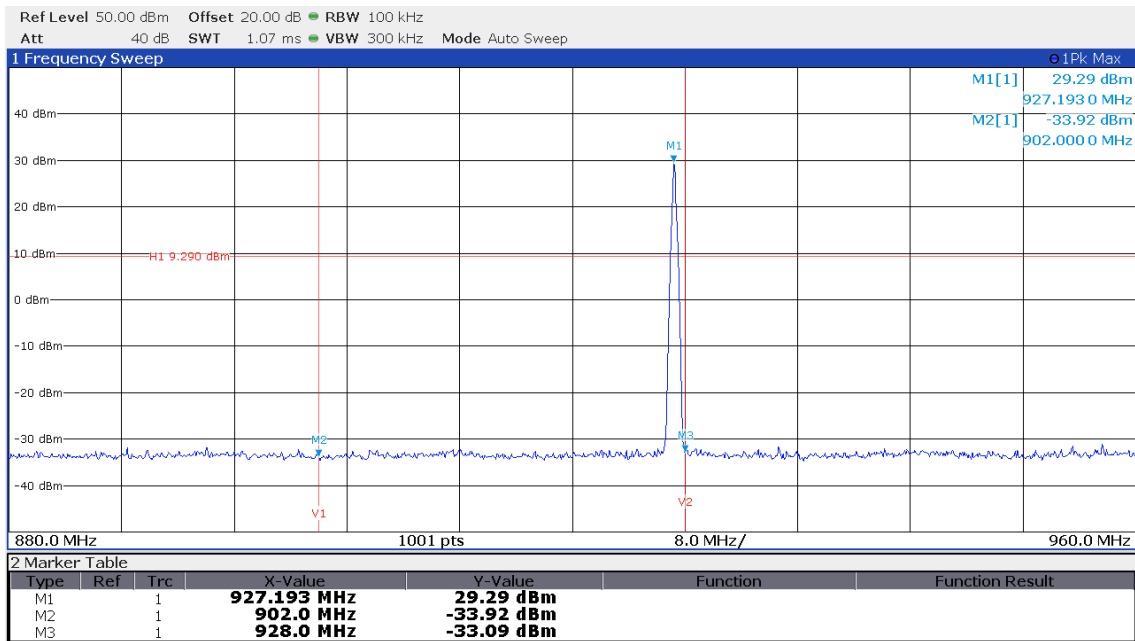
Hopping:



CH1



CH50



Peak-Limit according to FCC Part 15C, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the 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. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

The requirements are **FULFILLED**.

**Remarks:** For radiated emissions which fall in restricted bands refer to section 5.6.



## 5.6 Radiated emissions in restricted bands

For test instruments and accessories used see section 6 Part **SER1, SER2, SER3**.

### 5.6.1 Description of the test location

Test location: OATS 1

Test distance: 3 m

Test location: Anechoic chamber 1

Test distance: 3 m

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

Test setup 9 kHz – 30 MHz



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.

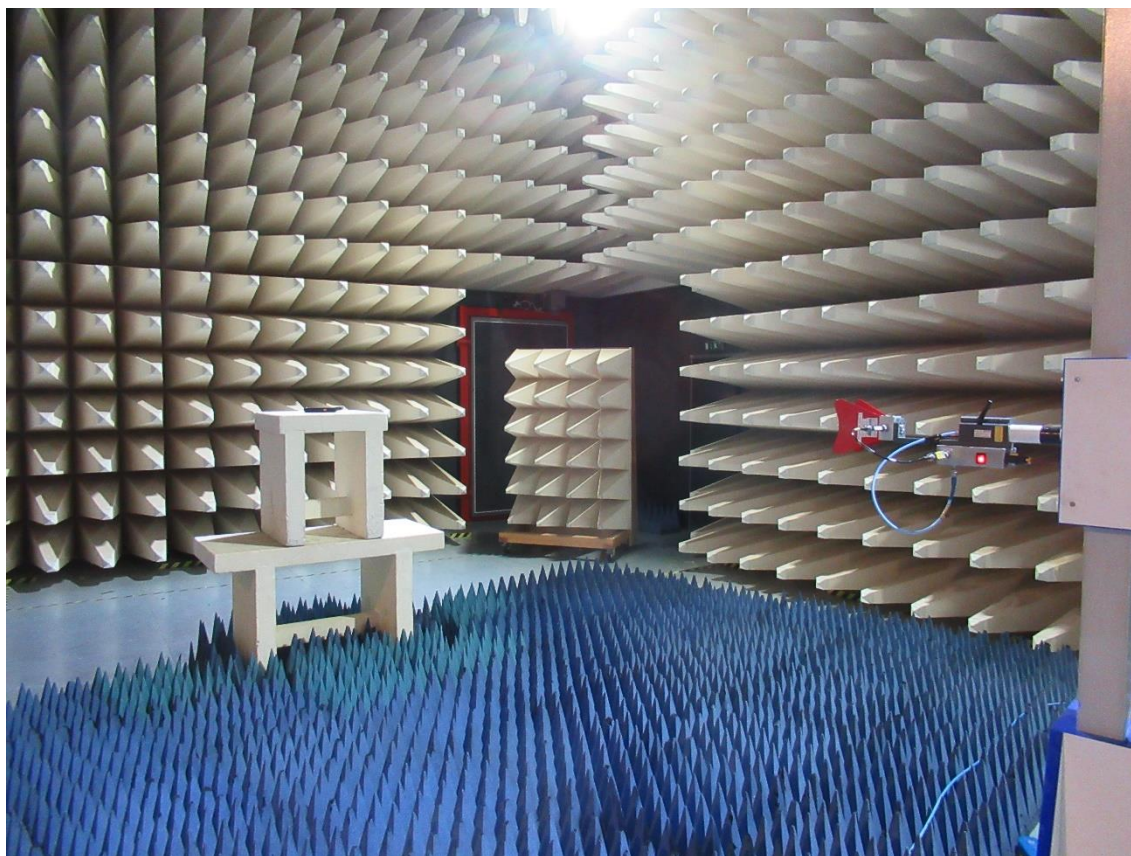


Test setup 30 MHz – 1 GHz





### Test setup 1 GHz – 10 GHz



### EUT Orientation:



### 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 was 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 resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: RBW: 200 Hz  
 150 kHz – 30 MHz: RBW: 9 kHz  
 30 MHz – 1 GHz: RBW: 120 kHz  
 1 GHz – 10 GHz: RBW: 1 MHz

### 5.6.5 Test result

**f < 1000 MHz**

Mode 1:

Hopping enabled

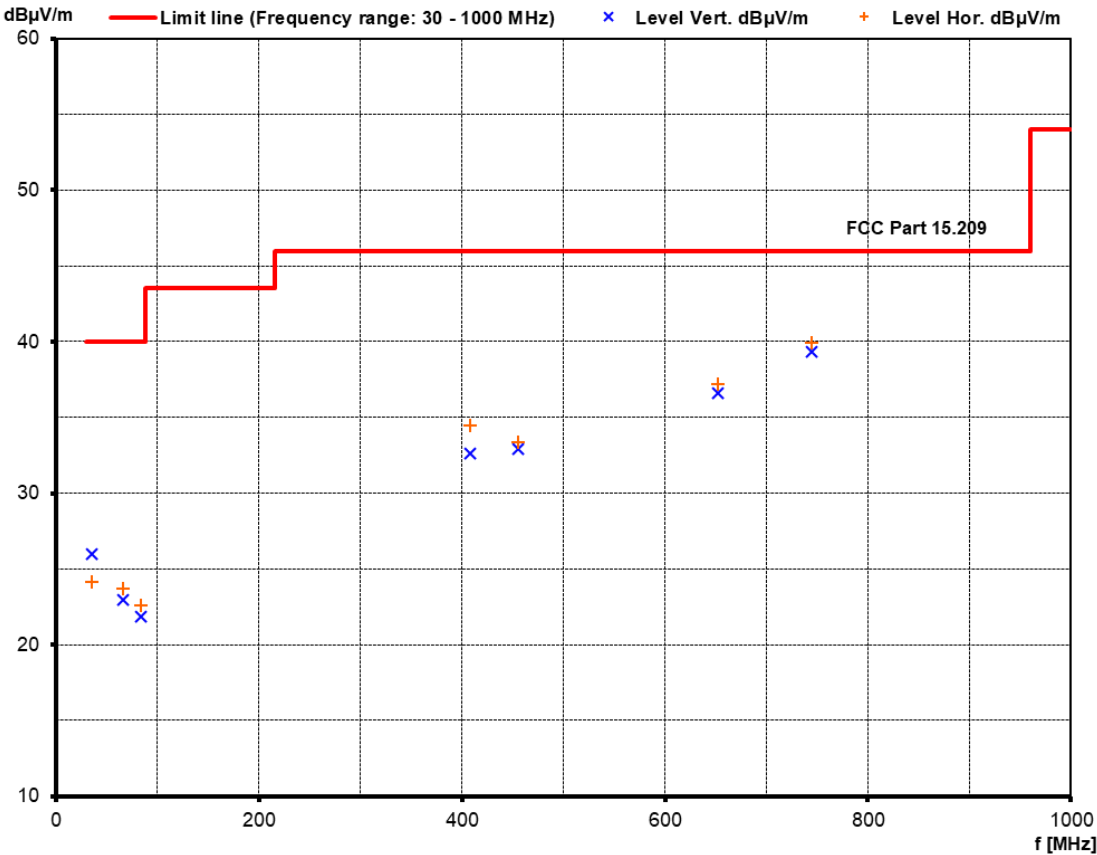
9kHz-30MHz

| f [kHz]   | PK reading [dBμV] | QP reading [dBμV] | Duty cycle corr. [dB] | Ant. factor [dB] | Distance corr. [dB] | corr. AV level [dBμV/m] | QP level [dBμV/m] | Limit [dBμV/m] | Margin [dB] |
|-----------|-------------------|-------------------|-----------------------|------------------|---------------------|-------------------------|-------------------|----------------|-------------|
| 10.000    | 46.7              | 40.7              | 0.0                   | 20.0             | -80.0               | -13.3                   | -19.3             | 47.6           | -60.9       |
| 50.000    | 37.5              | 35.3              | 0.0                   | 20.0             | -80.0               | -22.5                   | -24.7             | 33.6           | -56.1       |
| 200.000   | 40.2              | 39.1              | 0.0                   | 20.0             | -80.0               | -19.8                   | -20.9             | 21.6           | -41.4       |
| 5000.000  | 25.0              | 23.3              | 0.0                   | 20.0             | -40.0               | 5.0                     | 3.3               | 29.5           | -26.2       |
| 20000.000 | 20.3              | 19.9              | 0.0                   | 20.0             | -40.0               | 0.3                     | -0.1              | 29.5           | -29.6       |

Note: Only noise was recorded.

30MHz-1000MHz

| Frequency (MHz) | Reading Vert. (dBμV) | Reading Hor. (dBμV) | Correct. Vert. (dB) | Correct. Hor. (dB) | Level Vert. (dBμV/m) | Level Hor. (dBμV/m) | Limit (dBμV/m) | Dlimit (dB) |
|-----------------|----------------------|---------------------|---------------------|--------------------|----------------------|---------------------|----------------|-------------|
| 35.50           | 9.8                  | 6.9                 | 16.2                | 17.3               | 26.0                 | 24.2                | 40.0           | -14.0       |
| 65.50           | 6.6                  | 6.5                 | 16.3                | 17.2               | 22.9                 | 23.7                | 40.0           | -16.3       |
| 84.00           | 8.0                  | 8.8                 | 13.8                | 13.8               | 21.8                 | 22.6                | 40.0           | -17.4       |
| 408.00          | 9.3                  | 10.8                | 23.3                | 23.7               | 32.6                 | 34.5                | 46.0           | -11.5       |
| 455.50          | 8.4                  | 8.5                 | 24.5                | 24.9               | 32.9                 | 33.4                | 46.0           | -12.6       |
| 652.00          | 7.8                  | 7.9                 | 28.8                | 29.3               | 36.6                 | 37.2                | 46.0           | -8.8        |
| 744.00          | 9.0                  | 9.1                 | 30.3                | 30.8               | 39.3                 | 39.9                | 46.0           | -6.1        |



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.

Hopping disabled

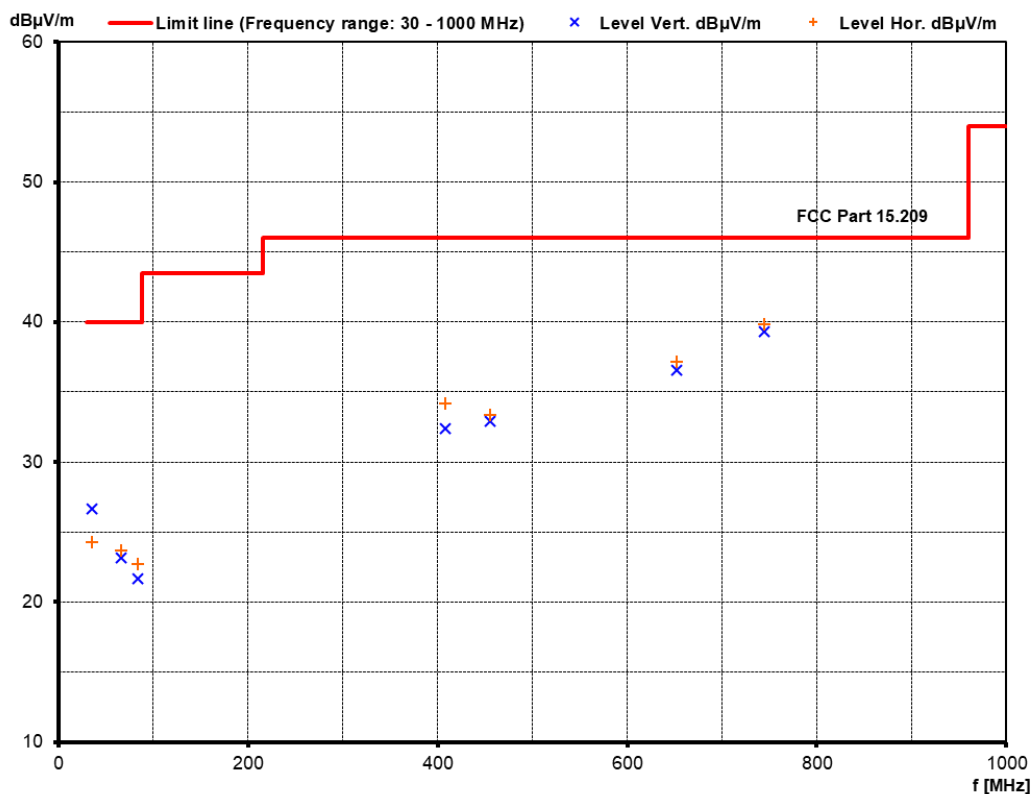
## 9kHz-30MHz

| f [kHz]   | PK reading [dBμV] | QP reading [dBμV] | Duty cycle corr. [dB] | Ant. factor [dB] | Distance corr. [dB] | corr. AV level [dBμV/m] | QP level [dBμV/m] | Limit [dBμV/m] | Margin [dB] |
|-----------|-------------------|-------------------|-----------------------|------------------|---------------------|-------------------------|-------------------|----------------|-------------|
| 10.000    | 46.7              | 40.7              | 0.0                   | 20.0             | -80.0               | -13.3                   | -19.3             | 47.6           | -60.9       |
| 50.000    | 37.5              | 35.3              | 0.0                   | 20.0             | -80.0               | -22.5                   | -24.7             | 33.6           | -56.1       |
| 200.000   | 40.2              | 39.1              | 0.0                   | 20.0             | -80.0               | -19.8                   | -20.9             | 21.6           | -41.4       |
| 5000.000  | 25.0              | 23.3              | 0.0                   | 20.0             | -40.0               | 5.0                     | 3.3               | 29.5           | -26.2       |
| 20000.000 | 20.3              | 19.9              | 0.0                   | 20.0             | -40.0               | 0.3                     | -0.1              | 29.5           | -29.6       |

Note: Only noise was recorded.

## 30MHz-1000MHz

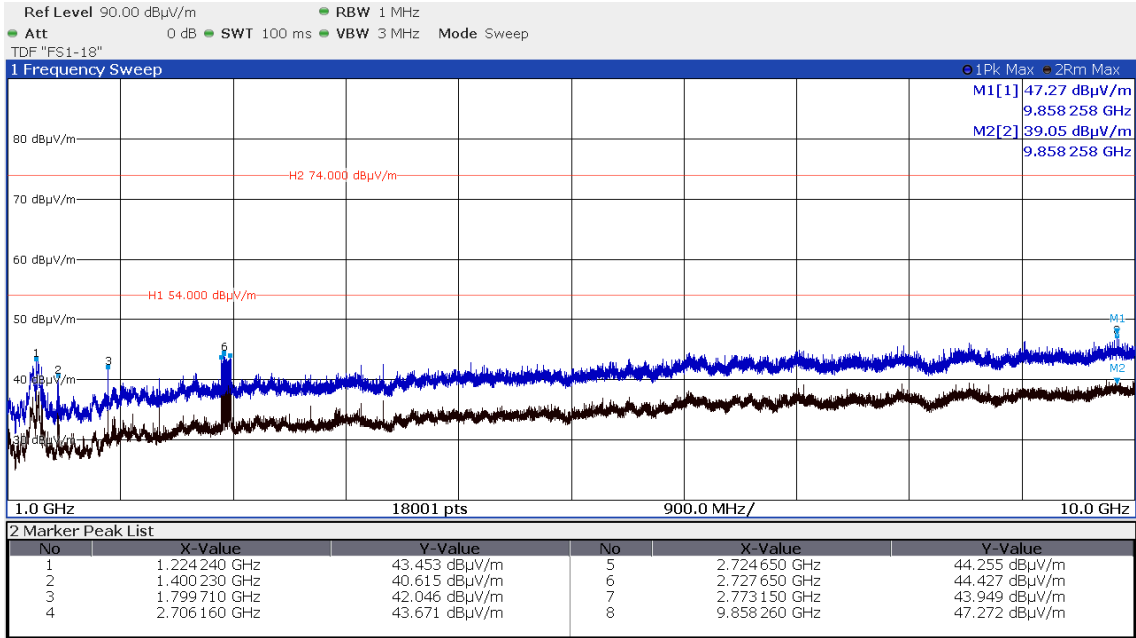
| Frequency (MHz) | Reading Vert. (dBμV) | Reading Hor. (dBμV) | Correct. Vert. (dB) | Correct. Hor. (dB) | Level Vert. (dBμV/m) | Level Hor. (dBμV/m) | Limit (dBμV/m) | Dlimit (dB) |
|-----------------|----------------------|---------------------|---------------------|--------------------|----------------------|---------------------|----------------|-------------|
| 35.50           | 10.5                 | 7.0                 | 16.2                | 17.3               | 26.7                 | 24.3                | 40.0           | -13.3       |
| 65.50           | 6.8                  | 6.5                 | 16.3                | 17.2               | 23.1                 | 23.7                | 40.0           | -16.3       |
| 84.00           | 7.8                  | 8.9                 | 13.8                | 13.8               | 21.6                 | 22.7                | 40.0           | -17.3       |
| 408.00          | 9.1                  | 10.5                | 23.3                | 23.7               | 32.4                 | 34.2                | 46.0           | -11.8       |
| 455.50          | 8.4                  | 8.5                 | 24.5                | 24.9               | 32.9                 | 33.4                | 46.0           | -12.6       |
| 652.00          | 7.8                  | 7.9                 | 28.8                | 29.3               | 36.6                 | 37.2                | 46.0           | -8.8        |
| 744.00          | 9.0                  | 9.0                 | 30.3                | 30.8               | 39.3                 | 39.8                | 46.0           | -6.2        |



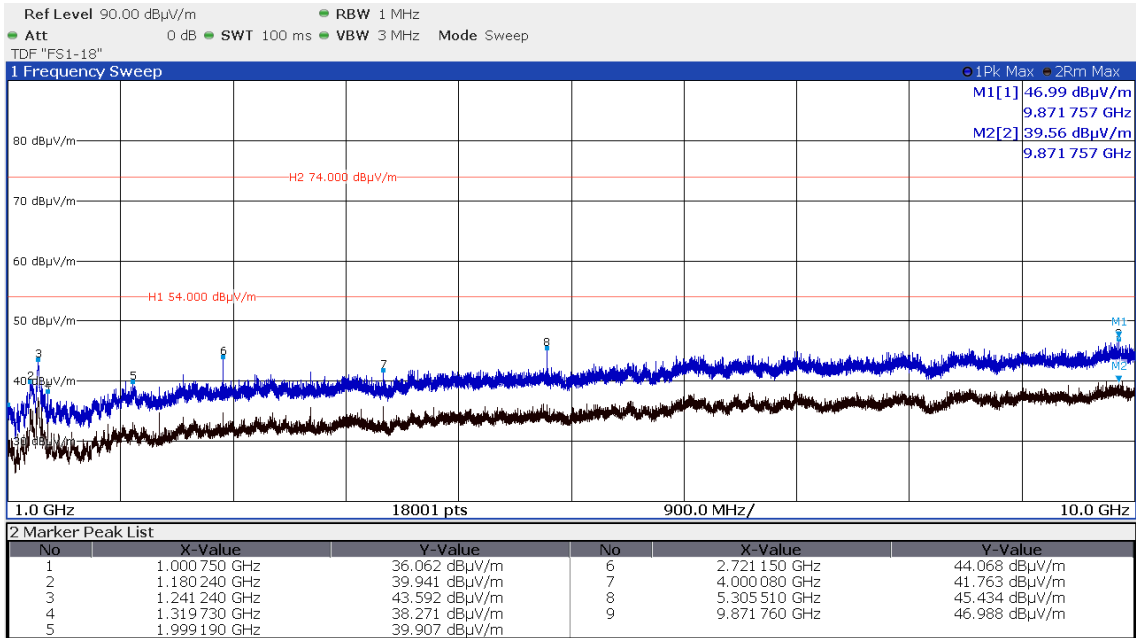
1GHz – 10GHz

Mode 1:

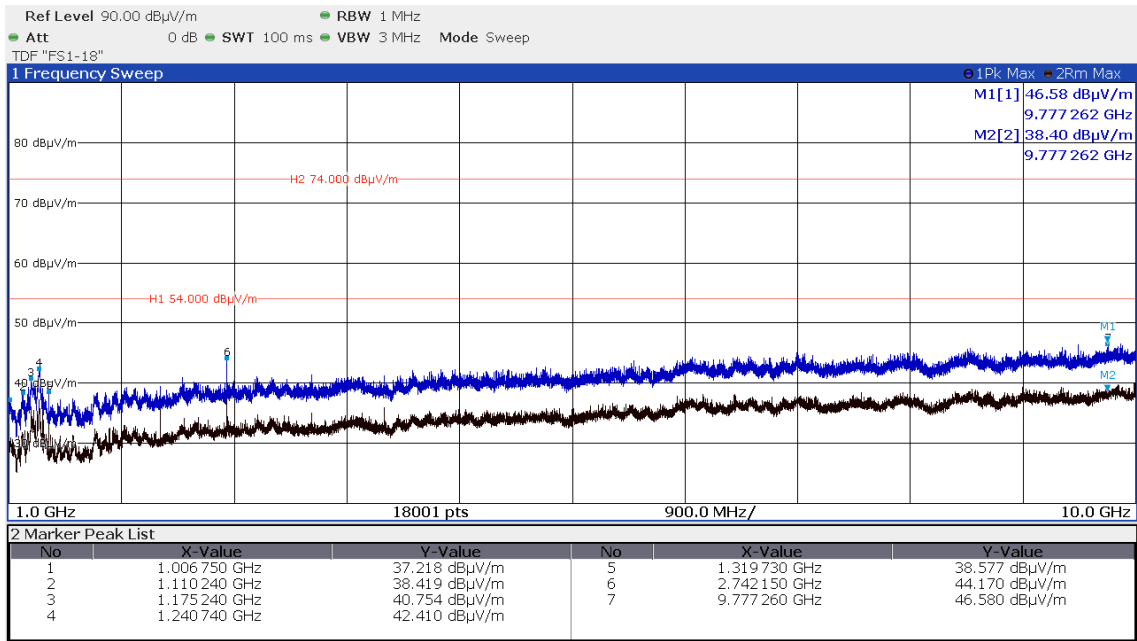
Hopping enabled



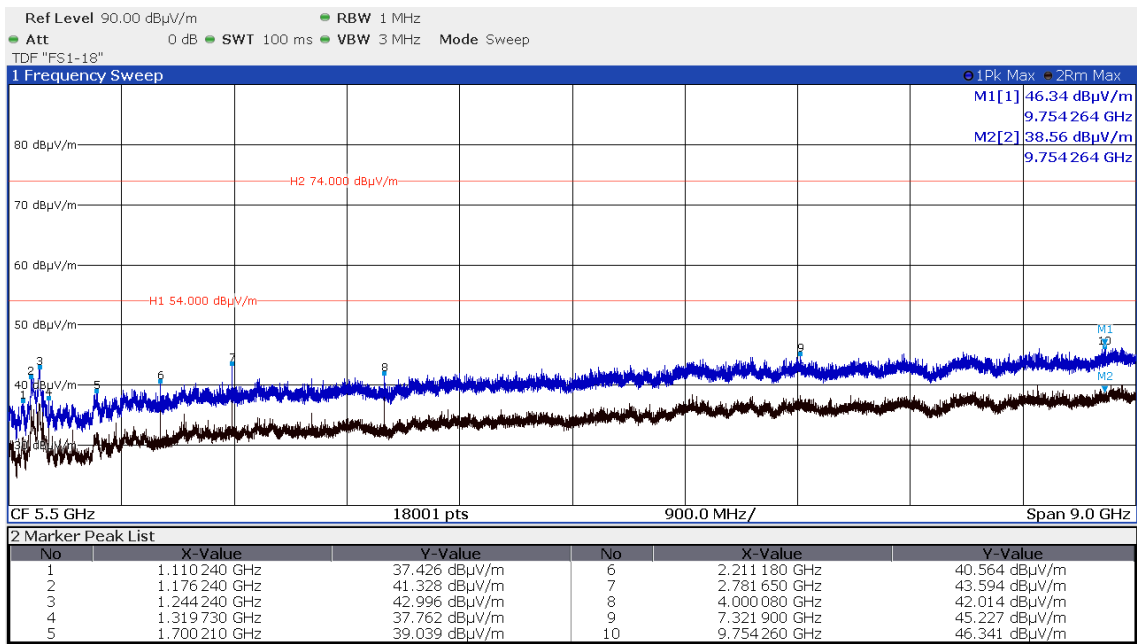
Hopping disabled, CH1



Hopping disabled, CH25

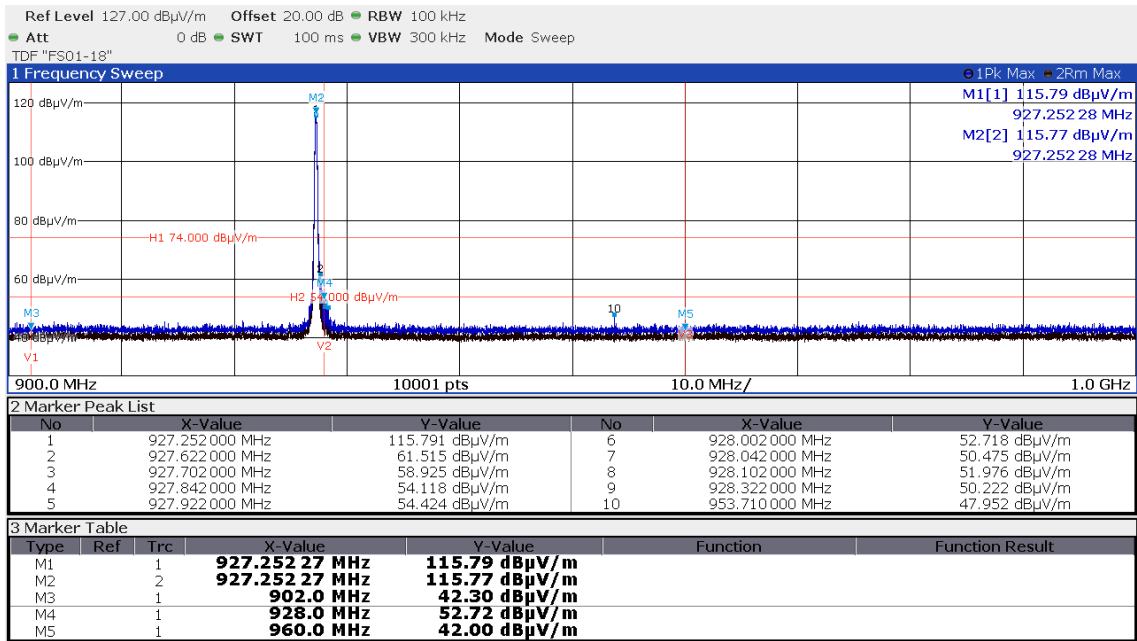


Hopping disabled, CH50



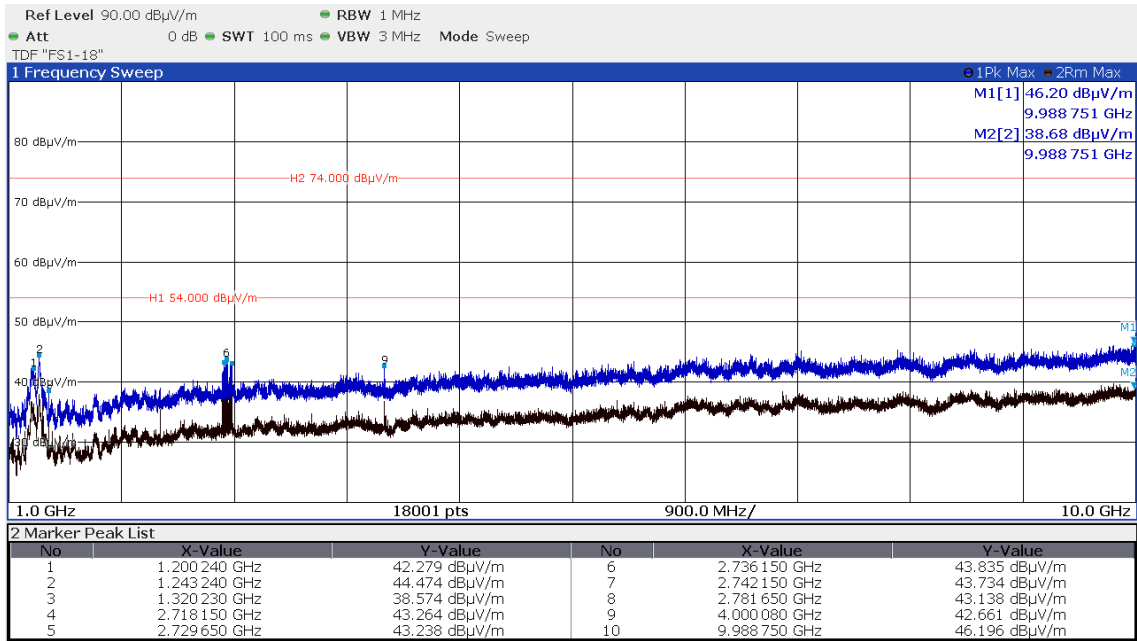


Band Edge (CH50):

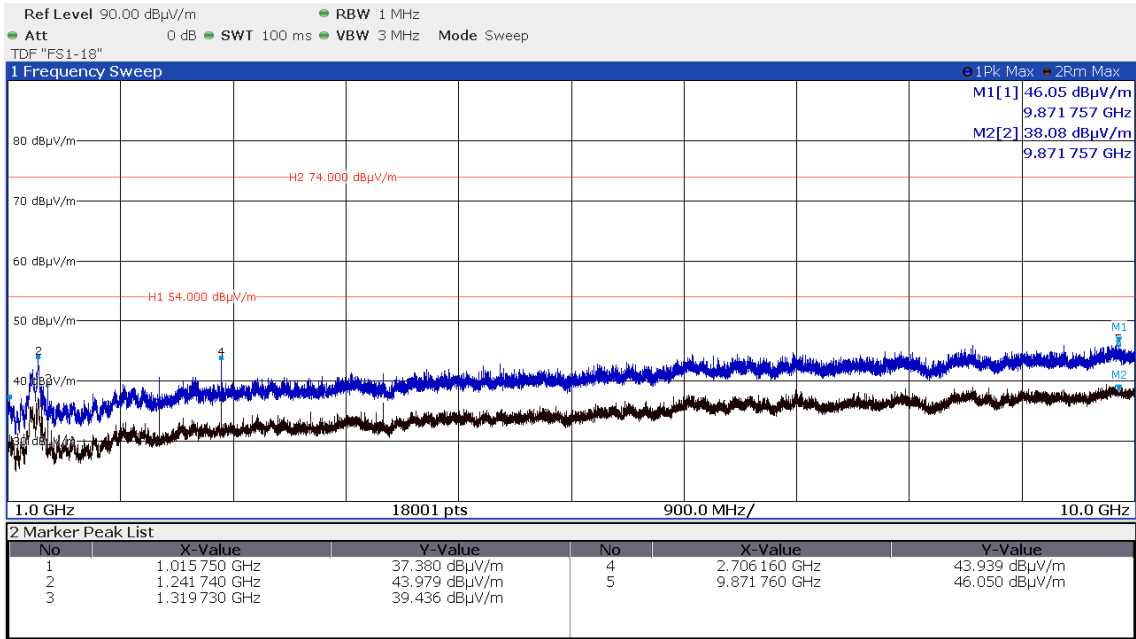


Mode 3:

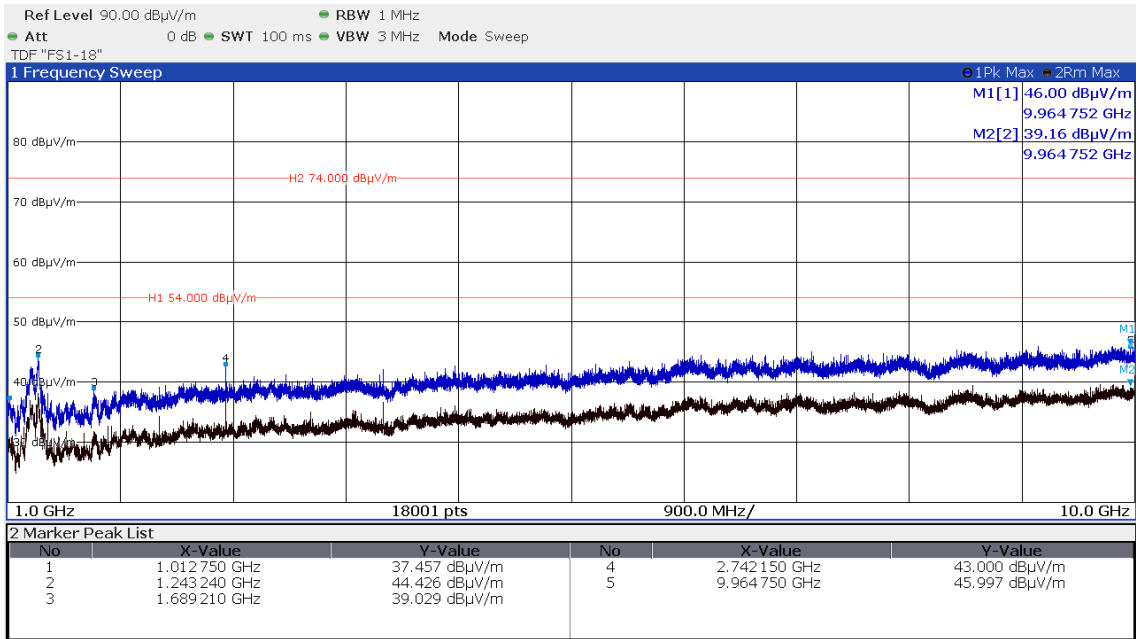
Hopping enabled



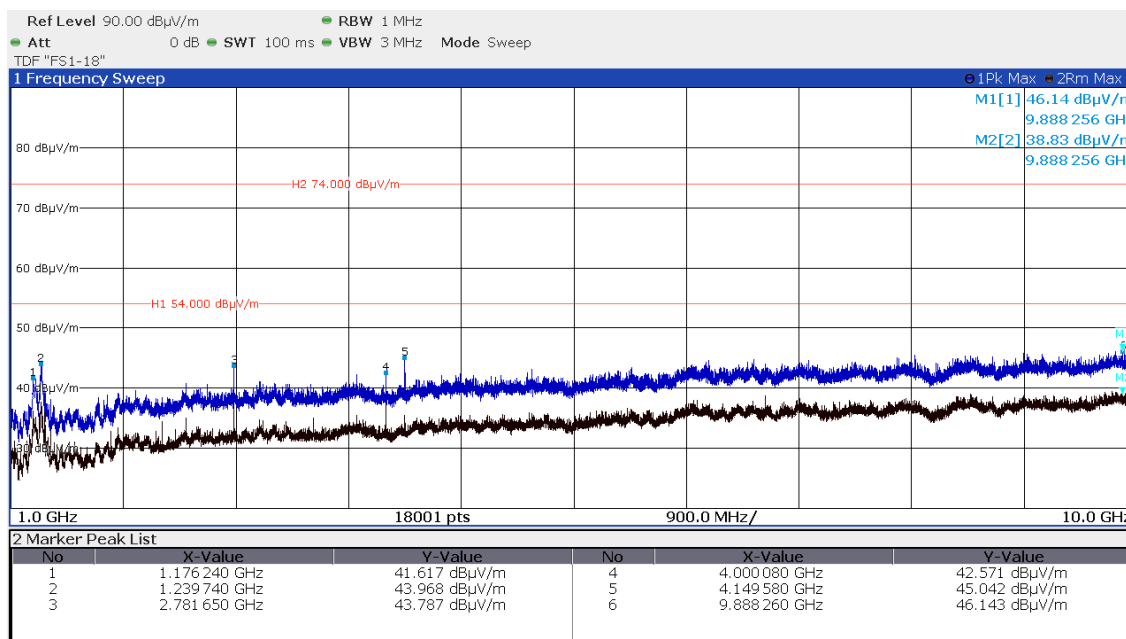
Hopping disabled, CH1



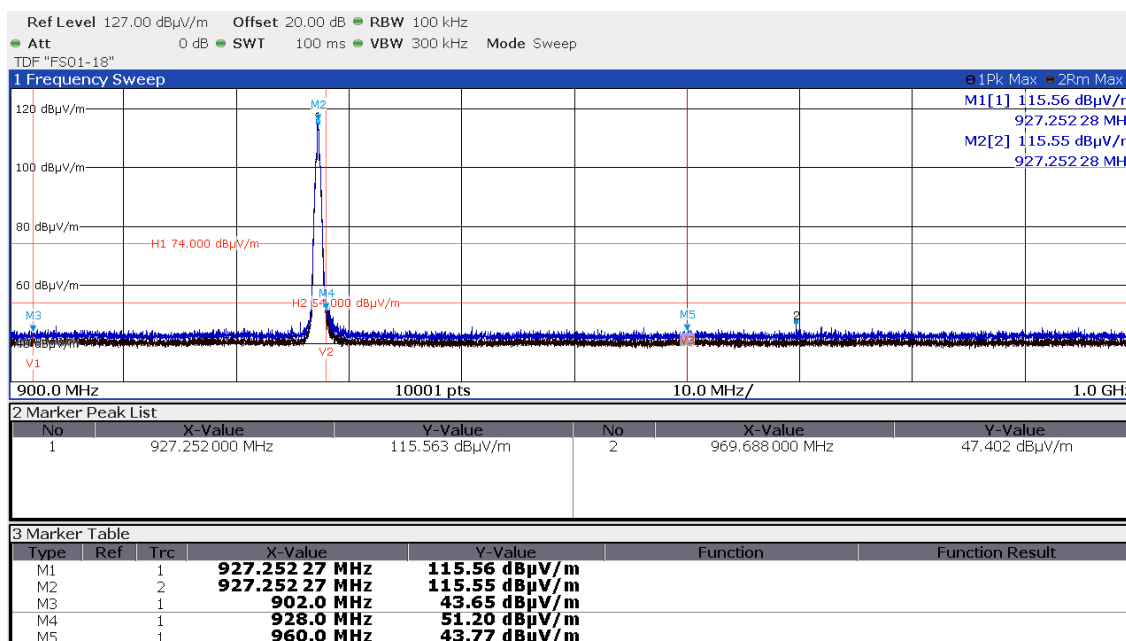
Hopping disabled, CH25



## Hopping disabled, CH50



## Band Edge (CH50):



Peak-Limit according to FCC Part 15C, 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).

| Frequency<br>(MHz) | Limits acc. 15.209 |                   | Measurement distance<br>(m) |
|--------------------|--------------------|-------------------|-----------------------------|
|                    | PK dB( $\mu$ V/m)  | AV dB( $\mu$ V/m) |                             |
| 216 - 960          | 66                 | 46                | 3                           |
| Above 960          | 74                 | 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    |

RSS-Gen, Table 6 – Restricted Frequency Bands

| MHz                 | MHz                   | MHz             | GHz           |
|---------------------|-----------------------|-----------------|---------------|
| 0.090 - 0.110       | 12.57675 - 12.57725   | 399.9 - 410     | 7.250 - 7.750 |
| 0.495 - 0.505       | 13.36 - 13.41         | 608 - 614       | 8.025 – 8.500 |
| 2.1735 - 2.1905     | 16.42 - 16.423        | 960 - 1427      | 9.0 - 9.2     |
| 3.020 - 3.026       | 16.69475 - 16.69525   | 1435 - 1626.5   | 9.3 - 9.5     |
| 4.125 - 4.128       | 16.80425 - 16.80475   | 1645.5 - 1646.5 | 10.6 - 12.7   |
| 4.17725 - 4.17775   | 25.5 - 25.67          | 1660 - 1710     | 13.25 - 13.4  |
| 4.20725 - 4.20775   | 37.5 - 38.25          | 1718.8 - 1722.2 | 14.47 - 14.5  |
| 5.677 - 5.683       | 73 - 74.6             | 2200 - 2300     | 15.35 - 16.2  |
| 6.215 - 6.218       | 74.8 - 75.2           | 2310 - 2390     | 17.7 - 21.4   |
| 6.26775 - 6.26825   | 108 – 138             | 2483.5 - 2500   | 22.01 - 23.12 |
| 6.31175 - 6.31225   | 149.9 - 150.05        | 2655 - 2900     | 23.6 - 24.0   |
| 8.291 - 8.294       | 156.52475 - 156.52525 | 3260 – 3267     | 31.2 - 31.8   |
| 8.362 - 8.366       | 156.7 - 156.9         | 3332 - 3339     | 36.43 - 36.5  |
| 8.37625 - 8.38675   | 162.0125 - 167.17     | 3345.8 - 3358   | Above 38.6    |
| 8.41425 - 8.41475   | 167.72 - 173.2        | 3500 - 4400     |               |
| 12.29 - 12.293      | 240 – 285             | 4500 - 5150     |               |
| 12.51975 - 12.52025 | 322 - 335.4           | 5350 - 5460     |               |

The requirements are **FULFILLED**.

**Remarks:** Only the worst-case plots are listed. From 9kHz to 1Ghz only noise was recorded.

Measurements performed up to the 10<sup>th</sup> harmonic.

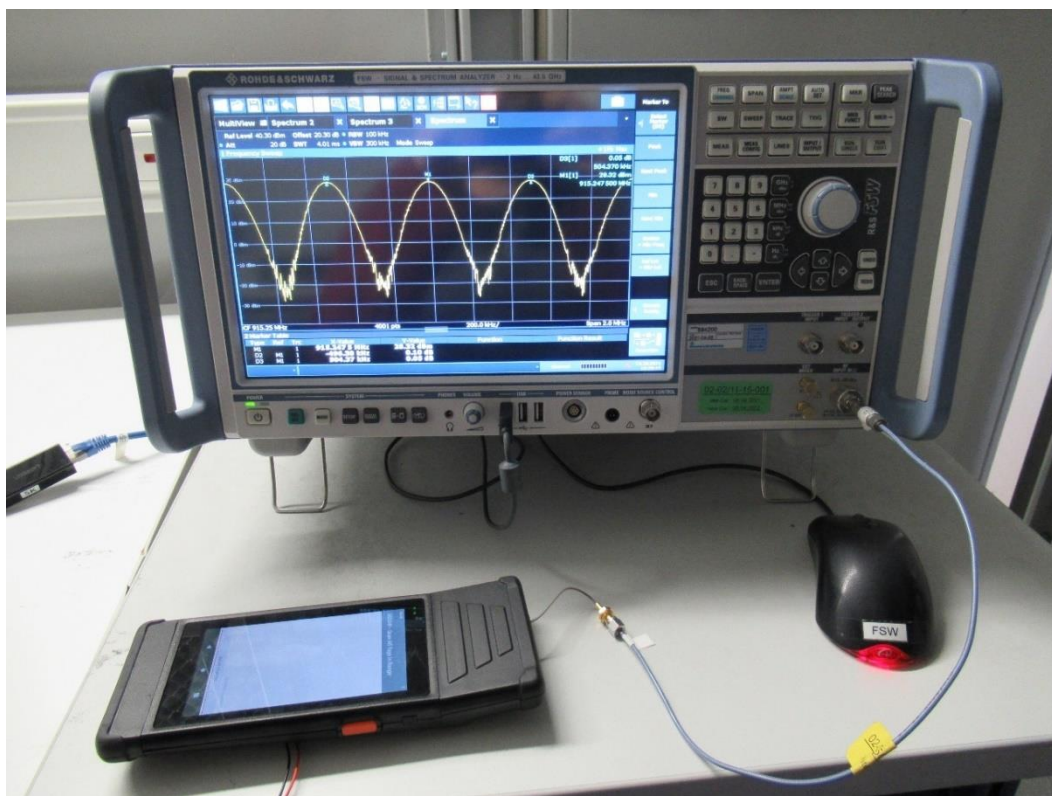
## 5.7 Dwell time

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

### 5.7.1 Description of the test location

Test location:                    Shielded Room S4

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



### 5.7.3 Applicable standard

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

In Section 15.247(a)(1)(i) are dwell times defined for the special frequency ranges should not exceed by a frequency hopping system.

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.

### 5.7.4 Test result

Dwell time = time slot length \* hop rate

Mode 1:  $199.99 \text{ ms} * 2 = 399.98 \text{ ms}$

Mode 3:  $198.89 \text{ ms} * 1 = 198.89 \text{ ms}$

Limit according to FCC Part 15C, Section 15.247(a)(1)(i):

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and 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 system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

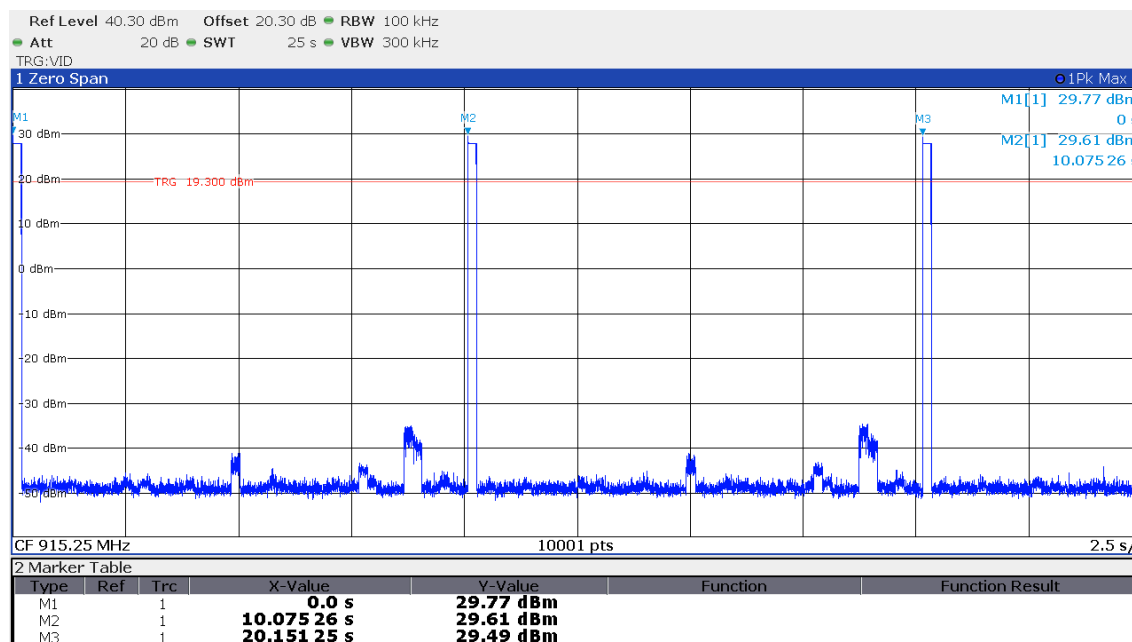
The requirements are **FULFILLED**.

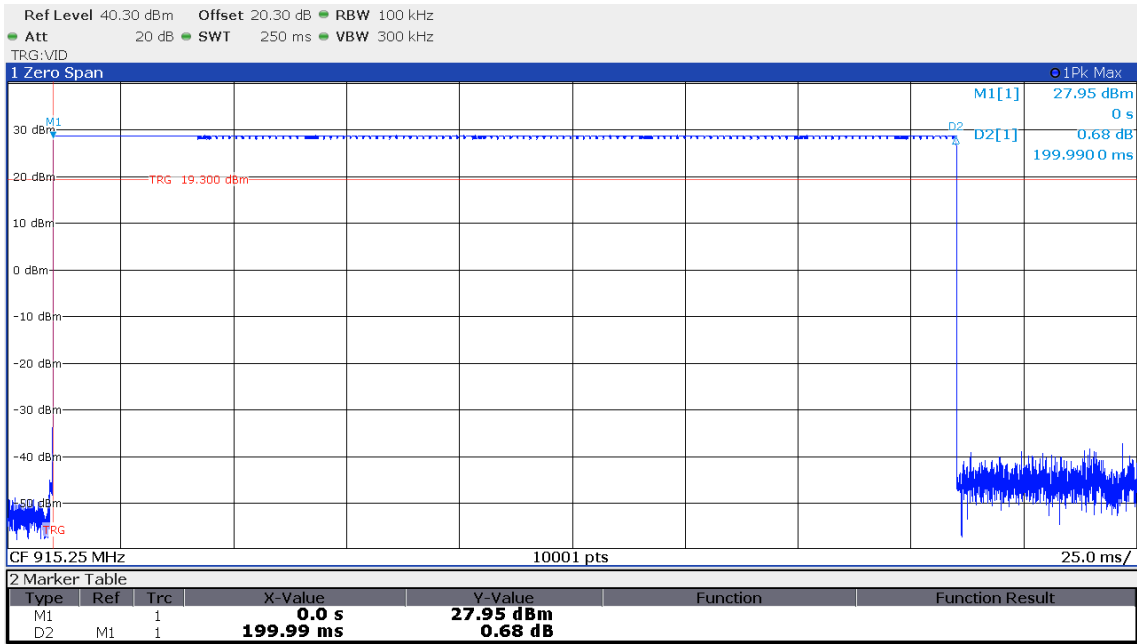
**Remarks:** The dwell time is measured at channel 26 in a 25 s period.

For detailed results see the following test protocols.

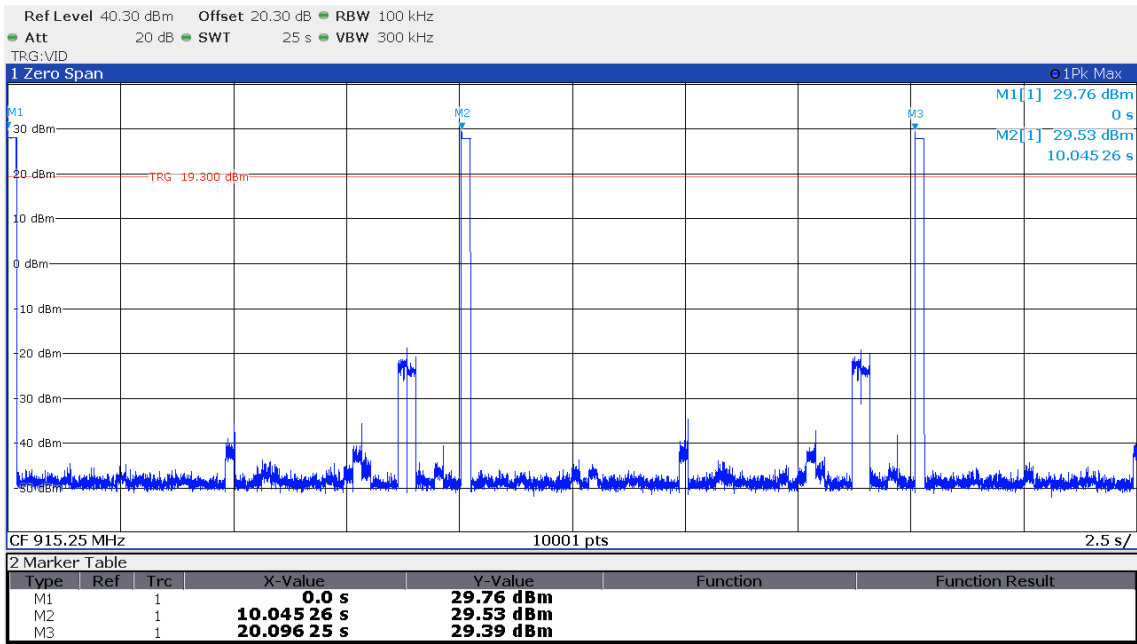
### 5.7.5 Test protocol

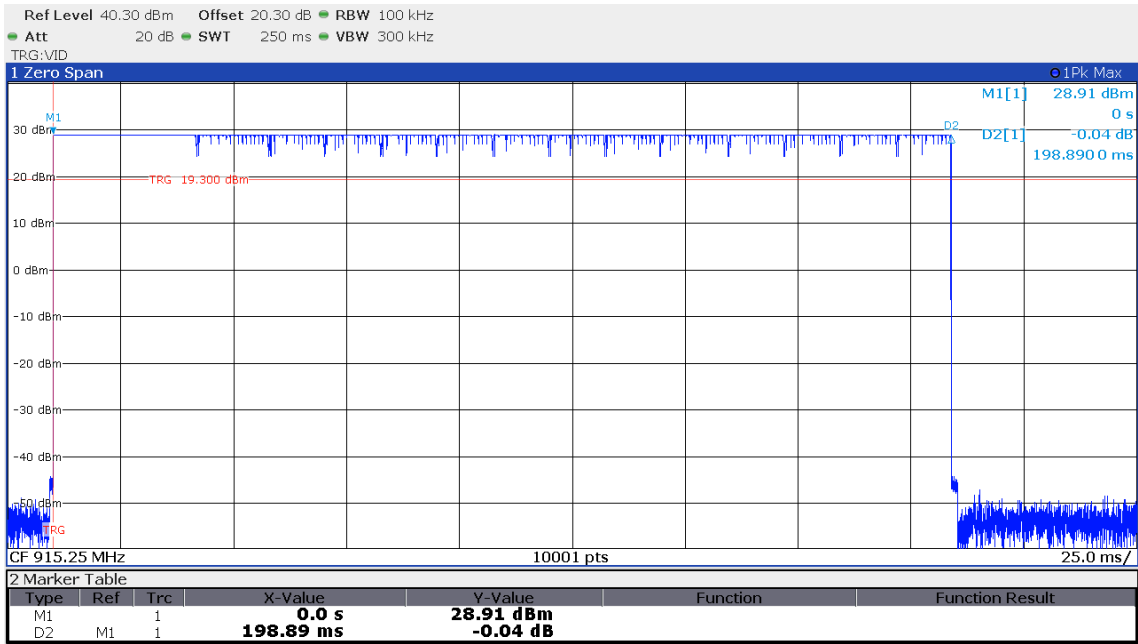
Mode 1:





Mode 3:





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.



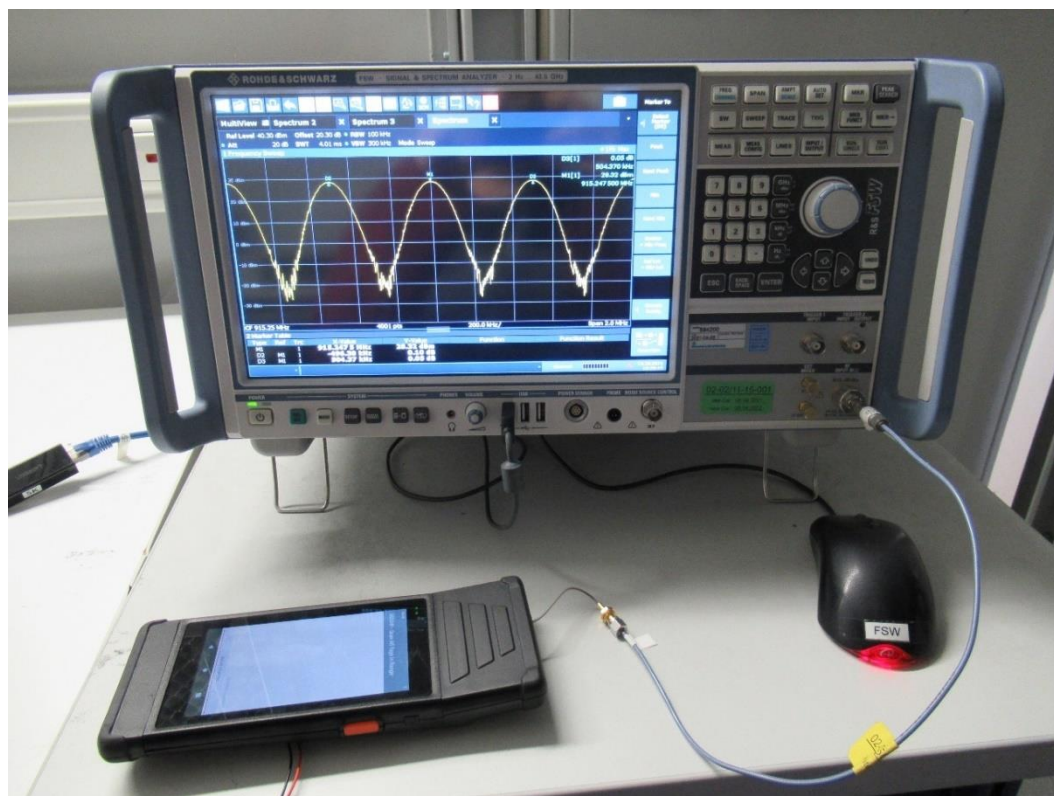
## 5.8 Carrier frequency separation

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

### 5.8.1 Description of the test location

Test location:                    Shielded Room S4

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



### 5.8.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(1):

Frequency hopping systems operating in the frequency band of 2400 MHz – 2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or 2/3 of the 20 dB bandwidth of the hopping channel.

### 5.8.4 Description of Measurement

The measurement is performed using a spectrum analyser in single sweep mode. A part of the operating frequency is used for better resolution. In normal application mode all the channels of the part of operating frequency are displayed and the separation is measured. The 20 dB OBW has to be measured before to compare whether the OBW requirement is fulfilled.

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.

### 5.8.5 Test result

#### Mode 1

| Channel | 20 dB BW (kHz) | Hopping channels | Separation (kHz) | Limit (kHz) |
|---------|----------------|------------------|------------------|-------------|
| 25, 26  | 42.764         | 50               | 496.38           | > 42.764    |

#### Mode 3

| Channel | 20 dB BW (kHz) | Hopping channels | Separation (kHz) | Limit (kHz) |
|---------|----------------|------------------|------------------|-------------|
| 26, 27  | 330.7          | 50               | 499.88           | > 330.7     |

Limit according to FCC Part 15C, Section 15.247(a)(1):

| Frequency     | Hopping channels | Limit channel separation                          |
|---------------|------------------|---------------------------------------------------|
| 902 - 928 MHz | $\geq 50$        | > 25 kHz or 20 dB bandwidth, whichever is greater |

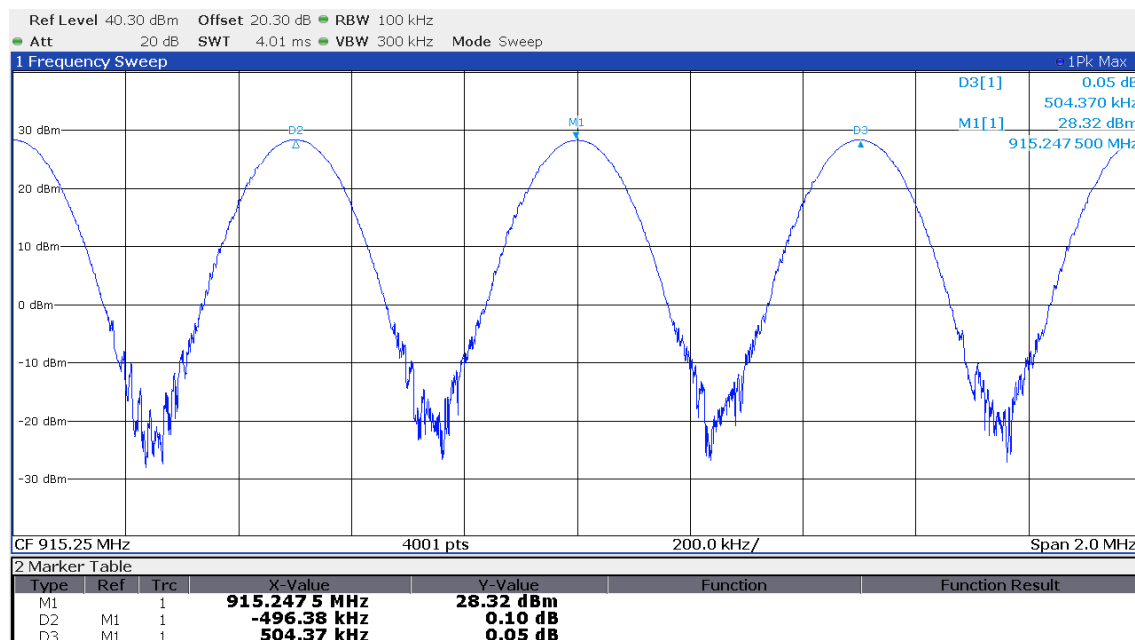
The requirements are **FULFILLED**.

**Remarks:** For detailed test results please see the following test protocol.

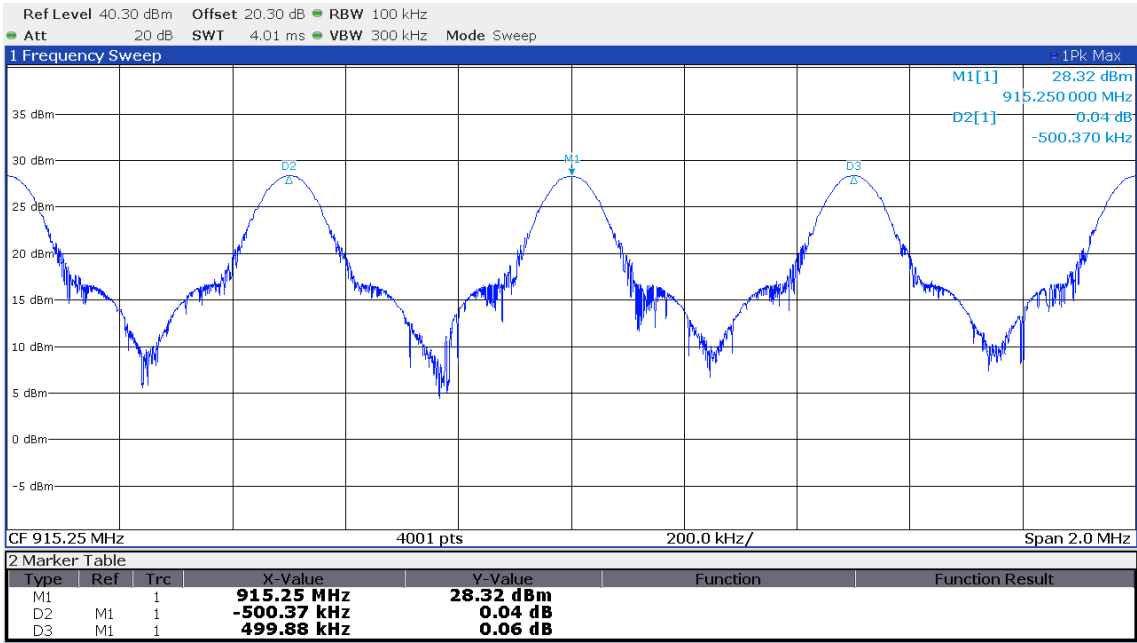
For the 20 dB BW measurement please see section 5.2.

### 5.8.6 Test protocol

#### Mode 1:



Mode 3:



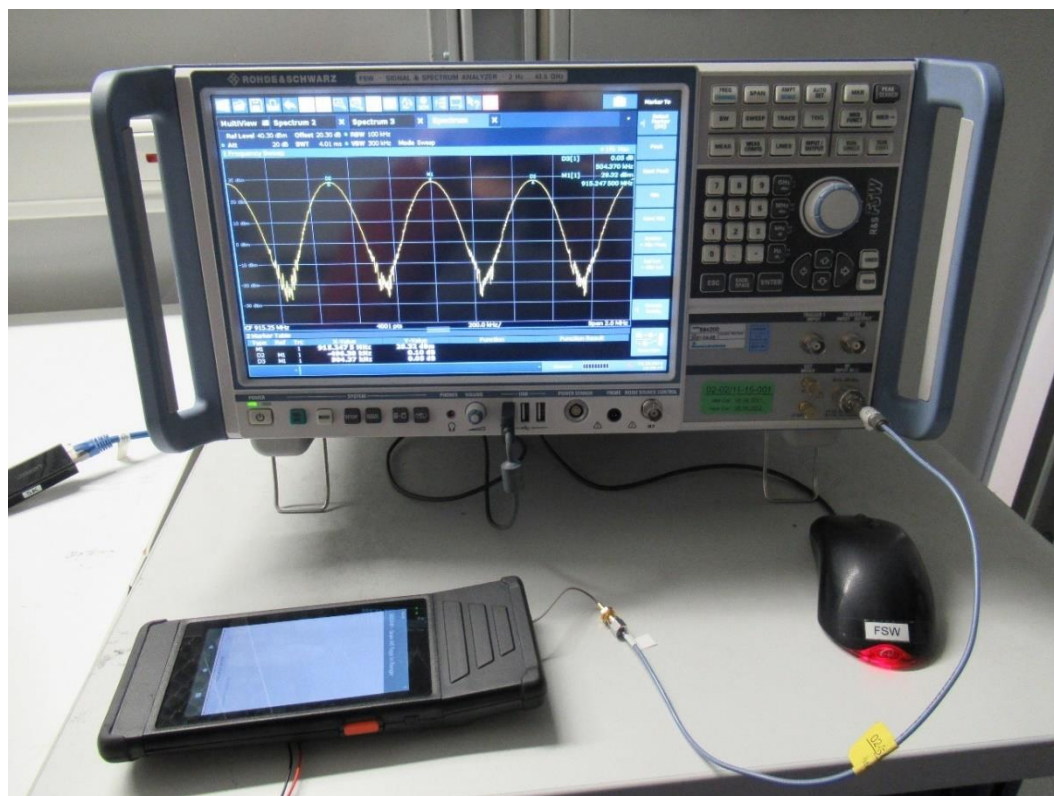
## 5.9 Number of hopping channels

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

### 5.9.1 Description of the test location

Test location:                    Shielded Room S4

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



### 5.9.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(1)(i):

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and 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 system shall use at least 25 hopping frequencies.

### 5.9.4 Description of Measurement

The method of measurement is used set out in ANSI C63.10, 7.8.3.

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.

5.9.5 Test result

| Hopping channel frequency range | Number of all available hopping channels |
|---------------------------------|------------------------------------------|
| 902 - 928                       | 50                                       |

Limit according to FCC Part 15C, Section 15.247(a)(1)(i):

| Frequency range (MHz) | LIMIT (Number of Hopping Channels) |                         |
|-----------------------|------------------------------------|-------------------------|
|                       | 20dB Bandwidth < 250kHz            | 20dB Bandwidth ≥ 250kHz |
| 902 - 928             | ≥ 50                               | ≥ 25                    |

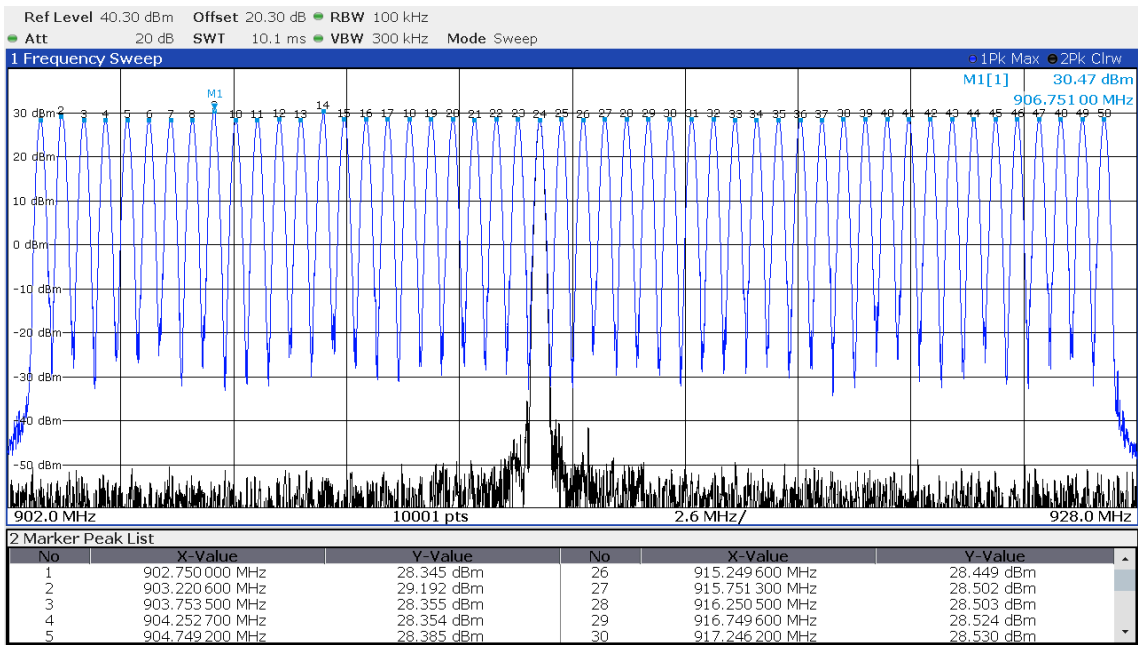
The requirements are **FULFILLED**.

Remarks: For detailed results see the following test protocols.

-

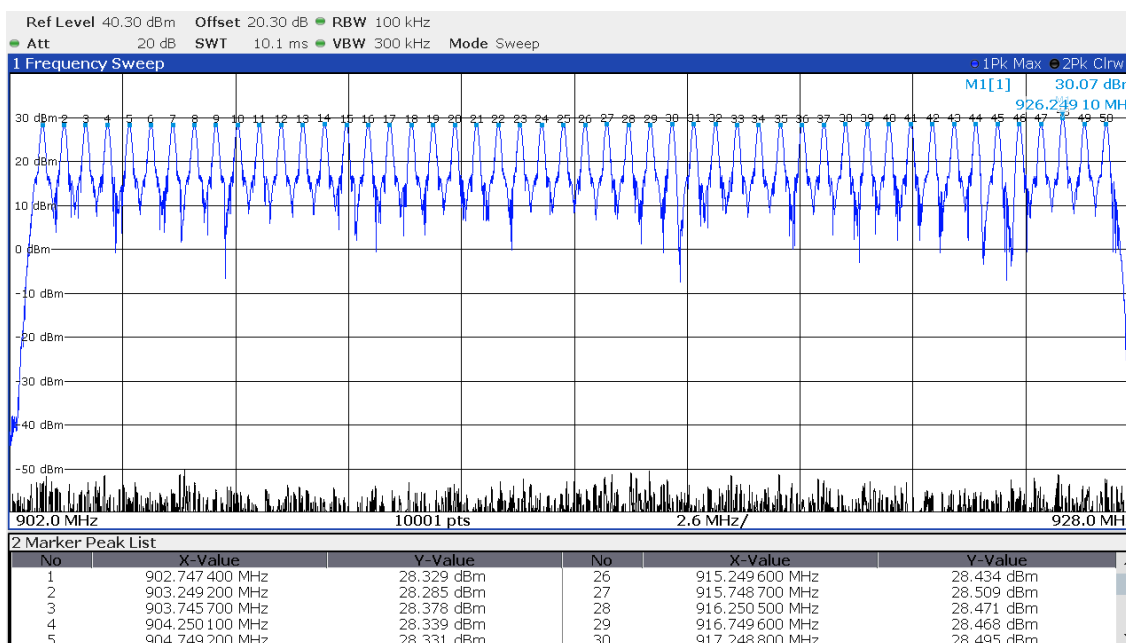
5.9.6 Test protocol

Mode 1:



| 2 Marker Peak List |                 |            |    |                 |            |
|--------------------|-----------------|------------|----|-----------------|------------|
| No                 | X-Value         | Y-Value    | No | X-Value         | Y-Value    |
| 1                  | 902.750 000 MHz | 28.345 dBm | 26 | 915.249 600 MHz | 28.449 dBm |
| 2                  | 903.220 600 MHz | 29.192 dBm | 27 | 915.751 300 MHz | 28.502 dBm |
| 3                  | 903.753 500 MHz | 28.355 dBm | 28 | 916.250 500 MHz | 28.503 dBm |
| 4                  | 904.252 700 MHz | 28.354 dBm | 29 | 916.749 600 MHz | 28.524 dBm |
| 5                  | 904.749 200 MHz | 28.385 dBm | 30 | 917.246 200 MHz | 28.530 dBm |
| 6                  | 905.248 400 MHz | 28.435 dBm | 31 | 917.753 100 MHz | 28.510 dBm |
| 7                  | 905.750 100 MHz | 28.417 dBm | 32 | 918.249 700 MHz | 28.536 dBm |
| 8                  | 906.244 100 MHz | 28.349 dBm | 33 | 918.751 400 MHz | 28.417 dBm |
| 9                  | 906.751 000 MHz | 30.467 dBm | 34 | 919.248 000 MHz | 28.441 dBm |
| 10                 | 907.252 800 MHz | 28.406 dBm | 35 | 919.749 700 MHz | 28.470 dBm |
| 11                 | 907.746 700 MHz | 28.458 dBm | 36 | 920.251 500 MHz | 28.473 dBm |
| 12                 | 908.248 500 MHz | 28.491 dBm | 37 | 920.748 000 MHz | 28.469 dBm |
| 13                 | 908.747 600 MHz | 28.456 dBm | 38 | 921.249 800 MHz | 28.487 dBm |
| 14                 | 909.262 400 MHz | 30.441 dBm | 39 | 921.751 500 MHz | 28.496 dBm |
| 15                 | 909.748 500 MHz | 28.492 dBm | 40 | 922.250 700 MHz | 28.546 dBm |
| 16                 | 910.250 300 MHz | 28.522 dBm | 41 | 922.749 800 MHz | 28.538 dBm |
| 17                 | 910.749 400 MHz | 28.519 dBm | 42 | 923.249 000 MHz | 28.531 dBm |
| 18                 | 911.251 200 MHz | 28.484 dBm | 43 | 923.750 700 MHz | 28.558 dBm |
| 19                 | 911.747 700 MHz | 28.540 dBm | 44 | 924.249 900 MHz | 28.533 dBm |
| 20                 | 912.249 500 MHz | 28.511 dBm | 45 | 924.749 000 MHz | 28.577 dBm |
| 21                 | 912.751 200 MHz | 28.474 dBm | 46 | 925.250 800 MHz | 28.578 dBm |
| 22                 | 913.250 400 MHz | 28.490 dBm | 47 | 925.749 900 MHz | 28.567 dBm |
| 23                 | 913.749 500 MHz | 28.653 dBm | 48 | 926.249 100 MHz | 28.565 dBm |
| 24                 | 914.248 700 MHz | 28.469 dBm | 49 | 926.748 200 MHz | 28.542 dBm |
| 25                 | 914.750 400 MHz | 28.484 dBm | 50 | 927.247 400 MHz | 28.578 dBm |

## Mode 3:



| 2 Marker Peak List |                 |            |    |                 |            |
|--------------------|-----------------|------------|----|-----------------|------------|
| No                 | X-Value         | Y-Value    | No | X-Value         | Y-Value    |
| 1                  | 902.747 400 MHz | 28.329 dBm | 26 | 915.249 600 MHz | 28.434 dBm |
| 2                  | 903.249 200 MHz | 28.285 dBm | 27 | 915.748 700 MHz | 28.509 dBm |
| 3                  | 903.745 700 MHz | 28.378 dBm | 28 | 916.250 500 MHz | 28.471 dBm |
| 4                  | 904.250 100 MHz | 28.339 dBm | 29 | 916.749 600 MHz | 28.468 dBm |
| 5                  | 904.749 200 MHz | 28.331 dBm | 30 | 917.248 800 MHz | 28.495 dBm |
| 6                  | 905.245 800 MHz | 28.397 dBm | 31 | 917.750 500 MHz | 28.494 dBm |
| 7                  | 905.750 100 MHz | 28.355 dBm | 32 | 918.249 700 MHz | 28.545 dBm |
| 8                  | 906.249 300 MHz | 28.361 dBm | 33 | 918.748 800 MHz | 28.423 dBm |
| 9                  | 906.748 400 MHz | 28.357 dBm | 34 | 919.248 000 MHz | 28.441 dBm |
| 10                 | 907.247 600 MHz | 28.327 dBm | 35 | 919.749 700 MHz | 28.428 dBm |
| 11                 | 907.749 300 MHz | 28.403 dBm | 36 | 920.248 900 MHz | 28.440 dBm |
| 12                 | 908.251 100 MHz | 28.382 dBm | 37 | 920.748 000 MHz | 28.462 dBm |
| 13                 | 908.747 600 MHz | 28.391 dBm | 38 | 921.249 800 MHz | 28.488 dBm |
| 14                 | 909.249 400 MHz | 28.495 dBm | 39 | 921.746 300 MHz | 28.491 dBm |
| 15                 | 909.751 100 MHz | 28.461 dBm | 40 | 922.248 100 MHz | 28.534 dBm |
| 16                 | 910.247 700 MHz | 28.453 dBm | 41 | 922.749 800 MHz | 28.519 dBm |
| 17                 | 910.746 800 MHz | 28.465 dBm | 42 | 923.249 000 MHz | 28.662 dBm |
| 18                 | 911.248 600 MHz | 28.437 dBm | 43 | 923.750 700 MHz | 28.547 dBm |
| 19                 | 911.747 700 MHz | 28.455 dBm | 44 | 924.247 300 MHz | 28.523 dBm |
| 20                 | 912.249 500 MHz | 28.464 dBm | 45 | 924.749 000 MHz | 28.524 dBm |
| 21                 | 912.748 600 MHz | 28.402 dBm | 46 | 925.250 800 MHz | 28.513 dBm |
| 22                 | 913.247 800 MHz | 28.439 dBm | 47 | 925.749 900 MHz | 28.488 dBm |
| 23                 | 913.746 900 MHz | 28.458 dBm | 48 | 926.249 100 MHz | 30.070 dBm |
| 24                 | 914.248 700 MHz | 28.423 dBm | 49 | 926.753 400 MHz | 28.491 dBm |
| 25                 | 914.747 800 MHz | 28.465 dBm | 50 | 927.250 000 MHz | 28.565 dBm |

## 5.10 Pseudorandom frequency hopping sequence

Requirement according to FCC Part 15C, Section 15.247(a):

The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies.

The manufacturer declares the following:

Frequency hopping in the FCC/IC region is maintained in a look-up table permanently stored in the microcontroller memory. The LO hopping sequence follows a pseudo-random pattern originally generated by a feedback shift register and cannot be altered by the end user. The LO dwells on each of the 50 hopping channels between 902.75 MHz and 927.25 MHz for 200 ms respectively. A firmware timer guarantees that the transmitter is turned off immediately before each 200 ms time period has elapsed. The use of a common local oscillator for the receiver and transmitter of the SiP ensures that they are always tuned to the same RF channel.

The requirements are **FULFILLED**.

Remarks: None

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## 5.11 Equal hopping frequency use

Requirement according to FCC Part 15C, Section 15.247(a):

Each frequency must be used equally on the average by each transmitter.

The manufacturer declares the following:

All communications between the reader and tags conform to the EPC Global Gen2 standard. At the start of a communication session the reader transmits CW for a minimum of 1.5ms to power all of the tags in the field. The reader then transmits a 'query' data command to direct tags in its range to identify themselves. Upon completion of the command, the reader again transmits CW to keep the tags powered and allow one of the tags to respond through backscatter modulation of the carrier which the tag receives from the reader. Once a particular tag has been singulated and its EPC code ('ID') received, that tag leaves the round, the reader issues another query command and the process repeats. This process continues until the transmitter ramps its RF power down as close as possible to the end of each 200ms transmission interval. A new communication round is initiated after the LO completes the hop when transmission is resumed.

The requirements are **FULFILLED**.

Remarks: None

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## 5.12 Receiver input bandwidth

Requirement according to FCC Part15C, Section 15.247(a):

The system receivers shall have input bandwidth that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signal.

The manufacturer declares the following:

In a passive RFID system, the tag sends data to the reader by means of Backscatter Modulation. The passive RFID tag modulates its antenna impedance between a reflective and absorptive state, thus reflecting some of the RF signal which the reader has transmitted to it. The composite RF signal reflected back to the reader then appears as modulation sidebands centered at the reader's RF carrier.

The R2000 receiver, as described in the LO section, is always tuned to the RF channel on which it is presently transmitting. The R2000 performs a direct conversion of its RF input which centers it at DC. After downconversion, analog bandpass filters separate the desired data sidebands from the DC component (down converted carrier). The filters also reduce any down converted adjacent channel that may have been received from an interfering reader. Each of the I and Q baseband signals is digitized, undergoes further digital filtering and the composite signal is demodulated.

The requirements are **FULFILLED**.

Remarks:

None

-

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.



## 5.13 Antenna application

### 5.13.1 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 an integrated PCB antenna; no replacing of the antenna is possible that prevents manipulation by a user. No external power amplifier can be connected. The requirements of part 15.203 and 15.204 are met.

### 5.13.2 Antenna requirements

According to FCC Part 15C, Section 15.247 (b)(4):

The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**Defacto EIRP-Limit:**

$$P_{out} = 30 - (G_x - 6);$$

**Remarks:**     The antenna is < 6 dBi gain, no Defacto limit results.

-

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.

## 6 USED TEST EQUIPMENT AND ACCESSORIES

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

| Test ID | Model Type             | Equipment No.   | Next Calib. | Last Calib. | Next Verif. | Last Verif. |  |
|---------|------------------------|-----------------|-------------|-------------|-------------|-------------|--|
| CPC 2   | FSW43                  | 02-02/11-15-001 | 06/04/2022  | 06/04/2021  |             |             |  |
|         | 4768-20                | 02-02/50-07-013 |             |             |             |             |  |
|         | minibend KR-16         | 02-02/50-16-013 |             |             |             |             |  |
|         | EA-PS 3032-05 B        | 02-02/50-20-008 |             |             |             |             |  |
| MB      | FSW43                  | 02-02/11-15-001 | 06/04/2022  | 06/04/2021  |             |             |  |
|         | 4768-20                | 02-02/50-07-013 |             |             |             |             |  |
|         | minibend KR-16         | 02-02/50-16-013 |             |             |             |             |  |
|         | EA-PS 3032-05 B        | 02-02/50-20-008 |             |             |             |             |  |
| SER 1   | FSW43                  | 02-02/11-15-001 | 06/04/2022  | 06/04/2021  |             |             |  |
|         | HFH 2 - Z 2            | 02-02/24-15-001 | 30/03/2022  | 30/03/2021  |             |             |  |
|         | 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 |             |             |             |             |  |
| SER 2   | ESVS 30                | 02-02/03-05-006 | 09/07/2022  | 09/07/2021  | 07/07/2022  | 07/07/2021  |  |
|         | VULB 9168              | 02-02/24-05-005 | 20/12/2022  | 20/12/2021  |             |             |  |
|         | 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 |             |             |             |             |  |
|         | 50F-003 N 3 dB         | 02-02/50-21-010 |             |             |             |             |  |
| SER 3   | FSW43                  | 02-02/11-15-001 | 06/04/2022  | 06/04/2021  |             |             |  |
|         | AMF-6D-01002000-22-10P | 02-02/17-15-004 | 28/06/2022  | 28/06/2021  |             |             |  |
|         | 3117                   | 02-02/24-05-009 |             |             |             |             |  |
|         | BAM 4.5-P              | 02-02/50-17-024 |             |             |             |             |  |
|         | NCD                    | 02-02/50-17-025 |             |             |             |             |  |
|         | KK-SF106-2X11N-6.5M    | 02-02/50-18-016 |             |             |             |             |  |

Note: Measurement with VULB 9168 was done on 21/01/2022.

-End of test report-