

# EMI – TEST REPORT

- FCC Part 15.249, RSS310 -

**Type / Model Name** : BSV101757

**Product Description** : Positioning radar 24 GHz

**Applicant** : Symeo GmbH

**Address** : Professor-Messerschmitt-Strasse 3  
85579 NEUBIBERG, GERMANY

**Manufacturer** : Symeo GmbH

**Address** : Professor-Messerschmitt-Strasse 3  
85579 NEUBIBERG, GERMANY

**Licence holder** : Symeo GmbH

**Address** : Professor-Messerschmitt-Strasse 3  
85579 NEUBIBERG, GERMANY

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

**POSITIVE**

**Test Report No. :** **T39256-02-03HS**

19. February 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.

# Contents

|   |           |
|---|-----------|
| <b>1 TEST STANDARDS</b>                             | <b>3</b>  |
| <b>2 EQUIPMENT UNDER TEST</b>                       | <b>4</b>  |
| <b>3 Test result summary</b>                        | <b>7</b>  |
| <b>3.1 FINAL ASSESSMENT:</b>                        | <b>7</b>  |
| <b>4 TEST ENVIRONMENT</b>                           | <b>8</b>  |
| <b>4.1 Address of the test laboratory</b>           | <b>8</b>  |
| <b>4.2 Environmental conditions</b>                 | <b>8</b>  |
| <b>4.3 Statement of the measurement uncertainty</b> | <b>8</b>  |
| <b>4.4 Measurement protocol for FCC and IC</b>      | <b>9</b>  |
| <b>5 TEST CONDITIONS AND RESULTS</b>                | <b>11</b> |
| <b>5.1 AC power line conducted emissions</b>        | <b>11</b> |
| <b>5.2 Field strength of fundamental</b>            | <b>14</b> |
| <b>5.3 Out-of-band emission, radiated</b>           | <b>15</b> |
| <b>5.4 EBW</b>                                      | <b>28</b> |
| <b>5.5 Antenna application</b>                      | <b>30</b> |
| <b>6 USED TEST EQUIPMENT AND ACCESSORIES</b>        | <b>31</b> |

Attachment A as separate supplement

Attachment B 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 15.249 | Operation within the bands 902 - 928 MHz, 2400 – 2483.5 MHz, 5725 - 5875 MHz and 24.0 – 24.25 GHz                          |
| ANSI C63.10: 2013                  | Procedures for compliance testing of unlicensed wireless devices   |
| ANSI C95.1:2005                    | IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz |
| CISPR 16-4-2: 2003                 | Uncertainty in EMC measurement   |

## **2 EQUIPMENT UNDER TEST**

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

### **2.2 Equipment type**

Radar detection and alert application

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

The EUT is a field disturbance sensor in the operating band of 24000 MHz to 24250 MHz. The channels 0-79 are for positioning evaluation and the remaining band is used for data transmission.

Number of tested samples: 1  
Serial number: CB26IL0135  
Firmware version: 0.9

#### **EUT configuration:**

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

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

There are no variants.

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

**FCC ID: W5IBSV101757**

The operating frequency is 24.0 GHz to 24.25 GHz.

| Channel | Usable channels | Centre frequency (MHz) | Channel | Usable channels | Centre frequency (MHz) |
|---------|-----------------|------------------------|---------|-----------------|------------------------|
| 0       |                 | 24000                  | 48      | 32              | 24048                  |
| 1       |                 | 24001                  | 49      | 33              | 24049                  |
| 2       |                 | 24002                  | 50      | 34              | 24050                  |
| 3       |                 | 24003                  | 51      | 35              | 24051                  |
| 4       |                 | 24004                  | 52      | 36              | 24052                  |
| 5       |                 | 24005                  | 53      | 37              | 24053                  |
| 6       |                 | 24006                  | 54      | 38              | 24054                  |
| 7       |                 | 24007                  | 55      | 39              | 24055                  |
| 8       |                 | 24008                  | 56      | 40              | 24056                  |
| 9       |                 | 24009                  | 57      | 41              | 24057                  |
| 10      |                 | 24010                  | 58      | 42              | 24058                  |
| 11      |                 | 24011                  | 59      | 43              | 24059                  |
| 12      |                 | 24012                  | 60      | 44              | 24060                  |
| 13      |                 | 24013                  | 61      | 45              | 24061                  |
| 14      |                 | 24014                  | 62      | 46              | 24062                  |
| 15      |                 | 24015                  | 63      | 47              | 24063                  |
| 16      | 0               | 24016                  | 64      | 48              | 24064                  |
| 17      | 1               | 24017                  | 65      | 49              | 24065                  |
| 18      | 2               | 24018                  | 66      | 50              | 24066                  |
| 19      | 3               | 24019                  | 67      | 51              | 24067                  |
| 20      | 4               | 24020                  | 68      | 52              | 24068                  |
| 21      | 5               | 24021                  | 69      | 53              | 24069                  |
| 22      | 6               | 24022                  | 70      | 54              | 24070                  |
| 23      | 7               | 24023                  | 71      | 55              | 24071                  |
| 24      | 8               | 24024                  | 72      | 56              | 24072                  |
| 25      | 9               | 24025                  | 73      | 57              | 24073                  |
| 26      | 10              | 24026                  | 74      | 58              | 24074                  |
| 27      | 11              | 24027                  | 75      | 59              | 24075                  |
| 28      | 12              | 24028                  | 76      | 60              | 24076                  |
| 29      | 13              | 24029                  | 77      | 61              | 24077                  |
| 30      | 14              | 24030                  | 78      | 62              | 24078                  |
| 31      | 15              | 24031                  | 79      | 63              | 24079                  |
| 32      | 16              | 24032                  | 80      | 64              | 24080                  |
| 33      | 17              | 24033                  | 81      | 65              | 24081                  |
| 34      | 18              | 24034                  | 82      | 66              | 24082                  |
| 35      | 19              | 24035                  | 83      | 67              | 24083                  |
| 36      | 20              | 24036                  | 84      | 68              | 24084                  |
| 37      | 21              | 24037                  | 85      | 69              | 24085                  |
| 38      | 22              | 24038                  | 86      | 70              | 24086                  |
| 39      | 23              | 24039                  | 87      | 71              | 24087                  |
| 40      | 24              | 24040                  | 88      | 72              | 24088                  |
| 41      | 25              | 24041                  | 89      | 73              | 24089                  |
| 42      | 26              | 24042                  | 90      | 74              | 24090                  |
| 43      | 27              | 24043                  | 91      | 75              | 24091                  |
| 44      | 28              | 24044                  | 92      | 76              | 24092                  |
| 45      | 29              | 24045                  | 93      | 77              | 24093                  |
| 46      | 30              | 24046                  | 94      | 78              | 24094                  |
| 47      | 31              | 24047                  | 95      | 79              | 24095                  |

Note: The RED marked channels are disabled by firmware. The blue marked channels are measured.

## 2.6 Transmit operating modes

TX continuous.

## 2.7 Antenna

The following integrated antennas are used with the EUT:

- Integrated linear polarised micro strip patch array antenna.

The antennas cannot be unattached by the user.

## 2.8 Power supply system utilised

Power supply voltage : 115 VAC, (DC-Input 7 - 32 VDC)

## 2.9 Peripheral devices and interface cables

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

- LAN cable, M15-RJ45 Model : Common style
- - Model : -

## 2.10 Determination of worst case conditions for final measurement

Exploratory measurements have been 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 Y position.

As worst case the following channels and test modes are selected for the final test:

|                    | Available channels | Tested channels | Power setting | Modulation | Modulation type          | Data rate |
|--------------------|--------------------|-----------------|---------------|------------|--------------------------|-----------|
| 24 GHz application | 16 to 95           | 16, 55, 95      | Max           | digital    | FMCW + FSK communication | 250 k     |

- TX continuous mode

### 2.10.1 Test jig

No test jig used.

### 2.10.2 Test software

No test software for the EUT is needed to set TX continuous mode, modulated.

### **3 Test result summery**

Operating in the 24000 MHz – 24250 MHz band:

| FCC Rule Part | RSS Rule Part  | Description                               | Result |
|---------------|----------------|---|--------|
| 15.203        | RSS-Gen, 7.1.2 | Antenna requirement                       | passed |
| 15.204        | RSS-Gen, 7.1.1 | External radio frequency power amplifiers | passed |
| 15.205(a)     | RSS Gen, 7.2.2 | Emissions in restricted bands             | passed |
| 15.207(a)     | RSS Gen, 7.2.4 | AC power line conducted emissions         | passed |
| 15.209(a)     | RSS-Gen, 7.2.2 | Radiated emission limits; general         | passed |
| 15.215(c)     | RSS-Gen, 4.6.1 | EBW                                       | passed |
| 15.249(a)     | RSS-310, 3.10  | Field strength of fundamental             | passed |
| 15.249(d)     | RSS-310, 3.10  | Out-of-band emission, radiated            | passed |
| 15.249(a)     | RSS-310, 3.10  | Harmonics, radiated                       | passed |

#### **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 : 14 December 2015

Testing concluded on : 15 January 2016

Checked by:

Tested by:

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

\_\_\_\_\_  
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.



## 4.4 Measurement protocol for FCC and IC

### 4.4.1 General information

#### 4.4.1.1 Test methodology

Conducted and radiated disturbance testing is performed according to the procedures set out in ANSI C63.10 and applying limits by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

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

### **IC 3009A-1**

In compliance with RSS 310 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

#### 4.4.1.2 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.

#### 4.4.1.3 Test methodology

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.

#### 4.4.1.4 Radiated Measurement

The radiated measurements are done in 2 steps

- Exploratory measurements
- Final measurements

##### 4.4.1.4.1 Method of exploratory radiated emission maximization

The maximum radiated emission for a given mode of operation may be found during exploratory testing by using the following step-by-step procedure:

- a) Monitor received signal across the frequency range of interest at a fixed antenna height and EUT azimuth.
- b) If appropriate, manipulate the system cables to produce the highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.
- c) Rotate the EUT 360° to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the corresponding azimuth position and repeat step b). Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.
- d) Move the antenna over its fully allowed range of travel to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, then return to step b) with the antenna fixed at this height. Otherwise, move the antenna to the height that repeats the highest amplitude observation and proceed.
- e) Change the polarization of the antenna and repeat step b) through step d). Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.
- f) The effects of various modes of operation shall be examined. One way to do this is to vary the equipment modes as step a) through step g) are being performed.
- g) After completing step a) through step f), record the final EUT arrangement, mode of operation, and cable arrangement to use for the final radiated emission test in 8.3.2.

#### 4.4.1.4.2 Final radiated emission measurements (9 kHz to 1 GHz)

Based on the measurement results from 8.3.1.1, the single EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurements are then performed on a site meeting the requirements of 5.3 or 5.4, as appropriate. If the EUT is relocated from an exploratory test site to a final test site, the highest emission relative to the limit shall be re-maximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarization and EUT azimuth are to be varied.

In addition, the full frequency spectrum (for the range to be checked for meeting compliance) shall be investigated. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated by 90° relative to the ground plane to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on those frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full spectrum test constitutes the compliance measurement.

#### 4.4.1.4.3 Final radiated emission measurements (1 GHz to 40 GHz)

The final measurements are performed on a site meeting the requirements of ANSI C63.10, Clause 6.6. For measurements above 1 GHz, use the cable, EUT arrangement, and mode of operation determined in the exploratory testing to produce the emission that has the highest amplitude relative to the limit. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the antenna in the "cone of radiation" from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response. The antenna may have to be higher or lower than the EUT, depending on the size and mounting height of the EUT, but the antenna should be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. If the transmission line for the measurement antenna restricts its range of height and polarization, the steps needed to ensure the correct measurement of the maximum emissions, shall be described in detail in the report of measurements. The data collected shall satisfy the report requirements of ANSI C63.10, Clause 15.

NOTE 1 — Where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

NOTE 2 — Use of waveguide and flexible waveguide may be necessary at frequencies above 10 GHz to achieve usable signal-to-noise ratios at required measurement distances. If so, it may be necessary to restrict the height search of the antenna, and special care should be taken to ensure that maximum emissions are correctly measured.

NOTE 3 — Most devices that cause emissions above 10 GHz are physically small compared with the beam widths of typical horn antennas used for EMC measurements. For such EUTs and frequencies, it may be preferable to vary the height and polarization of the EUT instead of the receiving antenna to maximize the measured emissions.

## 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: AREA4

#### 5.1.2 Photo documentation of the test set-up – Please see ATTACHMENT A

#### 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 9.0 dB at 0.314 MHz

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

| Frequency of Emission<br>(MHz) | Conducted limit (dBµV) |            |
|--------------------------------|------------------------|------------|
|                                | 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

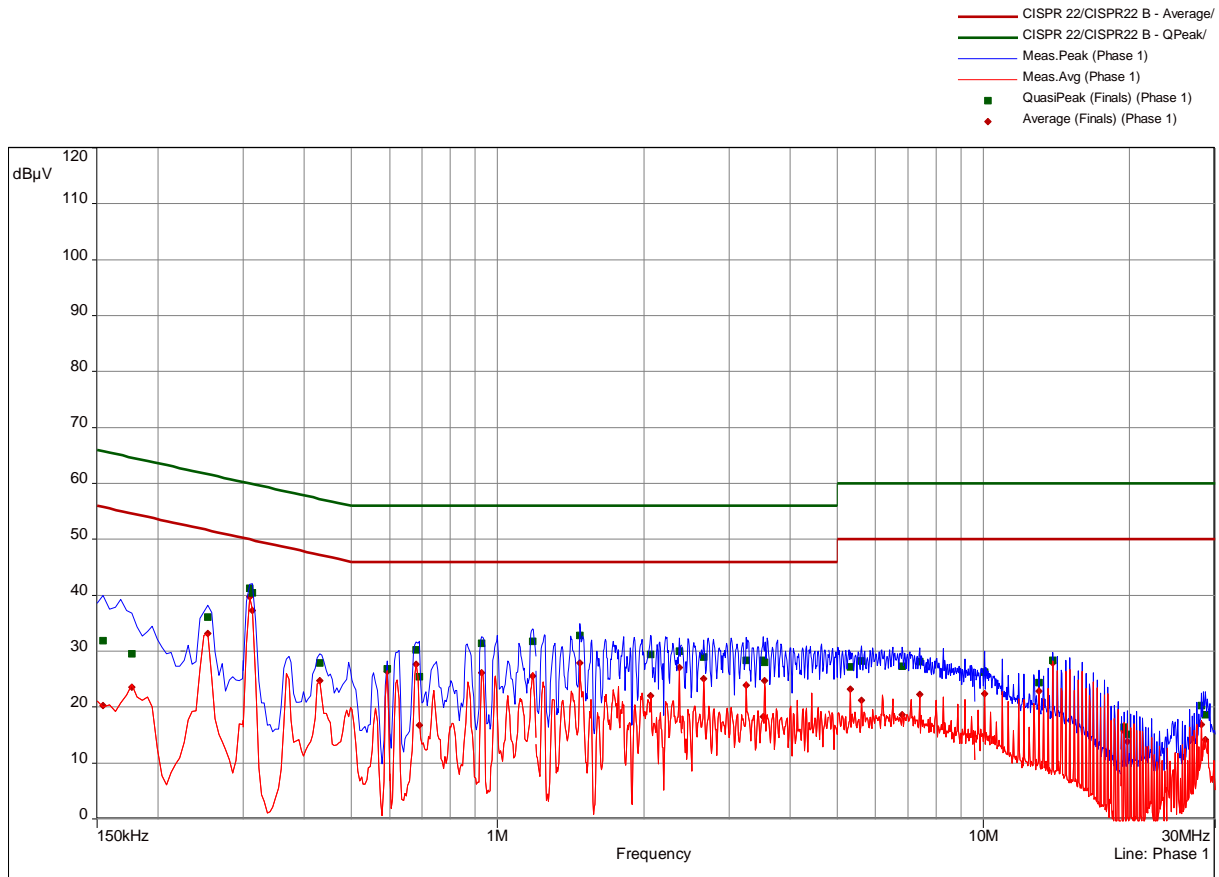
The requirements are **FULFILLED**.

Remarks: For detailed test result please see to following test protocols.

### 5.1.6 Test protocol

Test point: L1  
Operation mode: TX continuous  
Remarks:

Result: passed

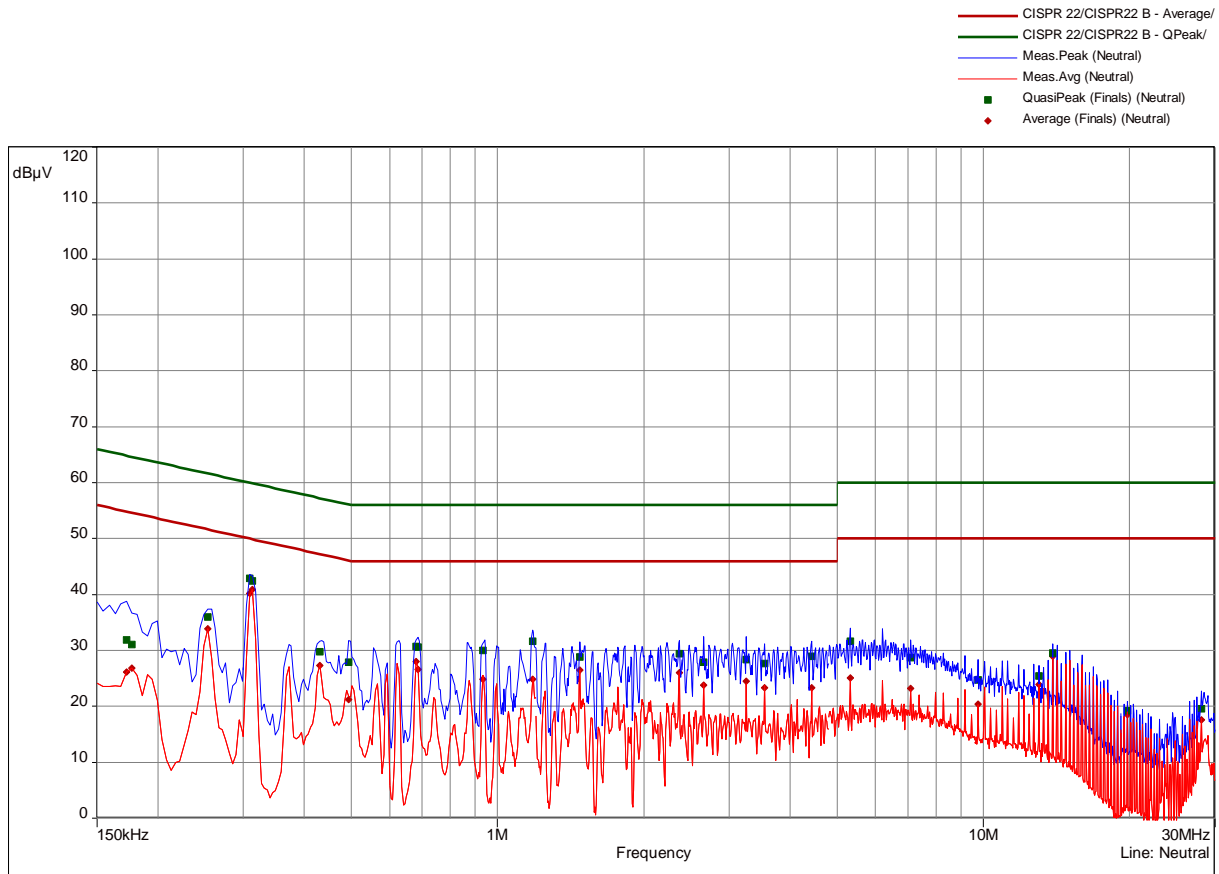


CISPR 22/CISPR22B

| 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    |
|---------------|----|--------------|--------------|-------------|--------------|--------------|-------------|---------|
| 0.155         | 1  | 31.8         | 33.9         | 65.8        | 20.3         | 35.5         | 55.8        | Phase 1 |
| 0.177         | 1  | 29.5         | 35.1         | 64.6        | 23.5         | 31.1         | 54.6        | Phase 1 |
| 0.254         | 1  | 36.1         | 25.6         | 61.6        | 33.2         | 18.5         | 51.6        | Phase 1 |
| 0.309         | 2  | 41.2         | 18.8         | 60.0        | 39.7         | 10.3         | 50.0        | Phase 1 |
| 0.314         | 2  | 40.4         | 19.4         | 59.9        | 37.3         | 12.6         | 49.9        | Phase 1 |
| 0.431         | 2  | 27.9         | 29.4         | 57.2        | 24.7         | 22.5         | 47.2        | Phase 1 |
| 0.593         | 2  | 26.8         | 29.2         | 56.0        | 26.3         | 19.7         | 46.0        | Phase 1 |
| 0.681         | 3  | 30.3         | 25.7         | 56.0        | 27.6         | 18.4         | 46.0        | Phase 1 |
| 0.690         | 3  | 25.4         | 30.6         | 56.0        | 16.7         | 29.3         | 46.0        | Phase 1 |
| 0.929         | 3  | 31.4         | 24.6         | 56.0        | 26.2         | 19.9         | 46.0        | Phase 1 |
| 1.181         | 3  | 31.7         | 24.3         | 56.0        | 25.6         | 20.4         | 46.0        | Phase 1 |
| 1.479         | 4  | 32.9         | 23.2         | 56.0        | 27.9         | 18.1         | 46.0        | Phase 1 |
| 2.069         | 4  | 29.4         | 26.6         | 56.0        | 22.0         | 24.0         | 46.0        | Phase 1 |
| 2.366         | 4  | 30.0         | 26.0         | 56.0        | 27.1         | 19.0         | 46.0        | Phase 1 |
| 2.661         | 5  | 28.9         | 27.1         | 56.0        | 25.1         | 20.9         | 46.0        | Phase 1 |
| 3.255         | 5  | 28.4         | 27.6         | 56.0        | 24.0         | 22.0         | 46.0        | Phase 1 |
| 3.521         | 5  | 28.4         | 27.6         | 56.0        | 18.3         | 27.7         | 46.0        | Phase 1 |
| 3.548         | 5  | 28.0         | 28.0         | 56.0        | 24.7         | 21.3         | 46.0        | Phase 1 |
| 5.322         | 6  | 27.2         | 32.8         | 60.0        | 23.3         | 26.8         | 50.0        | Phase 1 |
| 5.619         | 6  | 28.3         | 31.8         | 60.0        | 21.2         | 28.8         | 50.0        | Phase 1 |
| 6.803         | 6  | 27.3         | 32.7         | 60.0        | 18.7         | 31.4         | 50.0        | Phase 1 |
| 7.392         | 6  | 28.2         | 31.8         | 60.0        | 22.3         | 27.7         | 50.0        | Phase 1 |
| 10.055        | 7  | 26.2         | 33.8         | 60.0        | 22.4         | 27.6         | 50.0        | Phase 1 |
| 13.011        | 7  | 24.4         | 35.6         | 60.0        | 22.9         | 27.1         | 50.0        | Phase 1 |
| 13.898        | 7  | 28.3         | 31.7         | 60.0        | 28.0         | 22.1         | 50.0        | Phase 1 |
| 19.515        | 8  | 16.4         | 43.6         | 60.0        | 15.8         | 34.2         | 50.0        | Phase 1 |
| 19.812        | 8  | 15.2         | 44.9         | 60.0        | 13.9         | 36.1         | 50.0        | Phase 1 |
| 28.088        | 8  | 20.3         | 39.7         | 60.0        | 16.9         | 33.1         | 50.0        | Phase 1 |
| 28.677        | 8  | 18.6         | 41.4         | 60.0        | 14.2         | 35.8         | 50.0        | Phase 1 |

Test point: N  
Operation mode: TX continuous  
Remarks:

Result: passed



CISPR 22/CISPR22B

| 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    |
|---------------|----|--------------|--------------|-------------|--------------|--------------|-------------|---------|
| 0.173         | 9  | 31.8         | 33.0         | 64.8        | 26.2         | 28.7         | 54.8        | Neutral |
| 0.177         | 9  | 31.1         | 33.6         | 64.6        | 26.8         | 27.8         | 54.6        | Neutral |
| 0.254         | 9  | 35.9         | 25.7         | 61.6        | 33.9         | 17.7         | 51.6        | Neutral |
| 0.309         | 10 | 42.9         | 17.1         | 60.0        | 40.2         | 9.8          | 50.0        | Neutral |
| 0.314         | 10 | 42.4         | 17.5         | 59.9        | 40.9         | 9.0          | 49.9        | Neutral |
| 0.431         | 10 | 29.8         | 27.5         | 57.2        | 27.3         | 19.9         | 47.2        | Neutral |
| 0.494         | 10 | 27.8         | 28.3         | 56.1        | 21.2         | 24.9         | 46.1        | Neutral |
| 0.681         | 11 | 30.8         | 25.3         | 56.0        | 28.0         | 18.0         | 46.0        | Neutral |
| 0.686         | 11 | 30.6         | 25.5         | 56.0        | 26.6         | 19.4         | 46.0        | Neutral |
| 0.933         | 11 | 30.0         | 26.0         | 56.0        | 24.8         | 21.2         | 46.0        | Neutral |
| 1.181         | 11 | 31.7         | 24.4         | 56.0        | 24.9         | 21.1         | 46.0        | Neutral |
| 1.479         | 12 | 28.9         | 27.1         | 56.0        | 26.5         | 19.5         | 46.0        | Neutral |
| 2.366         | 12 | 29.4         | 26.6         | 56.0        | 26.0         | 20.0         | 46.0        | Neutral |
| 2.661         | 13 | 27.9         | 28.1         | 56.0        | 23.9         | 22.2         | 46.0        | Neutral |
| 3.251         | 13 | 28.4         | 27.6         | 56.0        | 24.5         | 21.5         | 46.0        | Neutral |
| 3.548         | 13 | 27.7         | 28.3         | 56.0        | 23.4         | 22.7         | 46.0        | Neutral |
| 4.430         | 13 | 29.0         | 27.0         | 56.0        | 23.3         | 22.7         | 46.0        | Neutral |
| 5.318         | 14 | 31.7         | 28.3         | 60.0        | 25.1         | 24.9         | 50.0        | Neutral |
| 7.091         | 14 | 28.7         | 31.3         | 60.0        | 23.2         | 26.8         | 50.0        | Neutral |
| 9.749         | 15 | 24.7         | 35.3         | 60.0        | 20.4         | 29.6         | 50.0        | Neutral |
| 12.998        | 15 | 25.4         | 34.6         | 60.0        | 23.9         | 26.1         | 50.0        | Neutral |
| 13.884        | 15 | 29.5         | 30.5         | 60.0        | 29.0         | 21.0         | 50.0        | Neutral |
| 19.794        | 16 | 19.2         | 40.8         | 60.0        | 18.5         | 31.5         | 50.0        | Neutral |
| 28.065        | 16 | 19.6         | 40.4         | 60.0        | 17.6         | 32.5         | 50.0        | Neutral |

## 5.2 Field strength of fundamental

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

### 5.2.1 Description of the test location

Test location: Anechoic chamber 1  
Test distance: 3 m

### 5.2.1 Applicable standard

According to FCC Part 15C, Section 15.249(a):

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the effective limits.

### 5.2.2 Photo documentation of the test set-up – Please see ATTACHMENT A

### 5.2.3 Description of Measurement

The radiated emission of the fundamental wave from the EUT is measured using a spectrum analyser and appropriate linear polarized antennas. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 6.6. The EUT is measured in TX continuous under normal conditions.

Analyser settings:

Peak measurement: RBW: 1 MHz, VBW: 3 MHz, Detector: Max peak  
AV measurement: RBW: 1 MHz, VBW: 3 MHz, Detector: RMS, Averaging over 1000 sweeps

### 5.2.4 Test result

| Channel | Level PK<br>dB(μV/m) | Limit PK<br>dB(μV/m) | Margin PK<br>(dB) | Polarisation | Level AV<br>dB(μV/m) | Limit AV<br>dB(μV/m) | Margin AV<br>(dB) |
|---------|----------------------|----------------------|-------------------|--------------|----------------------|----------------------|-------------------|
| CH16    | 123.9                | 128.0                | -4.1              | V            | 96.6                 | 108.0                | -11.4             |
| CH55    | 125.4                | 128.0                | -2.6              | V            | 98.1                 | 108.0                | -9.9              |
| CH95    | 125.9                | 128.0                | -2.1              | V            | 98.6                 | 108.0                | -9.4              |

Average-Limit according to FCC Part 15C, Section 15.249(a):

| Fundamental frequency<br>(MHz) | Field strength of fundamental |          |
|--------------------------------|-------------------------------|----------|
|                                | mV/m                          | dB(μV/m) |
| 24000 - 24250                  | 250                           | 108.0    |

Peak-Limit according to FCC Part 15C, Section 15.249(e):

As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

The requirements are **FULFILLED**.

Remarks:

---



---

### 5.3 Out-of-band emission, radiated

For test instruments and accessories used see section 6 Part **SER1, SER 2, SER 3.**

#### 5.3.1 Description of the test location

Test location: OATS 1  
 Test location: Anechoic chamber 1  
 Test distance: 3 m

#### 5.3.2 Photo documentation of the test set-up – Please see ATTACHMENT A

#### 5.3.3 Applicable standard

According to FCC Part 15C, Section 15.249 (d):

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation..

#### 5.3.4 Description of Measurement

The radiated emissions from the EUT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 6. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. If the emission level in peak mode complies with the average limit testing is stopped and peak values will be reported, otherwise, the emission is measured in average mode again and reported. The EUT is measured in TX continuous mode unmodulated under normal conditions.

Instrument settings:

|                    |      |         |
|--------------------|------|---------|
| 9 kHz – 150 kHz    | RBW: | 200 Hz  |
| 150 kHz - 30 MHz   | RBW: | 9 kHz   |
| 30 MHz – 1000 MHz: | RBW: | 120 kHz |
| 1000 MHz – 100 GHz | RBW: | 1 MHz   |

#### 5.3.1 Test result $f < 30$ MHz

Note: In the frequency range 9 kHz to 30 MHz no emission could be detected. The frequencies mean the noise level. The measurement results from distance 3 m are extrapolated (D factor) to the specified distance.

| Frequency<br>(MHz) | Reading PK<br>dB(μV) | D factor<br>dB(μV/m) | Level PK<br>dB(μV/m) | Limit AV<br>dB(μV/m) | Delta<br>(dB) |
|--------------------|----------------------|----------------------|----------------------|----------------------|---------------|
| 0.047              | 52.0                 | -80.0                | -28.0                | 34.2                 | -62.2         |
| 1.5                | 51.0                 | -40.0                | 11.0                 | 24.1                 | -13.1         |
| 18.2               | 39.0                 | -40.0                | -1.0                 | 29.5                 | -30.5         |

**5.3.2 Test result  $f < 1$  GHz**

| Frequency<br>(MHz) | Level QP<br>dB( $\mu$ V/m) | Limit QP<br>dB( $\mu$ V/m) | Delta<br>(dB) |
|--------------------|----------------------------|----------------------------|---------------|
| 43.14              | 37.8                       | 40.0                       | -2.2          |
| 128                | 29.2                       | 43.5                       | -14.3         |
| 285.1              | 30.2                       | 46.0                       | -15.8         |
| 448                | 40.5                       | 46.0                       | -5.5          |
| 583.2              | 39.1                       | 46.0                       | -6.9          |
| 768                | 38.1                       | 46.0                       | -7.9          |

Note: For frequencies  $< 1$  GHz the general radiated limits has been applied.

**5.3.3 Test result  $f > 1$  GHz**
**CH16:**

| Frequency<br>(MHz) | Level PK<br>dB( $\mu$ V/m) | Level AV<br>dB( $\mu$ V/m) | Polarisation | Limit PK<br>dB( $\mu$ V/m) | Margin PK<br>(dB) | Limit AV<br>dB( $\mu$ V/m) | Margin AV<br>(dB) |
|--------------------|----------------------------|----------------------------|--------------|----------------------------|-------------------|----------------------------|-------------------|
| 1279               | 54.3                       | 53.3                       | V            | 74.0                       | -19.7             | 54.0                       | -0.7              |
| 4504               | 48.4                       | -                          | V            | 74.0                       | -25.6             | 54.0                       | -                 |
| 7507               | 47.2                       | -                          | V            | 74.0                       | -26.8             | 54.0                       | -                 |
| 16591              | 52.8                       | -                          | V            | 74.0                       | -21.2             | 54.0                       | -                 |
| 23993              | 63.1                       | -                          | V            | 84.0                       | -20.9             | 64.0                       | -                 |
| 39687              | 59.0                       | -                          | V            | 84.0                       | -25.0             | 64.0                       | -                 |
| 40008              | 45.8                       | -                          | V            | 74.0                       | -28.2             | 54.0                       | -                 |
| 61823              | 29.9                       | -                          | V            | 74.0                       | -44.1             | 54.0                       | -                 |
| 89560              | 30.9                       | -                          | V            | 74.0                       | -43.1             | 54.0                       | -                 |
| 106088             | 37.6                       | -                          | V            | 74.0                       | -36.4             | 54.0                       | -                 |

Note: For frequencies  $> 40008$  MHz the noise level could be measured only.

**CH55:**

| Frequency<br>(MHz) | Level PK<br>dB( $\mu$ V/m) | Level AV<br>dB( $\mu$ V/m) | Polarisation | Limit PK<br>dB( $\mu$ V/m) | Margin PK<br>(dB) | Limit AV<br>dB( $\mu$ V/m) | Margin AV<br>(dB) |
|--------------------|----------------------------|----------------------------|--------------|----------------------------|-------------------|----------------------------|-------------------|
| 1249               | 42.8                       | -                          | V            | 74.0                       | -31.2             | 54.0                       | -                 |
| 4527               | 48.0                       | -                          | V            | 74.0                       | -26.0             | 54.0                       | -                 |
| 7511               | 47.4                       | -                          | V            | 74.0                       | -26.6             | 54.0                       | -                 |
| 15999              | 51.8                       | -                          | V            | 74.0                       | -22.2             | 54.0                       | -                 |
| 19506              | 53.9                       | -                          | V            | 84.0                       | -30.1             | 64.0                       | -                 |
| 39569              | 56.8                       | -                          | V            | 84.0                       | -27.2             | 64.0                       | -                 |
| 40356              | 46.5                       | -                          | V            | 74.0                       | -27.5             | 54.0                       | -                 |
| 61845              | 29.4                       | -                          | V            | 74.0                       | -44.6             | 54.0                       | -                 |
| 89289              | 30.8                       | -                          | V            | 74.0                       | -43.2             | 54.0                       | -                 |
| 106187             | 37.0                       | -                          | V            | 74.0                       | -37.0             | 54.0                       | -                 |

Note: For frequencies  $> 40356$  MHz the noise level could be measured only.



**CH95:**

| Frequency<br>(MHz) | Level PK<br>dB(μV/m) | Level AV<br>dB(μV/m) | Polarisation | Limit PK<br>dB(μV/m) | Margin PK<br>(dB) | Limit AV<br>dB(μV/m) | Margin AV<br>(dB) |
|--------------------|----------------------|----------------------|--------------|----------------------|-------------------|----------------------|-------------------|
| 1275               | 44.8                 | -                    | V            | 74.0                 | -29.2             | 54.0                 | -                 |
| 4517               | 47.7                 | -                    | V            | 74.0                 | -26.3             | 54.0                 | -                 |
| 7511               | 46.2                 | -                    | V            | 74.0                 | -27.8             | 54.0                 | -                 |
| 16139              | 52.5                 | -                    | V            | 74.0                 | -21.5             | 54.0                 | -                 |
| 23972              | 60.8                 | -                    | V            | 84.0                 | -23.2             | 64.0                 | -                 |
| 36281              | 56.9                 | -                    | V            | 84.0                 | -27.1             | 64.0                 | -                 |
| 40025              | 45.8                 | -                    | V            | 74.0                 | -28.2             | 54.0                 | -                 |
| 61737              | 30.5                 | -                    | V            | 74.0                 | -43.5             | 54.0                 | -                 |
| 89627              | 31.1                 | -                    | V            | 74.0                 | -42.9             | 54.0                 | -                 |
| 105892             | 36.9                 | -                    | V            | 74.0                 | -37.1             | 54.0                 | -                 |

Note: For frequencies > 40025 MHz the noise level could be measured only.

Average limit according to FCC Part 15C, Section 15.249(d):

Determination of the limit: Emissions shall be attenuated by at least 50 dB below the level of the fundamental or the general emission limits in §15.209, whichever is the lesser attenuation.

Fundamental field strength: = 96.6 dBμV/m

Emission limit: Fundamental field strength – 50 dB = 96.6 dBμV/m – 50 dB = **46.6 dBμV/m;**

General emission limit apply = 54 dBμV/m;

The field strength limits are defined in 3 m distance.

The measurement from 18 GHz to 40 GHz is done in a distance of 1 m. Therefore the measurement limit has to be changed from 54 dBμV/m to 64 dBμV/m.

General radiated limit according to FCC Part 15C, Section 15.209:

| Frequency<br>(MHz) | 15.209 Limits<br>(μV/m) | Measurement<br>distance (m) |
|--------------------|-------------------------|-----------------------------|
| 0.009 - -0.49      | 2400/f(kHz)             | 300                         |
| 0.49 – 1.705       | 24000/f(kHz)            | 30                          |
| 1.705 – 30.0       | 30                      | 30                          |
| 30 - 88            | 100                     | 3                           |
| 88 - 216           | 150                     | 3                           |
| 216 - 960          | 200                     | 3                           |
| Above 960          | 500                     | 3                           |

The limit according FCC Part 15C, Section 15.209 applies as lesser attenuation.

### 5.3.4 Test result harmonics

#### Harmonics at 48 GHz:

No harmonics could be detected.

#### Harmonics at 72 GHz:

No harmonics could be detected.

#### Harmonics at 96 GHz:

**FCC ID: W5IBSV101757**

No harmonics could be detected.

**Average limit according to FCC Part 15C, Section 15.249(a):**

Determination of the limit:

Harmonic field strength                      2.5 mV/m        =        **68 dB $\mu$ V/m;**

The field strength limits are defined in 3 m distance.

| Fundamental frequency | Field strength of harmonics |                |
|-----------------------|-----------------------------|----------------|
| (MHz)                 | mV/m                        | dB( $\mu$ V/m) |
| 24000 - 24250         | 2.5                         | 68.0           |

The requirements are **FULFILLED**.

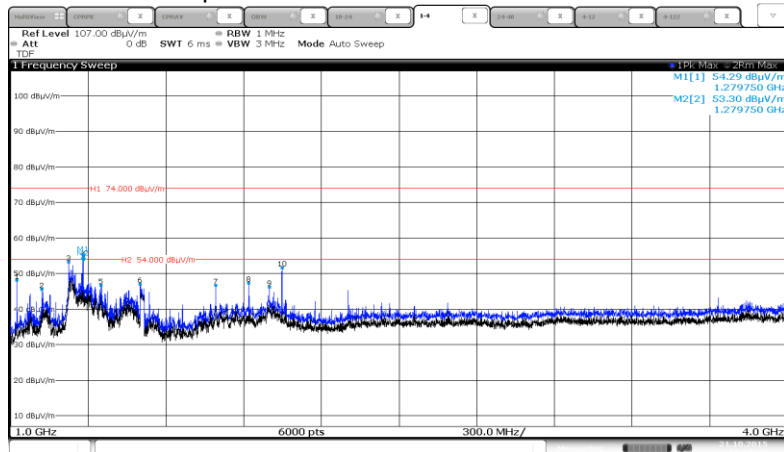
**Remarks:**     The measurement is performed up to 100 GHz. For detailed test result please see to following  
test protocols.

### 5.3.5 Test protocols

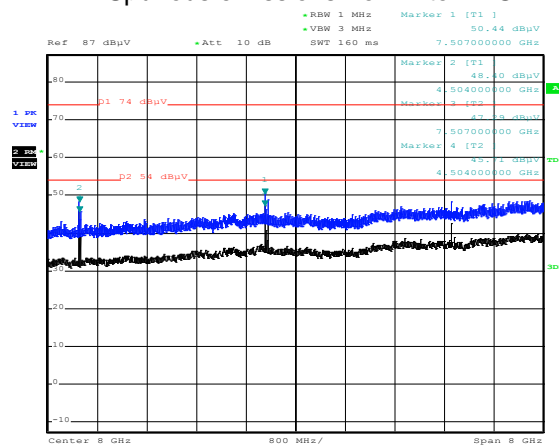
Note: The limits displayed in the plots are “general radiated limits” which are more stringent. The limits apply are the limits according FCC 15.249.

#### 5.3.5.1 CH16

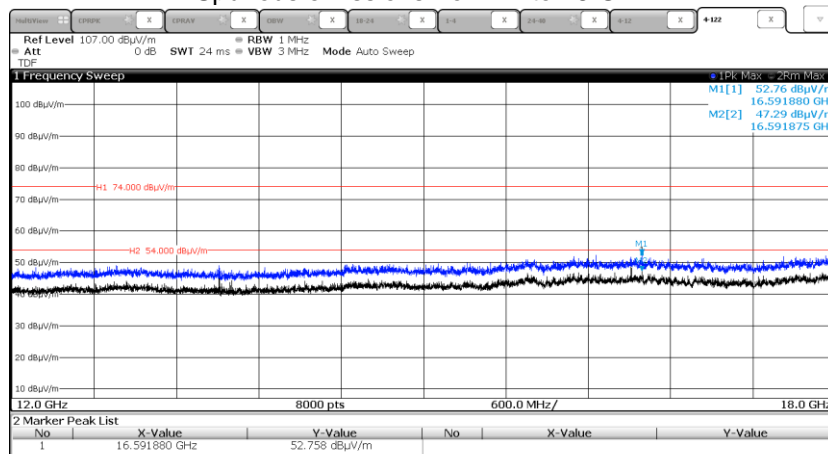
Spurious emissions from 1 to 4 GHz



Spurious emissions from 4 to 12 GHz

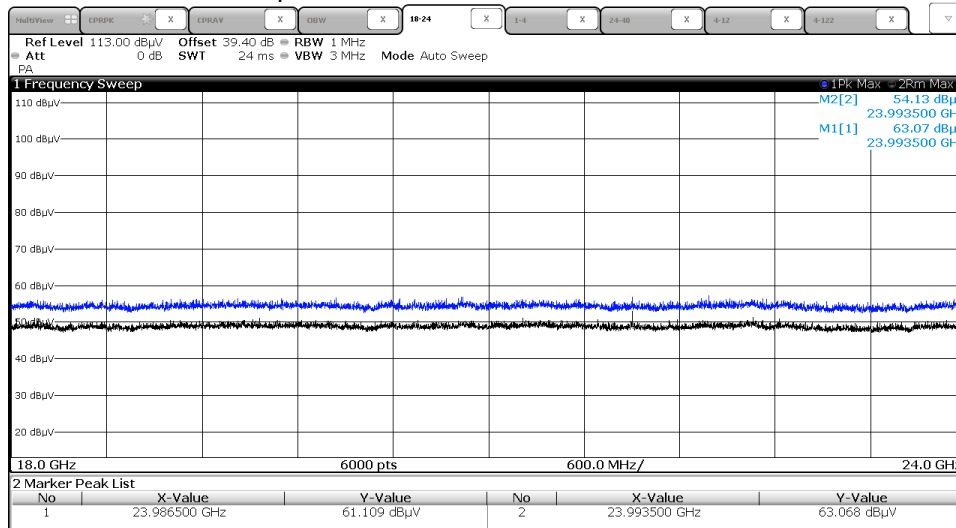


Spurious emissions from 12 to 18 GHz

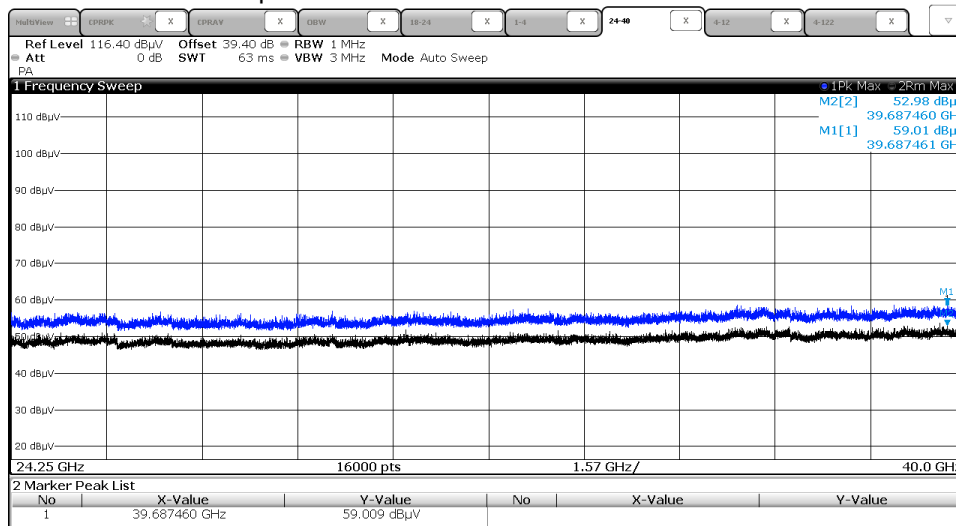


FCC ID: W5IBSV101757

### Spurious emissions from 18 to 24 GHz

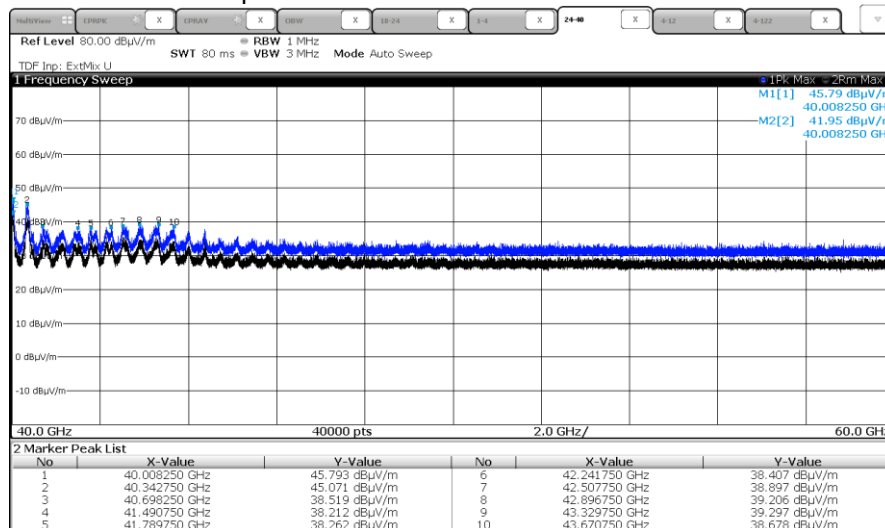


### Spurious emissions from 24.25 to 40 GHz



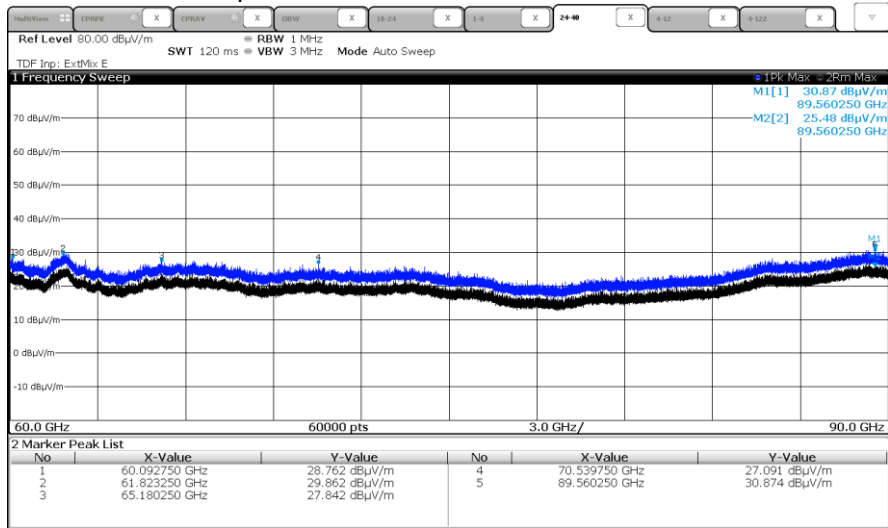
Note. The measurement 40 GHz to 100 GHz is measured in a 1 m distance, therefore the AV-limit needs to be changed to 64 dBμV/m.

### Spurious emissions from 40 to 60 GHz

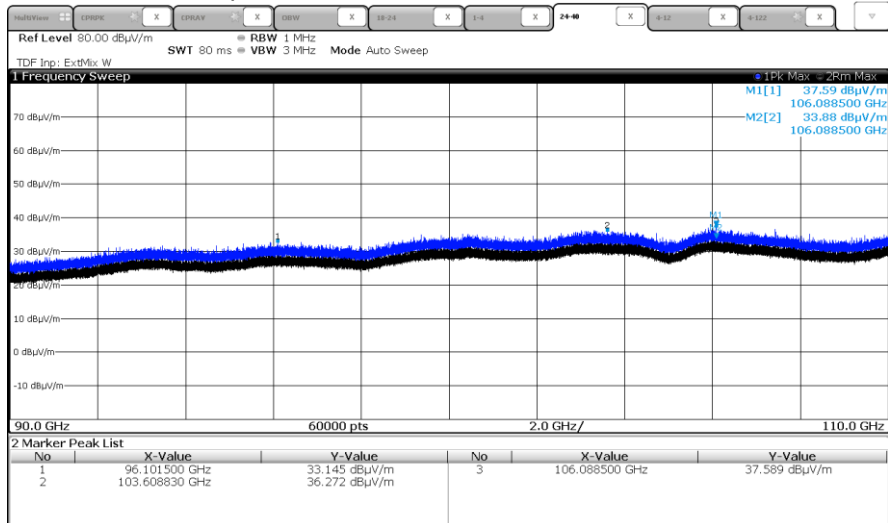


FCC ID: W5IBSV101757

### Spurious emissions from 60 to 90 GHz

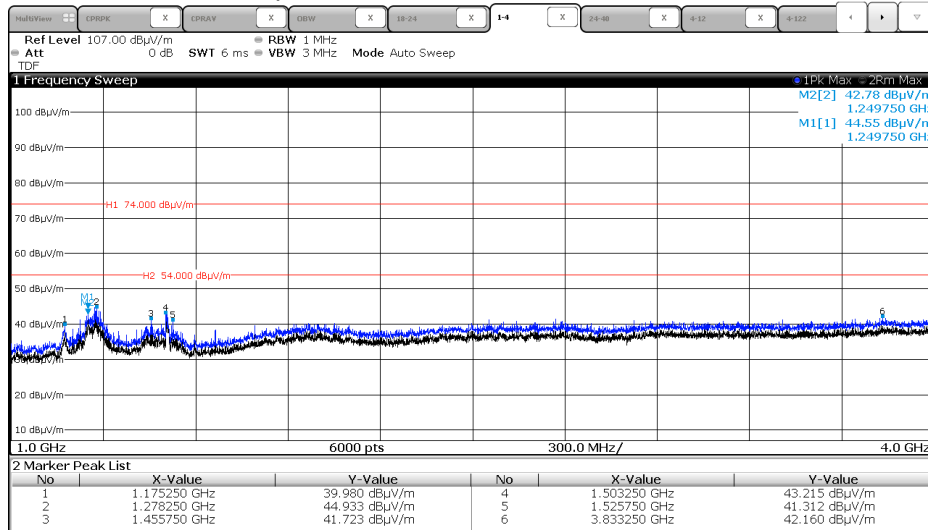


### Spurious emissions from 90 to 110 GHz

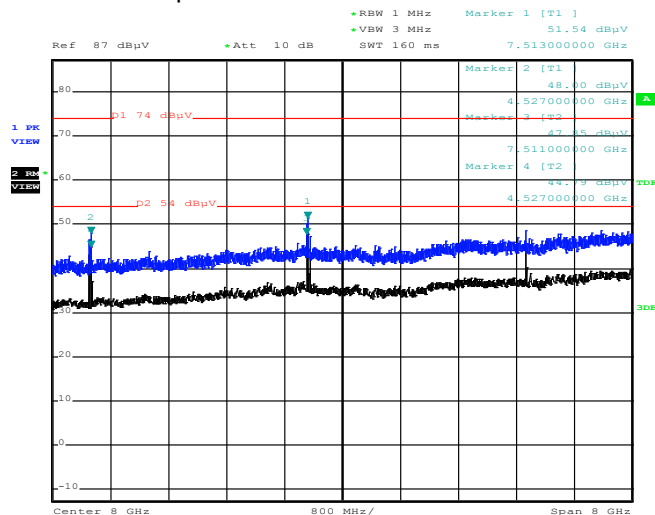


### 5.3.5.2 CH55

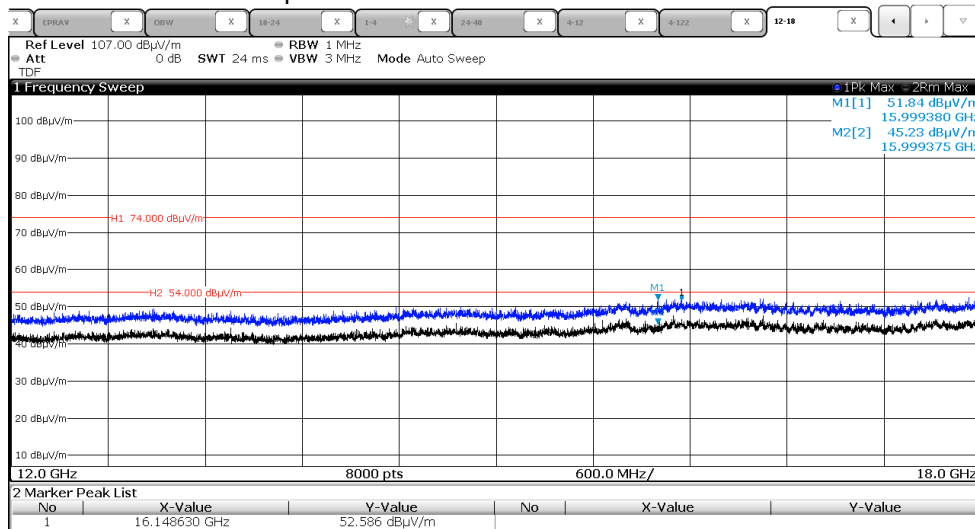
#### Spurious emissions from 1 to 4 GHz



#### Spurious emissions from 4 to 12 GHz

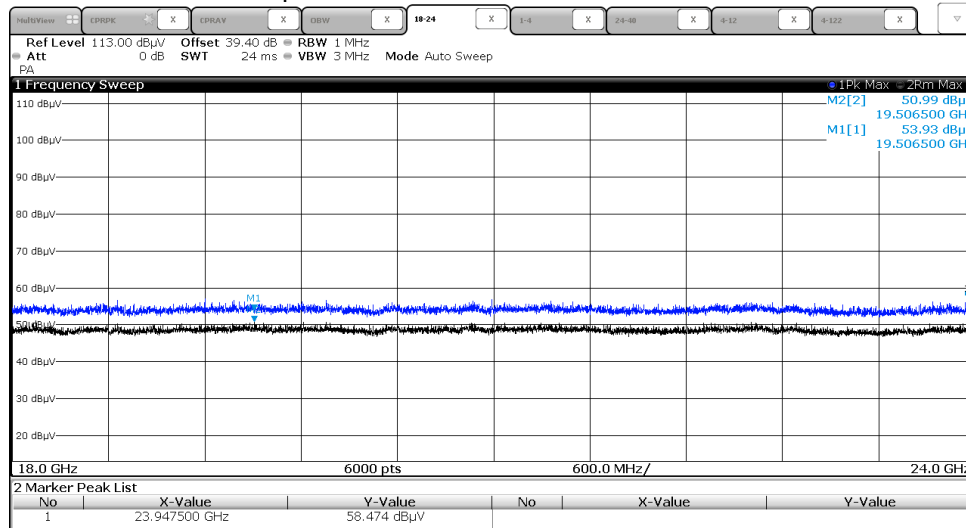


#### Spurious emissions from 12 to 18 GHz

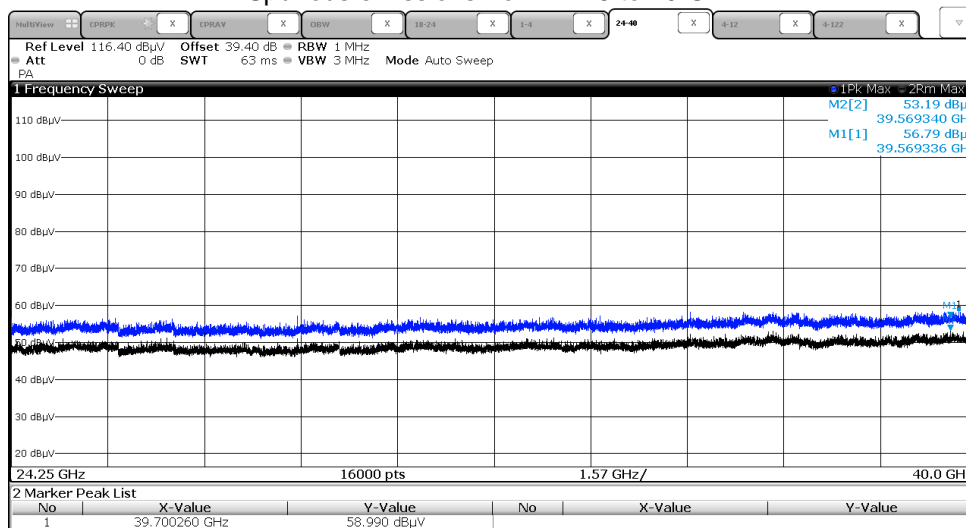


FCC ID: W5IBSV101757

### Spurious emissions from 18 to 24 GHz



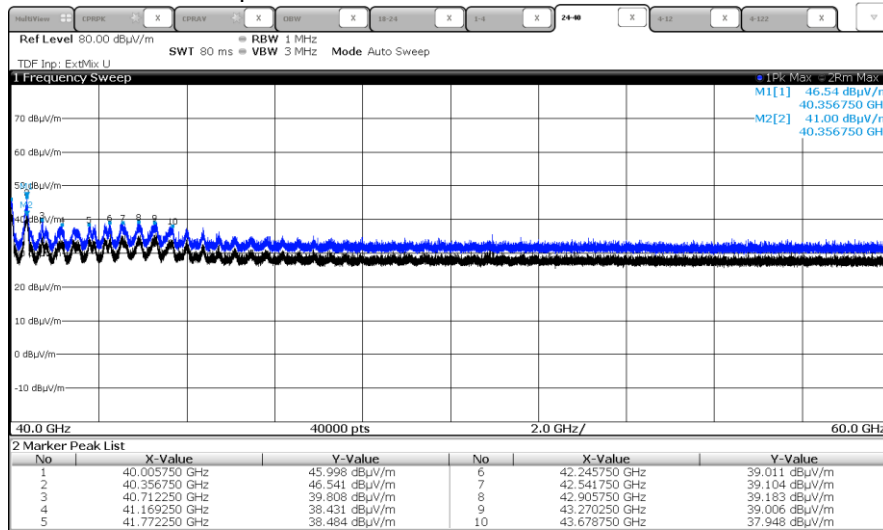
### Spurious emissions from 24.25 to 40 GHz



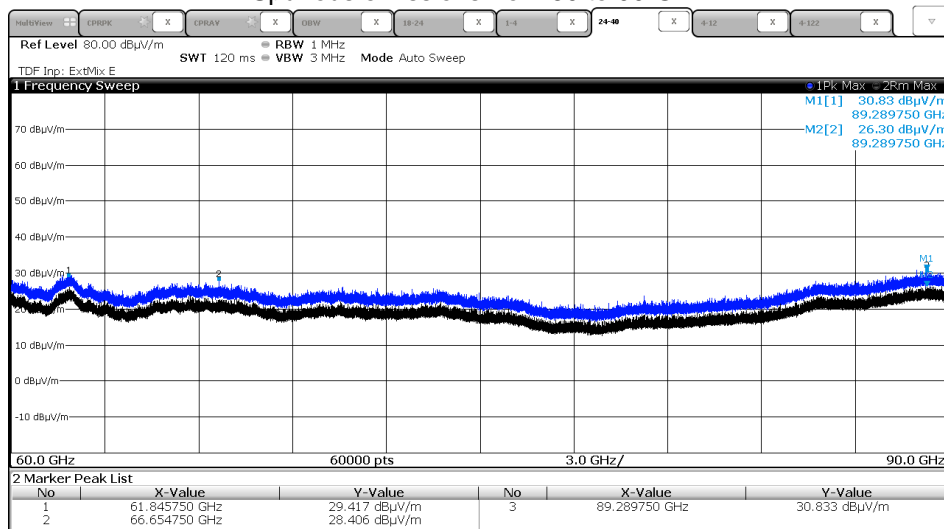
Note. The measurement 24 GHz to 40 GHz is measured in a 1 m distance, therefore the AV-limit needs to be changed to 64 dBμV/m.

FCC ID: W5IBSV101757

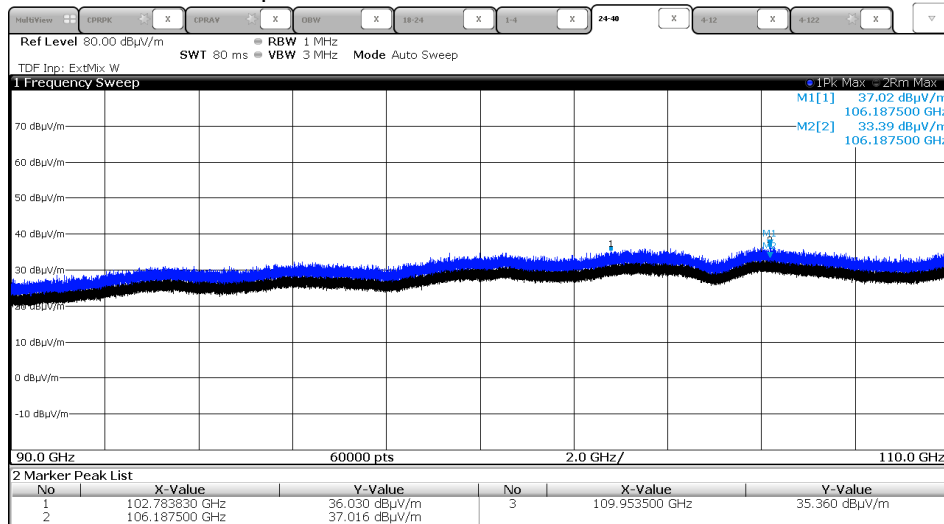
### Spurious emissions from 40 to 60 GHz



### Spurious emissions from 60 to 90 GHz



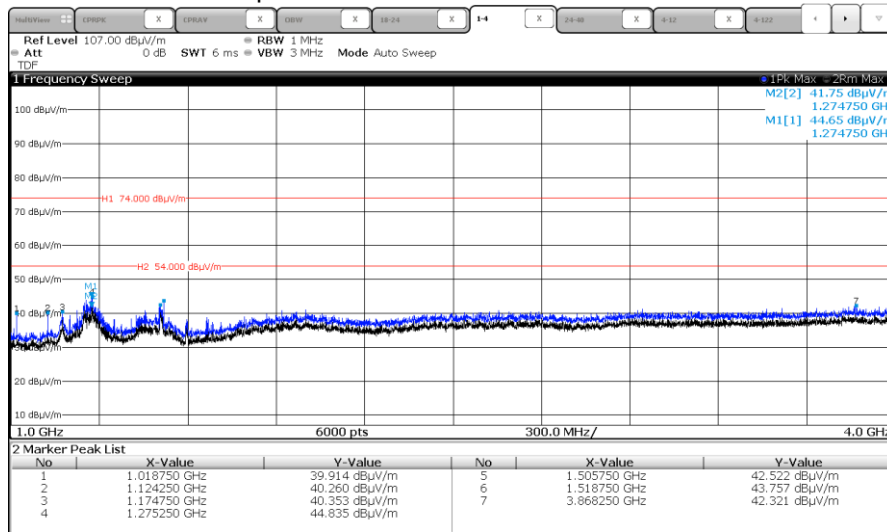
### Spurious emissions from 90 to 110 GHz



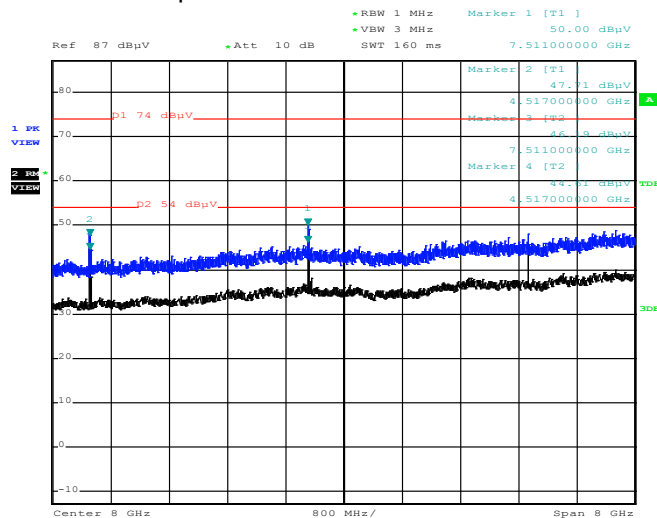


### 5.3.5.3 CH95

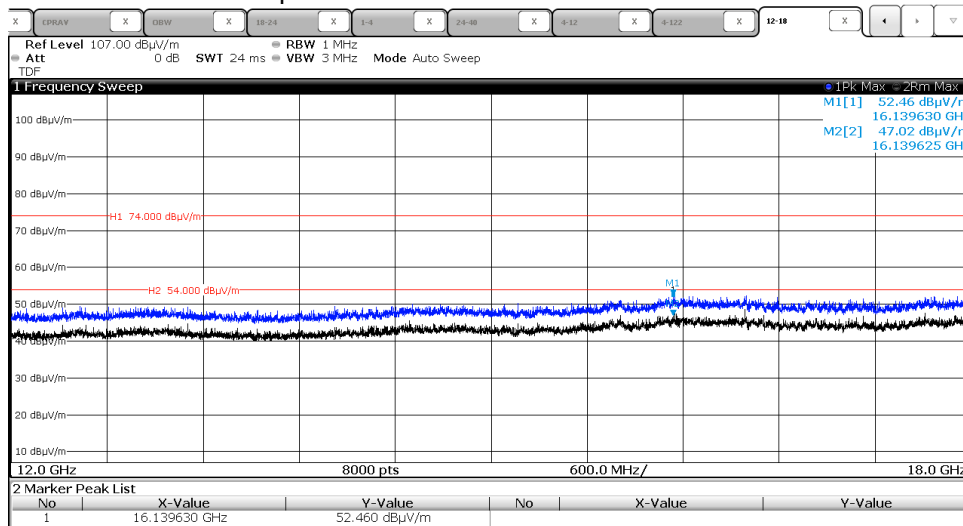
#### Spurious emissions from 1 to 4 GHz



#### Spurious emissions from 4 to 12 GHz

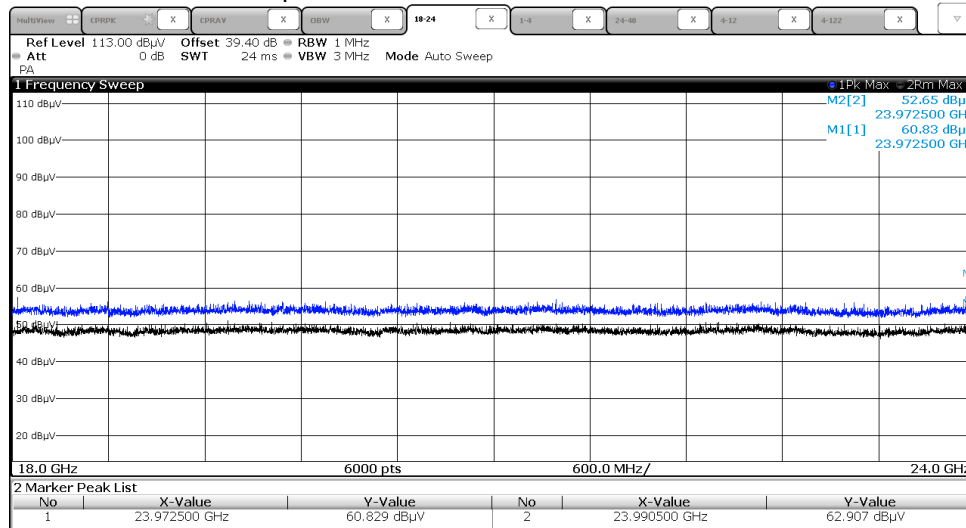


#### Spurious emissions from 12 to 18 GHz

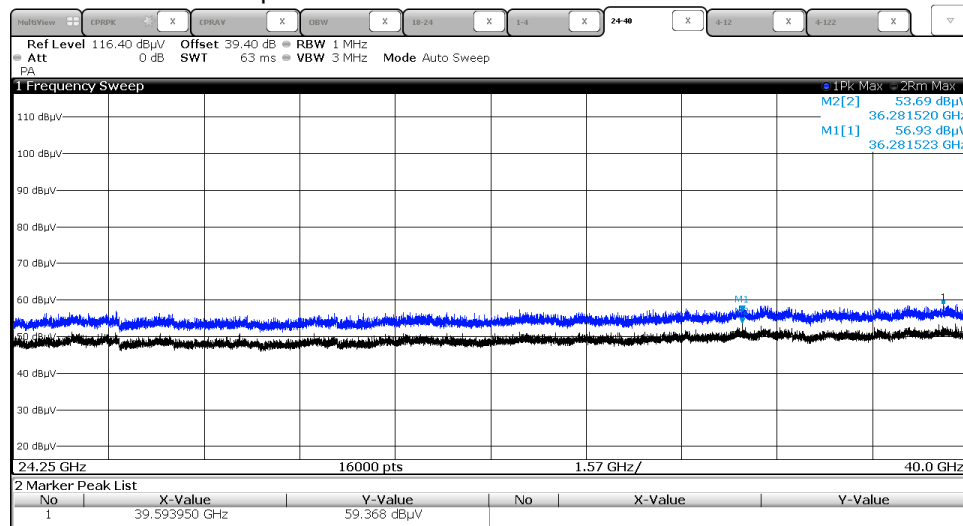


FCC ID: W5IBSV101757

### Spurious emissions from 18 to 24 GHz

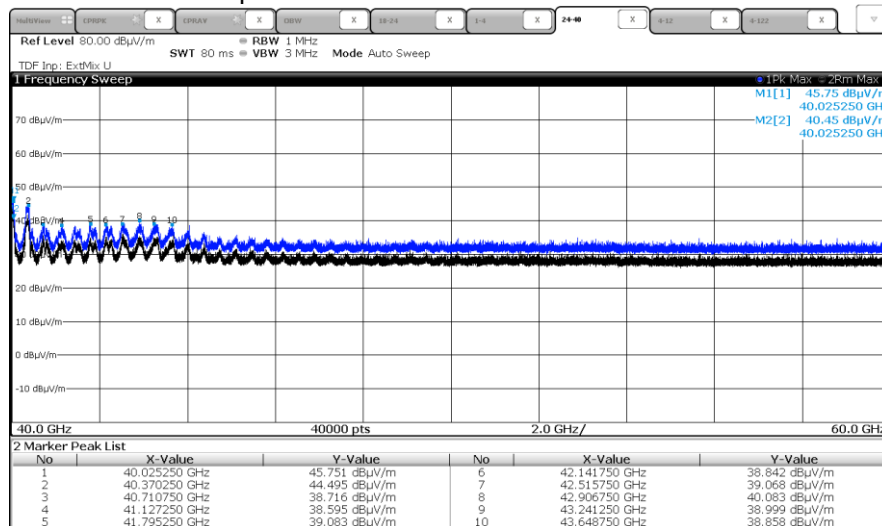


### Spurious emissions from 24.25 to 40 GHz



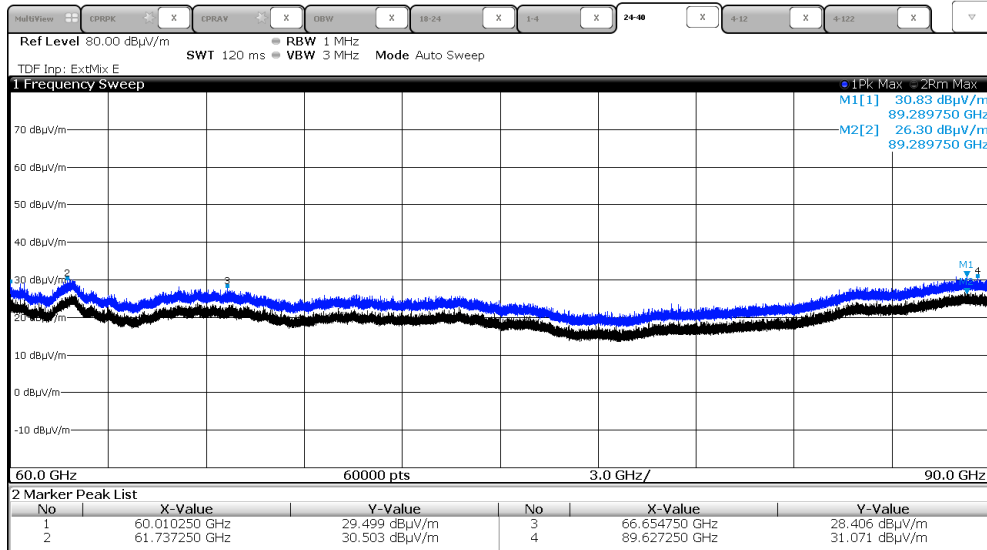
Note. The measurement 18 GHz to 40 GHz is measured in a 1 m distance, therefore the AV-limit needs to be changed to 64 dBμV/m.

### Spurious emissions from 40 to 60 GHz

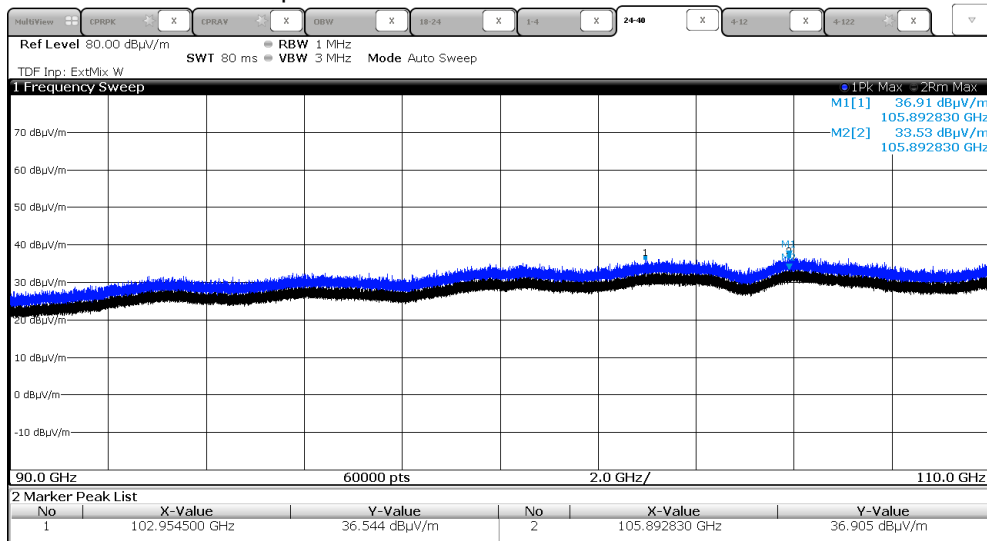


FCC ID: W5IBSV101757

### Spurious emissions from 60 to 90 GHz



### Spurious emissions from 90 to 110 GHz



## 5.4 EBW

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

### 5.4.1 Description of the test location

Test location: Anechoic chamber 1

### 5.4.2 Photo documentation of the test set-up – Please see attachment A

### 5.4.3 Applicable standard

According to FCC Part 15, Section 15.215(c):

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in Section 15.217 through Section 15.257, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated.

### 5.4.4 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -20 dB. The x-dB-down function of the analyser is used. The measurement is performed with normal modulation in TX continuous mode.

Spectrum analyser settings:

RBW: 1 MHz, VBW: 3 MHz, Span: 15 MHz, Trace mode: max hold, Detector: max peak;

### 5.4.5 Test result

| Centre $f$<br>(MHz) | 20 dB bandwidth<br>$f_1$ | 20 dB bandwidth<br>$f_2$ | Measured EBW<br>(MHz) |
|---------------------|--------------------------|--------------------------|-----------------------|
| 24015.0             | 24014.313                | 24240.995                | 226.682               |
| 24055.0             | 24053.354                | 24240.845                | 187.491               |
| 24095.0             | 24093.337                | 24241.020                | 147.683               |

| Operating frequency band<br>(MHz) | 20 dB Bandwidth |           |
|-----------------------------------|-----------------|-----------|
|                                   |                 | (MHz)     |
| $f_{low} > 24000$                 | $f_{low} =$     | 24014.313 |
| $f_{high} < 24250$                | $f_{high} =$    | 24241.020 |

Limit according to FCC Part 15C, Section 15.215(c):

If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

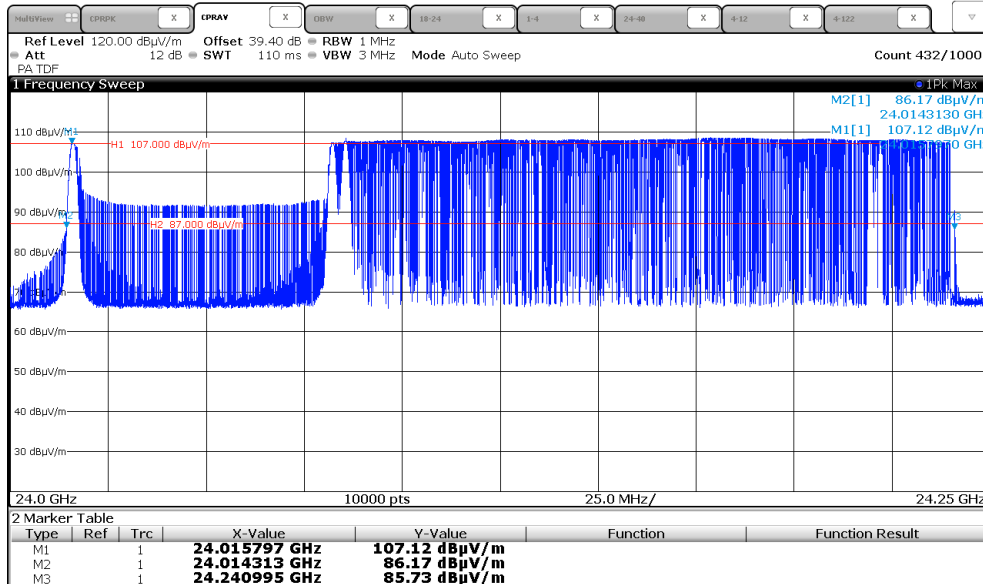
The requirements are **FULFILLED**.

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

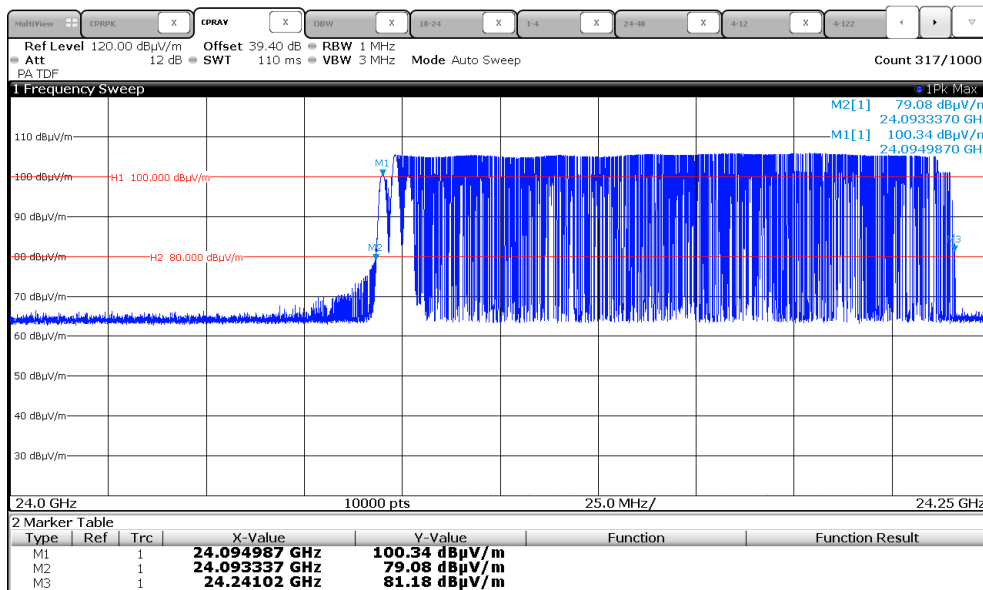
## 5.4.6 Test protocols

20 dB bandwidth

CH16



CH95



## **5.5 Antenna application**

### **5.5.1 Applicable standard**

According to FCC Part 15C, Section 15.203(a):

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.

### **5.5.2 Result**

The EUT use an integrated antenna. No other antenna than that furnished by the responsible party or external power amplifier can be applied by a customer.

The antenna of the EUT meets the requirement of FCC Part 15C, Section 15.203 and 15.204.

## **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>     | ESCI                   | 02-02/03-05-005      | 09/12/2016         | 09/12/2015         |                    |                    |
|                | ESH 2 - Z 5            | 02-02/20-05-004      | 26/10/2017         | 26/10/2015         | 21/01/2016         | 21/07/2015         |
|                | EMV D 30000/PAS        | 02-02/30-05-006      | 08/12/2015         | 08/12/2014         |                    |                    |
|                | 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         | 06/05/2016         | 06/11/2015         |
| <b>CPR 3</b>   | FSW43                  | 02-02/11-15-001      | 05/08/2016         | 05/08/2015         |                    |                    |
|                | BBHA 9170              | 02-02/24-05-014      | 02/06/2018         | 02/06/2015         | 02/12/2016         | 02/12/2015         |
|                | EA-PS 3032-20B         | 02-02/50-11-013      |                    |                    |                    |                    |
| <b>MB</b>      | FSW43                  | 02-02/11-15-001      | 05/08/2016         | 05/08/2015         |                    |                    |
|                | BBHA 9170              | 02-02/24-05-014      | 02/06/2018         | 02/06/2015         | 02/12/2016         | 02/12/2015         |
|                | EA-PS 3032-20B         | 02-02/50-11-013      |                    |                    |                    |                    |
| <b>SER 1</b>   | FMZB 1516              | 01-02/24-01-018      | 19/01/2016         | 19/01/2015         |                    |                    |
|                | ESCI                   | 02-02/03-05-005      | 09/12/2016         | 09/12/2015         |                    |                    |
|                | KK-EF393-21N-16        | 02-02/50-05-033      |                    |                    |                    |                    |
|                | NW-2000-NB             | 02-02/50-05-113      |                    |                    |                    |                    |
| <b>SER 2</b>   | ESVS 30                | 02-02/03-05-003      | 09/07/2016         | 09/07/2015         |                    |                    |
|                | VULB 9168              | 02-02/24-05-005      | 17/04/2016         | 17/04/2015         | 29/02/2016         | 31/08/2015         |
|                | 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         |                    |                    |
|                | FS-Z60                 | 02-02/11-14-001      | 19/03/2016         | 19/03/2015         | 05/05/2016         | 05/11/2015         |
|                | FS-Z110                | 02-02/11-14-002      | 05/05/2016         | 05/05/2015         | 05/05/2016         | 05/11/2015         |
|                | FS-Z90                 | 02-02/11-14-003      | 08/05/2016         | 08/05/2015         | 05/05/2016         | 05/11/2015         |
|                | FSW43                  | 02-02/11-15-001      | 05/08/2016         | 05/08/2015         |                    |                    |
|                | 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      | 12/05/2016         | 12/05/2015         |                    |                    |
|                | BBHA 9170              | 02-02/24-05-014      | 02/06/2018         | 02/06/2015         | 02/12/2016         | 02/12/2015         |
|                | QWH-UPRR00/WR-19/40-60 | 02-02/24-14-001      |                    |                    |                    |                    |
|                | QWH-VPRR00/WR-15/50-75 | 02-02/24-14-003      |                    |                    |                    |                    |
|                | QWH-WPRR00/WR-10/75-11 | 02-02/24-14-006      |                    |                    |                    |                    |
|                | Sucoflex N-2000-SMA    | 02-02/50-05-075      |                    |                    |                    |                    |
|                | EA-PS 3032-20B         | 02-02/50-11-013      |                    |                    |                    |                    |
|                | KMS102-0.2 m           | 02-02/50-11-020      |                    |                    |                    |                    |
|                | SF104/11N/11N/1500MM   | 02-02/50-13-015      |                    |                    |                    |                    |