# EMI – TEST REPORT

**- FCC Part 15.249, RSS210 -**

| | | |
|---|---|---|
| **Type / Model Name** | : | PR 30-HVSG A12 (02) |
| **Product Description** | : | Rotating Laser |
| **Applicant** | : | Hilti AG |
| Address | : | Feldkircherstrasse 100 |
| | | 9494 SCHAAN, LIECHTENSTEIN |
| **Manufacturer** | : | HILLOS GmbH |
| Address | : | Prüssingstraße 41 |
| | | 07745 JENA, GERMANY |
| **Licence holder** | : | Hilti AG |
| Address | : | Feldkircherstrasse 100 |
| | | 9494 SCHAAN, LIECHTENSTEIN |

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

| | |
|---|---|
| **Test Report No. : T43200-00-00WP** | 25. September 2017<br>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

# 1 TEST STANDARDS

The tests were performed according to following standards:

**FCC Rules and Regulations Part 15, Subpart A - General (September, 2016)**

| | |
|---|---|
| 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, 2016)**

| | |
|---|---|
| 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 C63.4: 2014 | Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. |
| ANSI C63.10: 2013 | Testing 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: 2013 | Uncertainty in EMC measurement |
| CISPR 22: 2008<br>EN 55022: 2010 | Information technology equipment |

# 2 EQUIPMENT UNDER TEST

## 2.1 Photo documentation of the EuT – Detailed photos see attachment A

## 2.2 General Remarks

According to the customers modification a re-test of the EuT was performed to show further compliance. The EuT is tested and compliant according CFR 47, Part 15.249, FCC ID: SDL-PR3XR01 with the Test Report No. T33893-01-02HS, 2010-08-02 and RSS 210, IC ID: 5228A-PR3XR01 with the Test Report No. T33893-01-03HS, 2010-08-03 by **mikes testing partners GmbH**. The EuT is re-tested and compliant according CFR 47, Part 15.249, FCC ID: SDL - PR3XR02 and IC ID: 5228A – PR3XR02 within the Test Report No. T36776-01-01TK, 2013-07-05 by **mikes testing partners GmbH** and Test Report No**.** T39470-00-01TK, 2015-07-14 and T40621-00-01TK, 2016-08-01 by **CSA Group Bayern GmbH**.

The EuT is modified in the laser section and now uses a green laser beam instead of the red one. Also, the keyboard of the EuT has been modified. It has 2 LED's less than the previous version, and one key function is different.

This Test Report shows the further compliance with CFR 47, Part 15.249 by re-measurement of the most concerned tests to the RF part.

- field strength of fundamental
- out-of-band emission, radiated (30 MHz – 18 GHz)

## 2.3 Equipment category

WPAN Zigbee device, portable equipment.

## 2.4 Short description of the equipment under test (EuT)

The EuT is a rotating laser alignment system and is equipped with an RF transceiver operating within the frequency range from 2.4 GHz up to 2.4835 GHz making available to the user to control the whole alignment system remotely. The RF section is not modified.

| | | |
|---|---|---|
| Number of tested samples | : | 1 |
| Serial number | : | 233150028 |

## 2.5 Variants of the EuT

None

## 2.6 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan:

| Channels | Frequency |
|---|---|
| 1 | 2405 |
| 2 | 2440 |
| 3 | 2480 |

Note: the marked frequencies are determined for final testing.

## 2.7 Transmit operating modes

The EuT use GFSK and provide following data rate:
250 kbps (kbps = *kilobits per second)*

## 2.8 Antenna

The following antennas shall be used with the EuT:

| Number | Characteristic | Model number | Plug | Frequency range (MHz) |
|---|---|---|---|---|
| 1 | F-type PCB-antenna | - | - | 2400 -2483.5 |

Note: The EuT uses a PCB antenna. Due to the absence of an antenna connector no temporary antenna can be connected.

## 2.9 Power supply system utilised

Power supply voltage, $V_{nom}$ : 12 VDC Lithium accumulator battery
Power supply voltage (alternative) : none

## 2.10 Peripheral devices and interface cables

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

- Power supply battery Model : B 12 / 2.6 Li-Ion
- Radio remote control Model : PRA 30G (02)
- - Model : -

## 2.11 Determination of worst case conditions for final measurement

Measurements have been made in all three orthogonal axes and the settings of the EuT were changed to locate at which position and at what setting of the EuT produce the maximum of the emissions.

### 2.11.1 Test jig

No test jig was used.

### 2.11.2 Test software

No special test software was used.

# 3 TEST RESULT SUMMARY

Operating in the 2400 MHz – 2483.5 MHz band:

| FCC Rule Part | RSS Rule Part | Description | Result |
|---|---|---|---|
| 15.35(c) | RSS-Gen, 6.10 | Pulsed operation | passed |
| 15.203 | RSS Gen, 8.3 | Antenna requirement | not tested |
| 15.204 | RSS Gen, 8.2 | External radio frequency power amplifiers | not tested |
| 15.205(a) | RSS Gen, 8.1 | Emissions in restricted bands | not tested |
| 15.207(a) | RSS Gen, 8.8 | AC power line conducted emissions | not tested |
| 15.215(c) | - | EBW | not tested |
| - | RSS-Gen, 6.6 | OBW | not tested |
| 15.249(a) | RSS-210, B10(a) | Field strength of fundamental | passed |
| 15.249(d) | RSS-210, B10(b) | Out-of-band emission, radiated | passed |
| - | RSS-Gen, 6.11 | Transmitter frequency stability | not applicable |

The mentioned RSS Rule Parts in the above table are related to:
RSS Gen, Issue 4, November 2014
RSS 210, Issue 9, August 2016

## 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 : 28 August 2017

Testing concluded on : 29 August 2017

Checked by:

Klaus Gegenfurtner
I confirm the correctness and Integrity of this document
2017.09.27 07:57:39 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Willibald Probst
I am the author of this document
2017.09.25 15:33:58 +02'00'

Willibald Probst
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.

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

## 4.1 Measurement protocol for FCC and ISED

### 4.1.1 Test methodology

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

**IC 3009A-1**

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

**IC 3009A-2**

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

### 4.1.2 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.

#### 4.1.2.1 General Standard information

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.

##### 4.1.2.1.1 Radiated emission (electrical field 30 MHz - 1 GHz)

Description of measurement

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. The setup of the equipment under test is established in accordance with ANSI C63.10.The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so that they are at least 40 centimetres from 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 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 or CISPR 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 | Level | + | Factor | = | Level | - | CISPR Limit | = | Delta |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBµV) | | (dB) | | (dBµV/m) | | (dBµV/m) | | (dB) |
| 719.0 | 75.0 | + | 32.6 | = | 107.6 | - | 110.0 | = | -2.4 |

#### 4.1.2.1.2 Radiated emission (electrical field 1 GHz - 40 GHz)

Description of measurement

Radiated emissions from the EuT are measured in the frequency range 1 GHz up to the maximum frequency 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 1.0 X 1.5 metre non-conducting table, 1.5 metre above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from 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. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyzer set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak measurement. The conditions determined as worst case will then be used for the final measurements. When the EuT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

# 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: NONE

**Remarks:** Not applicable, the EuT is battery powered and has no externally connectable cables.

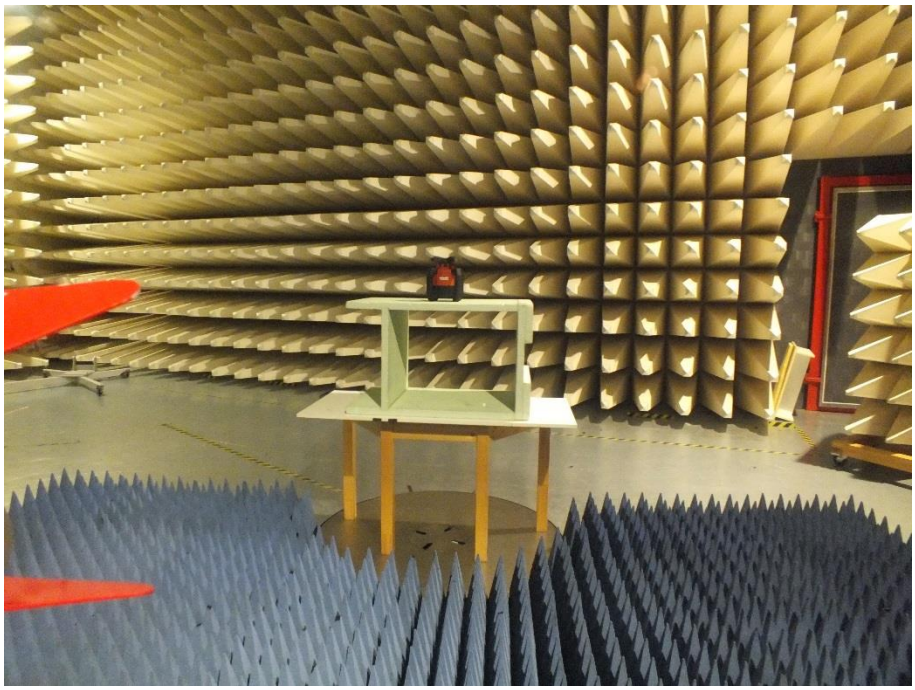
## Field strength of fundamental

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

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



### 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 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 set up of the EuT and the measurement procedure is in accordance to ANSI C63.10, Item 6.5. The EuT is measured in TX continuous mode unmodulated under normal conditions.

Analyser settings:

| | | | | | | |
|---|---|---|---|---|---|---|
| Peak measurement: | RBW: | 1 MHz | VBW: | 1 MHz | Detector: | Max peak |
| AV measurement: | RBW: | 1 MHz | VBW: | 10 Hz | Detector: | Max peak |

### 5.2.3 Test result

| Frequency | Reading level PK | Bandwidth | Correction factor | Corrected level PK | Limit PK | Duty cycle correction factor $K_E$ | Corrected level AV | Limit AV |
|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBµV) | (kHz) | (dB) | dB(µV/m) | dB(µV/m) | (dB) | dB(µV/m) | dB(µV/m) |
| 2405 | 114.8 | 1000 | -14.6 | 100.2 | 114 | -30.8 | 69.4 | 94 |
| 2440 | 114.6 | 1000 | -14.4 | 100.2 | 114 | -30.8 | 69.4 | 94 |
| 2480 | 112.8 | 1000 | -14.0 | 98.8 | 114 | -30.8 | 68.0 | 94 |
| Measurement uncertainty | | | | ±2.34 dB | | | | |

Note: The correction factor includes cable loss and antenna factor.

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

| Frequency | Field strength of fundamental | |
|---|---|---|
| (MHz) | (mV/m) | dB(µV/m) |
| 902 - 928 | 50 | 94 |
| **2400 - 2483.5** | **50** | **94** |
| 5725-5875 | 50 | 94 |
| 24000 - 24250 | 250 | 108 |

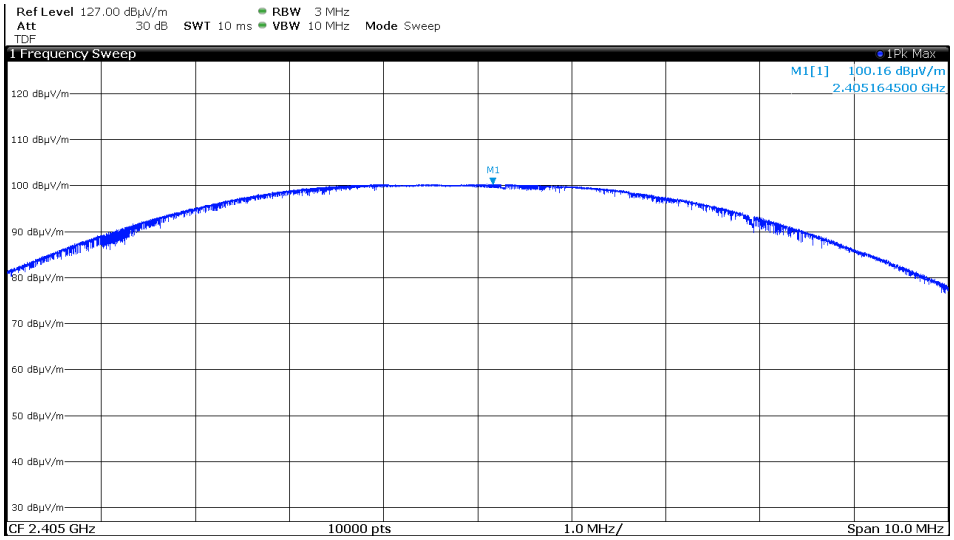
Peak-Limit according to FCC Part 15C, Section 15.249(e):
However the peak fieldstrength shall not exceed the maximum permitted average limit by more than 20 dB.

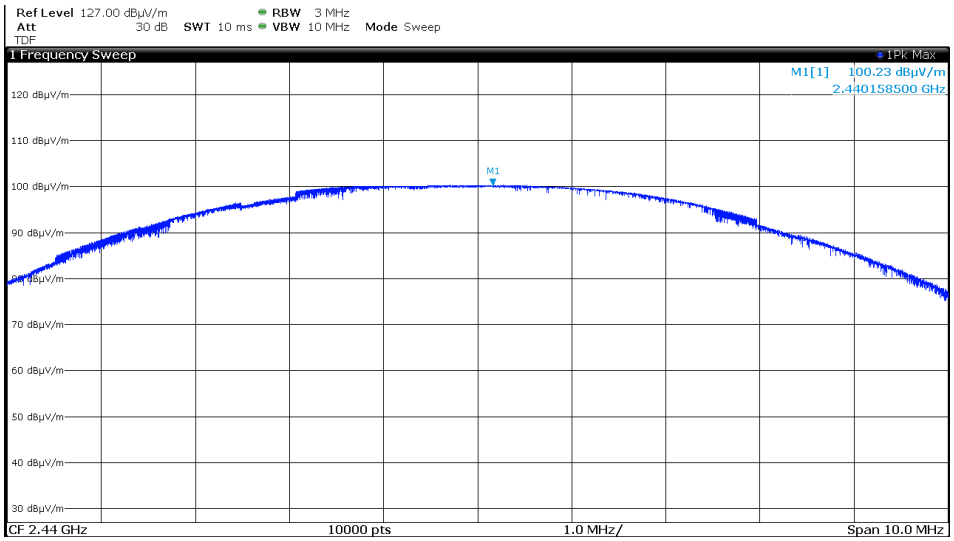
The requirements are **FULFILLED.**

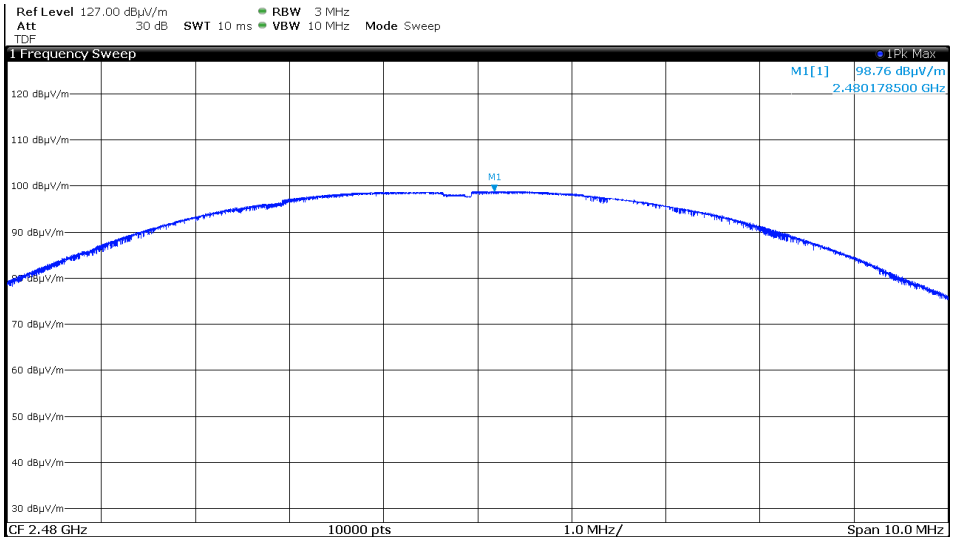
**Remarks:** _____

_____

### 5.2.4 Test protocols



## 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

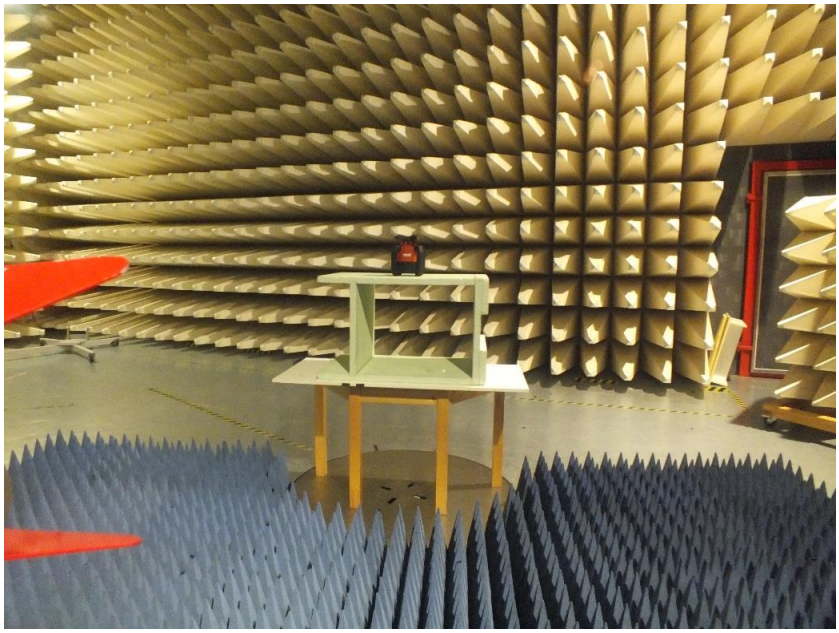
Test location: OATS 1
Test location: Anechoic chamber 1

Test distance: 3 m

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

Test setup 30 MHz – 1000 MHz:

Test setup 1 GHz – 18 GHz:



### 5.3.3 Applicable standard

According to FCC Part 15C, Section 15.249 (d):
Emission radiated outside of the specified frequency bands, except harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limit in FCC Part 15C, Section 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 6.3. 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.
**Note:**
According to section 2.2 of the present document the measurements in the frequency ranges from 9 kHz to 30 MHz and 18 GHz to 25 GHz were not performed because within these frequency ranges no emmisions could be detected within former tests.

Instrument settings:

| | | |
|---|---|---|
| 30 MHz – 1000 MHz: | RBW: | 120 kHz |
| 1000 MHz – 25 GHz | RBW: | 1 MHz |

### 5.3.5 Test result f 30 - 1000 MHz

| 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) |
|---|---|---|---|---|---|---|---|---|
| 63.70 | 1.5 | 8.9 | 14.5 | 13.6 | 16.0 | 22.5 | 40.0 | -17.5 |
| 79.72 | 2.3 | 3.9 | 11.2 | 10.9 | 13.5 | 14.8 | 40.0 | -25.2 |
| 111.60 | 5.2 | 2.2 | 10.9 | 11.7 | 16.1 | 13.9 | 43.5 | -27.4 |
| 216.02 | 3.4 | 6.8 | 12.1 | 12.6 | 15.5 | 19.4 | 46.0 | -26.6 |

### 5.3.6 Test result f 1 GHz – 18 GHz

Channel 1

| Test conditions: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **active communication** | | | Test results | | | | | |
| Start requency (MHz) | Stop frequency (MHz) | RBW (kHz) | Maximum emission | | AV Limit (dBµV/m) | Duty cycle correction (dB) | Margin (dB) | Detector |
| | | | (MHz) | (dBµV/m) | | | | |
| 1000 | 2400 | 1000 | 2400 | 67.5 | 54.0 | -30.8 | -17.3 | PK |
| 2483.5 | 4000 | 1000 | 3974 | 41.7 | 54.0 | 0.0 | -12.3 | PK |
| 4000 | 6000 | 1000 | 4810 | 49.3 | 54.0 | 0.0 | -4.7 | PK |
| 6000 | 12000 | 1000 | 11961 | 48.5 | 54.0 | 0.0 | -5.5 | PK |
| 12000 | 18000 | 1000 | 16709 | 52.0 | 54.0 | 0.0 | -2.0 | PK |
| Measurement uncertainty | | | ±6 dB | | | | | |

Channel 2

| Test conditions: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **active communication** | | | Test results | | | | | |
| Start requency (MHz) | Stop frequency (MHz) | RBW (kHz) | Maximum emission | | AV Limit (dBµV/m) | Duty cycle correction (dB) | Margin (dB) | Detector |
| | | | (MHz) | (dBµV/m) | | | | |
| 1000 | 2400 | 1000 | 2398 | 45.0 | 54.0 | 0.0 | -9.0 | PK |
| 2483.5 | 4000 | 1000 | 2494 | 43.3 | 54.0 | 0.0 | -10.7 | PK |
| 4000 | 6000 | 1000 | 4879 | 49.1 | 54.0 | 0.0 | -4.9 | PK |
| 6000 | 12000 | 1000 | 11953 | 49.0 | 54.0 | 0.0 | -5.0 | PK |
| 12000 | 18000 | 1000 | 17956 | 52.5 | 54.0 | 0.0 | -1.5 | PK |
| Measurement uncertainty | | | ±6 dB | | | | | |

Channel 3

| Test conditions: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **active communication** | | | Test results | | | | | |
| Start requency (MHz) | Stop frequency (MHz) | RBW (kHz) | Maximum emission | | AV Limit (dBµV/m) | Duty cycle correction (dB) | Margin (dB) | Detector |
| | | | (MHz) | (dBµV/m) | | | | |
| 1000 | 2400 | 1000 | 2053 | 40.3 | 54.0 | 0.0 | -13.7 | PK |
| 2483.5 | 4000 | 1000 | 2484 | 59.4 | 54.0 | -30.8 | -25.5 | PK |
| 4000 | 6000 | 1000 | 4959 | 47.2 | 54.0 | 0.0 | -6.8 | PK |
| 6000 | 12000 | 1000 | 11947 | 49.1 | 54.0 | 0.0 | -4.9 | PK |
| 12000 | 18000 | 1000 | 17965 | 52.0 | 54.0 | 0.0 | -2.0 | PK |
| Measurement uncertainty | | | ±6 dB | | | | | |

Limit according to FCC Part 15C, Section 15.209:

| Frequency (MHz) | 15.209 Limits (µV/m) | Measurement 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 |

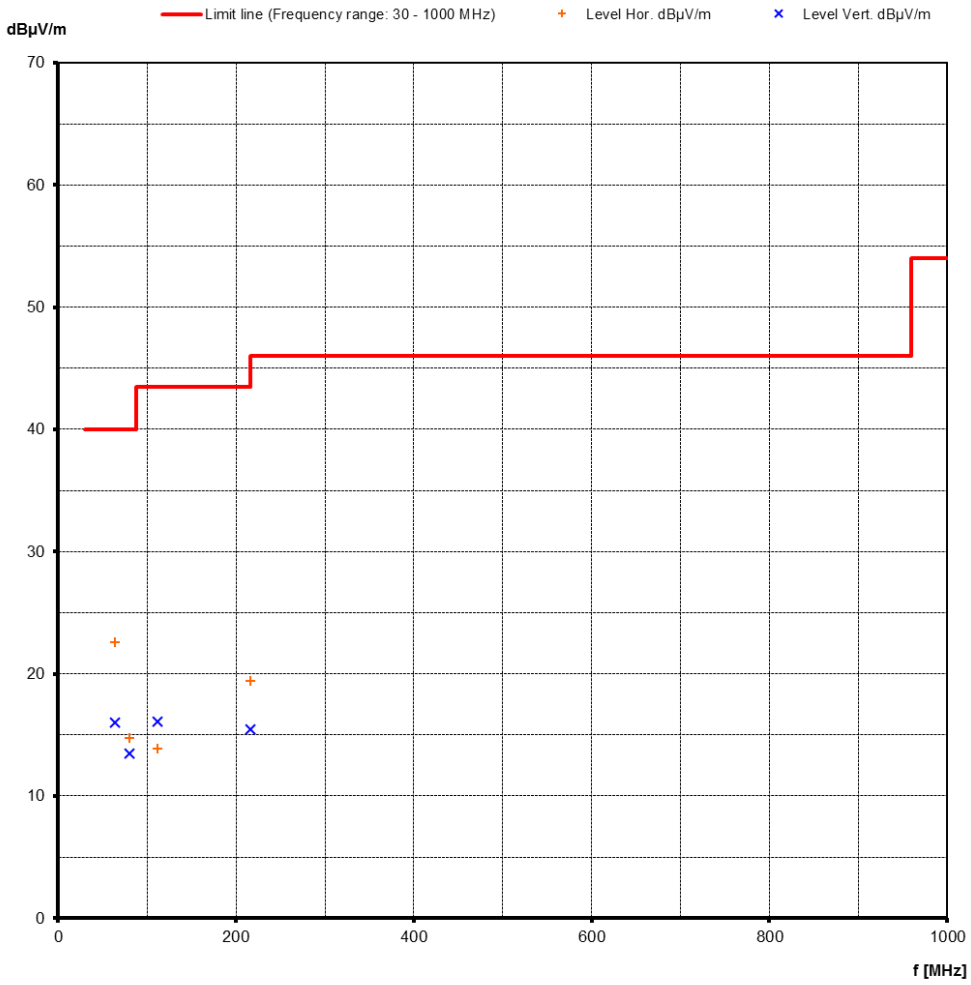
Average limit according to FCC Part 15C, Section 15.249(a):

| Fundamental frequency | Field strength of harmonics | |
|---|---|---|
| (MHz) | (µV/m) | dB(µV/m) |
| 902 - 928 | 500 | 54 |
| **2400 - 2483.5** | 500 | 54 |
| 5725 - 5875 | 500 | 54 |
| 24000 - 24250 | 2500 | 68 |

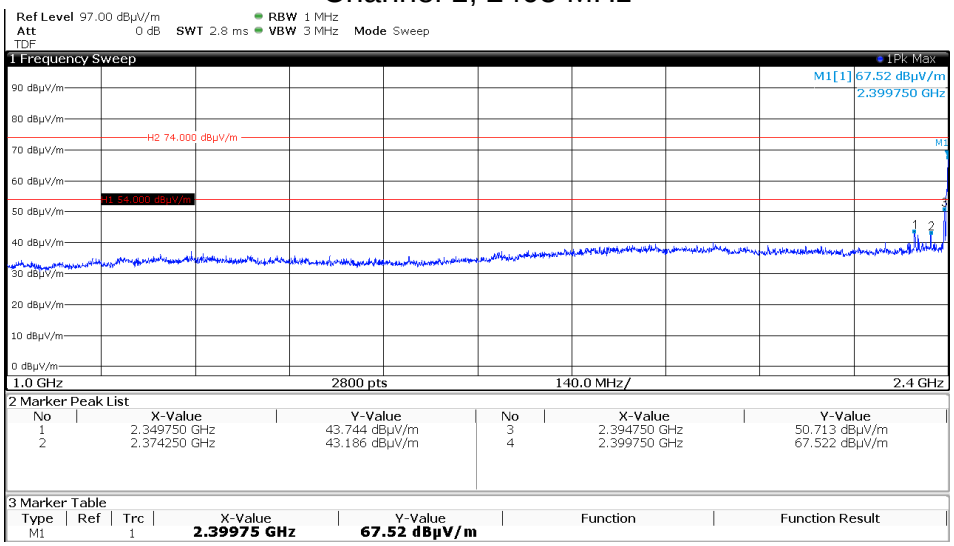
The requirements are **FULFILLED.**

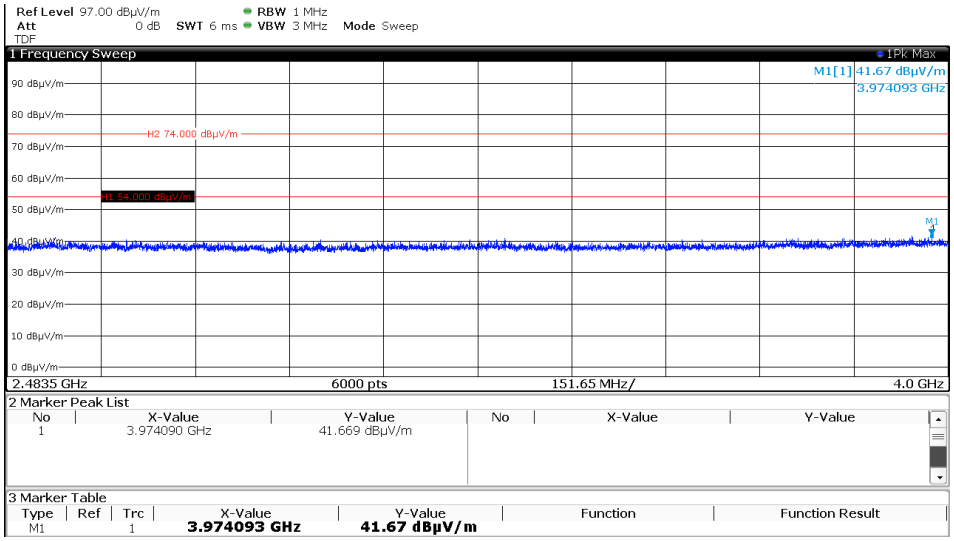
**Remarks:** For detailed test results please refer the following test protocols.

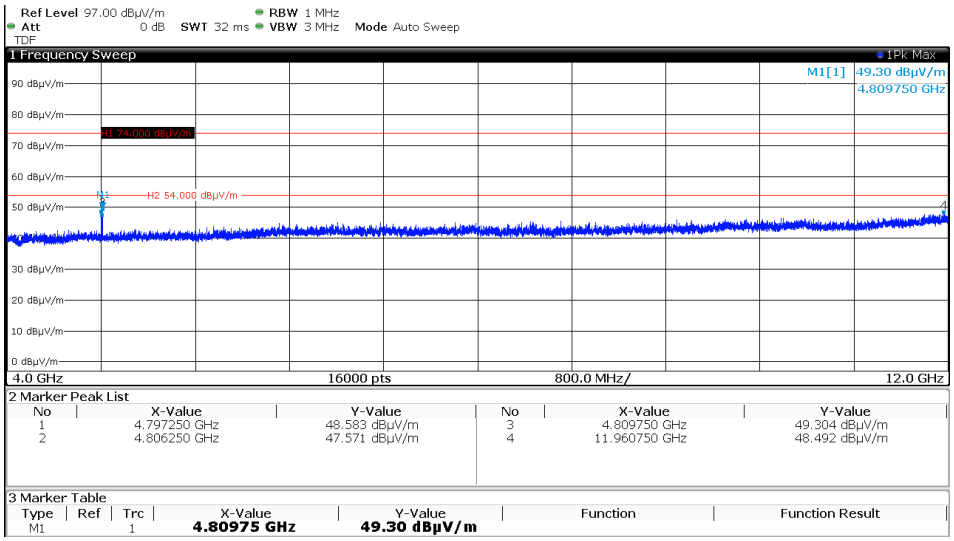
### 5.3.7 Test protocols

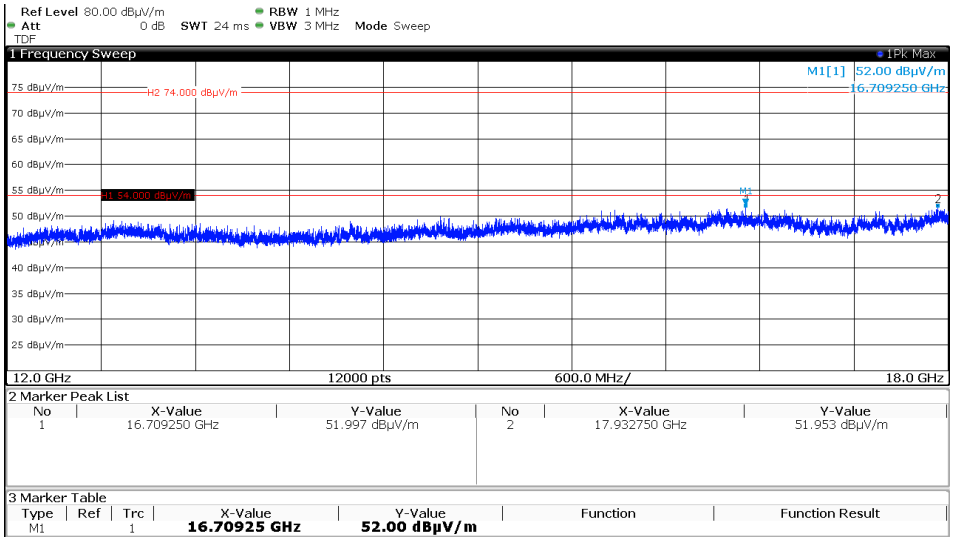


## Channel 1, 2405 MHz

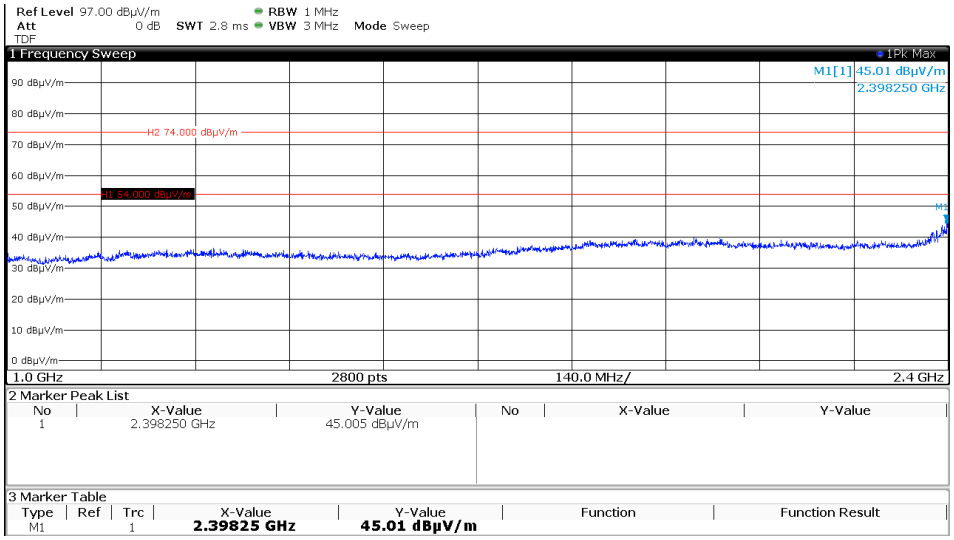


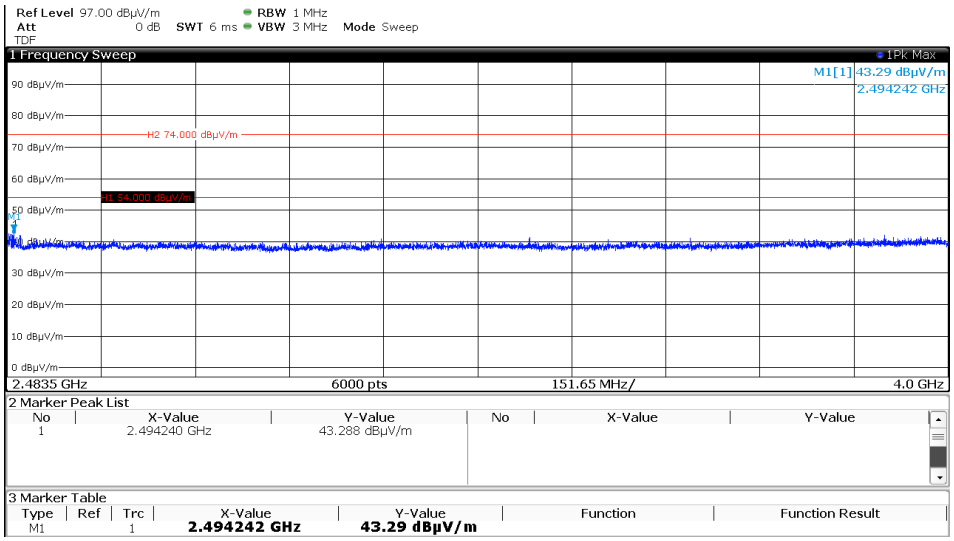



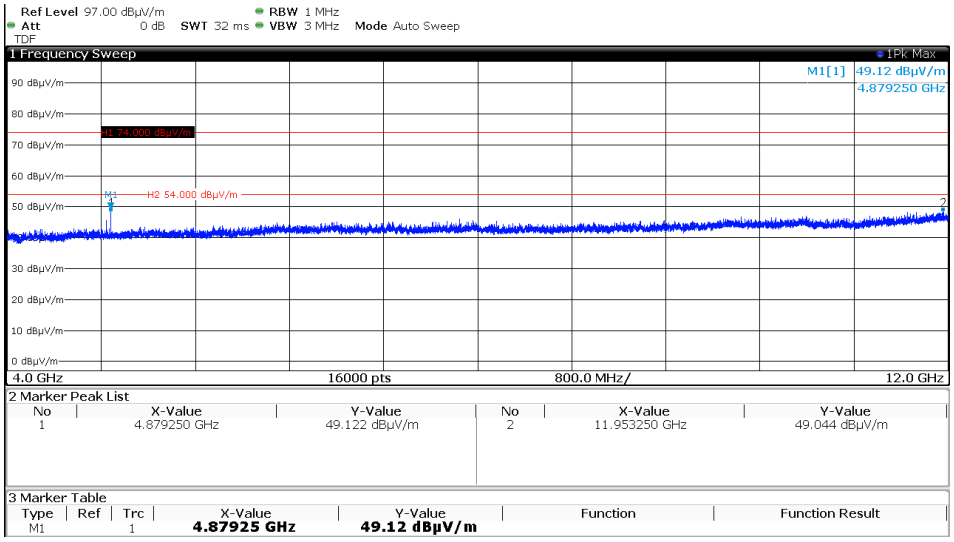



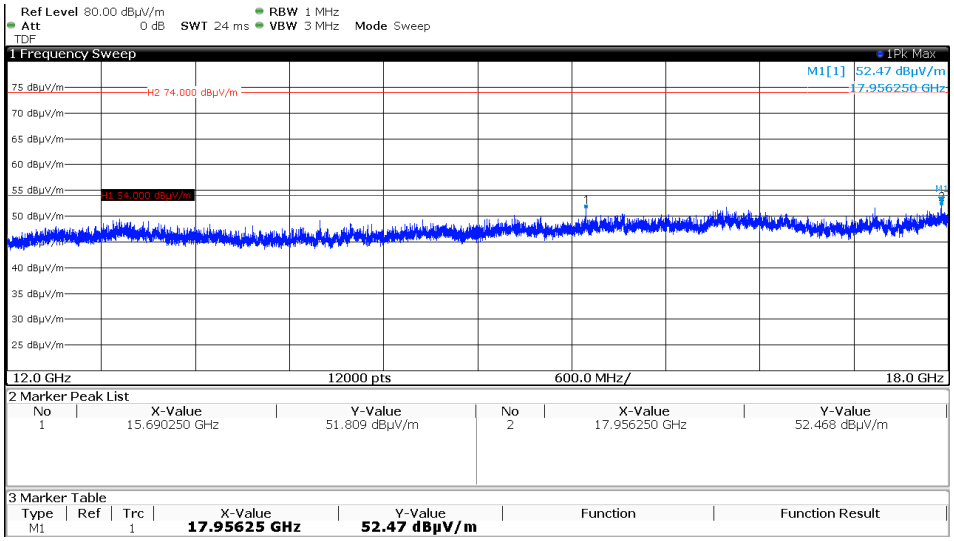



Channel 2, 2440 MHz

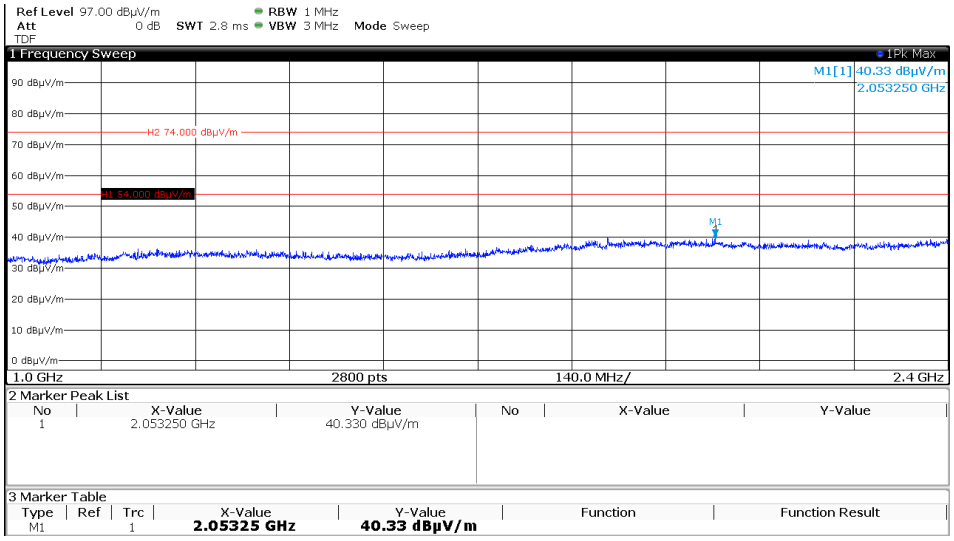


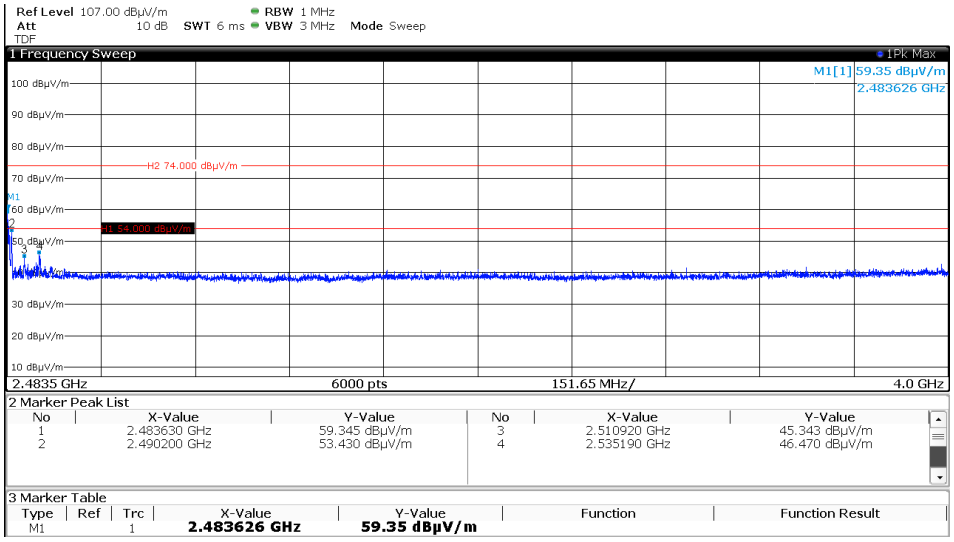



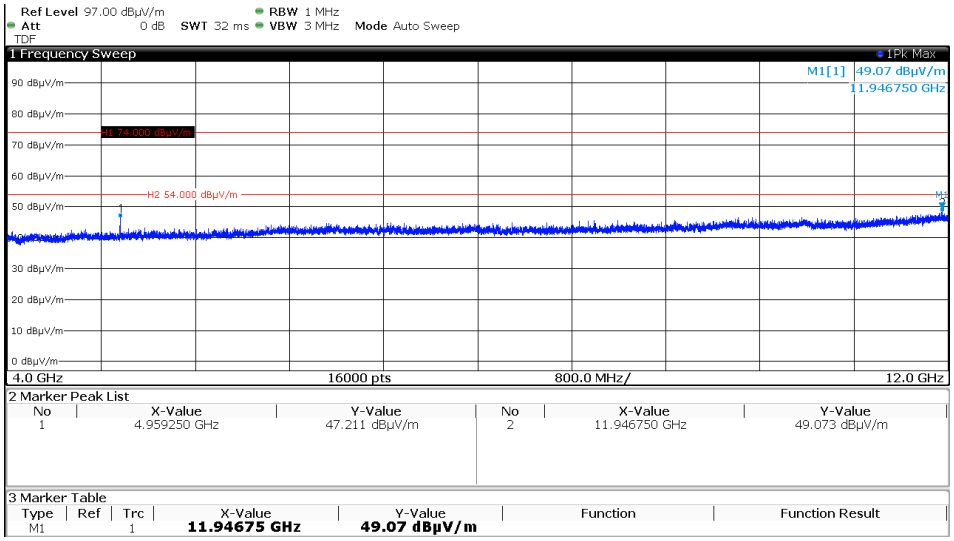


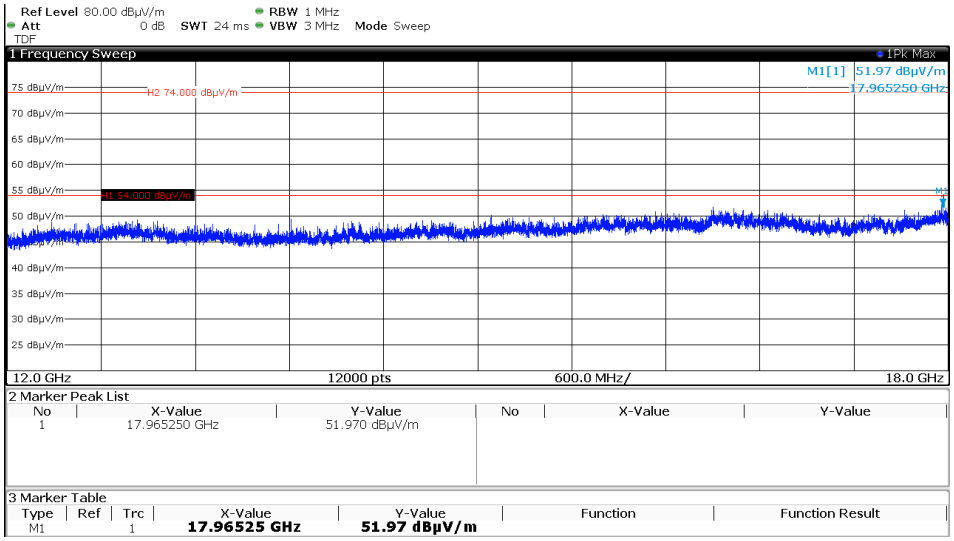




Channel 3, 2480 MHz




Ref Level 107.00 dBµV/m
RBW 1 MHz
Att 10 dB SWT 6 ms VBW 3 MHz Mode Sweep
TDF
1 Frequency Sweep
1Pk Max
M1[1] 59.35 dBµV/m
2.483626 GHz
H2 74.000 dBµV/m
H1 54.000 dBµV/m
2.4835 GHz
6000 pts
151.65 MHz/
4.0 GHz
2 Marker Peak List
No X-Value Y-Value No X-Value Y-Value
1 2.483630 GHz 59.345 dBµV/m 3 2.510920 GHz 45.343 dBµV/m
2 2.490200 GHz 53.430 dBµV/m 4 2.535190 GHz 46.470 dBµV/m
3 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 2.483626 GHz 59.35 dBµV/m


Ref Level 97.00 dBµV/m
RBW 1 MHz
Att 0 dB SWT 32 ms VBW 3 MHz Mode Auto Sweep
TDF
1 Frequency Sweep
1Pk Max
M1[1] 49.07 dBµV/m
11.946750 GHz
H1 74.000 dBµV/m
H2 54.000 dBµV/m
4.0 GHz
16000 pts
800.0 MHz/
12.0 GHz
2 Marker Peak List
No X-Value Y-Value No X-Value Y-Value
1 4.959250 GHz 47.211 dBµV/m 2 11.946750 GHz 49.073 dBµV/m
3 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 11.94675 GHz 49.07 dBµV/m


Ref Level 80.00 dBµV/m
RBW 1 MHz
Att 0 dB SWT 24 ms VBW 3 MHz Mode Sweep
TDF
1 Frequency Sweep
1Pk Max
M1[1] 51.97 dBµV/m
17.965250 GHz
H2 74.000 dBµV/m
H1 54.000 dBµV/m
12.0 GHz
12000 pts
600.0 MHz/
18.0 GHz
2 Marker Peak List
No X-Value Y-Value No X-Value Y-Value
1 17.965250 GHz 51.970 dBµV/m
3 Marker Table
Type Ref Trc X-Value Y-Value Function Function Result
M1 1 17.96525 GHz 51.97 dBµV/m

## 5.4 EBW and OBW

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

### 5.4.1 Description of the test location

Test location: NONE

**Remarks:** Not tested, because the RF section was not modified.

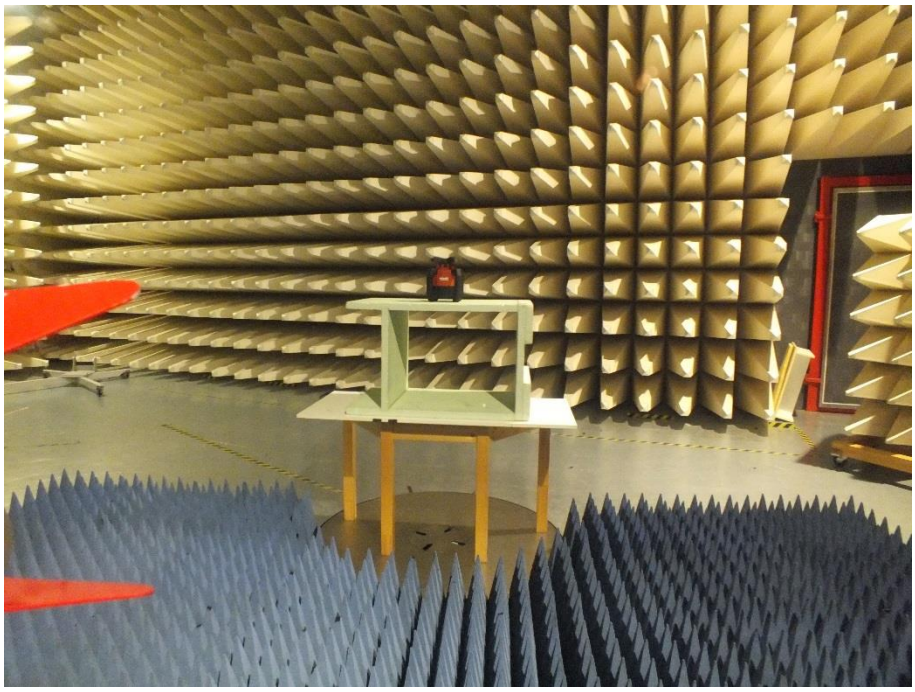
## 5.5 Correction for pulse operation (duty cycle)

For test instruments and accessories used see section 6 Part **CPR1**.

### 5.5.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

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



### 5.5.3 Applicable standard

According to FCC Part 15A, Section 15.35(c):
When the radiated emission limits are expressed in terms of average value and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete puls train, including blanking intervals, as long as the pulse train does not exceed 0.1s. In cases where the puls train exceeds 0.1s, the measured field strength shall be determined from the average absolute voltage during a 0.1s interval during which the field strength is at its maximum. The exact method of calculating the average field strength shall be submitted.

### 5.5.4 Description of Measurement

The duty cycle factor (dB) is calculated applying the following formula:

$$K_E = 20 \log \left( (t_{iw}/T_w) * (t_{iB}/T_B) \right)$$

$K_E$: pulse operation correction factor
$t_{iw}$ pulse duration for one complete pulse track
$t_{iB}$ pulse duration for one pulse
$T_w$ a period of the pulse track
$T_B$ a period of one pulse

### 5.5.5 Test result

| $t_{iw}$ (ms) | $T_w$ (ms) | $t_{iB}$ (ms) | $T_B$ (ms) | $K_E$ (dB) |
|---|---|---|---|---|
| 100 | 100 | 2.86 | 100 | -30.8 |

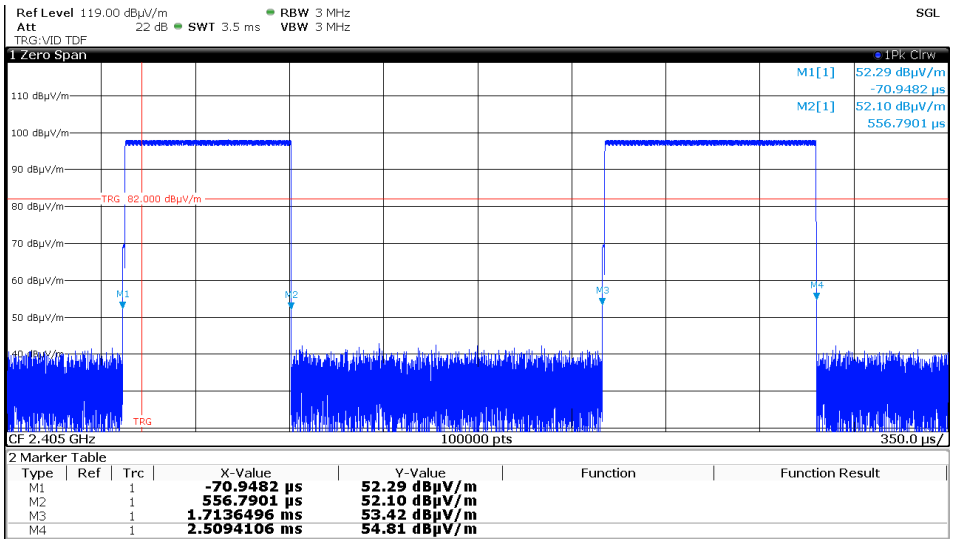
**Remarks:** The pulse train (*Tw*) exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulse widths over the 100 ms width with the highest average value.

For detailed results, please see the test protocol below.

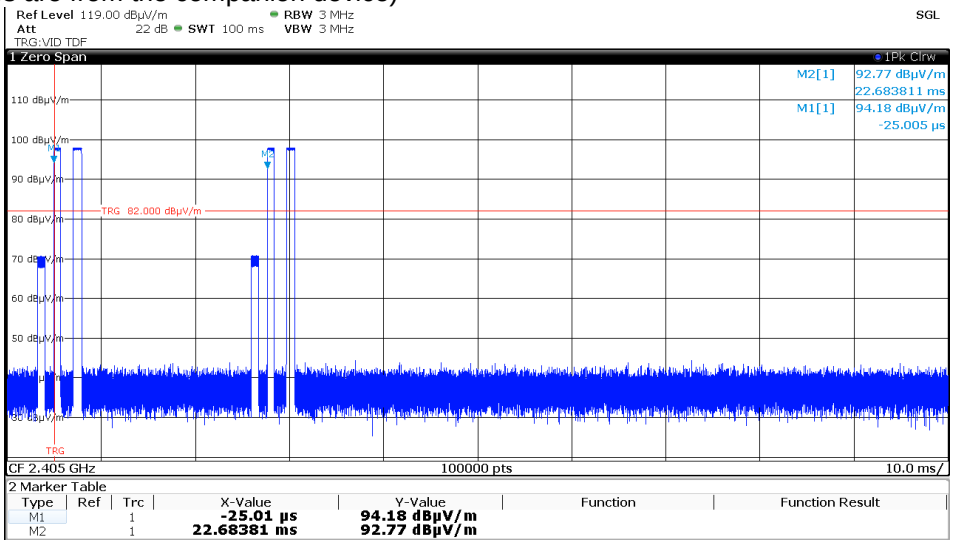
### 5.5.6 Test protocol

**Correction for Pulse Operation (Duty Cycle)**
FCC Part 15A, Section 15.35(c)

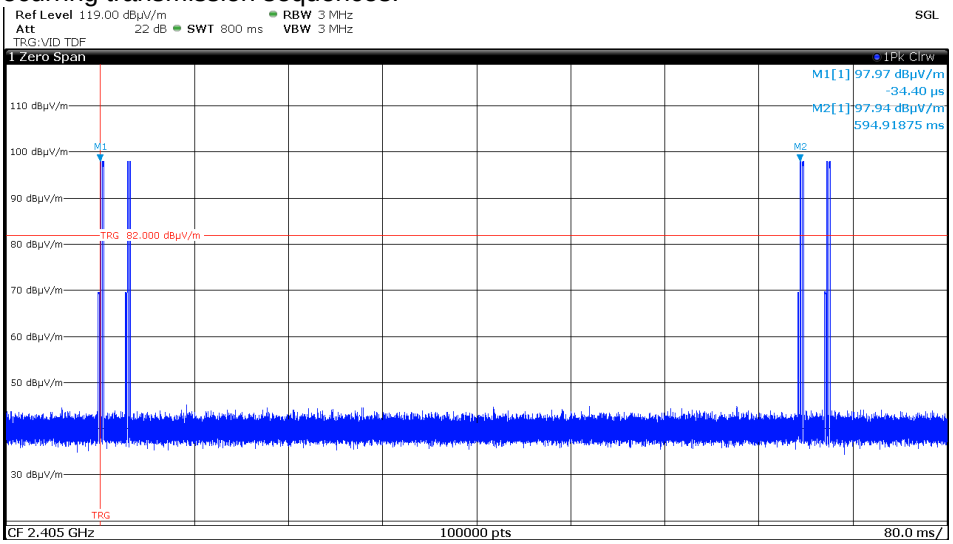
Single pulse train:




2 separate single pulses in a 100ms observation interval:
(the smaller pulses are from the companion device)



interval between recurring transmission sequences:



## 5.6 Antenna application

### 5.6.1 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.

**Remarks:** Not applicable, because the RF section was not modified.

# 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. |
|---|---|---|---|---|---|---|
| CPR 3 | FSW43 | 02-02/11-15-001 | 07/04/2018 | 07/04/2017 | | |
| | 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 | 10/05/2018 | 10/05/2017 | | | |
| | Sucoflex N-2000-SMA | 02-02/50-05-075 | | | | |
| | SF104/11N/11N/1500MM | 02-02/50-13-015 | | | | |
| SER 2 | ESVS 30 | 02-02/03-05-006 | 03/07/2018 | 03/07/2017 | | |
| | VULB 9168 | 02-02/24-05-005 | 12/04/2018 | 12/04/2017 | 12/10/2017 | 12/04/2017 |
| | 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 3 | FSW43 | 02-02/11-15-001 | 07/04/2018 | 07/04/2017 | | |
| | 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 | 10/05/2018 | 10/05/2017 | | | |
| | Sucoflex N-2000-SMA | 02-02/50-05-075 | | | | |
| | WHK 3.0/18G-10EF | 02-02/50-05-180 | | | | |
| | SF104/11N/11N/1500MM | 02-02/50-13-015 | | | | |