TÜVRheinland®
Precisely Right.

| | | | |
|---|---|---|---|
| ***Test Report No.:*** | **18112704.r01** | | *Page 1 of 52* |
| *Client:* | **N.V. Nederlandsche Apparatenfabriek 'Nedap', Parallelweg 2 7141 DC Groenlo** Netherlands, R. Ooijman , L. Hones | | |
| *Test Item:* | **Digital Transmission System (DTS)** **Luxon IoT Node Outdoor** | | |
| *Identification: HVIN* | p/n 9986979 & 9987061 | *Serial Number:* | **Node nr. 50, 70, 71,77 (conducted tests) and 34 (radiated tests)** |
| *Project No.:* | **18112704** | *Date of Receipt:* | **October 01, 2018** |
| *Testing Location:* | **TÜV Rheinland Nederland B.V.** Eiberkamp 10 9351VT Leek | | |
| *Test Specification:* | FCC 47 CFR Part 15, Subpart C, Section 15.247 (10-1-18 Edition)<br>RSS-Gen (Issue 4, November 2014) and RSS-247 (Issue 2, February 2017)<br>ANSI C63.10-2013<br>KDB 558074 D0115.247 Meas Guidance v05r01, February 11, 2019 | | |
| *Test Result:* | *The test item **passed** the test specification(s).* | | |
| *Testing Laboratory:* | **TÜV Rheinland Nederland B.V.** Eiberkamp 10 9351 VT Leek | | |

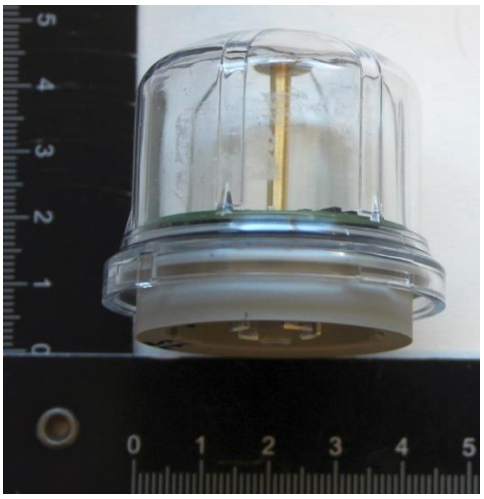
| *Tested by:* | | | *Reviewed by:* | | |
|---|---|---|---|---|---|
| 2019-05-01 | R. van der Meer / Inspector | | 2019-05-01 | E. van der Wal / Reviewer | |
| *Date* | *Name/Position* | *Signature* | *Date* | *Name/Position* | *Signature* |

*Other Aspects:two models are covered by one FCC/IC certification sharing the same RFsection.*

***Abbreviations:*** ***P(ass)*** = ***passed*** ***F(ail)*** = ***failed*** ***N/A*** = ***not applicable*** ***N/T*** = ***not tested***

**Prufbericht-Nr: 18112704.r01**
*Test report No:*



| | |
|---|---|
|  |  |
| (Big Node) HVIN 9987061 Nema | (Small node) HVIN 9986979 Zhaga |
|  | |

# TEST SUMMARY

| Test Specification Clause | Test Case | Pass | Fail | Not applicable | Not performed |
|---|---|---|---|---|---|
| §15.247(a2) | Spectrum Bandwidth of a DTS System / 6dB BW | ☒ | ☐ | ☐ | ☐ |
| § 15.247 (b) (3) | Maximum output power (conducted) | ☒ | ☐ | ☐ | ☐ |
| §15.247 (e) | Peak power spectral density | ☒ | ☐ | ☐ | ☐ |
| §15.247 (d) | Band-edge compliance of conducted emissions | ☒ | ☐ | ☐ | ☐ |
| §15.205 | Band-edge compliance of radiated emissions | ☒ | ☐ | ☐ | ☐ |
| §15.247 (d) | Spurious Emission - conducted (Transmitter) | ☒ | ☐ | ☐ | ☐ |
| § 15.209 | Spurious Emission - radiated (Transmitter) | ☒ | ☐ | ☐ | ☐ |
| § 15.207 | AC Power Line Conducted Emissions <30 MHz | ☒ | ☐ | ☐ | ☐ |

**Revisions**
***Revisions***

| **Revision** Revision | **Datum** Date | **Anmerkung** Remark | **Verfasser** Author |
|---|---|---|---|
| - | 12.03.2019 | First release | R. van der Meer |
| 01 | 16.03.2019 | typos | R. van der Meer |
| 02 | 01.05.2019 | added FCC ID IC ID,<br>corrected HVIN inconsistency | R. van der Meer |
| Note: Latest revision report will replace all previous reports | | | |

# Contents

# 1. General Remarks

## 1.1.1 Complementary Materials

There is no attachment to this test report.

## 1.1.2 Special Accessories

None.

## 1.1.3 Equipment modifications

None

# 2. Test Sites

## 2.1 Test Facilities

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meters. The site is listed with the FCC and ISED and accredited by RvA (Cert #L484). The 3 meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meter

The Federal Communications Commission and Industry Canada has reviewed the technical characteristics of the test facilities at TÜV Rheinland Nederland B.V., located in Leek, 9351VT Eiberkamp 10, The Netherlands, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948.

The description of the test facilities has been filed at the Office of the Federal Communications Commission under registration number 786213. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

The description of the test facilities has been filed to Industry Canada under registration number 2932G-2. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

Normal test conditions:

Temperature (*) : +15°C to +35°C
Relative humidity(*) : 20 % to 75 %
Supply voltage : 24 Vdc.

*(*)When it was impracticable to carry out the tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests are stated separately*.

## 2.2 List of Test and Measurement Instruments

### Table 1: List of Test and Measurement Equipment

| Kind of Equipment | Manufacturer | Model Name | Inventory number | Calibration date (mm/yyyy) | Calibration due date (mm/yyyy) |
|---|---|---|---|---|---|
| **For Antenna Port Conducted Emissions** | | | | | |
| Temperature-Humiditymeter | Extech | SD500 | A00446 | 06/2018 | 06/2019 |
| Spectrum Analyzer | Rohde & Schwarz | FSV | A01744 | 07/2018 | 07/2020 |
| Power supply | Voltcraft | PS303 | 2789038 /A00264 | 12/2018 | 12/2019 |
| RF Cable | Rohde & Schwarz | WF | 2789116 /A00347 | 07/2018 | 07/2019 |
| **For Radiated Emissions** | | | | | |
| Measurement Receiver | Rohde & Schwarz | ESCI | A00314 | 03/2018 | 03/2019 |
| RF Cable S-AR | Gigalink | APG0500 | A00447 | 01/2019 | 01/2020 |
| Controller | Maturo | SCU/088/ 8090811 | A00450 | N/A | N/A |
| Controller | EMCS | DOC202 | A00257 | N/A | N/A |
| Test facility | Comtest | FCC listed: 786213 IC: 2932G-2 | A00235 | 10/2017 | 10/2020 |
| Spectrum Analyzer | Rohde & Schwarz | FSV | A00377 | 07/2018 | 07/2019 |
| Antenna mast | EMCS | AP-4702C | A00258 | N/A | N/A |
| Temperature-Humiditymeter | Extech | SD500 | A00444 | 06/2018 | 06/2019 |
| Guidehorn 1-18 GHz | EMCO | 3115 | A00008 | 12/2017 | 12/2020 |
| Guidehorn 18-40 GHz | EMCO | RA42-K-F-4B-C | A00012 | 01/2018 | 01/2021 |
| Biconilog Testantenna | Teseq | CBL 6111D | A00466 | 10/2018 | 10/2019 |
| 2.4 GHz bandreject filter | BSC | XN-1783 | A00065 | N/A | N/A |
| Bandpass filter 4-10 GHz | Reactel | 7AS-7G-6G-511 | A00131 | N/A | N/A |
| Bandpass filter 10-26 GHz | Reactel | 9HS-10G/26.5G-S11 | A00151 | N/A | N/A |
| Preamplifier 0.5 - 18 GHz | Miteq | AMF-5D-005180-28-13p | A00247 | N/A | N/A |
| Filterbox | EMCS | RFS06S | A00255 | 04/2018 | 04/2019 |
| Power supply | Voltcraft | PS303 | 2789038 /A00264 | 12/2018 | 12/2019 |

| Kind of Equipment | Manufacturer | Model Name | Inventory number | Calibration date (mm/yyyy) | Calibration due date (mm/yyyy) |
|---|---|---|---|---|---|
| **For AC Powerline Conducted Emissions** | | | | | |
| Pulse limiter | R&S | ESH3-Z2 | 2788823 (A00051) | 11/2018 | 11/2019 |
| Variac | RFT | LSS020 | A00171 | NA | NA |
| LISN | R&S | ESH2-Z5 | 2788791 (A00019) | 06/2018 | 06/2020 |
| Measurement Receiver | Rohde & Schwarz | ESCS30 | A00726 | 10/2018 | 10/2019 |
| Shielded room for Conducted emissions | -- | -- | A00437 | NA | NA |
| Temperature-Humidity meter | Extech | SD500 | A00444 | 06/2018 | 06/2019 |
| Power supply | Voltcraft | PS303 | 2789038 /A00264 | 12/2018 | 12/2019 |

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing. NA= Not Applicable

**Accreditation**
The reported tests were performed under ISO17025 accreditation, unless otherwise specified as 'not under Accreditation'

An overview of all TÜV Rheinland Nederland B.V. accreditations, notifications and designations, please visit our website www.tuv.com/nl. You can find the relevant declarations under the download link.

## 2.3 Measurement Uncertainty

### Table 2: Emission Measurement Uncertainty

| Measurement Type | Frequency | Uncertainty |
|---|---|---|
| Antenna Port Conducted Emission | < 1.3GHz | 1.7dB |
| | 1.3 - 40GHz | 2.9 – 3.4dB |
| Radiated Emission | 150kHz - 30MHz | ±5.0dB |
| | 30MHz - 1GHz | ±5.0dB |
| | > 1GHz | ±5.5dB |
| AC Power Line Conducted Emissions | 150kHz - 30MHz | ±3.5dB |

# 3. General Product Information

The EUT is wireless controlled outdoor luminaires. The EUT has the capability of operating in the 2.4 GHz frequency band and uses propriety protocol.

Technical Specifications

| **Technical Specifications** | **Value** |
|---|---|
| Operating Frequency band | 2408 – 2475 MHz , Non Hopping |
| Default operating channel | 2450 MHz |
| Modulation | GFSK |
| Antenna Gain | 0 dBi |

By factory default, the center frequency for the RF communication is 2450MHz. It It can be changed in a range from 2408 to 2475 MHz, which must be performed by Nedap service personnel in rare case that there is too much interference present on 2450 MHz.

There are no interface ports present on the EUT.

## 3.1 Countermeasures to achieve compliance

No additional measures were employed to achieve compliance.

## 3.2 Operation Modes

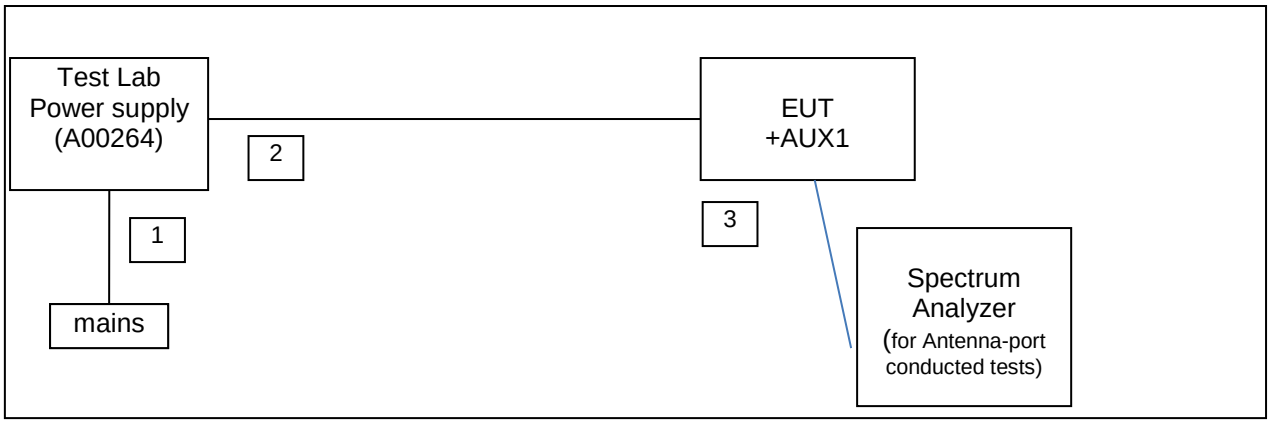
Testing was performed at the lowest operating frequency (2408 MHz), at the operating frequency in the middle of the specified frequency band (2450 MHz) and at the highest operating frequency (2475 MHz). These operation modes were selected after review of the capabilities and characteristics of the EUT.

## 3.3 Physical Configuration for Testing

The EUT was tested on a stand-alone basis as per Figure 1 for the antenna port conducted tests and with lamp driver and motion detector.

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10-2013.

**Figure 1: Test Setup Diagram – antenna port conducted tests and programming.**




| No. | Port | From | To | Remarks |
|---|---|---|---|---|
| 1. | Mains | Mains | Power Supply (A00264) | - |
| 2. | DC Power | Power Supply | EUT | - |
| 3. | Antenna port | EUT | Spectrum analyzer | Conducted tests |
| | | | | |

For radiated tests:

| List of used cables | | | | | |
|---|---|---|---|---|---|
| **No.** | **Function** | **From** | **To** | **Length** | **Remarks** |
| 1 | Power | EUT | DC *) | < 1 m | |
| 2 | Controlling | EUT | Lamp Driver | < 3 m | |
| 3 | Motion detecting | EUT | Manual control | < 3 m | |

*) EUT is part of lighting system and is powered from Host inside

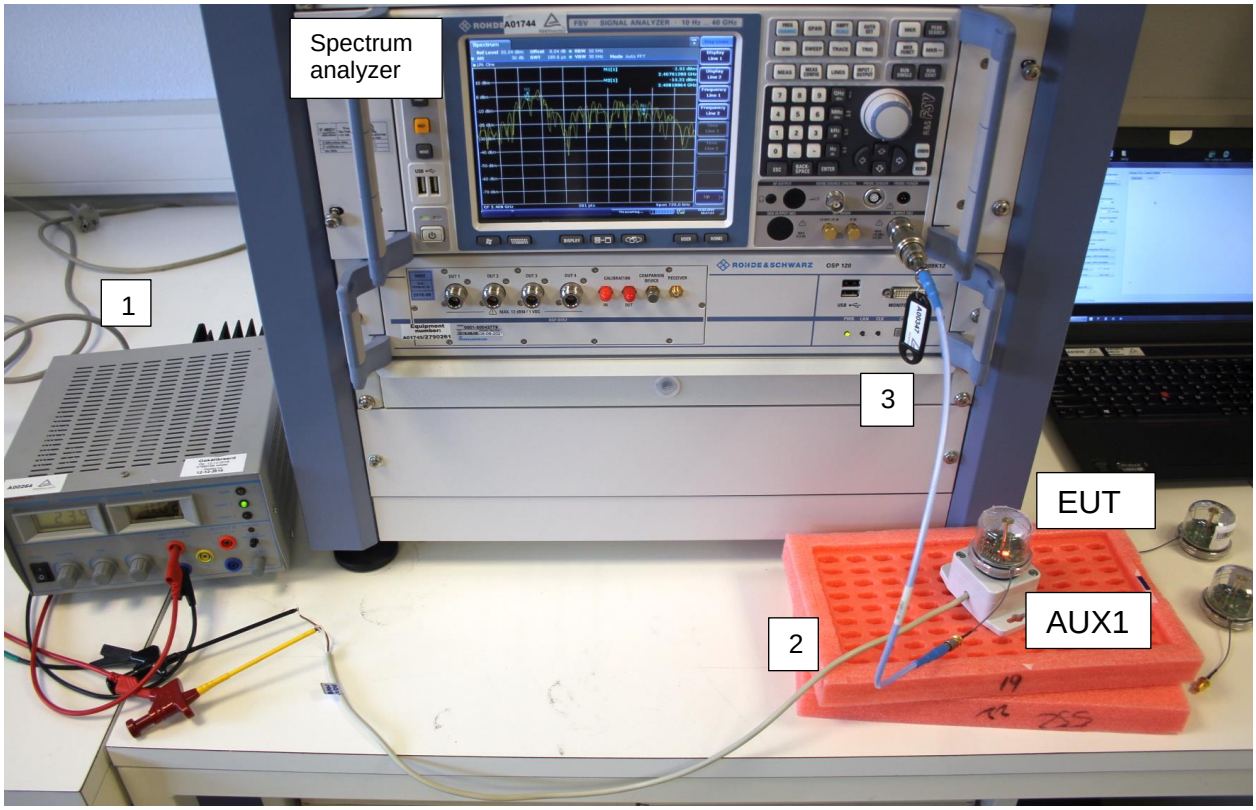



Figure 2a: Test Setup Photos – conducted tests

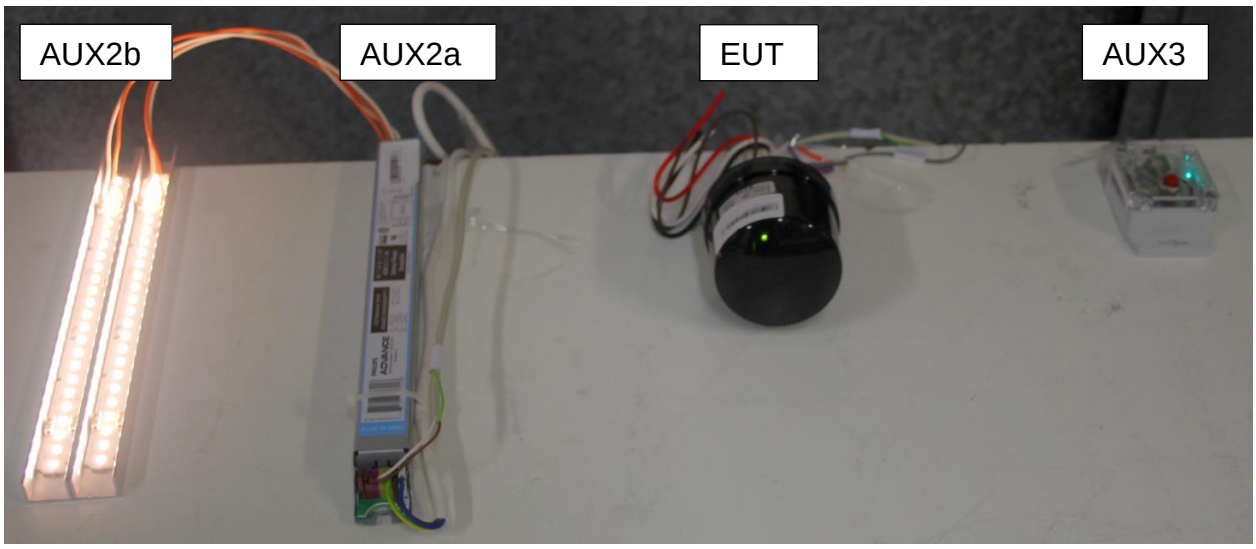
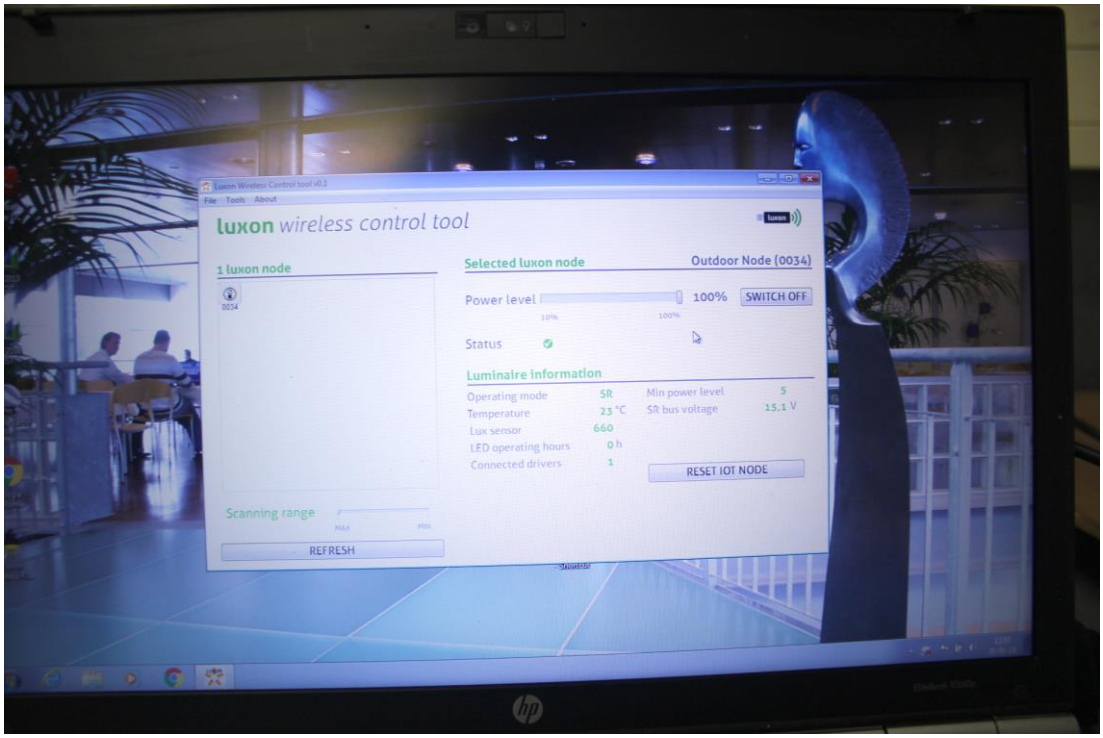



Figure 3b: Test Setup Photos – radiated tests

## 3.4 Test Software

Luxon wireless control tool v0.1 was used for AC power line conducted emissions to set the Normal operation mode. Dedicated samples for each test frequency was provided by the applicant for conducted and radiated emissions tests.




## 3.5 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:
AUX1 Test fixture for holding the EUT
AUX2a Lamp driver Philips Advance X1040C110V054VPT1 and
AUX2b LED lamps Philips Fortimo
AUX3 Motion detector Nedap

# 4. Test Results

## 4.1.1 6dB and 99% Bandwidth

**RESULT: PASS**

Date of testing: 2019-02-15

Requirements:

FCC 15.247(a)(2) and RSS-247 Section 5.2(1)
For systems using digital modulation in the 2400-2483.5MHz band, the 6dB bandwidth shall be at least 500kHz.

For 99% Bandwidth: RSS-Gen Section 4.6.1: No requirement is given.

Test procedure 6dB bandwidth:

ANSI C63.10-2013 section 11.8.1 Option 1

A spectrum analyzer was connected to the antenna port of the EUT. The spectrum analyzer resolution bandwidth was set to 100kHz, video bandwidth to 300kHz and the span wide enough to capture the modulated carrier.

For 99% Bandwidth:

Test procedure: RSS-Gen.

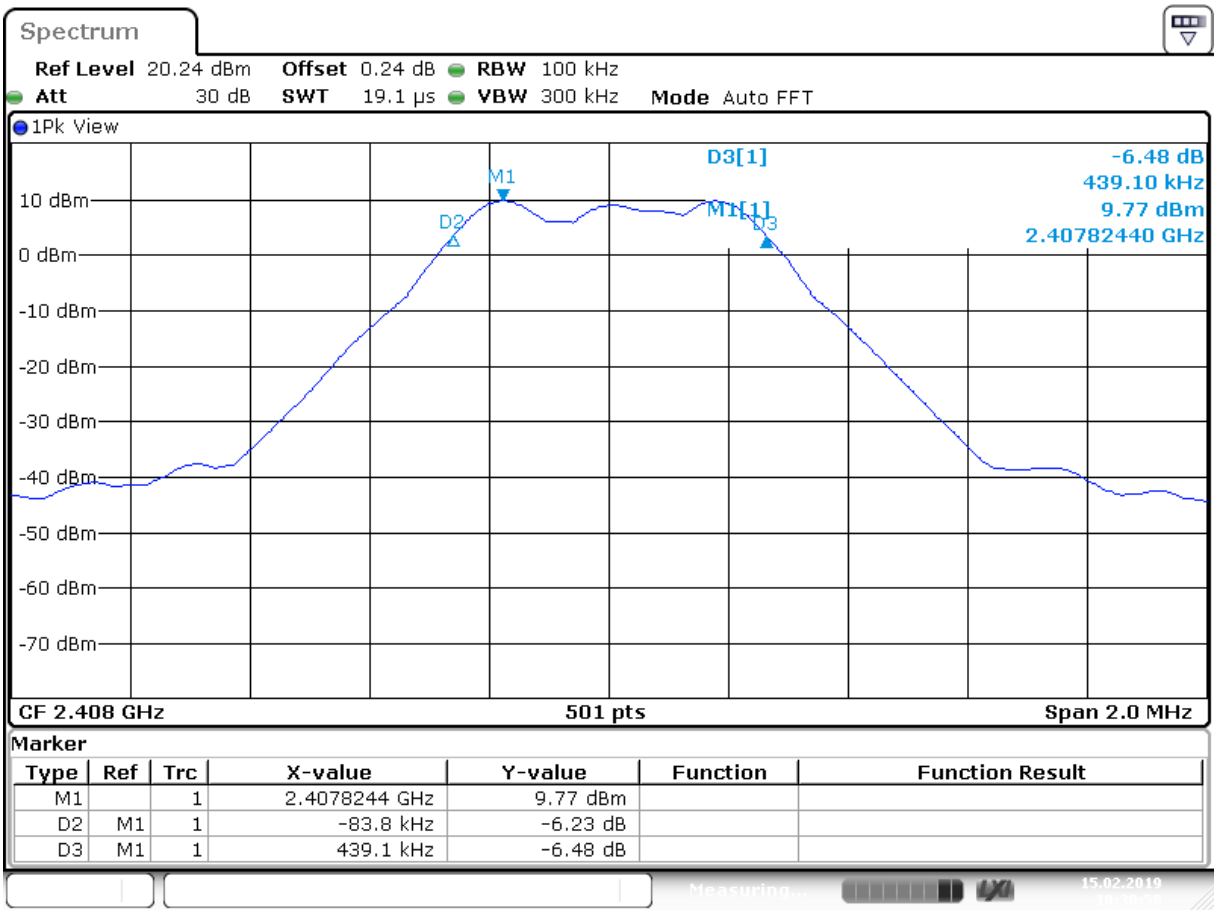
The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission sideskirts. The resolution bandwidth shall be set as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

A spectrum analyzer was connected to the antenna port of the EUT. The spectrum analyzer resolution bandwidth was set to 1% of the selected span, Video bandwidth was set to 3 times the resolution bandwidth. The span was set to capture the whole modulation process. The Spectrum analyzers automated function for 99% BW was used.
Measurement uncertainty is +/-

Plots A1,B1 and C1 shown on the next pages are of the 6 dB bandwidth.
Plots A2,B2 and C2 shown on the next pages are of the 99% bandwidth

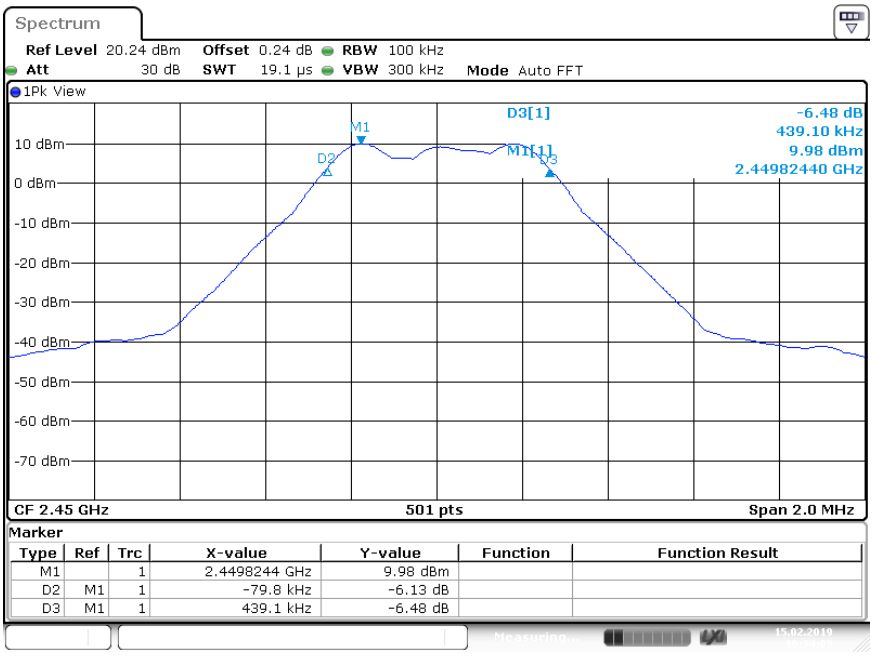
## 6dB and 99% Bandwidth

| Operating Frequency [MHz] | 99% Bandwidth [kHz] | 6dB Bandwidth [kHz] | Limit [kHz] | Verdict [Pass/Fail] | Plot number |
|---|---|---|---|---|---|
| 2408 | 622.8 | 522.9 | >500 | Pass | A1/A2 |
| 2450 | 614.8 | 518.9 | >500 | Pass | B1/B2 |
| 2475 | 626.7 | 522.9 | >500 | Pass | C1/C2 |

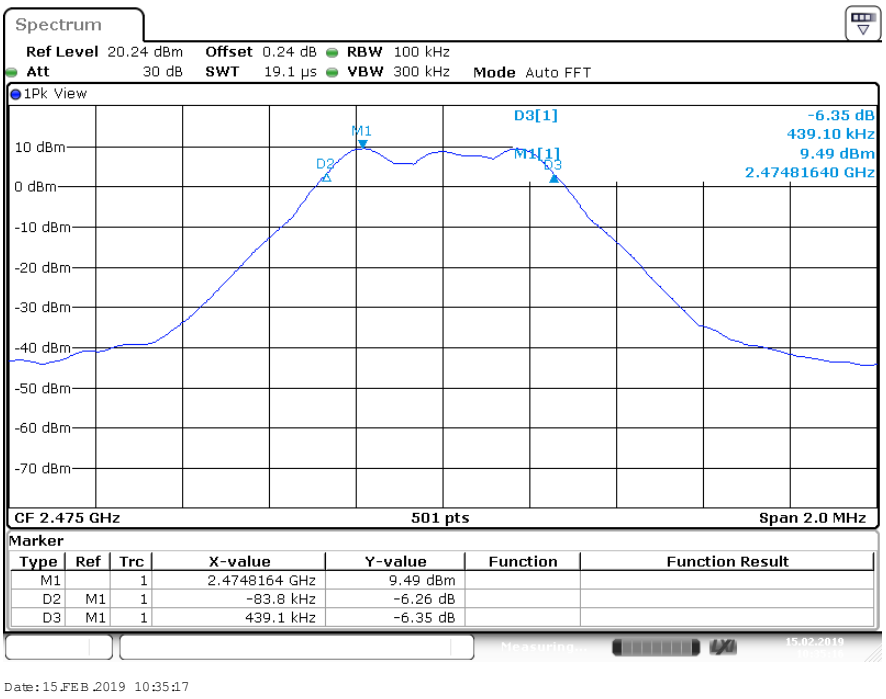



Date: 15.FEB.2019 10:30:58

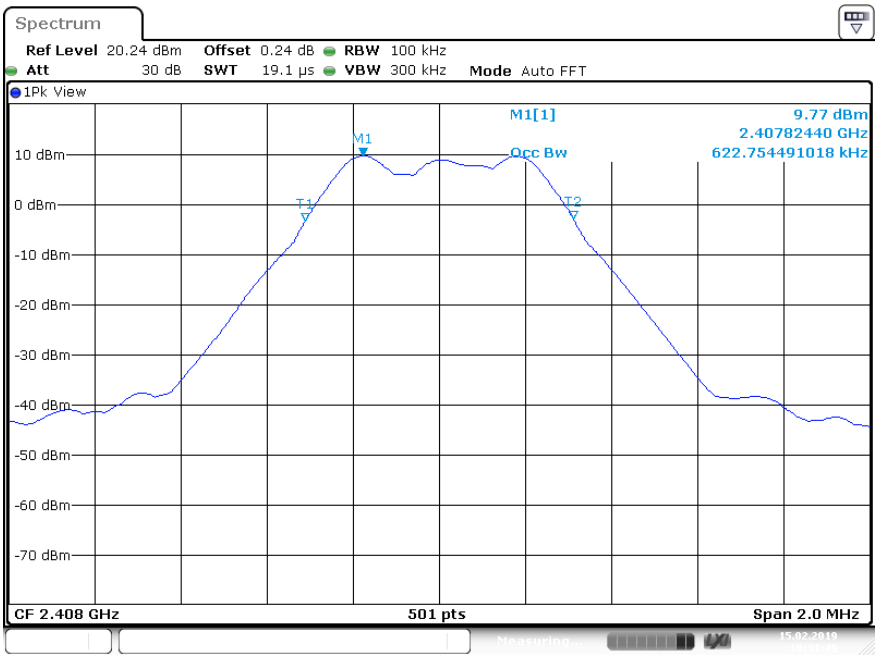
Plot A1



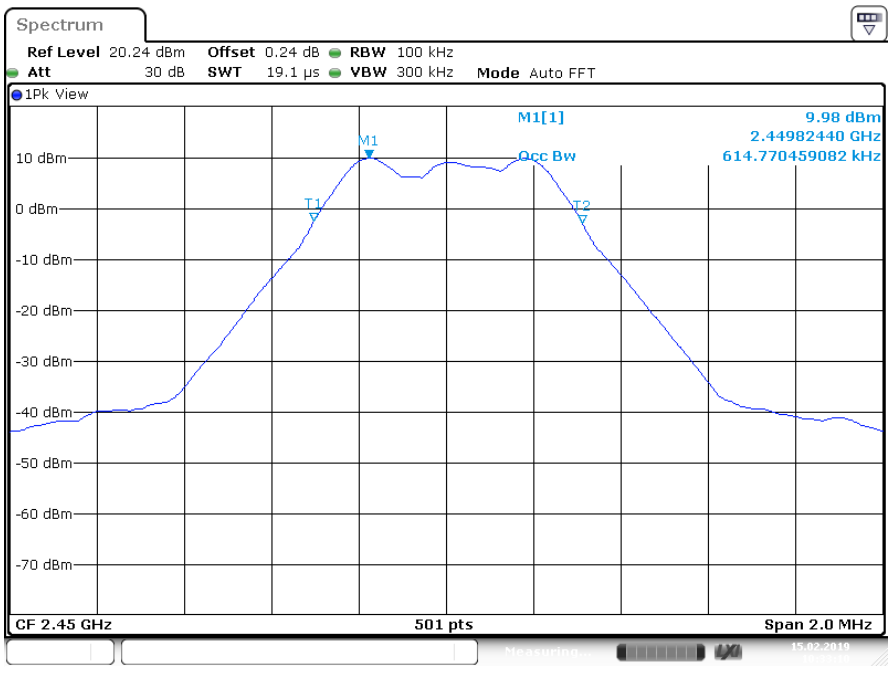

Plot B1



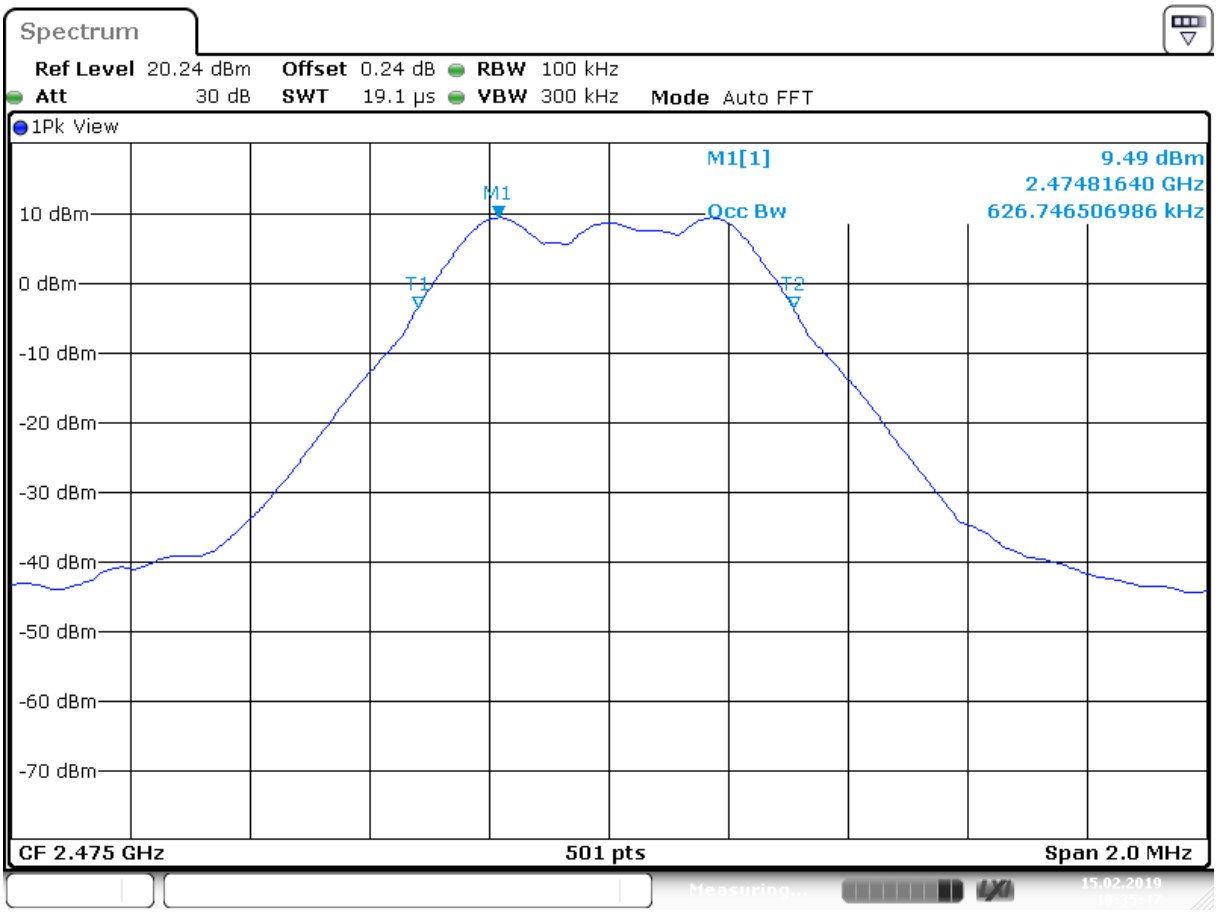

Plot C1




Plot A2




Plot B2




Date: 15.FEB.2019 10:35:47

Plot C2

### 4.1.2 Conducted Output Power

**RESULT: PASS**

Date of testing: 2019-02-15

Requirements:

FCC 15.247(b)(3)

For systems using digital modulation in the 2400-2483.5 MHz band, the maximum peak output power is 1W (+30dBm).
RSS-247 section 5.4(4): the e.i.r.p. shall not exceed 4 W (+36 dBm).

Test procedure:

The Peak Conducted Output Power was measured using the method according to section 11.9.1.1 in ANSI C63.10-2013.

The maximum peak output power (conducted) was measured at the antenna connector with a spectrum analyzer. The final measurement takes into account the loss generated by all the involved cables.

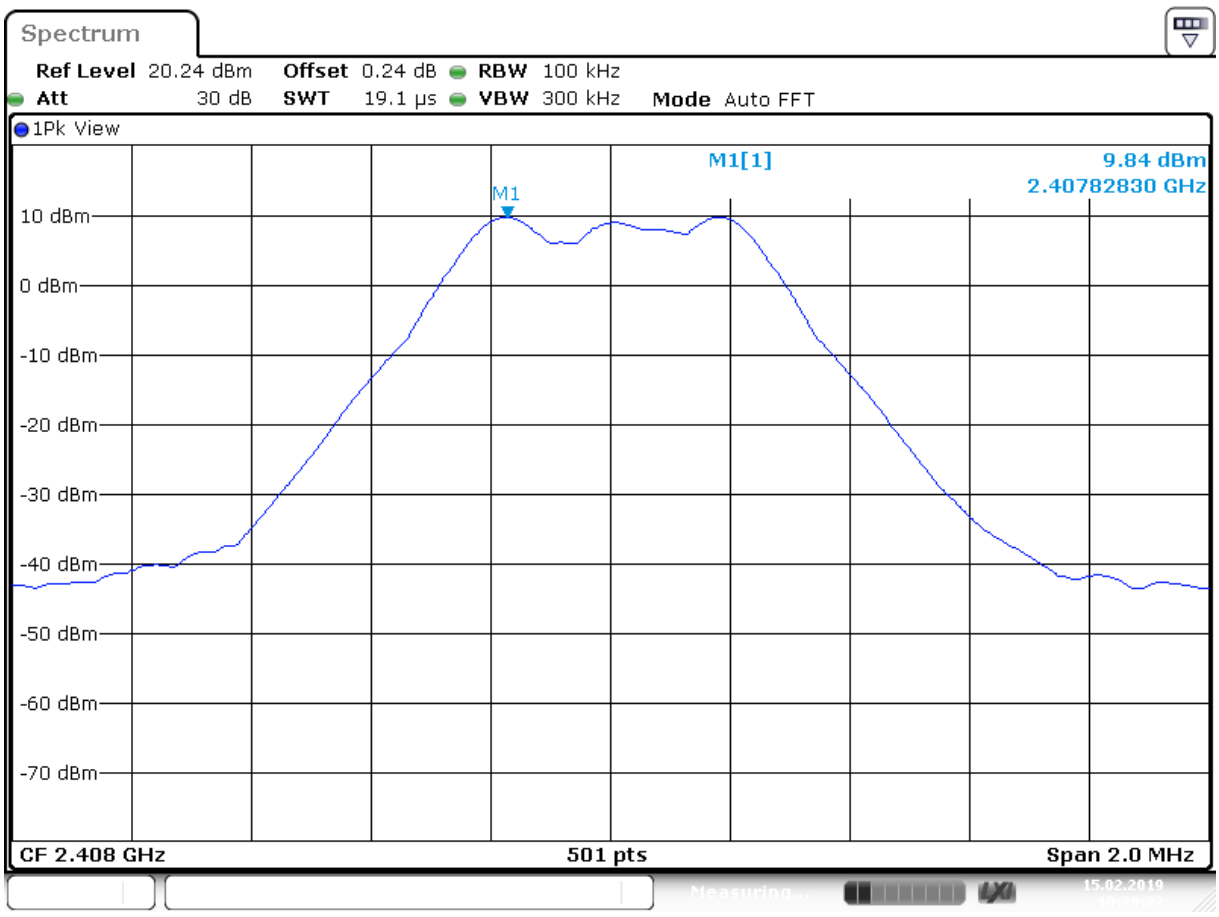
Measurement uncertainty is +/- 0.7 dB.

Notes: mW = 10 ^ (dBm/10)
dBm = 10 x log(mW)

**plots : Peak power plots**,
Figures 1a, 1b and 1c show plots of the Peak Power outputs, correction factors (= 0.24dB Cable loss) included in the reading.

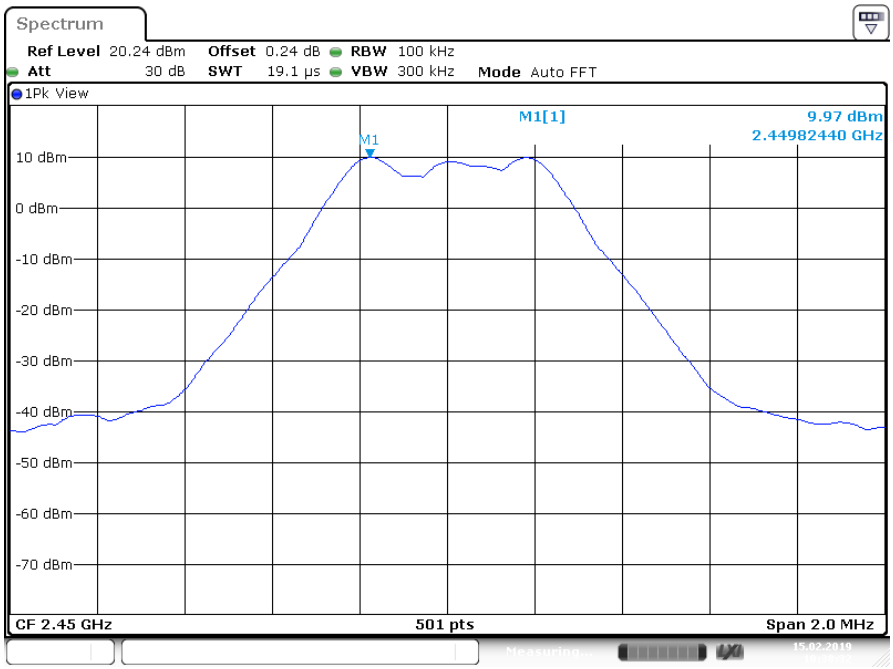
## Conducted Output Power

| Frequency [MHz] | Output Power [dBm] | Limit [dBm] | Verdict [Pass/Fail] | Antenna Gain (dBi) | EIRP (dBm) | EIRP (W) | Plot number |
|---|---|---|---|---|---|---|---|
| 2408 | 9.84 (9.6 mW) | +30 | Pass | 0 | 9.84 | 0.0096 | 1A |
| 2450 | 9.97 (9.9 mW) | +30 | Pass | 0 | 9.97 | 0.0099 | 1B |
| 2475 | 9.44 (8.8 mW) | +30 | Pass | 0 | 9.44 | 0.0088 | 1C |

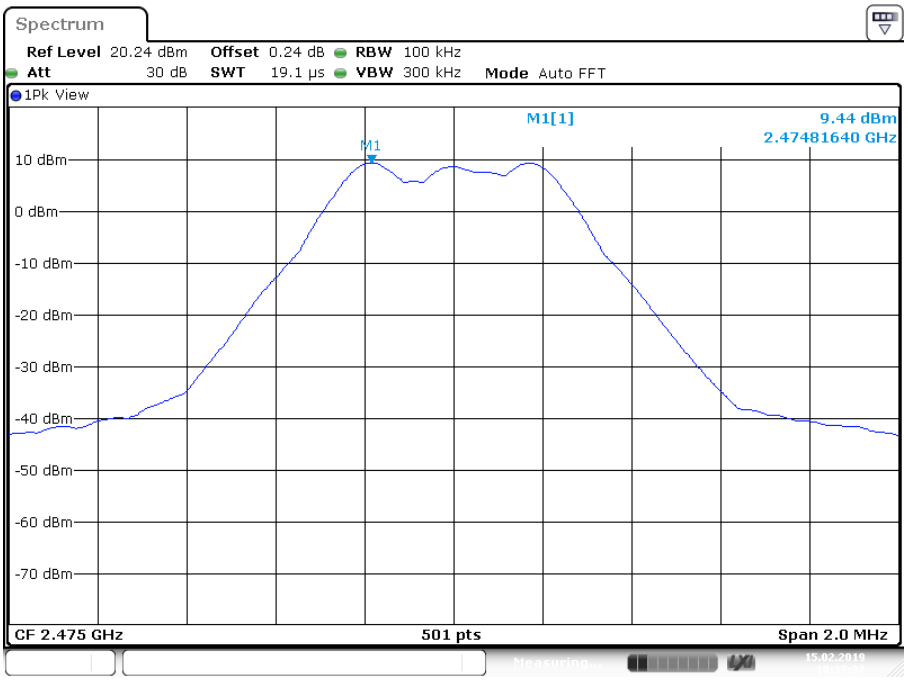



Date: 15.FEB.2019 10:39:22

Plot A


Spectrum
Ref Level 20.24 dBm Offset 0.24 dB RBW 100 kHz
Att 30 dB SWT 19.1 µs VBW 300 kHz Mode Auto FFT
1Pk View
M1[1] 9.97 dBm
2.44982440 GHz
M1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.45 GHz
501 pts
Span 2.0 MHz
Measuring...
15.02.2019
Date: 15.FEB.2019 10:38:32

Plot B


Spectrum
Ref Level 20.24 dBm Offset 0.24 dB RBW 100 kHz
Att 30 dB SWT 19.1 µs VBW 300 kHz Mode Auto FFT
1Pk View
M1[1] 9.44 dBm
2.47481640 GHz
M1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.475 GHz
501 pts
Span 2.0 MHz
Measuring...
15.02.2019
Date: 15.FEB.2019 10:37:37

Plot C

## 4.1.3 Peak Power Spectral Density

**RESULT: PASS**

Date of testing: 2019-02-15

Requirements:

FCC 15.247(e) and RSS-247 section 5.2(2)

For digitally modulated systems, the power spectral density (PSD) conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

Test procedure:

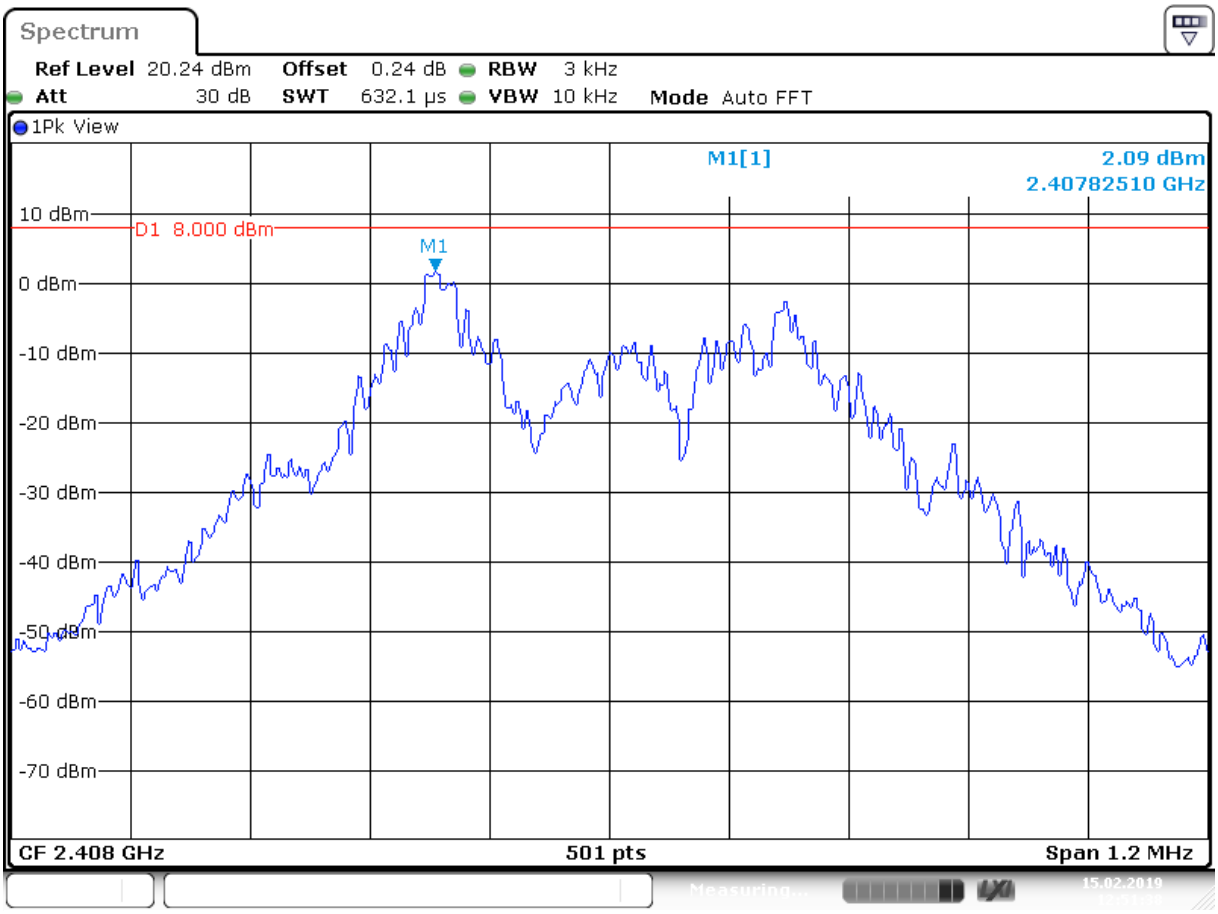
ANSI C63.10-2013

The section 11.10.2 PKPSD peak PSD procedure was used. A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 3kHz and the video bandwidth was set to 10kHz. The sweep time was set to auto couple and the trace was allowed to stabilize before making the final measurement. By using the Peak marker function the maximum amplitude was determined. The final measurement takes into account the loss generated by all the involved cables.

Measurement uncertainty is +/- 0.7 dB.

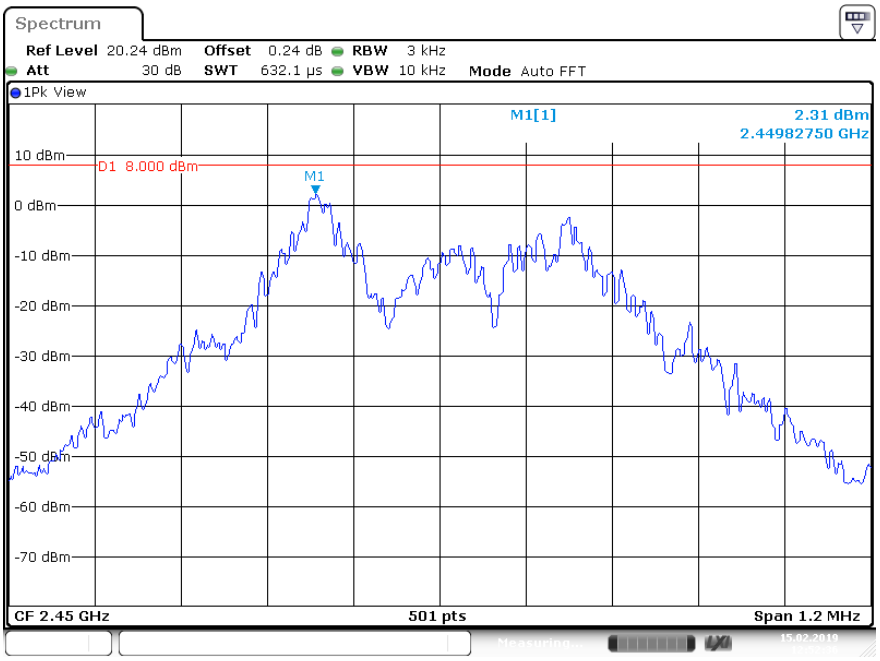
## Peak Power Spectral Density

| Operating Frequency [MHz] | Max PSD [dBm] | Limit [dBm] | Verdict [Pass/Fail] | Plot |
|---|---|---|---|---|
| 2408 | 2.09 | 8 | Pass | A |
| 2450 | 2.31 | 8 | Pass | B |
| 2475 | 1.76 | 8 | Pass | C |

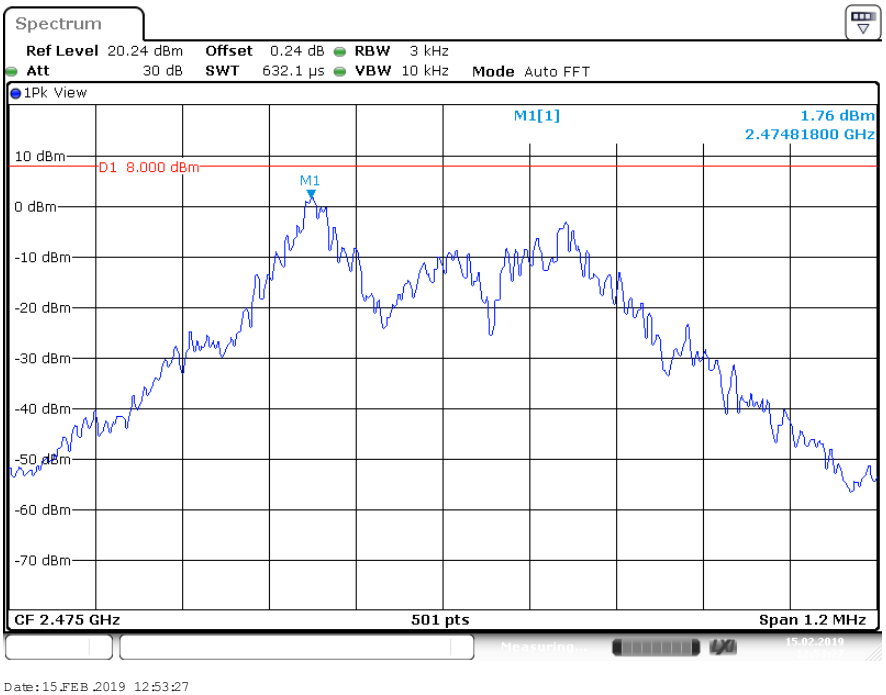



Date: 15.FEB.2019 12:51:38

Plot A


Spectrum
Ref Level 20.24 dBm Offset 0.24 dB RBW 3 kHz
Att 30 dB SWT 632.1 µs VBW 10 kHz Mode Auto FFT
1Pk View
M1[1] 2.31 dBm
2.44982750 GHz
D1 8.000 dBm
M1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.45 GHz
501 pts
Span 1.2 MHz
Measuring...
15.02.2019
Date: 15.FEB.2019 12:52:37

Plot B


Spectrum
Ref Level 20.24 dBm Offset 0.24 dB RBW 3 kHz
Att 30 dB SWT 632.1 µs VBW 10 kHz Mode Auto FFT
1Pk View
M1[1] 1.76 dBm
2.47481800 GHz
D1 8.000 dBm
M1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.475 GHz
501 pts
Span 1.2 MHz
Measuring...
15.02.2019
Date: 15.FEB.2019 12:53:27

Plot C

## 4.1.4 Band Edge Conducted Emissions

**RESULT: Pass**

Date of testing: 2019-02-15

Requirements:

FCC 15.205, FCC 15.209, FCC 15.247(d) and RSS-247 section 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test procedure:

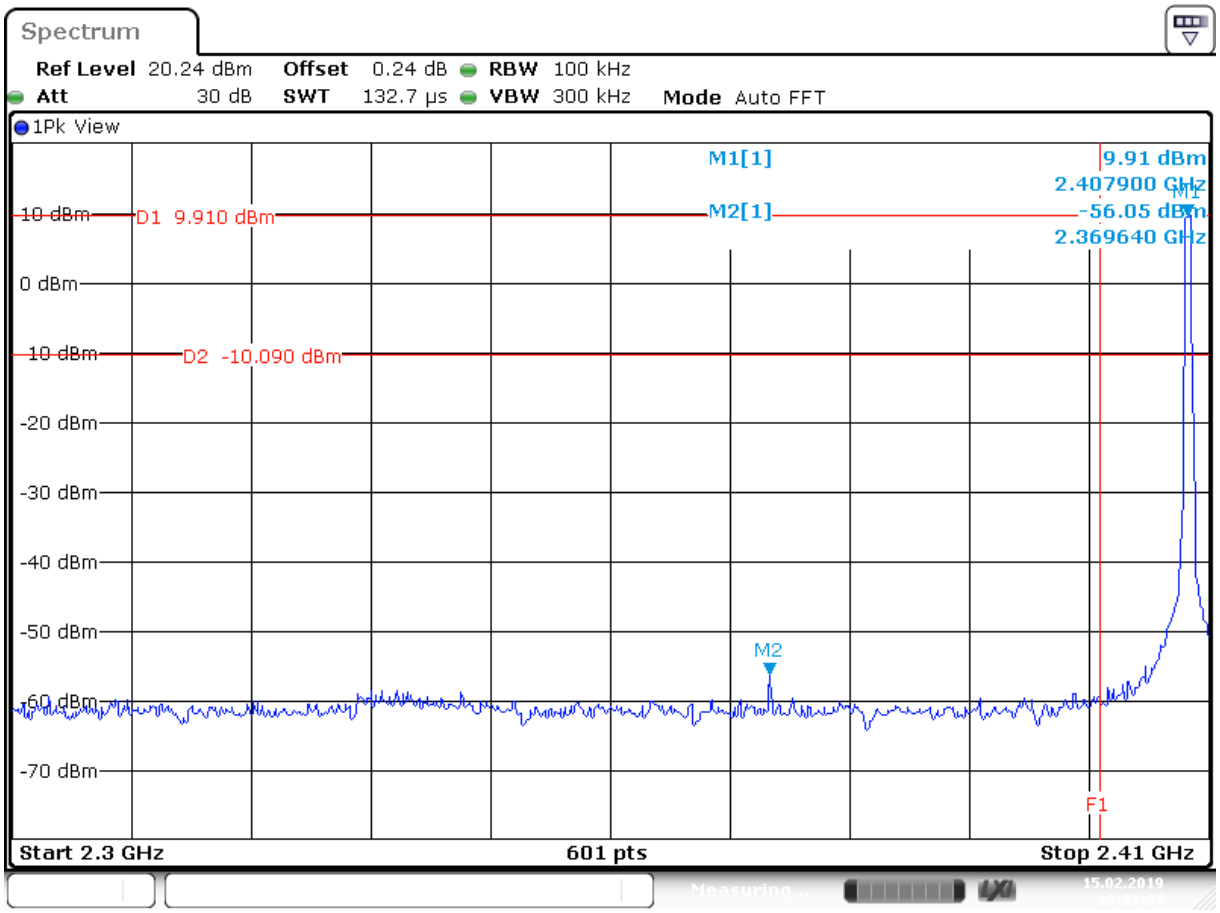
ANSI C63.10-2013
KDB 558074 D0115.247 Meas Guidance v05r01, February 11, 2019
Section 11.13

The marker-delta method, as described in ANSI C63.10 was used.

Measurements were performed using a spectrum analyzer with a suitable span to encompass the peak of the fundamental and using the following settings:
RBW = 100kHz, VBW = 300kHz.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.
Measurement uncertainty is +/- 0.7 dB.

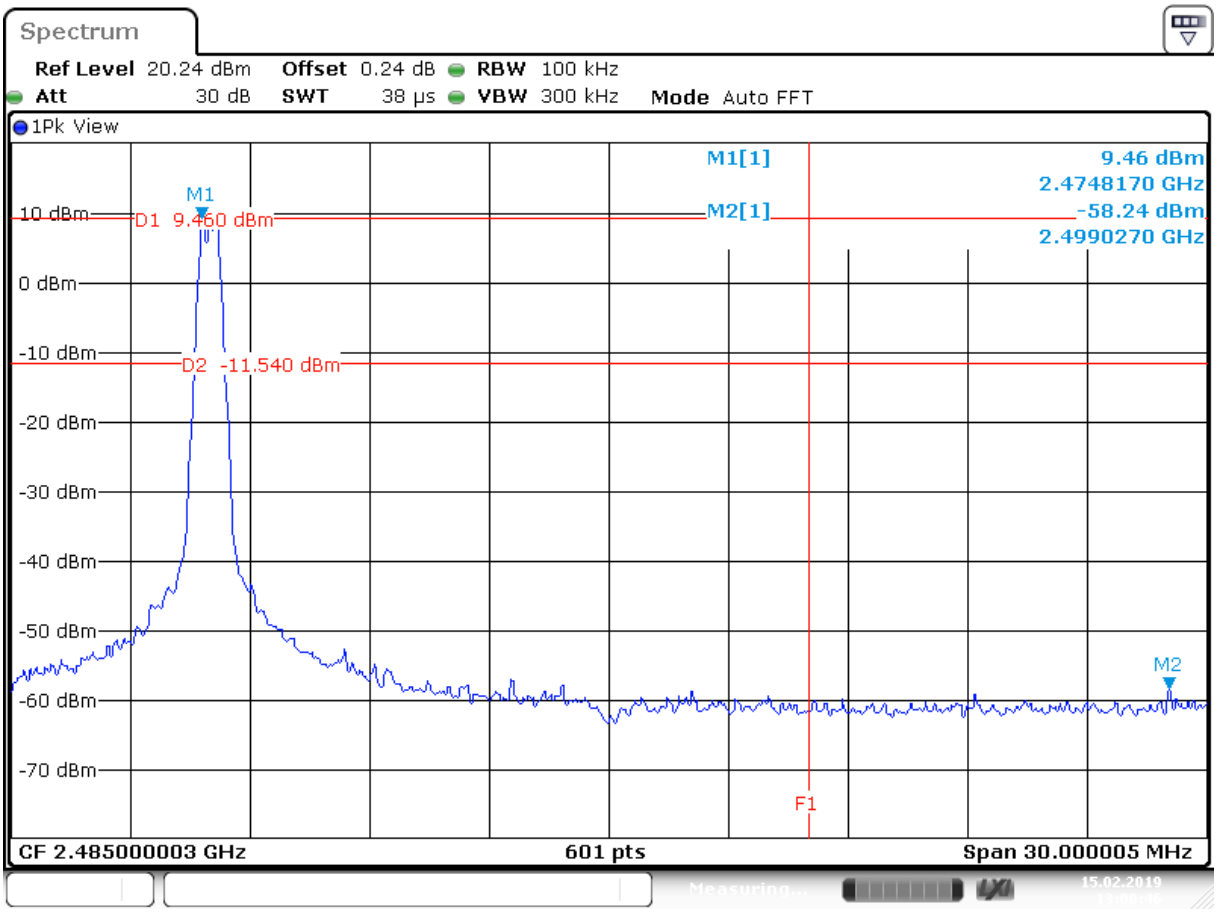
Results: All out of band spurious emissions are more than 20 dB below the fundamental.
See the figures on the following pages.




Date: 15.FEB.2019 13:03:38

Plot: Band Edge Conducted Emission, Spectral Diagram, 2408 MHz

Plot showing more than 20 dB band edge attenuation.
F1 shows the band edge frequency of 2400 MHz.




Date: 15.FEB.2019 13:00:47

Plot: Band Edge Conducted Emission, Spectral Diagram, 2475 MHz.
Plot showing more than 20 dB band edge attenuation.
F1 shows the band edge frequency of 2483.5 MHz.

## 4.1.5 Radiated Spurious Emissions of Transmitter

**RESULT: PASS**

Date of testing: 2019-02-01 & 19

Frequency range: 30MHz - 25GHz

Requirements:

FCC 15.209 and FCC 15.247(d) and RSS-Gen

Radiated emissions which fall outside the operation frequency band and outside restricted bands shall either meet the limit specified in FCC 15.209(a) or be attenuated at least 20dB below the power level in the 100kHz bandwidth within the band that contains the highest level of the desired power (the less severe limit applies).
Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) and RSS-Gen Table 6, must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen Table 4.

Test procedure:

ANSI C63.10-2013
KDB 558074 D0115.247 Meas Guidance v05r01, February 11, 2019

Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 30MHz to the 10th harmonic of the highest fundamental transmitter frequency (25GHz). Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit. Where Peak (Pk) values where at least 6 dB under the Average (Av) limits, Av value was not tested. Were Average values were tested, Average values were measured using a reduced Video Bandwidth, with a minimum of 10 kHz.

## Radiated Emissions, 30MHz - 1GHz

| Frequency [MHz] | EUT Orientation | Antenna Orientation | Level QP [dBµV/m] | Limit QP [dBµV/m] | Verdict [Pass/Fail] |
|---|---|---|---|---|---|
| 48.7 | Side | Vertical | 34.2 | 40.0 | Pass |
| 160.7 | Vertical | Vertical | 30.1 | 43.5 | Pass |
| 162.7 | Side | Vertical | 34.0 | 43.5 | Pass |
| 366.0 | Vertical | Vertical | 25.1 | 46.0 | Pass |
| 425.0 | Side | Horizontal | 25.9 | 46.0 | Pass |
| 844-960 noise | - | Vertical | 30.9 | 46.0 | Pass |

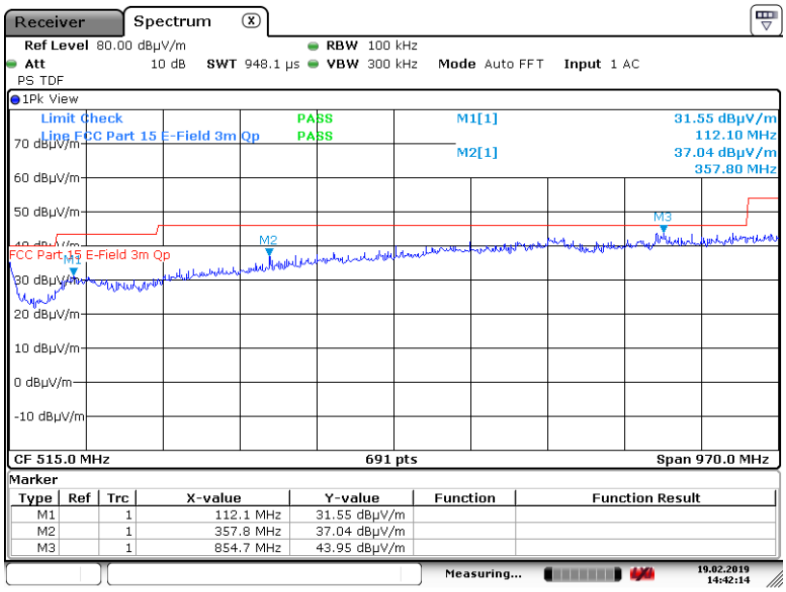
Results of the small node

| Frequency [MHz] | EUT Orientation | Antenna Orientation | Level QP [dBµV/m] | Limit QP [dBµV/m] | Verdict [Pass/Fail] |
|---|---|---|---|---|---|
| 36.3 | Side | Vertical | 28.8 | 40.0 | Pass |
| 47.3 | Side | Vertical | 25.5 | 40.0 | Pass |
| 163.9 | Side | Horizontal | 30.9 | 43.5 | Pass |
| 165.5 | Side | Horizontal | 29.7 | 43.5 | Pass |
| 357.8 | Vertical | Horizontal | 31.2 | 46.0 | Pass |
| 527.6 | Vertical | Horizontal | 35.6 | 46.0 | Pass |

Results of the large node

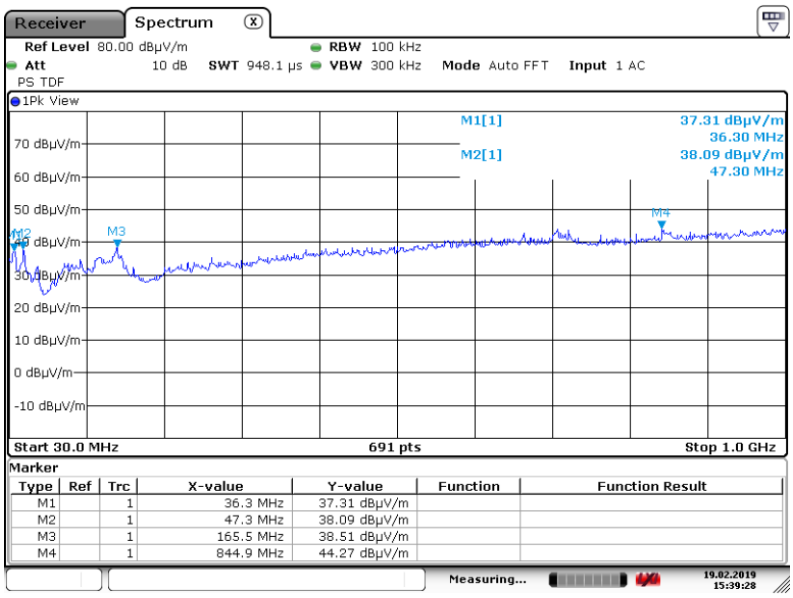
Note:
- Level QP = Reading QP + Factor
- Tested in modes as described in section 3.2, the 6 highest values noted.
Preliminary measurements indicated that the radiated emissions from EUT were not affected by the EUT's operating mode or frequency.
- $*^{R}$ refers to a frequency in a restricted band, $*^{H}$ refers to a harmonic of the fundamental
- Quasi Peak detector used with a bandwidth of 120 kHz.
- Measurement uncertainty is +/- 5.0 dB.
- a selection of plots are provided on the next pages

## 4.1.6 Plot of the emissions in the range 30 -1000 MHz




Date: 19.FEB.2019 14:42:15

Plot of the emissions in the range 30 – 1000 MHz (Peak detector values shown), Small node




Date: 19.FEB.2019 15:39:28

Plot of the emissions in the range 30 – 1000 MHz (Peak detector values shown), Large node

## Radiated Emissions, 1 - 25GHz, 2408 MHz, small node.

| Frequency [MHz] | EUT Orientation | Antenna Orientation | Detector | Level [dBµV/m] | Limit [dBµV/m] | Result |
|---|---|---|---|---|---|---|
| 1440*R | Side | Horizontal | Pk | 41.8 | 74 Pk<br>54 Av | Pass |
| 4816*H*R | Vertical | Vertical | Pk | 55.8 | 74 | Pass |
| 4816*H*R | Vertical | Vertical | Av | 50.9 | 54 | Pass |
| 7225*HR | Vertical | Vertical | Pk | 54.4 Pk<br>51.4 Av | 54 (Av)<br>74 (Pk) | Pass |
| 11.385*R | Vertical | Vertical | Pk | 63.3 Pk<br>48.0 Av | 54 (Av)<br>74 (Pk) | Pass |
| 13.254 | Side | Vertical | Pk | 57.2 Pk<br>45.4 Av | 54 (Av)<br>74 (Pk) | Pass |
| 17.97<br>noise | - | Horizontal | Pk | 69.3 Pk<br>53.0 Av | 54 (Av)<br>74 (Pk) | Pass |

## Radiated Emissions, 1 - 25GHz, 2450 MHz, small node.

| Frequency [MHz] | EUT Orientation | Antenna Orientation | Detector | Level [dBµV/m] | Limit [dBµV/m] | Result |
|---|---|---|---|---|---|---|
| 1441*R | Side | Horizontal | Pk | 46.0 | 54 (Av)<br>74 (Pk) | Pass |
| 4889*H*R | Side | Vertical | Pk | 56.0 Pk<br>51.1 Av | 54 (Av)<br>74 (Pk) | Pass |
| 7350*HR | Side | Horizontal | Pk | 53.7 Pk<br>52.9 Av | 54 (Av)<br>74 (Pk) | Pass |
| 13.928 | Side | Vertical | Pk | 57.2 Pk<br>45.4 Av | 54 (Av)<br>74 (Pk) | Pass |
| 15.216 | Side | Vertical | Pk | 57.2 Pk<br>45.4 Av | 54 (Av)<br>74 (Pk) | Pass |
| 17.925*R<br>noise | - | Horizontal | Pk | 69.2 Pk<br>53.0 Av | 54 (Av)<br>74 (Pk) | Pass |

## Radiated Emissions, 1 - 25GHz, 2475 MHz. small node

| Frequency [MHz] | EUT Orientation | Antenna Orientation | Detector | Level [dBµV/m] | Limit [dBµV/m] | Result |
|---|---|---|---|---|---|---|
| 4949*RH | side | Horizontal | Pk | 53.1 Pk<br>51.3 Av | 54 (Av)<br>74 (Pk) | Pass |
| 7426*H | Side | Vertical | Pk | 53.4 Pk<br>52.8 Av | 54 (Av)<br>74 (Pk) | Pass |
| 11386 noise | - | Vertical | Pk | 61.4 Pk<br>50.3 Av | 54 (Av)<br>74 (Pk) | Pass |
| 17250 noise | - | Vertical | Pk | 58.6 Pk<br>50.0 Av | 54 (Av)<br>74 (Pk) | Pass |

## Radiated Emissions, 1 - 25GHz, 2408 MHz, large node.

| Frequency [MHz] | EUT Orientation | Antenna Orientation | Detector | Level [dBµV/m] | Limit [dBµV/m] | Result |
|---|---|---|---|---|---|---|
| 1441*R | Vertical | Horizontal | Pk | 46.3 | 54 (Av)<br>74 (Pk) | Pass |
| 4816*H*R | Vertical | Vertical | Pk | 53.7 Pk | 54 (Av)<br>74 (Pk) | Pass |
| 7224*HR | Vertical | Vertical | Pk | 53.7 Pk | 54 (Av)<br>74 (Pk) | Pass |
| 11386 noise | - | Vertical | Pk | 63.3 Pk<br>52.6 Av | 54 (Av)<br>74 (Pk) | Pass |
| 17250 noise | - | Vertical | Pk | 58.5 Pk<br>50.0 Av | 54 (Av)<br>74 (Pk) | Pass |

## Radiated Emissions, 1 - 25GHz, 2450 MHz, large node.

| Frequency [MHz] | EUT Orientation | Antenna Orientation | Detector | Level [dBµV/m] | Limit [dBµV/m] | Result |
|---|---|---|---|---|---|---|
| 1441.8*R | Vertical | Vertical | Pk | 45.0 | 54 (Av)<br>74 (Pk) | Pass |
| 4900*H*R | Vertical | Vertical | Pk | 41.3 | 54 (Av)<br>74 (Pk) | Pass |
| 7350*HR | Vertical | Vertical | Pk | 45.0 | 54 (Av)<br>74 (Pk) | Pass |
| 11386 noise | - | Vertical | Pk | 61.0 Pk<br>53.0 Av | 54 (Av)<br>74 (Pk) | Pass |
| 17250 noise | - | Vertical | Pk | 58.5 Pk<br>50.0 Av | 54 (Av)<br>74 (Pk) | Pass |

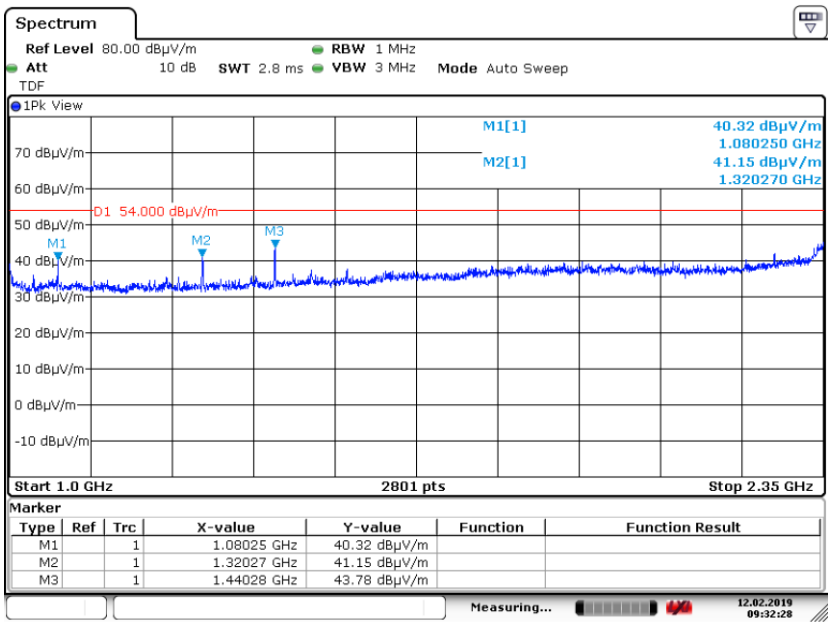
## Radiated Emissions, 1 - 25GHz, 2475 MHz. large node

| Frequency [MHz] | EUT Orientation | Antenna Orientation | Detector | Level [dBµV/m] | Limit [dBµV/m] | Result |
|---|---|---|---|---|---|---|
| 1440.8*R | Vertical | Vertical | Pk | 40.0 | 54 (Av)<br>74 (Pk) | Pass |
| 4950*H*R | Vertical | Vertical | Pk | 51.3Pk<br>48.0 Av | 54 (Av)<br>74 (Pk) | Pass |
| 7425*HR | Vertical | Vertical | Pk | 52.8 Pk<br>50.5 Av | 54 (Av)<br>74 (Pk) | Pass |
| 11401noise | - | Vertical | Pk | 61.0 Pk<br>53.0 Av | 54 (Av)<br>74 (Pk) | Pass |
| 17250 noise | - | Vertical | Pk | 58.5 Pk<br>50.0 Av | 54 (Av)<br>74 (Pk) | Pass |

Notes:
- *R refers to a frequency in a restricted band,
- *H refers to a frequency which is a harmonic of the fundamental.
- 1 MHz residual bandwidth filter setting used.
- Field strength values of radiated emissions not listed in the tables above are more than 20 dB below the applicable limit.
- Measurement uncertainty is +/- 5.5 dB

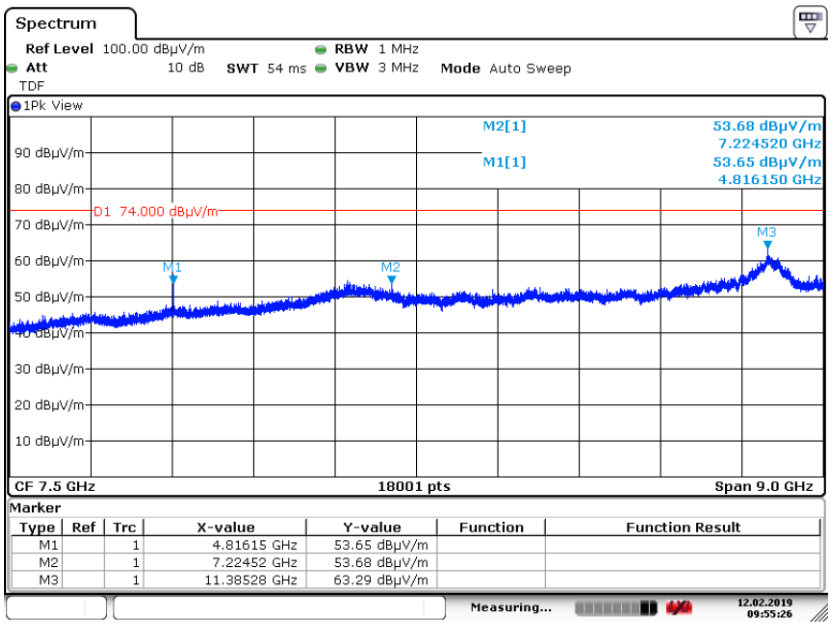
- a selection of plots are provided on the next pages.

## 4.1.7 Plots of the radiated unwanted emissions 1 – 25 GHz, small node



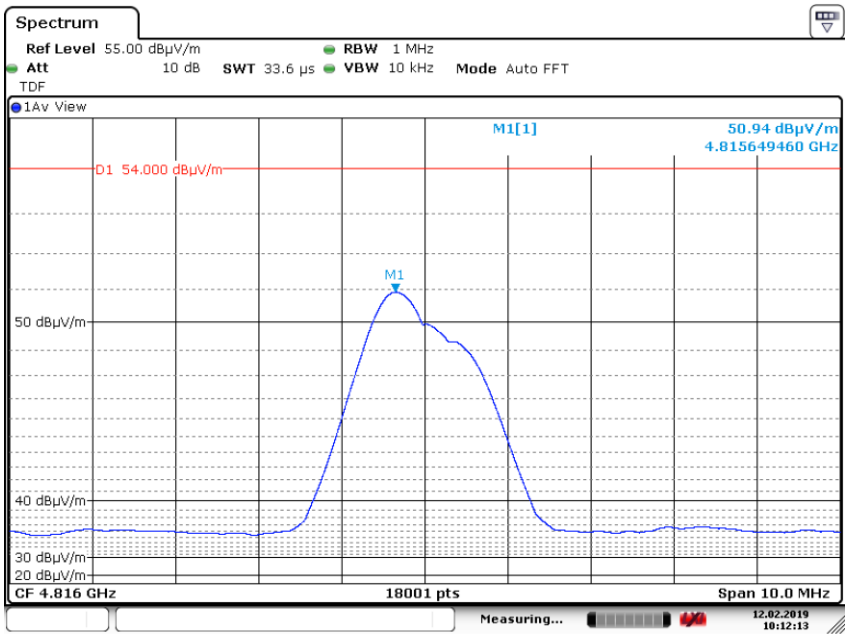

Date: 12.FEB.2019 09:32:28

Radiated unwanted emissions in the range 1 – 2.35 GHz at 2408 MHz
(Peak values, EUT Vertical, Antenna Horizontal position shown).



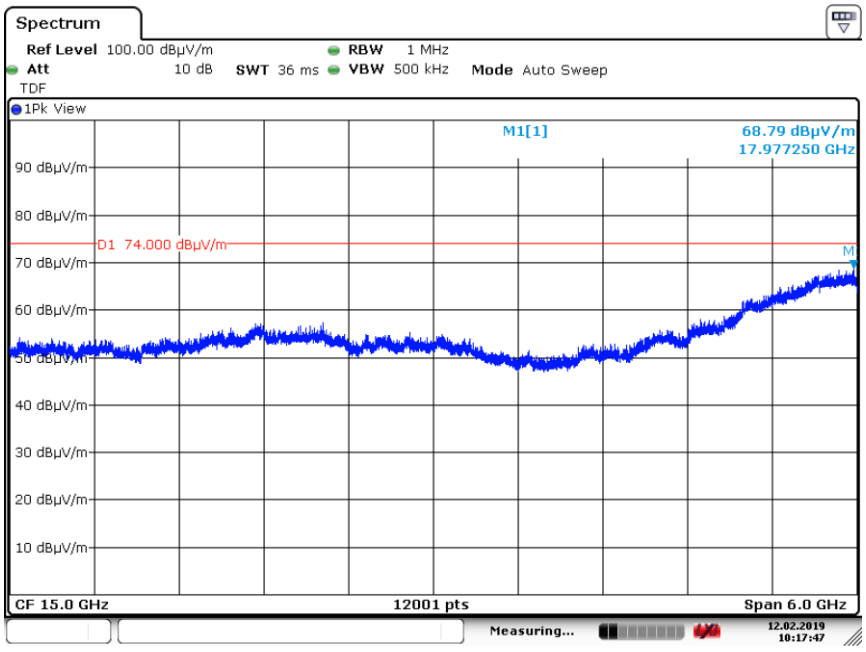

Date: 12.FEB.2019 09:55:26

Radiated unwanted emissions in the range 3 – 12 GHz at 2408 MHz
(Peak values, EUT side ways, Antenna horizontal position shown)



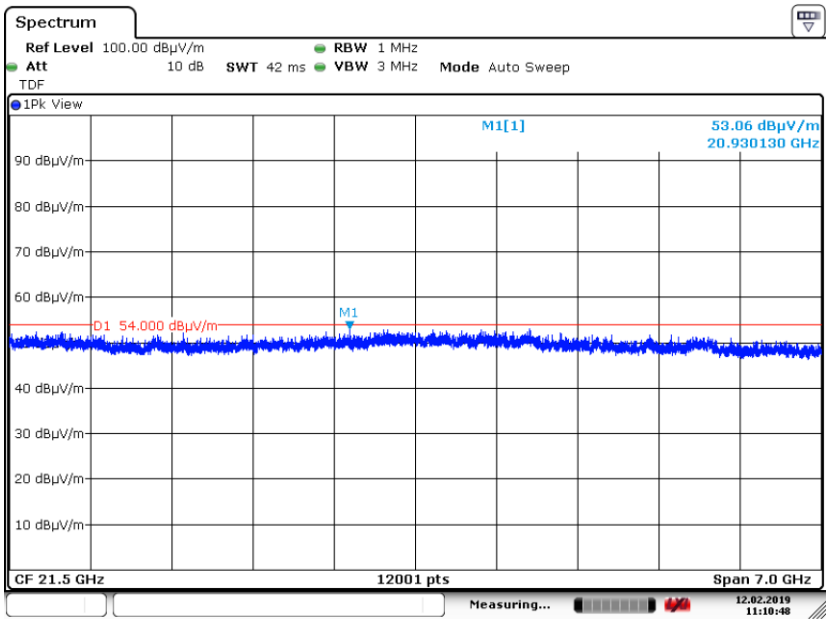

Date: 12.FEB.2019 10:12:13

Radiated unwanted emissions at 4.8 GHz, harmonic of 2408 MHz
(Average value, EUT Side ways, Antenna vertical position shown)



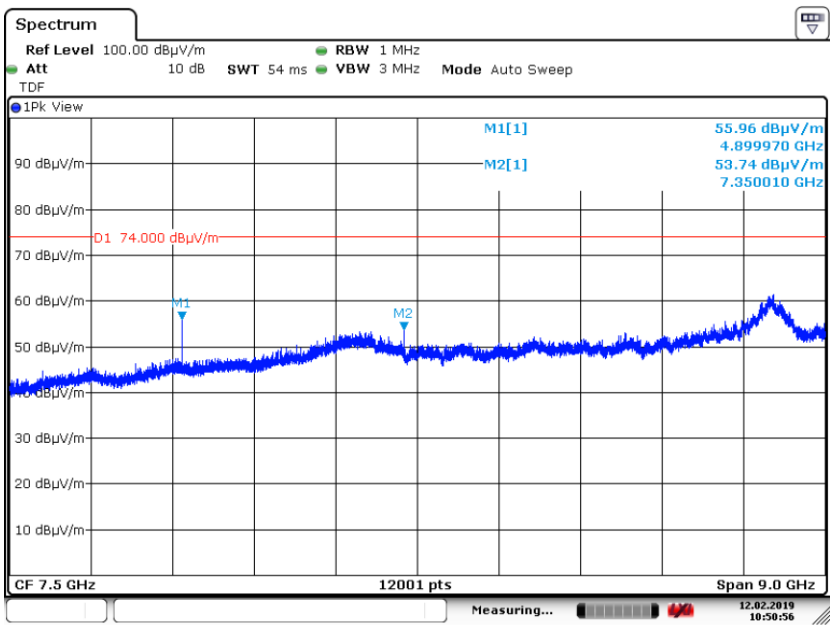

Date: 12.FEB.2019 10:17:47

Radiated unwanted emissions in the range 12 – 18 GHz at 2408 MHz
(Peak value, EUT Side ways, Antenna vertical position, reduced bw shown)



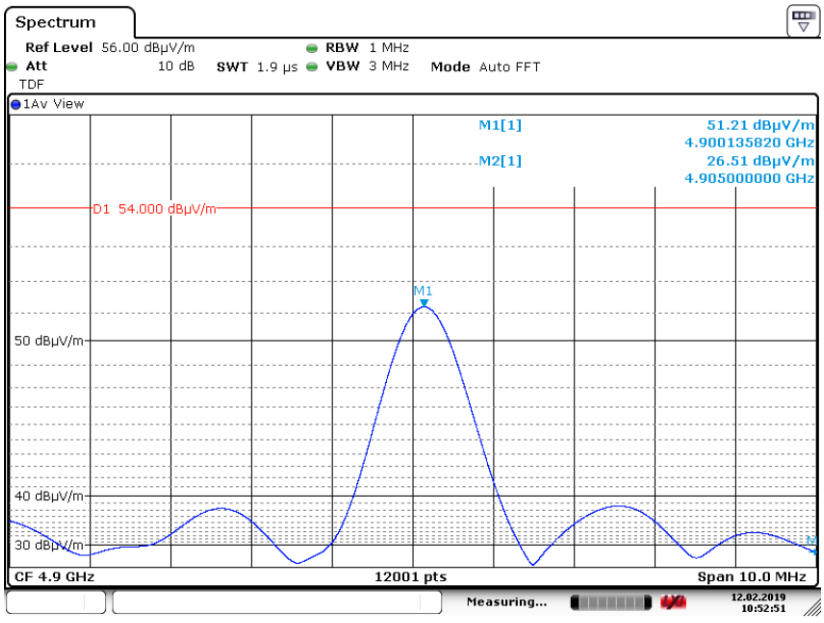

Date: 12.FEB.2019 11:10:48

Radiated unwanted emissions in the range 18 – 25 GHz at 2408 MHz
(Peak values, EUT Side ways, Antenna vertical position shown)



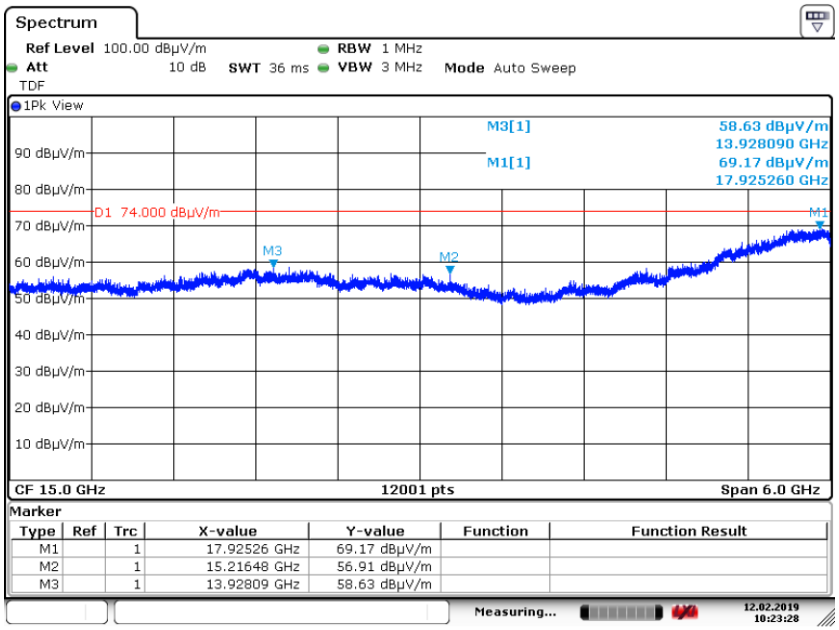

Date: 12.FEB.2019 10:50:55

Radiated unwanted emissions in the range 3 – 12 GHz at 2450 MHz
(Peak values, EUT side ways, Antenna vertical position shown)



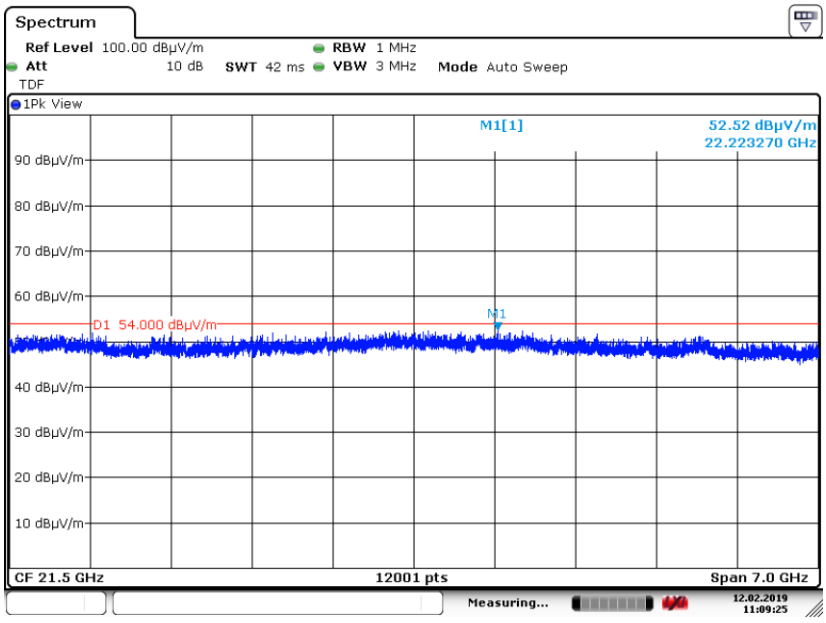

Date: 12.FEB.2019 10:52:50

Radiated unwanted emissions at 4.9 GHz, harmonic of 2450 MHz
(Average value, EUT Side ways, Antenna vertical position shown)



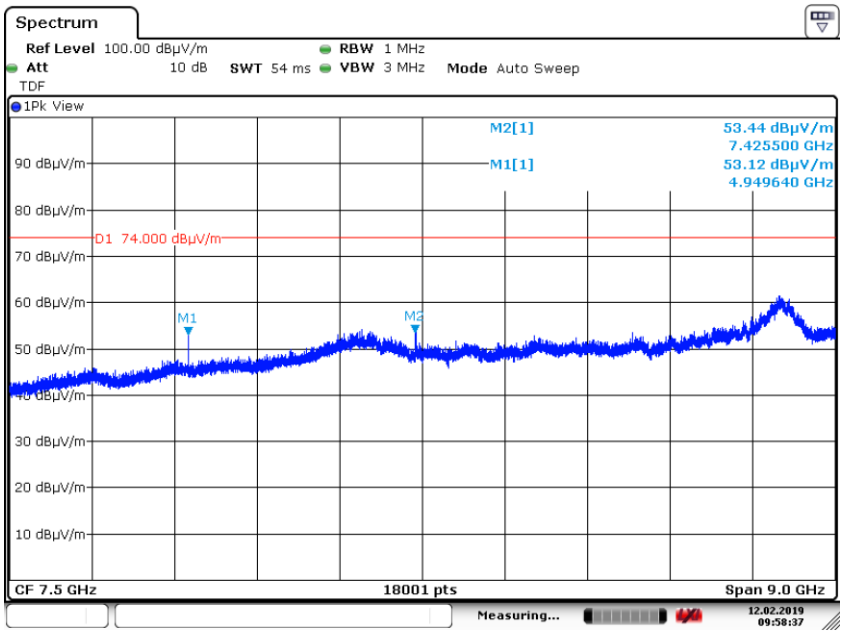

Date: 12.FEB.2019 10:23:28

Radiated unwanted emissions in the range 12 – 18 GHz at 2450 MHz
(Peak values, EUT Side, Antenna horizontal position shown)



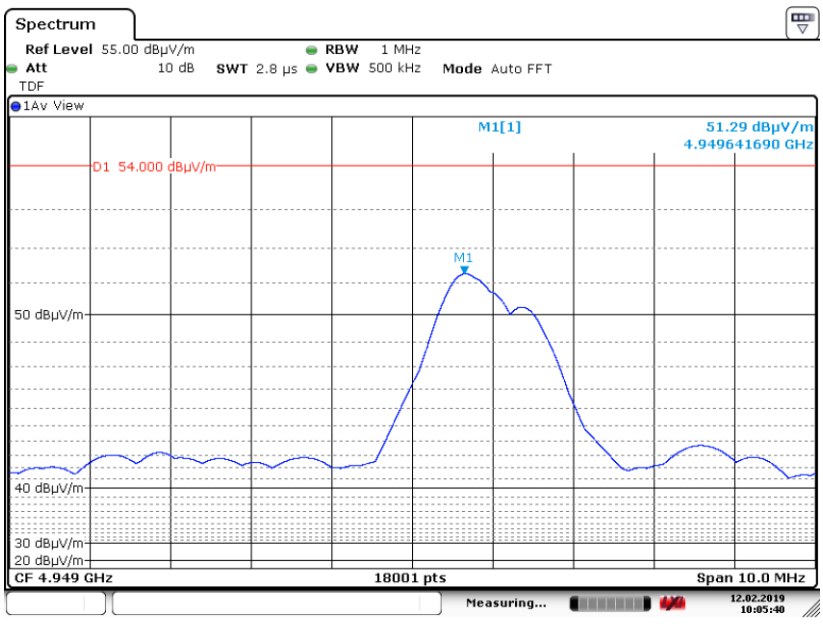

Date: 12.FEB.2019 11:09:25

Radiated unwanted emissions in the range 18 – 25 GHz at 2450 MHz
(Peak values, EUT side ways, Antenna vertical position shown)



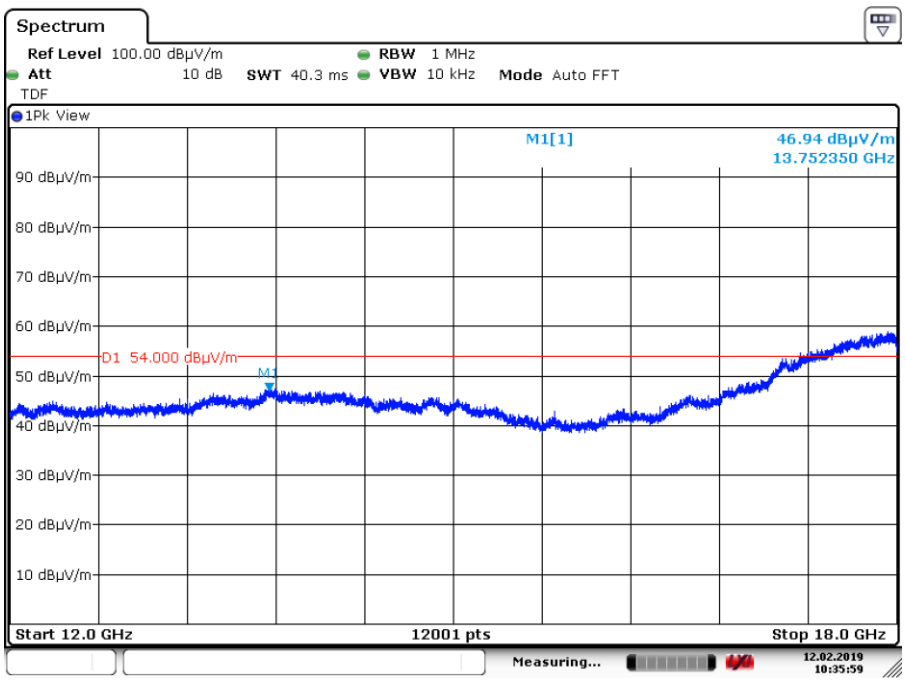

Date: 12.FEB.2019 09:58:37

Radiated unwanted emissions in the range 3 – 12 GHz at 2475 MHz
(Peak values, EUT Vertical, Antenna horizontal position shown)



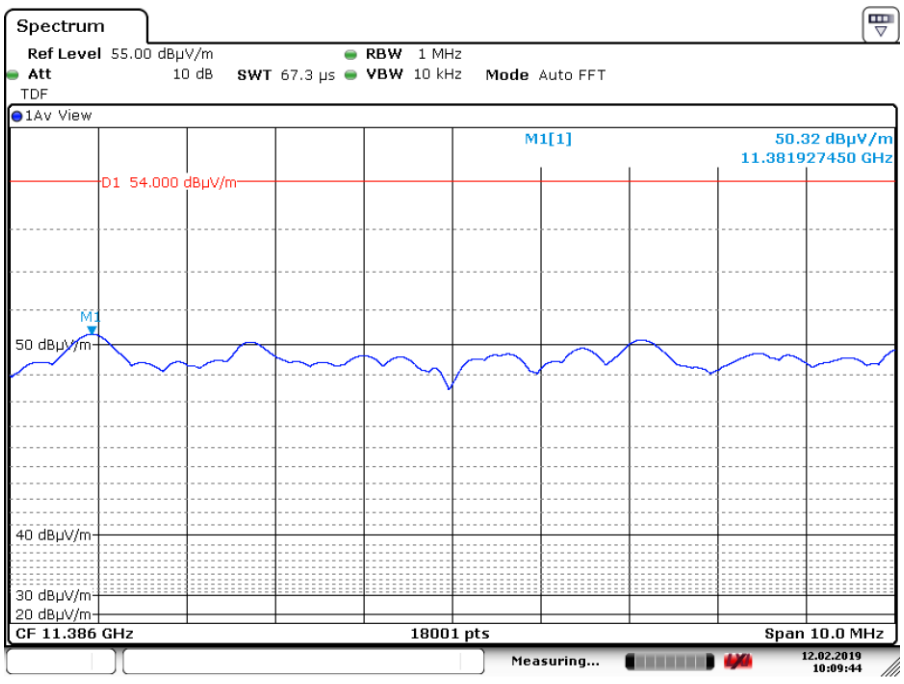

Date: 12.FEB.2019 10:05:40

Radiated unwanted emissions at 4.9 GHz, harmonic of 2475 MHz
(Average value, EUT Side ways, Antenna vertical position shown)



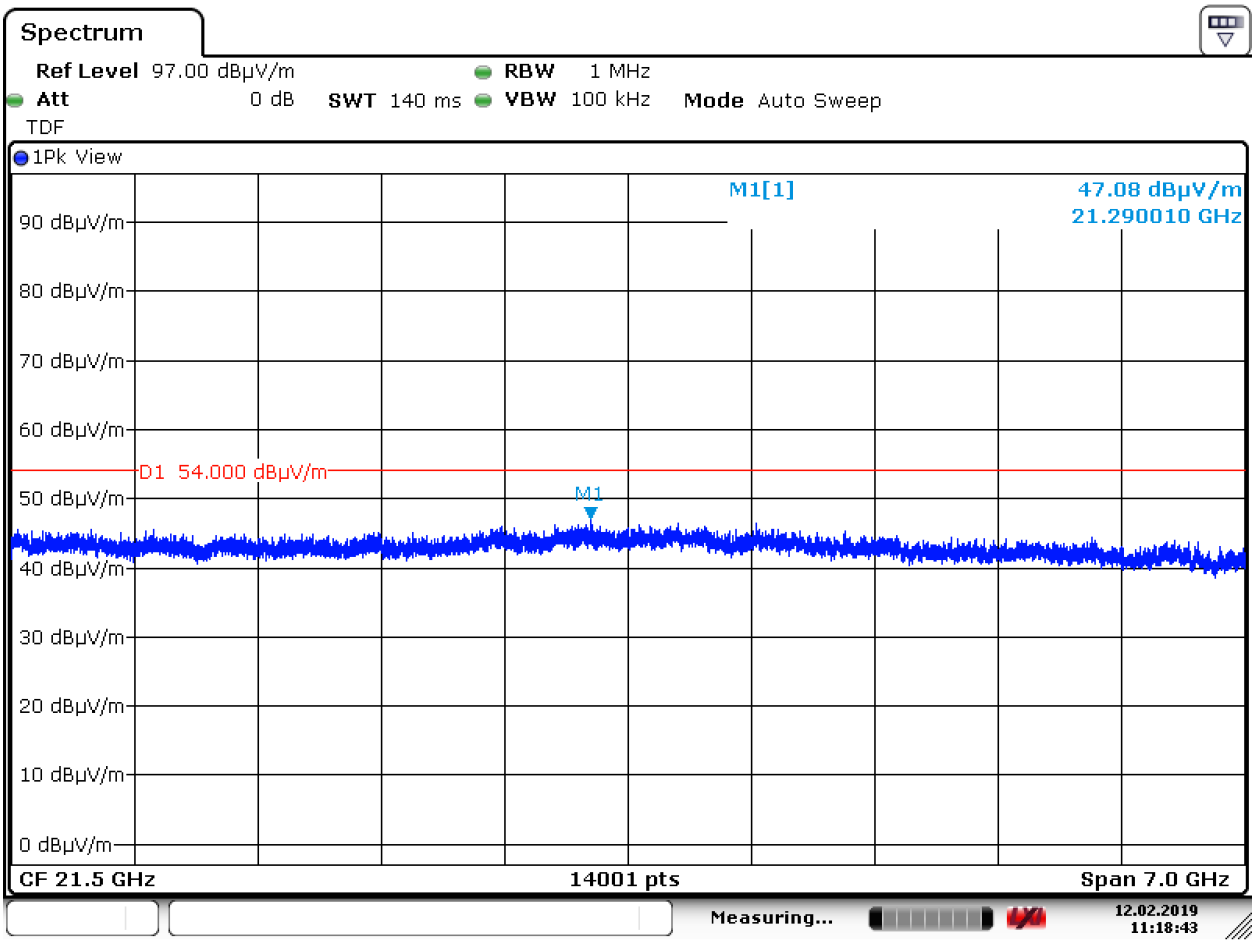

Date: 12.FEB.2019 10:35:59

Radiated unwanted emissions in the range 12 – 18 GHz at 2475MHz
(Peak values reduced VBW, EUT Side ways, Antenna vertical position shown)




Date: 12.FEB.2019 10:09:44

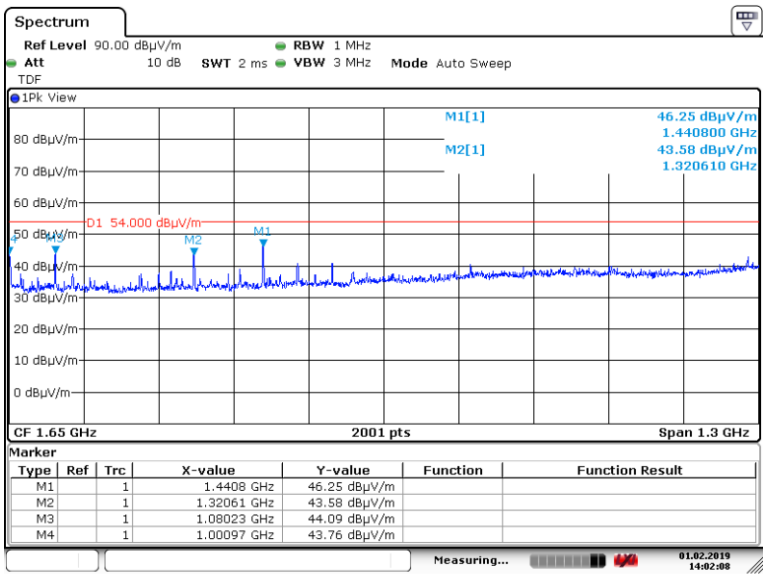
Radiated unwanted emissions at 11.4 GHz @ 2475 MHz
(Average value, EUT vertical, Antenna vertical position shown)




Date: 12.FEB.2019 11:18:44

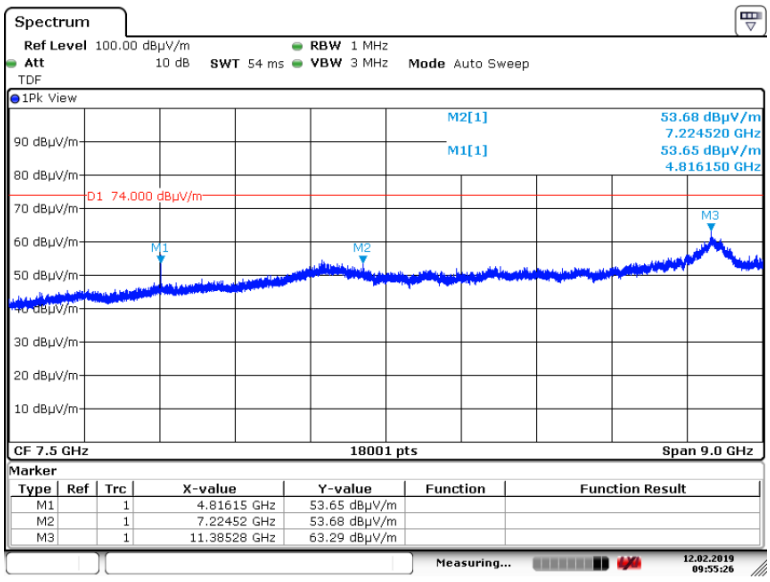
Radiated unwanted emissions in the range 18 – 25 GHz at 2475 MHz
(Peak values, reduced VBW EUT Vertical, Antenna horizontal position shown)

## 4.1.8 Plots of the radiated unwanted emissions 1 – 25 GHz, Large node



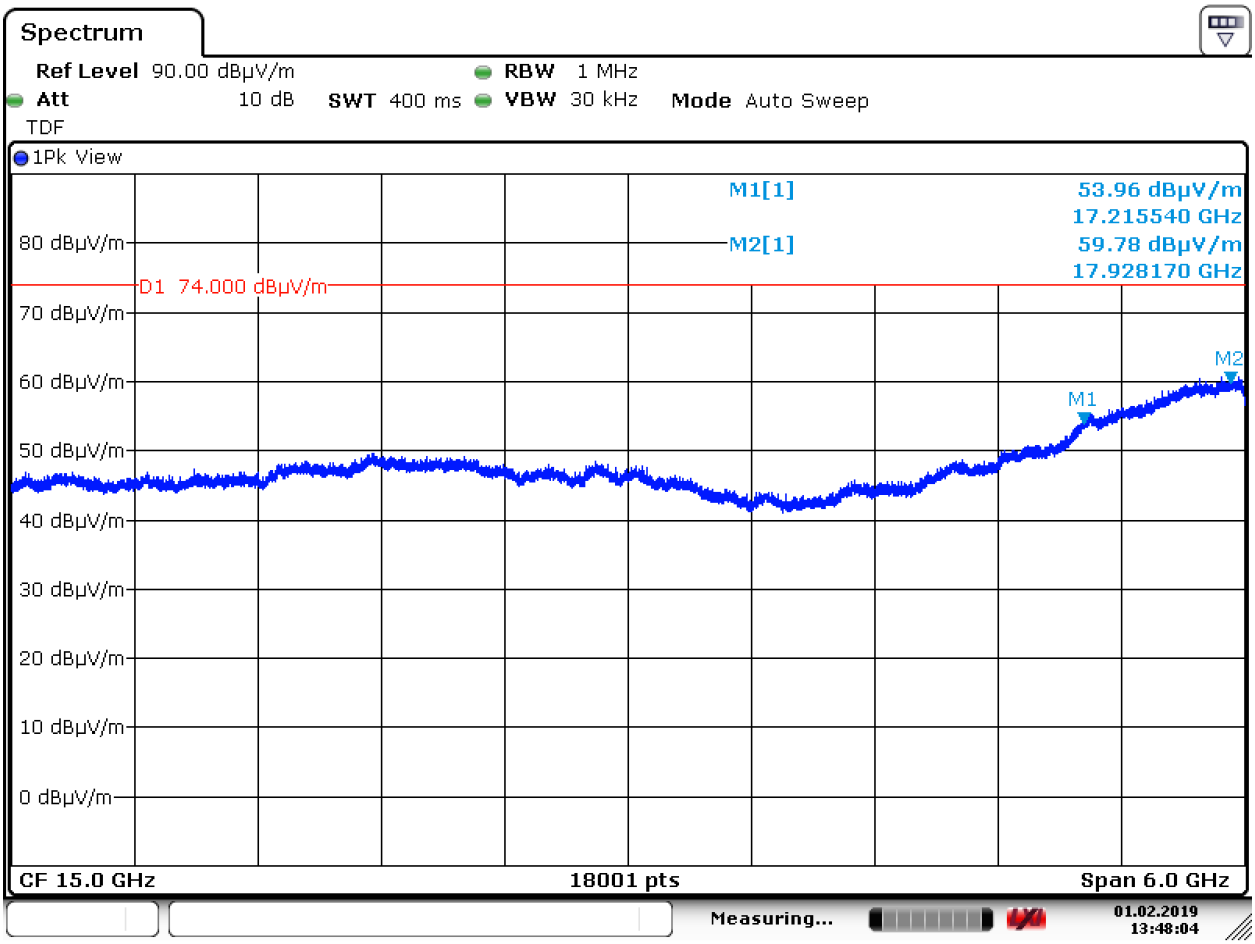

Date: 1.FEB.2019 14:02:08

Radiated unwanted emissions in the range 1 – 2.46 GHz at 2408 MHz
(Peak values, reduced VBW, EUT side, Antenna horizontal position shown).



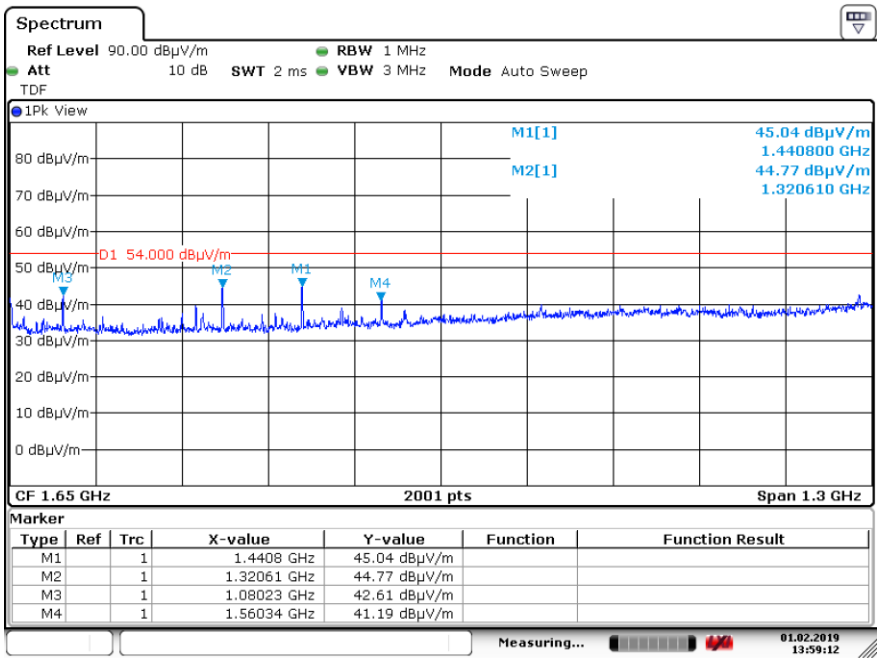

Date: 12.FEB.2019 09:55:26

Radiated unwanted emissions in the range 3 – 12 GHz at 2408 MHz
(Peak values, EUT Vertical, Antenna horizontal position shown)



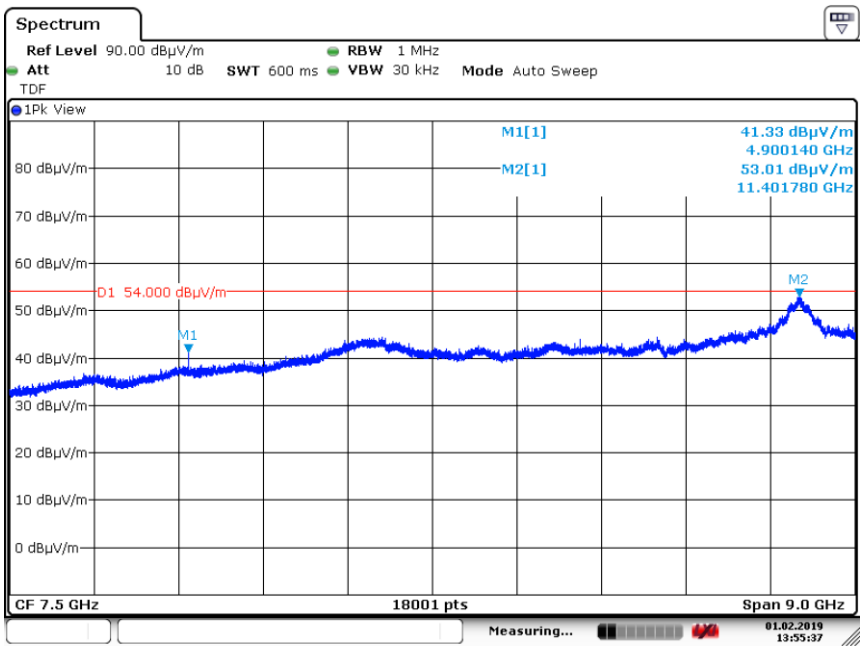

Date: 1.FEB.2019 13:48:04

Radiated unwanted emissions in the range 12 – 18 GHz at 2408 MHz
(Peak value, EUT side, Antenna horizontal position shown)



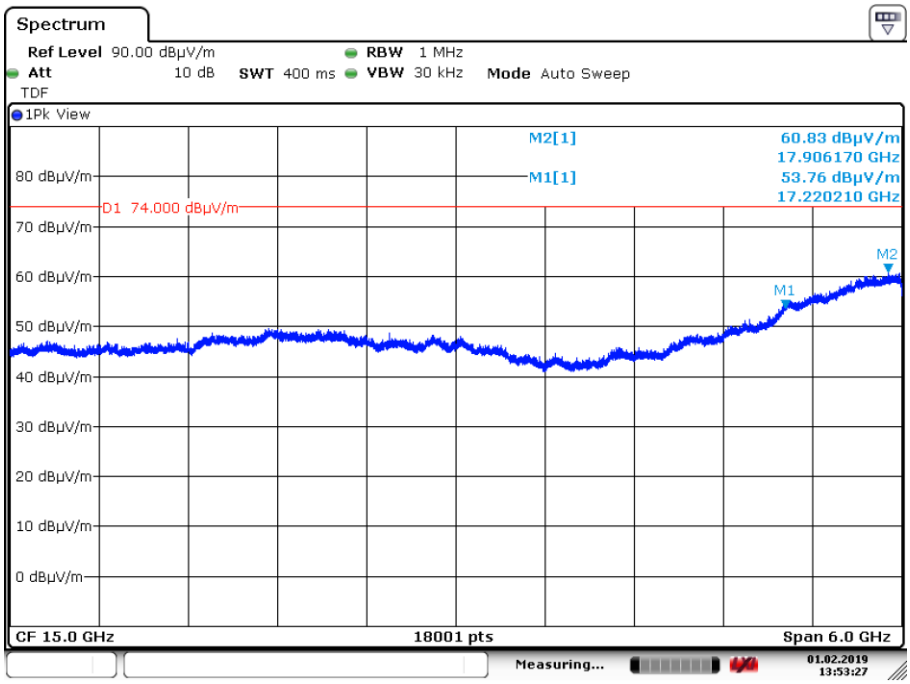

Date: 1.FEB.2019 13:59:13

Radiated unwanted emissions in the range 1 – 2.46 GHz at 2450 MHz
(Peak values, EUT Vertical, Antenna horizontal position shown).



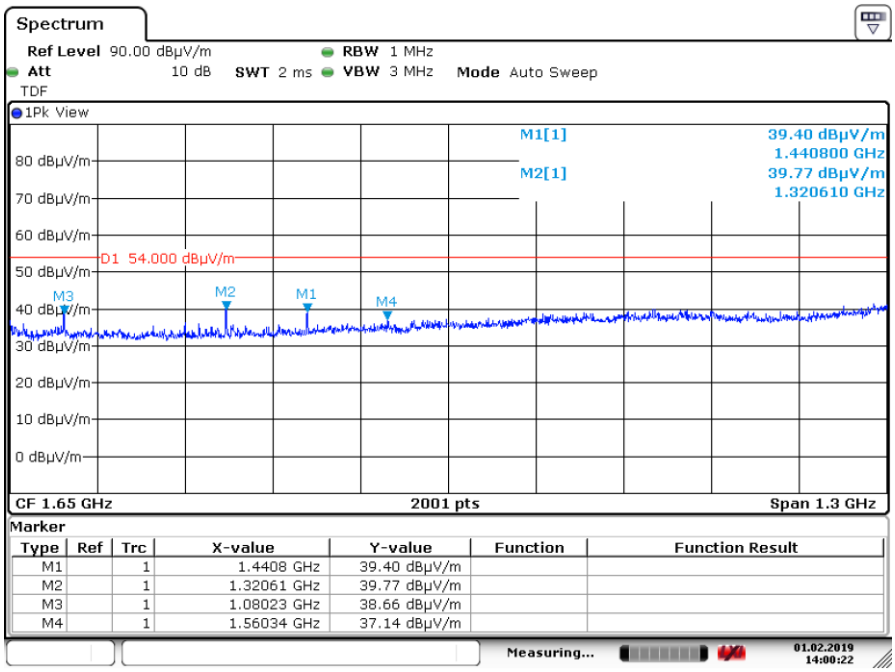

Date: 1.FEB.2019 13:55:37

Radiated unwanted emissions in the range 3 – 12 GHz at 2450 MHz
(Peak values, EUT Vertical, Antenna vertical position shown)




Date: 1.FEB.2019 13:53:28

Radiated unwanted emissions in the range 12 – 18 GHz at 2450 MHz
(Peak value, EUT Vertical, Antenna vertical position shown)




Date: 1.FEB.2019 14:00:21

Radiated unwanted emissions in the range 1 – 2.46 GHz at 2475 MHz
(Peak values, EUT Vertical, Antenna vertical position shown).

## 4.2 AC Power Line Conducted Measurements

**RESULT: Pass.**

Date of testing: 2016-01-30

Requirements: for equipment 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 limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

| Frequency of Emission (MHz) | Conducted Limit (dBμV) Quasi-Peak | Conducted Limit (dBμV) Average |
|---|---|---|
| 0.15 – 0.5 | 66 to 56* | 56 to 46* |
| 0.5 – 5 | 56 | 46 |
| 5 - 30 | 46 | 50 |

*Decreases with the logarithm of the frequency.

Test procedure:

ANSI C63.10-2013.

Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a 50 μH / 50 Ω LISN. The frequency range from 150kHz to 30MHz was searched. The six highest EUT emissions relative to the limit were noted. The EUT was positioned at least 80cm from the LISN. The power cable was routed over the non-conductive plate to the LISN.

### 4.2.1 AC Power Line Conducted Emission of Transmitter

| Frequency (MHz) | Measurement results (dBµV) L1 | | Measurement results (dBµV) L2/Neutral | | Limits (dBµV) | | Verdict (Pass/Fail) |
|---|---|---|---|---|---|---|---|
| | QP | AV | QP | AV | QP | AV | |
| 0.19297 | 52.6 | 45.2 | 52.8 | 46.7 | 64.0 | 54.0 | Pass |
| 0.20078 | 45.8 | 35.0 | 49.2 | 43.2 | 63.6 | 53.6 | Pass |
| 0.25156 | 46.4 | 40.1 | 48.1 | 44.3 | 61.8 | 51.8 | Pass |
| 1.0875 | 47.6 | 40.0 | 44.8 | 40.2 | 56.0 | 46.0 | Pass |
| 6.4234 | 44.0 | 33.3 | 43.1 | 34.1 | 60.0 | 50.0 | Pass |
| 9.76719 | 44.5 | 39.2 | 42.9 | 35.2 | 60.0 | 50.0 | Pass |

The results of the AC power line conducted emission tests, carried out in accordance with 47 CFR Part 15 section 15.207(a) and RSS-Gen section 8.8, at the 120 Volts/ 60 Hz AC mains connection terminals of the EUT (small node), are depicted in the table above.

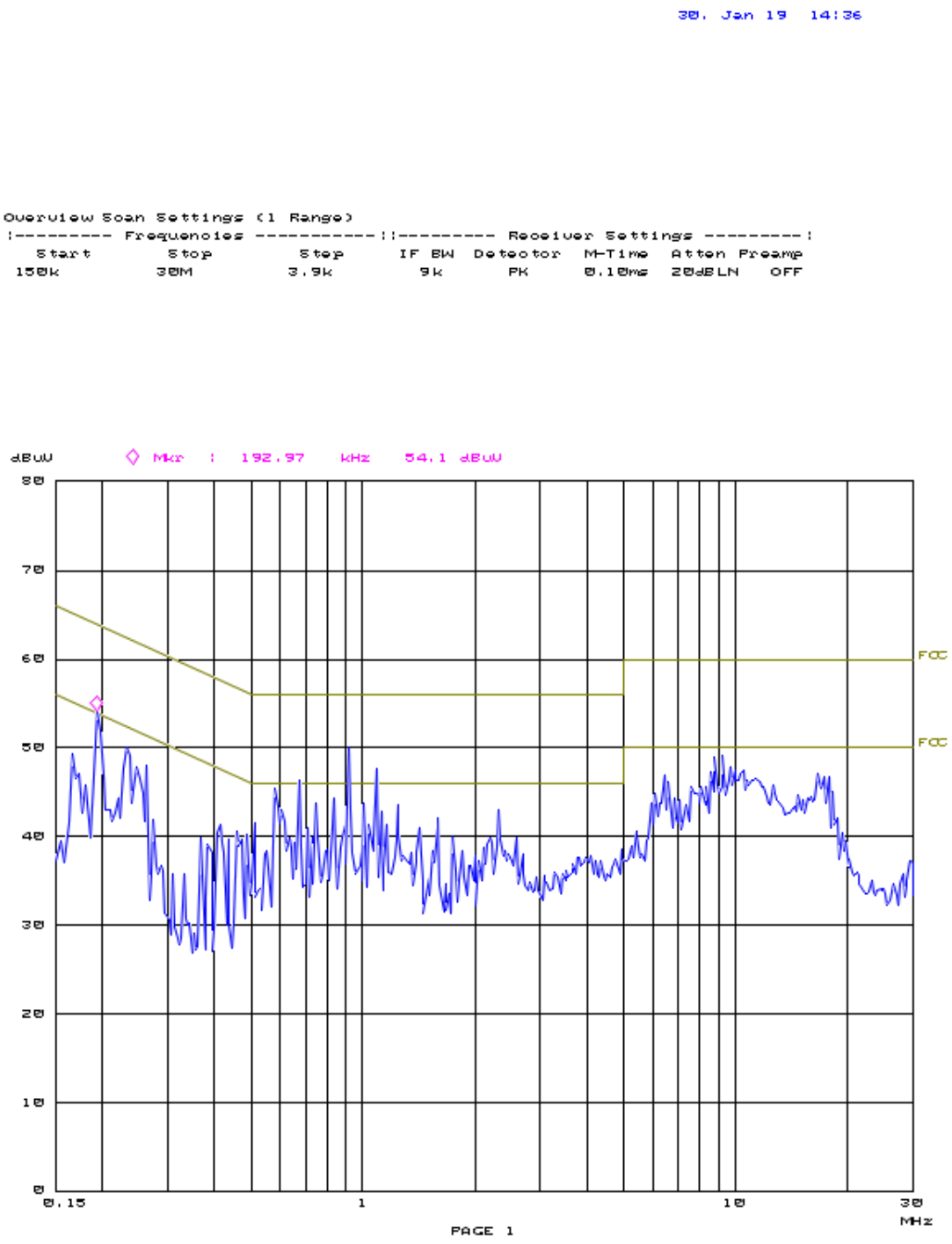
| Frequency (MHz) | Measurement results (dBµV) L1 | | Measurement results (dBµV) L2/Neutral | | Limits (dBµV) | | Verdict (Pass/Fail) |
|---|---|---|---|---|---|---|---|
| | QP | AV | QP | AV | QP | AV | |
| 0.1973 | 53.4 | 48.2 | 53.6 | 50.6 | 63.6 | 53.6 | Pass |
| 0.2516 | 48.4 | 44.0 | 47.4 | 44.3 | 61.8 | 51.8 | Pass |
| 0.2672 | 48.0 | 39.0 | 48.4 | 44.3 | 61.1 | 51.1 | Pass |
| 0.7516 | 48.2 | 41.8 | 48.4 | 42.2 | 56.0 | 46.0 | Pass |
| 0.9195 | 48.0 | 40.8 | 47.4 | 41.3 | 56.0 | 46.0 | Pass |
| 8.768 | 43.8 | 36.3 | 40.0 | 35.0 | 60.0 | 50.0 | Pass |

The results of the AC power line conducted emission tests, carried out in accordance with 47 CFR Part 15 section 15.207(a) and RSS-Gen section 8.8, at the 120 Volts/ 60 Hz AC mains connection terminals of the EUT (large node), are depicted in the table above.

Notes:

1. The resolution bandwidth used was 9 kHz.
2. From pre-test the worst case configuration proved to be the normal operation mode wherein both DTS transmitter and Bluetooth were operational but not transmitting simultaneously. Worst case values noted.
3. Measurement uncertainty is +/- 3.5 dB.
4. Plots are provided on the next pages.

## 9.2.2 Plots of the AC Power-line Conducted Emissions

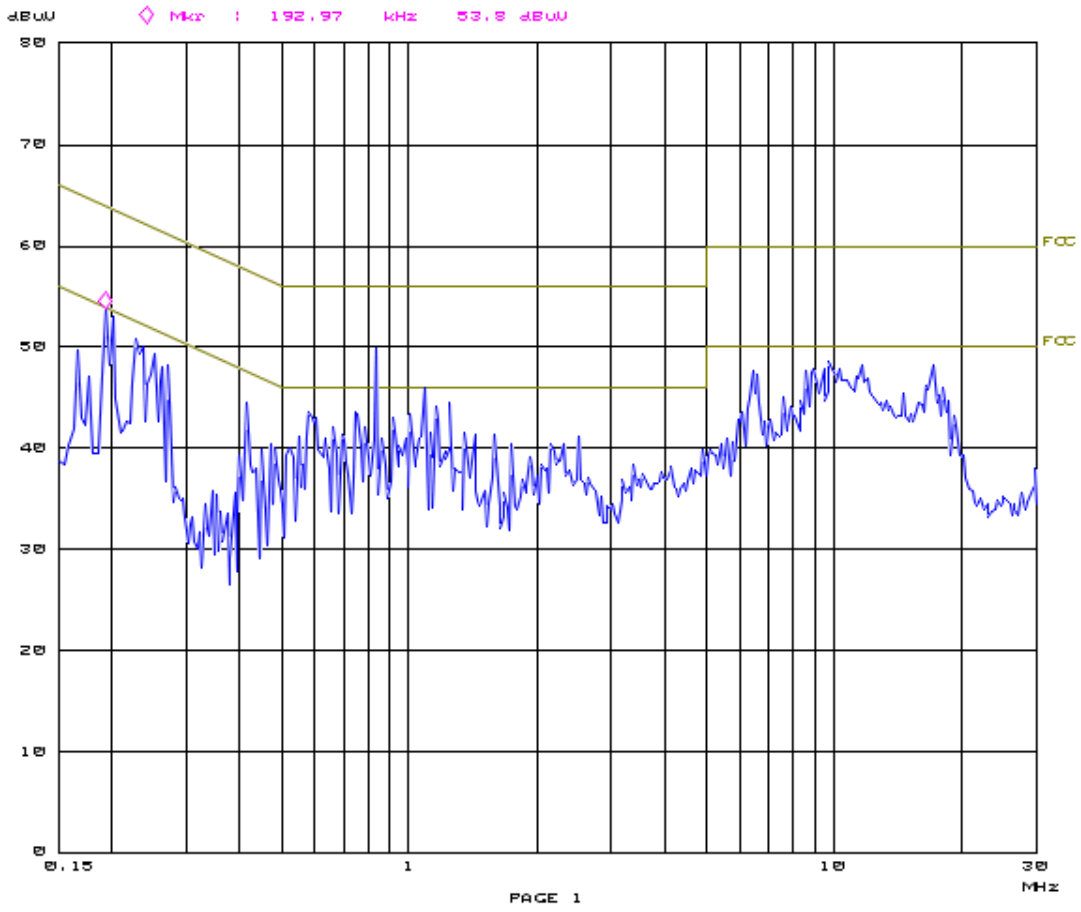



Plot of the AC Power-line Conducted emissions on L1, small node

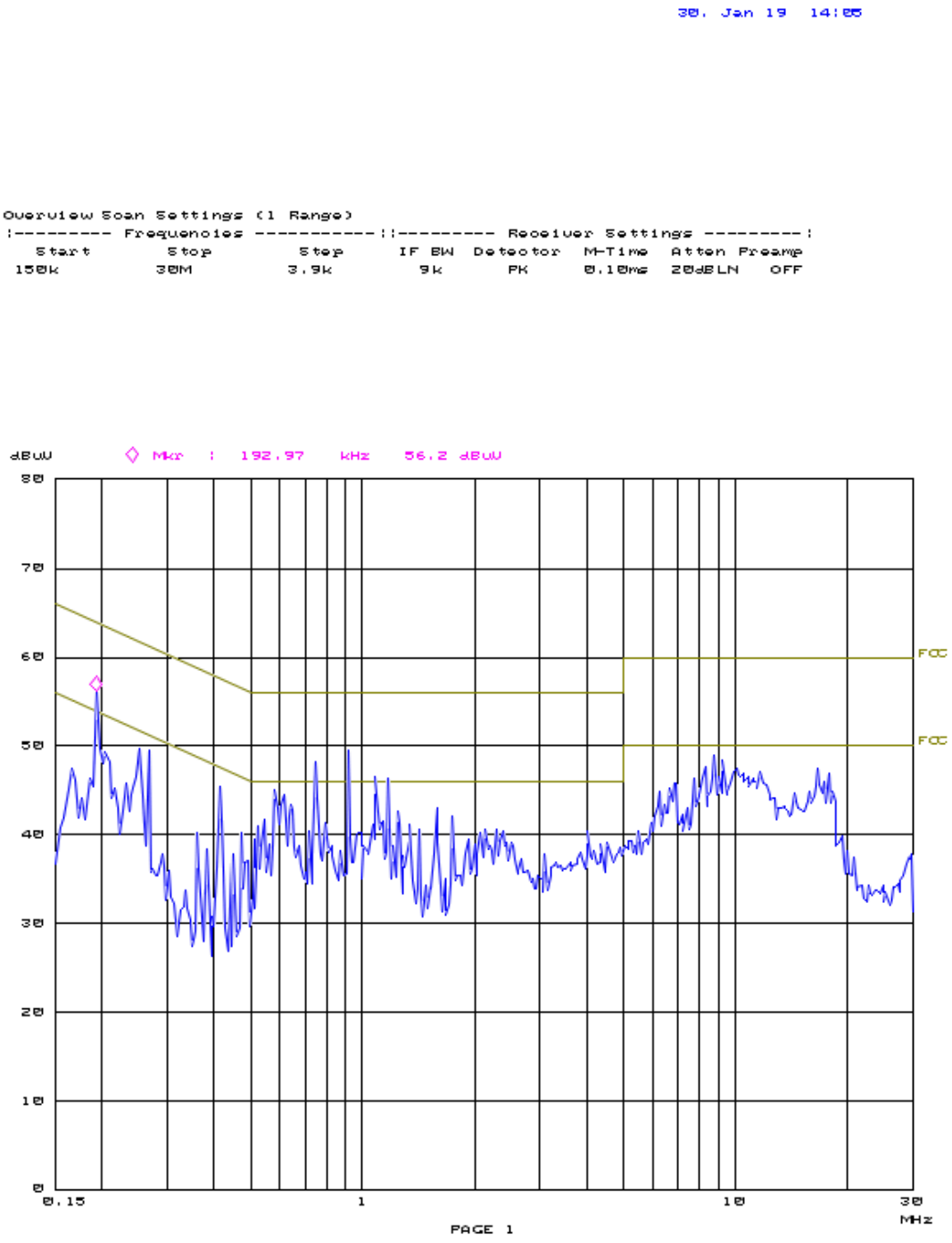
30. Jan 19 14:27

Overview Scan Settings (1 Range)

| Frequencies | | | Receiver Settings | | | | |
|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp |
| 150k | 30M | 3.9k | 9k | PK | 0.10ms | 20dBLN | OFF |




Plot of the AC Power-line Conducted emissions on L2, small node

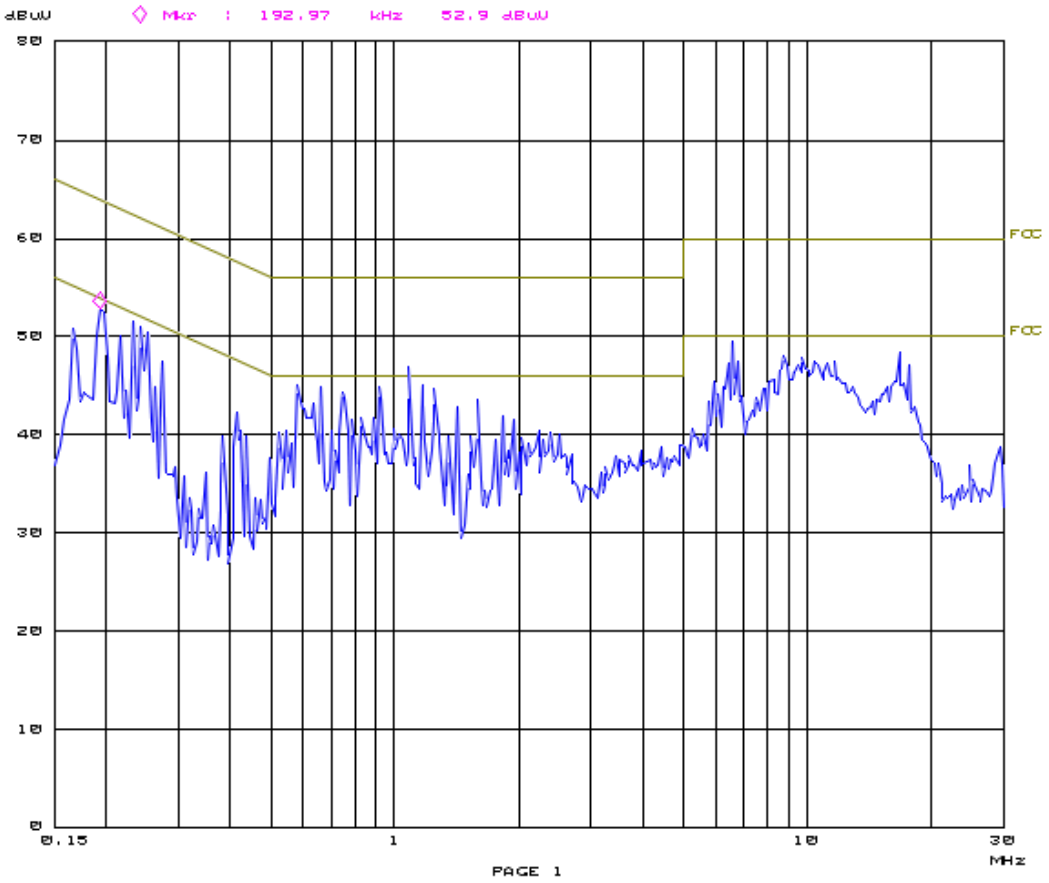



Plot of the AC Power-line Conducted emissions on L1, large node

30. Jan 19 14:12

Overview Scan Settings (1 Range)

| Frequencies | | | Receiver Settings | | | | |
|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp |
| 150k | 30M | 3.9k | 9k | PK | 0.10ms | 20dBLN | OFF |




Plot of the AC Power-line Conducted emissions on L2, large node

**End of report**