

EMI - TEST REPORT

- FCC Part 15.249, RSS310 -

Test Report No. : T38149-00-00HS

23. June 2014

Date of issue

Type / Model Name : UMR-0Axxxx-20xxxx-07xxxx

Product Description : Field disturbance sensor

Applicant : s.m.s. smart microwave sensors GmbH

Address : In den Waashainen 1

38108 BRAUNSCHWEIG, GERMANY

Manufacturer : s.m.s. smart microwave sensors GmbH

Address : In den Waashainen 1

38108 BRAUNSCHWEIG, GERMANY

Licence holder : s.m.s. smart microwave sensors GmbH

Address : In den Waashainen 1

38108 BRAUNSCHWEIG, GERMANY

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

POSITIVE



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

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Attachment A as separately supplement

2 SUMMARY

2.1 GENERAL REMARKS:

The EUT is a field disturbance sensor with frequency emissions in 19 settable ranges the operating band of 24000 MHz to 24250 MHz.

Variants of the EUT

Antennas

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.

Operation frequency and channel plan

The operating frequency is 24.0 GHz to 24.25 GHz.

Frequency range	Centre frequency (MHz)
0	24010
1	24022.5
2	24035
3	24047.5
4	24060
5	24072.5
6	24085
7	24097.5
8	24110
9	24122.5
10	24135
11	24147.5
12	24160
13	24172.5
14	24185
15	24197.5
16	24210
17	24222.5
18	24235

Note. The marked frequencies are determined for testing.

Transmit operating modes

As soon as the equipment is powered on, TX starts operating independent of a possible connected PC. For TX continuous no special test software is needed.

2.2 Test result summary

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

2.3 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 April 2014


Testing concluded on : 21 May 2014

Checked by:


 Klaus Gegenfurtner
 I confirm the correctness
 and integrity of this
 documents
 2014.06.24 07:57:14
 +02'00'

Klaus Gegenfurtner
 Teamleader Radio

Tested by:


 Hermann Smetana
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 this document
 2014.06.23
 14:23:20 +02'00'

Hermann Smetana
 Radio Team

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Please see attachment A

3.2 Power supply system utilised

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

3.3 Short description of the equipment under test (EUT)

The sensor is a 24 GHz Radar for traffic management applications. Based on the object list as a generic data interface, following applications are possible:

- Stop bar detection
- Queue length measurement
- Advance detection (exploiting the long detection range)
- Loop replacement (non-intrusive detection)
- Speed measurement.

Number of tested samples: 1
Serial number: #0x000233CD
DSP: #0x000233CD
RF: #0x00022A52

EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- TX continuous
-

EUT configuration:

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

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

- Power supply, 100 – 250 VAC, 50 – 60 Hz Model : Commercial type, DC out 22 VDC
- RS485 cable, 3 m Model : Commercial type
- Siemens notebook Model : _____

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 C63.4 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

In compliance with RSS 310 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.4 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 C63.4 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 C63.4, Clause 5.5. 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 C63.4, Clause 10.

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.

4.5 Determination of worst case measurement conditions

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.

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 C63.4 described under item 4.4.3. 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 -13.9 dB at 0.318 MHz

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

Frequency of Emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

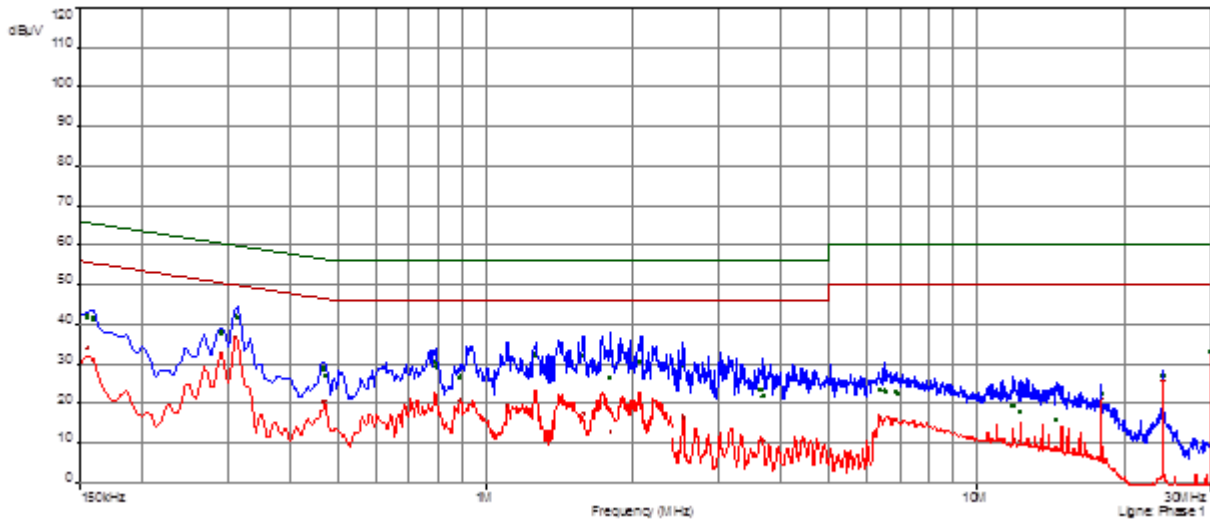
The requirements are **FULFILLED**.

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

5.1.6 Test protocol

Test point L1
 Operation mode: TX continuous
 Remarks:

Result: passed

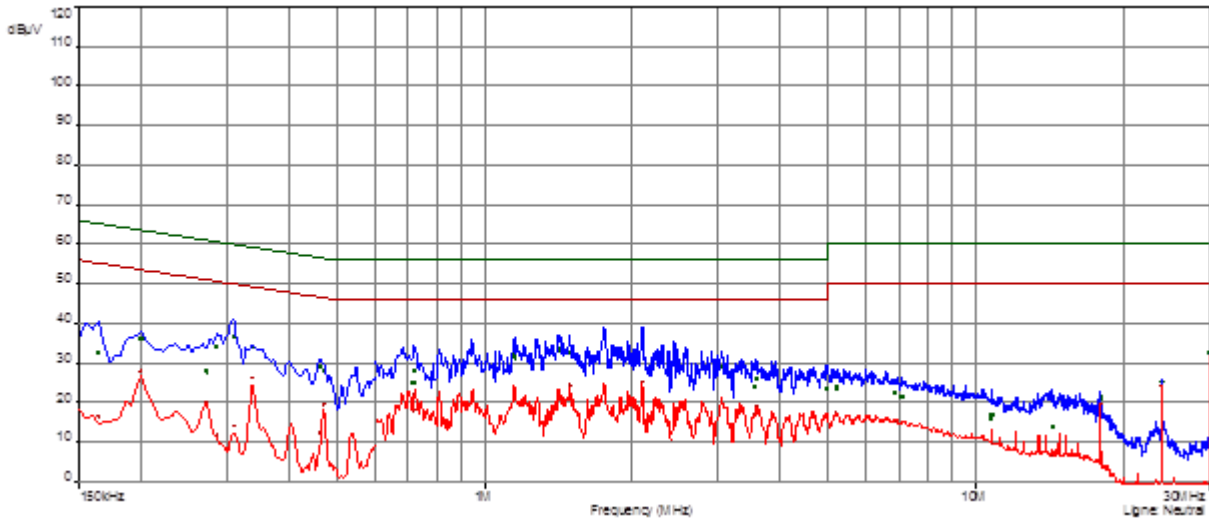


freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line
0.155	1	42.0	-23.8	65.8	34.1	-21.7	55.8	Phase 1
0.159	1	41.6	-23.9	65.5	30.9	-24.6	55.5	Phase 1
0.290	1	38.0	-22.5	60.5	32.8	-17.7	50.5	Phase 1
0.309	2	42.1	-17.9	60.0	36.7	-13.3	50.0	Phase 1
0.314	2	41.6	-18.3	59.9	35.6	-14.3	49.9	Phase 1
0.467	2	28.9	-27.6	56.6	20.3	-26.2	46.6	Phase 1
0.471	2	27.1	-29.4	56.5	20.5	-26.0	46.5	Phase 1
0.789	3	30.5	-25.5	56.0	22.1	-23.9	46.0	Phase 1
0.794	3	29.3	-26.7	56.0	21.5	-24.5	46.0	Phase 1
0.888	3	26.8	-29.2	56.0	20.9	-25.1	46.0	Phase 1
2.526	5	29.7	-26.3	56.0	16.8	-29.3	46.0	Phase 1
2.531	5	30.3	-25.7	56.0	16.3	-29.7	46.0	Phase 1
3.642	5	23.6	-32.4	56.0	11.5	-34.5	46.0	Phase 1
3.669	5	21.9	-34.1	56.0	10.7	-35.4	46.0	Phase 1
11.864	7	19.6	-40.4	60.0	11.3	-38.7	50.0	Phase 1
12.305	7	18.1	-41.9	60.0	10.5	-39.5	50.0	Phase 1
14.550	7	15.8	-44.2	60.0	8.0	-42.0	50.0	Phase 1
24.002	8	26.9	-33.1	60.0	25.8	-24.2	50.0	Phase 1
30.000	8	33.2	-26.8	60.0	32.8	-17.2	50.0	Phase 1

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Test point: N
 Operation mode: TX continuous
 Remarks:

Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB	
0.285	9	34.1	-26.6	60.7	11.6	-39.0	50.7	Neutral
0.462	10	29.3	-27.4	56.7	12.5	-34.2	46.7	Neutral
0.471	10	28.2	-28.3	56.5	19.6	-26.9	46.5	Neutral
0.717	11	25.0	-31.0	56.0	18.1	-27.9	46.0	Neutral
0.722	11	28.2	-27.8	56.0	22.3	-23.8	46.0	Neutral
1.149	11	32.9	-23.1	56.0	23.9	-22.1	46.0	Neutral
1.154	11	31.5	-24.5	56.0	23.0	-23.0	46.0	Neutral
1.416	12	33.3	-22.7	56.0	23.2	-22.9	46.0	Neutral
4.989	14	23.4	-32.6	56.0	16.8	-29.2	46.0	Neutral
5.210	14	23.8	-36.2	60.0	17.3	-32.7	50.0	Neutral
6.879	14	22.7	-37.4	60.0	15.5	-34.5	50.0	Neutral
7.086	14	21.6	-38.4	60.0	14.9	-35.1	50.0	Neutral
23.997	16	25.3	-34.7	60.0	24.2	-25.8	50.0	Neutral
24.002	16	25.2	-34.8	60.0	24.1	-25.9	50.0	Neutral
30.000	16	32.6	-27.5	60.0	32.2	-17.8	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 2
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 C63.4, Item 8.3. 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

5.2.4 Test result

Frequency (MHz)	Level PK dB(μV/m)	Polarisation	Limit PK dB(μV/m)	Margin PK (dB)
24010	107.3	V	128.0	-20.7
24135	106.1	V	128.0	-21.8
24235	106.4	V	128.0	-21.6

Frequency (MHz)	Level AV dB(μV/m)	Polarisation	Limit AV dB(μV/m)	Margin AV (dB)
24010	106.9	V	108.0	-1.0
24135	106.0	V	108.0	-1.9
24235	106.2	V	108.0	-1.8

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

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

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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 2
 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 C63.4, Item 6 and Item 8.3. 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.

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 (MHz)	Reading PK dB(μ V)	D factor dB(μ V/m)	Level PK dB(μ V/m)	Limit AV dB(μ V/m)	Delta (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

FCC ID: W34UMRR0A20X
5.3.2 Test result f < 1 GHz

Frequency (MHz)	Reading Vert. (dB μ V)	Reading Hor. (dB μ V)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dB μ V/m)	Level Hor. (dB μ V/m)	Limit (dB μ V/m)	Dlimit (dB)
33.00	9.6	0.1	13.5	12.3	23.1	12.4	40.0	-16.9
52.00	7.6	4.6	15.0	13.9	22.6	18.5	40.0	-17.4
86.00	16.2	9.4	9.3	9.7	25.5	19.1	40.0	-14.5
93.30	12.5	4.0	8.4	9.4	20.9	13.4	43.5	-22.6
113.00	1.9	0.1	10.9	11.7	12.8	11.8	43.5	-30.7
119.00	0.1	0.1	12.0	12.5	12.1	12.6	43.5	-30.9
128.00	2.2	0.3	12.6	13.2	14.8	13.5	43.5	-28.7
330.00	1.5	0.8	17.2	16.8	18.7	17.6	46.0	-27.3
490.00	0.7	0.8	21.5	21.1	22.2	21.9	46.0	-23.8
620.00	1.4	0.9	24.9	24.5	26.3	25.4	46.0	-19.7
850.00	2.5	2.4	28.9	28.4	31.4	30.8	46.0	-14.6
990.00	2.8	2.8	30.3	29.9	33.1	32.7	54.0	-20.9

Note: The frequencies 33 MHz to 990 MHz means the noise level.

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

5.3.3 Test result f > 1 GHz
Frequency range 0:

Frequency (MHz)	Level PK (dB(μ V/m))	Level AV (dB(μ V/m))	Limit PK (dB(μ V/m))	Margin PK (dB)	Limit AV (dB(μ V/m))	Margin AV (dB)
1077	60.2	-	78.0	-17.8	58.0	-
1145	56.1	-	78.0	-21.9	58.0	-
1348	52.8	-	78.0	-25.2	58.0	-
1616	50.16	-	78.0	-27.8	58.0	-
11965	49.2	-	78.0	-28.8	58.0	-
17561	56.7	-	78.0	-21.3	58.0	-
23864	60.5	39.4	78.0	-17.5	58.0	-18.6
23895	65.9	40.1	78.0	-12.1	58.0	-17.9
23924	60.6	38.8	78.0	-17.4	58.0	-19.2
24269	57.3	-	78.0	-20.7	58.0	-
31933	57.9	-	78.0	-20.1	58.0	-

Note: For frequencies > 24269 MHz the noise level could be measured only.

FCC ID: W34UMRR0A20X

Frequency range 10:

Frequency (MHz)	Level PK dB(μV/m)	Level AV dB(μV/m)	Limit PK dB(μV/m)	Margin PK (dB)	Limit AV dB(μV/m)	Margin AV (dB)
1078	59.8	55.5	78.0	-18.2	58.0	-2.5
1145	57.6	-	78.0	-20.4	58.0	-
1347	57.3	-	78.0	-20.7	58.0	-
1617	53.0	-	78.0	-25.0	58.0	-
11999	49.3	-	78.0	-28.7	58.0	-
17670	48.1	-	78.0	-29.9	58.0	-
23989	63.9	38.8	78.0	-14.1	58.0	-19.2
24251	69.9	40.6	78.0	-8.1	58.0	-17.4
24282	70.5	41.6	78.0	-7.5	58.0	-16.4
24320	67.4	40.9	78.0	-10.6	58.0	-17.1
24325	66.1	40.3	78.0	-11.9	58.0	-17.7

Note: For frequencies > 24325 MHz the noise level could be measured only.

Frequency range 18:

Frequency (MHz)	Level PK dB(μV/m)	Level AV dB(μV/m)	Limit PK dB(μV/m)	Margin PK (dB)	Limit AV dB(μV/m)	Margin AV (dB)
1060	44.3	-	78.0	-33.7	58.0	-
1078	41.5	-	78.0	-36.5	58.0	-
1204	44.8	-	78.0	-33.2	58.0	-
3886	41.3	-	78.0	-36.7	58.0	-
11712	49.1	-	78.0	-28.9	58.0	-
17988	56.3	-	78.0	-21.7	58.0	-
23856	57.1	-	78.0	-20.9	58.0	-
24344	70.4	41.9	78.0	-7.6	58.0	-16.1
24381	71.5	42.0	78.0	-6.5	58.0	-16.0
24419	69.2	42.0	78.0	-8.8	58.0	-16.0
24426	67.1	40.6	78.0	-10.9	58.0	-17.4

Note: For frequencies > 24426 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.

Fundamental field strength: 250 mV/m

= 108 dBμV/m

Emission limit: Fundamental field strength – 50 dB

= 108 dBμV/m – 50 dB = **58 dBμV/m**;

The field strength limits are defined in 3 m distance.

The measurement from 40 GHz to 100 GHz is done in a distance of 1 m. Therefore the measurement limit has to be changed from 58 dBμV/m to 68 dBμV/m.

FCC ID: W34UMRR0A20X

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

Frequency (MHz)	15.209 Limits ($\mu\text{V/m}$)	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

The limit according FCC Part 15C, Section 15.249(d) applies as lesser attenuation.

5.3.4 Test result harmonics

The measurement of the harmonics is done in 1 m distance.

Harmonics at 48 GHz:

Frequency range (MHz)	Frequency (MHz)	Level PK (dB($\mu\text{V/m}$))	Limit PK (dB($\mu\text{V/m}$))	Margin PK (dB)	Polarisation	Level AV (dB($\mu\text{V/m}$))	Limit AV (dB($\mu\text{V/m}$))	Margin AV (dB)
FR0	48016.0	55.4	88.0	-32.6	H	-	68.0	-
FR10	48277.0	54.6	88.0	-33.4	H	-	68.0	-
FR18	48463.0	56.1	88.0	-31.8	H	-	68.0	-

Note: Due to comply with the 3 m distance limit, the 1 m distance limit need not to be applied.

Harmonics at 72 GHz:

Note: this measurement is done with a down converter for frequency range 60 – 90 GHz. The LO-frequency is fixed at 59 GHz. This means the frequency range 60 – 90 GHz is converted to 1 GHz to 31 GHz. That the frequency displayed at spectrum analyser corresponds to the real frequency a frequency offset -1 GHz is set. Now a displayed frequency of 12 GHz corresponds to 72 GHz. All other frequencies may be calculated as follows:

Marker frequency + 60 GHz = Emission frequency;

No harmonics could be detected.

Harmonics at 96 GHz:

No harmonics could be detected.

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

Determination of the limit:

Harmonic field strength $2.5 \text{ mV/m} = 68 \text{ dB}\mu\text{V/m}$;

The field strength limits are defined in 3 m distance.

The measurement from 40 GHz to 100 GHz is done in a distance of 1 m. Therefore the measurement limit has to be changed from 68 dB $\mu\text{V/m}$ to 78 dB $\mu\text{V/m}$.

FCC ID: W34UMRR0A20X

Fundamental frequency (MHz)	Field strength of harmonics	
	mV/m	dB(μ V/m)
24000 - 24250	2.5	68.0

The requirements are **FULFILLED**.

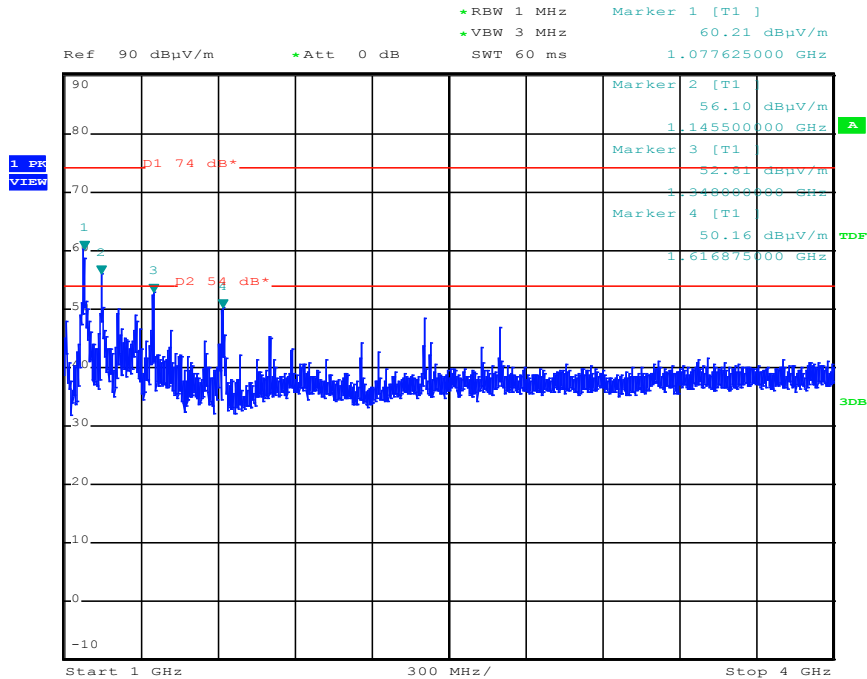
Remarks: The measurement was performed up to 100 GHz. For detailed test result please refer to following test protocols.

5.3.5 Test protocols

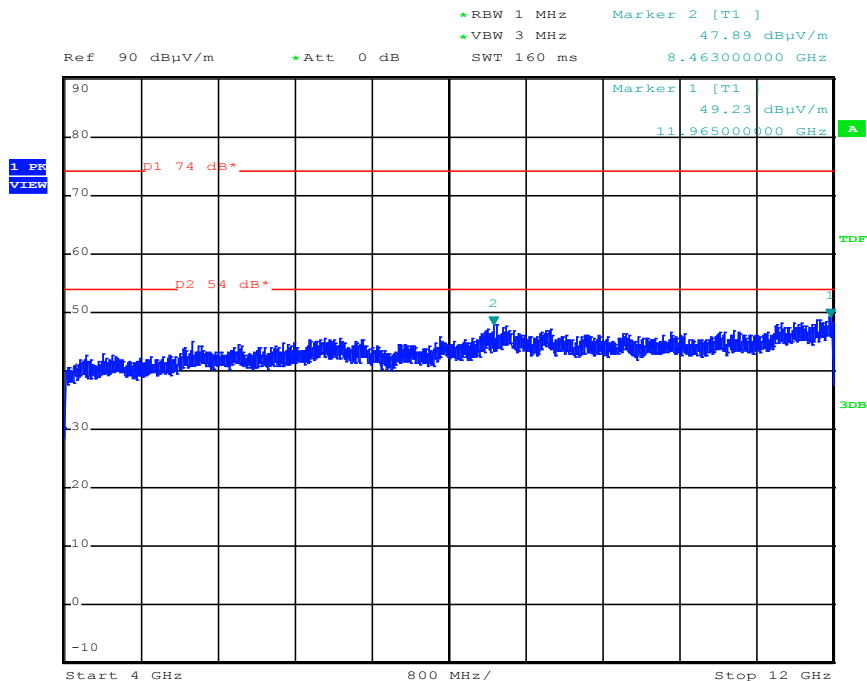
Note: The limits displayed in the plots are “general radiated limits” which are more stringent. The limits apply are the limits according FCC 15.249.

5.3.5.1 Frequency range 0

Spurious emissions from 1 to 4 GHz

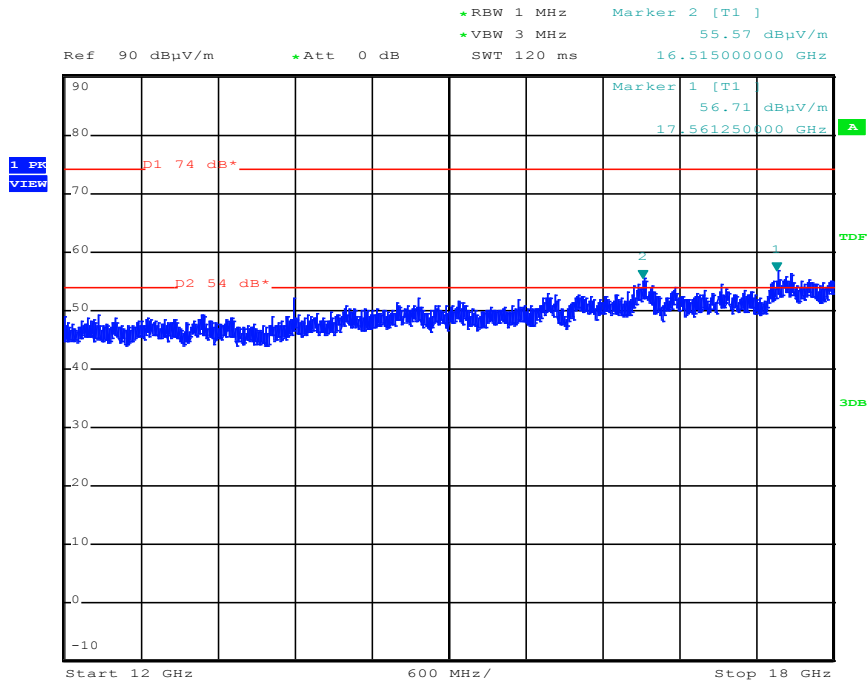


Spurious emissions from 4 to 12 GHz

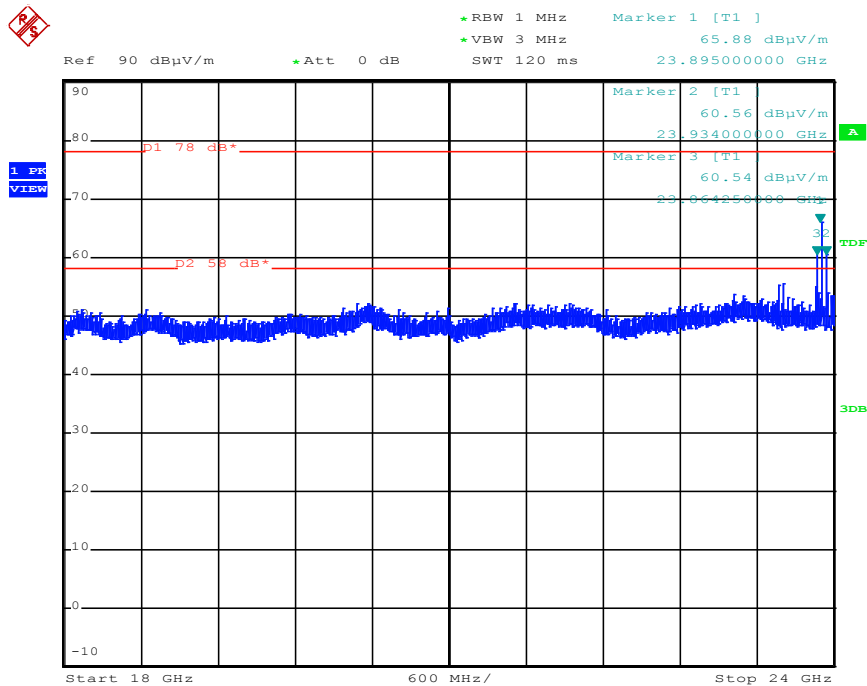


FCC ID: W34UMRR0A20X

Spurious emissions from 12 to 18 GHz

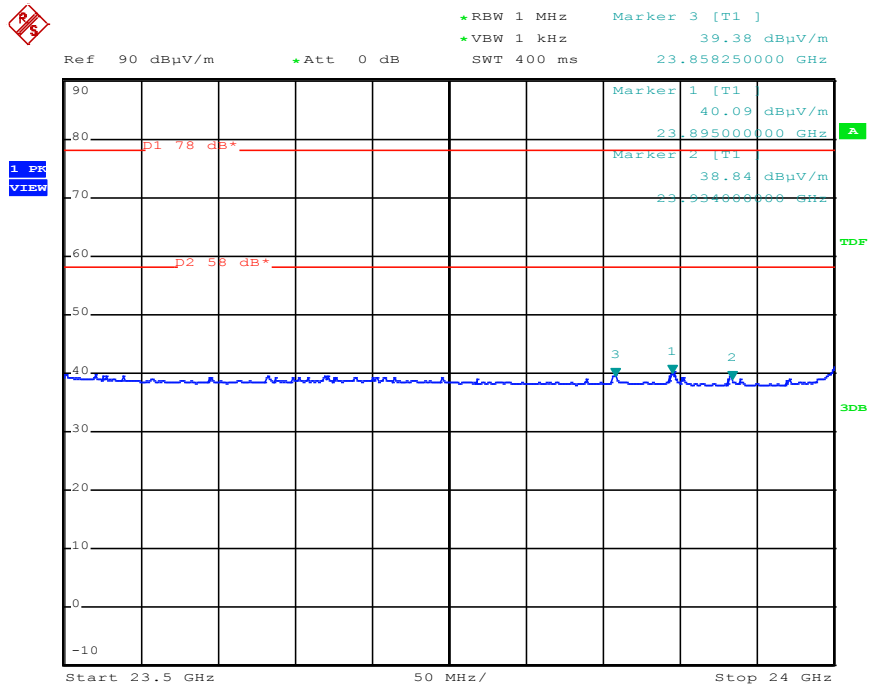


Spurious emissions from 18 to 24 GHz

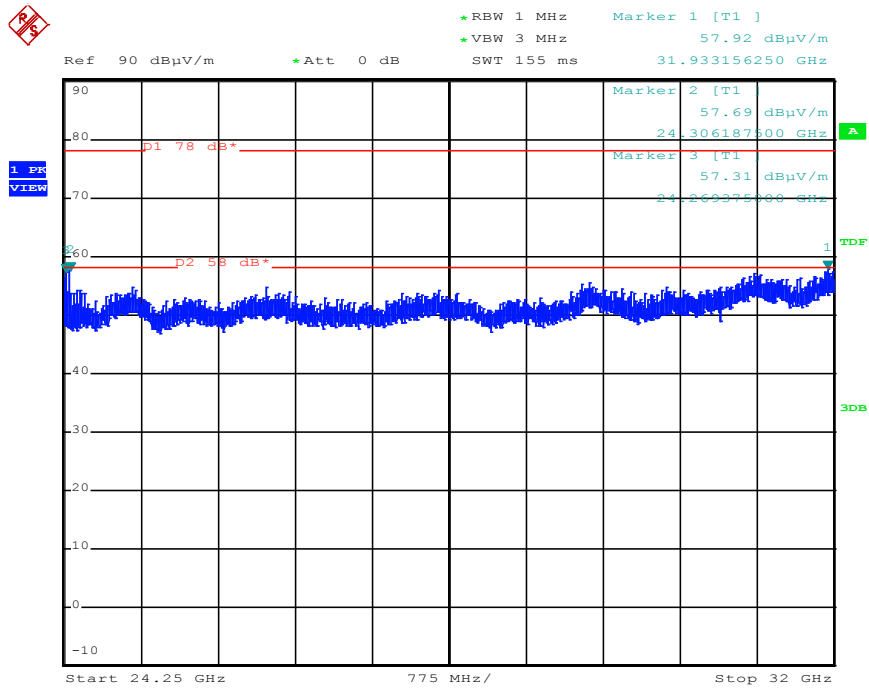


FCC ID: W34UMRR0A20X

Spurious emissions from 18 to 24 GHz, AV

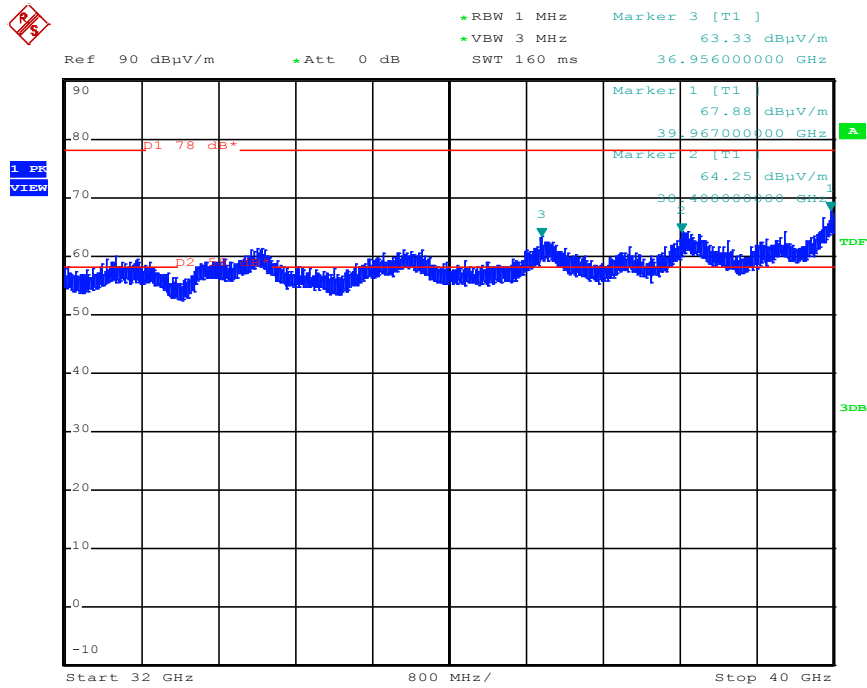


Spurious emissions from 24.25 to 32 GHz

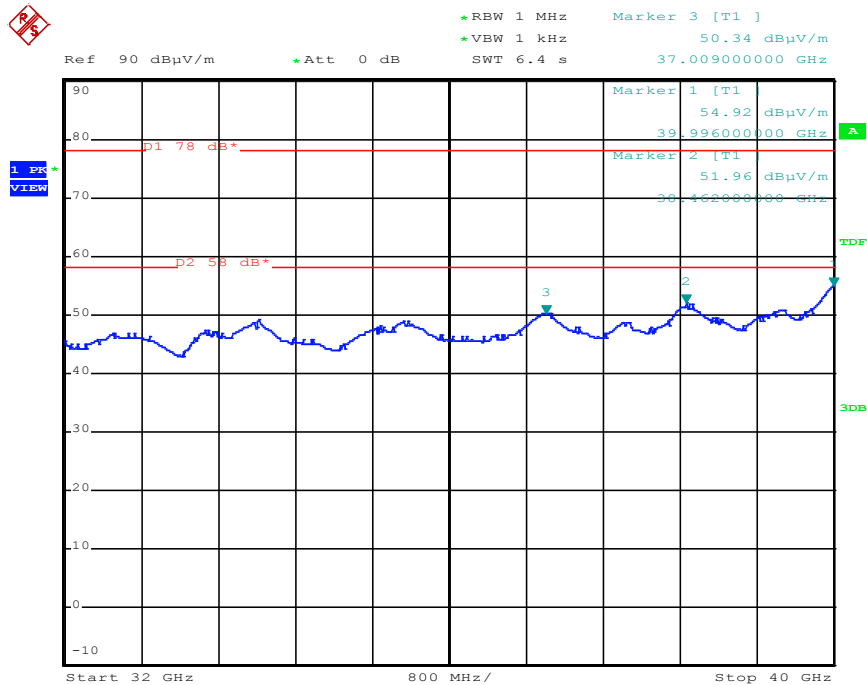


FCC ID: W34UMRR0A20X

Spurious emissions from 32 to 40 GHz

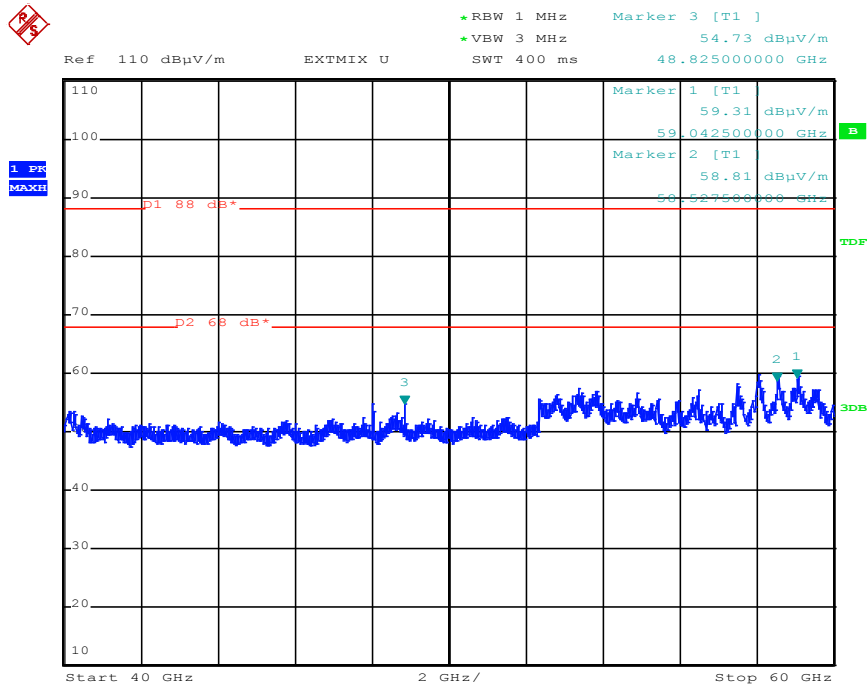


Spurious emissions from 32 to 40 GHz, AV



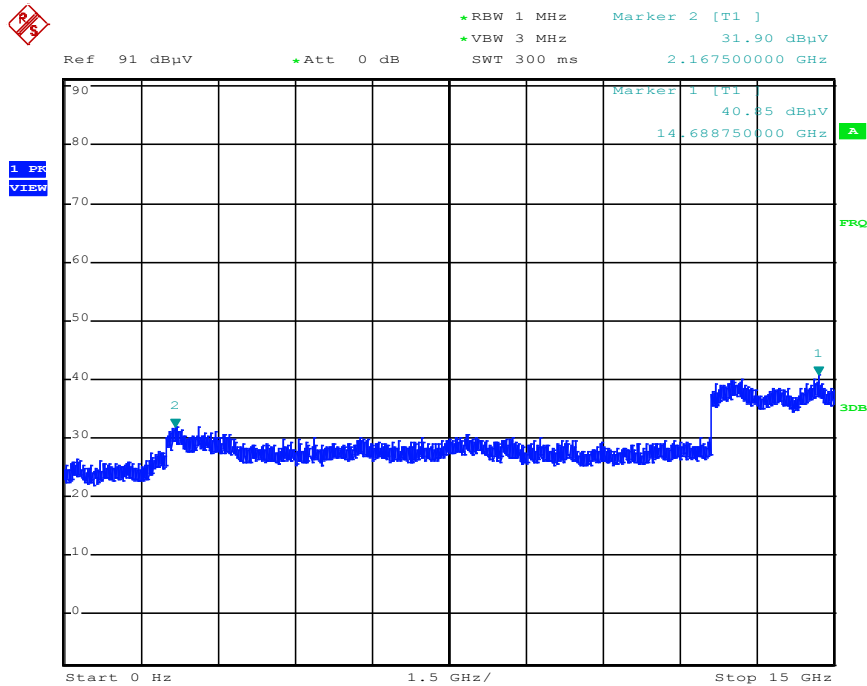
FCC ID: W34UMRR0A20X

Spurious emissions from 40 to 60 GHz



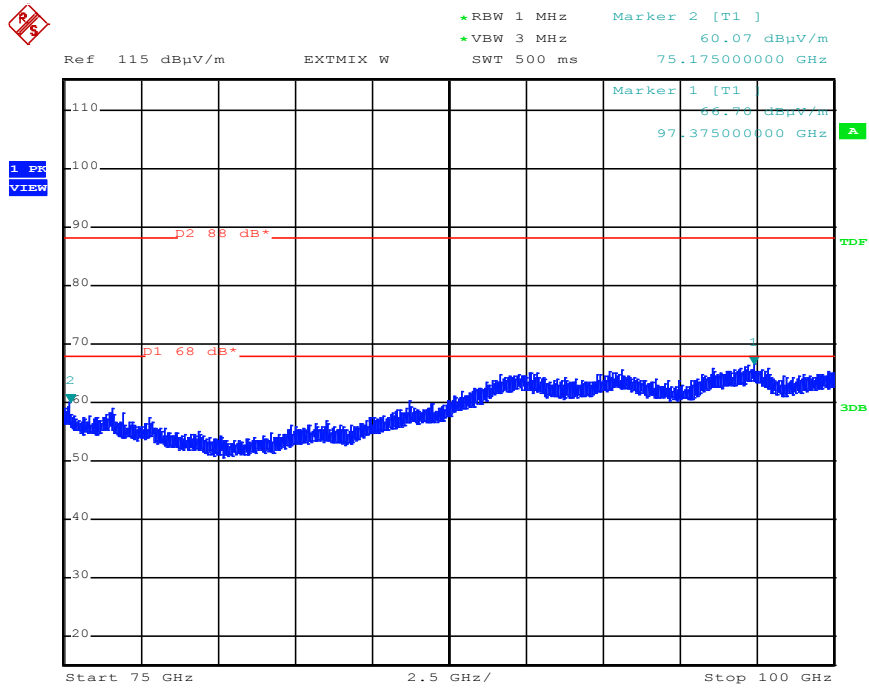
Note. The measurement 40 GHz to 100 GHz is measured in a 1 m distance, therefore the AV-limit needs to be changed to 68 dBuV/m.

Spurious emissions from 60 to 75 GHz



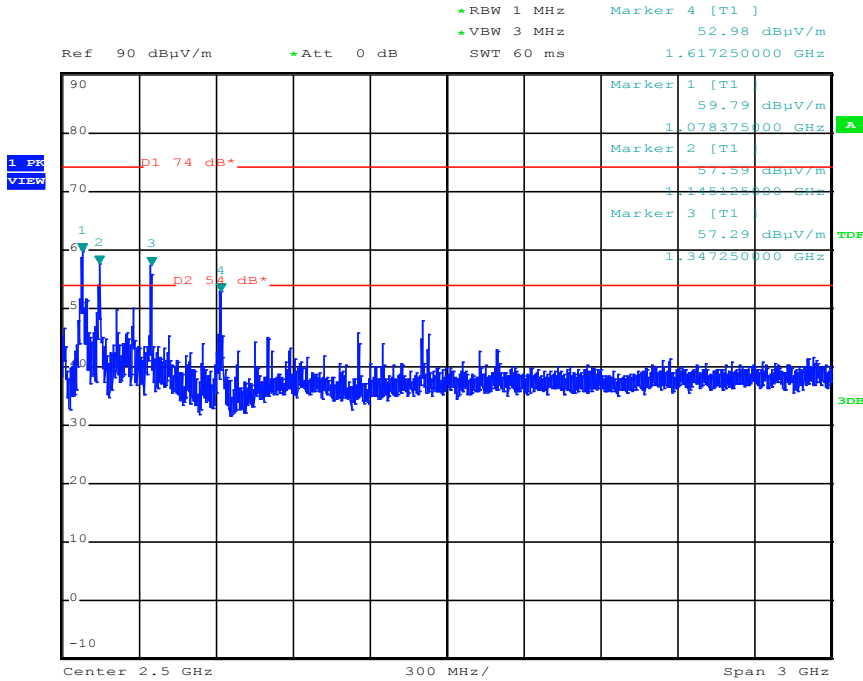
FCC ID: W34UMRR0A20X

Spurious emissions from 75 to 100 GHz

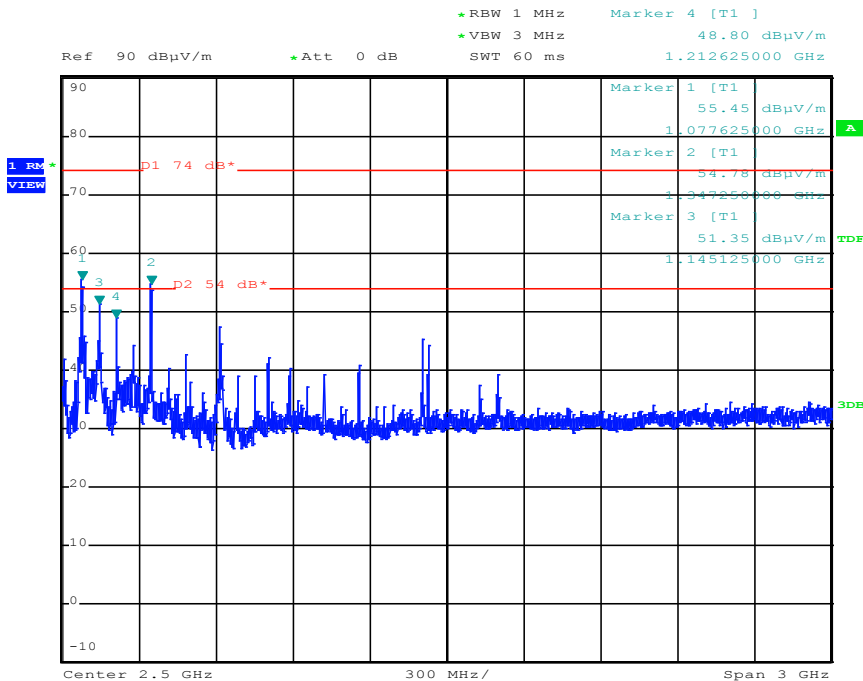


5.3.5.2 Frequency range 10

Spurious emissions from 1 to 4 GHz

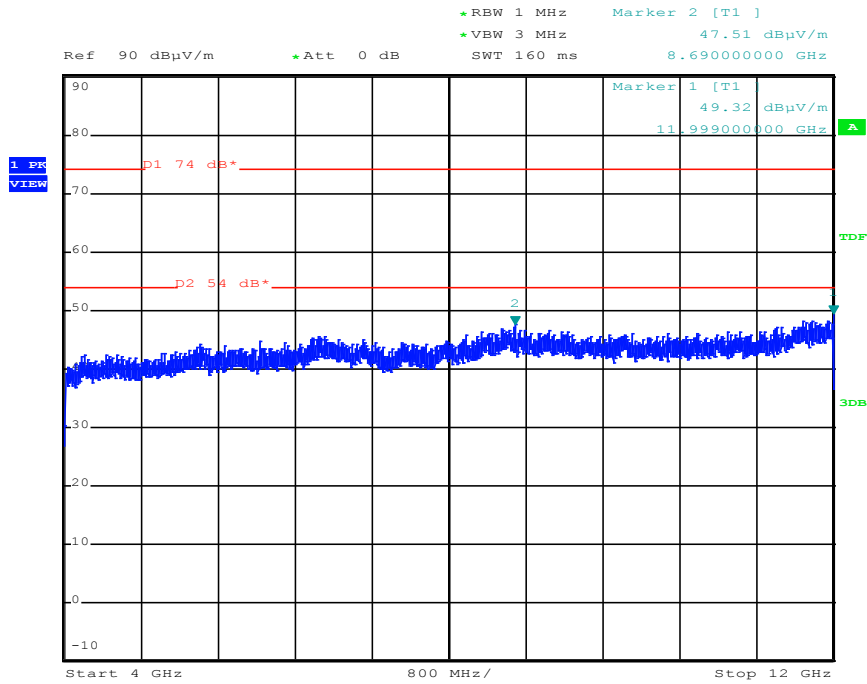


Spurious emissions from 1 to 4 GHz, RMS

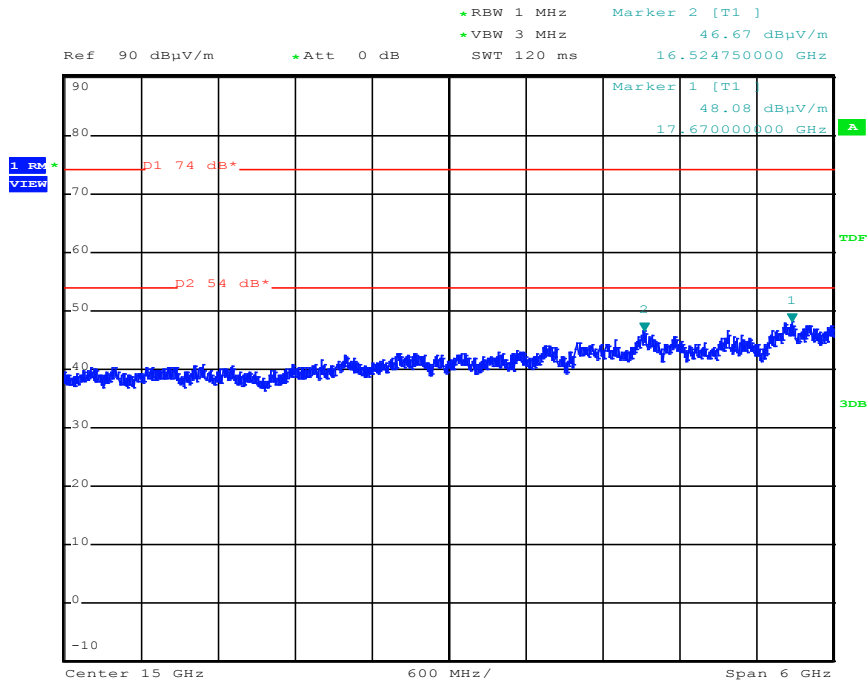


FCC ID: W34UMRR0A20X

Spurious emissions from 4 to 12 GHz

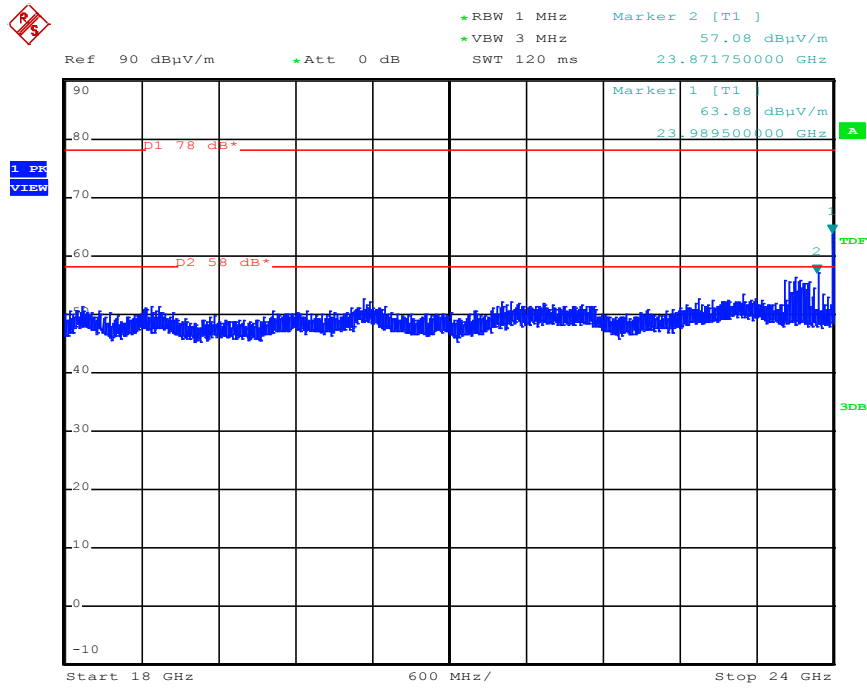


Spurious emissions from 12 to 18 GHz

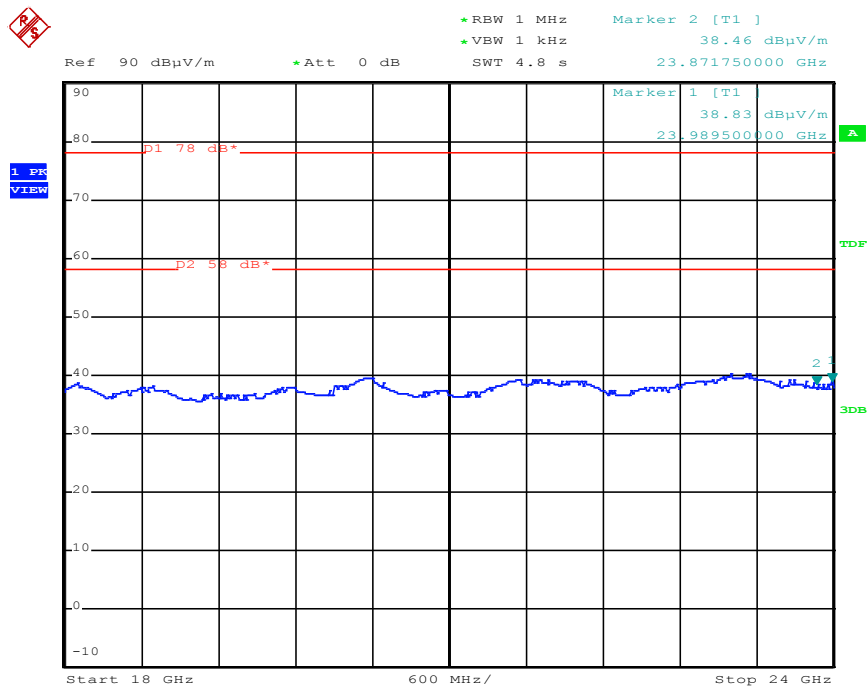


FCC ID: W34UMRR0A20X

Spurious emissions from 18 to 24 GHz

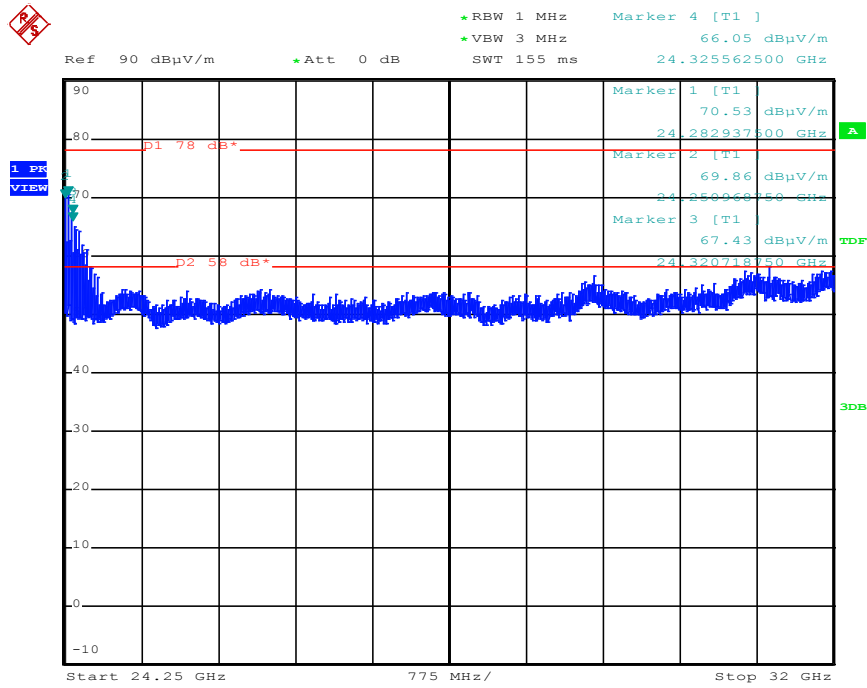


Spurious emissions from 18 to 24 GHz, AV

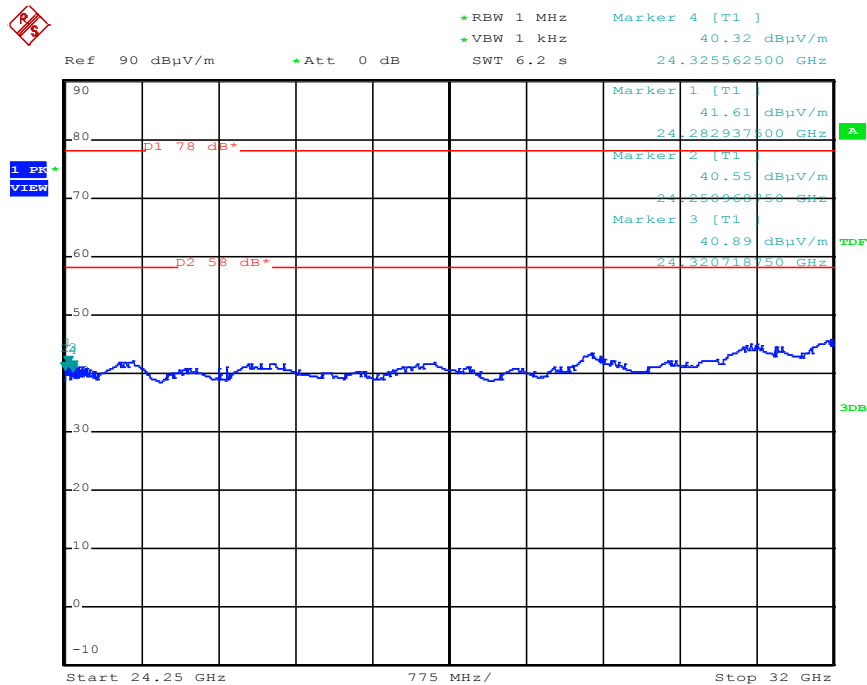


FCC ID: W34UMRR0A20X

Spurious emissions from 24.25 to 32 GHz

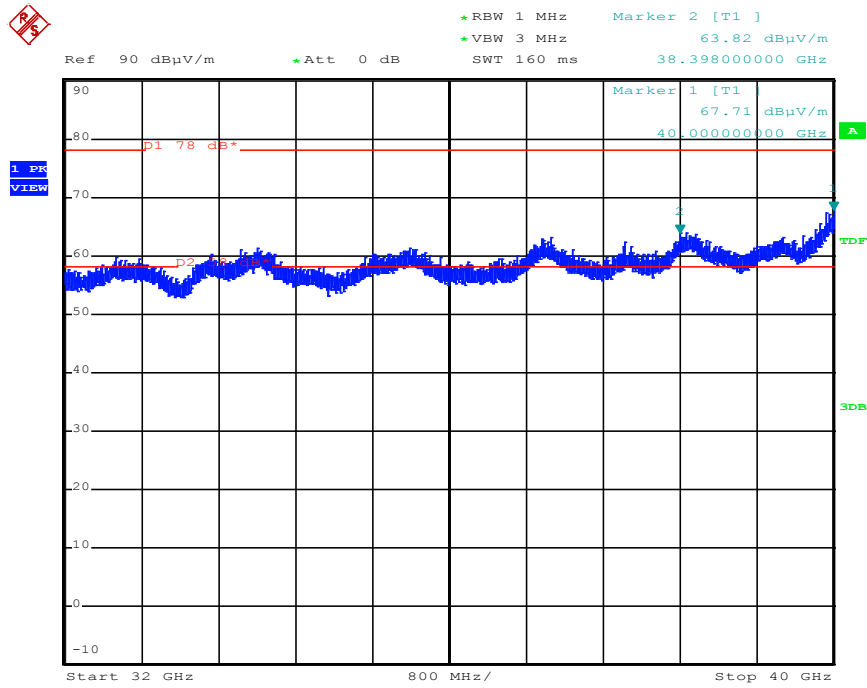


Spurious emissions from 24.25 to 32 GHz, AV

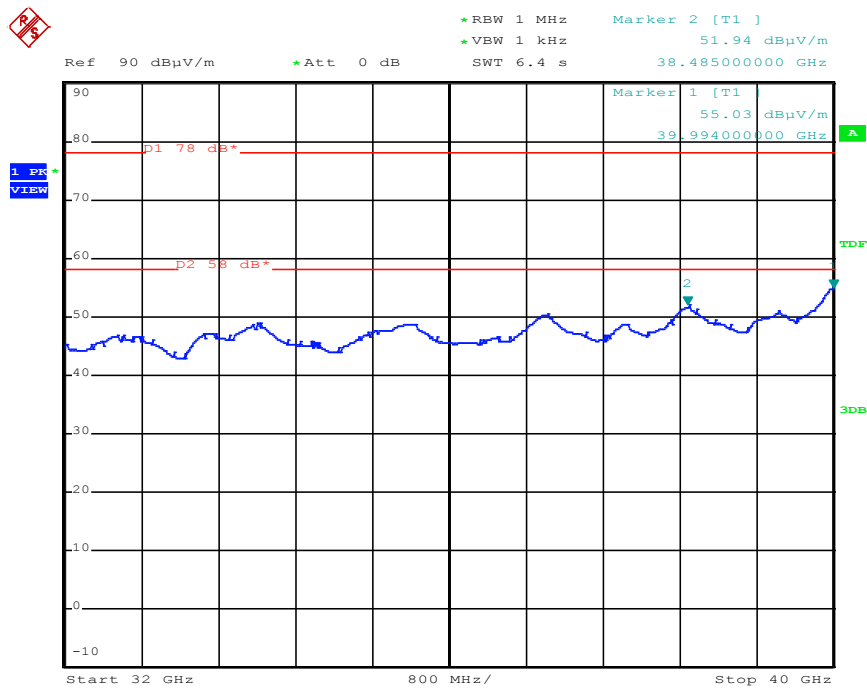


FCC ID: W34UMRR0A20X

Spurious emissions from 32 to 40 GHz

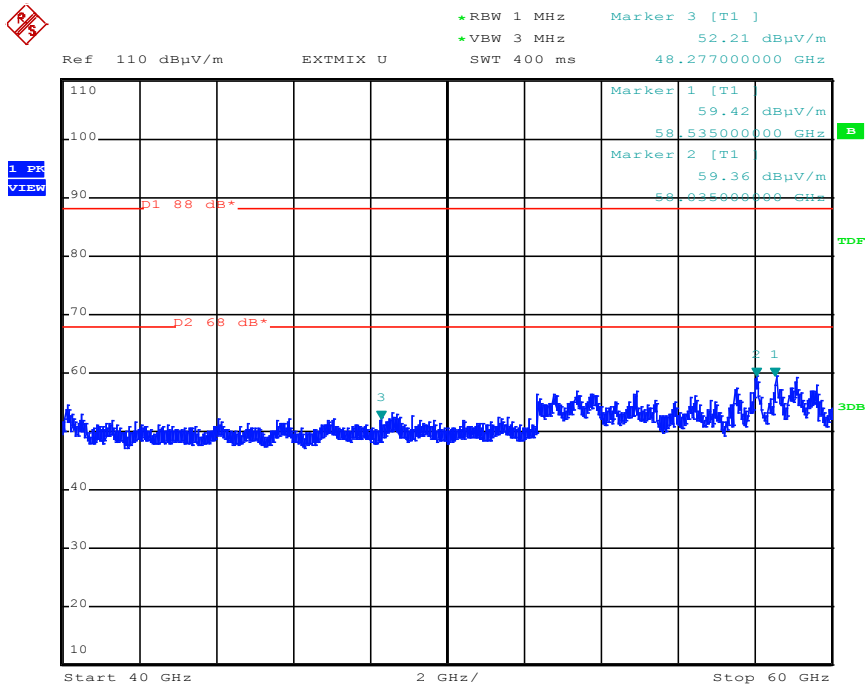


Spurious emissions from 32 to 40 GHz, AV



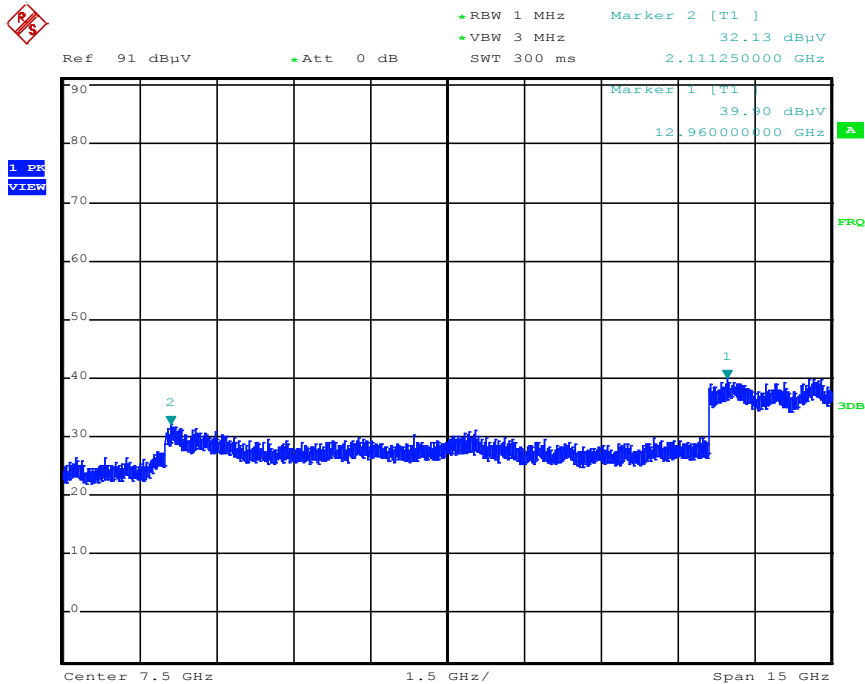
FCC ID: W34UMRR0A20X

Spurious emissions from 40 to 60 GHz



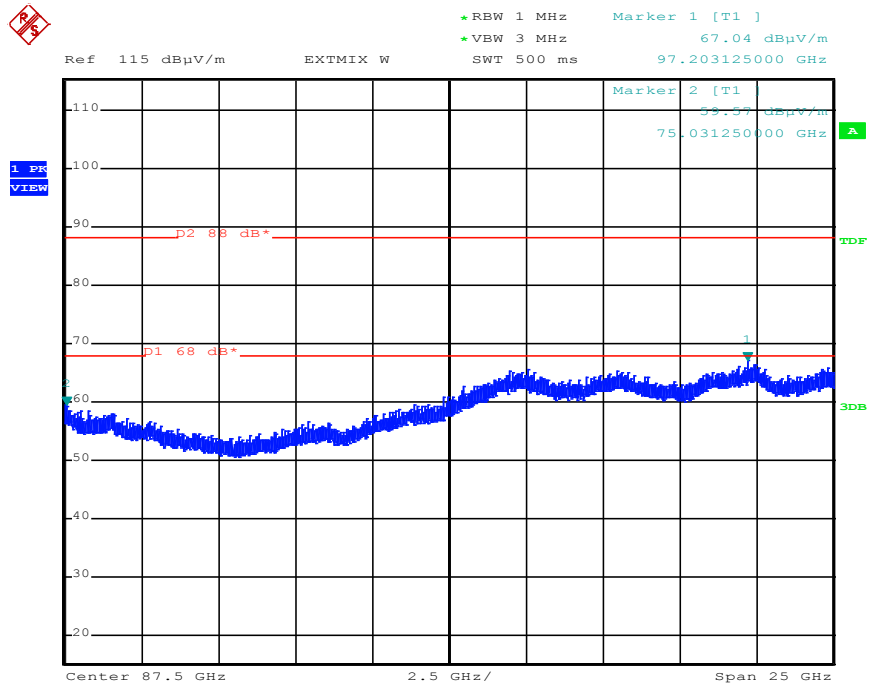
Note. The measurement 40 GHz to 100 GHz is measured in a 1 m distance, therefore the AV-limit needs to be changed to 68 dBμV/m.

Spurious emissions from 60 to 75 GHz



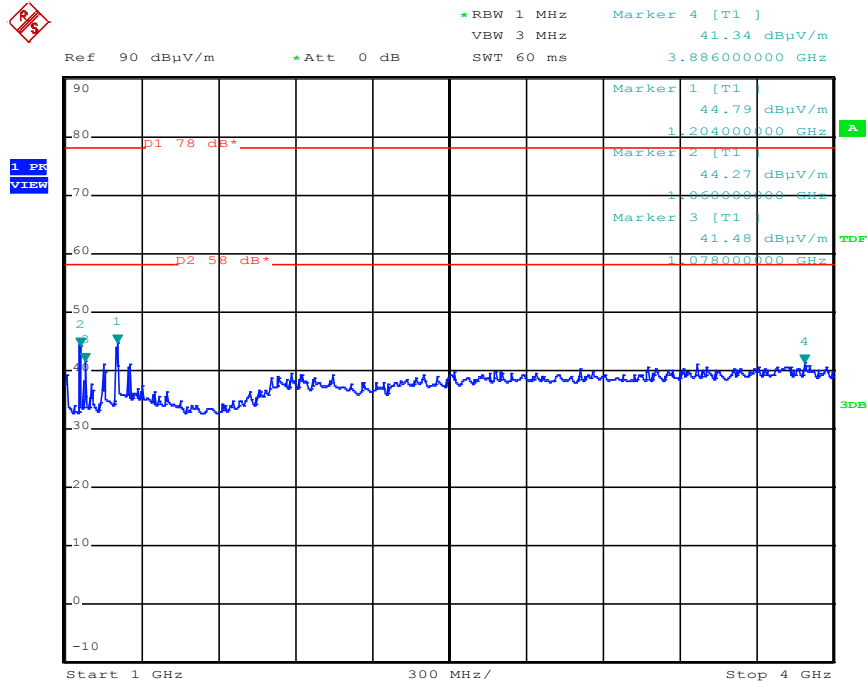
FCC ID: W34UMRR0A20X

Spurious emissions from 75 to 100 GHz

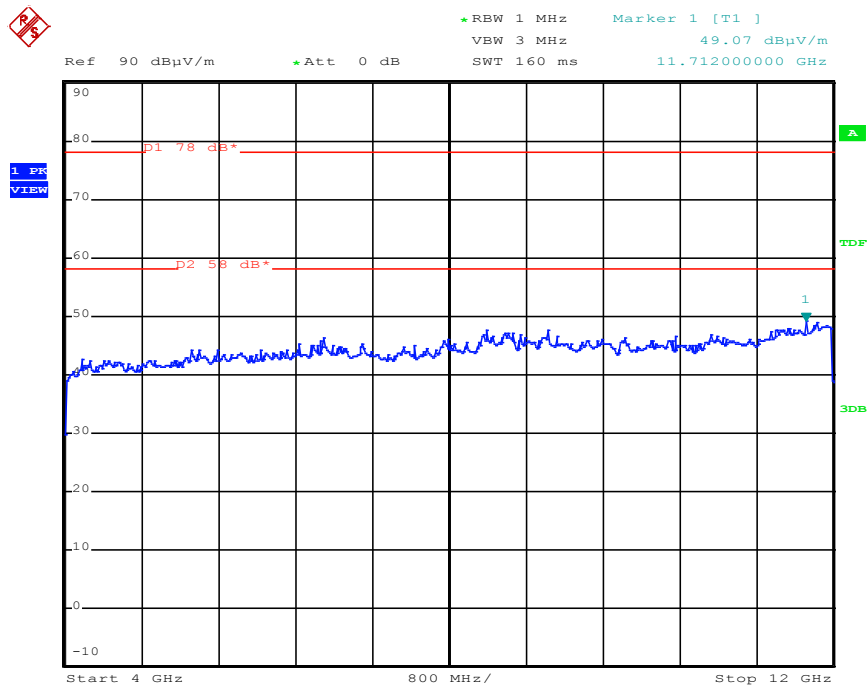


5.3.5.3 Frequency range 18

Spurious emissions from 1 to 4 GHz

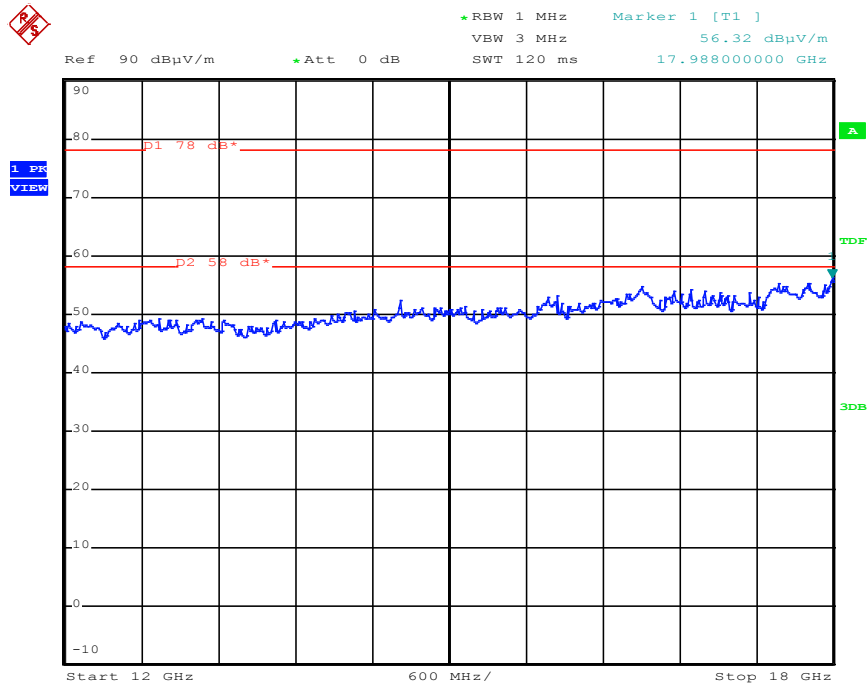


Spurious emissions from 4 to 12 GHz

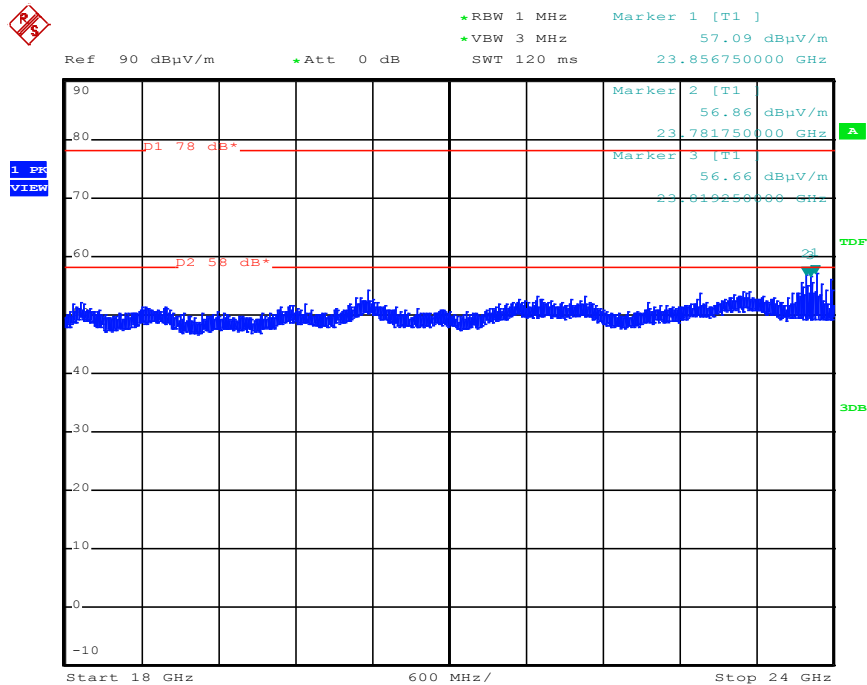


FCC ID: W34UMRR0A20X

Spurious emissions from 12 to 18 GHz

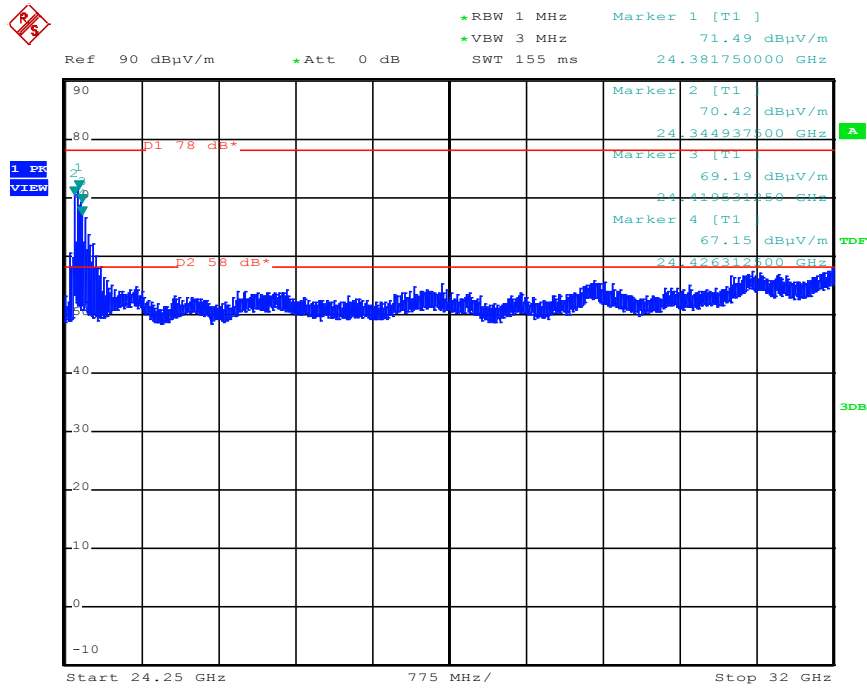


Spurious emissions from 18 to 24 GHz

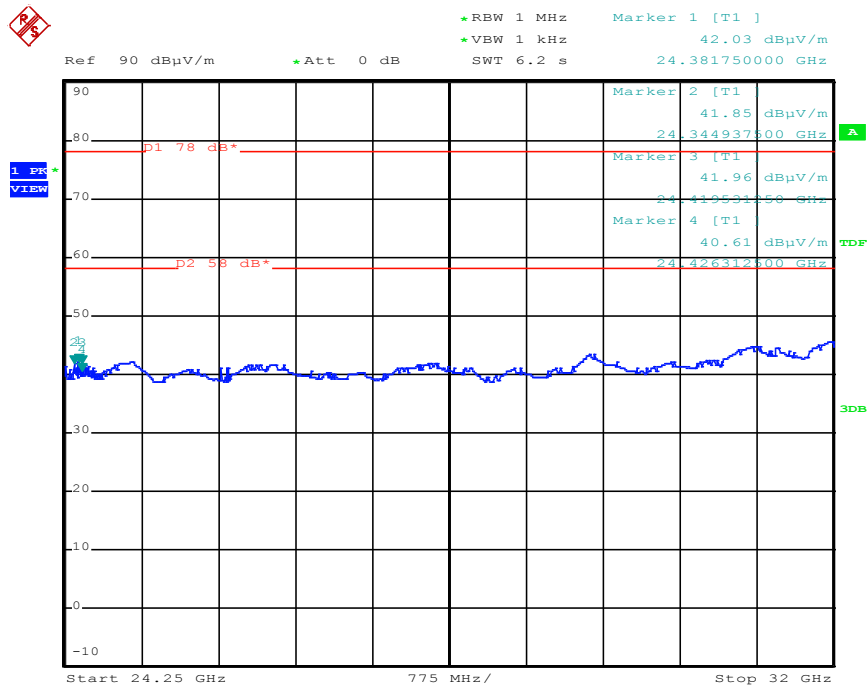


FCC ID: W34UMRR0A20X

Spurious emissions from 24.25 to 32 GHz

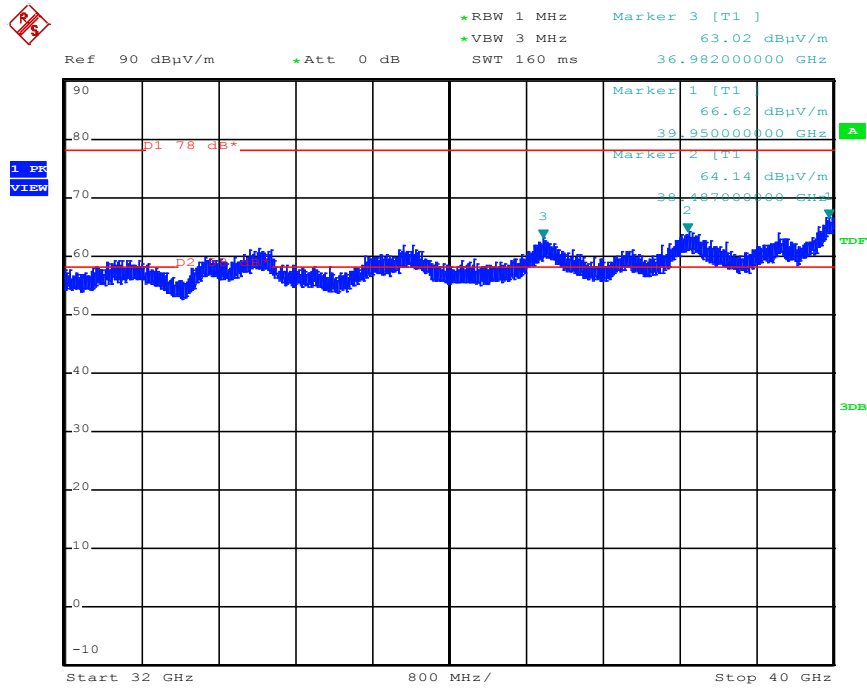


Spurious emissions from 24.25 to 32 GHz, AV

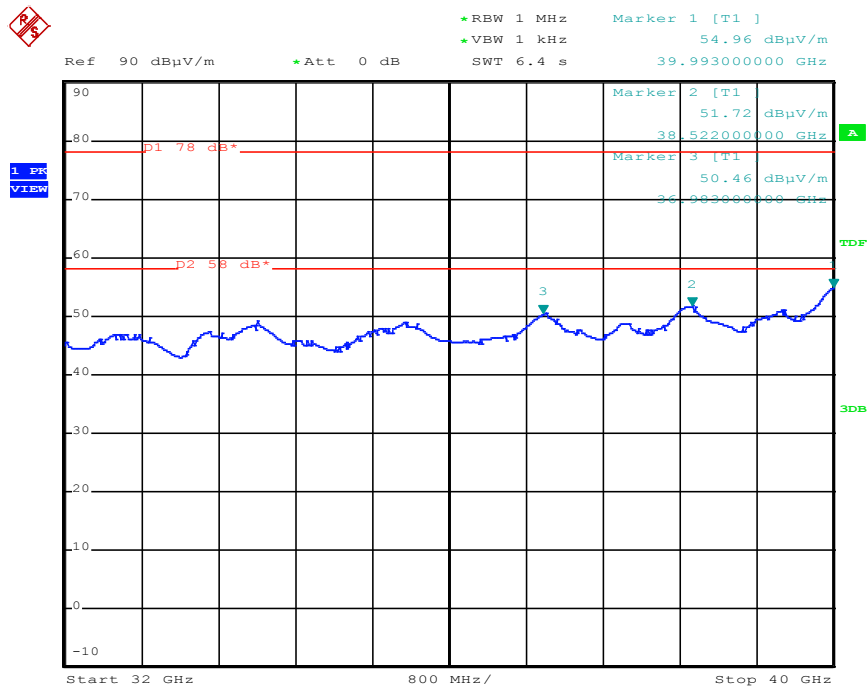


FCC ID: W34UMRR0A20X

Spurious emissions from 32 to 40 GHz

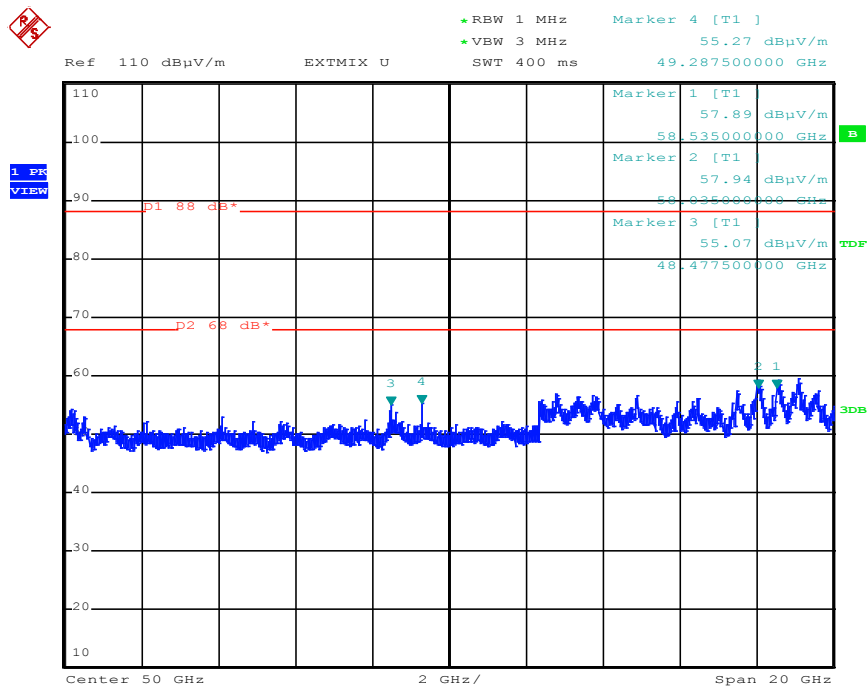


Spurious emissions from 32 to 40 GHz, AV



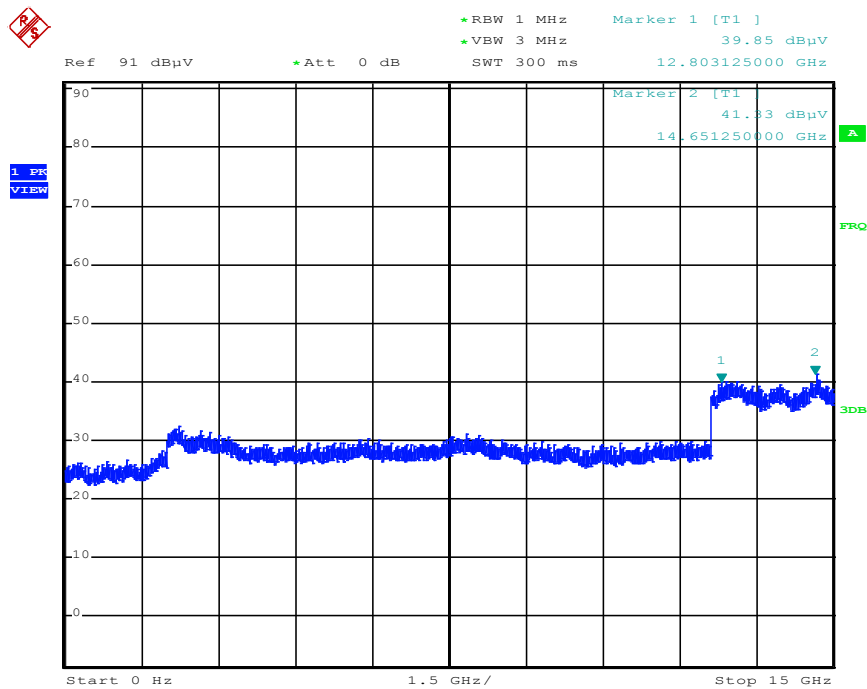
FCC ID: W34UMRR0A20X

Spurious emissions from 40 to 60 GHz



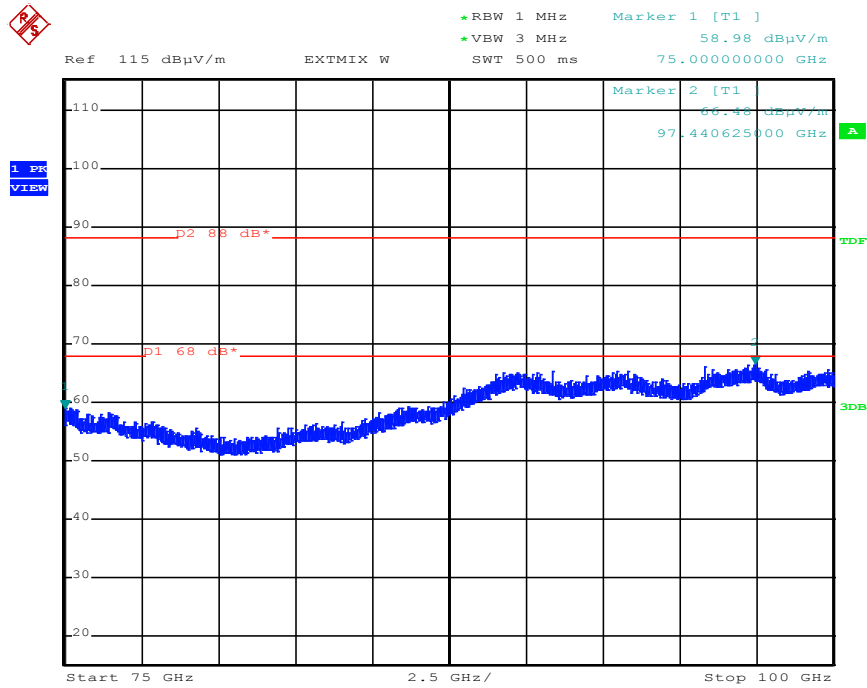
Note. The measurement 40 GHz to 100 GHz is measured in a 1 m distance, therefore the AV-limit needs to be changed to 68 dBuV/m.

Spurious emissions from 60 to 75 GHz



FCC ID: W34UMRR0A20X

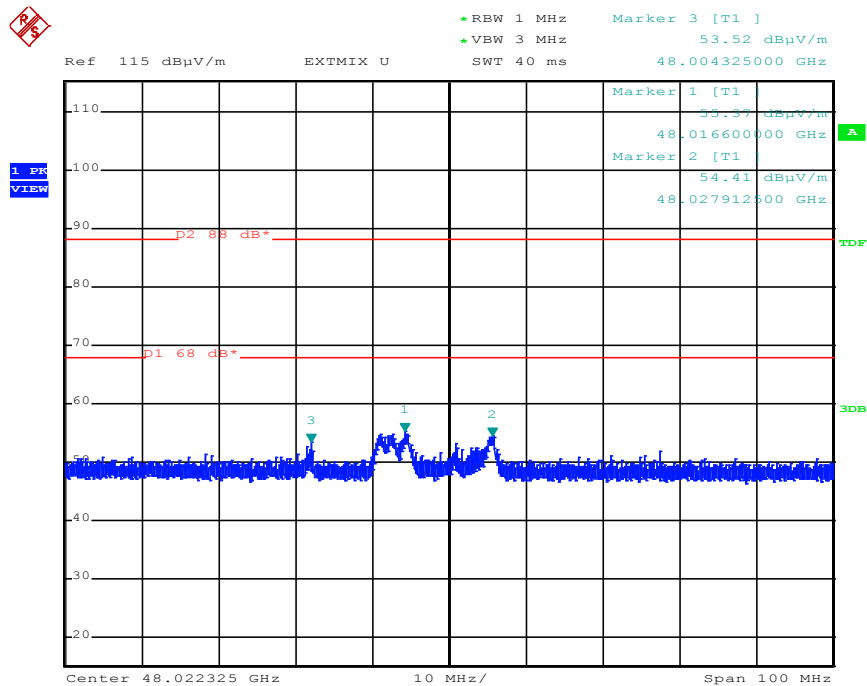
Spurious emissions from 75 to 100 GHz



5.3.6 Test protocols harmonics

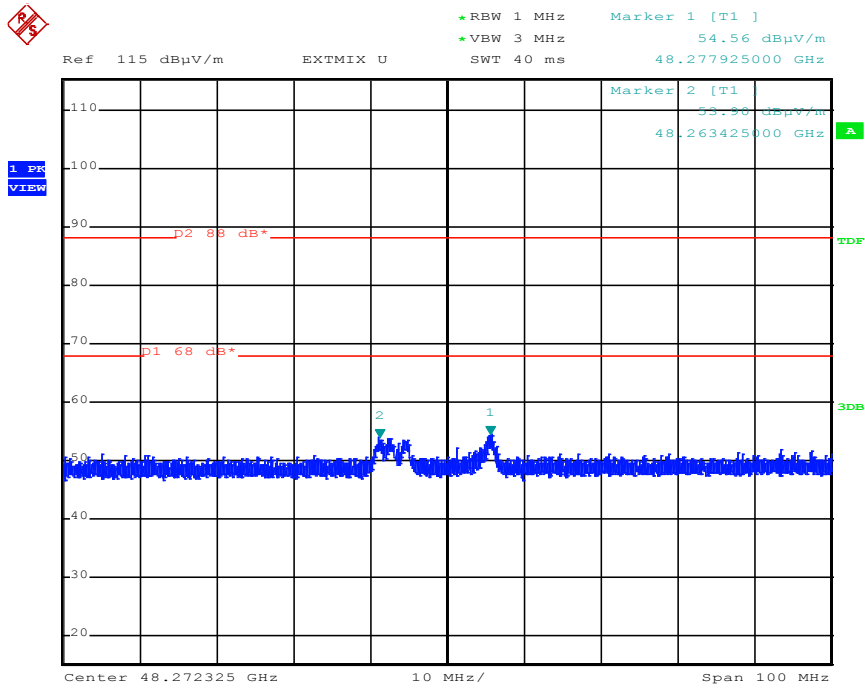
Harmonics 48 GHz:

FR0

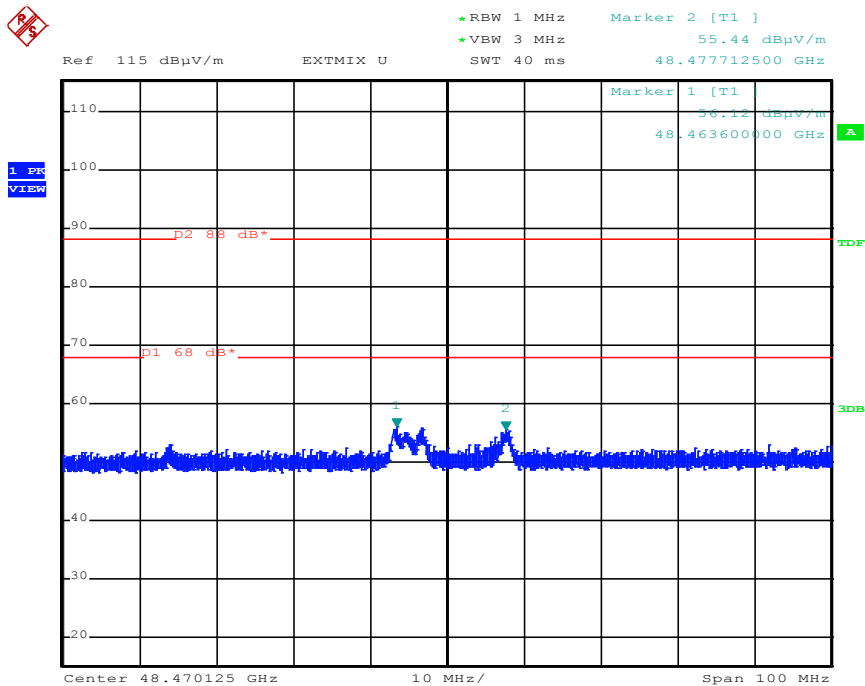


FCC ID: W34UMRR0A20X

FR10



FR18



5.4 EBW

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

5.4.1 Description of the test location

Test location: AREA4

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 (MHz)	20dB bandwidth f_1	20dB bandwidth f_2	Measured EBW (MHz)
24010.319	24005.001	24015.638	10.637
24135.280	24129.927	24140.633	10.706
24235.280	24229.910	24240.649	10.739

Operating frequency band (MHz)	20 dB Bandwidth (MHz)	
$f_{low} > 24000$	$f_{low} =$	24005.001
$f_{high} < 24250$	$f_{high} =$	24240.649

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.

FCC ID: W34UMRR0A20X

Due to the operation with a small OBW in an operating band of 100 MHz a virtual channelizing of the operating band is assumed. Therefore the stability of the EUT will be shown to the distance to the operating band edges.

Distance to the lower band edge	5.001 MHz
Distance to the lower band edge	47.0 %
Distance to the upper band edge	9.351 MHz
Distance to the upper band edge	87.1 %

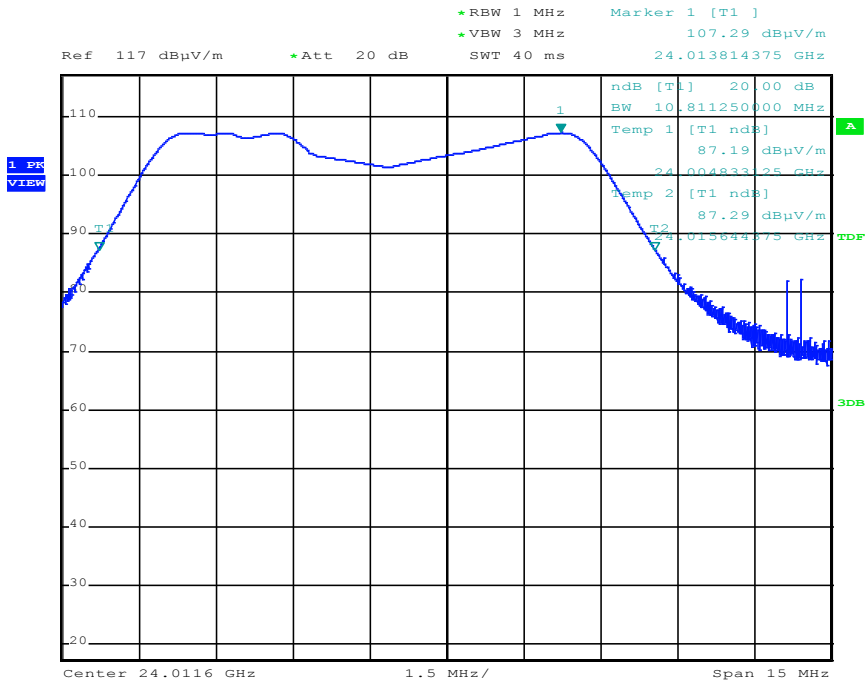
The requirements are **FULFILLED**.

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

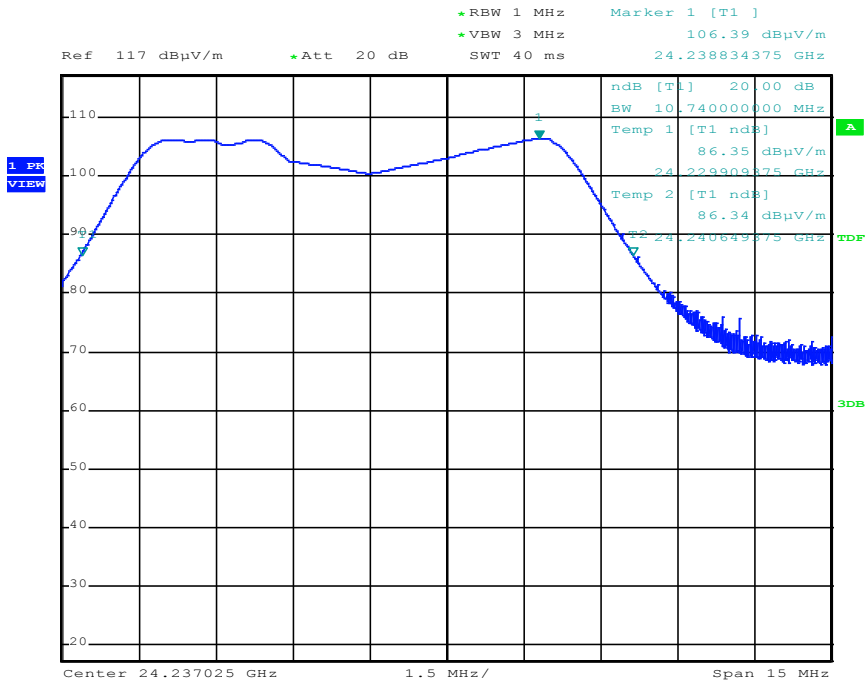
5.4.6 Test protocols

20 dB bandwidth

FR0



FR18



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.

5.6.2 Result

The EUT use an integrated PCB 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.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	ESHS 30	02-02/03-05-002	16/07/2014	16/07/2013		
	ESH 2 - Z 5	02-02/20-05-004	18/10/2014	18/10/2013	28/08/2014	28/02/2014
	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	10/10/2014	10/04/2014		
CPR 3	FSP 40	02-02/11-11-001	30/09/2014	30/09/2013		
	R1 _ 18 - 40 GHz	02-02/30-09-002	08/01/2015	08/01/2014		
MB	FSP 40	02-02/11-11-001	30/09/2014	30/09/2013		
	R1 _ 18 - 40 GHz	02-02/30-09-002	08/01/2015	08/01/2014		
SER 1	FMZB 1516	01-02/24-01-018	13/02/2015	13/02/2014		
	ESCI	02-02/03-05-005	12/12/2014	12/12/2013		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 2	ESVS 30	02-02/03-05-006	28/06/2014	28/06/2013		
	VULB 9168	02-02/24-05-005	08/04/2015	08/04/2014	08/10/2014	08/04/2014
	S10162-B	02-02/50-05-031				
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
SER 3	FSP 40	02-02/11-11-001	30/09/2014	30/09/2013		
	FS-Z60	02-02/11-14-001	26/03/2015	26/03/2014	26/09/2014	26/03/2014
	FZ-Z110	02-02/11-14-002	12/05/2015	12/05/2014	12/11/2014	12/05/2014
	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	07/05/2015	07/05/2014		
	BBHA 9170	02-02/24-05-014				
	QWH-UPRR00/WR-19/40-60	02-02/24-14-001				
	QWH-EPRR00/WR-12/60-90	02-02/24-14-004				
	QWH-WPRR00/WR-10/75-11	02-02/24-14-006				
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	RE-15 ; GE-590	02-02/50-07-017				
	KMS102-0.2 m	02-02/50-11-020				
SF104/11N/11N/1500MM	02-02/50-13-015					