EMI – TEST REPORT

- FCC Part 15.249, RSS310 -

Type / Model Name	:	BSV101757
Product Description	:	Positioning radar 24 GHz
Applicant	:	Symeo GmbH
Address	:	Professor-Messerschmitt-Strasse 3
		85579 NEUBIBERG, GERMANY
Manufacturer	:	Symeo GmbH
Address	:	Professor-Messerschmitt-Strasse 3
		85579 NEUBIBERG, GERMANY
Licence holder	:	Symeo GmbH
Address	:	Professor-Messerschmitt-Strasse 3
		85579 NEUBIBERG, GERMANY

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

Test Report No. : T39256-02-03HS	19. February 2016 Date of issue

Deutsche Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

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

Contents

1 TEST STANDARDS 3

2 EQUIPMENT UNDER TEST 4

3 Test result summery 7
3.1 FINAL ASSESSMENT: 7

4 TEST ENVIRONMENT 8
4.1 Address of the test laboratory 8
4.2 Environmental conditions 8
4.3 Statement of the measurement uncertainty 8
4.4 Measurement protocol for FCC and IC 9

5 TEST CONDITIONS AND RESULTS 11
5.1 AC power line conducted emissions 11
5.2 Field strength of fundamental 14
5.3 Out-of-band emission, radiated 15
5.4 EBW 28
5.5 Antenna application 30

6 USED TEST EQUIPMENT AND ACCESSORIES 31

Attachment A as seperate supplement

Attachment B as seperate supplement

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2015)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September, 2015)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.249	Operation within the bands 902 - 928 MHz, 2400 – 2483.5 MHz, 5725 - 5875 MHz and 24.0 – 24.25 GHz
ANSI C63.10: 2013	Procedures for compliance testing of unlicensed wireless devices
ANSI C95.1:2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
CISPR 16-4-2: 2003	Uncertainty in EMC measurement

2 EQUIPMENT UNDER TEST

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

2.2 Equipment type

Radar detection and alert application

2.3 Short description of the equipment under test (EUT)

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

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

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

2.4 Variants of the EUT

There are no variants.

2.5 Operation frequency and channel plan

FCC ID: W5IBSV101757

The operating frequency is 24.0 GHz to 24.25 GHz.

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

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

2.6 Transmit operating modes

TX continuous.

2.7 Antenna

The following integrated antennas are used with the EUT:

- Integrated linear polarised mocro strip patch array antenna.

The antennas cannot be unattached by the user.

2.8 Power supply system utilised

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

2.9 Peripheral devices and interface cables

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

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

2.10 Determination of worst case conditions for final measurement

Exploratory measurements have been made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in Y position.

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

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

- TX continuous mode

2.10.1 Test jig

No test jig used.

2.10.2 Test software

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

3 Test result summery

Operating in the 24000 MHz – 24250 MHz band:

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

3.1 Final assessment

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

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

Testing commenced on : 14 December 2015

Testing concluded on : 15 January 2016

Checked by:

Klaus Gegenfurtner
I confirm the correctness and Integrity of this document
2016.02.19 11:23:54 +01'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Hermann Smetana
I am the author of this document
2016.02.19 11:10:53 +01'00'

Hermann Smetana
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k = 2. The true value is located in the corresponding interval with a probability of 95 % The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.4 Measurement protocol for FCC and IC

4.4.1 General information

4.4.1.1 Test methodology

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

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

IC 3009A-1

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

4.4.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.1.3 Test methodology

In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

4.4.1.4 Radiated Measurement

The radiated measurements are done in 2 steps

- Exploratory measurements
- Final measurements

4.4.1.4.1 Method of exploratory radiated emission maximization

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

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

Based on the measurement results from 8.3.1.1, the single EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurements are then performed on a site meeting the requirements of 5.3 or 5.4, as appropriate. If the EUT is relocated from an exploratory test site to a final test site, the highest emission relative to the limit shall be re-maximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarization and EUT azimuth are to be varied.
In addition, the full frequency spectrum (for the range to be checked for meeting compliance) shall be investigated. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated by 90° relative to the ground plane to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on those frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full spectrum test constitutes the compliance measurement.

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

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

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

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

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

5 TEST CONDITIONS AND RESULTS

5.1 AC power line conducted emissions

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

5.1.1 Description of the test location

Test location: AREA4

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

5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):
Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10 described under item 6.2. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin 9.0 dB at 0.314 MHz

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

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

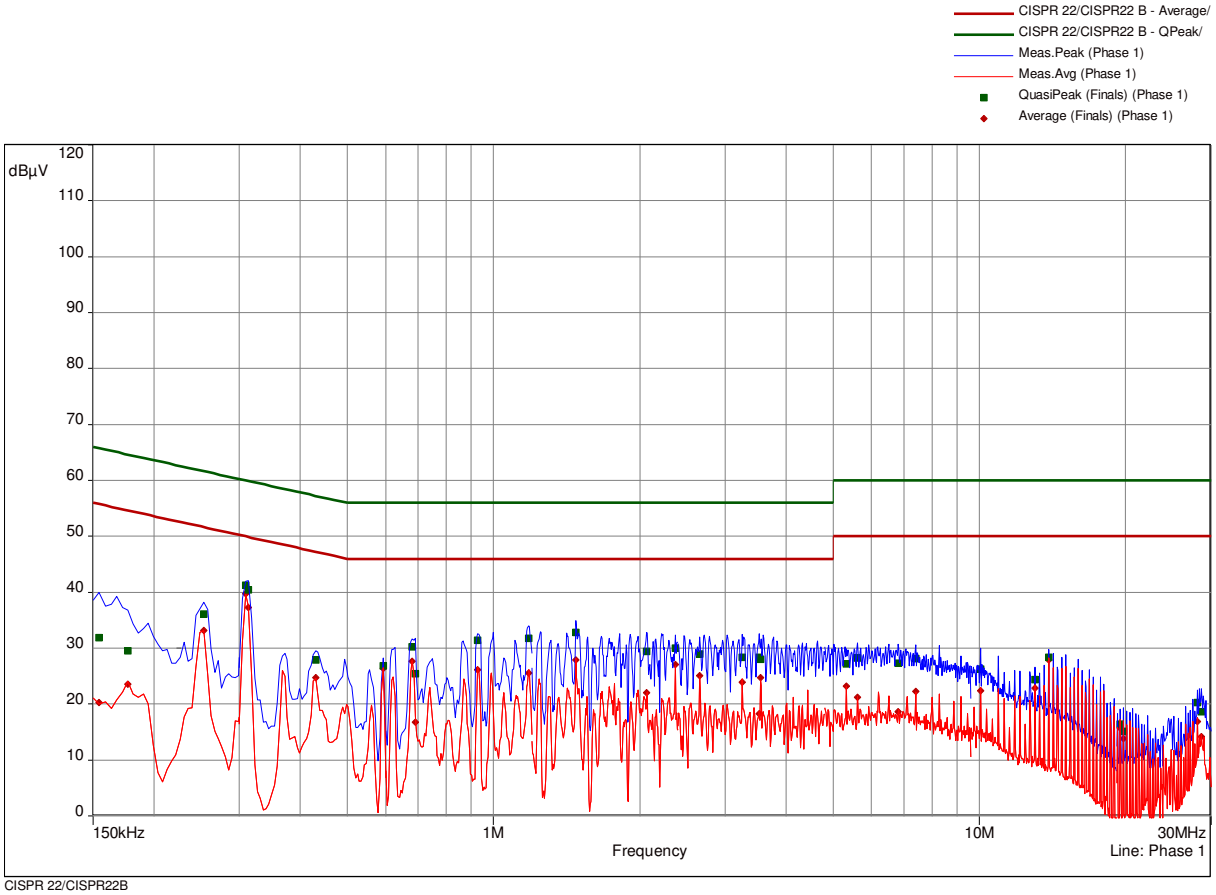
* Decreases with the logarithm of the frequency

The requirements are **FULFILLED.**

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

5.1.6 Test protocol

Test point L1 Result: passed
Operation mode: TX continuous
Remarks:



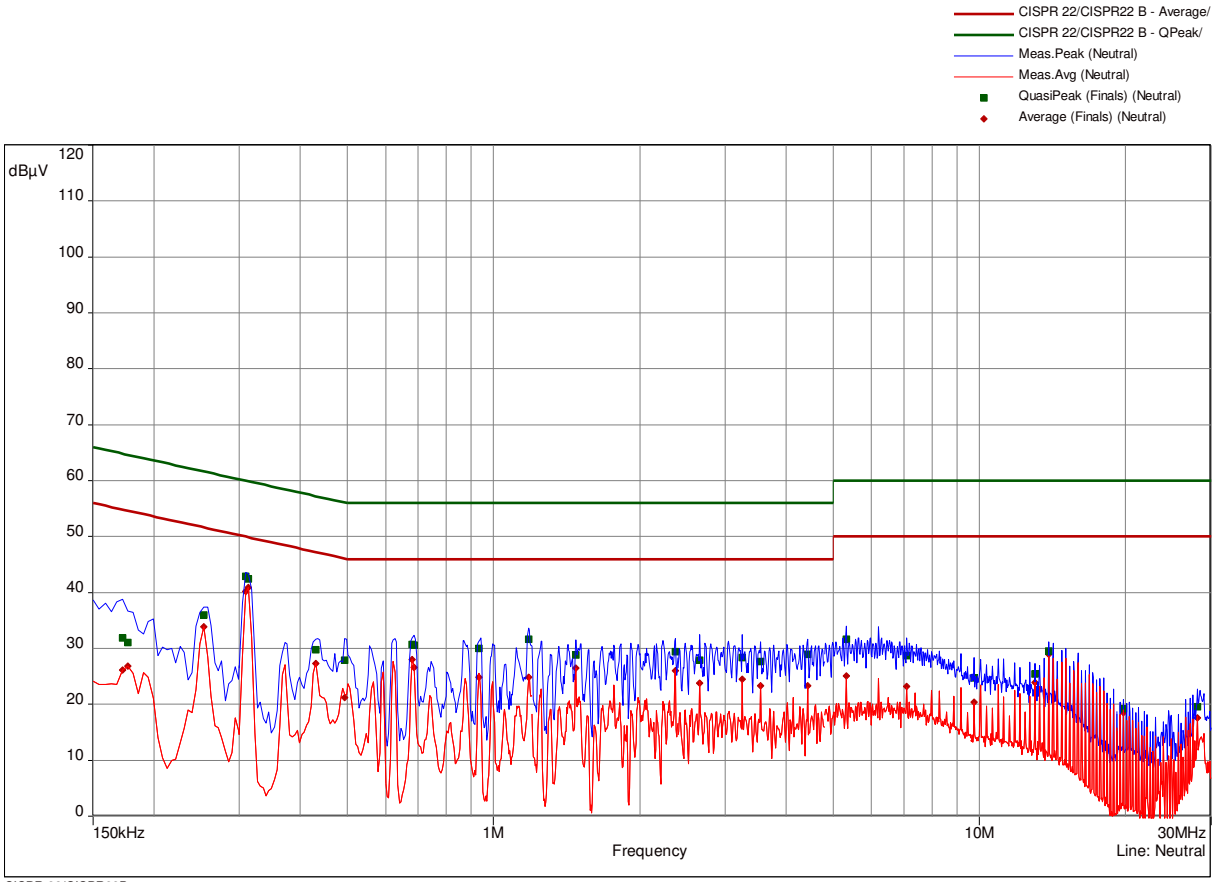
CISPR 22/CISPR22B

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

FCC ID: W5IBSV101757

Test point: N
Operation mode: TX continuous
Remarks:

Result: passed



CISPR 22/CISPR22B

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

5.2 Field strength of fundamental

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

5.2.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

5.2.1 Applicable standard

According to FCC Part 15C, Section 15.249(a):
The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the effective limits.

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

5.2.3 Description of Measurement

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

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

5.2.4 Test result

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

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

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

Peak-Limit according to FCC Part 15C, Section 15.249(e):
As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

The requirements are **FULFILLED.**

Remarks: _____

5.3 Out-of-band emission, radiated

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

5.3.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 1

Test distance: 3 m

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

5.3.3 Applicable standard

According to FCC Part 15C, Section 15.249 (d):
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation..

5.3.4 Description of Measurement

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

Instrument settings:

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

5.3.1 Test result f < 30 MHz

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

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

5.3.2 Test result f < 1 GHz

Frequency	Level QP	Limit QP	Delta
(MHz)	dB(µV/m)	dB(µV/m)	(dB)
43.14	37.8	40.0	-2.2
128	29.2	43.5	-14.3
285.1	30.2	46.0	-15.8
448	40.5	46.0	-5.5
583.2	39.1	46.0	-6.9
768	38.1	46.0	-7.9

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

5.3.3 Test result f > 1 GHz

CH16:

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

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

CH55:

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

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

CH95:

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

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

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

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

Fundamental field strength: = 96.6 dBµV/m
Emission limit: Fundamental field strength – 50 dB = 96.6 dBµV/m – 50 dB = **46.6 dBµV/m;**
General emission limit apply = 54 dBµV/m;

The field strength limits are defined in 3 m distance.
The measurement from 18 GHz to 40 GHz is done in a distance of 1 m. Therefore the measurement limit has to be changed from 54 dBµV/m to 64 dBµV/m.

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

Frequency (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

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

5.3.4 Test result harmonics

Harmonics at 48 GHz:

No harmonics could be detected.

Harmonics at 72 GHz:

No harmonics could be detected.

Harmonics at 96 GHz:

No harmonics could be detected.

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

Determination of the limit:
Harmonic field strength 2.5 mV/m = **68 dBµV/m**;

The field strength limits are defined in 3 m distance.

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

The requirements are **FULFILLED.**

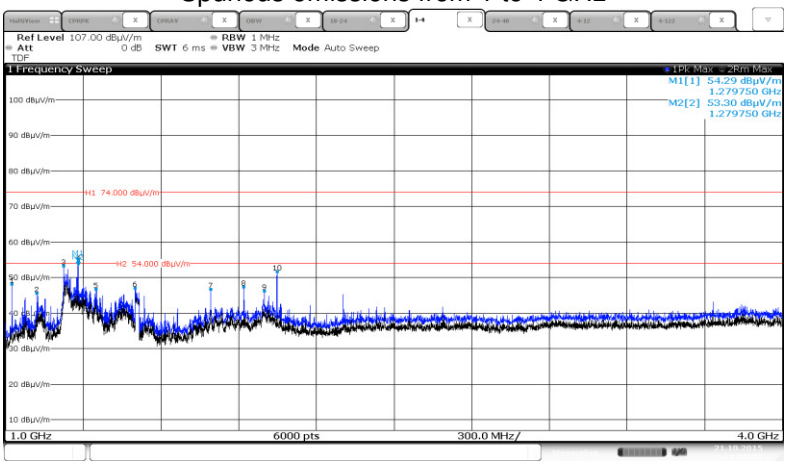
Remarks: The measurement is performed up to 100 GHz. For detailed test result please see to following test protocols.

5.3.5 Test protocols

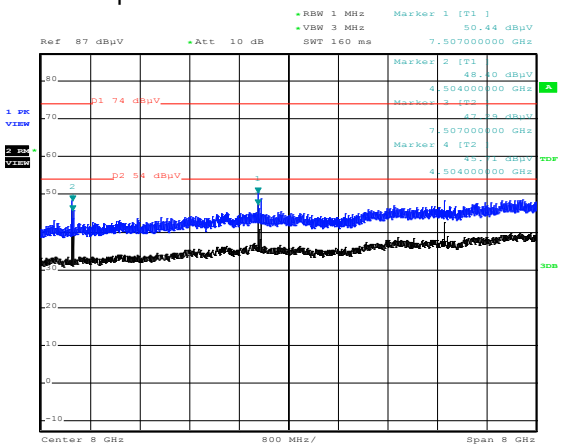
Note: The limits displayed in the plots are “general radiated limits” which are more stringent. The limits apply are the limits according FCC 15.249.

5.3.5.1 CH16

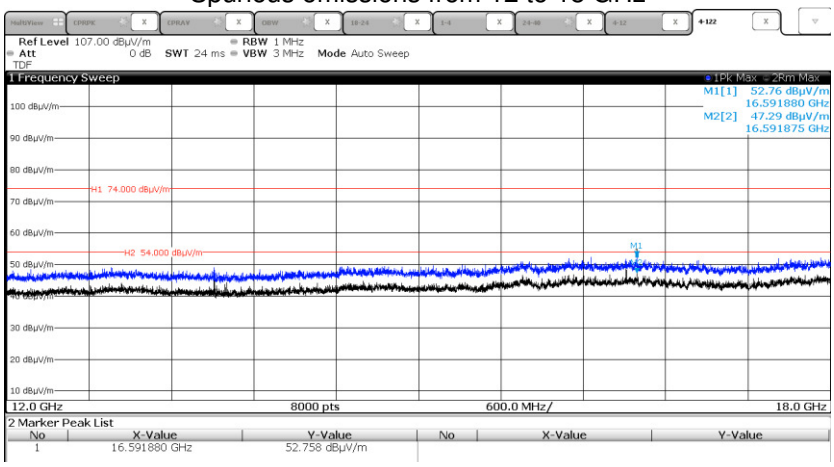
Spurious emissions from 1 to 4 GHz



Spurious emissions from 4 to 12 GHz

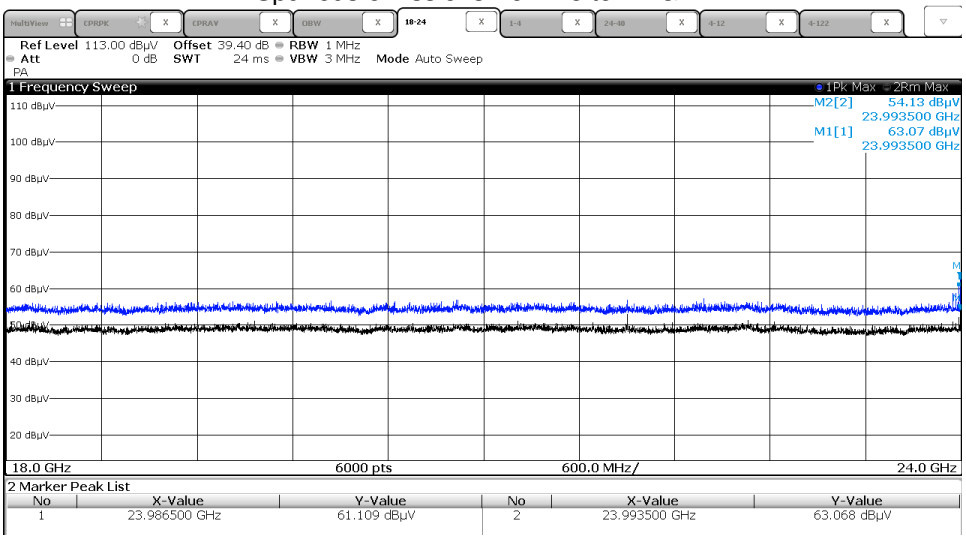


Spurious emissions from 12 to 18 GHz

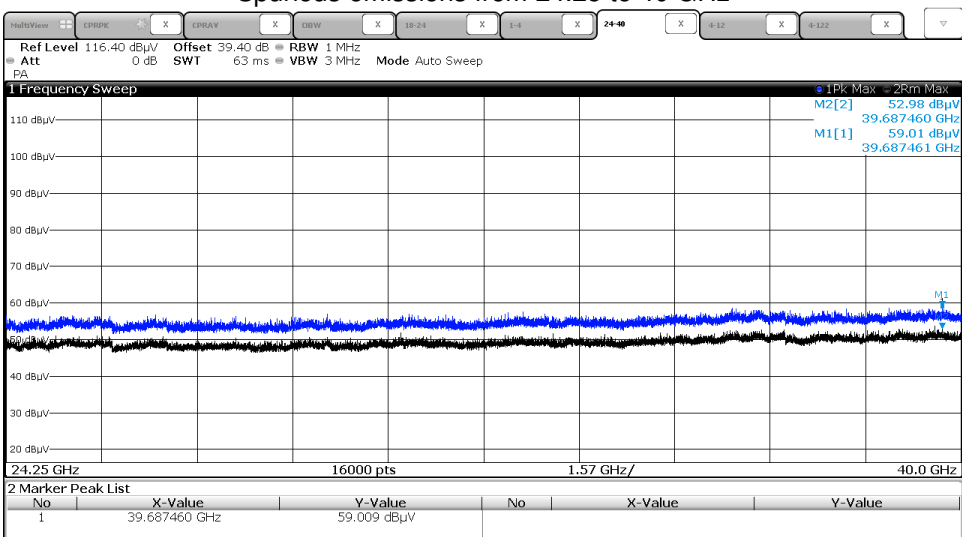


FCC ID: W5IBSV101757

Spurious emissions from 18 to 24 GHz

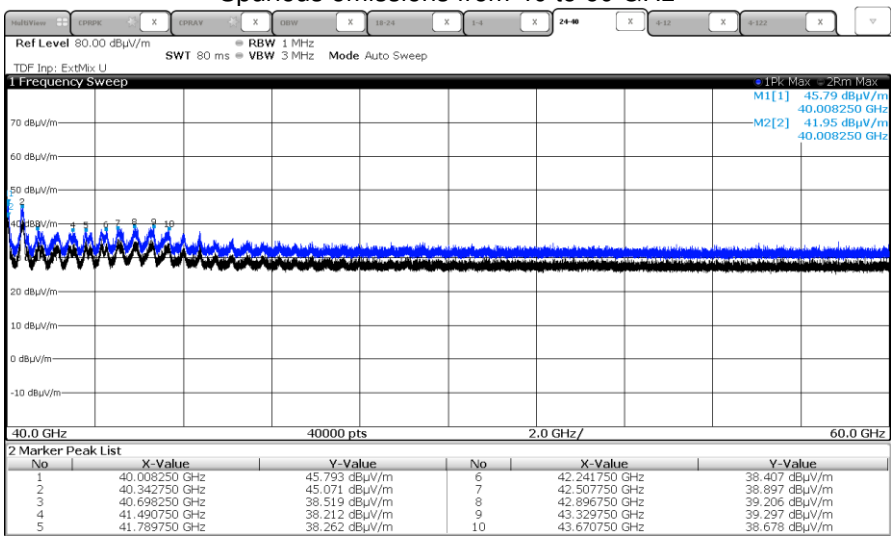


Spurious emissions from 24.25 to 40 GHz



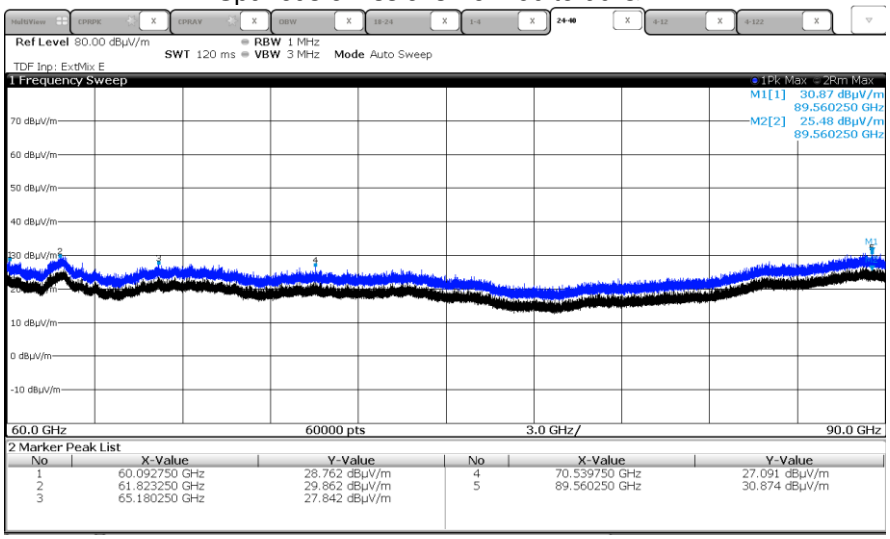
Note. The measurement 40 GHz to 100 GHz is measured in a 1 m distance, therefore the AV-limit needs to be changed to 64 dBµV/m.

Spurious emissions from 40 to 60 GHz

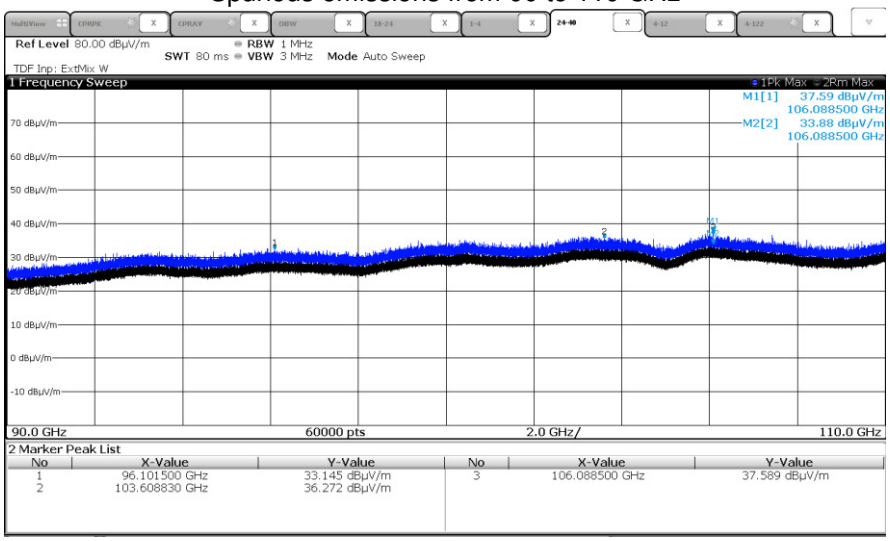


FCC ID: W5IBSV101757

Spurious emissions from 60 to 90 GHz

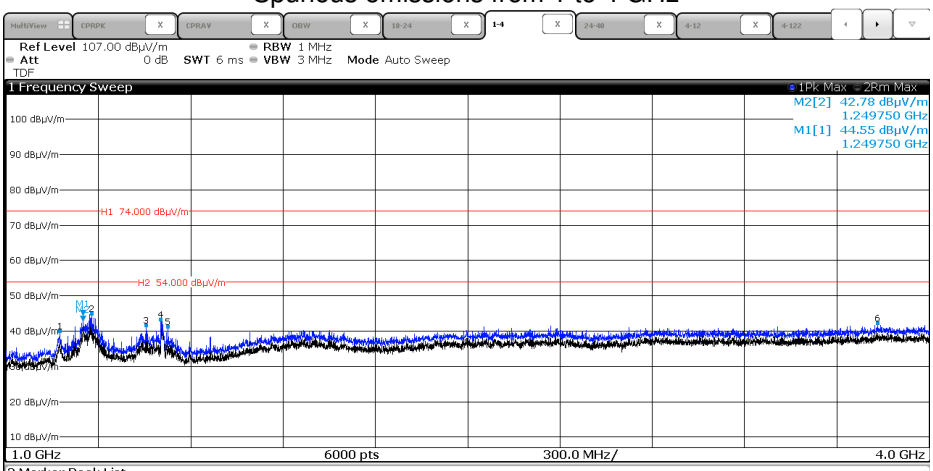


Spurious emissions from 90 to 110 GHz



5.3.5.2 CH55

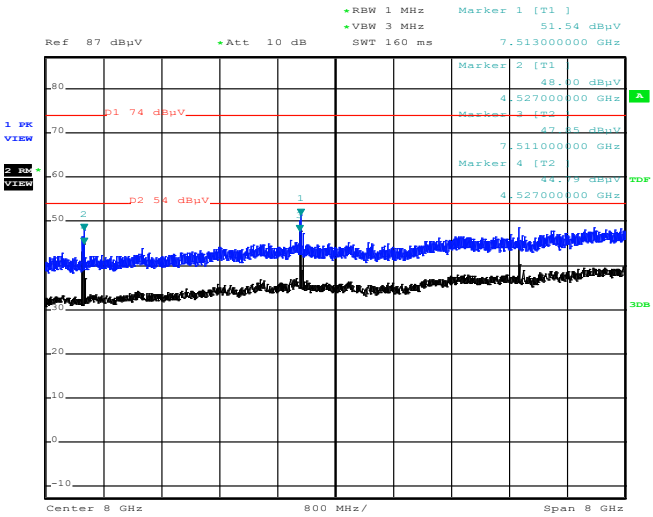
Spurious emissions from 1 to 4 GHz



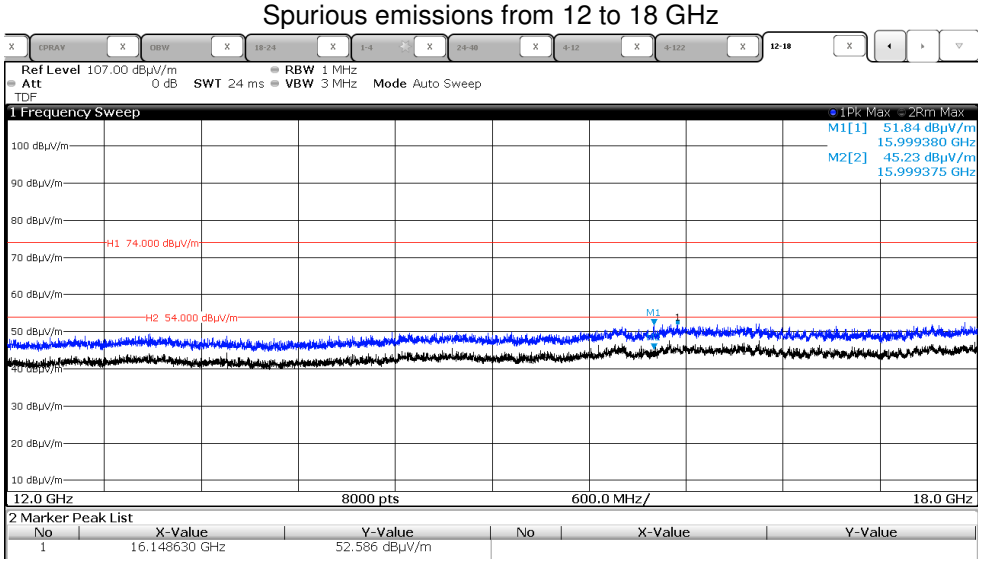
2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.175250 GHz	39.980 dBµV/m	4	1.503250 GHz	43.215 dBµV/m
2	1.278250 GHz	44.933 dBµV/m	5	1.525750 GHz	41.312 dBµV/m
3	1.455750 GHz	41.723 dBµV/m	6	3.833250 GHz	42.160 dBµV/m

Spurious emissions from 4 to 12 GHz



Spurious emissions from 12 to 18 GHz

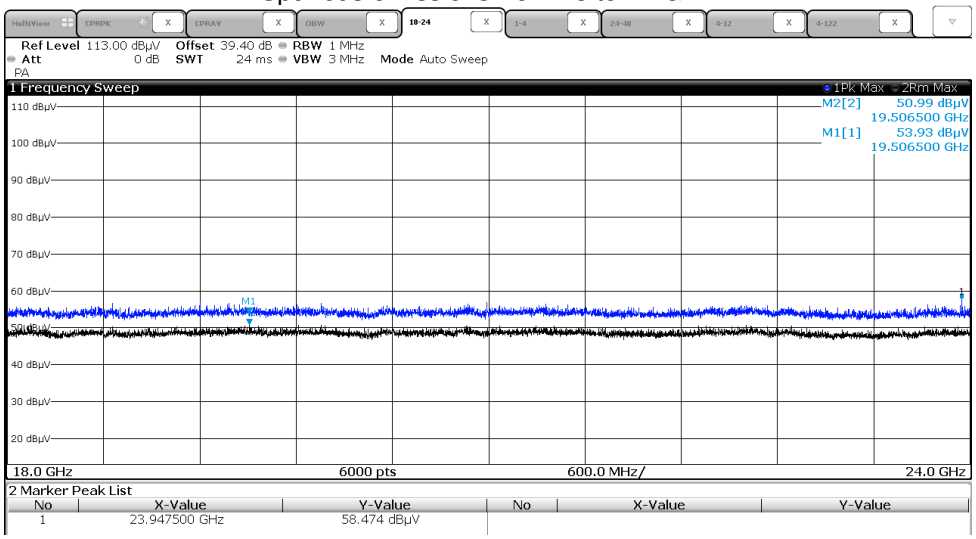


2 Marker Peak List

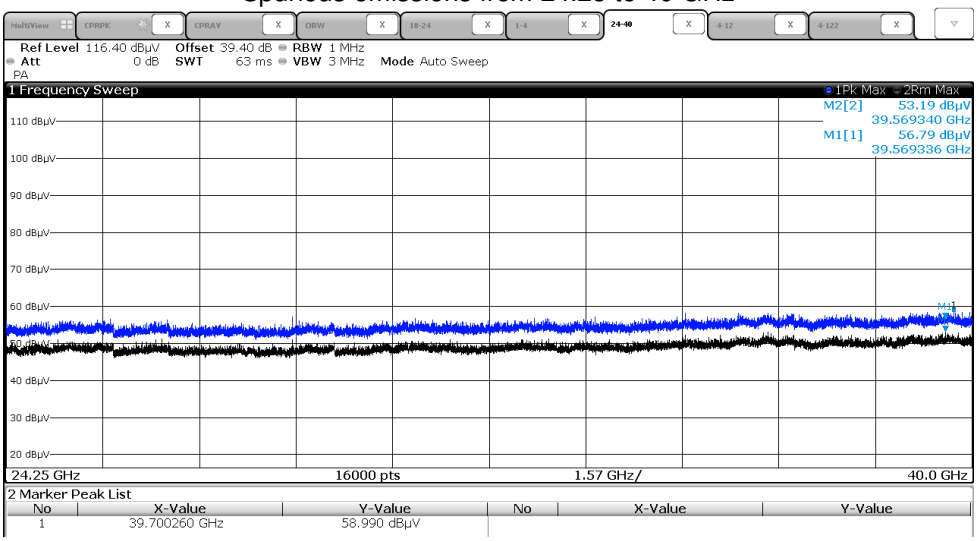
No	X-Value	Y-Value	No	X-Value	Y-Value
1	16.148630 GHz	52.586 dBµV/m			

FCC ID: W5IBSV101757

Spurious emissions from 18 to 24 GHz



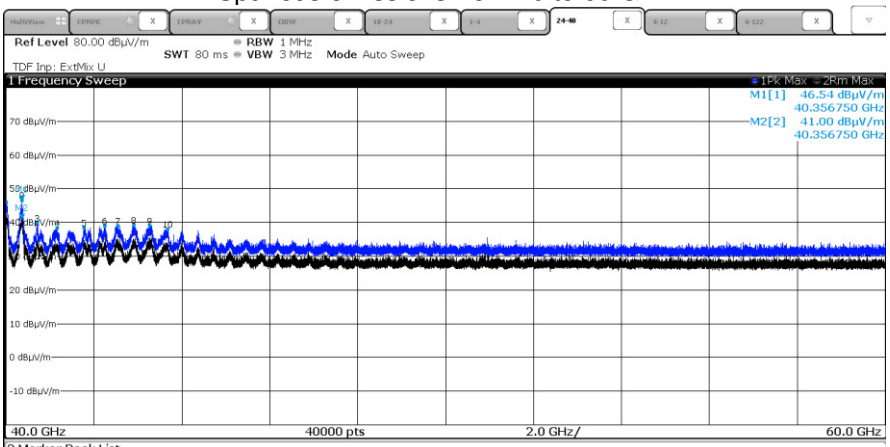
Spurious emissions from 24.25 to 40 GHz



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

FCC ID: W5IBSV101757

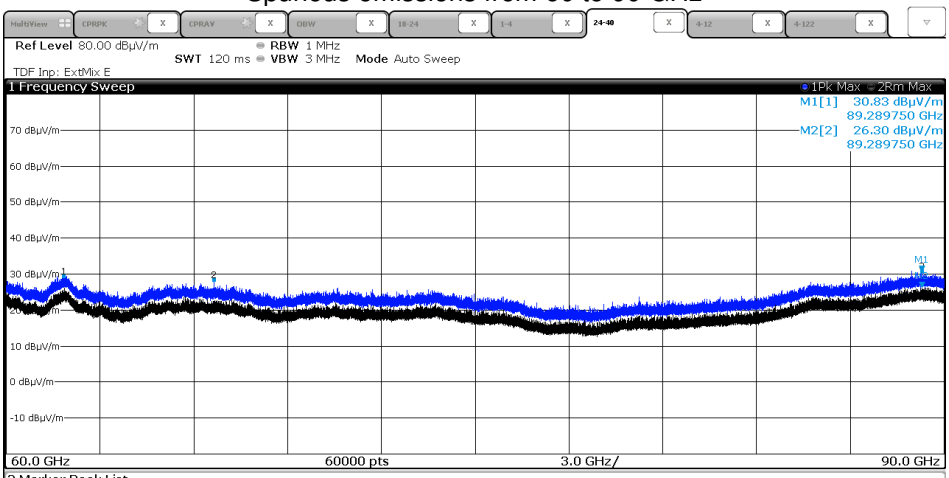
Spurious emissions from 40 to 60 GHz



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	40.005750 GHz	45.998 dBµV/m	6	42.245750 GHz	39.011 dBµV/m
2	40.356750 GHz	46.541 dBµV/m	7	42.541750 GHz	39.104 dBµV/m
3	40.712250 GHz	39.808 dBµV/m	8	42.905750 GHz	39.183 dBµV/m
4	41.169250 GHz	38.431 dBµV/m	9	43.270250 GHz	39.006 dBµV/m
5	41.772250 GHz	38.484 dBµV/m	10	43.678750 GHz	37.948 dBµV/m

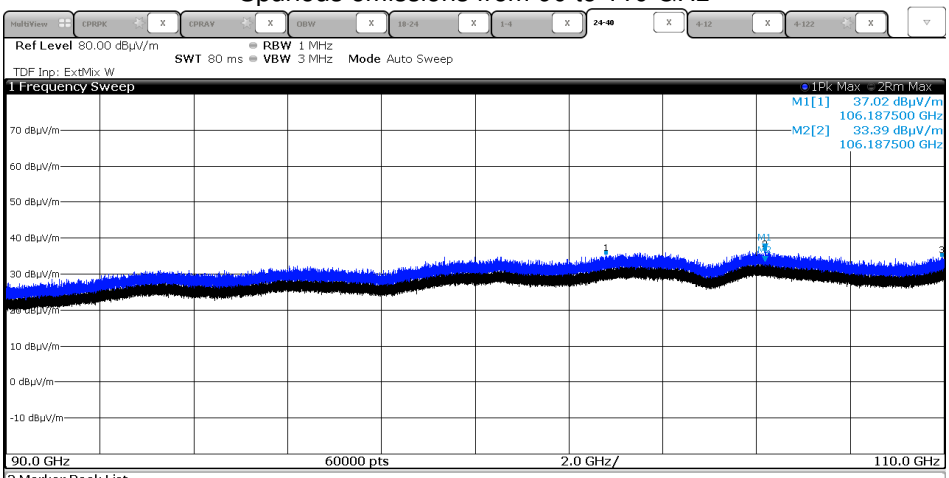
Spurious emissions from 60 to 90 GHz



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	61.845750 GHz	29.417 dBµV/m	3	89.289750 GHz	30.833 dBµV/m
2	66.654750 GHz	28.406 dBµV/m			

Spurious emissions from 90 to 110 GHz

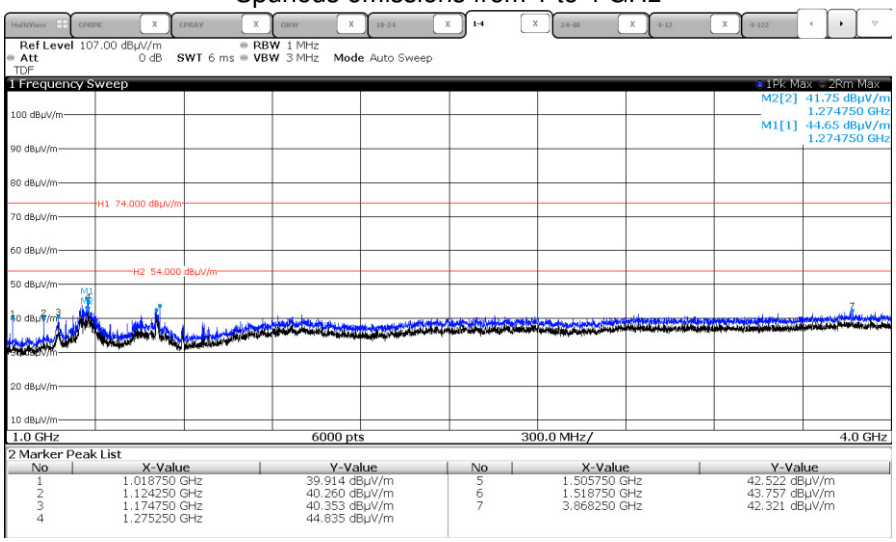


2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	102.783830 GHz	36.030 dBµV/m	3	109.953500 GHz	35.360 dBµV/m
2	106.187500 GHz	37.016 dBµV/m			

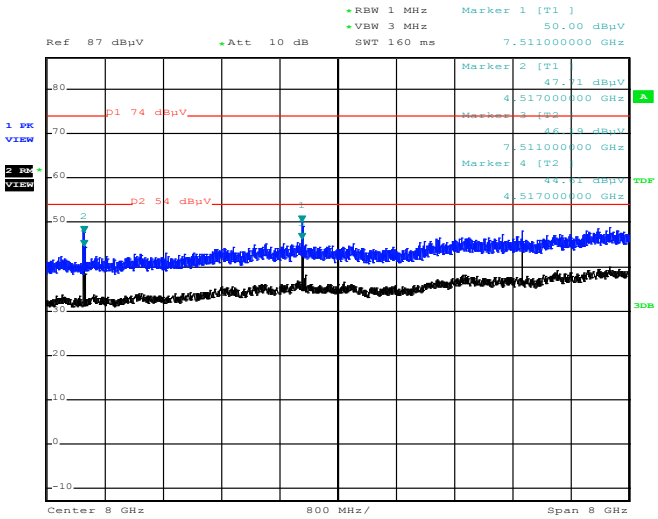
5.3.5.3 CH95

Spurious emissions from 1 to 4 GHz

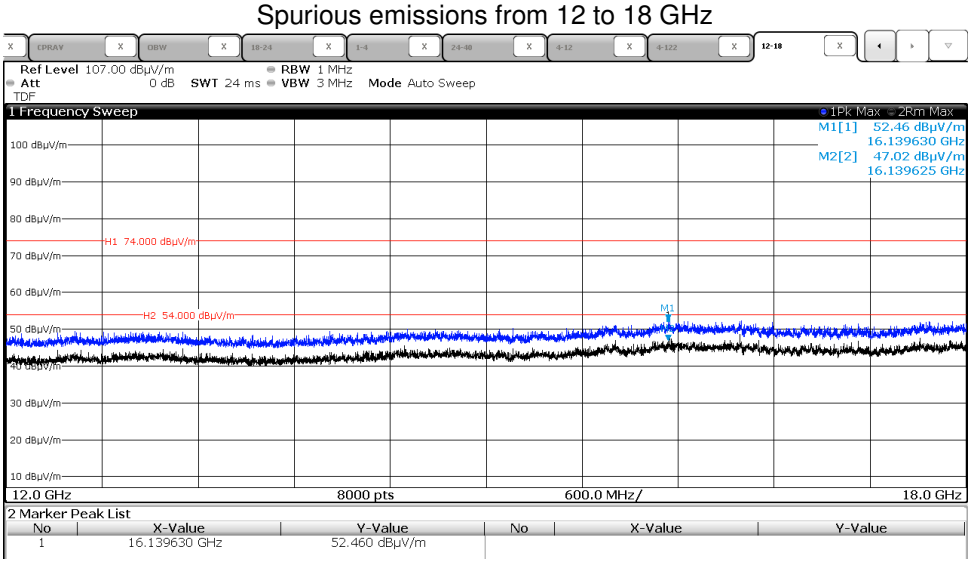


No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.018750 GHz	39.914 dBµV/m	5	1.505750 GHz	42.522 dBµV/m
2	1.124250 GHz	40.260 dBµV/m	6	1.518750 GHz	43.757 dBµV/m
3	1.174750 GHz	40.353 dBµV/m	7	3.868250 GHz	42.321 dBµV/m
4	1.275250 GHz	44.835 dBµV/m			

Spurious emissions from 4 to 12 GHz



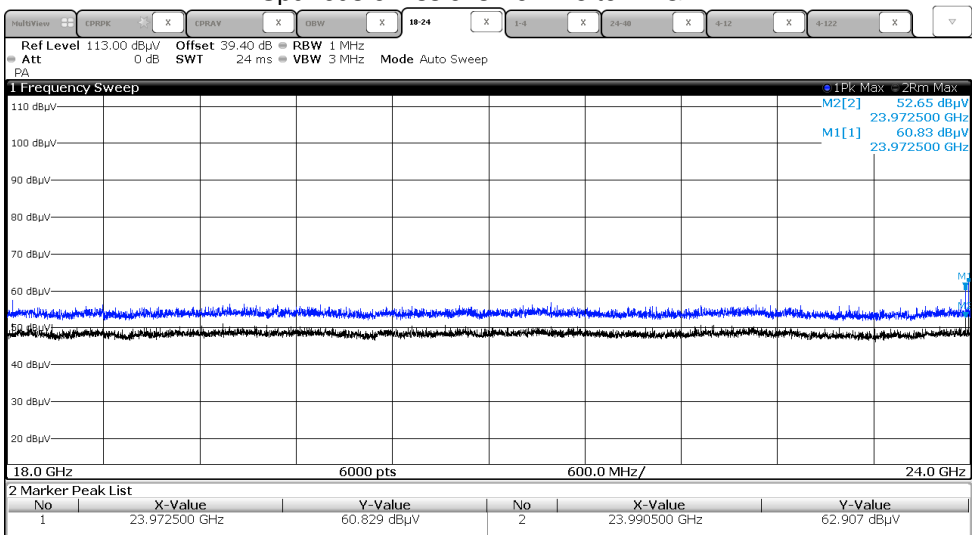
Spurious emissions from 12 to 18 GHz



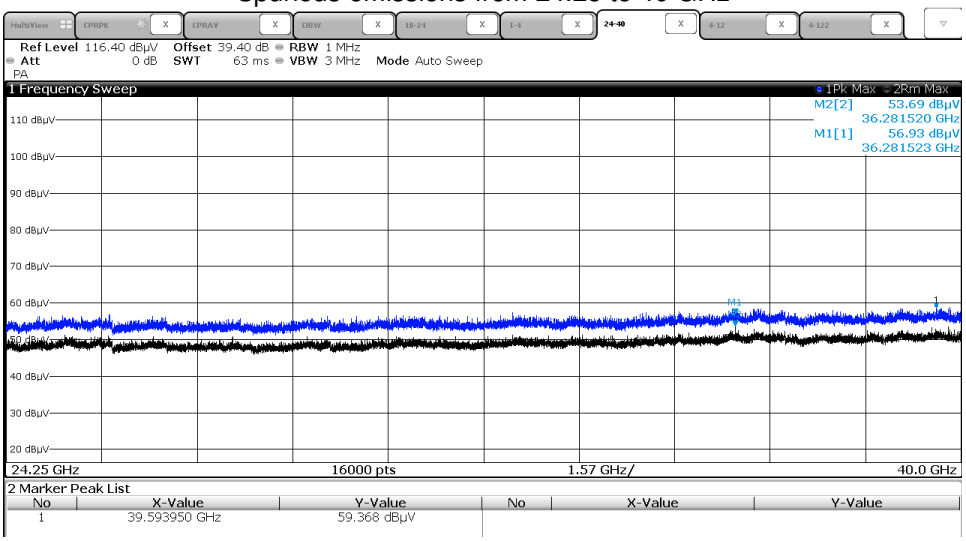
No	X-Value	Y-Value	No	X-Value	Y-Value
1	16.139630 GHz	52.460 dBµV/m			

FCC ID: W5IBSV101757

Spurious emissions from 18 to 24 GHz

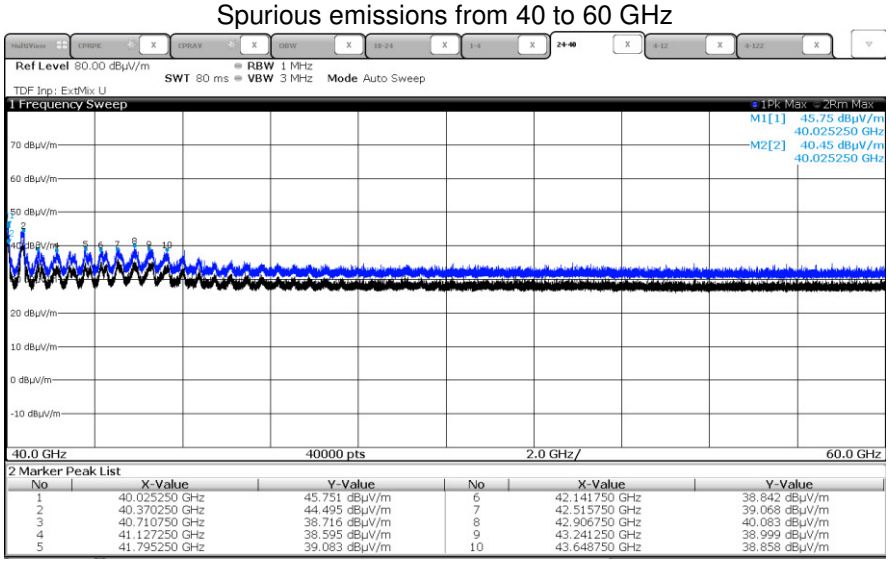


Spurious emissions from 24.25 to 40 GHz



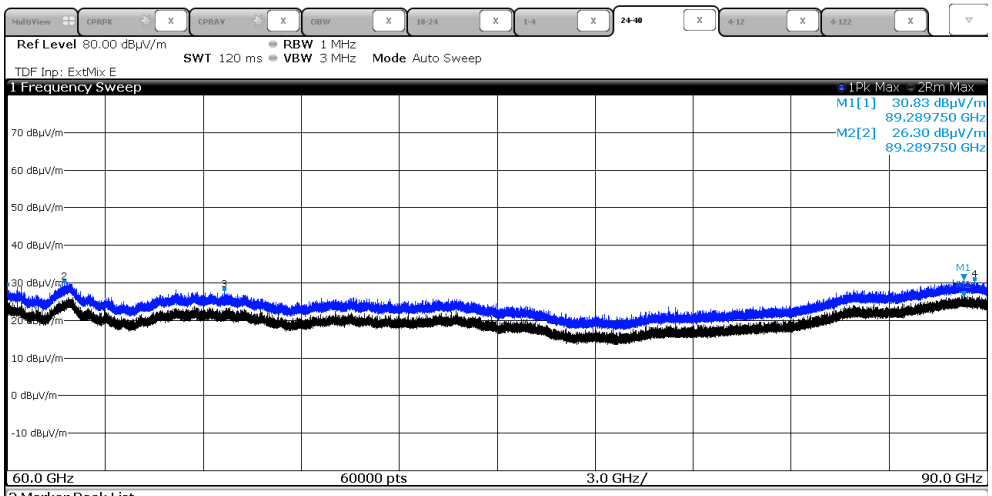
Note. The measurement 18 GHz to 40 GHz is measured in a 1 m distance, therefore the AV-limit needs to be changed to 64 dBµV/m.

Spurious emissions from 40 to 60 GHz



FCC ID: W5IBSV101757

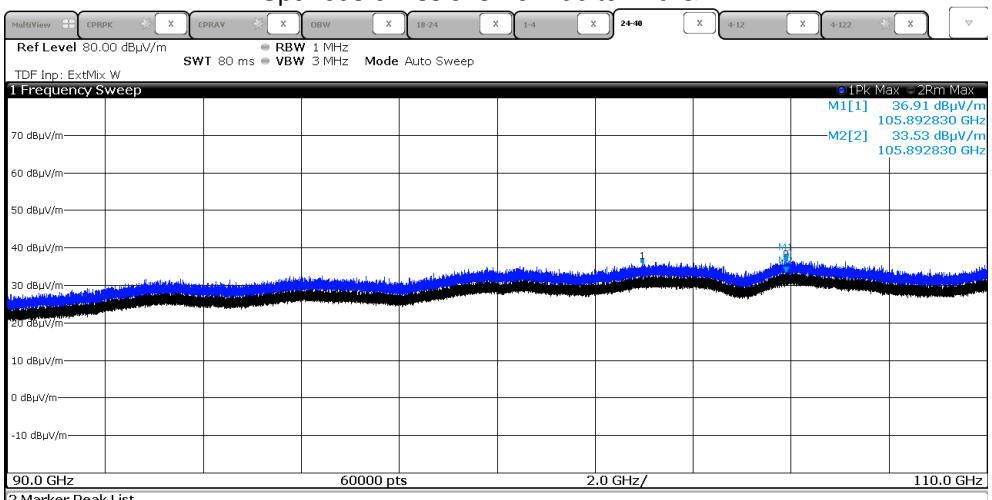
Spurious emissions from 60 to 90 GHz



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	60.010250 GHz	29.499 dBµV/m	3	66.654750 GHz	28.406 dBµV/m
2	61.737250 GHz	30.503 dBµV/m	4	89.627250 GHz	31.071 dBµV/m

Spurious emissions from 90 to 110 GHz



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	102.954500 GHz	36.544 dBµV/m	2	105.892830 GHz	36.905 dBµV/m

5.4 EBW

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

5.4.1 Description of the test location

Test location: Anechoic chamber 1

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

5.4.3 Applicable standard

According to FCC Part 15, Section 15.215(c):
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in Section 15.217 through Section 15.257, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated.

5.4.4 Description of Measurement

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

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

5.4.5 Test result

Centre *f*	20 dB bandwidth	20 dB bandwidth	Measured EBW
(MHz)	f_1	f_2	(MHz)
24015.0	24014.313	24240.995	226.682
24055.0	24053.354	24240.845	187.491
24095.0	24093.337	24241.020	147.683

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

Limit according to FCC Part 15C, Section 15.215(c):
If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

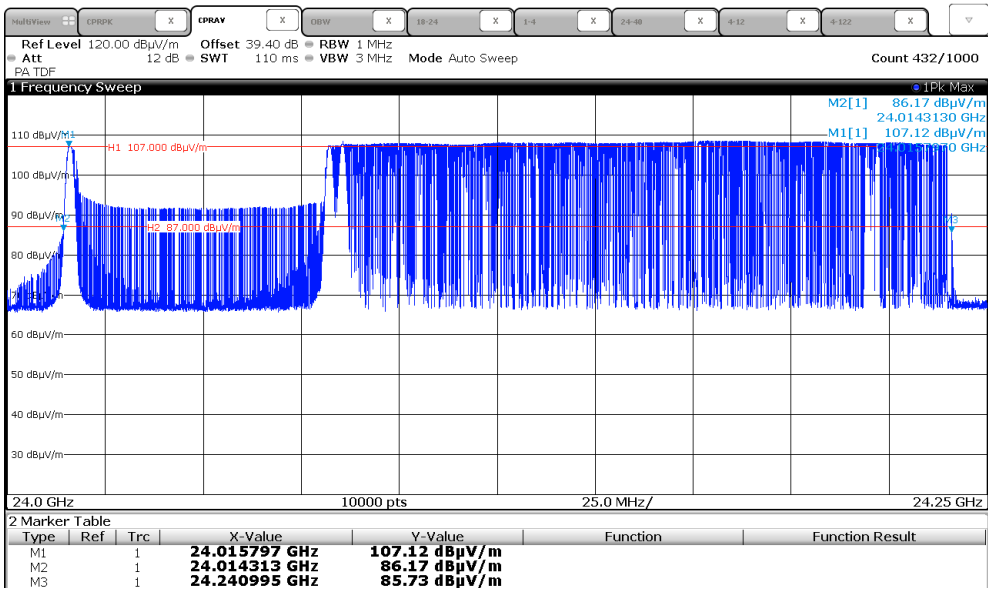
The requirements are **FULFILLED.**

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

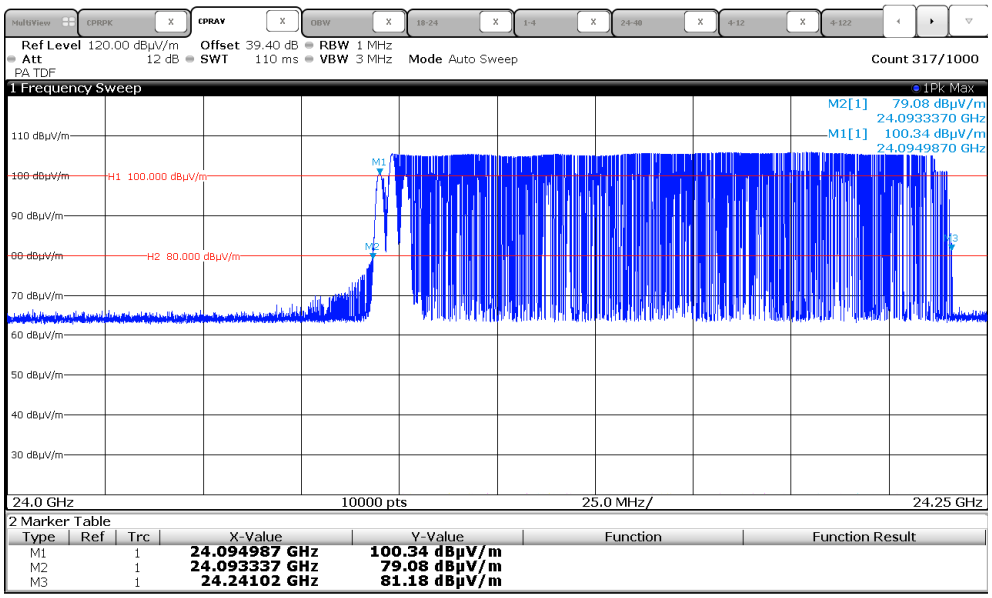
5.4.6 Test protocols

20 dB bandwidth

CH16



CH95



5.5 Antenna application

5.5.1 Applicable standard

According to FCC Part 15C, Section 15.203(a):
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

5.5.2 Result

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

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

6 USED TEST EQUIPMENT AND ACCESSORIES

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

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	ESCI	02-02/03-05-005	09/12/2016	09/12/2015		
	ESH 2 - Z 5	02-02/20-05-004	26/10/2017	26/10/2015	21/01/2016	21/07/2015
	EMV D 30000/PAS	02-02/30-05-006	08/12/2015	08/12/2014		
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	06/11/2016	06/11/2015	06/05/2016	06/11/2015
CPR 3	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
	BBHA 9170	02-02/24-05-014	02/06/2018	02/06/2015	02/12/2016	02/12/2015
	EA-PS 3032-20B	02-02/50-11-013				
MB	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
	BBHA 9170	02-02/24-05-014	02/06/2018	02/06/2015	02/12/2016	02/12/2015
	EA-PS 3032-20B	02-02/50-11-013				
SER 1	FMZB 1516	01-02/24-01-018	19/01/2016	19/01/2015		
	ESCI	02-02/03-05-005	09/12/2016	09/12/2015		
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 2	ESVS 30	02-02/03-05-003	09/07/2016	09/07/2015		
	VULB 9168	02-02/24-05-005	17/04/2016	17/04/2015	29/02/2016	31/08/2015
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSP 40	02-02/11-11-001	28/10/2016	28/10/2015		
	FS-Z60	02-02/11-14-001	19/03/2016	19/03/2015	05/05/2016	05/11/2015
	FS-Z110	02-02/11-14-002	05/05/2016	05/05/2015	05/05/2016	05/11/2015
	FS-Z90	02-02/11-14-003	08/05/2016	08/05/2015	05/05/2016	05/11/2015
	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
	JS4-18004000-30-5A	02-02/17-05-017				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	3117	02-02/24-05-009	12/05/2016	12/05/2015		
	BBHA 9170	02-02/24-05-014	02/06/2018	02/06/2015	02/12/2016	02/12/2015
	QWH-UPRR00/WR-19/40-60	02-02/24-14-001				
	QWH-VPRR00/WR-15/50-75	02-02/24-14-003				
	QWH-WPRR00/WR-10/75-11	02-02/24-14-006				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	EA-PS 3032-20B	02-02/50-11-013				
	KMS102-0.2 m	02-02/50-11-020				
	SF104/11N/11N/1500MM	02-02/50-13-015				