



EMI - TEST REPORT

- FCC Part 15B -

Type / Model Name : BSW200200 Series

Product Description : FMCW radar

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. : T43516-00-05HS

25. January 2019

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	<u>TEST STANDARDS</u>	<u>3</u>
3	<u>TEST RESULT SUMMARY</u>	<u>6</u>
3.1	Final assessment	6
4	<u>TEST ENVIRONMENT</u>	<u>7</u>
4.1	Address of the test laboratory	7
4.2	Environmental conditions	7
4.3	Statement of the measurement uncertainty	7
4.4	Measurement protocol for FCC	8
5	<u>TEST CONDITIONS AND RESULTS</u>	<u>10</u>
5.1	Conducted emission	10
5.2	Radiated emission	14
6	<u>USED TEST EQUIPMENT AND ACCESSORIES</u>	<u>20</u>

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart A - General (September, 2017)

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 B - Unintentional Radiators (September, 2017)

Part 15, Subpart B, Section 15.107	AC Line conducted emission <input type="checkbox"/> Class A device <input checked="" type="checkbox"/> Class B device
Part 15, Subpart B, Section 15.109	Radiated emission, general requirements
Part 15, Subpart B, Section 15.111	Antenna power conduction

ANSI C63.4: 2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
------------------	---

ETSI TR 100 028 V1.3.1: 2001-03	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2
---------------------------------	--

2 EQUIPMENT UNDER TEST

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

2.2 Equipment category

The EUT is a field disturbance sensor.

2.3 Short description of the equipment under test (EUT)

The EUT is a field disturbance sensor with frequency emissions in customer settable ranges the operating band of 57.5 GHz to 63.5 GHz.

Number of tested samples: 1
Serial number: D44AH40023
Firmware ID: V0.10.0-11

EUT configuration:

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

2.4 Variants of the EUT

There are the following variants of the EUT:

Device type	Software functionality		
	Primary radar	Secondary radar	Debugging
BSW200200	x	x	x
BSW200220	x	-	-
BSW200240	-	x	-
BSW200260	-	x	-
BSW200281	-	x	-
BSW200290	x	x	-

2.5 Antenna

The following integrated antennas are used with the EUT:

- Integrated linear polarised strip patch array antenna, gain 8.5 dBi additional lense antenna 20 dBi, effective gain 28.5 dBi.

The antennas cannot be unattached by the user.

2.6 Transmit operating mode

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

- LAN transmission

-

2.7 Power supply system utilised

Power supply voltage : 115 VAC, (DC-Input 11 - 36 VDC)

2.8 Peripheral devices and interface cables

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

- | | |
|-----------------------------|-----------------------------------|
| - Power supply, 100-120 VAC | Model : ZVC36FS24S91 |
| DC power cable, 2 m | Self-made |
| - LAN cable, 2 m | Model : Self-made |
| - Note book, Siemens | Model : Lifebook, 02-01/01-14-003 |

2.8.1 Test Jig

No test jig is used.

2.8.2 Test software

No test software is used.

3 TEST RESULT SUMMARY

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 : 12 June 2018

Testing concluded on : 25 January 2019

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Hermann Smetana
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

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

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

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

4.4 Measurement protocol for FCC

4.4.1 General information

4.4.1.1 Test methodology

The test methods used comply with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz".

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.

4.4.2 Conducted emission

4.4.2.1 Description of measurement

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\begin{aligned} \text{dB}\mu\text{V} &= 20 \cdot \log(\mu\text{V}) \\ \mu\text{V} &= 10^{(\text{dB}\mu\text{V}/20)} \end{aligned}$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50 Ω / 50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. 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.

4.4.3 Radiated emission (electrical field 30 MHz - 1 GHz)

4.4.3.1 Description of measurement

Spurious emission from the EUT is measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned in horizontal polarisation and is repeated vertically. To locate maximum emission from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.

The final level in dBµV/m is calculated by add the antenna correction factor and cable loss factor (dB) on the reading from the EMI receiver (dBµV). The FCC limit is subtracted from this result in order to provide the delta to limit listed in the measurement protocol.

Example:

Frequency (MHz)	Reading level (dBµV)	+	Correction Factor (dB/m)	=	Level (dBµV/m)	-	CISPR Limit (dBµV/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

4.4.4 Radiated emission (electrical field 1 GHz - 40 GHz)

4.4.4.1 Description of measurement

Radiated emission from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emission under better uncertainty and is calculated to the specified test distance.

5 TEST CONDITIONS AND RESULTS

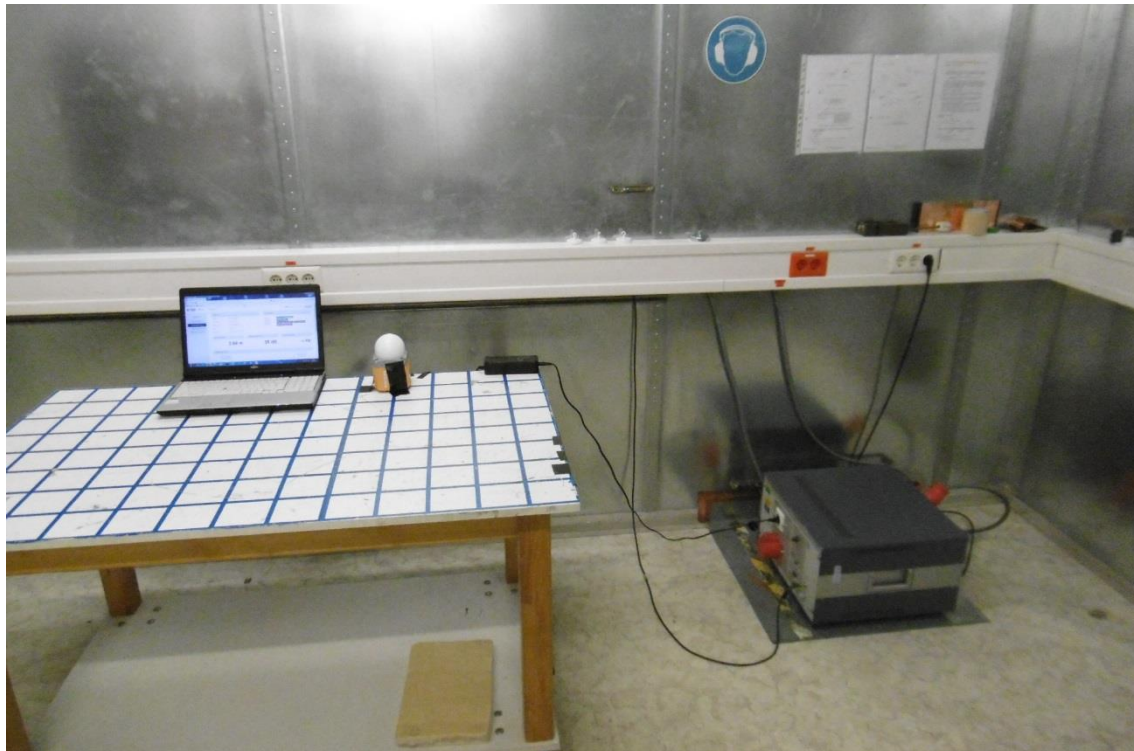
5.1 Conducted emission

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

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up



5.1.3 Applicable standard

According to FCC Part 15, Section 15.107(a):

Except for Class A devices, 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 given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.4. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission 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 10.6 dB at 0.318 MHz

Limit according to FCC Part 15, Section 15.107(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

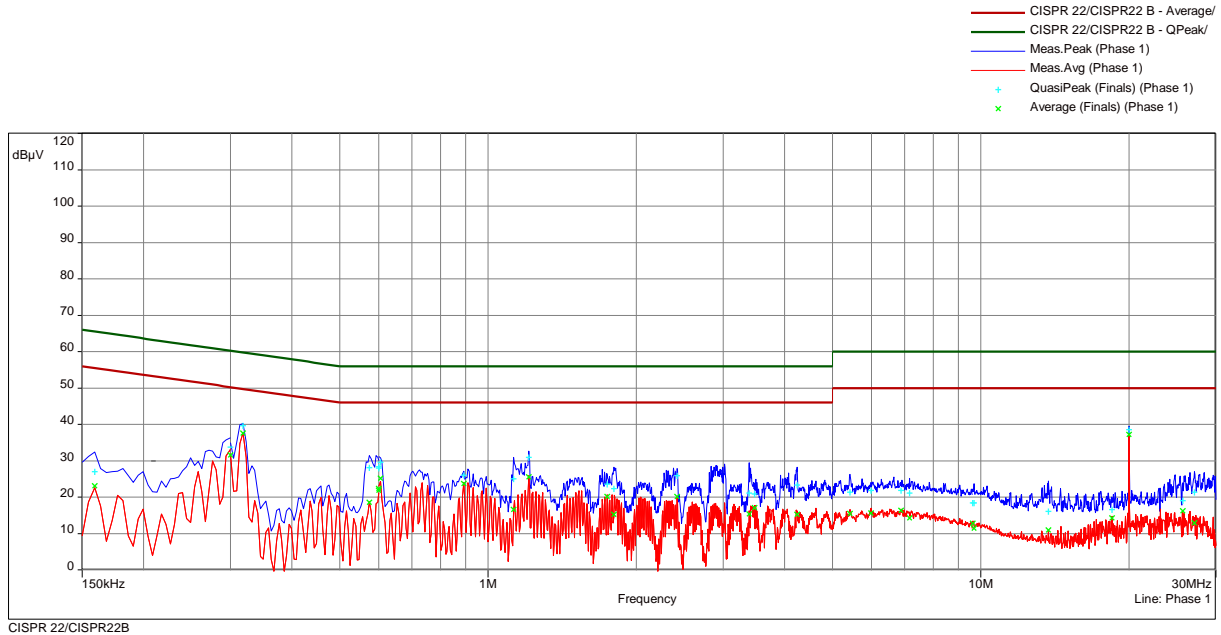
The requirements are **FULFILLED**.

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

5.1.6 Test protocol

Test point L1
Operation mode: LAN transmission
Remarks:

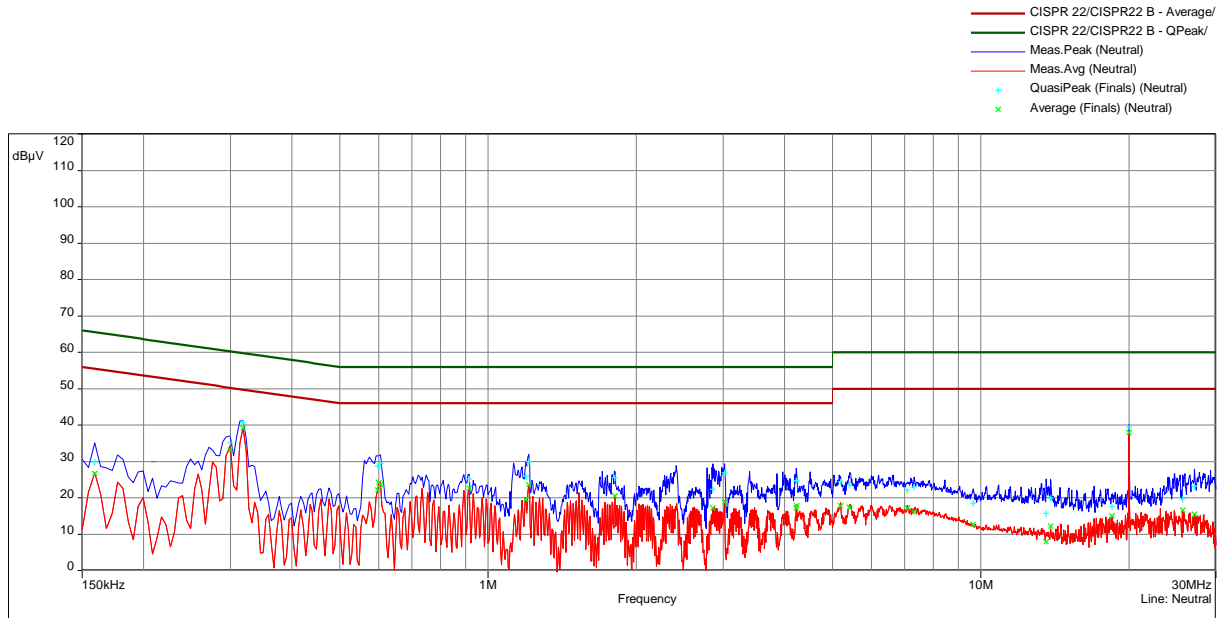
Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.159	1	27.0	38.6	65.5	23.1	32.4	55.5	Phase 1	10.08
0.300	1	33.7	26.5	60.2	31.6	18.7	50.2	Phase 1	10.12
0.318	2	39.6	20.1	59.8	37.6	12.2	49.8	Phase 1	10.13
0.575	2	28.1	27.9	56.0	18.6	27.5	46.0	Phase 1	10.15
0.600	2	28.0	28.0	56.0	21.8	24.2	46.0	Phase 1	10.15
0.600	3	28.4	27.6	56.0	22.4	23.7	46.0	Phase 1	10.15
0.605	3	29.6	26.4	56.0	25.1	20.9	46.0	Phase 1	10.16
0.893	3	26.0	30.0	56.0	23.7	22.3	46.0	Phase 1	10.18
1.127	3	25.1	30.9	56.0	16.5	29.5	46.0	Phase 1	10.21
1.209	4	30.9	25.1	56.0	25.5	20.5	46.0	Phase 1	10.22
1.745	4	23.6	32.4	56.0	20.1	25.9	46.0	Phase 1	10.27
1.799	4	22.3	33.7	56.0	15.2	30.8	46.0	Phase 1	10.26
2.418	5	25.9	30.1	56.0	20.1	25.9	46.0	Phase 1	10.31
3.390	5	21.2	34.8	56.0	15.3	30.7	46.0	Phase 1	10.35
3.471	5	20.9	35.1	56.0	17.1	28.9	46.0	Phase 1	10.35
4.236	5	23.3	32.7	56.0	15.2	30.8	46.0	Phase 1	10.42
5.430	6	21.4	38.6	60.0	15.5	34.5	50.0	Phase 1	10.49
5.993	6	21.9	38.1	60.0	15.6	34.4	50.0	Phase 1	10.53
6.893	6	21.9	38.1	60.0	16.3	33.7	50.0	Phase 1	10.6
7.163	6	21.1	38.9	60.0	14.2	35.8	50.0	Phase 1	10.62
9.632	7	18.4	41.6	60.0	12.7	37.3	50.0	Phase 1	10.72
9.681	7	18.4	41.6	60.0	11.4	38.6	50.0	Phase 1	10.73
13.709	7	16.1	43.9	60.0	10.9	39.1	50.0	Phase 1	11.07
18.443	7	16.6	43.4	60.0	14.2	35.8	50.0	Phase 1	11.38
20.001	8	38.6	21.4	60.0	37.1	12.9	50.0	Phase 1	11.46
25.689	8	19.1	41.0	60.0	16.3	33.8	50.0	Phase 1	11.69
27.161	8	21.4	38.6	60.0	12.9	37.1	50.0	Phase 1	11.7

Test point: N
Operation mode: LAN transmission
Remarks:

Result: passed



CISPR 22/CISPR22B

freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.159	9	29.8	35.7	65.5	26.6	28.9	55.5	Neutral	10.08
0.300	9	35.1	25.2	60.2	33.1	17.2	50.2	Neutral	10.12
0.318	10	40.8	19.0	59.8	39.1	10.6	49.8	Neutral	10.13
0.597	10	28.8	27.3	56.0	22.1	23.9	46.0	Neutral	10.15
0.600	10	28.7	27.3	56.0	24.1	21.9	46.0	Neutral	10.15
0.605	11	29.4	26.6	56.0	23.7	22.3	46.0	Neutral	10.16
0.915	11	25.1	30.9	56.0	22.6	23.4	46.0	Neutral	10.18
1.194	11	25.9	30.2	56.0	19.5	26.5	46.0	Neutral	10.22
1.209	12	30.0	26.0	56.0	23.6	22.4	46.0	Neutral	10.22
1.808	12	25.5	30.5	56.0	20.5	25.5	46.0	Neutral	10.26
2.859	13	22.4	33.7	56.0	17.2	28.8	46.0	Neutral	10.34
3.017	13	26.9	29.1	56.0	18.8	27.2	46.0	Neutral	10.34
4.223	13	24.7	31.3	56.0	17.2	28.8	46.0	Neutral	10.41
4.227	13	24.7	31.3	56.0	17.9	28.1	46.0	Neutral	10.41
5.187	14	24.5	35.6	60.0	17.8	32.3	50.0	Neutral	10.45
5.417	14	23.5	36.5	60.0	17.3	32.7	50.0	Neutral	10.48
7.100	14	22.1	37.9	60.0	17.2	32.8	50.0	Neutral	10.58
7.316	14	23.0	37.0	60.0	16.0	34.0	50.0	Neutral	10.59
9.645	15	18.5	41.5	60.0	12.7	37.3	50.0	Neutral	10.66
13.574	15	15.7	44.3	60.0	7.9	42.1	50.0	Neutral	10.91
13.866	15	19.9	40.1	60.0	12.1	37.9	50.0	Neutral	10.93
18.443	15	17.5	42.5	60.0	15.0	35.0	50.0	Neutral	11.18
20.001	16	39.4	20.6	60.0	37.9	12.1	50.0	Neutral	11.25
25.689	16	19.6	40.4	60.0	16.6	33.4	50.0	Neutral	11.24
27.152	16	23.3	36.8	60.0	15.4	34.6	50.0	Neutral	11.19

5.2 Radiated emission

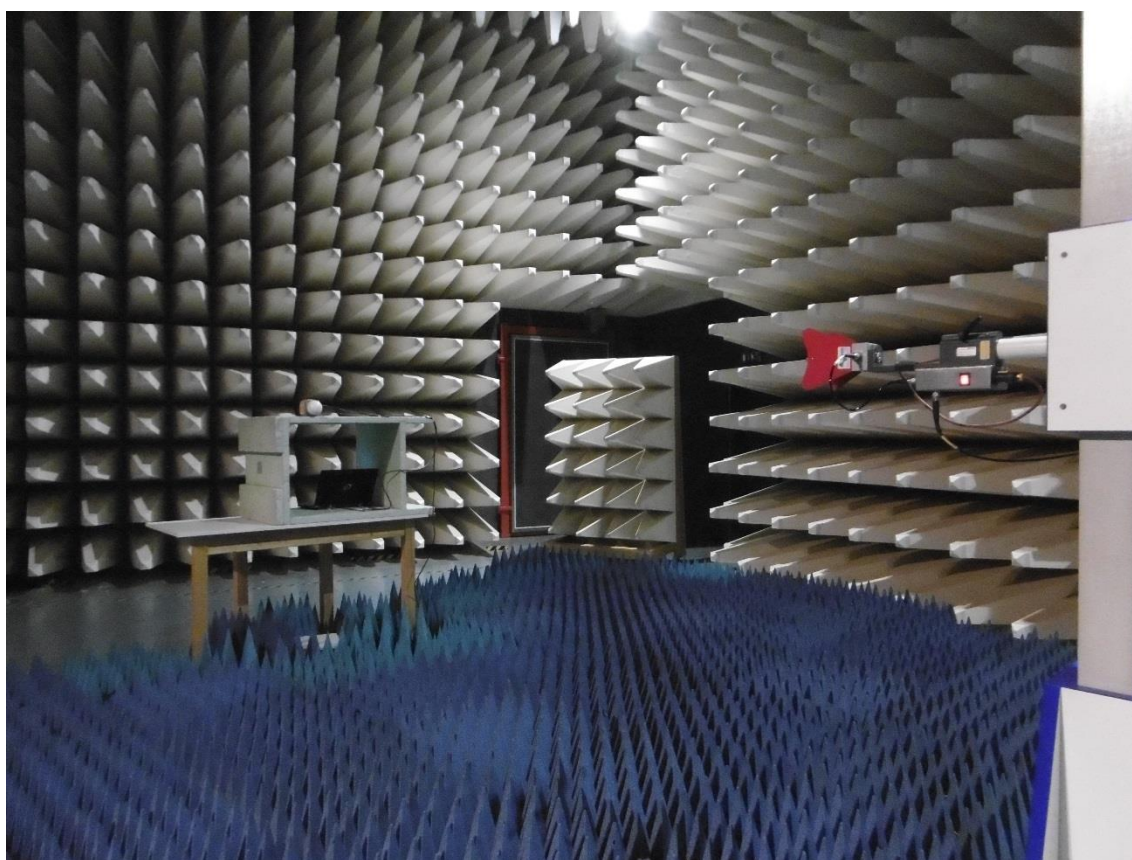
For test instruments and accessories used see section 6 Part **SER 2**, **SER 3**.

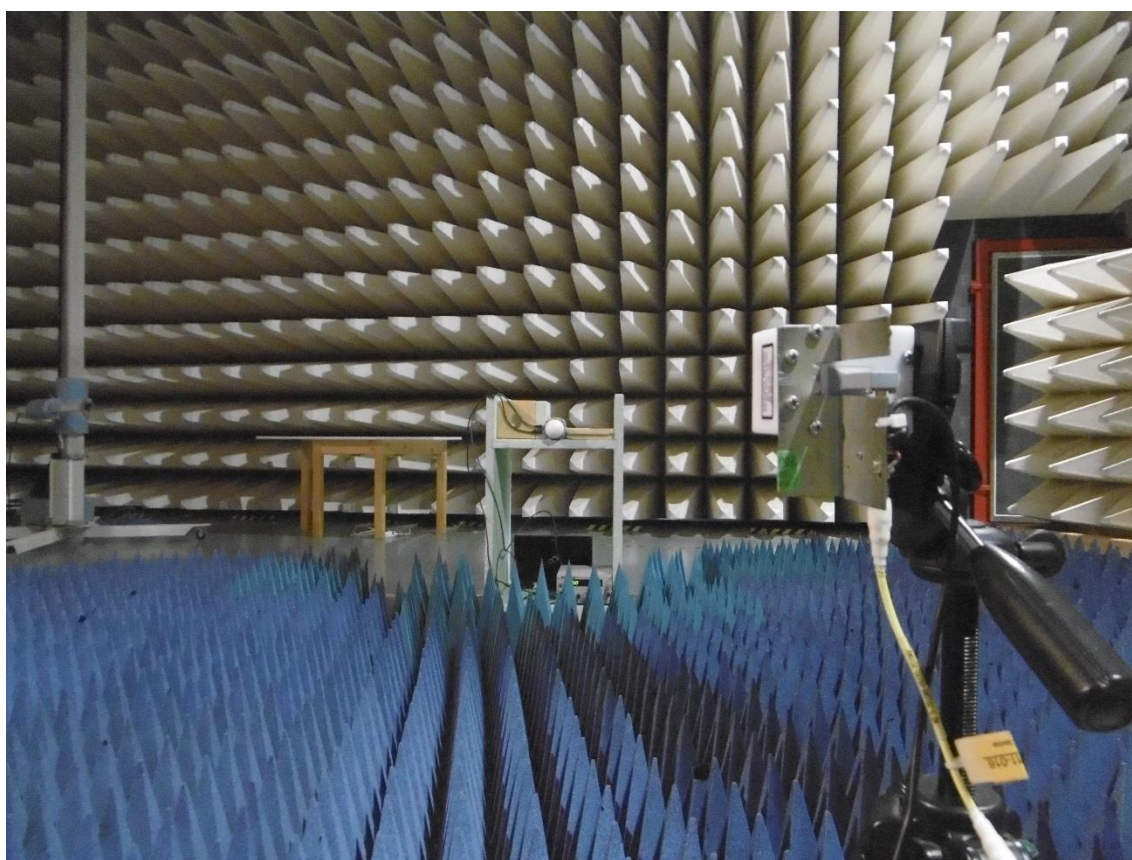
5.2.1 Description of the test location

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

5.2.2 Photo documentation of the test setup







5.2.3 Applicable standard

According to FCC Part 15B, Section 15.109 (a):

Except for Class A digital devices, the field strength of radiated emission from unintentional radiators at a distance of 3 m shall not exceed the given limit.

5.2.4 Description of Measurement

The radiated emissions from the EUT are measured in the frequency range of 30 MHz 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 8 and 12. In the frequency range above 1 GHz a spectrum analyser is used. 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 both are reported. The EUT is measured in RX/TX continuous mode under normal conditions.

Spectrum analyser settings:

30 MHz – 1000 MHz: RBW: 120 kHz

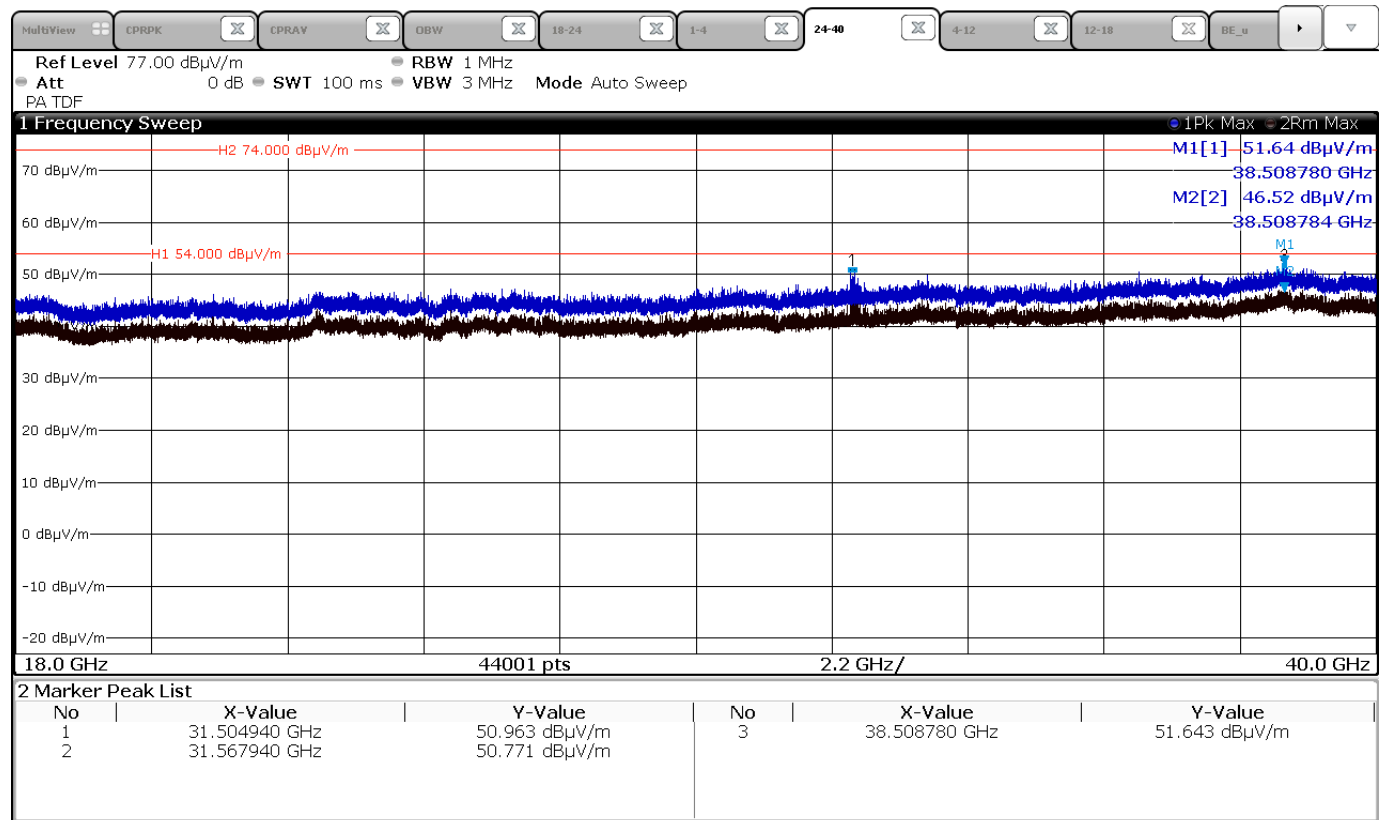
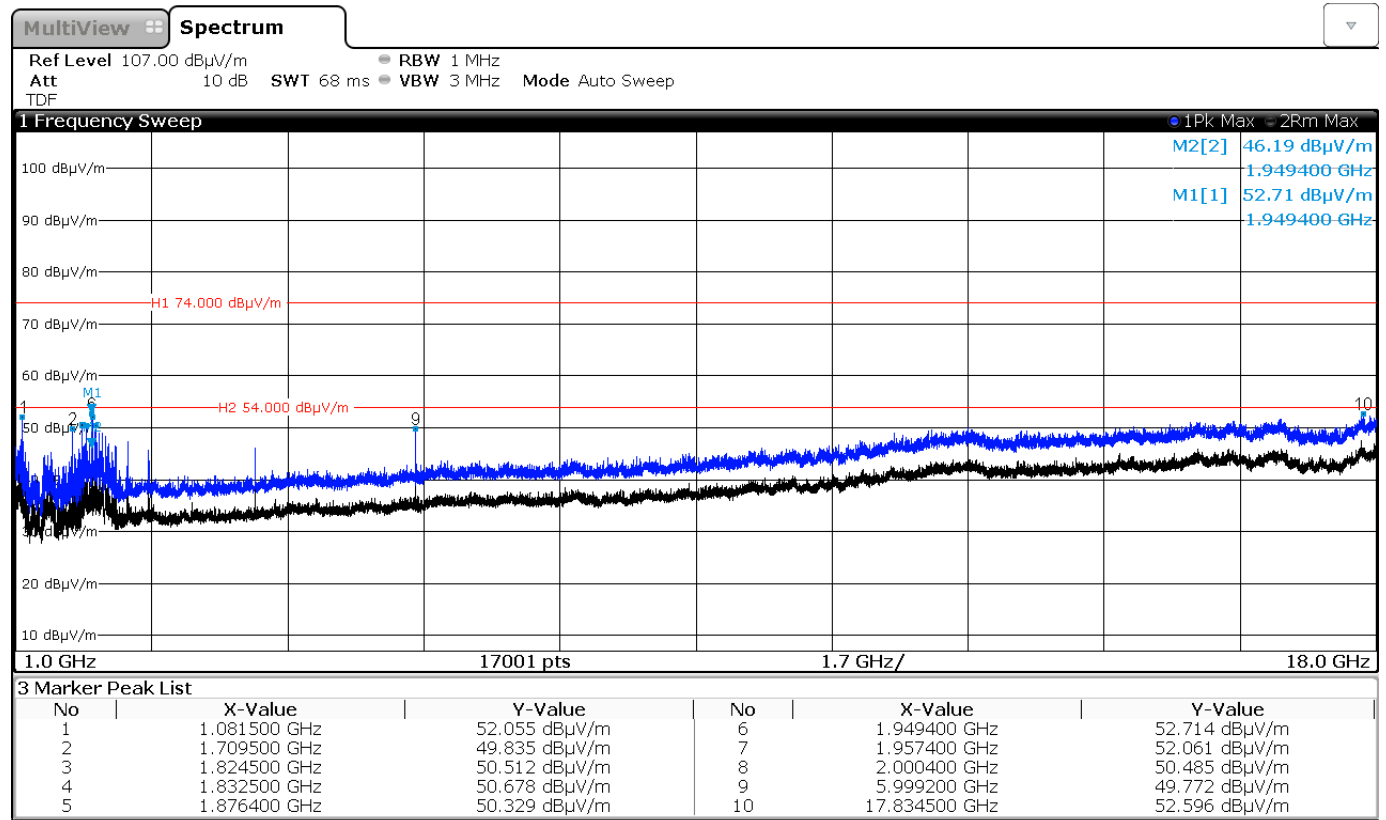
1000 MHz – 40 GHz: RBW: 1 MHz, VBW: 3 MHz, Sweep: Auto, Detector function: Peak

5.2.5 Test result

$f < 1 \text{ GHz}$

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)
40.00	7.3	2.7	13.7	12.4	21.0	15.1	40.0	-19.0
71.23	18.5	23.9	12.8	12.2	31.3	36.1	40.0	-3.9
134.50	5.2	10.3	12.4	13.2	17.6	23.5	43.5	-20.0
189.20	20.7	26.8	11.5	12.2	32.2	39.0	43.5	-4.5
270.00	10.7	20.7	14.1	14.0	24.8	34.7	46.0	-11.3
311.25	13.5	22.0	16.2	15.8	29.7	37.8	46.0	-8.2
680.00	-2.6	15.9	25.3	24.9	22.7	40.8	46.0	-5.2
880.00	15.3	9.5	28.8	28.3	44.1	37.8	46.0	-1.9

f > 1 GHz



Limit according to FCC Part 15B, Section 15.109(a):

Frequency (MHz)	Limit ($\mu\text{V/m}$)	Limit (dB $\mu\text{V/m}$)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

The requirements are **FULFILLED**.

Remarks: The measurement is performed according to FCC Part 15A, Section 15.33(b), up to the
5th harmonic or 40 GHz.

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	BAT-EMC 3.16.0.73	01-02/68-13-001				
	ESCI	02-02/03-15-001	11/06/2019	11/06/2018		
	ESH 2 - Z 5	02-02/20-05-004	25/10/2019	25/10/2017	30/10/2018	30/04/2018
	EMV D 30000/PAS	02-02/30-05-006	21/02/2020	21/02/2017	20/02/2019	20/02/2018
	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	18/11/2019	18/11/2016	07/11/2018	07/05/2018
SER 2	ESVS 30	02-02/03-05-006	06/06/2019	06/06/2018		
	VULB 9168	02-02/24-05-005	18/04/2019	18/04/2018	21/09/2018	21/03/2018
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSW43	02-02/11-15-001	19/03/2019	19/03/2018		
	JS4-18004000-30-5A	02-02/17-05-017				
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	08/05/2019	08/05/2018		
	BBHA 9170	02-02/24-05-014	02/06/2018	02/06/2015	26/10/2018	26/10/2017
	KMS102-0.2 m	02-02/50-11-020				
	18N-20	02-02/50-17-003				
	NMS111-GL200SC01-NMS11	02-02/50-17-012				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				