

RF - TEST REPORT

- FCC Part 15.255 -

Type / Model Name : REF BGT60LTR11AIP

Product Description : 60 GHz short range radar module

HVIN: Ref BGT60LTR11AIP_1

Applicant : Infineon Technologies AG

Address : Am Campeon 1-15

85579 NEUBIBERG, GERMANY

Manufacturer : Infineon Technologies AG

Address : Am Campeon 1-15

85579 NEUBIBERG, GERMANY

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

POSITIVE

Test Report No. : 80103696-01 Rev_0

20. December 2022

Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-03
D-PL-12030-01-04

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ATTACHMENTS A, B AS SEPARATE SUPPLEMENTS

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2021)

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, 2021)

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 15.255	Operation within the band 57-71 GHz.

ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
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2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according his/her instructions.

2.3 Photo documentation of the EUT – see Attachment A

2.4 Equipment category

The EUT qualifies under FCC 15.255, (c)(2), field disturbance sensor

2.5 Short description of the equipment under test (EUT)

The EUT is a field disturbance sensor in the operating band of 61.0 GHz to 61.5 GHz.

Number of tested samples: 2
Serial number: #1 (CW)
#4 (pulsed)
Firmware version: NO firmware,
RF relevant register settings hard coded.
Only channel selection in 61.0-61.5 GHz band possible (CH1-4)

2.6 Variants of the EUT

There are no variants of the EUT.

2.7 Operation frequency and channel plan

The operating frequency is 61.0 GHz to 61.5 GHz.

Channel	Frequency (GHz)
1	61.1
2	61.2
3	61.3
4	61.4

Note: The blue marked channels are measured.

2.8 Transmit operating modes

TX modulated
TX CW

2.9 Antenna

The following integrated antennas are used with the EUT:

Number	Characteristic	Model number	Plug	Frequency range (GHz)	Max gain (dBi)
1	linear	On chip patch antenna for TX	-	61.0-61.5	5.0
2	linear	On chip patch antenna for RX	-	61.0-61.5	5.0

The antennas cannot be unattached by the user.

2.10 Power supply system utilised

Power supply voltage, V_{nom} : 5 V/DC (test jig)
Power supply voltage EUT : 3.3 V/DC

2.11 Peripheral devices and interface cables

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

- Power Adapter with USB cable Model : A1400, Flextronics

2.12 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 vertical 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
1 - 4	1, 2, 4	P_{max}	digital	OOK

2.12.1 Test jig

The EUT is mounted on a carrier PCB with a LDO regulator 5.0 V/DC to 3.3 V/DC. The channels can be selected by jumpering the corresponding pins of the carrier PCB.

2.12.2 Test software

The test software allows to select a channel in TX CW or TX modulated mode.

3 TEST RESULT SUMMARY

Operating in the 61 GHz – 61.5 GHz band:

FCC Rule Part	Description	Result
15.207(a)	AC power line conducted emissions	passed
15.255(c)(2)	EIRP	passed
15.255(d) 15.209(a)	Spurious emissions	passed
15.255(e)	Peak conducted output power	passed
15.255(c)(2) 15.255(e)(1)	Emission bandwidth, 99% bandwidth	passed
15.255(f)	Frequency stability	passed
15.203	Antenna requirement	passed

3.1 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80103696-01	0	20 December 2022	Initial test report

The test report with the highest revision number replaces the previous test reports.

3.2 Final assessment

The equipment under test fulfils the requirements cited in clause 1 test standards.

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

Testing commenced on : 21 October 2021

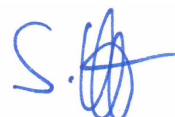
Testing concluded on : 26 October 2021

Checked by:

Tested by:

 **Jürgen Pessinger**
2023.02.03
11:13:29 +01'00'

Jürgen Pessinger
Radio Team



Sabine Kugler
2022.12.20 17:26:54
+01'00'

Sabine Kugler
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

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

4.2 Environmental conditions

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

Temperature: 15 - 35 ° C

Humidity: 30 - 60 %

Atmospheric pressure: 86 - 106 kPa

4.3 Statement of the measurement uncertainty

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

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
Output power ERP, radiated	40000 MHz to 110000 MHz	95%	± 5.41 dB
Field strength of the fundamental	1000 MHz to 40000 MHz	95%	± 2.34 dB
Field strength of the fundamental	40000 MHz to 110000 MHz	95%	± 5.41 dB
Power spectral density	40000 MHz to 110000 MHz	95%	± 5.41 dB
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	± 2.15 dB
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	± 3.47 dB
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	± 3.53 dB
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	± 4.44 dB
Spurious Emissions, radiated	1000 MHz to 40000 MHz	95%	± 2.89 dB
Spurious Emissions, radiated	40000 MHz to 60000 MHz	95%	± 5.04 dB
Spurious Emissions, radiated	60000 MHz to 90000 MHz	95%	± 5.04 dB
Spurious Emissions, radiated	75000 MHz to 110000 MHz	95%	± 5.04 dB
Spurious Emissions, radiated	110000 MHz to 170000 MHz	95%	± 5.04 dB
Spurious Emissions, radiated	140000 MHz to 220000 MHz	95%	± 5.04 dB

4.4 Conformity Decision Rule

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

4.5 Measurement protocol for FCC and ISED

4.5.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011
ISED: DE0009

4.5.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

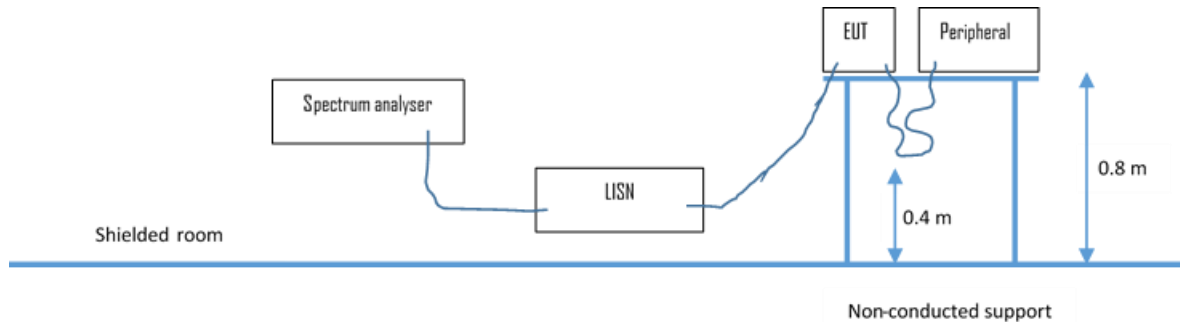
4.5.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions.

4.5.3 Details of test procedures

4.5.3.1 Conducted emission

Test setup according ANSI C63.10



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

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

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

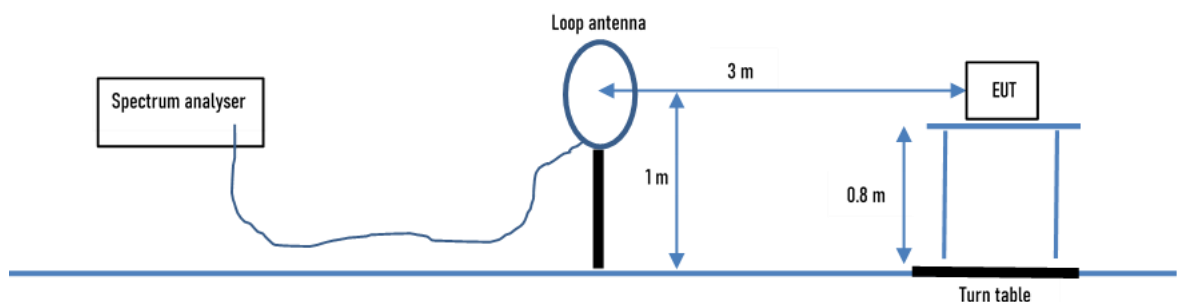
$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

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. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. 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 emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

4.5.3.2 Radiated emission

4.5.3.2.1 OATS1 test site (9 kHz - 30 MHz):

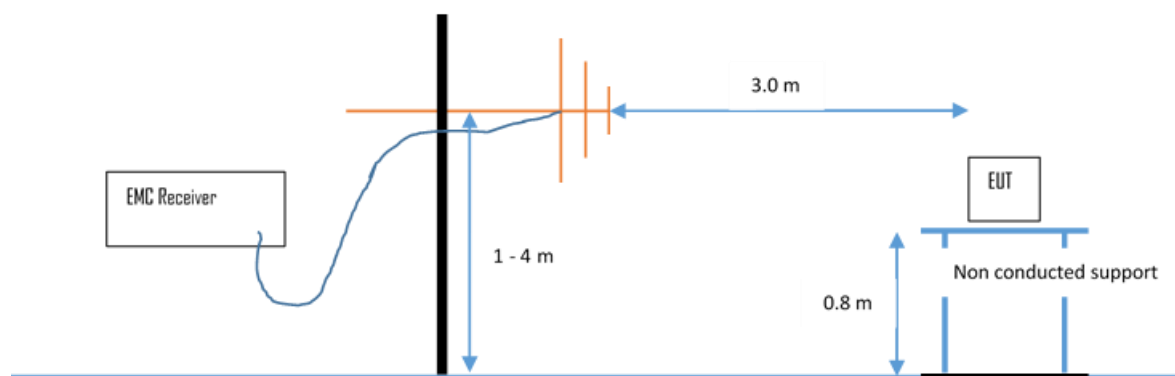
Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied along the site axis and the EUT is rotated 360 degrees.

4.5.3.2.2 OATS1 test site (30 MHz - 1 GHz):

Test setup according ANSI C63.10.



Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees. The final level in dB μ V/m is calculated by taking the reading from the EMI receiver (Level dB μ V) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:

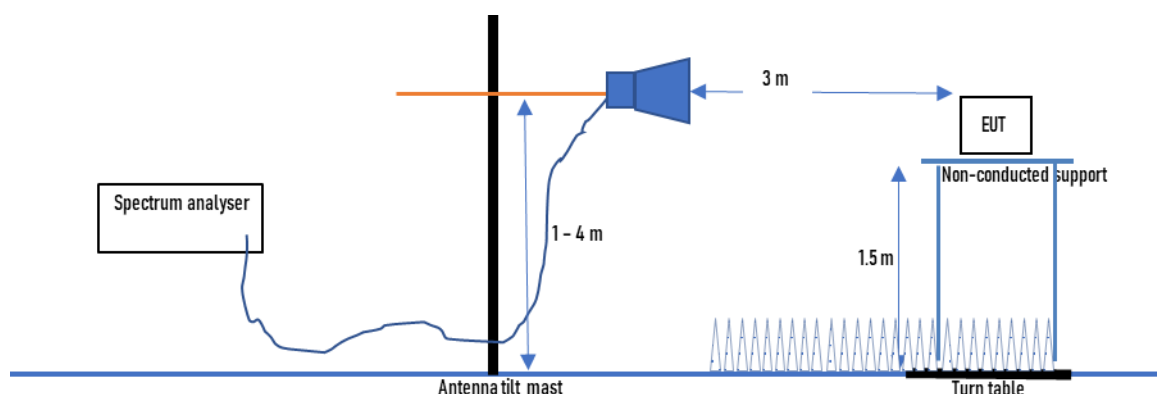
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Level (dB μ V)	+	Factor (dB)	=	Level (dB μ V/m)	-	Limit (dB μ V/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

4.5.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

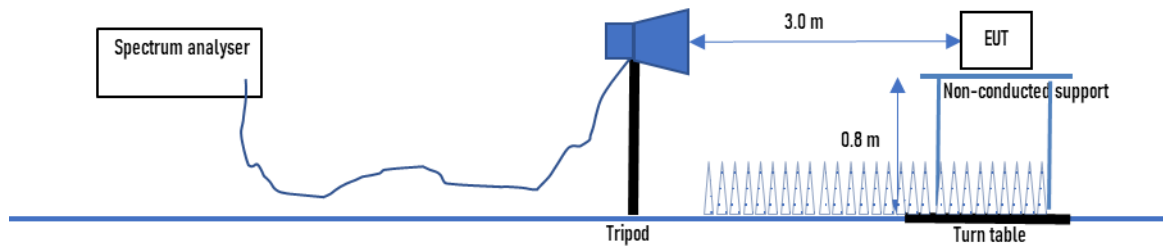
Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz 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 non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded

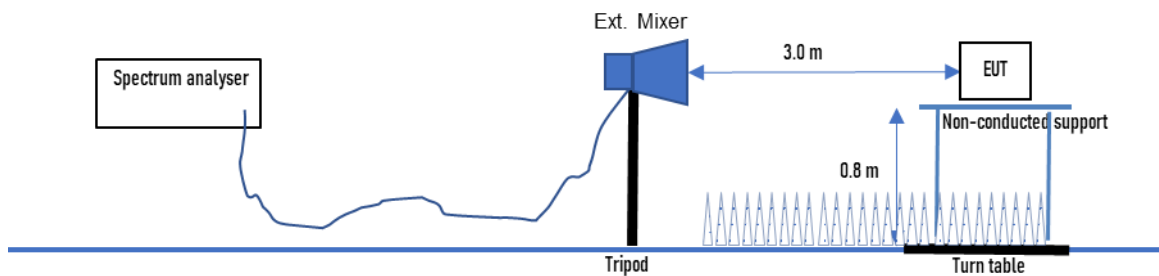
back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

4.5.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)



Emissions from the EUT are measured in the frequency range 18 GHz up to 40 GHz 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 non-conducting table, 0.8 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limit are adopted.

4.5.3.2.5 Anechoic chamber 1 (40 GHz – 200 GHz)



Emissions from the EUT are measured in the frequency range 40 GHz up to 200 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and external mixer with standard gain horn. Table top equipment is placed on a non-conducting table, 0.8 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limit are adopted.

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: Shielded Room S2

5.1.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

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 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 -27.5 dB at 0.2 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

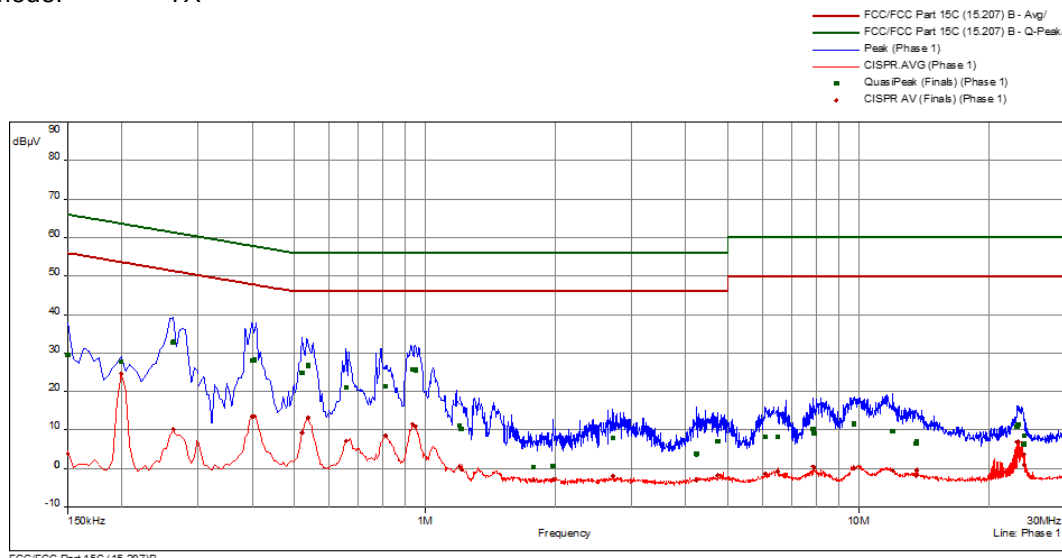
The requirements are **FULFILLED**.

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

5.1.6 Test protocol

Test point L1
Operation mode: TX

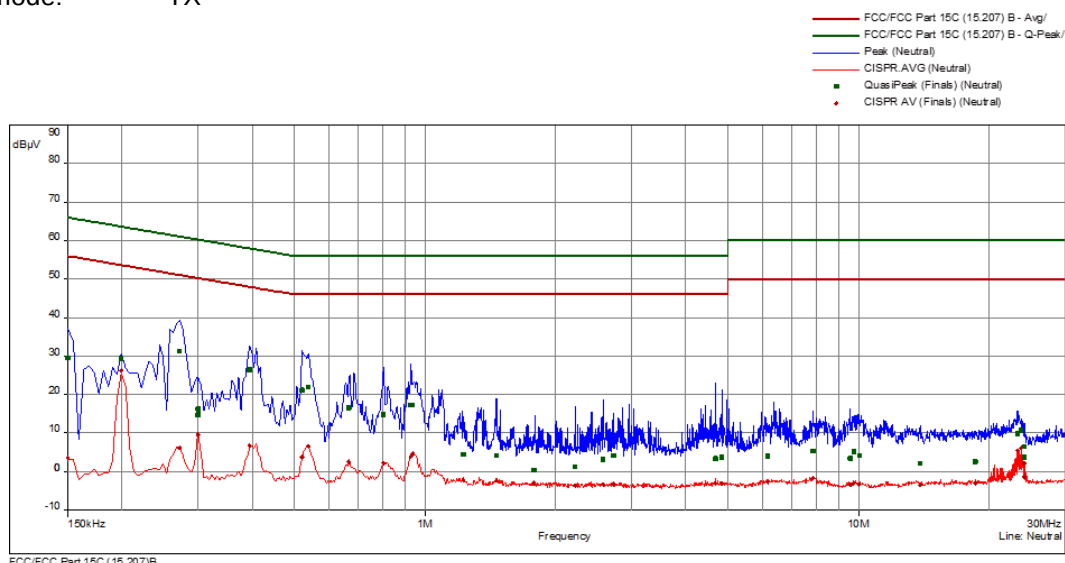
Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.150	1	29.5	-36.5	66.0	3.9	-52.1	56.0	Phase 1	10.1
0.200	1	27.9	-35.8	63.6	24.7	-29.0	53.6	Phase 1	10.1
0.263	1	32.9	-28.5	61.4	10.3	-41.1	51.4	Phase 1	10.1
0.399	2	28.1	-29.8	57.9	13.5	-34.4	47.9	Phase 1	10.2
0.404	2	28.2	-29.6	57.8	13.7	-34.1	47.8	Phase 1	10.2
0.521	2	24.9	-31.1	56.0	9.2	-36.8	46.0	Phase 1	10.2
0.539	2	26.8	-29.2	56.0	13.2	-32.8	46.0	Phase 1	10.2
0.659	3	21.1	-34.9	56.0	7.2	-38.8	46.0	Phase 1	10.2
0.812	3	21.4	-34.6	56.0	8.5	-37.5	46.0	Phase 1	10.2
0.938	3	25.6	-30.4	56.0	11.6	-34.4	46.0	Phase 1	10.2
0.951	3	25.6	-30.4	56.0	11.0	-35.0	46.0	Phase 1	10.2
1.200	4	11.2	-44.8	56.0	0.5	-45.5	46.0	Phase 1	10.2
1.214	4	10.3	-45.7	56.0	-0.3	-46.3	46.0	Phase 1	10.2
1.781	4	0.5	-55.6	56.0	-3.0	-49.0	46.0	Phase 1	10.3
1.974	4	0.7	-55.3	56.0	-2.8	-48.8	46.0	Phase 1	10.3
2.715	5	8.0	-48.0	56.0	-1.9	-47.9	46.0	Phase 1	10.3
4.232	5	3.8	-52.2	56.0	-3.1	-49.1	46.0	Phase 1	10.4
4.740	5	7.1	-48.9	56.0	-1.7	-47.7	46.0	Phase 1	10.4
6.101	6	8.3	-51.7	60.0	-1.3	-51.3	50.0	Phase 1	10.5
6.515	6	8.3	-51.7	60.0	-0.8	-50.8	50.0	Phase 1	10.6
7.865	6	10.3	-49.7	60.0	0.5	-49.5	50.0	Phase 1	10.7
7.910	6	9.2	-50.8	60.0	0.1	-49.9	50.0	Phase 1	10.7
9.762	7	11.6	-48.4	60.0	0.2	-49.8	50.0	Phase 1	10.7
11.999	7	9.8	-50.2	60.0	-0.5	-50.5	50.0	Phase 1	10.9
13.610	7	6.5	-53.5	60.0	-1.9	-51.9	50.0	Phase 1	11.1
13.637	7	6.9	-53.1	60.0	-0.5	-50.5	50.0	Phase 1	11.1
23.178	8	10.9	-49.1	60.0	6.9	-43.1	50.0	Phase 1	11.6
23.403	8	11.5	-48.5	60.0	7.0	-43.1	50.0	Phase 1	11.6
24.078	8	6.4	-53.6	60.0	1.0	-49.0	50.0	Phase 1	11.6
24.146	8	8.5	-51.5	60.0	3.7	-46.3	50.0	Phase 1	11.6

Test point: N
Operation mode: TX

Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.150	9	29.5	-36.5	66.0	3.7	-52.3	56.0	Neutral	10.1
0.200	9	29.3	-34.3	63.6	26.2	-27.5	53.6	Neutral	10.1
0.272	9	31.3	-29.8	61.1	6.2	-44.9	51.1	Neutral	10.1
0.300	9	16.2	-44.0	60.2	9.6	-40.6	50.2	Neutral	10.1
0.300	10	14.8	-45.5	60.2	9.4	-40.8	50.2	Neutral	10.1
0.395	10	26.4	-31.6	58.0	6.8	-41.2	48.0	Neutral	10.2
0.521	10	21.2	-34.8	56.0	3.7	-42.3	46.0	Neutral	10.2
0.539	10	22.0	-34.0	56.0	6.6	-39.4	46.0	Neutral	10.2
0.668	11	16.6	-39.4	56.0	2.5	-43.5	46.0	Neutral	10.2
0.803	11	14.7	-41.3	56.0	2.2	-43.8	46.0	Neutral	10.2
0.929	11	17.3	-38.7	56.0	4.0	-42.0	46.0	Neutral	10.2
0.938	11	17.3	-38.7	56.0	4.8	-41.2	46.0	Neutral	10.2
1.227	12	4.5	-51.5	56.0	-2.2	-48.2	46.0	Neutral	10.2
1.461	12	4.2	-51.8	56.0	-2.3	-48.3	46.0	Neutral	10.3
1.785	12	0.3	-55.7	56.0	-3.1	-49.1	46.0	Neutral	10.3
2.222	12	1.2	-54.8	56.0	-3.6	-49.6	46.0	Neutral	10.3
2.576	13	3.1	-52.9	56.0	-3.3	-49.3	46.0	Neutral	10.3
2.720	13	4.2	-51.8	56.0	-3.2	-49.2	46.0	Neutral	10.3
4.691	13	3.4	-52.7	56.0	-3.2	-49.2	46.0	Neutral	10.4
4.841	14	3.7	-52.3	56.0	-3.1	-49.1	46.0	Neutral	10.4
6.182	14	4.0	-56.0	60.0	-2.7	-52.7	50.0	Neutral	10.5
7.856	14	5.3	-54.7	60.0	-1.7	-51.7	50.0	Neutral	10.6
9.570	14	3.4	-56.6	60.0	-3.5	-53.5	50.0	Neutral	10.7
9.753	15	5.3	-54.7	60.0	-3.0	-53.0	50.0	Neutral	10.7
10.050	15	4.1	-55.9	60.0	-3.3	-53.3	50.0	Neutral	10.7
13.893	15	2.1	-57.9	60.0	-3.4	-53.4	50.0	Neutral	10.9
18.645	15	2.6	-57.5	60.0	-2.9	-52.9	50.0	Neutral	11.2
23.309	16	9.9	-50.1	60.0	5.6	-44.4	50.0	Neutral	11.3
23.759	16	10.8	-49.2	60.0	6.2	-43.8	50.0	Neutral	11.3
24.123	16	3.8	-56.2	60.0	-1.4	-51.4	50.0	Neutral	11.3
24.150	16	6.6	-53.5	60.0	2.2	-47.8	50.0	Neutral	11.3

5.2 EBW and OBW

For test instruments and accessories used see section 6 Part **CPR3**.

5.2.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 1 m

5.2.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.2.3 Applicable standard

According to FCC Part 15, Section 15.255(c)(2):

For fixed field disturbance sensors that occupy 500 MHz or less of bandwidth and that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm.

According to FCC Part 15, Section 15.255(e)(1):

Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz.

5.2.4 Description of Measurement

According to FCC Part 15, Section 15.255(e)(1):

For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitter at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

Spectrum analyser settings for EBW:

RBW: 100 kHz, VBW: 3 x RBW, Detector: Max peak, Sweep time: auto, Span: > 2 EBW;

Spectrum analyser settings for OBW:

RBW: 300 kHz, VBW: 3 x RBW, Detector: Max peak, Sweep time: auto, Span: > 2 OBW;

5.2.5 Test result

6dB bandwidth				
Channel	Centre frequency	f_{low}	f_{high}	Measured EBW
	(GHz)	(GHz)	(GHz)	(MHz)
CH1	61.1	61.0976942	61.1016638	3.9696
CH2	61.2	61.1984222	61.2022918	3.8696
CH4	61.4	61.3972703	61.4019838	4.7135

99% bandwidth				
Channel	Centre frequency	T_1	T_2	Measured OBW
	(GHz)	(GHz)	(GHz)	(MHz)
CH1	61.1	61.0916774	61.1062950	14.6175926
CH2	61.2	61.1932279	61.2055618	12.3339508
CH4	61.4	61.3905154	61.4075290	17.0135753

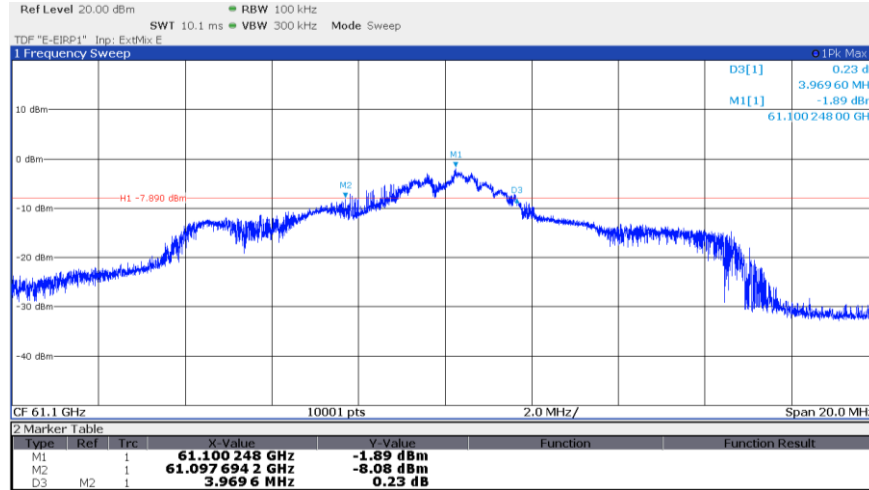
The requirements are **FULFILLED**.

Remarks: For detailed test results please refer to following test protocols. No limit defined for the
occupied bandwidth!

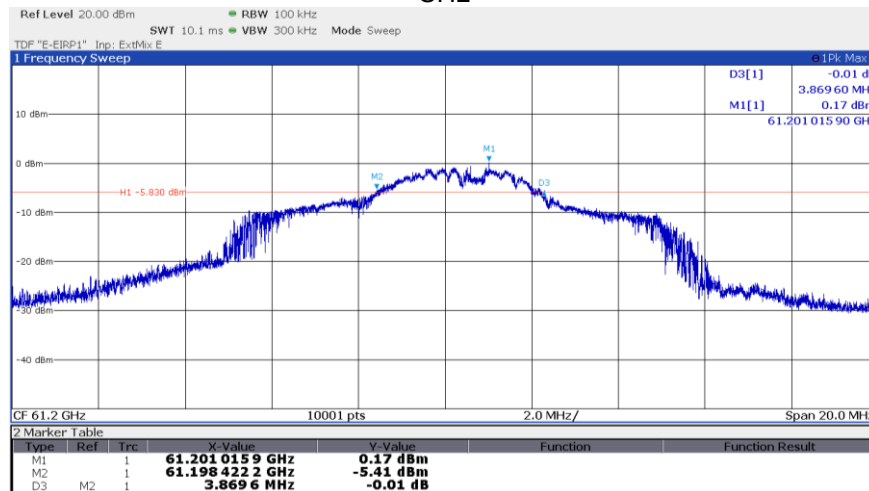
5.2.6 Test protocols

6dB EBW

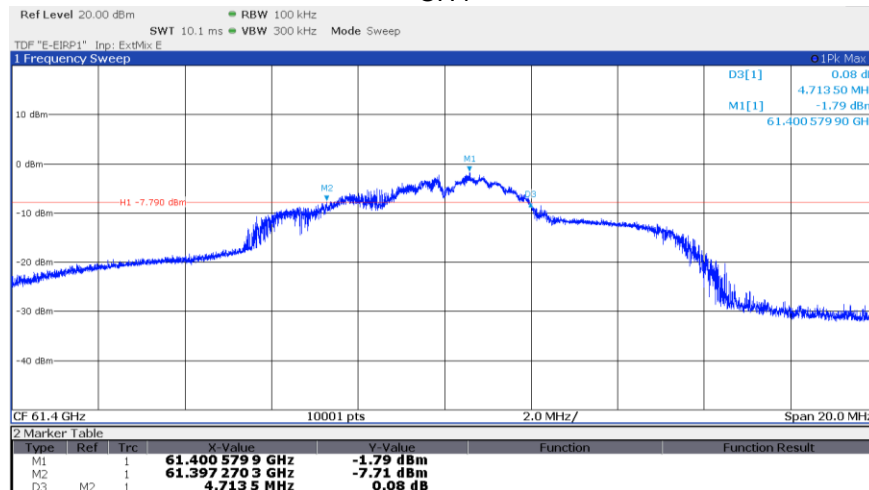
CH1



CH2



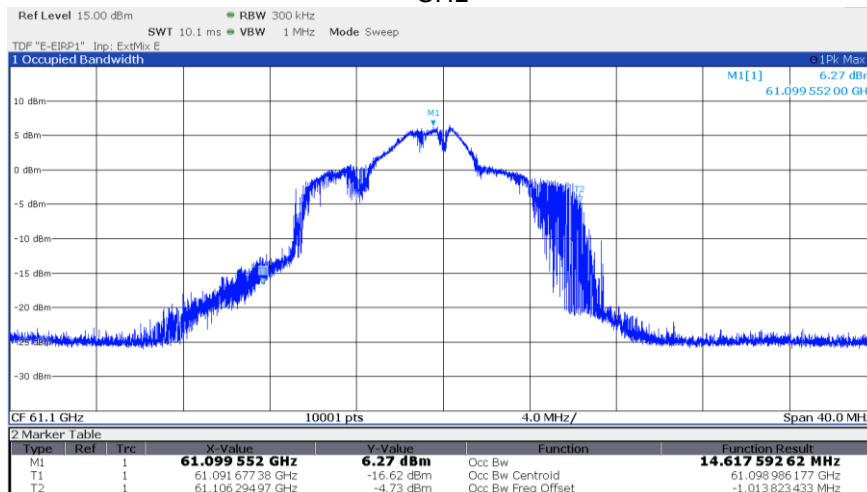
CH4



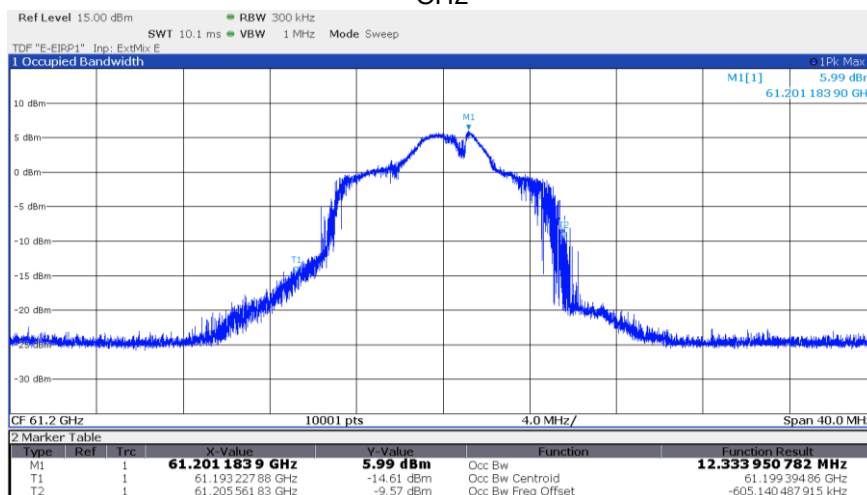
FCC ID: 2AYSQ60LTR11A1

99% OBW

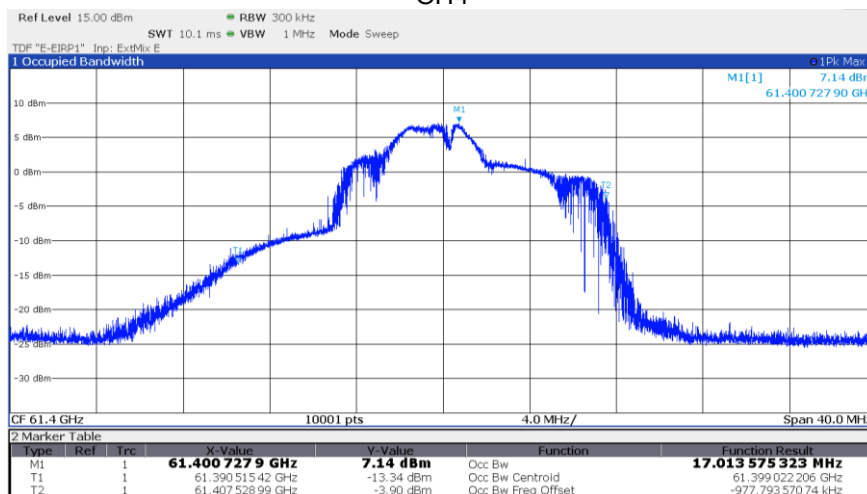
CH1



CH2



CH4



5.3 EIRP

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

5.3.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 1 m

5.3.2 Applicable standard

According to FCC Part 15C, Section 15.255(c)(2):

For fixed field disturbance sensors that occupy 500 MHz or less of bandwidth and that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm.

5.3.3 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.3.4 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 9.11. The EUT is measured in TX continuous modulated under normal conditions.

Analyser settings:

PK measurement:	RBW: 30 MHz	VBW: 80 MHz	Detector: PK	Trace. Max hold
AV measurement:	RBW: 30 MHz	VBW: 80 MHz	Detector: RMS	Trace. Max hold

5.3.5 Test result

Channel	Frequency (GHz)	Level PK (dBm)	Limit PK (dBm)	Margin PK (dB)	Level AV (dBm)	Limit AV (dBm)	Margin AV (dB)
CH1	61.1	9.1	43.0	-33.9	7.7	40.0	-32.3
CH2	61.2	9.4	43.0	-33.6	7.9	40.0	-32.1
CH4	61.4	10.5	43.0	-32.6	9.2	40.0	-30.9

EIRP limit according to FCC Part 15C, Section 15.255(c)(2):

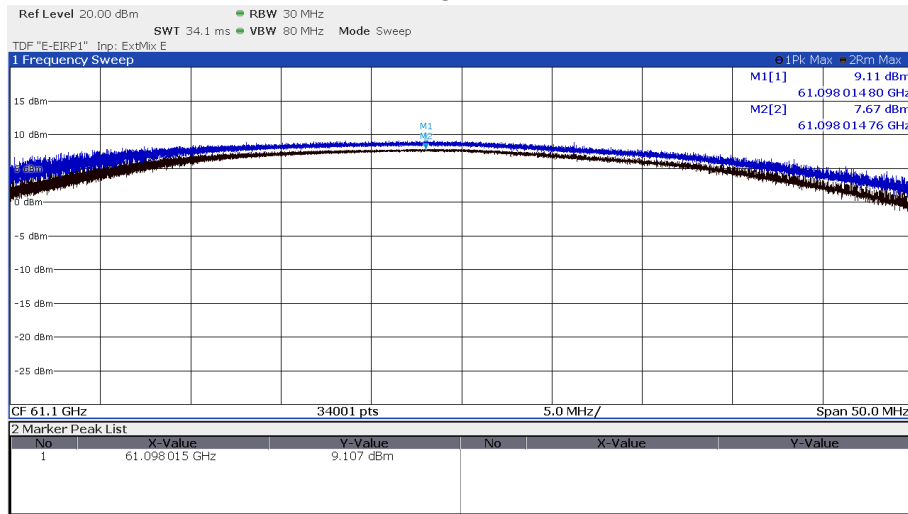
For fixed field disturbance sensors that occupy 500 MHz or less of bandwidth and that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm.

The requirements are **FULFILLED**.

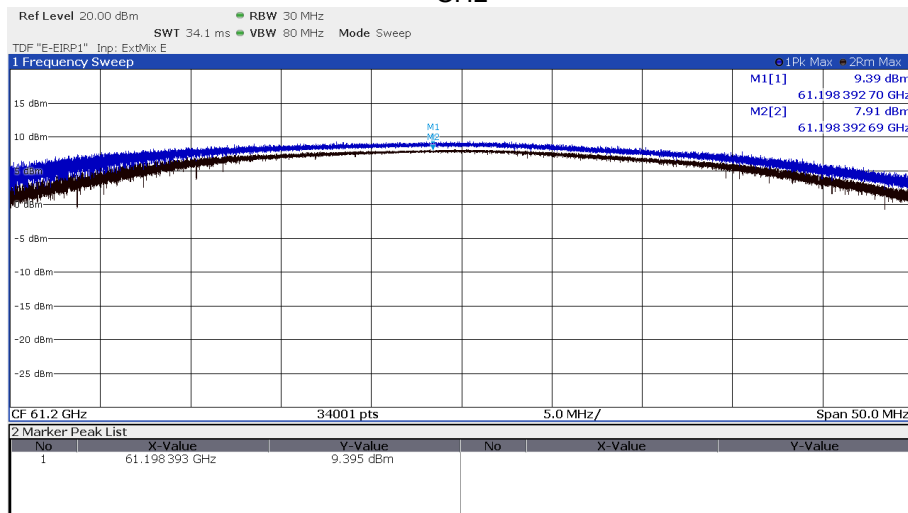
Remarks: For detailed test results please refer to following test protocols.

5.3.6 Test protocols

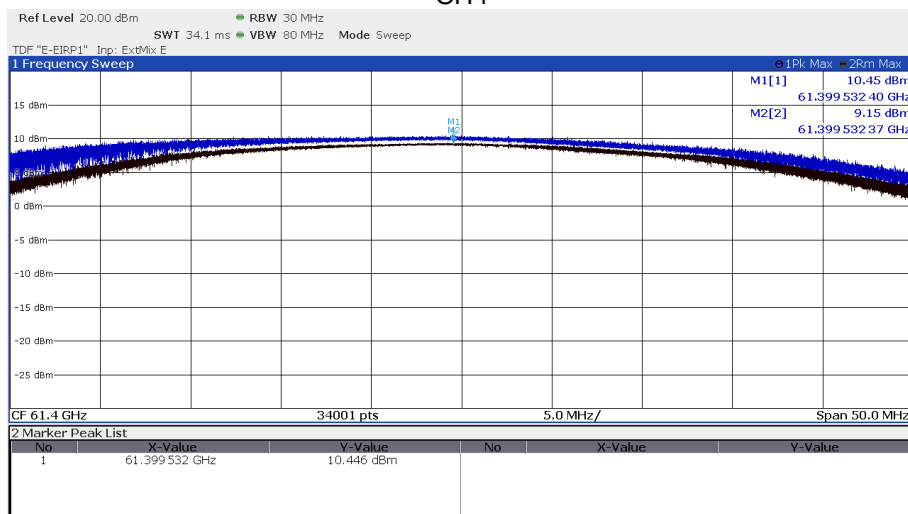
CH1



CH2



CH4



5.4 Peak conducted output power

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

5.4.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 1 m

5.4.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.4.3 Applicable standard

According to FCC Part 15C, Section 15.255(e):

Except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (c) of this section.

5.4.4 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 9.11. The EUT is measured in TX modulated, under normal conditions.

Analyser settings:

PK measurement:	RBW: 30 MHz	VBW: 80 MHz	Detector: Peak	Trace. Max hold
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5.4.5 Test result

Calculation of the peak transmitter output power:

Channel	Frequency	Level EIRP PK	Antenna gain	Conducted level PK	Conducted level PK	EBW	Limit	Margin
	(GHz)	(dBm)	(dBi)	(dBm)	(mW)	(MHz)	(mW)	(mW)
CH1	61.1	9.1	5.0	4.1	2.6	3.9696	19.8	-17.3
CH2	61.2	9.4	5.0	4.4	2.7	3.8696	19.3	-16.6
CH4	61.4	10.5	5.0	5.5	3.5	4.7135	23.6	-20.1

EIRP limit according to FCC Part 15C, Section 15.255(e):

Except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (c) of this section.

(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

Determination of the limit:

The limit is given as $500 \text{ mW} * \text{EBW } 6 \text{ dB (100 kHz RBW)} / 100 \text{ MHz}$;

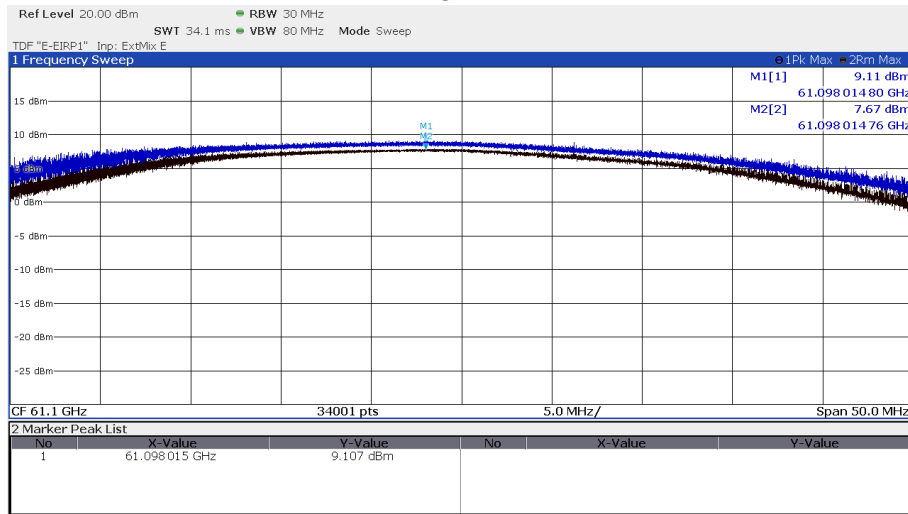
The requirements are **FULFILLED**.

Remarks: For determination of emission bandwidth please refer to section 5.2.

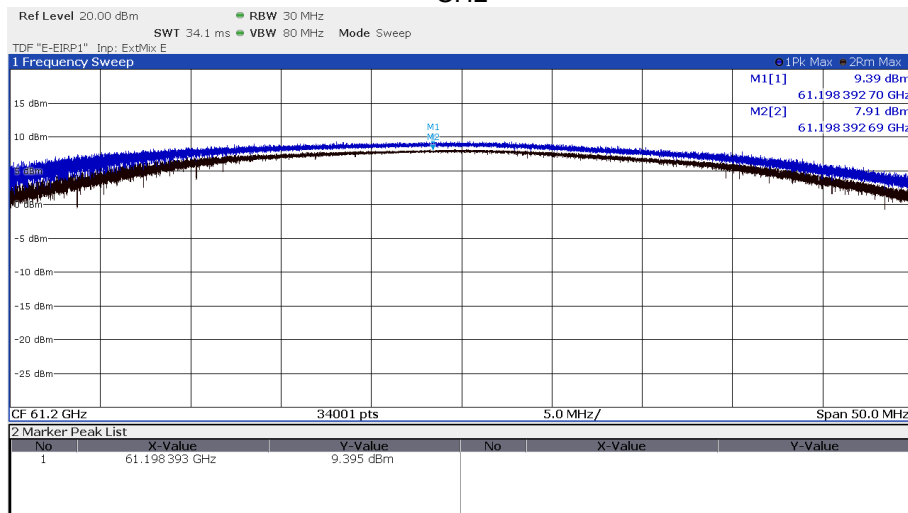
For detailed test results please refer to following test protocols.

5.4.6 Test protocols

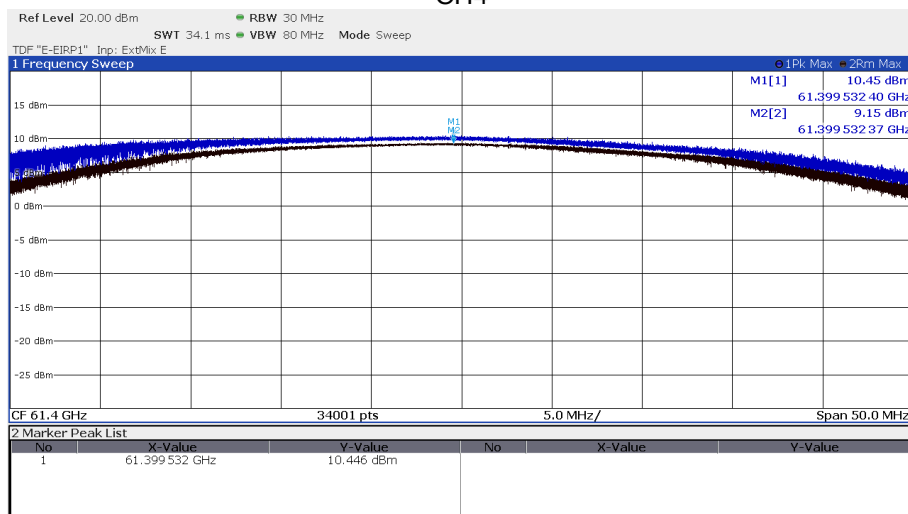
CH1



CH2



CH4



5.5 Spurious emissions

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

5.5.1 Description of the test location

Test location: OATS 1
Test distance: 3 m

Test location: Anechoic chamber 1
Test distance: 3 m (1 GHz – 40 GHz)
Test distance: 1 m (40 GHz – 200 GHz)

5.5.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.5.3 Applicable standard

According to FCC Part 15C, Section 15.255 (d):

- (1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.
- (2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.
- (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm² at a distance of 3 meters.
- (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

5.5.4 Description of Measurement

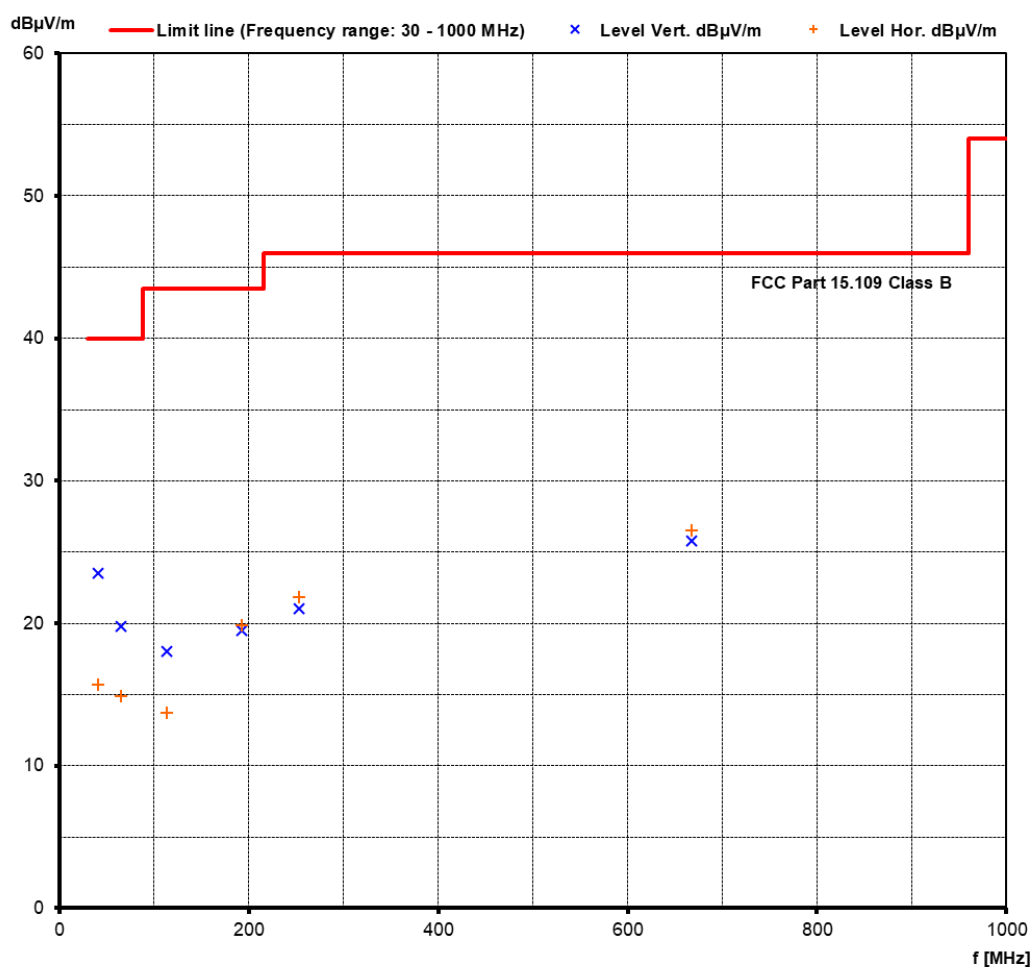
The radiated emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 9. In the frequency range above 1 GHz a 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 under normal conditions.

Instrument settings:

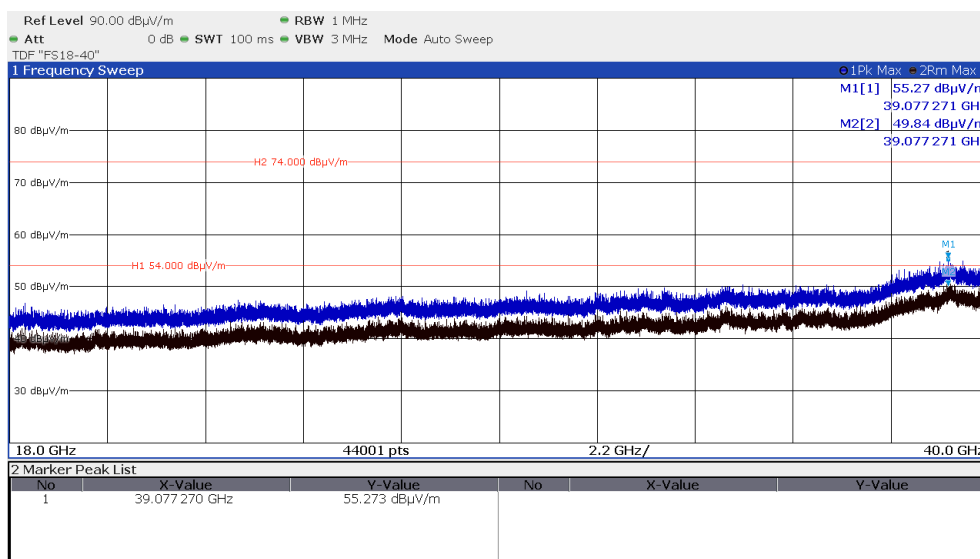
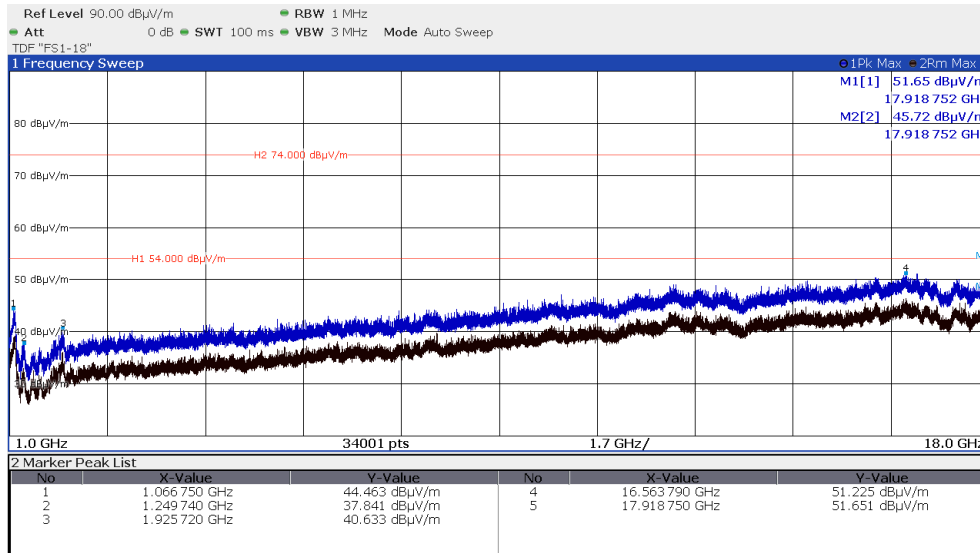
9 kHz – 150 kHz:	RBW: 200 Hz,	Detector: Quasi peak, Mes. Time: 1 s,
150 kHz – 30 MHz:	RBW: 9 kHz,	Detector: Quasi peak, Mes. Time: 1 s,
30 MHz – 1 GHz:	RBW: 120 MHz,	Detector: Quasi peak, Mes. Time: 1 s,
1 GHz – 26 GHz:	RBW: 1 MHz, VBW: 3 MHz,	Detector: Max. peak, Trace: Max. hold, Sweep: Auto

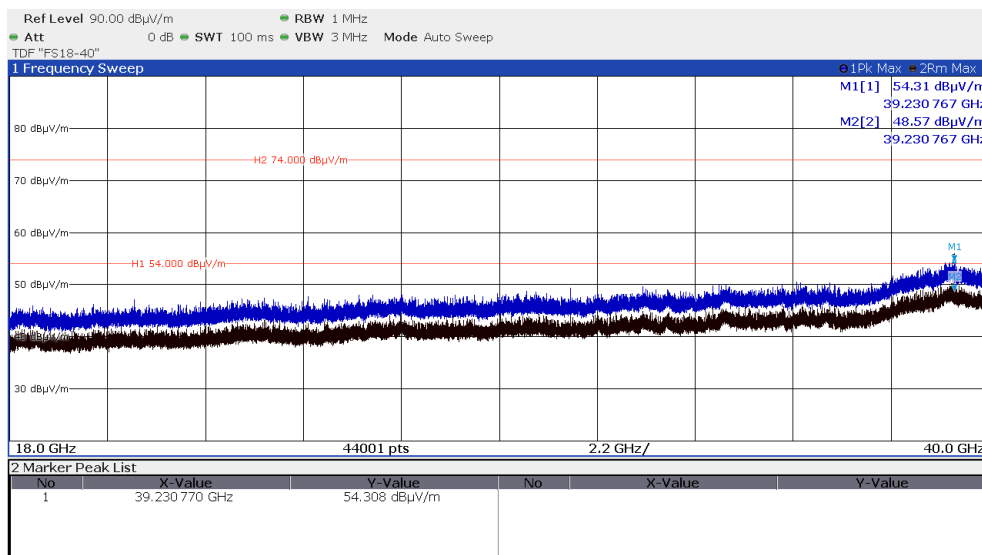
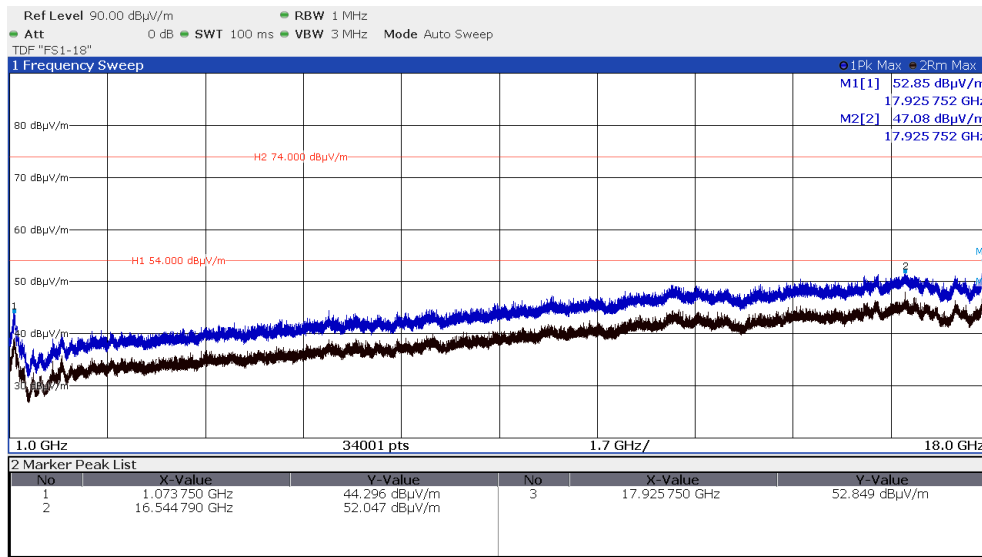
5.5.5 Test result $f < 1$ GHz

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)
41.30	6.3	-2.5	17.2	18.2	23.5	15.7	40.0	-16.5
64.80	3.4	-2.3	16.4	17.2	19.8	14.9	40.0	-20.2
113.80	1.3	-2.2	16.7	15.9	18.0	13.7	43.5	-25.5
192.00	2.0	3.0	17.5	16.8	19.5	19.8	43.5	-23.7
253.50	2.2	3.0	18.8	18.8	21.0	21.8	46.0	-24.2
668.00	-3.4	-3.2	29.2	29.7	25.8	26.5	46.0	-19.5

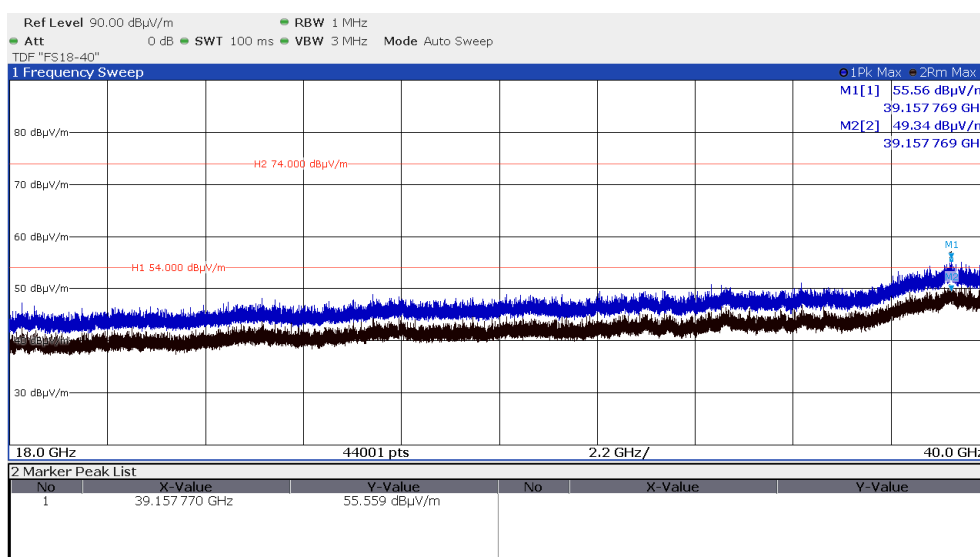
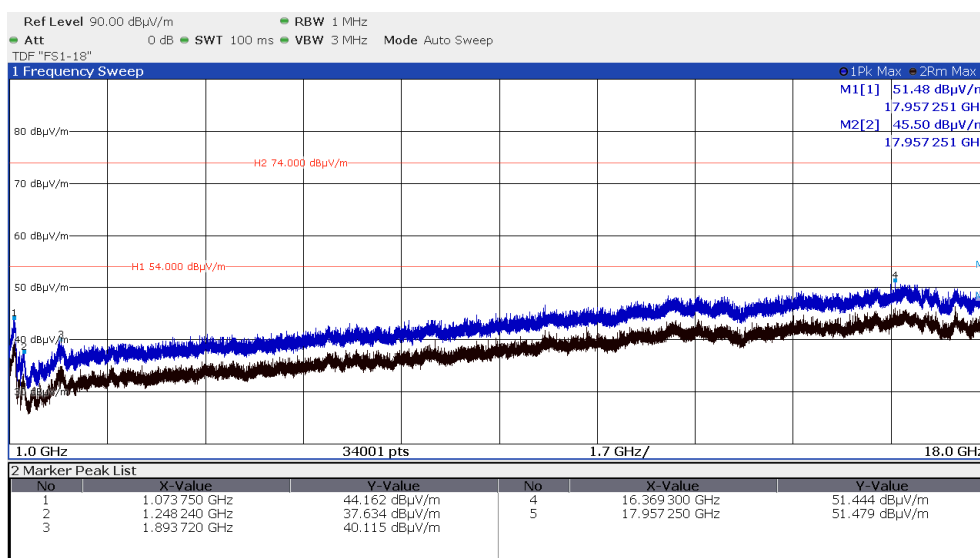


Note: For frequencies < 1 GHz the general radiated limits has been applied. During the measurements no emissions from the EUT could be detected in the frequency range 9 kHz to 1 GHz, given values only represent the noise floor.

5.5.6 Test result 1 GHz < f < 40 GHz
CH1, 61.1 GHz:


CH2, 61.2 GHz:


CH4, 61.4 GHz:



Note: For frequencies < 40 GHz the general radiated limits has been applied.

5.5.7 Test result f > 40 GHz

Determination of the EIRP emission limit for f > 40 GHz:

For calculation of the limit the friis formula is used.

$$P_d = \frac{P_{out} * G}{4 * \pi * r^2}$$

$P_{out} * G = \text{EIRP}$;
Therefore

$$\text{EIRP} = P_d * 4 * \pi * r^2$$

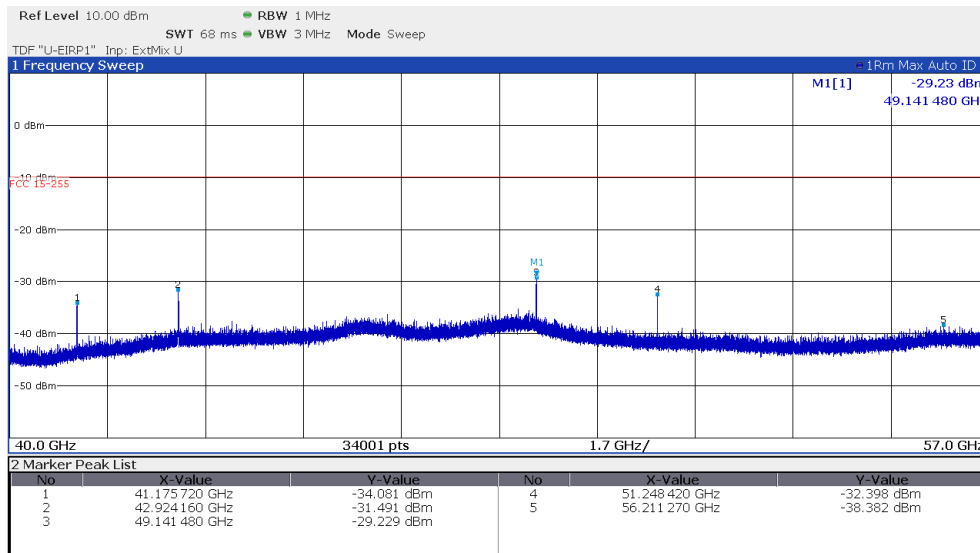
$$\text{EIRP} = -9.9 \text{ dBm}$$

where

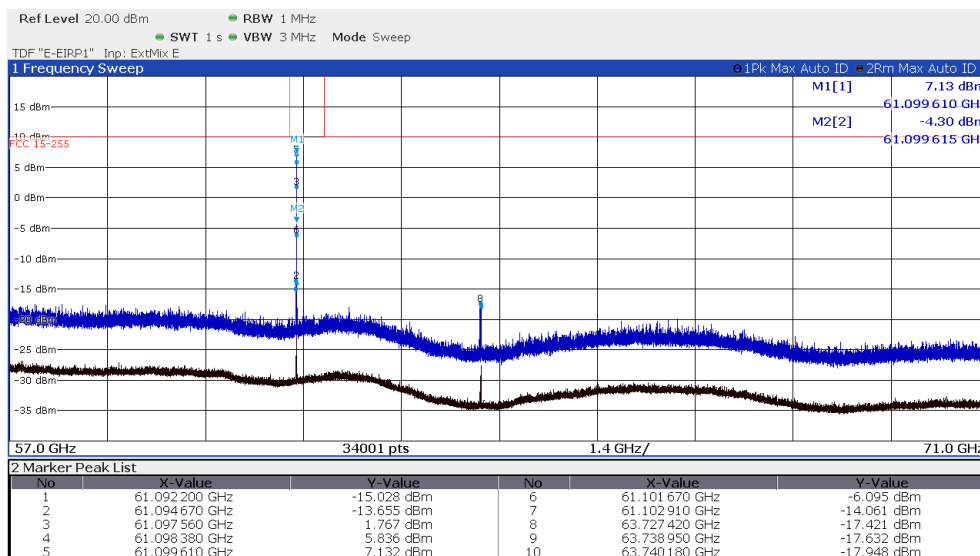
r is the measurement distance (3 m)

P_d is the emission density (90 pW/cm²)

CH1, 61.1 GHz:

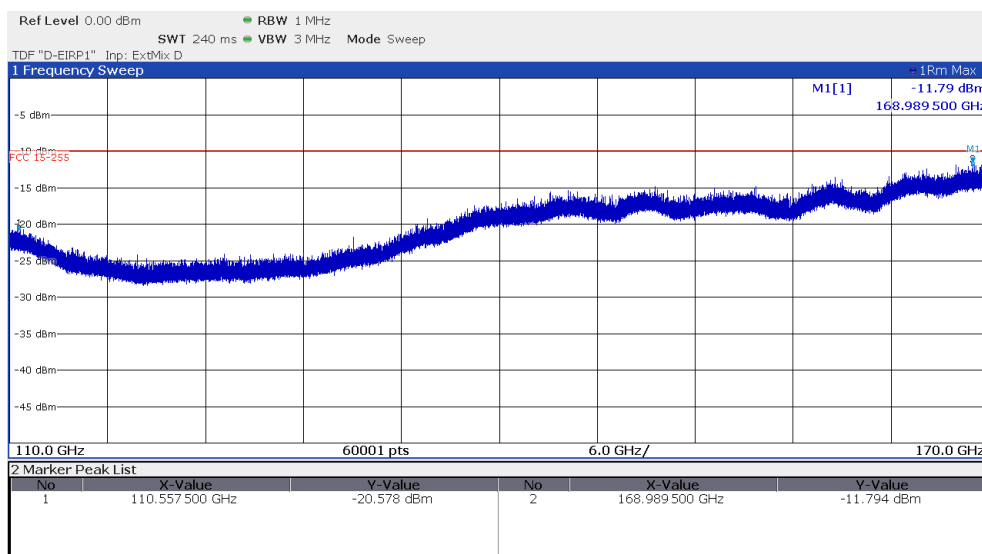
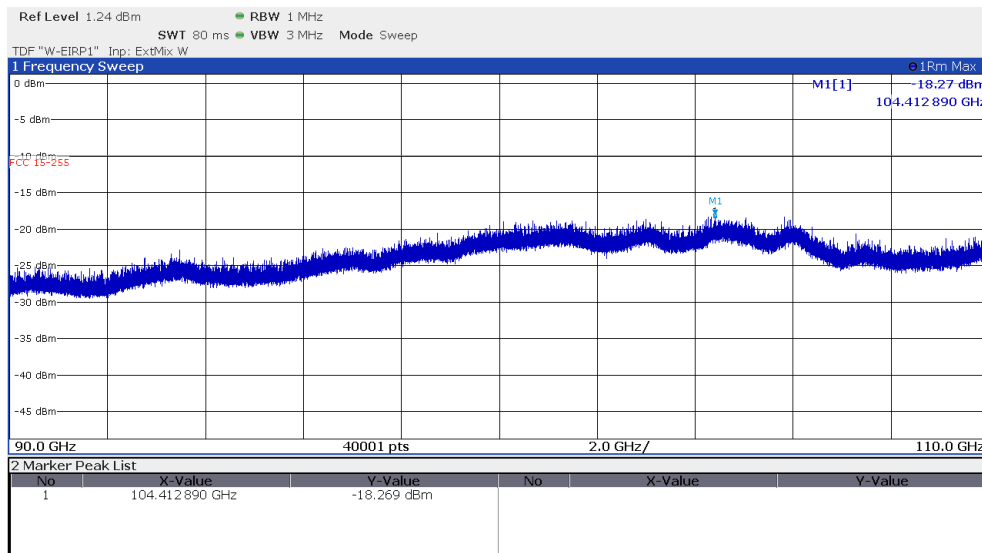
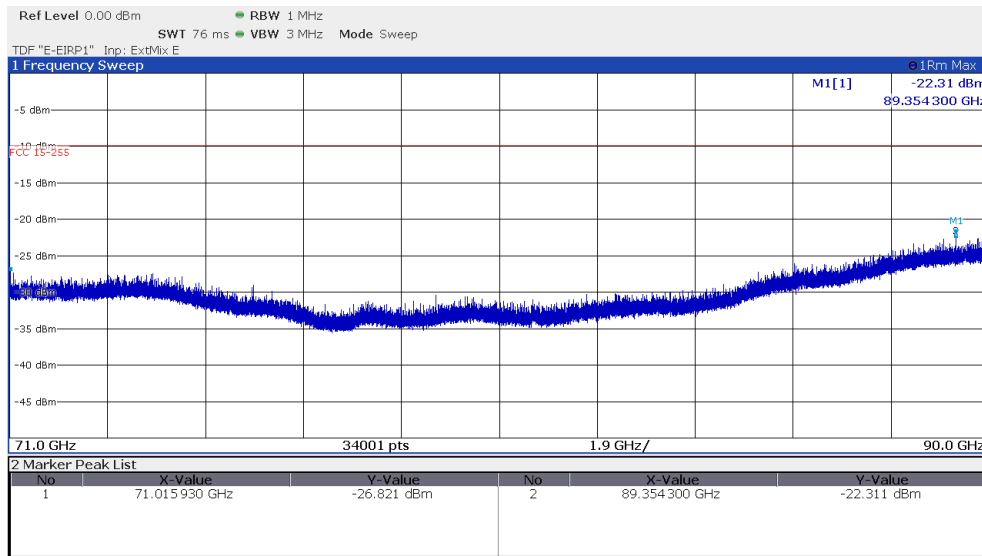


Note: To minimize unintended mixing products generated by the external mixer the AutoID function was used.

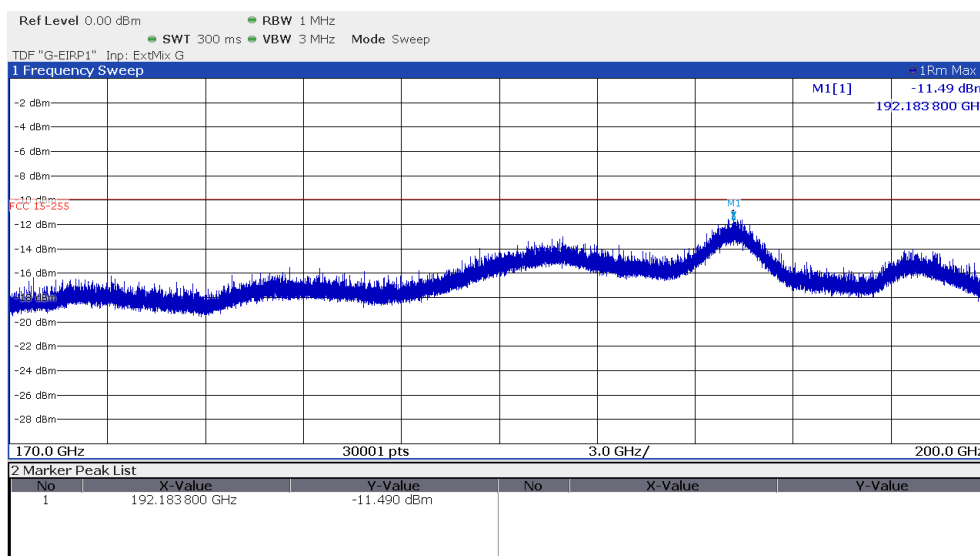


Note: To minimize unintended mixing products generated by the external mixer the AutoID function was used.

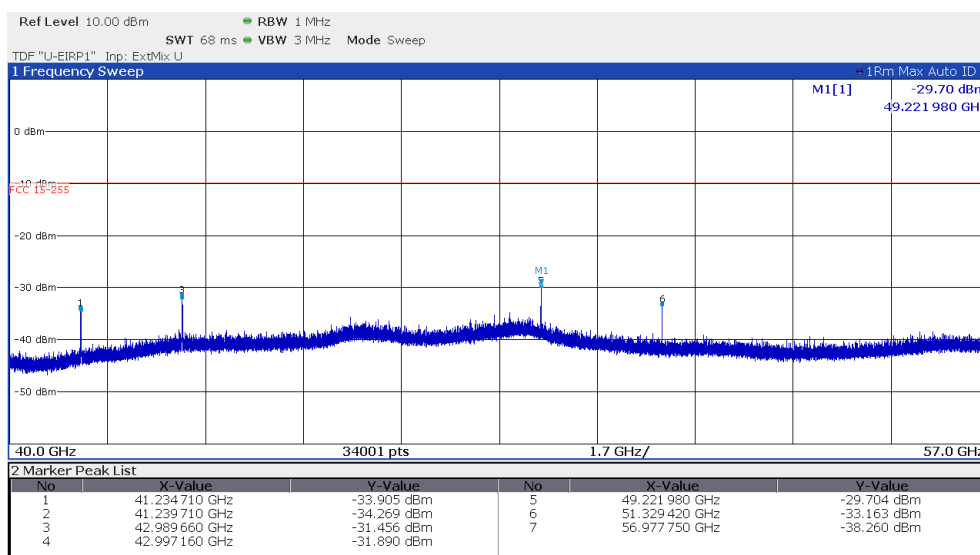
FCC ID: 2AYSQ60LTR11A1



FCC ID: 2AYSQ60LTR11A1

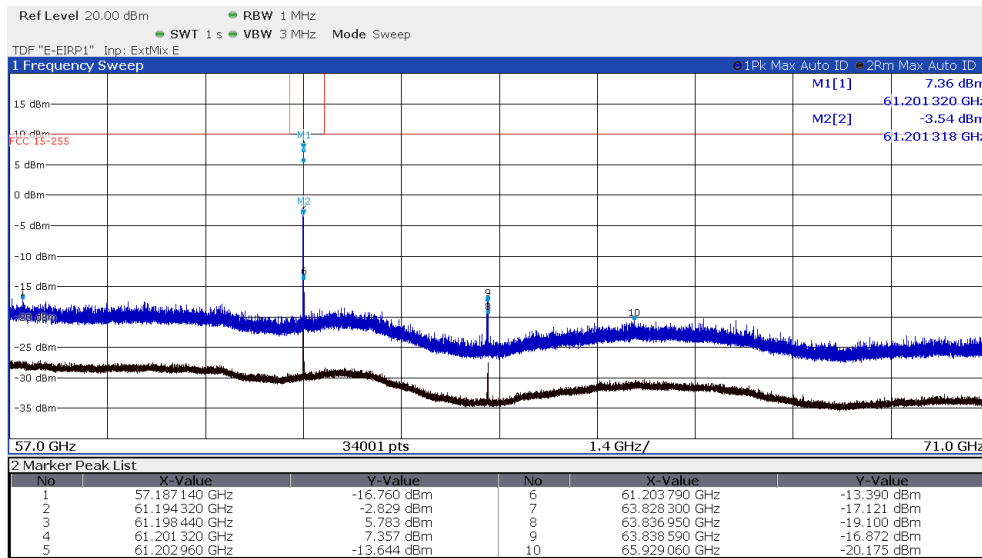


CH2, 61.2 GHz:

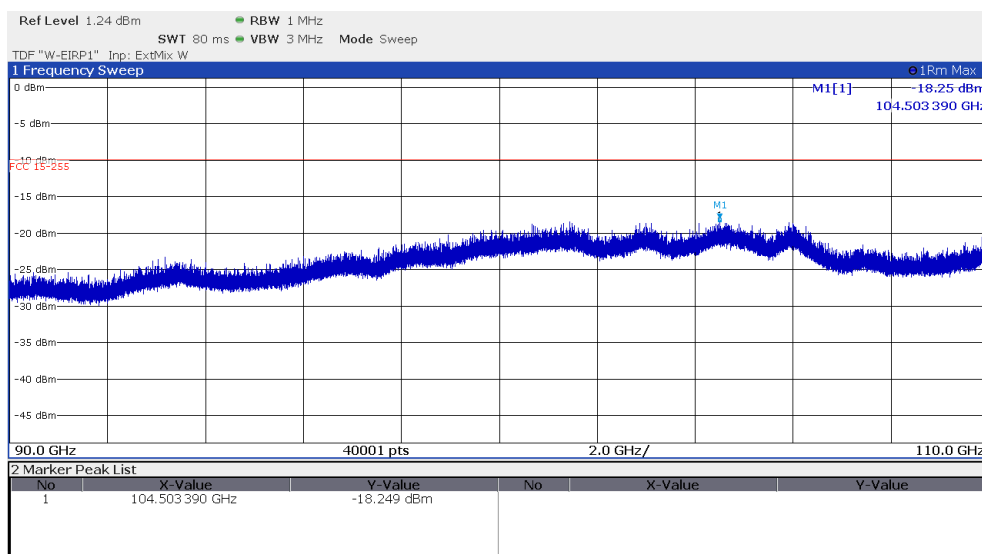
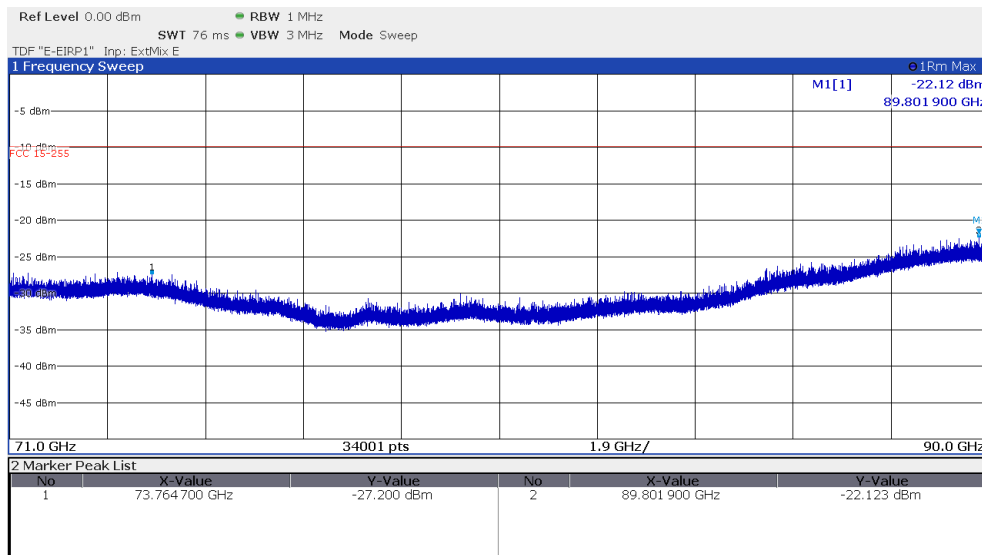


Note: To minimize unintended mixing products generated by the external mixer the AutoID function was used.

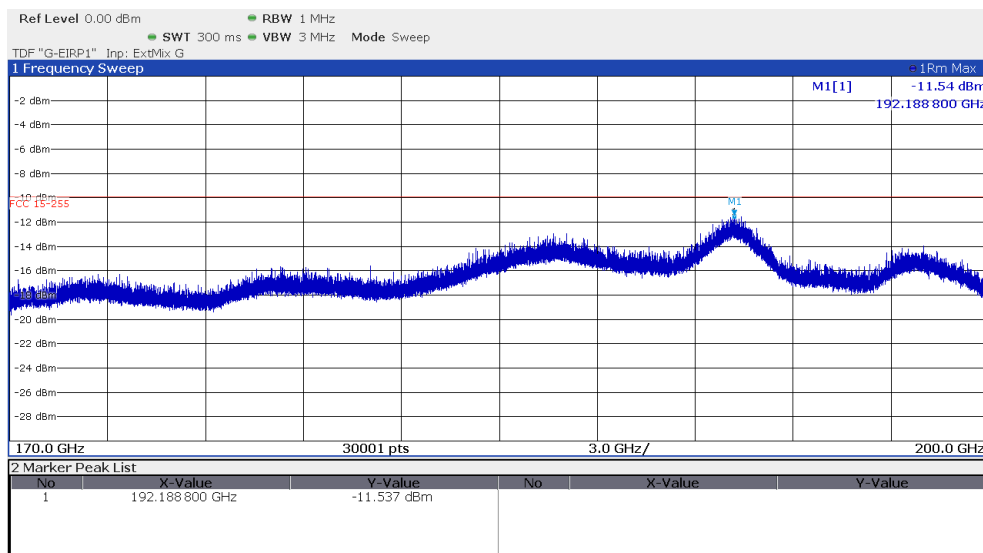
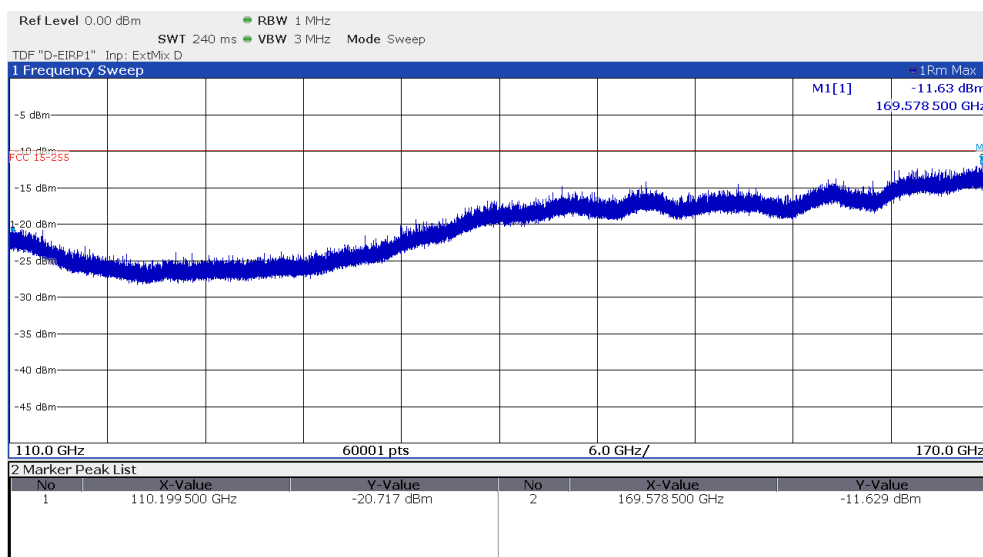
FCC ID: 2AYSQ60LTR11A1



Note: To minimize unintended mixing products generated by the external mixer the AutoID function was used.

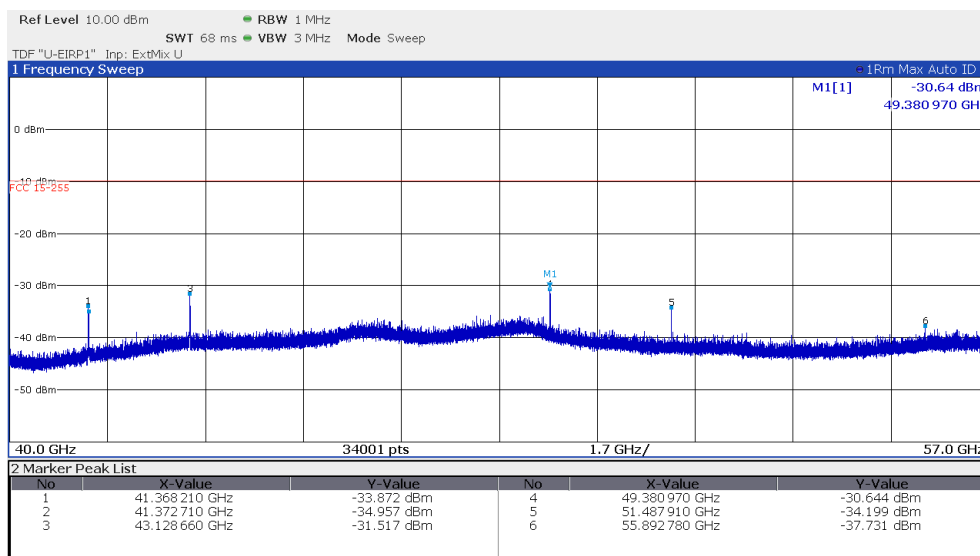


FCC ID: 2AYSQ60LTR11A1

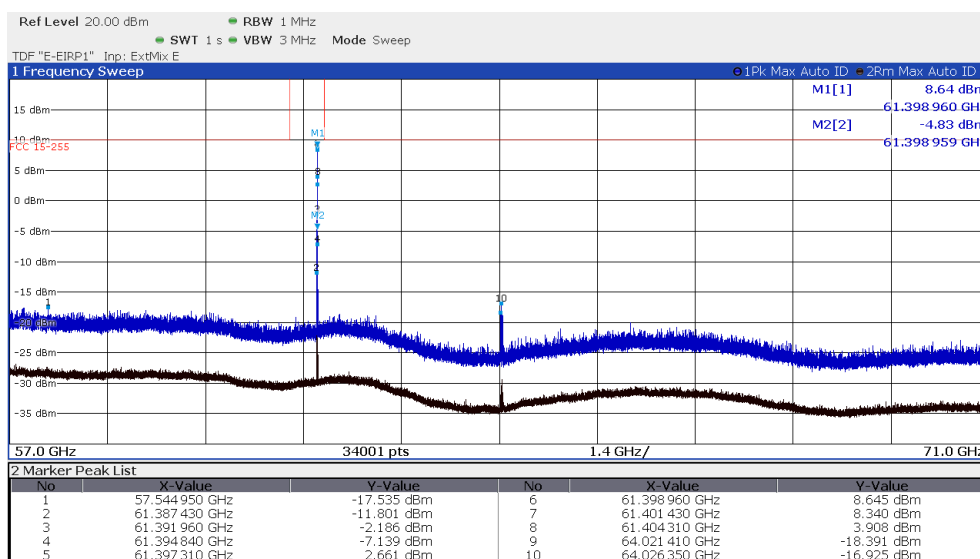


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

CH4, 61.4 GHz:

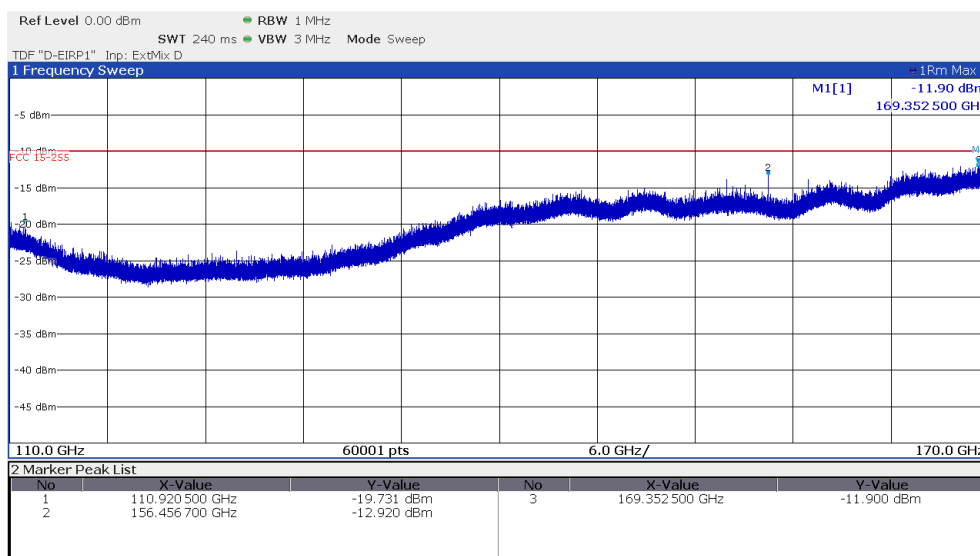
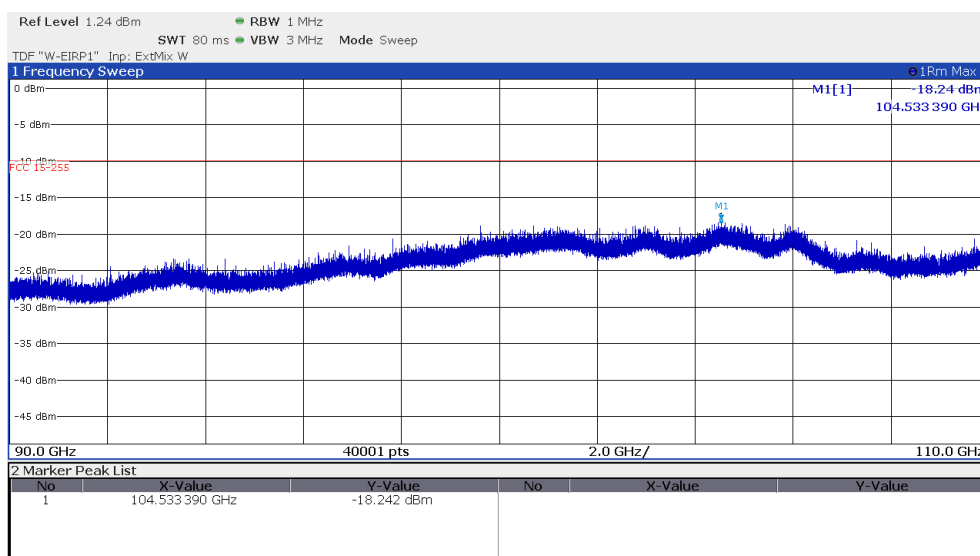
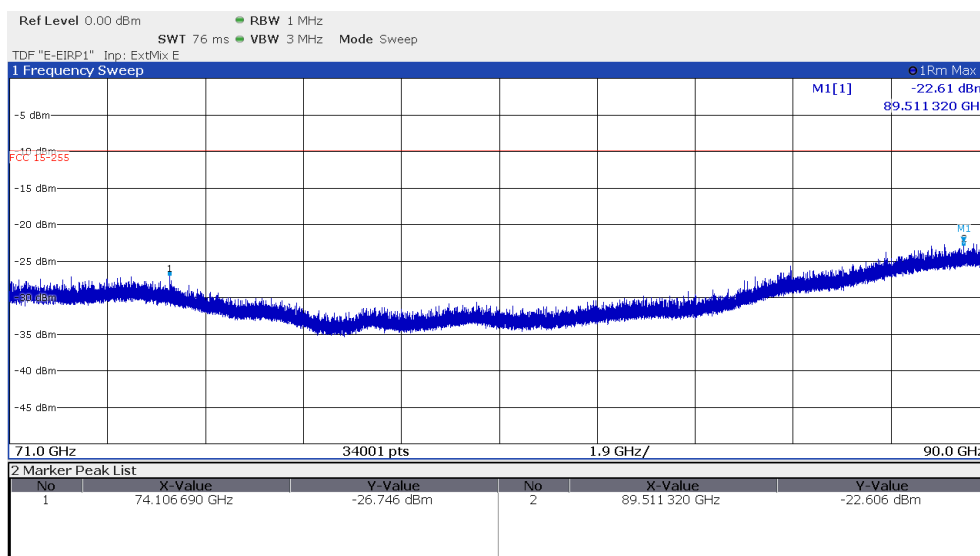


Note: To minimize unintended mixing products generated by the external mixer the AutoID function was used.

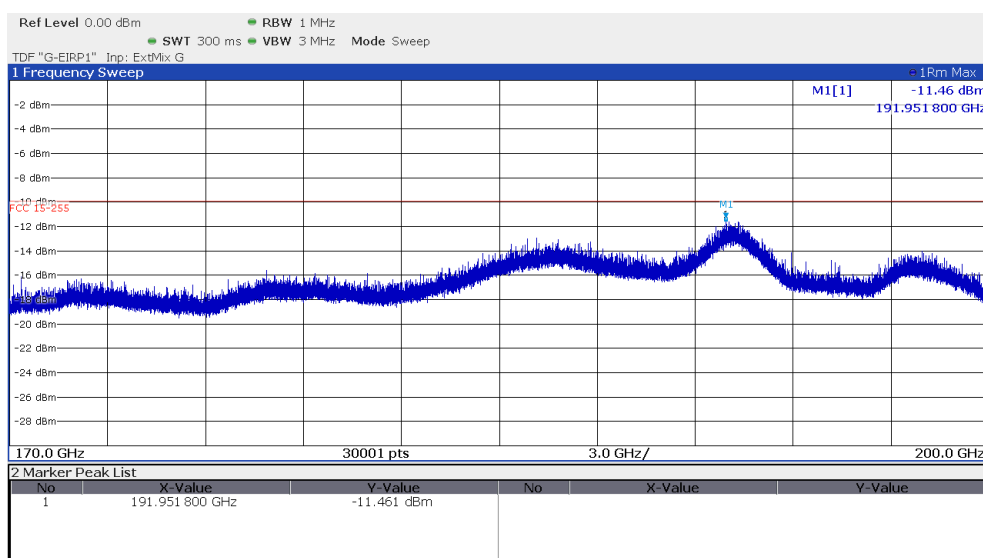


Note: To minimize unintended mixing products generated by the external mixer the AutoID function was used.

FCC ID: 2AYSQ60LTR11A1



FCC ID: 2AYSQ60LTR11A1



Average limit according to FCC Part 15C, Section 15.255(d):

- (1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.
- (2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.
- (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm² at a distance of 3 meters.
- (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

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 requirements are **FULFILLED**.

Remarks: The measurement was performed up to 200 GHz.

For frequencies < 40 GHz the general radiated limits has been applied.

For frequencies > 40 GHz the measurement distance was changed from 3m to 1m, therefore the transducer factor was adjusted by an offset of -9.5dB.

5.6 Frequency stability

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

5.6.1 Description of the test location

Test location: AREA4

5.6.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.6.3 Applicable standard

According to FCC Part 15C, Section 15.255(f):

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

5.6.4 Description of Measurement

The frequency stability is measured with the spectrum analyser. The sweep points are set to maximum for higher the frequency resolution or the function "frequency counter" is used. The signal is unmodulated; the marker of the analyser is set to maximum amplitude at normal temperature, the frequency is recorded. Then the maximum supply voltage is set and the marker of the analyser is set to maximum amplitude. This procedure is done again for the minimum supply voltage. The EUT is now driven at normal supply voltage but in the climatic chamber to range the temperature from -20 °C to +50 °C in steps of 10 degrees. The drifting carrier is measured by setting the marker at the analyser.

5.6.5 Result

Test conditions		Test result	
		Frequency (GHz)	
		CH1	CH4
$T_{min} (-20)^{\circ}C$	V_{nom}	61.09815300	61.39815017
$T (-10)^{\circ}C$	V_{nom}	61.09808657	61.39807041
$T (0)^{\circ}C$	V_{nom}	61.09797701	61.39796656
$T (10)^{\circ}C$	V_{nom}	61.09782588	61.39781935
$T_{nom} (20)^{\circ}C$	$V_{min} (4.25 V)$	61.09746517	61.39766203
$T_{nom} (20)^{\circ}C$	$V_{nom} (5.0V)$	61.09744364	61.39766727
$T_{nom} (20)^{\circ}C$	$V_{max} (5.75 V)$	61.09742175	61.39764891
$T (30)^{\circ}C$	V_{nom}	61.09750670	61.39748782
$T (40)^{\circ}C$	V_{nom}	61.09739795	61.39736004
$T_{max} (50)^{\circ}C$	V_{nom}	61.09730479	61.39728690

61.0 -61.5 GHz Range:

Highest frequency f_h	61.3981502 GHz
Lowest frequency f_l	61.0973048 GHz

Limit according to FCC Part 15C, Section 15.255(f):

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to $+50$ degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

The requirements are **FULFILLED**.

Remarks: None

5.7 Correction for pulse operation (duty cycle)

For test instruments and accessories used see section 6 Part **CPR3**.

5.7.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 1 m

5.7.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.7.3 Applicable standard

According to FCC Part 15A, Section 15.35(c):

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

5.7.4 Description of Measurement

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

$$K_E = 20 \log (T_{on} / T_{conn})$$

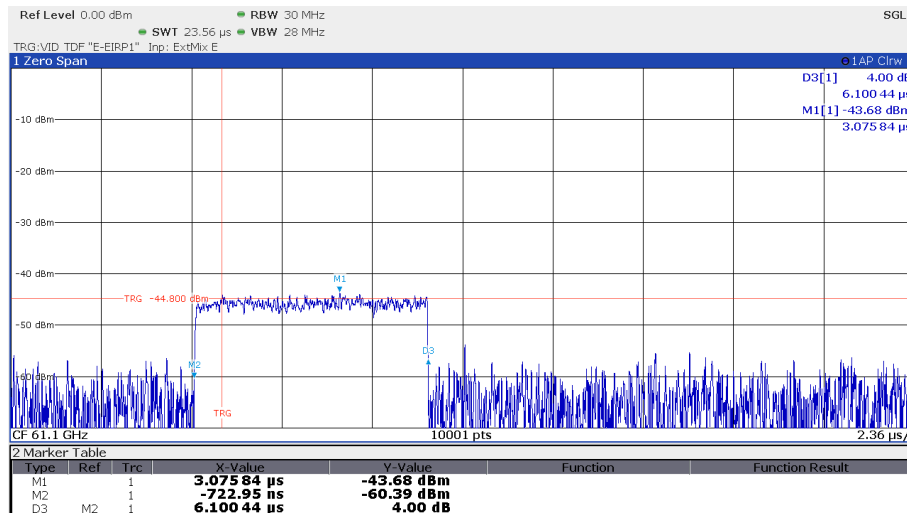
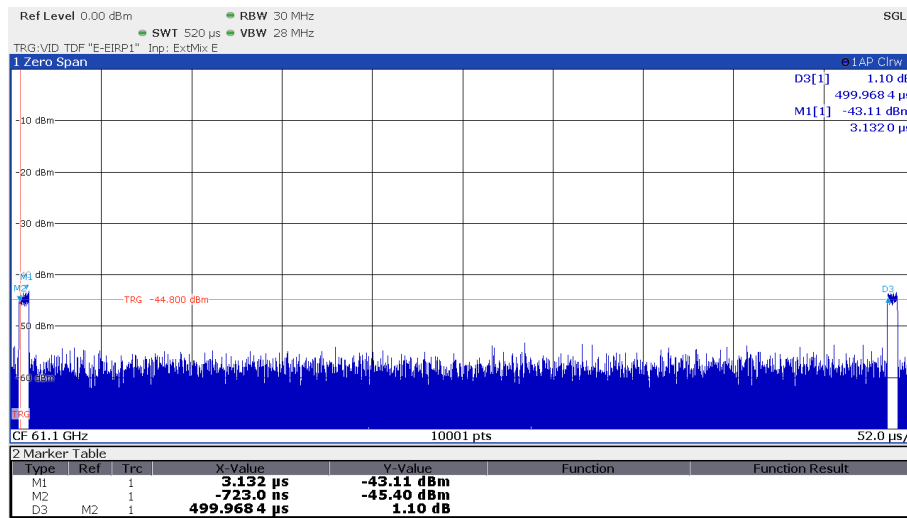
K_E : pulse operation correction factor
 T_{on} on air duration
 T_{conn} connection interval duration

5.7.5 Test result

$$K_E = 20 \log (6.1 / 500) = -38.3 \text{ dB}$$

Remarks: For detailed test results please see the following test protocol.

5.7.6 Test protocol



5.8 Antenna requirement

According to FCC Part 15C, Section 15.203:

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. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

The EUT has an integrated antenna. No other antenna can be used with the device.

The supplied antenna meets the requirements of part 15.203.

Remarks: None.

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 3.21.0.18	01-02/68-13-001				
	ESCI	02-02/03-15-001	21/06/2022	21/06/2021		
	ESH 2 - Z 5	02-02/20-05-004	31/10/2022	31/10/2019	19/04/2022	19/10/2021
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	6430	02-02/50-13-014				
CPR 3	FS-Z90	02-02/11-14-003	15/04/2022	15/04/2021	15/04/2022	15/04/2021
	FSW43	02-02/11-15-001	06/04/2022	06/04/2021		
	QWH-EPRR00/WR-12/60-90	02-02/24-14-004				
	UFA210A (LU7-022-1000)	02-02/50-17-030				
	UFA210A (LU7-022-1000)	02-02/50-17-031				
MB	FS-Z90	02-02/11-14-003	15/04/2022	15/04/2021	15/04/2022	15/04/2021
	FSW43	02-02/11-15-001	06/04/2022	06/04/2021		
	QWH-EPRR00/WR-12/60-90	02-02/24-14-004				
	METRAHIT WORLD	02-02/32-15-001	01/12/2021	01/12/2020		
	WK-340/40	02-02/45-05-001	05/08/2022	05/08/2021		
	6543A	02-02/50-05-157				
	UFA210A (LU7-022-1000)	02-02/50-17-030				
	UFA210A (LU7-022-1000)	02-02/50-17-031				
SER 1	ESR 7	02-02/03-17-001	29/07/2022	29/07/2021		
	HFH 2 - Z 2	02-02/24-15-001	30/03/2022	30/03/2021		
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
SER 2	ESVS 30	02-02/03-05-006	09/07/2022	09/07/2021		
	VULB 9168	02-02/24-05-005	18/12/2021	18/12/2020	07/07/2022	07/07/2021
	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				
	50F-003 N 3 dB	02-02/50-21-010				
SER 3	FS-Z110	02-02/11-14-002	08/04/2022	08/04/2021	08/04/2022	08/04/2021
	FS-Z90	02-02/11-14-003	15/04/2022	15/04/2021	15/04/2022	15/04/2021
	FSW43	02-02/11-15-001	06/04/2022	06/04/2021		
	RPG FS-Z170	02-02/11-17-001	19/04/2022	19/04/2021		
	RPG FS-Z220	02-02/11-17-002	07/04/2022	07/04/2021		
	FS-Z60	02-02/11-18-001	12/04/2022	12/04/2021	12/04/2022	12/04/2021
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	LNA-40-18004000-33-5P	02-02/17-20-002				
	3117	02-02/24-05-009	28/06/2022	28/06/2021		
	BBHA 9170	02-02/24-05-013	19/05/2023	19/05/2020	04/02/2022	04/02/2021
	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				
	FH-SG-170/WR6/110-170	02-02/24-17-002				
	05-HA25/WR5/140-220	02-02/24-17-004				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	UFA210A (LU7-022-1000)	02-02/50-17-030				

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UFA210A (LU7-022-1000)	02-02/50-17-031
KK-SF106-2X11N-6,5M	02-02/50-18-016
KMS116-GL140SE-KMS116-	02-02/50-20-026
BAT-EMC 3.21.0.18	02-02/68-13-001

- End of test report -

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.