R F – T E S T R E P O R T

- FCC Part 15.249, RSS-210 -

Type / Model Name	:	FineTuner Echo (product name)
		Ma010201 (product code)
Product Description	:	Remote Control for compatible MED-EL audio processors
Applicant	:	MED-EL Elektromedizinische Geraete GmbH
Address	:	Fuerstenweg 77a
		6020 INNSBRUCK, AUSTRIA
Manufacturer	:	MED-EL Elektromedizinische Geraete GmbH
Address	:	Fuerstenweg 77a
		6020 INNSBRUCK, AUSTRIA

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

Test Report No. : 80202871-02 Rev_1	02. July 2024 Date of issue

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

CSA Group Bayern GmbH
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Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (April 2024)

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 (April 2024)

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	Testing Unlicensed Wireless Devices

ISED Canada Rules and Regulations

RSS-Gen, Issue 5 + Amendment 1 + 2	General Requirements for Compliance of Radio Apparatus
RSS-210, Issue 10 + Amendment 1	Licence-Exempt Radio Apparatus: Category I Equipment
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices

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 General remarks

The EUT contains a 2.4 GHz proprietary transceiver and a BLE transceiver with one antenna being used by both transceivers.

This test report only covers the BLE part of the EUT. For the proprietary 2.4 GHz transceiver please refer to test report T44781-00-00KS issued by CSA Group Bayern GmbH.

2.4 Photo documentation of the EUT – Detailed photos see attachment A

2.5 Equipment category

BLE device.

2.6 Short description of the equipment under test (EUT)

The FineTuner Echo is a further development of the existing FineTuner and is intended to be used as a remote control for patients with a compatible MED-EL audio processor. The device allows the user to vary certain audio processor parameters within the limits set be the audiologist during fitting. It communicates over a proprietary low power 2.4 GHz link or Bluetooth Low Energy.

Number of tested samples	:	1 (radiated sample)	1 (conducted sample)	1 (normal sample)
Serial number	:	140860	084537	141049
Firmware number	:	PF24-0124 (Rev 2.0)	PF24-0124 (Rev 2.0)	SP140895 (Rev 0.1)

2.7 Variants of the EUT

There are no variants.

2.8 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
37	2402	18	2442
0	2404	19	2444
1	2406	20	2446
2	2408	21	2448
3	2410	22	2450
4	2412	23	2452
5	2414	24	2454
6	2416	25	2456
7	2418	26	2458
8	2420	27	2460
9	2422	28	2462
10	2424	29	2464
38	2426	30	2466
11	2428	31	2468
12	2430	32	2470
13	2432	33	2472
14	2434	34	2474
15	2436	35	2476
16	2438	36	2478
17	2440	39	2480

Note: the marked frequencies are determined for final testing.

2.9 Transmit operating modes

The EUT uses GFSK and provides following data rate:

- 1 Mbps (Mbps = *Megabits per second)*

2.10 Antenna

The following antennas shall be used with the EUT:

Number	Characteristic	Type	Plug	Frequency range (GHz)	Gain (dBi)
1	Omni	PCB	-	2.4 – 2.4835	4.3

2.11 Power supply system utilised

Power supply voltage, V_{nom} : 3.0 V/DC (battery – CR2032)

2.12 Peripheral devices and interface cables

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

- Serial interface and power supply cable Model : Supplied by manufacturer, modification only used for RF measurements

2.13 Determination of worst-case conditions for final measurement

Preliminary tests are performed in all three orthogonal axes of the EUT to locate at which position and at what setting of the EUT produce the maximum of the emissions.

For the final test the following channels and test modes are selected:

Radio	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
BLE	0 to 39	37, 17, 39	P_{def}	GFSK	digital	1 Mbps

2.13.1 Test jig

No test jig is used.

2.13.2 Test software

The EUT has a special firmware that allows enabling the Direct Test Mode.

3 TEST RESULT SUMMARY

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS-Gen, 8.8	AC power line conducted emissions	not applicable*
15.249(a)	RSS-210 B.10a	Field strength of fundamental	passed
15.249(a)	RSS-210 B.10a	Harmonics, radiated	passed
15.249(d) 15.209(a)	RSS-210 B.10b RSS-Gen 8.9	Spurious emissions, radiated	passed
15.205(a)	RSS-Gen, 8.10	Emissions in restricted bands	passed
15.215(c)	RSS-Gen, 6.7	Emission bandwidth, 99% bandwidth	passed
15.203	-	Antenna requirement	passed

*Note: not applicable, EUT is battery-powered

3.1 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80202871-02	0	26 April 2024	Initial test report
80202871-02	1	02 July 2024	4.5.3.2.4 correction table height

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 : 20 March 2024

Testing concluded on : 23 April 2024

Checked by:

Klaus Gegenfurtner 2024.07.02 16:51:43 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Sabine Kugler 2024.07.02 13:43:34 +02'00'

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 on basis of the ETSI Technical Report TR 100 028 Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1 and Part 2. The results are documented in the quality system acc. to DIN EN ISO/IEC 17025. 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
EBW and OBW	2400 MHz to 30000 MHz	95%	± 2.5 x 10^{-7}
Output power ERP, radiated	1000 MHz to 7000 MHz	95%	± 2.71 dB
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	± 2.71 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 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 30000 MHz	95%	± 2.34 dB
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	± 5.13 dB

4.4 Conformity Decision Rule

The applied conformity decision rule is based on ILAC G8:09/2019 clause 4.2.1 Binary Statement for Simple Acceptance Rule (w = 0).
Details can be found in the procedure CSA_B_V50_29.

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".

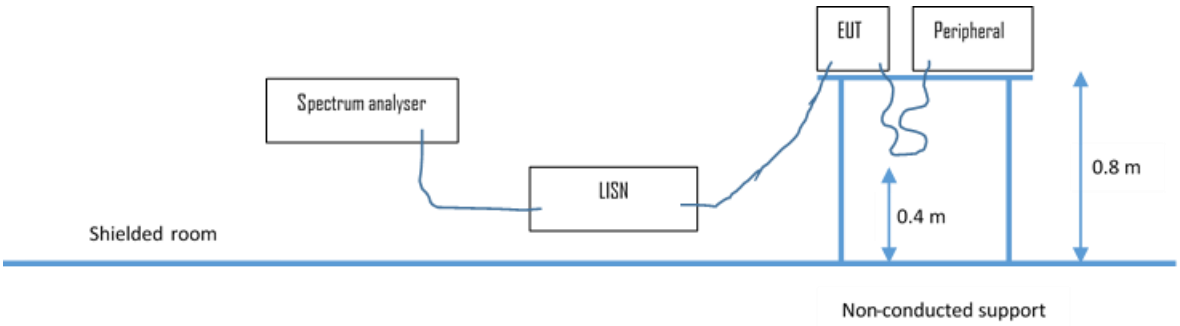
4.5.2.1 Justification

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 dBµV, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

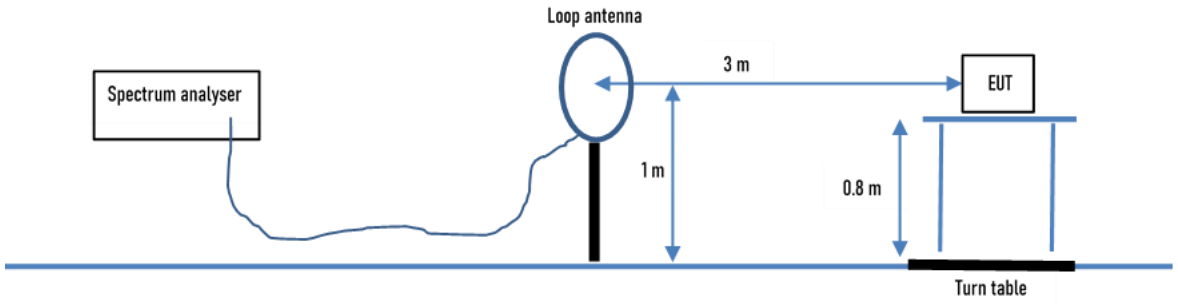
To convert between dBµV and µV, the following conversions apply:

dBµV = 20(log µV)
µV = Inverse log(dBµV/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 µH (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.

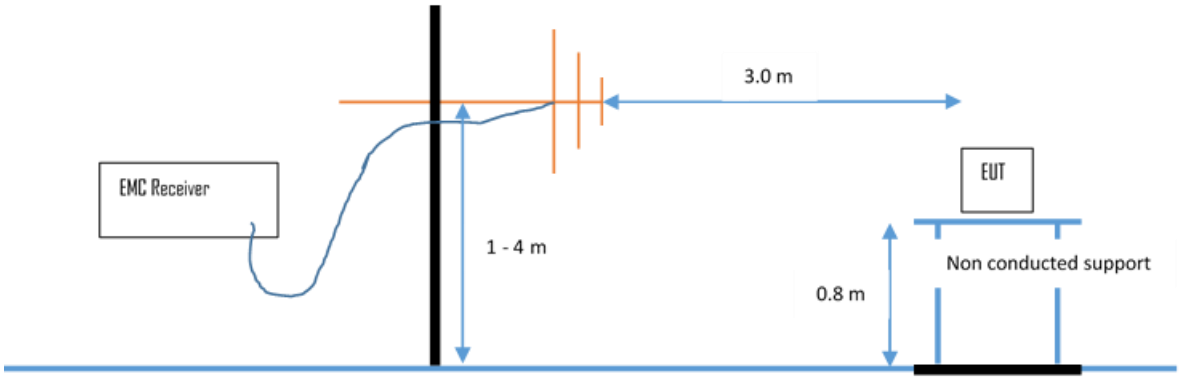
4.5.3.2 Radiated emission

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 centre 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 centre 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 dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) 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.

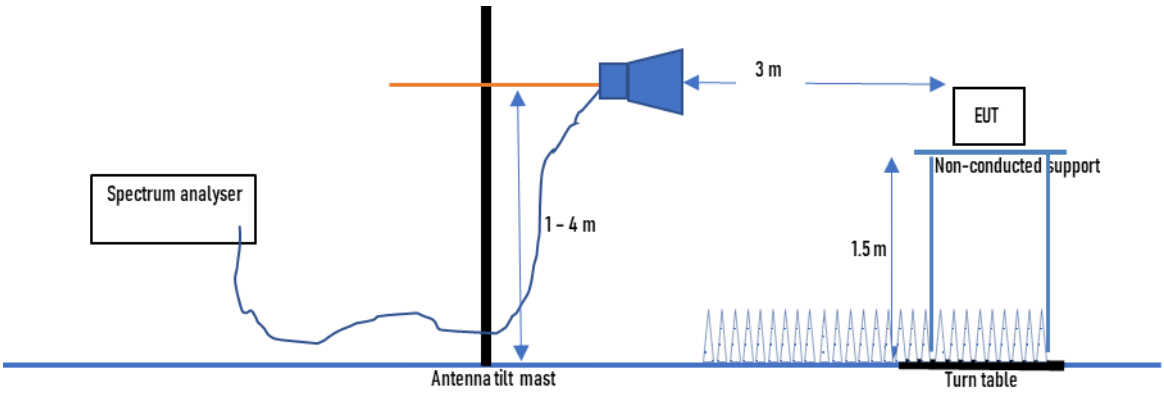
The resolution bandwidth setting:
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

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

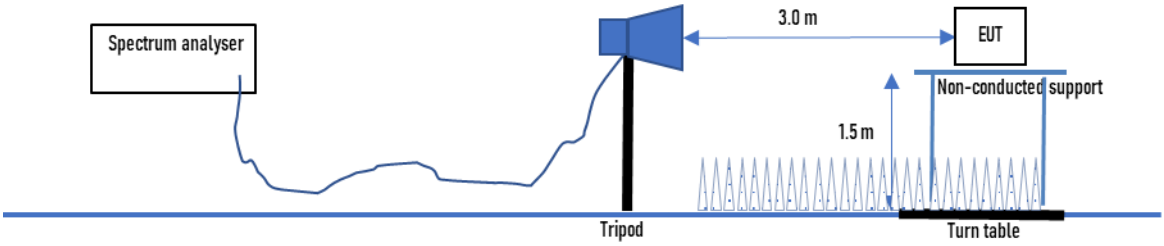
4.5.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

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 centre, 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, 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 centre, 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 is adopted.

5 TEST CONDITIONS AND RESULTS

5.1 Field strength of fundamental

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

5.1.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

5.1.2 Photo documentation of the test set-up – Please see attachment B

5.1.3 Applicable standard

According to FCC Part 15C, Section 15.249(a):
Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following.

According to RSS-210 B.10(a):
The field strength of fundamental and harmonic emissions measured at 3 m shall not exceed the limits in table B2.

5.1.4 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 with ANSI C63.10, Item 9. The EUT is measured in TX continuous mode under normal conditions.

Analyser settings:
Peak measurement: RBW: 3 MHz VBW: 10 MHz Detector: Max peak

5.1.5 Test result

Channel	Carrier frequency	Level PK	Limit PK	Margin PK	DC corr. factor	Level AV	Limit AV	Margin AV
(#)	(GHz)	(dBµV/m)	(dBµV/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
37	2.402	98.9	114.0	-15.1	-44.4	54.5	94.0	-39.5
17	2.440	98.8	114.0	-15.2	-44.4	54.4	94.0	-39.6
39	2.480	98.3	114.0	-15.7	-44.4	53.9	94.0	-40.1

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

Frequency	Field strength of fundamental	
(MHz)	(mV/m)	dB(µV/m)
902 - 928	50	94
2400 - 2483.5	**50**	**94**
5725-5875	50	94
24000 - 24250	250	108

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.

Average-Limit according to RSS-210 B.10(a), Table B2:

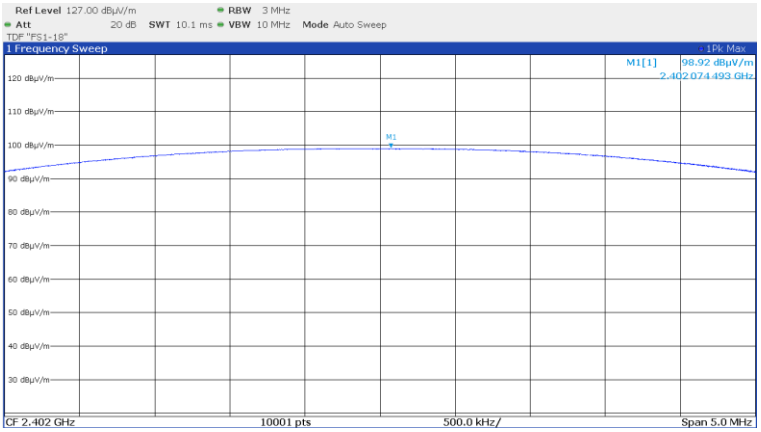
Frequency	Field strength of fundamental	
(MHz)	(mV/m)	dB(µV/m)
902 - 928	50	94
2400 - 2483.5	**50**	**94**
5725-5875	50	94
24000 - 24250	250	108

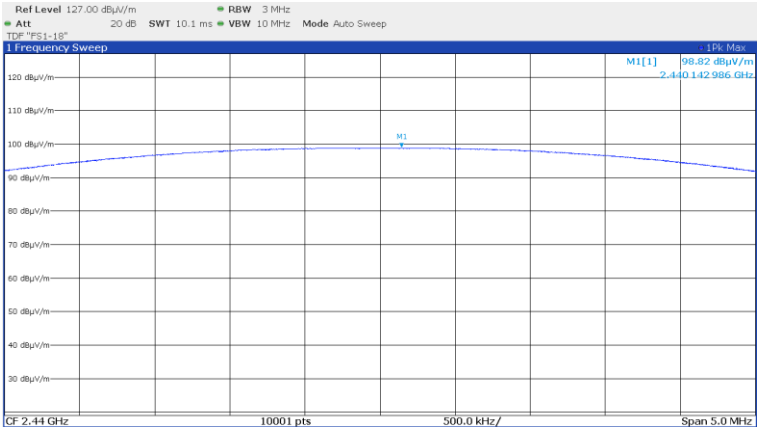
Peak-Limit according to RSS-Gen 8.1:
If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for factors such as pulse desensitization to ensure that the peak emission is less than 20 dB above the average limit.

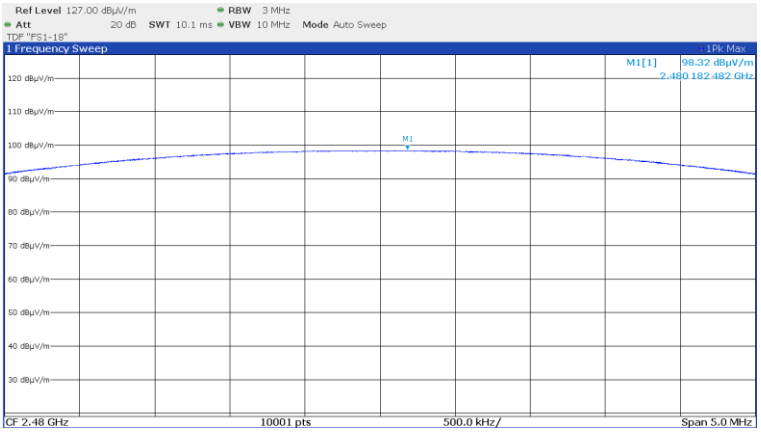
The requirements are **FULFILLED.**

Remarks: For determination of duty cycle correction factor please refer to section 5.4

5.1.6 Test protocols







5.2 Unwanted emissions, radiated

For test instruments and accessories used see section 6 Part **SER1, 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 set-up – Please see attachment B

5.2.3 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.

According to RSS-210 B10 (a):
The field strength of fundamental and harmonic emissions measured at 3 m shall not exceed the limits in table B2.

According to RSS-210 B10 (b):
Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

5.2.4 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 and Item 8.3. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. If the emission level in peak mode complies with the average limit testing is stopped and peak values will be reported, otherwise, the emission is measured in average mode again and reported. The EUT is measured in TX continuous mode unmodulated under normal conditions.

Instrument settings:

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

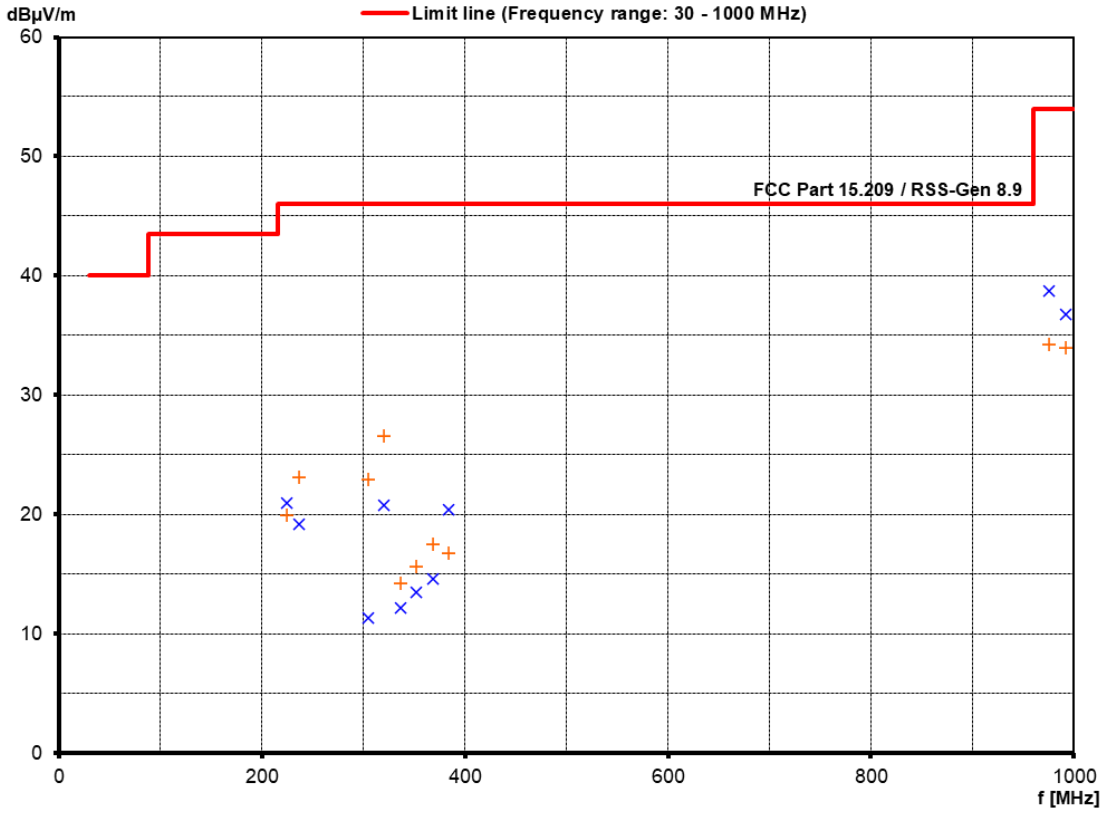
5.2.1 Test result f < 1 GHz

According to FCC 15.209					
Frequency (MHz)	Reading (dBµV)	Correction (dB)*	Field strength (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
0.051	9.2	18.9	-51.9	33.5	-85.4
0.130	10.0	18.0	-52.0	25.3	-77.3
3.000	17.5	17.9	-4.6	30.0	-34.6
16.700	12.5	18.6	-8.9	30.0	-38.9
22.300	10.5	16.4	-13.1	30.0	-43.1
29.000	8.8	19.4	-11.8	30.0	-41.8

* Correction = Antenna factor + Δ alternative test site + distance extrapolation factor

According to RSS-Gen 8.9				
Frequency (kHz)	Field strength (dBµV/m)	QP calc. (dBµA/m)	Limit (dBµA/m)	Dlimit (dB)
51	-51.9	-103.4	1.9	-105.3
130	-52.0	-103.5	-6.2	-97.3
3000	-4.6	-56.1	-21.9	-34.2
16700	-8.9	-60.4	-21.9	-38.4
22300	-13.1	-64.6	-21.9	-42.7
29000	-11.8	-63.3	-21.9	-41.4

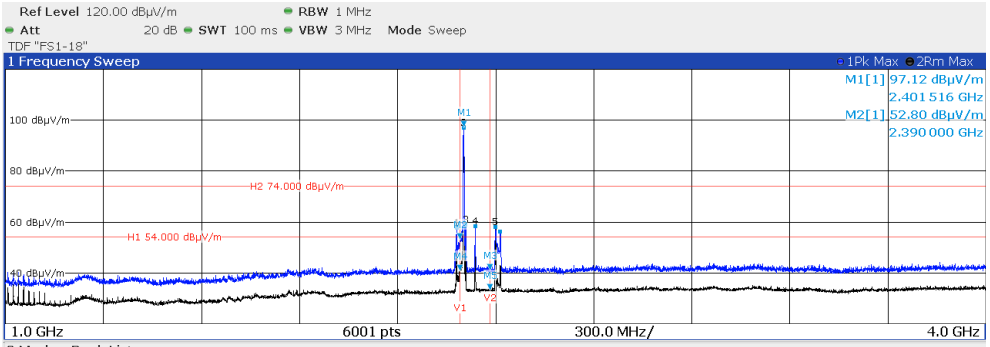
According to FCC 15.209 / RSS-Gen 8.9								
Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
224.15	3.1	2.4	17.9	17.6	21.0	20.0	46.0	-25.0
236.75	0.9	5.0	18.3	18.1	19.2	23.1	46.0	-22.9
304.13	-9.0	2.0	20.3	20.9	11.3	22.9	46.0	-23.1
320.13	-0.1	5.2	20.8	21.4	20.7	26.6	46.0	-19.4
336.12	-9.2	-7.6	21.3	21.8	12.1	14.2	46.0	-31.8
352.12	-8.3	-6.6	21.8	22.3	13.5	15.7	46.0	-30.3
368.12	-7.7	-5.2	22.3	22.7	14.6	17.5	46.0	-28.5
384.12	-2.4	-6.4	22.8	23.2	20.4	16.8	46.0	-25.6
976.00	5.0	0.1	33.7	34.2	38.7	34.3	54.0	-15.3
992.00	2.9	-0.4	33.9	34.3	36.8	33.9	54.0	-17.2



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

5.2.2 Test result f > 1 GHz

CH37:



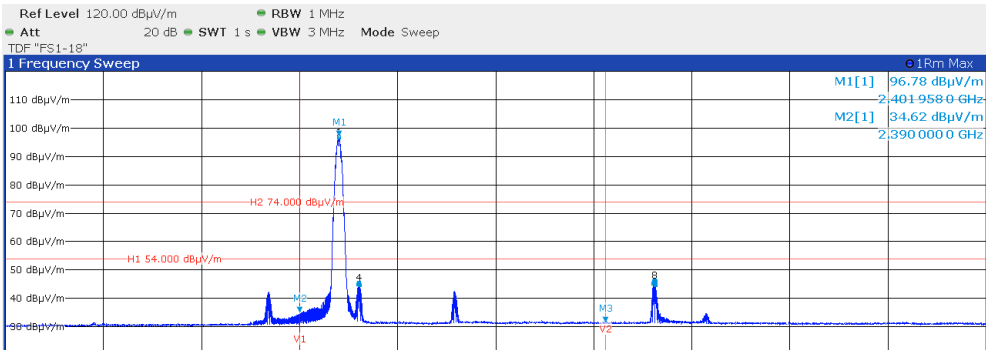
2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	2.380 020 GHz	57.676 dBµV/m	4	2.437 510 GHz	58.368 dBµV/m
2	2.401 520 GHz	97.118 dBµV/m	5	2.498 500 GHz	57.991 dBµV/m
3	2.408 020 GHz	58.950 dBµV/m	6	2.514 000 GHz	56.128 dBµV/m

3 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.401 516 GHz**	**97.12 dBµV/m**		
M2		1	**2.39 GHz**	**52.80 dBµV/m**		
M3		1	**2.483 5 GHz**	**40.71 dBµV/m**		
M4		2	**2.39 GHz**	**40.65 dBµV/m**		
M5		2	**2.483 5 GHz**	**33.11 dBµV/m**		

Note: PK measurement



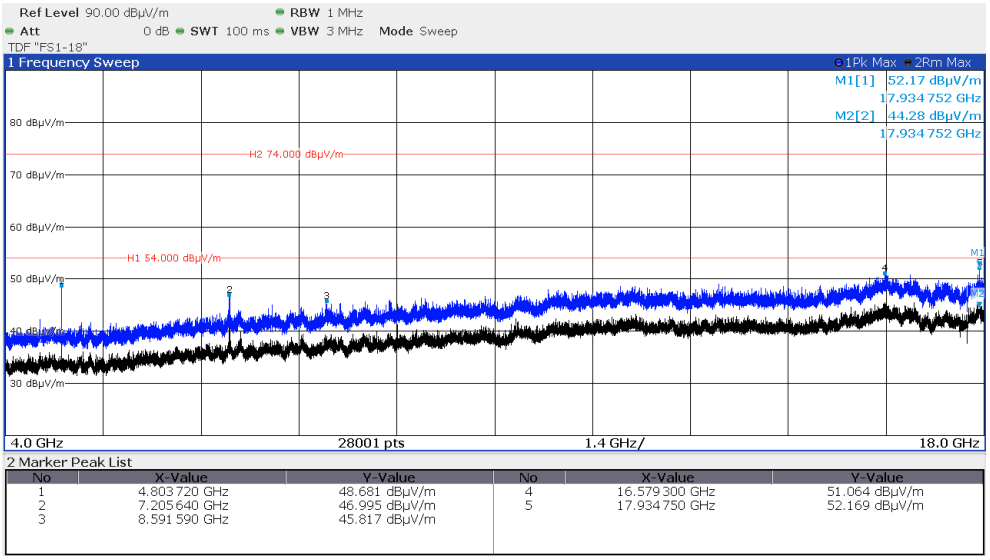
2 Marker Peak List

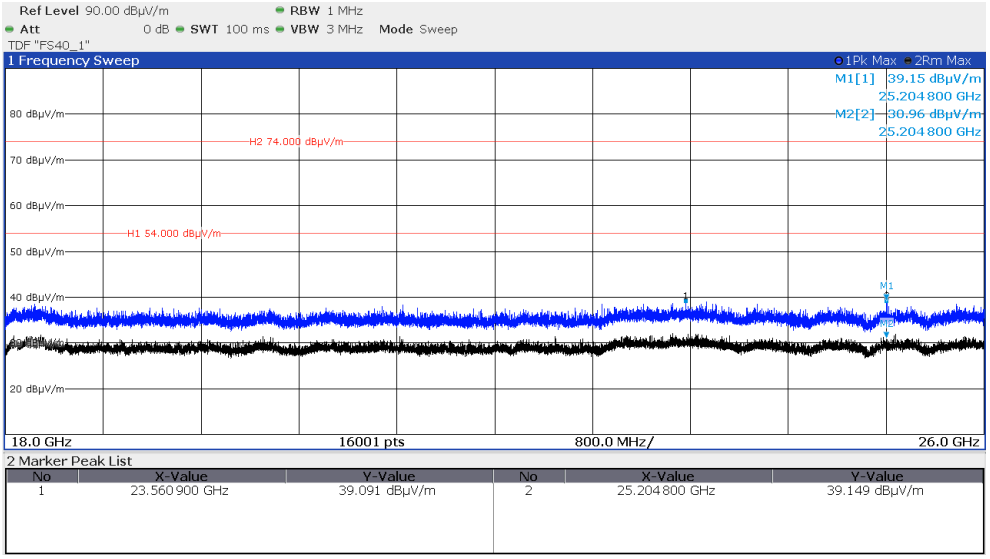
No	X-Value	Y-Value	No	X-Value	Y-Value
1	2.401 958 GHz	96.775 dBµV/m	6	2.498 192 GHz	45.110 dBµV/m
2	2.407 907 GHz	44.965 dBµV/m	7	2.498 392 GHz	46.026 dBµV/m
3	2.408 107 GHz	45.535 dBµV/m	8	2.498 592 GHz	46.381 dBµV/m
4	2.408 207 GHz	45.539 dBµV/m	9	2.498 792 GHz	45.882 dBµV/m
5	2.408 407 GHz	44.548 dBµV/m	10	2.498 942 GHz	44.703 dBµV/m

3 Marker Table

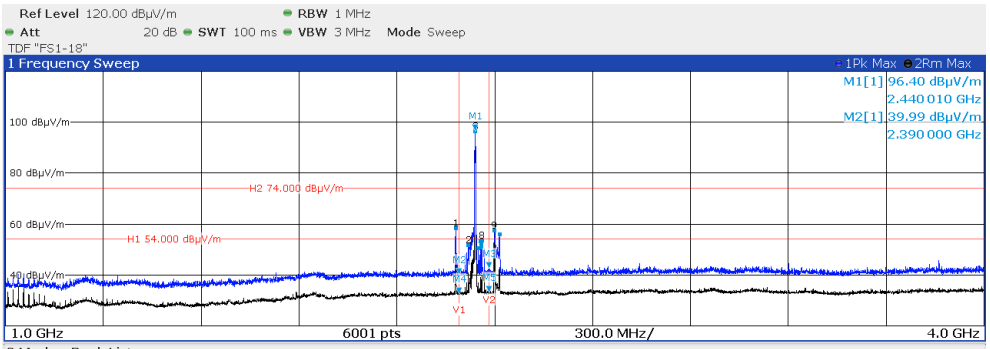
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.401 958 GHz**	**96.78 dBµV/m**		
M2		1	**2.39 GHz**	**34.62 dBµV/m**		
M3		1	**2.483 5 GHz**	**31.21 dBµV/m**		

Note: AV measurement





CH17:



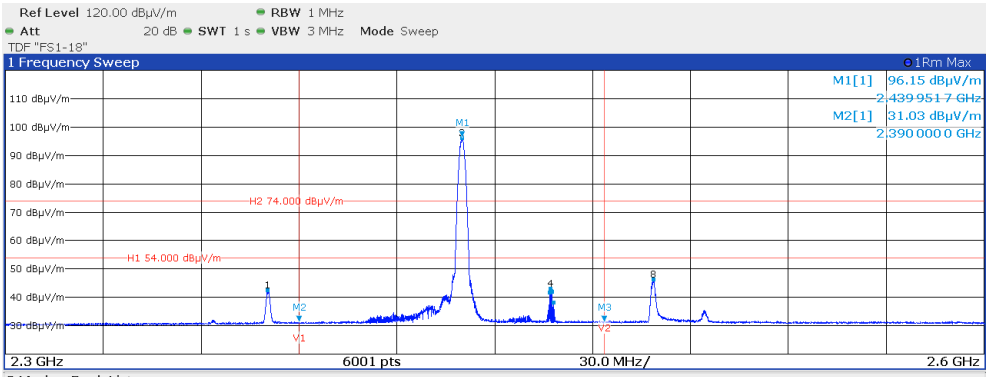
2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	2.380 520 GHz	58.349 dBµV/m	6	2.458 510 GHz	52.436 dBµV/m
2	2.419 510 GHz	51.633 dBµV/m	7	2.459 510 GHz	50.665 dBµV/m
3	2.440 010 GHz	96.397 dBµV/m	8	2.460 510 GHz	53.398 dBµV/m
4	2.449 010 GHz	50.524 dBµV/m	9	2.498 500 GHz	57.362 dBµV/m
5	2.457 510 GHz	53.194 dBµV/m	10	2.514 500 GHz	56.059 dBµV/m

3 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.440 01 GHz**	**96.40 dBµV/m**		
M2		1	**2.39 GHz**	**39.99 dBµV/m**		
M3		1	**2.483 5 GHz**	**42.47 dBµV/m**		
M4		2	**2.39 GHz**	**32.43 dBµV/m**		
M5		2	**2.483 5 GHz**	**33.09 dBµV/m**		

Note: PK measurement



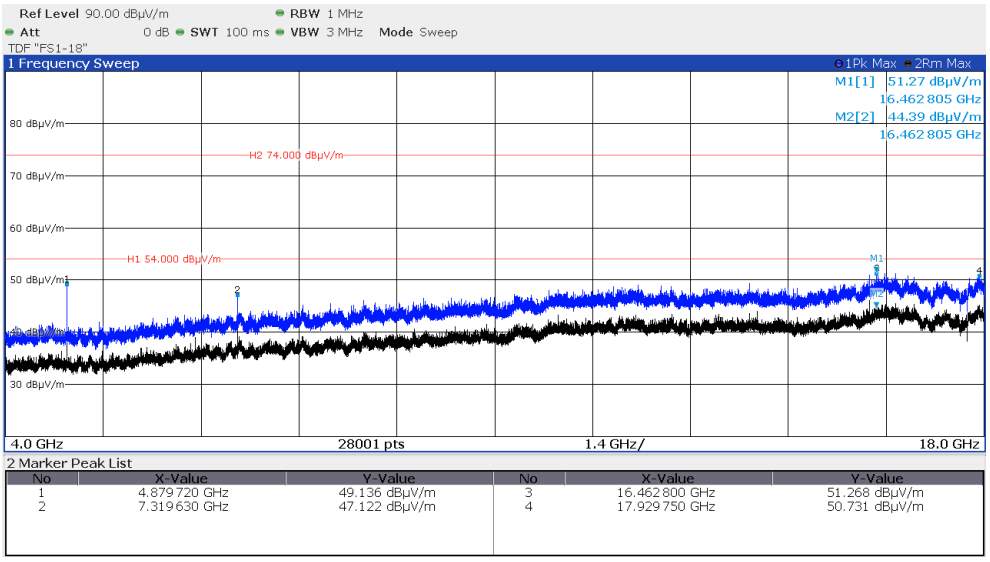
2 Marker Peak List

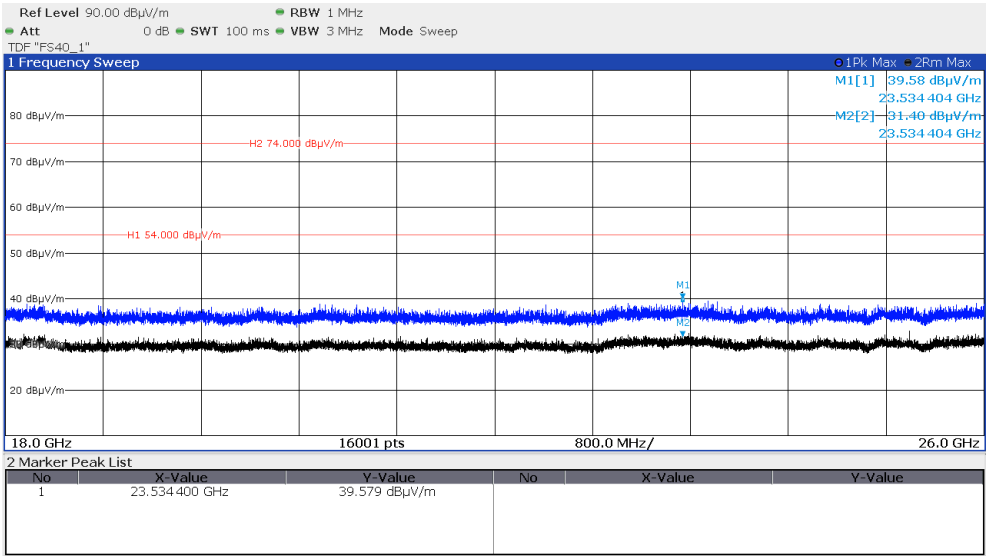
No	X-Value	Y-Value	No	X-Value	Y-Value
1	2.380 412 GHz	42.399 dBµV/m	5	2.467 247 GHz	42.356 dBµV/m
2	2.439 952 GHz	96.147 dBµV/m	6	2.467 447 GHz	42.007 dBµV/m
3	2.466 797 GHz	41.672 dBµV/m	7	2.467 947 GHz	38.211 dBµV/m
4	2.466 997 GHz	43.086 dBµV/m	8	2.498 642 GHz	46.302 dBµV/m

3 Marker Table

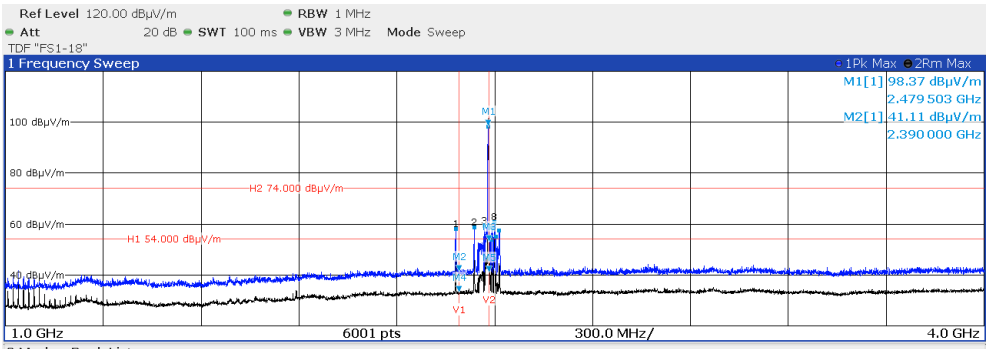
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.439 951 7 GHz**	**96.15 dBµV/m**		
M2		1	**2.39 GHz**	**31.03 dBµV/m**		
M3		1	**2.483 5 GHz**	**31.22 dBµV/m**		

Note: AV measurement





CH39:



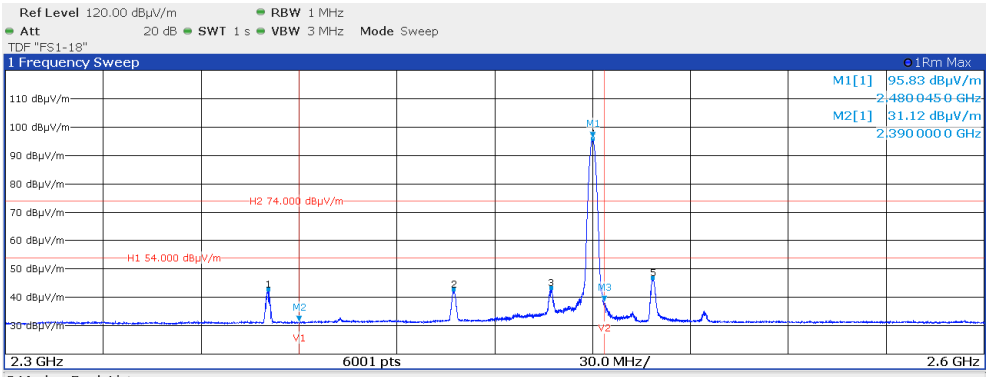
2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	2.380 520 GHz	58.185 dBµV/m	6	2.488 500 GHz	53.755 dBµV/m
2	2.437 510 GHz	58.645 dBµV/m	7	2.492 500 GHz	58.590 dBµV/m
3	2.467 510 GHz	59.157 dBµV/m	8	2.498 500 GHz	60.640 dBµV/m
4	2.479 500 GHz	98.365 dBµV/m	9	2.502 500 GHz	54.902 dBµV/m
5	2.487 000 GHz	54.648 dBµV/m	10	2.514 000 GHz	57.584 dBµV/m

3 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.479 503 GHz**	**98.37 dBµV/m**		
M2		1	**2.39 GHz**	**41.11 dBµV/m**		
M3		1	**2.483 5 GHz**	**52.79 dBµV/m**		
M4		2	**2.39 GHz**	**33.04 dBµV/m**		
M5		2	**2.483 5 GHz**	**40.86 dBµV/m**		

Note: PK measurement



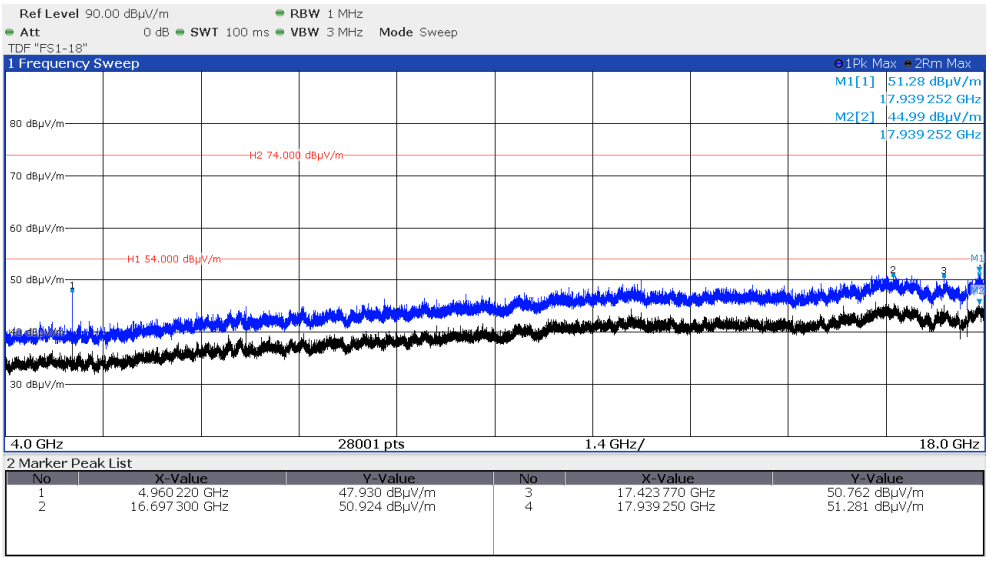
2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	2.380 562 GHz	42.872 dBµV/m	4	2.480 045 GHz	95.828 dBµV/m
2	2.437 502 GHz	42.713 dBµV/m	5	2.498 542 GHz	46.722 dBµV/m
3	2.467 247 GHz	43.308 dBµV/m			

3 Marker Table

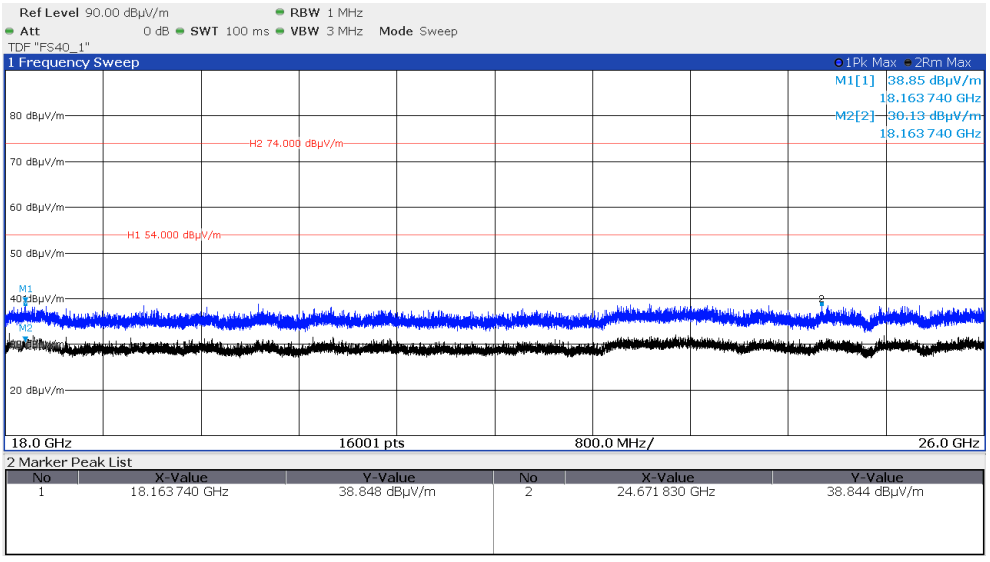
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.480 045 GHz**	**95.83 dBµV/m**		
M2		1	**2.39 GHz**	**31.12 dBµV/m**		
M3		1	**2.483 5 GHz**	**38.12 dBµV/m**		

Note: AV measurement



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	4.960 220 GHz	47.930 dBµV/m	3	17.423 770 GHz	50.762 dBµV/m
2	16.697 300 GHz	50.924 dBµV/m	4	17.939 250 GHz	51.281 dBµV/m



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	18.163 740 GHz	38.848 dBµV/m	2	24.671 830 GHz	38.844 dBµV/m

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

Frequency	Field strength of fundamental	
(MHz)	(µV/m)	dB(µV/m)
902 - 928	500	54
2400 - 2483.5	**500**	**54**
5725-5875	500	54
24000 - 24250	2500	68

Average limit spurious emissions according to FCC Part 15C, Section 15.249(d):
Emissions shall be attenuated by at least 50 dB below the level of the fundamental.

General 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

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.

Average limit harmonics according to RSS-210 B.10(a), Table B2:

Frequency	Field strength of fundamental	
(MHz)	(µV/m)	dB(µV/m)
902 - 928	500	54
2400 - 2483.5	**500**	**54**
5725-5875	500	54
24000 - 24250	2500	68

Average limit spurious emissions according to RSS-210 B.10(b)
Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

General limit according to RSS-Gen 8.9:

Frequency (MHz)	RSS-Gen Limits (µA/m)	Measurement distance (m)
0.009 - -0.49	63.7/f(kHz)	300
0.49 – 1.705	63.7/f(kHz)	30
1.705 – 30.0	0.08	30

Frequency (MHz)	RSS-Gen Limits (µV/m)	Measurement distance (m)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Peak limit according to RSS-Gen 8.1:
If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for factors such as pulse desensitization to ensure that the peak emission is less than 20 dB above the average limit.

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

RSS-Gen, Table 6 – Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	12.57675 - 12.57725	399.9 - 410	7.250 - 7.750
0.495 - 0.505	13.36 - 13.41	608 - 614	8.025 – 8.500
2.1735 - 2.1905	16.42 - 16.423	960 - 1427	9.0 - 9.2
3.020 - 3.026	16.69475 - 16.69525	1435 - 1626.5	9.3 - 9.5
4.125 - 4.128	16.80425 - 16.80475	1645.5 - 1646.5	10.6 - 12.7
4.17725 - 4.17775	25.5 - 25.67	1660 - 1710	13.25 - 13.4
4.20725 - 4.20775	37.5 - 38.25	1718.8 - 1722.2	14.47 - 14.5
5.677 - 5.683	73 - 74.6	2200 - 2300	15.35 - 16.2
6.215 - 6.218	74.8 - 75.2	2310 - 2390	17.7 - 21.4
6.26775 - 6.26825	108 – 138	2483.5 - 2500	22.01 - 23.12
6.31175 - 6.31225	149.9 - 150.05	2655 - 2900	23.6 - 24.0
8.291 - 8.294	156.52475 - 156.52525	3260 – 3267	31.2 - 31.8
8.362 - 8.366	156.7 - 156.9	3332 - 3339	36.43 - 36.5
8.37625 - 8.38675	162.0125 - 167.17	3345.8 - 3358	Above 38.6
8.41425 - 8.41475	167.72 - 173.2	3500 - 4400	
12.29 - 12.293	240 – 285	4500 - 5150	
12.51975 - 12.52025	322 - 335.4	5350 - 5460	

The requirements are **FULFILLED.**

Remarks: The measurement was performed up to 10th harmonic.

5.3 Emission bandwidth, 99% bandwidth

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

5.3.1 Description of the test location

Test location: Shielded Room S6

5.3.2 Photo documentation of the test set-up – Please see attachment B

5.3.3 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.

According to RSS-Gen 6.7:
The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

5.3.4 Description of Measurement

The bandwidth is measured using a spectrum analyser following the procedure set out in ANSI C63.10, item 9.3.

Spectrum analyser settings:
RBW: 30 kHz, VBW: 100 kHz, Span: 3 MHz, Trace mode: max hold, Detector: max peak;

5.3.5 Test result

Lowest band edge (GHz)	2.40144669
Highest band edge (GHz)	2.48055180

Limit according to FCC Part 15C, Section 15.215(c):
The 20 dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.

Frequency band
2.4 GHz – 2.4835 GHz

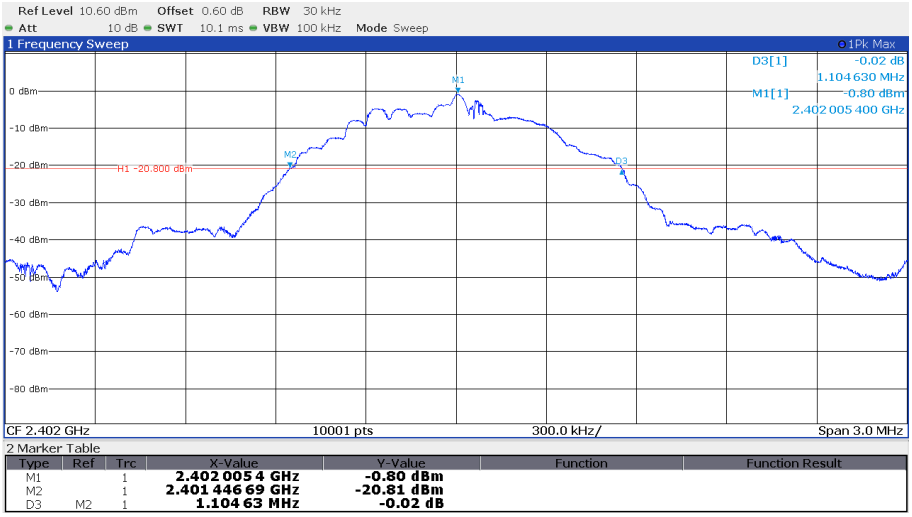
The requirements are **FULFILLED.**

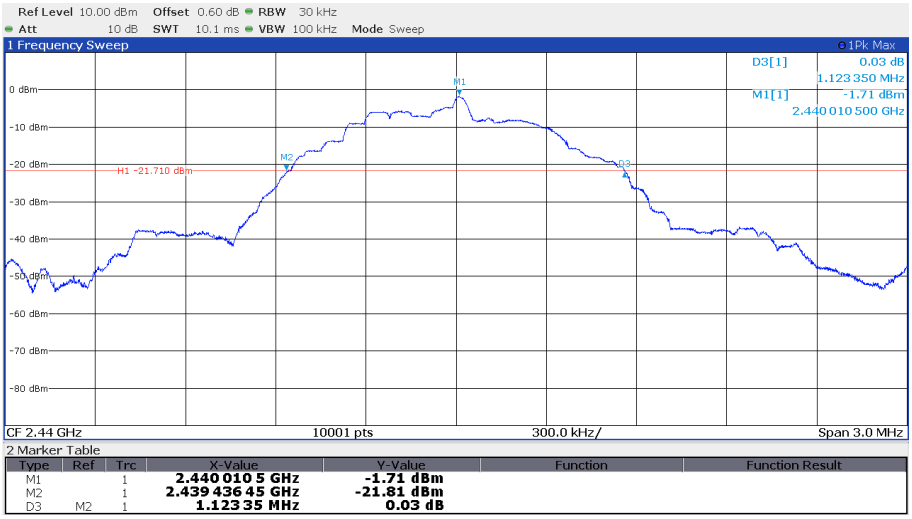
Remarks: For detailed test result please refer to following test protocols.

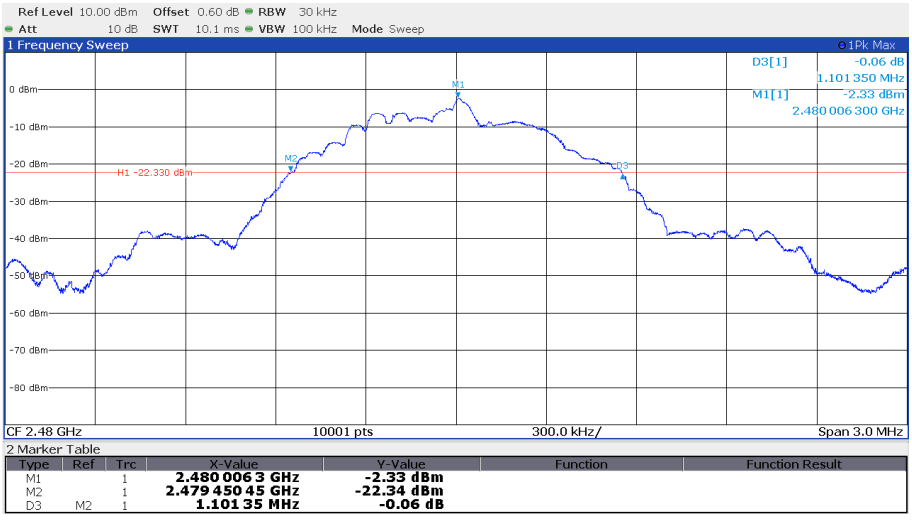
No limit defined for the 99% occupied bandwidth!

5.3.6 Test protocols

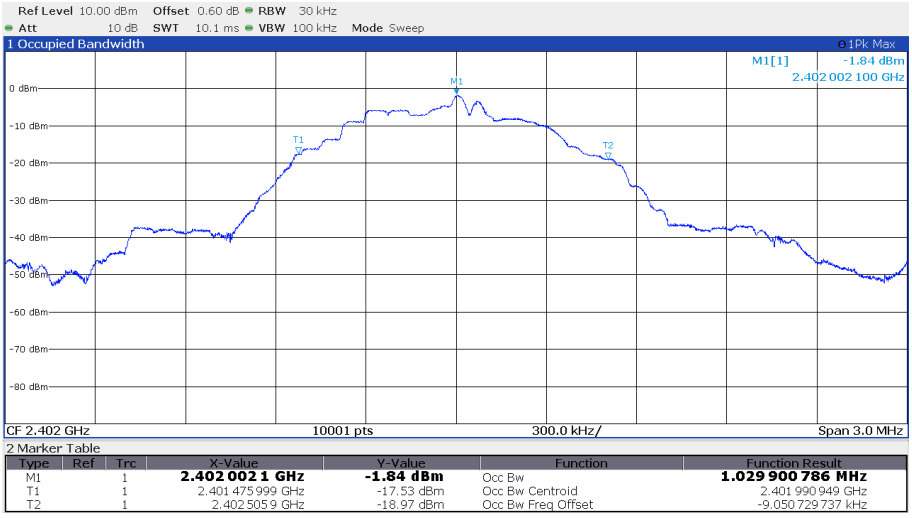
20dB EBW





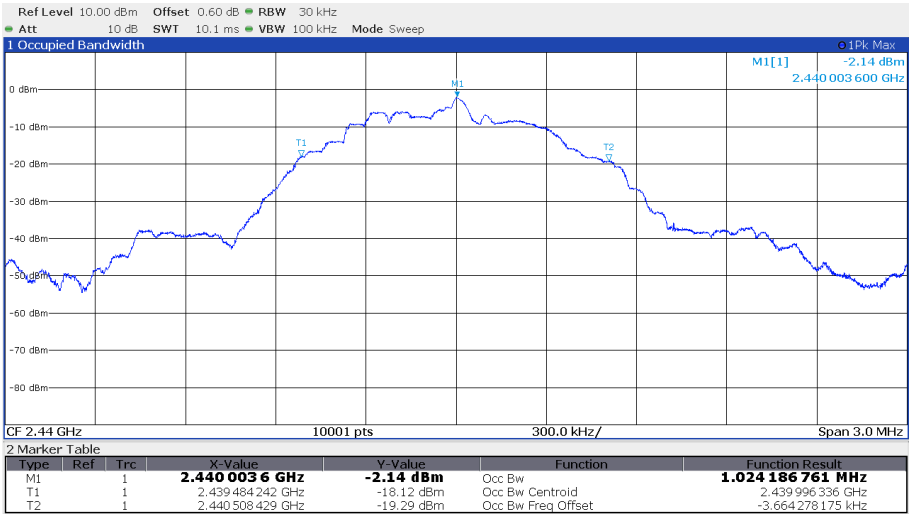


99% OBW



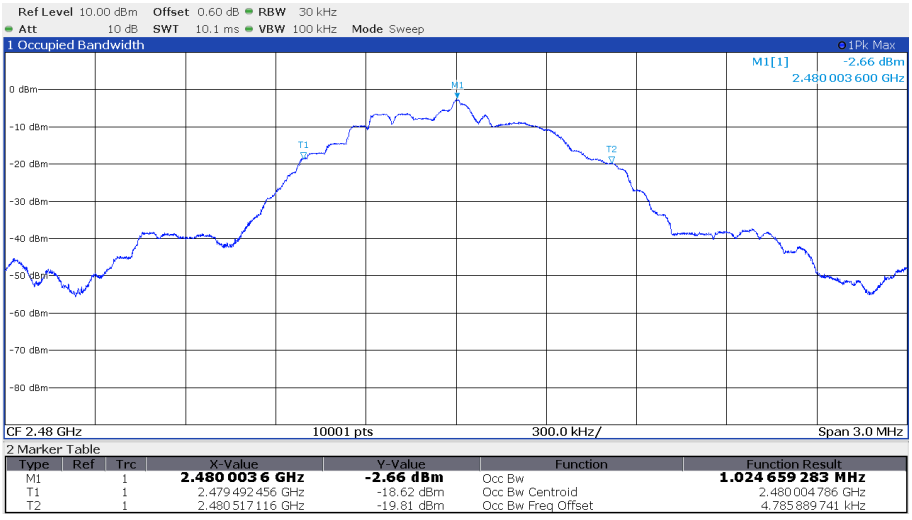
2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.402 002 1 GHz**	**-1.84 dBm**	Occ Bw	**1.029 900 786 MHz**
T1		1	2.401 475 999 GHz	-17.53 dBm	Occ Bw Centroid	2.401 990 949 GHz
T2		1	2.402 505 9 GHz	-18.97 dBm	Occ Bw Freq Offset	-9.050 729 737 kHz



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.440 003 6 GHz**	**-2.14 dBm**	Occ Bw	**1.024 186 761 MHz**
T1		1	2.439 484 242 GHz	-18.12 dBm	Occ Bw Centroid	2.439 996 336 GHz
T2		1	2.440 508 429 GHz	-19.29 dBm	Occ Bw Freq Offset	-3.664 278 175 kHz



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.480 003 6 GHz**	**-2.66 dBm**	Occ Bw	**1.024 659 283 MHz**
T1		1	2.479 492 456 GHz	-18.62 dBm	Occ Bw Centroid	2.480 004 786 GHz
T2		1	2.480 517 116 GHz	-19.81 dBm	Occ Bw Freq Offset	4.785 889 741 kHz

5.4 Correction for pulse operation (duty cycle)

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

5.4.1 Description of the test location

Test location: Shielded Room S6

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

5.4.3 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 puls train, including blanking intervals, as long as the pulse train does not exceed 0.1s. In cases where the puls 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.

According to RSS-Gen 8.2:
When the field strength or envelope power is not constant or it is in pulses, and an average detector is specified to be used, the value of field strength or power shall be determined by averaging over one complete pulse train during which the field strength or power is at its maximum value, including blanking intervals within the pulse train, provided that the pulse train does not exceed 0.1 seconds. In cases where the pulse train exceeds 0.1 seconds, the average value of field strength or output power shall be determined during a 0.1 seconds interval during which the field strength or power is at its maximum value.

5.4.4 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

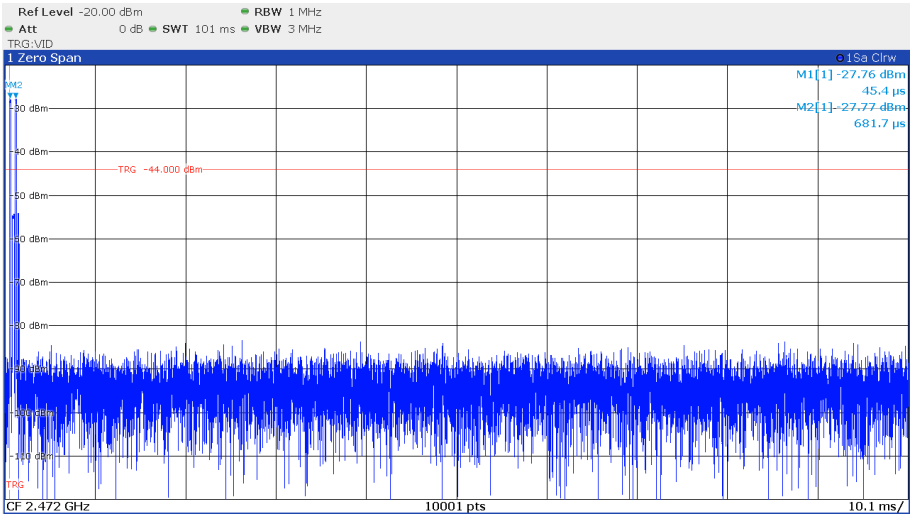
5.4.5 Test result

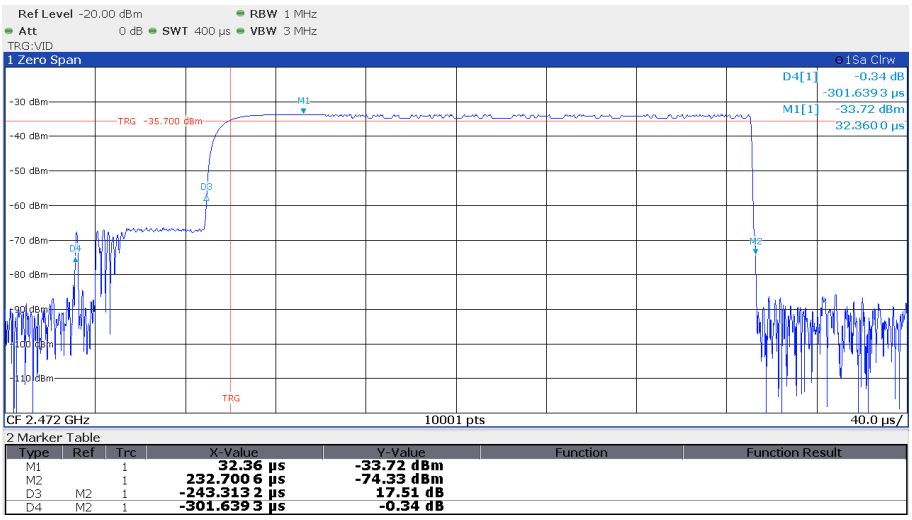
K_E = 20 log ((2*0.3016) / 100) = -44.4 dB

Remarks: For detailed results, please see the test protocol below.

Worst case scenario: EUT is paired with an audio processor, volume key is pushed repeatedly for maximum transmission rate.

5.4.6 Test protocol





2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	32.36 µs	-33.72 dBm		
M2		1	232.700 6 µs	-74.33 dBm		
D3	M2	1	-243.313 2 µs	17.51 dB		
D4	M2	1	-301.639 3 µs	-0.34 dB		

5.5 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 integrated antennas. No other antenna can be used with the device.

The supplied antennas meet 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.
CPR 3	FSW43	02-02/11-21-001	22/05/2024	22/05/2023		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	12/07/2024	12/07/2023		
	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				
	6820.17.B 18GHz	02-02/50-23-002			28/05/2024	28/11/2023
DC	FSW43	02-02/11-15-001	04/05/2024	04/05/2023		
	2.4/5.2/5.8GHz Antenna + S	02-02/50-17-027				
MB	FSW43	02-02/11-21-001	22/05/2024	22/05/2023		
	minibend KR-16	02-02/50-16-013				
SER 1	ESR 7	02-02/03-17-001	01/08/2024	01/08/2023		
	HFH 2 - Z 2	02-02/24-05-020	01/06/2025	01/06/2022	05/09/2024	05/09/2023
	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 2	ESVS 30	02-02/03-05-006	27/07/2024	27/07/2023		
	VULB 9168	02-02/24-05-005	20/04/2024	20/04/2023	03/05/2024	03/05/2023
	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	FSW43	02-02/11-21-001	22/05/2024	22/05/2023		
	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	12/07/2024	12/07/2023		
	BBHA 9170	02-02/24-05-013	21/03/2026	21/03/2023	22/01/2025	22/01/2024
	WHK 3.0/18G-10EF	02-02/50-05-180				
	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				
	KMS116-GL140SE-KMS116-	02-02/50-20-026				

Note: SER 2 performed on 02/04/2024

- End of test report -