



EMI - TEST REPORT

- FCC Part 15.249, RSS210 -

Type / Model Name : FineTuner Echo (product name), Ma010201 (product code)

Product Description : Remote control for MED-EL audio processors including a
2.4 GHz proprietary transceiver

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
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Test Report No. : T44781-00-00KS	25. April 2019 Date of issue
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Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

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

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ATTACHMENT A as separate supplement

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – See Attachment A

2.2 General remarks

The EUT contains a 2.4 GHz transceiver with integral antenna. The transceiver operates in the frequency band 2.400 GHz - 2.4835 GHz.

2.3 Equipment category

2.4 GHz transceiver

2.4 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 by the audiologist during fitting. It communicates over a proprietary low power 2.4 GHz link.

Number of tested samples: 2
Serial number: 000147, EMC220
Firmware version: 1.0.0, see PF17-004 (FT2 radio test firmware)

EUT configuration:

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

2.5 Variants of the EUT

None.

2.6 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan:

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

Note: the marked frequencies are determined for final testing.

2.7 EUT operation modes

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

- Cont. TX at CH1, CH19 and CH39 (the EUT uses GFSK and provides following data rate: 2 Mbps)

2.8 Antenna

The following antenna shall be used with the EUT:

Number	Characteristic	Type	Plug	Frequency range (GHz)	Gain (dBi)
1	Omni	PCB	None	2.4	4.3

2.9 Power supply system utilised

Power supply voltage, V_{nom} : 3.6 VDC Battery powered (LIR2032)

2.10 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
- - Model : -
- - Model : -

2.11 Determination of worst case conditions for final measurement

Measurements have been made in all three orthogonal axes of the EUT to locate at which position the EUT produces the maximum of the emissions.

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

Standard	Available channels	Tested channels	Power setting	Modulation	Modulation Type	Data rate
Proprietary	1 to 39	1, 19, 39	0 dBm	GFSK	digital	2 Mbps

2.11.1 Test jig

No special test jig was used for testing.

2.11.2 Test software

The test software for the EUT provides the special test modes continuous TX unmodulated (CW), continuous TX modulated (bursts) and the channel settings.

3 TEST RESULT SUMMARY

Operating in the 2400 MHz – 2483.5 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.35(c)	RSS-Gen, 8.2	Pulsed operation	passed
15.203	RSS-Gen, 6.8	Antenna requirement	passed
15.204	RSS-Gen, 8.3	External radio frequency power amplifiers	not applicable
15.205(a)	RSS-Gen, 8.10	Emissions in restricted bands	passed
15.207(a)	RSS-Gen, 8.8	AC power line conducted emissions	not applicable
15.215(c)	-	EBW	passed
-	RSS-Gen, 6.7	OBW	passed
15.249(a)	RSS-210, B10(a)	Field strength of fundamental	passed
15.249(d)	RSS-210, B10(b)	Out-of-band emission, radiated	passed
-	RSS-Gen, 6.11	Transmitter frequency stability	not applicable

The mentioned RSS Rule Parts in the above table are related to:
 RSS-Gen, Issue 5, April 2018
 RSS-210, Issue 9, August 2016

3.1 Final assessment

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

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

Testing commenced on : 01 February 2019

Testing concluded on : 14 February 2019

Checked by:

Issued by:

 Klaus Gegenfurtner
 Teamleader Radio

 Josef Knab
 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
EBW and OBW	2400 MHz to 30000 MHz	95%	$\pm 2.5 \times 10^{-7}$
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 Measurement protocol for FCC and ISED

4.4.1 General information

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:
IC 3009A-1

The Anechoic chamber is a listed test site under the Canadian Test-Sites File-No:
IC 3009A-2

4.4.2 General Standard information

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

4.4.2.1 Justification

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

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

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. The setup of the equipment under test is established in accordance with ANSI C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the 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 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 or CISPR 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	Level	+	Factor	=	Level	-	CISPR Limit	=
Delta								
(MHz)	(dBµV)		(dB)		(dBµV/m)		(dBµV/m)	(dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	= -2.4

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

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

5 TEST CONDITIONS AND RESULTS

5.1 AC power line conducted emissions

Remarks: Not applicable as the EUT is battery powered and has no AC mains connections.

5.2 Field strength of fundamental

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

5.2.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

5.2.2 Photo documentation of the test set-up – See Attachment B

5.2.1 Applicable standard

According to FCC Part 15C, Section 15.249(a):

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the effective limits.

5.2.2 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 set up of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 6.5. The EUT is measured in TX continuous mode unmodulated under normal conditions.

Analyser settings:

Peak measurement: RBW: 3 MHz

VBW: 10 MHz

Detector: Max peak

5.2.3 Test result

Frequency (MHz)	Level PK dB(μV/m)	Limit PK dB(μV/m)	Margin PK (dB)	Level AV dB(μV/m)	Limit AV dB(μV/m)	Margin AV (dB)
2404	97.1	114.0	-16.9	85.2	94.0	-8.7
2440	98.3	114.0	-15.7	86.5	94.0	-7.5
2480	97.1	114.0	-16.9	85.3	94.0	-8.7

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

Frequency (MHz)	Field strength of fundamental	
	(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):

However, the peak fieldstrength shall not exceed the maximum permitted average limit by more than 20 dB.

The requirements are **FULFILLED**.

Remarks:

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5.3 Out-of-band emission, radiated

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

5.3.1 Description of the test location

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

5.3.2 Photo documentation of the test set-up – See Attachment B

5.3.3 Applicable standard

According to FCC Part 15C, Section 15.249 (d):

Emission radiated outside of the specified frequency bands, except harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limit in FCC Part 15C, Section 15.209, whichever is the lesser attenuation.

5.3.4 Description of Measurement

The radiated emissions from the EUT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 6.3. 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 – 25 GHz	RBW:	1 MHz

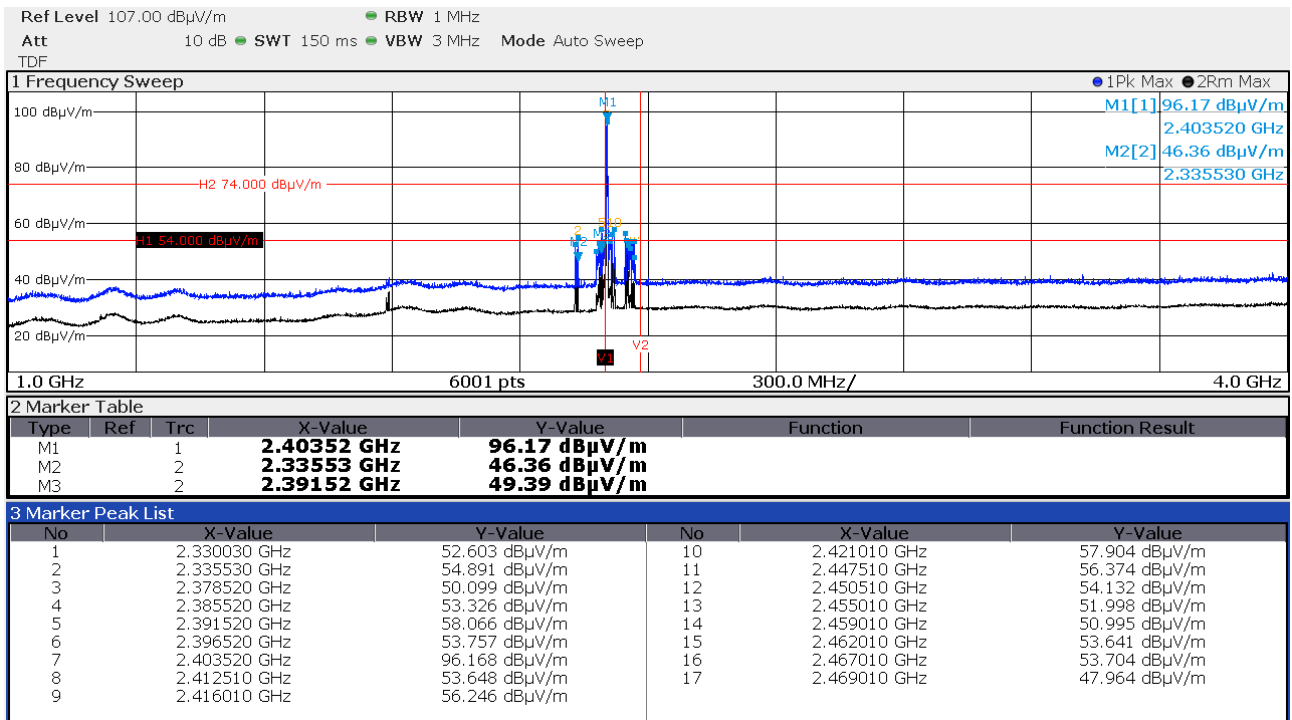
5.3.1 Test result $f < 1000$ MHz

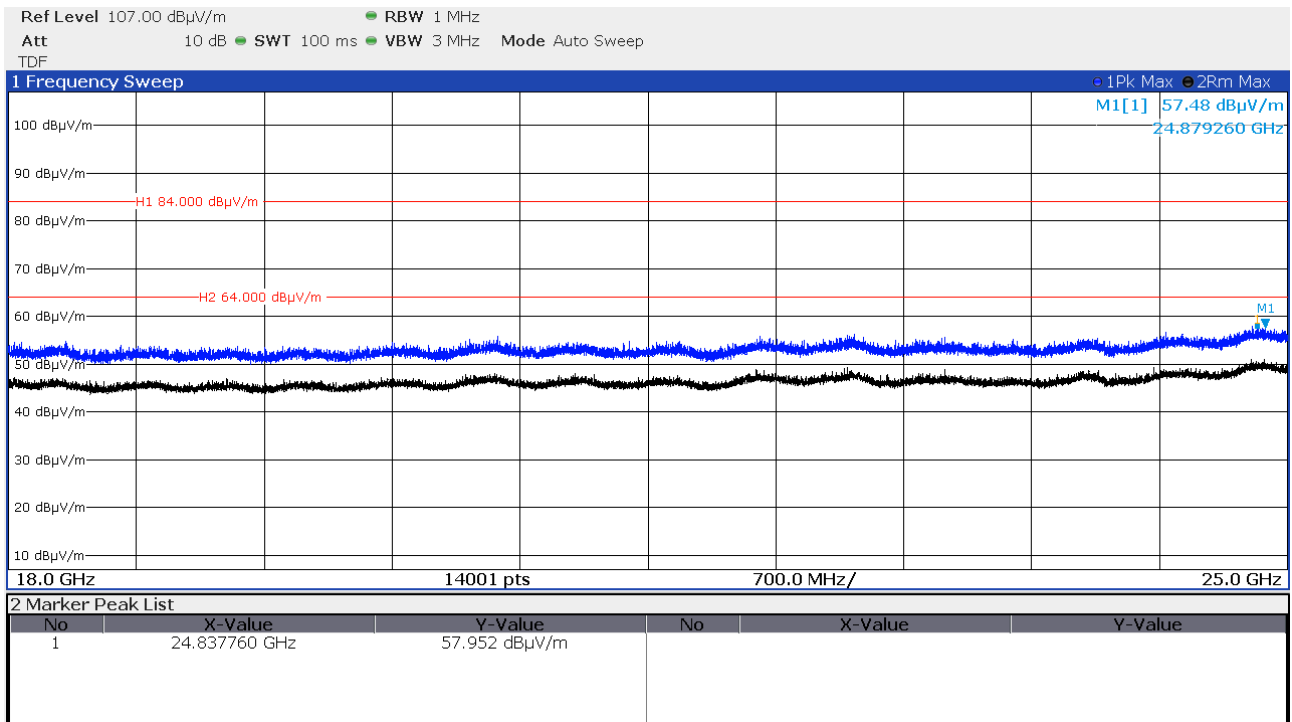
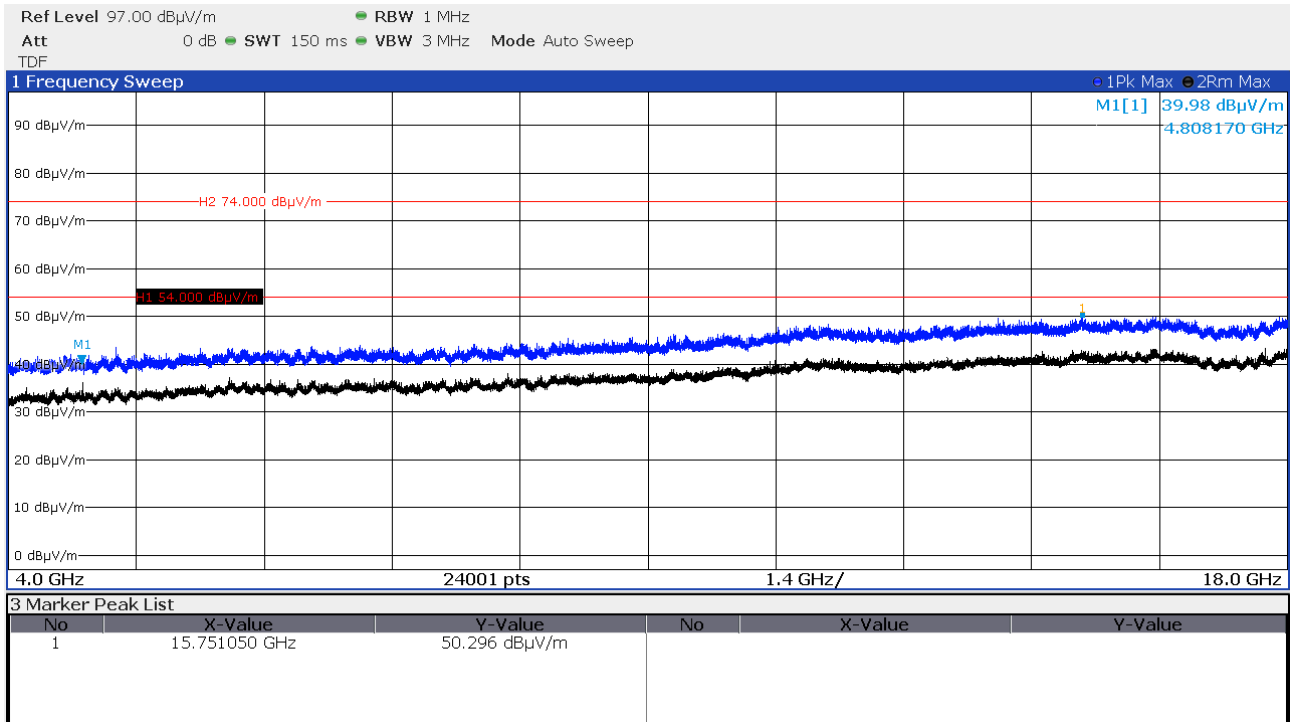
Frequency (MHz)	Reading Vert. (dB μ V)	Reading Hor. (dB μ V)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dB μ V/m)	Level Hor. (dB μ V/m)	Limit (dB μ V/m)	Dlimit (dB)
224.90	6.4	7.0	11.6	12.1	18.0	19.1	46.0	-26.9
171.57	6.5	6.8	13.0	13.8	19.5	20.6	43.5	-22.9
70.40	8.3	6.4	13.1	12.4	21.4	18.8	40.0	-18.6
31.40	11.3	5.7	12.9	11.5	24.2	17.2	40.0	-15.8

Note: In the frequency range 9 kHz to 1000 MHz no emission could be detected. The frequencies mention the noise level. No difference could be detected between the operating frequencies.

5.3.2 Test result $f > 1$ GHz

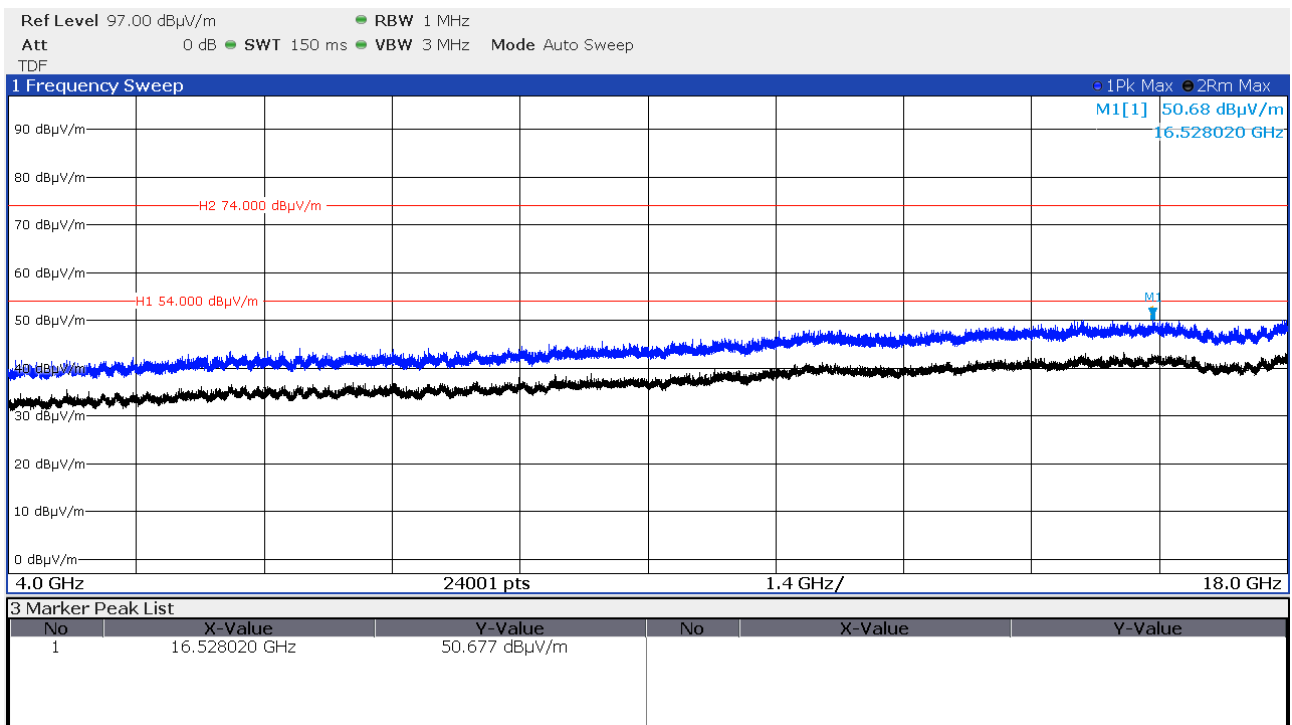
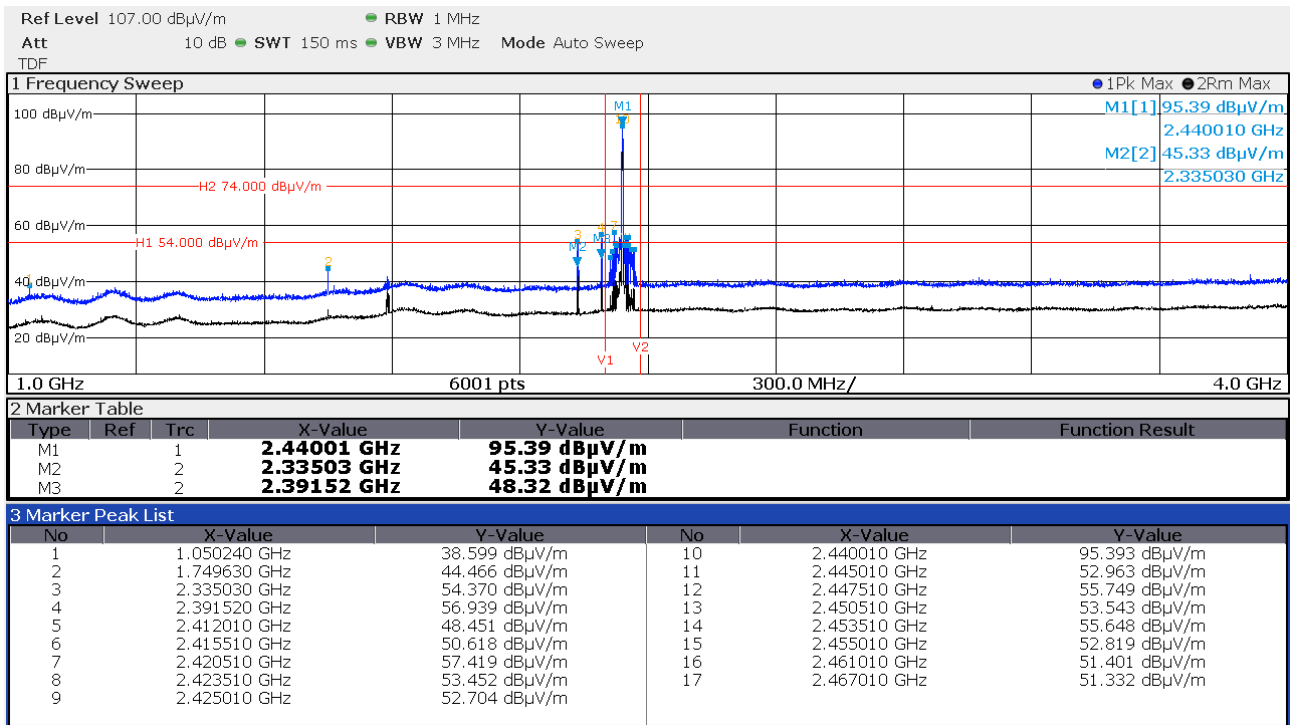
Channel 1

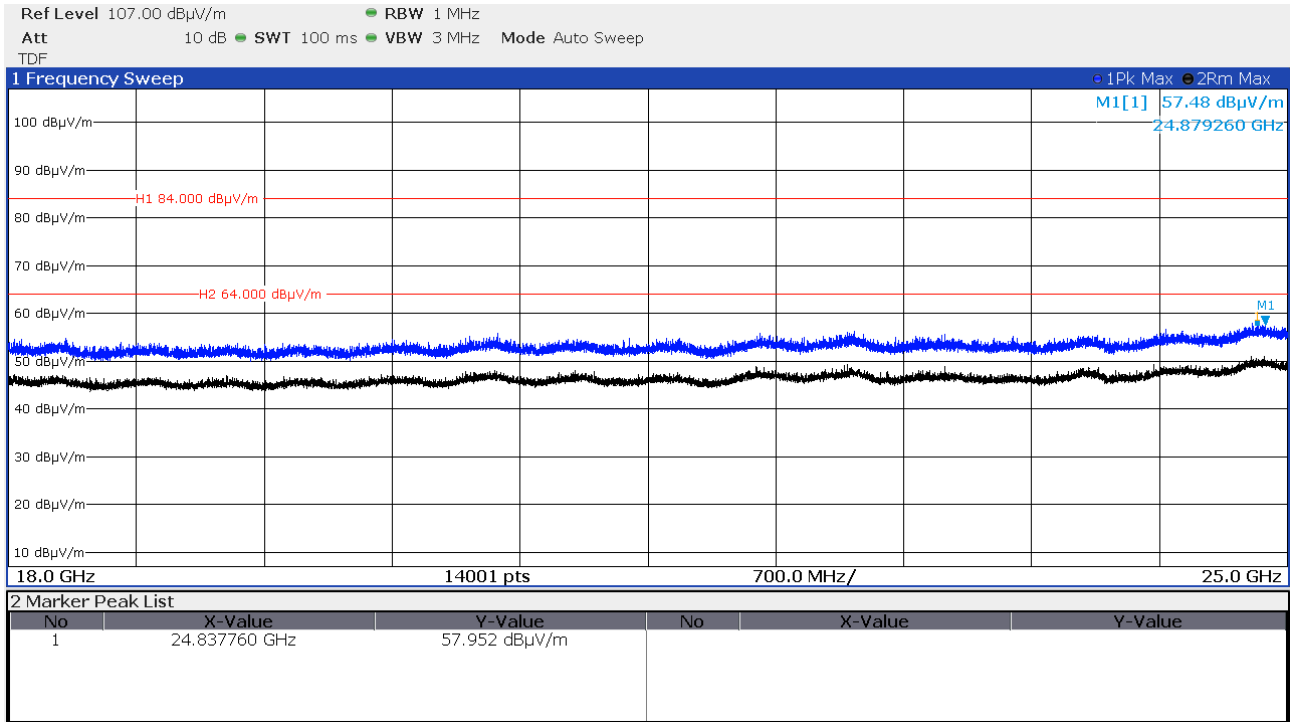




Note: the measurement distance was changed to 1 m for this frequency range, therefore the limit line has to be adjusted and was increased by 10 dB.

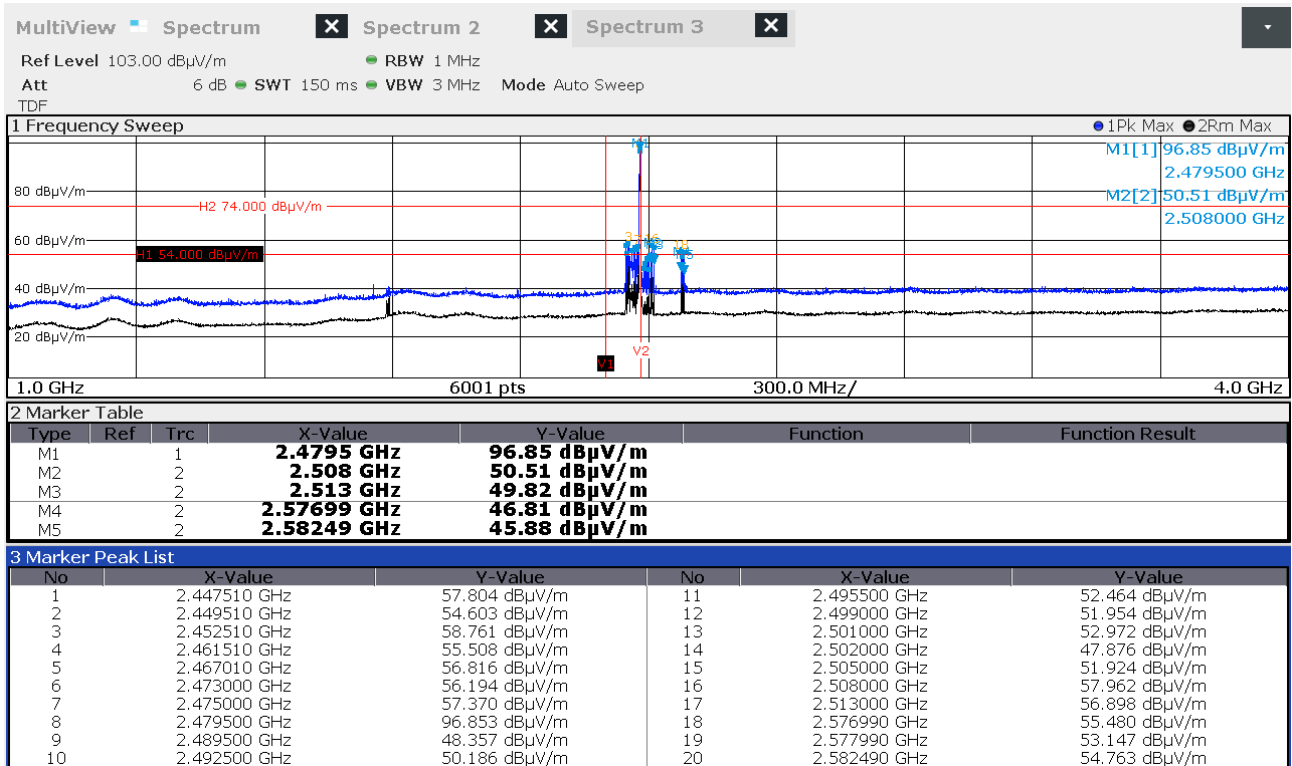
Channel 19

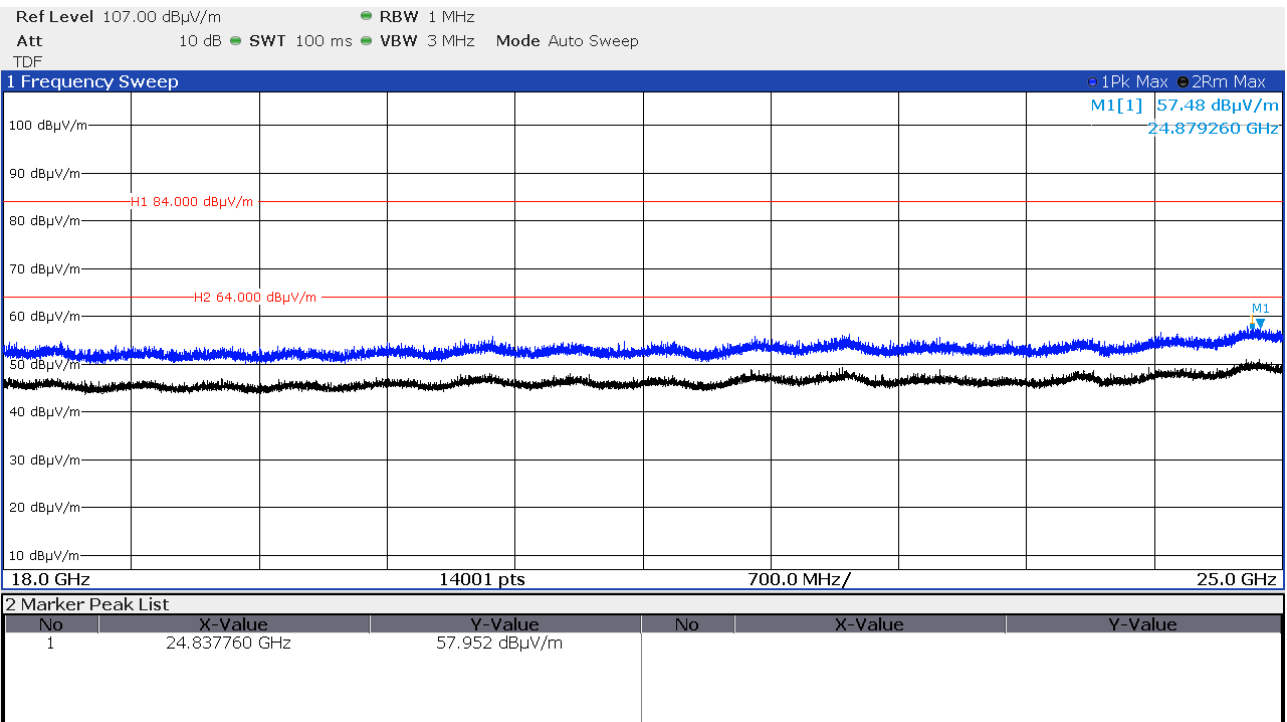
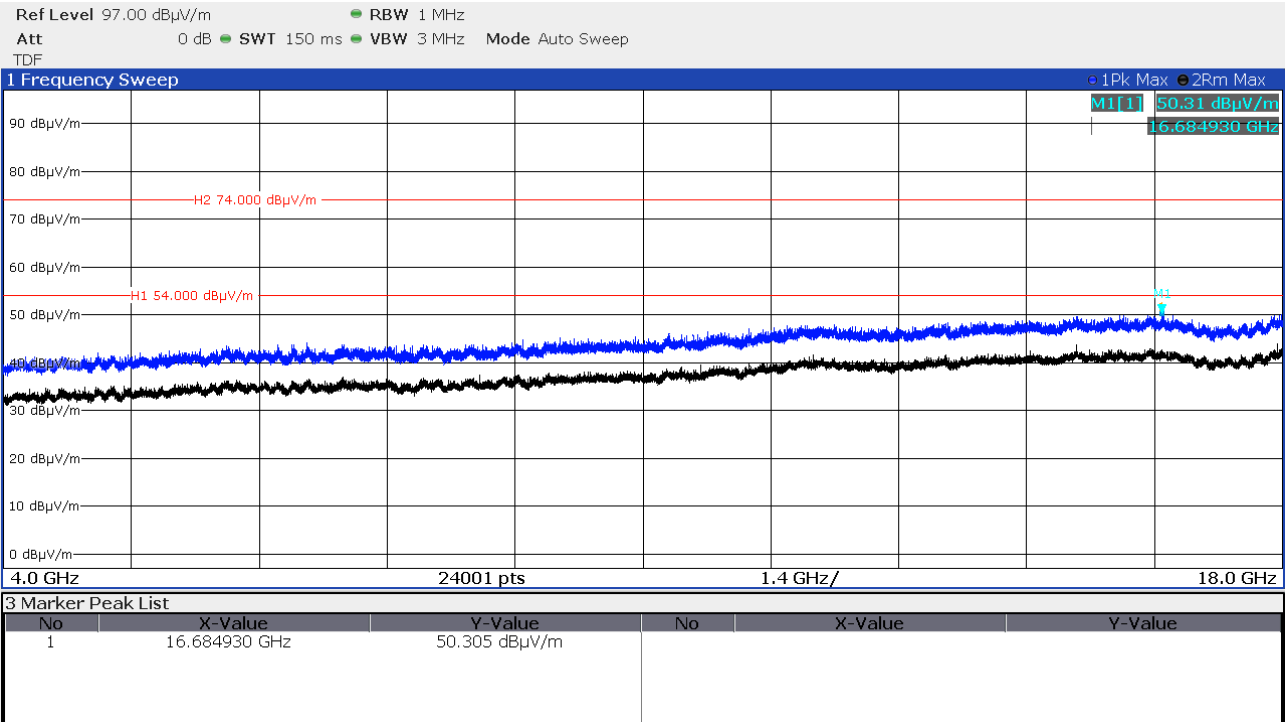




Note: the measurement distance was changed to 1 m for this frequency range, therefore the limit line has to be adjusted and was increased by 10 dB.

Channel 39





Note: the measurement distance was changed to 1 m for this frequency range, therefore the limit line has to be adjusted and was increased by 10 dB.

Limit according to FCC Part 15C, Section 15.209:

Frequency (MHz)	15.209 Limits ($\mu\text{V/m}$)	Measurement distance (m)
0.009 - -0.49	$2400/f(\text{kHz})$	300
0.49 - 1.705	$24000/f(\text{kHz})$	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

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

Fundamental frequency (MHz)	Field strength of harmonics	
	($\mu\text{V/m}$)	$\text{dB}(\mu\text{V/m})$
902 - 928	500	54
2400 - 2483.5	500	54
5725 - 5875	500	54
24000 - 24250	2500	68

The requirements are **FULFILLED**.

Remarks: The measurement was performed up to the 10th harmonic (25000 MHz).

5.4 EBW and OBW

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

5.4.1 Description of the test location

Test location: Anechoic chamber 1

5.4.2 Photo documentation of the test set-up – See Attachment B

5.4.3 Applicable standard

According to FCC Part 15, Section 15.215(c):

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

5.4.4 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -20 dB (99%). The x-dB-down (OBW) function of the analyser is used. The measurement is performed with normal modulation in TX continuous mode.

Spectrum analyser settings:

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

5.4.5 Test result

Centre f (MHz)	99% bandwidth f_1	99% bandwidth f_2	Measured OBW (MHz)
2404.012005	2403.26327	2404.760740	1.497470
2440.004825	2439.21221	2440.797440	1.585230
2480.000220	2479.22103	2480.779410	1.558380

Centre f (MHz)	20dB bandwidth f_1	20dB bandwidth f_2	Measured EBW (MHz)
2404.000755	2403.50163	2404.499880	0.998250
2439.970380	2439.43938	2440.501380	1.062000
2479.958380	2479.46038	2480.456380	0.996000

Operating frequency band (MHz)	20 dB Bandwidth (MHz)	
$f_{low} > 2400$	$f_{low} =$	2403.50163
$f_{high} < 2483.5$	$f_{high} =$	2480.45638
Operating Band occupancy	76.95	

Operating Band occupancy percentage	92.16 %
Operating channel occupancy percentage	53.10 %

Limit according to FCC Part 15C, Section 15.215(c):

If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within the central 80% of the permitted band in order to minimize the possibility of out-of-band operation. Due to the channelising of the operating band into 40 channels with channel bandwidth of 2 MHz the limit central 80% of the permitted band can not be applied. Therefore, the stability of the EUT will be shown staying within the central 80% of the operating channel.

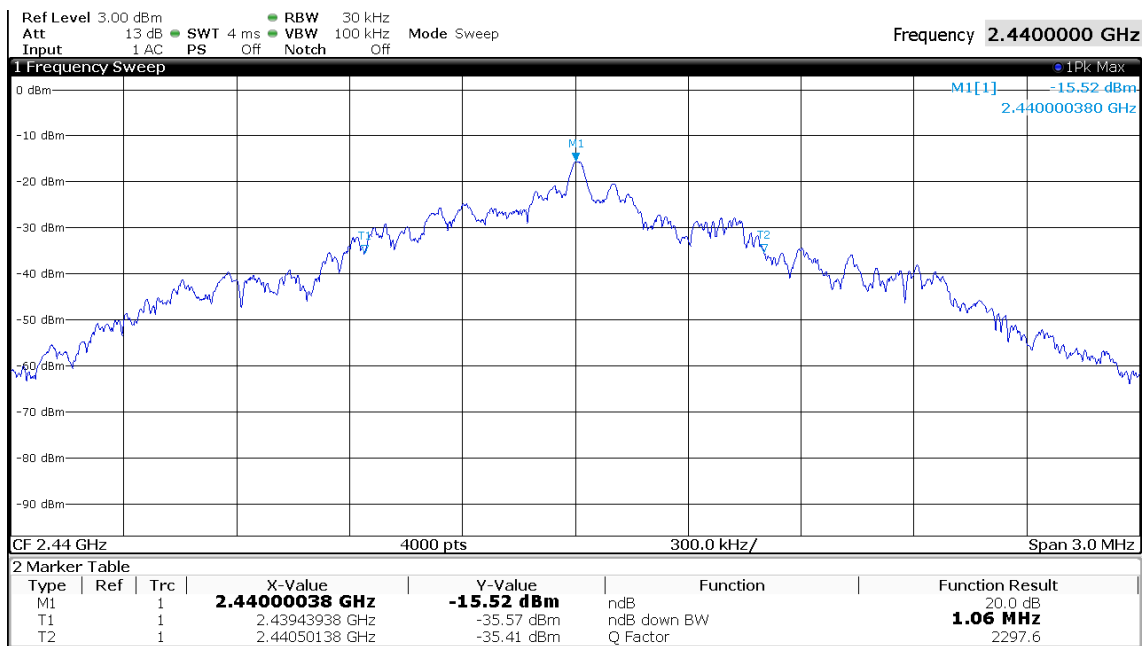
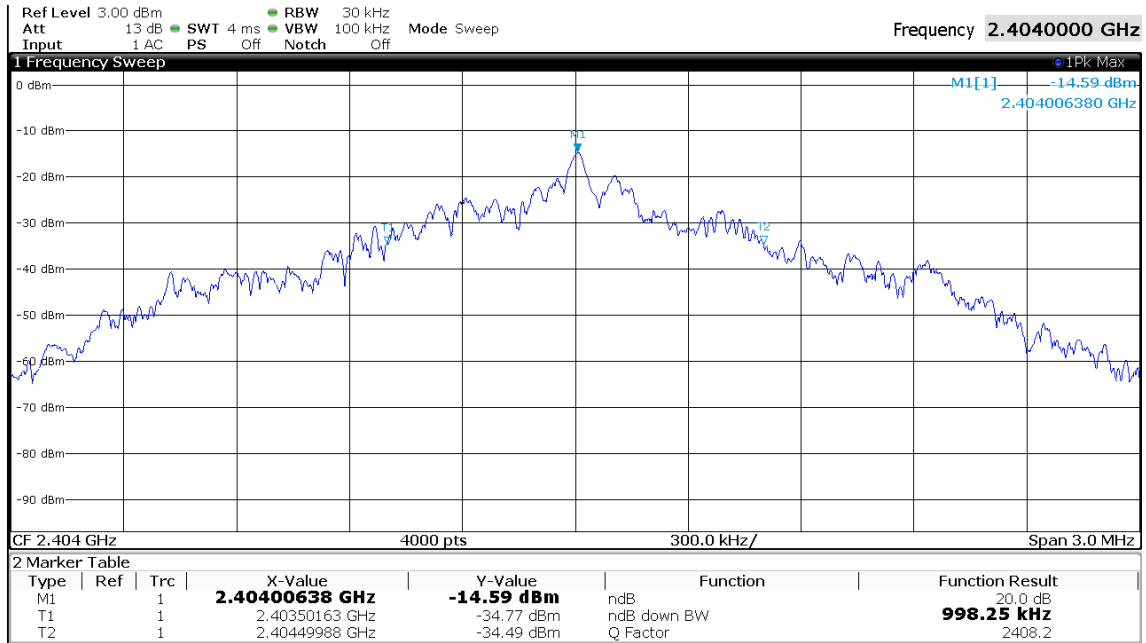
The requirements are **FULFILLED**.

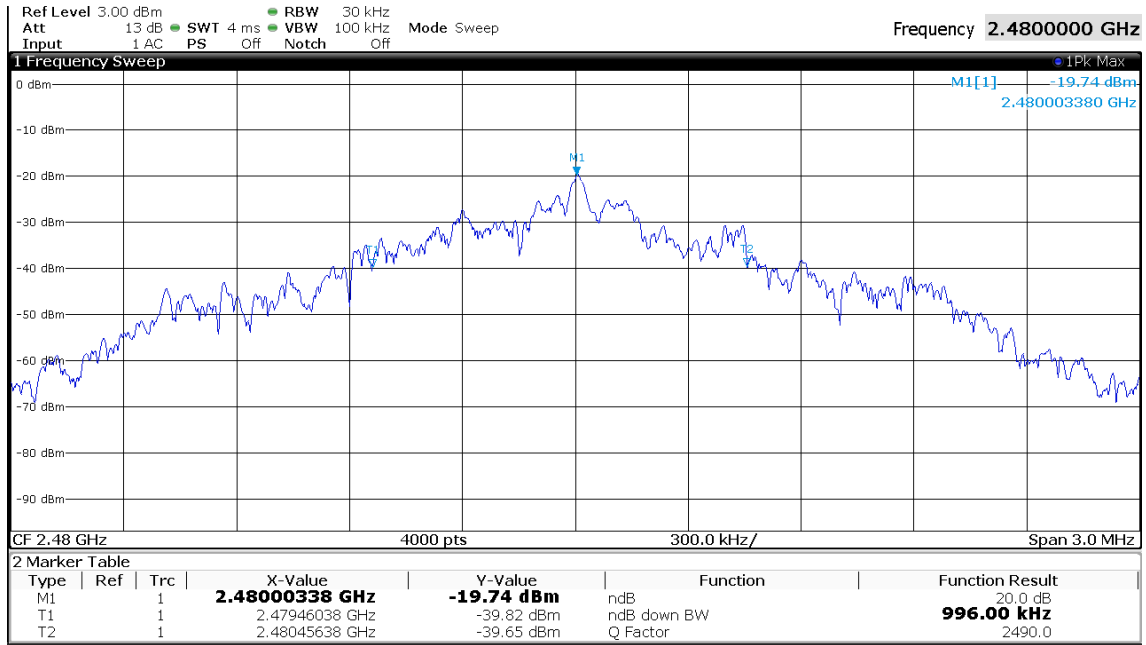
Remarks: For detailed test result please refer to following test protocols.

The OBW99 is measured for RSS only.

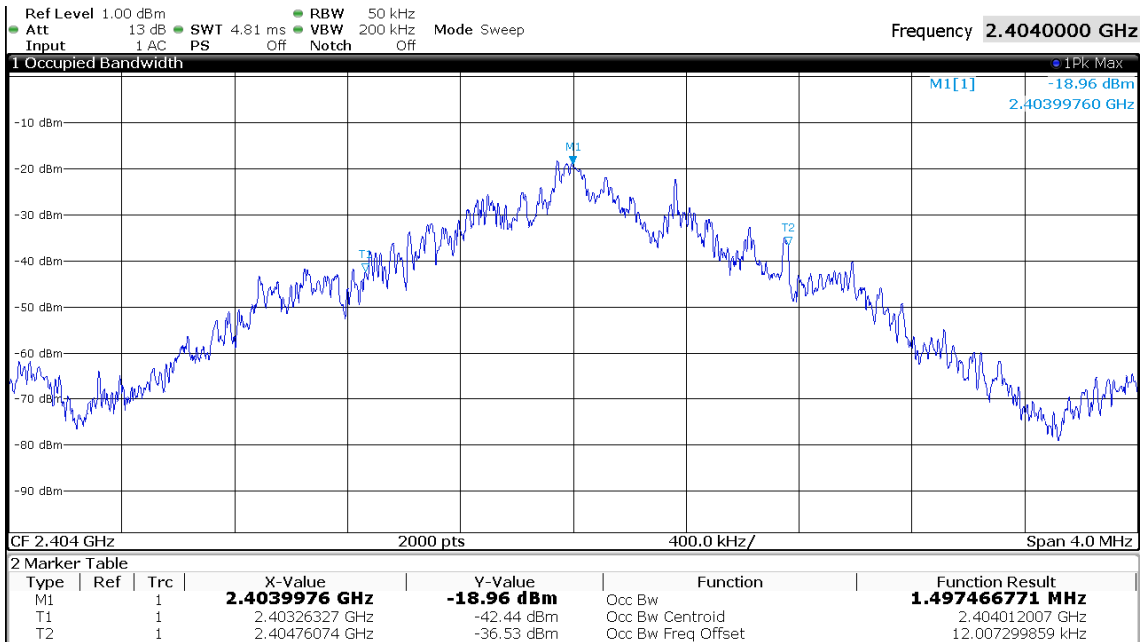
5.4.6 Test protocols

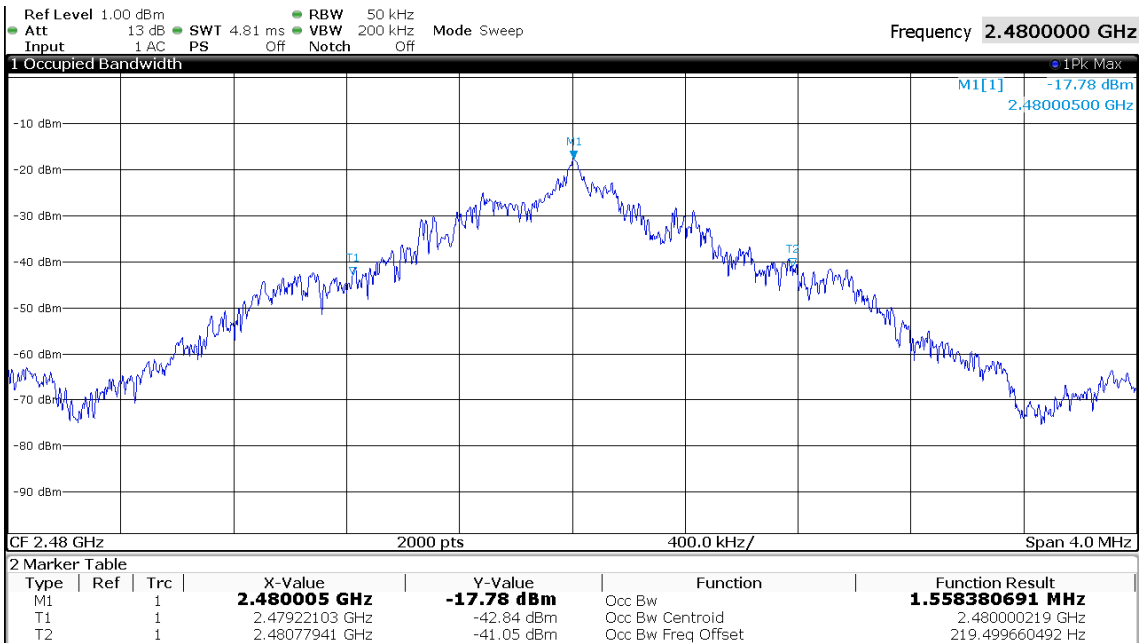
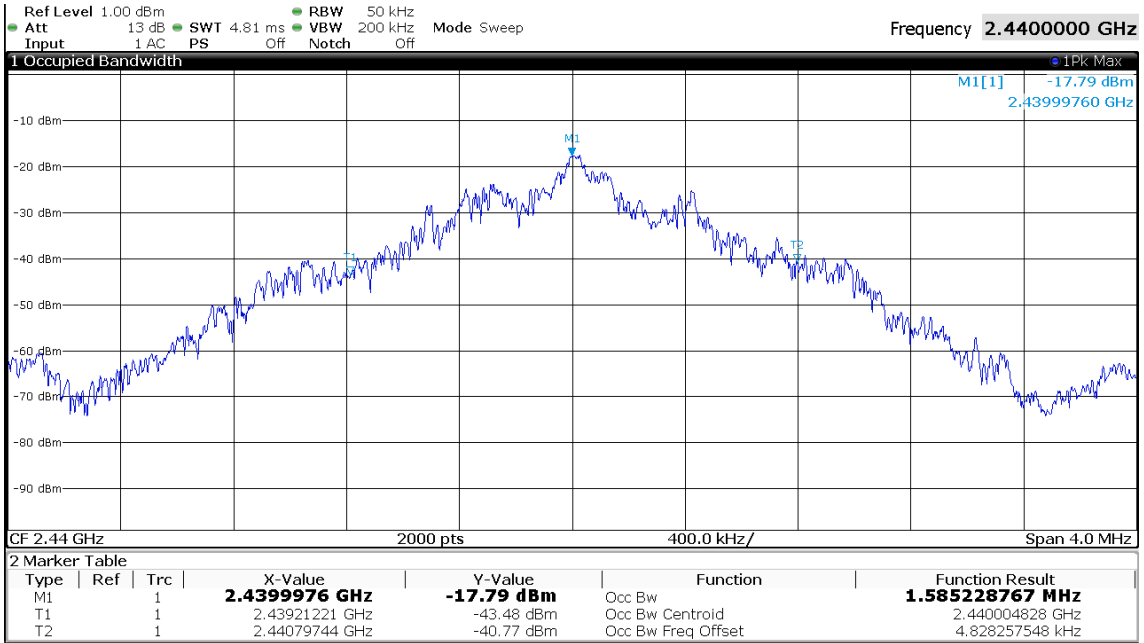
20 dB bandwidth





OBW 99%





5.5 Correction for pulse operation (duty cycle)

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

5.5.1 Description of the test location

Test location: AREA4

5.5.2 Photo documentation of the test set-up – See Attachment B

5.5.3 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.

5.5.4 Description of Measurement

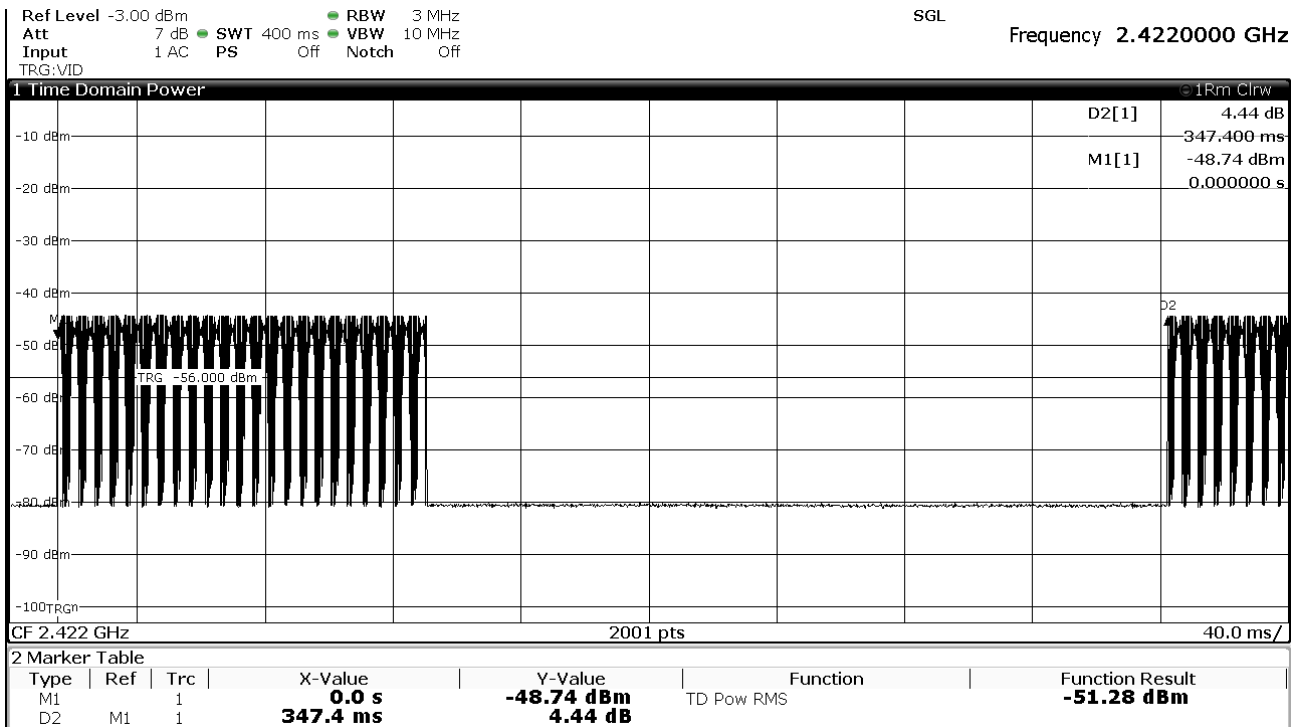
The duty cycle factor (dB) is calculated applying the following formula:

$$KE = 20 \log (t_{iw} / 0.1s)$$

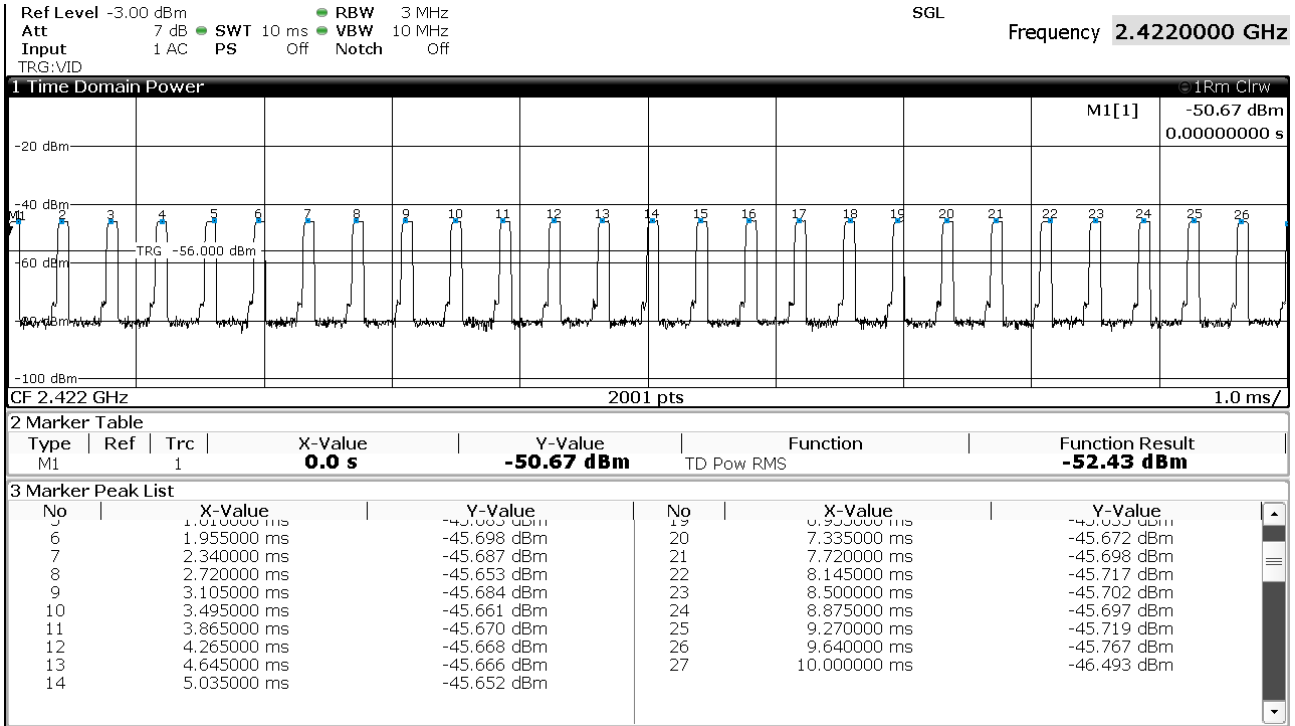
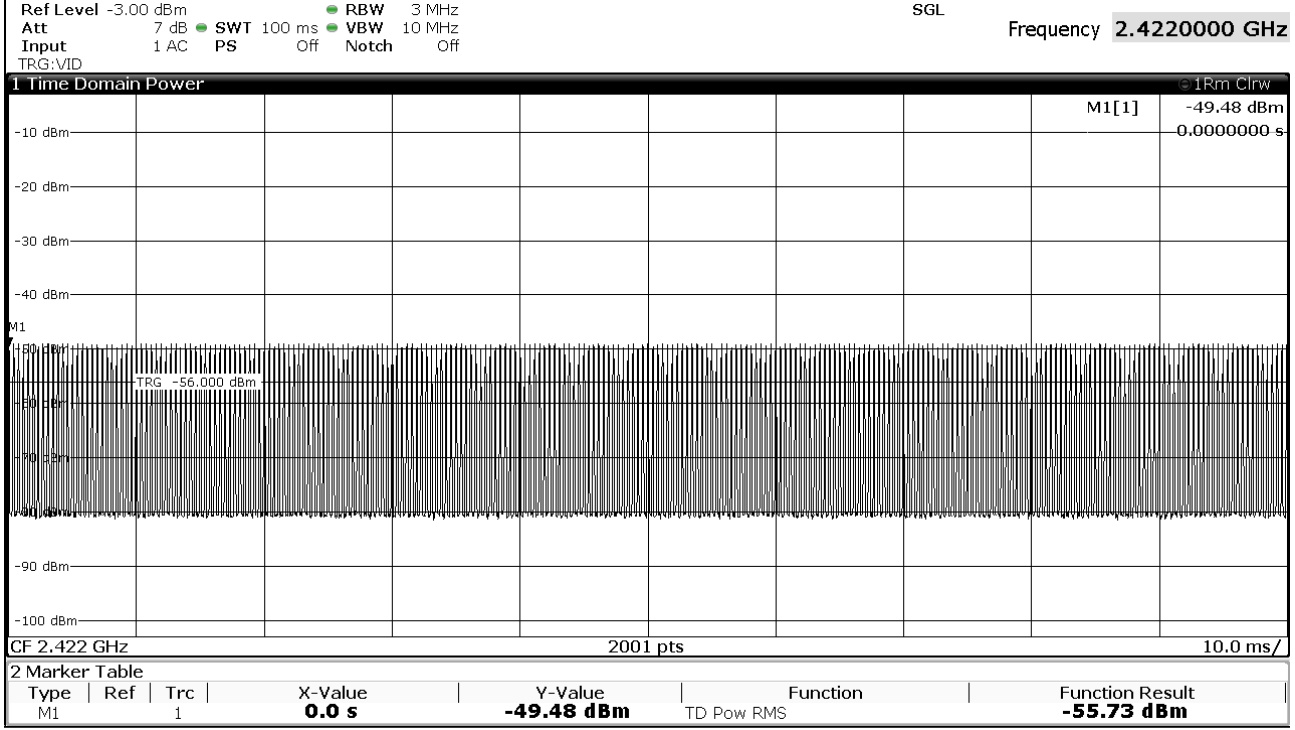
KE: pulse operation correction factor

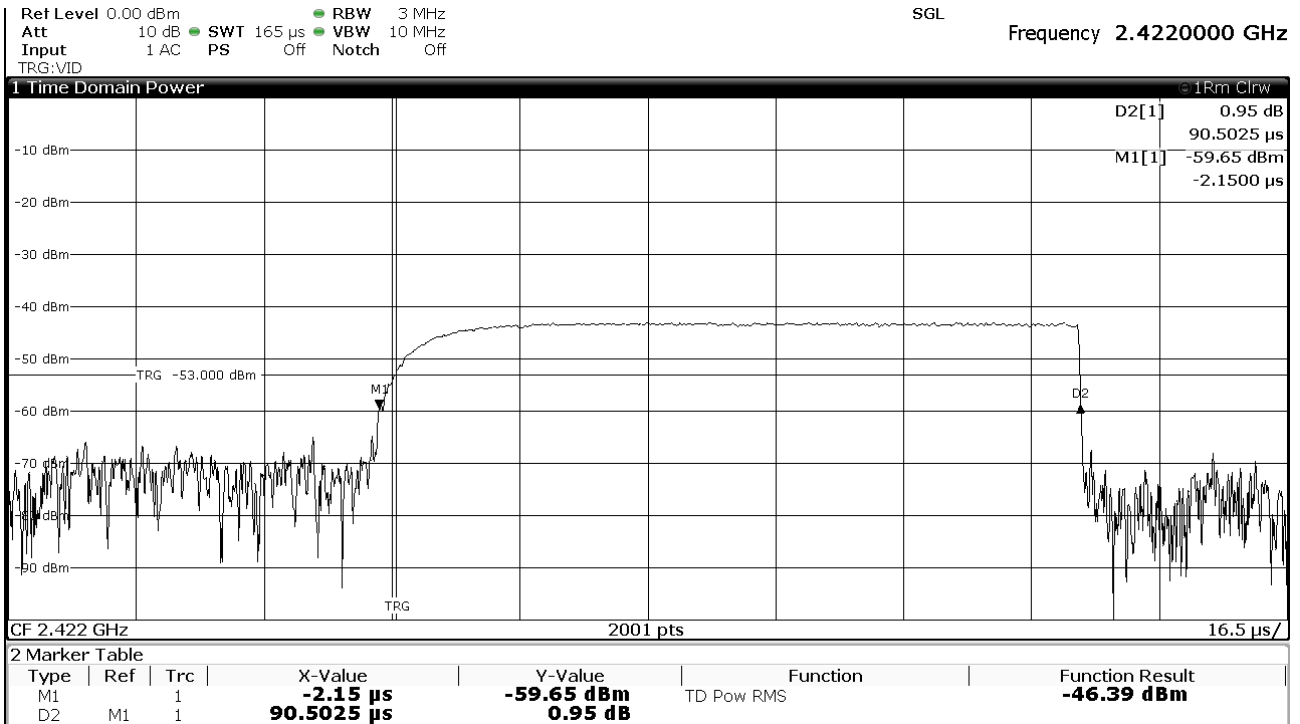
t_{iw} pulse duration for one complete pulse track

The pulse train exceeds 0.1s. Thus, the field strength is determined during a 100 ms interval.



5.5.5 Test result





$$K_E = 20 \log (25.65 \text{ ms} / 100 \text{ ms}) = -11.8 \text{ dB}$$

Total length of period	100 ms
Max. On time	25.650 ms
DC	0.2565
Correction factor	-11.8 dB

Remarks:

5.6 Antenna application

5.6.1 Applicable standard

According to FCC Part 15C, Section 15.203(a):

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

5.6.2 Result

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

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

The requirements are **FULFILLED**.

Remarks:

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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	02-02/11-15-001	19/03/2019	19/03/2018		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	08/05/2019	08/05/2018		
	18N-20	02-02/50-17-003				
	NMS111-GL200SC01-NMS11	02-02/50-17-012				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
DC	ESW26	02-02/03-17-002	13/12/2019	13/12/2018		
MB	EA-PS 3032-10B	01-05/50-11-011				
	ESW26	02-02/03-17-002	13/12/2019	13/12/2018		
SER 1	ESCI	02-02/03-15-001	11/06/2019	11/06/2018		
	HFH 2 - Z 2	02-02/24-05-020	09/08/2020	09/08/2017	15/01/2020	15/01/2019
	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				
	ANT1010A	02-02/50-16-034				
SER 2	ESVS 30	02-02/03-05-006	06/06/2019	06/06/2018		
	VULB 9168	02-02/24-05-005	18/04/2019	18/04/2018		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSP 40	02-02/11-11-001	17/10/2019	17/10/2018		
	FSW43	02-02/11-15-001	19/03/2019	19/03/2018		
	JS4-18004000-30-5A	02-02/17-05-017				
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	08/05/2019	08/05/2018		
	BBHA 9170	02-02/24-05-014	12/06/2021	12/06/2018	12/12/2019	12/12/2018
	WHJS 1000-10EE	02-02/50-05-070				
	WHK 3.0/18G-10EF	02-02/50-05-180				
	KMS102-1 m	02-02/50-11-014				
	KMS102-0.2 m	02-02/50-11-020				
	18N-20	02-02/50-17-003				
	NMS111-GL200SC01-NMS11	02-02/50-17-012				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				