

Test Report

of the accredited Testing Laboratory
0274 – TÜV AUSTRIA GMBH – Location Vienna - EMC Radio
ISED Laboratory Company Number: 2932K, CAB identifier: AT0001

Order Confirmation Number: 2024-AT-TC-EE-ET-EX-0-000005

About

the Radio - test listed below

Applicant: VusionGroup GmbH
Kalsdorfer Strasse 12
A – 8072 Fernitz-Mellach

Test object: Electronic shelf labelling system
Product Marketing Name: VPeg 1.3
Model: EDF5-0130-A
FCC-ID: 2ACQM-EDF5-0130-A
IC-ID: 12154A-EDF50130A

Serial number: Prototype

Accredited regulation: FCC: 47 CFR Part 15 (eCFR 05.11.2024)
RSS-210 Issue 11, June 2024
RSS-102 Issue 6, December 2023
ANSI C63.10-2020

Andreas Malek



Examined by / Testing Laboratory
TÜV AUSTRIA GMBH



Michael Emminger



Approved by / Testing Laboratory
TÜV AUSTRIA GMBH

The results of this test report only refer to the provided equipment.

Issued on 08.01.2025 in Vienna / TIC

Contents

	Designation	page
1.	Applicant	3
2.	Description of EUT	4
3.	Standards / Final result	5
4.	Test results	6-25
	List of measurements according to 47 CFR 15 and RSS-210	
4.1	Test object data	6
4.2	Number of channels and channel spacing	7
4.3	Duty Cycle for averaging	8
4.4	Field strength at 2400 – 2483,5 MHz	9-11
4.5	Emissions outside 2400 – 2483,5 MHz (15.209)	12-19
4.6	RF Exposure	20-22
Appendix	Designation	pages
1	Test equipment used	5
2	Photodocumentation	13

1. Applicant

Company: VusionGroup GmbH

Department: Product & Project Manager

Address: A – 8072 Fernitz-Mellach; Kalsdorfer Strasse 12

Contact person: Mrs. Tamara Risek-Gmajnic

EUT received on: 05.11.2024

Tests were performed on: 05.11. till 17.12.2024

2. Description of EUT

EUT:	Electronic shelf labelling system
Product Name:	VPeg 1.3
Model:	EDF5-0130-A
Serial Number:	Prototypes
Manufacturer:	VusionGroup GmbH A – 8072 Fernitz-Mellach; Kalsdorfer Strasse 12
Description:	VusionGroup GmbH provided the following configuration for the measurements: Prototype with special test-firmware for continuous transmission
Operating mode:	The measurements were carried out at the following running states: test-firmware running, transmitting continuously
Technical data EUT:	Rated voltage: 3VDC Rated frequency: DC Mains voltage during the tests: 3VDC internal battery Field strength: 2,74 mV/m average @ 3m distance Frequency range: 2404,053 - 2479,285 MHz 13,56 MHz (passive NFC) Channel separation: 0,35 MHz
Climatic conditions in the emc laboratory:	Relative humidity: 38% Temperature: 23°C

3. Standards / Final result

Name	Title	Deviation	Result
Title 47 CFR Part 15 eCFR 23.09.2024	RADIO FREQUENCY DEVICES	none	OK
RSS-210 Issue 11, June 2024	Licence-Exempt Radio Apparatus: Category I Equipment	none	OK
RSS-102 Issue 6, December 2023	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)	none	OK
ANSI C63.10-2020	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	none	OK
Result: Opinions and interpretation of testing laboratory OK: EUT passed NOK: EUT failed			

4. Test results

4.1 TEST OBJECT DATA

General EUT Description

This transceiver is working in a network consisting of a controller station, so called Accesspoint, and various displays. The Accesspoint transmits information to the displays and receives acknowledgements. This device is a display operating in the network system. The device is equipped with a passive NFC chip onboard which does not have its own rf generation. It works as tag and can also receive information from the NFC reader station.

2.1033 (c) Technical description

2.1033 (4) Type of emission: Minimum shift keying – declared channel bandwidth 250 kHz – 'virtual' channel spacing about 0,35 MHz. Only 11 channels from the channel plan are used, therefore the channel spacing in reality is much higher and varies from 2,45 MHz minimum up to 17,15 MHz.

2.1033 (5) Frequency range: 2404,053 – 2479,285 MHz (channel center frequencies of channel 0 up to ch. 10)

2.1033 (6) Power range and Controls: The maximum field strength measured is 2,74 mV/m average @ 3m distance. There is no power control or regulation.

2.1033 (7) Maximum output power rating: 2,74 mV/m average @ 3m distance.

2.1033 (8) DC Voltage and Current: 3 VDC (internal battery)
maximum current consumption: 28,0mA during continuous transmission

RSS-135 This standard does not apply to:

- 1.1.(a) a receiver that scans radio frequencies for the purpose of enabling its associated transmitter to avoid transmitting in an occupied frequency but which does not have the capability of decoding the message (e.g. converting it to audio voice) contained in the radio signal

Worst case Spurious Emissions: 26,02 dBµV/m Peak at 132,57MHz

Tests were performed on: November 5th till December 17th 2024.

4.2 Number of channels and channel spacing

§ 2.1033

Channel plan:

ESL-CH	RF-CH	f_{G2} [GHz] (26.000000 MHz) (6049109)
CH0	12	2.404053
CH1	29	2.410002
CH2	63	2.421899
CH3	71	2.424698
CH4	120	2.441844
CH5	141	2.449192
CH6	177	2.461789
CH7	199	2.469487
CH8	213	2.474386
CH9	220	2.476835
CH10	227	2.479285

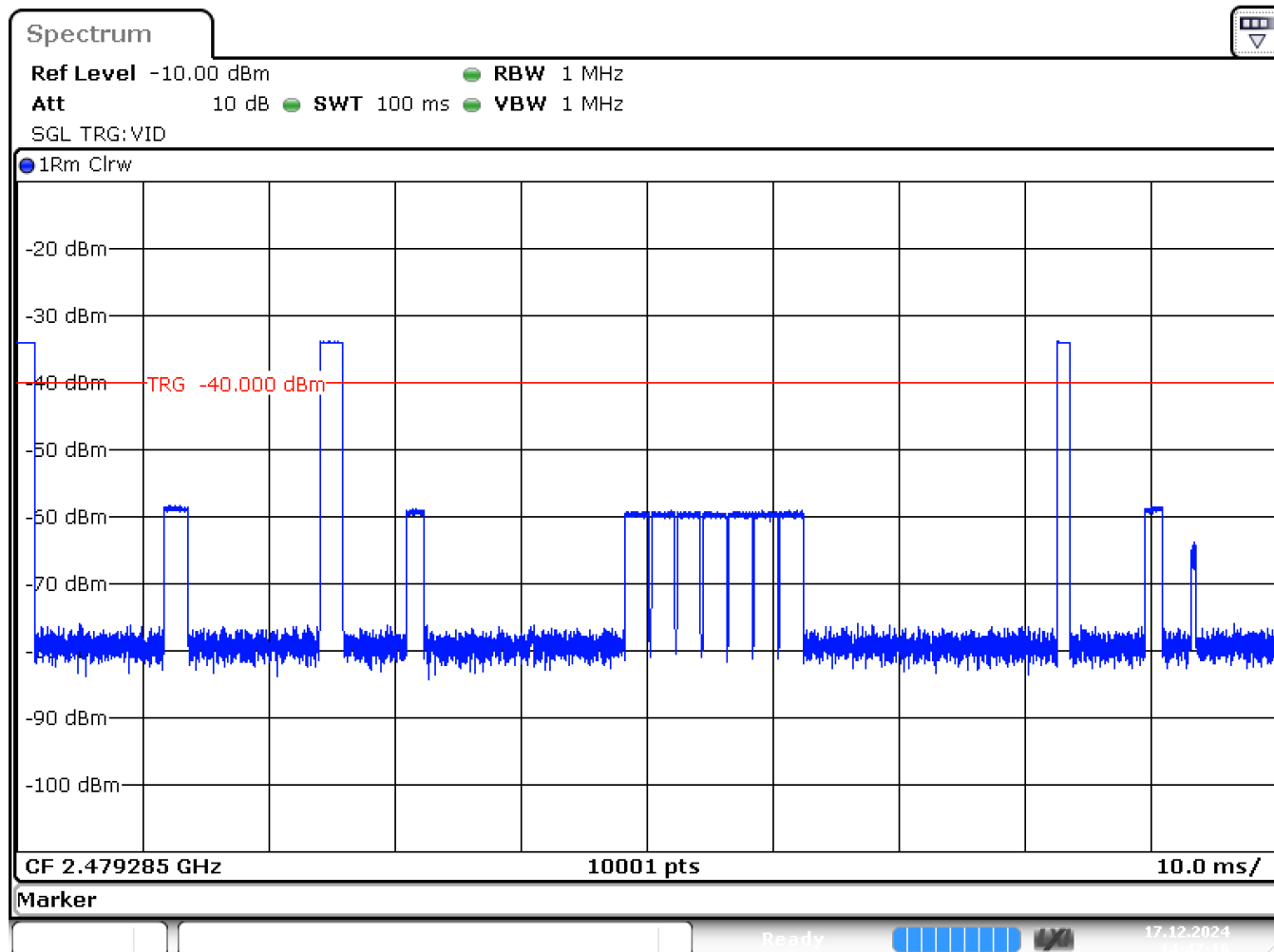
Tests were performed on ESL channels 0, 4 and 10.

Test Equipment used: N/A

4.3 Duty Cycle measurements for averaging

§ 15.249 (e)

Mode: data transmission (worst case in 100ms)



Date: 17.DEC.2024 14:47:16

According to the timing protocol description provided by the manufacturer and attached as technical description to the application for certification, the transmission burst time was checked to not exceed the declared value. The declared value was taken for calculation, as that gives the worst case. The first transmission burst in a 100ms time frame has a length of 1,46ms, the second one is 1,97ms in length and the third one is 1,19ms, giving a duty cycle of 4,62% or an average factor of -26,7 dB. The weaker emissions below -50 dBm are from the access point that was used to send the query.

LIMIT SUBCLAUSE 15.249(e)

(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. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

Test Equipment used: EMV-205

Grundvorlage / Basic Template: FM-TAGMBH-KBS-0100b Grundvorlage Prüfbericht akkreditiert-EN, Rev. 04

4.4 Field strength of emissions at 2400 – 2483,5 MHz

§ 15.249 (a) (c)

Operating on CH 0 (2404,053MHz)

The maximum peak value measured was 95,4 dBµV/m = 59,16 mV/m at 3m distance, see section 4.5.

With the averaging factor calculated on page 8 of this test report of -26,7 dB the maximum average value is then 68,74 dBµV/m = 2,74 mV/m at 3m distance.

LIMIT SUBCLAUSE 15.249(a) (c)

(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:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

(c) Field strength limits are specified at a distance of 3 meters.

Test Equipment used: EMV-100; EMV-101; EMV-102; EMV-103; EMV-105; EMV-110; EMV-200/1

Field strength of emissions at 2400 – 2483,5 MHz

§ 15.249 (a) (c)

Operating on CH 4 (2441,844 MHz)

The maximum peak value measured was 95,0 dBµV/m = 56,36 mV/m at 3m distance, see section 4.5.

With the averaging factor calculated on page 8 of this test report of -26,7 dB the maximum average value is then 68,32 dBµV/m = 2,61 mV/m at 3m distance.

LIMIT **SUBCLAUSE 15.249(a) (c)**

(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:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

(c) Field strength limits are specified at a distance of 3 meters.

Test Equipment used: EMV-100; EMV-101; EMV-102; EMV-103; EMV-105; EMV-110; EMV-200/1

Field strength of emissions at 2400 – 2483,5 MHz

§ 15.249 (a) (c)

Operating on CH 10 (2479,285 MHz)

The maximum peak value measured was 95,0 dBµV/m = 56,36 mV/m at 3m distance, see section 4.5.

With the averaging factor calculated on page 8 of this test report of -26,7 dB the maximum average value is then 68,32 dBµV/m = 2,61 mV/m at 3m distance.

LIMIT **SUBCLAUSE 15.249(a) (c)**

(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:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

(c) Field strength limits are specified at a distance of 3 meters.

Test Equipment used: EMV-100; EMV-101; EMV-102; EMV-103; EMV-105; EMV-110; EMV-200/1

4.5 Emissions outside 2400 – 2483,5 MHz**§ 15.249 (d) (e)****Channel 0 (2404,053 MHz) – average values above 1 GHz are shown in magenta – green = peak****Measuring apparatus parameters 9 kHz to 150 kHz**

Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	9 kHz	9 kHz	Detector	Max Peak	Quasi Peak
Stop frequency	150 kHz	150 kHz	Measuring time	10 ms	1 s
Stepsize	50 Hz	50 Hz	RF-attenuation	0dB	0dB
IF- Bandwidth	200 Hz	200 Hz	Preamplifier	20 dB	20 dB

Measuring apparatus parameters 150 kHz to 30 MHz

Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	150 kHz	150 kHz	Detector	Max Peak	Quasi Peak
Stop frequency	30 MHz	30 MHz	Measuring time	10 ms	1 s
Stepsize	2.25 kHz	2.25 kHz	RF-attenuation	0dB	0dB
IF- Bandwidth	9 kHz	9 kHz	Preamplifier	20 dB	20 dB

Measuring apparatus parameters 30 MHz to 1000 MHz

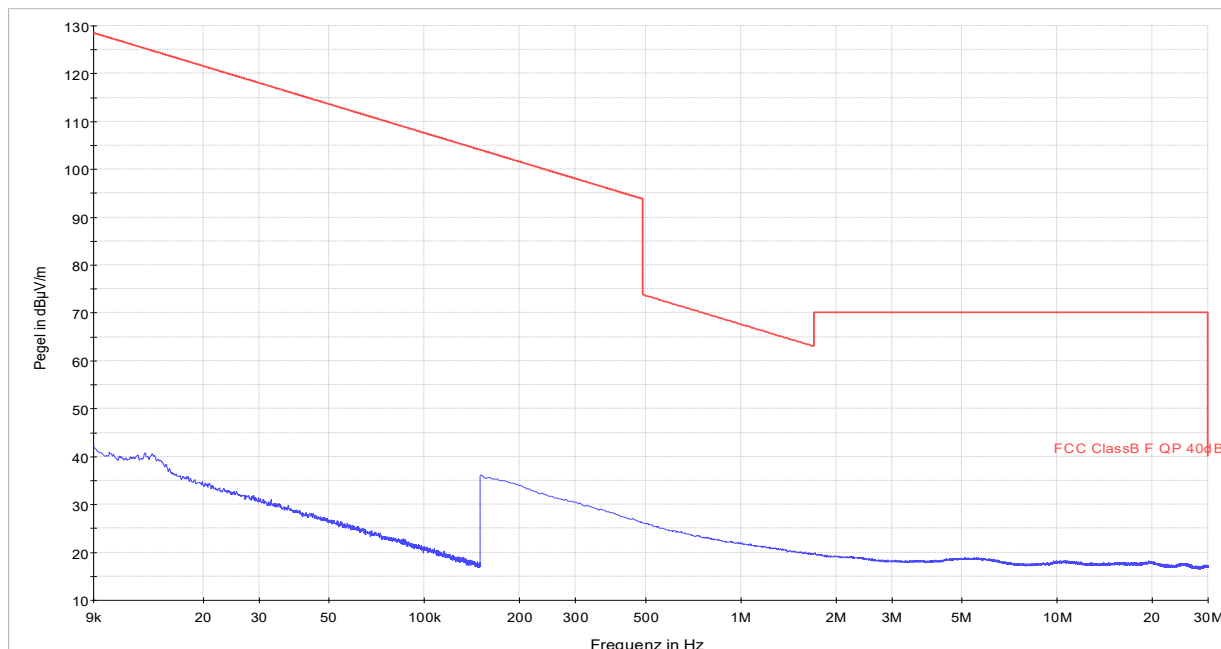
Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	30 MHz	30 MHz	Detector	Max Peak	Quasi Peak
Stop frequency	1000 MHz	1000 MHz	Measuring time	10 ms	1 s
Stepsize	30 kHz	30 kHz	RF-attenuation	0dB	0dB
IF- Bandwidth	120 kHz	120 kHz	Preamplifier	20 dB	20 dB

Measuring apparatus parameters 1 GHz to 25 GHz

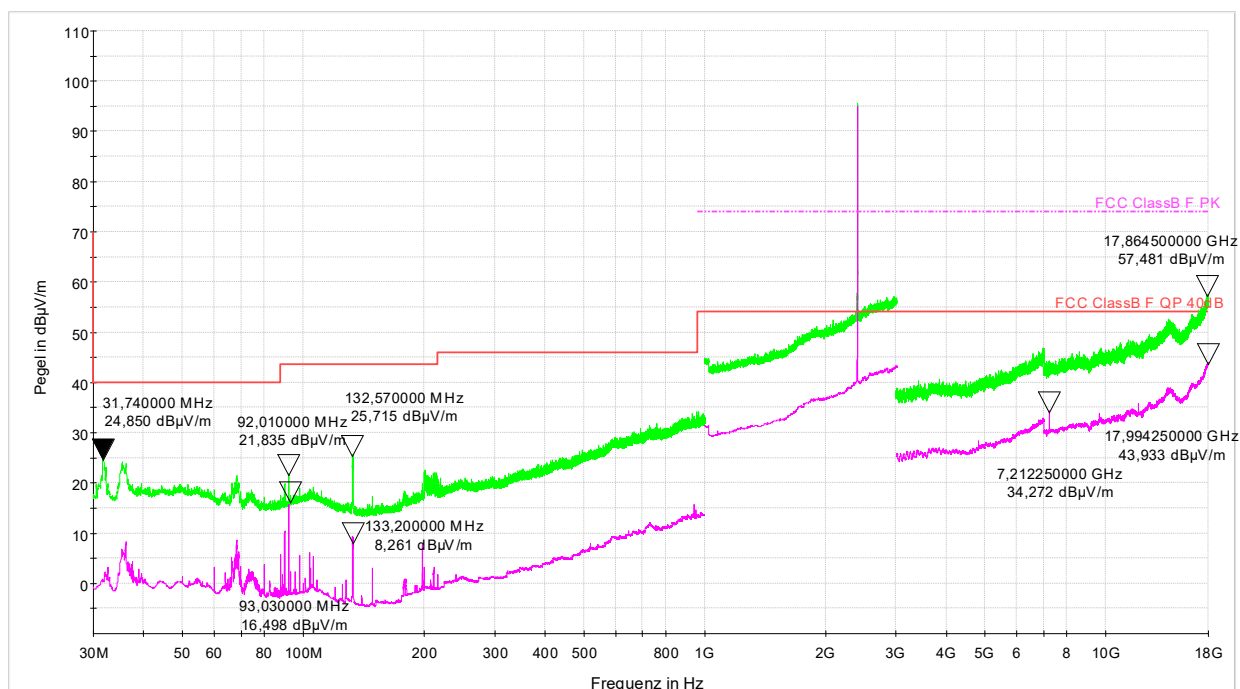
Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	1 GHz	1 GHz	Detector	Max Peak / Average	Max Peak / Average
Stop frequency	25 GHz	25 GHz	Measuring time	100 ms	100 ms
Stepsize	250 kHz	250 kHz	RF-attenuation	0dB	0dB
IF- Bandwidth	1 MHz	1 MHz	Preamplifier	20 dB	20 dB

Emissions outside 2400 – 2483,5 MHz**§ 15.249 (d) (e)****Channel 0 (2404,053 MHz) – average values above 1 GHz are shown in magenta – green = peak**

The NFC part of the EUT was powered on during the test.



— QPK_MAXH(1):VPeg_1.3_BWRY_CH0_F0 [VPeg_1.3_BWRY_CH0_F0.Result:2] QPK_CLRWR [Ergebnistabelle.Result:1]
 — FCC ClassB F QP 40dB [..EMI radiated\] QPK_MAXH [Ergebnistabelle.Result:2]



— PK+_MAXH(1):VPeg_1.3_BWRY_CH0_F1 AVG_MAXH(1):VPeg_1.3_BWRY_CH0_F1 PK+_MAXH(1):VPeg_1.3_BWRY_CH0_F2
 — AVG_MAXH(1):VPeg_1.3_BWRY_CH0_F2 FCC ClassB F QP 40dB FCC ClassB F PK
 — PK+_MAXH(1):VPeg_1.3_BWRY_CH0_F3 AVG_MAXH(1):VPeg_1.3_BWRY_CH0_F3 PK+_CLRWR
 — PK+_MAXH AVG_CLRWR AVG_MAXH

Worst case Emission: 24,85 dB μ V/m Peak at 31,74 MHz.

Frequency (MHz)	Value (dB μ V/m) without duty-cycle	Value (dB μ V/m) with duty cycle
31,74	24,85 PK	24,85 PK
92,01	21,84 PK	21,84 PK
132,57	25,72 PK	25,72 PK
7212,3	34,27 AVG	7,57 AVG
17864,5	57,48 PK	57,48 PK
17994,3	43,93 AVG	43,93 AVG

Remark: Although the measurements were made up to the 10th harmonic (25 GHz) the frequency range above 18 GHz is not automatized, so no graphs are available. Nevertheless, no emissions above noise level were found in the frequency range above 18 GHz.

LIMIT SUBCLAUSE 15.249(d) (e) (15.209)

(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.

(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. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

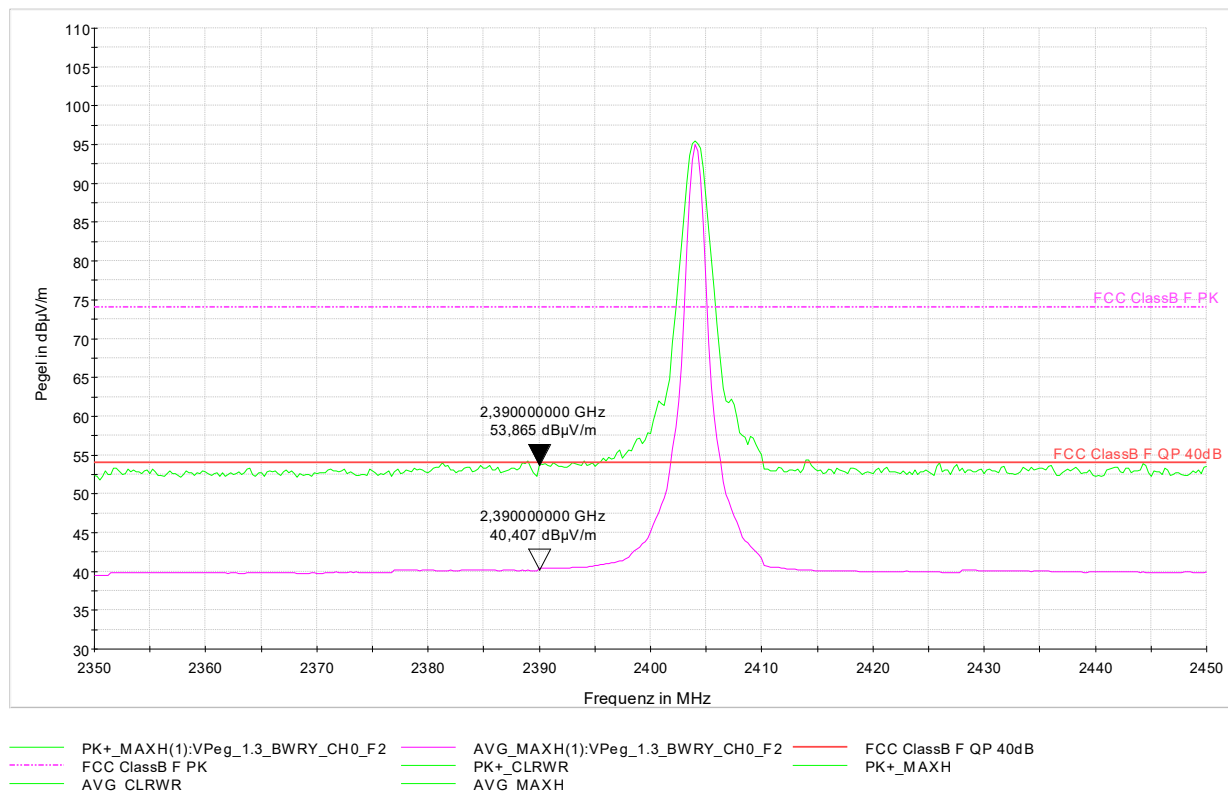
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100**	3
88–216	150**	3
216–960	200**	3
Above 960	500	3

Test Equipment used:

EMV-100; EMV-101; EMV-102; EMV-103; EMV-105; EMV-110; EMV-111; EMV-112; EMV-200/1; NT-416

Emissions outside 2400 – 2483,5 MHz

§ 15.249 (d) (e), § 15.212(c)

Channel 0 (2404,053 MHz) – band edge requirement – average values are in magenta – green = peak

Nearest Band Edge: 2390 MHz

Frequency band (§ 15.249): 2400-2483.5 MHz

The 20 dB bandwidth of the emission is fully contained within the frequency band.

LIMIT SUBCLAUSE 15.249(d) (e) (15.209)

(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.

(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. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	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

LIMIT SUBCLAUSE 15.212(c)

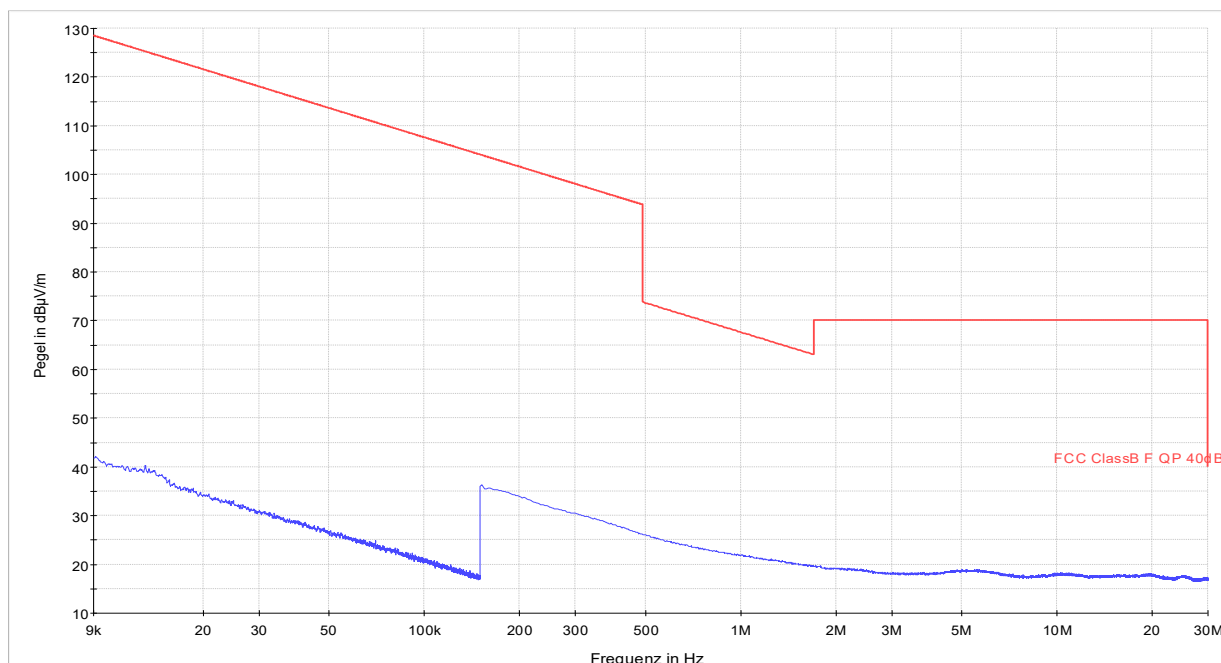
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Test Equipment used:

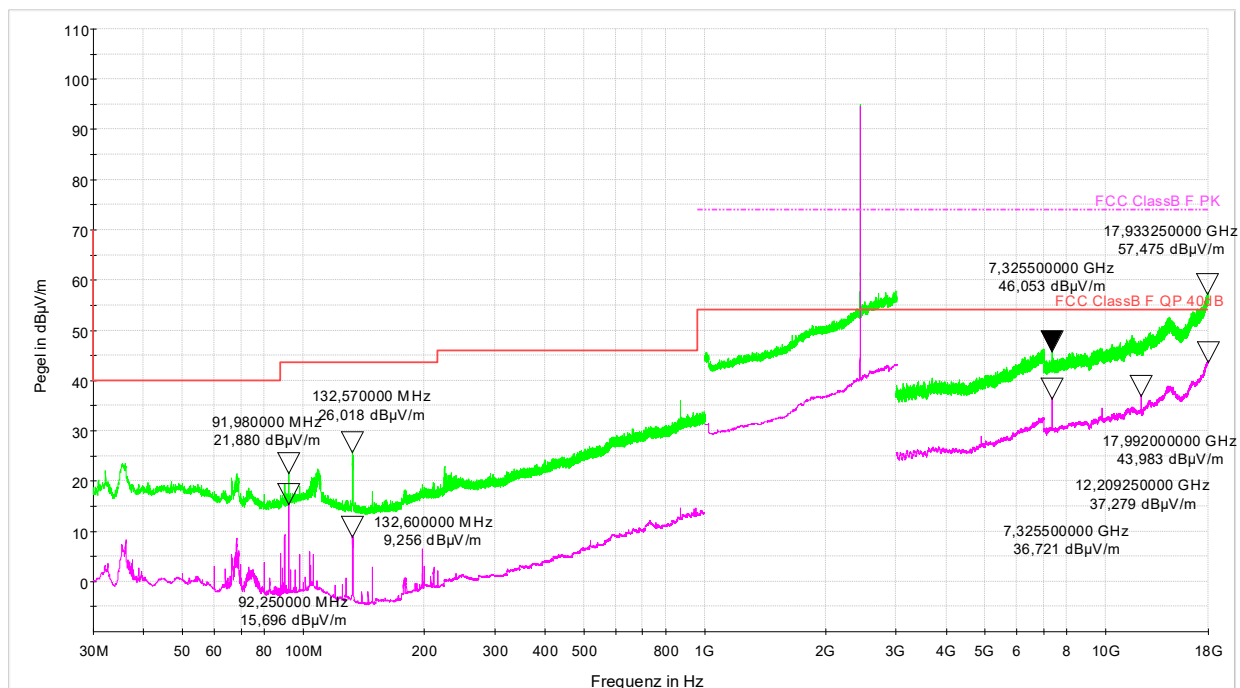
EMV-100; EMV-101; EMV-102; EMV-103; EMV-105; EMV-110; EMV-111; EMV-112; EMV-200/1; NT-416

Emissions outside 2400 – 2483,5 MHz**§ 15.249 (d) (e)****Channel 4 (2441,844 MHz) – average values above 1 GHz are shown in magenta – green = peak**

The NFC part of the EUT was powered on during the test.



— QPK_MAXH(1):VPeg_1.3_BWRY_CH4_F0 [VPeg_1.3_BWRY_CH4_F0.Result2] — QPK_CLRWR [Ergebnistabelle.Result:1]
 — FCC ClassB F QP 40dB [...]EMI radiated] — QPK_MAXH [Ergebnistabelle.Result2]



— PK+_MAXH(1):VPeg_1.3_BWRY_CH4_F3 — AVG_MAXH(1):VPeg_1.3_BWRY_CH4_F3 — PK+_MAXH(1):VPeg_1.3_BWRY_CH4_F2
 — AVG_MAXH(1):VPeg_1.3_BWRY_CH4_F2 — FCC ClassB F QP 40dB — PK+_MAXH(1):VPeg_1.3_BWRY_CH4_F1
 — PK+_MAXH(1):VPeg_1.3_BWRY_CH4_F1 — AVG_MAXH(1):VPeg_1.3_BWRY_CH4_F1 — PK+_CLRWR
 — PK+_MAXH — AVG_CLRWR — AVG_MAXH

Grundvorlage / Basic Template: FM-TAGMBH-KBS-0100b Grundvorlage Prüfbericht akkreditiert-EN, Rev. 04

Worst case Emission: 26,02 dB μ V/m Peak at 132,57MHz.

Frequency (MHz)	Value (dB μ V/m) without duty-cycle	Value (dB μ V/m) with duty cycle
91,98	21,88 PK	21,88 PK
132,57	26,02 PK	26,02 PK
7325,5	36,72 AVG	10,02 AVG
7325,5	46,05 PK	46,05 PK
12209,3	43,98 AVG	17,28 AVG
17933,3	57,48 PK	57,48 PK

Remark: Although the measurements were made up to the 10th harmonic (25 GHz) the frequency range above 18 GHz is not automatized, so no graphs are available. Nevertheless, no emissions above noise level were found in the frequency range above 18 GHz.

LIMIT SUBCLAUSE 15.249(d) (e) (15.209)

(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.

(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. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

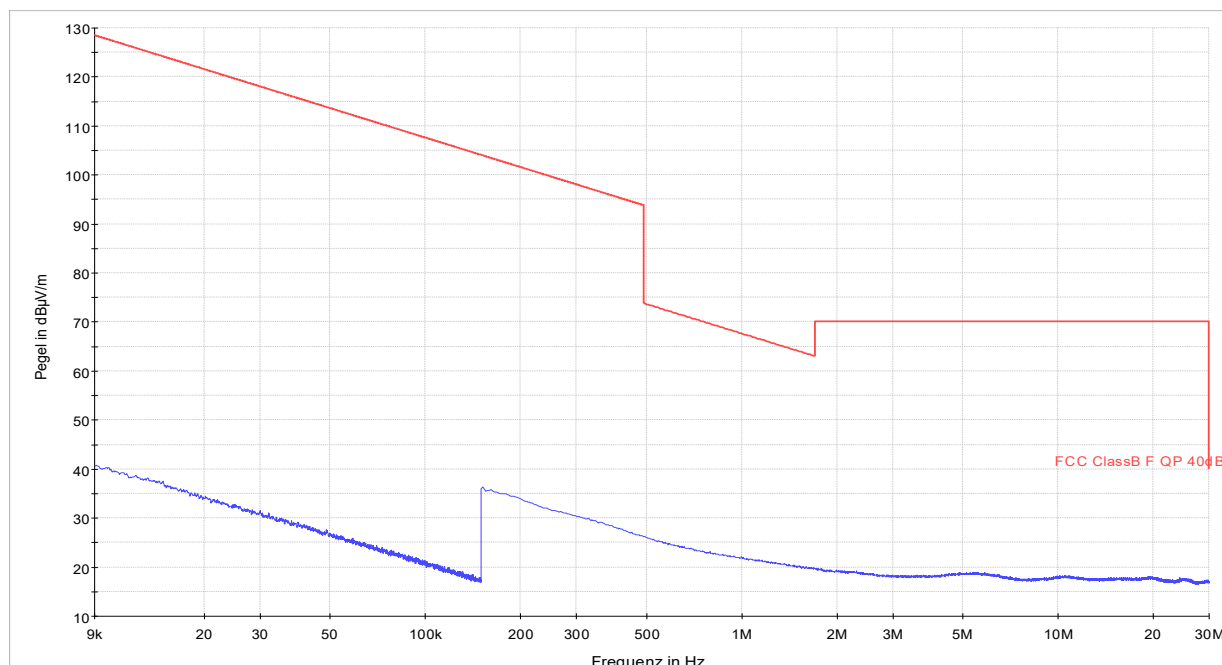
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100**	3
88–216	150**	3
216–960	200**	3
Above 960	500	3

Test Equipment used:

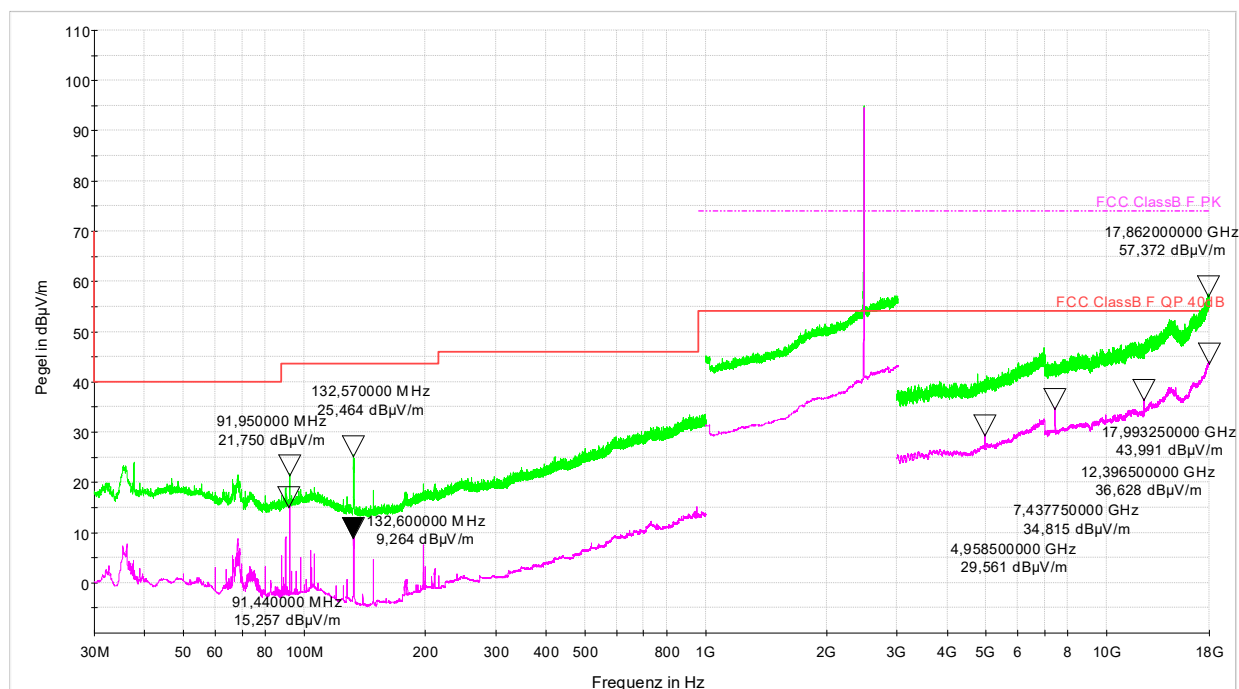
EMV-100; EMV-101; EMV-102; EMV-103; EMV-105; EMV-110; EMV-111; EMV-112; EMV-200/1; NT-416

Emissions outside 2400 – 2483,5 MHz**§ 15.249 (d) (e)****Channel 10 (2479,285 MHz) – average values above 1 GHz are shown in magenta – green = peak**

The NFC part of the EUT was powered on during the test.



QPK_MAXH(1):VPeg_1.3_BWRY_CH10_F0 [VPeg_1.3_BWRY_CH10_F0.Result2] QPK_CLRWR [Ergebnistabelle.Result1]
 FCC ClassB F QP 40dB [...]EMI radiated] QPK_MAXH [Ergebnistabelle.Result2]



PK+ _MAXH(1):VPeg_1.3_BWRY_CH10_F1 AVG _MAXH(1):VPeg_1.3_BWRY_CH10_F1 PK+ _MAXH(1):VPeg_1.3_BWRY_CH10_F2
 AVG _MAXH(1):VPeg_1.3_BWRY_CH10_F2 FCC ClassB F QP 40dB
 PK+ _MAXH(1):VPeg_1.3_BWRY_CH10_F3 AVG _MAXH(1):VPeg_1.3_BWRY_CH10_F3 PK+ _CLRWR
 PK+ _MAXH AVG _CLRWR AVG _MAXH

Grundvorlage / Basic Template: FM-TAGMBH-KBS-0100b Grundvorlage Prüfbericht akkreditiert-EN, Rev. 04

Worst case Emission: 25,46 dB μ V/m Peak at 132,57 MHz.

Frequency (MHz)	Value (dB μ V/m) without duty-cycle	Value (dB μ V/m) with duty cycle
91,95	21,75 PK	21,75 PK
132,57	25,46 PK	25,46 PK
4958,5	29,56 AVG	2,86 AVG
7437,8	34,82 AVG	8,12 AVG
12396,5	36,63 AVG	9,93 AVG
17862,0	57,37 PK	57,37 PK

Remark: Although the measurements were made up to the 10th harmonic (25 GHz) the frequency range above 18 GHz is not automatized, so no graphs are available. Nevertheless, no emissions above noise level were found in the frequency range above 18 GHz.

LIMIT SUBCLAUSE 15.249(d) (e) (15.209)

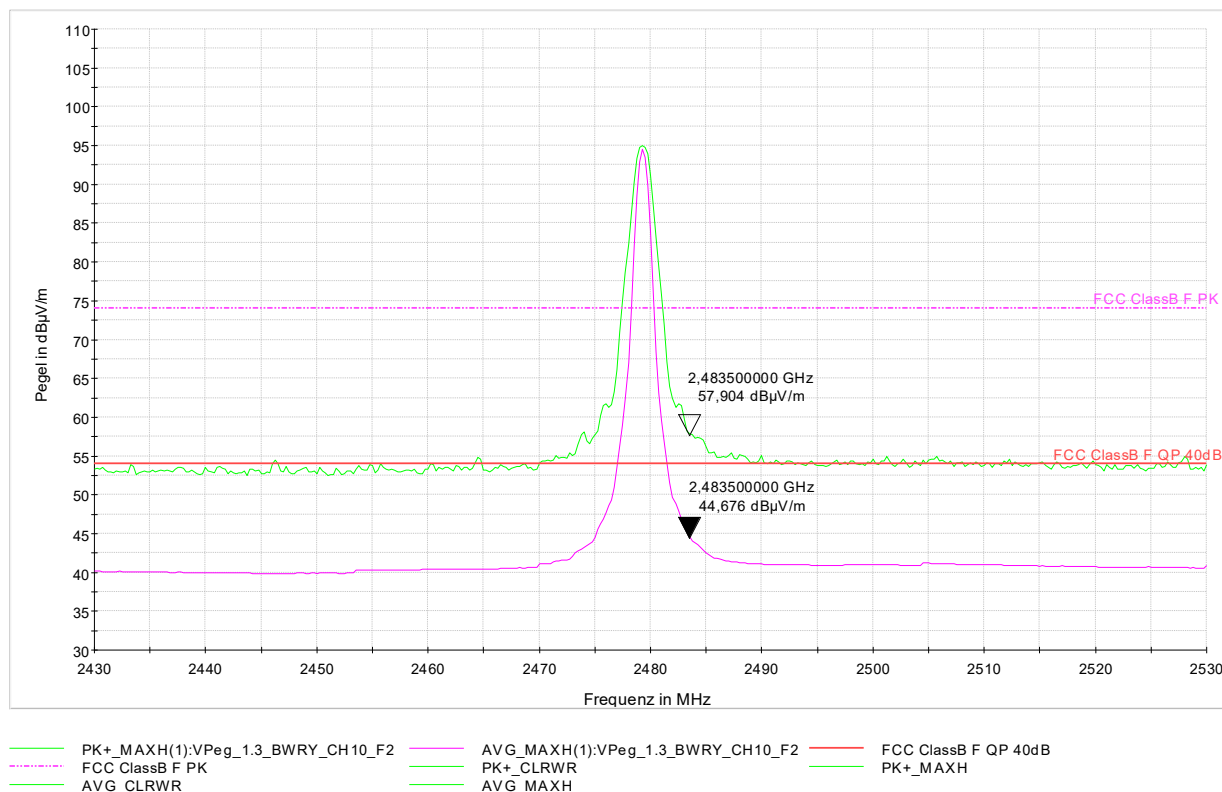
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(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. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	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

Test Equipment used:

EMV-100; EMV-101; EMV-102; EMV-103; EMV-105; EMV-110; EMV-111; EMV-112; EMV-200/1; NT-416

Emissions outside 2400 – 2483,5 MHz**§ 15.249 (d) (e), § 15.212(c)****Channel 10 (2479,285 MHz) – band edge requirement – average values are in magenta – green = peak**

Nearest Band Edge: 2483,5 MHz

Frequency band (§ 15.249): 2400-2483.5 MHz

The 20 dB bandwidth of the emission is fully contained within the frequency band.

LIMIT SUBCLAUSE 15.249(d) (e) (15.209)

(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.

(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. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	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

LIMIT SUBCLAUSE 15.212(c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Test Equipment used:

EMV-100; EMV-101; EMV-102; EMV-103; EMV-105; EMV-110; EMV-111; EMV-112; EMV-200/1; NT-416

4.6 RF Exposure

§ 1.1307(b)(3)(i)(A)

Title 47 §1.1307(b)(3)(i):

(3) Determination of exemption. (i) For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

max. Tx power [mW] (from conducted and ERP measurement)	Duty cycle [%] (see 4.3)	max. time-averaged power [mW]	§1.1307(b)(3)(i)(A) limit [mW]
1,32	4,62	0,061	1

The maximum time-averaged power is less than 1 mW.

The device is an *exempt RF device* as per Title 47 §1.1307(b)(3)(i)(A).

ERP measurement:		Effective radiated power (mW)		
Test condition		CH 0 (2404,053MHz)	CH 4 (2441,844MHz)	CH 10 (2479,285MHz)
T _{nom} 23 °C	V _{nom} (3)V	0,64	0,58	0,58

EIRP measurement:		Effective isotropically radiated power (mW)		
Test condition		CH 0 (2404,053MHz)	CH 4 (2441,844MHz)	CH 10 (2479,285MHz)
T _{nom} 23 °C	V _{nom} (3)V	1,06	0,96	0,96

Conducted measurement		conducted power (mW)		
Test condition		CH 0 (2404,053MHz)	CH 4 (2441,844MHz)	CH 10 (2479,285MHz)
T _{nom} 23 °C	V _{nom} (3)V	1,27	1,29	1,32

Maximum Gain derived from EIRP and conducted measurement:		Maximum Gain (dBi)		
Test condition		CH 0 (2404,053MHz)	CH 4 (2441,844MHz)	CH 10 (2479,285MHz)
T _{nom} 23 °C	V _{nom} (3)V	-0,79	-1,28	-1,37

RF Exposure

RSS-102, Issue 6

6.3 SAR exemption limits

Devices operating at or below the applicable output power levels (adjusted for tune-up tolerance) specified in table 11, based on the separation distance, are exempt from SAR evaluation. The separation distance, defined as the distance between the user and/or bystander and the antenna and/or radiating element of the device or the outer surface of the device, shall be less than or equal to 20 cm for these exemption limits to apply.

Table 11: Power limits for exemption from routine SAR evaluation based on the separation distance

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm (mW)	At separation distance of 10 mm (mW)	At separation distance of 15 mm (mW)	At separation distance of 20 mm (mW)	At separation distance of 25 mm (mW)
≤300	45	116	139	163	189
450	32	71	87	104	124
835	21	32	41	54	72
1900	6	10	18	33	57
2450	3	7	16	32	56
3500	2	6	15	29	50
5800	1	5	13	23	32

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm (mW)	At separation distance of 35 mm (mW)	At separation distance of 40 mm (mW)	At separation distance of 45 mm (mW)	At separation distance of ≥50 mm (mW)
≤300	216	246	280	319	362
450	147	175	208	248	296
835	96	129	172	228	298
1900	92	138	194	257	323
2450	89	128	170	209	245
3500	72	94	114	134	158
5800	41	54	74	102	128

The exemption limits in table 11 Table 11 are based on measurements and simulations of half-wave dipole antennas at separation distances of 5 mm to 50 mm from a flat phantom, which provides a SAR value of approximately 0.4 W/kg for 1 g of tissue.

For limb-worn devices where the 10 gram of tissue applies, the exemption limits for routine evaluation in table 11 are multiplied by a factor of 2.5.

For controlled-use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in table 11 Table 11 are multiplied by a factor of 5.

When the operating frequency of the device is between two frequencies located in table 11, linear interpolation shall be applied for the applicable separation distance. If the separation distance of the device is between two distances located in table 11, linear interpolation may be applied for the applicable frequency. Alternatively, the limit corresponding to the smaller distance may be employed. For example, in case of a 7 mm separation distance, either use the exception value for a 5 mm separation distance or interpolate between the limits corresponding to 5 mm and 10 mm separation distances.

For implanted medical devices, the exemption limit for routine SAR evaluation is set at an output power of 1 mW, regardless of frequency.

RSS-102 Exemption calculation

Frequency (MHz)	cond. P (mW)	max. EIRP (mW)	Duty Cycle (1)	Avg. cond. P (mW)	Avg. EIRP (mW)	separation distance (mm)	Limit (mW)	
2404.053	1,27	1,06	0,0462	0,059	0,062	5	8,13	OK
2441.844	1,29	0,96	0,0462	0,060	0,056	5	7,61	OK
2479.285	1,32	0,96	0,0462	0,061	0,056	5	7,43	OK

*) Calculations are done for a minimum separation distance that's derived from the antenna distance to the device casing and limb worn exposure. It is conservative, as customers are not expected to touch electronic shelf labels for extended periods of time.

The time-averaged output power is below the exemption limit for routine evaluation.

Appendix 1

Test equipment used

☐	Anechoic Chamber with 3m measurement distance	NT-100	☐	Ant. tripod for EN61000-4-3 Model TP1000A	NT-156
☐	Stripline according to ISO 11452-5	NT-108	☐	Power quality analyzer Fluke 1760 (complete set)	NT-160 - NT-173
☐	MA4000 - Antenna mast 1 - 4 m height	NT-110/1			
☐	DS - Turntable 0 - 400 ° Azimuth	NT-111/1	☐	ESCI - Test receiver 9 kHz - 7 GHz	NT-203/1
☐	CO3000 Controller Mast+Turntable	NT-112/1	☐	ESR – Test receiver 20 Hz – 26,5 GHz	NT-207/1
☐	HUF-Z3 - Log. Per. Antenna 200 - 1000 MHz	NT-121	☐	Digital Radio Tester CMW500	NT-208/1
☐	FMZB1513 - Loop Antenna 9 kHz - 30 MHz	NT-122/1	☐	Noise-gen., ITU-R 559-2 20 Hz – 20 kHz	NT-209
☐	HFH-Z6 - Rod Antenna 9 kHz - 30 MHz	NT-123	☐	CMTA - Radiocommunication analyzer ; 0,1 - 1000 MHz	NT-210
☐	Dipole Antenna VHA9103 30 - 300 MHz	NT-124/1a	☐	3271 - Spectrum analyzer 100 Hz - 26,5 GHz	NT-211
☐	Dipole Antenna UHA9105 300 - 1000 MHz	NT-124/1b	☐	Digital Radio Tester Aeroflex 3920	NT-212/1
☐	3115 - Horn Antenna 1 - 18 GHz (immunity)	NT-125	☐	Mixer M28HW 26,5 GHz - 40 GHz	NT-214
☐	3116 - Horn Antenna 18 - 40 GHz	NT-126	☐	RubiSource T&M Timing reference	NT-216
☐	SAS-200/543 - Bicon. Antenna 20 MHz - 300 MHz	NT-127	☐	Radiocommunicationanalyzer SWR 1180 MD	NT-217
☐	AT-1080 - Log. Per. Antenna 80 - 1000 MHz	NT-128	☐	Mixer FS-Z60 40 GHz – 60 GHz	NT-218/1
☐	HK-116 - bicon. Antenna 20 MHz - 300 MHz	NT-129	☐	Mixer FS-Z90 60 GHz – 90 GHz	NT-219/1
☐	HK-116 - bicon. Antenna 20 MHz - 300 MHz	NT-130	☐	GDS-2504 Digital scope	P-W/OS03
☐	3146 - Log. Per. Antenna 200 – 1000 MHz	NT-131	☐	TPS 2014 Digital scope	NT-222
☐	VULB 9163 Trilog Antenna 30 – 3000 MHz	NT-131/1	☐	Artificial Ear according to IEC 60318	NT-224
☐	Loop Antenna H-Field	NT-132	☐	1 kHz Sound calibrator	NT-225
☐	Horn Antenna 500 MHz - 2900 MHz	NT-133	☐	SRM-3006 Spectrumanalyzer	NT-233/1a
☐	Horn Antenna 500 MHz - 6000 MHz	NT-133/1	☐	E-field probe SRM 75 MHz – 3 GHz	NT-234
☐	Log. per. Antenna 800 MHz - 2500 MHz	NT-134	☐	Field Meter NBM-500 incl. E- and H-Field probes	NT-240a-e
☐	Log. per. Antenna 800 MHz - 2500 MHz	NT-135	☐	Magnetometer HP-01	NT-241/1
☐	BiConiLog Antenna 26 MHz – 2000 MHz	NT-137	☐	EFA-3 H-field- / E-field probe	NT-243
☐	Conical Dipol Antenna PCD8250	NT-138	☐	EHP-50F H-field- / E-field probe	NT-243/1
☐	HF 906 - Horn Antenna 1 - 18 GHz (emission)	NT-139	☐	Field Meter EMR-200 100 kHz – 3 GHz	NT-244
☐	HZ-1 Antenna tripod	NT-150	☐	E-field probe 100 kHz – 3 GHz	NT-245
☐	BN 1500 Antenna tripod	NT-151	☐	H-field probe 300 kHz – 30 MHz	NT-246

Competence Center:
Electrical & Enviromental

Test report number:
2024-AT-TC-EE-ET-EX-0-000005-FG-057

Page: 1 of 5

Date: 08.01.2025

Appendix 1 (continued)

Test equipment used

☐ E-field probe 3 MHz – 18 GHz	NT-247	☐ Prana N-MT 500 - RF-Amplifier 80 - 1000 MHz / 500 W	NT-332/1
☐ H-field probe 27 MHz – 1 GHz	NT-248	☐ BBA150 RF-Amplifier 1 GHz - 6 GHz	NT-333/1
☐ ELT-400 1 Hz – 400 kHz	NT-249	☐ APA01 – RF-Amplifier 0,5 GHz – 2,5 GHz	NT-334
☐ MDS 21 - Absorbing clamp 30 - 1000 MHz	NT-250	☐ Preamplifier 1 GHz - 4 GHz	NT-335
☐ CDN EMCL-35 EM Injection clamp	NT-251/1	☐ Preamplifier for GPS MKU 152 A	NT-336
☐ FCC-203I-DCN Ferrite decoupling network	NT-252	☐ Preamplifier 1 GHz – 18 GHz	NT-337/1
☐ PR50 Current Probe	NT-253	☐ DC Block 10 MHz – 18 GHz Model 8048	NT-338
☐ i310s Current Probe	NT-254/1	☐ 2-97201 Electronic load	NT-341
☐ Fluke 87 V True RMS Multimeter	NT-260	☐ TSX3510P - Power supply 0-30 V / 0 - 10 A	NT-344
☐ Model 2000 Digital Multimeter	NT-261	☐ TSX3510P - Power supply 0-30 V / 0 - 10 A	NT-345
☐ Fluke 87 V Digital Multimeter	NT-262/1	☐ VDS 200 Mobil-impuls-generator	NT-350
☐ ESH2-Z5-U1 Artificial mains network 4x25A	NT-300	☐ LD 200 Mobil-impuls-generator	NT-351
☐ ESH3-Z5-U1 Artificial mains network 2x10A	NT-301	☐ MPG 200 Mobil-Impuls-Generators	NT-352
☐ ESH3-Z6-U1 Artificial mains network 1x100A	NT-302	☐ EFT 200 Mobil-impuls-generator	NT-353
☐ ESH3-Z6-U1 Artificial mains network 1x100A	NT-302a	☐ AN 200 S1 Artificial Network	NT-354
☐ EZ10 T-Artificial Network	NT-305	☐ FP-EFT 32M 3 ph. Coupling filter (Burst)	NT-400/1
☐ SMA100A - Signal generator 9 kHz - 6 GHz	NT-310/1	☐ PHE 4500 - Mains impedance network	NT-401
☐ RefRad Reference generator	NT-312	☐ IP 6.2 Coupling filter for data lines (Surge)	NT-403
☐ SMP 02 Signal generator 10 MHz - 20 GHz	NT-313	☐ TK 9421 High Power Volt. Probe 150 kHz - 30 MHz	NT-409
☐ 40 MHz Arbitrary Generator TGA1241	NT-315	☐ ESH2-Z3 - Probe 9 kHz - 30 MHz	NT-410
☐ Artificial mains network NSLK 8127-PLC	NT-316	☐ CN-EFT1000 - Capacitive clamp (Burst)	NT-411/1
☐ PSURGE 4.1 Surge generator	NT-324	☐ Highpass-Filter 100 MHz – 3 GHz	NT-412
☐ IMU4000 Immunity test system	NT-325/1a-e	☐ Highpass-Filter 600 MHz – 4 GHz	NT-413
☐ VCS 500-M6 Surge-Generator	NT-326	☐ Highpass-Filter 1250 MHz – 4 GHz	NT-414
☐ Oscillatory Wave Simulator incl. Coupling networks	NT-328a+b+c	☐ Highpass-Filter 1800 MHz – 16 GHz	NT-415
☐ BTA-250 - RF-Amplifier 9 kHz - 220 MHz / 250 W	NT-330		

Competence Center:
Electrical & Environmental

Test report number:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 2 of 5

Date: 08.01.2025

Appendix 1 (continued)

Test equipment used

☐	RF-Attenuator 10 dB DC – 18 GHz / 50 W	NT-417/1	☐	95242-1 – Current probe 1 MHz – 400 MHz	NT-468
☐	RF-Attenuator 6 dB DC – 18 GHz / 50 W	NT-418	☐	94106-1L-1 – Current probe 100 kHz – 450 MHz	NT-471
☐	RF-Attenuator 3 dB DC – 18 GHz / 50 W	NT-419	☐	WHKX12-2700-3000-18000 3 GHz Highpass filter	NT-472
☐	RF-Attenuator 20 dB DC - 1000 MHz / 25 W	NT-421	☐	WHKX10-3870-4500-18000 4,5 GHz Highpass filter	NT-473
☐	RF-Attenuator 30 dB DC - 1000 MHz / 1 W	NT-423	☐	CDN S9 USB3.0 Coupling decoupling network	NT-474
☐	RF-Attenuator 30 dB	NT-424	☐	CDN S2 XLR3-1 Coupling decoupling network	NT-475
☐	RF-Attenuator 6 dB DC - 1000 MHz / 1 W	NT-425	☐	CDN S8 RJ45 Coupling decoupling network	NT-476
☐	RF-Attenuator 6 dB DC - 1000 MHz / 1 W	NT-426	☐	GA 1240 Power amplifier according to EN 61000-4-16	NT-480
☐	RF-Attenuator 6 dB	NT-428	☐	Coupling networks according to EN 61000-4-16	NT-481 - NT-483
☐	RF-Attenuator 0 dB - 81 dB	NT-429	☐	Van der Hoofden Test Head	NT-484
☐	WRU 27 - Band blocking 27 MHz	NT-430	☐	WRCJV12-5820-5850-5950-5980 5,9 GHz Band Reject Filter	NT-490
☐	WHJ450C9 AA - High pass 450 MHz	NT-431	☐	WHKX10-5670-6300-18000 6 GHz Highpass filter	NT-491
☐	WHJ250C9 AA - High pass 250 MHz	NT-432	☐	WHK12-935-1000-7000 1 GHz Highpass filter	NT-492
☐	RF-Load 150 W	NT-433	☐	EMC Video/Audiosystem	NT-511/1
☐	Impedance transducer 1:4 ; 1:9 ; 1:16	NT-435	☐	EMC32 Version 10.60.20 Test software	NT-520/1
☐	RF-Attenuator DC – 18 GHz 6 dB	NT-436	☐	SRM-TS Version 1.3 software for SRM-3000	NT-522
☐	RF-Attenuator DC – 18 GHz 6 dB	NT-437	☐	SRM-TS Version 1.3.1 software for SRM-3006	NT-522/1
☐	RF-Attenuator DC – 18 GHz 10 dB	NT-438	☐	Spitzenberger und Spies Test software V4.1	NT-525
☐	RF-Attenuator DC – 18 GHz 20 dB	NT-439	☐	Vertical coupling plane (ESD)	NT-531
☐	ESH3-Z2 - Pulse limiter 9 kHz - 30 MHz	NT-441	☐	Test cable #4 for EN 61000-4-6	NT-553
☐	Power Divider 6 dB/1 W/50 Ohm	NT-443	☐	Test cable #3 for conducted emission	NT-554
☐	Directional coupler 0,1 MHz – 70 MHz	NT-444	☐	Test cable #5+#6 ESD-cable (2x470k)	NT-555 + NT-556
☐	Directional coupler 0,1 MHz – 70 MHz	NT-445	☐	Test cable #8 Sucoflex 104EA	NT-559
☐	Tube imitations according to EN 55015	NT-450	☐	Test cable #9 (for outdoor measurements)	NT-580
☐	FCC-801-M3-16A Coupling decoupling network	NT-458	☐	Test cable #10 (for outdoor measurements)	NT-581
☐	FCC-801-M2-50A Coupling decoupling network	NT-459	☐	Test cable #13 Sucoflex 104PE	NT-584
☐	FCC-801-M5-25 Coupling decoupling network	NT-460	☐	Test cable #21 for SRM-3000	NT-592
☐	FCC-801-T4 Coupling decoupling network	NT-463	☐	Shield chamber	NT-600
☐	FCC-801-C1 Coupling decoupling network	NT-464	☐	Climatic chamber	M-1200
☐	SW 9605 - Current probe 150 kHz – 30 MHz	NT-465/1			

Competence Center:
Electrical & Environmental

Test report number:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 3 of 5

Date: 08.01.2025

Appendix 1 (continued)

Test equipment used

☐	Anechoic Chamber 3 m / 5 m measuring distance	EMV-100	☐	HF- Amplifier 9 kHz-225 MHz BBL200	EMV-300/1
☐	Turntabel 6 m diameter	EMV-101	☐	HF- Amplifier 80 -1000 MHz BBA150	EMV-301
☐	Antenna mast + controller	EMV-102+ EMV-103	☐	HF- Amplifier 0,8 - 6 GHz BBA150	EMV-302
☐	EMC Video/Audiosystem	EMV-104	☐	High Power Ant. 20-200 MHz HPBA-2510	EMV-303/1
☐	EMC Software EMC32 Version 10.6.2	EMV-105	☐	High Power Ant. 20-200 MHz S12018-21	EMV-303/2
☐	Hornantenna 1 – 18 GHz HF 907	EMV-110	☐	Log.per Antenna 80-2700 MHz STLP 9128 E special	EMV-304
☐	Antennapre.amp. 1 – 18 GHz BBV 9718 D	EMV-111/1	☐	Log.per Antenna 0,7 – 9 GHz STLP9149	EMV-305
☐	Trilog Antenna 30-3000 MHz VULB9163	EMV-112	☐	HF- Amplifier 9 kHz-250 MHz BBA150 (low noise)	EMV-306
☐	Monopol 9 kHz – 30 MHz VAMP 9243	EMV-113	☐	ISO11451-2 TLS 10 kHz – 30 MHz	EMV-307
☐	Antennapre.amp 18 – 40 GHz BBV 9721	EMV-114	☐	Load Dump Generator LD 200N	EMV-350
☐	Hornantenna 200 – 2000 MHz AH-220	EMV-115	☐	Ultra Compact Symulator UCS 200N100	EMV-351
☐	DC Artificial Network PVDC 8300	EMV-150	☐	Automotive Power fail module PFM 200N100.1	EMV-352
☐	AC Artificial Network NNLK 8121 RC	EMV-151	☐	Voltage Drop Symulator VDS 200Q100	EMV-353
☐	AC Artificial Network NNLK 140	EMV- 153a-d	☐	Arb. Generator AutoWave	EMV-354
☐	EMI Receiver ESW44	EMV-200/1	☐	Ultra Compact Symulator UCS 500N7	EMV-355
☐	Signalgenerator 9 kHz – 40 GHz N5173B	EMV-201	☐	Coupling decoupling network CNI 503B7 / 32 A	EMV-356
☐	GPS Frequency normal LBE-1420	EMV-202/1	☐	Coupling decoupling network CNI 503B7 / 63 A	EMV-357
☐	DC Power supply N5745A	EMV-203	☐	Telecom Surge Generator TSurge 7	EMV-358
☐	Spektrum Analyzator FSV40	EMV-205	☐	Coupling decoupling network CNI 508N2	EMV-359
☐	Thd Multimeter Model 2015	EMV-206	☐	Coupling decoupling network CNV 504N2.2	EMV-360
☐	Poweramplifier PAS15000	EMV- 207/abc	☐	Immunity generator NSG4060/NSG4060-1	EMV-361
☐	Inrush Current Source	EMV- 208/abc	☐	Coupling network CDND M316-2	EMV-362
☐	Arb.-generator Sycore	EMV-209	☐	Coupling network CT419-5	EMV-363
☐	Harmonics/Flicker analyzer ARS 16/3	EMV-210	☐	ESD Generator NSG 437	EMV-364
☐	Power Supply Regatron AC	EMV-214	☐	Pulse Limiter VTSD 9561-F BNC	EMV-405
☐	Power Supply Regatron DC	EMV-215	☐	Transient emission BSM200N40+BS200N100	EMV- 450+451
☐	Harmonics/Flicker analyser Zimmer	EMV-216	☐	Cap. Coupling Clamp HFK	EMV-455
☐	Flicker Impedanz Newtons4th 753	EMV-218	☐	Mag. Field System MS100N+MC26100+MC2630	EMV- 456-458
☐	Comemso	EMV-219			

Competence Center:
Electrical & Enviromental

Test report number:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 4 of 5

Date: 08.01.2025

Appendix 1 (continued)

Test equipment used

Competence Center:
Electrical & Enviromental

Test report number:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 5 of 5

Date: 08.01.2025

☐	Coupling network CDN M2-100A	EMV-459
☐	Coupling network CDN M3-32A	EMV-460
☐	Coupling network CDN M5-100A	EMV-461
☐	Current Clamp CIP 9136A	EMV-462
☐	DC Artificial Network HV-AN 150	EMV-464+465
☐	Coupling Clamp EM 101	EMV-466
☐	Decoupling Clamp FTC 101	EMV-467
☐	Power attenuator 10 dB / 250 Watt	EMV-469/2
☐	HV AMN NNHV 8123 800A	EMV-472
☐	HV AMN NNHV 8123 800A	EMV-473

Appendix 2

Photodocumentation

Description: Front view

Division:
Industry & Energy

Test report reference:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 1 of 10

Date: 08.01.2025



Appendix 2 Photodocumentation

Division:
Industry & Energy

Description: Rear view

Test report reference:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 2 of 10

Date: 08.01.2025



Appendix 2 Photodocumentation

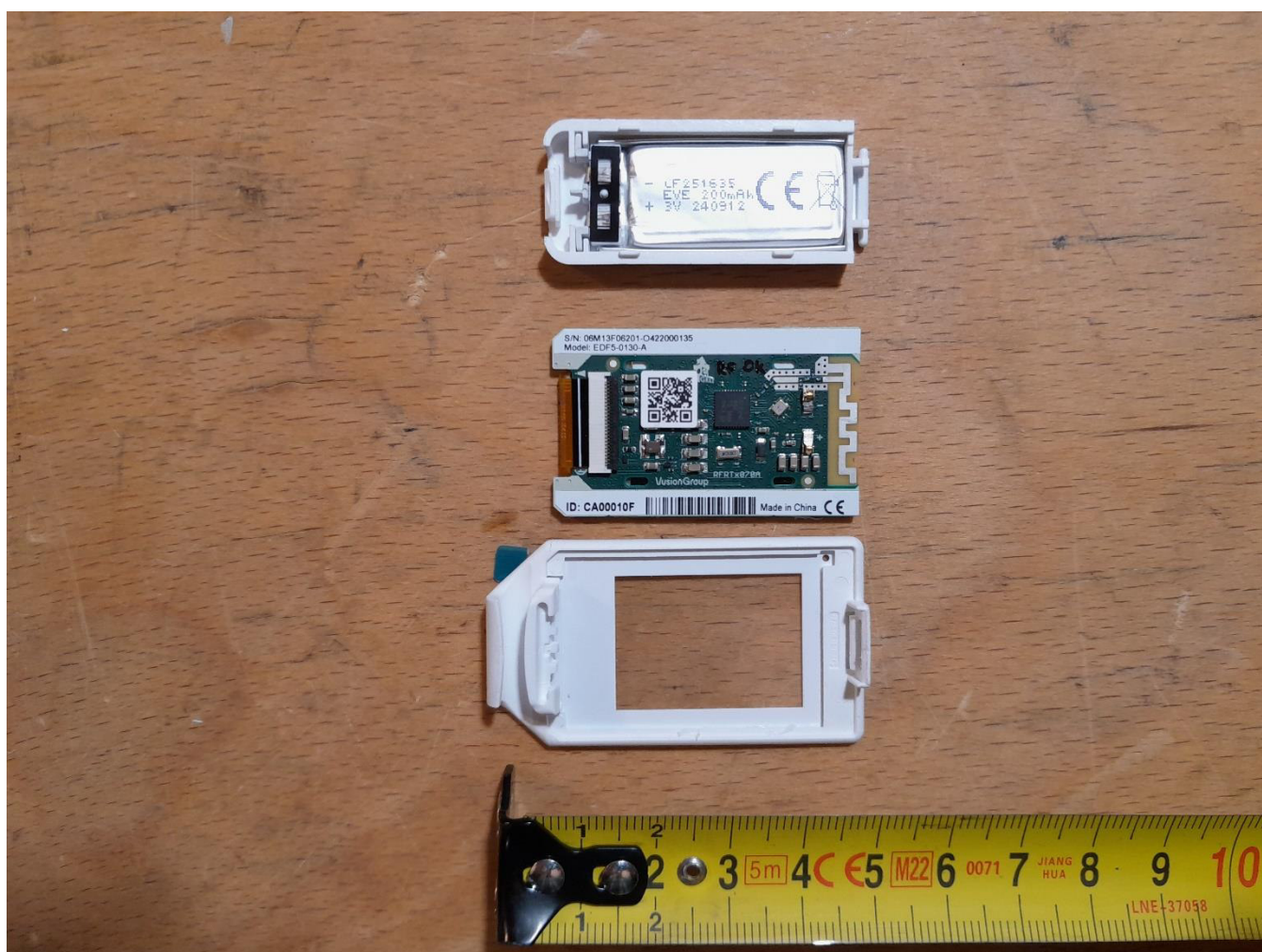
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Division:
Industry & Energy

Test report reference:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 3 of 10

Date: 08.01.2025



Appendix 2

Photodocumentation

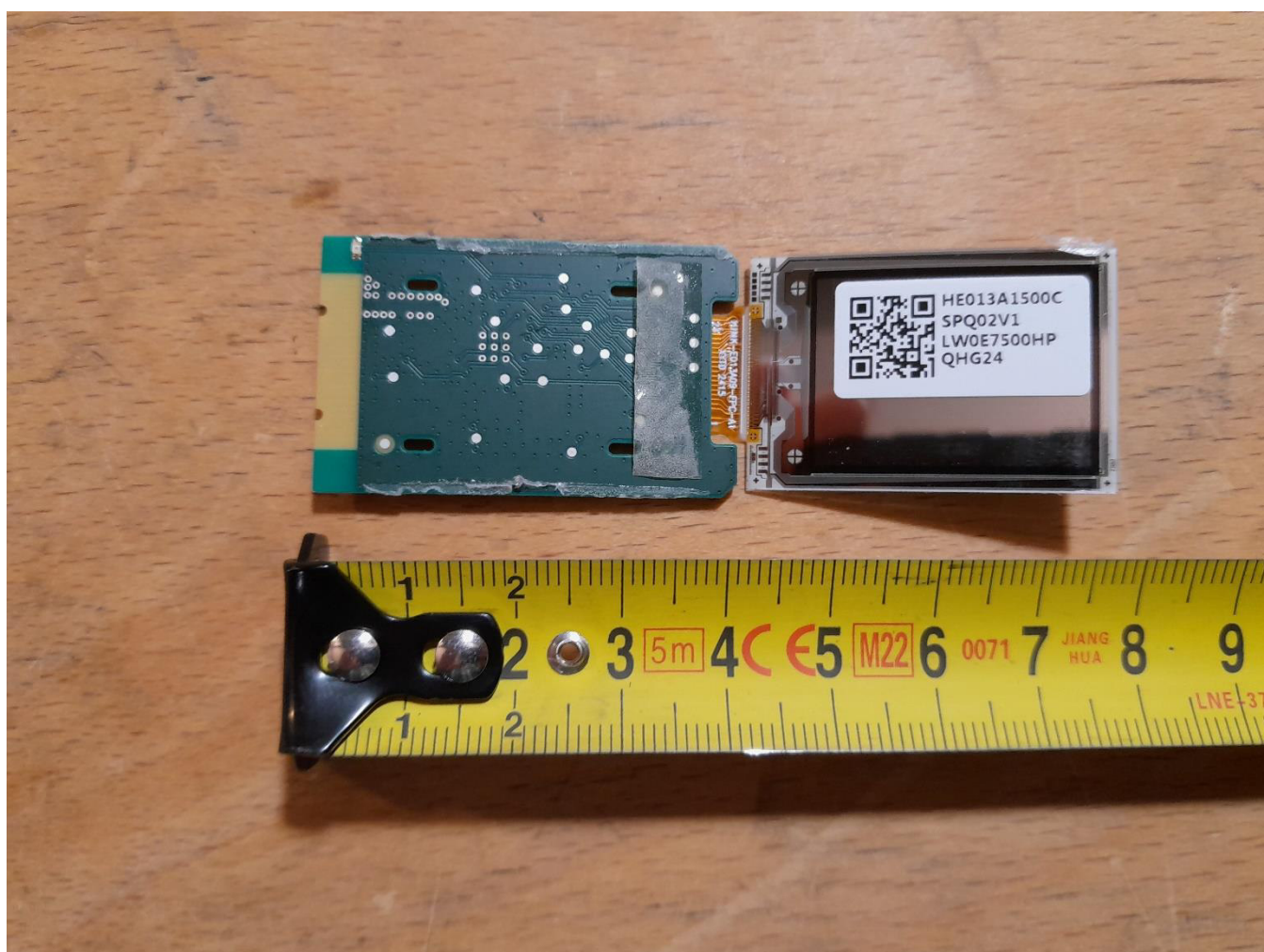
Division:
Industry & Energy

Description: Internal view #1

Test report reference:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 4 of 10

Date: 08.01.2025



Appendix 2 Photodocumentation

Division:
Industry & Energy

Description: Internal view #2

Test report reference:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 5 of 10

Date: 08.01.2025



Appendix 2 Photodocumentation

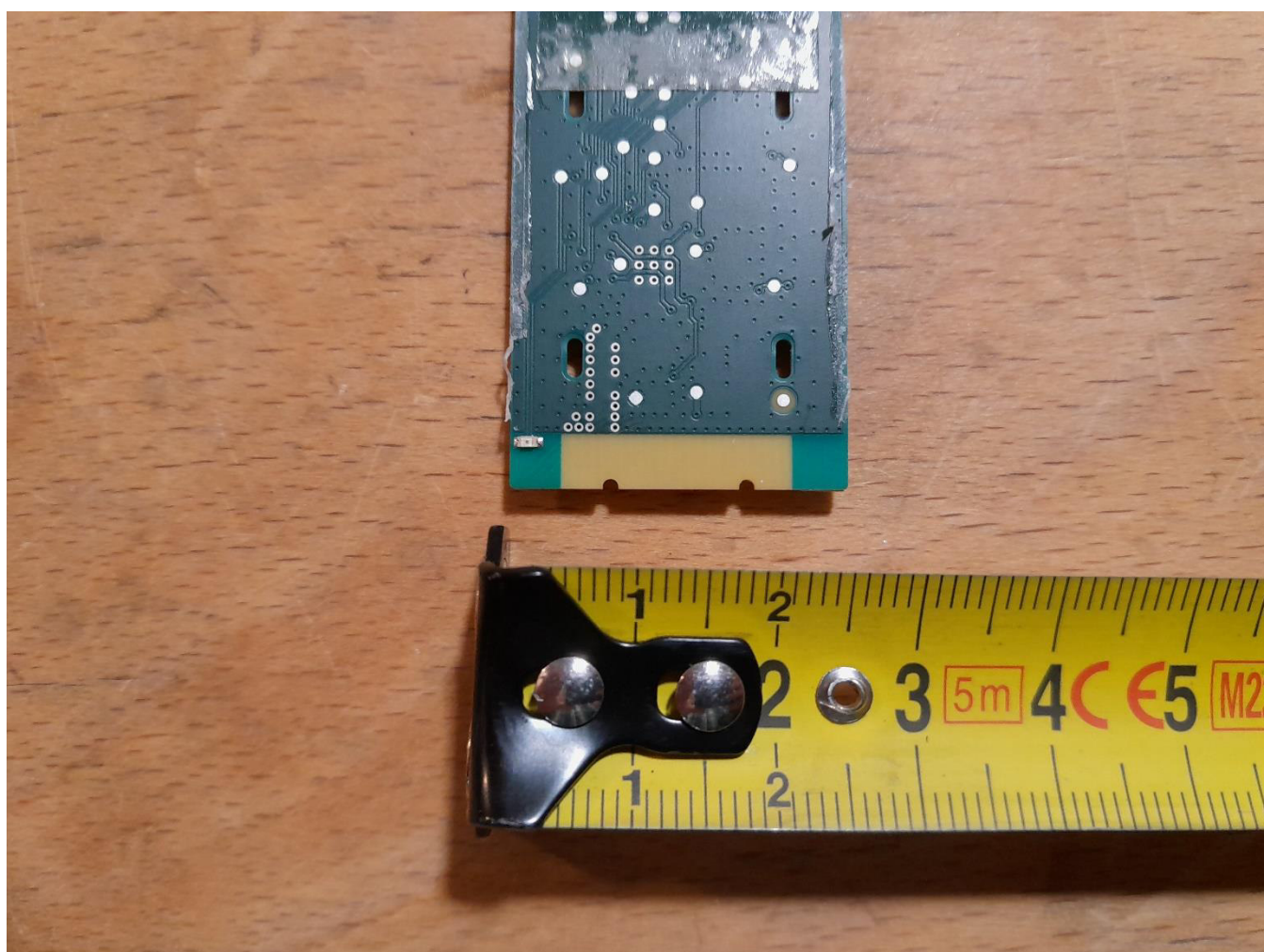
Description: Antenna detail #1

Division:
Industry & Energy

Test report reference:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 6 of 10

Date: 08.01.2025



Appendix 2

Photodocumentation

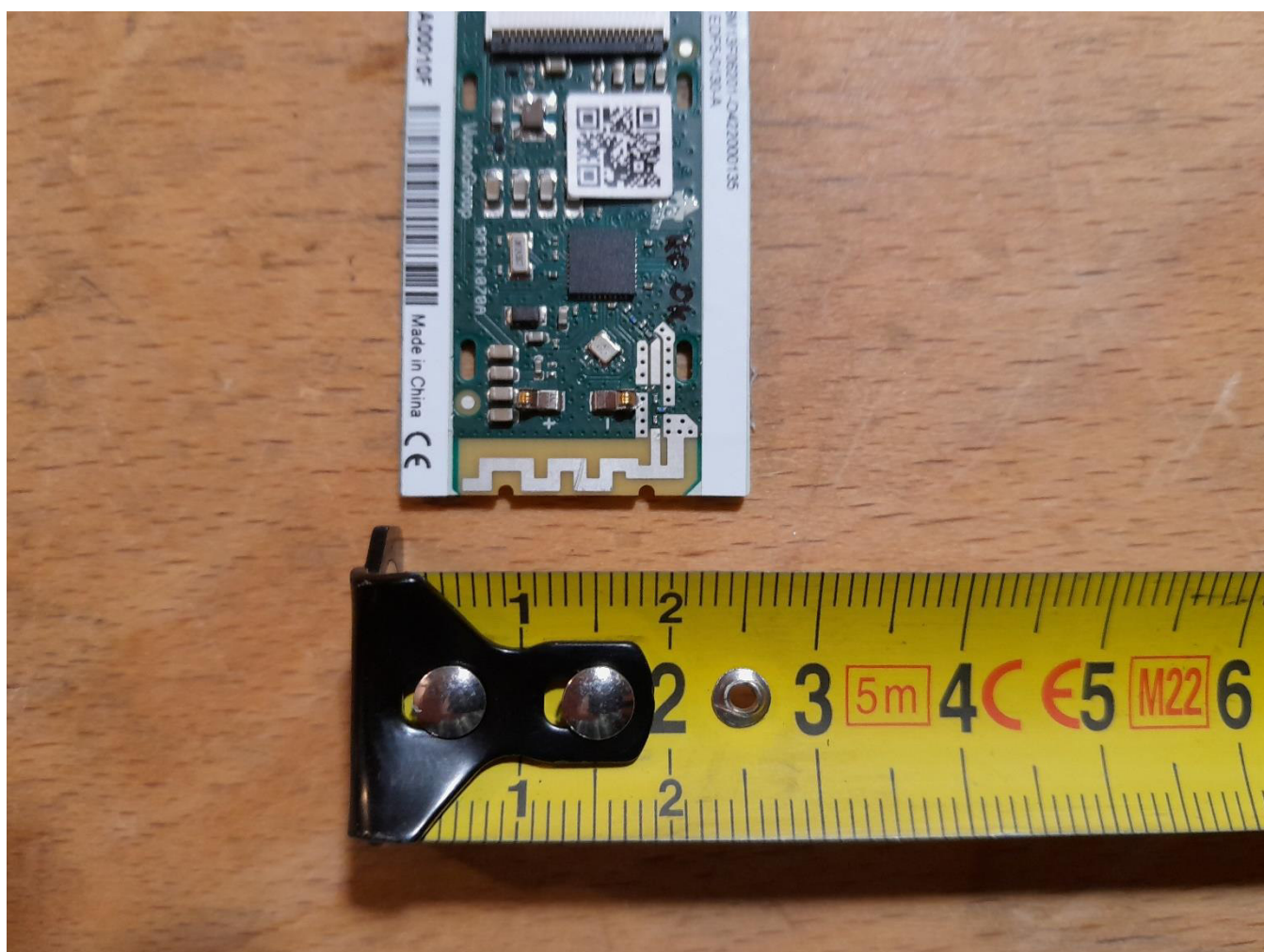
Division:
Industry & Energy

Description: Antenna detail #2
Meandered Inverted-F Antenna (IFA) fed by a
coplanar waveguide

Test report reference:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 7 of 10

Date: 08.01.2025



Appendix 2

Photodocumentation

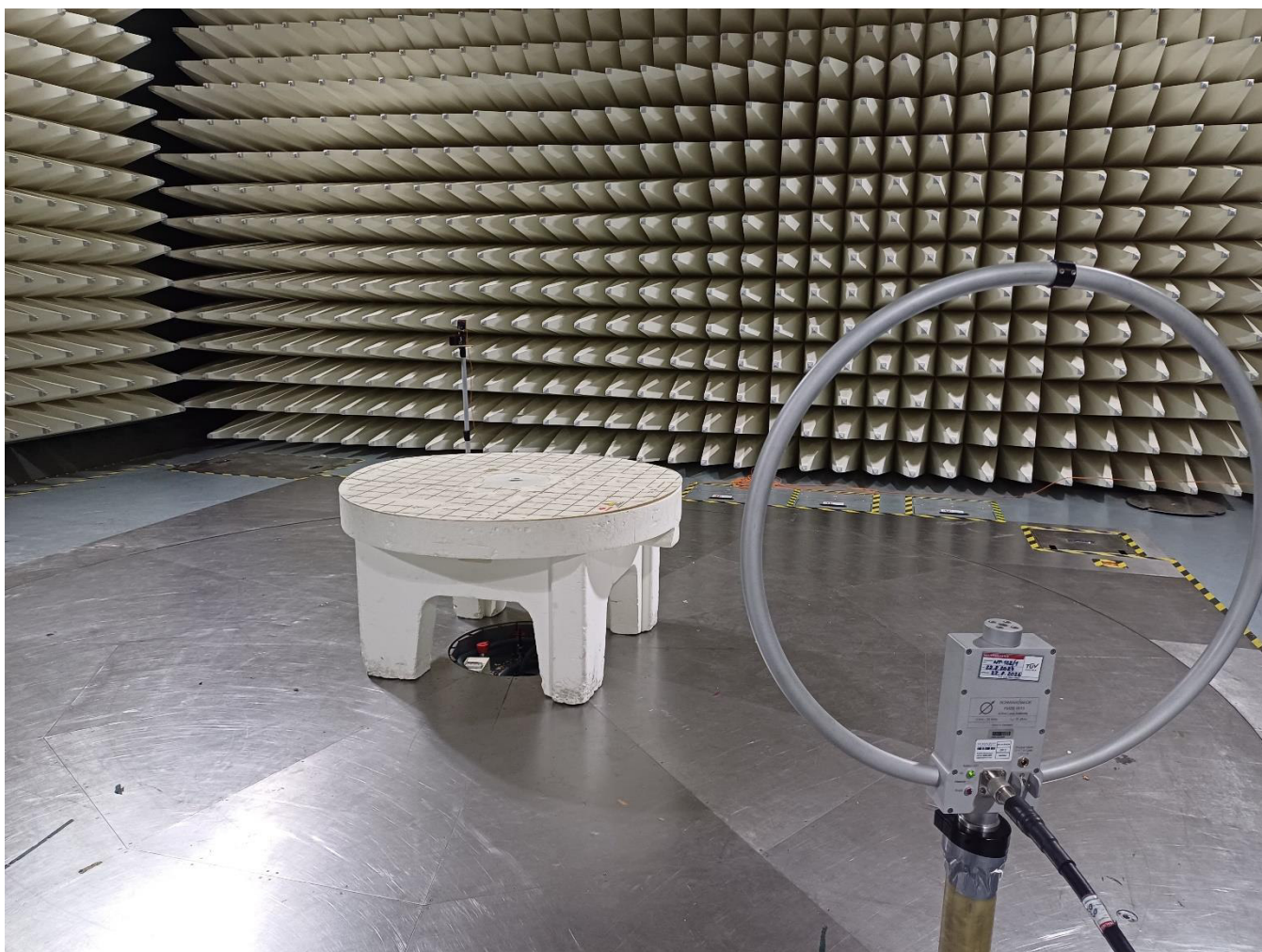
Division:
Industry & Energy

Description: Test setup emissions below 30 MHz

Test report reference:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 8 of 10

Date: 08.01.2025



Appendix 2

Photodocumentation

Division:
Industry & Energy

Description: Test setup emissions 30 MHz - 1 GHz

Test report reference:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 9 of 10

Date: 08.01.2025



Appendix 2 Photodocumentation

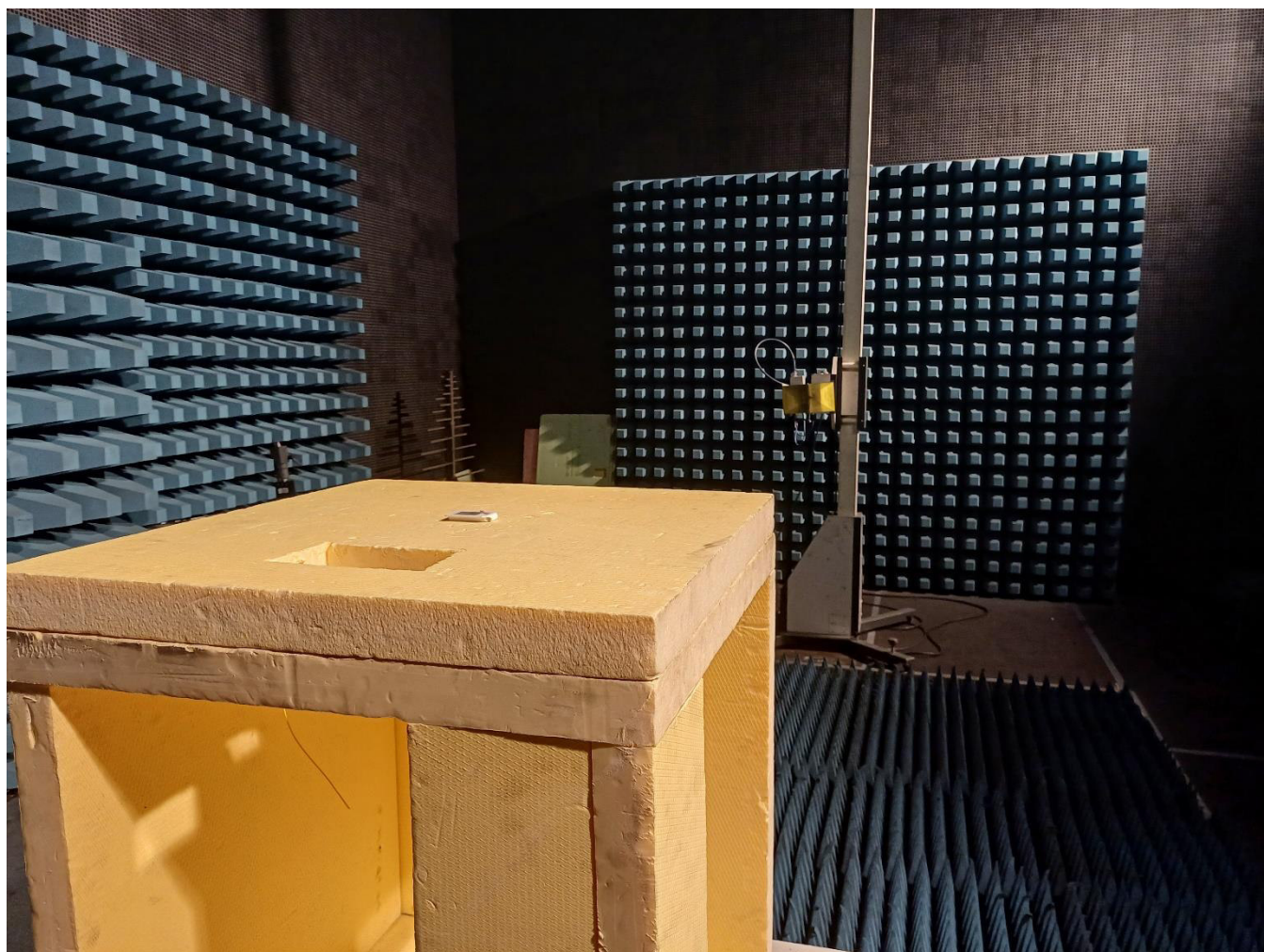
Division:
Industry & Energy

Description: Test setup emissions above 1 GHz

Test report reference:
2024-AT-TC-EE-ET-EX-0-
000005-FG-057

Page: 10 of 10

Date: 08.01.2025



--- END OF TEST REPORT ---

