TEST REPORT

of the accredited test laboratory

TÜV Nr.: 2023-IN-AT-TICL-E-EX-0-000070-FG-006

Applicant:	PDi Digital GmbH Kalsdorfer Strasse 6 A – 8072 Fernitz-Mellach
Tested Product:	Electronic shelf labelling system
Product Name:	sepioo D4.2 B
Model:	ED03-0420-A
FCC-ID:	2A3HY-ED03-0420-A
IC-ID:	27854-ED030420A
Manufacturer:	PDi Digital GmbH Kalsdorfer Strasse 6 A – 8072 Fernitz-Mellach

Output power / field strength:	4,79 mV/m average @ 3m distance / 1,32mW EIRP	**power supply:**	3V DC internal battery
Frequency range:	2404,053 - 2479,285 MHz / 2401-2481 MHz	**Channel separation:**	0,35 MHz 1 / 2 MHz
Standard:	FCC: 47 CFR Part 15 (eCFR 21.03.2023) RSS-102 Issue 5, March 2015 + Amd. 1 02.02.2021 RSS-247 Issue 2, February 2017 RSS-210 Issue 10, December 2019		

TÜV AUSTRIA SERVICES GMBH

Test laboratory for EMC

Ing. Andreas Malek
examined by / Testing Laboratory
TÜV AUSTRIA SERVICES GMBH

30.03.2023

Ing. Wilhelm Seier
approved by / Testing Laboratory
TÜV AUSTRIA SERVICES GMBH

TÜV AUSTRIA SERVICES GMBH

Office:
Deutschstrasse 10
1230 Vienna/Austria
T: +43 5 0454-0
F: +43 5 0454-6505
E: ticwien@tuv.at
W: www.tuv.at

Business Area
Industry & Energy Austria

Technik

TÜV ®

Testing Laboratory,
Inspection Body,
Certification Body,
Calibration Laboratory,
Verifizierungsstelle

Notified Body 0408
IC 2932K-1

Non-executive Board of Directors:
KR DI Johann Marihart

Management:
DI Dr. Stefan Haas
Mag. Christoph Wenninger

Registered Office:
Deutschstrasse 10
1230 Vienna/Austria

Branch Offices:
www.tuv.at/standorte

Company Register Court / - Number:
Vienna / FN 288476 f

Bank Details:
IBAN
AT131200052949001066
BIC BKAUATWW

VAT ATU63240488
DVR 3002476

A publication of this test report is only permitted literally.
Copying or reproduction of partial sections needs a written permission of TÜV AUSTRIA SERVICES GMBH.

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

Contents

	Designation	PAGE
1.	Applicant	3
2.	Description of EUT	4
3.	Standards / Final result	5
4.	Test results	
	List of measurements according to 47 CFR 15 and RSS-210 (SES-Imagotag Protocol)	
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)	12-16
4.6	RF Exposure	17-19
	List of measurements according to 47 CFR 15 and RSS-247 (BLE/Quuppa Protocol)	
4.7	Test object data	20
4.8	Number of channels and channel spacing	21
4.9	6 dB Bandwidth	22 – 24
4.10	99% dB Bandwidth	25 – 27
4.11	Maximum Peak RF Power Output	28
4.12	Power Spectral Density	29 – 31
4.13	Emissions in restricted bands	32 – 36
4.14	RF Exposure	37 – 40
Appendix	Designation	PAGES
1	Test equipment used	5
2	Photodocumentation	11

www.tuv.at | info@tuv.at | TÜV ®

1. Applicant

Company:	PDi Digital GmbH
Department:	Product & Project Manager
Address:	A – 8072 Fernitz-Mellach; Kalsdorfer Strasse 6
Contact person:	Mr. Klaus Niederl

EUT received on:	21.03.2023
Tests were performed on:	21. till 24.03.2023

www.tuv.at | info@tuv.at | TÜV ®

2. Description of EUT

EUT:	Electronic shelf labelling system
Product Name:	sepioo D4.2 B
Model:	ED03-0420-A
Serial Number:	Prototype
Manufacturer:	PDi Digital GmbH A – 8072 Fernitz-Mellach; Kalsdorfer Strasse 6
Description:	PDi Digital 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 current: <1A Rated frequency: DC Mains voltage during the tests: 3VDC internal battery
Climatic conditions in the emc laboratory:	Relative humidity: 31% Temperature: 23°C

www.tuv.at | info@tuv.at | TÜV ®

3. Standards / Final result

Name	Title	Deviation	Result
Title 47 CFR Part 15 eCFR 21.03.2023	RADIO FREQUENCY DEVICES	none	OK
RSS-210 Issue 10, December 2019	Licence-Exempt Radio Apparatus: Category I Equipment	none	OK
RSS-247 Issue 2, February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices	none	OK
RSS-102 Issue 5, March 2015 + Amd. 1 02.02.2021	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)	none	OK
ANSI C63.10-2013	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

www.tuv.at | info@tuv.at | TÜV ®

4.1 TEST OBJECT DATA (SES-Imagotag Protocol)

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. This device incorporates different communication protocols. The first part of this test report is for the proprietary SES-Imagotag Protocol, the second parts includes measurements for BLE/Quuppa protocol.

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 4,79 mV/m average @ 3m distance. There is no power control or regulation.

2.1033 (7) Maximum output power rating: 4,79 mV/m average @ 3m distance.

2.1033 (8) DC Voltage and Current: 3 VDC (internal battery)
maximum current consumption: 7,7 mA 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: 49,98 dBµV/m Peak at 7212,0 MHz.

Tests were performed: March 21st till 24th 2023.

www.tuv.at | info@tuv.at | TÜV ®

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

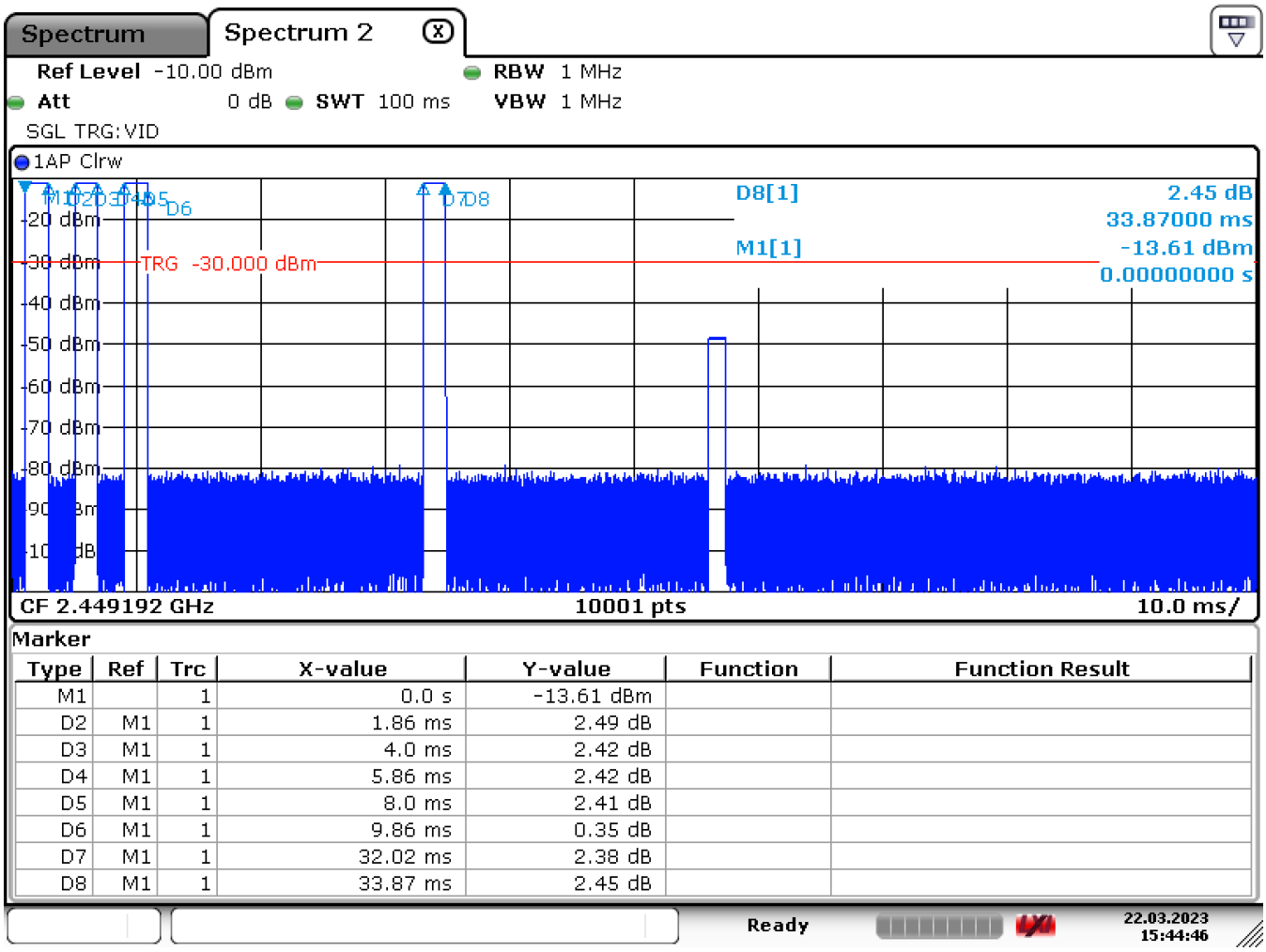
Tests were performed on ESL channels 0, 4 and 10.

Test Equipment used: N/A

www.tuv.at | info@tuv.at | TÜV ®

4.3 Duty Cycle measurements for averaging § 15.249 (e)

Mode: data transmission (worst case in 100ms)



Marker						
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	0.0 s	-13.61 dBm		
D2	M1	1	1.86 ms	2.49 dB		
D3	M1	1	4.0 ms	2.42 dB		
D4	M1	1	5.86 ms	2.42 dB		
D5	M1	1	8.0 ms	2.41 dB		
D6	M1	1	9.86 ms	0.35 dB		
D7	M1	1	32.02 ms	2.38 dB		
D8	M1	1	33.87 ms	2.45 dB		

Date: 22.MAR.2023 15:44:46

Worst Case: 4 transmissions in a 100ms time frame, each 1,86ms in length, giving a duty cycle of 7,44% or an average factor of -22,6 dB.

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

www.tuv.at | info@tuv.at | TÜV ®

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 96,2 dBµV/m = 64,57 mV/m at 3m distance.

With the averaging factor calculated on page 8 of this test report of -22,6 dB the maximum average value is then 73,6 dBµV/m = 4,79 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: NT-100; NT-110/1; NT-111/1; NT-112/1; NT-131/1; NT-139; NT-207/1; NT-216

www.tuv.at | info@tuv.at | TÜV ®

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 96,1 dBµV/m = 63,83 mV/m at 3m distance.

With the averaging factor calculated on page 8 of this test report of -22,6 dB the maximum average value is then 73,5 dBµV/m = 4,73 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: NT-100; NT-110/1; NT-111/1; NT-112/1; NT-131/1; NT-139; NT-207/1; NT-216

www.tuv.at | info@tuv.at | TÜV ®

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 95,8 dBµV/m = 61,66 mV/m at 3m distance.

With the averaging factor calculated on page 8 of this test report of -22,6 dB the maximum average value is then 73,2 dBµV/m = 4,57 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:

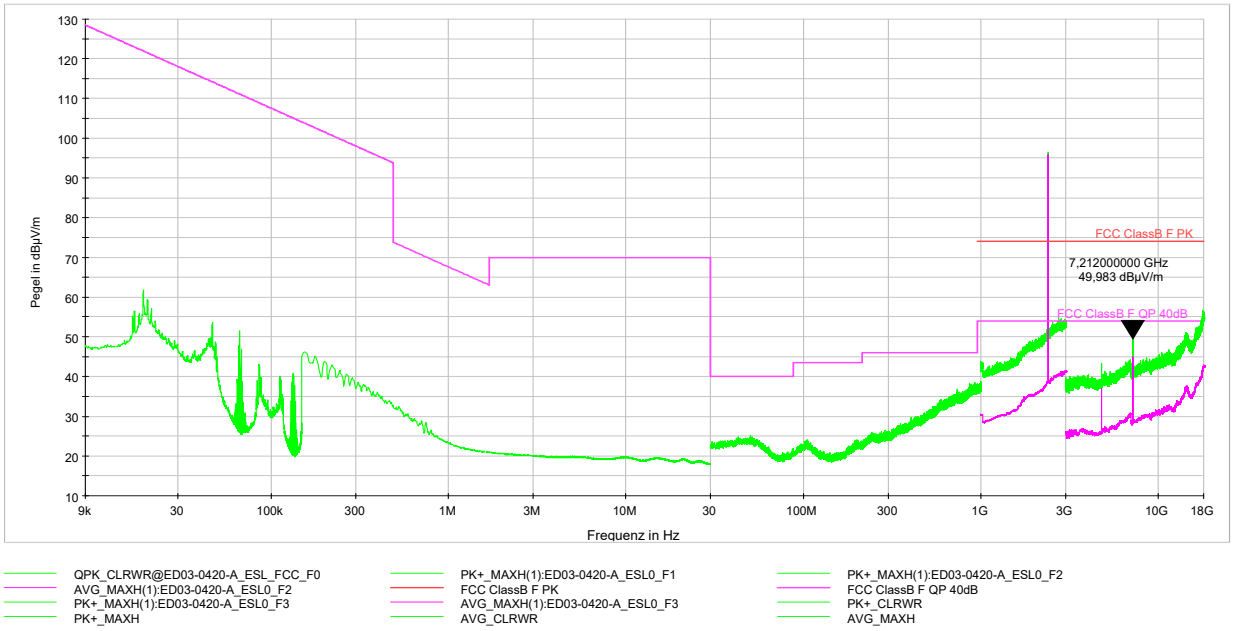
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

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

Test Equipment used: NT-100; NT-110/1; NT-111/1; NT-112/1; NT-131/1; NT-139; NT-207/1; NT-216

www.tuv.at | info@tuv.at | TÜV ®

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



Worst case Emission: 49,98 dBµV/m Peak at 7212,0 MHz which is below the AVG Limit.

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.

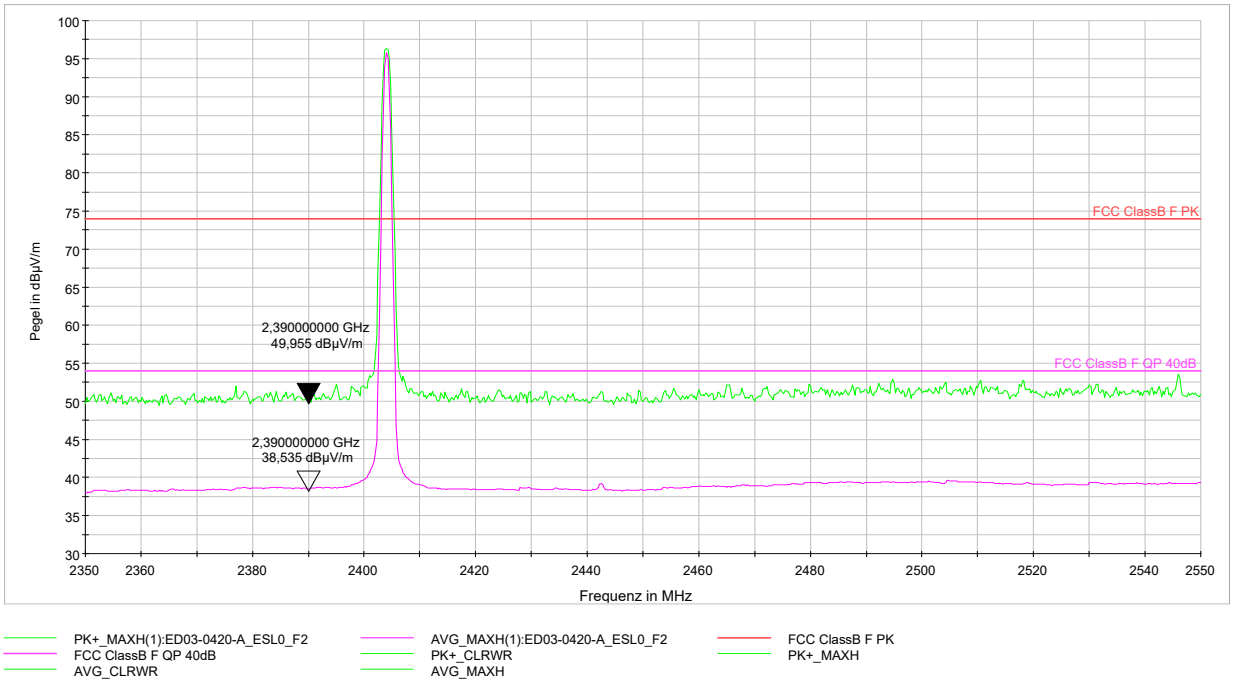
(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any 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-114; NT-100; NT-110/1; NT-111/1; NT-112/1; NT-122/1; NT-126; NT-131/1; NT-139; NT-207/1; NT-216; NT-337/1; NT-472
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.

www.tuv.at | info@tuv.at | TÜV ®

Emissions outside 2400 – 2483,5 MHz § 15.249 (d) (e)
Channel 0 (2404,053 MHz) – band edge requirement – average values are in magenta – green = peak



Nearest Band Edge: 2390 MHz

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.

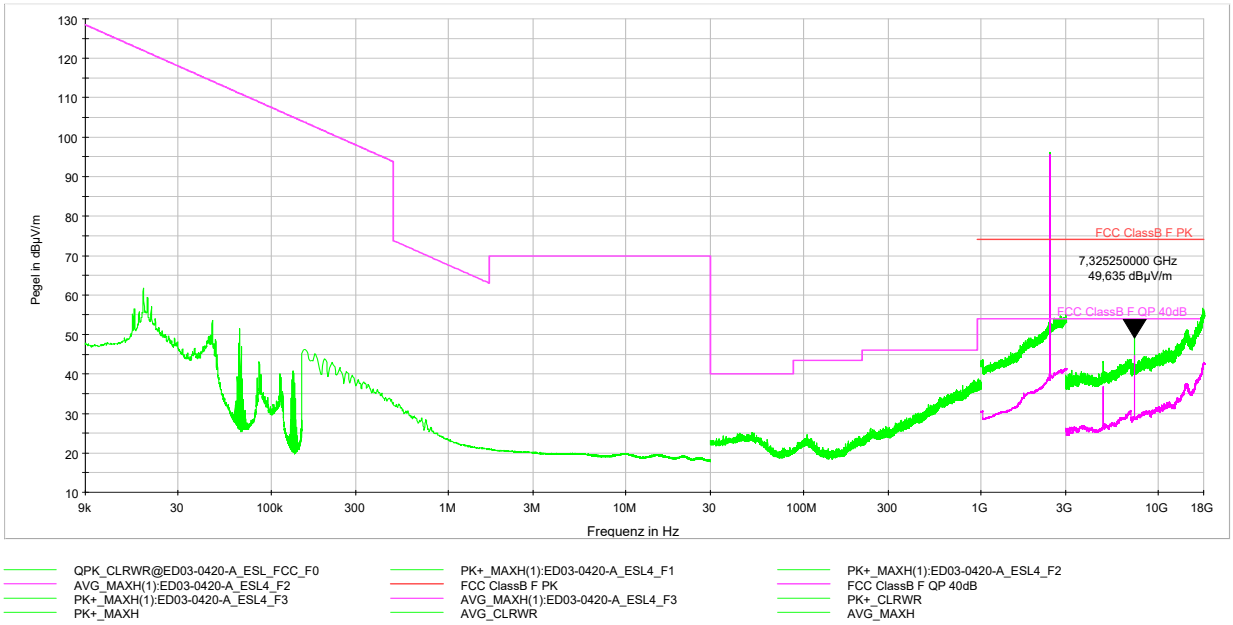
(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any 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:
NT-100; NT-110/1; NT-111/1; NT-112/1; NT-131/1; NT-139; NT-207/1; NT-216

www.tuv.at | info@tuv.at | TÜV ®

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



Worst case Emission: 49,64 dBµV/m Peak at 7325,25 MHz which is below the AVG Limit.

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.

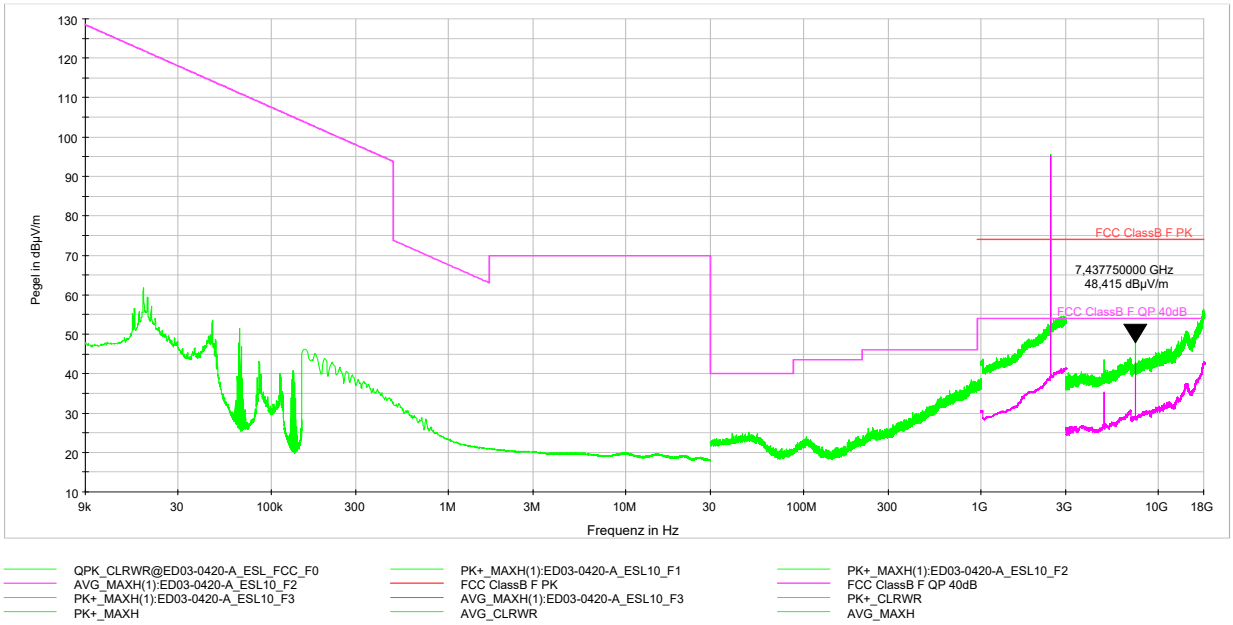
(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any 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-114; NT-100; NT-110/1; NT-111/1; NT-112/1; NT-122/1; NT-126; NT-131/1; NT-139; NT-207/1; NT-216; NT-337/1; NT-472
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.

www.tuv.at | info@tuv.at | TÜV ®

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



Worst case Emission: 48,42 dBµV/m Peak at 7437,75 MHz which is below the AVG Limit.

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.

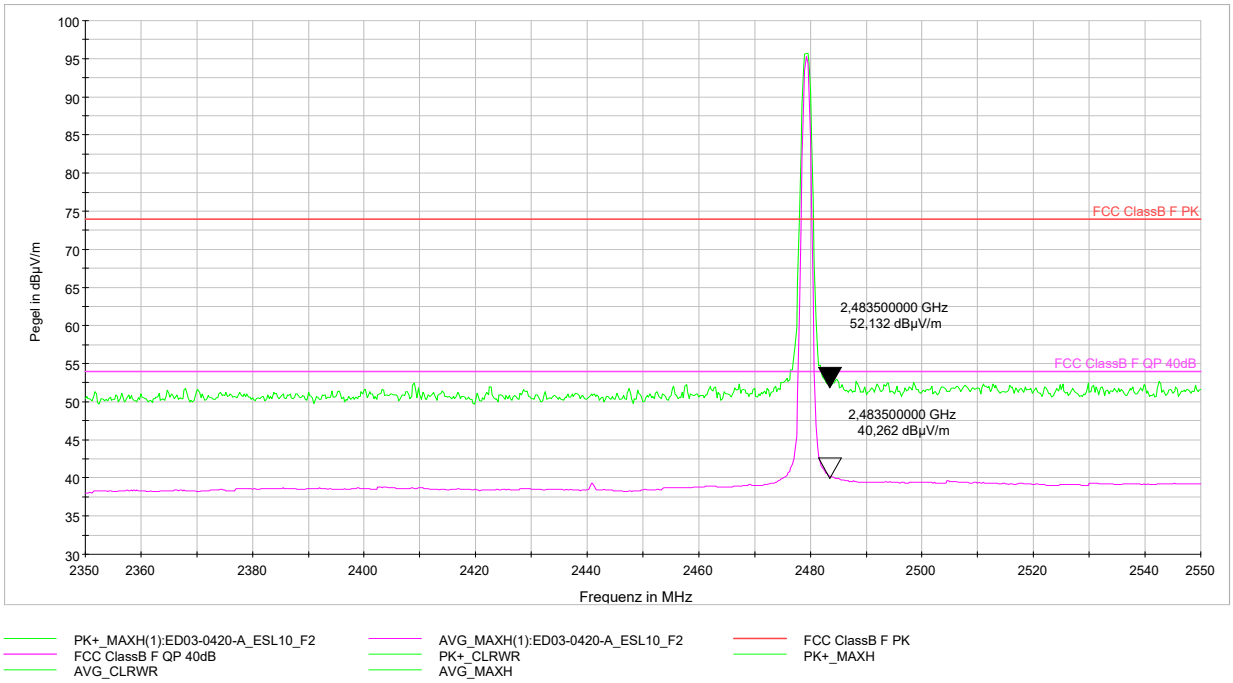
(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any 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-114; NT-100; NT-110/1; NT-111/1; NT-112/1; NT-122/1; NT-126; NT-131/1; NT-139; NT-207/1; NT-216; NT-337/1; NT-472
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.

www.tuv.at | info@tuv.at | TÜV ®

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



Nearest Band Edge: 2483,5 MHz

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:
NT-100; NT-110/1; NT-111/1; NT-112/1; NT-131/1; NT-139; NT-207/1; NT-216

www.tuv.at | info@tuv.at | TÜV ®

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]
1,13	7,44	0,084	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	0,77	0,75	0,70

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	1,26	1,23	1,15

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	1,13	1,12	1,10

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	0,46	0,42	0,20

www.tuv.at | info@tuv.at | TÜV ®

RF Exposure **RSS-102, Issue 5**

2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.

www.tuv.at | info@tuv.at | TÜV ®

RSS-102 2.5.1 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	1,13	1,26	0,0744	0,084	0,106	5	4,25	OK
2441.844	1,12	1,23	0,0744	0,083	0,104	5	4,04	OK
2479.285	1,10	1,15	0,0744	0,082	0,097	5	3,94	OK

*) Calculations are done for a minimum separaton distance of ≤5 mm. It is conservative, as customers are not expected to directly touch the modules. Exemption calculations are OK even with such a small separation distance and without considering limb worn exposure.

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

www.tuv.at | info@tuv.at | TÜV ®

4.7. TEST OBJECT DATA (BLE/Quuppa Protocol)

General EUT Description

2.1033 (c) Technical description

2.1033 (4) Type of emission: 1M02F1D – Channel spacing 2 MHz plus 2 additional 'Quuppa' channels at 2401 and 2481 MHz

2.1033 (5) Frequency range: 2402 to 2480 MHz (channel center frequencies) plus 2 additional 'Quuppa' channels at 2401 and 2481 MHz

2.1033 (6) Power range and Controls: The maximum peak output power is 1,32 mW eirp and there is no power regulation.

2.1033 (7) Maximum output power rating: 1,32 mW eirp.

2.1033 (8) DC Voltage and Current: 3 VDC (internal battery)
maximum current consumption: 7,7 mA 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: 42,11 dBµV/m Average at 7319,5 MHz.

Tests were performed: March 21st till 24th 2023.

www.tuv.at | info@tuv.at | TÜV ®

4.8. Number of channels and channel spacing § 2.1033

Conducted Measurement

Rated output power: 1,32 mW

There are 40 Channels used, starting at 2402 till 2480 MHz each separated by 2 MHz channel spacing.

Two additional channels are used with the same modulation but for positioning purposes. These channels use 2401 MHz and 2481 MHz as center frequencies.

Test Equipment used: N/A

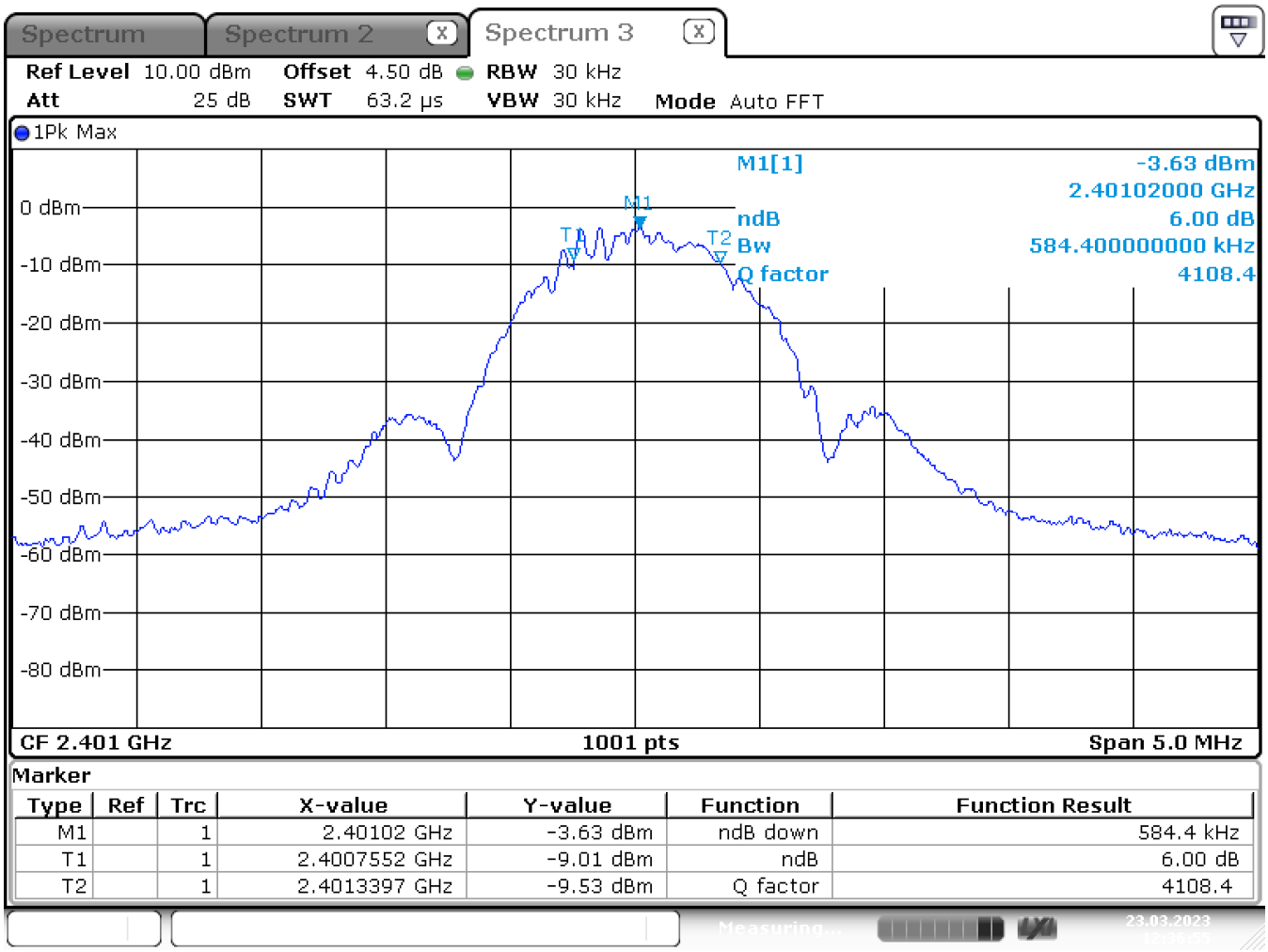
www.tuv.at | info@tuv.at | TÜV ®

4.9. 6 dB Bandwidth

§ 15.247(a)(2) 5.2.a)

Conducted Measurement

Rated output power: 1,32 mW 2401 MHz center frequency



Date: 23.MAR.2023 12:36:55

6dB Bandwidth: 584,4 kHz

LIMIT **SUBCLAUSE 15.247(e) – 5.2.a)**

Under normal test conditons	6 dB Bandwidth at least 500 kHz

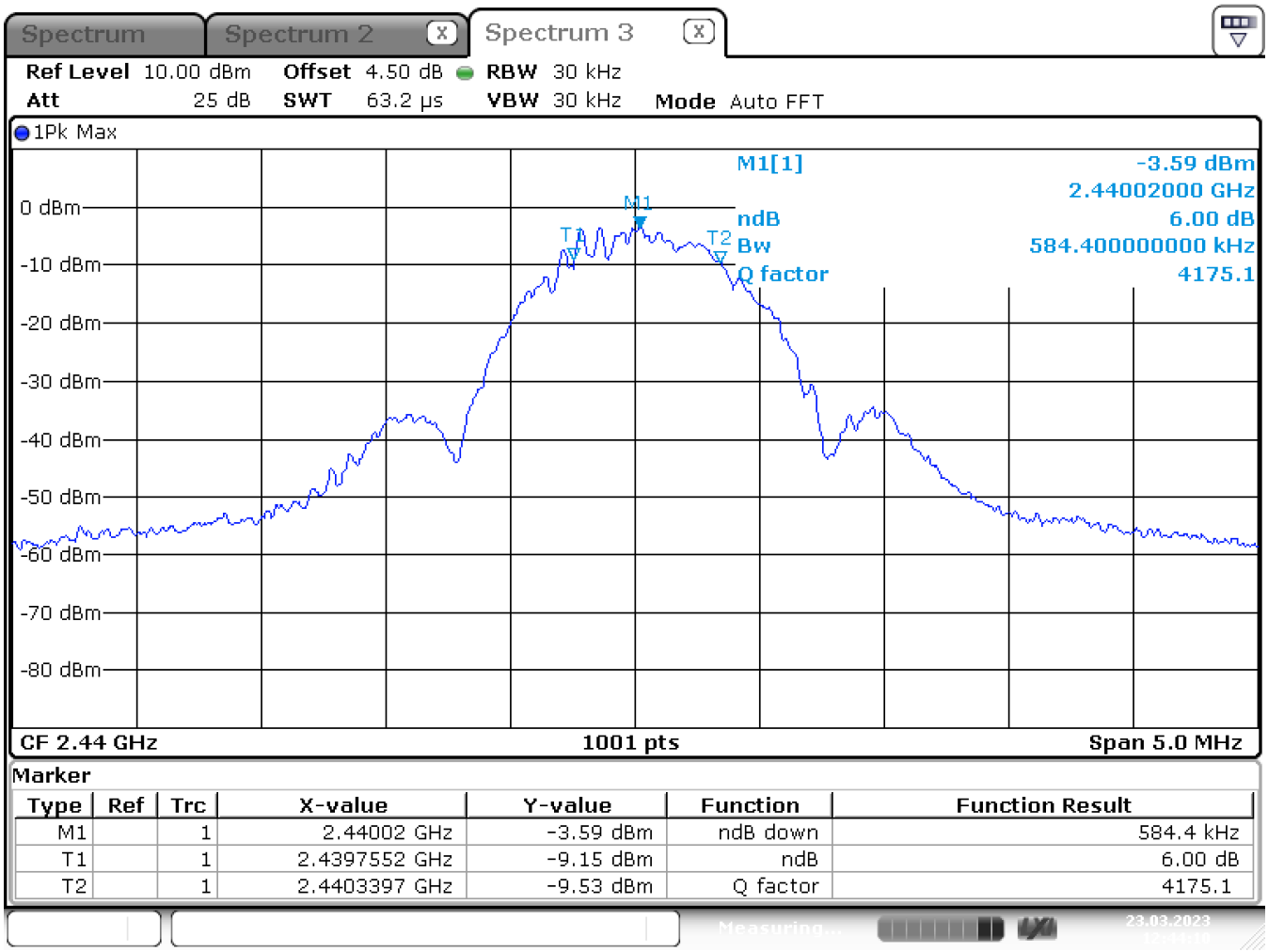
Test Equipment used: EMV-205;

www.tuv.at | info@tuv.at | TÜV ®

6 dB Bandwidth **§ 15.247(a)(2) 5.2.a)**

Conducted Measurement

Rated output power: 1,32 mW 2440 MHz center frequency



Date: 23.MAR.2023 12:44:10

6dB Bandwidth: 584,4 kHz

LIMIT **SUBCLAUSE 15.247(e) – 5.2.a)**

Under normal test conditons	6 dB Bandwidth at least 500 kHz

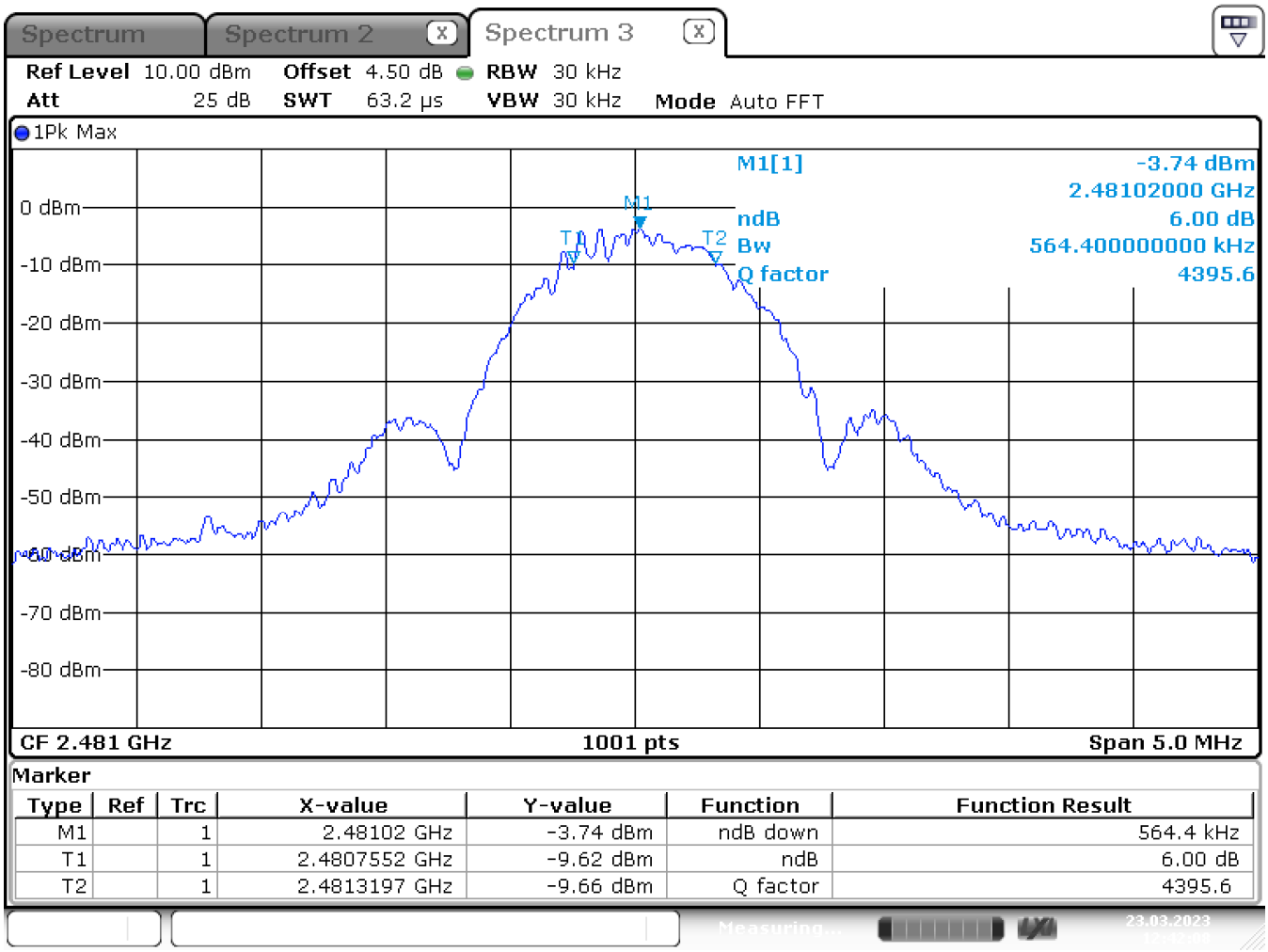
Test Equipment used: EMV-205;

www.tuv.at | info@tuv.at | TÜV ®

6 dB Bandwidth **§ 15.247(a)(2) 5.2.a)**

Conducted Measurement

Rated output power: 1,32 mW 2481 MHz center frequency



Date: 23.MAR.2023 12:42:08

6dB Bandwidth: 564,4 kHz

LIMIT **SUBCLAUSE 15.247(e) – 5.2.a)**

Under normal test conditons	6 dB Bandwidth at least 500 kHz

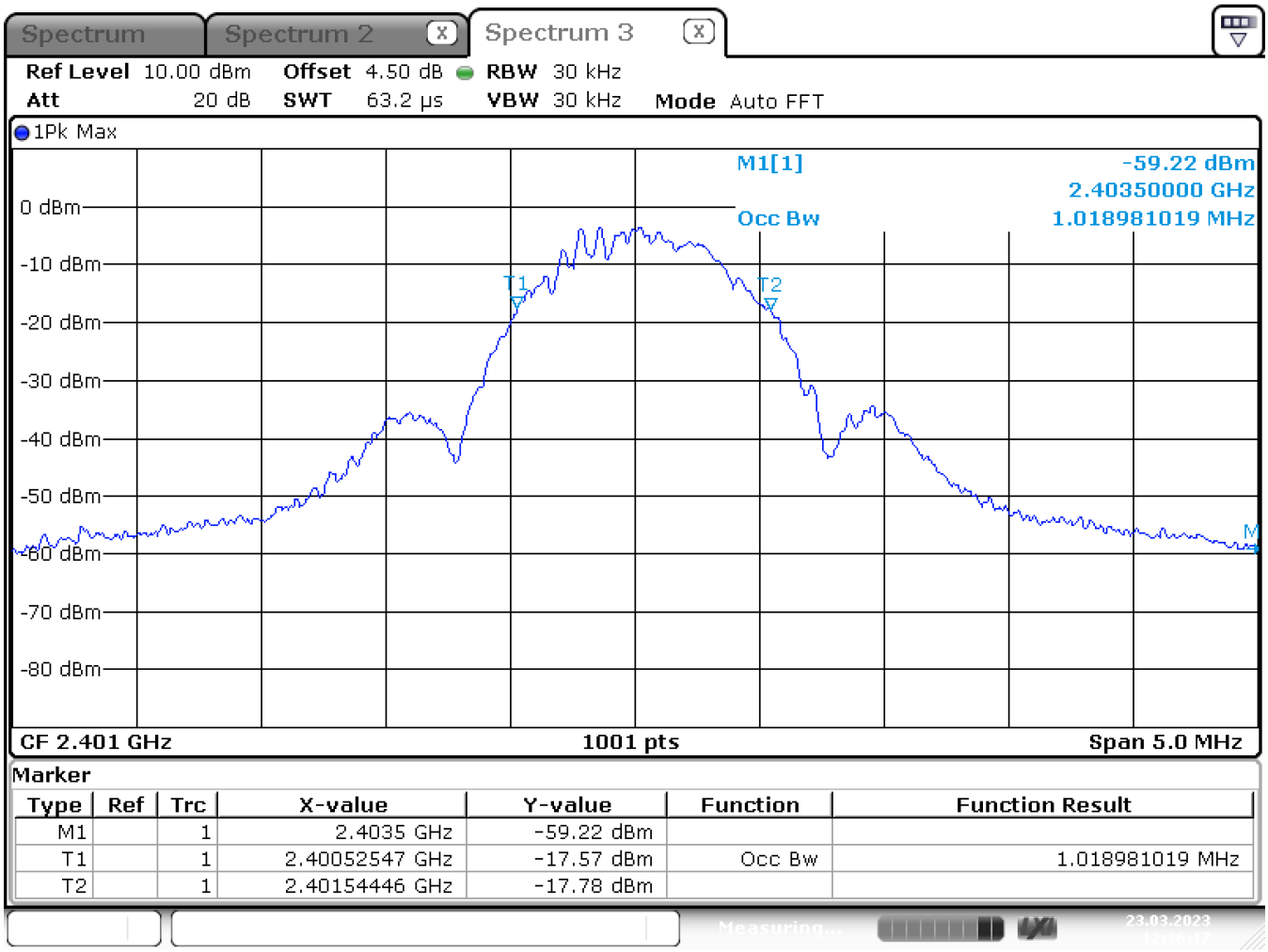
Test Equipment used: EMV-205;

www.tuv.at | info@tuv.at | TÜV ®

4.10. 99% Bandwidth RSS 247

Conducted Measurement

Rated output power: 1,32 mW 2401 MHz center frequency



Date: 23.MAR.2023 12:36:18

99% Bandwidth: 1019 kHz

LIMIT **RSS 247**

None; for IC reporting purposes only

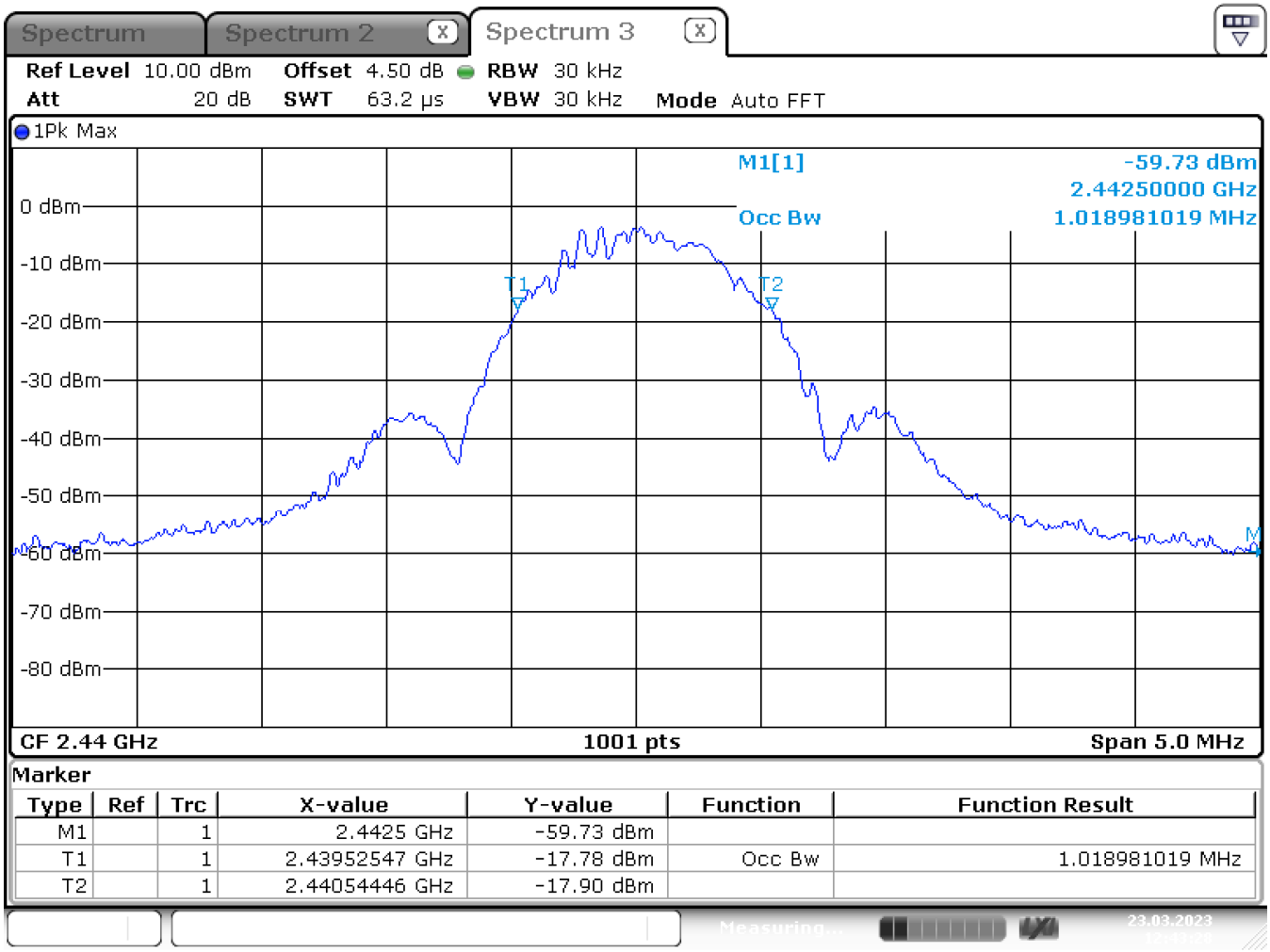
Test Equipment used: EMV-205;

www.tuv.at | info@tuv.at | TÜV ®

99% Bandwidth **RSS 247**

Conducted Measurement

Rated output power: 1,32 mW 2440 MHz center frequency



Date: 23.MAR.2023 12:43:28

99% Bandwidth: 1019 kHz

LIMIT **RSS 247**

None; for IC reporting purposes only

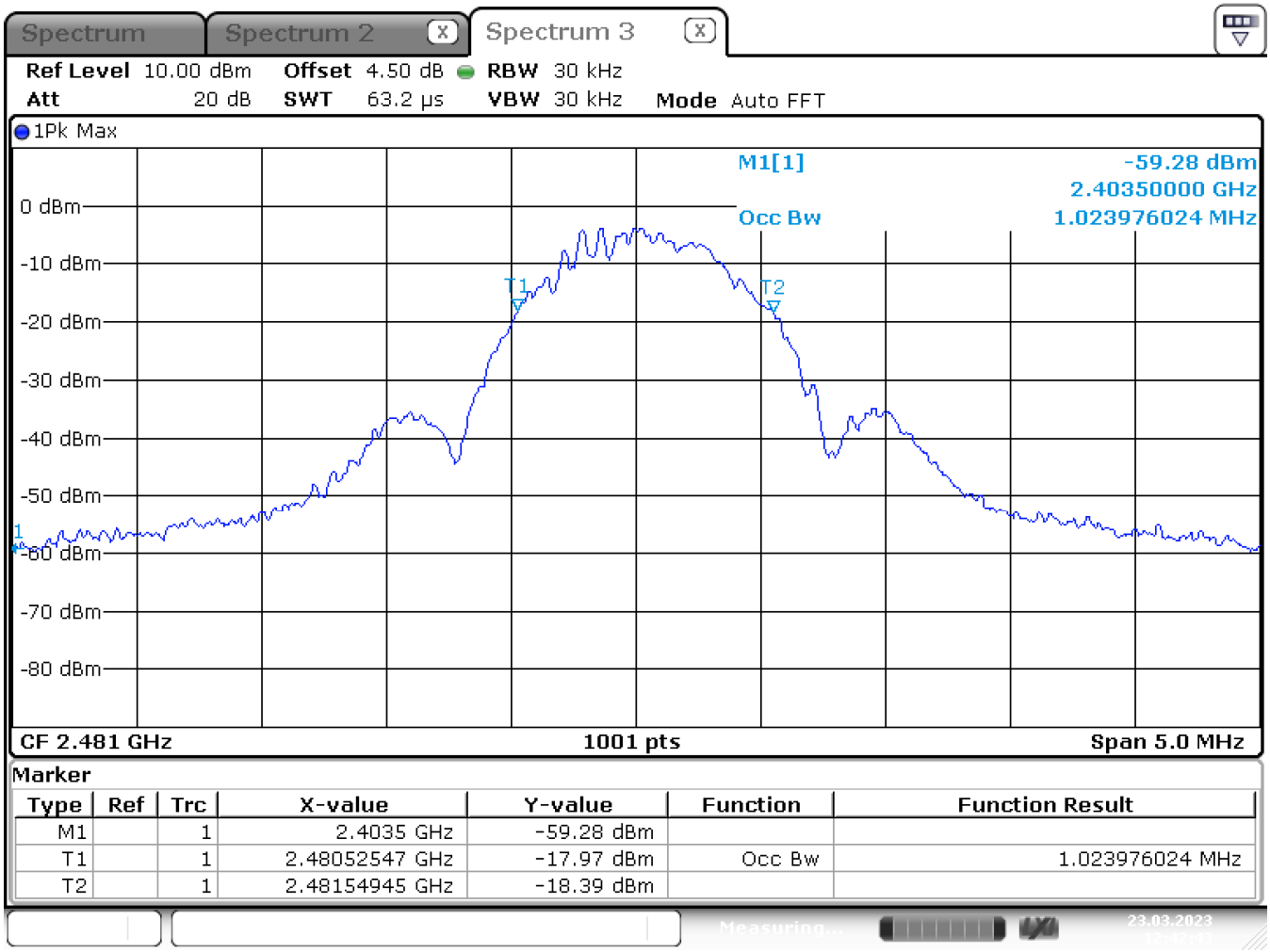
Test Equipment used:EMV-205;

www.tuv.at | info@tuv.at | TÜV ®

99% Bandwidth **RSS 247**

Conducted Measurement

Rated output power: 1,32 mW 2481 MHz center frequency



Date: 23.MAR.2023 12:42:43

99% Bandwidth: 1024 kHz

LIMIT **RSS 247**

None; for IC reporting purposes only

Test Equipment used: EMV-205;

www.tuv.at | info@tuv.at | TÜV ®

4.11. Maximum Peak RF Power Output

§ 15.247(b)(3)
5.4.4

Conducted Measurement

Rated output power: 1,32 mW

Test conditions		Transmitter power (mW)		
		2401 MHz	2440 MHz	2481 MHz
T_{nom} (23)°C	V_{nom} (3) V	1,13	1,12	1,09
Measurement uncertainty		± 0,75 dB		

Radiated Measurement

Rated output power: 1,32 mW

Test conditions		Transmitter power (mW) EIRP		
		2401 MHz	2440 MHz	2481 MHz
T_{nom} (23)°C	V_{nom} (3) V	1,32	1,23	1,15
Measurement uncertainty		± 2 dB		

Maximum Gain derived from EIRP and conducted measurement:		Maximum Gain (dBi)		
Test condition		2401 MHz	2440 MHz	2481 MHz
T_{nom} 23 °C	V_{nom} (3)V	0,66	0,42	0,21

LIMIT **SUBCLAUSE 15.247(b)(3) – 5.4.4**

Under normal test conditons	1W conducted (4W eirp)

Test Equipment used: NT-100; NT-110/1; NT-111/1; NT-139; NT-207/1; EMV-205

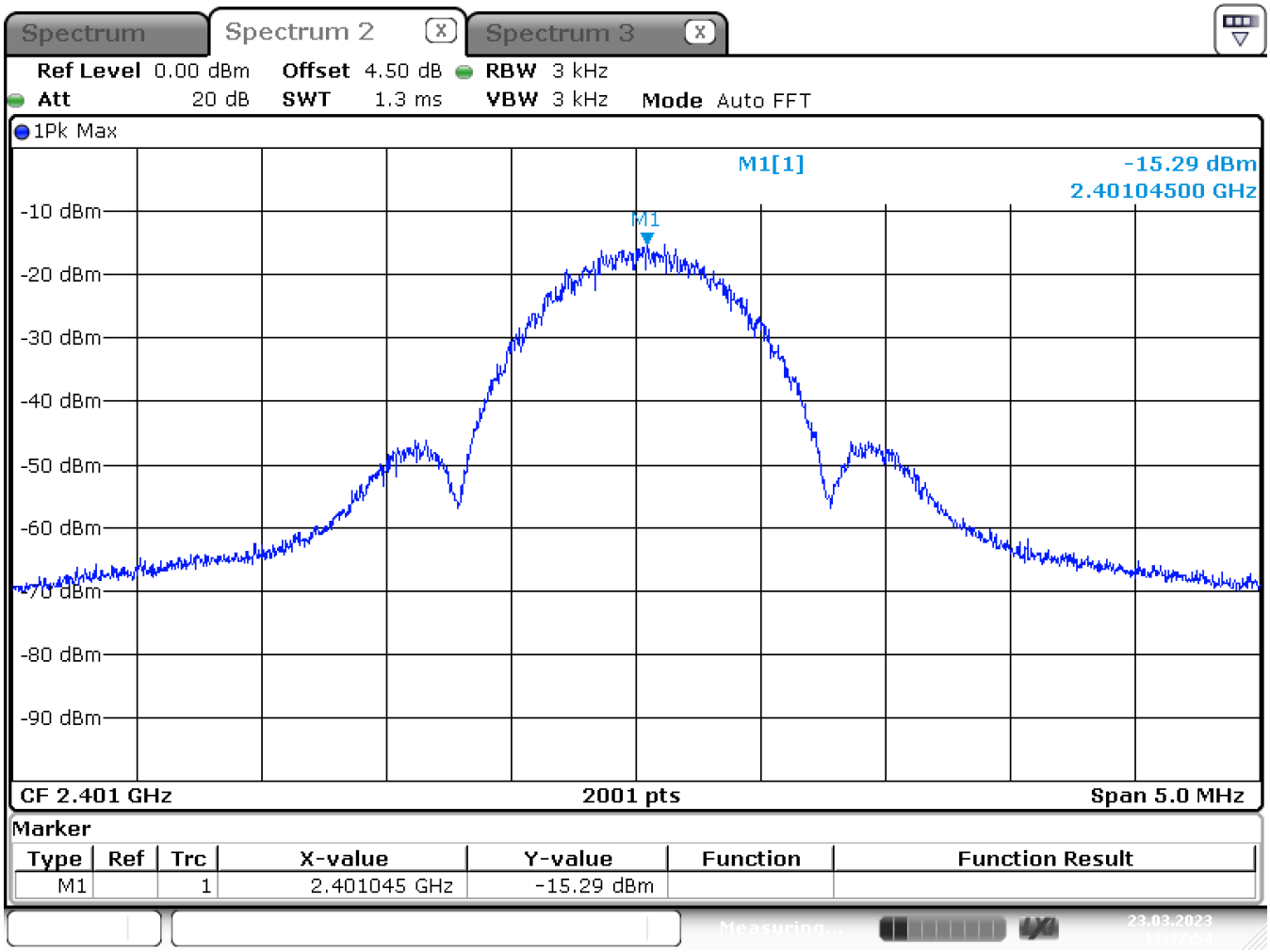
www.tuv.at | info@tuv.at | TÜV ®

4.12. Power spectral density (radiated)

§ 15.247(e)
5.2.2

Conducted Measurement

Rated output power: 1,32 mW 2401 MHz center frequency



Date: 23.MAR.2023 12:37:54

Power Spectral density: -15,29 dBm @ 2401,05 MHz

LIMIT **SUBCLAUSE 15.247(e) – 5.2 b)**

Under normal test conditons	+8dBm in any 3 kHz band

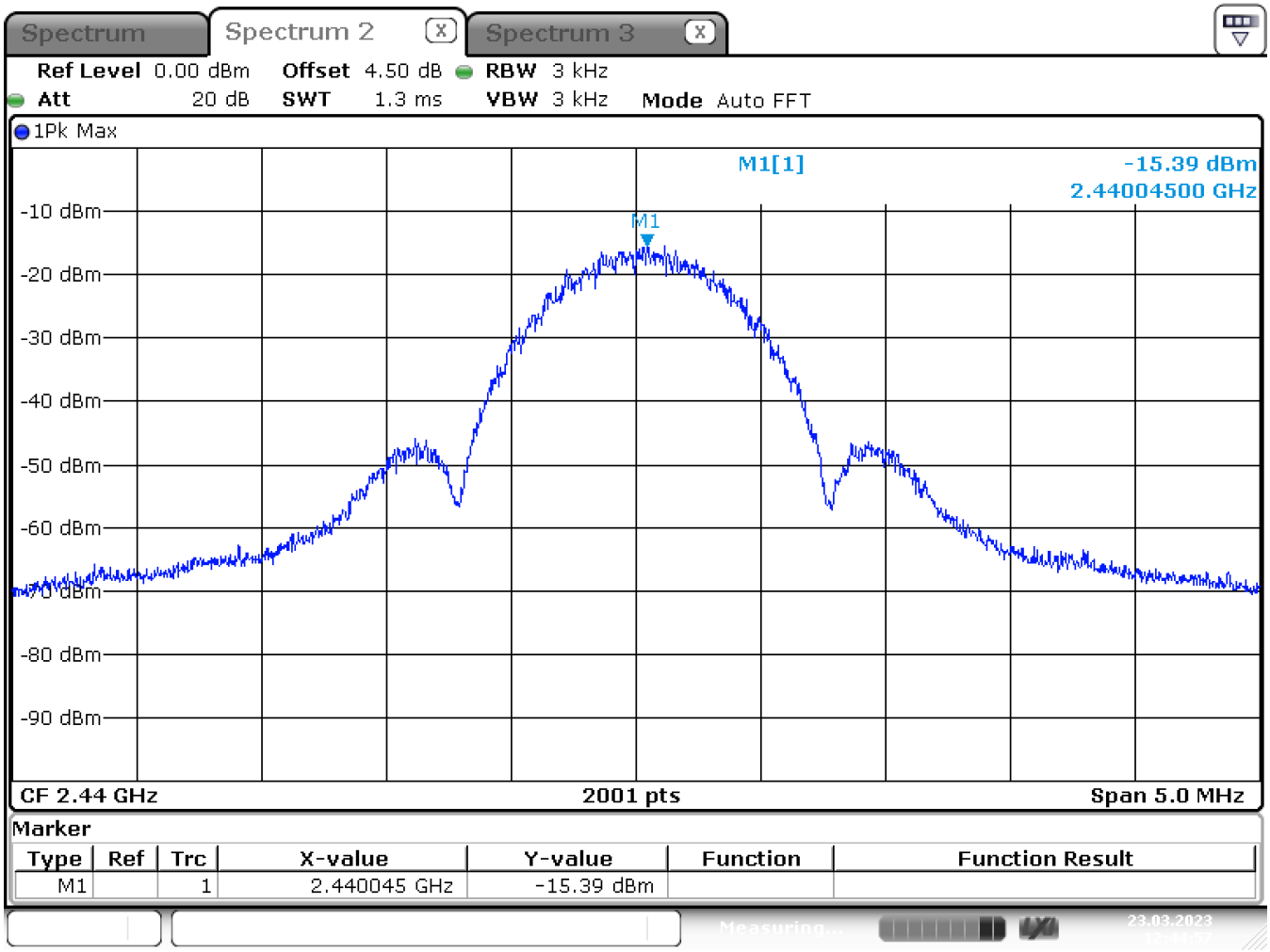
Test Equipment used: NT-100; NT-110/1; NT-111/1; NT-139; NT-207/1;

www.tuv.at | info@tuv.at | TÜV ®

Power spectral density (radiated) **§ 15.247(e) 5.2 b)**

Conducted Measurement

Rated output power: 1,32 mW 2440 MHz center frequency



Date: 23.MAR.2023 12:44:58

Power Spectral density: -15,39 dBm @ 2440,05 MHz

LIMIT **SUBCLAUSE 15.247(e) – 5.2 b)**

Under normal test conditons	+8dBm in any 3 kHz band

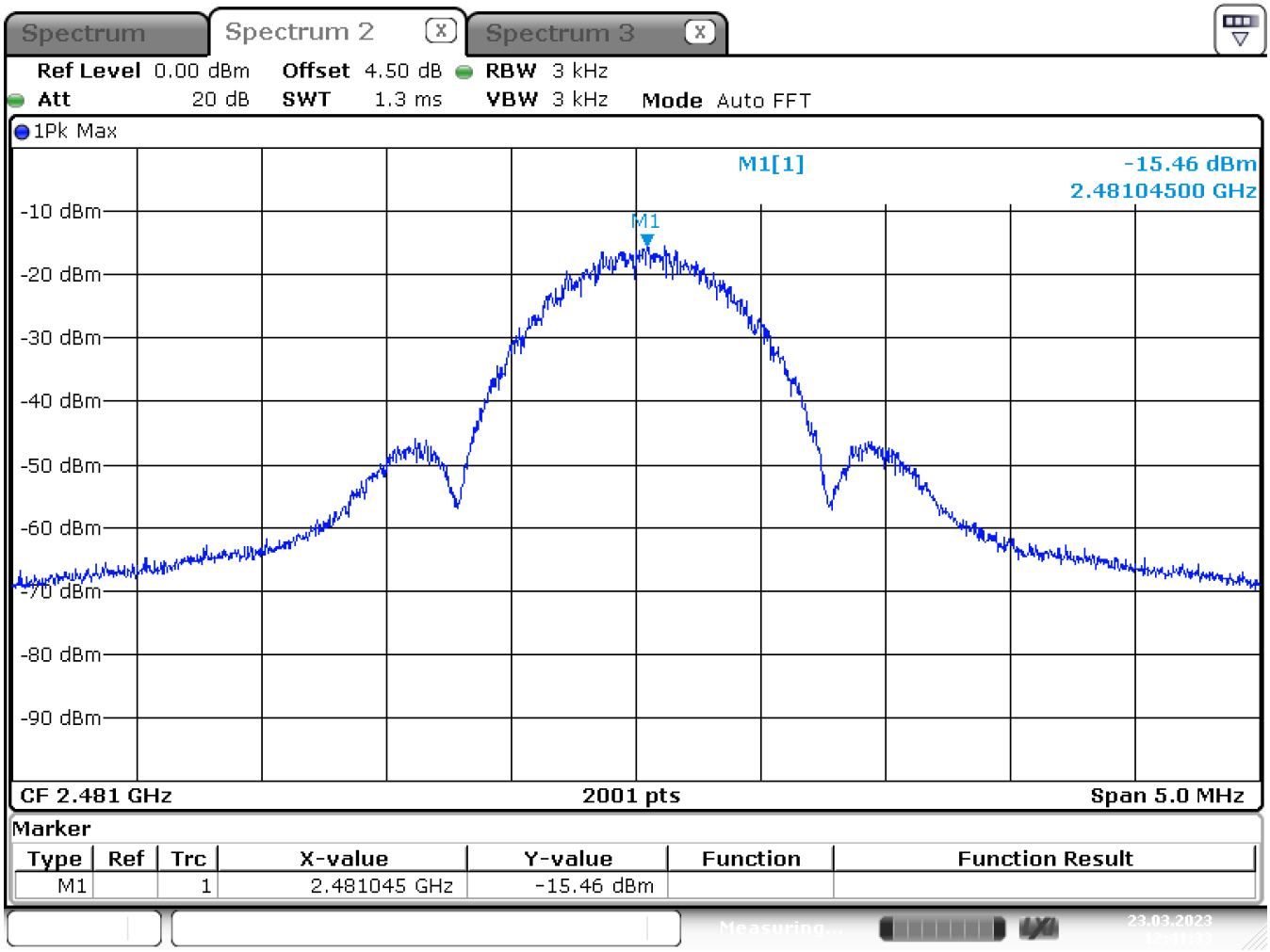
Test Equipment used: NT-100; NT-110/1; NT-111/1; NT-139; NT-207/1;

www.tuv.at | info@tuv.at | TÜV ®

Power spectral density (radiated) **§ 15.247(e) 5.2 b)**

Conducted Measurement

Rated output power: 1,32 mW 2481 MHz center frequency



Date: 23.MAR.2023 12:41:33

Power Spectral density: -15,46 dBm @ 2481,05 MHz

LIMIT **SUBCLAUSE 15.247(e) – 5.2 b)**

Under normal test conditons	+8dBm in any 3 kHz band

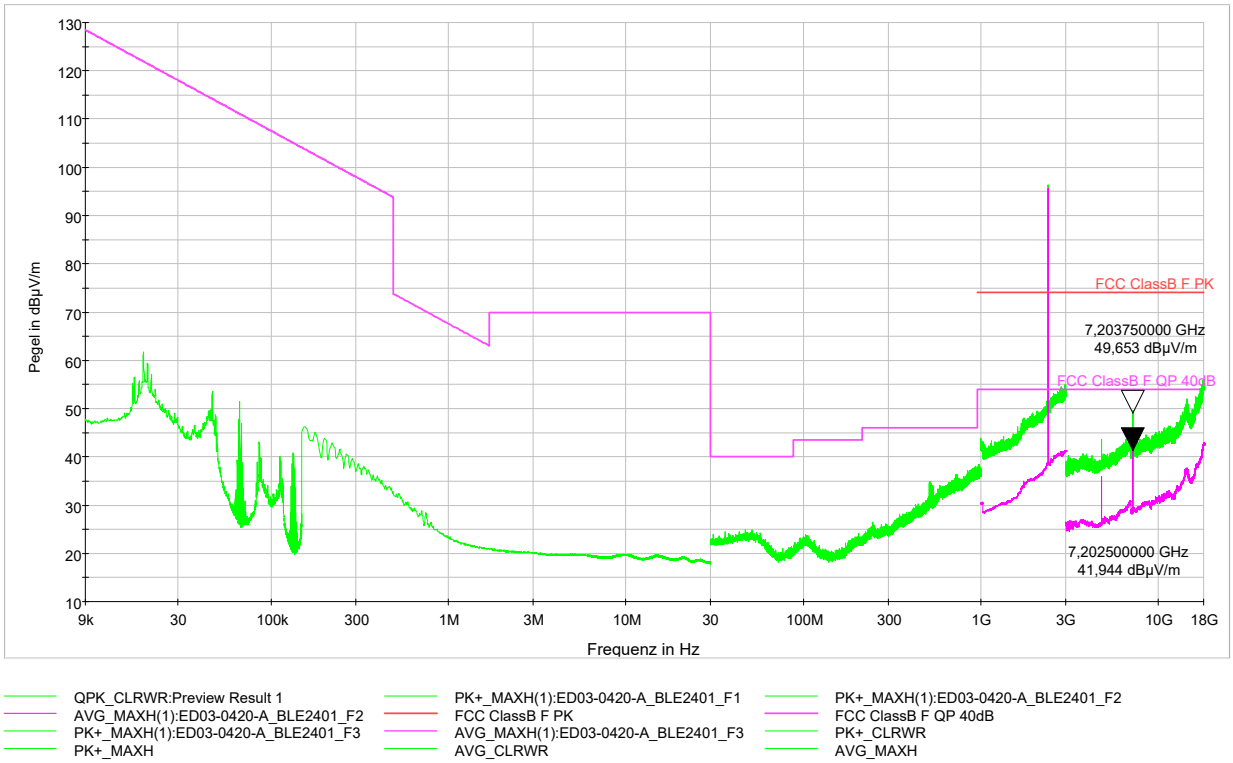
Test Equipment used: NT-100; NT-110/1; NT-111/1; NT-139; NT-207/1;

www.tuv.at | info@tuv.at | TÜV ®

4.13. Emissions in restricted bands **§ 15.209(a)**
Emissions falling within restricted frequency bands **RSS-Gen**

Measurement with Peak-Detector (green line) and Average detector (magenta line):

Setup: 2401 MHz



Worst case emission: Average @ 7202,5 MHz: 41,95 dBµV/m
Remark: Although the measurement above ends at 18 GHz, all measurements were performed up to the thenth harmonics of the transmitter frequency.

LIMIT **SUBCLAUSE 15.209(a) – RSS-Gen**

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: NT-100; NT-110/1; NT-111/1; NT-132; NT-207/1;

www.tuv.at | info@tuv.at | TÜV ®

Emissions in restricted bands **§ 15.209(a)**
Emissions falling within restricted frequency bands **RSS-Gen**

Measurement with Peak-Detector (green line) and Average detector (magenta line): Band Edge requirement

Setup: 2401 MHz

LIMIT **SUBCLAUSE 15.209(a) – RSS-Gen**

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

Band edges of the nearest restricted bands: 2390 MHz and 2483,5 MHz.

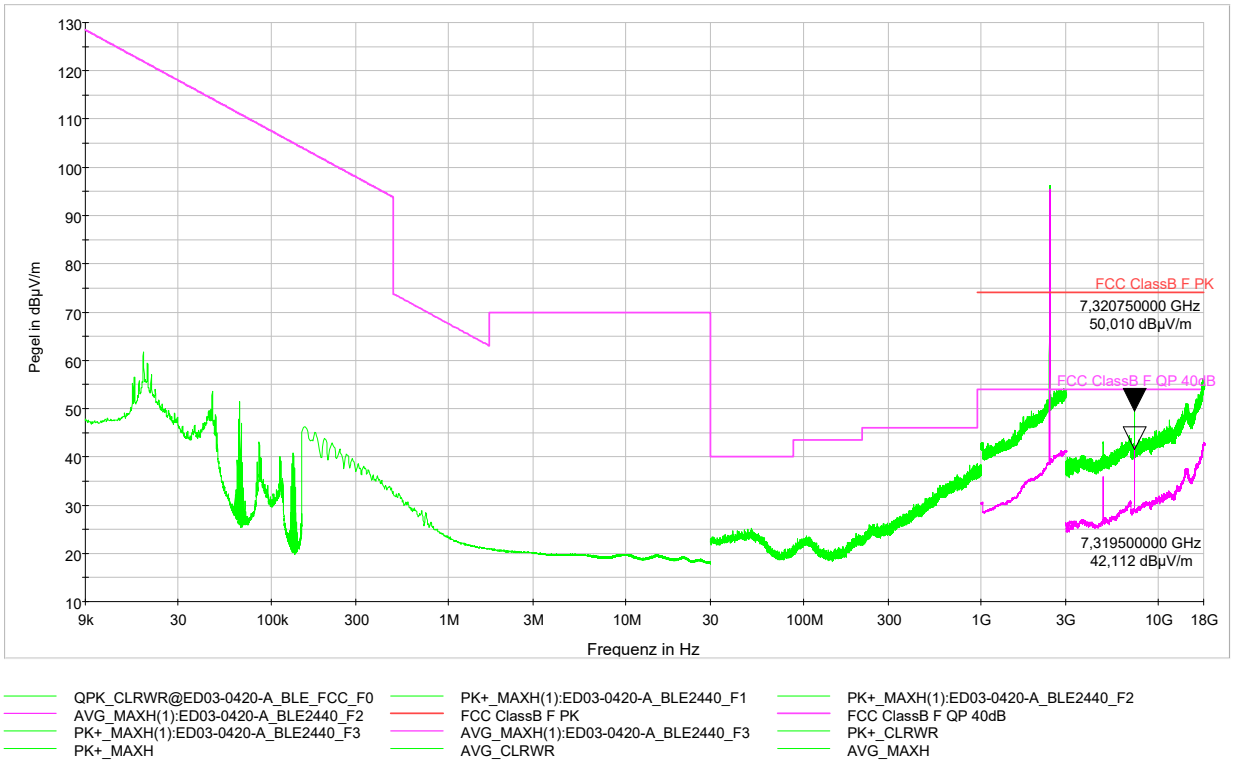
Test Equipment used: NT-100; NT-110/1; NT-111/1; NT-131/1; NT-139; NT-207/1;

www.tuv.at | info@tuv.at | TÜV ®

Emissions in restricted bands **§ 15.209(a)**
Emissions falling within restricted frequency bands **RSS-Gen**

Measurement with Peak-Detector (green line) and Average detector (magenta line):

Setup: 2440 MHz



Worst case emission: Average @ 7319,5 MHz: 42,11 dBµV/m
Remark: Although the measurement above ends at 18 GHz, all measurements were performed up to the thenth harmonics of the transmitter frequency.

LIMIT **SUBCLAUSE 15.209(a) – RSS-Gen**

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

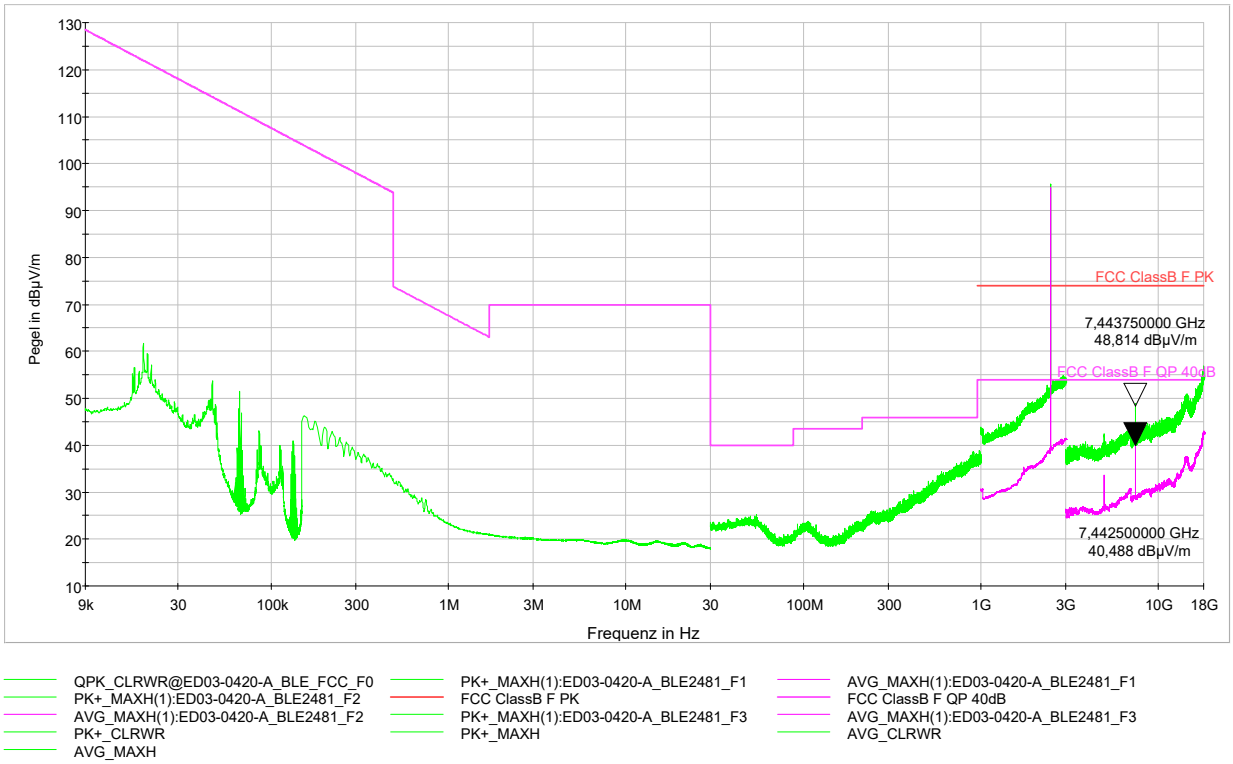
Test Equipment used: NT-100; NT-110/1; NT-111/1; NT-132; NT-207/1;

www.tuv.at | info@tuv.at | TÜV ®

Emissions in restricted bands **§ 15.209(a)**
Emissions falling within restricted frequency bands **RSS-Gen**

Measurement with Peak-Detector (green line) and Average detector (magenta line):

Setup: 2481 MHz



Worst case emission: Average @ 7442,5 MHz: 40,49 dBµV/m
Remark: Although the measurement above ends at 18 GHz, all measurements were performed up to the thenth harmonics of the transmitter frequency.

LIMIT **SUBCLAUSE 15.209(a) – RSS-Gen**

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

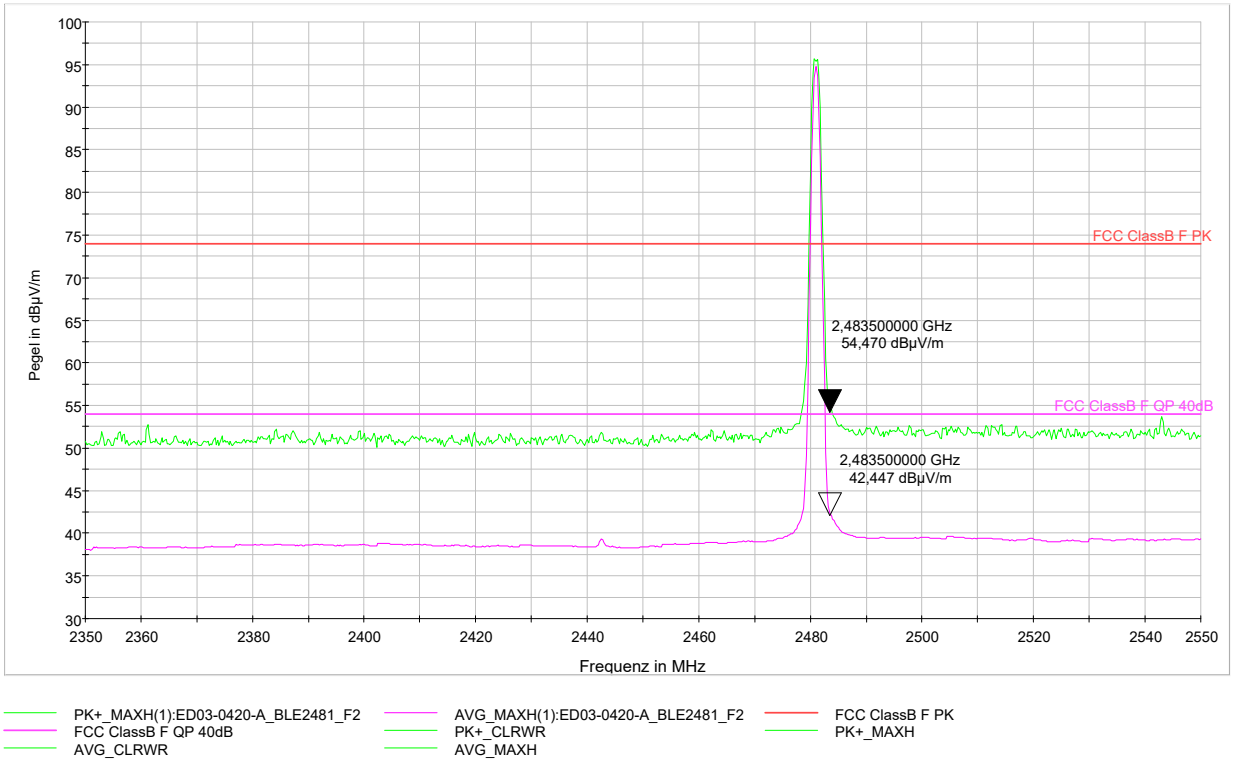
Test Equipment used: NT-100; NT-110/1; NT-111/1; NT-132; NT-207/1;

www.tuv.at | info@tuv.at | TÜV ®

Emissions in restricted bands
§ 15.209(a)
Emissions falling within restricted frequency bands **RSS-Gen**

Measurement with Peak-Detector (green line) and Average detector (magenta line): Band Edge requirement

Setup: 2481 MHz



LIMIT **SUBCLAUSE 15.209(a) – RSS-Gen**

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

Band edges of the nearest restricted bands: 2390 MHz and 2483,5 MHz.

Test Equipment used: NT-100; NT-110/1; NT-111/1; NT-131/1; NT-139; NT-207/1;

www.tuv.at | info@tuv.at | TÜV ®

4.14 RF Exposure

KDB 447498 D04
§1.1307(b)(3)(i)(B)

according to KDB 447498 D04 Interim General RF Exposure Guidance v01 “RF EXPOSURE PROCEDURES AND EQUIPMENT AUTHORIZATION POLICIES FOR MOBILE AND PORTABLE DEVICES”.

The device has only one antenna and simultaneous transmission does not apply.
The evaluation followed the flowchart in Figure A.1.

Title 47 §1.1307(b)(3)(i)(B):

(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:

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold Pth (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). Pth is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^x & d \leq 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \leq 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \leq f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \leq f \leq 6\ \text{GHz} \end{cases}$$

d = the separation distance (cm);

Maximum conducted power and EIRP values are taken from Section 4.5.
Calculations are done for a minimum separaton distance of 1 cm. This distance is derived from the device casing. It is conservative, as customers are not expected to touch or lean on electronic shelf labels for extended periods of time.
Production variance was declared by the manufacturer, see operational description.

f [MHz]	cond. P [mW]	duty cycle [1]	production variance [1]	max. time-averaged power [mW]	EIRP [mW]	ERP [mW]	ERP incl. prod. var. [mW]
2401	1,13	1	1,58	1,79	1,32	0,80	1,27
2440	1,12	1	1,58	1,76	1,23	0,75	1,19
2481	1,09	1	1,58	1,73	1,15	0,70	1,11

*) Duty cycle was not measured, factor 1 is a worst case assumption.

www.tuv.at | info@tuv.at | TÜV ®

Title 47 §1.1307(b)(3)(i)(B) exemption calculation:

Frequency range (see 4.1 and 4.2)	max(max. time avg. P, ERP) [mW]	§1.1307(b)(3)(i)(B) limit (P_{th}) [mW]	P / Pth [1]	< 1
2401	1,79	10,39	0,17	OK
2440	1,76	10,28	0,17	OK
2481	1,73	10,17	0,17	OK

The available maximum time-averaged ERP is below P_{th} for separation distances of 1 cm and above.

The device is a *SAR exempt RF device* as per Title 47 §1.1307(b)(3)(i)(B).

www.tuv.at | info@tuv.at | TÜV ®

RF Exposure RSS-102, Issue 5

2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.

www.tuv.at | info@tuv.at | TÜV ®

RSS-102 2.5.1 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)	
2401	1,13	1,32	1	1,13	1,32	5	10.65	OK
2440	1,12	1,23	1	1,12	1,23	5	10.14	OK
2481	1,09	1,15	1	1,09	1,15	5	9.86	OK

*) Duty cycle was not measured, factor 1 is a worst case assumption.

**) Calculations are done for a minimum separaton distance of 0.5 cm and limb worn exposure. The distance is derived from the device casing. 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.

www.tuv.at | info@tuv.at | TÜV ®

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	☐	Spectrumanalyzer – FSP7 9 kHz – 7 GHz	NT-200
☐	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	☐	DSO9104 Digital scope	NT-220/1
☐	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

www.tuv.at | info@tuv.at | TÜV ®

Appendix 1 (continued)
Test equipment used

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

www.tuv.at | info@tuv.at | TÜV ®

Appendix 1 (continued)
Test equipment used

☐	RF-Attenuator 10 dB DC – 18 GHz / 50 W	NT-417/1
☐	RF-Attenuator 6 dB DC – 18 GHz / 50 W	NT-418
☐	RF-Attenuator 3 dB DC – 18 GHz / 50 W	NT-419
☐	RF-Attenuator 20 dB DC - 1000 MHz / 25 W	NT-421
☐	RF-Attenuator 30 dB DC - 1000 MHz / 1 W	NT-423
☐	RF-Attenuator 30 dB	NT-424
☐	RF-Attenuator 6 dB DC - 1000 MHz / 1 W	NT-425
☐	RF-Attenuator 6 dB DC - 1000 MHz / 1 W	NT-426
☐	RF-Attenuator 6 dB	NT-428
☐	RF-Attenuator 0 dB - 81 dB	NT-429
☐	WRU 27 - Band blocking 27 MHz	NT-430
☐	WHJ450C9 AA - High pass 450 MHz	NT-431
☐	WHJ250C9 AA - High pass 250 MHz	NT-432
☐	RF-Load 150 W	NT-433
☐	Impedance transducer 1:4 ; 1:9 ; 1:16	NT-435
☐	RF-Attenuator DC – 18 GHz 6 dB	NT-436
☐	RF-Attenuator DC – 18 GHz 6 dB	NT-437
☐	RF-Attenuator DC – 18 GHz 10 dB	NT-438
☐	RF-Attenuator DC – 18 GHz 20 dB	NT-439
☐	I+P 7780 Directional coupler 100 - 2000 MHz	NT-440
☐	ESH3-Z2 - Pulse limiter 9 kHz - 30 MHz	NT-441
☐	Power Divider 6 dB/1 W/50 Ohm	NT-443
☐	Directional coupler 0,1 MHz – 70 MHz	NT-444
☐	Directional coupler 0,1 MHz – 70 MHz	NT-445
☐	Tube imitations according to EN 55015	NT-450
☐	FCC-801-M3-16A Coupling decoupling network	NT-458
☐	FCC-801-M2-50A Coupling decoupling network	NT-459
☐	FCC-801-M5-25 Coupling decoupling network	NT-460
☐	FCC-801-T4 Coupling decoupling network	NT-463
☐	FCC-801-C1 Coupling decoupling network	NT-464

☐	SW 9605 - Current probe 150 kHz – 30 MHz	NT-465/1
☐	95242-1 – Current probe 1 MHz – 400 MHz	NT-468
☐	94106-1L-1 – Current probe 100 kHz – 450 MHz	NT-471
☐	WHKX12-2700-3000-18000 3 GHz Highpass filter	NT-472
☐	WHKX10-3870-4500-18000 4,5 GHz Highpass filter	NT-473
☐	CDN S9 USB3.0 Coupling decoupling network	NT-474
☐	CDN S2 XLR3-1 Coupling decoupling network	NT-475
☐	CDN S8 RJ45 Coupling decoupling network	NT-476
☐	GA 1240 Power amplifier according to EN 61000-4-16	NT-480
☐	Coupling networks according to EN 61000-4-16	NT-481 - NT-483
☐	Van der Hoofden Test Head	NT-484
☐	WRCJV12-5820-5850-5950-5980 5,9 GHz Band Reject Filter	NT-490
☐	WHKX10-5670-6300-18000 6 GHz Highpass filter	NT-491
☐	WHK12-935-1000-7000 1 GHz Highpass filter	NT-492
☐	EMC Video/Audiosystem	NT-511/1
☐	EMC32 Version 10.60.20 Test software	NT-520/1
☐	SRM-TS Version 1.3 software for SRM-3000	NT-522
☐	SRM-TS Version 1.3.1 software for SRM-3006	NT-522/1
☐	Spitzenberger und Spies Test software V4.1	NT-525
☐	Vertical coupling plane (ESD)	NT-531
☐	Test cable #4 for EN 61000-4-6	NT-553
☐	Test cable #3 for conducted emission	NT-554
☐	Test cable #5+#6 ESD-cable (2x470k)	NT-555 + NT-556
☐	Test cable #8 Sucoflex 104EA	NT-559
☐	Test cable #9 (for outdoor measurements)	NT-580
☐	Test cable #10 (for outdoor measurements)	NT-581
☐	Test cable #13 Sucoflex 104PE	NT-584
☐	Test cable #21 for SRM-3000	NT-592
☐	Shield chamber	NT-600
☐	Climatic chamber	M-1200

www.tuv.at | info@tuv.at | TÜV ®

Appendix 1 (continued)
Test equipment used

Division:
Industry & Energy

Test report number:
2023-IN-AT-TICL-E-EX-0-000070-FG-006

Date: 30.03.2023

☐	Anechoic Chamber 3 m / 5 m measuring distance	EMV-100
☐	Turntabel 6 m diameter	EMV-101
☐	Antenna mast + controller	EMV-102+ EMV-103
☐	EMC Video/Audiosystem	EMV-104
☐	EMC Software EMC32 Version 10.60.20	EMV-105
☐	Hornantenna 1 – 18 GHz HF 907	EMV-110
☐	Antennapre.amp. 1 – 18 GHz BBV 9718 D	EMV-111/1
☐	Trilog Antenna 30-3000 MHz VULB9163	EMV-112
☐	Monopol 9 kHz – 30 MHz VAMP 9243	EMV-113
☐	Antennapre.amp 18 – 40 GHz BBV 9721	EMV-114
☐	Hornantenna 200 – 2000 MHz AH-220	EMV-115
☐	DC Artificial Network PVDC 8300	EMV-150
☐	AC Artificial Network NNLK 8121 RC	EMV-151
☐	AC Artificial Network NNLK 140	EMV- 153a-d
☐	EMI Receiver ESW44	EMV-200/1
☐	Signalgenerator 9 kHz – 40 GHz N5173B	EMV-201
☐	GPS Frequency normal B-88	EMV-202
☐	DC Power supply N5745A	EMV-203
☐	Spektrum Analyzator FSV40	EMV-205
☐	Thd Multimeter Model 2015	EMV-206
☐	Poweramplifier PAS15000	EMV- 207/abc
☐	Inrush Current Source	EMV- 208/abc
☐	Arb.-generator Sycore	EMV-209
☐	Harmonics/Flicker analyzer ARS 16/3	EMV-210
☐	Power Supply Regatron AC	EMV-214
☐	Power Supply Regatron DC	EMV-215
☐	Harmonics/Flicker analyser Zimmer	EMV-216
☐	Flicker Impedanz Newtons4th 753	EMV-218
☐	Comemso	EMV-219

☐	HF- Ampflifier 9 kHz-225 MHz BBL200	EMV-300/1
☐	HF- Amplifier 80 -1000 MHz BBA150	EMV-301
☐	HF- Amplifier 0,8 - 6 GHz BBA150	EMV-302
☐	High Power Ant. 20-200 MHz HPBA-2510	EMV-303/1
☐	High Power Ant. 20-200 MHz S12018-21	EMV-303/2
☐	Log.per Antenna 80-2700 MHz STLP 9128 E special	EMV-304
☐	Log.per Antenna 0,7 – 9 GHz STLP9149	EMV-305
☐	HF- Ampflifier 9 kHz-250 MHz BBA150 (low noise)	EMV-306
☐	ISO11451-2 TLS 10 kHz – 30 MHz	EMV-307
☐	Load Dump Generator LD 200N	EMV-350
☐	Ultra Compact Symulator UCS 200N100	EMV-351
☐	Automotive Power fail module PFM 200N100.1	EMV-352
☐	Voltage Drop Symulator VDS 200Q100	EMV-353
☐	Arb. Generator AutoWave	EMV-354
☐	Ultra Compact Symulator UCS 500N7	EMV-355
☐	Coupling decoupling network CNI 503B7 / 32 A	EMV-356
☐	Coupling decoupling network CNI 503B7 / 63 A	EMV-357
☐	Telecom Surge Generator TSurge 7	EMV-358
☐	Coupling decoupling network CNI 508N2	EMV-359
☐	Coupling decoupling network CNV 504N2.2	EMV-360
☐	Immunity generator NSG4060/NSG4060-1	EMV-361
☐	Coupling network CDND M316-2	EMV-362
☐	Coupling network CT419-5	EMV-363
☐	ESD Generator NSG 437	EMV-364
☐	Pulse Limiter VTSD 9561-F BNC	EMV-405
☐	Transient emission BSM200N40+BS200N100	EMV- 450+451
☐	Cap. Coupling Clamp HFK	EMV-455
☐	Mag. Field System MS100N+MC26100+MC2630	EMV- 456-458

www.tuv.at | info@tuv.at | TÜV ®

Appendix 1 (continued)
Test equipment used

☐	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

www.tuv.at | info@tuv.at | TÜV ®