

RADIO REPORT FCC 47 CFR Part 15C Digital transmission systems operating within the 2400.0 MHz - 2483.5 MHz band	
Report Reference No	G0M-2403-2495-TFC247ZB-RFR2a-V01
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	  DAkkS - Registration number : D-PL-12092-01-04 (FCC) FCC Filed Test Laboratory, Reg.-No.: 96970
Applicant	Jungheinrich AG
Address	Friedrich-Ebert-Damm 129 22047 Hamburg Germany
Test Specification	47 CFR Part 15C
Non-Standard Test Method	None
Equipment under Test (EUT):	
Product Description	UWB-Location-System is able to measure distances between the UWB components
Model(s)	52445054, Anchor
Additional Model(s)	None
Brand Name(s)	zoneCONTROL
Hardware Version(s)	10629
Software Version(s)	0.0.34
FCC ID	2AK6M-52445054
Test Result	PASSED

Possible test case verdicts:		
Required by standard but not tested	N/T	
Not required by standard	N/R	
Not applicable to EUT	N/A	
Test object does meet the requirement	P(PASS)	
Test object does not meet the requirement	F(FAIL)	
Testing:		
Test Lab Temperature	20 °C - 30 °C	
Test Lab Humidity	25 % - 55 %	
Date of receipt of test item	2024-05-14	
Report:		
Compiled by	Azamat Ibraimov	
Tested by (+ signature) (Responsible for Test)	Azamat Ibraimov	
Approved by (+ signature) (Test Lab Engineer)	Florian Voigt	
Date of Issue	2024-11-26	
Total number of pages	108	
General Remarks:		
The test results presented in this report relate only to the object tested. The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.		
Additional Comments:		
None		

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2024-11-26	Initial Release	--

ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
DSSS	Direct Sequence Spread Spectrum
EUT	Equipment Under Test
FCC	Federal Communications Commission
IEEE 802.15.4	MAC and PHY Layer for Wireless Personal Area Networks
ISED	Innovation, Science and Economic Development Canada
O-QPSK	Offset-Quadrature Phase Shift Keying
QPSK	Quadrature Phase Shift Keying
RBW	Resolution bandwidth
RMS	Root mean square
VBW	Video bandwidth
V _{NOM}	Nominal supply voltage

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1 Equipment (Test Item) Under Test

Description	UWB-Location-System is able to measure distances between the UWB components		
Model	52445054, Anchor		
Additional Model(s)	None		
Brand Name(s)	zoneCONTROL		
Sample Identification	EUT #	Sample-ID	Serial Number
	EUT 1 (radiated)	48554	ID:17:B4:10:03:19:D8
	EUT 2 (conducted)	48858	ID:17:B4:10:02:06:53
Hardware Version(s)	10629		
Software Version(s)	0.0.34		
FCC ID	2AK6M-52445054		
Equipment type	End Product		
Radio type	Transceiver		
Assigned frequency bands	2400.0 MHz - 2483.5 MHz		
Radio technology	IEEE 802.15.4		
Modulation	O-QPSK		
Number of antenna ports	2		
Antenna 1	Type	Integrated	
	Model	PCB Antenna	
	Manufacturer	Siemens	
	Gain	6.15 dBi	
	Port Name	RFR2a	
Antenna 2	Type	Integrated	
	Model	PCB Antenna	
	Manufacturer	Siemens	
	Gain	6.15 dBi	
	Port Name	RFR2a	
Supply Voltage	V _{NOM}	24 V DC (external supply) 48 V DC (via PoE)	
Operating Temperature	T _{NOM}	25°C	
	T _{MIN}	-30°C	
	T _{MAX}	60°C	
Dedicated AC/DC-Adaptor	None		
Manufacturer	Siemens Aktiengesellschaft R&D House CHE DI PA DCP R&D 5 Rochlitzer Str. 19 09111 Chemnitz Germany		

1.3 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	Laptop	HP	ProBook	For setting test modes
AE	PoE Midspan	Microsemi	9001GR	--
AE	PCB with COM port	Agilon	Not specified	--
CBL	Cable	Siemens	Not specified	From PCB with COM port to EUT
CBL	USB Cable	A-B Cable	Not specified	--
SFT	RadioMode Setup Tool v3.1.0	Siemens	Not specified	For setting test modes
AE	Power Adapter	HN Electronics	HNP60-UNIL6	AC Power line
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
SFT	Software			
Comment: --				

1.4 Test mode duty cycle

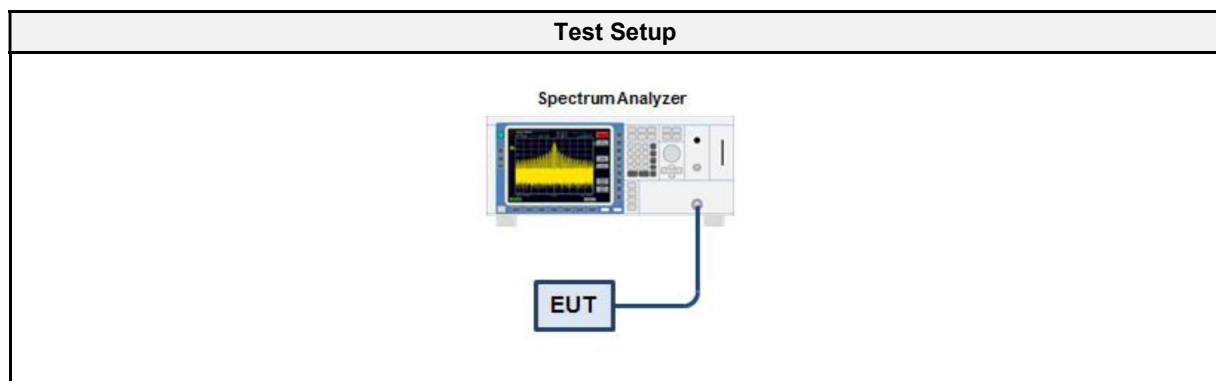
1.4.1 Information

Test Information	
Measurement Method	ANSI C63.10 11.6

1.4.2 Requirements

Requirements	
Duty cycle	Duty cycle correction
≥ 98 %	No correction required
< 98 %	Correction required ($10 \times \log_{10}(1/DC)$)

1.4.3 Setup



1.4.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSP 30	EF00312	2023-08	2024-08

1.4.5 Procedure

Test Procedure
- EUT set to test mode - Span is set to zero span - Detector set to peak - Sweep time is set long enough to capture at least 5 bursts - Envelope peak value of emission spectrum is selected - The maximum burst duration T_{ON} is measured using two markers set to the start and the end of the longest burst - The minimum idle duration T_{OFF} is measured using two markers set to the start and the end of the shortest idle period - The duty cycle is calculated by $DC = T_{ON} / (T_{ON} + T_{OFF})$ - The duty cycle correction is calculated by $DC = -10 \times \log_{10}(T_{ON} / (T_{ON} + T_{OFF}))$

1.4.6 Results

Duty Cycle Results		
Mode	Duty Cycle	Correction Factor [dB]
IEEE 802.15.4	1.0	N/R

1.5 Test Modes

Mode	Description
O-QPSK	Mode = Transmit Modulation = O-QPSK Spreading = None Data rate = 2000 kbps Power = 9 dBm (software setting) Duty cycle = 100%
Comment: --	

1.6 Test Frequencies

Designator	Mode	Channel	Frequency [MHz]
F1	Tx / Rx	11	2405
F2	Tx / Rx	18	2440
F3	Tx / Rx	25	2475
Comment: Channel 26 is deactivated by manufacturer			

1.7 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dB μ V. Any external preamplifiers used are taken into account through internal analyzer settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

$$\text{Reading on Analyzer (dB}\mu\text{V)} + \text{A.F. (dB/m)} = \text{Net field strength (dB}\mu\text{V/m)}$$

Net:

This is the net field strength measurement (as shown above).

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Field strength limit:

This is the FCC Class B radiated emission limit (in units of dB μ V/m). The FCC limits are given in units of μ V/m. The following formula is used to convert the units of μ V/m to dB μ V/m:

$$\text{Field strength limit (dB}\mu\text{V/m)} = 20 \cdot \log (\mu\text{V/m})$$

Example only for radiated field strength:

Reading + AF	= Net Reading	:	Net reading	- Field strength limit	= Margin
+21.5 dB μ V	+ 26 dB/m	:	47.5 dB μ V/m	- 57.0 dB μ V/m	= -9.5

2 Result Summary

FCC 47 CFR Part 15C				
Product Standard Reference	Requirement	Reference Method	Result	Remarks
FCC § 15.247(a)(2)	6 dB Bandwidth	ANSI C63.10-2013	PASS	--
FCC § 15.247(b)	Maximum peak conducted power	ANSI C63.10-2013	PASS	--
FCC § 15.247(e)	Power spectral density	ANSI C63.10-2013	PASS	--
FCC § 15.207	AC power line conducted emissions	ANSI C63.10-2013	PASS	--
FCC § 15.247(d)	Band edge compliance	ANSI C63.10-2013	PASS	--
FCC § 15.247(d)	Conducted spurious emissions	ANSI C63.10-2013	PASS	--
FCC § 15.247(d) FCC § 15.209	Transmitter radiated spurious emissions	ANSI C63.10-2013	PASS	--
Comment: The Decision Rule is applied on the basis of ETSI TR 102 273 and ETSI TR 100 028. These standards provide guidance on how to calculate and apply measurement uncertainty whilst providing maximum uncertainties allowance. In all cases due consideration will be given to ILAC-G8:09/2019. Where a result is considered conditional in respect of its proximity to the limit line, the customer would be made aware of situation so that they can make an informed decision on how to proceed.				

3 Test Conditions and Results

3.1 Test Conditions and Results - 6 dB bandwidth

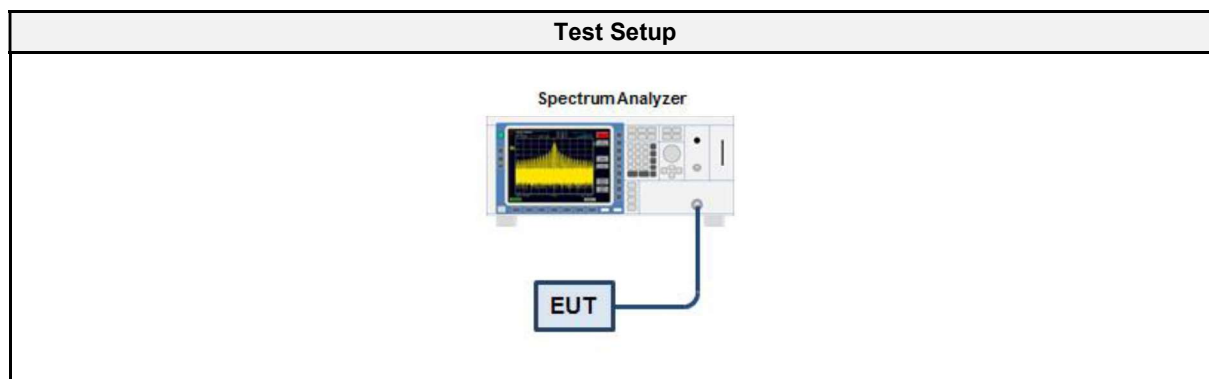
3.1.1 Information

Test Information	
Reference	FCC § 15.247(a)(2)
Measurement Method	ANSI C63.10 11.8
Measurement Uncertainty	± 1.26 %
Operator	Azamat Ibraimov
Date	2024-06-18

3.1.2 Limits

Limits
≥ 500kHz

3.1.3 Setup



3.1.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSP 30	EF00312	2023-08	2024-08
Cable	Gigalane	1730	EF00779 CAABE	2024-04	2025-04

3.1.5 Procedure

Test Procedure
1. EUT set to test mode 2. Span set to at least twice the emission spectrum 3. Detector set to peak and max hold and RBW is set to 100 kHz 4. Envelope peak value of emission spectrum is selected 5. Marker on envelope of spectrum is set to level of -6 dB to the left of the peak 6. Marker on envelope of spectrum is set to level of -6 dB to the right of the peak 7. 6 dB Bandwidth is determined by marker frequency separation

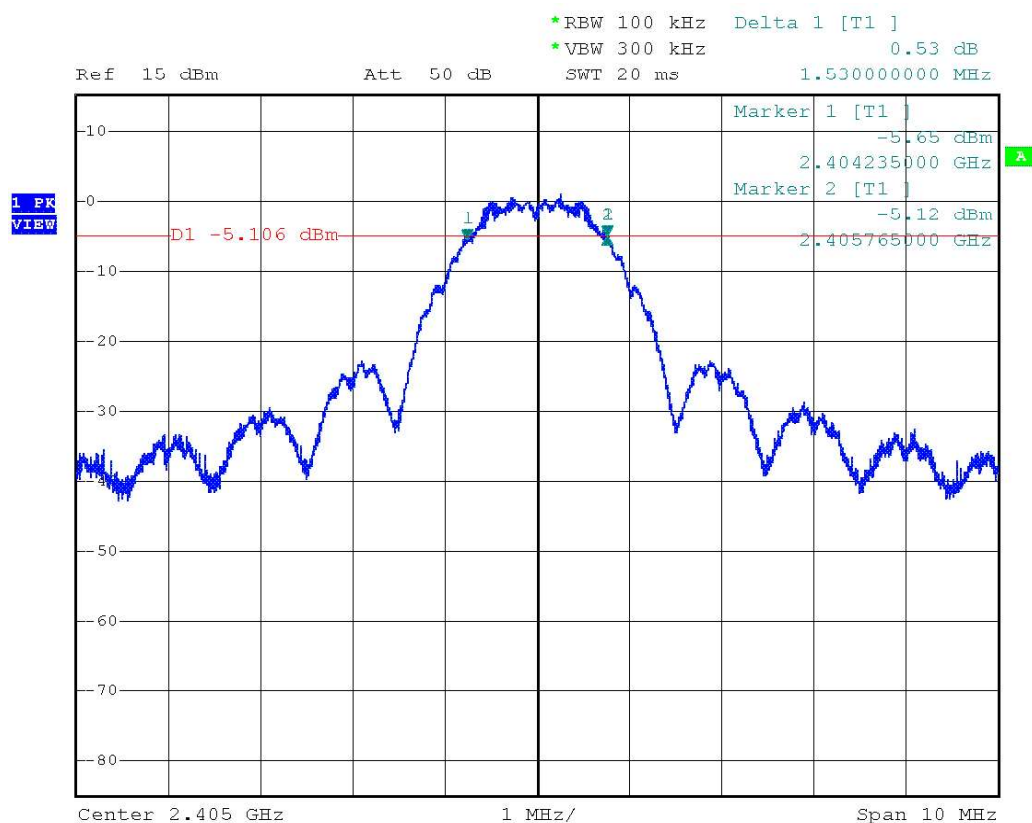
3.1.6 Results

Test Results ANT-1				
Mode	Frequency [MHz]	Bandwidth [kHz]	Limit [kHz]	Verdict
O-QPSK	2405	1530.0	500	PASS
O-QPSK	2440	1572.5	500	PASS
O-QPSK	2475	1605.0	500	PASS

Test Results ANT-2				
Mode	Frequency [MHz]	Bandwidth [kHz]	Limit [kHz]	Verdict
O-QPSK	2405	1545.0	500	PASS
O-QPSK	2440	1565.0	500	PASS
O-QPSK	2475	1585.0	500	PASS

DTS (6 dB) Bandwidth

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, Ant 1
 Lower Frequency [MHz]: 2404.235
 Upper Frequency [MHz]: 2405.765
 6 dB Bandwidth [kHz]: 1530.0



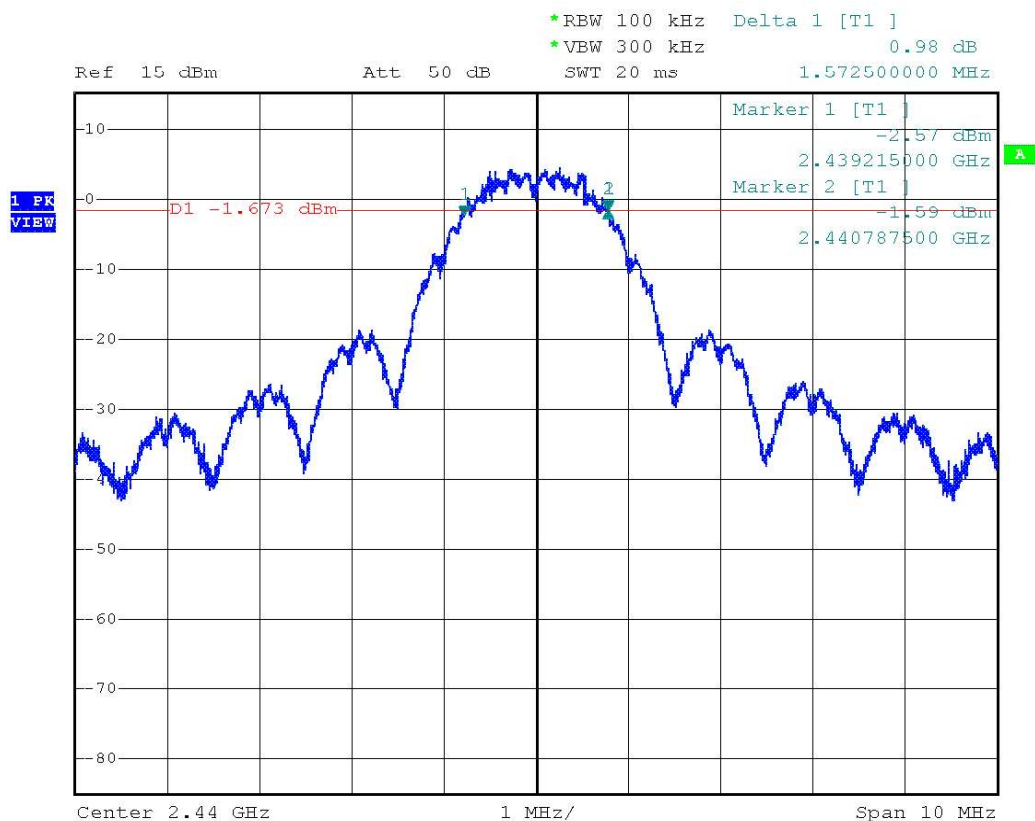
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

DTS (6 dB) Bandwidth

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, Ant 1
 Lower Frequency [MHz]: 2439.215
 Upper Frequency [MHz]: 2440.787
 6 dB Bandwidth [kHz]: 1572.5



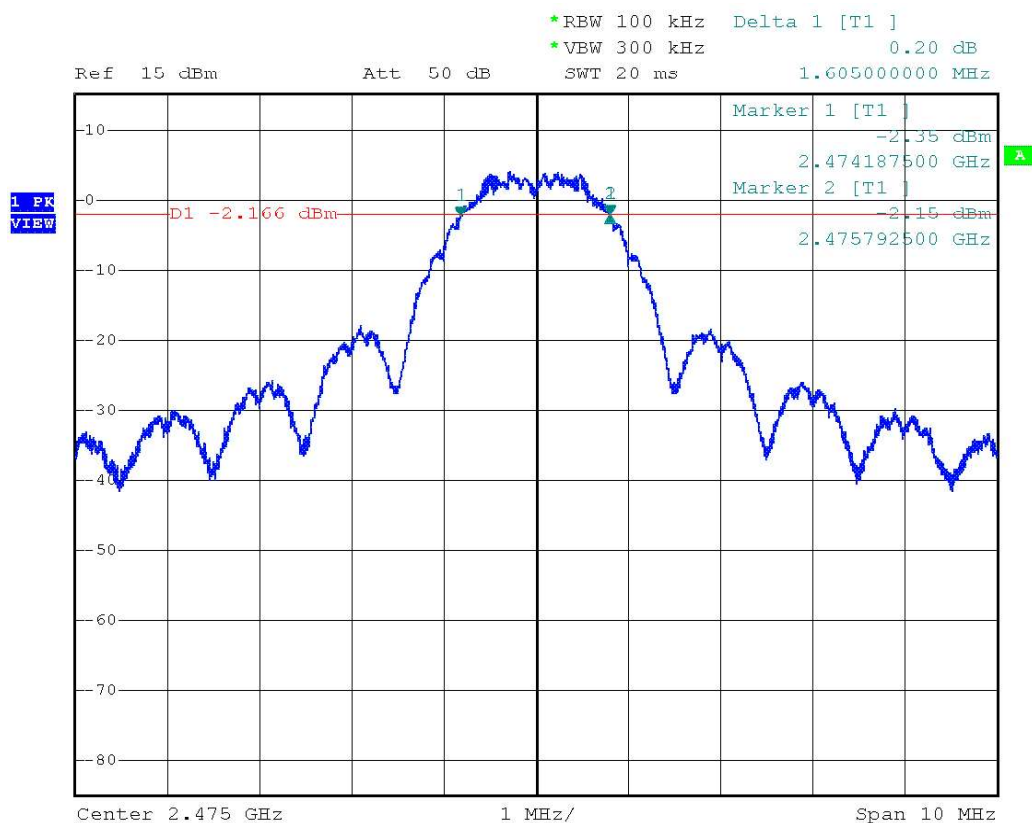
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Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

DTS (6 dB) Bandwidth

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 25, 2475 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, Ant 1
 Lower Frequency [MHz]: 2474.188
 Upper Frequency [MHz]: 2475.793
 6 dB Bandwidth [kHz]: 1605.0



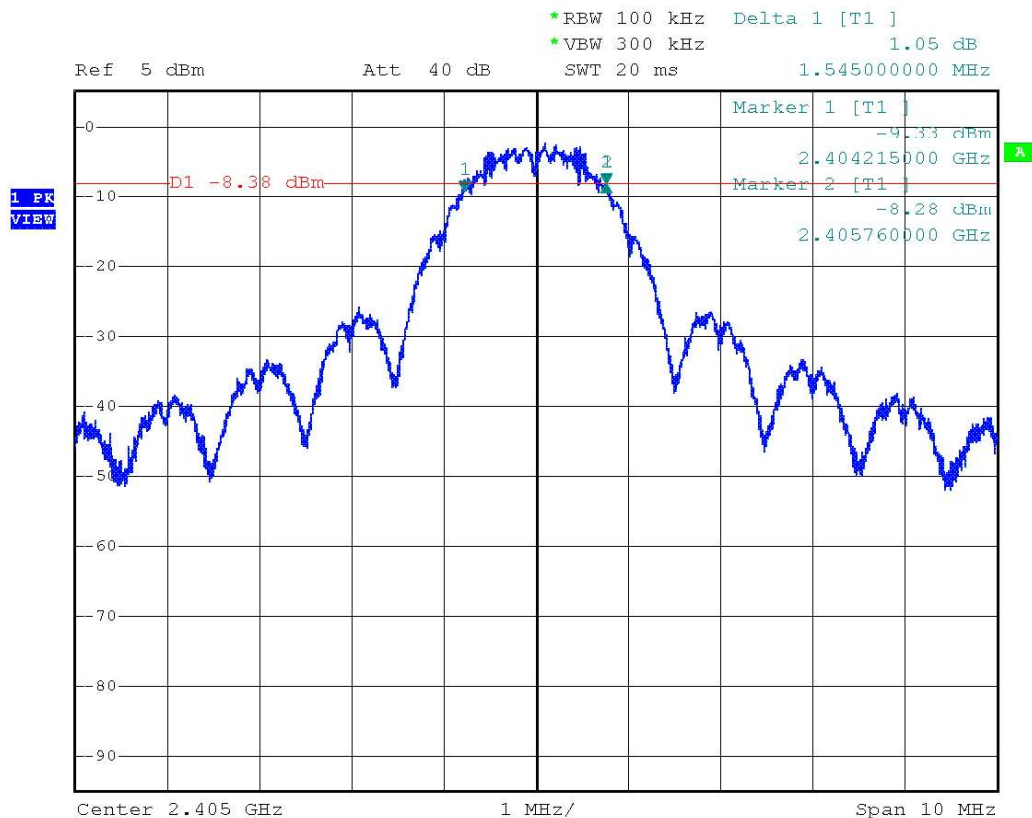
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

DTS (6 dB) Bandwidth

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 2
 Lower Frequency [MHz]: 2404.215
 Upper Frequency [MHz]: 2405.760
 6 dB Bandwidth [kHz]: 1545.0



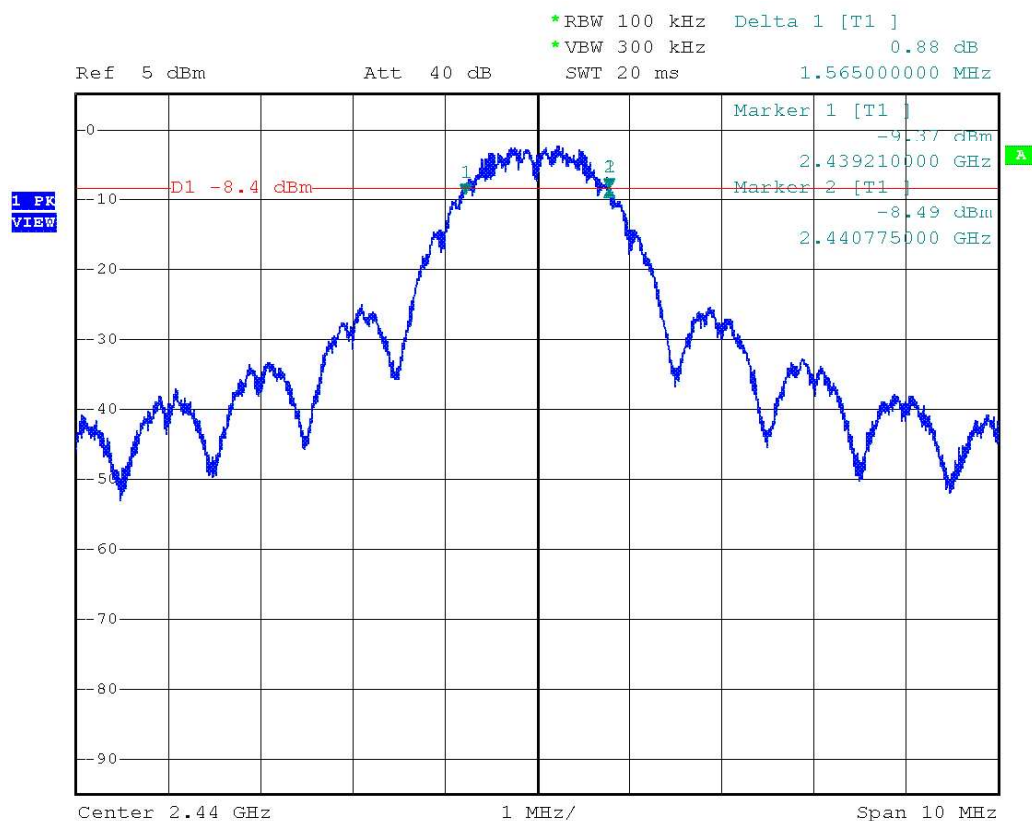
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

DTS (6 dB) Bandwidth

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 2
 Lower Frequency [MHz]: 2439.210
 Upper Frequency [MHz]: 2440.775
 6 dB Bandwidth [kHz]: 1565.0



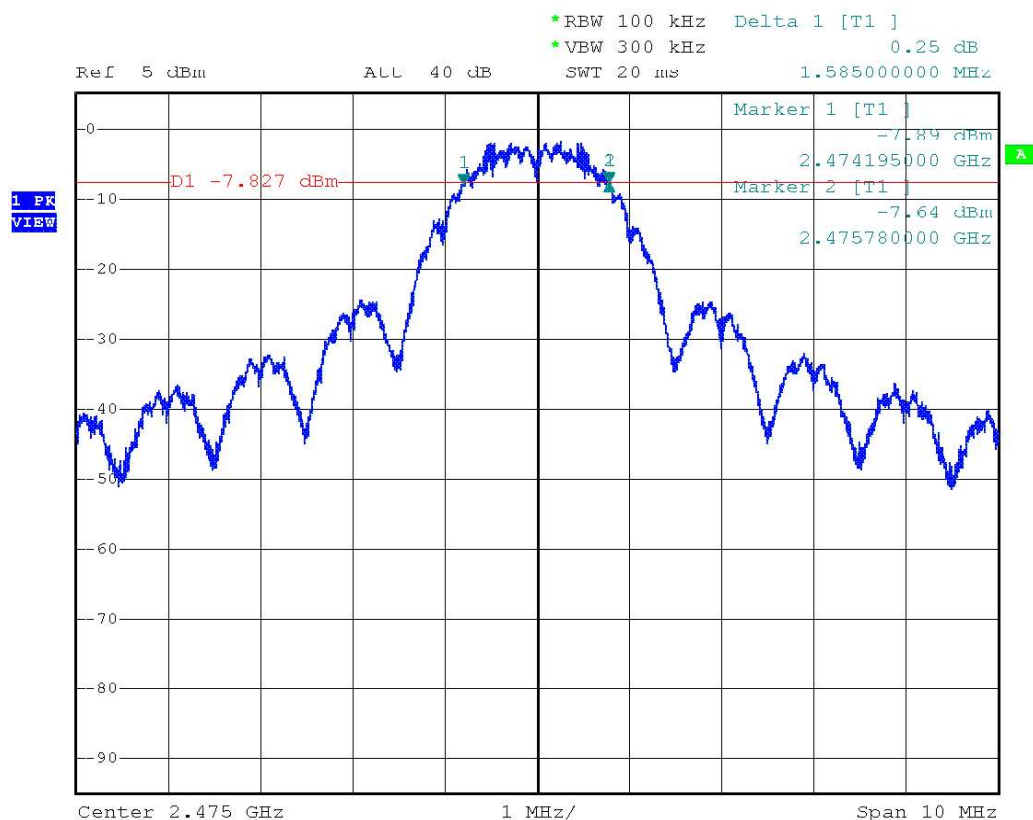
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

DTS (6 dB) Bandwidth

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 25, 2475 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 2
 Lower Frequency [MHz]: 2474.195
 Upper Frequency [MHz]: 2475.780
 6 dB Bandwidth [kHz]: 1585.0



Date: 18.JUN.2024 13:59:53

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

3.2 Test Conditions and Results - Maximum peak conducted output power

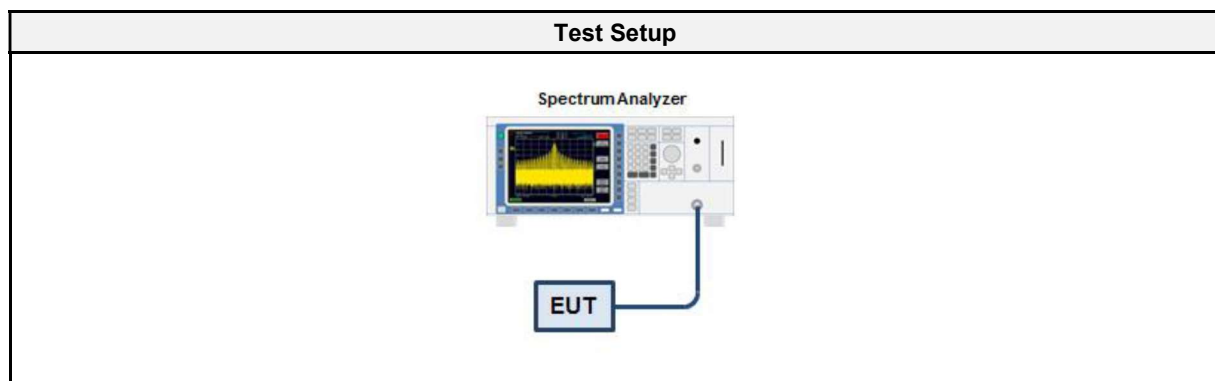
3.2.1 Information

Test Information	
Reference	FCC § 15.247(b)
Measurement Method	ANSI C63.10 11.9.1
Measurement Uncertainty	± 2.86 dB
Operator	Azamat Ibraimov
Date	2024-11-25

3.2.2 Limits

Limits
1 W (30 dBm)
The conducted output power limit specified above is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in the table, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.2.3 Setup



3.2.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSP 30	EF00312	2023-08	2024-08
Cable	Gigalane	1730	EF00779 CAABE	2024-04	2025-04

3.2.5 Procedure

Test Procedure
1. EUT set to test mode (Communication tester is used if needed) 2. Analyzer resolution bandwidth is set ≥ DTS bandwidth 3. Detector set to peak and max hold 4. Sweep time is set to auto 5. After the trace has stabilized a marker is set to peak of envelope

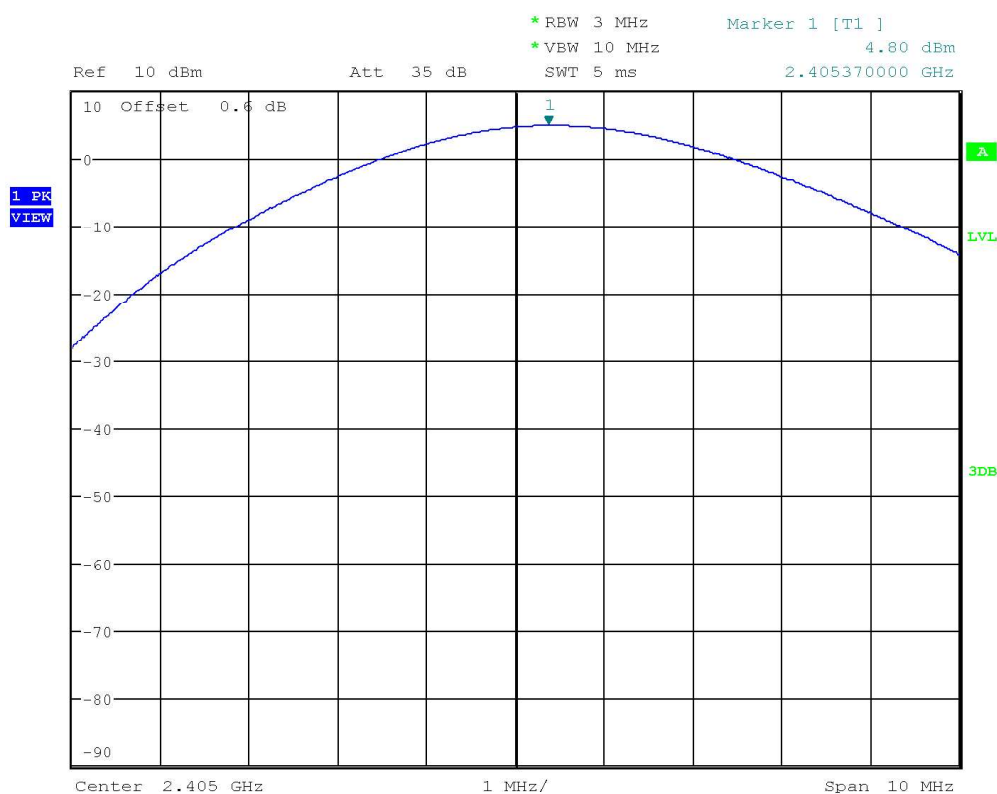
3.2.6 Results

Test Results ANT-1				
Channel [MHz]	Power [dBm]	Power [W]	Limit [W]	Verdict
2405	4.799	0.003019	0.966	PASS
2440	7.714	0.005907	0.966	PASS
2475	8.706	0.007423	0.966	PASS

Test Results ANT-2				
Channel [MHz]	Power [dBm]	Power [W]	Limit [W]	Verdict
2405	1.747	0.001495	0.966	PASS
2440	2.266	0.001685	0.966	PASS
2475	2.274	0.001688	0.966	PASS

Peak Conducted Output Power

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 51853936, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.9.1.1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-11-25
 Note: RFR2a ANT1
 Peak Power [dBm]: 4.799
 Peak Power [W]: 0.003019



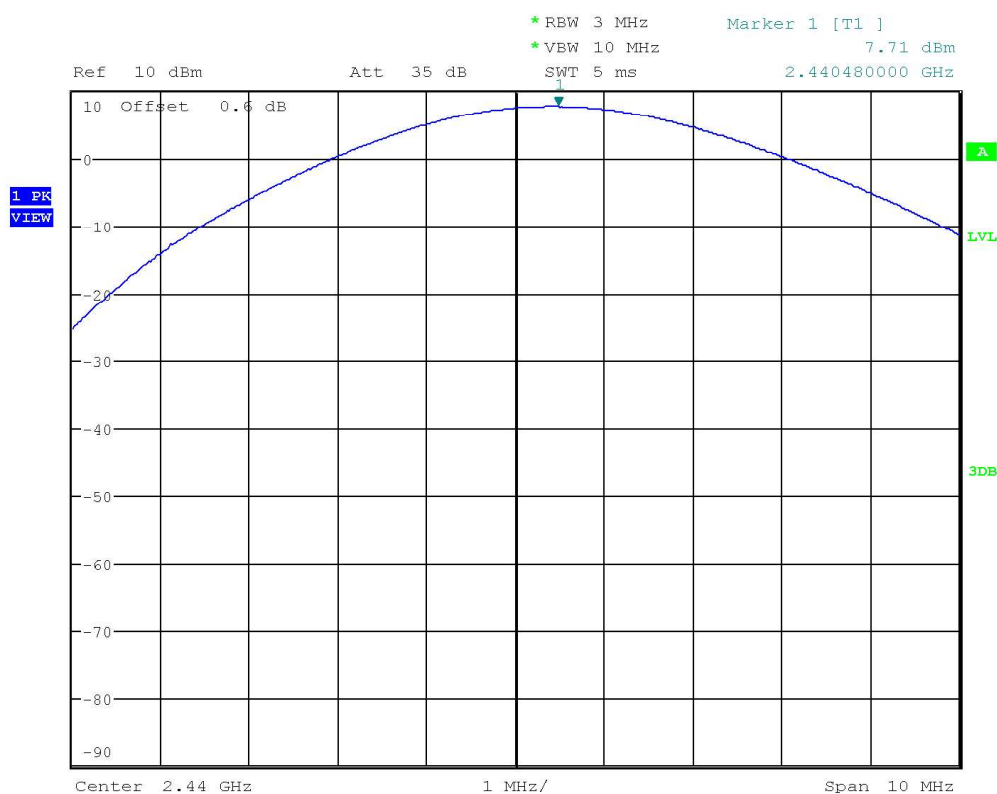
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Peak Conducted Output Power

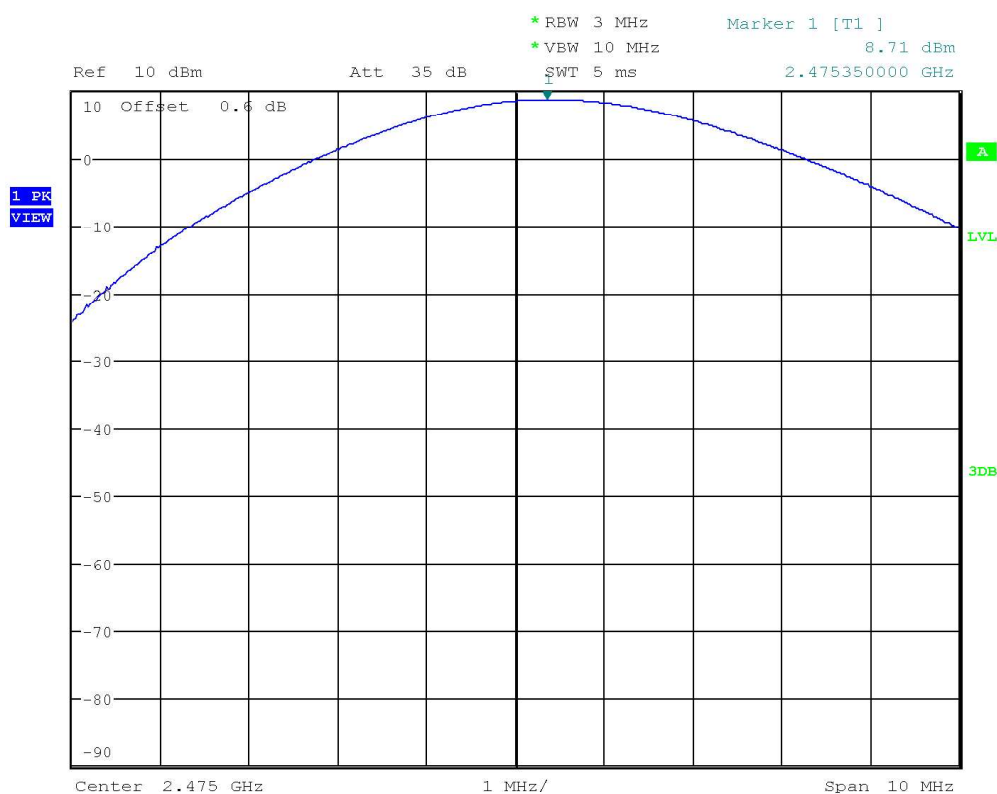
Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 51853936, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.9.1.1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-11-25
 Note: RFR2a ANT1
 Peak Power [dBm]: 7.714
 Peak Power [W]: 0.005907



Date: 25.NOV.2024 14:31:42

Peak Conducted Output Power

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 51853936, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.9.1.1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 25, 2475 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-11-25
 Note: RFR2a ANT1
 Peak Power [dBm]: 8.706
 Peak Power [W]: 0.007423



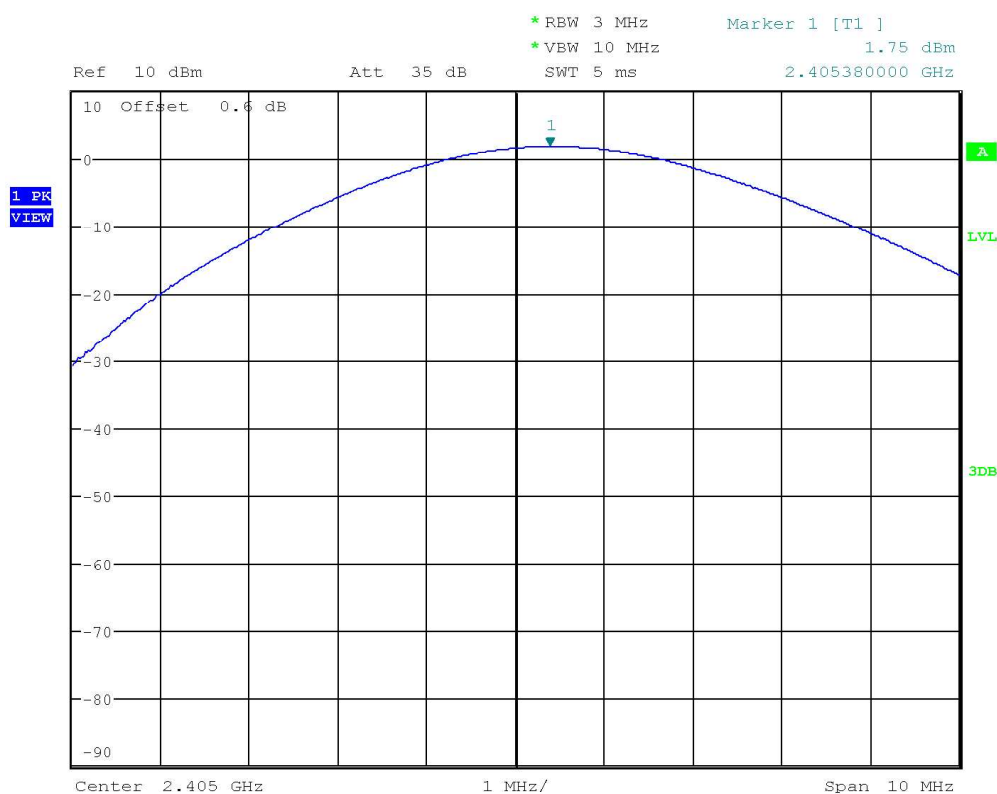
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Peak Conducted Output Power

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 51853936, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.9.1.1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-11-25
 Note: RFR2a ANT2
 Peak Power [dBm]: 1.747
 Peak Power [W]: 0.001495



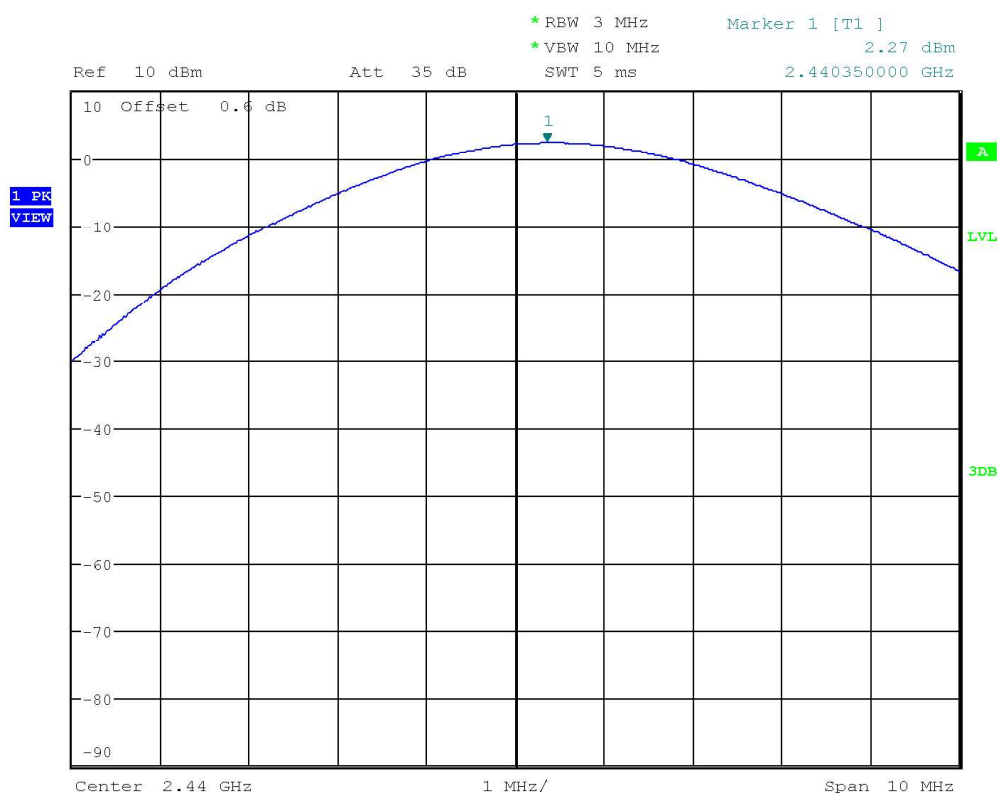
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Peak Conducted Output Power

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 51853936, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.9.1.1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-11-25
 Note: RFR2a ANT2
 Peak Power [dBm]: 2.266
 Peak Power [W]: 0.001685



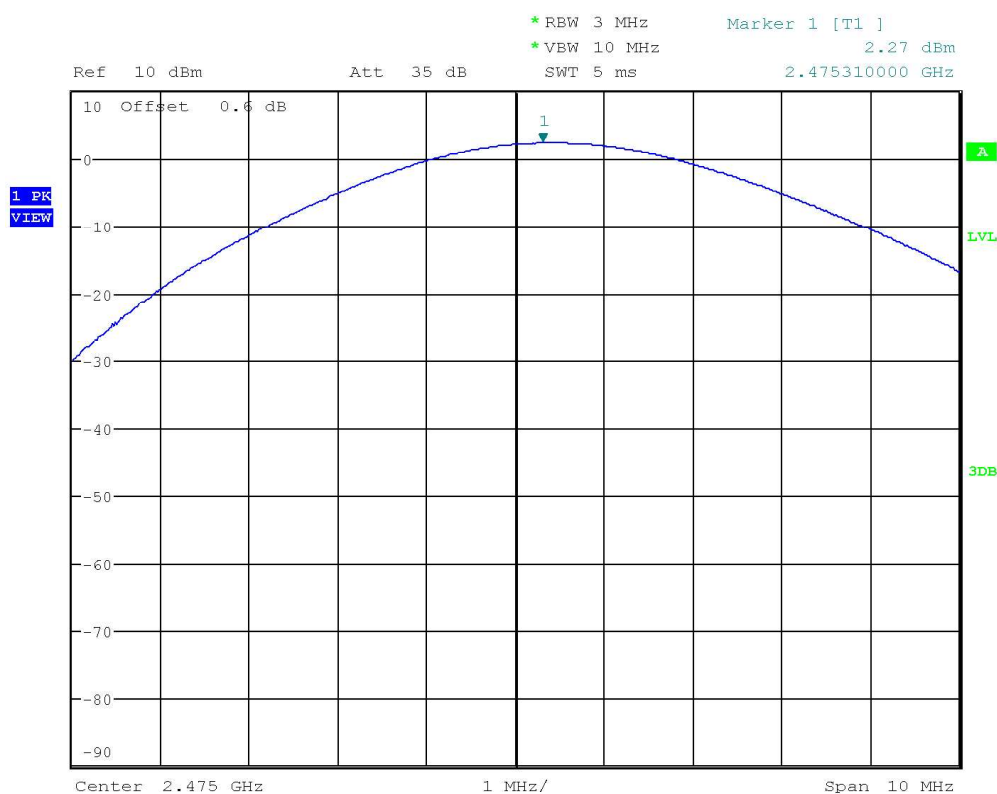
Date: 25.NOV.2024 14:47:21

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Peak Conducted Output Power

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 51853936, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.9.1.1
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 25, 2475 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-11-25
 Note: RFR2a ANT2
 Peak Power [dBm]: 2.274
 Peak Power [W]: 0.001688



Date: 25.NOV.2024 14:48:05

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

3.3 Test Conditions and Results - Power spectral density

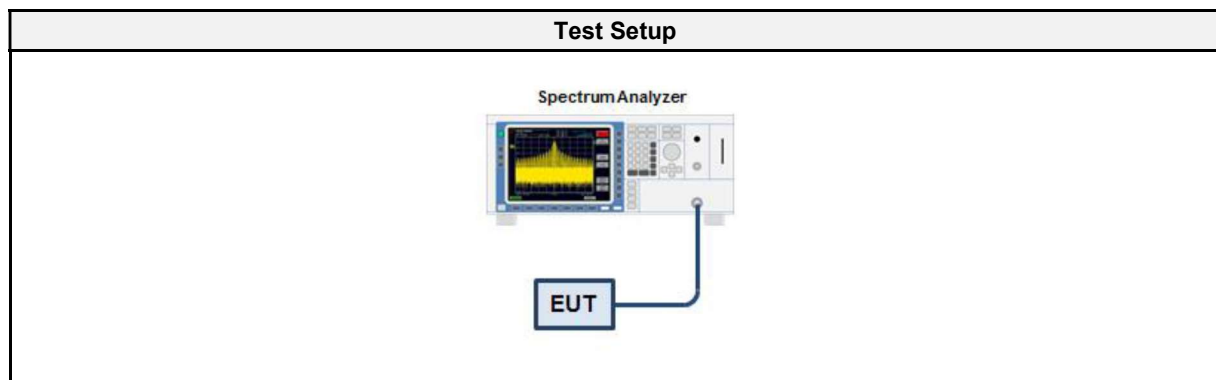
3.3.1 Information

Test Information	
Reference	FCC § 15.247(e)
Measurement Method	ANSI C63.10 11.10.2, 14.3.2
Measurement Uncertainty	± 2.86 dB
Operator	Azamat Ibraimov
Date	2024-06-18

3.3.2 Limits

Limits
8 dBm / 3 kHz

3.3.3 Setup



3.3.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSP 30	EF00312	2023-08	2024-08
Cable	Gigalane	1730	EF00779 CAABE	2024-04	2025-04

3.3.5 Procedure

Test Procedure
1. EUT set to test mode 2. The analyzer is set to DTS channel center frequency with a span of 1.5 times the DTS bandwidth 3. The RBW is set to 100 kHz with VBW ≥ RBW and the detector is set to peak with max hold 4. After the trace has stabilized a marker is set to the envelope maximum 5. If the power spectral density is above the limit the RBW is reduced (not lower than 3 kHz) and the measurement is repeated 6. If the EUT has more than one transmit chain the procedure is repeated for each transmit chain

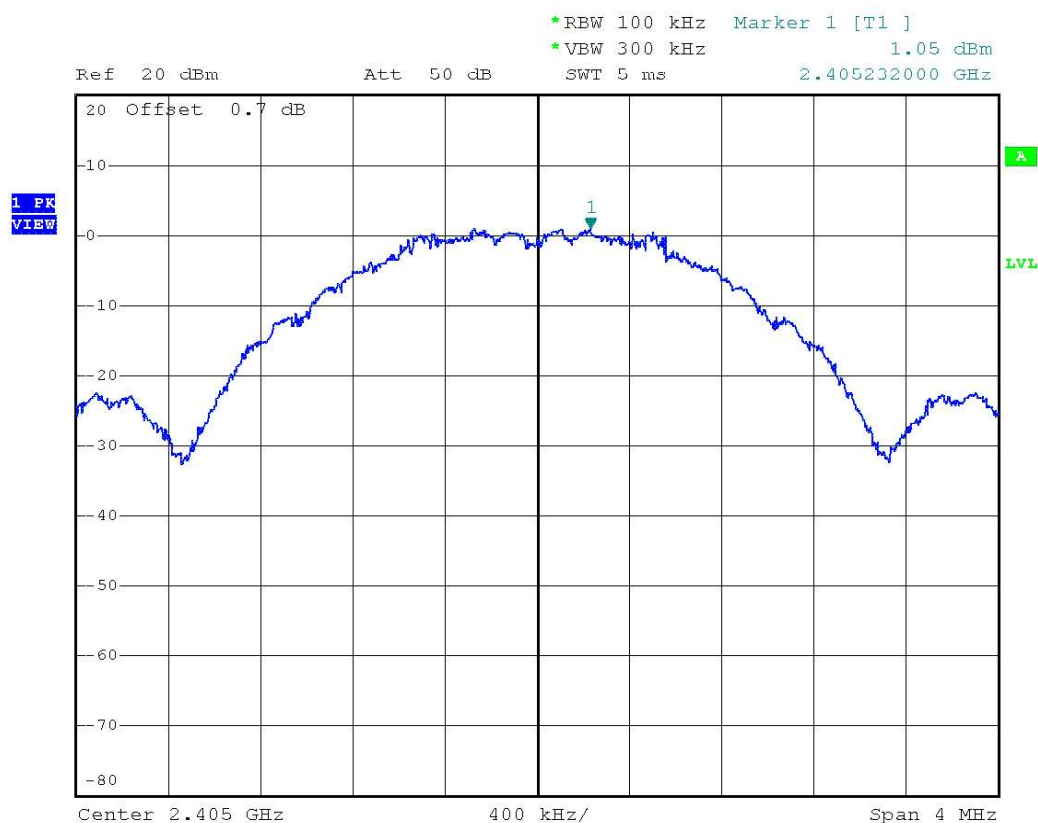
3.3.6 Results

Test Results ANT-1			
Channel [MHz]	PSD [dBm/RBW]	Limit [dBm/3kHz]	Verdict
2405	1.051	8.0	PASS
2440	4.842	8.0	PASS
2475	4.632	8.0	PASS
RBW = 100 kHz			

Test Results ANT-2			
Channel [MHz]	PSD [dBm/RBW]	Limit [dBm/3kHz]	Verdict
2405	-1.657	8.0	PASS
2440	-1.337	8.0	PASS
2475	-0.991	8.0	PASS
RBW = 100 kHz			

Peak Power Spectral Density

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 1
 Peak Frequency [MHz]: 2405.232
 Spectral Density [dBm/RBW]: 1.051
 Resolution Bandwidth [kHz]: 100 kHz



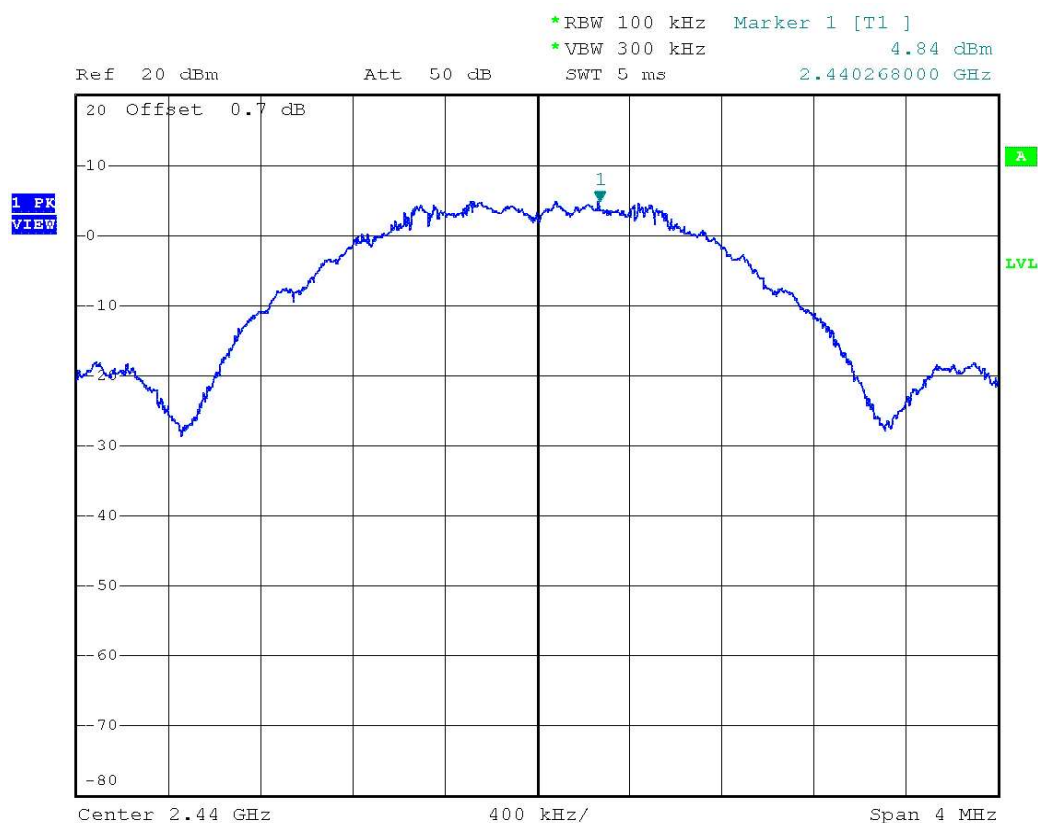
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Peak Power Spectral Density

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 1
 Peak Frequency [MHz]: 2440.268
 Spectral Density [dBm/RBW]: 4.842
 Resolution Bandwidth [kHz]: 100 kHz



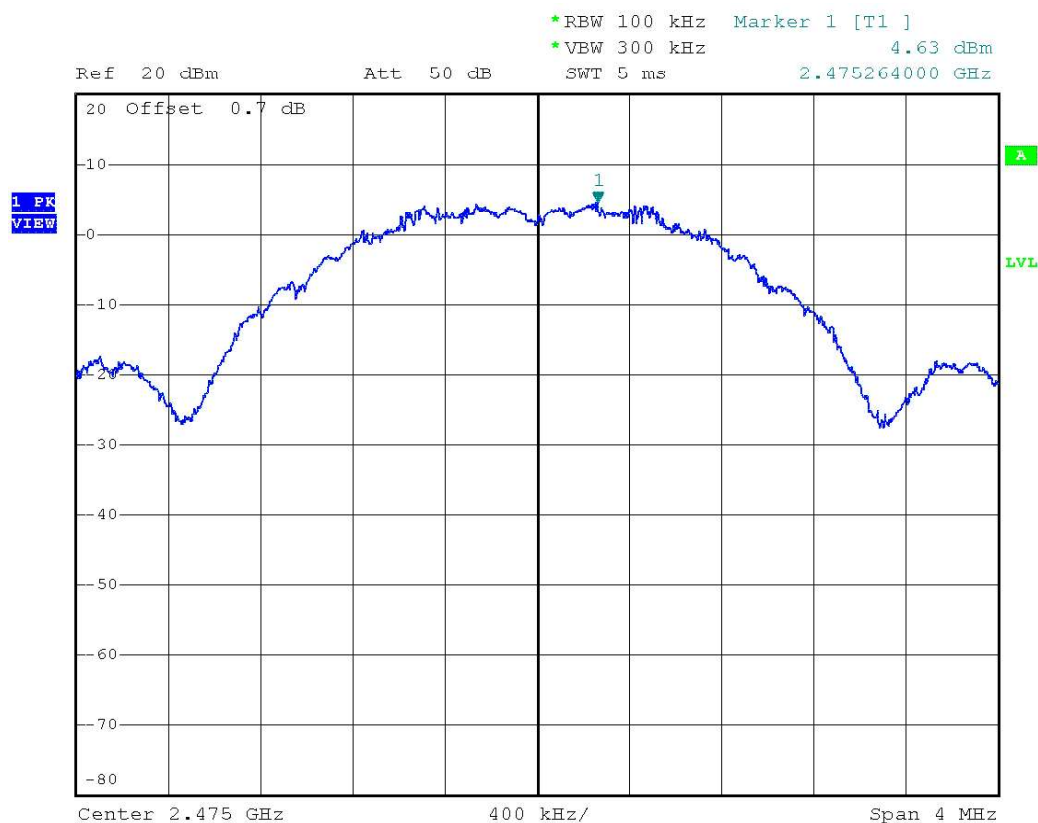
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Peak Power Spectral Density

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 25, 2475 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 1
 Peak Frequency [MHz]: 2475.264
 Spectral Density [dBm/RBW]: 4.632
 Resolution Bandwidth [kHz]: 100 kHz



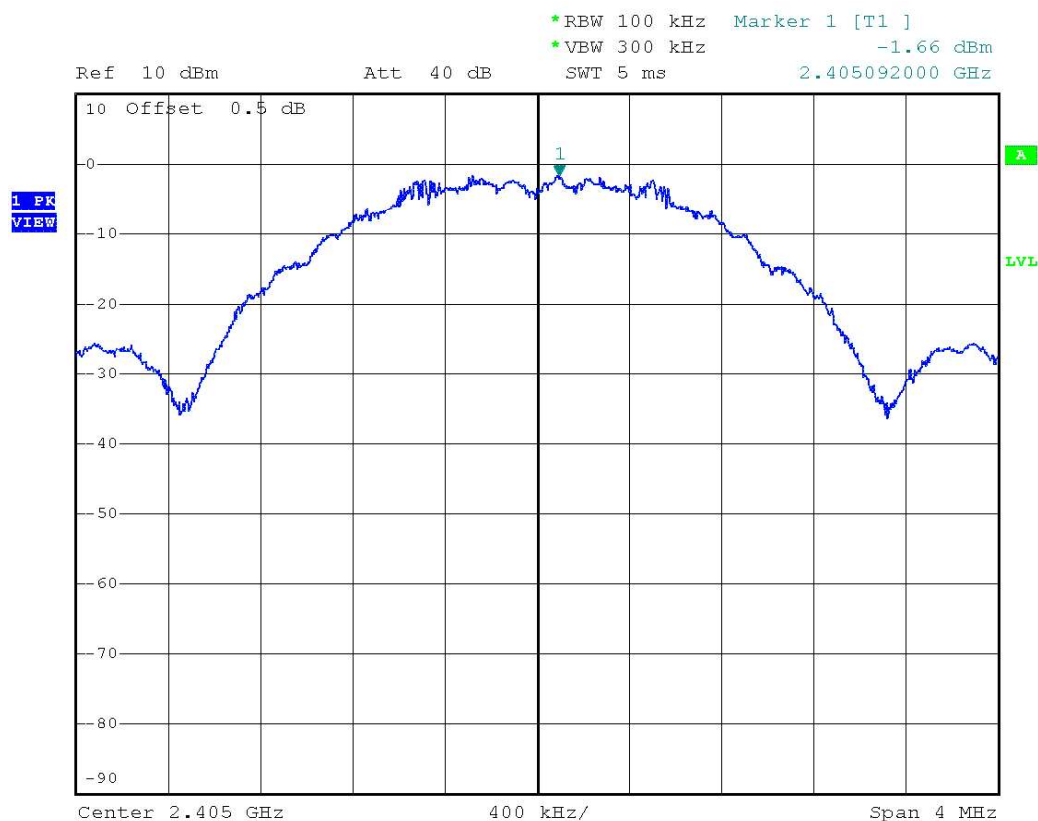
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Peak Power Spectral Density

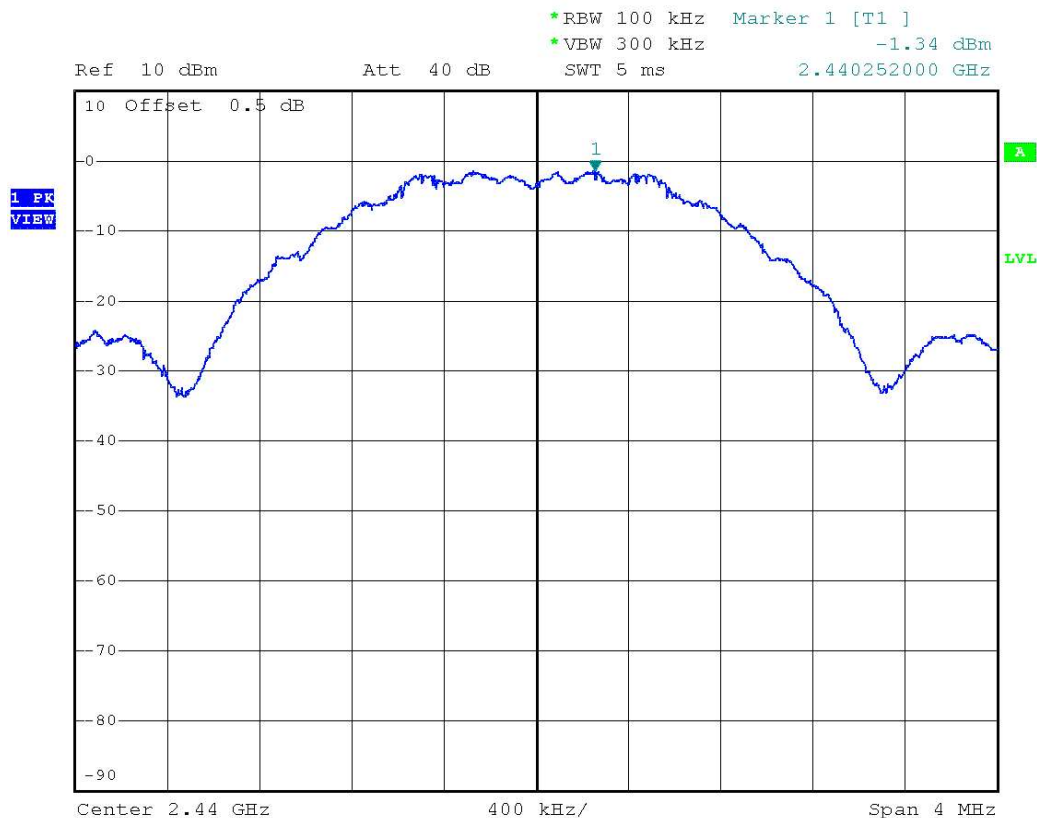
Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 2
 Peak Frequency [MHz]: 2405.092
 Spectral Density [dBm/RBW]: -1.657
 Resolution Bandwidth [kHz]: 100 kHz



Date: 18.JUN.2024 14:13:34

Peak Power Spectral Density

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 2
 Peak Frequency [MHz]: 2440.252
 Spectral Density [dBm/RBW]: -1.337
 Resolution Bandwidth [kHz]: 100 kHz



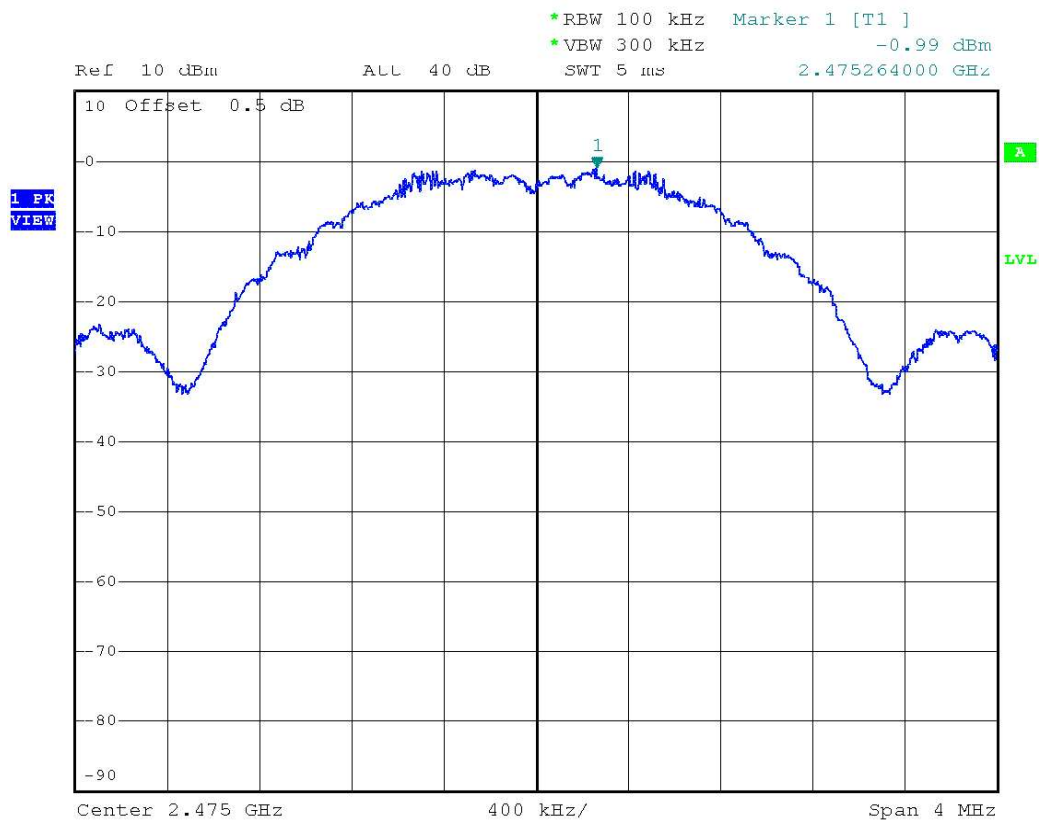
Date: 18.JUN.2024 14:14:45

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Peak Power Spectral Density

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 25, 2475 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 2
 Peak Frequency [MHz]: 2475.264
 Spectral Density [dBm/RBW]: -0.991
 Resolution Bandwidth [kHz]: 100 kHz



Date: 18.JUN.2024 14:15:32

3.4 Test Conditions and Results - AC powerline conducted emissions

3.4.1 Information

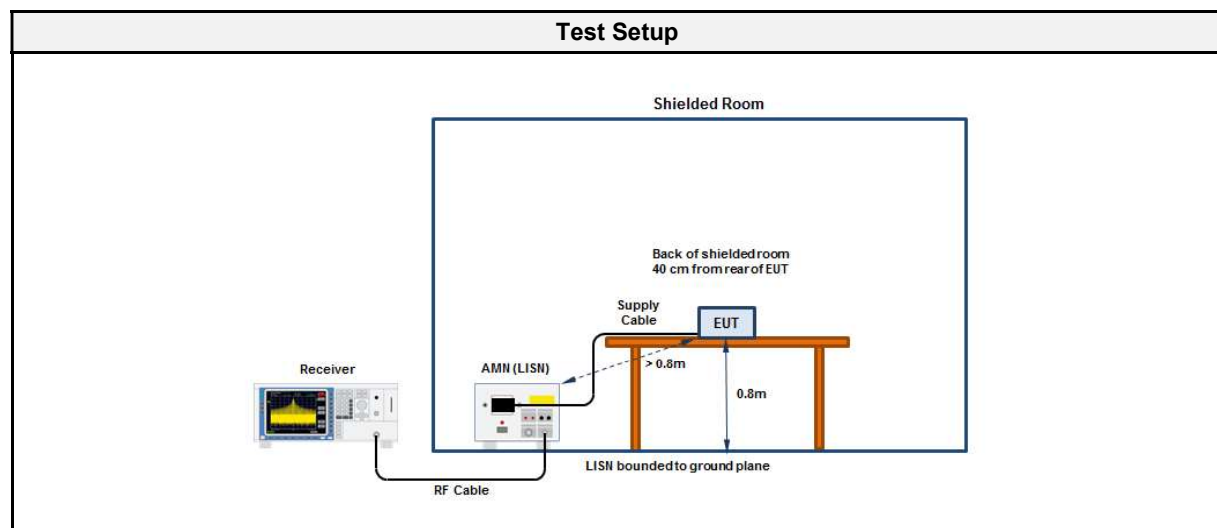
Test Information	
Reference	FCC § 15.207
Measurement Method	ANSI C63.10 6.2
Measurement Uncertainty	± 3.82 dB
Operator	Azamat Ibraimov
Date	2024-06-20

3.4.2 Limits

Limits		
Frequency [MHz]	Quasi-Peak [dBμV]	Average [dBμV]
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5	56	46
5 - 30	60	50

* Limit decreases linearly with the logarithm of the frequency

3.4.3 Setup



3.4.4 Equipment

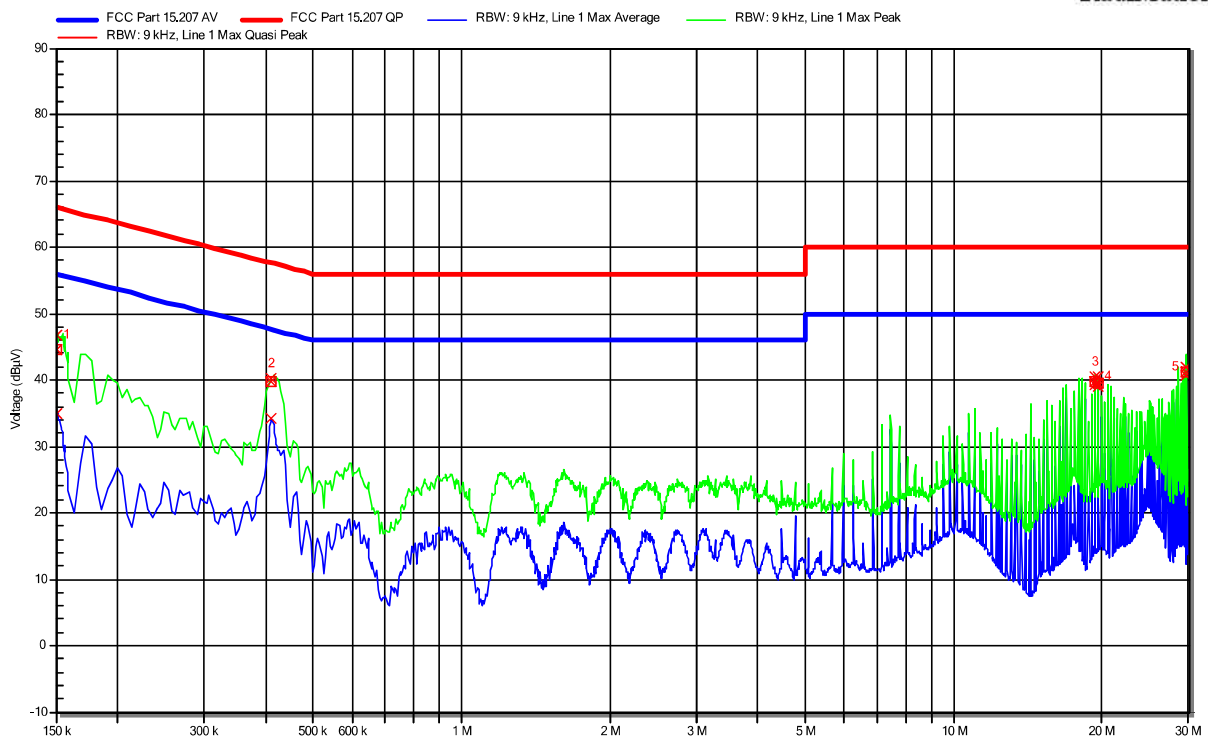
Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2020.1.8

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
EMI Test Receiver	Rohde & Schwarz	ESU26	EF00887	2024-01	2025-01
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	EF01222	2023-08	2025-08
LISN	Schwarzbeck	NSLK 8127 RC	EF01592	2023-06	2025-06

Conducted emissions at the mains power port according to FCC part 15 C

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48554
 Test Site: Eurofins Product Service GmbH
 Operator: Ibraimov Azamat
 Test Date: 2024-06-20
 Operating Conditions: ambient temperature: 23 °Celsius
 power input: 120 V AC, 60 Hz converted to 55 V DC
 LISN: Schwarzbeck NSLK 8127 L
 Operational Mode: 802.15.4_Tx_CH_18
 Applied to Port: Mains
 Note 1: ANT-1_PoE

Index 2
RadiMation



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	150 kHz	44.67 dBµV	66 dBµV	-21.33 dB	Pass	Line 1
2	411.45 kHz	39.66 dBµV	57.62 dBµV	-17.96 dB	Pass	Line 1
3	19.348 MHz	39.85 dBµV	60 dBµV	-20.15 dB	Pass	Line 1
4	19.647 MHz	39.6 dBµV	60 dBµV	-20.4 dB	Pass	Line 1
5	29.767 MHz	41.29 dBµV	60 dBµV	-18.71 dB	Pass	Line 1
Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	150 kHz	35.02 dBµV	56 dBµV	-20.98 dB	Pass	Line 1
2	411.45 kHz	34.16 dBµV	47.62 dBµV	-13.46 dB	Pass	Line 1
3	19.348 MHz	39.33 dBµV	50 dBµV	-10.67 dB	Pass	Line 1
4	19.647 MHz	39.07 dBµV	50 dBµV	-10.93 dB	Pass	Line 1
5	29.767 MHz	40.78 dBµV	50 dBµV	-9.22 dB	Pass	Line 1

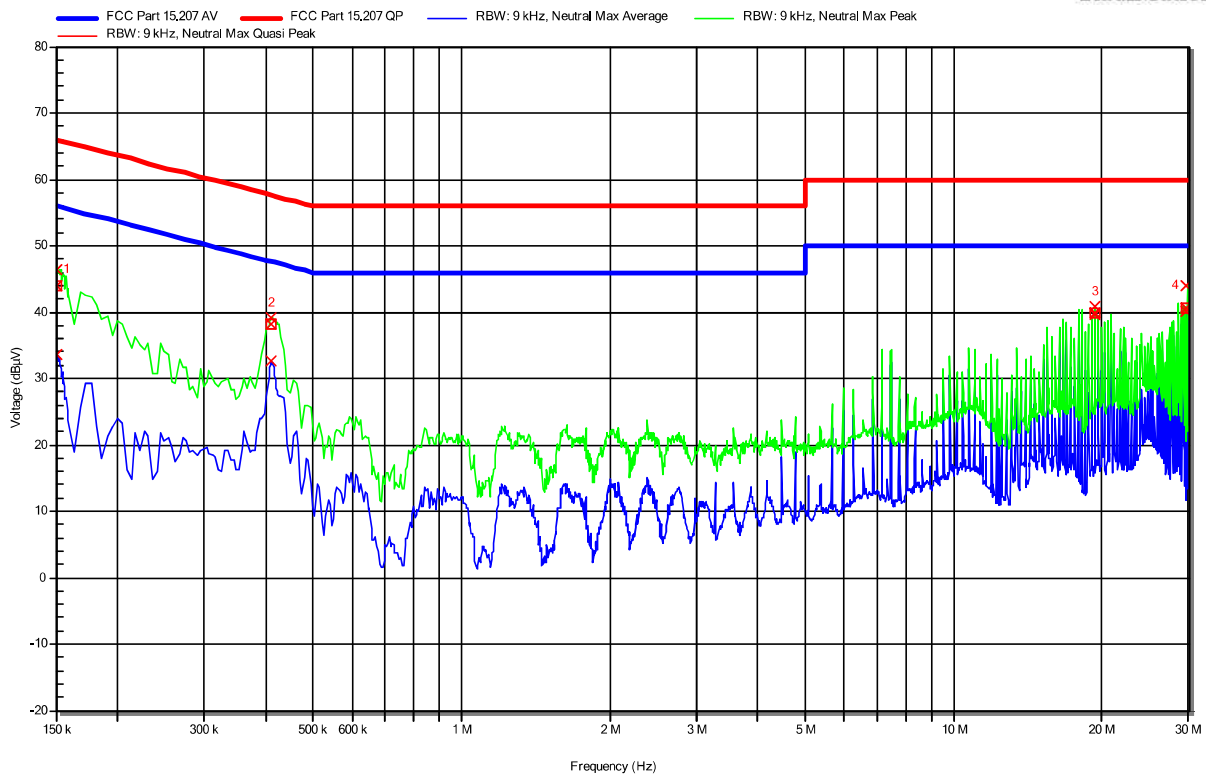
Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted emissions at the mains power port according to FCC part 15 C

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48554
 Test Site: Eurofins Product Service GmbH
 Operator: Ibraimov Azamat
 Test Date: 2024-06-20
 Operating Conditions: ambient temperature: 23 °Celsius
 power input: 120 V AC, 60 Hz converted to 55 V DC
 LISN: Schwarzbeck NSLK 8127 N
 Operational Mode: 802.15.4_Tx_CH_18
 Applied to Port: Mains
 Note 1: ANT-1_PoE

Index 3
RadiMation



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	150 kHz	43.96 dBμV	66 dBμV	-22.04 dB	Pass	Neutral
2	411.45 kHz	38.13 dBμV	57.62 dBμV	-19.49 dB	Pass	Neutral
3	19.352 MHz	39.9 dBμV	60 dBμV	-20.1 dB	Pass	Neutral
4	29.773 MHz	40.57 dBμV	60 dBμV	-19.43 dB	Pass	Neutral
Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	150 kHz	33.58 dBμV	56 dBμV	-22.42 dB	Pass	Neutral
2	411.45 kHz	32.62 dBμV	47.62 dBμV	-15 dB	Pass	Neutral
3	19.352 MHz	39.53 dBμV	50 dBμV	-10.47 dB	Pass	Neutral
4	29.773 MHz	40.12 dBμV	50 dBμV	-9.88 dB	Pass	Neutral

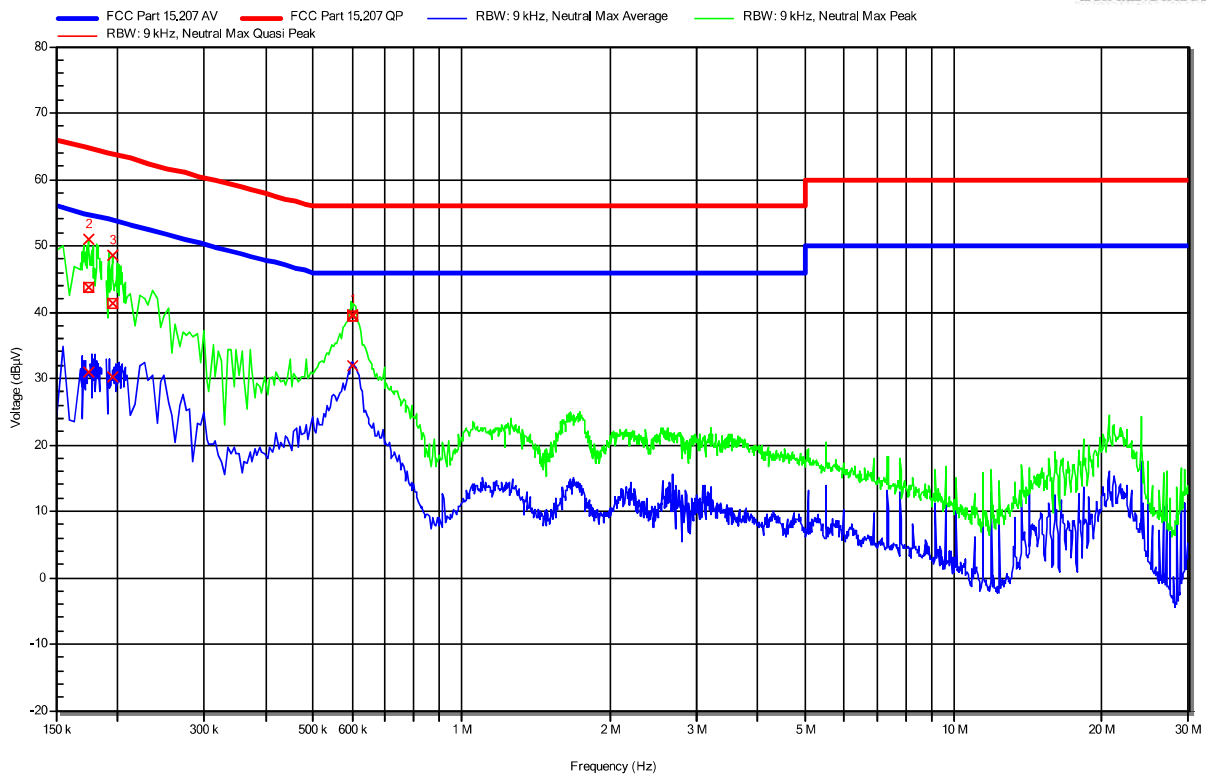
Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted emissions at the mains power port according to FCC part 15 C

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48554
 Test Site: Eurofins Product Service GmbH
 Operator: Ibraimov Azamat
 Test Date: 2024-06-20
 Operating Conditions: ambient temperature: 23 °Celsius
 power input: 120 V AC, 60 Hz converted to 24 V DC
 LISN: Schwarzbeck NSLK 8127 N
 Operational Mode: 802.15.4_Tx_CH_18
 Applied to Port: Mains
 Note 1: ANT-1_Power Adapter 24V

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RadiMation



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	600 kHz	39.39 dBµV	56 dBµV	-16.61 dB	Pass	Neutral
2	174.3 kHz	43.85 dBµV	64.75 dBµV	-20.9 dB	Pass	Neutral
3	195.45 kHz	41.29 dBµV	63.8 dBµV	-22.51 dB	Pass	Neutral

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	600 kHz	32.04 dBµV	46 dBµV	-13.96 dB	Pass	Neutral
2	174.3 kHz	30.97 dBµV	54.75 dBµV	-23.79 dB	Pass	Neutral
3	195.45 kHz	30.13 dBµV	53.8 dBµV	-23.67 dB	Pass	Neutral

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

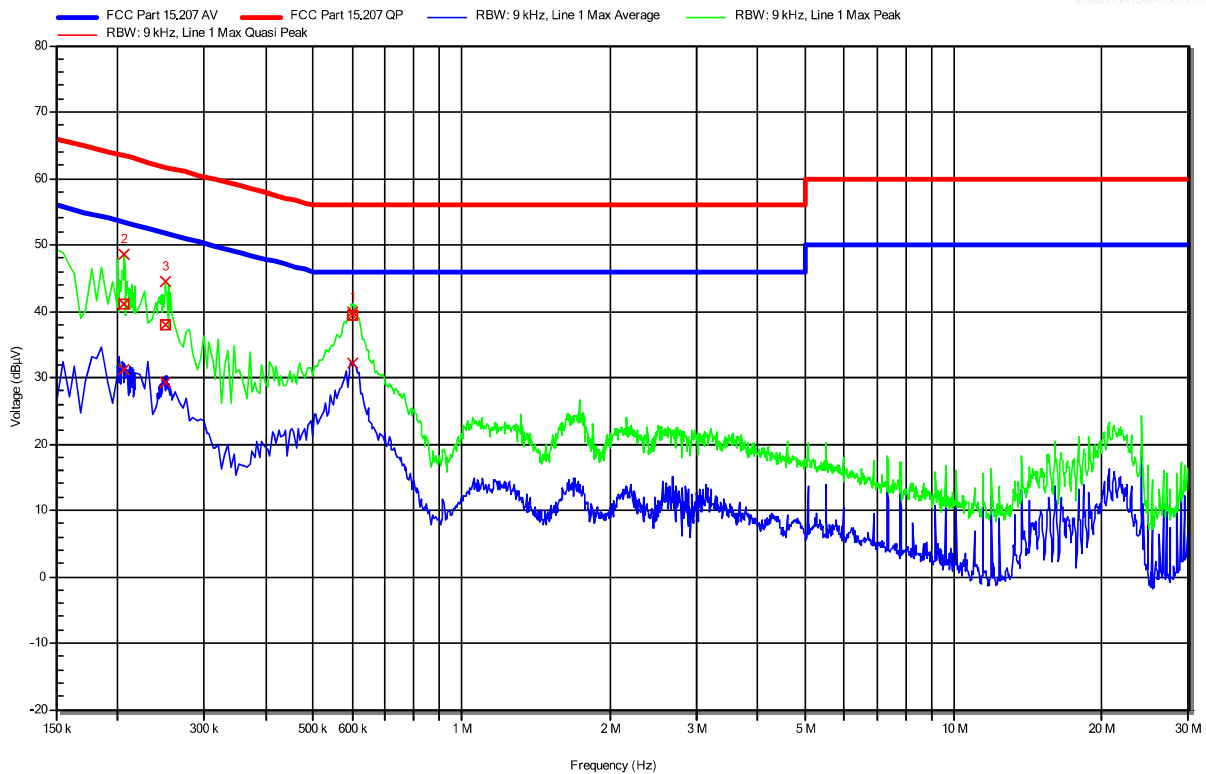
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted emissions at the mains power port according to FCC part 15 C

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48554
 Test Site: Eurofins Product Service GmbH
 Operator: Ibraimov Azamat
 Test Date: 2024-06-20
 Operating Conditions: ambient temperature: 23 °Celsius
 power input: 120 V AC, 60 Hz converted to 24 V DC
 LISN: Schwarzbeck NSLK 8127 RC L
 Operational Mode: 802.15.4_Tx_CH_18
 Applied to Port: Mains
 Note 1: ANT-1_Power Adapter 24V

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RadiMation



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	600 kHz	39.49 dBµV	56 dBµV	-16.51 dB	Pass	Line 1
2	206.25 kHz	41 dBµV	63.35 dBµV	-22.36 dB	Pass	Line 1
3	250.35 kHz	37.92 dBµV	61.75 dBµV	-23.82 dB	Pass	Line 1

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	600 kHz	32.15 dBµV	46 dBµV	-13.85 dB	Pass	Line 1
2	206.25 kHz	31.11 dBµV	53.35 dBµV	-22.24 dB	Pass	Line 1
3	250.35 kHz	29.21 dBµV	51.75 dBµV	-22.53 dB	Pass	Line 1

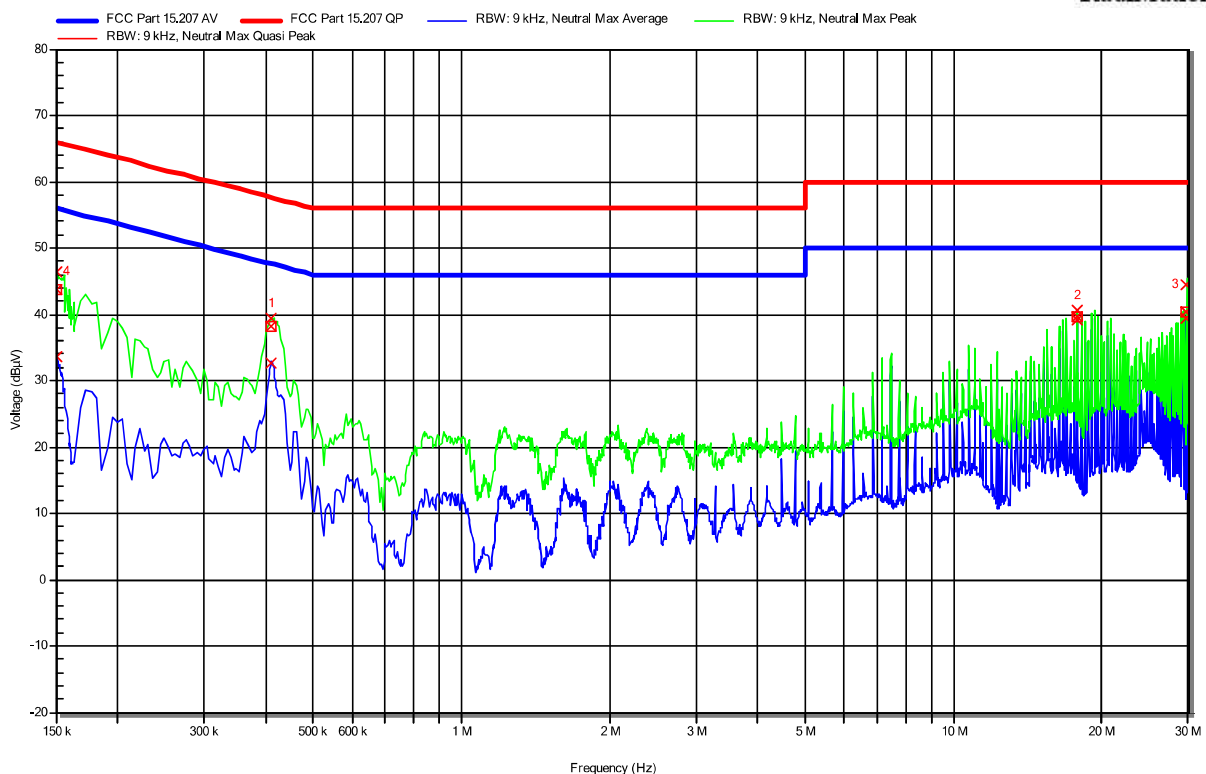
Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted emissions at the mains power port according to FCC part 15 C

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48554
 Test Site: Eurofins Product Service GmbH
 Operator: Ibraimov Azamat
 Test Date: 2024-06-20
 Operating Conditions: ambient temperature: 23 °Celsius
 power input: 120 V AC, 60 Hz converted to 55 V DC
 LISN: Schwarzbeck NSLK 8127 N
 Operational Mode: 802.15.4_Tx_CH_18
 Applied to Port: Mains
 Note 1: ANT-2_PoE

Index 4
RadiMation



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	411.45 kHz	38.24 dBµV	57.62 dBµV	-19.38 dB	Pass	Neutral
2	17.863 MHz	39.63 dBµV	60 dBµV	-20.37 dB	Pass	Neutral
3	29.776 MHz	40.34 dBµV	60 dBµV	-19.66 dB	Pass	Neutral
4	150 kHz	43.78 dBµV	66 dBµV	-22.22 dB	Pass	Neutral

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	411.45 kHz	32.73 dBµV	47.62 dBµV	-14.89 dB	Pass	Neutral
2	17.863 MHz	39.14 dBµV	50 dBµV	-10.86 dB	Pass	Neutral
3	29.776 MHz	39.51 dBµV	50 dBµV	-10.49 dB	Pass	Neutral
4	150 kHz	33.51 dBµV	56 dBµV	-22.49 dB	Pass	Neutral

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

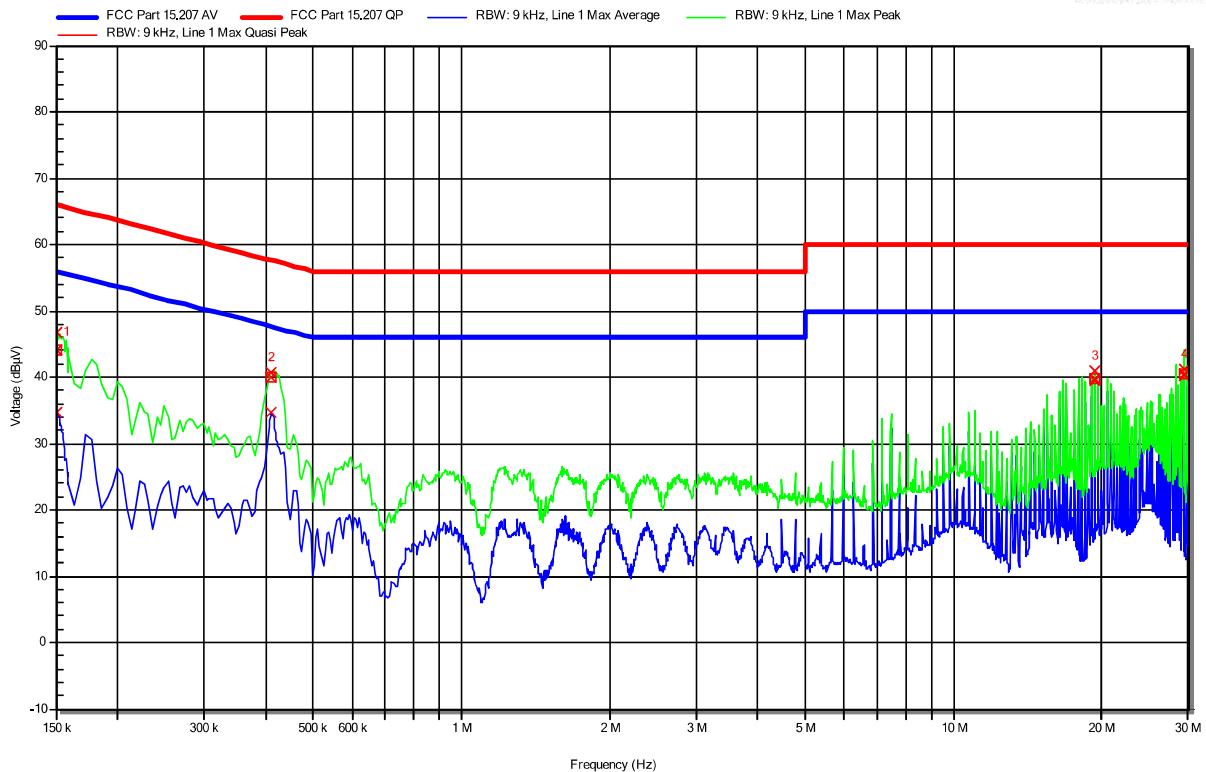
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted emissions at the mains power port according to FCC part 15 C

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48554
 Test Site: Eurofins Product Service GmbH
 Operator: Ibraimov Azamat
 Test Date: 2024-06-20
 Operating Conditions: ambient temperature: 23 °Celsius
 power input: 120 V AC, 60 Hz converted to 55 V DC
 LISN: Schwarzbeck NSLK 8127 L
 Operational Mode: 802.15.4_Tx_CH_18
 Applied to Port: Mains
 Note 1: ANT-2_PoE

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RadiMation



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	150 kHz	44.1 dBµV	66 dBµV	-21.9 dB	Pass	Line 1
2	411.45 kHz	40.11 dBµV	57.62 dBµV	-17.51 dB	Pass	Line 1
3	19.357 MHz	39.79 dBµV	60 dBµV	-20.21 dB	Pass	Line 1
4	29.481 MHz	40.54 dBµV	60 dBµV	-19.46 dB	Pass	Line 1
Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	150 kHz	34.79 dBµV	56 dBµV	-21.21 dB	Pass	Line 1
2	411.45 kHz	34.64 dBµV	47.62 dBµV	-12.98 dB	Pass	Line 1
3	19.357 MHz	39.48 dBµV	50 dBµV	-10.52 dB	Pass	Line 1
4	29.481 MHz	40.26 dBµV	50 dBµV	-9.74 dB	Pass	Line 1

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

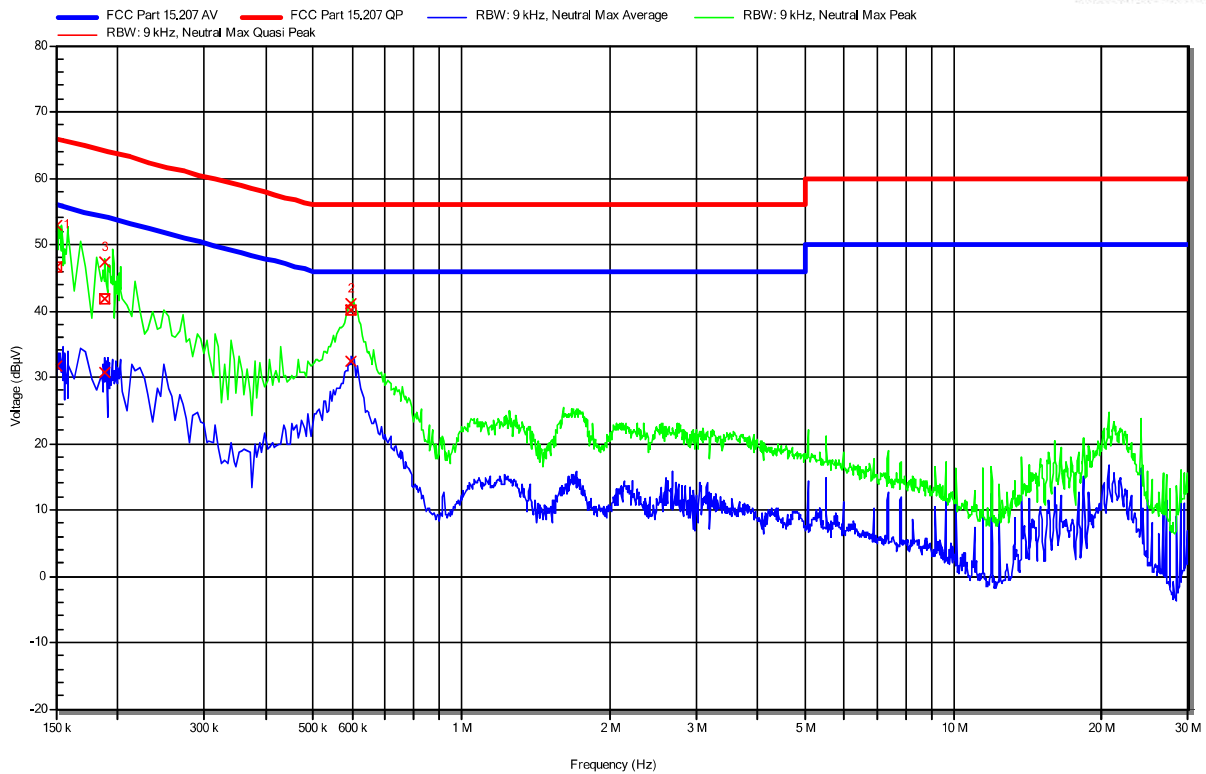
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted emissions at the mains power port according to FCC part 15 C

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48554
 Test Site: Eurofins Product Service GmbH
 Operator: Ibraimov Azamat
 Test Date: 2024-06-20
 Operating Conditions: ambient temperature: 23 °Celsius
 power input: 120 V AC, 60 Hz converted to 24 V DC
 LISN: Schwarzbeck NSLK 8127 N
 Operational Mode: 802.15.4_Tx_CH_18
 Applied to Port: Mains
 Note 1: ANT-2_Power Adapter 24V

Index 11

RadiMation



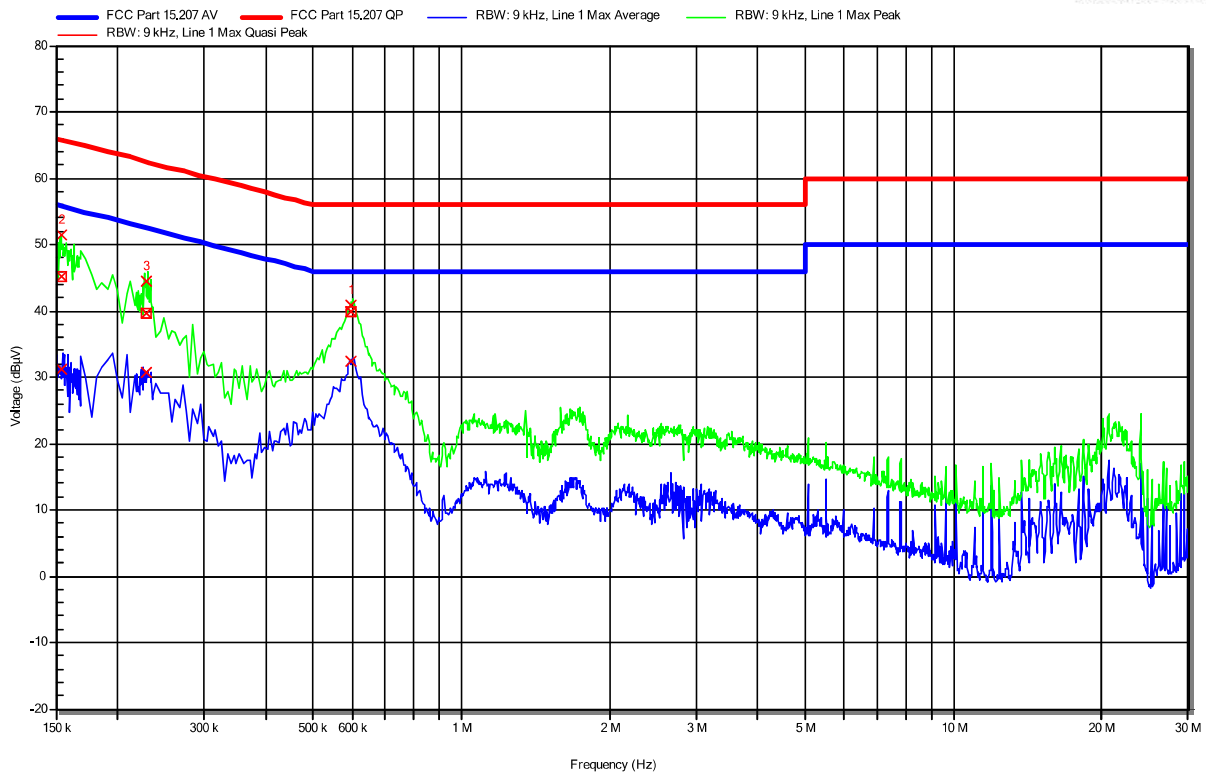
Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	150.9 kHz	46.51 dBμV	65.95 dBμV	-19.44 dB	Pass	Neutral
2	595.5 kHz	40.04 dBμV	56 dBμV	-15.96 dB	Pass	Neutral
3	188.25 kHz	41.74 dBμV	64.11 dBμV	-22.37 dB	Pass	Neutral
Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	150.9 kHz	31.57 dBμV	55.95 dBμV	-24.38 dB	Pass	Neutral
2	595.5 kHz	32.41 dBμV	46 dBμV	-13.59 dB	Pass	Neutral
3	188.25 kHz	30.66 dBμV	54.11 dBμV	-23.45 dB	Pass	Neutral

Conducted emissions at the mains power port according to FCC part 15 C

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48554
 Test Site: Eurofins Product Service GmbH
 Operator: Ibraimov Azamat
 Test Date: 2024-06-20
 Operating Conditions: ambient temperature: 23 °Celsius
 power input: 120 V AC, 60 Hz converted to 24 V DC
 LISN: Schwarzbeck NSLK 8127 RC L
 Operational Mode: 802.15.4_Tx_CH_18
 Applied to Port: Mains
 Note 1: ANT-2_Power Adapter 24V

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RadiMation



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	LISN
1	595.5 kHz	39.93 dBμV	56 dBμV	-16.07 dB	Pass	Line 1
2	153.6 kHz	45.13 dBμV	65.8 dBμV	-20.67 dB	Pass	Line 1
3	228.3 kHz	39.57 dBμV	62.51 dBμV	-22.94 dB	Pass	Line 1

Peak Number	Frequency	Average	Average Limit	Average Difference	Average Status	LISN
1	595.5 kHz	32.37 dBμV	46 dBμV	-13.63 dB	Pass	Line 1
2	153.6 kHz	31.29 dBμV	55.8 dBμV	-24.51 dB	Pass	Line 1
3	228.3 kHz	30.7 dBμV	52.51 dBμV	-21.81 dB	Pass	Line 1

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

3.5 Test Conditions and Results - Band-edge compliance

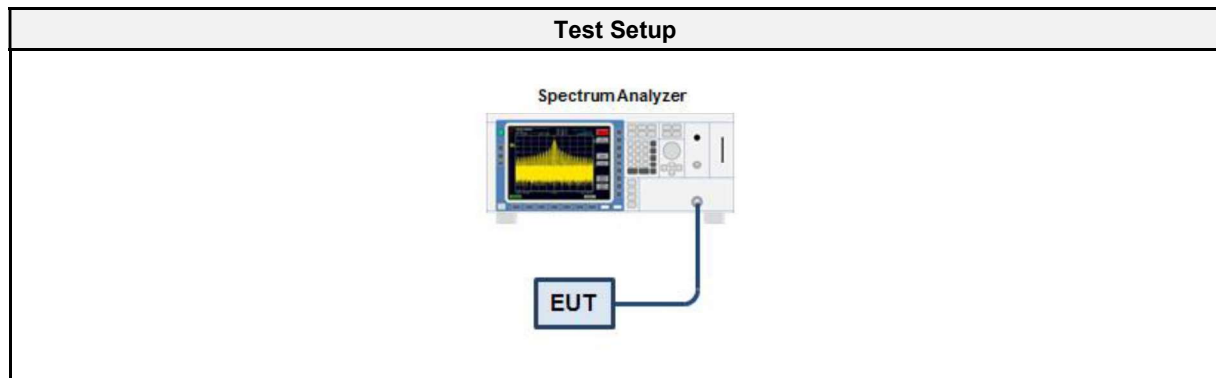
3.5.1 Information

Test Information	
Reference	FCC § 15.247(d)
Measurement Uncertainty	± 3.64 dB
Measurement Method	ANSI C63.10 11.13
Operator	Azamat Ibraimov
Date	2024-06-18

3.5.2 Limits

Limits	
Power Measurement	Out-of-band attenuation [dB]
Peak	20
RMS	30

3.5.3 Setup



3.5.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSP 30	EF00312	2023-08	2024-08
Cable	Gigalane	1730	EF00779 CAABE	2024-04	2025-04

3.5.5 Procedure

Test Procedure
1. EUT set to test mode (Communication tester is used if needed) 2. Span set around lower band edge and detector is set to peak and max hold 3. Resolution bandwidth is set to 100 kHz 4. Markers are set to peak emission levels within frequency band and outside frequency band 5. Band edge attenuation is determined from level difference

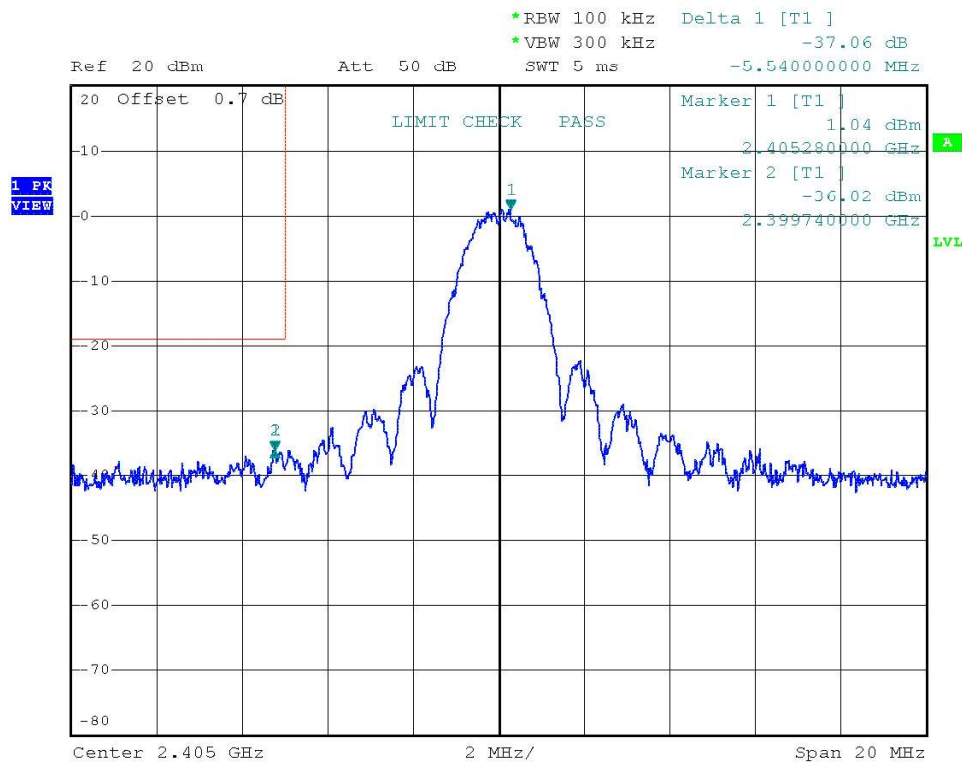
3.5.6 Results

Test Results ANT-1				
Mode	Channel [MHz]	Out-of-band Attenuation [dB]	Limit [dB]	Verdict
O-QPSK	2405	-37.06	-20	PASS
O-QPSK	2475	-47.9	-20	PASS

Test Results ANT-2				
Mode	Channel [MHz]	Out-of-band Attenuation [dB]	Limit [dB]	Verdict
O-QPSK	2405	-39.52	-20	PASS
O-QPSK	2475	-45.0	-20	PASS

Emissions in nonrestricted frequency bands at the Band-edge

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: ANT-1, RFR2a
 Band-edge: Lower
 In-band Frequency [MHz]: 2405.28
 Max. in-band Level [dBm/100 kHz]: 1.042
 Out-of-band Frequency [MHz]: 2399.74
 Max. out-of-band Level [dBm/100 kHz]: -36.017
 Attenuation [dB]: -37.06



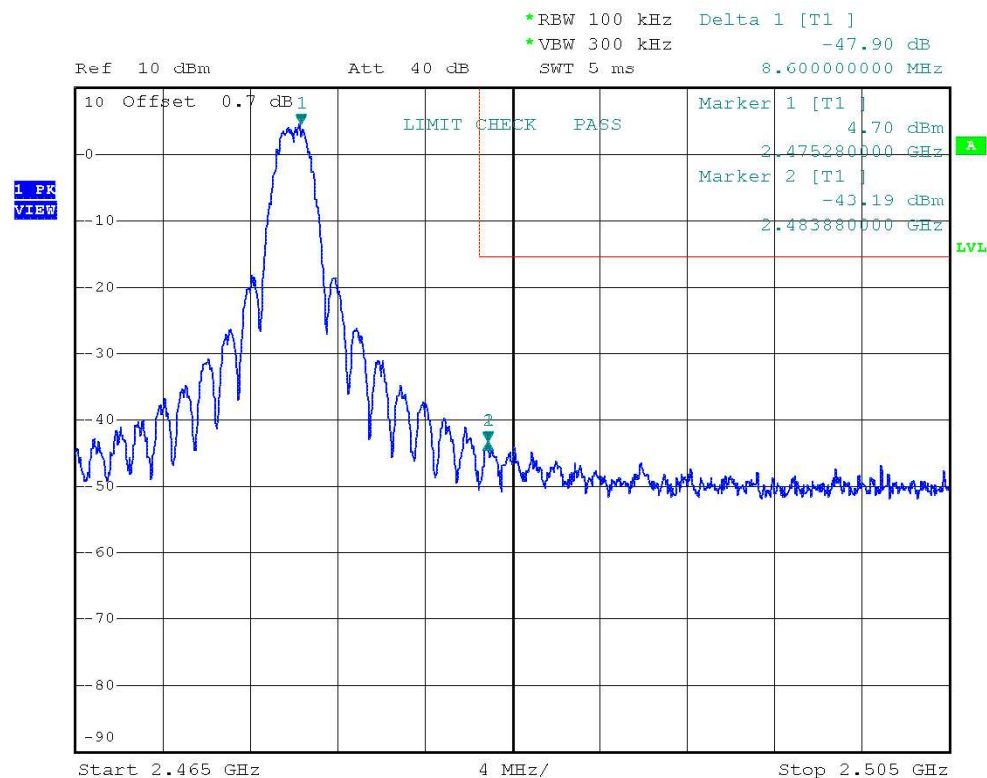
Date: 18.JUN.2024 11:09:01

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Emissions in nonrestricted frequency bands at the Band-edge

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 25, 2475 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: ANT-1, RFR2a
 Band-edge: Upper
 In-band Frequency [MHz]: 2475.28
 Max. in-band Level [dBm/100 kHz]: 4.704
 Out-of-band Frequency [MHz]: 2483.88
 Max. out-of-band Level [dBm/100 kHz]: -43.194
 Attenuation [dB]: -47.9



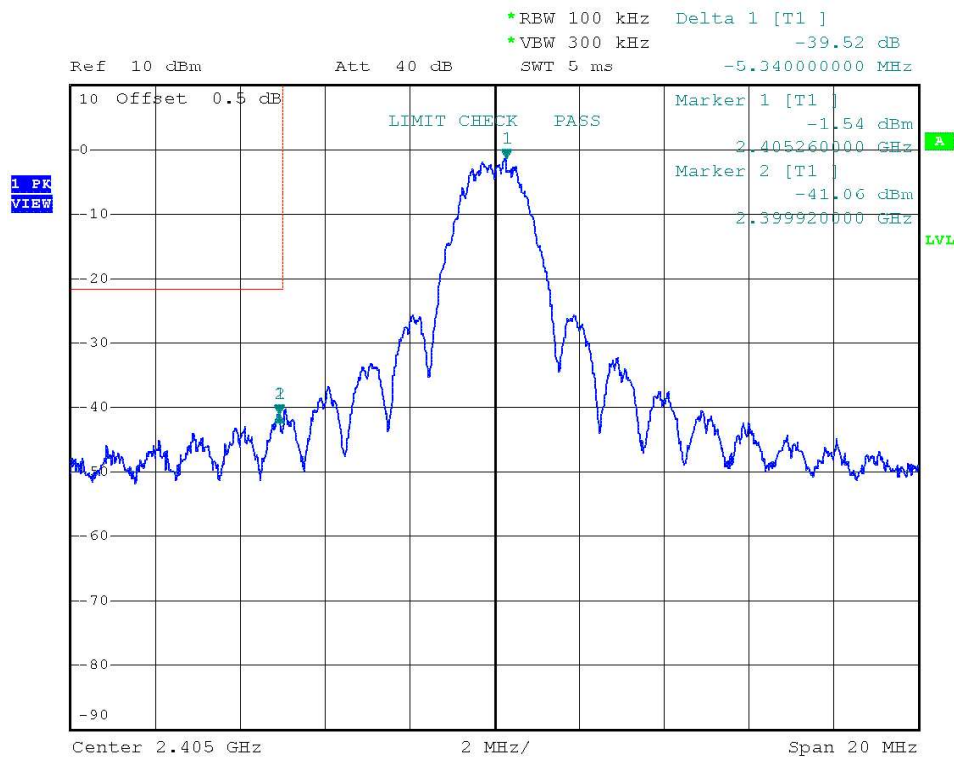
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Emissions in nonrestricted frequency bands at the Band-edge

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT-2
 Band-edge: Lower
 In-band Frequency [MHz]: 2405.26
 Max. in-band Level [dBm/100 kHz]: -1.544
 Out-of-band Frequency [MHz]: 2399.92
 Max. out-of-band Level [dBm/100 kHz]: -41.064
 Attenuation [dB]: -39.52



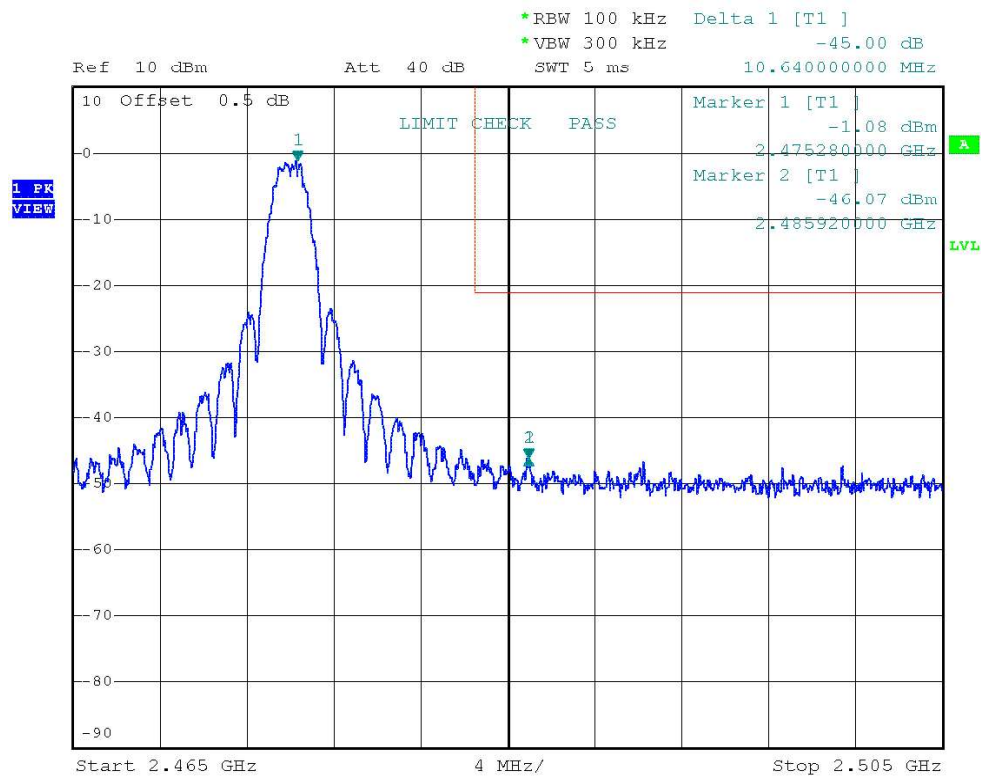
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Emissions in nonrestricted frequency bands at the Band-edge

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 25, 2475 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT-2
 Band-edge: Upper
 In-band Frequency [MHz]: 2475.28
 Max. in-band Level [dBm/100 kHz]: -1.076
 Out-of-band Frequency [MHz]: 2485.92
 Max. out-of-band Level [dBm/100 kHz]: -46.075
 Attenuation [dB]: -45.0



Date: 18.JUN.2024 14:18:16

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

3.6 Test Conditions and Results - Conducted spurious emissions

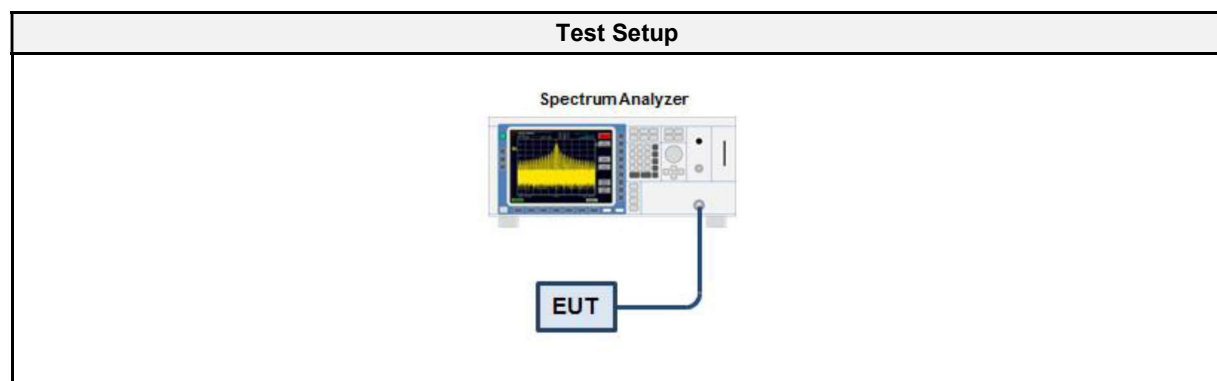
3.6.1 Information

Test Information	
Reference	FCC § 15.247(d)
Measurement Uncertainty	± 4.25 dB
Measurement Method	ANSI C63.10 11.11
Operator	Azamat Ibraimov
Date	2024-06-18

3.6.2 Limits

Limits	
Power Measurement	Out-of-band attenuation [dB]
Peak	20
RMS	30

3.6.3 Setup



3.6.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSP 30	EF00312	2023-08	2024-08
Cable	Gigalane	1730	EF00779 CAABE	2024-04	2025-04

3.6.5 Procedure

Test Procedure
1. EUT set to test mode (Communication tester is used if needed) 2. Span set around lower band edge and detector is set to peak and max hold 3. Resolution bandwidth is set to 100 kHz 4. Markers are set to peak emission levels outside frequency band

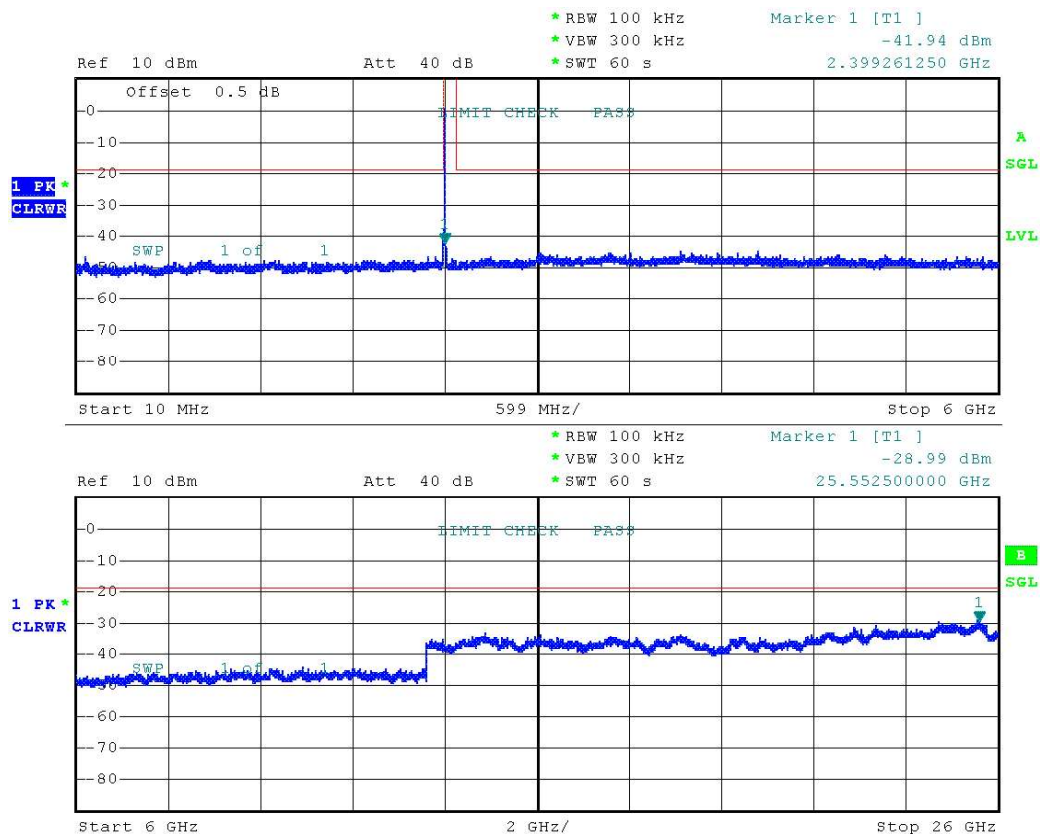
3.6.6 Results

Test Results ANT-1		
Mode	Channel [MHz]	Verdict
O-QPSK	2405	PASS
O-QPSK	2440	PASS
O-QPSK	2475	PASS

Test Results ANT-2		
Mode	Channel [MHz]	Verdict
O-QPSK	2405	PASS
O-QPSK	2440	PASS
O-QPSK	2475	PASS

Conducted Spurious Emissions

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Max. in-band Frequency [MHz]: 2405.2
 Max. in-band Level [dBm/100 kHz]: 1.0
 Out-of-band Limit [dBm/100 kHz]: -19.0
 Note: ANT-1



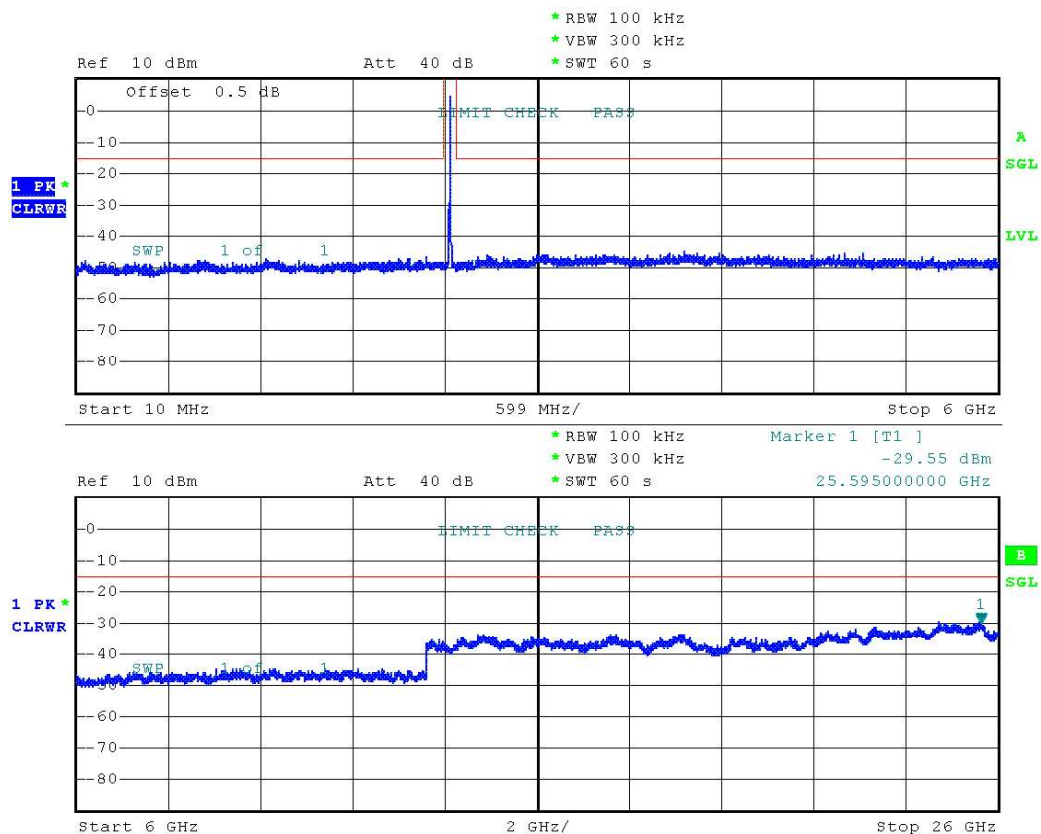
Date: 18.JUN.2024 12:43:53

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted Spurious Emissions

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Max. in-band Frequency [MHz]: 2440.5
 Max. in-band Level [dBm/100 kHz]: 4.3
 Out-of-band Limit [dBm/100 kHz]: -15.7
 Note: ANT-1



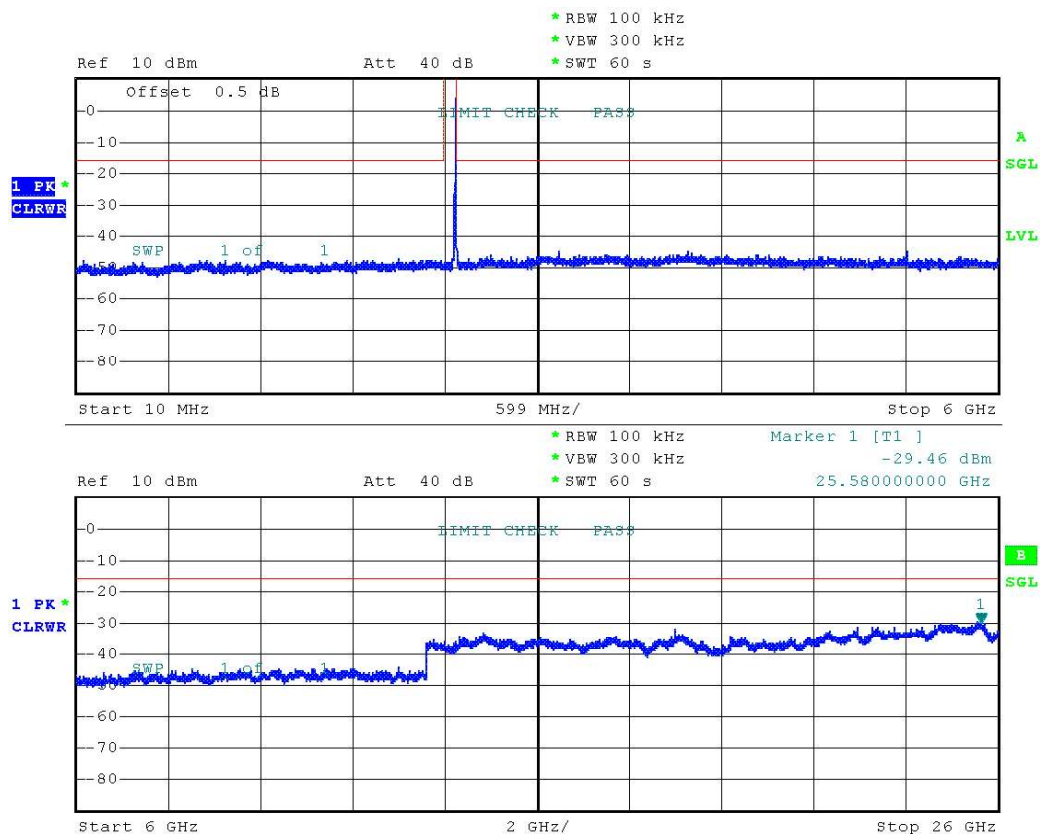
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted Spurious Emissions

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 25, 2475 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Max. in-band Frequency [MHz]: 2475.1
 Max. in-band Level [dBm/100 kHz]: 3.9
 Out-of-band Limit [dBm/100 kHz]: -16.1
 Note: ANT-1



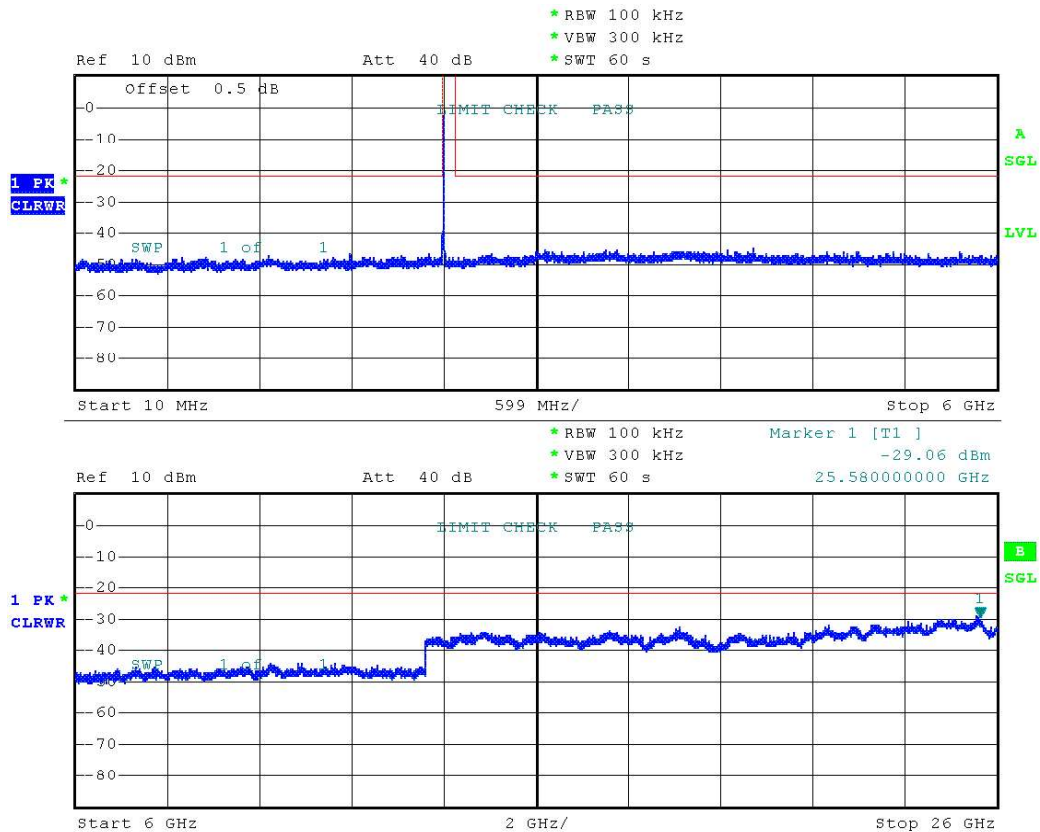
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted Spurious Emissions

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 11, 2405 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 2
 Max. in-band Frequency [MHz]: 2404.7
 Max. in-band Level [dBm/100 kHz]: -1.7
 Out-of-band Limit [dBm/100 kHz]: -21.7
 Note: ANT-2



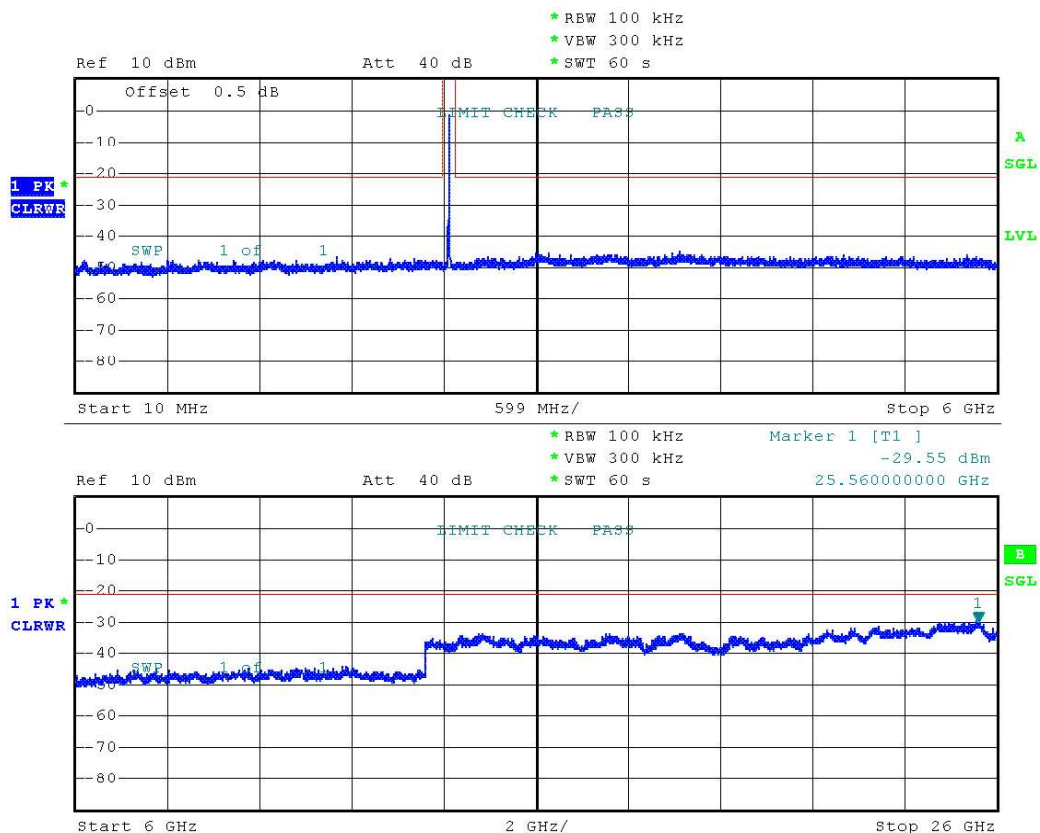
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted Spurious Emissions

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 18, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 2
 Max. in-band Frequency [MHz]: 2440.1
 Max. in-band Level [dBm/100 kHz]: -1.5
 Out-of-band Limit [dBm/100 kHz]: -21.5
 Note: ANT-2



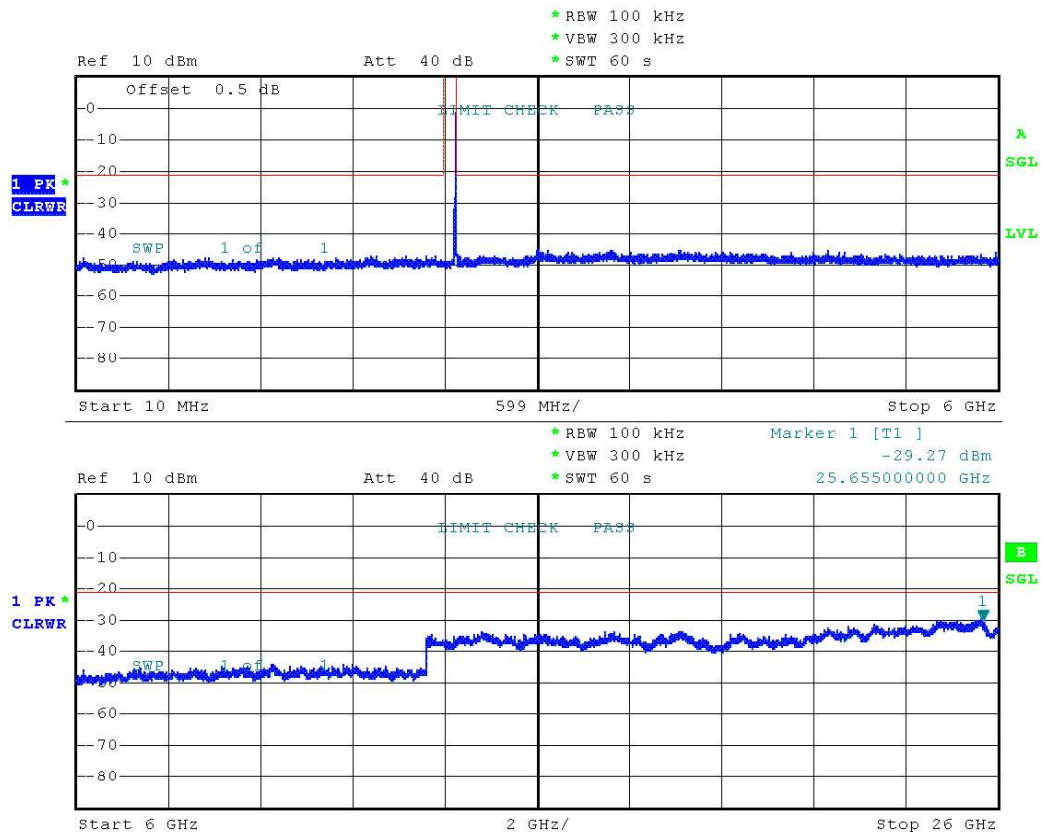
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Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Conducted Spurious Emissions

Project Number: G0M-2403-2495
 Applicant: Jungheinrich AG
 Model Description: UWB-Location-System
 Model: 52445054, Anchor
 Test Sample ID: 48858
 Reference Standards: FCC 15.247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: IEEE 802.15.4 (2000 kbps), Channel: 25, 2475 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Azamat Ibraimov
 Test Site: Eurofins Product Service GmbH
 Test Date: 2024-06-18
 Note: RFR2a, ANT 2
 Max. in-band Frequency [MHz]: 2475.3
 Max. in-band Level [dBm/100 kHz]: -1.0
 Out-of-band Limit [dBm/100 kHz]: -21.0
 Note: ANT-2



Date: 18.JUN.2024 14:29:52

Test Report No.: G0M-2403-2495-TFC247ZB-RFR2a-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

3.7 Test Conditions and Results - Transmitter radiated emissions

3.7.1 Information

Test Information	
Reference	FCC § 15.247(d); FCC § 15.209;
Measurement Uncertainty	± 5.95 dB
Measurement Method	ANSI C63.10 6.4, 6.5, 6.6, 11.12
Operator	Azamat Ibraimov
Date	2024-06-13 - 2024-06-14

3.7.2 Limits

Limits			
Frequency range [MHz]	Detector	Field strength [µV/m]	Measurement distance [m]
0.009 - 0.09	Average	2400/F[kHz]	300
0.09 - 0.110	Quasi-Peak	2400/F[kHz]	300
0.110 - 0.490	Average	2400/F[kHz]	300
0.490 - 1.705	Quasi-Peak	24000/F[kHz]	30
1.705 - 30.0	Quasi-Peak	30	30
30 - 88	Quasi-Peak	100	3
88 - 216	Quasi-Peak	150	3
216 - 960	Quasi-Peak	200	3
960 - 1000	Quasi-Peak	500	3
>1000	Average	500	3

3.7.3 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2020.1.8
EMC Software	DARE Instruments	RadiMation	2023.2.6

Test Equipment 30 MHz - 1000 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	2022-11	2025-11
Test Receiver	Rohde & Schwarz	ESW44	EF01856	2024-04	2025-04
Antenna	Schwarzbeck	VULB 9168	EF01824	2022-10	2025-10

Test Equipment > 1 GHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC2	EF01616	2023-12	2024-12
Spectrum analyzer	Rohde & Schwarz	FSU26	EF01407	2023-08	2024-08
Antenna	Schwarzbeck	BBHA 9120B	EF01678	2024-05	2027-05
Antenna	Schwarzbeck	HWRD 650	EF01679	2024-05	2027-05
Antenna	Amplifier Research	AT4560	EF00302	2023-09	2025-09