







<b>EMC TEST REPORT</b> <b>FCC CFR Title 47 / Chapter I / Subchapter A / Part 15 / Subpart B</b> <b>ISED ICES-003 Issue 7</b>	
<b>Report Reference No</b>	G0M-2403-2508-EF0115B-V02
<b>Testing Laboratory</b>	Eurofins Product Service GmbH
<b>Address</b>	Storkower Str. 38c 15526 Reichenwalde Germany
<b>Accreditation</b>	    <p> A2LA - Registration number: 1983.01 (ISED)  ISED wireless device testing laboratory: CN 3470A  DAkkS - Registration number : D-PL-12092-01-04 (FCC)  FCC Filed Test Laboratory, Reg.-No.: 96970 </p>
<b>Applicant</b>	Jungheinrich AG
<b>Address</b>	Friedrich-Ebert-Damm 129 22047 Hamburg Germany
<b>Test Specification Standard(s)</b>	FCC CFR Title 47 / Chapter I / Subchapter A / Part 15 / Subpart B ISED ICES-Gen Issue 1 ; Amendment 1 (February 2021) ISED ICES-003 Issue 7 ANSI C63.4:2014+A1:2017
<b>Non-Standard Test Method</b>	None
<b>Equipment under Test (EUT):</b>	
<b>Product Description</b>	UWB-Location-System is able to measure distances between the UWB components
<b>Model(s)</b>	52445052, Truck Tag
<b>Additional Model(s)</b>	None
<b>Brand Name(s)</b>	zoneCONTROL
<b>Hardware Version(s)</b>	10625 FS:04
<b>Software Version(s)</b>	0.0.51
<b>FCC-ID</b>	2AK6M-52445052
<b>IC</b>	N/A
<b>Test Result</b>	<b>PASSED</b>

<b>Possible test case verdicts:</b>		
required by standard but not tested	N/T	
not required by standard	N/R	
required by standard but not appl. to test object	N/A	
test object does meet the requirement	P(PASS)	
test object does not meet the requirement	F(FAIL)	
<b>Testing:</b>		
Date of receipt of test item	2024-05-14	
<b>Report:</b>		
Compiled by	Mounir Marea	
Tested by (+ signature) (Responsible for Test)	Stephan Liebich	
Approved by (+ signature) (Senior EMC Test Technician)	Matthias Handrik	
Date of Issue	2024-11-28	
Total number of pages	38	
<b>General Remarks:</b>		
<p>The test results presented in this report relate only to the object tested.</p> <p>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.</p> <p>This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.</p>		
<p><b>Statement concerning the uncertainty of the measurement systems used for decisions on conformity (decision rule):</b></p> <p>The Decision Rule is applied on the basis of CISPR 16-4-2 and/or IEC 61000-4-x (TR 61000-1-6) and their national publications. 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.</p> <p>Compliance or non-compliance with a disturbance limit is determined in the following manner.</p> <ul style="list-style-type: none"> <li>- If <math>U_{lab}</math> is less than or equal to <math>U_{cisp}</math>, then: compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit; non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.</li> <li>- If <math>U_{lab}</math> is greater than <math>U_{cisp}</math>, then: compliance is deemed to occur if no measured disturbance level, increased by <math>(U_{lab} - U_{cisp})</math>, exceeds the disturbance limit; non-compliance is deemed to occur if any measured disturbance level, increased by <math>(U_{lab} - U_{cisp})</math>, exceeds the disturbance limit.</li> </ul> <p>Where appropriate for the test, for example for EMC pulsed immunity tests, the laboratory has demonstrated, by calibrating its equipment and facilities, that it complies with the above requirements and therefore no allowance of uncertainties has been given to the tolerances.</p>		
<b>Additional Comments:</b>		
None		

Additional variants have been declared by the manufacturer. The listed models were not tested, evaluated or assessed in no way.

Additional Model 1	Product Type Description	UWB-Location-System is able to measure distances between the UWB components
	Model Name	52445053, Truck Tag
	Brand Name (optional)	zoneCONTROL
	Hardware Version	10625 FS:04
	Software Version	0.0.51

## ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
EUT	Equipment Under Test
FCC	Federal Communications Commission
ISED	Innovation, Science and Economic Development Canada
T <sub>NOM</sub>	Nominal operating temperature
V <sub>NOM</sub>	Nominal supply voltage

## VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2024-11-11	Initial Release	-
02	2024-11-28	Replaced document: G0M-2403-2508-EF0115B-V01 Replaced by: G0M-2403-2508-EF0115B-V02  Changes: Page 2: <ul style="list-style-type: none"> <li>Update signatures</li> </ul>	St. Liebich

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## 1 Equipment (Test Item) Under Test

Description	UWB-Location-System is able to measure distances between the UWB components		
Intended Use	Truck Tag is to be attached to a forklift or a vehicle for detecting potential danger points.		
Model	52445052, Truck Tag		
Additional Model(s)	None		
Brand Name(s)	zoneCONTROL		
Hardware Version(s)	10625 FS:04		
Software Version(s)	0.0.51		
Number of tested samples	1		
Sample Identification	EUT #	Sample-ID	Serial Number
	EUT 1	48551	ID:17:B4:10:02:06:74
EUT Dimensions [cm]	160 x 70 x 50 cm		
FCC-ID	2AK6M-52445052		
IC	N/A		
Class	Class A		
Equipment type	Table top		
Highest internal frequency [MHz]	6739.2		
Protective Earth	No		
Functional Earth	No		
Radio Module 1	Type	ZigBee Transceiver IEEE 802.15.4	
	Model	AT86RF215	
	Manufacturer	Atmel	
	FCC-ID	None	
	IC	None	
Radio Module 2	Type	UWB Transceiver Decawave	
	Model	DW1000	
	Manufacturer	Qorvo	
	FCC-ID	None	
	IC	None	
Supply Voltage	V <sub>NOM</sub>	24 V DC	
AC/DC-Adaptor	None		
Manufacturer	Siemens Aktiengesellschaft R&D House CHE DI PA DCP R&D 5 Rochlitzer Str. 19 09111 Chemnitz Germany		

## 1.1 Equipment Ports

Name	Type	Attributes	Comment
DC Mains	DC	Count: 1 Cable length [m]: 3 Direction: In Service only: No Shielded: No	-
Digital out	IO	Count: 2 Cable length [m]: 3 Direction: IO Service only: No Shielded: No	-
CAN	IO	Count: 1 Cable length [m]: 3 Direction: IO Service only: No Shielded: No	Board Bus
Description:			
AC	AC mains power input/output port		
DC	DC power input/output port		
BAT	DC power input port connected to external battery		
IO	Input/Output port		
TP	Telecommunication port		
NE	Non-electrical port		
GND	Functional Earth		

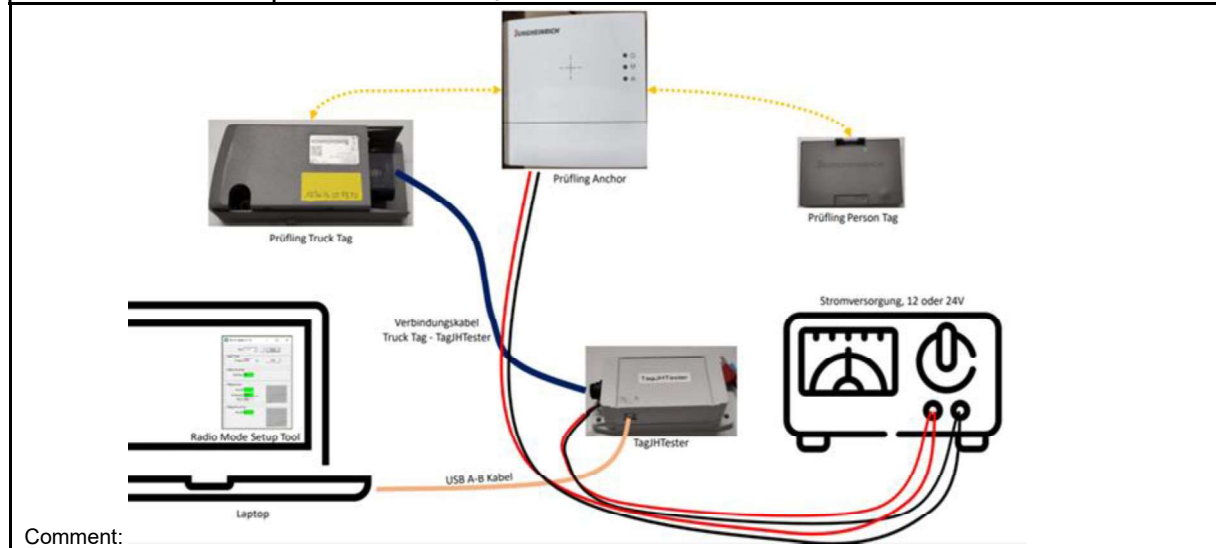
#### 1.4 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE/MON	Laptop	HP	ProBook 6570b Intel CORE i5 v pro	Customer support equipment
AE	PoE Adapter	Microsemi	9001GR	Customer support equipment
AE	TagJHTester	Siemens AG	-	Customer support equipment
AE	Personal Tag	Siemens AG	51853935	Customer support equipment
AE	Truck Tag	Siemens AG	51685242	Customer support equipment
AE	Personal Tag Changing Station	Siemens AG	6GT2790-0DD20	Customer support equipment
AE	Personal Tag AC/DC adapter	MeanWell	GST60A05	Customer support equipment
CBL	LAN	unknown	CAT 6- shielded	Customer support Cable
CBL	USB -2.0	Amazon Basics	Type A to B	Customer support Cable
CBL	Connection Cord	Siemens AG	-	Customer support Cable
SW	Software	Siemens AG	TAG JH Tester v1.1.0	Customer support Software
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
MON	Monitoring Equipment			
CBL	Connecting Cable			
SW	Software			
Comment: --				

## 1.5 Operational Modes

Mode #	Description
1	EUT transmits data at maximum 4 seconds from the Truck Tag, which is affixed to the vehicle. This communication occurs via two distinct wireless technologies: Zigbee at 2.4 GHz Ultra-Wideband (UWB) channel 2 at 3.9 GHz
Comment: EUT can operate on UWB channel 2 at 3.9 GHz and channel 5 at 6.48 GHz, for the worst-case scenario, UWB channel 2 has been chosen.	

## 1.6 EUT Configuration

Configuration #	Description
1	EUT powered via 24 V DC from TagJHTester which is connected to Power Supply via connection cord and laptop via USB-2.0, sending information about the status of the communication range on the TAG JH Tester v1.1.0 software.
 <p>The diagram illustrates the EUT Configuration setup. A Laptop is connected to a TagJHTester via a USB A-B Kabel. The TagJHTester is connected to a Stromversorgung (12 or 24V) via a connection cord. The TagJHTester is also connected to a Prüfling Truck Tag and a Prüfling Person Tag via a Verbindungskabel (Truck Tag - TagJHTester). The Prüfling Truck Tag is connected to a Prüfling Anchor, which is connected to the Prüfling Person Tag. The TagJHTester is also connected to a Radio Mode Setup Tool via a connection cord.</p> <p>Comment:</p>	

## 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 analyser in dBµV. Any external preamplifiers used are taken into account through internal analyser 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 analyser. 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:

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

Net:

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

Limit:

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

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

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.

Example only:

Reading + AF	= Net Reading	:	Net reading - FCC limit	= Margin
+21.5 dBµV + 26 dB/m	= 47.5 dBµV/m	:	47.5 dBµV/m - 57.0 dBµV/m	= -9.5 dB

## 2 Result Summary

Title 47 CFR Part 15B, ISED ICES-003 Issue 7				
Reference	Requirement	Reference Method	Result	Remarks
Emission				
FCC 15.109 ICES-003, 3.2.2	Radiated emissions	ANSI C63.4:2014 +A1:2017	PASS	--
FCC 15.107 ICES-003, 3.2.1	AC power line conducted emissions	ANSI C63.4:2014 +A1:2017	N/R	1
Comment: --				
1 EUT will not connected direct or indirect to an AC-Network.				

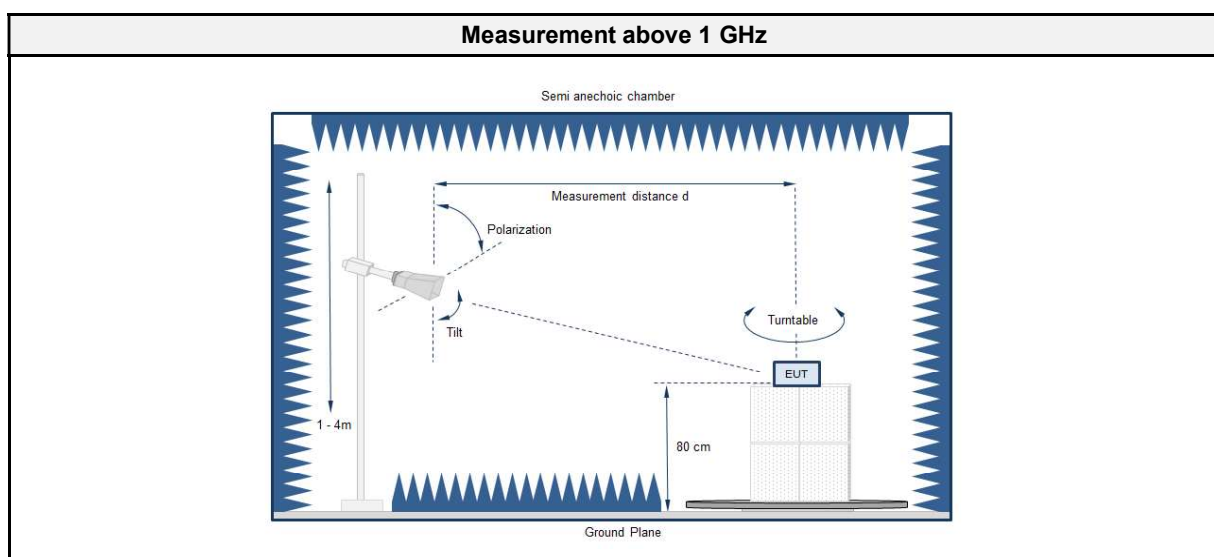
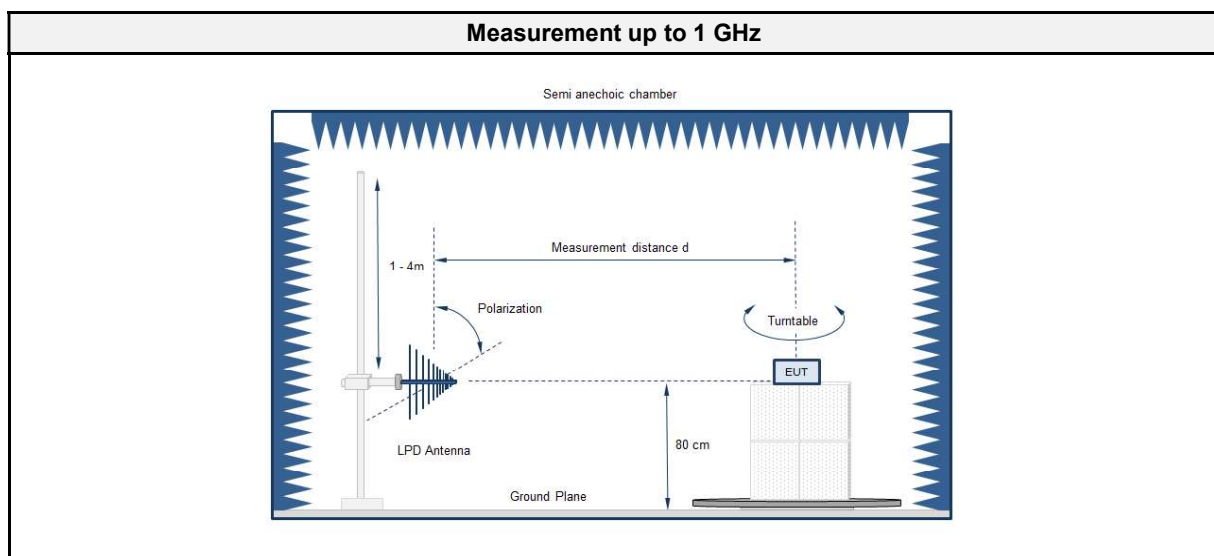
Possible Test Case Verdicts	
PASS	Test object does meet the requirements
FAIL	Test object does not meet the requirements
N/T	Required by standard but not tested
N/R	Not required by standard for the test object

## 2.1 Test Conditions and Results - Radiated emissions acc. to ANSI C63.4

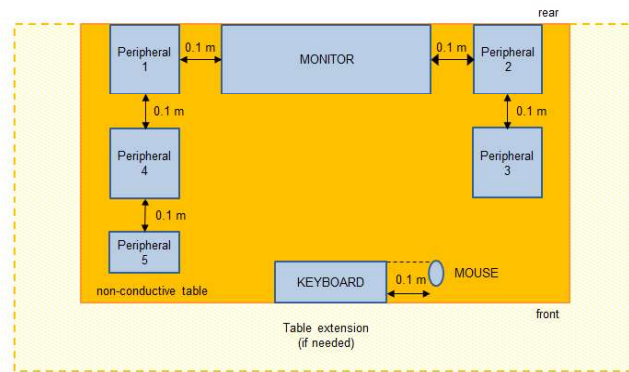
### 2.1.1 Information

Test Information	
Reference	FCC 15.109, ICES-003, 3.2.2
Reference method	ANSI C63.4 Section 8
Equipment class	Class A
Equipment type	Table top
Highest internal frequency [MHz]	6739.2
Measurement range	30 MHz to 40000 MHz
Temperature [°C]	24 – 27
Humidity [%]	38 – 40
Operator	Mounir Marea
Date	2024-06-05

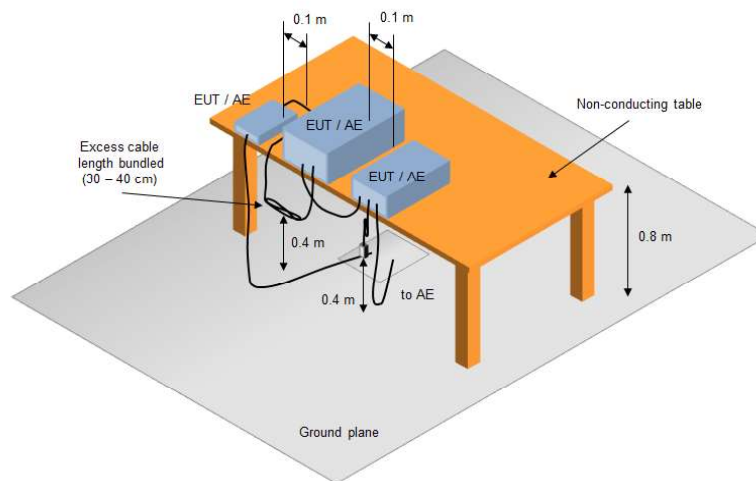
### 2.1.2 Setup *Table top*:



### Equipment placement - Table top



### Test Setup



### 2.1.3 Equipment

Test Software AC1			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	Radimation	2023.2.6

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic chamber (NSA)	Frankonia	AC1	EF00062	2022-11	2025-11
Anechoic chamber (SVSWR)	Frankonia	AC 1	EF01011	2022-11	2024-11
Programmable AC Source	Chroma ATE Inc.	61604	EF01068	2023-08	2025-08
Test Receiver	Rohde & Schwarz GmbH & Co. KG - Vertrieb Berlin	ESW44	EF01856	2024-04	2025-04
Horn Antenna	Schwarzbeck	BBHA9120D	EF00018	2022-12	2025-12
Climatic Sensor	Embedded Data Systems, LLC.	280010000025417E	EF01054	2023-07	2024-07

Test Software AC6			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	Radimation	2020.1.8

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic chamber (NSA)	Frankonia	AC6	EF00910	2021-07	2024-07
Anechoic chamber (SVSWR)	Frankonia	AC6	EF00899	2022-10	2025-10
EMI Test Receiver	R&S	ESU26	EF00887	2024-01	2025-01
TRILOG Broadband Antenna	Schwarzbeck	VULB 9162	EF00978	2022-11	2025-11
40GHz High Gain Antenna	Amplifier Research	AT4560	EF00302	2023-09	2025-09
40GHz Standard Standard Gain Horn Antenna with Amplifier	Flann Microwave Ltd	22240-25 Amp. CBL26402075	EF00301	2023-01	2026-01
Climatic Sensor	Embedded Data Systems, LLC.	020010000025377E	EF01336	2024-05	2025-05

## 2.1.4 Procedure

Exploratory measurement Table top	
1.	The EUT was placed on a non-conductive table at a height of 0.8m.
2.	The EUT and support equipment, if needed, were set up to simulate typical usage.
3.	Cables, of type and length specified by the manufacturer, were connected to at least one port of each type and were terminated by a device or simulating load of actual usage.
4.	The antenna was placed at a distance of 3 or 10 m.
5.	The received signal was monitored at the measurement receiver.
6.	This procedure has to be performed in both antenna polarizations, horizontal and vertical.
7.	The arrangement of the equipment with the maximum emission level is shown on the setup picture at item 2.1.2

Final measurement 3m/10m Table top	
1.	The EUT was placed on a 0.8 m non-conductive table at a 3 or 10 m distance from the receive antenna. The antenna output was connected to the measurement receiver.
2.	A broadband hybrid antenna was used for the frequency range 30 – 1000 MHz. Above one 1 GHz a Double Ridged Broadband Horn antenna was used. The antenna was placed on an adjustable height antenna mast. If required, in the range 1- 18 GHz a Double Ridged Broadband Horn antenna, in the range 18 – 40 GHz a High Gain / Standard Gain Horn was used. The antenna was placed on an adjustable height antenna mast.
3.	The EUT and cable arrangement were based on the exploratory measurement results.
4.	Emissions were maximized at each frequency by rotating the EUT and adjusting the receive antenna height and polarization. The maximum values were recorded.
5.	The test data of the worst-case conditions were recorded and shown on the next pages.

## 2.1.5 Limits

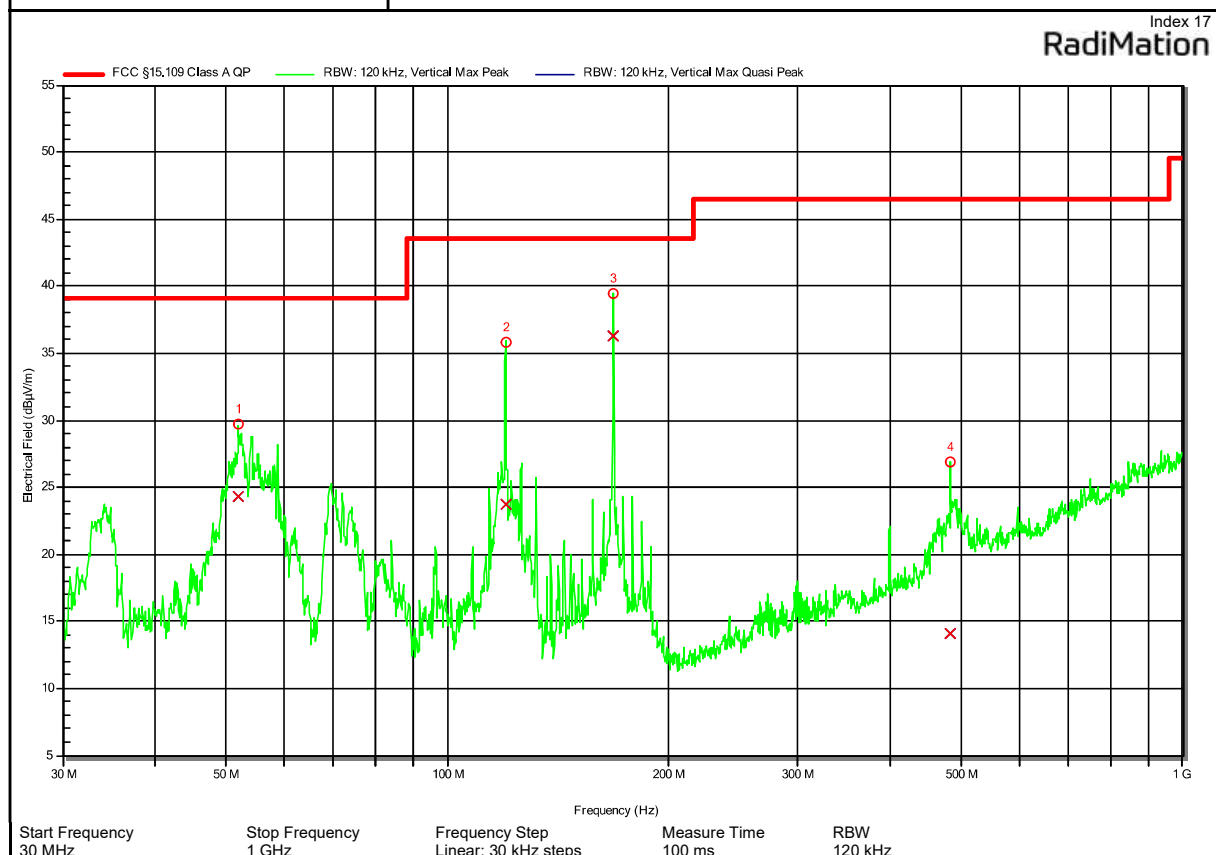
Class A @ 10 m		
Frequency [MHz]	Detector	Limit [dBµV/m]
30 - 88	Quasi-peak	39
88 - 216	Quasi-peak	43.5
216 - 960	Quasi-peak	46.5
960 - 1000	Quasi-peak	49.5
> 1000	Peak	69.5
	Average	49.5

#### 2.1.6 Results

Test Results			
Operational mode	EUT Configuration	Verdict	Remark
1	1	PASS	-
Note:-			

## 2.1.8 Records

Radiated emissions according to FCC 15B	
Project Number:	G0M-2403-2508
Applicant:	Siemens AG
Model Description:	UWB-Location-System can measure distances between the UWB components
Model:	52445052, Truck Tag
Test Sample ID:	48551
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Marea
Test Date & Time:	2024-06-05
Operating Conditions:	ambient temperature: 23 °Celsius power input: 24 V DC
Antenna:	Schwarzbeck VULB 9162, Vertical
Measurement Distance:	10 m
Operational Mode:	1
DUT Configuration:	1
Applied to Port:	-
Note 1:	-

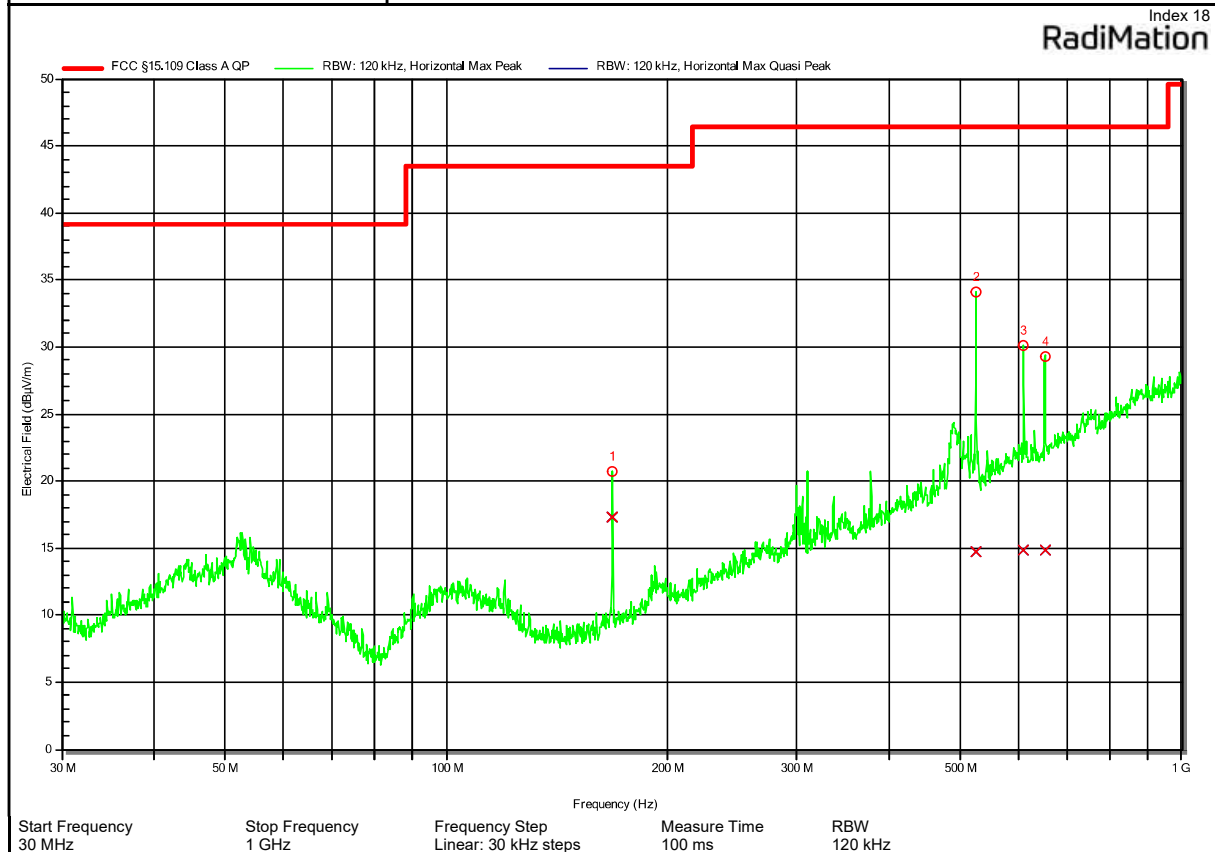


Peak Number	Frequency (MHz)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Difference (dB)	Quasi-Peak Status	Angle (degrees)	Height (m)
1	51.96	24.3	39.1	-14.8	Pass	160	1
2	120.06	23.8	43.5	-19.8	Pass	160	1
3	168	36.3	43.5	-7.2	Pass	160	1
4	482.91	14.1	46.4	-32.3	Pass	160	1

Test Report No.: G0M-2403-2508-EF0115B-V02

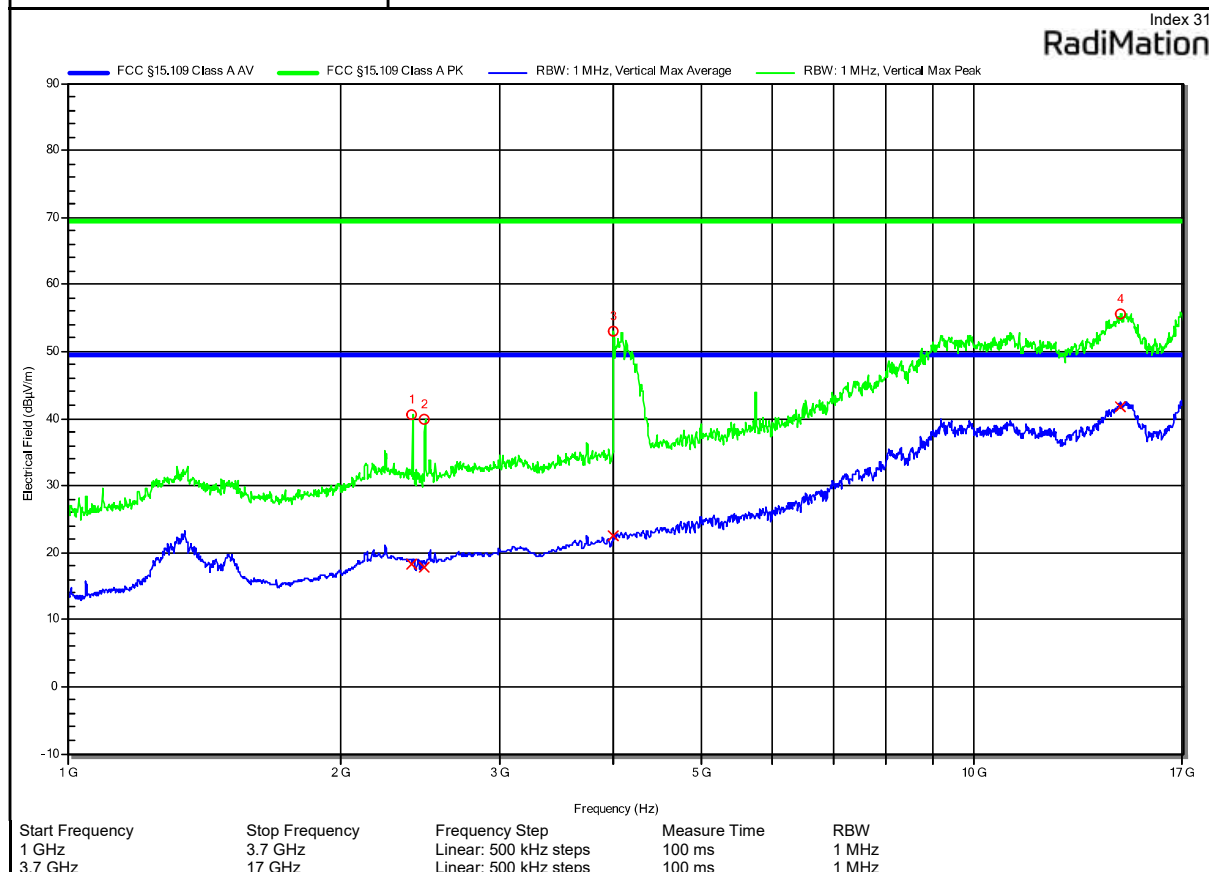
Eurofins Product Service GmbH  
Storkower Str. 38c, D-15526 Reichenwalde, Germany

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Operator:	Mr. Marea
Test Date & Time:	2024-06-05
Operating Conditions:	ambient temperature: 23 °Celsius power input: 24 V DC
Antenna:	Schwarzbeck VULB 9162, Horizontal
Measurement Distance:	10 m
Operational Mode:	1
DUT Configuration:	1
Applied to Port:	-
Note 1:	-



Peak Number	Frequency (MHz)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Difference (dB)	Quasi-Peak Status	Angle (degrees)	Height (m)
1	168	17.3	43.5	-26.2	Pass	180	1.7
2	525.03	14.8	46.4	-31.7	Pass	180	1.7
3	609.03	14.9	46.4	-31.6	Pass	180	1.7
4	651.12	14.9	46.4	-31.6	Pass	180	1.7

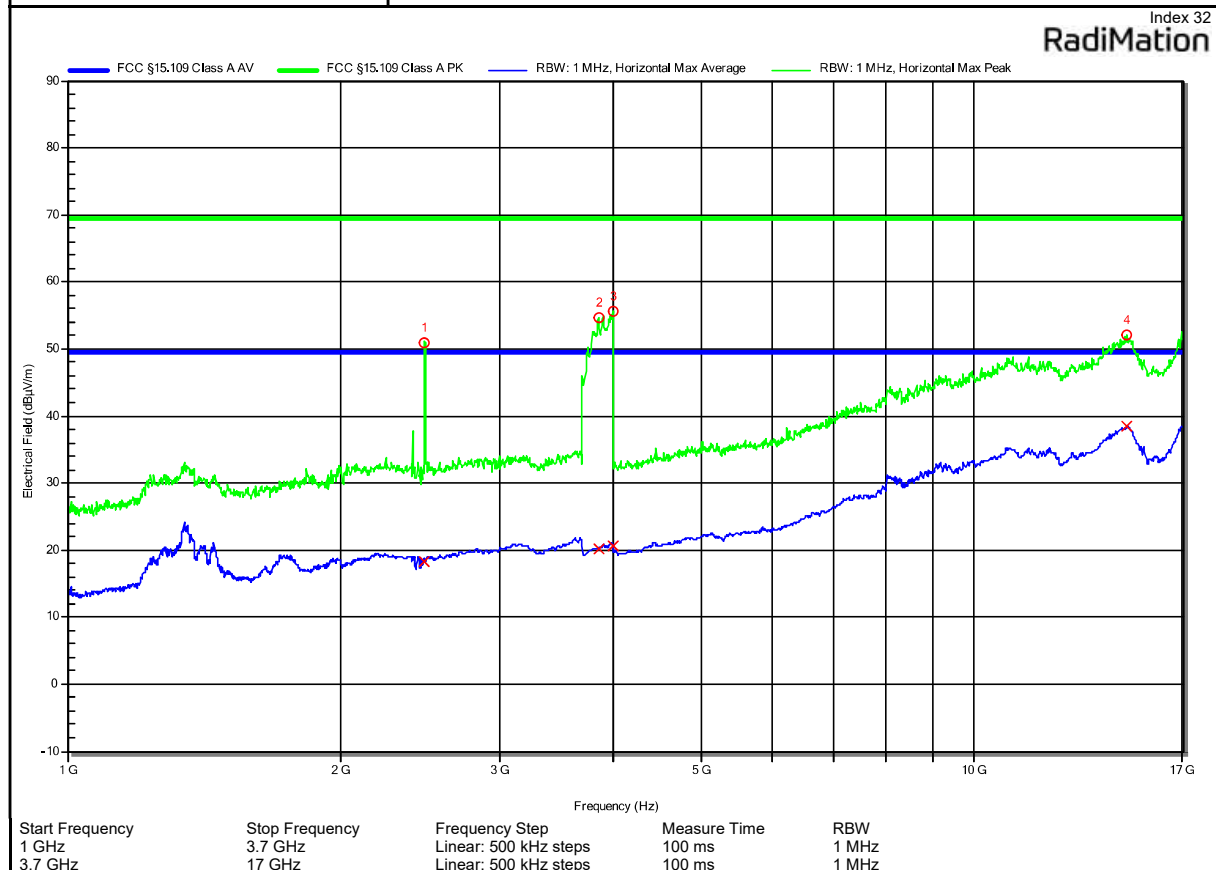
Radiated emissions according to FCC part 15B	
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Applicant:	Siemens AG
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Model:	52445052, Truck Tag
Test Sample ID:	48551
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Drabo
Test Date & Time:	2024-06-19
Operating Conditions:	ambient temperature: 24 °Celsius power input: 24 V DC
Antenna:	Schwarzbeck BBHA 9120D, Vertical
Measurement Distance:	3 m converted to 10 m
Operational Mode:	1
DUT Configuration:	1
Applied to Port:	-
Note 1:	-



Peak Number	Frequency (MHz)	Peak (dBµV/m)	Peak Limit (dBµV/m)	Peak Difference (dB)	Peak Status	Angle (degrees)	Height (m)
1	2402	40.5	69.54	-29.04	Pass	0	1
2	2479.5	39.9	69.54	-29.64	Pass	0	1
3	4003	53.04	69.54	-16.5	Pass	0	1
4	14543.5	55.53	69.54	-14.01	Pass	0	1

Peak Number	Frequency (MHz)	Average (dBµV/m)	Average Limit (dBµV/m)	Average Difference (dB)	Average Status	Angle (degrees)	Height (m)
1	2402	18.38	49.54	-31.16	Pass	0	1
2	2479.5	17.93	49.54	-31.61	Pass	0	1
3	4003	22.46	49.54	-27.08	Pass	0	1
4	14543.5	41.86	49.54	-7.68	Pass	0	1

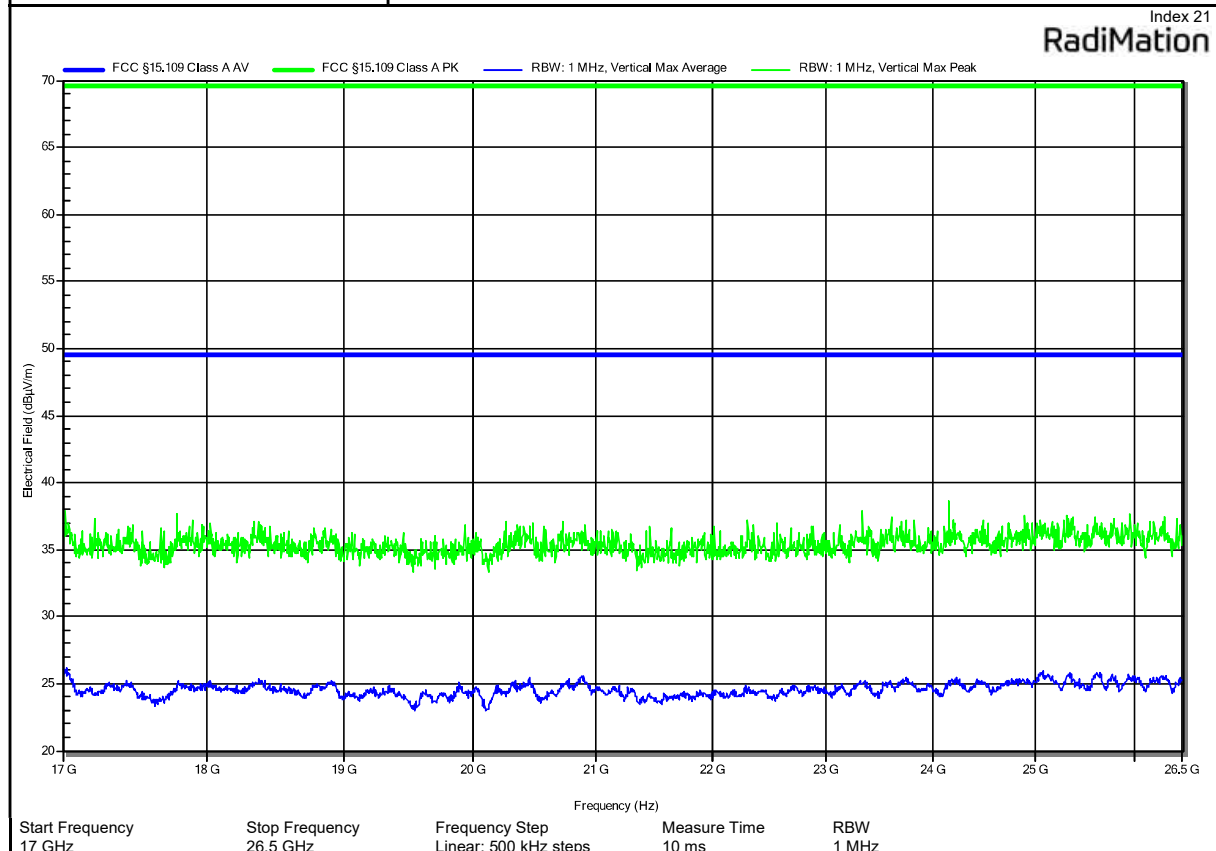
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Operating Conditions:	ambient temperature: 24 °Celsius power input: 24 V DC
Antenna:	Schwarzbeck BBHA 9120D, Horizontal
Measurement Distance:	3 m converted to 10 m
Operational Mode:	1
DUT Configuration:	1
Applied to Port:	-
Note 1:	-



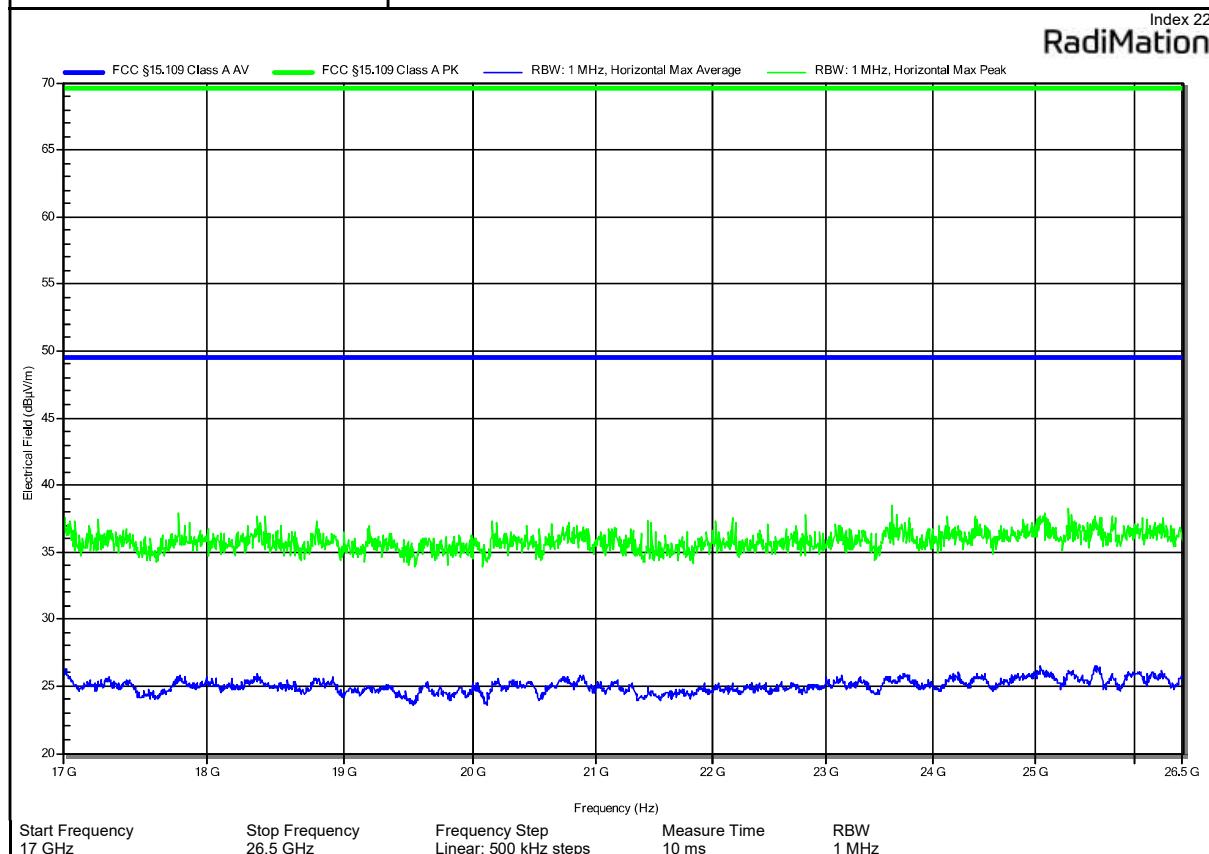
Peak Number	Frequency (MHz)	Peak (dBµV/m)	Peak Limit (dBµV/m)	Peak Difference (dB)	Peak Status	Angle (degrees)	Height (m)
1	2479.547	50.87	69.54	-18.67	Pass	0	1
2	3853.5	54.67	69.54	-14.87	Pass	0	1
3	3994.5	55.5	69.54	-14.04	Pass	0	1
4	14763	52.05	69.54	-17.49	Pass	0	1

Peak Number	Frequency (MHz)	Average (dBµV/m)	Average Limit (dBµV/m)	Average Difference (dB)	Average Status	Angle (degrees)	Height (m)
1	2479.547	18.18	49.54	-31.36	Pass	0	1
2	3853.5	20.25	49.54	-29.29	Pass	0	1
3	3994.5	20.68	49.54	-28.86	Pass	0	1
4	14763	38.5	49.54	-11.04	Pass	0	1

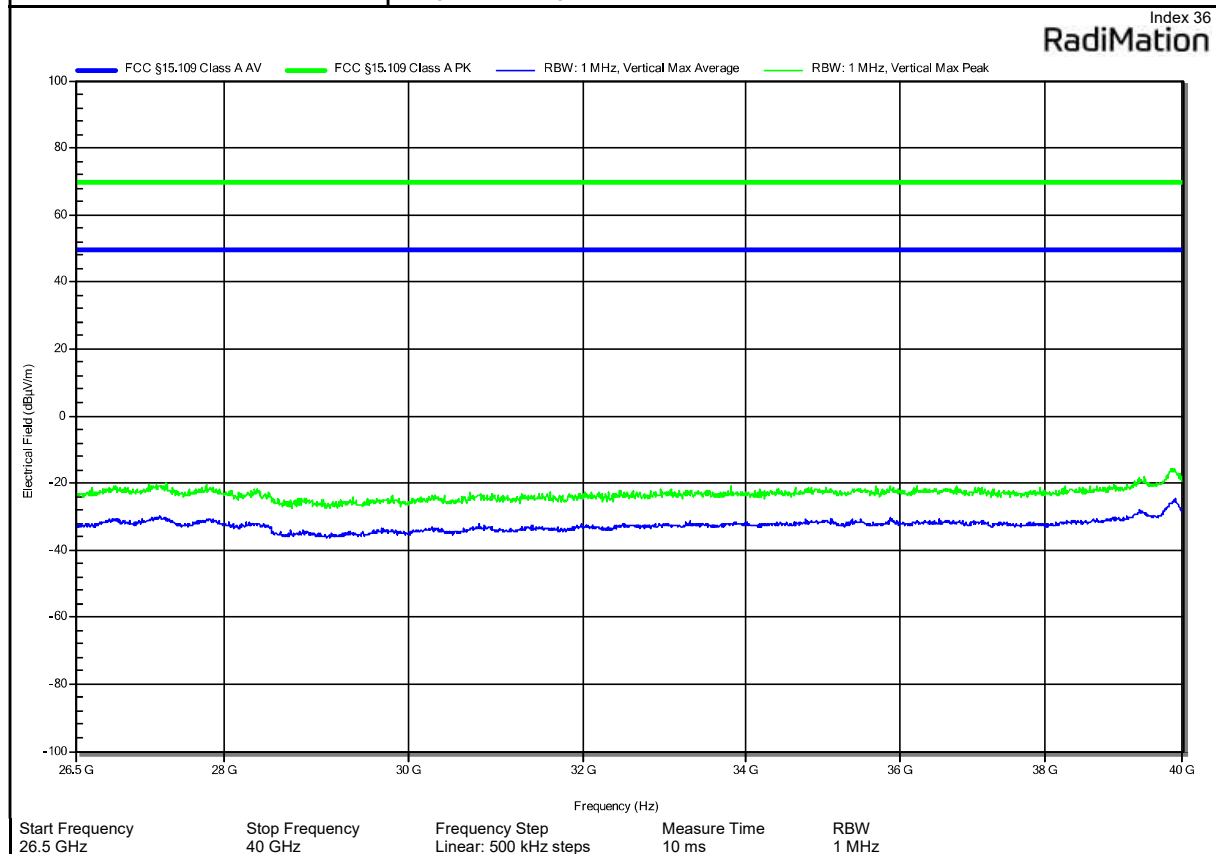
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DUT Configuration:	1
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Note 1:	-



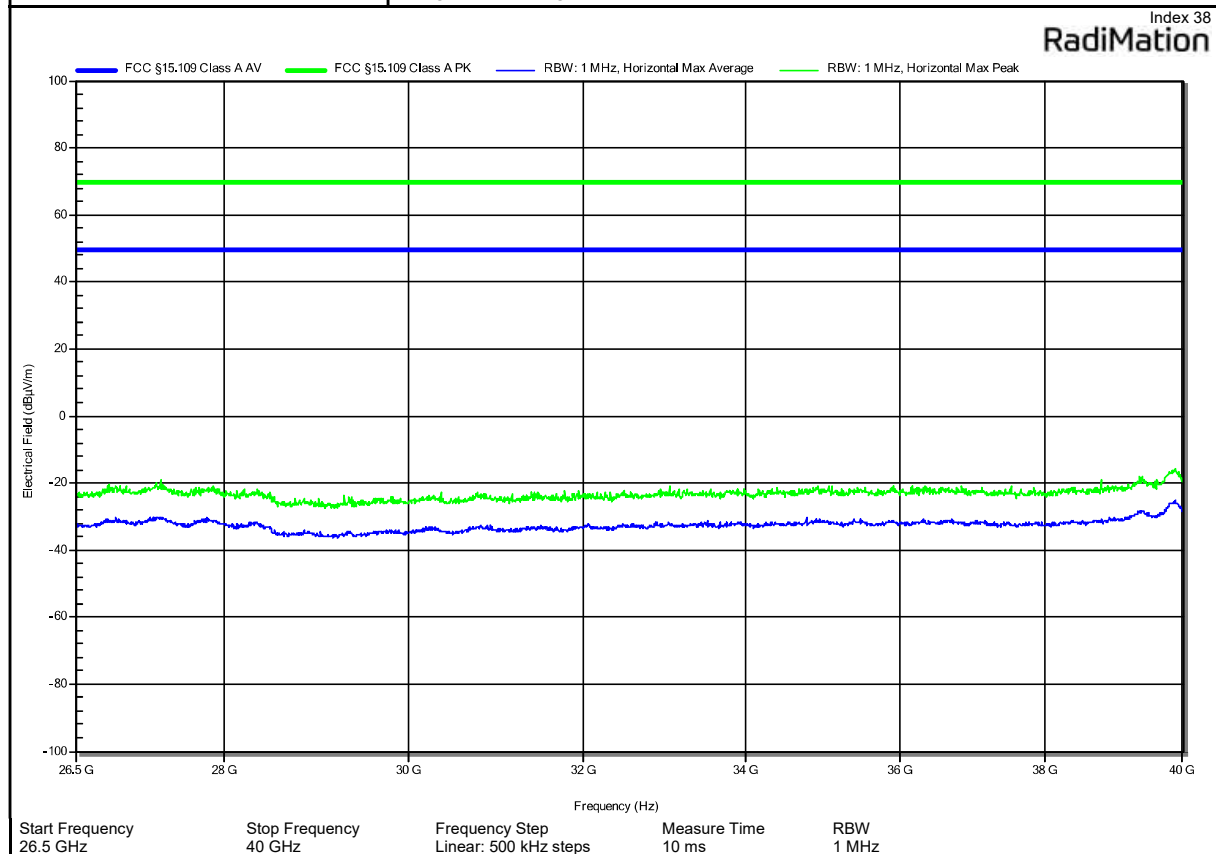
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Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Marea
Test Date & Time:	2024-06-05
Operating Conditions:	ambient temperature: 23 °Celsius power input: 24 V DC /48 V DC
Antenna:	AT4560, Horizontal
Measurement Distance:	3 m converted to 10 m
Operational Mode:	1
DUT Configuration:	1
Applied to Port:	-
Note 1:	-



Radiated emissions according to FCC 15B	
Project Number:	G0M-2403-2508
Applicant:	Siemens AG
Model Description:	UWB-Location-System can measure distances between the UWB components
Model:	52445052, Truck Tag
Test Sample ID:	48551
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Marea
Test Date & Time:	2024-06-06
Operating Conditions:	ambient temperature: 23 °Celsius power input: 24 V DC
Antenna:	22240-25, Vertical
Measurement Distance:	3 m converted to 10 m
Operational Mode:	1
DUT Configuration:	1
Applied to Port:	-
Note 1:	Height 1 m, angle 0°



Radiated emissions according to FCC 15B	
Project Number:	G0M-2403-2508
Applicant:	Siemens AG
Model Description:	UWB-Location-System can measure distances between the UWB components
Model:	52445052, Truck Tag
Test Sample ID:	48551
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Marea
Test Date & Time:	2024-06-06
Operating Conditions:	ambient temperature: 23 °Celsius power input: 24 V DC
Antenna:	22240-25, Horizontal
Measurement Distance:	3 m converted to 10 m
Operational Mode:	1
DUT Configuration:	1
Applied to Port:	-
Note 1:	Height 1 m, angle 0°



### 3 Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2.

Test Name	Measurement Uncertainty
Radiated Emission	>1GHz to 17GHz @3m, 5.95dB

Test Name	Measurement Uncertainty
Radiated Emission	30 MHz to 1 GHz @ 10 m, 6.25 dB 17 GHz to 40GHz @ 3 m, max. 5.39 dB