

<b>Prüfbericht-Nr.:</b> <i>Test report no.:</i>	<b>DE24GVPK 001</b>	<b>Auftrags-Nr.:</b> <i>Order no.:</i>	1151516 40	Seite 1 von 27 <i>Page 1 of 27</i>
<b>Kunden-Referenz-Nr.:</b> <i>Client reference no.:</i>	8320104705	<b>Auftragsdatum:</b> <i>Order date:</i>	2023-10-09	
<b>Auftraggeber:</b> <i>Client:</i>	Bosch Rexroth AG, Fornsbacher Str. 92, 71540 Murrhardt, Germany			
<b>Prüfgegenstand:</b> <i>Test item:</i>	Electronical Torque Wrench			
<b>Bezeichnung / Typ-Nr.:</b> <i>Identification / Type no.:</i>	OPEX 100 Nm			
<b>Auftrags-Inhalt:</b> <i>Order content:</i>	Prüfung der Funkparameter nach FCC & ISED <i>Test of radio parameters acc. to FCC &amp; ISED</i>			
<b>Prüfgrundlage:</b> <i>Test specification:</i>	Teilprüfung / Partial test FCC CFR 47 Part 15 Subpart C- §15.247 ISED RSS-247 issue 3 2023			
<b>Wareneingangsdatum:</b> <i>Date of sample receipt:</i>	2024-01-18	There are no photos of the EUT in this report acc. to the confidentiality letter. For Photo documentation please refer to Report numbers DE24ZCGB 001, DE24CSAG 001, DE24QI6V 001,		
<b>Prüfmuster-Nr.:</b> <i>Test sample no.:</i>	A003734791-001 to 02			
<b>Prüfzeitraum:</b> <i>Testing period:</i>	2024-05-17 - 2024-05-31			
<b>Ort der Prüfung:</b> <i>Place of testing:</i>	Nürnberg <i>Nuremberg</i>			
<b>Prüflaboratorium:</b> <i>Testing laboratory:</i>	Wireless Labor <i>Wireless Test Lab</i>			
<b>Prüfergebnis*:</b> <i>Test result*:</i>	Pass			
<b>geprüft von:</b> <i>tested by:</i>	X	<b>genehmigt von:</b> <i>authorized by:</i>	X	
<b>Datum:</b> <i>Date:</i>	2024-06-11 <small>Signed by: Shrinivas Naikar</small>	<b>Ausstellungsdatum:</b> <i>Issue date:</i>	2024-06-11 <small>Signiert von: Patrick Reusch</small>	
<b>Stellung / Position:</b>	Sachverständige(r)/Expert	<b>Stellung / Position:</b>	Sachverständige(r)/Expert	
<b>Sonstiges / Other:</b>	USA/FCC: C2PC filing for adding new host system. Canada/ISED: C4PC filing for adding new host system. Host device integrated with FCC & IC certificate radio module.			
<b>Zustand des Prüfgegenstandes bei Anlieferung:</b> <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
* Legend:	P(ass) = passed a.m. test specification(s)	F(ail) = failed a.m. test specification(s)	N/A = not applicable	N/T = not tested
<b>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</b> <i>This test report only relates to the above mentioned test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

**Anmerkungen**  
*Remarks*

1	<p>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben.</p> <p>Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</p> <p><i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system.</i></p> <p><i>Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i></p>
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3	<p>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben.</p> <p>Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</p> <p><i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i></p> <p><i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i></p>
4	<p>Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019.</p> <p><i>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</i></p>
5	<p>Wenn auf dem Bericht kein Akkreditierungshinweis aufgebracht ist, wurde der Bericht nicht im akkreditierten Bereich erstellt und ist folglich auch nicht vom EA MLA abgedeckt. Unabhängig davon wurde der Bericht auf Basis der allgemeinen Regeln der ISO/IEC 17000er Reihe erstellt. Mit "#" gekennzeichnete Prüfungen sind nicht Bestandteil der Akkreditierung D-PL-14169-03-00.</p> <p><i>If there is no accreditation notice on the report, the report has not been produced in the accredited area and is consequently not covered by the EA MLA. Regardless of this, the report has been prepared based on the general rules of the ISO/IEC 17000 series. Tests marked with "#" are not covered by the accreditation D-PL-14169-03-00.</i></p>

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**Produktbeschreibung**  
Product description

1	<b>Test item</b>	Electronical Torque Wrench			
2	<b>Typ-No.</b>	OPEX 100 Nm			
3	<b>Test sample obtaining</b>	<input checked="" type="checkbox"/> Sampling by customer <input type="checkbox"/> Sampling by TÜV Rheinland Group <input type="checkbox"/> others:			
4	<b>Serial-No.</b>				
5	<b>Supported radio technologies</b>	Wi-Fi 2.4GHz and Wi-Fi 5GHz			
6	<b>Evaluated in this Report</b>	Wi-Fi 2.4GHz			
7	<b>Description of EUT</b>	Electronic torque wrench for tightening screw connections in an industrial environment.			
8	<b>Max RF output power (measured) (Refer to module test report)</b>	<b>Protocol</b>	<b>Frequency (MHz)</b>	<b>FCC</b>	<b>IC</b>
		Wi-Fi 2.4GHz	2412 to 2462	24.72 dBm	
		Wi-Fi 5GHz	5180 to 5240	18.41 dBm	22,53 dBm (e.i.r.p)
			5260 to 5320	18.41 dBm	17,98 dBm
			5500 to 5700	18.01 dBm	18.01 dBm
5745 to 5825	18.26 dBm		18.26 dBm		
9	<b>Operating Frequency (declared)</b>	<b>Protocol</b>	<b>Band</b>	<b>Frequency (MHz)</b>	
		Wi-Fi 2.4GHz	2.4GHz	2412 to 2462	
		Wi-Fi 5GHz	UNII 1	5180 to 5240	
			UNII 2a	5260 to 5320	
			UNII 2c	5500 to 5700	
UNII 3	5745 to 5825				
10	<b>Number of Channels and Bandwidth (declared)</b>	<b>Protocol</b>	<b>Bandwidth (MHz)</b>	<b>No. of Channels</b>	
		Wi-Fi 2.4GHz	20MHz	11	
		Wi-Fi 5GHz	20MHz	24	
			40MHz	11	
11	<b>Modulation</b>	WiFi a/b/g/n: DSS/OFDM			
12	<b>Rated Voltage / Frequency (Device)</b>	3,6 V DC/5000 mAh Battery Docking adaptor: 9V DC/2.22amps			
13	<b>Input/output Voltage of the AC-DC adaptor</b>	Input:110V AC/60Hz Output: 9V DC/2.22amps			
14	<b>Radio Module Name</b>	xPico 200 Series Wi-Fi IOT Gateway			
15	<b>FCC-ID (Radio module)</b>	R68XPICO200			
16	<b>IC-ID (Radio module)</b>	3867A-XPICO200			
17	<b>Radio module Report Number</b>	<b>Protocol</b>	<b>FCC</b>	<b>IC</b>	
		Wi-Fi 2.4GHz	RF170513E01	IC170513E01	
		Wi-Fi 5GHz	RF170513E01-1 and RF170513E01-4	IC170513E01-1 and IC170513E01-4	
18	<b>Antenna Name</b>	PCB Antenna			
19	<b>Antenna Type</b>	<input checked="" type="checkbox"/> Integral antenna (designed as a fixed part of the EUT) <input type="checkbox"/> Dedicated antenna (removable, obligation to be used) <input type="checkbox"/> Permanent antenna connector			
20	<b>Antenna number of chains</b>	1			
21	<b>Antenna Gain (declared)</b>	Wi-Fi 2.4GHz: 2.5 dBi Wi-Fi 5GHz: 5dBi			
22	<b>Firmware</b>	240700			

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**Produktbeschreibung**  
Product description

23	<b>Hardware</b>	V1.000
24	<b>Provided Samples</b>	A003734791-001 to 02
25	<b>Radiated measurements sample</b>	A003734791-001
26	<b>Companion Device</b> used for radio connection with the EUT	EUT in Test Mode. Therefore, no Companion Device was used.
27	<b>Auxiliary equipment</b> used to set up the EUT	TUV lab laptop was used to configure the radio.
28	<b>Accessory Devices</b> used together with the EUT	Docking Station, Power Adaptor and USB Type C Cable
29	<b>Data Cable</b>	One type C USB cable
30	<b>I/O Ports</b>	N/A
31	<b>Temperature Range</b>	+0°C to +40° C
32	<b>Environment</b>	Indoor and Outdoor

33	<b>Identical Types</b>	 <p style="text-align: right; font-size: small;">GWK Norbert Gerlach GmbH &amp; Co. KG Elektronische Schraubsysteme Geschäftsleitung</p> <p style="font-size: x-small; text-align: center;"><a href="http://www.gwk.com">www.gwk.com</a></p> <p>Bosch Rexroth AG Fornsbacher Str. 92 71540 Murrhardt</p> <p>We, company GWK, herewith unitarily confirm that all variants of the electronic torque wrenches, which are available under the brand names Operator22 of company GWK and OPEX of company Bosch Rexroth AG, are completely identical with regard to the electronic hardware.</p> <p>The divergences in the brand appearance are limited solely to the external appearance and do not show any differences in the technical equipment.</p> <p>The divergences in the body sizes only concern the mechanical construction of the measuring equipment. The strain gages used are identical throughout. The adaptation to higher torques is only done by software due to different tube thicknesses and lengths.</p> <p>The different sizes of the torque/angle wrenches are specified by the respective supplier as follows:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; border-right: 1px solid black;">Bosch Rexroth AG</th> <th style="text-align: left;">GWK Norbert Gerlach GmbH &amp; Co. KG</th> </tr> </thead> <tbody> <tr> <td style="border-right: 1px solid black;">OPEX 30 Nm</td> <td>Operator22, 30 Nm</td> </tr> <tr> <td style="border-right: 1px solid black;">OPEX 50 Nm</td> <td>Operator22, 50 Nm</td> </tr> <tr> <td style="border-right: 1px solid black;">OPEX 100 Nm</td> <td>Operator22, 100 Nm</td> </tr> <tr> <td style="border-right: 1px solid black;">OPEX 200 Nm</td> <td>Operator22, 200 Nm</td> </tr> <tr> <td style="border-right: 1px solid black;">OPEX 300 Nm</td> <td>Operator22, 300 Nm</td> </tr> <tr> <td style="border-right: 1px solid black;">OPEX 400 Nm</td> <td>Operator22, 400 Nm</td> </tr> <tr> <td style="border-right: 1px solid black;">OPEX 600 Nm</td> <td>Operator22, 600 Nm</td> </tr> <tr> <td style="border-right: 1px solid black;">OPEX 800 Nm</td> <td>Operator22, 800 Nm</td> </tr> </tbody> </table> <p style="text-align: center;"> Dirk Wendt Geschäftsführender Gesellschafter</p> <div style="font-size: x-small; display: flex; justify-content: space-between; margin-top: 20px;"> <div> <p>gwkw Norbert Gerlach GmbH &amp; Co. KG In der Steinbach 2 62756 Seltmann Germany</p> </div> <div> <p>Geschäftsführer: Tel.: Fax: E-Mail: USt-Id-Nr.:</p> </div> <div> <p>Gerlach Verwaltungs GmbH, IHRA 11769 Am Ringen 11 Bad Kriemhild, IHRB 11158 +49 (0)6789 250490 +49 (0)6789 2504901 info@gerlach.de DE219859900</p> </div> <div> <p>Bankverbindung: Kontokorrent: Bankleitzahl: SWIFT Code: IBAN-Nummer: WEEE-Reg.-Nr.:</p> </div> <div> <p>Vollbank Hüntrück-Nähe 4762089 50001472 GENODED10NK DE7550014720000700382 DE16923115</p> </div> <div style="text-align: right;">  <p style="font-size: x-small;">Zertifizierte Leistungsleistung über 2000000 Produktions einheiten</p> </div> </div>	Bosch Rexroth AG	GWK Norbert Gerlach GmbH & Co. KG	OPEX 30 Nm	Operator22, 30 Nm	OPEX 50 Nm	Operator22, 50 Nm	OPEX 100 Nm	Operator22, 100 Nm	OPEX 200 Nm	Operator22, 200 Nm	OPEX 300 Nm	Operator22, 300 Nm	OPEX 400 Nm	Operator22, 400 Nm	OPEX 600 Nm	Operator22, 600 Nm	OPEX 800 Nm	Operator22, 800 Nm
Bosch Rexroth AG	GWK Norbert Gerlach GmbH & Co. KG																			
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OPEX 600 Nm	Operator22, 600 Nm																			
OPEX 800 Nm	Operator22, 800 Nm																			

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Absatz Clause	Anforderungen - Prüfungen / Requirements - Tests	Bemerkungen/ Remarks	Ergebnis Result
FCC 15.247 (a)(1) RSS-247 sec. 5.1	20 dB Bandwidth	Does not apply for DTS equipment	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/T <input type="checkbox"/>
FCC 15.247 (a)(1) RSS-247 sec. 5.1	Number of Hopping Frequencies	Does not apply for DTS equipment	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/T <input type="checkbox"/>
FCC 15.247 (a)(1) RSS-247 sec. 5.1	Time of Occupancy	Does not apply for DTS equipment	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/T <input type="checkbox"/>
FCC 15.247 (a)(1) RSS-247 sec. 5.1	Carrier Frequency Separation	Does not apply for DTS equipment	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/T <input type="checkbox"/>
FCC 15.247 (b) RSS-247 sec. 5.4	Maximum Output Power	No retest necessary, as transmitter output power has been certified based on conducted power.	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input checked="" type="checkbox"/>
FCC 15.247 (e) RSS-247 sec. 5.2 (b)	Power Spectral Density	-	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input checked="" type="checkbox"/>
FCC 15.247 (a)(2) RSS-247 sec. 5.2 (a)	6dB Bandwidth	-	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input checked="" type="checkbox"/>
FCC 15.247 (d) RSS-247 sec. 5.5	Unwanted Emissions	-	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
FCC 15.207 RSS-Gen sec. 8.8	AC Power Conducted Emissions	-	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>

**Prüfdokumentation**  
*Test documentation*

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**Prüfdokumentation**  
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## 1 Registration

The measurement facilities for conducted and radiated disturbance measurements of the TÜV Rheinland LGA Products have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules. Measurement data will be accepted in conjunction with applications for Certification under Parts 15 and 18 of the Commission's Rules.

FCC Registration Number: 939976

Bundesnetzagentur Registration Number: BNetzA-CAB-17/21-16

The measurement facilities are also recognized by Innovation, Science and Economic Development (ISED) Canada to test to Canadian radio equipment requirements.

Company Number: 11235A

CAB Identifier: DE0018

## 2 EUT Classification

### 2.1 Wireless technologies and frequencies supported by the EUT.

The named technologies are only those falling in the specification of the applied standard.

Technology	Frequency Range (TX)	TX Function	Supported by the EUT	Evaluated in this report
BLE	2400 – 2483.5 MHz	SISO	<input type="checkbox"/>	<input type="checkbox"/>
802.11b	2400 – 2483.5 MHz	SISO	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
802.11g	2400 – 2483.5 MHz	SISO	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
802.11n (20MHz)	2400 – 2483.5 MHz	SISO	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
802.11n (40MHz)	2400 – 2483.5 MHz	SISO	<input type="checkbox"/>	<input type="checkbox"/>
802.11a/g/n (20MHz)	5150 – 5850 MHz	SISO	<input checked="" type="checkbox"/>	<input type="checkbox"/>
802.11n (40MHz)	5150 – 5850 MHz	SISO	<input checked="" type="checkbox"/>	<input type="checkbox"/>

SISO: Single Input Single Output

### 2.2 Report References

Protocol	Product Test Report Reference
WLAN 2.4GHz – This Report	DE24GVPK 001
WLAN 5GHz	DE246UXJ 001
EUT External Photos	DE24CSAG 001
EUT Internal Photos	DE24QI6V 001
EUT test setup Photos	DE24ZCGB 001

### 2.3 Standard specific classification of the EUT

#### 2.3.1 Applied standards.

FCC CFR 47 Part 15 Subpart C - §15.247

ISED RSS-247 Issue 3 2023

#### 2.3.2 Test Methods and Guidance Documents

ANSI C63.10:2013

KDB 558074 D01 DTS Measurement Guidance v05

KDB 662911 D01 Multiple Transmitter Output v02r01

KDB 996369 D04 Module Integration Guide v01

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## 2.4 System Type

DTS (Digital Transmission System)

### 2.4.1 Type of equipment

Handheld Equipment

## 3 Test conditions and configurations

### 3.1 Normal environmental test conditions

Environmental condition	Parameter	Range during test
Temperature	°C	21-24
Relative humidity	%	20-60

### 3.2 Equipment modifications

No modifications were found to be necessary to perform the tests or to achieve compliance.

### 3.3 Antenna assemblies

No antenna connector is prepared so tests were done in radiated mode.

### 3.4 Worst case Test Modes

The EUT was tested in its worst-case configuration as stated in the test report of the radio module xPico 200 Series Wi-Fi IOT Gateway.

Following configurations were used for the test cases:

Test case	Worst case Configuration
Maximum Output Power	N/T
Radiated Spurious Emissions < 30 MHz	Mode 1
Radiated Spurious Emissions 30 MHz – 1 GHz	Mode 1
Radiated Spurious Emissions > 1 GHz	Mode 1

### 3.5 Test modes

Mode description	Mode configuration																										
All Modes	The auxiliary equipment was connected to the EUT during the tests to keep the configured settings active. The USB Cable was grounded and filtered at the point of feed-trough.																										
Mode 1: TX-Mode	The continuous transmission was enabled on different channels, as specified in the table below. The appropriate commands provided by the customer were used to configure the radio and used "OP_xp200-cmd_teraterm - Wi-Fi - opsinged.bat" software/tool for the configuration.																										
	<table border="1"> <thead> <tr> <th rowspan="2">Channel</th> <th rowspan="2">Frequency</th> <th rowspan="2">Bandwidth</th> <th rowspan="2">Data rate/Mode</th> <th colspan="2">Power level Settings</th> </tr> <tr> <th>FCC</th> <th>ISED</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2412MHz</td> <td>20MHz</td> <td>b</td> <td colspan="2">Default</td> </tr> <tr> <td>1</td> <td>2412MHz</td> <td>20MHz</td> <td>g</td> <td colspan="2">Default</td> </tr> <tr> <td>11</td> <td>2462MHz</td> <td>20MHz</td> <td>n</td> <td colspan="2">Default</td> </tr> </tbody> </table>	Channel	Frequency	Bandwidth	Data rate/Mode	Power level Settings		FCC	ISED	1	2412MHz	20MHz	b	Default		1	2412MHz	20MHz	g	Default		11	2462MHz	20MHz	n	Default	
	Channel					Frequency	Bandwidth	Data rate/Mode	Power level Settings																		
		FCC	ISED																								
1	2412MHz	20MHz	b	Default																							
1	2412MHz	20MHz	g	Default																							
11	2462MHz	20MHz	n	Default																							
Mode 2: RX-Mode	Not Applicable																										



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### 3.6 Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to ETSI TR 100 028-1/-2 and ETSI TS 103 051 (radiated measurements) and is documented in the quality system acc. to ISO/IEC 17025:2017.

Furthermore, component and process variability of devices similar to that tested may result in additional deviation.

The stated values are the expanded uncertainty values, the measured value lies within the assigned range of values with a probability of 95% (k = 1.96).

The manufacturer has the sole responsibility of continued compliance of the device.

Test	Value	Unit	Range
Frequency Error	2.7 *10 <sup>-8</sup>	Hz	-
Frequency Stability under low voltage conditions			
Time	1.1*10 <sup>-9</sup>	s	-
Conducted Carrier Power	1.0	dB	9k-1GHz
Conducted Spurious Emissions (RX/TX)	1.7	dB	1GHz-6GHz
	2.8	dB	6GHz-40GHz
Occupied Bandwidth (OBW)	0.1	%	-
TX Power Spectral Density	4.2	mW	9kHz - 6GHz
	1.6	dB	9kHz - 6GHz
Dwell Time	4.6 *10 <sup>-7</sup>	Hz	-
Frequency Separation			-
Measurement of conducted emissions at the power supply connection to LISN	2.3	dB	9kHz – 150kHz
	2.2	dB	150kHz – 30MHz
Measurement of the field strength at distance 3m	1.6	dB	9k-150kHz
	4.5	dB	30-1000MHz
	5	dB	1-6GHz
	5.3	dB	6-40GHz
Temperature	0.8	K	-
Humidity	4	%	-
Voltage (AC/DC)	1.0	%	-

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## 4 Test results in detail

### 4.1 Unwanted emissions

#### 4.1.1 Requirements / Limits

<input checked="" type="checkbox"/>	<p>FCC Part 15, Subpart C, §15.247 (d); [RSS-247 sec. 5.5]: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) [RSS-Gen sec. 8.9] is not required. Radiated emissions which fall in the restricted bands, as defined in § 15.205(a) [RSS-Gen sec.8.10], must comply with the radiated emission limits specified in § 15.209(a) [RSS-Gen sec. 8.9].</p>
<input type="checkbox"/>	<p>FCC Part 15, Subpart C, §15.247 (d); [RSS-247 sec. 5.5]: If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this test shall be 30 dB instead of 20 dB.</p>

FCC Part 15, Subpart C, §15.209; [RSS-Gen sec. 8.9]; Radiated Emission Limits

Frequency [MHz]	Measurement distance [m]	Limit [ $\mu\text{V}/\text{m}$ ]	Limits [ $\text{dB}\mu\text{V}/\text{m}$ ]	Limits @3m [ $\text{dB}\mu\text{V}/\text{m}$ ]
0.009 – 0.49	300	2400/F(kHz)	48.5 ... 13.8	128.5 ... 93.8
0.49 – 1.705	30	24000/F(kHz)	33.8 ... 23.0	73.8 ... 63.0
1.705 – 30	30	30	29.5	69.5
30 – 88	3	100	40.0	40.0
88 – 216	3	150	43.5	43.5
216 – 960	3	200	46.0	46.0
960 - 40000	3	500	54.0	54.0

Used conversion factor  $\mu\text{V}/\text{m} \rightarrow \text{dB}\mu\text{V}/\text{m}$ :  $\text{Limit} [\text{dB}\mu\text{V}/\text{m}] = 20 \log (\text{Limit} [\mu\text{V}/\text{m}] / 1\mu\text{V}/\text{m})$

At frequencies below 30MHz, the measured values are corrected with an inverse linear distance extrapolation factor (40dB/decade) according to FCC 15.31 (f)(2).

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90kHz, 110–490kHz and above 1000MHz. Radiated emission limits in these three bands are based on measurements employing a linear average detector.

FCC Part 15, Subpart C, §15.35(b) [RSS-Gen sec. 8.1]:

..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

ANSI C63.10:2013 clause 5.5:

The spectrum shall be investigated from the lowest radio frequency signal generated in the device and up to at least the frequency shown in Table 2. However, frequencies below 9 kHz do not need to be investigated.

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**Table 2—Frequency range of measurements for unlicensed wireless device**

<b>Lowest frequency generated in the device</b>	<b>Upper frequency range of measurement</b>
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

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## 4.1.2 Radiated spurious emission measurements with general limit

### 4.1.2.1 Test Method

Radiated unwanted Emissions were tested against the general limits specified in § 15.209(a) [RSS-Gen sec. 8.9]. Emissions that fall inside the frequency band in which the intentional radiator is operating were excluded.

Emissions that exceed the general limits were additionally tested for the further requirements of §15.247 (d); [RSS-247 sec. 5.5]

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT. The different measurement setups for each frequency range are shown below.

For the final testing, the placement of EUT and cables were the same as for preliminary testing. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked. For the measurements in the frequency range 30 MHz to 1 GHz for each measured frequency the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation.

For measurement above 1 GHz the turntable and positioner step sizes were set to continuous rotation and the antenna height is fixed.

For the measurements in the frequency ranges (90-110kHz, 490 kHz-1 GHz) quasi-peak detector is used, while average and peak detectors are used in other ranges.

Final testing was performed on an SVSWR compliant test site.

The final average electric field value ( $E_{final}$ ) is calculated in the final measurement table using the following equation:

$$E_{final} = RawRec + Corr.$$

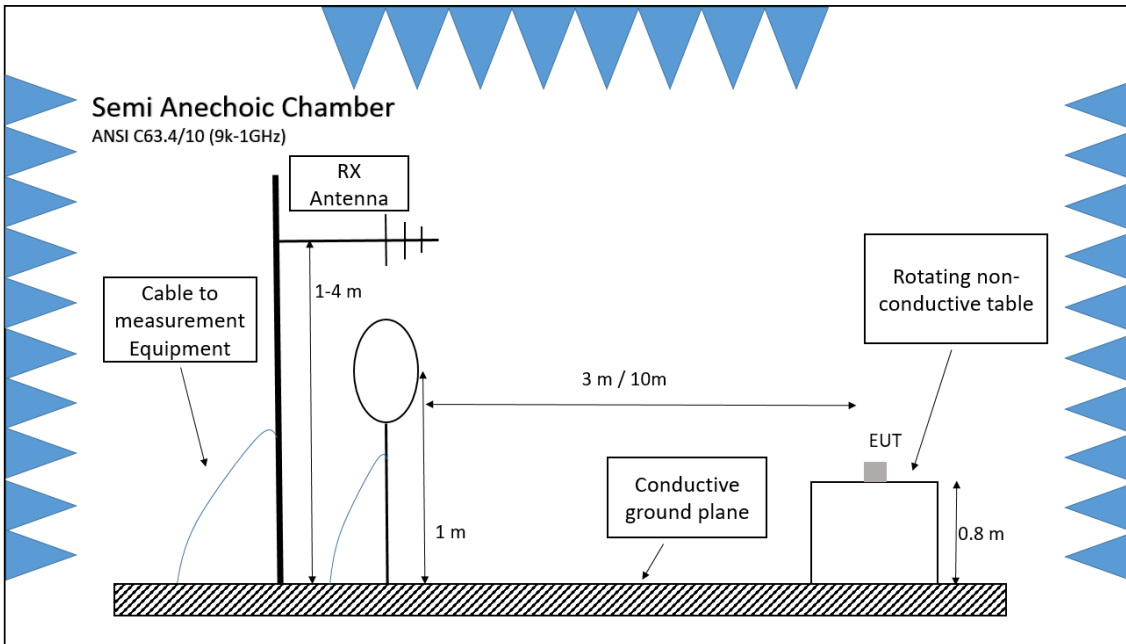
While

$$Corr. = Trd. Corr. + Sig Path + Preamp$$

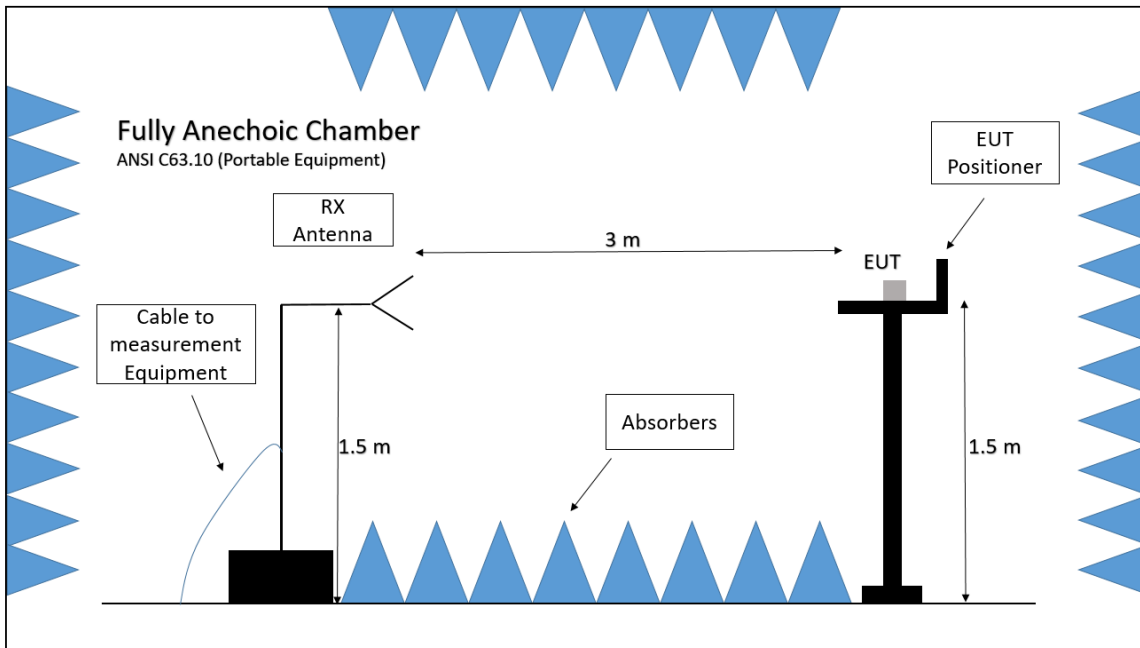
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**4.1.2.2 EUT positioning (Radiated measurements with general limit; Unwanted emissions)**

4.1.2.2.1 EUT positioning below 1GHz.



4.1.2.2.2 EUT positioning above 1GHz.



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**4.1.2.3 Measurement Setup** (Radiated measurements with general limit; Unwanted emissions)

4.1.2.3.1 Measurement Setup 9kHz - 30MHz

<b>Test Site</b>	SAC (Semi Anechoic Chamber)
<b>Receiving Antenna</b>	Loop antenna (HFH 2)
<b>Receiving Antenna Height</b>	1m (center of Loop antenna)
<b>Receiving Antenna Polarization</b>	Parallel and perpendicular (EUT with Loop antenna only in vertical position) According to ANSI C63.10:2013 clause 6.4.6
<b>EUT Table</b>	1.0m x 1.5m non-conductive table 80cm above the floor
<b>EUT Turn Table Step Size</b>	22.5° during exploratory tests Linear during maximizations for final measurements
<b>Receiver Configurations</b>	Average and peak detectors (9-90kHz and 110-490kHz) Quasi Peak detector (90-110kHz and 490kHz-30MHz)
	RBW: 200Hz (9 - 150kHz) and 9 kHz (150kHz – 30MHz)
	Step Size: 50Hz (9-150kHz) and 2.25kHz (150k-30MHz)
	Sweep Time: 100ms (FFT) during exploratory tests Sweep Time: 1s for final measurements

4.1.2.3.2 Measurement Setup 30MHz - 1GHz

<b>Test Site</b>	Semi-anechoic chamber
<b>Receiving Antenna</b>	Hybrid Antenna VULB 9168
<b>Receiving Antenna height</b>	Varied (1m to 4m, step size 1m) during exploratory tests Linear during maximizations for final measurements
<b>Receiving Antenna Polarization</b>	Horizontal and Vertical
<b>EUT Table</b>	1.0m x 1.5m non-conductive table 80cm above the floor
<b>EUT Turn Table Step Size</b>	45° during exploratory tests Linear during maximizations for final measurements
<b>Receiver Configurations</b>	Average and peak detector
	RBW :120 kHz
	Step Size: 30kHz (30-1000MHz)
	Sweep Time: 100ms (FFT) during exploratory tests Sweep Time: 1s for final measurements

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4.1.2.3 Measurement Setup above 1GHz; portable Device

<b>Test Site</b>	Fully anechoic chamber
<b>Receiving Antenna</b>	Horn Antenna HF907 (1-18GHz), 3116C-PA (18-40GHz)
<b>Receiving Antenna Height</b>	1.5m
<b>Receiving Antenna Polarization</b>	Horizontal – Vertical
<b>EUT Positioner</b>	40cm x 60cm non-conductive positioner 1.5m above the floor Step size elevation angle 45°
<b>EUT Turn Table Step Size</b>	45°
<b>Spectrum Analyzer</b>	Average and peak detectors
	RBW: 1 MHz
	Sweep Time: 60s during exploratory tests. Sweep Time: 10s for final measurements

4.1.2.4 **Test Setup** (Radiated measurements with general limit; Unwanted emissions)

<b>EUT</b>	A003734791-001	
<b>Companion device</b>	EUT in Test Mode. Therefore, no Companion Device was used.	
<b>Operation mode</b>	<input checked="" type="checkbox"/> 1: TX-Mode	<input type="checkbox"/> 2: RX-Mode
<b>Further parameters</b>	<input type="checkbox"/> 3: N/A	<input type="checkbox"/> 4: N/A
<b>Test engineer</b>	-	
<b>Test engineer</b>	Shrinivas Naikar	

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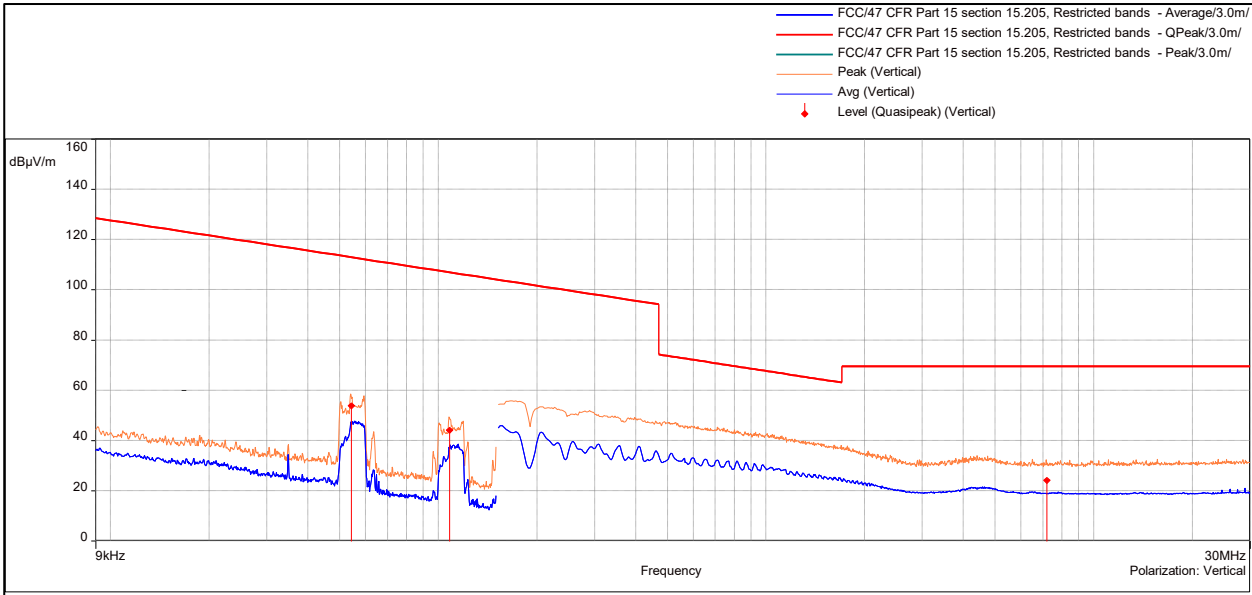
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**4.1.2.5 Worst case test results for radiated spurious emission and restricted bands of operation.**

4.1.2.5.1 9 kHz to 30 MHz,

4.1.2.5.2 Perpendicular Polarization



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height	Azimuth	Correction (dB)
0.0541429	53.83	112.94	-59.11	1.50	176.90	20.07
0.1079653	44.26	106.96	-62.70	1.50	184.50	20.02
7.1788813	24.28	69.50	-45.22	1.50	322.80	20.29

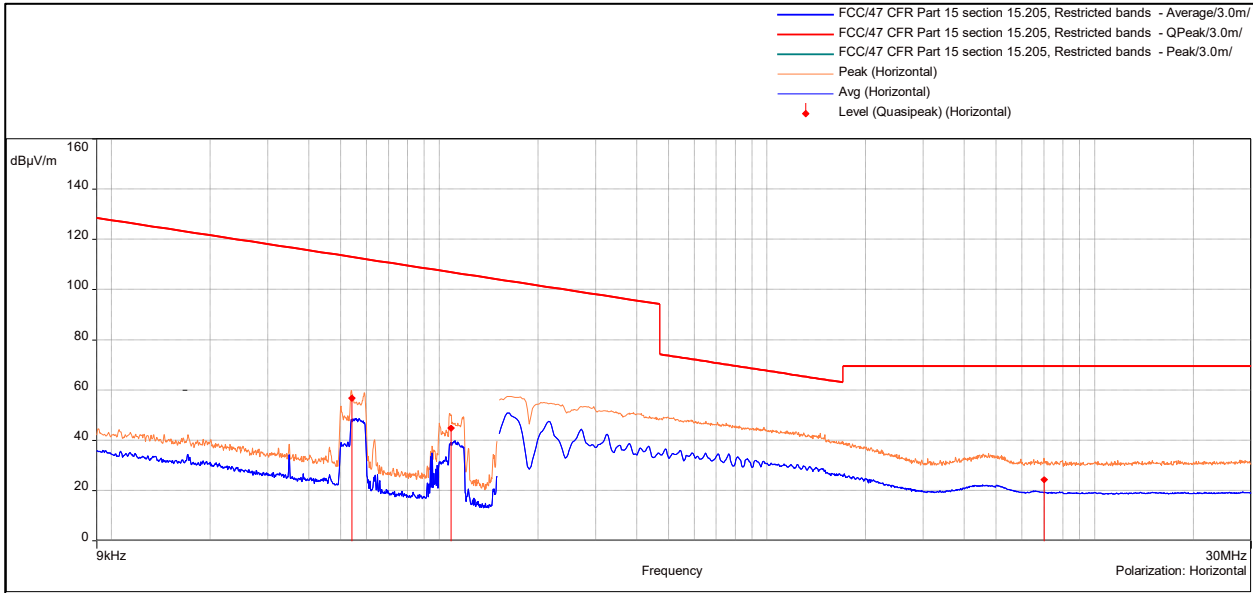


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4.1.2.5.3 Parallel Polarization



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height	Azimuth	Measuring time	Correction (dB)
0.053983	56.85	112.96	-56.11	1.50	212.30	1.00	20.07
0.108383	44.96	106.92	-61.96	1.50	209.20	1.00	20.02
6.99607	24.46	69.50	-45.04	1.50	223.70	1.00	20.29

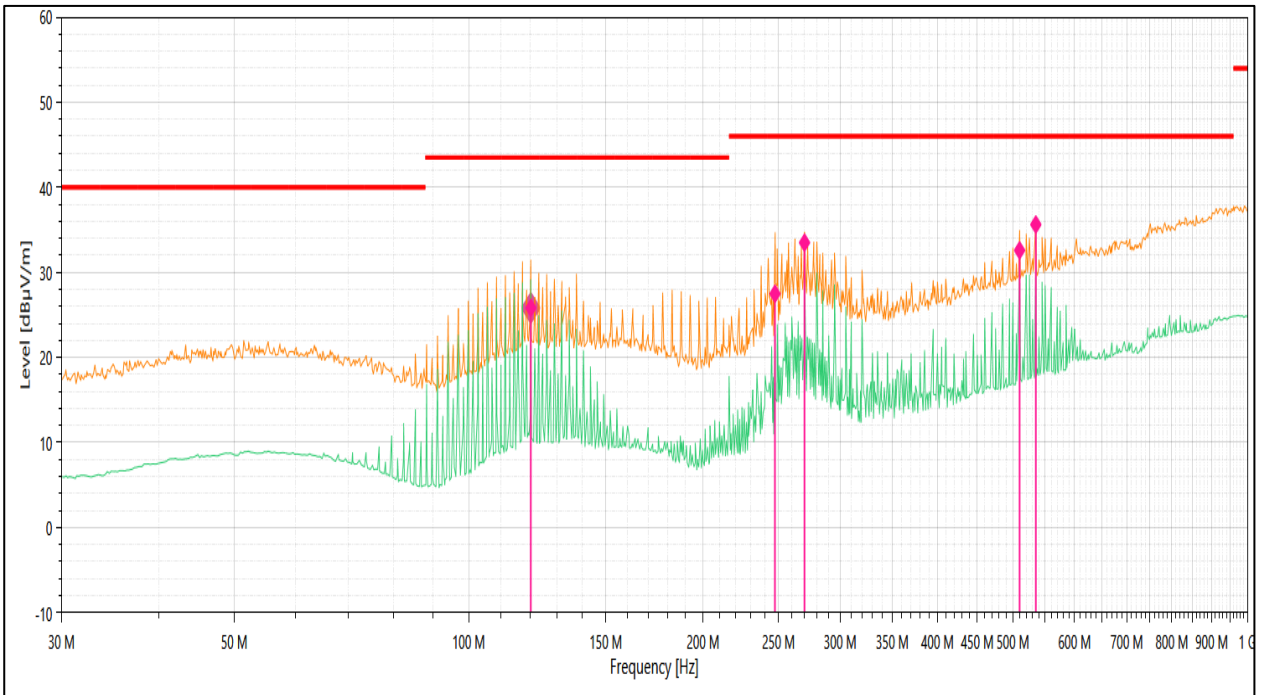
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**4.1.2.6 30 MHz to 1 GHz,**

**4.1.2.6.1 Horizontal Polarization**



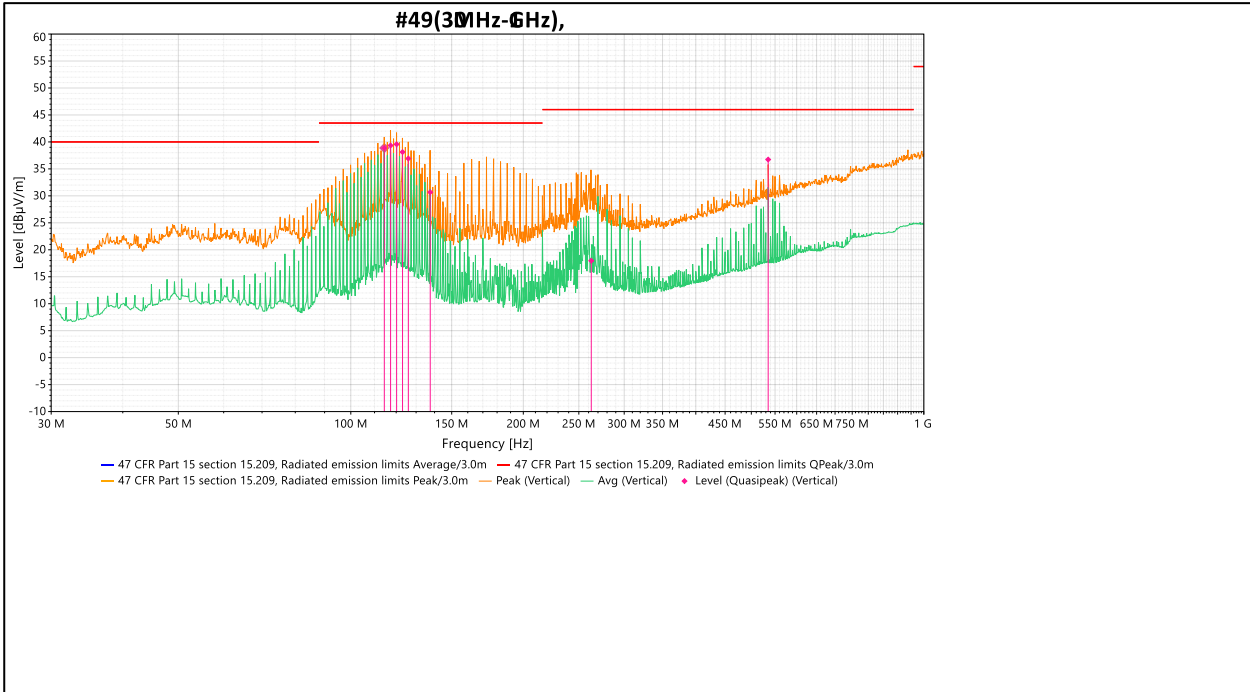
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Height (m)	Azimuth (deg)	Corr. (dB)
120.1912	25.81	43.50	-17.69	Horizontal	4.00	323.70	19.06
247.4102	27.49	46.00	-18.51	Horizontal	1.80	71.60	19.77
270.0112	33.49	46.00	-12.51	Horizontal	1.17	294.60	20.89
510.0219	32.59	46.00	-13.41	Horizontal	1.00	87.00	27.59
535.0216	35.62	46.00	-10.38	Horizontal	1.75	67.20	28.04

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4.1.2.6.2 Vertical Polarization



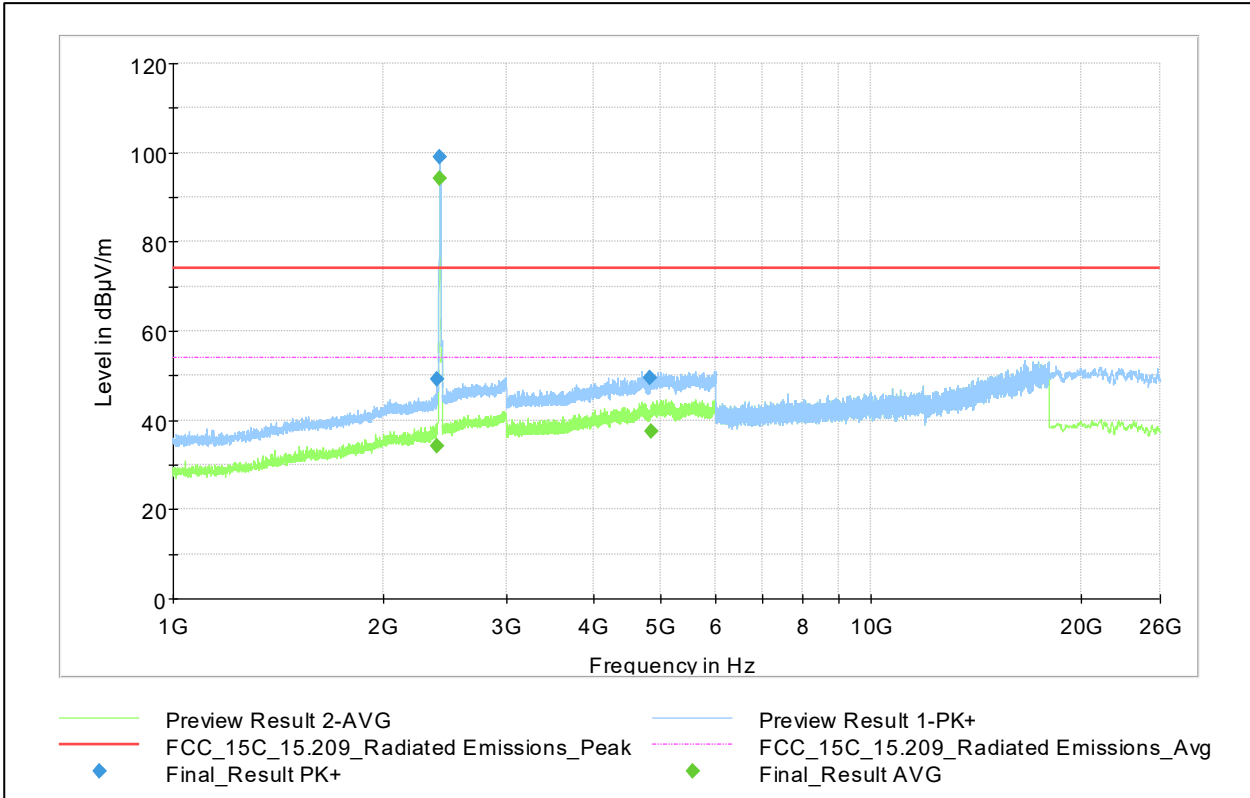
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Height (m)	Azimuth (deg)	Corr. (dB)
114.4140	38.87	43.50	-4.63	Vertical	1.02	29.50	18.42
117.3336	39.34	43.50	-4.16	Vertical	1.00	74.10	18.74
120.2104	39.56	43.50	-3.94	Vertical	1.02	20.90	19.06
123.1064	38.12	43.50	-5.38	Vertical	1.02	72.30	19.21
126.0116	36.92	43.50	-6.58	Vertical	1.03	126.10	19.45
137.6017	30.67	43.50	-12.83	Vertical	1.17	195.50	20.12
262.8157	17.96	46.00	-28.04	Vertical	1.15	246.50	20.48
535.0200	36.73	46.00	-9.27	Vertical	1.00	326.60	28.04

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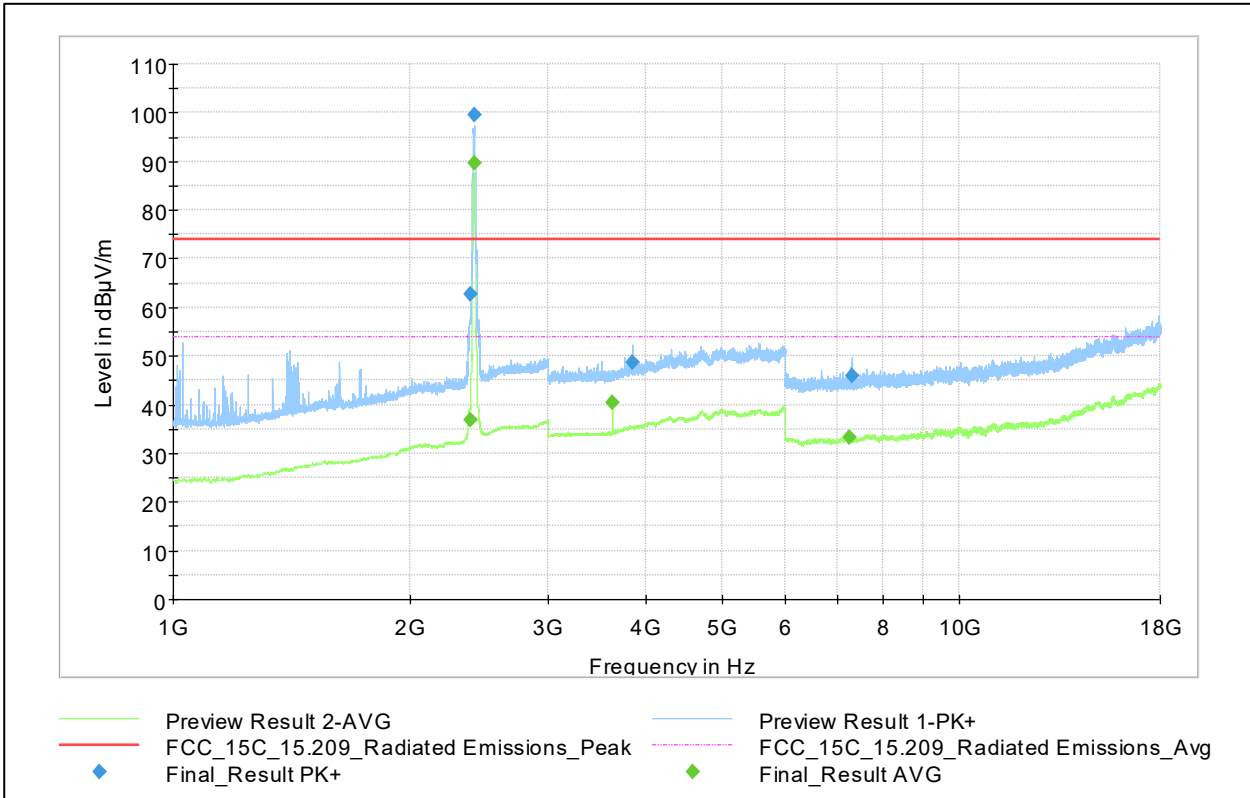
4.1.2.7 1 to 26GHz, Frequency: 2412MHz, b-mode



Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band width (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2390.000	---	34.30	54.00	19.70	100.0	1000	150.0	H	0.0	45.0	12.6
2390.000	49.20		74.00	24.80	100.0	1000	150.0	H	0.0	93.0	12.6
2412.546	---	94.24	Fundamental Frequency			1000	150.0	H	43.0	93.0	12.8
2413.409	98.99		Fundamental Frequency			1000	150.0	H	41.0	92.0	12.8
4828.632	49.51		74.00	24.49	100.0	1000	150.0	V	76.0	107.0	9.1
4849.422	---	37.57	54.00	16.43	100.0	1000	150.0	V	210.0	-15.0	9.4

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Test documentation

**4.1.2.8 1 to 26GHz, Frequency:2412MHz, g-Mode**

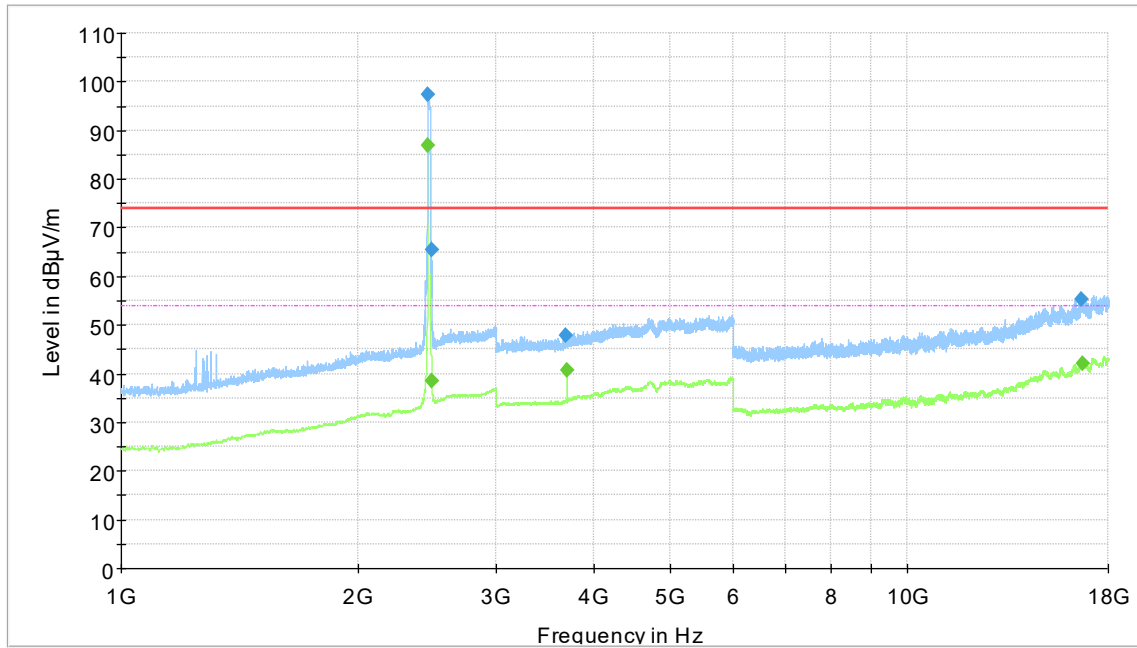


Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band width (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2390.000	---	36.73	54.00	17.27	10000	1000	150.0	V	96.0	120.0	12.6
2390.000	62.70	---	74.00	11.30	10000	1000	150.0	V	0.0	0.0	12.6
2414.246	---	89.60	Fundamental Frequency			1000	150.0	H	44.0	94.0	12.7
2416.805	99.44	---	Fundamental Frequency			1000	150.0	H	43.0	94.0	12.8
3617.987	---	40.56	54.00	13.44	10000	1000	150.0	H	80.0	77.0	4.2
3842.311	48.64	---	74.00	25.36	10000	1000	150.0	H	123.0	83.0	5.5
7233.896	---	33.35	54.00	20.65	10000	1000	150.0	H	68.0	107.0	-2.9
7296.448	46.04	---	74.00	27.96	10000	1000	150.0	V	96.0	120.0	-3.1

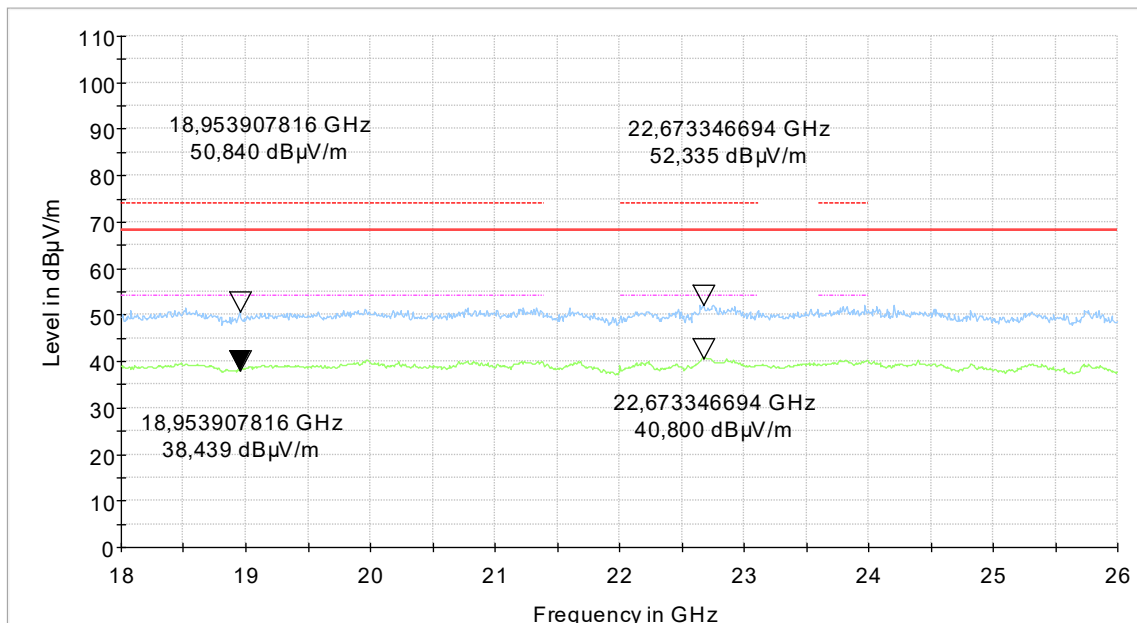
Note: No harmonics found above 18GHz

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**4.1.2.9 1 to 26GHz, Frequency:2462MHz, n-Mode**



— Preview Result 2-AVG  
— FCC\_15C\_15.209\_Radiated Emissions\_Peak  
◆ Final\_Result PK+  
— Preview Result 1-PK+  
— FCC\_15C\_15.209\_Radiated Emissions\_Avg  
◆ Final\_Result AVG



— Preview Result 2-AVG  
— FCC\_15E\_15.407\_Radiated Emissions\_Peak  
◆ Final\_Result AVG  
— Preview Result 1-PK+  
— FCC\_15C\_15.205\_Radiated\_Emissions\_Avg  
◆ Final\_Result PK+

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Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Band width (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2458.396	97.37	---	Fundamental Frequency		1000	150.0	H	51.0	96.0	13.4	
2459.396	---	86.87	Fundamental Frequency		1000	150.0	H	48.0	86.0	13.4	
2483.500	65.46	---	74.00	8.54	10000	1000	H	32.0	90.0	13.5	
2483.500	---	38.49	54.00	15.51	10000	1000	H	32.0	90.0	13.5	
3678.532	47.72	---	74.00	26.28	10000	1000	H	-21.0	103.0	4.6	
3693.038	---	40.74	54.00	13.26	10000	1000	H	81.0	80.0	4.7	
16667.454	55.31	---	74.00	18.69	10000	1000	V	337.0	30.0	9.9	
16728.909	---	42.12	54.00	11.88	10000	1000	H	53.0	-14.0	9.9	

<b>Final test result</b>	Pass
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## 4.2 AC Power Conducted Emission

Note: This test is covered under FCC Part B test report of this product. Please refer the report number DE24E7WJ 001 for detailed results.

Final test result

Pass



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**Zusatzdokumentation**  
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## 5 Application form

The following information was provided by the customer and form the basis for the execution of the tests and the assessment of conformity. The given information can affect the results of both.

No application form was provided.

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**Liste der verwendeten Prüfmittel**  
*List of used test equipment*

## 6 Equipment List

### 6.1 Hardware

Prüfmittel Test equipment		Prüfmittel-Nr. / ID-Nr. Equipment No. / ID- No.	Nächste Kalibrierung Next calibration
<b>Fully Anechoic Room</b>	Albatross Projects GmbH	2959749	08.10.2024
<b>Spectrum Analyzer FSU 26</b>	Rohde & Schwarz	2844118	04.08.2025
<b>EMI test receiver ESI 40</b>	Rohde & Schwarz	2728600	14.10.2024
<b>RSE-Filtersystem</b>	Rohde & Schwarz	9002802	-
<b>Antenna HF907 1-18GHz</b>	Rohde & Schwarz	2856263	01.09.2024
<b>Horn Antenna 3116C-PA 18-40GHz</b>	ETS LINDGREN	2900393	19.12.2025
<b>Semi-Anechoic Chamber 30-1000 MHz</b>	Siemens	2729645	15.06.2025
<b>Receiver ESU 8</b>	Rohde & Schwarz	2728844	23.02.2025
<b>Antenna HFH 2 (Loop) 9kHz-30MHz</b>	Rohde & Schwarz	2728893	09.07.2024
<b>Antenna VULB 9168 30MHz – 1GHz</b>	Schwarzbeck	2728136	05.10.2026

\*Equipment only Verified and not calibrated

### 6.2 Software

Test Software	Developer	Version
EMC32	Rohde & Schwarz	10.60.20
BAT-EMC	NEXIO	2022.0.8.0

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**Änderungsverzeichnis**  
*Change history*

## 7 Change history

Revision Number	List of revisions	Date of issue
001	Initial Release	2024-06-11

Note: Latest revision report will replace all previous reports.

**Ende des Prüfberichts**  
*End of Test Report*