

Prüfbericht-Nr.: <i>Test report no.:</i>	DE22HD9A 001	Auftrags-Nr.: <i>Order no.:</i>	1126676 40	Seite 1 von 43 Page 1 of 43
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	NA	Auftragsdatum: <i>Order date:</i>	2022-11-01	
Auftraggeber: <i>Client:</i>	Robert Bosch GmbH, Markwiesenstrasse 58, 72770 Reutlingen, Germany			
Prüfgegenstand: <i>Test item:</i>	Mini Remote			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	BRC3300			
Auftrags-Inhalt: <i>Order content:</i>	Prüfung der Funkparameter nach FCC & ISED <i>Test of radio parameters acc. to FCC & ISED</i>			
Prüfgrundlage: <i>Test specification:</i>	Teilprüfung / Partial test FCC CFR 47 Part 15 Subpart C- §15.247 ISED RSS-247:2017			
Wareneingangsdatum: <i>Date of sample receipt:</i>	18.10.2022	<div style="border: 1px solid black; background-color: black; color: white; padding: 5px; display: inline-block; margin-bottom: 10px;">1126676 40</div> <p>Photos were removed for confidentiality as demanded by the customer.</p>		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003355895-002 A003372714-001			
Prüfzeitraum: <i>Testing period:</i>	10.11.2022- 25.11.22			
Ort der Prüfung: <i>Place of testing:</i>	Nürnberg Nuremberg			
Prüflaboratorium: <i>Testing laboratory:</i>	Wireless Labor Wireless Test Lab			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>	<u>X </u>			
Datum: <i>Date:</i> 2022-12-07	Signiert von: Primoz Erzen	Ausstellungsdatum: <i>Issue date:</i> 2022-12-07	Signiert von: Matthias Kraeutlein	
Stellung / Position:	Sachverständige(r)/Expert	Stellung / Position:	Sachverständige(r)/Expert	
Sonstiges / <i>Other:</i>				
Zustand des Prüfgegenstandes bei Anlieferung: <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				
<p>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.</p> <p><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></p>				

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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.
Detaillierte Informationen bezüglich Prüfbedingungen, 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. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i></p> |
| 2 | <p>Wie vertraglich vereinbart, wurde dieses Dokument nur digital unterzeichnet. Der TÜV Rheinland hat nicht überprüft, welche rechtlichen oder sonstigen diesbezüglichen Anforderungen für dieses Dokument gelten. Diese Überprüfung liegt in der Verantwortung des Benutzers dieses Dokuments. Auf Verlangen des Kunden kann der TÜV Rheinland die Gültigkeit der digitalen Signatur durch ein gesondertes Dokument bestätigen. Diese Anfrage ist an unseren Vertrieb zu richten. Eine Umweltgebühr für einen solchen zusätzlichen Service wird erhoben.</p> <p><i>As contractually agreed, this document has been signed digitally only. TUV Rheinland has not verified and unable to verify which legal or other pertaining requirements are applicable for this document. Such verification is within the responsibility of the user of this document. Upon request by its client, TUV Rheinland can confirm the validity of the digital signature by a separate document. Such request shall be addressed to our Sales department. An environmental fee for such additional service will be charged.</i></p> |
| 3 | <p>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben.
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.
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 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.</p> <p><i>The decision rule for statements of conformity 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.</i></p> |

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Produktbeschreibung
Product description

1	Test item	Mini Remote
2	Typ-No.	BRC3300
3	Test sample obtaining	<input checked="" type="checkbox"/> Sending by customer <input type="checkbox"/> Sampling by TÜV Rheinland Group <input type="checkbox"/> others:
4	Serial-No.	-
5	FCC-ID (Radio module)	2AWRC-BRC3300
6	IC (Radio module)	26294-BRC3300
7	Description of EUT	Sets up a BLE connection to transmit button press information to eBike.
8	Supported radio technologies	BLE 5.0
9	Max RF output power (measured)	-0.3dBm
10	Operating Frequency (declared)	2402 – 2480MHz
11	Channel Bandwidth (declared)	2MHz
12	Number of Channels	40
13	Modulation	GFSK
14	Rated Voltage / Frequency	3V DC (Coin Cell Powered)
15	Radio Module / Antenna Type	<input checked="" type="checkbox"/> Radio module with antenna on module PCB <input type="checkbox"/> Radio module with dedicated antenna <input type="checkbox"/> Radio module with user accessible antenna connector
16	Antenna Name	CERAMIC ANTENNA P/N: RFECA3216060A1T
17	Antenna amount of chains	1
18	Antenna Gain (declared)	2 dBi
19	Software	1.2.13
20	Hardware	1.2.2
21	Used Samples	A003355895-002 (radiated sample) A003372714-001 (conducted sample)

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Product description

22	Accessory Devices	PC (Tüv Rheinland) with USB-to Serial adapter(provided by customer)
23	Temperature Range	-20°C to +60°C
24	Environment	Indoor and Outdoor

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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	-	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input 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	Band Edge Measurement	-	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
FCC 15.247 (d) RSS-247 sec. 5.5	Conducted Spurious Emission	-	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>
FCC 15.205, 15.209 RSS-Gen sec. 8.9, 8.10	Radiated Spurious Emission	-	P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/>

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Absatz <i>Clause</i>	Anforderungen – Prüfungen / <i>Requirements - Tests</i>	Bemerkungen / <i>Remarks</i>	Ergebnis <i>Result</i>

FCC 15.207 RSS-Gen sec. 8.8	AC Power Conducted Emissions	Does not apply for equipment with DC supply voltage	P <input type="checkbox"/> F <input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/T <input type="checkbox"/>
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EUT Classification

1.1 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 5.0	2402 – 2480 MHz	SISO	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

1.2 Standard specific classification of the EUT

1.2.1 Applied standards

FCC CFR 47 Part 15 Subpart C - §15.247
ISED RSS-247:2017

1.2.2 Test Methods and Guidance Documents

ANSI C63.10:2013
KDB 558074 D01 DTS Measurement Guidance v05
KDB 996369 D04 Module Integration Guide v01

1.2.3 System Type

<input checked="" type="checkbox"/>	DTS (Digital Transmission System)
<input type="checkbox"/>	FHSS (Frequency Hopping Spread Spectrum)

1.2.4 Type of equipment

<input type="checkbox"/>	Tabletop Equipment
<input type="checkbox"/>	Floor-Standing Equipment
<input checked="" type="checkbox"/>	Equipment that can be used in multiple orientations
<input type="checkbox"/>	Hand held Equipment

2 General

2.1 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

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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

2.2 Equipment modifications

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

2.3 Test modes

Mode	Description	Mode configuration
All Modes		The equipment was connected to the auxiliary equipment (PC) via USB. The auxiliary equipment was connected to the EUT during the tests to keep the configured settings active. The Equipment was powered via the USB-Connection (no Battery inserted). The equipment was set up with the program NRF-Connect in direct Test Mode V2.0.3
1	Transmit	Transmit Power setting 0dBm, 1Mbps, 2Mbps GFSK Modulation (PRBS9) Low Channel 2402MHz, Mid Channel 2440MHz and High Channel 2480MHz

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3 Test conditions

3.1 General

The DUT was tested standalone on the transmit test mode in normal test conditions.

3.2 Normal test conditions

Environmental condition	Parameter	Range
Temperature	°C	20-24
Relative humidity	%	30-40
Supply voltage	Volts DC	3

3.3 Antenna assemblies

Antenna connector is prepared so tests were done in conducted and radiated mode

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3.4 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 CISPR 16-4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the quality system acc. to ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation.

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

Test	Value	Unit	Range
Frequency Error	2,7 *10 ⁻⁸	Hz	-
Frequency Stability under low voltage conditions			
Time	1,1*10 ⁻⁹	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 ⁻⁷	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 Maximum Output Power

4.1.1 Requirements / Limits

The maximum output power limit is expressed in terms of either maximum peak conducted output power or maximum conducted output power.

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the full signal bandwidth.

The maximum conducted output power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

	Condition	Limit
<input checked="" type="checkbox"/>	Systems using digital modulation techniques in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands	<i>FCC Part 15, Subpart C, §15.247 (b) (3)</i> 1 watt. Maximum conducted peak output power: 30 dBm (excluding antenna gain, if antennas with directional gains that do not exceed 6 dBi are used).
<input type="checkbox"/>	Frequency hopping systems operating 2400-2483.5 MHz band.	Employing less than 75 non-overlapping hopping channels <i>FCC Part 15, Subpart C, §15.247 (b) (1)</i> 0.125 watt
<input type="checkbox"/>		Employing at least 75 non-overlapping hopping channels <i>FCC Part 15, Subpart C, §15.247 (b) (1)</i> 1 watt
<input type="checkbox"/>	Frequency hopping systems operating 5725-5850 MHz band.	<i>FCC Part 15, Subpart C, §15.247 (b) (1)</i> 1 watt
<input type="checkbox"/>	Frequency hopping systems operating 902-928 MHz band.	Employing less than 50 but at least 25 hopping channels <i>FCC Part 15, Subpart C, §15.247 (b) (2)</i> 0.25 watt
<input type="checkbox"/>		Employing at least 50 hopping channels <i>FCC Part 15, Subpart C, §15.247 (b) (2)</i> 1 watt
<input type="checkbox"/>	Antenna gain greater than 6dBi	<i>FCC Part 15, Subpart C, §15.247 (b) (4)</i> The conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3), as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi

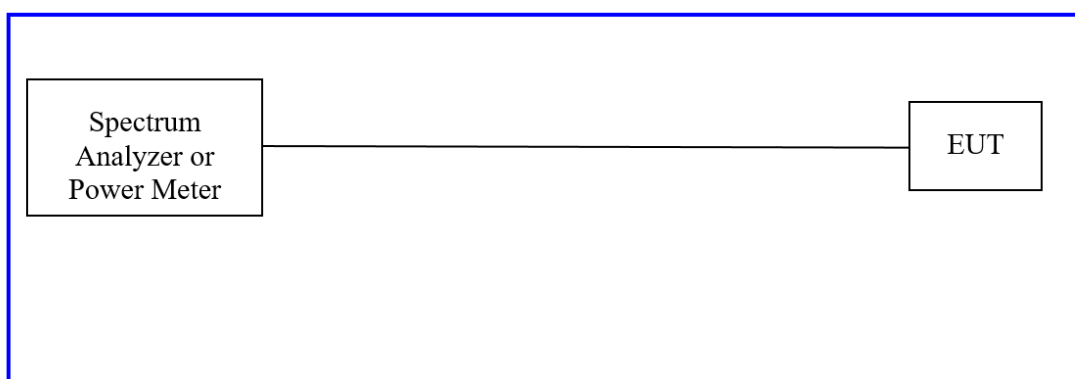
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4.1.2 Test Method

Conducted method was used to measure the maximum output power according to ANSI C63.10:2013 clause 11.9.1.1 peak power (RBW > DTS bandwidth). The EUT was connected to the spectrum analyzer via a coax cable with a known loss.



4.1.3 Test setup

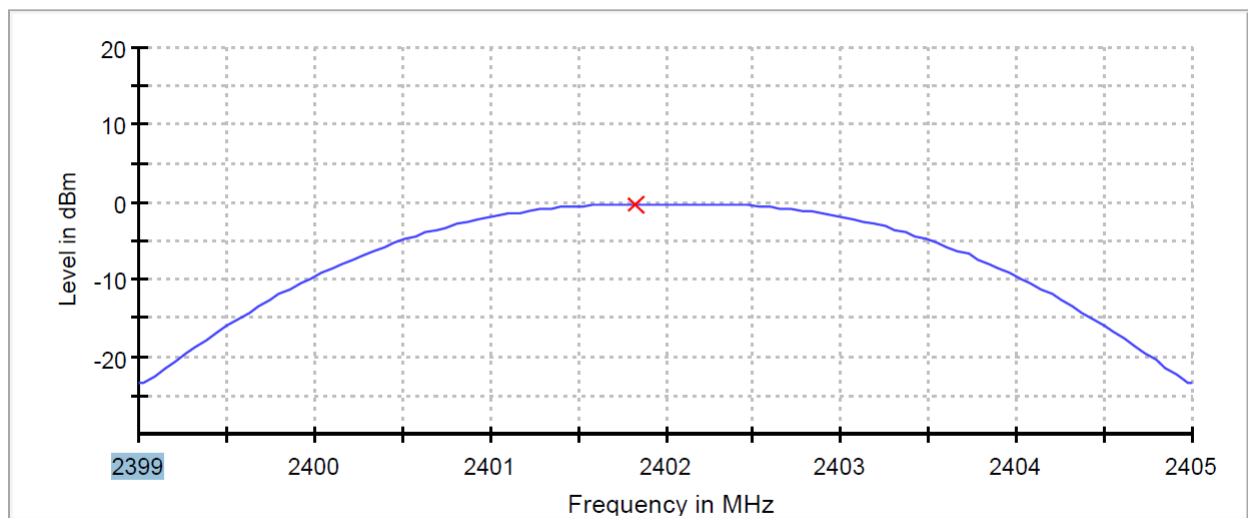
EUT		A003372714-001
Test Condition		Normal conditions
Chamber details		<input type="checkbox"/> 3m Fully Anechoic Chamber (FAC) <input type="checkbox"/> 10m Semi Anechoic Chamber (SAC) <input checked="" type="checkbox"/> Shielded room
Measurement positioning		Distance: EUT height: Antenna height: <input type="checkbox"/> 3m <input type="checkbox"/> 1.5m <input type="checkbox"/> 1.5m <input type="checkbox"/> 10m <input type="checkbox"/> 0.8m <input type="checkbox"/> 1m to 4m – height scan <input checked="" type="checkbox"/> N/A
Companion device		none
Operation mode		Mode 1: TX Modulated 1 Mbps with continuous transmission TX Modulated 2 Mbps with continuous transmission
Spectrum Analyzer	Frequency	2402 MHz, 2440 MHz, 2480 MHz
	Resolution Bandwidth	2.000 MHz (1Mbps); 3MHz (2Mbps)
	Video Bandwidth	10.000 MHz (1Mbps and 2Mbps)
	Measurement Time	953ns (1Mbps); 1,271µs (2Mbps)
Further parameters		-
Test engineer		Dipl. Ing. Primož Erzen

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4.1.4 Test results

- **Lowest Channel 1Mbps**

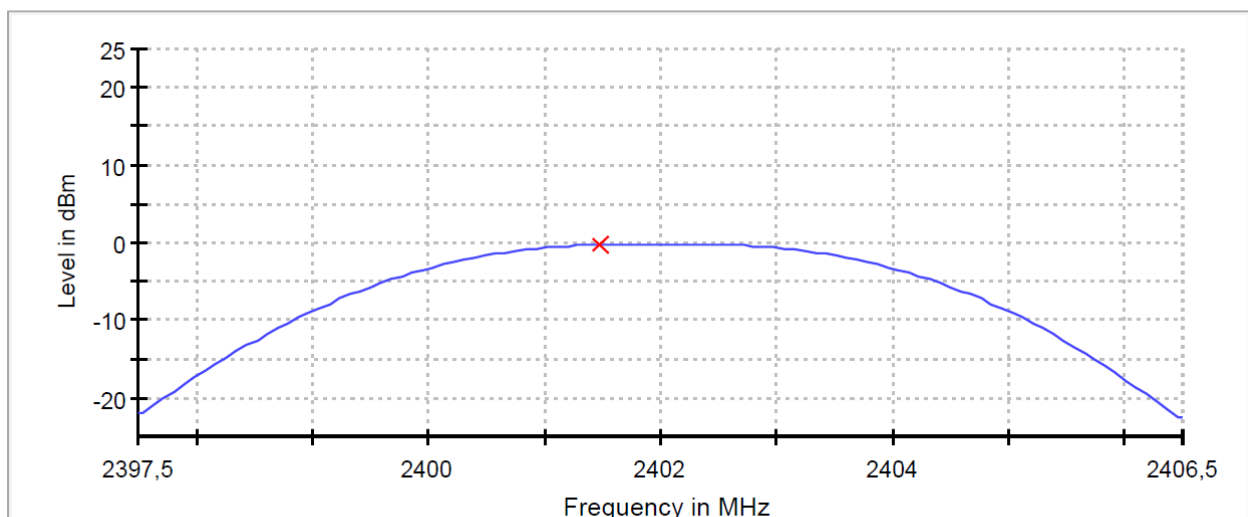
Peak Power



— Connector 1 × Peak Connector 1

- **Lowest Channel 2Mbps**

Peak Power

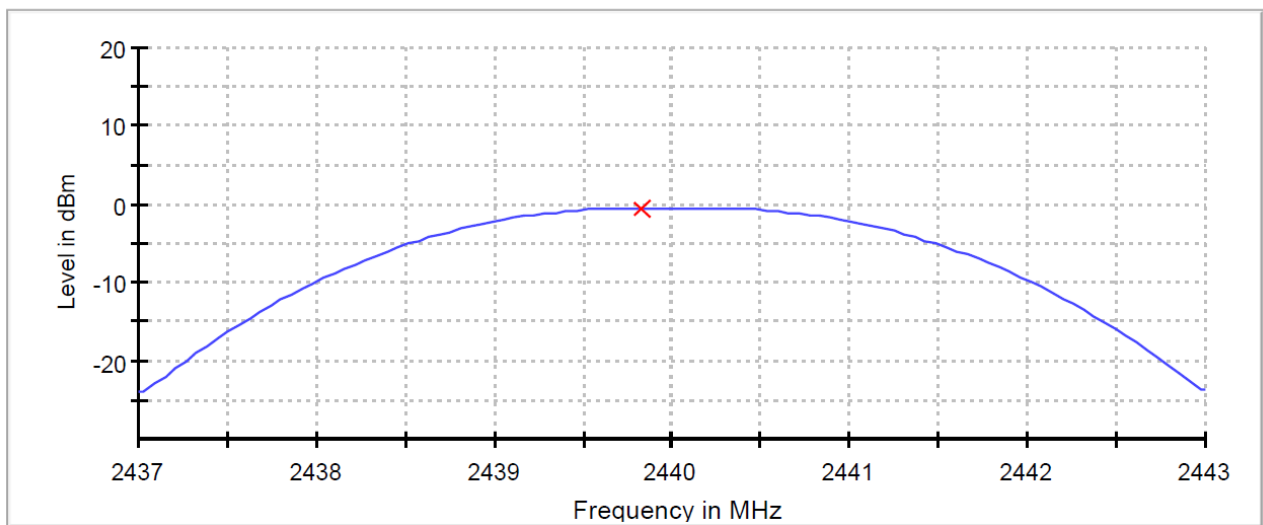


— Connector 1 × Peak Connector 1

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- **Middle Channel 1Mbps**

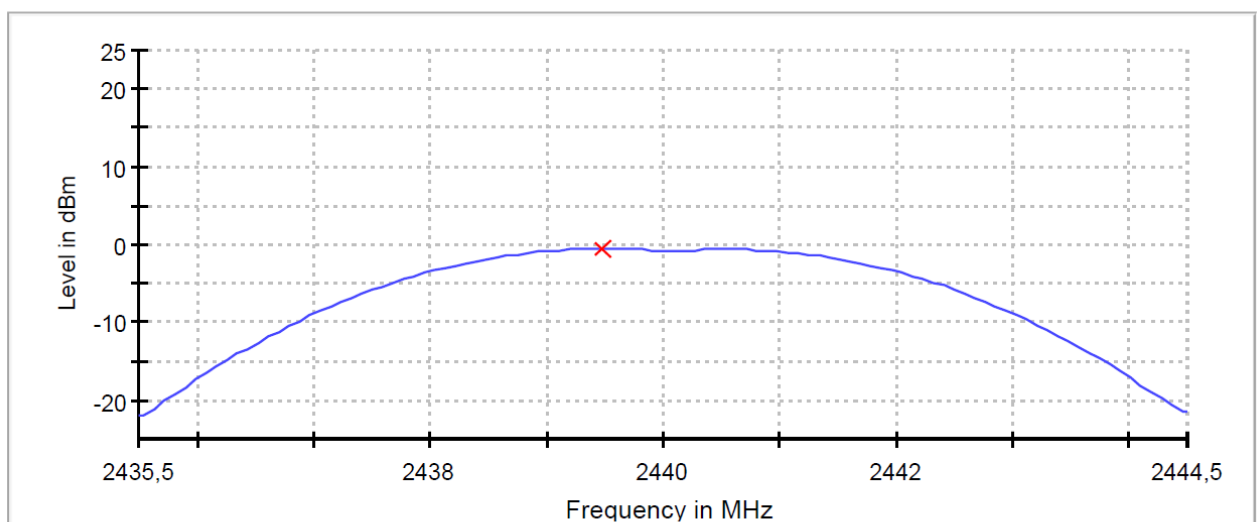
Peak Power



— Connector 1 × Peak Connector 1

- **Middle Channel 2Mbps**

Peak Power

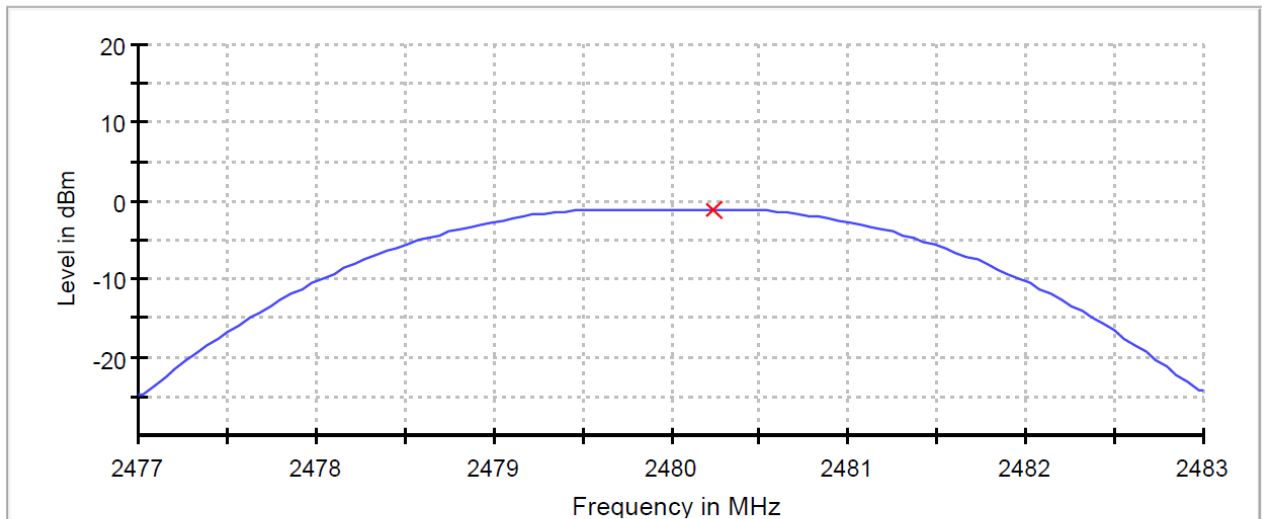


— Connector 1 × Peak Connector 1

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- **Highest Channel 1Mbps**

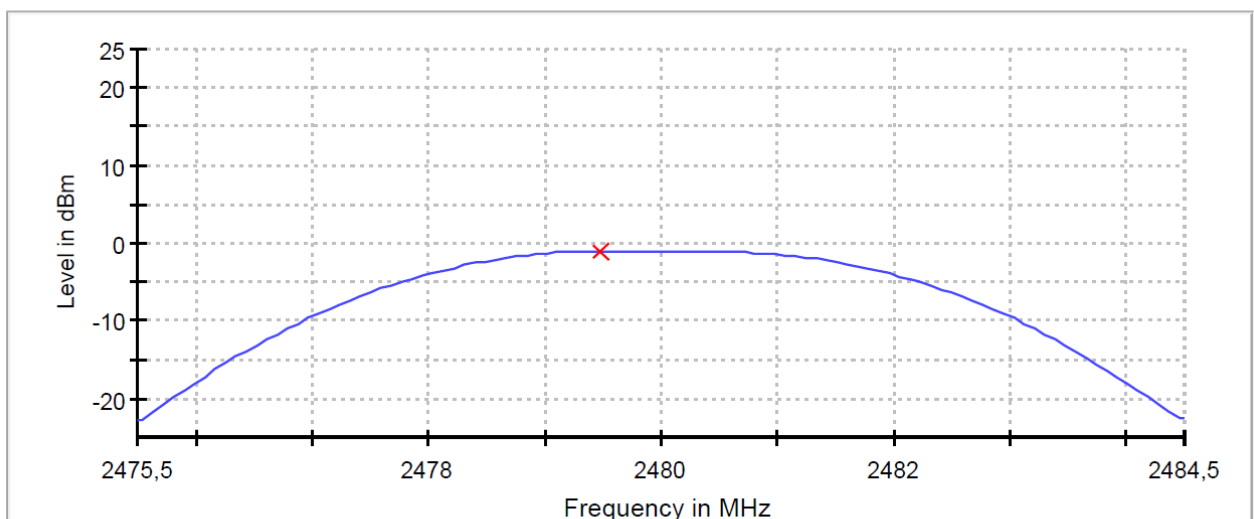
Peak Power



— Connector 1 × Peak Connector 1

- **Highest Channel 2Mbps**

Peak Power



— Connector 1 × Peak Connector 1

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Frequency	Peak conducted output power (dBm)	Limit (dBm)	Margin (dB)	Test Result
Lowest 1Mbps	-0.3	30	30.3	Pass
Middle 1Mbps	-0.6		30.6	Pass
Highest 1Mbps	-1.0		31.0	Pass
Lowest 2Mbps	-0.3		30.3	Pass
Middle 2Mbps	-0.5		30.5	Pass
Highest 2Mbps	-1.0		31.0	Pass

Final test result	Pass
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4.2 Conducted Spurious Emissions

4.2.1 Requirements / Limits

<input checked="" type="checkbox"/>	<p><i>FCC Part 15, Subpart C, §15.247 (d)</i> 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, provide the transmitter demonstrates compliance with the peak conducted power limits.</p>
<input type="checkbox"/>	<p><i>FCC Part 15, Subpart C, §15.247 (d)</i> 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>

4.2.2 Test Method

Conducted method was used to measure the conducted spurious emissions in frequency range (30 MHz to 26 GHz) according to ANSI C63.10:2013 11.11.3. The EUT was connected to the spectrum analyzer via a coax cable with a known loss.

4.2.3 Test Setup

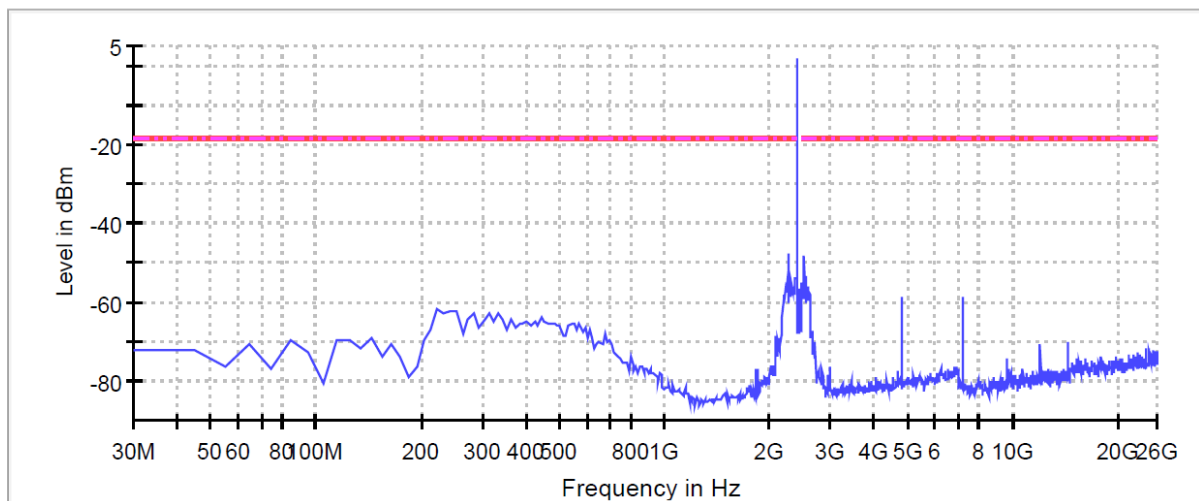
EUT		A003372714-001
Test Condition		Normal conditions
Chamber details		Shielded room
Operation mode		Mode 1: TX Modulated 1 Mbps with continuous transmission TX Modulated 2 Mbps with continuous transmission
Spectrum Analyzer	Centre Frequency	30MHz-2400MHz; 2400MHz-2483.5MHz; 2483.5MHz-26GHz
	Resolution Bandwidth	100kHz
	Video Bandwidth	300kHz
	Span	2.37GHz; 83.5MHz; 23.5165GHz
	Sweep time	23.7ms; 94.8µs; 236ms
Further parameters		-
Test engineer		Dipl. Ing. Primož Erzen

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4.2.4 Test results

- **Lowest Channel 1Mbit**

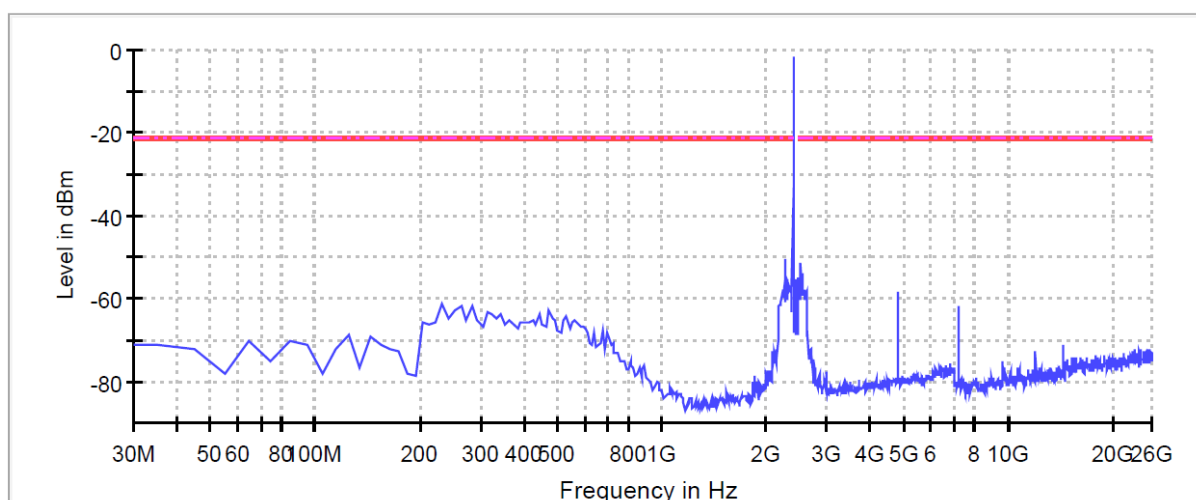
Spurious



— Limit — Sum Level - - - Threshold × Critical × Final Critical

- **Lowest Channel 2Mbit**

Spurious

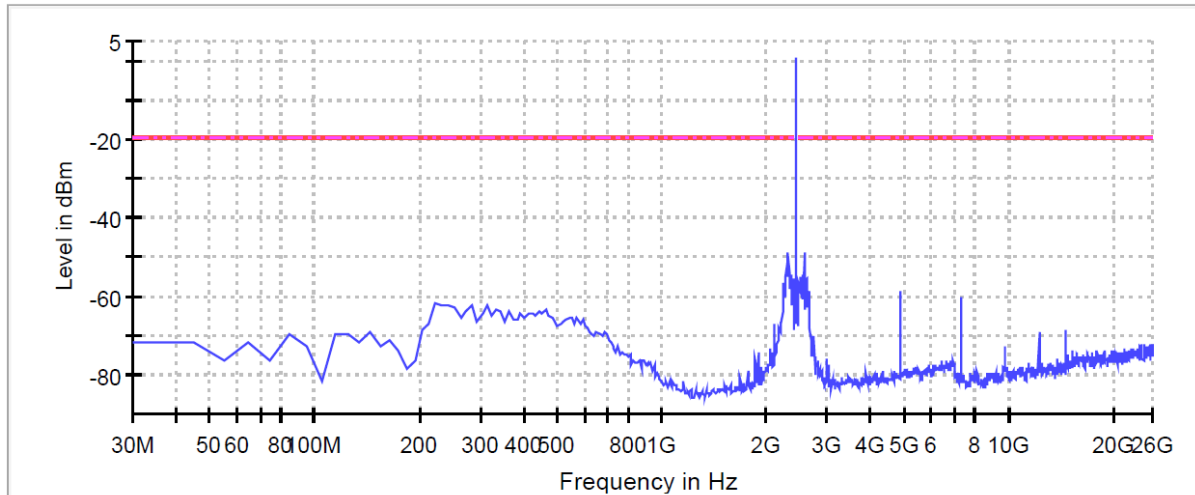


— Limit — Sum Level - - - Threshold × Critical × Final Critical

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- Middle Channel 1Mbit

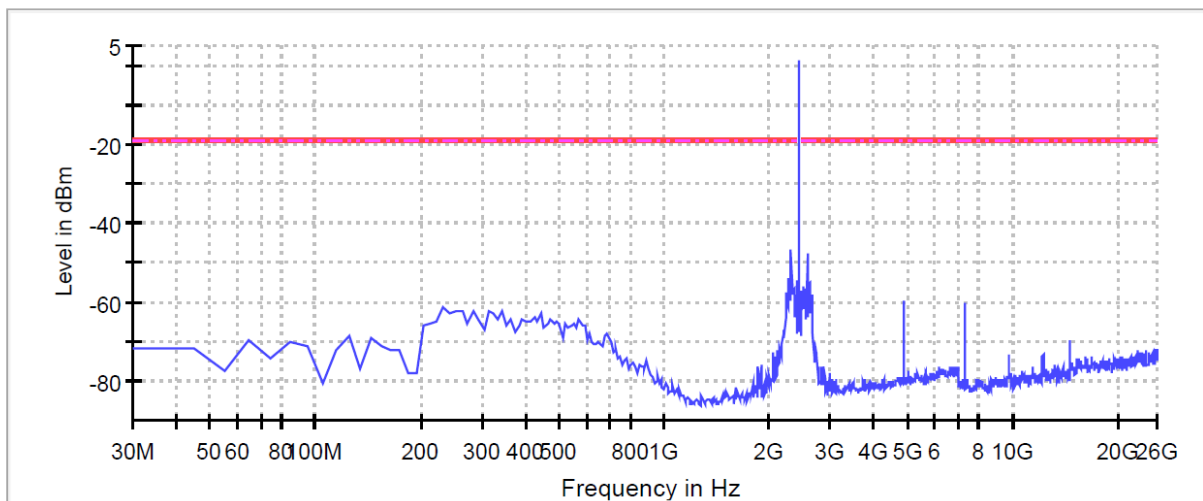
Spurious



— Limit — Sum Level - - - Threshold × Critical × Final Critical

- Middle Channel 2Mbit

Spurious

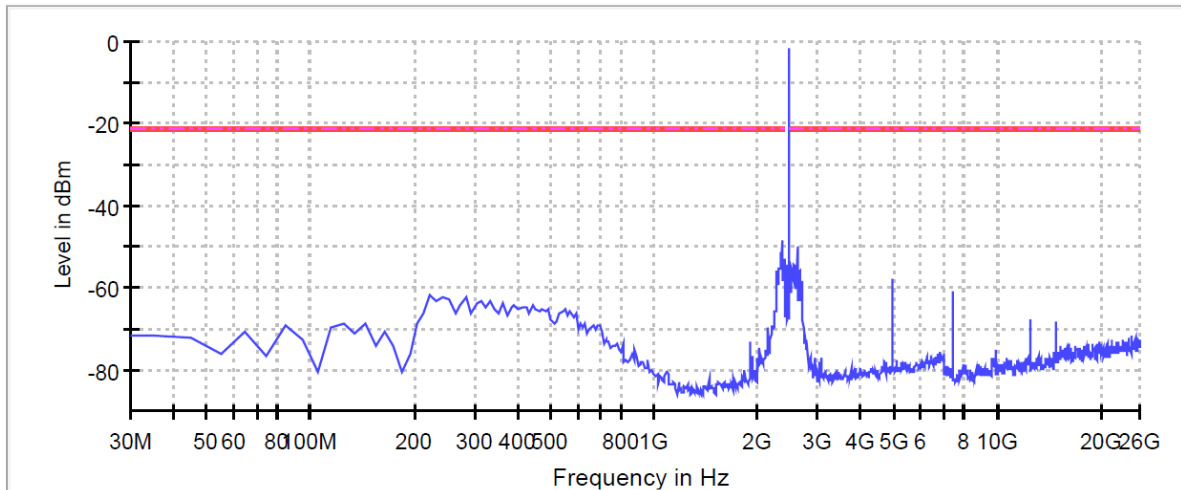


— Limit — Sum Level - - - Threshold × Critical × Final Critical

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- **Highest Channel 1Mbit**

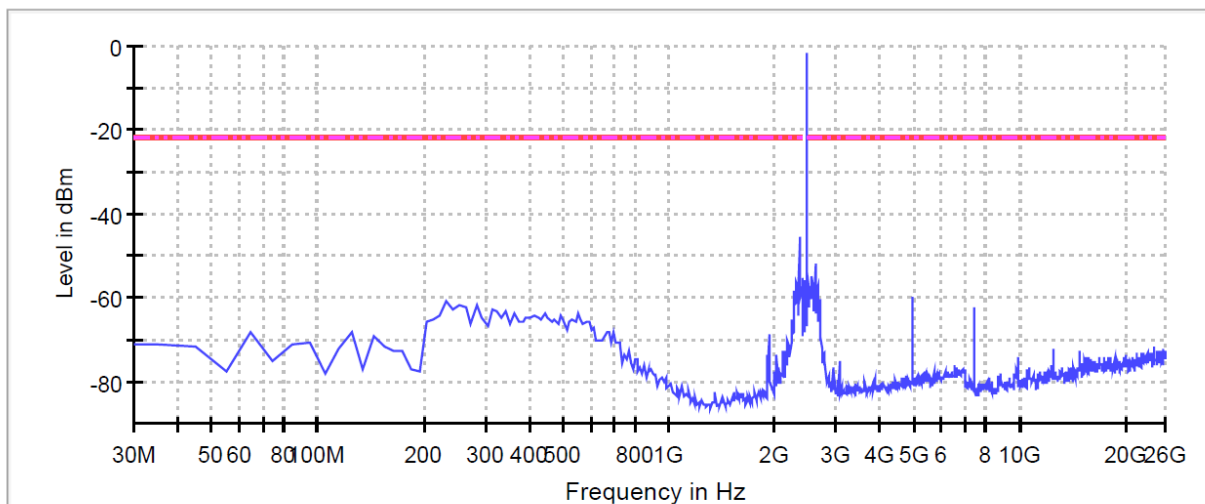
Spurious



— Limit — Sum Level - - - Threshold × Critical × Final Critical

- **Highest Channel 2Mbit**

Spurious



— Limit — Sum Level - - - Threshold × Critical × Final Critical

Final test result

Pass

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4.3 Band Edge Measurement

4.3.1 Requirements / Limits

<input checked="" type="checkbox"/>	<i>FCC Part 15, Subpart C, §15.247 (d)</i> 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, provide the transmitter demonstrates compliance with the peak conducted power limits.
<input type="checkbox"/>	<i>FCC Part 15, Subpart C, §15.247 (d)</i> 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.

4.3.2 Test Method

Conducted method was used to perform the band edge measurements according to ANSI C63.10:2013 clause 6.10. The EUT was connected to the spectrum analyzer via a coax cable with a known loss. The measurements are done when DUT is configured to the lowest and highest channels.

4.3.3 Test Setup

EUT		A003372714-001
Test Condition		Normal conditions
Chamber details		Shielded room
Companion device		-
Operation mode		Mode 1: TX Modulated 1 Mbps with continuous transmission TX Modulated 2 Mbps with continuous transmission
Spectrum Analyzer	Centre Frequency	2.355GHz; 2.44175GHz; 2.49175GHz
	Resolution Bandwidth	100kHz
	Video Bandwidth	300kHz
	Span	90MHz; 83.5MHz;16.5MHz
	Sweep time	114µs; 95µs; 19µs
Further parameters		-
Test engineer		Dipl. Ing. Primož Erzen

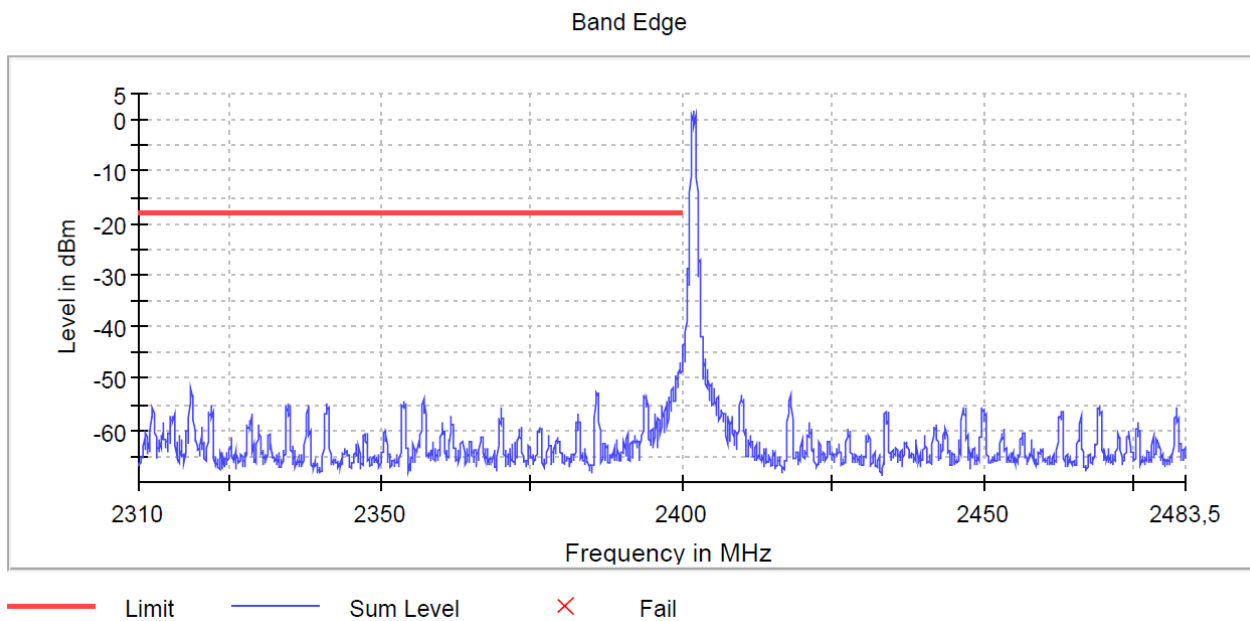
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4.3.4 Test results

- **Lowest Channel 1Mbit**



Inband Peak

Frequency [MHz]	Level [dBm]
2402.025000	1.8

Measurements

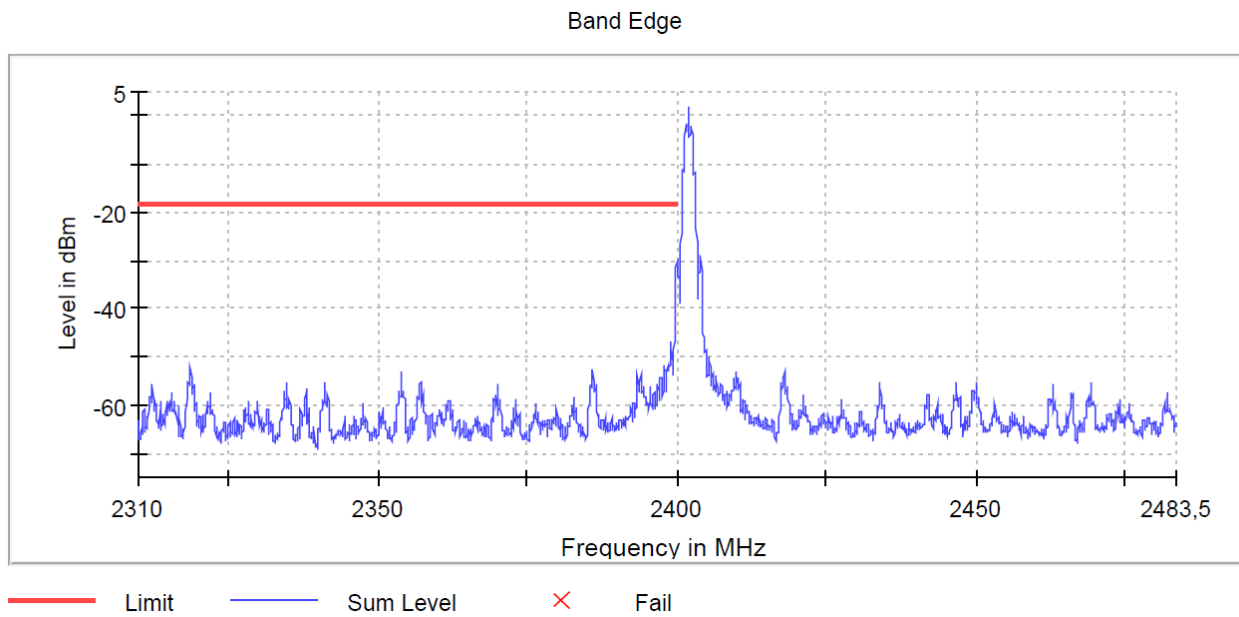
Frequency [MHz]	Level [dBm]	Margin [dB]	Limit [dBm]	Result
2399.725000	-47.0	28.8	-18.2	Pass

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- **Lowest Channel 2Mbit**



Inband Peak

Frequency [MHz]	Level [dBm]
2402.025000	1.8

Measurements

Frequency [MHz]	Level [dBm]	Margin [dB]	Limit [dBm]	Result
2399.975000	-30.3	12.0	-18.2	Pass

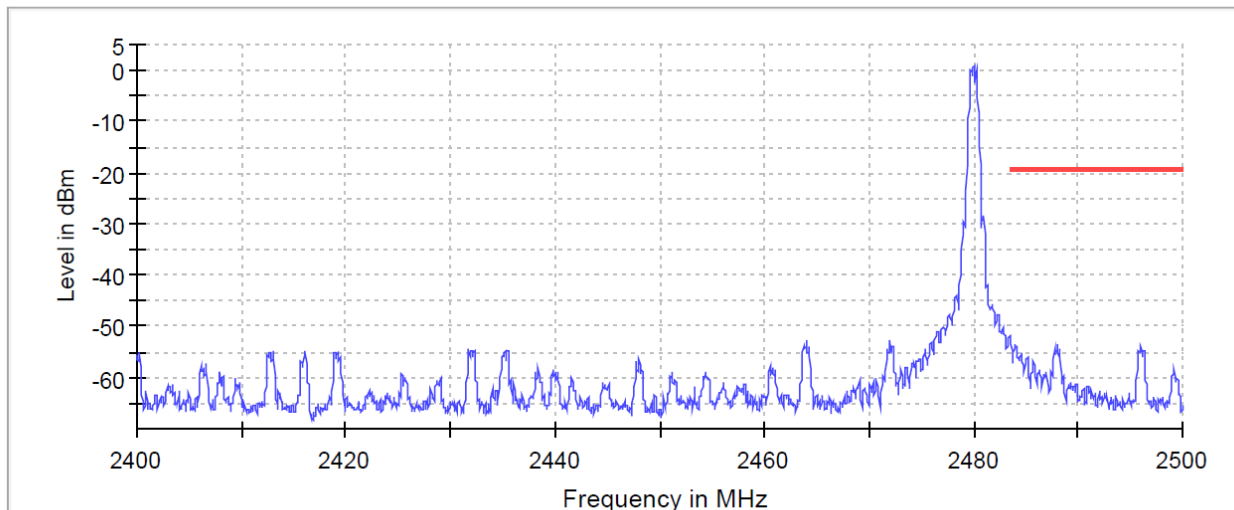
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- Highest Channel 1Mbit

Band Edge



— Limit — Sum Level × Fail

Inband Peak

Frequency [MHz]	Level [dBm]
2480.025000	0.7

Measurements

Frequency [MHz]	Level [dBm]	Margin [dB]	Limit [dBm]	Result
2483.525000	-52.9	33.7	-19.3	Pass

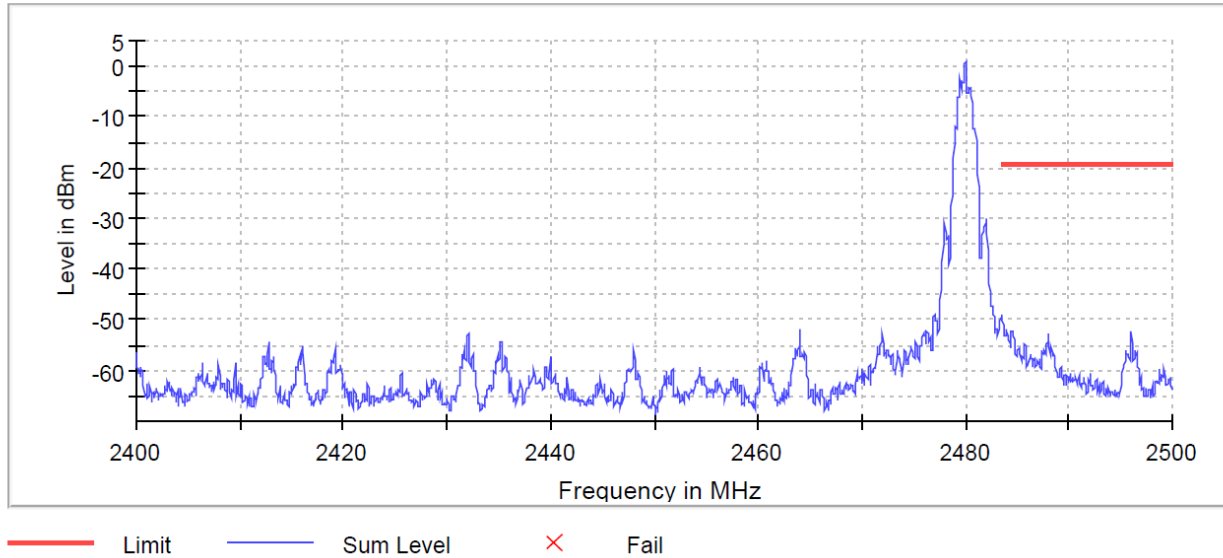
Prüfbericht-Nr.: DE22HD9A 001
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- **Highest Channel 2Mbit**

Band Edge



Inband Peak

Frequency [MHz]	Level [dBm]
2480.025000	0.7

Measurements

Frequency [MHz]	Level [dBm]	Margin [dB]	Limit [dBm]	Result
2483.525000	-49.1	29.8	-19.3	Pass

Final test result	Pass
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4.4 Radiated Spurious Emissions

4.4.1 Requirements / Limits

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode. The emissions shall not exceed the values in FCC Part 15, Subpart C §15.205, §15.209, §15.247(d).

FCC Part 15, Subpart C, §15.247 (d)

... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency [MHz]	Limit [$\mu\text{V}/\text{m}$]	Measurement distance [m]	Limits [$\text{dB}\mu\text{V}/\text{m}$]
0.009 – 0.49	2400/F(kHz)@300m	3	(48.5 – 13.8)@300m
0.49 – 1.705	24000/F(kHz)@30m	3	(33.8 – 23.0)@30m
1.705 – 30	30@30m	3	29.5@30m

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC 15.31 (f)(2).

Frequency [MHz]	Limit [$\mu\text{V}/\text{m}$]	Measurement distance [m]	Limits [$\text{dB}\mu\text{V}/\text{m}$]
30 – 88	100@3m	3	40.0@3m
88 – 216	150@3m	3	43.5@3m
216 – 960	200@3m	3	46.0@3m
960 - 40000	500@3m	3	54.0@3m

§15.35(b) ..., 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....

Used conversion factor:

$$\text{Limit [dB}\mu\text{V}/\text{m}] = 20 \log (\text{Limit } [\mu\text{V}/\text{m}] / 1\mu\text{V}/\text{m})$$

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4.4.2 Test Method

4.4.2.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. Preliminary emission profile testing was performed inside the anechoic chamber. The receiving antenna was placed at a distance of 3m for all measurements. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT. The different measurement setup for each frequency range are shown below.

9 kHz - 30 MHz

Following Measurement Setup is used:

Test Site	Semi-anechoic chamber
Receiving Antenna	Loop antenna (HFH 2)
Receiving Antenna Height	1 m
Receiving Antenna Polarization	Parallel – Perpendicular
EUT Table	1.0m x 1.5m non-conductive table 80cm above the floor
EUT Turn Table Step Size	22.5°
Receiver Configurations	Average and peak detectors
	RBW: 200Hz (9 - 150 kHz) and 9 kHz (150 kHz – 30 MHz)
	Step Size: 50Hz (9-150kHz) and 2.25kHz (150k-30MHz)
	Sweep Time: 100ms (FFT)

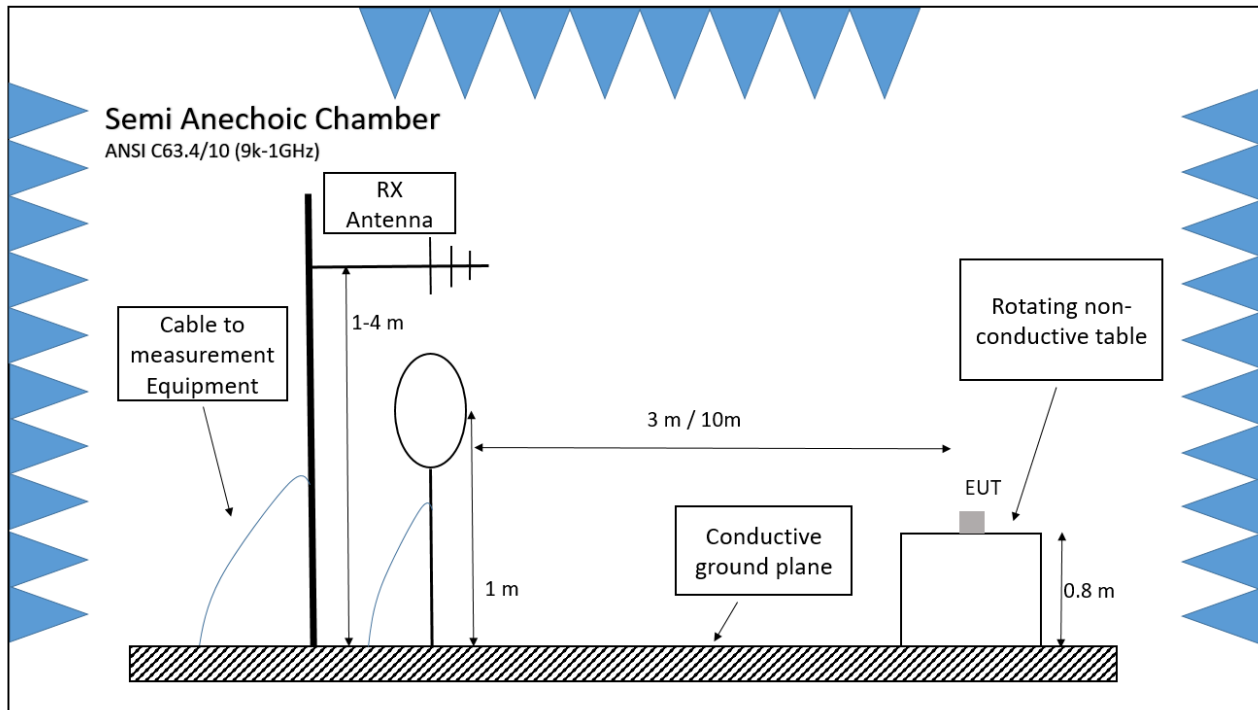
30 MHz - 1 GHz

Following Measurement Setup is used:

Test Site	Semi-anechoic chamber
Receiving Antenna	Hybrid Antenna VULB 9168
Receiving Antenna height	Varied (1m to 4 m, step size 1m)
Receiving Antenna Polarization	Horizontal– Vertical
EUT Table	1.0m x 1.5m non-conductive table 80cm above the floor
EUT Turn Table Step Size	45°
Receiver Configurations	Peak detector
	RBW :120 kHz
	Step Size: 30kHz (30-1000MHz)
	Sweep Time : 100 ms (FFT)

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For Measurements below 1 GHz, the EUT was positioned as shown in the setup photograph:



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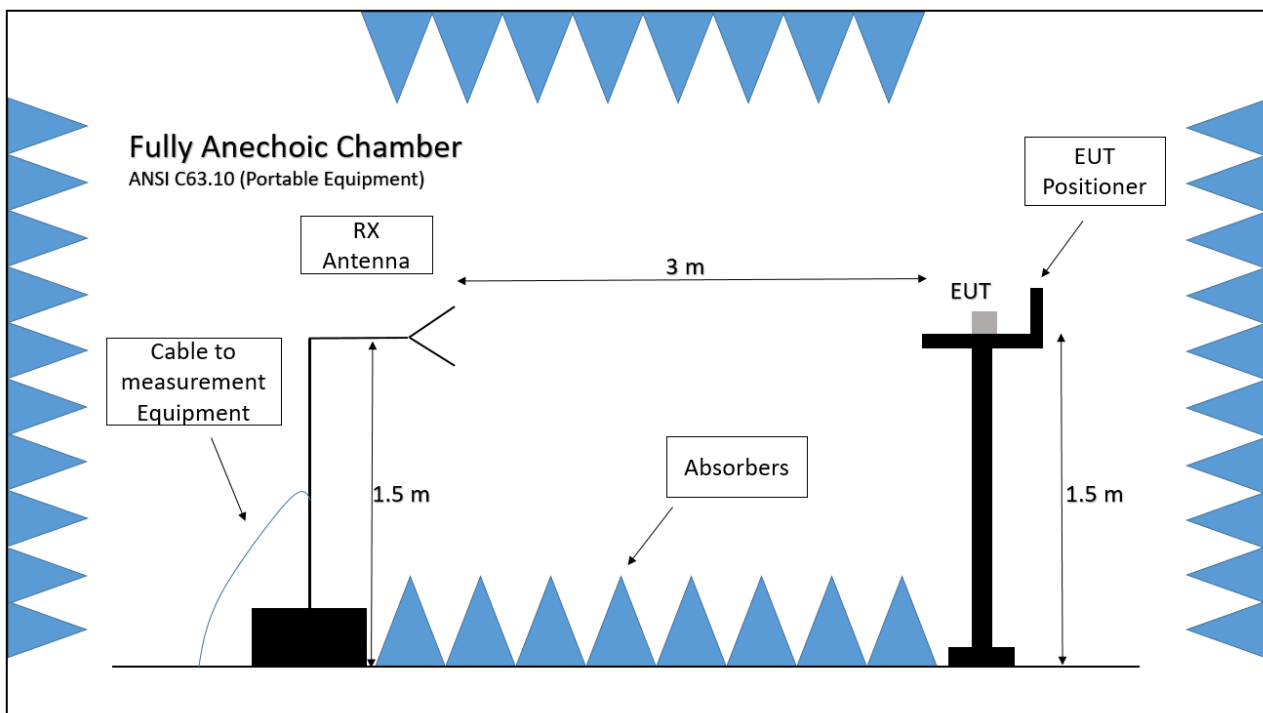
Prüfdokumentation
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1 GHz - 26 GHz

Following Measurement Setup is used:

Test Site	Fully-anechoic chamber
Receiving Antenna	Horn Antenna HF907 (1-18 GHz), 3116C-PA (18-26 GHz)
Receiving Antenna Height	1.5 m
Receiving Antenna Polarization	Horizontal– Vertical
EUT Positioner	40 cm x 60 cm non-conductive positioner 1.5 m above the floor / Step size,elevation angle 45°
EUT Turn Table Step Size	45°
Spectrum Analyzer	Average and peak detectors
	RBW: 1 MHz
	Sweep Time : 100 ms

For Measurements over 1 GHz, the EUT was positioned as shown in the setup photograph:



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4.4.2.2 Final Test

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, then 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 a range of 22° 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

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

4.4.3 Test Setup

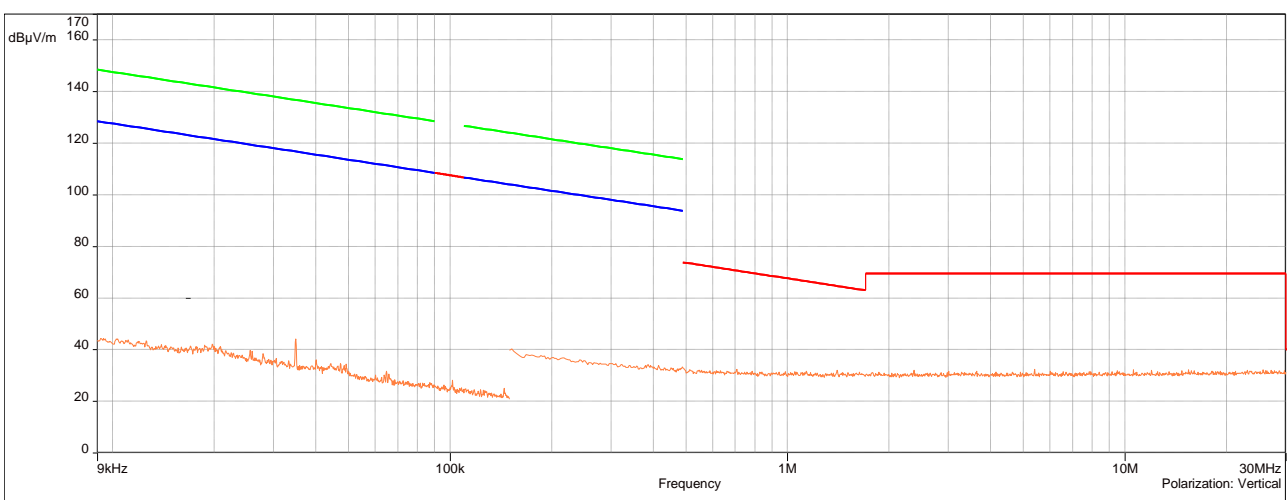
EUT	A003355895-002
Test Condition	Normal conditions
Companion device	-
Operation mode	Mode 1: TX Modulated 1 Mbps with continuous transmission TX Modulated 2 Mbps with continuous transmission For Measurements <1GHz, the DUT was connected to the auxiliary equipment (PC) via USB. The Battery was inserted into the DUT to keep the configured settings active. The auxiliary equipment was disconnected during the tests.
Further parameters	-
Test date	10.11.2022
Test engineer	Dipl. Ing. Primoz Erzen

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4.4.4 Test results

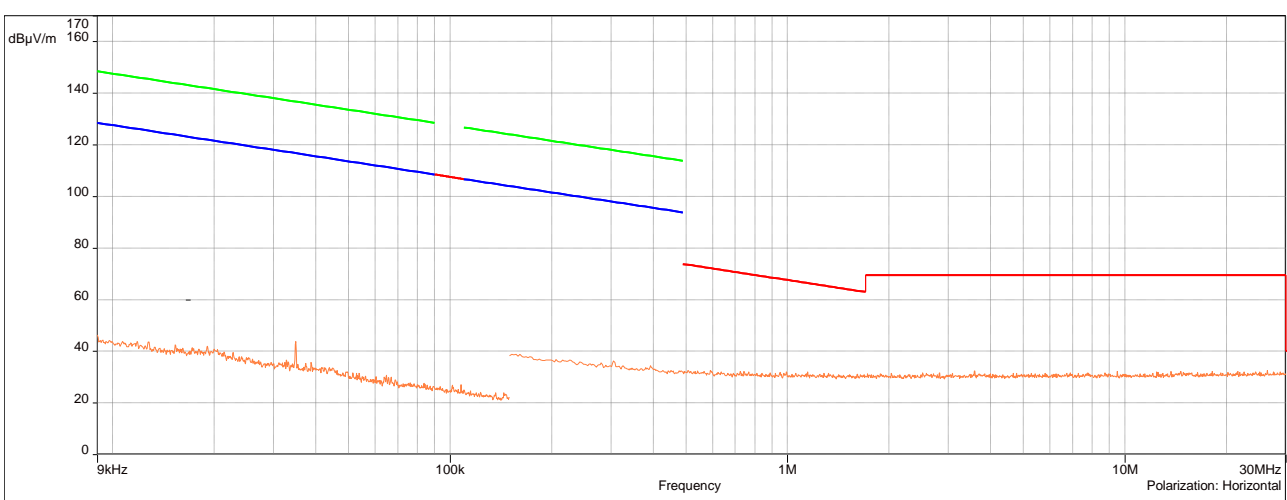
4.4.4.1 9 kHz to 30 MHz, Lowest Channel, 2Mbit

- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Average/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - QPeak/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Peak/3.0m/
- Peak (Vertical)



Perpendicular Polarization

- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Average/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - QPeak/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Peak/3.0m/
- Peak (Horizontal)

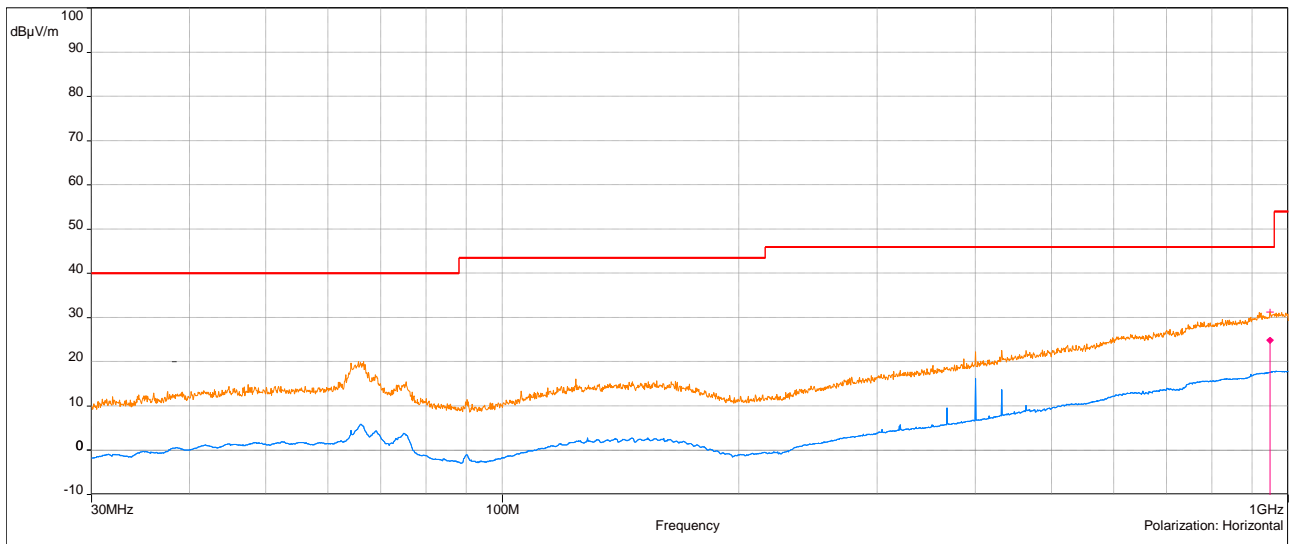


Parallel Polarization

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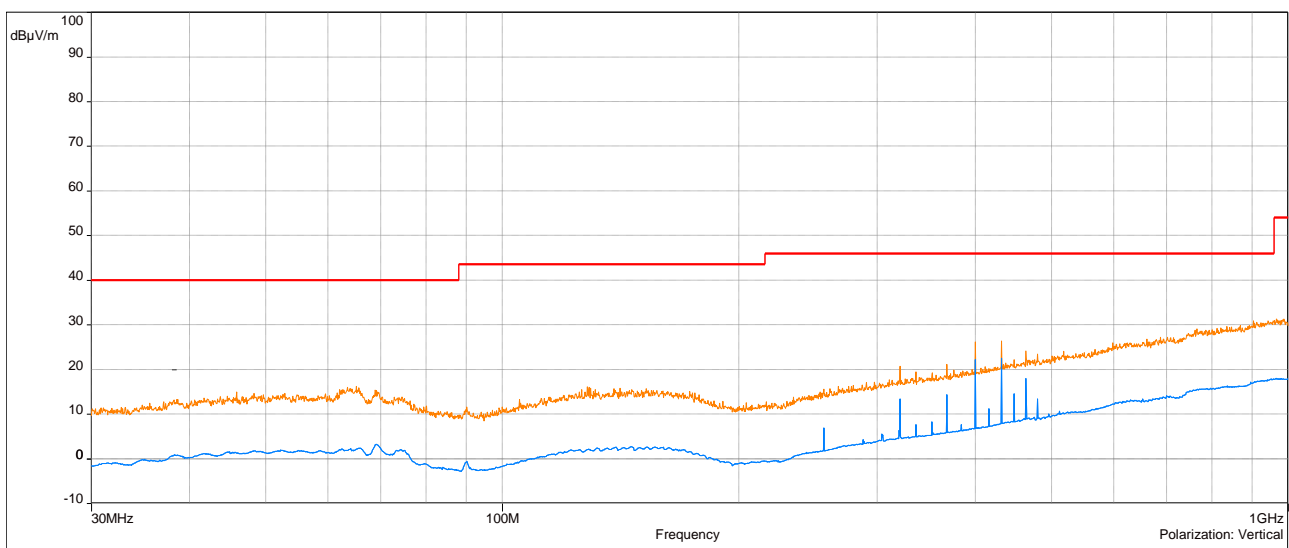
4.4.4.2 30 MHz to 1 GHz, Lowest Channel, 1Mbit

- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Average/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - QPeak/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Peak/3.0m/
- Peak (Horizontal)
- Avg (Horizontal)
- + Peak (Peak/Lim.Q-Peak) (Horizontal)
- ◆ Level (Quasipeak) (Horizontal)



Horizontal Polarization

- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Average/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - QPeak/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Peak/3.0m/
- Peak (Vertical)
- Avg (Vertical)

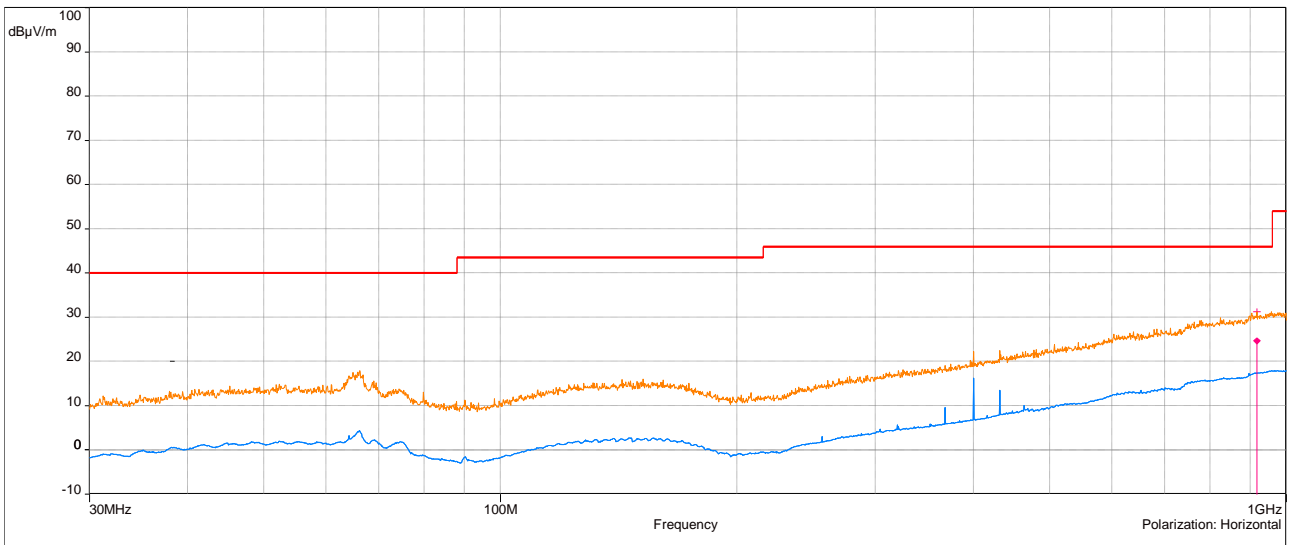


Vertical Polarization

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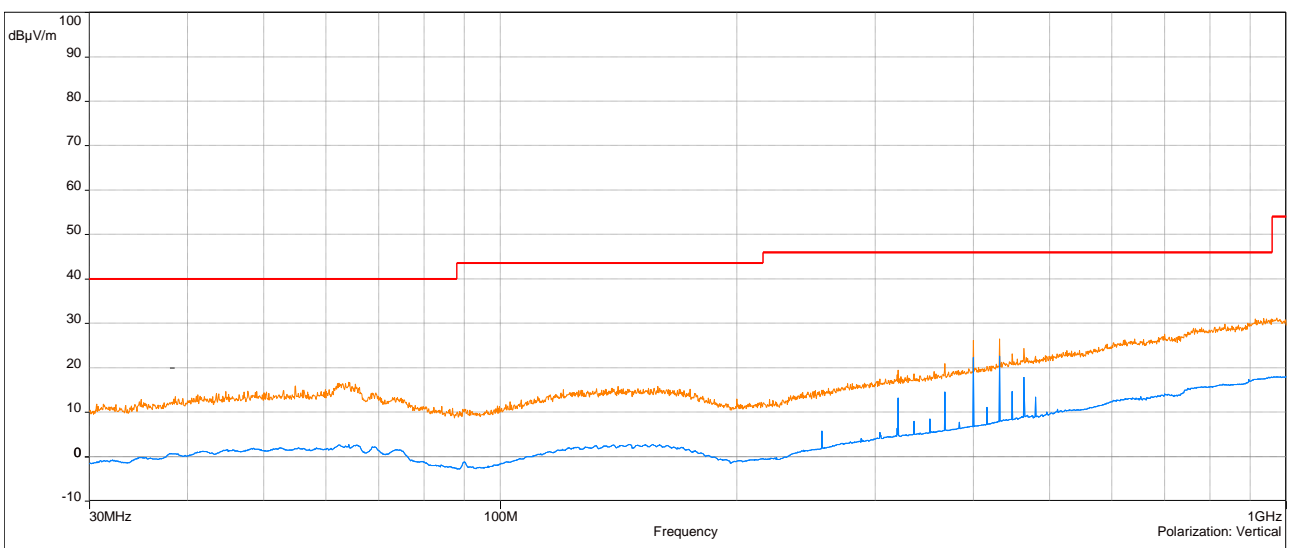
4.4.4.3 30 MHz to 1 GHz, Lowest Channel, 2Mbit

- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Average/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - QPeak/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Peak/3.0m/
- Peak (Horizontal)
- Avg (Horizontal)
- + Peak (Peak/Lim.Q-Peak) (Horizontal)
- ↓ Level (Quasipeak) (Horizontal)



Horizontal Polarization

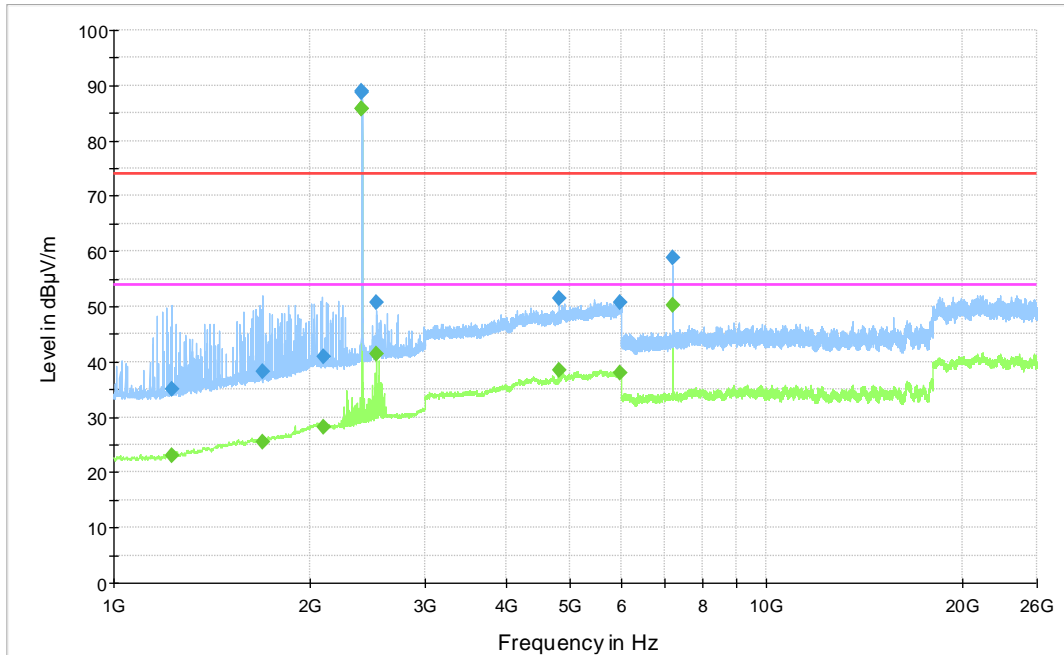
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Average/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - QPeak/3.0m/
- FCC/47 CFR Part 15 section 15.209, Radiated emission limits - Peak/3.0m/
- Peak (Vertical)
- Avg (Vertical)



Vertical Polarization

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4.4.4.4 1 to 26 GHz, Lowest Channel, 1Mbit

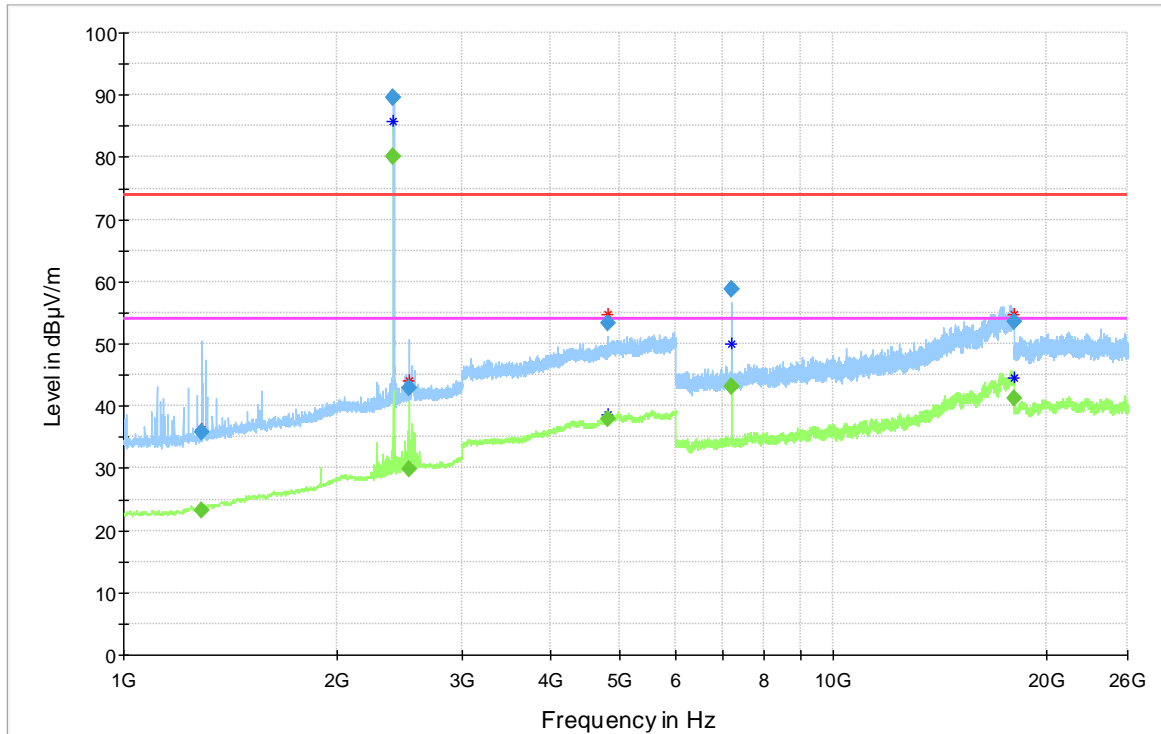


- Preview Result 2-AVG
- * Critical_Freqs AVG
- FCC_15C_15.209_Radiated Emissions_Peak
- ◆ Final_Result PK+
- × MaxPeak-PK+ (Single)
- Preview Result 1-PK+
- * Critical_Freqs PK+
- FCC_15C_15.209_Radiated Emissions_Avg
- ◆ Final_Result AVG
- + Average-AVG (Single)

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1227.695	34.94	---	74.00	39.06	1000	1000	H	86.0	33.0	-8.9
1227.695	---	22.96	54.00	31.04	1000	1000	H	86.0	33.0	-8.9
1692.720	38.29	---	74.00	35.71	1000	1000	V	103.0	21.0	-5.9
1692.720	---	25.57	54.00	28.43	1000	1000	V	103.0	21.0	-5.9
2091.975	40.82	---	74.00	33.18	1000	1000	V	10.0	9.0	-3.2
2091.975	---	28.08	54.00	25.92	1000	1000	V	10.0	9.0	-3.2
2401.985	TX-Signal				1000	1000	H	-3.0	0.0	-2.6
2401.985	TX-Signal				1000	1000	H	-3.0	0.0	-2.6
2529.840	50.74	---	74.00	23.26	1000	1000	H	192.0	0.0	-2.0
2529.840	---	41.50	54.00	12.50	1000	1000	H	192.0	0.0	-2.0
4804.535	51.43	---	74.00	22.57	1000	1000	V	217.0	48.0	7.9
4804.535	---	38.54	54.00	15.46	1000	1000	V	217.0	48.0	7.9
5960.960	50.84	---	74.00	23.16	1000	1000	V	101.0	6.0	11.1
5960.960	---	38.05	54.00	15.95	1000	1000	V	101.0	6.0	11.1
7205.225	---	50.30	54.00	3.70	1000	1000	V	263.0	74.0	-2.9
7205.225	58.79	---	74.00	15.21	1000	1000	V	263.0	74.0	-2.9

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4.4.4.5 1 to 26 GHz, Lowest Channel, 2Mbit

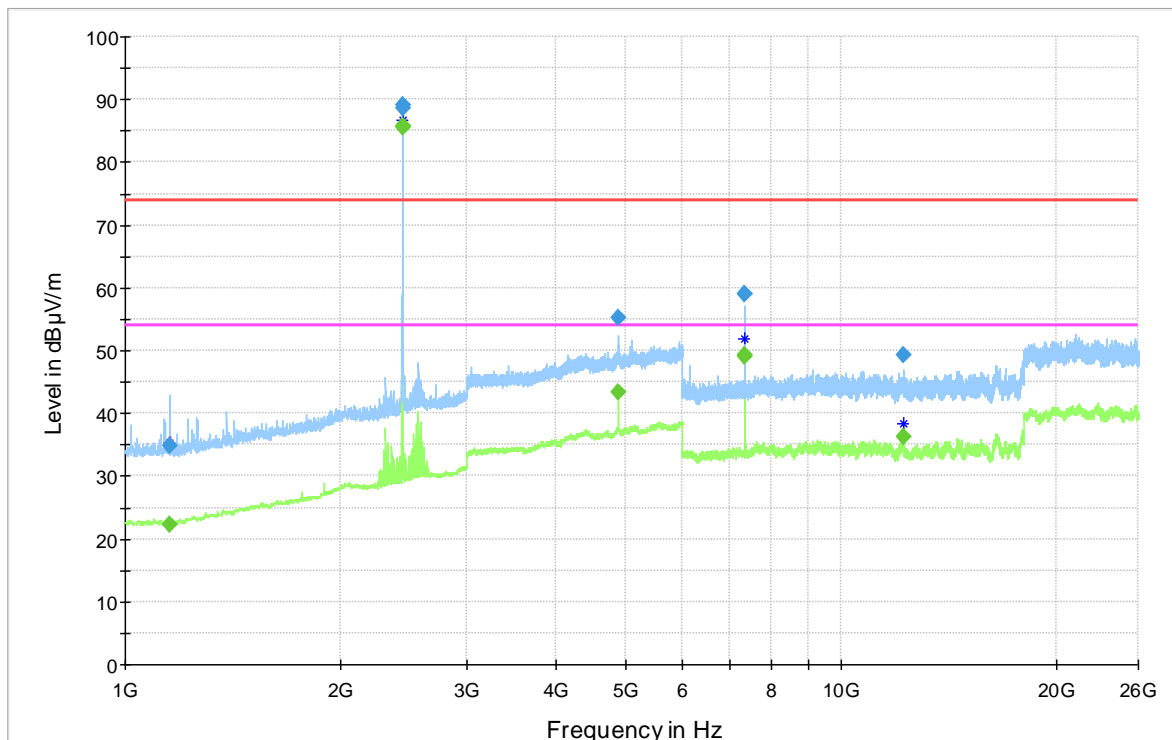


- Preview Result 2-AVG
- * Critical_Freqs AVG
- FCC_15C_15.209_Radiated Emissions_Peak
- ◆ Final_Result PK+
- Preview Result 1-PK+
- * Critical_Freqs PK+
- FCC_15C_15.209_Radiated Emissions_Avg
- ◆ Final_Result AVG

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas Time (ms)	Band-width (kHz)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1289.240	35.68	---	74.00	38.32	1000	1000	H	201.0	22.0	-8.6
1289.240	---	23.24	54.00	30.76	1000	1000	H	201.0	22.0	-8.6
2401.960	---	80.07	54.00	-26.07	1000	1000	H	-7.0	0.0	-2.6
2401.960	89.47	---	74.00	-15.47	1000	1000	H	-7.0	0.0	-2.6
2401.970	TX-Signal				1000	1000	H	-5.0	0.0	-2.6
2401.970	TX-Signal				1000	1000	H	-5.0	0.0	-2.6
2524.420	---	29.87	54.00	24.13	1000	1000	V	194.0	90.0	-2.0
2524.420	42.84	---	74.00	31.16	1000	1000	V	194.0	90.0	-2.0
4804.045	---	38.00	54.00	16.00	1000	1000	V	219.0	33.0	7.9
4804.045	53.41	---	74.00	20.59	1000	1000	V	219.0	33.0	7.9
7205.885	58.81	---	74.00	15.19	1000	1000	V	266.0	68.0	-2.9
7205.885	---	43.05	54.00	10.95	1000	1000	V	266.0	68.0	-2.9
17996.505	53.62	---	74.00	20.38	1000	1000	V	59.0	9.0	12.3
17996.505	---	41.20	54.00	12.80	1000	1000	V	59.0	9.0	12.3

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4.4.4.6 1 to 26 GHz, Middle Channel, 1Mbit

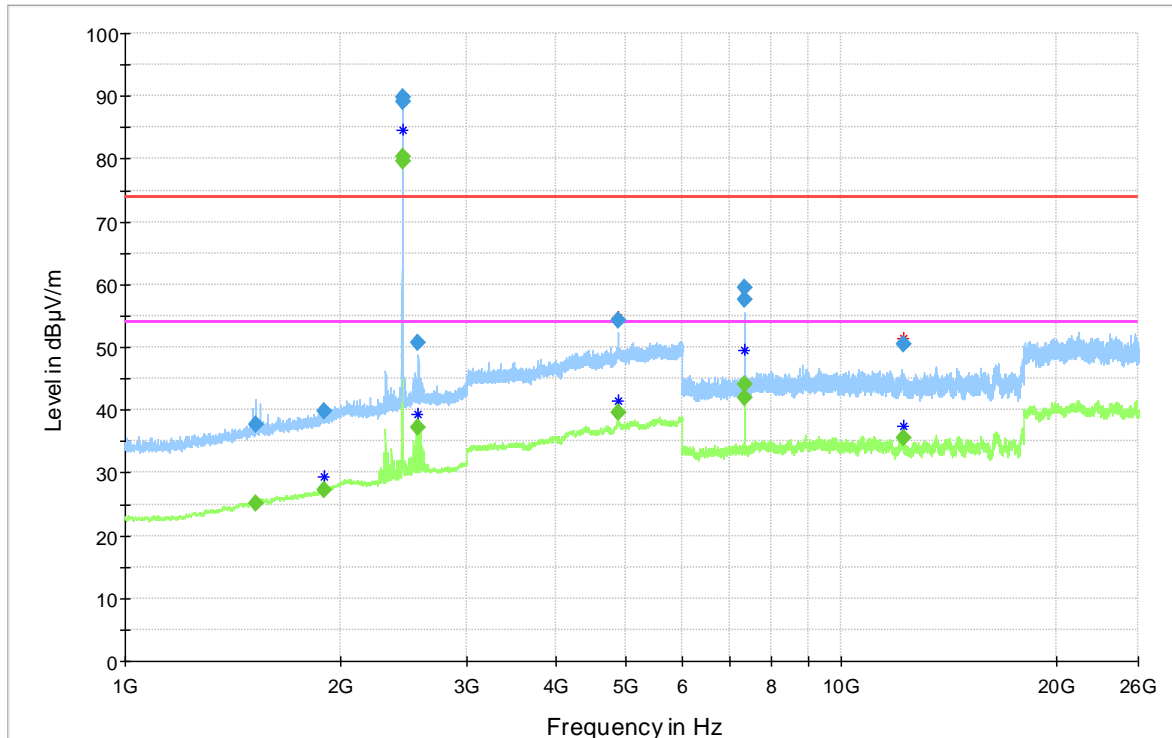


- Preview Result 2-AVG
- Preview Result 1-PK+
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- FCC_15C_15.209_Radiated Emissions_Peak
- FCC_15C_15.209_Radiated Emissions_Avg
- ◆ Final_Result PK+
- ◆ Final_Result AVG

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1153.255	34.79	---	74.00	39.21	1000	1000	V	98.0	0.0	-9.4
1153.255	---	22.39	54.00	31.61	1000	1000	V	98.0	0.0	-9.4
2439.995	TX-Signal				1000	1000	H	26.0	6.0	-2.3
2439.995	TX-Signal				1000	1000	H	26.0	6.0	-2.3
4880.265	---	43.47	54.00	10.53	1000	1000	H	274.0	11.0	8.6
4880.265	55.27	---	74.00	18.73	1000	1000	H	274.0	11.0	8.6
7320.860	---	49.12	54.00	4.88	1000	1000	V	248.0	78.0	-3.2
7320.860	59.01	---	74.00	14.99	1000	1000	V	248.0	78.0	-3.2
12198.655	49.25	---	74.00	24.75	1000	1000	H	212.0	41.0	2.2
12198.655	---	36.37	54.00	17.63	1000	1000	H	212.0	41.0	2.2

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4.4.4.71 to 26 GHz, Middle Channel, 2Mbit

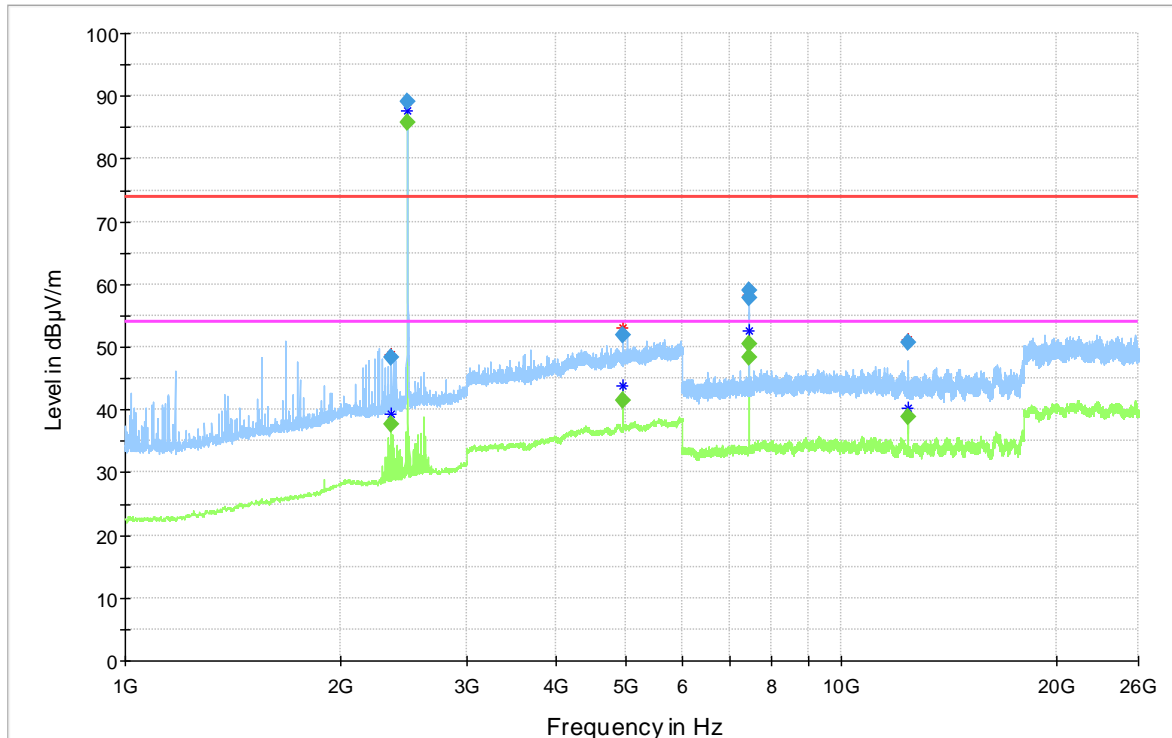


- Preview Result 2-AVG
- Preview Result 1-PK+
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- FCC_15C_15.209_Radiated Emissions_Peak
- FCC_15C_15.209_Radiated Emissions_Avg
- ◆ Final_Result PK+
- ◆ Final_Result AVG

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1523.950	---	25.16	54.00	28.84	1000	1000	V	267.0	60.0	-6.6
1523.950	37.63	---	74.00	36.37	1000	1000	V	267.0	60.0	-6.6
1897.085	39.80	---	74.00	34.20	1000	1000	H	156.0	11.0	-4.6
1897.085	---	27.21	54.00	26.79	1000	1000	H	156.0	11.0	-4.6
2439.990	TX-Signal				1000	1000	H	37.0	6.0	-2.3
2439.990	TX-Signal				1000	1000	H	37.0	6.0	-2.3
2568.185	---	37.24	54.00	16.76	1000	1000	H	188.0	13.0	-1.8
2568.185	50.73	---	74.00	23.27	1000	1000	H	188.0	13.0	-1.8
4879.710	54.19	---	74.00	19.81	1000	1000	V	214.0	80.0	8.6
4879.710	---	39.62	54.00	14.38	1000	1000	V	214.0	80.0	8.6
7321.505	---	44.12	54.00	9.88	1000	1000	V	246.0	77.0	-3.2
7321.505	59.50	---	74.00	14.50	1000	1000	V	246.0	77.0	-3.2
12200.015	50.47	---	74.00	23.53	1000	1000	V	276.0	35.0	2.2
12200.015	---	35.61	54.00	18.39	1000	1000	V	276.0	35.0	2.2

Prüfdokumentation
Test documentation

4.4.4.81 to 26 GHz, Highest Channel, 1Mbit

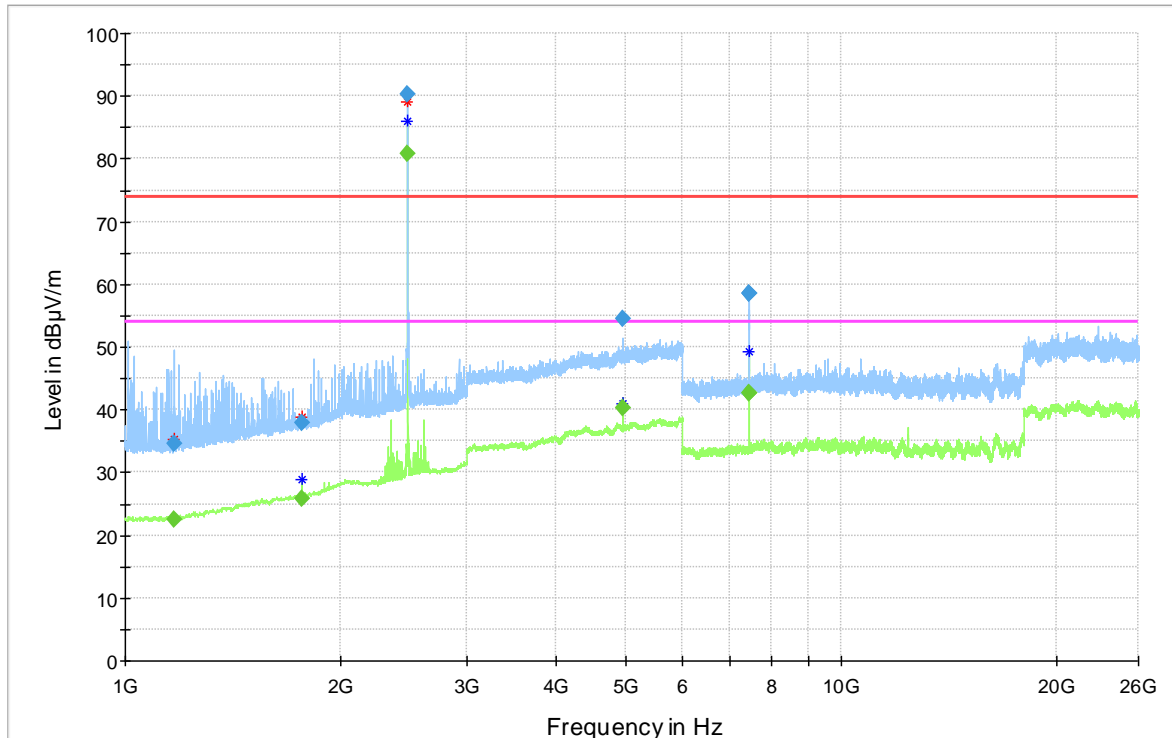


- Preview Result 2-AVG
- * Critical_Freqs AVG
- FCC_15C_15.209_Radiated Emissions_Peak
- ◆ Final_Result PK+
- Preview Result 1-PK+
- * Critical_Freqs PK+
- FCC_15C_15.209_Radiated Emissions_Avg
- ◆ Final_Result AVG

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2352.285	---	37.72	54.00	16.28	1000	1000	V	13.0	78.0	-2.7
2352.285	48.33	---	74.00	25.67	1000	1000	V	13.0	78.0	-2.7
2480.010	TX-Signal				1000	1000	H	39.0	0.0	-2.2
2480.010	TX-Signal				1000	1000	H	39.0	0.0	-2.2
4960.330	---	41.38	54.00	12.62	1000	1000	V	325.0	49.0	8.7
4960.330	51.99	---	74.00	22.01	1000	1000	V	325.0	49.0	8.7
7439.200	59.03	---	74.00	14.97	1000	1000	V	351.0	59.0	-3.2
7439.200	---	50.49	54.00	3.51	1000	1000	V	351.0	59.0	-3.2
12398.610	---	38.90	54.00	15.10	1000	1000	V	268.0	32.0	1.9
12398.610	50.78	---	74.00	23.22	1000	1000	V	268.0	32.0	1.9

Prüfdokumentation
Test documentation

4.4.4.91 to 26 GHz, Highest Channel, 2Mbit



- Preview Result 2-AVG
- * Critical_Freqs AVG
- FCC_15C_15.209_Radiated Emissions_Peak
- ◆ Final_Result PK+
- Preview Result 1-PK+
- * Critical_Freqs PK+
- FCC_15C_15.209_Radiated Emissions_Avg
- ◆ Final_Result AVG

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1168.970	34.70	---	74.00	39.30	1000	1000	H	126.0	21.0	-9.4
1168.970	---	22.44	54.00	31.56	1000	1000	H	126.0	21.0	-9.4
1766.960	---	25.92	54.00	28.08	1000	1000	H	198.0	16.0	-5.5
1766.960	37.95	---	74.00	36.05	1000	1000	H	198.0	16.0	-5.5
2479.990	TX-Signal				1000	1000	H	194.0	2.0	-2.2
2479.990	TX-Signal				1000	1000	H	194.0	2.0	-2.2
4960.085	54.61	---	74.00	19.39	1000	1000	H	284.0	11.0	8.7
4960.085	---	40.30	54.00	13.70	1000	1000	H	284.0	11.0	8.7
7439.965	---	42.72	54.00	11.28	1000	1000	V	349.0	58.0	-3.2
7439.965	58.57	---	74.00	15.43	1000	1000	V	349.0	58.0	-3.2

Final test result

Pass

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Zusatzdokumentation
Additional documentation

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 <i>Test equipment</i>		Prüfmittel-Nr. / ID-Nr. <i>Equipment No. / ID-No.</i>	Letzte Kalibrierung <i>Last calibration</i>	Nächste Kalibrierung <i>Next calibration</i>	
TS8997	OSP-B157 WX. (with integrated power meter)	Rohde & Schwarz	9000266	08.09.2022	08.09.2024
	OSP-B157W8	Rohde & Schwarz	9000267	07.09.2022	07.09.2024
	Spectrum Analyzer: FSV-30	Rohde & Schwarz	9000268	16.07.2021	16.07.2023
Fully Anechoic Room		Albatross Projects GmbH	2959749	08.10.2021	08.10.2024
Signal Analyzer FSU 26		Rohde & Schwarz	2844118	02.08.2021	02.08.2023
Signal Analyzer UXA N9041B		Keysight	2971644	06.04.2022	06.04.2023
RSE-Filtersystem		Rohde & Schwarz	9002802	19.01.2022	19.01.2023
Antenna CBL 6111D 25MHz-1GHz		CHASE	2815644	06.09.2021	06.09.2024
Antenna HF907 1-18GHz		Rohde & Schwarz	2856263	01.09.2021	01.09.2024
Horn Antenna 3116C-PA 18-40GHz		ETS LINDGREN	2900393	12.10.2020	12.11.2022
Semi-Anechoic Chamber 30-1000 MHz		Siemens	2729645	15.06.2022	15.06.2025
Receiver ESU 8		Rohde & Schwarz	2728844	23.12.2021	23.12.2022
Antenna HFH 2 (Loop) 9kHz-30MHz		Rohde & Schwarz	2728893	09.07.2021	09.07.2024
Antenna VULB 9168 30MHz – 1GHz		Schwarzbeck	2728136	04.09.2020	04.09.2023

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
DE22HD9A 001	Initial Release	07.12.2022

Note: Latest revision report will replace all previous reports.

Ende des Prüfberichts

End of Test Report