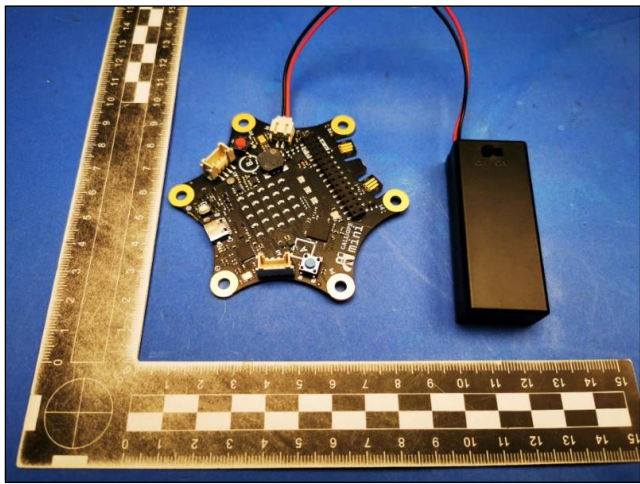


Test Report No.: <i>Prüfbericht-Nr.:</i>	DE23MWM8 001	Order No.: <i>Auftrags-Nr.:</i>	1145625_040	Page 1 of 40 Seite 1 von 40
Client Reference No.: <i>Kunden-Referenz-Nr.:</i>	Mr. Klaus J. Buß	Order date: <i>Auftragsdatum:</i>	2023-07-24	
Client: <i>Auftraggeber:</i>	Calliope gGmbH, Raumerstr. 11, Berlin 10437, Germany			
Test item: <i>Prüfgegenstand:</i>	Mikro Computer			
Identification / Type No.: <i>Bezeichnung / Typ-Nr.:</i>	Calliope mini V3			
Order content: <i>Auftrags-Inhalt:</i>	Test of electromagnetic compatibility EMC			
Test specification: <i>Prüfgrundlage:</i>	Complete test FCC Part 15 Subpart B ICES-003 (Issue 7)			
Date of receipt: <i>Wareneingangsdatum:</i>	2023-09-11			
Test sample No.: <i>Prüfmuster-Nr.:</i>	A003559646-002			
Testing period: <i>Prüfzeitraum:</i>	2023-10-17			
Place of testing: <i>Ort der Prüfung:</i>	Nuremberg/Nürnberg			
Testing laboratory: <i>Prüflaboratorium:</i>	EMC laboratory / EMV Labor			
Test result*: <i>Prüfergebnis*:</i>	PASS			
tested by: <i>geprüft von:</i>	 22.01.2024 Signiert von: Tom Zahlmann	authorized by: <i>genehmigt von:</i>	 23.01.2024 Signiert von: Patrick Reusch	
Date: <i>Datum:</i>	2024-01-22	Issue Date: <i>Ausstelldatum:</i>	2024-01-22	
Position / Stellung	Expert/Sachverständige(r)	Position / Stellung	Expert/Sachverständige(r)	
Other / Sonstiges:				
Condition of the test item at delivery: <i>Zustand des Prüfgegenstandes bei Anlieferung:</i>		Test item complete and undamaged <i>Prüfmuster vollständig und unbeschädigt</i>		
* 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 * Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet				
This test report only relates to the a. m. 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>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.</i>				

Test Report No.: DE23MWM8 001

Page 2 of 40

Remarks Anmerkungen

1	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>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.</i> <i>Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</i>
2	As contractually agreed, this document has been signed digitally only. TÜV 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, TÜV 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. For information on verifying the authenticity of our documents, please visit the following link: Introduction to Digital Signature <i>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. Informationen zur Verifizierung der Authentizität unserer Dokumente erhalten Sie über folgenden Link: Einführung in digitale Signaturen</i>
3	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>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.</i>
4	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>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</i>
5	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>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.</i>

Test Report No.: DE23MWM8 001

Page 3 of 40

Product description

6	Description	Refer to the technical documentation and user manual.
7	Serial number	260723-003
8	Manufacturer	Calliope GmbH
9	Ratings	battery operated device
10	Mounting position	Table top equipment
11	Equipment category	Emission: Class B
12	Protection class	III - Safety extra-low voltage
13	Hardware version	REV14
14	Software version	6.0.27
15	Dimensions	85x75mm
16	Weight	no information available
17	Comments	2.4GHz to 2.41GHz divided for BLE into 50 x 2MHz bands of which 40 are used. These are called channels and numbered 0 to 39. Channels 37, 38 and 39 are used for "advertising". Antenna Type: Integral Number of antennas: 1 Antenna Gain: 3.14 dBi (attached) FCC ID: 2AQMD & 2AQMD-CALLIOPE-V30 IC ID: 24686 & 24686-CALLIOPEV30 CALLIOPE Calliope mini
18	Test sample obtaining	☒ by customer ☐ by TÜV Rheinland Group ☐ others:

Test Report No.: DE23MWM8 001

Page 4 of 40

Clause	Requirements – Tests	Measuring results - Remarks	Result
19	Conducted Voltage Emission (150 kHz - 30 MHz) on Mains Supply FCC Part 15 Subpart B section 15.107 EUT: A003559646-002 Supply voltage: 120 V AC	Test protocol: 54 Operating mode: EUT ON, all lights on (red), USB connected Remarks:—	P ☒ F ☐ N/A ☐ N/T ☐
20	Conducted Voltage Emission (150 kHz - 30 MHz) on Mains Supply FCC Part 15 Subpart B section 15.107 EUT: A003559646-002 Supply voltage: 240 V AC	Test protocol: 55 Operating mode: EUT ON, all lights on (red), USB connected Remarks:—	P ☒ F ☐ N/A ☐ N/T ☐
21	Radiated Electric Emission (30 MHz - 1 GHz) FCC Part 15 Subpart B section 15.109 EUT: A003559646-002 Supply voltage: Battery operated	Test protocol: 22 Operating mode: EUT ON, all lights on (red), USB connected Remarks:—	P ☒ F ☐ N/A ☐ N/T ☐
22	Radiated Electric Emission (30 MHz - 1 GHz) ICES-003 (Issue 7) EUT: A003559646-002 Supply voltage: Battery operated	Test protocol: 29 Operating mode: EUT ON, all lights on (red), USB connected Remarks:—	P ☒ F ☐ N/A ☐ N/T ☐
23	Radiated Electric Emission (1 GHz - 6 GHz) FCC Part 15 Subpart B section 15.109 EUT: A003559646-002 Supply voltage: Battery operated	Test protocol: 21 Operating mode: EUT ON, all lights on (red), USB connected Remarks:-	P ☒ F ☐ N/A ☐ N/T ☐
24	Radiated Electric Emission (1 GHz - 6 GHz) ICES-003 (Issue 7) EUT: A003559646-002 Supply voltage: Battery operated	Test protocol: 30 Operating mode: EUT ON, all lights on (red), USB connected Remarks:-	P ☒ F ☐ N/A ☐ N/T ☐

Limits

47 CFR FCC Part 15 Subpart B section §15.109

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values

Frequency [MHz]	Quasi-peak [dB(μV)/m]
30 – 88	40
88 – 216	43.5
216 – 960	46
Above 960	54

The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following, using measurement instrumentation employing a CISPR quasi-peak detector.

Test Report No.: DE23MWM8 001

Page 5 of 40

Clause	Requirements – Tests	Measuring results - Remarks	Result
--------	----------------------	-----------------------------	--------

Frequency [MHz]	Quasi-peak [dB(μV)/m]
30 – 88	39.1
88 – 216	43.5
216 – 960	46.4
Above 960	49.5

Note: For frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function.
When average radiated emission measurements are specified, there also is a limit on the peak level of the radio frequency emissions which is 20 dB above the maximum permitted average emission limit. (see § 15.35 Measurement detector functions and bandwidths)

As an alternative to the radiated emission limits shown above, digital devices may be shown to comply with the standards contained in Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22 (acc. §15.109 (g)).

The field strength of radiated emissions from Class B devices at a distance of 10 meters shall not exceed the following values

Frequency [MHz]	Quasi-peak [dB(μV)/m]
30 – 230	30
230 - 1000	37

The field strength of radiated emissions from Class A devices at a distance of 10 meters shall not exceed the following values

Frequency [MHz]	Quasi-peak [dB(μV)/m]
30 – 230	40
230 - 1000	47

ICES-003 section 3.2.2

Radiated emissions limits (30 MHz to 1 GHz)

Frequency [MHz]	Class A (3 m) Quasi-peak [dB(μV)/m]	Class A (10 m) Quasi-peak [dB(μV)/m]	Class B (3 m) Quasi-peak [dB(μV)/m]	Class B (10 m) Quasi-peak [dB(μV)/m]
30 – 88	50.0	40.0	40.0	30.0
88 – 216	54.0	43.5	43.5	33.1
216 – 230	56.9	46.4	46.0	35.6
230 – 960	57.0	47.0	47.0	37.0
960 – 1000	60.0	49.5	54.0	43.5

Radiated emission limits at 3 m distance (at and above 1 GHz)

Frequency [GHz]	Class A Average [dB(μV)/m]	Class A Peak [dB(μV)/m]	Class B Average [dB(μV)/m]	Class B Peak [dB(μV)/m]
1 – F _M	60	80	54	74

The highest measurement frequency, F_M, in GHz, shall be determined as

Test Report No.: DE23MWM8 001

Page 6 of 40

Clause	Requirements – Tests	Measuring results - Remarks	Result										
	<table><tr><td>Highest internal frequency (F_x)</td><td>Highest measurement frequency (F_M)</td></tr><tr><td>F_x ≤ 108 MHz</td><td>1 GHz</td></tr><tr><td>108 MHz < F_x ≤ 500 MHz</td><td>2 GHz</td></tr><tr><td>500 MHz < F_x ≤ 1 GHz</td><td>5 GHz</td></tr><tr><td>F_x > 1 GHz</td><td>5 x F_x up to a maximum of 40 GHz</td></tr></table> F_x is the highest fundamental frequency generated and/or used in the ITE or digital apparatus under test. These limit levels apply for a measurement distance of 3 m. If using a different measurement distance, the measured levels shall be extrapolated to the 3 m limit distance using a factor of 20 dB per decade of distance. The measurement distance shall place the measurement antenna in the far field of the ITE or digital apparatus under test.	Highest internal frequency (F _x)	Highest measurement frequency (F _M)	F _x ≤ 108 MHz	1 GHz	108 MHz < F _x ≤ 500 MHz	2 GHz	500 MHz < F _x ≤ 1 GHz	5 GHz	F _x > 1 GHz	5 x F _x up to a maximum of 40 GHz		
Highest internal frequency (F _x)	Highest measurement frequency (F _M)												
F _x ≤ 108 MHz	1 GHz												
108 MHz < F _x ≤ 500 MHz	2 GHz												
500 MHz < F _x ≤ 1 GHz	5 GHz												
F _x > 1 GHz	5 x F _x up to a maximum of 40 GHz												
	Method of measurement of radiated emission Measurements were made in a 10-meter semi-anechoic chamber that complies to ANSI C63.4:2014. Floor-standing equipment was placed on a non-conducting support (0.1 ± 0.01) m over the reference ground plane. Tabletop equipment was placed on a table at a height of (0.8 ± 0.05) m above the reference ground plane. Preliminary measurements were performed with a receiver employing a peak detector at an antenna to EUT distance of 10 m or 3 m (as defined in the standard). The EUT was rotated in 45° steps for frequencies below 1 GHz and 22.5° steps for frequencies over 1GHz about its azimuth to determine the position of the highest emissions. The measurement antenna was adjusted between 1 m and 4 m above ground to find the maximum signal strength. These measurements were done in both horizontal and vertical polarizations. After this, final measurements with a receiver employing a quasi-peak detector for frequencies below 1 GHz and with a peak and an average detector for frequencies above 1 GHz were performed by rotating the EUT by 360° and adjusting the receive antenna height from 1 m to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity. For frequencies over 1 GHz floor absorbers were used between antenna and EUT to fulfil the SVSWR requirements. The whole required frequency range was investigated for maximum radiated interferences. After data reduction, a final measurement of the highest emissions was made with quasi-peak, peak and average detector with a measurement time of at least 1 s per single frequency. The emission limits are calculated from the field strength limit of this section using this formula: $Emission\ level\left(\frac{dB\mu V}{m}\right)=20\log Emission\ level\left(\frac{\mu V}{m}\right)$ When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade as per §15.31(f)(1). For this documentation a distance extrapolation factor was added to the limit that was calculated using this formula: $Emission\ limit_{new}\left(\frac{dB\mu V}{m}\right)=Emission\ limit_{old}+20\log\left(\frac{d_1}{d_2}\right)$ Where d₁: old distance(e. g. 3 m) d₂: new distance (e. g. 10 m) The field strength is calculated by adding the antenna factor and cable loss. The basic equation with a sample calculation is as follows: $E=U+AF+CA$ Where E: Field strength U: Receiver reading AF: Antenna factor CA: Cable loss For example:												

Test Report No.: DE23MWM8 001			Page 7 of 40
--------------------------------------	--	--	--------------

Clause	Requirements – Tests	Measuring results - Remarks	Result
--------	----------------------	-----------------------------	--------

	Frequency (MHz)	Receiver reading U (dBμV)	Correction antenna factor AF + cable loss CA (dB)	Field strength E (dBμV/m)	
	320	15.9	15.8	31.7	

ADDITIONAL DOCUMENTATION

25 US Federal Communications Commission

TUV Rheinland LGA Products GmbH located at, Tillystraße 2, 90431 Nuremberg is recognized by the Bundesnetzagentur (Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway) as conformity assessment body.

FCC designation number	DE0016
Bundesnetzagentur registration number	BNetzA-CAB-17/21-16

26 Applied basic standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- Title 47 CFR FCC Part 15 Subpart B
- ANSI C63.4-2014 (Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz)
- ICES-003:2020 (Issue 7) (Information Technology Equipment (Including Digital Apparatus) — Limits and Methods of Measurement)

The test setup and test was done according to ANSI C63.4-2014.

Appendix to Test Report No.: DE23MWM8 001

Page 9 of 40

ADDITIONAL DOCUMENTATION

27 Equipment used during test

Equipment under test

Product type	Manufacturer	Model	Comments
Mikro Computer	Calliope GmbH	Calliope mini V3	2.4GHz to 2.41GHz divided for BLE into 50 x 2MHz bands of which 40 are used. These are called channels and numbered 0 to 39. Channels 37, 38 and 39 are used for "advertising". Antenna Type: Integral Number of antennas: 1 Antenna Gain: 3.14 dBi (attached) FCC ID: 2AQMD & 2AQMD-CALLIOPE-V30 IC ID: 24686 & 24686-CALLIOPEV30

Auxiliary Equipment / Peripherals

Product type	Manufacturer	Model	Comments
<Port name or peripheral name>	<Peripheral manufacturer>	<Peripheral model>	—

28 Input/Output ports

Name	Type*	Max. length	Shielded	Comments
Enclosure	N/E	—	—	None

* AC = AC Power Port
 DC = DC Power Port
 N/E = Non-Electrical
 I/O = Signal Input or Output Port (Not Involved in Process Control)
 TP = Telecommunication Ports

29 Internal operating frequencies

Frequency	Description
no information available	—

ADDITIONAL DOCUMENTATION

30 Operating modes

No.	Description
1	EUT ON, all lights on (red), USB connected

For details see also the corresponding protocol

31 Special EMC measures

none

32 EUT configuration

The test setup was made in accordance with mentioned EMC standards.

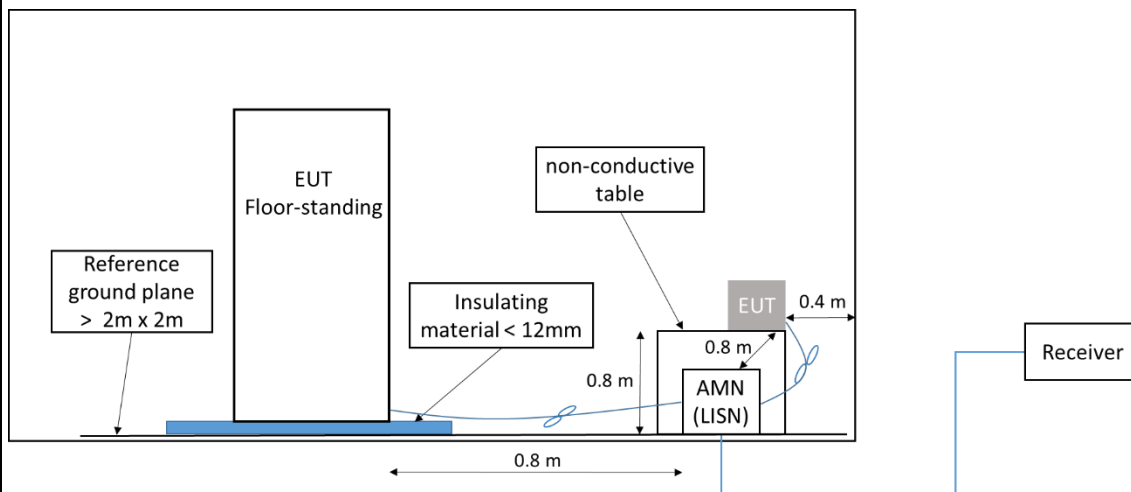
Measurements and tests were executed under "worst case" conditions. Typical EUT arrangements or operating modes were chosen or assumed which let suspect maximum emission or susceptibility (a so called "unfavourable configuration").

Details of test setup or adjustments are (particularly) shown inside the photo documentation.

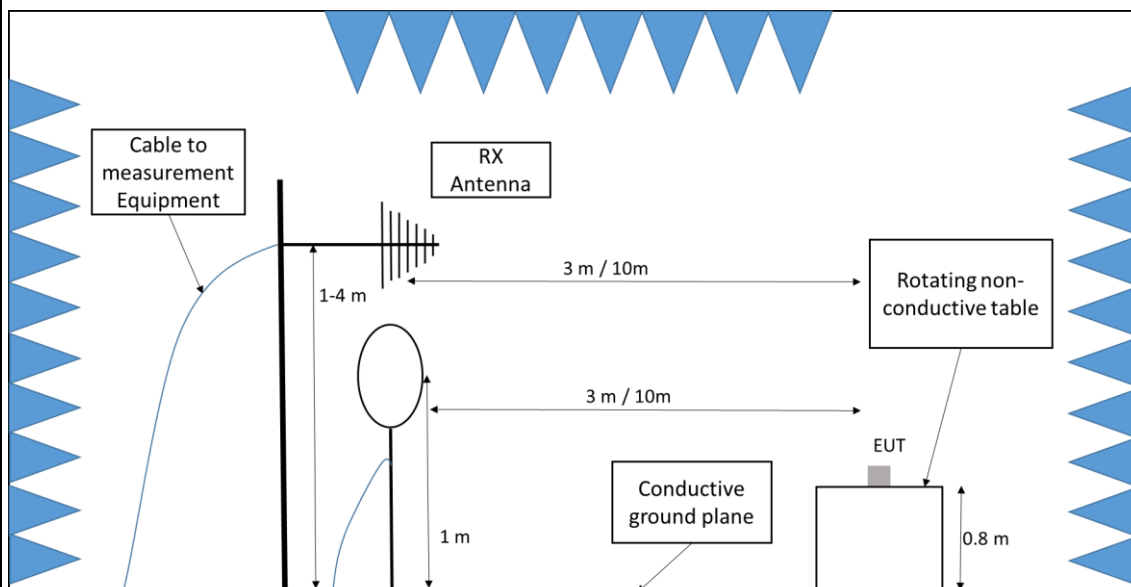
As far as not mentioned otherwise these statements are valid for all following tests.

ADDITIONAL DOCUMENTATION

33 Conducted emission (9kHz – 30 MHz) acc. ANSI C63.4

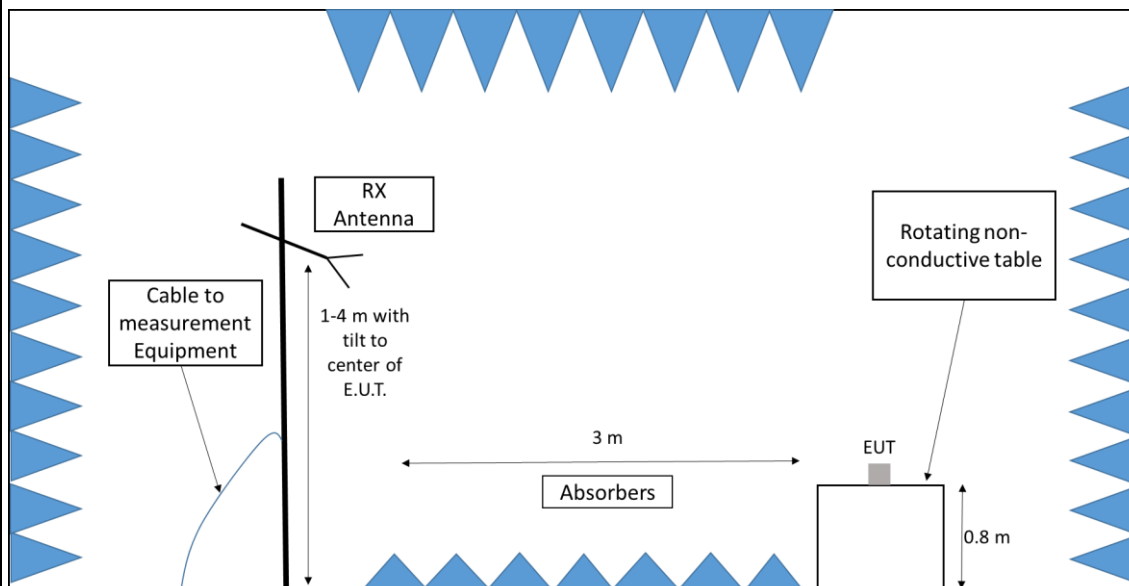


34 Field strength measurement (9 kHz – 30 MHz) with loop antenna Field strength measurement (30 MHz – 1000 MHz) with log-per antenna acc. ANSI C63.4



ADDITIONAL DOCUMENTATION

35 Field strength measurement (>1 GHz) horn antenna acc. ANSI C63.4



36 Climatic conditions

The climatic conditions during the tests are within the limits specified by the manufacturer for the operation of the EUT and the test equipment.
The climatic conditions during the tests were within the following limits:

Temperature	Humidity	Atmospheric pressure
15 °C – 35 °C	30 % - 60 %	800 hPa – 1060 hPa

If explicitly required in the basic standard or applied product standard the climatic values are recorded and documented separately in this test report.

ADDITIONAL DOCUMENTATION

37 Statement of the 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.

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Measurement procedure	U _{Lab}
Measurement of conducted emissions at the power supply connection to LISN in the frequency range 9k-150kHz (CISPR Band A)	2.3 dB
Measurement of conducted emissions at the power supply connection to LISN in the frequency range 150k-30MHz (CISPR Band B) with 150 ohm Delta LISN	3.3 dB
Measurement of conducted emissions at the power supply connection to LISN in the frequency range 150k-30MHz (CISPR Band B)	2.2 dB
Measurement of conducted emissions at the power supply connection to voltage probes in the frequency range 9k-30MHz (CISPR Band A and B)	2.0 dB
Measurement of conducted emissions at telecommunication connection to ISN in the frequency range 150k-30MHz (CISPR Band B) ISN CAT 5	3.3 dB
Measurement of conducted emissions at the telecommunication connection to ISN in the frequency range 150k-30MHz (CISPR Band B) ISN CAT 6 Shielded	2.6 dB
Measurement of conducted emissions at the telecommunications connection to current clamps in the frequency range 150k-30MHz (CISPR Band B)	2.2 dB
Measurement of interference power in the frequency range 30-300MHz (CISPR Band C)	2.9 dB
Measurement of interference power in the frequency range 30-300MHz (CISPR Band C) CDNE	2.6 dB
Measurement of magnetic emissions in the frequency range 9k-150kHz (CISPR Band A) with frame antenna HFH2 (small loop antenna)	1.6 dB
Measurement of magnetic emissions in the frequency range 9k-150kHz (CISPR Band A) with frame antenna HL562 (3-axis loop antenna)	1.6 dB
Measurement of the field strength in the frequency range 30-1000MHz (CISPR Band C and D) with 10m distance with VULB 9168 Vertical	4.5 dB
Measurement of the field strength in the frequency range 30-1000MHz (CISPR band C and D) with 10m distance with VULB 9168 Horizontal	4.4 dB
Measurement of the field strength in the frequency range 1-18GHz (CISPR Band E) with 3m distance with HL025 1-6GHz	5.0 dB
Measurement of the field strength in the frequency range 1-18GHz (CISPR Band E) with 3m distance with HL025 6-18GHz	5.3 dB

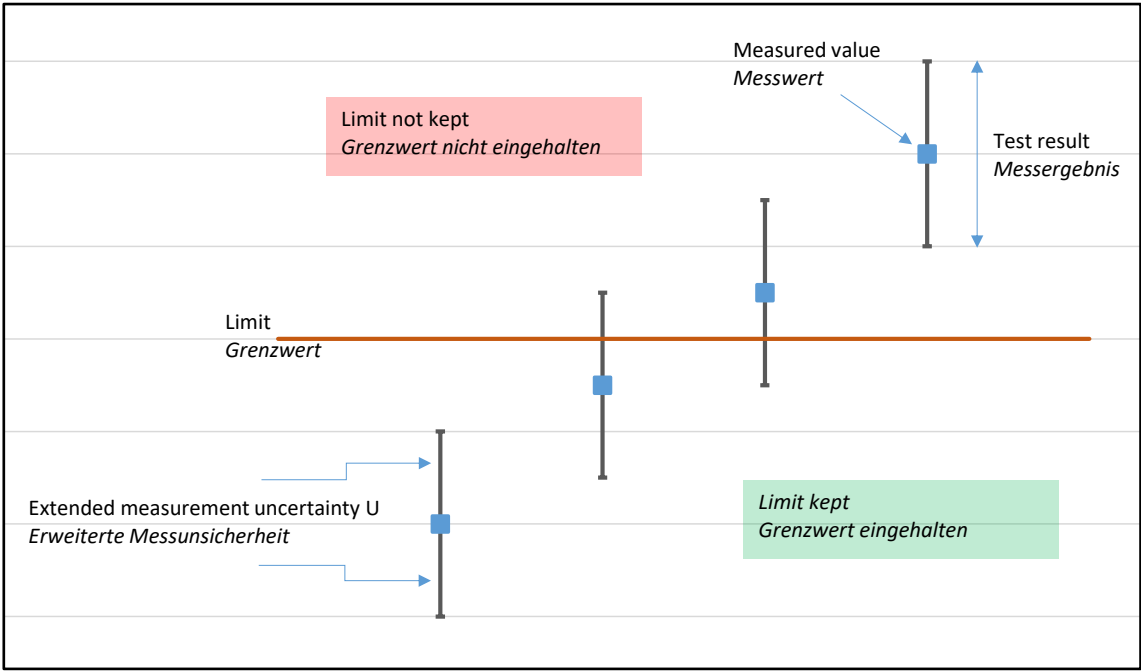
ADDITIONAL DOCUMENTATION

37 Statement of the measurement uncertainty

Measurement procedure	U _{Lab}
Limits for harmonic measurements $\leq 16A$ per conductor (Worst Case Estimation)	10.7%
Limits for voltage fluctuations and flicker $\leq 16A$ per conductor (Worst Case Estimation)	15.7%
Immunity to discharge of static electricity	18.1%
Immunity to high-frequency electromagnetic fields in the frequency range of 80-6000MHz calibration	1.2 dB
Immunity to high-frequency electromagnetic fields in the frequency range of 80-6000MHz level adjustment	2.6 dB
Immunity to fast transient disturbances	—
Immunity to surge voltages	—
Immunity to conducted electromagnetic fields in the frequency range of 0.150-30MHz Calibration CDN	1.4 dB
Immunity to conducted electromagnetic fields in the frequency range of 0.150-30MHz Level setting CDN	1.5 dB
Immunity to conducted electromagnetic fields in the frequency range of 0.150-30MHz Level adjustment EM coupling path	3.3 dB
Immunity to conducted electromagnetic fields in the frequency range of 0.150-30MHz Calibration Clamp	1.6 dB
Immunity to conducted electromagnetic fields in the frequency range of 0.150-30MHz Level adjustment Clamp	3.3 dB

ADDITIONAL DOCUMENTATION

38 Example for interpretation of measuring results



Measured value	Limit	Extended measurement uncertainty (k=2)	Test result
48.9 dBμV @ 16.5 MHz	50 dBμV	2.2 dB	46.7 dBμV – 51.1 dBμV

Appendix to Test Report No.: DE23MWM8 001

Page 16 of 40

ADDITIONAL DOCUMENTATION**Protocol of Conducted Voltage Emission (150 kHz - 30 MHz) on Mains Supply**

EUT: A003559646-002

[54](#)

Verdict	PASS
Applied Standard	FCC Part 15 Subpart B section 15.107
Test method	ANSI C63.4-2014
Supply voltage	120 V AC
Operating mode	EUT ON, all lights on (red), USB connected
Test setup	according to standard (see picture)
EMC measures	none
Remarks	—
Tested by	Shrinivas
Test Software	BAT-EMC 2022.0.19.0
Test date	2023-10-24
Temperature	15 - 35 °C
Rel. Humidity	30 - 60 %
Atmospheric pressure	860 - 1060 hPa

Appendix to Test Report No.: DE23MWM8 001

Page 17 of 40

ADDITIONAL DOCUMENTATION

Used test equipment for Conducted Voltage Emission

EUT: A003559646-002

[54](#)

Type	Manufacturer	Model	ID	Last calibration	Next calibration
LISN	Rohde & Schwarz	ESH2-Z5	2728096	2023-01-27	2026-01-27
Limiter	Rohde & Schwarz	ESH3-Z2	9017597	2022-08-25	2024-08-25
Receiver	Rohde & Schwarz	ESU 26	2723865	2023-10-04	2024-10-04
Commutation relay	MTS Systemtechnik	KRM4-5811-T-S1	2730174	---	---
Shielded room	TDK	SR 2	—	---	---

Test parameter of Conducted Voltage Emission on Mains Supply

EUT: A003559646-002

[54](#)

Subrange 1 (Wire + Measure, 150 kHz...30 MHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	9 kHz/ Auto	OFF	OFF	OFF/	ON	Auto	6dB	2.25 kHz	100 ms

Subrange 2 (Wire - Measure, 150 kHz...30 MHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	9 kHz/ Auto	OFF	OFF	OFF/	ON	Auto	6dB	2.25 kHz	100 ms

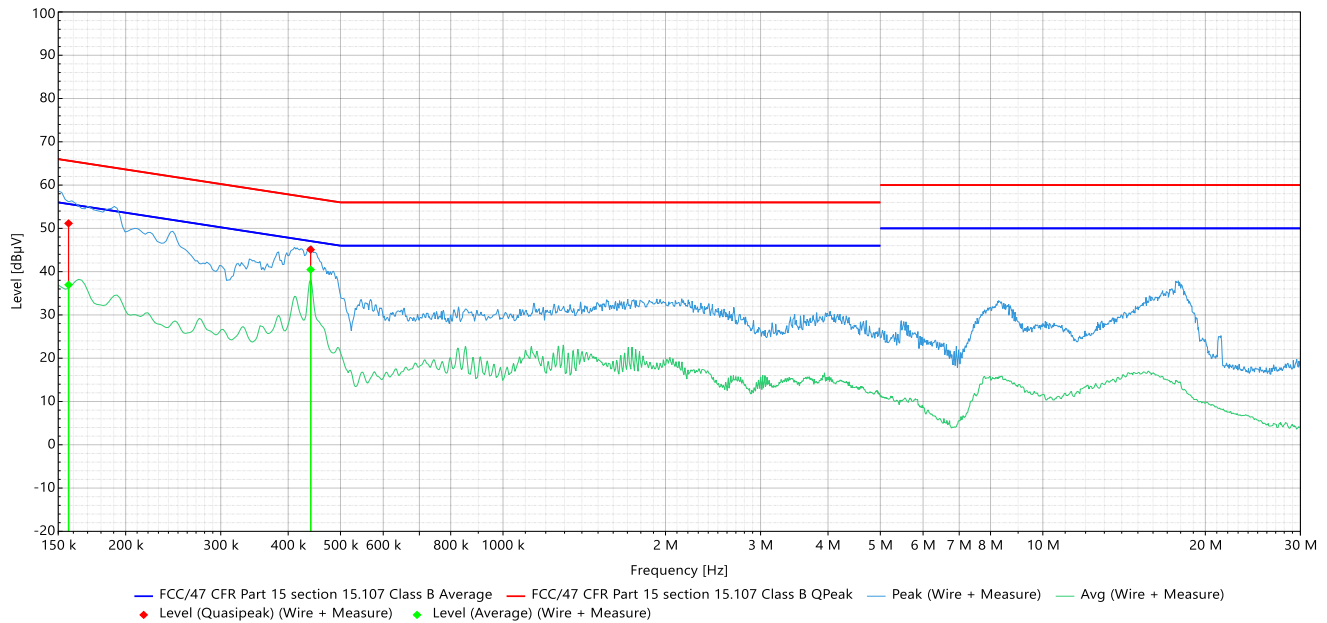
ADDITIONAL DOCUMENTATION

Chart of Conducted Voltage Emission on Mains Supply

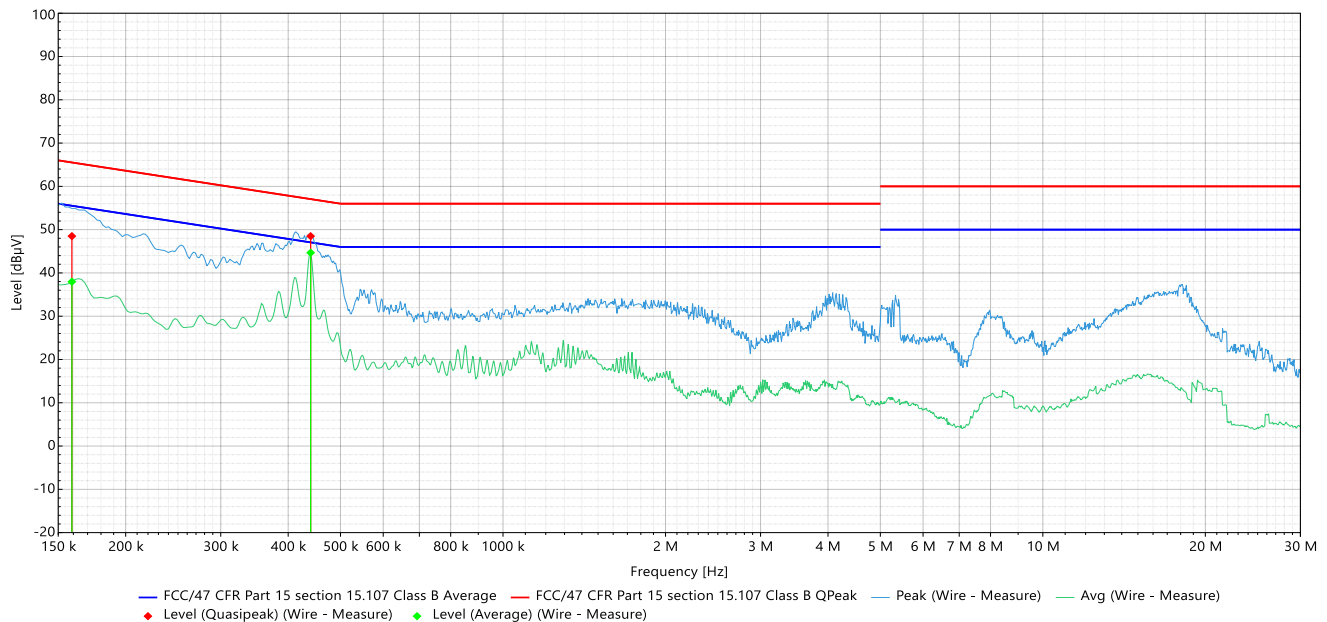
EUT: A003559646-002

[54](#)

#54(150 kHz-30 MHz), Wire + Measure



#54(150 kHz-30 MHz), Wire - Measure



Appendix to Test Report No.: DE23MWM8 001

Page 19 of 40

ADDITIONAL DOCUMENTATION

Result of Conducted Voltage Emission on Mains Supply

EUT: A003559646-002

[54](#)

QuasiPeak

Frequency (Hz)	Level (dBμV)	Limit (dBμV)	Margin (dB)	Pos	Correction (dB)	RBW (Hz)	M. time (s)	M. time (s)	Comments
159 k	48.5	65.5	-17.0	Wire - Measure	10.0	9 k	1.0	0.1	Pass
156.75 k	51.1	65.6	-14.5	Wire + Measure	10.0	9 k	1.0	0.1	Pass
440.25 k	45.1	57.1	-12.0	Wire + Measure	10.0	9 k	1.0	0.1	Pass
440.25 k	48.5	57.1	-8.6	Wire - Measure	10.0	9 k	1.0	0.1	Pass

Average

Frequency (Hz)	Level (dBμV)	Limit (dBμV)	Margin (dB)	Pos	Correction (dB)	RBW (Hz)	M. time (s)	M. time (s)	Comments
156.75 k	37.0	55.6	-18.7	Wire + Measure	10.0	9 k	1.0	0.1	Pass
159 k	38.0	55.5	-17.5	Wire - Measure	10.0	9 k	1.0	0.1	Pass
440.25 k	40.5	47.1	-6.6	Wire + Measure	10.0	9 k	1.0	0.1	Pass
440.25 k	44.7	47.1	-2.4	Wire - Measure	10.0	9 k	1.0	0.1	Pass

Measurement values which are more than 20 dB below the limit value were not detected or evaluated.

Margin value = Measurement value - Limit value

Appendix to Test Report No.: DE23MWM8 001

Page 20 of 40

ADDITIONAL DOCUMENTATION

Protocol of Conducted Voltage Emission (150 kHz - 30 MHz) on Mains Supply

EUT: A003559646-002

[55](#)

Verdict	PASS
Applied Standard	FCC Part 15 Subpart B section 15.107
Test method	ANSI C63.4-2014
Supply voltage	240 V AC
Operating mode	EUT ON, all lights on (red), USB connected
Test setup	according to standard (see picture)
EMC measures	none
Remarks	—
Tested by	Shrinivas
Test Software	BAT-EMC 2022.0.19.0
Test date	2023-10-24
Temperature	15 - 35 °C
Rel. Humidity	30 - 60 %
Atmospheric pressure	860 - 1060 hPa

Appendix to Test Report No.: DE23MWM8 001

Page 21 of 40

ADDITIONAL DOCUMENTATION

Used test equipment for Conducted Voltage Emission

EUT: A003559646-002

[55](#)

Type	Manufacturer	Model	ID	Last calibration	Next calibration
LISN	Rohde & Schwarz	ESH2-Z5	2728096	2023-01-27	2026-01-27
Limitor	Rohde & Schwarz	ESH3-Z2	9017597	2022-08-25	2024-08-25
Receiver	Rohde & Schwarz	ESU 26	2723865	2023-10-04	2024-10-04
Commutation relay	MTS Systemtechnik	KRM4-5811-T-S1	2730174	---	---
Shielded room	TDK	SR 2	—	---	---

Test parameter of Conducted Voltage Emission on Mains Supply

EUT: A003559646-002

[55](#)

Subrange 1 (Wire + Measure, 150 kHz...30 MHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	9 kHz/ Auto	OFF	OFF	OFF/	ON	Auto	6dB	2.25 kHz	100 ms

Subrange 2 (Wire - Measure, 150 kHz...30 MHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	9 kHz/ Auto	OFF	OFF	OFF/	ON	Auto	6dB	2.25 kHz	100 ms

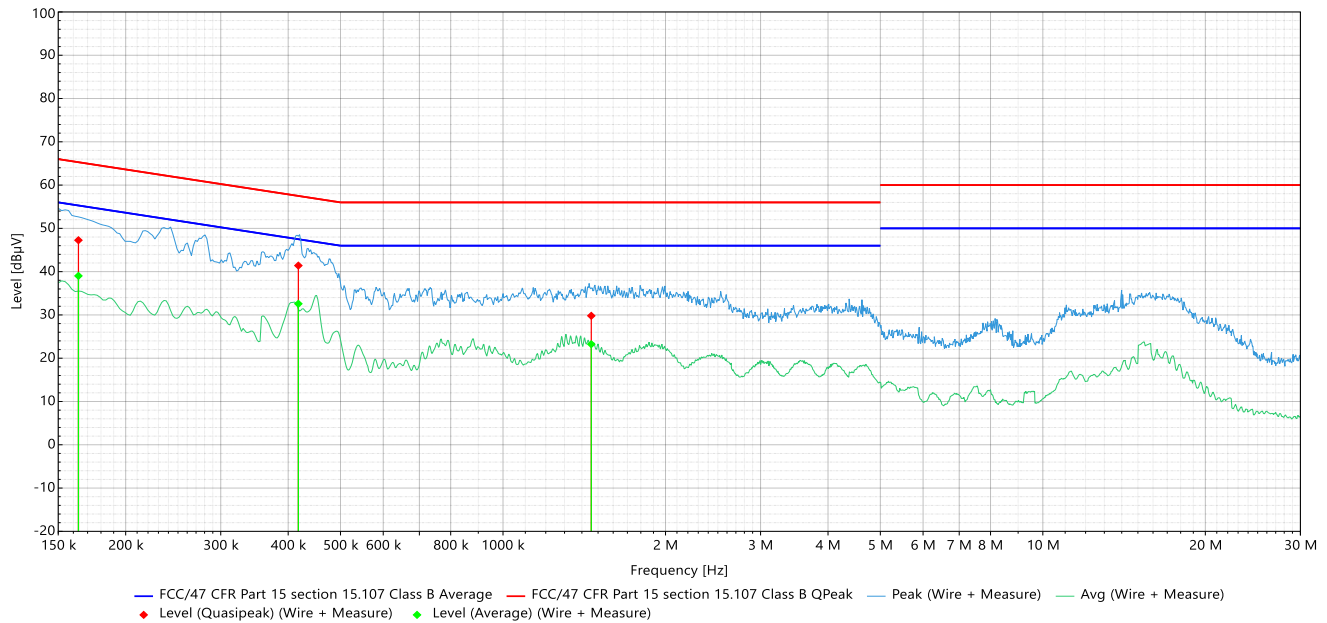
ADDITIONAL DOCUMENTATION

Chart of Conducted Voltage Emission on Mains Supply

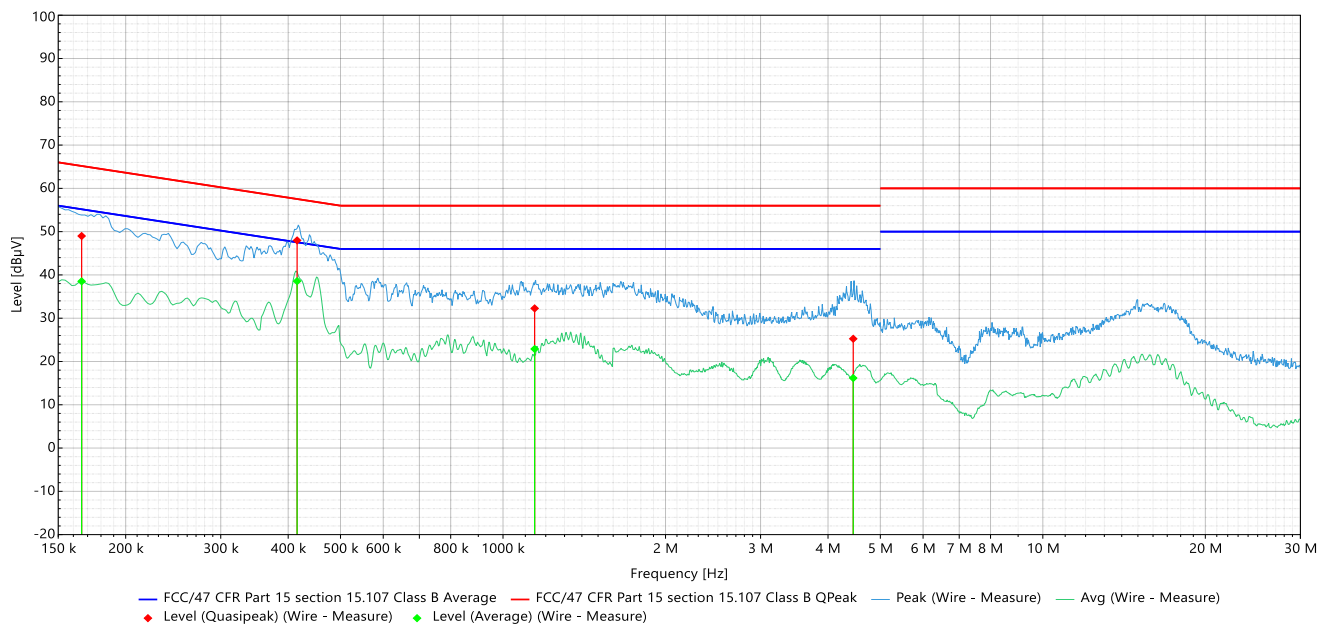
EUT: A003559646-002

[55](#)

#55(150 kHz-30 MHz), Wire + Measure



#55(150 kHz-30 MHz), Wire - Measure



Appendix to Test Report No.: DE23MWM8 001

Page 23 of 40

ADDITIONAL DOCUMENTATION

Result of Conducted Voltage Emission on Mains Supply

EUT: A003559646-002

55

QuasiPeak

Frequency (Hz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Pos	Correction (dB)	RBW (Hz)	M. time (s)	M. time (s)	Comments
4.454 M	25.2	56.0	-30.8	Wire - Measure	10.1	9 k	1.0	0.1	Pass
1.457 M	29.8	56.0	-26.2	Wire + Measure	10.1	9 k	1.0	0.1	Pass
1.145 M	32.3	56.0	-23.7	Wire - Measure	10.1	9 k	1.0	0.1	Pass
163.5 k	47.3	65.3	-18.0	Wire + Measure	10.0	9 k	1.0	0.1	Pass
165.75 k	49.0	65.2	-16.2	Wire - Measure	10.0	9 k	1.0	0.1	Pass
417.75 k	41.4	57.5	-16.1	Wire + Measure	10.0	9 k	1.0	0.1	Pass
415.5 k	48.0	57.5	-9.6	Wire - Measure	10.0	9 k	1.0	0.1	Pass

Average

Frequency (Hz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Pos	Correction (dB)	RBW (Hz)	M. time (s)	M. time (s)	Comments
4.454 M	16.2	46.0	-29.8	Wire - Measure	10.1	9 k	1.0	0.1	Pass
1.145 M	22.9	46.0	-23.1	Wire - Measure	10.1	9 k	1.0	0.1	Pass
1.457 M	23.2	46.0	-22.8	Wire + Measure	10.1	9 k	1.0	0.1	Pass
165.75 k	38.5	55.2	-16.6	Wire - Measure	10.0	9 k	1.0	0.1	Pass
163.5 k	39.0	55.3	-16.3	Wire + Measure	10.0	9 k	1.0	0.1	Pass
417.75 k	32.6	47.5	-14.9	Wire + Measure	10.0	9 k	1.0	0.1	Pass
415.5 k	38.6	47.5	-9.0	Wire - Measure	10.0	9 k	1.0	0.1	Pass

Measurement values which are more than 20 dB below the limit value were not detected or evaluated.

Margin value = Measurement value - Limit value

Appendix to Test Report No.: DE23MWM8 001

Page 24 of 40

ADDITIONAL DOCUMENTATION

Protocol of Radiated Electric Emission (30 MHz - 1 GHz)

EUT: A003559646-002

[22](#)

Verdict	PASS
Applied Standard	FCC Part 15 Subpart B section 15.109
Test method	ANSI C63.4-2014
Supply voltage	Battery operated
Operating mode	EUT ON, all lights on (red), USB connected
Test setup	according to standard (see picture)
EMC measures	none
Remarks	—
Tested by	Tom Zahlmann
Test Software	BAT-EMC 2022.0.19.0
Test date	2023-10-17
Temperature	15 - 35 °C
Rel. Humidity	30 - 60 %
Atmospheric pressure	860 - 1060 hPa

Appendix to Test Report No.: DE23MWM8 001

Page 25 of 40

ADDITIONAL DOCUMENTATION

Used test equipment for Radiated Electric Emission

EUT: A003559646-002

[22](#)

Type	Manufacturer	Model	ID	Last calibration	Next calibration
Turntable	INN-CO	CO 3000	2869231	---	---
Antenna mast	INN-CO	CO 3000	2869231	---	---
Receiver	Rohde & Schwarz	ESU 8	2728844	2023-01-26	2024-01-26
Anechoic chamber	Siemens	SAC 10 (NSA 30-1000MHz)	2729645	2023-06-15	2026-06-15
Antenna	Schwarzbeck	VULB 9168	2728787	2022-11-02	2025-11-02

Test parameter of Radiated Electric Emission

EUT: A003559646-002

[22](#)

Subrange 1 (Vertical, 30 MHz...1 GHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	120 kHz/ Auto	ON	OFF	ON/0 dB	ON	Auto	6dB	30 kHz	20 ms

Subrange 2 (Horizontal, 30 MHz...1 GHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	120 kHz/ Auto	ON	OFF	ON/0 dB	ON	Auto	6dB	30 kHz	20 ms

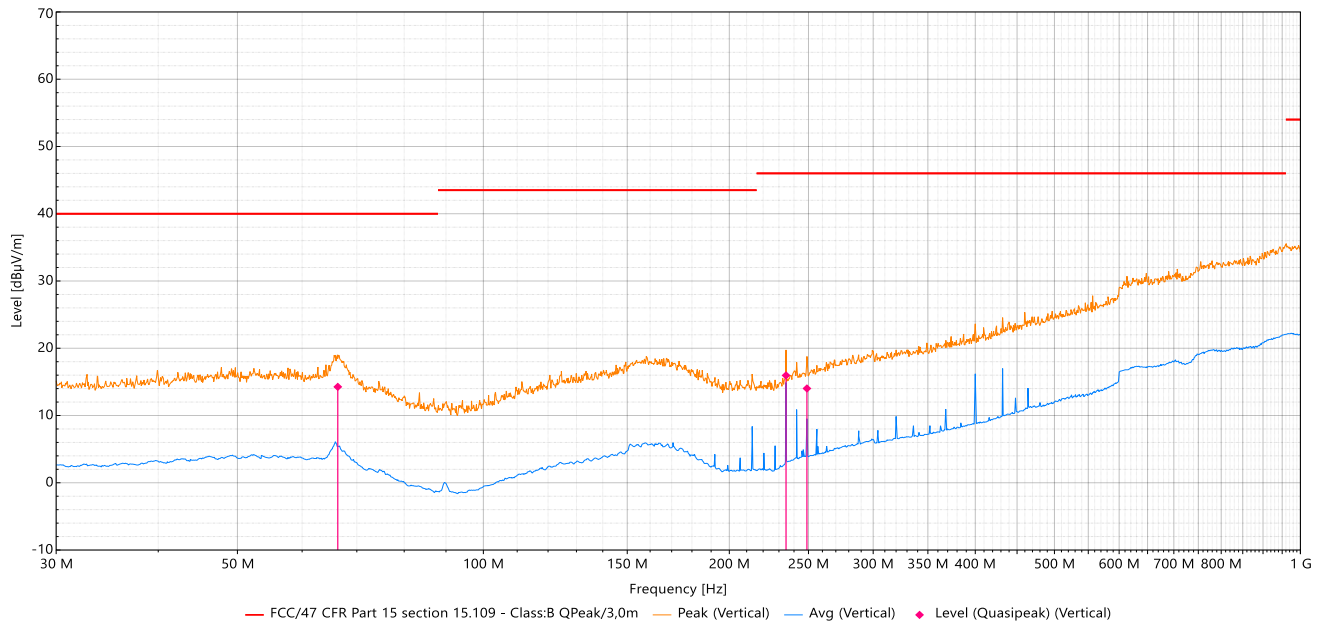
ADDITIONAL DOCUMENTATION

Chart of Radiated Electric Emission

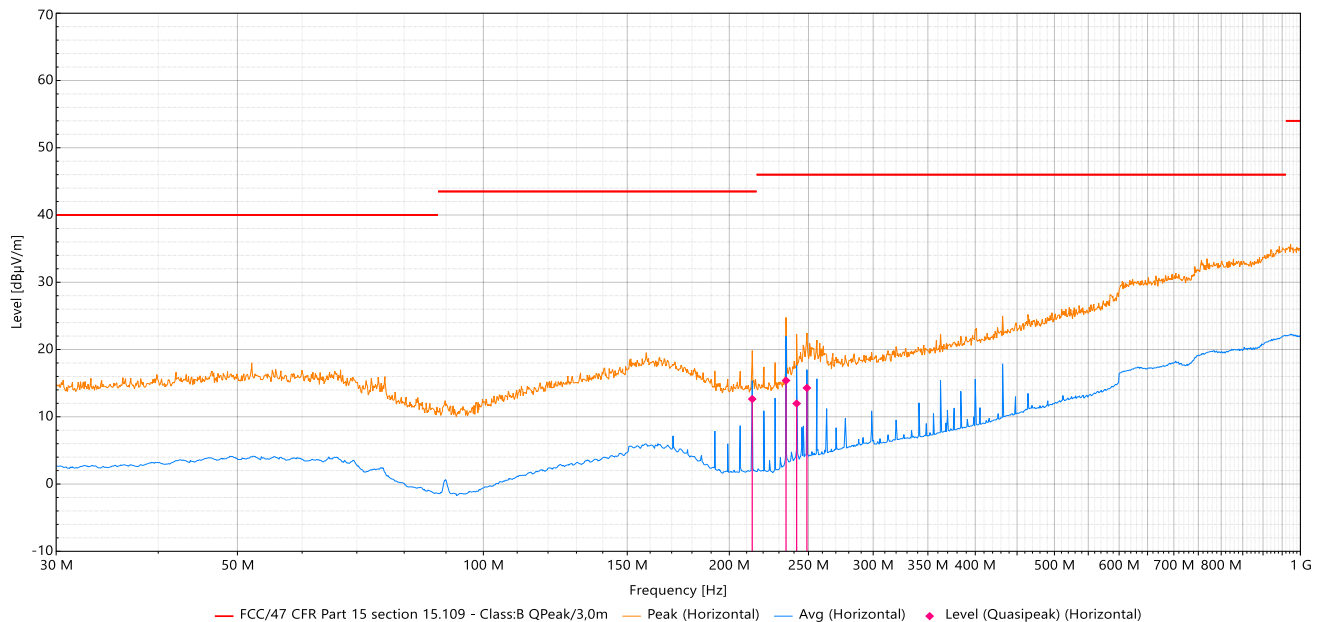
EUT: A003559646-002

[22](#)

#22(30 MHz-1 GHz), Vertical



#22(30 MHz-1 GHz), Horizontal



Appendix to Test Report No.: DE23MWM8 001

Page 27 of 40

ADDITIONAL DOCUMENTATION

Result of Radiated Electric Emission

EUT: A003559646-002

[22](#)

QuasiPeak

Freq uenc y (Hz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pos	Azimuth (°)	Height (m)	Correcti on (dB)	RBW (Hz)	M. time (s)	M. time (s)	Comments
241. 78 M	12.0	46.0	-34.0	H	190.7	1.43	13.4	120 k	1.0	0.0	Pass
248. 892 M	14.0	46.0	-32.0	V	170.1	1.94	13.7	120 k	1.0	0.0	Pass
248. 897 M	14.3	46.0	-31.7	H	278.3	1.50	13.7	120 k	1.0	0.0	Pass
213. 338 M	12.6	43.5	-30.9	H	151.9	1.91	11.8	120 k	1.0	0.0	Pass
234. 671 M	15.4	46.0	-30.6	H	171.0	1.68	12.7	120 k	1.0	0.0	Pass
234. 67 M	16.0	46.0	-30.0	V	319.6	1.59	12.7	120 k	1.0	0.0	Pass
66.3 46 M	14.3	40.0	-25.7	V	247.0	1.00	13.4	120 k	1.0	0.0	Pass

Measurement values which are more than 20 dB below the limit value were not detected or evaluated.

Margin value = Measurement value - Limit value

Appendix to Test Report No.: DE23MWM8 001

Page 28 of 40

ADDITIONAL DOCUMENTATION**Protocol of Radiated Electric Emission (30 MHz - 1 GHz)**

EUT: A003559646-002

[29](#)

Verdict	PASS
Applied Standard	ICES-003 (Issue 7)
Test method	ANSI C63.4-2014
Supply voltage	Battery operated
Operating mode	EUT ON, all lights on (red), USB connected
Test setup	according to standard (see picture)
EMC measures	none
Remarks	—
Tested by	Tom Zahlmann
Test Software	BAT-EMC 2022.0.19.0
Test date	2023-10-17
Temperature	15 - 35 °C
Rel. Humidity	30 - 60 %
Atmospheric pressure	860 - 1060 hPa

Appendix to Test Report No.: DE23MWM8 001

Page 29 of 40

ADDITIONAL DOCUMENTATION

Used test equipment for Radiated Electric Emission

EUT: A003559646-002

[29](#)

Type	Manufacturer	Model	ID	Last calibration	Next calibration
Turntable	INN-CO	CO 3000	2869231	---	---
Antenna mast	INN-CO	CO 3000	2869231	---	---
Receiver	Rohde & Schwarz	ESU 8	2728844	2023-01-26	2024-01-26
Anechoic chamber	Siemens	SAC 10 (NSA 30-1000MHz)	2729645	2023-06-15	2026-06-15
Antenna	Schwarzbeck	VULB 9168	2728787	2022-11-02	2025-11-02

Test parameter of Radiated Electric Emission

EUT: A003559646-002

[29](#)

Subrange 1 (Vertical, 30 MHz...1 GHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	120 kHz/ Auto	ON	OFF	ON/0 dB	ON	Auto	6dB	30 kHz	20 ms

Subrange 2 (Horizontal, 30 MHz...1 GHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	120 kHz/ Auto	ON	OFF	ON/0 dB	ON	Auto	6dB	30 kHz	20 ms

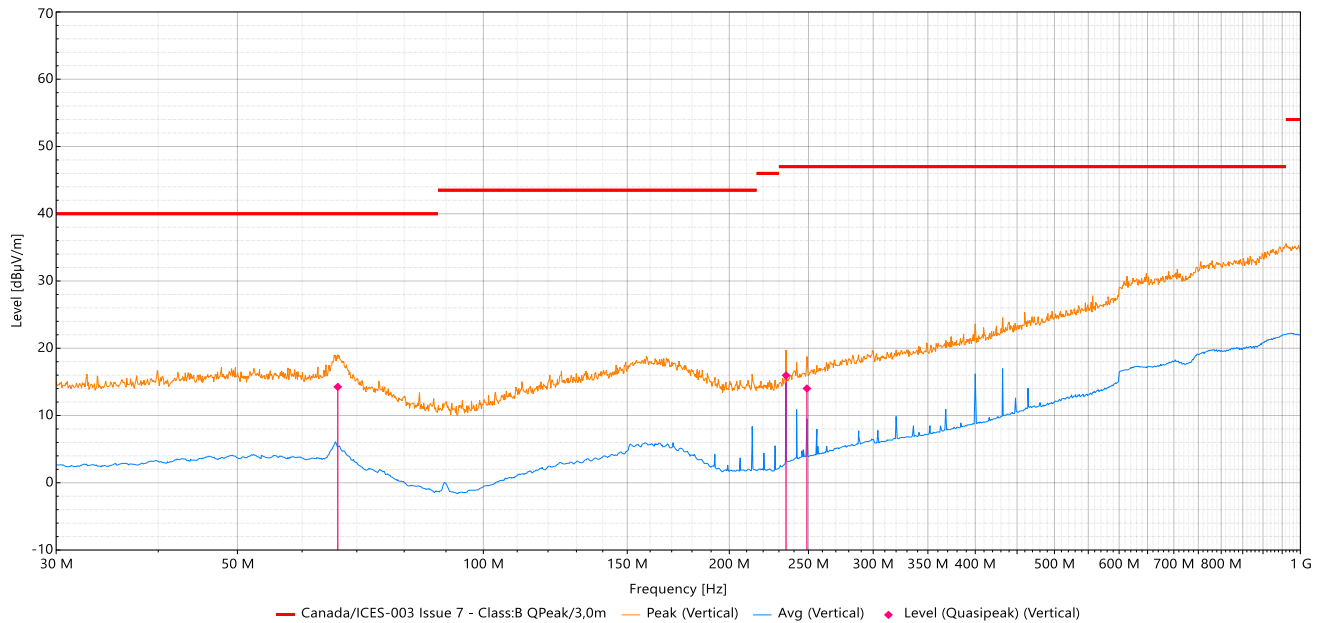
ADDITIONAL DOCUMENTATION

Chart of Radiated Electric Emission

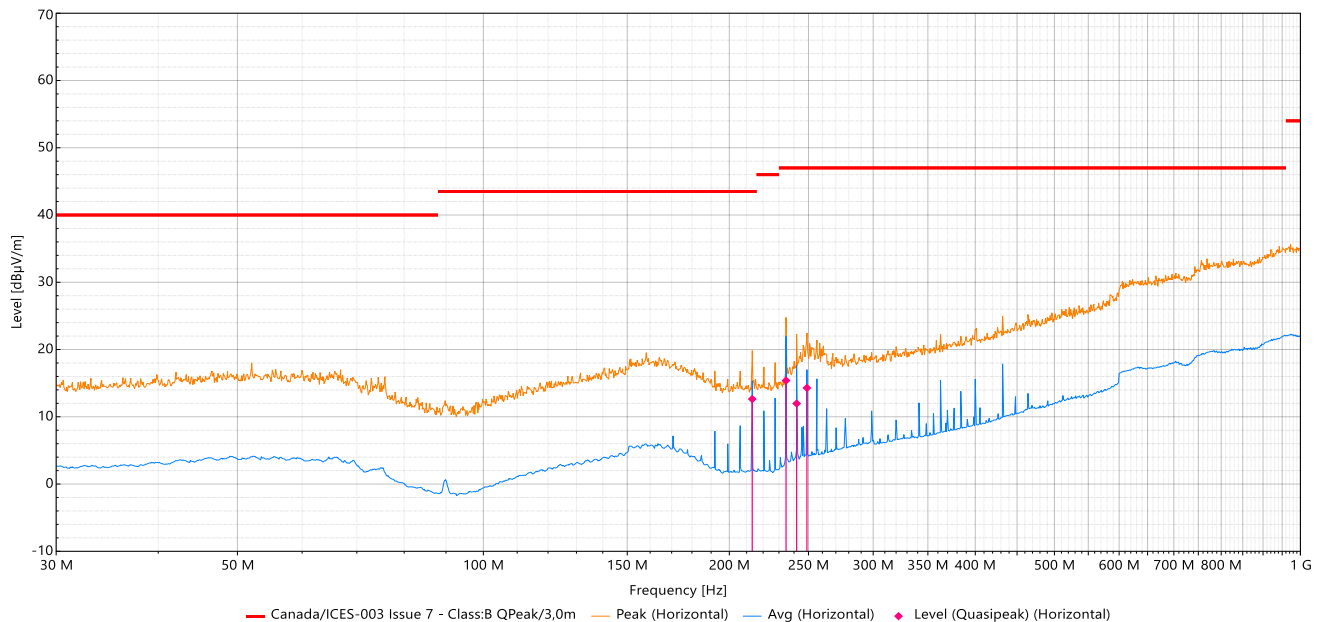
EUT: A003559646-002

[29](#)

#29(30 MHz-1 GHz), Vertical



#29(30 MHz-1 GHz), Horizontal



Appendix to Test Report No.: DE23MWM8 001

Page 31 of 40

ADDITIONAL DOCUMENTATION

Result of Radiated Electric Emission

EUT: A003559646-002

[29](#)

QuasiPeak

Freq uenc y (Hz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pos	Azimuth (°)	Height (m)	Correcti on (dB)	RBW (Hz)	M. time (s)	M. time (s)	Comments
241. 78 M	12.0	47.0	-33.0	H	190.7	1.43	13.4	120 k	1.0	0.0	Pass
248. 892 M	14.0	47.0	-31.0	V	170.1	1.94	13.7	120 k	1.0	0.0	Pass
213. 338 M	12.6	43.5	-30.9	H	151.9	1.91	11.8	120 k	1.0	0.0	Pass
248. 897 M	14.3	47.0	-30.7	H	278.3	1.50	13.7	120 k	1.0	0.0	Pass
234. 671 M	15.4	47.0	-29.6	H	171.0	1.68	12.7	120 k	1.0	0.0	Pass
234. 67 M	16.0	47.0	-29.0	V	319.6	1.59	12.7	120 k	1.0	0.0	Pass
66.3 46 M	14.3	40.0	-25.7	V	247.0	1.00	13.4	120 k	1.0	0.0	Pass

Measurement values which are more than 20 dB below the limit value were not detected or evaluated.

Margin value = Measurement value - Limit value

Appendix to Test Report No.: DE23MWM8 001

Page 32 of 40

ADDITIONAL DOCUMENTATION**Protocol of Radiated Electric Emission (1 GHz - 6 GHz)**

EUT: A003559646-002

[21](#)

Verdict	PASS
Applied Standard	FCC Part 15 Subpart B section 15.109
Test method	ANSI C63.4-2014
Supply voltage	battery powered
Operating mode	EUT ON, all lights on (red), USB connected
Test setup	according to standard (see picture)
EMC measures	none
Remarks	-
Tested by	Tom Zahlmann
Test Software	BAT-EMC 2022.0.19.0
Test date	2023-10-17
Temperature	15 - 35 °C
Rel. Humidity	30 - 60 %
Atmospheric pressure	860 - 1060 hPa

Appendix to Test Report No.: DE23MWM8 001

Page 33 of 40

ADDITIONAL DOCUMENTATION

Used test equipment for Radiated Electric Emission

EUT: A003559646-002

[21](#)

Type	Manufacturer	Model	ID	Last calibration	Next calibration
Turntable	INN-CO	CO 3000	2869231	---	---
Receiver	Rohde & Schwarz	ESU 8	2728844	2023-01-26	2024-01-26
Antenna mast	Maturo	FCU3.0	xxxxxxx	---	---
Antenna	Rohde & Schwarz	HL 025	2728919	2022-10-04	2025-10-04
Preamplifier	—	—	—	---	---
Anechoic chamber	Siemens	SAC 3 (SVSWR 1-18GHz)	2924440	2020-06-19	2023-10-19

Test parameter of Radiated Electric Emission

EUT: A003559646-002

[21](#)

Subrange 1 (Horizontal, 1 GHz...6 GHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	1 MHz/ Auto	ON	OFF	ON/0 dB	ON	Auto	6dB	250 kHz	5 ms

Subrange 2 (Vertical, 1 GHz...6 GHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	1 MHz/ Auto	ON	OFF	ON/0 dB	ON	Auto	6dB	250 kHz	5 ms

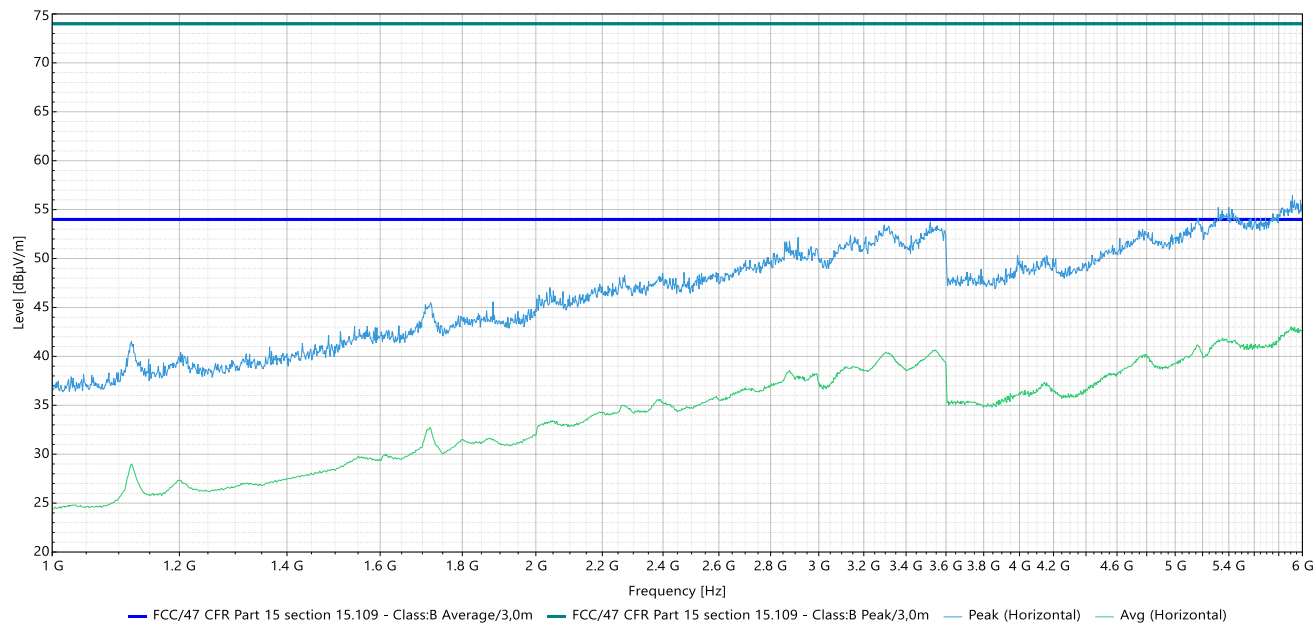
ADDITIONAL DOCUMENTATION

Chart of Radiated Electric Emission

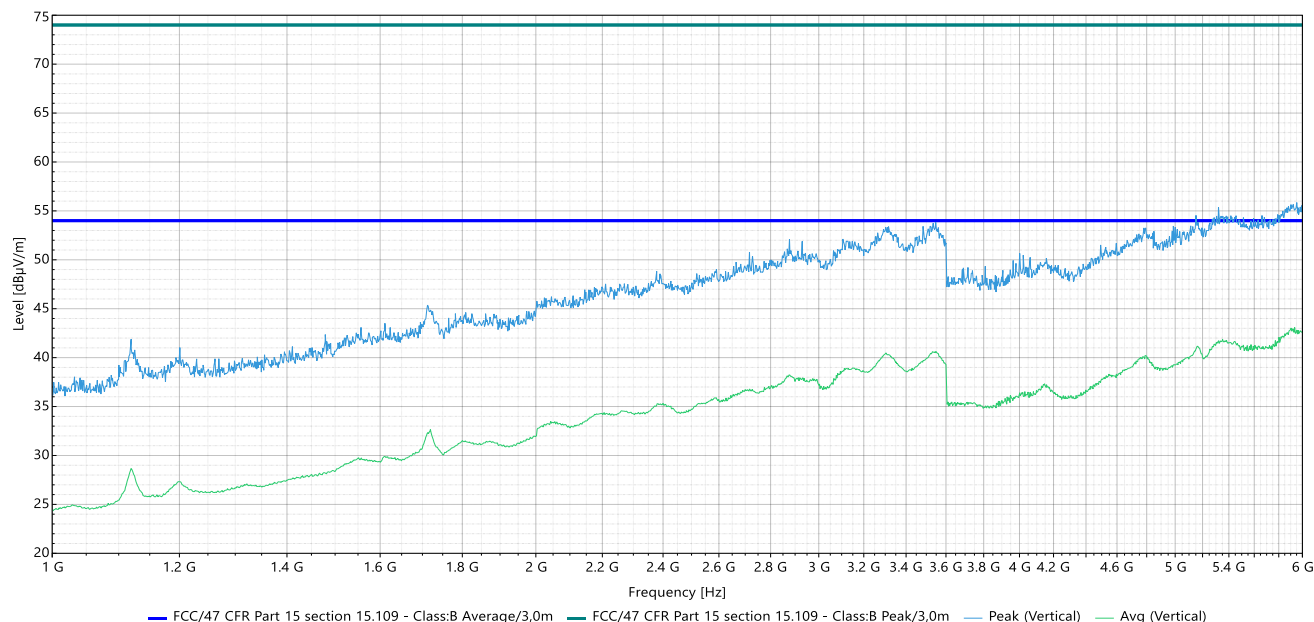
EUT: A003559646-002

[21](#)

#21(1 GHz-6 GHz), Horizontal



#21(1 GHz-6 GHz), Vertical



Result of Radiated Electric Emission

EUT: A003559646-002

[21](#)

Measurement values which are more than 20 dB below the limit value were not detected or evaluated.

Margin value = Measurement value - Limit value

Appendix to Test Report No.: DE23MWM8 001

Page 35 of 40

ADDITIONAL DOCUMENTATION**Protocol of Radiated Electric Emission (1 GHz - 6 GHz)**

EUT: A003559646-002

[30](#)

Verdict	PASS
Applied Standard	ICES-003 (Issue 7)
Test method	ANSI C63.4-2014
Supply voltage	battery powered
Operating mode	EUT ON, all lights on (red), USB connected
Test setup	according to standard (see picture)
EMC measures	none
Remarks	-
Tested by	Tom Zahlmann
Test Software	BAT-EMC 2022.0.19.0
Test date	2023-10-17
Temperature	15 - 35 °C
Rel. Humidity	30 - 60 %
Atmospheric pressure	860 - 1060 hPa

Appendix to Test Report No.: DE23MWM8 001

Page 36 of 40

ADDITIONAL DOCUMENTATION

Used test equipment for Radiated Electric Emission

EUT: A003559646-002

[30](#)

Type	Manufacturer	Model	ID	Last calibration	Next calibration
Turntable	INN-CO	CO 3000	2869231	---	---
Receiver	Rohde & Schwarz	ESU 8	2728844	2023-01-26	2024-01-26
Antenna mast	Maturo	FCU3.0	xxxxxxx	---	---
Antenna	Rohde & Schwarz	HL 025	2728919	2022-10-04	2025-10-04
Preamplifier	—	—	—	---	---
Anechoic chamber	Siemens	SAC 3 (SVSWR 1-18GHz)	2924440	2020-06-19	2023-10-19

Test parameter of Radiated Electric Emission

EUT: A003559646-002

[30](#)

Subrange 1 (Horizontal, 1 GHz...6 GHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	1 MHz/ Auto	ON	OFF	ON/0 dB	ON	Auto	6dB	250 kHz	5 ms

Subrange 2 (Vertical, 1 GHz...6 GHz)

Reference Level	RBW/VBW	Preamp	LN-Preamp	Preselector/Attenuation	Auto Ranging	Att.	Filter	Step	Sweep Time
80 dBμV	1 MHz/ Auto	ON	OFF	ON/0 dB	ON	Auto	6dB	250 kHz	5 ms

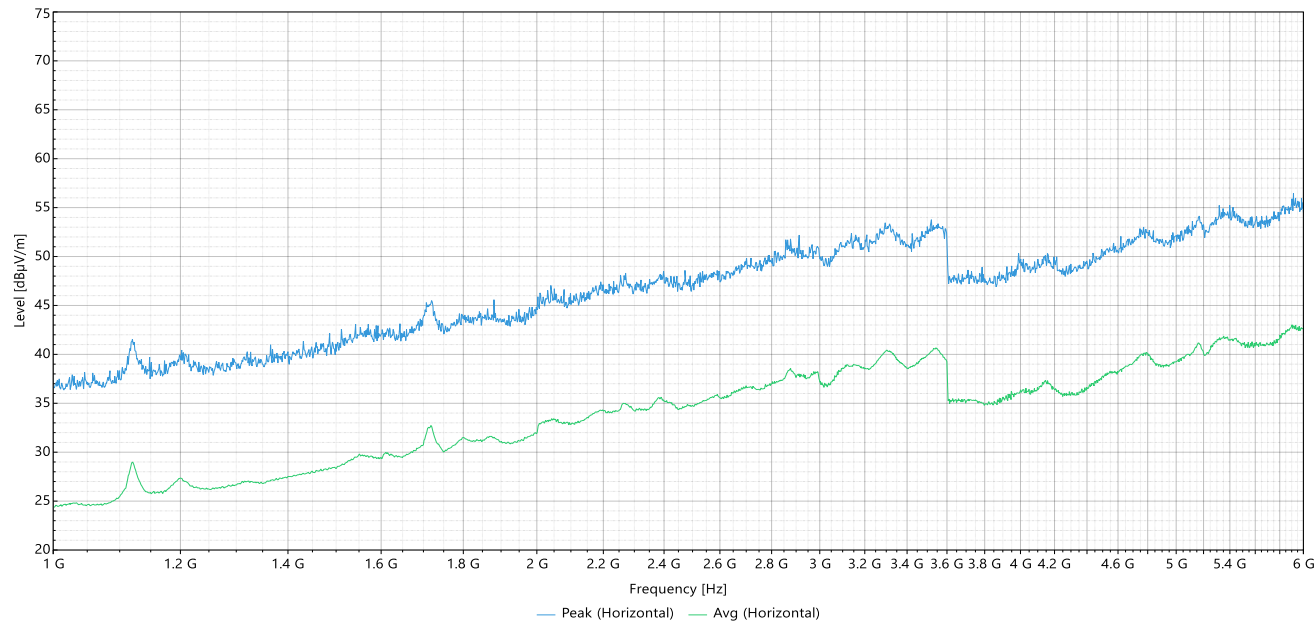
ADDITIONAL DOCUMENTATION

Chart of Radiated Electric Emission

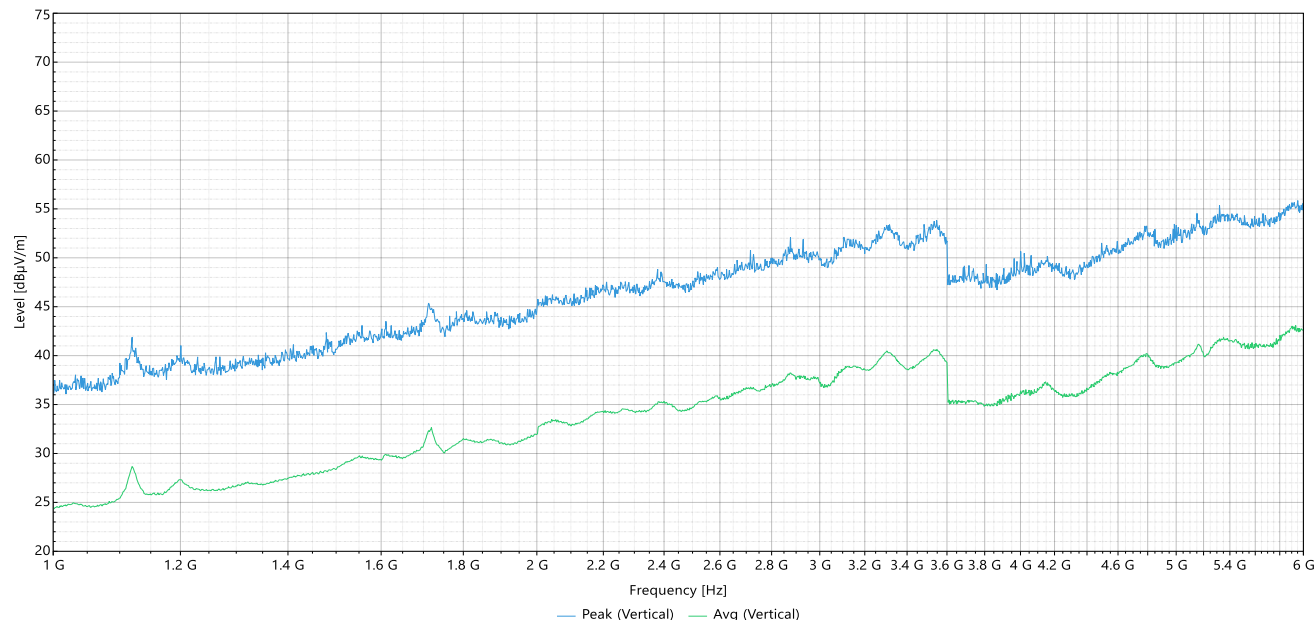
EUT: A003559646-002

30

#30(1 GHz-6 GHz), Horizontal



#30(1 GHz-6 GHz), Vertical



Result of Radiated Electric Emission

EUT: A003559646-002

30

Measurement values which are more than 20 dB below the limit value were not detected or evaluated.
Margin value = Measurement value - Limit value

REVISION HISTORY

Photo documentation

Refer to EUT Test Setup Photos_DE23MWM8 001
Refer to EUT Internal Photos_DE23OWMA 001
Refer to EUT External Photos_DE23OWMA 001

39	Change history		
	Rev. No.	List of changes	Date Author
	001	First edition (DE23MWM8 001)	2023-10-25 Tom Zahlmann

**TABLE OF CONTENTS
TABLE OF FIGURES**

Table of Contents

Equipment used during test	9
Input/Output ports	9
EUT configuration	10
Statement of the measurement uncertainty	13
Protocol of Conducted Voltage Emission (150 kHz - 30 MHz) on Mains Supply	16
Protocol of Conducted Voltage Emission (150 kHz - 30 MHz) on Mains Supply	20
Protocol of Radiated Electric Emission (30 MHz - 1 GHz)	24
Protocol of Radiated Electric Emission (30 MHz - 1 GHz)	28
Protocol of Radiated Electric Emission (1 GHz - 6 GHz)	32
Protocol of Radiated Electric Emission (1 GHz - 6 GHz)	35
Change history	38

Table of figures

Es konnten keine Einträge für ein Abbildungsverzeichnis gefunden werden.

Appendix to Test Report No.: DE23MWM8 001

Page 40 of 40

**TABLE OF CONTENTS
TABLE OF FIGURES**

————— End of test report —————