

Prüfbericht-Nr.: <i>Test report no.:</i>	CN23HPPO 002	Auftrags-Nr.: <i>Order no.:</i>	168442437	Seite 1 von 24 Page 1 of 24
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2023-09-05	
Auftraggeber: <i>Client:</i>	Nice North America LLC 5919 Sea Otter Place, Suite 100, Carlsbad, CA 92010, United States			
Prüfgegenstand: <i>Test item:</i>	Digital Transmitter			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	MMS100			
Auftrags-Inhalt: <i>Order content:</i>	Test Report			
Prüfgrundlage: <i>Test specification:</i>	CFR47 FCC Part 15: Subpart C Section 15.247 RSS-247 Issue3 RSS-Gen Issue 5			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2023-09-19	Please refer to Photo Document		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003564242-001~003			
Prüfzeitraum: <i>Testing period:</i>	2023-09-26 - 2023-10-18			
Ort der Prüfung: <i>Place of testing:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>	 Lin Lin	genehmigt von: <i>authorized by:</i>	 Hardy Suo	
Datum: <i>Date:</i>	2023-10-23	Ausstellungsdatum: <i>Issue date:</i>	2023-10-23	
Stellung / Position:	Sachverständige(r)/Expert	Stellung / Position:	Sachverständige(r)/Expert	
Sonstiges / <i>Other:</i>	FCC ID: EF400233 IC: 1078A-00233 HVIN: 10033233			
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
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V05

Prüfbericht-Nr.: CN23HPPO 002
Test report no.:

Seite 2 von 24
Page 2 of 24

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 Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</p> <p><i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i></p>
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3	<p>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</p> <p><i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i> <i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i></p>
4	<p>Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019.</p> <p><i>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information about the resulting risk based of this decision rule please refer to ILAC G8:2019.</i></p>

Test Summary

5.1.1 ANTENNA REQUIREMENT*RESULT: Pass***5.1.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER***RESULT: Pass***5.1.3 99% BANDWIDTH***RESULT: Pass***5.1.4 20DB BANDWIDTH***RESULT: Pass***5.1.5 CARRIER FREQUENCY SEPARATION***RESULT: Pass***5.1.6 NUMBER OF HOPPING FREQUENCY***RESULT: Pass***5.1.7 TIME OF OCCUPANCY***RESULT: Pass***5.1.8 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 KHZ BANDWIDTH***RESULT: Pass***5.1.9 RADIATED SPURIOUS EMISSION***RESULT: Pass***5.1.10 CONDUCTED EMISSION ON AC MAINS***RESULT: Pass*

Contents

1	GENERAL REMARKS	5
1.1	COMPLEMENTARY MATERIALS	5
2	TEST SITES	6
2.1	TEST FACILITIES	6
2.2	LIST OF TEST AND MEASUREMENT INSTRUMENTS.....	6
2.3	TRACEABILITY	7
2.4	CALIBRATION	7
2.5	MEASUREMENT UNCERTAINTY.....	7
2.6	LOCATION OF ORIGINAL DATA.....	7
2.7	STATUS OF FACILITY USED FOR TESTING.....	7
3	GENERAL PRODUCT INFORMATION	8
3.1	PRODUCT FUNCTION AND INTENDED USE.....	8
3.2	RATINGS AND SYSTEM DETAILS	8
3.3	CHANNEL LIST OF 915MHZ.....	9
3.4	INDEPENDENT OPERATION MODES	9
3.5	NOISE GENERATING AND NOISE SUPPRESSING PARTS.....	10
3.6	SUBMITTED DOCUMENTS.....	10
4	TEST SET-UP AND OPERATION MODES	11
4.1	PRINCIPLE OF CONFIGURATION SELECTION	11
4.2	TEST OPERATION AND TEST SOFTWARE.....	11
4.3	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	11
4.4	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE.....	11
4.5	TEST SETUP DIAGRAM.....	12
5	TEST RESULTS	14
5.1	TRANSMITTER REQUIREMENT & TEST SUITES	14
5.1.1	<i>Antenna Requirement</i>	<i>14</i>
5.1.2	<i>Maximum Peak Conducted Output Power.....</i>	<i>15</i>
5.1.3	<i>99% Bandwidth</i>	<i>16</i>
5.1.4	<i>20dB Bandwidth</i>	<i>17</i>
5.1.5	<i>Carrier Frequency Separation.....</i>	<i>18</i>
5.1.6	<i>Number of Hopping Frequency.....</i>	<i>19</i>
5.1.7	<i>Time of Occupancy</i>	<i>20</i>
5.1.8	<i>Conducted Spurious Emissions Measured in 100 kHz Bandwidth</i>	<i>21</i>
5.1.9	<i>Radiated Spurious Emission</i>	<i>22</i>
5.1.10	<i>Conducted Emission on AC Mains</i>	<i>23</i>
6	PHOTOGRAPHS OF THE TEST SET-UP.....	24
7	LIST OF TABLES.....	24

1 General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: Test Results

Appendix B: Photographs of the Test Set-up

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.

No. 362 Huanguan Road Middle, Longhua District, 518110, Shenzhen, P. R. China.

FCC Registration No.: 694916

ISED wireless device testing laboratory: 25069

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Radio Spectrum Testing (TS8997)				
Equipment	Manufacturer	Model	Serial No.	Cal. until
Signal Analyzer	R&S	FSV 40	101441	2024-07-25
OSP	R&S	OSP 150	101017	2023-11-21
Control PC	DELL	OptiPlex 7050	FTJZ9P2	N/A
Test Software	R&S	WMS32 (V11.00.00)	N/A	N/A
Power Meter	R&S	NRP2	107105	2023-11-21
Wideband Power Sensor	R&S	NRP-Z81	105677	2024-07-25
Shielding Room 8#	Albatross	SR8	APC17151-SR8	2024-06-22
Unwanted Emission Testing (TS9975)				
Equipment	Manufacturer	Model	Serial No.	Cal. until
EMI Test Receiver	R&S	ESR 7	102021	2024-07-25
Signal Analyzer	R&S	FSV 40	101439	2024-07-25
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	2024-07-25
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2024-07-25
Amplifier	R&S	SCU-18F	180070	2024-07-25
Amplifier	R&S	SCU40A	100475	2024-07-25
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2024-08-06
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2024-08-06
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2024-08-27
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2024-08-06
Test software	R&S	EMC32 (V10.60.10)	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NV9P2	N/A
3m Semi-Anechoic Chamber	Albatross	SAC-3m	APC17151-SAC	2024-06-22

Conducted Emission				
Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
EMI Test Receiver	R&S	ESR3	102428	2024-09-13
Artificial Mains Network	R&S	ENV216	102333	2024-07-31
EMC32 test software	R&S	EMC32(Ver.10.50.00)	N/A	N/A

2.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institute of Metrology) or where calibration is performed in other countries, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements as below table.

Table 2: Measurement Uncertainty

Parameter	Uncertainty (k=2)
Occupied Channel Bandwidth	± 2.08 %
RF output power, conducted	± 0.99 dB
Unwanted Emissions, conducted	± 0.89 dB
All emissions, radiated	±4.17 dB
Conducted Emission, (9kHz to 150kHz)/(150kHz to 30MHz)	± 3.70 dB / ± 3.30 dB

2.6 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendix A & B of this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Shenzhen) Co., Ltd. file for certification follow-up purposes.

2.7 Status of Facility Used for Testing

The TÜV Rheinland (Shenzhen) Co., Ltd. Test facility located at No. 362 Huanguan Road Middle, Longhua District, 518110, Shenzhen, P. R. China. is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

3 General Product Information

3.1 Product Function and Intended Use

The EUT (Equipment Under Test) is a Digital Transmitter. It supports Bluetooth dual mode, 2.4GHz Wi-Fi, and 915MHz functions.

It contains:
 FCC ID: 2AC7Z-ESP32WROVERE; IC: 21098-ESPWROVERE.

For details refer to the User Manual, Technical Description and Circuit Diagram.

3.2 Ratings and System Details

Table 3: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment:	Digital Transmitter
Type Designation:	MMS100
FCC ID:	EF400233
IC:	1078A-00233
HVIN:	10033233
Operating Voltage:	DC 5V@2A input via AC/DC adapter
Testing Voltage:	AC 120V, 60Hz
AC/DC Adapter:	Model: MKS050W2000U Input: 100-240Vac, 50/60Hz Output: 5Vdc, 2A
Technical Specification of 915MHz	
Operating Frequency:	902 MHz to 928 MHz
Type of Device:	Hopping device
Type of Modulation:	GFSK
Channel Number:	50 channels
Antenna Type:	Integral Antenna
Antenna Gain:	1.82 dBi (Provided by the Client)
Technical Specification of Bluetooth dual mode (Wireless module, ESP32-WROVER-E, FCC ID: 2AC7Z-ESP32WROVERE; IC: 21098-ESPWROVERE)	
Operating Frequency:	2402 MHz to 2480 MHz
Type of Modulation:	GFSK, $\pi/4$ -DQPSK, 8DPSK
Channel Number:	BR & EDR mode:79 channels, Low Energy mode:40 channels
Channel Separation:	BR & EDR mode:1MHz, Low Energy mode:2MHz
Data Rate:	BR & EDR mode:(1Mbps, 3Mbps) Low Energy mode: (1Mbps)
Antenna Type:	Integral Antenna
Antenna Gain:	3.40 dBi Max (Provided by the Client)
Technical Specification of Wi-Fi 802.11 b/g/n (Wireless module, ESP32-WROVER-E, FCC ID: 2AC7Z-ESP32WROVERE; IC: 21098-ESPWROVERE)	

Operating Frequency:	2412 - 2462MHz for 802.11b/g/n(HT20) 2422 - 2452MHz for 802.11n(HT40)
Type of Modulation:	DSSS(DBPSK/DQPSK/CCK) OFDM(BPSK/QPSK/16QAM/64QAM)
Data Rate:	1/2/5.5/11 Mbps for 802.11b 6/9/12/18/24/36/48/54 Mbps for 802.11g MCS0 ~ MCS7 for 802.11n
Channel Number:	11 channels for 802.11b/g/n(HT20) 7 channels for 802.11n(HT40)
Channel Separation:	5 MHz
Antenna Type:	Integral Antenna
Antenna Gain:	3.40 dBi Max (Provided by the Client)

3.3 Channel List of 915MHz

Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)
1	902.3	21	912.4	41	924.4
2	902.8	22	913.2	42	924.8
3	903.2	23	913.6	43	925.2
4	904.4	24	914	44	925.6
5	904.8	25	915.2	45	926
6	905.2	26	915.6	46	926.4
7	905.6	27	916	47	926.8
8	906	28	916.8	48	927.2
9	906.4	29	917.2	49	927.6
10	906.8	30	918	50	927.8
11	907.2	31	918.4		
12	907.6	32	919.2		
13	908.4	33	919.6		
14	908.8	34	920		
15	909.2	35	920.8		
16	909.6	36	921.2		
17	910	37	921.6		
18	910.4	38	922		
19	910.8	39	922.4		
20	911.6	40	922.8		

3.4 Independent Operation Modes

The basic operation modes are:

- A. On, 915MHz transmitting mode
- 1) Low Channel
 - 2) Middle Channel

3) High Channel

- B. On, Transmitting on Hopping channel
- C. On, 915MHz with Bluetooth / Wi-Fi Co-located mode
- D. On, Normal working
- E. Off

3.5 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.6 Submitted Documents

- Application Form
- IC Label and Location Info
- User Manual
- Operation Description

4 Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

Radio Spectrum: The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All tests were performed according to the procedures in ANSI C63.10: 2013.

According to clause 3.1, all tests were performed on model MMS100 in this report.

Table 4: Test channel and frequency

Mode	Test Channels (MHz)	Remark
Transmitting	L/M/H: 902.3MHz, 915.2MHz, 927.8MHz	--

4.3 Special Accessories and Auxiliary Equipment

Table 5: Auxiliary Equipment Used during Test

Description	Manufacturer	Model	S/N
Laptop	Lenovo	T480	PF-16A6N8
Digital Transmitter	Nice North America LLC	MMS915	--

4.4 Countermeasures to Achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Technical Construction File (TCF).

No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

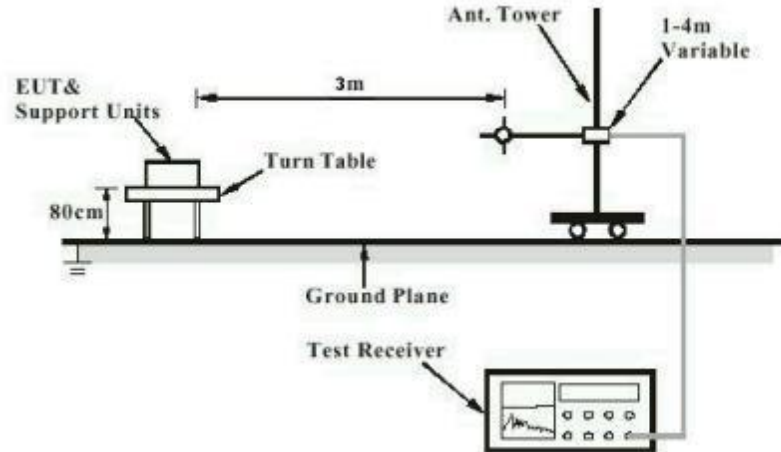


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

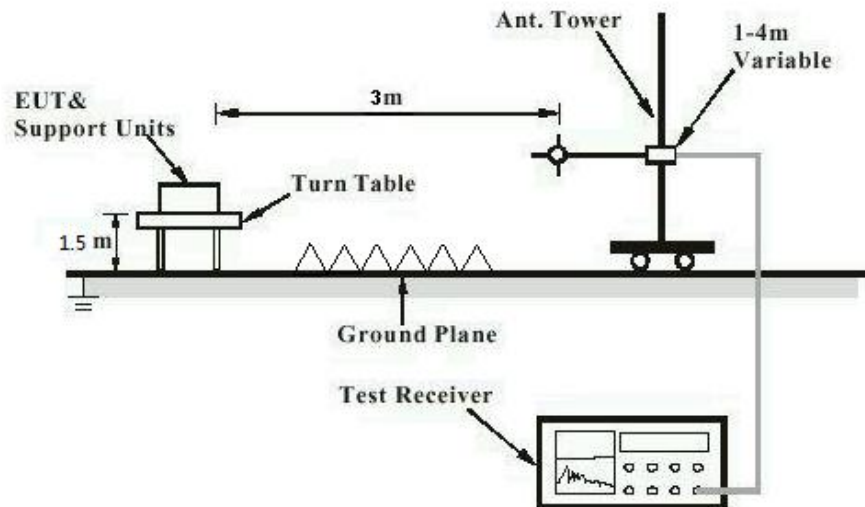


Diagram of Measurement Configuration for Conducted Transmitter Measurement

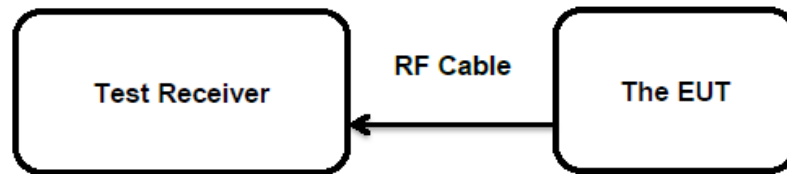
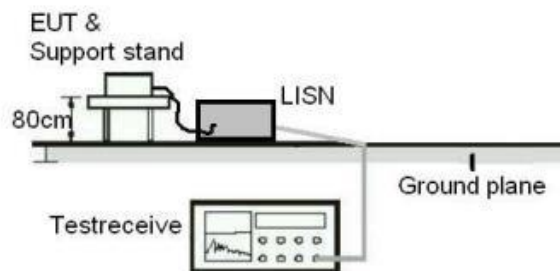


Diagram of Measurement Configuration for Mains Conduction Measurement



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:

Pass

Test Specification

Test standard : FCC Part 15.247(b)(4) and Part 15.203
RSS-Gen Clause 6.8

According to the manufacturer declared, the EUT 915MHz wireless has an Integral antenna, the directional gain of antenna is 1.82dBi, The wireless module is a PCB antenna with 3.4dBi max antenna gain, and the antenna connector is designed with permanent attachment and no consideration of replacement.

Therefore, the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

5.1.2 Maximum Peak Conducted Output Power

RESULT:
Pass
Test Specification

Test standard : FCC Part 15.247(b)(2)
 : RSS-247 Clause 5.4(a)
 Basic standard : ANSI C63.10: 2013
 Limits : < 1 Watts
 Kind of test site : Shielded Room

Test Setup

Date of testing : 2023-10-18
 Input voltage : AC 120V, 60Hz
 Operation mode : A
 Test channel : Low / Middle / High
 Ambient temperature : 23.8 °C
 Relative humidity : 52 %
 Atmospheric pressure : 101 kPa

Table 6: Test Result of Maximum Peak Conducted Output Power

Test Mode	Test Channel (MHz)	Measured Peak Power		Limit (W)
		(dBm)	(W)	
915MHz	902.3	19.45	0.0881	< 1
	915.2	17.27	0.0533	
	927.8	14.87	0.0307	
Maximum Measured Value		19.45	0.0881	
Maximum e.i.r.p. is 19.45 dBm + 1.82 dBi=21.27 dBm less than 4W(36dBm).				

Note:

- 1) The cable loss is taken into account in results.
- 2) Antenna gain(G): 1.82 dBi

5.1.3 99% Bandwidth

RESULT:**Pass****Test Specification**

Test standard	:	FCC Part 15.247(a) RSS-Gen Clause 6.7
Basic standard	:	ANSI C63.10: 2013
Limits	:	Within assigned band
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2023-10-07
Input voltage	:	AC 120V, 60Hz
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	23.8 °C
Relative humidity	:	52 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix A.

5.1.4 20dB Bandwidth

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.247(a)(1) RSS-247 Clause 5.1(a)
Basic standard	: ANSI C63.10: 2013
Limits	: Within assigned band
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2023-10-07
Input voltage	: AC 120V, 60Hz
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 23.8 °C
Relative humidity	: 52 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix A.

5.1.5 Carrier Frequency Separation

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.247(a)(1) RSS-247 Clause 5.1(b)
Basic standard	: ANSI C63.10: 2013
Limits	: $\geq 25\text{kHz}$ or 20dB bandwidth, whichever is greater
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2023-10-10
Input voltage	: AC 120V, 60Hz
Operation mode	: B
Test channel	: Low / Middle / High
Ambient temperature	: 23.8 °C
Relative humidity	: 52 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix A.

5.1.6 Number of Hopping Frequency

RESULT:**Pass****Test Specification**

Test standard	: FCC part 15.247(a)(1)(i) RSS-247 Clause 5.1(c)
Basic standard	: ANSI C63.10: 2013
Limits	: ≥ 50 non-overlapping channels
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2023-10-07
Input voltage	: AC 120V, 60Hz
Operation mode	: B
Ambient temperature	: 23.8 °C
Relative humidity	: 52 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix A.

5.1.7 Time of Occupancy

RESULT:**Pass****Test Specification**

Test standard	: FCC part 15.247(a)(1)(i) RSS-247 Clause 5.1(c)
Basic standard	: ANSI C63.10: 2013
Limits	: < 0.4 seconds within a 20 second period
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2023-10-07
Input voltage	: AC 120V, 60Hz
Operation mode	: B
Test channel	: Low / Middle / High
Ambient temperature	: 23.8 °C
Relative humidity	: 52 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix A.

Prüfbericht - Nr.: **CN23HPPO 002**
Test Report No.:Seite 21 von 24
Page 21 of 24

5.1.8 Conducted Spurious Emissions Measured in 100 kHz Bandwidth

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.247(d) RSS-247 Clause 5.5
Basic standard	: ANSI C63.10: 2013
Limits	: 20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power); In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified in 15.209(a)
Kind of test site	: Shielded Room

Test Setup

Date of testing	: Refer to test result
Input voltage	: AC 120V, 60Hz
Operation mode	: A, B
Test channel	: Low / Middle / High
Ambient temperature	: 23.8 °C
Relative humidity	: 52 %
Atmospheric pressure	: 101 kPa

Test results of 100kHz Bandwidth of Frequency Band Edge by Conducted method refer to test plots, and compliance is achieved as well.

For the measurement records, refer to the appendix A.

5.1.9 Radiated Spurious Emission

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.247(d) & FCC Part 15.205 RSS-247 Clause 3.3
Basic standard	: ANSI C63.10: 2013
Limits	: Refer to 15.209(a) of FCC part 15.247(d) RSS-Gen Section 8.9 & 8.10
Kind of test site	: 3m Semi-anechoic Chamber

Test Setup

Date of testing	: 2023-10-11
Input voltage	: AC 120V, 60Hz
Operation mode	: A, C
Test channel	: Low / Middle / High
Ambient temperature	: Refer to test result
Relative humidity	: Refer to test result
Atmospheric pressure	: 101 kPa

Remark:

Testing was carried out within frequency range 9kHz to the tenth harmonics. Only the worst case spurious emissions configuration of the each mode were reported.

For the measurement records, refer to the appendix A.

5.1.10 Conducted Emission on AC Mains

RESULT:**Pass****Test Specification**

Test standard	:	FCC Part 15.207(a) RSS-Gen Section 8.8
Basic standard	:	ANSI C63.10: 2013
Frequency range	:	0.15 – 30MHz
Limits	:	FCC Part 15.207(a) RSS-Gen Table 4
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2023-09-26
Input voltage	:	AC 120V, 60Hz
Operation mode	:	D
Earthing	:	Not connected
Ambient temperature	:	24.3 °C
Relative humidity	:	52.4 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix A.

6 Photographs of the Test Set-Up

For photographs of the test set-up, refer to the appendix B.

7 List of Tables

Table 1: List of Test and Measurement Equipment.....	6
Table 2: Measurement Uncertainty.....	7
Table 3: Technical Specification of EUT.....	8
Table 4: Test channel and frequency.....	11
Table 5: Auxiliary Equipment Used during Test.....	11
Table 6: Test Result of Maximum Peak Conducted Output Power.....	15