

Prüfbericht-Nr.: <i>Test report no.:</i>	CN21SUAP 002	Auftrags-Nr.: <i>Order no.:</i>	168327991	Seite 1 von 20 Page 1 of 20
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2021-09-10	
Auftraggeber: <i>Client:</i>	Nortek Security&Control LLC 5919 Sea Otter Place,Suite 100,Carlsbad,California, United States			
Prüfgegenstand: <i>Test item:</i>	Control Extender			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	EL-IO-200 (Trademark: ELAN)			
Auftrags-Inhalt: <i>Order content:</i>	FCC & IC			
Prüfgrundlage: <i>Test specification:</i>	CFR47 FCC Part 15: Subpart C Section 15.407 RSS-247 Issue 2 February 2017 CFR47 FCC Part 15: Subpart C Section 15.207 RSS-Gen Issue 5 March 2019 CFR47 FCC Part 15: Subpart C Section 15.209 RSS-102 Issue 5 March 2015 CFR47 FCC Part 2: Section 2.1091			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2021-09-16	Please refer to Photo Document		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A002938509-018,19, 021, 028, 029, 032, 033			
Prüfzeitraum: <i>Testing period:</i>	2021-10-27 – 2021-11-11			
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>	<u>X Bell Hu</u> <small>Signed by: Bell Hu</small>		genehmigt von: <i>authorized by:</i>	<u>X Lin Lin</u> <small>Signed by: Lin Lin</small>
Datum: <i>Date:</i>	2021-11-16		Ausstellungsdatum: <i>Issue date:</i>	2021-11-16
Stellung / Position:	Project Manager		Stellung / Position:	Reviewer
Sonstiges / Other:	FCC ID: EF400221, IC: 1078A-00221, HVIN: EL-IO-200S, PMN: Control Extender			
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:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend N/A = nicht anwendbar	4 = ausreichend N/T = nicht getestet
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory N/A = not applicable	4 = sufficient N/T = not tested
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>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>				

V05

Test Summary

5.1.1 ANTENNA REQUIREMENT*RESULT: Pass***5.1.2 MAXIMUM CONDUCTED OUTPUT POWER***RESULT: Pass***5.1.3 CONDUCTED POWER SPECTRAL DENSITY***RESULT: Pass***5.1.4 FREQUENCY STABILITY***RESULT: Pass***5.1.5 26dB BANDWIDTH, 6dB BANDWIDTH AND 99% BANDWIDTH***RESULT: Pass***5.1.6 RADIATED SPURIOUS EMISSION***RESULT: Pass***5.1.7 CONDUCTED EMISSION ON AC MAINS***RESULT: Pass*

Contents

1	GENERAL REMARKS	4
1.1	COMPLEMENTARY MATERIALS	4
2	TEST SITES	4
2.1	TEST FACILITIES	4
2.2	LIST OF TEST AND MEASUREMENT INSTRUMENTS.....	5
2.3	TRACEABILITY	6
2.4	CALIBRATION	6
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	INDEPENDENT OPERATION MODES	9
3.4	NOISE GENERATING AND NOISE SUPPRESSING PARTS	9
3.5	SUBMITTED DOCUMENTS.....	9
4	TEST SET-UP AND OPERATION MODES	10
4.1	PRINCIPLE OF CONFIGURATION SELECTION	10
4.2	TEST OPERATION AND TEST SOFTWARE.....	10
4.3	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	10
4.4	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE	10
4.5	TEST SETUP DIAGRAM	11
5	TEST RESULTS	13
5.1	TRANSMITTER REQUIREMENT & TEST SUITES	13
5.1.1	<i>Antenna Requirement</i>	<i>13</i>
5.1.2	<i>Maximum Conducted Output Power</i>	<i>14</i>
5.1.3	<i>Conducted Power Spectral Density</i>	<i>15</i>
5.1.4	<i>Frequency Stability.....</i>	<i>16</i>
5.1.5	<i>26dB Bandwidth, 6dB Bandwidth and 99% Bandwidth.....</i>	<i>17</i>
5.1.6	<i>Radiated Spurious Emission</i>	<i>18</i>
5.1.7	<i>Conducted Emission on AC Mains.....</i>	<i>19</i>
6	PHOTOGRAPHS OF THE TEST SET-UP.....	20
7	LIST OF TABLES.....	20

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: Photographs of the Test Set-up

Appendix B: Test Results of Wi-Fi operation for U-NII-1 band

Appendix C: Test Results of Wi-Fi operation for U-NII-3 band and Conducted Emission on AC Mains

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.

No.362, Huanguan Middle Road, Songyuansha Community, Guanhu Subdistrict, Longhua District, Shenzhen, Guangdong, China

FCC Accreditation Designation 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
Wireless Connectivity Tester	R&S	CMW270	101375	2022-08-09
Signal Analyzer	R&S	FSV 40	101441	2022-08-09
Vector Signal Generator	R&S	SMBV100A	263301	2022-08-09
Signal Generator	R&S	SMB100A	115186	2022-08-09
OSP	R&S	OSP 150	101017	2021-12-10
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	2021-12-10
Wideband Power Sensor	R&S	NRP-Z81	105677	2022-08-09
Humid & Temp Programmable Tester	BOST	NTH090-60	19040801	2022-04-02
Shielding Room 8#	Albatross	SR8	APC17151-SR8	2024-06-22
Unwanted Emission Testing (TS8996)				
Equipment	Manufacturer	Model	Serial No.	Cal. until
Signal Generator	R&S	SMB100A	180840	2022-08-09
Wideband Radio Communication Tester	R&S	CMW500	165339	2022-08-09
Signal Analyzer	R&S	FSV 40	101440	2022-08-09
System Controller Interface	R&S	SCI-100	S10010036	N/A
OSP	R&S	OSP 120	102041	N/A
OSP	R&S	OSP 150	101385	2021-12-10
Pre-amplifier	R&S	SCU08F1	08320030	2022-08-09
Amplifier	R&S	SCU-18F	180079	2022-08-09
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	192	2022-08-08
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218719	2022-08-08
Wideband Ridged Horn Antenna (12- 18 GHz)	Steatite	QMS-00208	18312	2022-08-08
Biconical Broadband Antenna (30 MHz - 1 GHz)	Schwarzbeck	VUBA 9117	357	2024-08-02
Double Ridged Broadband Horn Antenna (1 – 18 GHz)	Schwarzbeck	BBHA 9120 D	01760	2024-07-30

Test software	R&S	EMC32 (V10.50.40)	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NW9P2	N/A
3m Fully Anechoic Chamber	Albatross	FAC-3m	APC17151-FAC	2024-06-22
Conducted Emission				
Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
EMI Test Receiver	R&S	ESR3	102680	2022-04-25
Artificial Mains Network	R&S	ENV216	101445	2022-04-25

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.

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-7}$
RF Power (conducted)	± 2.5 dB
Radiated Emission of Transmitter, valid up to 26.5 GHz	± 6 dB
Radiated Emission of Receiver, valid up to 26.5 GHz	± 6 dB
Conducted Emission, (9kHz to 150kHz)/(150kHz to 30MHz)	± 3.70 dB / ± 3.30 dB
Radiated Emission (3m SAC), 30MHz to 1000MHz	± 4.52 dB
Radiated Emission (3m SAC), above 1000MHz	± 4.37 dB
Temperature	± 1 °C
Humidity	± 5 %
Voltage (DC)	± 1 %
Voltage (AC, <10kHz)	± 2 %

2.6 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendix A & B & C 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 Middle Road, Songyuansha Community, Guanhu Subdistrict, Longhua District, Shenzhen, Guangdong, 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 is a Control Extender, which supports Wi-Fi 802.11 a/b/g/n/ac wireless technologies. The EUT supports the following functions: Wireless access in the 2.4GHz band or 5GHz band.

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

3.2 Ratings and System Details

Table 2: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment	Control Extender
Type Designation	EL-IO-200
Trade Mark	ELAN
FCC ID	EF400221
IC	1078A-00221
HVIN	EL-IO-200S
Operating Voltage:	DC 5V@2A input via AC/DC adapter DC 48V@0.6A via POE
Testing Voltage	AC 120V@60Hz
Antenna Type	Integral Antenna
Antenna Gain	4.18 dBi for 2.4G/5G Wi-Fi
Power Adapter	Model: SEG0502000P Input: AC 100-240V~50/60Hz, 0.5A Output: DC5V@2A
Technical Specification of Wi-Fi 802.11 a/n	
Operating Frequency	U-NII-1 Band: 5180-5240 MHz U-NII-3 Band: 5745-5825 MHz
Type of Modulation	OFDM(BPSK/QPSK/16QAM/64QAM/256QAM)
Channel Number:	U-NII-1 Band: 4 channels for 20MHz bandwidth U-NII-3 Band: 3 channels for 20MHz bandwidth
Channel Separation	5 MHz

Table 3: RF Channel and Frequency of Wi-Fi 802.11 a/n

U-NII-1 and U-NII-3:

RF Channel	20MHz	RF Channel	20MHz
	Frequency (MHz)		Frequency (MHz)
36	5180.00	149	5745.00
40	5200.00	153	5765.00
44	5220.00	157	5785.00
48	5240.00	/	/

Test Channel:

CH36, CH40, CH48, CH149, CH 153, CH157

3.3 Independent Operation Modes

The basic operation modes are:

- A. On, Wi-Fi 802.11 a/n wireless transmitting mode
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. On, Wi-Fi 802.11 a/nconnecting mode
- C. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- FCC/IC Label and Location Info
- User Manual
- Schematics
- PCB Layout

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 EL-IO-200 in this report.

4.3 Special Accessories and Auxiliary Equipment

Table 4: List of Accessories and Auxiliary Equipment

Description	Manufacturer	Model	S/N	Rating
Laptop	Lenovo	T480	PF-16A6N8	N/A

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)

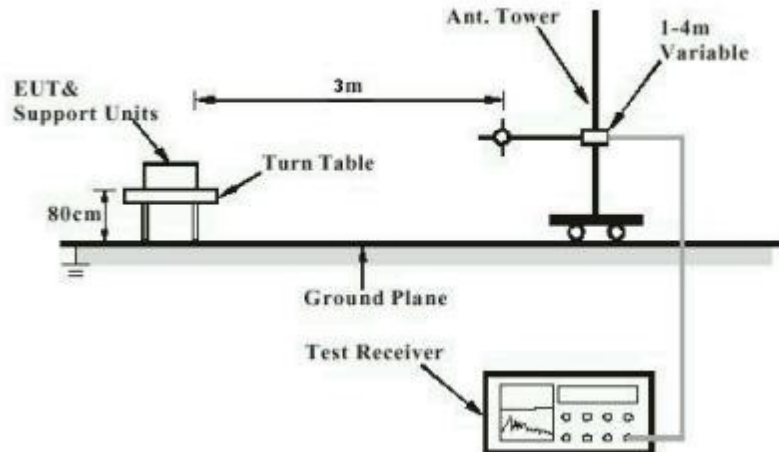


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

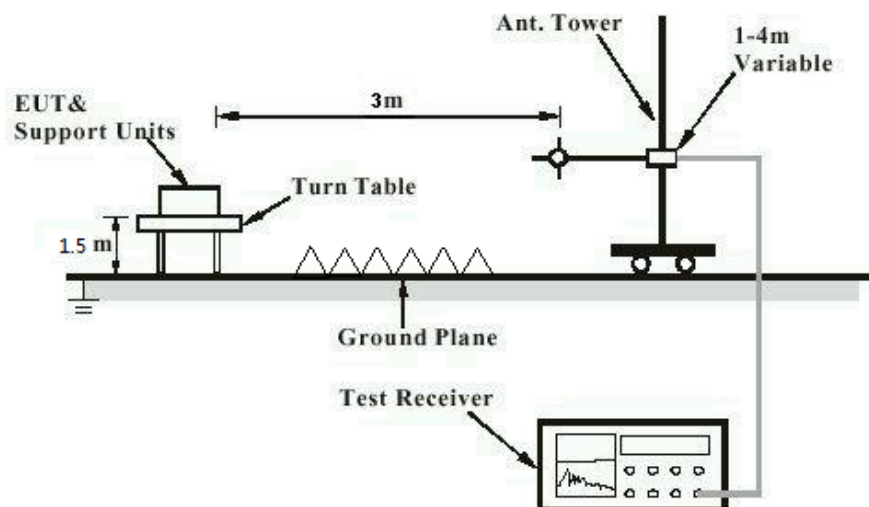


Diagram of Measurement Configuration for Mains Conduction Measurement

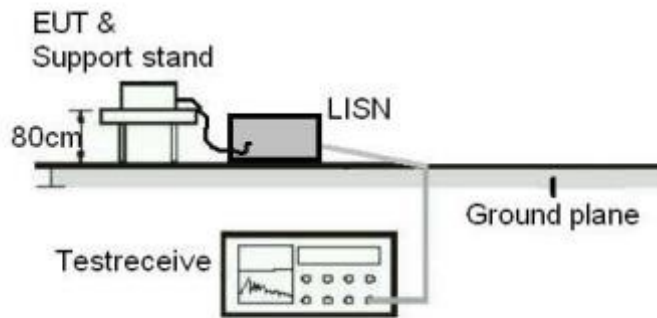
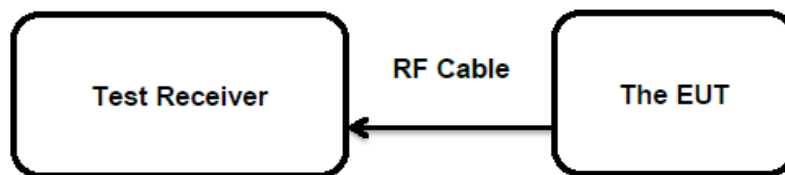


Diagram of Measurement Configuration for Conducted Transmitter Measurement



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

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

Test standard : FCC Part 15.203

According to the manufacturer declared, the EUT has an integral antenna, the directional gain of antenna is 4.18 dBi, 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.

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

Refer to EUT Photo for further details.

5.1.2 Maximum Conducted Output Power

RESULT:
Pass
Test Specification

Test standard : FCC Part 15.407(a)(1)&(2)&(4)
RSS-247 clause 6.2

Basic standard : ANSI C63.10: 2013
FCC:

Limits : <250mW (24dBm) (5150-5250MHz)
<1W (30dBm) (5725-5850MHz)
IC:
* Max e.i.r.p.<200mW (23dBm) (5150-5250MHz)
*200 mW (23dBm) or 10 dBm + 10 logB, where B is the 99% emission bandwidth in MHz, where is lesser.
Max conducted output power <1W (30dBm) (5725-5850MHz)

Kind of test site : Shielded Room

Test Setup

Date of testing : 2021-11-04
Input voltage : AC 120V@60Hz
Operation mode : A
Test channel : Low / Middle / High
Ambient temperature : 24.2 °C
Relative humidity : 52 %
Atmospheric pressure : 101 kPa

For details refer to following test result.

Table 5: Test Result of Maximum Conducted Output Power, Wi-Fi 802.11 a/n/ac

Test Mode	Frequency Range (MHz)	Test Channel (MHz)	Measured Avg. Power		Limit (dBm)
			(dBm)	(W)	
802.11a	5150-5250	5180	10.9	0.0123	U-NII-1: FCC: Max conducted output power 250mW IC: * Max e.i.r.p. 200 mW (23dBm) or 10 dBm + 10 logB, where B is the 99% emission bandwidth in MHz, where is lesser.
		5200	15.6	0.0363	
		5240	15.5	0.0355	
	5725-5850	5745	11.8	0.0151	
		5765	12.0	0.0158	
		5785	11.2	0.0132	
802.11n (HT20)	5150-5250	5180	11.0	0.0126	U-NII-3: FCC& IC Max conducted output power 1W
		5200	15.6	0.0363	
		5240	15.3	0.0339	
	5725-5850	5745	11.8	0.0151	
		5765	12.0	0.0158	
		5785	11.3	0.0135	
Maximum Measured Value			15.60	0.0363	-

Note:

- 1) The cable loss taken into account in results.
- 2) Antenna gain(G) **4.18** dBi.

5.1.3 Conducted Power Spectral Density

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

Test standard	: FCC part 15.407(a) RSS-247 clause 6.2
Basic standard	: ANSI C63.10: 2013 KDB 789033 D02 v01r03
Limits	FCC: : <11dBm/MHz (5150-5250MHz) <30dBm/500KHz (5725-5850MHz) IC: e.i.r.p. spectral density <10dBm/MHz (5150-5250MHz) <30dBm/500KHz (5725-5850MHz)
Kind of test site	: Shielded Room

Test Setup

Date of testing	: Refer to test result
Input voltage	: AC 120V@60Hz
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 24.2 °C
Relative humidity	: 52 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix B & C.

5.1.4 Frequency Stability

RESULT:
Pass
Test Specification

Test standard : FCC Part 15.407(g)
RSS-Gen Clause 6.11

Basic standard : ANSI C63.10: 2013

Limits : Within assigned bands

Kind of test site : Shielded Room

Test Setup

Date of testing : Refer to test result

Input voltage : AC 120V@60Hz

Operation mode : A

Test channel : Low / Middle / High

Ambient temperature : 24.2 °C

Relative humidity : 52 %

Atmospheric pressure : 101 kPa

Frequency (MHz)	Voltage (Vdc)	Temperature (°C)	Measurement Frequency (MHz)	Frequency deviation (Hz)	ppm
5180	120	0	5179.941	-0.059	-11.39
		10	5179.943	-0.057	-11.004
		20	5179.945	-0.055	-10.618
		30	5179.947	-0.053	-10.232
		40	5179.942	-0.058	-11.197
	108	25	5179.944	-0.056	-10.811
	132	25	5179.948	-0.052	-10.039
5785	120	0	5784.933	-0.067	-11.582
		10	5784.934	-0.066	-11.409
		20	5784.937	-0.063	-10.89
		30	5784.936	-0.064	-11.063
		40	5784.935	-0.065	-11.236
	108	25	5784.932	-0.068	-11.755
	132	25	5784.934	-0.066	-11.409

5.1.5 26dB Bandwidth, 6dB Bandwidth and 99% Bandwidth**RESULT:****Pass****Test Specification**

Test standard	: FCC Part 15.407(e) RSS-Gen Clause 6.6
Basic standard	: ANSI C63.10: 2013 KDB 789033 D02 v01r03
Limits	: No requirement for U-NII-1 band at least 500kHz for U-NII-3 band
Kind of test site	: Shielded Room

Test Setup

Date of testing	: Refer to test result
Input voltage	: AC 120V@60Hz
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 24.2 °C
Relative humidity	: 52 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix B & C.

5.1.6 Radiated Spurious Emission

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

Test standard	: FCC Part 15.407(b) & FCC Part 15.205 & FCC Part 15.209 RSS-247 clause 6.2 & RSS-GEN clause 8.9 and 8.10
Basic standard	: ANSI C63.10: 2013 KDB 789033 D02 v01r03
Limits	: FCC Part 15.209(a) FCC Part 15.407(b)(7) RSS-GEN
Kind of test site	: 3m Semi-anechoic Chamber

Test Setup

Date of testing	: 2021-11-01 ~ 2020-11-03
Input voltage	: AC 120V@60Hz
Operation mode	: A
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 B & C.

5.1.7 Conducted Emission on AC Mains

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

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

Test Setup

Date of testing	: 2021-10-30
Input voltage	: AC 120V@60Hz
Operation mode	: B
Earthing	: Not connected
Ambient temperature	: Refer to test result
Relative humidity	: Refer to test result
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix C.

6 Photographs of the Test Set-Up

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

7 List of Tables

Table 1: List of Test and Measurement Equipment.....	5
Table 2: Technical Specification of EUT	8
Table 3: RF Channel and Frequency of Wi-Fi 802.11 a/n	9
Table 4: List of Accessories and Auxiliary Equipment.....	10
Table 5: Test Result of Maximum Conducted Output Power, Wi-Fi 802.11 a/n/ac.....	14