Prüfbericht-Nr.: *Test report no.:*	**CN21SUAP 001**	**Auftrags-Nr.:** *Order no.:*	**168327991**	Seite 1 von 21 *Page 1 of 21*
Kunden-Referenz-Nr.: *Client reference no.:*	**N/A**	**Auftragsdatum:** *Order date:*	2021-09-10	
Auftraggeber: *Client:*	Nortek Security&Control LLC 5919 Sea Otter Place,Suite 100,Carlsbad,California, United States			
Prüfgegenstand: *Test item:*	Control Extender			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	EL-IO-200 (Trademark: ELAN)			
Auftrags-Inhalt: *Order content:*	FCC & IC			
Prüfgrundlage: *Test specification:*	CFR47 FCC Part 15: Subpart C Section 15.247 CFR47 FCC Part 15: Subpart C Section 15.207 CFR47 FCC Part 15: Subpart C Section 15.209 CFR47 FCC Part 15: Subpart B Section 15.107 CFR47 FCC Part 15: Subpart B Section 15.109 CFR47 FCC Part 2: Section 2.1091		RSS-247 Issue 2 February 2017 RSS-Gen Issue 5 April 2018 ICES-003 Issue 6 January 2016 RSS-102 Issue 5 March 2015	

Wareneingangsdatum: *Date of sample receipt:*	2021-09-16	Please refer to Photo Document
Prüfmuster-Nr.: *Test sample no:*	A002938509-018,19, 021, 028, 029, 032, 033	
Prüfzeitraum: *Testing period:*	2021-10-27 – 2021-11-11	
Ort der Prüfung: *Place of testing:*	TÜV Rheinland (Shenzhen) Co., Ltd.	
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shenzhen) Co., Ltd.	
Prüfergebnis*: *Test result*:*	Pass	

geprüft von: *tested by:*	X Bell Hu Signed by: Bell Hu	**genehmigt von:** *authorized by:*	X Lin Lin Signed by: Lin Lin
Datum: *Date:* 2021-11-16		**Ausstellungsdatum:** *Issue date:* 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: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

TÜV Rheinland (Shenzhen) Co., Ltd. 1601 R&D Room, 1602-1604, 17-18F, Building 7 Site C, Vanke Cloud City Phase I, Xingke First Street, Xili Street, Xili Community, Nanshan District, Shenzhen 518052, P.R. China
Mail: service@de.tuv.com · Web: www.tuv.com

Test Summary

5.1.1 ANTENNA REQUIREMENT
RESULT: Pass

5.1.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER
RESULT: Pass

5.1.3 CONDUCTED POWER SPECTRAL DENSITY
RESULT: Pass

5.1.4 6DB BANDWIDTH
RESULT: Pass

5.1.5 99% BANDWIDTH
RESULT: Pass

5.1.6 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 KHZ BANDWIDTH
RESULT: Pass

5.1.7 RADIATED SPURIOUS EMISSION
RESULT: Pass

5.1.8 RADIATED EMISSION
RESULT: Pass

5.1.9 CONDUCTED EMISSION ON AC MAINS
RESULT: Pass

Contents

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 802.11 b/g/n

Appendix C: Test Results of FCC Part 15B and ICES-003

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 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**
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 basics 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	±1 x 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.
This report is only for 2.4GHz bands.
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 b/g/n	
Operating Frequency	2412 - 2462 MHz for 802.11b/g/n(HT20)
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 Mbps for 802.11n(HT20)
Channel Number	11 channels for 802.11b/g/n(HT20)
Channel Separation	5 MHz

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

RF Channel	802.11 b/g/n(HT20)
	Frequency (MHz)
01	**2412**
02	2417
03	2422
04	2427
05	2432
06	**2437**
07	2442
08	2447
09	2452
10	2457
11	**2462**

Test frequencies are lowest channel: 2412 MHz, middle channel: 2437 MHz and highest channel: 2462 MHz for 802.11b/g/n(HT20)

3.3 Independent Operation Modes

The basic operation modes are:

A. On, Wi-Fi 802.11 b/g/n wireless transmitting mode
   1) Low Channel
   2) Middle Channel
   3) High Channel
B. On, Wi-Fi 802.11 b/g/n connecting mode
C. On, Normal work
D. 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: Auxiliary Equipment Used during Test

Description	Manufacturer	Model	S/N	Rating
Laptop	Lenovo	T480	PF-16A6N8	N/A
Wi-Fi router	Huawei	B311As-853	/	
Load	Nortek	/	/	
Adapter	/	SEG0502000P	/	
POE	/	ZX900-AFG-N301	/	

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)

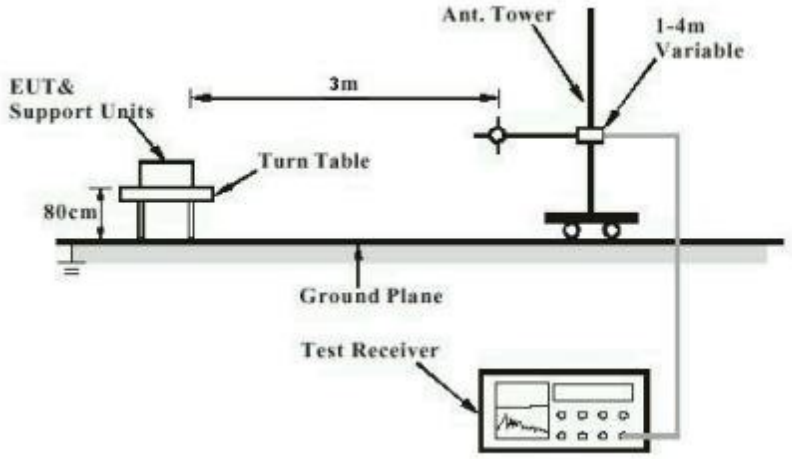


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

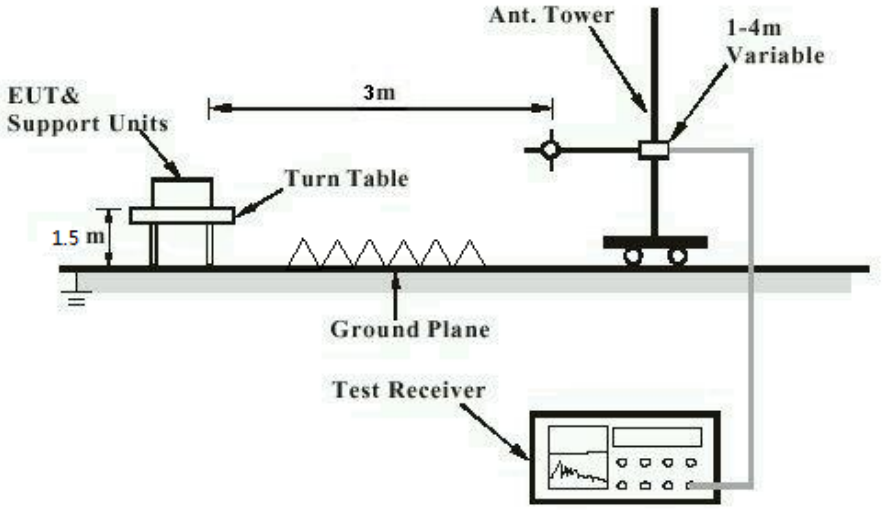


Diagram of Measurement Configuration for Mains Conduction Measurement

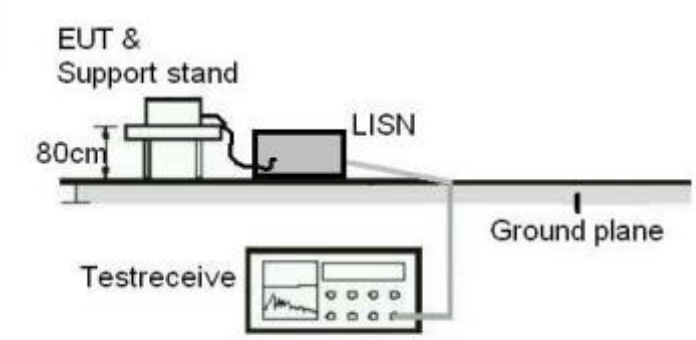
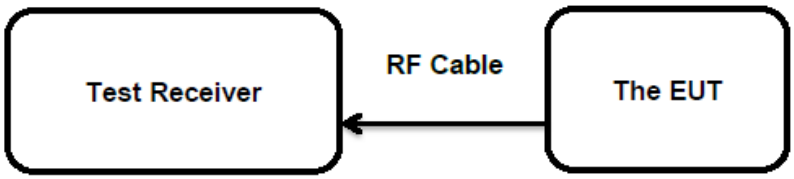


Diagram of Measurement Configuration for Conducted Transmitter Measurement



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT: **Pass**

Test Specification

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

According to the manufacturer declared, the EUT has an internal 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 Peak Conducted Output Power

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(b)(3) RSS-247 Clause 5.4(d)
Basic standard	:	ANSI C63.10: 2013
Limits	:	1.0 Watts
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2021-10-29
Input voltage	:	AC 120V@60Hz
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	24.2 ℃
Relative humidity	:	52 %
Atmospheric pressure	:	101 kPa

Table 5: Test Result of Maximum Peak Conducted Output Power, Wi-Fi 802.11 b/g/n

Test Mode	Data Rate	Test Channel (MHz)	Measured Peak Power		Limit (W)
			(dBm)	(W)	
802.11b	1 Mbps	2412	14.41	0.0276	< 1.0
		2437	14.26	0.0267	
		2462	14.28	0.0268	
802.11g	6 Mbps	2412	19.04	0.0802	
		2437	19.77	0.0948	
		2462	20.14	0.1033	
802.11n (HT20)	MCS0	2412	19.53	0.0897	
		2437	19.42	0.0875	
		2462	19.74	0.0942	
Maximum Measured Value			20.14	0.1033	

Note:
1) The cable loss is taken into account in results.
2) Antenna gain(G): 4.18 dBi
e.i.r.p.=$P_{(Peak\ power)}$+ G, which is far below the 4 W

5.1.3 Conducted Power Spectral Density

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(e) RSS-247 Clause 5.2(b)
Basic standard	:	ANSI C63.10: 2013
Limits	:	< 8 dBm / 3kHz
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 ℃
Relative humidity	:	52 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

TestMode	Channel	Result[dBm/3-100kHz]	Limit[dBm/3kHz]	Verdict
802.11b	2412	-3.9	≤8	PASS
	2437	-5.42	≤8	PASS
	2462	-4.91	≤8	PASS
802.11g	2412	-7.78	≤8	PASS
	2437	-6.67	≤8	PASS
	2462	-6.57	≤8	PASS
802.11n (HT20)	2412	-5.55	≤8	PASS
	2437	-6.2	≤8	PASS
	2462	-6.24	≤8	PASS

5.1.4 6dB Bandwidth

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(a)(2) RSS-247 Clause 5.2(a)
Basic standard	:	ANSI C63.10: 2013
Limits	:	> 500 KHz
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 ℃
Relative humidity	:	52 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

Test Mode	Channel	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
802.11b	2412	8.080	2407.960	2416.040	0.5	PASS
	2437	8.000	2433.000	2441.000	0.5	PASS
	2462	8.120	2457.920	2466.040	0.5	PASS
802.11g	2412	15.000	2404.440	2419.440	0.5	PASS
	2437	15.440	2429.440	2444.880	0.5	PASS
	2462	15.480	2454.400	2469.880	0.5	PASS
802.11n (HT20)	2412	16.800	2403.600	2420.400	0.5	PASS
	2437	15.120	2429.440	2444.560	0.5	PASS
	2462	15.040	2454.480	2469.520	0.5	PASS

5.1.5 99% Bandwidth

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(a)
Basic standard	:	ANSI C63.10: 2013
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 ℃
Relative humidity	:	52 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

Test Mode	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
802.11b	2412	11.495	2406.263	2417.758	---	PASS
	2437	11.431	2431.348	2442.779	---	PASS
	2462	11.296	2456.402	2467.698	---	PASS
802.11g	2412	16.785	2403.571	2420.356	---	PASS
	2437	16.731	2428.646	2445.377	---	PASS
	2462	16.750	2453.624	2470.374	---	PASS
802.11n (HT20)	2412	17.814	2403.077	2420.891	---	PASS
	2437	17.769	2428.108	2445.877	---	PASS
	2462	17.852	2453.096	2470.948	---	PASS

5.1.6 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
Test channel	:	Low / Middle / High
Ambient temperature	:	24.2 ℃
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 B.

5.1.7 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 Table 5
Kind of test site	:	3m Semi-anechoic Chamber

Test Setup

Date of testing	:	2021-11-02 ~ 2020-11-10
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.

5.1.8 Radiated Emission

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.109(a) ICES-003
Basic standard	:	C63.4-2014
Frequency range	:	30 - 6000MHz
Classification	:	Class B
Limits	:	FCC Part 15.109(a) ICES-003 Table 5 & Table 7
Kind of test site	:	3m Semi-anechoic Chamber

Test Setup

Date of testing	:	2021-10-22 ~ 2020-10-25
Input voltage	:	AC 120V@60Hz
Operation mode	:	C
Earthing	:	Not connected
Ambient temperature	:	23 ℃
Relative humidity	:	50 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix C.

5.1.9 Conducted Emission on AC Mains

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.207(a) & FCC Part 15.107(a) RSS-Gen Clause 8.8 & ICES-003
Basic standard	:	ANSI C63.10: 2013&C63.4:2014
Frequency range	:	0.15 – 30MHz
Limits	:	FCC Part 15.207(a) & FCC Part 15.107(a) RSS-Gen Table 3 & ICES-003 Table 2
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2021-10-22 ~ 2020-10-25
Input voltage	:	AC 120V@60Hz
Operation mode	:	B, C
Earthing	:	Not connected
Ambient temperature	:	23.1 ℃
Relative humidity	:	52 %
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