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FCC RF Test Report

For

Shenzhen Hangshi Electronic Technology Co.,Ltd

Fest Standards: Part 15C Subpart C §15.249				
Product Description:	Wireless Keyboard			
Tested Model:	<u>HW357-3</u>			
	<u>HW357-3G01,HW357-3G02,HW357-3G03,</u>			
Additional Model No.:	<u>HW357-3G04,HW357-3G05</u>			
FCC ID:	<u>2AKHJ-HW357-3</u>			
Classification	DXX-Low Power Communication Device Transmitter			
Report No.:	EC2304037RF01			
Tested Date:	2023-04-21 to 2023-05-26			
Issued Date:	<u>2023-05-26</u>			
Prepared By:	epared By: Jack Liu / Engineer			
Approved By:	Timy Yang			
	Tiny Yang / RF Manager			
Testing laboratory:				
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www.hn-ecloud.com				

Note: The test results in this report apply exclusively to the tested model / sample. Without written approval of Hunan Ecloud Testing Technology Co., Ltd., the test report shall not be reproduced except in full.

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2023.05.26	Valid	Original Report



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FCC Rule	Description	Limit	Result	Remark
15.215(c)	20dB Bandwidth	NA	Pass	Test Engineer: Luo Xiang
15.249(a)	Field strength of the fundamental signal	15.249(a)	Pass	Test Engineer: Jack Liu
15.249(a)(d)/15.209	Radiated Band Edges and Radiated Spurious Emission	15.249(a)(d)/15.209	Pass	Under limit 6.21 dB at 2405.05 MHz
15.207	AC Conducted Emission	15.207(a)	N/A	N/A
15.203	Antenna Requirement	N/A	Pass	-

Summary of Test Result



1 Test Laboratory

1.1 Test facility

CNAS (accreditation number:L11138)

Hunan Ecloud Testing Technology Co., Ltd. has obtained the accreditation of China National Accreditation

Service for Conformity Assessment (CNAS).

FCC (Designation number:CN1244, Test Firm Registration

Number:793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission

list of test facilities recognized to perform electromagnetic emissions measurements.

ISED(CAB identifier: CN0012, ISED# :24347)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of

innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

A2LA (Certificate Number:4895.01)

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory

Accreditation to perform electromagnetic emission measurement.



2 General Description

2.1 Applicant

Shenzhen Hangshi Electronic Technology Co.,Ltd

2nd Floor,A1 Building,G Area,Democracy West Industry Area,Shajing TownBao'an District,Shenzhen China

2.2 Manufacturer

Shenzhen Hangshi Electronic Technology Co.,Ltd

2nd Floor,A1 Building,G Area,Democracy West Industry Area,Shajing TownBao'an District,Shenzhen China

Product	Wireless Keyboard
Model No.	HW357-3
Additional No.	HW357-3G01,HW357-3G02,HW357-3G03,HW357-3G0
	4,HW357-3G05
	HW357-3G01,HW357-3G02,HW357-3G03,HW357-3G0
Difference Description	4,HW357-3G05 and HW357-3,Only the name is different
	and does not affect any RF parameters.
FCC ID	2AKHJ-HW357-3
Power Supply	3.0Vdc (dry battery)
Modulation Type	GFSK
Operating Frequency	2405MHz~2470MHz
Number Of Channel	8
Antenna Type	PCB Antenna with -1.2dBi gain
Sample no.	2304037R-1/2~2/2
Sample Received Date	2023/04/21
HW Version	v1.0
SW Version	v1.0
I/O Ports	Refer to user's manual
Accessory Devices	Refer to note as below

2.3 General Description Of EUT

NOTE:

1. The above EUT information is declared by manufacturer. Our laboratory is not responsible for the information provided by the manufacturer.



- 2. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
- 3. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.



2.4 Modification of EUT

No modifications are made to the EUT during all test items.

2.5 Support equipment List

Manufacturer	Description	Model	Serial Number	Certificate
Lenovo	Notebook	E470C	N/A	FCC sDoC
Shenzhen				
Hastech industries	2.4G Dongle	F0173	N/A	FCC sDoC
Co., Ltd				

2.6 Applicable Standards

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

- FCC Part 15 Subpart C §15.249
- ANSI C63.10-2013

Remark:

1. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



3 Test Configuration of Equipment Under Test

3.1 Descriptions of Test Mode

The Operation Frequency each of channel as follows:

Operation Frequency each of channel				
Channel	Frequency	Channel	Frequency	
01	2405MHz	05	2440MHz	
02	2413MHz	06	2450MHz	
03	2422MHz	07	2460MHz	
04	2430MHz	08	2470MHz	

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test

- a. Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.
- b. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.



3.2 Test Mode

3.2.1 Antenna Port Conducted Measurement

	Summary table of Test Cases			
Test Item 2.4G Wireless				
Conducted	Mode 1: CH01_2405 MHz			
Conducted	Mode 2: CH04_2430 MHz			
Test Cases	Mode 3: CH08_2470 MHz			

3.2.2 Radiated Emission Test (Below 1GHz)

	2.4G Wireless			
Radiated				
Test Cases	Mode 1:Transmitting	Mode 1: CH01_2405 MHz		

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.

2. All above modes were tested, but only the worst case test mode 1 while transmitting was reported.

3.2.3 Radiated Emission Test (Above 1GHz)

	2.4G Wireless		
Radiated		Mode 1: CH01_2405 MHz	
Test Cases	Mode 1:Transmitting	Mode 2: CH04_2430 MHz	
		Mode 3: CH08_2470 MHz	

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible

combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.

2. All above modes were tested, but only the worst case test mode 1 while transmitting was reported.

3.2.4 Power Line Conducted Emission Test:

AC	
Conducted	Mode 1 : Wireless 2.4G Link
Emission	

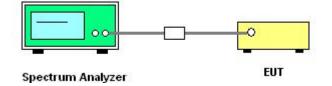




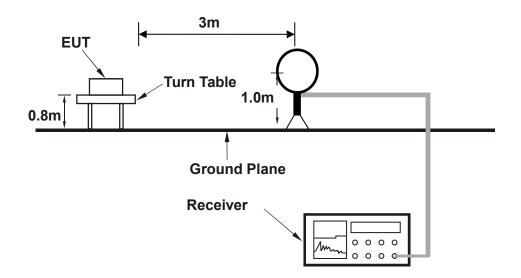
3.3 Test Setup

The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

Setup diagram for Conducted Test

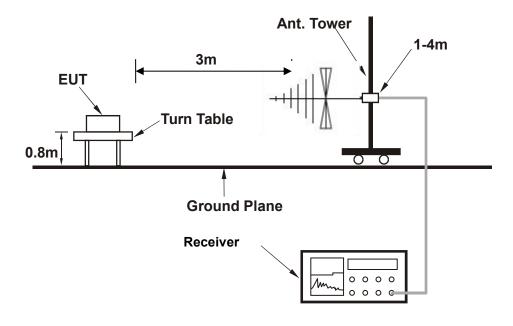


Setup diagram for Radiation(9KHz~30MHz) Test

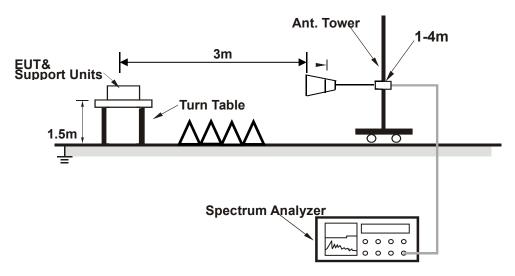




Setup diagram for Radiation(Below 1G) Test

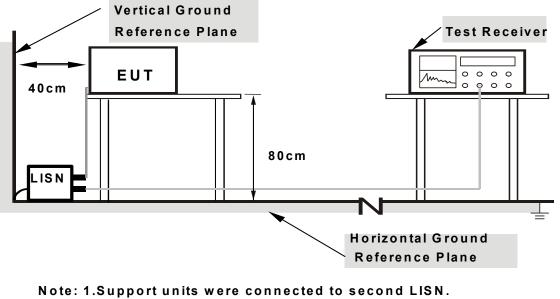


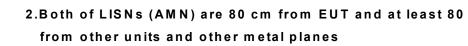
Setup diagram for Radiation(Above1G) Test





Setup diagram for AC Conducted Emission Test





3.4 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 5 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 5 + 10 = 15 (dB)

For all radiated test items:

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level Over Limit (dB μ V/m) = Level(dB μ V/m) - Limit Level (dB μ V/m)



4 Test Result

4.1 20dB Occupy Bandwidth Measurement

4.1.1 Limit of 20dB Occupy Bandwidth

None; for reporting purposes only.

4.1.2 Test Procedures

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Turn on the EUT and connect it to measurement instrument.
- 3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.

Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel; RBW = 1% to 5% of the 20 dB bandwidth; VBW = approximately 3 times RBW; Sweep = auto; Detector function = peak; Trace = max hold.

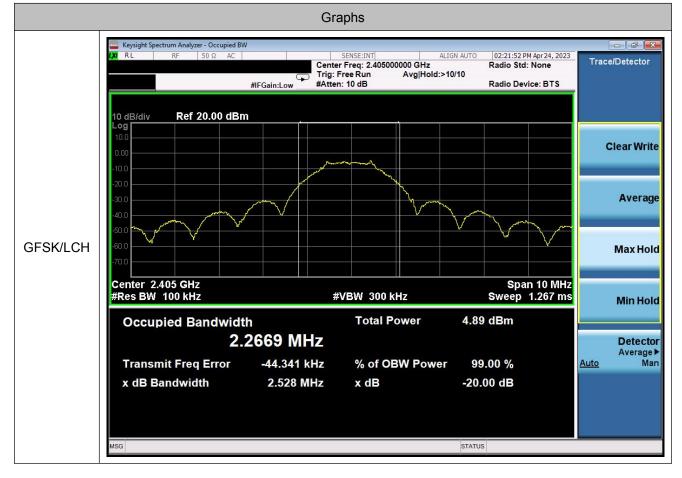
Tel.:+86-731-89634887



4.1.3 Test Result of 20dB Bandwidth

Test Mode :	2.4G Wireless Transmitting	Temperature	:	24~25 ℃	
Test Engineer :	Luo Xiang	Relative Hum	nidity :	52~55%	
Channel.	20dB Bandwidth [I	MHz]		Verdict	
LCH	2.528			PASS	
МСН	2.583		MCH 2.583 PASS		PASS
НСН	2.581			PASS	

20dB Plot





Report No.: EC2304037RF01





4.2 Field Strength of The Fundamental Signal, Radiated Band Edges and Spurious Emission Measurement

4.2.1 Limit of Fundamental Signal, Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209&15.249 limits as below.

Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

Frequency	Field Strength	Measurement Distance
(MHz)	(millivolts/meter)	(meters)
2400-2483.5	50	3m

Note: The frequency range from 9KHz to 10th harmonic (25GHz) are checked, and no any emissions were found from 18GHz to 25GHz, So the radiated emissions from 18GHz to 25GHz were not record.

4.2.2 Test Procedures

- 1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
- 2. The measurement distance is 3 meter.
- 3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
- 4. Set to the maximum power setting and enable the EUT transmit continuously.
- 5. Use the following spectrum analyzer settings:



- (1) Span shall wide enough to fully capture the emission being measured;
- (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW >RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
- (3) For average measurement:

VBW = 10 Hz, when duty cycle is no less than 98 percent.

VBW \geq 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

Band	Duty Cycle(%)	VBW Set	tting
2.4G Wireless	100		10Hz	2
Keysight Spectrum Analyzer - Swept SA	•			
XIRL RF 50Ω AC	PNO: Fast IFGain:Low Atten: 20 dB	ALIGN A Avg Type: Log-f Avg Hold:>100/1	Pwr TRACE 1 2 3 4 5 6	Marker
Ref Offset 1 dB I0 dB/div Ref 11.00 dBm				Select Marker 1
1.00				Norma
9.00				Delt
29.0				
39.0				Fixed
49.0				OI
39.0				Properties
79.0				Fropendes
center 2.405000000 GHz			Span 0 Hz	Mor 1 of
Res BW 1.0 MHz	#VBW 3.0 MHz		p 1.000 ms (1001 pts) Tatus	

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level



4.2.3 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

4.2.4 Field Strength of The Fundamental Signal

st Mode :	Mode	e 1: CH01_	2405 MH	z	Temp	erature :		21~23 ℃
st Engineer :	Jack	Liu			Relat	ive Humi	dity :	61~63%
equencey Rang	je 1GHz	<u>z</u> ∼3GHz			Polar	ization :		Horizontal
120 Level (d	BuV/m)				·		Date: 2	023-05-26
110			_					
-								
90						FCC PA	RT15.2	49 PEAK
70								-6dB
50						FCC	PART	5.249 AV -6dB
	Contract distribution	constation and a state	nas hurtune attress	Middeballwindeaucoucherable	Alberto line la talle	. Composition	Herings	and water the same
30	lifer a feedbarran	NU AND AND AND A A A A A A A A A A A A A A	all					
10			-					
0 <mark>1000</mark>	1300.	1500. 1		00. 2100 quency (Mi		2500.	2700.	3000
		Antenna	Cable loss	factor	level	Limit level		it Remark
10	evel BuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	i

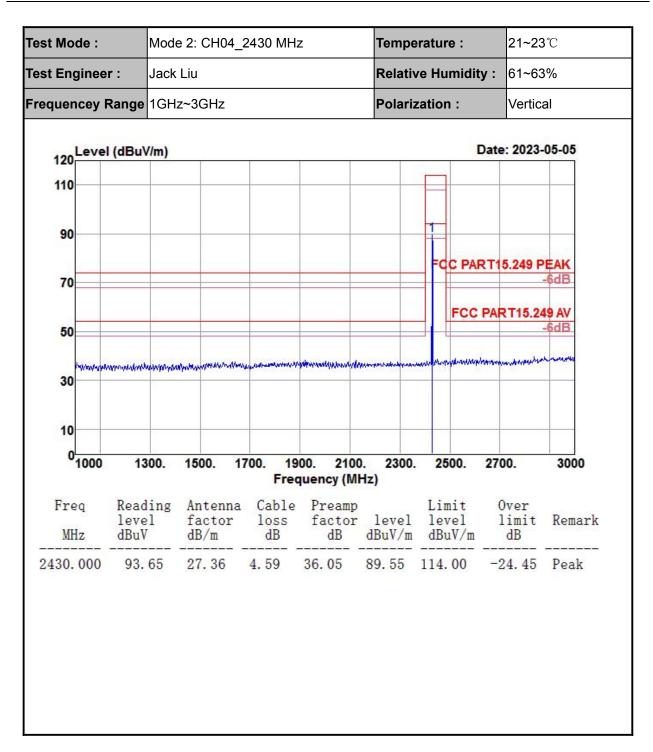


est Mode :	Mod	e 1: CH01	_2405 Mł	Ηz	Tem	perature	:	21~23 ℃
est Engineer :	Jack	(Liu			Rela	ative Hum	idity :	61~63%
Frequencey Rar	ige 1GH	lz~3GHz			Pola	arization :		Vertical
120 Level (dl	BuV/m)						Date: 20	23-05-05
110								
90								
						FCC PA	RT15.24	9 PEAK
70								-6dB
						FCC	PART1	5.249 AV
50							_	-6dB
merrowliterand	A bits lar we all on	AN MANAGENERAL	-	mountain		w you would	manutary	warme and may
30							10	1. T.
10				46)				
01000	1300.	1500. 1		00. 2100 Juency (MH		2500.	2700.	3000
	eading		Cable	Preamp		Limit	0ve	
	evel BuV	factor dB/m	loss dB			level dBuV/m	lim dB	it Remark
		27.31	4. 52	35.97				58 Peak



Fest Mode :	Mc	de 2: CH04_	_2430 M	Hz	Tem	perature :	21~23 ℃
est Engineer	: Jao	ck Liu			Rela	tive Humidity :	61~63%
Frequencey R	ange 1G	Hz~3GHz			Pola	rization :	Horizontal
120 Level	(dBuV/m)				·	Date:	2023-05-26
110							
90							
70			1-			FCC PART15.	249 PEAK -6dB
						FCC PART	Г15.249 AV -6dВ
50		the weather and a second and a se	d	. Marcalanda da mara	anter a marine	and house house many	AL CLES
30	lerhonene herdel	www.dirachites.com					
10					(2e		
⁰ 1000	1300.	1500. 1		900. 2100 quency (MH		. 2500. 2700	. 3000
Freq MHz	Reading level dBuV	g Antenna factor dB/m	Cable loss dB		level dBuV/m	level li	ver .mit Remark IB
2430.000	01 80	27.36	4.59	36.05	87.79	114.00 -26	5.21 Peak







st Mode :	Mc	ode 3: CH08	5_2470 M	Hz	Ten	nperature	:	21~23 ℃	
st Engineer	: Ja	ck Liu			Rel	ative Hum	nidity :	61~63%	
equencey Ra	ange 1G	Hz~3GHz			Pol	Polarization :			
					•		D-4 000	2 05 00	
120 Level	(dBuV/m		1		1		Date: 202	3-05-26	
110									
90						-			
						FCC PA	RT15.249	PEAK	
70							(110.240	-6dB	
						FCC	PART15.	249 AV	
50								-605	
30	where which the particular of the	weather and the second	wint way way him to be when the	the standard and the second	Karakatan derina dar	making historia	manufacturate	nutriture	
10									
01000	1300.	1500. 1		900. 2100 quency (MH		2500.	2700.	3000	
Freq MHz	Readin level dBuV	factor		Preamp	level	Limit level dBuV/m	Over limi dB	t Remark	
			3.67						



est Mode :	Mode	3: CH08_24	470 MHz		Temper	ature :	21~23	$^{\circ}$ C
est Engineer :	Jack L	.iu			Relativ	e Humidity	: 61~63	%
requencey Rar	ige 1GHz [,]	~3GHz			Polariza	ation :	Vertica	al
120 Level ((dBuV/m)					D	ate: 2023-	-05-05
120								
110								
90						1		
						FCC PAR	T15.249 P	
70								-6dB
50						FCCF	PART15.24	49 AV -6dB
								the Martin Martin
30 hipportation	Annanikina Mariti	warman	h-shear-handlinessin	animinan talamatuka	her have a series of the serie	adaration participation as	when when the program	
10								
01000	1300.	1500. 1		00. 2100 quency (M		2500.	2700.	3000
1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Reading level dBuV	Antenna factor dB/m		Preamp	level	Limit level dBuV/m	Over limit dB	Remark
мпz								

st Mode :	Mode 1	: CH01_2	405 MF	łz	Те	mperature	:	21~23℃
st Engineer :	Jack Liu	l			Re	lative Hun	nidity :	61~63%
equencey Range	2.30GH	z~2.41G	Hz		Ро	larization	:	Horizonta
	Contractor							
120 Level (d	BuV/m)						Date: 2023	
110	-					and a second		-6dB
								4
90	5			- 5				
70								4
							1	
50	-		2				3	
andre your	want with the start	mucharderarchid	Man	marketure	among the	alt and a should be a state of the state of	1	
30	8							
10								
0 2300 231	0.	2330.		350. quency (MI	2370. Hz)	23	90.	2410
Freq R	leading	Antenna	Cable	Preamp		Limit	0ver	
	evel BuV	factor dB/m	loss dB	factor dB	level dBuV/m	level dBuV/m	limit dB	Remark
	40.14	27.12	4. 15	35.70	35. 71	74.00	-38.29	Pook
2341.140	46.41	27.18	4.27	35.79	42.07	74.00	-31.93	Peak
	46.61	27.28 27.31	4.46	35.93 35.98	42. 42 97. 44	74.00 114.00	-31.58 -16.56	
2390.000 2405.490 1	01.59	21.01						
2390.000 2405.490 1	01. 59	21.51						
2390.000 2405.490 1	.01. 59	21.51						
2390.000 2405.490 1	.01. 59	21.51						
2390.000 2405.490 1	.01. 59	21.51						

4.2.5 Test Result of Radiated Spurious at Band Edges



Fest Mode :	Mode 1: C	CH01_240)5 MHz		Temp	erature :		21~23 ℃
est Engineer :	Jack Liu				Relat	ive Humi	idity :	61~63%
Frequencey Range	2.30GHz~	-2.41GHz			Polar	ization :		Horizontal
120	el (dBuV/m)			1		c	Date: 202	3-05-26
110					r			
90						FCC	PART15.	-6 ₄ dB
70								
50								Д
30	1		2		_ ~		3	
10								
0 2300	2310.	2330.		350. quency (MI	2370. Hz)	23	90.	2410
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.010 2340.920 2390.000 2405.050	30.21 29.41	27.12 27.18 27.28 27.31	4.15 4.27 4.46 4.52	35. 70 35. 79 35. 93 35. 97	22.87 25.87 25.22 86.37	54. 00 54. 00 54. 00 94. 00	-28.13 -28.78	Average Average Average Average Average



st Mode :	Mode 1:	CH01_240	05 MHz		Tempera	ture :	21~23 ℃	1
st Engineer :	Jack Liu	I			Relative	Humidity :	61~63%	I
equencey Ran	ge 2.30GH	z~2.41GHz	<u>.</u>		Polarizat	ion :	Vertical	
120 Level	(dBuV/m)	54		. ^		A REAL PROPERTY AND A REAL	ate: 2023-	
277,9230,75						FCC PAR	T15.249 P	-6dB
110								-000
90					123			4
70								
11000]	
50						2 3	a stort of	
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automic a	hoginsonstanionad	ar-turiten kalidonesi	ىمۇر چەلىمەلىم. ھايەرمى بىرى		and the second	2 .	an and a start of the start of	
30	1 	2330.		350. guency (Mi	2370. Hz)		3. 90.	2410
30 10	310. Reading level dBuV	2330. Antenna factor dB/m	Free	quency (M	Hz)			2410 Remark



est Mode :	Mod	e 1: CH01_	_2405 MF	łz	Temp	erature :	2	21~23℃
est Engineer	r: Jack	: Liu			Relat	ive Humid	l ity :	61~63%
requencey R	ange 2.30	GHz~2.410	GHz		Polar	١	Vertical	
Level	(dBuV/m)					D	ate: 20	23-05-05
120 110								
90						FCC	PART18	5.249 AV
70								
50								
30	1		2				-	
10			5				8	
0	2310.	2330.		50. quency (MI	2370. Hz)	23	90.	2410
2300 2		A	Cable			Limit level	Over limi	
Freq MHz	Reading level dBuV	Antenna factor dB/m	loss dB	factor dB	level dBuV/m	dBuV/m	dB	.t Remark

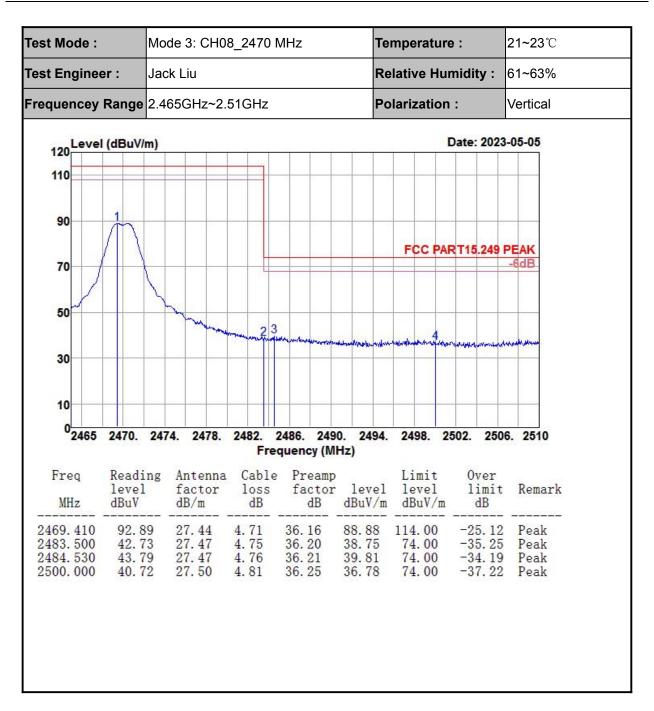


st Mode :	Mode	3: CH08_	2470 Mł	Ηz	Tem	perature :		21~23 ℃	
st Engineer :	Jack I	_iu			Rela	tive Humi	dity :	61~63%	
equencey Rar	nge 2.465	GHz~2.51	GHz		Pola	rization :		Horizontal	
120 Level (dBuV/m)						Date: 20	023-05-26	
110	1							- Y	
90									
70						FCC PAP	RT15.24	-6dB	
		m -							
50		- han	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	manna		4			
30						- Constraints	ani north tangad	new new products	
10					-				
0 <mark>2465</mark>	2470. 247	4. 2478.	2482. Fre	2486. 249 quency (M		2498. 2	502. 2	506. 2510	
1.00	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB		Limit level dBuV/m	Ove: lim dB	it Remark	
	103.36 49.77 50.19 44.18	27.44 27.47 27.47 27.50	3.67 3.68 3.68 3.68 3.68	36.16 36.20 36.21 36.25	98.31 44.72 45.13 39.11	74.00 74.00	-29. -28.	69 Peak 28 Peak 87 Peak 89 Peak	



est Mode :	Mode 3:	CH08_2470 N	ЛНz	Ten	nperatu	2'	21~23 ℃		
est Engineer :	Jack Liu			Rel	ative H	umidity	1: 6 ⁻	1~63%	
requencey Rang	e 2.465GH	z~2.51GHz		Pol	arizatio	on :	Н	orizontal	
120 Level (dB	uV/m)					Date:	2023-0	5-26	
120									
90									
70									
50					FC	C PAR		AV BdB	
	Jun								
30				_		2			
10				- 0 - 0 - 0		5	_		
02465 247	70. 2474.	2478. 2482.			2498.	2502.	2506.	2510	
Freq Re	ading An	tenna Cabl	e quency(M e Preamp	64	Limit	0v	er		
	vel fac	ctor loss		level dBuV/m	level	. li		Remark	
2469.950 9 2483.500 3	2.80 27. 1.33 27.	. 44 3. 67 . 47 3. 68	36.16 36.20	87.75 26.28	94.00 54.00			Average Average	
	8.83 27.	50 3.68	36.25	23.76	54.00			Average	







st Mode :	Mode	-						Temperature :			
st Engineer :	Jack L							nidity	: 61~	63%	
equencey Rang	je 2.4650	GHz~2.51	GHz			Polar	ization	:	Vert	tical	
120 Level (d	IBuV/m)							Date	: 2023-0	05-05	
120											
90	1										
70	1										
50							FC	C PAR	T15.24	9 AV 6dB	
30		m	~ 2	3							
				Ť <u></u>							
10 0 2465 2	470. 247	4. 2478.	2482.	2486.	2490.	2494.	2498.	2502.	2506.	2510	
Freq R	leading evel BuV	Antenna factor dB/m			amp tor		Limit level dBuV/	. 1	ver imit dB	Remark	
2483.500 2484.980	91.05 30.15 30.40 28.20	27.44 27.47 27.47 27.50	4.71 4.75 4.76 4.81	36. 10 36. 20 36. 2 36. 2	02 12	7.04 6.17 6.42 4.26	94.00 54.00 54.00 54.00	-2	7.83	Average Average Average Average	



4.2.6 Test Result of Radiated Spurious Emission

st Mode :	Мо	de 1: CH01	I_2405 M⊦	łz	Temp	erature :	2	1~23 ℃	
st Enginee	r: Jac	k Liu			Relat	ive Humic	dity: 6	61~63%	
equencey F	Range 3G	Hz~18GHz			Polar	ization :	Η	orizontal	
120Level	l (dBuV/m)	1					Date: 202	3-05-05	
110									
90									
					_	FCC PAF	RT15.249		
70								-6dB	
	2	4	6			FCC	PART15.	the second se	
50	Ī	3	5					-6dB	
30						204 			
10									
03000	60	000. 80		0000. 1 quency (Mi	12000. Hz)	14000.	16000.	18000	
Freq MHz	Reading level dBuV	Antenn factor dB/m		Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	: Remark	
4810.000 4810.000 7215.000 7215.000 9620.000 9620.000	41. 30 50. 14 30. 70 44. 04 28. 39 41. 48	$\begin{array}{c} 31.\ 16\\ 31.\ 16\\ 35.\ 57\\ 35.\ 57\\ 38.\ 45\\ 38.\ 45\\ 38.\ 45\\ \end{array}$	6.31 6.31 8.63 8.63 11.35 11.35	35.52 35.52 32.47 32.47 33.65 33.65	43. 25 52. 09 42. 43 55. 77 44. 54 57. 63	54.0074.0054.0074.0054.0074.0074.00	-10.75 -21.91 -11.57 -18.23 -9.46 -16.37	Peak Average Peak Average	



est Mode :		Mode	e 1: CH01	_2405 MH	łz	Temp	erature :		21~	23 ℃
est Enginee	r :	Jack	Liu	Relat	ive Humic	dity :	61~	63%		
requencey F	Range	3GH	z~18GHz	Polar	ization :		Ver	tical		
120 Leve	l (dBu\	//m)						Date: 2	2023-	05-05
110										
90				22			FCC PAF	2715.2	249 P	EAK
70				6		_				6dB
50	2		4				FCC	PART		9 AV 6dB
30			3							
30										
10										
03000		600	0. 80		0000. quency (Mi	12000. Hz)	14000.	1600	0.	18000
Freq MHz	Read leve dBuV	1	Antenna factor dB/m	a Cable loss dB		level dBuV/m	Limit level dBuV/m	Ove lin dl	nit	Remark
4810.000 4810.000 7215.000 7215.000 9620.000 9620.000	41. 50. 30. 44. 28. 41.	14 70 04 39		$\begin{array}{c} 6.\ 31 \\ 6.\ 31 \\ 8.\ 63 \\ 8.\ 63 \\ 11.\ 35 \\ 11.\ 35 \end{array}$	35.52 35.52 32.47 32.47 33.65 33.65	$\begin{array}{r} 43.\ 25\\ 52.\ 09\\ 42.\ 43\\ 55.\ 77\\ 44.\ 54\\ 57.\ 63\end{array}$	54.0074.0054.0074.0054.0074.00	-21. -11. -18. -9.	91 57 23 46	Average Peak Average Peak Average Peak

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.



fest Mode	:	Mode	2: CH	04_2430 N	ЛНz	Tem	nperature	:	21~23 ℃
est Engine	er:	Jack Liu					ative Hum	idity :	61~63%
requence	y Range	3GHz	~18GF	łz		Pola	arization :		Horizontal
120 Leve	l (dBuV/	m)			ľ			Date: 202	23-05-05
110									<u></u>
90	- 5						500 84		DEAL
70			29		c		FCC PAP		-6dB
50	2		4		6 5		FCC	PART15	.249 AV -6dB
30		22							
10		Č.		_					
03000		6000.	8		0000. quency (M	12000. Hz)	14000.	16000.	18000
Freq MHz	Readi level dBuV	f	ntenn actor B/m		Preamp factor dB	level dBuV/m		Over limi dB	
4860.000 4860.000 7290.000 7290.000 9720.000 9720.000		0 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3			35. 51 35. 51 32. 59 32. 59 33. 82 33. 82	$\begin{array}{r} 45.\ 04\\ 52.\ 97\\ 46.\ 10\\ 55.\ 74\\ 45.\ 12\\ 56.\ 65\end{array}$		-21.0 -7.9	6 Peak 8 Avera



est Mode :	Mode	2: CH04_	_2430 MHz	2	Temp	erature :		21~23 ℃		
est Engineer :	Jack L	iu			Relati	ve Humid	ity :	61~63%		
equencey Ra	nge 3GHz [,]	~18GHz			Polari	zation :	,	Vertical		
120 Level	(dBuV/m)					ľ	Date: 20	023-05-05		
110				- c						
90				2						
70						FCC PAF	RT15.24	49 PEAK -6dB		
50	2	4		5		FCC	PART1	5.249 AV -6dB		
30										
10			5.1							
0 <mark>3000</mark>	600	0. 8		0000. Juency (Mi	12000. Hz)	14000.	16000	0. 18000		
Freq MHz	Reading level dBuV	Antenn factor dB/m	a Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Ove lim dB	it Remar		
4860.000 4860.000 7290.000 7290.000 9720.000 9720.000	37. 51 48. 84 34. 90 42. 85 30. 92 40. 79	31. 25 31. 25 35. 74 35. 74 38. 49 38. 49 38. 49		35.51 35.51 32.59 32.59 33.82 33.82 33.82	39. 98 51. 31 47. 01 54. 96 46. 88 56. 75	$54.\ 00\\74.\ 00\\54.\ 00\\74.\ 00\\54.\ 00\\74.\ 00\\74.\ 00$	-22. -6.			

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.



st Mode :		: Jack Liu				Temp	perature :		21~23 ℃	
st Enginee	er:					Relat	tive Humi	dity:	61~63%	
equencey	Range					Pola	rization :	ł	Horizontal	
120 Lev	el (dBu	V/m)					ſ	Date: 202	23-05-05	
110										
90									0.2012	
70							FCC PAF	RT15.249	-6dB	
50	2		4		6		FCC	PAR T15	.249 AV -6dB	
30	- 22		3							
10 0 3000		600	0 8	000. 1	0000. 1	2000.	14000.	16000.	18000	
0000		000	. U		quency (MI		14000.	10000.	10000	
Freq MHz	Read leve dBuV		Antenn factor dB/m	a Cable loss dB		level dBuV/m		Over limi dB		
4940.000 4940.000 7410.000 7410.000 9880.000 9880.000	50. 29. 38. 28.	07 49 90 28	31.39 36.00 36.00 38.55	7.39 7.39 9.32 9.32 11.73 11.73	35. 51 35. 51 32. 80 32. 80 34. 10 34. 10	$\begin{array}{r} 43.\ 78\\ 53.\ 34\\ 42.\ 01\\ 51.\ 42\\ 44.\ 46\\ 56.\ 46\end{array}$	54.0074.0054.0074.0054.0074.00	-20.6 -11.9 -22.5 -9.5	2 Averag 6 Peak 9 Averag 8 Peak 4 Averag 4 Peak	



est Mo	ode :		Mode 3: CH08_2470 MHz				Tempe	Temperature :		21~23℃ 61~63%	
est Er	nginee	rr: Jack Liu			Relati	ve Humidi	t y : 61~6				
reque	ncey	Range	3GH	lz~18GHz			Polari	zation :	Vertio	cal	
120	Level	(dBuV/	/m)			1		[Date: 2023	-05-05	
110		2			-						
90		8	ć.			2	_				
70								FCC PA	RT15.249 F	-6dB	
50		2		4		6		FCC	PART15.2	49 AV -6dB	
100		1		3	3	5					
30											
10		5	-								
0	3000		600	0. 80		0000. quency (Mi	12000. Hz)	14000.	16000.	18000	
Fre MH	- 53) 9	Readi level dBuV		Antenna factor dB/m	a Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark	
4940. 4940. 7410. 7410. 9880. 9880.	000 000 000 000	37.2 46.5 30.5 40.4 25.2 39.8	50 51 49 24	31. 39 31. 39 36. 00 36. 00 38. 55 38. 55	7.39 7.39 9.32 9.32 11.73 11.73	35.51 35.51 32.80 32.80 34.10 34.10	40. 48 49. 77 43. 03 53. 01 41. 42 56. 04	$54.\ 00\\74.\ 00\\54.\ 00\\74.\ 00\\54.\ 00\\74.\ 00$	-13.52 -24.23 -10.97 -20.99 -12.58 -17.96	Average Peak Average Peak Average Peak	

Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.



fest Mode :		Mode 1: CH01_2405 MHz Jack Liu 30MHz~1GHz				Temp	erature	Temperature :			
est Engine	er:					Relat	,			61~63% Horizontal	
requencey	Range					Polar					
								Dete		05.05	
80 Level (dBuV/m)						Date	: 2023-	-00-00	
70						_			_		
60											
50							FCC P	ARII	5.249 F	-6dB	
40											
30						_			-		
20 1						3	4 Annon and and and and and and and and and an	Anteren .	6 Automaticher	nantheony	
10	2 Martine	No. ALLANAS	remainder	www.mahanshan	whenesses						
10											
1.44	_			400	500	200 7	00 0	00	000	4000	
0 30 100	_		300.	400. Free	500. (quency (Mi		00. 8	00.	900.	1000	
0 <mark>30 100</mark>	0. 20	g A	300.	Fre Cable	quency(MI Preamp	Hz) level	Limit level	0	900. ver imit dB		
030 100 Freq MHz 51.340 150.280	D. 20 Readin level dBuV 31.99 29.50	g A f _ d _ 1 1	300. ntenna actor B/m 5.41 4.43	Free Cable loss dB 1.36 2.36	Preamp factor dB 32.65 32.67	Hz) level dBuV/m 16.11 13.62	Limit level dBuV/ 40.00 43.50	0 1 -2 -2	ver imit dB 3.89 9.88	Remark Peak Peak	
030 100 Freq MHz 51.340	D. 20 Readin level dBuV 31.99 29.50	g A f 1 1 1 2	300. ntenna actor B/m 5.41 4.43	Free Cable loss dB 1.36	Preamp factor dB 32.65 32.67	Hz) level dBuV/m 16.11	Limit level dBuV/ 40.00 43.50	0 1 -2 -2 -2 -2	ver imit dB 3.89 9.88 4.59	Remark Peak Peak Peak Peak Peak	

4.2.7 Test Result of Radiated Spurious Emission (30MHz ~ 1GHz)



st Mode :	Mode 1: CH01_2405 MHz				Tempe	erature :	21~2	21~23 ℃	
st Engineer :	Jack	Jack Liu				ve Humidit	y: 61~6	3%	
equencey Range	30MF	Hz∼1GHz			Polariz	zation :	Verti	cal	
80 Level (dBu) 70 60 50 40 30 20 20 20 20 20 20 20 20 20 20 20 20 20		ahalarma araala			den hard medera		Pate: 2023		
0 <mark>30 100.</mark>	200.	300.	400. Fred	500. (00. 800.	. 900.	1000	
Freq Read leve MHz dBu	21	Antenna factor dB/m		Preamp	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark	
98.870 37. 161.920 32. 645.950 29. 731.310 30.	32 63	14.07 9.06 14.02 19.27 20.54 22.10		32. 65 32. 66 32. 67 32. 59 32. 35 32. 07	17.39 16.02 16.13 21.45 24.51 25.31	43.50 46.00	$\begin{array}{r} -22.\ 61\\ -27.\ 48\\ -27.\ 37\\ -24.\ 55\\ -21.\ 49\\ -20.\ 69\end{array}$	Peak Peak Peak	



4.3 AC Conducted Emission Measurement

4.3.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of omission (MHz)	Conducted limit (dBµV)				
Frequency of emission (MHz)	Quasi-peak	Average			
0.15-0.5	66 to 56*	56 to 46*			
0.5-5	56	46			
5-30	60	50			

*Decreases with the logarithm of the frequency.

4.3.2 Test Procedures

- 1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- 2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- 3. All the support units are connecting to the other LISN.
- 4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- 5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
- 6. Both sides of AC line were checked for maximum conducted interference.
- 7. The frequency range from 150 kHz to 30 MHz was searched.
- 8.Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.



4.3.3 Test Result of AC Conducted Emission

N/A



4.4 Antenna Requirements

4.4.1 Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded..

4.4.2 Antenna Connected Construction

An PCB antenna design is used.

4.4.3 Antenna Gain

The antenna peak gain of EUT is -1.2 dBi.



5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	Keysight	N9010A	MY56070788	2022-12-26	2023-12-25	Conducted
Power Sensor	Keysight	U2021XA	MY56510025	2022-12-27	2023-12-26	Conducted
Power Sensor	Keysight	U2021XA	MY57030005	2022-12-27	2023-12-26	Conducted
Power Sensor	Keysight	U2021XA	MY56510018	2022-12-27	2023-12-26	Conducted
Power Sensor	Keysight	U2021XA	MY56480002	2022-12-27	2023-12-26	Conducted
Thermal Chamber	Howkin	UHL-34	19111801	2022-12-23	2023-12-22	Conducted
Base Station	R&S	CMW 270	101231	2022-12-26	2023-12-25	Conducted
Signal Generator (Interferer)	Keysight	N5182B	MY56200384	2022-12-26	2023-12-25	Conducted
Signal Generator (Blocker)	Keysight	N5171B	MY56200661	2022-12-26	2023-12-25	Conducted

Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV 40	101433	2022-12-26	2023-12-25	Radiation
Amplifier	Sonoma	310	363917	2022-12-26	2023-12-25	Radiation
Amplifier	Schwarzbeck	BBV 9718	327	2022-12-27	2023-12-26	Radiation
Amplifier	Narda	TTA1840-35-HG	2034380	2023-01-04	2024-01-03	Radiation
Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-051	2023-02-12	2026-02-11	Radiation
Broadband Antenna	Schwarzbeck	VULB 9168	9168-757	2020-09-27	2023-09-26	Radiation
Horn Antenna	Schwarzbeck	BBHA 9120 D	1677	2023-02-12	2026-02-11	Radiation
Horn Antenna	COM-POWER	AH-1840	101117	2021-06-05	2024-06-04	Radiation
Test Software	Auidx	E3	6.111221a	N/A	N/A	Radiation
Filter	Micro-Tronics	BRM 50702	G266	N/A	N/A	Radiation
Communication Tester	R&S	CMW270	101231	2022-12-26	2023-12-25	Radiation



Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
LISN	R&S	ENV216	102125	2023-12-19	2023-12-20	Conducted
LISN	R&S	ENV432	101327	2023-12-19	2023-12-20	Conducted
EMI Test Receiver	R&S	ESR3	102143	2023-12-19	2023-12-20	Conducted
EMI Test Software	Audix	E3	N/A	N/A	N/A	Conducted

N/A: No Calibration Required



6 Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	3.29dB
	30MHz ~ 1GHz	5.40dB
Radiated emission	1GHz ~ 18GHz	5.03dB
	18GHz ~ 40GHz	5.21dB

MEASUREMENT	UNCERTAINTY
Occupied Channel Bandwidth	±57.212Hz
RF output power, conducted	±1.04dB
Power density, conducted	±2.31dB
Emissions, conducted	±2.18dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.



Appendix A. Setup Photographs

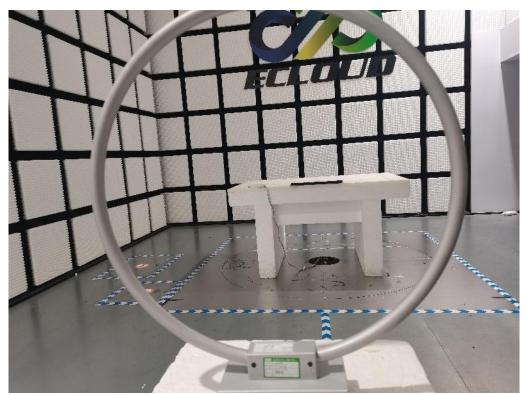


Fig. 1 Radiated emission setup photo(Below 30MHz)



Fig. 2 Radiated emission setup photo(30MHz- 1GHz)

Building A1, Changsha E Center, No. 18 Xiangtai Avenue, Liuyang Economic and Technological Development Zone, Hunan, P.R.C FCC ID : 2AKHJ-HW357-3 www.hn-ecloud.com Tel.:+86-731-89634887 Fax.: +86-731-89634887





Fig. 3 Radiated emission setup photo(Above 1GHz)

-----End of the report-----End of the report-----

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