FCC AND ISED CERTIFICATION TEST REPORT

Applicant:	Guangzhou Shirui Electronics Co.,Ltd.
Address:	192 Kezhu Road, Scientech Park, Guangzhou Economic & Technology Development District, Guangzhou, Guangdong, China
Manufacturer:	Guangzhou Shirui Electronics Co.,Ltd.
Address:	192 Kezhu Road, Scientech Park, Guangzhou Economic & Technology Development District, Guangzhou, Guangdong, China
Product Description:	Sensor Box
Brand Name:	MAXHUB
Tested Model:	WL10C
FCC ID:	2AFG6-WL10C
Report No.:	JCF230925208-001
Received Date:	Sep. 25, 2023
Tested Date:	Sep. 25, 2023 - Oct. 25, 2023
Issued Date:	Oct. 25, 2023
Test Standards:	FCC Rules and Regulations Part 15 Subpart C,
Test Procedure :	ANSI C63.10:2013
Test Result:	Pass

Prepared By:

Roger Li

Roger Li/Engineer **Date:** Oct. 25, 2023

Reviewed By:

Kennys Zhang

Kennys Zhang/Engineer **Date:** Oct. 25, 2023

Approved By:

Talent Zhang

Talent Zhang/Engineer **Date:** Oct. 25, 2023

Note: The test results in this report apply exclusively to the tested model / sample. Without written approval of Guangzhou Jingce 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	/	Oct. 25, 2023	Original Report	/

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1. Test Report Declare

Applicant:	Guangzhou Shirui Electronics Co.,Ltd.
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Manufacturer:	Guangzhou Shirui Electronics Co.,Ltd.
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Product Name:	Sensor Box
Brand Name:	MAXHUB
Model Name:	WL10C
Additional Models:	NA

We Declare:

The equipment described above is tested by Guangzhou Jingce Testing Technology Co., Ltd. and in the configuration tested the equipment complied with the standards specified above. The test results are contained this test report and Guangzhou Jingce Testing Technology Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

2. Summary of Test Results

Summary of Test Results			
Clause	**Test Items**	**FCC/ISED Rules**	**Test Result**
1	20 dB Bandwidth	FCC Part 15: 15.215 ANSI C63.10:2013	Pass
2	Frequency tolerance	FCC Part 15:15.225 ANSI C63.10:2013	Pass
3	Radiated Emission	FCC Part 15: 15.209 FCC Part 15: 15.225 ANSI C63.10:2013	Pass
4	Power Line Conducted Emissions	FCC Part 15: 15.207 ANSI C63.10:2013	NA
5	Antenna requirement	FCC Part 15: 15.203 ANSI C63.10:2013	Pass
Note: N/A is an abbreviation for Not Applicable.			

3. Test Laboratory

Guangzhou Jingce Testing Technology Co., Ltd.

Add.: No.192, Kezhu Road, Huangpu District, Guangzhou, Guangdong, China

Association for Laboratory Accreditation(A2LA). Certificate Number: 6594.01

FCC Designation Number: CN1331. Test Firm Registration Number: 360543

IC Test Firm Registration Number: 28796

Conformity Assessment Body identifier: CN0138

4. Equipment Under Test

4.1. Description of EUT

EUT Name:	Sensor Box
Model Number:	WL10C
EUT Function Description:	Please reference user manual of this device
Power Supply:	5V DC 300mA
Hardware Version:	N/A
Software Version:	N/A
Radio Specification:	NFC
Operation Frequency:	13.56 MHz
Modulation:	ASK
Antenna Type:	PCB Loop antenna

Note 1: EUT is the ab. of equipment under test.

Note 2: The antenna gain is declared by the customer and the laboratory is not responsible for the accuracy of the antenna gain.

4.2. Test Channel Configuration and Channel List

Tested mode, channel, information		
Mode	Channel	Frequency (MHz)
ASK	CH1	13.56

4.3. Test environment conditions

During the measurement the environmental conditions were within the listed ranges:

/	Normal Conditions	Extreme Conditions
Temperature range:	21-25 ℃	0 ℃ to +40 ℃
Humidity range:	40-75 %	40-75 %
Pressure range:	86-106 kPa	86-106kPa
Power supply	DC 5V	Low Voltage: 4.25V High Voltage: 5.75V
Note: The Extreme temperature range and extreme voltages are declared by the manufacturer.		

4.4. Description of Available Antennas

Test Mode	Transmit and Receive Mode	Description
ASK	☒ 1TX	Antenna 1 can be used as transmitting/receiving antenna.

5. Description of Test Setup

5.1. Accessory

Description of Accessories	Manufacturer	Model Number	Description	Remark
/	/	/	/	/

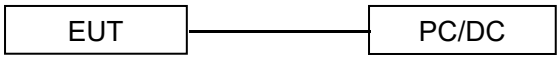
5.2. Support Equipment

Equipment	Brand Name	Model Name	P/N
PC	Lenovo	T480	/

5.3. Test Setup

The EUT can work in normal operation.

5.4. Setup Diagram for Tests



6. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test Item	Uncertainty
AC Power Conduction emission	1.37 dB
All Radiated emissions	4.6dB
Conducted emissions	3.09 dB
Occupied Channel Bandwidth	1.1%
Conducted Output power	0.82dB
Power Spectral Density	0.82dB
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k = 2.	

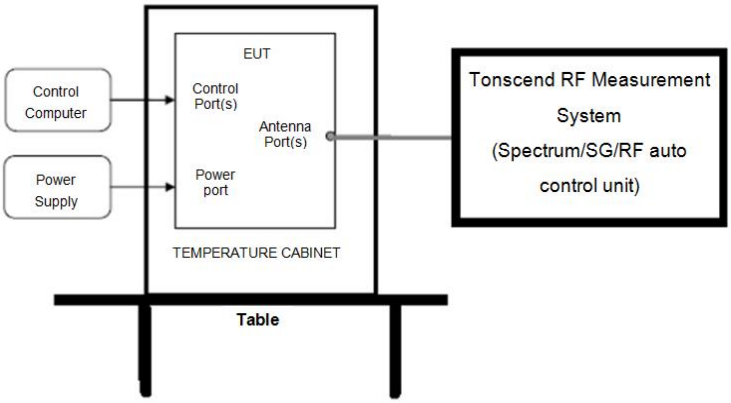
7. Measuring Instrument and Software Used

TS Test System						
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due. Date
☑	Spectrum Analyzer	Keysight	N9030B	MY56320512	Sep. 12, 2023	Sep. 11, 2024
☑	Vector Signal Generator	Keysight	N5182B	MY57300334	Sep. 12, 2023	Sep. 11, 2024
☑	Signal Generator	Keysight	N5171B	MY57280639	Sep. 12, 2023	Sep. 11, 2024
☑	DC POWER	Keysight	E342A	MY59020356	Jul. 14, 2023	Jul. 13, 2024
☑	Incubator thermometer	GWS	EL-02JA	21107288	Sep. 12, 2023	Sep. 11, 2024
☑	Control unit(Power sensor)	Tonscend	JS0806-2	/	Sep. 12, 2023	Sep. 11, 2024
☑	Wideband radio communication tester	R&S	CMW500	163478	Jul. 11, 2023	Jul. 10, 2024
Software						
Used	Description	Manufacturer	Name		Version	
☑	Test software	TS+	JS1120-3		V3.3.10	
RSE Test System						
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due. Date
☑	EMI Receiver	R&S	ESW	101685	Jul. 12, 2023	Jul. 11, 2024
☑	Bilog Antenna	Schwarzbeck	VULB 9163	01416	Mar. 21, 2023	Mar. 20, 2024
☑	Horn Antenna 1	Schwarzbeck	BBHA 9120 D	02411	May. 25, 2023	May. 24, 2024
☑	Horn Antenna 2	ETS	BBHA 9170	1090	Sep. 04, 2023	Sep. 03, 2024
☑	loop-antenna	Schwarzbeck	FMZB 1513-60	00030	Jan.14,2023	Jan.13,2024
☑	Signal Pre-Amplifier	Tonscend	TAP01018050	AP21C806122	Jul. 10, 2023	Jul. 09, 2024
☑	Signal Pre-Amplifier	Tonscend	TAP9K3G32	AP20K806104	Jul. 10, 2023	Jul. 09, 2024

☑	Signal Pre-Amplifier	ETS	3116C-PA	00217677	Aug. 24, 2023	Aug. 23, 2024
☑	3m Fully-anechoic Chamber	ETS	RFD-100	/	Apr. 24, 2021	Apr. 23, 2024
Software						
Used	Description	Manufacturer	Name		Version	
☑	Test software	TS+	TS+		V3.0.0.4	
Conducted Emission Test For AC Power Port						
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due. Date
☑	LISN	R&S	ENV216	102154	Jul. 10, 2023	Jul. 09, 2024
☑	EMI Receiver	R&S	ESR3	102509	Jul. 12, 2023	Jul. 11, 2024
Software						
Used	Description	Manufacturer	Name		Version	
☑	Test software	EZ	EZ-EMC		EMEC-3A1	
Other Instrument						
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due. Date
☑	Temperature & Humidity	Temperature	HTC-1	/	Nov. 25, 2022	Nov. 24, 2023

8. 20 dB Occupied Bandwidth and 99 % Occupied Bandwidth

8.1. Block diagram of test setup



8.2. Limit

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

8.3. Test Procedure

Connect EUT's antenna output to spectrum analyzer by RF cable.

Set the spectrum analyzer as follows:

RBW:	10kHz
VBW:	30kHz
Detector Mode:	Peak
Sweep time:	auto
Trace mode	Max hold

Allow the trace to stabilize, measure the 20dB of signal.

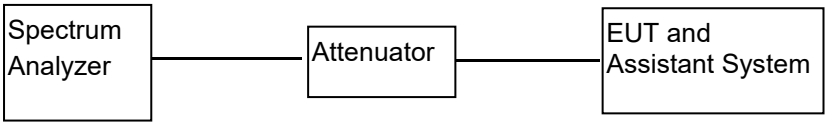
8.4. Results

Mode	Freq. (MHz)	20dB bandwidth Result (kHz)	Conclusion
ASK	13.56	27	PASS

8.5. Original test data

9. Frequency Tolerance

9.1. Block diagram of test setup



9.2. Limits

As contained in § 15.225 the frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply Voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

9.3. Test Procedure

(1) Connected the EUT's antenna port to the Spectrum Analyzer by suitable attenuator, set the Spectrum Analyzer as below:

Centre Frequency: The centre frequency of the channel under test.

Resolution BW: 1 KHz.

Video BW: 1 KHz.

Span: 1MHz.

Detector: Peak.

Trace Mode: Max Hold.

(2) When the trace is complete, find the peak value of the power envelope and record the frequency.

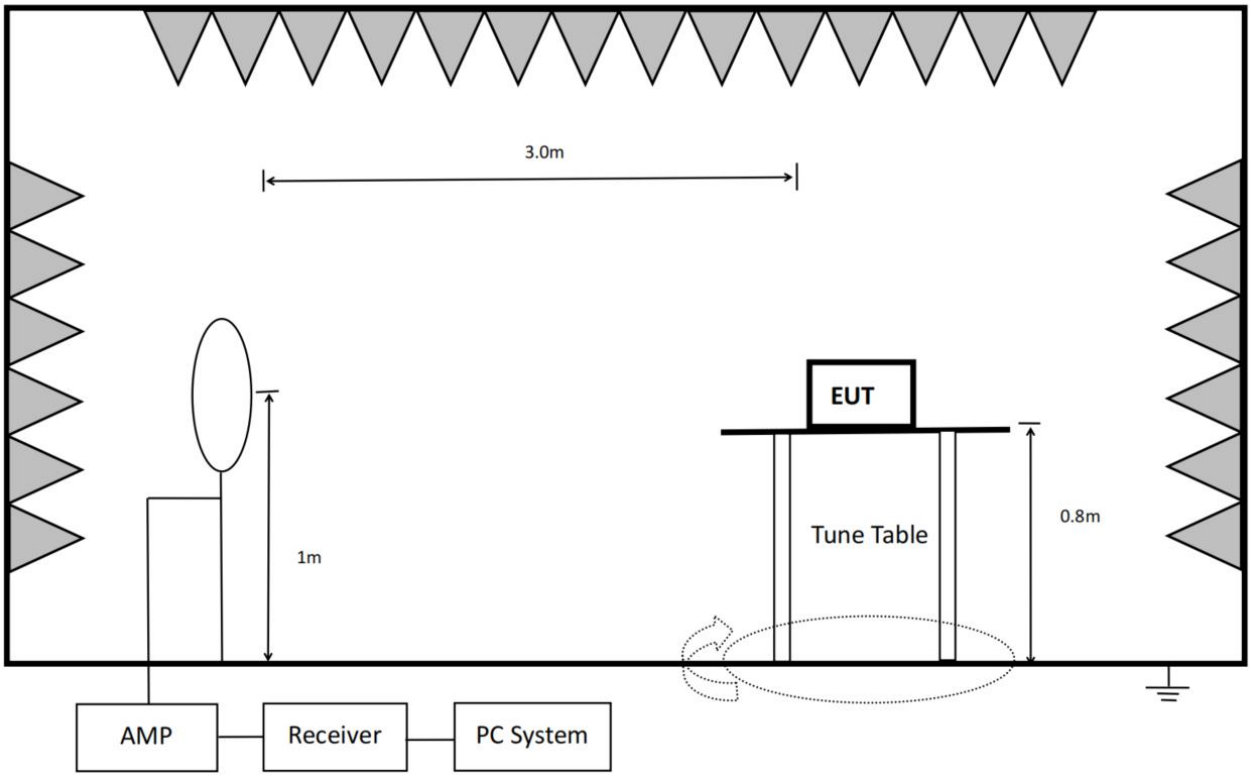
9.4. Results

Mode	Condition		Result			Limit
	Temperature (℃)	Voltage (V)	Measured (MHz)	Tolerance (kHz)	Tolerance (ppm)	ppm
	-20	NV	13.56006	0.06	4	100
	-10		13.56006	0.06	4	100
	0		13.56006	0.06	4	100
	10		13.56006	0.06	4	100
	20		13.56006	0.06	4	100
	30		13.56006	0.06	4	100
	40		13.56006	0.06	4	100
	50		13.56006	0.06	4	100
	20	4.25	13.56006	0.06	4	100
		5.75	13.56006	0.06	4	100
Note: NT:20℃,NV:5V						

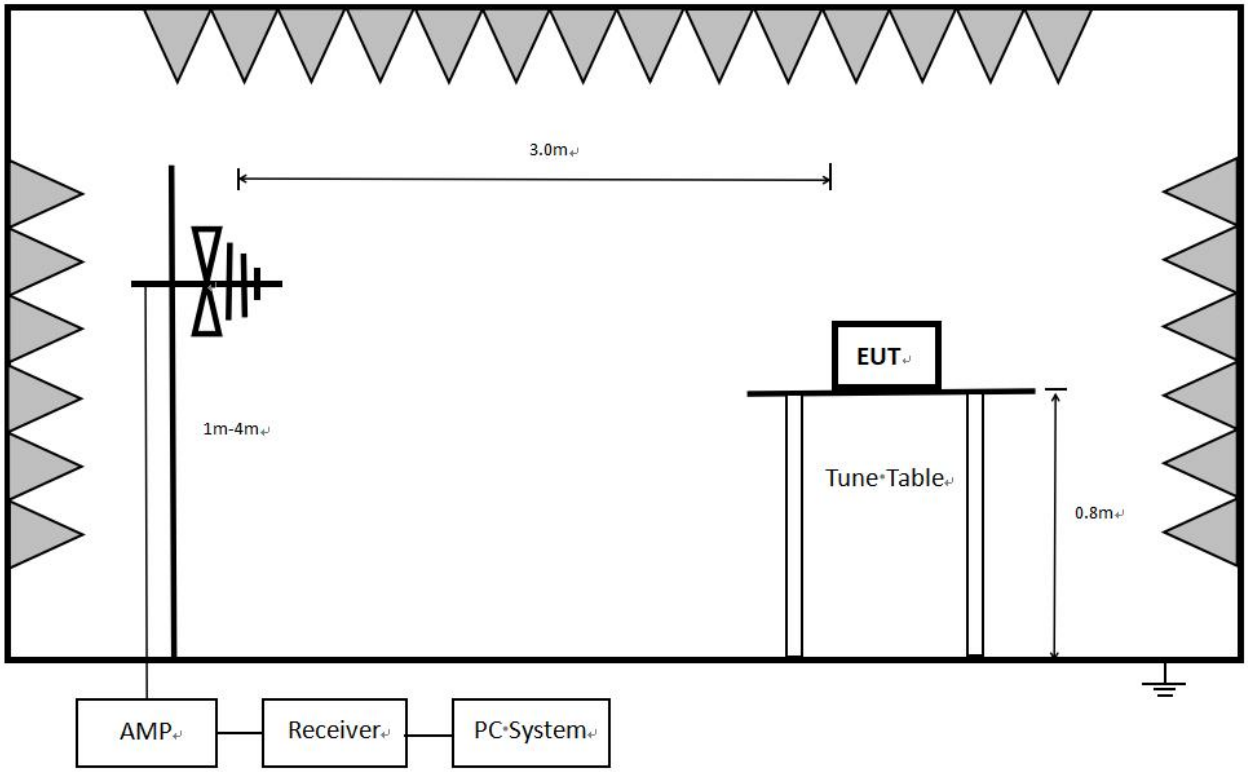
10. Radiated Emission

10.1. Block diagram of test setup

In 3m Anechoic Chamber, test setup diagram for 9kHz - 30MHz:



In 3m Anechoic Chamber, test setup diagram for 30 MHz - 1 GHz:



10.2. Limit

Operation within the band 13.110-14.010 MHz as contained in §15.225:

(a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		μV/m	dB(μV)/m
0.009 ~ 0.490	300	2400/F(KHz)	67.6-20log(F)
0.490 ~ 1.705	30	24000/F(KHz)	87.6-20log(F)
1.705 ~ 13.110	30	30	29.54
13.110 ~ 13.410	30	106	40.51
13.410~ 13.553	30	334	50.47
13.553~13.567	30	15848	84.00
13.567~13.710	30	334	50.47
13.710~14.010	30	106	40.51
14.010~30	30	30	29.54
30~88	3	100	40.0
88~216	3	150	43.5
216~960	3	200	46.0
960~1000	3	500	54.0

Note: (1) The emission limits shown in the above table are based on measurements employing a CISPR QP detector except for the frequency bands 9-90KHz, 110-490KHz and above 1000MHz.Radiated emissions limits in these three bands are based on measurements employing an average detector.

(2) At frequencies below 30MHz, measurement may be performed at a distance closer then that specified, and the limit at closer measurement distance can be extrapolated by below formula:

$Limit_{3m}(dBuV/m) = Limit_{300m}(dBuV/m) + 40Log(300m/3m) = Limit_{300m}(dBuV/m) + 80$

$Limit_{3m}(dBuV/m) = Limit_{30m}(dBuV/m) + 40Log(30m/3m) = Limit_{30m}(dBuV/m) + 40$

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT dB(μV)/m
0.009 ~ 0.490	3	147.6-20log(F)
0.490 ~ 1.705	3	127.6-20log(F)
1.705 ~ 13.110	3	69.54
13.110 ~ 13.410	3	80.51
13.410 ~ 13.553	3	90.47
13.553 ~ 13.567	3	124.00
13.567 ~ 13.710	3	90.47
13.710 ~ 14.010	3	80.51
14.010 ~ 30	3	69.54
30 ~ 88	3	40.00
88 ~ 216	3	43.50
216 ~ 960	3	46.00
960 ~ 1000	3	54.00

10.3. Test Procedure

(1) EUT was placed on a non-metallic table, 100 cm above the ground plane inside a semi-anechoic chamber.

(2) Test antenna was located 3m from the EUT on an adjustable mast, and the antenna used as below table.

Test frequency range	Test antenna used	Test antenna distance
9KHz-30MHz	Active Loop antenna	3m
30MHz-1GHz	Trilog Broadband Antenna	3m

According ANSI C63.10:2013 clause 6.4.4.2 and 6,5.3, for measurements below 30 MHz, the loop antenna was positioned with its plane vertical from the EUT and rotated about its vertical axis for maximum response at each azimuth position around the EUT. And the loop antenna also be positioned with its plane horizontal at the specified distance from the EUT. The center of the loop is 1 m above the ground. for measurement above 30MHz, the Trilog Broadband Antenna or Horn Antenna was located 3m from EUT, Measurements were made with the antenna positioned in both the horizontal and vertical planes of Polarization, and the measurement antenna was varied from 1 m to 4 m. in height above the reference ground plane to obtain the maximum signal strength.

(3) Below pre-scan procedure was first performed in order to find prominent frequency spectrum radiated emissions from 9KHz to 1GHz:

(a) Scanning the peak frequency spectrum with the antenna specified in step (3), and the EUT was rotated 360 degree, the antenna height was varied from 1m to 4m(Except loop antenna, it’s fixed 1m above ground.)

(b) Change work frequency or channel of device if practicable.

(c) Change modulation type of device if practicable.

(d) Rotated EUT though three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions. Spectrum frequency from 9KHz to 1GHz (tenth harmonic of fundamental frequency) was investigated.

(4) For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1m and 4m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipments and all of the interface cables were changed according to ANSI C63.10 2013 on Radiated Emission test.

(5) The emissions from 9KHz to 1GHz were measured based on CISPR QP detector except for the frequency bands 9-90KHz, 110-490KHz, for emissions from 9KHz-90KHz,110KHz-490KHz and above 1GHz were measured based on average detector, for emissions above 1GHz, peak emissions also be measured and need comply with Peak limit.

(6) The emissions from 9KHz to 1GHz, QP or average values were measured with EMI receiver with below RBW.

Frequency band	RBW
9KHz-150KHz	200Hz
150KHz-30MHz	9KHz
30MHz-1GHz	120KHz

10.4. Results

Pass. (See below detailed test result)

Below 30MHz

Frequency (MHz)	Result **@3m** (dBuV/m)	Limit **@3m** (dBuV/m)	Detector	Conclusion
0.0708	60.79	110.60	Average	PASS
0.0708	60.79	130.60	Peak	PASS
0.1500	51.46	104.08	Average	PASS
0.1500	51.46	124.08	Peak	PASS
0.8268	51.79	69.27	QP	PASS
1.1453	51.70	66.45	QP	PASS
1.8620	48.64	69.54	QP	PASS
2.2999	42.55	69.54	QP	PASS
13.5571	60.10	124.00	QP	PASS

Above 30MHz

Refer to appendix A

Note: EMI = Trace + Cable(Loss) + ERP Factor + Transducer

Margin = EMI - Limit

11. Antenna Requirements

11.1. Limits

Please refer to FCC §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 replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

11.2. Result

The antenna used for this product is PCB Loop antenna and that no antenna other than that furnished by the responsible party shall be used with the device.

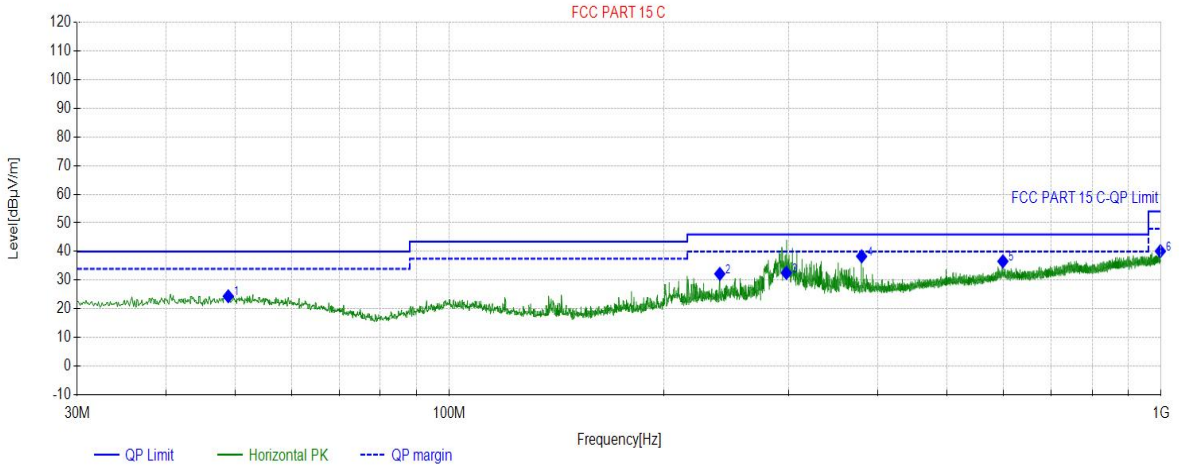
APPENDIX A – Radiated Emission Above 30MHz Test Data

Test Report

Project Information			
EUT:	Sensor Box	Environment:	23.5℃ 53%
Model:	WL10C	SN:	
Mode:	NFC Mode	Voltage:	DC 5V 300mA
Customer:		Engineer:	Kennys Zhang
Remark:			

Start of Test: 2023-10-21 17:03:54

Test Graph



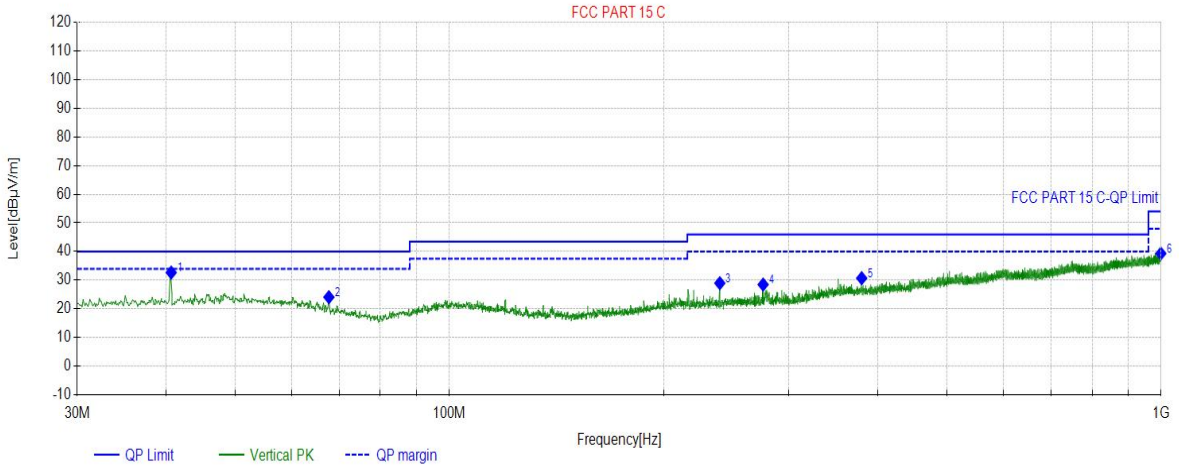
Final Data List								
NO.	Freq. (MHz)	Factor (dB)	QP Value (dBµV/m)	QP Limit (dBµV/m)	QP Margin (dB)	Height (cm)	Angle (°)	Polarity
1	48.9169	22.34	24.40	40.00	15.60	100	276	Horizontal
2	239.9290	21.30	32.21	46.00	13.79	100	251	Horizontal
3	297.5358	21.83	32.55	46.00	13.45	100	275.8	Horizontal
4	379.6230	25.24	38.34	46.00	7.66	100	318	Horizontal
5	599.5440	30.19	36.59	46.00	9.41	100	269	Horizontal
6	997.7688	35.51	40.13	54.00	13.87	100	237	Horizontal

Test Report

Project Information			
EUT:	Sensor Box	Environment:	23.5℃ 53%
Model:	WL10C	SN:	
Mode:	NFC Mode	Voltage:	DC 5V 300mA
Customer:		Engineer:	Kennys Zhang
Remark:			

Start of Test: 2023-10-21 17:04:29

Test Graph



Final Data List								
NO.	Freq. (MHz)	Factor (dB)	QP Value (dBµV/m)	QP Limit (dBµV/m)	QP Margin (dB)	Height (cm)	Angle (°)	Polarity
1	40.6711	21.31	32.68	40.00	7.32	100	104	Vertical
2	67.7368	18.95	24.08	40.00	15.92	100	277	Vertical
3	239.9290	21.30	28.97	46.00	17.03	100	154	Vertical
4	276.0166	21.70	28.49	46.00	17.51	100	30	Vertical
5	379.6230	25.24	30.71	46.00	15.29	100	148	Vertical
6	999.3209	35.52	39.32	54.00	14.68	100	208	Vertical

END OF REPORT