

TEST REPORT

For RF

Report No.: **CHTEW23020072** Report verification: 
Project No.: **SHT2301017601EW**
FCC ID: **2A932-5010V1**
Applicant's name: **Solo Automations Ltd**
Address.....: Houldsworth Business Centre, Houldsworth Street, Stockport,
Greater Manchester, SK5 6DA, UK
Product Name: **SOLOrader**
Trade Mark: **SOLO®**
Model No.: **5010V1**
Listed Model(s): **5010V1 (SOLOrader)**
Standard: **FCC CFR Title 47 Part 15 Subpart C Section 15.225**
Date of receipt of test sample.....: **Jan.09, 2023**
Date of testing.....: **Jan.09, 2023-Feb.10, 2023**
Date of issue.....: **Feb.13, 2023**
Result.....: **PASS**

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Testing Laboratory Name: **Shenzhen Huatongwei International Inspection Co., Ltd.**
Address.....: **1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road,
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The test report merely correspond to the test sample.

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1. **TEST STANDARDS AND REPORT VERSION**

1.1. Test Standards

The tests were performed according to following standards:

[FCC Rules Part 15.225](#): Operation within the band 13.110-14.010 MHz.

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices.

1.2. Report version information

Revision No.	Date of issue	Description
N/A	2023-02-13	Original

2. TEST DESCRIPTION

Report clause	Test Items	Standard Requirement	Result	Test Engineer
5.1	Antenna requirement	15.203	PASS	Xiaoxiao Li
5.2	AC Power Conducted Emissions	15.207	PASS	Chuanfeng Li
5.3	Field Strength of the Fundamental and Mask Measurement	15.225(a)(b)(c)	PASS	Xiaoxiao Li
5.4	20dB Bandwidth	15.215	PASS	Xiaoxiao Li
5.5	Radiated Spurious Emission	15.225(d)&15.209	PASS	Dongyang Wu
5.6	Frequency Stability	15.225(e)	PASS	Xiaoxiao Li

Note: The measurement uncertainty is not included in the test result.

3. SUMMARY

3.1. Client Information

Applicant:	Solo Automations Ltd
Address:	Houldsworth Business Centre, Houlsworth Street, Stockport, Greater Manchester, SK5 6DA, UK
Manufacturer:	Solo Automations Ltd
Address:	Houldsworth Business Centre, Houlsworth Street, Stockport, Greater Manchester, SK5 6DA, UK

3.2. Product Description

Main unit information:	
Product Name:	SOLOrader
Trade Mark:	SOLO®
Model No.:	5010V1
Listed Model(s):	5010V1 (SOLOrader)
Power supply:	DC 3.7V from Battery
Hardware version:	1.0
Software version:	0.7

3.3. Radio Specification Description

Modulation:	ASK
Operation frequency:	13.56MHz
Channel number:	1
Antenna type:	Inductive loop

3.4. Testing Laboratory Information

Laboratory Name	Shenzhen Huatongwei International Inspection Co., Ltd.	
Laboratory Location	1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China	
Connect information:	<p>Phone: 86-755-26715499 E-mail: cs@szhtw.com.cn http://www.szhtw.com.cn</p>	
Qualifications	Type	Accreditation Number
	FCC	762235

4. TEST CONFIGURATION

4.1. Test mode

For RF test items
The engineering test program was provided and enabled to make EUT continuous transmit.
For AC power line conducted emissions:
The engineering test program was provided and enabled to make EUT continuous transmit.
For Radiated spurious emissions test item:
The engineering test program was provided and enabled to make EUT continuous transmit. The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data Recorded in the report.

4.2. Test sample information

Test item	HTW sample no.
RF Radiated test items	YPHT23010176001
EMI test items	YPHT23010176003

Note:

RF Radiated test items: Field Strength of the Fundamental and Mask Measurement, 20dB Bandwidth, Radiated Spurious Emission, Frequency Stability

EMI test items : AC Power Conducted Emissions

4.3. Support unit used in test configuration and system

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The following peripheral devices and interface cables were connected during the measurement:

Whether support unit is used?			
<input checked="" type="checkbox"/> Yes			
Item	Equipement	Trade Name	Model No.
1	Adapter	HUAWEI	HW-050200C01
2	Type-c data cable	HUAWEI	-

4.4. Testing environmental condition

Type	Requirement	Actual
Temperature:	15~35°C	25°C
Relative Humidity:	25~75%	50%
Air Pressure:	860~1060mbar	1000mbar

4.5. Statement of the measurement uncertainty

Test Items	Measurement Uncertainty
AC Power Conducted Emissions	3.21 dB
Radiated emissions below 1GHz	4.54dB
Radiated emissions above 1GHz	5.10 dB
Occupied Bandwidth	0.002%

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=1.96$.

4.6. Equipments Used during the Test

● Conducted Emission							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Shielded Room	Albatross projects	HTWE0114	N/A	N/A	2018/09/28	2023/09/27
●	EMI Test Receiver	R&S	HTWE0111	ESCI	101247	2022/08/30	2023/08/29
●	Artificial Mains	SCHWARZBECK	HTWE0113	NNLK 8121	573	2022/08/29	2023/08/28
●	Pulse Limiter	R&S	HTWE0193	ESH3-Z2	101447	2022/08/29	2023/08/28
●	RF Connection Cable	HUBER+SUHNER	HTWE0113-02	ENVIROFLE X_142	EF-NM-BNCM-2M	2022/09/17	2023/09/16
●	Test Software	R&S	N/A	ES-K1	N/A	N/A	N/A

● Radiated Emission-6th test site							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Semi-Anechoic Chamber	Albatross projects	HTWE0127	SAC-3m-02	C11121	2018/09/30	2023/09/29
●	EMI Test Receiver	R&S	HTWE0099	ESCI	100900	2022/08/30	2023/08/29
●	Ultra-Broadband Antenna	SCHWARZBEC K	HTWE0119	VULB9163	546	2020/04/28	2023/04/27
●	Pre-Amplifier	SCHWARZBEC K	HTWE0295	BBV 9742	N/A	2022/11/04	2023/11/03
●	RF Connection Cable	HUBER+SUHN ER	HTWE0062-01	N/A	N/A	2022/02/25	2023/02/24
●	RF Connection Cable	HUBER+SUHN ER	HTWE0062-02	SUCOFLEX10 4	501184/4	2022/02/25	2023/02/24
●	Test Software	R&S	N/A	ES-K1	N/A	N/A	N/A

● Radiated emission-7th test site							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Semi-Anechoic Chamber	Albatross projects	HTWE0122	SAC-3m-01	C11121	2018/09/27	2023/09/26
●	Spectrum Analyzer	R&S	HTWE0098	FSP40	100597	2022/08/25	2023/08/24
●	Horn Antenna	SCHWARZBEC K	HTWE0126	9120D	1011	2020/04/01	2023/03/31
●	Broadband Pre-amplifier	SCHWARZBEC K	HTWE0201	BBV 9718	9718-248	2022/02/28	2023/02/27
●	RF Connection Cable	HUBER+SUHN ER	HTWE0126-01	RE-7-FH	N/A	2022/03/04	2023/03/03
●	Test Software	Audix	N/A	E3	N/A	N/A	N/A

Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Signal and spectrum Analyzer	R&S	HTWE0242	FSV40	100048	2022/08/25	2023/08/24
●	Signal & Spectrum Analyzer	R&S	HTWE0262	FSW26	103440	2022/08/25	2023/08/24
●	Spectrum Analyzer	Agilent	HTWE0286	N9020A	MY50510187	2022/08/25	2023/08/24
●	Radio communication tester	R&S	HTWE0287	CMW500	137688-Lv	2022/08/25	2023/08/24
●	Test software	Tonscend	N/A	JS1120	N/A	N/A	N/A

5. TEST CONDITIONS AND RESULTS

5.1. Antenna requirement

Requirement

FCC CFR Title 47 Part 15 Subpart C Section 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, 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.

TEST RESULT

Passed Not Applicable

The antenna type is a Inductive loop antenna, please refer to the below antenna photo.



5.2. AC Power Conducted Emissions

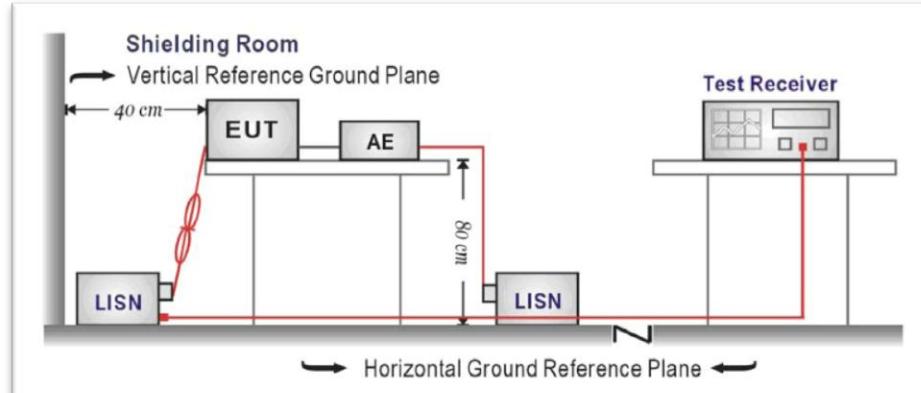
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207:

Frequency range (MHz)	Limit (dBuV)	
	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.

TEST CONFIGURATION



TEST PROCEDURE

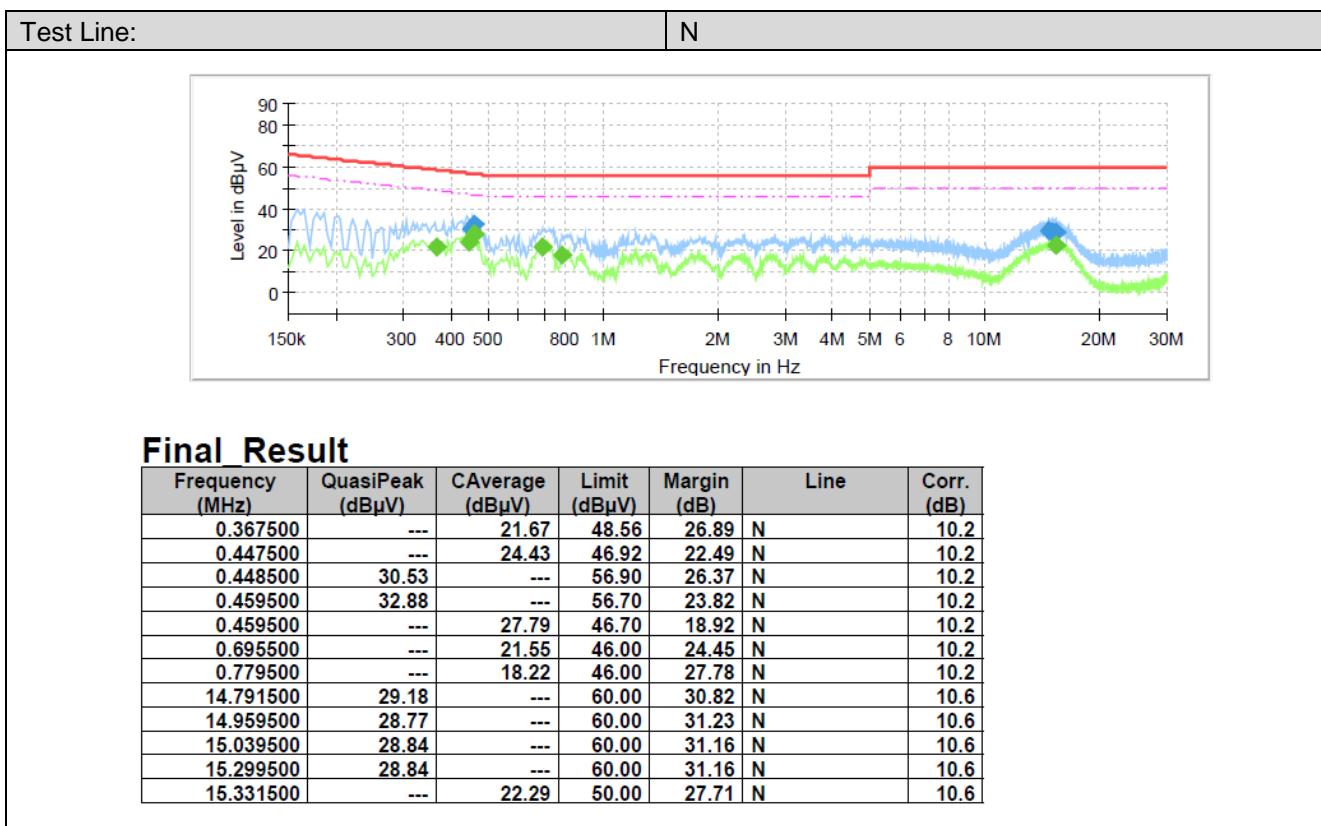
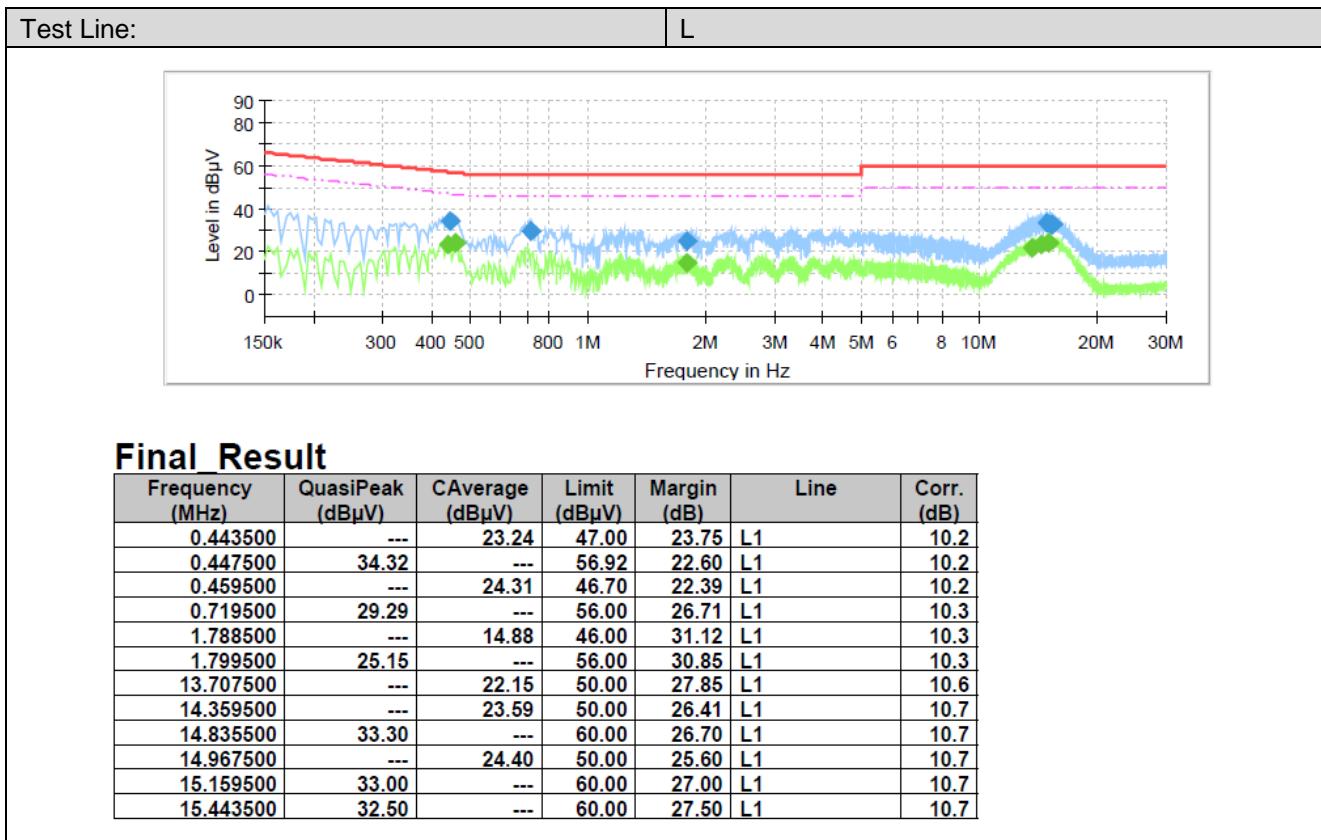
1. The EUT was setup according to ANSI C63.10
2. The EUT was placed on a plat form of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.
3. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50ohm / 50uH coupling impedance for the measuring equipment.
4. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)
5. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.
6. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
7. Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.
8. During the above scans, the emissions were maximized by cable manipulation.

TEST MODE:

Please refer to the clause 4.1

TEST RESULTS

Passed Not Applicable



5.3. Field Strength of the Fundamental and Mask Measurement

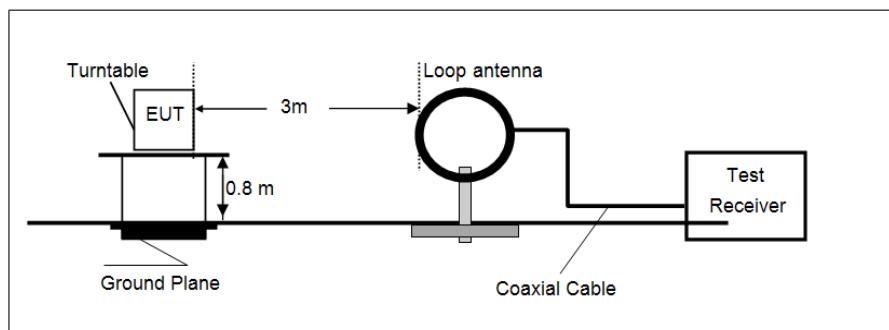
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.225(a)(b)(c)

Fundamental frequency(MHz)	Field strength of fundamental (uV/m @30m)	Field strength of fundamental (dBuV/m @3m)
13.553-13.567	15848	124.0
13.410-13.553&13.567-13.710	334	90.5
13.110-13.410&13.710-14.010	106	80.5

Note: Limit dBuV/m @3m =Limit dBuV/m @30m +40*log(30/3)= Limit dBuV/m @30m + 40.

TEST CONFIGURATION



TEST PROCEDURE

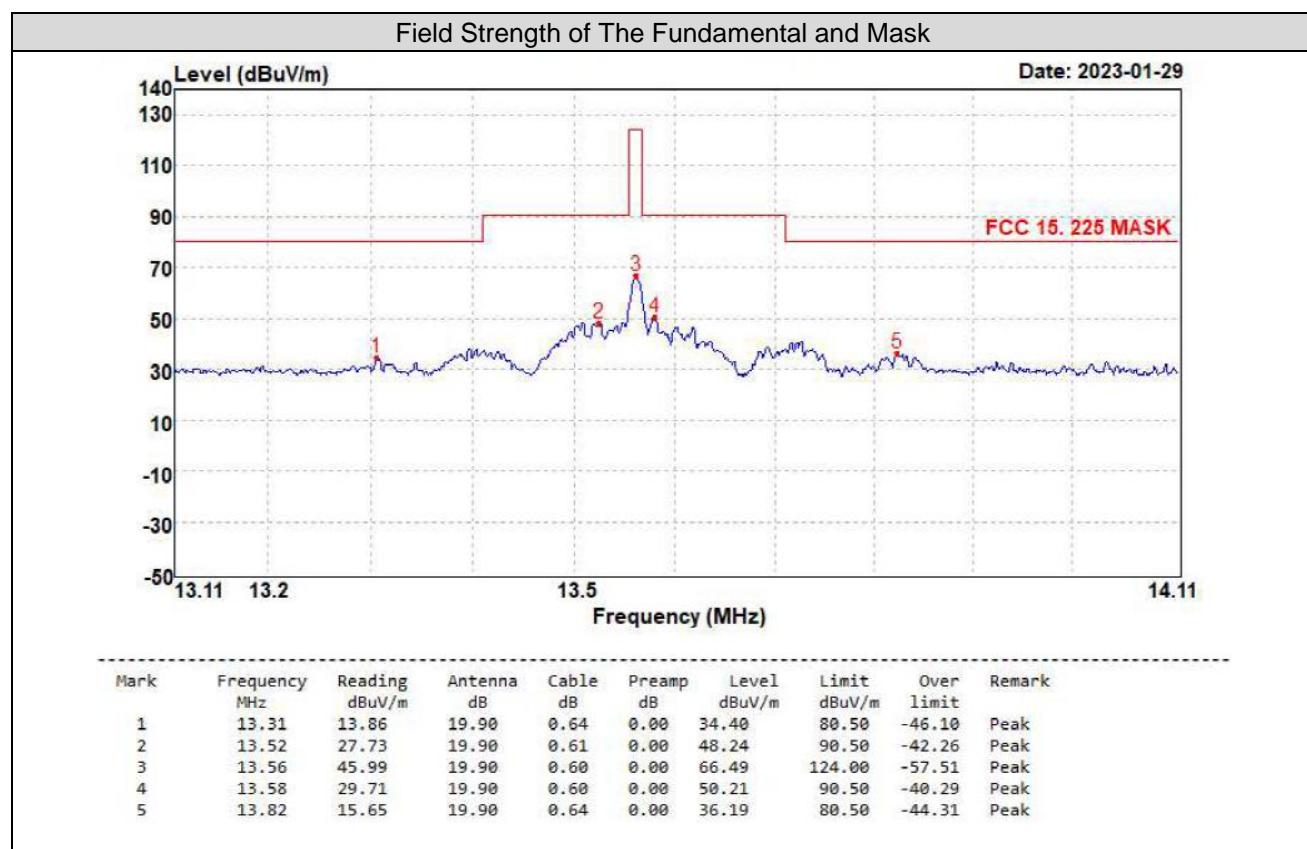
1. The EUT was setup and tested according to ANSI C63.10 requirements.
2. The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT waspositioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10 on radiated measurement.

TEST MODE:

Please refer to the clause 4.1

TEST RESULTS

Passed Not Applicable



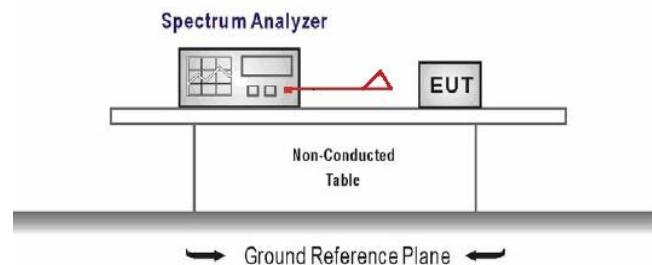
5.4. 20dB Bandwidth

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.215

Intentional radiators must be designed to ensure that the 20dB emission bandwidth in the specific band 13.553~13.567MHz.

TEST CONFIGURATION



TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW \geq 1% of the 20 dB bandwidth, VBW \geq RBW
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

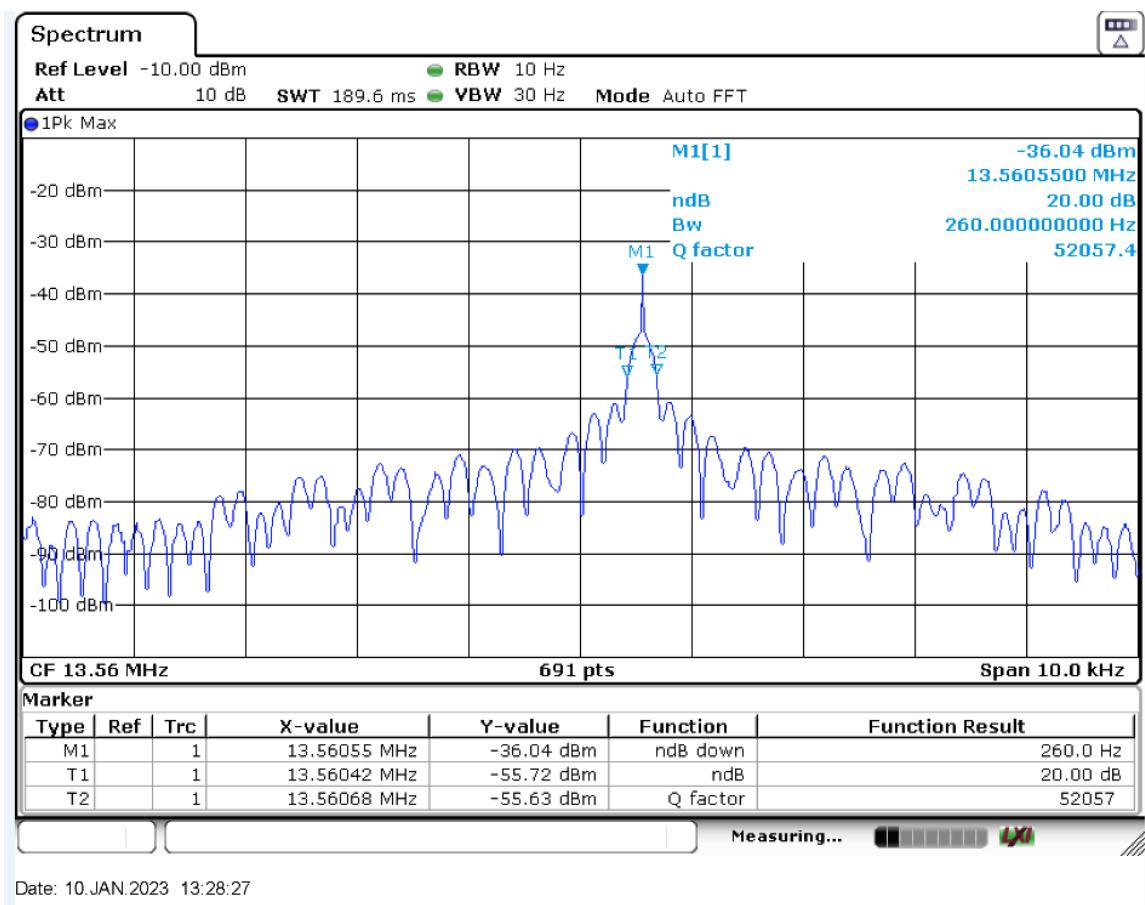
TEST MODE:

Please refer to the clause 4.1

TEST RESULTS

Passed Not Applicable

Frequency	Measurement data (MHz)	Limit (MHz)	Result
f_L	13.56042	>13.553	PASS
f_H	13.56048	<13.567	PASS



5.5. Radiated Spurious Emission

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.209&15.225(d)

Limit for frequency below 30MHz:

Frequency	Limit (uV/m)	Measurement Distance(m)	Remark
0.009~0.490	2400/F(kHz)	300	Quasi-peak
0.490~1.705	24000/F(kHz)	30	Quasi-peak
1.705~30.0	30	30	Quasi-peak

Note: Limit dBuV/m @3m = Limit dBuV/m @300m + 40*log(300/3)= Limit dBuV/m @300m +80,

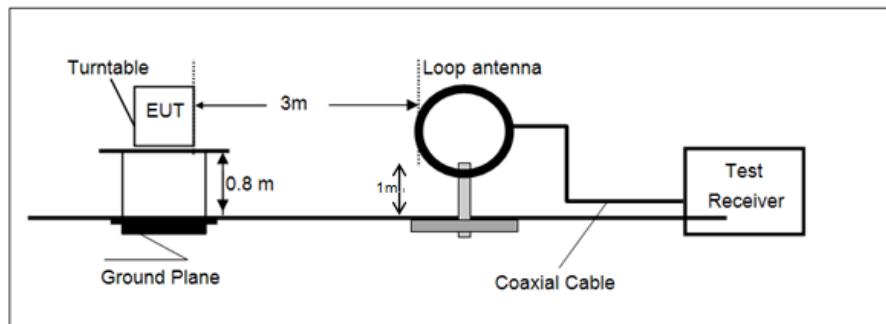
Limit dBuV/m @3m = Limit dBuV/m @30m +40*log(30/3)= Limit dBuV/m @30m + 40.

Limit for frequency above 30MHz:

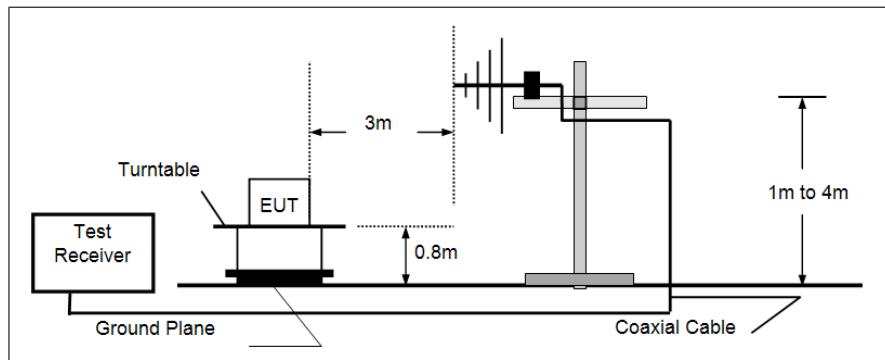
Frequency	Limit (dBuV/m @3m)	Remark
30MHz~88MHz	40.00	Quasi-peak
88MHz~216MHz	43.50	Quasi-peak
216MHz~960MHz	46.00	Quasi-peak
960MHz~1GHz	54.00	Quasi-peak
Above 1GHz	54.00	Average
	74.00	Peak

TEST CONFIGURATION

- 9 kHz ~ 30 MHz



- 30 MHz ~ 1 GHz



TEST PROCEDURE

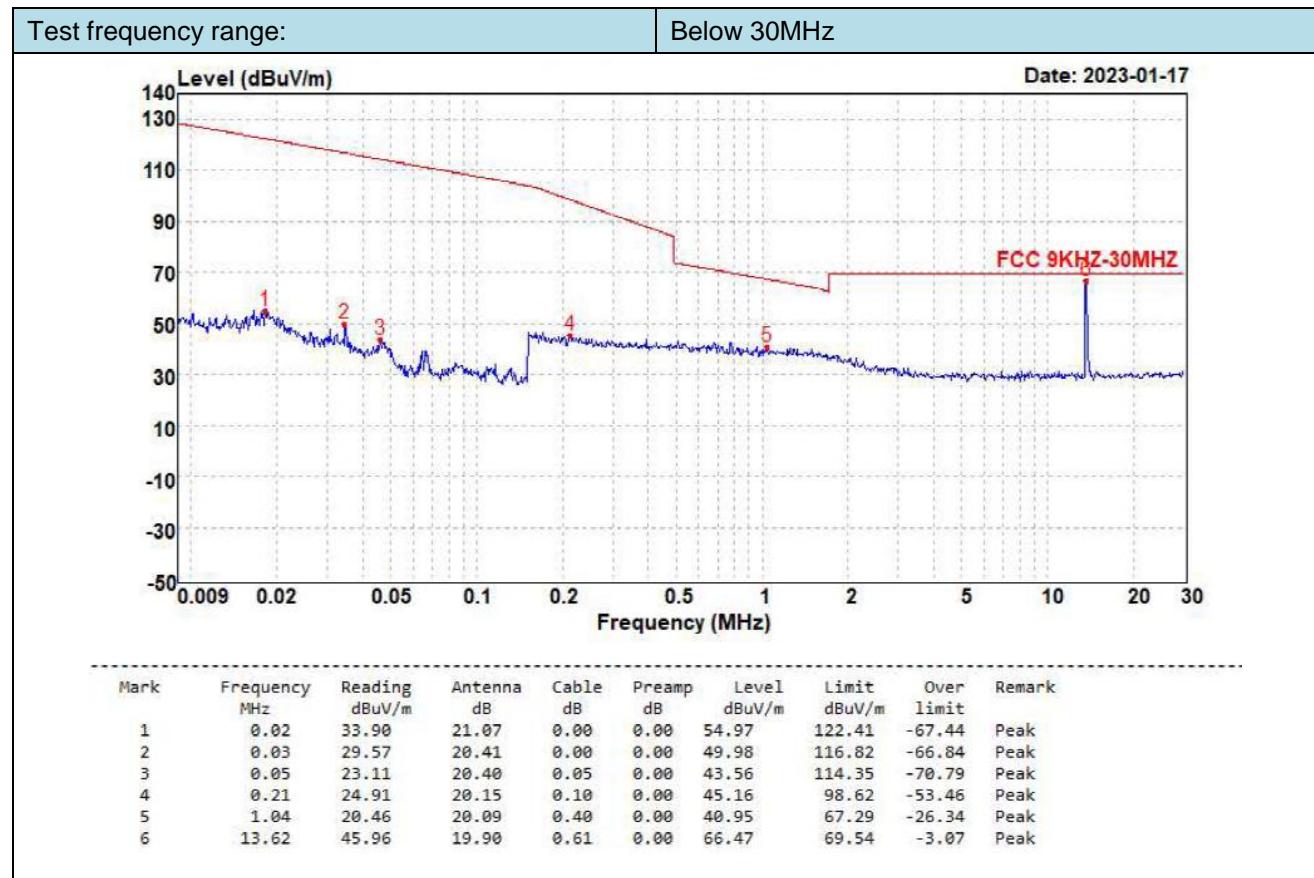
1. The EUT was setup and tested according to ANSI C63.10 requirements.
2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.
4. 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.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Below 30MHz:
RBW=10 kHz, VBW=30 kHz, Sweep=auto, Detector function=peak, Trace=max hold;
 - (3) 30MHz to 1 GHz:
RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold;
If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

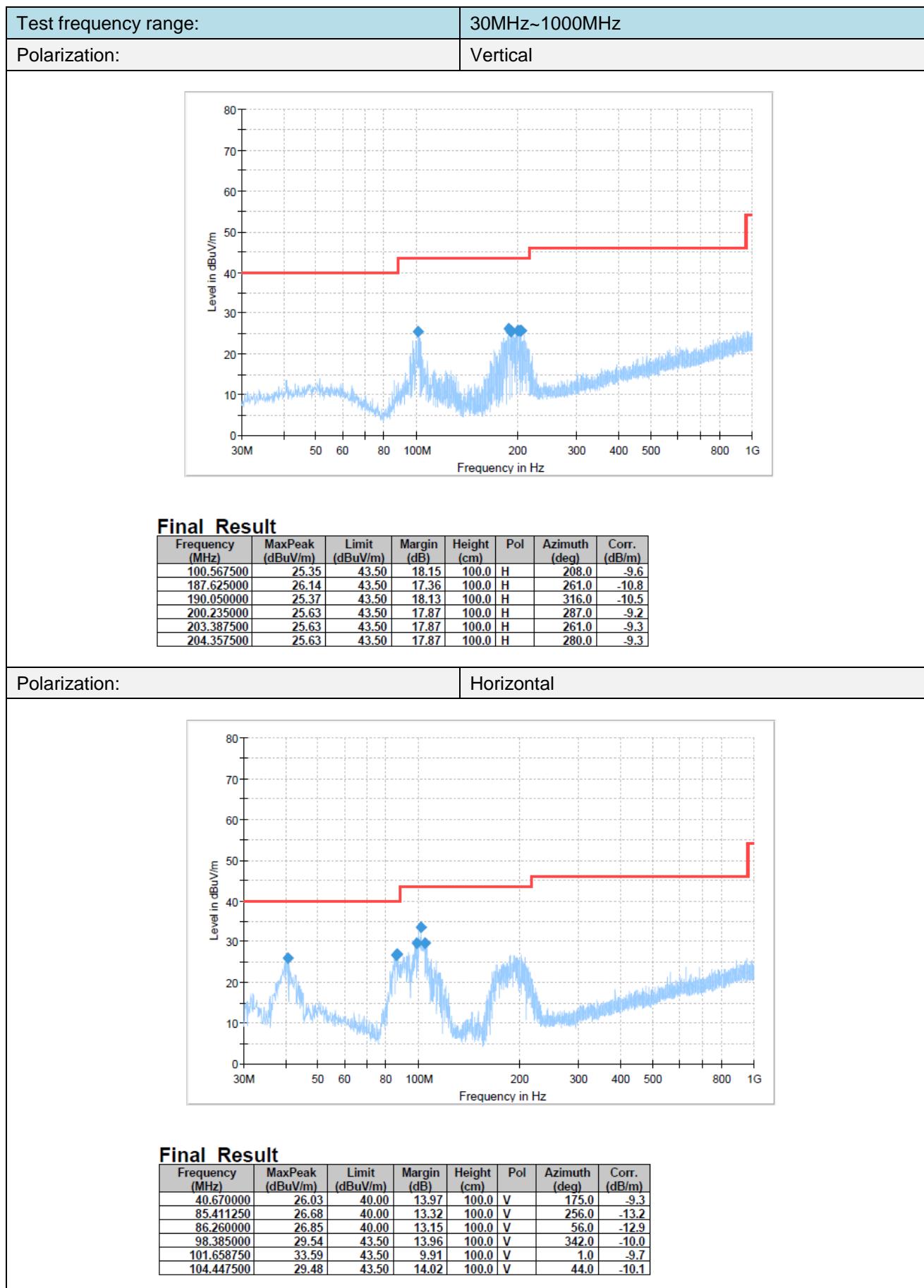
TEST MODE:

Please refer to the clause 4.1

TEST RESULTS

Passed Not Applicable



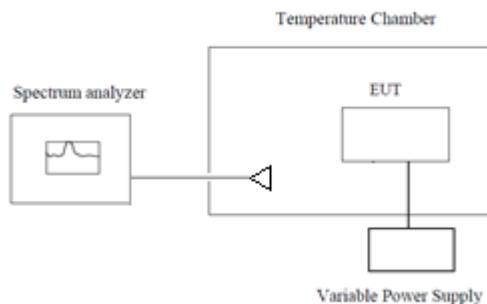


5.6. Frequency Stability

LIMIT

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ 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.

TEST CONFIGURATION



TEST PROCEDURE

1. The equipment under test was connected to an external power supply.
2. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators.
3. The EUT was placed inside the temperature chamber.
4. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 25°C operating frequency as reference frequency.
5. Turn EUT off and set the chamber temperature to -20°C . After the temperature stabilized for approximately 30 minutes recorded the frequency.
6. Repeat step measure with 10°C increased per stage until the highest temperature of $+50^\circ\text{C}$ reached.

TEST MODE:

Please refer to the clause 4.1

TEST RESULTS

Passed Not Applicable

Test Environment		Measurement data (MHz)	Frequency Error (%)	Limit	Result
Voltage	Temperature(°C)				
DC 3.7V	-20	13.56091	0.0073	±0.01%	Pass
	-10	13.56099	0.0070	±0.01%	Pass
	0	13.56095	0.0069	±0.01%	Pass
	10	13.56093	0.0066	±0.01%	Pass
	20	13.56090	0.0068	±0.01%	Pass
	30	13.56092	0.0069	±0.01%	Pass
	40	13.56093	0.0067	±0.01%	Pass
	50	13.56091	0.0069	±0.01%	Pass

6. TEST SETUP PHOTOS

Conducted Emissions (AC Mains)



Radiated Emissions



7. **EXTERNAL AND INTERNAL PHOTOS OF THE EUT**

Reference to the test report No. CHTEW23020071

-----End of Report-----