FCC Test Report

Client Name	:	Secukey Technology Co., Ltd.
Address	:	Building 5, Floor 13, Longbi Industrial Park, Longgang District, Shenzhen, China
Product Name	:	RFID Reader
Date	:	Apr. 21, 2021

Shenzhen Anbotek Compliance Laboratory Limited

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TEST REPORT

Applicant	:	Secukey Technology Co., Ltd.
Manufacturer	:	Secukey Technology Co., Ltd.
Product Name	:	RFID Reader
Model No.	:	S1-RX, S1/2/3-R(EM/MF), S5/6-R(EM/MF), S7/8/9-R(EM/MF), SK1/2/4-R(EM/MF), S1/2/3/4-RX, S5/6/9-RX, SK1/2/4/5-RX
Trade Mark	:	N.A.
Rating(s)	:	Input: DC 9-24V

Test Standard(s)	:	**FCC Part15 Subpart C, Section 15.225**
Test Method(s)	:	**ANSI C63.10: 2013**

The device described above is tested by Shenzhen Anbotek Compliance Laboratory Limited to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Shenzhen Anbotek Compliance Laboratory Limited is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the FCC Part 15 Subpart C requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of Shenzhen Anbotek Compliance Laboratory Limited.

Date of Receipt	Mar. 23, 2021
Date of Test	Mar. 23~Apr. 06, 2021
Prepared By	Ella Liang (Engineer /Ella Liang)
Reviewer	Bibo Zhang (Supervisor / Bibo Zhang)
Approved & Authorized Signer	Kingkong Jin (Manager / Kingkong Jin)

1. General Information

1.1. Client Information

Applicant	:	Secukey Technology Co., Ltd.
Address	:	Building 5, Floor 13, Longbi Industrial Park, Longgang District, Shenzhen, China
Manufacturer	:	Secukey Technology Co., Ltd.
Address	:	Building 5, Floor 13, Longbi Industrial Park, Longgang District, Shenzhen, China
Factory	:	Secukey Technology Co., Ltd.
Address	:	Building 5, Floor 13, Longbi Industrial Park, Longgang District, Shenzhen, China

1.2. Description of Device (EUT)

Product Name	:	RFID Reader	
Model No.	:	S1-RX, S1/2/3-R(EM/MF), S5/6-R(EM/MF), S7/8/9-R(EM/MF), SK1/2/4-R(EM/MF), S1/2/3/4-RX, S5/6/9-RX, SK1/2/4/5-RX (Note: All samples are the same except the model number, so we prepare "S1-RX" for test only.)	
Trade Mark	:	N.A.	
Test Power Supply	:	DC 24V (Note: During the test, pre-scan all test voltages and only show the test data of the worst case (DC 24V) in this Report.)	
Product Description	:	Operation Frequency:	13.56MHz
		Number of Channel:	1 Channels
		Modulation Type:	BPSK
		Antenna Type:	Inductive loop coil Antenna
		Antenna Gain(Peak):	0 dBi
Remark: 1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual. 2) This report is for 13.56MHz module.			

1.3. Auxiliary Equipment Used During Test

N/A	:	

1.4. Description of Test Modes

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	TX Mode

For Conduction Emission	
Final Test Mode	Description
Mode 1	TX Mode

For Radiated Emission	
Final Test Mode	Description
Mode 1	TX Mode

Note: During the test, the EUT was keeping continuous transmission.

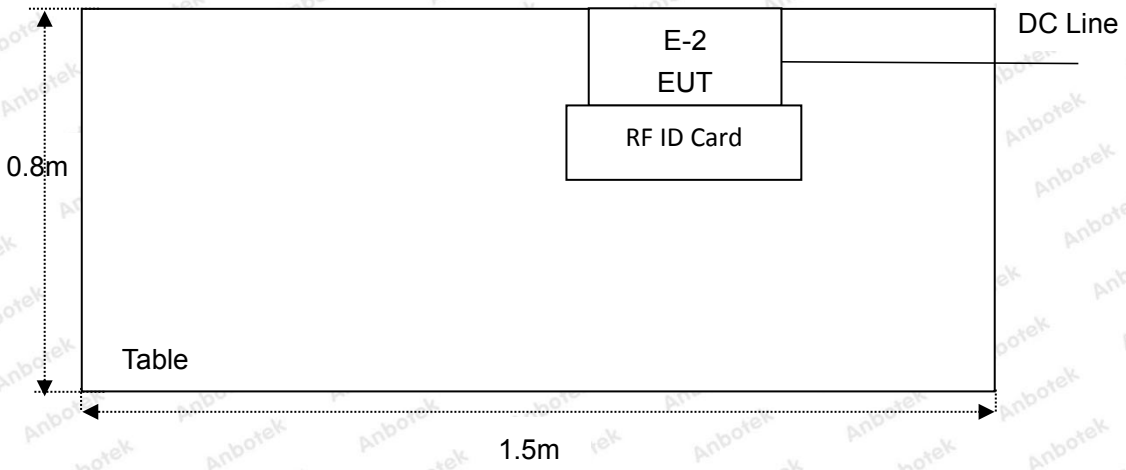
1.5. List of channels

Channel	Freq. (MHz)	Note (Modulation Type)
01	13.56	BPSK

Address: 1/F., Building D, Sogood Science and Technology Park, Sanwei Community, Hangcheng Street, Bao'an District, Shenzhen, Guangdong, China.
Tel:(86) 755-26066440 Fax: (86) 755-26014772 Email: service@anbotek.com
Hotline 400-003-0500
www.anbotek.com

1.6. Description Of Test Setup

RE



1.7. Test Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	L.I.S.N. Artificial Mains Network	Rohde & Schwarz	ENV216	100055	Oct. 26, 2020	1 Year
2.	EMI Test Receiver	Rohde & Schwarz	ESCI	100627	Oct. 26, 2020	1 Year
3.	EMI Test Receiver	Rohde & Schwarz	ESR26	101481	Oct. 26, 2020	1 Year
4.	RF Switching Unit	Compliance Direction	RSU-M2	38303	Oct. 26, 2020	1 Year
5.	MAX Spectrum Analysis	Agilent	N9020A	MY51170037	Oct. 26, 2020	1 Year
6.	Preamplifier	SKET Electronic	BK1G18G30D	KD17503	Oct. 26, 2020	1 Year
7.	Double Ridged Horn Antenna	Instruments corporation	GTH-0118	351600	Nov. 02, 2020	2 Year
8.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	VULB 9163-289	Nov. 02, 2020	2 Year
9.	Loop Antenna	Schwarzbeck	FMZB1519B	00053	Nov. 02, 2020	2 Year
10.	Horn Antenna	A-INFO	LB-180400-KF	J211060628	Nov. 02, 2020	2 Year
11.	Pre-amplifier	SONOMA	310N	186860	Oct. 26, 2020	1 Year
12.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A
13.	RF Test Control System	YIHENG	YH3000	2017430	Oct. 26, 2020	1 Year
14.	Power Sensor	DAER	RPR3006W	15I00041SN045	Oct. 26, 2020	1 Year
15.	Power Sensor	DAER	RPR3006W	15I00041SN046	Oct. 26, 2020	1 Year
16.	MXA Spectrum Analysis	Agilent	N9020A	MY51170037	Oct. 26, 2020	1 Year
17.	MXG RF Vector Signal Generator	Agilent	N5182A	MY48180656	Oct. 26, 2020	1 Year
18.	Signal Generator	Agilent	E4421B	MY41000743	Oct. 26, 2020	1 Year
19.	DC Power Supply	IVYTECH	IV3605	1804D360510	Oct. 26, 2020	1 Year
20.	Constant Temperature Humidity Chamber	ZHONGJIAN	ZJ-KHWS80B	N/A	Oct. 26, 2020	1 Year

1.8. Measurement Uncertainty

Radiation Uncertainty	:	Ur = 3.9 dB (Horizontal)
		Ur = 3.8 dB (Vertical)
Conduction Uncertainty	:	Uc = 3.4 dB

1.9. Description of Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

FCC-Registration No.: 184111

Shenzhen Anbotek Compliance Laboratory Limited, EMC Laboratory has been registed and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No. 184111, September 30, 2020.

ISED-Registration No.: 8058A

Shenzhen Anbotek Compliance Laboratory Limited, EMC Laboratory has been registered and fully described in a report filed with the (ISED) Innovation, Science and Economic Development Canada. The acceptance letter from the ISED is maintained in our files. Registration 8058A, September 30, 2020.

Test Location

Shenzhen Anbotek Compliance Laboratory Limited.
1/F, Building D, Sogood Science and Technology Park, Sanwei community, Hangcheng Street, Bao'an District, Shenzhen, Guangdong, China.518102

2. Summary of Test Results

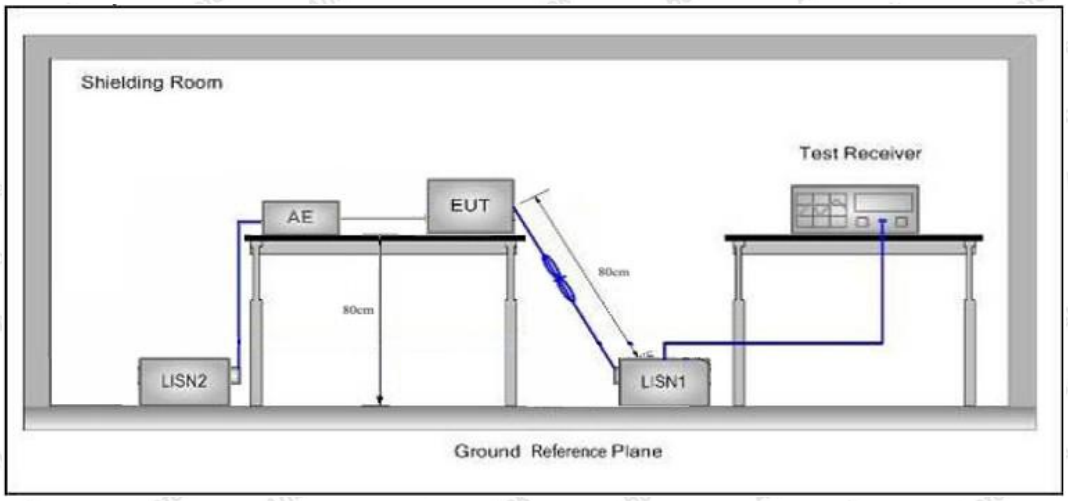
Standard Section	Test Item	Result
15.203	Antenna Requirement	PASS
15.207	Conducted Emission	N.A.
15.205/15.209/15.225(b)	Spurious Emission	PASS
15.225(c)	20dB Occupied Bandwidth	PASS
15.225	Frequency Tolerance	PASS
Remark: “N/A” is an abbreviation for Not Applicable.		

3. Conducted Emission Test

3.1. Test Standard and Limit

Test Standard	FCC Part15 Section 15.207		
Test Limit	Frequency	Maximum RF Line Voltage (dBuV)	
		Quasi-peak Level	Average Level
	150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
	500kHz~5MHz	56	46
	5MHz~30MHz	60	50
Remark: (1) *Decreasing linearly with logarithm of the frequency. (2) The lower limit shall apply at the transition frequency.			

3.2. Test Setup



3.3. Test Procedure

The EUT system is connected to the power mains through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm coupling impedance for the EUT system. Please refer the block diagram of the test setup and photographs. Both sides of AC line are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to FCC ANSI C63.10-2013 on Conducted Emission Measurement.

The bandwidth of test receiver (ESCI) set at 9kHz.

The frequency range from 150kHz to 30MHz is checked.

3.4. Test Data

Not applicable for equipment operated with DC power supply.

4. Radiation Spurious Emission and Band Edge

4.1. Test Standard and Limit

Test Standard	FCC Part15 C Section 15.209, 15.205 and 15.225(a)				
Test Limit	Frequency (MHz)	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz~0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz~88MHz	100	40.0	Quasi-peak	3
	88MHz~216MHz	150	43.5	Quasi-peak	3
	216MHz~960MHz	200	46.0	Quasi-peak	3
	960MHz~1000MHz	500	54.0	Quasi-peak	3
	Above 1000MHz	500	54.0	Average	3
		-	74.0	Peak	3
Remark: (1)The lower limit shall apply at the transition frequency. (2) 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.					

(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.

Note:
(1) The tighter limit shall apply at the boundary between two frequency range.
(2) Limitation expressed in dBuV/m is calculated by 20log Emission Level (uV/m).
(3) If measurement is made at 3m distance, then F.S Limitation at 3m distance is adjusted by using the formula of Ld1 = Ld2 * (d2/d1)2.
Example:
F.S Limit at 30m distance is 30uV/m , then F.S Limitation at 3m distance is adjusted as Ld1 = L1 = 30uV/m * (10)2 = 100 * 30 uV/m

4.2. Test Setup

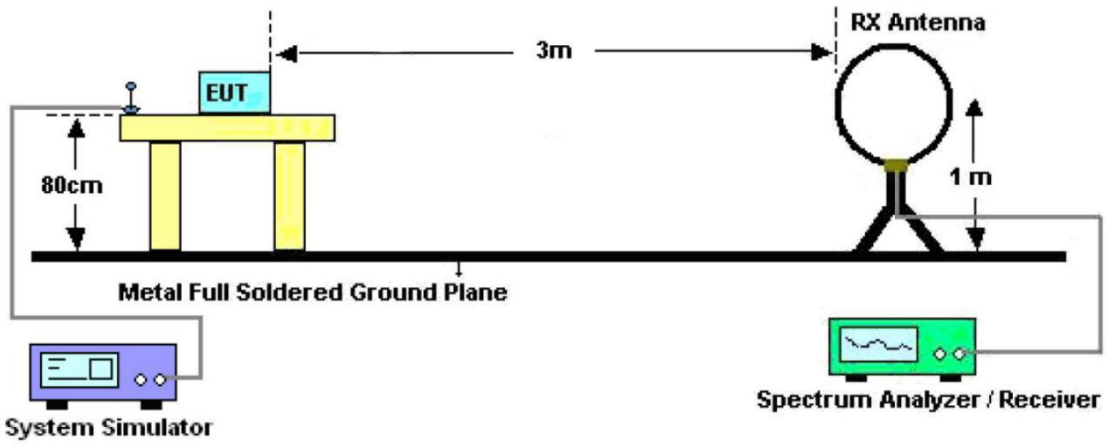


Figure 1. Below 30MHz

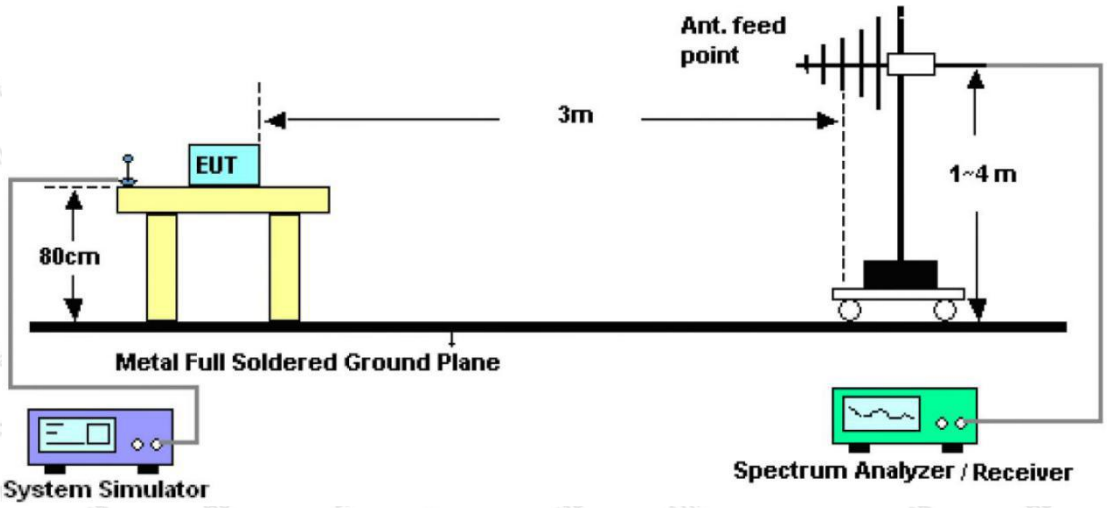


Figure 2. 30MHz to 1GHz

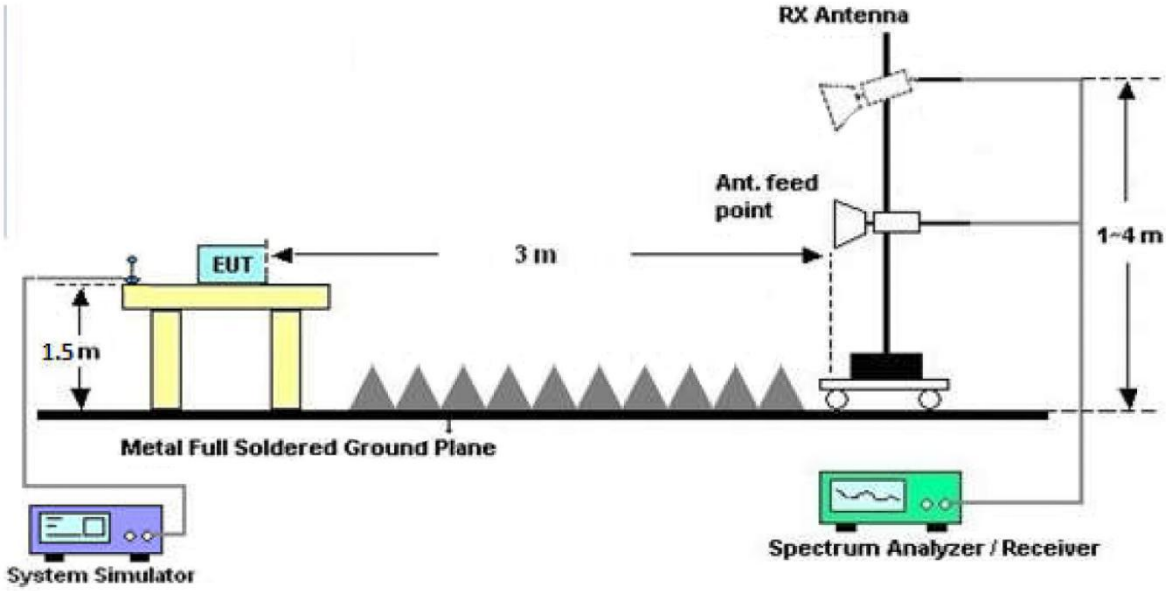


Figure 3. Above 1 GHz

4.3. Test Procedure

For below 1GHz: The EUT is placed on a turntable, which is 0.8m above the ground plane.
The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT is set 3 meters away from the receiving antenna which is mounted on a antenna tower. The antenna can be moved up and down from 1 to 4 meters to find out the maximum emission level. Rotated the EUT through three orthogonal axes to determine the maximum emissions, both horizontal and vertical polarization of the antenna are set on test. The EUT is tested in 9*6*6 Chamber. The device is evaluated in xyz orientation.

For 9kHz to 150kHz, Set the spectrum analyzer as:
RBW = 200Hz, VBW =1kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 150kHz to 30MHz, Set the spectrum analyzer as:
RBW = 9KHz, VBW =30kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 30MHz to 1000MHz, Set the spectrum analyzer as:
RBW = 100kHz, VBW =300kHz,Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For above 1GHz,Set the spectrum analyzer as:
RBW =1MHz, VBW =1MHz, Detector= Peak, Trace mode= Max hold, Sweep- auto couple.
RBW =1MHz, VBW =10Hz, Detector= Average, Trace mode= Max hold, Sweep- auto couple.

4.4. Test Data

PASS

During the test, Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the X-axis is the worst case.

Test Results (9KHz~30MHz)

Indicated		Table Angle Degree	Antenna Height (m)	Detector	Correction Factor			Corrected Amplitude (dBuV/m) @3m	FCC part 15.225	
Freq. (MHz)	Corrected Amplitude (dBuV/m) @3m				Ant. Factor (dB)	Cable Loss (dB)	Pre-Amp. Gain (dB)		Limit (dBuV/m) @3m	Result
0.052	2.53	67	1.0	QP	73.1	0.1	30	45.73	113.62	PASS
0.689	25.42	162	1.0	QP	50.2	0.1	30	45.72	70.83	PASS
27.12	17.73	73	1.0	QP	31.0	0.2	30	18.93	69.54	PASS

Address: 1/F., Building D, Sogood Science and Technology Park, Sanwei Community, Hangcheng Street, Bao'an District, Shenzhen, Guangdong, China.
Tel:(86) 755-26066440 Fax: (86) 755-26014772 Email: service@anbotek.com
Hotline 400-003-0500
www.anbotek.com

Test Results (30~1000MHz)

Standard:	FCC PART 15C	Temp.(℃)/Hum.(%RH):	23.2℃/54%RH
Test Mode:	TX Mode	Power Source:	DC 24V
Polarization:	Horizontal		
Note:			

No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	37.2855	38.15	-15.84	22.31	40.00	-17.69	QP	300	0	
2	71.0803	47.95	-20.98	26.97	40.00	-13.03	QP	300	16	
3	126.7723	47.92	-21.59	26.33	43.50	-17.17	QP	300	27	
4	173.2051	48.02	-19.65	28.37	43.50	-15.13	QP	300	99	
5	319.9370	47.13	-15.27	31.86	46.00	-14.14	QP	300	296	
6	399.0302	51.09	-12.88	38.21	46.00	-7.79	QP	300	360	

Test Results (30~1000MHz)

Standard:	FCC PART 15C	Temp.(℃)/Hum.(%RH):	23.2℃/54%RH
Test Mode:	TX Mode	Power Source:	DC 24V
Polarization:	Vertical		

Note:

No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	42.8998	46.17	-13.93	32.24	40.00	-7.76	QP	300	0	
2	67.2022	48.63	-18.74	29.89	40.00	-10.11	QP	300	25	
3	125.8864	49.31	-16.20	33.11	43.50	-10.39	QP	300	74	
4	167.2368	49.59	-16.64	32.95	43.50	-10.55	QP	300	101	
5	414.7223	48.57	-11.44	37.13	46.00	-8.87	QP	300	254	
6	831.9871	46.77	-4.96	41.81	46.00	-4.19	QP	3000	360	

Remark:

1. Results = Reading + Cable Loss +Ant Factor –Amplifier

Test Results (Inband)

Indicated			Table Angle Degree	Antenna Height (m)	Detector	Correction Factor			Corrected Amplitude (dBuV/m) @3m	FCC part 15.225	
Frequency Range (MHz)	Mark Point (MHz)	Corrected Amplitude (dBuV/m) @3m				Ant. Factor (dB)	Cable Loss (dB)	Pre-Amp. Gain (dB)		Limit (dBuV/m) @3m	Result
13.110~13.410	13.387	74.11	0	1.0	QP	20.8	0.2	30.2	64.91	80.5	PASS
13.410~13.553	13.547	71.84	0	1.0	QP	20.9	0.2	30.2	62.74	90.5	PASS
13.553~13.567	13.558	94.17	0	1.0	QP	20.9	0.2	30.2	85.07	124	PASS
13.567~13.710	13.576	70.76	0	1.0	QP	21.1	0.2	30.2	61.86	90.5	PASS
13.710~14.010	13.889	71.62	0	1.0	QP	21.2	0.2	30.2	62.82	80.5	PASS

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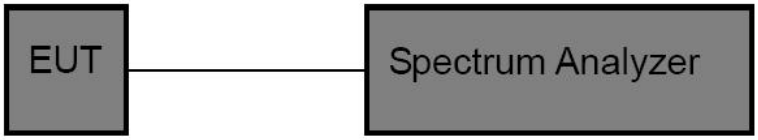
5. Frequency Tolerance

5.1. Test Requirement

According to FCC section 15.225, the devices operating in the 13.553~13.567 MHz shall maintain the carrier frequency within 0.01% of the operating frequency over the temperature variation of -20°C to +50°C using an environmental chamber. The primary supply voltage is varied from 85% to 115% of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

5.2. Test Setup



5.3. Test Procedure

Let the EUT works on 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.

5.4. Test Data

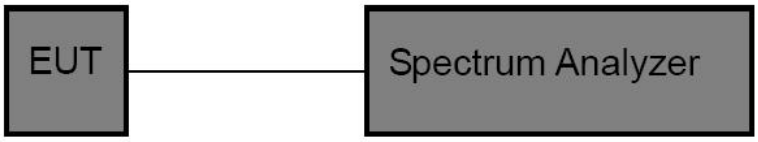
Test Condition				
	Voltage (V)	Temperature (℃)	Test Result (Hz)	Limit (Hz)
Normal Condition	DC 24V	-20	34	1356
		+20	30	1356
		+50	39	1356
Extreme Condition	DC 20.4V	+20	32	1356
	DC 27.6V	+20	41	1356

6. 20DB Occupy Bandwidth Test

6.1. Test Standard and Limit

According to FCC section 15.215(c), the 20dB bandwidth should be contained within the frequency band designated in the rule section under which the EUT is operated, it was measured with a spectrum analyzer connected the EUT while the EUT is operating in transmission mode.

6.2. Test Setup



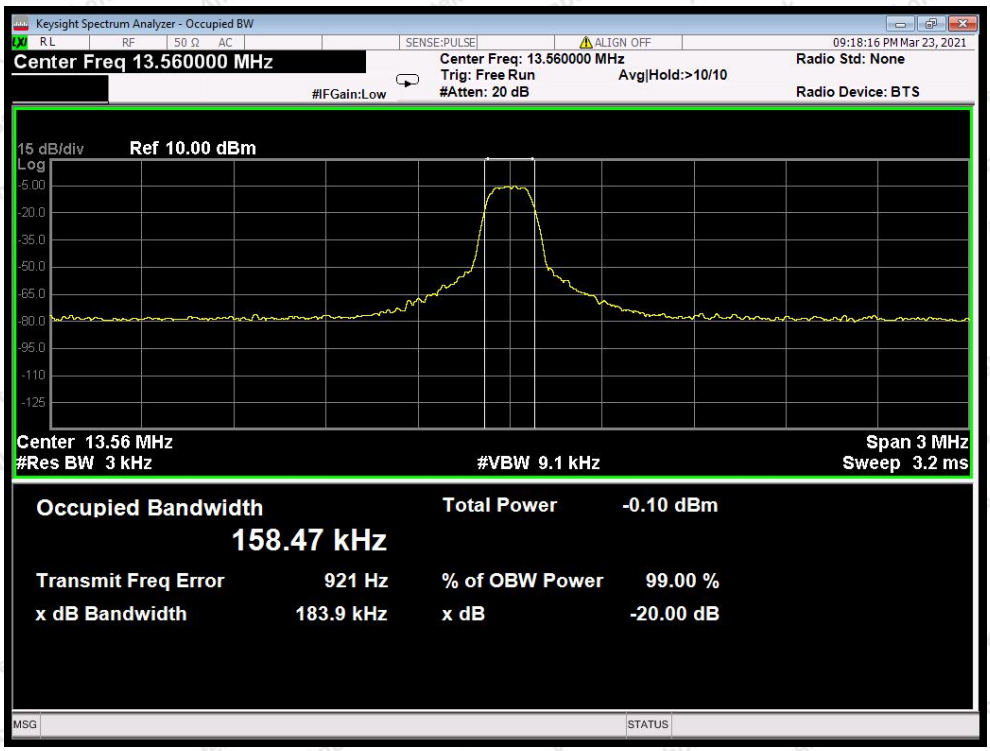
6.3. Test Procedure

The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3kHz RBW and VBW≥3*RBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

6.4. Test Data

Test Item	:	20dB Bandwidth	Test Mode	:	Continuously transmitting
Test Voltage	:	DC 24V	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Freq. (MHz)	Modulation Type	Bandwidth (kHz)	Results
13.56	BPSK	183.9	PASS


Keysight Spectrum Analyzer - Occupied BW
Center Freq 13.560000 MHz
Center Freq: 13.560000 MHz
Trig: Free Run
#Atten: 20 dB
Avg|Hold:>10/10
Radio Std: None
Radio Device: BTS
09:18:16 PM Mar 23, 2021
#IFGain:Low
15 dB/div
Ref 10.00 dBm
Center 13.56 MHz
#Res BW 3 kHz
#VBW 9.1 kHz
Span 3 MHz
Sweep 3.2 ms
Occupied Bandwidth
158.47 kHz
Total Power -0.10 dBm
Transmit Freq Error 921 Hz
% of OBW Power 99.00 %
x dB Bandwidth 183.9 kHz
x dB -20.00 dB

13.56MHz

7. Antenna Requirement

7.1. Test Standard and Requirement

Test Standard	FCC Part15 Section 15.203
Requirement	1) 15.203 requirement: 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. Antenna requirement must meet at least one of the following: 1) Antenna must be permanently attached to device. 2) The antenna must use a unique type of connector to attach to the device. 3) Device must be professionally installed. The installer shall be responsible for ensuring that the correct antenna is employed by the device.

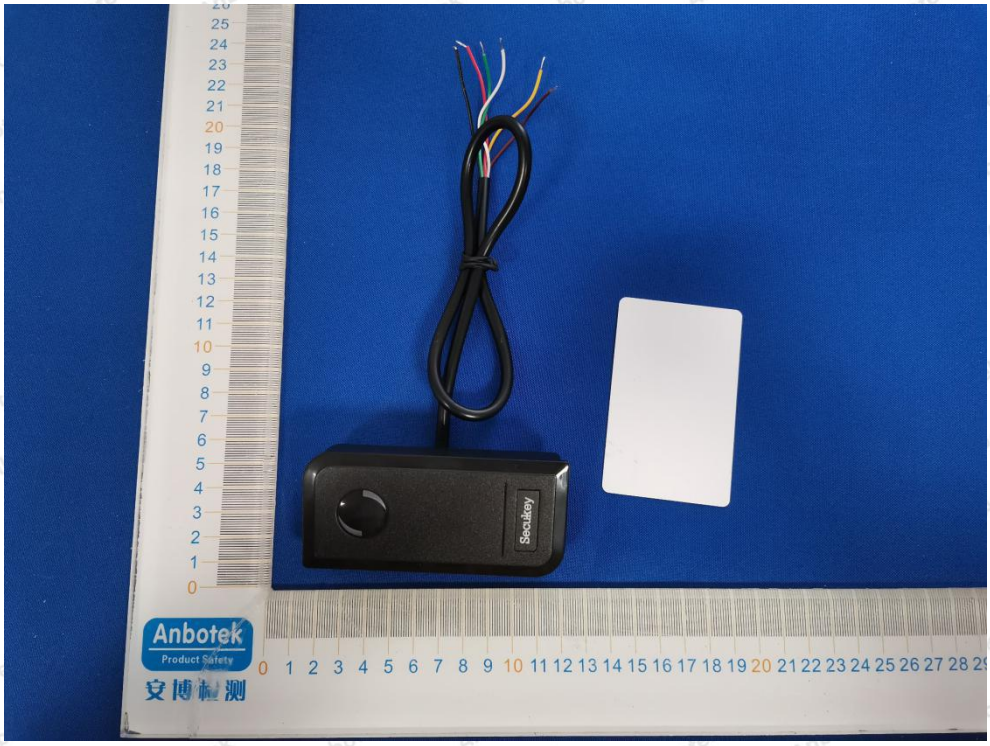
7.2. Antenna Connected Construction

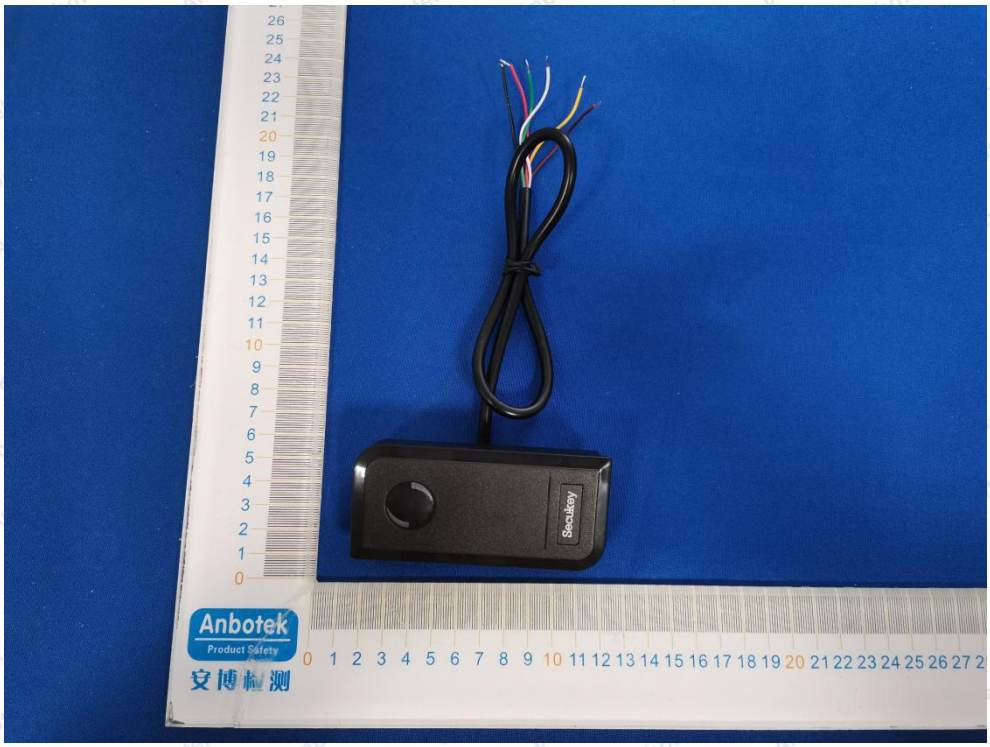
The antenna is a Inductive loop coil Antenna which permanently attached, and the best case gain of the antenna is 0 dBi. It complies with the standard requirement.

APPENDIX I -- TEST SETUP PHOTOGRAPH

Photo of Radiation Emission Test

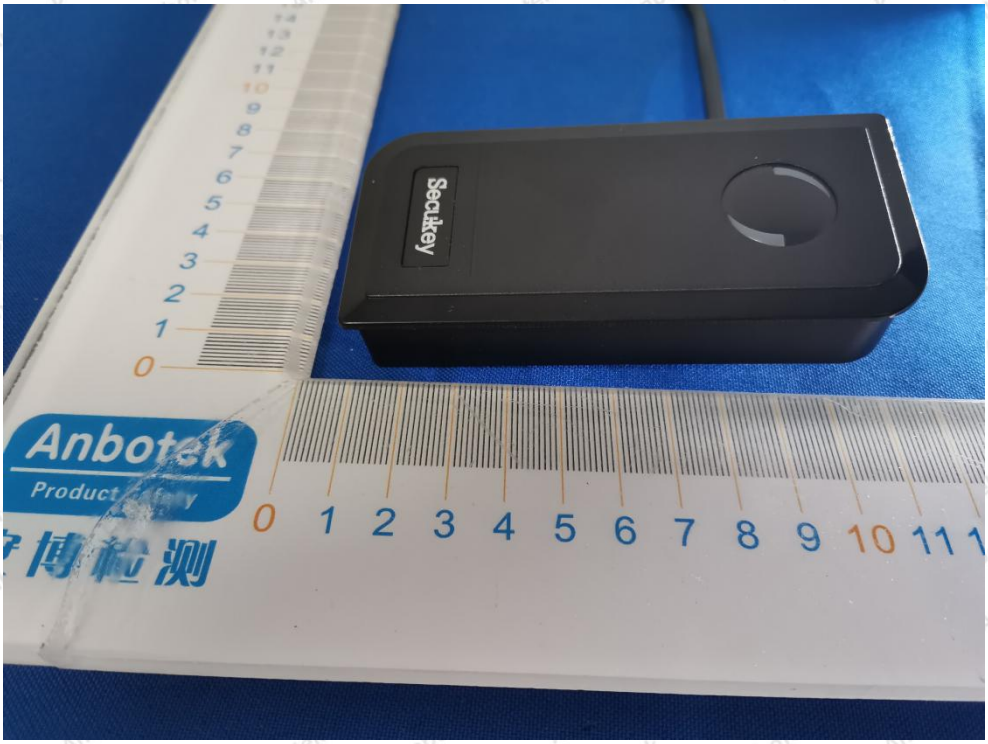
APPENDIX II -- EXTERNAL PHOTOGRAPH





Secukey
Anbotek
Product Safety
安博检测

Proximity Reader
MODEL NO.: S1-RX
INPUT: 9-24V DC
Made in China
Q.C. PASSED
202103174106
Anbotek
Product Safety
安博检测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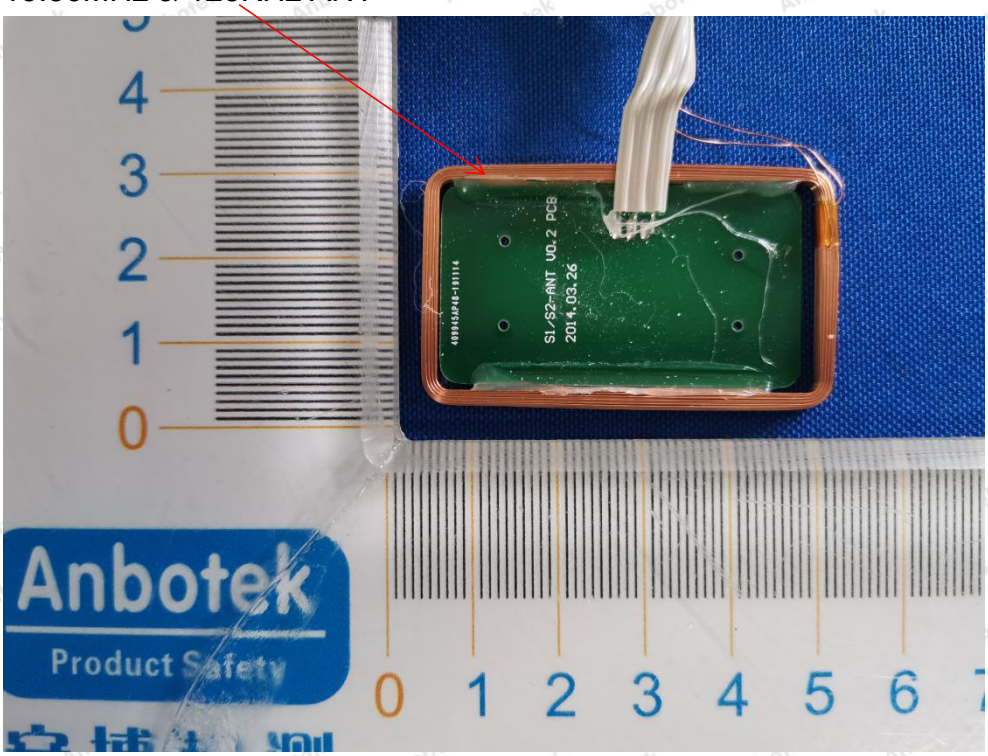
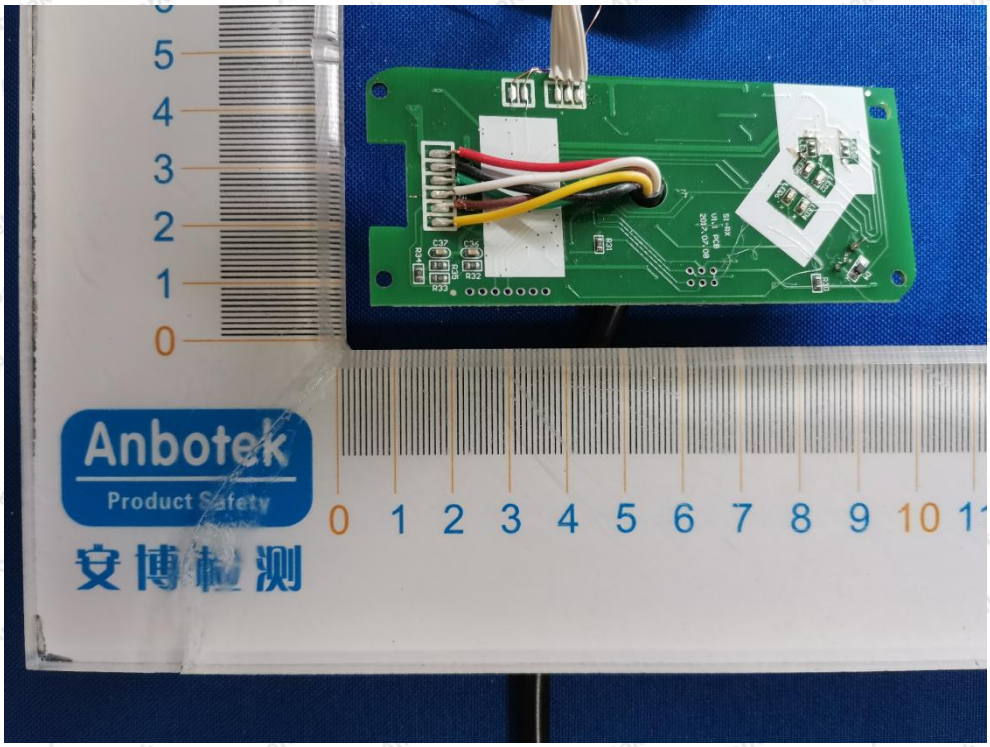
APPENDIX III -- INTERNAL PHOTOGRAPH

13.56MHz & 125KHz ANT





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