FCC Test Report

Client Name	:	Smart Box Technology LLC
Address	:	1600 Broadway Ste 1600, Denver, Colorado, United States, 80202
Product Name	:	CAR REMOTE
Date	:	Jul. 19, 2019

Shenzhen Anbotek Compliance Laboratory Limited

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TEST REPORT

Applicant	:	Smart Box Technology LLC
Manufacturer	:	Smart Box Technology
Product Name	:	CAR REMOTE
Model No.	:	SBox_k_0024
Trade Mark	:	N.A.
Rating(s)	:	Input: DC 3V Battery inside (with DC 3.7V, 230 mAh Battery inside)

Test Standard(s)	**:**	**FCC Part15 Subpart C 2018, Section 15.231**
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	Apr. 17, 2019
Date of Test	Apr. 17~May 13, 2019
Prepared By	Dolly Mo (Engineer / Dolly Mo)
Reviewer	Snowy Meng (Supervisor / Snowy Meng)
Approved & Authorized Signer	sally zhang (Manager / Sally Zhang)

Anbotek (SZ) Compliance Laboratory Limited Anbotek Product Safety * Approved *

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Hotline 400-003-0500 www.anbotek.com

1. General Information

1.1. Client Information

Applicant	:	Smart Box Technology LLC
Address	:	1600 Broadway Ste 1600, Denver, Colorado, United States, 80202
Manufacturer	:	Smart Box Technology
Address	:	Trg republike 3, 1000, Ljubljana, Slovenia
Factory	:	Smart Box Technology
Address	:	Trg republike 3, 1000, Ljubljana, Slovenia

1.2. Description of Device (EUT)

Product Name	:	CAR REMOTE	
Model No.	:	SBox_k_0024	
Trade Mark	:	N.A.	
Test Power Supply	:	DC 3V Battery inside	
Product Description	:	Operation Frequency:	433.92MHz
		Number of Channel:	1 Channels
		Modulation Type:	FSK
		Antenna Type:	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.			

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 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	433.92	FSK

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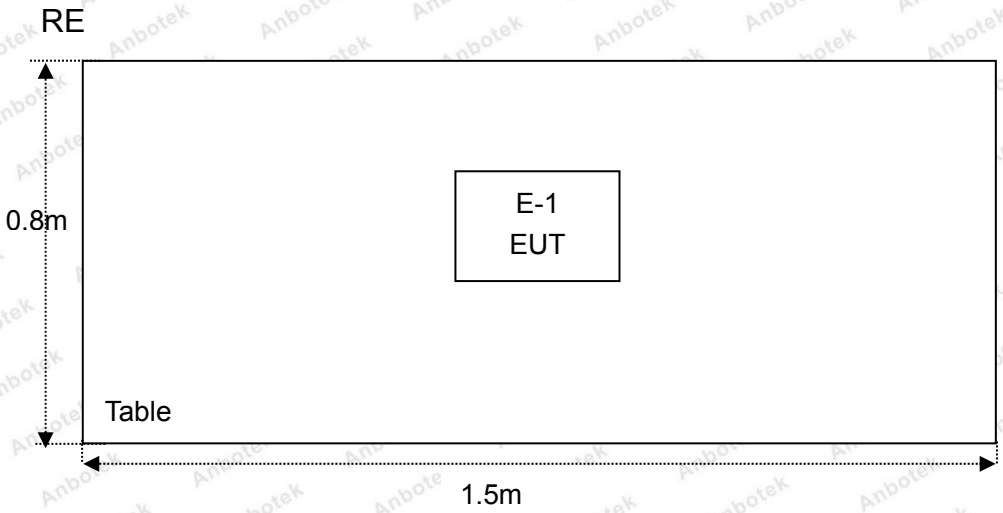
1.6. Description Of Test Setup



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	Nov. 26, 2018	1 Year
2.	EMI Test Receiver	Rohde & Schwarz	ESPI3	101604	Nov. 05, 2018	1 Year
3.	RF Switching Unit	Compliance Direction	RSU-M2	38303	Nov. 05, 2018	1 Year
4.	Spectrum Analysis	Agilent	E4407B	US39390582	Nov. 05, 2018	1 Year
5.	MAX Spectrum Analysis	Agilent	N9020A	MY51170037	Nov. 05, 2018	1 Year
6.	Preamplifier	SKET Electronic	BK1G18G30D	KD17503	Nov. 05, 2018	1 Year
7.	Double Ridged Horn Antenna	Instruments corporation	GTH-0118	351600	Nov. 20, 2018	1 Year
8.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	VULB 9163-289	Nov. 19, 2018	1 Year
9.	Loop Antenna	Schwarzbeck	FMZB1519B	00053	Nov. 20, 2018	1 Year
10.	Horn Antenna	A-INFO	LB-180400-KF	J211060628	Nov. 20, 2018	1 Year
11.	Pre-amplifier	SONOMA	310N	186860	Nov. 05, 2018	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	Nov. 05, 2018	1 Year
14.	Power Sensor	DAER	RPR3006W	15I00041SN045	Nov. 05, 2018	1 Year
15.	Power Sensor	DAER	RPR3006W	15I00041SN046	Nov. 05, 2018	1 Year
16.	MXA Spectrum Analysis	Agilent	N9020A	MY51170037	Nov. 05, 2018	1 Year
17.	MXG RF Vector Signal Generator	Agilent	N5182A	MY48180656	Nov. 05, 2018	1 Year
18.	Signal Generator	Agilent	E4421B	MY41000743	Nov. 05, 2018	1 Year
19.	DC Power Supply	LW	TPR-6420D	374470	Oct. 31, 2018	1 Year
20.	Constant Temperature Humidity Chamber	ZHONGJIAN	ZJ-KHWS80B	N/A	Nov. 01, 2018	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, 2018.

ISED-Registration No.: 8058A-1

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-1, March 07, 2019.

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
15.205/15.209/15.231(b)	Spurious Emission	PASS
15.231(c)	20dB Occupied Bandwidth	PASS
15.231(a)	Dwell time	PASS
Remark: "N/A" is an abbreviation for Not Applicable.		

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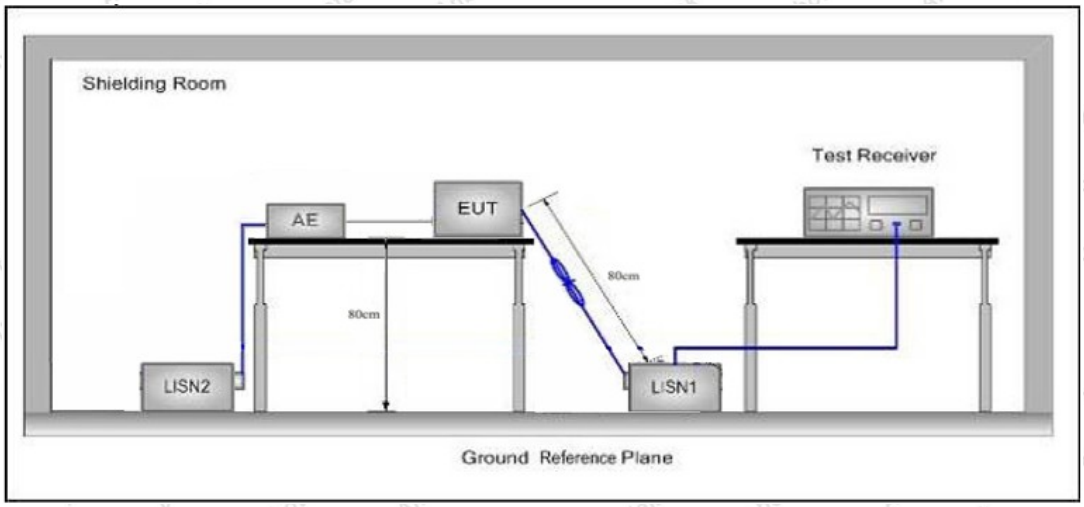
3. Conducted Emission Test

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

There is DC 3V Battery inside, So there is no need to test.

4. Radiation Spurious Emission and Band Edge

4.1. Test Standard and Limit

Test Standard	FCC Part15 C Section 15.209, 15.205 and 15.231(b)				
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.

the formulas for calculating the maximum permitted fundamental field strengths are as follows:
for the band 260-470 MHz, μV/m at 3 meters = 41.6667(F) - 7083.3333.
The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level

Emission Level (dBuV/m)=20log Emission Level(uV/m)

The field strength of emission limits have been calculated in below table:

Fundamental Frequency (MHz)	Field Strength of Fundamental (dBuV/m)@3m
433.92	80.82 (AVG)
433.92	100.82 (Peak)

4.2. Test Setup

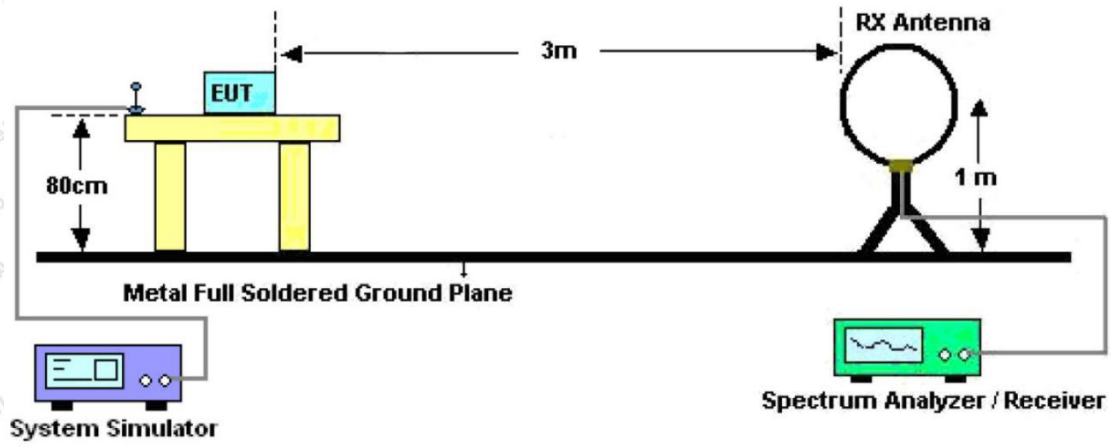


Figure 1. Below 30MHz

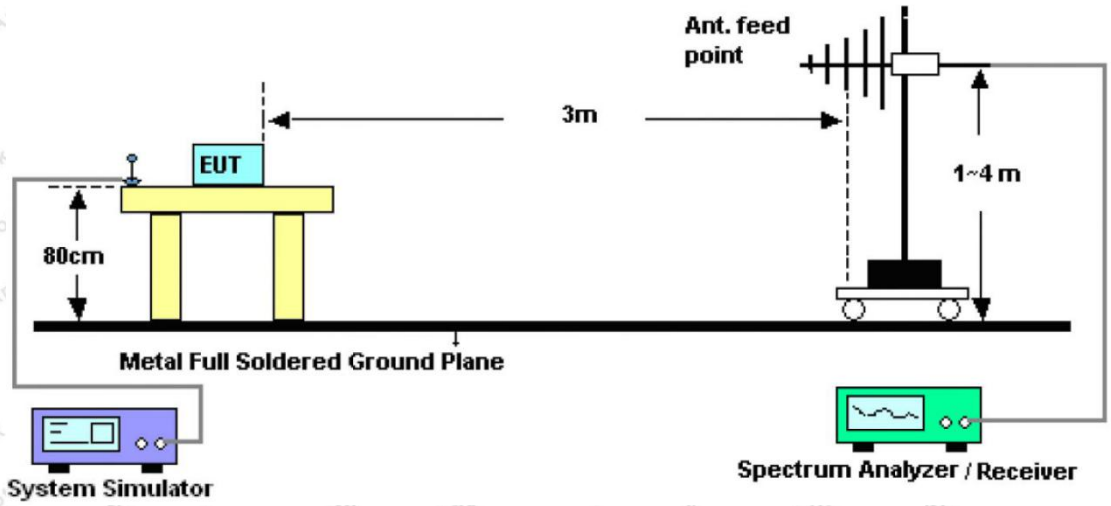


Figure 2. 30MHz to 1GHz

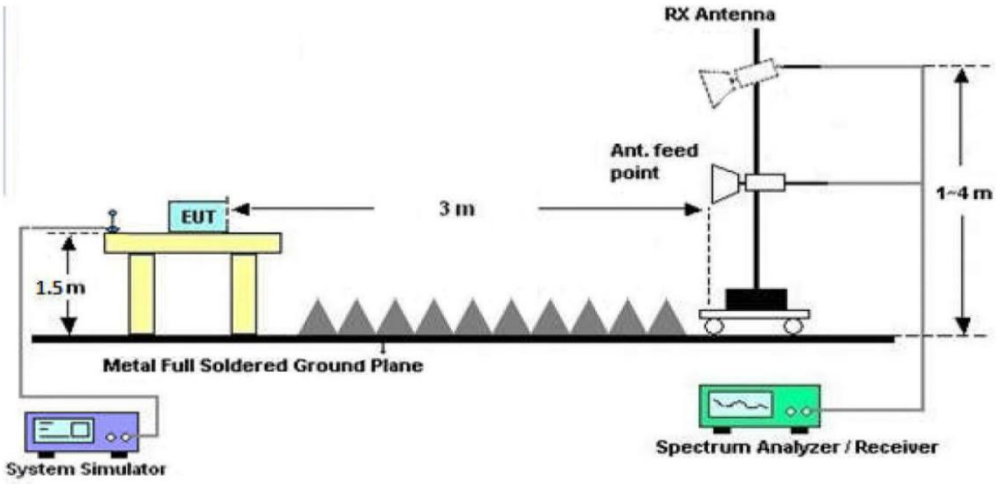


Figure 3. Above 1 GHz

4.3. Test Procedure

For below 1GHz: The EUT is placed on a turntable, which is 0.8m above the ground plane.
For above 1GHz: The EUT is placed on a turntable, which is 1.5m 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.

The test results of 9kHz-30MHz and above 18000MHz are attenuated more than 20dB below the permissible limits, so the results don't record in the report.

Test Results (Fundamental 433.92MHz)

Frequency	Antenna	Reading	Cable Loss	Ant Factor	Amplifier	Duty cycle Factor	Results	Limits	Det.
(MHz)	Pol.	(dBuV/m)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	Mode
433.92	H	94.99	1.52	12.64	31.45	-	77.70	100.82	PK
433.92	H	94.99	1.52	12.64	31.45	-16.20	61.46	80.82	AV
433.92	V	97.83	1.52	12.64	31.45	-	80.07	100.82	PK
433.92	V	97.83	1.52	12.64	31.45	-16.20	63.87	80.82	AV

Remark:

1. Result = Reading + Cable Loss +Ant Factor –Amplifier + Duty cycle Factor

2. Pulse Desensitization Correction Factor

Pulse Width (PW)= 0.198ms

2/PW=2/0.198=10.10kHz

RBW(1000kHz)＞ 2/PW (10.10KHz)

Therefore PDCF is not needed.

3. Duty Cycle Factor

Calculate Formula:

AV=PEAK +Duty Cycle Factor

Duty Cycle Factor=20log(Duty Cycle)

Duty Cycle= on time/ period

Test Data:

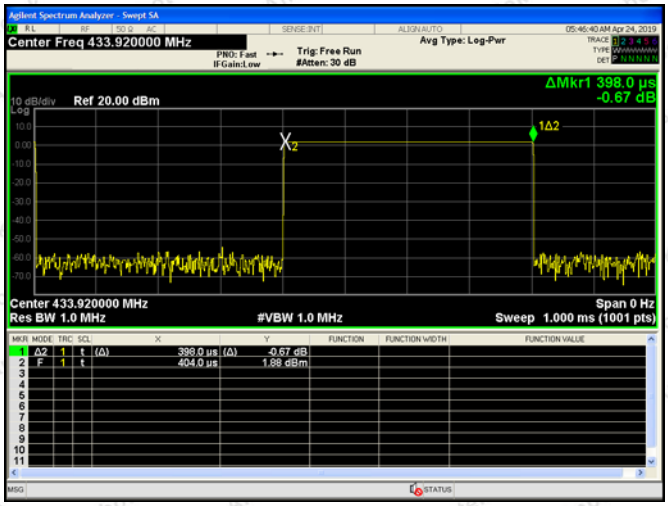
T on time=0.398ms*18+0.198ms*27=12.510 ms

T period=80.08ms

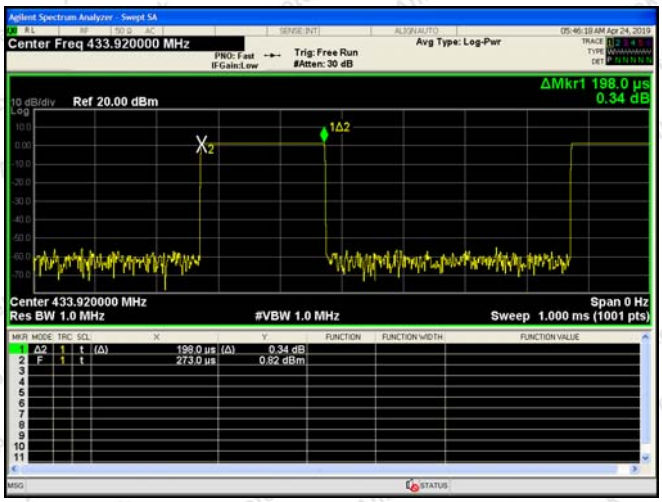
Duty Cycle=15.48%

Duty Cycle Factor =20log(Duty Cycle)=-16.20

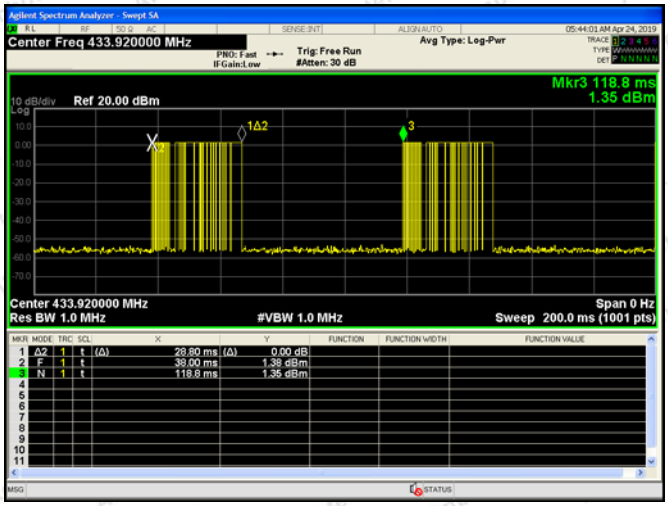
T on time slot-1



T on time slot-2



T period



Test Results (Harmonics Emissions)

Frequency	Antenna	Reading	Cable Loss	Ant Factor	Amplifier	Duty cycle Factor	Results	Limits	Det
(MHz)	Pol.	(dBuV/m)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	Mode
867.84	H	74.10	1.92	12.71	31.72	-	57.05	80.82	PK
867.84	H	74.10	1.92	12.71	31.72	-16.20	40.85	60.82	AV
867.84	V	76.92	1.92	12.71	31.72	-	59.44	80.82	PK
867.84	V	76.92	1.92	12.71	31.72	-16.20	43.24	60.82	AV
1301.76	H	63.96	2.38	21.43	32.45	-	55.02	74	PK
1301.76	H	63.96	2.38	21.43	32.45	-16.20	38.82	54	AV
1301.76	V	65.70	2.38	18.56	32.45	-	54.02	74	PK
1301.76	V	65.70	2.38	18.56	32.45	-16.20	37.82	54	AV

Remark :

1. Result = Reading + Cable Loss +Ant Factor –Amplifier + Duty cycle Factor
2. Pulse Desensitization Correction Factor

   Pulse Width (PW)= 0.198ms

   2/PW=2/0.198=10.10kHz

   RBW(1000kHz)＞ 2/PW (10.10KHz)

   Therefore PDCF is not needed.
3. Duty Cycle Factor=-16.20

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Test Results (Radiated Emission)

Frequency	Antenna	Reading	Cable Loss	Ant Factor	Amplifier	Results	Limits	Margin	Det.
(MHz)	Pol.	(dBuV/m)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Mode
54.73	H	56.74	1.03	11.15	40.74	27.69	40.0	-12.31	QP
127.91	H	59.30	1.24	12.24	40.48	32.05	43.5	-11.45	QP
732.70	H	61.25	1.67	13.75	41.27	35.56	46.0	-10.44	QP
54.73	V	55.03	1.03	11.15	40.74	27.29	40.0	-12.71	QP
127.91	V	61.00	1.24	12.24	40.48	33.00	43.5	-10.50	QP
732.70	V	62.06	1.67	13.75	41.27	36.74	46.0	-9.26	QP

Remark:

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

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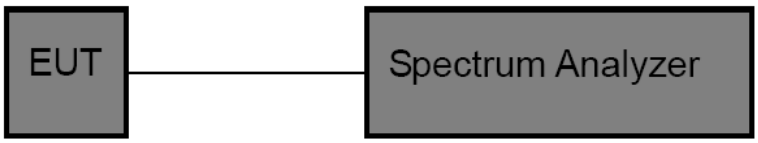
5. 20DB Occupy Bandwidth Test

5.1. Test Standard and Limit

Test Standard	FCC Part15 C Section 15.231 (c)
Test Limit	According to FCC Part 15.231(c), The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. For devices operating above 900MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20dB down from the modulated carrier. So the emission bandwidth limits have been calculated in below table:

Fundamental Frequency	Limit of 20dB Bandwidth
433.92 MHz	433920x0.0025=1084.80 kHz

5.2. Test Setup



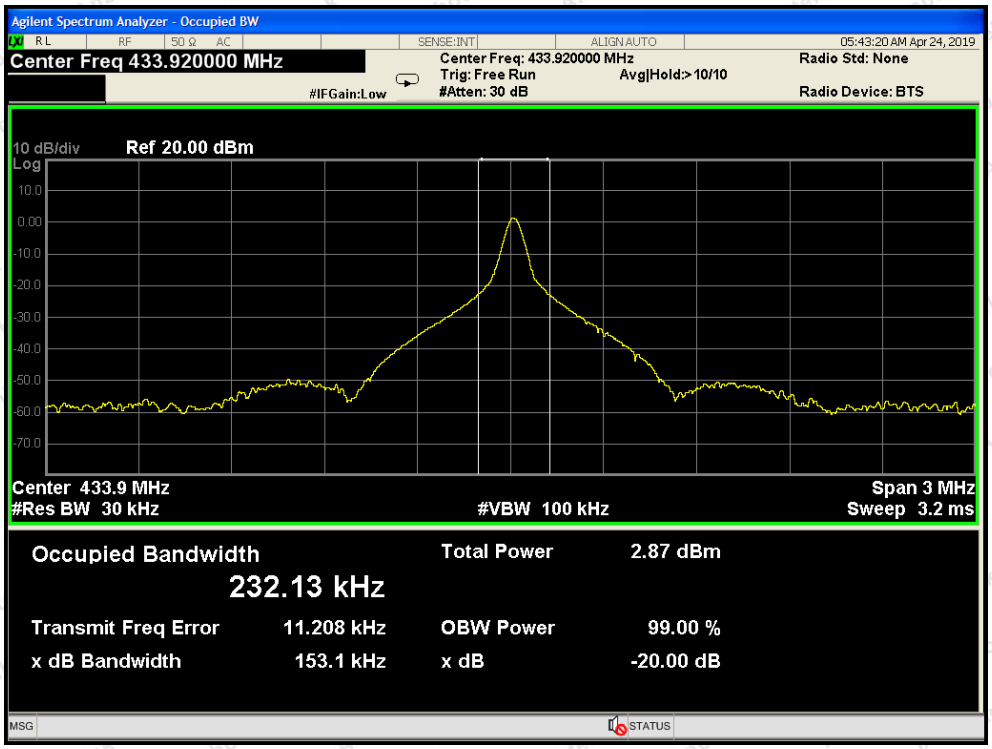
5.3. Test Procedure

1. Place the EUT on the table and set it in the continuously transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as:
   RBW = 100kHz, VBW≥3*RBW =300kHz,
   Span= 2MHz
   Detector= Peak
   Trace mode= Max hold.
   Sweep- auto couple.
4. Mark the peak frequency and –20dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

5.4. Test Data

Test Item	:	20dB Bandwidth	Test Mode	:	Continuously transmitting
Test Voltage	:	DC 3V Battery inside	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Freq. (MHz)	Modulation Type	Bandwidth (kHz)	Limit (kHz)	Results
433.92	FSK	153.1	<1084.80	PASS



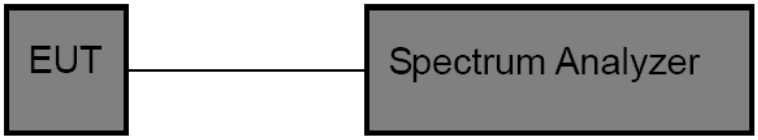
433.92MHz

6. Dwell Time Test

6.1. Test Standard and Limit

Test Standard	FCC Part 15.231(a)(1)
Test Limit	According to FCC Part 15.231(a)(1), A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released

6.2. Test Setup



6.3. Test Procedure

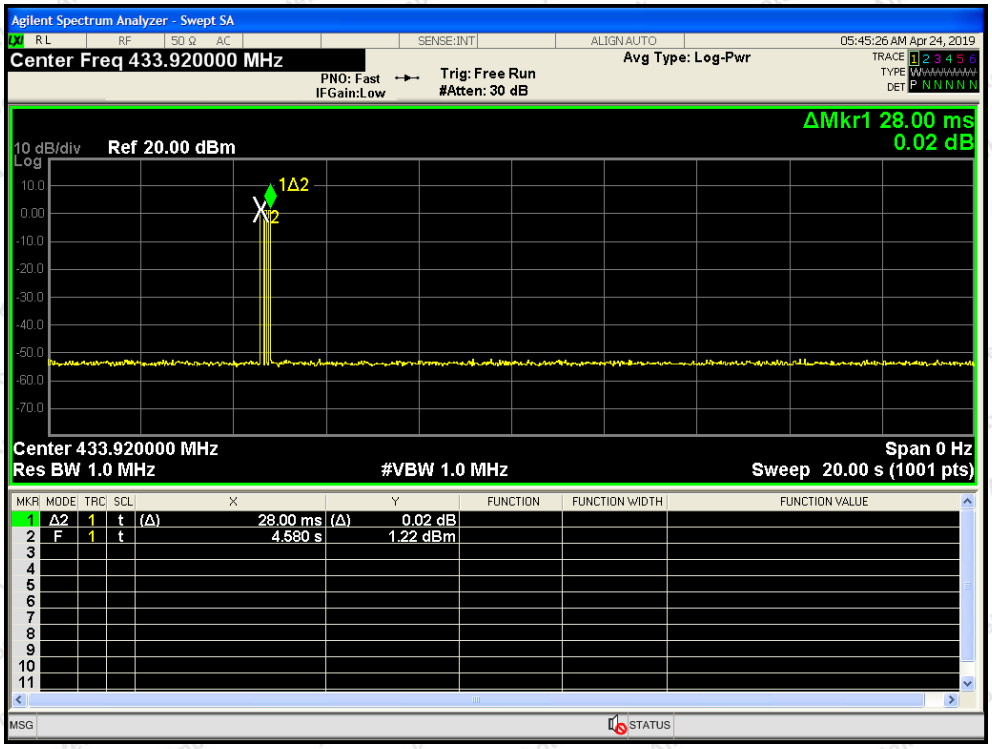
1. Place the EUT on the table and set it in continuously transmitting mode. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as
   RBW=1000kHz, VBW= 1000 kHz, Span= 0Hz, Sweep Time= 4 Seconds.
3. Record the Delta mark time.

6.4. Test Data

Test Item	:	Dwell Time	Test Mode	:	Continuously transmitting
Test Voltage	:	DC 3V Battery inside	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Test Mode	Transmitting time(s)	Limit(s)	Result
FSK mode	0.0280	≤5	PASS

Please refer the following plot.


Agilent Spectrum Analyzer - Swept SA
Center Freq 433.920000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
05:45:26 AM Apr 24, 2019
ΔMkr1 28.00 ms
0.02 dB
10 dB/div Ref 20.00 dBm
Log
Center 433.920000 MHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 20.00 s (1001 pts)
1 Δ2 1 t (Δ) 28.00 ms (Δ) 0.02 dB
2 F 1 t 4.580 s 1.22 dBm

Dwell Time

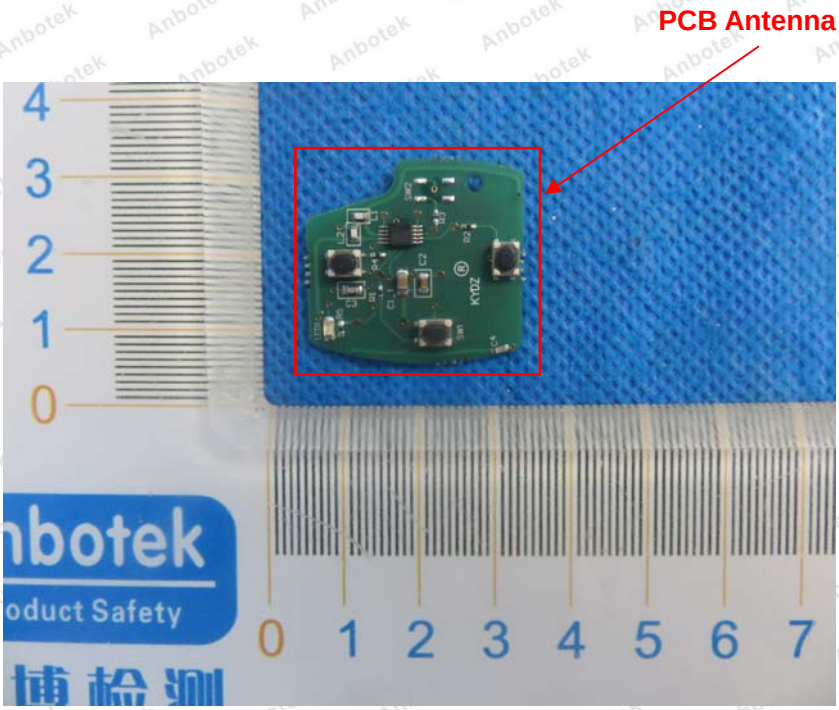
7. Antenna Requirement

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

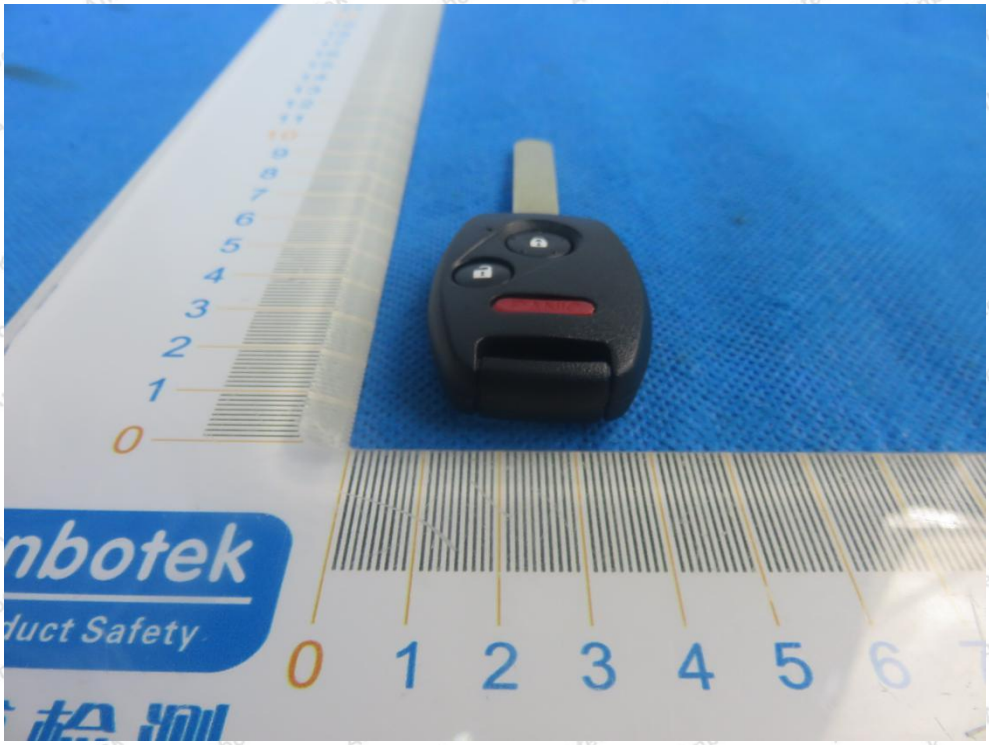
The antenna is a PCB antenna which permanently attached, and the best case gain of the antenna is 0 dBi. It complies with the standard requirement.

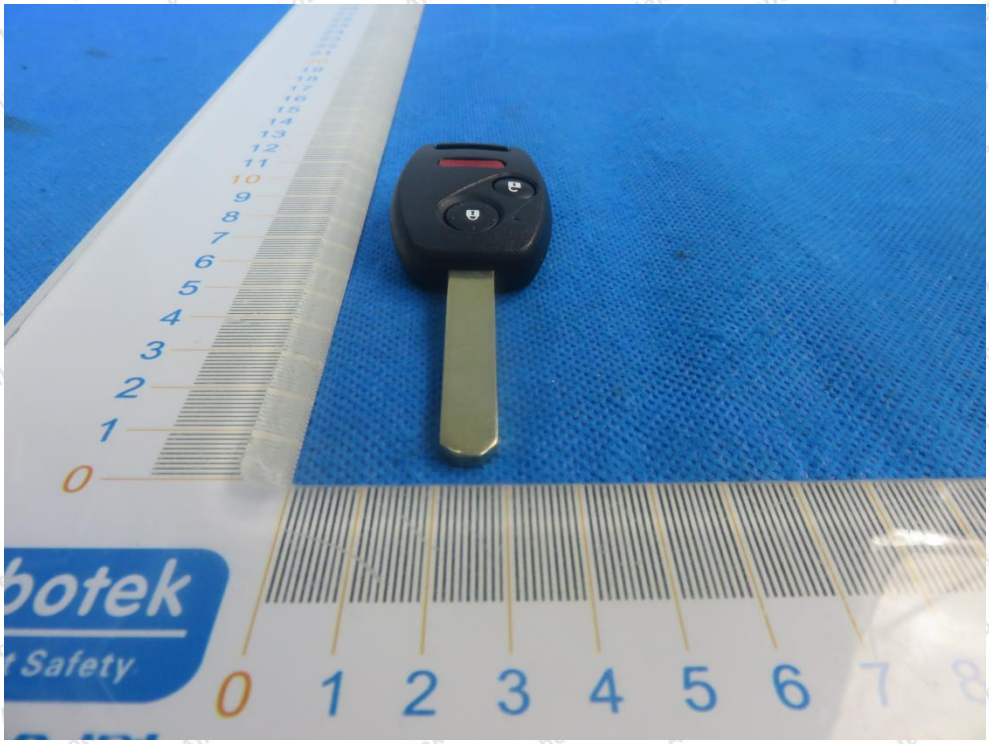


APPENDIX I -- TEST SETUP PHOTOGRAPH

Photo of Radiated Emission Measurement

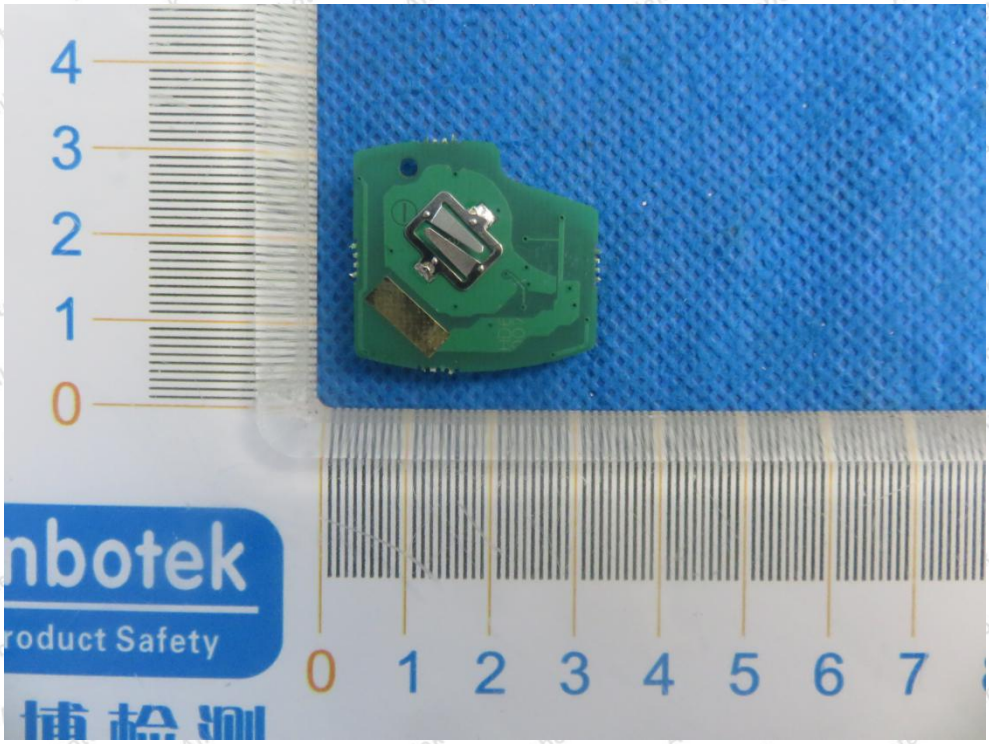
APPENDIX II -- EXTERNAL PHOTOGRAPH

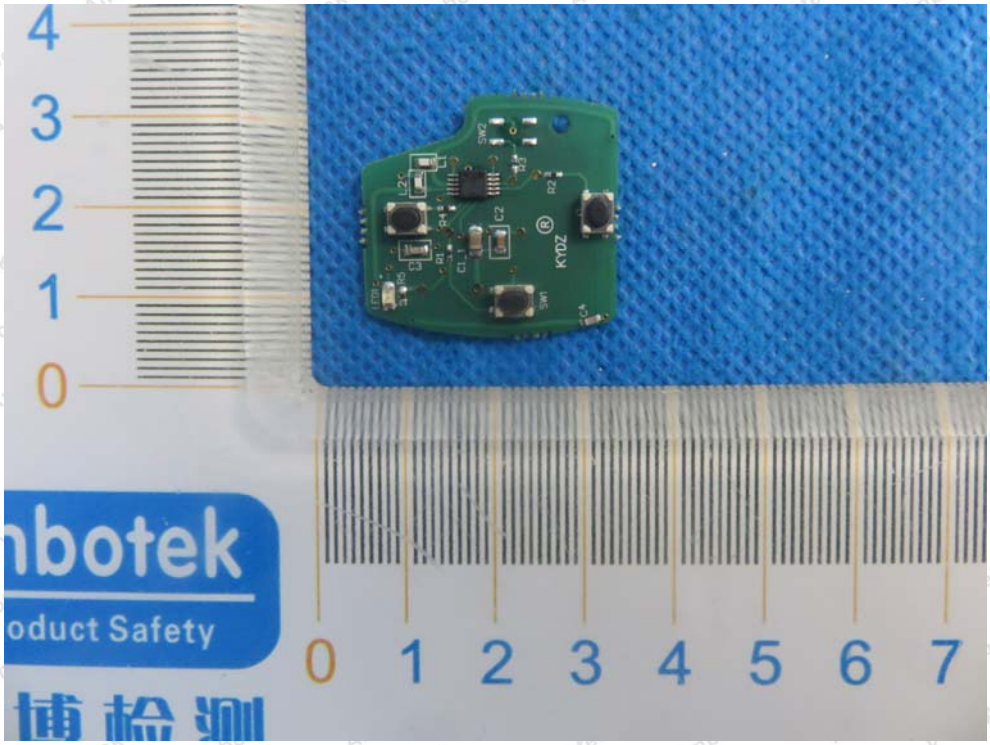


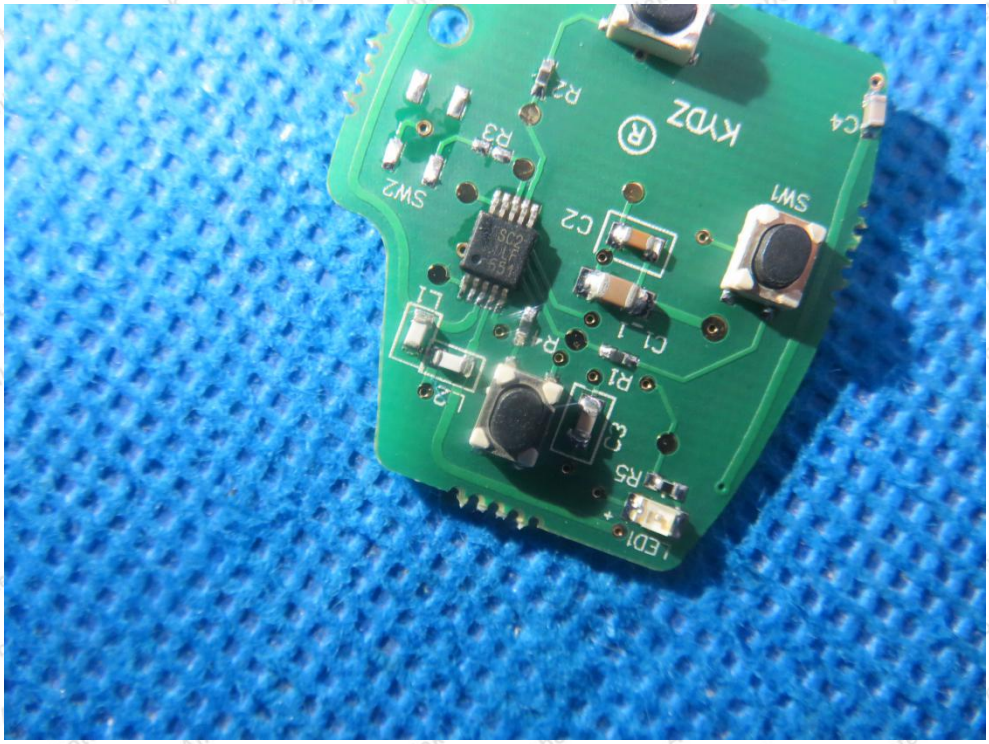


APPENDIX III -- INTERNAL PHOTOGRAPH

CR1616
muRata
3V LITHIUM JAPAN







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