TEST REPORT

Reference No.	:	WTF18S03105357-1W
FCC ID.....	:	2AC3T-B36T20RA
Applicant	:	Building 36 Technologies, LLC
Address	:	150 A Street, Suite 104, Needham, Massachusetts 02494, United States
Manufacturer	:	Building 36 Technologies, LLC
Address	:	150 A Street, Suite 104, Needham, Massachusetts 02494, United States
Product.....	:	SMART THERMOSTAT 2
Model(s).....	:	ADC-T3000
Standards.....	:	FCC CFR47 Part 15 Section 15.249:2018
Date of Receipt sample....	:	2018-04-17
Date of Test.....	:	2018-05-01 to 2018-07-26
Date of Issue.....	:	2018-09-05
Test Result.....	:	Pass

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

Prepared By:
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1 Laboratories Introduction

Waltek Services (Shenzhen) Co., Ltd is a professional third-party testing and certification laboratory with multi-year product testing and certification experience, established strictly in accordance with ISO/IEC 17025 requirements, and accredited by ILAC (International Laboratory Accreditation Cooperation) member. A2LA (American Association for Laboratory Accreditation) of USA, Meanwhile, Waltek has got recognition as registration and accreditation laboratory from EMSD (Electrical and Mechanical Services Department), and American Energy star, FCC(The Federal Communications Commission), CEC(California energy efficiency), IC(Industry Canada). It's the strategic partner and data recognition laboratory of international authoritative organizations, such as Intertek(ETL-SEMKO), TÜV Rheinland, TÜV SÜD, etc.

Waltek Services (Shenzhen) Co., Ltd is one of the largest and the most comprehensive third party testing laboratory in China. Our test capability covered four large fields: safety test. Electro Magnetic Compatibility (EMC), and energy performance, wireless radio. As a professional, comprehensive, justice international test organization, we still keep the scientific and rigorous work attitude to help each client satisfy the international standards and assist their product enter into globe market smoothly.

1.1 Test Facility

A. Accreditations for Conformity Assessment (International)

Country/Region	Accreditation Body	Scope	Note
USA	International Services	FCC ID \ DOC \ VOC	1
Canada		IC ID \ VOC	2
Japan		MIC-T \ MIC-R	-
Europe		EMCD \ RED	-
Taiwan		NCC	-
Hong Kong		OFCA	-
Australia		RCM	-
India		WPC	-
Thailand		NTC	-
Singapore		IDA	-

Note:

1. FCC Designation No.: CN1201. Test Firm Registration No.: 523476.
2. IC Canada Registration No.: 7760A

B.TCBs and Notify Bodies Recognized Testing Laboratory.

Recognized Testing Laboratory of …	Notify body number
TUV Rheinland	Optional.
Intertek	
TUV SUD	
SGS	
Phoenix Testlab GmbH	0700
Element Materials Technology Warwick Ltd	0891
Timco Engineering, Inc.	1177
Eurofins Product Service GmbH	0681

2 Contents

3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTF18S03105357-1W	2018-04-17	2018-05-01 to 2018-07-26	2018-09-05	original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product :	SMART THERMOSTAT 2
Model (s):	ADC-T3000
Model Similarity	N/A
Operation Frequency:	908.40-916.00MHz
Type of modulation:	FSK
Antenna Gain:	0dBi

4.2 Details of E.U.T.

Ratings:	Power supply: AC 24V; Backup: DC 3V by Batteries (2 AAA alkaline batteries)

4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	908.40	2	916.00

4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests.

Test mode	Low Channel	High Channel
Transmitting	908.40MHz	916.00MHz

5 Equipment Used during Test

5.1 Equipments List

Conducted Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	EMI Test Receiver	R&S	ESCI	100947	2017-09-12	2018-09-11
2	LISN	R&S	ENV216	100115	2017-09-12	2018-09-11
3	Cable	Top	TYPE16(3.5M)	-	2017-09-12	2018-09-11
3m Semi-anechoic Chamber for Radiation Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Spectrum Analyzer	R&S	FSP30	100091	2018-04-29	2019-04-28
2	Broad-band Horn Antenna(1-18GHz)	SCHWARZBECK	BBHA 9120 D	667	2018-04-29	2019-04-28
3	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2018-04-29	2019-04-28
4	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	EW02014-7	2018-04-29	2019-04-28
5	Spectrum Analyzer	R&S	FSP40	100501	2017-10-20	2018-10-19
6	Broad-band Horn Antenna(18-40GHz)	SCHWARZBECK	BBHA 9170	BBHA9170651	2017-10-25	2018-10-24
7	Microwave Broadband Preamplifier (18-40GHz)	SCHWARZBECK	BBV 9721	100472	2017-10-25	2018-10-24
8	Cable	Top	18-40GHz	-	2017-10-25	2018-10-24
3m Semi-anechoic Chamber for Radiation Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No**	**Last Calibration Date**	**Calibration Due Date**
1	Test Receiver	R&S	ESCI	101296	2018-04-29	2019-04-28
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2018-04-29	2019-04-28
3	Active Loop Antenna	Com-power	AL-130R	10160007	2018-04-17	2019-04-16
4	Amplifier	ANRITSU	MH648A	M43381	2018-04-29	2019-04-28
5	Cable	HUBER+SUHNER	CBL2	525178	2018-04-29	2019-04-28

6	Coaxial Cable (below 1GHz)	Top	TYPE16 (13M)	-	2017-09-12	2018-09-11
RF Conducted Testing						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Spectrum Analyzer	R&S	FSP30	100091	2018-04-20	2019-04-19
2	Coaxial Cable	Top	10Hz-30GHz	-	2017-09-12	2018-09-11
3	Antenna Connector*	Realacc	45RSm	-	2017-09-12	2018-09-11
4	DC Block	Gwave	GDCB-3G-N-SMA	140307001	2017-09-12	2018-09-11
"*": The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.						

5.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	± 1 x 10^{-6}
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (30M~1000MHz)
	± 5.47 dB (1000M~25000MHz)
Conducted Emissions test	± 3.64 dB (AC mains 150KHz~30MHz)

.

6 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	Pass
Radiated Spurious Emission	15.249(a) 15.209 15.205(a)	Pass
Periodic Operation	15.35(c)	Pass
Band Edge	15.249 15.205 15.209	Pass
Bandwidth	15:215(c)	Pass
Antenna Requirement	15.203	Pass
RF Exposure	1.1307(b)(1)	Pass
Note: Pass=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable.		

7 Conducted Emission

Test Requirement: FCC CFR 47 Part 15 Section 15.207

Test Method: ANSI C63.10:2013

Frequency Range: 150kHz to 30MHz

Class/Severity: Class B

Limit:

Frequency (MHz)	Conducted Limit (dBμV)	
	Qsi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5.0	56	46
5.0 to 30	60	50
*Decreases with the logarithm of the frequency.		

Test Result: PASS

7.1 E.U.T. Operation

Operating Environment **:**

Temperature: 25.5 °C

Humidity: 51 % RH

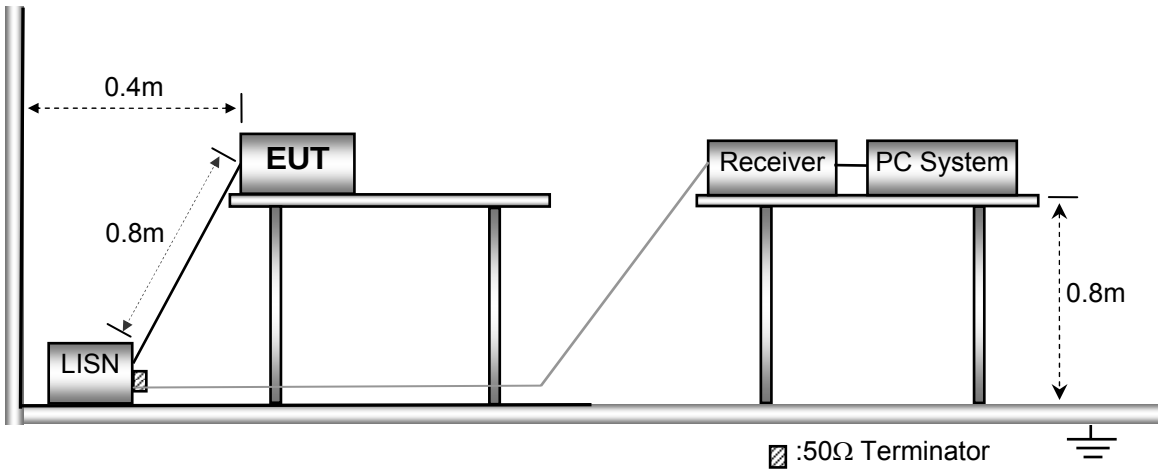
Atmospheric Pressure: 101.2kPa

EUT Operation **:**

The test was performed in transmitting mode, the worst test data (Low channel) were shown in the report.

7.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013

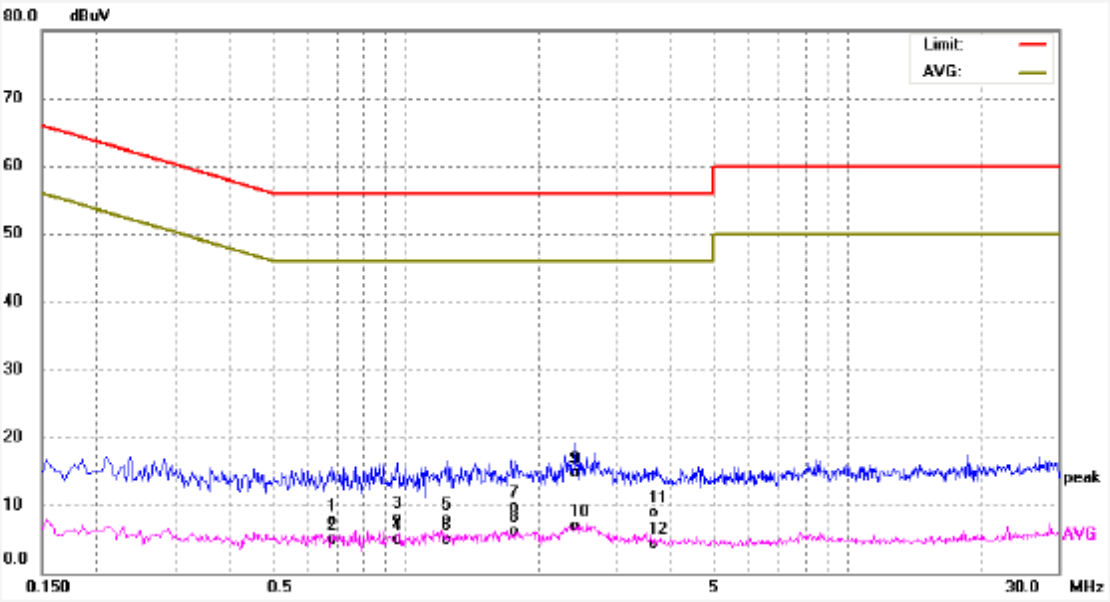


7.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

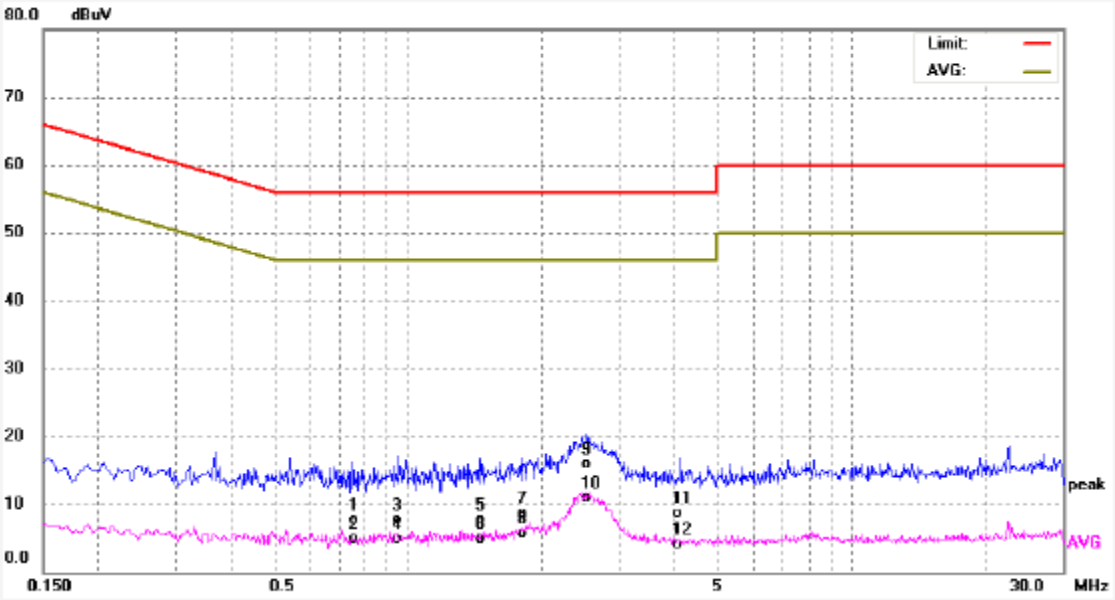
7.4 Test Result

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.6860	-1.94	9.72	7.78	56.00	-48.22	QP	
2	0.6860	-4.81	9.72	4.91	46.00	-41.09	AVG	
3	0.9620	-1.80	9.81	8.01	56.00	-47.99	QP	
4	0.9620	-4.82	9.81	4.99	46.00	-41.01	AVG	
5	1.2380	-1.90	9.87	7.97	56.00	-48.03	QP	
6	1.2380	-4.88	9.87	4.99	46.00	-41.01	AVG	
7	1.7420	-0.23	9.92	9.69	56.00	-46.31	QP	
8	1.7420	-3.75	9.92	6.17	46.00	-39.83	AVG	
9	2.4100	4.76	9.94	14.70	56.00	-41.30	QP	
10	2.4100	-3.00	9.94	6.94	46.00	-39.06	AVG	
11	3.6820	-0.99	9.94	8.95	56.00	-47.05	QP	
12	3.6820	-5.61	9.94	4.33	46.00	-41.67	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.7460	-2.13	9.75	7.62	56.00	-48.38	QP	
2	0.7460	-4.90	9.75	4.85	46.00	-41.15	AVG	
3	0.9580	-2.07	9.81	7.74	56.00	-48.26	QP	
4	0.9580	-4.91	9.81	4.90	46.00	-41.10	AVG	
5	1.4620	-2.20	9.90	7.70	56.00	-48.30	QP	
6	1.4620	-4.98	9.90	4.92	46.00	-41.08	AVG	
7	1.7980	-1.17	9.93	8.76	56.00	-47.24	QP	
8	1.7980	-4.24	9.93	5.69	46.00	-40.31	AVG	
9	2.5380	6.02	9.94	15.96	56.00	-40.04	QP	
10	2.5380	0.98	9.94	10.92	46.00	-35.08	AVG	
11	4.1140	-1.31	9.95	8.64	56.00	-47.36	QP	
12	4.1140	-5.93	9.95	4.02	46.00	-41.98	AVG	

8 Radiation Emission Test

Test Requirement: FCC Part15 Paragraph 15.249&15.209&15.205

Test Method: ANSI 63.10: 2013

Measurement Distance: 3m

Test Result: PASS

15.249(a)Limit:

Fundamental frequency	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBuV/m	uV/m	dBuV/m
902-928 MHz	50	94	500	54
2400-2483.5 MHz	50	94	500	54
5725-5875 MHz	50	94	500	54
24.0-24.25 GHz	250	108	2500	68

15.209 Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40=(29.54+40)$
30 ~ 88	100	3	100	$20\log^{(100)} =(40)$
88 ~ 216	150	3	150	$20\log^{(150)} =(43.5)$
216 ~ 960	200	3	200	$20\log^{(200)} =(46)$
Above 960	500	3	500	$20\log^{(500)} =(54)$

Note: RF Voltage(dBuV)=20 $\log_{10}$ RF Voltage(uV)

8.1 EUT Operation

Operating Environment **:**

Temperature: 23.5 °C

Humidity: 51.1 % RH

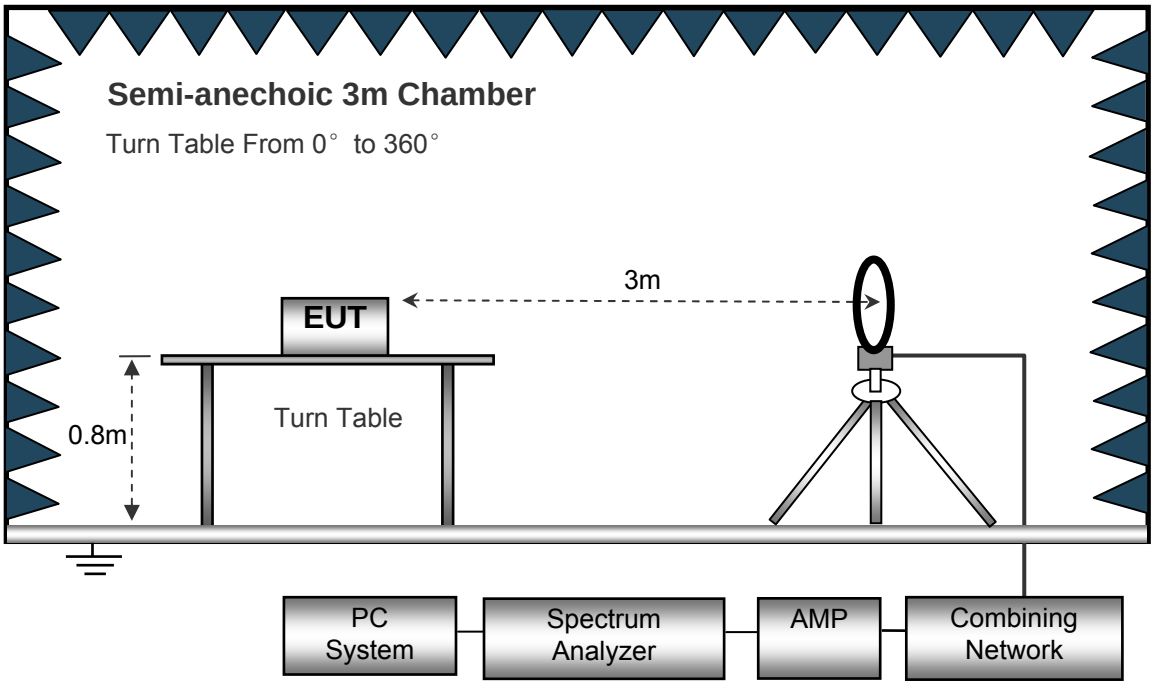
Atmospheric Pressure: 101.2kPa

EUT Operation **:**

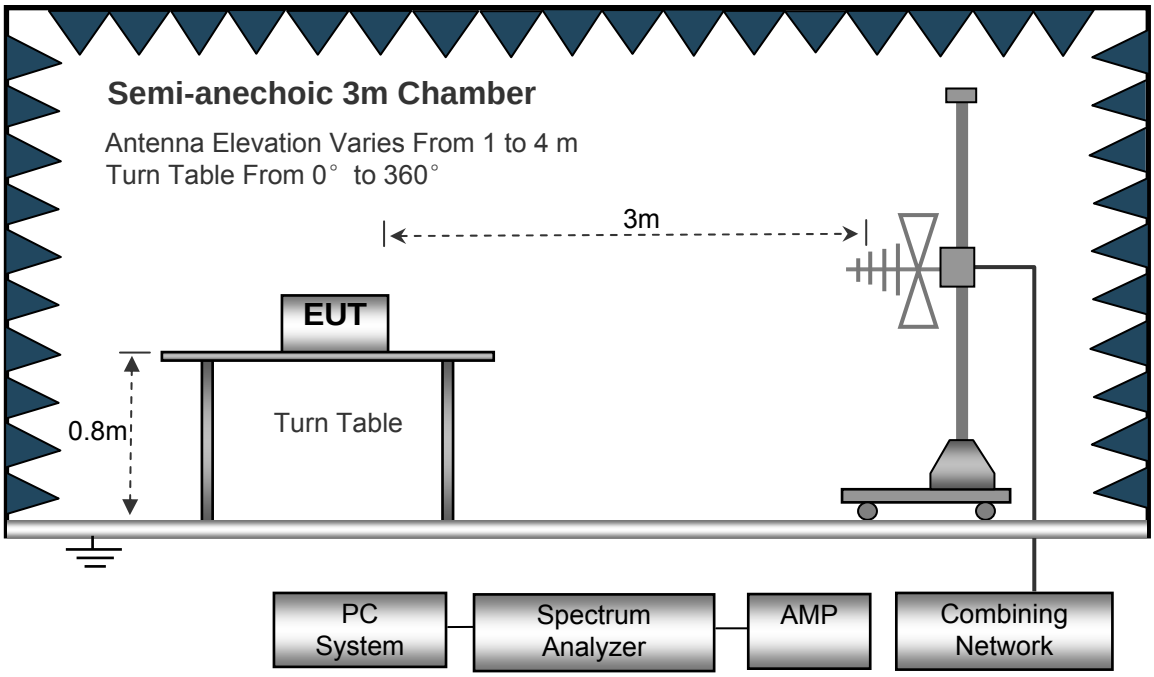
The test was performed in transmitting mode, the test data were shown in the report.

8.2 Test Setup

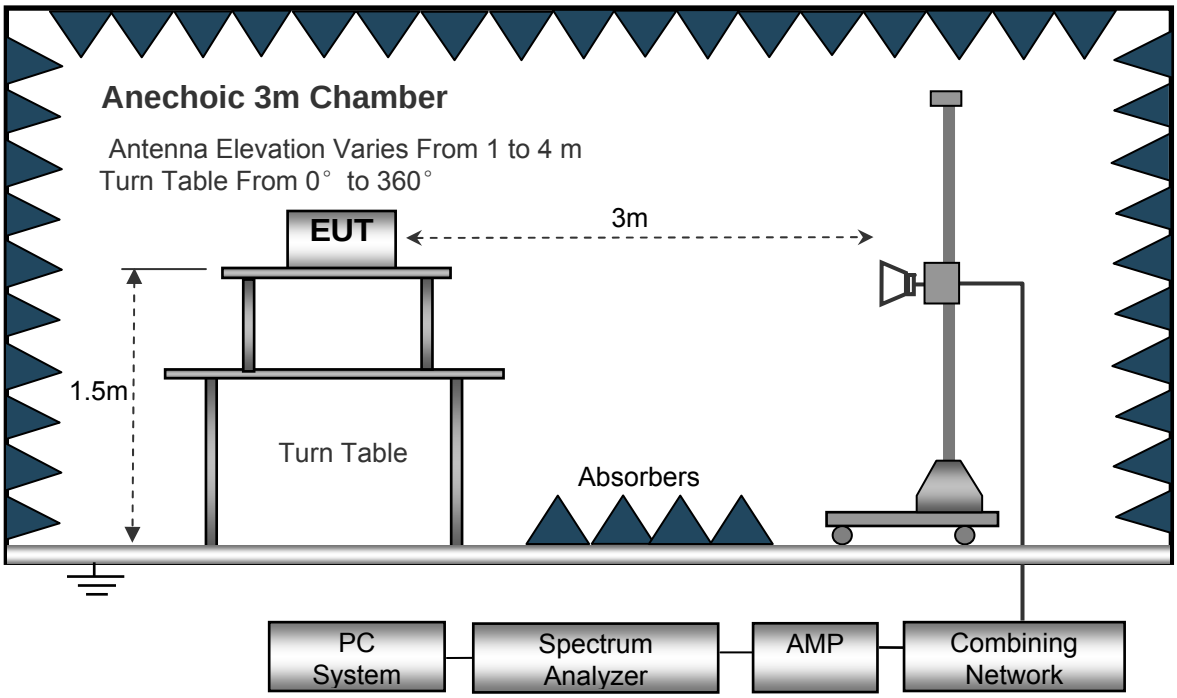
The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30MHz to 1GHz.



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed	Auto
IF Bandwidth	10kHz
Video Bandwidth	10kHz
Resolution Bandwidth	10kHz

30MHz ~ 1GHz

Sweep Speed	Auto
Detector	PK
Resolution Bandwidth	100kHz
Video Bandwidth	300kHz

Above 1GHz

Sweep Speed	Auto
Detector	PK
Resolution Bandwidth	1MHz
Video Bandwidth	3MHz
Detector	Ave.
Resolution Bandwidth	1MHz
Video Bandwidth	10Hz
Video Bandwidth	10Hz

8.4 Test Procedure

1. The EUT is placed on a turntable. For below 1GHz, the EUT is 0.8m above ground plane; For above1GHz, the EUT is 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are performed in X,Y and Z axis positioning(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand),the worst condition was tested putting the eut in X axis,so the worst data were shown as follow.
8. A 2.4GHz high –pass filter is used druing radiated emissions above 1GHz measurement.

8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Limit

8.6 Test Result

Test Frequency: 9 kHz~30 MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30 MHz ~ 10 GHz

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.249/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
Low Channel									
34.76	47.89	QP	237	1.2	V	-17.09	30.80	40.00	-9.20
908.40	90.97	PK	177	1.6	H	2.28	93.25	114.00	-20.75
908.40	84.54	PK	245	1.6	V	2.28	86.82	114.00	-27.18
1816.80	61.17	PK	290	1.1	H	-15.28	45.89	74.00	-28.11
1816.80	53.42	PK	265	1.3	V	-15.28	38.14	74.00	-35.86
2725.20	51.26	PK	60	1.3	H	-14.29	36.97	74.00	-37.03
2725.20	52.66	PK	296	1.5	V	-14.29	38.37	74.00	-35.63
3633.60	50.64	PK	187	1.6	H	-11.65	38.99	74.00	-35.01
3633.60	51.29	PK	214	1.9	V	-11.65	39.64	74.00	-34.36
High Channel									
34.76	46.94	QP	183	1.8	V	-17.09	29.85	40.00	-10.15
916.00	91.79	PK	85	1.8	H	2.17	93.96	114.00	-20.04
916.00	83.71	PK	128	1.6	V	2.17	85.88	114.00	-28.12
1832.00	65.64	PK	87	1.2	H	-15.22	50.42	74.00	-23.58
1832.00	51.39	PK	309	1.2	V	-15.22	36.17	74.00	-37.83
2748.00	53.82	PK	38	1.4	H	-14.16	39.66	74.00	-34.34
2748.00	50.34	PK	224	1.0	V	-14.61	35.73	74.00	-38.27
3664.00	50.53	PK	142	1.9	H	-8.82	41.71	74.00	-32.29
3664.00	50.31	PK	25	1.1	V	-8.82	41.49	74.00	-32.51

Note: AV = Peak +20Log10(duty cycle) =PK+(0) [refer to section 9 for more detail]

Frequency	PK	RX Antenna Polar	Duty cycle Factor	AV	FCC Part 15.249/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
Low Channel						
908.40	93.25	H	0	93.25	94.00	-0.75
908.40	86.82	V	0	86.82	94.00	-7.18
1816.80	45.89	H	0	45.89	54.00	-8.11
1816.80	38.14	V	0	38.14	54.00	-15.86
2725.20	36.97	H	0	36.97	54.00	-17.03
2725.20	38.37	V	0	38.37	54.00	-15.63
3633.60	38.99	H	0	38.99	54.00	-15.01
3633.60	39.64	V	0	39.64	54.00	-14.36
High Channel						
916.00	93.96	H	0	93.96	94.00	-0.04
916.00	85.88	V	0	85.88	94.00	-8.12
1832.00	50.42	H	0	50.42	54.00	-3.58
1832.00	36.17	V	0	36.17	54.00	-17.83
2748.00	39.66	H	0	39.66	54.00	-14.34
2748.00	35.73	V	0	35.73	54.00	-18.27
3664.00	41.71	H	0	41.71	54.00	-12.29
3664.00	41.49	V	0	41.49	54.00	-12.51

9 Periodic Operation

The duty cycle was determined by the following equation:

To calculate the actual field intensity,the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

Duty Cycle(%)=Total On interval in a complete pulse train/ Length of a complete pulse train * %

Duty Cycle Correction Factor(dB)=20 * Log_{10}(Duty Cycle)

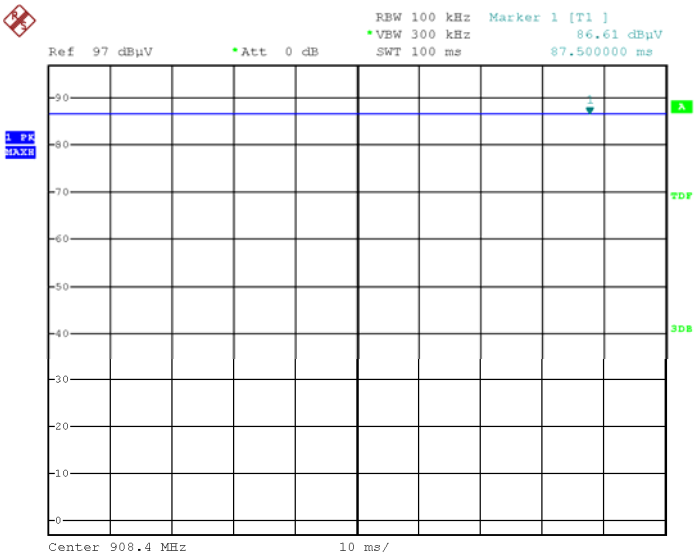
Total transmission time(ms)	100
Length of a complete transmission period(ms)	100*
Duty Cycle(%)	100
Duty Cycle Correction Factor(dB)	0

(* Note: the transmitter operates for longer than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. So the Length of a complete transmission period=100ms)

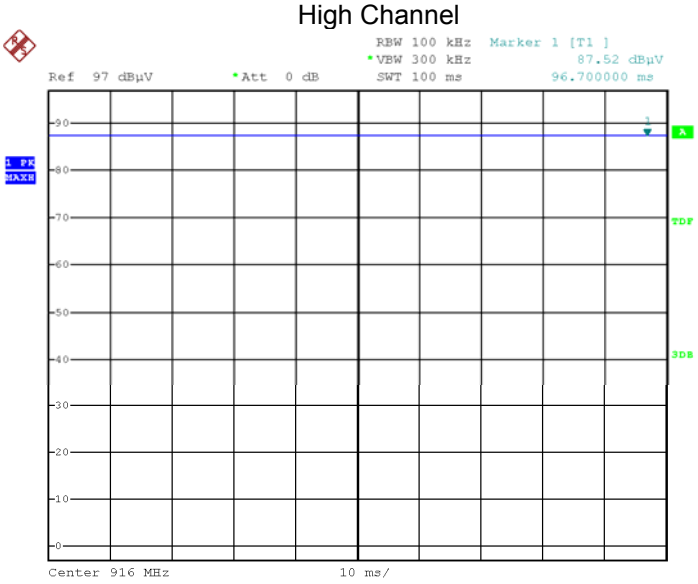
Refer to the duty cycle plot (as below)

Test plots

Low Channel



High Channel



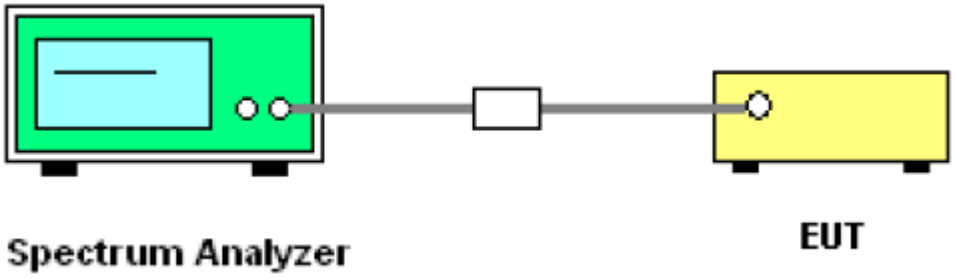
10 Band Edge

Test Requirement:	15.249(d):Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
Test Method:	ANSI C63.10:2013
Test Mode:	Transmitting

10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyser: RBW = 100 kHz, VBW = 300 kHz

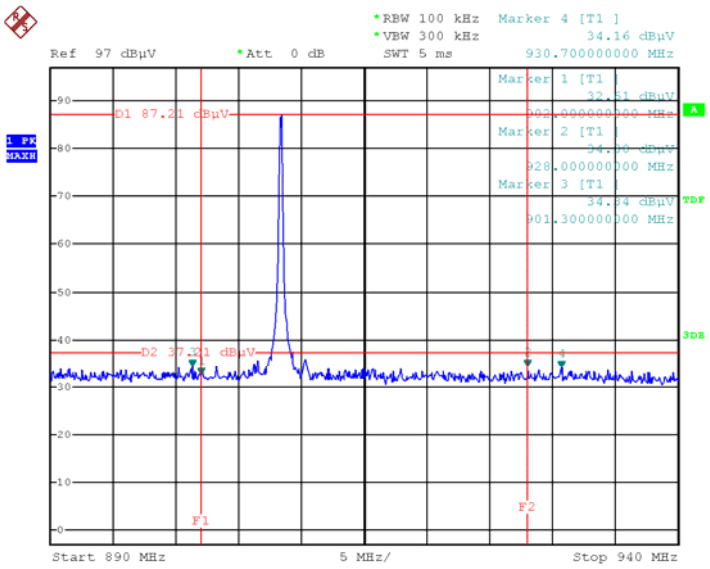
10.2 Test Setup



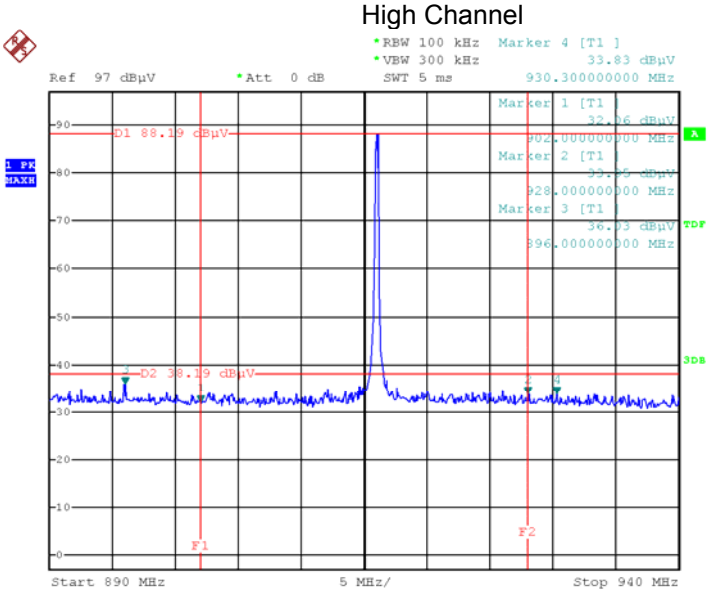
10.3 Test Result

Test plots

Low Channel



High Channel



11 Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.215(c)

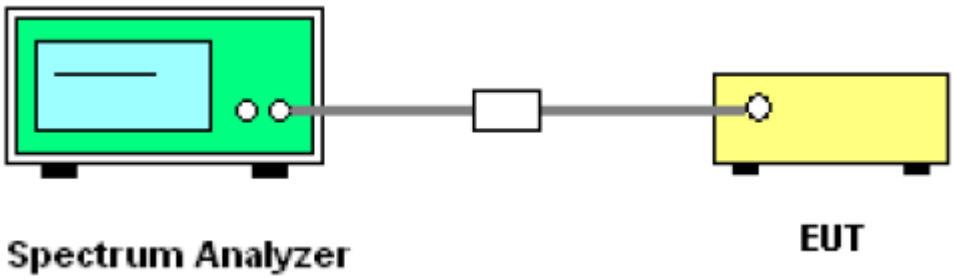
Test Method: ANSI C63.10:2013

Test Mode: Transmitting

11.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyser: RBW = 3 kHz, VBW = 10 kHz

11.2 Test Setup

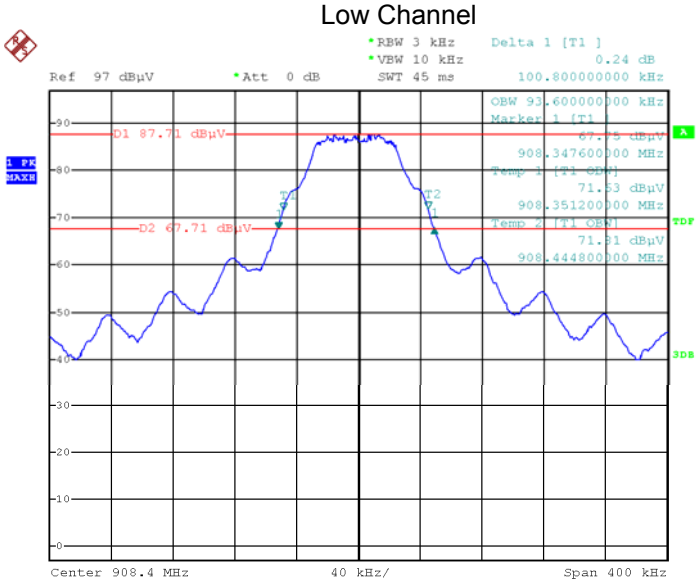


11.3 Test Result

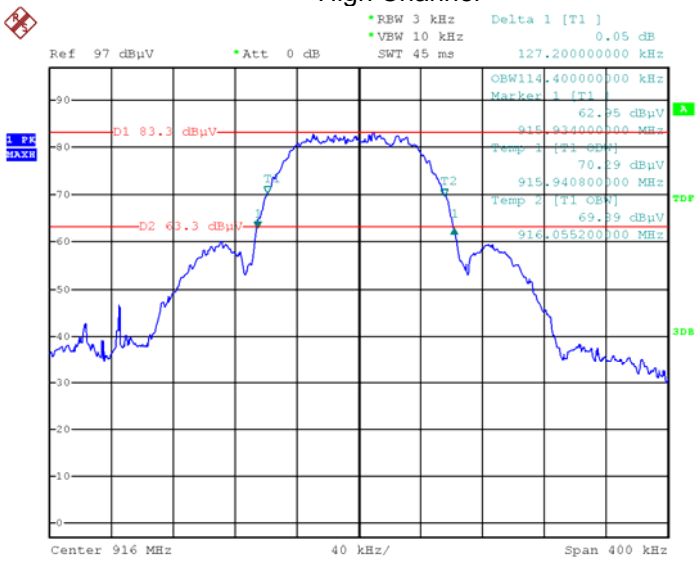
Test Frequency	20 dB Bandwidth Emission (kHz)	99% Bandwidth Emission (kHz)
Low Channel	100.80	93.60
High Channel	127.20	114.40

Test plots

Low Channel



High Channel



12 RF Exposure Report

Note: Please refer to RF exposure report: WTF18S03105357-2W.

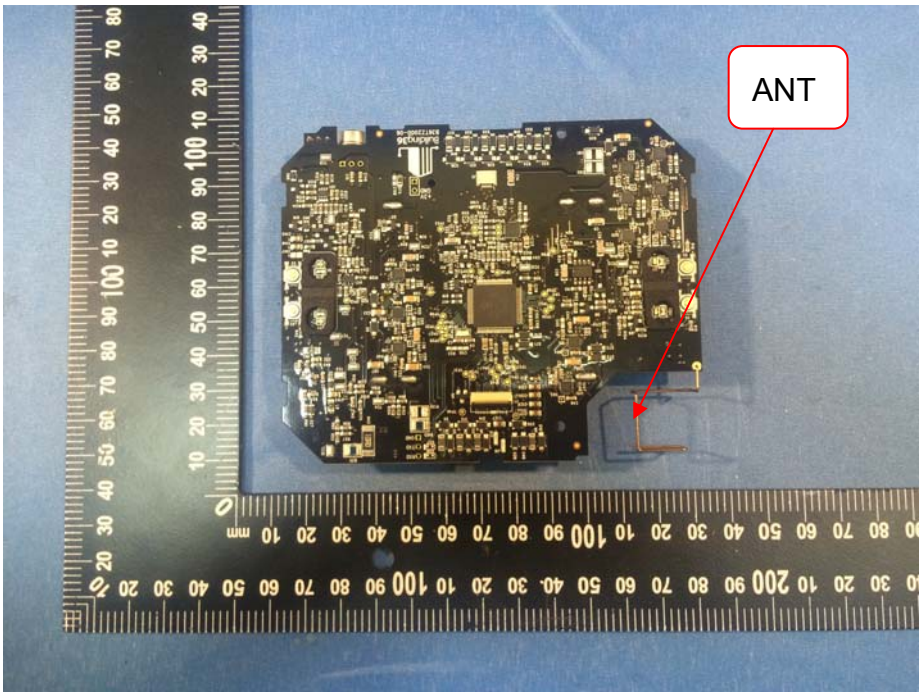
13 Antenna Requirement

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. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §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 §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.

For intentional device, according to FCC 47 CFR 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.

Result:

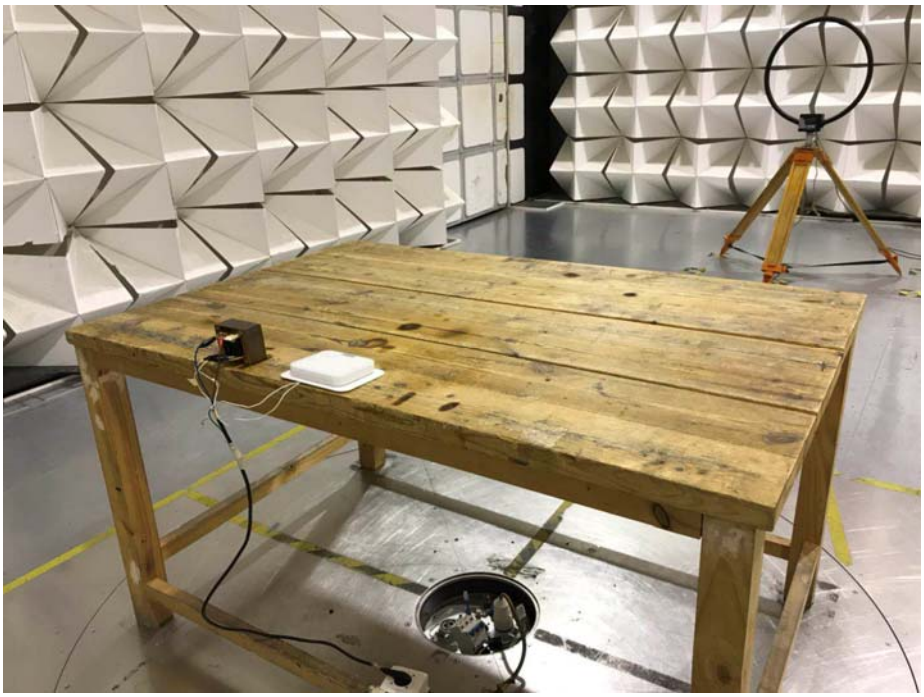
The EUT has one Internal Integrated Antenna, the gain is 0dBi. Meets the requirements of FCC 15.203.



14 Photographs- Model ADC-T3000 Test Setup Photos

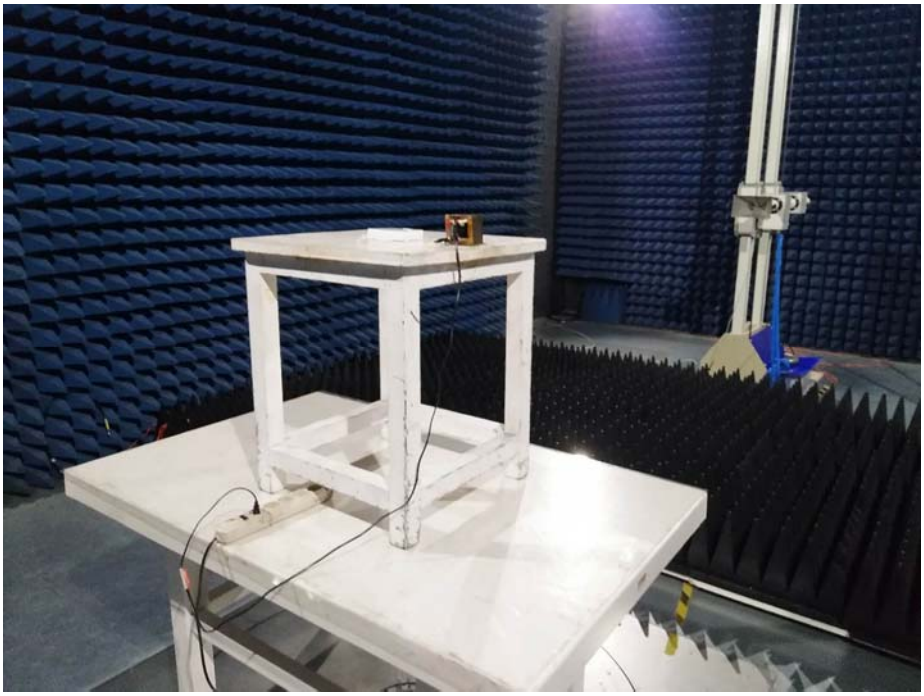
14.1 Photograph – Radiation Spurious Emission

Test frequency from 9 kHz to 30 MHz

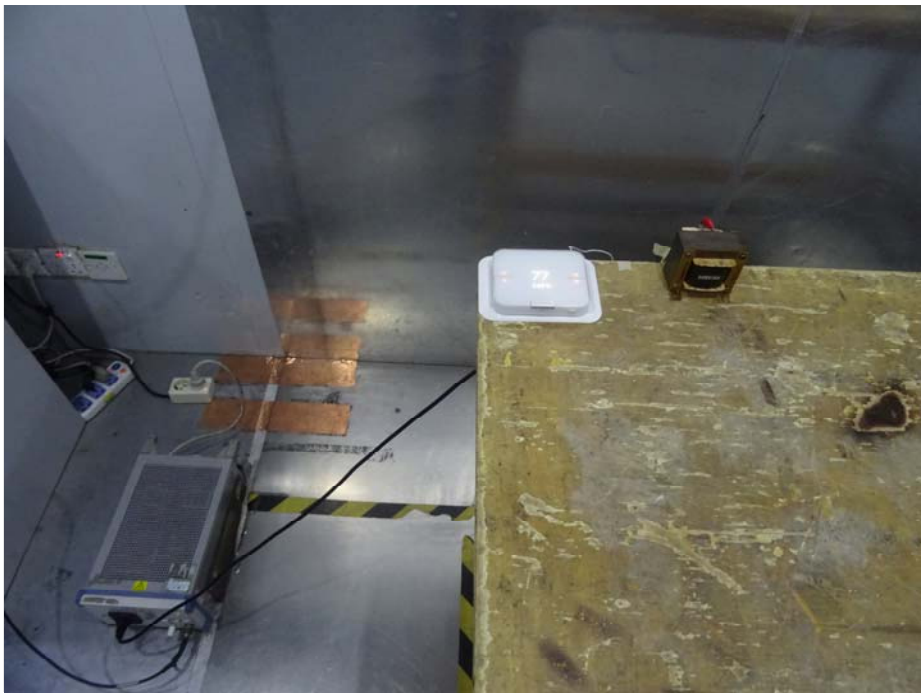


Test frequency from 30 MHz to 1 GHz

Test frequency from 1GHz to 10 GHz

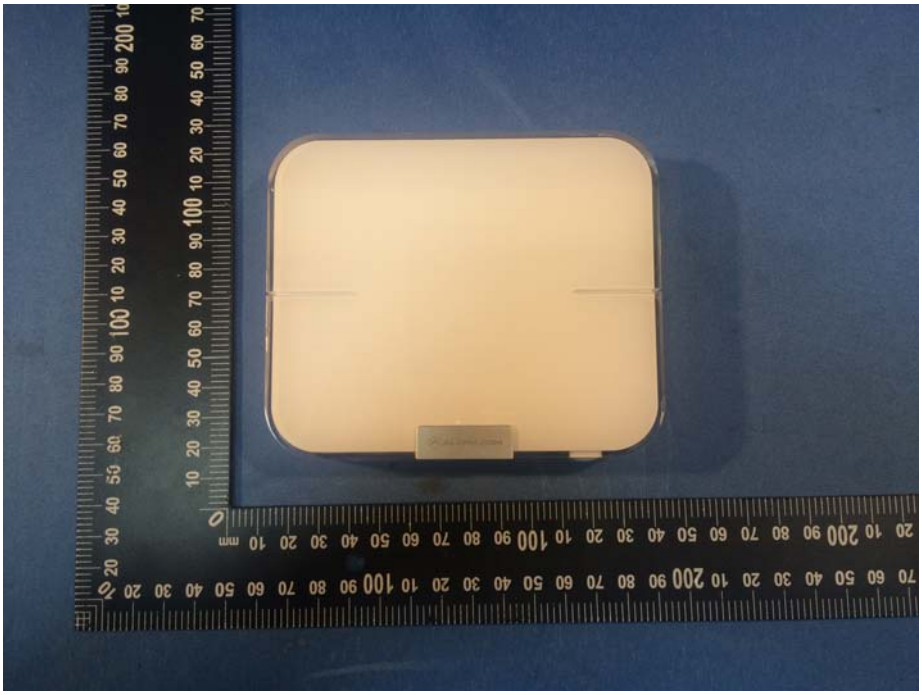


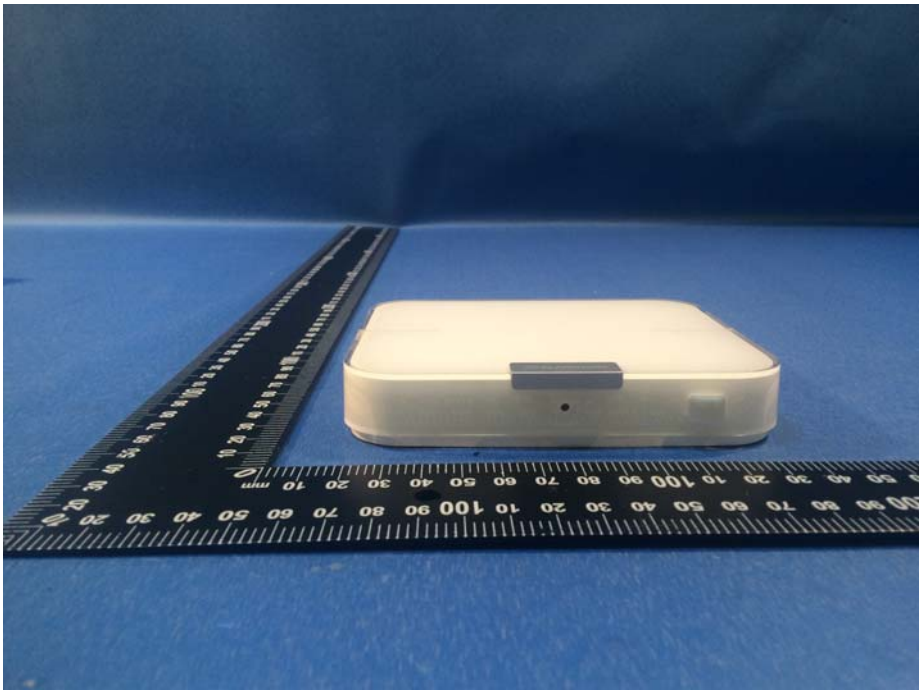
14.2 Photograph – Conducted Emission Test Setup

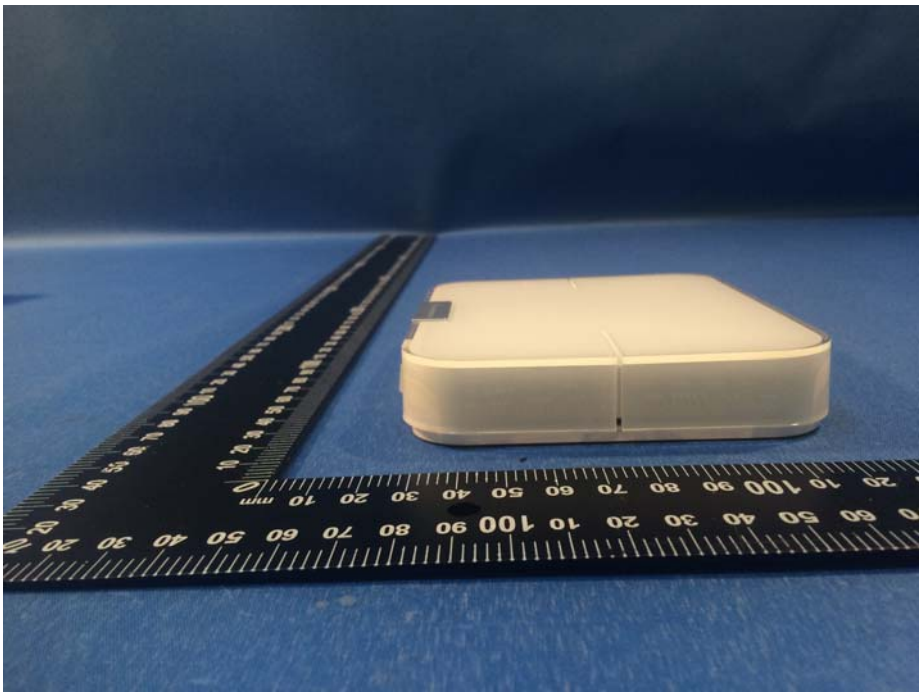


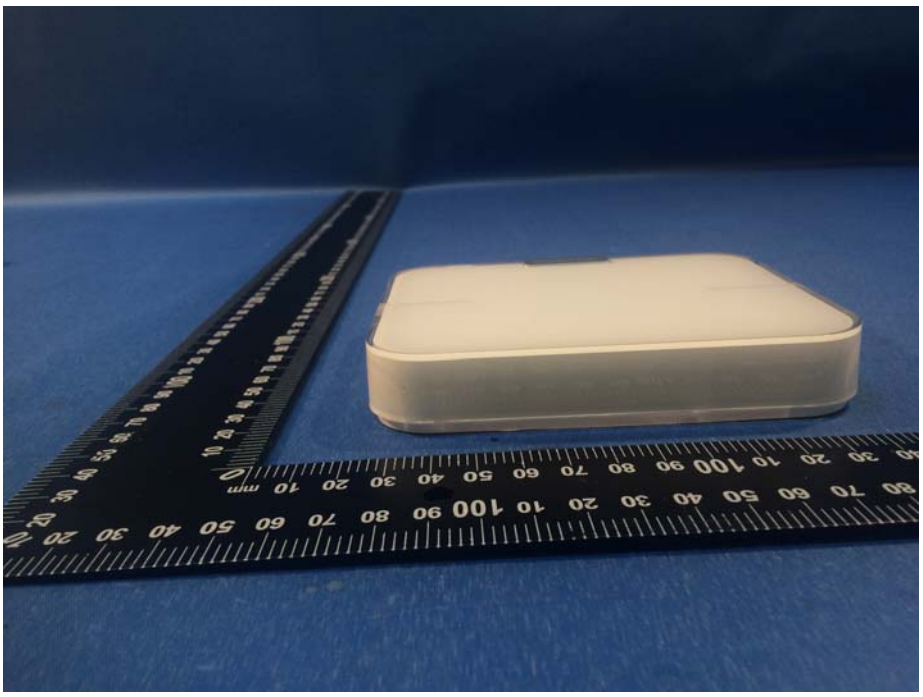
15 Photographs - Constructional Details

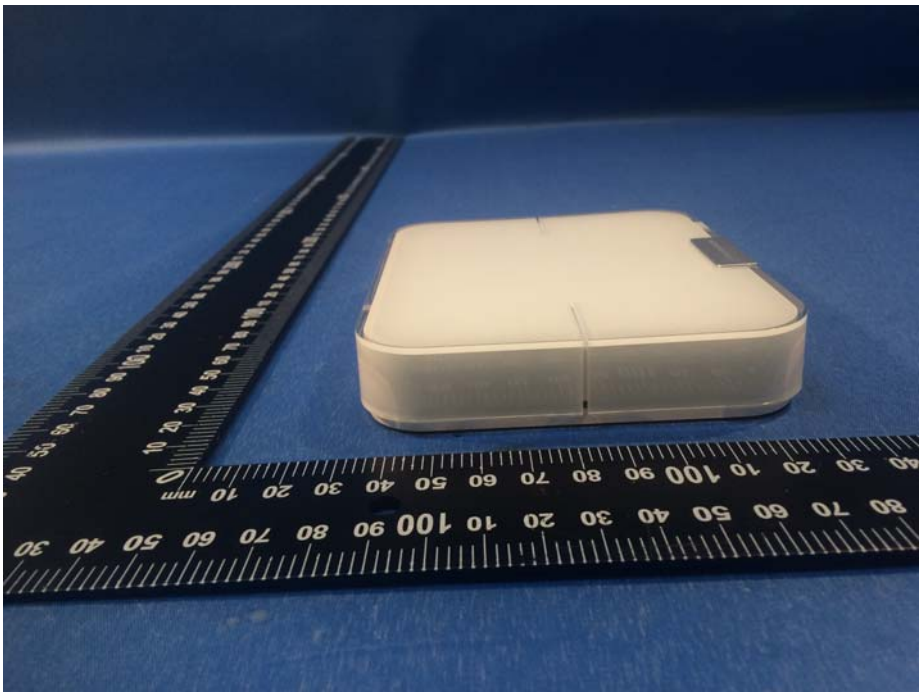
15.1 Model ADC-T3000 - External Photos

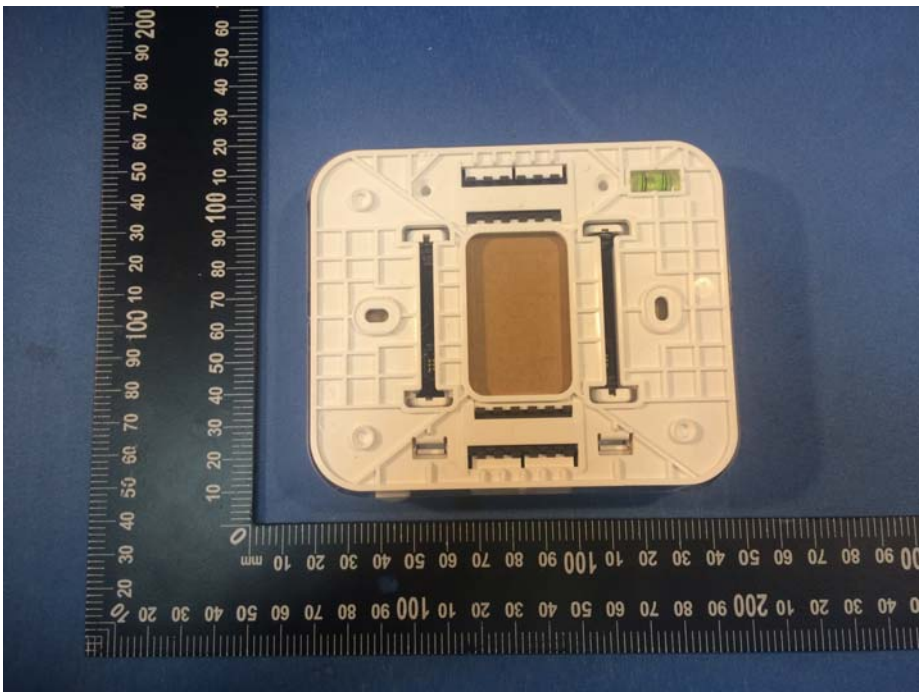


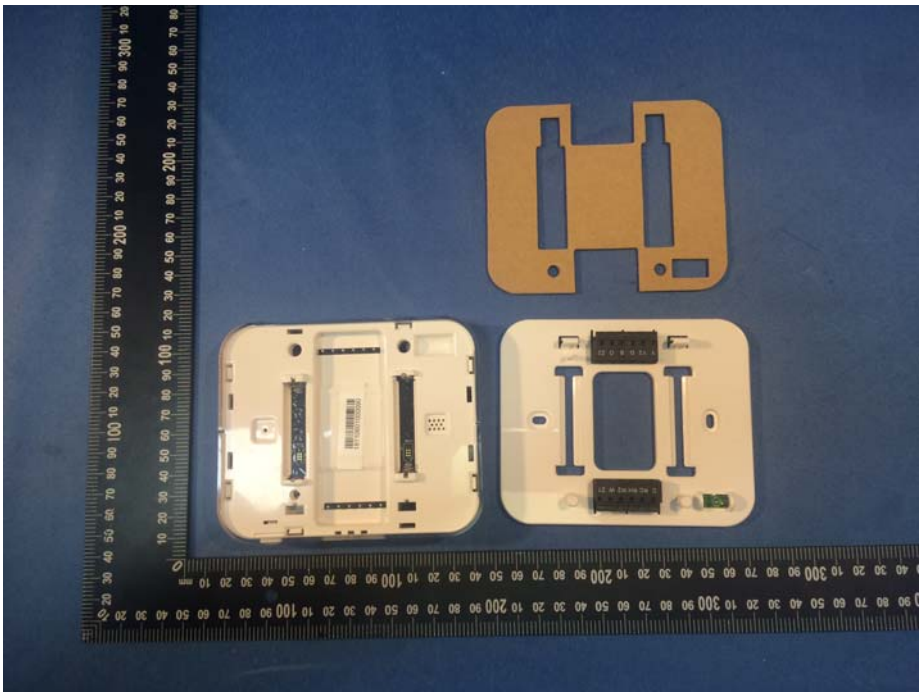


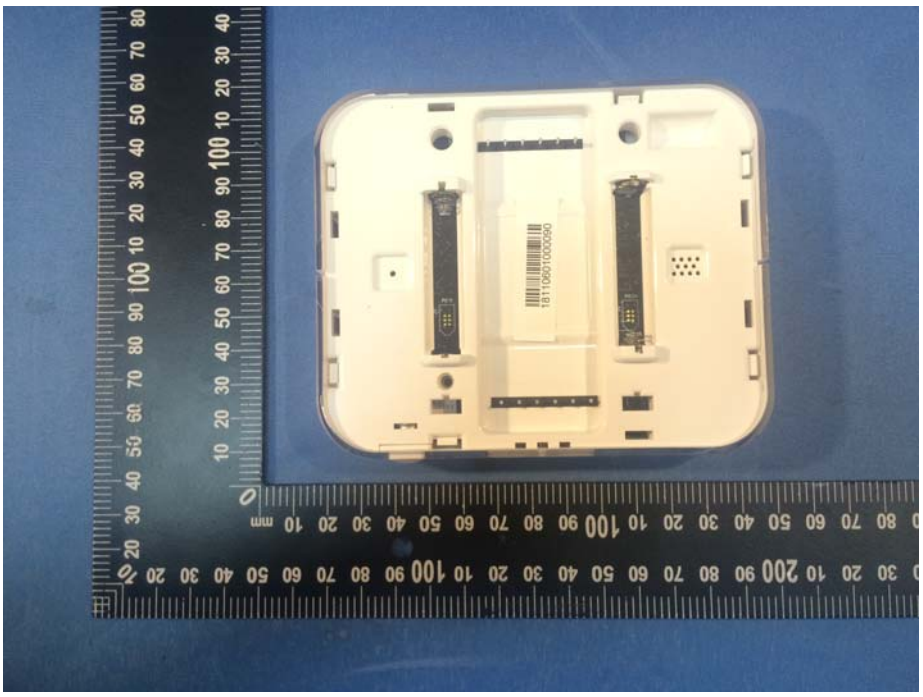




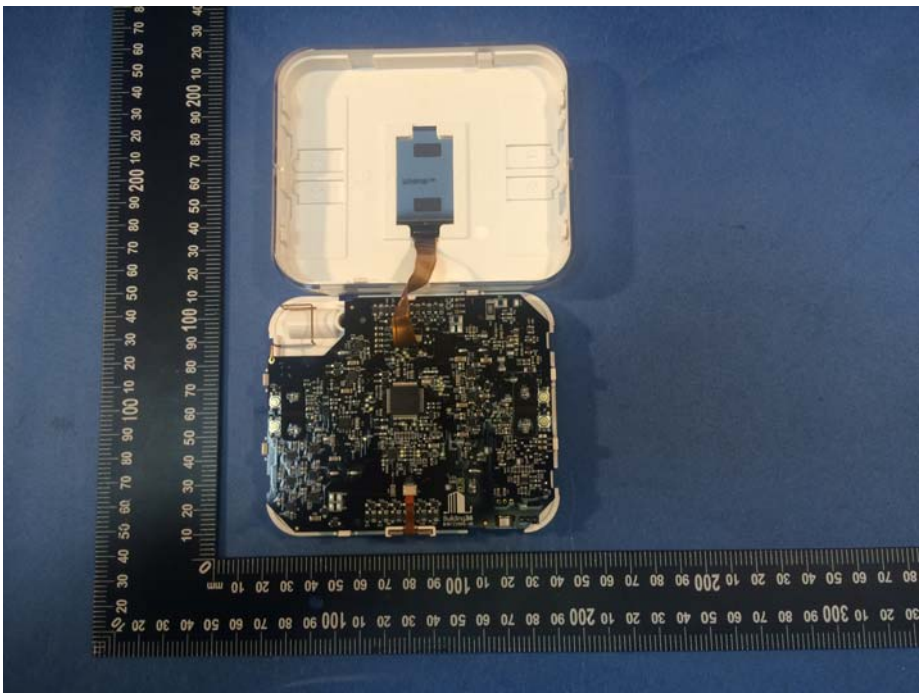


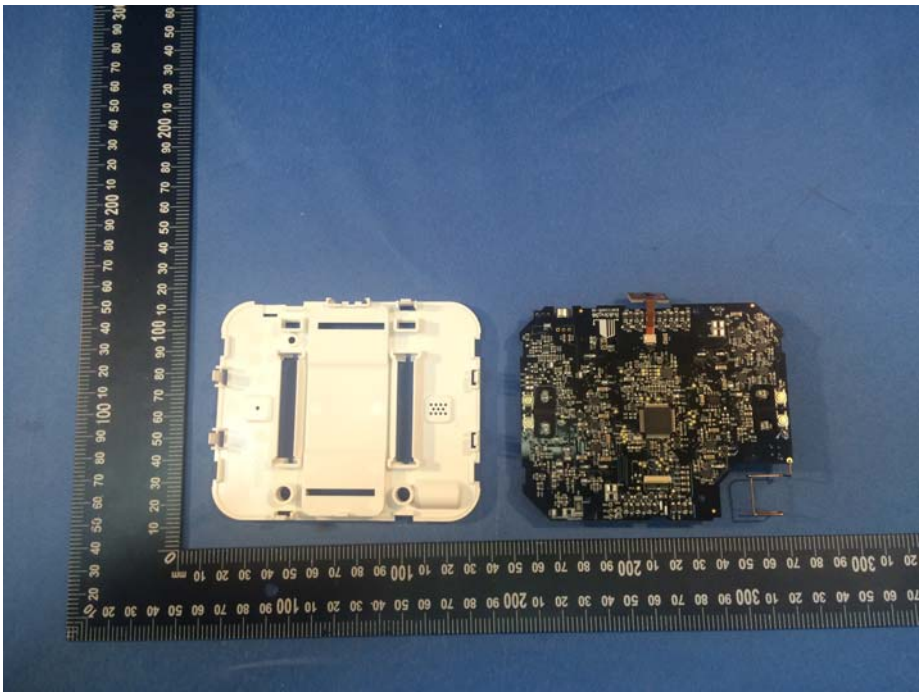


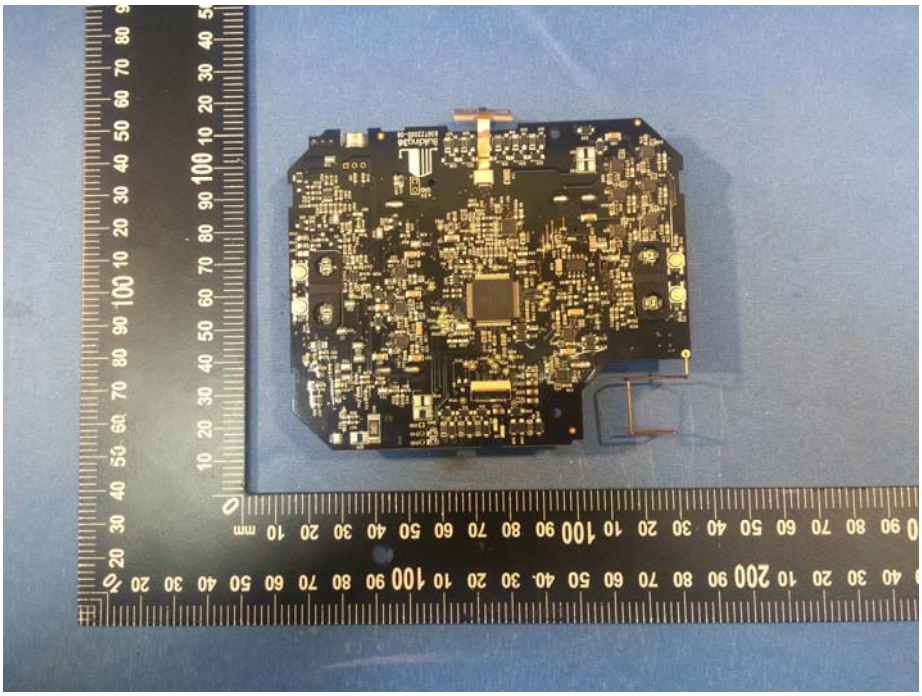


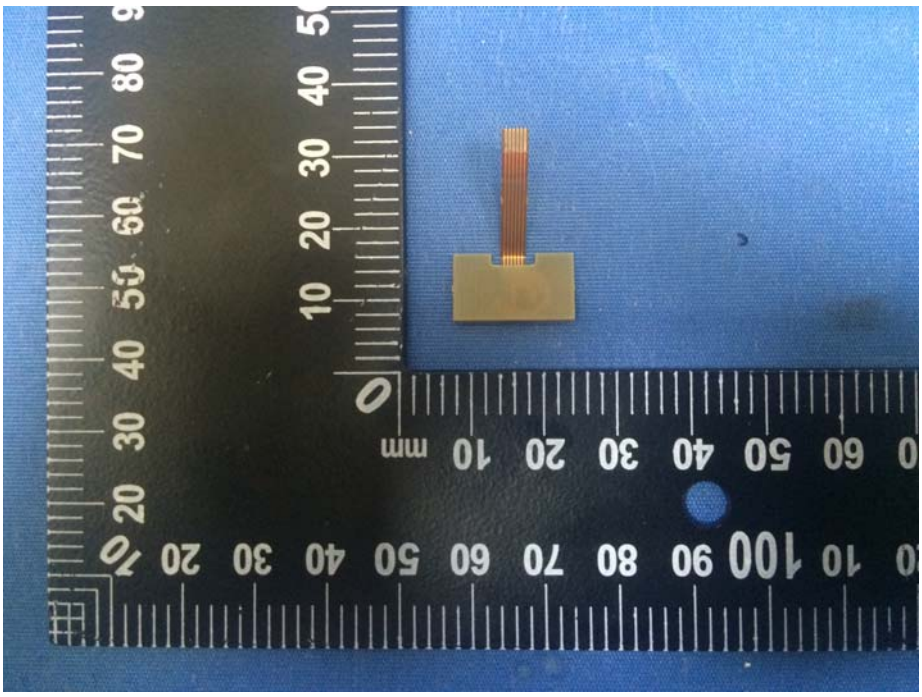


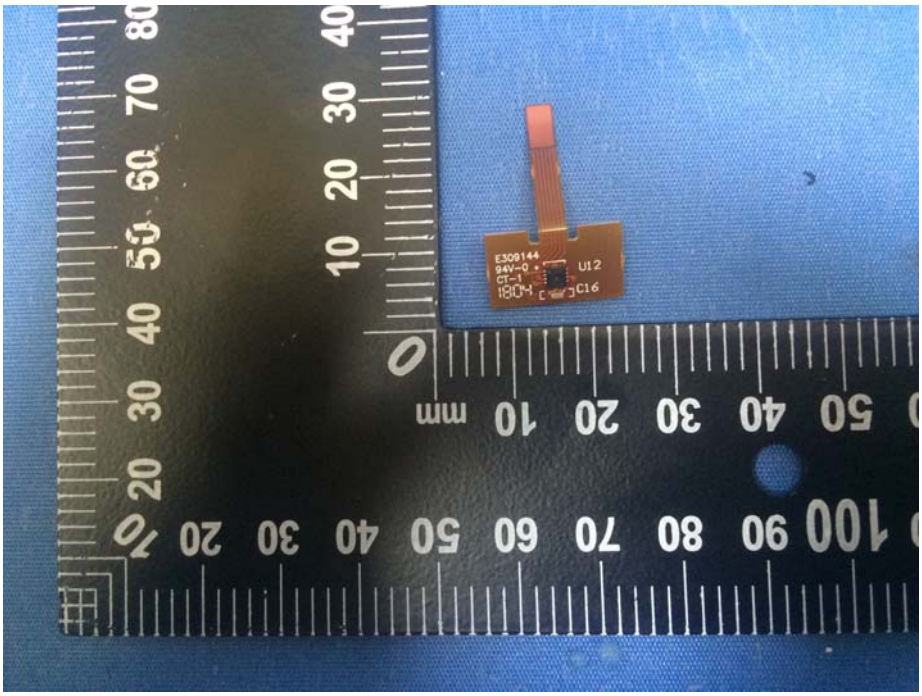
15.2 Model ADC-T3000 - Internal Photos

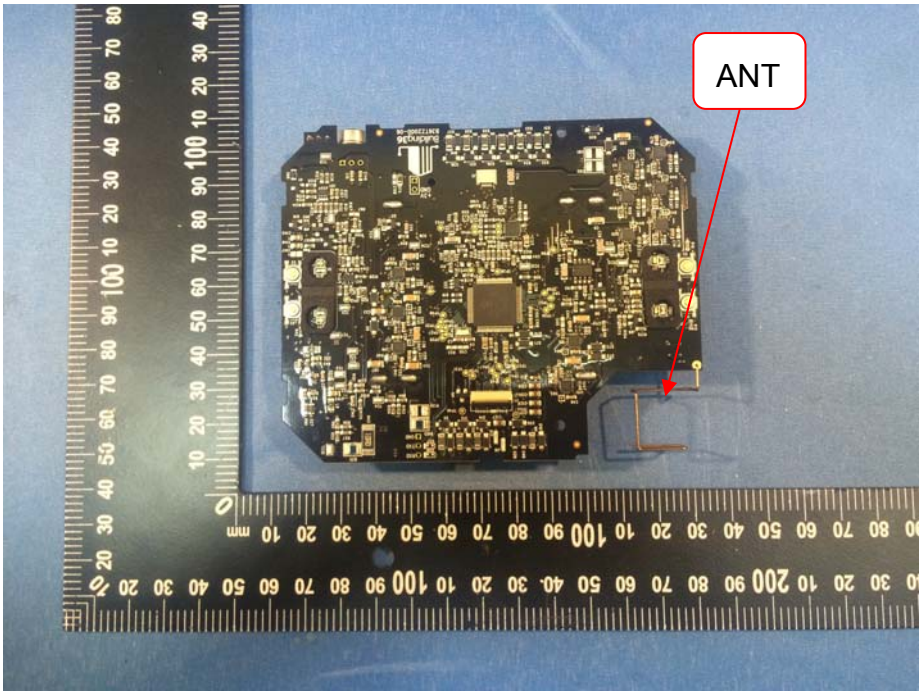








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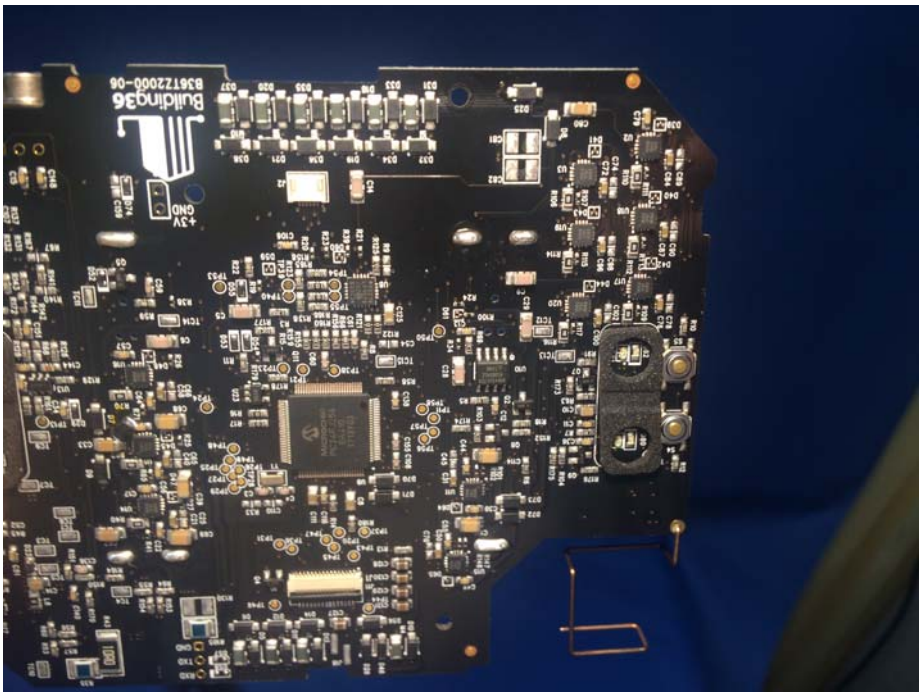

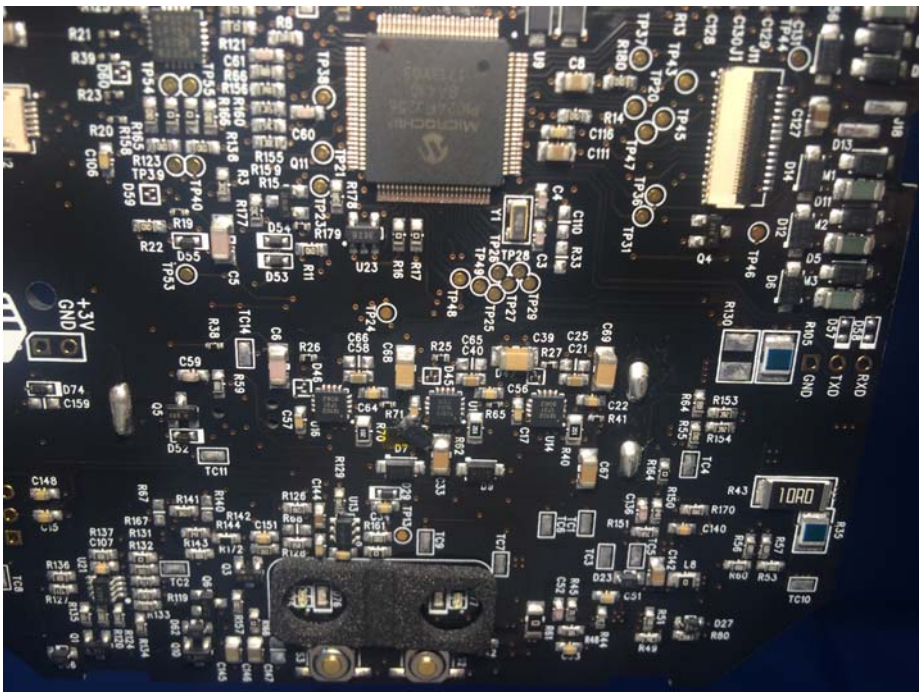

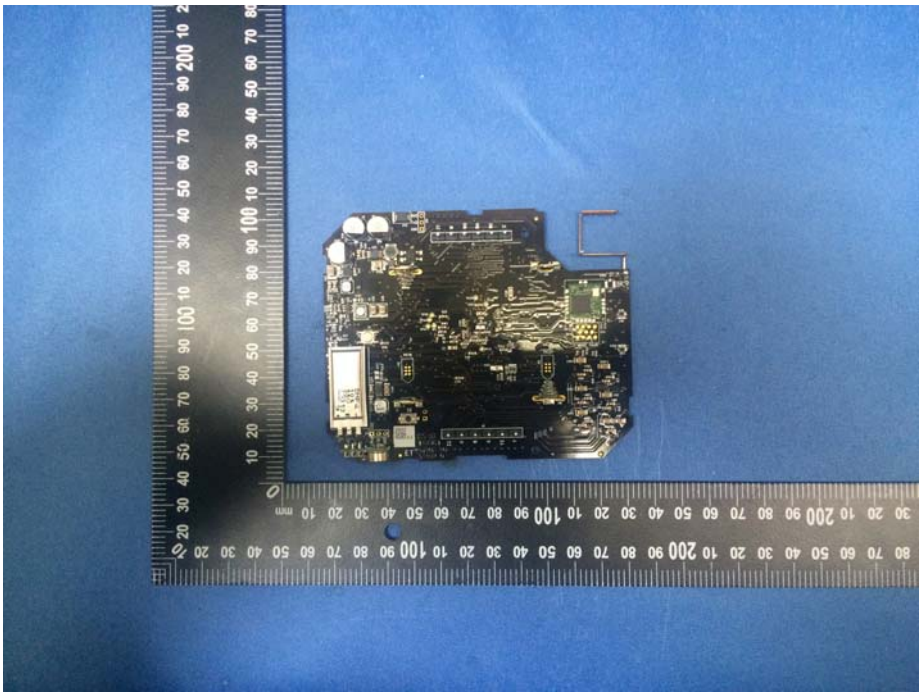

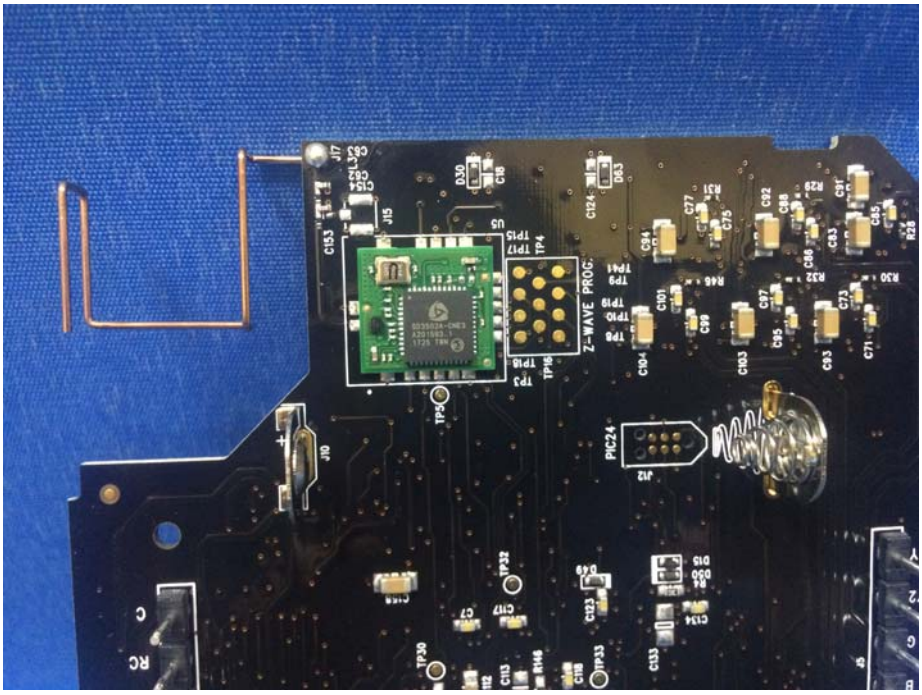

======End of Report======