

TEST REPORT

Reference No...... : WTF17S1093856E
FCC ID..... : 2ALP4-NST101W
Applicant..... : NEOCONTROL US LLC
Address..... : 3259, Progress Drive Suite 166, ORLANDO, Florida, United States
Manufacturer..... : NEOCONTROL US LLC
Address..... : 3259, Progress Drive Suite 166, ORLANDO, Florida, United States
Product..... : BOX 101
Model(s)..... : NST101W
Standards..... : FCC CFR47 Part 15 Section 15.231:2017
Date of Receipt sample.... : 2017-10-30
Date of Test..... : 2017-11-01 to 2018-05-02
Date of Issue..... : 2018-05-04
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.

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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. ElectroMagnetic 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	A2LA (Certificate No.: 4243.01)	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		International Services	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

	Page
COVER PAGE.....	1
1 LABORATORIES INTRODUCTION.....	2
2 CONTENTS	4
3 REPORT REVISION HISTORY	5
4 GENERAL INFORMATION.....	6
4.1 GENERAL DESCRIPTION OF E.U.T.....	6
4.2 DETAILS OF E.U.T.....	6
4.3 TEST MODE	6
5 EQUIPMENT USED DURING TEST	7
5.1 EQUIPMENTS LIST	7
5.2 MEASUREMENT UNCERTAINTY.....	8
5.3 SUBCONTRACTED.....	8
6 TEST SUMMARY	9
7 CONDUCTED EMISSION	10
7.1 E.U.T. OPERATION.....	10
7.2 EUT SETUP	10
7.3 MEASUREMENT DESCRIPTION	10
7.4 CONDUCTED EMISSION TEST RESULT.....	11
8 RADIATED SPURIOUS EMISSIONS.....	13
8.1 EUT OPERATION.....	13
8.2 TEST SETUP	14
8.3 SPECTRUM ANALYZER SETUP	15
8.4 TEST PROCEDURE.....	16
8.5 SUMMARY OF TEST RESULTS	17
9 PERIODIC OPERATION	18
10 EMISSION BANDWIDTH.....	21
10.1 TEST PROCEDURE.....	21
10.2 TEST SETUP	21
10.3 TEST RESULT	22
11 ANTENNA REQUIREMENT	23
12 PHOTOGRAPHS – MODEL NST101W TEST SETUP PHOTOS	24
13 PHOTOGRAPHS - CONSTRUCTIONAL DETAILS	24
13.1 MODEL NST101W - EXTERNAL PHOTOS.....	24
13.2 MODEL NST101W - INTERNAL PHOTOS.....	24

3 Report Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTF17S1093856E	2017-10-30	2017-11-01 to 2018-05-02	2018-05-04	original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product : BOX 101
Model(s) : NST101W
Model Difference : N/A
RTS Transmitter:
Type of Modulation : OOK
Frequency Range : 433.42MHz
Antenna installation : PCB Printed Antenna
Antenna Gain : -8dBi
Other three modules:
Z-wave Transmitter Module : Contains Transmitter Module FCC ID: D87-ZM5304-U
Wi-Fi Transmitter Module : Contains Transmitter Module FCC ID: 2ADUIESP-12-F
RTN Receiver Module : This module is receiving only.

4.2 Details of E.U.T.

Ratings: DC 5V, 2.5A powered by Switching Power Adapter
(Switching Power Adapter, Model: DSA-15P-05 US 0510125
Input: 100-240V~, 50/60Hz 0.5A)

4.3 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Test channel
Transmitting	433.42MHz

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	101155	2017-09-12	2018-09-11
2.	LISN	SCHWARZBECK	NSLK 8128	8128-289	2017-09-12	2018-09-11
3.	Limiter	York	MTS-IMP-136	261115-001-0024	2017-09-12	2018-09-11
4.	Cable	LARGE	RF300	-	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	BBHA917065 1	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	Beijing Dazhi	ZN30900A	-	2018-04-29	2019-04-28

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	FSL6	100959	2017-09-12	2018-09-11
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	$\pm 1 \times 10^{-6}$
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)
Confidence interval: 95%. Confidence factor:k=2	

5.3 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test Lab: N/A

Lab address: N/A

Test items: N/A

6 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	Pass
Radiated Spurious Emissions	15.205(a) 15.209 15.231(a)	Pass
Periodic Operation	15.231(a)	Pass
Emission Bandwidth	15.231(c)	Pass
Antenna Requirement	15.203	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

Test Result: PASS

Frequency Range: 150kHz to 30MHz

Class/Severity: Class B

Limit:

Frequency (MHz)	Conducted Limit (dB μ V)	
	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.		

7.1 E.U.T. Operation

Operating Environment :

Temperature: 22.8 °C

Humidity: 52.6 % RH

Atmospheric Pressure: 101.2kPa

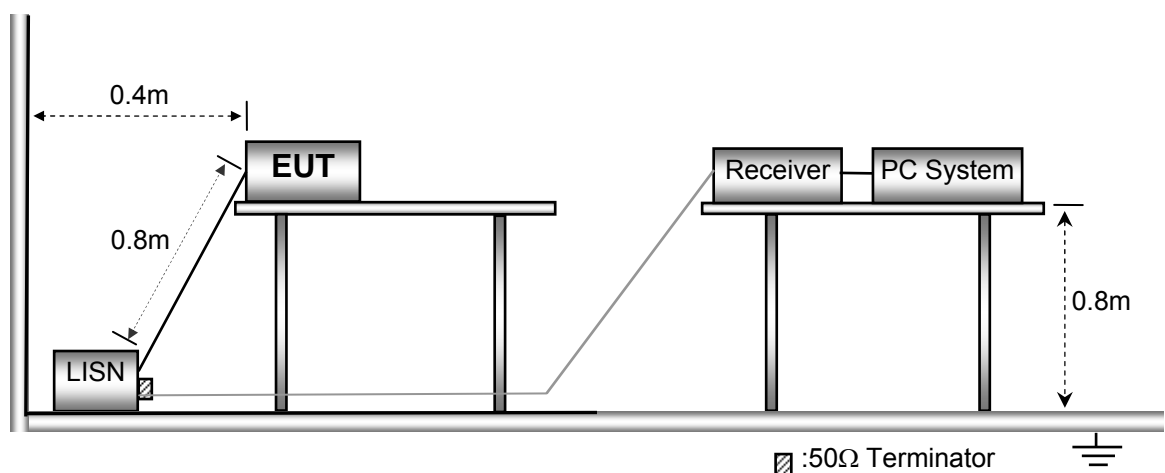
Test Voltage: AC 120V, 60Hz

EUT Operation :

The test was performed in Transmitting mode, the worst test data 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.

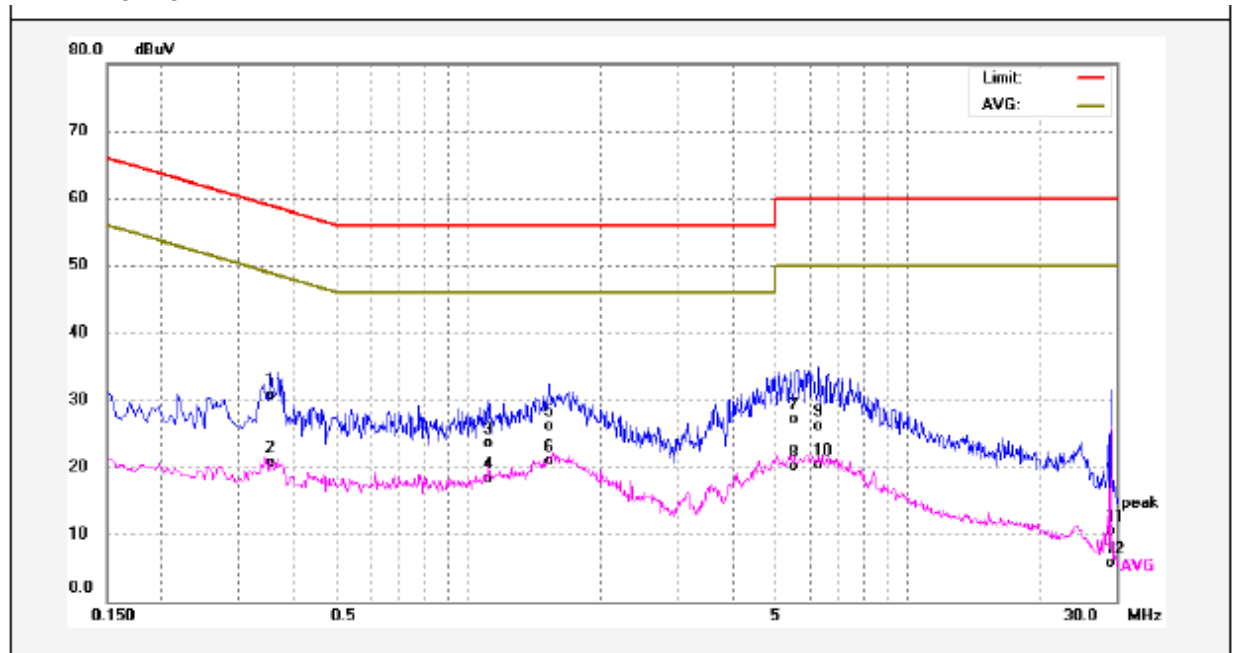


7.3 Measurement Description

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.

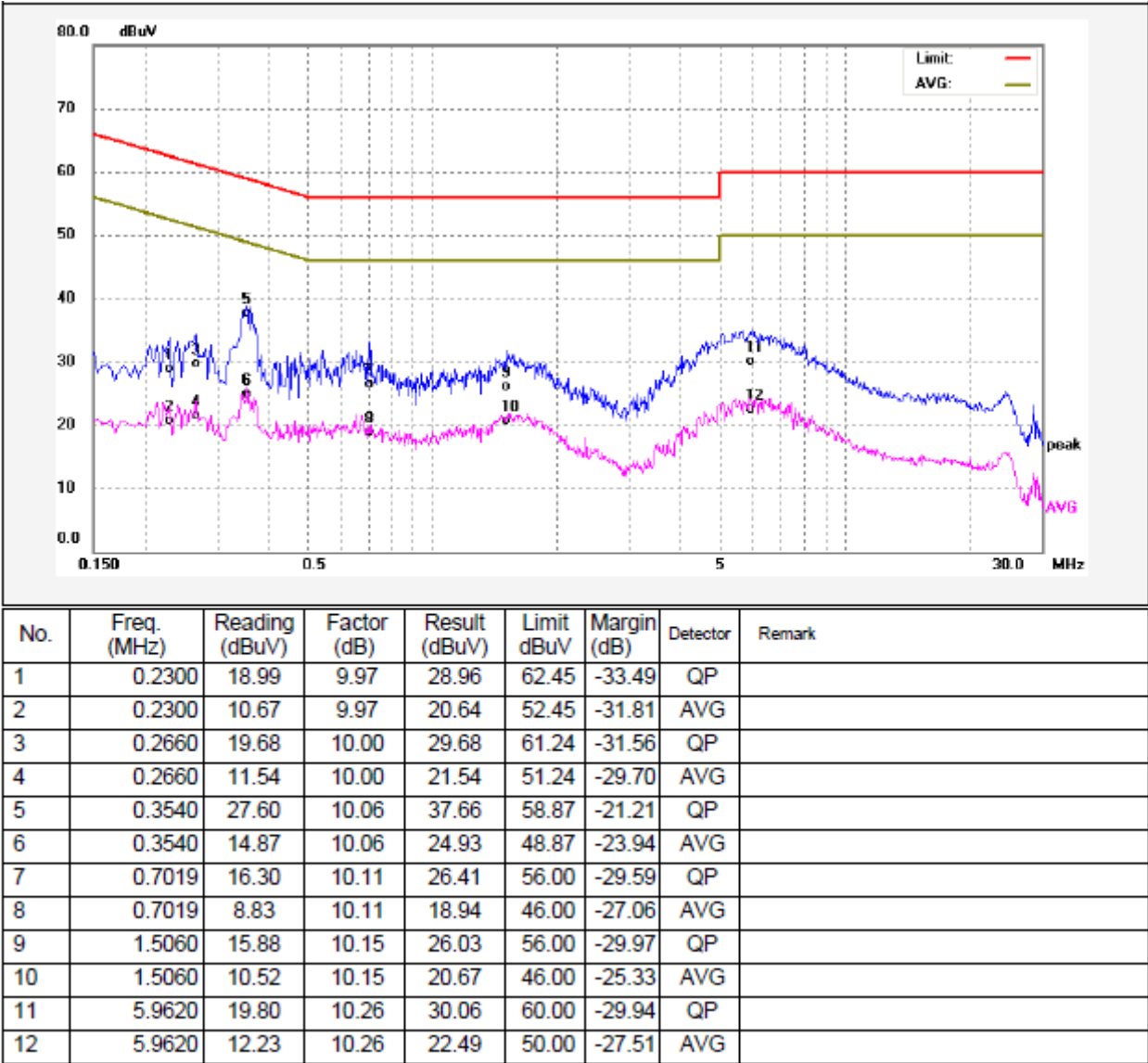
7.4 Conducted Emission Test Result

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.3540	20.74	10.06	30.80	58.87	-28.07	QP	
2	0.3540	10.56	10.06	20.62	48.87	-28.25	AVG	
3	1.1140	13.26	10.28	23.54	56.00	-32.46	QP	
4	1.1140	7.96	10.28	18.24	46.00	-27.76	AVG	
5	1.5339	16.03	10.15	26.18	56.00	-29.82	QP	
6	1.5339	10.67	10.15	20.82	46.00	-25.18	AVG	
7	5.6140	16.78	10.26	27.04	60.00	-32.96	QP	
8	5.6140	9.93	10.26	20.19	50.00	-29.81	AVG	
9	6.3180	15.93	10.27	26.20	60.00	-33.80	QP	
10	6.3180	9.99	10.27	20.26	50.00	-29.74	AVG	
11	29.0740	-0.12	10.64	10.52	60.00	-49.48	QP	
12	29.0740	-5.03	10.64	5.61	50.00	-44.39	AVG	

Neutral line:



8 Radiated Spurious Emissions

Test Requirement: FCC Part15 Paragraph 15.231(a), 15.209, 15.205

Test Method: ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

Fundamental Frequency (MHz)	Field Strength of Fundamental (uV/m)	Field Strength of Fundamental (dBuV/m)	Field Strength of Spurious Emission (uV/m)	Field Strength of Spurious Emission (dBuV/m)
44.66-40.70	2250	67	225	47
70-130	1250	62	125	42
130-174	1250 to 3750*	62 to 71.48*	125 to 375*	42 to 51.48*
174-260	3750	71.48	375	51.48
260-470	3750 to 12500*	71.48 to 81.94*	375 to 1250*	51.48 to 61.94*
Above 470	12500	81.94	1250	61.94
* linear interpolations				

8.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

Test Voltage: AC 120V, 60Hz

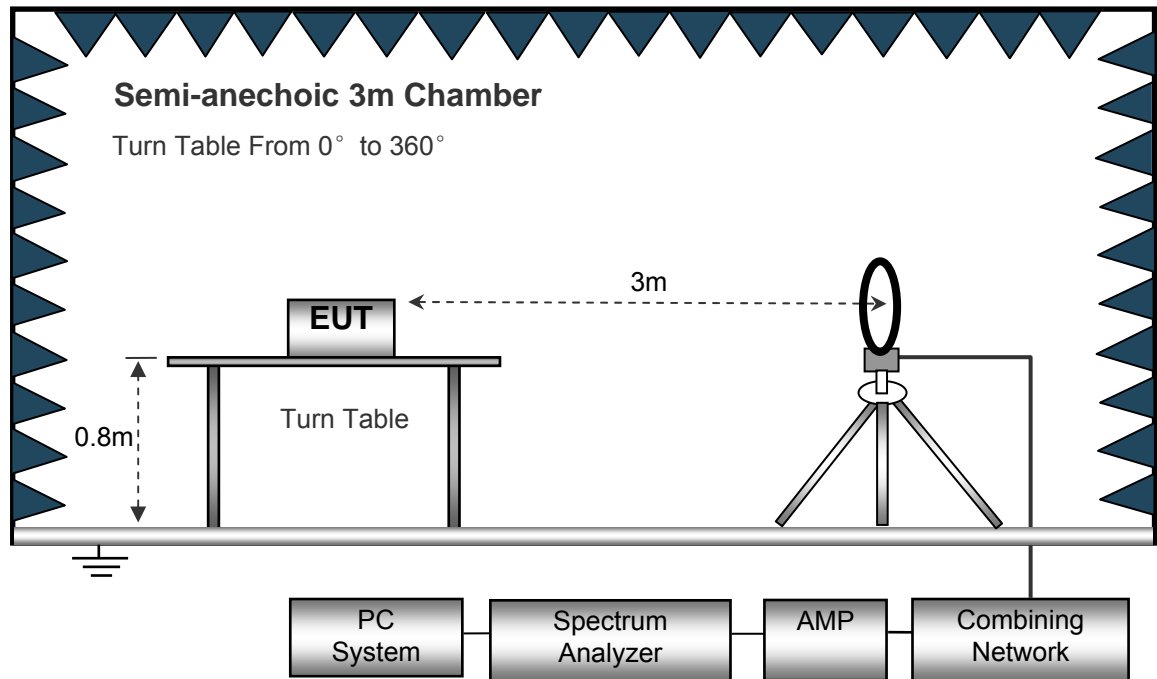
EUT Operation :

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

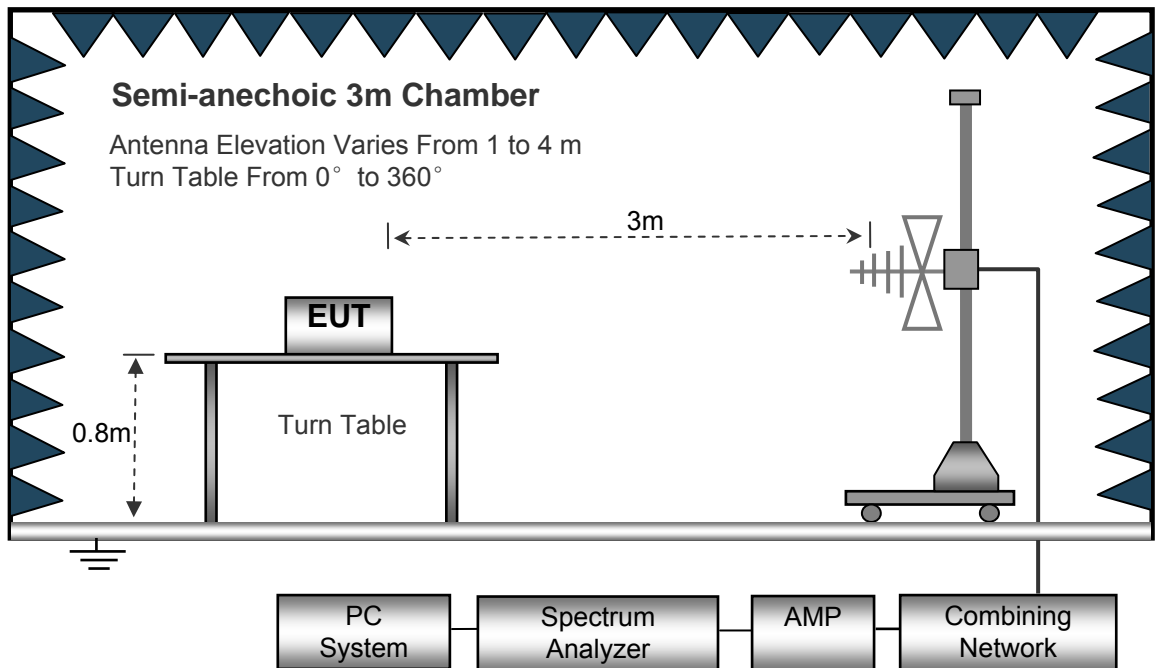
8.2 Test Setup

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

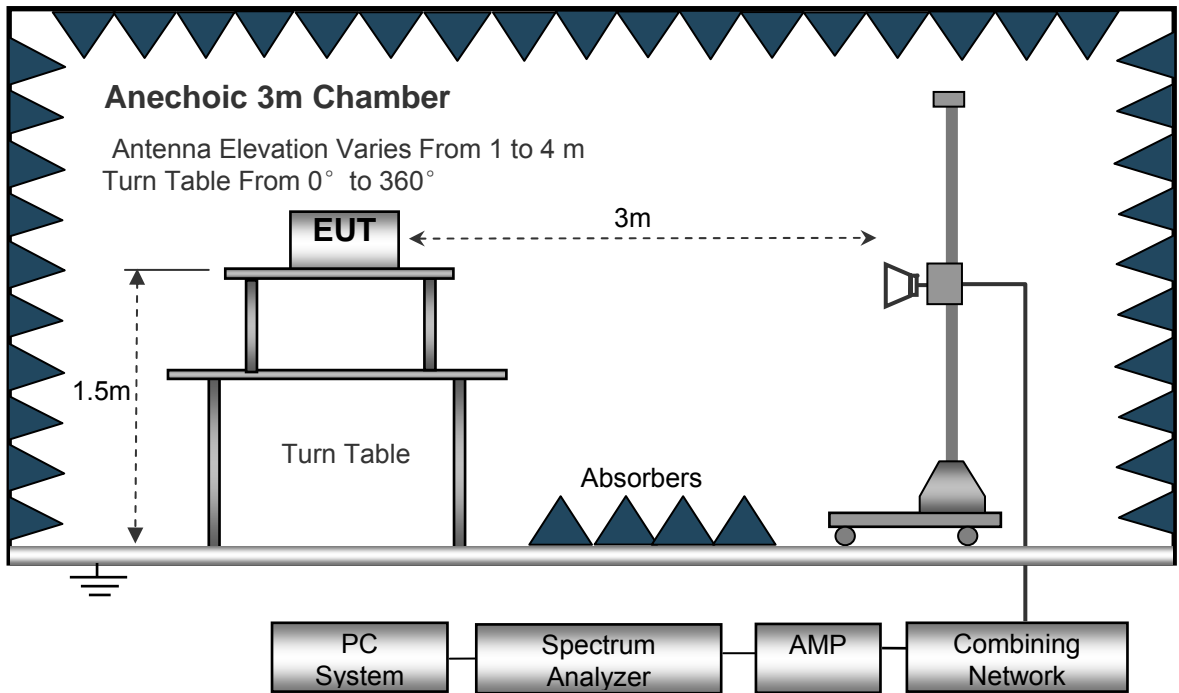
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep SpeedAuto
IF Bandwidth.....10kHz
Video Bandwidth.....10kHz
Resolution Bandwidth.....10kHz

30MHz ~ 1GHz

Sweep SpeedAuto
DetectorPK
Resolution Bandwidth.....100kHz
Video Bandwidth.....300kHz

Above 1GHz

Sweep SpeedAuto
DetectorPK
Resolution Bandwidth.....1MHz
Video Bandwidth.....3MHz

8.4 Test Procedure

1. The EUT is placed on a turntable. For below 1GHz, the EUT is 0.8m above ground plane; For above 1GHz, 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. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
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 tested under 3-axes(X, Y, Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

8.5 Summary of Test Results

Test Frequency: 9 kHz~30 MHz

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

Test Frequency: 30 MHz ~ 5 GHz

Test Channel: 433.42MHz

Frequency	Receiver Reading (PK)	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude (PK)	FCC Part 15.231/15.209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
433.42	88.47	118	2.0	H	-7.11	81.36	100.81	-19.45
433.42	77.64	254	1.8	V	-7.11	70.53	100.81	-30.28
866.84	54.56	10	1.9	H	1.18	55.74	80.81	-25.07
866.84	48.76	256	1.7	V	1.18	49.94	80.81	-30.87
2600.23	56.11	273	1.3	H	-11.34	44.77	74.00	-29.23
2600.23	59.49	290	1.6	V	-11.34	48.15	74.00	-25.85
3900.65	57.81	251	1.3	H	-8.15	49.66	74.00	-24.34
3900.65	56.86	25	1.7	V	-8.15	48.71	74.00	-25.29

$$AV = \text{Peak} + 20\text{Log}_{10}(\text{duty cycle}) = \text{PK} + (-5.88) \text{ [refer to section 8 for more detail]}$$

Frequency	PK	RX Antenna Polar	Duty cycle Factor	Calculated AV	FCC Part 15.231/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
433.42	81.36	H	-5.88	75.48	80.81	-5.33
433.42	70.53	V	-5.88	64.65	80.81	-16.16
866.84	55.74	H	-5.88	49.86	60.81	-10.95
866.84	49.94	V	-5.88	44.06	60.81	-16.75
2600.23	44.77	H	-5.88	38.89	54.00	-15.11
2600.23	48.15	V	-5.88	42.27	54.00	-11.73
3900.65	49.66	H	-5.88	43.78	54.00	-10.22
3900.65	48.71	V	-5.88	42.83	54.00	-11.17

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 * %

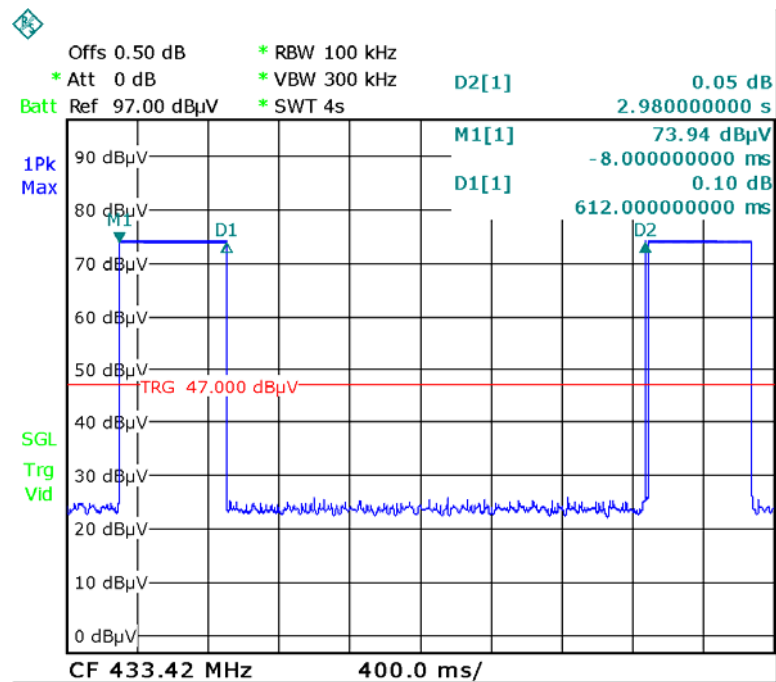
Duty Cycle Correction Factor(dB)=20 * Log₁₀(Duty Cycle(%))

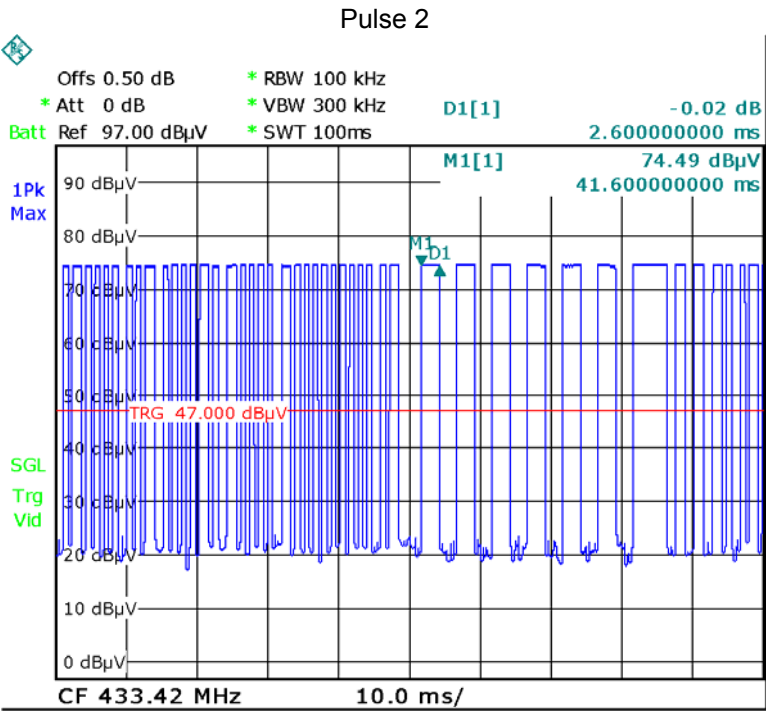
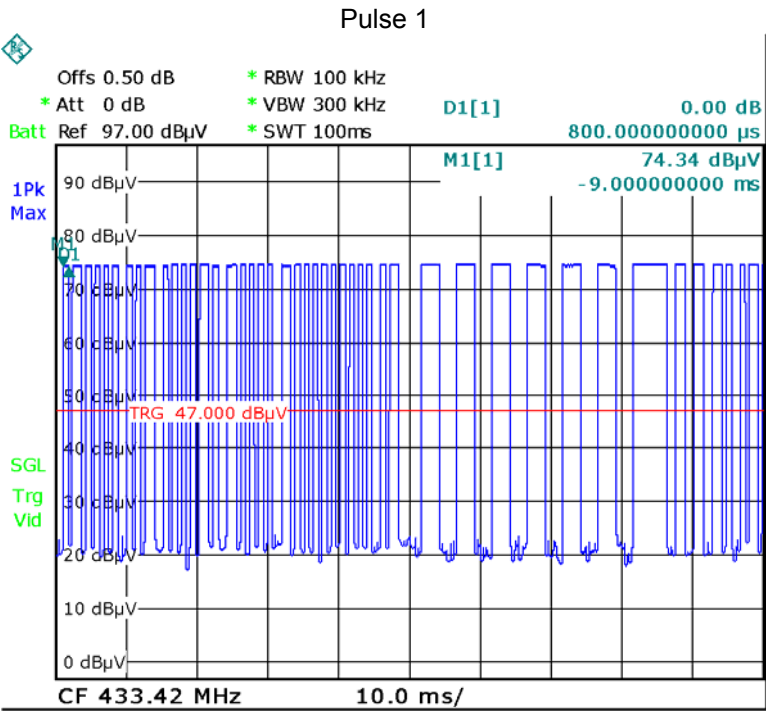
Total transmission time(ms)	0.8*38+2.6*6+4.8*1=50.80
Length of a complete transmission period(ms)	100*
Duty Cycle(%)	50.80
Duty Cycle Correction Factor(dB)	-5.88

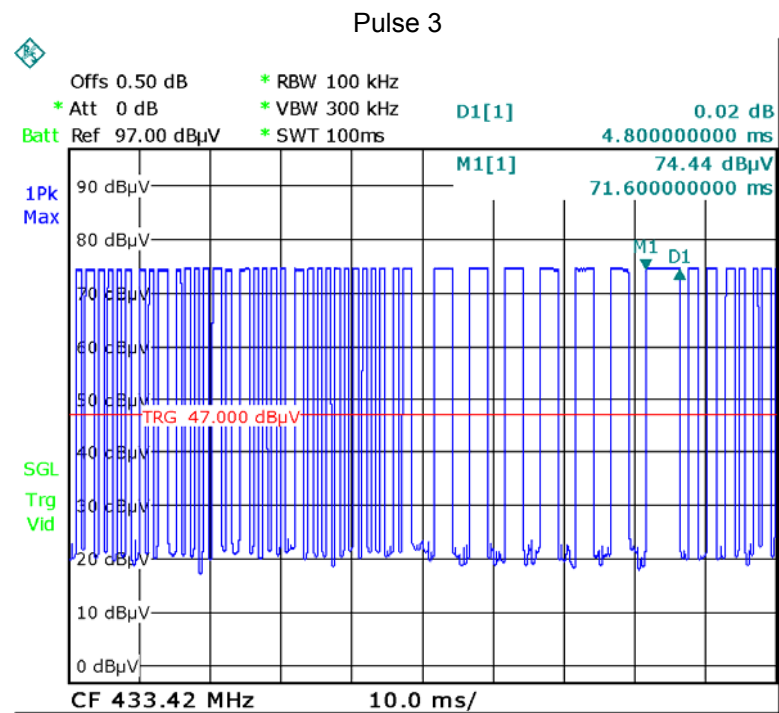
Refer to the duty cycle plot (as below), This device meets the FCC requirement.

Length of a complete pulse train:

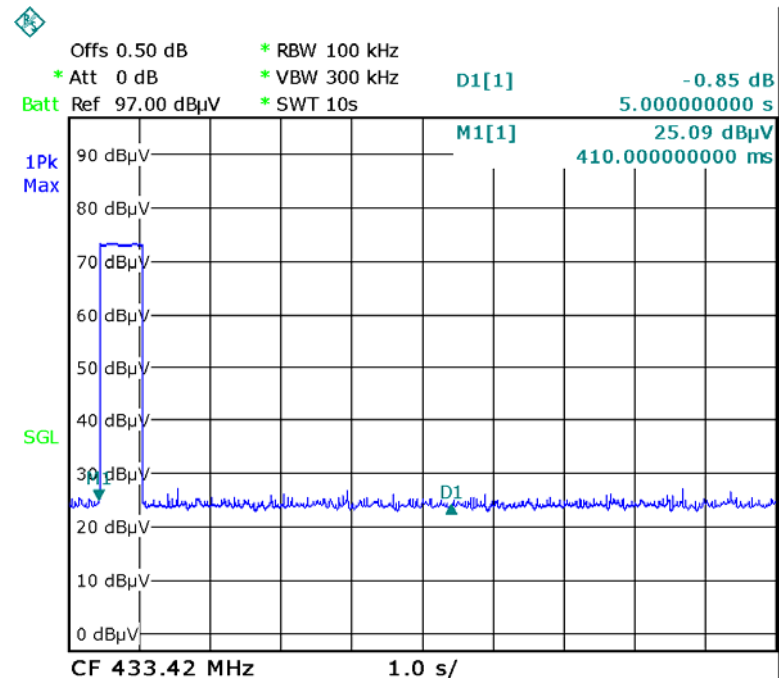
“*”: Remark: FCC part15.35(c) required that a complete pulse train is more than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.







- FCC Part15.231 (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.
- (2)A transmitter activated automatically shall cease transmission within 5 seconds after activation.



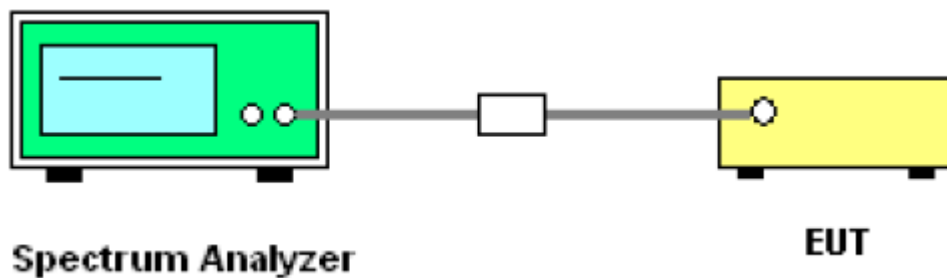
10 Emission Bandwidth

Test Requirement:	FCC Part15.231(c)
Test Method:	FCC Part15.231(c)
Limit	The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

10.1 Test Procedure

1. The transmitter output (antenna port) was connected to the spectrum analyzer. EUT and its simulators are placed on a table, let EUT working in test mode, then test it.
2. The bandwidth of the fundamental frequency was measure by spectrum analyser with 10 kHz RBW and 30 kHz VBW. The 20 dB bandwidth was recorded.

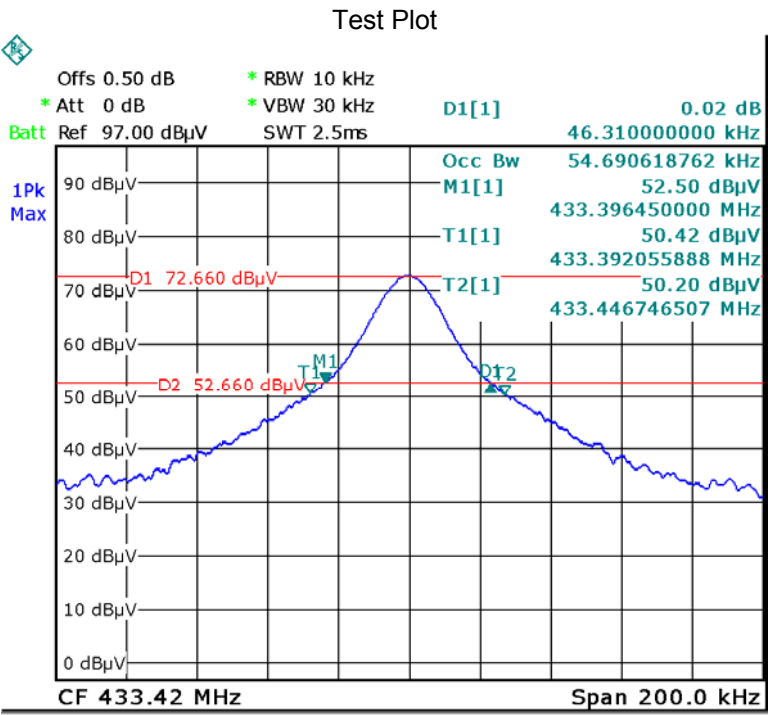
10.2 Test Setup



10.3 Test Result

Frequency (MHz)	20dB Bandwidth Emission(kHz)	Limit (kHz)	Result
433.42	46.31	1083.55	Compliance

Limit=Center Frequency*0.25%



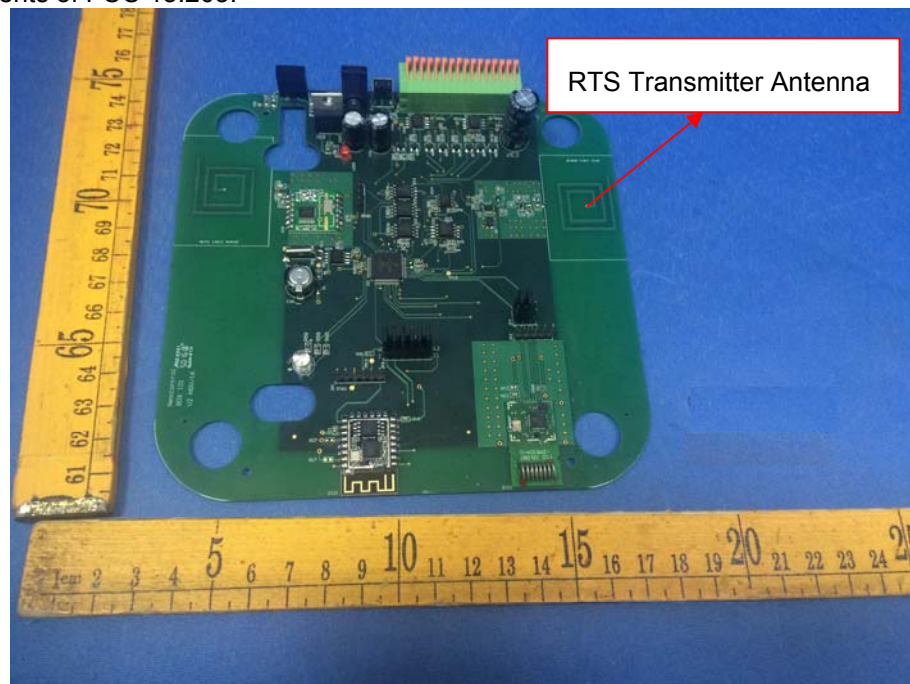
11 Antenna Requirement

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 PCB Printed Antenna for RTS Transmitter, the gain is -8 dBi. meets the requirements of FCC 15.203.



12 Photographs – Model NST101W Test Setup Photos

Note: Please refer to Photos: WTF17S1093856E_Photos.

13 Photographs - Constructional Details

13.1 Model NST101W - External Photos

Note: Please refer to Photos: WTF17S1093856E_Photos.

13.2 Model NST101W - Internal Photos

Note: Please refer to Photos: WTF17S1093856E_Photos.

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