

TEST REPORT

Reference No...... : WTF19S01005314W V1
FCC ID : BRWSTX3
Applicant..... : Horizon Hobby, LLC
Address..... : 2904 Research Rd. Champaign, Illinois 61821 United States
Manufacturer : The same as above.
Address..... : The same as above.
Product Name..... : Transmitter
Model No..... : STX3
Standards : FCC CFR47 Part 15 Section 15.249: 2016
Date of Receipt sample : 2019-01-23
Date of Test : 2019-01-24 to 2019-02-20
Date of Issue..... : 2019-03-15
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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Compiled by:

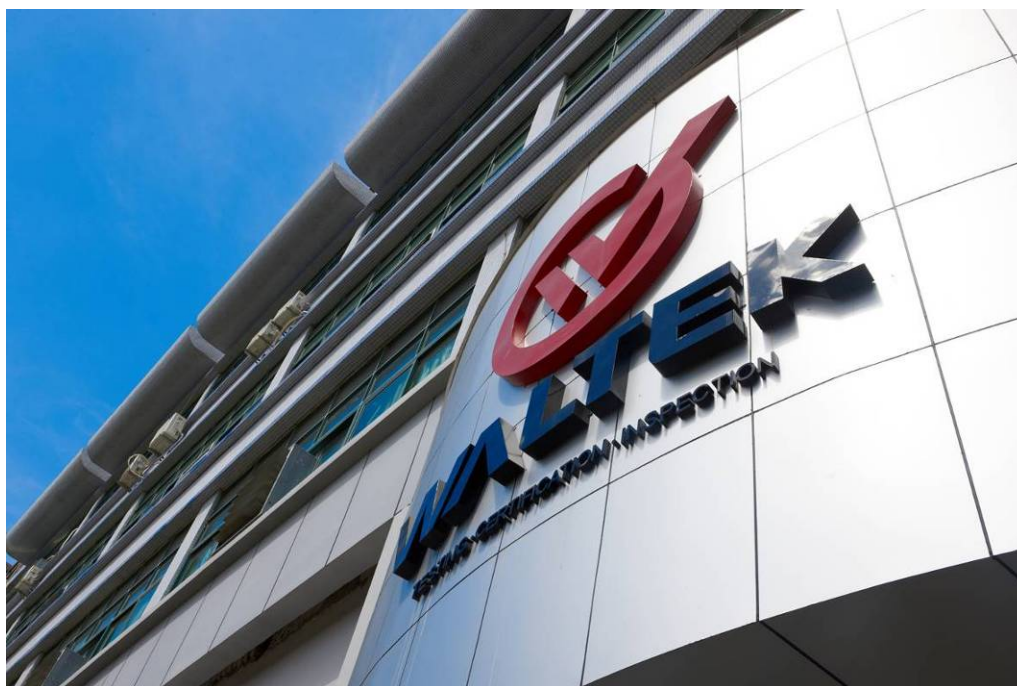
Approved by:

Ford Wang / Project Engineer

Philo Zhong / Manager

2 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, the certification number is 4243.01) of USA, CNAS (China National Accreditation Service for Conformity Assessment, the registration number is L3110) of China. 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), ISED (Innovation, Science and Economic Development 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.

Test Facility:**A. Accreditations for Conformity Assessment (International)**

Country/Region	Scope Covered By	Scope	Note
USA	ISO/IEC 17025	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. ISED CAB identifier: CN0013			

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

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4 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTF19S01005 314W	2019-01-23	2019-01-24 to 2019-02-20	2019-02-21	original	-	Replaced
WTF19S01005 314W V1	2019-01-23	2019-01-24 to 2019-02-20	2019-03-15	Version 1	Updated	Valid

5 General Information

5.1 General Description of E.U.T.

Product:	Transmitter
Model(s):	STX3
Model Description:	N/A
Operation Frequency:	2405-2475MHz
Hardware Version:	REVB
Software Version:	REVD
Highest frequency (Exclude Radio):	1.25GHz
Storage Location:	Internal Storage
Note:	N/A

5.2 Details of E.U.T.

Ratings:	DC4V-DC6V, <50mA for battery
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5.3 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	Lower channel	Middle channel	Upper channel
Transmitting	2405MHz	2440MHz	2475MHz

6 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	NA
Radiated Emission	15.249(a) 15.209 15.205(a)	PASS
Periodic Operation	15.35(c)	PASS
Outside of Band Emission	15.249 15.205 15.209	PASS
20dB Bandwidth	15.215(c)	PASS
Antenna Requirement	15.203	PASS

7 Equipment Used during Test

7.1 Equipment List

Conducted Emissions Test Site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	100947	2018-09-12	2019-09-11
2.	LISN	R&S	ENV216	101215	2018-09-12	2019-09-11
3.	Cable	Top	TYPE16(3.5M)	-	2018-09-12	2019-09-11
Conducted Emissions Test Site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	101155	2018-09-12	2019-09-11
2.	LISN	SCHWARZBECK	NSLK 8128	8128-289	2018-09-12	2019-09-11
3.	Limiter	York	MTS-IMP-136	261115-001-0024	2018-09-12	2019-09-11
4.	Cable	LARGE	RF300	-	2018-09-12	2019-09-11
3m Semi-anechoic Chamber for Radiation Emissions Test site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Spectrum Analyzer	R&S	FSP	100091	2018-04-29	2019-04-28
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	2018-04-09	2019-04-08
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	2018-04-09	2019-04-08
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	2018-09-12	2019-09-11
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	2018-04-09	2019-04-08
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	2018-04-09	2019-04-08
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2018-04-13	2019-04-12
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	2018-04-13	2019-04-12

3m Semi-anechoic Chamber for Radiation Emissions Test site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No	Last Calibration Date	Calibration Due Date
1	Test Receiver	R&S	ESCI	101296	2018-04-13	2019-04-12
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2018-04-09	2019-04-08
3	Amplifier	Compliance pirection systems inc	PAP-0203	22024	2018-04-13	2019-04-12
4	Cable	HUBER+SUHNER	CBL2	525178	2018-04-13	2019-04-12
RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMC Analyzer (9k~26.5GHz)	Agilent	E7405A	MY45114943	2018-09-12	2019-09-11
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	2018-09-12	2019-09-11
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	2018-09-12	2019-09-11

7.2 Description of Support Units

Equipment	Manufacturer	Model No.
/	/	/

7.3 Measurement Uncertainty

Parameter	Uncertainty
Conducted Emission	± 3.64 dB(AC mains 150KHz~30MHz)
Radiated Spurious Emissions	± 5.08 dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)
Radio Frequency	$\pm 1 \times 10^{-7}$ Hz
RF Power	± 0.42 dB
RF Power Density	± 0.7 dB
Conducted Spurious Emissions	± 2.76 dB (9kHz~26500MHz)
Confidence interval: 95%. Confidence factor:k=2	

7.4 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

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	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

Note: RF Voltage(dBuV)=20 log₁₀ RF Voltage(uV)

8.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

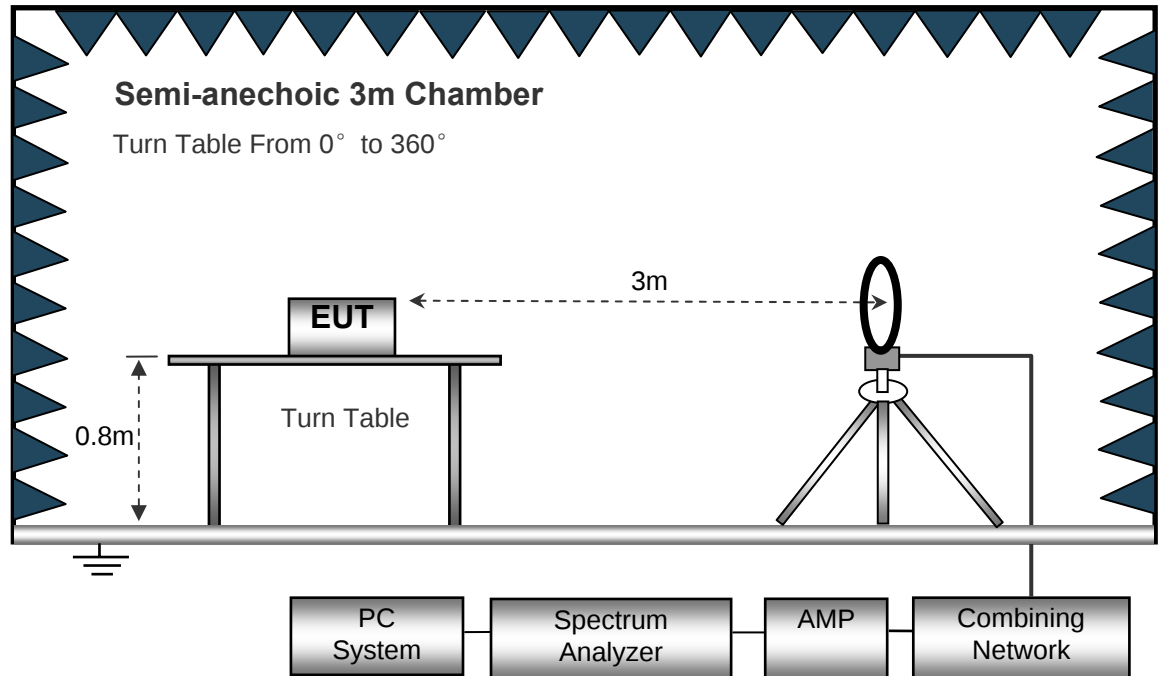
EUT Operation :

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

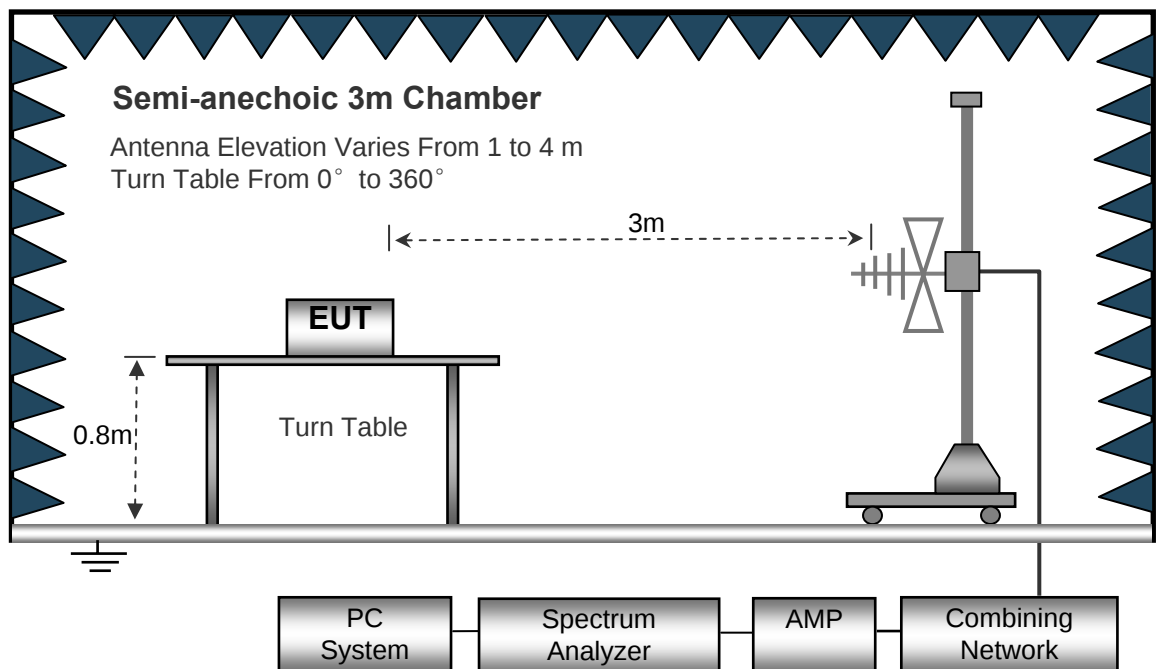
8.2 Test Setup

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

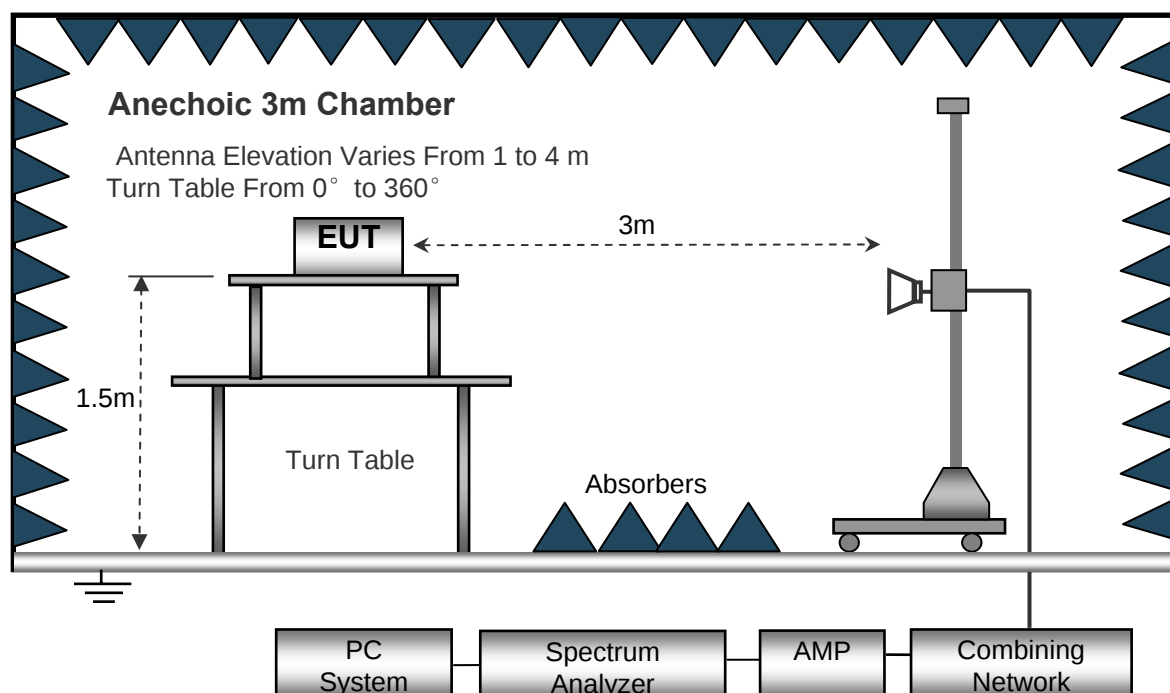
The test setup for emission measurement below 30MHz.



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 SpeedAuto
 IF Bandwidth.....10kHz
 Video Bandwidth10kHz
 Resolution Bandwidth10kHz

30MHz ~ 1GHz

Sweep SpeedAuto
 DetectorPK
 Resolution Bandwidth.....100kHz
 Video Bandwidth300kHz

Above 1GHz

Sweep SpeedAuto
 DetectorPK
 Resolution Bandwidth.....1MHz
 Video Bandwidth3MHz
 DetectorAve.
 Resolution Bandwidth.....1MHz
 Video Bandwidth10Hz

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. New battery is used during test.

8.5 Test Result

Test Frequency :16MHz~ 30MHz

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

Test Frequency: 30MHz ~ 18GHz

Test Mode:The Worst mode (Low channel Transmitting) data is recorded on the report

Frequency	Receiver Reading	Detector	Turntable Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.231/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
2405.00	91.19	PK	349	1.9	H	-13.08	78.11	114.00	-35.89
2405.00	95.47	PK	281	1.8	V	-13.08	82.39	114.00	-31.61
4810.00	50.21	PK	151	1.7	H	0.09	50.30	74.00	-23.70
4810.00	52.31	PK	11	1.1	V	0.09	52.40	74.00	-21.60
7215.00	45.21	PK	176	1.1	H	3.01	48.22	74.00	-25.78
7215.00	43.26	PK	64	1.9	V	3.01	46.27	74.00	-27.73
9620.00	41.52	PK	67	1.6	H	5.39	46.91	74.00	-27.09
9620.00	39.62	PK	125	1.7	V	5.39	45.01	74.00	-28.99
12025	36.25	PK	323	1.4	H	8.15	44.40	74.00	-29.60
12025	35.21	PK	295	1.5	V	8.15	43.36	74.00	-30.64
14430	32.12	PK	74	1.2	H	10.02	42.14	74.00	-31.86
14430	32.14	PK	267	1.5	V	10.02	42.16	74.00	-31.84

AV = Peak +20Log10(duty cycle) =Peak+(-4.25)[refer to section 7 for more detail]

Frequency	PK	Turn table Angle	RX Antenna		Duty cycle Factor	AV	FCC Part 15.231/209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV/m)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2405.00	78.11	349	1.9	H	-4.25	73.86	94.00	-20.14
2405.00	82.39	281	1.8	V	-4.25	78.14	94.00	-15.86
4810.00	50.30	151	1.7	H	-4.25	46.05	54.00	-7.95
4810.00	52.40	11	1.1	V	-4.25	48.15	54.00	-5.85
7215.00	48.22	176	1.1	H	-4.25	43.97	54.00	-10.03
7215.00	46.27	64	1.9	V	-4.25	42.02	54.00	-11.98
9620.00	46.91	67	1.6	H	-4.25	42.66	54.00	-11.34
9620.00	45.01	125	1.7	V	-4.25	40.76	54.00	-13.24
12025	44.40	323	1.4	H	-4.25	40.15	54.00	-13.85
12025	43.36	295	1.5	V	-4.25	39.11	54.00	-14.89
14430	42.14	74	1.2	H	-4.25	37.89	54.00	-16.11
14430	42.16	267	1.5	V	-4.25	37.91	54.00	-16.09

Test Frequency :From 18GHz to 25GHz

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

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 * %

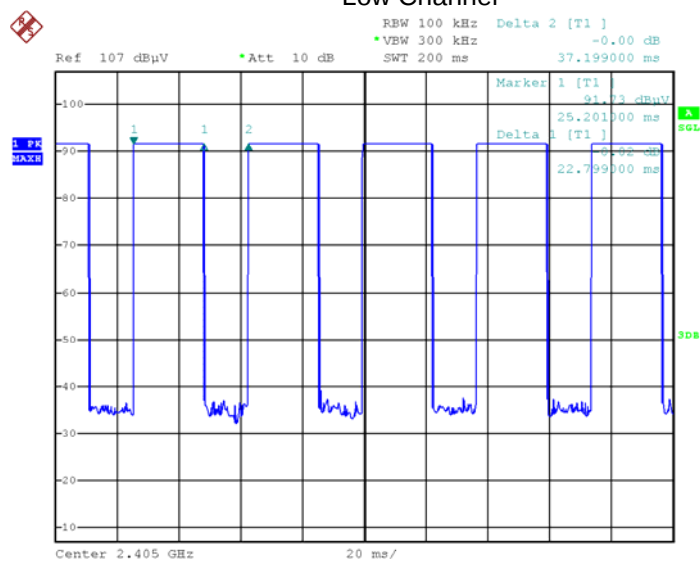
Duty Cycle Correction Factor(dB)=20 * Log₁₀(Duty Cycle)

Test Channel	Low Channel	Middle Channel	High Channel
Total transmission time(ms)	22.80	23.20	22.80
Length of a complete transmission period(ms)	37.20	37.20	37.20
Duty Cycle(%)	61.29	62.37	61.29
Duty Cycle Correction Factor(dB)	-4.25	-4.10	-4.25

Refer to the duty cycle plot (as below)

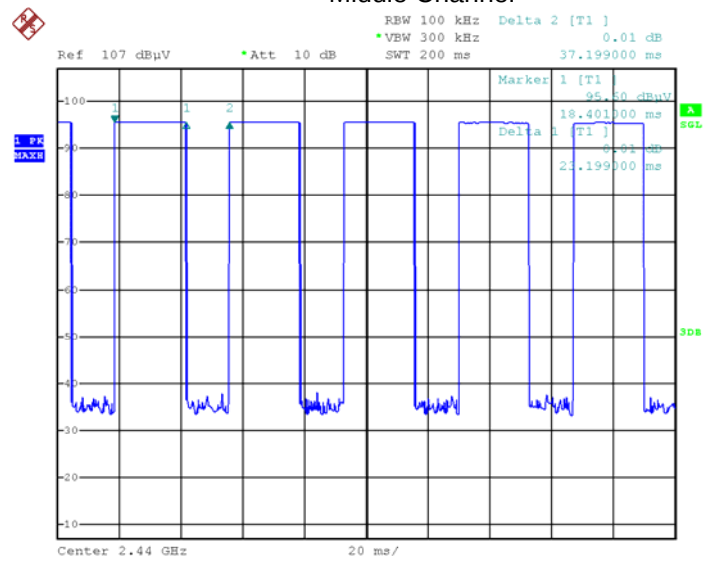
Test plots

Low Channel



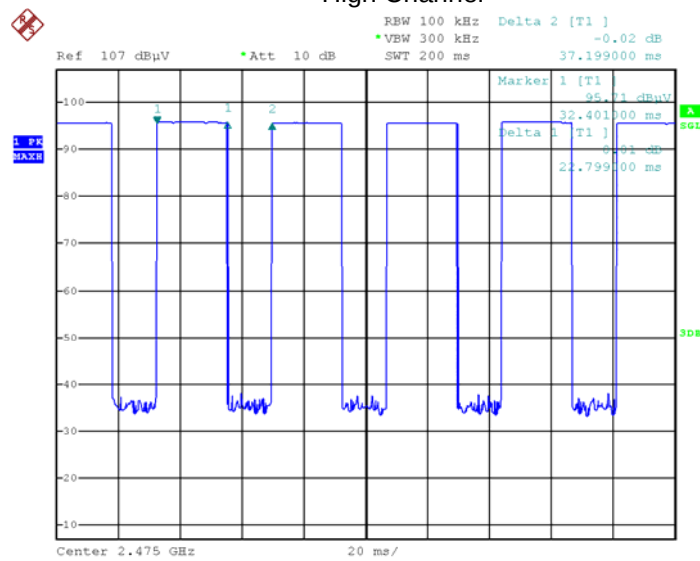
Date: 21.FEB.2019 02:40:52

Middle Channel



Date: 21.FEB.2019 02:42:05

High Channel



Date: 21.FEB.2019 02:42:55

10 Outside of Band Emission

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

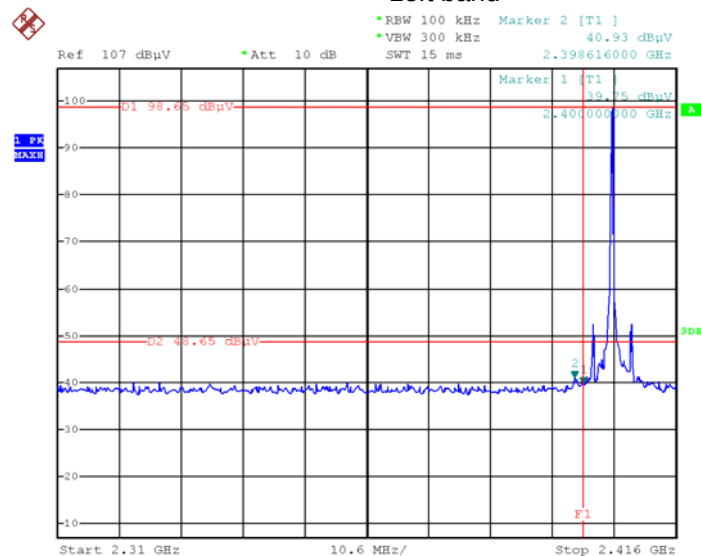
10.1 Test Procedure

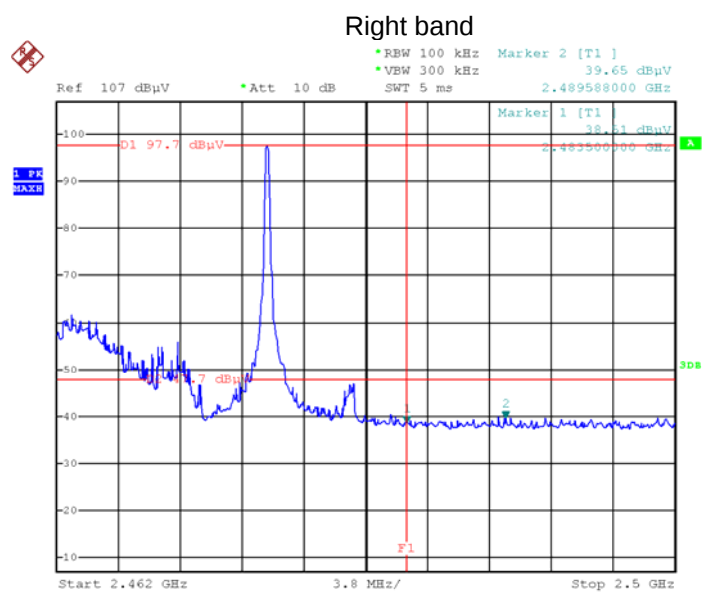
Refer to section 7.4 of this test report.

10.2 Test Result

Test plots

Left band





Date: 21.FEB.2019 02:48:52

11 20 dB 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

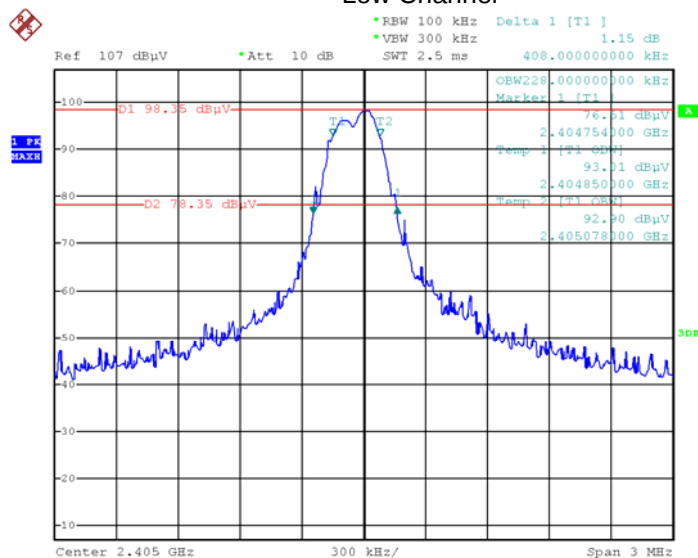
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

11.2 Test Result

Test Channel	20dB Bandwidth	99% Bandwidth
low	0.408MHz	/
Middle	0.390MHz	/
high	0.396MHz	/

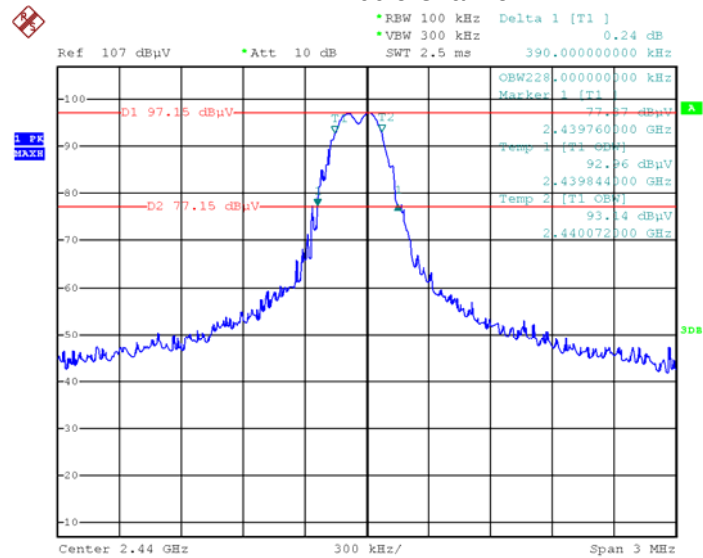
Test plots

Low Channel



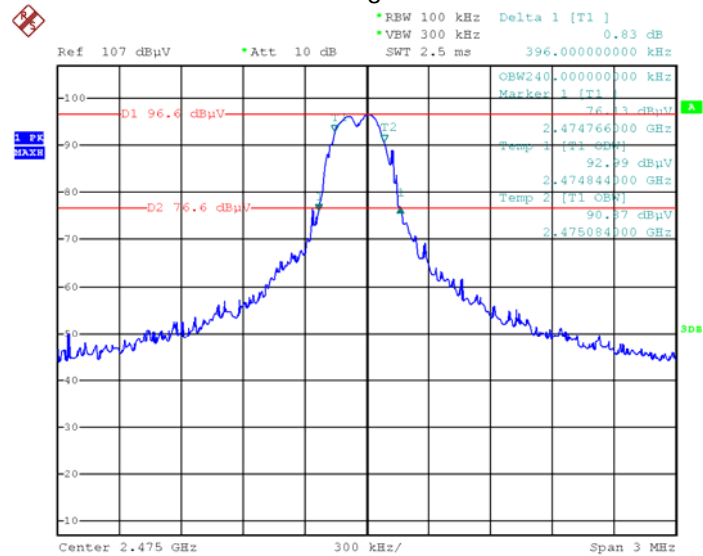
Date: 21.FEB.2019 02:52:16

Middle Channel



Date: 21.FEB.2019 02:53:52

High Channel



Date: 21.FEB.2019 02:55:54

12 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.

Refer to statement below for compliance.

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

TEST RESULTS

fulfil the requirement of this section.



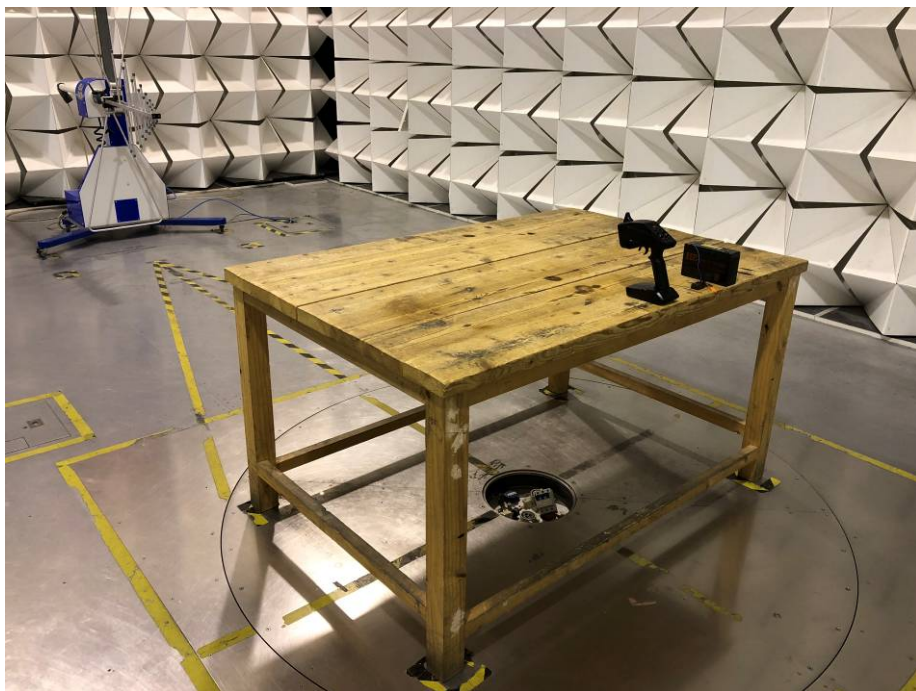
13 Photographs- STX3 Test Setup

13.1 Radiation Emission

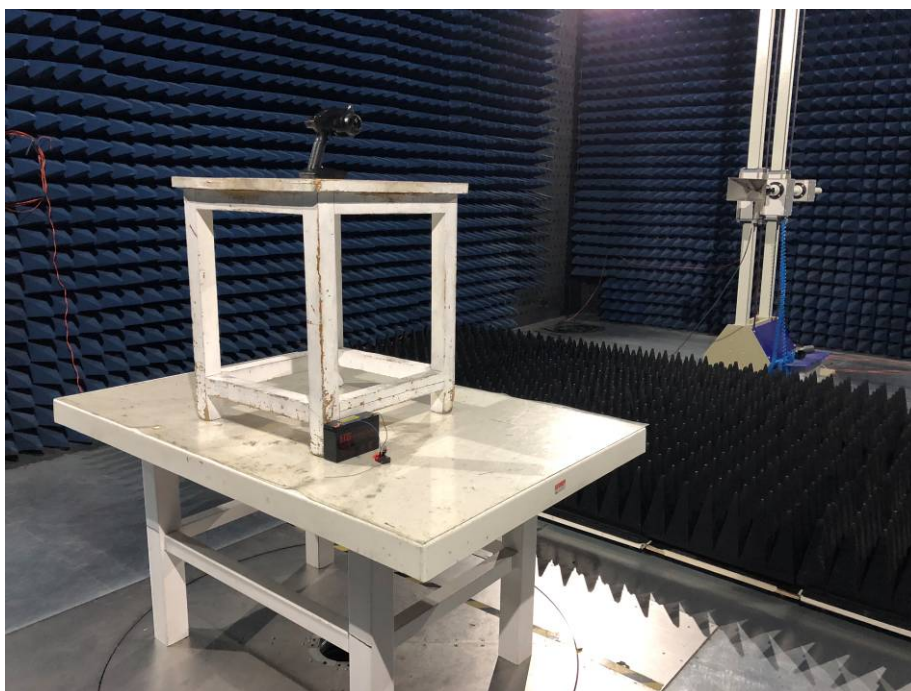
Test frequency Below 30MHz at test site 2#



Test frequency from 30MHz to 1GHz at test site 2#



Test frequency above 1GHz at test site 1#



14 Photographs - Constructional Details

14.1 Model STX3- External Photos

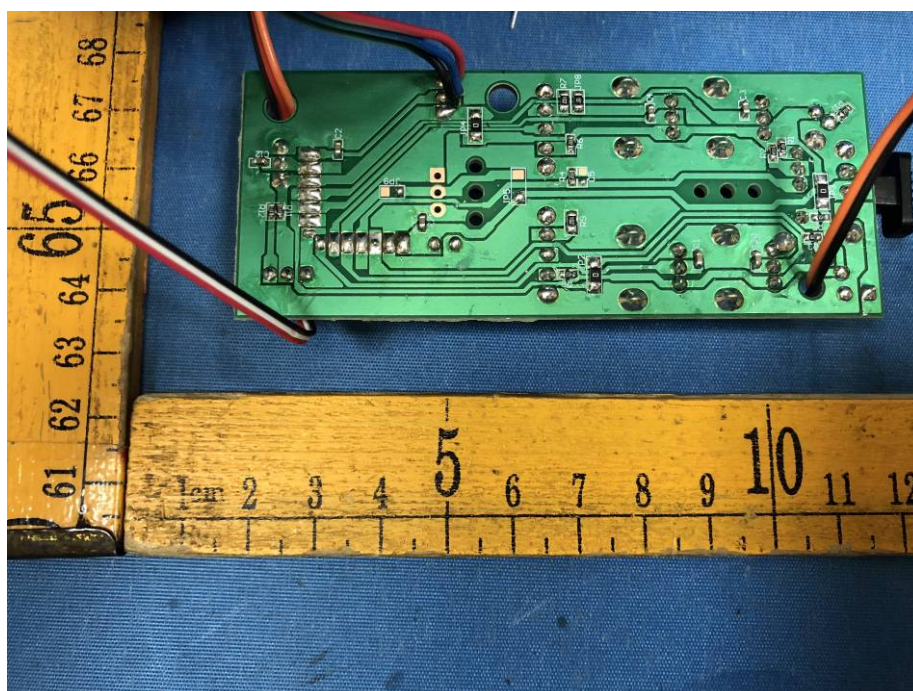
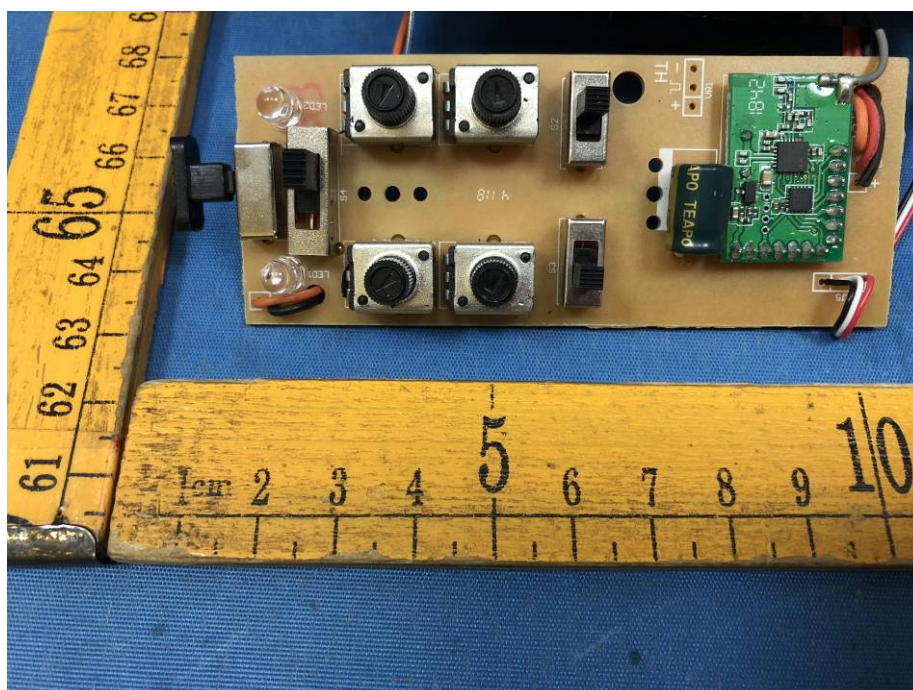






14.2 Model STX3 - Internal Photos





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