



## FCC PART 15.249

### TEST REPORT

For

**FrSky Electronic Co., Ltd.**

No.100 Jinxi Road , Wuxi, Jiangsu, China

**FCC ID: XYFX12SDP**

<b>Report Type:</b>	<b>Product Type:</b>
Original Report	Digital Telemetry Radio System
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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

The FrSky Electronic Co., Ltd.'s product, model number: HORUS X12S (FCC ID: XYFX12SDP) (the "EUT") in this report was a Digital Telemetry Radio System, was measured approximately: 222 mm (L) x230mm (W) x 75mm (H). rated input voltage: Supplied by Adapter DC 18V, (Built-in a 9.6V/2000mAh NI-MH rechargeable battery ).

*Note: The series product model HORUS X12, HORUS X12D, The difference between them was explained in the attached declaration letter.*

*All measurement and test data in this report was gathered from production sample serial number: 20160219001. (Assigned by BACL, Kunshan). The EUT was received on 2016-02-19.*

### Objective

This type approval report is prepared on behalf of FrSky Electronic Co., Ltd. in accordance with Part 2-Subpart J, and Part 15-Subparts A, B and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209 and 15.249 rules.

### Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS submissions with FCC ID: XYFX12SDP.

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Lab Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement uncertainty with radiated emission is 5.91 dB for 30MHz-1GHz and 4.92 dB for above 1GHz, 1.95dB for conducted measurement.

### Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the Chenghu Road, Kunshan Development Zone No.248, Kunshan, Jiangsu, China.

Test site at Bay Area Compliance Laboratories Corp. (Kunshan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on December 06, 2014. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 815570. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

## SYSTEM TEST CONFIGURATION

### Justification

The system was configured in testing mode which was provided by manufacturer, 3 channels are provided for testing:

Channel	Frequency(MHz)
Low	2406
Middle	2440
High	2474

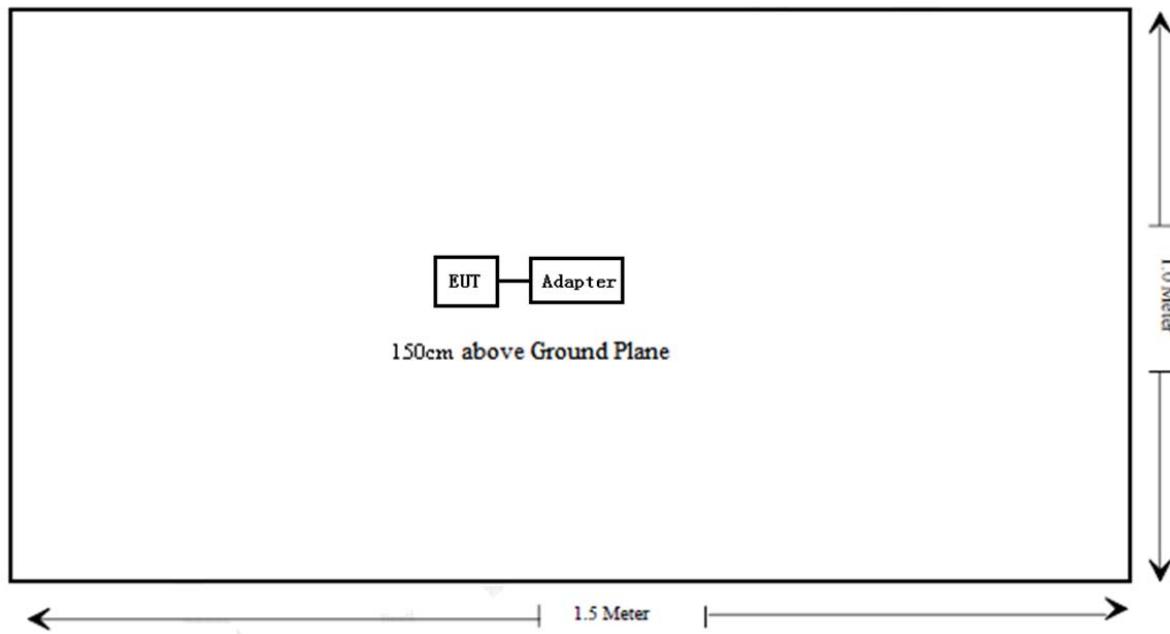
### EUT Exercise Software

No software was used during the test.

### Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
YNQX	AC Adapter INPUT:100-240V~50/60Hz 0.3A OUTPUT:18V,0.5A	YNQX12T018 0050VL	N/A

### Block Diagram of Test Setup



**SUMMARY OF TEST RESULTS**

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conduction Emissions	Compliance
15.205, §15.209, §15.249	Radiated Emissions& Out of Band Emission	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance

## **FCC§15.203 - ANTENNA REQUIREMENT**

### **Applicable Standard**

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used.

### **Antenna Connector Construction**

The EUT has one integral antenna arrangement and antenna gain is 2dBi, which was permanently attached ,fulfill the requirement of this section, please refer to the EUT photos.

**Result:** Compliant.

## FCC §15.207 (a) –Conduction Emissions

### Applicable Standard

FCC§15.207

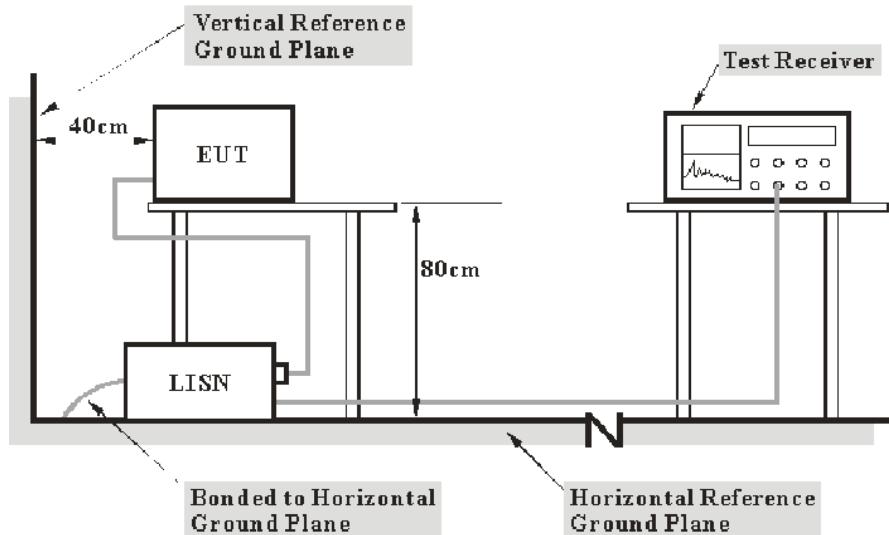
### Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements maybe receiver reading, attenuation of the connection between LISN and receiver, LISN voltage division factor, LISN VDF frequency interpolation and receiver related input quantities, etc.

Based on CISPR 16-4-2, the expended combined standard uncertainty of conducted disturbance test at Bay Area Compliance Laboratories Corp. (Kunshan) is shown as below. And the uncertainty will not be taken into consideration for the test data recorded in the report.

Port	Expanded Measurement uncertainty
AC Mains	3.26 dB (k=2, 95% level of confidence)
CAT 3	3.70 dB (k=2, 95% level of confidence)
CAT 5	3.86 dB (k=2, 95% level of confidence)
CAT 6	4.64 dB (k=2, 95% level of confidence)

### EUT Setup



**Note:**

1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The adapter was connected to a 120 VAC/60 Hz power source.

## EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

## Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCS30	934115/007	2015-11-12	2016-11-11
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2015-11-12	2016-11-11
Rohde & Schwarz	LISN	ESH3-Z5	892239/018	2015-6-23	2016-6-22
Rohde & Schwarz	Pulse limiter	ESH3-Z2	879940/0058	2015-6-19	2016-6-18
HP	Current probe	8710-1744	636	2015-6-19	2016-6-18
FCC	ISN	FCC-TLISN-T8-02	20376	2015-6-23	2016-6-22
Rohde & Schwarz	CE Test software	EMC 32	V 09.10.0	--	--

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

## Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss}$$

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

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

## Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207, the worst margin reading as below:

**12.02 dB at 24.000000 MHz in the Neutral conducted mode**

Refer to CISPR16-4-2 and CISPR 16-4-1, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL,  $U_{(Lm)}$  is less than  $U_{cispr}$ , if  $L_m$  is less than  $L_{lim}$ , it implies that the EUT complies with the limit.

## Test Data

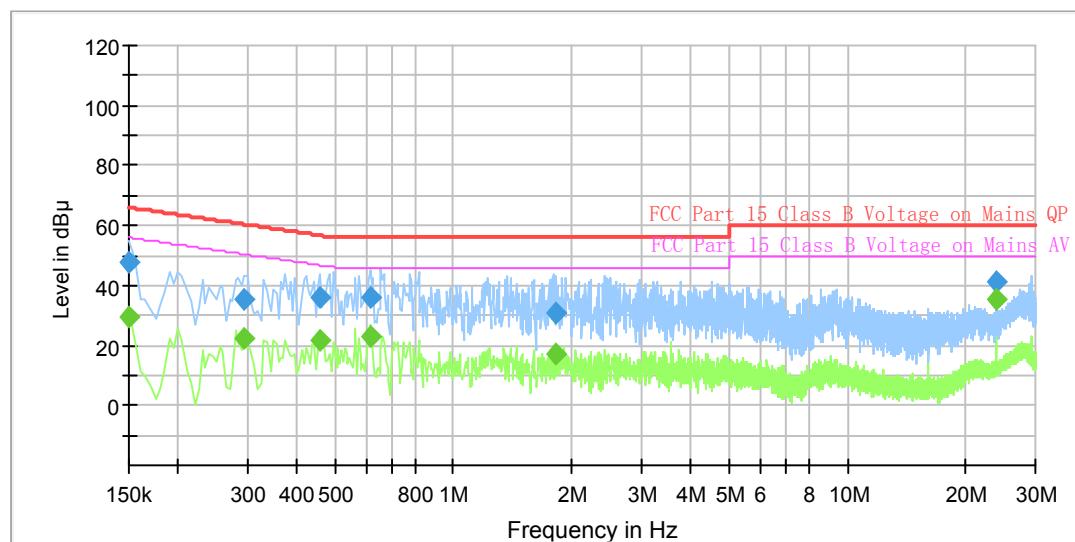
### Environmental Conditions

Temperature:	23 °C
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

*The testing was performed by Matt Yao on 2016-02-26*

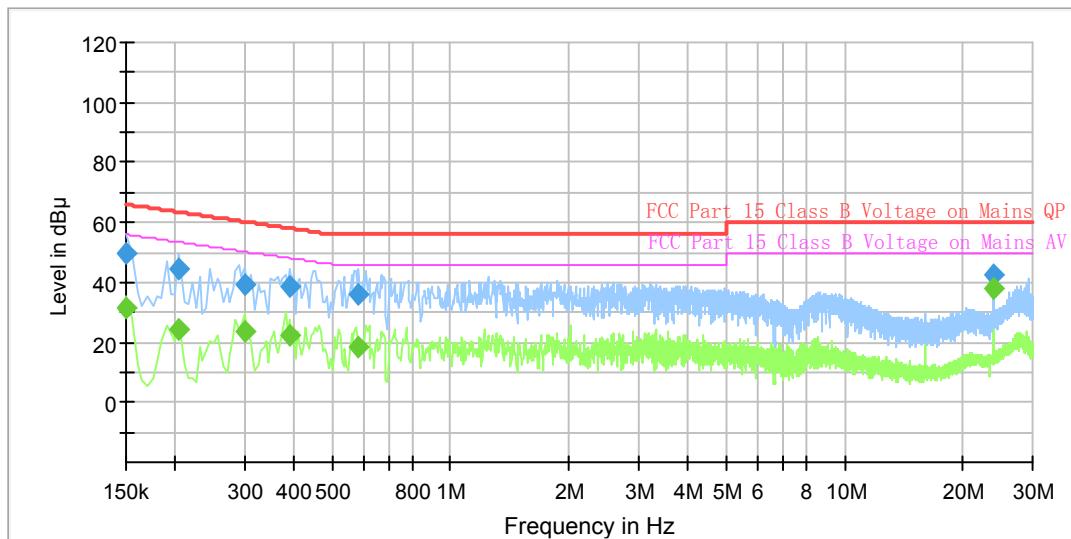
*EUT operation mode: Transmitting*

## AC 120V/60 Hz, Line



Frequency (MHz)	QuasiPeak (dB $\mu$ V)	Average (dB $\mu$ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB $\mu$ V)	Comment
0.150000	---	29.27	9.000	L1	11.0	26.73	56.00	Compliance
0.150000	47.63	---	9.000	L1	11.0	18.37	66.00	Compliance
0.295000	---	22.60	9.000	L1	11.0	27.78	50.38	Compliance
0.295000	35.64	---	9.000	L1	11.0	24.74	60.38	Compliance
0.460000	---	21.65	9.000	L1	11.0	25.04	46.69	Compliance
0.460000	36.11	---	9.000	L1	11.0	20.58	56.69	Compliance
0.615000	---	22.74	9.000	L1	11.1	23.26	46.00	Compliance
0.615000	36.25	---	9.000	L1	11.1	19.75	56.00	Compliance
1.825000	---	16.80	9.000	L1	11.2	29.20	46.00	Compliance
1.825000	30.75	---	9.000	L1	11.2	25.25	56.00	Compliance
24.000000	---	35.12	9.000	L1	11.4	14.88	50.00	Compliance
24.000000	41.18	---	9.000	L1	11.4	18.82	60.00	Compliance

## AC 120V/60 Hz, Neutral



Frequency (MHz)	QuasiPeak (dB $\mu$ V)	Average (dB $\mu$ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB $\mu$ V)	Comment
0.150000	---	31.57	9.000	N	11.0	24.43	56.00	Compliance
0.150000	49.92	---	9.000	N	11.0	16.08	66.00	Compliance
0.205000	---	24.35	9.000	N	11.0	29.06	53.41	Compliance
0.205000	44.55	---	9.000	N	11.0	18.86	63.41	Compliance
0.300000	---	23.56	9.000	N	11.0	26.68	50.24	Compliance
0.300000	39.43	---	9.000	N	11.0	20.81	60.24	Compliance
0.390000	---	22.20	9.000	N	11.0	25.86	48.06	Compliance
0.390000	38.83	---	9.000	N	11.0	19.23	58.06	Compliance
0.585000	---	18.52	9.000	N	11.0	27.48	46.00	Compliance
0.585000	36.32	---	9.000	N	11.0	19.68	56.00	Compliance
24.000000	---	37.98	9.000	N	11.4	12.02	50.00	Compliance
24.000000	42.53	---	9.000	N	11.4	17.47	60.00	Compliance

**Note:**

- 1) Corr.=LISN VDF (Voltage Division Factor) + Cable Loss
- 2) Corrected Amplitude = Reading + Corr.
- 3) Margin = Limit -Corrected Amplitude

## FCC§15.205, §15.209&§15.249- RADIATED EMISSIONS& OUT OF BAND EMISSION

### Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

(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.

### Measurement Uncertainty

Compliance or non- compliance with a disturbance limit shall be determined in the following manner:

If  $U_{lab}$  is less than or equal to  $U_{cispr}$  of Table 1, then:

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

If  $U_{lab}$  is greater than  $U_{cispr}$  of Table 1, then:

- compliance is deemed to occur if no measured disturbance level, increased by  $(U_{lab} - U_{cispr})$ , exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level, increased by  $(U_{lab} - U_{cispr})$ , exceeds the disturbance limit.

Based on CISPR 16-4-2: 2011, measurement uncertainty of radiated emission at a distance of 3m at Bay Area Compliance Laboratories Corp. (Kunshan) is:

30M~200MHz: 5.0 dB

200M~1GHz: 6.2 dB

1G~6GHz: 4.45 dB

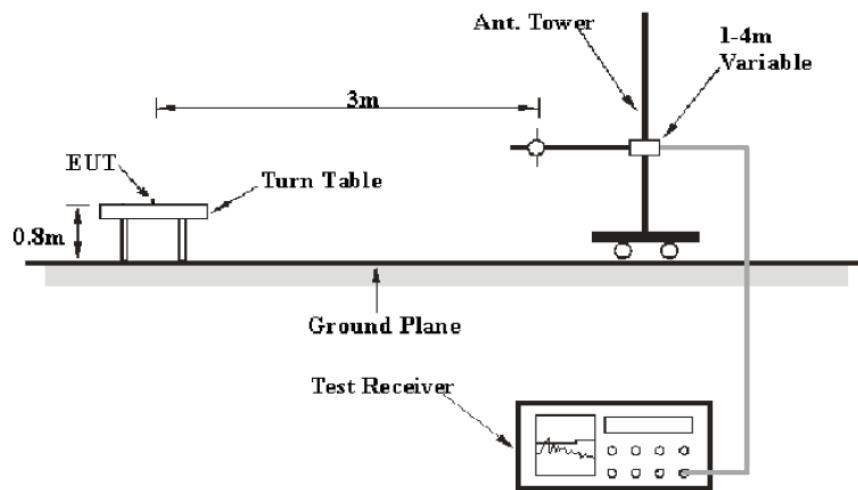
6G~18GHz: 5.23 dB

Table 1 – Values of  $U_{\text{cispr}}$ 

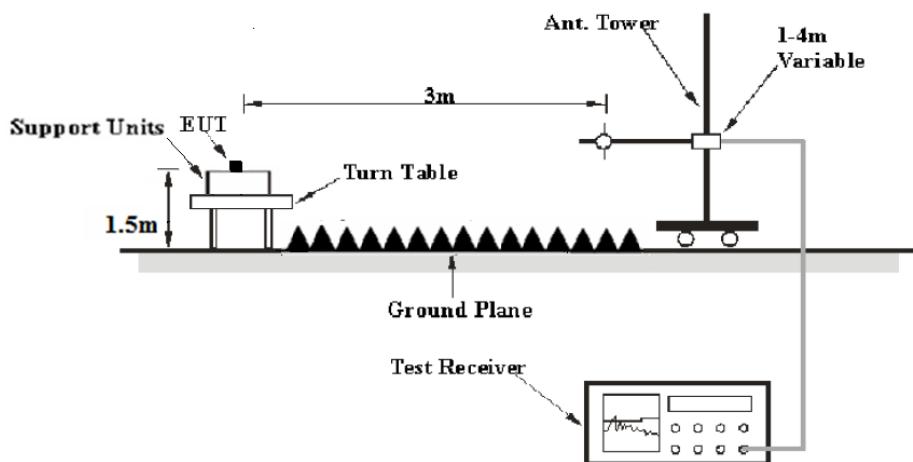
Measurement	$U_{\text{cispr}}$
Radiated disturbance (electric field strength at an OATS or in a SAC) (30 MHz to 1000 MHz)	6.3 dB
Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz)	5.2 dB
Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz)	5.5 dB

## EUT Setup

Below 1 GHz:



Above 1 GHz:



The radiated emission and out of band emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

## Test Equipment Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Ave.

## Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All data was recorded in the Quasi-peak detection mode from 30MHz to 1GHz, Peak and average detection mode above 1 GHz.

## Corrected Amplitude & Margin Calculation

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

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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 limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

**Test Equipment List and Details**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sonoma Instrument	Amplifier	330	171377	2015-9-16	2016-9-16
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2015-5-20	2016-5-19
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2015-11-7	2016-11-6
ETS	Horn Antenna	3115	6229	2015-11-7	2016-11-6
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2015-11-4	2016-11-3
Mini	Pre-amplifier	ZVA-183-S+	857001418	2015-9-16	2016-9-16
R&S	Auto test Software	EMC32	V 09.10.0	-	-
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-16	2016-6-15

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

**Test Results Summary**

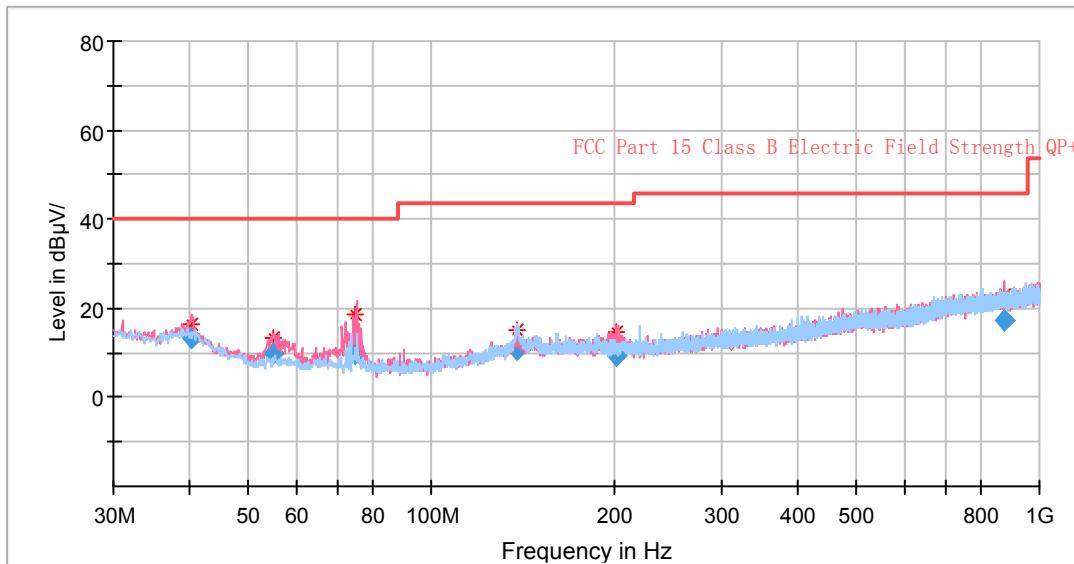
According to the data in the following table, the EUT complied with the FCC Part 15.209 & 15.205 & 15.249, with the worst margin reading of:

**7.28 dB at 2474 MHz** in the **Vertical** polarization for High Channel

**Test Data****Environmental Conditions**

<b>Temperature:</b>	25.6°C
<b>Relative Humidity:</b>	52%
<b>ATM Pressure:</b>	101.2 kPa

*The testing was performed by Matt Yao on 2016-02-25.*

**30MHz-1GHz:**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	FCC Part 15.249/15.205/15.209	
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dB µV/m)	Margin (dB)
40.12	24.22	QP	149	100	V	-10.5	13.72	40	26.28
54.82	26.81	QP	278	100	V	-16.6	10.21	40	29.79
75.01	26.88	QP	13	100	V	-17.1	9.78	40	30.22
137.83	22.42	QP	33	100	H	-12.1	10.32	43.5	33.18
200.82	21.90	QP	310	100	V	-12.3	9.60	43.5	33.90
873.53	18.12	QP	49	100	V	-0.7	17.42	46	28.58

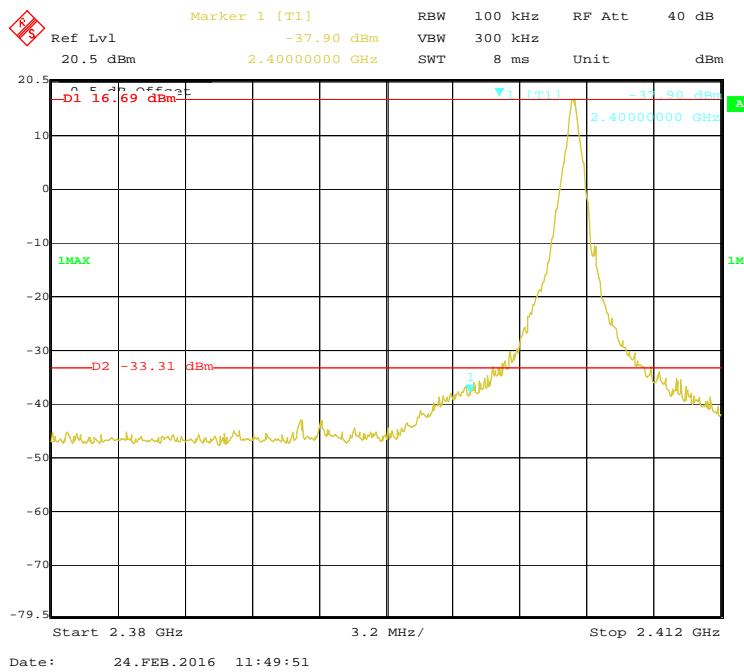
**1GHz-25GHz:***Test Mode: Transmitting (Scan with X, Y, Z axis, the worst case is X axis )*

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dB $\mu$ V/m)	FCC Part 15.249/15.205/15.209	
	Reading (dB $\mu$ V)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dB $\mu$ V/m)	Margin (dB)
Low Channel (2406 MHz)									
2406	94.58	PK	156	150	V	3.0	97.58	114	16.42
2406	81.28	Ave	156	150	V	3.0	84.28	94	9.72
2406	93.39	PK	185	150	H	3.0	96.39	114	17.61
2406	82.71	Ave	185	150	H	3.0	85.71	94	8.29
1265	49.59	PK	175	200	H	-2.1	47.49	74	26.51
1265	38.96	Ave	175	200	H	-2.1	36.86	54	17.14
2393	31.41	PK	109	150	H	4.1	35.51	74	38.49
2393	21.31	Ave	109	150	H	4.1	25.41	54	28.59
3076	20.92	Ave	86.0	150	H	7.0	27.92	54	26.08
3076	35.07	PK	86.0	150	H	7.0	42.07	74	31.93
4812	18.56	Ave	89.0	200	V	13.3	31.86	54	22.14
4812	31.59	PK	89.0	200	V	13.3	44.89	74	29.11
7218	16.04	Ave	147.0	150	V	19.7	35.74	54	18.26
7218	29.91	PK	147.0	150	V	19.7	49.61	74	24.39
Middle Channel (2440MHz)									
2440	94.61	PK	195	150	V	3	97.61	114	16.39
2440	83.56	Ave	195	150	V	3	86.56	94	7.44
2440	91.77	PK	135	200	H	3	94.77	114	19.23
2440	79.98	Ave	135	200	H	3	82.98	94	11.02
1269	38.97	Ave	244	200	H	-1.9	37.10	54	16.90
1269	52.70	PK	244	200	H	-1.9	51.01	74	22.99
4823	33.38	PK	200	200	H	13.9	47.54	74	26.46
4823	21.46	Ave	200	200	H	13.9	36.24	54	17.76
3076	20.92	Ave	219.0	150	V	7.0	27.92	54	26.08
3076	34.28	PK	219.0	150	V	7.0	41.28	74	32.72
4880	31.86	PK	163.0	200	H	13.6	45.46	74	28.54
4880	18.52	Ave	163.0	200	H	13.6	32.12	54	21.88
7320	30.23	PK	63.0	150	V	20.0	50.23	74	23.77
7320	16.74	Ave	63.0	150	V	20.0	36.74	54	17.26

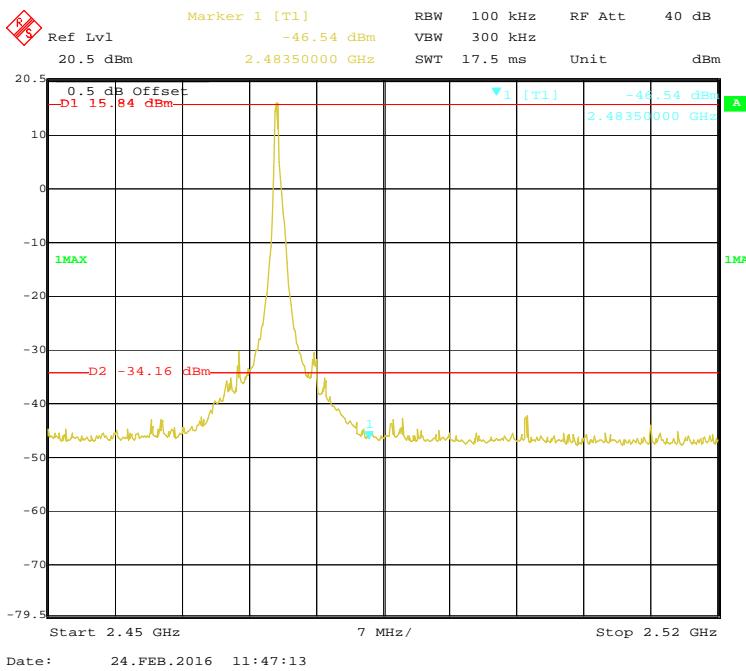
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dB $\mu$ V/m)	FCC Part 15.249/15.205/15.209	
	Reading (dB $\mu$ V)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dB $\mu$ V/m)	Margin (dB)
High Channel (2474MHz)									
2474	93.88	PK	62	150	V	3	96.88	114	17.12
2474	83.72	Ave	62	150	V	3	86.72	94	7.28
2474	91.74	PK	230	150	H	3	94.74	114	19.26
2474	83.22	Ave	230	150	H	3	86.22	94	7.78
2483.5	34.04	PK	183	200	H	5.0	39.04	54	14.96
2483.5	21.80	Ave	183	200	H	5.0	26.80	74	47.20
3076	20.92	Ave	210.0	200	V	7.0	27.92	54	26.08
3076	34.00	PK	210.0	200	V	7.0	41.00	74	33.00
4948	31.66	PK	18.0	150	V	13.8	45.46	74	28.54
4948	17.97	Ave	18.0	150	V	13.8	31.77	54	22.23
7422	30.10	PK	23.0	150	V	20.4	50.50	74	23.50
7422	16.70	Ave	23.0	150	V	20.4	37.10	54	16.90

### Conducted -50dB Out Of Band Emissions at Antenna Port

Left side



## Right side



*Note: The band emission compliant with the general radiated emission limits in § 15.209.  
Please refer to radiated emissions test section.*

## FCC §15.215(c) – 20 dB BANDWIDTH TESTING

### Applicable Standard

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

### Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the test table without connection to measurement instrument. Turn on the EUT. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2015-11-4	2016-11-3
Dressler	Attenuator	ATT 6/75	510020010004	2015-11-12	2016-11-12

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Data

#### Environmental Conditions

Temperature:	25.6°C
Relative Humidity:	51 %
ATM Pressure:	101.2kPa

\* The testing was performed by Matt Yao on 2016-2-25.

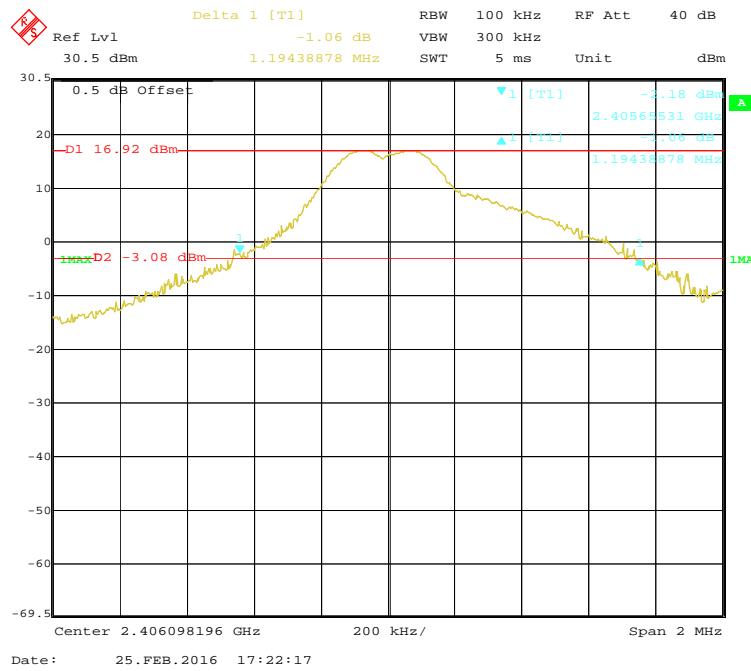
**Test Result:** Compliant.

Please refer to following tables and plots

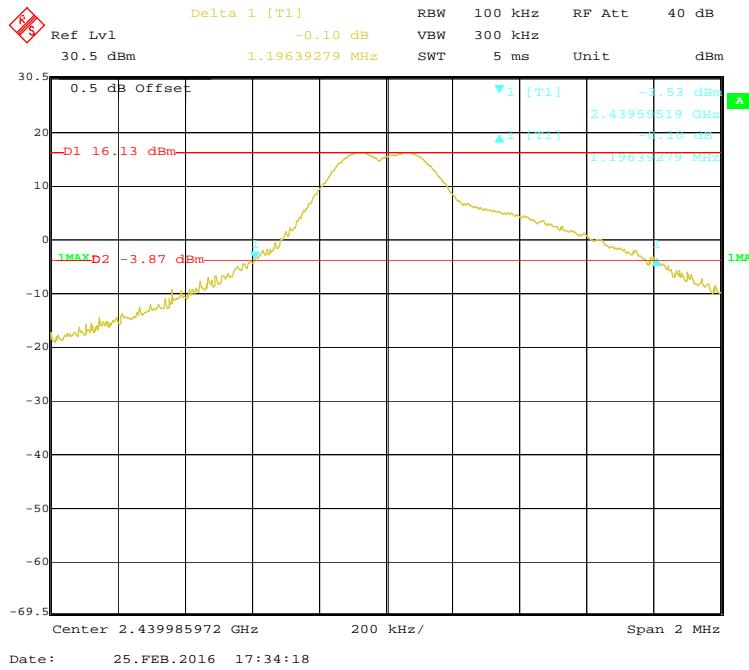
Test Mode: Transmitting

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2406	1.19
Middle	2440	1.19
High	2474	1.12

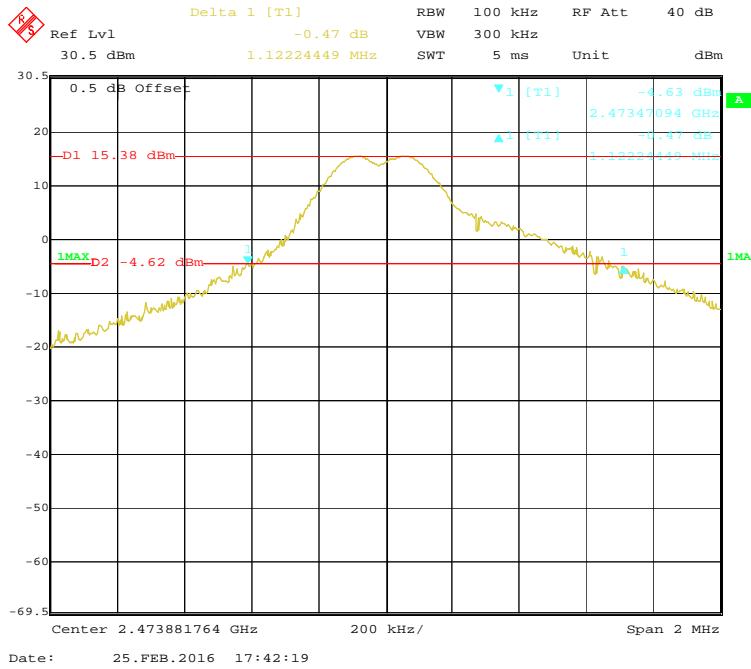
### Low Channel



### Middle Channel



### High Channel



\*\*\*\*\* END OF REPORT \*\*\*\*\*