

FCC PART 15C

TEST REPORT

For

INGENICO

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FCC ID: XKB-L2500CL3GWIBT

Report Type: Original Report	Product Type: Link/2500
Report Number: RXM160823052-00B	
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.(Dongguan). This report may contain data or test methods that are not covered by the NVLAP accreditation scope and shall be marked with an asterisk "*" and noted.

TABLE OF CONTENTS

GENERAL INFORMATION.....	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
OBJECTIVE	3
RELATED SUBMITTAL(S)/GRANT(S).....	3
TEST METHODOLOGY	3
TEST FACILITY	3
SYSTEM TEST CONFIGURATION.....	4
JUSTIFICATION	4
EUT EXERCISE SOFTWARE	4
LOCAL SUPPORT EQUIPMENT LIST AND DETAILS	4
SUPPORT CABLE LIST AND DETAILS	4
BLOCK DIAGRAM OF TEST SETUP	4
SUMMARY OF TEST RESULTS	5
FCC§15.203 - ANTENNA REQUIREMENT.....	6
APPLICABLE STANDARD	6
ANTENNA CONNECTED CONSTRUCTION	6
FCC §15.207 – AC LINE CONDUCTED EMISSION	7
MEASUREMENT UNCERTAINTY	7
EUT SETUP	7
EMI TEST RECEIVER SETUP.....	8
TEST EQUIPMENT LIST AND DETAILS.....	8
TEST PROCEDURE	8
CORRECTED AMPLITUDE & MARGIN CALCULATION	9
TEST RESULTS SUMMARY	9
TEST DATA	9
FCC§15.225, §15.205 & §15.209 - RADIATED EMISSIONS TEST	12
APPLICABLE STANDARD	12
MEASUREMENT UNCERTAINTY.....	12
EUT SETUP	13
EMI TEST RECEIVER SETUP.....	13
CORRECTED AMPLITUDE & MARGIN CALCULATION	13
TEST EQUIPMENT LIST AND DETAILS.....	14
TEST RESULTS SUMMARY	14
TEST DATA	14
FCC§15.225(E) - FREQUENCY STABILITY.....	16
APPLICABLE STANDARD	16
TEST PROCEDURE	16
TEST EQUIPMENT LIST AND DETAILS.....	16
TEST DATA	16
FCC §15.215(C) – 20 DB EMISSION BANDWIDTH.....	18

GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

The *INGENICO*'s product, model number: *LINK/2500 CL/3G/WiFi/BT (FCC ID: XKB-L2500CL3GWIBT)* (the "EUT") in this report was a *Link/2500*, which was measured approximately: 12.8 cm (L) x 7.0 cm (W) x 1.7cm (H), rated input voltage: DC 3.7V from rechargeable Li-ion battery or DC 5V from adapter.

Adapter information:

MODEL: PSA105R-050QL6

INPUT: 100-240V ~ 0.3A 50-60Hz 11-15VA

OUTPUT: DC 5V, 1.0A MAX

All measurement and test data in this report was gathered from production sample serial number: 160823052 (Assigned by BACL, Dongguan). The EUT was received on 2016-08-25.

Objective

This Type approval report is prepared on behalf of *INGENICO* in accordance with Part 2, Subpart J, and Part 15, Subparts A, B and C of the Federal Communications Commission's rules.

The objective is to determine the compliance of the EUT with FCC rules, sec 15.203, 15.205, 15.207, 15.209 and 15.225.

Related Submittal(s)/Grant(s)

FCC Part 22H, 24E PCB submissions with FCC ID: XKB-L2500CL3GWIBT.

FCC Part 15C DTS submissions with FCC ID: XKB-L2500CL3GWIBT.

FCC Part 15C DSS submissions with FCC ID: XKB-L2500CL3GWIBT.

FCC Part 15.407 NII submissions with FCC ID: XKB-L2500CL3GWIBT.

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 emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communications 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 February 06, 2015.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. 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 for testing in a test mode.

EUT Exercise Software

No software was performed under test.

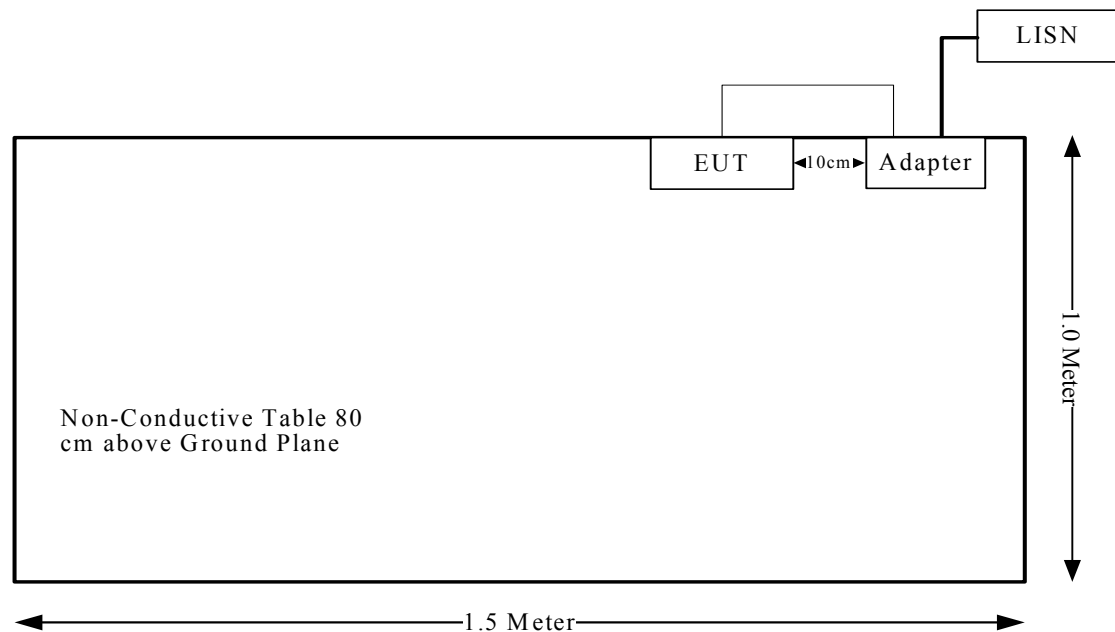
Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	/	/	/

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
USB Cable	no	no	1.08	Adapter	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207	AC Line Conducted Emission	Compliance
§15.225 §15.209 §15.205	Radiated Emission Test	Compliance
§15.225(e)	Frequency Stability	Compliance
§15.215(c)	20 dB Emission Bandwidth	Compliance

Test time: 2016.09.14

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

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.

Antenna Connected Construction

The EUT has one integral antenna arrangement, which was permanently attached and fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

FCC §15.207 – AC LINE CONDUCTED EMISSION

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_{cisp} 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_{cisp} of Table 1, then:

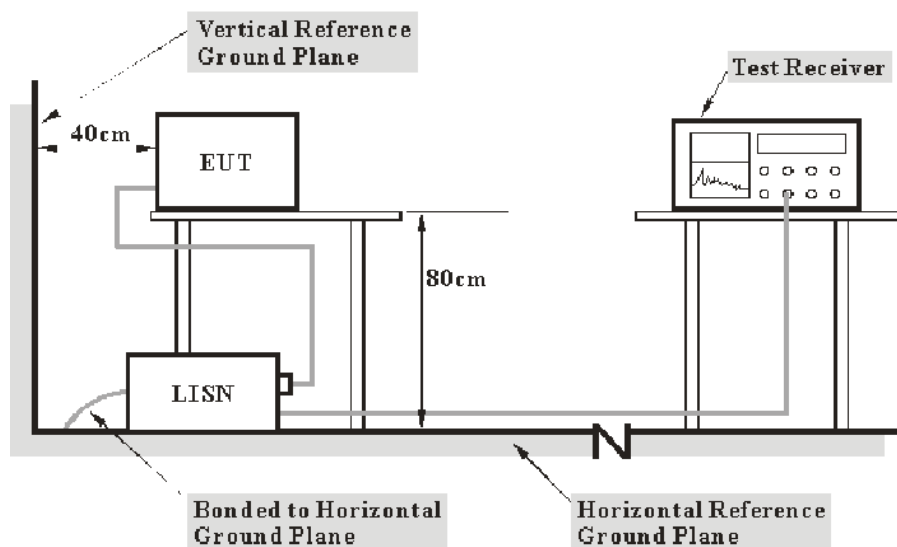
- compliance is deemed to occur if no measured disturbance level, increased by $(U_{lab} - U_{cisp})$, exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level, increased by $(U_{lab} - U_{cisp})$, exceeds the disturbance limit.

Based on CISPR 16-4-2-2011, measurement uncertainty of conducted disturbance at mains port using AMN at Bay Area Compliance Laboratories Corp. (Dongguan) is 3.12 dB (150 kHz to 30 MHz).

Table 1 – Values of U_{cisp}

Measurement	U_{cisp}
Conducted disturbance at mains port using AMN (9 kHz to 150 kHz)	3.8 dB
(150 kHz to 30 MHz)	3.4 dB
Conducted disturbance at mains port using voltage probe (9 kHz to 30 MHz)	2.9 dB
Conducted disturbance at telecommunication port using AAN (150 kHz to 30 MHz)	5.0 dB
Conducted disturbance at telecommunication port using CVP (150 kHz to 30 MHz)	3.9 dB
Conducted disturbance at telecommunication port using CP (150 kHz to 30 MHz)	2.9 dB

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

The spacing between the peripherals was 10 cm.

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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCS 30	830245/006	2015-12-10	2016-12-09
R&S	L.I.S.N	ESH2-Z5	892107/021	2016-09-01	2017-09-01
R&S	Two-line V-network	ENV 216	3560.6550.12	2015-11-26	2016-11-25
N/A	Coaxial Cable	1.8m	N/A	2016-05-06	2017-05-06
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A

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

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.

According FCC publication number 174176, for a device with a permanent antenna operating at or below 30 MHz, the measurements done with a suitable dummy load, in lieu of the permanent antenna under the following conditions: (1) perform the AC line conducted tests with the permanent antenna to determine compliance with the Section 15.207 limits outside the transmitter's fundamental emission band; (2) retest with a dummy load in lieu of the permanent antenna to determine compliance with the Section 15.207 limits within the transmitter's fundamental emission band.

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

Herein,

V_C : corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF: voltage division factor of AMN or ISN

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of 7dB means the emission is 7dB below the maximum 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.

Test Data

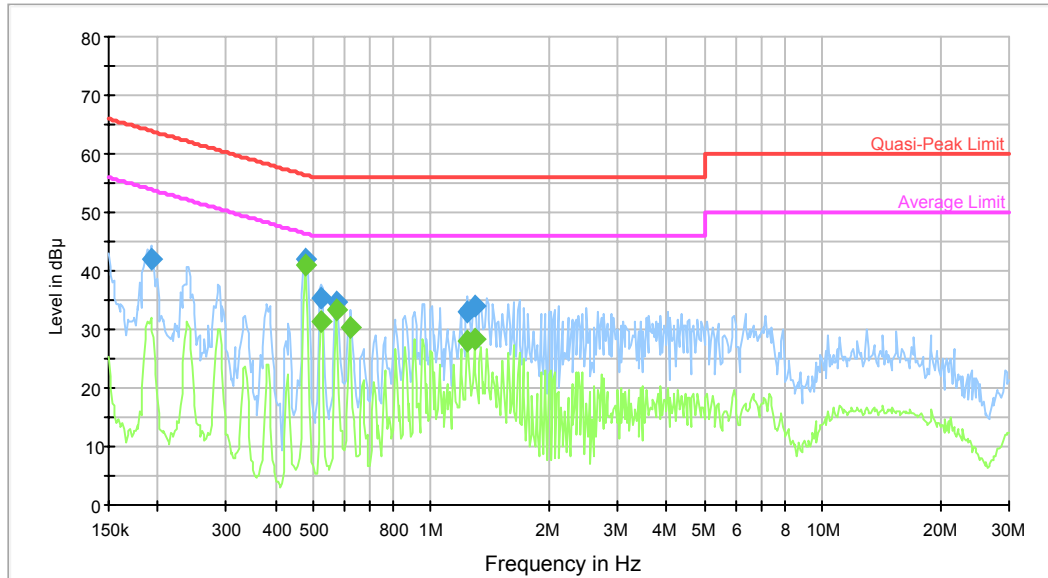
Environmental Conditions

Temperature:	28.9 °C
Relative Humidity:	52 %
ATM Pressure:	100.1 kPa

The testing was performed by Lion Xiao on 2016-09-14.

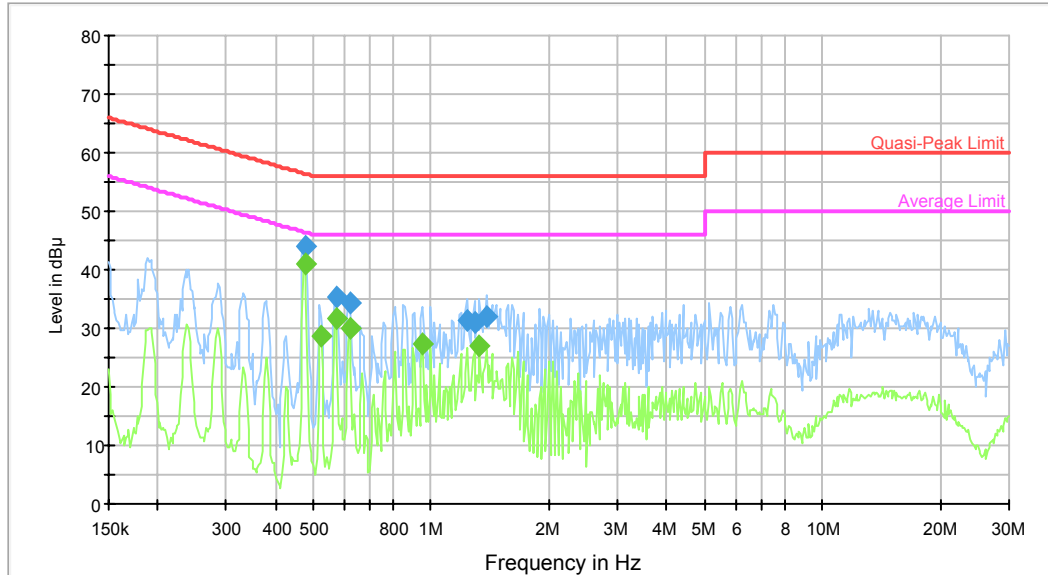
Test Mode: Transmitting

AC 120V, 60 Hz, Line:



Frequency (MHz)	Quasi Peak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)	Comment
0.192030	41.9	9.000	L1	9.7	22.0	63.9	Compliance
0.480097	41.9	9.000	L1	9.7	14.4	56.3	Compliance
0.524077	35.4	9.000	L1	9.7	20.6	56.0	Compliance
0.576662	34.6	9.000	L1	9.7	21.4	56.0	Compliance
1.239175	33.1	9.000	L1	9.7	22.9	56.0	Compliance
1.289541	34.0	9.000	L1	9.7	22.0	56.0	Compliance

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)	Comment
0.476287	41.0	9.000	L1	9.7	5.4	46.4	Compliance
0.524077	31.5	9.000	L1	9.7	14.5	46.0	Compliance
0.572086	33.5	9.000	L1	9.7	12.5	46.0	Compliance
0.619536	30.4	9.000	L1	9.7	15.6	46.0	Compliance
1.239175	28.2	9.000	L1	9.7	17.8	46.0	Compliance
1.289541	28.5	9.000	L1	9.7	17.5	46.0	Compliance

AC120 V, 60 Hz, Neutral:

Frequency (MHz)	Quasi Peak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)	Comment
0.476287	44.1	9.000	N	9.6	12.3	56.4	Compliance
0.572086	35.4	9.000	N	9.6	20.6	56.0	Compliance
0.619536	34.2	9.000	N	9.6	21.8	56.0	Compliance
1.239175	31.4	9.000	N	9.7	24.6	56.0	Compliance
1.289541	31.0	9.000	N	9.7	25.0	56.0	Compliance
1.385415	32.0	9.000	N	9.7	24.0	56.0	Compliance

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)	Comment
0.476287	40.8	9.000	N	9.6	5.6	46.4	Compliance
0.524077	28.8	9.000	N	9.6	17.2	46.0	Compliance
0.572086	31.8	9.000	N	9.6	14.2	46.0	Compliance
0.619536	30.0	9.000	N	9.6	16.0	46.0	Compliance
0.952654	27.3	9.000	N	9.7	18.7	46.0	Compliance
1.331304	26.8	9.000	N	9.7	19.2	46.0	Compliance

FCC§15.225, §15.205 & §15.209 - RADIATED EMISSIONS TEST

Applicable Standard

As per FCC Part 15.225

- (a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

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_{cisp} 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_{cisp} of Table 1, then:

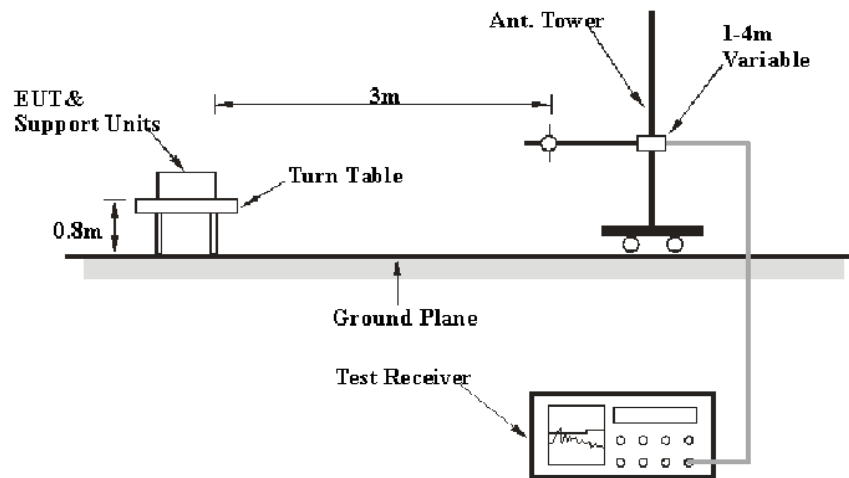
- compliance is deemed to occur if no measured disturbance level, increased by $(U_{lab} - U_{cisp})$, exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level, increased by $(U_{lab} - U_{cisp})$, exceeds the disturbance limit.

Based on CISPR 16-4-2: 2011, measurement uncertainty of radiated emission at a distance of 3m at Bay Area Compliance Laboratories Corp. (Dongguan) is:30M~200MHz: 4.58 dB for Horizontal, 4.59 dB for Vertical; 200M~1GHz: 4.83 dB for Horizontal, 5.85 dB for Vertical; 1G~6GHz: 4.45 dB, 6G~18GHz: 5.23 dB.

Table 1 – Values of U_{cisp}

Measurement	U_{cisp}
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



The radiated emission tests were performed in the 3-meter chamber a test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part Subpart C limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The system was investigated from 9 kHz to 1 GHz.

During the radiated emission test, the EMI test Receiver was set with the following configurations:

Frequency Range	RBW	Video B/W	Detector
9 kHz – 150 kHz	300 Hz	1 kHz	QP
150 kHz – 30 MHz	10 kHz	30 kHz	QP
30 MHz – 1000 MHz	100 kHz	300 kHz	QP

Corrected Amplitude & Margin Calculation

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

$$\text{Corr. Ampl.} = \text{Meter Reading} + \text{Antenna Loss} + \text{Cable Loss} - \text{Amplifier Gain}$$

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 maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corr. Ampl.}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2016-08-03	2017-08-02
Sunol Sciences	Antenna	JB3	A060611-3	2014-11-06	2017-11-05
HP	Amplifier	8447E	2434A02181	2016-09-01	2017-09-01
The Electro-Mechanics Company	Passive Loop Antenna	6512	9706-1206	2016-03-03	2019-03-03
N/A	Coaxial Cable	14m	N/A	2016-05-06	2017-05-06

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, 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&15.225 .

Test Data**Environmental Conditions**

Temperature:	26.6 °C
Relative Humidity:	49 %
ATM Pressure:	100.1 kPa

* The testing was performed by Lion Xiao on 2016-09-14.

Test mode: Transmitting

1) Fundamental (9 kHz~30 MHz):

Frequency	Receiver		Rx Antenna Factor	Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Detector						
MHz	dBμV	PK/QP/AV	dB(1/m)	dB	dB	dBμV/m	dBμV/m	dB
13.56	60.0	QP	32.08	0.35	21.44	70.99	124.00	53.01
8.91	31.9	QP	32.63	0.28	21.42	43.39	69.54	26.15
27.12	29.7	QP	30.48	0.44	21.45	39.17	69.54	30.37
13.553	33.2	QP	32.08	0.35	21.44	44.19	90.50	46.31
13.567	33.6	QP	32.08	0.35	21.44	44.59	90.50	45.91
13.121	27.1	QP	32.06	0.35	21.43	38.08	80.50	42.42
13.956	27.8	QP	32.10	0.35	21.44	38.81	80.50	41.69

2) Spurious Emissions (30 MHz ~1 GHz):

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Detector	Polar	Factor					
MHz	dBμV	PK/QP/AV	H/V	dB(1/m)	dB	dB	dBμV/m	dBμV/m	dB
40.60	30.1	QP	H	14.00	0.83	21.42	23.51	40.00	16.49
54.24	28.9	QP	H	7.70	0.96	21.41	16.15	40.00	23.85
78.50	27.5	QP	H	8.17	1.11	21.41	15.37	40.00	24.63
162.72	28.2	QP	H	12.59	1.56	21.44	20.91	43.50	22.59
216.96	27.7	QP	H	11.45	1.78	21.47	19.46	46.00	26.54
271.20	26.9	QP	H	13.71	2.00	21.50	21.11	46.00	24.89
325.44	27.3	QP	H	14.62	2.16	21.58	22.50	46.00	23.50
40.60	31.3	QP	V	14.00	0.83	21.42	24.71	40.00	15.29
67.80	30.5	QP	V	8.31	1.06	21.41	18.46	40.00	21.54
108.48	29.9	QP	V	12.61	1.26	21.41	22.36	43.50	21.14
176.28	28.2	QP	V	11.43	1.60	21.45	19.78	43.50	23.72
230.52	28.7	QP	V	11.92	1.82	21.48	20.96	46.00	25.04
257.64	29.0	QP	V	12.46	1.93	21.49	21.90	46.00	24.10
325.44	28.1	QP	V	14.62	2.16	21.58	23.30	46.00	22.70

FCC§15.225(e) - FREQUENCY STABILITY

Applicable Standard

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and loop antenna was connected to a Spectrum Analyzer. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the Spectrum Analyzer.

Frequency Stability vs. Voltage: An external variable DC power supply Source. The voltage was set to 115% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the end point. The output frequency was recorded for each voltage.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
Dongzhixu	High Temperature Test Chamber	DP1000	201105083-4	2016-09-10	2017-09-09
The Electro-Mechanics Company	Passive Loop Antenna	6512	9706-1206	2014-11-30	2017-11-29
N/A	Coaxial Cable	1.5m	N/A	2016-05-06	2017-05-06

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

Test Data

Environmental Conditions

Temperature:	28.8 °C
Relative Humidity:	49 %
ATM Pressure:	100.1 kPa

* The testing was performed by Lion Xiao on 2016-09-14.

Test Mode: Transmitting

Test Result: Compliant

$f_o = 13.56 \text{ MHz}$				
Temperature	Voltage	Measured frequency	Frequency Error (Hz)	Limit (Hz)
°C	V _{DC}	MHz		
-30	3.7	13.559500	-500	±1356
-20		13.559100	-900	±1356
-10		13.559700	-300	±1356
0		13.559200	-800	±1356
10		13.559800	-200	±1356
20		13.559000	-1000	±1356
30		13.559300	-700	±1356
40		13.559600	-400	±1356
50		13.559700	-300	±1356
25	3.5	13.559200	-800	±1356
25	4.2	13.559600	-400	±1356

Note: The extreme voltage is declared by manufacturer.

FCC §15.215(c) – 20 dB EMISSION BANDWIDTH

Applicable Standard

Per FCC §15.215 (c) 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. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

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 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. 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.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2016-09-01	2017-09-01
HP	Amplifier	8447E	2434A02181	2016-09-01	2017-09-01
The Electro-Mechanics Company	Passive Loop Antenna	6512	9706-1206	2016-03-03	2019-03-03
N/A	Coaxial Cable	14m	N/A	2016-05-06	2017-05-06

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

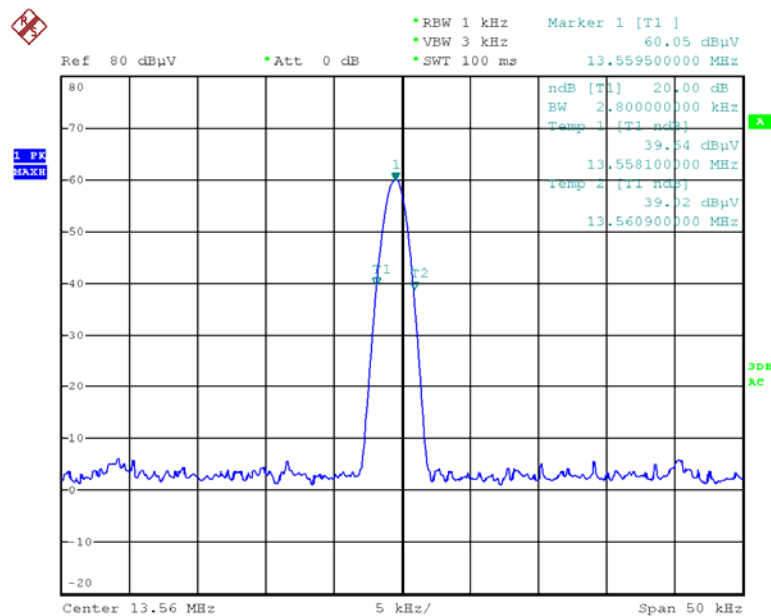
Test Data Environmental Conditions

Temperature:	28.8 °C
Relative Humidity:	49 %
ATM Pressure:	100.1 kPa

* The testing was performed by Lion Xiao on 2016-09-14.

Test Mode: Transmitting

20 dB Emission Bandwidth



Date: 14.SEP.2016 00:50:14

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