

FCC PART 15.225

TEST REPORT

For

Advanced Card Systems Limited

Units 2010-2013, 20/F, Chevalier Commercial Centre Kowloon, Hong Kong

FCC ID: V5MACR890

Report Type: Original Report	Product Type: ACR890
Test Engineer: Simon Wang <i>Simon wang</i>	
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Reviewed By: Bell Hu <i>Bell Hu</i> RF Engineer	
Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F, the 3rd Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn	

Note: This test report is prepared for the customer shown above and for the equipment described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.

TABLE OF CONTENTS

GENERAL INFORMATION.....	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
OBJECTIVE	4
RELATED SUBMITTAL(S)/GRANT(S).....	4
TEST METHODOLOGY	4
TEST FACILITY	4
SYSTEM TEST CONFIGURATION.....	5
JUSTIFICATION	5
EUT EXERCISE SOFTWARE	5
EQUIPMENT MODIFICATIONS	5
LOCAL SUPPORT EQUIPMENT.....	5
EXTERNAL I/O CABLE.....	5
BLOCK DIAGRAM OF TEST SETUP	6
SUMMARY OF TEST RESULTS	7
FCC§15.203 - ANTENNA REQUIREMENT.....	8
APPLICABLE STANDARD	8
ANTENNA CONNECTED CONSTRUCTION	8
FCC §15.207 – AC LINE CONDUCTED EMISSION	9
APPLICABLE STANDARD	9
MEASUREMENT UNCERTAINTY.....	9
EUT SETUP.....	9
EMI TEST RECEIVER SETUP.....	10
TEST EQUIPMENT LIST AND DETAILS.....	10
TEST PROCEDURE	10
CORRECTED FACTOR & MARGIN CALCULATION	11
TEST RESULTS SUMMARY	11
TEST DATA	11
FCC§15.225, §15.205 & §15.209 - RADIATED EMISSIONS TEST	14
APPLICABLE STANDARD	14
MEASUREMENT UNCERTAINTY.....	14
EUT SETUP	14
EMI TEST RECEIVER SETUP.....	15
CORRECTED AMPLITUDE & MARGIN CALCULATION	15
TEST EQUIPMENT LIST AND DETAILS.....	15
TEST RESULTS SUMMARY	16
TEST DATA	16
FCC§15.225(A) (B) (C) – FIELD STRENGTH OF RADIATED EMISSIONS.....	18
APPLICABLE STANDARD	18
EUT SETUP	18
TEST EQUIPMENT LIST AND DETAILS.....	18
TEST DATA	18
FCC§15.225(E) - FREQUENCY STABILITY.....	20
APPLICABLE STANDARD	20

TEST PROCEDURE	20
TEST EQUIPMENT LIST AND DETAILS.....	20
TEST DATA	20
FCC§15.215(C) - 20DB EMISSION BANDWIDTH	22
REQUIREMENT	22
TEST PROCEDURE	22
TEST EQUIPMENT LIST AND DETAILS.....	22
TEST DATA	22

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Advanced Card Systems Limited's* product, model number: *ACR890 (FCC ID: V5MACR890)* or the "EUT" in this report was a *ACR890*, which was measured approximately: 20.8cm (L) × 8.55cm (W) × 5.3cm (H), rated with input voltage: DC 7.4V rechargeable Li-ion battery or DC 12V from adapter.

Adapter Information:

Model: SAW48-12.0-4000

Input: AC 100-240V, 50/60Hz, 1.5A

Output: DC 12V, 4000 mA

**All measurement and test data in this report was gathered from production sample serial number: 1602138 (Assigned by Shenzhen BACL). The EUT supplied by the applicant was received on 2016-05-05.*

Objective

This Type approval report is prepared on behalf of *Advanced Card Systems Limited* in accordance with Part 2- Subpart J, and Part 15-Subparts A, B and C of the Federal Communication 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 15.247 DTS, Part 22H/24E PCB submissions with FCC ID: V5MACR890.

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. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement uncertainty with radiated emission is 5.81 dB for 30MHz-1GHz and 4.88 dB for above 1GHz, 1.95dB for conducted measurement.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp.(Shenzhen) to collect test data is located on the 6/F, the 3rd Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China.

Test site at Bay Area Compliance Laboratories Corp. (Shenzhen) 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 October 31, 2013. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.10-2014.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 382179. 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 typical fashion (as normally used by a typical user).

EUT Exercise Software

No Exercise Software.

Equipment Modifications

No modification was made to the EUT tested.

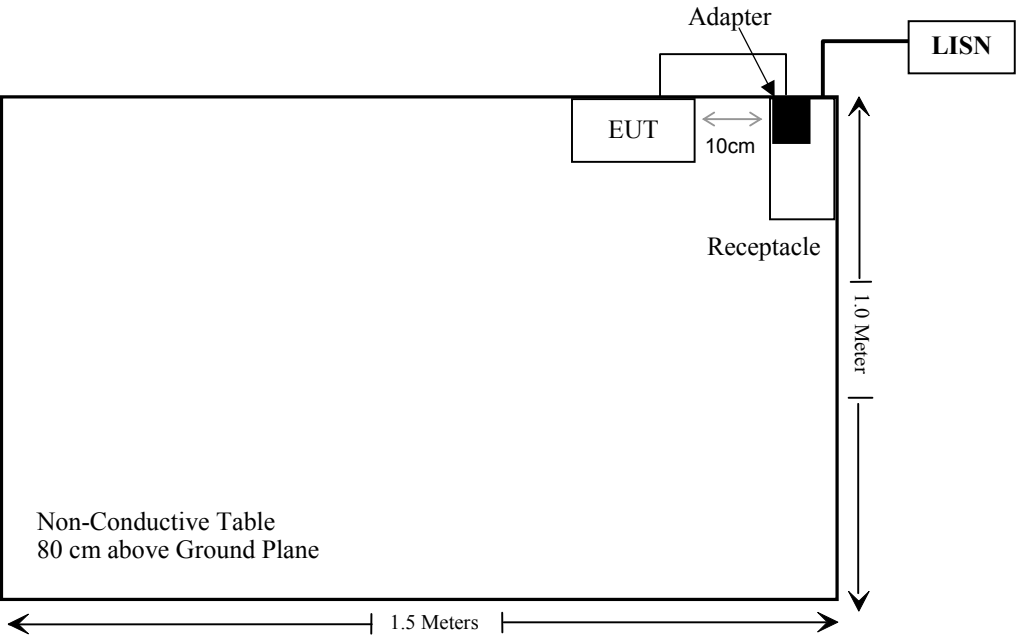
Local Support Equipment

Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-shielding Detachable Adapter Cable	2.0	EUT	Adapter

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)	20dB Emission Bandwidth	Compliance

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 an internal antenna arrangement which was permanently attached and the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

FCC §15.207 – AC LINE CONDUCTED EMISSION

Applicable Standard

FCC§15.207

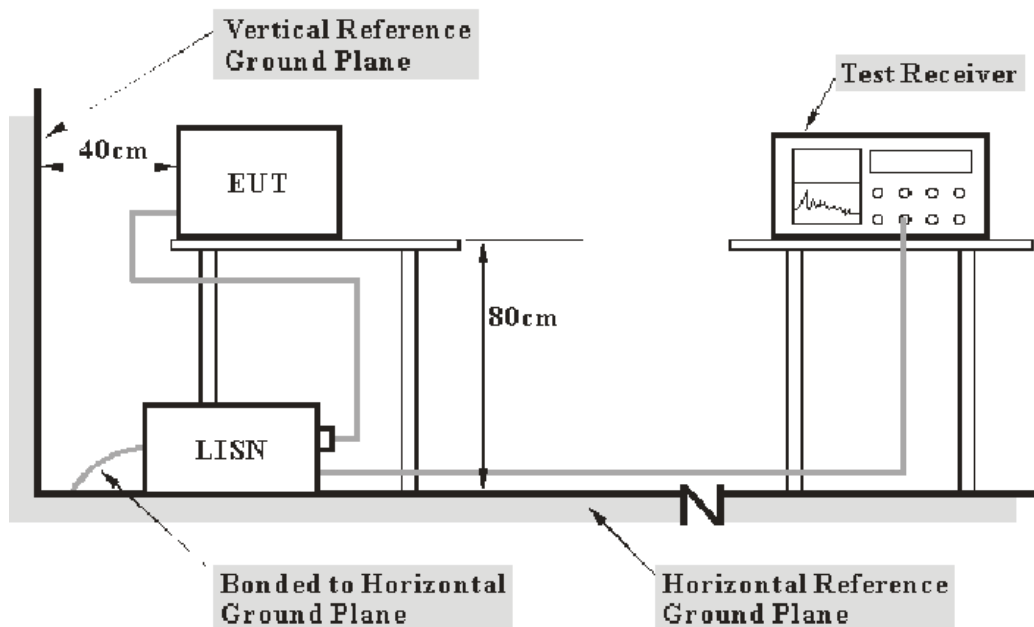
Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements may be 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 16-4-2:2011, the expanded combined standard uncertainty of conducted disturbance test at Bay Area Compliance Laboratories Corp. (Shenzhen) 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	3.34 dB (k=2, 95% level of confidence)
CAT 3	3.72 dB (k=2, 95% level of confidence)
CAT 5	3.74 dB (k=2, 95% level of confidence)
CAT 6	4.54 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.

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.

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
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2015-06-01	2016-05-31
Rohde & Schwarz	LISN	ENV216	3560.6650.12-101613-Yb	2015-12-15	2016-12-14
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2016-05-14	2017-05-14
Rohde & Schwarz	CE Test software	EMC 32	V8.53	NCR	NCR
Ducommun technologies	Conducted Emission Cable	RG-214	CB031	2015-06-15	2016-06-15

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that 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 final data was recorded in the Quasi-peak and average detection mode.

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:

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

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 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,

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{\text{lim}} + U_{\text{cisp}}r$$

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

Test Data

Environmental Conditions

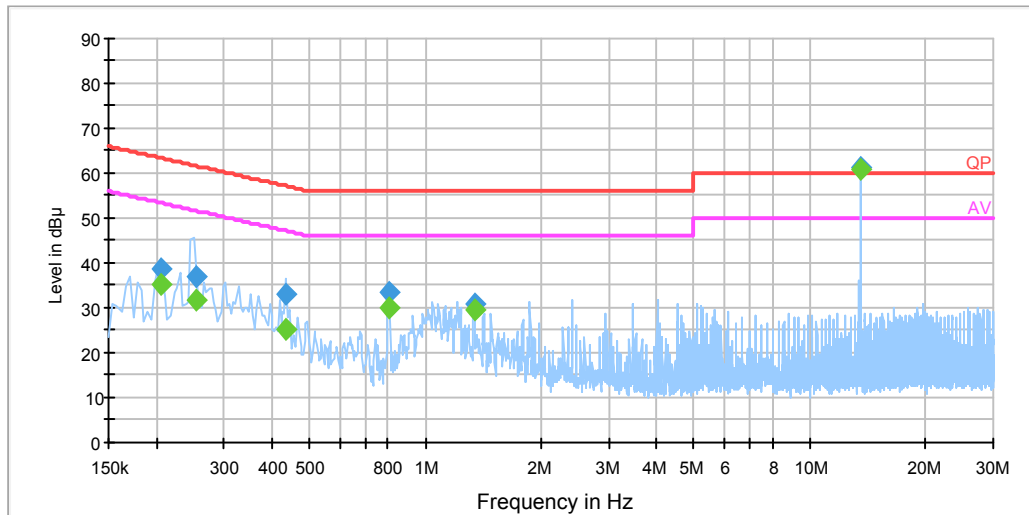
Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2016-05-16.

EUT operation mode: Reading Card

AC 120 V/60 Hz, Line:

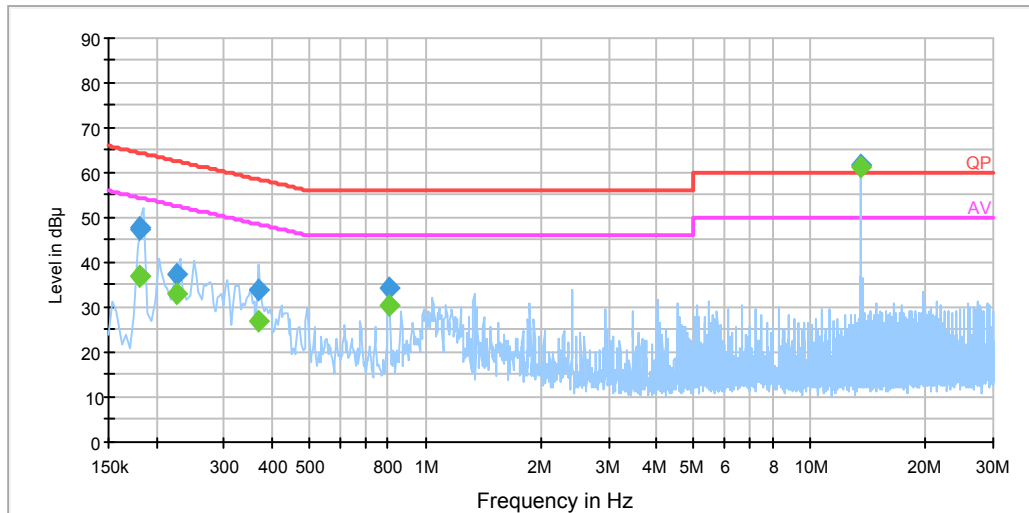
EMI Auto Test L



Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)	Remark
0.205500	38.9	20.0	63.4	24.5	QP	/
0.205500	35.1	20.0	53.4	18.3	Ave.	/
0.253500	37.0	19.9	61.6	24.6	QP	/
0.253500	31.5	19.9	51.6	20.1	Ave.	/
0.435490	33.3	19.9	57.1	23.8	QP	/
0.435490	25.3	19.9	47.1	21.8	Ave.	/
0.801970	33.5	19.9	56.0	22.5	QP	/
0.801970	30.0	19.9	46.0	16.0	Ave.	/
1.337930	30.9	20.0	56.0	25.1	QP	/
1.337930	29.5	20.0	46.0	16.5	Ave.	/
13.558630	61.1	20.1	60.0	-1.1	QP	Fundamental See Note 4)
13.558630	60.7	20.1	50.0	-10.7	Ave.	

AC 120V/60 Hz, Neutral:

EMI Auto Test N



Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)	Remark
0.181500	47.7	20.0	64.4	16.7	QP	/
0.181500	47.6	20.0	64.4	16.8	QP	/
0.181500	36.8	20.0	54.4	17.6	Ave.	/
0.181500	36.8	20.0	54.4	17.6	Ave.	/
0.225500	37.4	20.0	62.6	25.2	QP	/
0.225500	32.8	20.0	52.6	19.8	Ave.	/
0.368450	34.1	19.9	58.5	24.4	QP	/
0.368450	27.0	19.9	48.5	21.5	Ave.	/
0.801970	34.3	19.9	56.0	21.7	QP	/
0.801970	30.3	19.9	46.0	15.7	Ave.	/
13.558630	61.8	20.1	60.0	-1.8	QP	Fundamental See Note 4)
13.558630	61.3	20.1	50.0	-11.3	Ave.	

Note:

- 1) Correction Factor = LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
- 2) Corrected Amplitude = Reading + Correction Factor
- 3) Margin = Limit – Corrected Amplitude
- 4) Exemption is applicable for the Fundamental

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

Applicable Standard

As per FCC Part 15.225

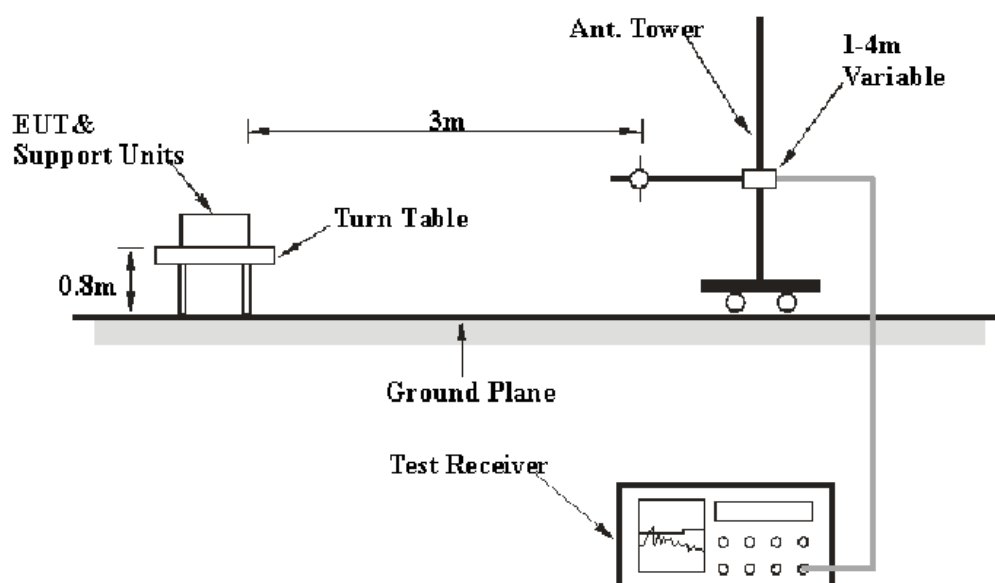
- (a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 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

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Shenzhen) is 5.81 dB for 30MHz-1GHz and 4.88 dB for above 1GHz. And it will not be taken into consideration for the test data recorded in the report

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

According to FCC Rules, 47 CFR 15.33, the EUT emissions were investigated up to 1000 MHz.

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

Frequency Range	RBW	Video B/W	IF 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 Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

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

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Corrected Factor}$$

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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2015-12-15	2016-12-14
ETS	Passive Loop Antenna	6512	00029604	2014-12-24	2017-12-23
HP	Amplifier	8447E	1937A01046	2016-05-06	2017-05-06
Sunol Sciences	Bi-log Antenna	JB1	A040904-2	2014-12-07	2017-12-06
Sunol Sciences	System Controller	SC99V	041304-1	NCR	NCR

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

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level is in compliance 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:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2016-05-16.

Test mode: Transmitting

1) Spurious Emissions (9 kHz~30 MHz):

Indicated		Table Angle Degree	Antenna Height (m)	Detector PK/QP/Ave.	Correction Factor			Corrected Amplitude (dBμV/m) @3m	FCC Part 15.225	
Frequency (MHz)	Maximum Reading (dBμV) @3m				Ant. Factor (dB)	Cable Loss (dB)	Pre-Amp. Gain (dB)		Limit (dBμV/m) @3m	Result
0.187	0.87	0	1.1	QP	64.3	0.1	0	65.27	102.17	Pass
27.12	8.21	0	1.1	QP	30.4	0.2	0	38.81	69.54	Pass

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

Frequency (MHz)	Corrected Amplitude (dBμV/m)	Detector PK/QP/Ave.	Antenna Height (m)	Antenna Polarity (H/V)	Turntable Position (deg)	Correction Factor (dB)	Limit (dBμV/m)	Margin (dB)
30.26	30.24	QP	1.5	H	141	-14.3	40	9.76
268.92	29.38	QP	1.2	H	132	-11.8	46	16.62
520.2	35.1	QP	1.3	V	205	-9.6	46	10.9
605.86	32.4	QP	1.2	H	104	-7.6	46	13.6
710.51	33.69	QP	1.3	H	122	-5.3	46	12.31
812.45	39.61	QP	1.2	H	236	-4.1	46	6.39

Note:

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

All other spurious data are 20dB below the limit or the floor noise.

FCC§15.225(a) (b) (c) – FIELD STRENGTH OF RADIATED EMISSIONS**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.

EUT Setup

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2015-12-15	2016-12-14
ETS	Passive Loop Antenna	6512	00029604	2014-12-24	2017-12-23
HP	Amplifier	8447E	1937A01046	2016-05-06	2017-05-06
Sunol Sciences	System Controller	SC99V	041304-1	NCR	NCR

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

Test Data**Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2016-05-16.

Test Mode: Transmitting

Test Result: Pass

Indicated			Table Angle Degree	Antenna Height (m)	Detector PK/QP/Ave.	Correction Factor			Corrected Amplitude (dBμV/m) @3m	FCC Part 15.225	
Frequency Range (MHz)	Mark point (MHz)	Maximum Reading (dBμV) @3m				Ant. Factor (dB)	Cable Loss (dB)	Pre- Amp. Gain (dB)		Limit	Result
										(dBμV/m) @3m	
13.110-13.410	13.39	9.06	0	1.1	QP	32.1	0.2	0	41.36	80.51	Pass
13.410-13.553	13.552	16.69	0	1.2	QP	32.1	0.2	0	48.99	90.47	Pass
13.553-13.567	13.560	50.85	0	1.3	QP	32.1	0.2	0	83.15	124.00	Pass
13.567-13.710	13.567	16.18	0	1.1	QP	32.1	0.2	0	48.48	90.47	Pass
13.710-14.010	13.825	7.96	0	1.2	QP	32.1	0.2	0	40.26	80.51	Pass

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 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: For battery operated equipment, the equipment tests shall be performed using a new battery.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2015-12-15	2016-12-14
ESPEC	Temperature & Humidity Chamber	EL-10KA	09107726	2015-11-01	2016-10-31

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

Test Data**Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2016-05-16.

Test Mode: Transmitting

Test Result: Pass

Power Supply (V _{DC})	Temperature (°C)	Measured Frequency (MHz)	Frequency Error (%)	Part 15.225 Limit (%)
7.4	-20	13.56047	0.00347	±0.01
	-10	13.56033	0.00243	±0.01
	0	13.56046	0.00339	±0.01
	10	13.55987	-0.00096	±0.01
	20	13.56032	0.00236	±0.01
	30	13.56035	0.00258	±0.01
	40	13.56059	0.00435	±0.01
	50	13.56049	0.00361	±0.01

FCC§15.215(c) - 20dB EMISSION BANDWIDTH**Requirement**

Per 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
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2015-06-13	2016-06-13
ETS	Passive Loop Antenna	6512	00029604	2014-12-24	2017-12-23

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

Test Data**Environmental Conditions**

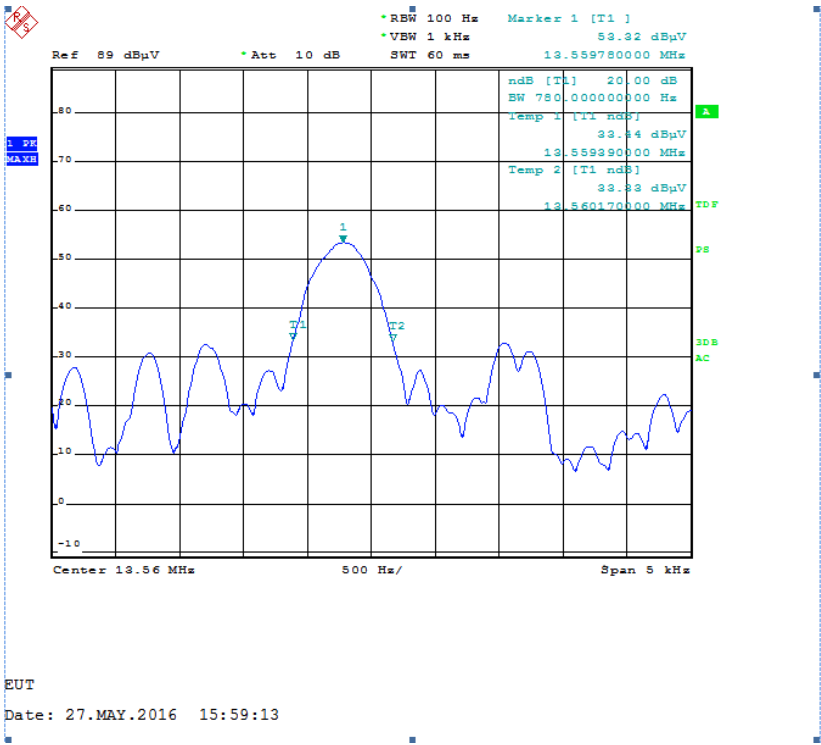
Temperature:	23 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Simon Wang on 2016-05-27.

Test Mode: Transmitting

Test Result: Pass

20 dB Emission Bandwidth



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